Prepar3D

Overview

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Training meets reality with Lockheed Martin's Prepar3D® simulation software. Private pilots, commercial organizations, militaries and academia rely on Prepar3D for immersive, experiential learning.

Prepar3D can be used for a wide range of learning scenarios including vehicle procedures training, cockpit familiarization, flight planning, air traffic control training and emergency response preparation. As a commercial off-the-shelf product, Prepar3D provides a cost effective training platform that evolves with technology. Take your training to the next level with Prepar3D!

Prepar3D offers professionals and students a platform to:

- Experience a scenario before it happens to increase effectiveness and reduce response time
- Learn and test their knowledge in the same environment in which they will operate
- Re-create scenarios with operational data and experiment with different variables
- Experience a learning lab where science, technology, engineering and math principles are taught in an immersive environment
- Train for scenarios in aviation, air traffic control, ground vehicle operation and disaster response
- Prepar3D furthers the development of Microsoft® ESP™ while maintaining compatibility with Microsoft Flight Simulator X, allowing many thousands of add-ons to be used within Prepar3D

Features

These are just some of Prepar3D's outstanding features:

- Virtual world with 40 high-detail cities and more than 24,900 airports
- Environments that include highways, air and maritime vehicles and traffic, as well as livestock and wild animals
- Customizable, data-driven graphics and models
- Whole earth WGS-84 model
- Accurate topography with regionally and culturally appropriate textures
- Modifiable real-time weather system, continuous time of day, seasons and a variety of lighting effects
- Realistic air traffic control
- Expandable library of vehicle models

More Information

For more information on specific areas of Prepar3D, visit the following sections:

- Scenarios
- Vehicles
- Navigation
- World
- Options
- Views
- Network
- Analysis

For even more information about Prepar3D, you can visit our website: http://www.prepar3d.com

We hope you enjoy flying with Prepar3D! See you in the skies.

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PREPAR3D

Prepar3D v5.0 Features and Enhancements

Release Notes

Prepar3D v5 - The Foundation of Next Generation Simulation and Training.

Prepar3D v5 is the first step in the development of an all new platform built for next generation simulation and training. This foundational release is the cornerstone for continuous development and evolution, bringing new capabilities and features to solve tomorrow's training needs. An all new DirectX 12 rendering engine brings unparalleled performance fully harnessing the latest graphics technologies. See the world like never before with groundbreaking weather visuals including volumetric clouds with localized precipitation and atmospheric haze. Train across a fully updated globe with the latest airport and geographic data including sloped runways with full AI support. An overhauled water system brings the seas to life with accurate wave simulations and ocean effects. See every detail with new high resolution physically based rendering (PBR) textures. Challenge yourself in an array of new vehicles including the Lockheed Martin Civilian Utility Aircraft and the F-35B developed by IndiaFoxtEcho with representative STOVL capabilities. Additionally, a slew of new updates across the entire SDK open up even more possibilities for every type of developer. Simulation and training is redefined with Prepar3D v5.

General Platform Updates

New Features

- Enhanced performance and graphical capabilities enabled by the new Microsoft DirectX 12 rendering engine.
- Realistic sky, clouds, and atmosphere with Simul trueSKY integration.
- Dynamic ocean with NVIDIA WaveWorks 2.0.
- Added sloped runway support including AI takeoff and landing capabilities.
- Updated time zones to match real-world boundaries.
- Added 8.33 kHz spacing support.
- Users can now switch vehicles while in multiplayer if enabled by the host.
- Updated multiplayer UI to streamline multiplayer setup and lobby interactions.
- Multiplayer host and clients can now choose any starting location.
- Multiplayer lobby is now available in session.
- The map screen is now available during flight.
- Added TACAN course selection and tracking support.
- Compiler and SDK updated to Visual Studio 2019 and .NET 4.8.
- Updated default mouse and joystick camera controls.
- Updated default controller layout.
- Added controllable flashlight to virtual cockpit views.
- Updated user interface design.
- Added brown-out and white-out effect support for helicopters.
- Updated over 24,000 airports with new data across the entire globe.
- Updated global terrain, elevation, water/shoreline data, and traffic routes.
- GPS data can now be broadcast to a specific IP address.
- Ground contact reaction is now done per contact point.
- Added prompt to warn if GPU memory has run out with option to revert graphics settings.
- Weather themes can now be customized in the weather UI.
- Added surface perturbations to 2D water.
- Added support for the Varjo XR-1 mixed reality (MR) headset.
- Added SIDS and STARS visualization support for gauges.
- New and updated default content:
    - Updated Randolph AFB (KRND) developed by Orbx.
    - Added the Lockheed Martin Civilian Utility Aircraft Single Engine (CUASE) aircraft.
    - Added the Lockheed Martin Turboprop Trainer (TTA) aircraft.
    - Added F-35B and F-35C variants with PBR textures developed by IndiaFoxtEcho.
    - Updated F-35A model with PBR textures developed by IndiaFoxtEcho.
    - Updated F-22 model developed by IRIS Simulations.
    - Updated C-130 to support 8.33 kHz spacing.
    - Updated runway surface textures to 4k PBR textures.
    - Updated various airport and land class textures.
    - Updated various road, railroad, stream, shoreline, and wake textures.
    - Fixed mismatched building textures.
    - Added several additional SpeedTree tree types and seasonal variants.
    - Added a sample race scenario showcasing racing scenario capabilities.
    - Added additional road traffic models.
    - Fixed incorrect light mappings in Maule aircraft.
    - Updated Deep Sea Submarine model.
    - Updated several models to reduce flickering issues at large distances.
    - Updated taxiway signs to use PBR textures.
    - Improved jetway models and textures.
    - Fixed several parts in F-16A model that were missing PBR textures.
    - Added a multitude of new landmark buildings spanning the globe.

- Sloped various airports across the globe.
- Added multiple wildlife models.
- Updated ATC tower interior.
- Updated various effect values.

Fixes and Improvements

- Improved VR performance.
- Adjusted autogenerated building height.
- Improved vehicle list caching speeding up vehicle selection and multiplayer loading.
- Added keyboard shortcuts for opening settings UI screens.
- Control bindings can now be searched by key name in the Controls UI.
- Added on/off/set key events for several light controls that previously only had toggle commands.
- Fixed issue where GPS ILS markers would be misaligned in some cases.
- A default scenario name is now generated when opening the Save Scenario screen.
- Scenery Library items can now be dragged to different locations.
- Vehicles can now be grouped by category in the Vehicle Select screen.
- Fixed various issues in the Pilot Records UI including page flips, distorted images, and only displaying .bmp screenshots.
- Launching SimDirector is now available from the Startup screen.
- Fixed issue where a corrupted exe.xml file would prevent other add-on .exe files from opening.
- Fixed UI sizing issues seen on lower resolution displays.
- Sound is now enabled by default in slew mode. This can be disabled in the Sound Settings UI.
- Added additional helicopter autopilot tuning capabilities.
- AI entities now smoothly transition to level flight after finishing playing back a recording.
- Infogen text now displays when voice comms are active.
- Fixed environmental forces for turboprops.
- Changed the default control mode to DirectInput.
- Updated airport light visibility.
- Fixed issue where cancelling out of the Failures screen would revert values back to 0.
- Opening the Failures screen no longer pauses the simulation.
- The Time Preview and Time and Season screens are now combined.
- Fixed issue where the Startup Screen would incorrectly prompt to convert structured scenarios in some cases.
- Fixed visible border lines in the water between the US and Mexico.
- Fixed height of the Oriental Pearl Tower.
- Fixed issue causing longer bridges to intersect water in some cases.
- Fixed issue causing bridge segments to clip into each other in some cases.
- Fixed cases where hangar buildings were too large in some cases.
- Updated boat terminals to prevent large boats from docking too close to shorelines.
- Fixed various issues with weather settings not applying as expected over multiple weather stations.
- Fixed issue where certain weather units would not convert to the correct types with the hybrid metric/imperial setting enabled.
- Improved weather interpolation between weather stations.
- Navigation visuals are now available in SimDirector.
- Added unit conversion drop-downs to additional data types in SimDirector.
- Fixed text alignment issues with long object names in SimDirector preview windows.
- Added NoAutogenSuppression and NoCrash flags to scenery objects created in SimDirector.
- Fixed SimDirector button state sync issue with Kneeboard, Time Preview, and Navigation Visuals buttons.
- Fixed issue with elapsed scenario time not resetting properly when switching modes in SimDirector.
- Fixed issue where the SimDirector Attachments screen would not update correctly in some cases.
- Updated vehicle UI to group by make and model by default and updated column headers.
- Improved lens flare logic.
- Reduced instances of freeway traffic disappearing along road segments.
- Improved bridge and overpass handling for freeway traffic.
- Improved HDR effect.
- Fixed issue causing PBR materials to completely black out in dark conditions.
- Added additional advanced Varjo headset options.
- Platform height is now correctly handled when changing locations.
- Improved altitude transitions between large airports and surrounding terrain.
- Fixed issue where fog could be applied to panel textures.
- Fixed issue where cloud altitude would be incorrect after changing locations.

Fixes and Improvements (Professional Plus Only)

- Fixed issue preventing weapon damage from applying when played back from a recording in some cases.
- Additional camera interface updates for CIGI.
- Added additional configuration options, descriptions, and validation checks to several AI behaviors in SimDirector.
- Fixed issue with entities assigned to the Combat Air Patrol behavior losing altitude.
- The elapsed scenario time now displays in SimOperator.
- Navigation visuals are now available in SimOperator.
- Added the measure tool to SimOperator.
- Fixed issue causing incorrect CombatAirPatrol altitude handling.

Prepar3D SDK

New Features

- Airports can now be created with sloping runways.
- Distance remaining signs can now be generated for runways.
- Updated SDK samples to Visual Studio 2019 and .NET 4.8.
- Added enhanced engine extensibility features for SimObjects.
- Added ability to define always on mapping for key events defined in gauge xml trigger events.
- Added new intensity value in lumens to PBR light effects.
- Added airport background flatten options to control altitude transition with surrounding terrain.

Fixes and Improvements

- Fixed bug preventing exclusion rectangles from correctly excluding scenery when using the excludeAllObjects setting.
- Updated the Autogen Editor UI.
- Converted several samples to the add-on.xml format.
- Fixed issue where some tools would write out generated data to the incorrect location.
- Fixed naming of Axis Steering Set event.
- Fixed bug where tail numbers were not being set for helicopters created with the SimConnect_AICreateNonATCAircraft function.
- Fixed Traffic Toolbox dump airport list to correctly parse airspace type.
- Fixed issue where ImageTool should not load certain DDS textures.
- Added ISimObjectManager UnRegister callbacks.
- Added 5551 texture support to PBR materials.
- Fixed issue that caused certain versions of 3dsMax to freeze during autosaving for several minutes.
- Fixed Ambient in cloud SimConnect call.

Prepar3D v5.0 Hotfix 1

Client Fixes and Improvements

- Reduced VRAM usage by automatically reducing texture sizes on distant objects.
- Variable Refresh Rate (VRR) displays are now supported.
- Fixed crash that could occur on approach at low altitudes in some cases.
- Fixed driver hang caused by the ATC window in some cases.
- Fixed crash when closing camera preview window.
- Vehicle preview screen now shows interior model if no exterior model exists.
- Fixed issue causing detached avatar to crash if parent vehicle crashed.
- Fixed issue causing shadow errors in SimDirector when Enhanced Atmospherics was active.
- Multichannel host now serializes library effect mappings.
- IsOnGround now properly set when initializing mobile scenery objects in SimDirector.
- DLLStop is now called on all DLL plugins before being removed.
- Fixed issues causing VR views to be out of sync.
- Fixed issue preventing traffic from clearing in some cases.
- Fixed issue causing invalid reflections in right eye in VR.
- Enhanced Atmospherics is now supported in VR stereo and mono modes.
- Fixed issue preventing AI from taking off and landing at airports in some cases.
- Improved Enhanced Atmospherics cloud shadows.
- Fixed issue where adjusting time preview would cause AI to spawn.
- Fixed crash that would occur when playing a flight recording from command line.
- Fixed issue causing multiplayer session status to appear differently on client and host machines.
- Fixed issue causing a crash to occur before user was prompted that VRAM budget was exceeded.
- Fixed issue where reflections in right eye were one frame behind in VR single pass mode.
- Fixed issue preventing panel mouse interaction from working in VR in some cases.
- Reduced intensity of default landing light effect.
- Improved AI brake behavior on sloped surfaces.
- Additional improvements to ground contact reaction.
- Fixed long UI load times if large amounts of add-ons were installed.
- Fixed issue where GPS broadcast and sound in slew settings were not loaded correctly at startup.
- Fixed issue where flight plans would reapply if currently active when pressing OK in the options screen.
- Various Enhanced Atmospherics cloud appearance improvements.
- Fixed application hang that would occur if VR threw an error in single pass mode.
- Fixed issue causing vehicle select sort ordering to reverse in some cases.
- Fixed crash that would occur if a docked view was closed while being moved.
- Fixe issue where SimConnect_CreateEffect was not initializing PBH values.
- Added VR cursor settings.
- Fixed issue where terrain textures would draw on top of each other in some cases.

Content Fixes and Improvements

- Fixed issue where right rudder could detach from vertical stabilizer in F-35A.
- Updated TTA paint scheme.
- Fixed various effect colors.
- Fixed issue with incorrect sun visor transparency in the CUASE.
- Fixed bad scenario briefing formatting seen in some resolutions.

Scenery Fixes and Improvements

- Improved freeway lane textures.

- Fixed issue preventing AI push back from occurring.
- Fixed various water data issues.
- Updates to several airports and surrounding areas including KSAN, KPVD, KXNA, and KTRI.
- Fixed VMMC taxiway elevation issues.
- Fixed various bridge issues.

SDK Fixes and Improvements

- Fixed issue with FX tool not loading certain values from effect files in some cases.

Prepar3D v5.0 Hotfix 2

Client Fixes and Improvements

- Improved Dynamic Texture Streaming performance.
- Fixed issue causing Scaleform elements to flash including the menu bar and ATC window.
- Fixed issue causing invalid wind aloft direction values.
- Improved startup load time.
- Fixed crash when switching views in PBR vehicles on various AMD graphics cards.
- Fixed issue causing effects to lag behind attach points in some cases.
- Improved effect rendering performance.
- Fixed issue causing invalid particle lighting in multiple views in some cases.
- Fixed issue causing emitted extrusions to be invalid at certain rotation angles.
- Fixed issue where flashing textures could occur in some cases with Dynamic Texture Streaming active.
- Fixed crash that would occur on startup if add-on description was blank.
- Fixed issue causing kneeboard and scenario briefing pages to be blank.
- Added chroma key support to Varjo XR-1 headset.
- Fixed issue where startup screen preview window would stop rendering after location change.
- Fixed issue preventing Dynamic Texture Streaming from disabling in some cases.
- Search boxes in relevant UI screens are now focused when opened.
- Fixed issue where preview window would not work in structured scenarios.
- Fixed crash seen when changing between tower and pilot roles in some cases.
- Fixed weather theme sync issues between the startup and weather screens.
- Fixed issue preventing Wingman AI Behaviors from saving offsets correctly.
- Fixed issue preventing SimDirector OffsetXYZ control from accepting negative values.
- Fixed issue where role type box would not size correctly in the multiplayer UI in some cases.
- Fixed issues with SimConnect BeginVideoStream.
- Improved reflection performance.
- Fixed visual issues with distance remaining signs.
- Fixed issue where loading flight plans would not update the map in startup and multiplayer screens.
- Map screen now supports heading and airspeed changes while moving the user.
- Adjusted sun and moon sizes in Enhanced Atmospherics.
- Fixed issue with TexturePlugin providing render targets with state data.
- Fixed DIS enumerations for F-22 and F-35 aircraft.
- Fixed terrain cracks that could occur in reflections.
- Fixed issue where location text could be cut off in the Startup and MiniChooser screens.
- Improved map UI loading times.
- Improved transparent object sorting with Enhanced Atmospherics.
- Fixed issue causing missing autogen in some cases when using add-on.xmls.
- Fixed issues with additive effects sorting incorrectly with clouds.
- Fixed multi-GPU crash with Dynamic Texture Streaming.
- Program and Environment simvars can now be set in XML gauge code.
- Updated attenuation for PBR and non PBR dynamic lighting.
- Updated falloff exponent for non PBR dynamic lighting.
- Fixed issue where high cockpit LOD configuration setting would be reverted to 0 when settings were reduced.
- Engines are now started for helicopter AI entities that spawn in the air.
- Fixed issue preventing tooltips from displaying in map UI screens.
- Added VR setting to disable Hidden Area Mesh.
- Fixed issue where SimConnect menu events were not being processed.
- Fixed issue preventing PDK add-ons from adding menu items to the "Add-ons" menu.
- UI search boxes no longer handle the escape key when empty and immediately process the search when pressing enter.
- Improved SinglePass VR latency fixing issue where dynamic light positions could be one or two frames behind.
- Fixed issue preventing Scaleform RTT elements from rendering.
- Fixed issue that could cause the SimDirector UI to become unresponsive if an error popup occurred when selecting an object.
- Entries in the Facility Selection screen can now be double-clicked.
- Fixed issue that could prevent AI Behaviors from activating at scenario start in some cases.
- Improved error handling when reading sim object configuration data.
- Fixed crash that could occur when running multiplayer and changing scenery library settings.
- Fixed crash that could occur when using the multiplayer autostart command line option with multiplayer autostart configuration settings enabled.
- Fixed issue causing differences in reported wind direction in some cases.

- Fixed issue that could cause visual errors with runway edge lines at sloped airports.
- Fixed crash that could occur when loading third party AI vehicles in some cases.
- Fixed error when comparing property name strings in recording/playback in some cases.
- Fixed shutdown crash when using Varjo headsets.
- Fixed crash when changing Varjo VR view options.

Content Fixes and Improvements

- Added landing light fx file.
- Updated tail number geometry and material on various default vehicles.

Scenery Fixes and Improvements

- Fixed issue with jetway decal textures turning asphalt aprons white.
- Fixed various water, terrain, coastline, bridge, and various other data issues.
- Fixed issues with St. Paul and St. George islands, Victoria Falls.
- Fixed issues with Washington DC scenery objects, San Siro Stadium, and Generali Tower.
- Updates to various airports including LFMV, KOFF, KGGG, EFHK, SBSP, EDDH, EDVK, KAKR, KPIT, RJBB, EDDS, EGPF, KBUR, PALR, VOTR, KVPD, LIMC, PASI, and EGGW.

SDK Fixes and Improvements

- Added OpenGLTexture sample back to SDK.
- Added 3dsMax 2020 and 2021 support.

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Prepar3D v4.5 Features and Enhancements

Release Notes

The latest update to Prepar3D is now available! Prepar3D v4.5 continues to build upon the solid foundation and advancements made to the platform by bringing new features, improvements, and fixes across the board.

Terrain night lighting has been overhauled adding greater visual detail and clarity. Highways illuminate through cityscapes like never before and sprawling urban environments come to life extending to the horizon with higher resolution night textures.

Major optimizations have been made to model loading vastly reducing load times for complex scenery add-ons. Additional enhancements were made across the entire platform ranging from smoother multiplayer animations, greater Virtual Reality (VR) performance, to improved Physically Based Rendering (PBR) lighting and color balance.

Expanded developer features including support for PBR autogenerated vegetation, greater effects customization, and various interface updates and new services further expand Prepar3D's open development architecture enabling richer and more customizable content.

New features added to the Professional Plus product include Distributed Interactive Simulation (DIS) auto-connection, DIS engagement lines, and Common Image Generator Interface (CIGI) collision detection expand Prepar3D's interoperability between professional simulation platforms. Additionally, multiple improvements to SimOperator including full sound support, a real-time progress log, and object visual ribbons, helps bring interactive scenarios to life while enhancing operator situational awareness.

Take your training to new heights with Prepar3D v4.5!

The following list of updates has been categorized based on the installer required. The *Client* installer is required for Prepar3D v4.5, however the *Content*, *Scenery*, and *SDK* installers are optional. You must first have Prepar3D v4 installed to utilize the *Client* only installer.

To install the *Prepar3D v4.5 Client*, you must first uninstall the previous *Prepar3D v4.0/v4.1/v4.2/v4.3/v4.4 Client* through **Programs and Features** in **Windows Control Panel**. Do not deactivate your license when prompted. If you selected to deactivate your license during uninstallation of your current *Client*, your will be prompted to reactivate Prepar3D. Please view the Prepar3D v4 Download and Installation Instructions for more information.

Prepar3D Client

General Platform Updates

New Features

- Added Network Test UI screen.
- Application can now be run over remote connections.
- Added native eye tracking support with the HTC Vive Pro Eye.
- Added native support for the Varjo VR-1 headset.

New Features (Professional Plus Only)

- Added Distributed Interactive Simulation (DIS) auto-connect capability.
- Engagement lines can now be drawn in DIS.
- Added Common Image Generator Interface (CIGI) collision detection.
- Sound now supported in SimOperator.
- The scenario Progress Log is now available in SimOperator.
- Visual ribbons now render in SimOperator.

Fixes and Improvements

- Improved terrain night lighting.
- Improved rendering performance.
- The IP address box is now focused when entering the Direct IP multiplayer screen.
- Slightly reduced the light energy on PBR objects to better match non-PBR object lighting.
- Fixed bounding box calculations for models.
- Fixed Learning Center button in the Virtual Reality (VR) Settings screen.
- Fixed mouse picking on Physically Based Rendering (PBR) textures.
- Fixed crash seen in aircraft with fewer propellers than engines.
- Fixed issue that caused scripted textures to not refresh correctly.
- Fixed memory leak that occurred when models contained invalid animations.
- PBR is now supported for autogen trees.
- Loading a scenario from the Startup Screen will now return to the Startup Screen instead of immediately launching the scenario.

- Fixed offset reflections in VR single pass mode.
- User objects with 0 hit points will now collide into objects instead of ignoring crashing.
- Fix for texture caching to prevent incorrect terrain tile textures from loading in certain cases.
- Improve animation smoothness in multiplayer.
- Doubled default send update rate frequency in multiplayer.
- Fixed issue preventing the C-130 from respecting the unlimited fuel setting.
- Fixed issue causing effects to not draw in some cases when multiple views were open.
- Fixed issue preventing the multiplayer host from switching vehicles during a scenario if option was enabled.
- Fixed loading issue that could sometimes prevent various buildings from loading.
- Errors in custom weather settings are now displayed when opening the UI window.
- VR now remains enabled after a scenario reset.
- Fixed issue where players could join in the wrong vehicle in some cases in multiplayer.
- Various performance improvements to single pass VR.
- Currently open views are now preserved when entering multiplayer unless specified by the scenario.
- Fixed various cases where the main application window was not blacked out when opening certain UI views.
- Added default VR window positions for global panels.
- Autorudder is now disabled by default.
- Fixed minor visual artifacts with focal points in VR.
- Fixed incorrect handling of several escape characters in aircraft configuration files.
- Fixed issue preventing panels positioned in 3D space from respecting the ignore input setting.
- VR gaze controls now support right clicking.
- Fixed various UI issues with saving and loading seasons in the southern hemisphere.
- Removed Multiplayer HostControlsScenarioEntities setting. This is now always defaulted to true.
- Scenario objects are now serialized by the host instead of loaded from the scenario file by each connected client.
- Fixed unwanted collisions between host scenario objects.
- Fixed issue preventing scenario entities owned by the host from being damaged.
- Fixed issue preventing global custom cameras from refreshing correctly after changing vehicles.
- Fixed HMD menu toggle button.
- Fixed issue where muting sounds would stop and resume sounds instead of playing at zero volume.
- Added temperature checks to particle emitter velocity calculations.
- Fixed minor visual issues with tree reflections.
- Fixed issue in some ground vehicles where vehicle would attempt to steer when not moving.
- Objects will now animate even when not being drawn if they have an object such as a weapon attached to an attachpoint.
- Various updates to multiplayer interfaces.
- Fixed issue where add-ons placed in the Prepar3D v4 Add-ons folder would not write to the app data configuration file.
- Fixed issue where sounds would not always disable when hitting 'Q' or pausing the simulation.
- Ribbons added in the Navigation Visuals menu can now have their width configured in the UI.
- The multiplayer chat window button now works as a toggle.
- White space is now prevented from being sent in the multiplayer chat window.
- Various layout and icon changes made to the multiplayer chat UI.
- Fixed issue where local client's chat window player icons would not update as they were talking.
- Fixed sound issues when switching views.
- Scenario panels can now be opened while viewing an AI aircraft.
- Fixed crash that could occur when playing back recordings with effects.
- Fixed radio frequency display in the multiplayer chat window.
- The chat window no longer closes when entering multiplayer.
- Fixed performance issues with the chat window when receiving new chat messages.
- Info text is now displayed when using multiplayer voice communications.
- Fixed effect placement issues when objects were frozen.
- Added Direct Voice key mapping to talk to players directly regardless of radio frequency settings.
- Optimized model loading times.
- Object visual ribbons can now have unique colors per association ID.
- Fixed the ClientEnableVoice setting in multiplayer.
- Unprocessed voice data is no longer sent over the network.
- Added an additional optional timeout value to ribbons to prevent them from remaining after an object is no longer moving.
- Fixed issue that could cause particle effects to incorrectly emit if the attached model wasn't animating.
- Multiplayer chat notifications are no longer sent when players join the lobby.
- Added content errors for duplicate autogen IDs.
- Fixed issue with docked panels not displaying correctly when loading a view group.
- Voice communication is now enabled by default in multiplayer.
- Visual ribbons no longer cast shadows.
- Added configuration option to group navigation visual icons.
- Added documentation covering the missionpanels.cfg file.

- Navigation visual icons are now positioned based on the object's bounding box.
- Added key event to refresh shaders.
- Added multiplayer "Ready Players" button so host can request each player enters the ready state when joining the session.
- Added additional tooltips to multiplayer UI windows.
- Reverted render mode for UI windows back to software-only.
- Fixed issues with attached objects being out of sync with parent object.
- Fixed issue where shared cockpit voice intercom could not be disabled by owner aircraft.
- Fixed batching issues with objects using two UV channels.
- Fixed crash when opening a new docked view with window titles on.
- Fixed bug preventing the HideTerrain camera configuration entry from functioning.
- Fixed UI hang when closing the Save Scenario screen using the X button.
- Fixed crash in the Vehicle Select screen when trying to preview a vehicle with no preview data when in the viewer object.
- Fixed issue with the "Use System Time" setting not being respected in some cases.

Fixes and Improvements (Professional Plus Only)

- Added delete object callbacks for High Level Architecture (HLA).
- Client roles are no longer reset when the scenario is restarted in SimOperator.
- Fixed issue preventing SimOperator from executing certain scenario actions.
- Attachments are now updated after the loadout is loaded instead of waiting for the first simulation update.
- Weapons and countermeasures that fail to register in multiplayer are now removed.
- Fixed issue where weapon effects would not draw in some cases after they were detached.
- Fixed issue where "Pause On Lost Focus" would not stop the simulation time in SimOperator.
- Updated AttackerBehavior to support firing weapons multiple times within a second.
- AttackerBehavior no longer fires against enemies with no health.
- Countermeasure System now utilizes the system on flag.
- Fixed crash that could occur when ending a scenario with ongoing delay actions.
- SimOperator now always starts the scenario paused.
- SimOperator will now display the correct player name and "Observer" role in lobby.
- The Measuring Tool is now available outside of staging mode in SimOperator.
- SimOperator now correctly persists Editor ribbon button and window states.
- Fixed inconsistent pause states when staring SimOperator.
- ControllableCameras now track weapon system targets.
- SimOperator can no longer enter roles or change user ownship.
- Fixed issue preventing "Center On" from working correctly in SimOperator.
- "Snap to Ground" is now available in SimOperator.
- Moving aircraft in SimOperator will no longer cause them to fly.
- Fixed issue when canceling an exit in SimOperator could cause the UI to freeze.
- Fixed issue that could cause the SimOperator confirmation prompt to appear multiple times on exit.
- Fixed issue where both multiplayer and SimOperator confirmation prompts would appear on exit in some cases.
- Fixed issue where launching a SimOperator session would sometimes return to the login screen.
- Fixed issue preventing recording from playing back correctly in multichannel.

SimDirector Updates

New Features

- Added StopFlightRecordingAction to stop a currently playing flight recording on an object.
- Play and stop recording actions can now be triggered on player objects.
- ScaleformObjects can now be added in Virtual Instructor mode.
- Added wait cursor to display when SimDirector is saving the scenario.
- Added ControlEventTrigger to process actions based on control input.
- Added Association ID object with friend/enemy support.

Fixes and Improvements

- Improved performance when making modifications to objects in large scenarios.
- Added angular data to the measure tool.
- Added additional validation to area objects.
- Crash detection is now correctly restored when leaving Virtual and Flight Instructor modes.
- Fixed bug preventing tail numbers from being set on entity objects.
- Fixed incorrect speed tree rotations when using the rotation gizmo.
- Scenario menu prompts can no longer be manually closed by the user without selecting an option.
- Simplified AI creation by removing unsupported types.
- CylinderPathAreas can now be moved with the mouse.
- SetTargetActions can now be applied to player objects.
- Goals objects can now be configured to pause the scenario when bringing up the goal completion popup window.
- Fixed issue with ObjectActivationActions not updating the next point of interest if applicable.
- Touch zoom now continuously updates instead of zooming only when touch was released.
- Fixed cases where alert messages would show below the Prepar3D window.
- Fixed object placement issues when using touch controls.
- Fixed issue with action triggers re-firing before child actions completed.

Prepar3D Content

New Content

- Leopard APC AI object.
- Tiger APC AI object.
- Animated Focal.swf file for use in scenario development.
- Donkey and cart scenery objects.

Fixes and Improvements

- Added dynamic lighting to fire, explosion, and firework effects.
- Updated S-97 external AI model with pilot silhouettes, added configurable tail numbers, and improved rudder animations.
- Several C-130 fixes to switches and lights.
- Added missing afterburner effect to the R-11 Scud missile.
- Improved R-11 Scud Transporter vehicle handling.
- Fixed missing light effects on beacon lights and extended the dynamic lighting range.
- F-16 wing rails are now always visible instead of being added as an attachment.
- Tuned several explosion and impact effects.
- Fixed F-16C HUD text to only display when looking through the glass.
- Fixed illogical stall speed in F-16A.
- Corrected pylon positioning to fix gaps.
- Added dynamic lighting to muzzle flash effects.
- Fixed issue with Pilot and Sensor reticles missing elements when opened on multiple displays.
- Updated autogen models to reduce flickering at long distances.
- Updated roles in the example multiplayer scenario to include the C-130 and F-16.
- Beacon lights scale based on distance.
- Fixed F-16 afterburner effect to no longer bleed through certain areas of the model.
- Updated Indago to reference common pilot and sensor reticle files.
- Additional minor tuning to various weapon objects.
- Updated Jet Fighter Time Trial scenario to prevent speed build up before selecting aircraft.

Prepar3D Scenery

Fixes and Improvements

- Added more building scenery objects.
- Added several SpeedTree variants.
- Fixed visual errors in various tree models.

Prepar3D SDK

New Features

- 3ds Max 2019 is now supported.
- Added functions to get bounding and crash boxes for objects through the Prepar3D Development Kit (PDK).
- Added flag to inhibit rudder input with nose wheel steering on tiller-equipped airplanes.
- Kill effects are now customizable for all SimObjects and support different effects when on the ground or in the air.
- Additional global panel configuration files can now be added through the add-on system.
- Added various PBR material templates and updated model template documentation.
- Added function to enable and disable the sending and receiving of DIS packets to the DISManager PDK.
- Added simulation and program variables to retrieve position freeze states.
- Added InitPosition function to IBaseObject.
- Added TargetLeadTime property to the WeaponSim guidance system.
- Particle effects emitters can now be configured to scale based on distance.
- Added VR PDK Service.
- Added Gaze Data Capture PDK sample.
- Added GUID validation for modeldef.xml files. Errors will be displayed during 3ds Max export.
- Added Unicode support to several SimConnect functions and events.
- Added ControllableCamera function to track the current target from the fire control system.

Fixes and Improvements

- SimConnect weather observation queries will now return global weather station data if the specified station does not have weather defined.
- Fixed incorrect reticle alignment in the Targeting Pod Sample.
- Fixed issue where changing global weather over SimConnect would not properly clear clouds and precipitation.
- A controllable camera is now automatically created when any corresponding variable is requested from an XML gauge or Scaleform.
- Fixed null return case in GetCurrentWindow with multiple views.
- Added GetGroundAlt to CameraPDK.
- Updated the Oil Rig sample .x and .max files.
- Updated AIR sample files in documentation.
- Use of global terrain view can now be set using the CameraPDK.
- Added CameraSystem PDK functions to control single pass rendering.
- Corrected return values in the Sound PDK service.
- Fixed issue where 3D sounds created through the PDK would always loop.
- Added missing latitude and attitude key events to the gauges header.
- Fixed issue preventing some sample projects from building correctly in debug.
- Fixed XtoMDL error that could cause certain elements to be incorrectly flagged as animated.
- Updated outdated documentation referencing dll.xml files instead of add-on.xml files.

- Fixed issues with camera sensor mode not updating when set using SimConnect.
- Updated helicopter sample flight model with min/max collective angles.
- Fixed crash when trying to create non-aircraft objects with the SimConnect_AICreateNonATCAircraft function.

Prepar3D v4.5 Hotfix 1

Client Fixes and Improvements

- Fixed performance issues seen on some systems and configurations.
- Fixed issue where the interpolated wind direction value would be invalid in some cases.
- Added configuration option to toggle UI hardware acceleration mode (UIHardwareAcceleration).
- Fixed crash when re-enabling Virtual Reality (VR) while using the Oculus headset.
- Fixed crash that could occur in some cases after a plugin removed its textures from the system.
- Varjo VR-1 eye tracking is now supported.
- Improved performance when using the Varjo VR-1 headset.
- Fixed issue where CreateEffect callbacks would not be issued unless both xyz and pbh offsets were present.
- CIGI ownship ID now set to 0 for versions prior to CIGI 4.0 (Professional Plus Only).
- Fixed error with empty EntityAffiliation tags being written out in saved scenarios.
- Fixed issue where sound volume could be incorrect when switching between interior and exterior views.
- Fixed issue where PBR textures could be black in interior views when first entering a vehicle.
- Fixed incorrect unit conversions for camera eyepoint altitude P variables.

Content Fixes and Improvements

- Fixed missing PBR texture in F-16A.
- Removed light scaling from beacon effects.

Scenery Fixes and Improvements

- Increased beacon light visibility distance.

SDK Fixes and Improvements

- Fixed issue where the PBRMaterial's effectFile property would not be updated during load.
- Fixed issue with 3dsMax exports causing material mismatch errors when P3DMaterial and PBRMaterial were being used in the same scene.
- Fixed issue with drawing and loading Annotator vegetation polygons.
- Fixed several minor errors in documentation.

Prepar3D v4.5 Hotfix 2

Client Fixes and Improvements

- Fixed Startup Screen UI issue where the incorrect date would be displayed after loading a scenario.
- Fixed bug preventing SSAA from being applied on PBR objects.
- Fixed issue where AI cargo doors would not close before taxi/takeoff in some cases.
- Fixed issue where AI baggage carts could get stuck in the TAXI state causing AI aircraft to remain in the PreFlight state.
- Fixed issue preventing pylons without attached weapons from serializing in multiplayer.
- Tracer rounds now render in multiplayer.
- VR recalibration origin can now be configured including an option to calibrate with a custom origin without triggering calibration from OpenVR.
- Fixed crash that could occur when DIS labels were active with high traffic settings.
- Improved fallback logic when a container title is not found in the DISEntityTypes.xml.
- Fixed bug where attach points would not animate in some cases.
- Fixed several positioning bugs with mixed reality portals.
- Improved portal editing including the ability to modify their PBH and name.
- Added FOV edit mode for VR controllers.
- Different shapes can now be used for portals including cylinders, spheres, and rectangles.
- Gaze detection can now be enabled in VR settings.
- Fixed crash that could occur when crashing the aircraft while using a Varjo VR-1 headset.
- Fixed light and text sizing, g-effects, and inverted eye openness values in Varjo VR-1 headsets.
- Fixed bug preventing 3D airport navigation visuals from drawing in some locations.
- Fixed crash that could occur during scenario validation if VI sessions were empty.
- VR mouse cursor is now hidden when not in use.
- Tooltips are now stored in each pick request.
- Fixed bug preventing VR tooltips from appearing if other external pick requests were active.
- Added an AllowLoopback DIS option to allow processing of packets sent by the local machine.
- Any VR interface can now be enabled on startup.
- Fixed bug affecting the visibility of attached effects.
- Added eye panel data to VR settings.
- Fixed issue causing brightness in HDR to be too low in some cases.
- Fixed issue where objects with PBR materials would have incorrect vertical positions in some cases.

- Scaleform panels now serialize local variables (L:Vars) in multiplayer.
- Added VR passthrough camera settings screen.
- Fixed issues preventing weapon targets from recording and playing back correctly in some cases.
- Simplified playback complete dialog text.
- Entities will now maintain their current course when a PlayFlightRecordingAction completes.
- Added CIGI auto-start capability.
- Fixed issue where OnCompleteActions would not fire after AI completed a waypoint list.
- Improved VR tracker calibration including the ability to use a tracker puck as the camera origin.
- Fixed bug where add-on airport LLA would not be updated in some cases.
- DIS pull to ground is now on by default.
- DIS pull to ground now uses CG height instead of the bounding box for placement.
- DIS pull to ground transition is now smoothed as well as clamping pitch and bank.
- Added button to calibrate eye tracking for Varjo VR-1 headsets.
- Fixed issue where add-on land class textures would not be loaded in some cases.
- Stereo mode now supported for Vive Pro Eye passthrough camera.
- Improved handling of alpha values in terrain vector textures.
- Eye tracking in supported VR headsets is now automatically enabled.
- Fixed issue where airport runway secondary landing attributes would be ignored and processed as primary landing attributes.
- Added VR Tuning Guide to the Learning Center.

Content Fixes and Improvements

- Fixed incorrect fire weapon voice control binding and added default fire gun command.
- Fixed DIS enumeration for wander boat.
- Fixed text display, target distance, and target aspect angle issues in the F-16 HMD overlay.
- Removed the momentum effect from the Virtual Cockpit Only camera.
- Fixed visibility issues with the explosion flak effect.
- Added Eye Tracking Demonstration Scenario.
- Moved F-16 eyepoint forward slightly.
- Fixed default DIS entity mappings for Lowboy Semi-Tractor Trailer and Tanker Truck Yellow to prevent collisions.

Scenery Fixes and Improvements

- Fixed incorrect transparency values in several autogen objects.

SDK Fixes and Improvements

- Fixed incorrect ordering of C-gauge tokens.
- Fixed variable naming for ISimObject attachment units and updated documentation.
- Fixed missing GetGeneralTimeOfDay function in the IGlobalDataV430 interface.
- Custom SimObject properties that override native SimVars now work over SimConnect.
- Added an OpenGL Panel sample.
- Updated the picking sample with an example of using world ray interrogation.
- Fixed a memory leak in the Custom Icon sample.
- Fixed bug preventing columns from being customized in the Traffic Toolbox tool.
- Added an Eye Tracking SDK sample.
- Fixed UV channel optimization issue causing vertex count mismatches in some cases.
- Added addition simulation categories to SimConnect_RequestDataOnSimObjectType.
- Added additional VR SDK interfaces.
- Added world object PDK service to create, place, and remove objects by GUID.
- Added world object PDK service sample.
- Added OpenCVStereoCamera PDK sample.
- Fixed crash that would occur when using the panel system InitializeVarByName function.

Prepar3D v4.5 Hotfix 3

Client Fixes and Improvements

- Added support for the Varjo XR-1 Mixed Reality (MR) headset.
- Fixed bug preventing gaze select cursor from appearing in some cases.
- Ownship can now follow waypoints when using the ActivateWaypointsAction.
- The ActivateWaypointsAction now correctly sets waypoint requested distance values.
- Fixed bug preventing waypoint list data from being queried by the PDK when running SimDirector.
- Fixed bug preventing Camera System PDK calls from accessing the latest interface version.
- Improved DIS wildcard handling and fixed issue preventing entity types from corresponding correctly in some cases.
- Fixed bug preventing preview windows from rendering in SimDirector in some cases.
- Fixed issue where shared cockpit would lag with more than four players in a vehicle.
- Fixed QueryService call for the IDISManagerv450 interface.
- Fixed issue causing irregular movements on nested attached objects.

- Fixed multichannel startup crash seen in some cases.
- Fixed issue where sound would still be muted in some cases when leaving multiplayer UI screens.
- Fixed wave animation issues when changing wind directions over the 0/360 degree boundary.
- Slew is now enabled by default in multichannel.
- Added a command line argument to launch Prepar3D directly into playing back a flight recording.
- Fixed cases where certain objects would have irregular movements in recording playbacks.
- Fixed issue preventing metallic occlusion properties from loading correctly.
- Fixed crash seen when loading airports with no taxiway paths.
- Fixed issue where scenario actions would not fire when starting directly into multiplayer.
- Improved handling of near clip in VR.
- Fixed issue where autopilot state would not load correctly in some cases.
- Fixed issue causing incorrect pitch to be set when loading an uncompressed 32 bit DDS texture.
- Added controls to emulate the mouse scroll wheel when using Gaze Selection in VR.
- Added support for the Varjo XR-1 Mixed Reality (MR) headset.
- Multichannel clients can now use direct IP autostart.
- Fixed issue where scenario objects would not handle events correctly in multichannel.
- Fixed crash when resetting structured scenarios in multichannel.

Content Fixes and Improvements

- Updated several DISEntityTypes.xml entries to ensure each default object is unique.
- Removed invalid FuelTruck object from DISEntityTypes.xml.
- Fixed flap configuration for the F-35A.
- Fixed issue with F-16 effects being added twice by removing effect file extensions in F-16 config entries.
- Fixed minor issues in the Basics of Flight scenario.

SDK Fixes and Improvements

- Added functionality to the PDK for Structured Scenario support for Mission Objectives, Goals and Flight Segments.
- Added additional multiplayer PDK service functions.
- Fixed TrafficToolbox dump airport list to correctly parse airspace types.
- Fixed issue preventing ImageTool from loading certain DDS textures.
- Fixed event ID filter for mouse inputs to allow custom ISimObject instance-based properties.
- Added [ClampingOnGround] variables to SimObjects to prevent stationary vehicles from sliding in some cases.

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Prepar3D v4.4 Features and Enhancements

Release Notes

Take to the skies like never before with Prepar3D v4.4!

Groundbreaking features and improvements make this the largest and most comprehensive Prepar3D point release yet. Prepar3D v4.4 not only adds extensive new features to the platform, but also includes numerous user and developer requests including multiple fixes identified by the community and further expansion of Prepar3D's open development architecture.

A focal point of this release is the core rendering engine has been updated to fully support Physically Based Rendering (PBR) laying the groundwork for next-level realism and unparalleled graphical fidelity in a full earth simulator. New content created using new PBR capabilities will allow all different types of materials, including metals, plastics, concrete, and glass, to be rendered and lit based on their unique physical properties. Photoreal scenery has never looked better in Prepar3D v4 with new high-resolution texture support offering up to 16 times the detail in previous versions.

In addition, scenery objects can now be drawn at further distances, most add-ons will no longer require a restart when enabling or disabling them inside the application, moon lighting and cloud appearances at night has been overhauled, and to showcase the new PBR pipeline, the native F-16 aircraft materials have been updated to PBR.

Experience next generation training now with Prepar3D v4.4!

The following list of updates has been categorized based on the installer required. The *Client* installer is required for Prepar3D v4.4, however the *Content*, *Scenery*, and *SDK* installers are optional. You must first have Prepar3D v4 installed to utilize the *Client* only installer.

To install the *Prepar3D v4.4 Client*, you must first uninstall the previous *Prepar3D v4.0/v4.1/v4.2/v4.3 Client* through **Programs and Features** in **Windows Control Panel**. Do not deactivate your license when prompted. If you selected to deactivate your license during uninstallation of your current *Client*, your will be prompted to reactivate Prepar3D. Please view the Prepar3D v4 Download and Installation Instructions for more information.

Prepar3D Client

General Platform Updates

New Features

- Updated rendering engine to support Physically Based Rendering (PBR) content.
- Photoreal textures can now be rendered at 512x512 and 1024x1024 resolution.
- Scenery draw distance, including airports, can now be configured.
- Enhanced night lighting based on moon phases.
- Most add-ons can now be activated and deactivated at runtime without requiring a restart.
- Multiplayer hosts can now change the time and weather during a session.
- Added visual notifications when chat messages are received in multiplayer.
- Added scroll wheel zoom control to map screens.
- Emitters can now emit particles underwater.
- Added support for placing panel windows in 3D space.
- Added Augmented Reality (AR) support using pass-through cameras on standard Vive headsets.
- Added menu bar and context menu support when using Virtual Reality (VR).
- Added gaze selection control mappings and mouse dragging functionality to VR. Now you can use head movements to control the mouse and select buttons in Virtual Cockpits.
- Cockpit tooltips are now available in VR.
- Added voice control debugging to show phrase detection in real time.

New Features (Professional Plus Only)

- Added debug label drawing for Distributed Interactive Simulation (DIS) and High-Level Architecture (HLA) interfaces. Currently shows various parameters including name, entity ids, and IP address.
- DIS can now be configured while in SimOperator.
- Added the ability to enable, disable, and modify DIS dead reckoning in real time.
- Added Common Image Generator Interface (CIGI) 2.0 and 2.1 support.
- Added CIGI packet interception interface.
- Added generic directed energy (laser) weapon support.
- Added generic torpedo weapon support.
- Submersible SimObjects now support weapons.

Fixes and Improvements

- Made optimizations to water rendering by removing unneeded emissive samples on water-only tiles.

- Fixed flight planner issues including waypoints being cleared and various problems with third-party created flight plans.
- Improved SpeedTree rendering performance.
- Added additional checks preventing black dynamic lights from being processed.
- Fixed inconsistent specular and emissive values between land, water, and land+water shader variations.
- Added distance-based texture requests for vehicle and library objects.
- Fixed issue where terrain texture tiles could be incorrect for one or two frames at night.
- Fixed issue where some terrain tiles were missing on max settings in some parts of the world.
- Improved water appearance in cube maps used for reflections.
- Fixed several scenery library sorting issues.
- Fixed issue where flight planner waypoints would not load correctly from a scenario causing ATC errors due to a failed departure airport look up.
- Fixed issue that prevented some bridge segments from drawing.
- Fixed issues with dynamic reflections distorting when zooming camera.
- Fixed issue preventing global custom cameras from saving and loading correctly.
- Fixed issue that could sometimes cause missing autogen at scenario start.
- Vehicle/avatar changes can now be done in a multiplayer session depending on host settings.
- Fixed issue causing transparent objects in virtual cockpits to draw incorrectly in some cases.
- Fixed issue that could cause minor visual artifacts in some aircraft models.
- Fixed 2D panel transparency when using multiple render-to-texture views.
- Fixed issues with certain taxiway and apron path intersections preventing beziers from drawing and layering correctly.
- Various avatar movement improvements.
- Fixed several multiplayer chat bugs that prevented players from communicating using the chat window and voice communication.
- Fixed sound distortion issues at high framerates.
- Fixed panel texture elements not rendering below other elements when window was undocked.
- Fixed issue with attachments preventing simulation logic from disabling for SimpleSimObjects.
- SimObjects can now use mobile scenery models by mapping the appropriate visual model GUID.
- Fixed issue that could cause the Window Definition menu item to be disabled.
- Fixed issue where VC texture's alpha was not respected in Scaleform-based VC panels.
- Prevented redundant control settings saves.
- Added errors reporting if controls settings fail to load.
- Fixed sizing issue with instrument panels when loading a scenario with an active view group.
- Increased max frame rate limit from 60 to 120.
- Added additional clarification to license activation errors.
- Added finer resolution to Helicopter autopilot altitude hold.
- Ambient wind is now factored into hover logic for helicopter AI.
- Fixed case where extreme collective movement could occur in altitude controller for helicopter autopilot.
- Changed the default HDR Brightness, Bloom, and Saturation levels back to 1.0.
- Sim rate overrides can now be configured for AI vehicles.
- Updated beacon lights to use dynamic lighting and removed cone geometry.
- Fixed an issue where detached avatar control mappings were not loading correctly when switching between avatar objects.
- Fixed 3D panel aspect ratio bug that could occur when exiting VR.
- Increased default camera LateralMoveRate, LongitudinalMoveRate, and VerticalMoveRate which slightly increases cinematographer camera movement.
- The Panel Manager window is now available on all vehicles.
- Moved video capture location to the My Videos directory.
- Fixed issue where Scaleform overlays would not be captured in video recordings.
- Fixed issues with the piston engine damage timer.
- Fixed issue that could cause large onscreen text blocks to have missing characters in some cases.
- Fixed PDK shutdown error when a C-130 variant was the user vehicle.
- Fixed issue that prevented mouse up events from being properly handled on virtual cockpit elements if the mouse was no longer over the object.
- Fixed crash in map system that could occur when making changes to the scenery library.
- Fixed crash that could occur during startup if error conditions were present.
- Fixed crash that could occur when changing DPI settings without logging off.
- Fixed crash that could occur when using controllable cameras.
- Fixed crash that could occur in multiplayer under certain connection conditions.
- Fixed potential crash with Scaleform Panels in VR.
- Pausing will now also pause the timer for message windows.
- RTT views will no longer show in the Manage Cameras user interface (UI) screen.
- Various improvements to the Manage Cameras screen including closing the window with the escape key and correctly focusing the window when opened.
- Various improvements to the Add-ons UI screen.
- Added button to Manage Camera screen to pull in data from the active view's camera.
- The Vehicle Preview window now preserves the zoom level when switching vehicles.
- Adjusted width of the End Scenario screen.
- Fixed bug with pause state not loading from fxml files correctly when loading from the startup screen.
- Added map and vehicle preview windows to the multiplayer host and mini-chooser UI screens.

- Fixed issue with Show On Startup setting not saving correctly for the Scenario Startup screen.
- Focal points and on-screen text have improved support for multi-line text.
- Removed the Restore Time On Move checkbox from the startup screen.
- Updated the Observer Management UI.
- Updated Time of Day and Weather UI images with higher resolution versions.
- Moved multiplayer realism and change location settings in multiplayer UI.
- Updated render mode for UI windows to be hardware accelerated.
- Added voice controls for VR gaze clicks.
- Updated soft particles and decals to support single pass VR depth reconstruction.
- Fixed issue preventing the ATC window from showing up in VR.
- Fixed issue with Scaleform panel background being black in VR.
- Added key command for toggling the VR Menu bar and context menu.
- Windows placed in 3D space now persist their locations when entering and exiting VR.
- Made minor adjustments to VR window controls.
- Added more precise VR error reporting when using Oculus headsets.
- VR cursor is now scaled to remain the same size on screen regardless of where hit was detected.
- Added max distance configuration for VR mouse picks.
- Added voice controls to change views and view categories.
- Added global certainty override to VoiceControl configuration.
- Updated core compiler.
- Updated framework to .NET 4.7.2.
- Reorganized Cinematographer control documentation.
- Added CIGI link to Network Overview documentation.
- Update Learning Center table of contents (TOC) titles.
- Fixed flight planner documentation to correctly refer to the updated flight planner UI layout.
- Added quick reference guide to default voice control phrases.
- Added documentation covering AR, portals, and gaze mouse control.
- Created VR documentation section in the Learning Center.

Fixes and Improvements (Professional Plus Only)

- Made several CIGI weather control fixes.
- Fixed CIGI shutdown crash.
- Post process lists for sensors now supported within CIGI.
- Fixed CIGI issue that caused polarity effects to remain on screen even after sensor was turned off.
- Fire control system now sends updates in multiplayer keeping the current target in sync.
- Added DIS enumeration for Torpedo (Mk 48).
- Added laser fire and detonation DIS PDUs.
- Fixed DIS tail number fallback logic.
- Fixing an oversight in DIS with a dead reckoning value of 0.
- Added new DIS enumerations to various objects.
- Added the ability to choose between World or Body space for dead reckoning in the DIS options menu.
- Prevented invisible objects from broadcasting across DIS when first being created.
- Weapon cameras will now be the nose view of the weapon by default.
- DIS UI window is now modeless.
- Fixed crash that could occur on a CIGI IG when closing a docked view.
- Fixed cases where HLA entities were not being created.
- Fixed CIGI issue causing IG Short Art Part packet contents to be overwritten in some cases.

SimDirector Updates

New Features

- Added white list capability allowing scenario creators to limit the amount of available objects in SimDirector.
- Added Com1/Com2 frequencies to MultiplayerRole in SimDirector and SimOperator
- Added CreateCamera option to entities allowing AI objects to automatically create a tracking camera attached to these objects.
- Added Simulate bool to entity objects allowing objects to stop simulating but still render.
- Added EntitySimulationAction to change the simulation state of entities dynamically in scenarios.

Fixes and Improvements

- Fixed issues with bounding box placements and sizes on some objects.
- FailureAction now updated to match failures available with currently referenced vehicle.
- Virtual and Flight Instructor modes now show all scenario objects.
- Fixed crash when selecting objects while the Attachments window was open.
- Fixed several focal point drawing issues.
- Focal points no longer draw icons in Sim Editor mode.
- The MDLGuid property now displays the model's GUID in addition to the model combobox.
- Fixed minor validation issue with ViewChangeActions.
- OneShotSoundAction now plays correctly if called after a 0 second timer at the beginning of a scenario.
- Added SpeedKnots property to ownship entity options.
- Entities and MobileScenery will now default IsOnGround to true when first placed preventing them from being displayed underground.
- Added tooltip explaining why sound recording is disabled based on Sound Type for SimDirector sound actions.
- OneShotSoundActions now save elapsed time and resume properly if scenario is saved during playback.

- Fixed file read errors when booting directly into SimDirector via command line.
- PanelWindow object now works with mission and UI panels.
- Moved the Snap to ground button to the Edit tab.
- Altitude and PBH changes now remove IsOnGround flag for AI, UserOwnship, and UserAvatar.
- Fixed issue with AGL not adjusting for ground elevation with vehicles.
- Moving objects now preserves IsAGL altitude rather than recalculating altitude based on elevation.
- Gizmo state is preserved when deselecting and reselecting objects.
- Increased translation gizmo mouse hit area to match rotation and scale gizmos.
- Fixed issues with audio recording within SimDirector.
- Center on object now positions camera directly over the object.
- Mouse icon now changes when hovering over object icons to indicate they can be moved.
- Fixed crash that could occur when trying to browse for a OneShotSound.
- ViewChangeActions are now disabled on the main window when in SimOperator.
- Fixed issue that caused VI sessions to not play back mouse events correctly.
- Fixed issue with AI recording playback not starting if an ownship recording is playing.
- OneShotSoundRecordings and FlightInstructor recordings are now moved when saving from the P3D default directory. This will move relative files from %APPLOCAL% to the new scenario location.
- Fixed issue that could prevent camera views created in SimDirector from playing sound.
- Added AGL toggle to ownship object.
- Removed PointOfInterestActivationAction and merged it with ObjectActivationAction.
- Animal SimObjects can now follow waypoints.
- MobileSceneryObjectController is now defaulted to a non-zero value.
- Fixed issue with SimDirector catalog view being cut off at certain resolutions.
- Fixed case where setting IsGlobal to true would prevent actions from firing in single player scenarios.
- Fixed stack overflow that could occur in certain scenario configurations.
- Fixed issue preventing OnCompleteActions from firing on PlayFlightRecordingActions in some cases.
- Fixed issue where OnCompleteActions would fire when a PlayFlightRecordingActions was executed instead of when playback was finished.
- Fixed various visual issues seen when opening SimDirector.
- Fixed collision triggers not firing in Preview Mode.
- Standardized Focal Points to always be activated when created.
- Fixed issue where crash detection would be permanently disabled after entering preview mode.
- Removed new line which caused extra space in property grid description for TargetPlayer objects.
- Updated SimDirector Course documentation.
- Updated MenuPromptTrigger documentation.
- Added additional clarity to MobileSceneryObject behavior in documentation.

Prepar3D Content

New Content

- AC11 Commander 114 user-selectable vehicle provided by Carenado.
- Indago UAS is now a user-selectable custom vehicle with auto-land capabilities, tracking camera, and custom UAV control scheme.
- Several large explosion effects.
- Generic torpedo weapon.
- Reintroduction of VEH_air_firetruck that was removed in a previous release.
- Generic 60ft Pusher Drone AI object with PBR textures.
- Drone 3 AI object with PBR textures.
- MHTK Launcher box AI object with PBR textures.
- S-97 AI object.
- 81mm mortar weapon and launcher with PBR textures.

Fixes and Improvements

- F-16 aircraft fully updated to PBR for both the interior and exterior models.
- Added example targeting pod to F-16 cockpits with controllable camera, IR sensor modes, zoom control, ground and entity targeting, and weapon target syncing.
- Tail numbers can now be modified on F-16s, C-130s, MH-60s, UH-60s, and CH-53s.
- Added laser weapons as an example to LCS variants.
- Added friendly names to F-16 controls.
- Added dynamic lighting to the F-16 afterburner.
- Added the new torpedo weapon to the Ohio Class Submarine AI object.
- Fixed texture errors on C-130 fuel tanks.
- Fixed flag textures on C-130s.
- Added RecordAndPlayback.xml file and necessary set/get functions for Driver ISimObjects. Updated/removed unused control mappings.
- Fixed ghosting tail number for 3 different F-16C variants.
- Slightly repositioned eyepoint in C-130.
- Updated MH-60s and UH-60s with animated Turn and Slip ball indicators.
- Updated the AC-130H gun effect so that it no longer lags behind the aircraft.
- Updated AC-130H gun effects and moved attach points.
- Fixed issue preventing Howitzer from firing in the correct direction
- Corrected several Desert Hawk 3 animations and materials.
- Additional tuning and stability updates for Desert Hawk 3 including improved waypoint following.
- Added pilot camera to Desert Hawk 3.
- Removed ground bump from Orion and SLS.
- Fixed typo in C-130 payload.

- Updated S-97 AI object animations and tuned contact points, lights, weapons, and various other properties.
- Added missing DesignSpecs section to various animals.
- Fixed crash seen by some users when opening the ACM panel in the P-38.
- Updated mouse pad textures in control towers.
- Removed all Beechcraft (Textron) related aircraft and scenarios.

Prepar3D Scenery

Fixes and Improvements

- Fixed trench running through large areas in Iran.
- Added several representative military jets to AI traffic. These require military cargo/combat parking spaces to appear.
- Fix for specular value of bare desert that caused background globe to be brighter than generated textures.
- Golf courses can be layered on top of airport backgrounds.
- Added several new scenery objects including warehouses, wooden pallets, wooden shipping crates, and military tents.

Prepar3D SDK

New Features

- Updated modeling tools to support creating Physically Based Rendering (PBR) content.
- Added material scripting support to PBR materials.
- Added PBR support to autogen tools utilizing Materials.xml/spb.
- Engine supports mixed materials enabling content to have PBR and non-PBR materials on the same object.
- PBR materials can be previewed in real time within 3ds Max.
- Model version will automatically update if PBR is used to prevent models from loading in previous versions.
- Added support for multiple autogen description files. Files can now also override subsets of autogen content.
- Native SimObjects can now register custom properties and events.
- Added panel.cfg entries for 3D placement of panels in Virtual Reality.
- Scenario panels can be added to application menu.
- Updated SDK samples to Visual Studio 2017.
- Real-time subsystems can now be attached and configured to any SimObject.
- Added SLI and texture format options to Rendering System in PDK.
- Update image tool to have RGB per channel viewing.
- Added IMultichannelService to the PDK.
- Added custom DIS PDU support to the PDK (Pro Plus only).
- Add an EVENTTYPE_NOT_MAPPABLE for ISimObject events that should not appear in the Controls Assignment UI.
- Consolidated all PDK code samples into a single SDK Samples solution.
- Added accessors and mutators for the world space offset, size, and camera reference in the Window PDK.
- Exposed Fuelflow -> N1 controller table in .air file allowing more control over the FF-N1 relationship.
- Added stop sound function to PDK. Can stop one shot and looping sounds.
- Added PDK call to get tooltip text for windows.
- Added 2D and 3D text drawing to the PDK.
- Added send/receive callback functionality through the PDK for intercepting DIS packets.
- Tail number colors can now be configured.
- Added ability for add-ons to override native key events.
- Added eyepoint (lat, lon, and alt) SimVars.
- Added SimProp and Configuration services to SDK.
- Added fallback script directories for SimObjects (similar to how texture directories are handled).
- Added horsepower as an available unit of measure.
- Added various new SDK samples, including:
  - CIGI Custom Packets
  - Linux Simulation Integration
  - Simulation Rate Modification
  - Supplemental Subsystems (Engine Model)

Fixes and Improvements

- Material scripts for placed BGL scenery objects now have access to adjacent texture directories when loaded.
- Corrected several internal QueryInterface and QueryService calls preventing ISimObjects to correctly respond to service requests.
- Streamlined PDK headers.
- Fixed issue with model exporter producing invalid values with certain models leading to minor visual artifacts.
- Fixed issue preventing elements from previewing correctly in the Ace tool.
- Changed name of external forces to explosion forces for clarity.
- Fixed externally registered Force/Moment management for SimObjects.
- Added check to prevent registering duplicate services through the PDK.
- Titles can now be modified for sim configuration UI windows.
- Fixed QueryInterface issue with IRenderData in the PDK.
- Added ISimObject RegisterSimulation overload that takes in a min/max simulation rate parameter.
- Simulation rate for objects can be modified using the PDK.
- Updated the SetData SimConnect sample to show how to use structs with different data type members.
- Fixed Visual FX tool issue where incorrect values would be loaded after reopening a saved effect.
- Fixed PDK sample art scripts.
- Fixed incorrect return values with create and remove texture PDK calls.

- Removed invalid SDK sample code build configurations and standardized output directories.
- Moved ISimObject samples to PDK ISimObject sample directory.
- Fixed an issue where PDK mouse rectangle ID's would not persist between loads.
- Added non-version specific queries for ISimObjectManager queries for user, avatar, and other IBaseObjects.
- Fixed SDK Scaleform Autopilot sample to support Units of Measure = Metric. This applies to Altitude Hold and VS Hold.
- Added Managed Voice Control sample back to SDK Samples.sln.
- Simplified the Camera PDK sample.
- Renamed car ISimObject sample to SimpleCar for consistency.
- Added basic waypoint following to SimpleCar sample.
- Fixed crash in targeting pod sample if vehicle did not have a FireControlSystem.
- Refactored HMD sample to use new 3D panel functionality.
- Converted radar panel callback to use an add-on.xml for installation.
- Added fix for the Show Location marker not appearing correctly in the FX Tool.
- Fixed crash that could occur when using SimConnect_AttachExternalSecondarySimToSimObject.
- Updated InterrogateWorldRay documentation.
- Clarifying DIS entity priorities documentation.
- Added TargetFrameRate in camera configuration documentation.
- Correcting mod operator description in RPN documentation.
- Added visual model GUID documentation in SimObject configuration.
- Corrected weapon xml file documentation.
- Improved documentation for SimConnect_SetDataOnSimObject.
- Consolidated SimConnect sample overview tables.
- Fixed table formatting in documentation for special effects.
- Created PDK sample overview replacing ISimObject sample overview.
- Updated missing units for feet per second and feet per minute in documentation.
- Fixed incorrect add-on installation path in documentation.
- Added parameter to SimConnect_PlaybackRecording to prevent dialog from displaying when playback finishes.

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Prepar3D v4.3 Features and Enhancements

Release Notes

The next update for Prepar3D v4 is here! Prepar3D v4.3 takes simulation to the next level offering new features including interactive panel windows in virtual reality (VR), improved scenery dynamic lighting performance, as well as numerous user interface (UI) enhancements, various stability and performance improvements, multiple bug fixes, and much more. Many updates were also made to the Software Development Kit (SDK) giving developers more power to create new and exciting content blurring the lines between simulation and reality.

The following list of updates has been categorized based on the installer required. The *Client* installer is required for Prepar3D v4.3, however the *Content*, *Scenery*, and *SDK* installers are optional. You must first have Prepar3D v4 installed to utilize the *Client* only installer. To install the *Prepar3D v4.3 Client*, you must first uninstall the previous *Prepar3D v4.0/v4.1/v4.2 Client* through **Programs and Features** in **Windows Control Panel**. The *Prepar3D v4.3 Client* update will require you to reactivate your product, however if you have an internet connection it will be automatic. Please view the Prepar3D v4 Download and Installation Instructions for more information.

Prepar3D Client

General Platform Updates

New Features

- Vehicle panels can now be used in VR.
- Window Definitions can now be created and applied to Prepar3D windows.
- Added Scenery Library and Add-ons to the Startup Screen.
- Added interactive Map to the Airport Selection Screen.

New Features (Professional Plus Only)

- Added Common Image Generator Interface (CIGI) support.
- Distributed Interactive Simulation (DIS) entity appearances can now be customized per bit via XML file.

Fixes and Improvements

- Fixed issue where right clicking the ATC and closing would cause the ATC window to reopen on a view change.
- Fixed inaccurate heading when broadcasting to ForeFlight.
- Invalid camera settings no longer save out when saving in VR.
- Various VR Performance improvements increasing overall framerates and stability.
- Virtual Cockpit (VC) rendering performance improvements.
- Fixed visual bug where UI windows would flash at the wrong location when opened.
- PreVC post processing optimized with new VC rendering techniques.
- Updated Colorizer post process to correctly use stencil buffer.
- Fixed numpad view panning when using SimConnect applications.
- Fixed rare bug in Oculus initialization that could cause visual anomalies.
- Fixed visual errors when using Oculus with SteamVR.
- Fixed VR issue which prevented the proper single pass stereo mode from updating based on settings.
- Fixed bug preventing the ShowMessageText setting from persisting.
- Fixed issue with undocked views not focusing and accepting input when closing their context menu.
- Fixed bug preventing add-ons from loading properly with trailing slashes '\' in file paths.
- Added a VR settings UI screen and reorganized VR menu items.
- Oculus VR headsets can now be used with SteamVR.
- Added VR emulator option to test VR without having a headset connected (requires installing SteamVR).
- Cinematographer camera movement speed is now updated based on joystick sensitivity settings.
- Fixed issue that could cause the ATC window to be disabled unexpectedly.
- Fixed issue that caused keypresses to be processed on SimConnect menu windows when opened.
- Zoom is now available in VR.
- Installer is now digitally signed.
- Fixed crash that would occur in vehicles with a large number of VCockpit panel entries.
- SimConnect menus no longer register for key presses larger than the menu option count.
- Reduced lag when opening context menus.
- Fixed bug where numeric keypresses to SimConnect windows would also be sent to the main application.
- Custom camera menu items are now displayed in their view category and can be applied to views when opened.
- Deleting a custom camera now only resets views that had that specific custom

camera applied instead of all views in that category.
- Default settings for VR, ViewGroups, and Multichannel are now written out to configuration files.
- Added reset camera menu option in context menu and menu bar. Reset also reapplies custom camera values if set on the view.
- Updated default zoom levels for cockpit and virtual cockpit entries to 0.3.
- Fixed issues with certain sensor views in VR singlepass with MSAA enabled.
- Fixed bug that caused voice communication issues over multiplayer.
- Added -rolename command line option. This lets users specify the rolename for multiplayer scenarios.
- Startup screen is no longer displayed when using the -net command line option.
- Both structured and unstructured scenarios can be selected when booting directly into multiplayer using the -mp command line option.
- Fixed visual issues with focal points.
- Placed dynamic lights are now processed in clusters with additional distance-based checks improving performance.
- Added ability to create custom voice control phrases from VR.
- Renamed Selection key events in the Controls UI to Selection/Zoom so that the key binding for zooming is easily searchable.
- Added magneto increment/decrement to Controls UI.
- Removed redundant work in water texture processing.
- Fixed hybrid unit display errors in UI.
- Added checkbox for disabling cockpit momentum effects.
- Fixed margin errors, tooltips, and minor visual bugs in several UI screens.
- Fixed issues where custom scenery could cause invalid data to be written in land classes.
- Fixed bug where secondary view group windows would not fully expand to the left and right of the display.
- Fixed bug where maximized windows on secondary monitors would not cover the taskbar in full screen on Windows 10.
- Fixed bug with vehicle doors opening after a SimConnect menu was opened.
- Added additional fallback case when loading control mappings to disregard any GUID in the title. This is useful when exporting controls on one machine and importing on another where GUIDs may not match.
- Fixed resizing issues with the timer panel.
- Changed default observer focus type to local instead of world.
- Updated installer to reduce potential hangs when installing DirectX.
- Fixed enter key not working with Activation UI windows.
- Fixed crash when opening the Save UI if any installed aircraft were missing titles in their aircraft.cfg.
- Fixed crash when originalID was missing from scenario file.
- Updated generic buildings to do more accurate position calculations.
- Redesigned the Custom Camera UI.
- Fixed bug where sensor mode would not be cleared when removing IR post processes from views.
- Post processes no longer render one additional frame after being removed.
- Fixed error preventing email activations from persisting on restart.
- InfoGen is now updated in panel only views.
- Fix bug with rotatable landing light PBH in ISimObject vehicles.
- Fixed Flight Planner UI bug with cruising altitude not automatically being calculated after a departure/destination is selected.
- Fixed collision bug with avatar.
- Distant vehicles are more accurately displayed.
- Fixed bug where VC only views would be white when set to the starting view in a scenario.
- Fixed issue preventing User Interface windows from blacking out the application on newer versions of Windows 10.
- Fixed bug where Payload UI would save changes when pressing escape.
- Fixed issue with attached effects that could cause them to disappear at certain viewing angles. This also affected attached dynamic lights.
- Fixed turbo prop shaft torque time constant preventing errors causing incorrect net negative torque values.
- Fixed crash that could occur when crashing vehicle.
- Fixed issue preventing the host machine in multiplayer from correctly serializing content to client machines. This would occur when the host did not have content that connected clients had.
- When multiple UI windows are open only the window accepting user input is enabled.
- Improved handling of autogen extrusion object intersections including bridges.
- Fixed bug which could cause night terrain textures to be incorrect for one frame in some cases.

Fixes and Improvements (Professional Plus Only)

- Various updates to DISEntityTypes.xml.
- Fixed potential infinite loop when two or more DIS entities were colliding.
- DIS articulated parts and entity appearances are now configurable via XML file for both native objects and ISimObjects.
- Fixed audio choppiness when using DIS radios and intercoms.
- Added MaxHeartbeatFrequency setting to DIS which allows entities to heartbeat more often if necessary.

SimDirector Updates

Fixes and Improvements

- Fixed bounding issues when zooming with double click in SimDirector.
- Fixed bug causing SimDirector to lock up when canceling out of the SimOperator UI.
- Fixed crash that would occur when closing SimDirector when starting Prepar3D in SimDirector mode.
- Fixed bug where SimDirector icons would not render with post processing disabled.

- Improved tab key handling in SimDirector catalog view.
- Windows in SimDirector can now be activated using the keyboard by pressing Ctrl + Tab.
- Updated SimDirector course documentation.
- Fixed bug where the SimDirector window title text would not display file names containing multiple periods correctly.
- Added "ShowText" property to Dialog Actions.
- Added clarification to goal objects to highlight that completed goals can still be failed.
- Fixed bug where wingman behavior would still move AI when position freeze all was active.
- The current AppVersion will now write out to fxml from SimDirector instead of the loaded scenario's AppVersion.
- Added confirmation prompt when exiting SimDirector.
- The AirportLandingTrigger IDENT field now correctly validates against all airport ICAOs and is treated as a validation error instead of warning.
- Fixed SimDirector bug with Zoom Mode resetting to Standard after pressing shift while in Precise mode.
- Fixed bug where opening the Select Vehicle UI would cause all placed objects to disappear.
- The SimDirector window position and size now persist when switching between modes.
- Fixed issue with mouse look behavior for docked views in SimDirector Preview mode.

Prepar3D Content

New Content

- Added six flyable C-130 aircraft as default selectable vehicles:
  - AC-130H 'Spectre'
  - C-130H
  - C-130J
  - C-130J-30
  - HC-130H
  - KC-130H
- New placeable 3D scenario objects added:
  - Outrider Unmanned Aircraft System (UAS) vehicle
  - 74K Aerostat lighter-than-air vehicle system and mooring platform
  - Miniature Hit-to-Kill (MHTK) missile
  - Javelin missile
  - Surface-to-Air Missile ground vehicle
  - Transportable Multipurpose Radar 53 ground vehicle
  - Multi-Mission Launcher ground vehicle
  - High Mobility Artillery Rocket System (HIMARS) ground vehicle

Fixes and Improvements

- Removed duplicate sound in AIM-120 missile.
- Fixed issue that caused Jet Fighter 27 and 29 to appear as selectable vehicles.
- Model and texture updates for the CH-53.
- Removed broken duplicate firetruck SimObject.
- Some Scaleform mission panels were missing window_size cfg entries leading to sizing errors in some cases.
- Fixed missing sounds for several AI ground vehicles.
- Updated CH-53 and UH-60 exterior models with more accurate crash boxes.
- Updated CH-53 interior textures.

Prepar3D Scenery

Fixes and Improvements

- Fixed scenery errors causing trenches to appear along Cyprus.
- Fixed elevation and exclusion issues at YBUD.
- Fixed elevation issues in Guam.

Prepar3D SDK

New Features

- Target frame rate can be applied to specific cameras in camera configuration files and through the PDK.
- Added INetworkServices.h and IMultiplayerService.
- Added TextEventDestroyed SimConnect notification for when text windows are closed.
- Windows and panels can be positioned in 3D space using the PDK.
- Added damage state variable to ModuleSim. Variable can be set via scenario, PDK, or SimVar and will be serialized in multiplayer. Developers can use this variable to control model appearances.
- Added 3ds Max 2018 support.

Fixes and Improvements

- Added PreScene pass to SDK for custom render objects.
- Changed several QueryBaseObject interfaces to return void** instead of the specific version in the PDK.
- Fixed build error in SimpleHelicopter PDK sample.
- Updated SDK to have input stencil available for the PreVC render pass.
- Stencil flag added to primitive drawing.
- Added attachment SetOffsetFeet and SetOffsetRadians functions to the PDK.
- Added create and destroy callbacks for effects to the PDK.
- Added pylon accessibility to weapon system PDK.
- Fixed crash that could occur on shutdown if execute_calculator_code was called from within panel callbacks.
- Fixed light SimVar inconsistencies and added Headlight, Brake, and General Light key events.

- FLOAT2 has been added as a Simprop type/property option.
- Added content error report for missing models.
- Improved content error reports for DLL loading errors.
- Aircraft panel folders will now take priority over global gauges folders.
- Fixed file path bug with SimConnect_CaptureImage.
- Fixed SimConnect_OpenView to open a view with the correct camera and window title.
- Corrected rotation issue when setting attachment orientation.
- RUDDER POSITION SimVar now settable on GroundVehicles.
- Fixed error preventing ISimObjects from signalling weapon fired events.
- Fixed various camera sensor mode SimConnect functions.
- Fix edge case in PDK callback list that could cause a crash on shutdown.
- Added function to change the color of the AG radar scan.
- Added several new SDK samples.
- Add GetDeviceWindow function to IRenderingPluginService.
- Fixed window focus bug when opening an observer view with SimConnect_OpenView.
- Fixed issue where SimConnect data requests with the same definition ID would collide even though they were different request types.

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Prepar3D v4.2 Features and Enhancements

Release Notes

Prepar3D v4.2 continues to improve on the groundbreaking Prepar3D v4 simulation platform. The new v4.2 release welcomes three new user controllable helicopters, new rendering techniques for improved virtual reality (VR) performance, countless legacy bug fixes, and even a couple new exciting experimental features to give users a feel of where the platform is heading! This is the first release to feature new helicopter capabilities, including scenario controllable artificial intelligence (AI) and autopilot functionality. Additionally, many developer requests were addressed, and we look forward to the Prepar3D ecosystem continuing to create high-end content that pushes simulation boundaries to new limits.

The following list of updates has been categorized based on the installer required. The *Client* installer is required for Prepar3D v4.2, however the *Content*, *Scenery*, and *SDK* installers are optional. You must first have Prepar3D v4 installed to utilize the *Client* only installer. To install the *Prepar3D v4.2 Client*, you must first uninstall the previous *Prepar3D v4.0/v4.1 Client* through **Programs and Features** in **Windows Control Panel**. The *Prepar3D v4.2 Client* update will require you to reactivate your product, however if you have an internet connection it will be automatic. For more information please view the **Prepar3D v4 Download/Installation Instructions** from the Prepar3D.com **Downloads** page.

Prepar3D Client

General Platform Updates

New Features

- Added Single-Pass VR support for improved VR performance.
- Added headset selection to the VR menu
- Added helicopter AI capabilities
- Added helicopter autopilot functionality
- Added support for ground based waypoint and wingman AI
- Added Voice Control (*experimental*). See Using Voice Controls for more information.

New Features (Professional Plus Only)

- Added Distributed Interactive Simulation (DIS) Collision PDU support

Fixes and Improvements

- Fixed crash that could occur when moving windows across different GPUs
- Fixed issue in VR where the red top-down cursor would only show in the left eye view
- Fixed issue that could cause AI to jitter when viewing recordings
- Fixed flickering issue in VR when changing to a sensor view for the first time
- Fixed bug preventing graphics profile names from saving correctly
- Fixed issue with the crash view being misaligned in VR
- Fixed issue in the flight planner screen where altitude units would not sync with user preferences
- Fixed issue with full screen not correctly blacking out monitors with certain resolution settings
- Filenames containing a '.' character are now supported
- Added additional VR error messages to assist in debugging common issues
- Specified content errors will now only be reported once
- Added pop-up message that is shown when graphics driver crashes allowing scenario to be saved before shut down
- Fixed issue preventing navigation visual ribbons from properly appearing in instant replay and recordings
- Fixed issue where invalid ATC options were assigned to ground vehicles
- Fixed issue where commands assigned to numeric keys with modifiers (i.e. shift + 1) would not execute when the ATC window was open
- Fixed crash that could occur when having the ATC window open for an extended period of time when using a ground vehicle
- Fixed Scaleform crash occurring in various third party add-ons
- Corrected time zone processing so the date changes correctly when switching to an airport in a different hemisphere
- Fixed several time zone issues including updating GMT references to UTC, updating daylight savings time dates, fixing default time zone locations, and fixing international date line behavior
- Added "Message Text" option to enable or disable additional information text messages including opening the aircraft canopy
- Fixed issue where Air Traffic views would not correctly sync in VR
- Fixed issue preventing HTC Vive headsets from being used on machines with Oculus Software installed
- Fixed crash with Ultra Water when using third party add-on aircraft
- Fixed crash in Scaleform sound playback
- Fixed Unicode error with CustomAction payload strings
- Fixed crash that would occur when deleting the last assignment in the Controls user interface

- Fixed several issues with the recording system including objects spawned from a SpawnList not appearing, avatar animations not playing, and bookmarks not saving all data
- VR settings can be now set to persist
- Fixed issue where base AI could overwrite AI behavior states
- Fixed issue where heading would be lost when AI tug was turned on
- Fixed issue that could cause incorrect or corrupt textures to load when having several scenery add-ons installed through the Add-on Package setup
- Updating vehicle airspeed in the map UI no longer causes the pitch and bank to reset back to 0
- Autopilot airspeed increment and decrement can now be mapped to keyboard commands
- Fixed bug where desktop resolution would not revert to its original value when exiting in some cases
- Fixed issue with sky color being incorrect when volumetric fog was disabled
- Fixed issue with focal points being incorrectly colored in IR Black Hot camera mode
- Minor improvements to terrain paging performance
- Camera definitions now use content pathing when loading Scaleform movies
- Gauge events and scripts are now processed by the user object when the avatar is detached
- Scaleform overlays can now be set to source data from a camera's target object
- Corrected frustum offsets for cameras. Fix corrects Roll being incorrectly handled across the platform for cameras.
- Fixed issue with loading third party dlls on Windows 10
- Undocked windows now correctly persist their maximized state when application is restored after being minimized
- Fixed left-eye lag seen in Oculus Rift VR headsets
- Fixed performance and stability issues with Ultra Water on Nvidia 10 series cards
- Improved AI waypoint following
- Fixed issue where cameras would save incorrect field of view values in some cases
- Fixed issue where batched objects would have incorrect positions at high altitudes
- Fixed tab order in Fuel and Payload UI and Failures UI
- Fixed small freezes that would occur when using the SimConnect text menu
- Fixed issue where Scaleform panels would flicker in SLI when undocking views
- Fixed issue where F-22 ground radar would flicker in SLI
- Improved performance for render-to-texture (RTT) views and plugins in SLI
- Improved Dynamic Lighting performance by filtering lights based on distance and size
- Adjusted the size of stars in reflections
- Fixed crash that could occur when certain jetways would animate
- Fixed issue where opening the context menu in undocked views would cause a slight delay
- Fixed incorrect tooltips in the Information options page
- Fixed issue that would cause text added through SimConnect to draw twice each frame
- Fixed cloud lighting inconsistencies between multiple views
- Fixed issue that could prevent certain model parts from becoming visible after switching between views

Fixes and Improvements (Professional Plus Only)

- IP address of machine is now automatically detected in the DIS menu configuration
- Fixed issue that could cause weapons to draw in the incorrect location depending on viewing angles inside the Virtual Cockpit
- Fixed issue that prevented the avatar from reloading weapon systems on a scenario load

SimDirector Updates

New Features

- Added support for configuring new helicopter AI capabilities
- Entities and Mobile Scenery now support AGL altitudes

Fixes and Improvements

- Fixed issue which caused scenario cameras to disappear when renamed
- Fixed issue where resize cursor would incorrectly appear in certain locations in the Selected Properties view
- Fixed crash that could occur when importing object groups
- Fixed crash that could occur when playing a flight recording
- Fixed incorrect terrain origin with scenario cameras
- Fixed issue that would cause objects to disappear after deactivating their corresponding waypoint list
- Added validation for missing object references in AI behaviors
- Fixed crash that would occur when setting the current waypoint of an object to a value out of range
- Fixed issue that prevented focal points from drawing after switching to an external view
- Fixed issue where translate and scale gizmos would incorrectly activate when dragging the mouse over them
- Fixed issue with drag selection not deselecting appropriate objects
- The waypoint window is now opened when creating a waypoint list
- Clicking a selected object now deselects all other selected objects
- Fixed selection issues seen when dragging icon clusters
- SetGaugeActions now persist their values when changing variants of the same vehicle
- Fixed issue where scale gizmo could be selected for the user ownship
- Fixed crash when running Comprehensive Scenario Validation
- Fixed driver crash caused by dragging multiple SpeedTree objects

- Fixed issue where moving objects would snap to their original location when moving while the translate gizmo was active
- Fixed issue where the rotate gizmo would jitter when selecting certain axes
- UI elements no longer lose focus when mouse moves over the 3D map view in Windows 10
- Reduced SimDirector loading time
- Fixed issue where SimDirector would hang on shutdown with third party add-ons installed
- Fixed serialization issue with the ScaleformPanelWindow
- Moved mode change buttons to a separate ribbon tab and refactored base ribbon tab layout
- Snap to Ground is now set to off by default

Prepar3D Content

New Features

- Added CH-53E Super Stallion Marine and Navy variants as default selectable vehicles
- Added MH-60R and MH-60S Seahawk variants as default selectable vehicles
- F-16A and F-16AM HMD reticles now display in VR
- New placeable scenario objects added:
  - Orion Multi-Purpose Crew Vehicle (MPCV)
  - Space Launch System (SLS) Block 1
  - Generic Jet Fighters
  - Special Forces Boats
  - Container Ship
  - Ro-Ro Cargo Ship
  - Transporter Erector
  - 6x4 Truck
  - M901 Patriots
  - M777
  - Tanker Truck Yellow
  - Lowboy Semi-Tractor Trailer
  - Desert Hawk 3.1
  - Indago UAS

Fixes and Improvements

- Updated default avatar cameras to use the avatar as the data source for Scaleform overlays. This corrects errors with the compass when using multiple views.
- Improved F-16 HUD readability
- Moved UH-60 default eyepoint to center of the seat

Prepar3D Scenery

Fixes and Improvements

- Fixed large trench running through Syria
- Fixed coastline dips in Guam
- Fixed runway Z-order issues at KNRB

Prepar3D SDK

New Features

- Added Voice Control PDK plugin and service to add custom voice commands to the system (*experimental*)
- Added Voice Control SimConnect sample
- Windows and panels can now be placed in 3D space using the PDK
- Added AttachPointService providing location and orientation of attached objects
- Grass can be added as autogen on airport backgrounds
- Added SimConnect camera type to create external AI cameras
- Added ability to listen to SimConnect_Text messages with SimConnect_SubscribeToSystemEvent
- Scaleform panel samples for:
  - Airspeed Indicator
  - Altimeter Instrument
  - Artificial Horizon Indicator
  - Autopilot
  - Control Display Unit
  - Cyclic and Collective
  - Heading Gauge
  - Magnetic Compass
  - Multi-Function Display
  - Vertical Speed Indicator

Fixes and Improvements

- Fixed bug preventing VK_NUMPAD keys from being handled correctly through SimConnect
- Add-on dlls now automatically search current directory for dependent dlls
- Fixed issue where SimConnect_RequestFacilitiesList would not return the complete list of relevant facilities in some cases
- Fixed incorrect pointer type in GetParameter function in gauges.h header
- Unified SimConnect and simulation variable functionality by providing the same capabilities in each system
- SimConnect_RequestAttachPointData now correctly returns the requested object id and also supports SIMCONNECT_OBJECT_ID_USER
- Fixed Unicode bug when exporting models with duplicate parts
- Fixed bug preventing the ExternalSim sample project from building in debug. ExternalSim is deprecated, please see SimObject API as the recommended replacement.

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Prepar3D v4.1 Features and Enhancements

Release Notes

The Prepar3D v4.1 release brings many exciting changes and enhancements to the platform.

The following list of updates has been categorized based on the installer required. The *Client* installer is required for Prepar3D v4.1, however the *Content*, *Scenery*, and *SDK* installers are optional. You must first have Prepar3D v4 installed to utilize the *Client* only installer. To install the *Prepar3D v4.1 Client*, you must first uninstall the *Prepar3D v4.0 Client* via **Programs and Features** in **Windows Control Panel**. The *Prepar3D v4.1 Client* update will require you to reactivate your product, however if you have an internet connection it will be automatic. For more information please view the **Prepar3D v4 Download/Installation Instructions** from the Prepar3D.com **Downloads** page.

Prepar3D Client

General Platform Updates

New Features

- Virtual Reality (VR) is now available in any view and has its own dedicated menu
- Added interactive mouse pointer in VR
- Added support for 4k Virtual Cockpit (VC) textures
- Custom icons can be placed and rendered in the world. Their location can also be viewed in the 2D map.
- Health points for the ownship are now displayed in InfoGen text
- Added "HideMouseLookCrosshair" config option to disable the cross icon when using mouse look
- Notification text can now be added using the "CustomNoticeText" config option
- Added support for cockpit rain effects. Added effect to default vehicles (requires Content installer)

New Features (Professional Plus Only)

- High-Level Architecture (HLA) network interface is implemented (*experimental*)

Fixes and Improvements

- Fixed an issue where turn rate was incorrect for large ships
- Fixed an issue that prevented legacy Prepar3D v1 SimConnect apps from properly connecting
- Fixed various z-ordering issues with primitive objects
- Fixed issue with SimConnect port values being written incorrectly to the registry
- Fixed intermittent issue with autopilot glide slope
- Barometric pressure units now display correctly in the Custom Weather screen
- Added scenario favorites button back to the Load Scenario screen
- Updated select camera control descriptions to be more consistent
- Fixed issue where weather data for animated scenery objects was invalid after a vehicle change
- Fixed rotation issues with certain lights and effects
- Fixed crash that could occur when calling the FlightPlanDeleteWaypoint function within a gauge
- Updated the default Max VC Texture Size config entry to 4096
- Fixed bug where user vehicle would still move to new location after hitting cancel from the Scenario Edit screen
- Fixed shader support for pre-lit materials without textures
- Fixed crash that could occur when zooming the GPS map
- Duplicated panels are now saved into scenario .fxml files
- Fixed crash that could occur when attempting to change airports at certain locations
- Fixed crash that could occur when reading in invalid autogen data
- Panels with pixel_size value set in config now correctly save their position in fxml files
- Fixed bug where changing the time in small increments in the Startup Screen did not update the simulation
- Fixed bug where quickly hitting enter after typing an entry in the Airport Select screen would not change the user's location
- Fixed bug where structured scenarios would load incorrectly at the startup screen when set to default
- Fixed bug where unlimited frame rate value was written out differently in saved profiles compared to Prepar3d.cfg settings
- The ATC window now longer processes key commands when key modifiers (Shift, Ctrl, Alt) are held down
- The ATC window now processes key commands when undocked and not focused
- Updated Learning Center file encodings to support Unicode characters
- Autogen polyline buildings now respect the autogen building density slider value
- Fixed issue that prevented light rotation key commands from controlling attached landing lights
- Fixed issue that prevented HDR lighting values from syncing correctly in VR
- Fixed several cases where attached effect rotation values would not update

correctly
- Previous camera settings are now restored correctly when leaving VR
- Fixed edge cases where full screen would not black out the main view at the Startup Screen
- Fixed issue preventing full screen resolution from being set correctly in the Startup Screen
- Fixed issue that prevented vehicles from positioning correctly on platforms when loading a scenario
- Updated VR social screen to show both stereo and single views
- Fixed erroneous ordering error that would display when opening Scenery Library with certain add-on sceneries installed
- VR can be disabled with the "LoadVirtualReality" Prepar3D.cfg option
- "Reload User Object" key command now additionally flushes and reloads textures
- Fixed issue that would cause ribbon visual paths to stop drawing after a short period of time
- SpeedTree models now draw correctly in Radar and GData sensor modes
- Fixed view change issues when using the view change hot key in a view group
- VR can be enabled at startup with the "EnableVirtualRealityOnStartup" Prepar3D.cfg option
- Improved detection of VR headsets with more robust error reporting
- Fixed crash that could occur after installing a large number of scenery add-ons

Fixes and Improvements (Professional Plus Only)
- Fixed bug where weapon loadouts would load incorrectly after a reset if the loadout title contained a comma
- Distributed Interactive Simulation (DIS) heartbeat now more configurable
- Attached DIS entities now correctly handled

Multiplayer Updates

New Features
- Added radio frequency support and direct voice chat through multiplayer Chat Window

Fixes and Improvements
- Improved panel state management when entering multiplayer

SimDirector Updates

New Features
- Scaleform Objects can now be placed and rendered within the VC
- The starting waypoint can now be set for AI Objects

Fixes and Improvements
- Gizmo buttons now toggle based on gizmo state
- Fixed slow down when entering the visualization
- BGL can now be exported again through SimDirector
- Fixed bug where translation gizmo would not be selectable if partially off screen
- Fixed crash that could occur when clicking panels while recording a Virtual Instructor (VI) session
- The position of copied objects is now slightly offset from the original
- Camera Objects can now be referenced by View Change Actions
- Fixed issue that prevented object rotation values from exporting to BGL
- Fixed issue where the xml file name would be truncated after the first period when clicking "Save as"
- Camera name validation errors now link to the correct property
- Fixed bug where navigation visuals would stay enabled in SimDirector if changed in core Prepar3D
- Fixed issue preventing RPN scripts from working correctly with Script Triggers

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Prepar3D Content

New Features
- Added rain effect to cockpit glass in default vehicles
- F-16A and F-16AM now feature a Helmet Mounted Display (HMD) reticle, which can also be viewed in VR

Fixes and Improvements
- Added configurable max_turn_rate for boat SimObjects
- Updated default scenario flt files to support Unicode characters
- Fixed flashing that would occur with the Fury 1500 when in Black Hot IR mode
- Fixed missing cockpit textures in the F-16
- Removed incompatible AI models

Prepar3D Scenery

Fixes and Improvements
- Fixed missing textures in St. Louis Adams Mark
- Removed invisible objects that could cause vehicle to crash at KBWI

Prepar3D SDK

New Features
- Weather PDK now supports all functions available in SimConnect
- Added CustomIcons sample showcasing new custom icon capabilities
- Added additional Window PDK functions supporting 3D window positioning
- Added PDK Menu service

Fixes and Improvements
- Updated various documentation including Panel API, user selectable vehicles, texture types, and add-on scenery
- Expanded IsSelectableVehicle support for use in fltsim cfg sections
- Fixed issue where Weather METAR functions in SimConnect and PDK would return different formats

- Fixed issue where the bounding box and radius override values were not being written out correctly by the 3dsMax exporter
- Fixed issue that prevented Optimize Parts from working with complex vehicle models
- Updated targeting pod sample showing controllable camera functionality
- Removed Learning Management System (LMS) SDK sample and associated documentation
- Added Managed Scenario Controller SDK sample. This can be used with LMS integration among other applications.
- Fixed SimConnect_Text issue with displaying extended ASCII characters
- Fixed issue with 3dsMax plugins not exporting OverrideRadius and OverrideBoundingBox values
- Added key event token and event id lookup functions to PDK
- Fixed crash and added warning message when attempting to create VC textures with filenames greater than 16 characters
- Fixed crash in managed SimConnect applications on shut down. These applications will need to be recompiled for this change to take effect.
- Fixed several issues with the EnvironmentForceManager

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Prepar3D v4.0 Features and Enhancements

Release Notes

The Prepar3D v4 release brings many exciting changes and enhancements to the platform. Prepar3D v4 completely changes the simulation landscape with a comprehensive baseline update to a 64-bit architecture. Higher resolution visuals, more objects, increased data precision, larger scenarios, and improved performance are now all possible at levels never seen before in the product's history. The sky's *not* the limit! Additionally, the release brings dynamic lighting, rain/snow particles, global 3D trees (SpeedTree), increased autogen draw distance, a fully reworked software development kit (SDK), new default vehicles, and an extensive list of other features and improvements.

General Platform Updates

New Features

- 64-bit simulation architecture
- Unicode compatible
- Modernized User Interface (UI) design for quick navigation and customization
- Updated native virtual reality (VR) support for Oculus Rift and HTC Vive
- Updated vector data (coastlines, lakes, rivers, roads, rails, parks, streams and utility lines) for:
  - Africa
  - Middle East (Israel, Turkey, Syria, Lebanon, Iran, Iraq, Afghanistan, Pakistan, Saudi Arabia, and more)
  - Southeast Europe (Greece, Albania, Macedonia, Bulgaria, Romania, Black Sea, and more)
  - Southeast Asia (Indonesia, Philippines, Vietnam, Cambodia, Laos, Thailand, Myanmar, Papua New Guinea, Solomon Islands, and more)
- Updated custom 3D model placement in Athens, Egypt, Israel, Dubai and Hong Kong
- Hundreds of new updated generic 3D model buildings in Tel Aviv and Hong Kong
- Updated Shuttle Radar Topography Mission (SRTM) 90m digital elevation for Southeast Asia and Middle East regions
- Updated native mission gauges to Scaleform
- Views and panels can now be docked into any undocked view
- Updated multiplayer voice chat codec - higher quality chat audio
- Expanded ribbon drawing capabilities in the Navigation Visuals screen including drawing based on vehicle type and the ability to change color per category
- Added video recording capability. Can be assigned to a key event in the UI.
- Control Tower can now be selected in the Select Airport screen
- Custom cameras can now be saved on a scenario or global level
- Material temperatures - IR sensor views now react accordingly
- 3D trees (SpeedTree) integrated into autogen system. This feature can be toggled on and off in the UI under Options - World (Dynamic 3D Autogen Vegetation).
- New 3D rain/snow system. This feature can be toggled on and off in the UI under Options - Weather (Detailed Precipitation).
- Dynamic lighting support
- Support for local SpeedTree wind effects
- Support for higher resolution ground textures
- Autogen visibility range can now be configured
- Updated various textures including runways, taxiways, hangars, and terminals
- Added SceneryLodOrigin and TerrainLodOrigin fields to camera definitions preventing terrain paging issues when switching between certain views.
- New and updated default vehicles:
  - F-22 Raptor (Updated)
  - F-35A Lightning II (Updated)
  - F-16A
  - F-16AM
  - F-16C
  - Lockheed Electra 10A
  - Milviz P-38L
  - Sikorsky MH-60K (Updated)
  - Sikorsky S-70A (Updated)
  - Sikorsky UH-60A (Updated)
  - Sikorsky UH-60L (Updated)
  - Sikorsky UH-60M (Updated)
  - Sikorsky UH-60Q (Updated)
- New default avatars:
  - Army Infantry
  - Navy Male Blue Camouflage
  - Rebel Male (1/2)
  - Soldier Desert
  - Soldier Jungle
  - Soldier Spec Ops
  - Soldier Swat

    - Soldier Winter
    - Arab Male Casual (1/2/3)
- Steering Set controls can now be set in the UI
- Added new white smoke marker particle effect

New Features (Professional Plus Only)

- F-16 aircraft has weapons and countermeasures
- Specific avatars have weapons
- New defensive flare countermeasure
- Additional advanced graphics features for low latency training devices

Fixes and Improvements

- Fixed bug where window maximized state could be incorrect
- Scenario versioning updated to match Prepar3D release number
- Prompt to enter SimDirector and SimOperator now blacks out screen and mutes sound
- Fixed bug with axis assignments on certain devices
- Fixed issue with X-Grip devices reporting out of range values
- Fixed bug where alt-tabbing into Prepar3D would open menu bar
- Fixed bug where facility data would not display correct airport runway information
- Fixed bug with avatar position after switching to an ISimObject
- Improved error messages due to permissions issues
- Fixed bug where selecting avatar could cause issues with camera controls
- Fixed crash that could occur when having a large number of joysticks connected
- Fixed performance issue when operating Fury 1500 tracking camera
- Fixed issue that could prevent multiple control devices of the same type from being distinguished when using Raw Input
- Made assigning key-up events more clear
- Fixed multiple issues with racing scenarios
- Fixed issue that could cause the enable add-on prompt from showing when uninstalling Prepar3D
- Fixed mouse hit detection issues in Flight Planner UI
- Fixed cases where main screen would not black out when loading bar appears
- Fixed bug where main screen would render for one frame when opening UIs containing a preview window
- Added search feature to Axis Controls assignment screen
- Opening the context menu can now be mapped to any key instead of being hardcoded to the "Apps" key
- Fixed issue where empty parking spaces were listed in the Select Airport UI
- Clarified airport name searching in Select Airport UI
- Reduced time to save controls from the UI and during shutdown
- Fixed bug that could cause weapons attached to ISimObjects to jitter in some cases
- UI screens can now be moved from any point in the window
- Fixed bug where rapidly changing views could cause a crash
- Fixed misaligned object highlights in the Preflight Walk Around scenario
- Fixed issue that caused timestamp on the scenery.cfg to always update on startup when using add-on scenery
- Fixed bug that could cause map to not update after changing airports in the Startup Screen
- Fixed bug where End Scenario menu would close if the esc key was held down for too long
- Active custom camera is now checked in the menu
- Fixed crash that could occur when changing vehicles while interacting with the ATC system
- Fixed bug that could cause flight plans to have invalid file names generated
- Preview window now displays "No Preview Available" instead of being blank for objects with no external model
- Preview window now has gray background and correctly renders transparent objects
- Fixed crash that could occur on certain multi-touch displays with gestures disabled
- Fixed issues that prevented long menu options from displaying correctly in Scaleform menu windows
- Improved error handling in ISimObjects
- Fixed issue where locked panels could be moved if transparent areas were clicked
- Fixed bug where Kneeboard menu would not always close when pressing escape
- Fixed issue where certain UI screens would stay open when crashing or resetting scenarios
- Fixed issue where the loading screen would show "Playback Loading" when loading a scenario that plays a flight recording
- Fixed bug where dashes in vehicle flight numbers could cause crash in the Select Vehicle screen
- Fixed issue that could cause Prepar3D to run off of integrated GPUs on laptops by default
- Fixed crash that could occur when using the HTC Vive on systems with multiple GPUs
- Settings menu can now be accessed through the Startup Screen
- Disabling controllers no longer has a default key binding
- Mute on Lost Focus setting no longer requires a restart to take effect
- Fixed slow search speeds in UI
- Fixed bug where weather layers could be out of order if error checks were bypassed
- Calibration UI now notifies user if controllers are disabled
- Fixed issue causing window sizes to expand when entering full screen on Windows 10
- Fixed issue that prevented mouse wheel zoom from functioning correctly in preview windows on Windows 10

- Fixed issue that prevented full screen auto fill from functioning properly across multiple monitors with different resolutions
- Fixed issue that caused the vehicle select screen to freeze if there were invalid characters in a vehicle's performance section
- Fixed bug where time adjusted in the time preview screen would still be applied when canceled in certain cases
- Fixed bug that caused other views to black out when resizing a view in full screen
- Fixed bug where virtual cockpit view could still be entered on vehicles with no interior by cycling views using the keyboard
- Fixed issue in add-ons UI where folder names containing a "." would be truncated
- Add-on system no longer removes required entries if a load failure occurs
- Fixed issue with GMT time in startup screen when changing locations
- Fixed crash that could occur when reloading SimConnect based C gauges
- Fixed bug where saving or resetting a scenario could be entered multiple times before finishing
- Fixed jitter seen in F-35 when on runway
- Default radio system no longer created in vehicles unless specified in aircraft/sim.cfg
- Fixed crash that would occur when switching aircraft while using progressive taxi
- Fixed issue where camera could not be panned around vehicles in spot view at high framerates
- Fixed several cases where pressing Esc would not close UI windows
- Fixed cockpit textures in Beech King Air 350
- Fixed SpeedTree and land class specular values
- Fixed bug with emitter offsets not being respected in some cases
- Fixed issue that could cause attach point based particle effects to be spawned twice
- Fixed terrain error that could occur when changing airports when using multiple views
- Fixed bug that could prevent terrain from correctly reloading when changing weather to and from snowy conditions
- Fixed bug that prevented attached effects on user vehicle from drawing correctly when dynamic lighting was off
- Fixed bug that prevented attached scenery effects from resetting with the scenario
- Improved handling of fog and precipitation in multiple views
- Fixed issue that could cause large number of batched objects to flicker or stop drawing in certain cases
- Adjusted specular values on SpeedTree trees
- Removed "Terrain Detail Textures" option, this is now always enabled
- Improved environment map appearance at night
- Improved the appearance of curved taxiway markings
- Expanded the pop-free autogen feature to include polyline buildings
- Improved appearance of airport path intersections
- Improved appearance of taxiway transitions
- Fixed bug that could cause incorrect night shadows and cloud lighting at certain times
- Improved scenery culling
- Fixed issue that caused certain bridges to draw incorrectly
- Added dynamic lighting to default first party aircraft
- Fixed missing texture on industrial buildings
- Adjusted lighting in the vehicle preview screen
- Adjusted runway, taxiway, and apron reflection values
- Scale of SpeedTree models is now factored in to wind effect
- Fixed issue where skid marks would appear slightly above surface
- Shadows now apply on reflections
- Improved star visibility on high resolution displays
- Fixed graphics memory leak that could occur when rapidly switching views
- Fixed issue where all effects would draw even at extremely far distances
- Fixed issue where attached effects would not draw if the parent object was no longer visible

Multiplayer Updates

New Features

- Added avatar attach/detach support

Fixes and Improvements

- Fixed issue with failure systems properly synchronizing
- Fixed bug with multiplayer weapon damage after client avatar attach/detach
- Fixed issues in multiplayer that could prevent Multichannel users from joining the session
- Fixed bug that prevented rejoining a multiplayer session if disconnected due to timeout
- Fixed issue where invalid multiplayer state could be entered when canceling while selecting a role
- Fixed issues seen when creating multiplayer scenarios in Viewer Sim

SimDirector Updates

New Features

- Added support for generic shape objects
- AttachEffectActions can now be applied to PlacementObjects
- Added Open in File Explorer button
- Variables can now be referenced in OnScreenText strings

Fixes and Improvements

- Fixed issue that could prevent the main Prepar3D window from reloading when leaving SimDirector
- Fixed bug that could prevent exiting out of the backstage menu in SimDirector
- Fixed bug where taking a screenshot would not capture the main view if a

preview window was open
- Fixed bug that could cause logic expressions to be clear out when modifying ScenarioVariable trigger conditions
- Fixed bug where avatar could be detached when previewing a scenario
- Fixed bug where incorrect camera would be used when launching SimDirector from command line without first running Prepar3D
- Fixed issues with Goal objects including preventing negative values and better GroupGoal support
- Fixed bug that caused the loading bar to appear in the wrong location
- Fixed bug where timing for camera change actions would not be affected when changing the sim rate
- EffectName custom template no longer displays or saves effect file extension
- Fixed lasso selection bug in SimDirector when using high DPI settings
- Fixed bug that prevented date and time from updating properly in SimDirector when changing locations in the backstage menu
- Fixed bug where two objects could be created in SimDirector when drag and dropping after a double click
- Fixed bug where main window would not be restored after exiting SimDirector in certain cases
- Fixed bug that could prevent CylinderPathArea collision from detecting in certain cases

SimOperator Updates

New Features
- Kneeboard now available
- Added additional hotkeys for common SimOperator operations

Fixes and Improvements
- Follow button now makes Prepar3D the active tab
- Easier to correlate Player Roles and Player Names
- Loading scenario now loads scenario to all clients
- Fixed bug where user could spawn in an incorrect location after crashing and then rejoining a SimOperator session
- Fixed bug where operator's detached avatar would show up on client machines
- Fixed bug where previous aircraft's lights would stay visible after loading a scenario
- Fixed several vehicle placement issues
- Fixed bug where camera controls would no longer work when operator was following a player that disconnected
- Fixed issue with failure systems properly synchronizing
- Fixed crash that could occur when entering SimOperator with a view group active
- Fixed issue where clients could spawn off of the ground

SDK and SimConnect Updates

New Features
- Compiler and SDK updated to Visual Studio 2015
- Scripting capabilities (Scenery/Model/Material)
- Added PDK functions to draw primitive objects
- Reorganized and updated SDK Documentation and samples
- Avatar object collision can now be configured
- Added temperature value and scripting to materials
- Specific cameras can be configured to not output sound when active
- Custom materials now supported for runways, taxiways, and aprons
- Added PDK service for reporting plugin errors
- Added IsSelectableVehicle override to Aircraft and Sim configs allowing vehicle to bypass the category based selection filter
- Precipitation rate now exposed through ISimObject, Simulation, and Object variables
- Added rope visual effect support to SDK
- Added detail texture material scripting support including offset, rotation, blend weight, blend mode, and alpha channel support
- The PDK is now accessible through the Panels SDK
- Panel API now available through the PDK
- Added Environment Force Service to PDK
- Added IgnorePostProcess entry to camera definition to disable HDR or FXAA on a per camera basis
- Added interfaces to play sounds in xml gauges using Lua
- Added second UV channel in model exports and files
- Exposed Final Alpha Blend material property to material scripts
- Weather information now available through RPN and Lua scripts
- Added UV offset property to material scripts and shaders
- Update materials to support additional Detail Alpha Flags
- Updated Material Scripting to support second UV Channel and new Detail Properties
- Friendly names can now be added to control events

Fixes and Improvements
- Improved performance of XtoMDL tool
- Fixed offset bug with AttachObjectToSimObject SimConnect function
- Fixed problems with error logging in XtoMDL
- Now report error when passing invalid datatypes into the SimConnect RequestDataEntry::DataEqual function
- Fixed bug that caused certain instances of PBH to XYZ conversions to be incorrect in external interfaces
- Fixed crash and other issues that prevented the RedirectStdOutToConsole SimConnect.ini flag from properly functioning
- Fixed issue that prevented the width of polyline buildings from being set in the Annotator tool
- Adding menu items through SimConnect now updates the menu bar

- Added Content Error Reporting for content attempting to load 32 bit dlls
- Improved XtoMDL to better handle large models
- Decoupled camera and window PDK interfaces
- Fixed export issue in XtoMdl related to international decimal formatting
- Fixed bug in VisualFX tool that prevented changes from saving from the menu
- Fixed bug where RegisterProperty could generate duplicate event IDs

Multichannel Updates

New Features

- Added avatar attach/detach support

Fixes and Improvements

- Fixed bug that could cause view groups to load incorrectly when joining a multiplayer session using Multichannel
- Fixed bug that could prevent clouds from synchronizing correctly in Multichannel
- Fixed bug where attach point based particle effects could be spawned multiple times on Multichannel slaves
- Fixed bug that prevented weather from syncing properly in Multichannel
- Fixed SpeedTree LOD issue in Multichannel
- Fixed bug that could cause Multichannel client machines to hang when changing time
- Fixed crash that could occur after loading several scenarios in Multichannel

Distributed Interactive Simulation (DIS) Updates

New Features

- Added DIS Exercise Region allowing only objects within a certain range to be processed
- Added defensive flare DIS entity type
- Added munition definitions for three phosphorous smoke effects

Fixes and Improvements

- Fixed bug that caused avatar to sink into the ground on remote DIS clients when in death state
- Clarified DIS connection settings in UI
- Improved DIS performance with large numbers of entities

Default User Selectable Vehicles

Aircraft

- Alabeo Extra 300s
- Beech Baron 58
- Beech King Air 350
- Carenado A36 Bonanza
- F-22 Raptor
- F-35A Lightning II
- Fury 1500
- F-16A
- F-16AM
- F-16C
- Lockheed C69
- Lockheed Electra 10A
- Lockheed L049
- Maule M7260C
- Milviz P-38L
- Mooney Acclaim
- Mooney Bravo
- Piper Cub

Rotary

- Robinson R22
- Sikorsky MH-60K
- Sikorsky S-70A
- Sikorsky UH-60A
- Sikorsky UH-60L
- Sikorsky UH-60M
- Sikorsky UH-60Q

Underwater

- Submarine Ohio Class
- Deep Sea Submarine

Avatars

- Army Infantry
- Civilian Male

Prepar3D v4.0 Hotfix 1

Client Fixes and Improvements

- Fixed an issue in VR views that prevented dynamic lighting in the right eye
- Fixed memory leak related to external views and vehicle textures
- Fixed performance impact when entering and then exiting VR
- Fixed text label size mismatches in VR
- Corrected an issue where a scenario saved from the startup screen would not be loaded after a reset
- Preventing vehicle sounds from playing during load
- Fixed a crash on startup due to controllers using bad port and hub values
- Added an unobtrusive watermark for developer licenses
- Fix for ICAO entries in the Logbook
- Added the Delete Scenario button back to the Scenario user interface
- Fixed effect texture orientations being flipped (e.g. coastline waves)
- Fixed the Graphics Profile Name not syncing with the correct saved graphics settings
- Interface windows will no longer move behind main window when losing

focus
- Fixed Logbook issue that was preventing logging start/end points
- Corrected various issues with the Flight Instructor user interface
- Added pitch, bank, heading to the GPS broadcast capabilities for electronic flight bags
- Updated various XML configuration file encodings
- Corrected a commands binding error with the Steering Set key
- Fixed issue preventing the vehicle preview screen from rendering in the Edit Scenario window
- Changed the default textbox to ICAO for the Select Airport user interface
- Fixed multiplayer crash when using Direct IP connections
- No longer instantiating radios if they are not configured for an object
- Fixed an issue where the vehicle preview window would not render in certain views
- Fixed an issue where View Group selection would be out of sync with the context menu
- Fixed scenery.cfg encoding issue after leaving the Scenery Library view
- Fixed an issue where SimConnect applications were receiving the wrong event id
- Fix for a crash when using index 0 with payload stations
- Fixed issue related to the flag SIMCONNECT_CLIENT_DATA_PERIOD_ON_SET not working with SimConnect_RequestClientData
- Fixed null terminating string issue when using RequestDataOnSimObject with ATC strings
- Fixed an issue where undocking views would not immediately be processed
- Fixed an issue regarding minimum temperature in the Advanced Weather view
- Fixed an issue where the Scenery Library was not reporting all errors
- The Select Airport view's ICAO search box is now above other search boxes
- Minor layout updates to the Select Airport screen
- Content error reports will now have more detailed XML parse error messages
- Fixed an issue where malformed DLL.xml and EXE.xml files would cause Add-on DLL and EXE to fail to load
- Fixed an issue where multiplayer settings were not correctly assigned when using the Direct Connect method
- Added reverse thrust axis events
- Fixed issues with certain locale settings
- Traffic settings now save again in Graphics Profiles
- Added exception handling for error that would occur when certain audio codecs were installed
- Fixed crash that could occur when making modifications to the Scenery Library with add-on scenery
- Fixed issue that caused stars to draw in the incorrect order
- Added Show Only Favorites button back to Vehicle Select Screen

Content Fixes and Improvements

- Corrected the clickable mouse area of the RadarGauge
- Fixed the F-16 speedbrakes

Scenery Fixes and Improvements

- Fixed errant river feature in ocean QMID 50,31 (West Africa)
- Fixed incorrect locations of certain buildings and bridges in Instanbul

SDK Fixes and Improvements

- Corrected issues with autogen Annotator building selection that would result in missed or incorrect selections
- Fixed unicode issues with Traffic Toolbox
- Fixed an issue where second UV channels were not correctly being exported to .X files
- Fixed a crash in the Shp2Vec tool when compiling polygons with less than three points

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Requested Features and Enhancements Implemented in Prepar3D v3.4

Release Notes

The Prepar3D v3.4 update brings several new features and numerous platform, rendering, SimDirector, SDK, SimConnect, and multiplayer updates.

The following list of updates has been categorized based on the installer required. The *Client* installer is required for Prepar3D v3.4, however the *Content*, *Scenery*, and *SDK* installers are optional. You must first have Prepar3D v3 installed to utilize the *Client* only installer. To install the *Prepar3D v3.4 Client*, you must first uninstall the *Prepar3D v3.0/v3.1/v3.2/v3.3 Client* via **Programs and Features** in **Windows Control Panel**. The *Prepar3D v3.4 Client* update will require you to reactivate your product, however if you have an internet connection it will be automatic. For more information please view the **Prepar3D v3 Download/Installation Instructions** from the Prepar3D.com **Downloads** page.

Prepar3D Client

General Platform Updates

New Features

- Oculus Rift runtime 1.7 support
- HTC Vive support
- Navigation Visuals UI showing facility, airspace, user, and AI overlays in the 3D world
- Scaleform gauges now support multitouch
- Avatar now supports weapons and designators including the ability to fire and aim guns
- Scaleform overlays can now be assigned to cameras
- Added Cinematographer control mode enabling high fidelity camera control
- Added new control events to rotate cameras without snapping back to original orientation when released and to linearly zoom cameras
- Control input method can now be switched between Raw Input and Direct Input

Fixes and Improvements

- Fixed issue that prevented gauges from handling quick successive mouse clicks
- ATC panel is now always on top of other open panels
- Mission timer panel now supports negative numbers
- Fixed issue where scenery items added through new add-on process could prevent layer ordering of other items in the Scenery Library UI
- Expanded .fxml documentation in Learning Center
- Added key commands to set the ADF standby frequency
- Increased max zoom level for Observer cameras
- Added more robust error messages for errors encountered during startup
- Fixed crash that could occur when clicking docked views repeatedly
- Fixed bug that prevented airport scenery added using an add-on.xml from correctly loading
- Scenery added using an add-on.xml now defaults to the top layer
- Fixed bug where scenery added using an add-on.xml would be removed when making changes in the Scenery Library
- Fixed bug where default map layers would not appear when initially opened
- Fixed bug where switching between different avatars would not update available cameras
- Controller trigger can now be mapped to fire guns
- Scaleform panels no longer pass key events to main application when focused and keyboard interactivity is enabled
- Better control support for throttle and rudder based devices
- Camera rotation speed adjusts based on zoom level when using avatar
- Selected view group is now persisted
- Fixed issue where weapons and pylons could cause a memory leak if configured incorrectly
- Fixed bug where drag-selecting multiple weather stations modified global weather settings
- Fixed crash that could occur when closing a child window while using view groups
- Fixed issue that would cause the avatar to still render when HideUserAvatar was set in the camera
- Fixed bugs with menu where incorrect items could be activated or focused when using the keyboard
- Fixed input issues seen with X-Grip devices
- Fixed bug in the Fuel and Payload UI where the center of gravity would be displayed in the wrong location when using certain aircraft
- Fixed inconsistencies with zoom values and object visibility when using custom fields of view
- Undocked panels now always stay on top of other views by default

- Fixed typos in various UI screens
- Fixed startup crash that would occur if the ShadersHLSL path is invalid
- Child views within view groups can now be closed
- The ATC window no longer processes key input when the menu bar is focused
- Fixed bug that could prevent certain UI screens from displaying properly when reading corrupt .xml files
- The Scaleform Menu Window (used for ATC, SimConnect, and Multiple Choice windows) now supports DPI settings
- Fixed bug that prevented the Scaleform Menu Window from being resized on the right side of the window
- The Scaleform Menu Window now shows when additional menu items are available but not shown due to the window's size
- Fixed bug where ATC menu items could continue to be activated when holding keys down
- Added Binocular and Compass avatar views
- Added new camera categories for First Person, Third Person, and Equipment views
- Fixed bug that prevented gauges from handling right mouse button double click events
- Fixed bug where vehicle could receive mouse yoke values when using mouse look mode
- Fixed bug where advanced weather settings would not be applied to stations in certain cases
- Fixed crash that would occur when setting APU Fire failures on certain aircraft
- Updated framework to .NET 4.6

Rendering and Performance Updates

New Features

- Screenshots can now be saved out in multiple formats including: bmp, png, jpeg, and tiff
- Added built-in network video streaming
- Support for alpha blending for custom zbias layering

Fixes and Improvements

- Fixed issue where changing texture resolution did not cause textures to reload
- Fixed bug that caused add-on scenery to appear washed out at certain times of the day
- Fixed minor precision errors in certain LLA conversions
- Fixed visual and performance issues with the aircraft skid mark effect
- Fixed bug that caused runway lights to flicker in dynamic reflections
- Fixed bug where certain bloom properties were still being applied with HDR disabled
- Fixed bug that could prevent beacon sprites from rendering
- Axis indicator is now red to be seen easier at different times of day
- Improved stability when using ultra water
- Added OpenCL support to ultra water increasing performance on AMD cards

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SimDirector Updates

New Features

- Virtual Instructor now records gauge variables set via user interactions
- Camera objects and the user's virtual cockpit can now be previewed while editing
- Added PlacementObject, an object with position and orientation that is capable of advanced waypoint following
- Added SetObjectPlacementAction, an object that can reposition an object's position and orientation to another position and orientation
- Added ChangeObjectPlacementAction, an action which allows objects to change position relative to other objects
- Added context menu and ribbon item to Activate/Deactivate all selected objects
- Added ability to fire actions when an object reaches a waypoint or finishes a waypoint list
- Added new mappable events to position and reposition objects
- Added ability to set Prepar3D's default scenario to the scenario that's being edited

Fixes and Improvements

- Fixed bug where CylinderPathArea joints could be misaligned when attached to scenery objects
- Fixed bug where key commands could be sent to Prepar3D when typing in text fields
- Fixed bug where certain objects would rotate when moved if attached to other objects
- Fixed bug where new panels would be created during validation when using Scaleform panels and never destroyed
- Fixed memory leaks that could occur when using Scaleform Objects, Camera Objects, or Focal Points
- Fixed bug where selected panel object's ID would reset to 0 when switching modes
- Fixed bug where camera direction would change when saving after rotating the camera
- Fixed bug where changing the display unit type would register as an undo edit
- Fixed bug where camera object would rotate when using certain move operations
- Objects can now be dragged to a group and added

- Fixed bug with translation gizmo that would prevent moving object if origin was not in view
- Attached objects can now be positioned and oriented relative to their attached object
- Fixed "Fatal Error Occurred" crash on startup that was occurring on certain configurations
- Renamed Descr property to Object Name
- Improved SimDirector load time
- Fixed crash that would occur when changing a waypoint's elevation with a waypoint list selected
- Fixed bug where waypoints will not move when their waypoint list is selected
- Fixed bug where the waypoint model draws in the wrong location when switching AltitudeIsAGL on or off
- Fixed bug where changing the elevation of waypoint objects does not work correctly when altitude is set to AGL
- Fixed bug where updating a waypoint list's attached object would incorrectly update waypoint positions when waypoint altitude was set to AGL
- Added more robust error reporting
- Fixed bug where a camera object set to picture-in-picture would sometimes not open on scenario load
- Camera object's origin can now be set to render the Virtual Cockpit
- Improved rendering of waypoint lists
- Fixed bug where unselected focal points would render in Virtual Instructor
- Open undocked panels now close when entering SimDirector
- Fixed bug where Preview Action Only would still fire OnCompleteActions
- Improved performance with scenarios containing large numbers of objects
- Waypoint Lists can now be referenced as object references making them easier to integrate into existing objects
- Fixed cases where scenery objects would incorrectly return AGL altitude
- Fixed bug where if you modified a waypoint while the object it was attached to was selected, the waypoint modification would be ignored and it would snap back to the original location
- Fixed bug where moving an object with attached waypoints would make waypoints continuously calculate new offsets causing them to move away from the attached object
- Fixed bug where waypoint lists could have AGL set independently of contained waypoints
- Fixed bug where drag/dropping to add a reference in the visualization would add two undo edits if the source object was already referencing a different object
- Fixed bug where OnScreenText would appear in the incorrect location with the wrong background color in certain cases
- Fixed bug where OnCompleteActions could not be added or modified in VI sessions using the property grid or visualization
- Fixed bug where holding shift in other applications when SimDirector was open would cause the zoom ribbon button to change states
- Fixed bug where player objects would not render when loading a scenario or copying existing objects
- Fixed bug where canceling out of the multiplayer UI when entering SimOperator would cause undefined behavior
- Focal points drawing is more smooth and is also drawn when the mouse is dragged
- Fixed bug where objects could be incorrectly loaded when opening scenarios in Preview Mode
- Fixed bug where Virtual Instructor reset mode was not respected when loading a new scenario
- Updated Waypoint speed property setting to be more clear
- Added Staging Mode button in home tab in SimOperator
- Reposition Object disabled when in non-staging mode in SimOperator
- Fixed crash that could occur in SimOperator when modifying certain objects
- Fixed bug where Center On object would snap to incorrect altitudes
- Fixed bug where player staging objects would show on SimOperator clients
- Fixed bug that could cause SimDirector scenario loading errors in some cases
- Fixed bug where staging objects could appear when clients join SimOperator sessions
- Fixed bug that prevented scenery models from loading when importing .sxml files

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Multiplayer Updates

New Features

- Avatar can now attach to scenario entities in multiplayer structured scenarios
- Avatars can be damaged by weapons in multiplayer

Fixes and Improvements

- First person avatar animation states now update in multiplayer
- Fixed crash that could occur when using weapons over multiplayer
- Multiplayer options now saved out where applicable
- Aircraft carrier elevators now work in multiplayer
- Fixed bug where vehicle control would not transfer correctly when the master player detached from a vehicle shared by three or more players
- Fixed bug where multiplayer cameras would not be removed from the camera list when exiting multiplayer when attached to another player's vehicle

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SDK and SimConnect Updates

Note: Some of these features will require installing the v3.4 SDK

New Features

- Exposed world space based ray tracing through the PDK
- Screenshots can be captured through SimConnect
- Added new Event Service to the PDK enabling generic callbacks to be registered to chain events
- Added new Custom Object Rendering Service to PDK
- Added PDK sample showing custom light rendering capability
- Added base multiplayer and SimOperator sample scenario
- Visibility scripts can now be executed on non-sim objects
- Network video streaming of views through SimConnect
- Lua scripting now supported in Modeldef.xml

Fixes and Improvements

- Fixed bug where SimConnect would return the wrong application version
- New rendering and window control functionality added to PDK.
- Added program variables for camera pitch, bank, and heading
- Added program variables for the lat, lon, alt, and distance of point targeted by camera (center of screen)
- Fixed bug where setting a camera's horizontal or vertical fov independently would distort the view
- Fixed bug where incorrect camera field of view was returned by RequestCameraFoV function
- Content error reporting added for missing Scaleform files in gauges
- 3dsMax 2017 now supported
- Fixed various typos in documentation
- Updated ISimObject documentation with list of provided samples
- Updated Scaleform keyboard support to include punctuation and modifier keys (ctrl, alt, shift)
- Fixed bug where releasing POV hat would not return -1 when using the SimConnect_MapInputEventToClientEvent function
- Fixed bug that would cause Render to Texture views to activate when using the SetCameraDefinition PDK function
- Updated pertinent samples to .NET 4.6

Multichannel Updates

Fixes and Improvements

- Fixed crash that could occur in Multichannel with remote entity attachments
- Fixed crash in Multichannel when joining a multiplayer session with an aircraft with a single COM radio
- Fixed crash that would occur when changing view groups on Multichannel child views
- Fixed issue where the Multichannel master would be set to zero airspeed when joining a multiplayer session
- Aircraft carrier elevators now work in Multichannel
- Fixed bug where user would respawn at the location of a crash when running Multichannel in multiplayer
- Fixed bug that could cause the Multichannel host to start at 90% throttle when vehicle was on the ground
- Fixed bug where the active view group's field of view was being saved out into the scenario file
- Fixed issue that could cause remote multiplayer clients to display incorrectly on slave machines
- Added more robust error messages when configuring MultiChannel
- Moved configuration files to %ProgramData%
- Fixed synchronization issues with avatar visibility and animation state in Multichannel over multiplayer

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Distributed Interactive Simulation (DIS) Updates

New Features

- Added multiplayer support within DIS
- Added DIS support for avatar, gun based munitions, AI traffic, Electromagnetic Emissions, designators, and transmitters
- Added ability to transmit navigation aids through Transmitter PDU in DIS including VOR, DME, TACAN, ILS Glideslope, and ILS Localizer
- Added DIS voice communication support
- DIS munition fire and detonation effects can now be configure in the UI
- Added toggle key event to connect and disconnect from DIS sessions

Fixes and Improvements

- Added new camera category for DIS entities
- Improved DIS configuration UI
- Dead reckoning, entity appearance, and articulated parts can be disabled in DIS
- Fixed issues with DIS using Multichannel that prevented certain states from serializing correctly
- Ground, surface, and life form types can now be forced to pull to ground in DIS
- Entity positions now based on center of bounding box for DIS
- Fixed DIS issue that could cause objects to start dead reckoning when nearly stationary
- Several DIS settings can now be modified while connected
- Fixed bug which caused camera to shake when viewing remote DIS entities in Multichannel
- Fixed bug which prevented multiplayer entities from showing on DIS clients

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Prepar3D Content

Fixes and Improvements

- Fixed issue with dialog action in Foul Weather scenario

- Removed unused ATC entries from The Deep scenario
- Added red and green marker smoke effects
- Added white phosphorus smoke effect

Prepar3D Scenery

Fixes and Improvements

- Updates to Twentynine Palms, Randolf AFB, and Iwakuni airports
- Fixed terrain crack and spike in northern Alaska

Prepar3D v3.4 Hotfix 1

Fixes and Improvements

- Updated baseline framework to Microsoft .NET 4.6.2
- Corrected a crash when entering SimDirector with Raw Input enabled due to a max handle count being exceeded
- Corrected Baron and Bravo typos in their panel.cfg files
- Fixing ATC window's title bar being cut off at high DPI settings
- Preserving Xbox controllers when switching control APIs
- Reenabling tablet behaviors when gestures are modified. Correctly reading the setting in without restarting.
- Fixed Focal Points not drawing in Virtual Instructor
- Fixed issues with Video Streaming; displaying incorrect resolutions and a crash at higher resolutions
- Allowing video stream clients to join after a stream has started
- Supporting higher quality video streams
- Enforcing alert dialog to correctly grab focus and pop when opening behind other windows
- Ensure 2D panels properly layer on top of 3D windows
- Added extended ASCII support for Scaleform panels
- Added additional joystick checks to fix issues of controllers not appearing or being settable
- Updated multichannel and view group documentation
- Fixed bug where hydraulic switch was not working through Panel API
- Added video streaming configuration options
- Fixed issue with HintPath not being preserved when saving a scenario
- Forcing alert windows to display when behind other windows
- Setting the Parking Brake infogen notification to the proper key
- Stopped resetting audio devices during a hardware change. Caching previous state when recreating audio devices
- Correcting issue with SimConnect global exceptions. Respecting client IDs for SimConnect exceptions.
- Splash screen now displays immediately at startup
- Correcting issue with Raw Input and Windows 10 keeping unplugged controllers in the device enumeration
- Fixed a Raw Input access violation crash
- Refactored how the splash screen is displayed during activation
- Exposed additional chain message support to the PDK IEventService

Prepar3D v3.4 Hotfix 2

Fixes and Improvements

- Added notifications for when a graphics card driver crashes. Can be disabled by setting ShowDeviceLostWarning = 0 under the Graphics section in the Prepar3D.cfg.
- Correctly applying cloud's bank to better orient the clouds.
- Fixed bug where closed panels would reopen when toggling mipmap settings.
- Entities will now report DAMAGED_DESTROYED when health points reach zero or when they are in a crash state when connected in a DIS session.
- Added additional checks when getting control maps to ensure they are properly read.
- Corrected a crash when attempting a VarGet on "AI TRAFFIC FROMAIRPORT" and "AI TRAFFIC TOAIRPORT" when the requested AI did not have a valid departure/destination airport defined.
- Fixed issues with wide-view aspect ratios clipping out the terrain on 4k resolutions.
- Disabled cloud pancaking on extrusion bridges to reduce cloud artifacts.
- Skipping Scenario Startup screen when launching directly into SimOperator using command lines.
- Corrected LanOperatorname being incorrectly saved out as LanUsername for SimOperator.
- Prevented multichannel slaves from incorrectly broadcasting GPS flight plan data.
- Fixed an issue when a scenario could not be deleted through the Scenario Select screen due to its filename containing periods.
- Fixed application hang on shutdown if more than one PDK event was registered.
- Fixed a SimDirector crash when setting a scenario's camera object's pitch to 90 degrees.
- Fixed a SimDirector issue that would cause Area Definition objects to move exaggerated distances when attached.
- Fixed a SimDirector crash when attempting to use an ActivateWaypointsActions when an object did not have an AIType assigned. This will now be reported in ContentErrorLogging.
- Aggressively purging of scenery regions to prevent running out of memory at high slew speeds
- Added additional Content Error Reports for missing textures and effects
- Serializing AI Behavior activated states and activated start times to ensure they properly load/save with scenarios

- Support for Virtual Cockpit textures above 1024 resolution (MAX_VC_TEXTURE_RESOLUTION in Prepar3D.cfg)
- Fixed collision detection for CylinderPathArea if the cylinder's radius was significantly greater than its length
- Made numerical formatting for billboard menus match the appropriate key stroke
- Fixed an issue where the 10th item of the MenuWindow would incorrectly shift items up as if it were the "Next" button although it was actually the last item in the list
- Fixed a hard crash during shutdown caused by the order in which windows were being deleted
- Fixed a hard crash related to key events via SimConnect being called before the SimConnect dialog was opened
- Fixed a GDI memory leak with static elements when resizing panels
- Fixed a hard crash related to key events via SimConnect being called before the SimConnect dialog was opened
- Fixed an issue where the multiplayer host would incorrectly rebroadcast avatar attach/detach notifications
- Fixed an issue with the About screen where the toggle link would be out of sync with the displayed page

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Prepar3D v3.4 Hotfix 3

Fixes and Improvements

- Fixed an issue where the main window would not restore to maximized state after being minimized
- Fixed an issue where the main window would be minimized in the top left corner of its tab after changing modes in SimDirector
- Fixed performance issues when using SLI
- Fixed user interface flickering when using SLI
- Fixed particle flickering when using SLI
- Fixed an issue where loading would potentially hang at 100 percent
- Fixed a crash when loading multi-window VR scenarios
- Fixed an infinite loop hang when loading multi-window VR scenarios
- Fixed a bug that prevented avatar collision with other objects
- Fixed a hard crash when using weapons in a multiplayer session
- Fixed an issue where weapon selection would no longer work after using the avatar to attach to another vehicle in a multiplayer session
- Fixed an issue where orientation was not correctly being processed by the GetScreenCoord PDK function
- Added SensorModeNone and SensorModeGDATA custom camera post processes
- Fixed a hard crash when decoding certain METAR strings depending on the given wind speed units

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Requested Features and Enhancements Implemented in Prepar3D v3.3

Release Notes

The Prepar3D v3.3 update brings several new features and numerous platform, rendering, SimDirector, SDK, SimConnect, and multiplayer updates.

In addition **Professional Plus** now features Multichannel capability, enabling multiple PCs to run Prepar3D concurrently increasing performance on multi-screen and dome setups.

The following list of updates has been categorized based on the installer required. The *Client* installer is required for Prepar3D v3.3, however the *Content*, *Scenery*, and *SDK* installers are optional. You must first have Prepar3D v3 installed to utilize the *Client* only installer. To install the *Prepar3D v3.3 Client*, you must first uninstall the *Prepar3D v3.0/v3.1/v3.2 Client* via **Programs and Features** in **Windows Control Panel**. The *Prepar3D v3.3 Client* update will require you to reactivate your product, however if you have an internet connection it will be automatic. For more information please view the **Prepar3D v3 Download/Installation Instructions** from the Prepar3D.com **Downloads** page.

Prepar3D Client

General Platform Updates

New Features

- Multichannel (Professional Plus only)
- Creating add-on content that integrates with Prepar3D has been simplified and also supports enabling and disabling add-ons from within the application
- Controller axis sensitivity can now be set per flight mode (normal, slew, etc.)
- Menu keyboard key now opens the context menu on the active view

Fixes and Improvements

- Fixed tab order and typos in various UI screens
- Fixed bug that prevented ground vehicles from updating their door system
- Improved avatar record and playback
- Fixed bug where panel-only state could load incorrectly depending on the scenario
- Fixed crash that could occur when leaving vehicles with many gauges
- Restore Local Time Setting in the Go To Airport UI is now on by default
- Fixed bug in Select Vehicle screen that prevented vehicles from being selected after clicking the search box
- Fixed issue where uninstalling could fail to deactivate license on Windows 10 in some cases
- Position freeze user is now automatically turned off when hosting multiplayer
- Updated installer to include .NET 4.5.1
- Scaleform MenuWindow now displays a scrollbar when text overflows window size
- Fixed bug where pressing '0' would not activate the last option in the ATC menu.
- Fixed bug that prevented setting KEY_ADF2_RADIO_SWAP
- Fixed bug where panel keyboard shortcuts would also activate ATC options if ATC window was open
- "Display fuel quantity as weight" setting in Fuel and Payload screen now saves correctly
- Updated item ordering in the multiplayer drop-down menu
- Fixed bug where Time Preview slider would not stop moving when hitting Apply
- Canceling out of the Select Airport screen will no longer unpause the simlulation
- Fixed bug that could cause label text to be invalid when being displayed in multiple views
- Fixed bug where opening the Scenery Library UI would change the title of Prepar3D Scenery to FS9 Scenery
- Fixed memory leak that could occur during scenery library reloads
- Fixed throttle issues when using X Grip joysticks
- Fixed bug that prevented custom mini panels from opening when loading a scenario
- Scaleform multiple choice options no longer add brackets around user-defined menu items
- Fixed bug which prevented temperature and winds aloft layers from being read in correctly when decoding WINDS ALOFT metar data

Rendering and Performance Updates

New Features

- View groups can be created to easily configure views across multiple displays using the View Group Management window

- Post processes can now be applied per display using the View Group Management window
- Support for Scalable Display Technologies Easy Blend™ to blend multiple projected images together on curved or flat surfaces

Fixes and Improvements

- Fixed bug that would prevent aircraft lights from appearing at startup
- Improved cloud rendering performance
- Fixed custom z bias scenery flickering issues including runways and runway markings
- Fixed crash in XML gauges using RTT elements when Mip-map VC Panels was disabled
- Fixed bug which could cause shadows to disappear when using RTT gauges
- Fixed bug preventing IR post process from being used in RTT views
- Fixed startup crash that would occur on laptops using both Intel HD Graphics and NVIDIA cards to drive different displays
- SpeedTree LOD transitions are now more consistent
- Fixed minor texture issues with multi-GPUs
- Added cloud facing mode setting to the weather section of the Prepar3D.cfg, refer to the Weather Settings section in learning center
- Fixed bug that could prevent certain views from blacking out during loading
- Fixed bug where Special Effects Distance slider was incorrectly modifying effect rates

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SimDirector Updates

New Features

- Scenery and Mobile Scenery models can now be swapped out without having to recreate the object
- Player objects now render their assigned vehicle in Director Mode
- Player objects can now be assigned an AssociationID
- Camera object now renders a directional wireframe
- Added zoom buttons to visualization
- Open Scenario Dialog now shows all scenario content directories defined in Content Pathing
- Visual Path can now be assigned to player objects
- Scenarios now autosave (default every 5 minutes but can be configured or disabled)
- Scaleform Object origin can now be modified
- Added units display to gauge variable and property logic nodes
- Added goal resolution to GoalResolutionAction node and goal state to goal nodes
- Entities can now be filtered by type in Catalog
- Added better visual feedback when dragging and dropping objects
- New splash screen shown when entering SimDirector and SimOperator
- Added button to toggle between zoom modes (standard and precise zoom)

Fixes and Improvements

- Fixed bug where attachments were not cleared when changing entity's container title
- Fixed crash that would occur when pressing Ctrl+G to group objects when focus was in visualization
- Dampened slew speed when using controllers
- Fixed bug where user would have to zoom out multiple times to zoom away from the ground in certain cases
- Fixed crash that could occur when renaming a waypoint list in the waypoint editor
- Improved Catalog search speed
- Director Mode Camera position is now saved between mode switches
- Fixed bug that prevented vehicle selection from working after changing weather
- Multiple object references can be added/removed at once in supporting objects
- Camera orientation property is now disabled if tracked target or track race leader is set
- Saving scenarios now adds them to the top of the recent items list
- Fixed bug where recently saved items would not update new title and description values
- Fixed bug where scenario object rotation would snap back to original values after modifying them using the object properties window
- Fixed memory leaks and optimized memory usage
- Added more validation feedback when using Spawn Lists
- Fixed crashes that could occur with Scaleform Objects attached to other objects
- Fixed bug that could cause attached Scaleform Objects to be in the incorrect position
- Fixed bug where waypoint list could be moved in Director Mode causing a crash
- Fixed crash that would occur when deleting an entity referenced by another entity's AI Behavior
- Fixed bug that could prevent the camera object from being set to the main view when activated
- Fixed bug where grouping an AIBehaviorActivationAction would delete its selected behavior
- Fixed bug where the IsOnGround flag did not work correctly for Mobile Scenery
- Fixed bugs causing the translation gizmo y axis to not work in certain cases including attached Scaleform objects and Mobile Scenery and AI entities when Snap to Ground was turned off
- Property Description box now remains at a fixed size preventing the Object

Properties window from resizing when clicking different properties
- Added more precision for decimal value properties
- Fixed object rename bug that could cause multiple objects to be stuck in edit mode when using F2 to rename
- Gizmo state now persists when selecting different objects back-to-back
- Fixed bug where scenario would not be marked as changed when deleting objects
- Fixed bug which could cause extra scenery objects to be created when moving or rotating objects
- Improved rotation gizmo
- Fixed bug that could cause waypoints to be selected when selecting a range of objects in the Objects view
- Fixed bug that would occasionally cause the cursor in the ScenarioVariable field to jump to the front of the text when typing
- Camera objects now autogenerate a name when created
- Fixed bug where key events would get sent to Prepar3D when typing in the Catalog search box
- Fixed bug where the user ownship bounding box would remain onscreen when moving the ownship offscreen
- Catalog window now displays the correct total number of objects
- Changed property order in Object window
- Removed descr field from object properties
- Gizmo size is now constant
- Improved speed of duplicating large number of objects
- Fixed bug where hidden reference lists were not filtered out of the drag/drop context menu in the Visualization
- Fixed bug which could cause Property Grid enumeration fields to revert back to their original values in some cases
- Added validation checks for attached world object cycles
- Fixed memory leak caused by deactivated Scaleform Objects
- Title and Descr no longer editable in the Advanced Properties section
- Fixed bug where file information would not update when clicking "Save As" in the File menu
- Fixed bug where the state of the Weather button would be incorrect on first launch
- Fixed bug where context menu in visualization could be brought up when no objects were selected
- Fixed bug where the incorrect camera would be used when booting to SimDirector from the command line
- Updated various sections of the documentation
- Fixed bug where object selection could be incorrect after selecting objects with a search and/or type filter applied in the objects view
- Fixed bug where search in Objects window would not find objects in minimized groups
- Fixed bug where moving attached objects would cause heading to oscillate or rotate
- Updated zoom controls to be more precise
- Moved Avatar Attach/Detach button to the File menu vehicle section
- Fixed bug where moving objects with platforms would cause the object to move offscreen
- Fixed crash that would occur when attaching a Scaleform object to an entity
- Fixed crash that could occur when previewing a flight recording in Flight Instructor mode
- .SPB files are now sent to clients in SimOperator
- Space for object description and preview in the Catalog is now always reserved
- Reduced the sensitivity of the translation gizmo
- Fixed bug where toggling AltitudeIsAGL on scenery objects would cause them to draw in the wrong location
- Fixed bug where using the rotation gizmo on objects attached to other objects would cause the heading to change
- AIType "Edit" button is now hidden when AIType is "None"
- Fixed bug where Center On would not position camera correctly with certain objects
- Fixed bug where snapping to the ownship or centering on an object could cause the zoom level to be incorrect
- Fixed bug that could cause gizmos to sometimes draw behind objects
- Fixed crash caused by repeatedly pressing the close button during initial load
- Fixed bug where vehicle could be at the wrong altitude after using Select Airport

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SDK and SimConnect Updates

New Features
- Side angles and local offsets can now be added to camera definitions

Fixes and Improvements
- Fixed PDK documentation errors
- Fixed bug where zeroed out packet received via SimConnect could close client
- Fixed bug where content remove command line command would fail if specifying both title and path
- ISimObject properties/events which share the same name can now be get and set using SimConnect
- Fixed bug that could cause empty/invalid SimConnect packets from being sent and handled
- Fixed bug that could prevent loading weather themes through SimConnect

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Multiplayer Updates

Fixes and Improvements

- Tweaked blend duration for Distributed Interactive Simulation (DIS) dead reckoning
- Time to Live (TTL) now configurable
- Fixed bug that prevented AI from firing weapons when using the Attacker behavior in multiplayer
- Fixed valid ranges for DIS multicast connections
- Fixed bug where clients could be placed at an incorrect location after vehicle crash in multiplayer
- Fixed issue where chat input text field would not be visible when using long usernames

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Prepar3D Content

New Features

- Added Fury drone to default selectable vehicles
- LCS-1 USS Freedom and LCS-3 USS Fort Worth can now be placed in SimDirector

Fixes and Improvements

- Fixed bug where installation was not looked up correctly on 32-bit Windows
- Fixed several default values for the IRIS T-6A Texas II SP2
- Updated several SDK samples

Prepar3D Scenery

Fixes and Improvements

- Fixed bug where installation was not looked up correctly on 32-bit Windows

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Prepar3D SDK

Fixes and Improvements

- Fixed documentation errors for freeze simulation variables
- Fixed issue where the local modeldef.xml would never be referenced by the 3dsMax exporter
- Mobile Scenery data now available through SimConnect
- Streamlined add-on installation process
- Fixed issues in XtoMDL tool when using /WRITETOFILE flag

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Requested Features and Enhancements Implemented in Prepar3D v3.2

Release Notes

The Prepar3D v3.2 update brings several new features and numerous platform, rendering, SimDirector, SDK, SimConnect, and multiplayer updates including increased performance for multiple views and touch gesture support.

In addition, for Professional Plus users, Prepar3D v3.2 introduces two new advanced simulation capabilities:

- **SimOperator**, a native Instructor Operating Station (IOS), enabling real-time scenario creation and modification. Instructors can now control the simulation in real-time by freezing users, introducing failures, and much more.
- **Distributed Interactive Simulation (DIS)** support. You can now integrate Prepar3D with other simulations using the IEEE standard for conducting real-time platform-level interactions. Current integration supports Entity State, Fire, and Detonation PDUs with additional capabilities coming in future releases.

The following list of updates has been categorized based on the installer required. The *Client* installer is required for Prepar3D v3.2, however the *Content*, *Scenery*, and *SDK* installers are optional. You must first have Prepar3D v3 installed to utilize the *Client* only installer. To install the *Prepar3D v3.2 Client*, you must first uninstall the *Prepar3D v3.0/v3.1 Client* via **Programs and Features** in **Windows Control Panel**. The *Prepar3D v3.2 Client* update will require you to reactivate your product, however if you have an internet connection it will be automatic. For more information please view the **Prepar3D v3 Download/Installation Instructions** from the Prepar3D.com **Downloads** page.

Prepar3D Client

General Platform Updates

New Features

- Added gesture support including pinch to zoom and camera panning when using touch-enabled displays
- Converted SimConnect Option Menu to Scaleform
- SimOperator - A native Instructor Operating Station (IOS) based on SimDirector (**Professional Plus**)
- Distributed Interactive Simulation (DIS) Support (**Professional Plus**)

Fixes and Improvements

- Fixed bug that prevented Invalid Locale message from being ignored
- ATC message box can now be shown/hidden through UI settings
- Fixed bug that prevented custom cameras from saving into scenario file when using more than one view
- Fixed bug where favorite vehicles could be cleared out when opening the Select Vehicle screen
- Fixed tab order and focus issues for various UI screens
- Installer now populates default install directory with location used by content/scenery when making client-only updates
- Fixed bug that prevented placed scenery objects from disappearing after loading when using low graphics settings
- Fixed issue where certain menu items would still be enabled when Instant Replay was active
- Corrected default Avatar attach/detach conditions when loading from configuration files
- Improved camera saving and loading in Avatar mode
- Fixed bug in Scenario Startup screen that prevented user defined weather from restoring when switching themes
- Fixed bug in Scenario Startup screen that caused selected weather theme to apply when pressing cancel
- Fixed bug that would prevent snow textures from disappearing when changing weather in the UI
- Fixed memory leak that would occur when using panel serialization
- Reverted default scenario weather to Fair Weather from Cold Fronts to prevent wind from pushing aircraft to the right
- Reorganized menu bar layout
- Fixed bug where load would occur when hitting cancel from the startup screen after changing weather
- Fixed bug where menu bar could sometimes be focused when alt-tabbing back to Prepar3D
- Fixed bug that increased load times for certain third party add-on sceneries
- Position freeze state now shown in InfoGen text
- Fixed bug that could cause axis values for some control devices to be overwritten with 0
- Fixed bug with email activation verification causing shut downs without notification
- Extended max range of saturation slider in UI to 2
- Reorganized several UI screens

- Fixed bug where Time Preview window would still be on screen when opening other UI screens
- Fixed bug that caused certain controller names to not be detected
- Added additional spacing between menu item text and shortcut text
- Added SimConnect call to get average surface elevation
- Fixed bug that prevented mouse clicks from processing in certain aircraft
- Fixed bug that could cause anti-cheat message to be displayed when new players join multiplayer sessions
- Added more detailed avatar attach/detach notifications
- Enhanced camera and position calculations where camera position would incorrectly shift when rotating vehicle
- Pressurization system now simulated for non-user aircraft
- Fixed bug which could cause attached objects to shift based on heading at high altitudes
- Fixed bug where boolean entries not present in the Prepar3D.cfg would get modified to true
- Saved Flight Plans are now referenced by a relative path to the scenario file instead of an absolute path
- Fixed bug that prevented Scaleform Panel gauge callbacks from being called when reloading scenarios
- Fixed bug where gauge update would only get called once when using Scaleform panels
- Fixed crash that could occur when clicking on certain airspace boundaries in the map
- Fixed crash caused by using the same .swf in multiple windows
- Updated Select Vehicle screen to show/hide vehicle details
- "Show Only Favorites" and "Group By:" filters in the Select Vehicle screen now persist
- Fixed bug that prevented clicks from passing through transparent areas in Scaleform panels
- Fixed bug that prevented global Minipanels from opening
- Added Spoiler On and Spoiler Off control settings
- Added Hat Switch POV controls for Elevator/Aileron Trim and Elevator/Rudder Trim
- Fixed bug where Scaleform Panels would not resize properly with main window
- Added ability to sort controller devices by name or number (number matching the SimConnect_MapClientEventToSimEvent ID)

Rendering and Performance Updates

New Features

- Subsurface scattering effect now applied to SpeedTree leaves
- Shoreline waves now appear along coastlines
- Special effect objects now support the static sprite flag enabling spawned effects to move with its emitter

Fixes and Improvements

- Improved overall rendering performance
- Fixed bug that prevented surface condition effects from triggering
- Reduced GPU memory bandwidth usage
- Fixed runway line aliasing seen with higher dynamic reflections settings
- Toned down wind effect on SpeedTree trees
- IR now applies to SpeedTree trees
- Fixed bug where light system would scale particles when zooming in
- Fixed bug that could cause scenery and bridges to move with 3D waves
- Increased autogen building draw distance
- Fixed bug that could cause autogen buildings to float in some cases
- Fixed bug that could cause emitted effects to spawn in incorrect locations
- Fixed bug which caused controller based effects to spawn when application was paused
- Fixed bug where certain SLI functions could be called when SLI was disabled
- Reduced cases of autogen buildings floating above ground
- Fixed bug where undocked Scaleform panels could go black when switching between different GPUs
- Fixed bug that could cause fresnel color issues in certain materials
- Fixed bug that could cause certain bump textured models to flicker
- Fixed visual bugs with certain specular map textures
- Fixed bug with terrain texture requests across multiple GPUs
- Smoothed out planar reflection altitude transitions
- Improved SLI performance when using reflections
- Fixed bug where effects that would trigger during a vehicle crash would persist for a few frames after reset
- Fixed bug that could cause Scaleform RTT elements to not reload when exiting and re-entering the vehicle
- Fixed bug where aircraft labels would drift away from the aircraft when it banked
- Minor performance improvement to CubeMap render
- Fixed bug that caused 3D waves to influence float planes too strongly
- Fixed bug that could cause certain effects to spawn twice with animation events

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SimDirector Updates

New Features

- Added touch controls when using touch-enabled displays
- Can now export all objects or specific groups to object file (.xml)
- Visual references to ownship can now be hidden, simplifying visualization for complex scenarios
- Visualization nodes now show useful properties for the corresponding object

- Groups can now be set to different colors
- Added ZOrder property to OpenPanelAction and MenuPromptTrigger

Fixes and Improvements

- Improved visual appearance during loading
- Quick access items now persisted between runs
- Fixed backstage button highlight color
- Fixed bug that would cause objects referenced grouped objects to be incorrectly removed from the visualization in certain cases
- Made toggling Execute Unreferenced Actions on and off easier
- Added warnings for actions that are unreferenced when Execute Unreferenced Actions is set to false
- Moved object manipulation to separate ribbon item
- Merged all import options to single button
- Can now select scenery export format (.sxml or .bgl)
- Fixed bug where collapsed state of Preview windows would not persist
- Added new hotkeys, default key mappings, and hotkey text descriptions
- Selected object is now unselected when clicking terrain (can be toggled off if desired)
- Fixed bug which prevented new objects from being referenced in trigger logic when using "Redirect Incoming References"
- Fixed crash bug that would occur when ctrl drag dropping one visualization node to another when the first node was not selected
- Fixed bug that could cause the ownship to be mistakenly selected in certain cases
- Fixed bug where the object properties preview window and title would not get updated when changing vehicles
- GaugeVariableName now allows custom properties
- Fixed crash bug that could occur when using SetTargetAction on unsupported objects
- Fixed bug where sorting could be incorrect when adding or renaming certain objects in the Scenario Objects View
- Waypoint List connectors for selected waypoint lists are now green
- Added additional quick action buttons to visualization nodes
- Fixed bug where scenario was not marked as modified after making changes to object attachments
- Fixed crash bug that could occur when trying to make a group before the catalog was loaded
- Updated Visualization text for various objects
- Fixed bug that could cause app to be disabled when opening the Visualization during certain Progress Log events in Preview mode
- Fixed bug where a double load would occur when entering SimDirector with RealismOverrides that affected Terrain Settings
- Made the "Duplicate" behavior consistent between the keyboard shortcut and context menu
- Fixed bug where scenario could not be edited after canceling out of the Select Vehicle screen
- Fixed bug where the UserAvatar icon would show when attached to a vehicle
- Cylinder Position in CylinderPathArea can now only have on child set at a time
- Fixed bug where the bounding box toggle setting would not apply to Scaleform Objects
- Relative size can now be set in OpenPanelAction for Scaleform Panels

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SDK and SimConnect Updates

Fixes and Improvements

- Fixed memory leak that would occur when creating cameras through SimConnect

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Multiplayer Updates

Fixes and Improvements

- Minor updates to multiplayer UI
- Fixed bug where Scenario Objects would not be cleared when rejoining a multiplayer scenario
- Fixed bug with serializing spoiler handle values
- Fixed bug where attached avatars were separate selectable targets
- Fixed bug where pause menu would not display if host paused scenario without providing a reason
- Shared cockpit now supported in structured scenarios
- Containers now synchronized during multiplayer structured scenarios
- Added player count to role labels

Prepar3D Content

General Updates

- Fixed bug where registry values would be written to the wrong location on 32-bit Windows versions

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Prepar3D Scenery

General Updates

- Improved vegetation alpha to coverage
- Fixed bug where registry values would be written to the wrong location on 32-bit Windows versions
- Fixed bug causing visual artifacts with certain mission objects
- Fixed visual defects with glass and z-fighting with certain buildings in KATL

Prepar3D SDK

General Updates

- Fixed issue with using local modeldef.xml in 3dsMax scripts
- Updated ISimObject, SimConnect, and Rendering PDK documentation
- Fixed minor bugs in several example projects
- Engine Tuner renamed to Engine Sound Tuner and now works with ISimObjects
- Fixed documentation error with Token_Vars
- Fixed documentation error with assigning RTTs to Scaleform Panels
- Added Scaleform gauge sample
- Renamed SimObject flag "always_use_avg_surface" setting to "ignore_waves"
- Added SimConnect_RequestJoystickDeviceInfo function

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Requested Features and Enhancements Implemented in Prepar3D v3.1

Release Notes

The Prepar3D v3.1 update brings several new features and numerous platform, rendering, SimDirector, SDK, SimConnect, and multiplayer updates. The following list of updates has been categorized based on the installer required. The Client installer is required for Prepar3D v3.1, however the Content, Scenery, and SDK installers are optional. You must first have Prepar3D v3.0 installed to utilize the Client only installer. To install the Prepar3D v3.1 Client, you must first uninstall the Prepar3D v3.0 Client via **Programs and Features** in **Windows Control Panel**. The Prepar3D v3.1 Client update will require you to reactivate your product, however if you have an internet connection or have not made any major hardware changes between installations this should not be an issue. For more information please view the **Prepar3D v3 Download/Installation Instructions** from the Prepar3D.com **Downloads** section.

Prepar3D Client

General Platform Updates

New Features

- Added OGG audio file support
- Added Scaleform sound support
- Added axis calibration screen to the Control Settings Calibration tab

Fixes and Improvements

- Fixed issue where BoatSim attached weapons would not transform correctly
- Fixed bug that prevented AircraftPilotWaypointAI from correctly loading the WaypointTouchDistance property
- Added "IgnoreInvalidLocale" option to Prepar3D.cfg
- Fixed issue that would prevent the ATC window from opening when using certain vehicles
- Fixed issue that caused input messages to not be received for an extended period of time on first launch
- Fixed crash that would occur if mission page in Kneeboard window referenced file or directory that did not exist
- Content Error Reporting now off by default
- Improved Select Airport search functionality
- Fixed issue that would cause doors to automatically close when near a fuel parking spot
- Fixed bug that would cause avatar fall animation to display too often
- Fixed bug where picture-in-picture view opened by scenario would become active when opened
- Prevent On Screen Text from showing on secondary views
- Fixed visual bug that could cause weapons to lag behind for one frame
- Fixed bug that would cause realism overrides to get overridden with current system settings when saving scenario
- Fixed additional UI layout bugs
- Improved readability of InfoGen text
- Fixed crash that could occur when autopilot key was triggered when no autopilot was present
- Fixed bug where ATC message area would expand when no options were present
- Fixed bug that altered menu appearance at high DPI settings
- Fixed crash that would occur in scenarios when closing a MultiChoicePopup window that was opened through a MenuPromptTrigger
- Fixed bug where weapons would not register mass and force properties when attached to pylons

Rendering and Performance Updates

New Features

- Added dynamic reflections on objects by replacing the static environment map with a dynamic cube map
- Special Effects can now be rendered on terrain and water
- Enhanced visual quality of water offering greater fidelity at high altitudes and better wave dynamics with high winds
- Boats now move with water surface elevation

Fixes and Improvements

- Fixed issue that caused weapon trails to not animate correctly at long distances
- Triton water updated to Cuda 6.5 and performance improved
- Fixed issue where sea foam texture would not display across multiple graphics cards
- Fixed bug where 3D water would not correlate correctly between multiple views
- Fixed terrain spikes that would occur with multiple moving views

- Reduced black textures when switching views showing previously requested objects
- Fixed crash that would occur when more than 24 2D views were opened
- Fixed issue with bump mapping where tangent was calculated incorrectly
- Fixed color of emissive night only materials
- Fixed lighting value used for nighttime reflections
- Prevent sun and moon from fogging when volumetric fog is disabled
- Fixed issue where last emitted extrusion would become detached from the emitter
- Fixed bug that caused light effects to be overridden to use incorrect effect file

SimDirector Updates

New Features

- Control modes now have hotkeys
- Focal points can now be drawn outside the vehicle and placed in the world

Fixes and Improvements

- Fixed bug where using gizmos near edge of screen would cause object to move unexpectedly
- Fixed issue where objects with AI behaviors would not process without being assigned a waypoint list
- Fixed crash that would occur when using MenuPromptTrigger to change user vehicle
- SimDirector command line switch now takes precedence over the startup screen
- Fixed issue that prevented large Sphere Areas from rendering correctly
- Fixed bug where AGL property would be out of sync with actual placed object
- Target Player can now be set to specific players within SimDirector
- Fixed cases where visualization auto-center would position incorrectly
- Fixed crash that would occur when running scenarios using legacy focal points
- Fixed crash that could occur when quickly entering and leaving the backstage menu multiple times

SDK and SimConnect Updates

New Features

- Updated window PDK with additional targeting controls
- Special effects can now be flagged as decals
- POV events can now be registered for ISimObjects
- Added "ignore_input" panel config entry enabling mouse clicks to pass through docked panels
- Panels can now support both xml gauges and Scaleform concurrently

Fixes and Improvements

- Added missing window PDK unregister callback functions
- Cleaned up Simvar documentation
- Fixed bug where setting global weather through SimConnect would not update at all altitudes
- Fixed crash that could occur when detaching avatar while using Window PDK
- Pick results requested through PDK now clarify if point is offscreen
- Added ISimObjectManager function to get all objects within radius excluding traffic
- Fixed bug that caused SimConnect_MapInputEventToClientEvent to behave differently than in previous versions
- Added content error reports for common Window PDK errors

Multiplayer Updates

Fixes and Improvements

- Enhanced ISimObject multiplayer support
- Updated multiplayer documentation
- Fixed bug where host would not correctly serialize the visibility state of client avatars
- Fixed bug where saving a scenario and then entering multiplayer would cause a blank Menu Window to appear
- Removed 30 second wait that would occur when starting non-race structured multiplayer scenarios

Prepar3D Content

General Updates

- Fixed Beech Baron virtual cockpit light offsets
- Additional updates to the India Foxt Echo F-35A

Prepar3D Scenery

General Updates

- Minimal accuracy changes for five south-eastern United States of America airports
- Updated coastlines, lakes, rivers, and elevation model in Singapore

Prepar3D SDK

General Updates

- Scripts will now utilize user temporary directory preventing the need to run as administrator

- The user now has an option to reference a local modeldef.xml in the same directory as there .max file
- Fixed an issue where the Shader Tool rollout would fail to load
- Fixed an issue where documentation would fail to load
- Improved Shader Tool in 3DS Max to preview more dynamic options including diffuse, specular, day/night textures, and alpha testing

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Requested Features and Enhancements Implemented in Prepar3D v3.0

The Prepar3D v3 update brings all new features to the platform, rendering and performance, SimDirector, and the SDK. The platform has been overhauled to take advantage of the latest development tools to increase performance and stability while streamlining future development. Optimizations and visual improvements to the rendering engine increase immersion to a whole new level. New development features, including the Scaleform SDK, provide developers even more flexibility to create new and exciting content for Prepar3D's ever increasing user base. A completely new way to interact with the platform has been added with the addition of Avatar mode. Avatar mode opens up endless new training possibilities including vehicle inspection, maintenance, and safety scenarios. Prepar3D's scenario creation tool SimDirector has also been enhanced with a new scripting system opening up possibilities to create more complex training scenarios.

General Platform Updates

Autodesk® Scaleform® Integration

- Gauges and panels as well as scenario object content can be built using Adobe® Flash® and integrated using Autodesk Scaleform.
- Several UI screens have been replaced with Scaleform implementations such as the ATC window, the Menu System, the InfoGen, and Menu Prompts. These aforementioned UI can be themed by third party developers.

Avatar Mode

- Enter and exit vehicles in Avatar Mode
- Avatar fully controllable in first and third person views
- Third party avatar support

Updated User Interface

- New default theme for v3
- Fixed UI layouts, position bugs, and improved overall usability
- ATC window now transparent and can be docked into main view
- Menu system performance and appearance improved
- InfoGen readability improved
- Fixed bug in menu system where blank entries could be created
- Fixed a bug where drop-down menu state would not always update while open
- Added close buttons to docked views when window titles are enabled (feature was always present but no visual indicator existed)
- Default scenario is now visible in Load Scenario screen
- Fixed a bug where Prepar3D.cfg setting 'ShowATCText' was not enabling ATIS captioning
- Fixed a bug where Prepar3D.cfg settings for ATC message color customization was not being respected
- Fixed bug with InfoGen where text would not appear when pausing or entering slew after changing start page to 0 in scenario
- Fixed issues with modifying default and favorites in save and load screens
- Load scenario page now shows vehicle name along with scenario description
- Trimmed down amount of menu items in certain cases including multiplayer and the context menu
- Fixed bug with Flight Planner that would prevent a flight plan from saving out if it was between two airports with no intermediate waypoints
- Fixed bug with certain text boxes where pasting text would not respect current selection and incorrectly move cursor
- Fixed bug where undocking a message view would instead undock the main view
- Fixed bugs with Scenario Startup screen where weather theme changes would apply when clicking cancel and user defined weather would not get applied when changed
- Fixed bug that prevented multiplayer menu items from being added to customized menus
- Fixed bug with Scenario Startup screen that prevented vehicle selection background from updating with the time of day
- Enhanced ATC window to provide feedback when ATC communication is disabled, i.e. Sim Paused, No Electric, etc.
- Fixed bug with ATC window that prevented UI from refreshing when switching from an AI camera back to the user
- Updated graphics profile UI and added prompt when attempting to save over existing profiles
- Time Preview window now takes up less space and readability improved
- Updated visual style of scroll buttons to be more clean
- Instrument Panel menu option now disabled if vehicle has no panels
- Added restrictions on what items can be accessed during Structured Scenarios (default restrictions can be overridden by developer)
- Removed redundant UIs used when importing and exporting controls
- Reassigned menu shortcut keys to remove duplicates
- Added Settings button to main menu screen
- Fixed bug where "Esc", "Spacebar", and "Enter" keys would not function in Scenario Startup screen
- Changing full-screen resolution while in full-screen now immediately changes

resolution
- Fixed bug with category selection in Settings menu
- Fixed bug with UI scaling at low resolution and high DPI settings
- Made OK/Cancel button alignment consistent across screens
- Updated About Menu

Platform Improvements

- "Flights" terminology has been changed to "Scenario" better reflecting Prepar3D's full land, sea, and air training capabilities
- Fixed controller/joystick dropping issues with Windows 8.1
- Fixed multiplayer issue preventing user log out when exiting
- Multiplayer NET_VERSION correctly incremented to prevent different versions connecting with each other
- Fixed a bug where the main view could be closed while window titles were enabled
- Fixed bug where crash would occur when entering invalid license
- Fixed bug where thumbnail images for scenarios and aircraft would not match correctly
- Fixed bug where piston engine failure could reverse itself back to 100% health
- Fixed and updated multiple areas in the Learning Center
- Added more options in Scenery.cfg to accept more variables
- Fixed bug causing certain library objects to be rendered in wrong locations
- Fixed issue with multiplayer weather serialization
- Oculus Rift VR headset fully integrated into core. Headset now appears in camera mode list if connected.
- Fixed scenario reset bug where full scenery reload would occur when not required
- Added content error reporting for gauge loading errors
- Fixed an issue when deleting a scenario from the Load Scenario screen, the xml file would not get deleted from the Prepar3D v3 Files folder
- Fixed focus issue with multiple views. Would sometimes cause the camera to change on the wrong view when using context menu
- Panel-only prevented from being set on non-main views
- Fixed bug that would cause frame drops when hitting escape during instant replay playback
- Fixed bug that would cause full scenery reload to occur even when not moving vehicle
- Fixed bug where application icon would not appear in taskbar when booting into multiplayer
- Fixed bug that would always prevent user from entering lobby when booting into multiplayer
- Fixed bug where TowerController could spawn on the ground in multiplayer
- Added greater customization of InfoText appearance
- Scenario captions now on by default
- Fixed bug where child views could become panel-only after being opened
- Scenery library items which cannot be found are now prompted for removal
- Fixed bug that would prevent Scenario Briefing from being displayed in certain cases
- Fixed bug that would prevent pilot records from updating
- Fixed crash that would occur from misconfigured weapons and pylons
- Fixed weather serialization bug in multiplayer
- Fixed bug that would cause custom camera zoom levels to save out incorrectly
- Invalid flight plans are now prevented from being saved
- Fixed bug where non-unicode languages would alter starting location
- Fixed bug with booting into multiplayer from command line that would prevent scenario from loading
- Fixed bug that prevented cockpit button picking from working in FS9 BGL models
- Changing default scenario now immediately writes out to the Prepar3D.cfg
- Fixed bug that would prevent thunder sounds from being audible
- Updated vehicle load failure popup to relay when user will be placed in viewer sim
- Fixed issue that caused instability when using hoist and sling features
- Fixed docked view positioning bug when undocked views were opened
- Undocked views now position themselves on top of other open views
- Change low speed thrust limit on propeller in order to better blend the low and high speed thrust calculations
- User tips now enabled by default
- Fixed bug that would cause the WindowPlugin system to hang when changing between certain vehicles during a crash sequence
- Fixed bug where slew would not disengage when entering Instant Replay
- Fixed bug where changing the assignment of the "esc" key would not register
- Fixed bug that caused XBox 360 controller triggers to register as z-axis on first assignment
- Added Camera Center Offset to camera configuration

SpeedTree Integration (IDV Inc.)

- Platform now supports SpeedTree models which are high quality 3D trees, with wind animations and smooth LOD transitions
- SpeedTree models can be placed using SimDirector

New Content

- Virtavia Sikorsky H-60 Black Hawk
- India India Alpha Foxtrot Echo F-35A
- 18 new scenery library models of 3D trees (powered by SpeedTree)

Rendering and Performance Updates

Updated Visuals and Performance

- Updated HDR to increase default brightness and enhance color clarity
- Developed animation blending support enabling lifelike avatar animations
- Fixed issues with water reflections that were affected by secondary views

- Fixed bug with non-tessellated terrain that would prevent ground detail flag from being respected
- Fixed visual bug with ground normal particles
- Fixed bug where taxiway lights would shift at large airports
- Removed old sun glare effect
- Fixed issue where virtual cockpit night lighting would not work as expected
- Fixed issue where global environment map would fail to load in some cases causing aircraft to look dull
- Fixed shadow issues seen with bathymetry enabled
- Added alpha write option for virtual cockpit panel textures
- Fixed bug where GPU terrain would shift at high altitudes
- Fixed light scaling issues
- Fixed issue that would prevent models from instancing in certain situations
- Fixed bug where applying vsync with triple buffering would cause rendering to freeze
- Fixed bug where shadows would not display properly on non-tessellated terrain
- Improved memory management reducing overall VAS usage and spikes
- Fixed bug that caused different objects to burn through fog including the sun, moon, galaxy, airport lights, and lens flare
- Fixed bug where material NO FOG setting was not always respected
- Multiplicative particles now fog correctly
- Fixed bug where pre-lit objects disabled fog
- Fixed water rendering issues while using non-tessellated terrain including reflection appearance and shadow brightness
- Optimized texture unloading during loads
- Unused terrain detail textures no longer loaded
- Added modifiable saturation effect to HDR enabling greater customization of visual appearance
- Fixed bug that would cause panel transparency to also affect virtual cockpit panels if Mipmap VC Panels was enabled
- Fixed issue where certain clouds would disappear at certain camera angles when on the ground
- Exposed bloom material scalar to Prepar3D.cfg to allow finer control of bloom
- Fixed bug that would cause fog to flicker when changing views
- Fixed bug where fog would not respect ShowWeather flag in camera config
- Fixed bug with fog appearance in reflections
- Overall shader optimizations for increased performance
- Fixed bug where certain scenery effects would only occur during the day
- Fixed bug where landing lights would draw incorrectly at steep angles
- Fixed bug where HDR and FXAA would not applied for one frame when switching views
- Fixed crash bug that could occur when opening multiple views in quick succession
- Fixed bug with wave animation wind offsets

Enhanced Particle System

- Optimized particle system by better utilizing GPU and system resources by reducing CPU side work, supporting indirect draw calls, and improving sorting algorithms
- Fixed issue where certain particle effects would not render due to prioritization errors
- Fixed bug with particle lifetimes
- Fixed z-fighting issue with particles using same emitter
- Fixed issue where certain aircraft light emitters would not be deleted
- Fixed bug where extrusions would not connect properly with certain effects

Enhanced Multiple GPU Support

- Fixed bug where lights would not draw correctly multiple GPUs
- Fixed bug where batched scenery objects would flicker across multiple GPUs
- Fixed bug where scenery objects would not correlate correctly across multiple views
- Fixed issue where effects would not synchronize properly between multiple GPUs
- Fixed bug where particles and extrusions would flicker and get out of order in SLI

SimDirector Updates

- Added Lua scripting support to SimDirector. Scripts can be fired through actions and ScenarioVariables can be used enabling more complex scenario logic
- Full avatar support in scenario creation. For example, the avatar can be referenced by other objects and can be given waypoints.
- Added scenery import and export support in SimDirector. BGLs can now be created from scenarios with scenery in SimDirector which greatly simplifies the scenery creation process
- Visual Path object added which can be attached to moving objects or waypoints
- Fixed bug where hang would occur occasionally when exiting backstage
- Updated internal error checking to prevent intermittent crashes
- Fixed bug that would prevent mobile scenery from appearing in preview window
- Fixed waypoint placement issue that would prevent waypoints from being placed close to other objects
- Fixed validation bug with timers
- Fixed issue where mouse cursor state would not change in certain cases
- Fixed bug with Menu Prompt Trigger that caused windows to close prematurely
- Fixed bug that prevented Jet Fighter Time Trial from loading in SimDirector
- Fixed tabbing issues in Catalog UI
- Fixed crash that would occur when attempting to play back VI session while in Virtual Instructor mode
- Fixed bug where sound would distort when entering SimDirector
- Fixed hang that would occur when booting directly into SimDirector
- ATC menu no longer stays open when entering SimDirector or switching SimDirector modes

- ThreatDome models added to object catalog
- Color property now supports alpha (e.g. Focal Point Color, Area Definition Color, On Screen Text Color)
- Fixed bug where SimDirector camera would be changed when switching the time of day
- Fixed bug with failure system index that would cause all instances to trigger when index of "0" was used
- Fixed bug where effects played in preview mode would persist when leaving preview mode
- Removed empty scenery objects
- Fixed bug that would cause a crash when entering SimDirector with auto validation on
- Fixed issue with ViewChangeAction that would prevent camera list from repopulating when loading new scenarios
- Fixed bug with POI scaling
- Fixed bug that would cause app to be disabled when pressing Ctrl+V in a group
- Enabling mouse yoke no longer prevents SimDirector controls from functioning
- Triggers now have OneShot set to false by default
- Improved scenario save and load times
- Scenario no longer unpaused when starting recording playback
- Fixed issue where help button was not selectable in undocked views
- Fixed catalog view to show selected object when using arrow keys to navigate through menu
- Fixed issue where SimDirector could crash if closed while changing modes
- Scenarios can now be saved in .spb format
- Snap to ground is now a global setting
- Minor errors in scenario .xml files no longer prevent scenario from loading
- Updated SimDirector settings page appearance and added options to enabled error logging
- Scenario error reporting now on by default
- Fixed resource path issues that could occur when modifying scenarios in both core Prepar3D and SimDirector
- Fixed issue where sounds in sound subfolder would prevent scenario from being previewed
- Improved scenario loading times
- ScenarioMetaData no longer required but still recommended
- Validation window now opened if validation errors are reported during a mode change and user cancels
- Fixed issue that could cause SimDirector to slow down after prolonged use
- Object titles in Scenario Visualization now show ellipsis when string is too long to fit instead of just clipping out
- Fixed crash that could occur on shutdown caused by invalid objects being accessed
- TargetPlayer now settable in actions that can occur in multiplayer scenarios
- Fixed bug that would prevent DisabledTrafficAirports Descr from updating
- Failure Action no longer shows systems that are not applicable to current vehicle
- Fix crash that could occur when loading scenarios with invalid containers
- Modified FlightRealism object to prevent users from opening the Flight Planner, entering slew, and changing location, vehicle, or fuel during Structured Scenarios
- Added WorldRealism object to prevent users from changing world settings (weather, time) during Structured Scenarios
- Fixed bug where SimDirector UI styles would be applied to core application when leaving SimDirector
- Updated OnCompleteActions to support multiplayer concepts including IsGlobal and Triggering
- Triggers now have one shot set to true by default
- Fixed bug where switching between an entity and scenery object would not correctly update the preview window
- Fixed bug where Scenario Name and Description would be changed when leaving Preview mode with legacy flight (FLT) files
- SimDirector window title now uses the File Name instead of Scenario Title
- Fixed crash that could occur when bringing an item in the History into view
- Failure Action can now be applied to specific subsystems
- Fixed bug preventing weather settings from being respected in SimDirector
- Added message box to show when LoadScenarioAction would fire in Preview Mode
- Fixed issues with resource path when saving the same scenario both in and out of SimDirector
- Fixed bug that caused placed objects that were scaled in SimDirector to cull out prematurely

SDK and SimConnect Updates

- The ATC, Menu System, and InfoGen support third-party skinning through the Scaleform SDK
- SimConnect_WeatherRequestCloudState now returns correct range of values
- Fixed bug with SimConnect_AIReleaseControl not fully releasing control of AI
- Enhanced ISimObject property management
- Additional improvements to path configuration files to support third party developers
- Multiple configuration files added to support the path configuration system
- Added command line parameters for developers to add or remove additional paths to core content
- Sample projects updated to use Visual Studio 2013
- SetupAcesRoot.ms script added back to 3dsMax SDK
- Fixed incorrect Learning Center scenario names in documentation
- Cameras can now be attached to model attach points
- Base scenery can now be overridden without being deleted
- DLL.xml can now be modified through command line

- Scenery.cfg now supports command line activate and deactivate operations
- Added Weather System PDK allowing developers to set weather related settings and interface with weather station data
- Updated Learning Center descriptions for goals and mission objective SimConnect enumerations
- XToMDL tool now displays exceptions more clearly
- Updated carrier documentation
- Restructured Add-Ons documentation
- Added function to CabDir tool to strip trailing slashes or quotes from end of path
- Corrected how up events and up/down data are returned when using SimConnect_MapInputEventToClientEvent with joystick buttons and POV hats
- Added new blend mode for instrument panels to better support HUDs.

Installer Updates

- Installer now split into three separate components which can be updated and installed independently: Client, Content, and Scenery.
- Folder organization scheme modified to support new content and scenery installers
- Updated versioning scheme for installed files
- Legacy SimConnect clients no longer installed with Prepar3D installer. Separate installers for these are provided in install package if needed.
- Process of activating from another computer has been simplified
- The licensing and Digital Rights Management (DRM) system has been completely overhauled

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Requested Features and Enhancements Implemented in Prepar3D v2.5

The Prepar3D v2.5 update brings rendering and performance updates, a few general platform updates, and a substantial update to SimDirector, Prepar3D's intelligent tutor, virtual instructor, and scenario generation tool.

General Platform Updates

- Fixed a crash that would occur if licensing check on startup failed
- Fixed a bug where thumbnail images for missions and aircraft were not matching up properly
- Renamed missions to reflect their content
- Restructured path configuration files to support third party developers
- Fixed issues that would prevent multiplayer missions from correctly validating
- Added several new settings available to use with a multiplayer mission

Rendering and Performance Updates

- Added post process for night vision that includes bloom
- Added a light scalar to camera so that NVG cameras can have a brighter scene
- Added a configuration option to the Prepar3D.cfg and Camera Definitions that allows cameras to share a single terrain view
- Added an option to specify whether or not a panel should write alpha when rendering into a texture
- Improved long range sensor capabilities by allowing plug-ins to set the scenery load origin for a camera independent of its location
- Fixed a bug that would prevent the HideAircraft flag from hiding aircraft attached effects
- Fixed a bug that would cause all extrusion effects to draw with a visible sawtooth pattern
- Fixed a bug where the exclude VC panels sensor setting was not working as intended
- Fixed a bug that would cause effects with smoke and fire to appear blue
- Fixed a bug that would prevent rotor wash effect from rendering
- Fixed issues with the bridge pylons that would cause them to look tall/stretched
- Fixed issues with resolution differences between shadow views and main views causing shadow artifacts to appear
- Fixed issue that caused clouds to face vertically
- Fixed out of memory issues with the Vehicle Selection Screen
- Fixed an issue that would prevent effects from visually displaying if the effect was at a low level of detail distance
- Fixed issues with shaders failing to compile if material is created without setting a specular map
- Fixed an issue that would cause some aircraft to load with the engines turned off
- Fixed an issue that would prevent engine wash effects from rendering
- Fixed an issue that would cause none facing sprites to be half their size
- Fixed an issue with landing light ground polygon fading based on view direction
- Fixed an issue with to rain and snow effects not taking into account precipitation rate adjustments

SimDirector Updates

- Added an Undo feature in SimDirector. Undo allows a user to undo and redo most actions in their mission. A history window provides visual feedback of what

actions have been done
- Added a Measure Tool to SimDirector. This allows the user to measure distances in several different unit types
- Added a setting that allows the user choose whether or not they would like to load their mission in Prepar3D after closing SimDirector
- Added the ability to preview actions from the visualization window in Preview Mode in SimDirector
- Added an option for hiding icons and bounding boxes in SimDirector
- Added catalog preview into the catalog and created object preview
- Added an Effect.cfg file to configure where system looks for effects
- Added ability to edit mission while in Preview Mode
- Added a setting that allows the user to filter object references by group
- Added the ability to copy values from the condition editor
- Added better error handling and error reports for missing Mission Briefing files
- Added a unit converter to several distance related properties
- Added the ability to read friendly names for third party models
- Added option to set whether SimDirector controls or Prepar3D controls have precedence when hovered over the Prepar3D window in Virtual Instructor, Flight Instructor, and Preview Mode
- Fixed a bug where saving scenario alters camera orientation
- Fixed bugs dealing with multiple item selects
- Fixed bug that effected saving properly observation profiles
- Fixed a bug that would prevent the file name from updating and saving properly in different modes
- Fixed a bug that would prevent pop-up windows from scrolling through all the options
- Fixed a bug that would prevent the context menu in the logic editor from opening properly when using non-standard DPI settings
- Fixed a bug that would remove referencing of an ownship if the ownship aircraft was changed
- Fixed a bug that would prevent multiple external properties from updating in monitoring
- Fixed a bug that would cause issues with loading missions located in Program Files
- Fixed a bug that would prevent visual model from updating orientation changes reflected in the property grid
- Fixed a bug that would prevent catalog friendly names from loading properly
- Fixed a bug that would prevent single row text box to extend scrolling with the cursor
- Fixed a bug that would cause backstage to hang when clicking the arrow
- Fixed a bug that would prevent property observation profiles from saving
- Fixed a bug that would prevent build object list from increasing the count
- Fixed a bug that caused bulk lasso selection to not appear as one selection
- Fixed a bug that would not progress the object list count
- Fixed a bug that would prevent visibility from resetting when toggling the weather on/off
- Fixed issues with broken timer validation check
- Fixed an issue where object preview would not display mobile scenery
- Fixed issues with Virtual Instruction recording while in inner group visualization
- Fixed SimDirector window sizing issues
- Fixed an issue that prevented Mission Preview from re-enabling the user interface
- Fixed issues with search boxes in SimDirector. All search boxes now search for any part of search phrase
- Fixed issues with selecting actions inside of a Virtual Instructor session
- Fixed issues with observer look-at and look-at-ground functionality
- Fixed issues with monitoring in Virtual Instructor mode
- Fixed issues that would cause the Preview window to stop working
- Fixed issues that would cause a slow down when dragging objects around in SimDirector
- Fixed an issue where the Preview Window would cause crash when resetting scenarios
- Fixed issues with waypoints being placed too close to each other or other objects
- Fixed issues with mouse cursor state not changing as expected

- Fixed issues that would cause crashes if user sim was null
- Enhanced translate, rotate, and scale gizmos
- Enhanced speed of object selection from validation window
- Enhanced speed of switching between viewer sim and vehicle
- Enhanced drag and drop feature in SimDirector
- Enhanced preview subset feature in Preview Mode
- Fixed an issue where mission menu windows would close prematurely

SDK and SimConnect Updates

- Added a way for developers to add and modify path configuration files through installers
- Added ability to manipulate visual effects during runtime through the PDK interface
- Added ability to retrieve attach point data via SimConnect
- Updated documentation regarding supported pylons, objects, and their interactions
- Added scenery load origin settings to camera definitions and PDK development
- Fixed a bug where bglcomp.exe could not parse Coastline values
- Fixed a crash that would occur if a panel developer requested an aircraft variable while the aircraft was shutting down

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Requested Features and Enhancements Implemented in Prepar3D v2.4

The Prepar3D v2.4 update brings general bug fixes, rendering updates, as well as several requested features and enhancements to the SimDirector mission creation tool.
This v2.4 is an incremental update to fix a handful of outstanding issues present in v2.3.
The full listing of improvements, fixes, and requested enhancements is listed below.

General Platform Updates

- Fixed a crash when saving/loading scenarios due to corrupt object configuration files
- Custom camera orientation will now load correctly when multiple views are open
- Saving the Internal Vehicle Cast setting with setting profiles
- Fixed issue of blending between unlimited visibility layers
- Resolved an indefinite hang when selecting the observer role in multiplayer missions

Rendering and Performance Updates

- Corrected issues with batched objects and airport lighting on systems with multiple graphics cards
- Fixed an issue with BGL objects that were causing a memory leak and crash
- Fixed an issue with clouds being rendered quadruple the intended size
- Fixed an issue with particle effect scale being larger than intended
- Fixed an issue with multiple texture entries in panel configurations not being rendered
- Fixed issue with vertical geometry spikes
- Corrected an issue with cursors causing issues when HDR was enabled
- Added transparent panel support for auxiliary windows
- Fixed issues with custom camera post process settings not properly loading
- General fixes to terrain shadow artifacts
- Fixed issues with material z-bias level behavior not being consistent

SimDirector Updates

- Added a backstage file menu to help configure the scenario, open recent files, change settings, and other useful operations
- Added hotkeys for common interactions
- Changed the behavior of actions so that if an action is unreferenced, then it will fire when the scenario begins
- Improved the object catalog by adding extensive filtering for new users and helpful key shortcuts for power users
- Improved and simplified the controls to navigate the world and manipulate objects
- Added the ability to use the Time Preview window and toggle Weather Visibility while editing scenarios
- Added the ability to preview text-to-speech for the DialogAction
- Fixed an issue where the application would hang when creating a scenario while the Mission Incomplete message box was open
- Fixed an issue where undocking windows would freeze SimDirector
- Fixed an issue where the VI Sessions window was not able to be used after resetting the scenario

- Fixed an issue where Panel objects would not respect the panel that they were referencing when previewing the mission

SDK and SimConnect Updates

- Added preliminary Oculus Rift Development Kit 2 (DK2) integration sample
- Added support for 3ds Max 2015
- Added SIMCONNECT_CAMERA_SENSOR_MODE to the C# SimConnect headers
- Corrected an issue with exported attach points being placed with the wrong orientation

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Requested Features and Enhancements Implemented in Prepar3D v2.3

At a very high level, the Prepar3D v2.3 update brings many bug fixes, performance and stutter improvements, as well as several requested features and enhancements to both the core platform as well as the SimDirector mission creation and virtual instruction suite.

The Prepar3D v2.3 update highlights include:

- Dozens of rendering and performance optimizations and updates
- The inclusion of the v2.2 'hotfix' that caused the Flight Planner to crash
- Several new features in the multiplayer system
- An update to the 'ultra' 3D water libraries that increase immersion and realism while improving performance
- A new panel serialization feature that saves the state of your panels and gauges when you save a flight or mission, so that you can resume training in the same conditions that you left with
- Three new tutorial missions that highlight the flexibility and power of SimDirector as a virtual instruction tool
- Several new updates to SimDirector to further it's position as the industry leading desktop virtual instruction suite

Reference the full listing of performance improvements, fixes, and requested enhancements broken out below.

Three new SimDirector Virtual Instruction Sample Missions Added

- Learn how to properly start up and run through the pre-flight checklist of the Bonanza A36
- Next test your abilities with a timed and graded exercise of the A36 startup procedures
- Finally, learn how to taxi, takeoff and land with assistance from the Prepar3D SimDirector Virtual Instructor

General Platform Updates

- Added a new panel (.PNL) file that is saved when a mission saves. This allows users to save their vehicle's gauge and panel states and settings and is transferable between workstations
- Fixed an issue with the value being written to the MUTE_ON_LOST_FOCUS variable in the Prepar3D configuration file

Rendering and Performance Updates

- Updated 3D water and terrain and improved performance
- Added new higher-resolution textures to the 3D water as well as sea foam
- Optimized GPU particles for higher visual performance
- Added more show/hide options to camera definitions
- Fixed an issue where the Render to Texture (RTT) would disappear after closing and reopening 2D panels
- Fixed an issue where specular maps for buildings could become corrupted
- Fixed an issue where airport parking detail markings could float off the ground
- Fixed a rendering issue related to the context menu causing 3D water not to render
- Fixed an issue where ultra water was not updating in certain conditions on AMD

video cards
- Fixed an issue where anisotropic filter would not respect user configuration settings
- Fixed an issue that caused boat wakes to be placed above the water surface
- Fixed an issue where the TextureMaxLoad configuration variable was not being respected
- Fixed an issue where some library object effects would not appear correctly
- Fixed issues with camera views becoming motionless
- Fixed cases where attached effects rendered incorrectly in virtual cockpit views
- Fixed an issue where particle effects would occasionally render with the wrong texture
- Fixed issues relating to scenery objects disappearing across a multiple monitor environment
- Improved clouds near camera to make them look more volumetric
- Added functionality to allow more than one window plug-in for add-ons
- Added bathymetry support to GPU (tessellated) terrain
- Fixed an issue where water textures would pop when changing altitudes
- Fixed Sea-Tac environment buildings that were covered with environment maps
- Fixed several issues with trees rendering on multiple video cards
- Fixed the BGL line list and point list from crashing AI aircraft.

Lighting and Shadows

- Improved performance and speed with changing the shadow settings
- Created consistent lights on aircraft
- Enhanced performance related to cloud shadows
- Fixed an issue where the lighting page would sometimes display incorrect data
- Optimized lighting at airports that improved performance
- Improved stability issues with HDR luminance
- Fixed an issue where lighting on 3rd party aircraft carriers would not display
- Fixed an issue where clouds and weather would not appear on first flight loads
- Fixed an issue with shadows being cast on objects that were set to be invisible
- Fixed an issue where the shadowing of the sun and moon was broken at dawn or dusk
- Added visibility support for cloud reflections
- Fixed an issue where landing lights could draw behind clouds
- Fixed an issue where airports below sea level could have their clouds appear black
- Fixed an issue with light scaling at high zoom levels
- Made PreFS9 AI aircraft now cast shadows as model type

Radar

- Fixed an issue where Air to Ground radar's cursor would not correlate exactly with the radar image
- Fixed radar issues relating to target range and zoom level precision
- Fixed an issue where airport surfaces and runways would show up bright on the radar

User Interface and Controls

- Fixed an issue where when resetting the flight, locked spot cameras could appear to be much closer to the user vehicle
- Consolidated temporary files in the User AppData that is deleted on shutdown and startup
- Fixed an issue where loading Prepar3D with a controller connected would reset saved views
- Fixed an issue where joystick control and button assignments would not register properly
- Fixed an issue where double-clicking an airport from the Select Airport screen would not work consistently
- Fixed an issue where drop down menus did not always appear while spanning across multiple monitors
- Fixed an issue where control setting changes would not be saved when changing modes, such as entering multiplayer
- Fixed an issue where labels would pop when new objects were created
- Fixed an issue where if Prepar3D was set to full-screen, the window would span across all available monitors upon restart

- Fixed an issue where searching in the Select Vehicle screen would not display all available options

Multiplayer

- Enhanced functionality of shared cockpit
- Improved overall functionality and capability of the multiplayer UI
- Added functionality to allow checkpoints during multiplayer missions. Users will be able to select roles at a checkpoint and load in a synchronized state
- Renamed Scoring Categories to Entity List since it now holds additional multiplayer player names and container titles
- Fixed an issue with switching roles or vehicles in multiplayer sessions
- Fixed an issue with multiplayer panel serialization
- Fixed an issue where missions were not being cleared when selecting Free Flight mode
- Removed duplicate data that displayed in the multiplayer UI
- Fixed an issue where multiplayer incorrectly swapped SimObjects of different categories
- Fixed an issue where default fake airport objects would cause a crash during multiplayer sessions

Professional Plus Weapons Capabilities

- Fixed an issue where the time on rail property is not respected when a missile was guided
- Fixed an issue where buildings and trees were unable to be targeted via mouse clicks
- Improved performance issues with the first weapon hit
- Fixed an issue where weapons hitting auto generated buildings do not trigger a hit effect
- Fixed an issue where the positioning of weapons would be incorrect when the aircraft loaded
- Fixed an issue where weapons would not fire when first loading a mission
- Fixed an issue that would not allow weapons to fire immediately after reloading
- Fixed simulation variable issues

Flight Recording and Playback

- Fixed an issue where "Reset Weapons" did not work correctly in the flight recorder
- Fixed an audio issue with engine sounds during playback
- Improved speed and functionality of the load recording screen
- Improved overall performance with playing back multiple AI objects
- Improved flight segment recording and playback performance
- Fixed an issue where the time preview window would not automatically close when starting a new recording

SimDirector

- Updated general SimDirector UI with new options and appearance
- Overall performance improvements when loading large missions
- Several improvements and enhancements to object interaction in the mission visualization window
- Added capability to tab through mission objects, scenario file editor, catalog, and visualization
- Added extra validation capability to improve mission creation experience
- Added capability to save and load missions in all three SimDirector modes
- Added a prompt that asks to save before exiting
- Added the ability to create focal points on 2D panels
- Improved zooming capability while using the Mission Visualization window
- Fixed an issue where play animation actions would not work with Mobile Scenery objects
- Fixed an issue where recording a new flight segment while in SimDirector would continue to record while you exit SimDirector
- Enabled the settings menu during Flight Instructor Mode that allows you to enable and disable failures while recording flight segments
- Allowed the start and end times for flight recordings to be automatically set when

a (Flight Segment Recording) FSR is selected
- Fixed an issue where AirplanePlaybackAI would not be resumed when saving during flight recording playback
- Fixed an issue with renaming Virtual Instruction sessions
- Fixed an issue where the conditional logic operator could change when switching modes
- Fixed an issue where actions were being bidirectionally referenced and added a validation warning to help further clarify this issue
- Added capability to reorder references in any object reference list
- Fixed an issue with the main Prepar3D window resizing incorrectly when exiting SimDirector
- Fixed an issue with the simulation rate slider not being in sync with the simulation
- Fixed an issue where some invalid property data would save in your mission if changed in SimDirector
- Improved Flight Recording graph capabilities and performance
- Fixed an issue with setting the pitch, bank, and heading of objects
- Added sorting to the comprehensive failures list in a FailureAction
- Improved performance with loading a large amount of Flight Recordings and Flight Segments
- Fixed an issue with centering after adding and removing mission objects
- Added extra editing options for recording options in Virtual Instructor
- Added abilities to enable and disable focal point and view change properties
- Added a mission state status in the status bar
- Updated the reset mission option to include drop down to select which kind of reset the user wants
- Updated logical conditions to ensure correct windows are enabled and disabled at the correct points
- Added a settings file to the SimDirector options file
- Added specific settings to ensure Virtual Instructor options persist
- Added the zoombox as default when entering Mission Visualization
- Fixed errors in controls, mouse clicks, and scroll wheel
- Fixed maximization issues upon startup
- Fixed OnScreenText position offsetting error
- Fixed an issue where creating a new scenario while in a mission does not reset the mission state
- Fixed several mouse scroll and dragging issues

SDK and SimConnect Updates

- Fixed flickering issues when changing weather through SimConnect, most noticeable when using 3rd party weather add-ons
- Fixed an issue with the METAR string of temperature without altitude not setting correctly
- Fixed an issue with the SimConnect_ChangeVehicleWithExternalSim that prevented legacy ExternalSim simulations from working

Resolved the Following Crashes that Could Occur

- Fixed a crash when entering SimDirector when a Flight Segment is playing in Prepar3D
- Fixed a crash that occurred in SimDirector when deleting objects with the same name
- Fixed a crash in SimDirector that would occur when un-grouping a large number of objects
- Fixed a crash in SimDirector with ViewChangeAction on exit
- Fixed a crash that would happen when using a vehicle that implements HelicopterAIService

Learning Center Documentation Updates and Additions

- Added extra documentation relating to Air Traffic Control
- Updated and improved SimDirector tutorial documentation
- Fixed attachments.cfg in the Learning Center

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Requested Features and Enhancements Implemented in Prepar3D v2.2

At a very high level, the Prepar3D v2.2 update has the following updates and addresses the following issues:

- Autogen out of memory crashes
- The inclusion of the v2.1 panels 'hotfix' that reverted changes to the ContentErrorLogging system that caused previously compatible aircraft to not work
- New cloud shadows feature as well as several new shadow system optimizations
- A new sample for the Prepar3D Development Kit (PDK) API - Oculus Rift integration
- Native radar support for Prepar3D developers
- A redesign and refactor of the legacy Flight Recorder system
- A new FlightInstructor mode for SimDirector, as well as several other SimDirector enhancements
- Several other community and developer issues resolved

Autogen Re-Architecture

The instancing system for trees was given a massive overhaul to improve memory usage, to increase performance, and to reduce stutters. The system (VAS) memory footprint per tree was reduced from 276 bytes to 16 bytes (that is a 17x reduction in system memory per tree). Some of the work previously done each frame was completely eliminated while other work was reduced or moved onto background threads and the GPU (graphics card). Visually, trees can now LOD (Level of Detail) in progressively while still scaling in to prevent popping. Random rotation of trees was also fixed, which means that trees will be more varied looking and will again load in at the full density near the camera. A max autogen default flight has had it's system memory reduced by over 550 megabytes!

Cloud Shadows and Shadow System Improvements

The biggest challenge we faced in shadow mapping the clouds is similar to the challenges we face with ground shadows. It stems from Prepar3D having very large viewing distances and the requirement to cover that view distance with enough shadow map texture coverage. It becomes a balancing act of performance and memory sacrifices to achieve acceptable visual fidelity. One big challenge of clouds in particular is clouds were not created with shadow mapping in mind and they rely on being blended into the image without writing depth. However, most modern shadow mapping techniques rely on the depth information to resolve if an object at a given depth is in shadow or not inside the pixel shader. These techniques require bounding volumes to be created around shadow receivers that project the range of these depth values between zero and one in DirectX applications. This could not be done easily for clouds, due to optimizations that are being done for the ground shadows bounding volumes, without losing quality on the ground shadows. So we're required to use a multiple channel resource to determine things like the depth and alpha of the current cloud per pixel inside the bounding volumes. We've found ways of reducing ground shadow only memory and having cloud shadows on will be equivalent memory usage to before v2.2. Cloud shadows do come with increased GPU work, which comes from having to render the clouds into multiple shadow maps and evaluating that information per pixel for the scene. Because of this, cloud shadows may cause a FPS hit on lower end graphics cards, which may already be pixel shader bound, but should

perform well on most modern graphics cards.

See the Lighting Settings page for more information about cloud shadows and how to enable them.

A New Recording and Playback System

The new recording and playback system was developed around the idea of giving instructors, developers, and users the power to record and playback data that is relevant to their training scenario. The goal was to convert the traditional flight recorder into a tool that could be used as an after action review of training scenarios. With that goal in mind, the flight recorder was overhauled and updated. It is now a full simulation recorder. The new system will record and playback more capabilities and interactions; no longer is it just the user's flight position. For instance, the new record and playback system has support for mission features, air traffic, boats, ground vehicles, weather, weapons, and a swath of other simulation capabilities. The user will be able to specify what simulation variables, along with what gauge variables, to record and playback. A new playback control window has been developed that displays relevant recording information. It allows users to play/pause, change simulation speed, and select bookmarks. Bookmarks are a completely new feature that allows seeking to a specific location of a recording. They can be inserted in recordings by creating checkpoints (AutoSaving) in missions.

See the Simulation Recording and Playback section for more information about the new Simulation Recorder.

Oculus Rift Development Kit Integration SDK Code Sample

Prepar3D v2 introduced a very powerful interface for developers, the Prepar3D Development Kit (PDK) API. The Prepar3D Development Kit (PDK) API is a service provider for obtaining services to the Prepar3D platform. The PDK functions similarly to SimConnect but is tied into Prepar3D at a lower level, which allows better performance and more direct interaction. Unlike SimConnect, there is not a network interface for PDK plug-ins as they must be developed as in-process dlls. Data can be injected into and received from the simulation by interfacing with a user-written .dll. Uses for the PDK include creating custom SimObjects, adding custom textures and post-processes, and modifying cameras. We have added a new sample to the SDK to show the power of the new PDK API by integrating Oculus Rift support through the new PDK. This example and code sample is available in the v2.2 SDK and allows those users with Oculus Rift Development Kits to use them with Prepar3D v2.2.

Native Radar Support for Content Developers

Prepar3D now provides an air-to-ground radar simulation and visualization. Because every radar system is different, it is provided as a highly configurable service which can be controlled via C++ plug-ins and XML gauges. Some examples of controllable parameters are Range, Sweep Angle, Sweep Rate, Zoom Level, Image, and Data resolution. Some of the advanced capabilities of the Prepar3D radar include accurate radar shadows, far-shore-enhancement, and Doppler-beam-sharpening. Also, we developed the radar service entirely through our SDK to showcase the power and flexibility that 3rd party developers have when developing content specifically for Prepar3D v2.

See the Radar Simulation and Visualization Service page for more information.

A New FlightInstructor Mode for SimDirector

With the SimDirector mission creation tool introduced in Prepar3D v2, instructors and trainees both could rapidly create rich training content faster than ever in Prepar3D. The virtual instructor modes allowed the creation of in-cockpit learning and training scenarios, but it was hard to create graded maneuvers and graded flight segments. SimDirector's new FlightInstructor mode now makes it easier than ever to rapidly create graded flight segments, so that instructors and trainees can create, grade, and debrief flight segments and flying maneuvers in real-time. If you haven't looked into the extremely powerful, yet easy to use, SimDirector mission planning tool in Prepar3D v2 yet, access SimDirector from your Flights menu to see what you've

been missing out on. SimDirector is included in every copy of Prepar3D v2.

Other issues resolved:

- Resolved an issue where force feedback joysticks would not continue to rumble after an initial vehicle crash
- Resolved a backwards compatibility issue where DTX 5 vegetation would flicker in several Orbx add-ons
- Resolved a backwards compatibility issue with the airport lighting in Aerosoft airport add-ons
- Resolved an issue where aircraft labels were not being drawn at the distance that was expected
- Resolved an issue where ground visibility was limited to 50 miles
- Resolved a crash where constantly spamming the pause and unpause in certain add-on aircraft could crash the Prepar3D sound system
- Resolved an issue where AI aircraft could swap texture sets
- Resolved an issue certain stock airports were not rendering their taxiways
- Resolved an issue where the modeling tools would not respond to EventID and CallbackJumpDragging tags
- Threaded out several jobs to help prevent stutters in rendering the autogen systems
- Resolved an issue where trees would render in and out with the camera rotating
- Resolved a legacy issue with setting brake SimVars via SimConnect would not work as documented
- Resolved an issue where render to texture views were not scaling correctly in 2D panels
- Resolved an issue where IR views showed the sun as large squares
- Disabled AA on clouds, particles and faded edges
- Added additional sliders to the lighting settings page to independently control terrain and shadow draw distances

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Requested Features and Enhancements Implemented in Prepar3D 2.1

After receiving great feedback from our user community, we have implemented new application enhancements and made a large numbers fixes to improve the stability and usability of Prepar3D v2.

Rendering, Performance, Backwards Compatibility, Weather and Clouds

Rendering Features Added

- DirectX® 10 fallback hardware support for displaylink and other monitors
- Dynamic shadows now can be enabled to render when you do not have tessellation (GPU Terrain) enabled
- Further optimizations and enhancements to prevent microstutters that were reported
- Further optimizations to the autogen and terrain paging system

Rendering/Performance Issues Resolved

- Lessened the specular shine on terrain to help alleviate anti-aliasing on runways, roads and terrain
- Fixed an issue where the HDR lighting feature could get into bad rendered states with extreme darkness
- Lightened star and other reflections at night
- Fixed an issue where Effect EffectParams didn't turn off lights or effects
- Fixed an issue where airport light beacons cast shadows
- Fixed an issue where cloud and fog visibility was rendered at about half of what was set
- Fixed an issue where terrain lighting and shadows could be in wrong direction
- Fixed an issue where windsocks did not visibly change at all, always pointed North
- Fixed a rendering issue where a white square was visible around the moon
- Fixed an issue where boat wakes were not being rendered on certain AMD graphics cards
- Fixed an issue where clouds could be seen through the horizon through thick fog
- Fixed an issue where a black screen could occur with HDR Lighting feature enabled
- Fixed an issue where a black screen could occur going in and out of fullscreen
- Fixed a rendering issue where progressive taxi arrows were not rendering
- Fixed a rendering issue where emissive objects were fogging inappropriately leaving artifacts on the sun and moon
- Fixed an issue where the new dynamic shadows did not respect tiled textures
- Fixed a large performance loss when main Prepar3D window did not have primary focus
- Fixed a large performance loss when moving panel(s) to a second monitor
- Resolved a few memory fragmentation issues

Additional Backwards Compatibility Features Implemented

- Resolved a rendering issue where white boxes could be seen around Orbx FTX Global lights during the daytime
- Resolved an issue where the Orbx FTX Global lights were not rendering along roads
- Resolved an issue where Orbx FTX Global lights cast shadows
- Resolved several legacy night apron/taxiway/runway approach lighting issues
- Resolved an issue where custom photosceneries weren't blending well with

shorelines
- Resolved an issue where light cone effects were rotating incorrectly about the z-axis
- Resolved an issue where shadows and batches were rendering off on zero altitude batches

Weather and Cloud Issues Resolved

- Fixed an issue where weather and cloud coverage issues with 7/8 in the UI not applying
- Fixed an issue where cumulus type clouds received NO cloud bottoms from the cumulus01 bitmap
- Fixed an issue where stratus and other clouds render at incorrect heights than what was set via the UI or SimConnect
- Fixed an issue where only one texture from each cloud group was being used
- Fixed an issue where during any WeatherSetObservation from SimConnect there was a "zero" altitude wind layer inserted at 75°C
- Fixed an issue where in the basic weather UI, setting wind speed to none did not clear wind speed
- Fixed an issue where rain and snow effects did not render across entire widescreen or multiple views
- Fixed an issue where rain and snow effects did not render when moving locations within the same airport
- Fixed an issue where temperature changes worked differently when set the same from SimConnect vs the in-simulation UI for non-GLOB observations

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Controls

Additional Default Controller Profiles Added:

- Saitek X52
- Saitek X52 Pro
- Saitek Rudder Pedals
- Saitek Cessna Rudder Pedals
- Saitek Combat Rudder Pedals
- Saitek Pro Flight TPM System
- Saitek Pro Flight Cessna Yoke
- Saitek Pro Flight Cessna Trim Wheel
- Saitek Pro Flight Yoke
- ThrustMaster T.160000M
- ThrustMaster T.Flight Stick X
- ThrustMaster T.Flight Hotas X
- ThrustMaster Joystick - HOTAS Warthog
- ThrustMaster Throttle - HOTAS Warthog
- Redbird JAY Rudder Pedals
- Wireless Controller (Playstation 4 Controller)

Controls Issues Resolved

- Fixed an issue where joysticks could disconnect mid-flight on Windows 8
- Fixed an issue where flights started with full throttle regardless of the vehicle's throttle position
- Fixed an issue where SimDirector control settings were not importing/exporting from the user interface
- Fixed an issue where joysticks remapped for iSimObjects but the keyboard did not
- Fixed an issue where imported control setting profiles got merged with existing settings instead of overwriting them

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SimConnect and Software Development Kit (SDK)

Added Features

- Added additional getters for new methods to the camera system

Bugs Resolved

- Fixed an issue that prevented the included ExternalSim sample from working
- Fixed an issue where the included Cabdir tool in the SDK was not working

Documentation Updates

- The PDK Rendering documentation was overhauled and several examples were added
- The SimDirector documentation was overhauled and several examples were added
- Fixed an issue where ISimObjectAttachments.h was left out of the SDK
- Made several clarifications to the weather documentation that was causing confusion
- The Weapons documentation was clarified and updated and the weapons and targetting gauge was included as an SDK sample

SimConnect Issues Resolved

- Fixed an issue where SimConnect value "ELECTRICAL MASTER BATTERY" cannot be written
- Fixed an issue where SimConnect FlightLoad was not working with .fxml files

Professional Plus Bugs Resolved and Documentation Added

- Resolved a crash when setting Health Points with an Int datatype
- Fixed an issue where SimConnect exceptions where thrown when removing an AI Weapon entity
- Fixed several rendering issues where attached weapons could render behind aircraft
- The weapons documentation was clarified and updated
- Include weapons and target gauge as an SDK sample

Updates to Included Air Vehicles

IRIS F-22

- Internal stores added to the visual model. (AIM-9X, AIM-120C, GBU-31 and GBU-39)
- Left and Right AIM-9 bays coded to be independent of each other. Now work on Exit 3 and 4
- Right Afterburner flame effect now independent of the left afterburner
- Elevator effectiveness reduced for more stable pitch authority
- Roll effectiveness reduced for more stable roll authority
- Increased airspeed overstress value to more realistic values
- Various internal code changes made to on-board systems
- Updated various audio elements

Dino Cattaneo F-35A

- More responsive auto-pilot
- New effects
- New, more-detailed pilot
- New textures
- Addition of a 2-D panel

Additional Features, Crashes and Issues Resolved

Installer Optimizations

- Resolved an issue where the installer would report that it could not write value to complete to key

Added Features

- Reverse order of sorting on favorite and date/time on load flight screen
- Scenario startup screen enhancements

Resolved Crashes Within Prepar3D

- Resolved the reported 'Pure Virtual Function Call' crash with AI traffic enabled

- Fixed several issues where the scenery library could be causing crashes
- Fixed several instances where the flight planner was causing hard crashes
- Fixed a crash caused by sending incorrect object names through SimConnect
- Fixed a crash caused by running Prepar3D.exe with the -cfgdir command line option
- Fixed a crash where add-on aircraft with incorrect LUA code could cause a crash in select vehicle screen
- Fixed a crash where virtual cockpit mip/mapping could cause crashes with vehicles that cannot re-initialize their gauges

Miscellaneous Issues Resolved

- Fixed an issue where instruments could disappear when using multiple monitors
- Resolved an issue where boat pitch could be rendered incorrectly
- Resolved an issue where planes could bounce on runways
- Resolved a memory leak with aircraft sounds not being freed if no sound devices are present
- Resolved an issue where the Scenery Library allowed for duplicate folder entries
- Resolved an issue where the Scenery Library had un-removable required=false scenery.cfg entries
- Resolved UI rendering spacing and visibility issues in the fuel and payload UI screen
- Resolved UI rendering spacing and visibility issues in the Facility UI screen
- Resolved an issue where some graphic settings were not getting written out to profiles
- Resolved an issue where sound settings and devices selected did not save out to profiles
- Resolved an issue where users could not hear DME (morse) ident sounds
- Resolved and issue where weapon cameras would not go to static when the weapon detonates on impact
- Resolved several texture.cfg spacing issues in included aircraft
- Resolved an issue where clickspots in Virtual Cockpits weren't working
- Resolved an issue where under bathymetry dynamic water a user could switch from sub to aircraft and could end up in an infinite crash loop
- Fixed a growing memory leak entering and exiting UI screens

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PREPAR3D®
WHAT'S NEW IN RELEASE 2.0

Requested Features and Enhancements Implemented in Prepar3D 2.0

Prepar3D v2.0 brings many exciting updates to the Prepar3D simulation platform

- A new DirectX® 11 rendering engine
- SimDirector - a brand new, modern training scenario generation tool suite
- The introduction of a new Professional Plus version of Prepar3D for advanced training
- Updates to the digital rights management and licensing process
- User interface updates, as well as many other exciting updates to the core platform
- An updated SDK including many requested features and a new iSimObject API that allows developers full control over their SimObjects
- Known issues resolved list

Rendering and Performance Improvements

The core rendering system in Prepar3D has been completely overhauled and updated from DirectX 9 to DirectX 11. Prepar3D is now able to better take advantage of modern graphics hardware. This has two main benefits to the user, increased performance and control over what is displayed, as well as the ability to have modern rendering features added to the rendering engine.

Performance Improvements

Object Instancing

- Instancing allows the rendering system to have graphics cards draw multiple copies of the same entity just once. This greatly improves autogen building and tree performance.

GPU Particle and Effect System

- Effects are now simulated through the new GPU (graphics card) particle system
- Training scenarios with much more effects rendered on the scene are now possible

Tessellated Terrain on the Graphics Card

- The previous work being done to generate terrain mesh is now done on the graphics card.
- Fully dynamic night and day light cycles
  - Terrain lighting is now able to be done dynamically on the card, whereas previous shadows and lighting had to be baked into the textures and reloaded when time changed
- Terrain paging performance greatly improved
  - Trainees in fast flight scenarios will see

their terrain paged in much quicker as it is being done on the graphics card

Multi-Threading Support

- Visual scene and rendering optimizations are now be done on background threads
- Shader compilation is now threaded out which greatly reduces stuttering effects that some users had with previous versions
- Resources are now able to be shared between views
  - A single update can be shared across virtual cockpit views greatly increasing performance with multiple views open
  - Round world coordinate conversion now able to be done on the GPU

Visual Rendering Engine Improvements

Prepar3D Now Has an Updated Real-Time Shadow System

- Fully dynamic variance cascaded shadow maps
- Supporting an unlimited number of objects receiving and casting shadows inside shadow range
- Full support for object self-occlusion, including virtual cockpit self-shadowing
- Terrain able to receive and cast shadows in real-time
- Soft shadows support through separable blur pass filters
- Day and night cycle support within the shadow system
- Weather support (lightning able to affect shadows)

A Modernized Lighting System

- Through tone mapping, views are now able simulate the effect of your eyes adjusting to the brightness of a scene
- Improved simulation of night visibility
- Bloom lighting effects greatly improved

A Vibrant New 3D Living Water Surface

- Dynamic 3D waves and water surface based on weather conditions and wind speed
- Water lighting and shading improved for greater realism

Volumetric Fog and Cloud and Weather Improvements

- The appearance of flying through fog and clouds has been greatly improved
- Light is now simulated as it passes through visibility and cloud layers defined in the Prepar3D weather system

Specular Lighting Terrain Support Enabled

- Land classes now have specular values that will affect how they reflect light (for example, snow and roads now reflect light differently, snow is shinier, etc.)

Improved control over anti-aliasing up to 8x MSAA and FXAA support

Global anisotropic filtering support up to 16x

A Modernized Full-Screen Mode

Fullscreen mode is now non-exclusive

- The mode switch is much faster
- Windows can span more than one monitor in full-screen mode
- Plug-ins can create their own windows
- Bringing up the kneeboard or ATC windows won't cause delays in fullscreen mode as they used to

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Prepar3D Professional Plus for Advanced Training

In addition to the academic and professional licenses of Prepar3D, a new Professional Plus license has been released to support advanced training. Professional Plus brings an extensible weapons training capability, as well as Learning Management System interfaces.
A fully-configurable, dynamic weapons system has been added to Prepar3D to allow our military-focused customers the ability to develop training using Prepar3D. Support for targeting, bombs, missiles, guns, and countermeasures are included, as are examples to show you how to implement features in your training.

Generic and Extensible Weapon System Functionality

- Add weapons features to existing vehicles or build features into newly developed vehicles
- Weapons can be generic or implemented through the new SimObject API
- Targeting can be accomplished programmatically or through mouse-clicking
- Attached objects dynamically influence the owner object until release
- Dynamic scoring and object health system implemented
  - Including damage to objects in the area surrounding a point of weapon impact
- Weapon Control system implemented
  - Includes aiming, safety enable/disable, and weapon select added
  - Supports Manual and Automatic Aiming/Targeting

Two new SimObject types have been implemented

Weapon SimObjects: Projectiles, Missiles, Bombs, etc.

- Configurable Propulsion and Aerodynamics xml files to quickly develop and configure created weapons
- Easily attachable to parent SimObjects through xml
- Externally to a modeled pylon or right to the vehicle model
- Internally to a modeled weapons bay

Countermeasure SimObjects

- System implemented for measures or actions taken to counter or offset another one (i.e. chaff and flare)
- Countermeasures affect weapon targeting

Guns

- Manual and Automatic Turret aiming
- Configurable Ballistics Tables for customization of ballistic characteristics
- Configurable impact effects based on impacted object type

Included Weapons Gauge Sample

- Example Gauge interface to weapons, guns and countermeasures
- All Weapons controls integrated into gauge
- Populate and display nearest targets
- Show weapon configuration for specific SimObject (station and load out information)

AI Behaviors Added

- Attacker
- Combat Air Patrol
- Combat Air Support
- Pursue
- Search and Track
- Wingman Formation Flight

Learning Management System Tools

- Implemented interface for launching flights
- Created services for Flight/Lesson Status

Updates to the Digital Rights Management and Licensing process

The Prepar3D licensing and digital rights management (DRM) has been updated to allow users greater control over their licenses and to make the process easier for users to uninstall and reinstall or change their computer hardware.

New digital rights management (DRM/licensing) control:

- Automatic license deactivation during uninstall. Allows users to uninstall Prepar3D and transfer the license to another computer without having to contact technical support
- Increased hardware modification leniency allows users to modify their hardware without always triggering a need for reactivation
- Licensing interface clarifications to better describe activation options

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User Interface Updates

We have received a lot of feedback on the user interface of Prepar3D and have made many changes to improve the layout, the functionality, and the look and feel of how you configure Prepar3D.

- A startup screen option has been introduced that allows trainees to pick initial conditions and graphical profile settings
- The graphical user interface design has been refreshed for version 2.0
- The default graphical setting profiles have been removed, and users now have the ability to configure and name their own custom graphical setting profiles
- A new Quick Time menu option that lets the trainee dynamically change the time of day of their training
- The select vehicle screen has been

redesigned with a 3D preview, a new way to browse, and the ability to add favorites
- The load and save flight screens have been redesigned to make it much easier to organize large collections of flights
- Controls Settings Interface Update
  - Added a search capability to quickly find relevant controls
  - Added sorting for SimObject Events
  - Added sorting for Weapon Events

Additional General Updates to the Platform

- Added the ability for customers to customize the menu and context menu items that trainees see and are able to access by allowing them to remove menu options via a config file or the command line
- Added a new pause mode "Host Freeze" where only the position of the ownship is frozen
- Added a new pause mode "Entities Freeze" where the position of all entities in the simulation are frozen
- Consolidated the in-app Learning Center and the SDK Learning Center into a more friendly windows help format
- Scenario File (.flt) is replaced with an XML wrapped version (.FXML) to support great flexibility and customization
- An error is now displayed to the user when their dll.xml is corrupt and cannot be loaded

Across the board updates to the windows and panels system

- Users can now create and customize cameras at run time through a dedicated user interface
- The Virtual Cockpit can now be made transparent
- Cameras can now pan to defined points of interest
- Per-view Render able Object Filtering has been added so users can filter out what should be and shouldn't be drawn in specific views
- Field of View settings for Cameras have been added and can be configured in the camera.cfg entries
- Camera definition options in the camera.cfg have been streamlined
- Custom post-process effects can now be added to windows and chained together via the Camera.cfg or at runtime

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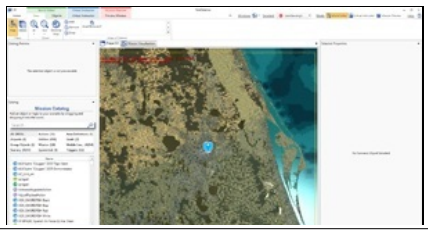
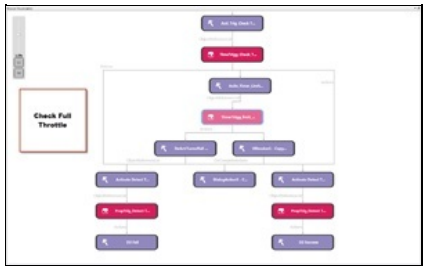
SimDirector: Mission Creation Tool Suite



A new set of tools was required for the rapid creation of training scenarios. SimDirector eclipses the legacy Object Placement Tool and adds drag-and-drop support and a new virtual instructor for more dynamic delivery of training

feedback to trainees using Prepar3D.



General Information

- A WYSIWG Modernized User Interface
  - Ribbon Interface for tool organization
  - Dock-able Framework to enable a user customizable workspace
  - Objects and actions and triggers are able to be dragged and dropped into the world
- Dynamic Mission Validation Provides Feedback as Missions are Created
- Areas of Interest support for quick navigation of the Prepar3D world
- Object Transform Gizmos for translation, rotation, and scaling of Mission Objects
- Snap to selected object button to enable quick object editing

Mission Object and Logic Property Editing

- Attributes including description and location
- Mission Object and Logic references are easily accessible and updated

Mission Object List Interface

- Separate Lists for Library and Mission Objects
- Expandable Tree view based on object type for quick navigation through lists
- Text based filtering based on Object Title
- Object placement using Drag-and-Drop (with drag gable previews)
- Preview object in thumbnail so reviewing objects is accessible

Two Separate Views for editing the world

Map View

- Mouse wheel zoom and pan for effortless world navigation
- Icons for mission objects when zoomed out

Object view

- 3D view of placed Objects

Waypoint Editor Interface

- Dynamically create multiple Waypoint Lists
- Create waypoints by clicking on Map view or from user interface
- Waypoint connectivity visualized for manageable list editing
- Waypoints are draggable for effortless list creation
- Move Waypoints from one list to another
- Easily assign Waypoint lists to AI Objects

Two Separate Modes for Mission Creation

World Editor Mode: Object Placement and Interaction

- Allows for free movement around the world detached from own ship

Preview Mode: Preview Mission and use the Virtual Instructor

- Dynamically change simulation speed

- Pause AI Objects during Mission Preview
- Monitor simulation variables to support debugging missions

Mission Step Recorder

- Configurable recording of flight and user inputs
- Converts user inputs (discrete and continuous) to Mission Steps

Mission Environment Editing enabled from within SimDirector

- Own ship
- Location
- Weather (User-defined or theme)
- Time and Season

Software Development Kit (SDK) Enhancements for Developers

The Prepar3D software development kit (SDK) has been greatly enhanced for v2.0. A new iSimObject API has been created to allow developers full control over the SimObject implementations. Several enhancements have also been made to the modeling tools, the gauges and panels system, as well as requested additions from our developer network and forum users to the SimConnect interface.

General Updates

- Streamlined the SDK content and examples to make it easier to find relevant information
- External SimObjects can now participate in ATC

SimObject API Implementation

- Create a simulation object (SimObject) complete with customized behaviors, input properties (also referred to as events or triggers), and state properties (also referred to as simvars or simply properties)
- Custom events created for your simobject implementation can be configured for joystick, keyboard, and mouse use
- Samples and Prototypes Included in the SDK
  - SimpleCar: Basic SimObject implementation
  - Car: Medium Complexity SimObject implementation
  - SimpleAirplane: Flight Dynamics Example
  - Professional Plus Specific Samples:
    - Countermeasure: Countermeasure Object implementation
    - Missile: Missile Object implementation
    - WheeledTank: SimObject with weapons

SimConnect interface enhancements

- Added METAR readable parameters to SimConnect weather requests
  - Added -RA, RA, +RA, -SN, SN, +SN, TS, TSRA, +TSRA, -FZRA, FZRA, +FZRA to METAR output that will readable be between winds and clouds data
- Added additional interfaces to read
  - Aircraft carrier properties
  - Scenery Complexity slider settings
  - Shadow settings
  - The actual eyeposition in LLA PBH
  - Joystick controller enable/disable functionality to SimConnect
  - Prepar3D version and license type information
- SimConnect can interface with camera views and can now move, size, undock, dock, zoom, rotate, open, close, change and update the FOV.

Gauges and Panel SDK updates

- XML gauges can now draw curved paths
- LUA scripting can now be used for Gauges and Panels
- Added the ability to create custom Render Textures and Post Processing for Windows and Cameras.
  - Plug-ins can define a texture and render into it using D3D11
  - Plug-ins can apply custom D3D11 Rendering to the output of a view
  - Custom post process can be defined via XML and XLSL without requiring a plug-in
- Added Render To Texture Gauge type and Removed DirectX 9 C gauges. (Replaced by Render To Texture Gauges)
- Added Prepar3D Development Kit (PDK) interface for window and camera control.
  - Window Control: Open, Close, Resize, Move, etc.
  - Camera Control: Position, Orientation, Field of View, etc.

Modeling SDK Updates

- Modeling tools updated to include 64-bit support
- 3D Studio Max 2012 and 2014 modeling tools support
- XtoMDL tool updated to allow more than 65,000 polygons

RadarSignatures can now be used as an object filter for gauges

- XML Gauge Maps: ObjectDetailLayerVehicles - 0x10 = Vehicles with a Radar Signature
- ITrafficInfo:Filter - TRAFFIC_FILTER_RADAR_SIGNATURE =

128 (Takes precedence over all other filters)

Field of View (FOV) can now be defined in the Camera.cfg

Terrain Import Tutorial Added

Known Issues Resolved

The Prepar3D development team constantly monitors the support forums for improvements to the platform, as well as leveraged feedback from the Prepar3D developer network. The issues below were brought up by various developers or forum members.

- The ATC and other windows now allow keyboard controls to be passed through to the simulation
- Fixed a bug where terrain was reloaded when you changed graphical settings that did not need a terrain reload
- Fixed a user-reported issue where the ATIS frequency and Tower Frequency were conflicting for AYPY
- Multiple Issues with the Flight Planner Have Been Resolved:
  - The Flight Plan Default title now populates and saves correctly
  - Flight Plans saved from a legacy application without titles now show in the Prepar3D Flight Planner
- Fixed an issue where many joysticks would have their throttle mapped to an incorrect axis by default
- Fixed an issue where the SimConnect variable SIMCONNECT_GROUND_INFO_LATLON_FORMAT_METERS returned the lat value in radians instead of the correct value of meters
- Fixed an issue where planes with multiple engines weren't having their flight hours saved in the log book
- Fixed an issue where the Scenery Library could crash if the scenery.cfg file had a "Required=" entry
- Fixed an issue where the Kneeboard and ATC window could render with an incorrect orientation if a monitor had its screen orientation rotated in Windows
- The phrase "Free Flight" has been removed or clarified in all documentation
- UISettings.xml has been moved to *%APPDATA%\Lockheed Martin\Prepar3D v2*
- Fixed an issue where the ShowUserLabel flag in the Prepar3D.CFG file was not getting properly saved
- Aprons and Taxiways will now respect the drawSurface flag to disable their rendering in the simulation if specified by a scenery developer
- Fixed an issue where there was a 4x rotational limit enforced even when a user selected a runtime sim rate greater than 4x
- Fixed an issue where the multiplayer port range would change back to 6112-6122 when changed to be outside of that range
- Fixed an issue where you could be sent to the wrong StartPoint from the SelectAirport screen
- Fixed an issue where IFROnly was not getting properly saved to the Prepar3D.cfg

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PREPAR3D®

WHAT'S NEW IN RELEASE 1.4

After receiving great feedback from our SW Forum users, we have implemented new application enhancements and made a large numbers fixes to improve stability and usability of Prepar3D.

Requested Features and Enhancements Implemented in Prepar3D 1.4

New Simulator Enhancements

- AMD EyeFinity Gold Certified - The simulation will now start with WideViewAspect enabled on EyeFinity-supported resolutions
- Windows and panels are now saved and loaded from multiplayer and multichannel scenario files like they are in Singleplayer flights
- Panel-only camera views now save and load from scenario files in single and multiplayer/multichannel flights

Performance Improvements

- Fixed several issues that caused stutters or performance issues in certain cases
- Bathymetry is now disabled by default in all performance profiles

User Interface Updates

- All user interface windows and dialogs now remember their last known position and what screen they were last on (see Learning Center User Interface Configuration section for details)
- Apply button has been removed from the user interface, and the accept and cancel button locations have been swapped
- Time of Day and Season are now accurately updated based on user input updates
- Advanced weather now accurately updates the simulation based on user input
- The flight map now saves all visual settings last set by the user
- Observer Management user interface refined and streamlined

Content Updates

Standard Vehicle Library Content Updates

- Mooney Acclaim M20TS provided courtesy of Lionheart Creations Ltd.
- IRIS T-6/A Texan II provided courtesy of IRIS Flight Simulation Software

Scenery Content Updates

- Fort Rucker Scenery Expansion - Three new airports with custom scenery objects on top of over 5km of aerial imagery including custom autogen tree placement.
- New Airports (Heliports) - KHEY (Hanchey Army Heliport), KFHK (Knox Army Heliport), and HEY (Hanchey Auxillary)
- Airport KOZR (Cairns Army Airfield) Updates - All new layout of buildings, taxiways, runways and airport objects to match 2010 aerial imagery, color corrected and blended to match the surrounding terrain.
- Fixed dozens of other legacy scenery and database issues in the existing scenery database as reported by our forum users

SimConnect and Software Development Kit (SDK) Enhancements for Developers

- Updated the Camera Configuration SDK adding a LinkGroup parameter to allow linked camera views to move concurrently with a single input correctly
- Engine sounds are now supported with ExternalSim implementations
- Reverted the fs9gps.cab file back to its previous version, and renamed the new GPS with SIDS/STARS support to p3dgps.cab

- Added functionality to support changing of a camera's colorization/sensor mode and updated the CockpitCamera SDK sample to show this capability.

Known Issues Resolved

- Snow and other mainly white textures will now properly render at their correct colors
- ShowATCText in the Prepar3D.CFG file now properly toggles the ATC text
- Fixed an issue where certain 3rd party aircraft had their mouse-picking disabled if water reflections were enabled
- Fixed an issue where SimObject context menu IDs were not being recycled, which could cause menu.dll crashes in certain long-distance or heavy traffic flights
- Fixed an issue where in some cases if you had bathymetry unchecked, the reflection slider could be disabled
- Fixed an issue where in some cases the menu system instrument panel labels would have incorrect names
- Fixed an issue where render-to-texture views created via the SDK could cause menu crashes in certain cases
- Fixed an issue where in certain flights users could receive a g3d.dll crash with 3rd party add-on scenery
- Reintroduced scenario file documentation in the Learning Center.
- Several Learning Center articles were clarified

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PREPAR3D®

WHAT'S NEW IN RELEASE 1.3

After receiving great feedback from our SW Forum users, we have implemented new application enhancements and made fixes to improve stability and usability of Prepar3D.

Requested Features and Enhancements Implemented in Prepar3D 1.3

New Simulator Enhancements

- ExternalSim based SimObjects can now participate in Air Traffic Control distributed simulation/multiplayer sessions
- The simulation can now play sound when it does not have focus in Windows
  - Accessible via a checkbox in the 'Options - Settings - Sound' menu (**Note:** a simulator restart is required for a change to take effect)
  - Or as the 'MUTE_ON_LOST_FOCUS' entry in the Prepar3D.CFG file
  - The Prepar3D Learning Center sound article has been updated with details on this change
- Used distributed simulation/multiplayer mission roles will now be recycled
  - If a player leaves the distributed simulation session their role will be recycled back to available so that the player can re-join or a new player can take their role
- Ground Vehicles can now support left and right wheel animations
- Custom weather themes are now supported and will be loaded into the simulation
  - The Prepar3D Learning Center weather themes article has been updated with details on this new feature

Performance Improvements

- Default performance configurations have been updated to reflect new updates to the user interface and performance profiles

User Interface Updates

- Two additional levels of detail (LOD) are now available for the Terrain LOD Radius slider
  - Very Large (5.5) and Extremely Large (6.5) are now available options
- The existing 'WideViewAspect' configuration setting in the Prepar3D.CFG file for wide screen monitors is now accessible via a checkbox in the 'Options-Settings-Display' user interface
- Simple and advanced control settings sections have been redesigned and simplified in the 'Options-Settings-Controls' user interface
- Air Traffic Control (ATC) window is now resizable
- Minimum sizes have been enforced when resizing the multiplayer chat, ATC and learning center windows
- Modeless windows now return the focus back to the main application when closed
- The "minutes until session starts" notice in multiplayer exercises can be expanded up to 100 minutes
- Tooltips have been added to the multiplayer user interface to give more detail on available settings

Content Updates

- Updated airport geometry, taxiways and aprons for
  - Langley Air Force Base (KLFI)

    - Orlando Executive Airport (KORL)
    - Eglin Air Force Base (KVPS)

SimConnect and Software Development Kit (SDK) Enhancements for Developers

- The first pass of a Content Error Reporting System is complete
    - More details are available in the SDK about to how enable with the ContentErrorLogging flag in your Prepar3D.CFG file
    - Asserts caused by content in the simulation will now be logged for developers to reference and fix
- SimStart and SimStop now function correctly

Known Issues Resolved

- Autogen and new season textures are now fully loaded after a change during runtime
- Time of day, season and weather information are now set, saved and loaded from FLT files
- Fixed an issue with the menu system not properly shutting down on exit with additional third party menu add-ons installed
- Several controls settings that were not being saved are now being saved
- Two controllers of the same type and name are now supported and can now be used in Prepar3D (including XBOX 360 controllers)
- 'CTRL-SHIFT-?' now loads the Prepar3D Learning Center
- Fixed several errors that would prevent multiplayer client missions from being loaded
- Fixed a program crash on exit if a user deletes their AppData and ProgramData directories

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WHAT'S NEW IN RELEASE 1.2

The Prepar3D team has worked to extend the core capabilities of Microsoft® ESP™ and continue to add new features and functions that make the new platform a front runner in the modeling and simulation marketspace. Release 1.2 improves on the solid foundation of Release 1.1 in many new and exciting ways:

Requested Features and Enhancements Implemented in Prepar3D 1.2

Full Windows 7 Support

- User interface redesign
  - New interface and extended multiplayer experience
  - Observer view camera management redesigned and expanded
  - Save flight user interface redesigned
  - Alert system and progress dialogs redesigned for continuity
  - End flight interface redesigned and clarification added

Performance Improvements

- Rendering pipeline performance improvements show a marked performance improvement in all cases
- Enhancements to water detail effects and rendering settings
  - Water effects settings are now divided into two sliders, Reflection Detail and Refraction Detail, which are clearly labeled
  - The Low, Med, High names have been replaced with text describing what scene elements are rendered at each setting
  - The water clarity slider controls the transparency of the water surface
  - Learning center article expanded upon to further explain details of each setting

Multichannel Capability Extended

- Expanded field of views able to support up to a 360 degree field of view
- Documentation and samples expanded in the Learning Center and further examples added to the Software Development Kit

Learning Center Documentation Enhanced

- Additional examples for new multichannel 360 degree field of view support
- Additional articles added including navigation section and glossary
- Multiplayer learning center article expanded for new features

Additional Aircraft Added to Standard Vehicle Set

- Beechcraft Baron 58
- Beechcraft King Air 350

Multiplayer Experience Redesigned and Improved

- Redesigned, streamlined multiplayer user interface
  - All multiplayer screens have been redesigned including the mission resolution and racing results windows
- Multiplayer simplified and streamlined for the end training user
- Connect to IP now works on a global scale
- Several improvements to the internal voice communication system
  - Removed local echo
  - No longer sends communication data packets when no one is talking
  - Able to select a sound device other than your default system sound device for multiplayer voice communication

- Submersible and other SimObject categories are now supported by multiplayer
- Multiplayer chat redesigned and able to be maximized and resized
- Other miscellaneous multiplayer updates
  - When ending your multiplayer session you are no longer placed back to your simulator's default flight
  - Add-on scenery is now an allowable option in multiplayer sessions
  - Tower controls now have access to the map feature
  - The 'Join Aircraft' button now swaps to 'Leave Aircraft' when joining a shared aircraft
  - If the map is chosen to be disabled, users can now not access it via the map button on certain aircraft panels

Other New Features in v1.2

- Users can specify where flight plans are saved and loaded from
- Enhancements to the Submersible SimObject Class
  - Animations and lighting support added to submersibles
  - Proper lighting at depth
  - Submersibles are properly rendered on the ground
- Observer view system enhancements
  - User interface redesigned for clarity and ease of use
  - Observer views can be easily configured with sensor and color views
- Users are prompted when they attempt to load an incomplete or incorrect mission file that does not load correctly
- Users can sort the columns of data in the Select Airport user interface
- Tail number, call sign and flight number can be set on an aircraft's 'View details' screen
- Underwater scenery is now visible from above water if appropriate detail settings are selected
- Menu system font has been changed for increased visibility and readability
- The scenery library dialog now defaults to a user's Prepar3D installation directory, not the desktop
  - The 'Use Directly' and 'Cache Scenery' radio buttons have been further explained with tooltip text

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PREPAR3D®

WHAT'S NEW IN RELEASE 1.1

The Prepar3D team has worked to extend the core capabilities of Microsoft® ESP™ and continue to add new features and functions that make the new platform a front runner in the modeling and simulation marketspace. Release 1.1 improves on the solid foundation of Release 1.0 in many new and exciting ways:

Requested Features and Enhancements Implemented in Prepar3D 1.1

- Multi-Touch support added
- New functionality to save and load custom control configurations
- Updated sensor view integration, examples and documentation - access the sensor views 'out of the box'
- Multichannel instructions and examples expanded upon
- Ability to control observer views through SimConnect
- Custom window placements across multiple monitors are saved

Performance Improvements Across the Simulation

- More efficient handling of Bathymetry
- Optimizations for running with Bathymetry disabled
- Upgraded rain/snow shaders to 3.0
- Upgraded default aircraft shaders to 3.0
- Default system performance configuration has been updated

Additions to Standard Vehicle Set

Legacy Lockheed Aircraft Courtesy of JustFlight Inc

- Lockheed P-38 Lightning
- Lockheed C-69 Constellation "Connie"

New GPS Gauge Enhancements

Enhancements made to Allow FAA Qualification

- GPS welcome/verification page
- Support for SIDs (Standard Instrument Departures) and STARs (Standard Arrivals)
- XML format defined for SIDs and STARs
- Added synchronization of CDI scale with analogue instruments

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What's New in Prepar3D™ 1.0

Highlights of the Prepar3D extension of, and enhancements to, the core capabilities of Microsoft® ESP™ include:

New User Interface

Customizable and More Rich User Experience

- Drag n' Drop
- Customized Data – save your favorites
- Save and quickly retrieve your aircraft, your missions, your pilot records
- Upgraded Learning Center – Create and edit your own articles for reference inside the simulation

Expanded Hardware Controls

32 Axes and 128 Buttons per Joystick

- Upgraded to DirectInput8
- Fully Supports Needs of All Vehicle Operators

Dynamic Underwater World

Dynamic Water Surface

- Train on or under the water surface
- Transparency - see through the water surface
- Water fog

Added Global Bathymetry

- Coastal Relief Model for Continental U.S.
- Selected deep-ocean sites
- Learn more...

Expanded Camera Control System

Free Roaming Camera Viewer

- Create, delete, save camera viewpoints
- Attach a camera to an existing object or a new location

Upgraded Landclass

10 Million Updated 1km Tiles

- 3 million tiles upgraded from urban/farms to higher density
- 7 million tiles upgraded from vegetation to more accurately reflect the human footprint in the real world

High-Resolution World Data

Norfolk, Virginia
Content Based on 12cm Real World Photography

- 1488 real-world buildings
- 3 seasons (summer, fall, winter)
- Day and night

Added Multichannel Capability

Wider Field of View for Your Training Needs

- Configurable up to 100 channels
- Freedom to choose different

Perspective Image Correction

Blend Multiple Projectors into a Single View
Prepar3D Supports Two Industry Leaders Out of the Box:

geometric displays
- Ready for COTS perspective correction software
- EasyBlend™ from Scalable Display Technologies
- OmniMap™ from The Elumenati

Upgraded Panels and Gauges System

C++ Gauges now support DirectX

- Embed hardware accelerated 3D Graphics into gauge displays
- Unprecedented freedom to design complex gauges while maximizing performance

Sensor Capability

Configure Your Vehicle with a Sensor View

- Design sensor views into cockpit gauges
- Static Infra Red model
- Gray scale and Green scale colorizer views

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PREPAR3D

Activate Prepar3D

After you have installed Prepar3D, you are required to activate the Prepar3D product the first time you run the application. There are three ways to activate your copy of Prepar3D:

- Activate Online (Recommended)
- Activate from Another Computer
- Activate by Email

When starting Prepar3D for the first time, you will be prompted with an **Activate** or **Purchase** dialog. If you have not purchased a copy of Prepar3D you can visit the web site (http://www.prepar3d.com) or choose the **Purchase** option.
If you have already purchased Prepar3D, and you have a License ID and Activation Password, you can select **Activate**, which will display the activation options:

1. Activate Online (Recommended)
2. Activate from Another Computer

After selecting one of the activation options, proceed with the corresponding section.
If it is ever necessary to open the activation dialog window again, simply hold down the **Shift** key when starting Prepar3D. This will allow you to reactivate with a different License ID or activate using a different method.
Your License ID and Activation Password can be found in your invoice, which was displayed and emailed to you after purchase. **Please be aware that those values are different than your Prepar3D.com login credentials.**

Activate Online (Recommended)

This is the recommended way to activate Prepar3D. It is the fastest activation option and it will allow you to deactivate/reactivate your license.

1. Enter your **License ID** and **Activation Password**.
2. Follow the on-screen prompts and you will have successfully activated your copy of Prepar3D.

If you have activated your license following this method, you are able to deactivate and reactivate your license on another computer. To deactivate your license, simply uninstall Prepar3D using the standard Windows **Programs and Features** manager. Your license will be reset once the uninstall process is complete. This will allow you to activate Prepar3D on another computer without contacting licensing support.

Activate from Another Computer

If you have installed your software on a computer without an internet connection you may activate by using a second computer that has an internet connection. This method will result in an instant activation and does not require contacting support. Activating using this method will not allow you to deactivate/reactivate and is only recommended when it is not possible to connect the installation computer to the internet.

1. Enter your **License ID** and **Activation Password**.
2. Click **Save Request...**.
3. Select a path to save the offline activation file. You should save this file to a USB drive or any removable media device. Once the file is saved, take it to a computer with an internet connection and double-click the file. Your browser will open to the offline activation page.
4. If prompted to download an ActiveX control. Click the **Download** button.
5. Click the **Download** button to save the **Response** to your Manual Request.
6. Save the **response.xml** to your USB drive or removable media device. Take the saved .xml file back to the original computer that does not have the internet connection.
7. On the installation computer, if Prepar3D was closed, restart Prepar3D. Agree to the prompts to enter the license information in their registry. Once the information is in the registry, you may start the application, which will detect the new license and automatically activate.

Activate by Email

If you have installed your software on a computer without an internet connection you may activate by emailing licensing support. Activating using this method will not allow you to deactivate/reactivate and is only recommended when it is not possible to connect the installation computer to the internet. There will be a delay in the response from licensing support. If instant activation is required on a computer without an internet connection, the Activate from Another Computer option is recommended over this option.

1. From the **Activation Options** screen, select **contact licensing**.
2. Follow the instructions on the **Activate By Email** prompt.
3. After you receive back **Activation Codes**, enter them in the **Activation Code** boxes. Click **Activate** and you will have successfully activated your copy of Prepar3D.

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PREPAR3D

Getting Help

Basic Information

Supported Operating Systems

Prepar3D v5 is currently supported on Windows 10.

The default installation directories for Prepar3D and the location of the registry key entries are:

- **Install Location:** C:\Program Files\Lockheed Martin\Prepar3D v5\
- **Registry Location:** HKEY_LOCAL_MACHINE\SOFTWARE\Lockheed Martin\Prepar3D v5

Computer System Requirements
You can find the system requirements for all versions of Prepar3D at http://www.prepar3d.com/system_requirements

RELATED LINKS

- What is Prepar3D?
- Where to Receive the Latest Information
- Where to Ask Your Question
- What to Do on Your Own
- Troubleshooting Video Card Support
- Uninstall and Reinstall

Where to Receive the Latest Information

Prepar3D Website
On the Prepar3D website (http://www.prepar3d.com/), you can find out about the latest information related to Prepar3D.
- You can Read the latest news
- You can Read Release Notes
- You can Receive Software Updates
- You can Download Free Software

Where to Ask Your Question

Prepar3D FAQ
Our frequently asked questions page (http://www.prepar3d.com/frequently-asked-questions) may answer your questions. Be sure to look there for answers first.

Prepar3D Support Forum
In our forum, your question will be posted publicly, allowing community experts to help you solve your problem.
- You can find the Prepar3D forums at http://www.prepar3d.com/forum-5/.
- Many questions have already been answered on our forum. If you can't find an answer to your problem, please post it on our forum, so others in the community can help you.

What to Do on Your Own

Update Drivers
Drivers are small software programs that allow your operating system to communicate with the hardware in your computer. Beyond acting as a translator, a driver can also enhance the operation of a particular piece of hardware, such as a video card or a sound card. A damaged or outdated video or audio driver can cause program errors. The manufacturer of your video or audio devices may offer free driver updates on their Web site.

Disable Program Conflicts
When starting Microsoft Windows by using a normal startup, several applications and services start automatically, and then run in the background. These programs include basic system processes, antivirus software, system utility applications, and other software that has been previously installed. These applications and services can cause interference when you install or run a program, such as Lockheed Martin Prepar3D. Consequently, you may receive an error message, or Prepar3D may stop responding.

Performing a Clean Boot
A computer can be set up to perform a clean boot, which prevents other programs from starting automatically.
Note: To complete this procedure, you must be logged on as an administrator or as a member of the Administrators group.

To perform a clean boot on Windows 7:

Step 1: Start the System Configuration Utility

1. Click **Start**, type **msconfig** in the **Start Search** box, and then press **ENTER**
   If you are prompted for an administrator password or for a confirmation, type the password, or provide confirmation.

Step 2: Configure Selective Startup options

1. In the **System Configuration Utility** dialog box, click the **General** tab, and then click **Selective Startup**.

2. Click to clear the **Load Startup Items** check box.
3. Click the **Services** tab.
4. Click to select the **Hide All Microsoft Services** check box.
5. Click **Disable All**, and then click **OK**.
6. When you are prompted, click **Restart** to restart the computer.

Notes: To return your computer to a Normal startup mode, follow these steps:

1. Click **Start** in the **Start Search** box.
2. Type **msconfig**, and then press ENTER.
   If you are prompted for an administrator password or for a confirmation, type the password, or provide confirmation.
3. On the **General** tab, click **Normal Startup - load all device drivers and services**, and then click **OK**.
4. When you are prompted, click **Restart**.

Troubleshooting Video Card Support

Prepar3D v5 includes limited down-level DirectX 12 support for DirectX 11 and DirectX 11.1 level hardware provided the GPU has DirectX 12 drivers and supports Tier 2 resource binding. When rendering on down-level hardware, some features may not work. Prepar3D does not officially support any specific down-level device or drivers because it has not been tested thoroughly on legacy hardware. As such, driver or hardware issues may cause Prepar3D to become unstable or even crash when rendering on down-level hardware. If that happens try the following steps:

- Only run 2D panel views on down-level devices
- If the problem persists, don't place any Prepar3D application windows on the down-level device
- If problem still persist, uninstall the down-level device.

If a down-level hardware warning is displayed but the device in question is a DirectX 12 device with 12.0 feature level Tier 2 resource binding support:

- There may be an issue with the device drivers. Try installing the latest graphics drivers.
- If the problem persists, the Prepar3D installation may have been corrupted. Try uninstalling and reinstalling Prepar3D with any virus scanners disabled.

If the device name in the warning does not look correct:

- There may be a driver or power-profile setting that is forcing Prepar3D to run on integrated graphics rather than a high-performance graphics processor. Most laptops and many desktops have integrated graphics support provided by the motherboard or processor. Changing the graphics profile options or disabling the embedded video device should clear up this issue.
- The primary graphics driver may be overridden by drivers for USB monitors such as DisplayLink. These displays generally do not support DirectX 11 and may not work with Prepar3D. Try unplugging and uninstalling the monitor drivers if this problem continues.

Current Workarounds for Known Issues

Configuring Multiple Windows Using Multiplayer Mode

Users using Prepar3D Multiplayer modes with multiple displays, windows, or monitors utilizing the "Main Panel" will need to configure the "panel.cfg" file for aircraft they wish to use in the simulation. Other panels and gauges will load and configure correctly from a scenario file, but users wishing to specially place the "Main Panel" will need to create a copy of the Main Panel window with a different identity due to the Multiplayer loading process. Simply create a new [WindowXX] attribute in the panel.cfg file, where XX is the next number in the panel sequence, and copy over all attributes for the main panel for use in the Multiplayer mode view scenario file. For instance, the Mooney Bravo G1000 panel.cfg file entry for:

```
[Window00]
file_1024=mooney_g1000_background.bmp
file_1024_night=mooney_g1000_background_night.bmp
size_mm=1024
position=7
visible=1
no_luminous=1
ident=MAIN_PANEL
[...]
window_size=1.000,1.000
```

Gets copied following the last [Window09] attribute entry and becomes (setting visible=0 as to not be displayed by default):

```
[Window10]
file_1024=mooney_g1000_background.bmp
file_1024_night=mooney_g1000_background_night.bmp
size_mm=1024
position=7
visible=0
no_luminous=1
ident=COPY_OF_MAIN_PANEL
[...]
window_size=1.000,1.000
```

In addition, a new line for the [Window titles] attribute should be added to read something like:

```
Window10=Copy of Main Panel
```

New views should then be created using the new [Window] instead of the Main Panel directly. Users wishing to have windowed Main Panel functionality in a non-default location while in Multiplayer Mode should use this process in all scenario files from that point on.

Uninstall and Reinstall

If the guidance above has not resolved the problem, it could be that files have been inadvertently corrupted after the Prepar3D installation process. Uninstalling Prepar3D, performing a clean boot of your computer and then reinstall Prepar3D may correct the issue.

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PREPAR3D

Backwards Compatibility

Legacy Content

RELATED LINKS

- Getting Help
- Glossary

Legacy content is any content that was made for a version of Prepar3D older than the current version.
The Prepar3D development team has partnered with many developers to ensure that most legacy content is backwards compatible. There are many different ways to build and create add-on content, so there are possibilities that some content might not be fully backwards compatible with the most current version of Prepar3D. Your best bet, as always, is to check with the developer of that add-on content to confirm compatibility. Also, it is your responsibility to ensure that the license of the add-on is authorized for use in Prepar3D.

Multiple Prepar3D versions (v1, v2, v3, v4, v5) can be installed on the same machine because they are all separate products. When a new version is released, most users will purchase the new version and install it alongside the previous one. This way, they can copy third party add-ons easily and make sure that the latest version of Prepar3D will work on their system.

Using an older Prepar3D release is one way that you can continue to use your legacy content if it is not compatible with current version of Prepar3D.

Some third party add-ons from older versions of Prepar3D may be compatible with the latest version. You may need to install an older version of SimConnect for some add-ons.

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PREPAR3D

Advanced Configuration

CONTENTS

- Prepar3D.cfg
- Advanced Tuning Options
- Display
- Terrain
- Graphics
- JobScheduler
- AContain
- Main
- NavigationVisuals
- UserInterface

Prepar3D.cfg

The Prepar3D.cfg configuration file stores simulation and graphics options. If you are an advanced user and feel comfortable editing it directly, you can open the Prepar3D.cfg with any text editor. Typically, all tuning should be done through the **Options** user interface.

How to Make Changes to your Prepar3D.cfg Configuration File

1. Locate the **Prepar3D.cfg** file in **%APPDATA%\Lockheed Martin\Prepar3D v5**
2. Create a backup of the original **Prepar3D.cfg** to restore if issues occur
3. Right click file and click **Open**, **Edit**, or if prompted choose **Notepad** or another text editor
4. Add the below text into the specific sections to make the desired change
5. Save the newly updated Prepar3D.cfg and restart Prepar3D

Advanced Tuning Options

The following entries are not written into the Prepar3D config by default, but may allow users to fine tune performance for specific training goals. Typically, users should not need to modify any configuration values for a stable and performant simulation experience, but the following tweaks may help advanced users optimize further. Headings are enclosed in brackets and the entries are bolded followed by *Performance Tuning Tips* with the intended purpose of the fix.

[DISPLAY]

TextureMaxLoad=6

Non-Default entry. This entry will not exist in your Prepar3D.cfg file by default and must be added to the file.
Performance Tuning Tip:
This can induce stutters. Use multiples of 3 **only** such as 3, 6, 9, etc. This is perfect for photorealistic scenery.

[TERRAIN]

SWAP_WAIT_TIMEOUT=30

Non-Default entry. This entry will not exist in your Prepar3D.cfg file by default and must be added to the file.
Performance Tuning Tip:
This variable is the number of frames that the terrain engine will wait for terrain textures to be loaded into video memory before forcing new tiles of terrain triangles to be rendered.

UseGlobalTerrainView=True

The default value is False.
Performance Tuning Tip:
By default, every camera has its own terrain view which requests texture and DEM tiles near the camera to ensure that all cameras get a quality view of terrain. It is possible for cameras to share data and avoid the extra work required to manage multiple terrain views. For multi-view scenarios in which all views are near each other, it may be desirable to have views simply render the terrain tiles loaded by the default view. Setting this option to True will prevent all cameras from creating a terrain view except for the default 3D view. This can help avoid texture flashing and terrain spikes that occur on some systems with multiple views and/or multiple video cards. This value can be overridden by the UseGlobalTerrainView entry in a given CameraDefinition allowing each camera to determine whether or not to create a terrain view.

LegacyAutogenScaling=False

Non-Default entry. This entry will not exist in your Prepar3D.cfg file by default and must be added to the file.
Reverts autogen building scaling to 4 meters per floor for all autogen building types. Scaling now uses 3.1 meters per floor for small buildings and 3.9 meters per floor for medium and large buildings including warehouses.

[GRAPHICS]

MAX_TEXTURE_REQUEST_DISTANCE = 1000

This setting can be used to change the distance that is used to request textures of aircrafts and library objects that are not visible. This prevents the objects from rendering with a black texture when looking at it after it has been out of view for a certain amount of time. The larger the distance the more graphics memory that is

required.

[JOBSCHEDULER]

AffinityMask=14

Non-Default entry. This entry will not exist in your Prepar3D.cfg file by default and must be added to the file.
Performance Tuning Tip:
By default, Prepar3D will use all available processor cores. On machines with four or more cores, it will dedicate a core to rendering tasks. The easiest method for modifying the affinity mask is to open the windows calculator in programmer view, select the binary display mode, and flip the bits in the binary number displayed to select which cores the application should run on. Note that the cores are represented right to left.

[PANELS]

PANELS_ALWAYS_ON_TOP = 1

Docked panel windows will always display above docked windows with 3D views. Setting this setting will enable the same functionality with undocked windows. This is especially useful in full-screen mode, where undocking panels and placing them above an undocked 3D view may be desirable. Note that as of Prepar3D v4, panel views can now be docked into any floating window.

PANEL_UPDATE_MODE = 2

This setting controls panel update frequency.

- 0) Prepar3D will use a default value.
- 1) Panel update every 18hz which could be more than once per frame if the framerate drops below 18.
- 2) Panels update on the 18hz event chain, but will never update more than once a frame.
- 3) Panels update every frame. (Professional Plus Only) Note that some content and features may be tuned to an 18hz panel update.

[ACONTAIN]

UserObjectRibbonColor= 0,FFFF0000,1,FFFF8000, ...

This setting can be used to further customize ribbon navigation visuals by allowing unique ribbon colors per association ID. This setting can be applied to the following entries: ShowRibbonUserObject, ShowRibbonUserAvatar, ShowRibbonAircraft, ShowRibbonGroundVehicles, ShowRibbonBoats, ShowRibbonAvatars, ShowRibbonWeapons, and ShowRibbonCountermeasures.
The formatting for this setting is a comma delimited list of assocation IDs with their corresponding heximdecimal color, i.e. "AssociationID1, Color1, AssociationID2, Color2, etc"
Note: The Navigation Visuals UI allows custimization of ribbon colors as well and will apply these to all association IDs unless this configuration entry is specified. This UI screen will show colors for association ID 0 if this entry is used.

[MAIN]

FIBER_FRAME_TIME_FRACTION=0.33

Non-Default entry. This entry will not exist in your Prepar3D.cfg file by default and must be added to the file.
Performance Tuning Tip:
This setting, which defaults to a value of .33 (33%), defines the percentage of each frame that is devoted to loading scenery. Increasing this number can reduce "the blurries", but it can cause stutters, and can also reduce the overall frame rate. Try reducing the number to the lowest level where you still get smooth scenery paging. This will vary depending on disk speed as well as the type of flying, as well as the selected scenery options.

[NAVIGATIONVISUALS]

GroupIconVisuals=1

Non-Default entry. This entry will not exist in your Prepar3D.cfg file by default and must be added to the file.
This setting will cause vehicles of the same type to only display one icon when close together instead of individual icons over each vehicle. By default this is disabled.

[USERINTERFACE]

UIHardwareAcceleration=True

This entry will toggle UI hardware acceleration on and off. This is enabled by default. Disabling UI hardware acceleration may adversely affect performance in some cases therefore keeping this enabled is recommended. Some third party applications, particularly ones that overlay graphics on top of the application window, may exhibit visual issues with this enabled.

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PREPAR3D

Scenario

Overview

Technically speaking, a scenario in the simulator is "a saved starting environment." Once saved, scenarios can be loaded again and again, starting with exactly the same scenario each time. This saves time that would have been spent manually configuring the vehicle and world conditions. Scenarios can start on the ground, at an airport, or in the air. Saved parameters include, but are not limited to:

- Aircraft
- Aircraft position
- Flight plan
- Positions of controls and instruments
- Time and season
- Weather conditions
- Panel and Gauge window positions and sizes

Scenarios can be categorized into two types:

- **Unstructured Scenarios:** includes saved starting environment but does not contain any dynamic scenario objects or file resources.
- **Structured Scenarios:** includes not only saved starting environment but also dynamic scenario objects in addition to potential file resources. These scenarios are created with Prepar3D's scenario creation tool, SimDirector, and are built to give the user a compelling experience. These experiences can be as diverse as demonstrating or completing a startup procedure, narrating an automatically controlled flight, or even engaging the user in the midst of a tactical situation such as a battle space or vehicle malfunction.

Creating Scenarios

Via Scenario Setup

The **Scenario Setup** screen allows the user to select the following, all from the convenience of one screen:

- Vehicle
- Location
- Weather
- Date and Time

This screen is available:

- When the application launches, if the **Show at Startup** option on the screen is checked
- By using the menu to click the **Scenario** menu item followed by the **Create...** menu item.

Via User Setup

An alternative to using the **Scenario Setup** screen is to use the various screens in the application to set the scenario conditions exactly as desired (e.g. on final approach to O'Hare with a challenging crosswind).

Saving Scenarios

1. Either:
   - Use the menu to click the **Scenario** menu item followed by the **Save....** menu item.
   - Use the keyboard shortcut: **;** (SEMICOLON)
2. Enter a name and description for the scenario.
3. You may optionally check the **Set as Default** checkbox to set this scenario as your default scenario when you launch Prepar3D.
4. You may optionally check the **Set as Favorite** checkbox to set this scenario as one of your favorites to make it easier to find later.
5. You may optionally assign favorites and the default scenario in the list on the lower half of the screen.
   - Changes to your favorites will be saved as changes are made.
   - Changes to the default scenario will only be retained when the **OK** button is pressed.
6. If you would prefer to **overwrite** an existing scenario, select it from the list of saved scenarios on the lower half of the screen.
7. Click **OK**.

The scenario can now be loaded from the **Load...** menu item contained in the **Scenario** menu item.

Checkpoints

Checkpoints are scenario save points that are created automatically at scenario runtime. Using checkpoints, the user can jump back to previous times in a scenario.

Checkpoints are saved in the order that they occur. Loading a checkpoint in a scenario will invalidate and remove any future checkpoints that occurred during a previous scenario run. Checkpoints are included in a scenario using SimDirector to add Create Checkpoint Actions.

Loading Scenarios

With just a few clicks of the mouse, you can enter any of the scenarios you've created.

To load a scenario

1. From **Scenarios** menu, click **Load...**.
2. Click on a scenario from the list.
   - All user saved scenarios will be in the **My Saved Scenarios** category.
   - Default scenarios and add-on scenarios will appear in other categories
3. You may optionally assign favorites in the list.
   - Changes to your favorites will be saved as changes are made.
   - Changes to the default scenario will only be retained when the **OK** button is pressed.
4. Click **OK**.

Scenario Briefings

Structured Scenarios may contain a briefing before the scenario loads to acquaint the user with the situation and objectives. The briefing screen is typically are divided into three sections, displayed on a tabbed page:

- The **Overview** describes the Scenario setting, what your role is, and in general what to expect along the way.
- The **Details** describe the route of flight, which maps to use, and communications options if any.
- The **Route** described the flight is marked on a map and if required, instrument charts are included.

To load a checkpoint

1. From **Scenario** menu, click **Load...**.
2. Click on a scenario from the list that has checkpoints.
   - The icon in the Checkpoints column will be highlighted for a scenario with checkpoints.
3. Click **OK**.
4. On the Load Checkpoints screen, select a checkpoint from the list.
   - The **Scenario Start** checkpoint will load the initial scenario and delete all checkpoints.
5. Click **OK**.

Deleting Scenarios

1. From **Scenario** menu, click **Load...**.
2. Select a Scenario from the list
3. Click on the Trash Can Icon. A prompt will appear asking you to confirm deletion of the Scenario.
   NOTE: Deleted scenarios will be sent to the **Recycle Bin** and can be recovered if deleted accidentally.

Ending Scenarios

1. From **Scenario** menu, click **End Scenario...**.
2. Choose from the options in the list.

Scenario Settings

You can change many settings in Prepar3D, such as realism, weather, and aircraft, to suit your flying preferences. The settings in each Scenario, however, are set specifically for that Scenario. Some in-game menus are disabled in Scenarios and the settings on those menus cannot be changed unless the scenario allows for these changes. For instance, disallowing slew mode or vehicle changing may be set so that the user does not unfairly complete the scenario.

Tips for Flying Scenarios

There are certain things to which you should pay attention in Scenarios and some tools to use to help you complete the Scenario successfully.

Scenario Audio

Don't assume that the narration or chatter in Scenarios is there just to fill empty space. Listen carefully to Scenario audio for information you may need to complete the Scenario successfully.

The Scenario Compass

The Scenario Compass appears in the upper left corner of the simulator screen during Scenarios. The Compass points to the next Scenario waypoint, providing distance to the waypoint and the elevation of the waypoint. You can cycle through waypoints by pressing **K**.

The Scenario Pointer

The Scenario Pointer is a circle and a string of arrows standing directly over the next Scenario waypoint. You can see the Pointer from many miles away and flying toward it will take you directly to the waypoint.

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PREPAR3D

Vehicles

Overview

Vehicles in Prepar3D are simulated objects and include not only aircrafts, but rotorcrafts, submersibles, ground vehicles, and more. Vehicles, because they're simulated, are often called **SimObjects** and can be controlled by the user or by an artificial entity.

Selecting a Vehicle

To select a new vehicle or change your current avatar, view the Vehicle and Avatar Selection article.

Using the Vehicle

To get started with using vehicles that are aircrafts, visit the following articles:

- Cockpit Basics
- Controlling the Engine
- Fueling and Loading Aircraft
- Setting Failures
- Using Autopilot
- Using the Kneeboard
- Using the Radios

As always, check the user manual of the vehicle to learn operating characteristics and procedures. For vehicles included in Prepar3D that are published by our featured developers, the corresponding user manuals can be found in the Prepar3D installation directory in the **Ecosystem** folder.

Acquiring Vehicles

To acquire new vehicles for Prepar3D, download add-ons from one of Featured Developers.

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PREPAR3D

Vehicle and Avatar Selection

You can filter the **Select Vehicle** browser to limit the selection choices. Use the filters at the top of the **Select Vehicle** dialog box. The display window will show your available vehicles in alphabetical order.

Manufacturer: Limit the list to only manufacturer properties of the installed vehicles.
Publisher: Limit the list to only vehicles published by a particular publisher.
Type: Limit the list to a type like Single-engine Prop, Helicopter, or Commercial Airliner.

Selecting a vehicle

1. On the **Vehicle** menu, choose **Select**.
2. Select a vehicle from the browser.
3. To read more about the selected vehicle, click **View Details**.
4. Press **OK**

Additional details of the selected vehicle are also shown on this screen. Details displayed include the type, manufacturer, description, as well as performance capabilities.From here, you can set the Air Traffic Control information for your vehicle. **Tail Number**, **Flight Number**, **Airline Call Sign**, as well as an option to **Append Heavy to Call Sign** and the option to **Show Tail Number** are all able to be set. If you'd like your Tail Number to be displayed on supporting vehicle, be sure to have **Show Tail Number** checked.

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PREPAR3D

Avatar Mode

General description of several Avatar Mode topics

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Overview

Avatar mode gives the user the ability to attach and detach from other objects during the simulation. Once detached, the user will be able to walk around the world as an avatar.

Attach/Detach

In order to attach or detach, the vehicle must first be stopped and on the ground. By default, the keyboard shortcut to attach/detatch is **Ctrl+Shift+E**. Once detached, the user can then attach back to their previous vehicle or attach to a completely different vehicle. Avatars can only attach to user selectable objects, which may also include traffic as well as scenario objects. See also Notes on User Selectable Vehicles. ISimObject developers can override this behavior by implementing the IAvatarAttachService.

Controls

The avatar SimObject has a unique control scheme compared to other objects. The avatar has the ability to switch between a first person and a third person control scheme. The control scheme is determined by the currently active view. Cockpit and Virtual Cockpit views will default to the first person control scheme, where as other views will default to the third person control scheme. Users can then override the control scheme by setting the AvatarMode section of the CameraDefinition. For more information, visit the Camera Configuration article.

Multiplayer

Avatar attachment and detachment is also available in multiplayer. Avatars will only be able to attach to other objects if the host allows the sharing of vehicles. In order to attach to another player's vehicle, that person must also allow sharing as well as avatar attachment. The attachment of non-player vehicles is currently disabled in multiplayer (i.e. traffic or scenario objects). For more information on these settings, visit the Multiplayer Sharing an Aircraft article.

SimDirector

Scenario developers will have the ability to create structured scenarios with user's avatar in either an attached or detached state. The avatar can also be referenced by scenario objects similar to the user ownship. If detached, the avatar and user ownship are able to be placed independent of one another. The avatar is also able to be used as an AI object. For more information, visit the Object Reference and SimDirector articles.

Developers

The following articles will provide developers with information on creating or configuring an avatar SimObject or ISimObject:

- Modeling:
  - Bipeds
- SimObject:
  - Simulation Object Configuration Files
  - SimObject API References

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PREPAR3D

Cockpit Basics

A general tour of the instruments, buttons, and levers in your airplane

Airplanes have evolved from relatively simple to incredibly complex machines. In the cockpit, for instance, most modern airplanes share six basic cockpit instruments: airspeed indicator, altimeter, attitude indicator, heading indicator (directional gyro), turn coordinator, and vertical speed indicator. Learning to use these six instruments and a few common controls, such as trim and flaps, will put you far down the runway toward flying any aircraft you wish.

Pitot Static Instruments

Three of the six primary flight instruments measure air pressure. These instruments—the altimeter, airspeed indicator, and vertical speed indicator—are called the pitot static instruments.
All three pitot static instruments are connected to a static port called the pitot tube. This port, or intake, introduces outside air into the case of each instrument. As an airplane climbs or descends, air pressure decreases or increases. The altimeter and vertical speed indicator display these pressure changes as altitude and rate of climb or descent.
The airspeed indicator, which is also connected to the pitot tube, measures the difference between static pressure and ram air pressure. Ram air pressure is the air pressure created when outside air enters the pitot tube. As the airplane flies faster, outside air is forced into the pitot tube more rapidly, increasing the ram air pressure. The airspeed indicator displays the pressure difference between static pressure and ram pressure as airspeed, usually in knots or Mach number.

Gyroscopic Instruments

Three of the six primary flight instruments use gyroscopes to provide pilots with critical flight information about the airplane's attitude, heading, and rate of turn.

Rigidity in Space and Precession

Gyroscopes work like spinning tops. They have two properties—rigidity in space and precession—that make them useful in flight instruments. See sidebar: Gyroscopic Properties.
The attitude indicator and heading indicator are based on a gyro's rigidity in space. Because a gyro resists being tipped over, it can provide a stable reference to the real horizon or to a specific direction.
The turn coordinator uses precession to display information about the direction and rate of turn. (For more information on precession, see the Gyroscopic Properties sidebar.)

Gyro Power

In most light airplanes, an engine-driven vacuum pump spins the gyros in the attitude indicator and the heading indicator. To provide a backup if the vacuum fails, the turn coordinator usually has a gyro spun by an electric motor.

Airspeed Indicator

The airspeed indicator is a differential pressure gauge. It measures the difference between the air pressure in the pitot tube and the static, relatively undisturbed air surrounding the airplane. A needle displays this difference as airspeed.

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- Pitot Static Instruments
- Gyroscopic Instruments
- Airspeed Indicator
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- Altimeter Errors
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- Vertical Speed Indicator
- Trim Control
- Flaps
- Landing Gear

RELATED LINKS

- Using the Mouse
- Controlling the Engine
- Setting Up Failures

Gyroscopic Properties

- From King Schools' *Cleared for Takeoff*

What does a child's spinning top have to do with flying an airplane? More than you might imagine.

Rigidity in Space
Remember how, when you were a kid, you'd spin a top and it would stand upright for almost as long as it had motion. You probably didn't know it then, but it was exhibiting a property common to all spinning discs, a property engineers call rigidity in space. As the name implies, the disc wants to remain as it is.

A gyroscope, or gyro, is a spinning disc whose axis is mounted in a frame that allows it to move freely in several directions. Just like your top, it wants to remain as it is. You'll see that some of the instruments in Prepar3D use gyroscopes that also work on the principle of rigidity in space.

Precession
Precession is another property of a spinning disc. If you push on the

Aircraft manufactured in the United States after 1976 have airspeed indicators with markings based on indicated airspeed in knots. Older aircraft typically have markings that reflect indicated airspeed in statute miles per hour.

How the Airspeed Indicator Works

The airspeed indicator is the only instrument connected to both the pitot tube and the static system. Air from the static system fills the case of the airspeed indicator, providing a "base" pressure against an expandable diaphragm. Air forced into the pitot tube as the airplane moves fills the diaphragm, which expands as ram air pressure (and speed) increase. A needle connected to the diaphragm rotates as the diaphragm expands. The needle's position on the instrument face indicates airspeed.
Note: The speeds used in Prepar3D checklists and operating procedures are all indicated airspeeds, unless otherwise noted.
Tip: To create a realistic flying experience, Prepar3D displays indicated airspeed by default. As your aircraft climbs, indicated airspeed decreases while true airspeed increases. The higher you climb, the greater the difference between IAS and TAS. To display true airspeed, choose **General...** from the **Options** menu and select the **Display True Airspeed** option on the **Realism** tab of the **General...** dialog box.

Altimeter

The altimeter is a sensitive barometer that measures air pressure. It's calibrated to display that air pressure as height, usually in feet above mean sea level (MSL).

How the Altimeter Works

The altimeter is connected to the static ports. The air pressure inside the instrument case decreases as the airplane climbs and increases as it descends. As the pressure in the case drops, sealed wafers in the instrument case expand. Increasing pressure squeezes the wafers. As the wafers expand and contract, needles connected to them rotate around the altimeter dial like hands on a watch.

Reading the Altimeter

Most small aircraft are equipped with two-needle altimeters. The long needle shows hundreds of feet. The short needle points to thousands of feet. A wedge-shaped striped indicator appears whenever the current altitude is less than 10,000 feet (3,048 meters). For example, if the long needle is on 5 and the short needle is between the 2 and 3, you're at 2,500 feet (762 meters) MSL. If the striped indicator isn't visible, the same needle orientation shows that you're at 12,500 feet (3,810 meters) MSL.
Jets and other high-performance aircraft typically have "needle and drum" altimeters. A long needle shows hundreds of feet and an odometer-like display shows altitude in numerical form.

Setting the Altimeter

To display altitude accurately, the altimeter must be set to the current barometric pressure adjusted to sea-level pressure. This setting appears in the Kohlsman window —the scale between the **2** and **3** on the dial in the cockpit. Before takeoff, the pilot turns a setting knob to set the correct pressure. When properly set, the altimeter indicates the airport elevation—not zero—before the airplane takes off.
Pilots can get the current altimeter setting from ATIS broadcasts, air traffic controllers, and Flight Service Stations (FSS). If one of these sources isn't available, the pilot should set the altimeter so that it displays the elevation of the departure airport. Pilots should also receive a current altimeter setting en route and for their destination airport.

Types of Altitude

The altimeter in an airplane is designed to show height above sea level (MSL). The instrument is calibrated to show that height under standard atmospheric conditions. The current temperature and pressure rarely match standard conditions, however, so pilots must understand several types of altitude and know how to correct for altimeter errors caused by nonstandard conditions.

- **Indicated altitude** is the altitude shown on the altimeter. If the altimeter is set to the current atmospheric pressure corrected to sea level, indicated altitude is approximately equal to the aircraft's height above sea level (MSL).
- **Pressure altitude** is the altitude shown on the altimeter when the pressure is set to 29.92 inches of mercury (or 1012.2 millibars). Pressure altitude is important in calculating density altitude, a critical factor in determining aircraft

axis of your top, it resists the push and the force actually moves in a direction 90 degrees from where you're pushing. In the same way, when you pitch your aircraft's nose down, it wants to go left (or 90 degrees from where the force is applied to the disc) because of the propeller's gyroscopic effect. Both are examples of gyroscopic precession.

Precession, by the way, is what lets you turn your bicycle by leaning in the direction you want to go when you're riding with no hands. Precession is predictable and gyroscopic instruments use that principle.

When it's used intentionally, precession can work to your advantage. But it can also work against you. Because of friction in bearings and other reasons, precession sometimes shows up where it's not wanted — for instance, when it causes gyros to drift, instead of remaining rigid in space. In this case, airplane designers offer a couple of choices: they either build in a correction for it over time, or they provide the pilot a means to adjust the gyro.

performance, true airspeed, and true altitude. In the United States, aircraft fly at pressure altitudes or "flight levels" when operating at or above 18,000 feet MSL (5,486 meters). That's why you must set the altimeter to 29.92 whenever you fly at or above that altitude.

- **Density altitude** is pressure altitude corrected for deviations from standard temperature. You must calculate density altitude to determine how much runway your airplane will need to take off and land, and its rate of climb. Calculating density altitude is especially important on a hot day when you're operating from an airport with an elevation well above sea level.
- **True altitude** is your actual height above sea level. If you set the altimeter to local pressure corrected to sea level, indicated altitude is approximately true altitude.
- **Absolute altitude** is your height at any instant above the terrain. Unless your aircraft is equipped with a radio or radar altimeter, you must estimate absolute altitude by comparing your indicated altitude with the terrain elevations shown on charts.
- **Radio (or radar) altitude** is the absolute altitude displayed by radio or radar altimeters in large aircraft. Pilots use radio or radar altitude during the final phases of approach and landing, particularly when the ceiling and visibility are low, to help them determine decision height.

Altimeter Errors

The altimeter is calibrated to display the correct height above mean sea level when the temperature and pressure of the atmosphere match standard conditions. Variations in temperature usually don't cause significant errors, but if atmospheric pressure doesn't change at the standard rate, the altimeter won't display the correct altitude unless the pilot periodically adjusts the altimeter setting to the local atmospheric pressure (corrected to sea level). In fact, FAA regulations require you to use the proper altimeter setting as you fly (see FAR 91.121).
For example, suppose the altimeter is set to 30.10 inches before takeoff. If the airplane travels to an airport surrounded by a low-pressure system and the pilot does not change the altimeter setting, the altimeter senses the lower pressure as higher altitude. In other words, the altimeter shows an altitude higher than the airplane's actual height above sea level.
Although the pilot thinks the airplane is at the correct altitude, it may be in conflict with other aircraft in the area whose pilots are using the correct local altimeter setting.
Tip: To set the altimeter to the current atmospheric pressure, press **B**.

Attitude Indicator

Sometimes called the "artificial horizon," the attitude indicator is the only instrument that simultaneously displays both pitch and bank information.

How the Attitude Indicator Works

The gyro mounted in the attitude indicator rotates in the horizontal plane and maintains its orientation relative to the real horizon as the airplane banks, climbs, and descends.
Note, however, that the attitude indicator alone can't tell you whether the airplane is maintaining level flight, climbing, or descending. It simply shows the aircraft's attitude relative to the horizon. To determine your flight path, you must crosscheck the airspeed indicator, altimeter, heading indicator, and other instruments.
The pointer at the top of the attitude indicator moves along a scale with marks at 10, 20, 30, 60, and 90 degrees of bank. The horizontal lines show the aircraft's pitch attitude in degrees above or below the horizon. The converging white lines in the bottom section of the indicator can also help you establish specific bank angles.

Limitations

The gyros in the attitude indicators used in most small aircraft tumble if the pitch attitude exceeds +/-70 degrees or if the angle of bank exceeds 100 degrees. When the gyro tumbles, it gives unreliable indications until it realigns itself, a process that usually requires several minutes of straight and level flight. Aerobatic planes and large aircraft are often equipped with gyros that are reliable through 360 degrees of pitch and bank.
Many modern attitude indicators have a blue "sky" and brown "earth," which is the origin of the phrase "keep the blue side up."

Heading Indicator

The heading indicator, sometimes called the "directional gyro" or "DG," is one of the three gyroscopic instruments. When aligned with the compass, it provides an accurate, stable indication of the aircraft's magnetic heading. It should be emphasized that without a compass, the heading indicator is useless because it "knows" nothing about the magnetic heading. Only a magnetic compass can read earth's magnetic field. For more information on reading a magnetic compass, see Using the Map.
The heading indicator is an important aid because the compass is subject to errors

caused by acceleration, deceleration, and the curvature of the earth's magnetic field, especially at high latitudes. The compass often oscillates or leads or lags a turn and it is especially hard to read in turbulence or during maneuvers. (To see how difficult it is to fly with only a compass, you can display a compass in a separate window.) To display or hide the magnetic compass, press **SHIFT+5**.

How the Heading Indicator Works

The gyro in the heading indicator rotates in the vertical plane. A card marked with headings maintains its orientation as the airplane turns. The apparent movement of the card gives the pilot an immediate, precise indication of the airplane's heading and the direction in which the airplane is turning.
The card is marked off in five-degree increments, with numbers every 30 degrees and the cardinal directions indicated by **N**, **S**, **E**, and **W**.

Aligning the Heading Indicator

On small aircraft, the pilot sets the heading indicator to coincide with the compass before takeoff and resets it periodically during flight to make sure that it remains in sync with the compass. The heading indicator drifts because it's based on a gyro, which precesses with time. As a rule, the heading should drift no more than three degrees every 15 minutes.
Tip: To reset or adjust the heading indicator manually, press **D**.
Larger aircraft usually have "slaved" heading indicators that automatically keep the instrument properly aligned with the compass.
Note: You can make the heading indicator drift by selecting the **Gyro Drift** option on the **Instrument** tab of the **Preferences** dialog box.

Turn Coordinator

The turn coordinator is really two instruments. The gyro portion shows the aircraft's rate of turn—how fast it's changing direction. A ball in a tube called the "inclinometer" or "slip/skid indicator" shows the quality of the turn—whether the turn is "coordinated."

How the Turn Coordinator Works

When the airplane turns, forces cause the gyro to precess. The rate of precession makes a miniature airplane on the face of the instrument bank left or right. The faster the turn, the greater the precession, and the steeper the bank of the miniature airplane.

Standard Rate Turn

When the wings of the miniature airplane align with the small lines next to the **L** and **R**, the aircraft is making a standard rate turn. For example, an aircraft with a standard rate of turn of three degrees per second will complete a 360-degree turn in two minutes.

Balancing Act

The black ball in the slip/skid indicator stays between the two vertical reference lines when the forces in a turn are balanced and the airplane is in coordinated flight. If the ball drops toward the inside of the turn, the airplane is slipping. If the ball moves toward the outside of the turn, the airplane is skidding.
To correct a skid, reduce rudder pressure being held in the direction of the turn and/or increase the bank angle.
To correct a slip, add rudder pressure in the direction of the turn and/or decrease the bank angle.
The auto-coordination feature automatically moves the rudder to maintain coordinated flight.

Useful Backup

The turn coordinator is usually electrically powered so that it's available if the vacuum pump fails and disables the attitude indicator and heading indicator.

Needle and Ball

The turn coordinator is common in modern light aircraft. Older airplanes often have a similar instrument called the "turn and slip indicator" or the "needle and ball," which uses a different presentation to display the same information.

Vertical Speed Indicator (VSI)

The vertical speed indicator (sometimes called the VSI or rate-of-climb indicator) shows how fast an aircraft is climbing or descending. The VSI is usually calibrated in feet per minute.
Pilots use the VSI primarily during instrument flight to help them establish the correct rate of descent during approaches and to maintain steady rates of climb or descent.

How the VSI Works

The VSI is connected to the static system. Air pressure inside the instrument case

decreases as the airplane climbs and increases as the airplane descends. Inside the case, a sealed wafer—much like the one used in the altimeter—expands and contracts as the pressure changes. A needle connected to the wafer rotates as the wafer expands and contracts, indicating a rate of climb or descent. The wafer also has a small, calibrated leak to allow the pressure in the wafer to equalize with the pressure in the case. When the pressure inside the wafer equals the pressure in the case, the needle returns to zero, indicating level flight.

Reading the VSI

You shouldn't use the VSI as the primary indicator of whether you're maintaining level flight. If the airplane begins to climb or descend, the VSI initially indicates the change in the proper direction. But the indicator lags the aircraft's movement and takes several seconds to catch up to the aircraft's actual rate of climb or descent. "Chasing" the needle on the VSI can make you feel like you're riding a roller coaster. Rely instead on the airspeed indicator and altimeter; they give quick, accurate indications of deviations from level flight. Then cross-check the VSI to verify that the airplane is climbing or descending at the rate you want.

Trim Control

The trim control is like the cruise control on a car. It helps you maintain a specific control position so that the airplane stays at a particular speed or attitude without making you hold constant pressure on the controls.
Most small aircraft have only one trim tab, located on the elevator. Larger aircraft usually have trim tabs on all the primary control surfaces: ailerons, rudder, and elevator.

How Trim Control Works

On small aircraft, the pilot moves the trim tab by rotating a wheel. The trim wheel is usually located below the engine controls or between the front seats. To apply nose-down trim, you rotate the wheel forward or up. To apply nose-up trim, you rotate the wheel backward or down.
Moving the trim wheel deflects the trim tab, which in turn moves the control surface in the opposite direction. To hold the elevator up, move the trim tab down.

What Trim Control Does

The elevator trim compensates for the changing force created by the flow of air over the elevator. When the airplane is properly trimmed for level-cruising flight, you can fly "hands off," applying only occasional, small control pressures to compensate for the occasional bump or minor change in heading. If you add power, however, the airplane speeds up, and the nose tends to rise because more air is flowing over the tail. To maintain altitude, you must apply forward pressure on the control yoke. Holding that forward pressure for more than a few minutes is fatiguing and difficult. To compensate, apply down elevator trim until the pressure disappears.
If you reduce power, the airplane slows down, and the nose tends to fall because less air is flowing over the tail. To maintain altitude, you must apply back pressure on the yoke. To compensate, apply up elevator trim until the pressure disappears.

Trim for Speed

You can also think of the trim control as the airplane speed control. For example, suppose you set the engine controls for cruise power and trim the airplane so that it flies straight and level "hands off." The airspeed will soon stabilize at a particular speed. If you reduce power, the airplane slows down and the nose drops. If you leave the trim setting alone, the airplane will gradually stabilize in a descent at the cruise speed you established earlier. Likewise, if you add power, the nose will rise and the airplane will stabilize in a climb at about cruise speed.

Trim to Relieve Pressure, Not Steer

Remember to use the trim control only to relieve control pressure. Don't try to fly the airplane with the trim control. If you want to change the airplane's pitch attitude, apply the appropriate control pressure on the yoke, change the power setting if necessary, and then adjust the trim after the airplane stabilizes.

Flaps

Flaps change the shape of the wing, creating more lift and adding drag. These two effects allow you to fly at low airspeed and descend at a steep angle without building up speed. Flaps are not primary control surfaces—you don't use them to steer the airplane.

How Flaps Work

Flaps extend from the trailing edge of the wing. They increase the curvature—or camber—of the wing, which increases lift. They also hang down, increasing drag. Pilots extend flaps in increments, typically measured in degrees. On most airplanes, flaps move in five- or ten-degree increments through a range of 0 (fully retracted) to about 40 degrees (fully extended). The first few increments add more lift than drag. On many aircraft, extending 5 to 15 degrees of flaps helps the airplane take off more quickly.
As the flaps extend beyond about 20 degrees, they add more drag than lift. Flap settings of 20 degrees or higher are used for approach and landing.

Pitch Changes

As you extend or retract flaps, be prepared for changes in pitch. For example, as you extend flaps the nose tends to rise. You need to add forward pressure on the yoke to hold the nose on the horizon, and then use the trim control to relieve the forward pressure. Likewise, as you retract flaps, the nose tends to drop, so be ready to add back pressure on the yoke and then use trim to relieve the back pressure as the airplane stabilizes.

Types of Flaps

Flaps come in several varieties:

- **Plain flaps** are mounted on simple hinges. The trailing edge of the wing simply pivots downward. Plain flaps are common on small aircraft because they're simple and inexpensive.
- **Split flaps** hang down from the trailing edge of the wing, but the top surface of the wing doesn't move.
- **Slotted flaps** work much like plain flaps, but they leave a gap between the flap and the wing, allowing air to flow from the bottom of the wing over the top surface of the flap. This airflow dramatically increases lift at low airspeed.
- **Fowler flaps** are the most complicated and efficient arrangement. They move backward and downward as they're deployed, increasing both the wing's area and its curvature. Large jet aircraft usually have Fowler flaps.

Operating the Flaps

Flaps increase drag, but they aren't speed brakes. You can extend the flaps only when the airplane is flying at or below the maximum flap operating speed (indicated by the top of the white arc on the airspeed indicator). Deploying the flaps at higher speeds may cause structural damage.

In general, extend 5 to 10 degrees of flaps before takeoff to help the airplane lift off the runway quickly. Remember, however, to follow the recommendations in each airplane flight manual. Retract the flaps after reaching a safe altitude and climb speed.

When preparing to land, extend the flaps in increments. A good rule of thumb is to extend about 10 degrees of flaps as you enter the traffic pattern or begin an approach. As you continue around the traffic pattern, add flaps in small increments. For example, in the aircraft's cockpit, set 10 degrees of flaps on the downwind leg, set 20 degrees of flaps as you turn from downwind to base, and add flaps as necessary as you turn to final and approach the runway.

On light aircraft, flaps are operated with levers located between the seats. More complex aircraft may have flaps located as buttons on the control panel. Using key commands to extend flaps in increments, press **F5**. To extend flaps fully, press **F6**. To retract flaps in increments, press **F7**. To retract flaps fully, press **F8**.

Landing Gear

Landing gear are the wheels, struts, and other equipment that an aircraft uses to land or maneuver on the ground, and are also known as the "undercarriage." The two most common types of landing gear are "taildragger" and "tricycle" arrangements. On a taildragger, the front of the aircraft is supported on two wheels, while the tail rests on the ground on a skid of a tailwheel. With tricycle landing gear, the aircraft sits level on the ground with one nosewheel and two wheels farther back on the aircraft. In both taildragger and tricycle gear, the main landing gear are located nearest the airplane's center of gravity. Main landing gear almost always come in pairs and are designed to withstand a greater landing shock than the more-fragile nosewheel or tailwheel.

Fixed landing gear cannot be retracted and lowered; controlling the landing gear position is not an option. But on retractable-gear aircraft, the gear can (and often must) be raised and, of course, lowered. Landing gear controls vary from aircraft to aircraft. To raise/lower the landing gear, press **G**.

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PREPAR3D

Fueling and Loading Aircraft

Fuel plays an important part in preflight planning. Aside from the fact that you need enough fuel to reach your destination, fuel also contributes to the weight carried by the airplane.
You may have heard the term "weight and balance." In this instance, an aircraft's weight includes fuel, cargo, passengers, and the unloaded weight of the aircraft itself. Balance refers to keeping all of those weights within the designed center of gravity.
The effect of weight and balance on performance is critical. Many small aircraft cannot fly safely with full fuel and all of the seats filled.
The effects of added weight on aircraft include:

- Higher takeoff speed
- Longer takeoff run
- Reduced rate and angle of climb
- Lower maximum altitude
- Shorter range
- Reduced cruising speed
- Reduced maneuverability
- Higher stalling speed
- Higher landing speed
- Longer landing roll.

For helicopters, the effect of added weight also affects:

- Hovering
- Takeoff
- Climb
- Auto-rotation
- Landing performance.

Where the loads are placed within the airplane also affects flight performance, especially during stalls and spins. It's important that you don't load your aircraft beyond its design limits, and that you distribute the weight in the proper locations. Loads distribution affects the center of gravity (CG), which in turn affects the stability and control of the aircraft.
Use the **Fuel and Payload** dialog box to set your airplane's weight and balance. Large, complex aircraft are usually equipped with additional fuel tanks and payload stations, which can be filled in various combinations.

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- Understanding Center of Gravity
- Understanding the Fuel and Payload Dialog Box

Fueling an Airplane

There are two ways to fuel your aircraft.
You can manually add fuel to an airplane by taxiing up to a fueling station at airports that have them. Fueling stations exist at many airports.

To fuel an airplane at a fueling station

- Taxi the airplane up to the fuel station and park until the fuel tanks indicate full.

You can also fuel your airplane using the **Fuel and Payload** dialog box. For more information about using the dialog box, see Understanding the Fuel and Payload dialog box below.

Understanding Center of Gravity

In technical terms, the center of gravity (CG) of any object is the average location of the object's weight. An airplane in flight rotates around its CG—the point at which the aircraft would balance in all directions if it could be suspended from that point—and if that center is outside of the aircraft's designed limits, its controllability may be severely compromised.
Think about how humans walk: We're designed to move with our center of gravity within certain limits in order to maintain balance. We throw our CG forward slightly to move forward, but it remains within a limit that keeps us upright. If you try to walk carrying a very heavy object, it throws your CG off, making it difficult to walk; it may even make you fall over.
Similarly, if you load an aircraft outside of its CG limits, the aircraft still rotates around that point. If the CG moves too far forward, the elevator may not have enough authority to maintain the correct attitude at minimum speeds, as when landing. If the CG moves too far aft, a less-stable condition occurs, decreasing the ability of the aircraft to right itself after maneuvering, stalling, or after disturbances by gusts. Remember also that higher weight means higher stall speed. Keeping the CG within limits makes for a safer and more comfortable flight.
The CG range for most helicopters is more restricted than for airplanes. In some cases this range is less than three inches.
The pilot operating handbook that comes with most aircraft has tables that the pilot uses to calculate weight and balance. It is possible to safely experiment flying aircraft that are loaded outside the CG limits.

Fuel and Payload

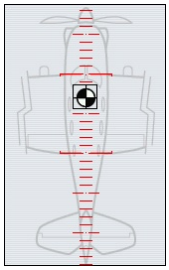
Empty weight: the weight of the aircraft without passengers, fuel, baggage, or cargo.
Payload: the weight of the passengers, baggage, and cargo.
Fuel: the weight or volume of fuel on board.
Gross weight: the Gross Weight is the sum of the empty weight, fuel weight, and the payload.
Max. gross weight: the aircraft should not be loaded beyond this weight or volume.
Max. allowable fuel: the aircraft cannot hold more fuel than indicated in this box.

In large aircraft, fuel capacity and load is usually based on weight (pounds or kilograms) rather than volume (gallons or liters).

If you load the aircraft beyond its gross weight, the Fuel and Payload dialog box displays a red warning message indicating the gross weight overage.

Center of gravity (CG) indicator

The **Fuel and Payload** dialog box also shows the aircraft's center of gravity. The red box indicates the design limits within which the CG should remain. The CG indicator (the black and white circle) shows the current location of the CG. When you change the fuel or payload settings, the CG indicator moves.



Fuel Settings

In the **Change Fuel** section, you can make adjustments in the fuel load. You cannot add more fuel than the capacity of the tanks. Remember, however, that with some aircraft, having a full load of fuel plus passengers in every seat may put the aircraft over its maximum allowable gross weight.

For aircraft with multiple fuel tanks, each tank is listed in the **Tank** column. The idea is to load the tanks in a balanced way to help keep the aircraft within CG limits. This can affect performance as well as safety: If one wing tank is too heavily loaded, the aircraft may fly inefficiently.
Swept-wing aircraft present special challenges. Fuel in outboard tanks has a tendency to rotate the aircraft in a tail-heavy direction and fuel in inboard tanks adds to a nose-heavy condition. The use of fuel from swept-wing tanks must be managed carefully to keep the CG within designed limits.
You can adjust fuel quantities by percentage of total fuel, by volume, or by weight. The volume capacity for each tank is listed in the **Capacity** column on the right of the **Fuel Settings** dialog box. The current gallons and pounds are totaled at the bottom of the table.

To adjust the fuel quantity in any tank, enter the Pounds or Gallons into the corresponding column, or the percentage filled that you want the tank to be at (0 to 100).

Payload Settings

Payload refers to the weight of the passengers, baggage, and cargo. The **Change Payload** section includes entries for each of these items. In technical terms, weights in an aircraft are measured at points called "stations," each station being a specific distance from a datum or reference point in the front of the aircraft. The payload for all stations is totaled at the bottom of the table.

To adjust the payload, enter the weight into the Pounds column of the corresponding station.

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PREPAR3D

Controlling the Engine

Learning the basics of engine control will keep you flying high

Engines can be humbling because they are reminders that humans really can't fly—at least not for long—without some help. So, you've got to be good to your aircraft's engine. Here are some operating tips that will help keep your aircraft's engine running strong.
Many gauges on the control panel monitor engine functions. Two important engine instruments that measure engine power are the tachometer (which indicates engine speed as measured in revolutions per minute, or rpm), and the manifold pressure gauge (which indicates the pressure of air moving into the cylinders).

CONTENTS

- Using the Engine Controls
- Throttle Control
- Mixture Control
- Propeller Control and Power Management
- Fixed-Pitch Propellers
- Constant-Speed Propellers
- Using the Engine Controls in Prepar3D

RELATED LINKS

- Using the Mouse

Using the Engine Controls

Most modern piston engine aircraft have two or three engine controls. Piston aircraft with a fixed-pitch propeller have two basic engine controls: a black throttle control—which has the most direct effect on power—and a red mixture control to adjust the air/fuel mixture as the airplane climbs and descends. Aircraft with a constant-speed propeller also have a blue propeller control to adjust the propeller's rotation speed.

Throttle Control

The throttle determines how much power the engine can develop by controlling the amount of fuel and air entering the engine cylinders. When fully open, the throttle allows the maximum amount of fuel and air to enter the system to produce maximum power. When the throttle is closed, only a small amount of fuel and air can enter the system, and the engine produces minimum power. To open the throttle, push the throttle control in. To close the throttle, pull the control out. The manifold pressure gauge on the instrument panel shows the pressure of the air moving into the engine's cylinders, and gives an approximate measurement of engine power. Generally speaking, the higher the manifold pressure, the more power you have available.

Mixture Control

Because an aircraft's engine operates over a wide range of altitudes, the fuel/air mixture can be adjusted for maximum efficiency as you climb into thinner air or descend into denser air. A mixture that is too rich contains too much fuel for the existing atmospheric conditions and may cause the engine to run rough and lose power. The solution is to "lean the mixture:" As you climb, make the mixture leaner by pulling the mixture control back until the needle on the exhaust gas temperature (EGT) gauge peaks, then push the mixture control forward a little. Don't lean the mixture too much, though: a mixture that is too lean can cause the engine to overheat or result in a problem known as detonation, a sudden, strong, uncontrolled, and often damaging explosion of fuel and air within the cylinder.

Propeller Control and Managing Power

Piston engines are typically connected to a fixed-pitch or a constant-speed propeller.

Fixed-Pitch Propellers

Fixed-pitch propellers are bolted directly to the crankshaft of the engine and therefore always turn at the same speed as the engine. A fixed-pitch prop is somewhat like a transmission with only one gear. This configuration makes up for its lack of efficiency by being very simple to operate. The only gauge that you need to monitor is the tachometer. Because the fixed-pitch propeller turns as fast as the engine, the engine's rpm is the best indicator of engine power. Use the tachometer to set your power during takeoff, cruising, and landing—the higher the rpm, the more power your engine is producing.
With a fixed-pitch propeller, managing power is simple. Push the throttle in, and rpm (and power) increases. Pull the throttle out, and rpm decreases. Be aware, however, that as airspeed increases, rpm tends to creep up, too. Monitor the tachometer carefully during descents at high speed to make sure that the rpm stays within limits.

Constant-Speed Propellers

A constant-speed propeller has a governor that adjusts the angle of the blades to maintain the rpm you select. This type of propeller makes much more efficient use of the engine's power. Adjusting the propeller in an airplane is very similar to using gears in a car. In low gears the engine turns fast to get you moving. Once you're underway, there's no need to use a lot of power, so you shift to a higher gear to make more efficient use of less power. In an airplane, the propeller control changes the angle at which the propeller blades meet the air, which affects how fast the engine

turns. The tachometer on the instrument panel shows how fast your engine is turning.
During takeoff and during landing (in case you need to abort and take off again) you'll need every bit of power your engine can develop. So during these two phases of flight, keep the propeller control pushed in: the angle of the blades will be low, slicing through the air easily so you can get the engine's full power (like using a low gear in a car). During cruise, pull the propeller control out a bit: the angle of the blades will increase and take a bigger bite out of the air, making more efficient use of the engine's power (like using a high gear in a car). Any time you change the throttle setting a governor will automatically adjust the angle of the blades to maintain the propeller speed.
A constant-speed propeller makes power management a bit more complicated. You must monitor the manifold pressure gauge, controlled by the throttle, and the tachometer, which shows the propeller rpm. You adjust rpm with the prop control. When using the throttle and prop controls, remember these basic rules to avoid overstressing the engine:

To increase power

1. Increase propeller speed by pushing the prop control forward.
2. Increase manifold pressure by pushing the throttle control forward.

To decrease power

1. Reduce manifold pressure by pulling the throttle control backward.
2. Decrease propeller speed by pulling the prop control backward.

Using the Engine Controls in Prepar3D

In Prepar3D, all three controls can be adjusted with the keyboard or the mouse (just drag the control in or out). Some joysticks have levers or sliders for these controls.

To feather the propeller

1. In the cockpit, click the propeller control knob.
2. Drag the knob to the desired position.
   Fine adjustments can be made by rotating the mouse wheel.

   - or -

- Press **CTRL+F1**.

To adjust propeller feathering

- Place the propeller at full forward speed by pressing **CTRL+F4**.
- Decrease propeller speed by pressing **CTRL+F2**.
- Increase propeller speed by pressing **CTRL+F3**.

To control the throttle

1. In the cockpit, click the throttle knob.
2. Drag the knob to the desired position.
   Fine adjustments can be made by rotating the mouse wheel.

   - or -

1. Press **F3** (or press **9** on the numeric keypad) to increase throttle.
2. Press **F2** (or press **3** on the numeric keypad) to decrease throttle.

Press **F4** to set the throttle at full open.
By default, mixture control is handled automatically in Prepar3D, but you can override the automatic settings if you prefer.

To adjust the mixture manually

1. On the General menu (under Options), click **Realism**.
2. Clear the **Enable Automixture** check box.

To control mixture settings

1. In the cockpit, click the mixture knob.
2. Drag the knob to the desired position.
   Fine adjustments can be made by rotating the mouse wheel.

   - or -

1. Press **CTRL+SHIFT+F2** to lean the mixture.
2. Press **CTRL+SHIFT+F3** to enrich the mixture.
3. Press **CTRL+SHIFT+F4** to set mixture to rich.

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PREPAR3D

Setting Failures

Using the **Failures** dialog box, you can set up failures in the aircraft's instruments, systems, radios, or engine that will occur immediately, randomly, or during a specified period of time.
Note: You cannot declare an emergency to air traffic control in the simulator.

To open the Failures dialog box:
- In the **Vehicle** menu, click **Failures**.

Setting Failures

While flying in clouds or fog, pilots rely entirely on their instruments to navigate and keep the aircraft right side up. Only instrument-rated pilots can legally fly in weather conditions below the minimum standards required for Visual Flight Rules.
All instrument-rated pilots practice instrument failures. Some instruments fail slowly, and as a result, the pilot may continue to refer to the failed instrument, which can be disastrous. For example, when the attitude indicator fails, it slowly tilts to one side. Referring to the tilting horizon on the instrument, the pilot will bank the aircraft, attempting to keep the attitude indicator horizon bar level. In the clouds, the seat-of-the pants perceptions that pilots rely on in visual conditions are not reliable. Unless the pilot is scanning and crosschecking the attitude indicator with other instruments, the pilot won't know that the aircraft is turning and won't realize the instrument has failed. That's why learning to scan and crosscheck is a critical part of instrument training.

Flying in visual conditions, a failed heading indicator forces the pilot to rely on the magnetic compass—a challenge due to inherent compass errors when turning, climbing, and descending. And without a functioning airspeed indicator, hitting a target landing speed is more difficult.
In a real aircraft, you can only practice complete, instantaneous failure by covering the instrument. By practicing failures in a simulator, you can learn to recognize situations as they occur in a real-life failure, where failures aren't often immediately obvious.

You can choose whether to trigger a failure immediately or whether the failure should occur during a specified period of time. Remember that if you set the failure time to a minute into the flight and you have a long way to taxi, the failure may occur before you ever get off the ground.

To set an immediate failure for a specific component

1. In the **Failure Category** drop down menu, click the category of component you want to fail.
2. Click **Component Failures**.
3. Select the **Failed** option for the component that you want to fail.

To set a timed failure for a specific component.

1. In the **Failure Category** drop down menu, click the category of component you want to fail.
2. Click **Component Failures**.
3. Select the **Armed** option for the component that you want to fail.
4. Select the left **Fails in** box and then type the minimum number of minutes you want to pass before the failure.
5. Select the right **Fails in** box and then type the maximum number of minutes you want to pass before the failure.

To set a random component failure

1. In the **Failure Category** drop down menu, click the category of component you want to fail.
2. Click **Random Component Failures**.
3. Enter the number of components, start, and end times that you want component to fail.

The **Failure timer** does not start until you click **OK.**

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PREPAR3D

Using Autopilot

Getting a helping hand

RELATED LINKS

- Cockpit Basics
- Using the GPS
- Using the Map

What is an Autopilot?

An autopilot (from "automatic pilot"), is a device that can automatically control an aircraft's motion about one or more of its three axes (pitch, yaw, and roll), via input from a human pilot pushing buttons and turning knobs, or via navigational equipment sensing signals from navigation aids on the ground.

What Can an Autopilot Do?

In Prepar3D, the aircraft are equipped with autopilots that can:

- Hold the wings level so that the airplane does not turn.
- Maintain the aircraft's current pitch attitude.
- Maintain a selected heading.
- Maintain a selected altitude.
- Maintain a selected rate of climb or descent.
- Follow a VOR radial.
- Track a localizer or localizer back course.
- Track the localizer and glide slope of an Instrument Landing System (ILS).
- Track a GPS course.

The GPS does not provide vertical guidance to the autopilot.

- Maintain a selected speed (indicated air speed or Mach number).
- Eliminate unwanted aircraft yaw.
- Help a pilot to manually fly the aircraft exactly as the autopilot would.

The DC-3 Autopilot

The autopilot on the Douglas DC-3 panel can:

- Maintain the aircraft's current pitch attitude.
- Maintain a selected heading.

Some of the add-on aircraft and panels for Prepar3D provide even more autopilot functionality, and model advanced features like:

- Flight management computers (FMCs)
- VNav (vertical navigation)
- LNav (lateral navigation)
- Flight Level Change
- Control Wheel Steering
- Autoland

Why Would I Want to Use an Autopilot?

There are some pilots who view using an autopilot as a crutch (as in, "Real pilots don't need autopilots!"), but they're missing out, because used properly an autopilot can substantially reduce your workload…especially when flying under Instrument Flight Rules (IFR). You can let the autopilot handle some of the grunt work (like maintaining heading and altitude) while you concentrate on more safety-oriented concerns (like navigating, looking for traffic, and communicating).
Reducing your workload by using an autopilot will also help you feel less tired at the end of a long flight. There's nothing more dangerous during the approach and landing phases of a flight (especially a bumpy IFR flight in the clouds) than a pilot who's mentally and physically exhausted from simply flying the airplane.

The Two Most Important Rules

When two pilots (for example, a flight instructor and a student) are taking turns controlling an airplane, they make it very clear who has control at any given moment. When one pilot hands over control to the other, he says, "You have the airplane." As the second pilot takes control, he may respond, "I have the airplane." In this way, they avoid a dangerous situation where both pilots are controlling the airplane (or no pilots are controlling the airplane).
Using an autopilot is no different. The two most important rules to remember when using a two- or three-axis autopilot like the ones modeled in the Prepar3D aircraft are:

1. When the autopilot is off, you control the airplane.
2. When the autopilot is on, the autopilot controls the airplane, and you monitor and control the autopilot.

Staying in the Loop

Never ask the autopilot to do something you can't (or wouldn't) do yourself. For example, no good pilot would be able to make a 120-degree turn and intercept a localizer while flying at 300 knots less than a mile from the localizer; neither would an autopilot. Keep your expectations realistic. If you make things easy for the autopilot, the autopilot will make things easy for you.
That said, just because the autopilot is on doesn't mean you should take a nap. The great thing about using an autopilot is that it frees up some of your attention to do

other important tasks. So instead of staring blankly out the window, get to work:

- Maintain situational awareness. Even when the autopilot is controlling the aircraft, as the pilot in command, you're still ultimately responsible. Don't rely on the autopilot to take you to your destination. If you know where you are at all times and the autopilot fails, you can easily take over.
- Monitor which autopilot functions are engaged. Talk to yourself, if it helps. For example, you might say, "The autopilot is engaged. Altitude hold mode is engaged and we're climbing to 7,000 feet MSL. Heading hold is engaged and holding heading 260 degrees, which is our ATC-assigned heading to intercept the 290 degree course from the Seattle VOR."
- Make sure the autopilot is doing what you want it to. If something seems wrong, if the autopilot seems to be malfunctioning, don't hesitate to disengage it: click the autopilot master switch, or press **Z**. Note that doing so does not disengage the autothrottle (available on Prepar3D jets), which is a separate system. To disengage the **autothrottle**, click the autothrottle switch (see below), or press **SHIFT+R**).
- Monitor the engine instruments. Use some of your extra attention to check on the engine. Confirm desired power settings, and check on fuel usage.

Other Tips

There's a lot to remember about using autopilots. Here are some key points to keep in mind as you fly:

- Don't attempt to manually control the aircraft with the joystick while the autopilot is turned on. If, for example, you select Altitude Hold mode and then try to hand-fly the airplane, the autopilot will compensate by running the trim. This situation can lead to several problems in the real world, especially if you're flying in the clouds. For example, upon disengaging the autopilot, you could find that the autopilot had run the trim all the way nose up or nose down and have a very hard time maintaining control of the airplane, or the autopilot could disengage itself after hitting the trim limits. You might assume that the autopilot is still on, release the controls to unfold a chart, or tune the radios, and enter a spiral, stall, or other unpleasant condition before you figured out what was going on.
- Always disengage the autopilot before landing. None of the autopilots in Prepar3D are equipped with autoland capabilities. Always disengage the autopilot and autothrottles during the final approach, at least by decision height (DH).
- Always "fly the airplane" first and foremost. If you're fiddling with the autopilot and something doesn't make sense, don't fixate on the problem. Fly the airplane (manually if necessary), and come back to the problem as your time and attention permit.
- Don't lose your manual flying skills. Autopilots make your job easier, but if you always use one, you may forget how to fly by hand. Hand-fly every now and then to keep your skills sharp.

Autopilot Controls

The autopilot appears slightly different on each aircraft. On many aircraft, it's part of the radio stack. To display the radio stack, click the Radio icon on the panel. On other Prepar3D aircraft (typically jets), the autopilot is on part of the main instrument panel called the "Mode Control Panel."
You can change the autopilot's settings using the mouse: Just click a button to "press" it. You can also use the mouse to change the selected heading, course, altitude, and other settings. Hold the hand pointer over the numbers you want to change, wait until the hand shows a plus or minus sign, then click to make the change (or rotate the mouse wheel, if your mouse has one).
As you read the following sections, look at the accompanying screenshots to learn what each control does. The controls are slightly different on the various autopilots in Prepar3D aircraft, but they all have the same effects in Prepar3D.

1 - Autopilot master switch

The autopilot master switch turns on the autopilot, making the other settings and options available, holds the current pitch attitude, and holds the wings level. When the autopilot is engaged, you cannot control the aircraft using your joystick or the keyboard. This is consistent with the functionality of real-world autopilots. As noted above, either the autopilot is controlling the aircraft, or the pilot is.
When the autopilot is engaged, it controls both pitch and roll, and an associated flight director (not available on all airplanes) displays both pitch and roll commands. The autopilot cannot control just pitch or just roll, nor can the flight director display just pitch or just roll commands.
If any autopilot mode buttons (for example, Heading mode, Altitude mode, or Navigation mode) are engaged when the autopilot master switch is turned on, the autopilot immediately maneuvers the aircraft to turn to that heading, climb/descend to that altitude, or intercept that course. For this reason, it's good practice to verify that the heading bug, altitude select, and course select are properly set before engaging the autopilot.

To turn the Autopilot Master switch on or off

- Click the **AP** button.
  -or-
  Press the **Z** key.

2 - Heading selection window/bug

The heading selection window/bug enables the selection of the heading the aircraft will turn to and fly when Heading mode is engaged (see below).

To set the desired heading

- Click and drag the heading bug on the Heading Indicator or on the Horizontal Situation Display.
  -or-

- Click in the **Heading Selection** window.
  -or-

1. Press **CTRL+SHIFT+H** to select the Heading bug.
2. Press the **EQUAL (=)** and **MINUS SIGN (-)** keys to move the bug.

In all non-jet Prepar3D aircraft, you can set the heading for Heading mode using the heading bug.

3 - Heading mode selector button

The heading mode selector button engages the autopilot's heading mode, and commands the aircraft to turn to and maintain the heading indicated by the heading bug on the Heading Indicator or Horizontal Situation Indicator (HSI). Any change in the position of the heading bug results in the aircraft turning to and maintaining that heading.

To engage Heading mode

- Click the **HDG** button.
  -or-
- Press **CTRL+ H**.

4 - Altitude selection window

The altitude selection window enables the selection of an altitude the aircraft will climb/descend to then maintain when Altitude hold mode is engaged (see below).

To set the desired altitude

- Click in the Altitude Selection window.
  -or-

1. Press **CTRL+SHIFT+Z** to select the Altitude selection window.
2. Press the **EQUAL (=)** and **MINUS SIGN (-)** keys on the numeric keypad to move the bug.

5 - Altitude hold mode selector button

The altitude hold mode selector button engages the autopilot's altitude hold mode. When engaged, the aircraft climbs/descends to the altitude set in the altitude selector at the rate set in the vertical speed selector (see below).

To engage/disengage Altitude hold

- Click the **ALT** button.
  -or-
- Press **CTRL+Z**.

6 - Vertical speed selection window

The vertical speed selection window enables the selection of a climb/descent rate for the aircraft to use when climbing or descending to the altitude set in Altitude mode (see above).

To set the desired vertical speed

- Click in the Vertical Speed window.

7 - Navigation mode selector button

The navigation mode selector button engages the autopilot's navigation mode, enabling automatic tracking of a VOR course, GPS course, or localizer for enroute navigation. When engaged:

- If the Nav/GPS switch on the panel is set to Nav, the aircraft captures and tracks the VOR course or localizer tuned on the Nav1 radio and set on the VOR1 indicator, HSI, or in the course window (jets only, see below).
- If the Nav/GPS switch on the panel is set to GPS, the aircraft captures and tracks the course to the next GPS waypoint.

Capturing a VOR course, Localizer, or GPS course

Remember: never ask the autopilot to do something you can't (or wouldn't) do yourself. For example, no good pilot would be able to make a 120-degree turn and intercept a localizer while flying at 300 knots less than a mile from the localizer; neither would an autopilot. Keep your expectations realistic. If you make things easy for the autopilot, the autopilot will make things easy for you.

To engage/disengage Navigation mode

- Click the **NAV** button.
  -or-
- Press **CTRL+N**.

8 - Approach mode selector button

The approach mode selector button engages the autopilot's approach mode, enabling automatic tracking of a VOR course, GPS course, localizer, or localizer and glide slope for instrument approaches. When engaged:

- If the Nav/GPS switch on the panel is set to GPS, the aircraft captures and tracks the course to the next GPS waypoint.
- If the Nav/GPS switch on the panel is set to Nav, the aircraft captures and tracks the VOR course, localizer, or localizer and glide slope tuned on the Nav1 radio and set on the VOR1 indicator or HSI.

Intercepting the glide slope

In order for the autopilot to capture a glide slope, you must intercept it from below. Although some real-world autopilots can capture a glide slope from above, standard operating procedure is to intercept and capture glide slopes from below. Thus, many real-world autopilots—and all Prepar3D autopilots—can only capture a glide slope from below. If you want to intercept a glide slope from above, descend through it, level off, and push the APR button twice to disengage and reset approach mode. Then intercept and capture the glide slope from below.

To engage/disengage Approach mode

- Click the **APR** button.
  -or-
- Press **CTRL+A**.

9 - Back Course approach mode selector button

The back course approach mode selector button engages the autopilot's back course approach mode, enabling automatic tracking of a localizer back course for instrument approaches. When engaged, the button functions just like approach mode, except the glide slope is disabled, and the autopilot's response to a localizer signal is reversed. (For example, if the localizer needle is offset to the left, the autopilot will turn the aircraft to the right to intercept it).

To engage Back Course approach mode

- Click the **REV** or **BC** button (depending on aircraft type).
  -or-
- Press **CTRL+B**.

10 - Nav/GPS switch

The Nav/GPS switch selects the navigation receiver (Nav 1 radio or GPS) that feeds the Nav 1 display and the autopilot.
When the Nav/GPS switch is in the GPS position and the autopilot's Navigation mode is enabled, the autopilot will follow the programmed GPS course to each lateral waypoint in sequence. The GPS does not provide vertical guidance to the autopilot.

To toggle the Nav/GPS switch

- Click the **Nav/GPS** switch.

11 - Yaw damper switch

The Yaw damper switch engages the yaw damper (on King Air 350, Learjet 45, and Boeing jets), which helps eliminate unwanted aircraft yaw and keeps turns coordinated.

To engage the yaw damper

- Click the **Y/D** button.
  -or-
- Press **CTRL+D**.

12 - Wing Leveler switch

The Wing Leveler switch disengages heading mode and engages the wing leveler (on the Learjet 45, Boeing 737–800, and Boeing 747–400), which keeps the aircraft's wings level. The switch is on by default, unless the autopilot is in heading mode.

To engage/disengage the Wing Leveler

- Click the **LVL** switch.

13 - Course selection window/knob

The course selection window/knob designates the VOR radial or localizer course the autopilot will track.

To set the desired course

- Click the **Course indicator** knob.
  -or-
- Click in the **Course Selection** window.
  -or-

1. Press **V** to select the **Course selector** knob.
2. Press the **EQUAL(=)** and **MINUS SIGN (-)** keys to change the course.

Using the Autothrottle

In addition to an autopilot, the Learjet 45 and Boeing jets in Prepar3D are each equipped with an auothrottle that can control airspeed by automatically adjusting the throttles. The autothrottle works independently from the autopilot, although most autothrottle controls are presented on the MCP along with the autopilot controls:

14 - Autothrottle arm switch

The autothrottle arm switch arms the autothrottle. When armed, the autopilot controls the aircraft's throttles to hold a specific airspeed or Mach number (see below).

To arm/disarm the Autothrottle

- Click the **AT/ARM** switch.
  -or-
- Press **SHIFT+R**.

15 - Airspeed/Mach selection window

The airspeed/Mach selection window enables the selection of the airspeed/Mach number the aircraft will turn to and fly when airspeed hold mode is engaged (see below).

To set the desired airspeed/Mach

- Click in the **Airspeed/Mach Selection** window.

-or-

1. Press **CTRL+SHIFT+R** to select the **Airspeed/Mach Selection** window.
2. Press the **EQUAL (=)** and **MINUS SIGN (-)** keys on the numeric keypad to change the airspeed/Mach setting.

16 - Airspeed Hold mode selector button

The airspeed hold mode selector button holds the aircraft at a constant airspeed you specify. The autothrottles must be engaged for airspeed hold to work.

To engage/disengage Airspeed Hold mode

- Click the **IAS/SPD** button.
  -or-
- Press **CTRL+R**.

17 - Mach Hold mode selector button

The Mach hold mode selector button holds the aircraft at a constant Mach speed (% of speed of sound) you specify. The autothrottles must be armed for Mach hold to work.

To engage or disengage Mach Hold mode

- Click the **MACH/SPD** button.
  -or-
- Press **CTRL+M**.

18 - Takeoff/go-around mode selector button

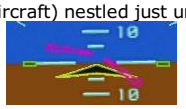
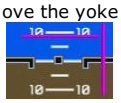
The Takeoff/go-around mode selector button engages TO/GA mode. Throttles automatically advance to takeoff power, and the Flight Director (see below) indicates takeoff pitch. TO/GA mode can be used for takeoff, or for a go-around on landing. The autothrottles must be armed for TO/GA mode to work.

To engage or disengage Takeoff/go-around mode

- Click the **TO/GA** button.
  -or-
- Press **CTRL+SHIFT+G**.

Using the Flight Director

A flight director helps you manually do what the autopilot would do if it were engaged: hold altitude, hold heading, track a VOR course, complete an ILS approach, and so forth.
The flight director consists of either:

- A pink chevron (on the King Air 350 and Learjet 45) that displays on the Primary Flight Display. The chevron indicates deviation from the suggested heading and pitch attitude. Move the yoke to keep the yellow chevron (which indicates the aircraft) nestled just under the pink chevron (the flight director).
  
- Two command bars (on the Boeing jets) that display on the Primary Flight Display. The vertical bar shows horizontal deviation from the suggested heading, the horizontal bar shows vertical deviation from the suggested pitch attitude. Move the yoke to keep the command bars centered.
  

Whereas an altimeter or a VOR display shows raw data (you need to figure out what to do with the information), a flight director displays computed data (it tells you what to do). This makes your job much easier.
With the flight director turned on and autopilot modes selected—but the autopilot master switch turned off—the flight director shows what the autopilot would do were it engaged, based on the setting of its modes. When both the flight director switch and the autopilot master switch are turned on, the flight director shows what the autopilot is doing.
The flight director has just one control:

19 - Flight director switch

The flight director switch turns the flight director on and off. Manipulate the yoke to follow the pink chevron, or to keep the command bars centered.

To turn the Flight Director on or off

- Click the **F/D** switch.
  -or-
- Press **CTRL+F**.

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PREPAR3D

Using the Kneeboard

Your best source for in-flight information

Real-world pilots need to refer to lots of information while they fly, and most put everything they need at their fingertips: on a kneeboard, a sort of clipboard that straps to the pilot's knee. In Prepar3D, you don't need to sort through piles of paper. Everything you need is assembled for you on an electronic kneeboard that is accessible as you fly.

RELATED LINKS

- Using the Flight Planner
- All About Scenarios

The Prepar3D kneeboard includes seven pages:

- **Briefing:** Displays an abbreviated briefing for the current Scenario.
- **Messages:** A log of Air Traffic Control transmissions and Scenario captions.
- **Nav Log:** A list of waypoints, headings, time, and distance for a flight plan created using the Flight Planner.
- **Keys:** A complete list of keyboard commands.
- **Checklist:** Operating procedures for the aircraft you're flying.
- **Reference:** A list of recommended speeds for the aircraft you're flying.
- **Scenario:** A list of Scenario objectives.

To display the kneeboard

- Click the kneeboard icon on the instrument panel.
  -or-
- Press **SHIFT+F10**.
  -or-
- On the **Vehicle** menu, point to **Kneeboard**, and choose one of the kneeboard pages.

Once the kneeboard is displayed, you can drag it around the screen or move it to another monitor. The next time you open the kneeboard, it will reopen to the same location. **SHIFT+F10** while the kneeboard is open will cycle through the pages.

Printing the Kneeboard Files

If you'd like to have a paper copy of the information on the kneeboard, it's easy to print out.

Briefings

You can print Scenario briefings from the **Briefing** dialog box before a Scenario begins.

Messages

The radio communications log and Scenario briefing are not printable from the kneeboard.

Navigation Log

You can print the navigation log by accessing it from the **Analysis** menu, select **Navigation Log**, and then click the **Print** button.

Printing Checklists and Reference Information

The files for Checklist and Reference pages are located in the
The files are ***aircraft name*_check.htm** and ***aircraft name*_ref.htm**, respectively. To print a checklist or reference page, open the file using your Web browser, and click **Print**.

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Using the Radios

Selecting, tuning, dialing it in

The radios in Prepar3D are used to communicate with air traffic control. Occasionally you must tune the radios to new frequencies as you pass through various controllers' areas of responsibility.
There are two ways to tune the radios: by using the Autotune feature and by tuning manually.

Using Autotune

Switching radio frequencies is easy if you use the Autotune feature because the switching is done for you automatically. This frees you to concentrate on flying the aircraft and navigating to your destination. When you select an ATC menu item that contacts a new controller (for example Contact Approach), the radio frequency changes to the new controller's frequency automatically.
When using Autotune, you may not hear anything on the radio until you choose an item from the ATC menu, even if there are other aircraft talking to ATC (unless you're already tuned to an active frequency). That's because the radio is not tuned until you initiate contact by choosing a message from the menu.

Tuning the Radios Manually

Pilots who want to do it all can bypass the Autotune feature by tuning the radios by hand. This means you'll have to tune the radios manually each time a frequency change is required.

1-Standby frequency
2-Standby flip/flop switch

New menu items appear in the ATC window when you tune the radio to a new frequency. If you want to see choices for messages to a tower controller, for example, you must first tune the radio to the tower frequency.

To tune a new frequency into a communication, navigation, or ADF radio

1. Press **SHIFT+2**, or click on the panel to bring up the radio stack.
2. Position the pointer over the radio frequency you want to change.
3. Use the mouse wheel to change the frequency up or down.

- or -

1. Point to the standby frequency numbers. The pointer changes to a hand.
2. Move the pointer left or right.
   A plus sign (+) or minus sign (-) appears on it.
3. To increase the frequency numbers, position the pointer so you see a plus sign, and then click the left mouse button.
4. To decrease the frequency numbers, position the pointer so you see a minus sign, and then click the left mouse button.
5. When you have the correct frequency dialed in, click the white button labeled **STBY** (sometimes called the flip-flop switch).

- or -

1. Press **C** to select the primary frequency numbers on Com 1 radio (the numbers to the left of the decimal). Press **C+2** to select the primary frequency numbers on Com 2 radio.
   - Press the **PLUS SIGN** key (+) to increase the frequency numbers.
     - or -
   - Press the **MINUS SIGN** key (-) to decrease the frequency numbers.
2. Press the **C** key twice to select the secondary frequency numbers on Com 1 radio (the numbers to the right of the decimal). Press the **C** key twice, and then press 2 to select the secondary frequency numbers on Com 2 radio.
   - Press the **PLUS SIGN** key (+) to increase the frequency numbers.
     - or -
   - Press the **MINUS SIGN** key (-) to decrease the frequency numbers.

This also works for the NAV, ADF, and transponder radios by first pressing the **N** (**N+2** for NAV 2), **A**, and **T** keys, respectively, or by using the mouse wheel.

The Audio Panel

Use the audio panel's **Com 1**, **Com 2**, or **Both** buttons to choose which radios you want to transmit on and listen to. To choose a radio to Autotune, transmit, and receive on, click either the **Com 1** or **Com 2** button on the **Audio** panel. If you click the **Both** button, you will still be transmitting on the radio you had previously selected, but listening to both radios. This can be especially helpful on approach,

since you don't want to tune away from the controller in order to hear ATIS (if you do, you'll miss traffic calls). You can also listen to the audio identifiers for the nav radios by selecting their buttons on the audio panel as well. If you have controllers tuned in on both radios, and the Both button is lit on the audio panel, it will sound very busy and perhaps be difficult to understand.

Example of an Audio Panel.

The audio panel may look different in other aircraft.

To use the audio panel

- Click the button for the radio you want to listen to.
- When the green light on the button is lit, the audio channel for that radio is active.

To listen to more than one radio at the same time

- Click the **Both** button on the audio panel.

To find a particular communication or navigation frequency

- Look up the frequency using real-world charts.

  - or -

1. On the **World** menu, select **Map**.
2. On the map, point to the airport or navigation aid whose frequency you are looking for.
   (You may have to use the map's **Zoom** feature.)

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PREPAR3D

Navigation Overview

Planning, coordination, and precision are paramount in flight navigation. Prepar3D offers tools to aid in replicating real flight navigation. Typically, a flight will begin at an airport. Read more about how to select airports and runways in the Airport article. Planning the flight route and type of flight (e.g. IFR, VFR) can be done through the Flight Planner. Once ready to depart, Prepar3D features virtual Air Traffic Control (ATC) which can be taken advantage of in order to share the airport and sky. While in the sky, the Map or, if the vehicle has it, GPS can be used along with the Vehicle's instruments to navigate.

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PREPAR3D

Airport Overview

Changing Your Aircraft's Location

With more than 24,900 airports to choose from, it's easy to place your airplane at any one of them. On the **Navigation** menu, click **Go to Airport...**.

RELATED LINKS

- Using the Flight Planner

Searching for an Airport

Finding one airport in a list of over 24,900 can be difficult. Luckily, the Go to Airport dialog box includes tools to help. You can search for an airport by name, ID, or city. You may not know the name or ID of the airport you're looking for, but you probably know the city. Even if you don't know the city, the dialog box includes filters to limit the number of names displayed.

Example:

Let's find **John F. Kennedy International Airport** in New York City, New York, in the United States.

If you know that the exact name of the airport (as it's listed in the simulator) is **Kennedy Intl**, you can type "Kennedy" or "Kennedy Intl" in the **Airport Name** text box. If you don't know the exact airport name, but you know that the airport identifier is **KJFK**, you can type the ID into the **ICAO ID** text box. The **City** text box limits the list of airports to those in the city you're searching. If you don't know either the airport name or the ID, but you know the airport is in New York City, you can type the city name in the **Airport City** text box, and then look for Kennedy in the resulting list.

Filtering the Airport List

Sometimes you may want to fly from an airport in a particular country, region, state, or province but you don't know any airport names, IDs, or city names. In this case, it would be easier to filter the airport list by location. A filter also helps in cases where you're not sure of the spelling of an airport or city name. Use the drop down menus under **Filter By** to filter by Country / Region, State / Province, or City and list airports from those areas only.

To clear the filter, select the **Reset All** button.

Selecting a Runway or Starting Position

Once you've selected an airport to fly from, you can select where on the airport you want the simulator to begin. In the real world a flight begins by taxiing from a gate or parking area to the runway. If you want to begin immediately on the active runway without having to taxi there, you can accept the default selection in the **Runway/Starting Position** list. Runways are listed by their runway number.

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PREPAR3D

Flight Planner

The Flight Planner helps you plan VFR and IFR routes. It's not necessary to have the navigation charts for your route (although it can help and adds realism). The Flight Planner determines your routing based on the type of flight you want to make, suggests a cruising altitude, provides navigation aid frequencies for your route, provides estimated times between waypoints, and keeps track of all these items in the Navigation Log. The Global Positioning System (GPS) also displays the route in the cockpit, including the next waypoint on the route, along with distance and bearing to that waypoint.

CONTENTS

- Creating a Flight Plan
- Editing a Flight Plan
- Saving, Loading and Clearing a Flight Plan
- The Navigation Log

Creating an IFR flight plan and clicking the **OK** button is equivalent to filling out a flight plan form at the airport and handing it to the flight service representative in the real world. Your flight plan is not active until you call ATC on the radio and ask for clearance.

You can activate an IFR flight plan from your current location, even during flight. You can also activate a previously created flight plan in the air. In theory you can create a flight plan from Jerusalem to Damascus, take off from Cairo, and then activate the flight plan when you get near Jerusalem. In this scenario, a message box will appear asking whether you want to move your airplane to the airport indicated as the departure airport on the flight plan form. If you choose not to move the airplane, you will be cleared from your current location to your destination.

Creating a Flight Plan

Selecting **Navigation** from the upper toolbar, and then **Flight Planning** make selections for the type of flight, the departure and destination points of the flight, and the type of routing you desire.

Choose the Departure Location

To enable the Flight Planner to automatically determine the route for your flight, you must define your departure location.
Note: The simulator supports filing an IFR plan during a flight. When you create a flight plan, you can choose to start the IFR flight at your current location.

To select a departing location

1. In the **Departure Location** box, click **Select**.
2. Choose an airport from the **Select Airport** dialog box.
3. Click **OK**.

Choose the Destination Airport

To enable the Flight Planner to automatically determine the route for your flight, you must tell it where you are going.

To select a destination airport

1. In the **Destination** box, click **Select**.
2. Choose an airport from the **Select Airport** dialog box.
3. Click **OK**.

Choose the Flight Plan Type

You can select the type of flight plan you intend to fly. The choice you make will be a factor in the altitude the Flight Planner chooses for your flight.

To choose a flight plan type

- Click **VFR** to plan a flight under visual flight rules.
  The elevation of the terrain you'll be flying over will determine the suggested altitude.
  -or-
- Click **IFR** to plan a flight under instrument flight rules.
  The minimum en route altitude (MEA) along your route will determine your clearance altitude. You can change altitude later.

Choose the Autorouting Method

You have a choice of methods that the Flight Planner can use to plot your route. These selections are unavailable until you have chosen departure and destination airports.

Choose a routing

- Click **Direct-GPS** to plot a direct point-to-point route. Navigate this route using the Global Positioning System (GPS) feature.
- Click **Low altitude airways** to plot a course along low altitude airways (Victor airways).
- Click **High altitude airways** to plot a course along high altitude airways (Jet airways).
- Click **VOR to VOR** to plot a course using VOR stations along the route.

Changing the Cruising Altitude

The altitude in a flight plan is determined automatically by whether you selected VFR or IFR. When you choose VFR, the altitude selected is what is required to safely clear terrain along your route. When you chose an IFR flight plan, the altitude selected is at or above the minimum en route altitude (MEA) requirements. Remember that you can request a new altitude from ATC in flight when flying IFR.

To change your cruising altitude

- Click the arrows on the right side of the **Cruising altitude** box to select a new altitude.
  -or-
- Double-click the **Cruising altitude** box and type a new altitude.

Be aware that the cruising altitude chosen for IFR flight plans will be used as the clearance altitude by ATC. The controller will clear you to that cruising altitude. You can, however, change the altitude in the Flight Planner or request altitude changes in flight.

Find the Route

Once you have completed the first four steps of planning your flight, selecting your routing will cause the **Map** to generate your route drawn as a red line across the display. You can now make adjustments and refinements to your flight plan. If you need to adjust the Departure, Destination, or Flight Plan Type, the map will not regenerate the route unless you reselect the autorouting method.

To complete the flight plan

1. Select **Save...**
2. When the **Save Flight Plan** dialog box appears, Click **OK**.
3. When the message appears asking if you want to move your aircraft to the departure airport listed in the flight plan:
   - Click **Yes** to move the aircraft.
     -or-
   - Click **No** to activate the flight plan from your current location.

Using the Route Map

After you create a flight plan, the map displays the route graphically as a red line. The red line indicates the route that you will follow, but you can add or delete waypoints along this route to customize it.
The map always displays north at the top. You can move the map in any direction in order to view another part of your route.

To move the map

- Click any edge of the map to scroll in that direction.

The map displays airport information, airspace boundaries, geographical borders, and latitude and longitude. You can also choose to display other features, such as navigational aids, airports, and airways. Learn what each of the icons at the top of the map represents, and use the icons to display only what you need in order to keep the map easy to read.

To display or hide individual map elements

1. Pause the pointer over any map icon to see which map element it controls.
2. Click the icon to turn the map element on or off.

See the **Map Display Icons** section below to learn the icon functions.

Map Display Icons

A set of 17 icons at the top of the map lets you customize the map display. When you move the pointer over an icon, rollover help describing the icon's function appears at the bottom of the Flight Planner screen.

Button	Function	How to use
	Zoom In	Click to zoom in on the map, so you can see more detail.
	Zoom Out	Click to zoom out on the map, so you can view a larger area.
	Reset Zoom	Click to reset the map to the default magnification.
	Airports	Click to display airports on the map.
	VORs	Click to display all VOR stations. VORs are displayed in blue.
	NDBs	Click to display all non-directional beacon (NDB) stations. NDBs are displayed as red concentric circles.

	ILS	Click to display ILS feathers.
	Intersections	Click to display all airway intersections. Intersections are displayed as green triangles.
	Victor Airways	Click to display all Victor airways. Victor airways are displayed as blue lines.
	Jet Airways	Click to display all Jet airways. Jet airways are displayed as magenta lines.
	Airspace	Click to display airspace boundaries. You may need to zoom in to see the boundaries.
	Route Line	Click to display the route line.
	Weather stations	Click to display all weather stations.
	Weather systems	Click to display weather systems when real-world weather has been downloaded.
	Data Tags	Click to display labels next to objects on the map.
	Icons	Display or hide icon symbology.
	Contour Map	Click to display terrain contours on the map.

The Waypoint List

The waypoint list is on the right side of the Flight Planner. The **Type** column shows the type of waypoint: WP (a custom waypoint), VOR, NDB, intersection, or airport. The **ID** column shows the ICAO (International Civil Aviation Organization) identifier for waypoint that have identifiers. Custom waypoints are labeled WP1, WP2, etc.
If you click any waypoint in the list, the map will zoom in on that waypoint. You can return to the default magnification by clicking the **Reset Zoom** icon.

Adding Waypoints

You can create waypoints using navigation facilities, navaid intersections, or airports. You can even add waypoints at arbitrary points in space using the Flight Planner.

To add waypoints to a route

- Drag the red route line to any point on the map that you wish to include in your route.

- or -

1. Drag the red route line to any navigation facility, navaid intersection, or airport. The **Facilities** dialog box will appear with a list of waypoints (VORs, NDBs, intersections, and airports) near the point you've chosen.
2. Select the waypoint you wish to add to your route from the list in the **Facilities** dialog box.
3. Drag the red route line to any navigation facility, navaid intersection, or airport. The Facilities dialog box will appear with a list of waypoints (VORs, NDBs, intersections, and airports) near the point you've chosen.
4. Click **OK**.
5. Click **Save** to save your flight plan again. You must save the Flight Plan again before the added waypoints will appear in the **Navigation Log**.
   Note: If your route is along an airway, hide the airway lines before you attempt to drag the route line. To hide the airway lines, click the airway icon at the top of the map.

To edit custom waypoints

1. Click a waypoint in the waypoint list.
2. Click **Edit Waypoint**.
3. Type a description, latitude, longitude, and altitude for the waypoint. You can enter values for any one or all of these variables.
4. Click **OK**.
5. Click **Save** to save your flight plan again. You must save the Flight Plan again before the added waypoints will appear in the **Navigation Log**.

To delete a waypoint

1. Click the waypoint you want to delete in the waypoint list.
2. Click **Delete waypoint**.
3. Click **Save** to save your flight plan again.
   You must save the Flight Plan again after deleting waypoints before they will disappear in the Navigation Log.

Note: You cannot delete the departure or destination airports from the waypoints list.

Saving, Loading and Clearing a Flight Plan

Once you've created a flight plan, you can save it for reuse. If you load a saved flight plan and make modifications to it, you will be prompted to save the file again. If you save the flight plan and click **Yes** to overwrite the previous file, the Navigation Log and Flight Planner map display will reflect your changes.

To save a flight plan

1. In the **Flight Planner**, click **Save**.
   Note: The **Save** button is dimmed until you create a flight plan.
2. In the **Save Flight Plan** dialog box, use the suggested name for your file
   -or-
   Type a new name in the **File name** text box.
3. Click **Save**.

To load a saved flight plan

1. In the **Flight Planner**, click **Load**.
2. When the **Load Flight Plan** dialog box appears, select a saved flight plan.
3. Click **Open** to load the file.

To clear the current flight plan:

- In the **Flight Planner**, click **Clear** to clear all flight plan information from the dialog box.
  This does not delete saved flight plan files.

The Navigation Log

The navigation log lists the waypoints and time en route for your flight, as well as headings, speeds, and fuel burn rate along the route. The portion of flight from one waypoint to another is referred to as a "leg."

To access the navigation log:

- Click the **NavLog** button.

Navigation Log Header

The navigation log header lists your flight's departure and destination airports, the total distance between them, the estimated fuel required to complete the trip, and the estimated time en route.

Waypoints

The waypoints listed from top to bottom in the first column of the navlog follow the order that your flight will pass over them. The ICAO identifier is used as the waypoint name. If the waypoint is a radio navigation facility, its frequency is listed in parentheses next to the identifier.

Route

The route listing depends on what type of routing you chose when creating the flight plan. Flight plans routed via **GPS** or **VOR** to **VOR** will always show the **-D**-> symbol, indicating that the route is direct from one waypoint to the next. Flight plans routed via airways will indicate the airway designation (e.g., J50 or V122) on which each leg of the flight is flown.

Alt

The **Alt** column displays the cruising altitude in feet or meters, depending on your international settings. (For more information, see International Options.)

Hdg

The **Hdg** column displays the heading to the waypoint.

Distance

The distance shown in the top row indicates the distance of the entire flight. Each row in the **Distance** column is split into two cells: The top cell indicates the distance of the leg, or the distance from the current waypoint to the next waypoint; the bottom cell indicates the distance remaining to the final destination.

GS (Kts)

Each row in the **GS** (or ground speed) column is split into two cells: The top cell indicates the estimated ground speed, which is based on the speed of the aircraft selected when the flight plan was created; the bottom cell indicates the actual ground speed, which is calculated and updated during the flight.

Fuel

The top of the **Fuel** column indicates the total fuel on board the aircraft. Each row in the **Fuel** column is split into two cells: The top cell indicates the estimated fuel burn for that leg, and the bottom column indicates the actual fuel burn, which is calculated and updated during the flight.

Time

The top value in the **Time** column indicates time of departure. Each row in the **Time** column is split into two cells: The top cell indicates the estimated time to the

waypoint, and the bottom cell indicates the actual time to the waypoint, which is calculated and updated during the flight.

To print the Navigation Log

- Click the **Print** button at the bottom of the Navigation Log.

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PREPAR3D

Map

The **Map** dialog box provides you with a graphical representation of your route, information about airports and facilities along the way, and the ability to instantly change your position, altitude, heading, and airspeed. The **Map** dialog box lets you display or hide graphical elements in the map itself. For example, if you want to see the locations of all of the airports in the simulator world, you can display them on the map. Doing so, however, may make the map too cluttered, so the Map dialog box also lets you hide the airports.
To open the **Map**, on the **Navigation** menu, click **Map**.

CONTENTS

- Using the Map
- Displaying or Hiding Map Elements
- Data Tags
- Using the Map in Aircraft Mode

Using the Map

Think of the map as an aviation chart. The map displays airports, navigational aid facilities, airways, flight paths, and other relevant data. The map can also display topographical information, an especially useful feature when flying in mountainous areas, as well as things a real-world navigation chart cannot, like weather fronts. The map displays your aircraft as a small plane icon, and the tower as a small tower icon. You can zoom in and out to display more detail or more territory on the map.

Moving the Map

The map always displays north at the top. You can move the map in any direction to view another part of your route by clicking near the edge of the map; you'll find this option particularly helpful when you zoom in to get a closer view of the map.
For example: To view a portion of the map south of the area currently displayed, place the pointer near the bottom edge of the map. When the pointer turns into a large arrow, click the edge of the map; the area of the map's view will move down. To move the map east, click the right side of the map; to move west, click the left side of the map; to move north, click the top of the map. You can also move diagonally by clicking a corner of the map.
The map also displays state and country borders, as well as latitude and longitude lines. Use the icons at the top of the map to display features such as navigational aids, airports, weather stations, airspace boundaries, and airways.

Displaying or Hiding Map Elements

Use the icons along the top of the **Map** dialog box to navigate within the map or to display or hide map elements. The table below explains the function of each icon.

Icon	Function
	Zoom in
	Zoom out
	Center map on your aircraft's current position.
	Print the current map.
	Display or hide airports.
	Display or hide VORs.
	Display or hide NDBs.
	Display or hide ILS feathers.
	Display or hide airway intersections.
V	Display or hide low altitude airways.
J	Display or hide high altitude airways.
	Display or hide airspace boundaries.
	Display or hide your aircraft's flight path.
W	Display or hide weather stations.
	Display or hide weather systems.
A	Display or hide data tags.
i	Display or hide icon symbology.
	Display or hide topographic features.

Data Tags

Data tags are displayed next to individual map elements, which makes it easy to get information quickly. Data tags include airport information (airport name, runway length and altitude, radio frequencies, and the like), airspace information, instrument

approach information, and navigational aid information.
To display or hide data tag information, click the Data Tags icon at the top of the map.

Changing Aircraft Position

Rather than flying to a location where you want to begin a flight, you can move your aircraft on the map. (You can also move your aircraft using the **Go to Airport** dialog box, but using the map allows you to quickly place your aircraft anywhere, including in off-airport locations.) Move your aircraft on the map by using the text boxes on the left side of the **Map** dialog box, or by dragging your aircraft to the desired location. On the right side, you can set the latitude, longitude, altitude (in feet), heading (from 1 to 360 degrees), and airspeed.

Note: You can exceed your aircraft's maximum speed, but an overspeed warning will appear during flight.

Getting Information about Airports and Facilities

You can get information about any airport, airspace, or facility depicted on the map. The information is displayed in **ToolTips** bubbles that appear when you pause the pointer over map elements. You may have to enlarge the map or hide some map elements to see other elements. Simply point over any map element to see ToolTip information.

The following table lists the information found in map ToolTips:

Map element	Information in ToolTip
Airport	Airport name, ICAO ID, runway, elevation, radio frequencies.
VOR	VOR name, ID, class, frequency.
NDB	VOR name, ID, class, frequency.
Marker beacon	Outer, middle, inner label.
ILS feather	ILS name, ID, final approach heading, frequency.
Intersections	Intersection name
Low altitude (victor) airways	Airway designator and minimum en route altitude.
High altitude (jet) airways	Airway designator and minimum en route altitude.
Airspace boundary	Airspace name, class, altitude limits.
Weather stations	Station name, temperature/dewpoint, wind direction and speed.

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PREPAR3D

ATC Overview

Air traffic control is a vital element of travel safety and commerce. Prepar3D's air traffic control helps new pilots to learn the basics, and helps veteran pilots to practice their skills. This page is air traffic control central. The links here take you to explanations of real-world air traffic control, air traffic regulations, and how to use the air traffic control feature of Prepar3D. Add realism to your flights with ATC.

General Air Traffic Control Information

Introduction to Prepar3D ATC
The basics of simulated air traffic control.

What is Air Traffic Control
How ATC makes the skies safe for travel.

Multiplayer ATC

Multiplayer ATC in Prepar3D
ATC as real as it gets.

Acting as a Tower Controller
Reading radar in Prepar3D.

Using Air Traffic Control

Using ATC in Prepar3D
How to make the most of ATC in Prepar3D.

VFR Flight and ATC in Prepar3D
Flying clear of clouds.

IFR Flight and ATC in Prepar3D
Flying in the clouds.

Understanding Airspace
Boundaries in the sky.

Other ATC Services
Getting other help from ATC.

Real-World ATC Differences
Understand how Prepar3D's ATC differs.

Airport ATC Operations
Airports from the Top Down.

ATC Glossary
What do those ATC terms mean?

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ATC Introduction

Introduction to Prepar3D ATC

Interactive air traffic control (ATC) is one of the most exciting features of Prepar3D. You'll have plenty of company in the skies, and you can ask for and receive clearances, be warned of air traffic near you, get vectors, and hear controllers speaking to other aircraft.
You do not have to interact with the ATC system in order to fly in Prepar3D; ATC is an enhancement to the Prepar3D world, but you can still fly from one place to another without communicating with anyone until you're ready to use the ATC system. When you start using ATC in Prepar3D, take advantage of the Autotune feature, which can tune the radio for you and lessen your workload. (For more information, see Using the Autotune Feature.)

CONTENTS

- Introduction
- The Phonetic Alphabet
- Towered (Controlled) Operations
- Non-towered Operations
- Acknowledging ATC Transmissions
- Asking ATC to Repeat Messages
- Getting Handed Off

Multiplayer ATC and Shared Aircraft

In multiplayer mode, you can connect over the Internet or a LAN to be an air traffic tower controller for Prepar3D pilots or interact with a live Prepar3D Tower Controller. How about live instruction on any aspect of using Prepar3D or on flying? You can give or receive instruction with another pilot or a friend over the Internet or a LAN using Prepar3D's Shared Aircraft feature in multiplayer. To learn more, see Sharing the Aircraft in Multiplayer in the Learning Center.
Remember that if you use Multiplayer ATC in Prepar3D, there really is no difference between ATC in the real world and ATC in Prepar3D. To learn more, see Multiplayer Air Traffic Control in the Learning Center.

Learning More about ATC

No single article can provide an extensive education in all the complexities of the real-world air traffic control system, but after reading this page you'll have enough information to use the ATC system in Prepar3D. Along the way, we'll include references that will let you explore the wider world of ATC and radio communications. The Aircraft Owners and Pilots Association (AOPA) also offers a wealth of information about all aspects of flying.
Although the Learning Center's ATC articles include advanced topics for instrument-rated pilots, this isn't some secret information that you're barred from if you're a novice. Once you get more experience under your belt and learn the system, you can make use of the advanced topics, too. For help with unfamiliar terminology, see the ATC Glossary.

Novices

If you're new to Prepar3D, you'll have more fun if you first learn to fly using the **Flight Academy**. Once you feel comfortable at the controls of one or more of the Prepar3D aircraft, take the time to read through the various ATC articles and learn how to use ATC and radio communications. You'll need to understand how the system works and have a basic familiarity with the language of ATC. Beginners often find the Autotune feature helpful; it will tune your radios to new frequencies automatically (see Using the Autotune feature).

Intermediate Users

If you're an experienced Prepar3D user but are unfamiliar with air traffic control, take time to read through the Learning Center's ATC articles. You'll learn how the ATC system works and learn how to operate within that system in Prepar3D.

Advanced Users

If you're a pilot or experienced simulator user, you may want to jump to the sections Using ATC in Prepar3D and Real-World Differences.

Getting Started in ATC

Remember to use the numbers along the top of the keyboard when making choices from the ATC menu. The numbers on the numeric keypad (usually on the right side of the keyboard) are assigned to other functions in Prepar3D.
To learn more about using the Air Traffic Control menu, see Using the ATC Menu.

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PREPAR3D

ATC Defined

How ATC makes the skies safe for travel

Introduction

Just as on a busy highway, the tremendous volume of aircraft flying the skies today requires traffic management. Someone has to be in control of where all those aircraft are flying, at what altitude and speed, and by what route. The task falls to the various air traffic control agencies located in nearly every country around the world. Air traffic control is a vital component in the safety and economy of the nations of the world. Without a system to keep things moving safely, people and goods cannot be transported efficiently in a timely manner.
In 2004, the top 30 airports in the world handled more than 15,244,065 takeoffs and landings (per the United States Bureau of Transportation). Smaller busy airports often surround these big airports situated in heavy air-traffic areas. The round-the-clock coordination required to keep this system working is crucial. Air traffic controllers—the people who do the job—are highly trained individuals who have to take yearly refresher training, as well as monthly computer-based instruction and evaluations of their use of proper phraseology.
There are different types of air traffic controllers who communicate with pilots from the time the pilot calls for a clearance, through taxi, takeoff, cruise, arrival, landing, and taxiing to parking. Some controllers work in the tall towers that you've seen at airports; others stare at a radar screen miles from any airport. Some serve more than one role; for example, a tower controller may act as a ground controller. (See Towered (Controlled) Operations later in this article.)

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- Introduction
- The Phonetic Alphabet
- Towered (Controlled) Operations
- Non-towered Operations
- Acknowledging ATC Transmissions
- Asking ATC to Repeat Messages
- Getting Handed Off

Call Signs

The controllers keep track of who's who on the radio using call signs. Call signs are composed of the registration letters and numbers painted on the side of the plane for civilian aircraft, airline flight numbers for airliners, and often a combination of a branch name and a number for military flights. Most countries use only letters for call signs, but the United States uses a combination of letters and numbers for many call signs. You can change the call sign of your aircraft in Prepar3D (see Changing the Call Sign).
N700MS indicates an aircraft with the civilian registration "N700MS." The call sign is spoken as "November seven zero zero Mike Sierra." November, in this instance, is the letter with which all United States aircraft registrations begin.
World Travel 455 refers to Flight 455 flown by World Travel Airlines. You generally say this as "World Travel four fifty-five" or "World Travel four five five."
Navy 44F denotes a military flight. This is spoken as "Navy four four Foxtrot." However, there are many variations of military call signs, depending on the branch of service, squadron designation, and what type of aircraft is being flown. You can search the Web for "military call signs" to see some of the real-world military call signs in use today.

Transponder (Squawk) Codes

In addition to the call sign, an aircraft can be identified on radar by a "squawk" code. Most modern aircraft, from the little guys to the big planes, are equipped with a specialized radio called a transponder.

The pilot can dial a series of four numbers (the transponder code, or squawk code) into the transponder. The transponder code identifies the aircraft on the ATC radar screen.
The standard real-world squawk code for VFR flight is 1200. If the flight is IFR (and in some instances while VFR) the controller will provide a squawk code to the pilot. In Prepar3D, the **Autotune** feature sets the squawk codes for you.

ATC in the Real World

A common misconception about the air traffic control system is the idea that every aircraft in the skies is under the control of the ATC system. Actually, aircraft can fly in what is called non-towered, or uncontrolled, airspace; in that case, they don't have to talk to anyone. Aircraft can also fly in controlled airspace under certain conditions without speaking to a controller. There are, however, certain conditions under which an aircraft is required to talk with ATC.
There are two sets of rules by which flights are conducted in most countries: visual flight rules (VFR) and instrument flight rules (IFR).

VFR Flight

If the weather is above certain established standards—which roughly means that the visibility is above the minimum for flying by visual reference alone, even though the pilot may still navigate by cockpit instruments—pilots may make flights by visual flight rules. While VFR, a pilot may fly in to and out of uncontrolled airports without any requirement to speak to a controller. VFR flights may also fly into airspace that requires them to speak to a controller.

IFR Flight

When the weather deteriorates below the VFR standard, pilots are required to be "instrument rated" in order to fly. It's also a requirement in many countries to be instrument rated to fly above a certain altitude (18,000 feet, or Flight Level 180, in the United States). Most airliners in the United States fly on IFR flight plans, although in Prepar3D you can choose to fly an airliner VFR. While IFR, a pilot is required to be in communication with ATC unless they are in areas where coverage is not available or they have a radio failure. In Prepar3D, there is ATC coverage over the entire world.

ATC Language

Many student pilots are intimidated by the language of ATC, but it really isn't difficult to learn. It's structured and often abbreviated, but once you learn what to expect and what the appropriate response should be, using ATC adds more fun to your flight experience.
Prepar3D is an ideal tool for learning to use the ATC system. Keep in mind that much of what you read about from here on is done for you automatically in Prepar3D. You don't have to know exactly what words to use, because the phraseology is spoken for you and the menu displays the correct choices for the particular phase of flight you're in. If you make a selection on the ATC menu in the simulator that you didn't intend, you can make another. The ATC menu is not a multiple-choice quiz, so don't feel like there's a wrong answer. The items listed are options; think of them as paths to different results. The choice you make depends on what you want to do.
The keys to ATC communication are **clarity** and **brevity**, especially when traffic is heavy. For that reason, it often sounds like pilots and controllers are speaking a special language. They are; it's really just a type of shorthand. The phraseology you hear in Prepar3D is based on standard ATC phraseology used in the real world.
Think about the minimum amount of information you can give to someone and still communicate the relevant message; that's what you're shooting for with ATC communications. When you call a controller for the first time, the essential information is:

1. Which controller you are calling.
2. Who you are.
3. Where you are.
4. What you want to do.

A typical transmission to a ground controller might fill in the blanks with the following:

1. Los Angeles Ground
2. Learjet N700MS
3. At parking
4. Requesting taxi for takeoff

Pilot: "Los Angeles Ground, Learjet N700MS, at parking, requesting taxi for takeoff."

You'll notice when responding to a communication from a controller that the phraseology you hear in Prepar3D is often just repeating what the controller said, only briefer. This is how it's done in the real world.
Here's an exchange between a pilot and controller. The pilot is VFR and wants to transition through the airspace over the Executive Airport in Orlando.

Pilot: "Executive Tower, Mooney N700MS is type Bravo, two miles west. Requesting transition."

Controller: "Mooney 0MS, transition approved. Report clear of Executive tower airspace."

Pilot: "0MS will report clear."

The pilot makes an initial request by stating whom she's addressing, the aircraft call sign (spoken as "November seven zero zero Mike Sierra"), what type of aircraft she's flying, where she is, and what she wants. The controller responds by approving the transition and requesting that the pilot report when clear of the airspace. When the pilot responds, she only repeats the relevant portion of the controller's transmission, so that the controller knows the pilot understands the expectation. Both the pilot and controller always use the aircraft call sign so there is no misunderstanding as to who's talking or being addressed.
If you think about ATC communications as following a standard, logical sequence, it's easier for you to become familiar with the style of communication. Some messages are longer and contain a bit more information, and some are shorter. The trick is to listen over and over to ATC phraseology until it becomes second nature.

Knowing the Lingo

Real-world pilots use a number of resources to become familiar with, or to brush up on, ATC phraseology. You might want to purchase a copy of one or more of the following:
Aeronautical Information Manual (AIM-Pilot/Controller Glossary. U.S. government publications)
Say Again, Please by Bob Gardner; Aviation Supplies & Academics (2005).
The Pilot's Radio Communications Handbook by Paul E. Illman; McGraw-Hill Professional Publishing (1998).
The Pilot's Reference to ATC Procedures and Phraseology by Mills and Archibald; Reavco Publishing (2000).
Comm1 Interactive software to learn IFR ATC procedures.

The Phonetic Alphabet

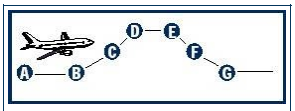
It's imperative that communications over air traffic control frequencies be concise and understandable. Cockpits can often be noisy, and radio audio is not always crystal clear. For this reason, the international flying community uses a standard phonetic alphabet to identify call signs and things like runway intersections, taxiways, and the like. Pilots and controllers use this alphabet, and you should memorize it, just like a real-world pilot, because you'll be hearing it in Prepar3D ATC.

The Phonetic Alphabet

Alfa	**N**ovember
Bravo	**O**scar
Charlie	**P**apa
Delta	**Q**uebec
Echo	**R**omeo
Foxtrot	**S**ierra
Golf	**T**ango
Hotel	**U**niform
India	**V**ictor
Juliet	**W**hiskey
Kilo	**X**-ray
Lima	**Y**ankee
Mike	**Z**ulu

Towered (or Controlled) Operations

What goes up must come down, and flights progress in a logical sequence, from startup until shut down at the destination. The various controllers you need to contact to get clearances when using the ATC system are discussed in the following sections. In most cases, the different controllers communicate on separate frequency ranges, although it's possible for controllers to share frequencies when necessary. Frequencies for airports and instrument approaches can be found in Prepar3D's map display (see Using the Map).



From takeoff to landing, flights follow a logical progression.
A: Preflight, B: Takeoff, C: Departure, D: En Route, E: Descent, F: Approach, G: Landing.

ATC and Charts

VFR pilots carry charts that depict the size, shape, and altitude of airspace. Some real-world pilots (and simulator pilots) buy handheld VHF radios and sit near their favorite airport to listen to the ATC chatter. You can also visit Web sites that connect you to live, real-world ATC transmissions.

Note: If you use **Autotune**, Prepar3D will automatically tune the radio to the correct frequency, and the appropriate ATC menu for each phase of flight will appear.
The following list of controllers assumes that your flight is taking off and landing at controlled airports—in other words, airports that require radio communications with controllers. In Prepar3D, as in the real world, you can take off and land at uncontrolled airports as well. (See Non-towered Operations later in this article.)

Clearance Delivery: Your First Stop

Before beginning a flight under instrument flight rules, you must obtain an IFR clearance from ATC. You have to create an IFR flight plan in Prepar3D in order to get an IFR clearance (see Using the Flight Planner). After you file an IFR flight plan, the first controller you'll contact to begin your flight is clearance delivery. This controller will read an IFR clearance to you that defines your destination, route, altitudes, and any special instructions ATC is expecting you to follow on your flight. You're required to read the clearance back to the controller.

Ground Control: Taxiing to the Runway

Before you move from the parking area, listen to the automated weather reporting system if one is available.
To move from parking to the runway at controlled airports, you need to contact the ground controller—who's actually one of the controllers in the tower—and request to taxi to the runway. You should state a direction of departure in your request; the Prepar3D ATC menu includes that choice. You can also choose to remain in the airport traffic pattern to practice takeoffs and landings. This is usually referred to as "touch and go". Your taxi instructions from ground can include detailed directions to the active runway. For reasons of ground-traffic congestion, ground control may not clear you all the way to the runway at first. Listen carefully, and don't go beyond the point to which you are instructed to go. You are not authorized to taxi until the ground controller issues instructions to do so. Stay on the ground frequency until you are ready for takeoff. Then, contact the tower.

Tower: Takeoff

Once you get to the runway, complete your preflight checks, and are ready for takeoff, you must contact the tower controller. Tower controllers are in the tall tower that overlooks the airport's runways, and generally control the airspace up to 2,500 feet above the airport in a radius of four nautical miles around the airport. They use radar, visual sighting, and radio communications to issue clearances to take off and land, advise pilots of conflicting traffic, provide the current wind and altimeter

information, and clear aircraft to transit the tower's airspace. Tower controllers in the real world usually rotate through assignments as clearance delivery and ground control. Listen carefully to any additional instructions tower may give you. You are not authorized to take off at the airport until the tower controller issues you a clearance to do so.

Approach/Departure

At many airports, there is an approach and departure controller who facilitates movement of IFR flights (and, in certain circumstances, VFR flights) out of congested areas, and may issue clearances to aircraft transiting the airspace controlled by departure. Tower can hand off flights to departure at any time after takeoff, usually about half a mile past the end of the runway. The departure controller will then handle getting the flight through the area and onto its route. The actual controller for this job is often located in a Terminal Radar Approach Control (TRACON) building near a primary airport or co-located in the airport control tower. The same controllers handle approach and departure, and that's why it's not uncommon for you to be handed off from tower to approach control even when you're departing an airport. Don't let that confuse you.

Center

The Air Route Traffic Control Center (ARTCC, or simply "center") controller handles a much larger area than other controllers. In the United States, there are 23 ARTCC facilities, each with multistate coverage. These controllers work in secure buildings that are often not even close to an airport. As a flight proceeds towards its destination, it's handed off from one center controller to the next, until it is handed off to an approach controller or tower.
In the United States, the areas controlled by the various ARTCC facilities are illustrated in the graphic below.

Air Route Traffic Control Centers: A. Seattle B. Oakland C. Los Angeles D. Salt Lake City E. Denver F. Albuquerque G. Minneapolis H. Kansas City I. Ft. Worth J. Houston K. Chicago L. Memphis M. Cleveland N. Indianapolis O. Atlanta P. Jackson Q. Miami R. Boston S. New York T. Washington

Approach

Approach control provides radar and non-radar services to IFR and VFR aircraft arriving, departing, or transiting the airspace controlled by the approach facility. Essentially, this service gets aircraft from the en route phase of their flight down to the point where they are handed off to a tower for landing. In the case of IFR flights, approach may issue vectors (directions) to an aircraft to get them on to the final approach path for their destination airport. If an airport doesn't have a TRACON near it, this service may be provided by ARTCC.

Tower: Landing

The goal of all flights is to end safely back on the ground. The tower controller at the destination airport handles takeoffs, landings, and transiting aircraft. On an IFR flight, the pilot will be instructed when to contact the tower controller. On a VFR flight, it's customary to contact the tower about 10 to 15 miles from the airport after listening to automated information about the airport. The tower controller issues instructions on how to approach the airport—that is, how to enter the traffic pattern—and may provide traffic and weather information. You are not authorized to land at the airport until the tower controller issues you a clearance to do so.

Ground Control: Taxiing to Parking

Once you turn off the active runway after landing, tower instructs you to contact the ground controller. Ground provides a route from your location to where you want to park. For reasons of ground-traffic congestion, ground control may not clear you all the way to parking in their first clearance. Listen carefully, and don't go beyond the point to which you are cleared. You are not authorized to taxi until the ground controller issues you a clearance to do so.

Non-towered Operations

Airports that are not equipped with control facilities (ground, tower, approach, or departure) are called non-towered, or uncontrolled, airports. Pilots operating on or around these airports use a Common Traffic Advisory Frequency or CTAF (usually pronounced "see-taf") to announce their intentions to other aircraft in the area. In addition, some airports have towers that don't operate 24 hours a day; these airports use CTAF when the tower is not in operation.
In Prepar3D, the ATC menu automatically lists CTAF message choices when operating at non-towered airports. When departing a CTAF airport, you should

announce your intention to taxi and to take off. When you are 10 to 15 miles away from arrival at a CTAF airport, you should announce your intention to enter the traffic pattern and land. You address the other aircraft in the area as "Traffic." By making these announcements, you're not only telling this information to pilots at the airport, you're announcing it to anyone else in the area listening on the same CTAF frequency —all the more reason to keep it brief, but informative.
The idea behind CTAF communications is similar to that at controlled facilities. You want to state the following:

- Who you are talking to.
- Who you are.
- Where you are.
- What you want to do.

An example of a flight out of Bremerton National Airport near Seattle, Washington might state this information as follows:

- Bremerton Traffic
- Mooney N700MS
- Taking off
- Runway 19, Bremerton

Pilot: "Bremerton Traffic, Mooney N700MS, taking off, Runway 19, northeast departure, Bremerton."

Note that the order of the sentence isn't the primary issue. What's important is that you tell other aircraft that might be operating on or near Bremerton National that you're about to launch into the skies from Runway 19 at Bremerton and that you're leaving the area to the northeast.

Acknowledging ATC Transmissions

It's important to acknowledge the transmissions you receive from air traffic controllers. The pilot's response to a message from ATC is often an abbreviated read-back of the controller's message.
Example:

Controller: "Mooney 0MS, turn right heading 270, descend and maintain 15,000. Contact Seattle Approach on 13485. Good day."

Pilot: "Right to 270, maintain 15,000, Approach on 13485, Mooney 0MS."

When you receive a message from ATC in Prepar3D, the ATC menu automatically displays a selection of responses to be transmitted by you, the pilot.

Asking ATC to Repeat Messages

The standard terminology to use when asking ATC to repeat a transmission is to say the name of the controlling facility, your call sign, and "say again." For example, an approach controller might tell you to turn to a certain heading, descend, and tune the transponder to a particular squawk code. If you didn't get all of that transmission, you would say, "Seattle Approach, Mooney 700MS, say again."
When the controller has transmitted a message, the last item in the menu is "Say again." Select this menu item to hear the last controller message repeated.
Example:

1. Acknowledge instruction.
2. Say again.

Getting Handed Off

Given the long range of many modern aircraft, it's not surprising that they often fly through the airspace of multiple controllers along the route to their destination. Even going from the parking area to the runway, a pilot will often speak to different controllers at controlled airports.
When under the control of ATC, pilots get "handed off" from one controller to the next until they reach their destination. The handoff is simple: the controller instructs the pilot to contact the next controller and provides the frequency on which the contact should be made.
Examples:

Controller: "Mooney 0MS, contact Executive Tower on 120.6"

Pilot: "Going to 120.6, Mooney 0MS."

Controller: "Mooney 0MS, contact Orlando Departure on 120.1"

Pilot: ", Departure on 120.1, Mooney 0MS."

The pilot then tunes in the new frequency and notifies the new controller that he is on the controller's frequency.

Pilot: "Seattle Center, World Travel 1123 is level at FL280."

Pilot: "Denver Approach, Baron N700MS with you."

Pilot: "Jackson Departure, Learjet N700MS is climbing through 10,500 for FL320."

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PREPAR3D

ATC Use

How to make the most of ATC in Prepar3D

If you are a real-world pilot or if you already have knowledge of the ATC system, you'll love using ATC in Prepar3D. If you're new to ATC, we've worked hard to make your introduction to the system fun and easy. (You may also want to follow the ATC lesson in the Private Pilot section of **Flight Academy**). The main thing to keep in mind is that the interaction between pilots and air traffic controllers is a kind of conversation; you'll either make requests from controllers or respond to their instructions.

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- Changing Call Signs
- Choosing a Pilot Voice
- Using the Autotune Feature
- Tuning the Radios Manually
- Using the ATC Menu
- Disabling ATC
- Air Traffic Density
- Add-On ATC

RELATED LINKS

- ATC Settings
- Traffic Settings

Multiplayer ATC and Shared Aircraft

In multiplayer mode, you can connect over the Internet or a LAN to be an air traffic tower controller for Prepar3D pilots or interact with a live Prepar3D Tower Controller. How about live instruction on any aspect of using Prepar3D or on flying? You can give or receive instruction with another pilot or a friend over the Internet or a LAN using Prepar3D's Shared Aircraft feature in multiplayer.
To learn more, see Sharing the Aircraft in Multiplayer in the Learning Center.
Remember that if you use Multiplayer ATC in Prepar3D, there really is no difference between ATC in the real world and ATC in Prepar3D. To learn more, see Multiplayer Air Traffic Control in the Learning Center.

Single-player ATC

There are two aspects to learning ATC in Prepar3D: learning the ATC system and language, and learning the **ATC** menu. Learning the system involves knowing who to talk to and what to expect from the ATC controllers who are communicating with you (for more information, see ATC Defined). Learning ATC commands means knowing how to send messages to ATC that are appropriate to your current flight. The ATC menu displays the response choices available to you. To learn more, see Using the ATC Menu.
When two people attempt to transmit a radio message at the same time on the same frequency, you hear an unpleasant squeal over the radio. In pilot parlance, this is known as getting "stepped on." Stepping on someone else's transmission in Prepar3D means ATC won't hear your transmission. Time your transmissions so that you don't step on other pilots or controllers.
The next several pages explain how to choose the pilot voice you want to use, how to use the **Autotune** feature, how to tune radios manually, and other nuts and bolts of using ATC in Prepar3D. Take your time, have fun, and remember: as real as this feels, it's a simulator. No one will yell at you or take your pilot certificate away if you make a mistake, and ATC is there to help guide you.

Changing Call Signs

In Prepar3D, you can change the ATC name of your aircraft, thus changing the call sign used by the pilot and ATC. Changing the airline name in the ATC Name dialog box will not change the airline livery painted on the outside of the aircraft.

To change your aircraft's ATC name

1. From the main screen click **Free Flight**, and then under **Current Aircraft**, click **Change**.
   -or-
   On the **Aircraft** menu, choose **Select Aircraft**.
2. Select an aircraft, then click **Details**.
3. Make changes to the **ATC Information**.
4. Click **OK**.

You can change your aircraft tail number to any combination of numbers and letters. The pilot and controller use the entire tail number during initial contact. The tail number is abbreviated to the last three characters of the call sign in subsequent contacts. If you always want to hear a short call sign (for example, if you never want to hear the "November" in United States call signs), create a short tail number.

To change the tail number

1. Double-click the **Tail number** box.
2. Type a new aircraft identification.

To change the airline name

- Select a name from the **Airline call sign** list.

To change the flight number

1. Double-click the **Flight number** box.

2. Type a new flight number.

Jumbo jets in the real world are often addressed as Heavy by ATC (such as, "World Travel 1123 Heavy...").

To hear the word "Heavy" included in the call sign

- Select the **Append "Heavy" to call sign** check box.

Choosing a Pilot Voice

When you select an item from the ATC menu, you'll see the text of the message on screen and hear the pilot voice—representing you—saying the phrase. Your messages to controllers are audible, unless you turn the pilot voice off (to learn how, see ATC Settings), as are controller messages to you and to other planes.
When a one of your phrases is played, the message displays in orange text.
Prepar3D displays controller messages in green text.
You can choose from 10 different options for your pilot voice. If the **Pilot Voice** check box is not selected in the **ATC Settings** dialog box, you can't choose a pilot voice and you won't hear a voice when you send a message to ATC.

To choose a pilot voice

1. On the main screen, click **Options** and then click **ATC**.
   -or-
   On the **Options** menu, click **General...** and then **Application**.
2. Select the **Use a Pilot Voice** check box.
3. In the **Pilot Voice** list, click the voice you want to use as your pilot voice.

Using the Autotune Feature

If you use the **Autotune** feature, Prepar3D will switch radio frequencies for you automatically, freeing you to concentrate on flying the aircraft and navigating to your destination. When you select an item from the ATC menu to contact a new controller (for example, "Contact Approach"), the radio frequency changes to the new controller's frequency automatically.
When using the **Autotune** feature, you may not hear anything on the radio until you choose an item from the ATC menu, (unless you're already tuned to an active frequency), even if there are other aircraft talking to ATC. Prepar3D will not autotune the radio until you initiate contact by choosing a message from the menu.

Tuning the Radios Manually

Pilots who want to do it all can bypass the **Autotune** feature by tuning the radios by hand each time a frequency change is required. (For more information, see Using the Radios.)

1-Standby frequency
2-Standby flip/flop switch

New menu items appear in the **ATC** window when you tune the radio to a new frequency. If you want to see choices for messages to a tower controller, for example, you must first tune the radio to the tower frequency.

To tune a new frequency into a communication, navigation, or ADF radio

1. Press **SHIFT+2**, or click on the panel to bring up the radio stack.
2. Position the pointer over the radio frequency you want to change.
3. Use the mouse wheel to change the frequency up or down.
   -or-

1. Point to the standby frequency numbers on the upper right. The pointer changes to a hand.
2. Move the pointer left or right.
   A plus sign (**+**) or minus sign (**-**) appears on it.
3. To increase the frequency numbers, position the pointer so you see a plus sign, and then click.
   -or-
   To decrease the frequency numbers, position the pointer so you see a minus sign, and then click.
4. When you have the correct frequency dialed in, click the white button labeled **STBY**.
   -or-

1. Press **C** to select the primary frequency numbers (to the left of the decimal) on Com 1 radio.
   -or-
   Press **C+2** to select the primary frequency numbers on Com 2 radio.
2. Press **PLUS SIGN (+)** to increase the frequency numbers.
   -or-
   Press **MINUS SIGN (-)** to decrease the frequency numbers.
3. Press the **C** key twice to select the secondary frequency numbers (to the right of the decimal) on Com 1 radio.
4. -or-
   Press the **C** key twice, and then press **2** to select the secondary frequency numbers on Com 2 radio.
5. Press the plus key (**+**) to increase the frequency numbers.
   -or-
   Press the minus key (**-**) to decrease the frequency numbers.

Note: This process also works for the NAV, ADF, and transponder radios by first pressing the N (N+2 for Nav 2), A, and T keys, respectively, or by using the mouse wheel.

The Audio Panel

Use the audio panel's **Com 1**, **Com 2**, or **Both** buttons to choose which radios you want to transmit on and listen to. To choose a radio to autotune, transmit, and receive on, click either the **Com 1** or **Com 2** button on the **Audio** panel. If you click the **Both** button, you will still be transmitting on the radio you had previously selected, but listening to both radios. This can be especially helpful on approach, since you don't want to tune away from the controller in order to hear ATIS (if you do, you'll miss traffic calls). You can also listen to the audio identifiers for the navigation radios by selecting their buttons on the audio panel as well. If you have controllers tuned in on both radios, and the Both button is lit on the audio panel, it will sound very busy and perhaps be difficult to understand.

Audio panel

To use the audio panel

- Click the button for the radio you want to listen to.

When the green light on the button is lit, the audio channel for that radio is active.

To listen to more than one radio at the same time

- Click the **Both** button on the audio panel.

To find a particular communication or navigation frequency

- Use real-world navigation charts.
  -or-

1. On the **World** menu, select **Map**.
2. Point to the airport or navigational aid whose frequency you are looking for. (You may have to use the map's **Zoom** feature).

Using the ATC Menu

Communicating with ATC in Prepar3D mimics the way pilots and controllers communicate in the real world. For example, the pilot makes a request, followed by a response from the controller, or the controller gives an instruction, followed by a pilot acknowledgment. The information in this section refers only to single-player ATC, not multiplayer ATC.
The ATC menu is displayed within a transparent window that you can move and resize. The ATC menu lists the available commands specific to the current state of your flight. You can click items on the panel without moving the ATC menu. Some menus are layered so when you select an item a new menu list appears, and you have to make another selection before Prepar3D will send the message to ATC. (See the example at the end of this section).
At non-towered airports, Prepar3D directs your ATC messages to other pilots in the area—not a controller—so don't expect a response.
The menu does not always contain messages to transmit. When the menu contains messages to transmit, the top line in the menu will read, "**Choose a message to transmit to agent name.**" When the menu contains no messages to transmit, the top line in the menu will read, "**There are currently no messages to transmit to agent name.**"

To display or hide the ATC window

- Press the **ACCENT (`)** or **SCROLL LOCK** key.
  -or-
- Click the ATC panel icon.
  -or-
- On the **Vehicle** menu, click **Air Traffic Control**.

To select an item from the ATC menu

1. If the **ATC** window is not visible, press **ACCENT** or **SCROLL LOCK**.
2. Press the number key at the top of your keyboard that tunes the frequency you want to tune, or that corresponds to the message you want to transmit. (You cannot use the numeric keypad to make selections on the **ATC** menu).
3. To tune to a new agent, choose **Tune x...** from the menu to display a list of messages to transmit to a particular agent.

The ATC menu overrides other commands of the simulator. For example, if you have something mapped to the 1 key, and the ATC menu is open, pressing 1 will select the first item in the ATC menu.

To return to a previous menu

- On layered menus in which you have to select from more than one list of items before the message is sent, select the number on the menu that corresponds to **(-Back-)** to return to the previous menu.

Selecting a landing airport presents a good example. The first menu may have the following selections:

1. Request Flight Following
2. Select landing airport

If you select **2**, the next menu would list all of the available landing airports nearby.

After selecting an airport, the third menu would look something like this:

1. Request touch and go
2. Request full stop landing
3. -Back-

To move the ATC menu window

1. Click the **ATC** window title bar and hold down the mouse button.
2. Drag the window to where you want it.

To resize the ATC menu window

- To change the width
  1. Point to the left or right window border.
  2. When the pointer changes to a horizontal double-headed arrow, drag the border to the right or left.
- To change the height
  1. Point to the top or bottom window border.
  2. When the pointer changes to a vertical double-headed arrow, drag the border up or down.
- To change the height and width simultaneously
  1. Point to any window corner.
  2. When the pointer changes to a diagonal double-headed arrow, drag the border in any direction.

Disabling ATC

If you don't initiate contact with ATC at the beginning of your flight, you can fly without any interaction with controllers. You may still hear transmissions to other aircraft if your radio is tuned to a local frequency. Turn off the avionics master switch if you don't want to hear local radio calls.

Air Traffic Density

You can adjust how much traffic shares the sky with you.

To adjust the amount of air traffic

1. From the main screen, click **Options** and then click **General...**.
2. Click the **Traffic** tab.
3. Move the **Airline traffic density** slider or the **General aviation traffic density** slider.
4. Click **OK**.

-or-

1. On the **Options** menu, click to the **Traffic** tab.
2. Move the **Air traffic density** slider to set the level of traffic you want.
3. Click the **Traffic** tab.
4. Move the **Airline traffic density** slider or the **General aviation traffic density** slider.
5. Click **OK**.

Add-On ATC

If you're using an add-on air traffic control product, you can't turn off ATC. You can, however, choose not to interact with Prepar3D's ATC, and ATC will, in effect, not be active. You can also reduce the volume of AI traffic generated in the simulator.

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PREPAR3D

ATC VFR

VFR Flight and ATC in Prepar3D

RELATED LINKS

- ATC Introduction
- ATC IFR
- ATC Airspace
- Weather Introduction
- ATC Glossary

There are two sets of rules by which flights are conducted in most countries: visual flight rules (VFR) and instrument flight rules (IFR). If the weather is above certain established standards—roughly that the visibility is above the minimum for flying by visual reference alone—pilots may make flights by visual flight rules. While operating under VFR, a pilot may fly into and out of uncontrolled airports without any requirement to speak to a controller.

Just as in the real world, you don't have to interact with ATC in Prepar3D when flying VFR. In fact, Prepar3D is even more flexible, because you don't have to talk with controllers even in VFR situations that would require communication in the real world.

The point to remember when flying VFR in Prepar3D is that ATC is there to help you. You can communicate when flying into airports, request transitions through controlled airspace, and request Flight Following service (see Airspace Transitions and Flight Following).

Another advantage of talking with controllers while under VFR is that the controller will tell you about air traffic flying near you. The controller won't tell you about every aircraft, but will help keep you advised when the workload permits. (See Traffic Messages from ATC).

You can use the Flight Planner to plan a trip from one airport to another in VFR conditions (see Using the Flight Planner). By using the Flight Planner, you can use the GPS to follow your route and even have the autopilot track it for you. You're not filing a flight plan when you use the Flight Planner under VFR, so there's no flight plan that you must cancel at the end of your flight (as is required in the real world).

Flying VFR in IFR Weather Conditions

You will be denied permission to take off or land if the weather at the airport is below VFR minimums. If the destination airport weather turns IFR after you're cleared to land, however, you'll be allowed to land.

If you want to mimic real-world airspace regulations, you should communicate with ATC while VFR when

- Operating within or transitioning Class B airspace.
- Operating within or transitioning Class C airspace.
- Operating within or transitioning Class D airspace.
- Using **Flight Following**.

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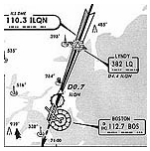
PREPAR3D

ATC IFR

Using Prepar3D ATC under instrument flight rules



Flight in instrument meteorological conditions (IMC) is often the most challenging and interesting kind of flying a pilot can do. You can set weather conditions in Prepar3D to be as easy or as difficult as you like, or even download real-world weather from the Web. For definitions of unfamiliar terms, see the ATC Glossary.
Note: Rendering solid overcast conditions in Prepar3D requires a lot of video processing power. If your computer does not have sufficient power, Prepar3D will automatically create less-than-solid overcast layers. You can adjust weather visuals on the **Weather** tab of the **Graphics Options** dialog box; higher options may decrease simulation performance. If you're practicing IFR approaches and the clouds do not form a solid overcast layer, try setting a low visibility layer at ground level.

Important Notes

In multiplayer mode, you can connect over the Internet or a LAN to be an air traffic tower controller for Prepar3D pilots or interact with a live Prepar3D Tower Controller. How about live instruction on any aspect of using Prepar3D or on flying? You can give or receive instruction with another pilot or a friend over the Internet or a LAN using Prepar3D's Shared Aircraft feature in multiplayer. To learn more, see Sharing the Aircraft in Multiplayer in the Learning Center.
Remember that if you use Multiplayer ATC in Prepar3D, there really is no difference between ATC in the real world and ATC in Prepar3D. To learn more, see Multiplayer Air Traffic Control in the Learning Center.

Getting an IFR clearance

Before flying IFR in Prepar3D, you have to create a flight plan or file IFR in the air. To learn more about using the Flight Planner, see Using the Flight Planner. Once you've created a flight plan, you can call clearance delivery to get your clearance. It will be read to you, and you'll be required to read it back. All clearances in Prepar3D are issued as filed, and route details are not included in the clearance. It's possible in rare instances that Approach frequency boundaries bisect an airport. When that happens, you might get a different departure frequency in your IFR clearance than you get from the tower when they hand you off, because you cross the boundary during taxi or takeoff.

Filing IFR in the Air

Prepar3D now includes the ability to open an IFR flight plan during flight. To file IFR in the air, you can open a previously created IFR flight plan while in flight, or create a flight plan in flight.

To file IFR in flight by opening an existing flight plan

1. During flight, press **ACCENT (`)** or **SCROLL LOCK** to open the **ATC** window.
2. Tune to an approach or center frequency.
3. Select **Create or Open an IFR Flight Plan**.
4. In the **Flight Planner**, click **Load**.
5. In the **Load Flight Plan** dialog box, select a flight plan and then click **OK**.
6. In the **Flight Planner**, click **OK**.
7. When the message box appears asking if you want to move the aircraft to the departure airport, click **No**.

You can now request your IFR clearance from ATC.

To create an IFR flight plan in flight

1. During flight, press **ACCENT** or **SCROLL LOCK** to open the **ATC** window.
2. Tune to an approach or center frequency.
3. Select **Create or Open an IFR Flight Plan**.
4. In the **Flight Planner**, create an IFR flight plan (see Using the Flight Planner).
5. Click **OK**.
6. When the message box appears asking if you want to move the aircraft to the departure airport, click **No**.

CONTENTS

- Getting an IFR clearance
- Filing IFR in the air
- DPs and STARs
- Requesting Altitude Changes
- Canceling IFR
- ILS approaches
- Visual approaches
- Missed approaches
- Full procedure approaches
- Non-precision approaches
- Non-aligned approaches
- Vectors
- Non-towered IFR
- Holding
- IFR Altitudes
- GPS and Instrument Flights

RELATED LINKS

- Weather Introduction
- Using the Flight Planner
- Using the GPS
- ATC VFR
- Aviation Weather Basics
- ATC Glossary

You can now request your IFR clearance from ATC.

DPs and STARs

Routes incorporating published DPs (departure procedures) or STARs (standard terminal arrival routes) are not issued in clearances and cannot be requested in Prepar3D. You can still create these routes, however, by customizing your waypoints in the Flight Planner file (for more information, see Using the Flight Planner). You will still hear ATC clear your flight "as filed," without including a DP or STAR.

Requesting Altitude Changes

You can request a change in cruising altitude while on an IFR flight plan. The option to request a change in altitude will not be available in the ATC menu during phases of flight when ATC is issuing step-up or step-down instructions.

Canceling IFR

If for any reason during your flight you want to cancel IFR, you may do so. "Cancel IFR" appears as one of the menu options during most phases of an IFR flight. To prevent inadvertent cancellation of an IFR flight plan you'll be asked to confirm that you want to cancel IFR when you choose this menu item.
If for any reason during your flight you want to cancel IFR, you may do so.
If you cancel IFR on the way to the runway, ATC will instruct you to taxi to the runway to request a VFR departure from the tower. If you cancel IFR above 18,000 feet, you will not be instructed to descend below 18,000 feet as you would be in the real world.
ATC cancels your IFR flight plan automatically under the following circumstances:

- You land at your filed destination
- You exceed a clearance void time.
- You exceed a clearance and don't respond to the controller's instructions to correct the error.
- You don't respond to controller transmissions.
- You're handed off to a controller and you land somewhere other than your destination or alternate.

ATC will notify you of your cancelled IFR flight plan in all instances except for landings at your filed destination.

ILS Approaches

At Prepar3D airports with precision approaches, the ILSs aligned with the active runways are the default instrument approaches but you can request a different procedure from the controller. The controller will vector you onto the final approach course unless you request the full procedure. If you declare a missed approach, the approach controller will direct you back for another attempt unless you choose a different action in the **ATC** menu.

Visual Approaches

In the real world, controllers frequently will clear pilots for a visual approach if conditions allow. The runway or airport environment must be in sight, or you must be able to follow other traffic to the airport to be cleared for a visual approach. When flying a precision approach in Prepar3D, the ATC menu will include **Request visual approach** as soon as you're cleared for the ILS.

Missed Approaches

If you make the approach and either can't see the runway or are practicing multiple approaches, you can declare a missed approach. You'll be routed back onto the approach course to attempt the approach again. You can cancel IFR and request a VFR landing or choose another destination. The ATC menu will include **Declare missed approach** as soon as you're cleared for the approach.

Full Procedure Approaches

You can now request to fly the full procedure during ILS approaches. You will obviously need the instrument approach plates to accomplish a full procedure.

Non-precision Approaches

Prepar3D ATC supports non-precision approaches. Once you've been told to expect the default approach at your destination airport, you may choose a different approach from those listed in the ATC menu.
ATC issues vectors to you when you're making instrument approaches...

Nonaligned Approaches

If the only instrument approach available at a particular airport is not aligned with the active runway, then you, as pilot, are responsible for knowing how to land. You must circle to land if the final approach course is more than 30 degrees from the runway heading.

Vectors

In Prepar3D, ATC issues vectors to you when you're making instrument approaches and when you're straying off your filed course. The vector includes an instruction to turn left or right and a new heading to follow.

Non-towered IFR

You can create IFR flight plans into and out of uncontrolled airports in Prepar3D. When departing IFR at an uncontrolled airport, ATC issues a clearance and a clearance void time. If you do not contact the departure controller by the clearance void time, your IFR flight plan will be canceled. (Prepar3D ATC notifies you of the cancellation.) All clearance void times are 30 minutes from the time that the clearance is read.
You can create IFR flight plans into and out of uncontrolled airports in Prepar3D.

When arriving at a non-towered airport on an IFR flight plan, approach control clears you for the approach and instructs you to change to the advisory frequency. Once you switch to the advisory frequency, the ATC menu includes two missed approach options. You can choose to announce the missed approach to traffic on the advisory frequency, or you can bypass that option and choose to announce the missed approach directly to the approach controller. When you notify the approach controller, you're routed back onto the course to attempt the approach again. You can cancel IFR and request a VFR landing at this point.

Holding

You can't request a hold in Prepar3D, nor will ATC issue holding instructions.

IFR Altitudes

The **Flight Planner** assigns an altitude based on your route. (For more information, see Using the Flight Planner). However, you can choose a different altitude in the **Flight Planner**. Whether you use the default altitude or set an altitude yourself, this is the altitude to which you'll be cleared in your IFR clearance. You can also request a change in altitude during flight.

GPS and Instrument Flights

Use the GPS in Prepar3D to lessen the workload on instrument flights. When you couple the autopilot to the GPS, the aircraft automatically follows ATC vectors since the ATC system in Prepar3D uses GPS waypoints, even on airways. To learn more, see Using the GPS.

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PREPAR3D

ATC Airspace

Understanding Airspace

RELATED LINKS

- ATC Introduction
- Using the GPS
- ATC Glossary

It's not essential that you understand the way airspace is carved up in order to enjoy using ATC and radio communications in Prepar3D. In Prepar3D, the ATC menu changes according to various factors, some having to do with what type of airspace you're in or approaching. In the real world, you're required to speak with a controller to enter certain classes of airspace. But if you don't speak to a controller in Prepar3D, we won't take your pilot certificate away. However, if you're interested in what various airspace classifications mean in the United States, read on.

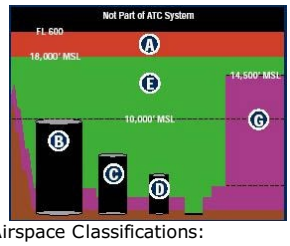
U.S. Airspace Classifications

Class A (Alfa)

Includes airspace from 18,000 feet (5,486 meters) above mean sea level (MSL) up to and including FL600 (Flight Level 600, or 60,000 feet/18,288 meters). Unless otherwise authorized, pilots must operate under instrument flight rules in Class A airspace.

Class B (Bravo)

Includes controlled airspace from the surface to 10,000 feet (3,048 meters) MSL surrounding the busiest airports. Class B airspace volumes are individually tailored, but usually include airspace within 30 miles of the primary airport. To operate in real-world Class B airspace, pilots must meet certain requirements for certification, weather conditions, and aircraft equipment, although you don't need to worry about these factors in Prepar3D. You're required to contact and receive a clearance from ATC prior to entering Class B airspace in the real world. If you take off from within Class B or Class C airspace in Prepar3D, ATC behaves as though **Flight Following** service is automatic, meaning that ATC will handle your flight until you're out of the Class B or Class C airspace.



Airspace Classifications:
A-Class Alfa, B-Class Bravo, C-Class Charlie, D-Class Delta, E-Class Echo, G-Class Golf

Class C (Charlie)

Includes airspace from the surface to 4,000 feet (1,219 meters) MSL above an airport with an operational control tower and that is serviced by a Terminal Radar Approach Control (TRACON). Class C airspace is individually tailored for each airport, but it usually extends in a radius of five nautical miles (9.26 kilometers), rising from the surface up to 4,000 feet, and then has a shelf area extending 10 nautical miles (18.52 kilometers) from 1,200 feet (366 meters) to 4,000 feet. You're required to establish communication with ATC prior to entering Class C airspace in the real world.

Class D (Delta)

Includes airspace from the surface to 2,500 feet (762 meters) MSL above an airport with an operational control tower. Class D airspace is individually tailored for the airport it surrounds. You're required to establish communication with ATC prior to entering Class D airspace in the real world.

Class E (Echo)

All other controlled airspace that is not included in Class A, B, C, or D. You're not required to communicate with anyone when flying in Class E airspace unless the weather calls for IFR.

Class G (Golf)

Uncontrolled airspace with three different altitude levels: from the surface up to and including 1,200 feet (365.76 meters) above ground level (AGL); more than 1,200 feet AGL but less than 10,000 feet (3,048 meters) MSL; and at or above 10,000 feet MSL up to but not including 14,500 feet (4,420 meters) MSL. You're not required to communicate with anyone when flying in Class G airspace.

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PREPAR3D

ATC Other Services

Getting other help from Prepar3D ATC

Prepar3D offers other ATC services, including traffic warnings, radar services, and current altimeter settings.

CONTENTS

- ATC Alert Messages
- Traffic Messages from ATC
- Airspace Transitions
- Flight Following
- Altimeter Settings
- Helicopter Operations

RELATED LINKS

- ATC Introduction
- Changing Traffic Options
- ATC Airspace
- ATC Glossary

Important Notes

In multiplayer mode, you can connect over the Internet or a LAN to act as an air traffic tower controller for Prepar3D pilots or interact as a pilot with a live Prepar3D Tower Controller. To learn more, see Multiplayer Air Traffic Control in the Learning Center.
How about live instruction on any aspect of using Prepar3D or on flying? You can give or receive instruction with another pilot or a friend over the Internet or a LAN using Prepar3D's Shared Aircraft feature in multiplayer. To learn more, see Sharing the Aircraft in Multiplayer in the Learning Center.

ATC Alert Messages

In Prepar3D, ATC alerts you to situations in which certain things require your attention. Rather than scolding you, alert messages are designed to help you stay within expected parameters. Sometimes it's just a gentle reminder to help you stay on course, but also includes giving you vectors (directions) to avoid terrain. In most cases, you must either acknowledge the transmission or take the corrective action that the controller instructs you to take.

Traffic Messages from ATC

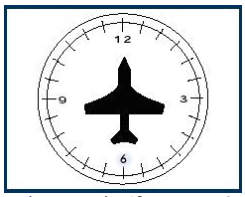
You're not alone out there. Just as in the real world, the Prepar3D skies are full of other aircraft that may conflict with your flight path. Air traffic controllers may advise you of potential conflicts using "traffic calls" that include:

- Who the controller is addressing.
- Where the traffic is.
- What the traffic is.
- What you should do.

Example:

> **Controller:** "Mooney 0MS; traffic is five miles; two o'clock; 7,500; type 767. Report them in sight."

The controller in this example is addressing Mooney 0MS. Another civilian aircraft is five miles from Mooney 0MS at 7,500 feet. "Two o'clock" refers to the position of the traffic in relation to Mooney 0MS.



In other words, if Mooney 0MS was sitting on the face of a clock with its nose towards the 12, the little hand would point at the 2 on the clock-that is, the relative position at which the other civilian aircraft is located. The controller wants to know if Mooney 0MS sees the traffic and wants 0MS to report if or when the traffic is in sight.
The pilot's response might be:

> Pilot: "Traffic in sight, Mooney 0MS."
> Or
> Pilot: "Traffic not in sight, Mooney 0MS."

Warnings for traffic on parallel runways are different. You are warned of traffic on other runways if they are in the same phase of flight as you are. In other words, if you're landing, you'll get traffic warnings for aircraft landing on parallel runways. If you're departing, you'll get traffic warnings for aircraft departing on parallel runways. These warnings will only occur for parallel runways that are separated by 4,500 feet (1,372 meters) or less.
Other aircraft in the Prepar3D world are marked with text labels. You will see the aircraft's call sign attached as a text label as the aircraft moves. These text labels can

be turned off if you don't want to view them. To turn off labels, see Turning Off Aircraft Labels.

Aircraft 888RW identified as 0.3 miles away.

Aircraft Not Seen

If Mooney 0MS never sees the other civilian aircraft (despite the size of this aircraft, it's more difficult than you might think to spot other planes in the sky), the controller may let the Mooney's pilot know when the traffic is no longer important. The pilot might hear:

> Controller: "Mooney 0MS, traffic no longer a factor."

Type Unknown

Sometimes, the controller can only tell the pilot where the traffic is relative to the pilot's position. In that case, the pilot hears a position report, such as "...traffic is two o'clock..." If the aircraft referred to in the traffic report has a Mode C transponder (all aircraft in Prepar3D are Mode C-equipped except the Piper Cub), the controller can give altitude information in the traffic call, such as, "...traffic is two o'clock, 5,000..." If the controller doesn't know the type of aircraft, she will simply say, "...type unknown." If you have imported add-on aircraft into Prepar3D, you may hear them referred to in traffic reports as "type unknown."

Traffic Alerts

When traffic is close and on a course and altitude that could present a hazard, the controller may begin the traffic call with the phrase, "Traffic Alert!" That's a cue to look quickly and carefully in the direction of the traffic. You may have to maneuver to avoid a collision.
When you are operating under VFR, ATC makes traffic calls only under certain circumstances. The controller may not advise you of *all* traffic that might conflict with your flight.

IFR Flights and Traffic Calls

If the pilot is on an IFR flight plan, ATC is watching the traffic around them. However, the controller is responsible for maintaining separation between aircraft within her airspace because, in theory, IFR aircraft are in clouds and the pilots can't see each other.

VFR Flights and Traffic Calls

If the pilot is operating under VFR rules, traffic calls are given when the pilot is transitioning airspace and talking to a controller, when the pilot is using **Flight Following**, and when the pilot is in the airport terminal airspace, provided the controller isn't too busy. Under VFR rules, it's the pilot's responsibility to maintain separation from other aircraft.

Speed Adjustments to Accommodate Traffic

Controllers may also ask you to adjust your speed to accommodate aircraft ahead or behind you that are slower or faster than your aircraft.

Airspace Transitions

The shortest route between two points is a straight line, and sometimes this means flying through controlled airspace. Because the airspace might be busy or have traffic that is bigger and faster than the pilot's aircraft (or vice versa), it makes good sense for the pilot to talk to a controller while in this airspace. The pilot could avoid this by flying around the airspace (which requires that the pilot have a sectional chart depicting the airspace), but that might mean adding considerable time and distance to the flight.
Getting a transition clearance is easy in Prepar3D. Whenever you fly towards airspace in which a transition clearance is available or required, the ATC menu includes Request transition. When you select this item, you'll hear something like this:

> **Pilot:** "Seattle Approach, Mooney N700MS, 10 miles east of Field, 5,000. Request clearance to transition Seattle Class B airspace."
>
> **Controller:** "Mooney 0MS, Seattle Approach, squawk 2212."
>
> **Pilot:** "Squawk 2212, Mooney 0MS."
>
> **Controller:** "Mooney 0MS, radar contact seven miles east of Field, 5,000. Cleared through the Seattle Class B airspace."

The pilot has addressed the ARTCC controller in Seattle stating who he is, where he is, at what altitude he's flying, and what he wants from the controller. The controller called 0MS and told him to dial 2212 into his transponder. 0MS responded by reading back the squawk code. Once the controller acquired 0MS's target on the radar screen, the controller told 0MS that she had radar contact, and then she cleared the Mooney through Seattle's Class B airspace. In the case of Class D airspace, the

menu will display the name of the controller. That way you'll be able to choose which towered airspace you want to transition.
Once through the airspace, the ATC menu will contain the item **Report clear of airspace**. Select this item to let the controller know you're clear of the airspace.

Flight Following

Flight Following is a radar service for VFR aircraft that provides traffic advisories when the controller isn't too busy. It's a useful service when pilots are flying cross-country and may have to transition multiple controllers' airspaces, as they don't have to request a transition from each controller along the way and can get traffic advisories. It also means someone knows where they are, which can be reassuring if the engine quits over Death Valley or the Sahara. Keep in mind, however, that the pilot is still responsible for navigation while using Flight Following.
Any time you're in airspace where Flight Following is available and you're VFR in Prepar3D, the **ATC** menu lists **Request Flight Following** as one of the options. When you select this item, you'll hear something like this:

> **Pilot:** "Seattle Center, Mooney N700MS is type Skylane, five miles east of Bremerton National, for Flight Following."
>
> **Controller:** "Mooney 0MS, Seattle Center, squawk 2212."
>
> **Pilot:** "Squawk 2212, Mooney 0MS."
>
> **Controller:** "Mooney 0MS, radar contact seven miles east of Bremerton, 5,000. Current altimeter 3102."
>
> **Pilot:** "Roger, Mooney 0MS."

The pilot has addressed the ARTCC controller in Seattle stating who she is, where she is, at what altitude she's flying, and what she wants from the controller. The controller responded to 0MS, telling her to dial 2212 into her transponder. 0MS responded by reading back the squawk code. Once the controller acquired 0MS's target on the radar screen, the controller told the pilot that he had radar contact and then gave her the current local altimeter setting.

Altimeter Settings

The altimeter provides pilots with information about their aircraft's altitude. In other words, it tells them how high above mean sea level (MSL) they are. Altimeters work by measuring differences in atmospheric pressure at different altitudes. It's critical to know your altitude, especially when in the clouds, and the altimeter reading changes depending on local atmospheric pressure. For a more complete explanation of altimeters, see **Flight Academy** on the left side of the screen.
In some countries, altimeter settings are measured in inches of mercury, and in other countries in millibars. The controllers issue current local altimeter settings by stating the atmospheric pressure in inches of mercury or millibars. The pilot must then dial this setting into the Kollsman window of the altimeter (the small window on the altimeter face).

The Kollsman window

Controllers often provide local altimeter readings when the pilot first contacts the controller. Listen for phraseology similar to the following:

> **Controller:** "...current altimeter 29.92."

When you hear this, check the current altimeter setting in your aircraft to make sure it matches the one the controller gave you. In Prepar3D, you can choose whether the altimeter setting is in inches of mercury (U.S.) or millibars (metric).

To switch between U.S. and metric altimeter settings

1. From the Options menu, choose **General...** and then **Application**.
2. Choose the settings you want, and then click **OK**.

To change the altimeter settings

- Click the altimeter calibration knob on the altimeter.

Helicopter Operations

Prepar3D ATC treats helicopter flights from the same as fixed-wing flights. You can request takeoff and landing clearance, and fly IFR approaches in other aircraft. There are no special taxi or pattern-entry instructions issued to helicopter flights.
If you call the ground controller, you'll still be told to taxi to a runway to takeoff. You'll have to hover-taxi to the runway and land just short of it before the menu will list tower controller options. Alternatively, you can just take off from your parking spot without ever contacting ATC. After takeoff, the menu changes to a list of airports at which you can land.
ATC will not issue clearances to land on buildings, ships, or anywhere except an airport. You can, however, land a helicopter on many of the buildings in Prepar3D. Although ATC does not recognize that a helicopter is different from any other aircraft, when you land directly in a parking spot, the ATC menu will immediately display takeoff options (as opposed to options for taxiing options that you would see after landing on a runway).

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PREPAR3D

ATC Real-World Differences

Understand how Prepar3D's ATC differs from real-world ATC

To provide you with the best ATC system possible in Prepar3D, we included the features we felt would provide Prepar3D pilots with a rich and compelling experience. The following list details aspects of Prepar3D ATC that are either different or enhanced from real-world ATC.

CONTENTS

- Airport choices
- IFR routes
- Expect further clearance
- DPs and STARs
- Lost communications
- Canceling IFR
- Cancellation of Flight Following
- Failure to respond
- Flight Service Station (FSS)
- Interacting with ATC
- VFR flight plans
- Mode C equipment
- Emergencies
- Special VFR and VFR On Top
- Airspace differences
- Airport differences
- Three-Decimal-Place Frequencies
- Intersection departures
- ASOS and AWOS
- Ocean operations

Important Notes

In multiplayer mode, you can connect over the Internet or a LAN to be an air traffic tower controller for Prepar3D pilots or interact with a live Prepar3D Tower Controller. You don't have to be an expert to get started with ATC. If you're a novice with ATC procedures, you can read the material below, and use Prepar3D's multiplayer to find an ATC session for novices on the Internet.
Remember that if you use Multiplayer ATC in Prepar3D, there really is no difference between ATC in the real world and ATC in Prepar3D. The differences listed below apply only to the single-player experience within the Prepar3D ATC system. To learn more, see Multiplayer Air Traffic Control in the Learning Center.

Airport Choices

The ATC menu **Select landing airport** item displays a list of the nearest airports within a 30-mile radius. Airports at the top of the list are closer than those farther down the list.

IFR Routes

All IFR flight plans in Prepar3D are cleared along the route filed in the **Flight Planner**. All IFR clearances are issued "cleared as filed." Detailed routes are not described in the clearance.

Expect Further Clearance

If you're told to hold during an IFR flight in Prepar3D, you will not be given an "expect further clearance" time. If you set up a random radio failure, the airspace ahead of you will not be cleared, as the ATC system won't know about your com failure. When ATC does not get a response from you, they will cancel your IFR flight plan.

DPs and STARs

Routes incorporating published DPs or STARs are not issued in clearances and cannot be requested in Prepar3D. You can still create these routes, however, by customizing waypoints in the **Flight Planner** file. You will still hear ATC clear your flight "as filed" without including a DP or STAR. To learn more about custom waypoints in routes, see Using The Flight Planner.

Lost Communications

Though it is possible to lose a radio in Prepar3D, ATC does not issue lost communication instructions. In addition, ATC will not know that you've lost communications. If they don't get a response from you, they will cancel your IFR flight plan. In that case, you won't be sequenced or cleared for landing.

Canceling IFR

When you cancel IFR, you'll be asked to confirm that you want to cancel IFR. This prevents inadvertent cancellation of an IFR flight. If you cancel IFR on the way to the runway, ATC will instruct you to taxi to the runway to request a VFR departure from the tower. If you cancel IFR above 18,000 feet, you will not be instructed to descend below 18,000 feet as you would in the real world when flying within positive control airspace (under United States rules).

Cancellation of Flight Following

You can cancel **Flight Following** at any time. If you are on Flight Following or if you are on a transition through controlled airspace, cancellation will occur when you choose to land. If you choose a landing airport from the ATC menu, the radio autotunes the airport frequency and any transition clearance or **Flight Following** is automatically canceled without any further communication.

Failure to Respond

When flying under IFR in Prepar3D, you must respond to controller's instructions. Failure to respond to instructions by ATC will result in cancellation of IFR flight plans.

Flight Service Station (FSS)

You can create IFR flight plans into and out of non-towered airports using the **Flight Planner**. If there is a Flight Service Station frequency at the departure airport, you'll receive your IFR clearance (including a clearance void time) on that frequency. Other FSS services, such as PIREPS, weather, and filing flight plans by radio, are not supported in Prepar3D.

Interacting with ATC

Unlike in the real world, you don't have to interact with ATC at all. You can fly through controlled airspace without ever calling a controller - and you won't be met by the authorities when you land.

VFR Flight Plans

The Flight Planner doesn't create VFR flight plans; using the **Flight Planner** under VFR is simply a tool to plan your route. In Prepar3D, you do not need to cancel your flight plan when you arrive at your destination under VFR.

Mode C Equipment

Prepar3D ATC always knows your altitude and responds as though all radio-equipped aircraft have Mode C equipment, because Prepar3D's ATC includes radar coverage everywhere in the world and receives Mode C data on all aircraft. Likewise, ATC announces the altitude of the non-Mode C aircraft when reporting them as traffic.

Emergencies

In Prepar3D, you cannot declare an emergency.

Special VFR and VFR On Top

Requests for Special VFR and VFR On Top are not supported by ATC in Prepar3D.

Airspace Differences

Although great effort has been made to make the airspace volumes in Prepar3D adhere to real-world boundaries, some airspace will differ. Airspace sectors and altitude steps may not be modeled exactly as they are in the real world. Some boundaries that do not exist in the real world were created in Prepar3D for the purpose of broader ATC coverage. Prepar3D's ATC has perfect radar coverage everywhere in the world.

Airport Differences

There is a tremendous amount of audio recorded for Prepar3D ATC. More than 3,000 worldwide airport and controlling facilities, hundreds of aircraft types and airline names, and hundreds of basic phrases are offered in 10 different voices. Non-towered airport names are not included, but they are, however, identified by their ICAO identifier.
Prepar3D airport and navigational aid data are based on the worldwide Jeppesen NavData database that was available at the time that Prepar3D was developed. In some cases, that data differs from what you might see in the real world for various reasons. Given the long development cycle necessary to create Prepar3D, some airport data may change in the real world by the time the product reaches retail shelves.

Three-Decimal-Place Frequencies

All three-decimal-place radio frequencies are shortened to two decimal places (for example, 122.375=122.37).

Intersection Departures

Prepar3D includes runway intersection data, but does not support requests for intersection departures. You can still make an intersection departure, but there is no specific ATC phraseology to request intersection takeoffs.

ASOS and AWOS

Although real-world ASOS and AWOS use separate frequencies, the two services are the same in Prepar3D and are reported as AWOS. AWOS does not update continuously in Prepar3D; it updates when the weather changes or on the hour, whichever comes first.

Ocean Operations

Extended flights across the oceans are no different from any other flights in Flight Simulator. You can file IFR across the ocean, and you'll be handled by ATC during the entire flight. Unlike the real world, there are no areas that lack radar coverage.

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PREPAR3D

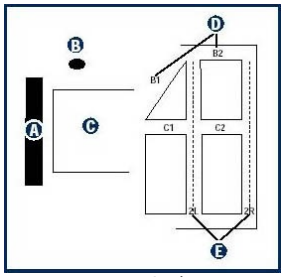
ATC Operations

Airports from the Top Down

CONTENTS

- Getting Airport Information
- Getting to the Runway
- Traffic Patterns at Airports

Large airports can be confusing places. Even for commercial airline pilots, moving a big airplane with limited visibility around an unfamiliar airport can be tricky. There's help, however. You can use an Airport/Facility Directory (A/FD), which includes airport diagrams for large airports. A/FDs can be purchased from most pilot supply stores.
You can ask for progressive taxi instructions at towered airports (see Getting to the Runway below), and a line will be drawn to guide you to the runway or to parking. Take a look at the following diagram. This is a top-down view of an airport. The layout of the runways, taxiways, and buildings is similar to what you'll find at airports in Prepar3D. Study the way the runways, taxiways, and parking are laid out. This will give you some idea of what to expect at airports in Prepar3D.



A. Terminal
B. Tower
C. Aircraft Ramp
D. Taxiway Designation
E. Runway Designation

Getting Airport Information (ATIS/ASOS/AWOS)

Selected airports have recorded or automated systems that give weather and non-control information to departing and arriving flights. The Automated Terminal Information Service (ATIS), Automated Surface Observation System (ASOS), and the Automated Weather Observation System (AWOS) broadcast airport information that is important for flight safety. These systems relieve frequency congestion by automating repetitive, but essential, information. Each time ATIS is updated (usually hourly or if there are changes in conditions at the airport), a new phonetic letter is assigned to the broadcast. When you tune an ATIS broadcast, you will hear it identified as "Information <*phonetic letter, such as Alfa*>." In the real world, ASOS and AWOS broadcasts are updated minute-by-minute because they are automated systems that take weather readings constantly. In Prepar3D, ASOS and AWOS update at the same rate as ATIS. ASOS and AWOS do not give an identifier when they update.
Note: In Prepar3D, ATIS, ASOS, and AWOS information is updated when you make changes to the weather in the simulator. Although there are separate frequencies for ASOS and AWOS, the two services are the same in Prepar3D and are reported as AWOS.

ATIS broadcasts include the following:

- Airport/facility name
- The phonetic code for the current broadcast (alpha, bravo, and so on.)
- Time of the weather broadcast in UTC (coordinated universal time, otherwise known as Greenwich Mean Time or Zulu time)
- Weather information that includes
  - Wind direction
  - Visibility
  - Cloud height and the ceiling
- Temperature
- Dew point
- Altimeter setting
- Other important weather observations, such as thunderstorms

Feel free to listen numerous times to ATIS and AWOS broadcasts until the format becomes familiar to you.
Note: Although you don't transmit to ATIS, the heading in the ATC menu always

reads, "Choose a message to transmit to...".ATIS frequencies vary from airport to airport. Use the map view to get the ATIS frequency, or select **Tune ATIS** from the ATC menu to have autotune tune the frequency for you.

To listen to a typical automated weather broadcast in Prepar3D

1. On the **World** menu, select **Go to Airport**.
2. Type Boeing Field in the **Airport name** box.
3. Click **OK**.
4. Press **ACCENT (`)** to display the **ATC** menu.
5. Press **2** to select **Tune Boeing ATIS on 127.750**.

Getting to the Runway

It isn't just the air above the airport that is busy with traffic. If you've been to an airport recently, you know that ground-traffic congestion is another big safety consideration. Moving a lot of machinery full of people from parking to the runway is an often-complicated job, and it falls to the ground controller to accomplish it efficiently and safely. At towered airports, you must make a request to taxi before moving from the parking area or gate.
You can begin your flight at a parking spot or gate, depending on the airport and the type of aircraft you choose to fly (you can also start at the runway). If you're using autotune, the ground frequency is tuned for you (see Using the *Autotune feature* in **Using ATC in Prepar3D** in the Learning Center).

Parking Spots

Parking spots at many airports look similar to a public parking lot: a big expanse of pavement with airplanes parked wing-to-wing. From a parking spot, tune to the ground control frequency and request to taxi to the active runway. Ground control will give you instructions on how they want you to proceed, and at larger airports, ground control will also indicate the specific taxiway or taxiways they want you to use en route to the runway. Taxi instructions will be given as a series of taxiway identifiers and sometimes runways. An example is, "Taxi to Runway 16 via taxiway A G2 F and H," which would be spoken as, "Taxi to Runway 16 via taxiway Alpha, Golf Two, Foxtrot, and Hotel."

Parking gates

You probably know from flying on commercial airliners that the big boys don't usually park in parking spots at huge commercial airports. They park at what is termed a "gate." A gate is attached to a terminal building, and in the real world, the gate is often permanently assigned to a particular airline. Gates are not assigned to a particular airline.
From a gate, you'll need a "push back" (see next paragraph) from the gate before requesting to taxi to the active runway. Ground control will give you instructions on how they want you to proceed, and at larger airports, ground control indicates the specific taxiway or taxiways they want you to use en route to the runway.

Pushback

Most of the time, the aircraft parked at a gate in Prepar3D will be the larger planes. These planes must be pushed back from the gate before they can taxi to the runway. In the real world, this task is accomplished by a "tug," a small tractor designed for the job. When you're parked at a gate, you'll need to have your aircraft pushed back before you can request a taxi clearance.

To get a pushback

1. Press **SHIFT+P** to push straight back.
   - or -
   Press **SHIFT+P** and then press 1 to turn the tail of the aircraft to the left as it pushes back.
   - or -
   Press **SHIFT+P** and then press 2 to turn the tail of the aircraft to the right as it pushes back.
2. Press **SHIFT+P** again to stop moving back.

After the pushback, the **ATC** menu includes a **Request Taxi** option.

Taxiway Markings

Painted lines on the taxiway mark the path between parking and the runway. Yellow-lettered taxiway signs indicate the name or designation of the taxiways.

- The taxiway centerline is a continuous yellow line.
- Edges of taxiways are often marked with two parallel lines six inches apart.
- Taxiway hold lines consist of two continuous lines and two dashed lines perpendicular to the taxiway centerline. Pilots should stop short of the hold line for run-up (the engine and instrument check before takeoff) or when instructed to hold short by ATC. Aircraft leaving a runway after landing are not clear of the runway until the aircraft is past the runway hold line.

Aircraft at runway hold line.

Progressive Taxi

In the real world, pilots often fly into or out of unfamiliar airports. It can be confusing to determine how to get from parking to the runway or vice versa. In this situation, the pilot can request progressive taxi instructions from the ground controller. You can do this at most towered airports as well. When you tune (or autotune) ground control, one of the ATC menu items is "Request Progressive Taxi." Select this item, and a line is drawn on the taxiway from your present location to the runway or parking space. The line is drawn directly from your position to the runway or parking space, so you may have to look around the aircraft to see where it starts. Top down view is helpful for seeing the progressive taxi line.

To see your aircraft in top-down view

- Press **CTRL+S**.
  Press **CTRL+S** again to return to the previous view.

The Active Runway

ATC recognizes multiple active runways at airports with more than one runway. Active runways are determined by weather conditions, and they are always the runways most closely aligned with the wind. When you communicate your intention to take off or land, your message automatically includes a request for the default active runway, but you can request a different runway from the ATC menu. Once you've been given clearance to land, you cannot change runways. You'll need to exercise caution, as other aircraft will be arriving and departing on other runways.

Hold short instructions

It's important to listen carefully to all instructions issued by ATC. Hold short instructions are issued by ground controllers when there is a potential for conflicting traffic. The ground controller will often ask you to hold short of the active runway and may tell you to hold short of any runways you have to cross on the way to the runway. If you receive a hold short instruction, heed the warning and acknowledge the controller's instruction. Taxiway hold lines consist of two continuous lines and two dashed lines perpendicular to the taxiway centerline (see the graphic in the Taxiway markings section).

Traffic Patterns at Airports

Imagine an intersection with a dozen or more highways feeding into it. If everyone just went in any direction they wanted, a chaotic and unsafe situation would be created. Similarly, traffic arriving and departing an airport needs to be orderly and logical. Pilots need to know what to expect from other pilots operating in the area. For this reason, there are standard patterns established for arriving and departing the airspace around airports.
There are multiple active runways at some airports Prepar3D. They are always the runways most closely aligned with the wind.

Standard airport traffic pattern:
A. Downwind leg
B. Base leg
C. Final leg
D. Upwind leg
E. Crosswind leg.

The standard pattern at most airports is a rectangle with left turns, but some airports have the pattern on the opposite side with right turns. At airports with multiple parallel runways, the runway on the right will have a right-hand pattern and the runway on the left will have a left-hand pattern. Right-hand patterns are used to avoid terrain or traffic patterns of parallel runways, to avoid interference with nearby airports, or to provide noise abatement. There are five sides, or "legs," to the traffic pattern:
Downwind: The aircraft is moving in the same direction as the wind, and the runway is located to the pilot's left or right, lying parallel to her course.
Base: The wind and runway are to the pilot's left or right, perpendicular to her course.
Final: The aircraft is headed into the wind, and the runway is dead ahead.
Upwind: The aircraft is flying into the wind, and the runway is behind the aircraft.
Crosswind: Opposite of the base leg.
When flying into any airport, it's good practice and a safe habit to contact the airport 10 to 15 miles out and communicate your intention to land. State where you are, where you're landing, and, if the airport is uncontrolled, how you're going to enter the pattern. You'll hear these position reports in Prepar3D when you select a landing airport and landing type (full stop, touch and go, and so on) from the ATC menu.

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PREPAR3D

ATC Glossary

Definitions for common ATC terms

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

A

active runway
The runways to which you'll be cleared for takeoffs and landings by ATC. In Prepar3D you can select a different active runway at airports with multiple runways. Active runways are the runways most closely aligned with the wind.
advisory (frequency)
In Prepar3D, similar to common traffic advisory frequency (CTAF). Pilots use the advisory frequency at nontowered airports to let other air traffic know they are on approach or taking off.
Airport/Facility Directory
A United States government publication that provides information about airports and navigation facilities. Use the A/FD to get information about radio frequencies, runways, instrument approaches, layout of airports, and other details. A/FDs can be purchased at most pilot supply stores.
airspace
Designated volumes of space that determine whether and by which controlling agency a particular area is controlled.
altimeter setting
The local barometric pressure reading dialed into the Kollsman window of an altimeter. The setting can be obtained from the automated weather services in Prepar3D, and is read to the pilot by ATC in some instances.
approach control
An air traffic controller that directs aircraft in and out of congested areas. Approach usually handles traffic between the tower-controlled and center-controlled phase of flight. Approach controllers frequently handle departing as well as arriving flights.
ARTCC
The Air Route Traffic Control Centers direct aircraft between the phases of IFR flight controlled by departure and arrival controllers. They may also handle VFR traffic on Flight Following.
ASOS (Automated Surface Observation System)
A continuously updated (minute-by-minute) automated weather briefing system used at some United States airports. For more on ASOS, see Airport ATC Operations.
ATC name
The name by which an aircraft is identified by ATC in Prepar3D in the aircraft call sign. ATC name corresponds to the atc_type entry in the Aircraft.cfg file for each aircraft.
Example:
atc_type=Mooney
atc_id_enable=1
atc_id=N700MS
ATIS (Automated Terminal Information System)
A recorded airport weather briefing updated hourly (or when there are significant weather changes). For more on ATIS, see Airport ATC Operations.
Autotune
A feature of ATC in Prepar3D that automatically switches radio frequencies on the communication radio and transponder. Switching occurs when you select an item from the ATC menu that contacts a new air traffic controller.
AWOS (Automated Weather Observation System)
A continuously updated (minute-by-minute), automated airport weather briefing system used at some United States airports. For more on AWOS, see Airport ATC Operations.

B

base
In airport traffic patterns, a pattern leg at right angles to the landing runway. Base leg connects the downwind leg to the extended runway centerline.

C

call sign
The identification that ATC and a pilot use for a particular flight or aircraft. Call signs are generally a combination of the aircraft type or manufacturer and the aircraft registration for civilian planes, a combination of the airline and flight number for airline flights, and a combination of branch of service and flight number for military flights. Call signs should always be included in any communication with ATC to avoid confusion about who's talking.
clearance delivery
Clearance delivery issues IFR clearances. A clearance is necessary before departing on an instrument flight plan.
closed traffic
A landing during which the pilot doesn't let the aircraft come to a complete stop before applying power and taking off again. This is often done to practice takeoffs and landings. Also known as touch and go.

crosswind
In airport traffic patterns, a pattern leg at right angles to the landing runway off the departure end.

D

departure control
Departure control directs aircraft out of congested traffic areas. Departure usually handles traffic between the tower-controlled and center-controlled phase of flight. Departure controllers frequently handle arriving as well as departing flights.
downwind
The direction the wind is blowing. In airport traffic patterns, downwind refers to the pattern leg flown parallel to the runway in the direction the wind is blowing (opposite to the direction of landing).
DPs (departure procedures)
DPs are published procedures for departing a particular airport on an instrument flight plan. ATC in Prepar3D does not include DPs in IFR clearances.

E

F

final
In airport traffic patterns, the pattern leg directly along the extended runway centerline.
flight following
A radar service for VFR aircraft that provides traffic advisories when the controller isn't too busy. It's a useful service when pilots are flying cross-country and may have to transition through multiple controllers' airspaces, as they don't have to request a transition from each controller along the way and can get traffic advisories.
flight plan
In Prepar3D, flight plans refer to IFR flights. You can create a flight plan in the Flight Planner, and ATC will clear you along that route. VFR routes can be planned using the Flight Planner, but ATC does not use the routing information in VFR plans for any communication during the flight.
flight level
In the United States, pilots flying above 18,000 feet (5,486 meters) are required to set the digits in the altimeter's Kollsman window to 29.92. The resulting altimeter reading is called a flight level. When the Kollsman window is set to 29.92 (1013.2 millibars) and the altimeter reads 30,000 feet, the altitude is stated as, "Flight Level 300 (three zero zero)."
Flight Planner
The Flight Planner is used to create IFR flight plans and for planning routes for VFR flights. You can access the entire airport database in Prepar3D through the **Flight Planner**. To learn more about using this feature, see Using the Flight Planner.
FSS (flight service station)
Air traffic facilities that provide a variety of services to pilots. In Prepar3D, remote IFR clearances at airports without clearance delivery are given on FSS frequencies.
full-stop landing
A landing that includes a complete stop on the runway, or when the aircraft leaves the runway on the ground before taxiing back for another takeoff.

G

ground control
Ground control directs aircraft traffic between parking and the runway.

H

hold short
When a ground or tower controller wants an aircraft to stop at a certain location while taxiing, the controller will tell the pilot to "hold short." This is usually in reference to a runway. The entire instruction is, "Hold short of runway X," where X is the runway number.

I

IFR (instrument flight rules)
Rules governing flights conducted under instrument meteorological conditions (flights conducted below VFR minimums).
IFR clearances
An IFR clearance is issued by clearance delivery prior to departure. The clearance includes information about the route of flight, altitude to be flown, and the radio frequency for the departure controller.
ILS (instrument landing system)
A precision approach system that includes a glide slope, localizer, marker beacons, and airport lighting.
instrument rated
Pilots who have received the required IFR training and have passed both written and practical exams are awarded an instrument rating. They can then fly in weather conditions during which they fly by reference to the cockpit instruments.

J

K

L

M

missed approach
Declaration by a pilot on an instrument approach that he has reached the point designated as a missed approach point without seeing the runway or airport lighting. Declaring a missed approach also signals the pilot's intent to execute the published missed approach procedure.

Mode C transponder
A transponder is a transmitter/receiver that returns a signal when interrogated by a signal from the ground. When a pilot dials a particular code into the transponder, that code shows up on controllers' radar screens next to the aircraft's radar image. Mode C provides the aircraft's altitude to the controller as well.

N

O

P

parking gate
In Prepar3D, parking gates are attached to airport terminal buildings.
parking spot
In Prepar3D, parking spots are usually located in open areas on the airport.
progressive taxi
Progressive directions from a ground controller to a pilot to assist the pilot in navigating between parking and the runway. In Prepar3D, **Progressive Taxi** draws a line from the user's current aircraft location to a runway or parking spot. Request progressive taxi using the ATC menu.
pushback
The act of being pushed back from an airport terminal gate. This is usually done by hooking a small tug to the nose wheel of a large aircraft and pushing it backwards into the taxi lane. In Prepar3D, press **SHIFT+P** to push back from the gate.

Q

R

radar contact
Acquisition of the radar image of a particular aircraft by the controller. A controller issues a transponder code to a pilot, and the pilot sets the code into the transponder. When the controller sees the image of that aircraft on the radar screen, she advises the pilot she has radar contact.

S

squawk
Terminology used by air traffic controllers to request a pilot to set a specific code into the transponder radio.
STARs (standard terminal arrival routes)
Published procedures for particular airports to get a flight from the en route to the approach phase of flight. Prepar3D ATC does not include STARs in IFR approach clearances.

T

taxiway
Avenues by which aircraft get to and from the runway at airports. By using a taxiway, the pilot avoids conflicts with other aircraft on the runway.
terminal
The building through which arriving and departing passengers pass when getting onto or off of aircraft at an airport. Parking gates in Prepar3D are attached to terminals.
touch and go
A landing during which the pilot doesn't let the aircraft come to a complete stop before applying power and taking off again. This is often done to practice takeoffs and landings. Also known as closed traffic.
tower control
The controllers in the tall towers at airports direct the air traffic within the airport traffic area. Takeoffs and landings are done under their control as well as transitions through their airspace.
Tower Controller
A multiplayer feature that allows the user to act as a live Prepar3D Tower Controller to manage air traffic by connecting over the Internet or a local area network (LAN). All other users joining a Tower Controller session participate as pilots.
transition
To cross through controlled airspace. In Prepar3D, you can request clearance from ATC to transition through controlled airspace. The ATC menu includes requests for transitions when you are heading toward airspace for which a transition is appropriate.
transponder
A cockpit receiver/transmitter that receives signals from ground-based radar and transmits a specific code back to the ground-based equipment. This allows air traffic controllers to identify specific aircraft moving across their radar screens.

U

upwind
In airport traffic patterns, a pattern leg parallel to the landing runway in the direction opposite the wind.

V

vectors
Directions given by a controller to pilots to position them for an approach or to avoid other aircraft. The directions include the direction in which pilots should turn (left or right) and the new compass heading they should fly.

> "Mooney 28T, turn right heading 270."

VFR (visual flight rules)
Below are the United States Federal Aviation Regulations regarding VFR minimums.
FAR 91.155: Basic VFR Weather Minimums
Except as provided in paragraph (b) of this section and Sec. 91.157, no person may

operate an aircraft under VFR when the flight visibility is less, or at a distance from clouds that is less, than that prescribed for the corresponding altitude and class of airspace in the following table:

Airspace	Visibility	Clouds
Class A	Not applicable	Not applicable
Class B	3 statute miles	Clear of clouds
Class C	3 statute miles	500 feet below; 1,000 feet above; 2,000 feet horizontal
Class D	3 statute miles	500 feet below; 1,000 feet above; 2,000 feet horizontal
Class E Less than 10,000 feet MSL	3 statute miles	500 feet below; 1,000 feet above; 2,000 feet horizontal
Class E At or above 10,000 feet MSL	5 statute miles	1,000 feet below; 1,000 feet above; 1 statute mile horizontal

VHF radio
Very high frequency radio range used for aircraft communication and navigation.
visibility
The ability to see and identify prominent unlighted objects by day and prominent lighted objects by night. Visibility is reported by weather services as statute miles, hundreds of feet, or meters.
visual approach
An IFR approach that authorizes the pilot to continue visually and clear of clouds to the airport. The pilot must, at all times, have either the airport or the preceding aircraft in sight. The approach must be authorized by and under the control of the appropriate air traffic control facility. Weather at the airport must include a reported ceiling at or above 1,000 feet and visibility of three miles or greater.

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PREPAR3D

GPS Overview

The Prepar3D GPS is revolutionizing General Aviation, and now you can see for yourself what all the excitement is about!

Welcome to the Revolution

The GPS takes many of the common instruments you're used to seeing on the panel of a small aircraft and displays them on two big computer displays. Everything is displayed in an easy-to-read electronic format, along with some new features too.
More than anything else, the information presented on the displays (the Primary Flight Display (PFD) and the Multi Function Display (MFD)) will increase your situational awareness. At all times, you'll have a much better picture of the aircraft's attitude, performance, and position.
There's a lot to look at, a lot to play with, and a lot to learn. In fact, the GPS's features rival those found in the cockpits of many airliners! Once you get used to flying with a glass cockpit, it's hard to go back to "steam gauges."

CONTENTS

- Welcome to the Revolution
- The Big Picture
- Controls and Keys
- The Primary Flight Display
- The Audio Panel
- The Multi Function Display
- Direct-to Navigation
- The Active Flight Plan Page
- Instrument Flying with the GPS
- Take it Slowly

RELATED LINKS

- Using Views and Windows
- Using the Flight Planner
- Using the Keyboard

In a simulator, the best way to get up to speed is to dive right in and learn by doing. Luckily, the GPS is designed to function intuitively. So in this article we'll keep things at a high level. We'll provide an overview of the GPS's major features and how to use them to do most of the basic tasks you're used to doing while flying any airplane under Visual Flight Rules (VFR).

The Big Picture

Ready to learn what all those glowing screens and buttons and knobs do?
Some Prepar3D pilots prefer the Virtual cockpit for the immersive feeling that it provides. Others prefer the crisp graphics of the 2-D panel. Some use the 2-D cockpit for instrument flying, and the Virtual cockpit for sight seeing. Try using both with the GPS and see which one you like best.
'

In **Virtual cockpit** view, you'll be sitting in a 3-D cockpit with the two GPS displays in front of you. You can zoom in and out by pressing **EQUAL SIGN (=)** and **HYPHEN (-)**. To look around, use the hat switch on your joystick, press keys on the numeric keypad, or use the thumbstick on an **Xbox 360 controller for Windows**. One of the best ways to look around the cockpit is the new mouse-look feature.

In **2-D Cockpit** view (press **A** to switch cockpit views), you'll be sitting in front of a 2-D GPS PFD, with just the engine gauges visible on the MFD on the right side of

your monitor. You can display additional panels by clicking the control panel icons, or by pressing **SHIFT**+**2** through **SHIFT**+**6**. Additional panels include:

- Autopilot
- Pop-up Multifunction display (MFD)
- Pop-up Primary Flight Display (PFD)
- Traditional backup gauges
- Engine controls and switches
- Compass

You can drag and resize any of these panels. You can, for example, pop-up the MFD, drag it to your second monitor, and resize it so that you can see both the PFD and the MFD at the same time.

Don't forget to look outside
With two big displays to look at, it's hard to imagine why you'd want to look at anything other than the GPS. But especially under Visual Flight Rules (VFR), you're responsible for keeping yourself separated from other aircraft.
For increased visibility in 2-D Cockpit view you can replace the GPS 2-D panel with a mini-panel of traditional instruments (press **W**), or get rid of the instruments altogether (press **W** again). You can also make the 2-D panel semi-transparent! To learn more, see Using Views and Windows.

Controls and Keys

The PFD and the MFD both feature the same controls and keys, which have been designed to minimize your workload as you access the GPS's sophisticated functionality.

To manipulate the knobs and keys on the GPS, use the mouse just like you'd use your hand in a real cockpit. You can display each control's name by moving the pointer over it.

Knobs

The GPS includes two types of adjustment knobs: single knobs and dual knobs. Dual knobs have a large knob with a small knob on top of it.
To rotate a knob, move the cursor across the knob. A hand with either a **-** (minus sign) or a **+** (plus sign) will appear.

- When the hand with the **-** appears, click to rotate the knob to the left.
- When the hand with the **+** appears, click to rotate the knob to the right.

To **press** a knob, move the cursor over the bottom of the knob until the cursor appears without a plus or minus sign, then click to press the knob.
You can also use the mouse wheel to rotate knobs. Move the cursor over the knob until the cursor changes to a hand, and then roll the mouse wheel to rotate the knob.

Keys

To press a key, place the cursor over the key and click it.

Note: You can also use your computer keyboard to control the knobs and keys on the GPS. There are no keyboard shortcuts assigned by default, but you can map them yourself. To learn more, see Using the Keyboard.

Softkeys

Softkeys are keys that can be reconfigured via software to do different things in different situations. One button can serve multiple purposes. Softkeys along the bottom of both the PFD and MFD provide you with access to numerous functions and pages in the GPS. If there is text above a softkey button, then it is an active softkey,

and pressing the button will have an effect.

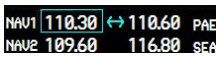
Note: To return to a previous level of softkeys press the **BACK** softkey.

The Primary Flight Display

The Primary Flight Display (PFD) provides all the information displayed on a traditional airspeed indicator, attitude indicator, altimeter, vertical speed indicator, horizontal situation indicator, and turn coordinator in a modern, easy-to-scan format featuring a large horizon that's easy to see. The PFD also displays communication and navigational radio information, flight plan data, an inset moving map, outside air temperature, transponder status, and time of day.
Let's explore each of these components.

NAV Frequency Window

The Navigation (NAV) frequency window displays active and standby frequencies for dual VOR/ILS receivers (NAV1 and NAV2), as well as the identifier of a valid, identified navigation aid. The active frequency of each radio is on the right and the standby frequency is on the left. The cyan-colored tuning box indicates which standby frequency will be set using the **NAV** knob.



To swap the standby NAV frequency and the active NAV frequency

- Press the **NAV Frequency Toggle** key.

To tune the standby frequencies for the NAV receivers

- Rotate the **NAV Frequency Selector** knob. The big knob tunes MHz and the small knob tunes kHz. To toggle the cyan-colored tuning box between the NAV1 and NAV2 fields, press the small knob.

Navigation Status Bar

The Navigation Status Bar displays flight plan information when flying a route created using the Flight Planner or the GPS Direct-to function:

- Next waypoint
- Distance to the next waypoint (DIS)
- Desired track to the next waypoint (DTK)
- Current track (TRK)
- Navigation annunciations

COM Frequency Window

The Communication (COM) frequency window displays active and standby frequencies for dual VHF transceivers (COM1 and COM2). The active frequency of each radio is on the left and the standby frequency is on the right. The cyan-colored tuning box indicates which standby frequency will be set using the **COM** knob.

To tune the standby frequencies for the COM receivers

- Rotate the **COM Frequency Selector** knob. The big knob tunes MHz and the small knob tunes kHz. To toggle the cyan-colored tuning box between the COM1 and COM2 fields, press the small knob.

To swap the standby COM frequency and the active COM frequency

- Press the **COM Frequency Toggle** key.

Airspeed indicator

The Airspeed Indicator displays airspeed on a moving tape. The speed is displayed both numerically and as tick marks on the tape, and speed ranges are shown on a color-coded strip. An airspeed trend vector (magenta line) on the right side of the airspeed tape indicates the approximate airspeed that will be reached in six seconds given any aircraft acceleration.
Vspeed References (set using the **TMR/REF** softkey) make it easy to fly specific speeds like best glide, best angle-of-climb, and best rate-of-climb. The aircraft's true

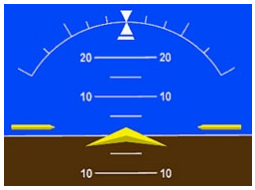
airspeed (indicated airspeed corrected for non-standard temperature and pressure) is displayed below the airspeed tape.

To change Vspeeds and turn the Vspeeds bug on or off

1. Press the **TMR/REF** softkey.
2. Rotate the large **FMS** knob to highlight the Vspeed field.
3. Rotate the small **FMS** knob to select the desired speed, and then press the **ENT** key. (An asterisk appears to indicate you changed the default speed.)
4. Rotate the large **FMS** knob to move the cursor to the Off/On field.
5. Rotate the small **FMS** knob to select **Off** or **On**, and then press the **ENT** key.
6. Press the **TMR/REF** softkey to close the window.

Attitude Indicator

The aircraft's attitude relative to the horizon is displayed via the large blue sky, brown ground, and white horizon line that extends the width of the PFD. The Attitude Indicator indicates degrees of pitch and degrees of roll.

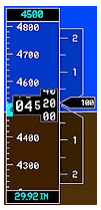


Slip/Skid Indicator

The Slip/Skid Indicator is the small bar under the Roll Pointer. It moves away from the Roll Pointer to indicate slip or skid, just like the ball on a traditional Turn Coordinator.

Altimeter

The Altimeter displays barometric altitude in feet on a moving tape. The altitude is displayed both numerically and as tick marks on the tape. An altitude trend vector (magenta line) on the left side of the altitude tape indicates the approximate altitude that will be reached in six seconds given the current vertical speed.
A reference altitude can be set in the box above the altitude tape, and a bug on the altitude tape indicates the reference altitude. The selected barometric pressure is displayed below the altitude tape.



To set the Altitude Reference bug

- Rotate the **ALT** knob. The large knob sets thousands of feet and small **ALT** knob sets hundreds of feet.

To set the altimeter barometric pressure

- Rotate the large **BARO** knob.

When an ILS is tuned in the active NAV radio, a Vertical Deviation/Glideslope Indicator appears on the left side of the altimeter. A green diamond indicates vertical deviation (like a glideslope needle). Marker beacon annunciations are displayed to

the left of the altitude reference box.

Vertical Speed Indicator

The Vertical Speed Indicator is to the right of the altitude tape. A pointer indicates the aircraft's vertical speed in hundreds of feet.

Horizontal Situation Indicator

The Horizontal Situation Indicator (HSI) displays a rotating compass card with the aircraft's current heading at the top. A heading bug on the compass rose can be set to a desired heading, and the selected heading appears in a box to the left of the HSI.

To set the Heading bug

- Rotate the **Heading Selector** knob or press the **Heading Selector** knob to synchronize with the aircraft's current heading.

Desired navigational course is indicated by a course pointer arrow just like a traditional HSI, and the selected course appears to the right of the HSI. The Course Deviation Indicator (CDI) moves to the left or right of the course pointer to indicate the aircraft's position relative to the course.

To set a course (NAV1 & NAV2 modes only)

- Rotate the small **CRS** knob to the desired course.

To change navigation sources

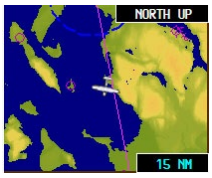
- Press the **CDI** softkey to toggle between **GPS**, **NAV1**, **NAV2**, **LOC1**, and **LOC2** (if a valid frequency is tuned).

Turn Rate Indicator

The Turn Rate Indicator is located above the rotating compass card on the HSI. A magenta trend vector indicates the heading predicted in six seconds given the current turn rate. Tick marks indicate standard and half-standard rate turns.

Inset Map

The Inset Map is a smaller version of the Navigation Map on the MFD. Range can be set independently of the MFD Map.



To display/hide the Inset Map

- Press the **INSET** softkey.

To change the Inset Map scale

- Rotate the PFD **Joystick** knob.

To declutter the Inset Map

1. Press the **INSET** softkey
2. Press the **DCLTR** softkey

Outside Air Temperature

The outside air temperature is displayed in degrees Celsius at the bottom left of the PFD.

Transponder Status

The selected transponder code is displayed in a box at the bottom right of the PFD.

To select a transponder code

1. Press the **XPDR** softkey, then press the **CODE** softkey and enter a code using the number softkeys.
2. Press the **VFR** softkey to enter **1200**.
3. Press the **BACK** softkey to return to the top level.

Local Time

The local time (LCL) is displayed to the right of the **Transponder Status** box.

Nearest Airports

Want to quickly navigate to one of the airports closest to your present position? Just press the **NRST** softkey, and the **Nearest Airports** window will display above the **Transponder Status** and **Local Time** boxes.

To navigate directly to one of the nearest airports

1. Press the **NRST** softkey
2. Turn the **FMS** knob to highlight the desired airport, and then press the **Direct-to** key. The **Direct-to** window will appear.
3. Press the **ENT** key twice.
4. Press the **CDI** softkey to switch to **GPS** navigation mode.

The Audio Panel

The Prepar3D GPS Audio Panel allows you to toggle your microphone and headset between the COM1 and COM2 radios, and to listen to the audio identifier of navigation aids.

COM MIC/COM keys

To select a communications radio as the active source for audio transmitting or receiving, press the **COM1 MIC**, **COM1**, **COM2 MIC**, or **COM2** keys.

MKR/MUTE key

To listen to marker beacon receiver audio, press the **MKR/MUTE** key. When the key is not illuminated, marker beacon audio is muted.

Aircraft Radio Input keys (NAV1, NAV2)

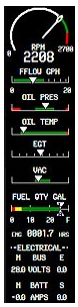
To listen to navigation radio audio, press the **NAV1** or **NAV2** keys. When a key is not illuminated, nav radio audio is muted.

The Multi Function Display

The GPS's Multi Function Display (MFD) combines engine information with a full-featured GPS and moving map display. To display the MFD, press **SHIFT**+**3**.

Engine Indication System (EIS)

The GPS Engine Indication System is displayed on the left side of the MFD and includes gauges, bar graphs, and numeric readouts of engine parameters.



The EIS displays all critical engine, fuel, and electrical indications. The indicators vary by aircraft, but contain all the information found in traditional engine and electrical system gauges including:

- Manifold Pressure gauge
- Tachometer
- Fuel Flow indicator
- Oil Pressure indicator
- Oil Temperature indicator
- Cylinder Head Temperature (CHT) indicator
- Exhaust Gas Temperature (EGT) indicator
- Turbine Inlet Temperature (TIT) indicator
- Fuel Quantity indicator
- Voltmeter
- Ammeter

(The real-world GPS also includes a **System** page that displays a numeric readout of critical engine, fuel, and electrical indications.)

What Can I Do with a GPS?

The GPS component of the GPS MFD can help you to:

- Determine where you are.
- Determine where your destination is.
- Determine how to get from your current location to your destination.
- See a graphic depiction of the terrain.
- Find information about airports, intersections, NDBs, and VORs.
- Locate the nearest airport, intersection, NDB, or VOR.
- Proceed direct to any airport, intersection, NDB, or VOR.
- Follow a VFR or IFR flight plan.
- Fly instrument procedures.
- Be aware of the airspace boundaries in your vicinity.

MFD Page Groups

The GPS/Navigation information that appears on the MFD is presented on pages, and you can only view one page at a time. Some pages are organized into groups of related pages, called page groups. Think of page groups as chapters in a book, and pages as the pages within each chapter. There are three page groups modeled in the

Prepar3D GPS. (The real GPS also includes an Auxiliary (AUX) page group, as well as some additional pages in each page group described below that are not modeled in Prepar3D.)

The **Map (MAP)** page group includes:
- Navigation Map page

The **Waypoint** page group includes:
- Airport Information page
- Intersection Information page
- NDB Information page
- VOR Information page

The **Nearest** page group includes:
- Nearest Airports page
- Nearest Intersections page
- Nearest NDB page
- Nearest VOR page

Navigating the Pages

To move through the pages of the MFD you'll use the **FMS** knobs.

To select a page group
- Rotate the large **FMS** knob to select a page group (**MAP**, **WPT**, or **NRST**).

To select a page within a page group
- Rotate the small **FMS** knob.

The bottom right corner of each page provides a graphical indication of which page group and page within that group is selected:

Additionally, the selected page group and page are displayed at the top of the MFD:

You'll also use the following keys as you work with the MFD pages:

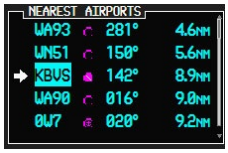
Key	Function
CLR	**Clear** - Press to erase information or cancel an entry. Press and hold to return to the Navigation Map page at any time.
ENT	**Enter** - Press to accept a menu selection or data entry.
MENU	**Menu** - Press to display context-sensitive options.
FMS PUSH CRSR	**Cursor** - Press (small **FMS** knob) to access and enter data.

Using the Cursor

When the cursor is on, you can access and enter data in different windows using the small and large **FMS** knobs, and the **ENT** and **CLR** keys.

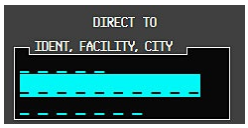
To turn on the on-screen cursor
- Press the small **FMS** knob.

To scroll down a list of choices or information
- Press the small **FMS** knob to activate the cursor, then turn the large **FMS** knob to scroll through the list.



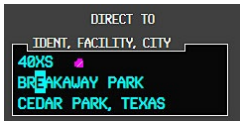
To move the cursor on a page

- Rotate the large **FMS** knob.



To select individual letters and numbers for input at the highlighted cursor location

- Rotate the small **FMS** knob.



Using the Navigation Map page

The **Navigation Map** page is the default MFD page and features a large moving map display that shows:

- Airports, airspace, navaids, and land data
- An icon representing the aircraft's present position
- The aircraft's heading

To change the Navigation map scale

- Rotate the MFD **Joystick** knob.

To display topographical information on the Navigation Map

1. Press the **MAP** softkey.
2. Press the **TOPO** softkey.

To display traffic on the Navigation Map

1. Press the **MAP** softkey
2. Press the **TRAFFIC** softkey

To declutter the Navigation Map

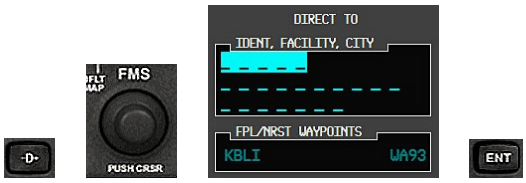
1. Press the **DCLTR** softkey

Direct-to Navigation

The GPS's Direct-to function provides a quick method of setting a course to a destination waypoint (an airport, VOR, NDB, or intersection). Once a Direct-to command is activated, the GPS will establish a point-to-point (great circle) course line from your current position to the selected destination. The **Navigation Status** bar at the top of the PFD will provide steering guidance until a new destination is selected, and the CDI will indicate the direct course to the next waypoint (when **GPS** is selected).
In addition to selecting a destination by identifier, the Direct-to page also allows you to select airports, VORs, and NDBs by facility name. You can also select a Direct-to destination from a list of the nearest airports.

To select a Direct-to destination

1. Press the **Direct-to** key, then rotate the large **FMS** knob to highlight the **Identifier (IDENT)**, **Facility**, **Flight Plan (FPL)**, or **Nearest (NRST)** data fields.
2. Use the **FMS** knobs to enter the desired destination, and press the **ENT** key twice to activate the Direct-to.



Recentering the CDI needle

If you're navigating to a waypoint using Direct-to and get off course, the Direct-to function may also be used to re-center the CDI needle and proceed to the same waypoint.

To recenter the CDI needle to the current waypoint

- Press the **Direct-to** key, followed by the **ENT** key twice.

The **Select Direct-to** waypoint page always displays the nearest airports (to your current position) in the **NRST** field. Navigating directly to a nearby airport is just a few simple steps away.

Direct-to Shortcuts

Shortcuts are available when using the **Direct-to** key, allowing you to bypass the use of the FMS knobs to enter the destination waypoint's identifier. You can set a Direct-to course from any page displaying a single waypoint identifier (such as the **WPT** pages for airports and navigation aids) by simply pressing the **Direct-to** key and then the **ENT** key twice. For pages that display a list of waypoints (e.g., the **Nearest Airport** page), you must highlight the desired waypoint with the cursor before pressing the **Direct-to** key.
Another tip: once you have one letter or number entered into a datafield, you can type the rest of the word on your keyboard instead of having to rotate the **FMS** knobs. (This is not a feature of the real GPS, but it saves time when you're "twisting" with a mouse!)

The Active Flight Plan Page

If you create a VFR or IFR flight plan using the Flight Planner, Prepar3D will automatically load the flight plan into the GPS and activate the plan for use in navigation. (For more information, see Using the Flight Planner.) The Active Flight Plan page provides information for the active flight plan or a Direct-to navigation course.

To select the Active Flight Plan page

- Press the **FPL** key.

Note: You cannot create flight plans directly in the Prepar3D GPS. Instead, you must use the Prepar3D Flight Planner. The flight plan automatically loads into the GPS and is activated for use.
With an activated Direct-to course or flight plan loaded, the **Active Flight Plan** page displays each waypoint for the flight plan (or a single waypoint for a Direct-to), along with the desired track (DTK) and distance (DIS) for each leg.
On the **Active Flight Plan** page, you can select any leg as the active leg within the active flight plan (the leg which will currently be used for navigation guidance), using the **MENU** key.

The **OBS** key is used to suspend and enable automatic sequencing of waypoints in a flight plan. Pressing the **OBS** key suspends waypoint sequencing, holds your currently active To waypoint as your navigation reference, and prevents the GPS from sequencing to the next waypoint. A **SUSP** message displays directly above the **OBS** key. When you cancel OBS mode, automatic waypoint sequencing resumes, and the GPS automatically selects the next waypoint in the flight plan once the aircraft has crossed the currently active waypoint.

Instrument Flying with the GPS

As you can imagine, the GPS makes instrument flying a much safer, more enjoyable experience. A thorough discussion of the GPS's IFR capabilities is beyond the scope of this article. If you want to learn more:

Take it Slowly

If you're a bit intimidated by all there is to learn about the GPS, there's a secret: you don't have to know how to do everything to use it effectively. So pick a GPS-equipped Prepar3D aircraft of your choice and go flying. Start slowly, and focus on learning to use the Primary Flight Display and Engine Indication System on easy VFR flights. Once you get comfortable flying in a glass cockpit, start playing with the MFD, explore all the page groups and pages, and start using Direct-to navigation.
Then, start planning longer flights with the Prepar3D flight planner and fly them using the GPS. Do some reading, and when you're ready, dive into the world of glass cockpit instrument flying. That's where you'll see the GPS really shine.
Most of all, play around, experiment, and have fun!

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PREPAR3D

Visual Flight Path

The Visual Flight Path makes it easier to fly a selected VOR radial or instrument landing system (ILS) approach. The Path puts a "follow me" display in the sky. To stay on course, just follow the display. The Visual Flight Path is especially useful when you're trying to learn the relationship between the VOR needles in your cockpit and the path to the VOR station.
The Visual Flight Path displays a variety of visual shapes for you to follow. You can lock the Path to an ILS or VOR signal, and select the spacing and density of the path that displays on the window.

CONTENTS

- Activating the Visual Flight Path
- Linking Visual Flight Path to Nav Aids
- Setting Visual Flight Path Shape
- Setting Visual Flight Path Density
- Setting Visual Flight Path Spacing
- Plotting an Intercept Course
- Setting Guide Altitude

Activating the Visual Flight Path

You must have the Visual Flight Path enabled to see the display in the sky.

To activate Visual Flight Path

1. Click **Navigation** from the menu and then **Visual Flight Path**.
2. Select the **Enable Visual Flight Path** checkbox.

Linking Visual Flight Path to Navigational Aids

You must have a VOR or ILS tuned into one of your radios in order to see the Visual Flight Path when selecting this option.

To lock the Visual Flight Path to a VOR or ILS

1. Tune a nav radio to the navigation facility you want to track.
2. In the **Visual Flight Path** dialog box, select **Nav1** or **Nav2** in the **Linked radio** list.
3. Set any options in the dialog box that you want to change.
4. Click **OK**.

Setting Visual Flight Path Shape

You can choose the shape of the of the flight guides.

1. Return to **Vehicle | Visual Flight Path**.
2. **Guide shape** drop down, select **Rectangles**, **Telephone poles**, **Yellow brick road**, or **Hoops**.
3. Click **OK**.

Setting Visual Flight Path Density

You can choose how densely the guides are placed along your path.

To set the Visual Flight Path density

1. Return to **Vehicle | Visual Flight Path**.
2. In the **Number of guides** drop down, select **Low**, **Medium**, or **High**.
3. Click **OK**.

Setting Visual Flight Path Spacing

You can choose how far apart guides are placed along your path.

To set the Visual Flight Path spacing

1. Select **Vehicle | Visual Flight Path**.
2. In the **Distance between guides** drop down, select **Maximum**, **Medium**, or **Minimum**.
3. Click **OK**.

Plotting an Intercept Course

You can have the Visual Flight Path draw an intercepting path to the radial or final approach course that you have set on the Omni Bearing Selector of a VOR or ILS.

To plot an intercepting path

1. Find **Vehicle | Visual Flight Path**.
2. Select the **Plot intercept course** checkbox.
3. Click **OK**.

Setting Guide Altitude

You can set the altitude at which the guides appear. If the Visual Flight Path is linked to an ILS, the Path will follow the glide slope on the approach phase of the flight.

To set the guide altitude

1. On Visual Flight Path screen, type an altitude in the **Draw guides at this altitude** box.

2. Click **OK**.

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PREPAR3D

World

Overview

Prepar3D is not only a vehicle simulation but also a full world simulation. Prepar3D supports extensive customization of world conditions such as weather, time of day, season, and the scenery areas the comprise the world.

Weather

Prepar3D supports customization of the weather on a per scenario basis. The user can select from a predefined weather theme, define their own weather on a per layer and station basis, or even use weather add-ons. Read more about configuring the weather in the Weather Overview article.

Date and Time

The traditional way of changing both the date and time is through the Date and Time screen. However, the traditional method does not support a live preview of the lighting conditions before the time is selected. If this is desired then the Time Preview screen can be used.

Scenery Library

Prepar3D's world is made of different scenery areas which can be added to, disabled, and arranged using the Scenery Library screen.

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PREPAR3D

Time Preview

Time Preview can be used to monitor the local time and simulated time. It gives the ability to preview the conditions of any given time of day at a desired time rate without changing the date and time in the options settings.

Having the ability to preview the different conditions based on the time of day allows you to see what flying conditions will be like with chosen lighting, weather, and season settings. It also allows you to apply the desired time of day that you have previewed using this feature.

Time Preview

On the **World** menu, click **Time Preview**.
The **Local Time** that the simulation is currently at will be displayed along with the **Previewed Time**. Both the date and time of day are displayed in this section.

Time Offset

Time Offset contains a slider with the hours displayed below it. This slider allows you to offset your current time in 0.05 of an hour increments. The range may go from -24.00 hours to +24.00 hours from the current time and day.

Time Rate

Time Rate is displayed in hours per second (hrs/sec). This slider allows you to preview the time at an increased rate from 0.00 hrs/sec to 12.00 hrs/sec in 0.25 hrs/sec increments.

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PREPAR3D

Date and Time

Changing the date, time, and season can alter the daylight conditions and ground textures for your scenario. Selecting winter, for instance, can cloak the mountains or prairies in deep snows. Then choose to take off at dawn, or on a moonlit summer night.
Changing date, time, and season is a great way to set up challenging flying conditions. Following landmarks on the ground becomes a special feat on a snowy day. By choosing a calendar date of the year, you also take daylight hours into account. Choose to fly during twilight or with a window of only a few hours of daylight during winter's darkness. With a little imagination you can even make this feature a time machine - revisit any time, date, and season of the current year, or at any point in history.

Changing Date, Time, and Season

- On the **World** menu, click **Time and Season**.

Change the time of day

1. In the **Time and Season** dialog box, click **Dawn**, **Day**, **Dusk**, or **Night**. With each **Time of Day** option the landscape graphic changes to match the choice you have made. It will also set the clocks to a time that depicts the general daylight condition of the **Dawn**, **Day**, **Dusk**, or **Night** option you selected.
2. The exact time of day is displayed as two clocks. **Local Time** is the time where you are. **UTC** refers to Coordinated Universal Time (sometimes referred to by the older standard Greenwich Mean Time). Both are displayed in 24-hour format, where A.M. hours are 0 through 11 and P.M. hours are 12 through 23.
3. To change the exact time of day on the clocks, click the hours, minutes, or seconds. Then click the spin box to advance or set back the time. Both Local Time and UTC clocks will remain synchronized. When you change one time clock, they both change to keep the correct difference between your local time and UTC.
4. Click **OK** to apply the new settings and return.

Select a season

- In the **Time and Season** dialog box, click **Winter**, **Spring**, **Summer**, or **Fall**. Note that with each season option, the landscape graphic along the left side of the screen changes to match the highlighted selection. This will change the landscape texture when you fly.

Select a specific date

- In the **Time and Season** dialog box, enter a date with the format mm/dd/yyyy. Alternatively, click the calendar icon and then select a date on the calendar.

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PREPAR3D

Weather

Understand how simulated weather operates

Weather is one of the most challenging elements of real-world flying. You often don't know exactly what conditions you'll find along the route or at your destination. You may break out of a thick cloud layer on an instrument approach only to confront a driving snowstorm, or you may breathe a sigh of relief as the clouds open up, allowing an easy visual approach.

Prepar3D weather gives you the option of choosing preset weather conditions (**Themes**), or specifying your own custom conditions (**User-defined weather**).

Weather Themes

The easiest way to set weather in Prepar3D is to choose one of the weather **Themes**. Themes are pre-built weather systems that are centered on the current location of your aircraft. To learn about using Themes, see Using Weather Themes.

Dynamic Conditions

When using the weather-rate slider on the **Weather** screen in the **World** menu, atmospheric conditions in Prepar3D affect the formation or dissipation of clouds, the onset of precipitation, and the movement of frontal systems. For the first time, you can set time-changing conditions along your route, making clouds form and move across the sky with the wind. To learn more, see Weather Settings.

The Weather Dialog Box

Think of the **Weather** dialog box as "weather central," the place where you choose the method you'll use to create weather. **Weather themes** allow you to choose from prebuilt weather systems and offers a fast path to complex weather settings. User-defined weather brings up a secondary dialog box where you can select your own custom weather. You can use the User-Defined Weather dialog box to make quick, broad changes to weather conditions for specific weather stations, or for the entire world.

Weather Stations in Prepar3D

You can set specific conditions at a specific weather station or group of stations, or set weather for all the stations in the world at one time. See User-Defined Weather for detailed instructions on how to set custom weather conditions.

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PREPAR3D

Aviation Weather Basics

What weather means to pilots

Even novice pilots understand that weather affects a plane in flight very differently than it affects a car driving down the freeway. Although weather conditions can compromise your safety both in the air and on the road, the stakes are higher in flight because you can't pull over to the shoulder if the severity of weather exceeds your abilities.

To better understand the forces that weather exerts on planes, it's important to realize that the atmosphere is not empty space. Heat from the sun and friction from the earth's surface act upon the gases and water in the air, creating a variety of weather conditions.

A number of factors—wind, cloud layers, temperature, dew point, barometric pressure, and visibility—affect your Prepar3D experience. You've probably heard your local weather forecaster use these terms, but as a pilot, it's important that you understand their precise meanings.

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- Introduction to Prepar3D Weather
- Weather Themes
- User-Defined Weather
- Weather Options

Wind

Wind is one of the basic weather factors affecting flight. Depending on its severity, wind can be a nuisance—pushing you off course by affecting your heading, airspeed, or altitude—or a true hazard, creating dangerous flight conditions. Wind can also make takeoffs and landings more challenging if it's not aligned with the active runway. And, although it seems basic, remember that if you're flying into the wind, you're going to fly slower; flying with the wind will move you along faster.

Friction on the ground acts as a kind of brake on the wind. Weather systems don't move in a straight line and often rotate, so wind in one area may not be blowing in the same direction as wind in another area nearby. Winds can also change quickly across a weather front. Because there can be dramatic differences between the direction and velocity of the wind on the ground and at high altitude, aviation weather reports include information on both surface winds and winds aloft.

Wind shear refers to situations when the wind direction and speed are shifting rapidly over a short distance. Encountering wind shear on final approach to landing can add unwelcome excitement to your flight. If the wind shifts dramatically from a headwind to a tailwind, for example, you may experience severe downdrafts. Because a plane's airspeed is already relatively low on approach to landing, wind shear can create a dangerous situation.

You also need to exercise care when taking off or landing in crosswinds, and you'll need to adjust your navigation if wind coming from one side blows you off track. If you're flying into a headwind, you'll need to keep fuel consumption in mind so that your plane doesn't run out of fuel before reaching your destination.

Knowing the current conditions of winds aloft can help you plan your route and altitude to either take advantage of a tailwind or to avoid the worst of a headwind. Let's say the wind at an altitude of 15,000 feet is blowing 360 degrees at 15 knots and the wind at 25,000 feet is blowing 320 degrees at 30 knots. Assume for this example that your course for the flight is 340 degrees.

Assuming further that the aircraft you choose to fly performs well at either altitude, you might want to plan your flight for 25,000 feet, since you'll get a speed boost from a quartering tailwind (a quartering wind comes at you from 45 degrees off your tail or nose). If your course was 160 degrees, you might plan to fly at 15,000 feet to minimize the effect of a quartering headwind.

When using the **Weather themes** option in Prepar3D's **Weather** surface winds and winds aloft will be set for you. You can set surface winds and winds aloft yourself using the **User-defined weather** option.

To learn how to set wind conditions, see User-Defined Weather.

Cloud Types

Even to the most casual observer, scattered, puffy clouds are obviously different than solid overcast conditions. But there's more to it than simple scenery. Clouds vary in appearance due to the different atmospheric conditions that cause them to form. Understanding the conditions that create certain cloud types helps pilots determine what conditions they may encounter up ahead. Conversely, researching weather conditions ahead of time can give pilots an idea of what kinds of cloud layers to expect during flight.

Stratus

Because the air in which stratus clouds form is relatively stable, stratus layers have a flat, even appearance and cover much of the sky.

Although you will likely enjoy a smooth ride in these conditions, visibility is often less clear when the air is stable. Smoke, smog, and moisture can stay suspended in stable air, reducing visibility. (You can use the **Visibility** setting to determine the visibility distance; the type of cloud formations alone will not affect visibility.).

Stratus clouds can be high and transparent, or low and dark gray. The lowest layers of stratus, nimbostratus clouds, are rain clouds. Higher, less-dense stratus layers can produce rain, but it tends to be more showery than the drizzle produced by low stratus layers.

Cumulus

Cumulus clouds are the puffy, pretty ones.

They aren't, however, always benign. Cumulus clouds form in unstable air, which allows them to have greater vertical development than stratus clouds. Most frequently they have flat bases and lumpy tops, and form below 6,000 feet (1,828 meters). The more unstable the atmosphere, the higher cumulus can build.

Cumulonimbus

Cumulonimbus clouds can tower to greater than 50,000 feet (15,240 meters). Cumulonimbus are the clouds that make thunderstorms.

Unstable atmosphere with rapidly rising masses of air creates the conditions necessary for thunder and lightning. Pilots should avoid these hazards whenever possible.
Lightning strikes are actually not the most dangerous aspect of thunderstorms. Severe updrafts in a thunderstorm can overstress an aircraft's airframe, and violent hailstorms often associated with thunderclouds can cause damage to an aircraft's skin and windshield.

Squall Lines

Thunderstorms can line up along a weather front, creating a squall line. Aircraft must navigate around squall lines, sometimes taking them hundreds of miles off their intended course. If you want to create your own squall lines, you'll have to create thunderstorms along a line of weather stations by clicking on the **Customize** button under the **User-defined weather** option.

Cirrus

Cirrus clouds are characterized by a wispy appearance and very high altitude. Cirrus are composed of ice crystals. Aircraft don't often fly at the extreme altitudes at which the cirrus reside.

Cold and Warm Fronts

Cold fronts aren't necessarily cold. It's actually just the boundary between a mass of cold air and a mass of warm air in conditions where the cold air is moving in to replace the warm air. In the summer, the "cold" air is just cooler than the warm air and may not seem cold to you at all. Warm fronts are just the opposite; a warm air mass moving in to replace cooler air.
Cold fronts are represented on weather maps such as those that you'll find in Prepar3D's **Weather** dialog box as a blue line with triangles pointing in the direction the front is moving. Warm fronts are represented by red lines.

As a pilot, you need to be aware of how cold and warm fronts affect the conditions you'll be flying in. The cloud conditions and weather you'll encounter once the front passes depend on the stability and moisture content of the air mass the front is replacing.
You won't create fronts using the **User-defined weather** option, but you'll see fronts (as well as high and low pressure areas) depicted on the weather map when using the **Real-world weather** option.

Pressure Changes

Barometric pressure is important to pilots for two reasons: it affects how the plane's altimeter works and it affects the weather. In order to measure how high above sea level your aircraft is, its altimeter is set to local barometric pressure. When an air traffic controller says, "Altimeter is 2992" she's saying the local barometric pressure is 29.92 inches of mercury. She's also telling the pilot to set the Kollsman window of the altimeter to read 2992. The reading in feet or meters on the altimeter is known as pressure altitude.

Dew Point

You really don't need to care about dew, unless you're sleeping under your airplane's wing. But when you're planning a flight you should care about the dew point—the temperature to which the air must be cooled to reach saturation.
The air around us contains invisible moisture known as water vapor. The difference between a location's temperature and its dew point indicates how well the air can

currently hold moisture. Because cool air has a harder time holding moisture than warm air, pilots use this information to determine how likely it is that fog, clouds, or precipitation will form.
The temperature/dew point spread is usually given in terms of a percentage of *relative humidity*. For example, if the temperature is 72 F (22 C) and the dew point is 52 F (11 C), the relative humidity is 49 percent. Using this example, the air is 49 percent saturated with moisture.
When the air is cooled to a point where it reaches 100 percent saturation, the water vapor condenses, forming clouds. If the temperature falls further, water drops form and fall to the ground as rain or, if it's cold enough, ice or snow. The presence of clouds does not guarantee precipitation, but the presence of precipitation guarantees there are clouds in the area.
In Prepar3D, the **Automated Terminal Information Service** (ATIS) reports the current temperature and the dew point. The closer the dew point is to the current temperature, the more likely you're going to encounter clouds. If you're flying into an area where the temperature is 80 F (29 C) and the dew point is 65 F (18 C), you don't need to worry about a thick layer of clouds blanketing the area. If the temperature is 65 F and the dew point is 60 F (15 C), watch for clouds.
You can set the temperature and dew point for any temperature layer in Prepar3D. In practical terms, this means you can create conditions where it is more or less likely that clouds will form (although **Precipitation** is a separate setting within **User-defined weather**). Be aware that setting a low cloud layer in Prepar3D weather will not constitute a layer of fog. To create fog-like conditions, modify the **Visibility** settings using the **User-defined weather** option.

Density Altitude

Density altitude is pressure altitude corrected for temperature. When the temperature is high, air is less dense. Density altitude affects aircraft performance: An increase in density altitude corresponds to a decrease in engine power output, propeller efficiency, and aerodynamic lift. Density altitude is normally computed using graphs in the pilot operating handbook for each aircraft, but for simplicity's sake, just be aware that if the weather is hot, your aircraft's performance will likely suffer. Turbine engine aircraft and turbocharged reciprocating engines suffer less, but density altitude is still a factor.

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PREPAR3D

Weather Themes

Weather themes allow you to take advantage of the weather features without having to choose all of the settings on your own.
Think of themes as big blocks of weather with preset conditions. By choosing a theme, you can experience a variety of complex weather conditions with just a few clicks, and without having to set conditions at many individual weather stations.
Themes measure 1,000 square kilometers, centered on the location of your aircraft. When you fly beyond the boundaries of a weather theme, you will enter global weather. For example, when flying beyond the **Major Thunderstorm** theme, you would see gloomy weather set globally in all other areas. Similarly, the **Clear Skies** theme is a quick way to clear all the weather around you.
Note: To make weather change over time, move the **Rate that weather changes over time** slider.
When using themes, the weather options are different at different weather stations. When using one of these weather options, the options on the **Custom** or **Advanced** weather dialog boxes may not match the conditions displayed in the simulator or on the first weather screen. By default the **Custom** and **Advanced** weather dialog do not display conditions at individual stations; select the **Specific weather station** option on the **Custom** or **Advanced** dialog boxes to view conditions at individual weather stations.

To choose a theme

1. On the **World** menu, click **Weather...**.
2. On the **Weather** dialog box, click the **Weather themes** option.
3. Select a theme in the list.
   To the right of the list, a picture represents each theme's weather conditions, and text describes the themes.
4. Click **OK**.

Pre-Existing Weather Themes

The following table describes the conditions that weather themes can provide.
Note: When a theme with snow is loaded into the simulator, choosing a different theme will not make the snow on the ground disappear immediately. You'll have to fly away from the area and return or start a new scenario before the snow on the ground will disappear.

Theme Name	Description	General Conditions
Clear Skies (default)	A great day for flying: No clouds, calm winds, and mild temperatures prevail.	**Clouds:** None **Precipitation:** None **Visibility:** Unlimited **Wind:** None
Building Storms	A hot, humid day with storms building in the area.	**Clouds:** Scattered thunderstorms **Precipitation:** Moderate to heavy rain **Visibility:** 10 miles/16 kilometers **Wind:** Strong and variable
Cold Fronts	Fast-moving storms to the east and west offer a flying challenge.	**Clouds:** Broken to overcast **Precipitation:** Moderate to heavy rain **Visibility:** Variable **Wind:** Moderate to strong
Fair Weather	Isolated cumulus and high-level cirrus clouds, combined with mild temperatures and light winds, make for a great day for sightseeing.	**Clouds:** Scattered cumulus **Precipitation:** None **Visibility:** 20 miles/32 kilometers **Wind:** Light

Fogged In	Low-lying fog obscures the ground, and you can barely make out the runway lights. How proficient are you on instruments?	**Clouds:** Overcast **Precipitation:** Light Rain **Visibility:** 0.5 miles/0.8 kilometers **Wind:** Light
Gray and Rainy	Even though the skies are gray, it's still fine for flying. Stay out of the clouds and you'll be okay.	**Clouds:** Broken to Overcast **Precipitation:** Light **Visibility:** 20 miles/32 kilometers **Wind:** Variable
Heavy Snows	A heavy snowstorm with high winds and low visibility is closing in on your position from the northeast.	**Clouds:** Overcast **Precipitation:** Heavy snow **Visibility:** 2 miles/3.2 kilometers **Wind:** Moderate
Major Thunderstorm	A large area of low pressure has generated a massive storm front with concentrated thunderstorms at its center.	**Clouds:** Thunderstorm **Precipitation:** Heavy **Visibility:** 3 miles/4.8 kilometers **Wind:** Strong and gusting
Stormy Weather	Strong winds, clouds, and precipitation will make you earn your pay today.	**Clouds:** Broken to Overcast **Precipitation:** Moderate **Visibility:** 10mi/16km **Wind:** Strong
Winter Wonderland	Isolated snow flurries, broken clouds, and gentle winds make for a fun day of winter flying.	**Clouds:** Scattered to Broken **Precipitation:** Light snow **Visibility:** 10 miles/16 kilometers **Wind:** Light

Note: If you load a **Weather theme** and then customize the conditions in **User-defined weather**, the effects of the theme will be redistributed and diluted to some degree. This doesn't mean you shouldn't modify weather when a theme is loaded; it just means you should be aware that the results are not entirely predictable.

Custom Weather Themes

Several third-party tools or add-ons allow you to build custom weather themes. If you have custom weather themes Prepar3D will attempt to load them from the *Prepar3D v5\weather* directory or the *%USERPROFILE%\Documents\Prepar3D v5 Files* directory.

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PREPAR3D

User-Defined Weather

User-defined weather gives you more control over the simulated weather than **Weather themes**. You can create custom conditions that define where you want to encounter weather, and what type of weather you want across the path of your intended flight. Better yet, you can also create conditions that will cause surprises along the way.

Note: You can also use **User-defined weather** to modify the conditions set by **Weather theme**. When you open the **Weather** dialog box, all of the weather settings will be set to clear skies. When you select a specific weather station (or stations) the weather will be reflected in its settings.

When using weather themes, the weather settings are different at different weather stations. When using one of these weather options, the settings on the **Custom** or **Advanced** weather dialog boxes may not match the conditions displayed in the simulator or on the first weather screen. By default the **Custom** and **Advanced** weather dialog do not display conditions at individual stations; select the **Specific weather station** option on the **Custom** or **Advanced** dialog boxes to view conditions at individual weather stations.

CONTENTS

- Using Weather Stations
- Using the Weather Map
- Advanced Weather
- Creating and Modifying Cloud Layers
- Creating and Modifying Wind Layers
- Temperature and Pressure Layers
- The Visibility Layer and Fog

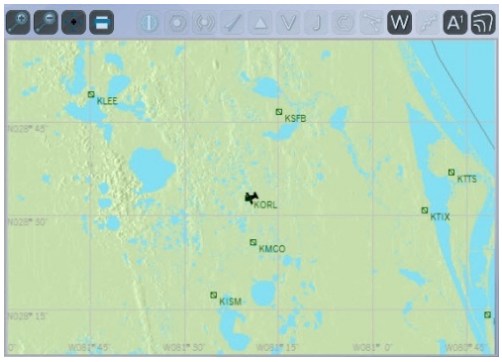
To open the User-defined weather dialog boxes

1. On the **World** menu, click **Weather**.
2. On the **Weather** screen, select the **User-defined weather** option.
3. Click **Customize** to go to the **User-defined Weather** dialog box.

Note: Your goal is to select the locations where you want to set weather, then choose the weather conditions that you want to appear in those locations.

Using Weather Stations

To create your own weather, first select a weather station or group of stations on the map. If you want to set the same weather at all locations across the entire world, read the **All Weather Stations** section below.



To select a single weather station

- Click a weather station on the map.
  -or-
- Drag a box around a weather station on the map.

To select multiple weather stations

- Drag a box around weather stations on the map.

Once you've set weather at specific weather stations, you can define weather at all other stations by clicking the **Stations that you have not set** option, and then moving the weather sliders. Using this option lets you quickly set weather in the rest of the world without losing the settings you already chose for specific stations.

All Weather Stations

If you want to set identical weather conditions at all locations in the entire world, click the **All weather stations** option and then move the weather sliders. When you select this button and move the weather sliders, any weather you've set at specific weather stations will be lost.

To make quick, broad changes to weather elements

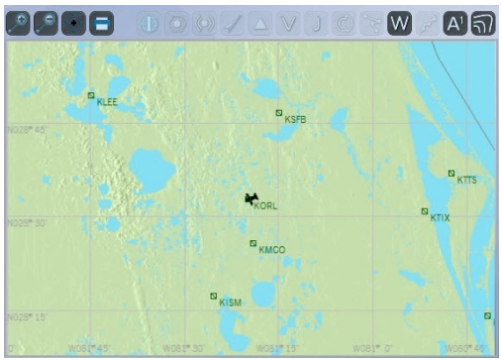
- Use the **Conditions** drop-down boxes at the bottom of the **Weather** dialog box.

Item	Function
Clouds	Use the **Clouds** listbox to select your cloud coverage, selecting from **Few**, **Scattered**, **Broken**, **Overcast**, or **Thunderstorms**.

Precipitation	Use the **Precipitation** listbox to select your desired precipitation, selecting from **None**, **Very Low**, **Low**, **Moderate**, **High**, or **Very High**.
Visibility	Use the **Visibility** listbox to select your desired visibility, ranging from **1/16mi / 0.1km** to **50mi / 80km**
Wind Speed	Use the **Wind speed** listbox to select your desired wind speed, ranging from **Light (8kts)** to **Severe (36kts)**.
Wind Direction	Drag the pointer around the circle to select a wind direction. The wind direction in the center will update as you move the pointer.
Advanced Weather	Click **Advanced Weather** to set more specific weather conditions.

Using the Weather Map

The weather map helps you select locations where you want to set weather. The interactive map displays a variety of information to help you decide where to set the weather.

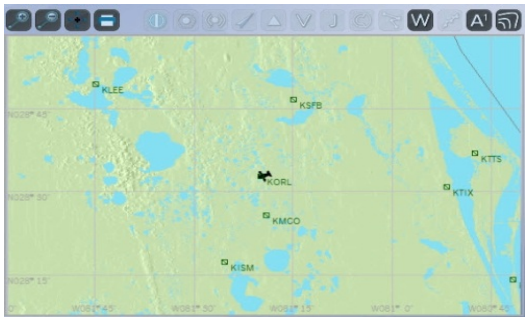


Use the buttons at the top of the map to zoom in and out, display navigational aids on the map, and print the map.

Icon	Function
	Zoom in
	Zoom out
	Center map on your aircraft's current position.
	Print the current map.
	Display or hide airports.
	Display or hide VORs.
	Display or hide NDBs.
	Display or hide ILS feathers. (To learn more, see the Instrument Lessons in the **Flight Academy**.)
	Display or hide airway intersections.
	Display or hide low altitude airways.
	Display or hide high altitude airways.
	Display or hide airspace boundaries.
	Display or hide your aircraft's flight path. (Note: You must create a flight plan before this button will work.)
	Display or hide weather stations.
	Display or hide weather systems.
	Display or hide data tags.
	Display or hide topographic features.

Navigating on the Map

If you want to set weather at a station that isn't near your current location, you can scroll to a new location on the map. When you move the pointer to any edge of the map, note that it becomes a large arrow pointing towards the edge of the map. Click the left mouse button to scroll the map.



If the distance between where the map is currently centered and the area where you want to set weather is not great, you may be able to see the new area simply by zooming out.

Selecting Weather Stations

Weather stations appear on the map as a point with a text label showing the station identifier. You can select a single weather station or a group of weather stations.

To select a single weather station

- Click a weather station on the map.
  -or-
- Drag a box around a weather station on the map.

To select multiple weather stations

- Drag a box around weather stations on the map.

If you want to set the same weather at all locations everywhere in the world, you don't need to select specific weather stations; you can select the **All weather stations** option.
Note: You can select a specific weather station or group of weather stations using the weather map. You don't have to position your airplane at the location where you want to set weather.

Advanced Weather

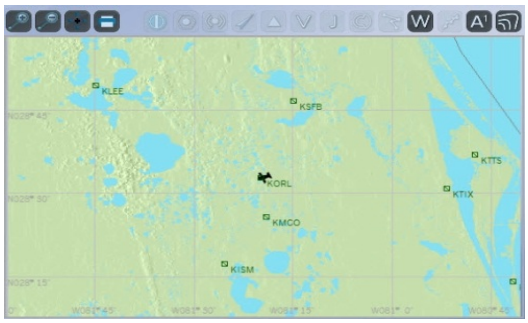
Advanced weather settings give you the greatest degree of control over weather conditions. You can fine tune all the weather variables, experimenting with different combinations of clouds, wind, and other conditions to create the weather you want. Your goal is to select the locations where you want to define weather conditions, and then choose the conditions that you want to appear in those locations.
The **Advanced Weather** dialog box is divided into four tabs: **Clouds**, **Wind**, **Temp/Pressure**, and **Visibility**. You can make changes to all of these areas during one visit to the **Advanced Weather** dialog box, or return again and again to refine the weather.

To use the Advanced weather dialog box

1. On the **World** menu, click **Weather**.
2. On the **Weather** screen, click **User-defined weather** and then click **Customize**.
3. On the **Weather** dialog box, click **Advanced**.

The Weather Map

First, select a weather station or group of stations on the map. (If you want to set the same weather at all locations across the entire world, see **All weather stations** below.)



To select a single weather station

- Click a weather station on the map.
  -or-
- Drag a box around a weather station on the map.

To select multiple weather stations

- Drag a box around weather stations on the map.

Once you've defined weather at specific weather stations, you can choose to define weather at all other stations by clicking the **Stations not already set** option and then moving the weather sliders. The **Stations not already set** option lets you quickly set weather conditions in the rest of the world without losing the weather settings you already chose for specific stations.

All Weather Stations

If just want to set identical weather conditions at all locations for the entire world, click the **All weather stations** option and then move the weather sliders. When you select this button and move the weather sliders, any weather you've set at specific weather stations will be lost.

Creating and Modifying Cloud Layers

You can create multiple cloud layers containing different types of clouds, and you can adjust the tops and bases of the layers. The **Clouds** tab also lets you create turbulence in cloud layers, add icing conditions, and modify precipitation levels.
The **Clouds** tab allows you to view all cloud layers and modify them. Use the **Current Layer** drop-down box to select any existing cloud layer to view and modify. The altitude in feet (MSL) is show in the title of the layer.

To add a cloud layer

- On the **Clouds** tab, click the **Add** button.
  The new cloud layer will be added above existing layers.

To delete a cloud layer

1. On the **Clouds** tab, select the **Current Layer** you wish to delete to using the drop-down box.
2. Click the **Delete** button.
3. Click **OK**.

To select a cloud layer

- On the **Clouds** tab, select the **Current Layer** you wish to change to using the drop-down box.

To change a cloud layer's type

1. On the **Clouds** tab, select the **Current Layer** you wish to change to using the drop-down box.
2. Select a cloud type in the **Cloud type** listbox.
3. Click **OK**.

Cloud Coverage

Cloud coverage applies to the area you've selected for a particular cloud layer. In other words, if you selected only one weather station and then created a cloud layer with **Overcast** coverage, it will only be overcast above that one station. If you select **All weather stations** and choose **Overcast** cloud coverage, the entire world would be overcast.

Coverage Setting	Amount of Sky Covered
Few	1/8 to 1/4
Scattered	3/8 to 1/2
Broken	5/8 to 7/8
Overcast	Completely covered

To change a cloud layer's coverage

1. Select the **Current Layer** you wish to apply the cloud coverage to using the drop-down box.
2. Select cloud coverage from the **Cloud coverage** box.
3. Click **OK**.

The **Tops** box determines the highest vertical development of the layer; the **Base** box specifies where the cloud layer begins. Note that cloud layers are set to altitudes above sea level, not above the ground. If the airport where you want to set the weather is located at 1,000 feet, you must set the first cloud layer higher than 1,000 feet MSL. Cloud layers set at the same level as the ground will not appear as fog. There are two ways to set the tops and bases of cloud layers.

To change a cloud layer's tops or base

1. Select the **Current Layer** you wish to apply the cloud coverage to using the drop-down box.
2. Use the Numeric Up-Down to select the **Tops** and **Base** altitude you want.
3. Click **OK**.

Turbulence in Cloud Layers

Turbulence—or instability in the atmosphere—usually manifests itself as bumpy flying conditions. You can add turbulence either to cloud layers or to wind layers.
In aviation, turbulence is defined by its severity:
Light: Loose objects in aircraft remain at rest.
Moderate: Unsecured objects are dislodged. Occupants feel definite strains against seat belts and shoulder straps.
Severe: Occupants thrown violently against seat belts, momentary loss of aircraft control, and unsecured objects tossed about.
Extreme: Aircraft is tossed violently about and impossible to control; extreme turbulence may cause structural damage.

To add turbulence to a cloud layer

1. Select the **Current Layer** you wish to apply the cloud coverage to using the drop-down box.
2. Select a severity in the **Turbulence** drop-down box.
3. Click **OK**.

Icing

Icing is a condition in which moisture in the air turns to a solid form when it strikes a solid surface like an aircraft wing. This can create a critical flight situation, as even a

small amount of ice buildup on a wing's surface seriously affects the wing's ability to create lift and keep the airplane aloft. Icing will affect lift, but you will not see the ice build up on the wings.

To add icing to a cloud layer

1. Select the **Current Layer** you wish to apply the cloud coverage to using the drop-down box.
2. Select a severity in the **Icing** drop-down box.
3. Click **OK**.

Precipitation

Precipitation—moisture that falls from clouds in the form of rain or snow—can restrict visibility and create a greater challenge on takeoffs and landings. ***Precipitation only takes place when a cloud layer is visible.***
You can set precipitation for any cloud layer that you create. The precipitation group includes a precipitation **Type**, a **Base altitude**, and a **Rate**.
Two types of precipitation are offered: **Rain** and **Snow** (the simulation does not model hail, sleet, or other forms of precipitation). **Note:** Turning off snow in the Weather dialog box will not make snow on the ground disappear immediately. You'll have to fly away from the area and return or start a new flight before the snow on the ground will disappear.

To add precipitation to a cloud layer

1. Select the **Current Layer** you wish to apply the cloud coverage to using the drop-down box.
2. Select **Rain** or **Snow** from the **Type** list.
   -or-
   Select **None** if you don't want any precipitation.
3. Click **OK**.

The **base altitude** box defines the altitude (above sea level) where precipitation dissipates or stops. The value in this box is automatically set to the earth's lowest altitude: -1,499 feet. If you leave the box at this setting, any precipitation that you define will fall to the ground; you can set the base altitude higher if you don't want the precipitation to fall all the way to the ground. You can also set the base altitude within a cloud layer or above a lower cloud layer.

To set the precipitation base

1. Select the **Current Layer** you wish to apply the cloud coverage to using the drop-down box.
2. Click in the **Base altitude** text box and then type an altitude.
3. Click **OK**.

You can set the precipitation rate—that is, define how much precipitation is falling —using settings that range from very light to very heavy.

To set the precipitation rate

1. Select the **Current Layer** you wish to apply the cloud coverage to using the drop-down box.
2. Select a precipitation rate in the **Rate** drop-down box.
3. Click **OK**.

Cloud Specifications

The list below details the specifications of the various cloud types that are included.

Type	Height	Altitude	Coverage
Cumulus			
Altocumulus	Below 3,000 feet	Medium	5/8 to complete
Stratocumulus	Below 3,000 feet	Low to High	5/8 to complete
Cumulus Humilis	Below 3,000 feet	All	1/8 to 1/2
Cumulus Mediocris	Between 3,000 feet and 6,000 feet	All	All
Cumulus Congestus	Between 6,000 feet and 10,000 feet	All	All
Towering Cumulus	Higher than 10,000 feet	All	All
Cumulonimbus (Thunderstorms)			
Cumulonimbus Calvus	Below (or at) 15,000 feet	All	1/8 to 1/4; 3/8 to 1/2; 5/8 to 7/8; complete
Cumulonimbus Incus	Below 15,000 feet	All	1/8 to 1/4; 3/8 to 1/2; 5/8 to 7/8; complete
Stratus			
Nimbostratus	All (with rain or snow)	All	All
Altostratus	Between 2,000 feet and 5,000 feet	Medium	5/8 to complete
Stratus	All (without precipitation)	All	All
Cirrus			
	Thin, wispy ice	Above	

Cirrostratus	Thin, wispy ice crystals	Above 18,000 feet	Variable
Cirrocumulus	Small, rounded, ice crystals	Above 18,000 feet	Variable

Creating and Modifying Wind Layers

Have you ever driven a van on the highway in a strong side wind? Even with the friction of the tires on the road, the wind pushes the vehicle around. When flying, you deal with winds not only during takeoff and landing, but also up at higher altitudes. Wind doesn't just push the airplane around like a van on a highway; depending on the direction of the wind and the direction you're flying, the wind might increase or decrease your airspeed.

If you set a strong wind blowing in the same direction that you're traveling, that *tailwind* will make you fly faster. Conversely, a *headwind* will slow you down. You can also set winds at right angles to a runway to practice taking off and landing in crosswind situations. For example, on a runway that has a designation number of 9, set a crosswind at 180 or 0 degrees, depending on whether you want the wind blowing from the right or from the left.

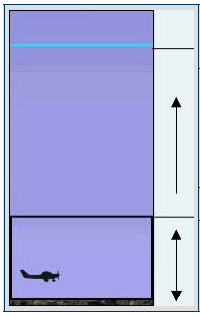
Real-world pilots pay close attention to surface winds and winds aloft in their weather briefings. Winds aloft factor into preflight planning, depending on how the wind is blowing at the altitudes where the pilot wants to fly. You can create multiple wind layers, each with different conditions.

Wind Layers

Wind doesn't divide neatly into layers in the real world. Wind layers create changes in wind speed and direction at different altitudes. In the **Wind** tab you can select, modify, add, or delete different wind layers by using the **Current Layer** listbox and its respective **Add** and **Delete** buttons.

The lowest-level wind layer's wind speed and direction you set will be the same from the surface up to the highest altitude you set for that layer. Any wind layers you create for altitudes above the lowest layer will be true only for the exact altitude set for that layer. The simulator gradually adjusts all values between layers automatically as you move between layers.

Example: If you set the lowest-level wind layer to an upper altitude of 3,000 feet (914 meters) with wind speed of 15 knots and wind direction of 180 degrees, those conditions will apply within that entire layer. If you create a second layer at 9,000 feet (1,524 meters) and set the speed to 25 knots and the direction to 240 degrees, the wind will gradually shift between 3,000 feet and 9,000 feet from the values set for the lower level to the values set for the upper layer. You can make the wind shift more dramatic by increasing the shear strength.



9,000 feet
Wind conditions for upper layers adjust gradually from the conditions set in the layers below to the conditions set above. In the example, from 3,000 ft up to 9,000 ft the wind speed would gradually adjust from 15 knots to 25 knots.
3,000 feet
Wind conditions in the lowest layer, 240 at 25, apply from the surface to the top of layer (in this example, 3,000 ft).

To add wind layers

- On the **Wind** tab, click the **Add** button. The new wind layer will be added above existing layers.

To delete wind layers

1. On the **Wind** tab, select the **Current Layer** you wish to delete to using the drop-down box.
2. Click the **Delete** button.
3. Click **OK**.

To select a wind layer

- On the **Wind** tab, select the **Current Layer** you wish to change to using the drop-down box.

To change wind layer altitude

1. On the **Wind** tab, select the **Current Layer** you wish to change to using the drop-down box.
   Click the **Altitude** text box and type the altitude you want.
2. Click **OK**.

To modify a wind layer

1. On the **Wind** tab, select the **Current Layer** you wish to change to using the drop-down box.
2. Change **altitude**, **speed**, **direction**, **gusts**, **turbulence**, or **shear strength**.
3. Click **OK**.

Note: Wind speeds increase as your aircraft moves higher. If you set a wind layer at the surface, however, and set no layers above it, the wind will have a speed of zero above the initial layer.

Wind Direction

Wind direction refers to the direction from which the wind is blowing. If the wind is a northerly wind that means that the wind is blowing from the north towards the south. In aviation, surface winds are reported in degrees of magnetic compass heading. If you listen to the Automated Terminal Information Service (ATIS) at an airport in the simulator, you'll hear wind reported as something like, "Wind one-eight-zero at one-zero." This means the wind is blowing from 180 degrees magnetic (due south) at ten knots, blowing towards the north.
You can set the wind to help or challenge your flight.

To set the wind direction

1. On the **Wind** tab, select the **Current Layer** you wish to change to using the drop-down box.
2. Drag the triangle pointer around the **Wind Direction** compass.
3. Click **OK**.

Wind Gusts

Gusts are unpredictable wind surges of short duration. Encountering gusts is especially challenging when taking off or landing.

To set wind gusts

1. On the **Wind** tab, select the **Current Layer** you wish to change to using the drop-down box.
2. Click the **Gusts** text box and then type a speed in knots.
3. Click **OK**.

Turbulence in Wind Layers

You can set turbulence in wind layers or cloud layers, or in both. If you have wind and clouds set at the same altitude and you set turbulence in both layers, the turbulence you define for the wind layer will take precedence.
Turbulence—or instability in the atmosphere—usually manifests itself as bumpy flying conditions. You can add turbulence either to cloud layers or to wind layers.
In aviation, turbulence is defined by its severity:
Light: Loose objects in aircraft remain at rest.
Moderate: Unsecured objects are dislodged. Occupants feel definite strains against seat belts and shoulder straps.
Severe: Occupants thrown violently against seat belts, momentary loss of aircraft control, and unsecured objects tossed about.
Extreme: Aircraft is tossed violently about and impossible to control; extreme turbulence may cause structural damage.

To set turbulence in a wind layer

1. On the **Wind** tab, select the **Current Layer** you wish to change to using the drop-down box.
2. Select a severity from the **Turbulence** list.
3. Click **OK**.

Wind Shear

Wind shear—a change in wind speed or wind direction (sometimes both) over a short distance, resulting in a tearing or shearing effect—can occur in a horizontal or vertical direction, and occasionally in both. The change in wind speed and direction between any two wind layers is adjusted gradually as you move from one to the other. You can make these changes more drastic by increasing the shear strength.

To adjust the shear strength

1. On the **Wind** tab, select the **Current Layer** you wish to change to using the drop-down box.
2. Select the **Shear strength** using the listbox, ranging from **1/3** to **3/3**.
3. Click **OK**.

Creating and Modifying Temperature and Pressure Layers

Temperature and atmospheric pressure play an important role in weather formation and aircraft performance. Temperature decreases with an increase in altitude at a rate known as the *standard lapse* rate. For every 1,000-foot (305-meter) increase in altitude, temperature decreases 3.5° F (2° C) in standard conditions. In some conditions, the temperature will actually increase with an increase in altitude; this is known as a *temperature inversion*. You can create this kind of condition (or other temperature conditions) by creating temperature layers in the **Temp/Pressure** tab of the **Advanced Weather** dialog box.

Temperature Layers

The lowest temperature layer is automatically set to ground level at your current location. You can use this layer to set the temperature on the ground, and then add more layers to create different temperatures at different altitudes. If you use only the lowest layer and don't add any higher layers, the standard lapse rate will apply as you increase in altitude, and the temperature will decrease.
If you chose to set temperature at all weather stations to 80 F while at a high-altitude airport such as Denver, Colorado, and then you flew to an airport at sea level, the temperature would rise as altitude decreased. If you set the temperature at all stations at 80 F while you were at a sea level airport and then flew to Denver, you would see the temperature drop as you increased in altitude.

To add temperature layers

- On the **Temp / Pressure** tab, click the **Add** button. The new layer will be added above existing layers.

To delete temperature layers

1. On the **Temp / Pressure** tab, select the **Current Layer** you wish to delete to

using the drop-down box.
2. Click the **Delete** button.
3. Click **OK**.

To select a temperature layer

- On the **Temp / Pressure** tab, select the **Current Layer** you wish to change to using the drop-down box.

To modify a temperature layer

1. On the **Temp / Pressure** tab, select the **Current Layer** you wish to change to using the drop-down box.
2. Change the altitude or temperature.
3. Click **OK**.

To change a temperature layer's altitude

1. On the **Temp / Pressure** tab, select the **Current Layer** you wish to change to using the drop-down box.
2. Drag the layer to the altitude you want.
   -or-
   Click the **Altitude** text box and then type the altitude you want.
3. Click **OK**.

Barometric Pressure

The value you set for barometric pressure in the simulator is always set at sea level. It is reported as inches of mercury (Hg). When the barometer reads 29.92, the atmospheric pressure at sea level will push a column of mercury up a glass tube 29.92 inches. As your aircraft climbs, atmospheric pressure decreases. Low pressure areas are often associated with poor weather, high pressure with better weather.

To change the sea level barometric pressure

1. Click the **barometric pressure** text box.
2. Type a value between 25.00 and 35.00.
3. Click **OK**.

Hotter temperatures also make the atmosphere less dense. The combination of high temperature and high altitude create a condition called density altitude, a potentially dangerous condition. Pilots need to factor density altitude into their flight planning when flying to airports with this condition.

The Visibility Layer and Fog

Visibility—the ability to see objects at a distance—is limited by a number of factors like cloud layers, fog, and the amount of light. Aviation weather reports describe visibility in miles and fractions of miles.
You can add multiple visibility layers to simulated weather. As with all the weather features, you can choose where you want the effects to appear and how large an area they'll cover. You may want low visibility at one weather station and unlimited visibility by the time you reach another.

To add visibility layers

- On the **Visibility** tab, click the **Add** button.
  The new visibility layer will be added above existing layers.

To delete visibility layers

1. On the **Visibility** tab, select the **Current Layer** you wish to delete to using the drop-down box.
2. Click the **Delete** button.
3. Click **OK**.

To select a visibility layer

- On the **Visibility** tab, select the **Current Layer** you wish to change to using the drop-down box.

To modify a visibility layer

1. On the **Visibility** tab, select the **Current Layer** you wish to change to using the drop-down box.
2. Change the altitude or temperature.
3. Click **OK**.

To change a visibility layer's altitude

1. On the **Visibility** tab, select the **Current Layer** you wish to change to using the drop-down box.
2. Click the **Altitude** text box and then type the altitude you want.
3. Click **OK**.

Fog

To create the appearance of fog, use a combination of low clouds and reduced visibility.

To create fog

1. Add a cloud layer with the **Base** at ground level and the **Tops** at 500 to 3,000 feet (152 to 914 meters).
2. Set the top of the visibility layer at the same altitude as the top of the cloud layer in step 1.
3. Set the visibility listbox value to 5 miles (8 kilometers) or less, depending on how thick you want the fog to be.

Did You Know?

You can hear weather reports by using the **Air Traffic Control** feature.

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PREPAR3D

Scenery Library

There is a great deal of custom scenery available on the Internet, created by third parties. You can use the Scenery Library to find, add, delete, and organize scenery, or to add, delete, or modify the cache of the scenery files that load from the CD as you fly between scenery areas.
Note: During setup, default scenery is installed into the proper directories and organizes it into appropriate areas and layers. Before you use the Scenery Library, make sure that you read and understand all the topics in this article. If you accidentally delete scenery areas or reorganize scenery areas improperly, you may need to reinstall the application to restore the proper settings.

CONTENTS

- Organization
- Arranging Scenery Areas
- Disabling Scenery Areas
- Adding Scenery Areas
- Editing Scenery Areas
- Deleting Scenery Areas
- Managing Scenery File Storage
- Windows Scenery Privileges

To access the Scenery Library

1. On the **World** menu, click **Scenery Library...**.

How Scenery is Organized

To display the proper level of detail as you fly throughout the world, it's important that your scenery is organized into the correct areas and layers.
Each scenery area is associated with a layer that is ordered by priority. The first layer in the list has the highest priority whereas the last layer in the list will have the lowest priority. Think of it as the top and bottom of the scenery stack.
Scenery areas vary in size and complexity. The lower an area's priority in the layer list, the larger the area generally is. For example, the Tokyo scenery area is smaller and more detailed than the Japan scenery area, so Tokyo is a higher-priority layer than Japan.

Arranging Scenery Areas

You can rearrange scenery areas by assigning them to different layers. The concept to keep in mind when you place a new scenery area in the Scenery Library priority list is that it must have a higher priority (a lower number) than the default scenery upon which you want it to rest.
In other words, if you add custom scenery for the Chicago area, you'll want that scenery area to be higher in the Scenery Library priority list than the Central North America scenery area.

To arrange scenery areas from the Scenery Library

1. Select the area you want to arrange.
2. Click **Move up** or **Move down** to change the priority of the scenery area.
3. Click **OK**.

Disabling Scenery Areas

You may want to keep a scenery area on your hard drive but not have it appear in the simulator. To accomplish this, you must disable the scenery area in the Scenery Library. In order to manage one add-on scenery area separately from other add-on scenery, you must put it in its own folder in the **.\Addon Scenery** folder.

To disable scenery areas from the Scenery Library

1. Select the area you want to disable.
2. Clear the check box for the selected area in the **Enabled** column.
3. Click **OK**.

Adding Scenery Areas

If you purchase or download additional compatible scenery, it's best to use the setup program that accompanies the software to install the scenery area. There are three ways to manually add scenery that doesn't include a setup program. Two ways involve creating add-on packages. Refer to the Add-on Packages documentation for more information.

To add a scenery area manually to the Scenery Library

1. In Windows Explorer, create a folder for the new scenery anywhere on your hard drive.
2. Copy the **Scenery** and **Texture** folders for the new scenery into the folder you just created.
3. In the **Scenery Library** click **Add area**.
4. In the **Select scenery directory**, select the folder containing the new scenery.
5. In the **Scenery area name** text box, type the name as you want it to appear in the Scenery Area list.
6. Select **Cache this scenery** or **Use this scenery directly**.
7. Click **OK**.
   -or-

1. In Windows Explorer, create a folder for the new scenery in the

%userprofile%\Documents\Prepar3D v5 Add-ons.
2. Copy the **Scenery** and **Texture** folders for the new scenery into the folder you just created.
3. Create an add-on.xml with texture and scenery entries.
4. Run the simulator. Prepar3D will prompt to enable this add-on and the new scenery will automatically be loaded.
-or-

1. In Windows Explorer, create a folder for the new scenery anywhere on your hard drive.
2. Copy the **Scenery** and **Texture** folders for the new scenery into the folder you just created.
3. In Windows Explorer, create a folder for the add-on.xml in the %userprofile%\Documents\Prepar3D v5 Add-ons.
4. Create an add-on.xml with texture and scenery entries in this folder. Make sure the path points to the folder containing the content.
5. Run the simulator. Prepar3D will prompt to enable this add-on and new scenery will automatically be loaded.

After you install the new scenery, you can use the Scenery Library to change the priority of the area, change its name, and edit the options for it.

Editing Scenery Areas

You can change the name by which a scenery area is displayed in the Scenery Area list. You can also change the setting that determines whether that scenery area is cached or loaded from the hard drive.

To edit a scenery area from the Scenery Library

1. Click **Edit area**.
2. Select the folder you want to edit.
3. In the **Scenery area name** text box, type the name of the scenery area as you'd like it to appear in the Scenery Area list.
4. Select **Cache this scenery** or **Use this scenery directly**.
5. Click **OK**.

Deleting Scenery Areas

Deleting scenery that you no longer want frees up space on your hard drive.

To delete a scenery area from the Scenery Library

1. Select the area you want to delete.
2. Click **Delete area**.
3. Click **OK**.

Managing Scenery File Storage

If you performed a full installation during setup, all scenery data has been to your hard drive. If you didn't run a full install, the scenery files are copied to your hard disk from the CD as they're needed. To free up hard disk space, you can choose to automatically remove these files when you exit the application.

NOTE: If you didn't choose a full installation during setup, and you select **Empty scenery cache on exit**, the application rebuilds its scenery indexes each time you start. This increases startup time.

Windows Administrator Privileges and the Scenery Library

You must have administrator privileges to use the Scenery Library. If you make changes to the Scenery Library as an administrator, the scenery indexes are rebuilt automatically. If you are not logged in to the workstation as an administrator, you won't be allowed to change scenery files.

Editing the Scenery.cfg file for advanced control of the Scenery Library

The Scenery.cfg file stores the changes you make to your Scenery Library through the Prepar3D User Interface. You can manually edit this file using a text editing application such as notepad.

Path to scenery.cfg
%PROGRAMDATA%\Lockheed Martin\Prepar3D v5

NOTE: The Scenery.cfg file at the root directory where Prepar3D.exe is located should not be edited and that any manual editing of the Scenery.cfg file could result in unwanted scenery configuration errors.

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PREPAR3D

Options Overview

To utilize Prepar3D to its full potential, it helps to understand the options that are available. Some customization of the options may be required depending on the user's hardware specifications, controllers, and desired content.

Add-ons

Add-ons allow the user to completely customize their Prepar3D experience. To learn how to acquire and manage add-ons, view the Add-ons article.

General Options

To learn how to change Prepar3D general settings, visit the following articles, categorized by section:

- Application
- Information
- Realism
- Sound
- Traffic

Controls

Prepar3D is compatible with most Windows supported controllers and devices. To learn how to configure keyboard, mouse, controllers, or joysticks, view the Controls article.

Display Options

To learn how to change Prepar3D graphics options, visit the following articles, categorized by section:

- Display
- Lighting
- Scenery

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PREPAR3D

Application

Application Options allow you to change general application options and international options.

To open the Application Options dialog box

- On the **Options** menu, click **General...** and then click the **Application** tab.

CONTENTS

- General
- International

General

Pause on Task Switch

Select the **Pause on task switch** option if you want to pause when you switch to another application. When you switch back to the simulator, you must press the **P** key to resume the scenario.
If you don't select this option and you switch to another application, your scenario will continue behind the scenes until you task switch back to the simulator (or until you crash).

Prompt on Exit

If you select **Prompt on exit** and you choose to exit the simulator (by clicking the "X" button in the upper right of the main screen, or choosing **Exit...** from the **Scenarios** menu), you will be prompted to confirm that you want to exit. If you clear this option, the application exit without confirmation.

Use system time for Default Scenario

System time refers to the time currently set on your computer's clock. If you select this option, any scenario that loads as the Default Scenario will start at the time of day currently set in your computer's clock.

Show Scenario Startup Screen

You have the option of displaying the **Startup Screen** when you first launch Prepar3D. This can also be toggled at the Startup Screen.

Panel Serialization

You have the option of saving the panel configuration on your aircraft. This creates a *.pnl* file that saves with your scenario.

Avatar Mode

You have the option of turning on Avatar Mode with a key press, which allows you to walk around as a human and enter/exit vehicles. Unchecking this option will disable the key press to enter Avatar Mode.

Scenario Error Reporting

You have the option of turning on scenario error logging, which will log scenario errors (to ObjectErrors.txt in Prepar3D v5 Files) when you load a scenario with errors.

Content Error Reporting

This is typically a developer option that can be turned on to ensure the correctness of add-on content. Read the Content Error Reporting article to learn more.

Screenshot Format

You have the option of which format to save screenshots as from the screenshot key.

Enable GPS Data Transmission

Enabling GPS data transmission allows you to send packets with data of the aircraft position either to the entire network (Broadcast GPS data) or to a specified device on the LAN using a local IPv4 address (Send GPS data) that can be read by third party applications such as ForeFlight.

International Options

Use the International options to set the system of measurement used and the basis for your coordinates. These options define the system of measurement used throughout the application. The default option is the U.S. system.

Unit of Measure

These options will configure which units to display distances as.

Unit of measure	Effect
U.S. System	All measurements in U.S. standards.
Metric (altimeter feet)	All measurements in metric except for the altimeter.
Metric (altimeter meters)	All measurements in metric including the altimeter.

Selecting Latitude and Longitude Preferences

If you frequently use the in-simulator map, and you set your position by typing the coordinates into the latitude and longitude boxes on the map dialog box, you may want to adjust the **Latitude** and **Longitude** options in the **International Options** dialog box. This will depend on where you're flying in the real world. By default, the latitude is set to the Northern Hemisphere and longitude is set to the Western Hemisphere. When the options are configured this way, you can type in coordinates on the map dialog box without typing "N" for north and "W" for west. If you're flying in the Southern Hemisphere or Eastern Hemisphere you'll have to type "S" before the latitude value and "E" before the longitude value.

Features Affected by International Options

The list below details some of the features affected by changes in international options.

Displayed in meters or feet
Autopilot: Altitude Hold
Autopilot: Vertical Speed Hold
Flight Analysis: Vertical Analysis Graph, Altitude
Map: Altitude
Weather: Clouds, Layers
Weather: Wind, Layers
Weather: Temp / Pressure, Layers
Weather: Visibility, Layers

Displayed in millibars or inches of mercury (Hg)
Weather: Temp / Pressure, Barometric Pressure

Displayed in Celsius or Fahrenheit
Weather: Temp / Pressure, Temperature

Displayed in kilograms or pounds
Fuel Options: Fuel quantity
Fuel Options: Fuel weight

Displayed in liters or gallons
Fuel Options: Fuel capacity

Displayed in kilometers or miles
Navigation Log: Distance
Navigation Log: Fuel
Navigation Log: Waypoint altitude

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PREPAR3D

Information

Information Options allow you to change how information displays on the screen.

To open the Application Options dialog box

- On the **Options** menu, click **General...** and then click the **Information** tab.

CONTENTS

- Information
- Air Traffic Control
- Vehicle Labels

Air Traffic Control

Customize the air traffic control options for more realism and to use a voice that you like.

Show message log in ATC menu

As air traffic control messages are sent, they are audible and displayed as text in the ATC console. Some virtual pilots prefer to only listen to air traffic control and not see the text onscreen.

Auto-open ATC Window

By default, the ATC window is opened automatically when messages are sent or when a response is required from the pilot. Some pilots prefer that the ATC window remain hidden until they want to open it manually; others want it to appear automatically.

Use a Pilot Voice

You'll hear three different kinds of voices in the simulator: the pilot voice (which represents you), the ATC controller's voice, and the voices of other pilots talking on the same frequency. Some pilots prefer to hear only the ATC controller voice and not their pilot voice. You can turn off the pilot voice (although you'll still hear the controller and the pilots in other aircraft).

You can choose from ten voices to use as your pilot voice. If the **Use a Pilot Voice** check box is not selected in the **ATC Options** dialog box, you can't choose a pilot voice and you won't hear a voice when you send a message to ATC.

Information Text

When flying Scenarios, you can choose from several display options. You may choose to display captioning for the voiceover, text preferences, cockpit ToolTips, user tips, and whether to use the Scenario pointer and compass together or not at all. These options will toggle the visibility of information text on the screen.

Text Cycling

You can choose between **Continuous** for a continuous block of text or **Single line** for a single line of scrolling text.

Scenario Compass/Pointer

You can configure the scenario pointer type and enable a compass, pointer, or both.

Cockpit ToolTips

ToolTips provide useful cockpit information. When you select this option, anytime you point to a vehicle panel feature, you'll see a ToolTip with information about that feature. The ToolTip provides the name of the feature and, for some panels, the current readout for that instrument, switch, or gauge. For example, if you point to the altimeter on a panel that has dynamic ToolTips when the Vehicle is flying at 2,000 feet, the ToolTip text will read "Altimeter 2,000 ft."

ToolTips display in metric units if you select metric International options. If you do not select **Show cockpit ToolTips**, ToolTips will not appear. Note that you must be in cockpit view or virtual cockpit view to see ToolTips.

User tips

User Tips are onscreen text that appear during a scenario to prompt you take an action. For example, if the altimeter's Kollsman window has the wrong barometric pressure, a User Tip will remind you to set the correct pressure by pressing B.

Scenario captions

This will toggle voiceover captioning in scenarios.

Vehicles Labels

All vehicles, including the one you are flying, have labels in the air above the vehicle that provide useful information that you can see from a distance. When you're using air traffic control and the controller gives you a traffic warning, these labels prove particularly useful. You can choose the type of information you want displayed in labels, or you can choose to turn the labels off.

User Vehicle

When you select **User vehicle**, your own vehicle will be labeled; this is a useful feature if you're flying in dense traffic conditions and viewing your vehicle from **Tower** or **Spot plane** view.

Manufacturer

The vehicle manufacturer's name can be useful to identify traffic when using air traffic control. Traffic advisories from ATC are often given as "...traffic is a <manufacturer>: <model>." In this case, "manufacturer" is the manufacturer's name.

Model

The vehicle model can be useful to identify vehicle mentioned in ATC traffic reports. Traffic advisories from ATC are often given as "...traffic is a <manufacturer> <model>." In this case, "model" is the model name. If you're looking for the traffic, the model name in the label can help differentiate2 or more vehicle from the same manufacturer operating within the same region.

Tail Number

The tail number is useful when listening to air traffic control. The controller may be issuing instructions to an aircraft near you that is not currently close enough to warrant giving you an advisory. Seeing the tail number allows you to identify who ATC is talking to. Tail numbers are usually the aircraft registration number.

Distance

Whether or not you're listening to air traffic control, aircraft labels can show you the distance between your aircraft and another. Depending on your current **International** options , the distance is displayed in miles or kilometers.

Altitude

It's often difficult to determine by sight whether another aircraft is flying at the same altitude as your aircraft. Air traffic advisories always include the altitude of the other aircraft, so seeing the altitude in the label can help identify the traffic. Depending on your current International options , the altitude is displayed in feet or meters.

Label Color

Experiment with setting different colors for aircraft labels to determine which color is easiest for you to see. Different weather conditions may dictate using a different label color.

Cycle Rate

If you select all of the **Aircraft labels** options, the labels will contain a lot of information. The information cycles, or changes, by displaying one piece of information at a time. Experiment with different cycle rates to determine which rate works best for you. You can select an interval, ranging from one to five seconds, which determines how long each piece of information remains on screen before cycling to the next piece of information.

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Realism

You can adjust options for a number of features that affect your in-cockpit experience. These aren't strictly difficulty options , but their effects can determine whether your flight is more or less challenging.

To open the Realism Options dialog box

- On the **Options** menu, click to **General...** and choose **Realism**.

CONTENTS

- Flight Model
- Instrument and Lights
- Crashes and Damage
- Engines
- Special Effects
- Flight Controls

Overall Realism Options

Use the **Current Settings** list to control the overall level of realism you'll experience in flight. The choice made in this list box affects the options in the rest of this dialog box. For example, if you choose **Easy**, you'll notice that options like **Unlimited fuel** and **Autorudder** are automatically selected, and options like **Pilot controls aircraft lights** and **Detect crashes and damage** are cleared. Selecting realism options individually sets the **Current realism options** to **Custom**.

Flight Model

The flight model refers to the extent that certain forces act on your aircraft. The more realistic you make these options , the more challenging your flying experience will be.

P-factor refers to the asymmetrical thrust generated by a spinning propeller. It contributes to the left-turning tendency of single-engine airplanes and twin-engine airplanes that lack counter-rotating propellers.

Torque—another force caused by an airplane's spinning propeller—causes the airplane to rotate clockwise about its longitudinal axis. It is also a contributing factor for the left-turning tendency.

Gyro refers to gyroscopic precession caused by the propeller. It, too, is a contributing factor for the left-turning tendency.

Crash Tolerance refers to how much the aircraft will be damaged during hard landings or violent maneuvers. For example, a landing that would destroy the aircraft at the most realistic setting might only damage it severely at a medium setting. Note that you must select **Detect crashes and damage** for the **Crash tolerance** slider to have any effect on crashes, and you must select **Aircraft stress causes damage** for the **Crash tolerance** slider to have any effect on violent maneuvers or hard landings.

Instruments and lights

Pilot controls aircraft lights

When this is selected, you must turn the aircraft lights on manually when you want them on. If you do not select this setting, the aircraft lights will automatically turn on at dusk.

Enable gyro drift

Due to gyroscopic precession, the heading indicator needs to be reset to the magnetic compass heading periodically during a flight. If you select the **Gyro Drift** setting, the heading indicator will precess, causing the heading indicator to drift from the magnetic heading. If you do not select this setting, the heading indicator will not be affected by gyro drift. Be aware that the **Gyro Drift** option will not affect heading indicators in glass cockpits.

Display true/indicated airspeed

In the real world, pilots calculate true airspeed—the airspeed shown on the airspeed indicator corrected for atmospheric conditions— which is not displayed on the airspeed indicator. You can choose to display true airspeed on the airspeed indicator, although indicated airspeed is displayed by default.

Crashes and Damage

Ignore/Detect crashes and damage

You can choose whether crashes have any effect on your aircraft, and how much effect they have when detected. When an aircraft crashes, the scenario is reset. This can be configured by choosing between **Ignore crashes and damage** and **Detect crashes and damage.**

Vehicle stress causes damage

You can also choose whether vehicles are stressed during violent maneuvers or hard landings. Aircraft damage is not the same as a crash, as the aircraft may continue

flying with damage. You must select **Detect crashes and damage** before you can select **Vehicle stress causes damage**.

Allow collisions with other vehicles

You can choose whether collisions with other vehicles result in a crash. You must select **Detect crashes and damage** before you can select **Allow collisions with other vehicles**.

Ignore avatar collision

You can choose whether or not the user avatar will collide with other objects. This option is available regardless of the **Ignore crashes and damage** and **Detect crashes and damage** options.

Engines

Enable automixture

Pilots adjust the mixture manually in the real world, but you can have the simulator manage the mixture for you. You can also choose to have unlimited fuel so that you never have to refuel.

IMPORTANT NOTE: When you select **Unlimited fuel**, your aircraft's gauges indicate fuel consumption until the tanks are empty. **Unlimited fuel** allows the aircraft to keep flying after the fuel is exhausted, as though it still had fuel.

Special Effects

Visualize G-effects

G-effects refer to the effect of gravity on the human body. When you stand, walk, or sit when you're on the ground, your body is subjected to the force of one "G," or the normal force of gravity. When an aircraft is climbing, turning, or descending, you experience an effect as if the weight of your body has changed. When you climb or turn in an aircraft, you subject yourself to positive Gs, or the effects of more than one G. When descending, you subject yourself to negative Gs, or less than one G. Because added G-forces make it more difficult for blood to get to your brain, subjecting your body to high positive Gs may result in a gray-out and eventual black-out effect beginning with a loss of visual acuity and then unconsciousness. High negative Gs have the opposite effect of forcing too much blood to your head and causing your vision to turn red.
These effects are simulated by a change in color on the screen.

Flight Controls

Airplane rudders help with directional control of the airplane. You can control the rudder on airplanes (and the tail rotors on helicopters) in different ways: using the keyboard, using a joystick with rudder capability, or using rudder pedals. If you don't want the realism of controlling the rudder yourself—which makes coordinated flight more challenging—you can have the rudder controlled for you.

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PREPAR3D

Sound

Quick Tip: To turn all sounds on or off while in the aircraft, press **Q**.
The sound system in Prepar3D controls all volume levels and Windows sound devices in the simulation.

To open the Sound Options dialog box

- On the **Options** menu, click **General...** and choose **Sound**.

CONTENTS

- Adjusting Volume
- User Interface Sounds
- Using a Headset
- Enable Voice Only
- Enable or Disable Muting Sounds When Application Loses Focus

Volume Levels

You can adjust and toggle the volume of different sounds. For example, if you're flying a jet, you might want to turn down the sound of the engines, and turn up the sound of the environment. The result will be more realistic for many jet aircraft. **Mute On Lost Focus** will mute the application when it becomes a background window.

Using a Headset

Using a headset for voice communications in Multiplayer air traffic control will add a great deal of realism. Your hands are free to fly the aircraft or to push buttons if you're the air traffic controller.

To use a headset in Multiplayer

1. Be sure the headset is plugged into the correct port on your computer.
2. Enable the voice communication host options.
3. During the session, press and hold **CAPS LOCK** to talk to other pilots or air traffic control. Release **CAPS LOCK** to stop transmitting.

IMPORTANT: There are a couple of things to know if you're going to use a headset. For the most realism, you only want voice communication coming through the headset.

- If your headset is your only audio output, all sounds will come through the headset, including engine noise, wheels on pavement, and even e-mail notifications if you have your e-mail client running.
- You must have two or more audio devices (sound cards) in your computer to enable voice-only audio through your headset.

To enable voice-only audio on a headset
(Two sound cards required)

1. On the **Options** menu, click **General...** and choose **Sound**.
2. Under **Windows sound devices**, select your headset in the **Voice** list.
3. Click **OK**.

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PREPAR3D

Traffic

CONTENTS

- Aviation Traffic
- Land and Sea Traffic

In addition to the aircraft you're flying, other aircraft —flown by artificial intelligence (AI)—cruise the simulated world. You can choose how much AI traffic you want flying around the skies with you using the **Traffic** dialog box.

During installation, the setup program automatically chose the best overall options for your computer's hardware. The **Traffic** tab lets you customize traffic to make the world as busy as you want it to be.
Depending on your computer, traffic options may affect performance. Experiment with the options to find the combination of performance and realism that you like.

To open the traffic tab

1. On the **Options** menu, click **General...**
2. Click the **Traffic** tab.

Aviation Traffic

Air traffic consists of both airline traffic and general aviation traffic. Airline traffic includes regularly scheduled air carriers while general aviation traffic refers to all other non-military aircraft. The **Density** sliders determine how busy the traffic is. You can turn off all traffic by setting the sliders to zero (moving the sliders all the way to the left), or you can make traffic very busy by moving the sliders all the way to the right.

Be aware that if you're flying from a small airport in the middle of nowhere, even with a high air traffic density setting you'll encounter less traffic than you would using a medium setting at a busy international airport. On some computer systems, a high density setting may affect simulator performance.

You can choose to have airline, general aviation, or both kinds of traffic flying during your flights. You'll see the aircraft on the ground and in the air, and you'll hear them communicate with the tower if you're using air traffic control on the same frequency.

To add more realism, there is also airport vehicle traffic, including baggage handlers and fuel trucks.

Land and Sea Traffic

Land and sea traffic sliders control the amount of highway and freeway traffic, large ships, ferries, yachts, and small pleasure boats.

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PREPAR3D

Display

The **Graphics Options** dialog box includes the following tabs: **Display**, **World**, **Lighting**, and **Weather**. The **Display** tab contains options that globally affect the way Prepar3D runs.

When you installed the application, the setup program automatically chose the best overall general options for your computer's hardware. The **Display** tab in the Graphics Options dialog box lets you customize things to look and perform the way you want it to. You may want to display higher detail in airports and cities, or you may want greater definition in mountains and valleys. You can also choose whether to display special effects and shadows.

CONTENTS

- Graphics Global Options
- Image and Texture Quality
- Hardware Tessellation
- Frame Rate Controls
- View and Panel Options

Depending on your computer, graphics options may affect performance. Experiment with the options to find the combination of performance and appearance that you like best.

To open the Display options

1. On the **Options** menu, click **Graphics...**
2. Select **Display**

The Display options include:

- Graphics Global Options
- Image and Texture Quality
- Hardware Tessellation
- Full Screen Options
- Frame Rate Controls
- View and Panel Options

Graphics Global Options

Use the **Display Global Settings** list to control the general quality. The choice you make in this list box automatically affects the options in the rest of this screen. Selecting Graphics options individually below sets the global options to **Custom**. You are able to save current options as a configuration file.

To reload custom graphic options

1. On the Graphics Options **Display** tab, click **Save**.
2. Save the configuration file with a unique name.
3. Select the custom profile from the drop down menu.

Default options can also be reset in this section.

Image and Texture Quality

FXAA, MSAA

Fast Approximate Anti-Aliasing (FXAA) Makes jagged edges of rendered images appear smoother by analyzing the final image and smoothing edges.
Multi-sample Anti-Aliasing (MSAA) improves image quality by taking the specified number of samples to determine the coverage of rendered pixels and blend them to form the rendered image.

Texture Filtering

Filtering makes textures appear less "blocky". Anisotropic filtering provides the highest quality of texture filtering, yielding a crisper image.

Texture Resolution

The maximum allowed texture resolution. Higher resolution textures can improve graphics quality, but require more memory.

Hardware Tessellation

Hardware Tessellation generates terrain on GPU enabling advanced features including dynamic lighting, improved terrain paging performance, and smoother frame rates on higher end graphics cards. Changing the tessellation enabling will require a restart of Prepar3D.

Full Screen Settings

A computer screen is made up of tiny dots called pixels. The more pixels used to draw an image on screen, the higher its display resolution and the more detail visible. The numbers in the Full screen resolution list indicate the number of pixels displayed as well as the depth of color. For example, 1024 x 768 x 32 refers to 1024

pixels x 768 pixels x 32 million colors. A setting of 1280 x 720 x 32 will show more detail than a setting of 1024 x 768 x 32, and objects on the screen will also appear smaller. These options only affect the display when running in full-screen mode, not in windowed mode. Only the resolutions supported by your video card will be displayed in the list. Experiment with resolutions to find the one that works best for you.

Display

Some computer systems are equipped with more than one video graphics card; select the card that provides the best performance.

Resolution

Select the resolution that Prepar3D should display at.

Black-out Desktop, when unchecked, will have application style windows but also allows you to access the desktop as if still in windowed mode.
Auto-fill Main View will have the main view automatically fill all monitors as it spans.

Frame Rate Controls

Target frame rate

In a movie theater, the film generally runs past the projector's lens at a rate of 24 frames per second. At this speed, the human eye cannot detect the fact that the film is actually a series of rapidly changing still pictures. Like a movie, computer programs are rendered on a computer screen one frame at a time. This happens at a high frame rate so it seems like a constantly moving picture.

For some computers, it may be advantageous to limit the target frame rate. By limiting the upper end of the frame rate, the computer does not spend any more resources than necessary to render the selected frame rate. Resources not used to increase the frame rate beyond that setting can be used for other tasks like rendering clouds or drawing scenery in the distance. Experiment to find the frame rate that works best for you.

Vsync

Screen tearing occurs when the video display is not in sync with the display's refresh cycle, thus displaying a "tear" in the screen image. **Vertical Synchronization (VSync)** prevents the graphics card from modifying the display memory until after the monitor finishes its current refresh cycle. When **Triple Buffering** is checked, the consistency with which the display is swapped with the next image can be improved since there are two back buffers waiting to be flipped to the front image already drawn on the monitor.

View and Panel Options

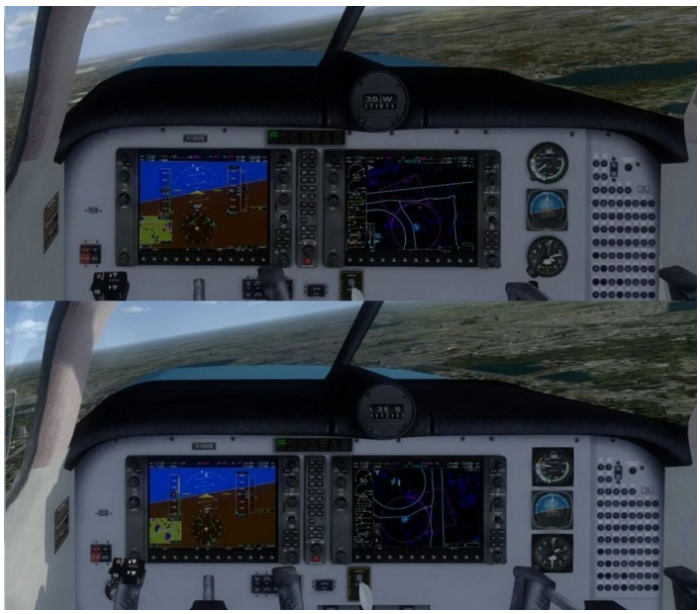
Wide-view Aspect Ratio

The wide view aspect ratio setting changes the width of the viewing angle.

Above, you can see standard to the left and wide-view to the right.

Mipmap VC Panels

Mipmap VC Panels will improve the appearance of the virtual cockpit panels by enabling mipmapping. This uses extra memory on the graphics card, but it greatly improves the distraction of the jittery cockpit while flying. The one on the top shows the VC with no mipmapping. The one on the bottom shows the VC with mipmapping turned on. Notice how all the lines on the panels have a smooth appearance with mipmapping on.



2-D panel transparency

This is the percentage that open 2-D panels will be transparent against the sim background.

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PREPAR3D

World

CONTENTS

- Terrain
- Water and Bathymetry
- Scenery Objects

During installation, the setup program automatically chose the best overall display options for your computer's hardware. **Graphics Options** allows you to customize the simulator to look and perform the way you want it to. You may want to display higher detail in airports and cities, or you may want greater definition in mountains and valleys. You can also choose whether to display special effects and shadows.
Depending on your computer, display options may affect performance. Experiment with the options to find the combination of performance and appearance that you like best.

To open the World options

1. On the **Options** menu, click **Graphics...**
2. Select **World**

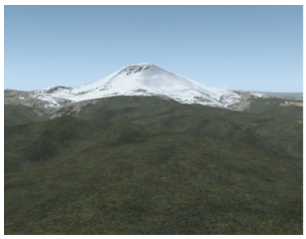
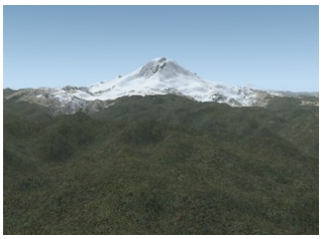
Terrain

Level of Detail Radius

Drawing fine-detail scenery farther in the distance can create a greater sense of immersion and realism, but this may come at a cost in performance on some computers. By setting a lesser distance at which details are drawn, you free up computer resources for other graphics tasks.

Tessellation Factor

The hills, valleys, mountains, and canyons are drawn using real-world digital elevation data. The mesh includes a map of points at different elevations. The more points that get drawn at any time, the more detail in the terrain, and the more computing power required.

Higher options include more points; lower options drop less-significant points. In the two pictures above, note the difference of the **Tessellation Factor** at low (left) and high (right). Increasing the **Tessellation Factor** options to ultra may affect your computer's performance.

Mesh Resolution

This slider increases or decreases the level of detail in the terrain mesh. At the highest options, the terrain mesh includes elevation data down to one meter resolution. At the lowest options, the terrain mesh includes elevation data every 4.9 kilometers. Obviously, the higher option will display a great deal more detail so you can recognize small terrain features in your area of the world quite easily.

Texture Resolution

Textures on the ground include roads, rivers, fields, shorelines, water, and the textures underlying cities. When you fly at high altitudes, the difference between high and low **Texture resolution** options becomes unnoticeable. High options (2 meters to 7 centimeters) make flights at low altitude more realistic and interesting.

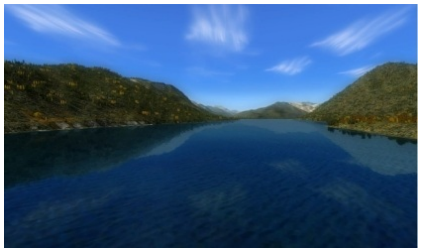
Notice how sharp and detailed the fields are in the picture on the right, using a high **Texture resolution** setting.

Water and Bathymetry

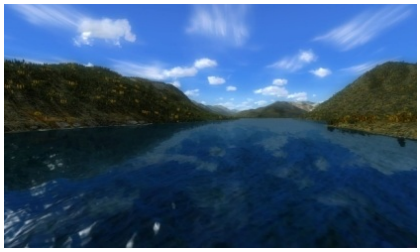
NOTE: Not all video cards support water effects. If your video card does not support these effects, you will not see water effects in the simulator even when this slider is moved to the right.

Water Detail

Displaying water in Prepar3D has become more realistic than ever. With the addition of three-dimensional dynamic water, any water environment such as a lake or an ocean, will appear vibrant and react to wind speed and weather conditions. At the ultra water detail option, the water reacts to the tessellation factor and mesh resolution options just as they would on any other texture.



The 3D living water can react to wind speed and different weather conditions that the user applies. For example in high wind environments, the waves on the surface will react more turbulently than they would on a low breeze day. The following image was taken with high wind options applied.



Bathymetry

This enables underwater elevations. Select this option for underwater training scenarios.

Reflections

These check boxes determine what scene elements are reflected in the water surface. Higher options will increase realism but will also lower the framerate.

Scenery Objects

Scenery Complexity

Scenery complexity affects the density of non-autogen buildings and scenery objects like monuments, custom buildings in cities and airports, or any object that requires non-generic models or non-generic textures.

The picture above on the left shows a city with sparse scenery complexity. Notice the difference in the picture on the right, which has very dense scenery complexity. Higher options may affect simulator performance on some computers.

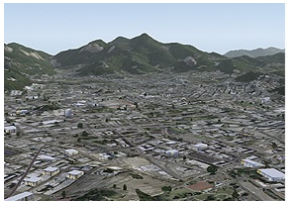
Autogen Draw Distance

The draw distance of autogen objects refers to how far out autogen objects will appear.

NOTE: Higher settings may have a significant impact on frame rate.

Autogen Vegetation/Building Density

Autogen creates generic scenery objects, such as trees and buildings. The objects appear in the distance as you approach them.



The picture above on the left shows the minimum autogen option; the picture on the right displays the maximum autogen option. Note the greater number of trees and buildings in the picture on the right. Higher options may affect simulator performance on some computers.

Special Effects

Special effects detail

This option manages effects such as smoke, fountains, and fireworks that are created using units called sprites. The more sprites displayed, the better the effect looks, but higher options may decrease performance on some computers.

Special Effects Distance

This option increases or decreases the distance that special effects will be seen from.

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PREPAR3D

Lighting

Lighting options allow you to customize the environment of your flight. Adjusting the light options can enhance the flying experience by emphasizing certain light-dependent aspects. For example, shadows being cast will allow the pilot to anticipate flying conditions in the different forms of light.

Lighting in Prepar3D consists of two sections: **Lighting** and **Shadows**.

To open the Lighting options

1. On the **Options** menu, click **Graphics...**
2. Select **Lighting**

Lighting

Lighting includes HDR Lighting, dynamic lighting, Landing-light options, and lens flare.

HDR Lighting
High-Dynamic-Range lighting, or HDR, displays more realistic lighting with an increased level of detail. HDR lighting renders a more detailed scene by using light calculations done with a larger dynamic range. This appears to the user as crisper light, natural light reflections of the sunbeams and rays, as well as moonlight on the surrounding atmosphere. With HDR enabled brightness, bloom, and saturation can also be modified offering greater control of the final image.

Brightness
Adjust this slider to control the overall brightness of the scene. Requires HDR.

Bloom
Objects in direct sunlight are subject to exposure effects, making them look washed out. Adjust the Bloom level by moving the slider left and right to decrease or increase it. Requires HDR.

Saturation
Adjust this slider to control the color saturation of the scene. Requires HDR.

Dynamic Reflections
Makes reflections more realistic by replacing the static global environment map with a real-time environment map based on the camera. The resolution of the environment map doubles each quality step starting at 128 and ends at 1024. The types of objects that reflect at different options are outlined below.

Low: basic world features (ex: terrain, sky, water)
Medium: taxiway and runway features)
High: autogen buildings and air features (ex: stars, clouds)
Ultra: details (ex: particles, vegetation)

Landing-Lights
Landing-lights can be used in low-lit times of the day in order to illuminate the runway that the pilot will land on.

Lens Flare
When the sun comes into direct view, the glare causes streaks of light called lens flares (like what you see when shooting a camera into bright light). This is beneficial for training when using an external camera view.

Shadows

Shadows are a new addition to Prepar3D that will add to the overall training experience. There are several options that customize the user's flying experience.

Shadow Quality
Shadow quality controls the quality and frequency of the rendered shadows. Setting this to off will disable shadows entirely.

Shadow Draw Distance
Shadow draw distance adjusts the largest distance that a shadow will render out starting at the player's view origin.

Object Shadow Casting and Receiving
The object shadow cast distance ranges from 0 to 12,000 meters. The options allow you to choose which objects you want to cast or receive shadows.

Each object has the option for the shadow to be cast by the object type or to be a recipient of shadows. This allows the user to customize which shadows are displayed in the simulated view while having greater control over the overall performance of the software. **No Shadow Flagged Content** will respect 3rd party content shadow preferences.

Advanced Options

There are advanced properties that can be adjusted from the Prepar3D configuration file found in *%APPDATA%\Lockheed Martin\Prepar3D v5\Prepar3D.cfg*

```
SHADOW_NUM_CASCADES_LOW
SHADOW_NUM_CASCADES_MID
SHADOW_NUM_CASCADES_HIGH
SHADOW_NUM_CASCADES_ULTRA
GROUND_SHADOW_TEXTURE_SIZE
CLOUD_SHADOW_TEXTURE_SIZE
SHADOW_LOG_PARTITION_LOW
SHADOW_LOG_PARTITION_MID
SHADOW_LOG_PARTITION_HIGH
SHADOW_LOG_PARTITION_ULTRA
HDR_BLOOM_THRESHOLD
HDR_BLOOM_MAGNITUDE
HDR_BLOOM_BLUR_SIGMA
EXPOSURE_KEY
DAY_MAX_EXPOSURE
NIGHT_MAX_EXPOSURE
HDR_BRIGHTNESS
HDR_SATURATION
ADAPTATION_RATE_SCALAR
HDR_BLOOM_EMISSIVE_SCALAR
HDR_BLOOM_SPECULAR_SCALAR
HDR_BLOOM_MODALPHA_SCALAR
HDR_BLOOM_COPY_SCALAR
```

The following properties can be adjusted to the user's specifications: **Cascades** and **Log Partition**.

Cascades
A cascade is a small area that encompasses the field in the player's view. This value can be between 2 and 12. At a value of 2 cascades, one cascade displays detailed

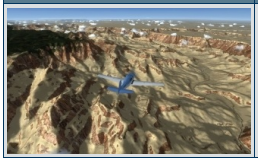
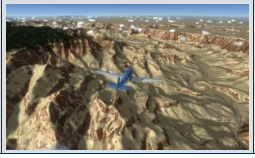
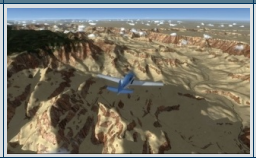
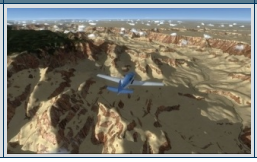
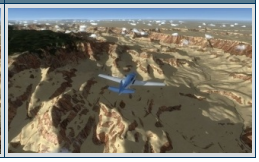
shadows close up, and the rest of the shadows are encompassed in the second, so they are less detailed further away from the view origin. On the other hand, the more cascades that are added, the more detailed the shadows have to distribute across the player's view. Twelve cascades gives the highest ability to create detailed shadows at farther distances.

Shadows

Shadow textures for the ground and cloud size can be adjusted. The recommended values are values of 2 between 256 and 8096.

Log Partition

The log partition value can take on a value between 1.00 and 0.00, 1.00 provides more detail close up and 0.00 distributes detail further away.
Below is a juxtaposition of the five shadow options with adjusted options.

Off	Low	Medium	High	Ultra
				

Bloom

The HDR bloom threshold, magnitude, blur sigma, and material bloom scalars can be adjusted. The threshold and magnitude is recommended to be set between 0 and 10 and bloom blur sigma should be set between 0 and 1. The bloom threshold sets a limit for how bright the bloom can be, and the magnitude adjusts that brightness level. The blur sigma determines the level of sharpness that the environment is set to. It is an approximation of how much the image should 'spread' or blur to. The emissive, specular, mod alpha and copy scalar values scale the materials flagged to support bloom to better distinguish materials flagged to bloom when HDR is enabled. These values are recommended to be between 0 and 10.

Exposure

Exposure for both day and night can be adjusted. These values are between 0 and 16. The day and night exposure allow the level of light to be adjusted based on user preference.

Eye Adaptation

The eye adaptation rate can be modified by ADAPTATION_RATE_SCALAR to control the speed at which the adaptation transitions between bright and light environments.

Dynamic Lighting

The number of dynamic lights can be modified by MAX_POINT_LIGHTS and MAX_SPOT_LIGHTS to change the number of lights supported per view.

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PREPAR3D

Weather

In addition to the weather choices that you can make using the **Weather** screens, you can also set options in the **Weather** options window.
You can:

- Set the distance at which clouds draw
- Make thermals visible
- Change the appearance of clouds
- Turn off the aircraft's response to turbulence
- Adjust the rate at which weather changes

To open the Weather options

1. On the **Options** menu, click **Graphics...**
2. Select **Weather**

CONTENTS

- Visual Weather Options
- Dynamic Weather Options
- Resetting Defaults
- Advanced Options

Visual Settings

Cloud draw distance

Displaying clouds uses a lot of graphics processing power. Drawing clouds at great distances may affect computer performance. You can change the distance at which clouds display to a shorter distance to free up computer resources for other tasks.

Thermal visualization (for soaring)

Thermals are rising columns of warm air caused by the sun's uneven heating of the Earth's surface. Glider pilots use thermals to gain altitude, in the same way that birds do. Thermals can be difficult to find but there are two kinds of visual aids to find thermals.
Natural thermal indicators are birds circling within the thermal. A **Schematic** thermal indicator is an artificial graphic that is drawn within the thermal.

Cloud detail

As with most graphic options, the greater the detail, the more computer resources are required to display it. Options are available for simple and detailed clouds. Experiment with each to see how your computer performs.

Simulation Settings

Enable turbulence and thermal effects on vehicle

When flying over areas heated by the sun, the atmosphere contains thermals of rising air. You can enable or disable the effect turbulence and thermals have on your aircraft to make your flight smoother.

Dynamic weather rate

When the weather rate slider is set to **No change**, weather remains as you set it in the **User-defined weather** dialog box. When this option is set to **Low**, **Medium**, **High**, or **Very High**, weather conditions change dynamically depending on the atmospheric conditions set in the **Weather** dialog box. For example, at the **Low** setting, it might take a couple of hours to see much change in the weather. At the **Very High** setting, you're likely to see changes in 15 to 20 minutes.

Dynamic weather applies to all three weather types: **Weather themes**, **Real-world weather**, and **User-defined weather**. Clouds, winds, and precipitation form and dissipate over time depending on the conditions chosen.

Advanced Options

These are advanced properties that can be adjusted inside the weather section of the Prepar3D configuration file found in *%APPDATA%\Lockheed Martin\Prepar3D v5\Prepar3D.cfg*

```
CLOUD_FACING_MODE
```

Cloud Facing Modes
The cloud facing mode setting changes the behavior of how the clouds face. The valid values for this setting are 0 and 1.

- **Mode 0:** Camera facing far away, screen facing up close.
- **Mode 1:** Always camera facing.

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PREPAR3D

Controls Overview

Prepar3D is compatible with most Windows supported controllers and devices. Read more about the different types of input that can be used to control the simulation:

- Joysticks and Controllers
- Xbox 360 Controllers
- Mice
- Keyboards
- Voice Controls

If an issue arises while configuring the controls, either view the Troubleshooting or Advanced Troubleshooting article.

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PREPAR3D

Using the Keyboard

The keys to an easier experience are right in front of you

Controlling aircraft in the simulator is a lot like flying a real aircraft. You can move the ailerons, elevator, and rudder with a joystick instead of a yoke or control stick, and you can use a mouse to work all the buttons, levers, and knobs on the panel.
A real pilot needs to pull a lever to raise or lower the landing gear, but in the simulator, you can just press the **G** key. By learning which keys handle each action, and by changing the key assignments to suit your own preferences, you can be more efficient in the cockpit.

CONTENTS

- Key Commands
- Changing Key Assignments
- Navigating Using Cinematographer

Key Commands

The **Key Commands** page of the Kneeboard features a comprehensive list of keyboard commands. To display the Kneeboard, press **F10** or the Kneeboard icon. Whenever you need to know which key to press, just look at the Kneeboard.
Note: The list displayed on the **Keyboard Commands** page of the Kneeboard is dynamic. If you change a command, the list will reflect that change.

Adjusting Keyboard Sensitivity

The aircraft are much easier to fly using a joystick, but you can also control the aircraft using a keyboard. By default, the keyboard sensitivity is set in the middle of the normal operating range. You can change these options to make the controls that control the primary flight surfaces (ailerons, elevator, and rudder) more or less sensitive to key presses. Experiment to find an option that suits your flying style. Use the **Control Sensitivities** dialog box to fine-tune the sensitivity of the controls to your key presses.

To adjust keyboard sensitivity

1. On the **Options** menu, click **Controls...**
2. On the **Calibration** tab, drag the **Keyboard sensitivity** sliders. Drag the sliders to the left to decrease sensitivity, and to the right to increase sensitivity. To reset all sensitivity options to their default values, click the **Reset Defaults** button.
3. Click **OK**.

Changing Key Assignments

In a real aircraft, there's only one button, lever, or knob for each task. In the simulator, you can easily customize joystick buttons and keyboard shortcuts so that your simulated cockpit works the way you like best.
Let's look at an example. The default key for the wheel brakes is the **PERIOD (.)** key, an important command to know to prevent your plane from rolling off the end of the runway after a flawless approach and landing. If you find yourself forgetting that the brakes are activated by pressing **PERIOD (.)**, you might prefer to use the **B** key (which by default resets the altimeter). You can easily switch these two keyboard commands.

To change keyboard command assignments

1. On the **Options** menu, click **Controls...**
2. Click the **Key Assignments** tab.
3. Select either the **Normal** or **Slew Mode** option, depending on which mode you want to change key commands for.
4. In the **Event category** list box, choose the category of buttons, options, or controls that you want to set. (For example, select **Engine controls** to customize the options for engine commands.) Your selection determines what appears in the **Assignment list** below.
5. In the **Assignment list**, select the event whose keyboard command you want to reassign.
6. Click **Change Assignment** to choose a new keyboard assignment for the event you've selected. The **Select Assignment** dialog box will open.
7. Press the key that you want to assign to the selected event. If the command is currently being used and you don't want to replace it, click the **Clear** button.
8. Click **OK**.
9. Make any additional changes you want, using steps 3 through 8 above.
10. Click **OK**.

Removing and Resetting Key Assignments

To remove a keyboard assignment from an event you've selected, click the **Delete Key Assignment** button.
To cancel any changes you've made to your key assignments and return to the default options, click the **Reset Defaults** button.

Navigating Using Cinematographer

Cinematographer is a control mode that simplifies the process of moving the camera's eyepoint and orientation. Cinematographer mode works best with a

controller because controller axes are mapped to smooth axis movement of the eyepoint and orientation by default. In Prepar3D, Cinematographer is toggled by pressing **SHIFT+F5**.

Eyepoint movement can be accomplished by:

- **A** and **D** for lateral movement left and right, respectively.
- **W** and **S** for longitudinal movement forward and back, respectively.
- **Q** and **E** for vertical movement down and up, respectively
- The number pad allows for pitch and heading adjustments.

To change the eyepoint move rate, orientation adjust rate, zoom adjust rate, or smooth reset times, see the camera configuration article here to learn how to change the default values in the camera configuration files.

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PREPAR3D

Using the Mouse

Clicking, dragging, scrolling, and flying

Using the Mouse to Fly

Flying with the mouse is easier than using the arrow keys on the keyboard, which is great if you don't own a joystick, yoke, or other controller.
Once you active the mouse as a flight control device (see below):

- move the mouse right to go right,
- move the mouse left to go left,
- move the mouse toward you to go up,
- and move the mouse away from you to go down.

RELATED LINKS

- Using a Joystick
- Using an Xbox 360 Controller
- Using the Keyboard
- Using Voice Controls

Use a VERY light touch and small control movements when using the mouse to fly the aircraft.

To use the mouse to fly

1. Load a scenario and then click **Fly now!**
2. When the scenario loads, press **CTRL+Y** to toggle mouse flight control on and off.
   When the mouse flight control is ON, the cursor changes to a small cross.

Using the Mouse to Move the Camera

You can use the mouse to look around, move the eyepoint, and zoom in and out. or in spot plane view.

To use the mouse to look around while in 3-D virtual cockpit or spot plane view

- Press and hold **SPACEBAR**, then move the mouse.

  -or-

- Press **SHIFT+O** to toggle the mouse look function ON or OFF.

  -or-

- With **Advanced Mouse Controls** enabled, right-click then move the mouse.

When mouse look is ON, the cursor changes to a small cross.

To use the mouse to move the eyepoint

- With **Advanced Mouse Controls** enabled, middle-click then move the mouse.
- Hold **Shift** while middle-clicking to move the eyepoint vertically instead of longitudinally.

The Mouse as a Cockpit Tool

The mouse can be a Prepar3D pilot's best copilot, acting as the hand that flicks switches, resets the altimeter, moves the GPS display within view, and helps you scroll through your flight notes. Just click the control you want to operate. Some controls act like toggle switches: for example, clicking the landing gear lever once retracts the wheels; clicking it again extends them. Other controls, such as the throttle and trim wheel, move through a series of positions. You can drag these controls using the mouse, much as you would move them using your hand in a real airplane.

Using the Mouse Wheel

If you have a mouse with a wheel on it, you can use it to manipulate many cockpit controls, such as adjustment knobs and the trim wheel. Move the pointer over the control until the pointer changes to a hand, and then roll the mouse wheel to change the control.

Rollover Descriptions

You can discover each gauge's function by simply rolling over it with the mouse without clicking; a description will pop up.

Toggle Switches

To flip toggle switches, position the mouse over the switch you wish to change and then click. Since toggles only have two positions, clicking a second time on the same switch returns it to its original position.

Adjustment Knobs

Many of the cockpit gauges, such as the altimeter and heading indicator, have

adjustment knobs, which should be adjusted prior to and during flight. Other instruments, such as the VOR OBS knob, should be adjusted during flight.
To turn knobs, position your pointer over the instrument's control knob. When the pointer sits on either side of the knob, a hand cursor appears.

When the hand with the minus sign (-) appears, clicking will reduce the instrument's setting; the opposite is true when the plus sign (+) hand appears. If you click and hold the knob, the instrument's control knob will begin to rotate in the direction indicated. Release the mouse when the knob reaches the desired setting.
Remember: You can also use the mouse wheel to turn the adjustment knobs. Move the pointer over the control until the pointer changes to a hand, and then roll the mouse wheel to change the control.

Dragging

Some controls—such as the throttle, trim wheel, and mixture—can be pulled using the mouse. First move the pointer over the desired control, then click and hold while dragging.

The Control Panel

Control panel icons offer an easy way to access flight maps, the GPS receiver, and other instruments located outside the screen frame. Familiarize yourself with their functions:

- To display or hide the Kneeboard, click the icon.
- To display or hide the ATC window, click the icon.
- To display or hide the flight map, click the icon. Viewing the flight map will pause the simulation. To hide the map, click **Cancel** or **OK** at the bottom of the map.
- To display or hide the GPS, click the icon.

Some aircraft also have throttle control icons, ceiling panel icons, and flap lever panel icons; these icons will also appear on the control panel. Roll over the icons to read what each represents, then click on the items that you wish to display or hide.

Using the Mouse in the Virtual Cockpit

The mouse works in the 3D Virtual Cockpit just as it works in the two-dimensional Cockpit View. Use your joystick's hat switch or your keyboard's numeric keypad to display the panel you want, then use the mouse as described above.

Using the Mouse as a Flashlight

The mouse can additionally be used as a flashlight inside the virtual cockpit. When the flashlight is active, it will follow the mouse cursor and camera position. The flashlight can be toggled on and off using the "\" key. This can be reassigned in the **Controls** settings by changing the **Flashlight Toggle** key event.

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PREPAR3D

Using an Xbox 360 Controller

Setting up and adjusting your controller

RELATED LINKS

- Changing Key Assignments
- Using the Keyboard
- Using the Mouse
- Using Voice Controls

Prepar3D is most realistic when you use a joystick, yoke, or other controller. You can fly more precisely, and the buttons and controls make it easy to change views, adjust the throttle, extend or retract the landing gear and flaps, and operate other aircraft controls. The **Xbox 360 Controller for Windows** combines the ease of a joystick with the ergonomics of a game controller.
Prepar3D is compatible with joysticks, yokes, game pads, and other controllers supported by Microsoft Windows and the DirectInput device standard. Use the device that works best for you as your primary control, and customize it to suit your needs. Many products feature different configurations, so refer to your controller's documentation for its button assignments.
Before you fly, make sure your Xbox 360 Controller is:

- Plugged into your computer.
- Enabled in Microsoft Windows (point to **Start/Settings/Control Panel/Game Controllers**).
- Calibrated properly (see Calibrating Your Controller).

Also make sure you have the latest device drivers. If in doubt, download and install them from the Microsoft.com Web site.

Controller Commands

Depending on your controller, you'll probably have buttons for frequently used controls and for cockpit views, but you'll still need to use the mouse or keyboard for other functions.

Action	Command
Increase throttle	Press button **Y**
Decrease throttle	Press button **B**
Apply brakes	Press button **A**
Toggle flashlight	Press button **X**
Left rudder	Press left trigger (**1**)
Right rudder	Press right trigger (**2**)
Climb/Descend	Left thumbstick back/forward (**5**)
Bank left/right	Left thumbstick left/right (**5**)
Look around	Move right thumbstick (**6**)
Reset view	Press right thumbstick (**6**)
Trim nose up	Press D-pad down (**7**)
Trim nose down	Press D-pad up (**7**)
Extend flaps incrementally	Press D-pad right (**7**)
Retract flaps incrementally	Press D-pad left (**7**)
Landing gear extend/retract	Press right shoulder button (**4**)
Spoilers extend/retract	Press left shoulder button (**3**)
Pause simulator	Press **Start** button (**9**)
Cycle frame rate/coordinates	Press **Back** button (**8**)

Customizing Controller Assignments

Use the **Controls Assignments** dialog box to customize controller assignments to suit your flying style.

To change controller button commands

1. On the **Options** menu, click **Controls...**

2. Click the **Key Assignments** tab.
3. On the **Calibration** tab, select the **Xbox 360 Controller** from the **Joystick type** list.
4. Select either the **Normal** or **Slew Mode** option.
5. In the **Event category** list, choose the category of events that you want to set.
6. In the **Assignment list**, select the event that you want to assign to a different controller button.
7. Click **Change Assignment**. The **Select Assignment** dialog box will open.
8. Press the controller button that you want to use for the selected event. If the button is currently being used and you don't want to replace it, click the **Clear** button.
9. Click **OK**.
10. Make any additional changes you want using steps 3 through 9 above.
11. Click **OK**.

The Xbox 360 Controller for Windows has two thumbsticks that act like joysticks. You can change the axes assignments for each thumbsticks.

To change thumbstick axes

1. On the **Options** menu, click **Controls...**
2. Click the **Joystick Assignments** tab.
3. Select either **Normal** or **Slew Mode**.
4. In the **Assignment list**, select the event that you want to set to a different joystick axis.
5. Click **Change Assignment**. The **Select Assignment** dialog box will open.
6. Move the joystick axis that you want to use for the selected event. If the axis is currently being used and you don't want to replace it, click the **Clear** button.
7. Click **OK**.
8. Make any additional changes you want using steps 3 through 7 above.
9. Click **OK**.

Calibrating Your Controller

If your Xbox 360 controller seems to be behaving erratically, you may need to calibrate it.

To calibrate your controller

1. Make sure your controller is plugged in and installed according to the manufacturer's instructions.
2. On the **Options** menu, click **Controls...**
3. Click the **Calibration** tab.
4. Click **Calibrate**.
5. Click **Properties**.
6. On the **Options** tab, follow the instructions on-screen.
7. Click **OK**.

Deleting and Resetting Assignments

To remove a control assignment from a command you've selected, click the **Delete Assignment** button on the **Key Assignments** or **Axis Assignments** tab.
To cancel any changes you've made to your key assignments and return to the Prepar3D default options, click the **Reset Defaults** button.

Adjusting Controller Sensitivity

Prepar3D's preset sensitivity for joysticks is in the middle of the range, and the response rate is average. You can adjust these sensitivities; experiment to find the option you like best.
"Sensitivity" refers to how sensitive the joystick is for a given axis. For example, with high sensitivity, the slightest movement of the joystick will have a large effect on the aircraft's controls in Prepar3D.
"Null Zone" refers to how much "dead space" there is in a given joystick axis center position. For example, with a large null zone, you will be able to move the joystick slightly before it has an effect on the aircraft's controls in Prepar3D.

To adjust the sensitivity of your controller thumbsticks

1. Make sure your controller is plugged in and installed according to the manufacturer's instructions.
2. On the **Options** menu, click **Controls...**
3. On the **Calibration** tab, select the **Xbox 360 Controller** from the **Joystick type** list.
4. To adjust the sensitivity for all axes simultaneously, click the **Simple** option, then drag the **Sensitivities-all axes** and **Null zones-all axes** sliders to the options you want.
   -or-
   To adjust the sensitivity for each axis separately, click the **Advanced** option, then select each axis and drag its **Sensitivity** and **Null zone** sliders to the options you want.
5. Click **OK**.

Note
To reset all sensitivity options to their default values, click the **Reset Defaults** button.

Adjusting Controller Forces

You can enable or disable force-feedback options. Be aware that the Xbox 360 for Windows Controller does not support all of the forces listed in the dialog box.

- **Crash effects:** If you crash, the controller will vibrate.
- **Ground bumps:** As you roll across the ramp, taxiway, and runway, the controller will vibrate.
- **Landing gear:** When you retract or extend the landing gear, the controller will vibrate.

To adjust controller forces

1. On the **Options** menu, click **Controls...**
2. Click the **Other** tab.
3. Select or clear the desired force feedback options.
4. Click **OK**.

Note
To disable all force feedback options, clear the **Enable force feedback** checkbox in the **Forces** dialog box.

Navigating Using Cinematographer

Cinematographer is a control mode that simplifies the process of moving the camera's eyepoint and orientation. Cinematographer mode works best with a controller because controller axes are mapped to smooth axis movement of the eyepoint and orientation by default. In Prepar3D, Cinematographer is toggled by pressing **SHIFT+F5**.

- Lateral and longitudinal eyepoint movement is mapped to the **left thumbstick**. A smooth reset of the eyepoint can be performed by pressing down the left thumbstick.
- Vertical eyepoint movement is mapped to the **triggers**.
- Orientation adjustment is mapped to the **right thumbstick**. A smooth reset of the orientation can be performed by pressing down the right thumbstick.
- Adjusting the zoom in and out is mapped to the **Y** and **B** buttons, respectively.

To change the eyepoint move rate, orientation adjust rate, zoom adjust rate, or smooth reset times, see the camera configuration article here to learn how to change the default values in the camera configuration files.

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PREPAR3D

Using a Joystick

Setting up and adjusting your controller

Prepar3D is most realistic when you use a joystick, yoke, or other controller. You can fly more precisely, and the buttons and controls make it easy to change views, adjust the throttle, extend or retract the landing gear and flaps, and operate other aircraft controls.
Prepar3D is compatible with joysticks, yokes, game pads, and other controllers supported by Microsoft Windows and the DirectInput device standard. Use the device that works best for you as your primary control, and customize it to suit your needs. Many products feature different configurations, so refer to your controller's documentation for its button assignments.
Before you fly, make sure your joystick or other controller is:

- Plugged into your computer.
- Enabled in Microsoft Windows Control Panel.
- Calibrated properly (see Calibrating Your Joystick).

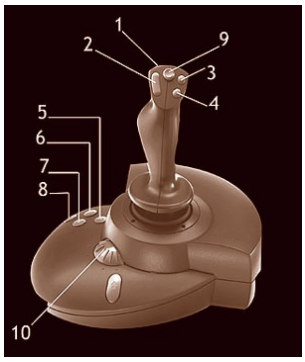
RELATED LINKS

- Changing Key Assignments
- Controller Troubleshooting Basics
- Advanced Controller Troubleshooting
- Using the Keyboard
- Using the Mouse
- Using Voice Controls

Also make sure you have the latest device drivers. If in doubt, download and install them from the manufacturer's Web site.

Joystick Commands

Depending on your joystick, you'll probably have buttons for frequently used controls and for cockpit views, but you'll still need to use the mouse or keyboard for other functions.



1. (Trigger) release brakes
2. Cycle views
3. Elevator trim down
4. Elevator trim up
5. Extend flaps
6. Retract flaps
7. Drop objects
8. Landing gear up/down
9. (Hat switch) Look around
10. Throttle control

Here's a list of the default joystick commands:

Action	Command
Apply/release brakes	Button 1 (trigger)
Cycle views (Cockpit, Tower, Track, Spot)	Button 2
Elevator trim down	Button 3
Elevator trim up	Button 4
Extend flaps	Button 5
Retract flaps	Button 6
Drop objects	Button 7
Landing gear up/down	Button 8
Bank left (ailerons)	Move stick left
Bank right (ailerons)	Move stick right
Pitch down (elevator)	Move stick forward
Pitch up (elevator)	Move stick backward

Yaw left (rudder) Yaw right (rudder)	Twist stick left Twist stick right
Look ahead/right	Move hat switch up/right
Look right Look back/right	Move hat switch right Move hat switch down/right
Look back	Move hat switch down
Look back/left Look left	Move hat switch down/left Move hat switch left
Look ahead/left Look up	Move hat switch up/left Move hat switch up

Customizing Joystick Assignments

Change the control assignments to customize the joystick use to suit your flying style.

To change joystick button commands

1. On the **Options** menu, click **Controls...**.
2. Click the **Key Assignments** tab.
3. Select either the **Normal** or **Slew Mode** option, depending on which mode you want to change commands for.
4. In the **Event** category list, choose the category of events that you want to set. For example, select **Autopilot commands** to customize the commands for the autopilot. Your selection determines what appears in the **Assignment list** below, which lists events and their corresponding key and joystick commands.
5. In the **Assignment list**, select the event that you want to set to a different joystick button.
6. Click **Change Assignment** to choose a new joystick button assignment for the event you've selected.
   The **Select Assignment** dialog box will open.
7. Press the joystick button that you want to use for the selected event. If the button is currently being used and you don't want to replace it, click the **Clear** button.
8. Click **OK**.
9. Make any additional changes you want using steps 3 through 8 above.
10. Click **OK**.

To change joystick assignments

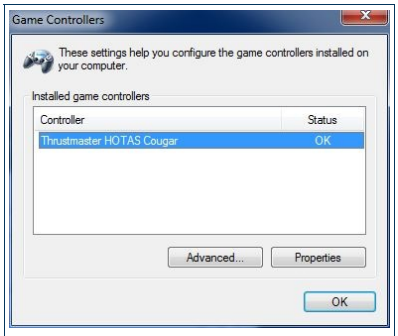
1. On the **Options** menu, click **Controls...**.
2. Click the **Joystick Assignments** tab.
3. Select either the **Normal** or **Slew Mode** option, depending on which mode you want to change commands for.
4. In the **Assignment list**, select the event that you want to set to a different joystick axis.
5. Click **Change Assignment** to choose a new joystick axis for the event you've selected.
   The **Select Assignment** dialog box will open.
6. Move the joystick axis that you want to use for the selected event. If the axis is currently being used and you don't want to replace it, click the **Clear** button.
7. Click **OK**.
8. Make any additional changes you want using steps 3 through 8 above.
9. Click **OK**.

Resetting and Deleting Assignments

To remove a control assignment from a command you've selected, click the **Delete Assignment** button on the **Key Assignments** or **Joystick Assignments** tab.
To cancel any changes you've made to your controller assignments and return to the Prepar3D default options, click the **Reset Defaults** button.

Calibrating Your Joystick

If your joystick seems to be behaving erratically, you may need to calibrate it.



You can calibrate your joystick in the Windows Game Controllers dialog box when using the DirectInput API.

To calibrate your joystick

1. Make sure your joystick is plugged in and installed according to the manufacturer's instructions.

2. On the **Options** menu, click **Controls...**.
3. Click the **Calibration** tab.
4. Click **Calibrate**.
5. On the **Options** tab follow the instructions on-screen.

Adjusting Joystick Sensitivity

Prepar3D's preset sensitivity for joysticks is in the middle of the range, and the response rate is average. You can adjust these sensitivities; experiment to find the option you like best.
"Sensitivity" refers to how sensitive the joystick is for a given axis. For example, with high sensitivity, the slightest movement of the joystick will have a large effect on the aircraft's controls in Prepar3D.
"Null Zone" refers to how much "dead space" there is in a given joystick axis center position. For example, with a large null zone, you will be able to move the joystick slightly before it has an effect on the aircraft's controls in Prepar3D.

To adjust the sensitivity of your joystick

1. Make sure your joystick is plugged in and installed according to the manufacturer's instructions.
2. On the **Options** menu, click **Controls...**.
3. Click the **Calibrate** tab.
4. To adjust the sensitivity for all axes simultaneously, click the **Simple** option, then drag the **Sensitivities-all axes** and **Null zones-all axes** sliders to the options you want.
   -or-
   To adjust the sensitivity for each for each axis separately, click the **Advanced** option, then select each axis and drag its **Sensitivity** and **Null zone** sliders to the options you want.
5. Click **OK**.

Note
To reset all sensitivity options to their default values, click the **Reset Defaults** button.

Adjusting Joystick Forces

If you are using a force-feedback joystick, you can enable or disable any or all force-feedback options:

- **Control surfaces:** When moving the rudder, elevator, and ailerons, you'll feel control surface forces.
- **Stick shaker:** If you exceed the maximum speed in a jet, the controller will shake.
- **Crashes:** If you crash, you'll feel it in the controller.
- **Ground surfaces:** As you roll across the ramp, taxiway, and runway, you'll feel the bumps through the controller.
- **Retractable landing gear:** When you retract the landing gear, you'll feel it through the controller.

To adjust joystick forces

1. On the **Options** menu, click **Controls...**
2. Click the **Other** tab.
3. Select or clear the desired force feedback options.
4. Click **OK**.

Note
To disable all force feedback options, clear the **Enable force feedback** checkbox on the **Other** tab.

Navigating Using Cinematographer

Cinematographer is a control mode that simplifies the process of moving the camera's eyepoint and orientation. Cinematographer mode works best with a controller because controller axes are mapped to smooth axis movement of the eyepoint and orientation by default. In Prepar3D, Cinematographer is toggled by pressing **SHIFT+F5**.

- Lateral, longitudinal, and vertical eyepoint movement is mapped to the **X**, **Y**, and **Z** axes of the joystick, respectively.
- The orientation is mapped to the **POV hat**

To change the eyepoint move rate, orientation adjust rate, zoom adjust rate, or smooth reset times, see the camera configuration article here to learn how to change the default values in the camera configuration files.

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PREPAR3D

Using Voice Controls

Enabling Voice Controls

Voice Controls are currently considered ***experimental***. Major changes are expected in future updates. You must manually enable this capability inside the Prepar3D.cfg by setting *EnableVoiceControl=1* under the *[STARTUP]* category.

RELATED LINKS

- Changing Key Assignments
- Using the Keyboard
- Using the Mouse
- Using an Xbox 360 Controller

Speech recognition can control many aspects of Prepar3D without the need for a keyboard or joystick. Using voice controls allows for a more interactive experience without losing the immersion by letting go of the joystick or taking off a virtual reality headset. The combination of physical controllers and speech recognition opens up a whole new world of simulation!

In order to use voice controls, make sure you have a microphone or headset that is:

- Plugged into your computer.
- Enabled in Microsoft Windows and unmuted.
- Set as the *Default Recording Device*.

Using Voice Controls

Voice Commands

When Voice Controls are active, simply speak a Phrase into the microphone and the Action will be executed in Prepar3D! Voice controls are best used for actions that require a single activation, instead of continuous actions such as firing an automatic weapon or adjusting an axis. Here is a list of the default voice commands:

Action	Phrase
Pause/Unpause	"Pause Prepar3D" "Unpause Prepar3D"
Reset the scenario	"Reset scenario"
Load a scenario	"Load scenario [scenario name]"
Reset VR headset position	"Reset VR" "Reset virtual reality"
Open/Close the ATC	"Open ATC" "Close ATC"
Select an ATC Option	"Select option [#]"
Turn engines on/off	"Start engines" "Shut down engines"
Set throttles to max/idle	"Set throttles to max" "Set throttles to idle"
Turn autopilot on/off	"Enable autopilot" "Disable autopilot"
Turn landing lights on/off	"Turn on landing lights" "Turn off landing lights"
Capture a screenshot	"Take a screenshot"
Change the weather	"Make it rain" "Make it snow" "Clear the weather"

Customizing Voice Commands

Phrases can be added or modified by editing the VoiceControlPhrases.cfg file located in *%APPDATA%\Lockheed Martin\Prepar3D v5*. Each line in the VoiceControlPhrases.cfg file represents a command, and one can be added to a new line with the comma-delimited format *[phrase], [event], [certainty]*.

- **Phrase:** The phrase that the speech recognizer will listen for.
- **Event:** The Event ID to be triggered when the Phrase is recognized.
- **Certainty:** How certain the recognizer needs to be to trigger the Event (0.0 to 1.0).

GLOBAL_CERTAINTY can be set at the top of the .cfg file to override all Certainty levels in the file. **GLOBAL_CERTAINTY = -1** turns the override off.

Keep in mind that shorter phrases may be incorrectly picked up more often than

longer ones. Use more complex phrases or a higher Certainty value to keep these commands from accidentally triggering.

A default command can also be removed by deleting the line for that command, or modified by changing the phrase for that command. The voice commands are loaded at startup and will require a restart for the changes to take effect.

Note: The VoiceControlPhrases.cfg only contains phrases that are bound to an Event ID. Some special phrases, such as "Load Scenario" and "Make it Rain", are not listed in this file.

Adjusting to Background Noise

Speech recognition works best in a quiet environment and with a good quality microphone. With a lot of background noise or talking, there may be some phrases that are recognized when they shouldn't. Decreasing the sensitivity of a microphone in the Windows sound settings to only pick up the words that are being spoken into it can help resolve some of these issues. To modify the sensitivity of a microphone:

1. Open the **Control Panel** and select **Sound**.
2. Change to the **Recording** tab.
3. Select the microphone you are using and then **Properties**.
4. Change to the **Levels** tab and adjust the slider to increase or decrease the sensitivity.

If a microphone is too close to the speaker, this may cause interference with voice recognition. Additionally, changing the Certainty requirement of a Phrase will change how often the Phrase will be recognized. A high Certainty will require that the speech recognizer will need to be more sure that the phrase was heard, and a lower Certainty requirement will activate when the recognizer is less sure.

Customizing Voice Commands Using the PDK

The Voice Control PDK service expands the capability of speech recognition even further than key events. Phrases can be added, similar to the VoiceControlPhrases.cfg file, and bound to key_events. However, a key_event parameter is optional and the phrase can be used with a custom event instead. When adding a phrase, a unique ID to that phrase is returned. This ID is broadcasted to all callbacks that are registered with the Voice Control Service. If a PDK plugin keeps track of the IDs, it can listen for them and run its own custom event when that phrase is recognized. This opens up the entire functionality of the PDK to the speech recognition in Prepar3D.

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PREPAR3D

Controller Troubleshooting

Most hardware controllers come ready to plug and play with Prepar3D. If any of the following symptoms occur, use the guidance below for assistance.

- The controller behaves erratically.
- The controller does not respond.
- The rudder or throttle does not respond.

CONTENTS

- Controller Connection
- Calibrating the Controller
- Resetting Defaults
- Rebuilding the Configuration File
- Input Method
- Installing DirectX

Verify Latest Drivers

For best performance, verify that the latest version of the driver for your hardware controller is installed on your computer. Visit the Web site of your controller's manufacturer to check for availability of a newer driver.

Verify Controller Connection

Verify that the hardware controller is connected directly to the correct USB or joystick port in your computer. "Daisy chained" joystick controllers (a controller connected to another controller, which is in turn connected to the computer) or joystick port adapters can interfere with communication between the computer and the joystick controller.
If you use a USB joystick controller, verify that the controller is connected properly to the USB port in your computer or to a compatible USB hub that is connected to the USB port in your computer.

Calibrate the Controller

If your controller is behaving erratically, it might need to be calibrated. Calibration can be performed from within Prepar3D.

Test calibration of controller

1. On the **Options** menu, click **Controls...**
2. Click the **Calibration** tab.
3. Select the device that you want to test in the **Controller Type** drop down menu, and then click **Calibrate**.
4. If using the **DirectInput** API, **Windows** will allow you to test and calibrate all the functions of your controller. If using the **Raw Input** API, calibration will be handled by the Prepar3D application.

If you cannot calibrate your controller, or if your controller does not function properly when you test it, Windows may be unable to communicate properly with the controller. Contact the manufacturer of your controller for information about how to configure the device correctly in Windows. You may also need to obtain and install the latest version of the controller device driver.
If you calibrate and test the controller successfully, start the simulator to test the controller. If the issue continues to occur, try resetting to the controllers default values.

Resetting the Defaults

To reset the default actions assigned to the controller

1. On the **Options** menu, click **Controls...**
2. In the Controls dialog box, click **Reset defaults**.
3. Click **OK**.

Rebuild the Configuration File

The simulator's configuration file contains options for your joystick. Rebuilding this file may resolve problems you are having with the joystick.

To rebuild the simulator configuration file

1. Press and hold down **CTRL+CAPS LOCK** as you start the application and start a new flight.
2. Continue to hold down **CTRL+CAPS LOCK** until the simulator is in Cockpit view.
   Note: Upon rebuild of configuration file, all options in the simulator will return to default values. (Ex: display, joystick controllers).

If your controller is installed properly and the devices configuration file contains the default options for your controller, appropriate entries for your controller are added to the configuration file.

Input Method

Prepar3D offers the user the ability to choose between both **Raw Input** and **DirectInput** API's. The **Raw Input** API was introduced due to the deprecation of the **DirectInput** API. If you are experiencing issues with either API it is recommended you try the other.

Selecting the input method

1. On the **Options** menu, click **Controls...**

2. In the Controls dialog box, click the **Other** tab.
3. Enable either the **Raw Input** or **DirectInput** API.
4. Click **OK**.
   Note: Key assignments may have to be reassigned when switching between input methods. It is recommended you select your input method before making any key assignments.

Installing DirectX

DirectX is a free software program that allows the simulator to communicate properly with the various hardware devices in your computer. DirectX is updated from time to time. Download and install the latest version of DirectX from **http://www.microsoft.com/en-us/download/details.aspx?id=35**

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PREPAR3D

Advanced Controller Troubleshooting

CONTENTS

- Force-Feedback Effects
- Controllers & Sound Acceleration
- Device Drivers

Adjusting Joystick Forces

Joystick force feedback is currently only available when using the **DirectInput** API. Force feedback is supported for XBox One and XBox 360 controllers when using either the **Raw Input** or **DirectInput** API. See Input Method for more information about selecting your controls API.

If you are using a force feedback joystick, you can enable or disable any or all force feedback options:

- **Control surfaces:** When maneuvering the aircraft, you'll feel forces exerted on the aircraft control surface through the controller.
- **Stick shaker:** If you exceed the maximum speed in a jet, the controller will shake.
- **Crash effects:** If you crash, you'll feel it in the controller.
- **Ground bumps:** As you roll across the ramp, taxiway, and runway, you'll feel the bumps through the controller.
- **Retractable gear thumps:** When you retract or extend the landing gear, you'll feel it through the controller.

To adjust controller forces

1. On the **Options** menu, click **Controls...**
2. Click the **Other** tab.
3. Select or clear the desired force feedback options.
4. Click **OK**.

Note: To disable all force feedback options, clear the **Enable force feedback** checkbox on the **Other** tab.

Force-Feedback Effects

If you're having a problem while using a force-feedback controller and have no problems while the force-feedback effects are disabled, the problem may be with the joystick controller.

To disable force-feedback effects

1. On the **Options** menu, click **Controls...**.
2. Click the **Other** tab (not displayed if a force-feedback controller is not installed).
3. Clear the **Enable force feedback** check box.
4. Click **OK**.

Controllers and Sound Acceleration

Controller ports are sometimes located on the computer's sound card. If your sound card cannot properly process game port signals and high-quality audio sounds at the same time, you may need to reduce the sound playback quality.

To reduce the sound playback quality

1. Click **Start**, and then click **Run**.
2. In the **Open** box, type DXDIAG.
3. In the **DirectX Diagnostic Tool** dialog box, click the **Sound** tab.
4. Click **Exit**.

Device Drivers

Drivers are small software programs that allow your operating system to communicate with the hardware installed in or attached to your computer. A driver acts as a translator between your hardware and operating system, and can also enhance the operation of a particular piece of hardware, such as a video adapter or joystick. A damaged or outdated driver can cause many types of errors to occur. A new driver for your joystick might allow your joystick to use features more efficiently or improve performance. The manufacturer of your controller probably offers free driver updates on their Web site. Contact your manufacturer to inquire about how to obtain and install the latest version of the driver.

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PREPAR3D

Add-ons

Prepar3D® has the capability of being enhanced by adding add-ons of Aircraft, Scenery, Missions and more. These add-ons can improve your Prepar3D experience. Before installing any add-on it is important to check the add-on's legal terms, conditions and license agreement to ensure you can legally install and run the add-on.

Refer to the add-on developer for installation instructions as well as support specific to the add-on. Add-on management is available within the application for add-ons using Prepar3D's latest development features. Go to **Options, Add-ons...** in the menu to access the Add-on management UI. Descriptions, locations, and the ability to enable and disable add-ons are available in this screen.

Manual Installation

Manual installation options are available for add-ons that do not include an installer. Always refer to documentation provided with the add-on for any specific steps or requirements before following the steps listed here.

Installing add-ons that use Prepar3D's latest development features is a very simple process. Add-ons compatible with this method will have an add-on.xml file located in the add-on's root directory. To install move the folder containing the add-on to the *%USERPROFILE%\Documents\Prepar3D v5 Add-ons* directory. You will be prompted to enable this add-on the next time Prepar3D is started. To uninstall this add-on simply delete the add-on's folder located in *%USERPROFILE%\Documents\Prepar3D v5 Add-ons.*

Please refer to add-on developer instructions for add-ons that are not compatible with this feature.

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PREPAR3D

Views

Get a better look at all there is to see in Prepar3D

In a real airplane, you can look around by moving your head. To look around in Prepar3D you have to change views. The best part is that unlike in the real world, you can even change views outside the airplane!
Press S to select a view category, then press A to select a view within that category.
Quick keys for frequently-used views

Virtual Cockpit	**F9**
2-D Cockpit	**F10**
Locked Spot view	**F11**
Top-Down view	**F12**

Think of view modes as camera position categories. Within each category, you can choose individual camera positions. When you use **Cockpit** views, the camera is like your eyes; showing the view you have as the pilot in the cockpit. When you use **Outside** Views, it's a camera view from the outside, looking at your aircraft.
Experiment with views to find the right combination for your style of flying.

CONTENTS

- Cockpit Views
- Outside Views
- Tower Views
- Aircraft Views
- Runway Views
- Air Traffic Views
- Instrument Panels
- Looking Around
- Using Multiple Windows
- Displaying Instrument Sub Panels
- Keyboard Shortcuts
- Displaying Axis Indicators

There are six main view modes in Prepar3D. You cycle through the view modes using the keyboard, buttons on a joystick, an *Xbox 360 for Windows* controller, or the menus (more on that below) and you can choose which view you want to display within each mode.
Whenever you change views, text in the upper-right corner of the screen displays the view name for three seconds.

To cycle through view modes

- Press **S** to cycle forward.

-or-

- Press **SHIFT+S** to cycle backwards.

-or-

- On the **Views** menu, point to **Change View**, point to a category, then click a view.

To cycle views within a view mode

- Press **A** to cycle forward.

-or-

- Press **SHIFT+A** to cycle backwards.

-or-

- On the **Views** menu, point to **Change View**, point to a category, then click a view.

The view modes are:

View mode	What you see
Cockpit	Pilot's view from the 2-D cockpit or 3-D virtual cockpit.
Outside	Your aircraft from an external viewpoint.
Tower	Your aircraft from a control tower or tower-like perspective (non-towered airports).
Aircraft	Your aircraft from an external camera on or near the aircraft.
Runway	A runway from the viewpoint of your cockpit. Very useful for finding the runway on approach.
Air traffic	Other aircraft in the sky and on the ground.
Sensor	Sensor or Colorized view

Cockpit Views

There are several cockpit views, not all of which are available in all aircraft:

View	What you see
2-D Cockpit	2-D instrument panel with various panel options.
Virtual cockpit	3-D cockpit with the ability to pan the camera view.

Right seat	Virtual cockpit with the ability to pan the camera view.
Rear seat	Virtual cockpit with the ability to pan the camera view.
Radio stack	Close-up view of radios with the ability to pan the camera view.
Light switches	Close-up view of switches with the ability to pan the camera view.

The 2-D cockpit and the 3-D virtual cockpit differ in how you are able to look around the cockpit. In the 2-D cockpit, you can display hidden sections of the panel with key commands and use the keyboard, a joystick, or an Xbox controller to make quick changes to the direction in which you're looking. In 3-D virtual cockpit, you can use the keyboard, your joystick, the mouse, or an Xbox controller to look around, using a panning action, which provides a realistic movement as if you are moving your head.

To cycle through view modes to Cockpit view

- Press **S**.

-or-

- On the **Views** menu, point to **Change View**, point to **Cockpit**, then click a cockpit view.

To cycle through cockpit views

- Press **A**.

-or-

- On the **Views** menu, point to **Change View**, point to **Cockpit**, then click a cockpit view.

You can set 2-D cockpit or 3-D cockpit as the default view.

To set the default cockpit view

1. On the **Options** menu, click **Settings**.
2. Select **Display** from the sidebar.
3. Click the **Aircraft** tab.
4. Select the **2-D instrument panel** or the **3-D virtual cockpit** option.
5. Click **OK**.

There are also several different panels you can choose while in 2-D cockpit mode. To learn more, see Instrument Panels below.

Panel	What you see
2-D panel	Normal 2-D panel.
IFR panel	Larger 2-D panel for flying only by reference to instruments.
Approach panel	A smaller version of the 2-D panel with greater visibility over the top of the panel.
Mini panel	Only the primary instruments with no panel.
No panel	No panel or instruments.

Outside Views

Outside views place the camera at a point in space, viewing your aircraft from outside. There are four options for outside views:

View	What you see
Spot	Your aircraft as viewed from a chase plane (fluid transition).
Locked Spot	Your aircraft as viewed from a chase plane (direct transition).
Flyby	Your aircraft as it flies past a fixed point.
Top-down	Your aircraft viewed top-down from high altitude.

To cycle through view modes to Outside view

- Press **S**.

-or-

- On the **Views** menu, point to **Change View**, point to **Outside**, then click an outside view.

To cycle through outside views

- Press **A**.

-or-

- On the **Views** menu, point to **Change View**, point to **Outside**, then click an outside view.

Tower Views

When you select a Tower view, the default view is from the tower nearest to your aircraft. You can change the Tower view to any of the towers listed in the Tower view submenu.

To cycle through view modes to Tower view

- Press **S**.

-or-

- On the **Views** menu, point to **Change View...**, point to **Tower**, then click a tower.

To cycle through tower views

- Press **A**.

-or-

- On the **Views** menu, point to **Change View...**, point to **Tower**, then click a tower.

Aircraft Views

When you select an Aircraft view, the default view depends upon which aircraft you're flying. Different aircraft have different options for Aircraft view. You can change the aircraft view on the Aircraft View submenu.

To cycle through view modes to Aircraft view

- Press **S**.

-or-

- On the **Views** menu, point to **Change View**, point to **Aircraft**, then click an aircraft view.

To cycle through aircraft views

- Press **A**.

-or-

- On the **Views** menu, point to **Change View**, point to **Aircraft**, then click an aircraft view.

Runway Views

When you select a Runway view, the view shifts toward the runway selected in the Runway View submenu as seen from your cockpit. This view is very useful if you're close to your destination airport but you're having difficulty seeing the runway.

To cycle through view modes to Runway view

- Press **S**.

-or-

- On the **Views** menu, point to **Change View**, point to **Runway**, then click a specific runway.

To cycle through runway views

- Press **A**.

-or-

- On the **Views** menu, point to **Change View**, point to **Runway**, then click a specific runway.

Air Traffic Views

Important note: you must have air traffic turned on or the Air Traffic view mode will not appear in the Views menu.
Air Traffic view shifts your viewpoint to other aircraft in the sky and on the ground.

To cycle through view modes to Air Traffic view

- Press **S**.

-or-

- On the **Views** menu, point to **Change View**, point to **Air Traffic**, then click a specific aircraft.

To cycle through air traffic views

- Press **A**.

-or-

- On the **Views** menu, point to **Change View**, point to **Air Traffic**, then click a specific aircraft.

Sensor Views

Sensor views simulate sensors such as Infrared or Night Vision Goggles
There are two options for outside views:

View	What you see
IR	IR Sensors using a basic thermal model in which terrain, water, air, buildings, and vehicles have different core temperatures. Terrain and water temperatures change in response to location/climate, time of day, and day of year.
NVG	Night Vision Goggle simulation using a Colorization view to apply image post processing to colorize the rendered scene.

To cycle through view modes to Sensor view

- Press **S**.

-or-

- On the **Views** menu, point to **Change View**, point to **Sensor**, then click a sensor view.

To cycle through sensor views

- Press **A**.

-or-

- On the **Views** menu, point to **Change View**, point to **Sensor**, then click an sensor view.

Looking Around

In most views, you can look around by using the hat switch on your joystick, by pressing keys on the numeric keypad, or by using the thumbstick on an **Xbox 360 controller for Windows**.

One of the fastest and best tools for looking around the cockpit or the world in Prepar3D is to use the special mouse-look feature.
To use a joystick hat switch to change view direction:

Action	Move hat switch
Look forward/right	Up/right
Look right	Right
Look back/right	Down/right
Look back	Down
Look back/left	Down/left
Look left	Left
Look forward/left	Up/left
Look up	Straight/up

To use key commands to change view direction **(you must have NUM LOCK on):**

Action	Key command
Look forward/right	NUMPAD 9
Look right	NUMPAD 6
Look back/right	NUMPAD 3
Look back	NUMPAD 2
Look back/left	NUMPAD 1
Look left	NUMPAD 4
Look forward/left	NUMPAD 7
Look up	CTRL+SHIFT+NUMPAD 8

To change view direction with an Xbox 360 controller for Windows

- Move the right thumbstick.

  -or-
- Press the **D-pad**.

Zooming In and Out

You can use zoom controls to magnify or reduce any view. Zoom in close enough to see the rivets on your aircraft, or zoom out to get a bird's-eye view of the airport below. Text in the upper-right corner of the screen displays the current zoom factor.

To zoom in and out in Cockpit, Tower, Spot Plane, or Top-down view

- Press the **EQUAL SIGN (=)** to zoom in.
  -or-
- Press **HYPHEN (-)** to zoom out.

Moving the Eyepoint

Having trouble seeing over the instrument panel? In a real airplane you'd just lean forward a bit or sit on a phone book. In Prepar3D you can move the eyepoint, the point from which your virtual eyes look out. This is particularly useful ability when taxiing taildraggers in Cockpit or Virtual Cockpit views.
To move the eyepoint in any view:

Action *3-D virtual cockpit only	Key command
Move Eyepoint Back*	CTRL+ENTER
Move Eyepoint Up	SHIFT+ENTER
Move Eyepoint Down	SHIFT+BACKSPACE
Pan Eyepoint Up	CTRL+SHIFT+Q
Pan Eyepoint Down	CTRL+Q
Move Eyepoint Forward*	CTRL+BACKSPACE
Move Eyepoint Left*	CTRL+SHIFT+BACKSPACE
Move Eyepoint Right*	CTRL+SHIFT+ENTER
Reset Eyepoint	CTRL+SPACEBAR
Look up	CTRL+SHIFT+NUMPAD 8

Instrument Panels

You can adjust the transparency of instrument panels (2-D only), or eliminate the panel altogether to see the world beyond the cockpit.

To adjust panel transparency

1. Press **CTRL+SHIFT+T**.
2. Press **+** (PLUS) or **-** (MINUS) to to increase or decrease transparency.

-or-

1. On the **Options** menu and click to **Settings**.
2. Select **Display** from the sidebar.
3. Click the **Aircraft** tab.
4. Move the **2-D panel transparency** slider right or left to increase or decrease transparency.
5. Click **OK**.

You can select one of five 2-D cockpit instrument panel options:

To choose a 2-D cockpit view

1. Press **S** to select 2-D cockpit.
2. Press **W** to select a specific panel display.

Displaying Instrument Subpanels

Some Prepar3D aircraft have separate windows or subpanels for their radio stacks, compass, engine controls, and other cockpit controls. Use **SHIFT+1-7** to display the various subpanels (see the list of key commands for each aircraft on the kneeboard in the cockpit)..

Quick Keys

You can use some keyboard shortcuts to rapidly switch to some of the most useful views.

View	Key command
Virtual Cockpit	F9
Spot View	F10
Top-Down View	F11
Starting View	F12

Axis Indicators

An axis indicator makes it easy to determine pitch and bank angles relative to the horizon without having to look at the attitude indicator; real-world pilots often use a smudge on the windscreen for the same purpose. The axis indicators in Prepar3D are a great tool when you're learning basic flying maneuvers. They're also very useful if you hide the instrument panel by pressing **W**.
Using the **Axis indicator** drop-down list, you can display one of three axis indicators on the windscreen of your aircraft:

- **4 dots**
- **Small V**
- **Large V**

Cofiguring Displays and Multichannel

Prepar3D has the ability to be displayed in several ways. Now Prepar3D can be displayed with the ability to add multiple view groups, multiple views, and multiple displays, as well as, the ability to be distribute views among several boxes with our new Multichannel feature. Assistance with these features can be found at Display Configuration

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Multiple Monitor Configuration

Overview

Prepar3D offers many different ways to set up multiple monitors and create additional views. The ideal way to accomplish this depends on the desired system setup. Below are a few options for achieving a multi-monitor configuration.

Contents

- Creating New Views and Moving Views
- Stretching Views across Multiple Monitors
- Using Auto-fill Desktop

Related Links

- Using Views and Windows
- Display and View Group

Creating New Views and Moving Their Windows

Prepar3D has the capability to create child views within the main application window. For example, you can fly in Cockpit view and open an additional window that displays the Top-down view for extra situational awareness in the traffic pattern.

Making a New View

- Create a new view by navigating to the top menu bar and selecting **Views -> New View** OR Press **[(LEFT BRACKET)**.
- Select the desired view, and you will see this new view appear in a smaller window within the main application window. Notice that you can click and drag the window around the screen, but it cannot be forced out of the main application window. This is because it is currently docked by default.
- To undock the window, right-click within the view and select **Undock Window**. The window should now be separated from the main application and can be dragged to a different monitor.

Making a Window Active

You can have several different windows open at once. Prepar3D adds new windows to the bottom of the **Views** menu, and numbers them in the order that you opened them. The active view window has a check mark next to it. All keyboard and joystick view commands apply to the active window.

IMPORTANT NOTE: Instrument subpanels, the kneeboard, the air traffic control menu, and the chat window are also treated as windows.

To activate a window

- Click anywhere inside the window.
  -or-
- Press **CTRL+TAB** to cycle through the open windows, selecting the window you want to activate.
  -or-
- In the list at the bottom of the **Views** menu, click the window that you want to make the active window.

Other Prepar3D window tricks

Prepar3D has many keyboard shortcuts to help you work with views and windows. For the complete list, see the **Keys** page of the **Kneeboard** (press **SHIFT+F10**). Under the **View Commands** section are some other tricks you can do with windows. The best way to learn about these is to experiment with them.

To close a window

- Click the view window, then press **] (RIGHT BRACKET)**.
  -or-
- Right-click on the window, then choose **Close Window** from the shortcut menu.

To resize a window

- Drag a corner or a side of the window.

NOTE: To move a window between monitors in full screen view, it is not necessary to undock the window as described below.

To move a Prepar3D window outside the Prepar3D application window

1. Click the window that contains the view you want to move.
2. On the **Views** menu, click **Undock View**.
3. Drag the undocked window anywhere on the Windows desktop.

-or-

1. Right-click the window that contains the view you want to undock.
2. Click **Undock Window**.
3. Drag the undocked window anywhere on the Windows desktop.

Stretching Views across Multiple Monitors

One way to span Prepar3D across a multi-monitor setup is to stretch the non-fullscreen window. Hover the cursor over the sides of the window and drag the edges out to the monitors you want Prepar3D to span across.
Once Prepar3D is touching all desired monitors, press **Alt+Enter** to fullscreen. This should maximize Prepar3D so it is visible on all monitors you stretched it across.

Using Auto-fill Desktop

Another method of spanning Prepar3D across various monitors is to use the Auto-fill Desktop view group.

Right-click within the main Prepar3D window and select **View Groups->Auto-fill Desktop**. This will create a separate Prepar3D window per monitor to display the multi-monitor view.
Press **Alt+Enter** to get rid of the borders and enter full screen mode.

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PREPAR3D

Observer View

Anywhere, Anytime

Observers provide a means of defining arbitrary camera views within Prepar3D, unattached to any existing simulation object or entity. These views may be created, deleted, and modified by the user at will, allowing for customized viewpoints during runtime.

CONTENTS

- Observer Management
- Display Configuration
- Definition of Attributes

Observer Management

Management of observers is made possible through the **Observer Management** dialog. This allows the creation of new observers as well as the modification and deletion of existing observers. Observer Management occurs through a single screen launched via the **Views->Observer Management** menu from the main Prepar3D screen.

Observers are listed as they are created in the **Observer** drop-down list and are selectable from this list after the creation process is complete. If a user wants to create a new Observer, they can simply enter the new Observer's name in the text field. As long as the name is unique, this will enable the **Create Observer** button at the bottom of the screen. Similarly, selecting an Observer from the drop-down list enables the **Delete Observer** and **Accept Edits** buttons.

Position and Orientation values are the Latitude/Longitude/Altitude and the Heading/Pitch/Bank values of the Observer. **Grab Current Position** and **Grab Current Rotation** buttons will automatically populate this portion of the screen with the user's current camera values. The **Relative Position...** and **Look At...** buttons will open new windows for the user to select relative LLA positions to objects already existing in the simulation or rotation values looking in the direction of a given object.

View Settings define focal point length and horizontal/vertical field of views in degrees. The user may lock the horizontal and vertical aspects and apply the ratio by clicking the **Apply Display Aspect Ratio** button. The user may also select the **Colorizing** or **Sensor Value** by clicking on the drop-down menu. The graphical panel will change camera views as the user scrolls through different sensor/colorizer combinations.

The **Manipulation Behavior** panel allows the user to define the step size or angular step size that an Observer can take, as well as designate **Ghost Mode** or **Pass Through Water Surface** mode.

The **Create Observer**, **Delete Observer**, **Accept Edits**, and **Close** buttons are enabled at different times when the user is performing **Observer Management** operations. If the user has selected the **Enter New Observer Name...** option and has a valid name entered into the text field, they may click the **Create Observer** button to create the Observer in the simulation. If the user selects an existing Observer, then the user may either **Delete Observer** which removes the Observer from the system, or **Accept Edits** which update the Observer's characteristics. Every field except for the Observer name may be edited. The user may click the **Close** button at any time to exit Observer Management.

Display Configuration

After creating an observer, it will be listed with the other view modes. Various observer manipulation actions are available to be bound to control interfaces (i.e. the keyboard, mouse, joystick, or gamepad). Below are the observer movements and default keybinds.

"Local Axis" means a coordinate system tied to the observer's current orientation; for example, forward means directly forward (analogous to zooming), left means directly left (which could be partially "up" relative to the world if the observer was banked), etc.

"World Plane" means a coordinate system developed from projecting the observer's orientation onto the base world-surface; up-and-down movements are perpendicular to the horizon while other movements are parallel to the horizon.

Move Observer		Description	Default
Up	World Plane	Moves the observer upwards, parallel to the local world up direction	Page up
Down	World Plane	Moves the observer downwards, parallel to the local world up direction	Page down
Left	World Plane	Moves the observer left, parallel to the local world horizon	Left arrow
Right	World Plane	Moves the observer right, parallel to the local world horizon	Right arrow

Forward	World Plane	Moves the observer forward, parallel to the local world horizon	Up arrow
Backward	World Plane	Moves the observer backward, parallel to the local world horizon	Down arrow
Up	Local Axis	Moves the observer upwards relative to its own local coordinate system	Unassigned
Down	Local Axis	Moves the observer downwards relative to its own local coordinate system	Unassigned
Left	Local Axis	Moves the observer left relative to its own local coordinate system	Unassigned
Right	Local Axis	Moves the observer right relative to its own local coordinate system	Unassigned
Forward	Local Axis	Moves the observer forward relative to its own local coordinate system	Unassigned
Backward	Local Axis	Moves the observer backward relative to its own local coordinate system	Unassigned

Rotate Observer	Description	Default
Pitch Axis	Rotates the observer along the pitch axis (maps to a device axis)	Mouse Y-axis (mouse-look mode)
Yaw Axis	Rotates the observer along the yaw axis (maps to a device axis)	Mouse X-axis (mouse-look mode)
Roll Axis	Rotates the observer along the roll axis (maps to a device axis)	Unassigned

Yaw Observer	Description	Default
Left	Rotates the observer to the left along the yaw axis	Numpad 4
Right	Rotates the observer to the right along the yaw axis	Numpad 6

Pitch Observer	Description	Default
Up	Rotates the observer up along the pitch axis	Numpad 8
Down	Rotates the observer down along the pitch axis	Numpad 2

Roll Observer	Description	Default
Left (CCW)	Rotates the observer counter-clockwise along the roll axis	Unassigned
Right (CW)	Rotates the observer clockwise along the roll axis	Unassigned

Zoom Observer	Description	Default
Zoom Out	Zooms out the observer (increasing its focal distance)	Numpad minus, mouse wheel backward
Zoom In	Zooms in the observer (decreasing its focal distance)	Numpad plus, mouse wheel forward
Toggle Rotation	Toggles between rotating on the observer's origin and rotating on the observer's focal point (target)	Numpad 0
Reset Rotation	Resets the observer's rotation, zeroing pitch and roll while setting heading to due north)	Numpad period

Definition of Attributes

Name:	Specifying unique title for Observer
Latitude:	The angular distance north or south of the earth's equator
Longitude:	Angular distance on the earth's surface, measured east or west from the prime meridian at Greenwich
Altitude:	The height of an object above a reference level, especially above sea level or above the earth's surface
Heading:	The rotation of the observer relative to the standard world coordinate frame.
Pitch:	The rotation of the observer relative to the standard world coordinate frame.

Bank:	The rotation of the observer relative to the standard world coordinate frame.
Grab Current Position:	Copies the position of the currently-active view (whether camera-based or observer-based)
Grab Current Rotation:	Copies the orientation of the currently-active view (whether camera-based or observer-based)
Set Relative Position:	Sets the position and orientation of the observer to observe a given simulation object. The observer is placed a specified distance away from the object and is oriented to look at the object. Additionally, it is set to point-focus on the object
Look At Point:	Rotates the observer in-place to face the given point in the world.
Linear Step Size:	The discrete step that a move action takes. (see "control bindings")
Angular Step Size:	The discrete step that a rotation action takes. (see "control bindings")
Focal Length:	The distance from the observer to its focal point, measured along the forward viewing vector. This value is automatically calculated if the focal point is kept relative to the world by use of the world-focus mode. (This value is used to specify the focal point in point-focus mode; instead of specifying a focal point, the focal length is specified and the focal point is calculated based on the current observer position, rotation, and focal length.)
Point Focus:	The observer is focused on a specific point in space, at a fixed focal distance from the observer. Normally used when the observer is being used to observe entities (thus allowing zooming based on the entity, not the world-surface)
World Focus:	The observer automatically re-calculates its focal distance so that the focal point always lies on the world-surface (terrain, water, etc)
Field-Of-View(H):	The horizontal field-of-view, in degrees, of the observer's rendered view.
Field-Of-View(V):	The vertical field-of-view, in degrees, of the observer's rendered view
Lock Aspect:	Locks the aspect ratio for the field-of-view, causing the selected dimension (horizontal or vertical) to be auto-calculated from that point on, in order to maintain the same ratio of horizontal-to-vertical values that existed when the lock was enabled.
Pass Through Water Surfaces:	This allows the observer to view undersea features when bathymetry is available
Ghost Mode:	This allows the observer to pass through any object or surface

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Custom Camera UI

Customizing Prepar3D Camera Configurations

Overview

Prepar3D offers the capability to create new custom cameras at runtime. Once created, these cameras can be switched to at any time and can be either globally available or specific to a scenario. To create a new custom camera click on the **Manage Cameras** menu option from the top-level menu or context menu. This brings up the Custom Camera Management window. This brings up the **Custom Camera Management** window.
Once the Custom Cameras are created they will appear in the corresponding camera category option in the context menu.
To edit and delete Custom Cameras click on the **Manage Cameras** menu option from the top-level menu or context menu and select the desired camera.
When saving a scenario custom cameras are saved in the **CameraLocation.X** section (Scenario files are saved to the *%USERPROFILE%\Documents\Prepar3D v5 Files* directory). To make custom cameras available in all scenarios change the Save To dropdown to Global. They will then save to the **CustomCameras.xml** file in the *%APPDATA%\Lockheed Martin\Prepar3D v5* directory.

Explanation of UI fields

Camera Name: Desired name of the new custom camera.
Available Cameras: The current list of available cameras.

Translation and Rotation

X, Y, Z: Position of the camera in meters relative to the origin. These values must be between 0.0 and 100.0 inclusive.
Pitch, Bank, Heading: Rotation of the camera in degrees. These values must be between 0.0 and 180.0 inclusive.

Zoom and Field of View

Zoom: Zoom value of the camera. This value must be between 0.3 and 512.0 inclusive.
Use Active Window: This button will populate all fields in the Translation, Rotation, and Zoom section with the values of the currently active camera.
Override Default FOV: Setting this checkbox enables the FOV (Field of View) to be modified for the camera. When unchecked the camera's FOV is based on the window size.
Horizontal: The horizontal FOV of the camera. This value must be between 0.0 and 180.0 exclusive.
Vertical: The vertical FOV of the camera. This value must be between 0.0 and 180.0 exclusive.

Camera Effects

Effects: This list view enables post process effects to be added to the custom camera. This includes standard colorizers (NVG, IR, etc.) and also includes any user-defined post processes. The added effects display in a list below and can also be removed. Additionally post processes can be configured to exclude the virtual cockpit. For more information on creating post processes please refer to the Custom Post-process section.

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Post-Processes

Overview

RELATED LINKS

- Custom Post-process
- Custom Camera UI

This provides a description and an example for each of the Post-process effects that can be applied to custom camera views. When adding custom post-processes to camera views, each camera view can apply up to 16 effects. They are applied in the order shown in the **Camera Effects** section.
The following list contains the Post-processes available for use:

- 8 Bit
- Black Hot Colorizer
- Black Hot Green Colorizer
- Blur
- Example
- FXAA Resolve
- Fisheye
- Gray Scale Colorizer
- Green Scale Colorizer
- HDR Post Process
- IR Black Hot
- IR White Hot
- Invert Color
- Invert Color Pre VC
- NoOpPreVC
- Signal Noise
- VC Transparency [100]
- VC Transparency [50]
- VC Transparency [75]
- White Hot Colorizer
- White Hot Green Colorizer

8 Bit

Flattens color palette to 8 bits providing a more "retro" look. Useful for mimicking certain sensors by reducing image color quality.

Black Hot Colorizer

Applies grayscale to the image with hotter objects appearing black. This is only based on the color of objects and not based on actual object heat intensity values. If this is required, use the IR Black Hot post process instead.

Black Hot Green Colorizer

Maps all colors to different shades of green making hotter objects appear darker. Mimics an NVG sensor.

Blur

The Blur effect will create an obscured view with blurry edges and outlines of the of the desired camera view.

Example

Evenly grayscales the image. This is provided as a simple example on how to use the post process API.

FXAA Resolve

FXAA Resolve or Fast approximate anti-aliasing makes jagged edges of rendered images appear smoother by analyzing the final image and smoothing edges. This allows for FXAA to appear on a certain camera view even if it is not turned on for the general simulation.

Fisheye

Fisheye applies a fisheye distorter to the camera image.

Gray Scale Colorizer

Grayscales the image. Calibrated to emphasize certain color channels more than others.

Green Scale Colorizer

Maps all colors to different shades of green. Mimics an NVG sensor.

HDR Post Process

Adds HDR to the custom camera view, even if HDR is not turned on for the general simulation.

IR Black Hot

Displays an infrared black and white negative filter. When IR Black Hot is chosen as the desired effect, invert color is automatically added as an effect as well.

IR White Hot

IR White Hot displays an infrared white negative filter.

Invert Color

Invert Color takes the current colors and inverts them all to their polar opposites on the color spectrum.

Invert Color Pre VC

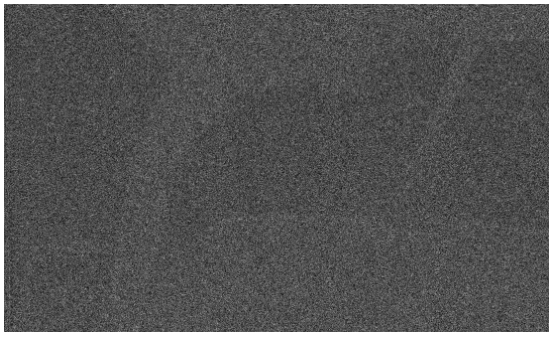
Inverts the color of everything except the panels and gauges in the virtual cockpit view.

NoOpPreVC

Automatically applied with certain VC post process exclusion configurations. Has no effect when used standalone.

Signal Noise

Displays an image of radio or signal failure. The static image indicates failure or poor signal.



VC Transparency [100]

VC Transparency [100] displays the view through a virtual cockpit set at 100% transparency. The panels and gauges are still visible.

VC Transparency [50]

VC Transparency [50] displays the view through a virtual cockpit set at 50% transparency. The panels and gauges are still visible.

VC Transparency [75]

VC Transparency [75] displays the view through a virtual cockpit set at 75% transparency. The panels and gauges are still visible.

White Hot Colorizer

Applies grayscale to the image with hotter objects appearing white. This is only based on the color of objects and not based on actual object heat intensity values, if this is required use the IR white hot sensor mode.

White Hot Green Colorizer

Maps all colors to different shades of green making hotter objects appear brighter. Mimics an NVG sensor.

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PREPAR3D

Display and View Group

Overview

View groups allow a large field of view to be distributed across multiple displays by assigning a view to each display. When a view group is active, it can be controlled by any of its members so that a group of displays behaves similarly to a single large display.

CONTENTS

- Configuring Displays
- Configuring View Groups
- View Group XML Examples
- Property Sets
- Display Properties

Configuring Displays

In order to map views to displays, a Display entry must exist in the Displays configuration which assigns a DisplayID and AdapterIndex, with an AdapterIndex and MachineID. The adapter index indicates the monitor/projector to use, while the MachineID indicates which computer the display is connected to (*MachineID needed in Multichannel only*). Each view in a ViewGroup needs to reference a DisplayID listed in the Displays configuration in order for it to automatically open on that display when the group is activated.

There are two ways to edit ViewGroups and Displays. The simplest is by using the View Group Management UI which updates the underlying xml configurations automatically. After making adjustments, selecting "Ok" will save out the configuration into the appropriate xml files. The second way to set up the display configuration is to manually edit the xml files. The Displays.xml, ViewGroups.xml, and Multichannel.xml (*Pro Plus Only*) can be found in *%PROGRAMDATA%\Lockheed Martin\Prepar3D v5*. Both methods will be covered here.

Configuring Displays via UI

1. Open Views->View Group Management.
2. Select Displays->Configuration 1.
3. Rename "Configuration 1" to a custom name by filling out the "Name" textbox.
4. Below "Display" is a list of the current displays. If this list is empty, or needs to be added to, select "Add".
5. Select the appropriate display by either double-clicking, or selecting the pencil beside the display name.
6. This will bring up the edit page for the selected display. This window has several fields, such as "DisplayID", "AdapterIndex", and "MachineID". The user interface also allows the addition of a plugin or post-process to a display. This post-process or plugin will be added to the display globally, so they will be applied to any view on that display. An example of editing a plugin can be found on the EasyBlend page, under *"Setup EasyBlend™ using the Prepar3D UI".*

   Note: You can add a new Display Configuration, but it will not be active. To make your configuration active, you must move it to the top of the list of Configurations by selecting Displays, then clicking to highlight the configuration you would like to move. Use the arrows to the right of the box to move the highlighted display up and down in the list.

Configuring Displays by Editing Displays.xml

Below is the .xml output from following the steps above.

```
<?xml version="1.0" encoding="UTF-8"?>
<SimBase.Document Type="ConfigurationFile" version="4,1">
    <Descr>AceXML Document</Descr>
    <SimDisplay.ConfigurationSet>
        <Configuration>
            <Display>
                <Name>NVIDIA Quadro K5000.0.0</Name>
                <AdapterIndex>1</AdapterIndex>
            </Display>
        </Configuration>
    </SimDisplay.ConfigurationSet>
</SimBase.Document>
```

Configuring View Groups

A View Group is series of views which are each associated with a Display. Each view contains field of view and offset information describing the section of the overall scene which will be rendered on a given display. View groups can be created and modified in the View Management window, or by editing ViewGroups.xml. There are a number of ways to define a view group:

1. Automatically using an AutoDetect GridSetup
2. Automatically using a GridSetup with grid size and a starting DisplayID
3. Manually by defining a relative Viewport
4. Manually using a ViewFrustum

Note: You can add a new View Group, but it will not be active if there are more than one view groups. To make your view group active, you must move it to the top of the list of View Groups by selecting View Groups, then clicking to highlight the view group you would like to move. Use the arrows to the right of the box to move the highlighted view group up and down in the list.

Selecting a View

To select a view once you have saved (by selecting 'OK') and exited the View Group Manager, right click on the screen and hover over View Groups, and click on your view.

View Group Samples

The following examples set up different view groups using various features of the view group management user interface. A detailed list of features/options is included later in this document.

Configuring a View Group via UI Using a GridSetup

1. Open Views->View Group Management.
2. Select View Groups->ViewGroup 1.
   Note: If you are auto generating views, the first View Group in the list will be Auto-Fill Desktop. Do not edit that View Group. You will need to select View Groups and click Add to make a new View Group to customize.
3. Rename "ViewGroup 1" to a custom name by filling out the "Name" textbox.
4. Below Name, is the option to set the Side Angles that describe the field of view of the entire group. Adjusting these angles will widen or narrow down a field of view. For example: Left: -60.000, Right: 60.000, Top:20.000, Bottom:-20.000 would result in a 120 degree horizontal FOV and a 40 degree vertical FOV
5. ViewGroupShape describes the layout of the monitors that are being used to run Prepar3D. The supported setup for a set of monitors can be either flat, cylindrical, or spherical. This will affect how the view groups adjust perspectives. Note that while Flat is useful for scenarios like a multi-channel video wall, it is not recommended for single-machine groups because the same result can be achieved with better performance by stretching a single window across multiple monitors. Cylindrical view groups will correct for the perceptive of each monitor and is recommended in most cases.
6. AllowZoom will either enable or disable the ability to zoom the camera. Yes = Allow zooming.
7. GridSetup is the horizontal (X) and vertical (Y) description of the layout of the physical monitors being used to visualize Prepar3D.
8. Under GridSetup, select "Add", then select "Edit".

   When in the edit window for GridSetup, there will be 4 groups of options.
   - GridSize is the value pair for how many monitors wide and how many monitors tall a setup is. X = width, Y = height.
   - EdgeOverlap is a way to correct the view for how much distance there may be between monitors, also called bezel correction. For this example, the fields will be set to -1.000.
   - The FirstDisplayID field is how Prepar3D knows what the furthest left, and furthest top monitor is in a setup. This is where Prepar3D will begin filling in displays sequentially to make a correct picture. This is typically left at 1 for most users.
   - In this first example, AutoDetect will be left off since most of the fields it would look at have been set. A way to simplify this process is to simply leave everything on its default value and turn "AutoDetect" on by flipping this switch to "Yes". This will tell Prepar3D to make the best guess it can at assigning monitors in the correct order with the correct viewports based on the desktop layout.
9. At this point, selecting "Ok" will generate a ViewGroups.xml file that should look exactly as it does below in the first xml example.

Configuring a View Group via UI Using by Manually Defining Views

Note that manually defined views should not be combined with views generated by a GridSetup unless special care is taken to ensure that two views do not map to the same DeviceID. If two views are mapped to the same device, a validation error will be displayed and the second view will be ignored.

1. Create a new view by repeating steps 1-6 of the example above.
2. Repeat steps 3-9 below for each view in the group.
3. Select "Add" under the View heading in the ViewGroup editing window.
4. After adding a view, double-click that view to open the view editor.
5. Customize the name of this view by editing the "Name" field
6. Next, set the DisplayID that this view will be associated with. This number is associated with a display ID that was set in the "Displays" tab. More than one view in a view group should not be mapped to the same DisplayID.
7. Under the "Viewport" heading, set what part of the viewport this view will take up. These 4 numbers are on a 0.000 to 1.000 scale. Meaning, to view only the left half of what is possible to be viewed, then assign a left value of 0.000, a right value of 0.500, a top value of 1.000, and a bottom value of 0.000. Viewport values will be overridden by a ViewFrustum if one is defined, so leave these fields set to 0 when using ViewFrustum values to define Views.
8. The EdgeOverlap is how much of the screen gets adjusted to make up for a bezel between monitors. The EdgeOverlap for the views is based on a percentage. So a value of -2.5 would be 2.5% of the screen that would be moved to make the picture look correct.
9. For advanced display configurations a ViewFrustum can be defined. ViewFrustum values will override Viewport definitions, so the Viewport should be left 0,0,0,0 to avoid getting a validation warning. Inside the view settings, edit the view frustum. The frustum defines where the camera is looking

and how much of the world it can see. Changes here will affect the Field of View, orientation, and offset from the origin of the View Group.

1. Just like earlier, the first option here is the SideAngles of the frustum.
2. Next, there are the OffsetPBH values. These are the Pitch, Bank, and Heading offsets of the view from the view group origin point.
3. The last option regarding the view frustum is the OffsetXYZ. This is where the offset of the view frustum's position from the view group origin point can be set. This option should only be used in vary specific situations such as multi-projector setups.
4. An example of the XML associated with Views and ViewFrustums can be found in the last XML example below.

AutoDetect Flat, 120 degree horizontal, 40 degree

```
<SimBase.Document Type="ConfigurationFile" version="4,1">
    <Descr>AceXML Document</Descr>
    <ViewGroups.ViewGroupSet>
        <ViewGroup>
            <Name>View120x40</Name>
            <ViewGroupShape>Flat</ViewGroupShape>
            <SideAngles>-60.000000,60.000000,20.000000,-
20.000000</SideAngles>
            <GridSetup>
                <GridSize>0,0</GridSize>
                <EdgeOverlap>-1.000000,-1.000000,-1.000000,-
1.000000</EdgeOverlap>
            </GridSetup>
        </ViewGroup>
    </ViewGroups.ViewGroupSet>
</SimBase.Document>
```

Cylindrical, Manual View Definitions using Viewports

```
<SimBase.Document Type="ConfigurationFile" version="4,1">
    <Descr>AceXML Document</Descr>
    <ViewGroups.ViewGroupSet>
        <ViewGroup>
            <Name>UsingViewports</Name>
            <SideAngles>-60.000000,60.000000,20.000000,-
20.000000</SideAngles>
            <View>
                <Name>LeftMonitor</Name>
                <Viewport>0.000000,0.500000,1.000000,0.000000</Viewport>
                <EdgeOverlap>-2.500000,-2.500000,-5.000000,-
5.000000</EdgeOverlap>
            </View>
            <View>
                <Name>RightMonitor</Name>
                <DisplayID>2</DisplayID>
                <Viewport>0.500000,1.000000,1.000000,0.000000</Viewport>
            </View>
        </ViewGroup>
    </ViewGroups.ViewGroupSet>
</SimBase.Document>
```

Manually Defining Views using ViewFrustums

```
<SimBase.Document Type="ConfigurationFile" version="4,1">
    <Descr>AceXML Document</Descr>
    <ViewGroups.ViewGroupSet>
        <ViewGroup>
            <Name>Using View Frustum</Name>
            <ViewGroupShape>Flat</ViewGroupShape>
            <View>
                <Name>LeftMonitor</Name>
                <ViewFrustum>
                    <OffsetPBH>0.000000,0.000000,-
30.000000</OffsetPBH>
                    <SideAngles>-30.000000,30.000000,20.000000,-
20.000000</SideAngles>
                </ViewFrustum>
            </View>
            <View>
                <Name>RightMonitor</Name>
                <DisplayID>2</DisplayID>
                <ViewFrustum>
                    <OffsetPBH>0.000000,0.000000,30.000000</OffsetPBH>
                    <SideAngles>-30.000000,30.000000,20.000000,-
20.000000</SideAngles>
                </ViewFrustum>
            </View>
        </ViewGroup>
    </ViewGroups.ViewGroupSet>
</SimBase.Document>
```

Manually Defining Views using Flat (Off-Axis) ViewFrustums

```
<SimBase.Document Type="ConfigurationFile" version="4,1">
    <Descr>AceXML Document</Descr>
    <ViewGroups.ViewGroupSet>
        <ViewGroup>
            <Name>OffAxisProjections</Name>
            <ViewGroupShape>Flat</ViewGroupShape>
```

```
            <View>
                <Name>LeftMonitor</Name>
                <ViewFrustum>
                    <SideAngles>-60.000000,0.000000,20.000000,-
20.000000</SideAngles>
                </ViewFrustum>
            </View>
            <View>
                <Name>RightMonitor</Name>
                <DisplayID>2</DisplayID>
                <ViewFrustum>
                    <SideAngles>0.000000,60.000000,20.000000,-
20.000000</SideAngles>
                </ViewFrustum>
            </View>
        </ViewGroup>
    </ViewGroups.ViewGroupSet>
</SimBase.Document>
```

View Group Properties

The tables that follow provide more details about each XML property and UI element which can be used for view group configuration.

View Group Set

A list of View Groups. Currently only one view group set is supported by a set can contain any number of view groups.

Property	Description	Default Value(s)	Type
ViewGroup	A group of views which can be used to create one large display area that spans multiple displays by assigning a portion of the view to each display.	*None*	*None*

Grid Setup

A GridSetup can be used to automate the process of generating view definitions for a view group.

Property	Description	Default Value(s)	Type
GridSize	Horizontal and Vertical grid size to use for generating a view group. If these values are set to 0, a view group will be generated based on the windows desktop display settings.	1,1	LONG2
EdgeOverlap	Size of display overlap as a percent of display size. Positive values can be used for projector blending, and negative values can be used for bezel correction. Example: For a 20in by 10in monitor with a half inch bezel, left/right is -2.5 and	0.0,0.0,0.0,0.0	FLOAT4

	top/bottom is -5.0		
FirstDisplayID	DisplayID of the top-left display of the grid. IDs will be assigned by incrementing the ID from left to right for each row starting at the top row.	1	ULONG
AutoDetect	If true, grid size is ignored and views are generated for each display based on their location on the windows desktop.	FALSE	BOOL

View Group

A group of views which can be used to create one large display area that spans multiple displays by assigning a portion of the view to each display.

Property	Description	Default Value(s)	Type
Name	The name of this View or ViewGroup	*None*	TEXT
SideAngles	View frustum's half angles in degrees from main axis to sides (allowing for off-axis projection). Example: A 120x40 degree field of view would be defined as: Left:-60, Right:60, Top:20, Bottom:-20	0,0,0,0	FLOAT4
ViewGroupShape	Shape of the virtual display described by this view group. Options are Flat, Cylindrical, and Spherical. Cylindrical or Spherical is recommended for groups with fields of view wider than 120 degrees to avoid distortion.	Cylindrical	ENUM
AllowZoom	Allow zooming for this view group.	TRUE	BOOL
GridSetup	A GridSetup can be used to automate the process of generating view definitions for a view group.	*None*	*None*

View	Defines the portion of the overall view which will be rendered on a given display. A single view should be limited to about 140 degrees.	*None*	*None*

View

Defines the portion of the overall view which will be rendered on a given display.

Property	Description	Default Value(s)	Type
Name	The name of this View or ViewGroup	*None*	TEXT
DisplayID	DisplayID of the display this view should open on when group is active.	1	ULONG
ViewPort	Viewport of this view relative to the entire display group. This will be used to generate a view frustum unless of ViewFrustom is explicitly defined. The Viewport dimensions for the entire group is Left:0, Right:1.0, Bottom:0 Top:1.0.	0,0	FLOAT4
EdgeOverlap	Size of display overlap as a percent of display size. Positive values can be used for projector blending, and negative values can be used for bezel correction. *Example: For a 20in by 10in monitor with a half inch bezel, left/right is -2.5 and top/bottom is -5.0*	0.0,0.0,0.0,0.0	FLOAT4
ViewFrustum	Explicitly defines the position, orientation, and field of view of the camera. This is only necessary for advanced display/projector configurations and will be ignored if a non-zero Viewport is provided for a view.	*None*	*None*

View Frustum

Explicitly defines the position, orientation, and field of view of the camera. This is only necessary for advanced display/projector configurations and will be ignored if a non-zero Viewport is provided for a view.

Property	Description	Default Value(s)	Type
	View frustum's		

SideAngles	half angles in degrees from main axis to sides (allowing for off-axis projection). *Example: A 120x40 degree field of view would be defined as: Left:-60, Right:60, Top:20, Bottom:-20*	0,0,0,0	FLOAT4
OffsetPBH	View frustum origin offset Pitch, Bank, and Heading angles in degrees for orientation	0,0,0	FLOAT3
OffsetXYZ	View frustum origin offset (X, Y, Z) in meters	0,0,0	FLOAT3

Display Properties

Configuration Set

Encapsulates the entire set of configuration settings

Configuration

Name of a configuration associated with a DisplayID that houses all of the configuration data for that display

Property	Description	Type
Name	The name of this element (Display, Plugin, or Parameter).	TEXT
Display	Contains the settings for specific display (such as a monitor or projector).	*None*

Display

Name of a configuration associated with a DisplayID that houses all of the configuration data for that display

Property	Description	Default	Type
DisplayID	An integer index that identifies a display. Views in a ViewGroup are assigned to displays using this value.	1	ULONG
Adapterindex	Adapter index of a display output. Adapter index values are assigned in the order outputs are listed by the operating system and often match the display numbers shown in the Windows screen resolution menu. This value may change if displays are disconnected and reconnected.	1	ULONG
	The index of the		

MachineID	computer/machine the display is connected to. This value is used to specify displays on Multichannel clients when a simulation session is being distributed across multiple machines.	1	ULONG
Name	The name of this element (Display, Plugin, or Parameter).	*None*	TEXT
Plugin	Houses all of the information about a plugin and its parameters	*None*	*None*

Plugin

A plugin such as a post-process which will be applied to all views on this device.

Property	Description	Default	Type
Name	The name of this element (Display, Plugin, or Parameter).	*None*	TEXT
Parameter	The values passed to the plugin when the plugin is made	*None*	*None*

Parameter

A parameter name/value pair which can be used to configure a plugin.

Property	Description	Default	Type
Name	The name of this element (Display, Plugin, or Parameter).	*None*	TEXT
Value	The value to pass in to a Plugin parameter. This is a TEXT element but it may be interpreted as a numeric value by some Plugins.	*None*	TEXT

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EasyBlend™

EasyBlend by Scalable Display Technologies provides image perspective correction and blending for projection onto curved surfaces, such as domes. Prepar3D can be configured to take advantage of the EasyBlend software in both single-channel and multi-channel configurations. Since EasyBlend is a third party application to Prepar3D you will need to purchase the EasyBlend software.

Note: The EasyBlend runtime software currently is not compatible with Prepar3D v5 due to its reliance on DirectX 11 for view distortion and blending effects. Prepar3D v5 uses a DirectX 12-based rendering engine and does not support plugins that utilize DirectX 11 at this time. For compatibility with hardware setups that require EasyBlend, we recommend using Prepar3D v4.5.

The following sections detail the configuration setup steps required to use EasyBlend with Prepar3D. These instructions assume that you have already purchased the EasyBlend SDK software.

CONTENTS

- Setup of EasyBlend with Prepar3D
- Setup using Prepar3D UI
- Setup using Displays.xml
  - Single Monitor
  - Multi-Monitor
- Mesh Files

RELATED LINKS

- Scalable Display EasyBlend

Preparation of EasyBlend SDK for Prepar3D

To configure the EasyBlend SDK software with Prepar3D follow the steps below.

1. Install the EasyBlend SDK software.
2. Create your mesh files using EasyBlend. See Mesh Files for locations to save your custom .ol file.

Setup EasyBlend using the Prepar3D UI

Prepar3D allows users to assign plugins and effects via the User-Interface. This means that the user can select which monitor has certain effects or plugins affecting them. For example, you could set up one monitor with an EasyBlend mesh and everything on that monitor would be warped and blended appropriately. Simultaneously on another monitor, you could have standard output rendering to the screen for utility purposes. While the possibilities are endless, below you will step-by-step instructions explaining how to take your EasyBlend mesh file and apply it to a single monitor, or multiple monitor setup.

1. Run Prepar3D and select Views->View Group Management->Displays->Configuration 1. *"Configuration 1" can be changed by the user, so this may vary after the first run.*
2. Select your Default Monitor, then click the "Add" button below Plugin.
3. Double-Click "Plugin 1" in the list.
4. Type "EasyBlend" in the "Name" text box.
5. Click "Add" below "Parameter".
6. Double-Click "Parameter 1".
7. In the second text box, below "Value," you can type one of three things:
   - **Nothing:** If you leave this field blank, Prepar3D will use the default EasyBlend path to find your file.
   - **The Name of Your File:** If you type the name of your file (including the .ol ending), Prepar3D will search for your file in your *%APPDATA%\Lockheed Martin\Prepar3D v5* folder.
   - **Fully Qualified Path:** If you type the full path of your file, Prepar3D will search for your file at that exact location. Ex: *C:\Users\My Documents\TestMesh.ol.*
8. You can repeat steps 1 through 7 for each monitor in your setup. Ensure that each Display has a different ID and each Adapter has a different ID.
9. At this point, you can either select OK and your settings will be saved at: *%APPDATA%\Lockheed Martin\Prepar3D v5\Displays.xml* or select Preview to view or validate your changes before saving.

Setup EasyBlend using Displays.xml

The Displays.xml file can be found in your *%APPDATA%\Lockheed Martin\Prepar3D v5* folder. The Displays.xml file is where display configurations are stored for single monitor and multi-monitor displays. This is where the user can hand edit the displays, adapters, and file names without opening Prepar3D.

An example of a Displays.xml configuration file on a **Single Monitor** is as follows:

```
<?xml version="1.0" encoding="UTF-8" ?>

<SimBase.Document Type="ConfigurationFile" version="3,3">
 <Descr>AceXML Document</Descr>
 <SimDisplay.ConfigurationSet>
```

```
   <Configuration>
    <Display>
     <DisplayID>1</DisplayID>
     <AdapterIndex>1</AdapterIndex>
     <Name>Default Monitor</Name>
     <Plugin>
       <Name>EasyBlend</Name>
       <Parameter>
         <Value>YourMeshName.ol</Value>
       </Parameter>
     </Plugin>
    </Display>
   </Configuration>
 </SimDisplay.ConfigurationSet>
</SimBase.Document>
```

An example of a Displays.xml configuration file on **Multiple Monitors** is as follows:

```
<?xml version="1.0" encoding="UTF-8" ?>

<SimBase.Document Type="ConfigurationFile" version="3,3">
 <Descr>AceXML Document</Descr>
 <SimDisplay.ConfigurationSet>
   <Configuration>
    <Display>
     <DisplayID>1</DisplayID>
     <AdapterIndex>1</AdapterIndex>
     <Name>Default Monitor</Name>
     <Plugin>
       <Name>EasyBlend</Name>
       <Parameter>
         <Value>YourMeshName.ol</Value>
       </Parameter>
     </Plugin>
    </Display>
    <Display>
     <DisplayID>2</DisplayID>
     <AdapterIndex>2</AdapterIndex>
     <Plugin>
       <Name>EasyBlend</Name>
       <Parameter>
         <Value>YourMeshName.ol</Value>
       </Parameter>
     </Plugin>
    </Display>
   </Configuration>
 </SimDisplay.ConfigurationSet>
</SimBase.Document>
```

Mesh Files

The EasyBlend run-time software uses mesh files to define the surface that the image will be projected on to. These mesh files are used by the EasyBlend run-time software to warp and stitch the image together so it is properly displayed on the desired surface. These necessary mesh files are generated by the EasyBlend software. For instructions on how to generate a mesh files, refer to the instructions provided with the EasyBlend software.

Once the mesh file has been generated, it needs to be placed in one of three places:

1. The default path for EasyBlend. *(C:\Program Files\Scalable Display\DEI\LocalCalibration\ScalableData.ol)*
2. Your %APPDATA%\Lockheed Martin\Prepar3D v5\ folder. *(%APPDATA%\Lockheed Martin\Prepar3D v5\YourCustom.ol)*
3. Any custom location. However this will require you providing the **Full Path** to Prepar3D when adding the EasyBlend plugin *(Ex: C:\Users\My Documents\TestMesh.ol)*

Please see the multi-channel setup guide for additional details on setting up a multi-channel configuration.

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Multichannel

General description and overview

Overview

Multichannel allows additional systems to be configured and linked to drive additional displays. This enables the distribution of processing to increase system performance when multiple visual output channels are required. This is accomplished by sharing the rendering process across multiple computers in a synchronized fashion. Since the systems are synchronized, the overall frame rate for the simulation is determined by the slowest or most computationally bound computer.

Multichannel systems can be composed of multiple flat panel displays or a series of projectors in conjunction with a dome surface. For high end systems, an additional hardware gen-lock capability can be used to provide more accurate synchronization.

CONTENTS

- Overview
- System Requirements
  - Licensing Requirements
  - Hardware Synchronization
- Network Configuration
  - Host Computer
  - Client Computer

Regardless of the system configuration, the maximum number of supported channels is 100.

NOTE: Multichannel is a Professional Plus only feature.

System Requirements

Multiple computers are required to multichannel. One computer is required to act as a host, which processes the simulation and user input. All other computers connect as clients. A Client is responsible for rendering a portion of the scene generated by the Host. Multichannel clients can be connected to more than one display allowing more than one channel per machine.
All of the computers that comprise the multichannel system are required to be networked together in a Local Area Network (LAN) configuration where each computer is on the same subnet. Ideally, for performance, no other computers are on the same LAN.

Licensing Requirements

Prepar3D must be licensed and activated on the multichannel Host in order to be launched. Activation must be done by launching Prepar3D without using the /MULTICHANNEL command line argument. Multichannel Clients do not require activation when connecting to a licensed and activated Host.

For more information on licensing and activation, see How to Activate Prepar3D.

Synchronization

For best performance, the client machines should utilize genlock-synchronized graphics cards to ensure an exact frame-for-frame match between adjoining display devices. Failure to use graphics cards with synchronized frame generation locks may result in undesirable display characteristics, as one display may fall out-of-sync with another adjoining display. This is especially probable if the complexity of the visual scene varies across the complete field of view. Without genlock synchronization, a client rendering a simple portion of the scene may finish and present its display earlier than another client rendering a more complex region of the same scene. The software synchronization ensures that all clients have submitted all GPU work before the host sends a message to present the frame. If the GPU is not done with all this work by the time the present message is received, the frame flip may be delayed. If hardware synchronization is not being used, this delay may lead to displays being noticeably out of sync. The best way to avoid this scenario is to run with settings that keep all systems CPU bound, or to limit the frame rate of the Host to provide enough time for all clients to finish GPU work.

NOTE: While client displays are software synchronized, the host simulates and renders as fast as possible to provide the highest quality simulation. Rendering to displays from the host is allowed, but host displays are not synchronized with client displays (even when using hardware synchronization).

Network Configuration

The cornerstone of the multichannel setup is the network configuration that allows the host and client computers to communicate on the same subnet. This communication is managed by a configuration file that is passed to the Prepar3D application during startup. Config files will need to be created for each machine involved. On each machine that is participating as part of the overall multichannel system, the following command line argument must be supplied to specify the

configuration file to run:

```
/MULTICHANNEL:"<Config File Path>"
```

Where <Config File Path> is the absolute path to the network configuration file. For example, to start Prepar3D using a configuration file created at C:\Prepar3D\Network.CFG, the command would be:

```
Prepar3D.exe /MULTICHANNEL:"C:\Prepar3D\Network.CFG"
```

The file Network.CFG can be located in any directory and can be named in any fashion required for the setup. For example on the host machine the file may be called Host.CFG and on the clients it could be called Client01.CFG, Client02.CFG, etc. In either case the file must be passed to Prepar3D through the command prompt as outlined previously.

The default port range for multichannel is 6132-6142. These values can be changed by using the **HostPortFirst** and **HostPortLast** settings in your network configuration file.

NOTE: Multichannel and multiplayer port ranges must not overlap

Host Computer

The host computer network configuration file contains the following elements in the format depicted below:

```
[MULTICHANNEL]
AutoStart=2
AutoSignOn=1
AccountLogin=0
LanUsername=HostMachine
PublicOnWEB=0
PublicOnLAN=1
MaxPlayers=64
ReservedForFriends=0
EnableFrameSync=1
FrameSyncRate=30
EnableShare=1
PasswordForSharingAircraft=""
AllowSharedAircraft=1
AllowJoinInFly=1
ConnectionLostTimeOut=600
```

Of the configuration parameters in the host file, only the following should be modified:

- **LanUsername** - specifies the machine name of the host as visible to the client machines. This parameter needs to be noted so that the client machines may be configured to connect to the appropriate host.
- **FrameSyncRate** - specifies the rate, in hertz, that the host should send data to the client machines in order to update and synchronize the displays. The default value is 30 Hz.

Client Computer

The client computer network configuration file contains the following elements in the format depicted below:

```
[MULTICHANNEL]
AutoStart=1
AutoSignOn=1
AccountLogin=0
LanUsername=ClientMachine1
AutoStartHostId=HostMachine
AutoStartJoinAircraft=HostMachine
EnableFrameSync=1
ClientEnabledVoice=0
ConnectionLostTimeOut=600
```

Of the configuration parameters in the client file, only the following should be modified:

- **LanUsername** - specifies the username of this client as visible to the host computer. This value must be unique to the host machine as well as all other client machines.
- **AutoStartHostId** - specifies the username of the host that this client shall connect to. This value should exactly match the value specified for LanUsername that was used in the host network configuration file.
- **AutoStartJoinAircraft** - specifies the username of the host that this client shall connect to. This value should exactly match the value specified for LanUsername that was used in the host network configuration file.

The **AutoStartHostId** and **AutoStartJoinAircraft** fields need to point to the host computer to ensure that the views are properly displayed. View groups are defined in ViewGroups.xml or in the ViewGroups section of the View Group Management UI.

NOTE: The host waits until all clients report the current frame has been rendered before allowing the clients to present to the display.

Multichannel View Group Configuration Overview

In multichannel, a view group needs to be used in order to control cameras on the Clients from the Host. View group configuration in multichannel is divided into three sections: Multichannel, Displays, and View Groups. A Multichannel configuration assigns a MachineID to each machine by name. A Displays configuration assigns a DisplayID to each display and associates it with the MachineID of the machine and the AdapterIndex of the output the display is connected to. A ViewGroups configuration assign a View to each display by DisplayID. These three configuration sets are defined in Multichannel.xml, Displays.xml, and ViewGroups.xml respectively. These files can be found in *%PROGRAMDATA%\Lockheed Martin\Prepar3D v5*. These files can be edited directly, or by using the View Group Management UI which has a section for each. Changes made in the UI will save out to XML unless the cancel button is pressed.

Configuring Machines

The Multichannel configuration is defined in Multichannel.xml and can be modified in the View Group Management UI. Each Machine listed includes a MachineName and MachineID. The MachineID is used to associate displays with a given machine in the Displays configuration via xml or the UI. The MachineName for a given machine needs to match the LanUsername used to connect that machine to the multichannel setting.
To configure your multichannel settings, take the following steps:

1. Open Views->View Group Management.
2. Select Multichannel->2 Channel Cfg.
3. Change the name of the configuration by editing the "Name" field.
4. By default, there will be one host and two clients listed. Double-click the host or select it by clicking the pencil beside the name "Host".
5. This is where the MachineName and MachineIDs can be edited.

Here is an example of the XML generated by the UI for reference when manually editing the XML:

Multichannel.xml

```
<?xml version="1.0" encoding="UTF-8"?>

<SimBase.Document Type="ConfigurationFile" version="3,3">
    <Descr>AceXML Document</Descr>
    <Multichannel.ConfigurationSet>
        <Configuration>
            <ConfigurationName>2 Channel Cfg</ConfigurationName>
            <Machine>
                <MachineName>HostMachine</MachineName>
            </Machine>
            <Machine>
                <MachineName>ClientMachine1</MachineName>
                <MachineID>2</MachineID>
            </Machine>
            <Machine>
                <MachineName>ClientMachine2</MachineName>
                <MachineID>3</MachineID>
            </Machine>
        </Configuration>
    </Multichannel.ConfigurationSet>
</SimBase.Document>
```

NOTE: The LanUsername of the Network.cfg files must match the MachineName entry in the Multichannel.xml file.

Configuring Displays And View Groups

Details on configuring displays and view groups with the UI can be found in Display and View Group Configuration. The primary differences when configuring displays, is that they need a MachineID. In multichannel, activating a view group on the Host will assign the current camera to control the view group. View groups can only be controlled from the host. In general, a multichannel view group should only assign views to client displays. It is possible to assign a view to a host display, however this view will not by synchronized with client views. Here is an example of the XML generated by the UI for reference when manually editing the XML:

Displays.xml

```
<?xml version="1.0" encoding="UTF-8"?>

<SimBase.Document Type="ConfigurationFile" version="3,3">
    <Descr>AceXML Document</Descr>
    <SimDisplay.ConfigurationSet>
        <Configuration>
            <Display>
                <Name>Master Monitor</Name>
                <DisplayID>1</DisplayID>
                <AdapterIndex>1</AdapterIndex>
            </Display>
            <Display>
                <Name>Client 1 (L)</Name>
                <DisplayID>2</DisplayID>
                <AdapterIndex>1</AdapterIndex>
                <MachineID>2</MachineID>
            </Display>
            <Display>
                <Name>Client 2.1 (C)</Name>
```

```
                <DisplayID>3</DisplayID>
                <AdapterIndex>2</AdapterIndex>
                <MachineID>3</MachineID>
            </Display>
            <Display>
                <Name>Client 2.2 (R)</Name>
                <DisplayID>4</DisplayID>
                <AdapterIndex>1</AdapterIndex>
                <MachineID>3</MachineID>
            </Display>
        </Configuration>
    </SimDisplay.ConfigurationSet>
</SimBase.Document>
```

ViewGroups.xml

```
<?xml version="1.0" encoding="UTF-8"?>

<SimBase.Document Type="ConfigurationFile" version="3,3">
    <Descr>AceXML Document</Descr>
    <ViewGroups.ViewGroupSet>
        <ViewGroup>
            <Name>2 Clients - 3 Monitors</Name>
            <SideAngles>-75.000000,75.000000,25.000000,-
25.000000</SideAngles>
            <GridSetup>
                <GridSize>3,1</GridSize>
                <FirstDisplayID>2</FirstDisplayID>
            </GridSetup>
        </ViewGroup>
    </ViewGroups.ViewGroupSet>
</SimBase.Document>
```

NOTE: FirstDisplayID is the starting location for view groups in multichannel for the grid to be oriented from. This implies that the DisplayIDs should be in order from Left to Right, Top to Bottom. So if there are 6 monitors labeled 1 to 6, they would be physically set up as follows:
1 2 3
4 5 6

NOTE: If you have multiple view groups, ensure that the desired view group is at the top of the list.

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PREPAR3D

Analysis Overview

Even after the flight or scenario is over, the chance for skill improvement is not. Prepar3D offers analysis tools to review flights or scenarios as well as keep a running tally of statistics about the pilot. Many of the analysis tools that Prepar3D offers are passive and the user does not need to engage these tools for them to provide analytics. These systems include:

- Flight Analysis: This tool allows for inspection of the vehicle's altitude drawn as a function of time and the vehicle's path drawn as a route on a Map.
- Instant Replay: This tool is a lighter version of Simulation Recording and Playback. It can replay a basic simulation of the vehicle's most recent events.
- Pilot Records: This tool is often called the **Logbook** because Prepar3D logs details about every flight flown and picture taken and organizes them in this screen.

Other analysis tools such as Simulation Recording and Playback need to be turned on before they can be used since they are more performance intensive.

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PREPAR3D

Flight Analysis

Flight Analysis helps you evaluate your skills as a pilot on any flight. The **Flight Analysis** dialog box contains a map depicting the horizontal path of the flight, a vertical analysis graph, and controls for animating the flight analysis playback. You do not need to complete a flight before viewing the analysis. Flight Analysis will work even when using **Slew** mode or when using high and low simulation rates.

Flight Analysis will reset under the following conditions

- The aircraft crashes.
- You change aircraft during the flight.
- You select or create a new flight.

To open the Flight Analysis dialog box

- On the **Analysis** menu, click **Flight Analysis**.

CONTENTS

- Using the Playback Controls
- Using the Playback Slider
- Using the Flight Analysis Map
- Using the Dynamic Text Boxes
- Using the Vertical Analysis Graph
- Using the Playback Timer
- Using Time Compression

Using the Playback Controls

The playback controls in the **Flight Analysis** dialog box act like the controls on a DVR. Use them to play, rewind, fast forward, or stop the flight analysis playback.

Using the Playback Slider

Use the playback slider to move to a particular point in the flight analysis. You can drag the slider quickly and move across a large area, or move the slider slowly to view a second-by-second analysis. Dragging the playback slider affects playback on the map as well as in the vertical analysis graph.

Move rapidly through the flight analysis

- Drag the playback slider.

Using the Flight Analysis Map

The flight analysis map displays the horizontal path of your flight. When you animate the flight analysis, the airplane on the map will move along the path you flew, trailing a red line. You can use this feature to evaluate how precise your path was. For example, you can observe how well you flew a traffic pattern at an airport or how well you flew an instrument approach.

You can zoom in or out on the map, and, if the map looks too cluttered, you can choose not to display airspace lines or other elements.

To view a larger or smaller area of the map

- Click the **Plus** or **Minus** buttons above the map to zoom in or out.

Turn a map element on or off

- Click the element's corresponding icon above the map.

To see the horizontal path of the flight

- Click an arrow (for example, the **Play** button) on the VCR-style controls and observe the small airplane on the map.
  - or -
- Drag the playback slider and observe the small airplane on the map.

Using the Dynamic Text Boxes

Text boxes along the left side of the map display your aircraft's current latitude, longitude, altitude, heading, and airspeed. When you animate the flight analysis, the values in these text boxes update as the flight progresses—a valuable tool for analyzing how well you held heading, altitude, or airspeed. (You cannot type new values in the dynamic text boxes when using the map in Flight Analysis.)

View dynamic text box values

- Click an arrow on the VCR-style controls and observe the values in the dynamic text boxes.
  - or -
- Drag the playback slider and observe the values in the dynamic text boxes.

Using the Vertical Analysis Graph

The vertical analysis graph displays your vertical path along the flight. The left side of the graph is marked off in altitude. The bottom of the graph is marked off in distance. The graph helps you evaluate how well you held altitude, or how precisely you ascended or descended. You can also zoom in or out on the graph.

View the vertical path of the flight

- Click an arrow on the VCR-style controls and observe the graph.
  - or -
- Drag the playback slider and observe the graph.

View a larger or smaller portion of the graph

- Click the **Plus** or **Minus** buttons above the graph to zoom in or out.

Using the Playback Timer

Use the Playback Timer to play back parts of the flight, or to skip to a particular part of the flight. You will also see the Playback Timer values change during VCR playback

or if you drag the playback slider.

To use the Playback Timer

1. Click on the hours, minutes, or seconds.
2. Click the spin box to adjust the time.

Using Time Compression

Use time compression to slow down or speed up the playback of the flight analysis from 0.025 times (or 1/40th) normal speed to 128 times normal speed.

To adjust Time Compression

- Select a speed from the **Time Compression** box.

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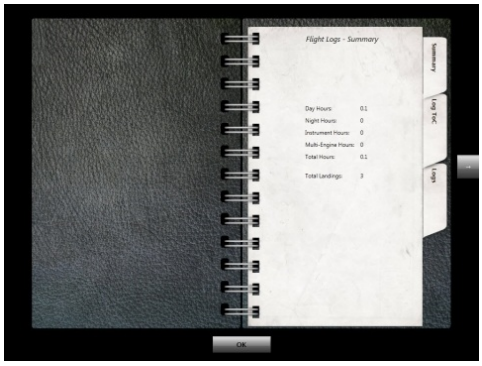
PREPAR3D

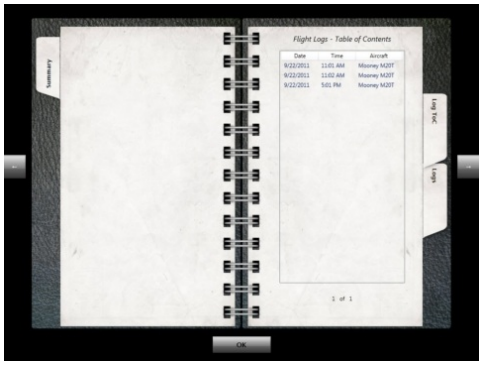
Pilot Records



Pilot Records help you keep track of your time and progress. They include the **Logbook** and **Photos**.
You can also share your favorite places and flights by capturing photos in flight.

Logbook

Reading the Logbook



In the Logbook **Table of Contents**, you can double click on an entry to quickly go to that detailed Logbook page.

The Logbook detail page is an abbreviated version of an official pilot's logbook. The logbook tracks your flight time automatically every time you fly.
The logbook keeps track of various types of flight data:

Date	Date of the flight.
Time	Time of the flight.
Aircraft	Aircraft used for the flight.
From	Airport of origin for the flight.
To	Airport destination for the flight.
Landings	Number of landings during the flight.
Day	Amount of time this flight was flown during daylight.

Night	Amount of time this flight was flown during nighttime.
Instr	Amount of time this flight was flown during instrument meteorological conditions.
Total	Total time for this flight.

Note: Automatic Logbook entries are recorded only after you shut down the aircraft's engine or when you exit *Prepar3D*.

Editing Logbook Details

You can edit some but not all of the details of your logbook entries.

To change logbook entry details

1. On the Pilot Records **Logbook** tab, select a logbook entry and then click **Details**.
2. Edit the details you want to change.
3. Click **OK**.

Photos

You can capture photos and store them on the **Photos** tab of the Pilot Records screen.

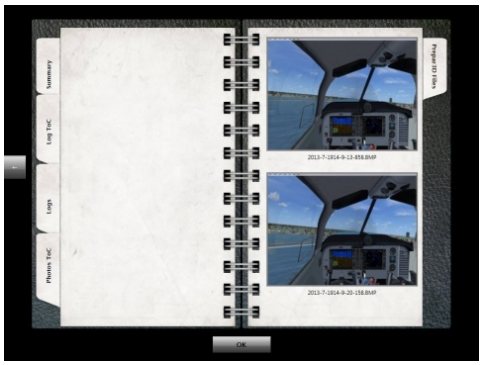
Taking photos

You can capture a photo anytime you are in a scenario or while participating in a Multiplayer session.

To take photos while in flight or on the ground

- Press the **V** key.

Viewing Photos



All of your photos are stored in a photo album with your other pilot records. You can view and print photos from your photo album.

To view your photos

1. If you're in a scenario, on the Scenarios menu, select **End Scenario**.
2. On the **Analysis** menu, select **Pilot Records**.
3. Click the **Photos** tab.
4. Select a photo in the album.
5. Click **View Photo**.

Printing Photos

To print your photos

1. On the Pilot Records **Photos** tab, select a photo album in the **Album** list.
2. Select a photo in the album.
3. Click **View Photo**.
4. Click **Print**.

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PREPAR3D

Simulation Recording and Playback

Prepar3D's recording and playback capabilities are useful tools for evaluating your performance. Various simulation states and variables are available for recording and playback. Record and playback support includes simulation variables, local panel parameters, registered properties, and environmental states. It is configurable for user objects and other simulation objects. Additionally, what is recorded can be specified for each individual simulation object, which allows a user to increase the playback fidelity or to minimize the recording file size. The only limit on recorded scenario length is the available space on your hard disk.

RELATED LINKS

- Simulation Variables
- Creating XML Gauges
- SDK Overview
- Object Reference

Getting Started

Starting, Stopping, and Saving a Recording

Select **Start Recording** from the **Analysis** menu. When you are finished recording you should press the **ESC** key.
After the recording is stopped, a window will open asking to **Discard**, **Resume**, or **Save** the recording file.

- **Discard**: Stops the current recording and deletes it.
- **Resume**: Cancels the stop recording and resumes recording.
- **Save**: Saves the recording file to the specified folder. Enabled after a **Title** has been entered.

In scenarios, the **RecordStartAction** and **RecordStopAction** can be used to start and stop recordings. Additionally, the ability to start recording can be mapped to a key press. The associated key event is **Recording (Start)**. Please note that during recording certain menu options and simulation options will be disabled.

Playing a Recording

Under the **Analysis** menu, select **Load Recording...**. A dialog box will open that allows the selection of a simulation recording.
A list of saved recordings will be displayed. A recording can be double clicked or the **Play** button can be clicked to start the playback of a selected file. If the recording has bookmarks, they will be displayed in the lower right panel. Bookmarks can be selected as an alternate starting spot for the recording. When a file begins playing back, a simple **Playback Controls** interface will be made visible. This interface can be exited if desired. Along with displaying current progress, the **Playback Controls** allows the user to loop the playback, pause, jump to bookmarks, and change simulation speed. Please note that during playback certain menu options and simulation options will be disabled. This is by design and ensures the playback closely mimics the recording it is based on. The Toggle Bookmarks check box will extend the bottom of the window to list the available bookmarks for this recording.

Configuration

Prepar3D.cfg

There are three recording options that can be configured in the **Prepar3D.cfg**, RecordAITraffic, RecordAirportVehicles, and RecordLeisureBoats. They are booleans that are set in the **[Recorder]** section.

Section	Property	Value	Function/Description
Recorder	RecordRateHz	float	Specifies the rate at which data will be recorded. The default value is 60Hz. This setting has no affect on playback, which will happen per-frame by default.
Recorder	Record18HzChain	BOOL	Specifies whether record and playback functionality should be performed at 18Hz. This setting can be used to help ensure that gauges/panels playback in the same manner they were recorded. If set, this will override the **RecordRateHz** rate specified. The default value is false.
Recorder	RecordAITraffic	BOOL	Enable the recording of air traffic.
Recorder	RecordAirportVehicles	BOOL	Enable the recording of the default airport vehicles.
Recorder	RecordLeisureBoats	BOOL	Enable the recording of the leisure boats.

Inside **Prepar3D.cfg**:

```
...
[Recorder]
```

```
RecordRateHz=60
Record18HzChain=False
RecordAITraffic=True
RecordAirportVehicles=True
RecordLeisureBoats=True
...
```

DefaultRecordAndPlayback.xml

Located in **%APPDATA%\Lockheed Martin\Prepar3D v5**, DefaultRecordAndPlayback.xml contains the default properties to record and playback for each SimObject. It contains two **RecordAndPlaybackDefinitions**. The first definition is for all of the base properties and the second definition is for all native aircraft and helicopter SimObject properties.

```
<?xml version="1.0" encoding="UTF-8"?>

<SimBase.Document Type="AceXML" version="1,0">
    <Simvar.RecordAndPlaybackDefinition name="Base Properties"
id="{72C83459-3F8A-4DE2-AE26-815D164D6179}">
        <Property NameGet="PLANE LATITUDE"
Units="Degrees"            Index="0" ValueThreshold="0.0"
Frequency="frame" Type="Number"/>
        ...
    </Simvar.RecordAndPlaybackDefinition>
    <Simvar.RecordAndPlaybackDefinition name="Native SimObject
Properties" id="{9F445DDF-600E-4096-B56C-02734E22F36E}">
        <Property NameGet="ROTATION VELOCITY BODY X"
Units="Radians per second" Index="0" ValueThreshold="0.0"
Frequency="frame" Type="Number"/>
        ...
    </Simvar.RecordAndPlaybackDefinition>
</SimBase.Document>
```

RecordAndPlaybackDefinition Properties:

Property	Description
NameGet	The name of the Simulation Variable, local parameter, or registered property to record and playback. If the property is not settable, it will not be set during playback.
NameSet	The name of the Simulation Variable, local parameter, or registered property to playback with the data recorded from the **NameGet**. If blank, the **NameGet** will be used. Commonly, this will only be utilized with ISimObject's registered properties.
Index	When there is more than one entry of this property, this index indicates which one to record/playback data for. For example, multiple engines.
Frequency	The attempted Frequency to record the property. The fastest and most storage intensive option is **frame**, which will attempt to record the property every frame. Used in combination with the **ValueThreshold** to limit unnecessary recording of properties. Available Frequencies: • **frame** • **16hz** • **8hz** • **4hz** • **2hz** • **1sec** • **5sec** • **15sec**
ValueThreshold	The value threshold to trigger a record of the property. For this to be utilized, the **Frequency** must have been triggered. When the **Frequency** of the recording is hit, it checks this **ValueThreshold**. If the **ValueThreshold** is exceeded, the data will be recorded. A value of **0** will record any change of the property.
Units	The units of measure. See Units of Measure for the possible values.
Type	The data type of this property. Available Types: • **boolean** • **number** • **ordinal**

RecordAndPlayback.xml

In addition to the DefaultRecordAndPlayback.xml, a vehicle specific **RecordAndPlayback.xml** file can be created on a per-SimObject basis. This file must be saved in the SimObject's folder (in the same folder as the **aircraft.cfg** or **sim.cfg** file). The GUID that is defined for the **RecordAndPlaybackDefinition**, in the XML file, must be set in the configuration file under the **[GENERAL]** section in a **RecordAndPlaybackDefinitionGUID** property (see example below). It must be a unique GUID for the vehicle (see Generating GUIDs).

Note: Due to the way properties are stored and retrieved, more frequently recorded properties should be listed toward the top of RecordAndPlaybackDefinition list, whereas less frequently recorded properties should be listed toward the bottom.
An example **RecordAndPlayback.xml**:

```
<?xml version="1.0" encoding="UTF-8"?>
<SimBase.Document Type="AceXML" version="1,0">
    <Simvar.RecordAndPlaybackDefinition id="{5CF91663-39A0-46CE-
BEFB-9FC153868941}">
        <Property NameGet="RUDDER TRIM PCT" Units="Percent Over
100" Index="0" ValueThreshold="0.0" Frequency="8hz"
Type="Number"/>
    </Simvar.RecordAndPlaybackDefinition>
</SimBase.Document>
```

Inside **aircraft.cfg** or **sim.cfg**:

```
...
[General]
...
RecordAndPlaybackDefinitionGUID={5CF91663-39A0-46CE-BEFB-
9FC153868941}
...
```

Bookmarks

Bookmarks are selectable starting spots in a recording. They allow the user to jump to various points of a recording during playback. They can be created by using a **CreateCheckpointAction** with its **RecordingBookmark** option enabled. While running and recording that scenario, when the **CreateCheckpointAction** is triggered with the **RecordingBookmark** option enabled, a bookmark will be created in the recording. The bookmark will then be selectable from the **Load Recording** interface and from the **Playback Controls** interface.

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Instant Replay

Use the Instant Replay to see a portion of flight that you just flew. You can replay the flight at a speed of your choosing.

To open the Instant Replay dialog box

- On the **Options** menu, click **Instant Replay**.

To set the replay length

1. Highlight the numbers in the **Replay length** box
2. Type the number of seconds you want the replay to last.

- or -

- Click the spin box next to the **seconds** box.

To set the replay speed

1. Highlight the numbers in the **Replay speed** box.
2. Type a number between **20** and **255**.

- or -

- Click the spin box next to the **percent of actual speed** box.

To see the replay repeat automatically

- Select the **Repeat replay continuously** check box.

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Network Overview

Prepar3D has extensive networking capabilities designed to allow multiple Prepar3D as well as non Prepar3D machines to participate together in a shared session. Networking capabilities include:

- Multiplayer: This capability allows Prepar3D to host a scenario that other Prepar3D clients can join. Defining features include sharing the vehicle's cockpit, using the radios for voice communication, and loading multiplayer structured scenarios to experience synchronized scenario content.
- Multichannel: This capability allows additional machines running Prepar3D to drive Prepar3D visuals.
- Distributed Interactive Simulation (DIS): This capability provides simulation interoperability via the DIS standard.
- High Level Architecture (HLA): This capability provides simulation interoperability via the HLA standard.
- Common Image Generator Interface (CIGI): This capability provides simulation interoperability via the CIGI standard.

These networking capabilities work in tandem! For instance, a user could be running on a **Multichannel System** while engaged in a **Multiplayer Scenario** with other Prepar3D clients. At the same time, the Prepar3D host can be engaged in a **DIS** session with non-Prepar3D clients.

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PREPAR3D

Multiplayer Overview

Multiplayer opens up a wide new world of opportunities for pilots, vehicle operators, and Air Traffic Controllers to either work together or against each other (e.g. Racing) in a collective scenario. Before getting started, learn how machines using Prepar3D can connect to each other in the Multiplayer On A Local Area Network (LAN) article.

Once the computer's connectivity is verified, there are two options. Either:

1. Host A Session
2. Join A Session

Scenarios can either be unstructured scenarios or structured scenarios. In structured scenarios, the user either joins a predefined role or as an observer. While in unstructured scenarios, the user can choose their starting location and vehicle. Depending on the host's settings, vehicles can be shared among multiple users. In unstructured scenarios, the user can even pick to be an Air Traffic Controller and use ATC Panels to survey the airspace.

While in session, users can communicate over the radio or more simply chat using the Chat Window.

To fine tune the multiplayer experience, read the Multiplayer Settings article

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PREPAR3D

Hosting a Session

Setting up sessions for other pilots to join

When you host a Multiplayer session, you set the location, weather, and other options that all the other pilots will experience in flight. You can host your session on a Local Area Network and other players on that network can join. To learn more about connecting using a Local Area Network, see Multiplayer on a Local Area Network.
As host, you can either fly as a pilot or act as an air traffic controller for the other pilots who join your session. Other players who join your session can also choose whether to fly or direct air traffic.

CONTENTS

- Creating a Multiplayer Session
- Basic Session Options
- Additional Options (Standard Scenarios)
- Scenario Options (Standard Scenarios)
- Structured Scenario Options (Structured Scenarios)
- Displayed Windows
- Removing Players
- Join Direct to Host
- Disconnecting

RELATED LINKS

- Joining a Multiplayer Session
- Sharing Aircraft in Multiplayer
- Multiplayer Settings
- Multiplayer on a LAN

How To Create Multiplayer Session

To Host a Multiplayer Standard Scenario Session

1. Open **Multiplayer**. You will be on the **Multiplayer Login Screen**.
2. Enter a **User Name**. This will be the name that player's will see you as when joining and hosting LAN Sessions.
3. Click **Sign In**. (**NOTE:** This may take a few moments while the system broadcasts that you are now signed in and also searches for available sessions.)
4. You will be in the **Multiplayer Session Selection Lobby**. From here click **Host Session**.
5. Fill in the Basic Options tab and Additional Options tab (optional) on the **Create Session** screen, and then click **OK**.
6. Choose the Scenario Options, then click **OK**.
7. You are now in the final Multiplayer session lobby. From here you can choose to fly now, wait for incoming players, or change your scenario options before the session starts. By pressing **Fly Now** the session commences.

To Host a Multiplayer Structured Scenario Session

1. Open **Multiplayer**. You will be on the **Multiplayer Login Screen**.
2. Enter a **User Name**. This will be the name that player's will see you as when joining and hosting LAN Sessions.
3. Click **Sign In**. (**NOTE:** This may take a few moments while the system broadcasts that you are now signed in and also searches for available sessions.)
4. You will be in the **Multiplayer Session Selection Lobby**. From here click **Host Session**.
5. Fill in the Basic Options tab on the **Create Session** screen, and then click **OK**.
6. Choose the multiplayer scenario that you would like to fly and press **Accept**. (**NOTE:** You must have a multiplayer scenario in order to create a multiplayer scenario type session.)
7. **Accept** the briefing.
8. Choose the Structured Scenario Options, then click **OK**.
9. You are now in the final Multiplayer session lobby. From here you can choose to fly now, wait for incoming players, or change your flight options before the session starts. By pressing **Fly Now** the session commences.

Basic Session Options

As host, you can provide detailed information about your session. See the table below to understand the fields on the **Basic Options** tab.

Option	Description
Room Name	Provides an easy way for players on the network to find your session in the lobby list.
Room password	Protects your session so that only players who know the password can join (optional).
Session type	**Standard Scenario**: host a session flying anywhere in any aircraft. **Structured Scenario**: host a structured experience in a specific location. **Current Scenario** (*SimOperator only*): host a session based on the currently loaded scenario.
	You can decide whether you want your

Room Visibility	room visible to everyone who might be looking for a session to join over the network. If you want a private session with only friends, you can make the room invisible to others. **To make your room visible** 1. Under **Room Settings**, select the **Public** checkbox. 2. Click **OK**. **To make your room invisible** 1. Under **Room Settings**, select the **Private** checkbox. 2. Click **OK**.
Additional Players	The more players that join your session, the more network bandwidth is required. The maximum number of players in a session depends on the speed and capacity of your Internet or LAN connection. Under optimal conditions (for example, a high-bandwidth, single-subnet LAN) you might be able to host more than 32 players. You can usually expect 16-32 players to join a session and still have good performance. You can restrict the number of players in your session. You can also make the session available to anyone but reserve slots for friends. When you reserve slots, only players in your **Friends** list can occupy them. Even if your friends don't fill all of the reserved slots, the number of other players who can join is limited to the **Maximum players** minus the reserved slots. You can also set a time limit until the session starts. **To set player restrictions** • Type a number between **1** and **63** in the **Additional Players** box.
Room Description	Provides any additional information you want to give about the session (optional).
Minutes until session starts	Type a number between 0 and 100 in the **Minutes until session starts** box to determine the amount of time the session will automatically launch in (optional). If the value is 0 the host determines when to start the simulation.
Enable Voice Communication	If you and your players have a Windows-compatible headset (or a microphone and speakers) and want to use voice communications, enable this option. A broadband Internet connection is required for voice communication. **IMPORTANT:** There are a couple of things to know if you're going to use a headset. For the most realism, you want only voice communication coming through the headset. • If your headset is your only audio output, all sounds will come through the headset, including engine noise, wheels on pavement, and even e-mail notifications if you have your e-mail program running. • You must have two or more audio devices (sound cards) in your computer to enable voice-only audio through your headset. To learn more about voice-only audio through a headset, see Changing Sound Settings.
Always activated for all players	All players in the session can hear all other players. Players must press and hold **CAPS LOCK** to talk.
Only activated using aircraft radios	Players wishing to talk to each other must tune to the same radio frequency, and then press and hold **CAPS LOCK** to talk. Press and hold **SHIFT+CAPS LOCK** to broadcast to all players, regardless of whether they're on the same radio frequency.

Additional Options (Standard Scenarios)

As a Multiplayer session host, there are a number of options you can set to determine what other players are allowed to do in your session.
When a player is changing aircraft, location, and other settings during a Multiplayer session, the session continues. That means that everyone else is probably flying away from that player while they're changing settings.
That might be fine when the intent of your session is not to stay together. For example, if all the players are practicing landings at a particular airport, no one is going to get lost from your group of players while changing aircraft or settings. Or if you're acting as a Multiplayer air traffic controller, you likely don't care where anyone is in the sky when you're not controlling them.
Under these conditions, you probably want to give players as much freedom to change settings as possible.
If, however, you are flying with new pilots, flight instructing, racing, or formation flying, you might want to restrict players' freedom to make changes in the session to prevent players from getting lost.
See the tables below for an explanation of the various advanced options.
All of the advanced options are enabled by selecting check boxes.
To enable any option select the check box next to that option.

Player Options

Option	What it does
Players can change realism settings	By selecting this option, any player can change their Realism Settings at any time during your session.
Players can change location after joining	By selecting this option, any player can change to any airport in the world at any time during your session.
Players can share aircraft	By selecting this option, any player can share their aircraft with any other player during your session.
Players can use Slew mode	By selecting this option, any player can use **Slew mode** to move their aircraft at any time during your session.
Players can join during session	By selecting this option, a player can join your session after the session has started.
Players can pause their session	By selecting this option, any player can pause their session by pressing **P** at any time.
Players can use Professional Plus features	By selecting this option, a player with the Professional Plus variant of Prepar3D can use the Professional Plus features during this multiplayer session. Otherwise, Professional Plus features will be blocked.
Host can pause session for everyone	By selecting this option, the host can pause the session for all players by pressing **CTRL+P** at any time.

Starting Location

Option	What it does
Players can start at an airport of their choice	By selecting this option, any player can start at any airport in the world.
Players can start in the air near the host	By selecting this option, any player can start the session in the air near the host aircraft. This is a good option if your intent is to do formation flying or racing.
Players can start at the airport nearest the host's aircraft	By selecting this option, any player can start the session at the airport nearest the host aircraft. This is a good option if a player is joining your session after you're already flying.

Send Update Intervals

Option	What it does
Host	This option will determine the maximum amount of time that may pass between updates sent by the host.
Clients	This option will determine the maximum amount of time that may pass between updates sent by the clients.
Enable high-frequency update	By selecting this option, the host and all connected clients will send updates as often as they are received without exceeding send update interval values.

Sharing aircraft

A host can share control of an aircraft with another player. Whether you're new to flying or a certified flight instructor, this is a great feature to use for instruction. It's also a fun way to share secrets about Prepar3D with a friend, or learn from them!
Note: The host can share his aircraft at any time but the host cannot join another player's shared aircraft.

Additional Note: To enable shared voice communication, voice communication must first be enabled by the host.
To learn more about this feature, see Sharing an Aircraft.

Scenario Options (Standard Scenarios)

This screen is where you set the flight conditions for yourself and the other players in your session. Choose your aircraft, the weather, starting location, and other options. See the table below for links to articles about each feature on this screen.

Feature	How It Works
Select role	Select whether you want to be a pilot or an air traffic controller.
State intentions	Type some notes to the other pilots in your session about what you intend to do in the session (optional).
Current Aircraft	See Selecting an Aircraft.
ATC Name	See the ATC Name section of the Selecting an Aircraft article.
Current Location	See Changing Your Aircraft's Location.
Current Weather	See Weather for a discussion on weather settings.
Current Time and Season	See Date, Time, and Season for a discussion on date, time, and season settings.
Load Scenario	See All About Scenarios.
Save Scenario	See All About Scenarios.
Flight Planner	See Using the Flight Planner.
Failures	See Setting Up Failures for a discussion on failures settings.
Fuel and Payload	See Fueling and Loading an Aircraft.

Structured Scenario Options (Structured Scenarios)

When hosting a Structured Scenario, you have several choices to make about your session and how other players participate.

Player roles

For each Structured Scenario, there are a predetermined number of default roles available to other players joining your session. As host, you can decide whether all of these roles remain available and whether to disable them.

Option	What It Does
Disabled	Selecting this option makes the role unavailable to any players joining the session.

Scenario rules

As host, you can set certain rules for the current Scenario.

Option	What It Does
Enable anti-cheat	Limits allowable aircraft to those installed on both host and player computers, and verifies Object file compatibility.
Enforce host realism	Settings in the host's Realism dialog box are enforced for all players.
Allow racing aids	Allows players to display/hide the Race Map and Pointer during a race.
Number of laps	Sets the total number of laps players must fly to win a race in this Scenario.
Time until race start	Sets a time limit to wait until the session starts.

Displayed Windows

Feature	How It Works
Show Choose Structured Scenario Options Window	Show the Structured Scenario options screen to the host. This page will allow you to Disable Roles and edit Racing Options for a Structured Scenario.

Removing Players from Multiplayer Sessions

A multiplayer host can remove any player from the session.

To remove a player from a multiplayer session

1. If you're in a session, exit to the **Final Session Lobby**.
2. Click on the player you wish to kick on the player list and then hit the Kick Player button.
3. Confirm that you would like to remove the player from the session.
4. Click **Fly Now** to rejoin the session.

Join Direct to Host

If you're hosting a multiplayer session over a LAN, your session is only visible on your subnet. There may be other players on your LAN who are on a different subnet. They can still join your session, but you must provide them with your computer's internet protocol (IP) address so they can use that to connect directly to your

session.

To determine your computer's IP address
Windows 7

1. On the Windows taskbar, click **Start**, then type **Run** into the search box and press **ENTER**.
2. The **Run** dialog box should appear. In the **Run** dialog box, type **cmd**, and then click **OK**.
3. At the command prompt, type **ipconfig**, then press **ENTER**.
4. Make a note of the IP address.
5. Give your IP address to the players joining your session.

Disconnecting Multiplayer

Whether you're hosting or joining, you can disconnect from a multiplayer session at any time. If the host ends the scenario, the session is closed for all players and they exit the scenario. The options to exit multiplayer can be found under **Scenarios** on the main menu or by pressing **ESC** to trigger the **End Scenario** dialog.

To disconnect from a multiplayer session you have two options available:
Exit Multiplayer Session

This will end your current multiplayer session and return you to the **Multiplayer Session Selection** screen. At that point you can rejoin a session or start hosting a new session.

Exit Multiplayer

This will disconnect you from multiplayer. Once disconnected, the simulation will continue as normal. At any point the multiplayer session can be relaunched following the normal procedure.

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PREPAR3D

Joining a Session

Join a Multiplayer session

When you join a Multiplayer session, the host has already set the location, weather, and other options that all the players will experience in flight. Other players can join using a Local Area Network.
To learn more about joining using a Local Area Network, see Multiplayer on a Local Area Network.

You can either fly as a pilot or act as an air traffic controller for the other pilots in the session you join. Other players can also choose whether to fly or direct air traffic.

CONTENTS

- Joining a Multiplayer Session
- Session Conditions
- Join Direct to Host
- Disconnecting from Multiplayer

RELATED LINKS

- Chatting in Multiplayer
- Multiplayer Air Traffic Control
- Sharing Aircraft in Multiplayer
- Multiplayer Settings
- Multiplayer on a LAN

Joining a Multiplayer session

You can join a multiplayer session hosted by someone you know or find an open session to join. You can find an open session on a LAN.

To join a Multiplayer session

1. Open **Multiplayer**. You will be on the **Multiplayer Login Screen**.
2. Enter a **User Name**. This will be the name that player's will see you as when joining and hosting LAN Sessions.
3. Click **Sign In**. (**NOTE:** This may take a few moments while the system broadcasts that you are now signed in and also searches for available games.)
4. Once on the **Multiplayer Session Selection** screen, select a session in the session list.
5. After a session is selected the **Session Information** is displayed at the bottom of the screen for a description of the session.
6. Click **Join Session** to attempt to join the session.

Session Conditions

This Multiplayer host sets most of the session conditions. When you join someone else's session, you can choose what role you want to play (pilot or air traffic controller), which aircraft to fly, whether to share your aircraft or tower with another player, and where in the world you want to start.
Be aware, however, that the host may turn off some of these options. If, for example, the host turns off the option for players to choose their starting airport, that option will be disabled on your screen and you will automatically start in the air near the host or at an airport near the host.

Feature	How it works
Select role	Select whether you want to be a pilot or an air traffic controller.
State intentions	Type some notes to the other pilots in your session about what you intend to do in the session (optional).
Current Aircraft	See Selecting an Aircraft.
ATC Name	See the ATC Name section of the Selecting an Aircraft article.
Sharing Share control of your aircraft	See Sharing an Aircraft in Multiplayer.
Starting Location At an airport of my choice	See Changing Your Aircraft's Location.
Starting Location Start in the air near the host	Selecting this option will start the session with you flying near the host.
Starting Location Start at the airport nearest the host	Selecting this option will start the session with you at the airport closest to the host.

Join Direct to Host

See Join Direct to Host.

Disconnecting from Multiplayer Sessions

See Disconnecting from Multiplayer.

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PREPAR3D

On a Local Area Network

Choosing a Multiplayer connection

CONTENTS

- Using Local Area Networks
- Join Direct to Host
- Determining Your IP Address

To host or join a Multiplayer session, you must connect using a Local Area Network (LAN).

Using Local Area Networks (LANs)

Local Area Networks (LANs) connect computers that are usually in close physical proximity or that share common network servers. LANs are most often used by companies and organizations for the purpose of sharing files and resources.
You must be signed into your LAN before trying to create a Multiplayer Session or joining one using the LAN.

To connect via a LAN

1. Open **Multiplayer**. You will be on the **Multiplayer Login Screen**.
2. Enter a **User Name**. This will be the name that player's will see you as when joining and hosting LAN Sessions.
3. Click **Sign In**. (**NOTE:** This may take a few moments while the system broadcasts that you are now signed in and also searches for available games.)
4. You will be in the **Multiplayer Session Selection Lobby**. From here you can:
   a. **Join Directly to the Host**
   b. **Join Another Players Session**
   c. **Host your Own Session**

Join Directly to Host (LAN)

A Multiplayer LAN session is only visible on the host computer's subnet. There may be other players on the LAN who are on a different subnet. They can still join the host session, but they must have the host computer's internet protocol address (IP address) to connect directly to the host session. See below for instructions on determining the host IP address.

To connect directly to a specific computer

1. On the **Multiplayer** screen, type a **Player name**.
2. Click **Sign In**.
3. On the next screen, click **Direct connection**.
4. Type the other computer's **IP address**.
5. Click **Find Sessions**.

Determining your computer's IP address

To determine your computer's IP address
Windows 7

1. On the Windows taskbar, click **Start**, then type **Run** into the search box and press **ENTER**.
2. The **Run** dialog box should appear. In the **Run** dialog box, type **cmd**, then click **OK**.
3. At the command prompt, type **ipconfig**, then press **ENTER** .
4. Make a note of the IP address.
5. Give your IP address to the players joining your session.

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PREPAR3D

Multiplayer Settings

There may be times when you want to set specific numbers for some connection settings. In general, these are advanced settings that should only be changed for special-purpose configuration.

CONTENTS

- Host Settings
- Client Settings
- Other Settings

To open the Network Settings dialog box

- Open **Multiplayer**, and from the **Multiplayer Login Screen** click the **Network Settings** link.
- You will now be on the **Networks Setting Screen**. You have a variety of network settings which can be adjusted such as **Host Settings**, **Client Settings**, and **Other Settings**.

Host Settings

Port range

If you need to go through a Network Address Translator (NAT), you can set the port range through which the simulator will communicate. The default port range is 6112 to 6122.

To set the port range

- Type a range into the two **Port Range** boxes.

Voice compression

When players are using voice communication, voice packets are compressed to free bandwidth. Compression, however, degrades audio quality. You can make tradeoffs between compression and quality with the voice compression setting.

To set the voice compression

- Select a setting from the **Voice Compression** list.

Client Settings

Enable Voice communication

When you are in a Multiplayer session and other players are using voice communication, voice packets are sent to your computer whether you're using voice communication or not. Those packets will tax your connection bandwidth, which is usually not a problem if you have a high-bandwidth connection.
Voice communication is on by default. You can disable voice communication on the **Network Settings** screen and free bandwidth by preventing voice packets from being sent to your computer. An icon next to your player name in the **Multiplayer Session Lobby** indicates to other players that you do not have voice communications turned on.

To disable voice communication

- Clear the **Enable Voice Communication** check box.

Other Settings

Connection time out

When the simulator cannot make a Multiplayer network connection, it will notify you that it has timed out. You may want to set a limit on how long you wait until the connection attempt times out.

To change the Connection time out setting

- Type the number of seconds you want to keep the connection alive in the **Connection Time Out** box.

Keep alive

Periodic checks are made to verify that information packets are still being sent across a network connection. By default, if there is no response after fifteen seconds, it shuts the connection down. You can increase or decrease the amount of time that is used to keep the connection alive without receiving packets.

To change the Keep alive setting

- Type the number of seconds you want to keep the connection alive in the **Keep Alive** box.

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PREPAR3D

Sharing an Aircraft

The perfect training tool

CONTENTS

- How to Share
- How to Join
- Transferring Aircraft Control
- Voice Communication

RELATED LINKS

- Connecting to a LAN
- Hosting a Multiplayer Session
- Joining a Multiplayer Session
- Chatting in Multiplayer

What if there was a way to get flight instruction over a LAN? What if a friend could take you for a flight over their favorite spot in Kathmandu? How about acting as a crew member on one of Prepar3D's airliners?
That's all possible using Prepar3D's shared skies feature. Prepar3D Multiplayer allows you to share control of a single aircraft. This is a great tool for giving or receiving instruction over a LAN.
Sharing the aircraft can also be a fun way to have a friend show you some beautiful scenery without you ever having to travel to their part of the world.
Note: As a participant in a Multiplayer session, you either host a session or join someone else's session. The host must enable the sharing option on the Additional Options tab of creating a session to allow other participants to share with players other than the host.

How to Share an Aircraft

The essential thing to know about sharing aircraft is that you can pass control of the aircraft back and forth between two participants in a Multiplayer session. An instructor can demonstrate a maneuver, and then hand control to a student to have them try the same maneuver. Or you can take turns showing each other scenery in your part of the world.
Note: The host can share his aircraft at any time but the host cannot join another player's shared aircraft. The host must enable other players to share aircraft with each other.
To allow players to share the host aircraft

1. Open **Multiplayer**. You will be on the **Multiplayer Login** screen.
2. Enter a **User Name**. This will be the name that player's will see you as when joining and hosting LAN Sessions.
3. Click **Sign In**. (**NOTE:** This may take a few moments while the system broadcasts that you are now signed in and also searches for available games.)
4. You will be in the **Multiplayer Session Selection**. From here click **Host Session**.
5. Fill in the Basic Options tab and Additional Options tab (optional) on the **Create Session** screen. Be sure to check **Players can share aircraft** in **Additional Options**. Once this is done, click **OK**.
6. Choose the Scenario Options, and then click **OK**.
7. You are now in the final game lobby. From here you can choose to fly now, wait for incoming players, or change your scenario options before the session starts. By pressing **Fly Now** the session commences.

Players can also share their aircraft with each other when the host enables that option. When a player uses this option, the next player in the session to click the **Join** button is the one who will share that aircraft.
To allow players to share their aircraft with other players make sure your 'Share my aircraft' checkbox is checked in the in-game Scenario Options.
There are three options that you can select when sharing:

- **Disable sharing after session begins if no one has joined**
  This option prevents anyone from joining after you click **Fly Now** to start the session.
- **Enable shared voice communication**
  This option simulates an intercom system in the aircraft. The advantage of this option is that players do not need to press a button to talk to each other.
- **Allow avatar attachment**
  This option will determine whether or not another player's avatar can attach to your shared vehicle. Avatar Mode does not need to be enabled to allow another avatar to attach to and share your vehicle.

All players see a list of shared aircraft when they reach the **Multiplayer Session Lobby** (the last screen before the session starts). Unless the shared aircraft has been password-protected, any player can join one of them.

How to Join an Aircraft

You can join the host's aircraft if the host has made their aircraft available to join. You can also join another players aircraft if:

1. The host has enabled sharing for all players.
2. Another player has chosen to share their aircraft.

Note: The host can share his aircraft at any time but the host cannot join another player's shared aircraft.

To join a shared aircraft

1. Start Multiplayer and sign in as normal.
2. On the **Multiplayer Session Selection** screen, click the session you wish to join from the **Choose a Session** list box. Next, click the **Join Session** button to join.
3. On the **Choose Your Scenario Options** screen, click **OK** as most of the options will be overridden during a shared session.
4. On the **Multiplayer Session Lobby** screen, click the player you wish to share from the **Players** list box. Next, click the **Share Aircraft** to join the highlighted player.
5. Click **Ready** and wait till the server begins the session.

Transferring Aircraft Control

Once you start flying in a Multiplayer shared-aircraft session, you can transfer control of the aircraft back and forth with the other pilot.
The pilot in control is the only one who can fly the aircraft. However, the other pilot can still operate aircraft systems and radios.
To transfer aircraft control

- Press **SHIFT+T**.

The other pilot receives a message asking if they want to accept control of the aircraft.
To accept aircraft control

- Press **SHIFT+T**.

Voice Communication

If you have a Windows-compatible headset (or a microphone and speakers) and want to use voice communications while sharing an aircraft, you must select the voice communication option. A broadband Internet connection is required for voice communications.
The advantage to using the intercom is that players don't have to push a button to talk. This feature simulates a “hot” microphone that is always on.
This option is only available when you share an aircraft.
To enable voice communication
(broadband Internet connection required)

1. On the **Multiplayer** screen, sign in using a Local Area Network.
2. Host or join a session.
3. Under **Sharing**, select the **Enable shared voice communication** check box.

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PREPAR3D

Chat

Text and voice in Multiplayer

To more effectively coordinate multiplayer scenarios, voice and text messaging is built into Prepar3D.

CONTENTS

- Pre-session Text Chat
- In-session Text Chat
- Voice Communication

RELATED LINKS

- Sharing Aircraft in Multiplayer
- Hosting a Multiplayer Session
- Joining a Multiplayer Session

Pre-session Text Chat

Once you are signed in to a LAN connection in Multiplayer, you can start using text chat. Use chat to pass information between the host and players while setting up the session.

To display/hide the chat window

- Click the **Chat** button in the lower left corner of the final **Multiplayer Session Lobby** screen.

To send a message to all players

1. Click the **Chat** button.
2. Type a message in the text field provided.
3. Click **Send**.

In-session Text Chat

Multiplayer sessions have chat built in so players can send and receive messages while flying together.

To display/hide the chat window

- Press **CTRL+SHIFT+]** (right bracket).

To send a message to players

1. Type a message in the text field provided.
2. Click **Send**.

To eject people from the multiplayer session (HOST ONLY)

1. Select the user you wish to eject from the **Online Players** list.
2. Click the red **X** next to the player's name.
3. Confirm that you would like to eject the player from the session.
4. Player is successfully ejected from the game.

Voice Communication in Multiplayer

Voice communication during a Multiplayer session frees you from having to type text messages to other players. It adds realism if you are using Multiplayer Air Traffic Control, especially if you use a Windows-compatible headset.
The Multiplayer host must enable voice communication options before starting a session. To learn more about setting host options for voice communication, see Basic Options.
There are three voice communication options (broadband Internet connection required):

Option	How it works
Always activated for all players	All players in the session can hear all other players. Players must press and hold **CAPS LOCK** to talk.
Only activated using aircraft radios	Players wishing to talk to each other must tune to the same radio frequency, then press and hold **CAPS LOCK** to talk. Press and hold **SHIFT+CAPS LOCK** to broadcast to all players, regardless of whether they're on the same radio frequency.
Enable shared voice communication via aircraft intercom	Only available when two players are sharing an aircraft. With this option, players are not required to press a button to talk.

Direct Voice

Users have the ability to directly talk to one or more player using the **Direct Voice** option in the chat window's **Online Players** list. When enabled on a player, users can press and hold **CTRL+CAPS LOCK** to directly talk to those specific player(s) over a microphone regardless of the current radio frequency. This could be useful when in SimOperator mode to allow an operator to directly talk to one or more players without having to change frequencies or broadcast to everyone.

To use a headset in Multiplayer

1. Be sure the headset is plugged into the correct port on your computer.
2. Enable the voice communication host options.
3. During the session, press and hold **CAPS LOCK** to talk to other pilots or air traffic control. Release **CAPS LOCK** to stop transmitting.

IMPORTANT: There are a couple of things to know if you're going to use a headset. For the most realism, you only want voice communication coming through the

headset.

- If your headset is your only audio output, all sounds will come through the headset, including engine noise, wheels on pavement, and even e-mail notifications if you have your e-mail client running.
- You must have two or more audio devices (sound cards) in your computer to enable voice-only audio through your headset.

To enable voice-only audio on a headset

(Two sound cards required)

1. On the main menu, click **Settings**, and then click **Sound**.
2. Locate the **Windows sound devices** section.
3. In the **Sound playback** list, select a sound card to play all sounds other than voice.
4. Click the **Voice** tab.
5. In the **Voice playback** list, select a sound card to receive voice audio (it must be a different sound card than the one chosen on the Audio tab).
6. In the **Voice recording** list, select a sound card to transmit voice audio (it must be different from the sound card chosen on the Audio tab).
7. Click **Accept** to successfully save your changes.

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PREPAR3D

ATC

Pilots and controllers in Prepar3D Multiplayer

An exciting feature of Prepar3D is the ability to have realistic communications between pilots and air traffic control during flights. As a Multiplayer participant you can act as an air traffic controller for other Prepar3D pilots or interact with ATC as a pilot yourself.
If you're new to this, you can learn from other virtual pilots and controllers online using Prepar3D Multiplayer.
For an overview of real ATC, see Air Traffic Control Defined.

CONTENTS

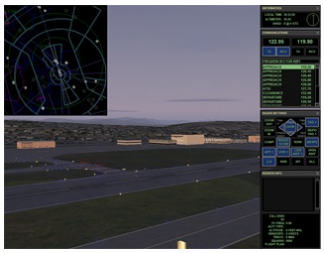
- Control Tower
- Multiplayer Pilots
- Using a Headset

RELATED LINKS

- Acting As A Tower Controller
- Hosting a Multiplayer Session
- Joining a Multiplayer Session

Control Tower

Setting up a control tower in Prepar3D is easy. Whether you're hosting a Multiplayer session or joining someone else's session, you can choose to be a pilot or a tower controller. And you can choose among thousands of real-world airport control towers.
Note: To learn how to use the tower controller screens, see Acting as a Tower Controller.
Your view as a tower controller is from the inside of the control tower cab. You can move to different stations in the tower, and display various parts of the controller screens as you need them.



You'll direct traffic for the other pilots flying in and out of your airport. You can communicate with them by voice (or text chat) so it helps to gain some proficiency with air traffic control procedures and language if you want your tower to be realistic.
Your Prepar3D tower can be as real or as fun as you want it to be.
But if you want to ignore the rules, this is a simulator and you're supposed to have fun. Use Prepar3D Multiplayer tower your way.
To learn more about the air traffic control panels in the tower, see Acting as a Tower Controller.
To learn more about real-world air traffic control procedures, see Air Traffic Control Defined.

Knowing the lingo

Real-world pilots use a number of resources to become familiar with, or to brush up on, ATC phraseology. You might want to purchase a copy of one or more of the following:
Aeronautical Information Manual (AIM-Pilot/Controller Glossary. U.S. government publications)
Say Again, Please by Bob Gardner; Aviation Supplies & Academics (2005).
The Pilot's Radio Communications Handbook by Paul E. Illman; McGraw-Hill Professional Publishing (1998).
The Pilot's

Multiplayer Pilots

Whether you're a non-pilot newbie who just wants to interact with other players and ignore the rules, or a real-world pilot or serious virtual pilot who wants high realism,

Prepar3D's Multiplayer air traffic control is your ticket to fun.
Some pilots will tell you that one of the hardest parts of learning to fly in the real world is learning to talk to air traffic control. Prepar3D's Multiplayer air traffic control is great for student pilots or aspiring pilots. Real air traffic control interaction can be intimidating to a new pilot, and Prepar3D allows you to learn and make mistakes all in the comfort and safety of your home or office.

Reference to ATC Procedures and Phraseology by Mills and Archibald; Reavco Publishing (2000).
Comm1 Interactive software to learn IFR ATC procedures.

Using a Headset

Using a headset for voice communications in Multiplayer air traffic control adds realism. Your hands are free to fly the aircraft or to push buttons if you're the air traffic controller.

To use a headset in Multiplayer

1. Be sure the headset is plugged into the correct port on your computer.
2. Enable the voice communication host options.
3. During the session, press and hold **CAPS LOCK** to talk to other pilots or air traffic control. Release **CAPS LOCK** to stop transmitting.

IMPORTANT: There are a couple of things to know if you're going to use a headset. For the most realism, you only want voice communication coming through the headset.

- If your headset is your only audio output, all sounds will come through the headset, including engine noise, wheels on pavement, and even e-mail notifications if you have your e-mail client running.
- You must have two or more audio devices (sound cards) in your computer to enable voice-only audio through your headset.

To enable voice-only audio on a headset

(Two sound cards required)

1. On the main menu, click **Options**, then **General...**, and finally click the **Sound** tab.
2. Locate the **Windows sound devices** section.
3. In the **Sound playback** list, select a sound card to play all sounds other than voice.
4. Click the **Voice** tab.
5. In the **Voice playback** list, select a sound card to receive voice audio (it must be a different sound card than the one chosen on the Audio tab).
6. In the **Voice recording** list, select a sound card to transmit voice audio (it must be different from the sound card chosen on the Audio tab).
7. Click **Accept** to successfully save your changes.

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PREPAR3D

ATC Panels

Tools of the trade for multiplayer ATC

The Prepar3D Tower feature lets you host or join a multiplayer session as an air traffic controller. The Tower panels are based on the tools that real controllers use every day. This article explains how to use the Tower panels to monitor and direct aircraft flying in a multiplayer session.
You don't have to conduct your Tower sessions by the rules (that's the beauty of a simulator). But if you want to know more about how air traffic control is conducted in the real world, start by reading ATC Defined in the Learning Center. You'll find help to get you started and information about Air Traffic Control resources outside of Prepar3D.

CONTENTS

- Introduction
- Getting to Work
- Looking Around
- Controller Panels
- Panel Options
- Radar Screen
- Airport Information
- Communications
- Radar Options
- Session Information
- Putting It All Together

RELATED LINKS

- ATC Defined
- Multiplayer ATC
- Multiplayer Connect

Introduction

Real-world air traffic controllers work in one of three specialties: Tower, Approach, or Enroute. While the radar features of the multiplayer Tower can be used to simulate Approach and Enroute controller roles, this article will focus on the Tower controller role. Tower controllers work in the room at the top of a control tower (the cab), and are responsible for directing aircraft on the ground and in the air within 5 miles of the airport, up to an altitude of 3,000 above the ground. They have many of the tools of Approach and Enroute controllers, but instead of sitting at a radar scope they get to look out the window. If you like looking at airplanes—real or simulated—this is the job for you!

Getting to Work

Your session will begin in the control tower at your chosen airport.

To set up a control tower

Hosting a Game

1. Open **Multiplayer**. You will be on the **Multiplayer Login Screen**.
2. Enter a **User Name**. This will be the name that player's will see you as when joining and hosting LAN Sessions.
3. Click **Sign In**. (**NOTE:** This may take a few moments while the system broadcasts that you are now signed in and also searches for available games.)
4. Click the **Host Session** button.
5. Choose a **Standard Scenario** type session and complete the **Basic Options** and **Additional Options**.
6. On the **Scenario Options** screen, select **Air traffic Controller** as the **Role Type**.

Joining a Game

1. Open **Multiplayer**. You will be on the **Multiplayer Login Screen**.
2. Enter a **User Name**. This will be the name that player's will see you as when joining and hosting LAN Sessions.
3. Click **Sign In**. (**NOTE:** This may take a few moments while the system broadcasts that you are now signed in and also searches for available games.)
4. Select the session you would like to join and then click the **Join Session** button.
5. On the **Scenario Options** screen, select **Air traffic Controller** as the **Role Type**.

You can move to any one of four controller stations within the tower cab. You'll probably want to move to the station that gives you the best view of the active runway (the runway that is most closely aligned with the wind). At a large airport with multiple runways, you might need to move around quite a bit to see everything.
To change stations

- On the **Panel Options** panel, press the **Next Station** button.

-or-
- Press **A** to cycle the views with the Cockpit view mode.

Note: When you change stations or views all open Controller panels will close.

Looking Around

Just like in a Prepar3D aircraft, in the tower you can cycle view categories by pressing **S**, and cycle views within a view category by pressing **A**. Generally, when acting as a Tower controller you'll want to use Virtual Cockpit view, so you can see the 3-D cab interior and easily pan your view to look around. The equipment you'll use to do your job is found on the pop-up panels explained below.
You can look around the tower cab using your mouse. Press and hold the **SPACEBAR** and move the mouse. You can also look around by moving the hat switch on your joystick, by pressing keys on the numeric keypad, or by using the thumb stick on an Xbox 360 controller for Windows. You can zoom in and out for a better view.
To zoom in and out
- Press the **EQUAL SIGN (=)** to zoom in.
-or-
- Press **HYPHEN (-)** to zoom out.

Having trouble seeing the runway? In a real tower you'd just lean forward a bit or stand up. In Prepar3D you can move the eyepoint, the point from which your virtual eyes look out.
To move the eyepoint:

Action *3-D virtual cockpit only	Key command
Move eyepoint back*	**CTRL+ENTER**
Move eyepoint up	**SHIFT+ENTER**
Move eyepoint down	**SHIFT+BACKSPACE**
Move eyepoint forward*	**CTRL+BACKSPACE**
Move eyepoint left*	**CTRL+SHIFT+BACKSPACE**
Move eyepoint right*	**CTRL+SHIFT+ENTER**
Reset eyepoint	**CTRL+SPACEBAR**

Controller Panels

Controller panels based on existing real-world technology provide you with all the information you need to get the job done as a multiplayer Tower controller. There are six pop-up panels that you can display one at a time, or all at once (press **SHIFT+1** through **SHIFT+6**):
- Panel Options
- Radar Screen
- Airport Information
- Communications
- Radar Options
- Session Information

Each panel can be dragged and resized. If you use multiple monitors, you can move controller panels between monitors to avoid blocking your view out the tower windows. Additionally, you can adjust the transparency of all the panels so that you can see through them.
Each panel is explained below.

Panel Options

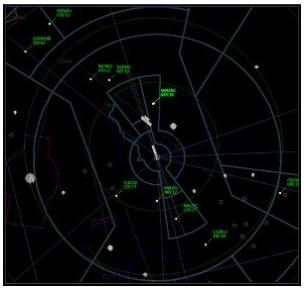
The **Panel Options** panel gives you easy access to all of the other pop-up panels. Just click a button to display that panel. Additionally, you can use the **Fade Out** and **Fade In** buttons to change the transparency of all the panels.

To display the Panel Options panel
- Press **SHIFT+2**.

Radar Screen

While Approach and Enroute control facilities use radar as the primary means to separate aircraft, many small control towers don't have radar. In fact, some of the most fun you can have as a Tower controller is trying to keep track of all the aircraft you're controlling using only the view out the window and what you hear on the radio! That said, radar provides additional situational awareness. Instead of having to

keep the big picture in your head, you can just look at the radar and see exactly where each aircraft is.



To display the **Radar Screen**

- On the **Panel Options** panel, click the **Radar Screen** button.

  -or-
- Press **SHIFT+1**.

The **Radar Screen** displays a map, a compass, range rings, airports, navigational aids, fixes, airways, and aircraft symbols with associated datatags. Each screen element can be displayed or hidden using buttons on the **Radar Options** panel.

Which direction am I looking?

The **Radar Screen** is presented with magnetic north at the top. When you look out the window of the tower cab, you must be aware of what direction you are looking (relative to the runways) to see the aircraft that appear on the radar.

Targets and History Trails

Because radar does nothing more than show the location of an aircraft, a "history trail" provides a visual indication of the aircraft's position over time, as well as its speed and relative direction of flight.

Datatags

Datatags provide you with important information about each aircraft shown on the radar screen. The datatag is connected to the aircraft symbol with a "leader line." There are two types of datatags: **Realistic** and **Detailed**. The tags can be toggled between Off, Realistic, and Detailed by pressing the **TAG** button on the **Radar Options** panel.

The **Realistic** datatags are based on the radar displays in U.S. Tower and Approach Control facilities.

N123MS 033 11	Aircraft Call Sign
	[Three-digit **altitude** in hundreds of feet] [**Groundspeed** in knots divided by 10] Note: The second line cycles every few seconds between [altitude/groundspeed] and [destination (if a flight plan was created)/aircraft type].

The **Detailed** datatags provide information in a more easily-understood format.

N99PT ACFT: C208 DEST: KSBA ALT: 8,000' MSL SPD: 130 KTS	Aircraft Call Sign **ACFT:** (Aircraft type)
	DEST: (Destination ID if a flight plan was created) **ALT:** (Altitude in feet above mean sea level)
	SPD: (Groundspeed in knots)

By default, datatags are positioned up and to the right of the aircraft symbol with which they're associated. To avoid overlapping datatags, reposition them.

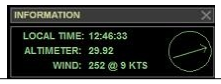
To reposition a datatag

1. Select the desired aircraft in the **Session Info** panel.
2. Click the **REPO TAG** button on the **Radar Options** panel to move the datatag clockwise around the aircraft symbol.

Airport Information

The **Airport Information** panel provides you with three key pieces of information:

- The current local time of day (24-hour clock)
- The current local altimeter setting
- The wind direction, wind speed, and a visual wind direction indicator



To display the Airport Information panel

- On the **Panel Options** panel, click the **Local Info** button.

  -or-
- Press **SHIFT+3**.

Communications

The **Communications** panel features two communications radios, each with a frequency selection window, a **Transmit (TX)** button, and a **Receive (RCV)** button. You can receive on either or both radios. You can transmit on only one radio at a time.
Below the radios is a list of frequencies for your airport. You can manually tune a frequency using the mouse, or use the scrollbar and click one of the frequencies in the list to quickly tune the radio you're set to transmit on.

To display the Communications panel

- On the **Panel Options** panel, click the **Comm Radios** button.

  -or-
- Press **SHIFT+4**.

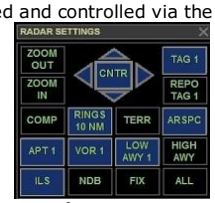
If you have a headset, you can communicate with other players in the session via voice if the host of the session has chosen to enable voice on the **Host Option** screen. How you communicate depends on the voice communication option that the host selected:

Option	How to communicate
Always activated for all players (default)	All players in the session can hear all each other at all times. To talk, press and hold **CAPS LOCK**.
Only activated using aircraft radios	Players must be tuned to the same radio frequency to hear each other. To transmit, press and hold **CAPS LOCK**. To broadcast to all players, regardless of whether they're tuned to your radio frequency, press and hold **SHIFT+CAPS LOCK**.

If you're in a session with a single Tower controller, the "Always activated for all players" option makes it easy to communicate. But if you have multiple towers, or want a more realistic experience, the "Only activated using aircraft radios" option is a better choice, as it forces players to tune to your frequency to communicate with you. Before starting a session, it's helpful to tell other players what frequency you'll be operating on.
To learn more about using voice and chat, see Talking to Other Players.

Radar Options

The **Radar Screen** is configured and controlled via the **Radar Options** panel.



To display the Radar Options panel

- On the **Panel Options** panel, click the **Radar Options** button.

  -or-
- Press **SHIFT+5**.

Each **Radar Options** button has multiple states. Click a button multiple times to cycle through the button states and observe the changes displayed on the **Radar Screen**.

Button	Function
ZOOM OUT	Zooms map out
ZOOM IN	Zooms map in
CNTR	Centers map on airport
ARROWS	Pan map
TAG	Toggles datatags (Off/Realistic/Detailed)

REPO TAG	Repositions datatag of aircraft selected on Session Information panel
COMP	Toggles compass rose (Off/On)
RINGS	Toggles range rings (Off/2/5/10/20 miles)
TERR	Toggles terrain (Off/On)
ARSPC	Toggles airspace boundaries (Off/On)
APT	Toggles airports (Off/Symbols/Symbols and Labels)
VOR	Toggles VORs (Off/Symbols/Symbols and Labels)
LOW AWY	Toggles low-altitude (victor) airways (Off/Lines/Lines and Labels)
HIGH AWY	Toggles high-altitude (jet) airways (Off/Lines/Lines and Labels)
ILS	Toggles ILSs (Off/Symbols)
NDB	Toggles NDBs (Off/Symbols, Symbols and Labels)
FIX	Toggles fixes (Off/Symbols/Symbols and Labels)
ALL	Toggles radar filter (All/Ground/Air)

Session Information

The **Session Information** panel provides you with a list of all the aircraft in the multiplayer session, as well as details about each player and their aircraft.

To display the Session Information panel

- On the **Panel Options** panel, click the **Session Info** button.

  -or-
- Press **SHIFT+6**.

At the top of the **Session Information** panel is a list of the players in the session. The list is sorted by distance from the airport, with the closest aircraft at the top of the list.
Use the scrollbar and click an aircraft to see details about that aircraft in the details box below the list. When you click on an aircraft, that aircraft's target and datatag on the **Radar Screen** will turn red for ten seconds.
The lower half of the **Session Information** panel displays details about the aircraft and player selected in the list above. Details include:

- Aircraft call sign
- Transmit frequency tuned to
- Aircraft type
- Altitude
- Groundspeed
- Magnetic track (track over the ground, not heading)
- Squawk (transponder code)
- Flight plan (if one was created)

Putting It All Together

There are two main roles in most control towers: Local Control and Ground Control. The Local controller (more commonly known as the Tower controller) handles aircraft in the air and aircraft on the ground waiting for takeoff. The Ground controller handles aircraft on the ground moving on the taxiways. In some towers, one person handles both jobs. In Prepar3D, it's up to you.
With the tools described above you have everything you need to be a Ground or Tower controller at any airport in Prepar3D. With a little creative thinking, you also have most of the tools you need to provide virtual pilots with fairly realistic Approach and Enroute services too. The feature was designed to appeal to a wide cross-section of Prepar3D fans with a broad range of knowledge and skills. As you explore the world of flying and controlling online you'll quickly learn that there's something for everyone.
If you need some help along the way, just ask. Most of the folks you'll encounter in the Prepar3D community love this stuff as much as you do, and it's not difficult to find someone to help you get up to speed.

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Racing

What you need to know to race

Prepar3D offers some of the most exciting flying to be found on a desktop. Try your hand at fast, challenging, and fun air racing.

To race against a human opponent

- Host a multiplayer scenario session using the desired multiplayer race scenario.

Race courses in *Prepar3D* have pylons gates, hoops in the sky, narrow canyons, islands, or turn points you must negotiate. Here is an explanation of a few racing aids that can help you win.

CONTENTS

- Race Map
- Aircraft Information
- Race Information
- Maneuvers Icon
- Race Results Screen

RELATED LINKS

- Hosting a Multiplayer Session
- Joining a Multiplayer Session

Race Map

It can be extremely challenging to keep track of where you are while whipping around a race track at low altitude and high speed. *Prepar3D* includes a **Race Map** that points in the direction of the next waypoint and depicts the waypoints in relation to your aircraft and each other.

Map element	How it works
Pointer	Points to the currently active waypoint/pylon gate.
Waypoints Map	Displays all waypoints in relation to each other. Current waypoint is highlighted.
Aircraft	Depicts your aircraft in the middle of the waypoints map.
Zoom in/Zoom out	Displays a greater or lesser area of the waypoints map.

To display/hide the Race Map

- Press **U** to cycle through map states.

Aircraft Information

Racing is hard on airplanes and if you push your racer too hard, it might break down before you get to the finish line. Monitor the **Aircraft Information** gauges through the entire race.

Icon	Indicates
	Level of boost (nitrous) or coolant remaining.
	Engine temperature.
	Inches (Hg) of manifold pressure.
	Overall engine health.

Race Information

Prepar3D displays race information onscreen to keep you abreast of your status and progress. This will help you manage how fast to fly the course and perhaps help you

prevent incurring penalties.

Element	Indicates
Place	Your place relative to other racers.
Lap Counter	Lap number/total laps number.
Total Time	Time elapsed since race started.
Current Lap	Time elapsed in current lap.
Last Lap	Time elapsed in last lap (speed flown during last lap).
Ahead/Behind By	Indicates your position in the race.

Maneuvers Icon

Some race courses require you to perform aerobatic maneuvers to stay within the course. When a gate requires a maneuver, an icon appears onscreen to help guide you through the maneuver. Note that the Maneuvers Icon indicates the actual maneuver you need to fly, not just the direction you must fly.
To use the **Maneuvers Icon**, follow the pointer through the maneuver.

Race Results Screen

At the end of each race, a screen displays the race results. If the race is flown in Multiplayer, your results appear as soon as you finish the race. The screen updates with the results of other pilots as they finish the race.

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Sample Network Configuration Files

The ***.cfg** files listed below should be passed to *Prepar3D* using the **-net** command line switch. For example, to use the **MPHost.cfg** file found in the SDK, Prepar3D should be run as follows:

Prepar3D.exe "-net:<Lockheed Martin/SDK v5 *>/config/Sample Network Configuration Files/Multiplayer/MPHost.cfg"

The sample network configuration files are located at:

<Lockheed Martin/SDK v5 *>/config/Sample Network Configuration Files/Multiplayer/

These files are for launching standard Multiplayer sessions from the command line.

File	Description
MPHost.cfg	This file is used to start a multiplayer host session. You will probably also want to use a **"-flt:d:\Some\Path\filename.flt"** to specify what vehicle the host is using and where the host is located.
MPClient1.cfg to **MPClient6.cfg**	These files are used to join clients to a multiplayer session. All of these are setup to share their aircraft.
MPClientDirectIP.cfg	This file can be used to connect join a client to a multiplayer session by IP address. Change the values of IP1, IP2, IP3, and IP4 to the desired IP address to connect to.
MPShare1.cfg to **MPShare6.cfg**	These files are used to join clients to a multiplayer session and join another clients shared aircraft. They join the client with the same suffix number.

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Distributed Interactive Simulation (DIS)

Distributed interactive simulation (DIS) is a simulation interoperability standard that provides simulation applications with the ability to communicate and exchange information. The native DIS implementation is only available with the **Professional Plus** variant. Current support is for protocol version 6 (IEEE 1278.1a-1998), however other versions may be compatible.

Starting a Session

The DIS user interface can be found under **Networking** in the main menu bar. The user should configure their DIS session before attempting to connect. Configuration includes items such as site, application, entity, and exercise ids as well as heartbeat and timeout values. The exercise id must match that of the session you intend to join. PDUs of other exercises will not be processed by your machine. To process PDUs from all exercises, a value of zero may be entered in the exercise id field. The user must then provide their machine's IP address as well as either a subnet mask or a multicast address depending on the connection type. Once this information is complete, the user may click connect to start or join a DIS session. See below for a more detailed description of each option.

User Interface

The DIS user interface allows the user to configure items such as entity and connection settings. The following is a description of options available from within the user interface as well as descriptions and examples of the XML format used for the configuration.

Entity

Option	Description
Exercise ID	The **Exercise ID** of the distributed interactive simulation. Applications participating in the same simulation should have matching **Exercise IDs**. A value of zero may be entered to receive network traffic from all connected exercises. Valid **Exercise IDs** range from 0 to 255.
Site ID	The **Site ID** of this application instance. **Site IDs** may be the same for multiple applications as long as each application's **Application ID** is unique. Valid **Site IDs** range from 0 to 65535.
Application ID	The **Application ID** of this application instance. **Application IDs** should be unique for all applications participating in a given exercise from a given site. For example, the **Application ID** should be unique for all simulations sharing the same **Exercise ID** and **Site ID**. Valid **Application IDs** range from 0 to 65535.
Entity ID	The **Entity ID** of the user entity. Valid **Entity IDs** range from 0 to 65535.
Force	The **Force ID** of the user entity. Valid **Force IDs** range from 0 to 255. Force values for non-user objects will be determined by their **ASSOCIATION ID** simulation variable value.
Marking	The **Marking** of the user entity. The **Marking** must be 11 characters or less. The marking value for non-user objects will be determined in following order: • The **IdentificationNumber** value defined in a structured scenario • The AI traffic tail number • The tail number defined in the objects configuration file If none of the above are present no marking will be assigned.

Connection

Option	Description
	The desired connection type, either **Multicast** or **Broadcast**. **Multicast**

CONTENTS

- Starting a Session
- User Interface
  - Entity
  - Connection
  - Timing
  - Options
  - Radios
  - Emissions
  - Munitions
- Entity Type Configuration
  - Entity Type XML File
  - Entity Type String
- Entity Appearances Configuration
  - Entity Appearances XML File
  - Custom Entity Appearances XML File
- Articulated Part Configuration
  - Articulated Parts XML File
  - Custom Articulated Parts XML File
- Feature Support

RELATED LINKS

- Not Applicable

Connection Type	connection types must provide a valid **Multicast Address**. **Broadcast** connection types must provide a valid **Subnet Mask**. The default connection type is **Multicast**.
IP Address	The local **IP Address** of this machine. The local **IP Address** is used in conjunction with the subnet mask to create the broadcast address when using the broadcast connection type. The local **IP Address** is also used to filter incoming packets that may have been sent from this machine.
Multicast Address	The **Multicast Address** is only used by the **Multicast** connection type. The valid **Multicast Address** range is **224.0.0.1** to **239.255.255.255**.
Subnet Mask	The **Subnet Mask** to be used in conjunction with the machine's **IP Address** to create the final broadcast address. The default value of the **Subnet Mask** is 255.255.255.0 (class C network). The **Subnet Mask** should be within the range **0.0.0.0** to **255.255.255.254**. For universal broadcast mode, a **Subnet Mask** of **0.0.0.0** should be entered. This value is only valid for **Broadcast** connection types.
Port	The **Port** used by both **Multicast** and **Broadcast** connection types. Valid **Port** ranges are from 1024 to 65535. The default value is 3000.
Time to Live	The packet **Time to Live** value. This value represents the number of routers that a packet is allowed to cross. The default value is 64 and the maximum value is 255.

Timing

Option	Description
Heartbeat	The maximum time in seconds that an entity will wait between heartbeats. Simulation objects will automatically heartbeat when their current location or dead reckoning values exceed that of the DIS standard.
MaxHeartbeatFrequency	The maximum frequency that an entity will heartbeat in Hertz. For example, a value of 60 Hz means that an entity will heartbeat no more than 60 times per second.
Timeout	The maximum duration in seconds that remote simulation objects must heartbeat. If this duration is exceeded, the object will be removed from the simulation.
Relative Timestamp	Specifies that PDU's will be sent with a relative timestamp versus an absolute timestamp.

Options

Option	Description
Allow Loopback	Set to true to process packets sent by the local machine.
Auto Connect	Set to true to automatically start a DIS connection when the application is started.
Auto Find IP Address	Set to true to automatically fill in the IPAddress field with the local machine's IP address.
Broadcast AI Traffic	Set to true to enable the broadcasting of AI traffic as DIS entities.
Broadcast Nav Aids	Set to true to enable the broadcasting of navigation aids such as VOR, DME, TACAN, and NDB.
Dead Reckoning Method	Determines the coordinate system to be used when broadcasting entity dead reckoning values. Values should be one of the following: • **BodySpace** • **WorldSpace**
Disable Articulated Parts	Set to true to disable the serialization and deserialization of articulated parts.
Disable Entity Appearance	Set to true to disable the serialization and deserialization of entity appearances.
Disable Dead Reckoning	Set to true to disable the dead reckoning of remote entities.
Draw Engagements	Set to true to draw engagement lines when munitions are fired and detonated.
Draw Labels	Set to true to draw labels next to entities displaying information such as name, entity id, and IP address.
Enable Logging	Set to true enable logging.

Exercise Region Top-Left	The latitude and longitude of the top-left corner of the exercise region in degrees. Remote entities reporting outside of the exercise region will not be processed. To disable the exercise region, a value of zero should be entered for the latitude and longitude of both the top-left and bottom-right corners.
Exercise Region Bottom-Right	The latitude and longitude of the bottom-right corner of the exercise region in degrees. Remote entities reporting outside of the exercise region will not be processed. To disable the exercise region, a value of zero should be entered for the latitude and longitude of both the top-left and bottom-right corners.
Pull To Ground	Set to true to pull land and surface based platforms and lifeforms onto the terrain or water. Air based platforms will also be pulled when determined to be on the ground.

Radios

Option	Description
Intercom Channel	The channel number (frequency) of the intercom. Valid values range from 1 to 100,000. Only intercom transmissions on the same channel will be heard.
Intercom Priority	The priority associated with the intercom transmission. A value of 0 represents exempt meaning the transmission will always be heard. Valid values are within the range 1 to 255 with 1 being the highest priority and 255 being the lower priority. Intercoms with higher priorities will be heard over intercoms with lower priorities when transmitting at the same time. The intercom with the lower priority in this case will be muted.
Supported Audio Formats	• 16-bit Linear PCM 2's complement, Big Endian • 16-bit Linear PCM 2's complement, Little Endian • Only a 48 kHz sampling rate is supported for all supported audio formats

Emissions

Emissions can be configured on a per object basis or in a fallback manner based on the use of wildcards in the EntityTypeString.

Emissions XML Element

Option	Description
ElectromagneticEmission	This set represents an electromagnetic emission definition for a given EntityType which is composed of one or more ElectromagneticEmissionSystem.

ElectromagneticEmission XML Element

Property	Description
EmissionName	Text based friendly name of the emission.
EntityTypeString	A period delimited string representing the entity's kind, domain, country, category, subcategory, specific, and extra. See the Entity Type String for more information.
ElectromagneticEmissionSystem	This set represents a single electromagnetic emission system which is composed of one or more EmitterBeam.

ElectromagneticEmissionSystem XML Element

Property	Description
EmissionSystemName	Text based friendly name of the emission system.
EmitterFunction	An integer value representing the emitter function.
EmitterNumber	The unique emitter identification number for a specific emitter. Valid values are within the range 1 to 254 inclusively.
EmitterName	An integer value representing the emitter name.
EmitterBeam	This set represents a single emitter beam.

EmitterBeam XML Element

Property	Description
EmitterBeamName	Text based friendly name for the emitter beam.
BeamNumber	The unique beam identification number for a specific beam. Valid values are within the range 1 to 254 inclusively.
BeamParameter	The beam parameter used in conjunction with the emitter name for database look-ups.
Frequency	The average center frequency of the beam emission in Hertz.
FrequencyRange	The difference between the upper and lower limits of the center frequency.
EffectiveRadiatedPower	The average effective radiated power for the emission in dBm.
PulseRepetitionFrequency	The average pulse repetition frequency of the emission in Hertz.
PulseWidth	The average pulse with of the emission in micro-seconds.
AzimuthCenter	The center azimuth of the beam in degrees relative to the emitter.
AzimuthSweep	The half-angle sweep of the azimuth in degrees relative to the center azimuth.
ElevationCenter	The center elevation of the beam in degrees relative to the emitter.
ElevationSweep	The half-angle sweep of the elevation in degrees relative to the center elevation.
SweepSync	The semi-open range from 0.0 to 100.0 representing the percentage of the pattern scanned from its origin.
BeamFunction	An integer value representing the beam function.
IsHighDensityTrack	True if all targets in the scan pattern are to be considered tracked or jammed.
JammingMode	The jamming mode sequence for the given emitter in string representation. For example, 1.2.3.4

Emissions XML Configuration Schema

An example **Emissions** section is shown below.

*Note: This is not a complete and valid file. This an example of the **Emissions** section of the **DISConfiguration.xml** file located in the **%APPDATA%\Lockheed Martin\Prepar3D v5** directory and can also be configured via the DIS user interface.*

```
<Emissions>
    <ElectromagneticEmission>
        <EmissionName>F-22 Raptor - 525th Fighter Squadron</EmissionName>
        <EntityTypeString>1.2.225.1.6.1.0</EntityTypeString>
        <ElectromagneticEmissionSystem>
            <EmissionSystemName>Radar</EmissionSystemName>
            <EmitterFunction>1</EmitterFunction>
            <EmitterNumber>1</EmitterNumber>
            <EmitterName>1945</EmitterName>
            <EmitterBeam>
                <EmitterBeamName>Main Beam</EmitterBeamName>
                <BeamNumber>1</BeamNumber>
                <BeamParameter>1</BeamParameter>
                <Frequency>50000000.000000</Frequency>
                <FrequencyRange>1000000.000000</FrequencyRange>
                <EffectiveRadiatedPower>1000.000000</EffectiveRadiatedPower>
                <PulseRepetitionFrequency>60.000000</PulseRepetitionFrequency>
                <PulseWidth>500.000000</PulseWidth>
                <AzimuthCenter>0.000000</AzimuthCenter>
                <AzimuthSweep>30.000000</AzimuthSweep>
                <ElevationCenter>0.000000</ElevationCenter>
                <ElevationSweep>30.000000</ElevationSweep>
                <SweepSync>0.000000</SweepSync>
                <BeamFunction>5</BeamFunction>
                <IsHighDensityTrack>False</IsHighDensityTrack>
                <JammingMode>3.25.10.5</JammingMode>
            </EmitterBeam>
        </ElectromagneticEmissionSystem>
    </ElectromagneticEmission>
</Emissions>
```

Note: Emission PDUs are issued every five seconds and only if the owning entity is not in the destroyed damage state. Emissions are not currently able to be activated or deactivated by the user once the session has started.

Munitions

Munitions can be configured on a per object basis or in a fallback manner based on the use of wildcards in the EntityTypeString. Munition definitions are set based and support multiple cardinality for some properties. Below is a description of each entry available in the user interface.

Munitions XML Element

Option	Description

MunitionEffectTimeOut	The time in seconds before infinite lifetime munition effects will be removed from the simulation. A value of 0 can be used to prevent munition effects from timing out.
MunitionDefinition	A MunitionDefinition is used to configure settings for a given munition type (i.e. particle effects).

MunitionDefinition XML Element

Property	Description
MunitionName	Text based friendly name of the munition.
EntityTypeString	A period delimited string representing the entity's kind, domain, country, category, subcategory, specific, and extra. See the Entity Type String for more information.
FireEffectList	The FireEffectList is used to configure the list of particle effects to be created at the time this munition type is fired.
DetonationEffects	The DetonationEffects section is used configure how particle effects should be created at the time this munition type is detonated.

FireEffectList XML Element

Property	Description
EffectName	The file name of the particle effect (without the extension). Multiple effect names can be associated with a single definition.

DetonationEffects XML Element

Property	Description
DefaultDetonationEffectList	The DefaultDetonationEffectList is used to configure the default list of particle effects to be created for all detonation result types. The DefaultDetonationEffectList does not override a detonation type of NONE. The DefaultDetonationEffectList can be overridden by creating additional DetonationDefinitions.
DetonationDefinition	The DetonationDefinition entry is used to bind a list of particle effects to a list of detonation results. Multiple particle effects can be bound to multiple detonation results using a single DetonationDefinition. For example, one could bind a list of water based particle effects to a list of water based detonation results.

DefaultDetonationEffectList XML Element

Property	Description
EffectName	The file name of the particle effect (without the extension). Multiple effect names can be associated with a single definition.

DetonationDefinition XML Element

Property	Description
DetonationName	Text based friendly name of the detonation.
DetonationResults	The DetonationResults list is used to configure the list of detonation results associated with this DetonationDefinition.
DetonationEffectList	The DetonationEffectList is used to configure the list of particle effects to be created with this DetonationDefinition.

DetonationResults XML Element

Property	Description
	The detonation result type of the munition. Multiple detonation result types can be associated with a single detonation definition. Values should be one of the following: • **Other** • **Entity Impact** • **Entity Proximate Detonation** • **Ground Impact** • **Ground Proximate Detonation**

DetonationResult	• **Detonation** • **None or No Detonation** • **HE Hit Small** • **HE Hit Medium** • **HE Hit Large** • **Armor Piercing Hit** • **Dirt Blast Small** • **Dirt Blast Medium** • **Dirt Blast Large** • **Water Blast Small** • **Water Blast Medium** • **Water Blast Large** • **Air Hit** • **Building Hit Small** • **Building Hit Medium** • **Building Hit Large** • **Mine Clearing Line Charge** • **Environment Object Impact** • **Environment Object Proximate Detonation** • **Water Impact** • **Air Burst** • **Kill with Fragment Type 1** • **Kill with Fragment Type 2** • **Kill with Fragment Type 3** • **Kill with Fragment Type 1 after Fly out Failure** • **Kill with Fragment Type 2 after Fly out Failure** • **Miss Due to Fly out Failure** • **Miss Due to End Game Failure** • **Miss Due to Fly out and End Game Failure**

DetonationEffectList XML Element

Property	Description
EffectName	The file name of the particle effect (without the extension). Multiple effect names can be associated with a single definition.

Fire and Detonation Effects

When configuring fire and detonation effects, multiple effects are able to be chained together. When configuring detonation effects, definitions are able to be bound to multiple detonation results. A default detonation effect list can be provided as well, which will be used for all undefined detonation results except for detonation result types OTHER and NONE. To override this default behavior for a detonation result of type OTHER or NONE, a detonation definition must be created for that type.

Munitions XML Configuration Schema

Below is an example **Munitions** set.

Note: This is not a complete and valid file. This an example of the ***Munitions*** *section of the* ***DISConfiguration.xml*** *file located in the* ***%APPDATA%\Lockheed Martin\Prepar3D v5*** *directory and can also be configured via the DIS user interface.*

```
<Munitions>
    <MunitionEffectTimeOut>300</MunitionEffectTimeOut>
    <MunitionDefinition>
        <MunitionName>AIM-9</MunitionName>
        <EntityTypeString>2.1.225.1.1</EntityTypeString>
        <DetonationEffects>
            <DefaultDetonationEffectList>
                <EffectName>fx_explosionDestroyLandMedium</EffectName>
            </DefaultDetonationEffectList>
            <DetonationDefinition>
                <DetonationName>Building Hit</DetonationName>
                <DetonationResults>
                    <DetonationResult>Building Hit Small</DetonationResult>
                    <DetonationResult>Building Hit Medium</DetonationResult>
                    <DetonationResult>Building Hit Large</DetonationResult>
                </DetonationResults>
                <DetonationEffectList>
                    <EffectName>fx_explosionDestroyBuildingMedium</EffectName>
                </DetonationEffectList>
            </DetonationDefinition>
            <DetonationDefinition>
                <DetonationName>Dirt Spray Medium</DetonationName>
                <DetonationEffectList>
                    <EffectName>fx_dirtspray_m</EffectName>
                </DetonationEffectList>
                <DetonationResults>
                    <DetonationResult>Dirt Blast Medium</DetonationResult>
                    <DetonationResult>Ground Impact</DetonationResult>
                    <DetonationResult>Air Burst</DetonationResult>
                    <DetonationResult>Air Hit</DetonationResult>
                    <DetonationResult>Armor Piercing Hit</DetonationResult>
                </DetonationResults>
            </DetonationDefinition>
            <DetonationDefinition>
                <DetonationName>Dirt Spray Large</DetonationName>
                <DetonationEffectList>
                    <EffectName>fx_dirtspray_l</EffectName>
                </DetonationEffectList>
                <DetonationResults>
                    <DetonationResult>Dirt Blast Large</DetonationResult>
                </DetonationResults>
            </DetonationDefinition>
            <DetonationDefinition>
                <DetonationName>Entity</DetonationName>
                <DetonationEffectList>
                    <EffectName>fx_explosionDestroyVehicleMedium</EffectName>
                </DetonationEffectList>
                <DetonationResults>
                    <DetonationResult>Entity Impact</DetonationResult>
                    <DetonationResult>Entity Proximate Detonation</DetonationResult>
                </DetonationResults>
            </DetonationDefinition>
```

```
            <DetonationDefinition>
                <DetonationName>Water Impact</DetonationName>
                <DetonationEffectList>
                    <EffectName>fx_wtrspray_l</EffectName>
                </DetonationEffectList>
                <DetonationResults>
                    <DetonationResult>Water Impact</DetonationResult>
                </DetonationResults>
            </DetonationDefinition>
            <DetonationDefinition>
                <DetonationName>Water Blast</DetonationName>
                <DetonationEffectList>
                    <EffectName>fx_explosionDestroyWaterMedium</EffectName>
                </DetonationEffectList>
                <DetonationResults>
                    <DetonationResult>Water Blast Small</DetonationResult>
                    <DetonationResult>Water Blast Medium</DetonationResult>
                    <DetonationResult>Water Blast Large</DetonationResult>
                </DetonationResults>
            </DetonationDefinition>
        </DetonationEffects>
    </MunitionDefinition>
</Munitions>
```

Entity Type Configuration

Entity Type XML File

The **DISEntityTypes.xml** file is used to map SimObject container titles to DIS entity types. The file can be located within the **%PROGRAMDATA%\Lockheed Martin\Prepar3D v5** directory after Prepar3D has been launched at least once. Most default included SimObjects have already been mapped to an appropriate DIS entity type where possible, however users are able to expand the included list. Multiple **EntityType** entries can be present. Each **EntityType** entry will be used as a two-way map for both the sending and receiving of EntityState PDU's. Entries in **DISEntityTypes.xml** will take priority, but entity type strings can also be assigned via the Aircraft Configuration Files and Simulation Object Configuration Files as well as the Gun System Configuration File.

Example DISEntityTypes.xml file:

```
<?xml version="1.0" encoding="UTF-8"?>

<SimBase.Document Type="DIS Entity Types" version="3,1" id="DISEntityTypes">
    <Descr>DIS Entity Type Map File</Descr>
    <Filename>DISEntityTypes.xml</Filename>
    <DIS.EntityTypes>
        <EntityType>
            <EntityTypeString>1.2.225.85.11.0.0</EntityTypeString>
            <ContainerTitle>Mooney Bravo</ContainerTitle>
        </EntityType>
    </DIS.EntityTypes>
</SimBase.Document>
```

Entity Type String

The entity type string is a period delimited numerical string used to define the type of a given entity. Each integer represents properties of the entity type in the following order: *Kind*, *Domain*, *Country*, *Category*, *Subcategory*, *Specific*, and *Extra*. Asterisks (*) can be used as wildcards for each of the entity type properties. If an entity type property is not explicitly set it will be considered a wildcard. For example, an entity type string with all digits explicitly defined suchas 1.2.225.85.11.0.0 would only be matched to other exact types. On the other hand, a wildcard based entity type string with such as 1.2 or 1.2.*.*.*.*.* would be matched to all aircraft based platforms.

Example Entity Type Strings:

```
1.2.225.85.11          // Implicit Wildcards
1.2.225.85.11.*.*      // Explicit Wildcards (same as above)
1.2.*.85.11          Wildcards
1.2.225.85.11.0.0      // Explicit definition (7 digits defined)
```

Entity Appearances Configuration

Entity Appearances XML File

The **DISEntityAppearances.xml** file is used to map simulation variables and registered properties to DIS entity appearances. The default file can be located within the **%PROGRAMDATA%\Lockheed Martin\Prepar3D v5** directory after Prepar3D has been launched at least once. The default file contains appearance definitions for native Airplane, Helicopter, GroundVehicle, Boat, and Submersible simulations. In addition to the default DISEntityAppearances.xml file, a Custom Entity Appearances XML File can be assigned on a per-SimObject basis.

```
<?xml version="1.0" encoding="UTF-8"?>

<SimBase.Document Type="DIS Entity Appearances" version="3,1" id="DISEntityAppearances">
    <Descr>DIS Entity Appearances File</Descr>
    <Filename>DISEntityAppearances.xml</Filename>
    <DIS.EntityAppearanceDefinitions>
        <EntityAppearanceDefinition Name="Native Airplane" DefinitionGuid="{3389C282-752D-49C8-B6C1-
B60D357B8DC7}" >
            <Appearance PropertyGet="LIGHT NAV" PropertySet="LIGHT NAV" AppearanceType="NavigationLightsOn" />
            <Appearance PropertyGet="LIGHT LANDING" AppearanceType="Custom" AppearanceMask="0x00001000" />
            ...
        </EntityAppearanceDefinition>
    </DIS.EntityAppearanceDefinitions>
</SimBase.Document>
```

EntityAppearanceDefinition XML Element

Property	Description	Required
Name	The friendly name of the EntityAppearanceDefinition.	No
	The **DefinitionGUID** is used to look up **EntityAppearanceDefinition**	

DefinitionGuid	sets. This GUID should be unique for each EntityAppearanceDefinition. See also Custom Entity Appearances XML File.	Yes

Appearance XML Element

Property	Description	Required
PropertyGet	The property or simulation variable to be used to retrieve the **Appearance** value. This property will be used by local DIS entities when a packet is sent.	Yes
PropertySet	The property or simulation variable to be used to apply the **Appearance** value. This property will be used by remote DIS entities when a packet is received. If this value is not present, the **PropertyGet** value will be used instead.	No
AppearanceType	The **Appearance** type. These values will vary based on the entity's Kind and Domain. An **AppearanceType** of **Custom** can also be used in conjunction with an **AppearanceMask** value to define custom appearance bit values. Values should be one of the following depending on the entity Kind and Domain: • **Platform-Land** ◦ **PaintScheme** ◦ **MobilityKilled** ◦ **FirePowerKilled** ◦ **Damage** ◦ **IsSmokeEmanating** ◦ **IsEngineEmittingSmoke** ◦ **TrailingEffect** ◦ **Hatch** ◦ **HeadLightsOn** ◦ **TailLightsOn** ◦ **BrakeLightsOn** ◦ **IsFlaming** ◦ **LauncherOperational** ◦ **CamouflageType** ◦ **ConcealedPosition** ◦ **PowerPlantOn** ◦ **TentExtended** ◦ **RampExtended** ◦ **BlackoutLightsOn** ◦ **BlackoutBrakeLightsOn** ◦ **SpotSearchLightsOn** ◦ **InteriorLightsOn** ◦ **OccupantsSurrendered** ◦ **MaskedCloaked** • **Platform-Air** ◦ **PaintScheme** ◦ **MobilityKilled** ◦ **NVGMode** ◦ **Damage** ◦ **IsSmokeEmanating** ◦ **IsEngineEmittingSmoke** ◦ **TrailingEffect** ◦ **CanopyTroopDoor** ◦ **LandingLightsOn** ◦ **NavigationLightsOn** ◦ **AntiCollisionLightsOn** ◦ **IsFlaming** ◦ **AfterburnerOn** ◦ **LowerAntiCollisionLightOn** ◦ **UpperAntiCollisionLightOn** ◦ **AntiCollisionDayNight** ◦ **IsBlinking** ◦ **PowerPlantOn** ◦ **FormationLightsOn** ◦ **LandingGearExtended** ◦ **CargoDoorsOpened** ◦ **NavigationPositionBrightness** ◦ **SpotSearchLightsOn** ◦ **InteriorLightsOn** ◦ **ReverseThrustEngaged** ◦ **WeightOnWheels** • **Platform-Surface** ◦ **PaintScheme** ◦ **MobilityKilled** ◦ **Damage** ◦ **IsSmokeEmanating** ◦ **IsEngineEmittingSmoke** ◦ **TrailingEffect** ◦ **RunningLightsOn** ◦ **IsFlaming** ◦ **PowerPlantOn** ◦ **SpotSearchLightsOn** ◦ **InteriorLightsOn** • **Platform-Subsurface** ◦ **PaintScheme** ◦ **MobilityKilled** ◦ **Damage** ◦ **IsSmokeEmanating** ◦ **IsEngineEmittingSmoke** ◦ **Hatch** ◦ **RunningLightsOn** ◦ **IsFlaming** ◦ **PowerPlantOn** • **Platform-Space** ◦ **PaintScheme**	Yes

	◦ **MobilityKilled** ◦ **Damage** ◦ **IsSmokeEmanating** ◦ **IsEngineEmittingSmoke** ◦ **IsFlaming** ◦ **PowerPlantOn** • **Munition** ◦ **Damage** ◦ **IsSmokeEmanating** ◦ **IsEngineEmittingSmoke** ◦ **TrailingEffect** ◦ **IsFlaming** ◦ **LaunchFlashPresent** ◦ **PowerPlantOn** ◦ **CoverShroudStatus** ◦ **MaskedCloaked** • **Expendable** ◦ **Damage** ◦ **IsSmokeEmanating** ◦ **ParachuteStatus** ◦ **FlareSmokeColor** ◦ **IsFlaming** ◦ **LaunchFlashPresent** ◦ **FlareSmokeStatus** ◦ **PowerPlantOn** ◦ **SpotChaffStatus** ◦ **MaskedCloaked** • **LifeForm** ◦ **PaintScheme** ◦ **Health** ◦ **ComplianceStatus** ◦ **SignalSmokeInUse** ◦ **FlashLightsOn** ◦ **SignalMirrorInUse** ◦ **FlareSmokeStatus** ◦ **IRStrobeOn** ◦ **IRIlluminatorOn** ◦ **LifeFormPosture** ◦ **MountedHoistedStatus** ◦ **WeaponImplement1** ◦ **WeaponImplement2** ◦ **CamouflageType** ◦ **ConcealedStationary** ◦ **ConcealedMovement**	
AppearanceMask	The **AppearanceMask** can be used in conjunction with an **AppearanceType** value of **Custom** to define custom appearance bit values. The AppearanceMask value should be in hexadecimal format and will represent which bits of the appearance field the given property or simulation variable value will be stored in. The hexadecimal value representation is least significant value on the right to the most significant value on the left. Examples (least significant bit is 0 and most significant bit is 31): **AppearanceMask="0x00000001"** represents bit 0 **AppearanceMask="0x000000F0"** represents bits 5 through 8 **AppearanceMask="0x0000C000"** represents bits 14 through 15 **AppearanceMask="0x80000000"** represents bit 31	Yes/No

Custom Entity Appearances XML File

In addition to the default DISEntityAppearances.xml, a vehicle specific **DISEntityAppearances.xml** file can be created on a per-SimObject basis. This file must be saved in the SimObject's folder (in the same folder as the **aircraft.cfg** or **sim.cfg** file). The GUID that is defined for the **EntityAppearanceDefinition**, in the XML file, must be set in the configuration file under the **[GENERAL]** section in a **DISEntityAppearanceDefinitionGuid** property (see example below). It must be a unique GUID for the vehicle (see Generating GUIDs).
An example **DISEntityAppearances.xml**:

```
<?xml version="1.0" encoding="UTF-8"?>

<SimBase.Document Type="DIS Entity Appearances" version="3,1" id="DISEntityAppearances">
    <Descr>DIS Entity Appearances File</Descr>
    <Filename>DISEntityAppearances.xml</Filename>
    <DIS.EntityAppearanceDefinitions>
        <EntityAppearanceDefinition Name="Custom Appearance" DefinitionGuid="{EA75C6F4-FD7B-47F0-90E8-
4FD771CD8AC7}" >
            <Appearance PropertyGet="LIGHT NAV" PropertySet="LIGHT NAV" AppearanceType="NavigationLightsOn" />
            <Appearance PropertyGet="LIGHT LANDING" AppearanceType="Custom" AppearanceMask="0x00001000" />
            ...
        </EntityAppearanceDefinition>
    </DIS.EntityAppearanceDefinitions>
</SimBase.Document>
```

Inside **aircraft.cfg** or **sim.cfg**:

```
...
[General]
...
DISEntityAppearanceDefinitionGuid={EA75C6F4-FD7B-47F0-90E8-
4FD771CD8AC7}
...
```

Articulated Part Configuration

Articulated Parts XML File

The **DISArticulatedParts.xml** file is used to map simulation variables and registered properties to DIS articulated part values and units. The default file can be located within the **%PROGRAMDATA%\Lockheed Martin\Prepar3D v5** directory after Prepar3D has been launched at least once. The default file contains articulated part definitions for native Airplane, Helicopter, GroundVehicle, and Boat simulations. In addition to the default DISArticulatedParts.xml file, a Custom Articulated Part XML File can be assigned on a per-SimObject basis.

```
<?xml version="1.0" encoding="UTF-8"?>

<SimBase.Document Type="DIS Articulated Parts" version="3,1" id="DISArticulatedParts">
    <Descr>DIS Articulated Parts File</Descr>
    <Filename>DISArticulatedParts.xml</Filename>
    <DIS.ArticulatedPartDefinitions>
        <ArticulatedPartDefinition Name="Native Airplane" DefinitionGuid="{3389C282-752D-49C8-B6C1-B60D357B8DC7}">
            <ArticulatedPart PropertyGet="RUDDER DEFLECTION" Units="Degrees" Class="Rudder" Metric="Azimuth" Offset="0.0" Scale="1.0" />
            ...
        </ArticulatedPartDefinition>
    </DIS.ArticulatedPartDefinitions>
</SimBase.Document>
```

ArticulatedPartDefinition XML Element

Property	Description	Required
Name	The friendly name of the ArticulatedPartDefinition.	No
DefinitionGuid	The **DefinitionGUID** is used to look up **ArticulatedPartDefinition** sets. This GUID should be unique for each ArticulatedPartDefinition. If a definition is not found, no articulated part data will be sent or processed by that entity. See also Custom Articulated Part XML File.	Yes

ArticulatedPart XML Element

Property	Description	Required
PropertyGet	The property or simulation variable to be used to retrieve the **ArticulatedPart** value. This property will be used by local DIS entities when a packet is sent.	Yes
PropertySet	The property or simulation variable to be used to apply the **ArticulatedPart** value. This property will be used by remote DIS entities when a packet is received. If this value is not present, the **PropertyGet** value will be used instead.	No
Units	The units to be used when getting or setting the **PropertyGet** and **PropertySet** variables.	Yes
Class	The **ArticulatedPart** class. If a value of **Custom** is selected, the **CustomClass** value must also be present. Values should be one of the following: • **Custom** • **Rudder** • **LeftFlap** • **RightFlap** • **LeftAileron** • **RightAileron** • **HelicopterMainRotor** • **HelicopterTailRotor** • **Propeller1** • **Propeller2** • **Propeller3** • **Propeller4** • **LeftStabilator** • **RightStabilator** • **LeftRuddervator** • **RightRuddervator** • **LeftLeadingEdgeFlap** • **RightLeadingEdgeFlap** • **LeftElevator** • **RightElevator** • **LandingGear** • **TailHook** • **SpeedBrake** • **LandingGearNose** • **LandingGearLeftMain** • **LandingGearRightMain** • **DeckElevator1** • **DeckElevator2** • **Catapult1** • **Catapult2** • **JetBlastDeflector1** • **JetBlastDeflector2** • **WingRotorFold**	Yes
CustomClass	This value will represent the **ArticulatedPart** class if a **Class** enumeration value of	Yes/No

CustomClass	**Custom** is selected. This value is required if and only if Custom Class enumeration is selected.	Yes/No
Metric	The **ArticulatedPart** metric. If a value of **Custom** is selected, the **CustomMetric** value must also be present. Values should be one of the following: • **Custom** • **Position** • **PositionRate** • **Extension** • **ExtensionRate** • **TranslationX** • **TranslationRateX** • **TranslationY** • **TranslationRateY** • **TranslationZ** • **TranslationRateZ** • **Azimuth** • **AzimuthRate** • **Elevation** • **ElevationRate** • **Rotation** • **RotationRate**	Yes
CustomMetric	This value will represent the **ArticulatedPart** metric if a **Metric** enumeration value of **Custom** is selected. This value is required if and only if Custom Metric enumeration is selected.	Yes/No
Offset	This value will be added to the **ArticulatedPart** property value before it is sent or subtracted from the ArticulatedPart value after it is received. This value will be added before the scale value is multiplied if being sent or subtracted after the scale value is divided if being received. The default value is 0.0. If being sent, the formula is: *SendValue = (Property + Offset) * Scale* If being received, the formula is: *Property = (ReceivedValue / Scale) - Offset*	No
Scale	This value will be multiplied against the **ArticulatedPart** property value before it is sent or divided from the ArticulatedPart value after it is received. This value will be multiplied after the offset value is added if being sent or subtracted after the scale value is divided if being received. The default value is 1.0. If being sent, the formula is: *SendValue = (Property + Offset) * Scale* If being received, the formula is: *Property = (ReceivedValue / Scale) - Offset*	No

Custom Articulated Parts XML File

In addition to the default DISArticulatedParts.xml, a vehicle specific **DISArticulatedParts.xml** file can be created on a per-SimObject basis. This file must be saved in the SimObject's folder (in the same folder as the **aircraft.cfg** or **sim.cfg** file). The GUID that is defined for the **ArticulatedPartDefinition**, in the XML file, must be set in the configuration file under the **[GENERAL]** section in a **DISArticulatedPartDefinitionGuid** property (see example below). It must be a unique GUID for the vehicle (see Generating GUIDs).
An example **DISArticulatedParts.xml**:

```
<?xml version="1.0" encoding="UTF-8"?>

<SimBase.Document Type="DIS Articulated Parts" version="3,1" id="DISArticulatedParts">
    <Descr>DIS Articulated Parts File</Descr>
    <Filename>DISArticulatedParts.xml</Filename>
    <DIS.ArticulatedPartDefinitions>
        <ArticulatedPartDefinition Name="Custom XML File" DefinitionGuid="{1EFB1100-8901-4EBE-86A0-63344D55375A}">
            <ArticulatedPart PropertyGet="RUDDER DEFLECTION" Units="Degrees" Class="Rudder" Metric="Azimuth" Offset="0.0" Scale="1.0" />
            ...
        </ArticulatedPartDefinition>
    </DIS.ArticulatedPartDefinitions>
</SimBase.Document>
```

Inside **aircraft.cfg** or **sim.cfg**:

```
...
[General]
```

```
...
DISArticulatedPartDefinitionGuid={1EFB1100-8901-4EBE-86A0-
63344D55375A}
...
```

Feature Support

The following features are currently supported:

- Protocol Data Units (PDUs)
  - Entity State PDU
  - Fire PDU
  - Detonation PDU
  - Electromagnetic Emission PDU
  - Designator PDU
  - Transmitter PDU
  - Signal PDU
- Entity Kinds
  - Platforms
  - Munitions
  - Expendables
  - Lifeforms
- Entity Appearance
- Articulated Parts
- Dead Reckoning
- AI Traffic Broadcast
- Multiplayer Broadcast (multiplayer host only)
- Multichannel Support
- SimOperator Support

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High Level Architecture (HLA)

High Level Architecture (HLA) support is currently considered ***experimental*** and is only available with the **Professional Plus** variant. Major changes are expected in future updates.

High Level Architecture (HLA) is a simulation interoperability standard that provides simulation applications with the ability to communicate and exchange information. Prepar3D utilizes the **OpenRTI** library and supports **Real-time Platform Reference Federation Object Model Version 2.0** (RPR FOM 2).

CONTENTS

- Starting a Session
  - The RTINode Server
  - RPR FOM v2
  - Entity Configuration
  - Connection Configuration
  - Federate Configuration
  - Connect
  - Troubleshooting
- User Interface
  - Entity
  - Connection
  - Federate
  - Options
- Entity Type Configuration
- Feature Support

RELATED LINKS

- Not Applicable

Starting a Session

The user should configure their HLA session before attempting to connect. Configuration includes items such as entity ids, connection parameters, and federate names. The OpenRTI RTINode server executable and the RPR FOM 2 are not included with Prepar3D. The creation of RTINode and the download of RPR FOM 2 are described below.

The RTINode Server

In order to run the RTINode server, the OpenRTI API must be first downloaded and built:

- Download the OpenRTI library (https://sourceforge.net/projects/openrti/)
- Make the OpenRTI solutions and projects using a program like **CMake** (https://cmake.org/)
- Build the OpenRTI **RTINode** project

Once you have the RTINode application built, it will need to be executed on a separate machine. When running the RTINode, command line parameters can be passed to tell it what IP addresses to listen to. To listen to all IP addresses, pass the following command line parameter to RTINode:

- **-i 0.0.0.0**

Prepar3D applications on that network can now connect to the server.

RPR FOM v2

The RPR FOM v2 (Real-time Platform Reference Federation Object Model Version 2.0) XML file must then be downloaded and configured:

- Go to the **Simulation Interoperability Standards Organization Digital Library** (https://www.sisostds.org/digitalLibrary.aspx)
- Search for **SISO-STD-001.1-2015**
- Download the **SISO-STD-001.1-2015 Annex B Files Informative** zip file
- Extract the zip file
- Set the **RPRFOM2FilePath** entry of the **Federate** section of the HLA user interface to the full file path of the **RPR_FOM_v2.0_1516-2010.xml** file.

Entity Configuration

Each HLA federate must also configure their entity information. This includes the site, application, and entity ids. This set of IDs should be unique for each federate in the federation.

Connection Configuration

The name of the federation execution to join must then be provided. This name should be the same for machines joining the given federation execution. RTI specific local parameters can also then be specified. For **OpenRTI**, this should be of the form **rti://[ip_address]:[port]** where **[ip_address]** and **[port]** are the IP address and port of the machine running the remote **RTINode** server.

Federate Configuration

The name and type of the machine's federate can then be specified. The federate type is optional, however the federate name is required. The full file path to the RPR FOM v2 XML file can also specified as described above.

Connect

If the above has been configured correctly, the federate should be able to connect to the federation execution.

Note: HLA is considered experimental and no error reporting is currently supported.

Troubleshooting

Here are some basic troubleshooting steps:

1. Ensure the machines attempting to connect can ping one another

2. Ensure the **OpenRTI** or RTI specific local parameters are correct
3. If using **OpenRTI**, ensure that the **RTINode** server is executed with the correct command line parameters
4. Ensure you are using the correct FOM version and the path is correctly configured
5. Ensure that each machine has a unique set of site, application, and entity id's
6. Ensure that each machine is specifying the correct federate execution name

User Interface

The HLA user interface can be found under **Networking** in the main menu bar. The following is a description of options available from within the user interface as well as descriptions and examples of the XML format used for the configuration.

Entity

Option	Description
Site ID	The **Site ID** of this application instance. **Site IDs** may be the same for multiple applications as long as each application's **Application ID** is unique. Valid **Site IDs** range from 0 to 65535.
Application ID	The **Application ID** of this application instance. **Application IDs** should be unique for all applications participating in a given exercise from a given site. For example, the **Application ID** should be unique for all simulations sharing the same **Exercise ID** and **Site ID**. Valid **Application IDs** range from 0 to 65535.
Entity ID	The **Entity ID** of the user entity. Valid **Entity IDs** range from 0 to 65535.

Connection

Option	Description
LocalParameters	The local parameters to be passed into the RTI's connect() function. For **OpenRTI**, this should be of the form **rti://[ip_address]:[port]** where **[ip_address]** and **[port]** are the IP address and port of the machine running the remote RTINode server.
FederationExecutionName	The name of the federation execution to join.

Federate

Option	Description
FederateName	The federate name.
FederateType	The federate type.
RPRFOM2FilePath	The full file path of the RPR FOM v2 XML file.

Options

Option	Description
Attribute Update Rate	The amount of time between sending attribute updates in seconds. Attribute data is only sent if it has changed.
DrawLabels	Set to true to draw labels next to entities displaying information such as name, entity id, and entity type.
Endianness	The endianness in which attribute data is broadcast.

Entity Type Configuration

Entity configuration is currently shared between both HLA and DIS. Please see the Entity Type Configuration article for more information.

Feature Support

The following classes and interactions are currently supported:

- RPR FOM v2 Object Classes
  - BaseEntity
    - PhysicalEntity
      - Platform
        - Aircraft
        - AmphibiousVehicle
        - GroundVehicle
        - MultiDomainPlatform
        - Spacecraft

        - SubmersibleVessel
        - SurfaceVessel
    - Lifeform
        - Human
        - NonHuman

- RPR FOM v2 Interactions
    - *None at this time*

Note: Only BaseEntity object class attributes are currently supported.

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PREPAR3D PROFESS

Common Image Generator Interface (CIGI)

Common Image Generator Interface (CIGI) is a simulation interoperability standard that provides communication between a Host simulation and an Image Generator (IG). Prepar3D, as an all-in-one simulation platform, can function as either a Host or IG.

The currently supported CIGI versions include version **4.0**, **3.3**, and **2.1**.

The native CIGI implementation is only available with the **Professional Plus** variant.

Note: The CIGI interface is great for integrating and testing established simulators and tools. When developing and integrating new simulators it is strongly recommended to use the SimObject API. Using the SimObject API will help ensure you are creating the most performant solution that can leverage all of Prepar3D's native features and capabilities. See PDK Samples Overview to quickly get started creating and integrating your own systems.

CONTENTS

- Starting a Session
- Session Configuration
- Animation Configuration
- Articulated Part Configuration
- Entity Type Configuration
  - Entity Type XML File
  - Entity Type ID
  - Entity Type String
- Supported Packets

RELATED LINKS

- Not Applicable

Starting a Session

A CIGI session can be started by selecting either **Start Host** or **Start IG** under **Networking, CIGI** in the main menu bar. The CIGI session should be configured before attempting to connect (see below).

Session Configuration

CigiConfig.cfg

The **CigiConfig.cfg** file can be found in **%APPDATA%\Lockheed Martin\Prepar3D v5\CigiConfig.cfg** after Prepar3D has been launched at least once. This file is used by both the Prepar3D Host and Prepar3D IG modes. Most settings are shared between the Host and IG, however some are exclusive to either the Host or IG (i.e. clamp settings).

Common Options

Option	Description
AutoStartMode	The **AutoStartMode** setting allows Prepar3D to start up with CIGI Host/IG automatically started. Valid **AutoStartMode** options are 0 for no auto-start, 1 for Host auto-start, 2 for IG auto-start. The default value is 0.
BufferSizeReceive	The **BufferSizeReceive** setting represents the size of the receive buffer used to queue packets in bytes. Valid **BufferSizeReceive** range from 1024 to 65536. The default value is 32768.
BufferSizeSend	The **BufferSizeSend** setting represents the size of the receive buffer used to queue packets in bytes. Valid **BufferSizeSend** range from 1024 to 65536. The default value is 32768.
CigiMajorVersion	The **CigiMajorVersion** of this application instance. Currently supported CigiMajorVersion values are 4, 3, or 2 (with a **CigiMinorVersion** of 0, 3, or 1, respectively. i.e. 4.0, 3.3, or 2.1).
CigiMinorVersion	The **CigiMinorVersion** of this application instance. Currently supported CigiMinorVersion values are 0, 3, or 1 (with a **CigiMajorVersion** of 4 or 3, respectively. i.e. 4.0, 3.3, or 2.1).
DrawCollisionVolumes	Set to 1 to draw collision volumes around entities. Volumes will be rendered green if there is no collision and will turn red when there is a collision.
DrawLabels	Set to 1 to draw labels next to entities displaying information such as entity id and entity type.
Frequency	The **Frequency** that the Host or IG will send IG Control and Start of Frame packets in Hertz. The Host or IG will send packets no faster than this value. This value only applies to the Host if the **IsSynchronous** option is set to 0 (i.e. asynchronous mode).
	The **EnableCollisionDetectionSegment** determines whether the Host or IG will send and process Collision

EnableCollisionDetectionSegment	Detection Segment Packets. Set to 1 to enable the collision detection definitions on the host or detect collisions on the IG, set to 0 to disable.
EnableCollisionDetectionVolume	The **EnableCollisionDetectionVolume** determines whether the Host or IG will send and process Collision Detection Volume Packets. Set to 1 to enable the collision detection definitions on the host or detect collisions on the IG, set to 0 to disable.
IsSynchronous	The **IsSynchronous** option determines whether the session will be synchronous or asynchronous. Valid **IsSynchronous** range are 0 or 1. When set to 1 on the Host, the Host will not send an IG Control packet until it has received a Start of Frame packet from the IG (i.e. the Host waits on the IG). When set to 0 on the Host, the Host will continuously send IG Control packets based on the **Frequency** option's value. This value should also be set for the Prepra3D IG based on the session's Host configuration.
OwnshipID	The **Entity ID** to be used for the user object. This value is only used for CIGI version 4.0. For versions prior to 4.0, the user object's **Entity ID** will automatically be set to 0. The default value is 0.
ReceivePort	The port that the Host or IG should receive packets on. For example, if the Host is sending on port 8001, the IG should be receiving on port 8001 and vice versa. Must be set on the Host and the IG. The default value is 8001.
SendAddress	The IP address of the session's opposing computer (i.e. 192.168.1.1). For example, if this machine is the Host then the **SendAddress** should be that of the IG and vice versa. Must be set on the Host and the IG.
SendPort	The port that the Host or IG should send packets on. For example, if the Host is sending on port 8000, the IG should be receiving on port 8000 and vice versa. Must be set on the Host and the IG. The default value is 8000.
ViewID	The **ViewID** to be associated with the Prepar3D main window. As the Host, this **ViewID** will be used when broadcasting the Prepar3D main window View Control packet. As the IG, this **ViewID** will be used to associate an incoming View Control packet with the Prepar3D main window. Only one view is currently supported.

Host Exclusive Options

Option	Description
ClampModeAircraft	The **ClampModeAircraft** clamps the aircraft entities. Valid **ClampModeAircraft** values are 0 for No Clamp, 1 for Non-Conformal, 2 for Conformal. (Not applicable to v2.1.)
ClampModeBoat	The **ClampModeBoat** clamps the boat entities. Valid **ClampModeBoat** values are 0 for No Clamp, 1 for Non-Conformal, 2 for Conformal. (Not applicable to v2.1.)
ClampModeGround	The **ClampModeGround** clamps the ground entities. Valid **ClampModeGround** values are 0 for No Clamp, 1 for Non-Conformal, 2 for Conformal. (Not applicable to v2.1.)
ClampModeLifeform	The **ClampModeLifeform** clamps the lifeform entities. Valid **ClampModeLifeform** values are 0 for No Clamp, 1 for Non-Conformal, 2 for Conformal. (Not applicable to v2.1.)
EnableMoon	The **EnableMoon** enables sending moon data. Valid **EnableMoon** range from 0 to 1. (Not applicable to v2.1.)
EnableSmoothing	The **EnableSmoothing** enables dead reckoning on the IG. Valid **EnableSmoothing** range from 0 to 1. (Not applicable to v2.1.)
EnableStars	The **EnableStars** enables sending star data. Valid **EnableStars** range from 0 to 1. (Not applicable to v2.1.)
	The **EnableSun** enables sending sun

EnableSun	data. Valid **EnableSun** range from 0 to 1. (Not applicable to v2.1.)
SensorID	The **SensorID** of the CIGI instance. The **SensorID** should be a unique int value for each CIGI instance. Currently only supports whether a sensor is on or off, and if it's white hot or black hot.
StarIntensity	The **StarIntensity** specifies the intensity of the star field within the sky model. Valid **StarIntensity** range from 0 to 100.
UseExtendedType	The **UseExtendedType** determines whether to use extended entity types or not (only valid for CIGI version 4.0). Valid **UseExtendedType** range from 0 to 1.

IG Exclusive Options

Option	Description
LosResponseLimit	The **LosResponseLimit** limits the number Line Of Sight Response packets sent. Valid **LosResponseLimit** values are any integer value. Note that the current method used for these packets is expensive, so the higher the **LosResponseLimit** value is the worse the performance will be. The default value is 1.
EnableLosDebugVisuals	When enabled, the **EnableLosDebugVisuals** will draw lines in 3D space where the raycast is traveling. A green line represents a raycast that hit something. A red line represents a raycast that hit nothing. The lines will start to disappear after 5 seconds pass from the Line Of Sight call, and will be completely gone after 10 seconds pass. If the same Line Of Sight packet ID is called before the line disappears, it will update the lines location and reset the disappearance timer. Valid **EnableLosDebugVisuals** values are 0 and 1. The default value is 0.
EnableHatHotDebugVisuals	When enabled, the **EnableHatHotDebugVisuals** will draw spheres in 3D space where the Hat/Hot requests are happening. The color of the spheres will change between Red, Blue, and Green based on a modulus 3 in regards to the Hat/Hot ID. The spheres will start to disappear after 5 seconds pass from a Hat/Hot call, and will be completely gone after 10 seconds pass. If the same Hat/Hot packet ID is called before the sphere disappears, it will update the spheres location and reset the disappearance timer. Valid **EnableHatHotDebugVisuals** values are 0 and 1. The default value is 0.

Animation Configuration

CigiAnimations.xml

The embedded **CigiAnimations.xml** file is used to map entity types to animation effects. CigiAnimations.xml can be found in **%PROGRAMDATA%\Lockheed Martin\Prepar3D v5\CigiAnimations.xml** after Prepar3D has been launched at least once. This file applies to both the Prepar3D Host and Prepar3D IG modes.

```
<SimBase.Document Type="CIGI Animations" version="4,3" id="CigiAnimations">
    <Descr>CIGI Animations File</Descr>
    <Filename>CigiAnimations.xml</Filename>
    <AnimationDefinitions>
        <AnimationDefinition>
            <EntityTypeID>40000</EntityTypeID>
            <EffectFileName>fx_dirtcrash</EffectFileName>
        </AnimationDefinition>
    </AnimationDefinitions>
</SimBase.Document>
```

AnimationDefinitions

Property	Description
AnimationDefinition	This is where the animation type id and the effect's filename are stored.

AnimationDefinition

Property	Description
	This stores the ID to be shared with the Host and the IG. Must be a unique

EntityTypeID	EntityTypeID. This should be an integer value from 0-65535. Extended entity type is not supported for animations.
EffectFileName	This is where the animation effect's filename is stored.

Articulated Part Configuration

CigiArticulatedParts.xml

The embedded **CigiArticulatedParts.xml** file is used to simulation variables and registered properties to CIGI articulated part values and units. CigiArticulatedParts.xml can be found in **%PROGRAMDATA%\Lockheed Martin\Prepar3D v5\CigiArticulatedParts.xml** after Prepar3D has been launched at least once. This file applies to both the Prepar3D Host and Prepar3D IG modes.

```
<?xml version="1.0" encoding="UTF-8"?>

<SimBase.Document Type="CIGI Articulated Parts" version="3,1" id="CigiArticulatedParts">
    <Descr>CIGI Articulated Parts File</Descr>
    <Filename>CigiArticulatedParts.xml</Filename>
    <ArticulatedPartDefinition Name="Native Airplane" DefinitionGuid="{3389C282-752D-49C8-B6C1-
B60D357B8DC7}">
        <ArticulatedPart ID="1">
            <ValueDefinition PropertyGet="RUDDER DEFLECTION" ValueType="Heading" Units="Degrees" />
        </ArticulatedPart>
        <ArticulatedPart ID="2">
            <ValueDefinition PropertyGet="AILERON LEFT DEFLECTION" ValueType="Pitch" Units="Degrees" />
        </ArticulatedPart>
        <ArticulatedPart ID="3">
            <ValueDefinition PropertyGet="AILERON RIGHT DEFLECTION" ValueType="Pitch" Units="Degrees" />
        </ArticulatedPart>
    </ArticulatedPartDefinition>
</SimBase.Document>
```

ArticulatedPartDefinition

Property	Description	Required
Name	This is the friendly name of the articulated part definition.	No
DefinitionGuid	The **DefinitionGuid** is used to look up **ArticulatedPartDefinition** sets. This GUID should be unique for each ArticulatedPartDefinition. If a definition is not found, no articulated part data will be sent or processed by that entity. See also Custom Articulated Part XML File.	Yes
ArticulatedPart	This set stores a unique ID for an articulated part as well as the type and units of movement the part performs.	Yes

ArticulatedPart

Property	Description	Required
ID	The unique ID of the articulated part.	Yes
ValueDefinition	This set stores the type and units of movement the articulated part performs.	Yes

ValueDefinition

Property	Description	Required
ValueType	The type of movement for this articulated part. Values should be one of the following: • **Pitch** • **Bank** • **Heading** • **XOffset** • **YOffset** • **ZOffset**	Yes
PropertyGet	The property or simulation variable to be used to retrieve the **ArticulatedPart** value.	Yes
PropertySet	The property or simulation variable to be used to apply the **ArticulatedPart** value. If this value is not present, the **PropertyGet** value will be used instead.	No
Units	The units to be used when getting or setting the **PropertyGet** and **PropertySet** variables.	Yes
Offset	This value will be added to the **ArticulatedPart** property value before it is sent or subtracted from the ArticulatedPart value after it is received. This value will be added before the scale value is multiplied if being sent or subtracted after the scale value is divided if being received. The default value is 0.0. If being sent, the formula is:	No

	*SendValue = (Property + Offset) * Scale* If being received, the formula is: *Property = (ReceivedValue / Scale) - Offset*	
Scale	This value will be multiplied against the **ArticulatedPart** property value before it is sent or divided from the ArticulatedPart value after it is received. This value will be multiplied after the offset value is added if being sent or subtracted after the scale value is divided if being received. The default value is 1.0. If being sent, the formula is: *SendValue = (Property + Offset) * Scale* If being received, the formula is: *Property = (ReceivedValue / Scale) - Offset*	No
WrapMode	This value is optional and should be one of **180** or **360**. This setting determines how angles should be wrapped, either -180 to 180 or 0 to 360. This setting is only used when the application is in IG mode, so it only has an effect when setting a property based on the incoming packet value.	No

Custom Articulated Parts XML File

In addition to the default CigiArticulatedParts.xml, a vehicle specific **CigiArticulatedParts.xml** file can be created on a per-SimObject basis. This file must be saved in the SimObject's folder (in the same folder as the **aircraft.cfg** or **sim.cfg** file). The GUID that is defined for the **ArticulatedPartDefinition**, in the XML file, must be set in the configuration file under the **[GENERAL]** section in a **CigiArticulatedPartDefinitionGuid** property (see example below). It must be a unique GUID for the vehicle (see Generating GUIDs).
An example **CigiArticulatedParts.xml**:

```
<?xml version="1.0" encoding="UTF-8"?>

<SimBase.Document Type="Cigi Articulated Parts" version="3,1" id="CigiArticulatedParts">
    <Descr>Cigi Articulated Parts File</Descr>
    <Filename>CigiArticulatedParts.xml</Filename>
    <ArticulatedPartDefinition Name="6x4 Truck MRBM Launcher" DefinitionGuid="{A2C4A4F0-6AAF-4FF9-AE0C-86BFF426A637}">
        <ArticulatedPart ID="1">
            <ValueDefinition PropertyGet="SteerAngle:0" PropertySet="SteerAngleSet:0" ValueType="Heading" Units="Degrees" />
        </ArticulatedPart>
        <ArticulatedPart ID="2">
            <ValueDefinition PropertyGet="SteerAngle:1" PropertySet="SteerAngleSet:1" ValueType="Heading" Units="Degrees" />
        </ArticulatedPart>
        <ArticulatedPart ID="3">
            <ValueDefinition PropertyGet="TurretHeadingAngle" PropertySet="TurretHeadingAngleSet" ValueType="Heading" Units="Degrees" />
            <ValueDefinition PropertyGet="TurretPitchAngle" PropertySet="TurretPitchAngleSet" ValueType="Pitch" Units="Degrees" />
        </ArticulatedPart>
    </ArticulatedPartDefinition>
```

Inside **aircraft.cfg** or **sim.cfg**:

```
...
[General]
...
CigiArticulatedPartDefinitionGuid={A2C4A4F0-6AAF-4FF9-AE0C-
86BFF426A637}
...
```

Entity Type Configuration

Entity Type XML File

The **DISEntityTypes.xml** file is also used by CIGI to map SimObject container titles to CIGI entity types. The file can be located within the **%PROGRAMDATA%\Lockheed Martin\Prepar3D v5** directory after Prepar3D has been launched at least once. Most default included SimObjects have already been mapped to an appropriate extended entity type where possible, however users are able to expand the included list. Multiple **EntityType** entries can be present.

Entity Type ID
The **EntityTypeID** is an integer value ranged from 0 to 65535 used to bind a container title to a given entity type.

*Note: This value is required for CIGI versions 3.3 and 2.1. For CIGI version 4.0, this value is required if the **UseExtendedType** option is set to 0, otherwise **EntityTypeString** is required.*

Entity Type String
The entity type string is a period delimited numerical string used to define the type of a given entity. Each integer represents properties of the entity type in the following order: *Kind*, *Domain*, *Country*, *Category*, *Subcategory*, *Specific*, and *Extra*. Asterisks (*) can be used as wildcards for each of the entity type properties. If an entity type property is not explicitly set it will be considered a wildcard. For example, an entity type string with all digits explicitly defined such as 1.2.225.85.11.0.0 would only be matched to other exact types. On the other hand, a wildcard-based entity type string with such as 1.2 or 1.2.*.*.*.*.* would be matched to all aircraft-based platforms.

*Note: This value is not available in CIGI versions 3.3 and 2.1. This value is required for CIGI version 4.0 if **UseExtendedType** is set to 1, otherwise **EntityTypeID** is required.*

Example Entity Type Strings:

```
                    // Implicit Wildcards
1.2.225.85.11       // Explicit Wildcards (same as above)
1.2.225.85.11.*.*   // Explicit Inner and Implicit Outer
1.2.*.85.11       Wildcards
1.2.225.85.11.0.0   // Explicit definition (7 digits defined)
```

Example DISEntityTypes.xml file:

```
<SimBase.Document Type="DIS Entity Types" version="3,1" id="DISEntityTypes">
    <Descr>DIS Entity Type Map File</Descr>
    <Filename>DISEntityTypes.xml</Filename>
    <DIS.EntityTypes>
        <EntityType>
            <EntityTypeID>20001</EntityTypeID>
            <EntityTypeString>1.2.225.85.11.0.0</EntityTypeString>
            <ContainerTitle>Mooney Bravo</ContainerTitle>
        </EntityType>
    </DIS.EntityTypes>
</SimBase.Document>
```

Supported Packets

The following packets are currently supported:

- Common Packets
  - Start Of Frame
  - IG Control
  - View Definition
  - Entity Control
  - Component Control
  - Short Component Control
  - Conformal Clamp Entity Control
  - Articulated Part Control
  - Short Articulated Part Control
  - Articulated Part Control
- Common Packets Partially Supported
  - View Control (one view supported)
  - Hat/Hot Request [IG only]
  - Hat/Hot Response [IG only]
  - Line of Sight Request (does not return RGBA) [IG only]
  - Line of Sight Response (does not return RGBA) [IG only]
  - Sensor Control (whether the Sensor is on/off and if the Polarity is black/white)
  - Weather Control (lacking Local/Regional Weather, Scud Frequency, Transition Band, Vertical Wind Speed, and Aerosol Concentration)
  - Collision Detection Segment Definition (does not send material mask, sends rough estimate of lines for the object) [Host only]
  - Collision Detection Volume Definition (currently only defines the rough outer box of the object, currently does not define spheres) [Host only]
  - Collision Detection Segment Notification/Response (does not send material code or intersection distance) [IG only]
  - Collision Detection Volume Notification/Response (does not support sweeping collision calculations) [IG only]
- CIGI v4.0
  - Entity Position Control
  - Animation Control
  - Velocity Control
  - Acceleration Control [IG only]
  - Celestial Control
  - Atmosphere Control (lacking Vertical Wind Speed)
- CIGI v3.3
  - Rate Control
  - Trajectory Definition [IG only]
  - Celestial Control
  - Atmosphere Control (lacking Vertical Wind Speed)
- CIGI v2.1
  - Environment Control (lacking Humidity, Global visibility, and Aerosol Concentration)
  - Rate Control
  - Trajectory Definition [IG only]

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Virtual Reality

Contents

- Using Virtual Reality
- Augmented Reality
- Eye Tracking
- Advanced Settings (Pro Plus)
- HMD Specific Settings (Pro Plus)

Related Links

- Tuning Guide

Overview

Virtual Reality can be used with the Oculus Rift, HTC Vive, other headsets which support SteamVR, and Varjo VR-1.

Using Virtual Reality in Prepar3D

1. Ensure that the headset is plugged in and working, and that the latest runtime and firmware updates for your hardware are installed.
    - For Oculus Rift, ensure that Allow 3rd Party Content is checked in the Oculus Home settings.
2. Start Prepar3D.
3. Click on the Virtual Reality menu.
4. Select Enable Virtual Reality and then select the desired runtime for the headset (SteamVR, Oculus, Varjo VR-1, or HMD Emulator).
5. Prepar3D should now be visible inside the virtual reality headset.
6. Select Recalibrate Origin to reset the position of the headset to where you are sitting.
7. The active view can be changed through the Views menu.

Display Modes

After enabling virtual reality, the menu dropdown will have additional options allowing you to further configure your experience.

Recalibrate Origin

- **Recalibrate Origin** centralizes your view point to ensure you are aligned correctly with the visual scene. This can also be configured in the **Controls** as a **Key Assignment** (*HMD - Recalibrate Origin*).

Headset Display Modes

- **Stereo** uses two views (one per-eye) to provide depth perception. This can be performance intensive, but provides the most immersive 3D visual effect.
- **Single-Pass Stereo** is a stereo mode that draws two views in a single rendering pass. For high-end CPUs and GPUs, this should be faster in most cases. On AMD GPUs, MSAA and SSAA will be disabled when in this mode.
- **Mono** uses a single view which provides a performance increase, but no depth perception. Some

headsets do not support this setting including Varjo VR-1.

On-Screen Display Modes

- **Single** view combines what is seen in the headset to one view.
- **Double** view shows what is rendering in both eyes, showing one eye per-view on the screen.

Virtual Reality Settings

Configuration options can be found the **VirtualReality.xml** file located in *%PROGRAMDATA%\Lockheed Martin\Prepar3D v5*

HeadsetDisplayMode

represents the in headset display mode.

- 0 is Stereo
- 1 is Mono
- 2 is Single-Pass Stereo

OnScreenDisplayMode

represents the on screen display mode.

- 0 is Single
- 1 is Double

SyncMode

This determines when the sync for an HMD will be called. This setting currently only impacts SteamVR and Varjo.

- Update - Lowest latency. (This mode is currently required for WindowsMR headsets to work properly)
- Pre-Rendder - Recommended for best performance

Enable Hidden Area Mesh

Disabling this will remove the hidden area mesh surrounding the VR headset. Default: Enabled

Enable Zoom

Enables the user to zoom in the view while in VR. Default: Disabled

---

Eye Tracking Settings

The cursor in Virtual Reality is visualized by a sphere in 3D space based on the mouse position relative to the Prepar3D window. This cursor will not work if you move your mouse to a monitor that is not displaying Prepar3D. The Mouse Cursor and the Virtual Reality cursor will not be at the same location on the screen.

EnableEyeTracking

Turning this on sets the cursor to the eye position. If Eye tracking is not supported the cursor will be placed at the center of the screen. The Vive Pro Eye is currently the only native eye tracking HMD supported by Prepar3D.

EnableGazeDetection

Turning this on displays Green Spheres for Eye Tracking data when P3D is paused, similar to a heat map to show the areas that were looked at most.

EnablePanelEyeData

Turning this on displays a single Green Sphere for where the User is looking along with text data about the Eye such as Openness, Pupil Diameter, and screen Location

EnableGazeSelection

Turning this on locks the cursor to the center of the screen, requiring head movement to move the cursor around.

When Gaze Selection is enabled, you can use the following Key Controls to emulate the functions of mouse clicks to interact with the Virtual Cockpit in VR. This can be useful for users that need mouse controls for interaction with the Virtual Cockpit while wearing a VR Headset, allowing them to 'click' VC elements using keys or buttons on a control surface, instead of operating a mouse. The emulated mouse clicks will interact with the Virtual Cockpit elements underneath the cursor.

To emulate:

- **Left Mouse Click:** Map Key Controls for **HMD - Gaze Click Down** and **HMD - Gaze Click Up**. Ideally, Up should be mapped to the same key or button as Down, but with the **On Release** check box checked.
- **Right Mouse Click:** Map Key Controls for **HMD - Gaze Right Click Down** and **HMD - Gaze Right Click Up**. Ideally, Up should be mapped to the same key or button as Down, but with the **On Release** check box checked.
- **Mouse Scroll Wheel:** Map Key Controls for **HMD - Gaze Scroll Down** and **HMD - Gaze Scroll Up**. These controls should be mapped to two separate keys or buttons.

GazeDragVelocity

Specifies the speed and direction of the mouse drag when EnableGazeSelection is toggled on. This may need to be adjusted per aircraft.

GazeSelectionOffset

Moves the cursor position (in pixels).

Cursor Settings

MouseHitDistance

Specifies the max distance (in meters) the object can be for the mouse to detect it. This may need to be adjusted per aircraft..

MouseCursorRadius

Changes the radius of the Virtual Reality Cursor. (Default is 0.0125)

MouseCursorOpacity

Changes the opacity of the Virtual Reality Cursor. (Default is 200)

MouseCursorColor

Changes the color of the Virtual Reality Cursor. (Default is 200, 200, 250)

Prepar3D Config

In the **Prepar3D.cfg**, there are the following Virtual Reality entries:

- **LoadVirtualReality:** sets whether Prepar3D will load the Virtual Reality library. This is enabled by default. Setting this to 0 will disable Virtual Reality from loading.
- **EnableVirtualRealityOnStartup:** sets whether Prepar3D will load into Virtual Reality on startup. This is disabled by default. Setting this to 1 will enable Virtual Reality automatically when Prepar3D starts.
- **EnableViveProEyeTracking:** sets whether Prepar3D will load the SRanipal Vive Pro Eye Tracking libraries (v0.5). This is disabled by default. Enable Eye Tracking in the VR Settings must also be enabled.

To automatically enable a VR Interface at Startup, edit the 'EnableVirtualRealityOnStartup' variable found in the Prepar3D.cfg file.

Options for Startup VR Interfaces are:

- 0: Disabled - VR will not initialize at startup
- 1: SteamVR - P3D will initialize the SteamVR Interface at startup
- 2: Oculus - P3D will initialize the Oculus Interface at startup
- 3: Varjo - P3D will initialize the Varjo Interface at startup
- 4: HMD Emulator - P3D will initialize the HMD Emulator at startup

For Example, to automatically start SteamVR for a VIVE Pro HMD (or any other openVR HMD) when P3D starts, my Prepar3D.cfg file would have the following entry:

EnableVirtualRealityOnStartup=1

Instrument Panels

If an Instrument Panel is opened before entering Virtual Reality, it will be shown in the headset. An Instrument Panel can be opened by selecting the Vehicle menu item and choosing Instrument Panel. Note that not all vehicles have Instrument Panels.

Controls

- **Translate:** LeftMouseDown + Shift
- **Rotate X Axis:** LeftMouseDown + Ctrl + ScrollWheel
- **Rotate Y Axis:** LeftMouseDown + Ctrl + '

- **Rotate Z Axis:** LeftMouseDown + Ctrl + PlusKey
- **Uniform Scale:** LeftMouseDown + Shift + Ctrl
- **Resize Panel:** LeftMouseDown + Shift + Tab

NOTE: The Virtual Reality cursor must be hovering over the panel to move it.

Developer Mode

Turning on Developer Mode will enable a new headset interface selection in the Virtual Reality drop down menu called HMD Emulator. The HMD Emulator allows Virtual Reality to be enabled without plugging in a headset. Panning can be used to simulate head movement.

Augmented Reality

Overview

Augmented Reality is available for those who have an headset with passthrough camera capabilities (ie. HTC Vive, Varjo, etc.) Developer mode must be enabled to see the Passthrough Camera menu item under Virtual Reality. A passthrough camera must be selected to utilize any AR functionality. The following settings can be found in the AR Settings UI.

EyepointZOffset

Value that corrects the position of camera where the camera is offset from the headset eyepoint.

EnableGreenScreen

Value that enables the green screen for Passthrough cameras. See advanced settings for how to configure chromakey color values.

Passthrough Mode

Selects which mode the passthrough camera will operate in.

- **Camera:** Feed from selected camera will be displayed in the headset.
- **Portals:** Feed from the camera only displayed within placed portals.
- **Inverted Portals:** Prepar3D scene rendered within placed portals.

Mixed Reality Portals

Portals are masking areas where either the passthrough camera feed is displayed or the Prepar3D scene is displayed. You can enable and disable groups of portals (portal sets) through the drop down menu. An entire set can be deleted in the VR Settings UI. VIVE controllers are necessary for real-time portal placement. Otherwise, they can be created in the UI, or through the Portals.xml file.

Note: You will need to have a Passthrough Camera enabled and your Passthrough Mode set to Portals in order to see portals.

Using Portals

Your controllers will need to be in Portal Edit Mode to directly manipulate portals in the Virtual Environment. Edit mode is enabled if you see the controllers pulsating a green hue. The selected portal will also appear green in this mode. You can select a portal by passing the controller through it. Delete will only delete a selected portal. Creating a portal without having a portal selected will create a new portal set. See the Portal Controls table below for more info on how to enter Portal Edit Mode and the available controls. Delete will only delete a selected portal. Creating a portal without having a portal selected will create a new portal set.

Portal Controls

The first controller that the system recognizes is assigned the Left Hand role. If it feels more natural to have the roles swapped, simply switch the controller hands.

The following table displays the controls for each operating mode. The default mode is entered when an AR pass through camera is selected. Once controllers are connected, you will see 3D representations of the controllers in the Virtual Environment. Pressing the trigger will bring up the Help Text, which hovers over the mouse cursor and displays the controls for the current mode.

Controller Modes when using Mixed Reality Portals:

- Default Mode: Mode you will enter when first enabling AR. Checks for input to enter other modes. Controllers appear gray in this mode.
- Portal Edit Mode: In this mode, you can create, resize, move, and delete MR portals with the controllers. Controllers pulse green in this mode.
- FOV Edit Mode: In this mode, you can increase and decrease the Horizontal and Vertical Field of View of applicable AR cameras. Controllers pulse blue in this mode.

If you only have one controller, you can use the Grip Button on the Left Controller to emulate Right Controller functions. Simply press the grip button, and the color of the label on the Left Controller will toggle to indicate the controller has switched functionality.

Left Controller	**Default Mode**	**Portal Mode**	**FOV Mode**
DPAD Up/Down	Toggle Help Text	Create Portal	Scale Vertical FOV
DPAD Left/Right	Toggle Help Text	Cycle Portal Shape	Scale Horizontal FOV
Menu	Enter FOV Mode	Delete Portal	Exit FOV Mode
Trigger	Toggle Help Text	Move Portal	---
Grip	Toggle 'Right' Controls	Toggle 'Right' Controls	Toggle 'Right' Controls
Right Controller	**Default Mode**	**Portal Mode**	**FOV Mode**
DPAD Up/Down	Enter Portal Mode	Exit Portal Mode	Scale Vertical FOV
DPAD Left/Right	Enter Portal Mode	Exit Portal Mode	Scale Horizontal FOV
Menu	Enter FOV Mode	---	Exit FOV Mode
Trigger	Toggle Help Text	Move Portal	---

Eye Tracking

Overview

In Prepar3D, eye tracking takes on a new meaning in training and simulation. Demonstrate your awareness of start-up procedures while controlling knobs and switches as you use your eyes to follow instructions. Review which panels, knobs, and other areas in the current view have been given the most attention by pausing the simlation and seeing the most frequented regions marked by concentrated green circles. Where your eyes travel and how long they remain there provide not only useful functionality but interesting insights that can revolutionize the way you train.

Eye Tracking Setup

Prepar3D currently supports eye tracking using the HTC VIVE Pro Eye and Varjo VR-1. Because of the uniqueness of these devices, it is important to understand the proper way to enable and configure eye tracking for use in Prepar3D.

Using Eye Tracking with HTC VIVE Pro Eye

HTC VIVE Pro Eye makes use of the SR (Super Reality) runtime to enable eye tracking capabilities. Please ensure the latest version of the SR runtime is installed on your device. This should be installed from having run the VIVE software installer, but may have not been included in the installation if the installer was ran for a prior VIVE (non-VIVE Pro Eye) headset. If you are missing the SR runtime, you may get it by following the instructions at https://www.vive.com/us/support/vive-pro-eye/category_howto/installing-eye-tracking-software.html.

Additional things to note while using eye tracking with the VIVE Pro Eye are the following:

- The SR runtime will be brought up automatically when eye tracking is enabled and a scenario is loaded in Prepar3D
- Eye tracking calibration must be done manually by using a connected VIVE remote to enter the VIVE menu, select VIVE Pro Eye, and begin the calibration process
- In Prepar3D.cfg underneath the "STARTUP" section, "EnableViveProEyeTracking" should be set to 1 to enable VIVE Pro Eye eye tracking - this is the default and may remain enabled unless you desire otherwise
- Eye tracking calibration with the VIVE Pro Eye is persistent - you may exit Prepar3D and load it again, and/or remove the headset, and the calibration previously made will remain
- SR_Runtime remains running after exiting both Prepar3D and SteamVR

Note: To configure Prepar3D to start up with virtual reality enabled for the HTC VIVE Pro Eye, set "EnableVirtualRealityOnStatup" to 1 in Prepar3D.cfg.

Using Eye Tracking with Varjo VR-1

Varjo VR-1 uses Varjo Base to enable both position and eye tracking. Please ensure the latest version of Varjo Base is installed on your device. If you have not yet installed Varjo Base, you may find it at https://varjo.com/downloads/#varjo-base.

Additional things to note while using eye tracking with the VR-1 are the following:

- Varjo Base needs to be brought up manually before launching Prepar3D

- Varjo eye tracking calibration will be brought up automatically when eye tracking is enabled and a scenario is loaded in Prepar3D
- Once the headset is taken off, even partially, the headset will lose its eye tracking calibration and you will need to calibrate again
- You may manually start eye tracking calibration via the Virtual Reality menu in Prepar3D

Note: To configure Prepar3D to start up with virtual reality enabled for the Varjo VR-1, set "EnableVirtualRealityOnStatup" to 3 in Prepar3D.cfg.

Advanced Settings (Professional Plus)

Overview

These are settings intened for advance mixed reality training use cases where additional tracking capabilities and scene blending techniques are required to correlate objects in the real world with the virtual scene.

Recalibration Origin

HMDReferenceOrigin Controls the origin Prepar3D will use during recalibration. This is used to set whether Prepar3D will use the zero pose coming in from HMD software as the calibration center, or if Prepar3D will calculate it's own offsets to center the HMD.

- **HMD Seated Origin**: Default option, recalibrate via the HMD's interface. Recalibration triggers external software to update the HMD.
- **P3D Custom Origin**: Recalibration will be handled by Prepar3D, not an external request to HMD software. This is useful to only recenter the HMD without recalibrating all VR objects.
- **P3D Tracker Origin**: Recalibrate using a tracked object as the reference origin. Will use the first controller or VIVE tracking puck detected.

Tracker Origin

To configure a VIVE tracker puck or controller as the reference origin, connect the tracked object through Steam VR, and select 'P3D Tracker Origin' as the HMDReferenceOrigin from the VR settings menu. Once selected, place the tracked object in its desired location within view of the lighthouses, and hold the HMD where you would like to save as the origin. Select 'Save Tracker Offset' from the Virtual Reality drop down menu, and then select 'Recalibrate Origin'. Moving the tracked object and recalibrating again will move the headset so it maintains the previously saved offset, now based from the tracked object's new position.

Note: P3D Custom Origin and Tracker Origin currently only supported for HMDs using openVR.

KeyColorValue

Color that will be keyed out and replaced with Prepar3D scene.

KeyColorThreshold

How much margin of error is allowable for the key color value. X represents min, Y represents max.

The threshold is applied to each color channel (red, green, and blue.) The larger the threshold, the wider the color range being keyed out will be.

Color Picker

Sets the KeyColorValue based on the color in the center of the camera's vision. To use, point the camera so that the desired color to be keyed out is roughly in the center of the screen, then press the Color Picker button. The KeyColorValue field will be filled out for you.

HMD Specific Settings (Professional Plus)

Varjo Settings and Configuration

Settings

VarjoEnableChromaKey

Enables the XR-1 camera passthrough to overlay the chosen greenscreen color. Disabled by default. (Enable XR1 Camera must be enbaled)

Enable XR-1 Camera

This will allow the XR-1's camera system to be selectable from the camera passthrough system.

Varjo Chroma Key Color

This is the chosen color for the chroma key. The default color used below is a pure green RGB of (0, 255, 0). Hue Range: 0 - 360 Saturation and Brightness Range: 0-100, Default: (120, 100, 100)

Varjo Chroma Key Falloff

Falloff is the size of the fade at the edge of the tolerance, think of this as a slight blur on the edges of chroma. Typically want to keep these values small. Range: 0-100, Default: (3, 3, 3)

Varjo Chroma Key Tolerance

This is the hard cut off of what is considered chroma and what isn't. Range: 0-100, Default: (3, 75, 50)

Varjo Views

This setting allows users to switch between rendering either two views or four views

- **Stereo:** This will render the Varjo's two 2k views, lowering the renering cost.
- **Four-Views:** This will render all four views of the Varjo, making use of the high resolution focus views. This will come at a higher rendering cost.

Enabling XR-1 Camera

1. Start Prepar3D.
2. Activate Varjo (Virtual Reality > Enable Virtual Reality > Varjo)
3. Open VR Settings (Virtual Reality > VR Setting)
4. Under Varjo Settings select Yes for Enable XR1 Camera
5. Activate the XR-1 (Virtual Reality > Passthrough Cameras > XR-1)

Using Cockpit Masking

1. Start Prepar3D.
2. Navigate to Custom Camera Management. (Views > View Management > Manage Cameras)
3. In the Available Cameras menu choose Virtual Cockpit. (This is selected by default)
4. In the Camera Effects menu scroll down and enable "MaskVCAlphaAndColor"
5. In the Camera View menu give your new camera a name. I'll call it "XR-1 View"
6. **(Optional)** In the Save To dropdown, choose Global so you won't have to re-create the camera next time you run.
7. Save the camera and exit out of the Custom Camera Management menu
8. Change views to the new camera (Views > Change View > Cockpit > XR-1 View

Virtual Reality Tuning Guide

Contents

- Settings
- Frame Timing
- Simulation Rates
- System Configuration
- Content
- User Aircraft Model
- Instrument Panels
- Summary

Related Links

- Virtual Reality

Overview

The purpose of this article is to provide information on how to tune Prepar3D settings and content for the best possible virtual reality (VR) experience. Prepar3D is an advanced training platform built for scalability and reconfigurability. It is used on a wide variety of hardware from laptops and tablets, to full motion simulators and domes. Each training use case and hardware platform has unique requirements to consider when configuring application settings and content. Virtual Reality is a great example of this. Virtual reality scenarios have several unique characteristics:

1. At least two 3D views (one for each eye)
    - Each view has a wide field of view (FOV). This means more objects are visible
    - Each view is high resolution. This means objects render at a higher level of detail (LOD) and the GPU has more pixels to process.
2. Target framerate is 90 frames per second (FPS) to avoid nausea

Virtual Reality Settings:

The most important VR setting for performance is **Headset Display Mode**. Users with NVIDIA hardware should set this to **Single-Pass Stereo**, which is a stereo mode that draws two views in a single rendering pass. Much of the CPU work for the second 3D view is offloaded to the GPU. Similarly, performance can be boosted by setting this mode to **Mono**, which uses only one view. The drawback, though, is that objects will not appear as three dimensional without true stereoscopic rendering.

The VR use case can be very taxing for the CPU and GPU. In general, CPU workload depends on several factors:

1. Number of objects simulated (Adjustable by traffic settings)
2. Number of objects in the scene. (Graphics settings have many options to adjust this)
3. Number of 3D views. Note that reflections and shadows make use of additional views.
4. Complexity of user aircraft simulation and rendering
    - Instrument panels
    - Virtual Cockpit panels
    - Animations

Settings to Consider

Graphics - World:

- **Dynamic 3D Autogen Vegetation:** Unchecking this, will replace Prepar3D's newer dynamic vegetation with simpler static models.
- **Reflections:** To disable planar reflections entirely, uncheck all object types. This removes the need for an additional 3D view used for reflections.

Graphics - Lighting:

- **Shadows:** Shadows also use an additional 3D view. Simplest way to turn shadows off is moving shadow quality slider all the way to the left.
- **Dynamic Lighting:** Dynamic lighting can be taxing to the GPU. Note that even when disabled, sun and moon lighting is still dynamic. Lights attached to the user sim object will also still dynamically light the sim object.
- **Dynamic Reflections:** These require additional 3D views.

Frame Timing:

VR headset interfaces such as SteamVR control the frame timing for the HMD display. Prepar3D still controls the frame timing for the onscreen display. It's a good idea to disable VSync in Prepar3D when using VR. This should help ensure the application is only waiting on the VR.

Simulation Rates:

VR is heavily dependent on high and consistent frame-rates for smooth performance. This means that any content that is not simulating at a high frame-rate may impact the VR experience. Prepar3D by default defines a range of rates at which different groups of SimObjects update. It is recommended to set the minimum rates for all groups to your target VR frame-rate (usually 90 Hz) to avoid any potential ghosting or visual anomalies.

Adding the following lines to your Prepar3D.cfg file will make sure the rate of simulation for AI and the user object will target the same frame-rate as the VR headset.

[SIM]

min_user_sim_fps = 90

max_user_sim_fps = 90

min_AI_sim_fps = 90

max_AI_sim_fps = 90

It is recommended to leave the target frame-rate in the Prepar3D settings menu to unlimited, even when you have these keywords in your Prepar3D.cfg. For more information about SimObject

Simulation Rates, see the the Notes on SimObject Simulation Rates.

Operating System and Driver Configuration:

There are some external applications and OS or driver settings that can impact performance.

1. Disabling the GeForce Experience Share In-game Overlay:
    - From the GeForce Experience app, click the Settings icon on the top right corner
    - From the General panel, toggle the SHARE setting to off
2. Disable Window10 Game bar
    - Open "Settings" app
    - Select "Gaming"
    - Under "Game Bar" select "off"
3. Disable full screen optimization in app properties for Prepar3D.exe
    - Browse to Prepar3D install directory
    - Right-click Prepar3D.exe and select "Properties"
    - Click the "Compatibility" tab at the top of the properties window
    - Check the "Disable Fullscreen Optimizations" box and hit Apply.

In addition to OS settings, is recommended that SteamVR users check and/or modify their SteamVR settings.

1. **Video:** Consider enabling or disabling motion smoothing via the "Enable Motion Smoothing" checkbox. This feature is available in Steam VR Beta. This allows SteamVR to interpolate the next frame, based off the two previous frames. It allows for a higher framerate while lowering performance requirements, but it may cause distracting visual artifacts.
2. **Camera** Camera rate increases or decreases the refresh rate. When experiencing trouble with tracking, it is recommended to lower the rate, or disable the camera.
3. **Error Logs** When troubleshooting an issue, be sure to check the error logs. You can view logs by going to Settings -> General -> View Logs. You can also change the log directory at Settings -> Developer -> Paths -> Set Log Directory

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Content and its impacts on performance:

Content has a big role in overall performance. Examples of content are scenery, aircraft, models, textures, and scenarios. The number of objects on screen and the complexity of each object is directly impacted by the content. Reducing the level of detail in content by lowering your settings or disabling performance cost-intensive add-ons will increase VR performance.

User Aircraft Model:

User aircraft models can be very complex, because many model parts are individually animated and scripted to support user interaction. Doing separate performance tests in Cockpit, Virtual Cockpit, and Locked Spot views is a good way to determine the impact of the interior and exterior model on performance. Prepar3D has a diverse ecosystem of developers that may use different approaches for building and optimizing models. As an example, a model built for procedural training in a large airliner,

may be designed to target 30-60FPS in a single view as a trade-off for having a very complex and fully interactive virtual cockpit model.

Instrument Panels:

Most 3D models use virtual textures to map instrument panels into the 3D cockpit. These VCockpit instrument panel each have their own offscreen window. While Prepar3D supports GPU accelerated systems such as Scaleform, many models rely on the XML based instrument panel system. This system uses the CPU for drawing 2D gauges elements. The GPS map can be expensive because it renders terrain data. Gauges are updated at 18hz to keep overall FPS impact down, but this can impact the consistency of frame times if not using the FPS limiting or vsync. Pro Plus customers can force panels to update every frame using PANEL_UPDATE_MODE=3. More details can be found in the Advanced Configuration section.

For VR scenarios, it may be beneficial to modify the panel.cfg or gauge XML in for an aircraft to disable more expensive elements such as the GPS-map (if they are not needed for the given training scenario).

Summary:

Virtual reality scenarios have several unique characteristics which require special consideration. Settings and content should be tuned for a given training scenario to provide the best possible VR experience. The information in this article is intended to inform and guide the tuning process.

PREPAR3D

Glossary

Prepar3D terms explained

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

A

abeam
A relative location approximately at right angles to the longitudinal axis of the aircraft. An object beside an aircraft is said to be abeam of it.
accelerated stall
A stall induced by turns, pull-ups, or other maneuvers that increase the load factor (G-load) on an airplane. The loads imposed by such maneuvers typically increase the speed at which a wing stalls, but they do not affect the angle of attack at which the stall occurs. That angle, the critical angle of attack, is always the same.
ace
A military pilot who has destroyed at least five enemy aircraft. The term originated in France during World War I, where it was given only to top pilots who had downed at least 10 aircraft. Later, "ace" was commonly used for any pilot who claimed at least five aircraft. German aces in World War I were called Kanone ("cannons").
active runway
The runway currently in use for takeoffs and landings. Many large airports have more than one runway, usually arranged in a pattern to take advantage of prevailing winds. Some airports have parallel runways to accommodate more takeoffs and landings. Under specific conditions at airports with operating air traffic control towers, aircraft may also use intersecting runways for takeoffs and landings to expedite the traffic flow.
advection
The horizontal movement of air or atmospheric properties. In meteorology, this process is sometimes referred to as the horizontal component of convection.
advection fog
Fog resulting from the movement of warm, humid air over cooler ground or water. Advection fog is most common along coastal areas, although it often develops deep in continental areas. At sea, it is called "sea fog." Advection fog deepens as wind speed increases up to about 15 knots. Stronger winds lift the fog into a layer of low stratus or stratocumulus clouds.
advisory circulars (ACs)
In the United States, nonregulatory information and procedures published by the FAA. Advisory circulars provide background information and more detail on subjects not completely outlined in the FARs or AIM. Advisory circulars are published by the Government Printing Office; many publishers also reprint important ACs as references for pilots. ACs are arranged in series, designated by a two- or three-digit number. Those in series 00 cover general subjects. ACs in the 10 series deal with procedural rules. ACs in the 20 series deal with aircraft; those in the 60 series cover pilots. ACs in the 70s series deal with airspace, while 90-series ACs cover air traffic and general operating rules. Issues related to air carriers (airlines) are covered in 120-series ACs.
aerobatics
Precision maneuvers, such as barrel rolls, loops, hammerhead stalls, spins, and Cuban eights. Often performed at airshows and competitions, many of these maneuvers are also part of a military pilot's training and can be used in aerial combat. In fact, many basic aerobatic maneuvers evolved from air-combat tactics invented during World War I.
"Aerobatics" is also defined in FAR 91.303, which describes restrictions on aerobatic flight. In that section, "aerobatic flight" means "any intentional maneuver involving an abrupt change in an aircraft's attitude, an abnormal attitude, or abnormal acceleration, not necessary for normal flight."
aerodrome forecast (TAF)
A concise statement of the expected meteorological conditions at an airport during a specified period (usually 24 hours). TAFs use the same codes employed in METAR weather reports. TAFs are scheduled four times daily for 24-hour periods, beginning at 0000Z, 0600Z, 1200Z, and 1800Z. They contain the following information: type of report, location, issuance time, valid time, and forecast.
aerodynamics
The study of air in motion, in particular, the interactions between air and surfaces, such as an aircraft wing. Aerodynamicists--scientists and engineers who specialize in aerodynamics--use wind tunnels, computer models, and other tools to design and build aircraft and airfoils.
aeronaut
The pilot or navigator of an airship or balloon. Famous aeronauts include the Montgolfier brothers, inventors of the hot-air balloon; Henri Giffard, builder and pilot of the first powered dirigible; and August Piccard, who rode a balloon into the stratosphere.
Aeronautical Information Manual (AIM)
An official source of information about navigational aids, airport operations, air traffic control procedures, and other subjects of importance to pilots and air traffic controllers. Published by the FAA, the AIM is available from many publishers in

printed and electronic formats.

aeronautical sectional chart
A 1:500,000-scale aeronautical map that includes topographical and navigational information for pilots to use during VFR flight.

aeronautics
The study or science of flight.

aerospace
The study of the science and technology of travel in the space above the earth. Aerospace includes travel within the atmosphere as well as in space beyond the earth's atmosphere.

aerostat
A lighter-than-air craft, such as a hot-air balloon or dirigible, that gets lift principally from buoyancy instead of generating lift with airfoils.

afterburner
Device that injects fuel into the exhaust stream of a turbojet engine. The combustion of the unburned oxygen from the exhaust and the jet fuel provides an extra boost at takeoff or during combat maneuvers. Also known as "reheat," especially in Great Britain.

AGL
Abbreviation for "above ground level." The height of clouds in airport weather observations and forecasts is usually reported in AGL.

ailerons
Movable control surfaces, usually located near the wing tips, that control the rolling motion of an aircraft. The pilot deflects the ailerons by moving the control yoke or stick left and right. The ailerons move simultaneously in opposite directions. For example, when the pilot moves the yoke or stick left, the aileron on the left wing moves up, decreasing the lift on the left wing. At the same time, the right aileron moves down, increasing the lift on the right wing. The word derives from the French word *aile*, meaning "wing."

air mass
In meteorology, an extensive body of air within which the conditions of temperature and moisture in a horizontal plane are essentially uniform.

air traffic control (ATC)
A network of control towers, approach and departure controls, and Air Route Traffic Control Centers (ARTCCs) designed to ensure the safe and efficient flow of air traffic. ATC's primary responsibility is to maintain separation between aircraft operating under Instrument Flight Rules (IFR), but ATC also provides services to aircraft operating under Visual Flight Rules (VFR).
ATC's functions are divided into several segments. Ground control supervises aircraft taxiing to and from runways. The tower, or "local control," handles aircraft in the vicinity of an airport, clearing them for takeoff or landing. Departure and approach controls manage the airspace surrounding one or more airports, and en route centers control traffic between airports.

aircraft
A flying machine. In the United States, the FAA divides aircraft into classes and categories. With respect to the certification of aircraft, classes are broad groupings, such as airplanes, rotorcraft, gliders, balloons, landplanes, and seaplanes. Categories define aircraft based on their intended use or operating limitations; for example, transport, normal, utility, acrobatic, limited, experimental, restricted, and provisional. With respect to the certification of pilots, class means a classification of aircraft with similar operating characteristics; for example, single engine, multiengine, land, water, and helicopter. Category means a broad classification of aircraft, such as airplane, rotorcraft, and glider.

Aircraft Owners and Pilots Association
The world's largest aviation organization, dedicated to making flying safer, more productive, more affordable, and more fun. AOPA is headquartered in Frederick, Maryland.

airfoil
A device that interacts with a moving stream of air to produce lift or thrust. Wings, propellers, tail surfaces, helicopter rotor blades, ailerons and other control surfaces, and turbine blades are all airfoils.

airframe
From 14 CFR Part 1: "The fuselage, booms, nacelles, cowlings, fairings, airfoil surfaces (including rotors but excluding propellers and rotating airfoils of engines), and landing gear of an aircraft and their accessories and controls."

airline transport pilot certificate (ATP)
In the United States, the pilot certificate required to act as pilot in command of an aircraft for an air carrier (airline) and for certain other operations. The ATP is often referred to as "the Ph.D. of aviation." To be eligible for an ATP certificate, a pilot must be at least 23 years old and hold a current first-class medical certificate. In general, an ATP applicant must also have at least 1,500 hours of flight time, including minimum amounts of time on cross-country flights, flights at night, and instrument flight time.

airship
An engine-driven, lighter-than-air aircraft that can be steered.

airspace
The part of the atmosphere that lies above the surface and is under the jurisdiction of a nation or controlling authority. In the United States, there are two categories of airspace: regulatory and nonregulatory. Within those two categories, there are four types of airspace: controlled, uncontrolled, special use, and other. Airspace is assigned to one of the types according to the density and complexity of the air traffic using the airspace, the types of operations conducted in that airspace, and other factors.

airspeed
The rate at which an aircraft moves through the surrounding air. Pilots use several types of airspeed during flight. For example, indicated airspeed (IAS) is the speed shown on the airspeed indicator (usually in knots). Pilots use IAS to control an aircraft and manage its performance. Calibrated airspeed (CAS) is IAS corrected for instrument and installation error. True airspeed (TAS) is IAS corrected for changes in atmospheric temperature and pressure. Pilots use TAS to solve navigation problems.

The aircraft's speed over the ground—ground speed—is TAS corrected for the effect of a headwind or tailwind.

airspeed indicator
The instrument that displays an aircraft's speed relative to the air in which it is moving. Most modern aircraft have airspeed indicators calibrated in knots or in Mach number.

altimeter
The indicator that displays an aircraft's present altitude. It is usually calibrated to give mean sea level (MSL) altitude. Most altimeters are called "pressure altimeters" because they measure the decrease in atmospheric pressure as the aircraft climbs. Because of this, the altimeter must be calibrated to the local atmospheric pressure to compensate for regional variations in pressure that would make the readings inaccurate.

altimeter setting
The value to which the scale of a pressure altimeter is set so it reads true altitude at field elevation. The setting is usually given in inches of mercury (Hg) or millibars.

altitude
Height of the aircraft above a reference level. Altitude above ground level (AGL) is the absolute height above the earth. Altitude above mean sea level (MSL) is the height above the average level of the earth's oceans.

altocumulus
White or gray layers or patches of middle clouds, often with a waved appearance. Altocumulus clouds appear as rounded masses or rolls. They are composed mostly of liquid water droplets which may be supercooled. At subfreezing temperatures, altocumulus clouds may contain ice crystals.

altocumulus castellanus
A type of middle cloud that includes some vertically developed, cumuliform protuberances (some of which are taller than they are wide, as castles). These cumuliform sections give the cloud a crenelated or turreted appearance that is especially evident when seen from the side. This cloud indicates instability and turbulence at the altitudes where it appears.

altostratus
Stratiform—flat, layered—clouds that form in the middle altitudes. The height of their bases ranges from 6,500 to 23,000 feet (1,980 to 7,000 meters) in middle latitudes.

anemometer
An instrument for measuring wind speed.

aneroid barometer
A barometer that operates on the principle of changing atmospheric pressure bending a metallic surface, which, in turn, moves a pointer across a scale graduated in units of pressure.

angle of attack
The angle between the wing and the oncoming airflow—the relative wind. It's important to understand that the angle of attack is related to the direction in which an aircraft is moving, not to the angle the wing makes with the horizon. In general, as angle of attack increases, so does the amount of lift a wing produces. However, at a specific point, called the "critical angle of attack," the air flowing over a wing can no longer follow the airfoil's contour, and it becomes turbulent. The sudden loss of lift at this point is called a "stall."

angle of incidence
The angle at which a wing or propeller blade is mounted to the aircraft fuselage or to the propeller hub. The pilot cannot control the angle of incidence.

anticyclone
An area of high atmospheric pressure with a closed anticyclonic circulation. Viewed from above, the circulation is clockwise in the Northern Hemisphere, counterclockwise in the Southern Hemisphere, and undefined at the equator.

antitorque pedals
Pedals in a helicopter that control the tail rotor speed to compensate for the torque of the main rotor. Antitorque pedals are used to maintain coordinated flight.

anvil cloud
Popular name given to the top portion of a cumulonimbus (thunderstorm) cloud that has an anvil-like appearance.

approach
The phase of flight just prior to touchdown during landing. It is important that airspeed and attitude be stabilized during approach.

approach attitude
The aircraft's longitudinal axis angle with respect to the horizon when making a landing approach.

approach lighting system (ALS)
Color-coded or sequenced flashing lights that clearly define the approaches to a runway. The ALS helps pilots make the transition to visual references at the end of an instrument approach. It can also aid pilots operating at night under visual flight rules (VFR).

area forecast (FA)
In the United States, a forecast of general weather conditions over an area the size of several states. It is used to forecast en route weather and to interpolate conditions at airports that do not issue terminal forecasts. FAs are issued three times a day by the National Aviation Weather Advisory Unit (NAWAU) in Kansas City, Missouri, for each of six areas in the contiguous 48 United States. Other offices issue reports for Alaska, Hawaii, and the Gulf of Mexico.

An area forecast contains a 12-hour specific forecast, followed by a 6-hour (18-hour in Alaska) categorical outlook, giving a total forecast period of 18 hours. The information in an FA includes several parts, including a synopsis, VFR clouds and weather, and other items of significance to VFR flight, including thunderstorms and strong winds, if forecast.

area rule
An aeronautical engineering principle that helps designers reduce drag at speeds near the speed of sound. Pinching in the fuselage where it meets the canopy, tail, or wings —creating the so-called Coke-bottle effect—cuts drag dramatically, reducing the amount of power an aircraft needs to reach supersonic speeds.

Aresti notation
A system of "aerocryptographics" for pilots and judges at aerobatic competitions and airshows. Named for José Louis Aresti, a Spanish aerobatic pilot who devised the notation system and built a dictionary of maneuvers and sequences.
artificial horizon
See attitude indicator.
aspect ratio
The ratio between the length (span) and width (chord) of a wing. In general, a wing with a high aspect ratio is more efficient than a wing with a smaller aspect ratio.
atmospheric pressure
The pressure exerted by the air on the earth and everything on it. This is measured in inches (or millibars) of mercury on an instrument called a barometer. Thus, the term "barometric pressure" is frequently interchanged with atmospheric pressure. Typically, the pressure measures between 28 and 32 inches of mercury at sea level, decreasing at higher elevations. See also barometer.
attitude
The aircraft's position around its axis.
attitude flying
Flying based on an aircraft's attitude (orientation to the world around it).
attitude indicator (artificial horizon)
The instrument that shows the aircraft's pitch and bank attitudes with respect to the ground. Pilots use the attitude indicator, sometimes called the "artificial horizon," when the true horizon isn't visible.
autocoordination
In Prepar3D, an option that automatically synchronizes the actions of the ailerons and rudder to maintain coordinated, that is, balanced, flight, especially during turns. You can turn autorudder on or off by choosing the Realism section from the **General...** menu under **Options**.
autogyro
An engine-powered aircraft that uses a propeller for forward motion and a large, free-rotating, horizontal rotor for lift. Also spelled "autogiro."
automatic direction finder (ADF)
A radio navigation instrument that receives signals from nondirectional radio beacons (NDBs) or AM radio stations. The needle on the ADF indicator always points toward the selected radio signal. A pilot can determine the magnetic bearing to the station by using the formula, Relative Bearing + Magnetic Heading = Magnetic Bearing.
automatic pilot (autopilot)
A device that automatically controls an aircraft. Similar in concept to the cruise control feature on an automobile, simple autopilots keep an airplane's wings level. More sophisticated autopilots can fly an airplane from immediately after takeoff all the way to its destination and then make an automatic landing. Autopilots use gyros and other sensors to keep track of the airplane's altitude, speed, and position, and then send signals to the appropriate controls to keep the airplane on course and altitude.
automatic terminal information service (ATIS)
A continuous-loop recording played over a specified frequency that gives pilots the current weather, runway or runways in use, and other airport information. ATIS is available at many airports with an operating control tower. The tape is updated hourly or whenever there is a significant change in weather or airport information. Each update is labeled with a letter of the alphabet, which is pronounced according to the ICAO standard. For example, the broadcast at 11:00 a.m. might be designated "Information Delta"; the next update would be designated "Information Echo." Pilots are expected to listen to the ATIS and indicate that they have received the current information before they make initial contact with air traffic controllers.
autorotation
The descent of a helicopter without power being applied to its rotor. Aerodynamic forces cause the rotor to spin.
autothrottle
In addition to an autopilot, Prepar3D jets are equipped with an auothrottle that can control airspeed automatically . The autothrottle works independently from the autopilot, although most autothrottle controls are presented on the mode control panel (MCP) along with the autopilot controls.
avgas
Grades of gasoline approved for use in aircraft.
avionics
Derived from "aviation electronics," this term most commonly refers to the electronic communication, navigation, and flight-control equipment on board an aircraft.
axial flow
Flow of air in a path parallel to the center. In an axial-flow turbine engine, air enters the front and follows a straight path through a series of turbine blades that compress the air before it enters the combustion chamber.
axis indicator
In Prepar3D, a display that shows the current axis of the aircraft and gives a good indication of where the aircraft's center is pointing. You can turn the axis indicator on and off or change its shape by Axis Indicator from the Views menu.
azimuth
Angular measurement made in a horizontal plane and in a clockwise direction from a fixed reference direction to an object. Two points on adjacent legs that both extend from the same right angle are said to be 90 degrees in azimuth from one another.

B

balloon (verb)
To increase the pitch attitude and angle of attack too rapidly. Ballooning can lead to a low-altitude stall, a hard landing, or porpoising if a tricycle-gear airplane lands nose-wheel first.
bank
The angle of an airplane's wings with respect to horizon; rotation about an aircraft's longitudinal axis. Pilots control bank using the ailerons. Airplanes turn principally because banking the wings creates a horizontal component of lift. Pilots measure bank

in degrees.
barnstormer
A pilot who tours the countryside, performing at exhibitions and taking passengers on sightseeing flights.
barometer
An instrument for measuring the pressure of the atmosphere. The two most common types are mercurial and aneroid.
barometric altimeter
A barometer that measures altitude by registering changes in atmospheric pressure as an aircraft climbs or descends. Large aircraft often are also equipped with a radio altimeter that measures the height of an aircraft by sending a radio beam to the ground and converting the time it takes to return into height above the surface. Radio altimeters are particularly useful during instrument approaches.
barometric pressure
See atmospheric pressure.
base leg
The leg flown in a standard left or right traffic pattern that is at right angles to both the downwind and final approach legs and is parallel to the threshold of the runway.
bearing
The horizontal direction to one object from another. An example would be the horizontal direction to a navigation transmitter from an aircraft.
Bernoulli's principle
The physical law stating that the total energy of fluid in motion remains constant: if its speed increases, its pressure drops; if its speed decreases, its pressure increases. Wings are designed to exploit this relationship by accelerating air that passes over their curved upper surfaces, thereby decreasing its pressure. The difference between the lower pressure above a moving airfoil and the relatively higher pressure below creates lift. This principle was first established by the Swiss scientist Daniel Bernoulli (1700–1782). Although aeronautical engineers continue to debate the theory of how lift is created, Bernoulli's principle is still regarded as a fundamental explanation of how airfoils produce lift.
biplane
An airplane equipped with two pairs of wings, usually one above and one below the fuselage. Early-model biplanes had their wings connected to each other with struts and wires. Modern biplanes are most often used for aerobatic flying.
bleed off
To decrease airspeed or altitude in a slow, carefully controlled manner.
blimp
A nonrigid airship generally shaped like a cigar. Internal gas pressure maintains both the blimp's buoyancy and its shape. There are many theories as to the term's origin —one of the most popular states that "blimp" is the sound made if you plunk the envelope with your finger.
booster
See performance booster.
buffet
Vibration, usually affecting the horizontal stabilizer and elevator, caused by turbulent airflow. Buffet occurs as the wing approaches its critical angle of attack and the smooth flow of air over the top surface of the wing becomes turbulent, like water flowing over rocks. This turbulent air strikes the airplane's tail surfaces and induces a mild vibration that the pilot feels through the flight controls. Pilots use the onset of buffeting as one indication of an impending stall.
Buys Ballot's law
The law that states that if an observer in the Northern Hemisphere stands with his or her back to the wind, lower pressure is to the left.

C

cache
See disk cache.
calibrated airspeed (CAS)
Indicated airspeed (IAS) corrected for instrument and installation error. The position of the pitot tube and static ports, flap setting, and pitch attitude of an aircraft can affect the accuracy of the airspeed indicator—especially at the low end of an airplane's speed range. Aircraft operating handbooks and placards on the instrument panel often include a table to help pilots determine CAS.
call sign
The identification that ATC and a pilot use for a particular flight or aircraft. Call signs are generally a combination of the aircraft type or manufacturer and the aircraft registration for civilian planes, a combination of the airline and flight number for airline flights, and a combination of branch of service and flight number for military flights. Call signs should always be included in any communication with ATC to avoid confusion about who’s talking.
canard
A horizontal surface, mounted in front of an aircraft's main wing, that serves as a stabilizer to control pitch. Canards also reduce drag by cutting down the force generated by a conventional tail. Canards were first used in the pioneering days of aviation, and today, their principle advantage in modern design is in preventing deep stalls. The canard is designed to stall before the main wing, lowering the angle of attack of the main wing before that wing can stall. The term "canard" is also used to describe any aircraft that flies tail first.
canopy
A transparent enclosure that covers an aircraft cockpit. Modern canopies are formed from a single piece of transparent plastic.
canted gyroscope
A gyroscope within a flight instrument, usually the turn coordinator, with its rotational axis tilted, or canted, with respect to the aircraft's longitudinal axis. The tilted axis causes the gyro to respond to a banking or yawing motion.
cantilever wing
A wing attached to the fuselage without external struts or wire bracing.

carburetor icing
Because of the effect of vaporizing fuel and the decrease in pressure in the carburetor's venturi, ice can form in the carburetor throat with the presence of moisture in the air. This can occur even on warm days with temperatures as high as 100 F (38 C), but is more likely when temperatures are below 70 F (21 C) and the relative humidity is above 80 percent.
carburetor
The part of a piston engine that mixes fuel and air, creating a combustible mixture that is ignited and burned in the cylinders. Filtered air enters the carburetor through a venturi, a narrow throat. As the air flows through the venturi, its velocity increases. The air pressure drops, creating a partial vacuum that draws in fuel through a needle valve. The fuel, atomized into tiny drops, mixes with the air, and the mixture flows into the intake manifold, a tube with branches that delivers the mixture to each cylinder.
category (aircraft)
In the United States, with respect to the certification of aircraft, a grouping based on intended use or operating limitations. In the United States, all aircraft are certified in a specific category. Examples include: transport, normal, utility, acrobatic, limited, restricted, and provisional. With respect to pilot certification, category refers to a broad classification of aircraft, such as airplane, rotorcraft, and glider.
ceiling
The height above the earth's surface of the lowest layer of clouds or obscuring phenomena that is reported as "broken" or "overcast." The height of the ceiling is one of the factors that determines whether flight under visual flight rules (VFR) is possible. In the United States, the ceiling generally must be at least 1,000 feet (305 meters) for operations under VFR in controlled airspace.
ceilometer
A cloud-height measuring system. It projects light on the cloud, detects the reflection by a photoelectric cell, and determines height by triangulation.
cell
Another name for a thunderstorm or cumulonimbus cloud. Pilots, air traffic controllers, and meteorologists often use this term to report areas of intense precipitation, lightning, or turbulence associated with a thunderstorm.
center of gravity (CG)
The point at which an airplane would balance if it were suspended by a cable. The CG is also the point at which the three axes—longitudinal, lateral, and vertical—of an airplane intersect and the point at which the four fundamental forces of flight—lift, weight, thrust, and drag—are assumed to act.
Pilots must ensure that the CG of a loaded aircraft falls within a specified range, called the "CG envelope." If the CG is outside the envelope, the aircraft may be difficult or impossible to control. To determine the position of the CG, divide total aircraft movement by total weight.
centerline
A painted line running along the center of a runway (or taxiway) that divides it into two sections.
centrifugal flow
Flow of air outward from the center of rotation. Early turbine engines used the principle of centrifugal flow to compress air before it entered the combustion chamber.
centrifugal force
The force that tends to impel an object outward from the center of rotation.
Certified Flight Instructor
An individual certified by a country's aviation authority to provide flight instruction.
certified flight instructor certificate
In the United States, a certificate that allows a person to give instruction to applicants for other pilot certificates. To be eligible for a certified flight instructor (CFI) certificate, a person must be at least 18 years old and hold a current second-class medical certificate and a commercial pilot certificate. The applicant must demonstrate proficiency in teaching and in demonstrating the maneuvers required for various pilot certificates. A CFI certificate must be renewed every 24 months.
checklist
A procedure list used by pilots to systematically check and set an aircraft's systems prior to takeoff and landing and during emergencies.
checkride
A flight administered by an examiner from a country's aviation authority to test an individual before issuing a pilot certificate to that individual.
chord
Also called the "chord line," an imaginary line drawn in cross-section from the leading edge to the trailing edge of a wing. The chord line is the reference used to determine the angle of attack and to draw lift, weight, and other vectors when analyzing a wing that is producing lift.
cirriform
Clouds composed mostly or entirely of small ice crystals, usually transparent and white, often producing halo phenomena not observed with other cloud forms. Cirriform clouds include cirrus, cirrocumulus, and cirrostratus clouds. The average height of cirriform clouds ranges upward from about 20,000 feet (6,096 meters) in the middle latitudes.
cirrocumulus
A cirriform cloud appearing as a thin sheet of small white puffs resembling flakes or patches of cotton without shadows; sometimes confused with altocumulus.
cirrostratus
A cirriform cloud appearing as a whitish veil, usually fibrous, sometimes smooth. Cirrostratus clouds often produce halo phenomena and may totally cover the sky.
cirrus clouds
Feathery, high-altitude clouds composed of ice crystals. Cirrus clouds typically form in shallow, scattered-to-broken layers on the equatorial side of the jet stream when high-level moisture is available. They indicate strong upper winds. Cirrus clouds do not in themselves constitute a hazard to aircraft, but they should alert pilots to the possibility of high-altitude turbulence and the approach of developing or intense weather systems.

class
With respect to the certification of aircraft, this is a broad grouping of aircraft with similar characteristics of propulsion, flight, or landing. In the United States, the FAA recognizes the following classes of aircraft: airplanes, rotorcraft, gliders, balloons, landplanes, and seaplanes.
With respect to the certification of pilots, this is a grouping of aircraft with similar operating characteristics; for example, single engine, multiengine, land, water, and helicopter.
Class A airspace
In the United States, the airspace extending from 18,000 feet (5,486 meters) above mean sea level up to and including Flight Level 600 (approximately 60,000 feet [18,288 meters]). Formerly known as "positive control airspace (PCA)." All operations in Class A airspace are conducted according to instrument flight rules (IFR) under direct air traffic control. Class A airspace is not marked on aeronautical charts.
Class B airspace
In the United States, the airspace around the busiest major terminals. Formerly called a "terminal control area (TCA)," Class B airspace is typically arranged in rings centered on the primary airport. The innermost ring usually extends from the surface up to 10,000 feet (3,050 meters). The next rings each begin at different intermediate altitudes to allow nonairline traffic to transit the area beneath the Class B airspace and operate at satellite airports. This stair-step arrangement, drawn in cross-section, makes Class B airspace look like an inverted wedding cake.
All aircraft operating in Class B airspace must receive a clearance from air traffic control, regardless of current weather conditions. Aircraft must also have a transponder with automatic altitude-reporting capability. The boundaries of Class B airspace are marked with solid blue lines on United States aeronautical charts.
Class C airspace
In the United States, the airspace around airports that have an operating air traffic control tower, radar approach control, and a high level of IFR operations or airline traffic. Class C airspace is typically designated around second-tier airports that are not as busy as major terminals. Many military airports are also surrounded by Class C airspace.
Class C airspace is typically arranged in two rings centered around the primary airport. The innermost ring, with a typical diameter of 5 nautical miles (nm), generally extends from the surface up to 4,000 feet (1,220 meters). The next ring begins at 5 nm from the center and extends to 10 nm. It begins at 1,200 feet (365 meters) above the airport elevation and extends to 4,000 feet (1,220 meters). Class C airspace also includes an outer area, which extends to 20 nm from the primary airport
All aircraft operating in Class C airspace must establish communications with air traffic control, regardless of current weather conditions. Aircraft must also have a transponder with automatic altitude-reporting capability (Mode C). The boundaries of Class C airspace are marked with solid red lines on United States aeronautical charts.
Class D airspace
In the United States, the airspace around an airport that has an operating air traffic control tower. Class D airspace is typically a circle centered on the airport with a diameter of about 5 nm. It typically extends from the surface to 2,500 feet (762 meters) above the airport elevation. Class D airspace often includes extensions to ensure that the controlled airspace encloses instrument approaches.
All aircraft operating in Class D airspace must establish communications with the air traffic control tower, regardless of current weather conditions. The boundaries of Class D airspace are marked with dashed blue lines on United States aeronautical charts.
Class E airspace
Generally, in the United States, controlled airspace not designated as Class A, B, C, or D. Class E airspace includes low-altitude airways, extensions to Class D airspace, transition areas, and other airspace where air traffic control clearances are required when the ceiling and visibility do not meet the minimums for operations under visual flight rules (VFR).
Class E airspace typically begins at either 700 feet (213 meters) or 1,200 feet (365 meters) above the surface. It extends upward to the base of any overlying controlled airspace. When designated as an extension to Class D airspace, Class E airspace begins at the surface. Aircraft operating in Class E airspace must establish communications with the air traffic control tower only when operating under instrument flight rules (IFR). The boundaries of Class E airspace are marked with dashed red lines or with shaded red or blue lines on United States aeronautical charts.
Class G airspace
In the United States, airspace not designated as Class A, Class B, Class C, Class D, or Class E airspace. Class G airspace typically begins at the surface and extends upward to either 700 feet (213 meters) or 1,200 feet (365 meters) above ground level (AGL). The boundaries of Class G airspace are not explicitly marked on United States aeronautical charts.
clear ice
Relatively transparent ice with a homogeneous structure and few, small air spaces. Clear ice is usually associated with large, supercooled water drops typically found in cumuliform clouds. Clear ice forms when the liquid portion of a drop flows out over the aircraft surface before it freezes. Clear ice is hard, heavy, and difficult to remove.
clear-air turbulence (CAT)
Turbulence in an area where no clouds are present; in particular, turbulence at high altitudes. CAT is also sometimes used to describe turbulence associated with wispy cirrus clouds. Many phenomena can generate CAT, but it is often associated with the jet stream, especially in winter, when temperature contrast is greatest between cold and warm air. CAT also occurs in wind shears associated with sharply curved contours of strong lows, troughs, and ridges aloft, mountain waves, and areas of strong cold or warm air advection.
climbout
That portion of a flight between takeoff and the initial cruising altitude.
cloud layer
In Prepar3D, a user-specified weather option that includes the type of cloud, the heights of the bases and tops of the clouds, visibility, turbulence, and whether icing

conditions exist. You select these options in the Advanced Weather dialog box. You can create two cloud layers in each weather area.

col
In meteorology, the neutral area between two highs and two lows or the intersection of a trough and ridge. The col on a pressure surface is analogous to a mountain pass on a topographic surface.

cold front
Any non-occluded front that moves in such a way that colder air replaces warmer air.

collective
(Short for collective pitch control.) A helicopter's primary altitude and power control. It varies the lift produced by the main rotor system by increasing or decreasing the pitch of all the main rotor blades simultaneously (that is, collectively, hence the name of the control).

COM
Abbreviation for "communication"; usually refers to radio communication. Aircraft communications radios are typically labeled "COM 1," "COM2," and so forth.

commercial pilot certificate
In the United States, a pilot certificate that allows a person to act as pilot in command of an aircraft for compensation or hire. To be eligible for a commercial pilot certificate, a person must be at least 18 years old and hold a current second-class medical certificate and a private pilot certificate. The applicant must have at least 250 hours of flight time, including at least 10 hours of instruction in an aircraft with a controllable pitch propeller, flaps, and retractable landing gear. The applicant also must have at least 50 hours of cross-country flight time and meet other experience and knowledge standards.

compass rose
A graduated circle painted on a ramp or taxiway to be used by pilots to verify and compensate a magnetic compass in their aircraft.

composites
Materials consisting of glass or carbon fibers set in a matrix of plastic or epoxy resin. Composites are increasingly used in the construction of modern aircraft because they are stronger and lighter than metals. Many new kit-built and experimental aircraft are built primarily out of composites.

condensation
The change of water vapor to liquid water.

condensation trail
A cloud-like streamer that frequently forms behind aircraft flying in clear, cold, humid air. Condensation trails are also called "contrails" and "vapor trails."

contrarotating propellers
A pair of propellers, mounted one behind the other on the same engine, that rotate in opposite directions. Contrarotating propellers make more efficient use of the power from the engine and counteract the gyroscopic and aerodynamic forces generated by a single large propeller turning in one direction. The principle was first applied to an Italian Macchi-Castoldi racing plane in 1933.

control yoke
The steering-wheel-like control connected to the ailerons and elevator. A pilot turns the yoke to move the ailerons and bank the wings. The pilot moves the yoke forward and back to move the elevator, which lowers and raises the nose. Some airplanes have a stick or "joystick" instead of a control yoke.

controlled airport
An airport with an operating control tower. You must obtain a clearance to take off or land at a controlled airport and follow the tower controller's instructions while operating on or around a controlled airport. Controlled airports are usually located within Class B, Class C, or Class D airspace. The basic rules for operating at an airport with a control tower are contained in FARs 91.131, 91.130, and 91.129 and in the Aeronautical Information Manual (AIM).

controlled airspace
In the United States, airspace in which operations may require a clearance from air traffic control (ATC), especially when a low ceiling or restricted visibility requires aircraft to operate under instrument flight rules (IFR). Controlled airspace is divided into several classes (A, B, C, D, E, and G) according to standards established by ICAO. Each class has different operating rules, including requirements for communications with ATC, specific clearances from ATC, pilot qualifications, aircraft equipment, maximum operating speeds, and minimum ceiling and visibility for operations under visual flight rules (VFR).

convection
In meteorology, atmospheric motions that are predominantly vertical, resulting in vertical transport and mixing of atmospheric properties.

convective clouds
Clouds exhibiting vertical development; cumuliform clouds. Convective clouds form in air that is moving primarily upward rather than horizontally.

coordinated flight
Flight, especially during turns, in which the horizontal and vertical forces at work on the airplane are in balance. The inclinometer, part of the turn coordinator or "needle and ball," shows the pilot whether the aircraft is in coordinated flight. When the ball moves to the inside of a turn, the airplane is "slipping"—that is, the angle of bank is too steep for the rate of turn. If the ball moves to the outside of a turn, the airplane is "skidding"—that is, the rate of turn is too great for the angle of bank. Uncoordinated flight can also occur during flight at low airspeed if the pilot does not apply enough rudder to compensate for the yaw force created by the propeller and engine at high power settings.

Coordinated Universal Time
See Greenwich Mean Time.

coordinates
The intersection of lines of reference, expressed in degrees, minutes, and seconds of latitude and longitude, used to determine a position or location.

Coriolis force
A deflective force resulting from the earth's rotation. In the Northern Hemisphere, the Coriolis force deflects moving air to the right. In the Southern Hemisphere, the force

deflects moving air to the left. The force acts at a right angle to wind direction and is directly proportional to wind speed. That is, as wind speed increases, Coriolis force increases. At a given latitude, double the wind speed, and you double the Coriolis force. Coriolis force also varies with latitude, from zero at the equator, to a maximum at the poles. It influences wind direction everywhere except immediately at the equator; but its effects are most pronounced in middle and high latitudes.

course deviation indicator
A vertical needle on the omnibearing indicator (OBI) that shows your deviation from the very high frequency omnidirectional range (VOR) radial set by the course selector. If the needle is to the right of center, the radial lies to the right of your current position.

course selector
The knob or other control a pilot uses to select a VOR radial. Also known as the "omnibearing selector (OBS)."

cowling
That removable portion of the airframe of an aircraft that covers the engine.

crab angle
The angle between an aircraft's heading and ground track. This angle is determined by the crosswind component and the airspeed of the aircraft; the stronger the crosswind and the lower the airspeed, the larger the aircraft's crab angle.

critical angle of attack
The angle of attack at which a wing stalls. The critical angle of attack is determined by the airfoil design. A wing always stalls when it reaches its critical angle of attack, regardless of the aircraft's airspeed or attitude. Most general aviation aircraft have wings with a critical angle of attack of 18–20 degrees.

cross-country flight
A flight from one airport to another covering a distance great enough to require the use of some form of navigation.

crosswind
A wind that is blowing at an angle to the flight path of an aircraft. Pilots must correct for crosswinds by pointing the nose of the aircraft at some angle into the wind in order to maintain the desired course across the ground.

cruise speed
The average speed of an aircraft during straight-and-level flight at normal power settings.

cumuliform
A descriptive term applied to all convective clouds that develop vertically rather than into horizontally extended stratiform types. Cumuliform clouds develop in unstable air.

cumulonimbus clouds
Dense, vertical cloud formations that usually produce heavy rain, thunderstorms, or hailstorms. "Cumulus" is from the Latin for "heap"; "nimbus," for "rain cloud." Like all cumuliform clouds, cumulonimbus form in unstable air. A cumulonimbus cloud is heavy and dense. It can have massive towers, often with tops in the shape of an anvil or plume. Cumulonimbus clouds are often associated with virga, precipitation, and low ragged clouds (scud), lightning, thunder, and sometimes hail. They occasionally produce a tornado or a waterspout. Cumulonimbus clouds can extend well into the stratosphere.

cumulonimbus mamma
A cumulonimbus cloud having hanging protuberances, such as pouches, festoons, or udders, on the underside of the cloud. It is usually indicative of severe turbulence.

cumulus clouds
Fluffy, flat-based clouds formed by rising, unstable air. "Cumulus" is from the Latin for "heap." Cumulus clouds are usually dense and well defined. They develop vertically in the form of rising mounds; the bulging upper part often resembles cauliflower. Sunlit parts of these clouds are mostly brilliant white; their bases are relatively dark and nearly horizontal.

cyclic
Cyclic controls a helicopter's pitch-and-bank attitude (serving the same function as the yoke or stick that controls the elevator and ailerons in an airplane). It is the primary airspeed control in flight. Applying forward cyclic causes airspeed to increase. Aft cyclic reduces airspeed.

cyclone (low)
An area of low atmospheric pressure with a closed, cyclonic circulation. Viewed from above, the circulation is counterclockwise in the Northern Hemisphere, clockwise in the Southern Hemisphere, and undefined at the equator. Because cyclonic circulation and relatively low atmospheric pressure usually coexist, in common practice, the terms "cyclone" and "low" are used interchangeably. Also, because cyclones often are accompanied by inclement (sometimes destructive) weather, they are frequently referred to simply as storms. "Cyclone"" is frequently misused to denote a tornado.

D

datum
An imaginary vertical plane or line used as a reference in weight-and-balance calculations; specifically, the line from which all "arm" measurements are taken. The center of gravity (CG) is often referenced from the datum. The aircraft manufacturer sets the datum for a particular airplane. Most manufacturers set the datum at the position of the firewall separating the engine from the passenger compartment or at the tip of the propeller spinner.

dead reckoning (de'd reckoning)
The navigation of an airplane solely by computations based on airspeed, course, heading, wind direction and speed, ground speed, and elapsed time. The term derives from "deduced" reckoning. Also known as "ded reckoning."

deadstick
To execute a landing without engine power.

decision height (DH)
The altitude at which, during an ILS or other precision landing approach, a pilot must decide whether to land or execute a missed approach. A typical ILS approach has a DH of 200 feet (60 meters) above ground level.

density altitude
Pressure altitude corrected for variations from standard temperature. Density altitude measures the actual density of the air and, therefore, is a critical factor in calculating aircraft performance. If the temperature is warmer than standard, density altitude is higher than pressure altitude, and vice versa. For example, assume an airport is 3,000 feet (914 meters) above sea level and the altimeter setting is 29.92 (1013.2 millibars). If the temperature is 90 F (32 C), the density altitude is 5,592 feet (1,704 meters). An airplane taking off from this airport performs as if it's at nearly 5,600 feet (1,705 meters). The engine produces less power, the propeller is less efficient, and the wings create less lift. The airplane uses more runway to reach takeoff speed and climbs at a lower rate.
design maneuvering speed
See maneuvering speed.
detonation
The sudden, explosive burning of the air/fuel mixture in the cylinders of a piston engine. Detonation usually occurs when the air/fuel mixture is too lean—when there is not enough fuel for the current weight of air entering the cylinder. Detonation imposes excessive loads on the pistons and other engine components. If not corrected by enriching the mixture, detonation causes engine damage and may lead to sudden engine failure.
dew
Water condensed onto grass and other objects near the ground when the temperature of those objects has fallen below the initial dew point of the surface air but is still above freezing.
dew point
The temperature to which air must be cooled to reach saturation, that is, 100 percent relative humidity. Weather reports usually include the air temperature and dew point temperature. A narrow "temperature/dew point spread" (less than 2.8 C or 5 F) indicates a strong likelihood of fog, clouds, or precipitation.
dihedral
The angle at which an aircraft's wings tilt upward from the fuselage forming a slight "V" shape as seen from head-on. Dihedral increases stability about the longitudinal, or roll, axis of an airplane. It tends to level the wings after an airplane is established in a shallow bank. Anhedral, tilting the wings downward, produces the same effect, but it is much less common.
directional gyro
See heading indicator.
direct user access terminal (DUAT)
Automated weather service in the United States allowing pilots to receive weather briefings and file flight plans using personal computers.
dirigibles
A general term for airships or lighter-than-air powered aircraft. An engine and the ability to steer distinguishes airships from balloons. From the Latin, *dirigere, "to direct."*
disk cache
An information storage area. Prepar3D stores scenery information in a cache directory on your hard drive for quick access as you fly.
distance-measuring equipment (DME)
Avionics that determine and display distance in nautical miles. DME equipment, which operates in the UHF band, is usually installed at a VOR station. A complementary unit installed in the aircraft transmits timed pulses to the ground station, which replies. The unit in the aircraft converts the time between the pulses and the replies into distance and also derives ground speed and time to reach the station. The distance displayed by DME equipment is the "slant range" from the station, that is, the length of the hypotenuse of a right triangle formed by the aircraft's altitude and its distance from the station as measured along the ground. The difference between the slant range and the aircraft's actual distance from the station is negligible when the aircraft is more than about 10 nm from the station and at a moderate altitude.
downburst
A strong downdraft that results in damaging winds at or near the ground. The size of a downburst can vary from less than one-half mile to more than 10 miles.
downdraft
A relative small-scale downward current of air often observed on the lee side of large objects that restrict the smooth flow of the air, or in precipitation in or near cumuliform clouds.
downwind
The leg of a standard left or right traffic pattern that is parallel to the runway but prior to the turn to base and final.
drag
The resistance of an object to movement through a fluid. With respect to aircraft, drag is one of the four fundamental forces in flight. It opposes thrust. There are two basic types of drag. Parasite drag is caused by friction. The airplane surface, antennas, landing gear, and other appendages all cause parasite drag, which increases in proportion to the square of the aircraft's velocity. Induced drag is a by-product of lift. At the tip of a wing, air moves from the high-pressure area below the wing to the low-pressure area above. The energy used to create these vortices manifests itself as induced drag, which increases as airspeed drops.
drift
The displacement of an aircraft from its intended course caused by wind.
drizzle
A form of precipitation composed of small water droplets that appear to float with the air currents while falling in an irregular path. Drizzle differs from rain, which falls in a comparatively straight path, and fog droplets, which remain suspended in the air. In weather reports and forecasts, drizzle is indicated by the abbreviation DZ. On weather charts in the United States, drizzle is indicated by a comma (,).
dry adiabatic lapse rate
The rate of decrease of temperature with height when unsaturated air is lifted adiabatically (due to expansion as it is lifted to lower pressure).
dual

In aviation, this term refers to either the number of sets of controls in the plane, or the fact that a pilot is flying under the supervision of an instructor.

dissymmetry of lift

A condition in which the main rotor of a helicopter does not produce lift equally across the entire rotor disk. This occurs only when in forward flight or hovering in a wind and is most apparent in a retreating blade stall.

E

EFAS (Flight Watch)

Shorthand for En-route Flight Advisory Service, a weather service provided in the United States by Flight Service Stations. EFAS disseminates weather reports and forecasts, particularly en route weather, and receives and distributes pilot reports (PIREPS). Flight Watch is available throughout the United States on frequency 122.0 from 5,000 to 17,500 feet (1,500 to 5,000 meters) and on a variety of discrete frequencies for high-altitude traffic.

effective translational lift

When air moves horizontally across a helicopter blade, the rotor produces more lift at a given power setting. This occurs in forward flight or when hovering in a light wind. It might take 90 percent of a helicopter's available power to fly at 20 knots and take only 80 percent to fly at 45 knots.

electronic flight instrument system (EFIS)

Computer-driven cockpit instruments and displays that replace electromechanical instruments in many modern flight decks. The EFIS can display basic flight information, such as engine status, moving maps, checklists, and so on.

elevator

A movable control surface located on the horizontal stabilizer of an aircraft's empennage, or tail. Although its name implies that the elevator makes the airplane climb or descend, it actually controls only the aircraft's pitch attitude, that is, the angle of the nose above or below the horizon. The pilot moves the elevator by applying forward pressure on the control yoke or stick to decrease pitch attitude and by applying back pressure to increase the pitch attitude. On some aircraft, the entire horizontal stabilizer moves. This arrangement is often called a "stabilator" or "flying tail."

elevator trim

See trim.

empennage

The tail assembly of an airplane. The empennage usually includes the fin (vertical stabilizer), rudder, horizontal stabilizer, and elevator.

Experimental Aircraft Association (EAA)

One of the largest aviation organizations in the world, the EAA was founded in 1953 by Paul Poberezny and several other aviation enthusiasts as a club for people who build their own airplanes. The first fly-in convention that same year attracted about 40 people. Today, the EAA numbers more than 150,000 members around the world and brings more than 800,000 people each year to its Oshkosh Fly-In, including homebuilders, restorers of classic and antique aircraft, and warbird enthusiasts.

Extended Range Twin-Engine Operations (ETOPS)

An FAA certification that allows airlines to operate twin-engine aircraft for extended distances over water.

F

fast file

A feature of the Flight Service Station telephone system that allows a pilot to file IFR flight plans by recording them via voice mail. After the pilot hangs up, a briefer processes the flight plan.

feather

The action of turning the propeller blades until they are parallel to the aircraft fuselage. After an engine failure, a windmilling propeller can cause enough drag to seriously degrade aircraft controllability. Feathering reduces that drag by reducing aerodynamic forces on the prop, allowing it to stop windmilling. Feathering the prop is accomplished by moving the propeller levers in the cockpit into the feather position.

Federal Aviation Administration (FAA)

The federal government agency responsible for the regulation and promotion of aviation in the United States. The FAA regulates and certifies pilots, aircraft, airports, and airspace. It also manages the air traffic control system and supervises and inspects airlines, flight schools, flight instructors, maintenance technicians, and facilities. The FAA was created in 1958 to supersede the Civil Aeronautics Authority (CAA). It operated under the name Federal Aviation Agency until 1966, when it became the Federal Aviation Administration, an organization within the Department of Transportation.

Federal Aviation Regulations (FARs)

In the United States, the parts of the Code of Federal Regulations that pertain to the certification and regulation of pilots, flight schools and instructors, maintenance technicians and facilities, aircraft, air navigation, airspace, air traffic control, and other activities related to aviation and air commerce. Pilots must be familiar with and adhere to a variety of FARs. The most important parts of the FARs for day-to-day operations are: Part 1, Definitions and Abbreviations; Part 61, Certification: Pilots and Flight Instructors; and Part 91, General Operating and Flight Rules. Other parts pertain to commercial and airline operations, certificated flight schools, transportation of hazardous materials, certification standards for aircraft, and procedures for reporting accidents.

final

The leg of a standard traffic pattern that is aligned with the runway prior to touchdown. The final approach leg can be short for small planes in light air traffic or extend out a few miles from the threshold for large planes or in heavy air traffic.

fix

A reference point in space usually defined by a signal from one or more navigational aids and used by pilots for navigation.

fixed gear
Landing gear that cannot be retracted.
fixed-base operator
At an airport, a person or an organization that sells fuel, sells or rents aircraft, and possibly provides flight instruction.
flaps
A hinged portion of an airplane's wing, generally on the trailing edge, that can be lowered during takeoff and landing to increase the wings' lift and drag. When partially extended, a flap adds lift by increasing the camber, or curvature, of the wing. Because flaps extend into the oncoming air, they also increase drag, helping an aircraft descend steeply without building up speed. Modern aircraft use several types of flaps; the most common designs are plain, split, and Fowler. Often confused with ailerons, flaps are not the primary control surfaces of an airplane.
flare
To level off and establish the correct landing attitude just above the runway prior to landing. A pilot flares by applying back pressure to the control yoke or stick, which raises the nose of the aircraft. When done properly, the flare is a smooth, continuous transition from a nose-low, descending flight path to a nose-high attitude that almost stops the aircraft's descent.
flight level
The altitude measurement used by aircraft flying above 18,000 ft. Flight levels are expressed in three digits representing the pressure altitude in hundreds of feet. An aircraft flying at 35,000 feet is at FL350.
flight path
The track over the earth's surface defined by an airborne aircraft.
flight plan
Specific information about a flight that is filed either orally or in writing with air traffic control.
flight school
A facility that offers aviation training.
Flight Service Station (FSS)
A government facility that provides a variety of services to pilots. FSS personnel take weather observations, brief pilots, coordinate flight plans, and assist aircraft in distress. In the United States, the FSS network includes one or more stations in each state. Each FSS typically has responsibility for a large geographic area. FSS specialists communicate with pilots over a network of remote transmitters and receivers. They also have direct telephone and computer connections to air traffic control facilities and search-and-rescue organizations.
fly-by-wire controls
Electronic flight control system in which there are no direct mechanical links between the controls in the cockpit and the aircraft's control surfaces. A computer detects movements of the flight controls, interprets them, and sends signals to move the rudder, ailerons, and elevators. Fly-by-wire systems were first used in fighter aircraft to make aircraft more maneuverable and ensure that the pilot could not exceed the design limitations of the aircraft. Today, large transports, such as the Boeing 777 and several Airbus models, include fly-by-wire systems.
fractus
Clouds in the form of irregular shreds. They have a torn, clearly ragged appearance. The term applies only to stratus and cumulus cloud types, such as cumulus fractus and stratus fractus.
frame rate
The speed at which successive frames of a computer image display on the screen, similar to the frames of a movie passing through the light source of a movie projector.
freezing level
A level in the atmosphere at which the temperature is 0 C (32 F).
front
The boundary between two different air masses. More specifically, a surface, interface, or transition zone of discontinuity between two adjacent air masses of different densities.
frontal zone
A front or zone with a marked increase of density gradient. The term is used to describe an area of rapid transition of meteorological elements.
frontogenesis
The initial formation of a front or frontal zone.
frontolysis
The dissipation of a front.
fuel injection system
A set of controls, pumps, nozzles, and other components used in many piston engines to deliver fuel to the cylinders. The system squirts fuel directly into the cylinders or just ahead of the intake valve, where it mixes with air. Because a fuel injection system requires high-pressure pumps, an air/fuel control unit, fuel distributor, and discharge nozzles for each cylinder, it's generally more expensive than a carburetor. However, a fuel-injected engine is more efficient than a carburetor, and fuel injection is used on most large piston engines.
fully articulated
One of three types of main rotor systems used in modern helicopters. A fully articulated system utilizes three or more rotor blades that flap independently to compensate for dissymmetry of lift. Fully articulated rotor systems are more expensive than semirigid systems, but are less susceptible to low G conditions and mast bumping. However, they are more affected by ground resonance.
fuselage
The body of an airplane that holds the crew and passengers or cargo. From the French, fuselé, for "spindle-shaped."

G

G force
See Gs.

game pad
A device used as a game controller that consists of a handheld body and several buttons. Unlike a joystick, the game pad uses a D switch, which is operated by the user's thumb, for directional control.
general aviation
In the United States, a term applied to all aviation not related to the military or scheduled airline service. It includes flight training, charter flights, flying for pleasure, and business-related aviation. The term is also used to describe a broad class of aircraft not used by the military or scheduled airlines. General aviation is sometimes abbreviated as GA.
glass cockpit
Refers to the replacement of conventional cockpit gauges with computerized cathode ray tubes (CRTs) or liquid crystal displays (LCDs). A number of gauges are combined into the displays, and the pilot can often flip to different "pages" to view navigation or aircraft system information.
glide ratio
Ratio of horizontal distance traveled per unit of descent. For example, a sailplane with a 60:1 glide ratio travels 60 meters forward for every 1 meter it descends. A typical single-engine aircraft has a glide ratio of about 10:1.
glide path
The vertical path defined by an aircraft in a controlled descent.
glider
See sailplane.
glide slope
The electronic approach path projected as part of an instrument landing system (ILS). Glide slope transmitters, located near the end of a runway, send out radio signals to form the proper descent path to the runway. The angle of the glide slope is usually set about 3 degrees to the horizontal.
Global Positioning System (GPS)
A constellation of satellites that sends signals to a ground-based, seaborne, or airborne receiver. By interpreting three or more signals, the receiver can give incredibly precise information about the location of the receiver on the face of the earth, usually within 50 meters or so.
go-around
An air traffic control command for a pilot to abandon his approach to landing.
Greenwich Mean Time
The local time at the Greenwich Observatory, which lies on the prime meridian, or 0 degrees longitude. This time, now known officially as Coordinated Universal Time (UTC), is used in air navigation to provide a standard for proposed departure and arrival times, weather observations and forecasts, and air traffic control functions. Also known as Zulu time, UTC is expressed in a 24-hour format; for example, 6 P.M. is 1800 hours.
ground clearance
In aviation, this usually refers to the distance between the tips of an aircraft's propeller blades and the ground surface.
ground effect
A decrease in induced drag as an aircraft flies near the surface. The effect is caused when the ground interferes with the normal flow of air from below the wing to the low-pressure area above the wing. Ground effect is most apparent when an aircraft's height is about one-half wingspan or less above the surface. In practical terms, an aircraft flying in ground effect stalls at lower airspeed than normal. Pilots can use ground effect to lift off from a soft or short field with a minimum ground roll, but they must accelerate to normal flying speed before climbing away from the surface.
ground fog
In the United States, a fog that conceals less than 0.6 percent of the sky and that is not contiguous with the base of clouds.
ground loop
An aggravated, uncontrolled, tight turn on the ground, usually during rollout after landing or while taxiing. A ground loop often involves a turn of more than 90 degrees and frequently results in one wing touching the ground. Aircraft with tailwheels (often called taildraggers) are most susceptible to this loss of control because the center of gravity in such aircraft lies behind the main landing gear.
ground school
The portion of pilot training that is conducted in a classroom on the ground.
ground speed
An aircraft's speed relative to the ground; an aircraft's true airspeed corrected for the effects of a headwind or tailwind. For example, if an aircraft is flying level at 120 knots with a 15-knot headwind, its ground speed is 105 knots.
Gs
A measurement of the load factor, or apparent gravity, experienced by an aircraft during flight. One G represents the force of gravity exerted on a body at rest. When an aircraft climbs, turns, or accelerates, positive G forces act upon it. When it descends or decelerates, negative G forces act upon it.
gust
A sudden, brief increase in wind. In weather reports and forecasts, gusts are indicated by "G," followed by the 2- or 3-digit maximum speed, and units, usually knots (KT). For example, "G25KT" indicates wind gusting to a maximum of 25 knots.
gyro
Short for gyroscope, an instrument based on a free-spinning wheel mounted within a ring. Gyros are used in instruments such as the attitude indicator, heading indicator, and turn coordinator. Because a spinning gyro maintains its orientation even when an airplane banks, climbs, or dives, it provides a stable reference to help pilots control an aircraft while flying in clouds or poor visibility.
gyroplane
A type of rotorcraft that relies on aerodynamic forces to spin the main rotor during normal flight.
gyroscopic precession
The reaction of a gyro when a force is applied to the spinning wheel. When force is applied to a gyro, it reacts as if the force had been applied at a point 90 degrees from

the point of actual application, in the direction of rotation. Precession affects propellers, which act like gyros, and gyro instruments. Its principal effect is on the heading indicator, which tends to drift over time.

H

hail
Frozen precipitation often associated with thunderstorms. Hail forms when supercooled water droplets begin to freeze. After a drop has frozen, other drops latch on and freeze to it. The hailstone grows—sometimes into a huge iceball. As hailstones fall through warming air, they begin to melt, and precipitation may reach the ground as either hail or rain. Rain at the surface does not mean the absence of hail aloft. You should anticipate possible hail with any thunderstorm, especially beneath the anvil of a large cumulonimbus. In weather reports and forecasts, hail is denoted by the abbreviation "GR," from the French, grêle.

heading
The direction in which the aircraft is pointed, usually in reference to magnetic north. Because wind pushes an airplane in flight, heading does not necessarily correspond to the aircraft's path over the ground, that is, its track. For example, if you want to fly due east with respect to the ground and the wind is blowing from the north, you must turn the aircraft slightly into the wind to correct for drift.

heading indicator
A gyro instrument that accurately and quickly shows changes in aircraft heading, sometimes called the "directional gyro," or "DG." Because the heading indicator is driven by a gyro, it provides smooth, precise indication of heading or turns. The compass, which is subject to acceleration, deceleration, dip, and other errors, often oscillates or leads or lags a turn. However, because gyros are affected by precession, the pilot must periodically set the heading indicator to correspond to the compass (unless the heading indicator is "slaved" electronically to the compass).

headwind
A wind that blows in opposition to the intended course of flight.

high
An area of high barometric pressure. Also called an anticyclone or high-pressure system.

high-performance airplane
As defined in FAR 61.31(e), an airplane that has more than 200 horsepower or that has retractable landing gear, flaps, and a controllable propeller. A private or commercial pilot may not act as pilot in command of a high-performance airplane unless a flight instructor has certified that the pilot is competent to fly such aircraft.

holding pattern
An ovoid-shaped pattern flown in reference to a fixed (nav radio) reference point. Holding patterns are assigned by ATC to provide traffic separation during peak load times.

hood
A view-limiting device worn by pilots who are learning or practicing flight by instruments. The hood covers the upper portion of the pilot's field of vision. A safety pilot or instructor must always accompany a pilot who is using a hood.

horizontal situation indicator (HSI)
An instrument that combines the functions of the heading indicator and the VOR indicator in one display.

horizontal stabilizer
The horizontal surface of the tail, or empennage. The horizontal stabilizer is an airfoil that creates a downward force on the tail to balance the upward force generated by the wing. It also incorporates the elevator, the control surface used to adjust the aircraft's pitch attitude. On some airplanes, the entire horizontal stabilizer acts as an elevator.

horsepower
A unit of power equal to 745.7 watts or 33,000 foot-pounds per minute. The power exerted by one horse pulling.

hypersonic
Speeds at or above Mach 5 (that is, five times the speed of sound).

hypoxia
A condition in which an insufficient amount of oxygen reaches the tissues of the human body. The complete lack of oxygen, called anoxia, is fatal. Hypoxia is a serious hazard at high altitudes, particularly because its warning symptoms are varied and sometimes difficult to detect. Cabin pressurization or oxygen equipment is generally necessary for flying at altitudes at or above 10,000 feet (3,048 meters).

I

IFR en route charts
Navigational charts that depict aids to navigation, airways, and restricted airspace. Used for navigation by pilots flying instrument flights.

Immelmann
An aerobatic maneuver said to have been invented by World War I ace Max Immelmann in which an airplane reverses its direction of flight while gaining altitude. The maneuver begins with a half loop. At the top of the loop, the pilot rolls the plane upright. In modern aerobatic competitions, an Immelmann is called a "half loop, half roll."

inclinometer
An instrument that displays the inclination to the horizontal of an axis. In most aircraft, there is an inclinometer at the bottom of the turn coordinator. It indicates when the aircraft is yawing to the left or right.

indefinite ceiling
A ceiling classification that describes vertical visibility into a surface-based obscuration.

indicated airspeed (IAS)
The speed shown on the airspeed indicator uncorrected for variations in atmospheric density, installation error, or instrument error. Except at sea level under standard

atmospheric conditions, IAS does not correspond to the aircraft's actual speed through the surrounding air (that is, its true airspeed, or TAS).

indicated altitude

Altitude read directly from the altimeter after it is set to the local barometric pressure corrected to sea level. Indicated altitude is not corrected for temperature. Pilots use indicated altitude to control their aircraft.

induced drag

The portion of total drag created by lift. Induced drag is created when high-pressure air below a wing swirls around the wing tip to the low-pressure area above. This motion creates vortices, which in effect siphon off the aircraft's energy. This lost energy is induced drag. Induced drag increases as airspeed decreases.

infrared

Electromagnetic radiation with wavelengths beyond the red end of the visible color spectrum. Infrared photography, used in aerial surveillance, can penetrate haze and clouds to capture images of objects that are not visible to the naked eye.

initial climb

An aircraft's climb away from the runway after liftoff.

inner marker

Marker beacons are selective signal transmitters used in conjunction with instrument landing systems. The inner marker is located between the middle marker and the runway threshold. Used during Category II instrument approaches, it is the point at which an aircraft will be decision height on the glide slope.

instrument approach chart

Also known as the "approach plate." Approach charts depict, both horizontally and in elevation, the procedure to be flown during an instrument approach at a specific airport.

instrument approach procedure (IAP)

An official procedure designed to guide aircraft to a runway when a visual descent isn't possible. IAPs describe the route and altitude aircraft are to fly as they transition from en route flight to landing. There are two basic types of instrument approach procedures: nonprecision and precision. Nonprecision approaches do not have an electronic glide slope to provide vertical guidance to landing aircraft. Examples of nonprecision approaches include VOR, NDB, localizer, and GPS approaches. Precision approaches have electronic glide slopes that provide precise vertical guidance. The most common precision approach is the ILS.

instrument flight rules (IFR)

In the United States, regulations that apply to pilots, aircraft, and aircraft operations when weather conditions do not meet the criteria for visual flight, when aircraft are operated in Class A airspace—that is, at altitudes at and above 18,000 feet (5,486 meters), or when pilots choose to operate in controlled airspace under those rules regardless of the prevailing weather. The rules establish minimum fuel reserves, equipment requirements and checks, and other operational standards for instrument flight.

The abbreviation "IFR" is sometimes used to describe weather that doesn't meet the minimums established for flight under visual flight rules (VFR). For example, if an air traffic controller alerts a pilot to nearby traffic and the pilot is flying in the clouds, the pilot may say, "I'm IFR" and ask for a change in heading or altitude to avoid a conflict. The proper abbreviation for describing those conditions is "IMC," for "instrument meteorological conditions."

instrument flight time

Flight time during which the pilot operates an aircraft solely by reference to instruments under actual or simulated instrument flight conditions. Instrument flight time is not necessarily the total time during which an aircraft operates under instrument flight rules (IFR).

instrument landing system (ILS)

A system of navigation aids and approach lights that provide both horizontal and vertical guidance to aircraft approaching a runway. The ILS is the primary precision-approach system in use today around the world. A typical ILS includes a localizer and a glide slope, as well as outer, middle, and inner marker beacons. The localizer transmits a directional signal that provides left/right guidance. The glide slope is an electronic glide path that defines the proper descent angle to the runway. Marker beacons indicate distance from the runway.

instrument meteorological conditions

Weather conditions that require flight under instrument flight rules (IFR). In controlled airspace in the United States, IMC conditions generally mean that the ceiling is less than 1,000 feet (305 meters) and flight visibility is less than 3 miles (5 kilometers).

instrument rating

A rating added to a pilot certificate that allows a pilot to act as pilot in command of an aircraft solely by reference to flight instruments. An instrument rating is required for operations in clouds or when the ceiling and visibility are less than required for flight under visual flight rules (VFR). A pilot also must hold an instrument rating to act as pilot in command of an aircraft in class A airspace. In the United States, class A airspace begins at 18,000 feet (5,486 meters) above mean sea level.

instrument scan

A methodical scan of the primary flight instruments during a flight in instrument flight conditions (flight by reference to the instruments).

instrument

From 14 CFR Part 1: "A device using an internal mechanism to show visually or aurally the attitude, altitude, or operation of an aircraft or aircraft part. It includes electronic devices for automatically controlling an aircraft in flight."

intercooler

A mechanical device between the turbocharger and the carburetor. When the turbocharger compresses air, the air becomes too hot to use. The air is cooled by being passed through the intercooler before it enters the induction system.

International Civil Aviation Organization (ICAO)

Based in Montreal, this body sets international standards for airports, pilots, communications, and other matters related to air transportation.

International Standard Atmosphere (ISA)

An arbitrary standard established as a baseline for calculations used in meteorology, aviation, and aerodynamics. A set of standard conditions exists for each altitude. At sea level, standard conditions are defined as 29.92 inches of mercury (1,013 millibars) and 59 F (15 C).

intersection

In aviation, a point in space defined by the intersection of signals from two or more navigation transmitters.

interstage turbine temperature (ITT)

Temperature of gases in a turbine engine as measured between the high-pressure and low-pressure turbine wheels. ITT is a limiting factor of the amount of power an engine can produce.

inversion

An increase in temperature with height. An inversion is the reverse of the normal decrease of temperature with height in the troposphere.

inverted

Upside down.

isobar

A line of equal or constant barometric pressure, as shown on a weather chart.

isogonic line

A line on a chart connecting points of equal magnetic variation.

isotherm

A line of equal or constant temperature, as shown on a weather chart.

J

Jet-airways

Airways delineated by navigation radio signals for high routes (18,000 to 45,000 feet MSL). Sometimes referred to as "J" airways, or highways in the sky.

jet blast

The high-velocity stream of air exiting a jet engine's exhaust nozzle.

jet stream

A quasihorizontal stream of winds of 50 knots or more concentrated within a narrow band. The term usually applies to such winds embedded in the westerlies in the high troposphere.

joystick

Name sometimes given to the stick used to control the ailerons and elevators in some aircraft. The joystick is said to have been invented by French aviator Robert Esnault-Pelterie in 1907.

In Prepar3D, "joystick" refers to an input device connected to a computer's game port and used to control the ailerons and elevator. A computer joystick may also incorporate buttons and switches to control the throttle, landing gear, flaps, and other functions.

K

katabatic wind

A wind blowing downslope.

kneeboard

A clipboard used in the cockpit to hold charts and other items the pilot needs to have at hand. Kneeboards are sometimes, but not always, strapped to the pilot's knee.

knots

Nautical miles per hour. Abbreviation: kt, kts, or KTS. One nautical mile (nm or NM) measures 6,076 feet (1,852 meters). This distance is based on the length of one minute of arc of a great circle—an arc representing the shortest distance between two points on a globe. One knot equals about 1.15 statute miles per hour; therefore, 100 knots equals about 115 mph (185 kilometers per hour), 150 knots equals about 172 mph (278 kilometers per hour), and 200 knots equals about 230 mph (370 kilometers per hour). All speeds filed on flight plans and for air traffic control purposes are in knots. In the United States, light aircraft manufactured in 1976 and later have airspeed indicators marked in knots. Earlier models had airspeed indicators marked in statute miles per hour.

Note that "knots" by definition assumes "per hour." You should never state speed as "knots per hour.

L

landing gear

The wheels, struts, and other equipment that an aircraft uses to land or maneuver on the ground. Also known as the "undercarriage." The two most common types of landing gear are "taildragger" and ""tricycle" arrangements. On a taildragger, the front of the aircraft is supported on two wheels, while the tail rests on the ground on a skid or a tailwheel. With tricycle landing gear, the aircraft sits level on the ground with one nosewheel and two wheels farther back on the aircraft. The main landing gear are those nearest the airplane's center of gravity. Main landing gear almost always come in pairs and are designed to withstand a greater landing shock than the more-fragile nosewheel or tailwheel.

landing roll

The distance from the point where an aircraft touches down on the runway to the point where the aircraft comes to a stop or can exit the runway.

landplane

An airplane with wheels that can land on land, as opposed to a floatplane or a skiplane.

lapse rate

The average decrease of temperature with altitude. In the lower level of the atmosphere, the standard lapse rate is 2 C (3.6 F) per 1,000 feet (305 meters). Weather forecasters and pilots use the actual lapse rate to estimate the altitude at which the temperature and dew point will merge and lead to the formation of clouds or precipitation. An increase in temperature with altitude is an inversion.

large aircraft
In the United States, an aircraft with a maximum certificated takeoff weight of more than 12,500 pounds (5,670 kilograms). To act as pilot in command of a large aircraft, a pilot must have a type rating for that aircraft.
laser
A device that produces an intense, focused beam of energy in the form of light rays.
lateral axis
One of the three axes of an aircraft, the lateral axis is defined by an imaginary line running from wing tip to wing tip. Movement about the lateral axis is called "pitch" and is controlled by the elevator.
leading-edge slats
Openings near the forward edge of a wing designed to allow more air to flow over the top of a wing at high angles of attack, thus delaying the onset of a stall. Leading-edge slats and flaps are often known as high-lift devices.
left-turning tendency
The result of four forces that together cause a propeller-driven aircraft to yaw to the left. This tendency is most pronounced when the airplane is flying at a low airspeed and a high angle of attack. The pilot compensates by applying and holding right rudder pressure.
The four forces are: the reactive force, the spiraling slipstream, gyroscopic precession, and "P factor." The reactive force is the opposite and equal force generated by the rotation of the propeller. This force induces a rolling motion about the airplane's longitudinal axis. The spiraling slipstream is the rotating column of air produced by the propeller. It swirls around the fuselage and strikes the left side of the vertical stabilizer, producing a left yaw. Gyroscopic precession occurs when the nose of the airplane rises or falls. This change in pitch attitude applies a force to the spinning mass of the propeller, which is 90 degrees ahead of the point where the force was applied. "P factor," or asymmetric propeller loading, induces a left yawing motion because the downward-moving propeller blade has a higher angle of attack and produces more thrust than the upward-moving blade.
lenticular cloud (lenticularis)
A species of cloud whose elements have the form of more or less isolated, generally smooth lenses, or almonds. These clouds appear most often in formations of orographic origin—the result of lee waves—in which case, they remain nearly stationary with respect to the terrain (standing cloud), but they also occur in regions without marked orography.
lift
The upward force produced by an airfoil, such as a wing interacting with the air. Lift acts at right angles to the relative wind or the aircraft's flight path. Lift, one of the four fundamental forces in flight, is opposed by weight.
liftoff
The moment at which an aircraft leaves the ground during takeoff.
light aircraft
Generally speaking, small single- and twin-engine aircraft. More precisely, in the United States, aircraft with a maximum-certified takeoff weight of 12,500 pounds(5,760 kilograms) or less.
light-gun signals
Colored lights that control tower operators use to issue instructions to aircraft without radios or to aircraft that have a radio failure. The red, green, and white lights convey such messages as "cleared to land," "stop," and "exercise extreme caution." The meaning of all the signals is defined in FAR 91.125.
light icing
Ice, regardless of type, that accumulates slowly. Anti-icing or deicing equipment prevents accumulations. Light icing may become hazardous to aircraft without anti-icing or deicing equipment if conditions persist for an hour or more.
light turbulence
In aviation weather reports and pilot reports, turbulence that momentarily causes slight, erratic changes in altitude, attitude, or both. When light turbulence produces rhythmic bumpiness without appreciable changes in altitude or attitude, it is called "chop." In light turbulence, occupants may feel a slight strain against seat belts or shoulder straps. Unsecured objects may be displaced slightly. On large aircraft, food service may be conducted and walking is possible with little or no difficulty.
lightning
Short, intense electrical discharges generated by thunderstorms. Lightning is rarely a great hazard to most aircraft, but it can damage electronic equipment. Lightning can also temporarily blind a pilot.
load factor
The ratio between the total load supported by an aircraft's structure and the actual weight of the aircraft and its contents; also known as "Gs." In steady-state flight, the load factor is 1. When an aircraft turns or pulls up out of a dive, load factor increases. For example, an airplane in a level turn at a bank angle of 60 degrees experiences a load factor of 2. In such a turn, the aircraft's structure must support twice the airplane's weight and the pilot must increase the aircraft's pitch attitude to produce more lift.
local airport advisory
Pertinent, known field conditions and local weather provided to pilots by a Flight Service Station or the military for airports without an operating control tower.
local weather area
In Prepar3D, a user-defined region with similar weather characteristics. You can create two local weather areas, each with a different type of weather. Unless you specifically create a local weather area, all weather characteristics are assigned to the global weather area.
localizer
The component of the instrument landing system (ILS) that provides left-right guidance to a pilot approaching the runway. The localizer is a highly directional radio signal transmitted on one of 40 channels between 108.10–111.95 MHz. The beam is funnel-shaped. It is typically 10 degrees wide 18 nautical miles from the runway, narrowing to just 700 feet (213 meters) wide at the threshold.
logbook

An FAA-required record of events to be kept by pilots listing all flight activity. Also required by the FAA are logs on engines, airframes, propellers, and rotors showing the amount of time in service and any maintenance performed on each part.

Lomcevàk

A tumbling aerobatic maneuver. First conceived of by Ladislav Bezàk, a former world-champion aerobatic pilot, the maneuver has at least five variations—all initiated from a near-vertical attitude and flown under negative G forces. Although Lomcovàk is commonly believed to be the Czech or Polish word for "headache," it apparently comes from a Slovak slang term for a large, stiff drink.

longitudinal axis

An imaginary line running from the nose to the tail of an aircraft; one of the three axes of an aircraft. Rotation about the longitudinal axis is called "roll" and is controlled using the ailerons.

longitudinal separation

A minimum distance expressed in minutes or miles between aircraft at the same altitude.

loop

An aerobatic maneuver in which an aircraft flies in a complete vertical circle. An outside loop, begun at the top of the circle, is considerably more difficult to perform, because the pilot encounters negative G-forces throughout the maneuver.

low

An area of low barometric pressure, including the attendant system of winds. Also called a barometric depression, or cyclone.

low G

A condition in which a helicopter's rotor blades have a load of less than 1 G (the weight of the helicopter) exerted upon them. This can occur due to abrupt cyclical control movements, flying in turbulence, or when pushing over from a steep climb. When pushing over from a steep climb, a low G condition will cause the nose to drop and the aircraft to roll to the right. The main rotor may hit the tail boom, and helicopters with semirigid rotor systems may experience mast bumping. Either effect could cause the loss of the main and tail rotors.

Recovering from a low G condition before losing control entails gently applying aft cyclic to raise the nose and load the main rotor. Apply left cyclic to counteract the right-turning tendency.

M

Mach number

The ratio of an aircraft's speed to the speed of sound. The speed of sound varies with the density of the medium carrying the sound waves. For example, sound travels faster through iron or water than through air. Because the density of air decreases with altitude, the speed of sound also decreases. Sound travels at approximately 1,226 kilometers per hour (762 mph) at sea level, 1,138 kilometers per hour (707 mph) at 20,000 ft (6096 meters), and 664 mph (1,068 kilometers per hour) at 35,000 feet (10,668 meters). Named for Ernst Mach, Austrian physicist.

Mach 1

The speed of sound. Mach 1 varies according to altitude and temperature: At sea level, it is about 762 mph (1,226 kilometers per hour); at the bottom of the troposphere, Mach 1 is about 660 mph (1,062 kilometers per hour). Above the tropopause, at about 36,000 feet (11,000 meters), the speed of sound remains constant.

magnetic compass

A device for determining direction relative to the earth's magnetic field.

magnetic course

A line drawn on a chart between two points with its direction referenced to the earth's magnetic North Pole.

magnetic declination

See magnetic variation.

magnetic heading

The direction in which an aircraft is pointed, measured relative to the magnetic north pole. The magnetic heading is displayed on the compass. A pilot determines the magnetic heading to fly by compensating for the difference between true north and magnetic north and then adjusting the resulting magnetic course to compensate for wind. If the wind is blowing directly along the intended course, the magnetic heading equals the magnetic course. If a crosswind component is present, however, a pilot must turn the aircraft slightly into the wind to compensate. Under these conditions, the airplane's track over the ground is slightly different from the direction in which the nose is pointing.

magnetic variation

The angle between "true north" and "magnetic north"; that is, the angle between the geographic North Pole and the magnetic North Pole as measured from a point on the earth. To determine the magnetic course between two points on the earth's surface, a pilot must determine the true course—the angle formed between the line drawn on a chart and lines of longitude—and then add or subtract the variation at points along that course.

magneto

A device that creates an electric current by rotating a magnet. In aircraft engines, the crankshaft turns the magnetos, which provide the electrical energy to fire the spark plugs. This arrangement ensures that the spark plugs fire even if the aircraft's battery and electrical system fail. Certified aircraft engines typically have two sets of magnetos for additional redundancy.

maneuvering speed (Va)

The maximum speed at which the pilot can use full, abrupt control movement without creating excessive G forces that could damage the aircraft; the maximum speed at which you can safely stall an aircraft. Pilots also use maneuvering speed when flying through turbulent air.

Abbreviated "Va," maneuvering speed is not marked on the airspeed indicator.

manifold pressure gauge

An instrument that measures the air pressure in the intake manifold of a piston

engine. Usually calibrated in inches of mercury, this instrument (really a barometer) is used in combination with the tachometer to set engine power. Most small training aircraft have only a tachometer. Aircraft with larger engines and aircraft with constant-speed propellers usually have manifold pressure gauges.

manually coordinated flight

See uncoordinated flight.

marker beacons

Low-power radio beacons that identify specific positions along an instrument approach, usually an ILS. A typical ILS has at least two marker beacons. The outer marker (OM) normally indicates the point at which an aircraft intercepts the electronic glide slope. It transmits three dashes in Morse code. On the instrument panel, the OM is indicated by a blue light. The middle marker (MM) indicates a position about 3,500 feet (1,067 meters) from the runway threshold. It also marks the point where an aircraft is about 200 feet (61 meters) above the elevation of the runway touchdown zone. The middle marker transmits a "dot-dash-dot-dash" code and is indicated in the cockpit by an amber light.

Some ILSs also have an inner marker (IM), which indicates the point at which an airplane flying along the proper glideslope reaches the decision height. The inner marker transmits a rapid "dot-dot-dot-dot" code and is indicated in the cockpit by a white light.

maximum L/D

Maximum lift-to-drag ratio. This is the speed at which the aircraft will travel the farthest distance for a given altitude at a given weight. Also known as Best Glide.

minimum sink

The speed at which the aircraft will lose the least amount of altitude over time at a given weight.

mayday

The international call for help. The term comes from the French phrase, m'aidez (help me), pronounced "mayday." This is the voice-transmission equivalent of the letters SOS used in code transmissions.

mean sea level (MSL)

The average level of the earth's oceans; used as reference for true altitude—the vertical distance of an aircraft above sea level. Airport, terrain, and obstacle elevations shown on aeronautical charts are expressed as true altitude.

measured ceiling

A ceiling classification applied when the ceiling value has been determined by instruments or the known heights of unobscured portions of objects other than natural landmarks.

medical certificate

In the United States, a certificate showing that a pilot, required flight crewmember, or air traffic controller meets a set of physical and mental standards established for the safe operation of an aircraft or the performance of other duties. The FAA issues third-, second-, and first-class medical certificates. The certification standards are more restrictive with each class. Student, recreational, and private pilots are required to hold at least a third-class medical certificate, which is valid for either 24 or 36 months. A second-class medical is required for certain commercial operations. It is valid for 12 months for those operations and for 24 months for noncommercial operations. Airline pilots require a first-class medical, which is valid for 6 months for air carrier operations, 24 months for certain commercial operations, and 24 months for noncommercial operations.

METAR

From the French term for Aviation Routine Weather Report, the worldwide standard report for hourly weather observations taken at airports. The United States recently adopted the METAR to replace SA reports. A METAR includes the following information: type of report, station designator, time of report, wind, visibility, weather and obstructions to visibility, sky condition, temperature and dew point, altimeter setting, and any remarks.

microburst

Violent, localized winds often associated with thunderstorms. In a microburst, strong vertical downdrafts spill out of a thunderstorm and then spread along the ground, like water poured from a bucket. These downdrafts can exceed 6,000 feet per minute (1,829 meters per second) and create strong wind shears—areas where the speed and direction of the wind change abruptly. An airplane flying through a microburst and the associated wind shear experiences rapid changes in airspeed and can even sink to the ground if caught in a strong downdraft.

middle marker

A marker beacon located approximately 3,500 feet from the runway threshold. This is the point at which an aircraft will be approximately 200 feet AGL on the glide slope.

millibar (mb)

An international unit of pressure equal to 1,000 dynes per square centimeter. It is convenient for reporting atmospheric pressure.

mixed ice

A combination of clear and rime ice that can form rapidly. Mixed ice forms when water drops vary in size or when liquid drops are intermingled with snow or ice particles. Ice particles become imbedded in clear ice, building a rough accumulation, sometimes in a mushroom shape, on the leading edges of an aircraft's surfaces.

mixture control

A device for controlling the ratio between fuel and air entering an engine's carburetor or fuel injection system. In most aircraft, the mixture control is a push-pull knob or lever marked in red, usually located to the right of the throttle.

Because aircraft engines operate over a wide range of altitudes, the pilot must adjust the mixture to produce the most efficient fuel/air mixture as an airplane climbs into less dense air or descends into more dense air. A mixture that is too rich contains too much fuel for the existing conditions and causes the engine to run rough and lose power. A mixture that is too lean can cause an engine to overheat or can cause detonation—the sudden, explosive combustion of fuel within the cylinders.

mmo

Abbreviation for Mach maximum operating speed; the maximum airspeed, indicated in Mach number, at which an aircraft can be operated safely. The actual value of

mmo varies with atmospheric pressure, temperature, and other factors.

moderate icing

Ice, regardless of type, that accumulates at a rate that requires the use of anti-icing or deicing equipment. Aircraft without such equipment must divert immediately.

moderate turbulence

In aviation weather reports and pilot reports, turbulence that causes changes in altitude or attitude and small variations in airspeed. The aircraft remains in positive control at all times, Occupants feel definite strains against seat belts or shoulder straps. Unsecured objects are dislodged. On large aircraft, food service and walking are difficult.

monoplane

An airplane having only one main pair of wings. Monoplanes create less drag than biplanes, but early aircraft relied on biplane designs because of the ease of constructing a sufficiently strong plane this way. Once engineering advanced to the stage where strong monoplanes were possible, the biplane design became obsolete.

mountain waves

A standing wave or lee wave to the lee of a mountain barrier; waves created by massive amounts of air pushed over mountain ranges, such as the Rockies and the Sierra Nevada in the United States. Intense mountain waves are typically produced when a strong, turbulent jet stream flows directly across a mountain ridge. Sailplane pilots often use mountain waves to soar to high altitudes—50,000 feet (15,240 meters) or more.

N

N1

The rotational speed of the low-pressure compressor in a dual-spool gas turbine engine.

N2

The rotational speed of the high-pressure compressor in a dual-spool gas turbine engine.

National Aeronautics and Space Administration (NASA)

A civilian agency of the United States government created in 1958 with the responsibility for all nonmilitary developments in aeronautics and space flight. NASA replaced the National Advisory Committee for Aeronautics.

National Flight Data Center

A facility in Washington, D.C. established by the FAA for the dissemination of aeronautical information essential to flight safety.

National Transportation Safety Board (NTSB)

In the United States, the government agency that investigates aircraft accidents and determines their probable cause. The NTSB is independent of the FAA, which regulates aviation. The FAA participates in accident investigations and responds to recommendations made by the NTSB when the board determines that new regulations, procedures, or equipment would help prevent future accidents.

nautical mile (nm)

A distance of about 6,076 feet (1852 meters). The nautical mile is based on the length of one minute of arc of a great circle. In aviation, distances and speeds are measured in nautical miles (nm) and nautical miles per hour (knots).

NAV

Abbreviation for navigational; usually refers to a navigational radio, as in "NAV 1" or "NAV 2."

NAV/COM

A radio that combines the functions of communication and navigational radios.

navigation lights

The basic anticollision light system required on all aircraft certified to fly at night. The system includes a red light on the left wing tip, a green light on the right wing tip, and a white light on the tail. These lights tell other aircraft which direction an aircraft is flying when only the lights can be seen. Navigation lights must be turned on between sunset and sunrise.

navigational aid

Any visual or electronic device, either airborne or ground-based, established to provide point-to-point guidance information or position data to aircraft in flight.

nimbostratus

A principal cloud type, gray colored, often dark. Its diffuse appearance is caused by more or less continuously falling rain or snow, which in most cases reaches the ground. A nimbostratus cloud is thick enough throughout to blot out the sun.

Ninety-Nines (99s)

Association of women fliers formed in 1929 with 99 charter members, including Amelia Earhart, Jackie Cochran, Louise Thaden, and Amy Johnson. The Ninety-Nines were responsible for the acceptance and respect accorded women contestants in the air races of the 1930s. Today, the Ninety-Nines is a worldwide organization with thousands of members.

nondirectional radio beacon (NDB)

A radio beacon that transmits nondirectional signals in the low- or medium-frequency band (190–535 kHz); today, used primarily for NDB nonprecision approaches and in conjunction with the outer marker component of an ILS. An automatic direction finder (ADF) points to these beacons.

nonprecision approach

Nonprecision approaches do not have an electronic glide slope to provide vertical guidance to landing aircraft. Examples of nonprecision approaches include VOR, NDB, localizer, and GPS approaches.

nose gear

In an aircraft equipped with tricycle landing gear, the wheel located under the forward end of the fuselage.

nose over

To rapidly lower the nose relative to the horizon; to decrease pitch. On the ground, a nose over—an aircraft tipping forward or doing a somersault—can result when the nosewheel digs into a soft surface or when a tailwheel-equipped airplane decelerates too rapidly.

Notice to Airmen (NOTAM)
A notice containing information not known far enough in advance to publish, provided for persons concerned with flight operations. NOTAMs generally deal with changes in facilities, services, procedures, or hazards in the National Airspace System.

O

obscuration
In weather reports, denotes a sky hidden by surface-based phenomena and restricted vertical visibility overhead.
occluded front (occlusion)
A composite of two fronts as a cold front overtakes a warm front, or a quasistationary front.
oleo-pneumatic
A hydraulic-air system usually incorporated into aircraft landing-gear systems. Oleo-pneumatic shock absorbers dissipate the shock of landing by forcing fluid through a restrictor valve from the upper chamber of the strut to the lower chamber.
omnibearing indicator (OBI)
The instrument that displays information about an aircraft's position relative to a VOR station. The OBI includes a needle, or course deviation indicator (CDI), to show the aircraft's position relative to a selected course or "radial" and a TO-FROM-OFF indicator that shows the aircraft's position relative to the VOR station. A glideslope needle is also included in some OBI. Each OBI is typically connected to a navigation receiver (NAV 1 or NAV 2).
ornithopter
Hypothetical human-powered flying machine based on flapping wings. Leonardo da Vinci was perhaps the first to attempt a scientific design of ornithopters, but the idea reaches back at least to the Greek legend of Daedalus and Icarus. No actual ornithopter has ever been built.
orographic
Of, pertaining to, or caused by mountains, as in orographic clouds, orographic lift, or orographic precipitation.
outer marker
A marker beacon that usually indicates a point at which an aircraft at the appropriate altitude on a localizer course will intercept the glideslope on an ILS approach.
oversquare operation
Running with the manifold pressure at a higher setting than the rpm. For instance, "square" would be 24 inches of manifold pressure (MP) and 2400 rpm. "Oversquare" would be 26 inches MP and 2400 rpm. Pilots used to be warned not to run the engines oversquare, but now, oversquare is considered acceptable and can be more efficient.
ozone
An unstable form of oxygen. The heaviest concentrations of ozone are in the stratosphere. Ozone is corrosive to some metals and it absorbs most ultraviolet solar radiation.

P

panel
Equivalent to an automobile's dashboard, the panel is the surface in which the aircraft's instruments and radios are installed. Larger aircraft often have multiple panels, sometimes on the sides or ceiling of the cockpit.
Pan-Pan
Indicates uncertainty or alert when transmitted three times successively followed by the nature of the urgency.
parasite drag
Resistance to motion through the air composed of form drag (due to landing gear, radio antennas, shape of the wings, and so on), skin friction, and airflow interference between aircraft components (such as the junction of the wings and fuselage, or fuselage and tail). Parasite drag increases as the square of velocity. It is one component of total drag, the force that opposes thrust. The other component is induced drag, a by-product of lift.
partial obscuration
A designation of sky cover when part of the sky is hidden by surface-based obscuring phenomena.
performance booster
Software to enhance performance of Prepar3D or scenery add-ons. The performance booster monitors your aircraft's position and automatically loads scenery from the CD-ROM drive to a disk cache on your hard drive.
phonetic alphabet
A spoken alphabet endorsed by the International Civil Aviation Organization (ICAO) and used by pilots and air traffic controllers to avoid confusion during radio communications. Instead of saying "a," "b," "c," pilots say "alpha," "bravo," "charlie," and so on.
Pilcher, Percy
1866–1899. Scottish marine engineer whose experiments with gliders between 1895 and 1899 produced a number of design advances. Pilcher was developing a light engine for use with one of his gliders but did not complete the project. Like his mentor, Otto Lilienthal, Pilcher died when one of his gliders crashed.
pilot certificate
In the United States, a pilot license. The FAA issues several types of pilot certificates, including student, recreational, private, commercial, certified flight instructor, and airline transport pilot certificates. Pilot certificates define broad privileges and limitations. Ratings on those certificates (single-engine land, instrument, multiengine land, helicopter, and so on) further specify the classes of aircraft that a pilot may fly and whether the pilot is allowed to act as pilot in command when the weather does not meet the minimums specified for flight under visual flight rules (VFR).
pilot in command
The pilot responsible for the operation and safety of an aircraft during flight time. For purposes of logging flight time, a pilot holding a recreational, private, or commercial

pilot certificate may log as pilot-in-command time (PIC time) only that flight time during which that pilot is the sole manipulator of the controls. The pilot must hold an appropriate pilot certificate and rating for the aircraft. An airline transport pilot may log as PIC time all of the flight time during which that pilot acts as PIC. A certified flight instructor may log as PIC time all flight during which that pilot acts as PIC.

pilot report (PIREP)

A PIREP describes actual in-flight conditions, such as the height of clouds, visibility, precipitation, turbulence, and icing. On weather reports in the United States, pilot reports are preceded by the letters "UA." A pilot report includes the following items: position relative to a weather reporting station or navigation aid, time (UTC), altitude, aircraft type, cloud types and altitudes, visibility, outside air temperature, wind, turbulence, and any remarks. Some of the information may be omitted.

pilotage

Flying cross-country from one visible landmark to another using only a chart.

Piper, Bill

1881–1970. American aircraft manufacturer who founded Piper Aircraft Corporation in 1937. Piper left his earlier career in oil exploration to invest in Taylor Brothers, builder of the E-2 Cub. He took over the company in 1932 and changed its name five years later. Piper Aircraft was, for many years, the world's leading producer of light aircraft.

piston engine

One of the common terms for an internal-combustion reciprocating engine.

pitch

Movement of an aircraft about its lateral axis (nose up or nose down), or the angle of an airplane's nose above or below the horizon. The pilot moves the control stick or yoke forward and back to move the elevator, located on the horizontal stabilizer. Forward pressure lowers the nose; back pressure raises the nose.

pitch/power rule

The pitch/power rule states that for normal flight, unless the throttle is fully open or fully closed, power changes should be used to change airspeed, and pitch changes should be used to change altitude.

pitot tube

A small metal probe, usually attached to a wing or the nose of an aircraft, that measures ram air pressure as the aircraft moves. The pitot tube is part of the pitot-static system. It is connected directly to the airspeed indicator, which displays the ram air pressure on a scale, usually calibrated in knots. The pitot tube usually has a heater to prevent ice from blocking the device. The probe is named after Henri Pitot (1695–1771), a French scientist who invented devices to measure the flow of water in rivers and canals.

pitot-static system

The sensors, connecting lines, and flight instruments that measure, transmit, and display information about an aircraft's airspeed, altitude, and rate of climb or descent. The pitot-static system includes the pitot tube, static ports, and tubing that connects the sensors and instruments in the cockpit. The airspeed indicator is connected to both the pitot tube and the static ports. The altimeter and vertical speed indicator are connected only to the static ports.

pivot point

The center of gravity on an aircraft.

positive control

From 14 CFR Part 1: "Control of all air traffic, within designated airspace, by air traffic control."

power glide

A long, shallow approach in which engine power is used to maintain the glide. Power glides should be avoided when they are not required to maintain instrument flight rule (IFR) approach angles, because an engine failure can cause an aircraft to land short of the runway.

power plant

An aircraft engine, propeller, and all components necessary for their proper functioning.

practical test

In the United States, an oral and flight test required for a pilot certificate or rating. Practical tests are given by government inspectors or designated examiners. The required knowledge and performance standards for each pilot certificate or rating are specified in a series of Practical Test Standards (PTS) available from the Government Printing Office or from many publishers of aviation-related books and study guides.

precipitation

Any or all forms of water particles, whether liquid or solid, that fall from the atmosphere and reach the surface. Precipitation is distinguished from cloud and virga in that it must reach the surface.

precipitation-induced fog

Fog formed when relatively warm rain or drizzle falls through cool air. Evaporation from the precipitation saturates the cool air and forms fog. Precipitation-induced fog can become quite dense and persistent. It often extends over large areas, completely suspending flight operations. It is most commonly associated with warm fronts, but it can occur with slow-moving cold fronts and with stationary fronts. Precipitation-induced fog is especially critical because it occurs in precipitation and related hazards such as icing, turbulence, and thunderstorms.

preflight briefing

The acquisition of weather conditions and forecasts for a route of flight prior to takeoff.

pressure altimeter

An aneroid barometer with a scale graduated in altitude instead of pressure. Using standard atmospheric pressure-height relationships, a pressure altimeter shows indicated altitude (not necessarily true altitude). It may be set to measure indicated altitude from any arbitrarily chosen level.

pressure altitude

The altitude indicated when the altimeter is set to 29.92 inches of mercury or 1013.2 millibars. Pressure altitude is used in several important calculations, including the determination of density altitude, true altitude, and true airspeed. In the United

States, aircraft operating at 18,000 feet (5,486 meters) or higher fly at "flight levels," which are pressure altitudes. When operating at or above FL180, the pilot should set the altimeter to 29.92 to display pressure altitude.

prevailing easterlies
The broad current or pattern of persistent easterly winds in the tropics and polar regions.

prevailing visibility
In the United States, the greatest horizontal visibility that is equaled or exceeded throughout half of the horizon circle; it need not be a continuous half.

prevailing westerlies
The dominant west-to-east motion of the atmosphere, centered over middle latitudes of both hemispheres.

primary flight instruments
The six instruments displayed on the standard instrument cluster: airspeed indicator, attitude indicator, altimeter, turn coordinator, heading indicator, and vertical speed indicator.

private pilot certificate
In the United States, a pilot certificate issued to a person who does not intend to act as a pilot in command for compensation or hire. To be eligible for a private pilot certificate, a person must be at least 17 years old and hold a current third-class medical certificate. To earn a private pilot certificate, a person must acquire at least 40 hours of flight time, including 20 hours of flight instruction and 20 hours of solo flight time. The training must include basic maneuvers, cross-country navigation, and other specific tasks.

procedure turn
A predefined turn during an instrument approach that reverses the aircraft's course and puts it on the final approach heading to the runway.

prognostic chart
A chart of expected or forecast weather conditions.

propeller
Often called a "prop;" a rotating airfoil that is driven by an aircraft engine. The propeller produces thrust when turning and either pushes or pulls the aircraft through the air.

propwash
The air blown back from an airplane propeller (or rotor, in the case of helicopters).

pushback
The act of being pushed back from an airport terminal gate. This is usually done by hooking a small tug to the nose wheel of a large aircraft and pushing it backwards into the taxi lane. In Prepar3D, press SHIFT+P to push back from the gate.

Q

R

radar
A device for detecting distant objects by reflecting radio waves from their surfaces. The British first integrated radar into their military defenses, and its value during the Battle of Britain was enormous. Today, radar is the primary tool for air traffic control. Some aircraft also carry weather radar, designed to detect precipitation and wind shears associated with thunderstorms and other hazards.

radar altitude
The altitude of an aircraft determined by radar or radio altimeter. It is the actual distance between an aircraft and the ground or water surface directly beneath it.

radarsonde observation
An observation in which winds are determined by tracking a balloon-borne target with radar.

radial
One of the 360 "spokes," one for each degree in a circle, radiated from a VOR station. To fly a specific course, the pilot tunes the appropriate VOR station and selects a radial to fly. An indicator in the cockpit, called an OBI, shows the aircraft's position relative to that radial.

radial engine
A type of reciprocating piston engine in which the cylinders are arranged like the spokes of a wheel.

radiation fog
Fog characteristically formed over land at night or near daybreak when cooling of the earth's surface lowers the air temperature near the ground to or below the initial dew point. Radiation fog is especially common on calm, clear nights. It is relatively shallow and may be dense enough to hide the entire sky.

radio stack
The area where the COM, NAV, and transponder radios are installed in an aircraft instrument panel. Radios are usually arranged in a vertical column, or stack.

radiosonde
A balloon-borne instrument for measuring pressure, temperature, and humidity aloft.

rate of climb
The speed (usually measured in feet per minute) at which an aircraft is climbing. The term sometimes is stretched to include the rate of descent. The rate of climb is read on the vertical speed indicator (VSI).

rate of climb indicator
See vertical speed indicator (VSI).

rating
In the United States, an endorsement added to a pilot certificate that specifies the classes of aircraft (single-engine land, instrument, multiengine land, helicopter, and so forth) that a pilot may fly and whether the pilot is allowed to act as pilot in command when the weather does not meet the minimums specified for flight under visual flight rules (VFR).

rate of sink

See sink rate.

rawinsonde observation

A combined winds-aloft and radiosonde observation. Winds are determined by tracking the radiosonde by radio direction finder or radar.

recreational pilot certificate

In the United States, a pilot certificate issued to a person who intends to fly only for recreation in basic aircraft. To be eligible for a recreational pilot certificate, a person must be at least 17 years old and hold a current third-class medical certificate. To earn a recreational pilot certificate, a person must acquire at least 30 hours of flight time, including 15 hours of flight instruction. Recreational pilots are subject to many restrictions. For example, they may not carry more than one passenger and must remain within 50 nautical miles of an airport where they received flight instruction. Recreational pilots are restricted to basic single-engine aircraft with no more than 180 horsepower, four seats, and fixed landing gear. They also cannot fly at night, above 10,000 feet (3000 meters), or when the visibility is less than 3 sm.

relative humidity

The ratio, usually expressed in percent, between the amount of water present in the air and the maximum amount that could be present at a given temperature. Warm air can hold more water vapor than cool air. If temperature increases and the amount of water vapor in the air remains constant, relative humidity decreases. If temperature drops while the amount of water vapor stays constant, relative humidity increases. Air with 100 percent relative humidity is said to be "saturated." The temperature at which the air reaches 100 percent relative humidity is called the "dew point."

relative wind

The speed and direction of air striking an airfoil; that is, the air flow caused by an aircraft or airfoil's movement through the air. The relative wind blows parallel and opposite to the aircraft's flight path. The angle between the relative wind and the chord line is the angle of attack. Lift acts perpendicular to the relative wind.

resolution

The level of graphics detail displayed on a computer screen.

retractable gear

Landing gear that can be retracted into the fuselage of an aircraft. Though they are more complex than fixed-gear, the ability to retract the gear provides a significant reduction in drag.

retreating blade stall

A condition in which a helicopter's rotor blades on the left side of the rotor disk (as viewed from above) exceed their critical angle of attack and stall. This is most apparent during high forward speed and is the primary limiting factor on a helicopter's maximum speed. Recovery from a retreating blade stall entails lowering the collective to reduce the rotor blade's angle of attack and slowing down.

reverse thrust

An engine's thrust directed forward to help slow the aircraft's forward motion. On turbojet aircraft, this is accomplished by the use of movable devices that are extended across the engine's exhaust path or by movement of the cowling on high-bypass turbofans. On turboprop engines, this is accomplished by movement of the propeller blades into a position that directs thrust forward.

ridge

In meteorology, an elongated area of relatively high atmospheric pressure; usually associated with and most clearly identified as an area of maximum anticyclonic curvature of the wind flow. In soaring, rising terrain that is often accompanied by rising air.

ridge lift

An area of rising air created when wind blows against the side of a ridge and is deflected upward. In such conditions, sailplanes can stay aloft for hours by flying parallel to a ridge and riding those rising currents of air.

rigid

One of three main types of main rotor systems used in modern helicopters. A rigid rotor system utilizes three or more rotor blades that flap independently to compensate for dissymmetry of lift. Unlike the fully articulated system, the rigid system is hingeless, and the rotors can lead and lag independently.

Rigid rotor systems are typically made of composite materials and titanium (and are, therefore, expensive) and tend to give a rough ride. They resist low G conditions and ground resonance, and are less expensive to maintain than other rotor systems.

rime ice

White or milky and opaque granular deposits of ice formed by the rapid freezing of supercooled water droplets on exposed parts of an aircraft. Rime ice forms when drops are small, usually in stratiform clouds or light drizzle. The liquid portion remaining after initial impact freezes before the drop spreads over the aircraft surface. The small frozen droplets trap air between them, giving the ice a milky appearance. Rime ice is lighter than clear ice, but its irregular shape and rough surface quickly degrade the efficiency of airfoils.

roger

Used to acknowledge that the speaker has understood a radio transmission he or she has received.

roll

Rotation about an aircraft's longitudinal axis. The pilot controls roll, or the bank of the wings, with the ailerons. A roll is also an aerobatic maneuver in which an airplane rotates completely around its longitudinal axis.

roll cloud

A dense and horizontal roll-shaped accessory cloud located on the lower leading edge of a cumulonimbus. Roll clouds can also be found near a rapidly developing cumulus cloud. They indicate turbulence.

rotary engine

Type of piston engine, common in World War I aircraft, with a stationary crankshaft and cylinders that rotate around the crankshaft. Rotary engines were lighter-weight, more reliable, and more easily cooled than many contemporary radial and inline piston engines, but they had high fuel consumption and their rotational inertia sometimes made an aircraft difficult to maneuver.

rotation
Pulling back on the control yoke or stick to raise the nose of an aircraft during the takeoff roll.
rotation speed (Vr)
The speed at which the pilot should pull back on the control yoke or stick to begin raising an aircraft's nose during takeoff.
rotor
The rotating airfoil that provides lift or antitorque capabilities on a helicopter. Can also refer to the moving part of an axial-flow compressor in a turbine engine.
rotor cloud
A turbulent cloud formation found in the lee of some large mountain barriers, the air in the cloud rotates around an axis parallel to the range; indicative of possible violent turbulence.
roundout
See flare.
rudder
A movable control surface usually mounted on the vertical stabilizer of the tail. The rudder moves the aircraft about its vertical, or yaw, axis. It does not, however, turn the airplane. It is used primarily to balance forces in turns and to counteract yawing motions induced by the propeller during flight. A pilot moves the rudder by applying pressure to the left or right rudder pedal. The pedals are mounted on the floor of the cockpit. In normal maneuvering, the pilot uses simultaneous aileron and rudder pressures to maintain balanced or coordinated flight.
runway
A prepared surface designed for departing or landing aircraft.
run-up
Before taking the runway for takeoff, most pilots of piston-powered aircraft "run up" the engine(s) to a high rpm setting to test the magnetos and carburetor heat, and to check vacuum system suction, among other things. Better to find problems on the ground before takeoff, than in the air.
runway visual range (RVR)
The horizontal distance (in feet or meters) that a pilot should be able to see down the runway from the approach end. RVR is based on either the sighting of high intensity runway lights or on the visual contrast of other objects, whichever yields the greatest visual range.

S

S turn
A taxiing technique employed by pilots of tailwheel aircraft. Due to the attitude of a taildragger when it's sitting on the ground, the nose of the aircraft limits forward visibility. By alternately turning the aircraft left and right, the pilot can see ahead of the aircraft.
Also refers to a technique used in flight during training. Student pilots are taught to S turn across a fixed ground reference (such as a road), in order to gain proficiency in making uniform turns.
sailplane
A highly efficient unpowered aircraft that can maintain or gain altitude by riding thermals or other rising air.
saturated adiabatic lapse rate
The rate of decrease of temperature with height as saturated air is lifted with no gain or loss of heat from outside sources. This value varies with temperature, and is greatest at low temperatures.
scan
Refers to the methodical examination of flight instruments during IFR flight. Can also refer to a methodical examination of the sky around an aircraft when looking for traffic.
scud
Small detached masses of stratus fractus clouds below a layer of higher clouds, usually nimbostratus. More generally, "scud" is any low-level clouds or fog. Pilots who fly at low altitude beneath clouds are said to be "scud running."
sea fog
A type of advection fog formed when air that has been lying over a warm surface is transported over a colder water surface.
see and avoid
The responsibility of pilots flying in visual meteorological conditions (VMC) to look for other aircraft and avoid them.
semimonocoque
A kind of fuselage construction that distributes the structural load of the aircraft between its skin and the framework.
semirigid
One of three main types of main rotor systems used in modern helicopters. A semirigid rotor system utilizes two rotor blades that flap together as a unit to compensate for dissymmetry of lift. Semirigid rotor systems are relatively inexpensive to maintain but are susceptible to low G conditions, and their flapping characteristics can lead to mast bumping.
settling with power
Also called a retreating blade stall. A condition in which a helicopter's rotor blades on the left side of the rotor disk (as viewed from above) exceed their critical angle of attack and stall. This is most apparent during high forward speed and is the primary limiting factor on a helicopter's maximum speed. Recovery from a retreating blade stall entails lowering the collective to reduce the rotor blade's angle of attack and slowing down.
severe icing
Icing, regardless of type, that accumulates so rapidly that even aircraft equipped with anti-icing or deicing equipment must divert immediately.
severe turbulence
In aviation weather reports and pilot reports, turbulence that causes large, abrupt changes in altitude, attitude, or both. Severe turbulence usually causes wide

variations in indicated airspeed. The aircraft may be momentarily out of control. Occupants are forced violently against seat belts or shoulder straps. Unsecured objects are tossed about. On large aircraft, food service and walking are impossible.

shaft horsepower (SHP)

A power output measurement for turboprop engines. SHP is determined by propeller rpm, and the torque power output of exhaust and shaft forces is called Equivalent Shaft Horsepower (ESHP).

shock wave

Created when airflow changes abruptly from subsonic to supersonic speed, causing an enormous increase in air pressure and temperature. When an aircraft travels above Mach 1, shock waves bend backward to form a cone. If this cone reaches the earth's surface, it causes an explosive sound called a sonic boom.

shower

Precipitation from a cumuliform cloud. A shower is characterized by the suddenness with which it begins and ends, by a rapid change of intensity, and usually by rapid change in the appearance of the sky. Showery precipitation may be in the form of rain, ice pellets, or snow.

SIGMET advisory (significant meteorological information)

An advisory of concern to all aircraft that covers severe weather conditions.

sink rate

Negative vertical velocity, usually expressed in feet per second.

simplified directional facility

A navigational aid used for nonprecision approaches. Similar to an ILS, but not as accurate.

skid

A turn in which the rate of turn is too great for the angle of the bank. In a skid, the ball at the bottom of the turn coordinator moves to the outside of the turn. To correct a skid, use the ailerons to increase the bank, reduce rudder pressure, or both, in the direction of the turn.

slat

A movable auxiliary airfoil on the leading edge of a wing. The slat extends into the flow of air and creates a gap that allows air to flow smoothly over the top of the wing, delaying the stall at high angles of attack.

slewing

In Prepar3D, a method of rapidly changing aircraft position, direction, location, or altitude without flying.

slip

A turn in which the rate of turn is too slow for the angle of the bank. In a slip, the ball at the bottom of the turn coordinator moves to the inside of the turn. To correct for a slip, use the ailerons to decrease the bank, increase rudder pressure, or both, in the direction of the turn. Pilots also use forward slips and side slips to correct for crosswinds during landings and to increase an aircraft's rate of descent without increasing its airspeed.

slow flight

Flight at an aircraft's minimum controllable airspeed.

solo

Flight during which only one pilot is flying the aircraft.

speed brakes

A type of secondary control on a highly streamlined aircraft designed to allow it to descend rapidly without an excess buildup of airspeed. Speed brakes produce drag without affecting lift or changing the aircraft's pitch.

spin

A steep, spiraling descent during which an aircraft is stalled and rotating rapidly. The characteristic rotation is the result of a strong yawing moment that occurs when one wing is stalled while the other still produces some lift.

spoilers

Panels on an aircraft's wings that disrupt the flow of air over the wing surface. Spoilers reduce the wing's lift and increase drag. They enable a jet aircraft to make a rapid descent without building excess speed. They are also used immediately after landing to "dump" lift and increase braking efficiency. Sailplane pilots also use spoilers during descent and landing to control their rate of descent.

spool up

To increase power in a jet engine.

spot plane

A view in Prepar3D that allows the user to see the airplane they are flying as though they were viewing it from another plane flying alongside.

squall

A sudden increase in wind speed by at least 15 knots to a peak of 20 knots or more and lasting for at least one minute. The essential difference between a gust and a squall is the duration of the peak speed.

squall line

A narrow band of active, often severe, thunderstorms not associated with a front. Squall lines often form ahead of a cold front in moist, unstable air, but they can also develop in unstable air far removed from any front. Squall lines present the single most-intense weather hazard to aircraft. They usually develop rapidly and reach maximum intensity during the late afternoon and early evening. Squall lines may also be too long to fly around and too wide and severe to fly through, creating a true barrier in the sky.

stability (aircraft)

Generally, a measure of how an object reacts after it is disturbed by an outside force. Aircraft stability is classified as three types. Positive stability is the tendency to return to steady-state flight after a change in attitude or power. Aircraft are generally designed to exhibit positive stability. An aircraft with neutral stability would remain in the new attitude after being disturbed and would not return to its initial condition. An aircraft with negative stability would diverge from its initial condition, with the oscillations increasing with time.

Stability can also be classified as "static" and "dynamic." Static stability is the initial tendency to return to equilibrium. Dynamic stability refers to the dampening of oscillations over time.

stability (atmospheric)
A measure of the vertical movement of air within an air mass. More specifically, it is a state of the atmosphere in which the vertical distribution of temperature is such that a parcel of air resists displacement from its initial level.
stabilizer
See horizontal stabilizer, vertical stabilizer.
stall
A sudden loss of lift caused by a disruption of the normal smooth flow of air over the upper surface of a wing. A stall is an aerodynamic phenomenon and has nothing to do with the engine. A stall occurs when a wing's angle of attack reaches a specific value, called the critical angle of attack. It is this angle between the wing and the oncoming air—not the airplane's speed, weight, or pitch attitude relative to the horizon—that determines when a wing stalls. In fact, an airplane can stall at any airspeed and in any attitude.
stall speed
The speed at which an aircraft enters a stall under a specified set of conditions. Although an airplane always stalls when the wing's angle of attack reaches the critical angle of attack, the speed at which the stall occurs depends on the aircraft's weight, load factor, the amount of thrust being produced, angle of bank, position of flaps and landing gear, and other factors.
In fact, an airplane can stall at any airspeed—because regardless of speed, a stall occurs only when the angle between the relative wind (parallel and opposite to the aircraft's flight path) and the wing reaches the critical angle of attack.
standard atmosphere
A hypothetical atmosphere based on climatological averages. The most important constants defined in the standard atmosphere are: a surface temperature of 15 C (59 F) and a surface pressure of 1,013.2 millibars (29.92 inches of mercury) at sea level; a lapse rate in the troposphere of approximately 2 C (3.6 F) per 1,000 feet (6.5 C per kilometer), a drop in pressure of approximately 1 inch of mercury per 1,000 feet (110 millibars per 1,000 meters), a tropopause of approximately 36,000 feet (11 kilometers) with a temperature of –56.5 C; and an isothermal lapse rate in the stratosphere to an altitude of approximately 80,000 feet (24 kilometers).
standard conditions
An arbitrary standard established as a baseline for calculations used in meteorology, aviation, and aerodynamics. A set of standard conditions exists for each altitude. At sea level, standard conditions are defined as 29.92 inches of mercury (1,013 millibars) and 59 F (15 C).
Standard Terminal Arrival Route (STAR)
A published procedure that provides an efficient route for arrival at an airport while on an IFR flight plan. STARs are designed to facilitate air traffic control.
Standard Instrument Departure (SID)
A published procedure that provides an efficient route for departure from an airport while on an IFR flight plan. SIDs are designed to facilitate air traffic control.
standard pressure
An arbitrary standard established as a baseline for calculations used in meteorology, aviation, and aerodynamics. A standard pressure is defined at all altitudes. At sea level, the standard is 29.92 inches of mercury or 1,013 millibars.
standard rate turn
A turn of either 3 degrees or 1.5 degrees per second. Small aircraft typically use the 3 degrees per second rate, which results in a 360-degree turn after 2 minutes. Large, fast aircraft typically use the slower rate, which results in a 360-degree turn after 4 minutes. Pilots use the standard rate turn while flying under Instrument Flight Rules (IFR). It provides a steady, predictable, and easy-to-control rate of turn. Standard rate turns are also useful if the heading indicator fails. The pilot can make accurate turns to specific headings by banking at the standard rate and timing the turn.
standard temperature
An arbitrary standard used by aeronautical engineers and pilots in calculations to determine aircraft performance, true airspeed, true altitude, and so forth. The standard temperature is part of the definition of the International Standard Atmosphere (ISA). At sea level, the standard temperature is defined as 59 F (15 C). The standard temperature of dry air drops by about 3.5 F (2 C) per 1,000 feet (305 meters). The standard temperature drops to about 32 F (0 C) at about 7,500 feet (2,300 meters).
standardized instrument cluster
An industry-accepted standard for arranging the six most-commonly used flight instruments on an aircraft instrument panel. The instruments are arranged in two rows. The top row contains the airspeed indicator, attitude indicator, and altimeter. The bottom row contains the turn coordinator, heading indicator, and vertical speed indicator.
stationary front
A front in which neither air mass is replacing the other. In such cases, the surface winds tend to blow parallel to the frontal zone. The slope of a stationary front is normally shallow, although it may be steep, depending on wind distribution and density difference.
statute mile (sm)
A distance of 5,280 feet (1,609 meters). In the United States, statute miles are used to measure visibility in weather reports. Speeds and distances are measured and reported in nautical miles (6,076 feet or 1,852 meters) or nautical miles per hour (knots).
steady-state flight
Flight in which the opposing pairs of forces (lift and weight, thrust and drag) are balanced. An aircraft is considered to be in steady-state flight when it flies at a constant altitude and airspeed, or when it flies at a constant airspeed and is climbing or descending at a constant rate.
steam fog
Fog formed when air blows from a cold surface (either land or water) over warmer water.
stick
A tubular control in some aircraft, usually between the pilot's knees, used to control

the aircraft about its roll and pitch axis (the same function as a yoke).

stick shaker

A mechanism that shakes the control column in some aircraft to warn the pilot of an impending aerodynamic stall.

STOL

Abbreviation for "short takeoff and landing." It describes aircraft capable of operating from airfields with short runways.

stop and go

Similar to a touch and go landing, except the aircraft makes a complete stop.

straight-and-level flight

One of the more difficult maneuvers to master. Like a balancing act, straight-and-level flight requires that you make smooth, small corrections to keep from wobbling all over the sky. To master straight-and-level flight, you must hold a constant altitude and hold a constant heading.

stratiform

Clouds with extensive horizontal development. Stratiform clouds develop in stable air and, therefore, are composed of small water droplets.

stratocumulus

A low, predominantly stratiform cloud. It is usually a mosaic of gray and whitish patches or layers. The layers may or may not merge, and such clouds are rounded or roll-shaped with relatively flat tops.

stratosphere

The region of the earth's atmosphere above the troposphere and tropopause, beginning at an altitude of 5–10 mi (8–16 km), depending on latitude and season. The stratosphere is a region of relatively uniform temperatures and winds, extending to about 30 miles (48 kilometers), where it meets the mesosphere.

stratus clouds

A low, gray cloud layer or sheet with a fairly uniform base formed in stable air. Stratus clouds sometimes appear in ragged patches. They seldom produce precipitation, but may produce drizzle or snow grains.

student pilot certificate

In the United States, a pilot certificate issued to a pilot in training. To be eligible for a student pilot certificate for powered aircraft, a person must be at least 16 years old and hold at least a current third-class medical certificate. A student pilot certificate is valid for 24 months. Student pilots cannot carry passengers, act as pilot in command of an aircraft for compensation or hire, or make international flights (except between certain places in Alaska and Canada). Student pilots can fly only when visibility is at least 3 sm (5 sm at night) and must maintain visual contact with the ground. Student pilots also must receive specific endorsements from a certified flight instructor before flying solo, making cross-country flights, or operating an aircraft in certain types of controlled airspace. Those endorsements must be renewed every 90 days.

sublimation

The changing of ice directly to water vapor, or water vapor to ice, bypassing the liquid state in each process. Snow or ice crystals result from the sublimation of water vapor directly to the solid state.

subsonic

Speeds below the speed of sound, that is, less than Mach 1.

supercharger

A compressor used to increase the density of the air or the air-fuel mixture supplied to a piston engine. As an aircraft climbs, the density of the air entering the engine decreases. Without a supercharger or a turbocharger, an engine gradually loses power. A normally aspirated, or "unboosted," engine is most efficient at about 8,000 feet (2,438 meters). By the time an aircraft reaches 18,000 feet (5,486 meters), the density of the air is about half its value at sea level, and a supercharger or turbocharger is required for efficient operation of the engine.

supercooled water

Water droplets colder than 0 C (32 F). When supercooled droplets strike an exposed object, such as an aircraft's wings and other structures, the impact induces freezing. Supercooled water droplets often are in abundance in clouds at temperatures between 0 and –15 C with decreasing amounts at colder temperatures. However, strong vertical currents may carry supercooled water to great heights where temperatures are much colder. Supercooled water has been observed at temperatures colder than –40 C.

supersonic

Speed that exceeds the speed of sound; Mach 1 or greater.

surface inversion

An inversion with its base at the surface, often caused by cooling of the air near the surface as a result of terrestrial radiation, especially at night.

surface visibility

Visibility observed from eye-level above the ground.

synchrophaser

A device that automatically adjusts the speed of the propellers of all engines on a multiengine aircraft so that a master blade on each propeller keeps the same relative position in its rotation to the master blade of each of the other propellers. Propellers out of synch result in higher cabin-noise levels and a sort of washing-machine-like sound. During World War II, pilots flying with their props out of synch earned the nickname "Washing Machine Charlie."

T

tachometer

The instrument that shows the speed of rotation of the engine. It is marked in revolutions per minute (rpm). Engines that produce more than about 180 horsepower usually have constant-speed propellers that can change the blade angle to make more efficient use of engine power throughout a wide range of airspeeds.

taildragger

An aircraft that has its main wheels mounted ahead of the center of gravity and a small pivoting or steerable wheel supporting the aft fuselage. There is no nosewheel, as with tricycle-gear aircraft. Taildraggers were the norm during the early years of

aviation and are sometimes referred to as conventional-gear aircraft. They are trickier to handle on the ground than tricycle-gear aircraft and require special training and skill.

tailwind

A wind that blows in the same direction as the aircraft is traveling.

takeoff roll

The portion of the takeoff during which the airplane accelerates on the runway.

taxi

To move an aircraft under its own power on the ground.

temperature layer

In Prepar3D, a user-specified weather option that includes the air temperature at a specific altitude and the day-night variation in temperature. You select temperature options in the Advanced Weather dialog box. You can create four temperature layers to see how temperature affects density altitude and aircraft performance.

temperature-dew point spread

The difference between air temperature and dew point temperature. As this difference narrows, clouds and fog are more likely to appear. Pilots must also be aware that even if the spread at ground level is quite large, as temperature drops with altitude, the spread narrows, and clouds may form. Pilots should be especially alert for fog whenever the temperature-dew point spread is 5 F (2.8 C) or less and decreasing.

terminal velocity dive brakes

See spoilers.

tetrahedron

A large wind-direction indicator made of lightweight material in the shape of pyramid.

thermal

A rising column of air caused by the sun heating the earth's surface. Sailplane pilots use thermals to climb or maintain altitude.

threshold

The beginning of the runway surface that is usable for landings. The threshold may coincide with the physical end of the runway or be displaced if part of the runway is not usable for landings. The threshold is marked by a single white line on visual runways or by eight parallel white lines arranged in two groups of four on either side of the centerline of an instrument runway.

throttle

The cockpit control that most directly determines the power output of the engine. In a piston engine, the throttle actually controls the amount of air entering the carburetor or induction system. The carburetor, or fuel metering system, mixes the appropriate amount of fuel with the air to create a combustible mixture. When fully "open," the throttle allows the maximum amount of air to enter the system to produce maximum power. When the throttle is "closed," only a small amount of air enters the system and the engine produces minimum power.

thrust

The forward force generated by a propeller or jet engine that moves the aircraft forward through the air. One of the four major forces, thrust is opposed by drag.

thunderstorm

In general, a local storm invariably produced by a cumulonimbus cloud and always accompanied by lightning and thunder.

tie-down

The spot on an airport ramp where an aircraft is parked and secured with ropes or chains. Airplanes are designed to fly, so they must be tied down to prevent catastrophe in windy weather.

tilt-rotor

A vertical-takeoff aircraft with rotors that can tilt from the horizontal to the vertical. An example of this type of aircraft is the V-22 Osprey.

torque

A force that produces or attempts to produce rotation.

touch and go

A landing during which the aircraft does not come to a complete stop before power is applied and the aircraft takes off again. Often done for pilot practice and training.

tower

A building on an airport from which an air traffic controller directs traffic within the immediate airport traffic area. The top of the tower, called a cab, is usually glassed in on all sides giving a 360-degree view.

tower visibility

Prevailing visibility determined from the control tower.

towering cumulus

A rapidly growing cumulus in which height exceeds width.

trace icing

Icing, regardless of type, that accumulates at about the same rate as it dissipates by sublimation. Trace icing is not considered hazardous, even to aircraft without anti-icing or deicing equipment, unless the airplane remains in icing conditions for more than one hour.

track

The path followed by an aircraft while in flight.

trade winds

Prevailing, almost continuous, winds blowing with an easterly component from the subtropical high pressure belts toward the intertropical convergence zone. They blow northeast in the Northern Hemisphere, southeast in the Southern Hemisphere.

traffic

Aircraft other than yours that present a potential for occupying the same airspace.

traffic pattern

The traffic flow prescribed for aircraft landing at and taking off from an airport. Also called a "circuit" in Britain. A complete landing pattern includes a downwind leg, a base leg, and a final leg. Aircraft taking off typically fly an upwind leg and crosswind leg to depart the airport traffic pattern.

trainer

Aircraft used for pilot training. They are usually (not always) single-engine light

aircraft.

transmissometer

An instrument system that measures the transmission of light through the atmosphere. The transmission value is converted either automatically or manually into visibility, runway visual range (RVR), or both.

translating tendency

The tendency of a helicopter to drift in the direction of the tail rotor thrust.

transonic

Speeds close to the speed of sound in which both subsonic and supersonic airflow conditions exist. Transonic speeds range from about Mach 0.8 to Mach 1.4.

transponder

An airborne transceiver that receives signals from air traffic control (ATC) radar and replies with a preset identification code, or "squawk," set by the pilot. A computer uses the code to display information about each aircraft on an air traffic controller's radar display. Most aircraft today are also equipped with altitude encoders, which transmit the aircraft's altitude along with the transponder code. In the United States, aircraft operating under visual flight rules (VFR) squawk code 1200 unless they are using air traffic control services and are assigned a specific code by ATC. Under instrument flight rules (IFR), all aircraft are assigned transponder codes by ATC.

transverse flow effect

A decrease in lift in the aft portion of a helicopter rotor disk when in forward flight or hovering in a wind.

tricycle-gear

A landing gear system that includes a nosewheel assembly and two main gear assemblies. Because the center of gravity of a tricycle-gear airplane lies ahead of the main gear, this geometry is much more stable on the ground than the so-called conventional gear or "taildragger" arrangement, which has two main gear assemblies and a tailwheel.

trim

To adjust a movable tab on a control surface, usually the elevator, to relieve pressure on the flight controls. Trim is necessary because as an aircraft changes speed, the amount of air flowing over the control surfaces varies. Without trim, a pilot would have to hold forward or back pressure on the yoke or column to maintain a specific airspeed or pitch attitude. Larger aircraft also have aileron and rudder trim.

tropopause

A thin layer in the upper atmosphere that forms the boundary between the troposphere and stratosphere. The tropopause is usually characterized by an abrupt change in lapse rate. The height of the tropopause varies from about 65,000 feet (19.8 kilometers) over the equator to 20,000 feet (6,096 meters) or lower over the poles. Temperature and wind vary greatly in the vicinity of the tropopause. Maximum winds generally occur at levels near the tropopause. These strong winds create narrow zones of wind shear, which often generate hazardous high-altitude turbulence.

troposphere

The layer of the atmosphere from the surface to an average altitude of about 7 miles (11 kilometers). Most weather occurs within the troposphere. Temperature generally decreases with altitude in the troposphere at an average rate of 2 C (3.6 F) per 1,000 feet (305 meters). The height of the troposphere varies with latitude and seasons. It slopes from about 20,000 feet (6,096 meters) over the poles to about 65,000 feet (19.8 kilometers) over the equator. It is higher in summer than in winter. A very thin layer called the tropopause marks the boundary between the troposphere and the next highest layer, the stratosphere.

trough

In meteorology, an elongated area of relatively low atmospheric pressure. A trough is usually associated with and most clearly identified as an area of maximum cyclonic curvature of the wind flow.

true airspeed (TAS)

An aircraft's actual speed through the surrounding air. As an aircraft climbs, the surrounding air becomes less dense. Therefore, indicated airspeed tends to decrease as altitude increases. To determine how fast the airplane is really moving through the air, the pilot calculates TAS based on the aircraft's current pressure altitude and the outside air temperature. A pilot must know TAS to solve navigation problems and file flight plans. As a rule of thumb, at a given indicated airspeed, true airspeed increases about 2 percent for each 1,000 feet (305 meters) of altitude. Therefore, an aircraft flying at an indicated airspeed of 100 knots at 10,000 feet (3,050 meters) is actually flying at about 120 knots through the air.

true altitude

An aircraft's actual height above mean sea level. True altitude is the altitude shown on the altimeter, corrected for nonstandard temperature. If the temperature at a particular indicated altitude is warmer than the standard temperature for that altitude, an aircraft's altimeter senses higher-than-normal pressure and shows an altitude lower than the aircraft is actually flying. If the temperature is cooler than the standard temperature for a particular altitude, the altimeter senses lower-than-normal pressure and shows an altitude higher than the aircraft is actually flying. Variations from nonstandard temperature usually cause only small errors in the altimeter. When flying without visual references over mountainous terrain, however, or when temperatures aloft differ significantly from the standard temperatures, a pilot should check the aircraft's true altitude to ensure obstacle clearance.

true north

A heading, or course, pointed directly at the earth's geographic North Pole. The earth's magnetic North Pole is offset from the geographic North Pole, so course lines drawn on a chart are usually referenced to lines of longitude, which indicate true north. To solve navigation problems, pilots convert true courses, or headings, into magnetic courses and headings that they can fly by referencing the aircraft's compass. The difference between true north and magnetic north is called "variation." The actual value of the variation depends on your location. Many weather reports and forecasts indicate wind direction in reference to true north.

turbine

The fan-like portion of a jet engine or turboprop engine that compresses the incoming air.

turbine inlet temperature (TIT)
Air temperature measured as it enters the turbine inlet guide-vanes or the first stage of a turbocharger or a turbine engine. TIT is the highest temperature inside a turbocharged engine and is a limiting factor of the amount of power an engine can produce.
turbocharger
A device on a piston engine that compresses the air entering the engine to maintain power output at high altitudes. Exhaust gas from the engine spins a turbine in the turbocharger at high speed. A compressor attached to the same shaft as the turbine compresses the air entering the intake manifold, "boosting" the engine's power as the density of the outside air decreases with altitude. Turbochargers increase the temperature of the air entering the engine, so pilots must monitor engine temperatures carefully.
turbofan
A jet engine in which most of the air entering the engine is accelerated by a large fan and does not pass through the combustion chamber of the engine. Turbofan engines have largely replaced turbojet engines, in which most of the air entering the engine passes through the combustion chamber. Turbofan engines are much more efficient and significantly quieter than turbojets.
turbojet
A jet engine in which most of the air entering the engine passes through several compressing turbines and then enters the combustion chamber. In a turbojet engine, the exhaust stream produces most of the engine's thrust. Turbojet engines have largely been replaced by more efficient and quieter turbofan engines.
turboprop
A jet engine that drives a propeller to create thrust. Turboprop aircraft are less noisy and burn less fuel than turbojet aircraft, but they are also efficient only at speeds up to about 640 kilometers per hour (400 mph). Also called a propjet.
turn coordinator
One of the six primary flight instruments, the turn coordinator shows the rate of turn and the quality of a turn—whether the aircraft is slipping, skidding, or in a balanced turn. In most modern light aircraft, the turn coordinator has replaced the "needle and ball," which served the same function.
TWEB
Abbreviation for "transcribed weather broadcast." These recorded weather reports and forecasts, prepared by a Flight Service Station (FSS) in the United States, are broadcast over many navigation facilities, especially VORs. Pilots can monitor TWEB broadcasts while en route to stay up-to-date with the latest weather information.
type certificate
An official document that certifies that an aircraft or engine design has met all the criteria specified in the regulations governing the certification and testing of aircraft. In the United States, the FAA issues normal, utility, transport, aerobatic, experimental, limited, restricted, and provisional type certificates.
type rating
In the United States, an authorization added to a pilot certificate that permits a person to act as pilot in command of a specific type of aircraft, usually a heavy, turbojet-powered, or rotary wing aircraft. Type ratings are required for all aircraft with a maximum certified takeoff weight of more than 12,500 pounds (5,670 kilograms) and all turbojet-powered aircraft, regardless of maximum takeoff weight. A type rating is also required to act as pilot in command of a helicopter if the operation also requires that the pilot hold an airline transport pilot certificate.

U

ultralight
Single-seat, lightweight aircraft designed for recreational flying. Also known as "microlights" in Britain. In the United States, ultralight aircraft are not certified by the FAA and no pilot certificate is required to fly them. According to United States regulations (FAR Part 103), an aircraft qualifies as an ultralight if it has an empty weight of no more than 254 pounds(115 kilograms), if it is equipped with an engine, can carry no more than 5 gallons (18.9 liters) of fuel, cannot fly more than 55 knots in level flight at full power, and has a power-off stall speed no greater than 24 knots.
uncontrolled airspace
Airspace in which air traffic control does not provide services and in which an ATC clearance is not required to operate, regardless of weather conditions.
uncoordinated flight
Slipping or skidding flight caused by yawing forces produced by a turn, by the action of the propeller and slipstream, or by an imbalance of power in a multiengine aircraft. The inclinometer (ball) of the turn coordinator shows whether the yawing forces are properly balanced. If the ball is on the inside of a turn, the airplane is slipping. If the ball moves to the outside of a turn, the airplane is skidding.
under the hood
See hood.
undercast
A solid cloud layer as viewed from above the layer.
UNICOM
A privately owned radio station on an airport used to give advisories to pilots. UNICOM cannot be used to control traffic.
updraft
A localized upward current of air.
upslope fog
Fog formed when air flows upward over rising terrain and is cooled to or below its initial dew point. Once the upslope wind ceases, the fog dissipates. Unlike radiation fog, upslope fog can form under cloudy skies. It often is quite dense and extends to high altitudes.
upwind
That leg of a standard traffic pattern aligned with the runway on takeoff. The aircraft is said to be on the upwind leg until it is turned 90 degrees onto the crosswind leg.
useful load

The maximum allowable weight of an aircraft minus its empty weight. The useful load includes the weight of the fuel, oil, crew, passengers and their baggage, and any cargo carried.

UTC (Universal Coordinated Time)

The official time used in air navigation. Also known as Zulu time, or Greenwich Mean Time (GMT). UTC is based on the 24-hour clock; for example, 6 P.M. is 1800 hours. Departure and arrival times, air traffic control clearances, the valid time of weather reports and forecasts, and other time-sensitive information in aviation is expressed in UTC.

V

variometer

An instrument that helps you know when you're in rising air and how strong the lift is. Unlike a vertical speed indicator in a powered aircraft, which indicates the vertical speed of the aircraft, a compensated variometer indicates the vertical speed of the air through which a glider is moving.

vector

A heading given by an air traffic controller to a pilot for the purpose of navigation or traffic avoidance.

vertical axis

An imaginary vertical line running through the center of an aircraft. Rotation about the vertical axis is called "yaw" and is controlled by the rudder.

vertical speed indicator

One of the six basic flight instruments, the vertical speed indicator shows an aircraft's rate of climb or descent, usually in feet per minute. Also known as the rate of climb indicator (RCI) or vertical velocity indicator (VVI). Large aircraft are typically equipped with a sophisticated version of this instrument, called an "instantaneous vertical speed indicator" (IVSI) that reacts immediately to changes in altitude.

vertical stabilizer

The vertical tail surface on an aircraft; sometimes called a "fin." The vertical stabilizer is fixed on most aircraft. With the attached rudder, the vertical stabilizer provides directional stability by controlling movement about the vertical (yaw) axis.

vertigo

A state of temporary spatial confusion resulting from misleading information sent to the brain by various sensory organs; also called "spatial disorientation." Vertigo typically occurs when a pilot cannot see the ground or other references due to clouds or darkness. Turns and other maneuvers can cause the vestibular system—a set of tubes and other sensory organs in the inner ear—to send conflicting signals about the aircraft's orientation and movement. Without visual references to overcome those sensations, the pilot quickly becomes disoriented and unable to tell whether the airplane is flying straight and level, turning, climbing, or descending. To avoid or overcome vertigo, a pilot must rely on the flight instruments to verify the aircraft's attitude and maintain control.

very high frequency (VHF)

The portion of the radio spectrum used in civil aviation for primary radio navigation and communications. Voice communications are assigned frequencies between 118.0 and 136.975 MHz. VORs operate on frequencies between 108.0 and 177.95 MHz.

very high frequency omnidirectional radio (VOR) range

A ground-based radio transmitter that sends signals in 360 radials. Some of these radials define airways, but pilots can track any radial to fly a specific path over the ground. VORs operate on frequencies between 108.0 to 177.95 MHz in the VHF band. Although satellite-based navigation systems are rapidly coming into widespread use, VORs still remain the primary electronic navigation system in use today.

VFR sectional charts

Navigational charts published for use by pilots flying under visual flight rules (VFR). The charts depict navaids, landmarks, Victor airways, terrain elevations, and other important information relevant to VFR flight.

Victor airways

Airways delineated by navigational radio signals for low routes (below 18,000 feet). Sometimes referred to as highways in the sky. Jet airways are used for high-altitude routes.

view-limiting device

See hood.

virga

Water or ice particles falling from a cloud, usually in wisps or streaks, that evaporate before reaching the ground.

virtual airline

Airlines created on the World Wide Web by and for pilots of flight simulators. Virtual airlines simulate the world of commercial aviation by hiring, training, and assigning routes to virtual pilots. There has been a great increase in interest in these airlines in recent years, and some operations are quite elaborate.

visibility

The ability to see and identify prominent, unlighted objects by day and prominent, lighted objects at night. Visibility is expressed in units of distance (statute miles, hundreds of feet, or meters). Atmospheric conditions determine the distance.

visual approach slope indicator

A lighting system that indicates an airplane's position relative to the desired glideslope to a particular runway.

visual flight rules (VFR)

The "rules of the road" that govern flight when the visibility and ceiling allow pilots to navigate and avoid obstacles and other aircraft by visual reference. In the United States, VFR flight is generally permitted when the visibility is at least 3 miles (5 kilometers) and a pilot is able to operate at a safe altitude that is at least 500 ft (152 meters) below and 1,000 feet (304 meters) above any clouds. In addition, the pilot must remain at least 2,000 feet (608 meters) horizontally from any clouds. Specific requirements for VFR depend on the type of airspace, time of day, and height above the terrain.

visual meteorological conditions

Weather conditions that permit flight under visual flight rules (VFR). In controlled airspace in the United States, VMC conditions generally mean that the ceiling is at least 1,000 feet (305 meters) and flight visibility is at least 3 miles (5 kilometers).

VOR approach
A nonprecision instrument approach in which a VOR is the initial approach fix.

VOR hold
A holding pattern over a VOR station.

VOR intercept
Tuning in, identifying, and turning toward a VOR station.

vortices
Rotating air currents created by wings and other airfoils that are producing lift. Vortices are typically created when high-pressure air below a wing circulates toward the low-pressure area above a wing. These vortices are the primary source of induced drag, a by-product of lift. Vortices created by large, heavy aircraft (called "wake turbulence") are a serious hazard to smaller aircraft, especially during takeoff and landing.

V-speeds
Used to designate speeds during specific flight conditions.

- ***VA*** *- Design maneuvering speed; the maximum speed at which full control deflection can be made without overstressing the aircraft.*
- ***VAPP*** *- Approach climb speed; the airspeed used in the approach configuration.*
- ***VFE*** *- Maximum flap-extended speed; the maximum allowable speed with the flaps extended.*
- ***VLE*** *- Maximum landing gear-extended speed; the maximum allowable speed with the landing gear extended.*
- ***VLO*** *- Maximum landing gear-operating speed; the maximum speed at which the landing gear can be extended or retracted.*
- ***VMC*** *- Minimum control speed; the lowest speed at which the airplane is controllable when one engine is inoperative and the other engine is operating at full power.*
- ***VMO/MMO*** *- Maximum operating limit speed; the speed that cannot be exceeded in any flight condition. VMO is expressed in KIAS. VMMO is expressed in Mach number.*
- ***VNE*** *- Never-exceed speed (the red line on the airspeed indicator).*
- ***VN*** *- Maximum structural cruising speed; the maximum allowable airspeed in turbulent air (the lower limit of the yellow arc on the airspeed indicator).*
- ***VR*** *- Rotation speed; the speed at which the pilot raises the nose to lift off the runway during the takeoff roll.*
- ***VREF*** *- Approach speed (based on weight and conditions).*
- ***VS*** *- Stalling speed; the minimum steady flight speed at which the aircraft is controllable.*
- ***VSO*** *- Stalling speed; the minimum steady flight speed in the landing configuration.*
- ***VTT*** *- Target threshold speed.*
- ***VX*** *- Best angle of climb speed; the speed at which the aircraft will gain the most altitude in the least horizontal distance.*
- ***VY*** *- Best rate of climb speed; the speed at which the aircraft will gain the most altitude in the least amount of time.*
- ***V1*** *- Takeoff decision speed; the speed at which it may not be possible to stop the aircraft on the runway in case of a rejected takeoff (RTO).*
- ***V2*** *- Minimum takeoff safety speed; the minimum safe flying speed should an engine fail immediately after takeoff.*

VTOL
Abbreviation for "vertical takeoff and landing," describing aircraft that can take off straight up and land straight down without the need of a runway. The most successful application of VTOL technology, based on the vectored-thrust engine, is the British Harrier jump jet.

W

wake turbulence
Turbulence caused by a moving aircraft. More specifically, the powerful vortices generated by the wing tips of a large, heavy aircraft.

warm front
Any nonoccluded front in which warmer air replaces colder air.

waypoint
A predetermined navigational point in space along a route of flight. Waypoints can be electronically stored in some navigation devices, such as RNAV and GPS units.

weather areas
In Prepar3D, regions with similar weather characteristics. Prepar3D has a global weather area, and you can create two local weather areas. You can define the size of the local weather areas and specify the type of clouds, visibility, temperature, wind, atmospheric pressure, and other characteristics of each area.

weathercock
(Verb) To display a tendency to veer in the direction of the wind.

weathervane effect
The tendency of an aircraft to pivot around its center of gravity and point into the wind.

weight
One of the four basic forces at work on an aircraft in flight. Lift opposes weight (more accurately, the sum of all downward forces), which always acts directly toward the center of the earth. In most calculations, aeronautical engineers assume that all of an aircraft's weight is concentrated at a point called the center of gravity.

wet wing
An aircraft wing in which fuel is stored directly inside the skin of the wing as opposed to enclosing the fuel in a rubber bladder inside the wing.

wilco
Used in radio transmissions as shorthand for "will comply."

wind layer
In Prepar3D, a user-specified weather option that includes wind speed, direction, gust factor, and turbulence between two altitudes. You select these options on the Wind tab in the Advanced Weather dialog box. You can create two wind layers in each weather area.
wind shear
A sudden, sharp change in wind direction or speed, often associated with a violent, downward burst of air called a microburst or a low-level temperature inversion. Wind shear is particularly dangerous to aircraft during takeoff and landing, where it can cause large variations in airspeed and lead to a rate of sink that can push an aircraft into the ground.
wind tunnel
A device for studying the effects of airflow on aircraft and other vehicles or structures. To simulate the conditions of flight, an aircraft model is mounted in the tunnel and subjected to a stream of air. Sensors gather data on lift and drag, pressure, and other forces acting on the model.
wing loading
An aircraft's weight divided by the area of its wings. For example, an aircraft weighing 4,000 pounds (1,814 kilograms) that has 400 square feet of wing area has a wing loading of 10 pounds per square foot.
winglets
Vertical extensions added to the ends of a main wing. Winglets reduce induced drag by increasing the effective aspect ratio of the wing, thereby decreasing the intensity of wingtip vortices produced as a by-product of lift.
wingspan
The distance from one wing tip to the other.
wingtip vortex
Rapidly rotating air at an aircraft's wing tips created when a wing produces lift. At the tips, high-pressure air below the wing spirals up to the low-pressure area above the wing. Large, heavy aircraft produce intense vortices that are extremely hazardous to small aircraft, especially during takeoff and landing. For example, a small aircraft that flies into a wingtip vortex can be rolled inverted because the rotation of the vortex exceeds the rolling capability produced by the ailerons. Also known as "wake turbulence."

X

Y

yaw
Movement of an aircraft about its vertical axis, as when the nose turns left or right. Along with roll and pitch, yaw is one of an airplane's three basic movements. The vertical stabilizer and rudder are designed to control yaw.
yoke
See control yoke.

Z

zeppelin
An airship with rigid internal bracing. The helium or hydrogen used to lift a zeppelin is usually contained in large cells. The largest of airships, zeppelins were used as bombers in World War I, but they caused little damage; instead, most were lost to accidents and enemy fire. In 1937, the "Hindenburg" disaster brought a swift end to the use of the rigid airship as a civil transport.
Zulu time
See Greenwich Mean Time.

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