# AFSIM Changelog

***Version 2.9.0***

**United States Air Force**

**Feb 25, 2022**

# Contents

# AFSIM 2.9 - 25 Feb 2022

Visit the AFSIM 2.9 Release Page on DI2E (Access Controlled) for more information and resources related to this release.

## Release Dates

- AFSIM 2.9.0 - 25 Feb 2022

## Security Updates

- Corrected several buffer and integer overflow issues identified by Fortify static code analysis as being high severity.
- Corrected several type mismatch (signed to unsigned) issues throughout the codebase identified by Fortify static code analysis as being high severity, fully resolving this category of issues.
- **Addressed multiple security vulnerabilities in the following third party libraries: (AFSIM-1817)**
  - Curl: CVE-2020-8285, CVE-2020-8286, CVE-2021-22876, CVE-2021-22890, CVE-2020-8284
  - Libtiff: CVE-2020-35524, CVE-2020-35523, CVE-2020-35522, CVE-2020-35521
  - Jpeg: CVE-2020-14152, CVE-2020-14153
  - FFmpeg: CVE-2019-15942, CVE-2020-14212, Multiple "Denial of Service" and "Buffer Overflow" CVEs (AFSIM-1404)
  - Qt: CVE-2020-17507
- Corrected a mismatched free memory error in the ../weapon_tools ATG_LAR_AND_LC_GENERATOR.
- Corrected a memory leak in the kinematic trajectory model of WSF_TSPI_MOVER.
- Corrected a potential memory leak that could occur in certain conditions when using a route_network.
- Corrected memory leaks in the WSF_BALLISTIC_MISSILE_LAUNCH_COMPUTER that occur when show_graphics is enabled.
- Corrected memory leaks in the WSF_QUANTUM_TASKER_PROCESSOR when an evaluator, generator, or allocator is re-defined in a derived processor. (AFSIM-1786)

## Development Updates

- The `myst-parser` Python package is a new requirement for generating documentation. The Python package requirements have been combined into a top-level `requirements.txt` file for convenient and consistent installation. This file may be used with a command such as:

  ```
  pip install --user --requirement requirements.txt
  ```

- Updated the following third party libraries to address security vulnerabilities and access new features: SDL from 2.0.14 to 2.0.16, Curl from 7.71.1 to 7.79.1, Libtiff from 4.1.0 to 4.3.0, JPEG from 9b to 9d, FFMPEG from 4.2.1 to 4.2.4, GDAL from 3.0.4 to 3.3.2, Qt from 5.12.9 to 5.12.11, and Proj from 7.0.0 to 8.1.1. See *Security Updates* for more information. (AFSIM-1817)

- Changed default value for `PROMOTE_HARDWARE_EXCEPTIONS` CMake flag to true. Plugins must be compiled with the same value as the host application was compiled with. (AFSIM-1640, AFSIM-1616)
- Modified CMake configuration, for versions 3.13 and higher, so that Visual Studio user files will not be automatically overwritten. The macro `write_vcproj_user` was renamed to `create_vs_debug_env`. (AFSIM-2387)
- Add new type-safe coordinate vector classes for each of the major coordinate frames. These new classes are available in the `ut::coords` namespace. They currently have a deprecated implicit conversion to `UtVec3<T>`, the legacy non-coordinate-specific vector class. This will be removed in a future release, leaving only an explicit conversion. (AFSIM-1177)
- Added convenience macros for C++14, C++17, and C++20 compiler attributes to `UtCompilerAttributes.hpp`.
- Added `ut::stacktrace` as a stand-in for C++23's `std::stacktrace`. (AFSIM-1732)
- The remaining *.hxx and *.cxx files in util were renamed to *.hpp and *.cpp for consistency with coding standards. The old *.hxx headers are deprecated and will be removed in a future release. In the meantime compatibility stubs are provided which emit a message (Visual Studio) or warning (GCC). (AFSIM-2395)
- Newer versions of Sphinx, including 3.x and 4.x, are now supported for building documentation. Sphinx 2.1 remains the minimum supported version. (AFSIM-1343)

# Changelogs

## Demos 2.9 - 25 Feb 2022

Visit the AFSIM 2.9 Release Page on DI2E (Access Controlled) for more information and resources related to this release.

### Release Dates

- Demos 2.9.0 - 25 Feb 2022

### General

- Usages of the deprecated PLATFORM_KILLED event for observer and event_output were replaced with docs/event/platform_events:PLATFORM_BROKEN throughout the demos. (AFSIM-250)
- Usages of the deprecated WSF_TRACK_MANAGER processor were replaced with WSF_TRACK_PROCESSOR throughout the demos. (AFSIM-1253)
- Updated deprecated usages of WsfEventPipe.Record throughout the demos. (AFSIM-1421)
- Usages of the deprecated transform_route were replaced with insert_route throughout the demos. (AFSIM-2082)
- Added new scenario to sensor_demos for the functionality of the scheduler_commands.spin scheduler. (AFSIM-1882)
- Added multiresolution_demos demo, which demonstrates the capabilities of the AFSIM multiresolution plugin, including the commands multiresolution_comm, multiresolution_fuel, multiresolution_optical_signature, multiresolution_processor, multiresolution_mover, multiresolution_radar_signature, and multiresolution_sensor.
- Introduced a laser_designator demo which provides an example of how to designate a target with a laser and command a remote UAV to fire on the target. (AFSIM-1948)

- Added a demo variant to air_to_air which uses the predict functions of the WSF_SA_PROCESSOR.
- Updated all air_to_air demos that use WSF_SA_PROCESSOR to use the new update intervals introduced by AFSIM-2218. (AFSIM-2302)
- Added avengers_detonate_effect scenario to cyber to demonstrate the WSF_CYBER_DETONATE_EFFECT. (AFSIM-1493)
- Made small changes to duck_hunt scenario in cyber to demonstrate CYBER_ATTACK_ATTRIBUTED. (AFSIM-1484)
- Added MITM_exfiltrate_demo scenario to cyber to demonstrate the new exfiltrate functionality for WSF_CYBER_MAN_IN_THE_MIDDLE_EFFECT. (AFSIM-1495)
- Added GoneFishing_ConstraintDemo scenario to cyber to demonstrate the cyber_constraint. (AFSIM-1481)
- Updated SixDOF Demos to work with updated solid-rocket fuel interface. (AFSIM-1182)
- Added demonstration of missile interception in the missile demos for SixDOF. (AFSIM-1183)
- Added ground-to-orbit launch demo for SixDOF. (AFSIM-1184)
- Updated all six_dof demos that use WSF_SA_PROCESSOR to use the new update intervals introduced by AFSIM-2218. (AFSIM-2302)

### Corrections

- Modified aerobraking from satellite_demos in response to a correction made to WSF_INTEGRATING_SPACE_MOVER, and to make use of periapsis_altitude, and apoapsis_altitude. (AFSIM-1720)
- Fixed and restored the l16_j11 demo. Demo was removed in v2.3 since it was non-functional. (AFSIM-210)

### Enhancements

- Updated gun_engagement to more robustly handle a user-provided bullet name. (AFSIM-197)

## Mover Creator 2.9 - 25 Feb 2022

Visit the AFSIM 2.9 Release Page on DI2E (Access Controlled) for more information and resources related to this release.

### Release Dates

- Mover Creator 2.9.0 - 25 Feb 2022

### Development

- Fixed an issue that prevented users from configuring a lightweight Mover-Creator-specific installation. (AFSIM-998)

### General

- Moved propellant mass for solid rockets into fuel mass rather than including it in a vehicle's specified empty mass. Users should subtract propellant mass from any existing vehicles using solid-propellant rockets. (AFSIM-1019)
- Added initial support for WSF_POINT_MASS_SIX_DOF_MOVER. For this initial effort, aerodynamics are not finalized, and control mapping and dynamic response factors should be treated as starting points for manual tuning. (AFSIM-1832)

### Corrections

- Fixed issue where SixDOF Tuner would not open with Warlock via the Tune Controls button, and when initialized manually, would not find the test platform. (AFSIM-2110)
- Errors caused by failing Performance Tests now alert the user that a test has failed. Previously, errors would only be generated if test results were not in the expected directory. (AFSIM-2110)
- High-detail movers are no longer given active WSF_SA_PROCESSOR definitions. Example definitions are still provided in the platform file, but commented out. This will be the case at least while grammar for WSF_SA_PROCESSOR is under active development, as mismatches between Mover Creator script output and expected grammar can cause vehicle testing to fail. (AFSIM-2110)
- Corrected a units error that caused aircraft range tests to output unreasonable data. (AFSIM-2108)

### Enhancements

- Added support for the WSF_RIGID_BODY_SIX_DOF_MOVER. See the updated User's Guide for more information. (AFSIM-1019)
- Added initial support for conversions of WSF_BRAWLER_MOVER aircraft to WSF_POINT_MASS_SIX_DOF_MOVER. (AFSIM-1020)

## Mystic 2.9 - 25 Feb 2022

Visit the AFSIM 2.9 Release Page on DI2E (Access Controlled) for more information and resources related to this release.

### Release Dates

- Mystic 2.9.0 - 25 Feb 2022

### General

- The AFSIM Windows installer will now associate AER files with Mystic. (AFSIM-1981)
- Hidden objects on the Map Display can no longer be selected. Additionally, when selected platforms and annotations are hidden, they are now automatically deselected.

### Corrections

- Corrected an issue where a crash could occur on review of the AER timestamp at 5 seconds. (AFSIM-2329)
- Corrected an issue where weapon-fire events would not affect trace-lines. (AFSIM-1005)
- Corrected an issue preventing exclusion zones within zone sets from being displayed in Warlock and Mystic. (AFSIM-1115)
- Clicking "Clear Recents" button on the Start-up Dialog will clear the File>Open Recent menu. (AFSIM-1116)
- Corrected an issue where zones with reference platforms would not follow their platform during simulation in Warlock and Mystic. (AFSIM-1333)
- Fixed an issue where a zone attached to a platform with use_zone had default line_color and fill_color values instead of inheriting them. (AFSIM-1350)
- Corrected a crash that occurred when trying to load a non-aer file via the Start-up Dialog. (AFSIM-1407)
- Corrected the sign of range rate that is reflected in the RelativeGeometry plugin. (AFSIM-1754)
- Corrected an issue that prevented some data from plotting or displaying as a dragged overlay. (AFSIM-2246)
- Updated the event-pipe to represent time with a double-precision value. (AFSIM-2295)
- Comment output now clears itself at the start of each debug run. (AFSIM-2120)
- Eliminated warnings caused by not loading the P6DOF data plugin by default. (AFSIM-1096)
- Displayed platforms' mach values are now calculated by the simulation. (AFSIM-1393)
- Corrected altitude unit in platform details plot. (AFSIM-1553)
- Corrected an issue where having more than one range_ring on a platform would cause only the last defined ring to display. (AFSIM-1950)
- Corrected an issue where WsfDraw geometries are rendered behind the Earth when using a Satellite Tether View. (AFSIM-989)
- Corrected an issue where the time controller<../wkf_plugin/rv_time_controller>‘ would not display correctly at narrow widths. (AFSIM-2406)
- Improved the performance of the Platform Browser. (AFSIM-1445)
- Task IDs from MsgTaskUpdate are now accounted for so that there are no longer orphaned interactions. (AFSIM-408)
- Renamed the jam interaction line to jam request and added documentation indicating the limitations of this feature. (AFSIM-1122)
- Added correlation of interactions' events based on hover-text data. (AFSIM-1810)
- Corrected satellite orbits in 2D map displays. (AFSIM-1331)
- Corrected satellite orbits in ECEF mode. (AFSIM-1361)
- Fixed a bug in the Event List where filters would not import correctly. (AFSIM-1042)
- Fixed a bug that prevented selecting cells in the Event List results table.
- Corrected the reprojection of several field-of-view volumes when displayed in flat maps. (AFSIM-1323)
- Volumes will not draw beyond 600,000 km to avoid display problems. (AFSIM-1420)
- Corrected an issue which could cause a crash when displaying routes and loading a new scenario. (AFSIM-1740)
- Corrected a crash that occurred when a platform was deleted while a zone's color was being changed through the Zone Browser. (AFSIM-1124)

- Fixed an issue where polygonal zones defined using lat_lon or MGRS coordinates were not visualized as Earth-tangential. (AFSIM-1195)
- Corrected an issue where trying to set an alpha value for a zone's lines via line_color wouldn't take effect. (AFSIM-1247)
- Corrected an issue where a WsfWeaponEngagement using a weapon with no platform would not render an explosion at the target. (AFSIM-1040)
- Corrected a lighting bug that caused polygonal zone line colors to appear incorrectly. (AFSIM-1104)
- Corrected an issue where ../zone color changes would revert during a replay if the owning platform was destroyed. (AFSIM-1105)
- Some visualizations no longer appear offset from their respective platforms when far away from the center of the 2D Map Display. (AFSIM-398)
- Fixed ../route waypoint labels clipping through the Map Display. (AFSIM-394)
- Fixed double-clicking a platform with a route causing the platform to remain unselected, but its route's labels visible. (AFSIM-393)
- Corrected visualization of routes which include waypoints using the goto command. (AFSIM-396)
- Corrected an issue where platform-defined zones appeared to be affected by the platform's pitch and roll. (AFSIM-1258)
- Corrected an issue where platform-defined zones wouldn't respect minimum_altitude and maximum_altitude commands for display in Wizard, Warlock, and Mystic. (AFSIM-1259)
- Corrected an issue where zone colors (fill_color and line_color) weren't inherited through references. (AFSIM-1369)
- Improved the load times of scenarios which use many routes. (:issue: *AFSIM-1570*)
- Prevent Mystic's views from getting stuck below the map surface when dealing with subsurface platforms. (:issue: *AFSIM-1815*)
- Corrected an issue where coastline segments that cross the dateline would draw across an entire 2D map.
- Corrected an issue which prevented the Model Viewer auto-complete from working. (AFSIM-1423)

### Enhancements

- Added units to plot dialogs. (AFSIM-1024)
- Made unrecognized messages only display a warning if they are used in the scenario. (AFSIM-1133)
- AFSIM Event Recording files can now be loaded by dragging/dropping into the Map Display. (AFSIM-1162)
- Added track ID labels to tracks. This can be enabled/disabled from the track preferences. (AFSIM-1383)
- Added the Comms Visualization Plugin for Mystic. (AFSIM-1597)
- Added support for missile icons in the SA Display. (AFSIM-684)
- Added the ability to right click and minimize a nodes children, as well as a way to view if a node is a tree, if it has its children hidden, and how many blackboard variables a node currently has in the Behavior Tree View. The blackboard has been updated to show WsfTrack and WsfPlatform variables. (AFSIM-977)
- Changed the icon for Sequence nodes to a question mark and the icon for Parallel nodes to three arrows down for a more intuitive look in the Behavior Tree View. (AFSIM-1186)
- Added a 'Center Tree in View' context menu option and precondition tooltips to the Behavior Tree View. (AFSIM-1298)

- In the Behavior Tree View composite nodes now will show their node type symbol when they are a tree rather than the root node symbol. (AFSIM-1298)
- Hiding/showing children will now collapse and expand tree layouts as necessary in the Behavior Tree View. (AFSIM-1298)
- Added the option to hide columns in the Event List results table by right-clicking on the column header.
- Added keyboard shortcuts for actions in the time controller. (AFSIM-1161)
- The maximum rate of play may now be increased in the time controller preferences. (AFSIM-1738)
- Improvements to Battle Management's Platform Status dialog: default color may be set separately for each column, default color no longer applies to 'n/a' values, and shortened aux data column titles. (AFSIM-1273)
- Added support for missile icons in the Head Down View. (AFSIM-684)
- Added preferences to vary the number of periods displayed on an orbit. (AFSIM-1361)
- Added the ability to display projections of sensor volumes. (AFSIM-1323)
- Sensor volumes will now be blocked by the Earth. (AFSIM-1323)
- Improved the sensor volumes' preferences user-interface. (AFSIM-1323)
- Added new plugin Orbital Data to show orbital elements in Platform Details for platforms with space movers. (AFSIM-716)
- Added the ability to see a platform's current advanced behavior tree state by the color of its trace line. (AFSIM-110)
- Added visualization of spherical zones to the Zone Browser. (AFSIM-597)
- Moved WsfDraw from the Preferences to a dock widget. (AFSIM-1378) (AFSIM-1739)
- Updated WsfDraw to use the Qt system to render. (AFSIM-1681)
- Added a new ACES Display. (AFSIM-1075)
- Zone color preferences are now shared across Wizard, Warlock, and Mystic. (AFSIM-1112)
- Added support for the Map Display to correctly display nonzero minimum_radius values for circular and elliptical zones. (AFSIM-198)
- Added support for coloration of individual contours in shapefile generated by sensor_plot horizontal_map. (AFSIM-1141)
- Added additional options to control the visibility of Map Annotations. (AFSIM-1163)
- Added duration as a type of units to unit preferences. Duration is distinguished from the previously existing Time Format options in that the former specifies units for an amount of time that passes, and the latter specifies the manner in which a single instant in time is displayed.
- Added capability for Coverage Overlay panel to respond to unit preferences, and label the legend with values in the units according to the user's preferences.
- Visual applications now give some indication of what went wrong prior to closing for most crashes. (AFSIM-1565)
- Labels in the Map Display for platforms, routes, and tracks will now load and run faster, and use the Qt system to render. (AFSIM-1679)
- Exception logs are now saved to a file when the application unexpectedly closes due to an exception. (AFSIM-1733)
- Added keyboard shortcuts to hover info for interface controls. (AFSIM-2244)

- Updated the ruler, banner and scale in the Map Display to use a Qt rendered font. (AFSIM-1680)
- Added a search utility to the Map Toolbar find geographic locations by name in the Map Display. (AFSIM-2415)
- Spherical zones now display with a minimum radius. (AFSIM-1328)

### Development

- Added virtual methods *GetUnitsX()* and *GetUnitsY()* to *rv::PlotUpdater* which should return the units of the data on the axis. Default implementation returns empty string (unitless).
- Added macro *WKF_UNIT_NAME(TYPE)* to WkfUnitsObject.hpp to get the name of the user's prefered units for type *TYPE*. E.g. *WKF_UNIT_NAME(Length)*
- Added macro *WKF_UNIT_FROM_STANDARD(TYPE, VALUE)* to WkfUnitsObject.hpp to convert a *VALUE* of type *TYPE* from the standard value to the user's preferred units. E.g. *WKF_UNIT_FROM_STANDARD(Length, altitude)*
- Added pymystic module, which allows Python3 script access to event_pipe data in AER files. (AFSIM-1210)
- Modified CMake to prevent unnecessary rebuilds due to time-stamp changes in the event_pipe auto-generated-code. (AFSIM-1236)
- Missing plugin dependencies will now cause a CMake error. (AFSIM-1029)
- Renamed `wkf::MainWindow::AddDialogToViewMenu()` to `wkf::MainWindow::AddDockWidgetToViewMenu` to more accurately reflect what the function does. (AFSIM-1386)
- Removed `wkf::StdRedirector`. Instead declare `ut::log::Subscriber consoleSub{ "raw" };` to access the console output.
- Deprecated text drawing classes `UtoTextShape`, `VaAttachmentLabel`, `VaOverlayLabel`, `VaOverlayText`, `VaOverlayTextBox`, `VaOverlayWindow`. The `VaDecoratorNode` class should be used in their place. (AFSIM-1682)
- Classes *VaAttachmentZone*, *VaAttachmentZoneBase*, *VaAttachmentZoneCircle*, *VaAttachmentZoneEllipse*, *VaAttachmentZonePolygon*, *VaAttachmentZoneSphere*, and *VaZonePoint* have been deprecated, use the wkf namespaced 'AttachmentZone', 'AttachmentZoneBase', 'AttachmentZoneCircle', 'AttachmentZoneEllipse', 'AttachmentZonePolygon', 'AttachmentZoneSphere', and 'ZonePoint' instead.(AFSIM-1522)

## Warlock 2.9 - 25 Feb 2022

Visit the AFSIM 2.9 Release Page on DI2E (Access Controlled) for more information and resources related to this release.

### Release Dates

- Warlock 2.9.0 - 25 Feb 2022

### General

- Renamed Tuner menu item to P6DOF Tuner to reduce confusion with SixDOF Tuner. (AFSIM-2110)
- Hidden objects on the Map Display can no longer be selected. Additionally, when selected platforms and annotations are hidden, they are now automatically deselected.

### Corrections

- Corrected an issue preventing exclusion zones within zone sets from being displayed in Warlock and Mystic. (AFSIM-1115)
- The Script Arguments pop-up window associated with the Dialog Builder will now execute the specified script when the enter key is pressed. The user is no longer required to use the mouse to click the execute button.
- Corrected an issue that caused a global relative zone to appear in an unsuitable default location when no position was defined. (AFSIM-1193)
- Corrected an issue where zones with reference platforms would not follow their platform during simulation in Warlock and Mystic. (AFSIM-1333)
- Corrected the sign of range rate that is reflected in the RelativeGeometry plugin. (AFSIM-1754)
- Limited length of popup notifications to prevent buttons from being pushed off the screen. (AFSIM-1388)
- Improved clarity of popup notifications by replacing "Ignore" button with a check box. (AFSIM-1554)
- Removed ability to disable popup notifications for fatal errors. (AFSIM-1538)
- Corrected satellite orbits in 2D map displays. (AFSIM-1331)
- Corrected satellite orbits in ECEF mode. (AFSIM-1361)
- Renamed the jam interaction line to jam request and added documentation indicating the limitations of this feature. (AFSIM-1122)
- Corrected a crash that occurred when a platform was deleted while a zone's color was being changed through the Zone Browser. (AFSIM-1124)
- Fixed issue where zone visualization would sometimes not match the simulation when using the reference_platform command. (AFSIM-1201)
- Fixed an issue where polygonal zones defined using lat_lon or MGRS coordinates were not visualized as Earth-tangential. (AFSIM-1195)
- Trace line colors are now correctly updated when the platform state changes. (AFSIM-404)
- Corrected the reprojection of several field-of-view volumes when displayed in flat maps. (AFSIM-1323)
- Volumes will not draw beyond 600,000 km to avoid display problems. (AFSIM-1420)
- Corrected an issue where WsfDraw geometries are rendered behind the Earth when using a Satellite Tether View. (AFSIM-989)
- Removed potential instability when adding tracks to a Satellite Tether View. (AFSIM-1055)
- Corrected an issue where an open Satellite Tether View for a platform that is then removed could lead to a crash, either shortly thereafter if other platforms were being tracked, or when the user attempts to open the context menu. (AFSIM-1158)
- Corrected an issue where the relative orbit trace for a tracked platform in an open Satellite Tether View might not update frequently enough during non-real-time operations. (AFSIM-407)
- Corrected an issue where trying to set an alpha value for a zone's lines via line_color wouldn't take effect. (AFSIM-1247)
- Corrected an issue where a WsfWeaponEngagement using a weapon with no platform would not render an explosion at the target. (AFSIM-1040)
- Corrected a lighting bug that caused polygonal zone line colors to appear incorrectly. (AFSIM-1104)
- Corrected an issue where ../zone color changes would revert during a replay if the owning platform was destroyed. (AFSIM-1105)

- Some visualizations no longer appear offset from their respective platforms when far away from the center of the 2D Map Display. (AFSIM-398)
- Fixed ../route waypoint labels clipping through the Map Display. (AFSIM-394)
- Fixed double-clicking a platform with a route causing the platform to remain unselected, but its route's labels visible. (AFSIM-393)
- Corrected visualization of routes which include waypoints using the goto command. (AFSIM-396)
- Corrected an issue where platform-defined zones appeared to be affected by the platform's pitch and roll. (AFSIM-1258)
- Corrected an issue where platform-defined zones wouldn't respect minimum_altitude and maximum_altitude commands for display in Wizard, Warlock, and Mystic. (AFSIM-1259)
- Corrected an issue where zone colors (fill_color and line_color) weren't inherited through references. (AFSIM-1369)
- Improved the load times of scenarios which use many routes. (:issue: *AFSIM-1570*)
- Prevent Warlock's views from getting stuck below the map surface when dealing with subsurface platforms. (:issue: *AFSIM-1815*)
- Corrected an issue where coastline segments that cross the dateline would draw across an entire 2D map.
- Corrected an issue which prevented the Model Viewer auto-complete from working. (AFSIM-1423)

### Enhancements

- Updated Dialog Builder to support calling scripts with parameter types of WsfSensor, WsfWeapon, and WsfComm, as well as arrays of these types. (AFSIM-1103)
- Scenarios can now be loaded by dragging/dropping files into the Map Display. (AFSIM-1162)
- Added a sub-menu, 'Scripts', that provides access to Dialog Builder custom scripts from the platform context menu. Additionally, a new option has been added in the Script Builder to clamp platform selection when executing a custom script. (AFSIM-1168)
- Dialog Builder script input prompts will now be consolidated into a dockable widget. The dock widget will open whenever a script prompt is generated or it can be manually opened through the View Menu. (AFSIM-1172)
- Added track ID labels to tracks. This can be enabled/disabled from the track preferences. (AFSIM-1383)
- Improved error messages when the simulation crashes. (AFSIM-1515)
- Added preferences to vary the number of periods displayed on an orbit. (AFSIM-1361)
- Added a new ACES Display. (AFSIM-1075)
- Added support in Astrolabe for targeting a specified kinematic state in targeting-class maneuvers.
- Added support in Astrolabe for optimizing orbital targeting events with a cost function. (AFSIM-1787)
- Added new plugin Orbital Data to show orbital elements in Platform Details for platforms with space movers. (AFSIM-716)
- Added the ability to filter tracks and platforms in the Dialog Builder selector widgets when prompting the user for input. (AFSIM-1174)
- Added the ability to tune and modify low_pass_alpha within SixDOF Tuner. (AFSIM-2110)
- Added the ability perform simple sensor commands with the Sensor Controller. (AFSIM-1366)

- Added the ability to display No-Escape and No-Maneuver shot ranges via aux_data in the Weapon Browser. (AFSIM-1170)
- Moved the "New Target" button to the same line as the weapon information in the Weapon Browser. (AFSIM-1170)
- Moved WsfDraw from the Preferences to a dock widget. (AFSIM-1378) (AFSIM-1739)
- Updated WsfDraw to use the Qt system to render. (AFSIM-1681)
- Added visualization of spherical zones to the Zone Browser. (AFSIM-597)
- Added support for missile icons in the Head Down View. (AFSIM-684)
- Improvements to Battle Management's Platform Status dialog: default color may be set separately for each column, default color no longer applies to 'n/a' values, and shortened aux data column titles. (AFSIM-1273)
- Added support for missile icons in the SA Display. (AFSIM-684)
- Added customizable colored text to the Console Output display. (AFSIM-1155)
- Added Line Cap to the Console Output Preferences.
- Chat messages are now written to the WsfEventPipe as `MsgChatMessage`. (AFSIM-1314)
- Added time stamps (wall time and/or sim time) to Chat messages. (AFSIM-1314)
- Moved Chat network preferences to the Network Preferences page. (AFSIM-1390)
- Added the ability to display projections of sensor volumes. (AFSIM-1323)
- Sensor volumes will now be blocked by the Earth. (AFSIM-1323)
- Improved the sensor volumes' preferences user-interface. (AFSIM-1323)
- Zone color preferences are now shared across Wizard, Warlock, and Mystic. (AFSIM-1112)
- Added support for the Map Display to correctly display nonzero minimum_radius values for circular and elliptical zones. (AFSIM-198)
- Added support for coloration of individual contours in shapefile generated by sensor_plot horizontal_map. (AFSIM-1141)
- Added additional options to control the visibility of Map Annotations. (AFSIM-1163)
- Added duration as a type of units to unit preferences. Duration is distinguished from the previously existing Time Format options in that the former specifies units for an amount of time that passes, and the latter specifies the manner in which a single instant in time is displayed.
- Added capability for Coverage Overlay panel to respond to unit preferences, and label the legend with values in the units according to the user's preferences.
- Visual applications now give some indication of what went wrong prior to closing for most crashes. (AFSIM-1565)
- Labels in the Map Display for platforms, routes, and tracks will now load and run faster, and use the Qt system to render. (AFSIM-1679)
- Exception logs are now saved to a file when the application unexpectedly closes due to an exception. (AFSIM-1733)
- Added keyboard shortcuts to hover info for interface controls. (AFSIM-2244)
- Updated the ruler, banner and scale in the Map Display to use a Qt rendered font. (AFSIM-1680)
- Added a search utility to the Map Toolbar find geographic locations by name in the Map Display. (AFSIM-2415)
- Spherical zones now display with a minimum radius. (AFSIM-1328)

### Development

- Renamed the `WkEnvironment` class to `WkSimEnvironment`. Created new `WkAppEnvironment` class. (AFSIM-1387)
- Added a Warlock-to-Warlock multicast network interface. Access from `wkEnv.GetNetwork()`. (AFSIM-1390)
- Added the Network Log dialog for inspecting the traffic/status of the Warlock Network interface. (AFSIM-1391)
- Missing plugin dependencies will now cause a CMake error. (AFSIM-1029)
- Renamed `wkf::MainWindow::AddDialogToViewMenu()` to `wkf::MainWindow::AddDockWidgetToViewMenu` to more accurately reflect what the function does. (AFSIM-1386)
- Removed `wkf::StdRedirector`. Instead declare `ut::log::Subscriber consoleSub{ "raw" };` to access the console output.
- Deprecated text drawing classes `UtoTextShape`, `VaAttachmentLabel`, `VaOverlayLabel`, `VaOverlayText`, `VaOverlayTextBox`, `VaOverlayWindow`. The `VaDecoratorNode` class should be used in their place. (AFSIM-1682)
- Classes *VaAttachmentZone*, *VaAttachmentZoneBase*, *VaAttachmentZoneCircle*, *VaAttachmentZoneEllipse*, *VaAttachmentZonePolygon*, *VaAttachmentZoneSphere*, and *VaZonePoint* have been deprecated, use the wkf namespaced 'AttachmentZone', 'AttachmentZoneBase', 'AttachmentZoneCircle', 'AttachmentZoneEllipse', 'AttachmentZonePolygon', 'AttachmentZoneSphere', and 'ZonePoint' instead.(AFSIM-1522)

## Wizard 2.9 - 25 Feb 2022

Visit the AFSIM 2.9 Release Page on DI2E (Access Controlled) for more information and resources related to this release.

### Release Dates

- Wizard 2.9.0 - 25 Feb 2022

### General

- Improved functionality of options when right clicking on Wizard editor Tabs. (AFSIM-1527)
- Hidden objects on the Map Display can no longer be selected. Additionally, when selected platforms and annotations are hidden, they are now automatically deselected.

### Corrections

- Fixed the issue where moving a point-of-interest via Ctrl+Left-click drag, via the Rotate dialog, or via the Translate dialog would crash Wizard if the point-of-interest did not have a position defined. (AFSIM-1406)
- Auto-complete popup no longer appears when requested on basic script types. (AFSIM-185)
- Fixed case where attempting to view reference info through the Text Editor's context menu would fail in some cases. (AFSIM-389)
- Fixed bug where changing certain preferred units in Preferences would slightly alter Text Editor values. (AFSIM-400)

- User actions applied to points-of-interest and bullseyes (including those from Rotate Dialog or Translate Dialog) can now be undone. (AFSIM-598)
- Fixed an issue where externally editing a scenario file would cause an asterisk to appear by the file name when there are no unsaved changes. (AFSIM-615)
- Corrected an issue where the asterisk would not appear after the file name in the Text Editor if there was only one file open. (AFSIM-809)
- Corrected an issue where docking the Map Display with a Text Editor tab would make the Map Display tab unclosable. (AFSIM-809)
- Corrected grammar rule for the filename used by the WSF_TSPI_MOVER to allow the parser to identify scenario dependencies. (AFSIM-974)
- Fixed an issue where an erroneous heading command would be inserted in the Text Editor if a platform was dragged to a new location on the Map Display. (AFSIM-980)
- Fixed issue where scenarios would partially run before Script Debugger breakpoints would break. (AFSIM-1072)
- Fixed issues where Wizard would not append attributes to platforms and zones correctly. (AFSIM-1036 AFSIM-1045)
- Fixed the issue where moving a platform via Ctrl+Left-click drag, via the Rotate dialog, or via the Translate dialog may corrupt input in the Text Editor. (AFSIM-1050)
- Corrected an issue where polygonal zones defined using MGRS coordinates or polar coordinates were incorrectly displayed (AFSIM-1109)
- Corrected some issues causing points in polygonal zones to display incorrectly (AFSIM-1110)
- Clicking "Clear Recents" button on the Start-up Dialog will clear the File>Open Recent menu. (AFSIM-1116)
- Corrected an issue where circular and elliptical zones had unexpected behavior while being dragged (AFSIM-1154)
- Global routes containing offset waypoints now render correctly. (AFSIM-1176)
- Fixed issue where zones defined on a platform would not be updated if the platform's heading was changed. (AFSIM-1200)
- Fixed issue where zone visualization would sometimes not match the simulation when using the reference_platform command. (AFSIM-1201)
- Fixed issue where Wizard would not display members of a zone_set if they were included with use_zone or use_exclude_zone. (AFSIM-1202)
- Corrected an issue where using both embedded inclusion zones and embedded exclusion zones in a zone set would cause a crash. (AFSIM-1203)
- Fixed issue where Wizard would not display zones if they were in a references chain of length 2 or greater. (AFSIM-1249)
- Corrected an issue where right-clicking a ../zone in the Zone Editor and clicking "Go to Definition" crashed Wizard, for zones defined on platforms using use_zone. (AFSIM-1316)
- Corrected an issue where platform-defined zones, when defined using use_zone, could sometimes inherit their parent platform's heading when they weren't supposed to. (AFSIM-1349)
- Improved scenario loading performance. (AFSIM-1385)
- Fixed a Wizard crash that happens when the scenario input has a chain of include commands that is too long. (AFSIM-1654)

- The “Select All” action (default Ctrl-A) now works in both editor and console windows (AFSIM-857)
- Improved handling of code folding in text editor. (AFSIM-1917)
- Fixed a crash where opening a project during a Wizard Debugger run would crash Wizard. (AFSIM-1848)
- Added a user prompt to stop the current run or all runs when the Stop Debugging button is pressed while using the Wizard Debugger on a multi-run simulation. (AFSIM-1779)
- Fixed a bug where recursive data was presented for script watches (AFSIM-1780)
- Allow the use of script_variables for update_interval in the grammar. (AFSIM-2180)
- Added base mover commands to the WSF_TBM_MOVER grammar.
- Corrected an issue with Astrolabe in which a spurious character would be erased from the input file when accepting a mission sequence, sometimes leading to malformed input. (AFSIM-1179)
- The Wizard Comms Visualiztion plugin now supports multiple links per comm device. (AFSIM-1595)
- Fixed an issue where a near-zero heading would be added to a platform after applying a translation with Ctrl+Left-click drag operation or the Translate Dialog.
- Fixed an issue where the Rotate and Translate dialogs would look squished due to different screen resolutions.
- Fixed issues adding, editing, and deleting command_chain or commander commands from the platform definition using the Command Chain Browser. (AFSIM-397)
- Fixed issue where the Command Chain Browser would keep previous command_chain names listed after they have been changed. (AFSIM-604)
- Now, the context menu documentation links support the revised event_output documentation format. (AFSIM-593)
- Fixed an issue where Wizard would crash if the user supplied a csv_event_output log without the headers and pressed Generate Report in the Post Processor>DSV Report dialog.
- Corrected the display of AGL in the Route Browser. All routes local to platforms now show at the proper altitude when AGL is selected. (AFSIM-852)
- Fixed an issue where polygonal zones defined using lat_lon or MGRS coordinates were not visualized as Earth-tangential. (AFSIM-1195)
- Corrected issue where stopping the Script Debugger could cause a crash when the application was closed. (AFSIM-1520)
- Corrected an issue where trying to set a breakpoint through the margin context menu (using “Set Breakpoint” or “Set Conditional Breakpoint...”) did nothing. (AFSIM-1623)
- Fixed a bug which prevented Wizard from using the Script Debugger with sensor_plot. (AFSIM-1643)
- Corrected an issue where breakpoints were shifting up lines instead of being removed when the lines that they were located on were deleted. (AFSIM-2413)
- Limited length of popup notifications to prevent buttons from being pushed off the screen. (AFSIM-1388)
- Improved clarity of popup notifications by replacing “Ignore” button with a check box. (AFSIM-1554)
- Removed ability to disable popup notifications for fatal errors. (AFSIM-1538)
- Waypoint altitude now renders correctly when AGL altitude reference is specified. (AFSIM-841)
- Fixed a crash which occurs when using Mission 2.7.X or older upon defining a WSF_SPACE_MOVER on a platform. (AFSIM-1159)
- Fixed an issue where the current waypoint would inherit the previous waypoint’s ground level, instead of using its ground level, when AGL is specified. (AFSIM-1185)

- Corrected satellite orbits in 2D map displays. (AFSIM-1331)
- Corrected satellite orbits in ECEF mode. (AFSIM-1361)
- Corrected error where mover agl routes would not take additional specified altitude information into account. (AFSIM-1970)
- Improved route loading performance. Removed default index labels from routes. (AFSIM-2031)
- Fixed crashes in Pattern Visualizer when viewing non-standard signatures. (AFSIM-848)
- Fixed a crash on start-up in the Pattern Visualizer. (AFSIM-1102)
- Corrected the display of antenna_pattern.esa_pattern in Pattern Visualizer. (AFSIM-1266)
- Corrected an issue where trying to set an alpha value for a zone's lines via line_color wouldn't take effect. (AFSIM-1247)
- Corrected an issue where a WsfWeaponEngagement using a weapon with no platform would not render an explosion at the target. (AFSIM-1040)
- Corrected a lighting bug that caused polygonal zone line colors to appear incorrectly. (AFSIM-1104)
- Corrected an issue where ../zone color changes would revert during a replay if the owning platform was destroyed. (AFSIM-1105)
- Some visualizations no longer appear offset from their respective platforms when far away from the center of the 2D Map Display. (AFSIM-398)
- Fixed ../route waypoint labels clipping through the Map Display. (AFSIM-394)
- Fixed double-clicking a platform with a route causing the platform to remain unselected, but its route's labels visible. (AFSIM-393)
- Corrected visualization of routes which include waypoints using the goto command. (AFSIM-396)
- Corrected an issue where platform-defined zones appeared to be affected by the platform's pitch and roll. (AFSIM-1258)
- Corrected an issue where platform-defined zones wouldn't respect minimum_altitude and maximum_altitude commands for display in Wizard, Warlock, and Mystic. (AFSIM-1259)
- Corrected an issue where zone colors (fill_color and line_color) weren't inherited through references. (AFSIM-1369)
- Improved the load times of scenarios which use many routes. (:issue: *AFSIM-1570*)
- Prevent Wizard's views from getting stuck below the map surface when dealing with subsurface platforms. (:issue: *AFSIM-1815*)
- Corrected an issue where coastline segments that cross the dateline would draw across an entire 2D map.
- Corrected an issue which prevented the Model Viewer auto-complete from working. (AFSIM-1423)

### Enhancements

- Implemented and improved validation for inputs to Platform Details attribute fields. (AFSIM-400)
- Added support for descriptions on all nodes rather than just trees for Advanced Behavior Trees. The name and desc commands have been swapped to use <quotable-string> grammar tokens for more robust string handling. (AFSIM-1186)
- Added visualization of spherical zones to the Zone Editor. (AFSIM-597)
- Added support for platform and mover altitude reference to Wizard. (AFSIM-1030)

- Added visualization of global zones created using the references command. (AFSIM-1113)
- Added various features to help debug line readability, and changed button layout for the Script Debugger. (AFSIM-1465)
- Added support for displaying aux data for simulation objects in the Watch Control. (AFSIM-1521)
- Added comment folding for block comments and consecutive line comments that do not overlap with exiting folds. (AFSIM-1525)
- Text Editor margin icons now resize with font. (AFSIM-1852)
- Indentation and deindentation in Wizard Text Editor now jumps to nearest indent multiple (AFSIM-1853)
- Added the Task List plug-in. (AFSIM-1705)
- Added support in Astrolabe for targeting a specified kinematic state in targeting-class maneuvers.
- Added support in Astrolabe for optimizing orbital targeting events with a cost function. (AFSIM-1787)
- Created option to go to definition for zones on map display. (AFSIM-1522)
- Added orbit preferences. (AFSIM-1361)
- Colored text in the Console Output display is now customizable. (AFSIM-1155)
- Added Line Cap to the Console Output Preferences.
- The Script Debugger now displays breakpoints in a table and shows the hit count for each breakpoint. (AFSIM-1466)
- The Script Debugger now sorts breakpoints by file name and line number rather than by order created. (AFSIM-1469)
- Right-clicking a breakpoint in the Script Debugger now displays a context menu with options for deleting the breakpoint, enabling/disabling the breakpoint, and editing the breakpoint's condition. (AFSIM-1471)
- The Watch Control and Callstack widgets no longer close themselves after completing a simulation in debug mode. (AFSIM-1488)
- Breakpoints placed on an invalid line will be moved to the next valid line within the same file (when able) on debugger run. (AFSIM-1480)
- The Watch Control now preserves watches added by the user across multiple simulation runs. (AFSIM-1519)
- Reorganized Breakpoints, Callstack, and Watch Control into "Script Tool" submenu under View. (AFSIM-1536)
- Modifying any file during a debug run will now prompt the user to set all breakpoints (if any) in the file to inactive or stop the debug run. Any future breakpoints added to the file will be inactive and locked until the run is over. (AFSIM-1596)
- Added buttons to allow user to delete all/selected watches for script variables. (AFSIM-1782)
- Re-ordered buttons in Wizard Sim Execution. (AFSIM-1784)
- Modified breakpoint handling to disallow users from stepping into modified files. (AFSIM-1846)
- Added "Profiling Output Path" to the Simulation Execution preferences page to support new Profiling plugin from Wizard. (AFSIM-1866)
- Added "Extra arguments" to the Simulation Execution preferences page to support application-specific arbitrary arguments from Wizard. (AFSIM-1866)
- Added restart button to Wizard Sim Execution. (AFSIM-2243)
- Zone color preferences are now shared across Wizard, Warlock, and Mystic. (AFSIM-1112)

- Added support for the Map Display to correctly display nonzero minimum_radius values for circular and elliptical zones. (AFSIM-198)
- Added support for coloration of individual contours in shapefile generated by sensor_plot horizontal_map. (AFSIM-1141)
- Added additional options to control the visibility of Map Annotations. (AFSIM-1163)
- Added duration as a type of units to unit preferences. Duration is distinguished from the previously existing Time Format options in that the former specifies units for an amount of time that passes, and the latter specifies the manner in which a single instant in time is displayed.
- Added capability for Coverage Overlay panel to respond to unit preferences, and label the legend with values in the units according to the user's preferences.
- Visual applications now give some indication of what went wrong prior to closing for most crashes. (AFSIM-1565)
- Labels in the Map Display for platforms, routes, and tracks will now load and run faster, and use the Qt system to render. (AFSIM-1679)
- Exception logs are now saved to a file when the application unexpectedly closes due to an exception. (AFSIM-1733)
- Added keyboard shortcuts to hover info for interface controls. (AFSIM-2244)
- Updated the ruler, banner and scale in the Map Display to use a Qt rendered font. (AFSIM-1680)
- Added a search utility to the Map Toolbar find geographic locations by name in the Map Display. (AFSIM-2415)
- Spherical zones now display with a minimum radius. (AFSIM-1328)

### Development

- Moved the parser/proxy timers from the text editor status bar to the `Developer>Parser/Proxy Timers` menu. In that menu are times for grammar parsing (`Grammar T`), input parsing (`Parse T`), proxy deserializing (`Deserialize T`), and proxy merging/GUI updating (`Merge/GUI T`).
- Added `MoveMode` to the `VtkInterface` to allow custom behavior corresponding to different geometric transformations to the scenario. (AFSIM-980)
- Added `ProxyUtil::InvalidateInput` to allow developers to invalidate input if the processing of the proxy data reaches an invalid state. (AFSIM-1176)
- Fixed the issue where the `WsfParser` would record duplicate comment entries in the `WsfParseSourceInclude` object if a comment was inside of an input block. (AFSIM-1856)
- Added line feed (`\f`) and vertical tab (`\v`) to the available whitespace characters for the `WsfParser`, so that it matches `ProcessInput` in terms of valid whitespace. (AFSIM-1938)
- Missing plugin dependencies will now cause a CMake error. (AFSIM-1029)
- Renamed `wkf::MainWindow::AddDialogToViewMenu()` to `wkf::MainWindow::AddDockWidgetToViewMenu` to more accurately reflect what the function does. (AFSIM-1386)
- Removed `wkf::StdRedirector`. Instead declare `ut::log::Subscriber consoleSub{ "raw" };` to access the console output.
- Deprecated text drawing classes `UtoTextShape`, `VaAttachmentLabel`, `VaOverlayLabel`, `VaOverlayText`, `VaOverlayTextBox`, `VaOverlayWindow`. The `VaDecoratorNode` class should be used in their place. (AFSIM-1682)

- Classes *VaAttachmentZone*, *VaAttachmentZoneBase*, *VaAttachmentZoneCircle*, *VaAttachmentZoneEllipse*, *VaAttachmentZonePolygon*, *VaAttachmentZoneSphere*, and *VaZonePoint* have been deprecated, use the wkf namespaced 'AttachmentZone', 'AttachmentZoneBase', 'AttachmentZoneCircle', 'AttachmentZoneEllipse', 'AttachmentZonePolygon', 'AttachmentZoneSphere', and 'ZonePoint' instead.(AFSIM-1522)

## WSF Core 2.9 - 25 Feb 2022

Visit the AFSIM 2.9 Release Page on DI2E (Access Controlled) for more information and resources related to this release.

### Release Dates

- WSF Core 2.9.0 - 25 Feb 2022

### General

- Updated documentation of WsfPlatform script methods for setting location, velocity, and orientation to caution usage of these methods on uninitialized platforms created via script. (AFSIM-190)
- Deprecated the precession_nutation_update_interval command, to be replaced by nutation_update_interval. (AFSIM-1354)
- Deprecated the WsfEventPipe.Record script method that takes time as an argument. Use the new Record script that does not have a time argument. Setting a time other than TIME_NOW would cause issues in Mystic. (AFSIM-1421)
- Deprecated WSF_TRACK_MANAGER processor as an alias for WSF_TRACK_PROCESSOR. (AFSIM-1253)
- The WsfPlatform script class now has a well-defined ordering, so that insertion of WsfPlatform objects into sorted containers (i.e. Map and Set) is now deterministic and will not affect simulation repeatability. (AFSIM-1871)
- Removed platform state data from event_output and csv_event_output for platforms that have not been initialized. (AFSIM-1878)
- Updated documentation to notify users of future changes to implicit usage of the default command_chain. (issue:*AFSIM-2135*)
- Deprecated the transform_route command and replaced with two new commands, insert_route and insert_offset_route. (AFSIM-2082)
- Removed the previously deprecated target specification options, platform and offset, from the ../target, ../intercept, and ../rendezvous maneuvers. (AFSIM-693)
- Removed previously deprecated methods from the script classes WsfTargetManeuver, WsfInterceptManeuver, and WsfRendezvousManeuver that constructed the maneuver or modified the maneuver's target information without using the WsfTargetPoint . (AFSIM-693)
- Deprecated the versions of WsfSpaceMover.ComputeRendezvous, and WsfSpaceMover.ComputeIntercept that accept a WsfTrackId as an argument. Users should instead use the versions accepting a WsfTargetPoint instance. (AFSIM-692)
- Deprecated orbital propagator debug output commands debug_output_wsf, debug_output_oe, debug_output_stk, debug_output_xyz, and debug_output_tle. (AFSIM-694)
- Clarified the documentation with respect to hyperbolic end-states of maneuvers (e.g., ../rendezvous), and other orbital targeting operations (e.g., WsfSpaceMover.ComputeIntercept). (AFSIM-745)

- The PLATFORM_KILLED event for event_output, csv_event_output, and observer has been deprecated and will be removed in a future release. Use docs/event/platform_events:PLATFORM_BROKEN instead.
- Propellant for WSF_SIX_DOF_MOVER solid-rocket boosters is now defined and treated as a fuel tank, with positioning based on the reference point of the vehicle. Existing models can be migrated with no effect on performance by following the guidance in SixDOF_Solid_Propellant_Rocket_Motors_2p9. (AFSIM-1182)
- SixDOF PID derivative controllers now track rate-of-change of the process variable rather than the error. This reduces spikes in output caused by updates from middle- and outer-loop controllers. (AFSIM-2110)
- Clarified documentation to provide detail for incidental_damage_allowed usage in WSF_ENGAGE_LAUNCH_PK_TABLE_LETHALITY. Added warning message when this command is used. (AFSIM-1563)

### Corrections

- New movers provided via WsfPlatform.SwapMover now respect maximum_mover_update_interval. (AFSIM-2121)
- A script compiler error is now produced under two new conditions: script methods declared with a non-void return type that fail to return a value, and unreachable script code due to inappropriate control flow (e.g. after `return`). (AFSIM-762)
- Corrected an issue in the line_of_sight_manager that could cause multi-threaded simulations to hang or crash. (AFSIM-1244)
- Corrected an issue in LocationValid2D() that caused some tracks with known 3-D location information to report false for this method and true for LocationValid(). Clarified documentation for these methods. (AFSIM-209)
- Corrected an issue where WSF_TABULAR_ATTENUATION was limiting attenuation values to the range [0, 1] absolute. (AFSIM-172)
- Corrected issues with docs/event/sensor_events:SENSOR_FREQUENCY_CHANGED event output that caused errors in event and CSV files for some scenarios. (AFSIM-179)
- Invoking script Object methods on basic types is now a script compilation error rather than a runtime exception. (AFSIM-185)
- Corrected the return value of script methods WsfSimulation.ExecuteAtTime, WsfPlatform.ExecuteAtTime, and WsfProcessor.ExecuteAtTime to indicate whether the supplied script is valid. (AFSIM-642)
- Corrected an issue where GPS navigation_errors were not being converted from a platform's local XYZ coordinate frame to the WCS frame correctly. (AFSIM-932)
- Corrected an issue with the WSF_ROTORCRAFT_MOVER not moving along a route correctly after encountering a waypoint with a pause_time. (AFSIM-150)
- Corrected an issue in the kinematic trajectory model for the WSF_TSPI_MOVER that is used to predict future locations and time of apogee. (AFSIM-167)
- Corrected an issue where measurement data being sent over XIO was not preserving error values. (AFSIM-1998)
- Corrected an issue where platforms with route movers initially turned off will move along the provided route, jumping between waypoints, despite the mover being off. (AFSIM-182)
- Corrected an issue where platforms with route movers initially turned off and given a route, if later turned on using the WsfMover.TurnOn script method, will cause the platform to jump to the location on the route as if the mover had been on the entire time. (AFSIM-183)
- Corrected an issue where the WSF_ROAD_MOVER would not use the road network when commanded using the WsfPlatform.GoToLocation or WsfPlatform.FollowRoute script methods. (AFSIM-211)

- Corrected an issue where platforms following a route with a segment longer than ~1/4 of the earth's circumference would not reach the proper location. (AFSIM-311)
- Corrected an issue where converting MGRS coordinates to Latitude/Longitude would fail in certain cases. (AFSIM-1039)
- Corrected a crash when using ProcessInput() on a command that depends on other input that has not been loaded. For example, a route referenced in the use_route command must be loaded or the scenario crashed. A console_output Info message will get issued when using the ProcessInput script method on a command with dependencies. (AFSIM-1071)
- Added missing documentation for signal_processor.mti_processor commands filtered_doppler_speed and unfiltered_doppler_speed. Added commands to the grammar for correct parsing in Wizard. (AFSIM-1073)
- Fixed crash that could occur when sending a WsfDraw command over XIO. (AFSIM-1097)
- Corrected observer documentation to include missing events, remove events no longer available, and accurately reflect event signatures. (AFSIM-1099)
- Removed excess console output from WsfPlatform.SetSignatureState. (AFSIM-234)
- Added warnings when using various zone commands on zone shapes they are not intended for. (AFSIM-1119)
- Fixed crash that could occur when osm_traffic vehicles are changing lanes to an unoccupied neighboring lane. (AFSIM-1132)
- Corrected the application of range_error_sigma value to the track measurement when *percent_of_true_range* is specified. (AFSIM-1151)
- Corrected an issue where Advanced Behavior Tree Shared Blackboard script commands would not propagate all the way up the tree. (AFSIM-1234)
- Corrected an issue causing priority_selector to not work with root_node_type on Advanced Behavior Trees. Also fixed crashes involving root_node_type with sequence_with_memory/selector_with_memory nodes. (AFSIM-1241)
- Fixed the propulsion DIS appearance mask and added missing air domain flags. (AFSIM-1209)
- Corrected an issue where latitude and longitude values were inaccessible for route waypoints defined with a turn command (turn_left, turn_right, or turn_to_heading) and a distance command. (AFSIM-1204)
- Added docs/event/sensor_events:SENSOR_DETECTION_CHANGED callbacks for event_output, csv_event_output, and observer to indicate that detected targets are no longer detected on sensor turn off or when targets are deleted. (AFSIM-134)
- Corrected an issue in which using the script method Array<T>.Insert would result in a script compilation error if T was not an Object. (AFSIM-1394)
- Fixed an issue with the Record Length in the DIS Record Specification. (AFSIM-1395)
- Corrected an issue which often resulted in a crash when running multi-threaded with the event_pipe (AFSIM-1409)
- Fixed two problems where platforms and WsfGeoPoints continued to utilize a WGS-84 Earth ellipsoid for coordinate conversions when another option for the central_body in the global_environment is selected. (AFSIM-1424)
- Fixed an issue involving priority_selector selecting from multiple children weighted_random nodes incorrectly for Advanced Behavior Trees. (AFSIM-1298)
- Fixed a crash that happens when the scenario input has a chain of include commands that is too long. (AFSIM-1653)

- Corrected a crash in osm_traffic that occurred when background vehicles exited the route_network via an one-way road. Vehicles are now deleted and a new vehicle is spawned at the beginning of a road that originates from an edge of the network. (AFSIM-1677)
- Fixed incorrect parsing of script string literals. (AFSIM-1788)
- Corrected an issue in which floating point values provided to integer inputs would silently truncate the input. An input error is now generated in such a case. (AFSIM-2273)
- Changed console_output format of script_struct to no longer span multiple lines. (AFSIM-1722)
- WSF_KINEMATIC_MOVER now correctly reports velocity vector. (AFSIM-1729)
- Fixed an issue where relocate_and_rotate used a spherical earth model instead of an ellipsoidal earth. (AFSIM-177)
- Fixed an issue where a WSF_TSPI_MOVER would always report 0 heading after a relocate_and_rotate command. (AFSIM-730)
- WSF_KINEMATIC_MOVER now correctly reports acceleration. (AFSIM-1730)
- Corrected an issue with azimuth_beamwidth and elevation_beamwidth where the error sigmas should have been driven by steered beamwidth when electronic beam steering was enabled. (AFSIM-1006)
- Corrected documentation for structures in aux data. (AFSIM-131)
- Corrected an issue when computing range_rate_error_sigma to reflect doppler resolution used in WSF_RADAR_SENSOR as a velocity instead of frequency. (AFSIM-1325)
- Corrected an issue where enabling csv_event_output or print_eci_locations for event_output would change the initial orbiting locations of satellites. (AFSIM-1878)
- WsfFuel now correctly inherits WsfPlatformPart as documented, making WsfPlatformPart script methods available on fuel objects. (AFSIM-2029)
- Fixed a regression introduced from AFSIM-169 regarding usage of transform_route with offset waypoints. (AFSIM-1885)
- maximum_mover_update_interval will now properly interact with update_interval set from script_variables. (AFSIM-2180)
- Corrected multiple issues causing a priority_selector node to call the precondition block for its selected node twice in one tick. (AFSIM-2296)
- Corrected an issue with precondition blocks being skipped unintentionally for nodes in certain situations involving priority_selectors. (AFSIM-2364)
- Corrected a problem where the WSF_GUIDED_MOVER was not computing all of the forces for each sub-step when using a Runge-Kutta integrator. Users can now optionally require computation of all forces for each sub-step, instead of only recomputing the gravitational force. (AFSIM-152)
- Corrected an issue in which WsfWeapon.TimeToIntercept was returning inaccurate results for weapons using the WSF_SAM_LAUNCH_COMPUTER. (AFSIM-153)
- Corrected an issue with the documentation for the WSF_GUIDED_MOVER where the commands divert_thrust, divert_fuel_mass, divert_fuel_flow_rate, and divert_altitude_limits, were not explicitly noted as erroneous for use in WSF_GUIDED_MOVER's for a weapon used by weapon_tools to generate ballistic missile launch computer data. (AFSIM-181)
- Corrected an issue with the WSF_PERCEPTION_PROCESSOR providing incorrect number of available systems/resources on an asset platform. (AFSIM-165)
- WSF_BALLISTIC_MISSILE_LAUNCH_COMPUTER can now compute intercept solutions for platforms using a WSF_TSPI_MOVER. (AFSIM-167)

- Corrected an issue where continuous- and discrete-fire implicit weapons were generating more hits or PK draws than expected during an engagement. (AFSIM-206)
- Fixed a crash when the WSF_QUANTUM_TASKER_PROCESSOR purges multiple received tasks. (AFSIM-208)
- Corrected the issue of WSF_IMPLICIT_WEAPON ignoring quantity, reloading and firing interval settings. (AFSIM-361)
- Corrected an issue with the WSF_TRACK_EFFECT not applying the range_error, azimuth_error elevation_error, or velocity_error. (AFSIM-660)
- Corrected an issue where turning optical sensors off and on that report to a WSF_IMAGE_PROCESSOR with a filter could cause a crash. (AFSIM-838)
- Corrected an issue where the WSF_TBM_MOVER would occasionally hang when computing launch angles. (AFSIM-2043)
- Clarified documentation and grammar to provide guidance on weapon_effects commands that are incompatible with WSF_CARLTON_LETHALITY, WSF_EXOATMOSPHERIC_LETHALITY, WSF_GRADUATED_LETHALITY, WSF_HEL_LETHALITY, WSF_MOBILITY_AND_FIREPOWER_LETHALITY, and WSF_TABULATED_LETHALITY. (AFSIM-840)
- Fixed an issue where the docs/clutter_model:surface_clutter model fails silently with low antenna_height used with a surface platform on rough seas. (AFSIM-170)
- Corrected a problem where intercepts of space domain objects by platforms using the WSF_GUIDED_MOVER and fired using the WSF_BALLISTIC_MISSILE_LAUNCH_COMPUTER were missing their target when running in a distributed environment (i.e., the shooter is in one simulation; the target in another). (AFSIM-1041)
- Corrected an issue with the WSF_QUANTUM_TASKER_PROCESSOR incorrectly allocating extra tasks when using the allocator_extra_tasks feature. (AFSIM-1059)
- Fixed a rare crash with WSF_QUANTUM_TASKER_PROCESSOR when using the allocator_extra_tasks feature. (AFSIM-2142)
- Corrected an issue with WsfAssetPerception.RelativeBearingTo so that it correctly returns relative bearing instead of true bearing. (AFSIM-1317)
- Clarified documentation of ../target_recognition_commands for WSF_IMAGE_PROCESSOR and removed references to non-existent events and event_output flags. (AFSIM-174)
- Corrected an issue with the WSF_QUANTUM_TASKER_PROCESSOR crashing during the evaluation step when the reallocation_strategy is either static or event and the evaluator is either distance or intercept_time. (AFSIM-1634)
- Corrected an issue where launching a WSF_GUIDED_MOVER or WSF_UNGUIDED_MOVER without a target track could use orientation rather than velocity when separating from the launching vehicle. (AFSIM-1675)
- Fixed crash that would occur with WsfClusterManager when using H_TREE_AVG clustering. (AFSIM-1313)
- Corrected an issue with fuse_function_range to allow weapons to detonate at the appropriate distance specified. (AFSIM-1537)
- Corrected an issue when computing range_rate_error_sigma to reflect doppler resolution used in WSF_OTH_RADAR_SENSOR and WSF_SURFACE_WAVE_RADAR_SENSOR as a velocity instead of frequency. (AFSIM-1325)
- Corrected a crash in alternate_locations where a platform using a reference to a platform that was turned off using platform_availability would cause the sim to crash. (AFSIM-2356)
- Fixed inconsistent definition of success/failure in cyber attack status report. (AFSIM-1626)

- Corrected deficiencies in the documentation of antenna_pattern.element_esa_pattern. Added average_element_spacing_x and average_element_spacing_y commands to the grammar for correct parsing in Wizard. (AFSIM-258)
- Clarified documentation and grammar to provide guidance on which weapon_effects commands are incompatible with WSF_ENGAGE_LAUNCH_PK_TABLE_LETHALITY. (AFSIM-840)
- Clarified documentation to provide detail on Pk table file requirements and command usage with WSF_ENGAGE_LAUNCH_PK_TABLE_LETHALITY. (AFSIM-317)
- Fixed an issue where sensor tracks were not being suppressed from subordinate sensors that are attached to a WSF_TRIMSIM_PROCESSOR. (AFSIM-1641)
- Fixed a crash in the WSF_TRIMSIM_PROCESSOR when error covariance data is being updated on the sensor track. (AFSIM-1647)
- Corrected an issue with the documentation for the BALLISTIC_MISSILE_LAUNCH_COMPUTER_GENERATOR where the WSF_GUIDED_MOVER commands divert_thrust, divert_fuel_mass, divert_fuel_flow_rate, and divert_altitude_limits, were not listed as erroneous for use in WSF_GUIDED_MOVER's for a weapon used by weapon_tools to generate ballistic missile launch computer data. (AFSIM-181)
- Corrected an issue with the sign of delta_altitude generated by the ATG_LAR_AND_LC_GENERATOR. (AFSIM-975)
- Corrected an issue with the horizontal_map and flight_path_analysis functions in sensor_plot not using the initial_mode of sensor when running with multiple sensors. (AFSIM-161)
- Corrected the formatting of the DBF file header generated by shapefile in sensor_plot horizontal_map to improve the compatibility of AFSIM generated shapefiles. (AFSIM-1141)
- Corrected the documented set of events which trigger the docs/post_processor:Engagement Report for the ../post_processor. (AFSIM-227)
- Addressed a possible issue where WsfSA_Processor could be providing incorrect platform data to scripted queries prior to its first update. (AFSIM-1235)
- Fixed issues in SixDOF PID controller evaluation that could cause additional process noise and report artificially high derivative signals for middle and outer loop controllers. Users should increase kd for these controllers according to their outer and middle loop factor settings (AFSIM-2110)
- Fixed an error in SixDOF PID controller evaluation that caused PIDs to incorrectly track the sampled derivative rather than the filtered output. Users may wish to significantly reduce low_pass_alpha values to recover previous behavior. (AFSIM-2110)
- Corrected a problem where the orbit_determination fusion method was not producing a valid Initial Orbit Determination (IOD) result in the angles-only case (where only sensors that report bearing and elevation contribute to the IOD), particularly for satellites in Geosynchronous orbits. (AFSIM-291)
- Corrected an issue with WsfSolarTerminator.PlatformSolarIllumination for platforms on the surface of the Earth, or which had no mover. (AFSIM-1111)
- Corrected an issue where the high_resolution_eclipse option for the WSF_SPACE_OPTICAL_SIGNATURE would incorrectly compute a zero solar illumination.
- Corrected the behavior of WsfPlatform.FutureLocation for platforms with space movers. (AFSIM-744)
- Corrected a problem where the three argument, WsfTrackId accepting version of WsfInterceptManeuver.Construct would silently fail and halt the simulation when used outside a platform's script context. (AFSIM-555)
- Removed the non-functional, undocumented script method WsfOrbitalManeuver.RequiredDeltaV. (AFSIM-552)

- Corrected an error in orbital mission sequence execution that was causing the MOVER_STAGED observer to not trigger for multi-stage space platforms.
- Removed epoch warnings from most space mover types. Updated warning in WSF_NORAD_SPACE_MOVER. (AFSIM-719)
- Corrected issues where orbital targeting optimization (such as for the ../rendezvous or ../intercept maneuvers) would not find solutions, or give sub-optimal solutions. (AFSIM-1347)
- Corrected an issue where WsfSpaceMover.RIC_AtTime would report incorrect results for platforms with no mover. (AFSIM-1360)
- Corrected an issue where WSF_INTEGRATING_SPACE_MOVER would use an incorrect mass. (AFSIM-1719)
- Corrected an issue where WSF_SPACE_MOVER had an input order dependence between setting the initial condition's epoch and setting the initial ECI kinematics. (AFSIM-2239)
- Fixed a bug which prevented Wizard from using the Script Debugger with sensor_plot. (AFSIM-1643)
- Fixed issues with WSF_LINK16_COMPUTER not handling J11 messages correctly. The documentation and grammar were updated as well. (AFSIM-210)
- Fixed issues with WSF_LINK16_COMPUTER J3_5 messages incorrectly reporting speed and course data as zero. (AFSIM-1812)
- Corrected an issue in WSF_SENSOR_COVERAGE where multiple sensors on the same platform providing free assets are all set to ignore the grid assets. (AFSIM-1233)

### Enhancements

- Set the script type to "WSF_DIS_MOVER" for DIS mover instances. It was previously unset and so mover.Type() returned an empty string. (AFSIM-2117)
- Applied optimizations throughout the comm framework to realize performance gains in comms usage. Improvements are mostly realized through elimination of unnecessary data copying and using map lookup O(lg(N)) instead of array find O(N) in the comm medium for finding messages in flight. (AFSIM-1270)
- Applied optimizations throughout the framework and scripting engine to realize performance gains in script execution runtimes. (AFSIM-762)
- Improved multi-threaded performance in the simulation and line_of_sight_manager. (AFSIM-1244)
- The regular_table format now supports loading binary table files, allowing terabyte sized tables to be easily loaded into AFSIM, through use of the memory mapping technique. The save_as_rectangular_indexed_binary_file command is provided as a convenience for converting the old ASCII format to the new binary format, to allow speeding up the loading of pre-existing tables. (AFSIM-1242)
- The linear_equation command for regular_table is now provided as a shorthand for specifying independent variables of equally-spaced datapoints. (AFSIM-1242)
- Added option to use nearest interpolation in regular_table instead of linear. Default interpolation behavior remains linear. (AFSIM-1242)
- Added the option to declare a category as private in dis_interface. (AFSIM-244)
- Added WsfSensor.TrackQuality methods that allow a user to access track_quality inputs per sensor mode. (AFSIM-245)
- Added and modified various script methods and expanded blackboard variable support for Advanced Behavior Trees. (AFSIM-977)

- Added support for methods WsfZone.Draw and WsfZone.DebugDrawZone to draw all types of polygonal zones as well as absolute ones. (AFSIM-203)
- Added command falling_behind_threshold in xio_interface to control how far a simulation can fall behind before notifying connected simulations. (AFSIM-1062)
- Added a version of WsfPlatform.RadarCrossSection that allows a user to query a platform's bistatic RCS using both receiver and transmitter aspect angles. (AFSIM-952)
- Added command force_flushing to configure the automatic flushing of console_output. (AFSIM-953)
- Added additional functionality to FileIO for users to query mode and path information for opened files. (AFSIM-820)
- Added new versions of WsfPlatform.SlantRangeTo, WsfTrack.SlantRangeTo, and WsfGeoPoint.SlantRangeTo that perform the slant range calculation with spherical coordinates. (AFSIM-996)
- Added new script method KeySet to access the full set of keys for a Map. (AFSIM-1056)
- Optimized the performance of a graph pathfinding algorithm, resulting in improved runtimes for scenarios utilizing communications. (AFSIM-1117)
- Added methods WsfGeoPoint.ApparentTimeNow and WsfGeoPoint.ApparentTime for querying the mean solar time of a WsfGeoPoint. (AFSIM-1153)
- Added a method WsfPlatform.ApparentTime for querying the mean solar time of a WsfPlatform. (AFSIM-1153)
- Added the ability to dynamically change fields of view on sensors, using a new field of view class hierarchy: WsfFieldOfView, WsfCircularFieldOfView, WsfRectangularFieldOfView, WsfPolygonalFieldOfView, and WsfEquatorialFieldOfView. (AFSIM-406)
- Added the option to forward console_output to a file. (AFSIM-1166)
- Added the transmitter command use_peak_power for allowing the use of peak power instead of average power for all predicated transmitter power algorithms. (AFSIM-1007)
- Added new command solar_elevation_at_target to all passive IR and passive visual sensors, as well as WSF_GEOMETRIC_SENSOR. (AFSIM-722)
- Platform aux_data is now updated over the xio_interface. (AFSIM-1320)
- Added the absolute error model that defines a one standard deviation absolute position error measurement in two or three dimensions about the sensor detection target. (AFSIM-1054)
- Added Sun.Elevation and Sun.Azimuth for querying information about the sun's position. (AFSIM-1321)
- Added support for scripted sensor detection constraints via the OnSensorDetectionAttempt method. Sensors can now also utilize the capabilities of the Common_Script_Interface. (AFSIM-1334)
- Added new script method WsfEM_XmtrRcvr.Index and alias WsfEM_Xmtr.BeamNumber.
- Improved error messages when the application crashes. (AFSIM-1515)
- Added the ability for all nodes to use precondition/execute blocks, and added safety/convenience to all script functions for Advanced Behavior Trees. (AFSIM-1298)
- Added GetAllAuxDataTypes methods to all classes supporting aux_data for querying for information about available aux data attributes and their types. (AFSIM-1521)
- Added new script methods WsfTrack.RangeRate and WsfTrack.RangeRateErrorSigma. (AFSIM-1664)
- Added variants of script methods WsfAntennaPattern.AzimuthBeamwidth and WsfAntennaPattern.ElevationBeamwidth to account for electronic beam steering. (AFSIM-1006)
- Added the capability to clone script_struct s. (AFSIM-1757)

- Exception logs are now saved to a file when the application unexpectedly closes due to an exception. (AFSIM-1733)
- WsfEventPipe.Record may now publish integer, boolean, and string type data in addition to double. (AFSIM-2053)
- Added the Matrix script class. (AFSIM-1952)
- Added a new gps_status option in the navigation_errors block (option **3**). Selecting this option using gps_status or SetGPS_Status enables GPS errors to be set in script using WsfPlatform.SetPerceivedLocationErrorWCS. (AFSIM-2404)
- Added new sensor scheduler scheduler_commands.spin to model spinning radars. (AFSIM-1882)
- Added output of jamming beam number to the JAMMING_ATTEMPT event for event_output and csv_event_output.
- Added beam_director command to WSF_CUED_LASER_WEAPON to allow specification of a WSF_BEAM_DIRECTOR to attach to. (AFSIM-988)
- Added the command, align_heading_with_velocity, that when enabled, sets the WSF_GUIDED_MOVER or the WSF_UNGUIDED_MOVER heading to match owning platform's velocity vector, rather than orientation. (AFSIM-1974)
- Added new script method WsfWeapon.FireAtLocation to fire a weapon without a track at a WsfGeoPoint.
- Added support in the SA (Situation Awareness) Processor (WSF_SA_PROCESSOR), to perceive missiles/weapons, improving overall SA and providing the means to distinguish between aircraft threats and missile threats. (AFSIM-670)
- Modified user-override script functions to use 'Calculated' instead of 'Calc'. (AFSIM-670)
- Added support for entity persistence and coasting time in the WSF_SA_PROCESSOR. (AFSIM-1769)
- Introduced runtime change capability for WSF_SA_PROCESSOR sa_update_interval_commands as well as a redesign of the event-based implementation of these twelve update types. All individual update interval settings are constrained to be a multiple of this base value. (AFSIM-1356)
- Implemented a new perception delay setting for WSF_SA_PROCESSOR that simulates human cognition by delaying a new track's transition to perceived entity status. Support includes the display_perception_delay, visual_perception_delay, and script method access. (AFSIM-1362)
- Implemented initial prediction capability for WSF_SA_PROCESSOR, including a "generic" prediction function and building-block primitives for possible anticipated moves. (AFSIM-672)
- Introduced WsfSA_PerceivedItem, which represents a perceived entity or a group. A limit can be placed on the maximum allowable number of them which can be recognized by a WSF_SA_PROCESSOR at once. (AFSIM-671)
- Exposed methods for modifying and querying WsfSA_Groups to script. (AFSIM-671)
- Added an asset_ignore command to the WSF_SA_PROCESSOR allowing for categories of platforms to be ignored on the ACES Display. (AFSIM-2111)
- Added ability in the SA (Situation Awareness) Processor (WSF_SA_PROCESSOR), to set a maximum prioritized threat and target counts. (AFSIM-2282)
- Added ability in the SA (Situation Awareness) Processor (WSF_SA_PROCESSOR), to Get, Set, and Reset cognitive limits. (AFSIM-1670)
- Added a ../drift orbital maneuver with corresponding class WsfDriftManeuver. (AFSIM-750)
- Added a ../teardrop orbital maneuver with corresponding class WsfTeardropManeuver. (AFSIM-752)

- Added lag_time and offset_time to the specification of targets for maneuvers and via WsfTargetPoint. (AFSIM-752)
- Added space track position and velocity extrapolation using orbital propagation, such that WsfTrack.LocationAtTime now returns accurate results. (AFSIM-509)
- Added methods to WsfSpaceMover to compute common space mission-relevant geometric quantities (WsfSpaceMover.LookAngleTo, WsfSpaceMover.IncidenceAngle, WsfSpaceMover.TargetElevationAngle, WsfSpaceMover.SquintAngleTo, WsfSpaceMover.DistanceToHorizon, and WsfSpaceMover.LookAngleToHorizon). (AFSIM-1152)
- Added a WsfOrbitDesigner that can be used to create a sun-synchronous orbit (see SunSynchronous) given the desired altitude and local time of descending node. (AFSIM-1156)
- Added alternative forms of the methods WsfSpaceMover.ComputeRendezvous, and WsfSpaceMover.ComputeIntercept, allowing computation of intercept and rendezvous maneuvers with a target specified by a WsfTargetPoint instance. (AFSIM-692)
- Added the ability to target a specific kinematic state when specifying targets for maneuvers and via WsfTargetPoint.
- Added WsfSpaceMover.InitialHeading, which calculates the heading of a satellite from its initial velocity state. (AFSIM-697)
- Added WsfSpaceMover.SetInitialOrbitalState, which allows specification of orbital state from script, along with new script types ReferenceFrame, CentralBody, CoordinateSystem, OrbitalElements, and OrbitalState. (AFSIM-559)
- Added variant of WsfSpaceMover.SetOrbit that accepts an initial epoch as a parameter. (AFSIM-1254)
- Added the ability to optimize orbital targeting using a cost function. This is supported in input, optimize_cost, and in scripting, WsfOrbitalOptimizationCost and WsfOrbitalBlendedCost. (AFSIM-1787)
- Added orbital targeting pre-computation methods WsfSpaceMover.ComputeIntercept and WsfSpaceMover.ComputeRendezvous accepting a WsfOrbitalOptimizationCost to specify the cost to be minimized. (AFSIM-1787)
- Added constructors to the script classes for the targeting class events (WsfTargetManeuver, WsfInterceptManeuver, WsfRendezvousManeuver, WsfNaturalMotionCircumnavigation, WsfTeardropManeuver, and WsfDriftManeuver). (AFSIM-1787)
- Added orbital_state input block to WSF_SPACE_MOVER and WSF_NORAD_SPACE_MOVER, which fully describes an orbital state as a two-line element, a position and velocity vector, or a sufficient set of orbital elements. (AFSIM-747)
- Propellant for WSF_SIX_DOF_MOVER solid-rocket boosters is now defined and treated as a fuel tank, with positioning based on the reference point of the vehicle. Existing models can be migrated with no effect on performance by following the guidance in SixDOF_Solid_Propellant_Rocket_Motors_2p9. (AFSIM-1182)
- Added the ability to explicitly define per-PID update rates, including for inner-loop controllers. (AFSIM-2110)
- Added a wsf_multiresolution plugin. This plugin is an experimental feature preview, and no future compatibility is guaranteed. This provides multiresolution selection of several platform components including comm, fuel, mover, processor, and sensor (using, e.g., command multiresolution_comm and model WSF_MULTIRESOLUTION_COMM) from a script specified set of platform component candidates. Also, multiresolution signatures may be used in a similar way, including acoustic, infrared, optical, and radar. Also included is a multirun table, specified with multiresolution_multirun_table, which may be used to vary fidelity values. (AFSIM-1921, AFSIM-1922, AFSIM-1996, AFSIM-2071)
- Added the ability to add access interval duration constraints (interval_constraint) to coverage computations.

- This is the initial release of the OMS/UCI interface. The intent of this release is to allow users to become familiar with AFSIM's OMS/UCI implementation and provide feedback. The functionality provided in this release is limited. (AFSIM-1457)
- Added regression tests for OMS/UCI messages. (AFSIM-1529)
- Added contour_variable to horizontal_map in sensor_plot and removed the range limitations on contour_level, enabling the contouring of data other than probability-of-detection. (AFSIM-1136)
- Added duration to cyber_attack, which allows a cyber_attack to end before the attack_detection_delay_time and attack_recovery_delay_time of an associated cyber_protect block. (AFSIM-1486)
- Added new effect WSF_CYBER_DETONATE_EFFECT that detonates every weapon of a given name or type on a platform. (AFSIM-1493)
- Added new phase to cyber attacks called attribution. When the random draw is successful the platform has notionally traced the source of the attack. When this happens, CYBER_SCAN_ATTRIBUTED and CYBER_ATTACK_ATTRIBUTED are fired. (AFSIM-1484)
- Added exfiltrate command to WSF_CYBER_MAN_IN_THE_MIDDLE_EFFECT to allow the exfiltration of comms messages back to an attacker. (AFSIM-1495)
- Added new feature cyber_constraint which allows a platform to be bound by the resources available. (AFSIM-1481)

### Development

- Added a `WsfObserver::MoverChanged` callback to the base `WsfEventPipeInterface` callbacks. Associated with this are small refactors of the code associated with updating a platform's mover's `WsfMover.mUpdateInterval` based on the maximum mover update interval associated with the event pipe. (AFSIM-2027)
- Method signatures for `wsf::comm::Comm::Send` and `wsf::comm:Message` constructor that take a `const WsfMessage&` argument have been deprecated in favor of a `unique_ptr<WsfMessage>` argument. This now puts the onus of creating a copy of the message (if needed) on the caller, allowing for elimination of unnecessary copies. (AFSIM-1270)
- Marked constructors in `UtScriptData` as `explicit`; inserting into a container of script data (e.g. `UtScriptDataList`) may require using `emplace_back` over `push_back`. (AFSIM-762)
- The maximum number of supported dimensions for a regular_table has increased from 4 to 8, as specified by `RegularTable::cMAX_DIMENSIONS`. It is recommended that all future development needing table inputs utilize the `UtTable` format. (AFSIM-1242)
- The full API of `UtTable` is now thread-safe for concurrent access. (AFSIM-1242)
- Introduced a strategy-based measurement and track data extrapolation architecture (`wsf::TrackExtrapolation`), along with a strategy object (`wsf::TrackExtrapolationStrategy`) and associated types factory (`wsf::TrackExtrapolationStrategyTypes`) that populate tracks with customized extrapolation objects. Alternate strategies and extrapolation types can be implemented in plug-ins. (AFSIM-509)
- Added CMake module and macro `wsf_project_template` that simplifies the configuration of WSF extensions and plugins. (AFSIM-412)
- `WsfXIO_ScriptListPkt` now correctly reports a platform index of 0 for global scripts. (AFSIM-1053)
- Improved the API of `ut::CloneablePtr` to include move semantics and be more consistent with the API of managed pointers in the C++ standard library. (AFSIM-917)

- Function template `UtInput::ReadValue` for unsigned types now throws an exception when a negative value is read. (AFSIM-994)
- Script classes are no longer less-than or equality comparable by default. Any derivation of `UtScriptClass` that implements `LessThan` or `EqualTo` should also re-assign member `mLessThanComparable` or `mEqualityComparable`, respectively, in its constructor. (AFSIM-201)
- Modified interface of `GenTCP_Connection::Init` to take its argument by `unique_ptr` rather than by reference, to explicitly convey ownership of the socket is transferred.
- Declared class `WsfNavigationErrors` methods `SetGPS_Status`, `InitializeGPS_Status`, and `GPS_Update` as `virtual`.
- Fixed several potential issues caused by the misuse of the `typeid` operator; added `ut::TypeNameOf` as a cross-platform method of accessing type names. (AFSIM-1070)
- Data written to `std::cout`, `std::cerr`, and `std::clog` is redirected through the `ut::log::Publisher`. (AFSIM-1166)
- Method `UtMeasurementData::GetLocationWCS()` now returns a `const UtVec3d&`, and it now correctly converts LLA to WCS before returning the WCS location in the case that the LLA location is valid and the WCS location is not. Because of this change, this method can no longer be used to set the WCS location using the previous version that returned a non-const `UtVec3d&`. As with some code in the *tracking_filters* library, the method had been used to more easily set data using older mutator methods that use an array parameter (i.e., `double aParameter[3]`). (AFSIM-1178)
- Added a new flag to `UtProcess` that allows executing the process in a new console window on Windows systems. (AFSIM-1199)
- Removed the deprecated namespace `WsfMeasurementUtil`; any usages should be replaced with `UtMeasurementUtil`. (AFSIM-1207)
- Improved the interface for registering scripted events with `WsfScriptObserver`, requiring extension/plugin registrants to simply provide a function that will pack the arguments for the script, or use a default argument packer. The previous `AddEvent` interface returning the event's unique integer identifier is now deprecated. (AFSIM-1296)
- Added a user flag `mUsePeakPower` for using peak or average power for `WsfEM_Xmtr`, and an explicit method for querying average power `GetAveragePower`. The `GetPower` method now conditionally returns either peak or average power based on this flag, set by user input. (AFSIM-1007)
- Raw pointer interfaces `WsfRouteNetwork::Add` and `WsfRouteTypes::LoadInstance` have been deprecated in favor of overloads expressing ownership semantics via `unique_ptr`.
- Added export macros to several classes maintaining type lists, including `WsfTrackReportingStrategyTypes` and `WsfVisualPartTypes`, to allow plugin developers to extend them with custom object types. (AFSIM-1260)
- Refactored the `WsfSensorErrorModel` class hierarchy to derive from a more abstract base class in order to support non-spherical and/or non-Gaussian error models. The new base class is `wsf::SensorErrorModel`, and the functionality of the legacy `WsfSensorErrorModel` now resides in the `wsf::StandardSensorErrorModel` class. (AFSIM-1251)
- Deprecated the `WsfSensorMode::ComputeMeasurementErrors` method. It is a compile-time error for a derived mode to override this method. Any sensor code that uses this method should be refactored to call an implementation of `wsf::SensorErrorModelBase::ApplyMeasurementErrors`, which will both compute and apply measurement errors to a sensor detection result. (AFSIM-1251)
- Deprecated the `WsfSensorComponent::ComputeMeasurementErrors` method. It is a compile-time error for a derived component to override this method. Any sensor observer code that uses this method should

be refactored to call `WsfSensorComponent::ComputeSphericalMeasurementErrors`, which will only be invoked when the error model is a type of `wsf::StandardSensorErrorModel`. (AFSIM-1251)

- Deprecated the sensor mode error access methods in `WsfSensorMode`. In the future sensor errors will only be accessible through the `WsfSensorErrorModel` subtype aggregated by `WsfSensorMode` (`WsfSensorMode::mErrorModelPtr`). (AFSIM-1251)
- Added a new `ut::CentralPoint` class as the base class of `ut::CentralBody`. This new class serves to transform between rotating and inertial frames but does not include the concept of a gravitating ellipsoid as `ut::CentralBody` does. Other classes that depended on `ut::CentralBody` such as `UtEntity` and `UtECI_Conversion` are now dependent on `ut::CentralPoint` instead.
- Deprecated methods taking `ut::CentralBody`, replacing them with equivalent methods using `ut::CentralPoint` (`UtECI_Conversion::SetCentralBody` -> `UtECI_Conversion::SetCentralPoint`, `UtOrbitalPropagatorBase::SetInitialCentralBody` -> `UtOrbitalPropagatorBase::SetInitialCentralPoint`, `ut::OrbitalState::SetCentralBody` -> `ut::OrbitalState::SetCentralPoint`.
- Deprecated methods `UtECI_Conversion::GetPrecessionNutationUpdateInterval`, `UtECI_Conversion::SetPrecessionNutationUpdateInterval`, and `UtEntity::SetPrecessionNutationUpdateInterval`, replacing them with `UtECI_Conversion::GetNutationUpdateInterval`, `UtECI_Conversion::SetNutationUpdateInterval`, and `UtEntity::SetNutationUpdateInterval`, as only the nutation matrix can be cached with acceptable loss of conversion accuracy.
- Removed the redefinition of `isfinite` on Windows systems in `DisValidationUtils.hpp`, allowing developers to use `std::isfinite` in translation units that include it. (AFSIM-978)
- Added support for scripted sensor detection constraints via the OnSensorDetectionAttempt method. In order to use this method, the `WsfSensor` method `ScriptAllowDetection` must be invoked immediately before any calls of `NotifySensorDetectionAttempted`. (AFSIM-1334)
- Modified CMake to prevent unnecessary rebuilds due to time-stamp changes in the event_pipe auto-generated-code. (AFSIM-1236)
- Deprecated method `WsfEventPipeInterface::Record` with a time argument, replaced with `WsfEventPipeInterface::RecordDouble` without the time argument. (AFSIM-1421)
- Added `const char*` constructor to `ut::script::Data`, so that passing in a string literal effectively uses the `Data(const std::string&)` constructor, not the `Data(bool)` constructor (which it was using before). (AFSIM-1660)
- Fixed `ut::script::Data::operator<` when comparing a string with some other type, so that `std::map` insertion with `ut::script::Data` keys works correctly. (AFSIM-1660)
- Added the ability to run auto-tests on a per plugin basis. Also added all test files to the target in Visual Studio. To use, open the CMakeAutoTestTargets, open the folder for the tool (mission, engage, etc), then build the target corresponding to the plugin of interest. (AFSIM-1655)
- Deprecated zero and single parameter virtual methods `GetAzimuthBeamwidth` and `GetElevationBeamwidth` in `WsfEM_XmtrRcvr` and `WsfAntennaPattern`, and replaced them with two and three (respectively) parameter methods to account for electronic beam steering. (AFSIM-1006)
- Introduced `UtScriptMethodDefine.hpp` which provides new macros for registering script methods that are safer, easier, and more efficient to use than the legacy macros in `UtScriptClassDefine.hpp`. The script classes in the util_script library were converted to use the new macros to act as examples on how to use them. The intention is to have all future development try to utilize these new macros, and to have usages of the legacy macros gradually converted to the new macros. (AFSIM-860)
- Added early access feature preview of a performance profiling interface for C++ code. The profiling interface can be enabled via the mission command line. (AFSIM-1613)

- Fixed issue caused by `WsfApplication` managing the global `UtDictionary`. Also added unit tests for `WsfApplication` and `UtDictionary`. (AFSIM-1410)
- Added `WsfEM_Antenna::IndicateNondefaultFieldOfView` to allow sensor developers to appropriately note programmatic changes from the default field-of-view. (AFSIM-1858)
- Deprecated methods `WsfNavigationErrors::GetLocationErrorWCS`, `WsfNavigationErrors::GetLocationErrorXYZ`, and `WsfNavigationErrors::GetPerceivedLocationWC` that took arguments of c-style arrays, replacing them with same-named methods returning coordinate-specific types from the `ut::coords` namespace. (AFSIM-2404)
- Improved the extensibility of `WsfTrackManager` by adding virtual keyword to functions. (AFSIM-2536)
- Moved the perception and assessment data from WsfSA_Perceive to WsfSA_Processor. (AFSIM-1880)
- Separated WsfSA_Processor's threat and prioritized data update intervals into separate calculation and event pipe data update intervals. (AFSIM-2218)
- Combined WsfSA_Processor's threat processing and group processing into perceived item processing. (AFSIM-2218)
- Added group focus, entity coasting, and importance to the event pipe output. (AFSIM-2384)
- `WsfEW_Effect` Can now functionally be extended within plugins. Data classes were missing the `WSF_MIL_EXPORT` macro. (AFSIM-1933)
- `WsfEW_Effects` API change to improve readability and pass all available `WsfEM_Interaction` objects to an `WsfEW_Effect`. (AFSIM-1805)
- Fixed errors in test object functions affecting both WSF_RIGID_BODY_SIX_DOF_MOVER and WSF_POINT_MASS_SIX_DOF_MOVER (AFSIM-1180)
- Corrected an issue where the methods `SetTrueAnomaly` and `SetMeanAnomaly` in `UtOrbitalElements` did not respond well to inputs outside [0, 2pi]. (AFSIM-1422)
- Removed unused variables from `WsfOrbitalManeuvers::Target` and completed the factoring of `WsfOrbitalManeuvers::Target` to make use of `WsfOrbitalTargeting`. (AFSIM-698)
- Refactored `WsfOrbitalEvent::Condition` into a hierarchy (deriving from `wsf::space::OrbitalPropagatorCondition`) to allow for easier extension in the future. (AFSIM-2344)