

Tanks Multiplayer

Documentation

V1.5

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Scripting Reference

<http://www.rebound-games.com/docs/tanksmp>

1 Getting Started

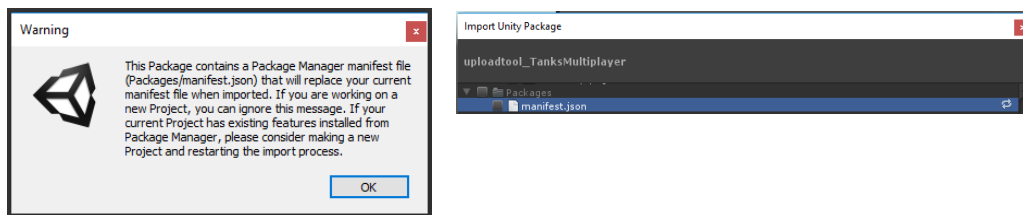
The following steps in this chapter describe how to enable a multiplayer service for use with this asset. Without enabling a multiplayer service, the game will not function. Therefore, please read at least the first chapter of this documentation.

You can choose between Unity Networking (UNET)*, Photon or Mirror Networking as a multiplayer and matchmaking service. For a detailed comparison about features and pricing, please refer to the official pages for [UNET](#) / [Photon](#) / [Mirror](#).

For a (dated) **video tutorial** on how to get started, please have a look at our [YouTube channel](#).

1.1 Package Manager

When importing the asset, you will be prompt with a warning that your Package Manager dependencies might be changed. Deselect the manifest.json file on import, if you are importing the asset into an existing project (which already contains your own manifest).



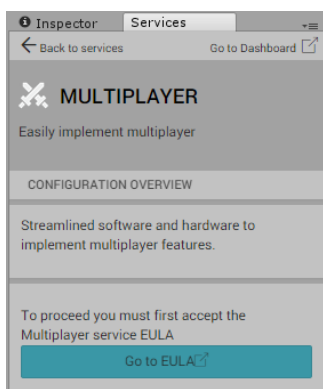
1.2 Unity Networking (UNET)

If you read this section, you've decided to go with Unity's (deprecated) Networking Service.

*Please note that due to the deprecation, we are no longer able to provide support for UNET.

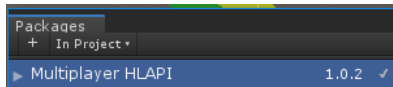


In order to activate it, the first step is to open the **Services** panel in Unity and log into your project.



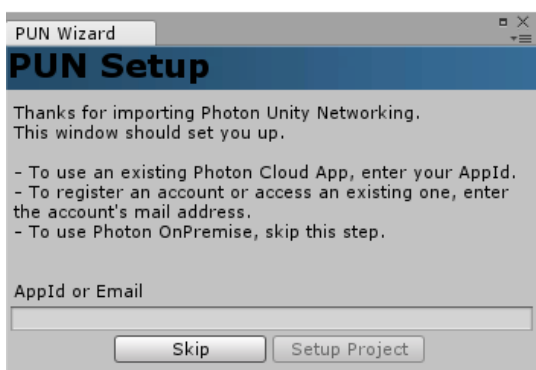
If you haven't created a project in the services panel yet, please do so now. Next, select the **Multiplayer** service and click on the **EULA button**. You will be prompted to log in to your Unity account for accepting it. On the following page you need to set the maximum amount of players per room (we use 12 in this project). Also on the [dashboard](#) you can see other Multiplayer settings for tracking concurrent users or bandwidth for this project.

If you are using Unity 2019 and above, please install the Multiplayer HLAPI package via the Package Manager. This is required since Unity stripped all UNET high-level API code out of the engine and built a separate package for it instead.



1.3 Photon (PUN)

If you read this section, you've decided to go with Photon as the networking provider. First, open the Unity Asset Store and import either [PUN 2 FREE](#) or [Photon PUN 2+](#) (in case you already own that). After the import finishes, set up your **AppID** for the Photon services in the popup windows that shows up. If it doesn't, navigate to *Window > Photon Unity Networking > PUN Wizard > Setup Project*. If you already have created an app for the Photon Cloud, you will find your app ID on the [Photon Cloud dashboard](#).

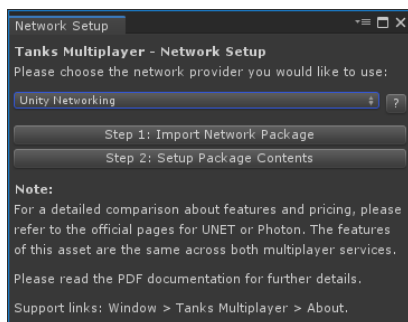


1.4 Mirror Networking

So, you've decided to go with [Mirror Networking](#), a community development of UNET, as your networking provider. Mirror is available for free on the Unity Asset Store. [Download](#) and import it into your project – no additional project setup required.

1.5 Scene

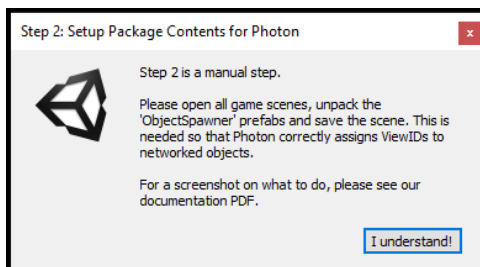
Also, each networking solution comes with its own **network components** only available for that particular networking scenario. There are several prefabs in the project, which require having those network components attached to them. For UNET/Mirror, such a component would be the [NetworkIdentity](#) script. For Photon, there is [PhotonView](#). We have created an **editor window** that automates the setup of all scripts, prefabs and components for you. Please navigate to *Window > Tanks Multiplayer > Network Setup*.



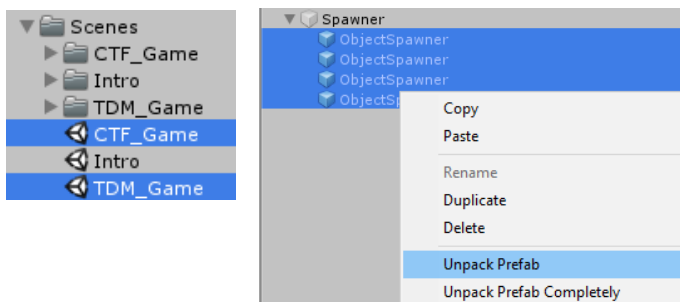
First, you have to select the network provider you would like to use with this asset via the dropdown. Then press the “**Step 1**” button and let the import process do its job,

There could be errors showing up after Step 1 – **do not panic!** Continue by pressing the “**Step 2**” button and wait for the compiler to finish. Clear the Console log (if you have it open) to get rid of all the irrelevant warnings.

[Photon only] If you've decided to go with Photon, Step 2 cannot be automated and you will see an additional popup instead:



Photon needs to assign new ViewIDs to the networked prefab objects. Open the game scenes and right-click Unpack the 'ObjectSpawner' prefabs. Save the scenes.



You are ready to play the game now - load the 'Intro' scene!

Go ahead and build one or two instances to play against each other (or yourself).

We will just take another minute here to go over the scene settings used in the **Game scenes**. You can locate it in the project panel under *Tanks Multiplayer > Scenes*. In these scenes, different layers are used for the environment, scene and player objects. This is done so that our customized **physics collision matrix** (*Edit > Project Settings > Physics*) ensures collisions between certain objects only occur where we want them to.

	Default	TransparentFX	Ignore Raycast	Water	UI	Player	HUD	Bullet
Default	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
TransparentFX	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ignore Raycast	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Water	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
UI	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Player	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
HUD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bullet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Default: static environment with colliders to create game world boundaries

TransparentFX: team spawn area boundaries, should not collide with anything

IgnoreRaycast: collectibles, should collide with players and collectible-zones

UI: all visual game elements on the canvas, no collision

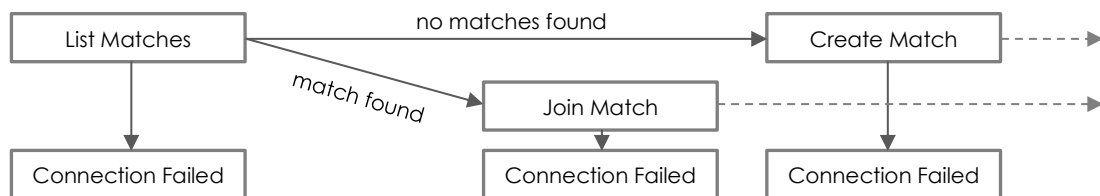
Player: collides with environment, collectibles or bullets, not with other players

HUD: visual player elements, hidden on player death, no collision

Bullet: only collides with environment or players, not with other bullets

2 Matchmaking Login

You may have noticed that in the **Intro scene**, there is a **Play button** that directly tries to enter an online game via matchmaking. The code for this lies in the [NetworkManagerCustom](#) script. If something fails during the connection, an error window shows up. In summary, the matchmaking workflow looks like this:



In the further course of this document and especially in network-related chapters, you will find additional **text boxes** like `UNET`, `Photon` or `Mirror`. These are specifically directed at a networking solution, so you only have to read the one that is relevant to you.

UNET/Mirror

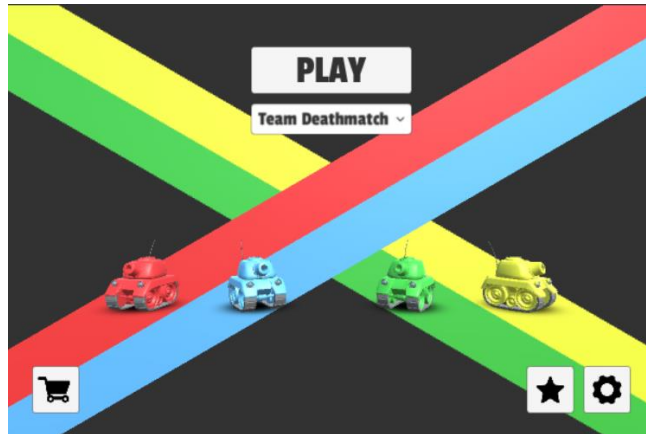
On the [NetworkManagerCustom](#) script inspector, you can define some network specific settings, such as the maximum size of a match (under Network Info). Additionally, the player prefabs you are going to use for your game need to be assigned in the 'Spawn Info' section, under 'Player Prefab' and 'Registered Spawnable Prefabs'. Other networked prefabs (like bullets) do not go here, because these are being handled exclusively by our [PoolManager](#) during the game.

Photon

The [NetworkManagerCustom](#) script has some additional variables in the inspector to match UNET functionality, but also a variable in code to define the amount of teams for initialization - named 'initialArrayLength'. You have to change its value in the `OnCreatedRoom()` method if you want a different team count per game mode.

2.1 Game Settings

In the **Intro scene**, below the Play button, you'll find a dropdown for selecting the game mode to be played. Currently, this asset supports Team Deathmatch, which is the default mode, as well as Capture The Flag. Each game mode creates its own list of lobbies for the matchmaking service, so that players can only the game mode they're interested in. Be cautious about adding too many game modes: if your population is low, games might end up not getting filled.



At the top right bottom, the player has the option to customize some game settings in the **Settings window** while running the game. This window contains an input field for entering the player's name, which is synchronized over the network and put over the player's model once connected. Also, selecting the desired network play mode is possible. Further in-depth explanation of the network mode implementation is listed in the [Advanced](#) section. Other settings in this menu only affect the local user, such as controlling music or sound effect volume.

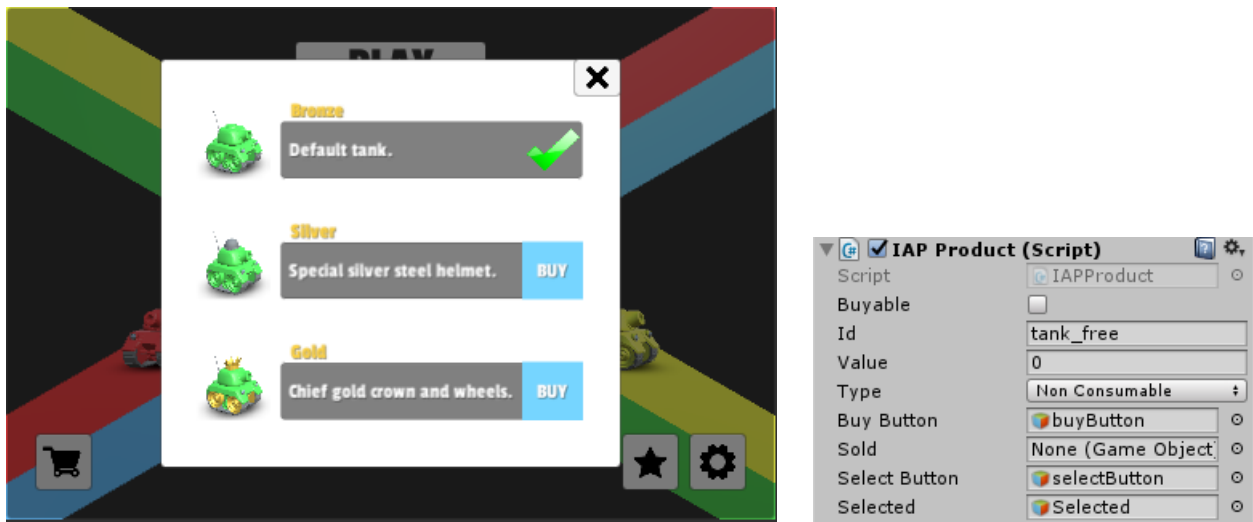


Selected settings in this window are being saved on the device at the point of closing it, then loaded every time on scene launch. The [UIMain](#) script handles all of this and provides default values in its `Start()` method (in case of first app launch) as well.

Right next to the Settings button you will find a button that allows users to **rate your app**. It does so by opening the App Store page for your app via your project's bundle identifier.

2.2 Player Selection

Your players can choose what model they want to play with. This happens in the **Shop window**, by selecting available **player models**. If you are selling models for in-app purchases, these models have to be bought first. You can find more details on billing with Unity IAP in the [Services](#) chapter.



The [IAPProduct](#) script, which is attached to each shop entry, handles the purchasing and selection state via a [Toggle](#) functionality for all player models within a [ToggleGroup](#). In the inspector of an [IAPProduct](#), a selection value needs to be defined to identify which model has been selected by the player at runtime. This value gets saved on the user's device. The current active model selection index along with the player name entered in the game settings are being sent to the host of a game, wrapped in a custom [JoinMessage](#) (extends [MessageBase](#)) class while connecting. As a result of this client-side request, the host knows exactly which player prefab to spawn by matching the selection value to the list of available player prefabs on the [NetworkManagerCustom](#) inspector and also the name of the player.

When the client connection to the 'Game' scene has been made, the host (via [NetworkManagerCustom](#)) finally assigns a team to the newly created player object. The logic behind this can be found in the [GameManager](#) script. In simple words: it iterates over all existing teams, tries to find the team with the lowest count of team members and assigns the new player to that team. More on what the [GameManager](#) does is described later in its own section.

3 Player

This chapter explains how the client and server handle **user input**, fulfilling **shot requests**, **registering damage** taken and **respawning players** upon death. Most of these things are done **authoritative** (where possible), meaning that the server should be in control about what happens next at all times. By sending requests to the server instead of executing them directly on each client, there is a higher barrier for cheaters to send fake events.

Each player prefab (located under *Tanks Multiplayer > Prefabs*) has the [Player](#) script attached to it, handling all of the networked user interaction. Please see its scripting reference for a detailed description of all public variables.

Photon

In order to instantiate prefabs over the network, Photon requires placing them in a folder called 'Resources'. Player prefabs are thus located under *Tanks Multiplayer > Prefabs > Resources*.

3.1 Movement

There are two different **input controls** implemented for moving the player object. On mobile devices operated via touch, one **joystick handle** is responsible for keeping track of the player's position relative to the camera (so the angle of the camera does not matter). The player position can be changed by dragging the joystick around. The exact movement speed and listening to the actual drag input events is done by the [Player](#) script, but the input direction changes are computed by the [UIJoystick](#) script that is attached to the joystick gameobject itself. This means that the [Player](#) script only takes this direction and applies it to the player's [Rigidbody](#) at the movement speed specified.

The second input control scheme is directed at Web Players and desktop platforms, i.e. non-touch devices. On these platforms, the joystick controls are hidden (except in the Unity Editor for debug purposes) and movement is controlled via **arrow keys** on your keyboard instead.

UNET/Mirror

In order to synchronize player position changes over the network, player prefabs have a [NetworkTransform](#) component attached to them, listening to [Rigidbody](#) changes in 3D space. The synchronization happens at the sync rate specified, where usually 10-12 is a feasible rate.

UNET TIP: To save some more bandwidth, you can disable the rotation syncing for axes that don't change in your game. In this asset for example, it makes sense to set the rotation axis on all [NetworkTransform](#) gameobjects (bullets and player prefabs) to Y-only.



Rotation:
Rotation Axis Y (Top-Down 2D)

Photon

Player movement in Photon is being sent across the network by using their [PhotonTransformView](#) component attached to player prefabs. Similar to UNET/Mirror, this script lerps between rotation updates to make them more smooth. The only difference is that the movement speed is not defined in the [Player](#) script, but in the inspector for this script directly. Also, a [PhotonView](#) component is needed on the prefab to observe the movement synchronization behavior.

3.2 Shooting

Just like movement, shooting has different **control schemes** for mobile/touch and non-touch devices too. On mobile platforms, there is **another joystick** on the screen that calculates an input direction for the [Player](#) script, but this time the direction is used to rotate the player's turret and for automatic shooting after a short delay. The delay is in place so that the user is able to position the turret before firing off the first bullet.

On non-touch devices, the **mouse position** on the screen is used to rotate the turret. Firing a bullet is triggered by clicking the **left mouse button** (or holding it down). To further illustrate the current turret rotation and shot direction, on desktop builds the mouse cursor has been replaced with a crosshair like icon, set under Edit > Project Settings > Player – Default Cursor. Since mobile devices don't have a cursor visible at all times, there is an **aiming indicator object** set on the [UIGame](#) script that is instantiated and attached to the player's turret at runtime:



In the event of shooting, a client processes its input in the [Player](#) script and determines to shoot a bullet. So it sends a shot request to the server. In our case we send the position of the bullet along with it. The server receives the request, processes it and spawns a bullet over the network. This is the signal for all other clients to spawn their own local copy of the bullet using our pooling system. At this point, a new bullet has been created successfully.

UNET/Mirror

For shooting, we make use of a very common Unity Networking approach to send something along the network: [Commands](#). Commands are methods with the [Command] attribute that can be used on clients to send events or data to the server. They can have parameters, but be aware of the bandwidth consumed.

Photon

Photon does not have a separate attribute like Commands (see the UNET version above) for sending data to the server. This is included under the [PunRPC] attribute which is explained in [4.1](#).

Only the server is responsible for determining whether a bullet hit a player or not. This is because even though collisions are registered on all clients, e.g. to spawn particle effects, only the server executes the logic for calculating player damage. It does so by getting the damage value from the bullet and applying it to the player's health value (or shield, if any). Read more about the type of these variables in the next section.

There are three types of different bullet prefabs in this asset, but they all have the same [Bullet](#) script attached to them. While there is endless ammunition for the default bullet a player can shoot, the other two bullets have to be collected via powerups and also have limited ammunition – read more about powerups in the [Advanced](#) section. The selected bullet is controlled by the currentBullet variable on the [Player](#) script. Changing bullets only means changing this index variable, as all available bullet prefabs are referenced in an array on the [Player](#) script per player prefab. This also means that different player prefabs can have different bullets, allowing for highly customized player prefabs and awesome gaming opportunities.



3.3 Properties

There are several **networked variables** on the [Player](#) script which are getting updated by the server whenever they change. Other players need to be **immediately aware** of variables (current health, shield amount, etc.) that change very often, but there are also variables where the latest update is **not that important** (e.g. turret rotation) or **not network synced** at all (e.g. max health, movement speed etc.). Different approaches are used to sync them over the network.

UNET/Mirror

Commands have been explained already. Another way to distribute variable values is the [\[SyncVar\]](#) attribute, written before the variable declaration. Few SyncVars are exposed in the [Player](#) script's inspector, but there are also a few hidden ones. As per Unity scripting reference, SyncVars can only be changed by the server and are synchronized at least 10 times per second, if needed.

There is one mixed combination of Commands and SyncVars we are using this asset: turret rotation. As the turret is only controlled by the client, but SyncVars can't be changed directly on clients, the client sends a Command to the server with its updated rotation value. So now the server updates the turret rotation SyncVar with this value and distributes it across the network.

Photon

Photon introduces automatically synced variables that are very easy to use, but can be updated by anyone in the network. So for our authoritative network approach, we have to make sure that only the server accesses them. These synced variables are called Player Properties and exist for each networked player object/client. Changes are always synced immediately i.e. on the next network update. For event-specific changes (as with health, shield hits etc.) that don't change every frame, this functionality is of great use. All custom player property definitions and accessors are contained in its own class, the PlayerExtensions script.

In case something changes very often, Player Properties might not be the best fit. This is true for the turret rotation value fully controlled by the client, which could change constantly. For this scenario OnPhotonSerializeView comes in handy. This method is called 10 times per second on PunBehaviours to synchronize ever changing variables across the network.

4 Managers

Managers in Tanks Multiplayer are scripts which handle a core functionality of the game, providing access to its functions via static methods (so they can be called from any other script) or by getting direct access via their GetInstance() methods. We will go over all important manager scripts in the following sections to get an understanding of their various purposes.

4.1 Game Manager

Let's start with the managing script for the actual game logic. In the inspector for the [GameManager](#) script in the **Game scene**, you are able to define **highly important game aspects** such as the number of teams in the game, the color they should be visualized in, as well as the spawn area for each team and the maximum score count for one round. For a full description of each variable, please see its scripting reference.

Hidden from the public inspector variables, the [GameManager](#) also takes care of the score count and team fill for each team, stored in separate lists with their size equal to the team size. If a player died (meaning a team scored), the respective value in the score list for that team goes up. The same happens for the fill list when a new player connected, but here it can also decrease on player disconnects. The last part is fully handled by the [NetworkManagerCustom](#) script, as it is aware of all player connection states. What the [GameManager](#) now does is to reflect these value changes to the [UIGame](#) by updating the labels and sliders responsible for showing current scores and team fill to the end user.

UNET/Mirror

For storing multiple values in one variable, as done in arrays and lists, this networking solution offers the functionality of synced lists. The [SyncList](#) attribute is basically the same as a list of SyncVars. For syncing the score and team fill across the network, here we make use of SyncLists for the first time.

Photon

In the context of storing individual values for each player across the network, we've made use of Player Properties in section Properties already. Photon offers another type of networked storage for variables that are not bound to a specific player, but to the game (room) as a whole. This feature is called Room Properties. As with Player Properties, Room Properties are synced as soon as possible and in this matter they are perfect for storing scores and team fill of the game as done here. Room property definitions are contained in the [NetworkManagerCustom](#) script.

The [GameManager](#) script is also the main access point for checking whether the game has ended (in case the maximum score limit has been reached) and because it has a reference to the [UIGame](#), it toggles displaying the player death and game over windows too. With the player respawn logic showing a delay timer or video ad in-between player deaths, that's basically everything needed for handling the game logic in one place. You can find more details on our video ad respawn workflow and Unity Ads in the [Services](#) chapter.

UNET/Mirror

In this context we are now going to have a look at the last way of sending events or data across the network. Syncing variables and lists have been mentioned already, but there is another attribute complementary to Commands, called [\[ClientRPC\]](#). Instead of getting invoked by clients and executed on the server (like Commands), ClientRPCs are invoked by the server and called on all clients (including the server).

This type of network call is used on the [Player](#) script, so that the server can tell all clients that a player got killed/respawned or that the game has ended. The latter is just an event without parameters for all clients, in terms of "the game is finished, your [GameManager](#) script can show the game over screen now".

Photon

Photon uses the same RPC approach like Unity Networking (see above), only the terminology is different. When using this type of RPC, authoritative methods that should be invoked on the server are tagged with the [\[PunRPC\]](#) attribute. Clients are then able to send request-like messages for execution on the server by raising a RPC call on a [PhotonView](#) component, providing the name of the PunRPC method. This principle is highly used in the [Player](#) script.

4.2 Audio Manager

The [AudioManager](#) script is attached to an indestructible gameobject in the 'Intro' scene living throughout scene changes, **handling long** (background music) **and short** (one-time effects) **audio playback** across the scenes. By using this manager we are offered with a unique component for playing all kind of [AudioClips](#) easily accessible via static methods. We don't have to provide [AudioSource](#) components in the scenes either, because the manager object has two of them - one for music, one for one-shot sounds) already attached to it. For one-shot clips which are usually instantiated and destroyed by default, we are also making use of our own object pooling behavior to reduce garbage collection even more. Except for background music clips which could be used across scenes and are referenced in the inspector of the [AudioManager](#) directly, all one-shot clips are referenced in their originating scripts (bullet sounds in the [Bullet](#) script, player sounds in the [Player](#) script etc.) instead.

4.3 Pool Manager

Pooling objects means **reusing gameobjects** instead of instantiating and destroying them every time when they are needed. As Unity's garbage collector is very performance-heavy and could result in serious hiccups and dropping frames during the game, this asset implements strict pooling (activating/deactivating) for gameobjects needed multiple times in one scene. Thus instantiate and destroy should be replaced by PoolManager.Spawn and .Despawn.

Setting up object pooling in your scene is very easy:

- have a container gameobject with the [PoolManager](#) script in the scene
 - beneath this container, add one or multiple child gameobjects and name them as you wish
 - add the [Pool](#) script to these child gameobjects and enter your configuration in the inspector
 - if the prefab specified has a [NetworkIdentity](#) it is considered as networked pool automatically
- Done!

5 Advanced

Since the previous chapters covered the basics on how this asset is structured and where networking code is used, this chapter goes into more detail on the advanced networking topics.

5.1 Network Mode

Right at the beginning in the settings menu of the Intro scene, you have the option to select a network mode you want to play with. Each network mode uses a completely different network layer, but they are all handled internally by the [NetworkManagerCustom](#) script automatically, so that players do not get confused with difficult interfaces or additional buttons such as entering IP addresses (except on Photon LAN) and so on.

Online: selected by default. This is using the cloud matchmaking servers for automatic match creation and joining as described earlier in this document, which is the simplest way to get right into a battle and play against other players. The timeout for finding and joining a match is set to 10 seconds, which could be reached due to connectivity or device networking issues.

Mirror

Since Matchmaking and Room features are not supported by Mirror itself, it comes with a separate component that allows listing your game online, for others to join. By attaching our NetworkListServer component to the Network prefab in the Intro scene, Mirror will connect to the public (or your own) List Server on launch, for finding and listing games. It is not attached to the Network prefab by default. In the APIConnector component, you can use the Address & Key values of Mirror's example scenes for testing. Note that you need to open ports in your firewall and have a static IP for this. Read up on [List Server](#) concepts and pricing for more information.

LAN: local area network mode does not forward traffic to the cloud servers, but rather keeps it locally in a private network, where only other devices in the same network are able to host and join a battle. A common use case is hosting a game that can only be joined by your friends.

UNET/Mirror

This asset supports local discovery using the [NetworkDiscovery](#) component in order to detect other devices in the same network and join a game automatically. If no match can be found after exceeding the timeout value, then the searching device creates a new LAN match itself. Note that on Windows/Mac LAN mode requires disabling firewalls for detecting other devices.

Photon

Please note that with Photon there is no explicit LAN mode. You have to download and run a Photon Server on your own machine/server, connected to the internet, in order to set up a private network. You can find out more about this process [here](#). If you select LAN mode in the Intro's settings menu, an additional InputField will show up so you can enter your server address.

Offline: playing against bots. This mode is simulated by creating a private LAN game but without making it public for other devices. The big advantage of this is that there are no changes to existing network code necessary. Bots are controlled by the [PlayerBot](#) class, a derived script of the [Player](#) class, which uses Unity's navigation system for movement. They are then getting spawned by the [BotSpawner](#) after the player joins the game scene.

5.2 Host Migration

[Host Migration](#) describes a concept where a game **continues to run** with minimal interruption when the **match host left**. The technique behind this is that after the host disconnected, one of the connected clients takes over the role of hosting the game to keep it alive. The disconnected host could even join the same game again as a client later. By using host migration, terminated games because of temporary lost connections and host rage quits should be prevented. For using host migration efficiently, it should be noted that when switching hosts, only data that is available on the client becoming the new host will be kept in the game. This in turn means that any data that is only available on the server is lost after a host migration. So, you should plan in advance what data should be synced across all clients and build your client/server networking code around that principle.

Mirror

Host Migration is not supported by Mirror.

UNET

Unity Networking offers a [NetworkMigrationManager](#) component enabling host migration. Please read a detailed summary containing its workflow on [this page](#). The default component does not provide automatic migrations without UI buttons though, so we've created a new script based on the [NetworkMigrationManager](#) named [NetworkMigrationManagerCustom](#). It is attached along our [NetworkManagerCustom](#) script in the 'Intro' scene. You can toggle the use of host migration by enabling the checkbox on it.

Note: UNET does not support host migration via online matchmaking yet, only for LAN games.



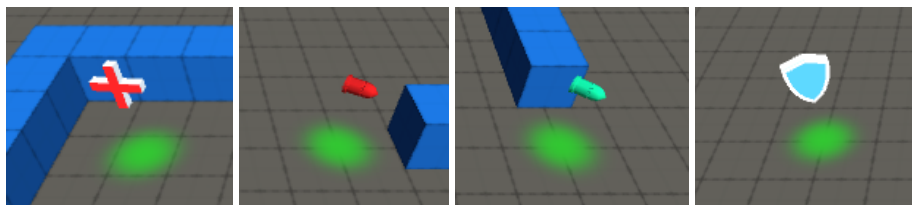
Photon

Host migration is supported by default on all platforms, but certain limitations still apply, such as keeping data in sync between all clients for a successful migration. Since we mostly use player and room properties which can be accessed by all clients, we don't run into issues in this regard.

5.3 Collectibles

Collectibles are objects that can be consumed by players to **boost their effectivity** in the game. The [Collectible](#) script is working like a **template** for different powerups, such as for the [PowerupBullet](#) or [PowerupHealth](#) scripts. If you would like to create new powerups, simply extend your script from [Collectible](#) and override its Apply method. This method is responsible for what to do when a player collects the powerup, so all of your collectible logic should go in here.

Prefabs for all types of collectibles are located in the project panel under *Tanks Multiplayer > Prefabs*. Just like bullets, collectibles have their own [Pool](#) in the Game scene making use of our [PoolManager](#) in their spawn behavior. The actual spawning instruction is coming from an [ObjectSpawner](#) in the scene, which lets you define the exact position and respawn delay.



Networked variables in this asset (see chapter [Properties](#)) are compatible with host migration already, as they are being distributed to all clients. Collectibles are a great example of something that is **not compatible** with host migration **since the beginning**, because they rely on timed gameobject states i.e. hierarchy changes (active/inactive) in the scene. The way we are syncing gameobject states (and respawn timer) is via the managing [ObjectSpawner](#) script. In this case, we have three possible outcomes to synchronize:

- ✓ **Active powerups** should be visible to all clients: each [ObjectSpawner](#) and [Collectible](#) instance have a unique network component attached, so all clients are aware of their existence in the scene already. When the host spawns a powerup, each client stores a reference to the local gameobject it just spawned via the [ObjectSpawner](#).
- ✓ **Inactive powerups** should be invisible to all clients: despawn instructions over the network are handled by our [PoolManager](#) automatically. Joining clients will create an inactivate object by themselves, instructed by the master client or host migration scenario.
- ✓ **Current respawn timer**: once a powerup has been collected, the server then runs a coroutine on the [ObjectSpawner](#) waiting for the respawn delay to pass. If the host disconnects now, the new host would not know where it left off i.e. when to respawn the powerup. Because of this, the [ObjectSpawner](#) saves the remaining respawn time on all clients on despawn. This ensures that we are fully aware of all host migration scenarios.

UNET/Mirror

Collectibles have a [NetworkIdentity](#) component attached to them, for making the network aware of the gameobject. Their relationship to its ObjectSpawner is then saved in a [NetworkInstanceid](#), which is basically just the same, unique number across all clients. We do this because when networked objects are spawned for other clients, it does it without clear allocation. By using and syncing the NetworkInstanceid across all clients, we can match each Collectible with its corresponding ObjectSpawner.

Due to the way spawning of [NetworkIdentity](#) objects is handled for joining clients, we do not have to explicitly cover enabling/disabling powerups as this is done automatically.

Photon

In Photon, the only object that needs a PhotonView is the ObjectSpawner. Each Collectible instance can then be handled locally on the client. The relationship between Collectibles and their spawner is set locally too, directly via the ObjectSpawner that instantiates the powerup. Syncing of Collectible states for joining clients or a new master client is covered via Photon's callbacks:

OnPlayerEnteredRoom: the master client sends whether the object should be instantiated or spawned later

OnMasterClientSwitched: the new master client decides whether the spawn routine needs to be run

5.4 Game Modes

Each game mode has a separate matchmaking queue, as described in the [Game Settings](#) section. Within the specified game mode, the map loaded for a new room is random. This works by **defining** game modes and **assigning** scenes.

```
public enum GameMode
{
    TDM,
    CTF
}
```

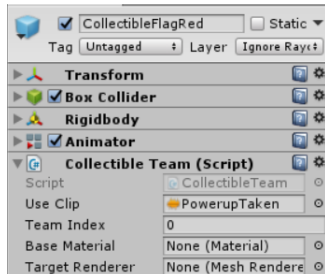
If you would like to create a completely new game mode, first you have to **define** it in the [GameManager](#) enumeration named GameMode.



In order to **assign** scenes to that game mode for the matchmaking service, your scenes then have to follow the GameMode naming convention. Meaning for a Team Deathmatch scene, the scene should start with "TDM".

In addition, only scenes are chosen which are added and active in Unity's [Build Settings](#). This allows for testing new maps without affecting live builds. Finally, in the scene's [GameManager](#) inspector, select the GameMode the map was designed for.

Since Team Deathmatch is the default mode, the following section only describes the differences to **Capture The Flag (CTF)**. CTF is based on Collectibles. Powerups mentioned previously are consumed directly on collision, but Collectibles can actually be picked up, dropped and returned too! All of this is handled by the managing [ObjectSpawner](#) as well.



The flags in CTF have the [CollectibleTeam](#) script attached to them, which is responsible for checking the player's team before executing the desired logic: pick up enemy flag, return own flag if dropped.

In this regard, the "Team Index" variable assigned in the inspector is the team that owns this Collectible.

For the sake of covering several different network approaches in this asset, a new RPC type is used for the pickup/drop/return synchronization of Collectibles: **buffered RPCs**. Buffered RPCs are like regular RPCs, but remembered on the server and executed for newly joining players.

UNET/Mirror

Buffered RPCs are not supported by default. This is why we are using a new type of SyncList instead: [SyncListStruct](#). The inheriting class and struct are defined in the [ObjectSpawner](#) (SyncListCollectible, CollectibleState), whereas the actual list implementation is defined in the GameManager. With each entry, the SyncListStruct stores data such as the Collectible, assigned carrier and position. Just like SyncLists, SyncListStruct is automatically synced to new players.

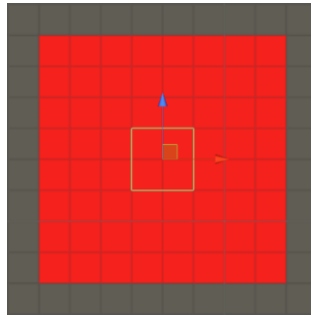
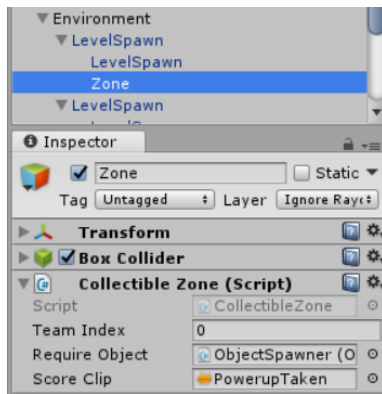
With our implementation for Collectibles, we wouldn't want to store an infinite amount of entries in the SyncListStruct every time a player picks up or drops a Collectible though – just the most recent action. For this, we are searching for an existing entry in the list first and then modify that.

Photon

Unlike UNET, Photon does support buffered RPCs already. With that, we are just calling a regular RPC method on the target ObjectSpawner, by passing in RpcTarget.AllBuffered on the call. Depending on the action executed (pick up or drop), an additional variable (carrier or position) is then provided to all clients as well. An exception is the RPC to return a dropped Collectible, which is not buffered: having the Collectible at its original position is the default, so we don't have to explicitly save that for connecting players – the Collectible will spawn there either way.

Just like in the UNET part, we would like to send other players only the most recent action for a Collectible, not everything that happened since the match started. This is for saving bandwidth. Every time a new buffered RPC is being sent, we remove all RPCs related to that PhotonView.

Note that our implementation of buffered RPCs for both UNET or Photon is a sample for demonstrating a different networked approach. In this case, since we only store the most recent RPC, the same functionality could also be achieved easily by storing the necessary variables on the Collectible itself, and letting the clients request them from the server via a single RPC call.



With the networked functionality for pick ups done via buffered RPCs, we still need a way to detect if a player has scored by getting the enemy flag to its own base. In the CTF mode, we have added the [CollectibleZone](#) component for this reason.

The [CollectibleZone](#) component, including a BoxCollider for detecting player or collectible collisions, is attached to a gameobject in the scene, defining the home base for one team. If the variable "Require Object" is assigned with an ObjectSpawner, that specific object needs to be present at its home base before the player can score. In the CTF scene and the screenshot above, this means that Team=0 (Red Team) can only score by getting the blue flag, if the required object (their own - red flag) is at their base. With the "Require Object" unassigned, players could also score when someone else has taken their own flag.

6 Unity Services

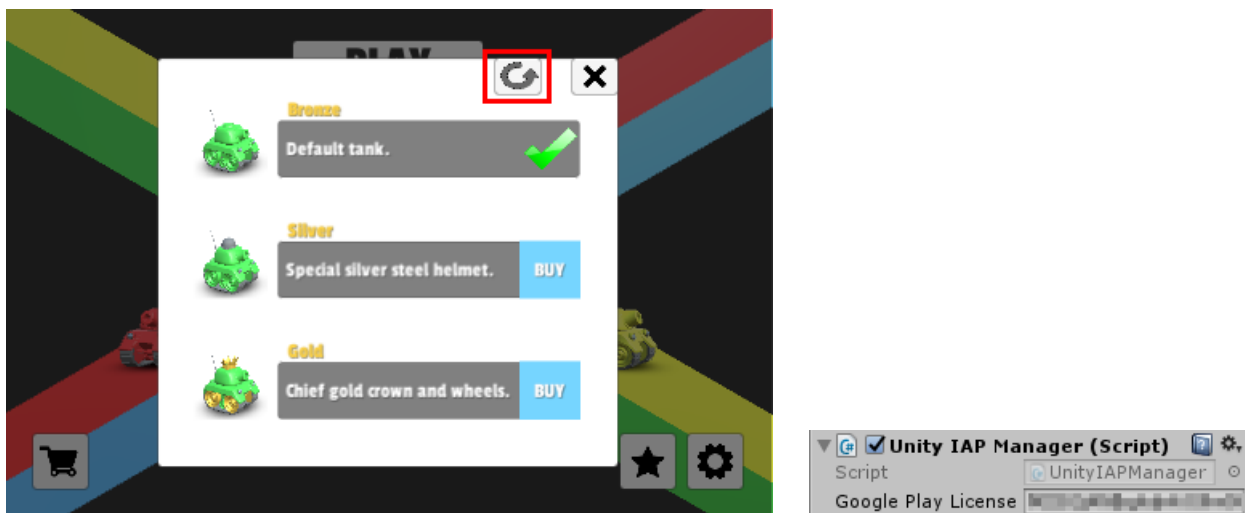
According to their own [landing page](#), Unity offers a **range of services** to help game developers engage with their players, understand how they are playing your app and monetize them in the most efficient way. In this asset, we've tried to integrate as many services as possible, in the areas it made the most sense. **Note that none** of the following services **are required** to run the game. You can just turn them off in Unity's in-editor services panel, and nothing will complain.

6.1 IAP

This asset makes use of Unity IAP and integrates a very basic implementation for in-app purchases. If you would like to look into a fully featured shop system with real money and virtual currency purchases, please have a look at our [Simple IAP System](#) asset on the Unity Asset Store. Unity IAP requires Analytics to be enabled too. It will get automatically turned on if you try to enable Unity IAP. How to enable Unity IAP is explained [here](#).

For in-app purchases to work, you must first create an app in your respective App Store account, then create products there. Note that depending on the App Store you are deploying to, certain limitations apply when testing in-app purchases. For example, Google Play requires your app to be submitted and live as alpha/beta version (not draft).

With your app and products created in the App Store, open the Intro scene and have a look at our IAPProducts shop items in the inspector again. They have an identifier and type defined in there. This should be your identifier and type used when creating your products on the App Store. You will also notice that when opening the shop window on iOS, there is an additional button at the top (highlighted in the following screenshot). This button handles restoring purchases, because as per Apple requirements, your app would get rejected without having it.



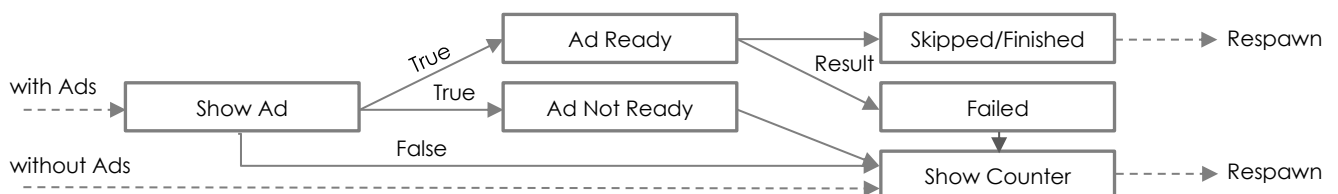
The [UnityIAPManager](#) script handles initiating and processing of in-app purchases. For Google Play, the developer license key should be entered in its inspector. If you are using shop entries, like with the IAPProducts showcased in this asset, you already have a buy button linked to them in the UI. If you would like to initiate a purchase directly via code instead, you can do so by calling `UnityIAPManager.PurchaseProduct`. In this case you will have to add the product identifier to the Purchasing builder in the `Start()` method manually though.

6.2 Ads

How to enable Unity Ads is explained [here](#) (you can skip the coding parts).

Instead of pushing users to in-app purchases, video ads (or ads in general) are a great alternative to monetize Free2Play games. Especially not being intrusive and limiting the ad amount per user session have been proved to maximize ad revenue. In this asset, when a player dies a respawn counter gets displayed. If Unity Ads is enabled, we are replacing the respawn counter with a video ad once in every round. One ad per round (~0.5 Cent/user) should be sufficient to pay the server bill for that round. The percentual chance for showing a video ad increases on each player death, until one ad has been shown after a maximum of 6 attempts/deaths. See the [UnityAdsManager](#) script for detailed comments on the ad chance calculation. The scenario fully handles failed ad requests too.

To summarize, the video ad workflow on player death looks like this:



7 Contact

As full source code is provided and every line is well-documented, please feel free to take a look at the scripts and modify them to fit your needs.

If you have any questions, comments, suggestions or other concerns about our product, do not hesitate to contact us. You will find all important links in our 'About' window, located under *Window > Tanks Multiplayer*.



If you would like to support us on the Unity Asset Store, please [write a short review](#) there so other developers can form an opinion. Again, thank you for your support, and good luck with your apps!

Rebound Games