Multi User VR

Getting Started

Virtual Reality Course - Final Project - WS 2021/22

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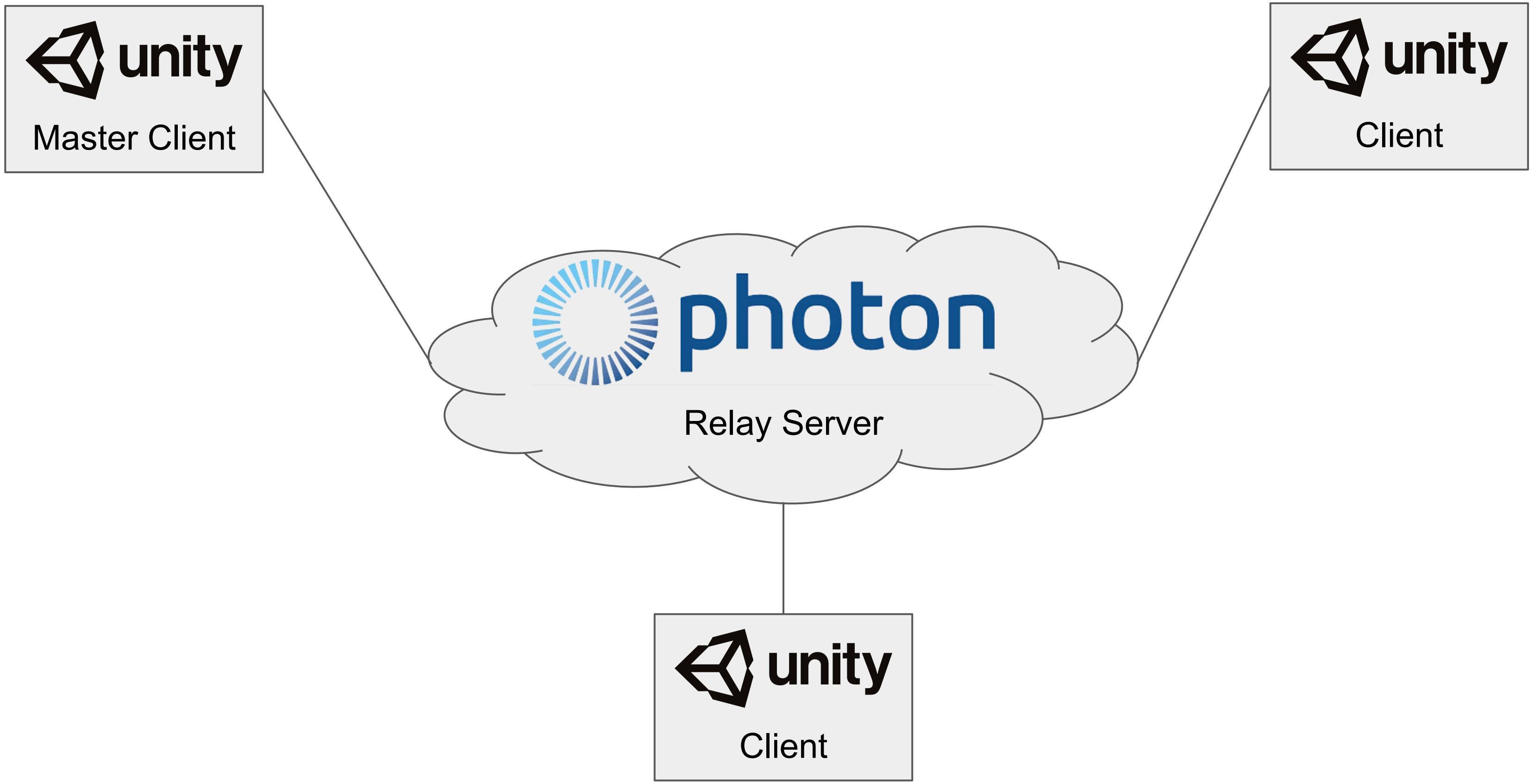
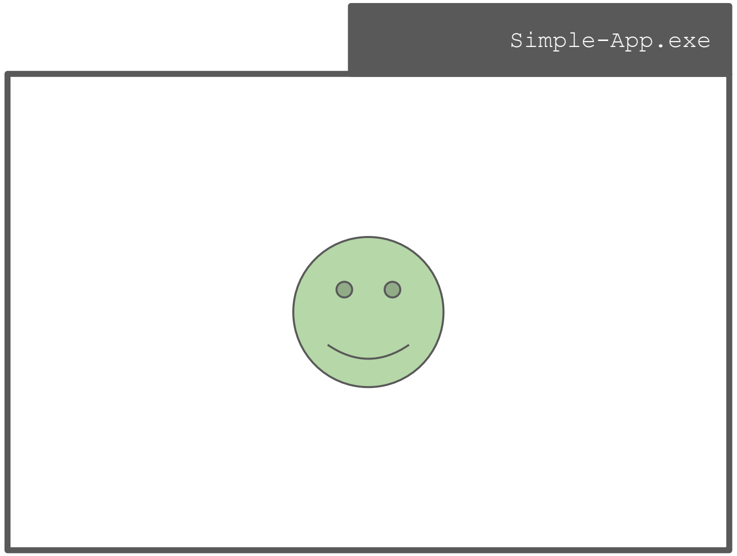
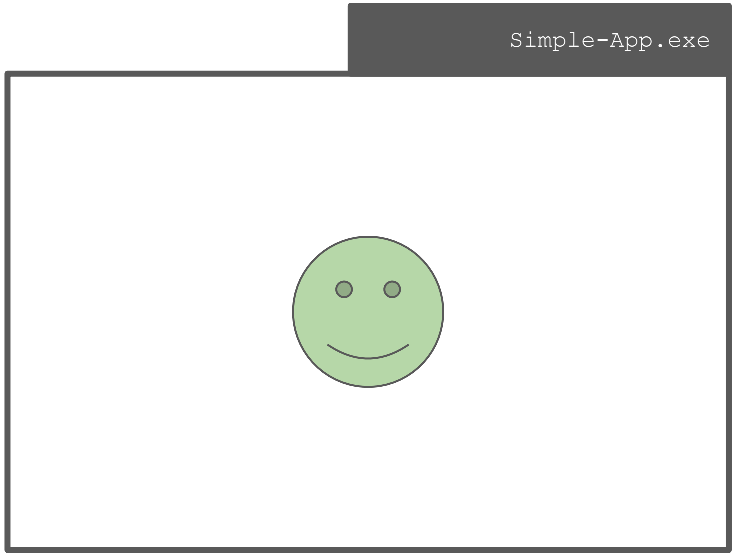
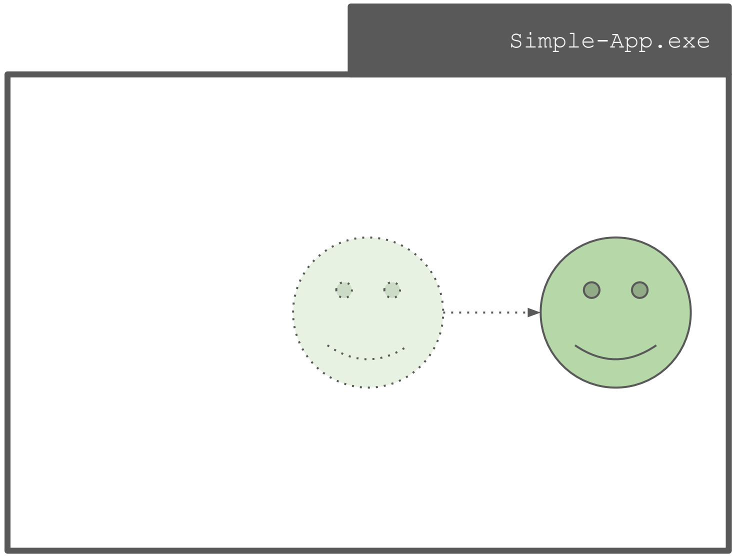

unity
Master Client
unity
Client
photon
Relay Server
unity
Client



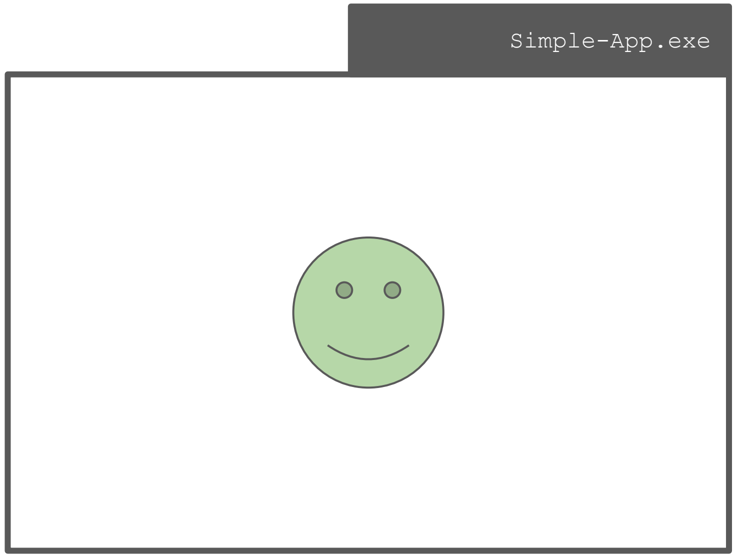
Client A



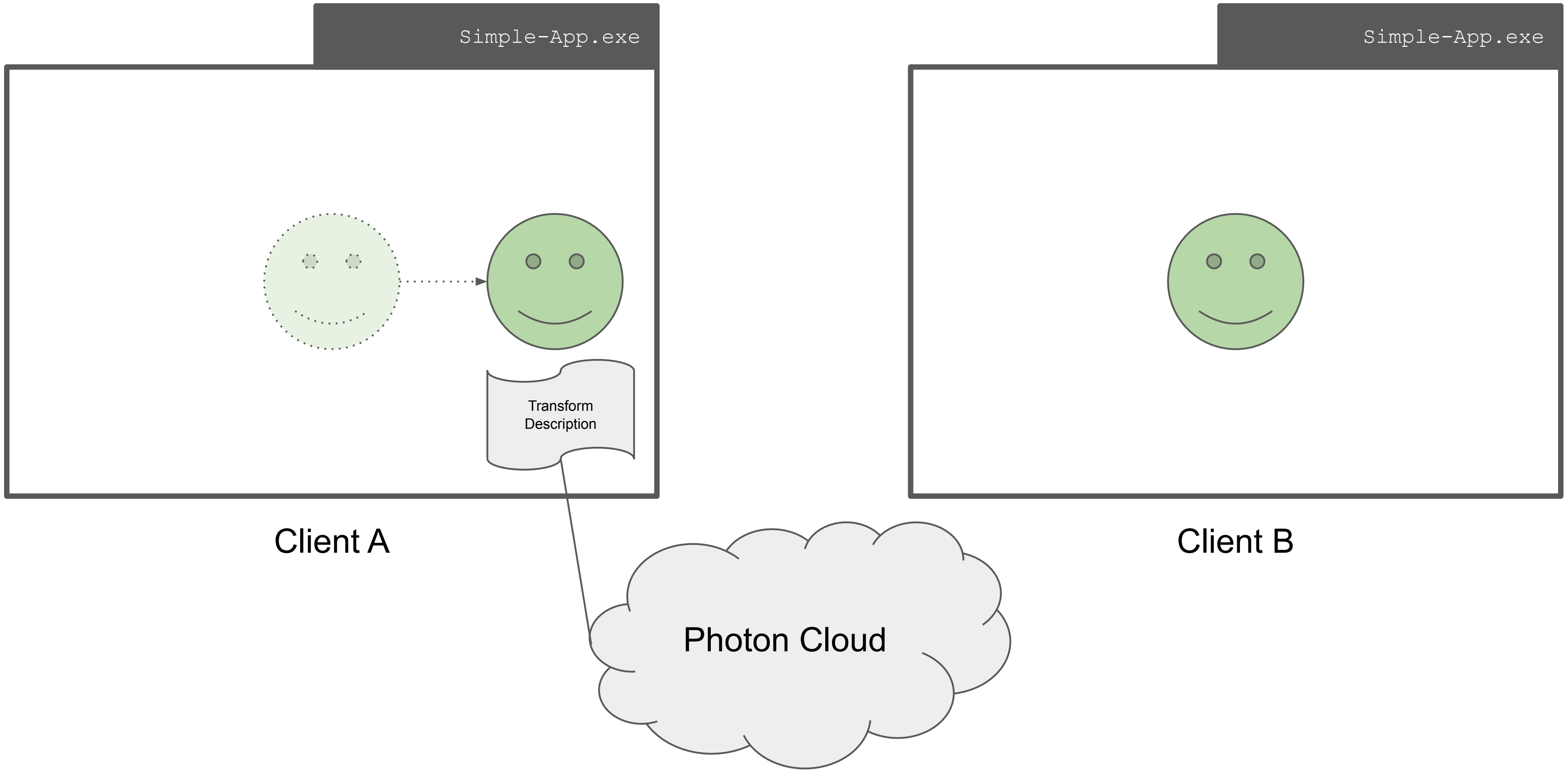
Client B

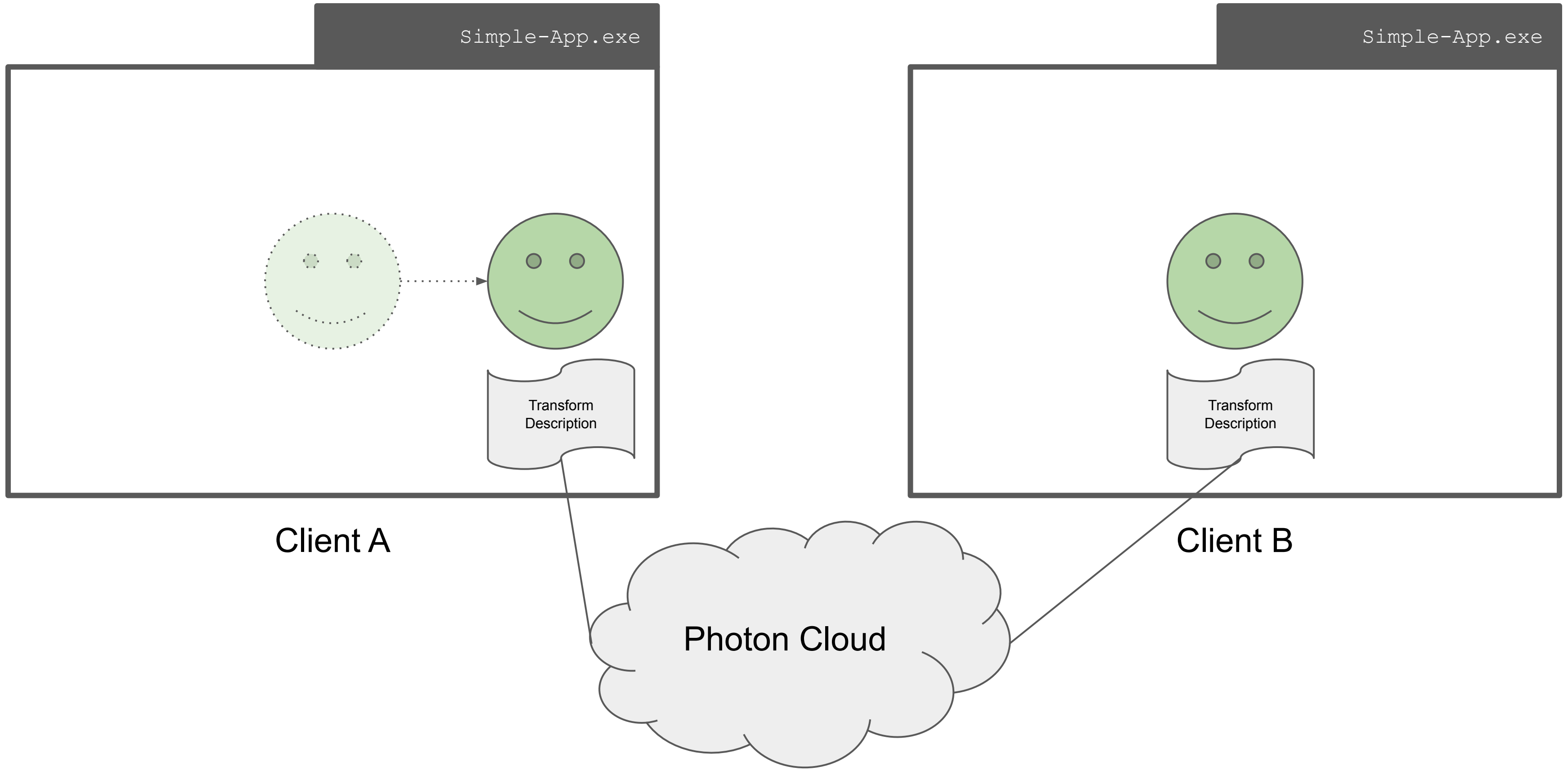


Client A

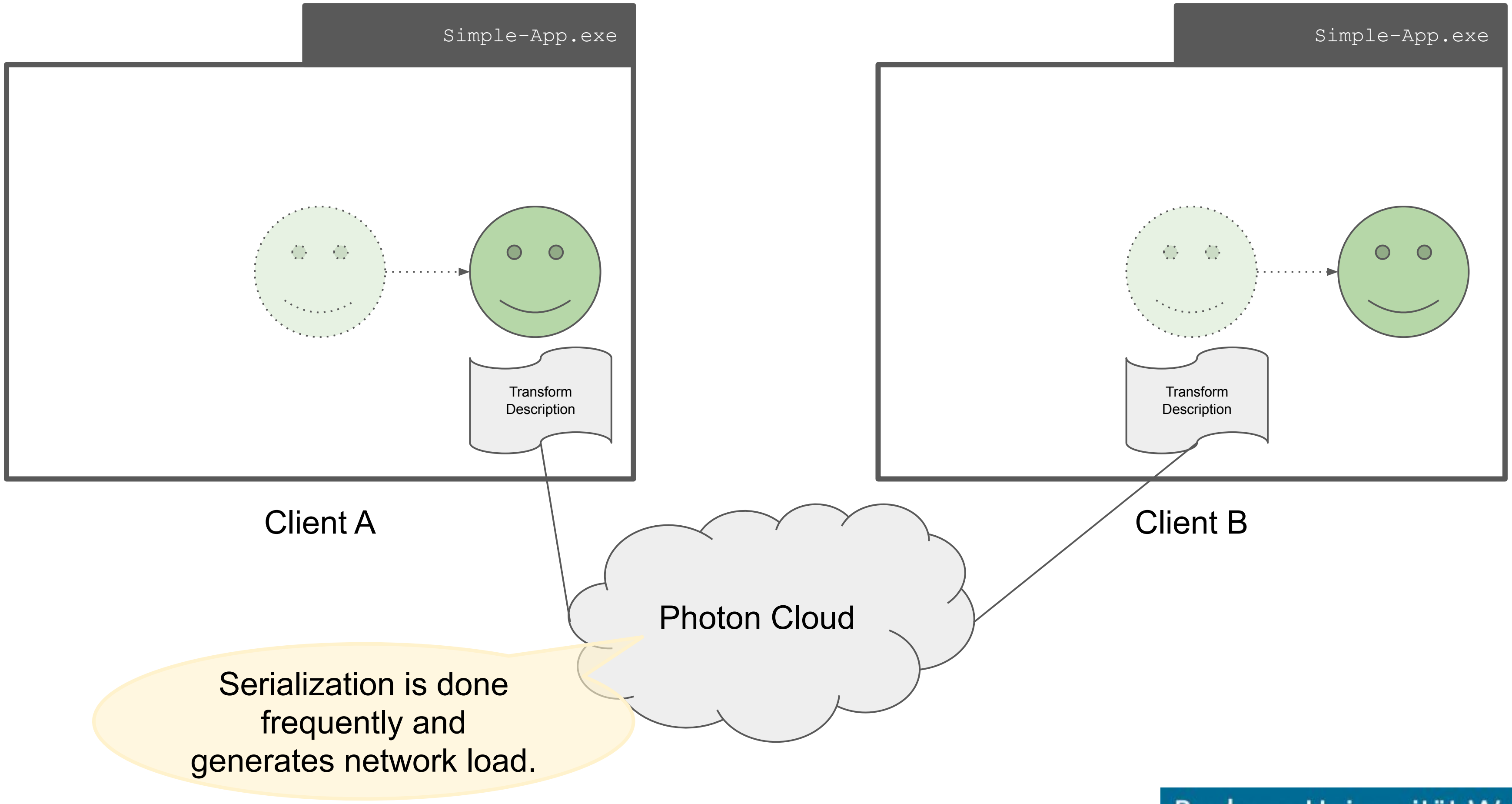


Client B


Simple-App.exe
Simple-App.exe
Transform Description
Client A
Client B
Photon Cloud


Simple-App.exe
Transform Description
Client A
Simple-App.exe
Transform Description
Client B
Photon Cloud

Property Serialization



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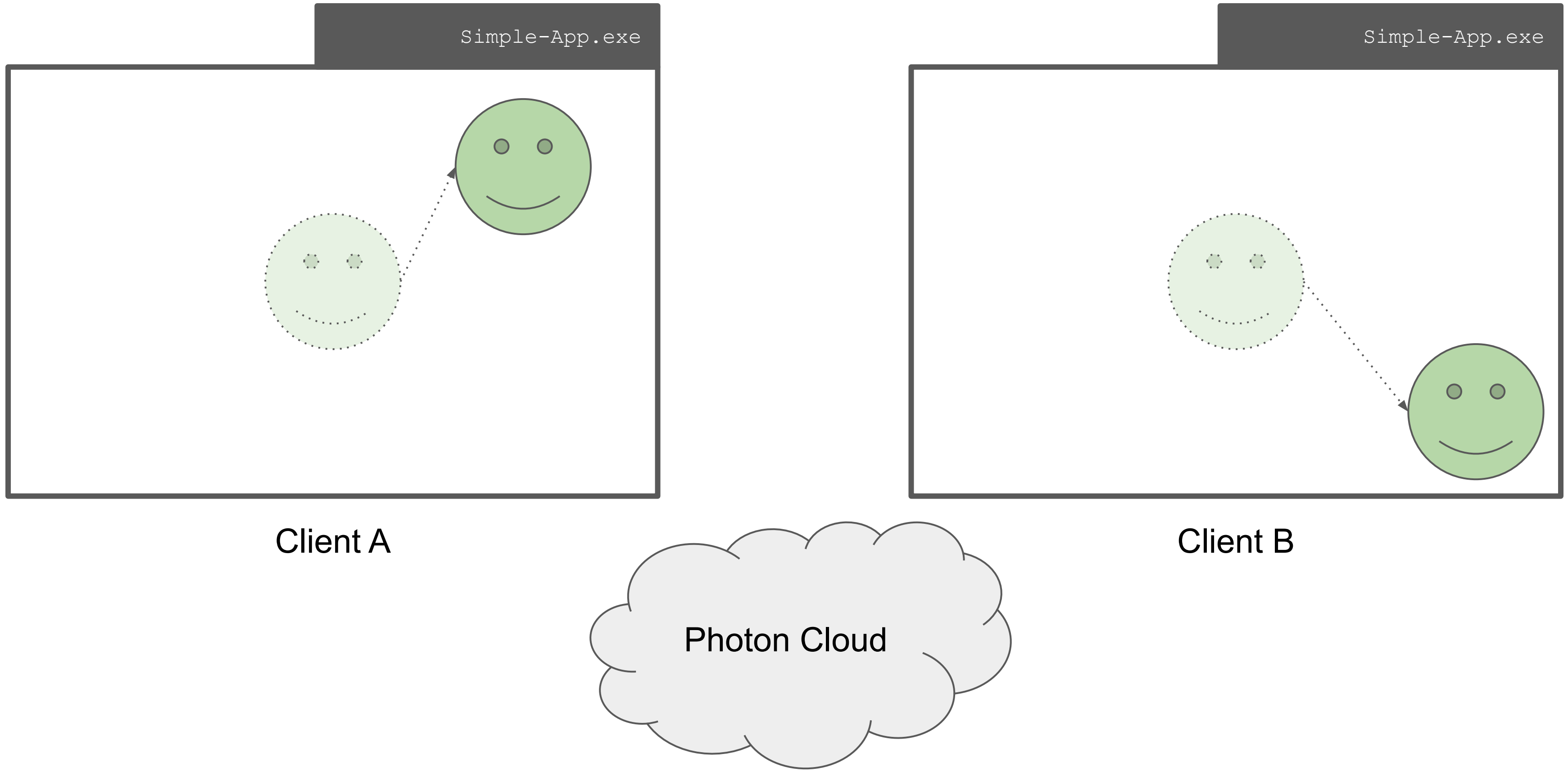
What if clients simultaneously interact with the same distributed object?



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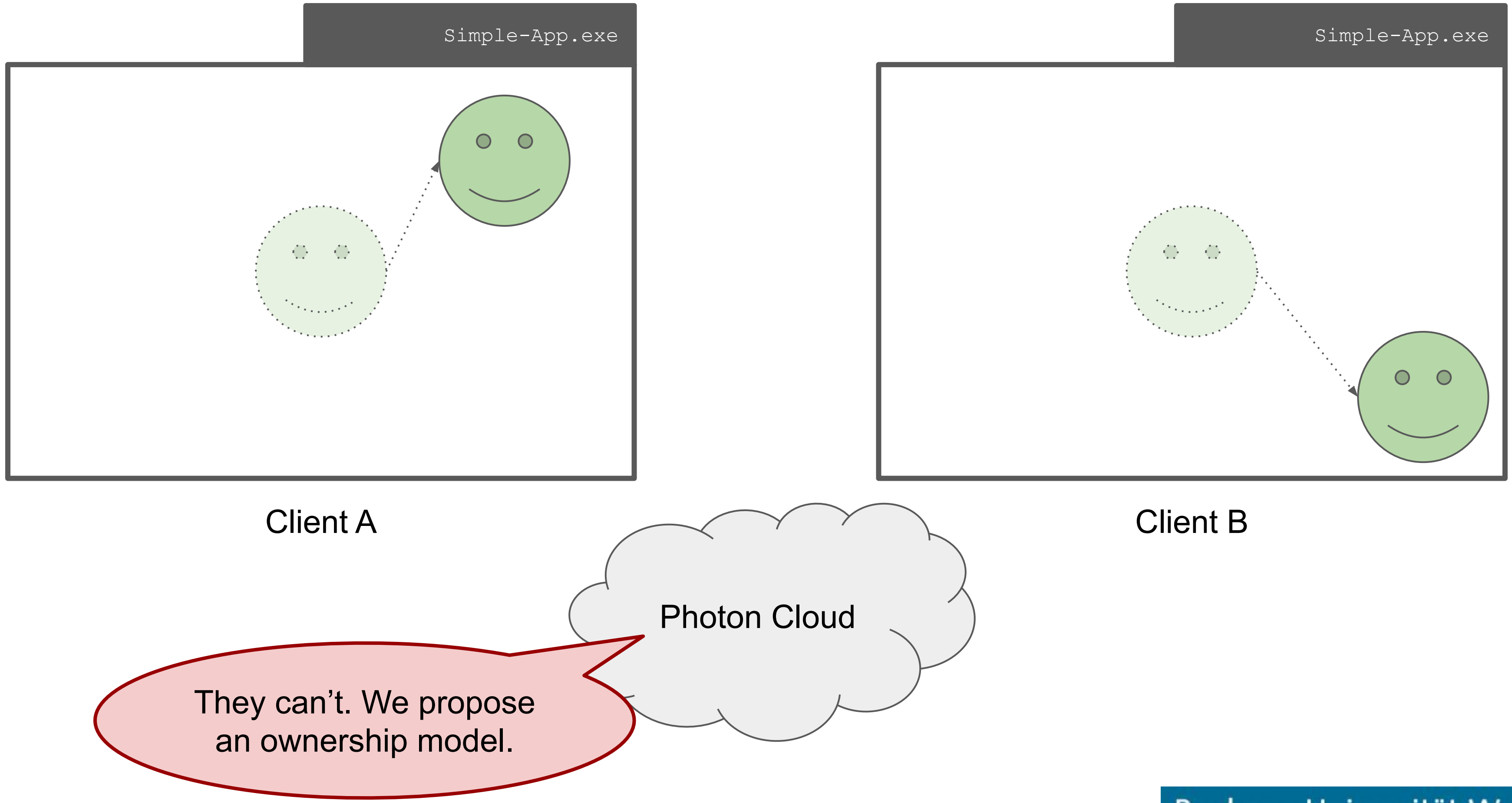
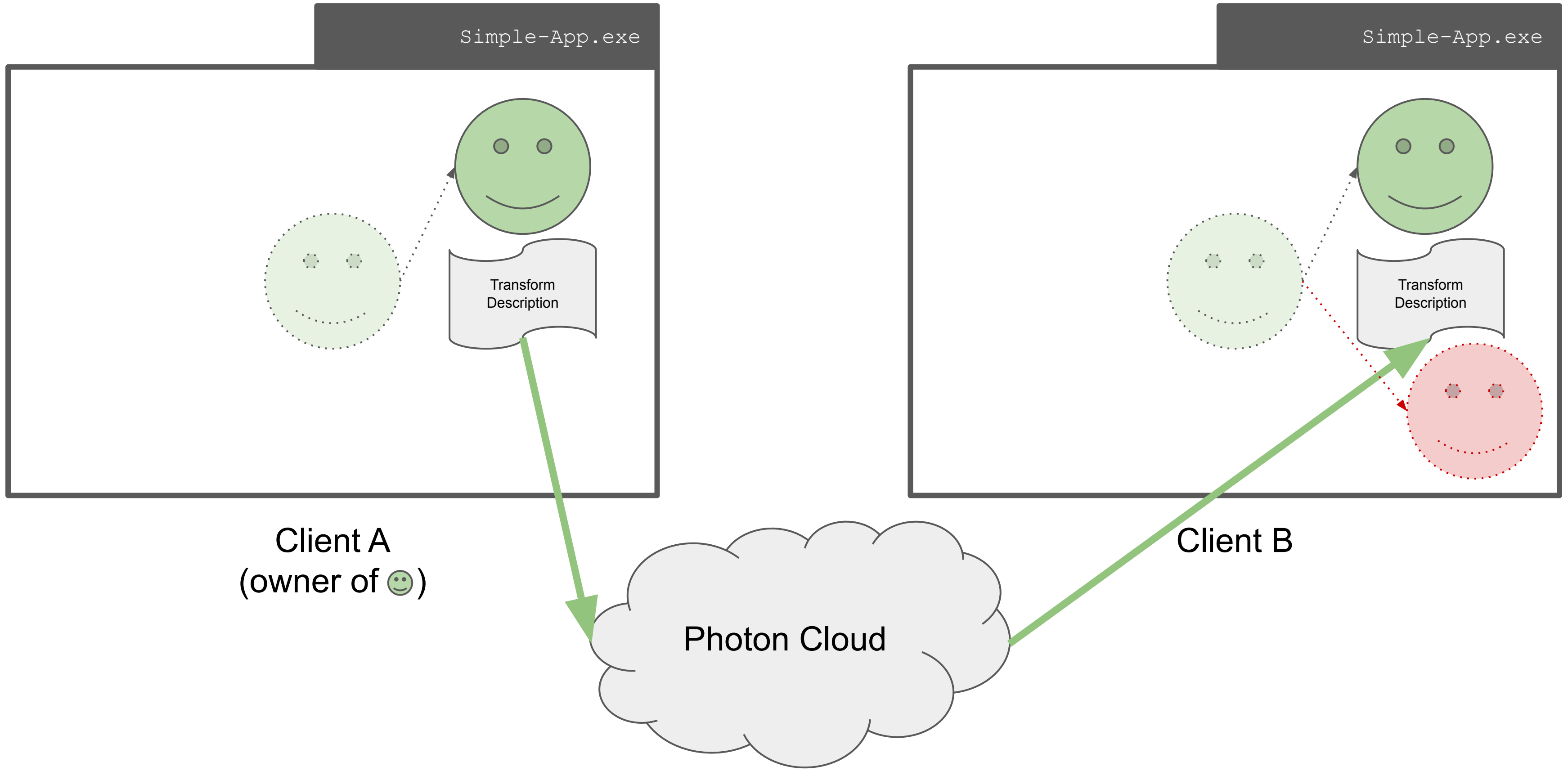
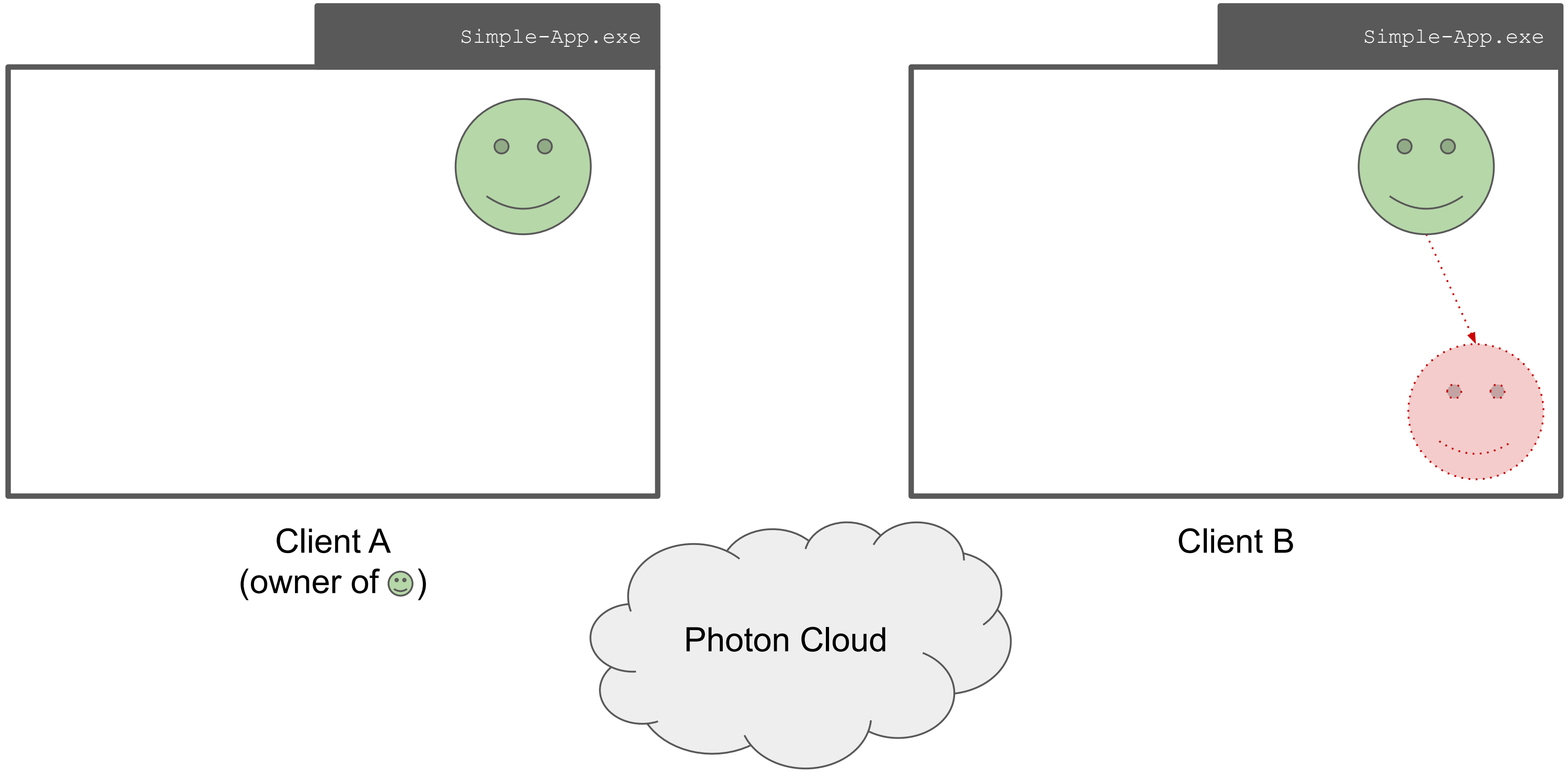
What if clients simultaneously interact with the same distributed object?



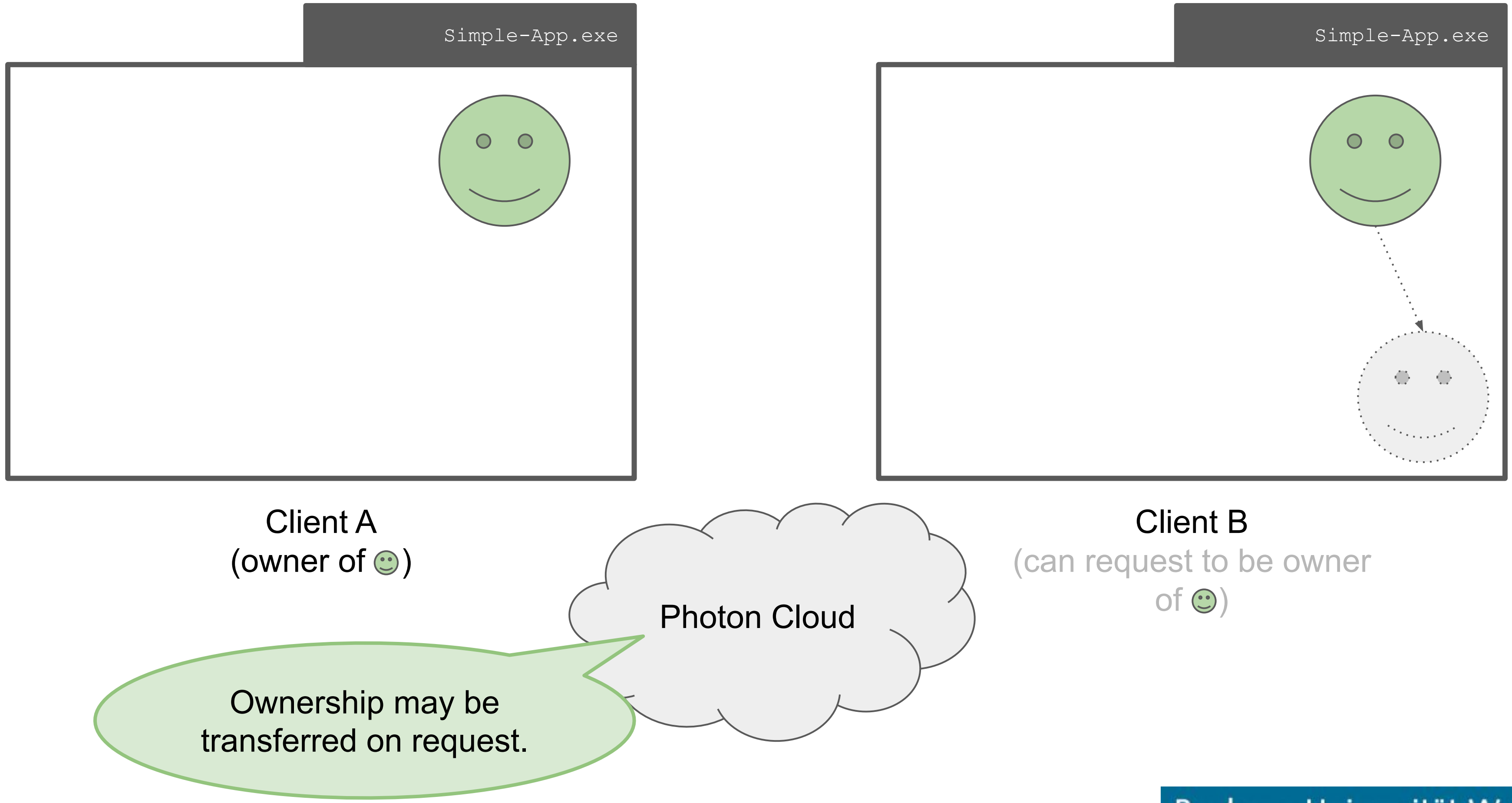
Property Serialization



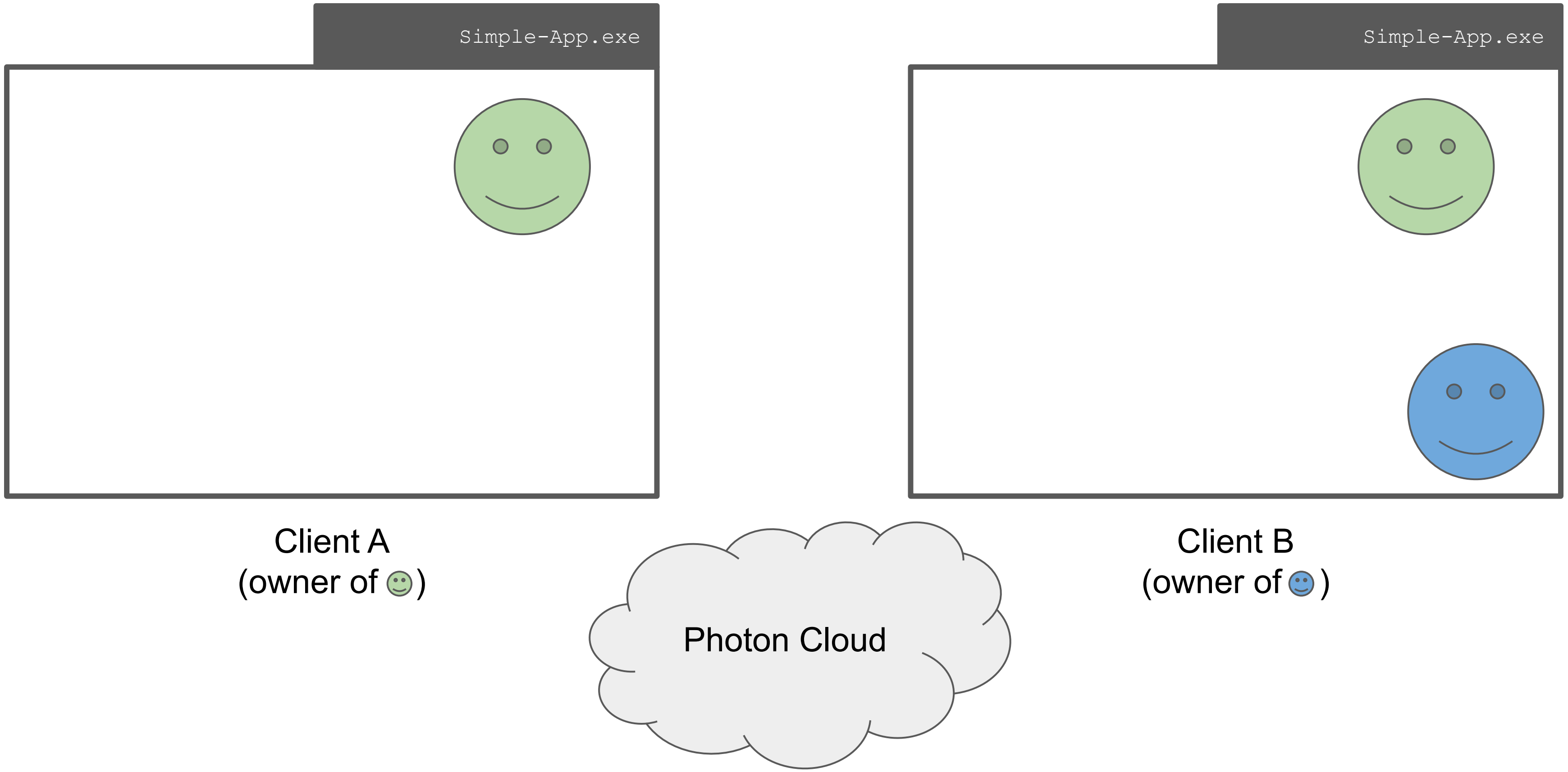
What if a client wants to interact with a non-owned object?



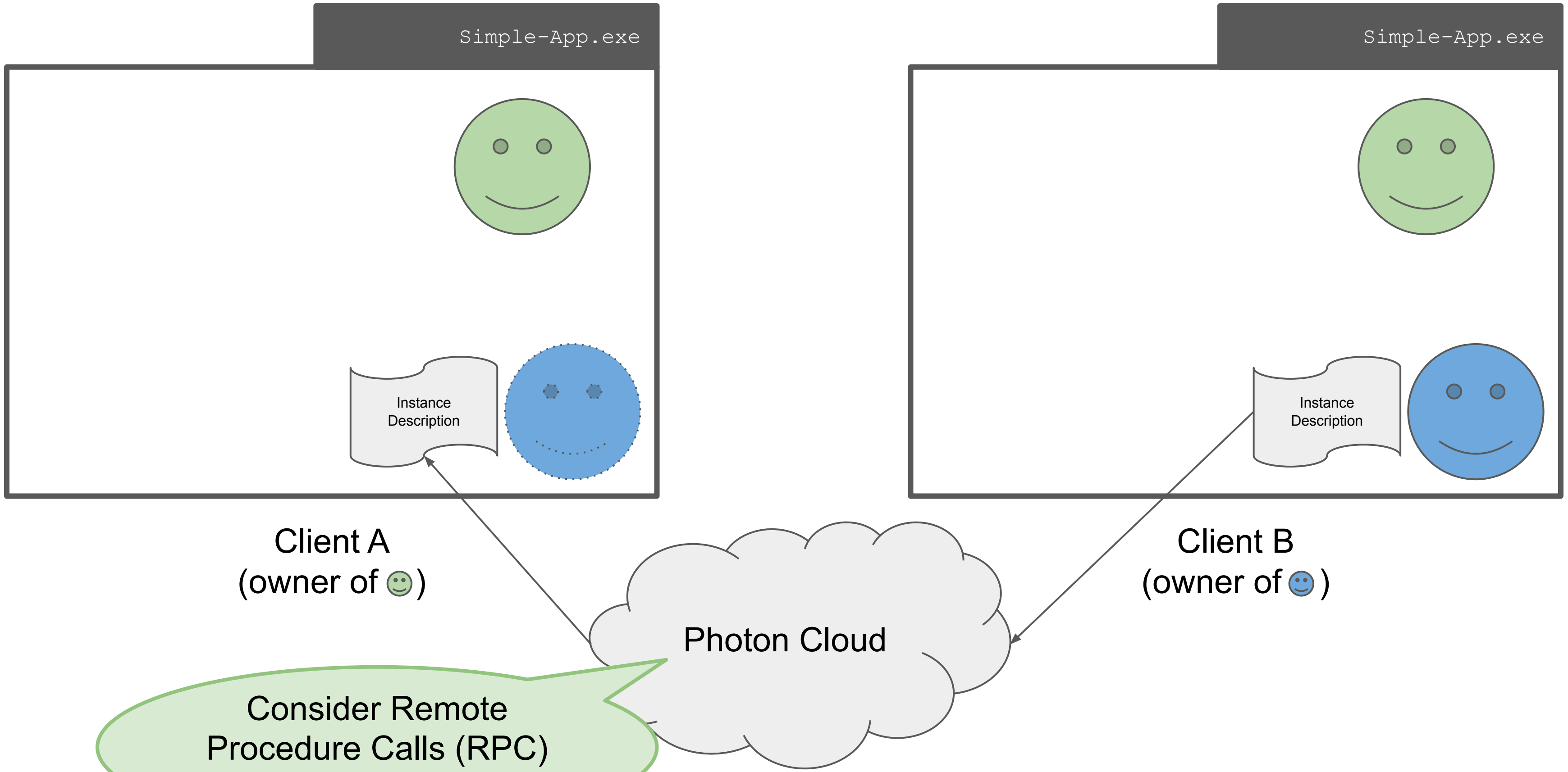
What if a client wants to interact with a non-owned object?


Simple-App.exe
Simple-App.exe
Client A
(owner of ☺)
Client B
(can request to be owner of ☺)
Photon Cloud
Ownership may be transferred on request.

What if a client wants to add a distributed object?

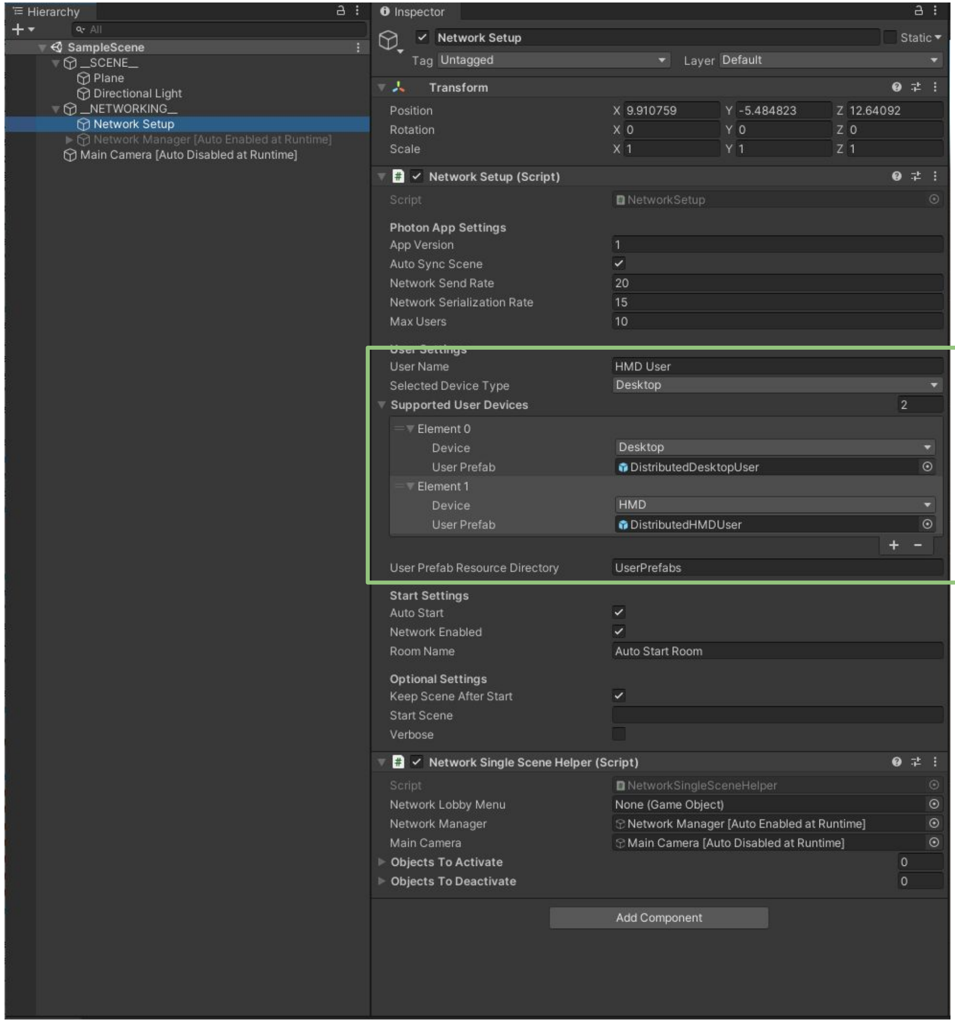


What if a client wants to add a distributed object?



Consider Remote Procedure Calls (RPC) for less frequent events.

Let’s look at how this works in practice.


Hierarchy

SampleScene
SCENE
Plane
Directional Light
NETWORKING
Network Setup
Network Manager [Auto Enabled at Runtime]
Main Camera [Auto Disabled at Runtime]

Inspector

Network Setup — Static
Tag: Untagged — Layer: Default

Transform

	X	Y	Z
Position	9.910759	-5.484823	12.64092
Rotation	0	0	0
Scale	1	1	1

Network Setup (Script)

Script	NetworkSetup
Photon App Settings	
App Version	1
Auto Sync Scene	✓
Network Send Rate	20
Network Serialization Rate	15
Max Users	10
User Settings	
User Name	HMD User
Selected Device Type	Desktop
Supported User Devices	2
Element 0	
Device	Desktop
User Prefab	DistributedDesktopUser
Element 1	
Device	HMD
User Prefab	DistributedHMDUser
User Prefab Resource Directory	UserPrefabs
Start Settings	
Auto Start	✓
Network Enabled	✓
Room Name	Auto Start Room
Optional Settings	
Keep Scene After Start	✓
Start Scene	
Verbose	

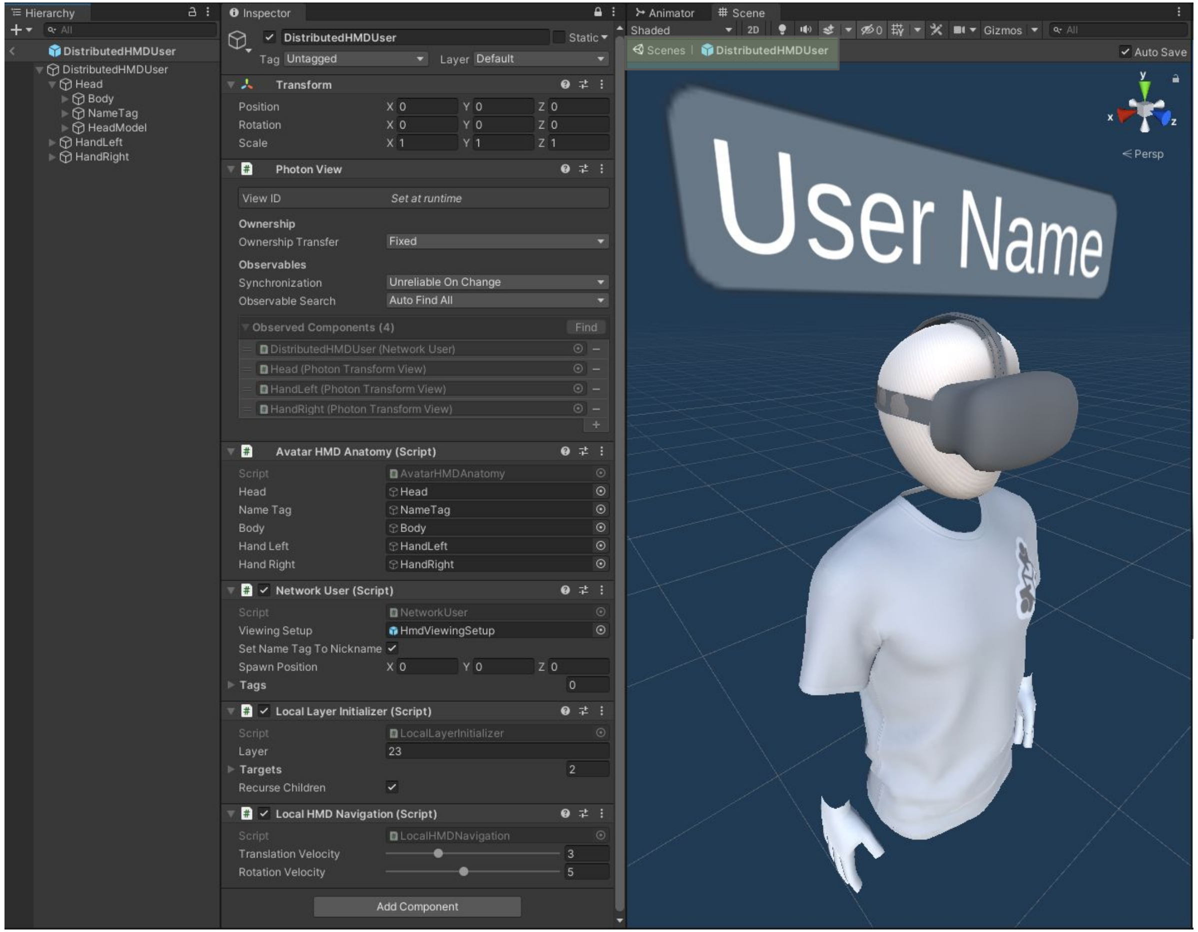
Network Single Scene Helper (Script)

Script	NetworkSingleSceneHelper
Network Lobby Menu	None (Game Object)
Network Manager	Network Manager [Auto Enabled at Runtime]
Main Camera	Main Camera [Auto Disabled at Runtime]
Objects To Activate	0
Objects To Deactivate	0

Add Component

Our sample codebase supplies:

- connection setup
- creation and joining of distributed scenes
- distributed user instantiation
- simple user prefabs (HMD & desktop)



Hierarchy:
- DistributedHMDUser
  - DistributedHMDUser
    - Head
      - Body
      - NameTag
      - HeadModel
    - HandLeft
    - HandRight

Inspector: DistributedHMDUser — Static — Tag: Untagged — Layer: Default

Transform
	X	Y	Z
Position	0	0	0
Rotation	0	0	0
Scale	1	1	1

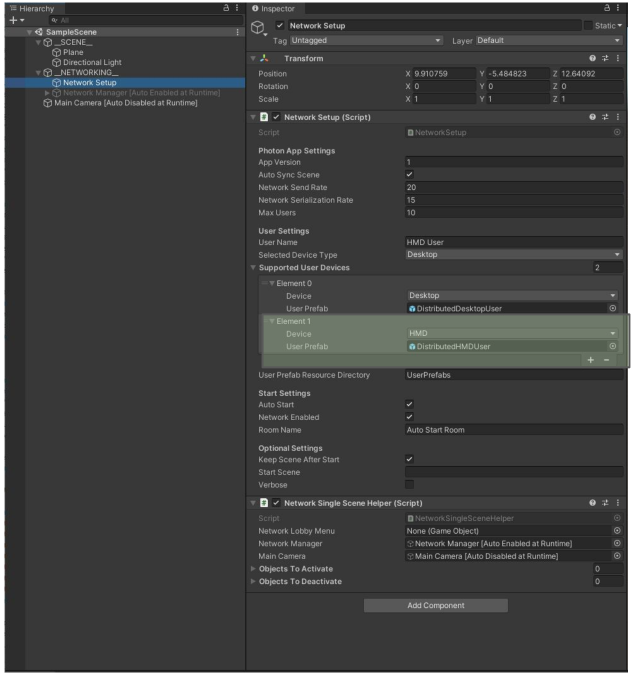
Photon View
- View ID: *Set at runtime*
- **Ownership**
- Ownership Transfer: Fixed
- **Observables**
- Synchronization: Unreliable On Change
- Observable Search: Auto Find All
- Observed Components (4)
  - DistributedHMDUser (Network User)
  - Head (Photon Transform View)
  - HandLeft (Photon Transform View)
  - HandRight (Photon Transform View)

Avatar HMD Anatomy (Script)
- Script: AvatarHMDAnatomy
- Head: Head
- Name Tag: NameTag
- Body: Body
- Hand Left: HandLeft
- Hand Right: HandRight

Network User (Script)
- Script: NetworkUser
- Viewing Setup: HmdViewingSetup
- Set Name Tag To Nickname: ✓
- Spawn Position: X 0, Y 0, Z 0
- Tags: 0

Local Layer Initializer (Script)
- Script: LocalLayerInitializer
- Layer: 23
- Targets: 2
- Recurse Children: ✓

Local HMD Navigation (Script)
- Script: LocalHMDNavigation
- Translation Velocity: 3
- Rotation Velocity: 5



Hierarchy:
- SampleScene
  - __SCENE__
    - Plane
    - Directional Light
  - __NETWORKING__
    - Network Setup
    - Network Manager [Auto Enabled at Runtime]
  - Main Camera [Auto Disabled at Runtime]

Inspector: Network Setup — Static — Tag: Untagged — Layer: Default

Transform
	X	Y	Z
Position	9.910759	-5.484823	12.64092
Rotation	0	0	0
Scale	1	1	1

Network Setup (Script)
- Script: NetworkSetup
- **Photon App Settings**
- App Version: 1
- Auto Sync Scene: ✓
- Network Send Rate: 20
- Network Serialization Rate: 15
- Max Users: 10
- **User Settings**
- User Name: HMD User
- Selected Device Type: Desktop
- Supported User Devices: 2
  - Element 0
    - Device: Desktop
    - User Prefab: DistributedDesktopUser
  - Element 1
    - Device: HMD
    - User Prefab: DistributedHMDUser
- User Prefab Resource Directory: UserPrefabs
- **Start Settings**
- Auto Start: ✓
- Network Enabled: ✓
- Room Name: Auto Start Room
- **Optional Settings**
- Keep Scene After Start: ✓
- Start Scene:
- Verbose:

Network Single Scene Helper (Script)
- Script: NetworkSingleSceneHelper
- Network Lobby Menu: None (Game Object)
- Network Manager: Network Manager [Auto Enabled at Runtime]
- Main Camera: Main Camera [Auto Disabled at Runtime]
- Objects To Activate: 0
- Objects To Deactivate: 0

<u>UserPrefabs:</u> Determine user interaction capabilities and visual representation. (Extend / Switch under *Network Setup* > *Supported User Devices*)

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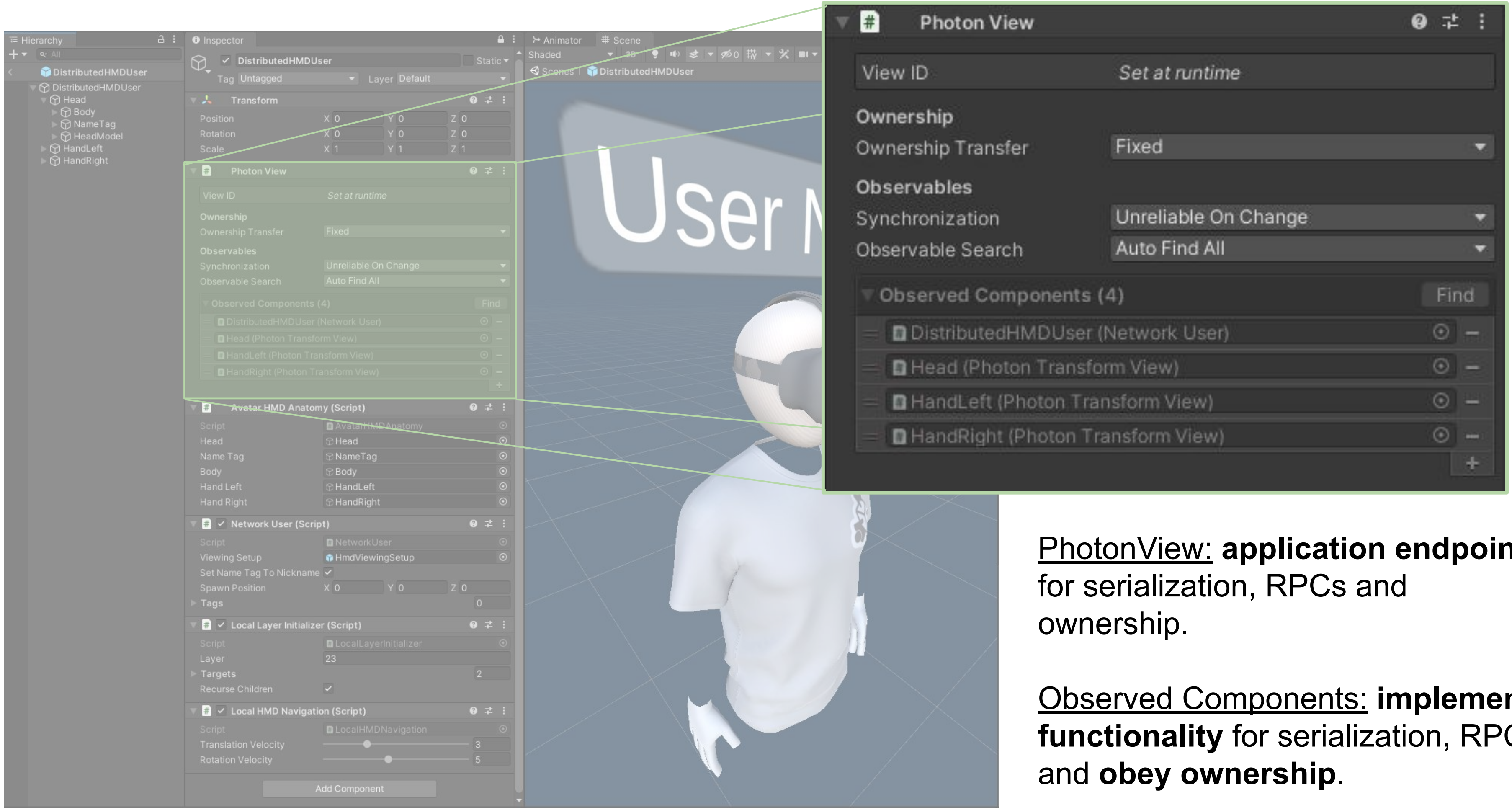


DistributedHMDUser
- DistributedHMDUser
  - Head
    - Body
    - NameTag
    - HeadModel
  - HandLeft
  - HandRight

DistributedHMDUser Static
Tag Untagged Layer Default

Transform
Position X 0 Y 0 Z 0
Rotation X 0 Y 0 Z 0
Scale X 1 Y 1 Z 1

Photon View
View ID Set at runtime
Ownership
Ownership Transfer Fixed
Observables
Synchronization Unreliable On Change
Observable Search Auto Find All
Observed Components (4) Find
DistributedHMDUser (Network User)
Head (Photon Transform View)
HandLeft (Photon Transform View)
HandRight (Photon Transform View)

Avatar HMD Anatomy (Script)
Script AvatarHMDAnatomy
Head Head
Name Tag NameTag
Body Body
Hand Left HandLeft
Hand Right HandRight

Network User (Script)
Script NetworkUser
Viewing Setup HmdViewingSetup
Set Name Tag To Nickname ✓
Spawn Position X 0 Y 0 Z 0
Tags 0

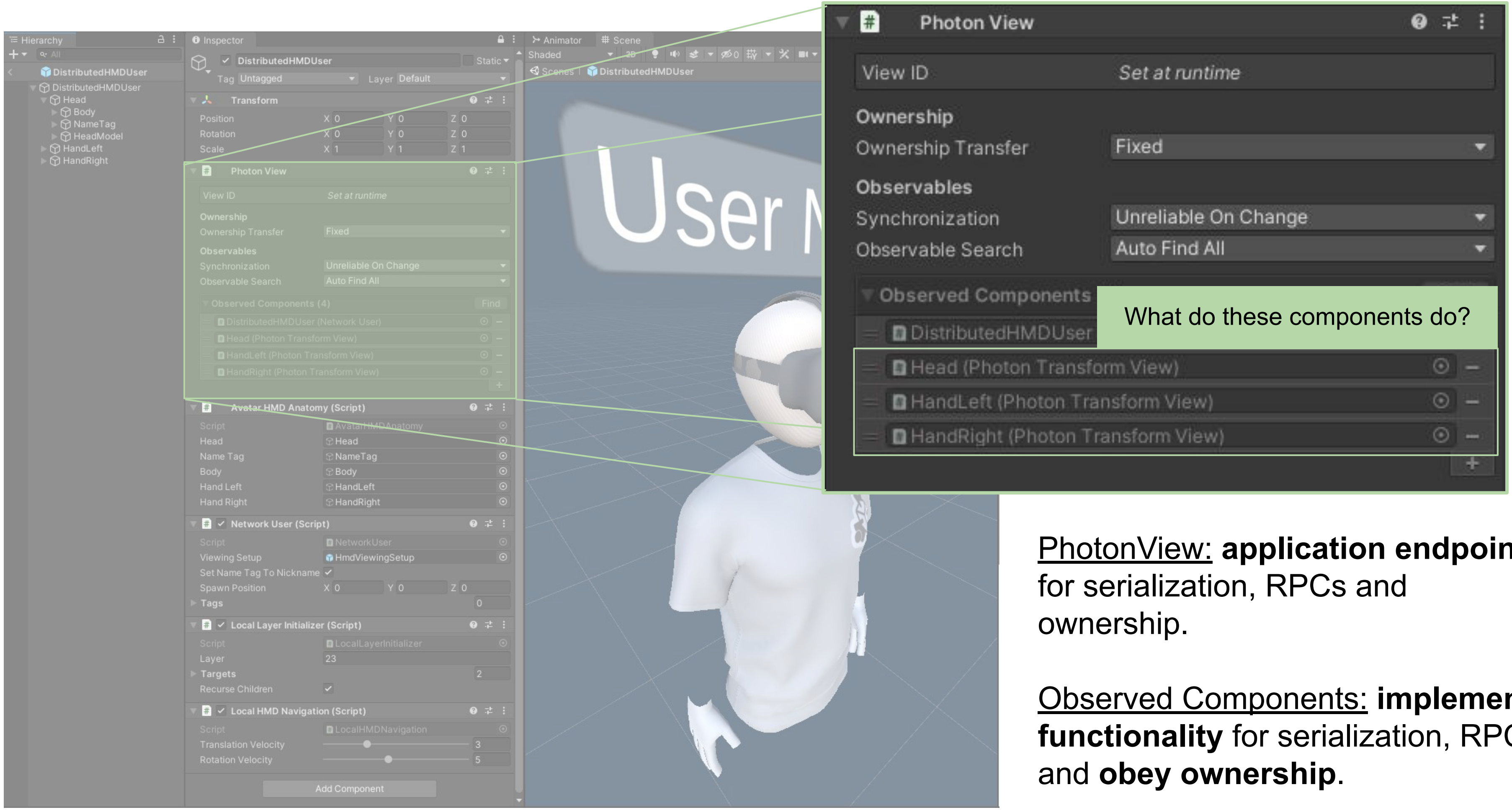
Local Layer Initializer (Script)
Script LocalLayerInitializer
Layer 23
Targets 2
Recurse Children ✓

Local HMD Navigation (Script)
Script LocalHMDNavigation
Translation Velocity 3
Rotation Velocity 5

Add Component

<u>PhotonView:</u> **application endpoint** for serialization, RPCs and ownership.

<u>Observed Components:</u> **implement functionality** for serialization, RPCs and **obey ownership**.



Hierarchy
- DistributedHMDUser
  - DistributedHMDUser
    - Head
      - Body
      - NameTag
      - HeadModel
    - HandLeft
    - HandRight

Inspector
DistributedHMDUser — Static
Tag: Untagged — Layer: Default

Transform
Position X 0 Y 0 Z 0
Rotation X 0 Y 0 Z 0
Scale X 1 Y 1 Z 1

Photon View
View ID: Set at runtime
Ownership
Ownership Transfer: Fixed
Observables
Synchronization: Unreliable On Change
Observable Search: Auto Find All
Observed Components (4) — Find
- DistributedHMDUser (Network User)
- Head (Photon Transform View)
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- HandRight (Photon Transform View)

Avatar HMD Anatomy (Script)
Script: AvatarHMDAnatomy
Head: Head
Name Tag: NameTag
Body: Body
Hand Left: HandLeft
Hand Right: HandRight

Network User (Script)
Script: NetworkUser
Viewing Setup: HmdViewingSetup
Set Name Tag To Nickname: ✓
Spawn Position X 0 Y 0 Z 0
Tags: 0

Local Layer Initializer (Script)
Script: LocalLayerInitializer
Layer: 23
Targets: 2
Recurse Children: ✓

Local HMD Navigation (Script)
Script: LocalHMDNavigation
Translation Velocity: 3
Rotation Velocity: 5

Add Component

What do these components do?

<u>PhotonView:</u> **application endpoint** for serialization, RPCs and ownership.

<u>Observed Components:</u> **implement functionality** for serialization, RPCs and **obey ownership**.

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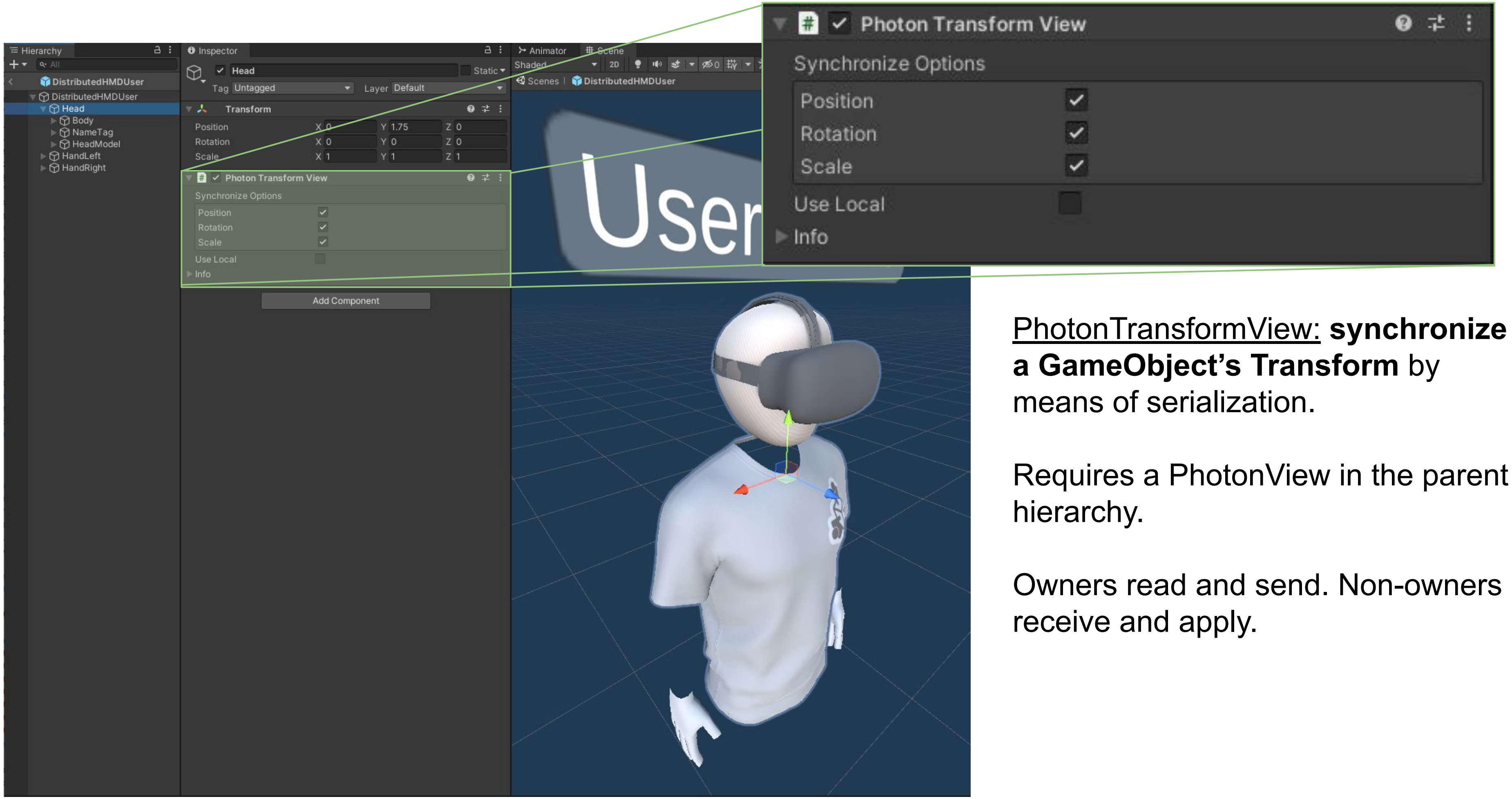


Head — Static
Tag: Untagged — Layer: Default

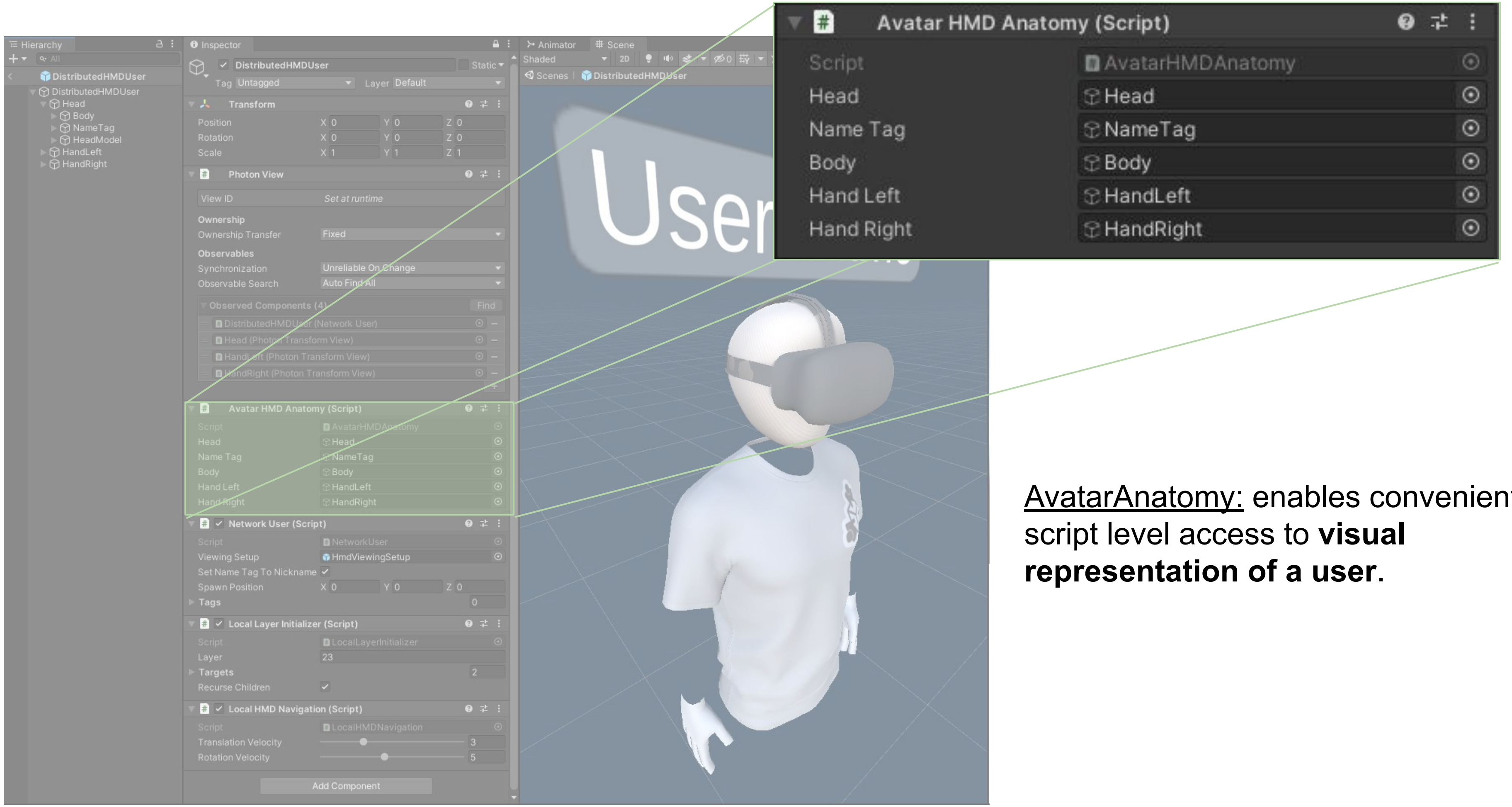
Transform
Position X 0 Y 1.75 Z 0
Rotation X 0 Y 0 Z 0
Scale X 1 Y 1 Z 1

Photon Transform View
Synchronize Options
Position ✓
Rotation ✓
Scale ✓
Use Local ☐
Info

PhotonTransformView: **synchronize a GameObject's Transform** by means of serialization.

Requires a PhotonView in the parent hierarchy.

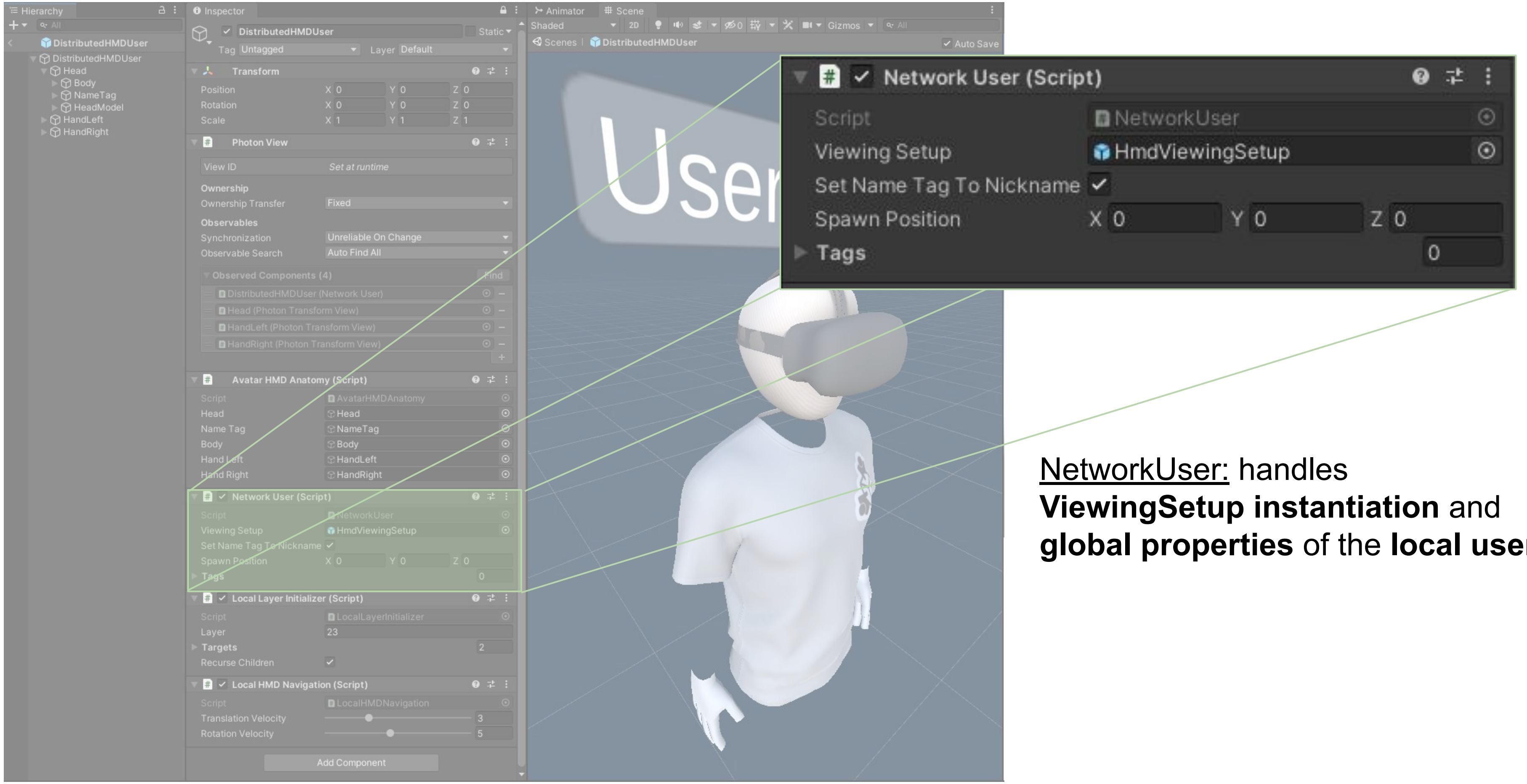
Owners read and send. Non-owners receive and apply.



Hierarchy:
```
DistributedHMDUser
  DistributedHMDUser
    Head
      Body
      NameTag
      HeadModel
    HandLeft
    HandRight
```

Inspector:
```
DistributedHMDUser                          Static
Tag Untagged                 Layer Default

Transform
Position          X 0     Y 0     Z 0
Rotation          X 0     Y 0     Z 0
Scale             X 1     Y 1     Z 1

Photon View
View ID                     Set at runtime
Ownership
Ownership Transfer          Fixed
Observables
Synchronization             Unreliable On Change
Observable Search           Auto Find All
Observed Components (4)                     Find
  DistributedHMDUser (Network User)
  Head (Photon Transform View)
  HandLeft (Photon Transform View)
  HandRight (Photon Transform View)

Avatar HMD Anatomy (Script)
Script                      AvatarHMDAnatomy
Head                        Head
Name Tag                    NameTag
Body                        Body
Hand Left                   HandLeft
Hand Right                  HandRight

Network User (Script)
Script                      NetworkUser
Viewing Setup               HmdViewingSetup
Set Name Tag To Nickname    ✓
Spawn Position    X 0     Y 0     Z 0
Tags                                    0

Local Layer Initializer (Script)
Script                      LocalLayerInitializer
Layer                       23
Targets                                 2
Recurse Children            ✓

Local HMD Navigation (Script)
Script                      LocalHMDNavigation
Translation Velocity                    3
Rotation Velocity                       5

Add Component
```

<ins>AvatarAnatomy:</ins> enables convenient script level access to **visual representation of a user**.



DistributedHMDUser Static
Tag Untagged Layer Default

Transform

Position	X 0	Y 0	Z 0
Rotation	X 0	Y 0	Z 0
Scale	X 1	Y 1	Z 1

Photon View

View ID: Set at runtime
Ownership
Ownership Transfer: Fixed
Observables
Synchronization: Unreliable On Change
Observable Search: Auto Find All
Observed Components (4)
DistributedHMDUser (Network User)
Head (Photon Transform View)
HandLeft (Photon Transform View)
HandRight (Photon Transform View)

Avatar HMD Anatomy (Script)

Script: AvatarHMDAnatomy
Head: Head
Name Tag: NameTag
Body: Body
Hand Left: HandLeft
Hand Right: HandRight

Network User (Script)

Script: NetworkUser
Viewing Setup: HmdViewingSetup
Set Name Tag To Nickname: ✓
Spawn Position: X 0 Y 0 Z 0
Tags: 0

Local Layer Initializer (Script)

Script: LocalLayerInitializer
Layer: 23
Targets: 2
Recurse Children: ✓

Local HMD Navigation (Script)

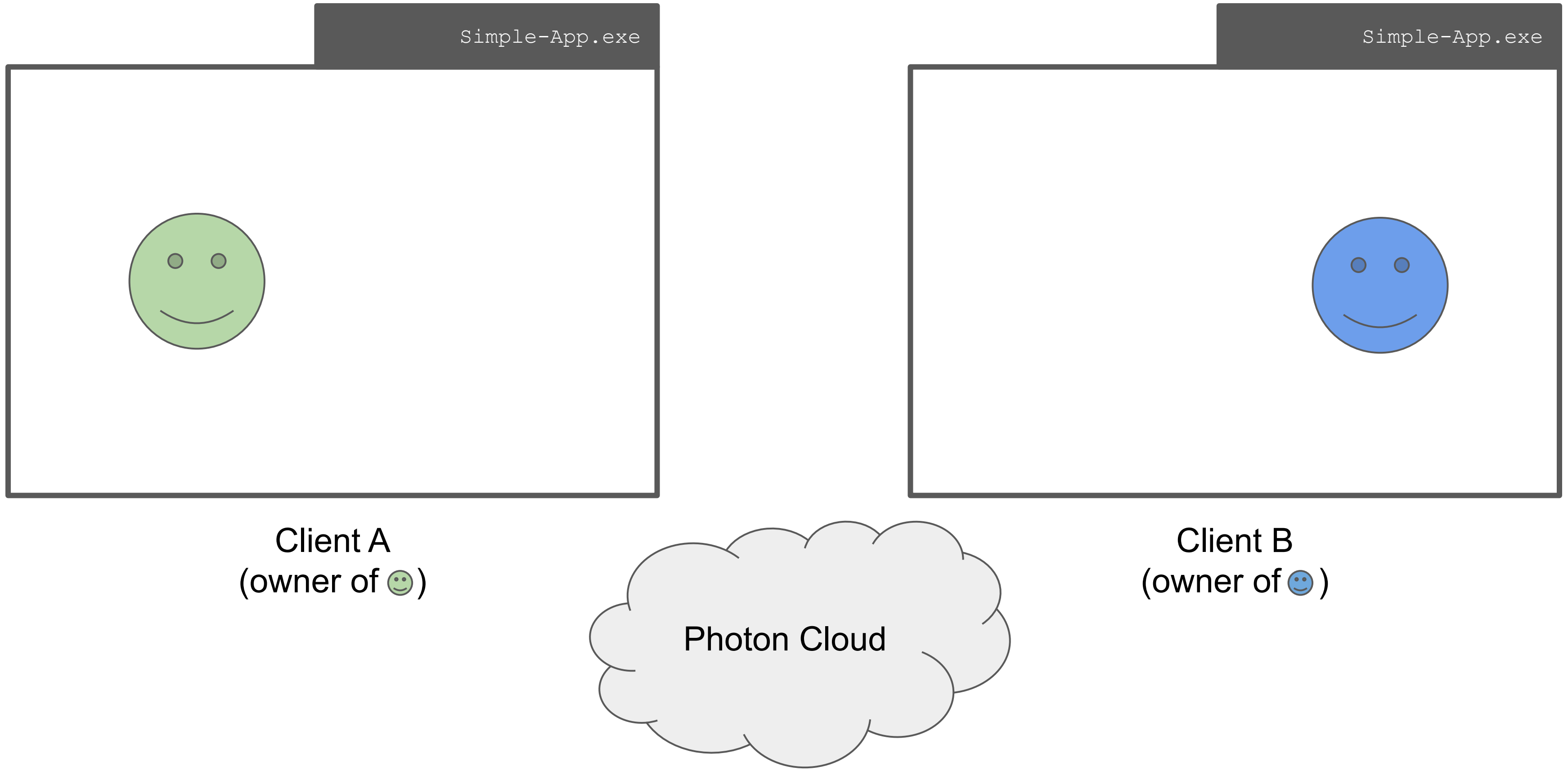
Script: LocalHMDNavigation
Translation Velocity: 3
Rotation Velocity: 5

<u>NetworkUser:</u> handles **ViewingSetup instantiation** and **global properties** of the **local user**.

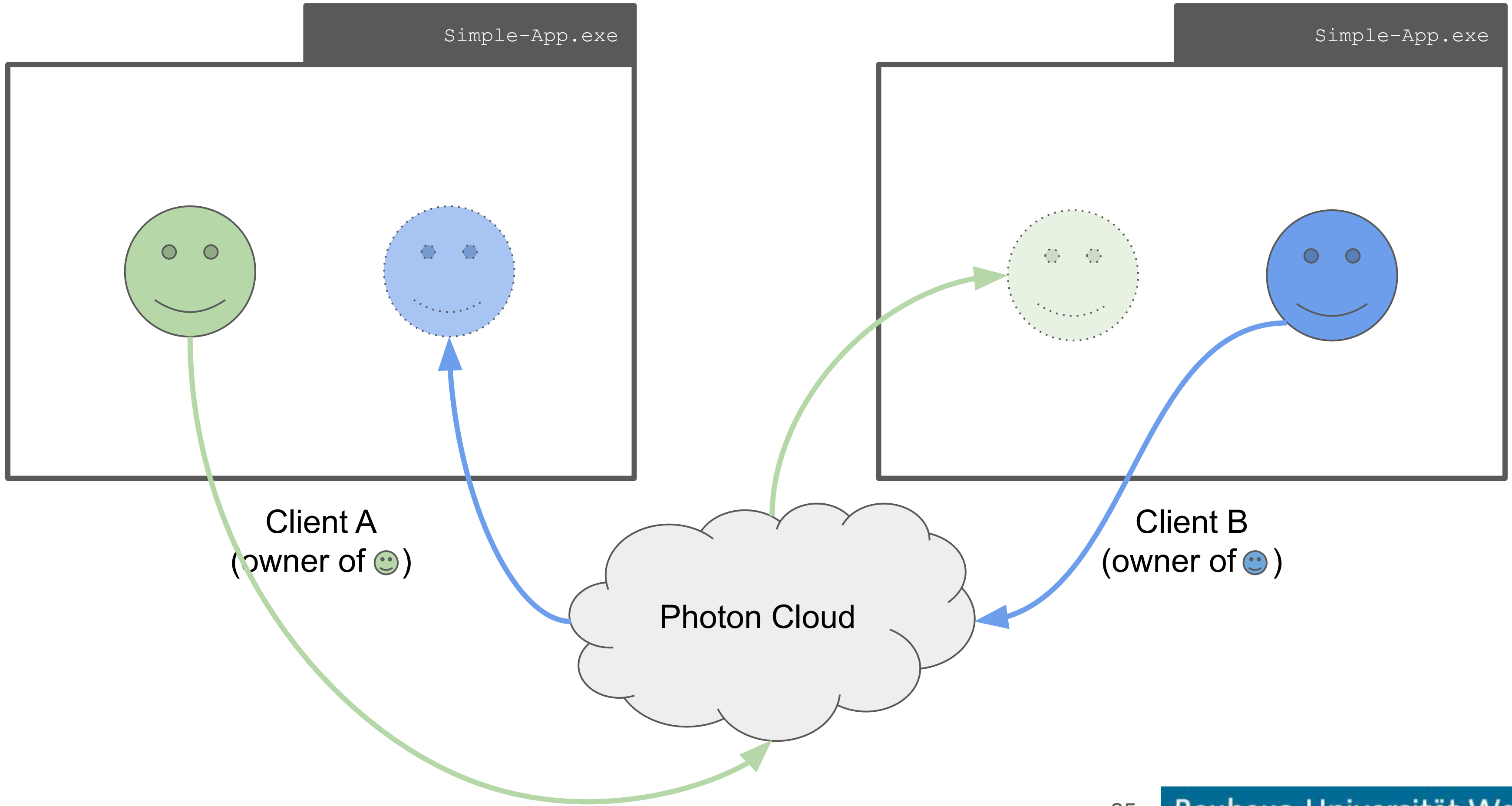
Distributed objects represent states and features on their owners system.

Therefore, they need to behave differently between clients.

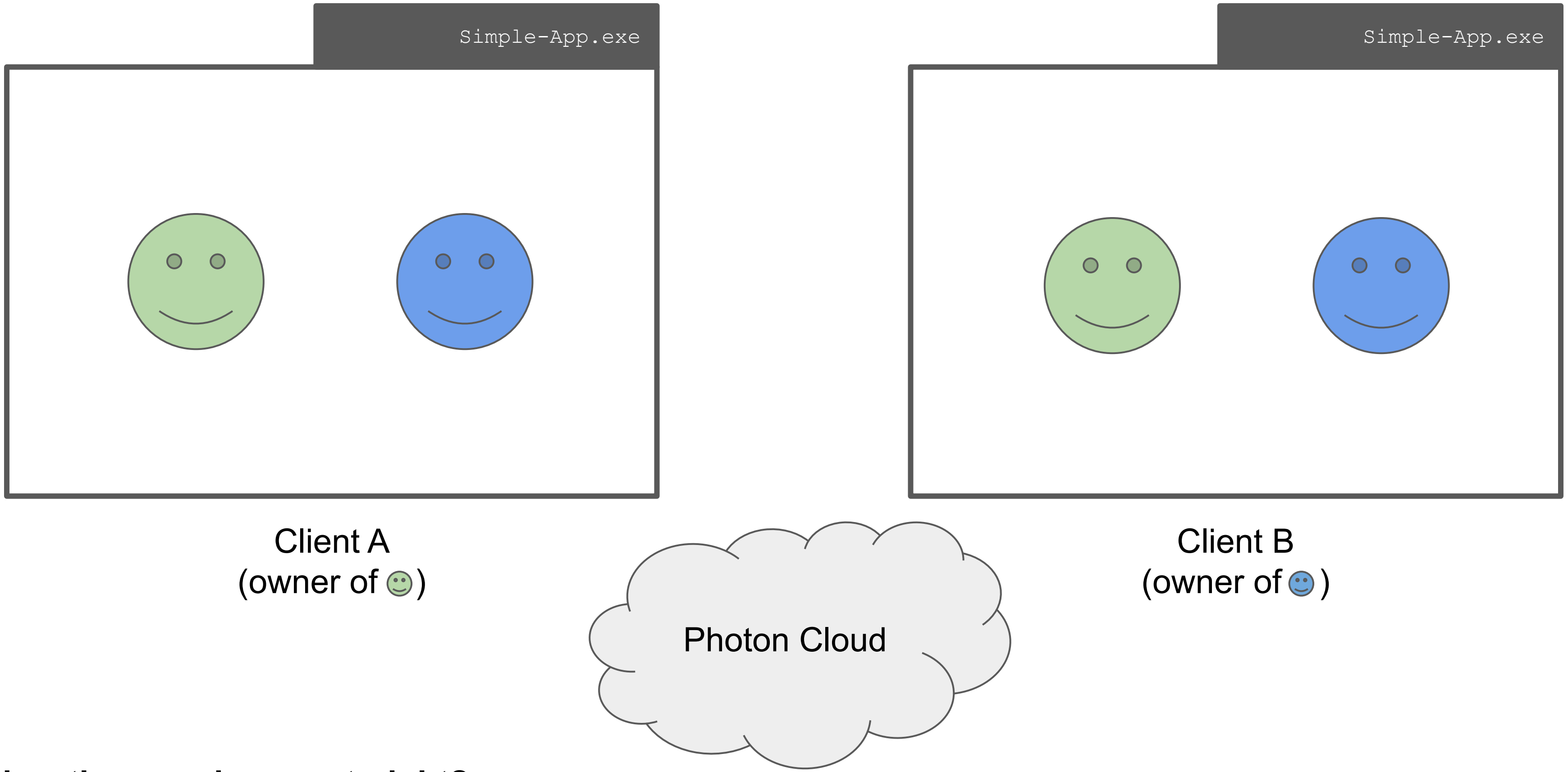
Consider the story of two users who want to meet virtually…



Consider the story of two users who want to meet virtually…

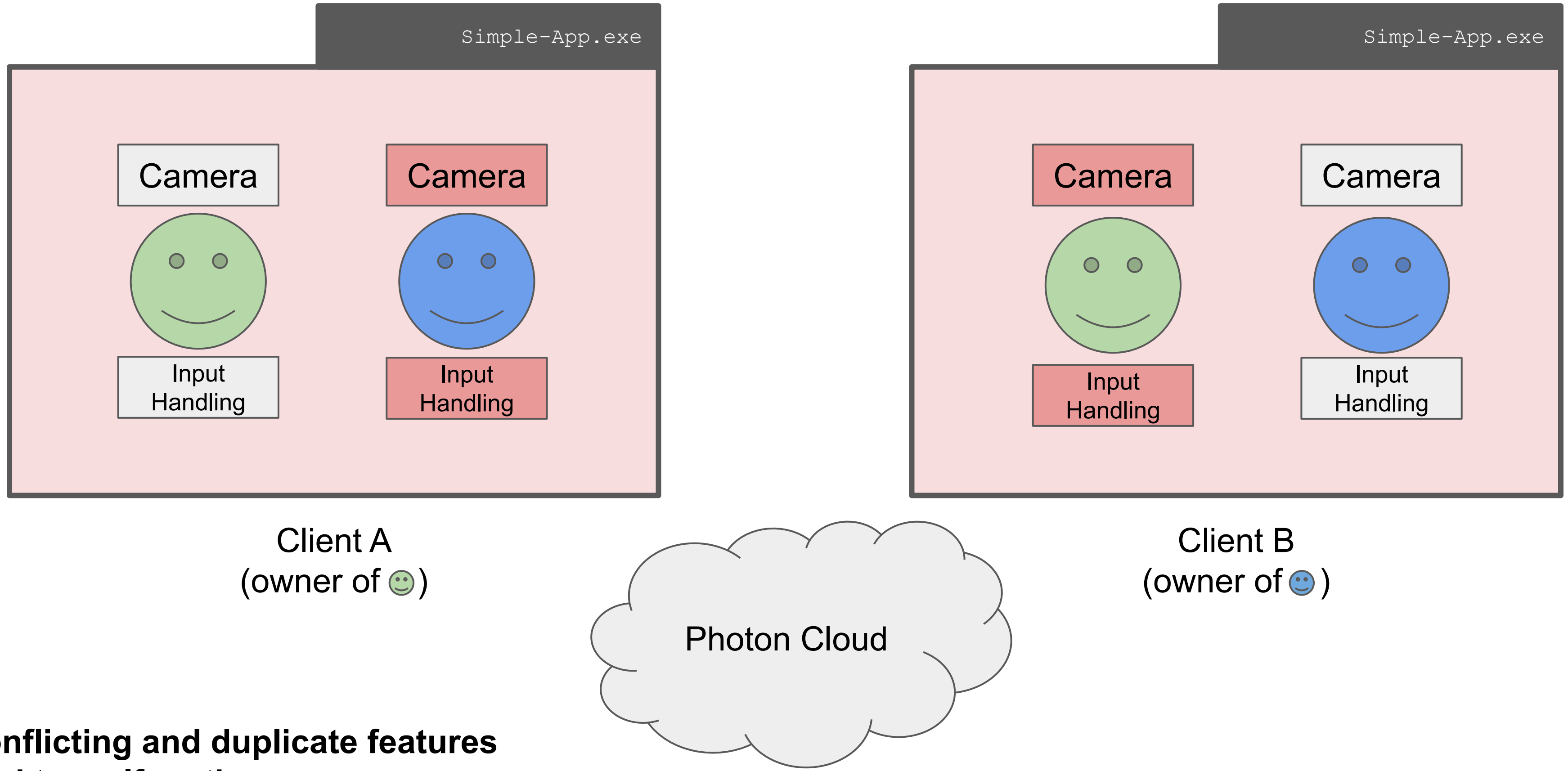


Consider the story of two users who want to meet virtually…

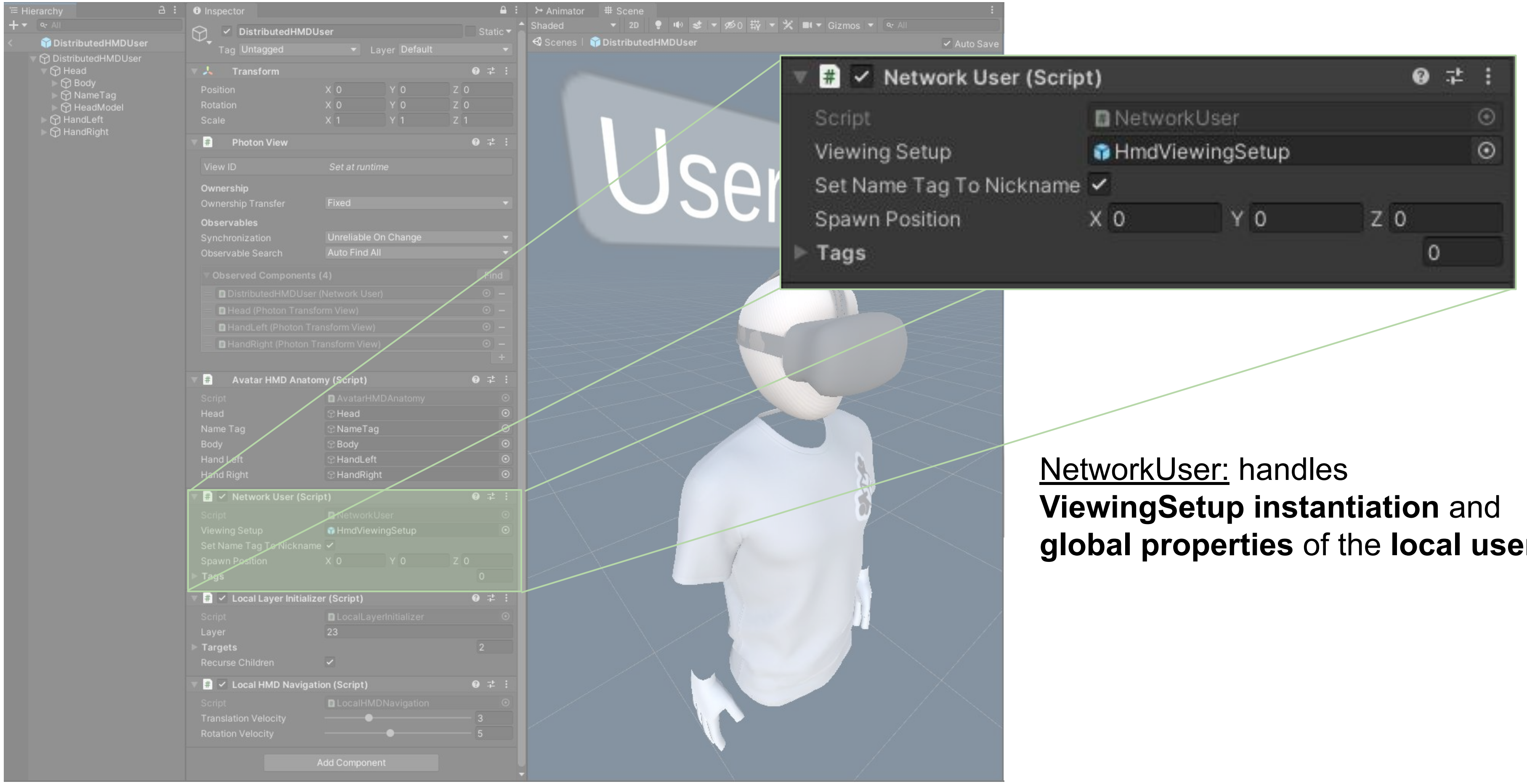


Now they can hang out, right?

Consider the story of two users who want to meet virtually…



Conflicting and duplicate features lead to malfunction.



Hierarchy:
- DistributedHMDUser
  - DistributedHMDUser
    - Head
      - Body
      - NameTag
      - HeadModel
    - HandLeft
    - HandRight

Inspector: DistributedHMDUser, Static
Tag Untagged, Layer Default

Transform
- Position X 0, Y 0, Z 0
- Rotation X 0, Y 0, Z 0
- Scale X 1, Y 1, Z 1

Photon View
- View ID: *Set at runtime*
- Ownership
- Ownership Transfer: Fixed
- Observables
- Synchronization: Unreliable On Change
- Observable Search: Auto Find All
- Observed Components (4): DistributedHMDUser (Network User); Head (Photon Transform View); HandLeft (Photon Transform View); HandRight (Photon Transform View)

Avatar HMD Anatomy (Script)
- Script: AvatarHMDAnatomy
- Head: Head
- Name Tag: NameTag
- Body: Body
- Hand Left: HandLeft
- Hand Right: HandRight

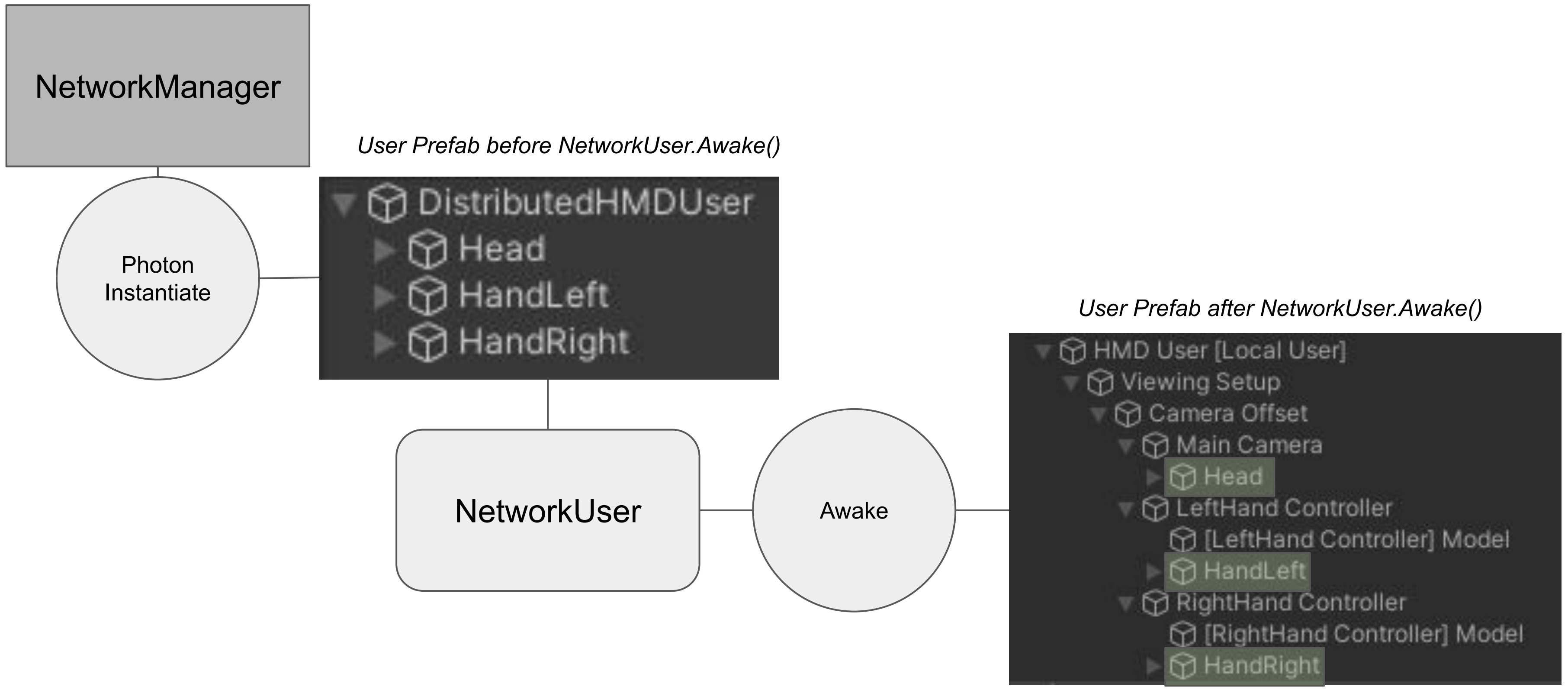
Network User (Script)
- Script: NetworkUser
- Viewing Setup: HmdViewingSetup
- Set Name Tag To Nickname: ✓
- Spawn Position: X 0, Y 0, Z 0
- Tags: 0

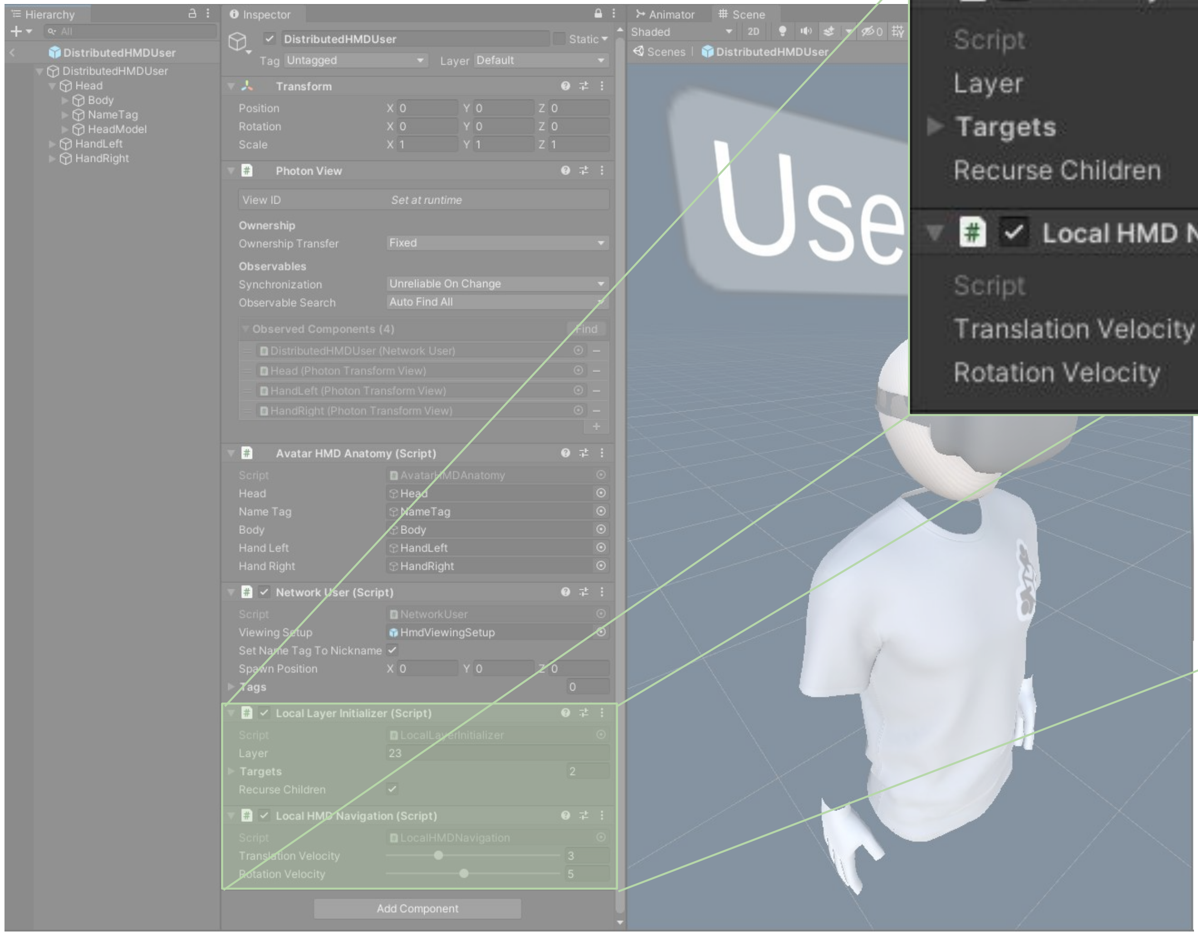
Local Layer Initializer (Script)
- Script: LocalLayerInitializer
- Layer: 23
- Targets: 2
- Recurse Children: ✓

Local HMD Navigation (Script)
- Script: LocalHMDNavigation
- Translation Velocity: 3
- Rotation Velocity: 5

Add Component

<u>NetworkUser:</u> handles **ViewingSetup instantiation** and **global properties** of the **local user**.


NetworkManager
Photon Instantiate
User Prefab before NetworkUser.Awake()
DistributedHMDUser
Head
HandLeft
HandRight
NetworkUser
Awake
User Prefab after NetworkUser.Awake()
HMD User [Local User]
Viewing Setup
Camera Offset
Main Camera
Head
LeftHand Controller
[LeftHand Controller] Model
HandLeft
RightHand Controller
[RightHand Controller] Model
HandRight


Hierarchy
- DistributedHMDUser
  - DistributedHMDUser
    - Head
      - Body
      - NameTag
      - HeadModel
    - HandLeft
    - HandRight

Inspector
DistributedHMDUser — Static
Tag Untagged — Layer Default

Transform
Position X 0 Y 0 Z 0
Rotation X 0 Y 0 Z 0
Scale X 1 Y 1 Z 1

Photon View
View ID — Set at runtime
Ownership
Ownership Transfer — Fixed
Observables
Synchronization — Unreliable On Change
Observable Search — Auto Find All
Observed Components (4)
- DistributedHMDUser (Network User)
- Head (Photon Transform View)
- HandLeft (Photon Transform View)
- HandRight (Photon Transform View)

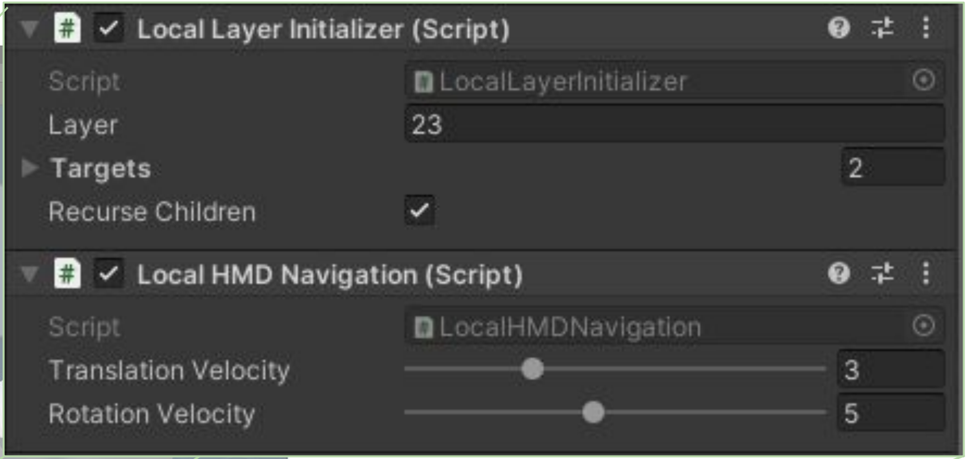
Avatar HMD Anatomy (Script)
Script — AvatarHMDAnatomy
Head — Head
Name Tag — NameTag
Body — Body
Hand Left — HandLeft
Hand Right — HandRight

Network User (Script)
Script — NetworkUser
Viewing Setup — HmdViewingSetup
Set Name Tag To Nickname ✓
Spawn Position X 0 Y 0 Z 0
Tags 0

Local Layer Initializer (Script)
Script — LocalLayerInitializer
Layer 23
Targets 2
Recurse Children ✓

Local HMD Navigation (Script)
Script — LocalHMDNavigation
Translation Velocity 3
Rotation Velocity 5

Add Component


Local Layer Initializer (Script)
Script — LocalLayerInitializer
Layer 23
Targets 2
Recurse Children ✓

Local HMD Navigation (Script)
Script — LocalHMDNavigation
Translation Velocity 3
Rotation Velocity 5

<u>Local<Feature>:</u> Scripts that will **only** compute **for the local user** *(owning the PhotonView in their parent hierarchy)*.

Non-owners will destroy this script, to avoid computational overhead or misbehavior.

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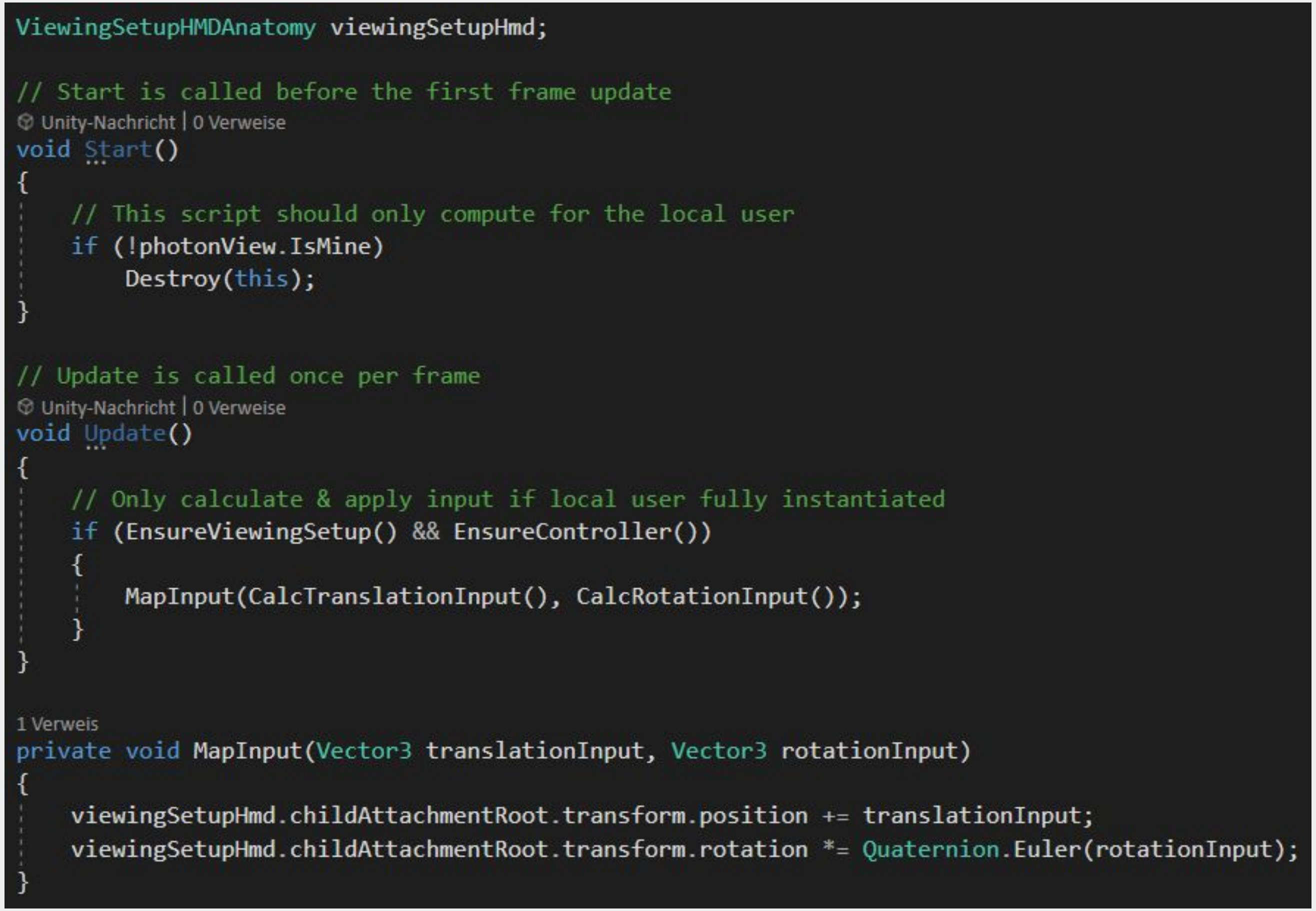
A snippet from LocalHMDNavigation.cs

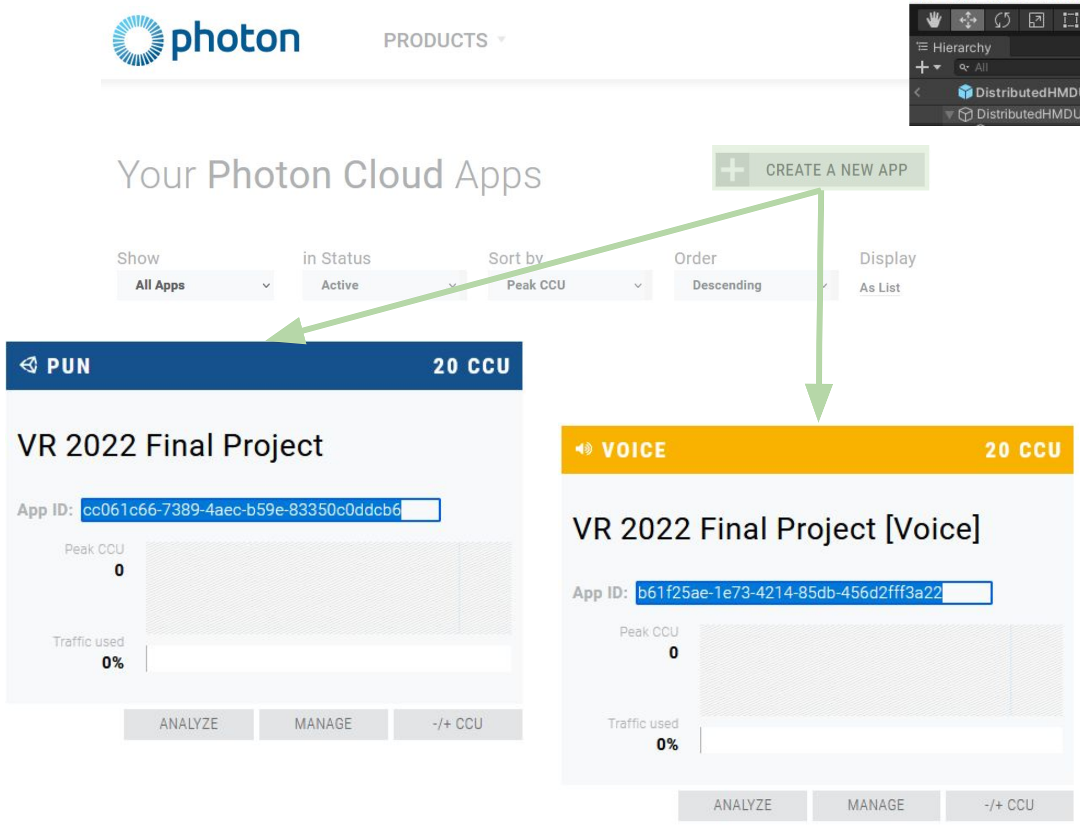


```
ViewingSetupHMDAnatomy viewingSetupHmd;

// Start is called before the first frame update
Unity-Nachricht | 0 Verweise
void Start()
{
    // This script should only compute for the local user
    if (!photonView.IsMine)
        Destroy(this);
}

// Update is called once per frame
Unity-Nachricht | 0 Verweise
void Update()
{
    // Only calculate & apply input if local user fully instantiated
    if (EnsureViewingSetup() && EnsureController())
    {
        MapInput(CalcTranslationInput(), CalcRotationInput());
    }
}

1 Verweis
private void MapInput(Vector3 translationInput, Vector3 rotationInput)
{
    viewingSetupHmd.childAttachmentRoot.transform.position += translationInput;
    viewingSetupHmd.childAttachmentRoot.transform.rotation *= Quaternion.Euler(rotationInput);
}
```

Bauhaus-Universität Weimar

Before you start reviewing, tetsing and coding...

Please sign up for a free Photon Cloud account and integrate your own server.


photon PRODUCTS

Your Photon Cloud Apps

CREATE A NEW APP

Show	in Status	Sort by	Order	Display
All Apps	Active	Peak CCU	Descending	As List

PUN 20 CCU

VR 2022 Final Project

App ID: cc061c66-7389-4aec-b59e-83350c0ddcb6

Peak CCU 0

Traffic used 0%

ANALYZE MANAGE -/+ CCU

VOICE 20 CCU

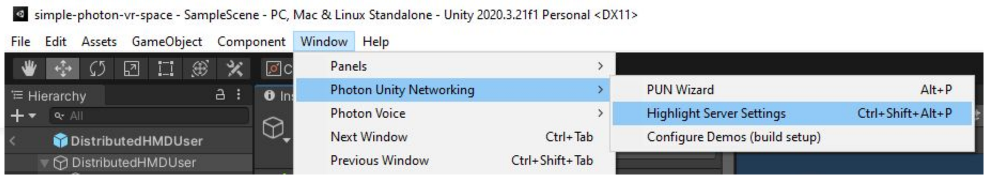
VR 2022 Final Project [Voice]

App ID: b61f25ae-1e73-4214-85db-456d2fff3a22

Peak CCU 0

Traffic used 0%

ANALYZE MANAGE -/+ CCU


simple-photon-vr-space - SampleScene - PC, Mac & Linux Standalone - Unity 2020.3.21f1 Personal <DX11>

File Edit Assets GameObject Component Window Help

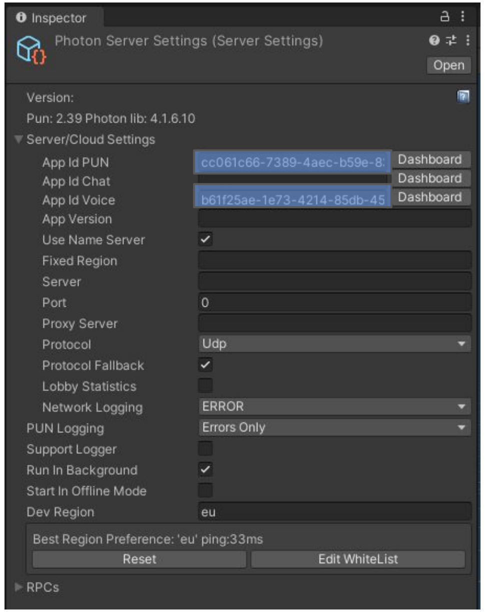
Hierarchy

DistributedHMDUser

DistributedHMDUser

Panels	>
Photon Unity Networking	>
Photon Voice	>
Next Window	Ctrl+Tab
Previous Window	Ctrl+Shift+Tab

PUN Wizard	Alt+P
Highlight Server Settings	Ctrl+Shift+Alt+P
Configure Demos (build setup)	


Inspector

Photon Server Settings (Server Settings)

Open

Version:

Pun: 2.39 Photon lib: 4.1.6.10

Server/Cloud Settings

App Id PUN	cc061c66-7389-4aec-b59e-8:	Dashboard
App Id Chat		Dashboard
App Id Voice	b61f25ae-1e73-4214-85db-45	Dashboard
App Version		
Use Name Server	✓	
Fixed Region		
Server		
Port	0	
Proxy Server		
Protocol	Udp	
Protocol Fallback	✓	
Lobby Statistics		
Network Logging	ERROR	
PUN Logging	Errors Only	
Support Logger		
Run In Background	✓	
Start In Offline Mode		
Dev Region	eu	

Best Region Preference: 'eu' ping:33ms

Reset Edit WhiteList

RPCs

Also, check out the official Photon documentation. The PUN Basics Tutorial is a great entrypoint to boilerplate code towards custom Serialization, RPCs and much more.