



AI for Testing: The Development of Bots that Play 'Battlefield V'

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GDC

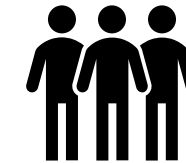
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Why?

- Fun & interesting challenges
- At capacity
- We need to scale



Why?

Battlefield V Multiplayer at launch

	Airborne	Breakthrough	Conquest	Domination	FinalStand	Frontlines	Team Deathmatch
Aerodrome		64	64	32	64	32	32
Arras		64	64	32	64	32	32
Devastation		64	64	32	64	32	32
Fjell 652		64	64	32	64	32	32
Hamada	64	64	64	32		32	32
Narvik	64	64	64	32		32	32
Rotterdam	64	64	64	32		32	32
Twisted Steel	64	64	64	32		32	32

Test 1 hour per level / mode – 2304 hours

A photograph of a server room with rows of server racks. The racks are filled with various electronic components, including circuit boards and modules. The room has a high ceiling with exposed ductwork and lighting fixtures. The perspective is looking down a long aisle between the racks.

Machines

Proof of Concept - MP Client Stability Testing Requirements



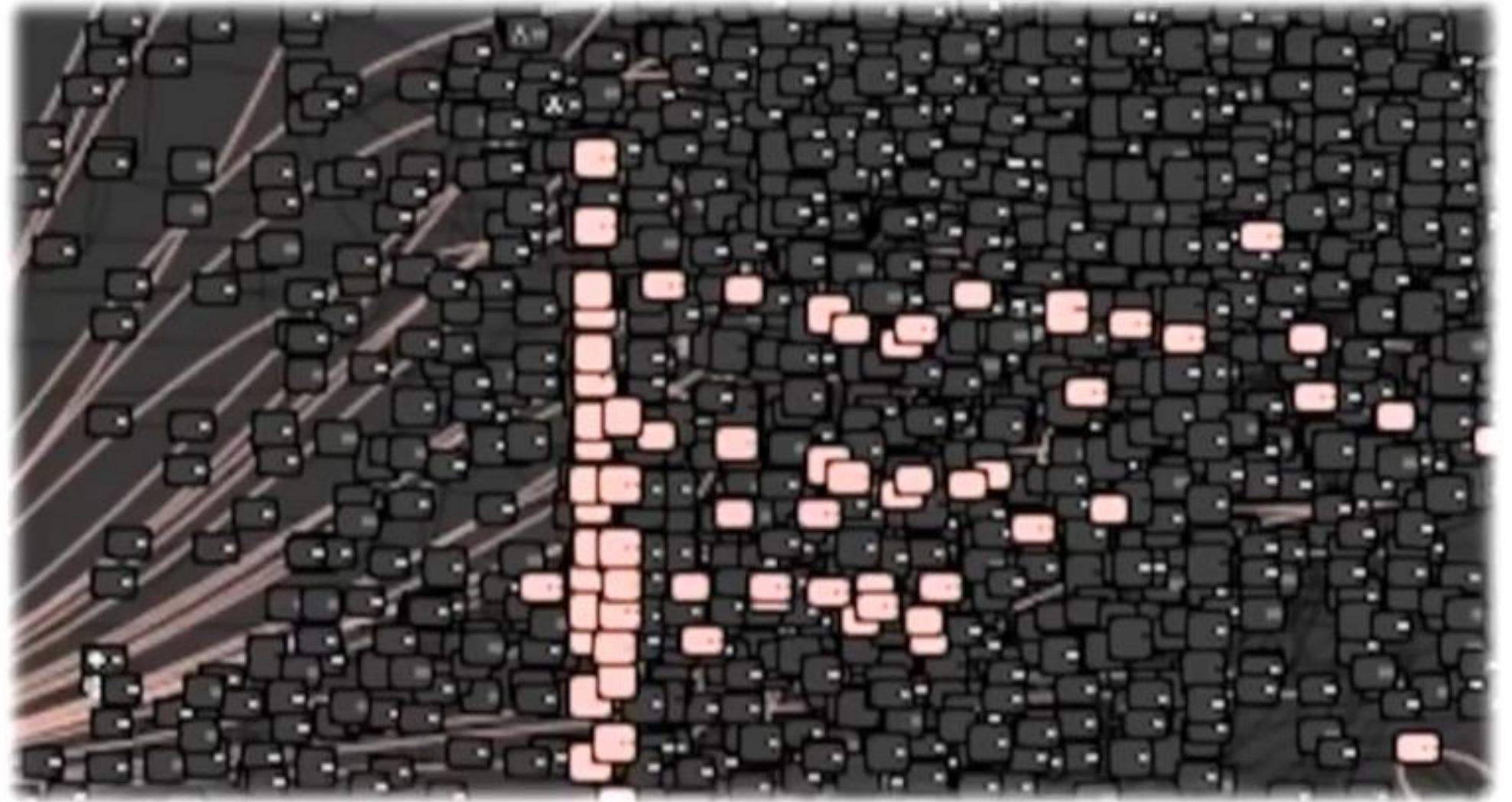
- All platforms
- Player similar
- Separate from game code
- No code required
- DICE QA Collaboration

Previously...

Technical Lead AI Programmer

Tom Clancy's The Division

Behavior Trees, server bots etc..



GDC 2016: Tom Clancy's The Division AI Behavior Editing and Debugging

Initial Investigation

- Reuse existing AI?
- Navmesh – Not used for MP
- Player scripting, input injection...
- Parallel implementation



Machine Learning?



Experimental Self-Learning AI in Battlefield 1

Implementation

Functionality

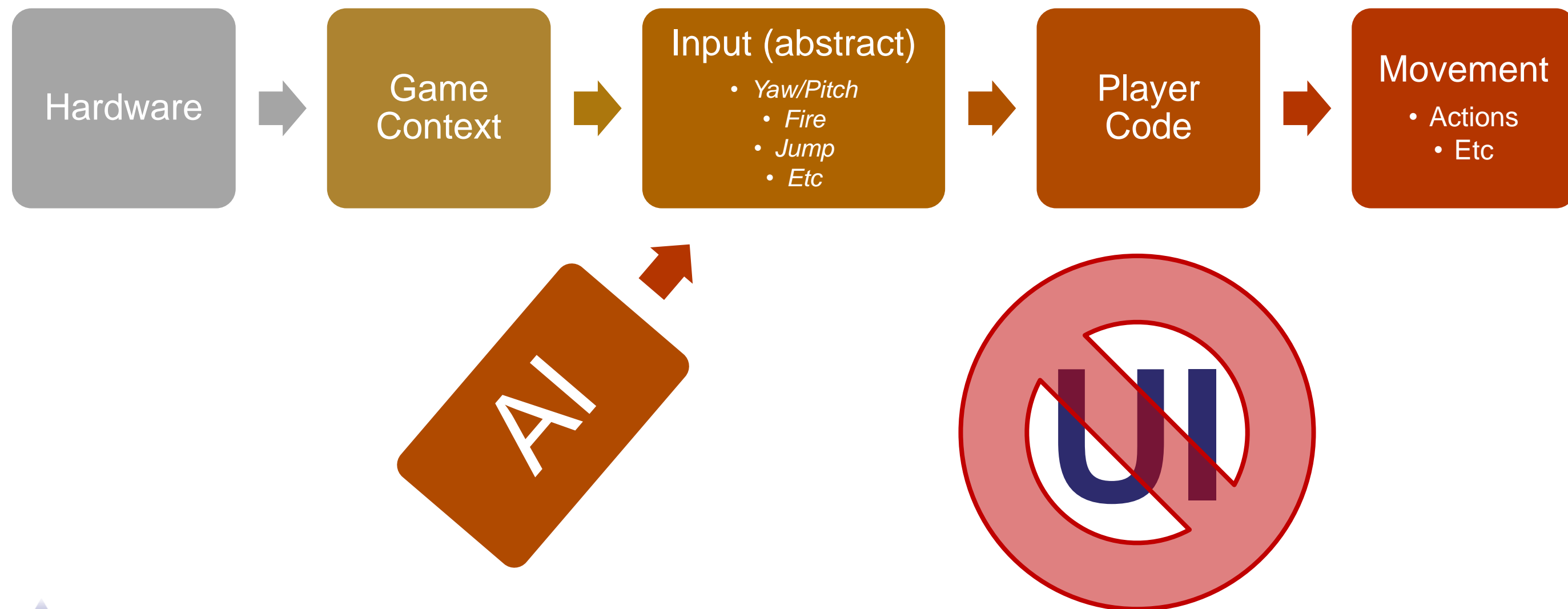
Fun

Fidelity

Single Client Control



Inputs?



Combat

- Weapon data=>Behavior
- Simple representation
- Closest target only
- Very cheap – good enough
- Blacklist invalid targets



Navigation

- Server Pathfinding
- Not to be trusted
- Monitor progress
- No progress
- Button Spam (Jump, interact, open door)

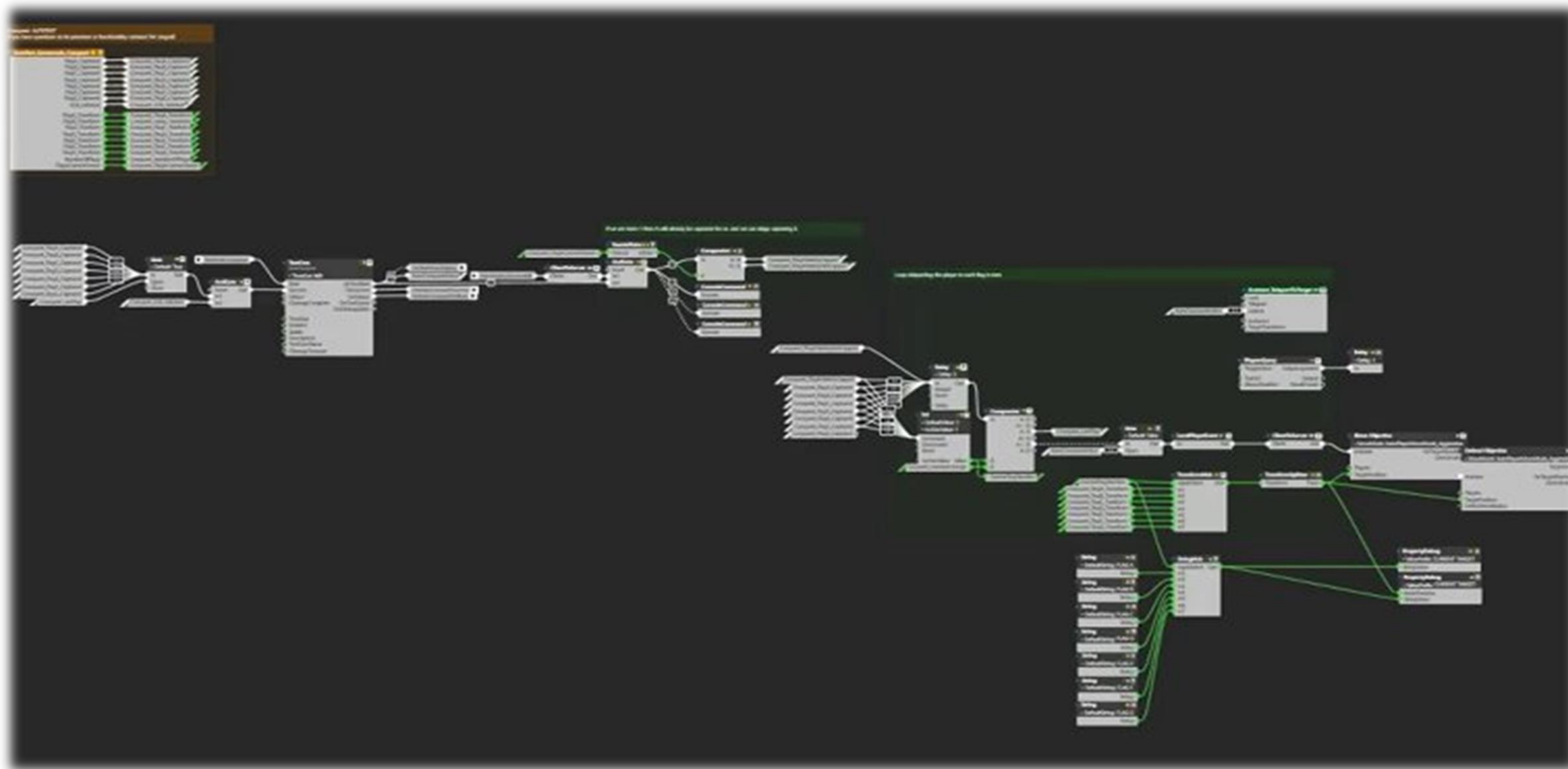


Navigation

- Server Pathfinding
- Not to be trusted
- Monitor progress
- No progress
- Button Spam (Jump, interact, open door)
- Still stuck - Teleport



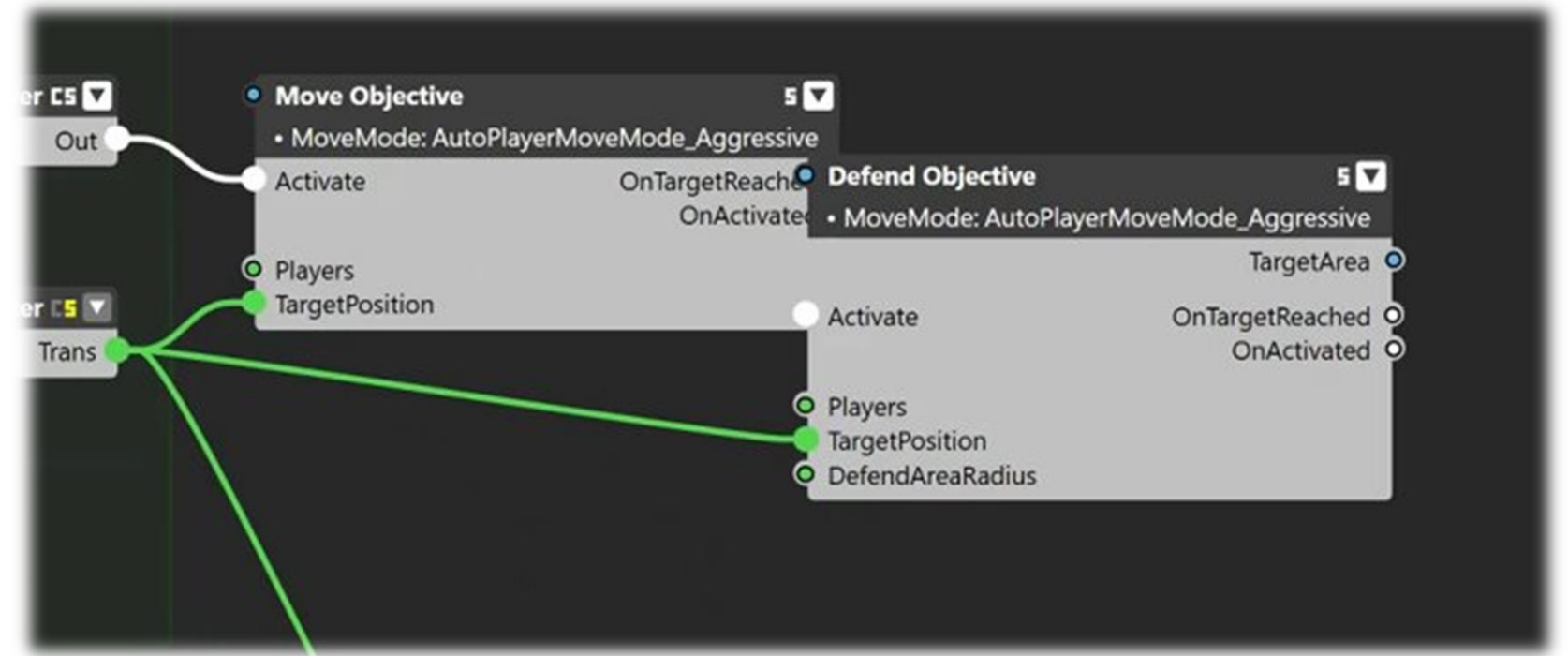
Visual Scripting – Frostbite Schematics



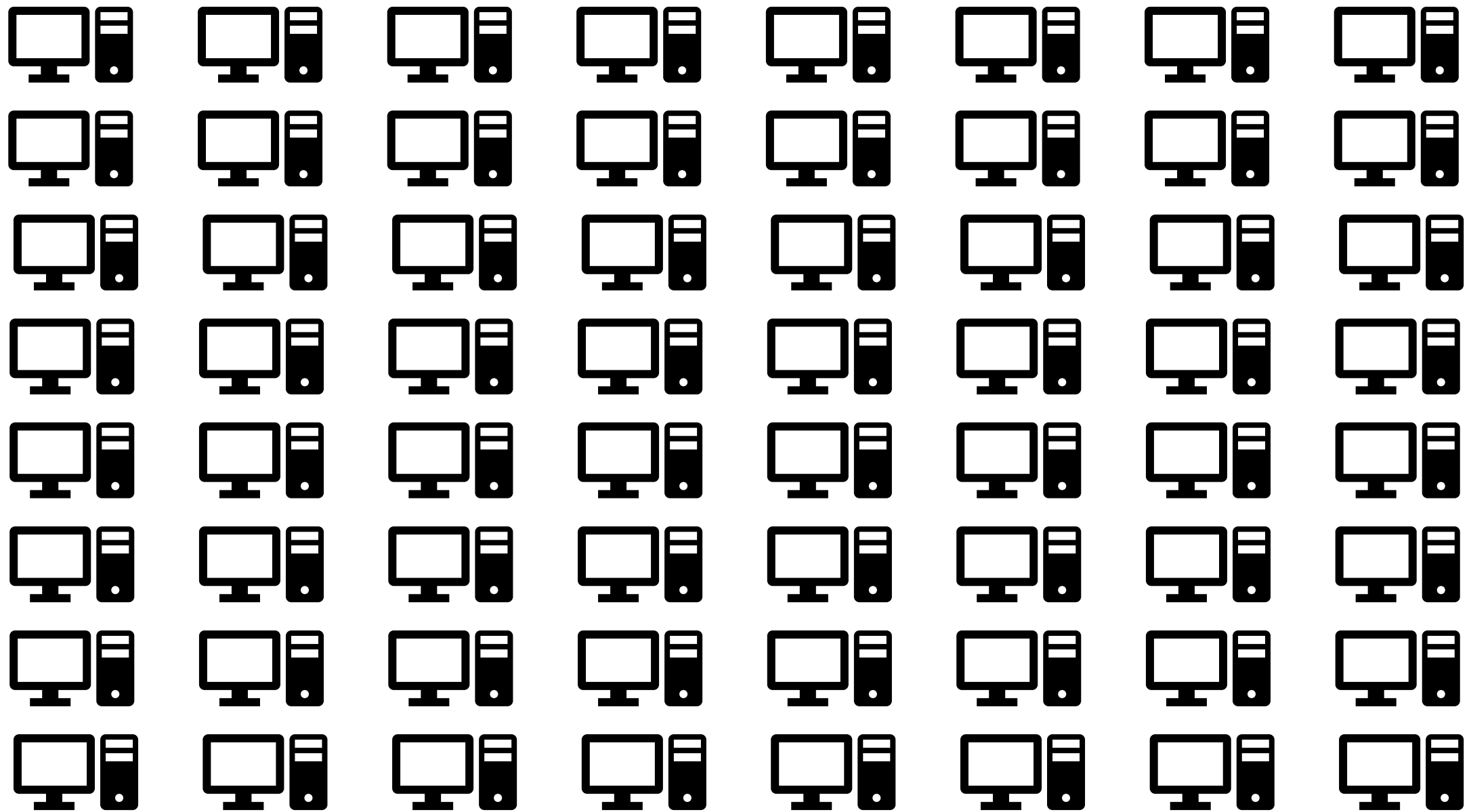
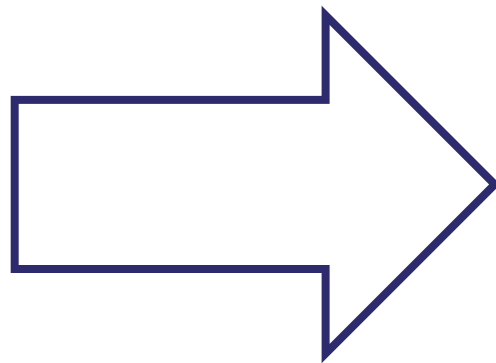
AutoPlayer Objectives

Objective Parameters

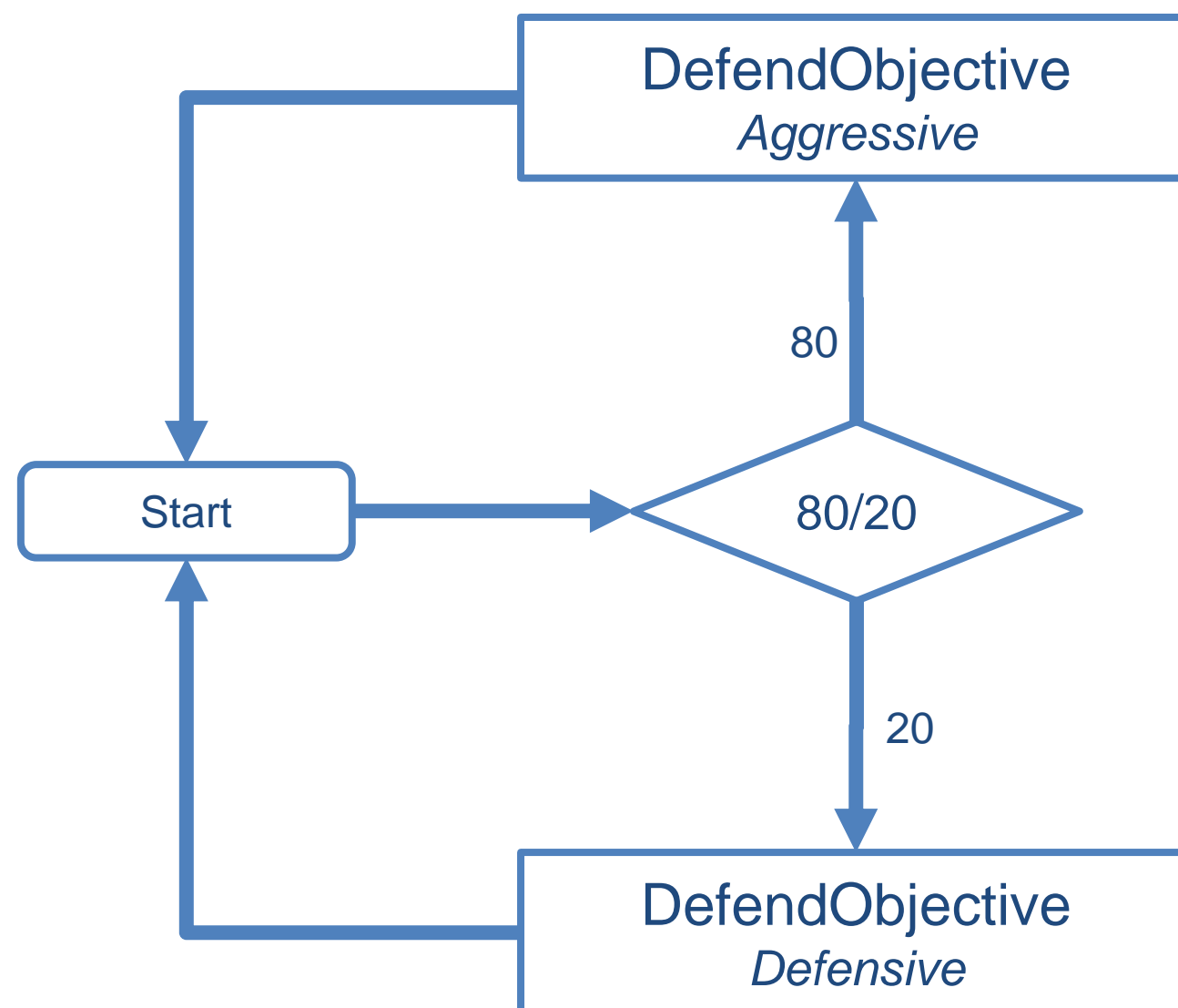
- MoveMode
 - Aggressive: Chase everything
 - Defensive: Keep moving – shoot if able
 - Passive: Stay on path – ignore all
- Other Parameters:
 - Unlimited Ammo
 - GodMode
 - Teleportation...



Scaling up



Conquest AutoPlaytest



525,1057,108.161,-240.29/
get: CharacterSpawnReferenceObjectData[0EDF3399-E007-440E-B422-D7263E3FEF23] (ClientCharacterSpawnEntity)/SoldierEntityData[5FB33F98-E1D7-45B0-A7F0-B9E2F25D0590] (ClientSoldierEntity)
ry veh>
n: artassets/architecture/arctic_house_01/arctic_house_01_Mesh(ClientBreakableModelEntity)
Mt1Dec1(P:0 M:0 F:0x800)
MManager.EnableLookups=true for proper names
ualEnvironment Levels/MP/MP_ArcticFjord/Lighting/VE_MP_ArcticFjord_Base_01 force override active!
MManager.EnableLookups=true for proper names



Increased Coverage Tanks & Airplanes



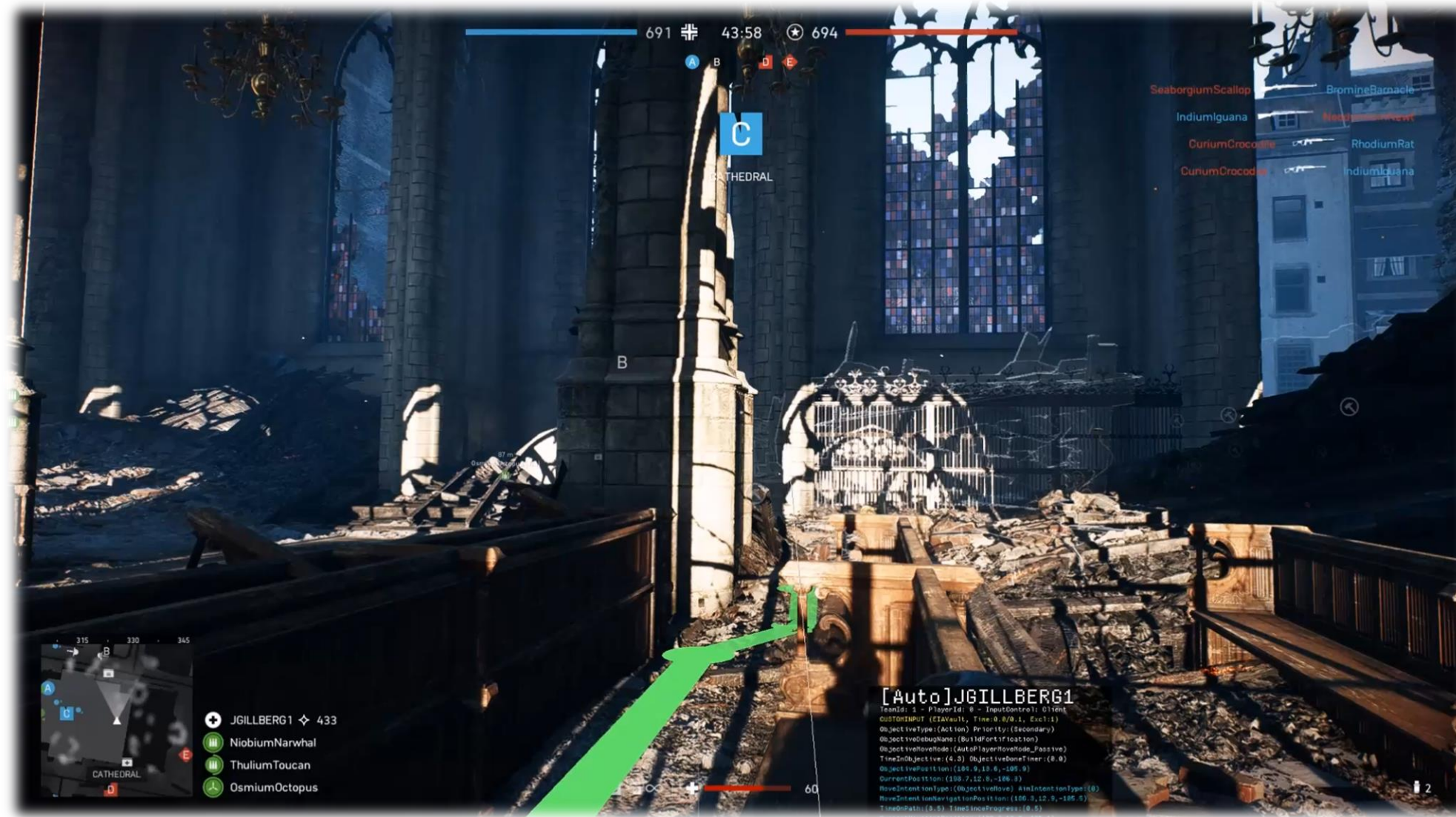
Increased Coverage

Primary & Secondary Objectives

- Primary Objectives
 - Loops until cancelled
 - Drives the Game mode
- Secondary Objectives
 - Temporary
 - Additional coverage and contextual actions

Secondary Objectives

Example 1: Fortifications



Secondary Objectives

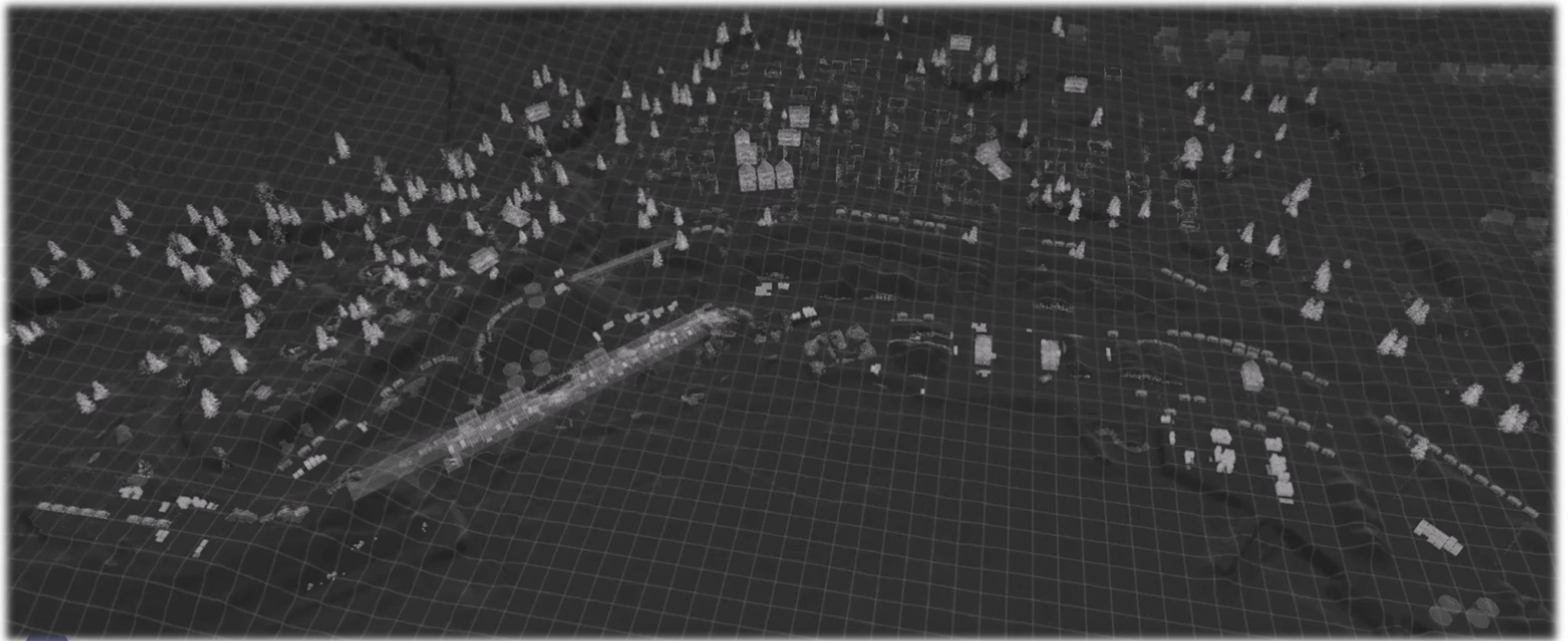
Example 2: Blow things up



View from above

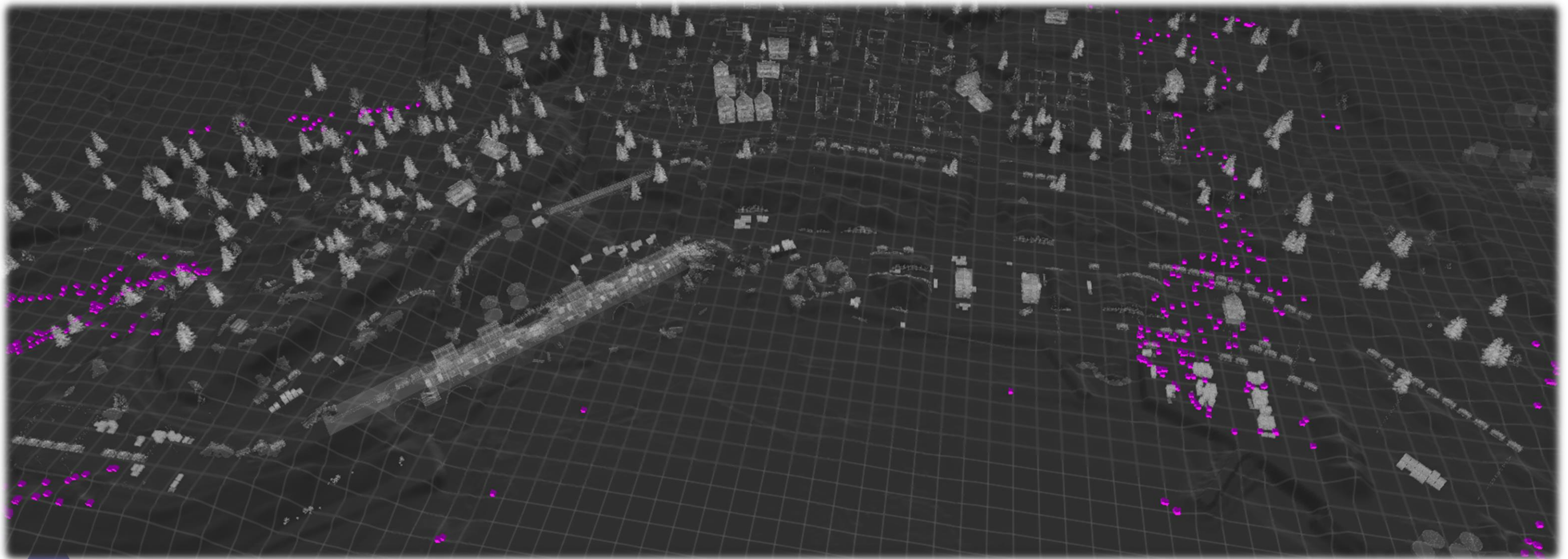


Validation - Telemetry

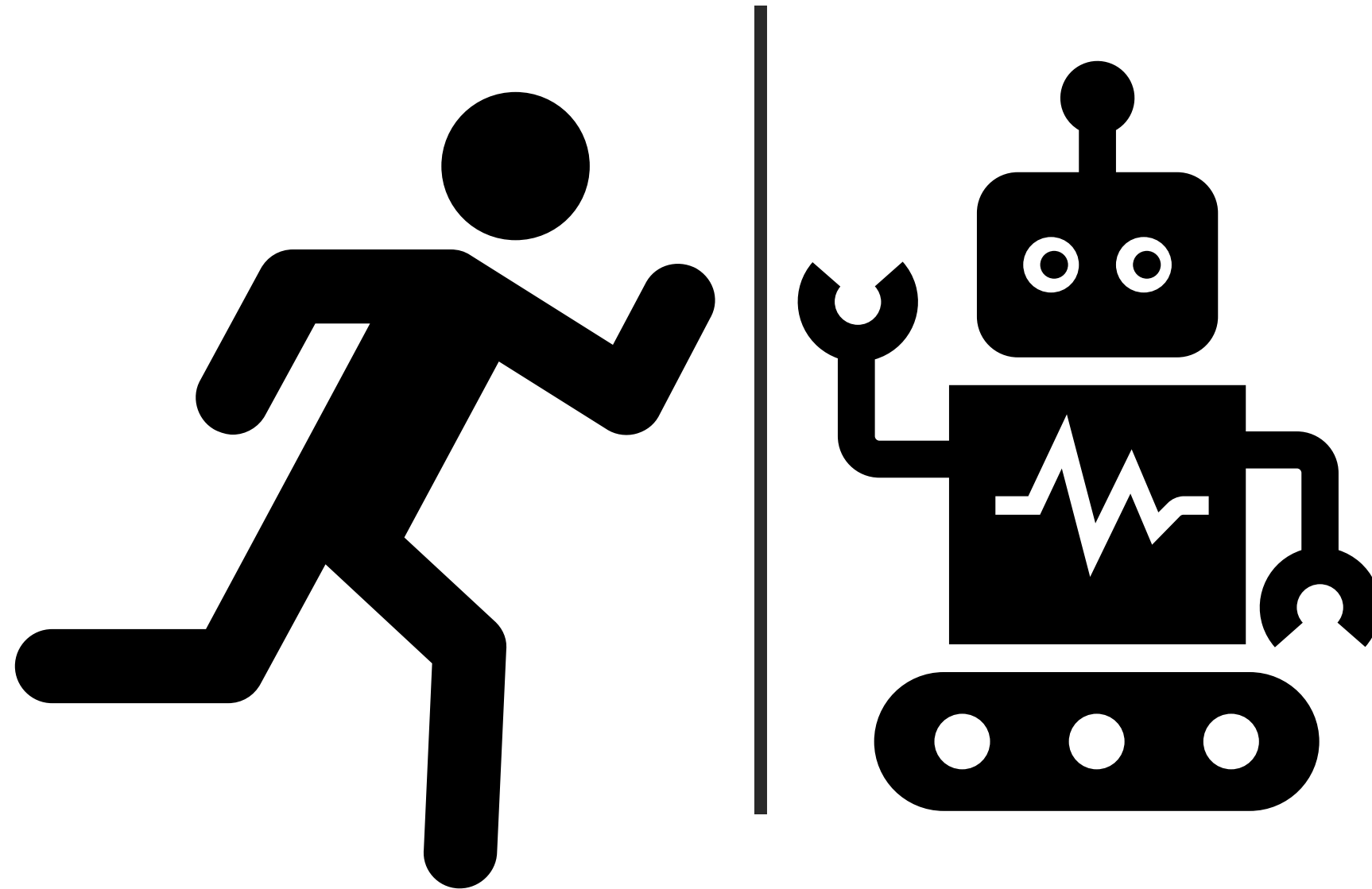


Validation – Telemetry

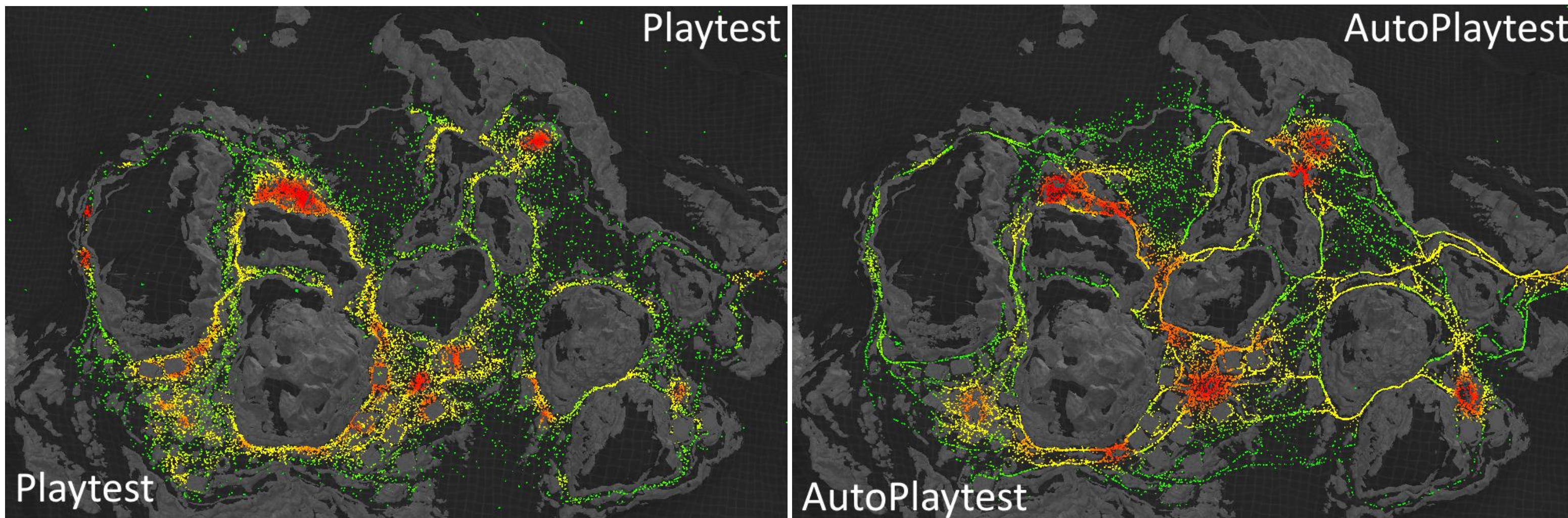
Example: Out of bounds

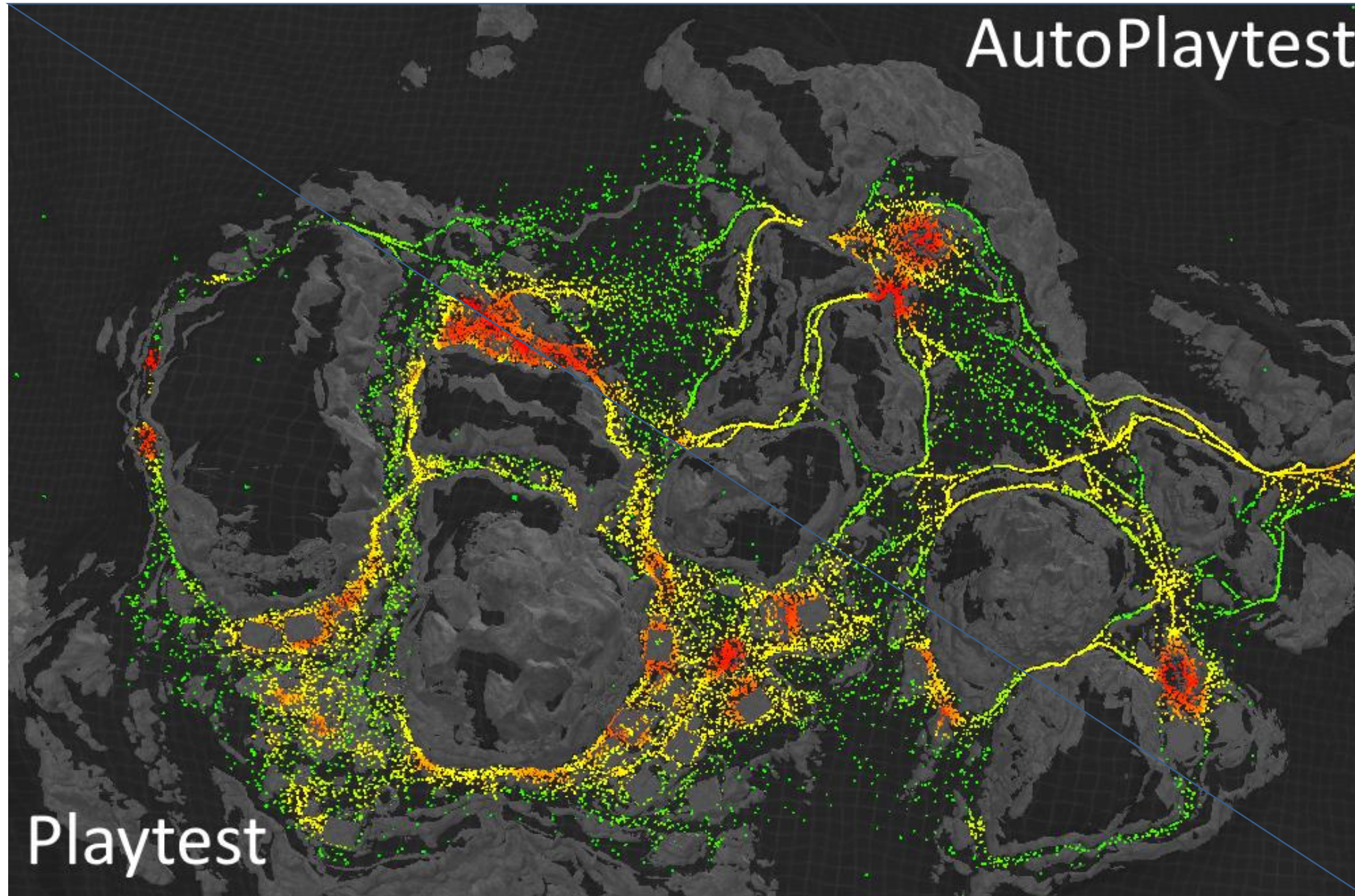


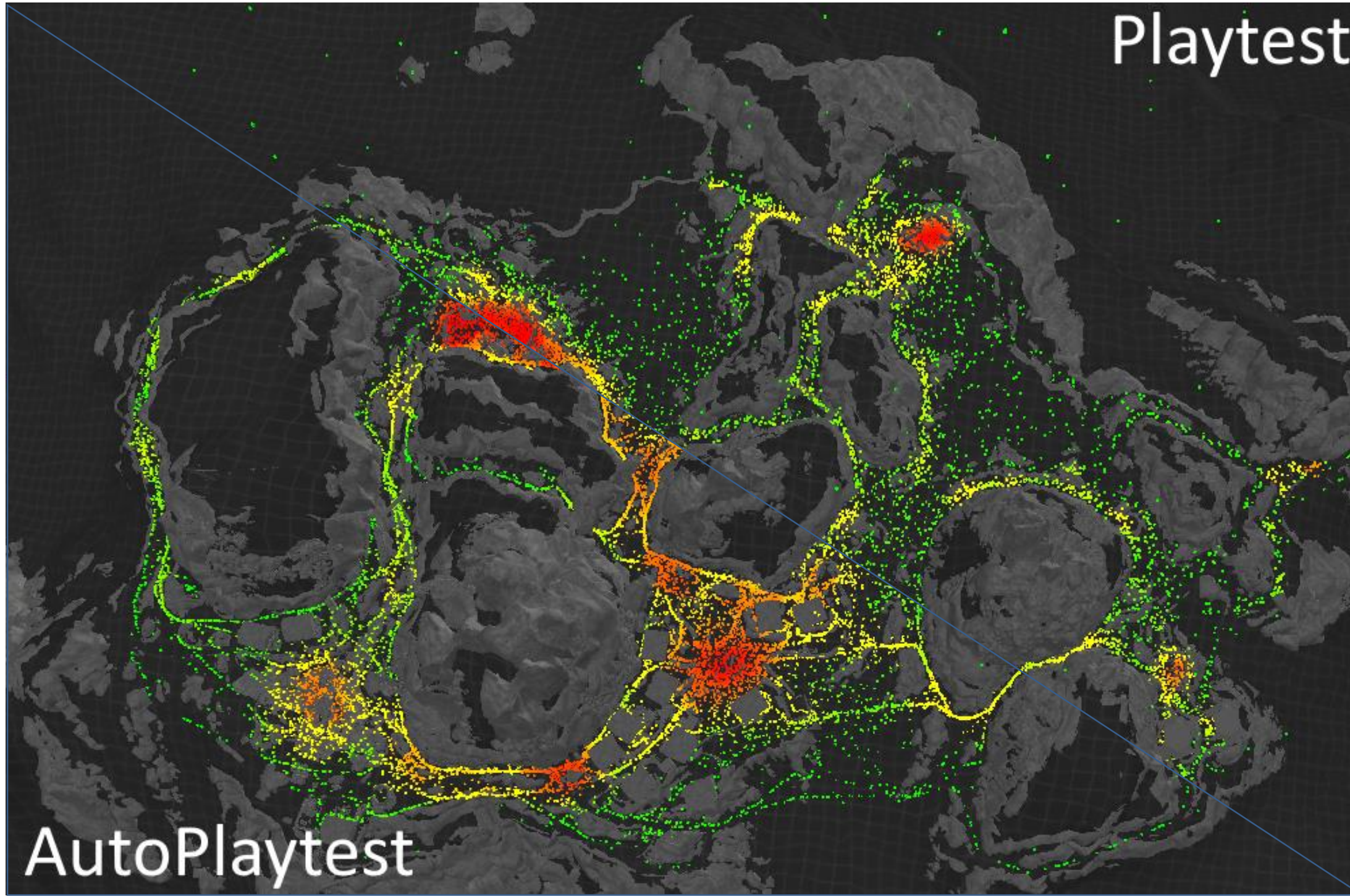
Validation – Mirror Tests



Validation – Mirror Tests



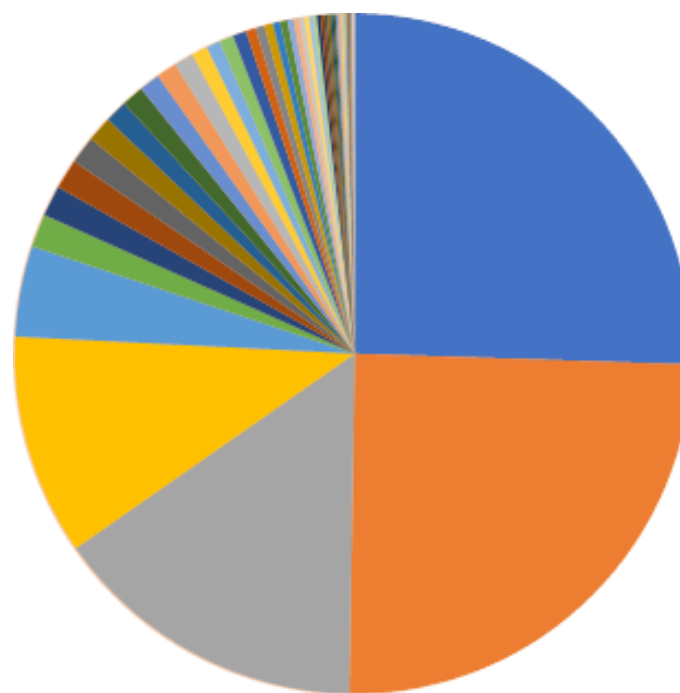




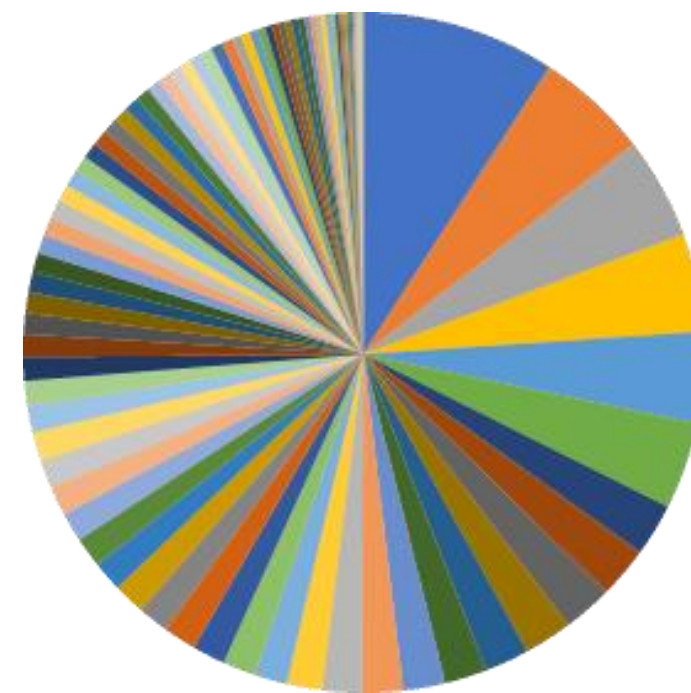
Validation – Telemetry Example

Spawning & Customization

- Random Class
(Medic, Assault etc)
- Default/Random
Customization
- Re-randomization
chance on respawn

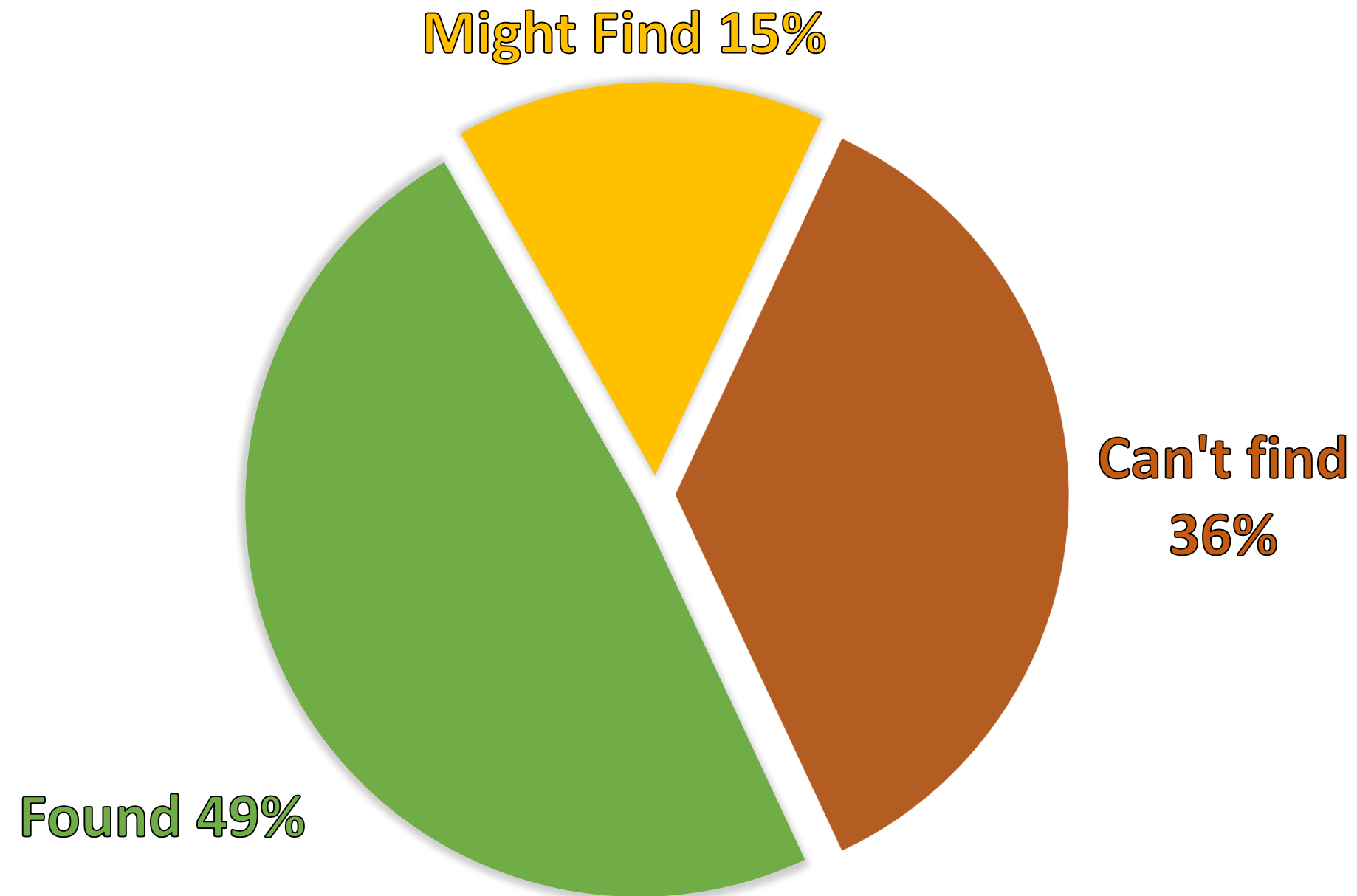


PlayTest
Kill distribution

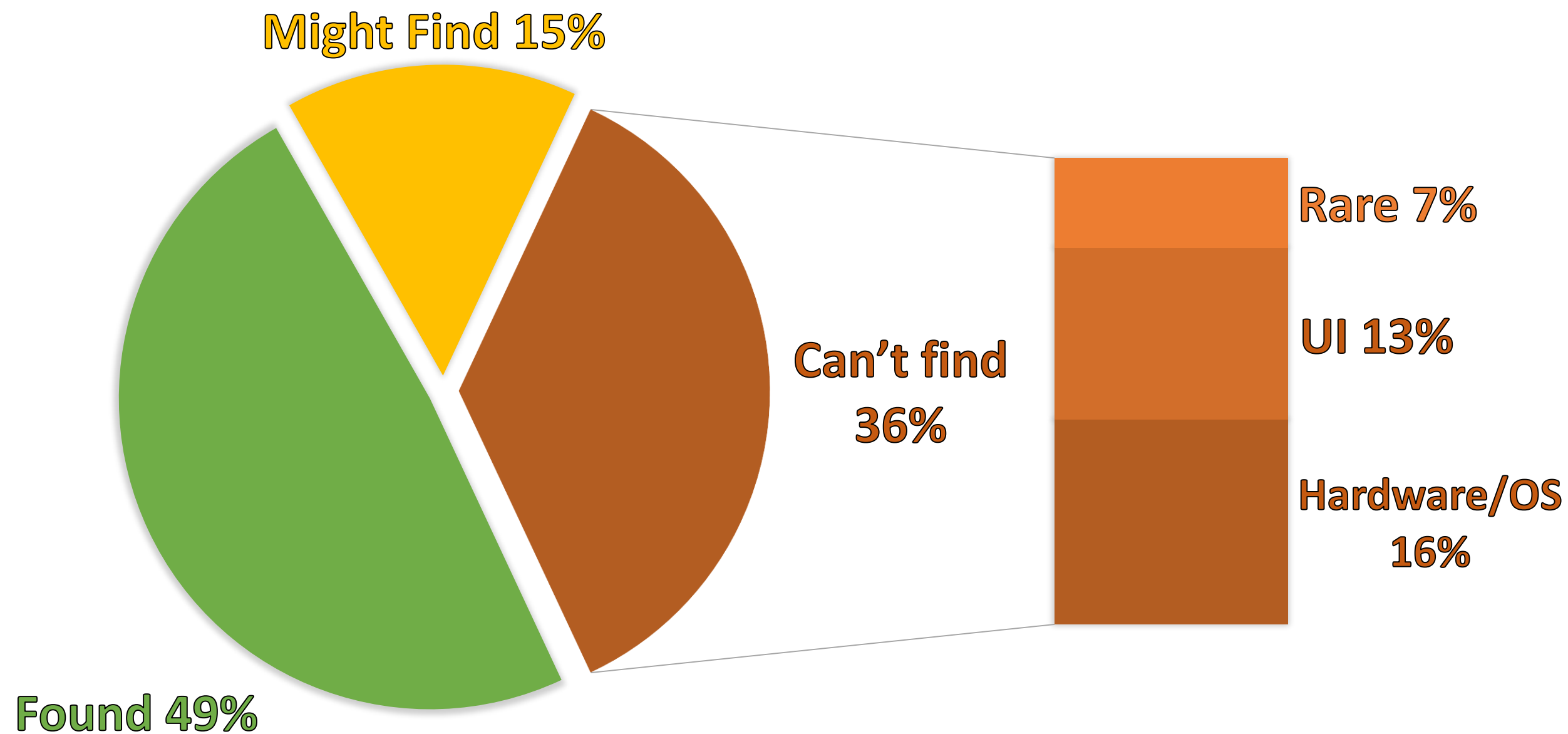


AutoPlayTest
Kill distribution

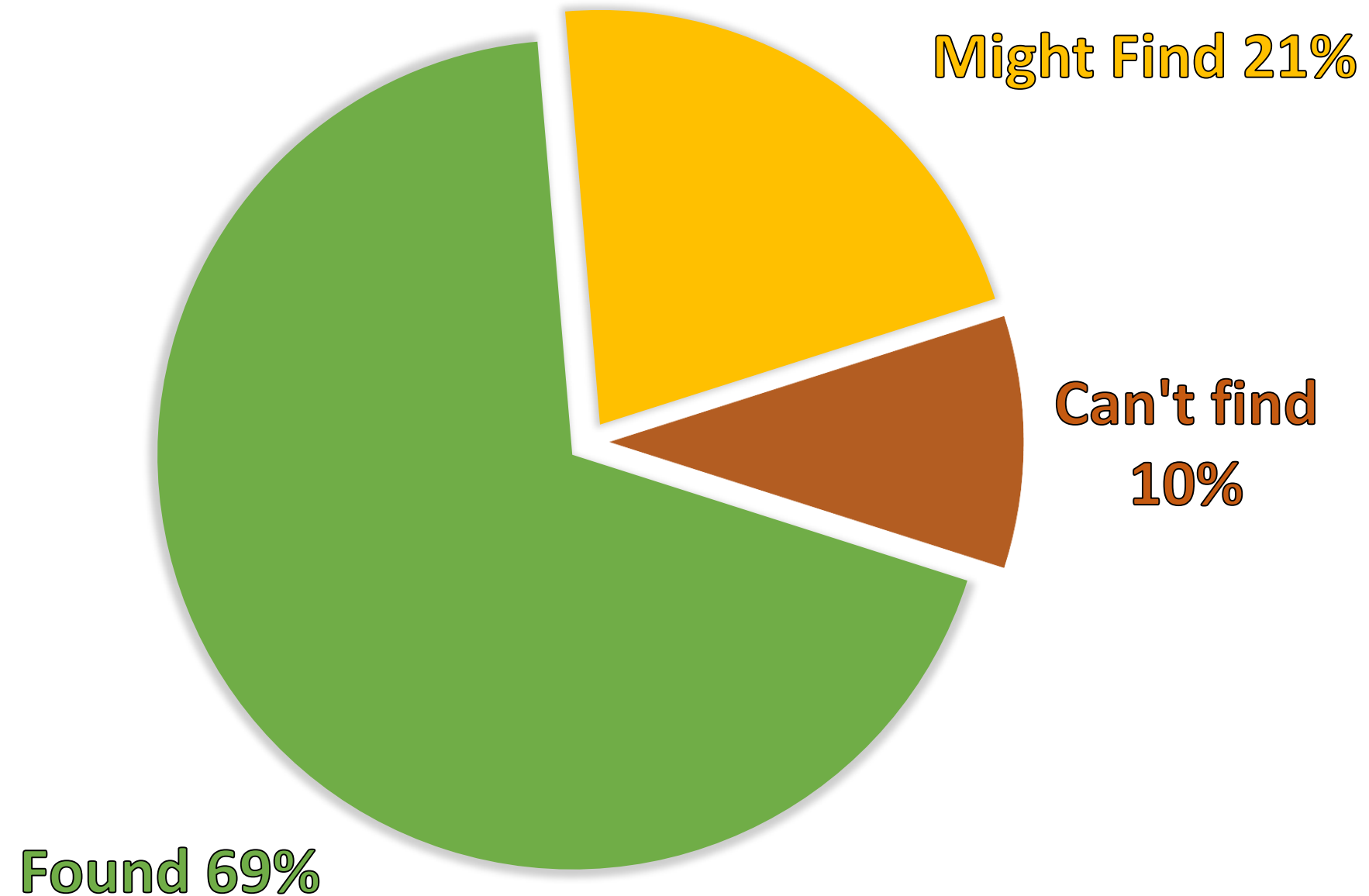
Validation – Crash Investigation



Validation – Crash Investigation



Validation – Crash Investigation

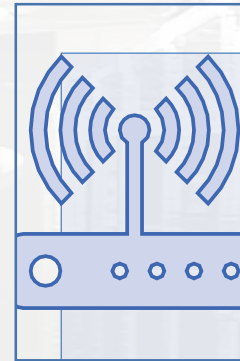






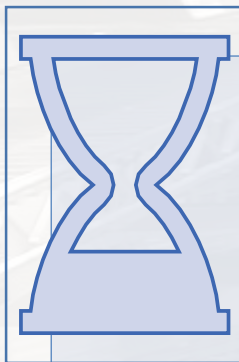
601

BFV Game mode & Feature test cases



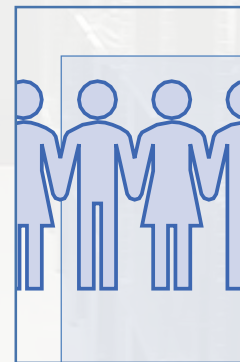
330

Hours run all tests on all platforms

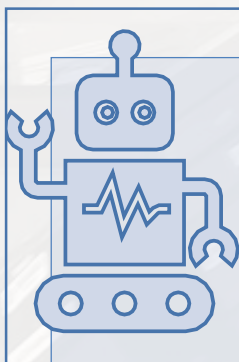


>1/2 Million

BFV Automation Hours

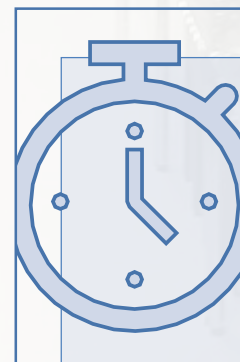


~300 work-years



178

AutoPlayer test cases



>50% of the time

Honorable mention: AFK Takeover



Other Use Cases

Use Case - MP Client Testing – Performance

- Early Adopter
- Flythrough – AutoPlaytest
- Humanless testing
- Profile Guided Optimization



Use Case – At desk MP Testing

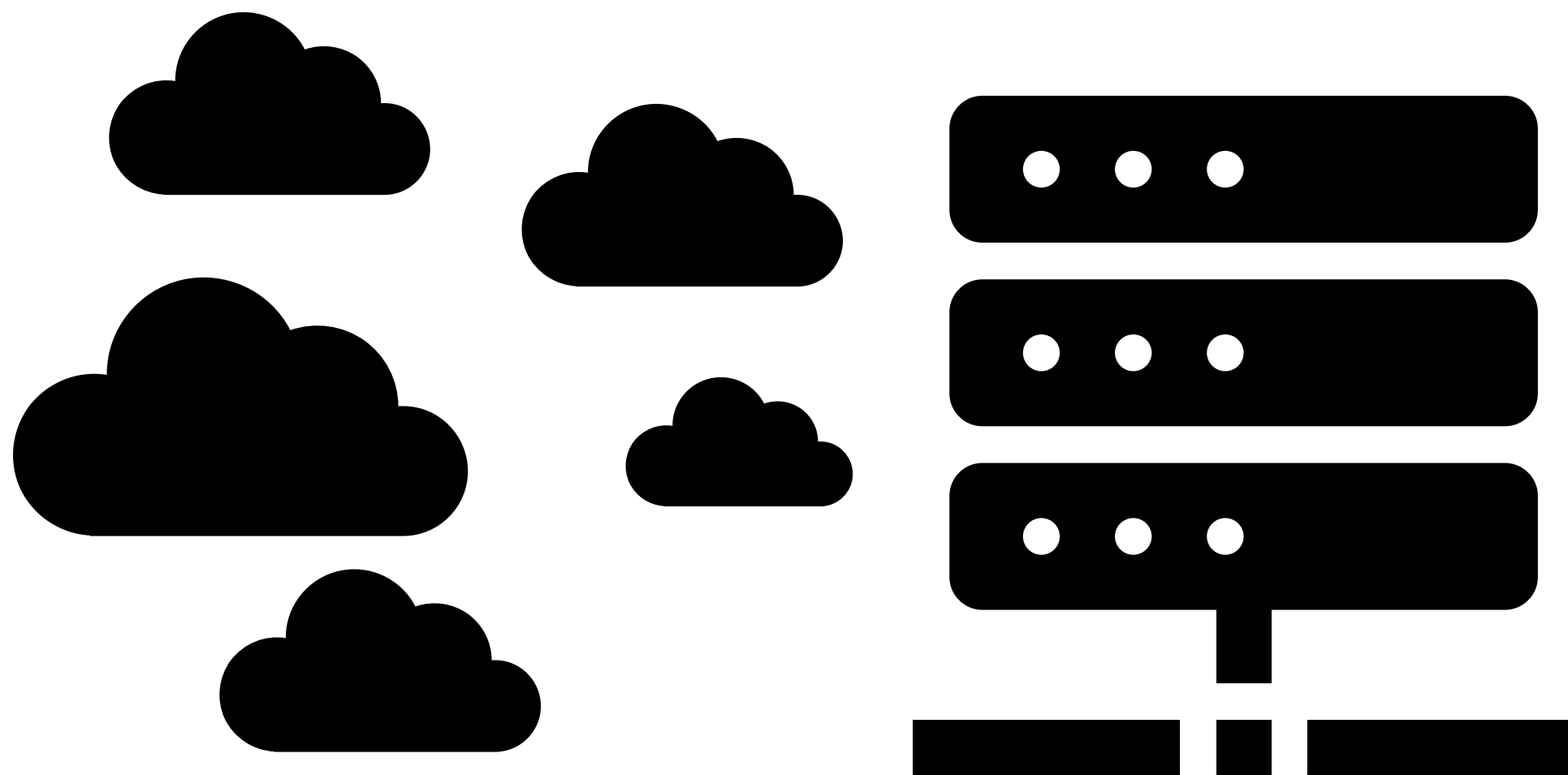
- Easy local testing
- Minor playability tweaks
- Fill servers (some cases)



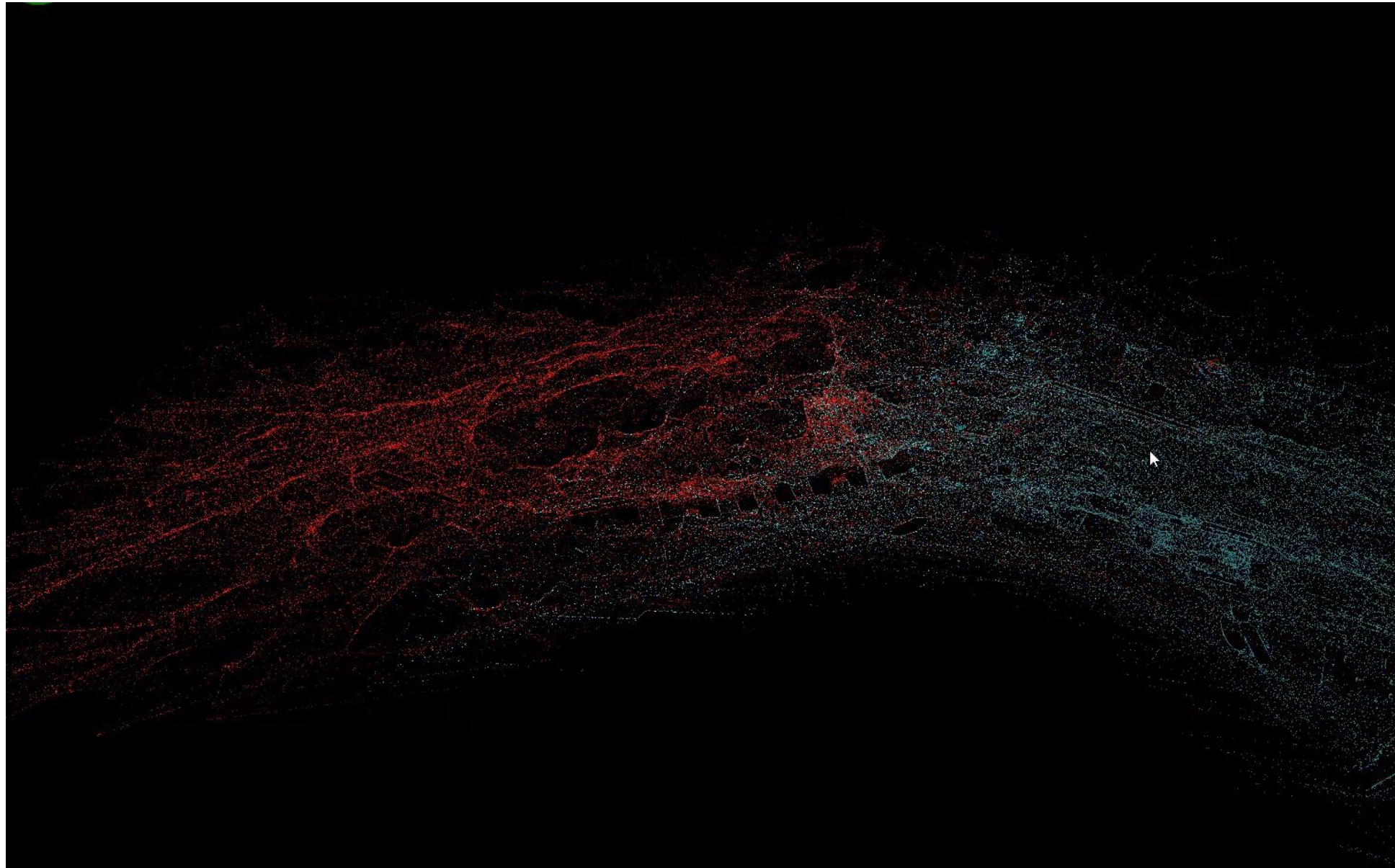
Use Case - SP Client Testing

- Scripted Playthrough
- Augment existing
- More resilient
- Closer to reality

Use Case - MP Server Testing



Use Case - Map Integrity Testing

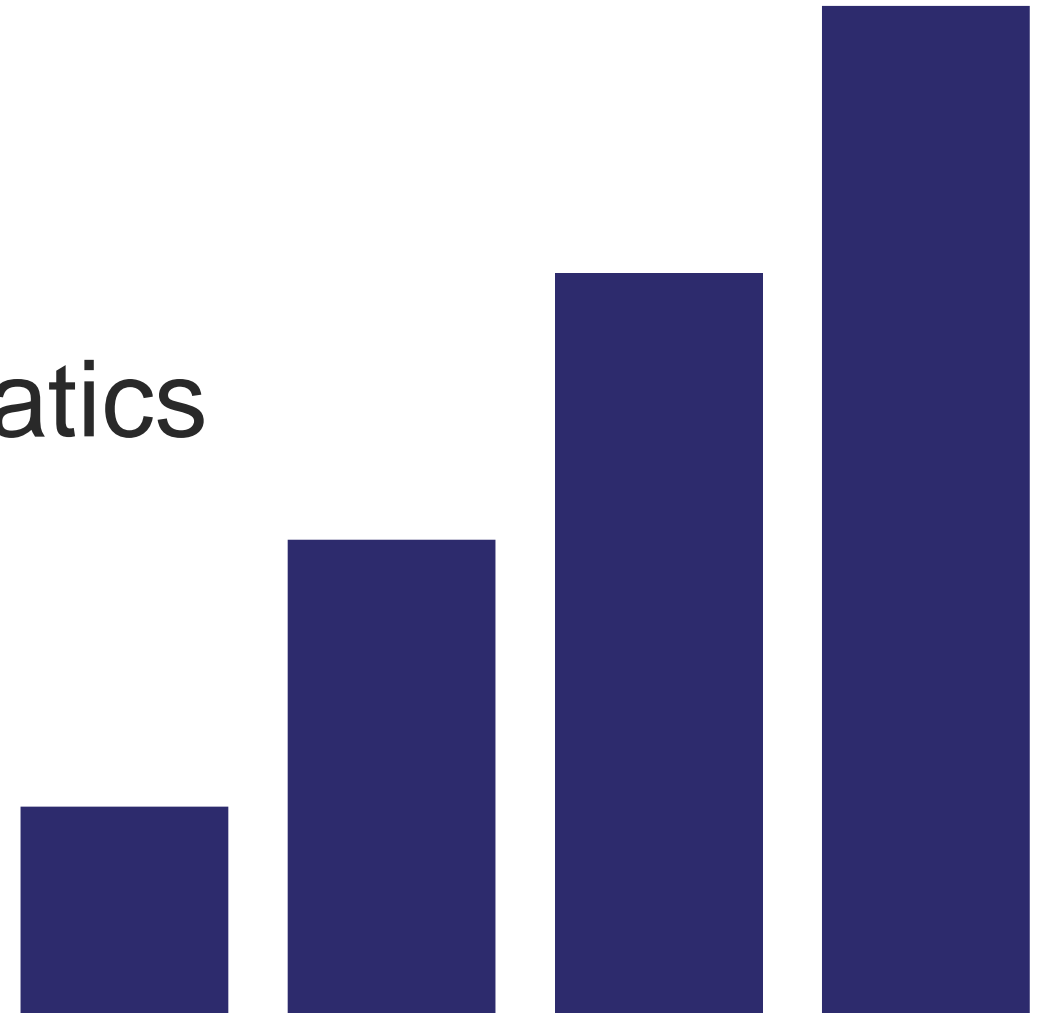


Use Case – Independent Hardware Vendors & Tech Partners



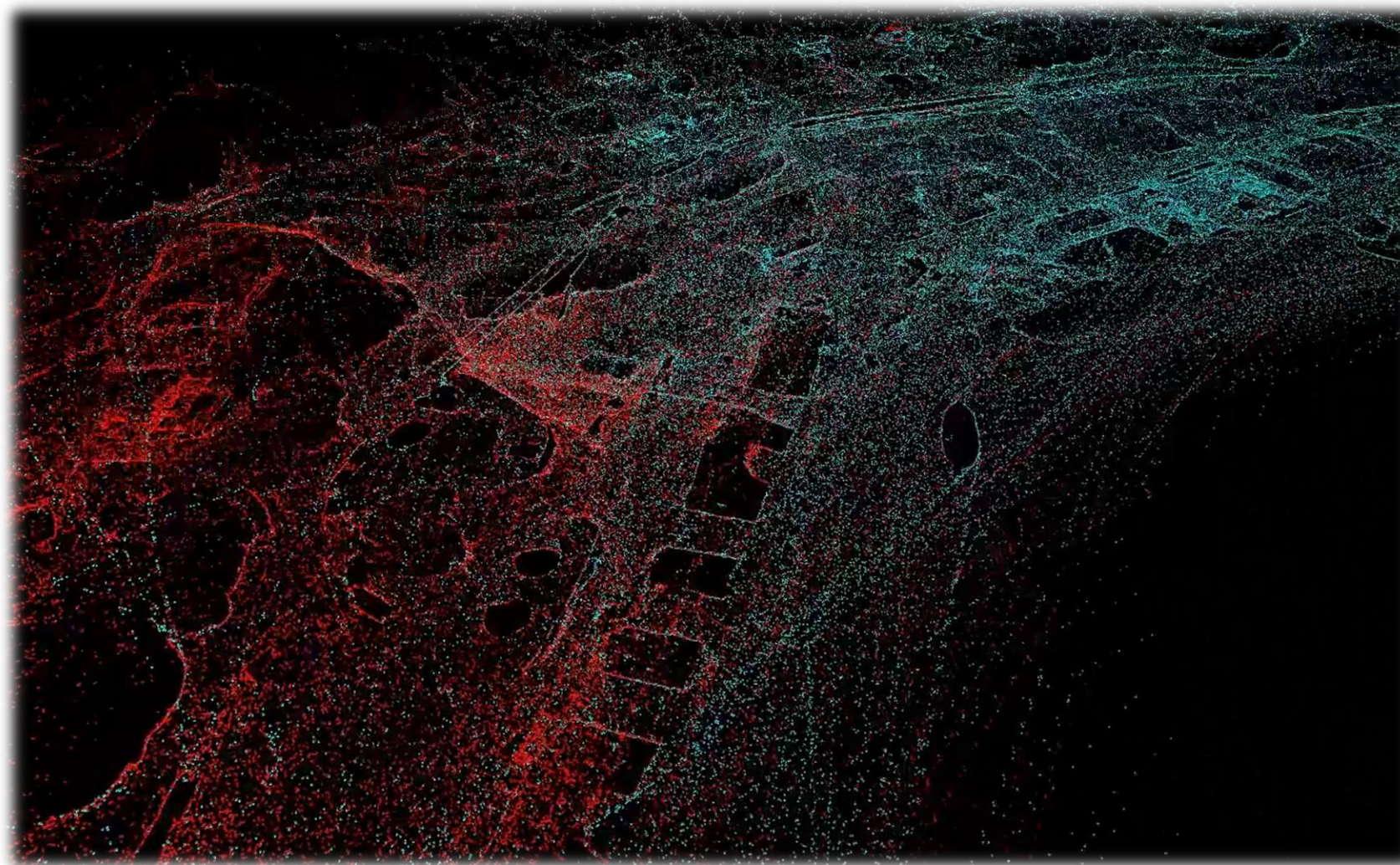
Conclusions

- Scaling problem addressed
- Empowered users using Frostbite Schematics
- Surprisingly simple behaviors required



Just the beginning...

- Explore
- Expand
- Exploit







Thank you!

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