A large, blue, elephant-like creature with a harness is being pulled by a group of people in a dark, forested environment. The creature is moving towards the left, and the people are pulling it with ropes. The scene is dimly lit, with a bright light source in the background creating a strong glow.

LIVING IN PROCEDURAL WORLDS: CREATURE MOVEMENT AND SPAWNING IN NIGHTINGALE

GDC

PRESENTATION BY: ARTA SEIFY & NATHAN STURTEVANT

INFLEXION GAMES



OVERVIEW

- Introduce Nightingale
- Navigation technology
 - Abstract Graph
- Making the realms feel alive
 - Using K-means clustering



TAKEAWAYS

- Adding an Abstract graph on top of Recast enables:
 - Longer distance pathfinding with terrain preferences
 - More efficient custom queries
 - Find closest unit
 - Connectivity Graph (Connected Components)
- Use K-means clustering to evenly distribute creature population in 3D space











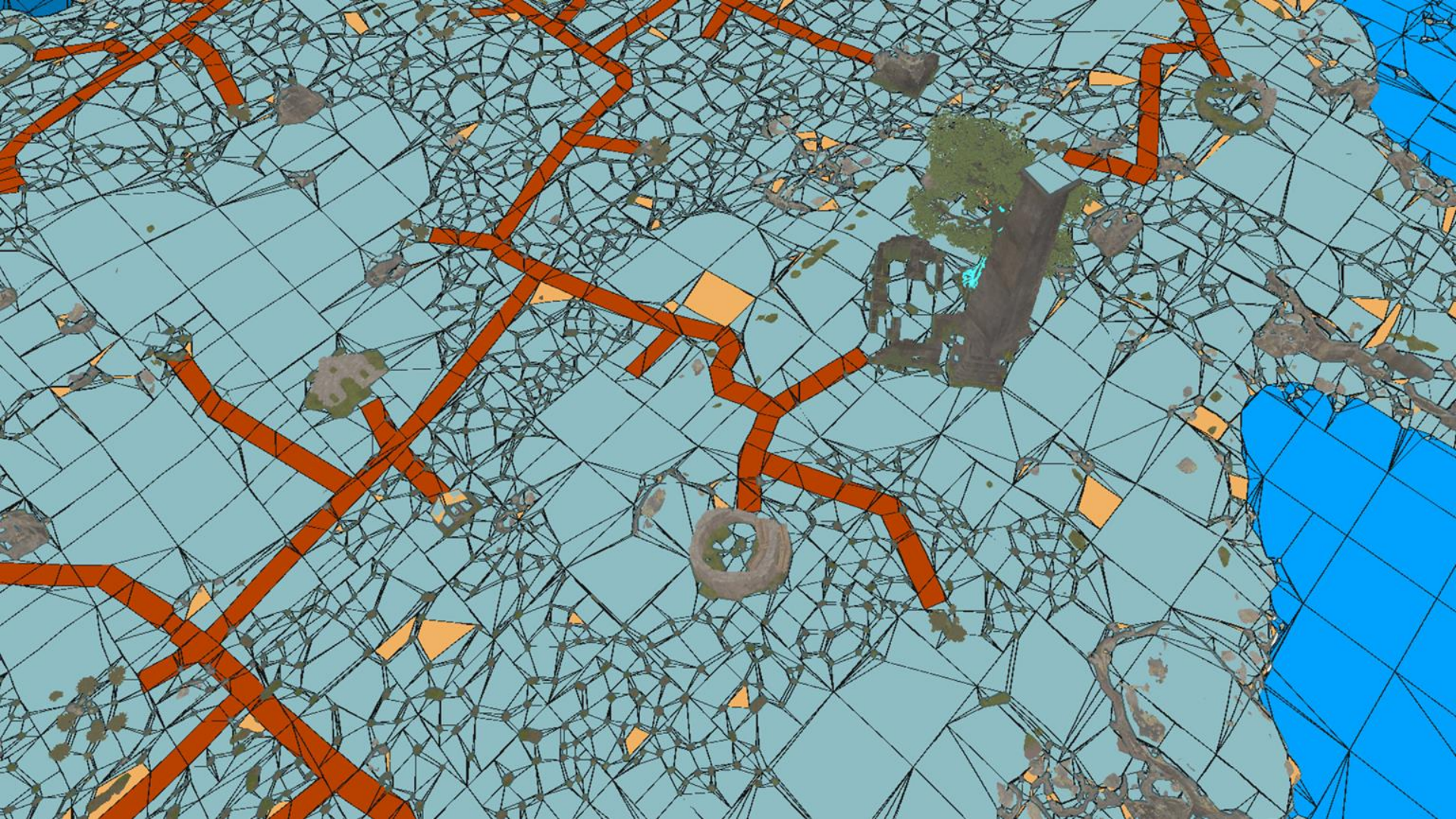




NAVIGATION SYSTEM

An efficient navigation technology will enable fun gameplay opportunities





NIGHTINGALE NAVIGATION OVERVIEW

- Unreal's Recast
 - Supports all of our requirements
 - Not efficient for many of our use cases
- Custom Tech: **Abstract Graph**
 - Built directly on top of Recast
 - Supports various gameplay needs
- Some of the work published in AIIDE 2019 conference:
“Pathfinding and Abstraction With Dynamic Terrain Costs”
 - Authored by Nathan Sturtevant in collaboration with the Inflexion team



BENEFIT: TERRAIN PREFERENCES

Recast/UE5
Abstraction

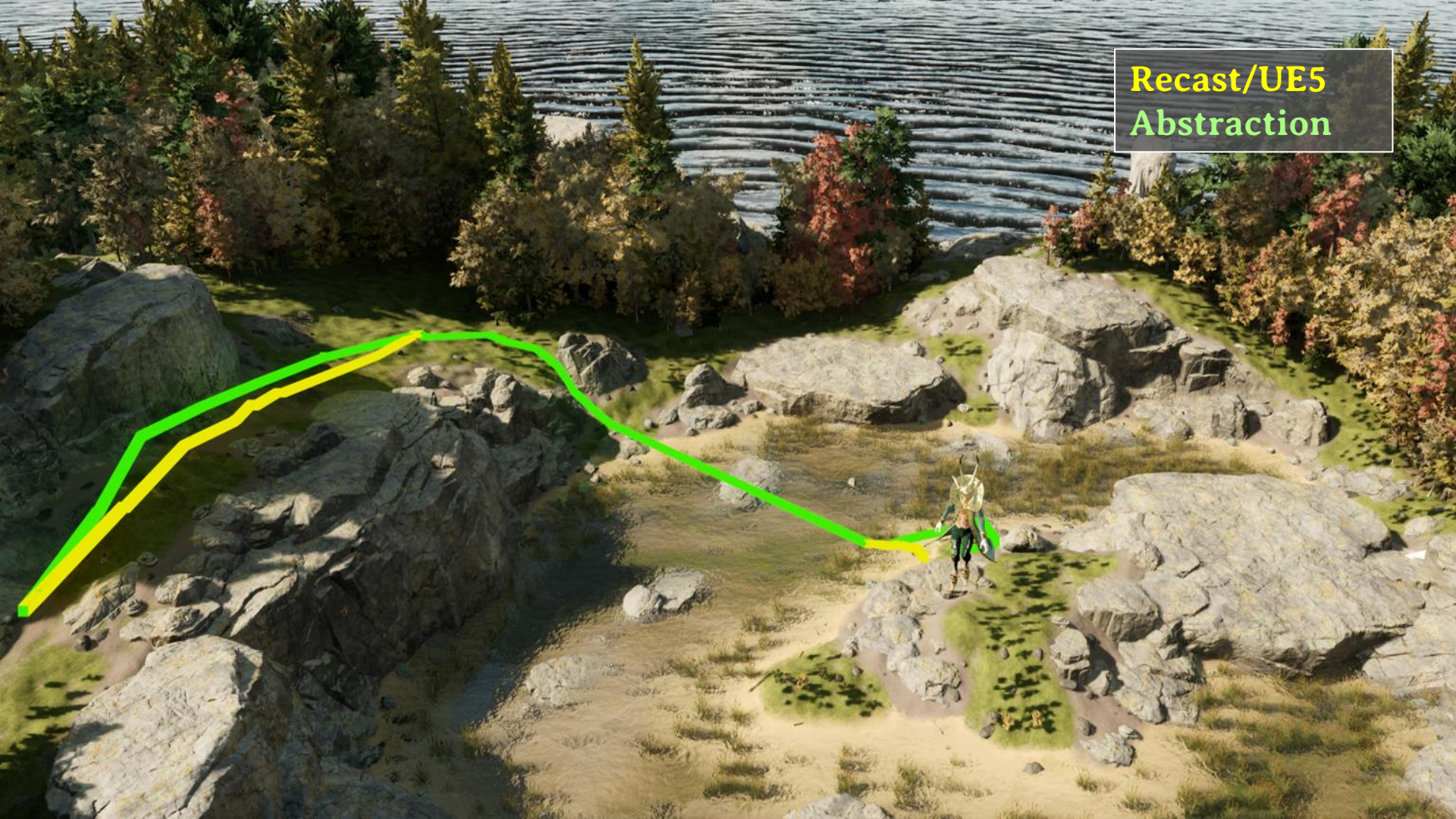


Recast/UE5
Abstraction

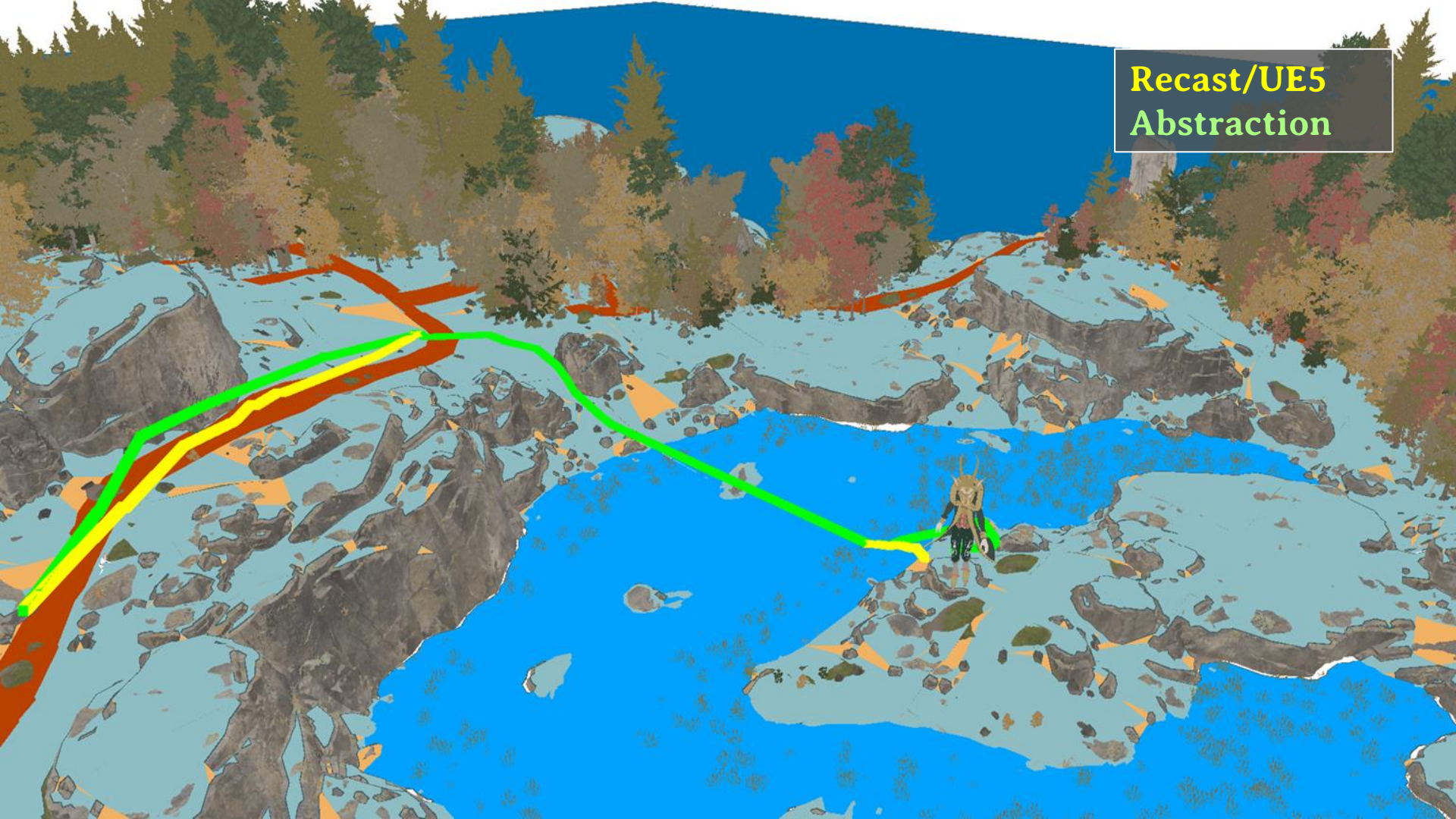




Recast/UE5
Abstraction



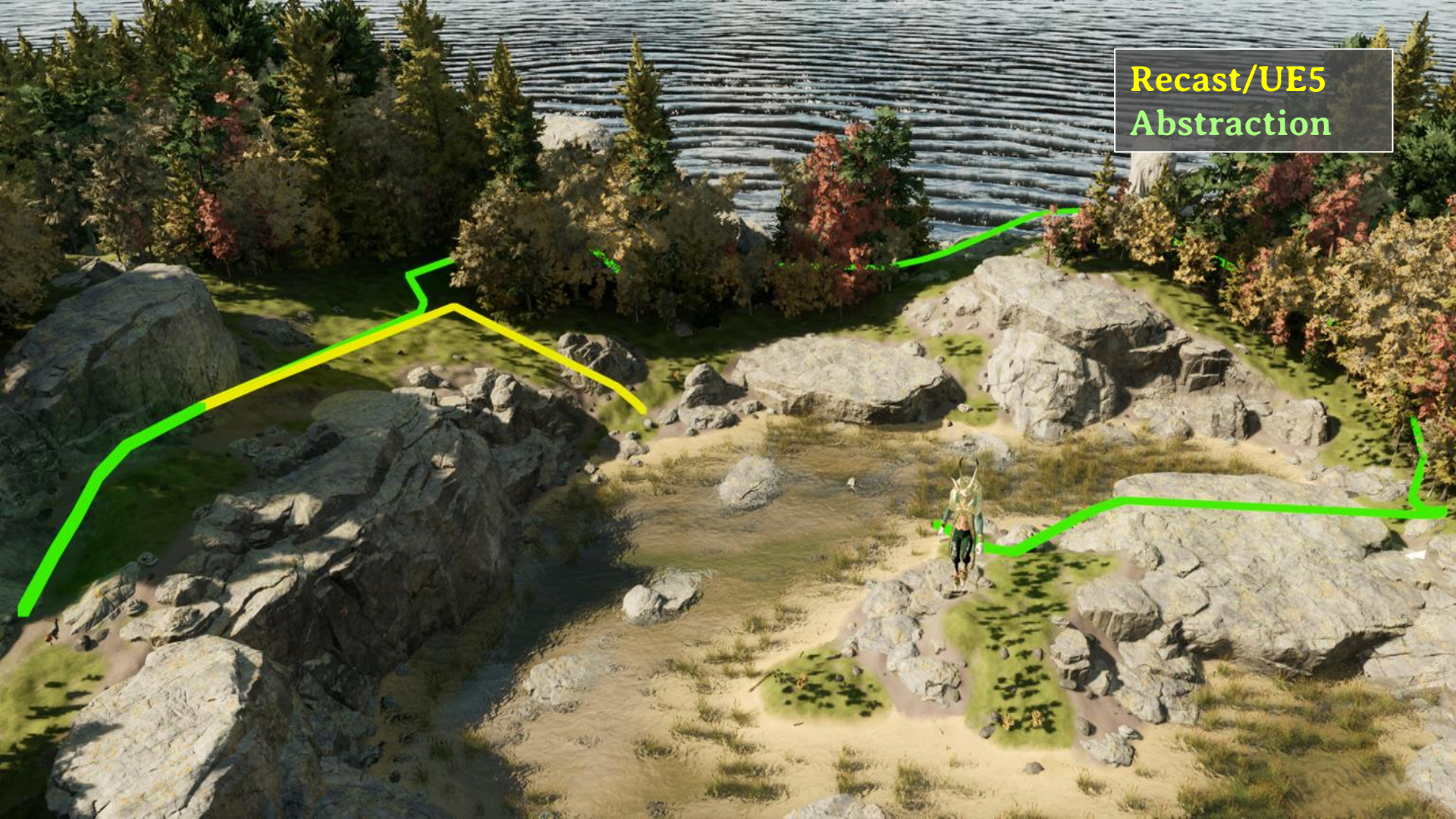
Recast/UE5
Abstraction



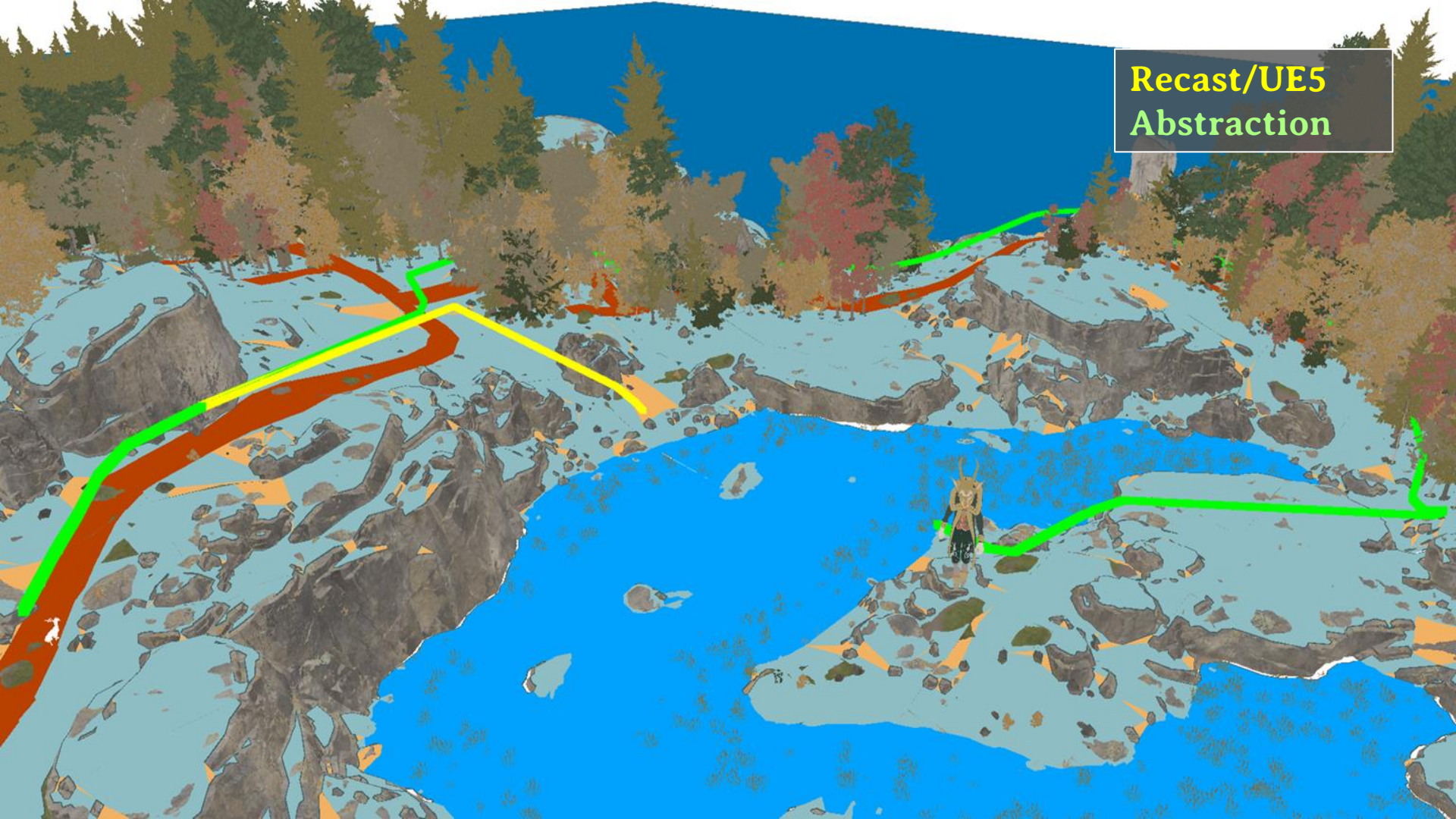
Recast/UE5 Abstraction

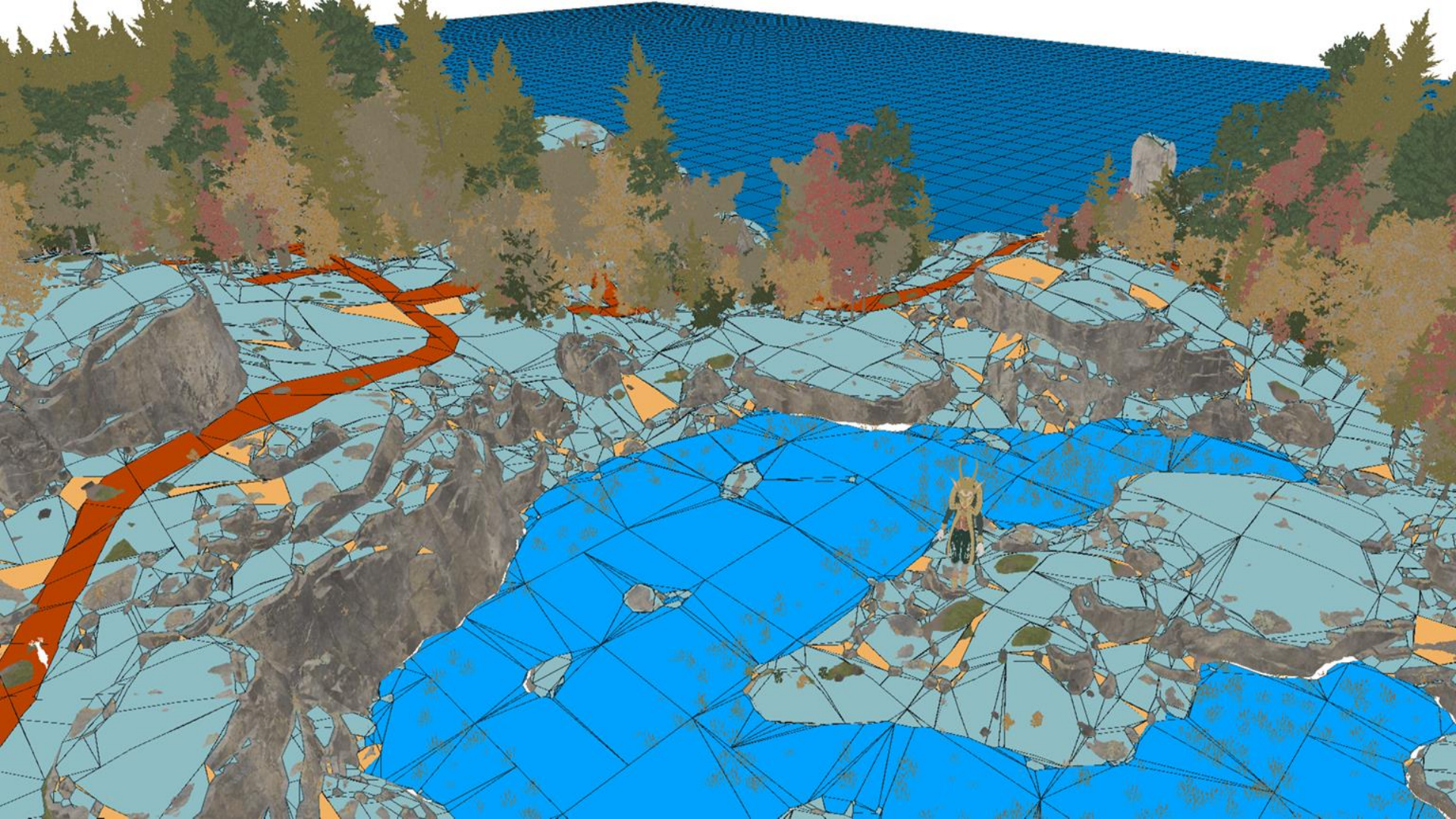


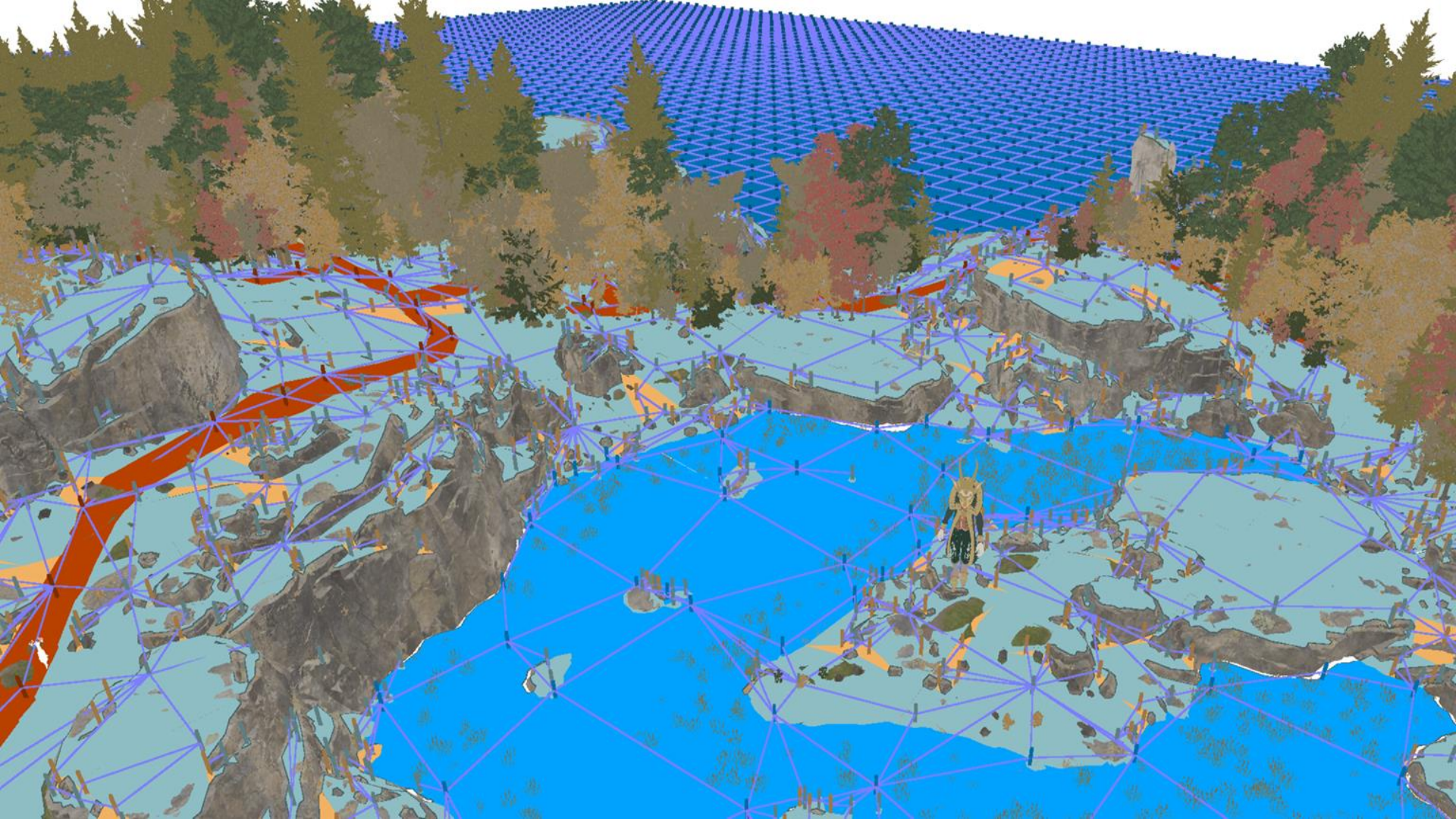
Recast/UE5
Abstraction



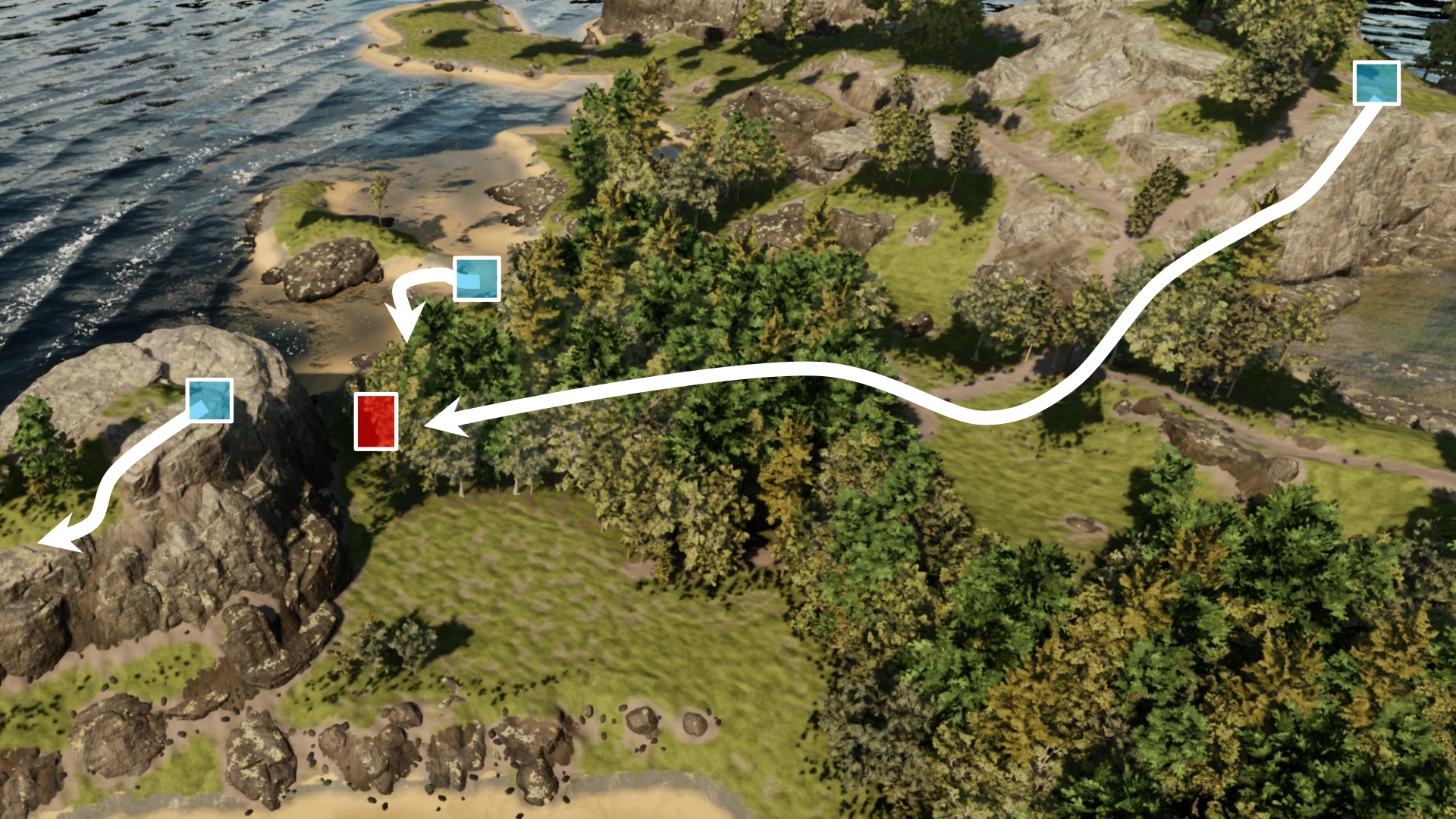
Recast/UE5
Abstraction

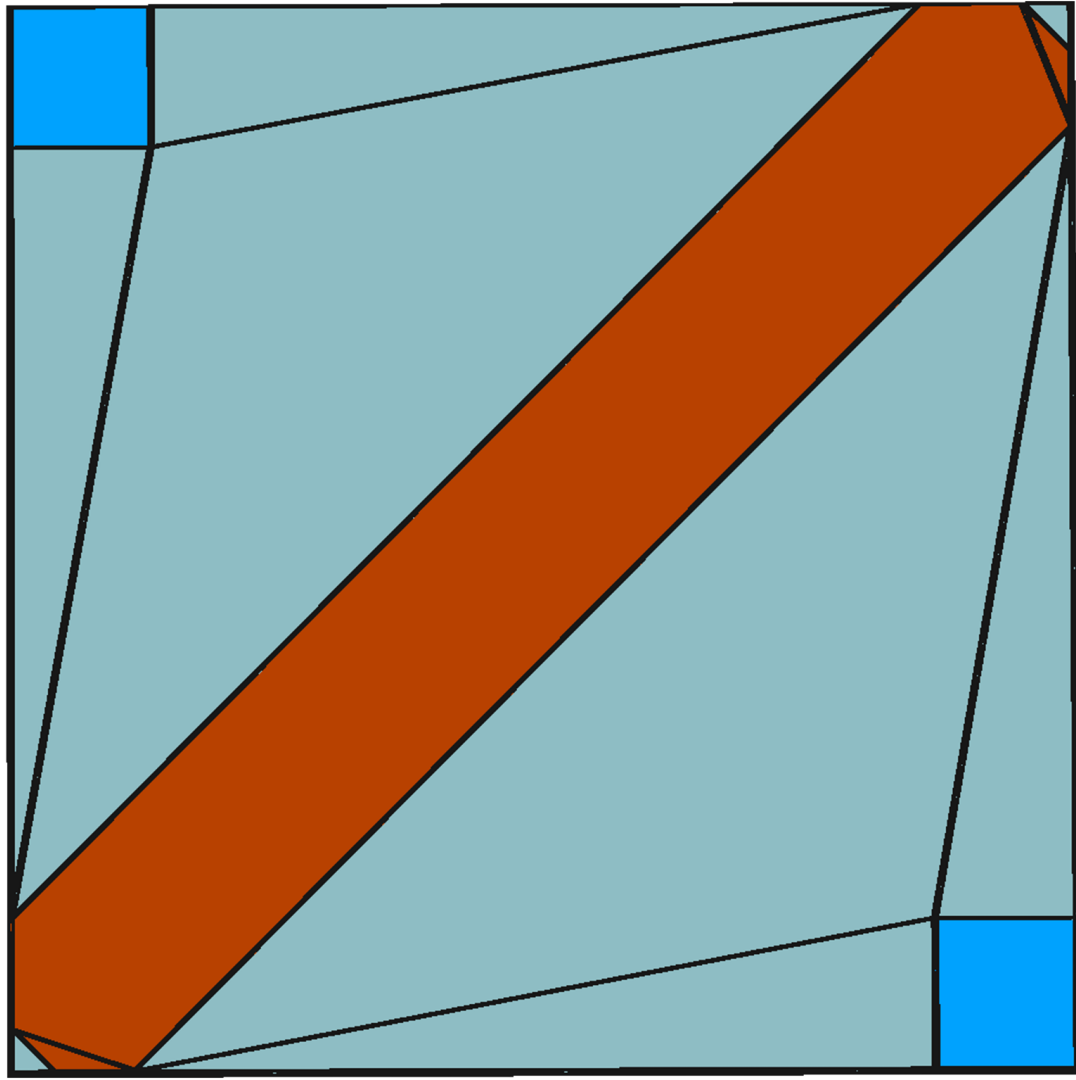


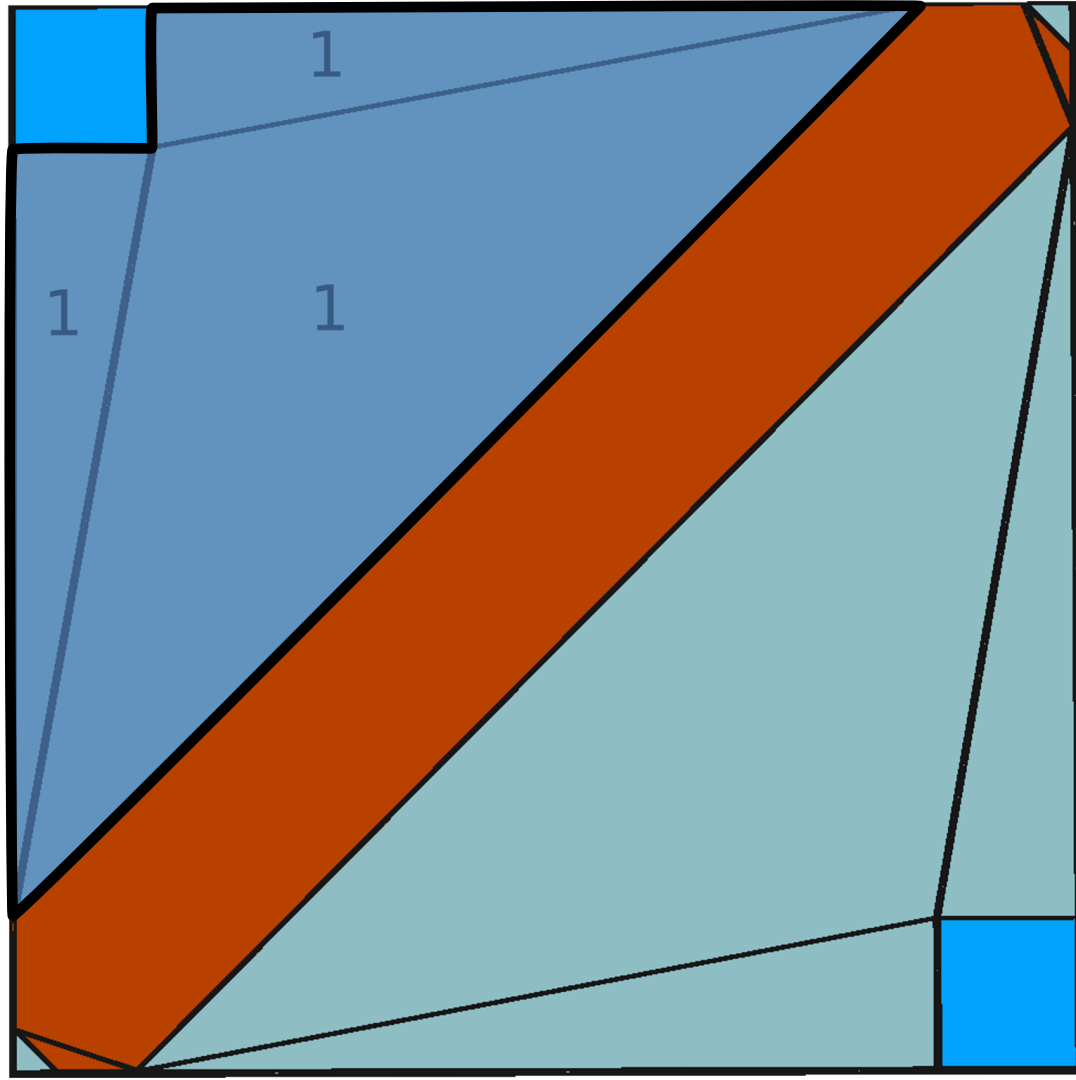


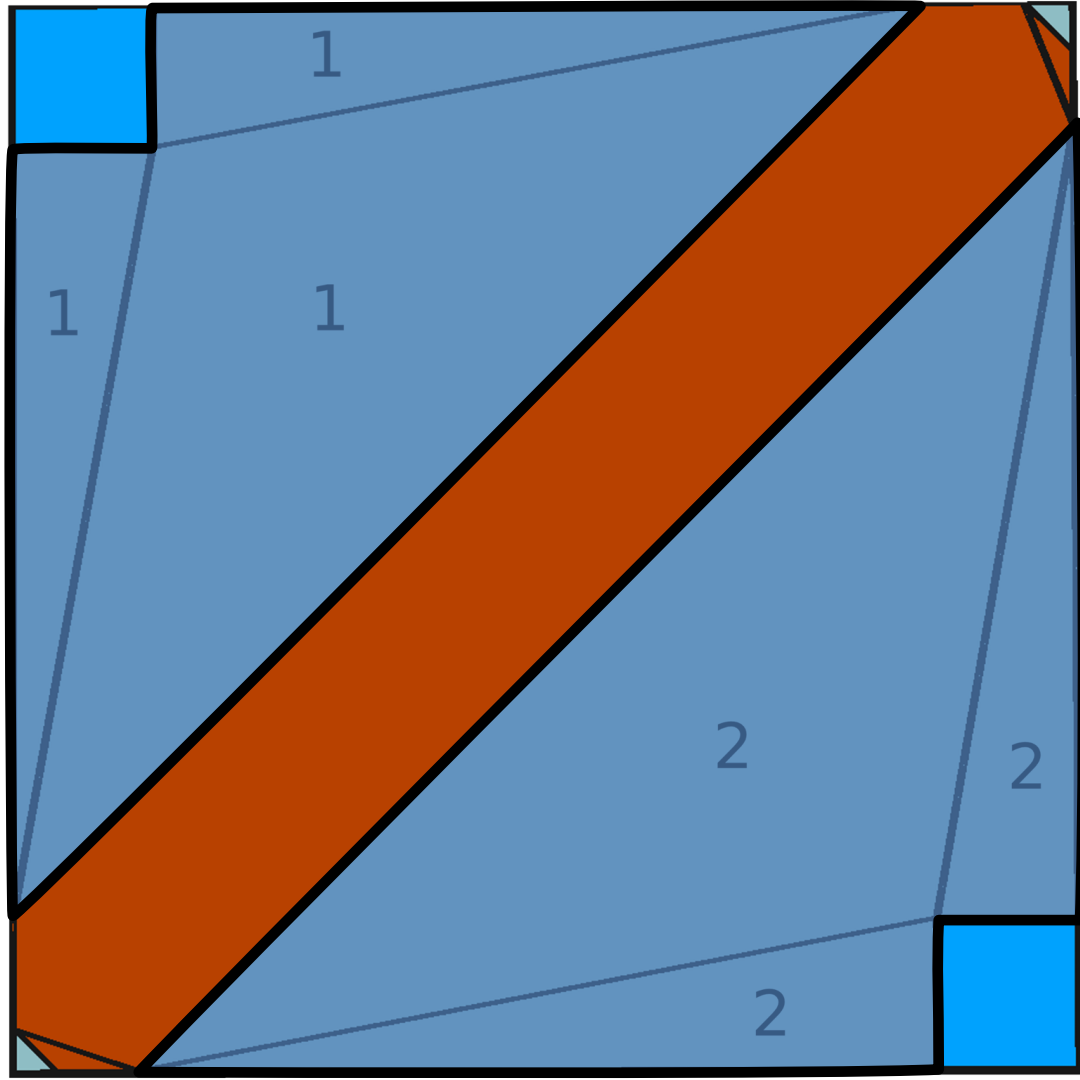


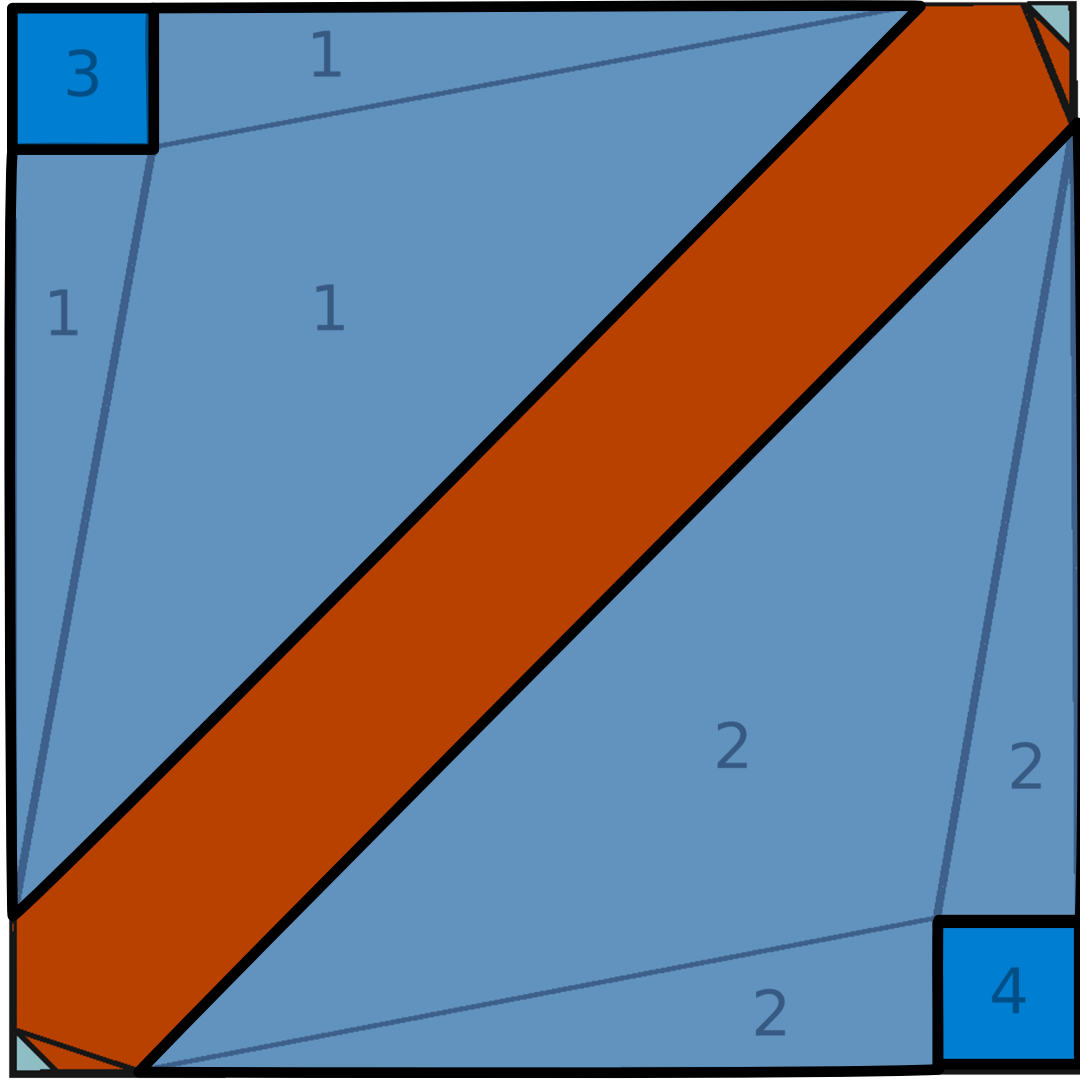
BENEFIT: CUSTOM PATH QUERIES

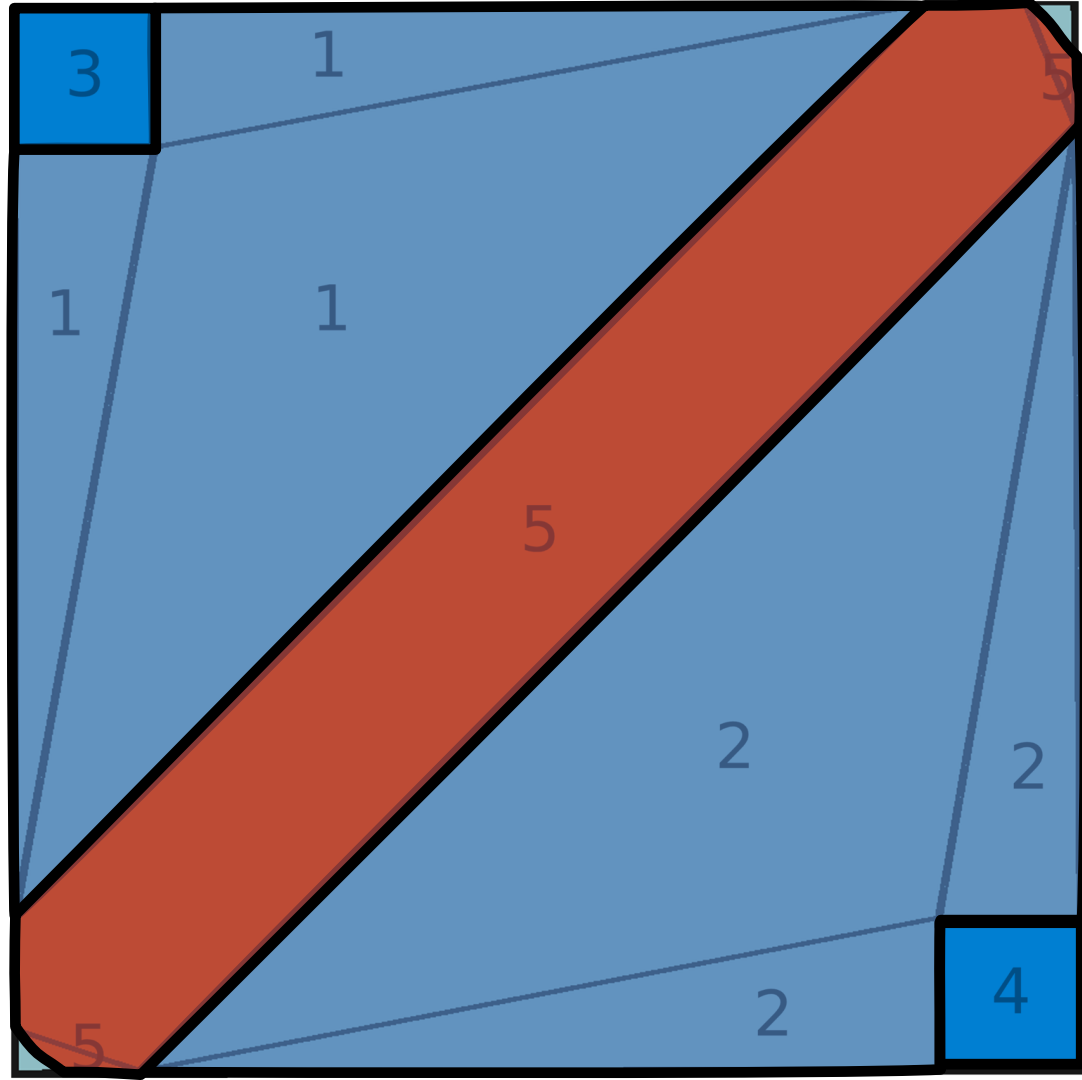


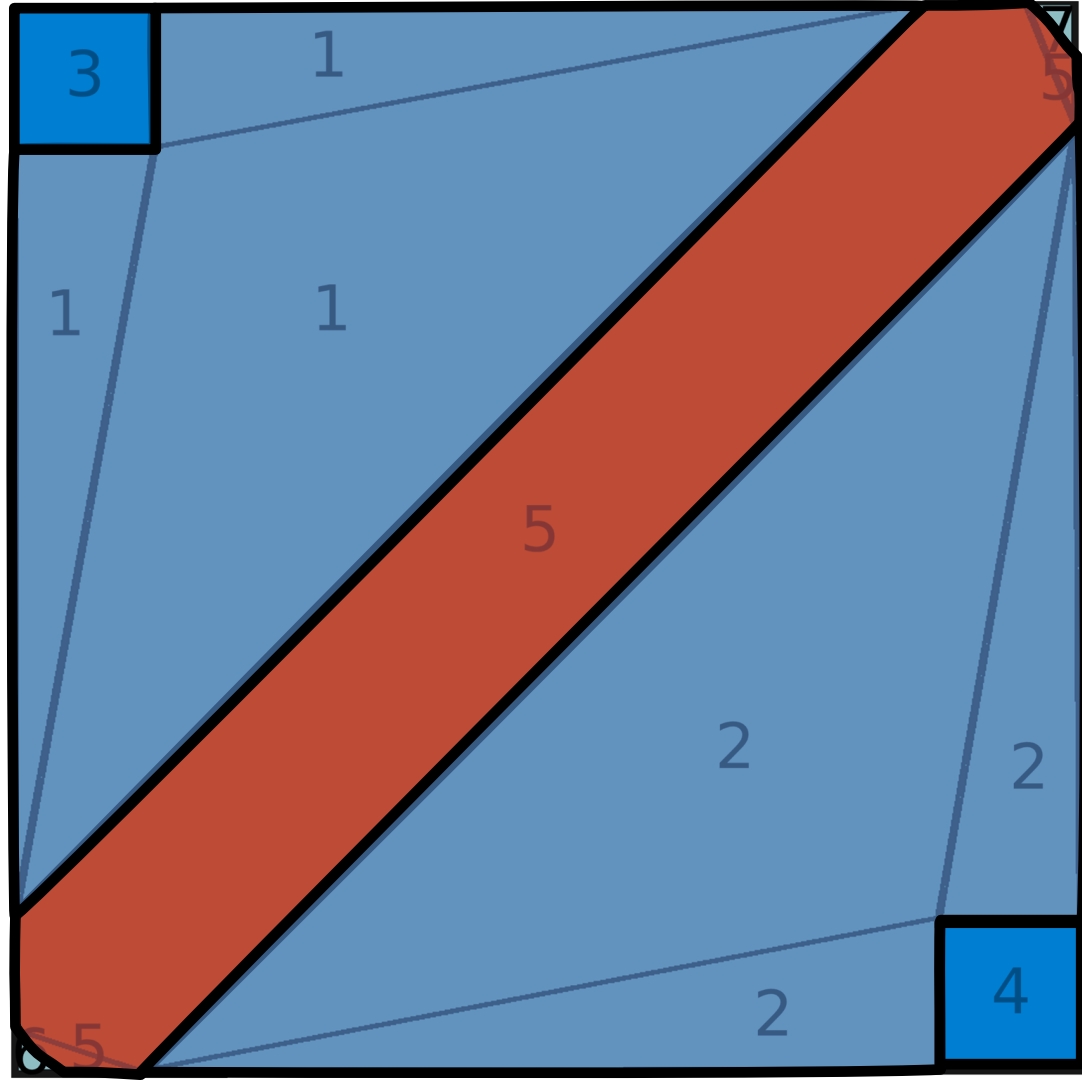


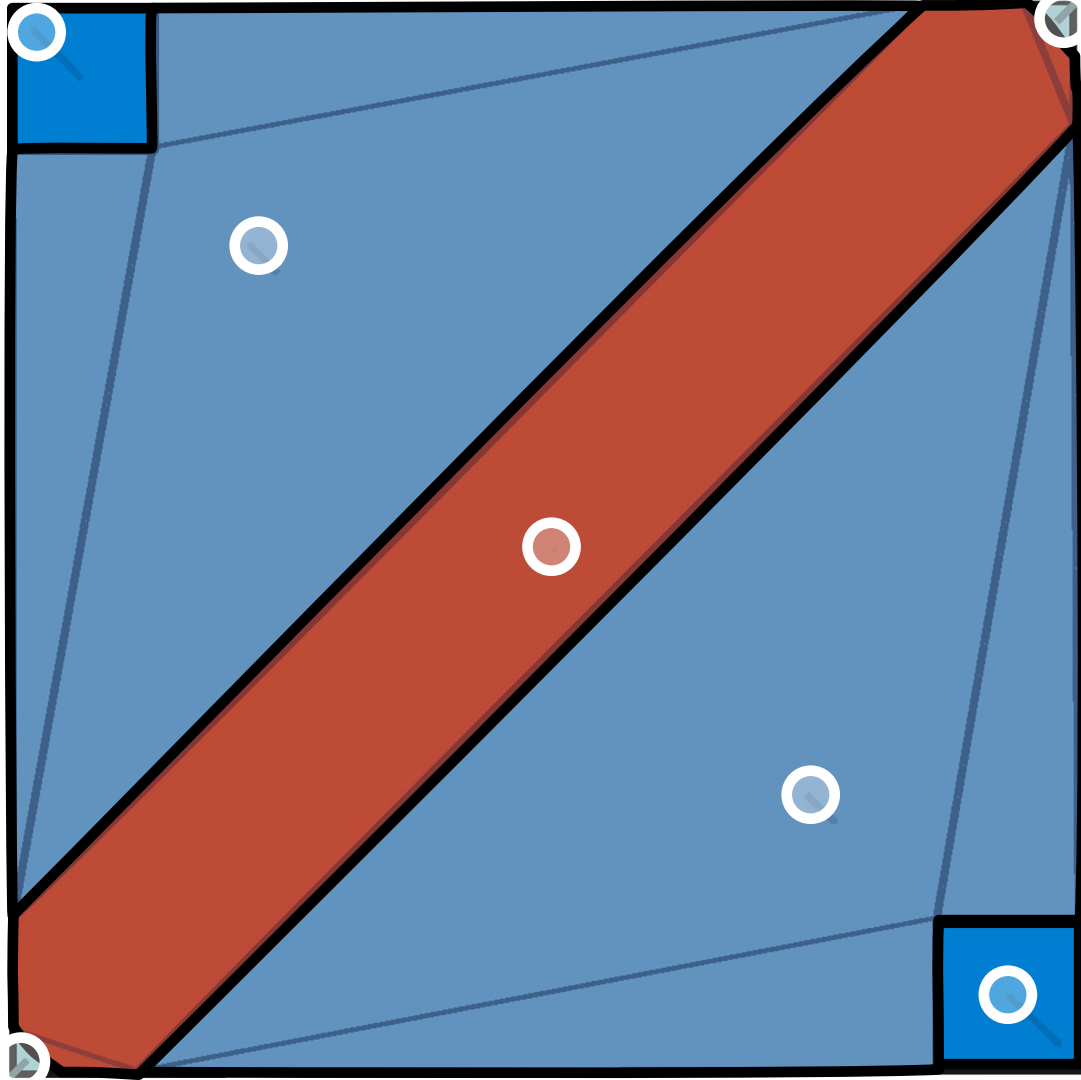


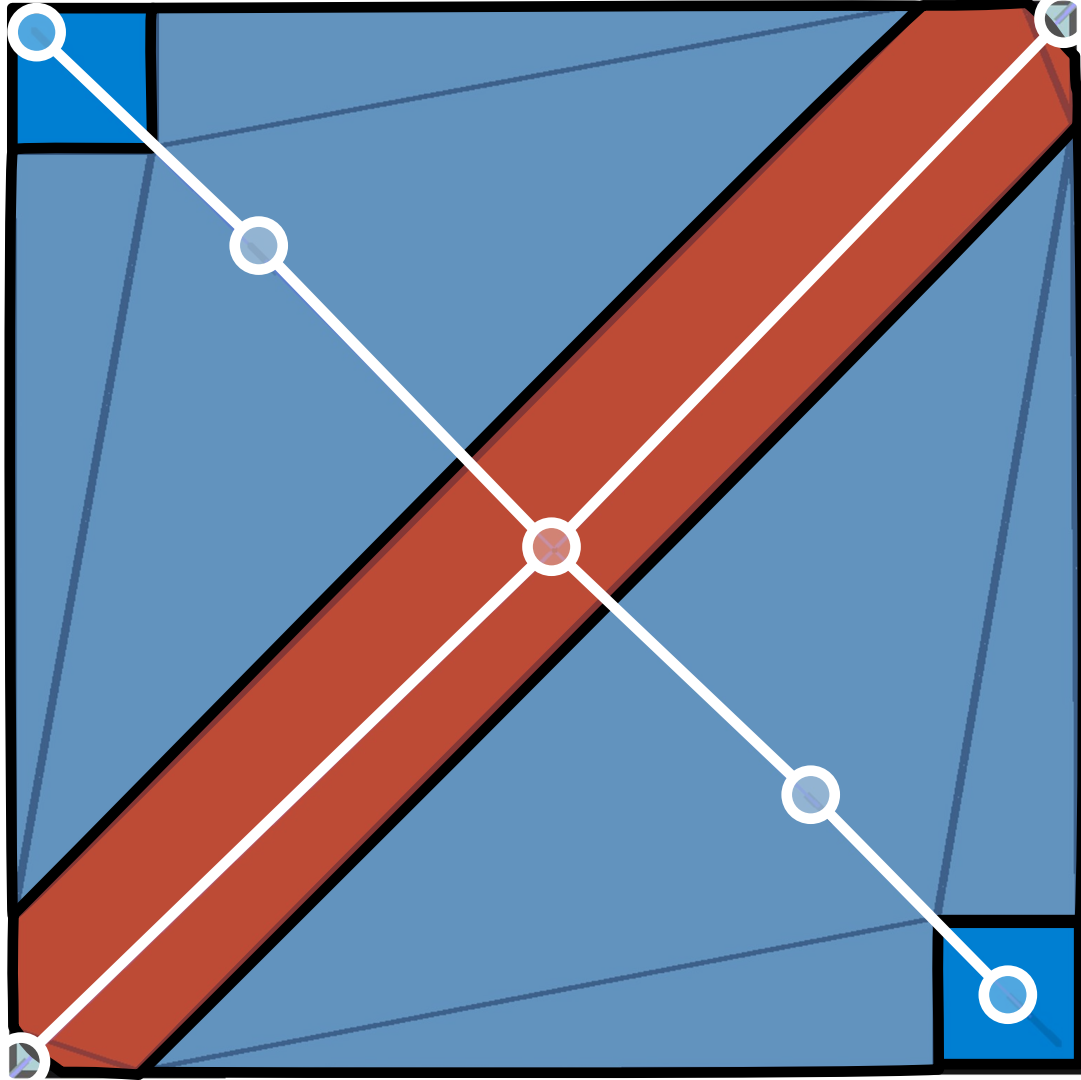


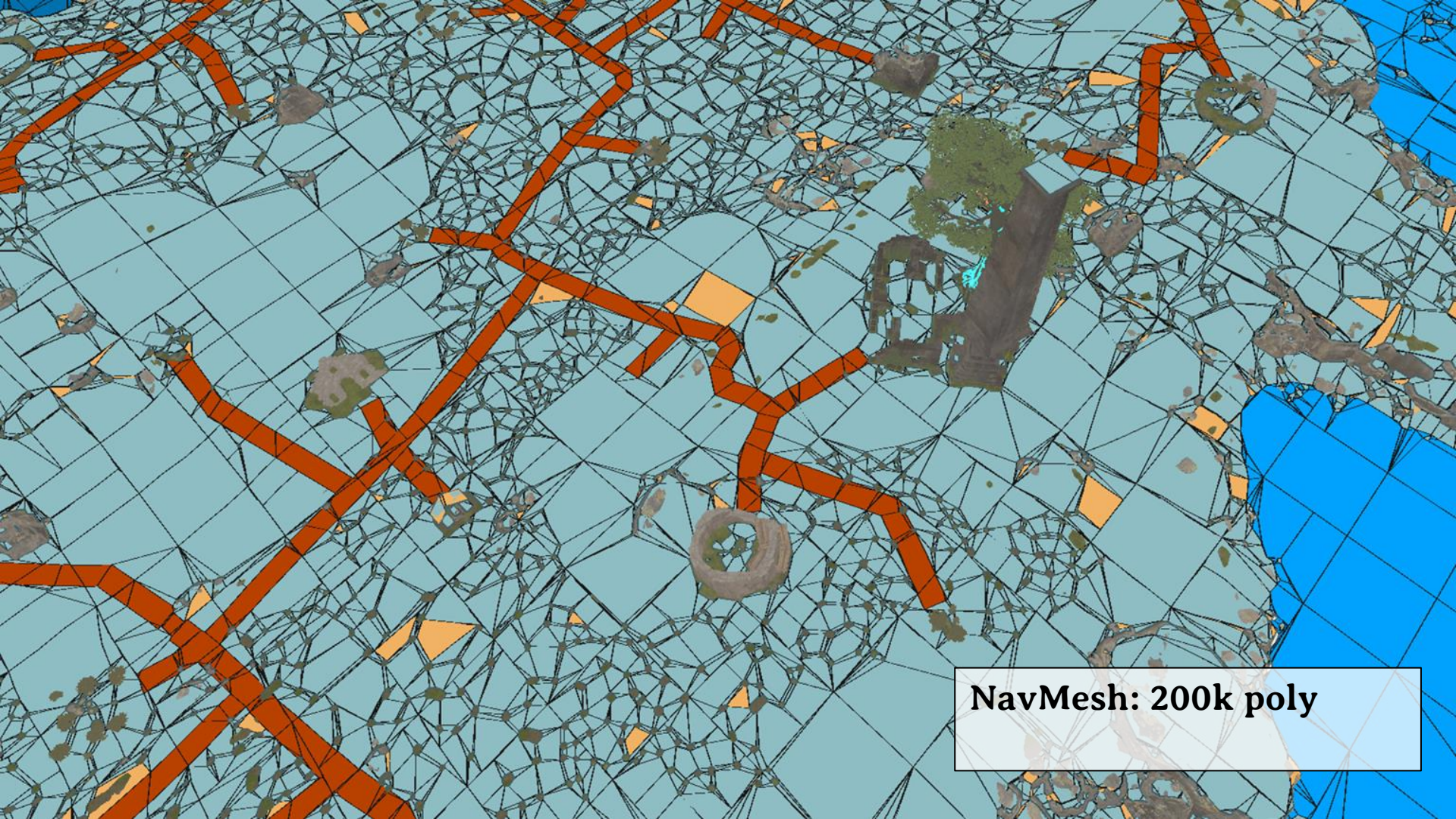




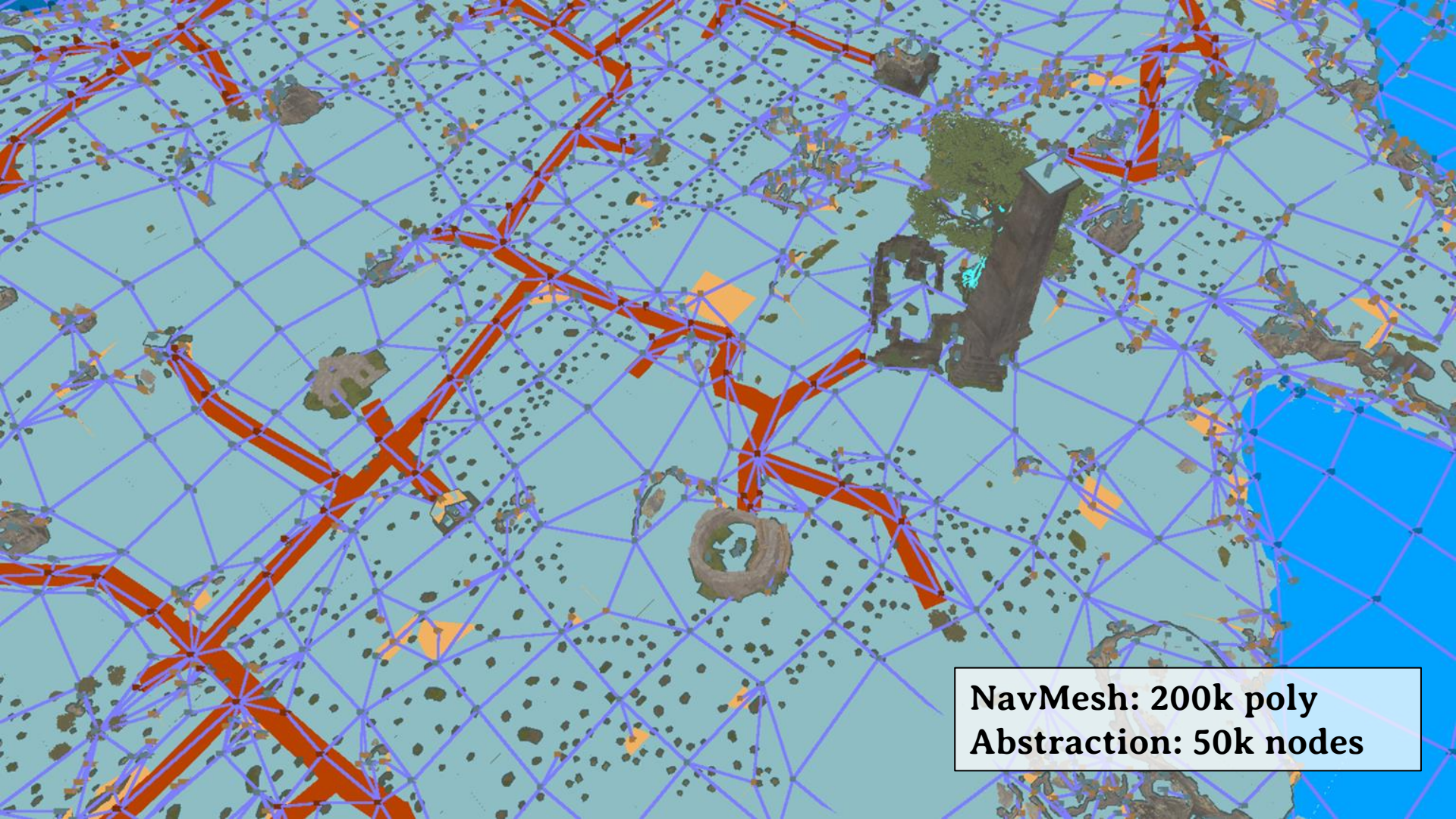






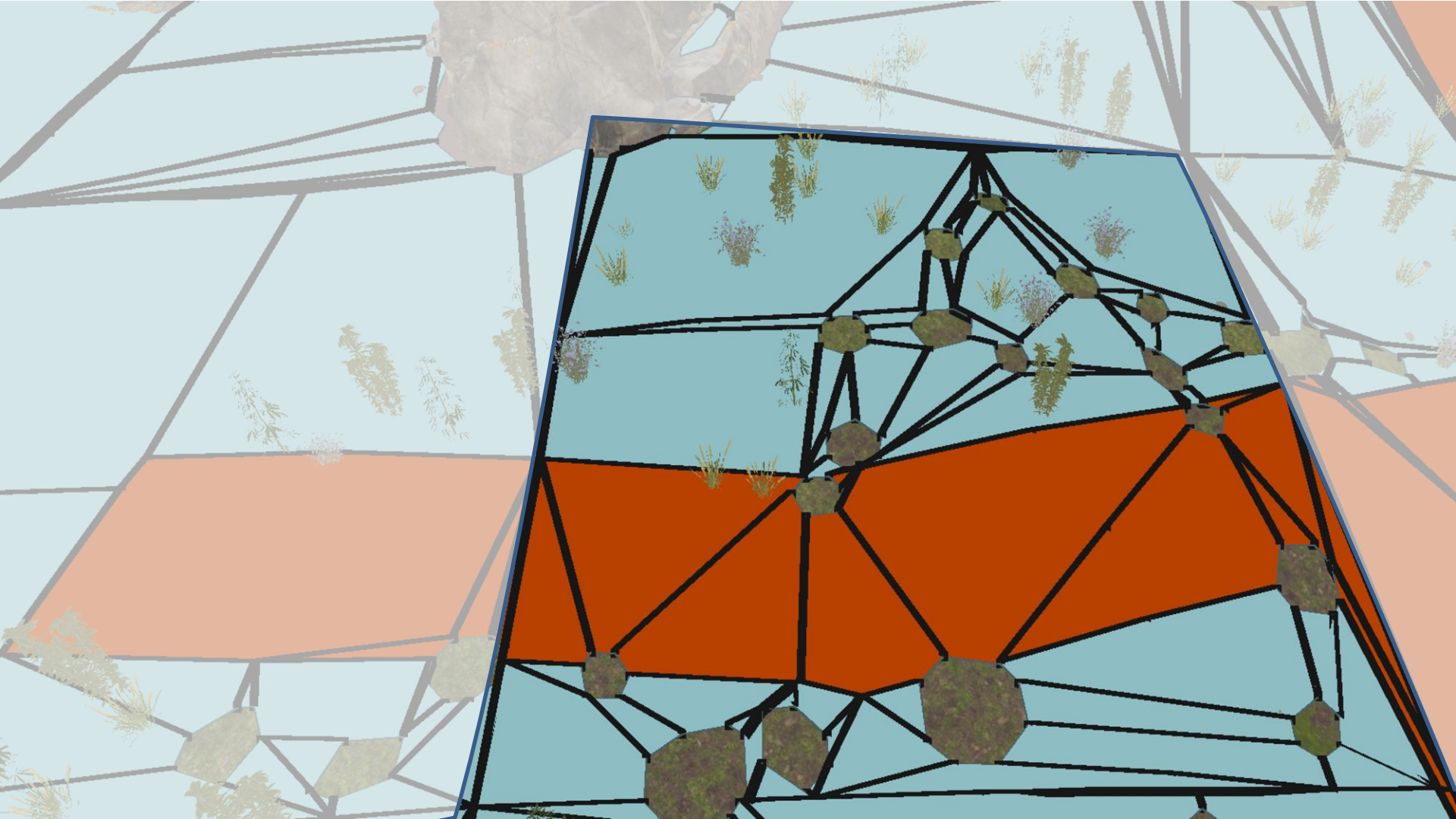


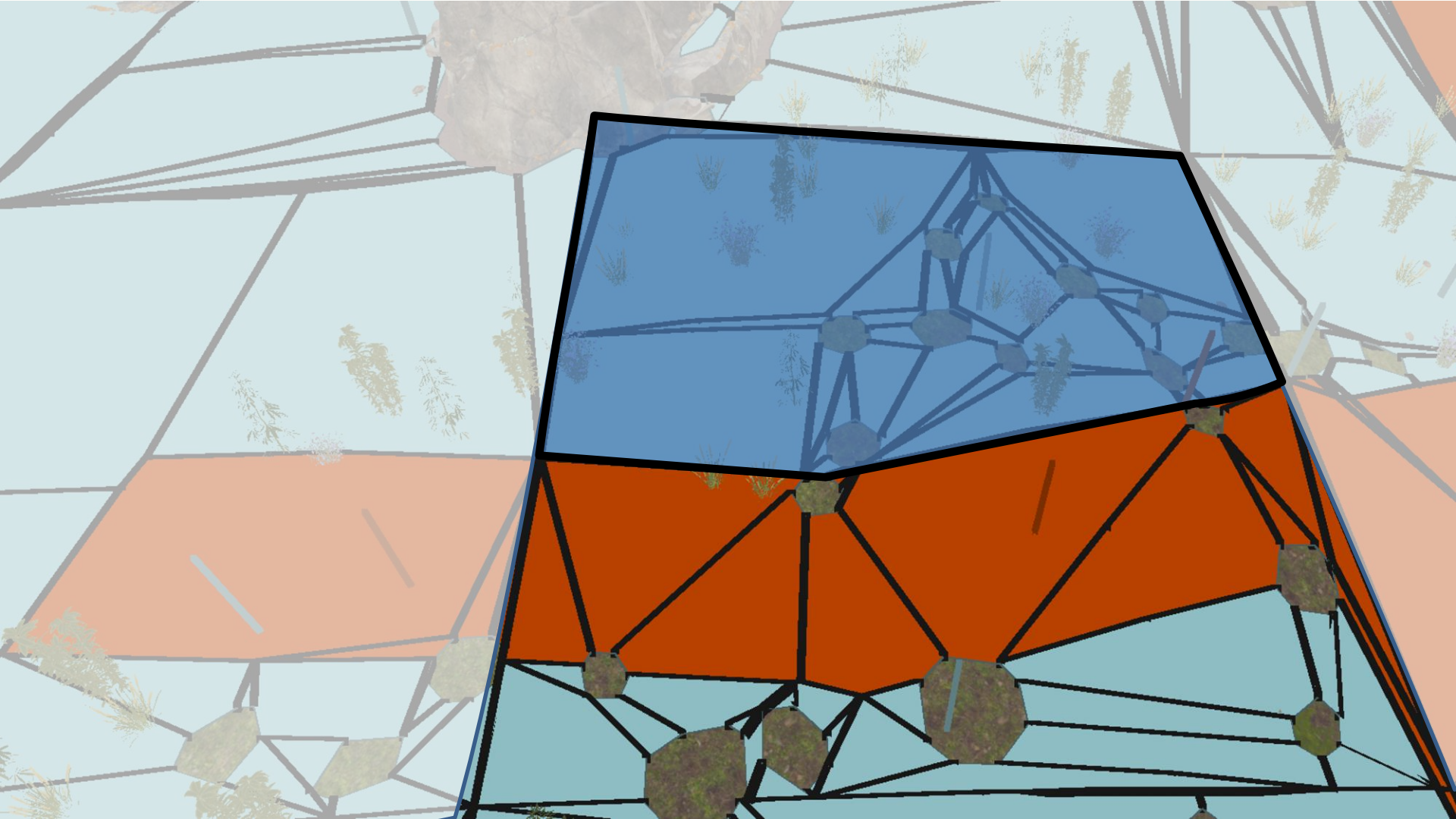
NavMesh: 200k poly

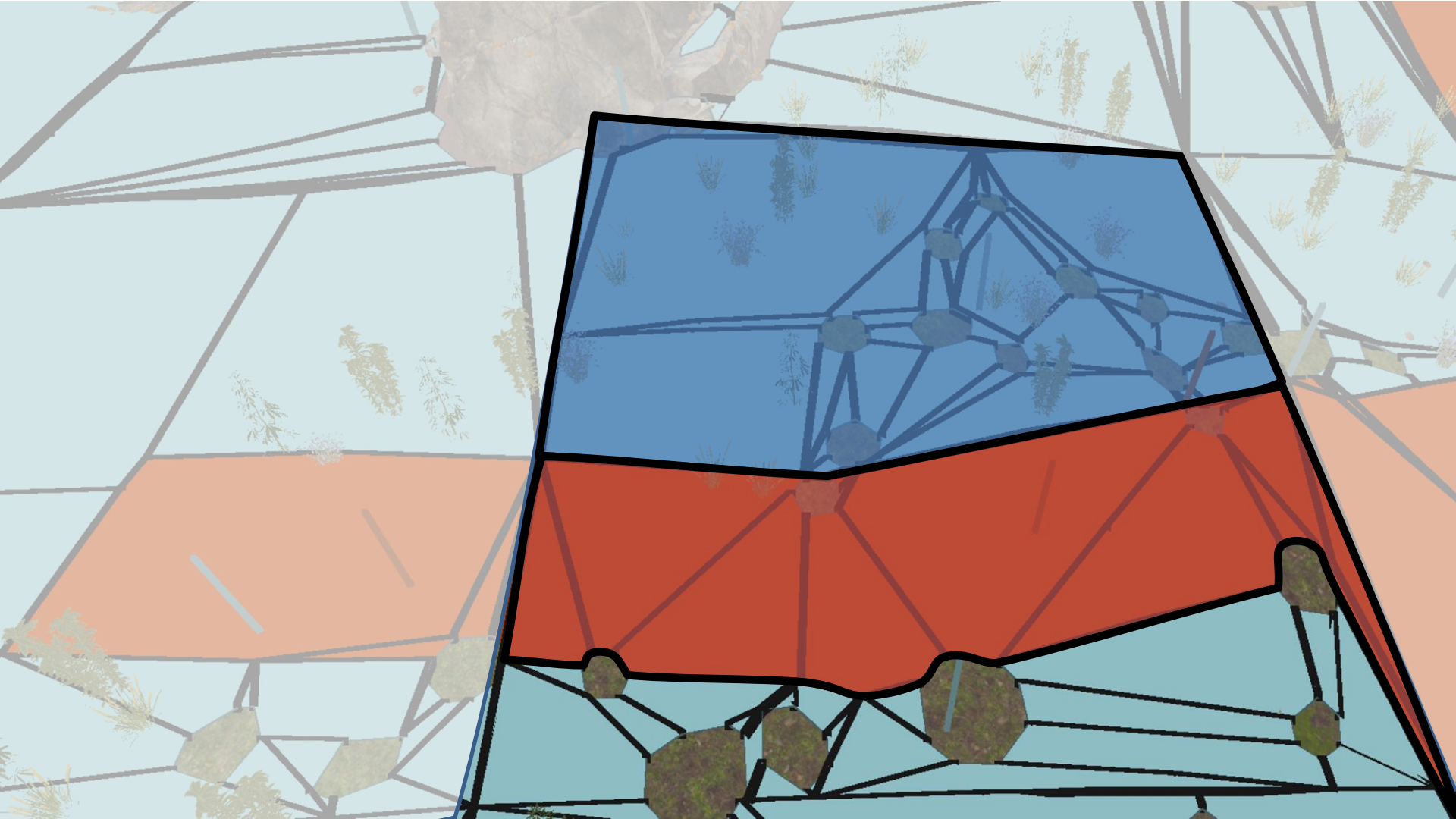


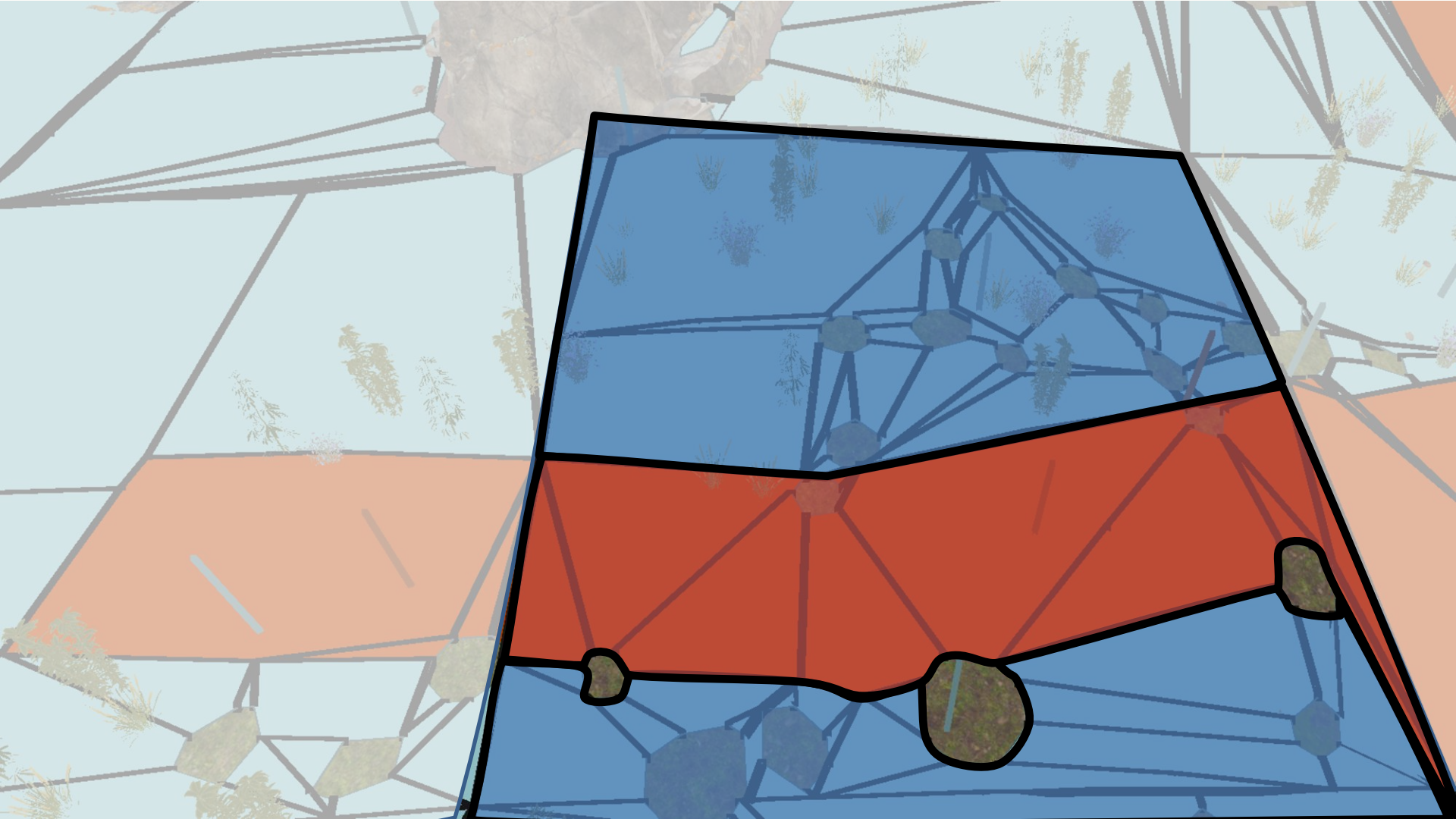
NavMesh: 200k poly
Abstraction: 50k nodes

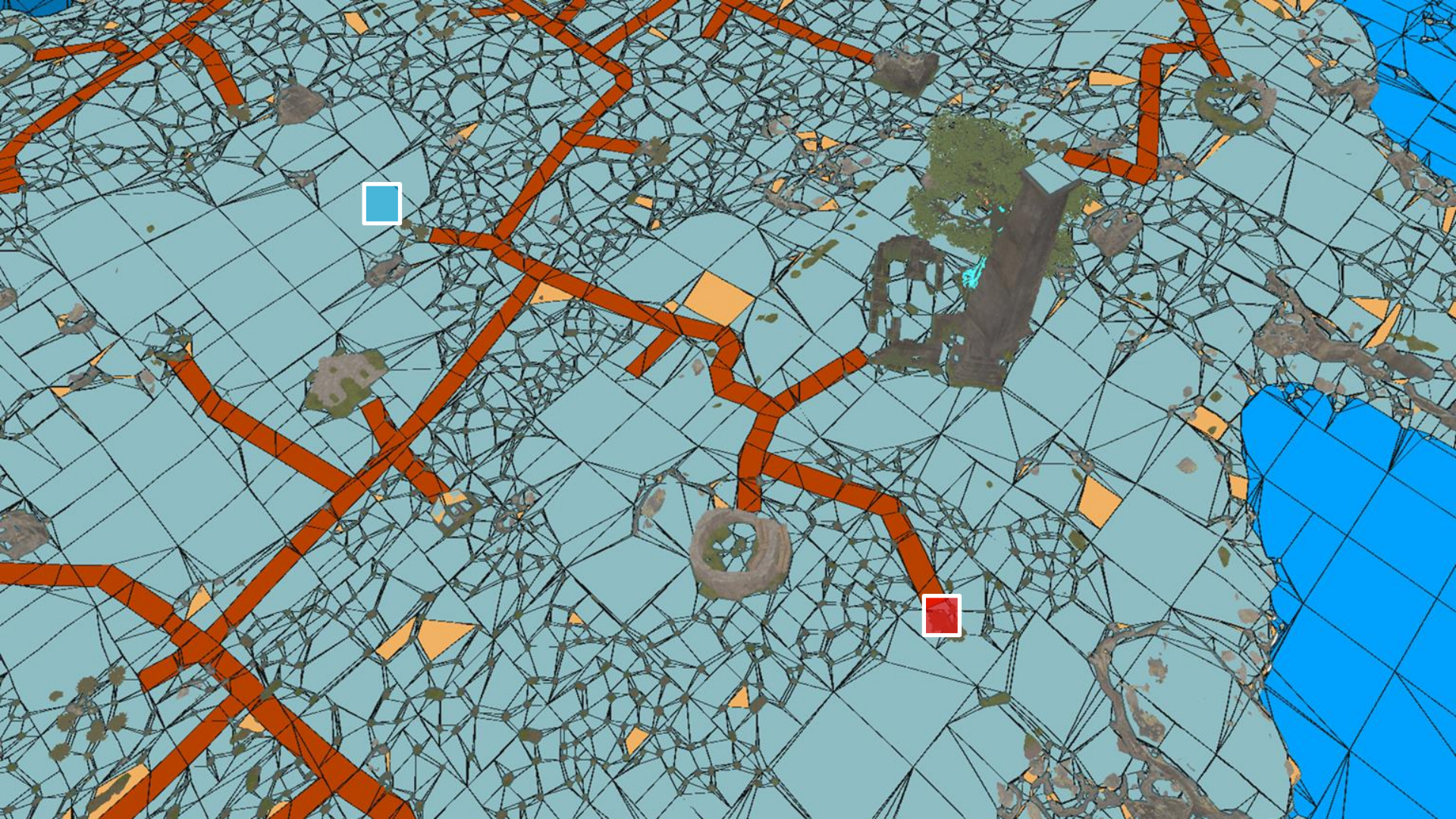














CONNECTIVITY GRAPH

Labeling connected components



4x Speed

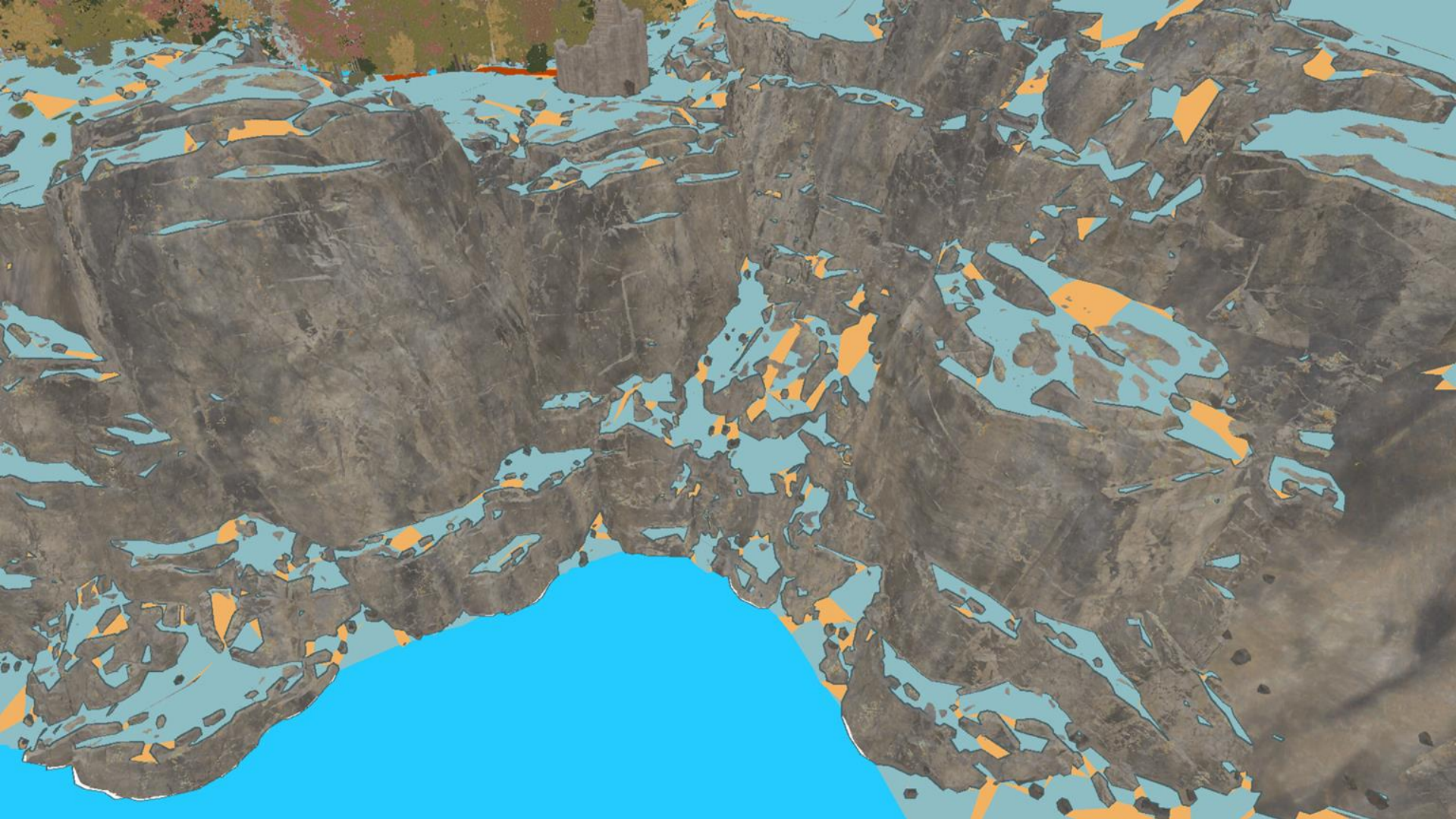


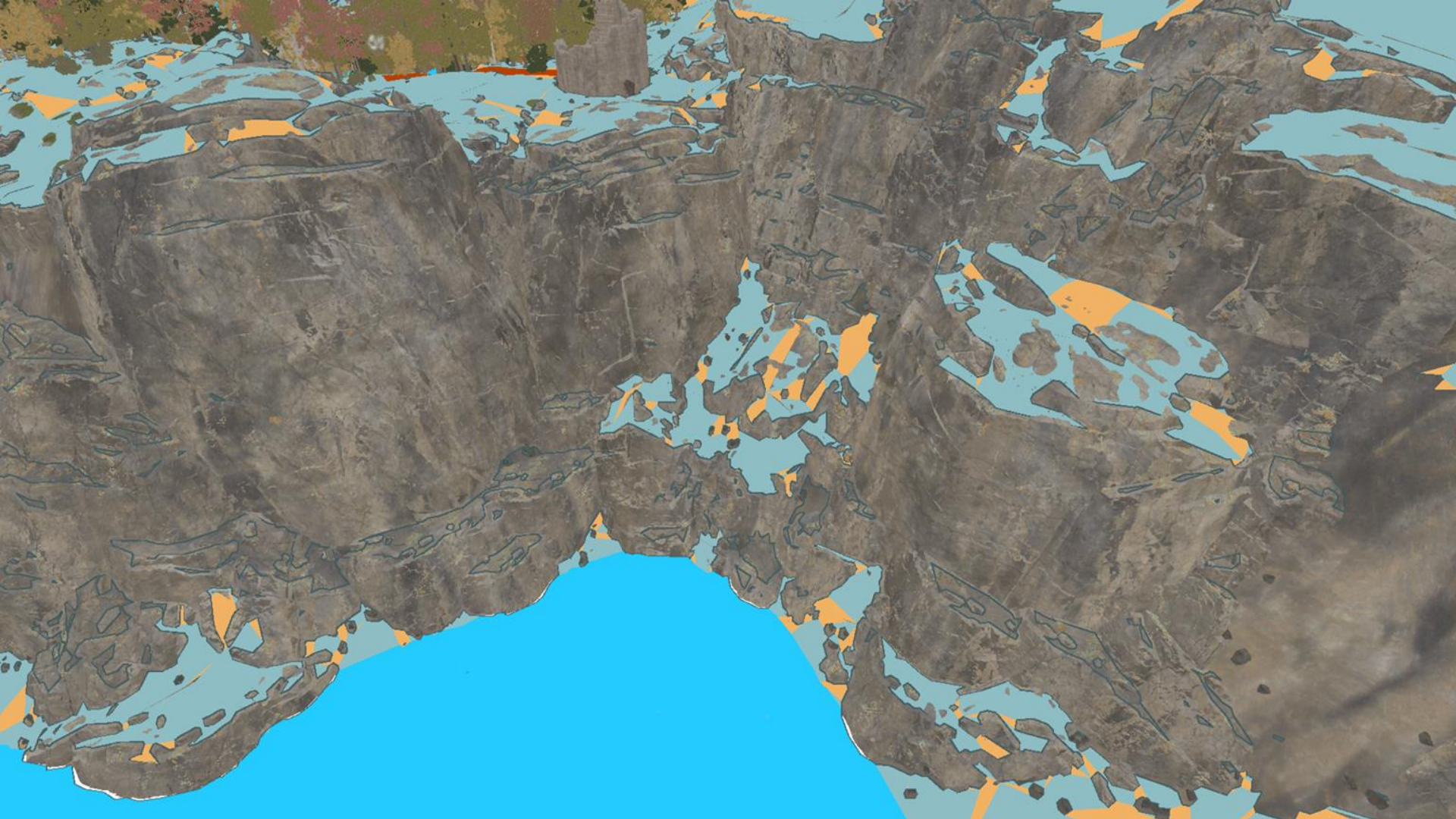




Charles
The Company





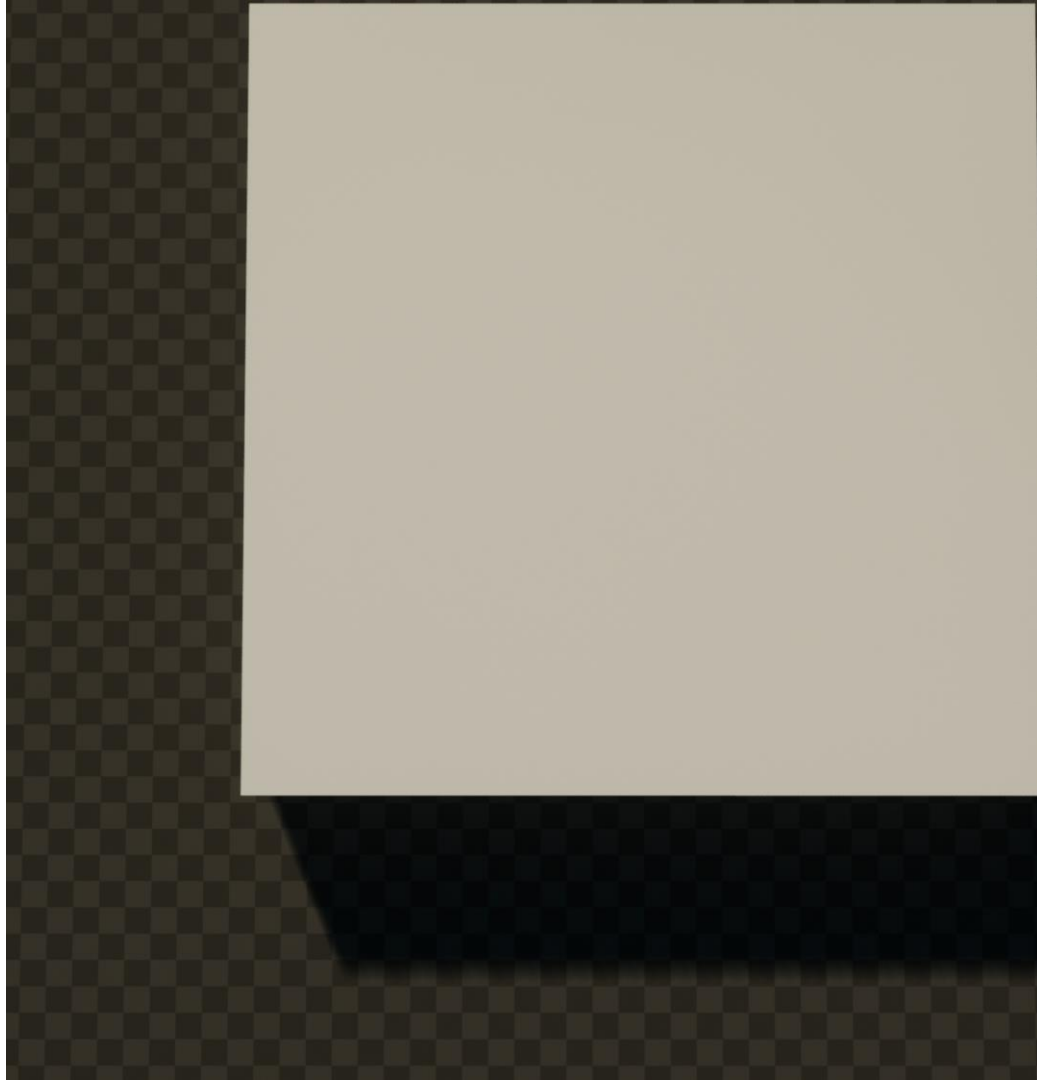


HOW TO GENERATE - STATIC NAV

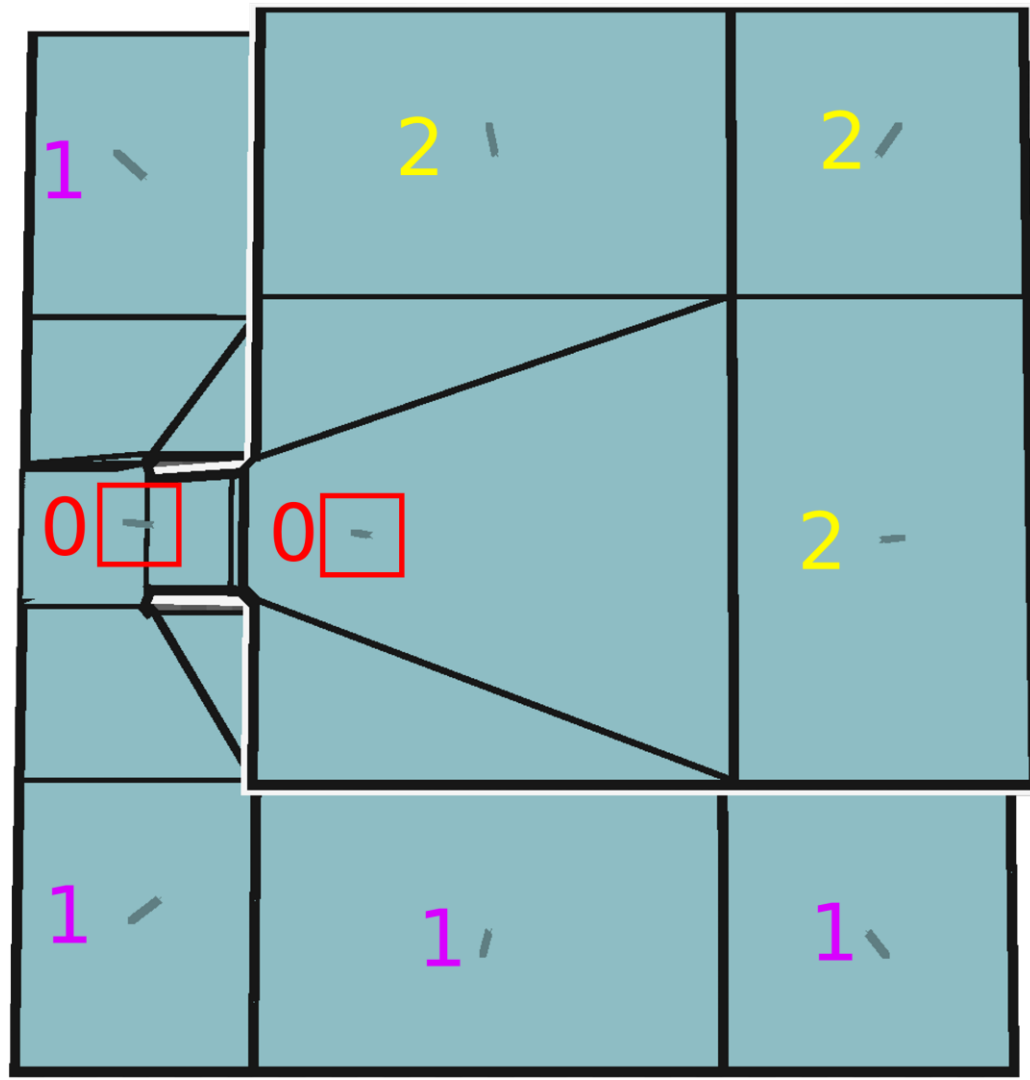
- . Flood-fill using Breadth-First Search

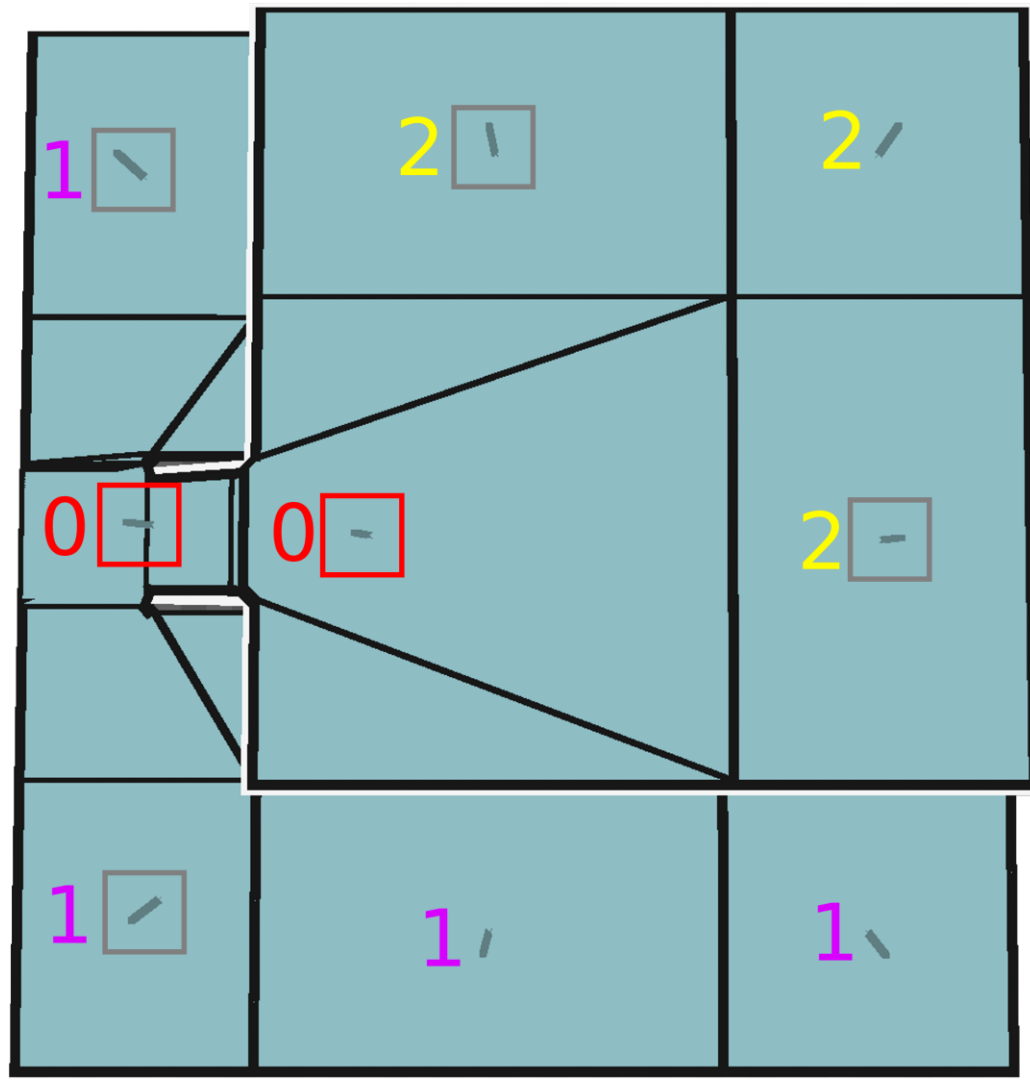
HOW TO GENERATE - DYNAMIC NAV

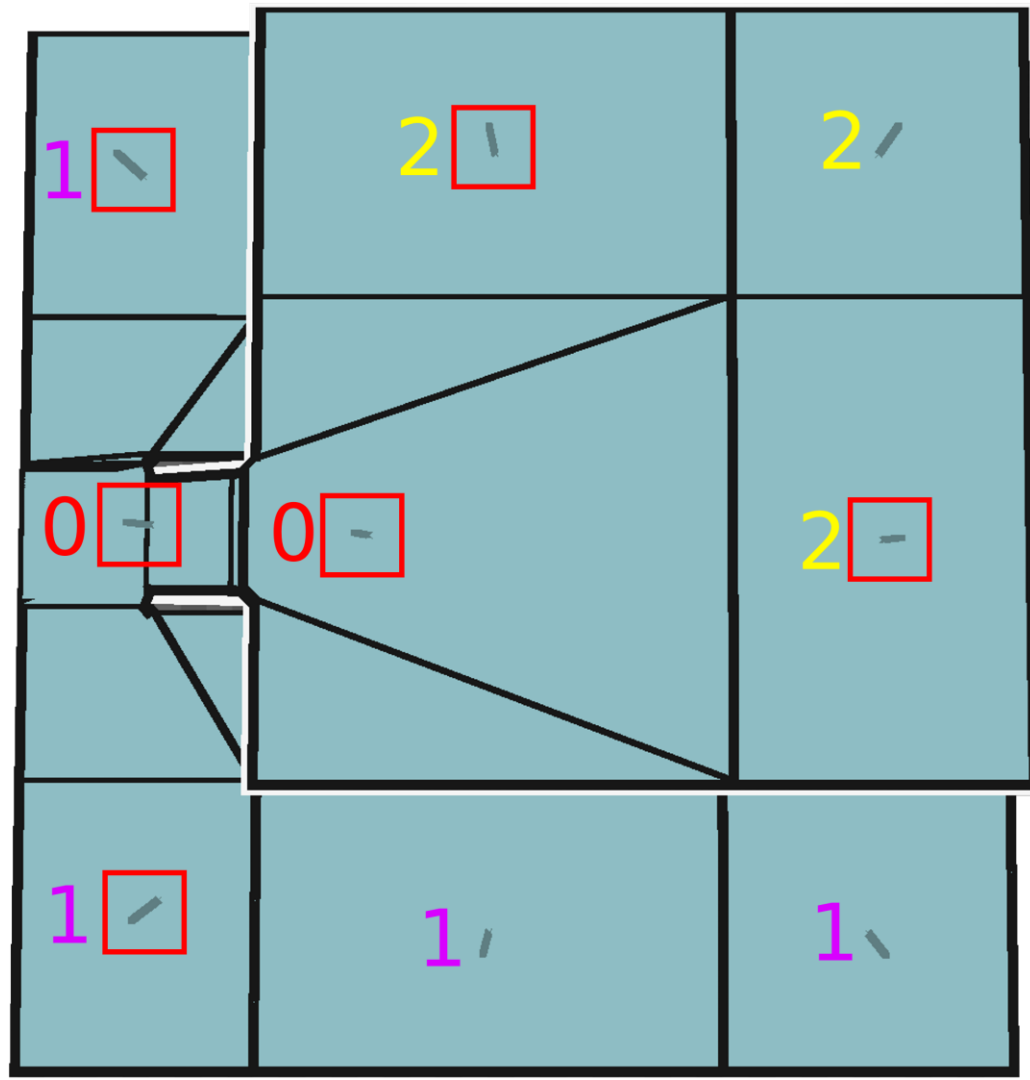
- Calculate initial labels using flood-fill
- Locally repair when tiles are repaired

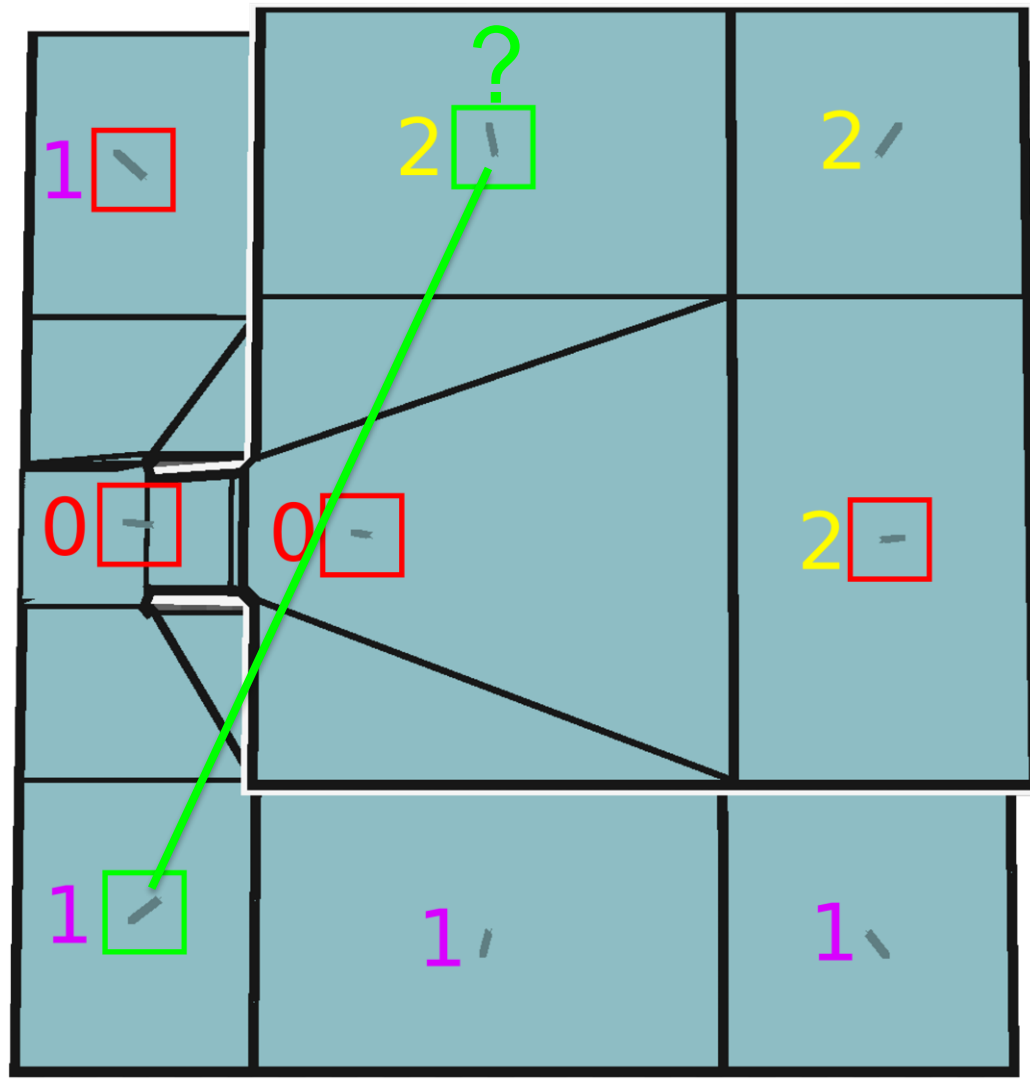


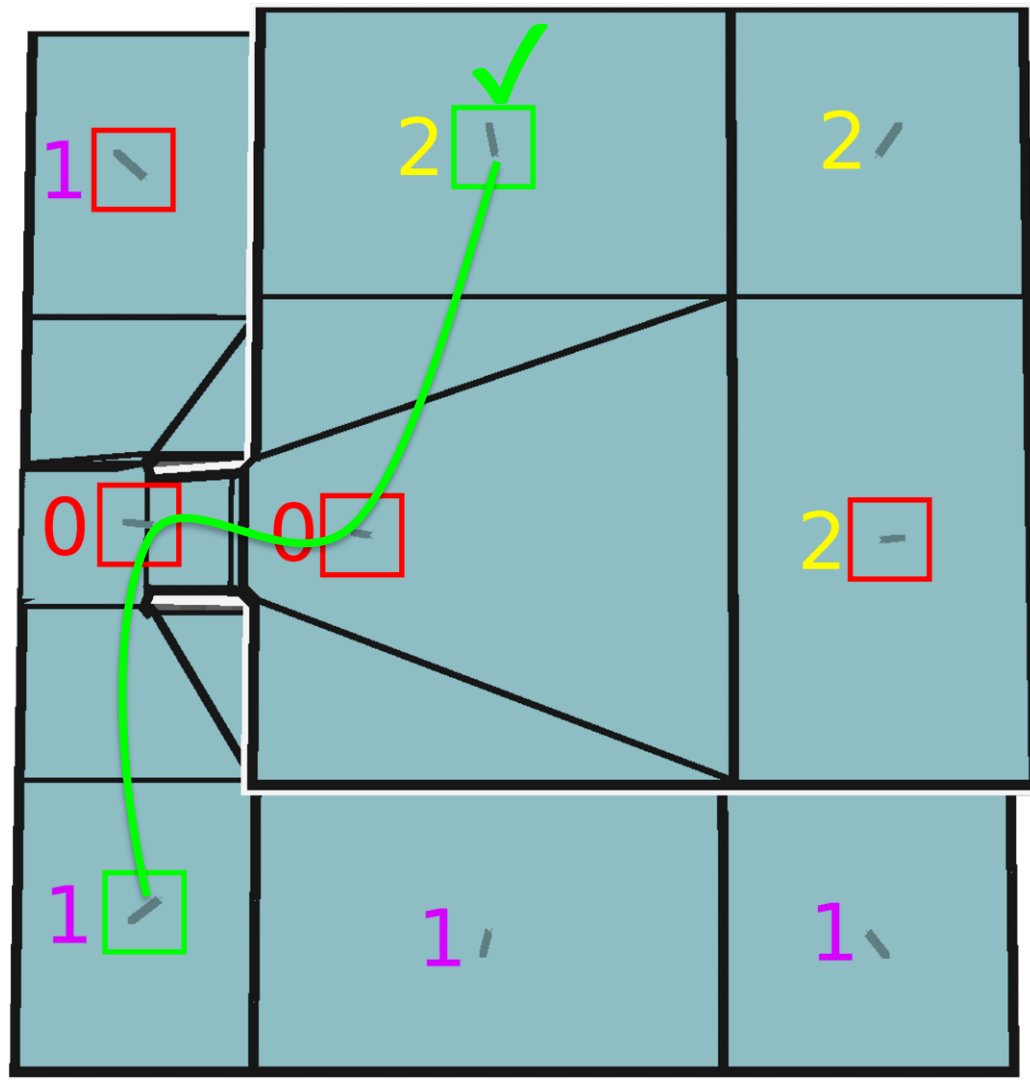


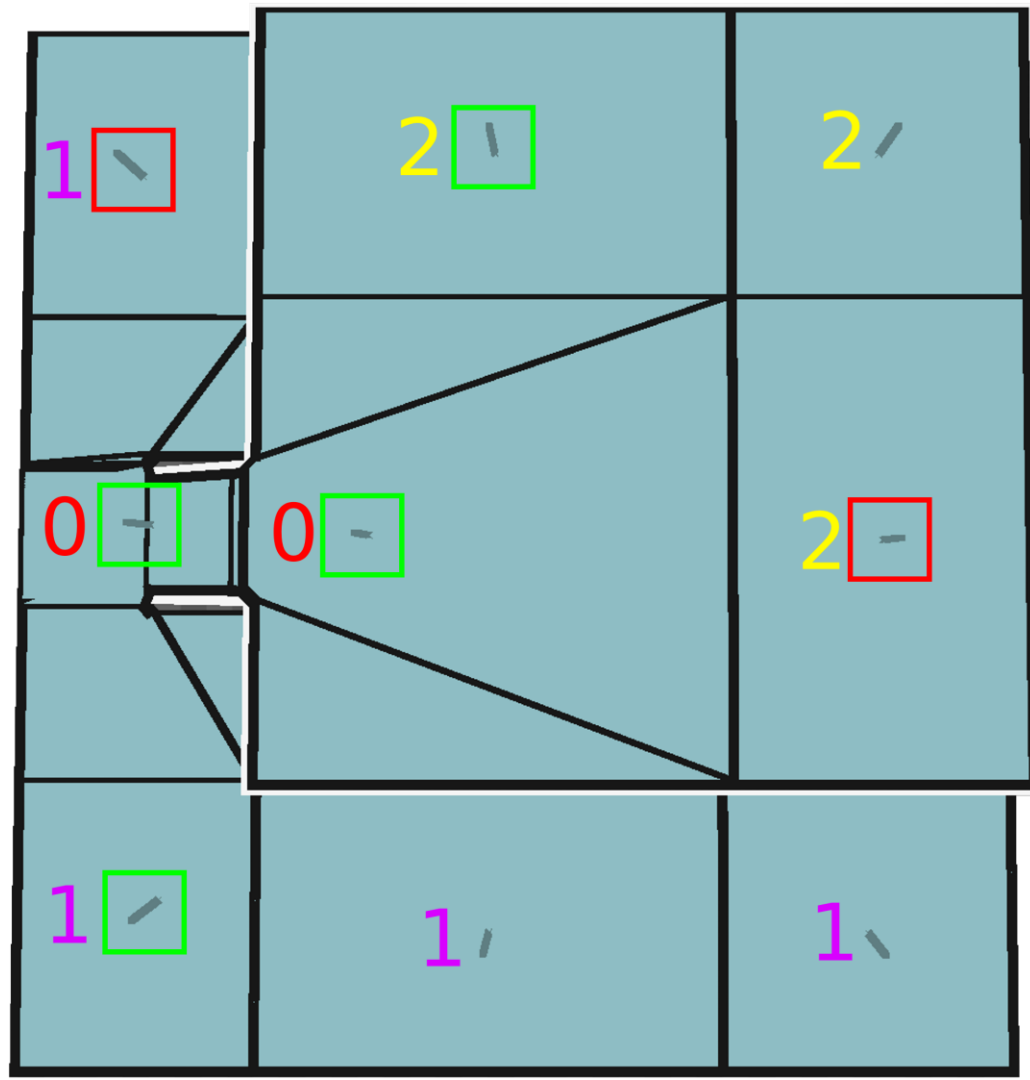


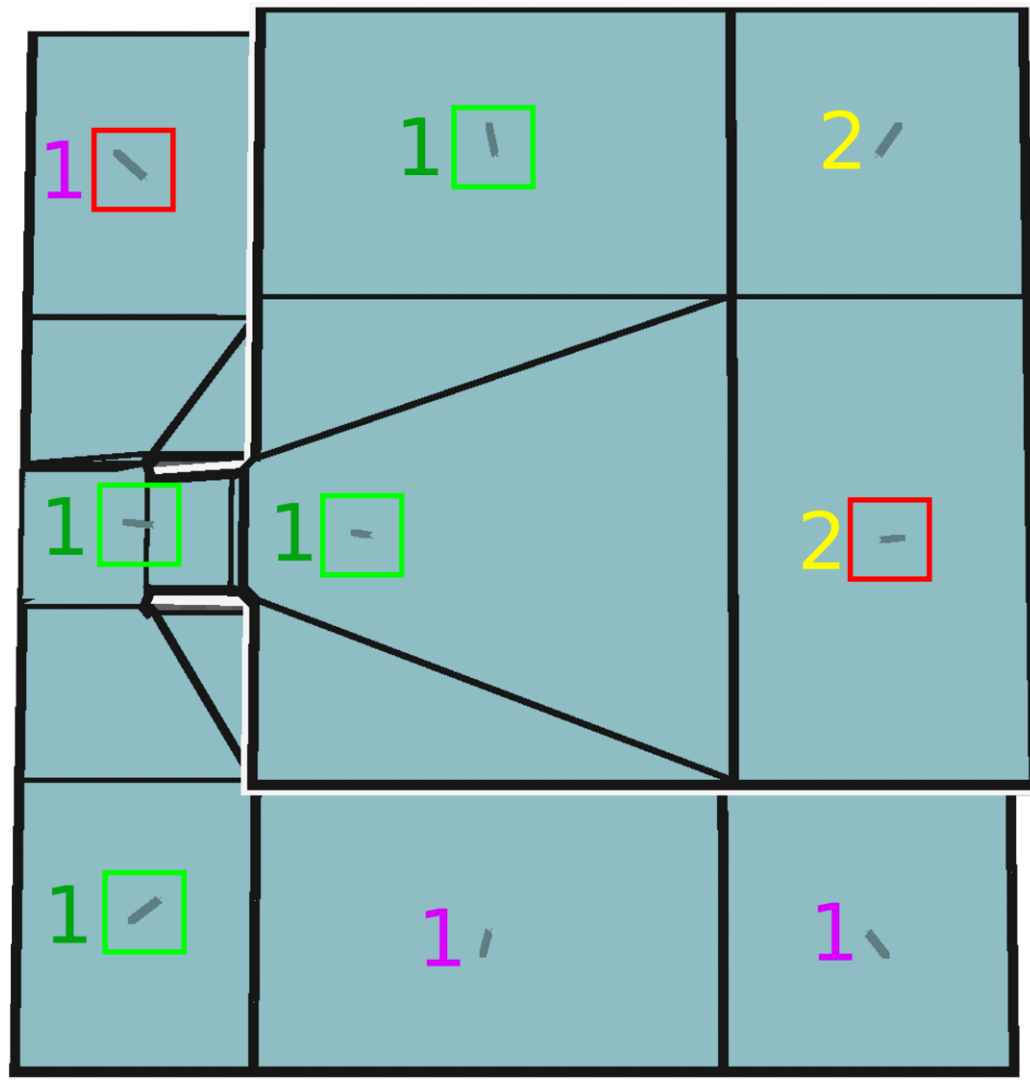


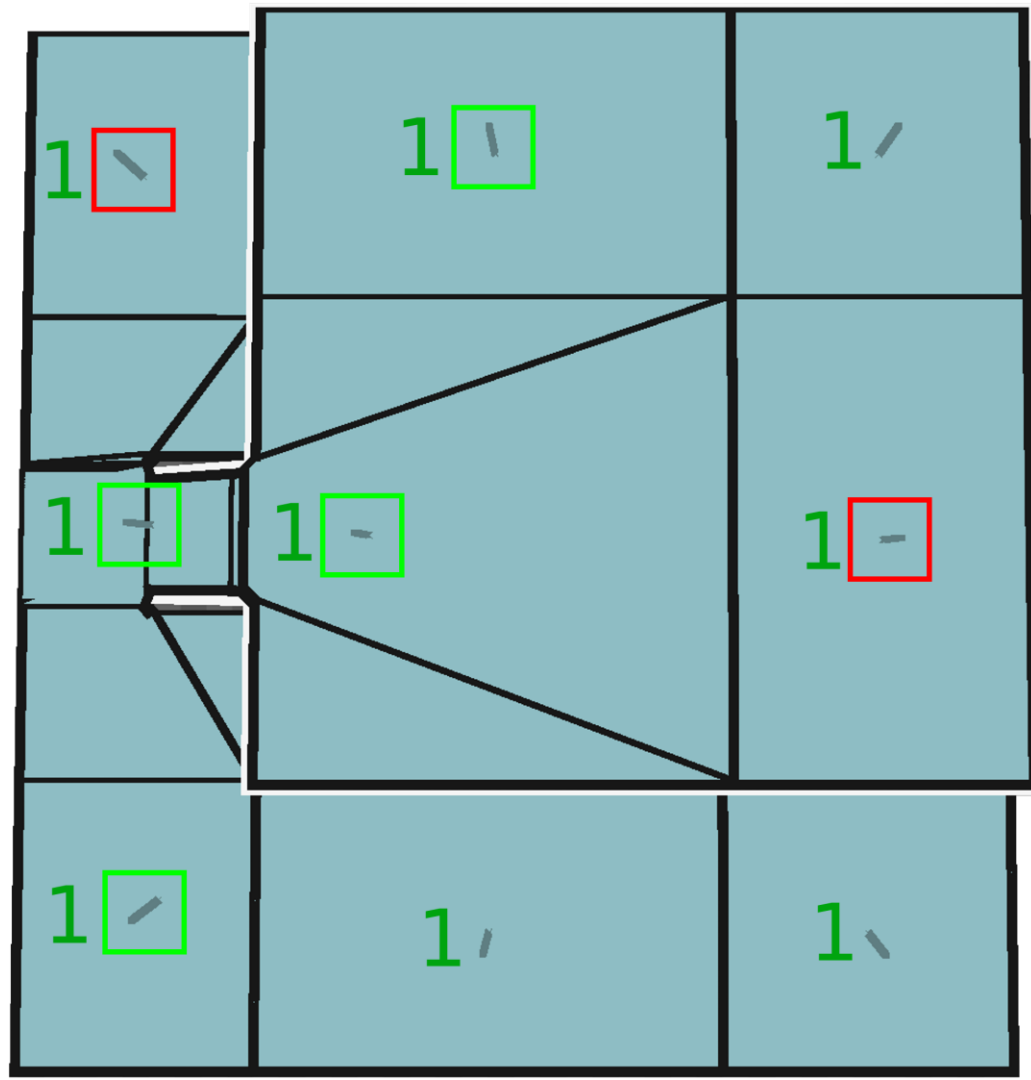




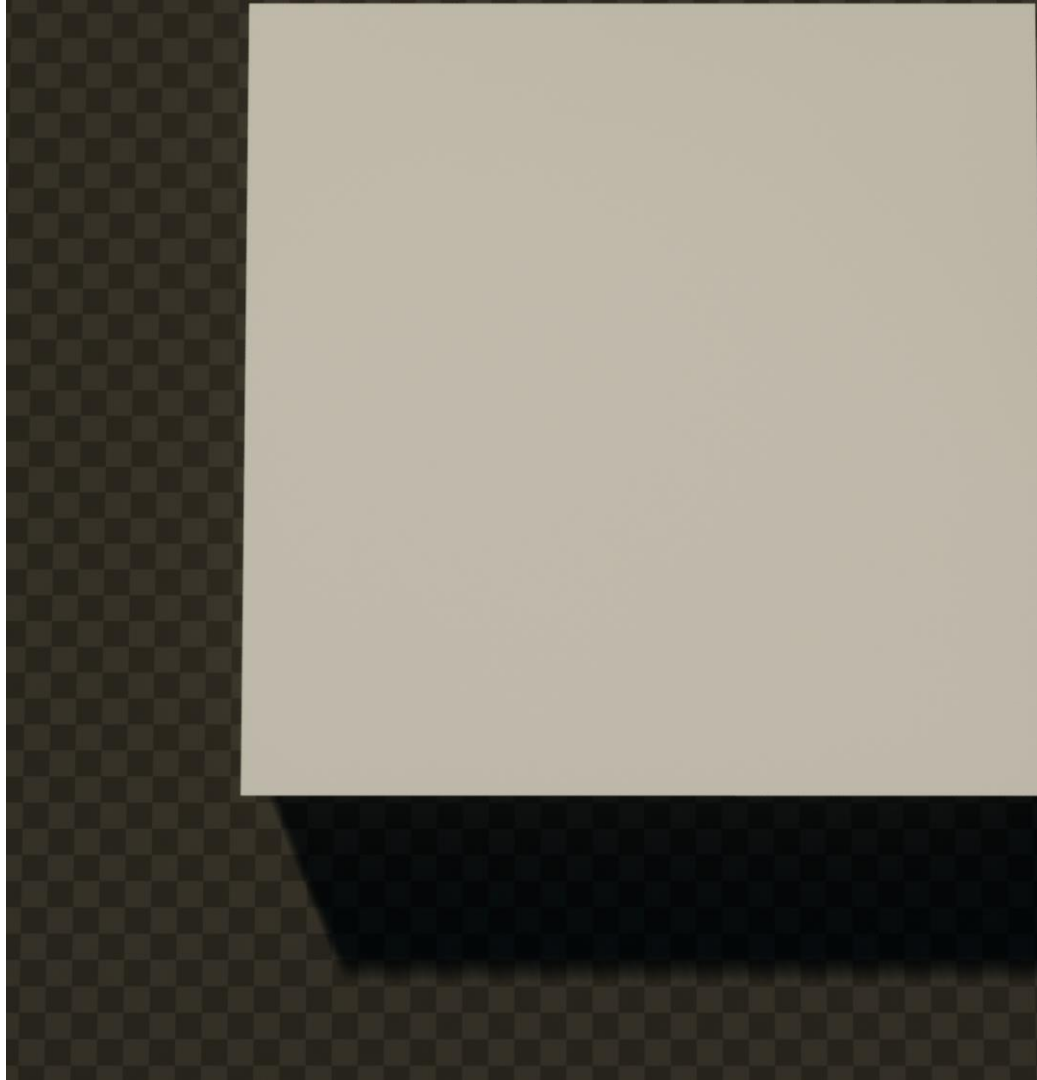


























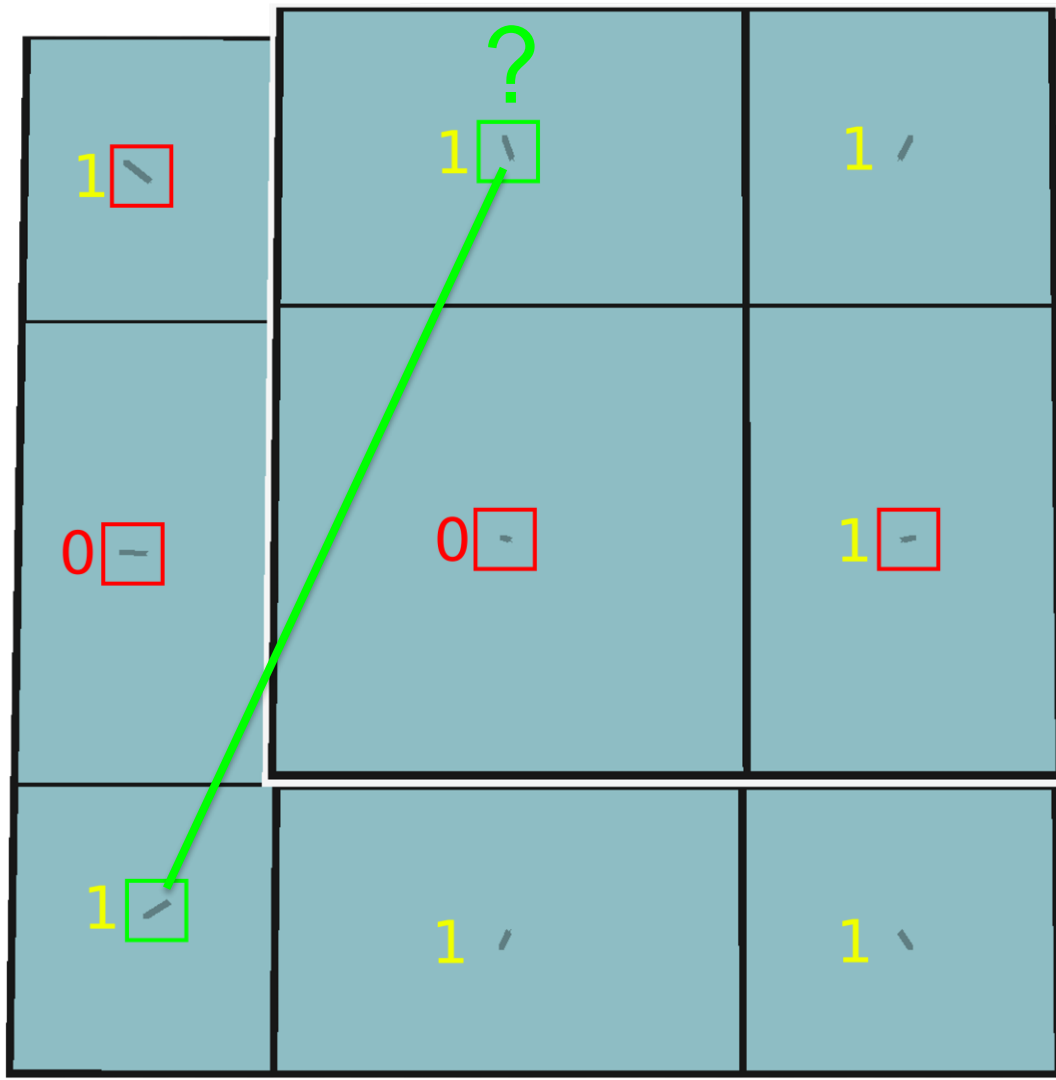


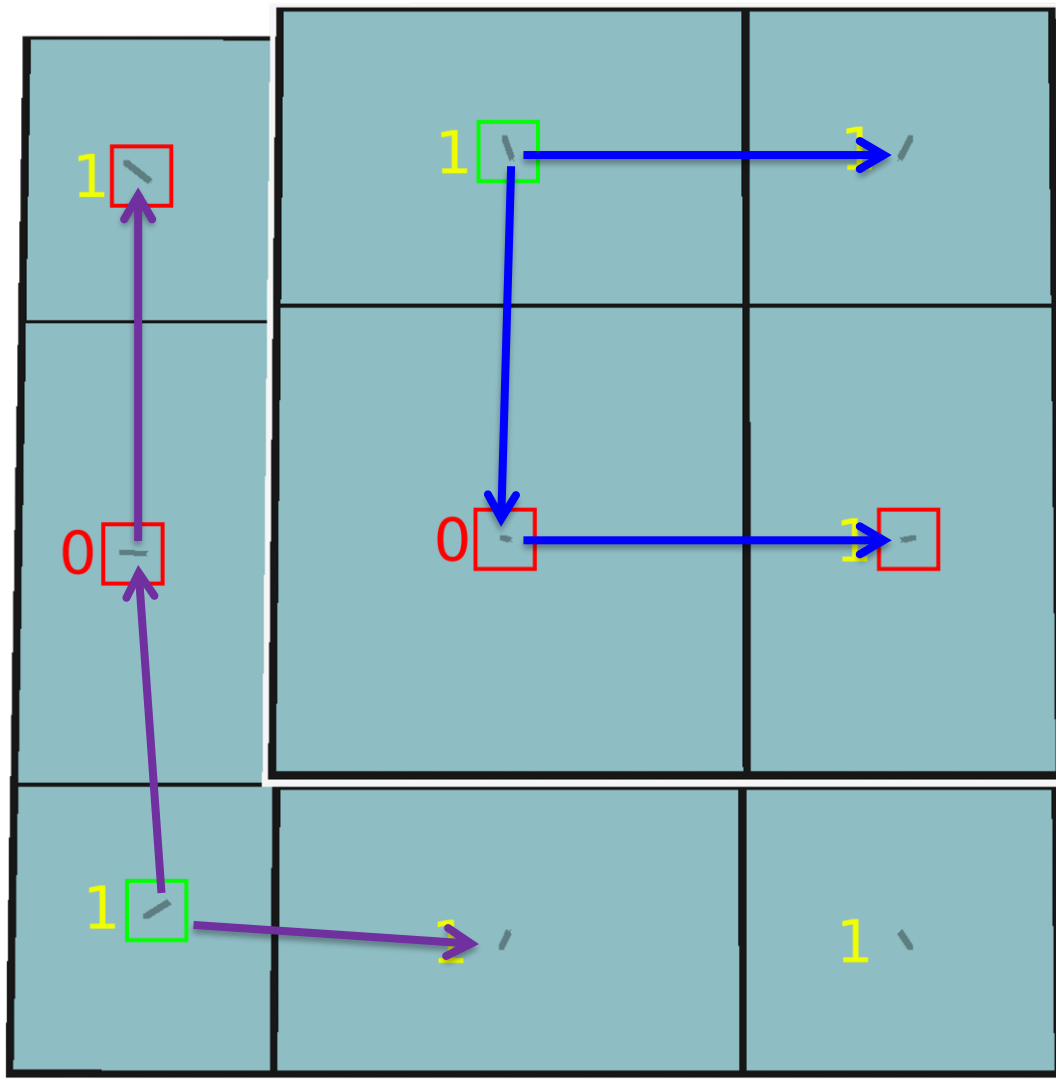











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




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LIVING WORLDS

Realms need to “feel alive and teeming with life”



DYNAMIC SPAWNING POINTS





POINTS OF INTEREST



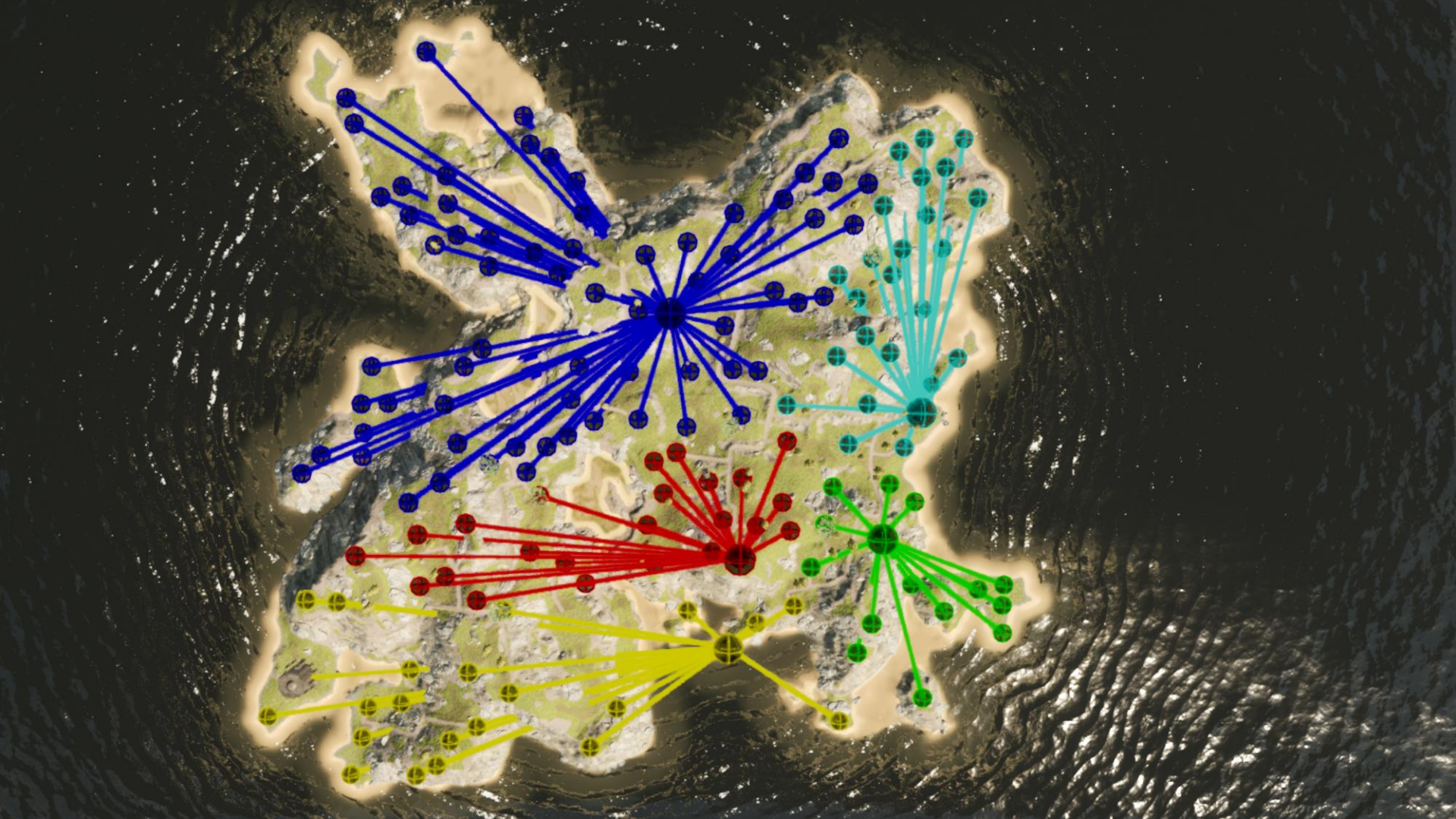


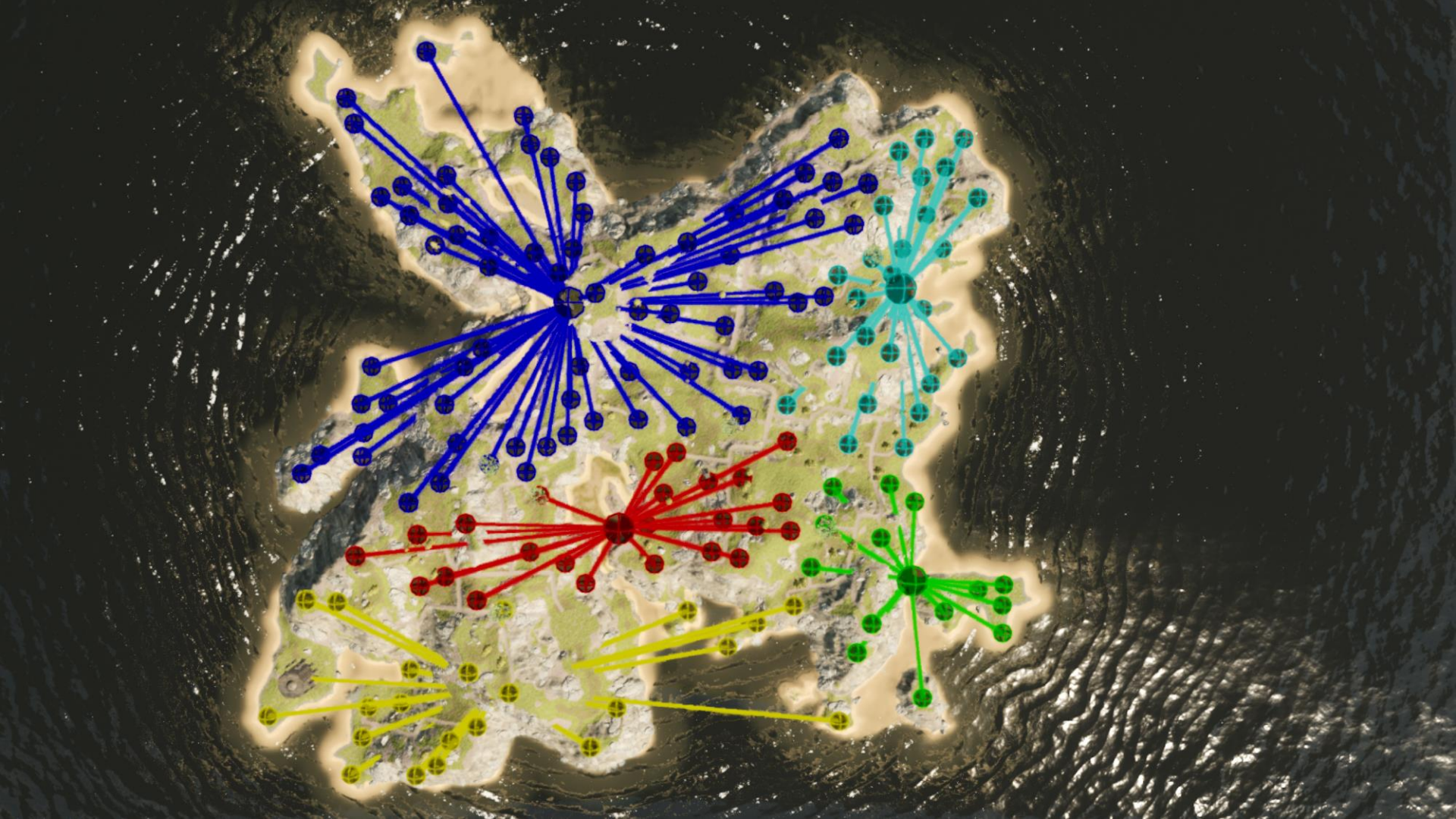


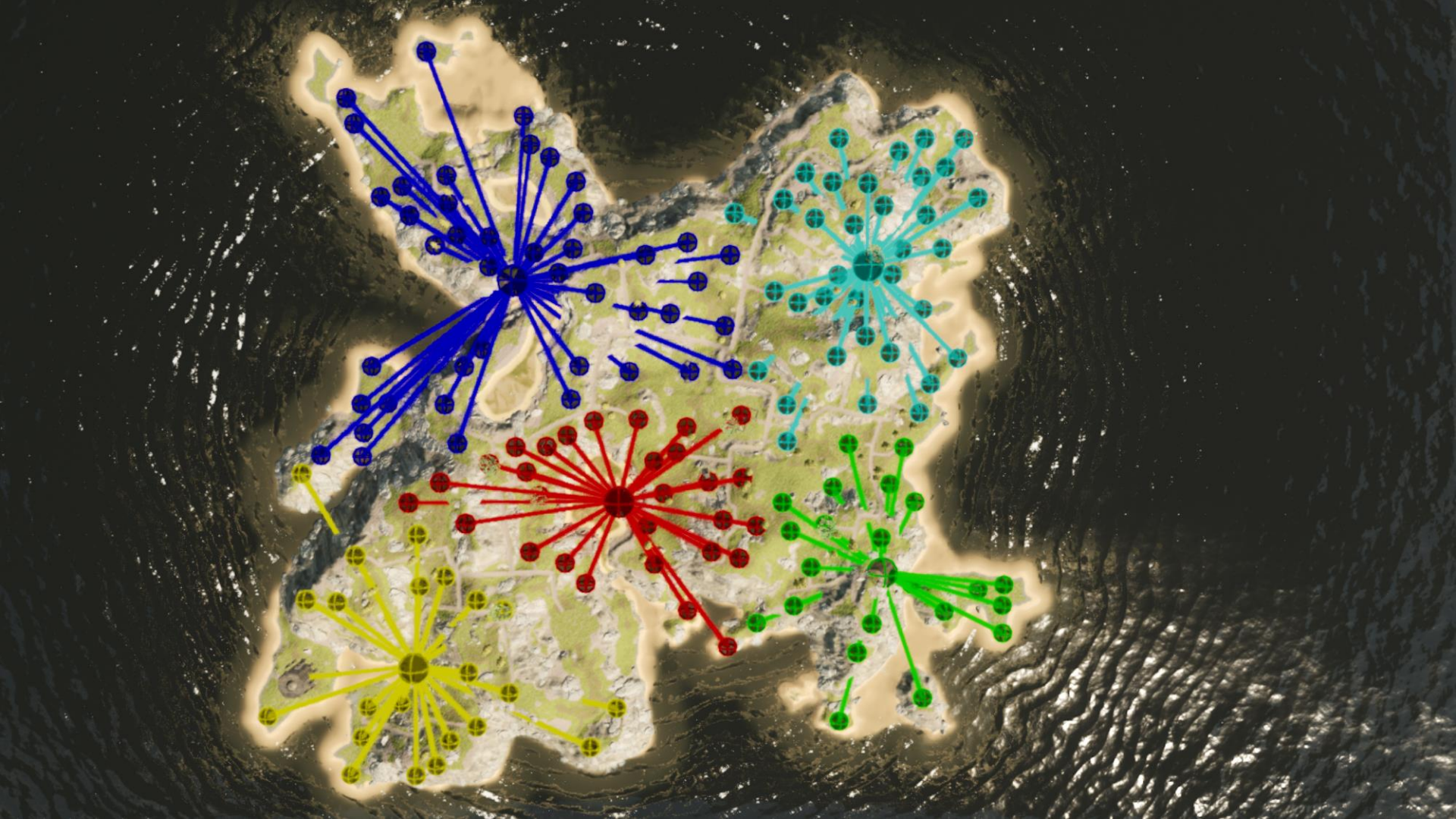
K-MEANS CLUSTERING

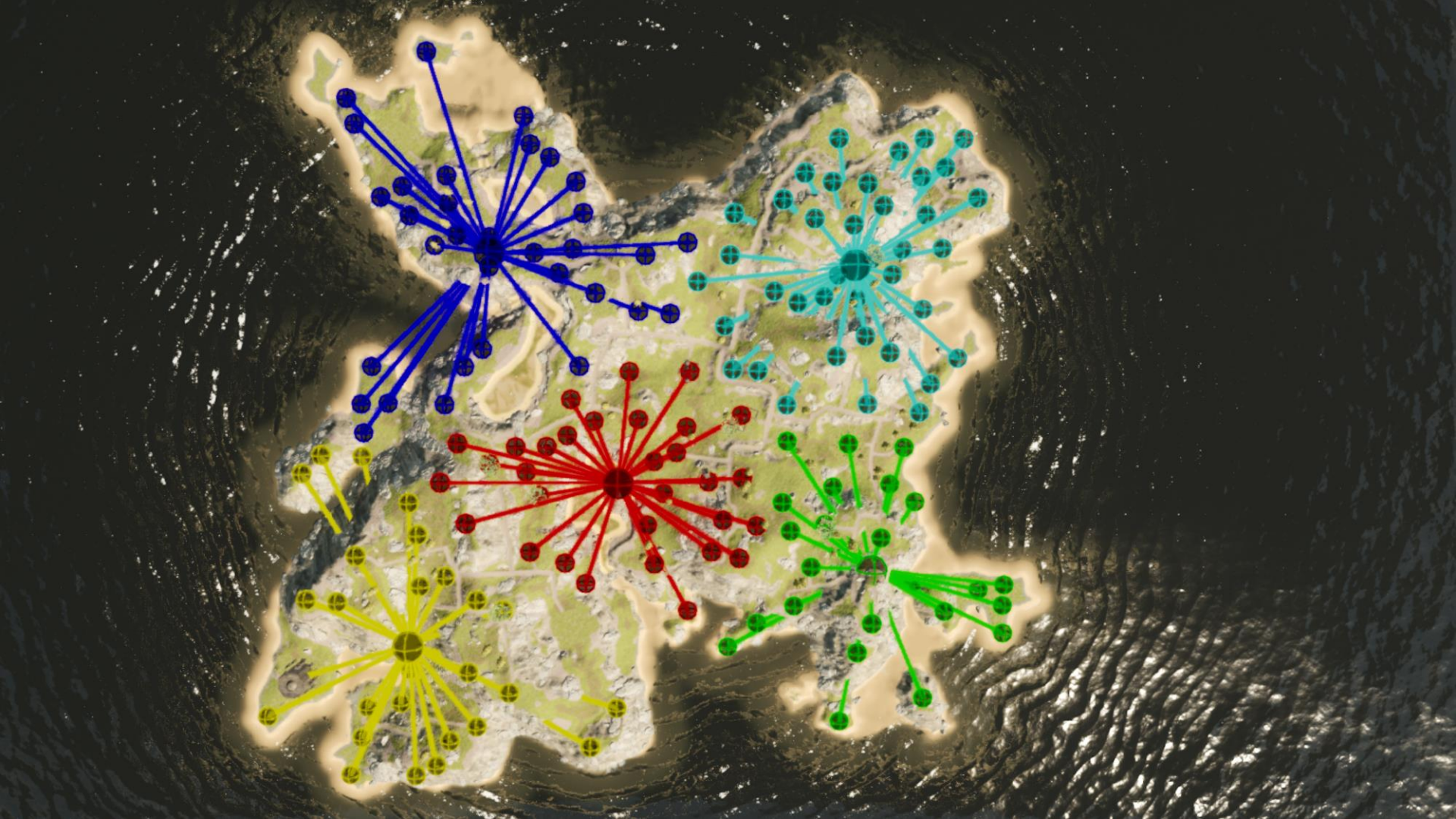


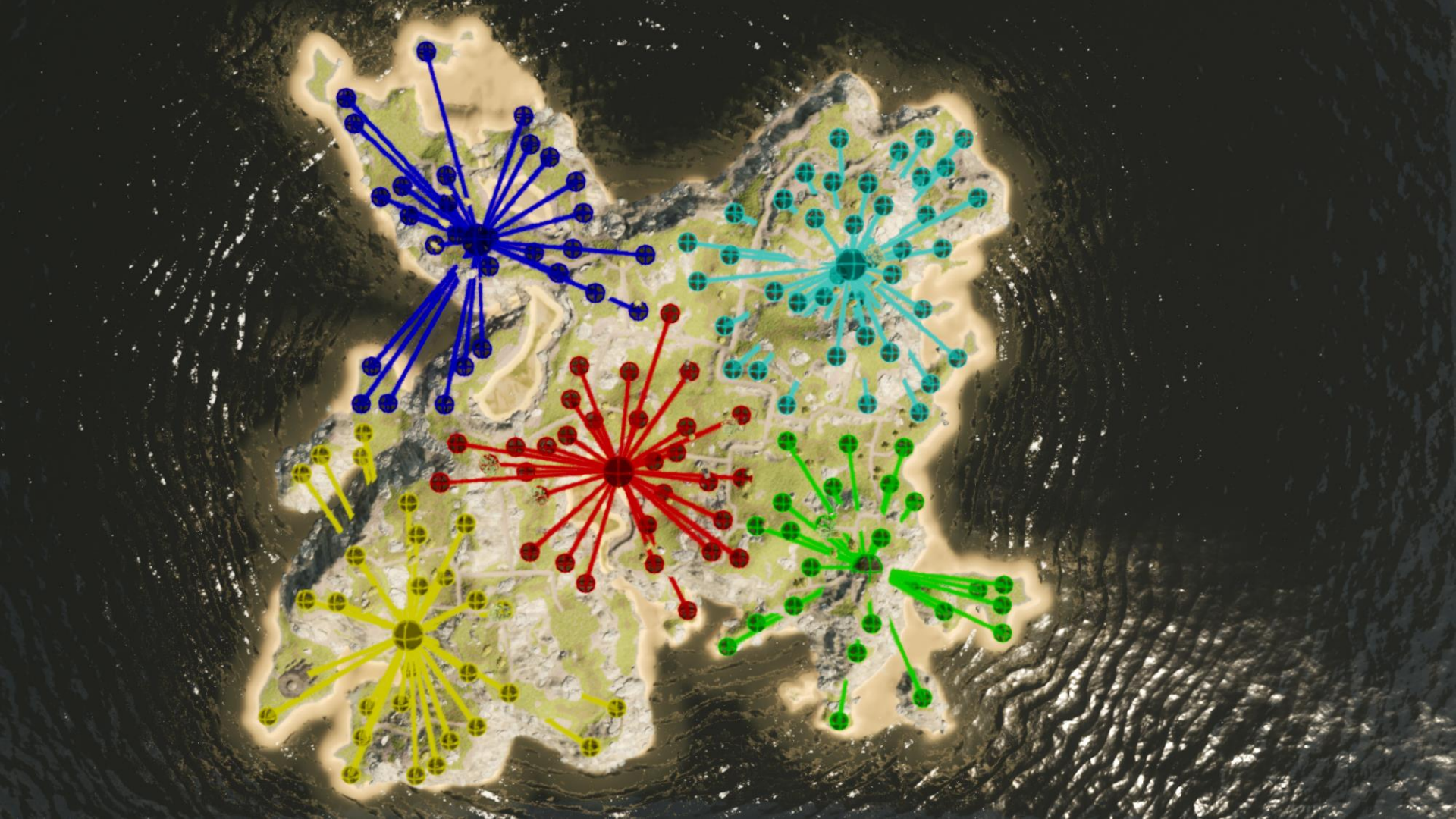


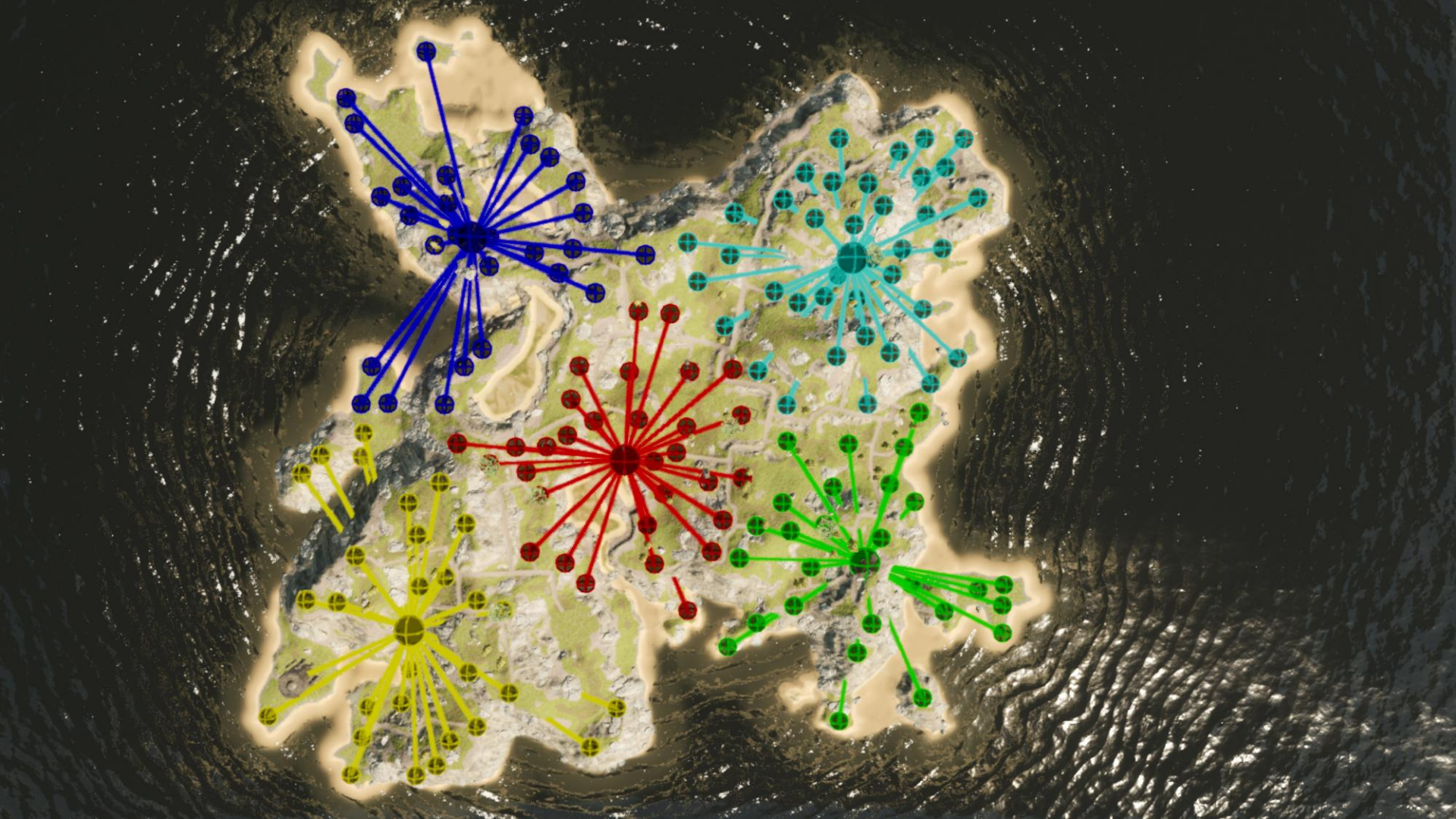














SUMMARY

- Adding an Abstract graph on top of Recast enables:
 - Longer distance pathfinding with terrain preferences
 - More efficient custom queries
 - Find closest unit
 - Connectivity Graph (Connected Components)
- Use K-means clustering to evenly distribute creature population in 3D space



Demos and more information:
<https://www.movingai.com/gdc23>



<https://www.playnightingale.com>