Visualization of OSGi based Software Architectures in Virtual Reality

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DLR

eclipsecon Europe 2018

OSGi™ Community Event 2018

Introduction

Intelligent and Distributed Systems
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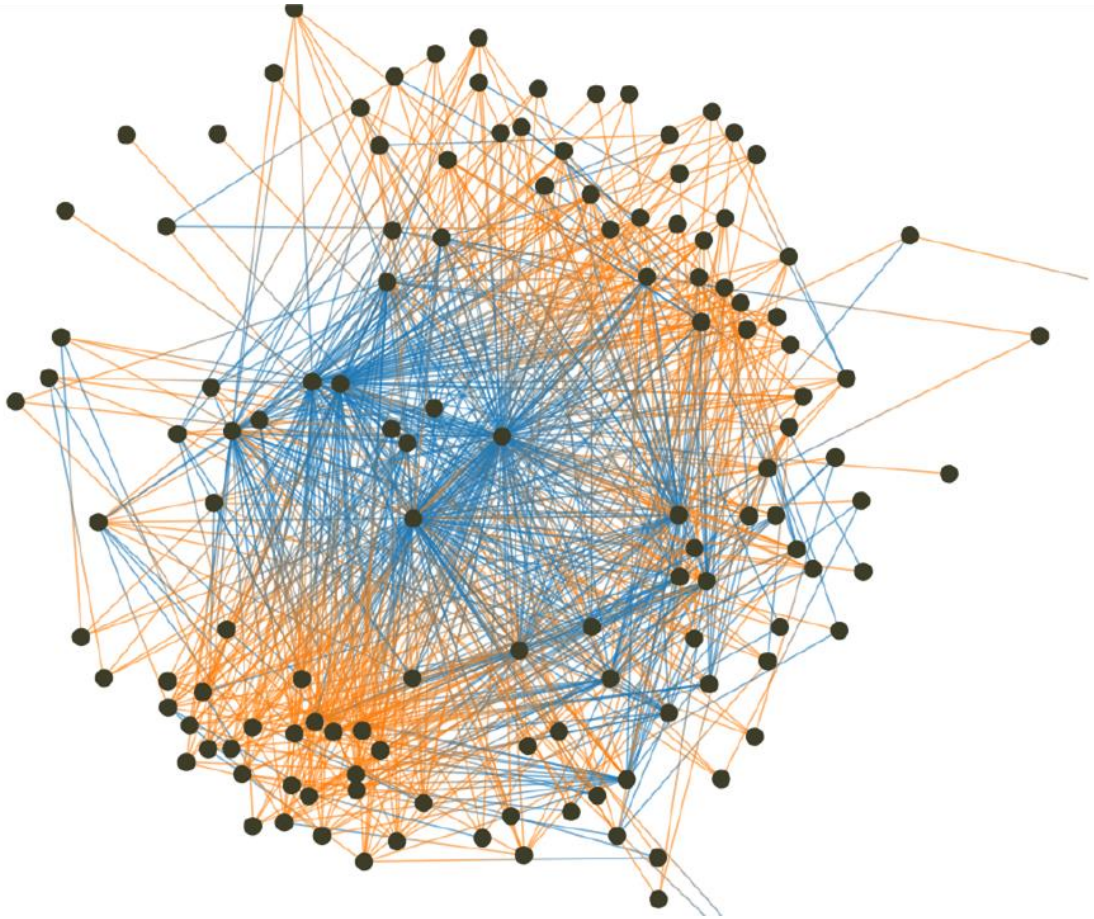
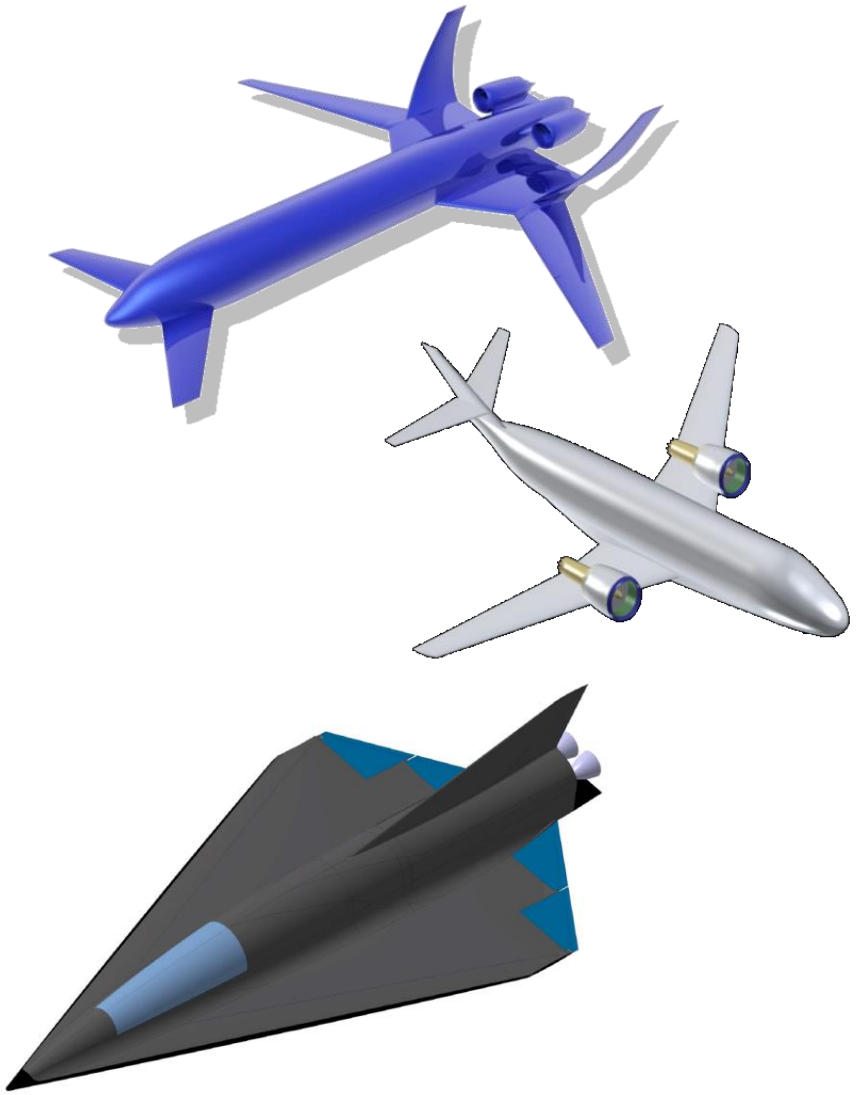
Pointing out Problems

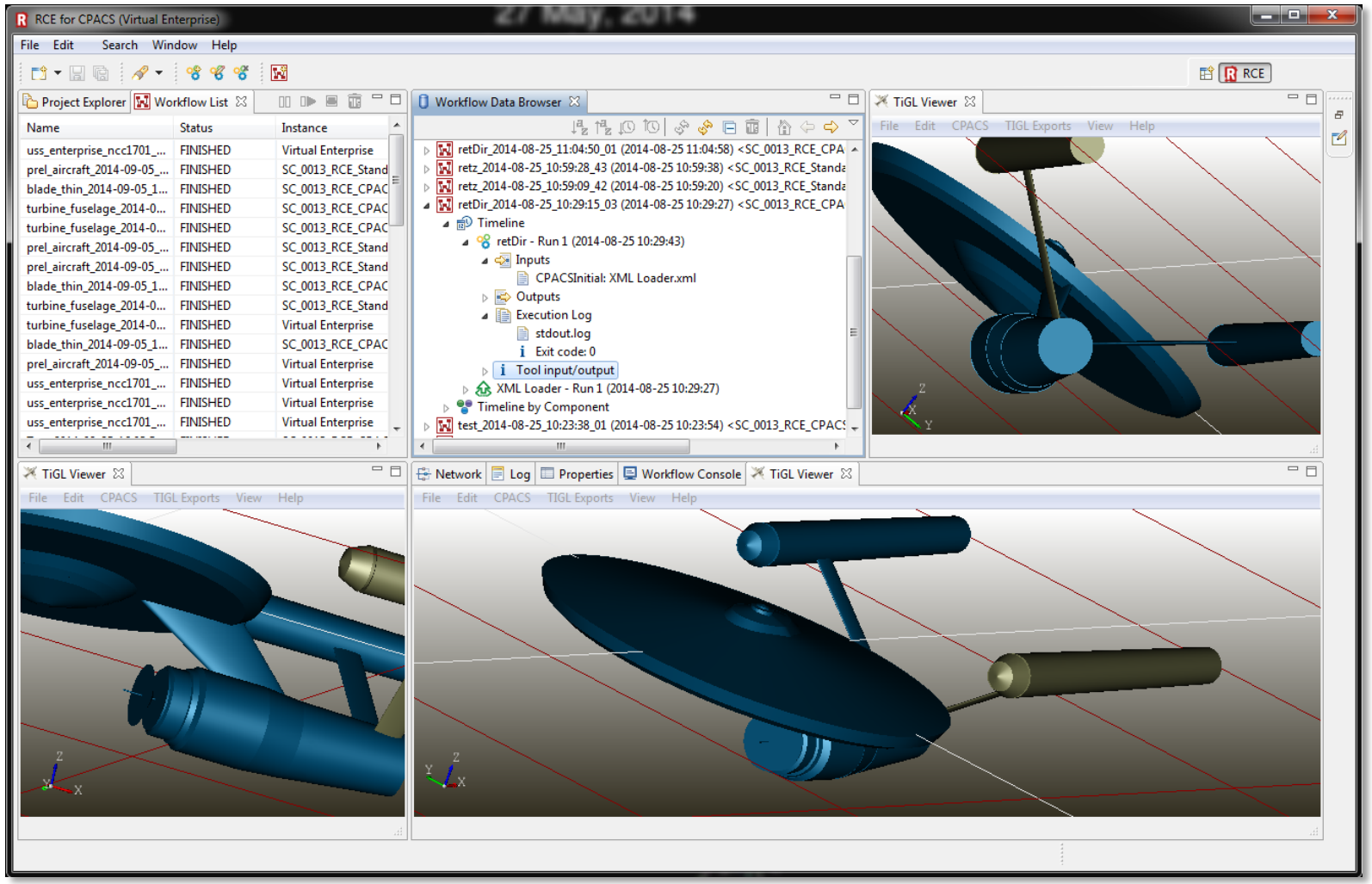
- Visualization of Software Architectures: Large projects can become confusing
- Complex Systems: Uncluttered
- 2D Visualization: Less information



Software Dependencies

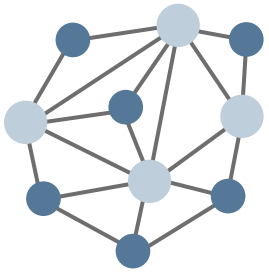
Software Projects in Space and Aerospace



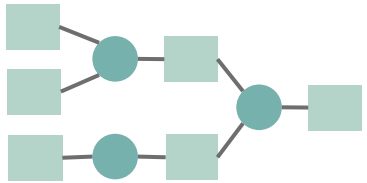


DLR

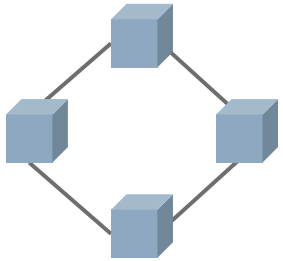
Research Topics – DLR Intelligent and Distributed Systems



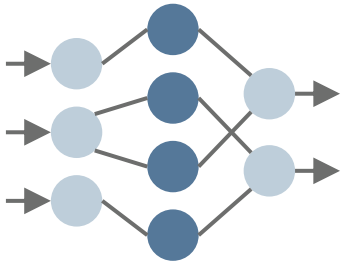
Distributed Systems



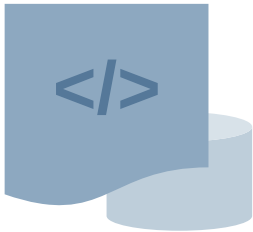
Workflows & Provenance



Blockchains



Machine Learning



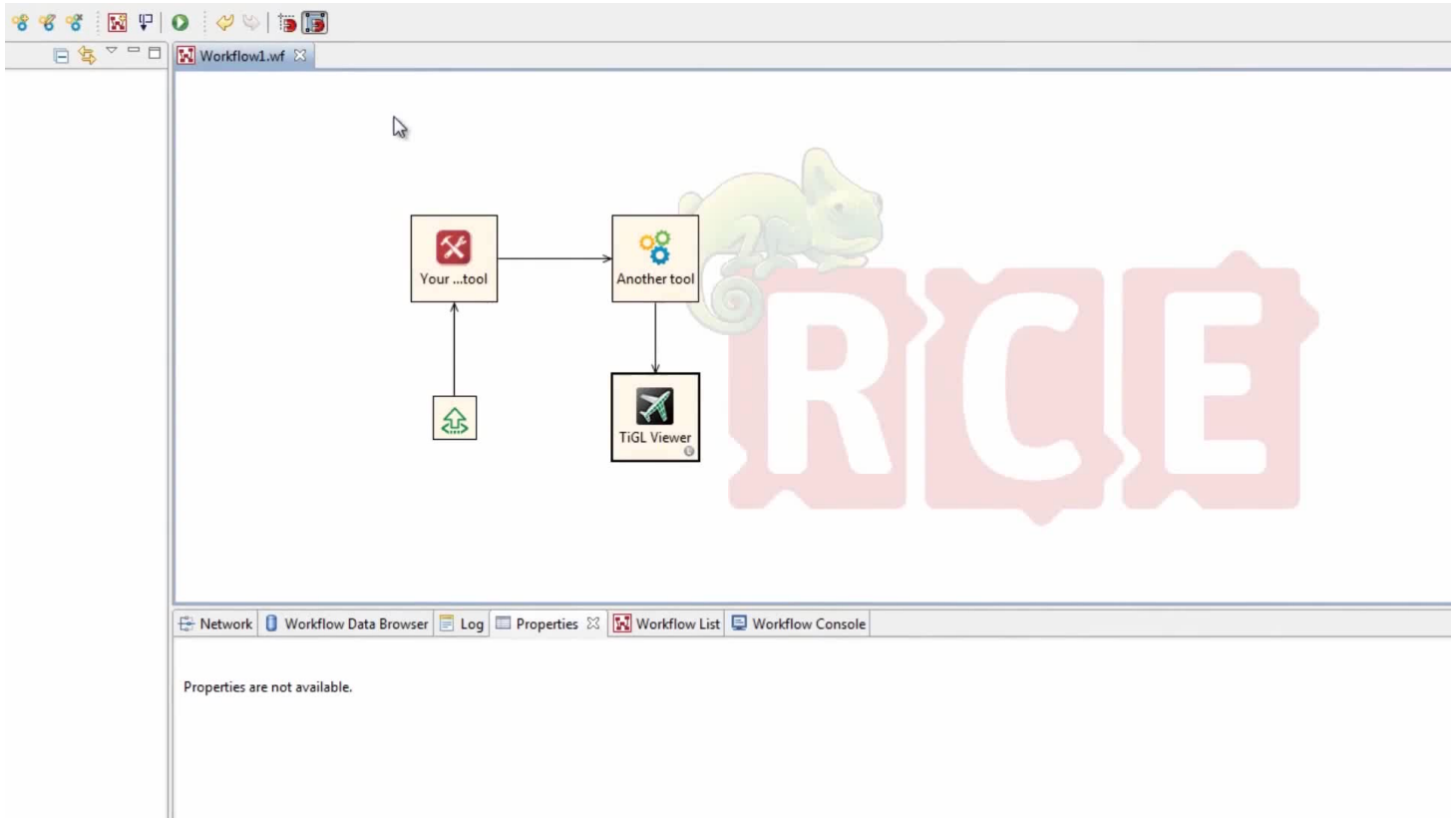
Software Engineering

Software Analytics

Distributed Integration System

Remote Component Environment

- Language Java
- Platform RCP
- Framework OSGi

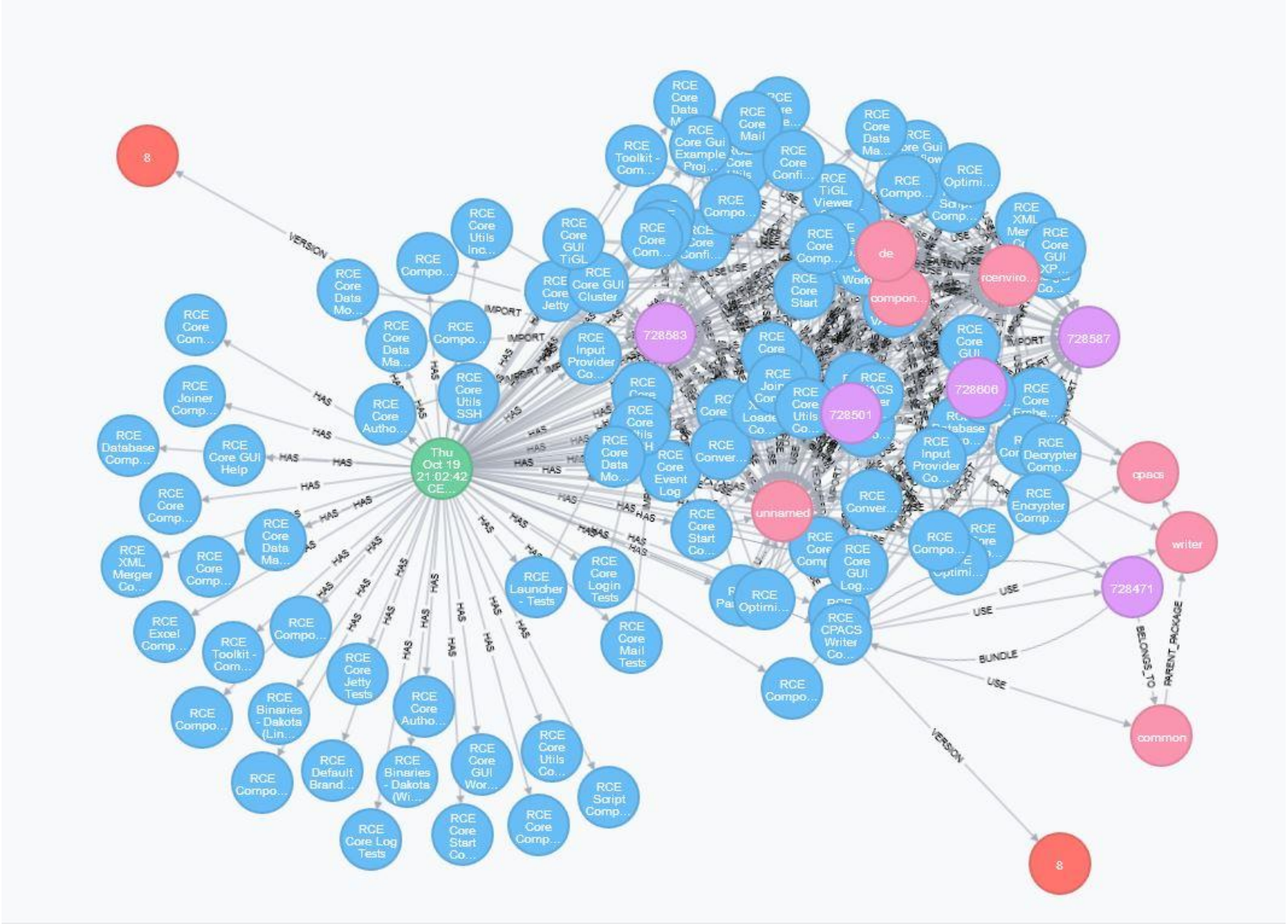


http://rcenvironment.de/

Software Engineering

Focus on..

- Automated Testing
- Repository Mining
- Integration



Software Analytics

Definition

- Human-machine-interface
- Insightful & actionable information
- Tasks
  - software development
  - Systems
  - Users

Software Visualization

Interactive Visualization of OSGi -based Software Architectures

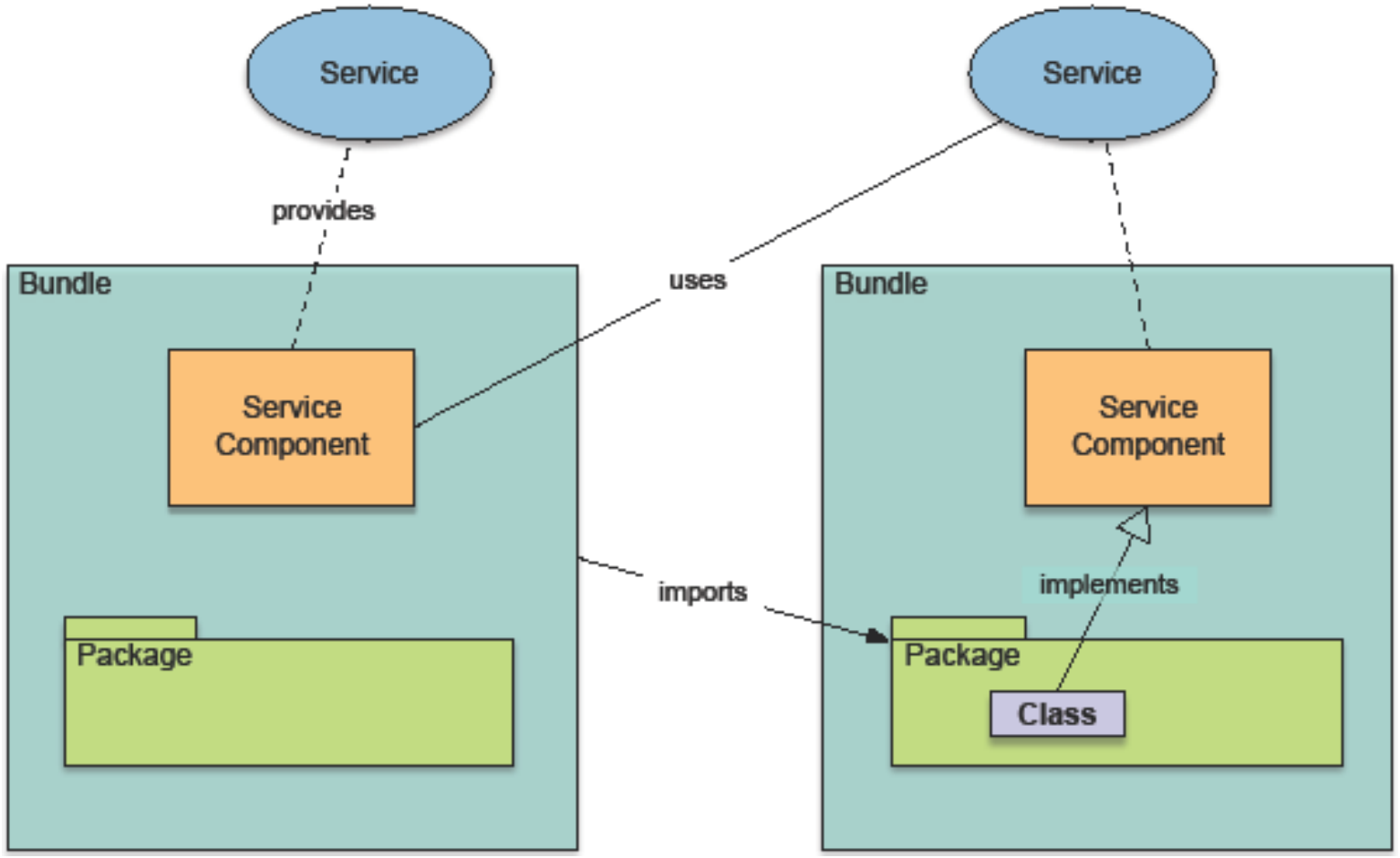
Goals

- Getting an impression of the dimensions of the application
- Introducing a new member of the development team
- Checking for abnormalities in the architecture

Java Framework: OSGi

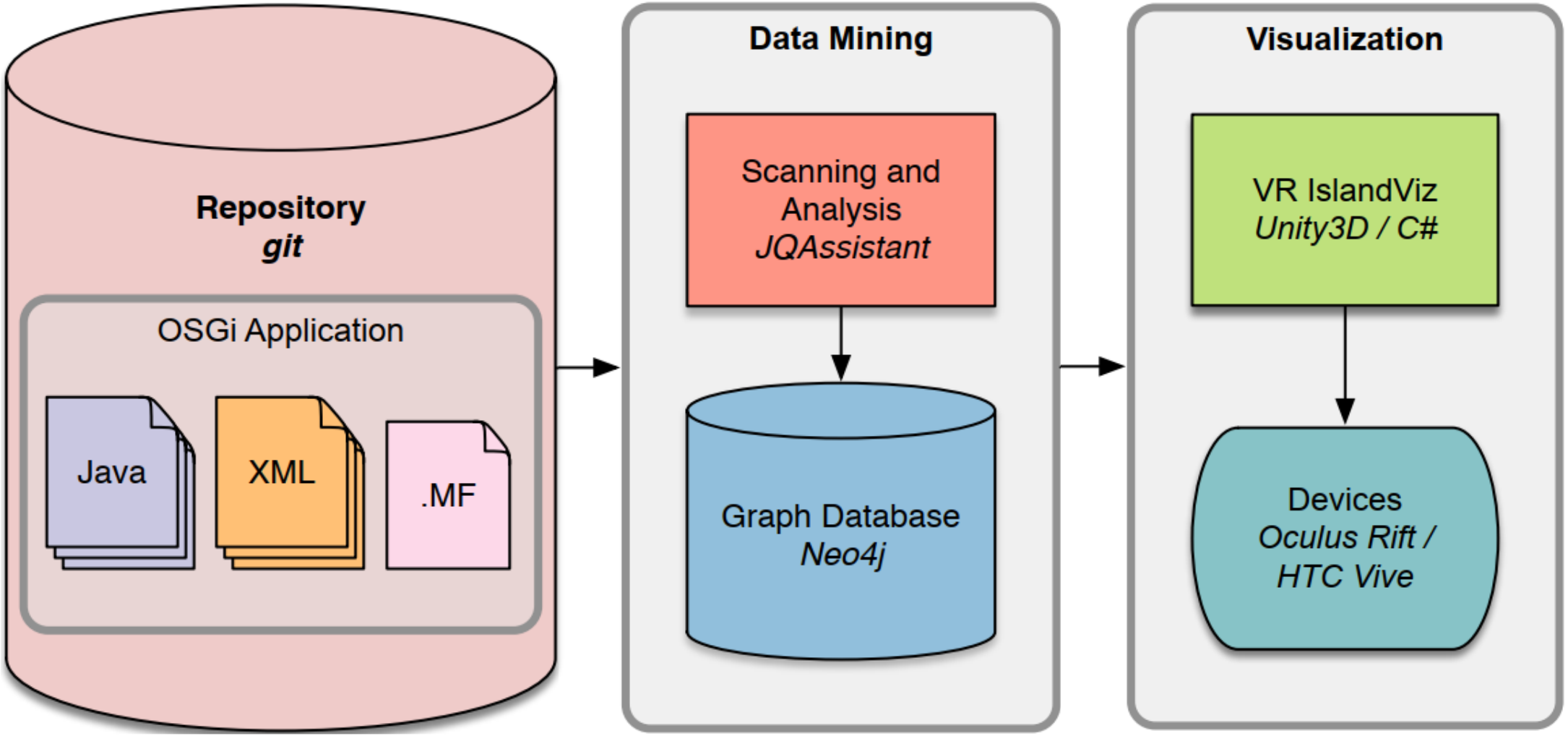
Components & Dependencies

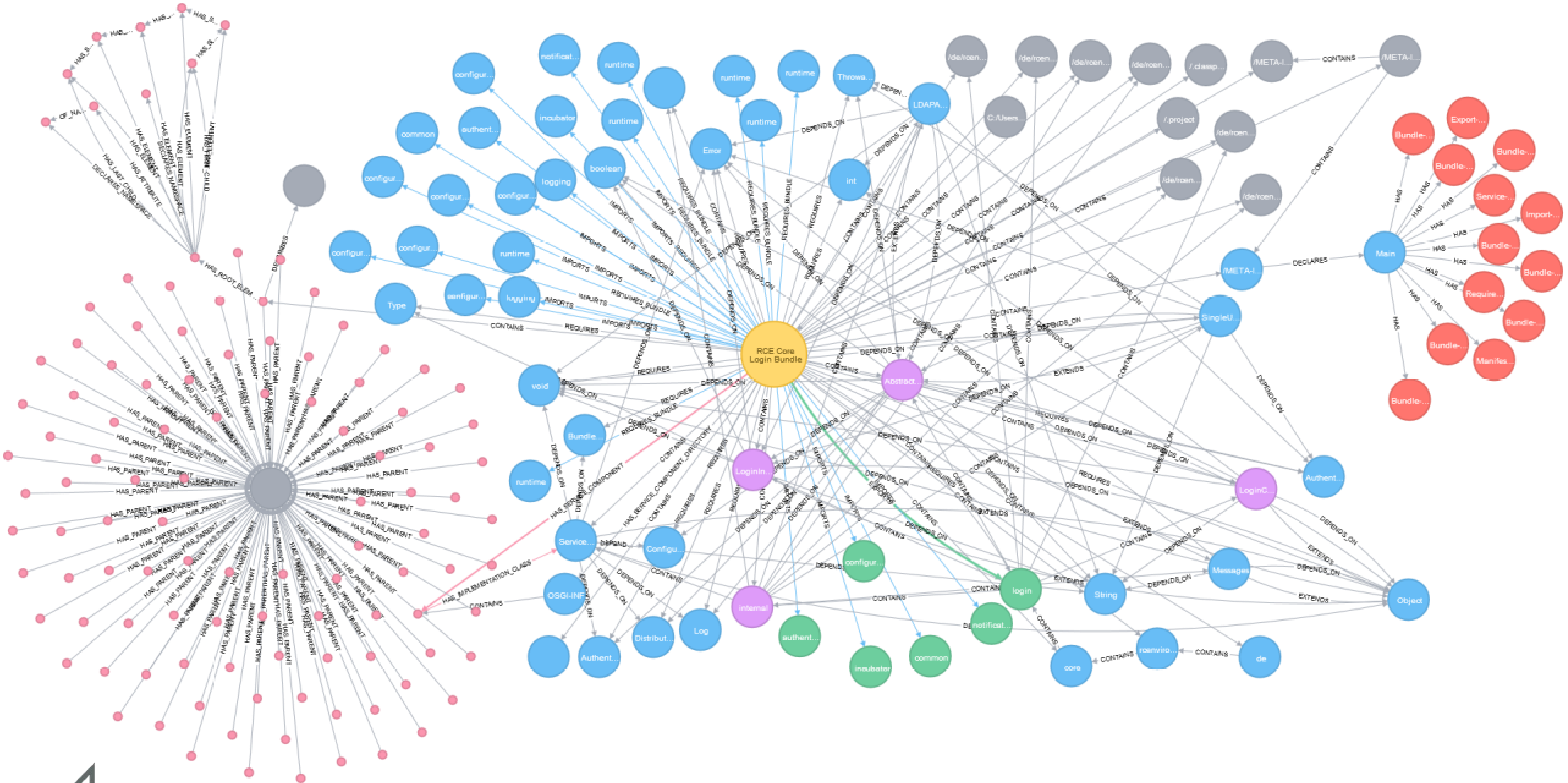
- Bundle
- Package
- Service
- Class



Source: D. Seider, A. Schreiber, T. Marquardt and M. Brüggemann, "Visualizing Modules and Dependencies of OSGi-Based Applications," 2016 IEEE Working Conference on Software Visualization (VISSOFT), Raleigh, NC, 2016, pp. 96-100.

Software Analytics – Source Code Analysis and Repository Mining




RCE Core Login Bundle
LDAPA...
Error
int
Throwa...
Abstract...
LoginIn...
LoginC...
SingleU...
Authent...
Object
String
Messages
login
core
roenviro...
de
internal
Service...
Configu...
OSGI-INF
Distribut...
Log
void
Type
Bundle...
Main
/META-I...
/de/roen...
C:/Users
/.project
/.classp...
Export-...
Import-...
Manifes...
Require...
DECLARES
CONTAINS
DEPENDS_ON
IMPORTS
REQUIRES
EXTENDS
HAS_PARENT
HAS

Visualization in 2D: Dependencies of Key Bundles

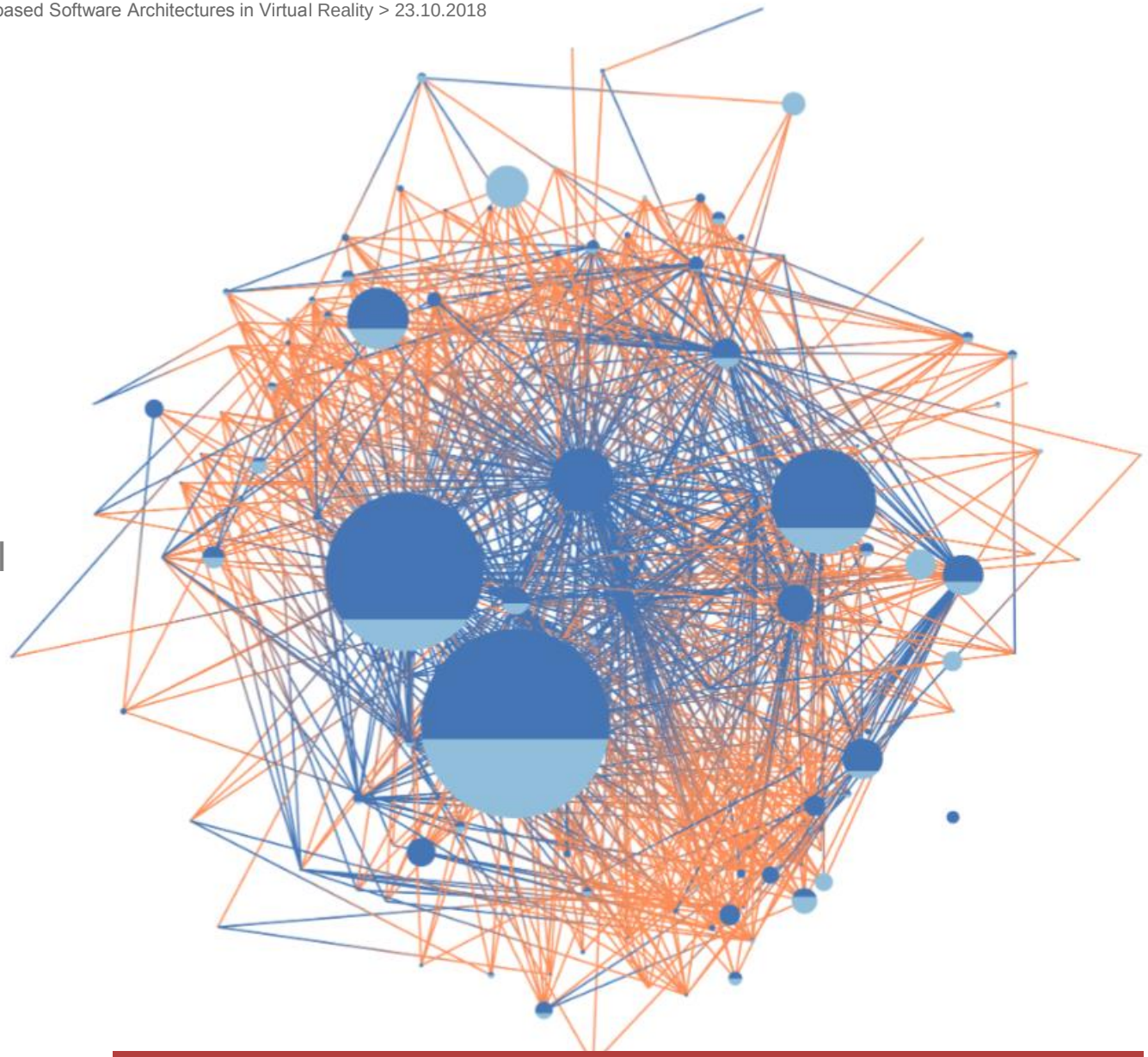
Pro

✓ Bundle size visualized

Cons

✗ Less information of all components
- Bundle name
- Packages name
- Class name

✗ Only 2 components visualized



Source: D. Seider, A. Schreiber, T. Marquardt and M. Brüggemann, "Visualizing Modules and Dependencies of OSGi-Based Applications," 2016 IEEE Working Conference on Software Visualization (VISSOFT), Raleigh, NC, 2016, pp. 96-100.

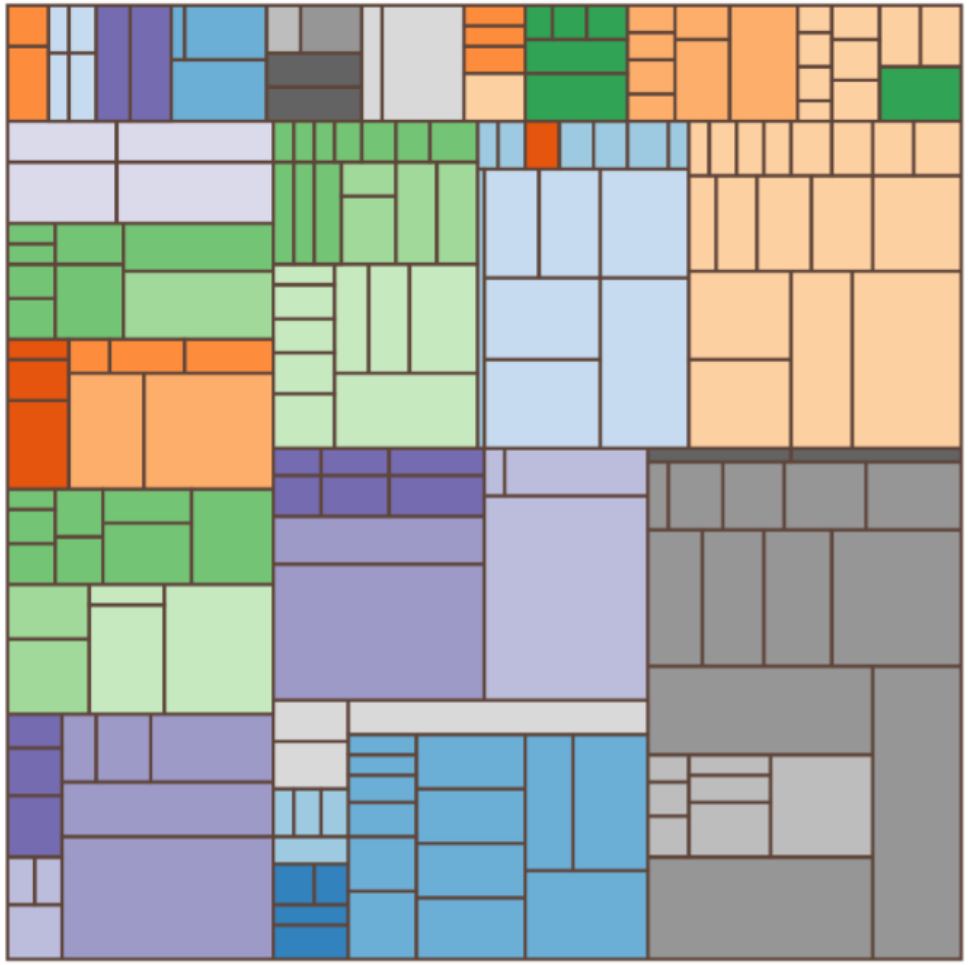
Visualization in 2D: Package Structure of a Bundle

Pro

- ✓ Packages size visualized
- ✓ Class size visualized

Cons

- ✗ Less information of all components
  - Bundle name
  - Packages name
  - Class name
- ✗ Missing Relationships
  - Import & Export of Packages



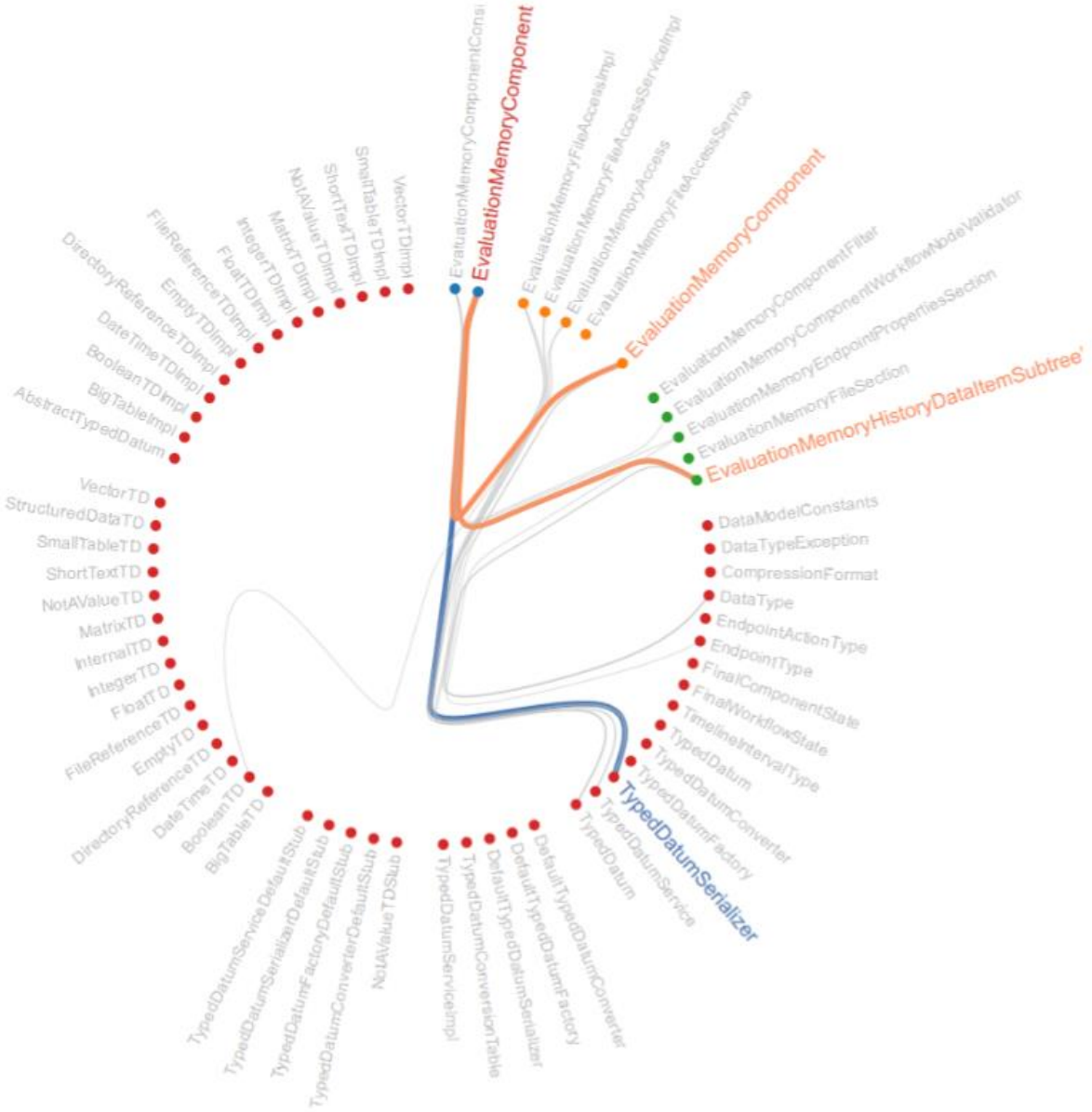
Visualization in 2D: Dependencies Between Classes

Pro

- ✓ Shows Bundle Dependencies

Cons

- ✗ Missing Dependencies between & inside packages
- ✗ Confusing for large projects



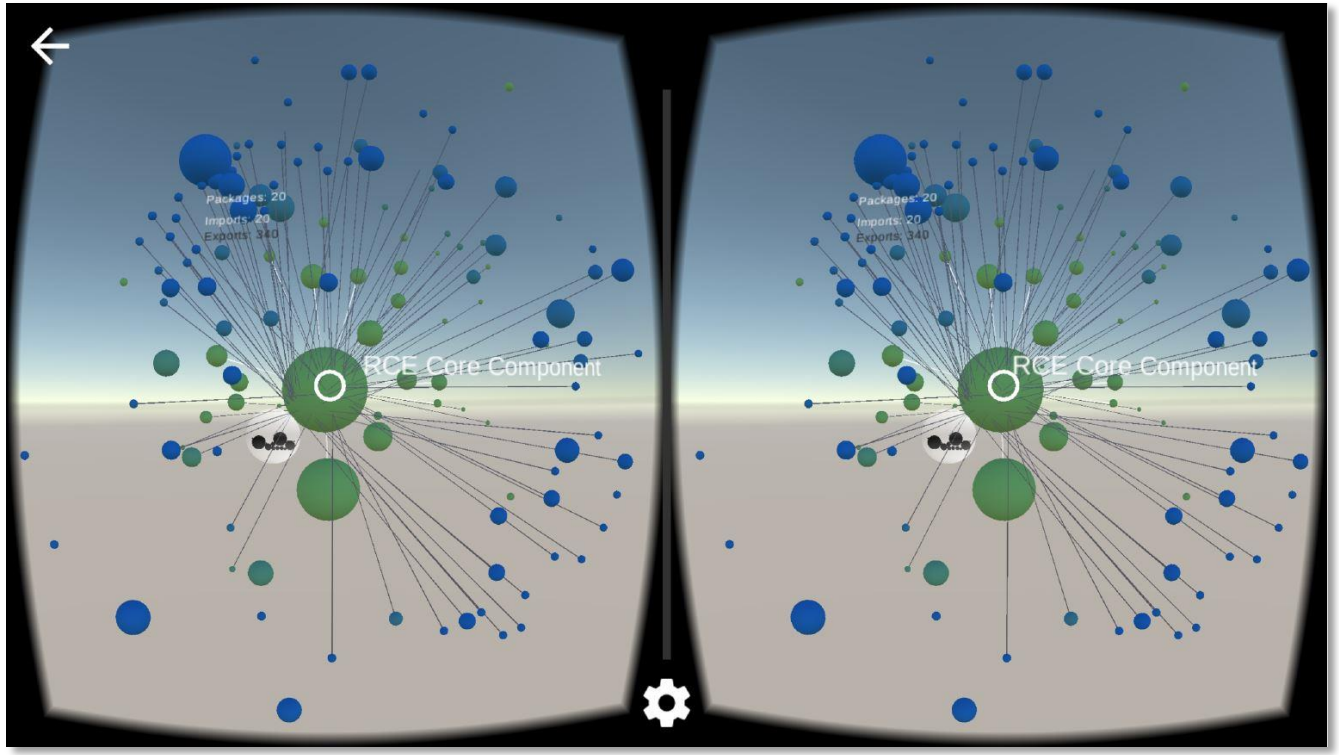
Visualization in VR: Prototype App “OSGiViewer”

Pro

- ✓ Third dimension
- ✓ Shows depencencies

Cons

- ✗ Less information of all components
  - Packages name
  - Class name



Technology

Microsoft HoloLens

HTC Vive

Oculus Rift

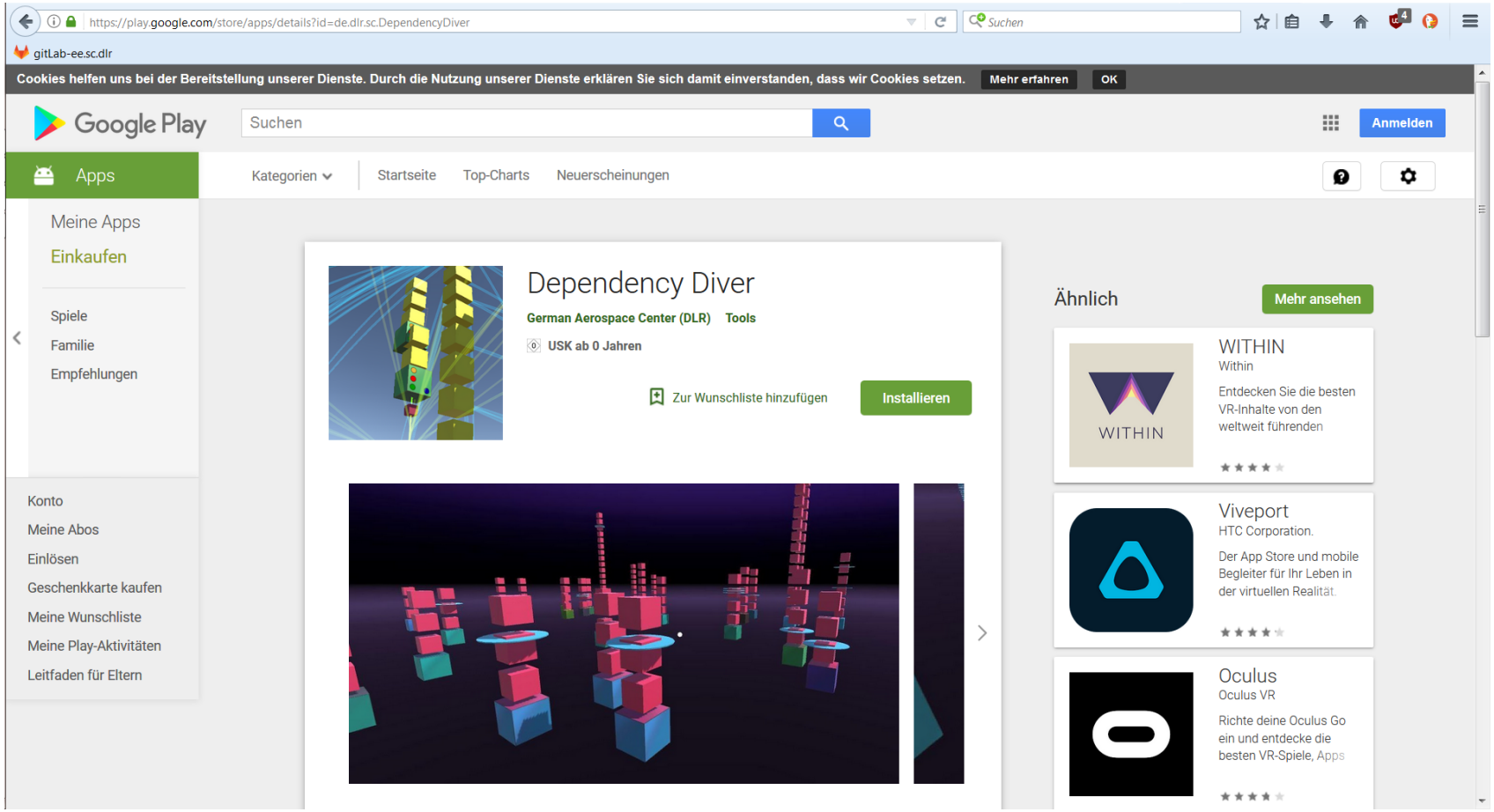
Tobii Eye Tracking

Virtual Reality & Augmented Reality

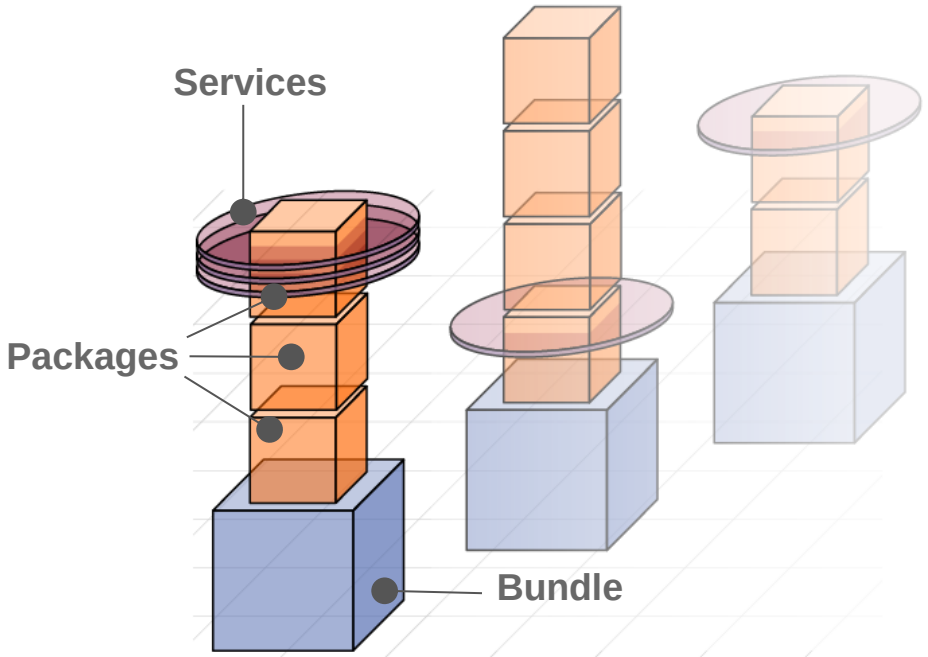
Virtual Reality App – “Dependency Diver“

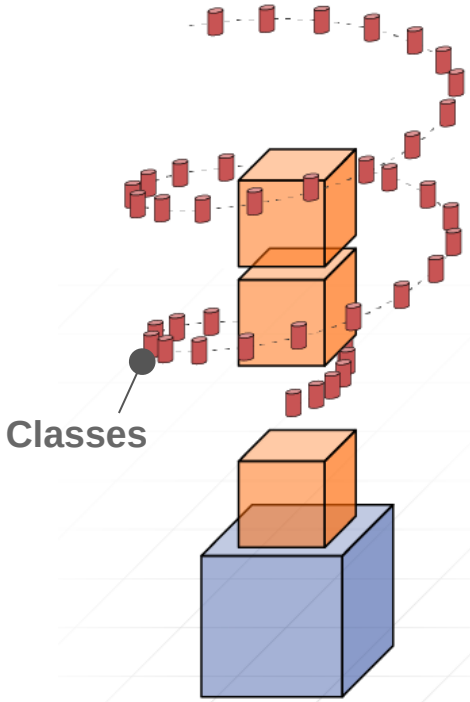
Software Architecture

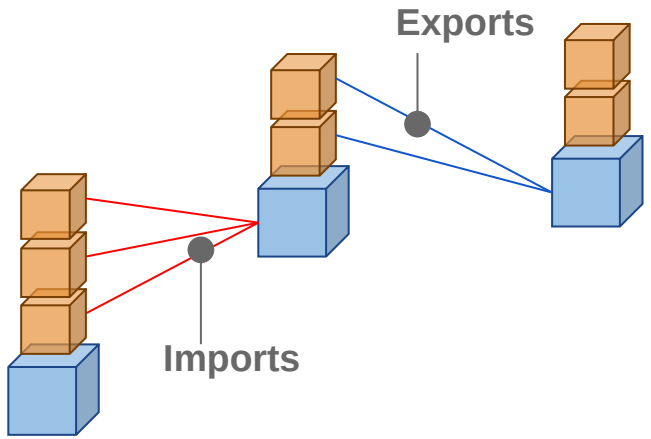
- OSGi Framework
- RCE Project
- Android App (Beta version)
- Motion Sickness



VR Approach 1: Module Stacks







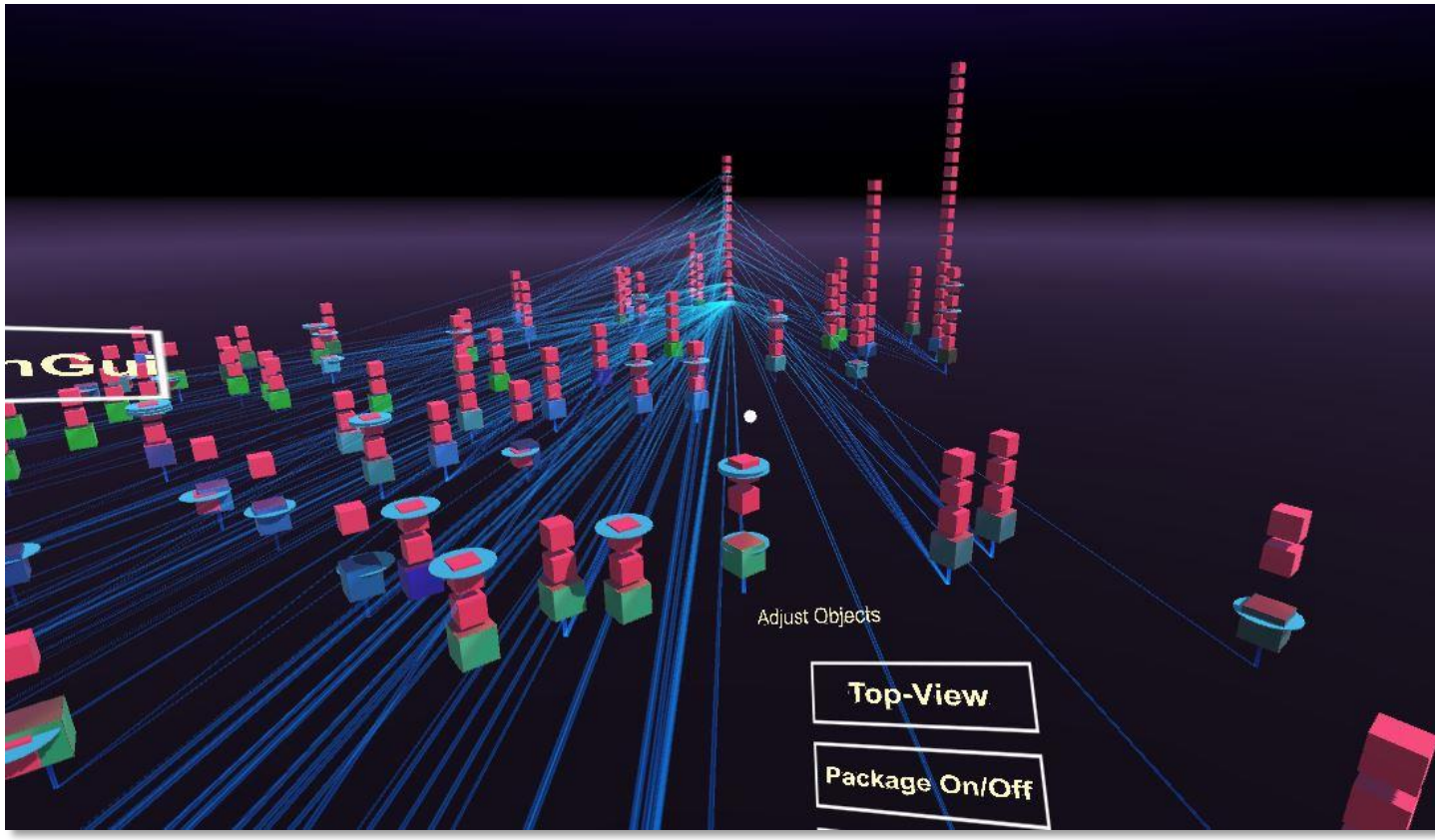
Source: A. Schreiber and M. Brüggemann, "Interactive Visualization of Software Components with Virtual Reality Headsets," 2017 IEEE Working Conference on Software Visualization (VISSOFT), Shanghai, 2017, pp. 119-123.

VR Approach 1: Prototype “Dependency Diver“

Components

- need constant positions
- need a realistic metaphor

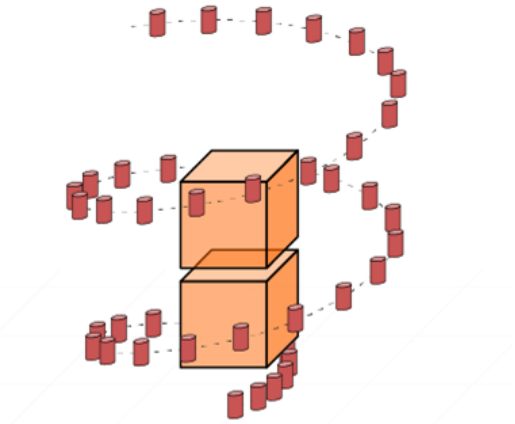
… to reduce **Motion Sickness**



VR Approach 1: Prototype “Dependency Diver“

Components include

- Packages
- Classes



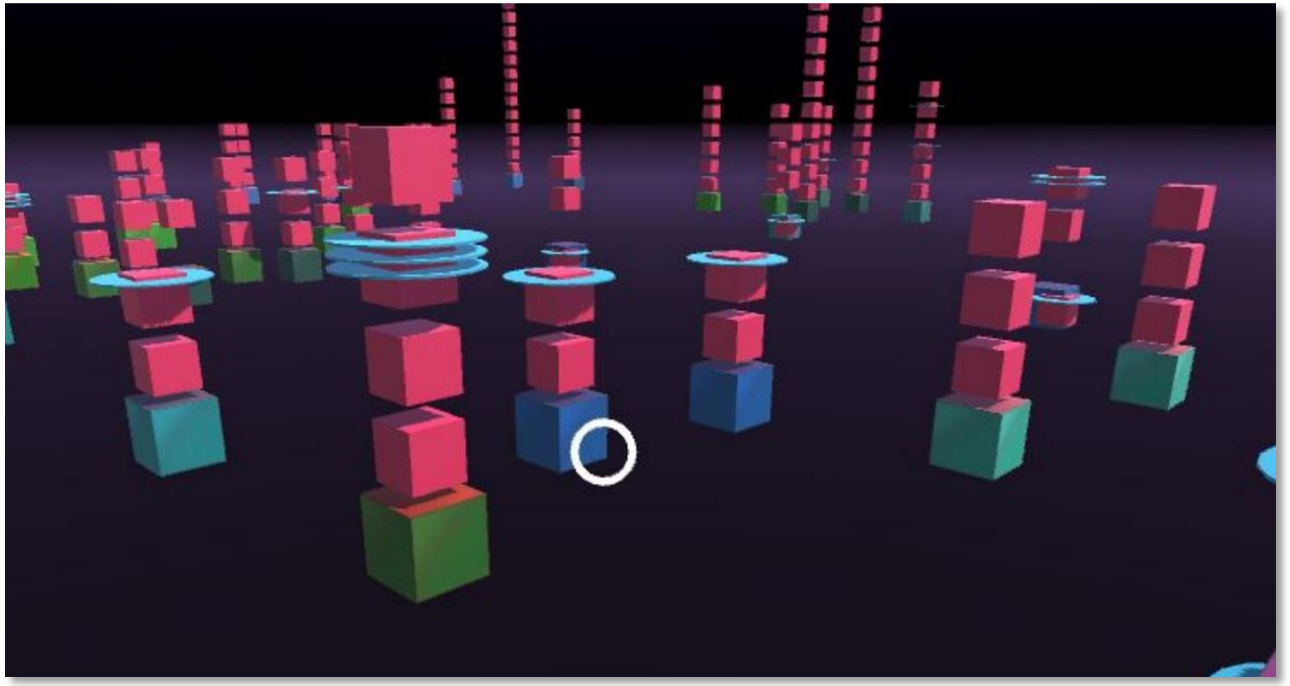
VR Approach 1: Prototype “Dependency Diver“

Pro

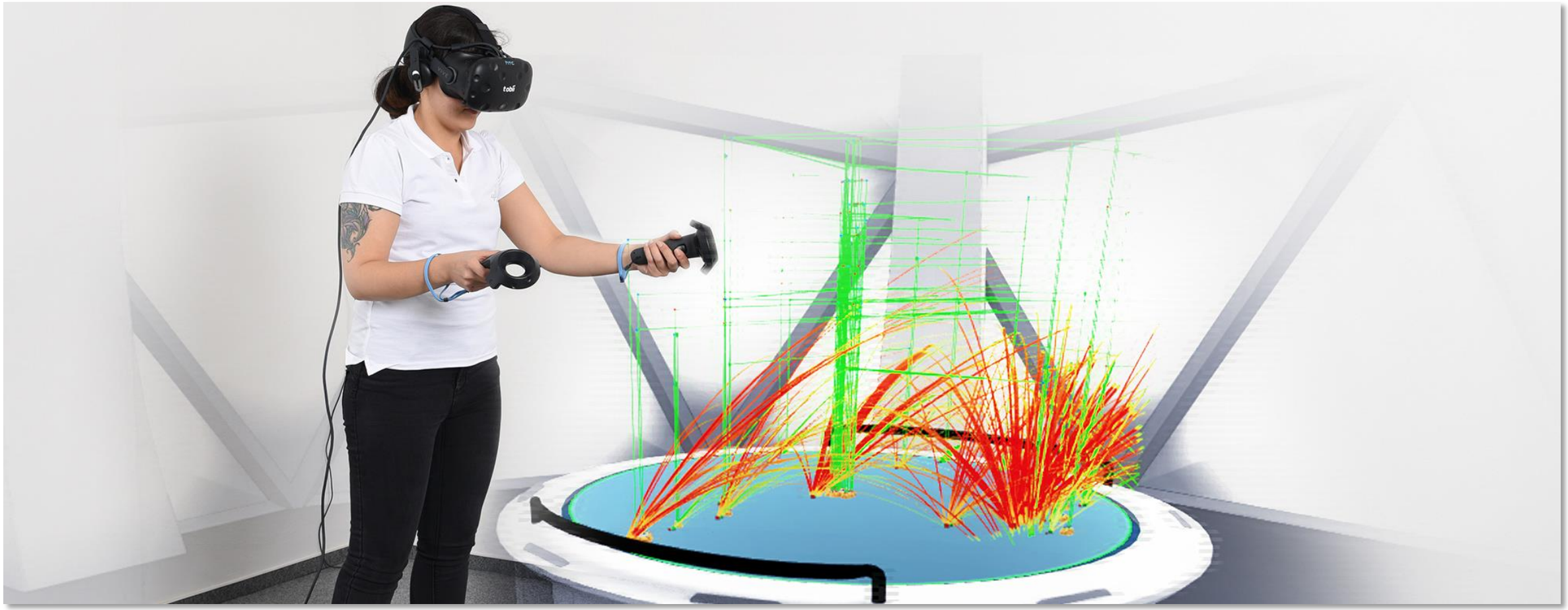
- ✓ Cheap Headsets
- ✓ Interactive App

Cons

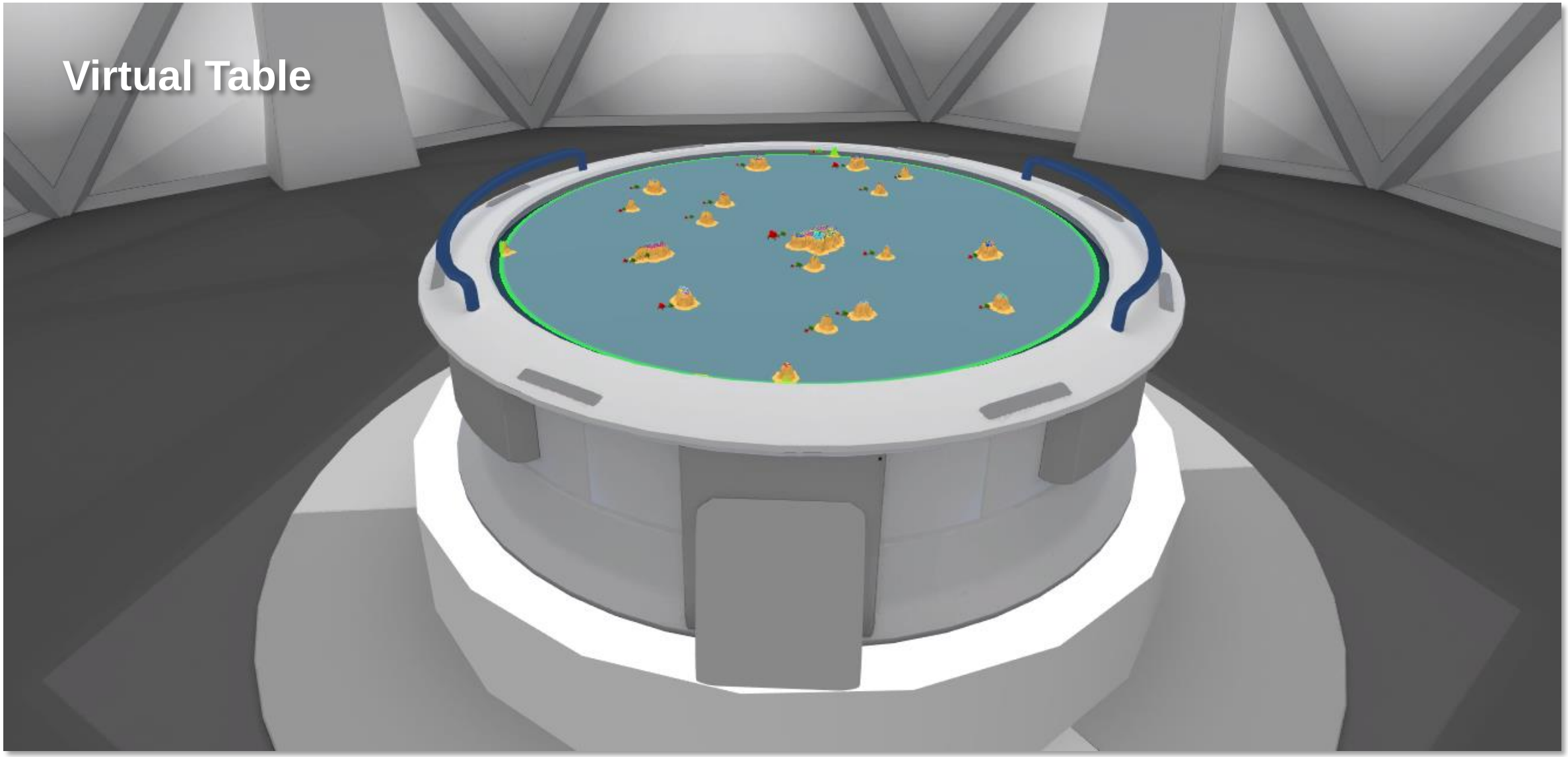
- ✗ Motion Sickness



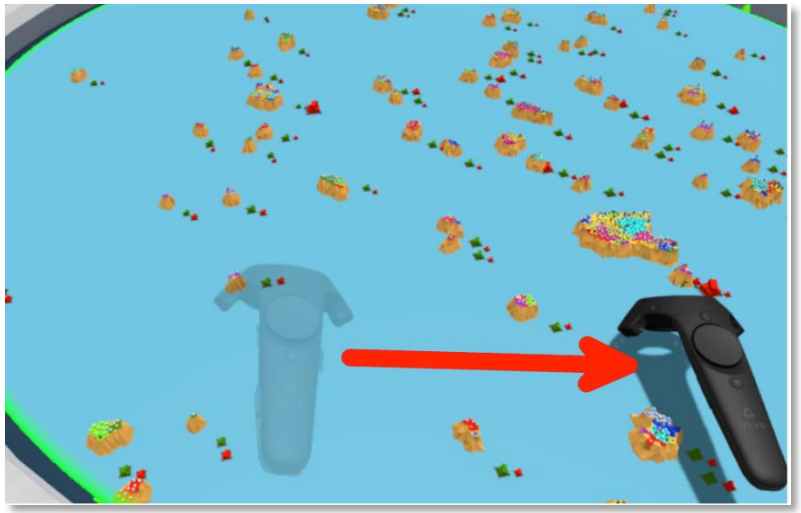
VR Approach 2: „IslandViz“

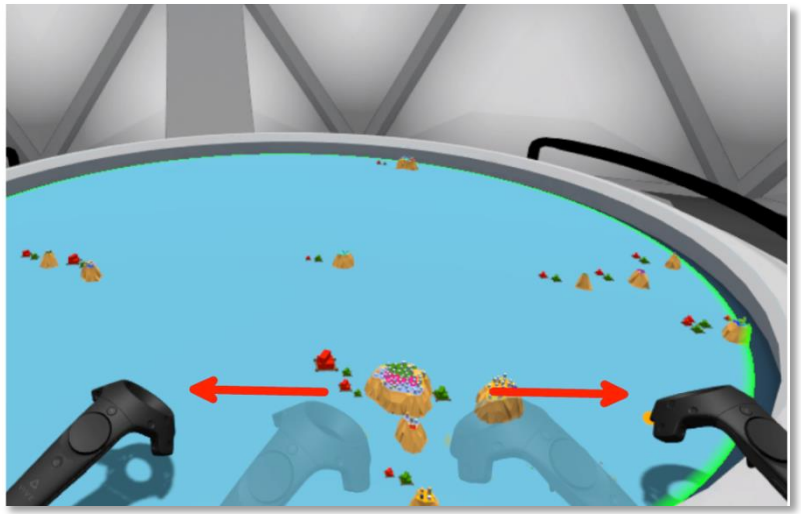


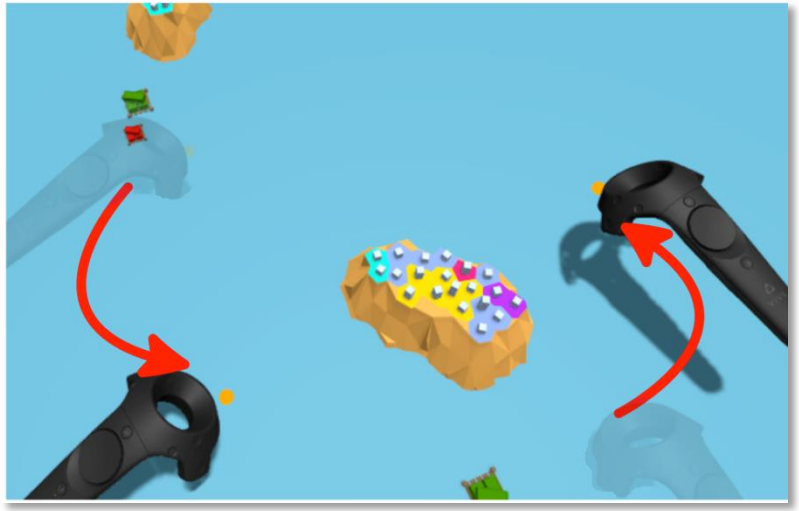
Virtual Table



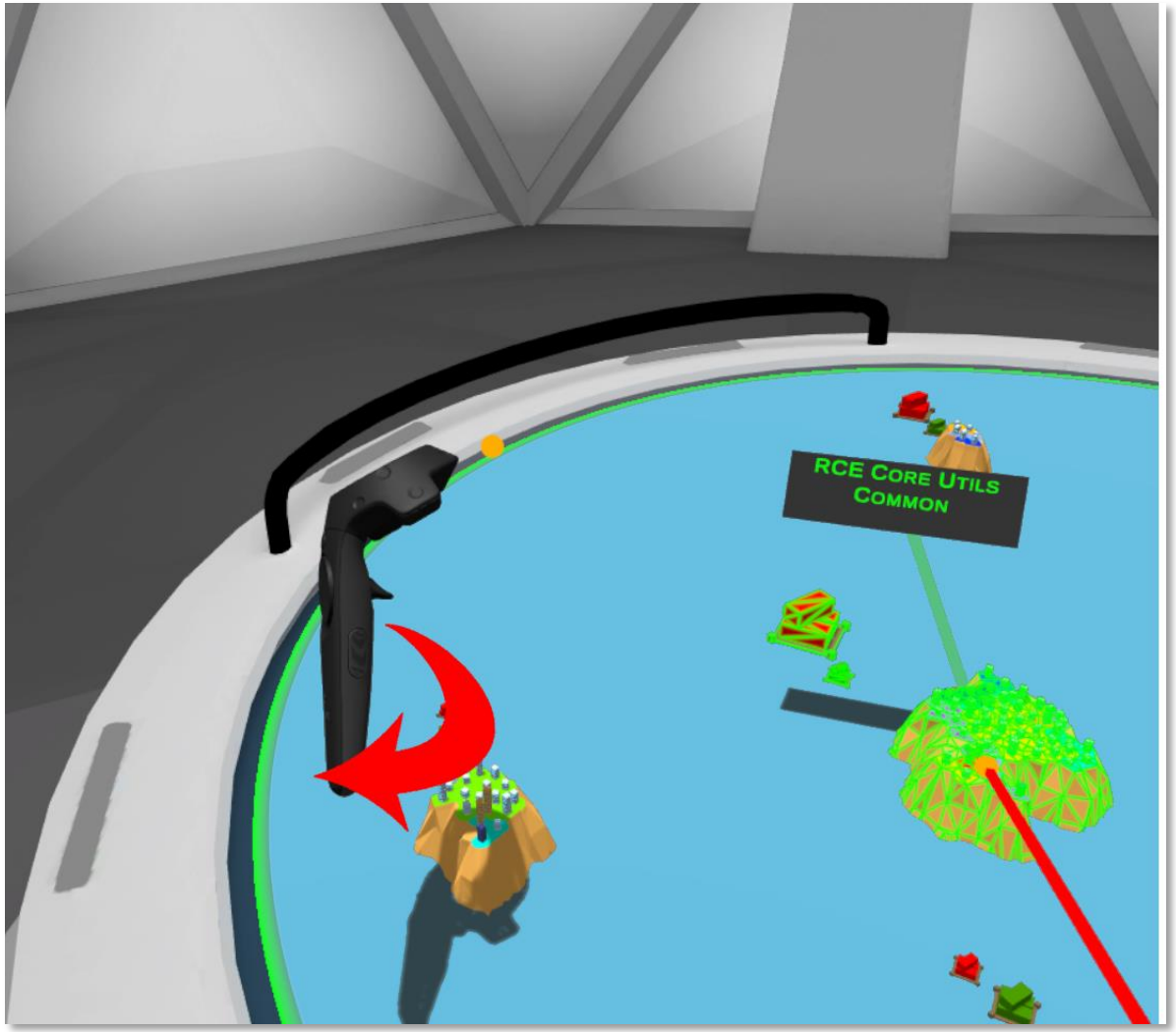
Navigation

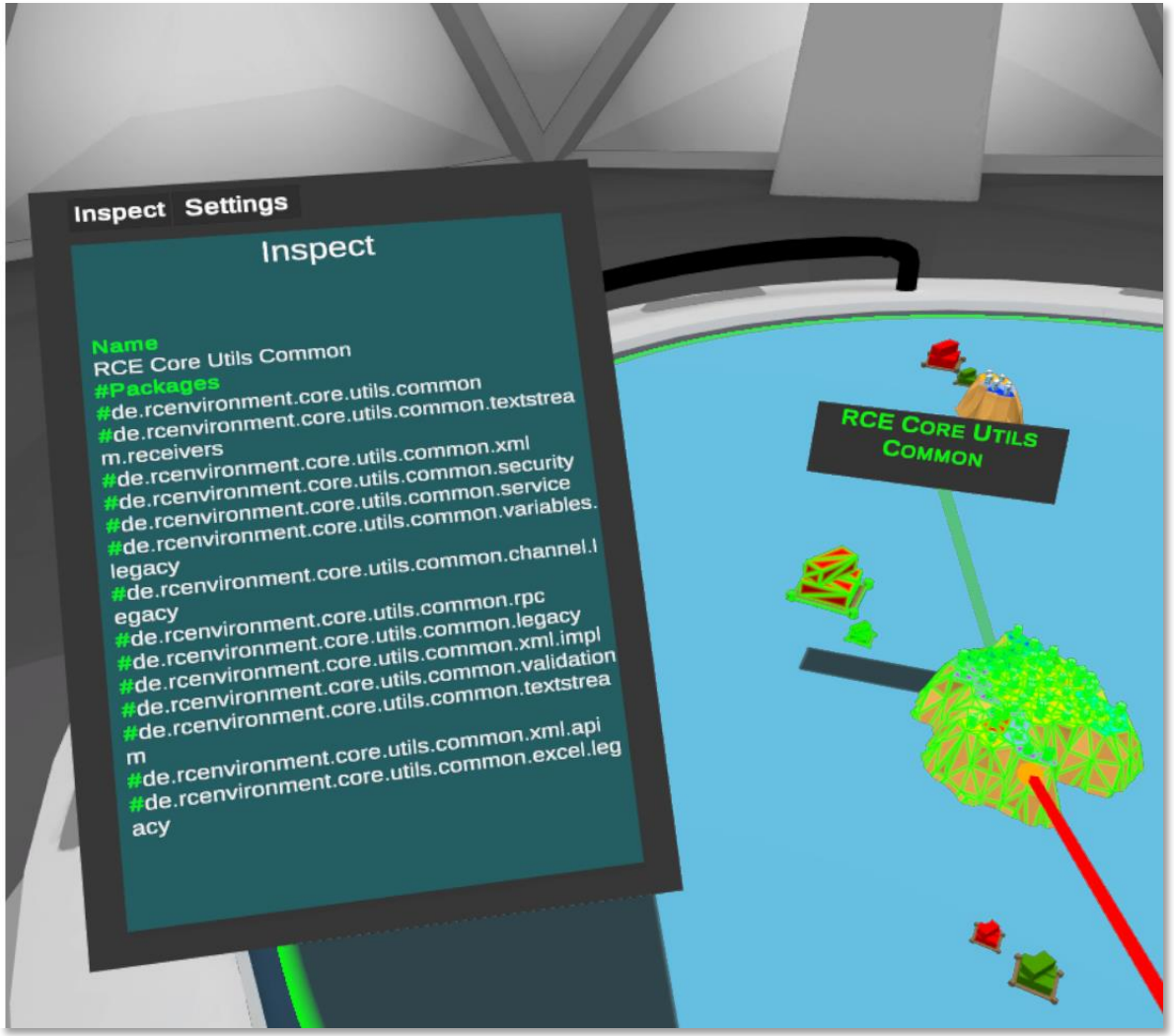


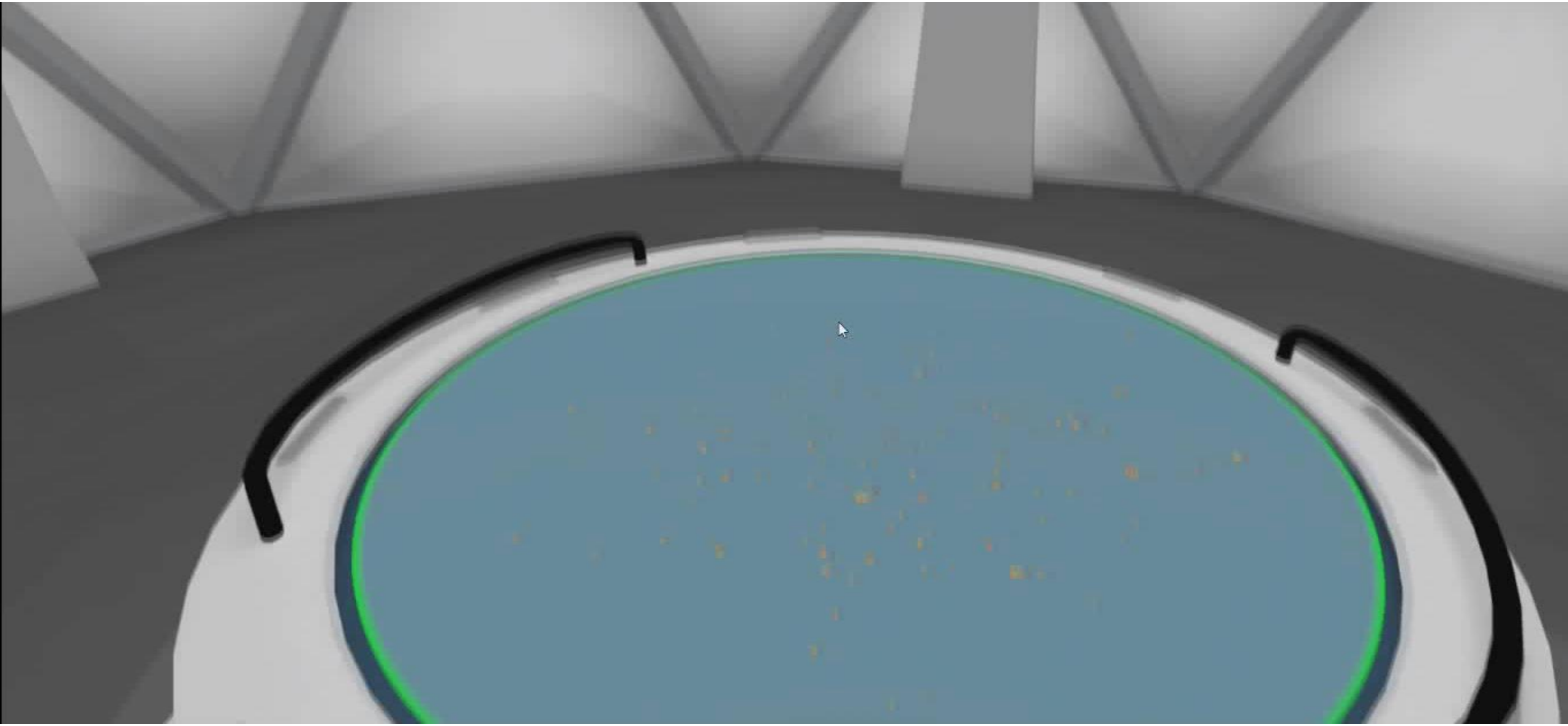




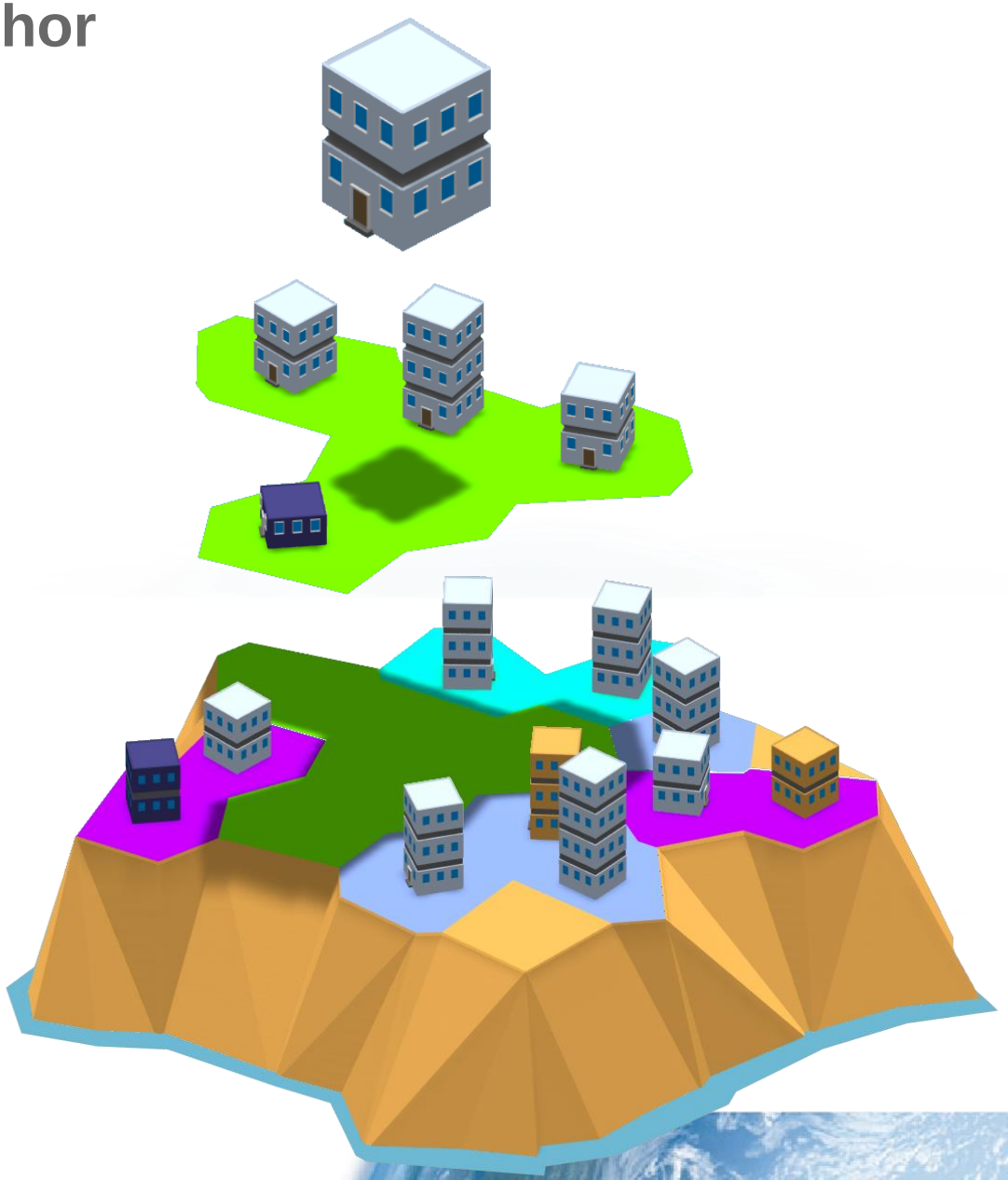
Virtual Tablet







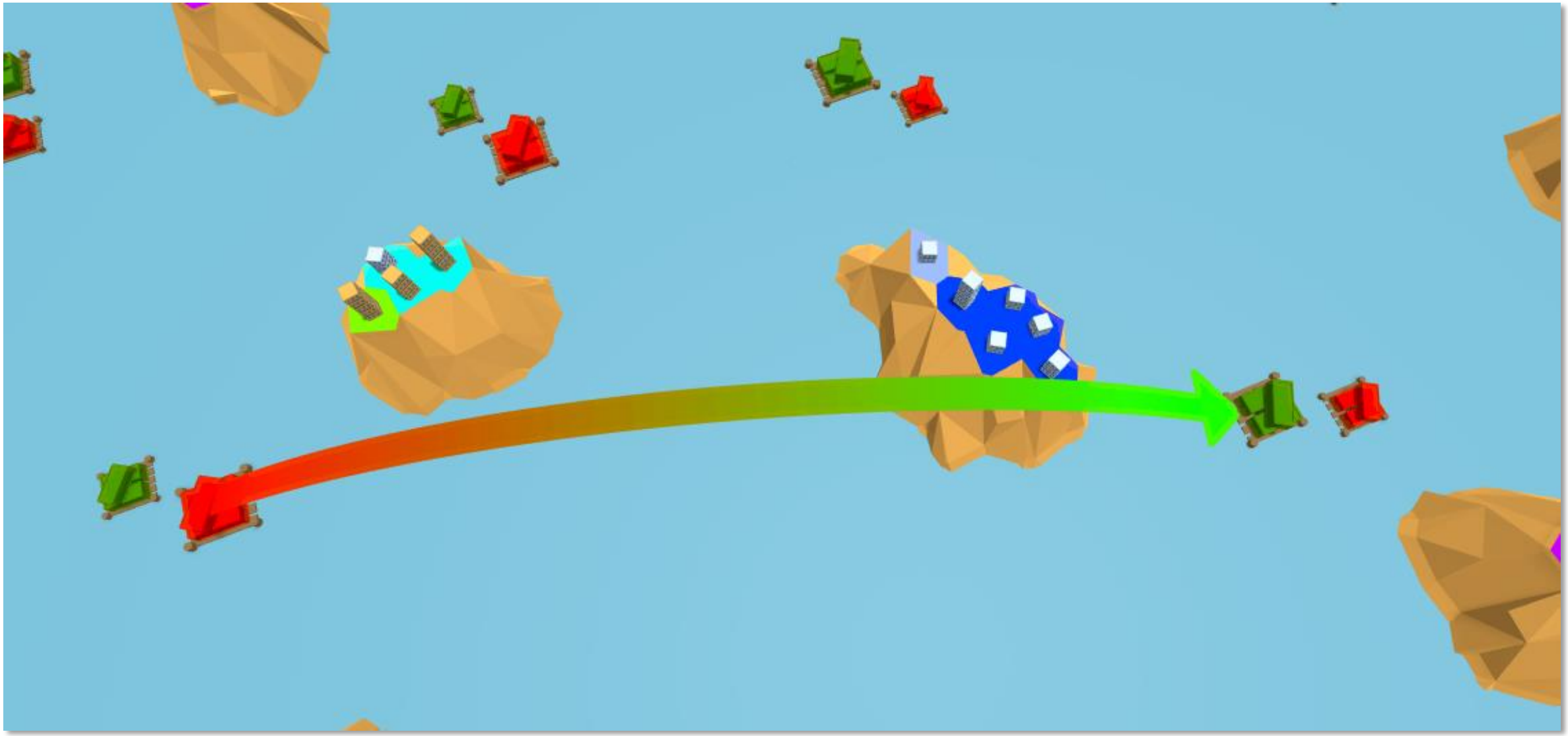
Island Metaphor



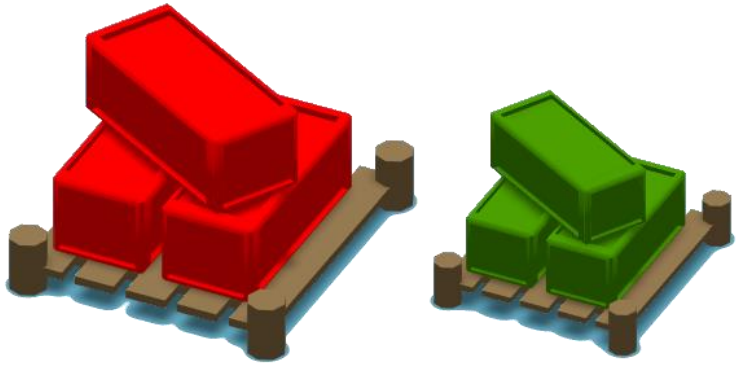
Classes
Multi-storey **buildings** with a new storey for every n lines of codes

Packages
Continuous **regions**

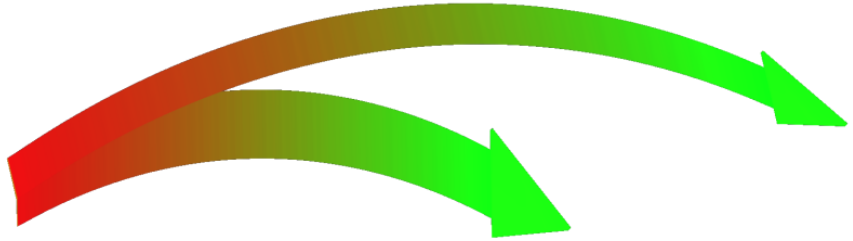
Bundles
Islands with multiple regions; each island with distinct shape



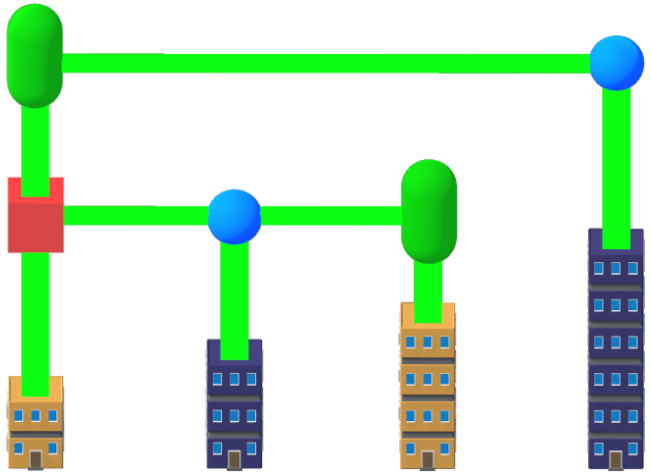
Dependencies



Ports
Incoming and outgoing package dependencies

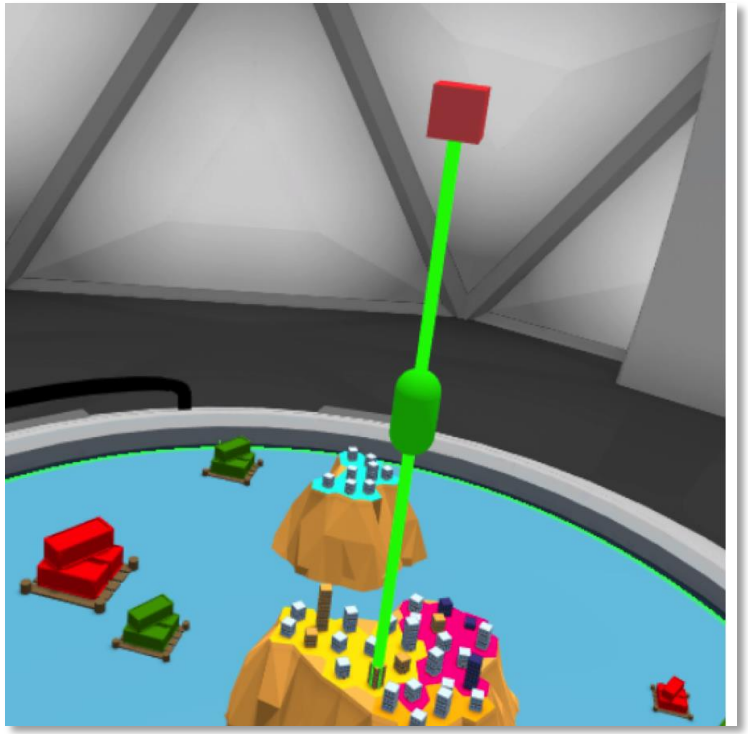


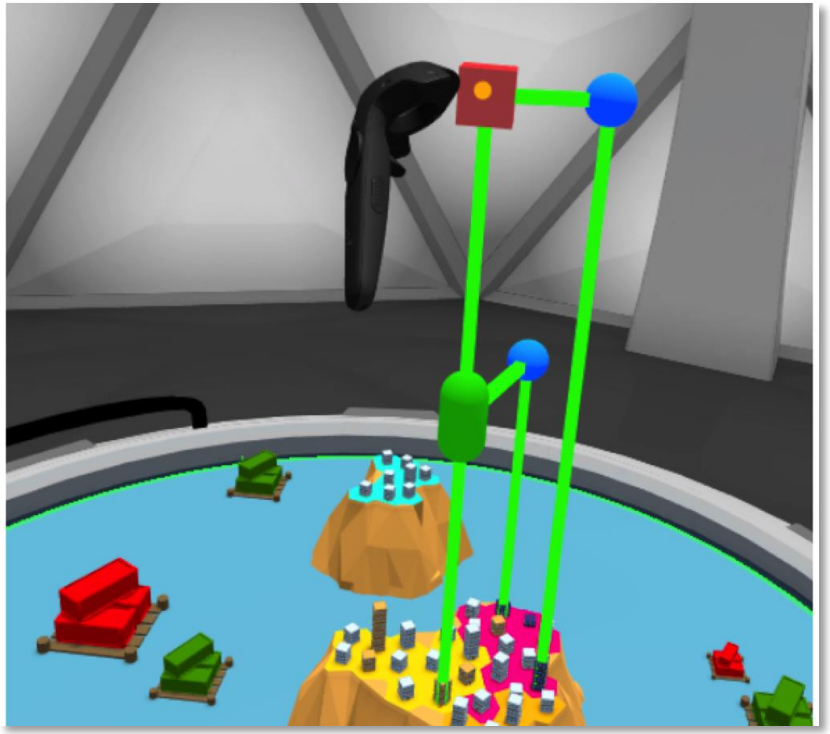
Arrows
Strength and direction of a package dependency

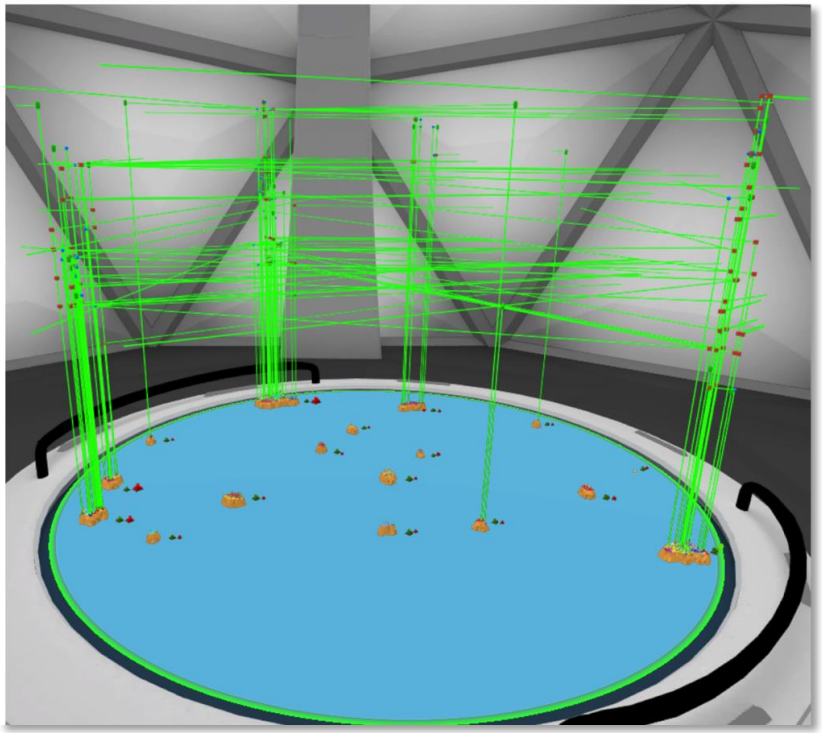


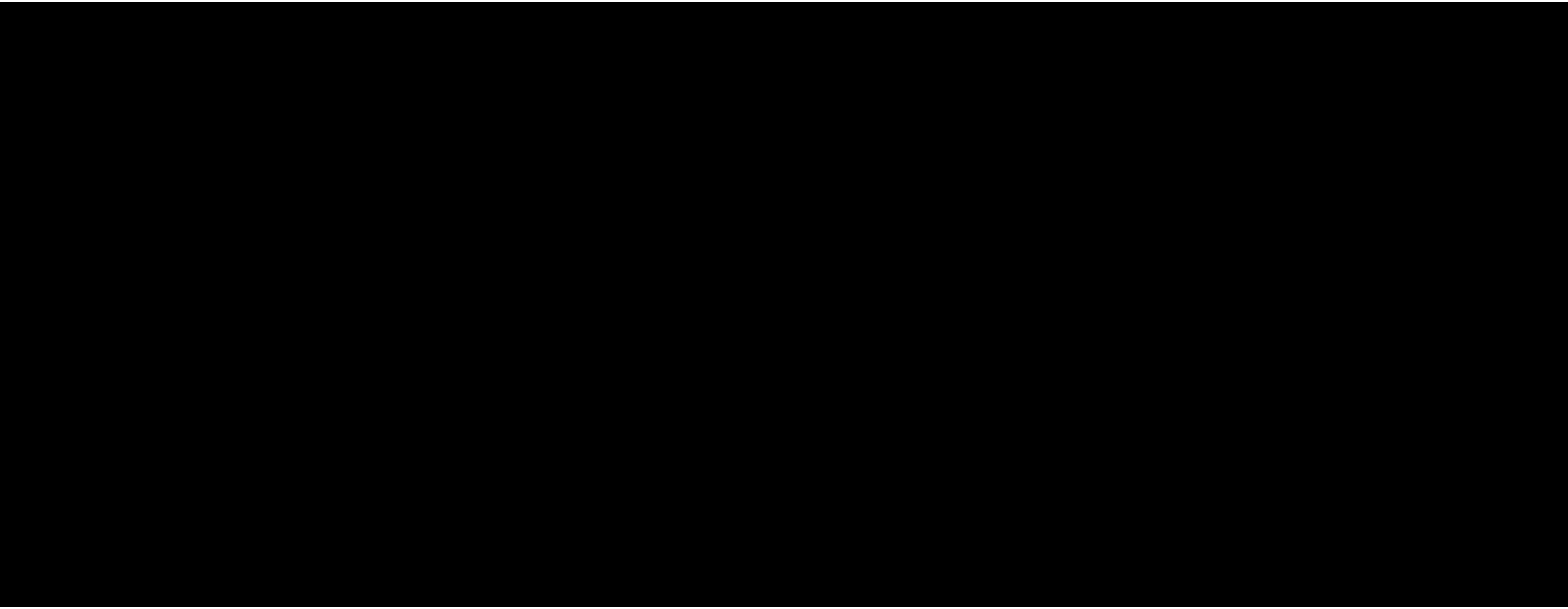
Services
OSGi service interfaces and service components

Services



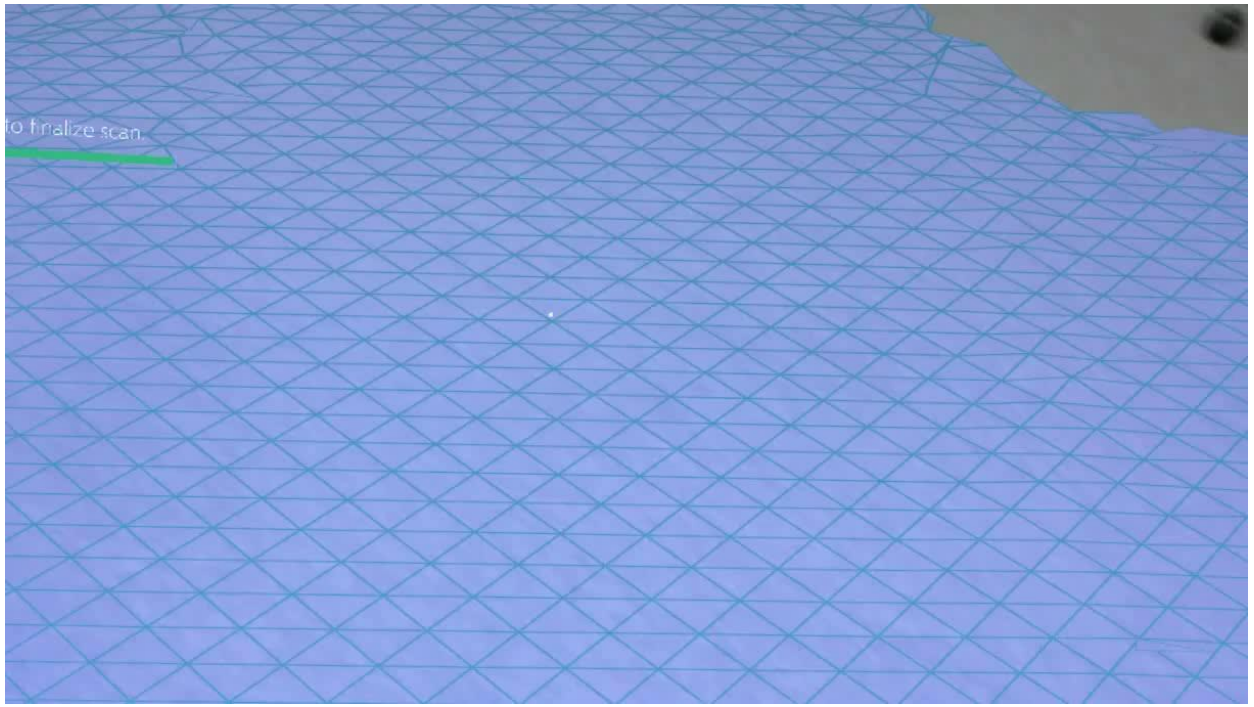


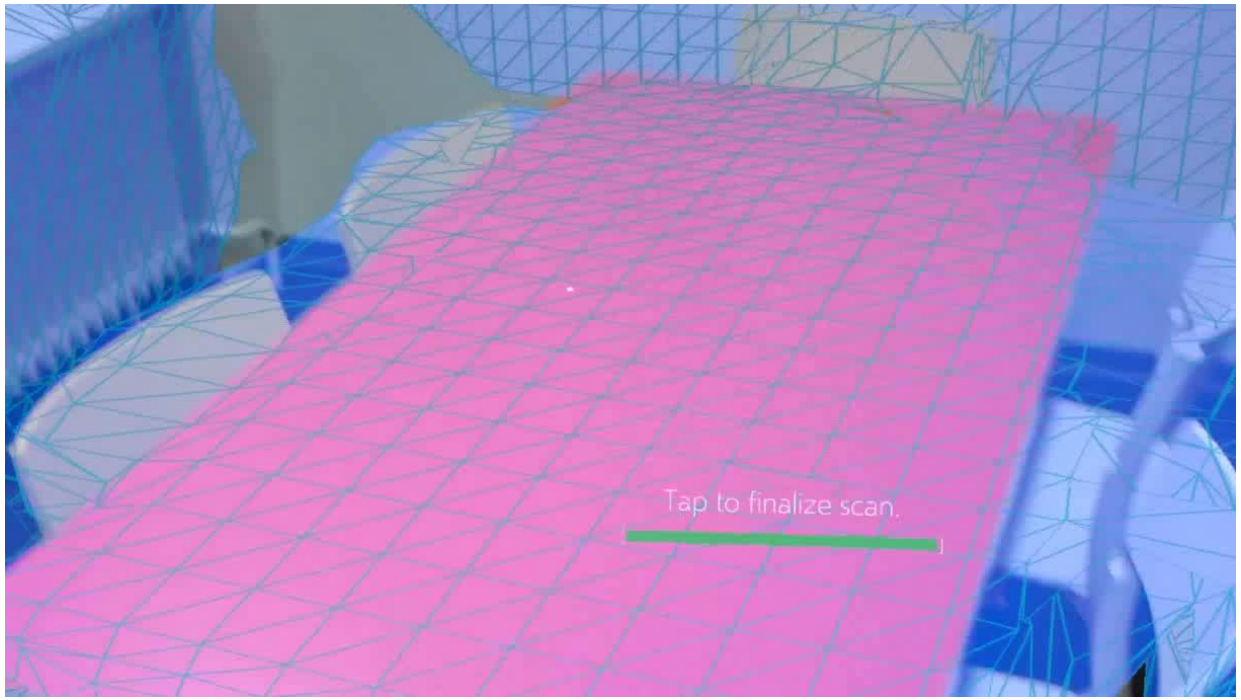


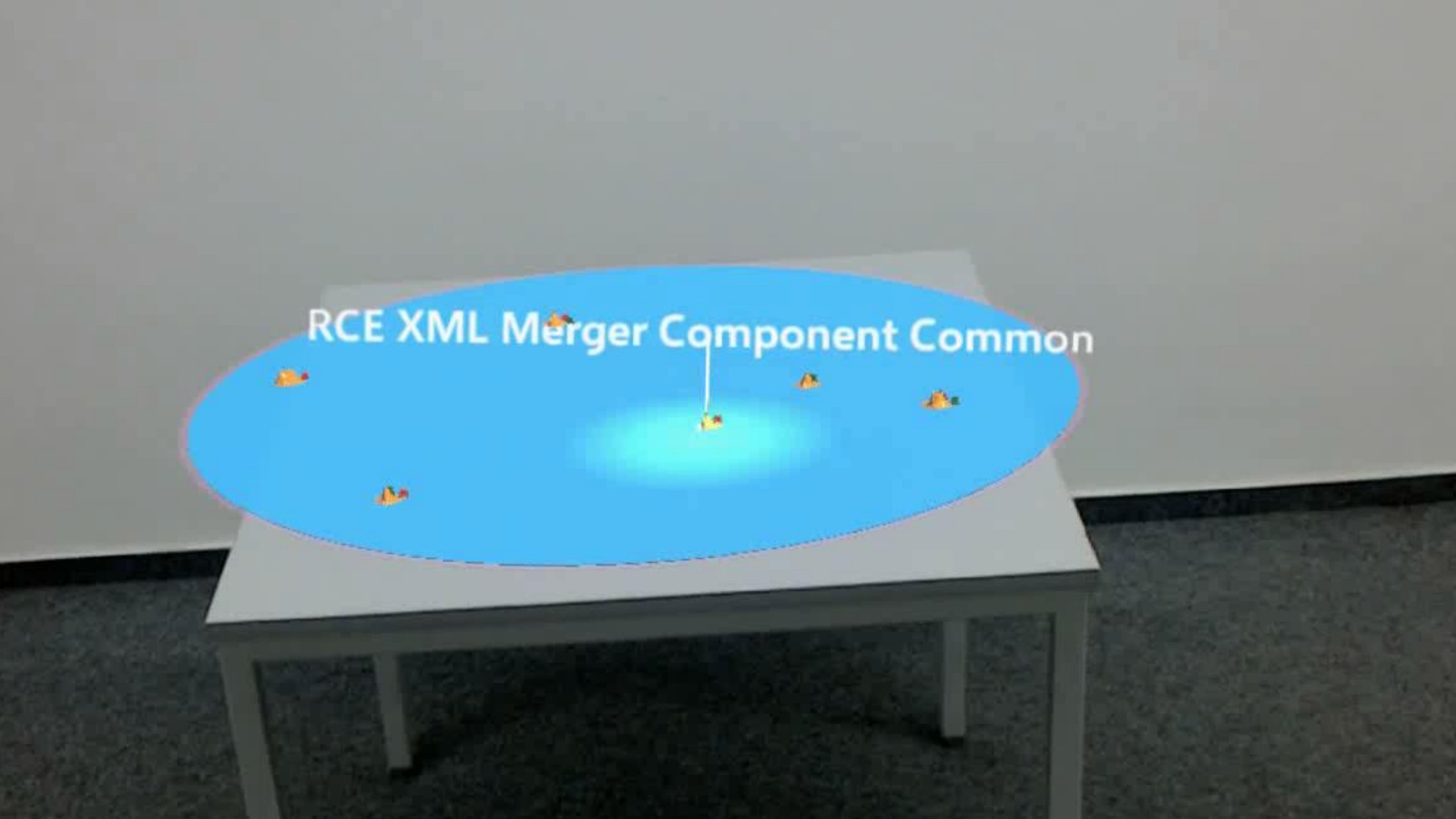


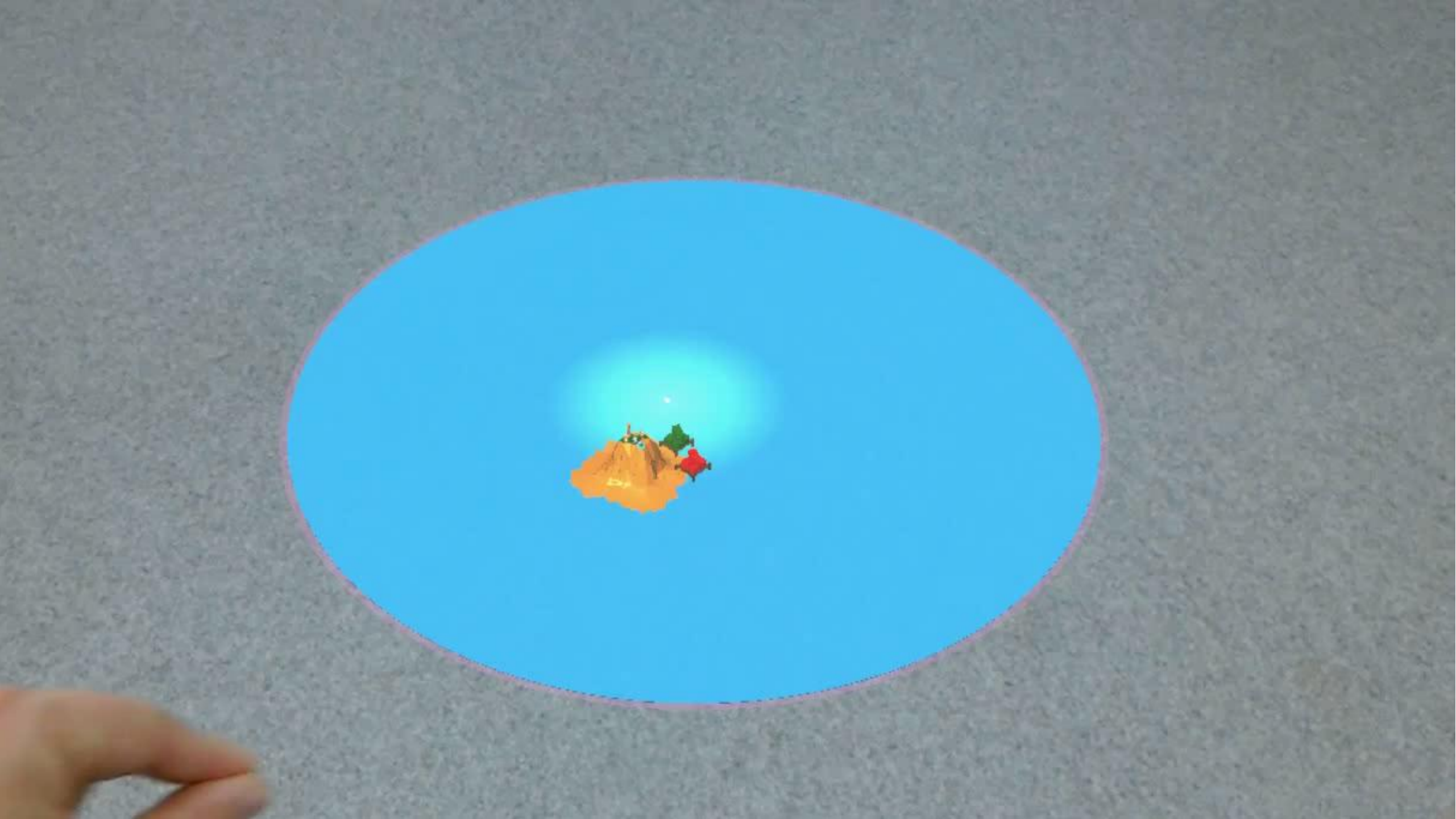
Augmented Reality

Positioning virtual surface on any surface






RCE XML Merger Component Common



Approach 1: Dependency Diver

Pro

- ✓ Cheap Headsets
- ✓ Interactive App

Cons

- ✗ Limited usage time
- ✗ Motionsickness

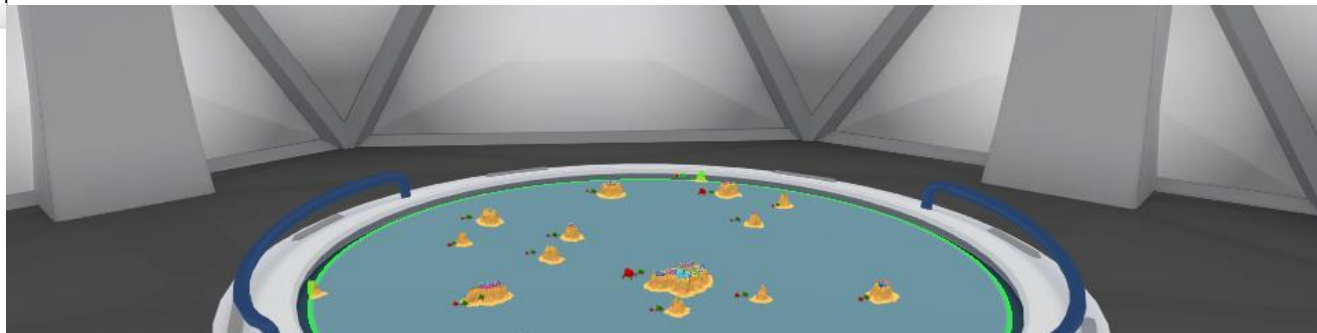
Approach 2: IslandViz

Pro

- ✓ “Any (Cheap) Headsets“
- ✓ Real-world Metaphor
- ✓ Interactive App
- ✓ Open Source
- ✓ Detailed information of OSGi Components

Cons

- ✗ Currently available Java & OSGi

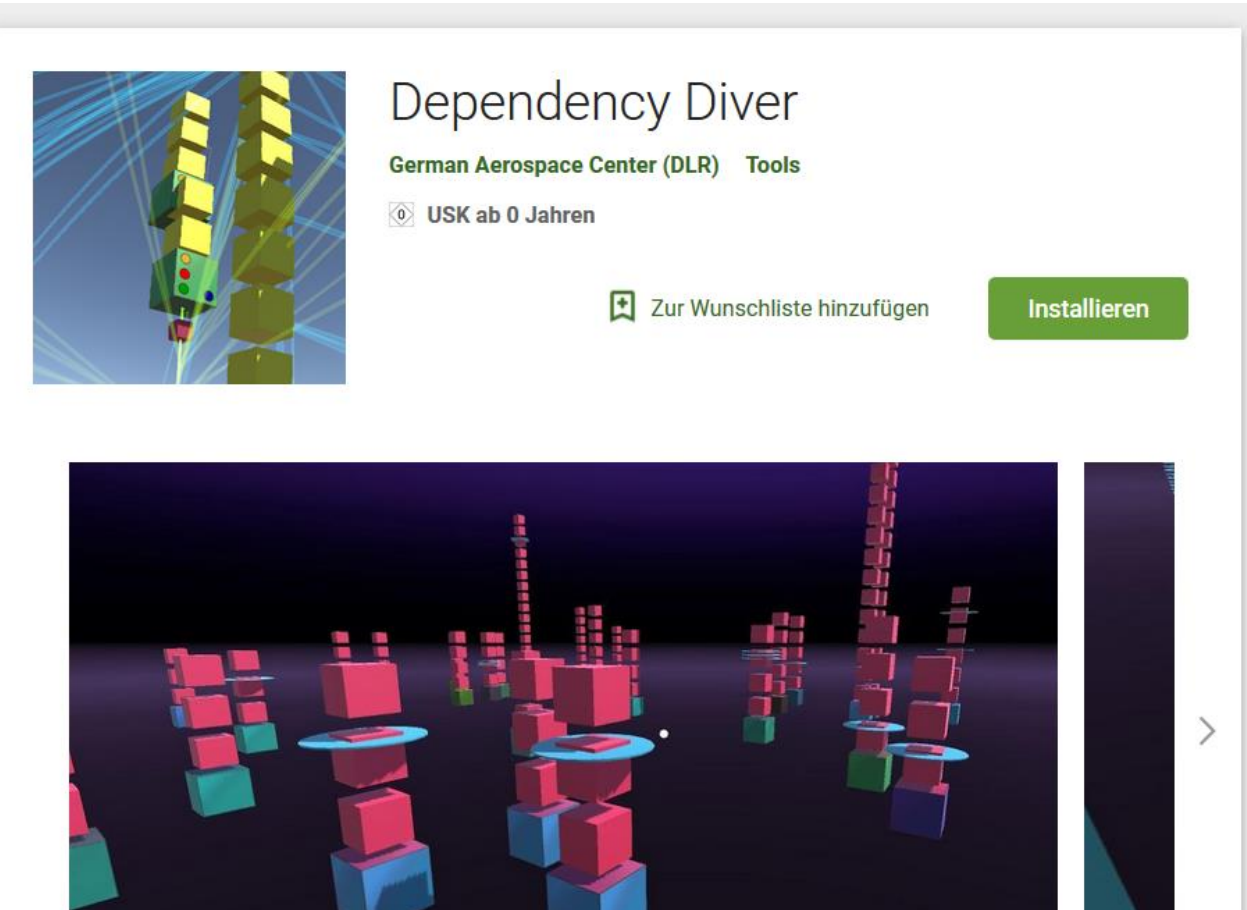


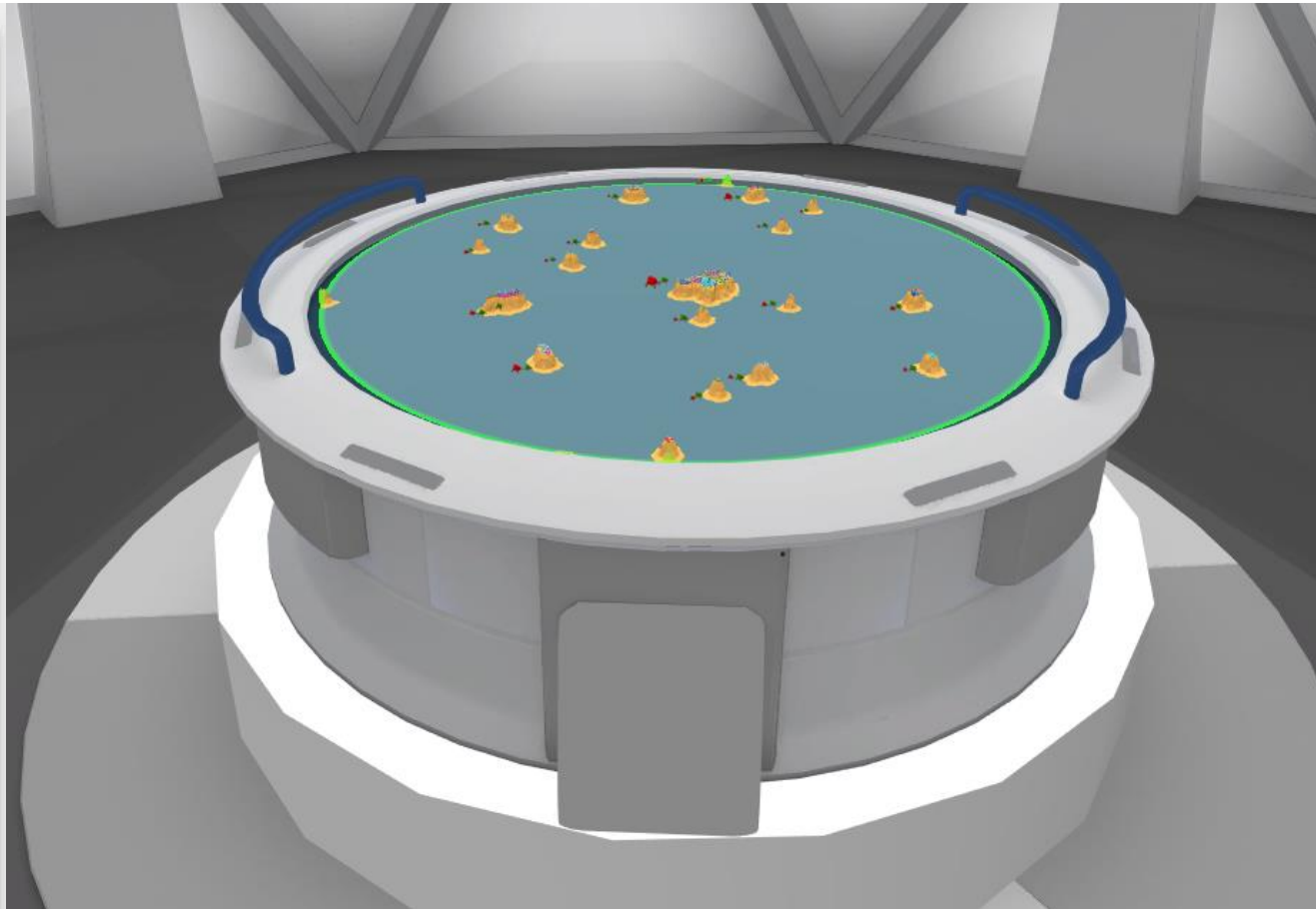
Approach 1: Dependency Diver

Googe PlayStore: “DependencyDiver“

Approach 2: IslandViz

https://github.com/DLR-SC/island-viz





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Links

GitHub *“IslandViz”*- https://github.com/DLR-SC/island-viz

DependencyDriver - https://play.google.com/store/apps/details?id=de.dlr.sc.DependencyDiver

jQAssistant - https://jqassistant.org/

RCE - http://rcenvironment.de/

VirtualSatellite- https://www.dlr.de/sc/en/desktopdefault.aspx/tabid-5135/8645_read-8374/

2D – 3D? - https://elib.dlr.de/110129/1/vissoft-toolpaper-osgivis_SeiderEtAl.pdf

DLR Jobs - https://www.dlr.de/dlr/jobs/#S:479