TWIST: TKN Wireless Indoor Sensor Network Testbed

TKN WSN Group

Telecommunication Networks Group
Technische Universität Berlin

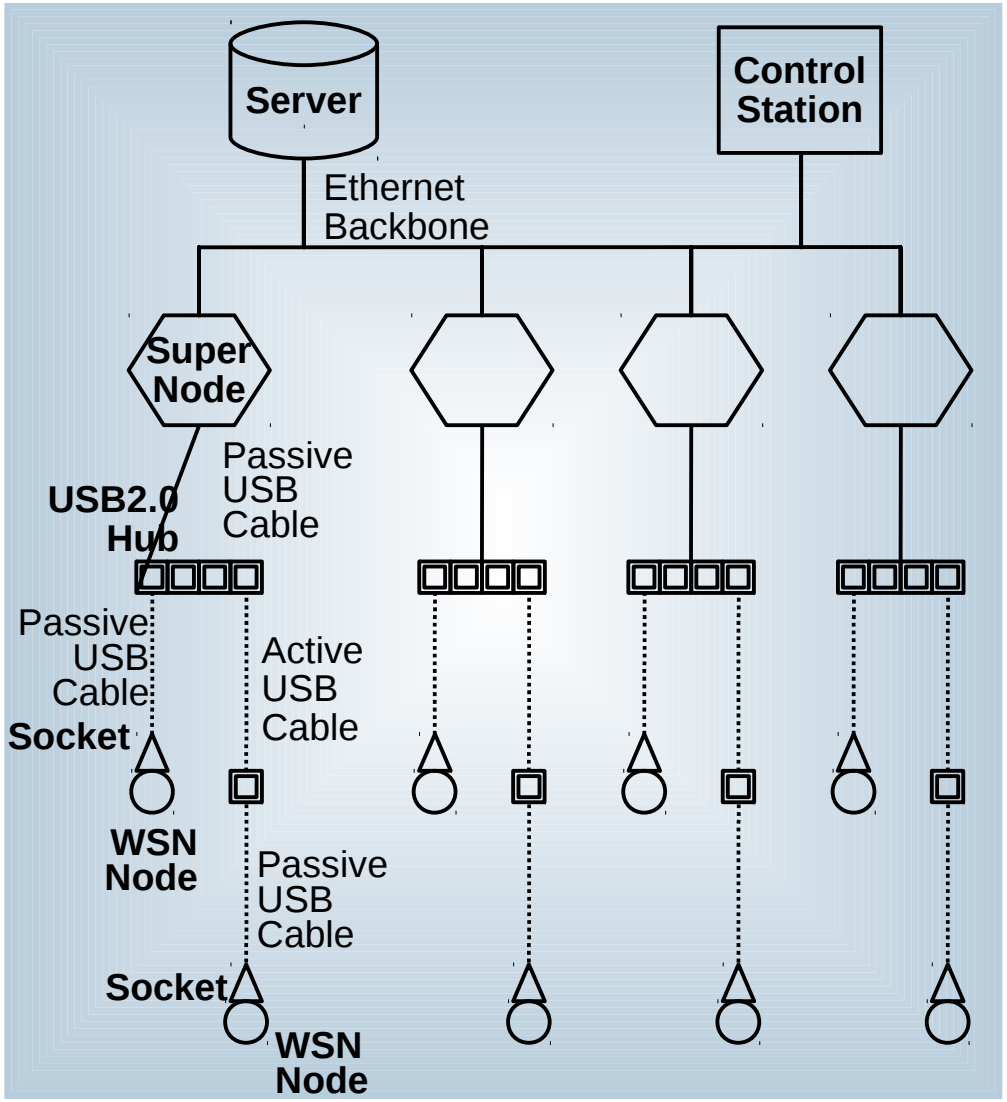
Motivation

- Design, implementation and evaluation of sensor network applications and communication protocols is difficult
- First design steps can often be made with the help of simulations
- Last steps require the use of real hardware, realistic environments and realistic experimental setups

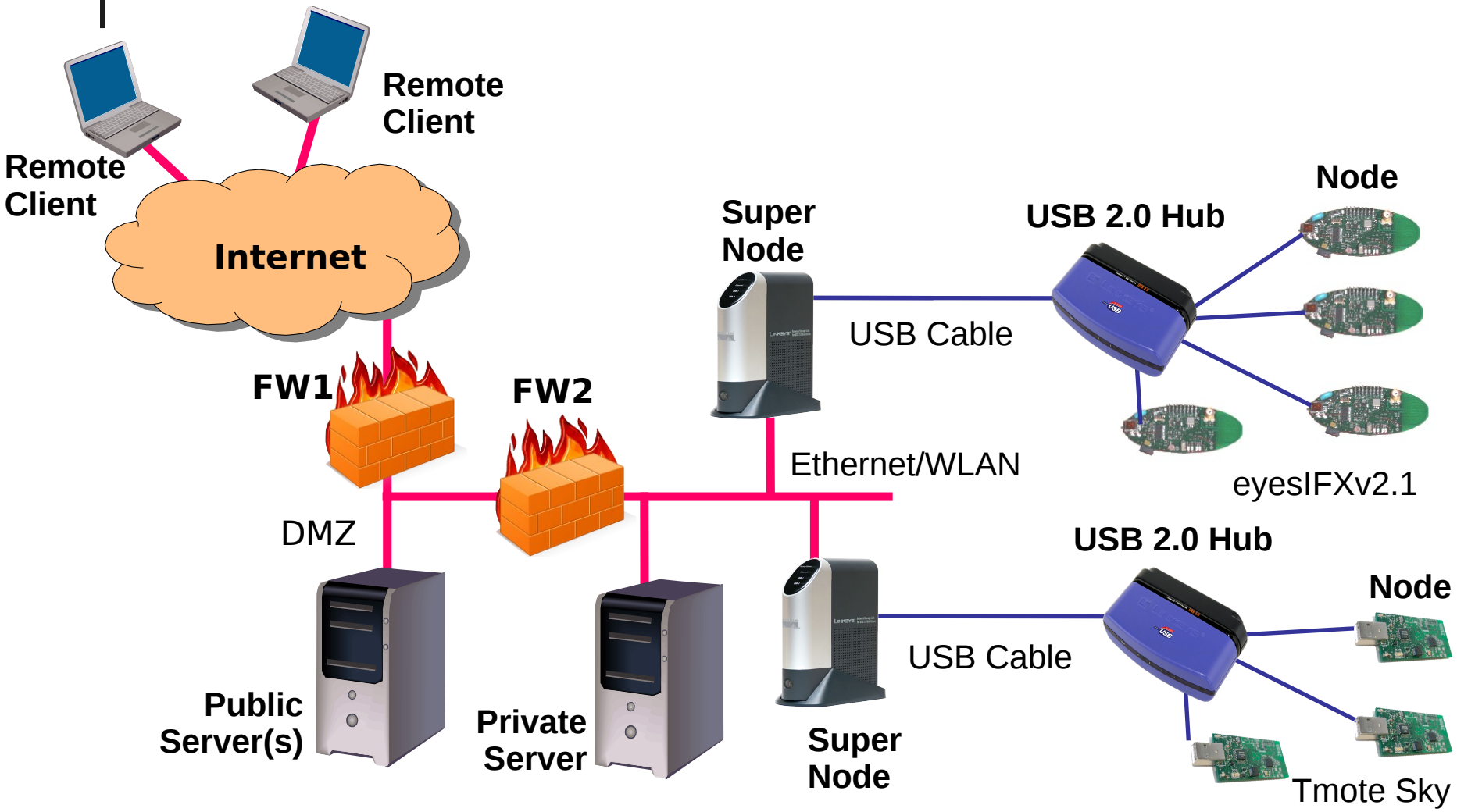
Use a large-scale sensor network testbed with dedicated out-of-band signaling in a realistic setting

TWIST Architecture

TKN
Wireless
Indoor
Sensor
network
Testbed



TWIST Components

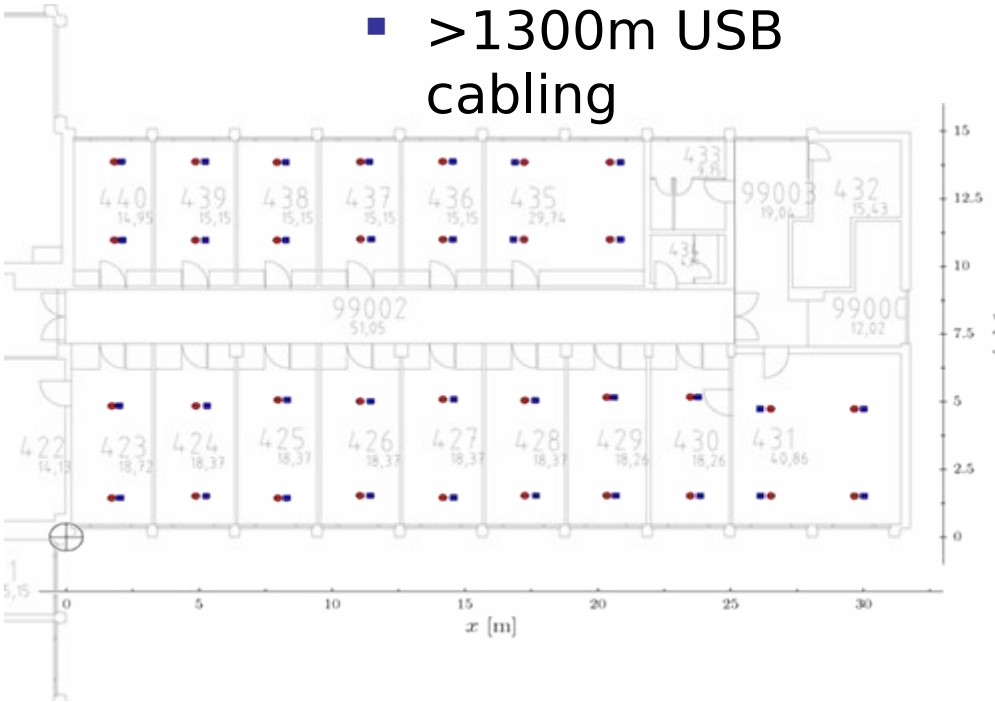


TWIST Features

- Basic services
  - Network-wide re-programming
  - Node configuration
  - Out-of-band extraction of debug information
- Additional features
  - Support for heterogeneous platforms
  - Active power control
  - Support for hierarchical networks
- Built on open standards, open architectures, open source

TWIST Instance at the TKN Building

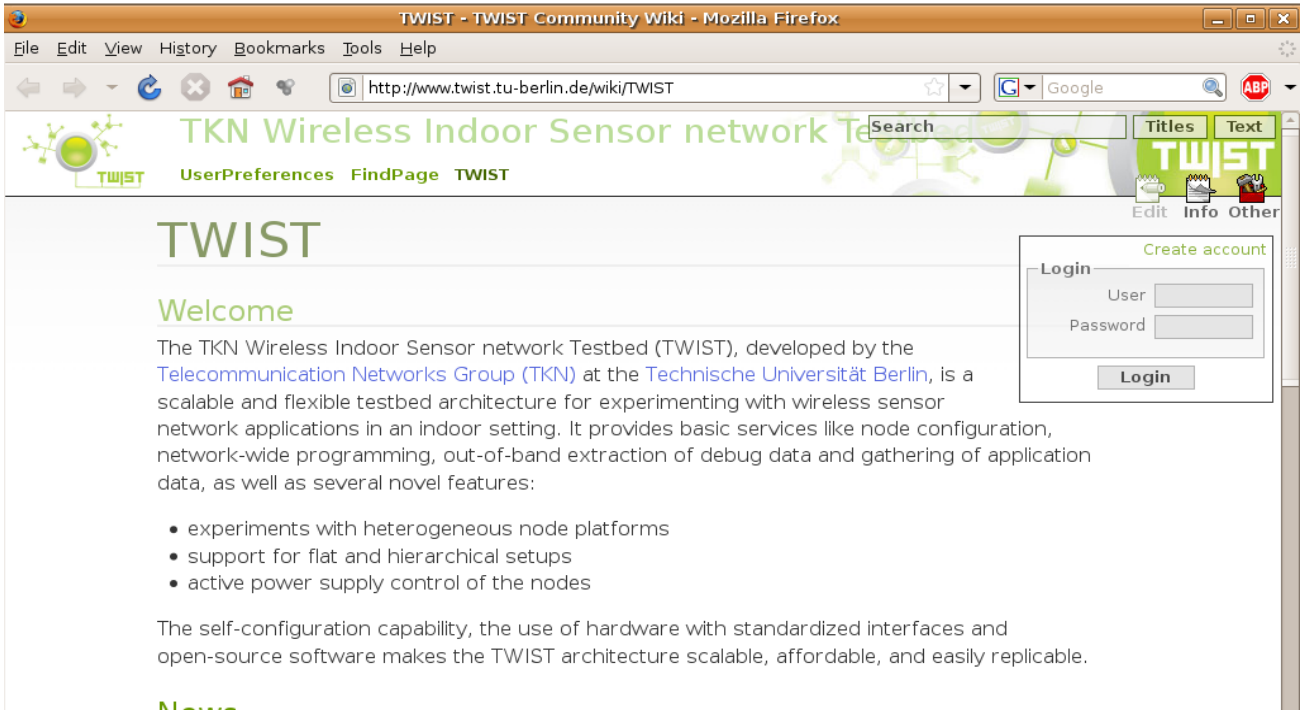
- Spans 3 floors of the TKN office building
  - More than 1500 m² of instrumented space
- Current configuration: **204 sensor nodes**
  - 102 Tmote Sky
  - 102 eyesIFXv2
  - 46 super nodes
  - 60 USB hubs
  - >1300m USB cabling



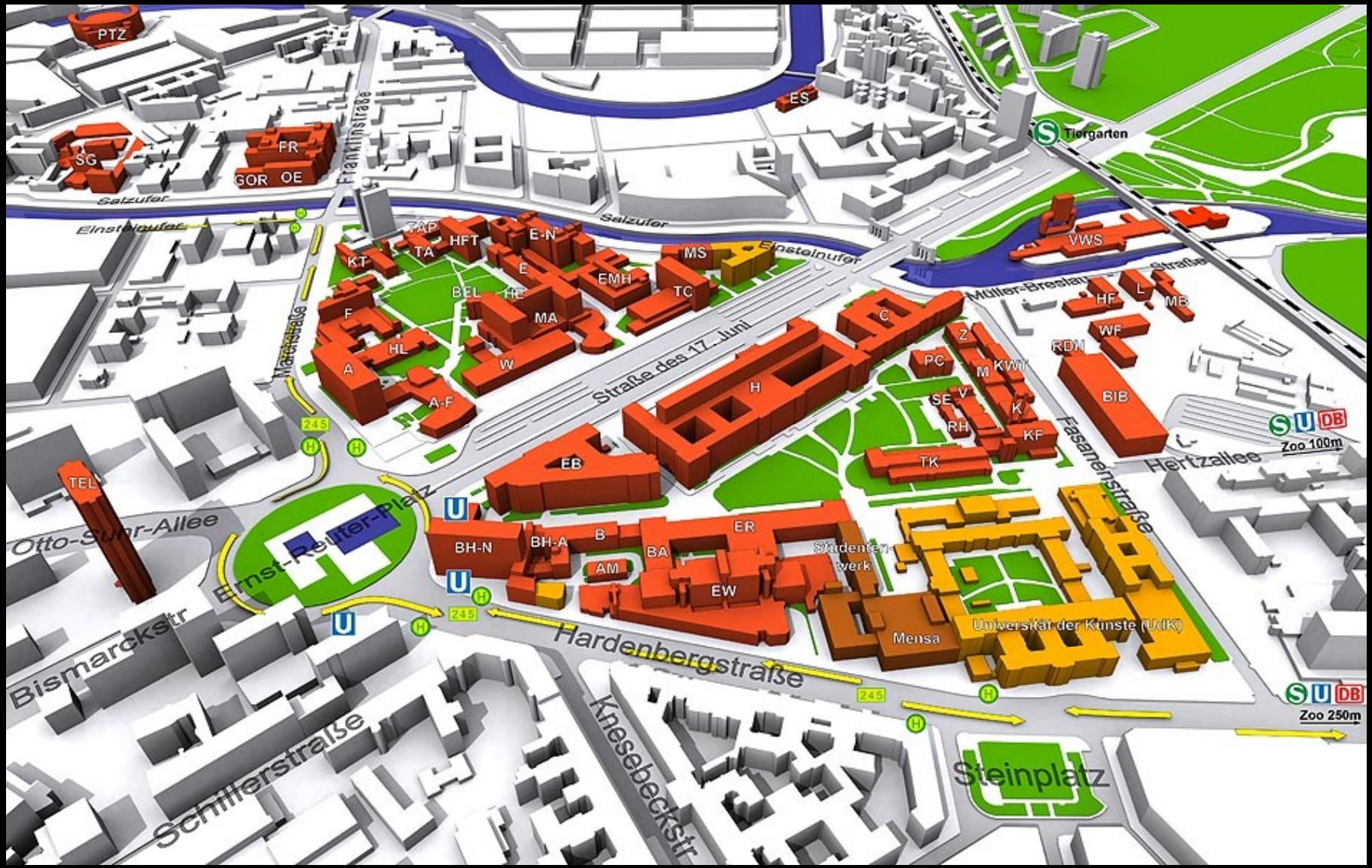
TKN Telecommunication Networks Group

More Information

- V.Handziski et al., "TWIST: A Scalable and Reconfigurable Testbed for Wireless Indoor Experiments with Sensor Network", In Proc. of the 2nd Intl. Workshop on Multi-hop Ad Hoc Networks: from Theory to Reality, (RealMAN 2006)
- http://www.twist.tu-berlin.de



Demo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Ernst-Reuter-Platz
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Hardenbergstraße
Schillerstraße
Knesebeckstr
Steinplatz
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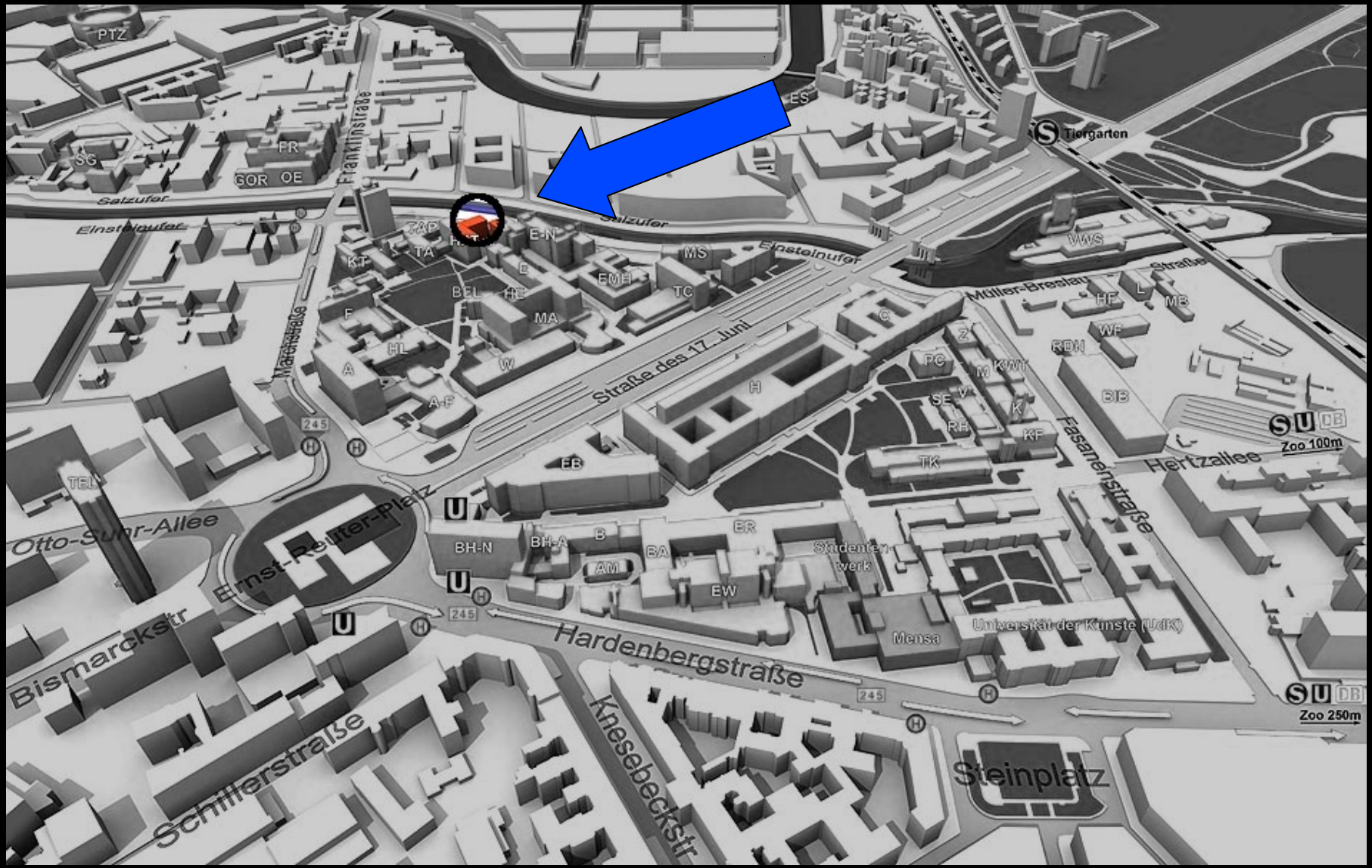
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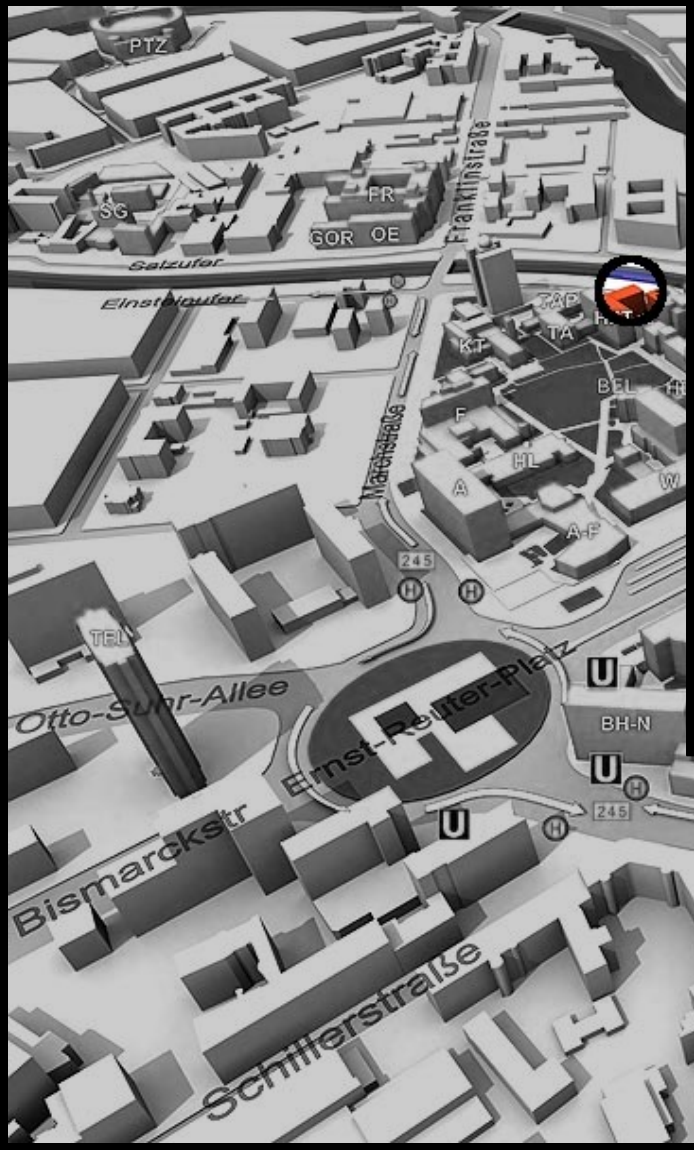
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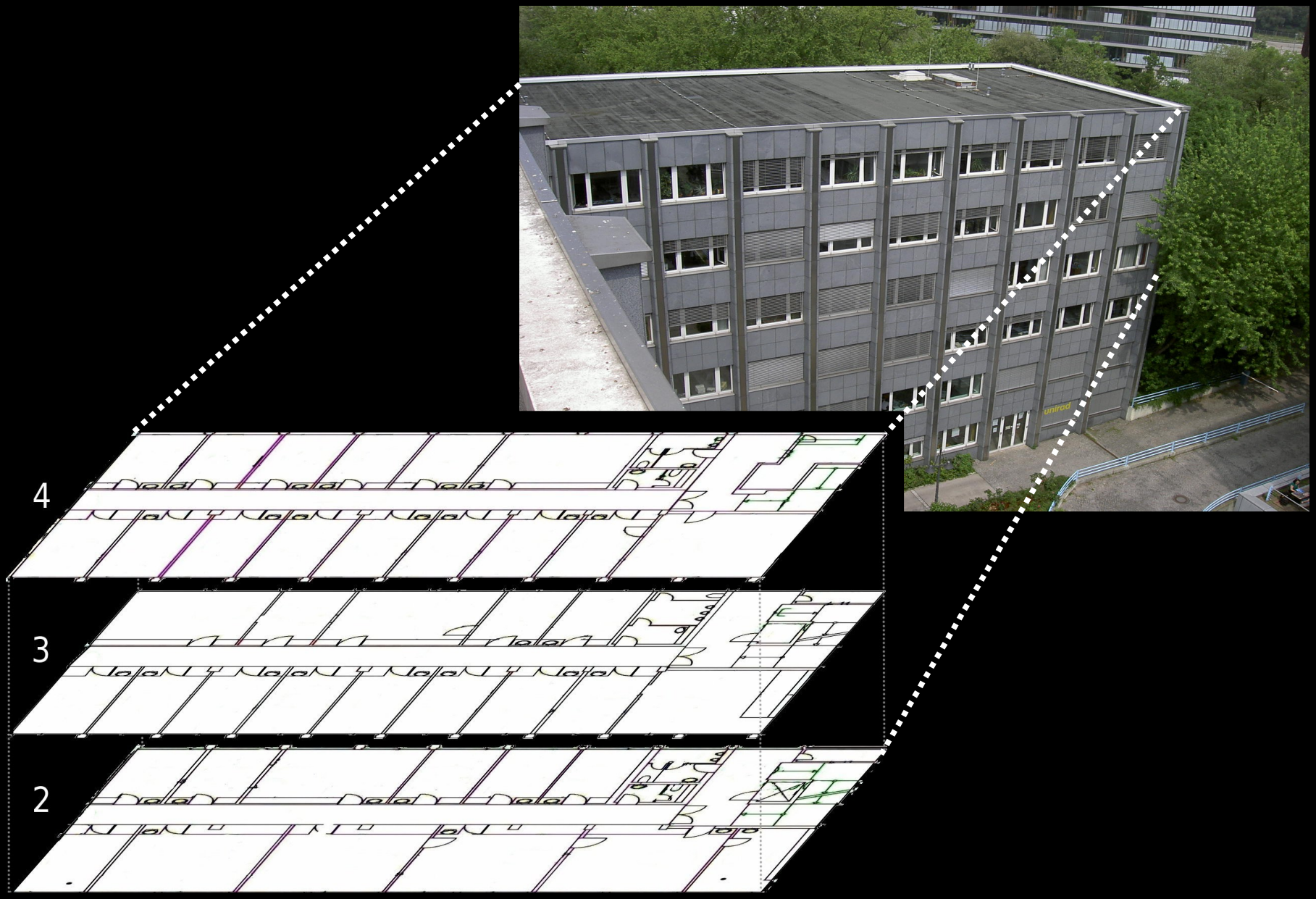
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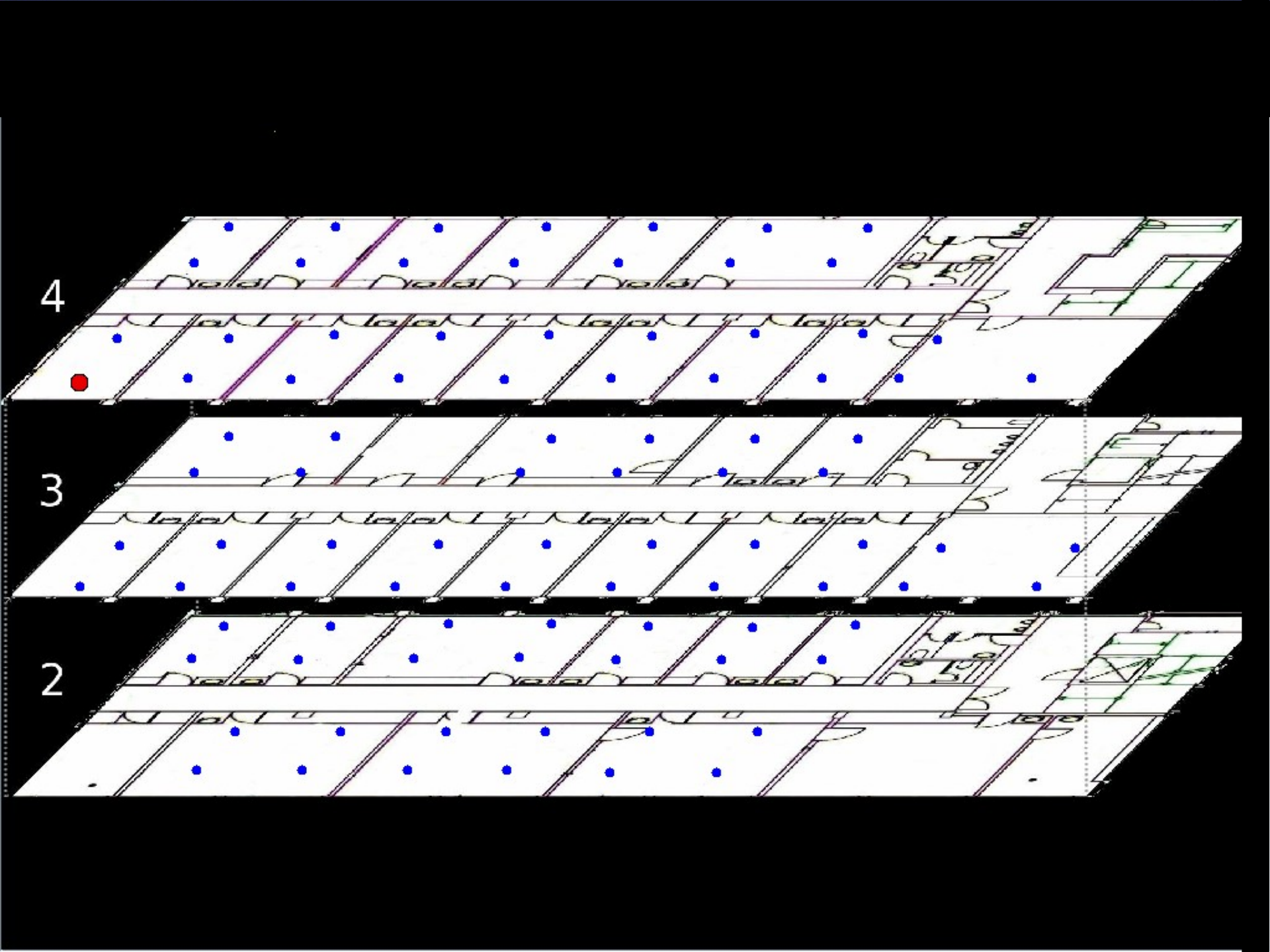
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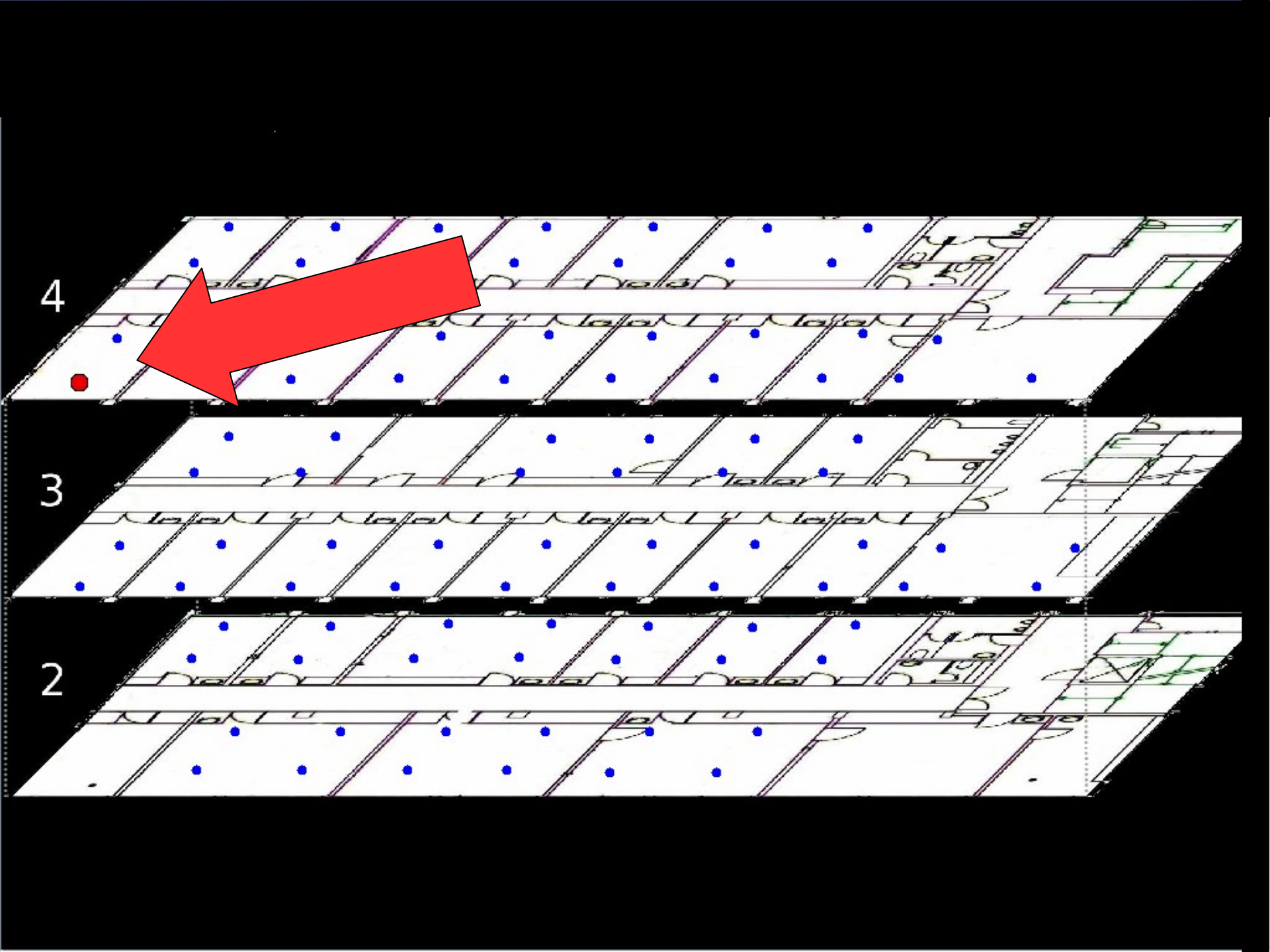
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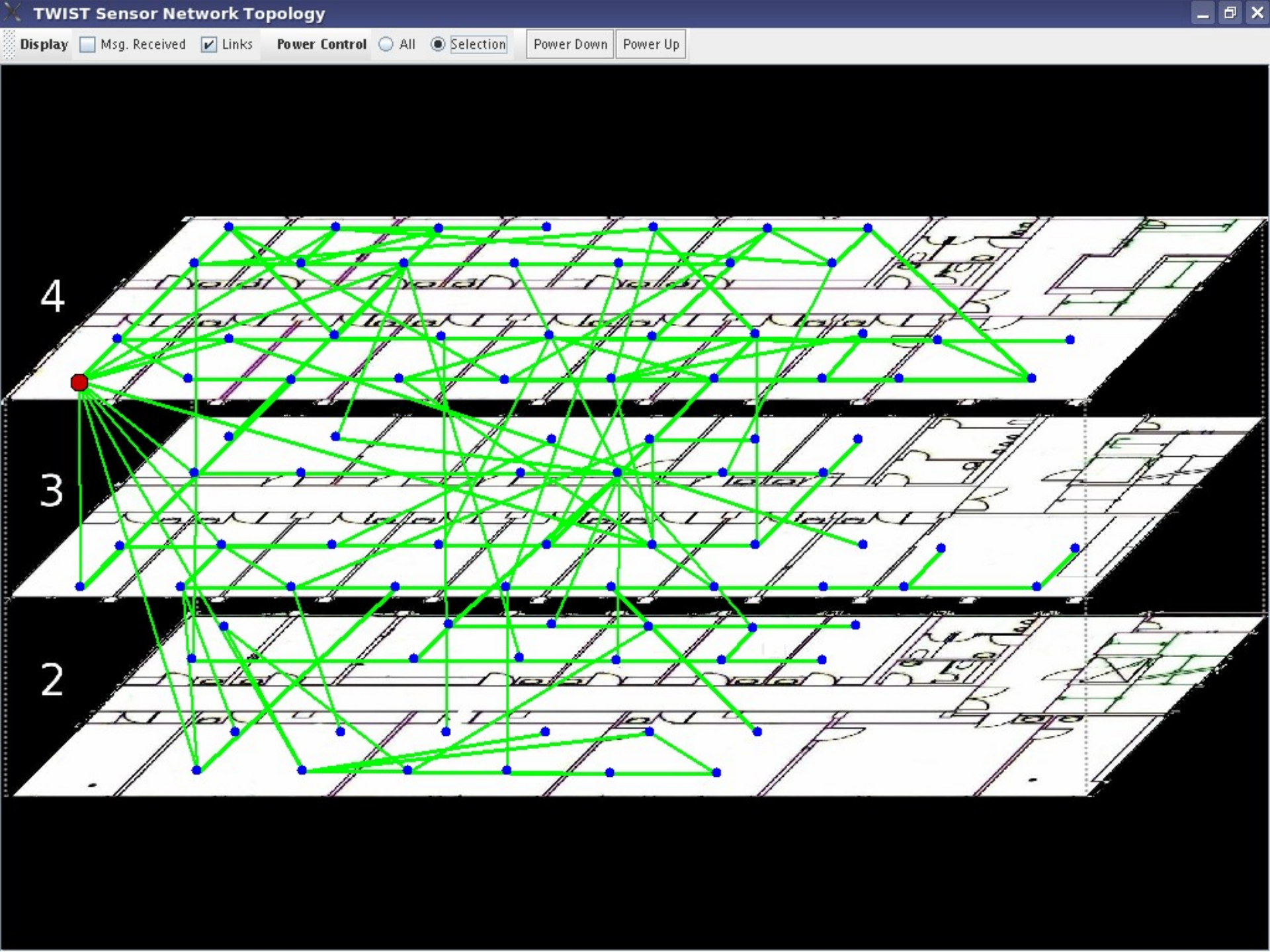
Live Demo


TWIST Sensor Network Topology
Display
Msg. Received
Links
Power Control
All
Selection
Power Down
Power Up
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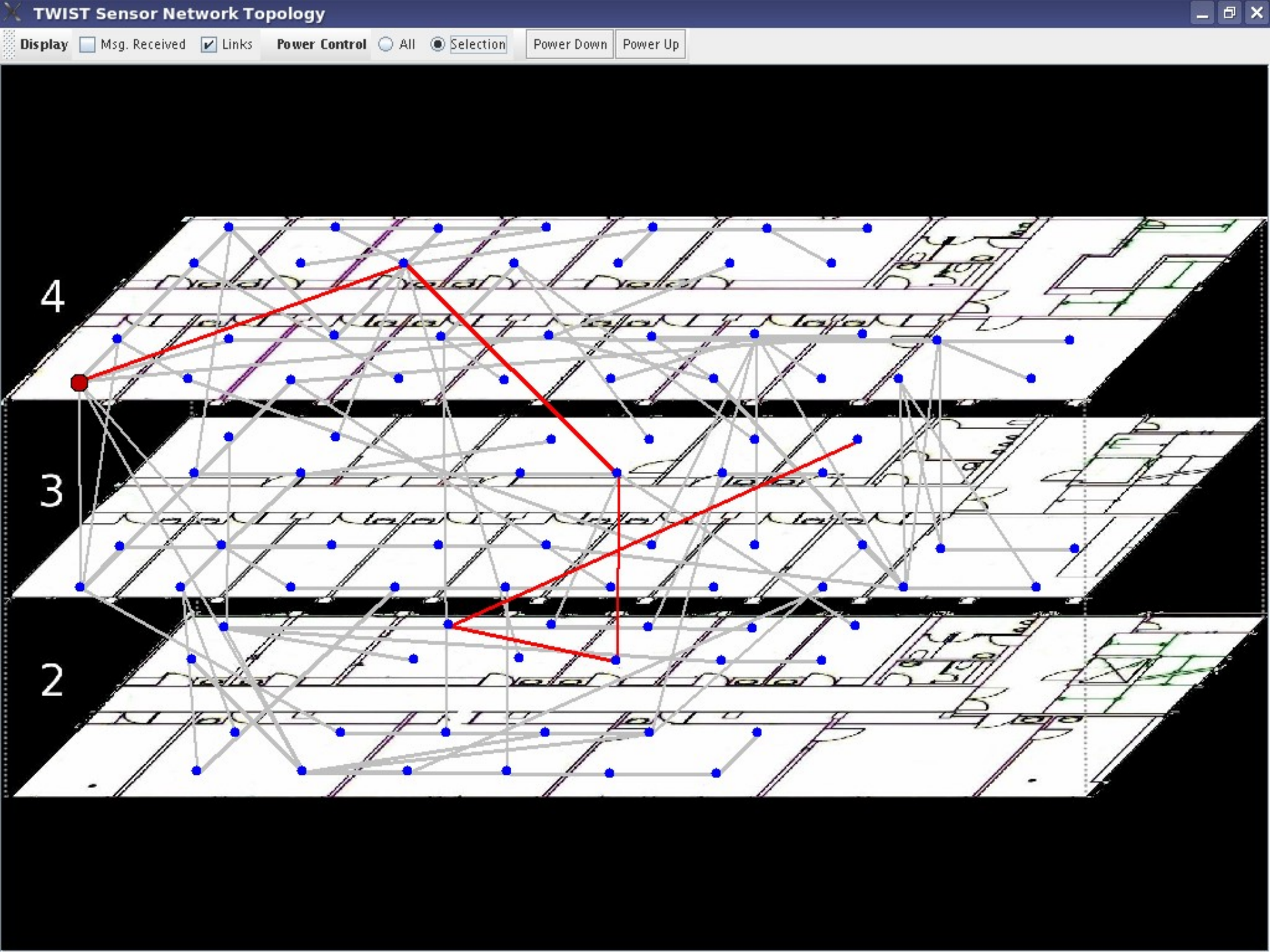
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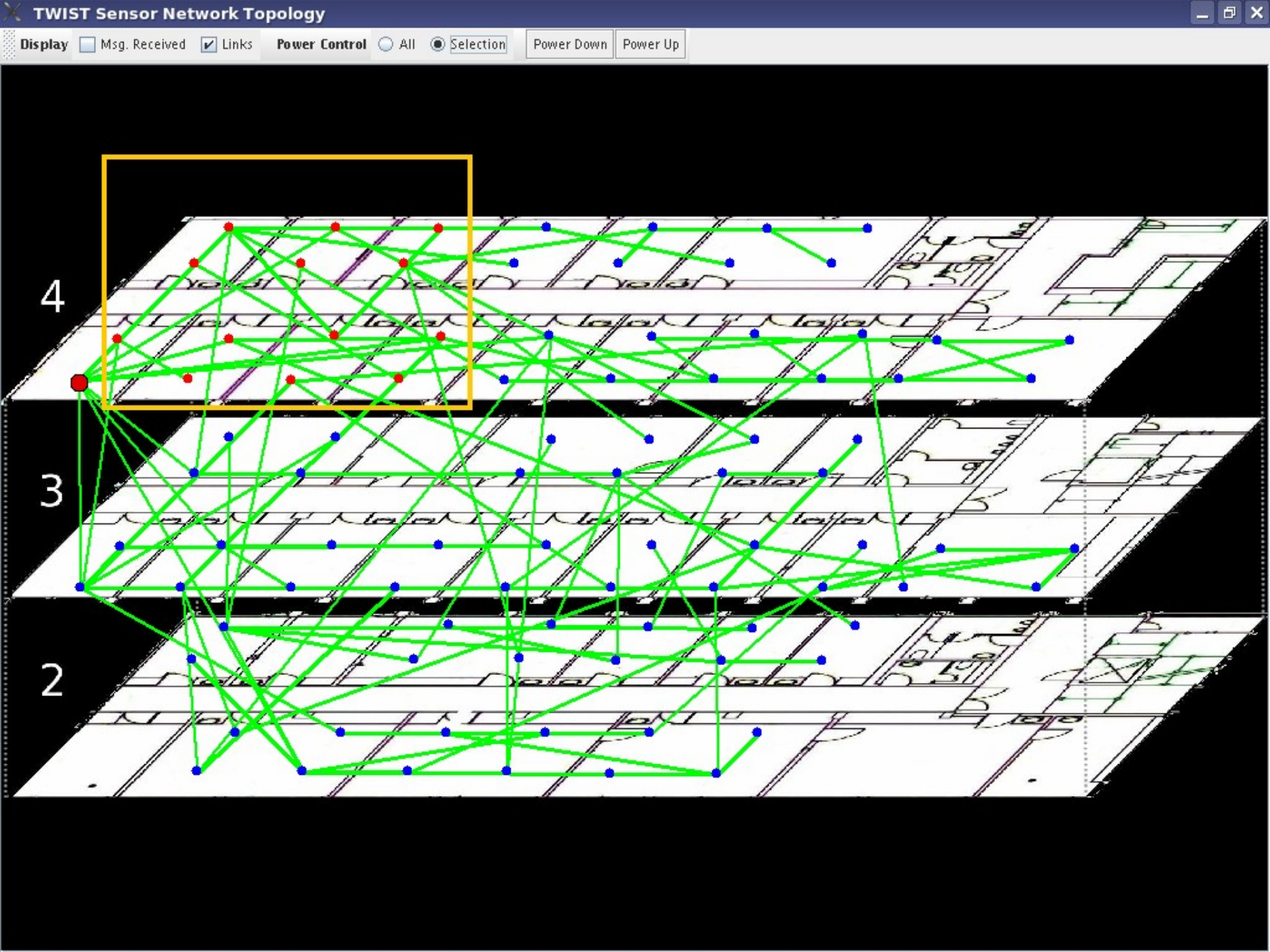
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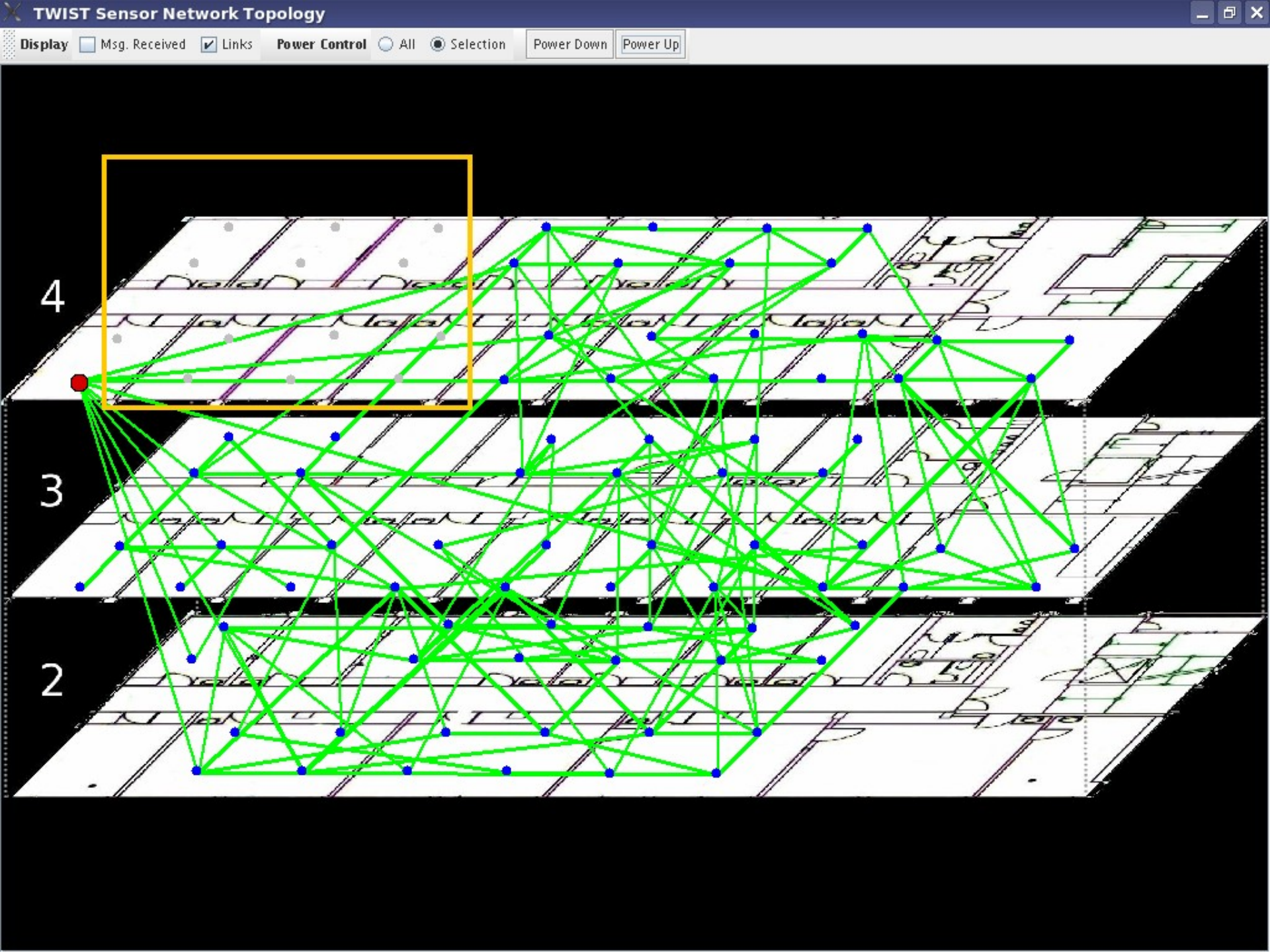
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COTEFE

Design experiments in a testbed-independent way. Run your experiments and cross-validate your results across multiple testbeds. All in your Web browser.

Objectives

Develop hardware and software infrastructure for federating autonomous testbeds

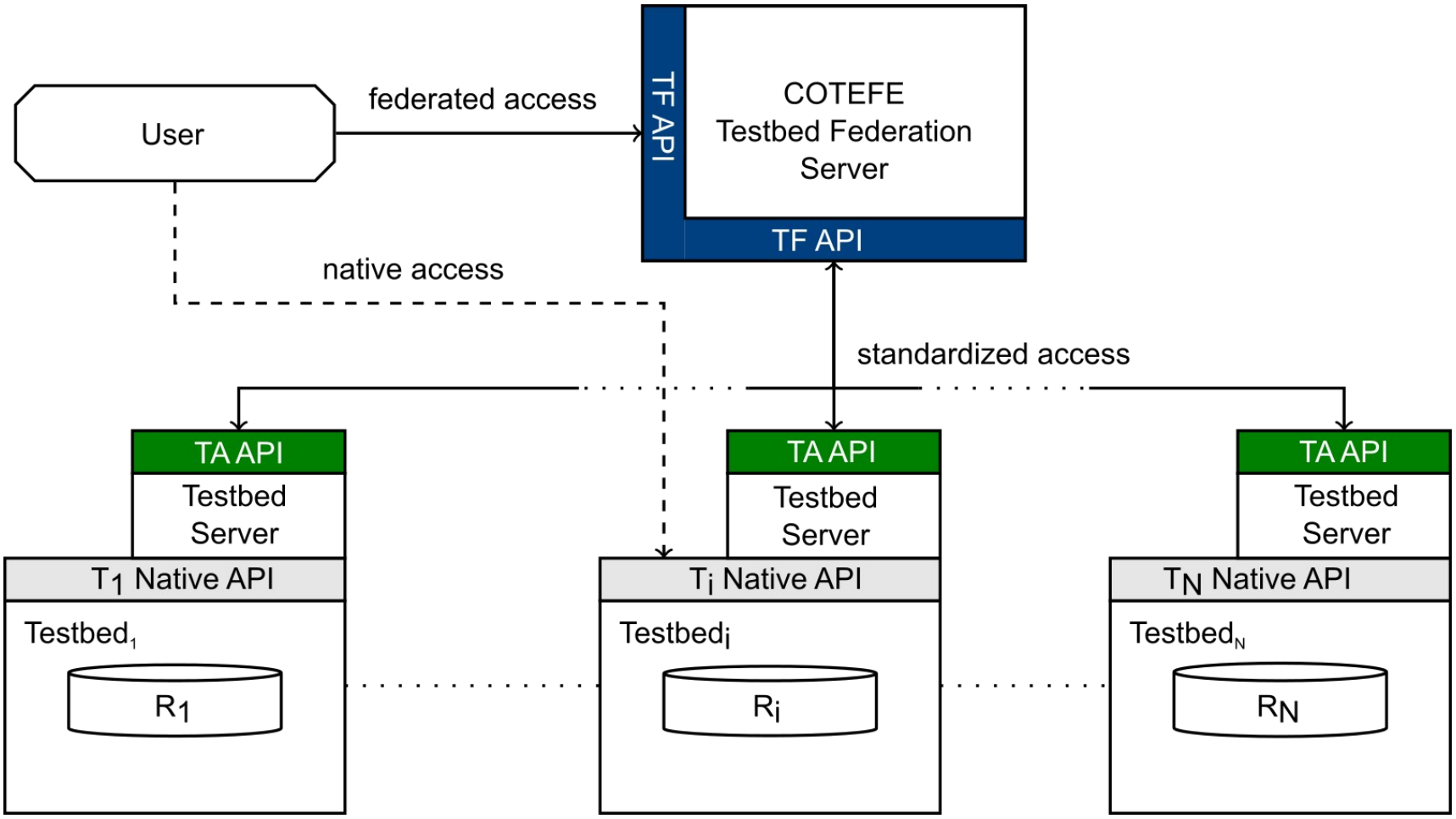
How to abstract testbeds as reusable web services?

COTEFE Testbed Abstraction API

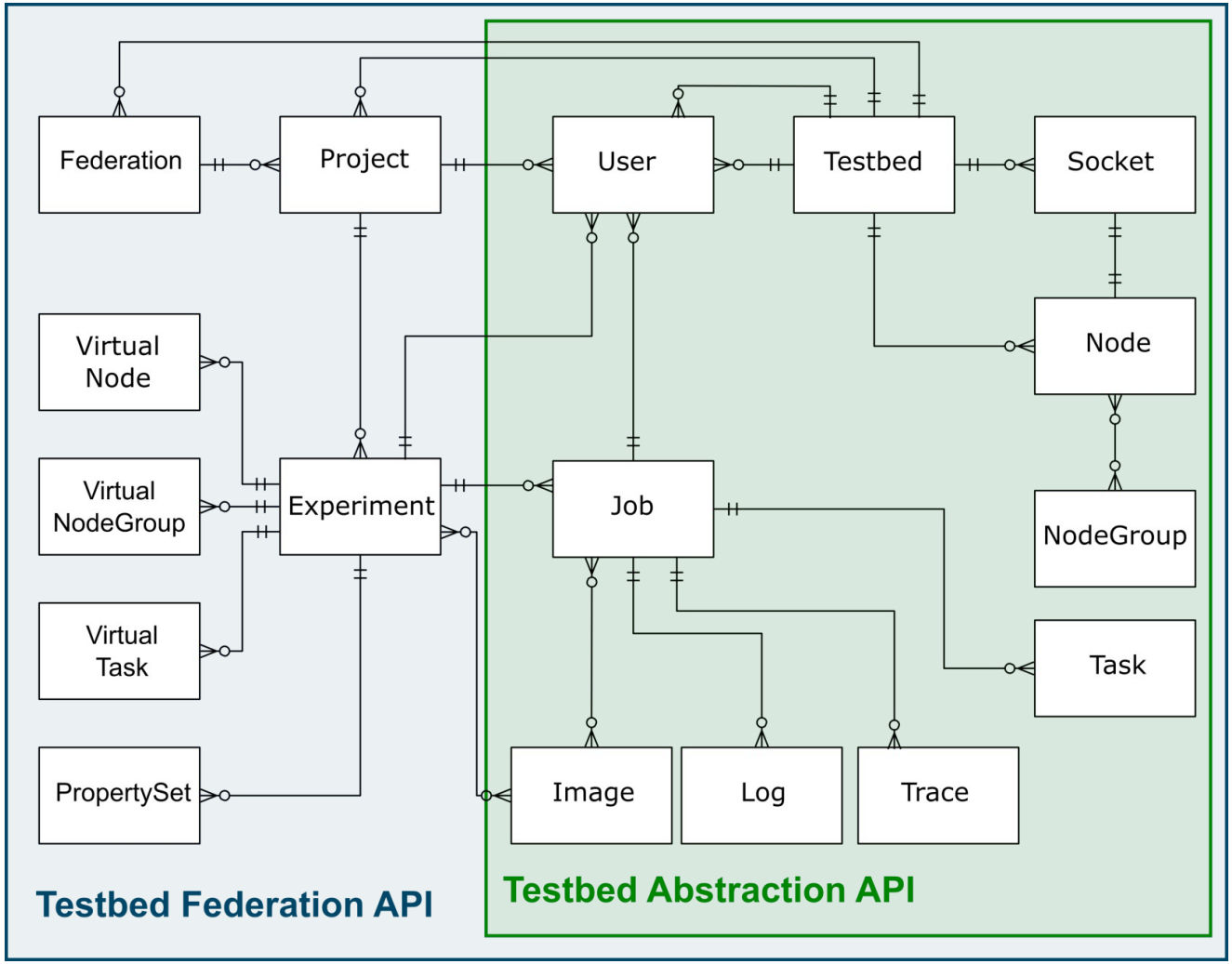
How to streamline experiment specification, execution and migration across a federation of autonomous testbeds?

COTEFE Testbed Federation API

CONET Testbed Federation Architecture



RESTful Design

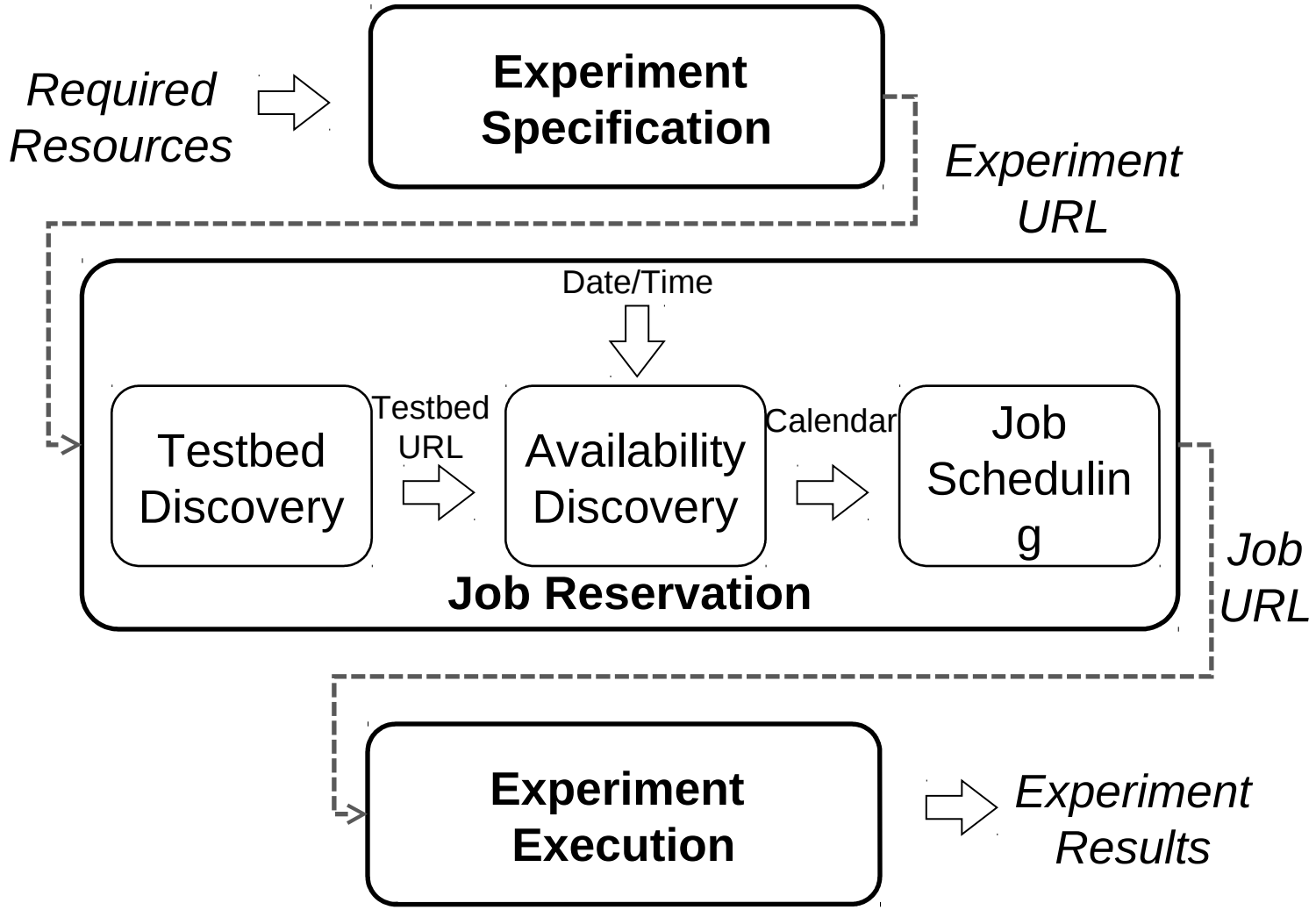


Experiment Specification

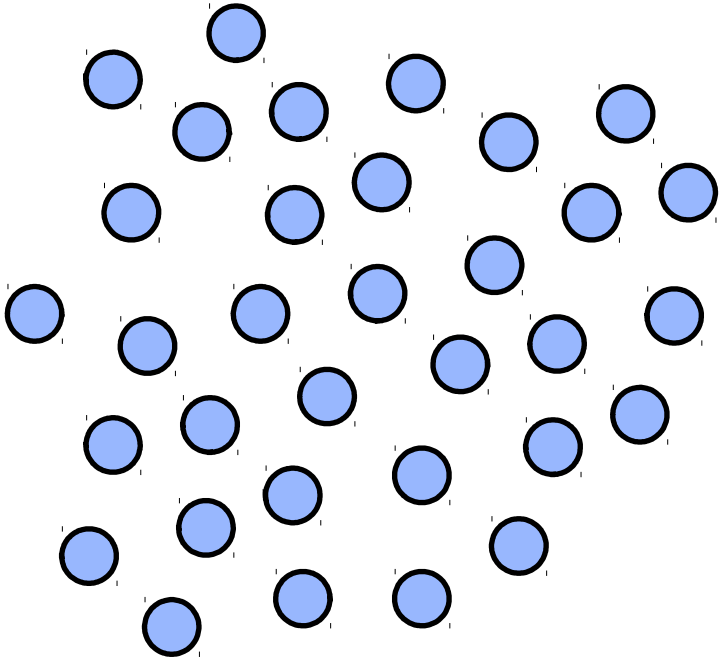
- Requirements
  - Hardware
  - Software
  - Sensing
  - Position
  - Mobility
- Tasks
  - Configuration setup
  - Firmware image deployment
  - Timed command injection
  - Application data collection
  - Debug data collection

Testbed Federation API	Testbed Abstraction API
Experiment	**Job**
PropertySet	-
Virtual Node	Node
Virtual NodeGroup	NodeGroup
Image	Image
Virtual Task	Task

Full Experiment Life-cycle Support



PropertySets



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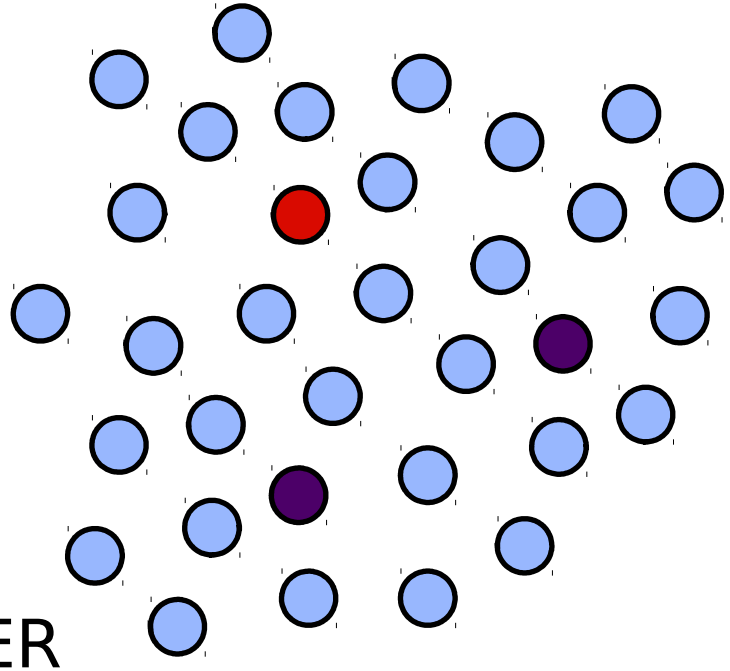
NodeGroups



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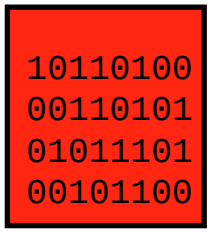
Images



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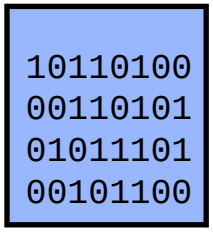
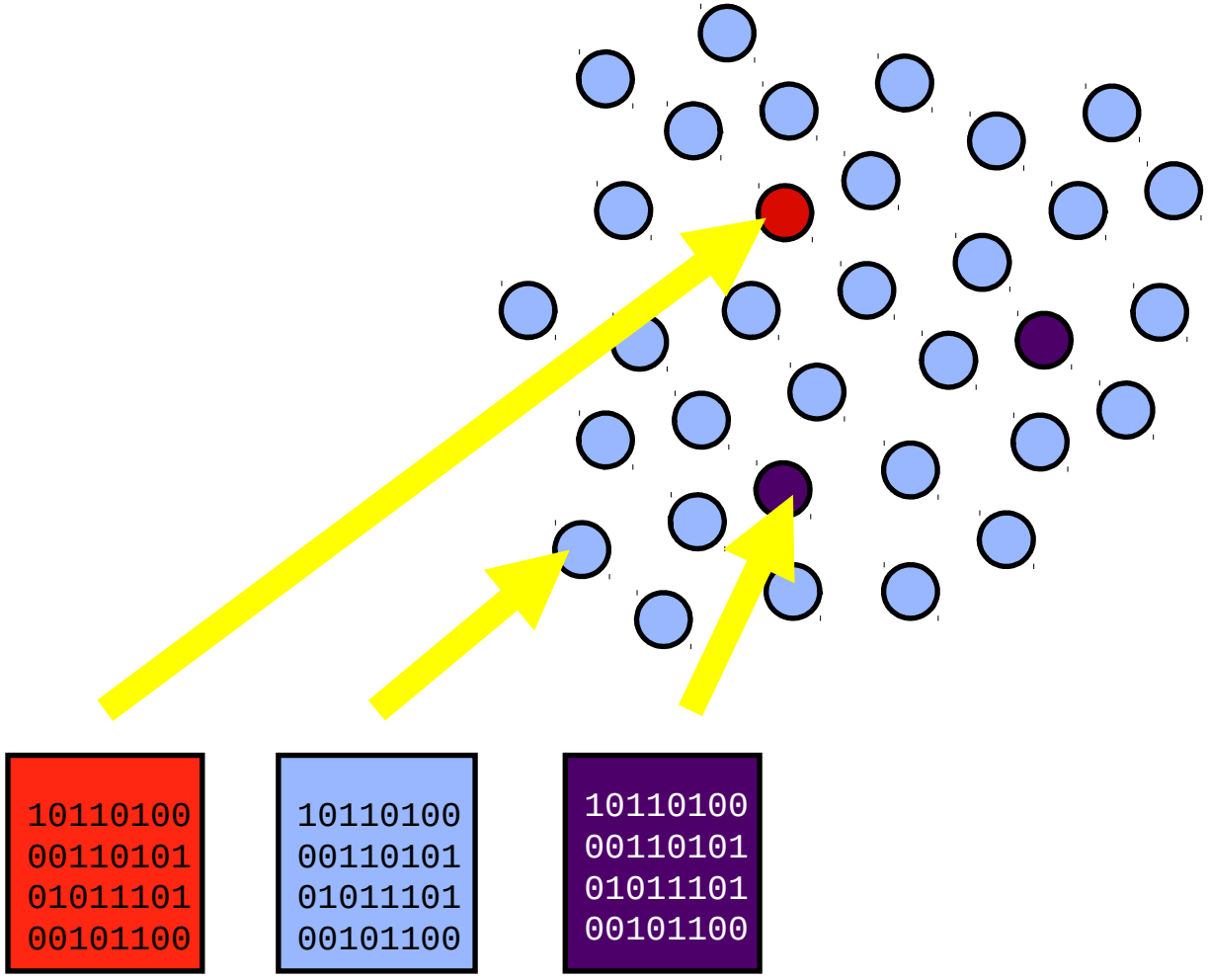


PUBLISHER

INTERFERER

Tasks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Resource Discovery

Input : Experiment

Output : List of Testbeds

GET https://api.cotefe.net/testbeds/?supports_experiment=ID

Availability Discovery

Input : Testbed & Experiment

Output : Availability Calendar

GET https://api.cotefe.net/jobs/?testbed=ID&for_experiment=ID&date_from=2011-07-18&date_to=2011-07-24

Mobility Support

Reading current position

```
GET /nodes/4dd1ba50
Host: www.twist.tu-berlin.de:8001
Accept: application/json
```

Setting positional goal

```
PATCH /nodes/4dd1ba50
Host: www.twist.tu-berlin.de:8001
Content-Type: application/json
{   "location_x" : 1.0,
    "location_y" : 1.0,
    "location_z" : 1.0     }
```

COTEFE Prototype

- Testbed Abstraction API
  - Implemented and deployed on top of TWIST
  - https://www.twist.tu-berlin.de:8000/
- Testbed Federation API
  - Implemented and deployed on Google™ App Engine
  - https://api.cotefe.net
- Client Libraries
  - COTEFE Python Library
  - COTEFE JavaScript Library
- Web Interface
  - Implemented and deployed on Google™ App Engine
  - https://web.cotefe.net