

ORDNANCE SURVEY

Smart City: Digital Twin?

Ordnance Survey Developments

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What we do

- Create, maintain and distribute detailed geospatial information for Britain
- 500 million geospatial features in the master map
- 10,000+ changes a day
- International business



What is Smart? - Helping Dubai become the world's happiest city



Protective Marking | Date

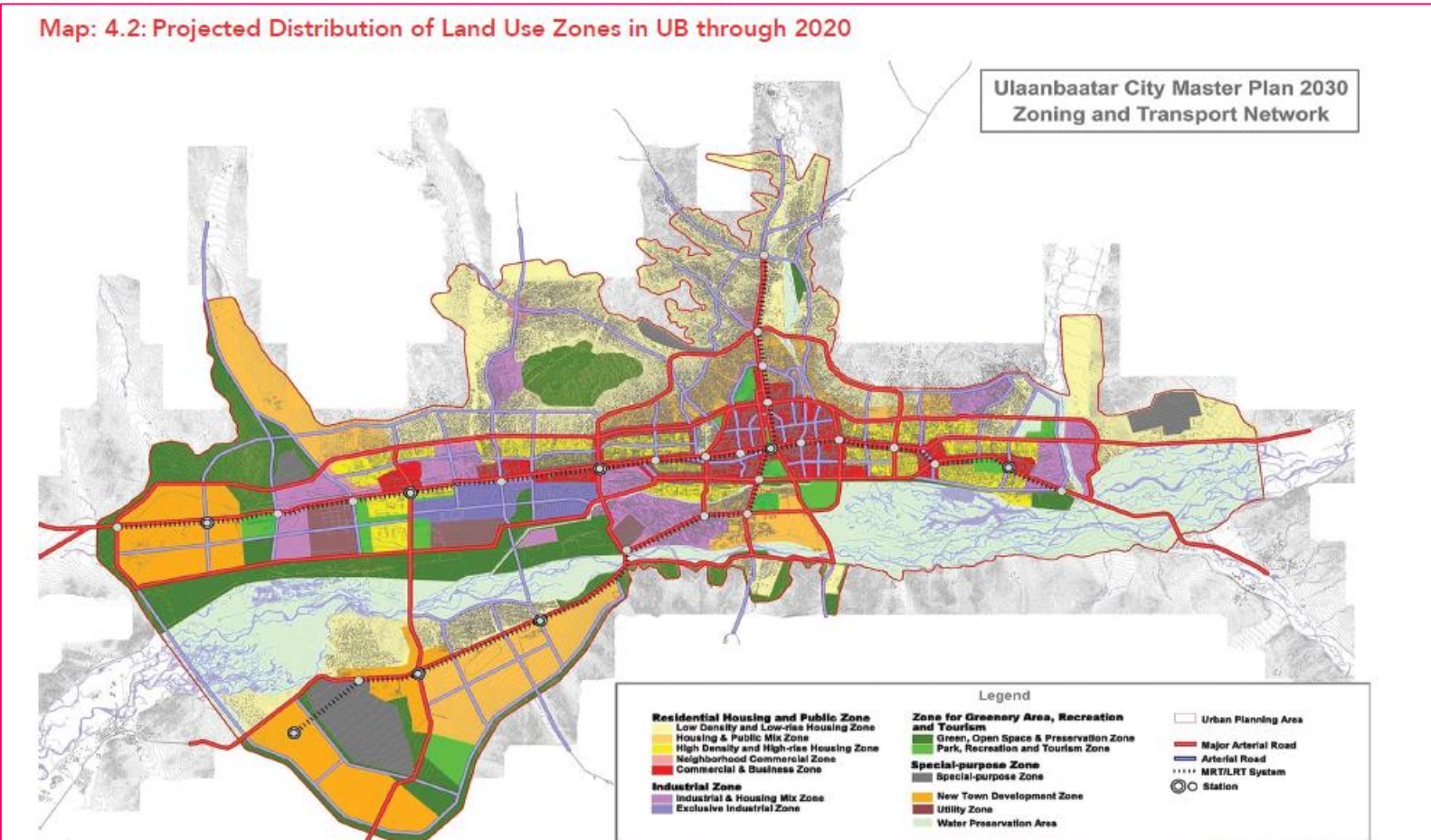


What is Smart? – land administration?



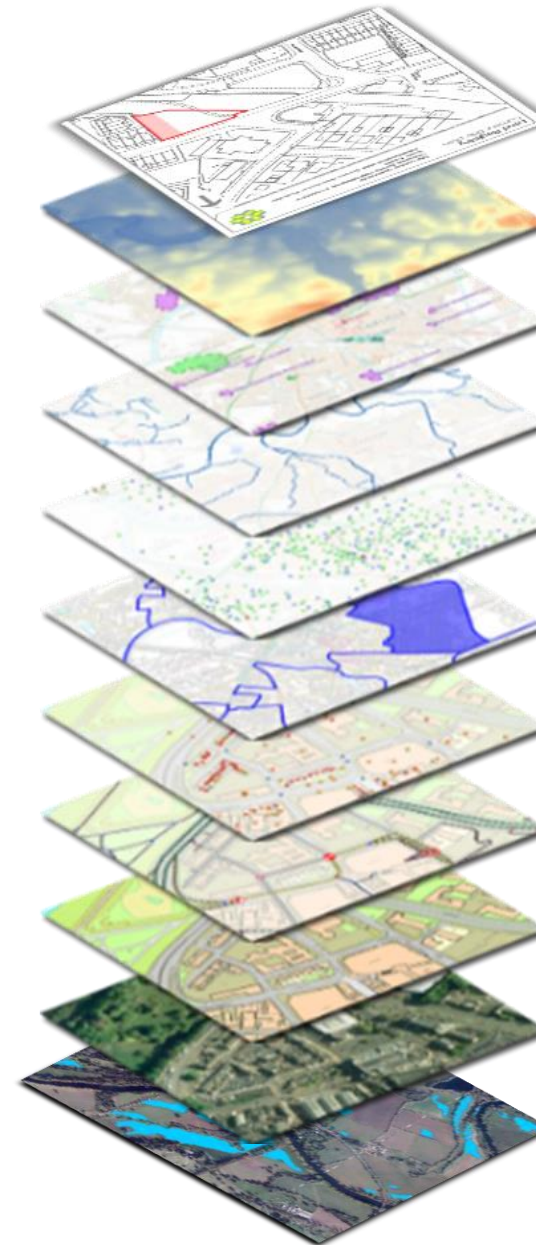
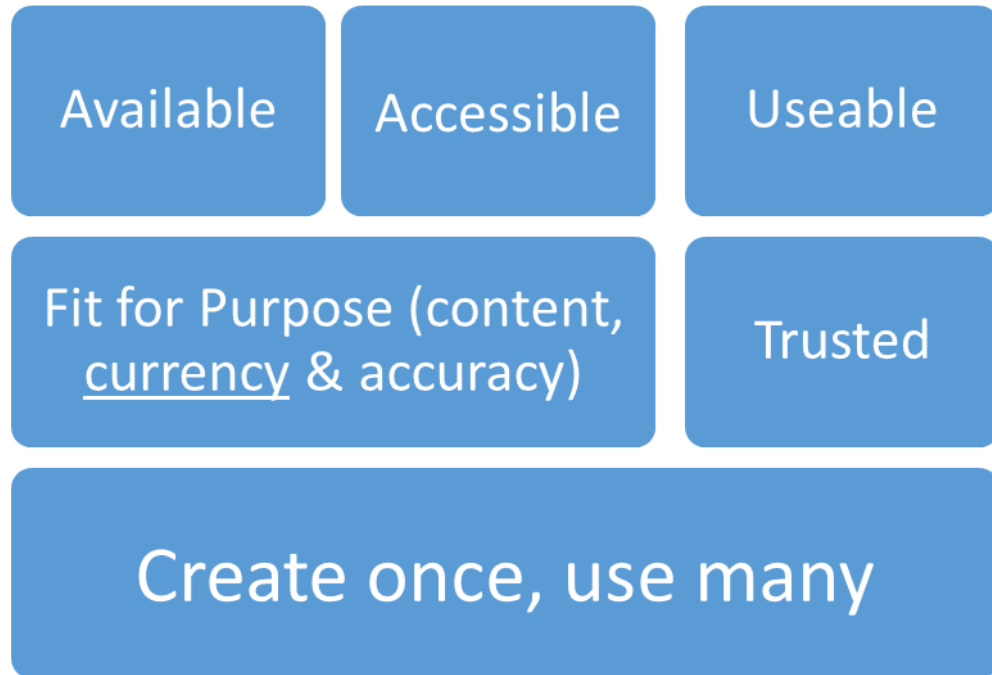
What is Smart? - City planning?

Map: 4.2: Projected Distribution of Land Use Zones in UB through 2020



‘Data are an infrastructural resource – a form of capital that cannot be depleted and that can be used for a theoretically unlimited range of purposes.’

Organisation for Economic Cooperation and Development (OECD) , 2015



- Geographical Names
- Addresses
- Functional Area
- Settlements
- Land Parcels
- Transport Networks
- Elevation/Depth
- Population Distribution
- Land Cover/Use
- Geology/Soils
- Physical Infrastructure
- Imagery
- Water

The data ecosystem.....

.....Location as a means

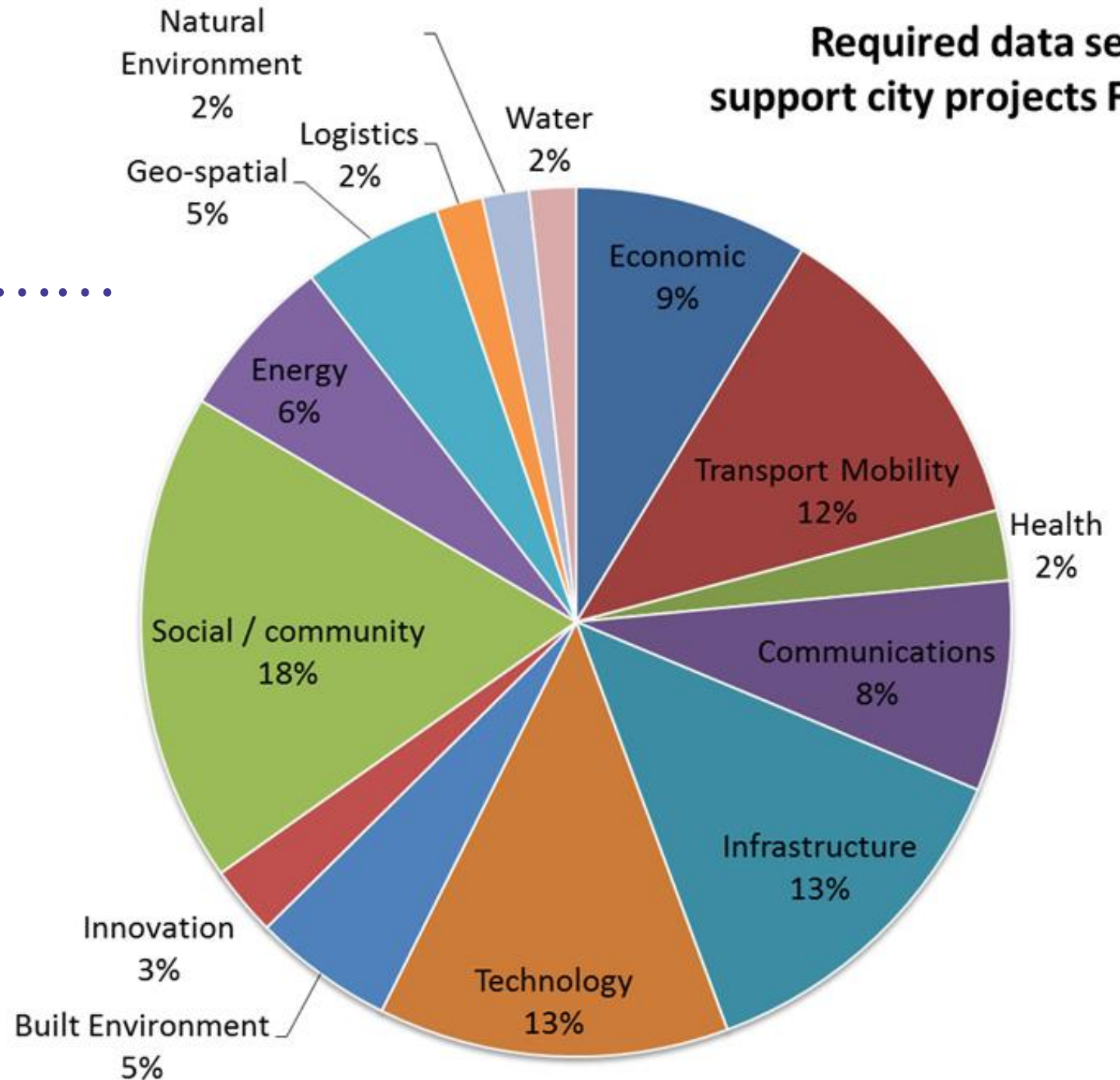
.....Data sharing

.....Collaborate

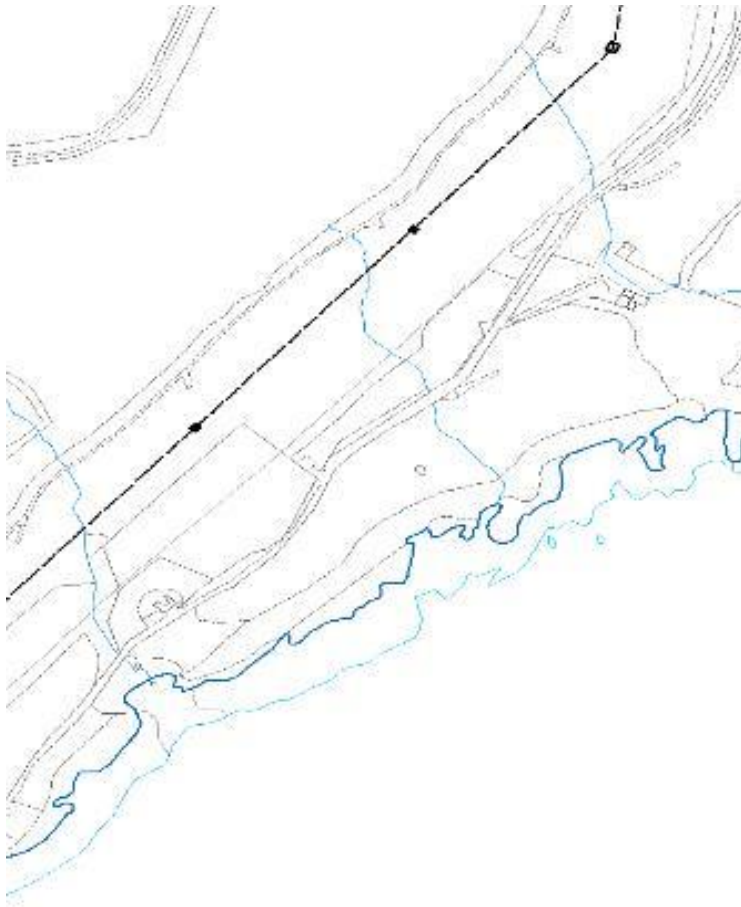
..... Integrate

.....Evidence

Required data sets to support city projects Full survey



Cartography

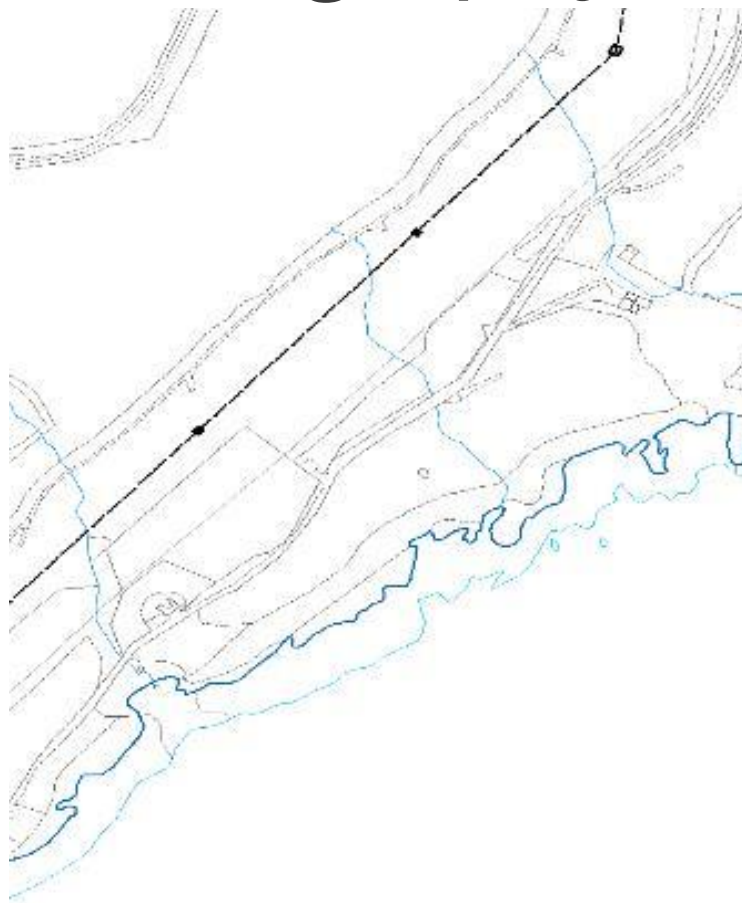


Years

Data Currency
Weeks

Seconds

Cartography



Years

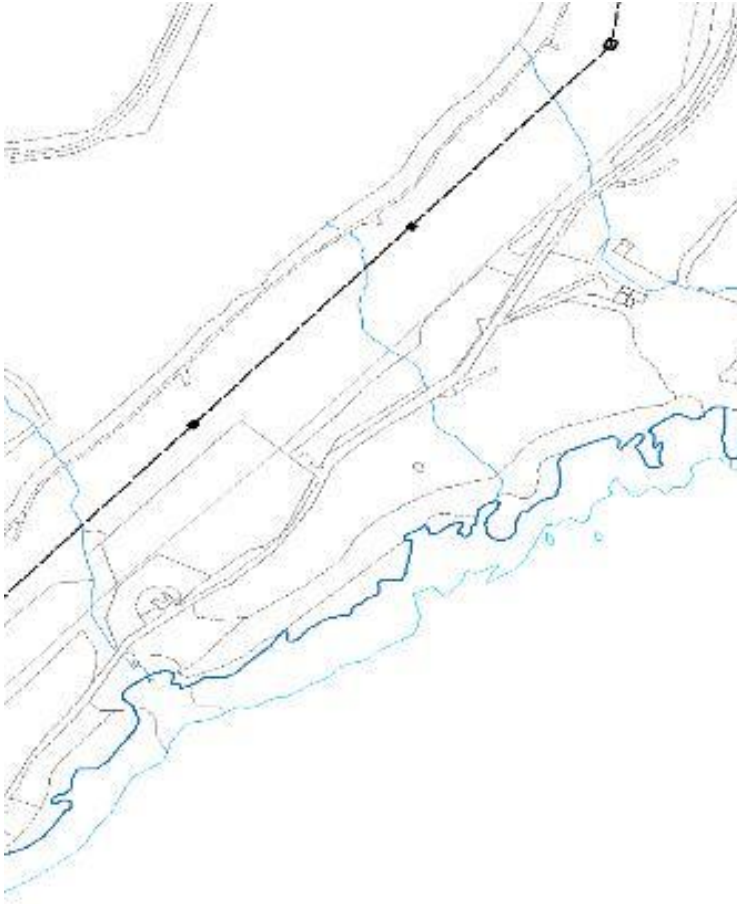
Data



Data Currency
Weeks

Seconds

Cartography



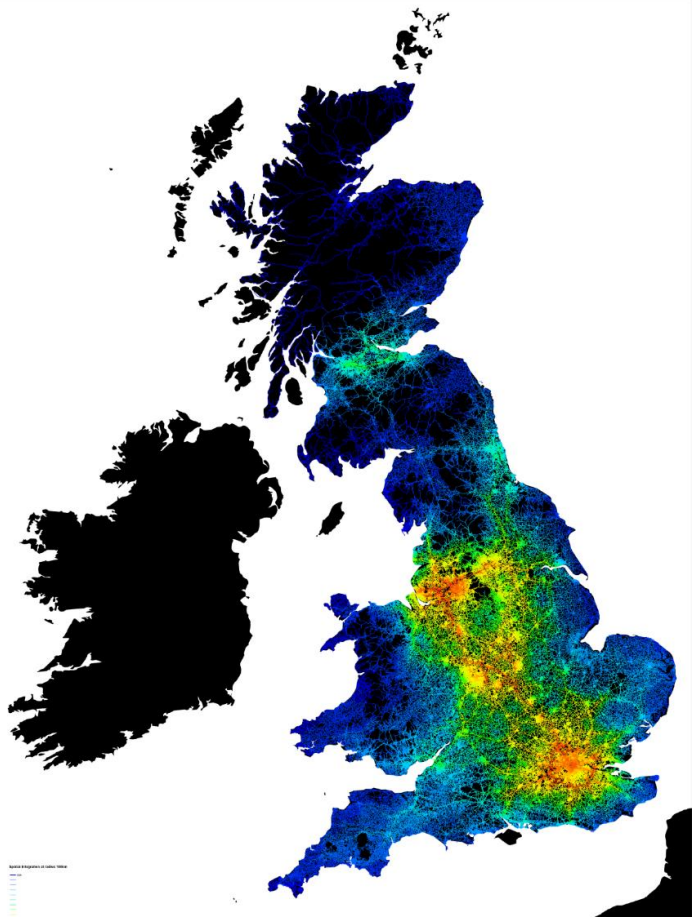
Years

Data



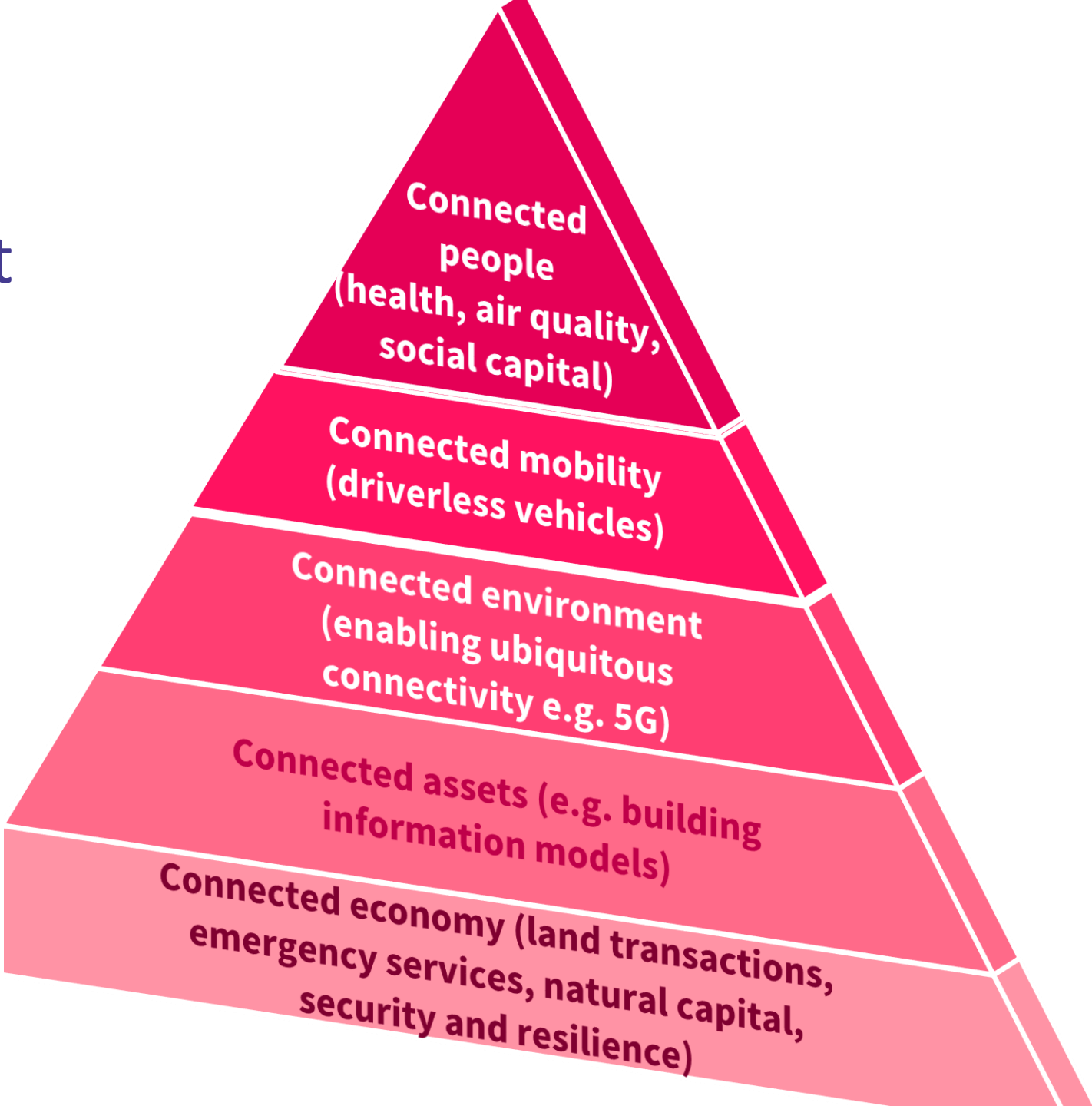
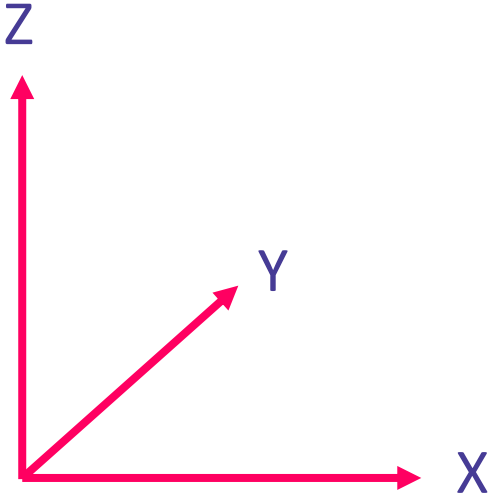
Data Currency
Weeks

Connectivity



Seconds

Connectivity at multiple levels

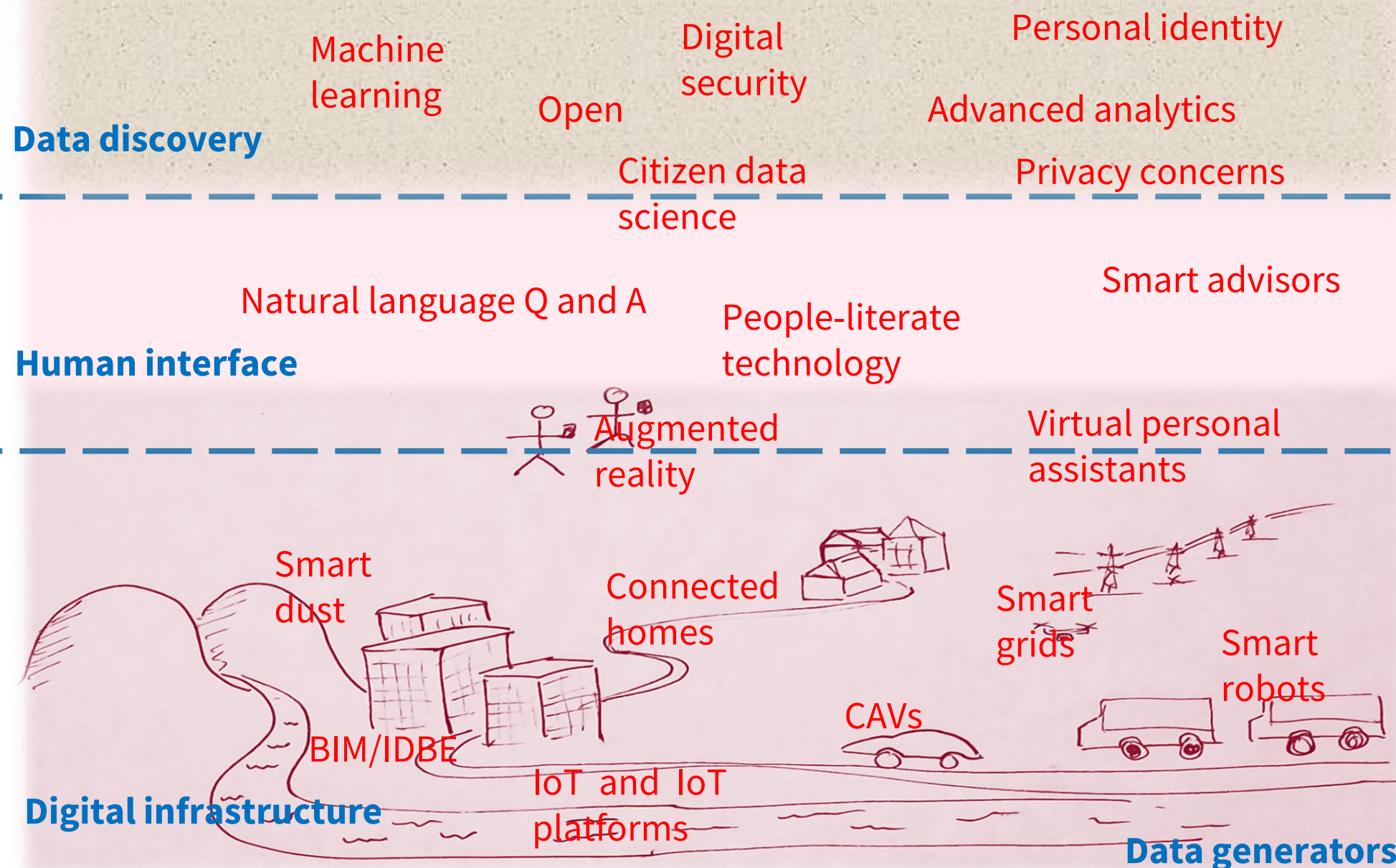


Digital

**Conceptual/
Cognitive -**

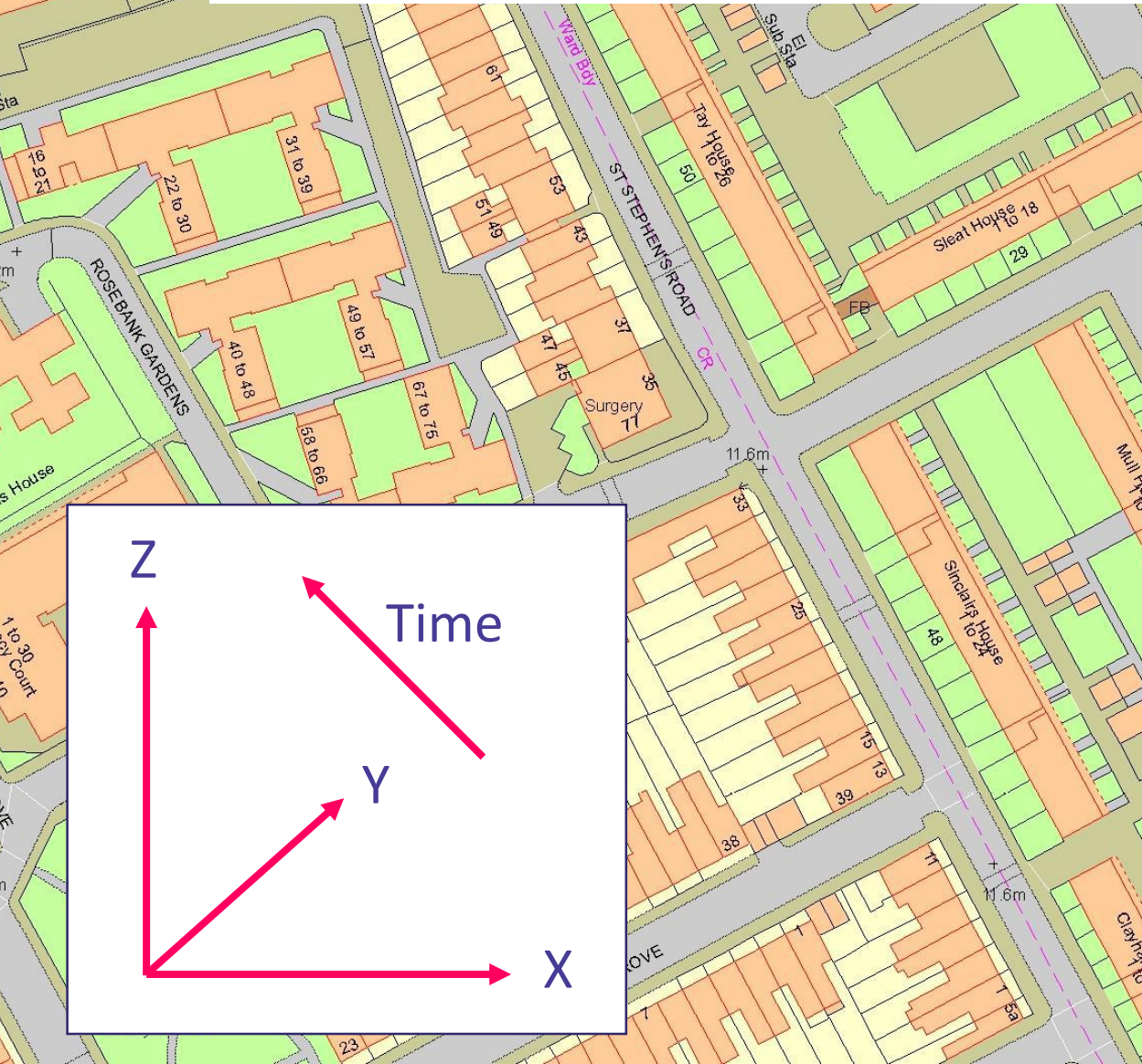
**Physical &
technological**

the human
dimension





Time and Place – the 4th dimension is critical





cityverve



Ordnance Survey



The University of Manchester



Manchester Metropolitan University

Central Manchester University Hospitals

NHS Foundation Trust



SIEMENS



Asset Mapping



PRISMTECH™
AN ADLINK COMPANY



Telensa



CityVerve – our role

- Understanding and advising on the place-based architecture to support Smart Cities.
- Developing new ways for users to consume and share “geo” data through access and visualisation
- Capturing more data than ever before, based around a cities needs and use cases – streetside assets, 3D, point clouds, imagery etc
- Enabling new and emerging technology such as the Internet of Things and dynamic data content
- Ensuring that location data is a first consideration when designing and developing places and spaces
- Encouraging the need for spatial frameworks to be a key element in the design of Smart Cities and places



An aerial photograph of a city grid with a dark blue overlay. The overlay features a network of yellow and orange lines, likely representing roads or utility paths, and numerous small green and blue dots scattered across the urban landscape. A semi-transparent dark blue rectangle is positioned in the center-left, containing white text.

A unique view

Combining this new information with OS MasterMap
creates a unique view

This enables innovation and creates compelling opportunities
for Smart Cities and IoT

Urban Navigation

995 Tactile pavings

262 Pedestrian crossings

133 Crossing control posts

82 Bus stops

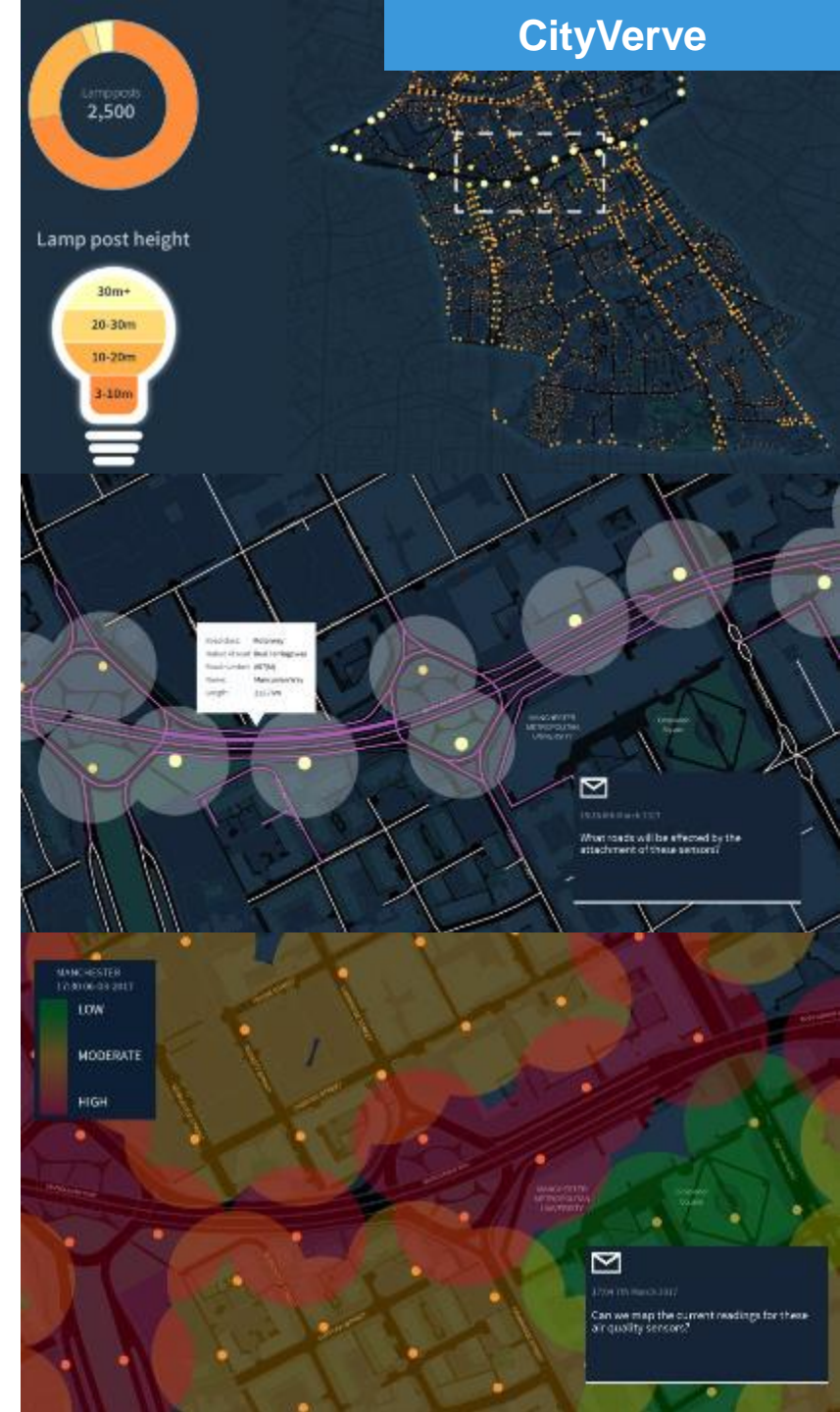


Ordnance Survey

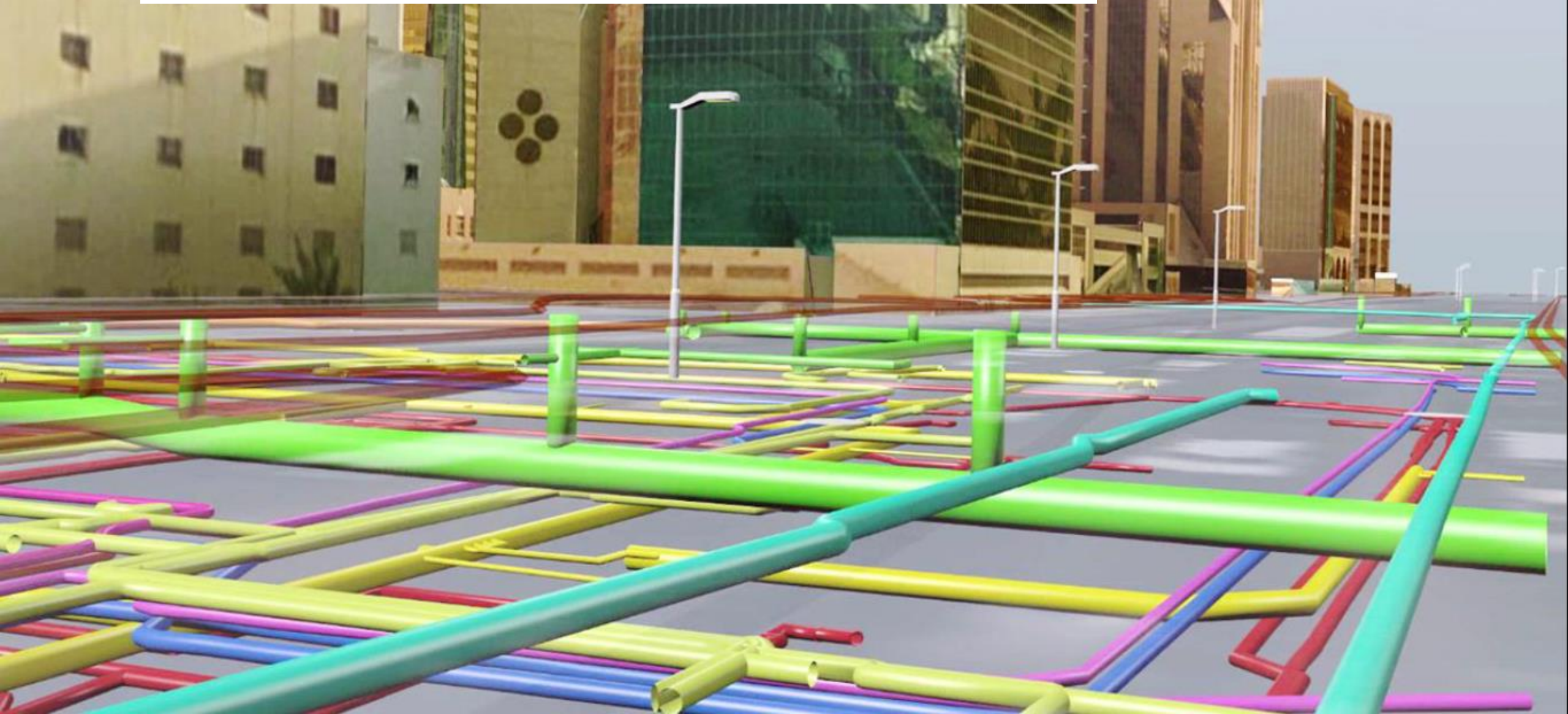
CityVerve - Case Study

Mapping and analysing Air Quality data

- Each street side asset has been accurately located and attributed
- This can help determine if they are suitable for sensor deployment, such as Air Quality devices
- Infrastructure can be assessed for suitability and deployment plans can be integrated with other schedules
- Combined with other geospatial data and real time information, disruption can be minimised
- Real time Air Quality data and information on routes and traffic can provide citizens with more choice on where to go and when




Above and below ground data integration



Integration of third party data for city and region planning and development

Search location

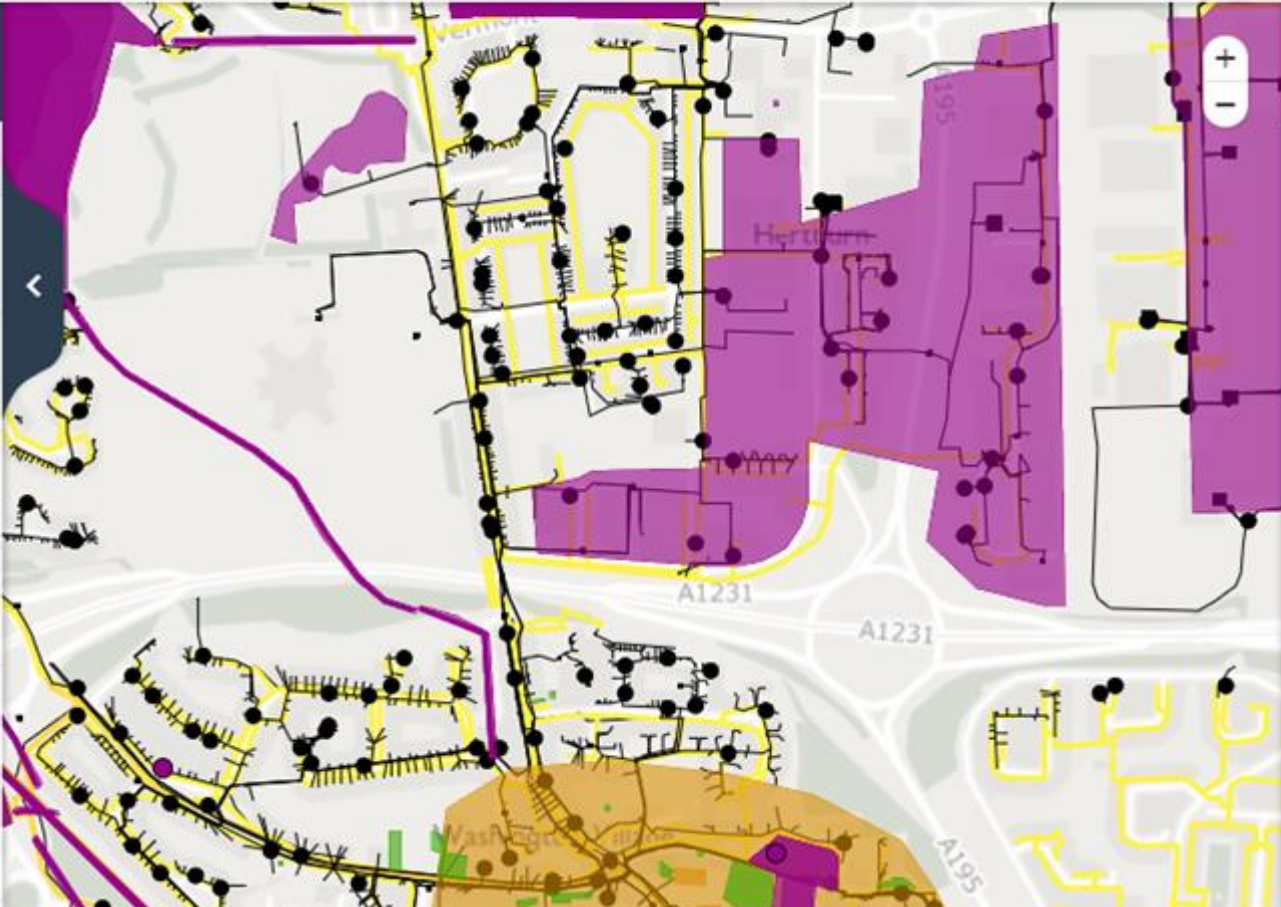
NWG Innovation Festival 2018



Data catalogue

Clear all layers

- Durham County Council
- Newcastle City Council
- Sunderland City Council
- Northumbrian Water Group
- Northern Powergrid
- Northern Gas Networks



Properties

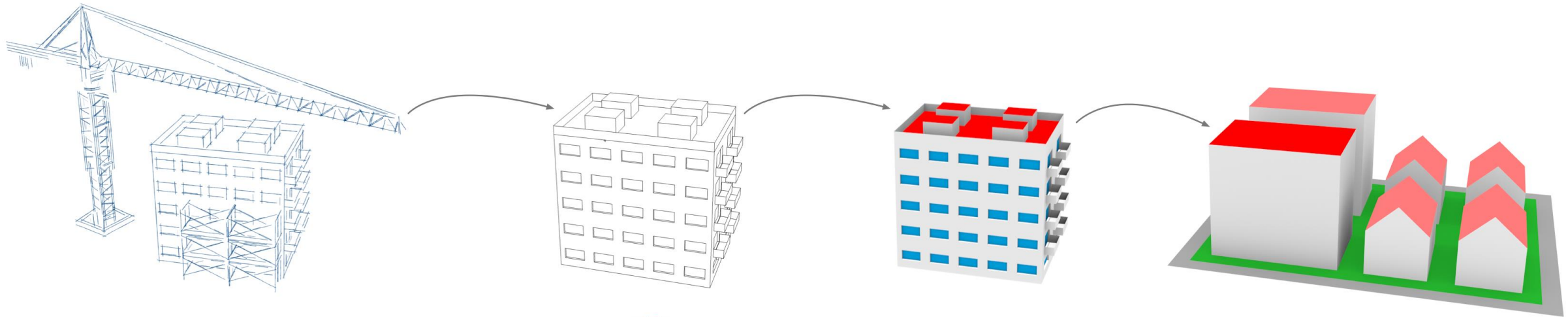
OBJECTID	2049
GISURN	s167100007745
CONTAM_N	6
DATE_	1990
DESCRPT	Factory or works - use not specified
UNIQUE_ID	2049
SHAPE_AREA	189090.535617
SHAPE_LEN	2694.22106463

Developing a 3D data model in Singapore

GovTech asked Ordnance Survey International for expert advice about creating data specifications, and a product flowline and process to generate CityGML-compliant data.



Development of tools to enable further enhancement of the Virtual Singapore representation... combining BIM, Geospatial, and urban use cases



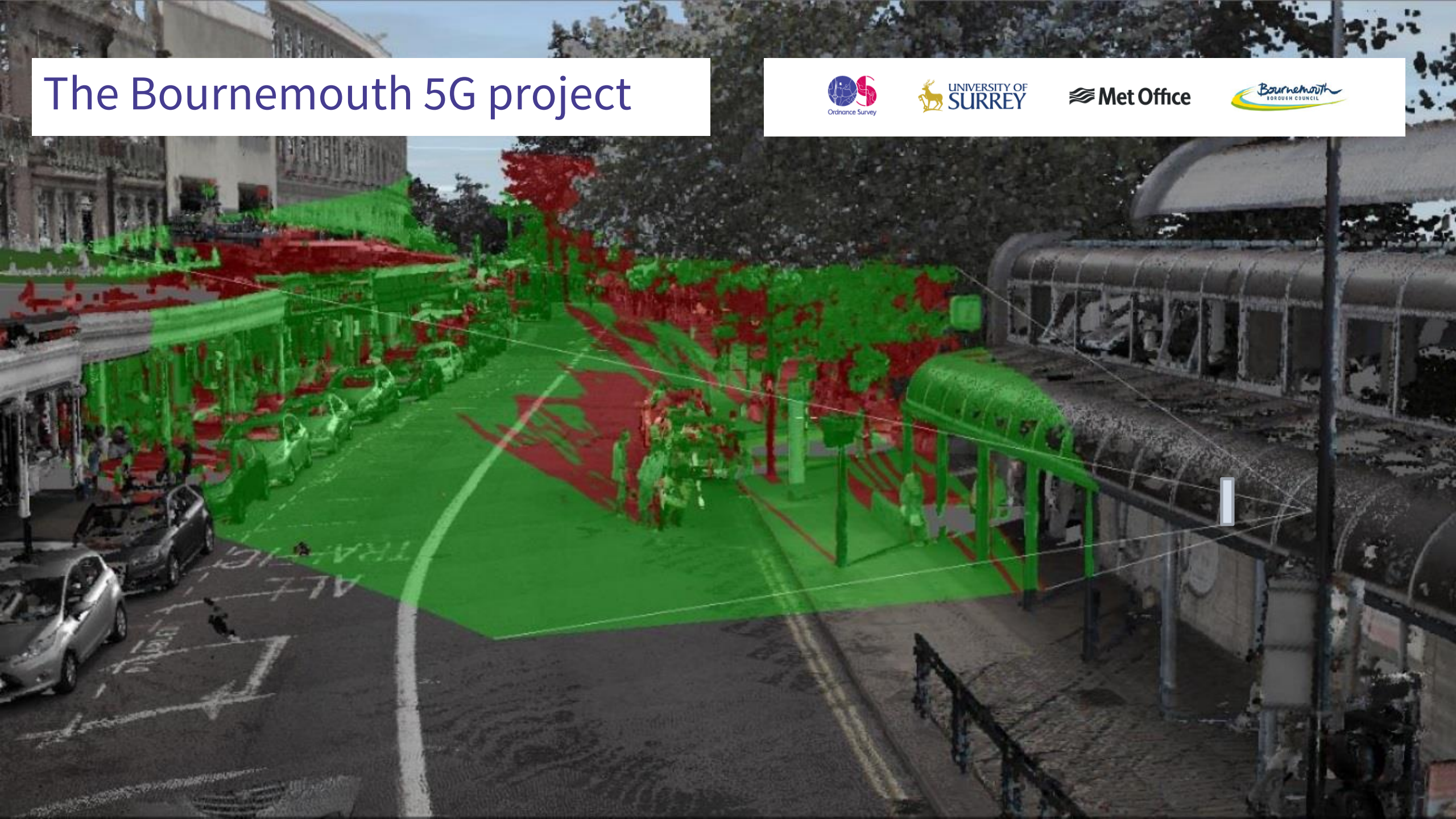
Native BIM

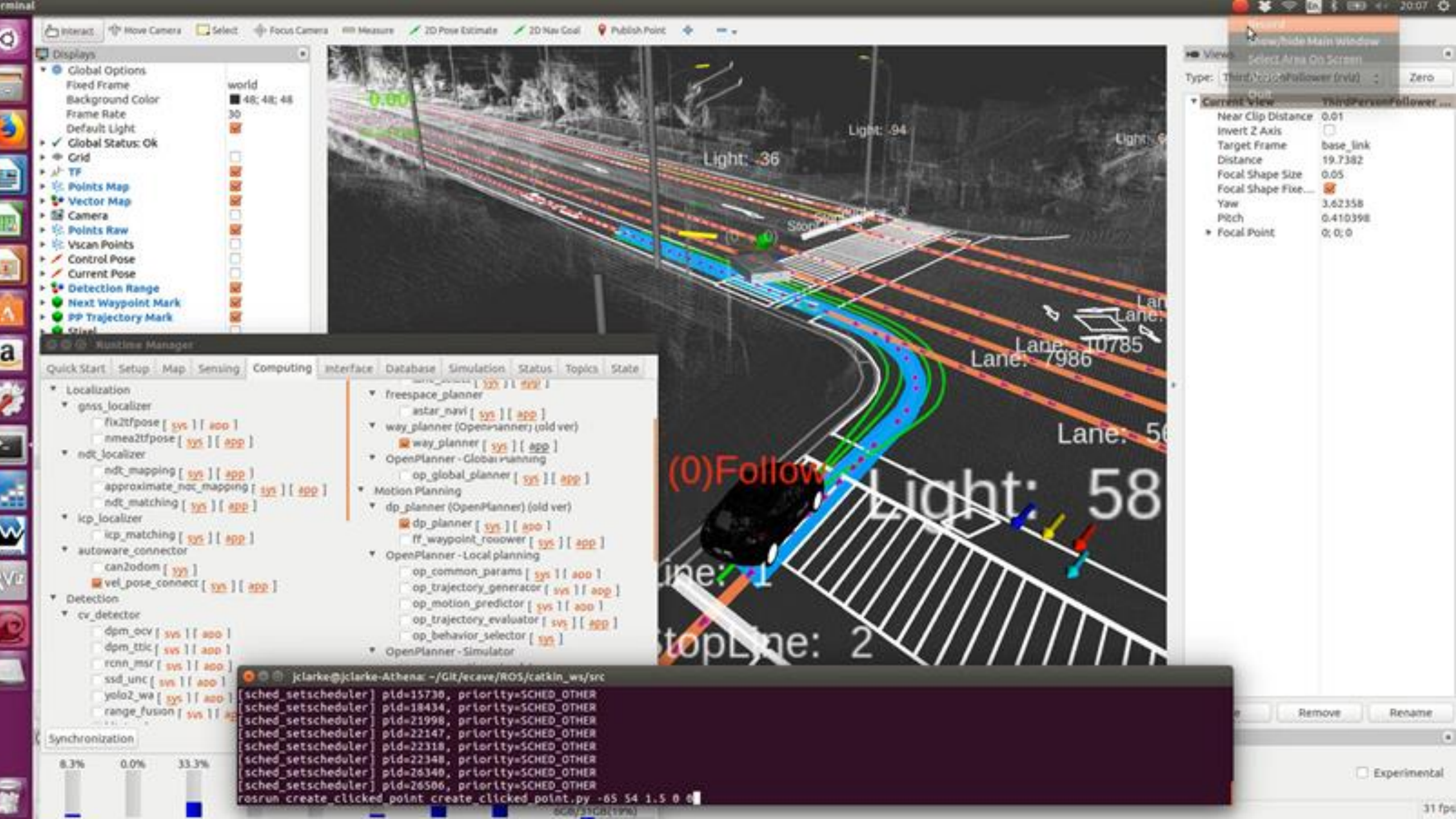


Virtual Singapore



The Bournemouth 5G project





- Displays
- Global Options
 - Fixed Frame: world
 - Background Color: 48: 48: 48
 - Frame Rate: 30
 - Default Light:
- Global Status: Ok
- Grid:
- TF:
- Points Map:
- Vector Map:
- Camera:
- Points Raw:
- Vscan Points:
- Control Pose:
- Current Pose:
- Detection Range:
- Next Waypoint Mark:
- PP Trajectory Mark:
- Global:

- Quick Start
- Setup
- Map
- Sensing
- Computing
- Interface
- Database
- Simulation
- Status
- Topics
- State
- Localization
 - gssss_localizer
 - fix2tfpose [sys | [app]
 - nmea2tfpose [sys | [app]
 - ndt_localizer
 - ndt_mapping [sys | [app]
 - approximate_ndt_mapping [sys | [app]
 - ndt_matching [sys | [app]
 - icp_localizer
 - icp_matching [sys | [app]
 - autoware_connector
 - can2odom [sys]
 - vel_pose_connect [sys | [app]
 - Detection
 - cv_detector
 - dpm_ocv [sys | [app]
 - dpm_ttic [sys | [app]
 - rcnn_msr [sys | [app]
 - ssd_unc [sys | [app]
 - yolo2_wa [sys | [app]
 - range_fusion [sys | [app]
- freespace_planner
 - astar_navi [sys | [app]
- way_planner (OpenPlanner) (old ver)
 - way_planner [sys | [app]
- OpenPlanner - Global planning
 - op_global_planner [sys | [app]
- Motion Planning
 - dp_planner (OpenPlanner) (old ver)
 - dp_planner [sys | [app]
 - ff_waypoint_resolver [sys | [app]
 - OpenPlanner - Local planning
 - op_common_params [sys | [app]
 - op_trajectory_generator [sys | [app]
 - op_motion_predictor [sys | [app]
 - op_trajectory_evaluator [sys | [app]
 - op_behavior_selector [sys]
- OpenPlanner - Simulator

Views: Select Area On Screen

Type: ThirdPersonFollower (rviz) : Zero

Current View	ThirdPersonFollower...
Near Clip Distance	0.01
Invert Z Axis	<input type="checkbox"/>
Target Frame	base_link
Distance	19.7382
Focal Shape Size	0.05
Focal Shape Fixe...	<input checked="" type="checkbox"/>
Yaw	3.62358
Pitch	0.410398
Focal Point	0: 0: 0

```
jclarke@jclarke-Athena: ~/GIT/ecave/ROS/catkin_ws/src
[sched_setscheduler] pid=15730, priority=SCHED_OTHER
[sched_setscheduler] pid=18434, priority=SCHED_OTHER
[sched_setscheduler] pid=21998, priority=SCHED_OTHER
[sched_setscheduler] pid=22147, priority=SCHED_OTHER
[sched_setscheduler] pid=22318, priority=SCHED_OTHER
[sched_setscheduler] pid=22348, priority=SCHED_OTHER
[sched_setscheduler] pid=26340, priority=SCHED_OTHER
[sched_setscheduler] pid=26506, priority=SCHED_OTHER
roslaunch create_clicked_point create_clicked_point.py -65 54 1.5 0 0
```

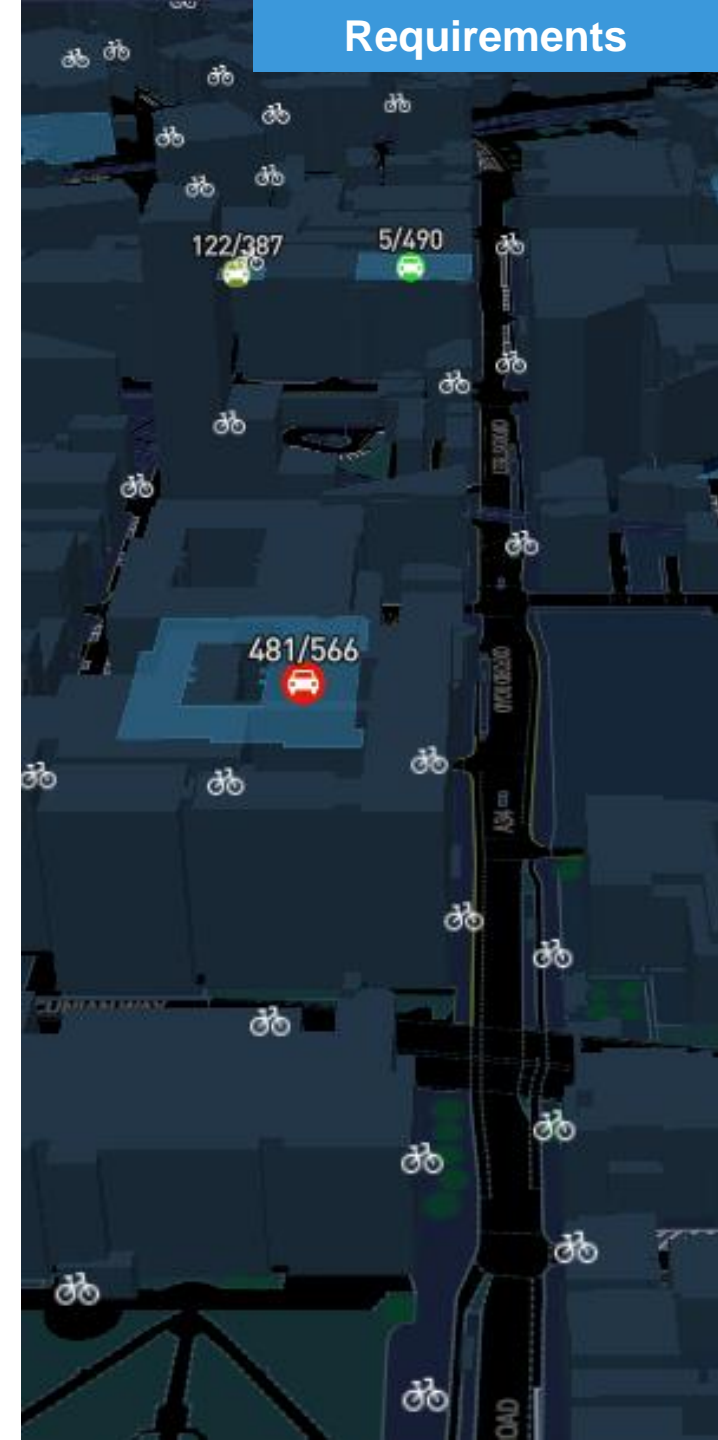


Experimental

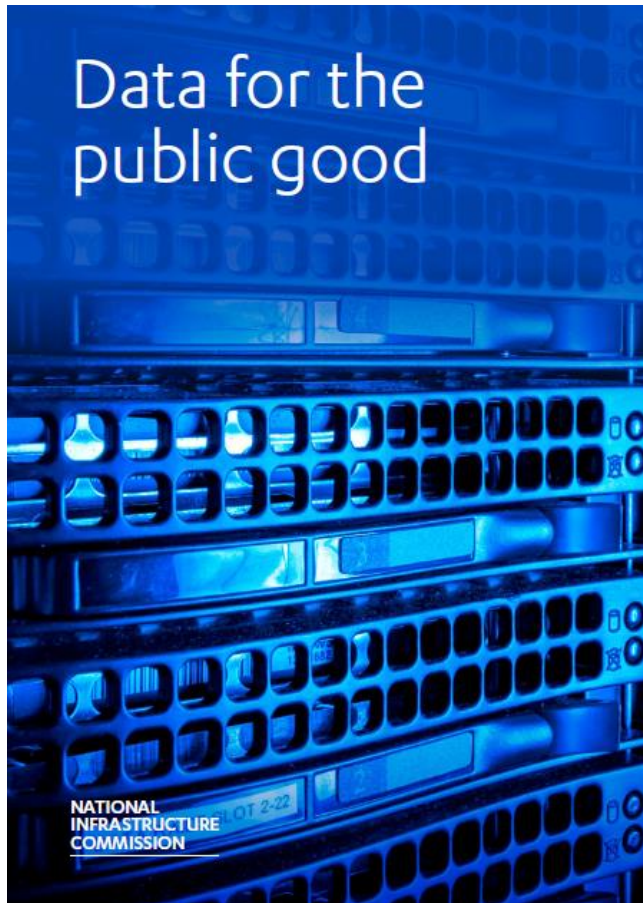
31 fps

We are seeing a growing need from cities for:

- **Granularity.** We are seeing emerging requirements for high-resolution, 3D data frameworks.
- **Connectivity.** Networks need to support the transfer of dynamic data, rich, attributed content and underpin the connection of fixed and mobile assets
- **Standards.** Ever-more important to enable true interoperability and machine-readability.
- **Data models.** Need to be authoritative, federated, fully integrated, extensible and secure, supporting alternative interpretations of the real world.
- **Sustainability.** Frictionless data exchange and the right business models.
- **Visualisation.** (AKA cartography) remains fundamentally important because humans are still in charge.

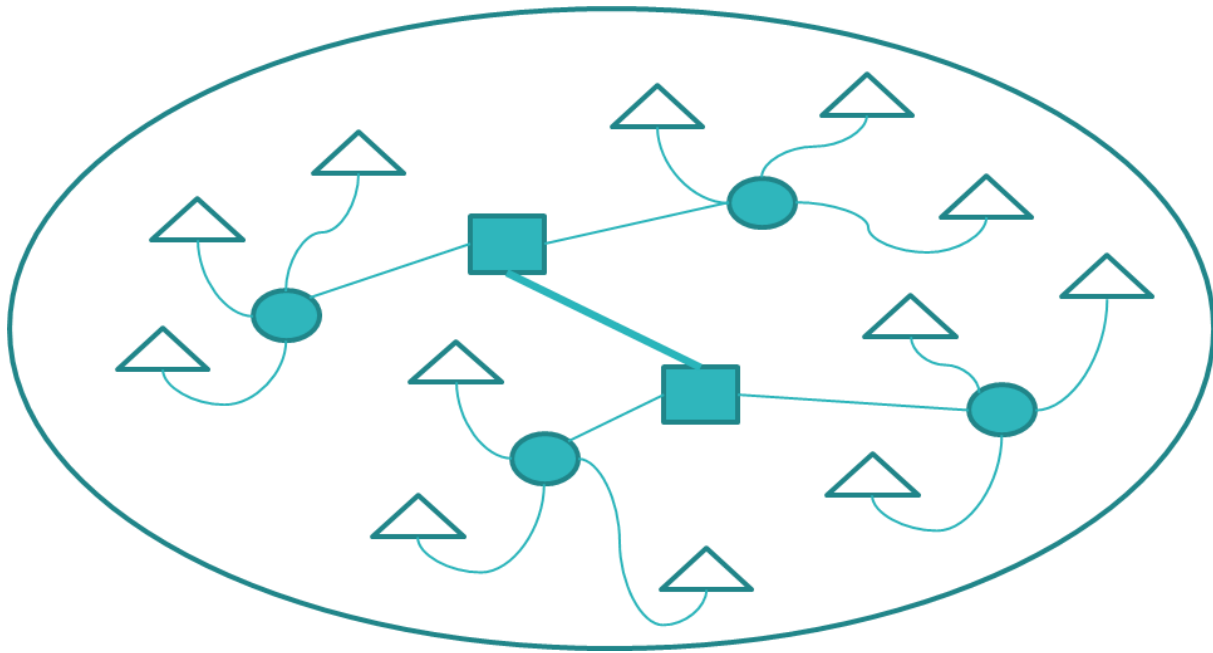


Connecting infrastructure: all roads lead to the Digital Twin

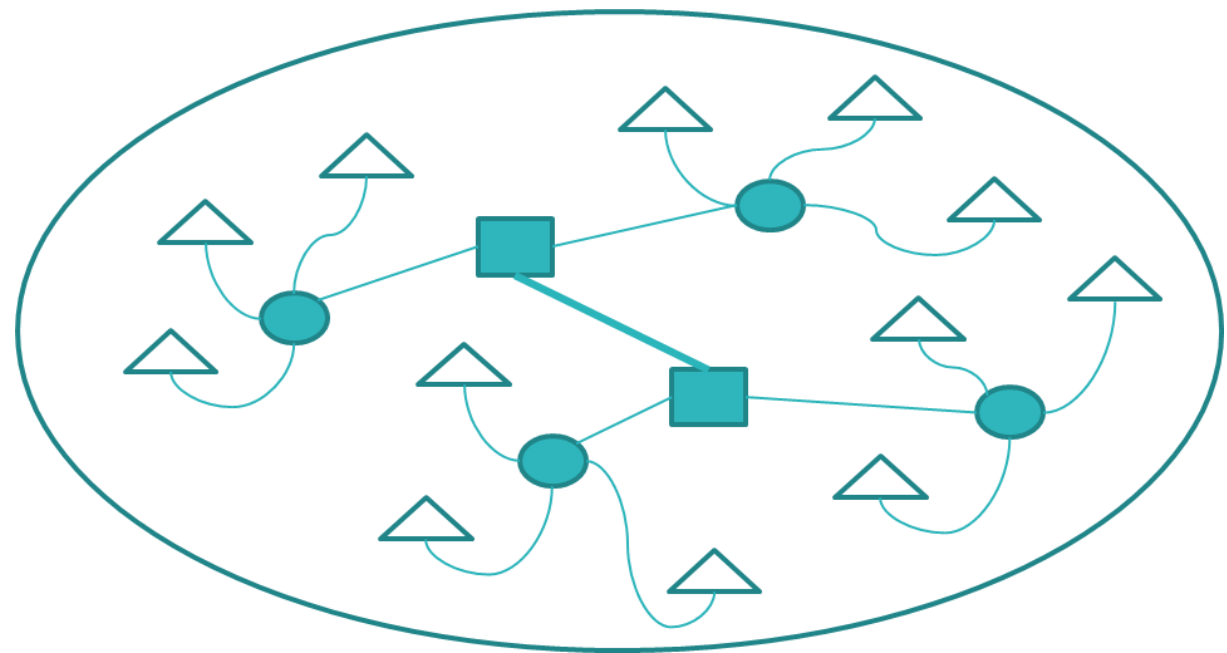


‘The UK will develop a national digital twin: a virtual model of our national infrastructure which will both monitor infrastructure in real-time and have predictive capability. This will help manage, plan, predict and understand the UK’s infrastructure, delivering resilient, responsive, high-performance systems.’

Infrastructure

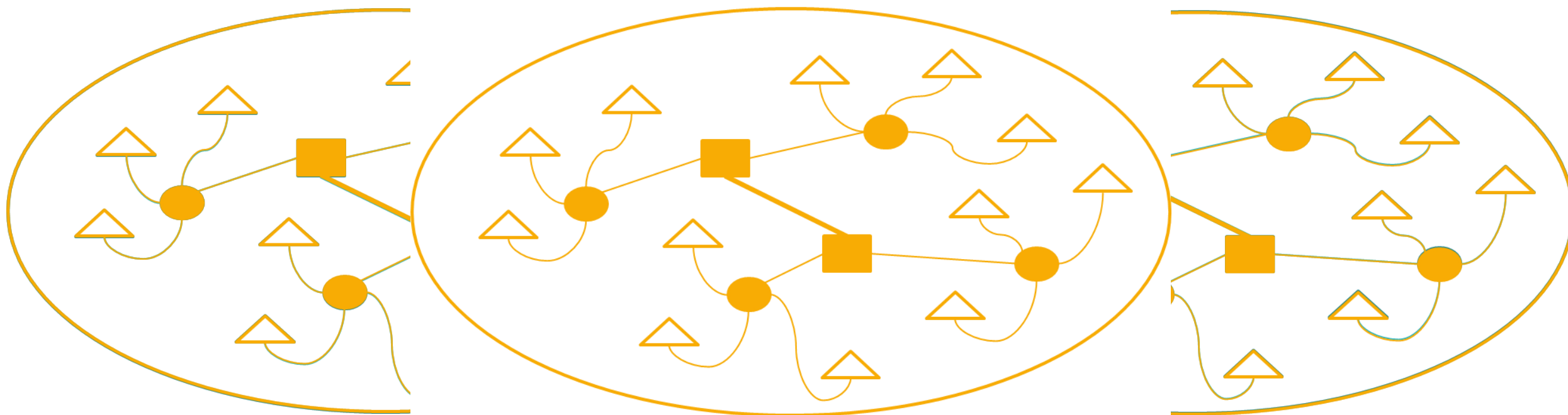


Physical infrastructure



Digital twin

Smart Infrastructure



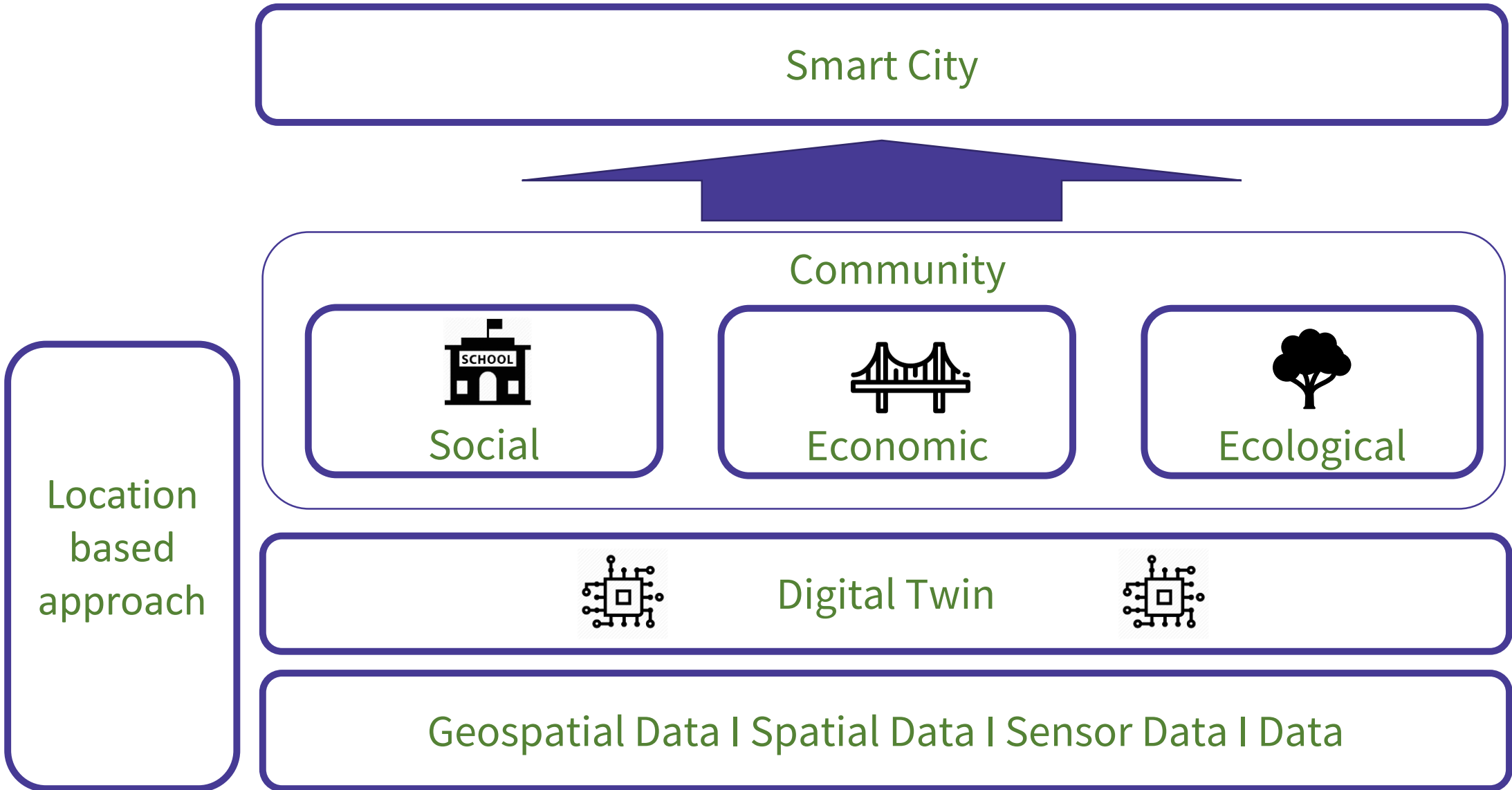
Physical infrastructure Smart infrastructure

Digital twin

The next Smart City?... “the Digital Twin”

- **A digital version of the real world** including physical assets indoors, outdoors, above and below ground.
- A federated approach - multiple contributors, multiple geometries
- A Digital Twin enables scenario modelling, simulation and analytics
- Dynamic and linkable representations of real-world features, supported with strong, persistent identifiers.
- Machine readable content, integrated with other views of the real world





Ordnance Survey: Using emerging technology

- Refining high-altitude image capture techniques
- Using sensors in urban areas
- Surveying with vehicles on the ground, and unmanned aerial vehicles
- Using pointclouds to create a 3D 'digital twin' of structures and cities
- Automatic change detection and machine-to-machine learning
- Research with academic partners into augmented reality; crowdsourcing and high-accuracy GNSS positioning
- New ways of enriching our data for users who will demand even more content and detail
- **Moving onto the cloud**

Thank You

John Kedar

Director International Engagement

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