Australian Government
Department of Defence

Challenge of Suitable Integrated Information System

Sensors, communications, networks, distributed situational awareness, tasking, …

- What learnt and achieved so far, opportunities going forward

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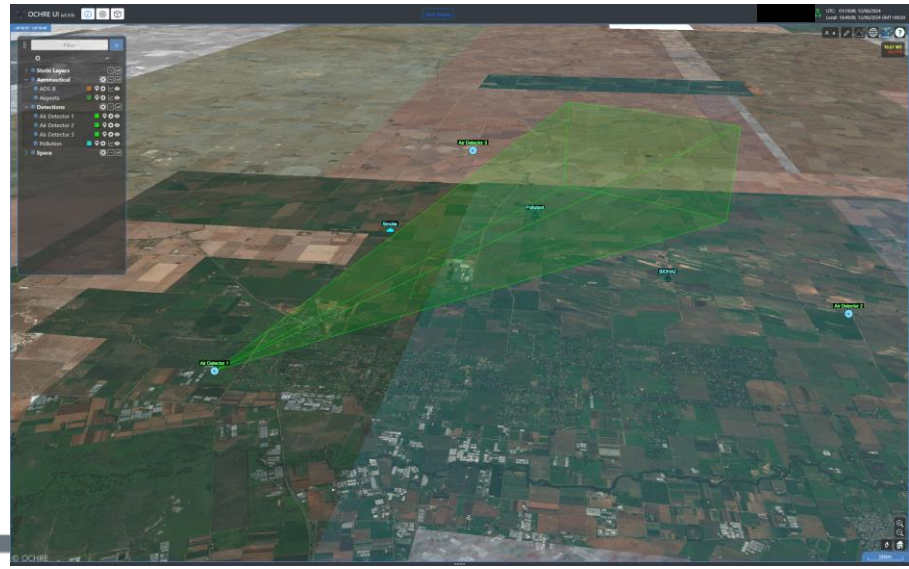
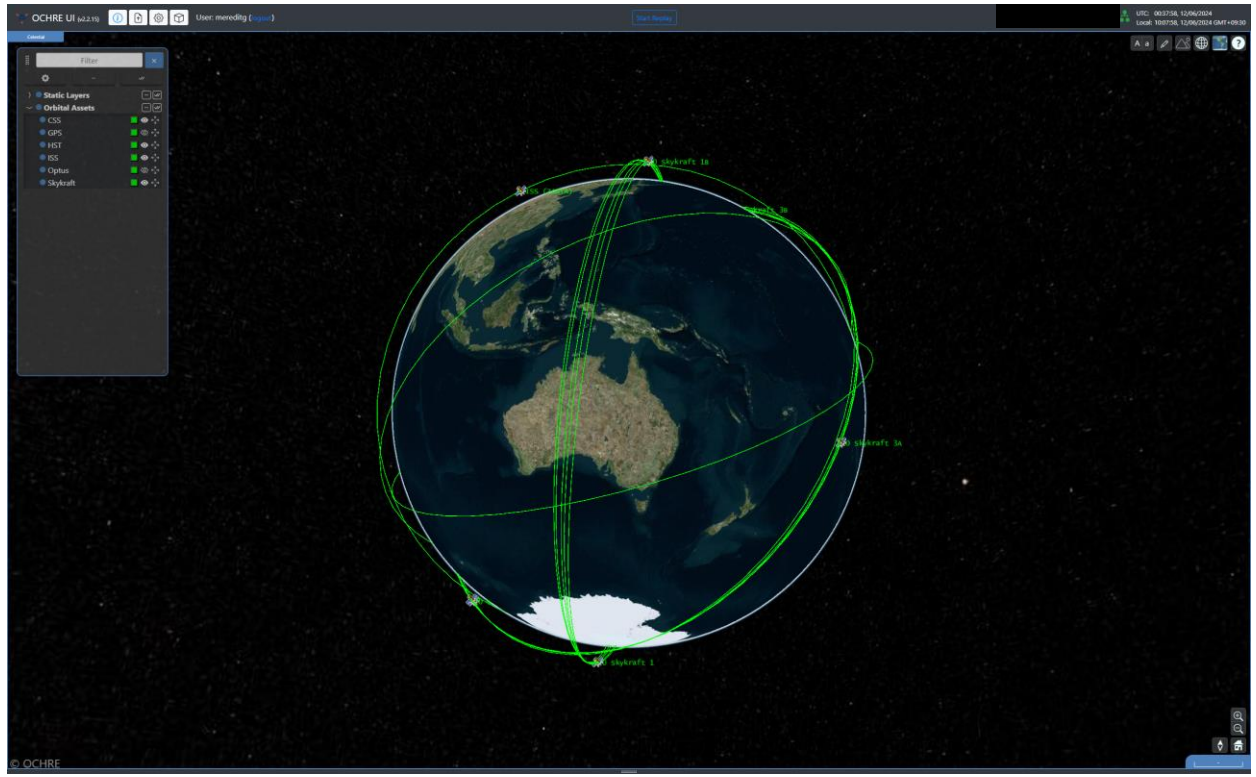
What challenges do you have? Are some of them:

- Finding and distilling information from numerous systems
- Disconnected / infrequent communications from remote sensors/nodes
- Synchronising information and displays
- Quickly integrating many different systems
- A common situational awareness that is able to be distributed
- Locations that have power / footprint challenges
- System scaling
- Remote tasking of systems/sensors
- Developing suitable display representations
- Storage and retrieval for analysis, after action
- …



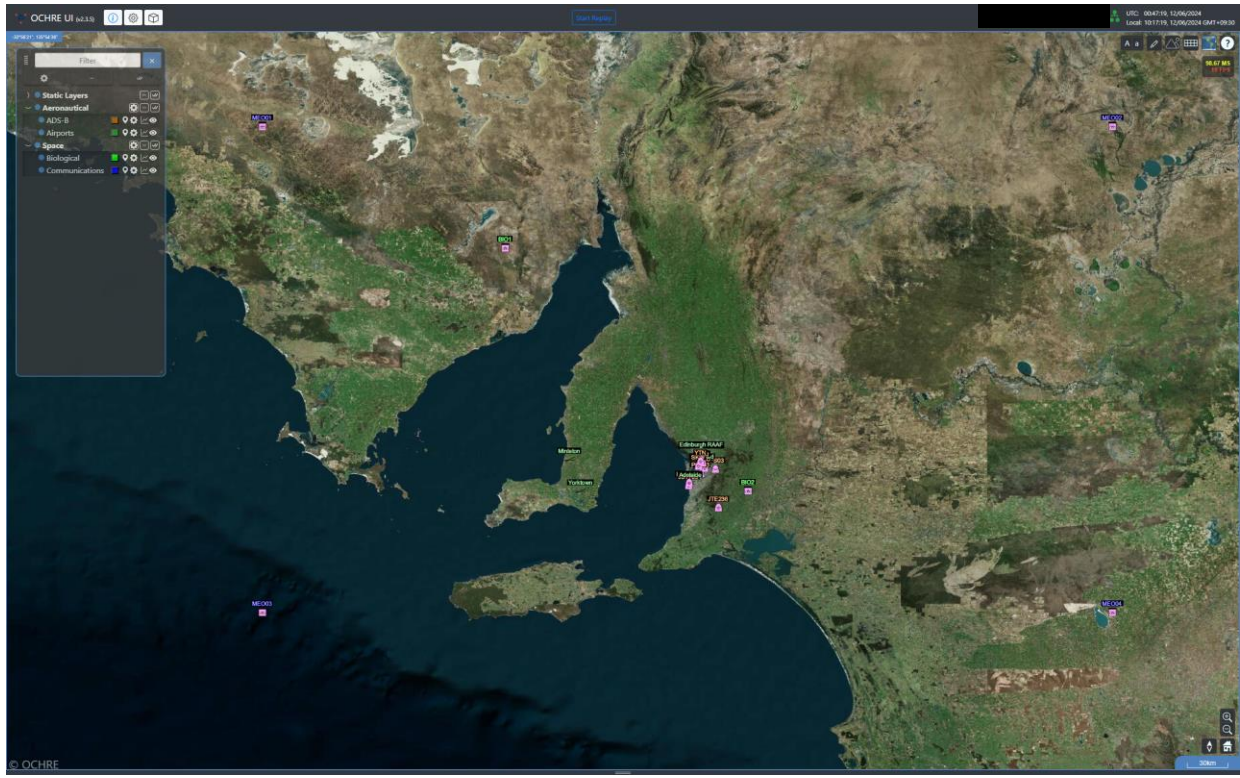
What we have built

- An Information Integration and Sharing Environment comprising
  - Multiple different sensors & nodes
  - Deployable ICT hardware
  - Network
  - Distributed Integration Architecture
  - Integrated software applications and simulations
  - Distributed situational awareness and Command and Control
  - Integrated storage, analysis, monitoring, replay
  - Patternised interfaces



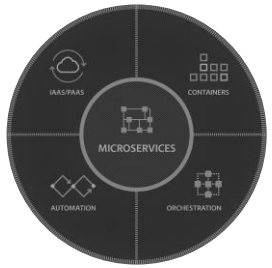
What we have built and principles

- Principles
  - Reference architecture
  - Scalable deployable nodes
  - Shared distributed understanding
  - Resilience to connectivity challenges
  - Resilience to power and ICT constraints
  - Storage and retrieval
  - Patternised to speed integration of new
  - Acceptance that all sensors/systems have their own standards
  - Enable decision makers
  - Towards a plug’n’play system
  - A back-end and a front-end

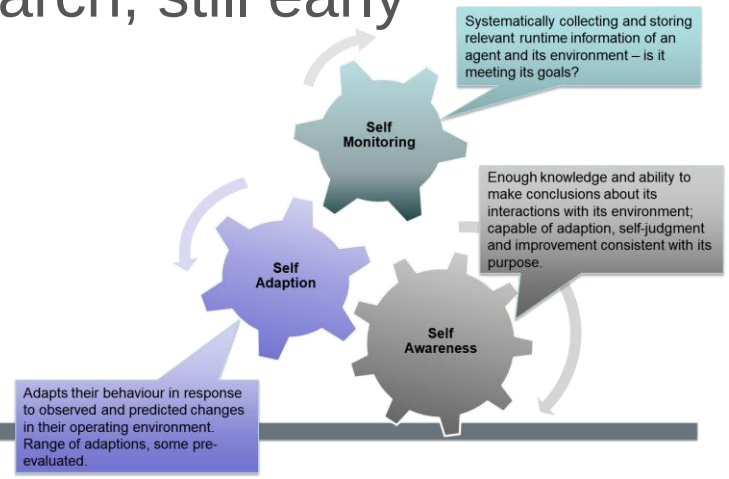


The Architecture

- Generic Reference Architecture
  - Recognise can't enforce one common standard
  - What is the minimum needed to achieve effective integration
  - Set of patterns and interfaces
  - Based on 20+yrs experience
  - Shareable
  - Built on latest cloud technologies – micro-services
  - Web browser-based interface

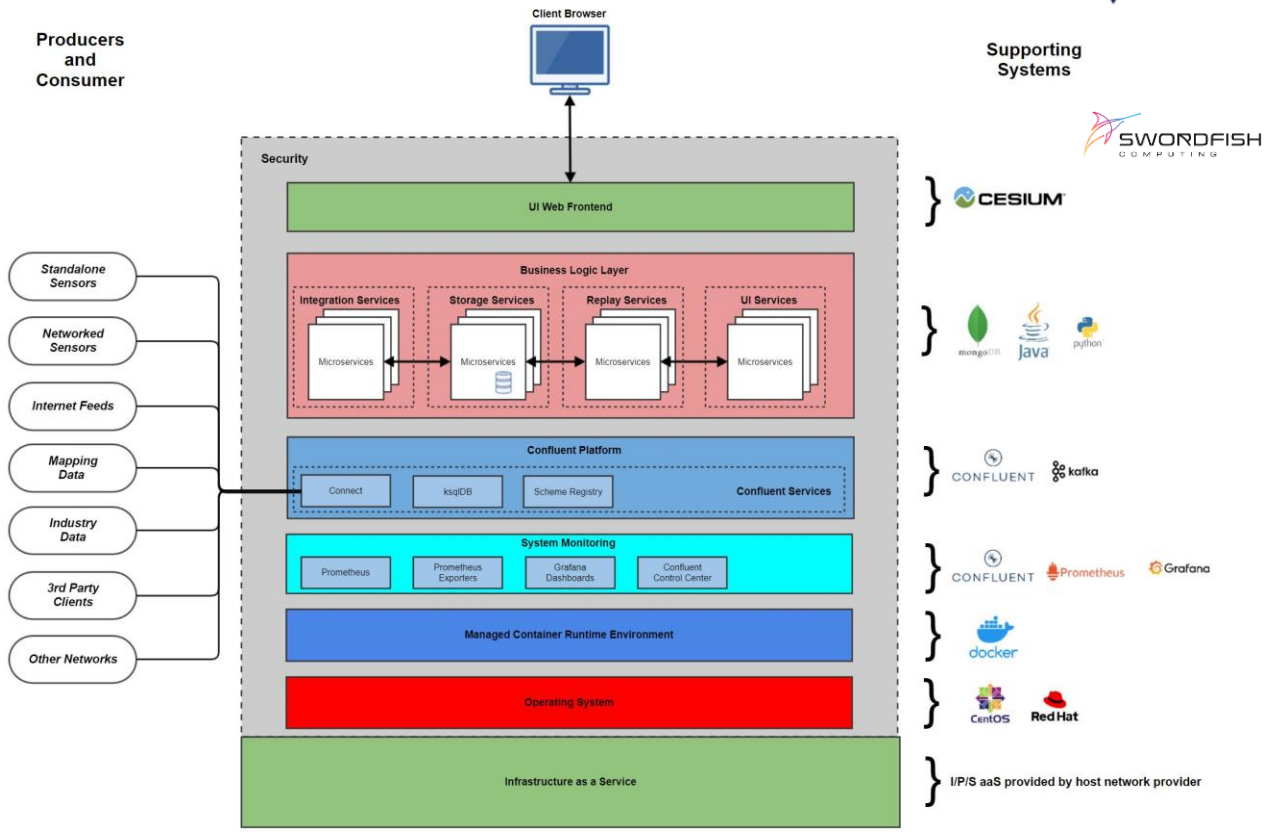


- Autonomic – self integrating
  - Self Monitoring
  - Self Adaption
  - Self Awareness
  - Integrating while retaining function and performance
  - Area of research, still early

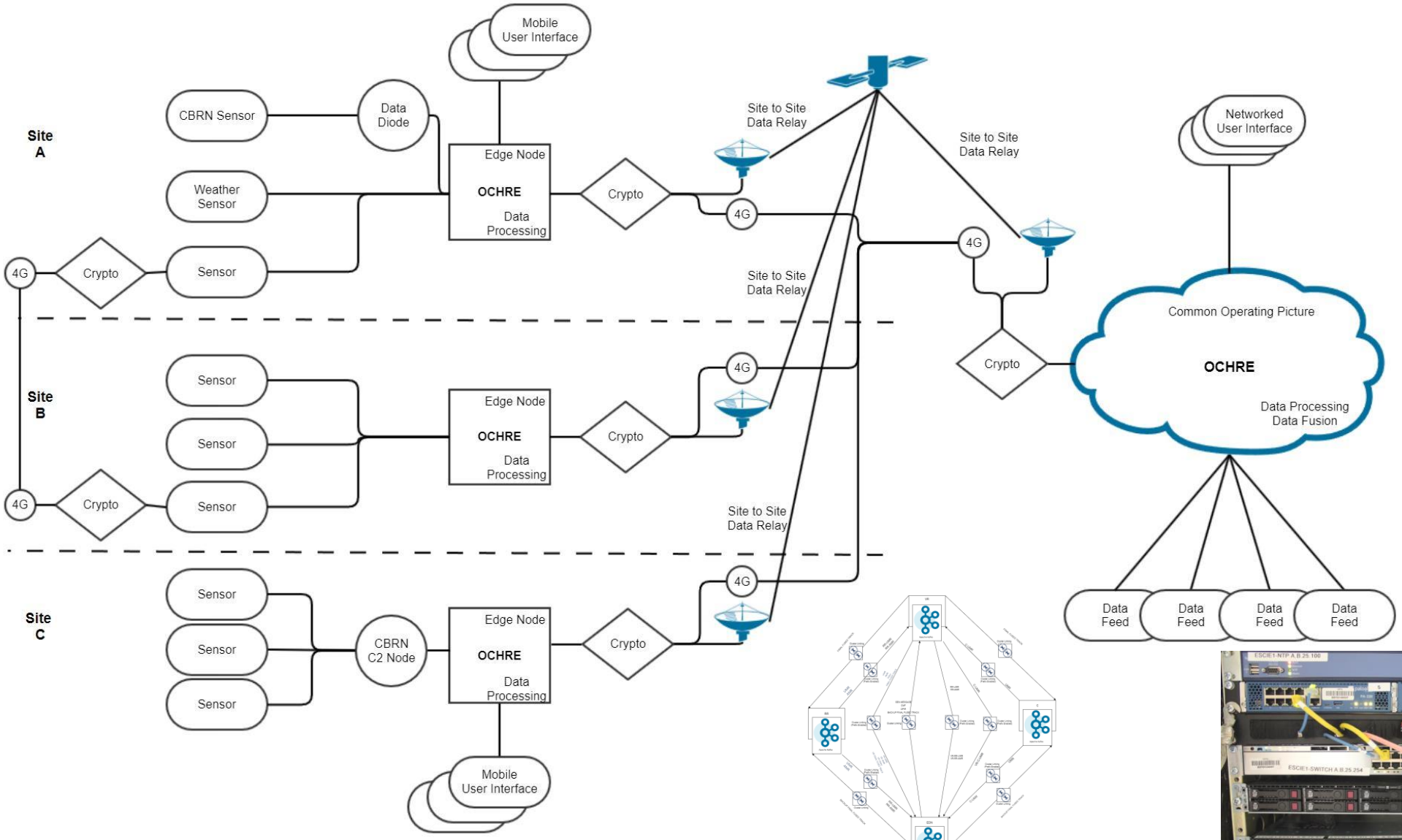


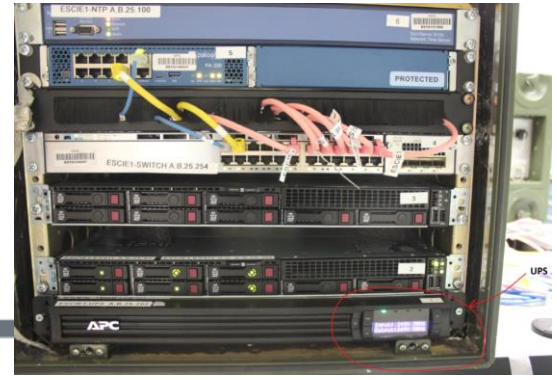
OCHRE - Open Collaborative Heterogeneous Research Environment

- OCHRE is the Software Implementation of the GRA
- Provides a sandbox for:
  - Integration pattern development
  - Data handling
    - Buffering
    - Storage
    - processing
    - Forwarding
    - Visualisation
  - Security patterns
  - Visualisation techniques
    - Formulation of fused picture
  - Plug'n'play
  - Industrialisation



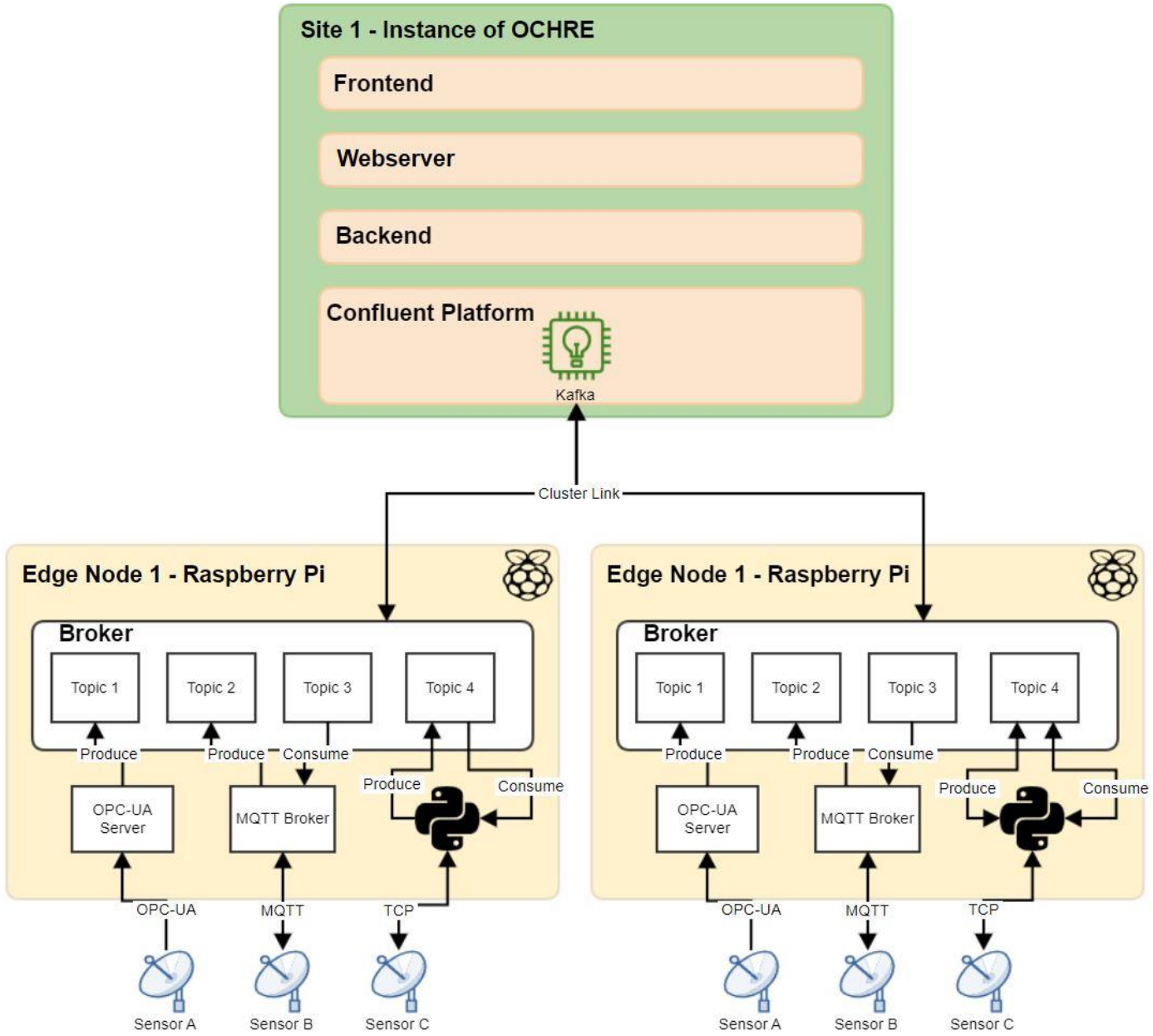
Example Configuration of a Distributed Architecture





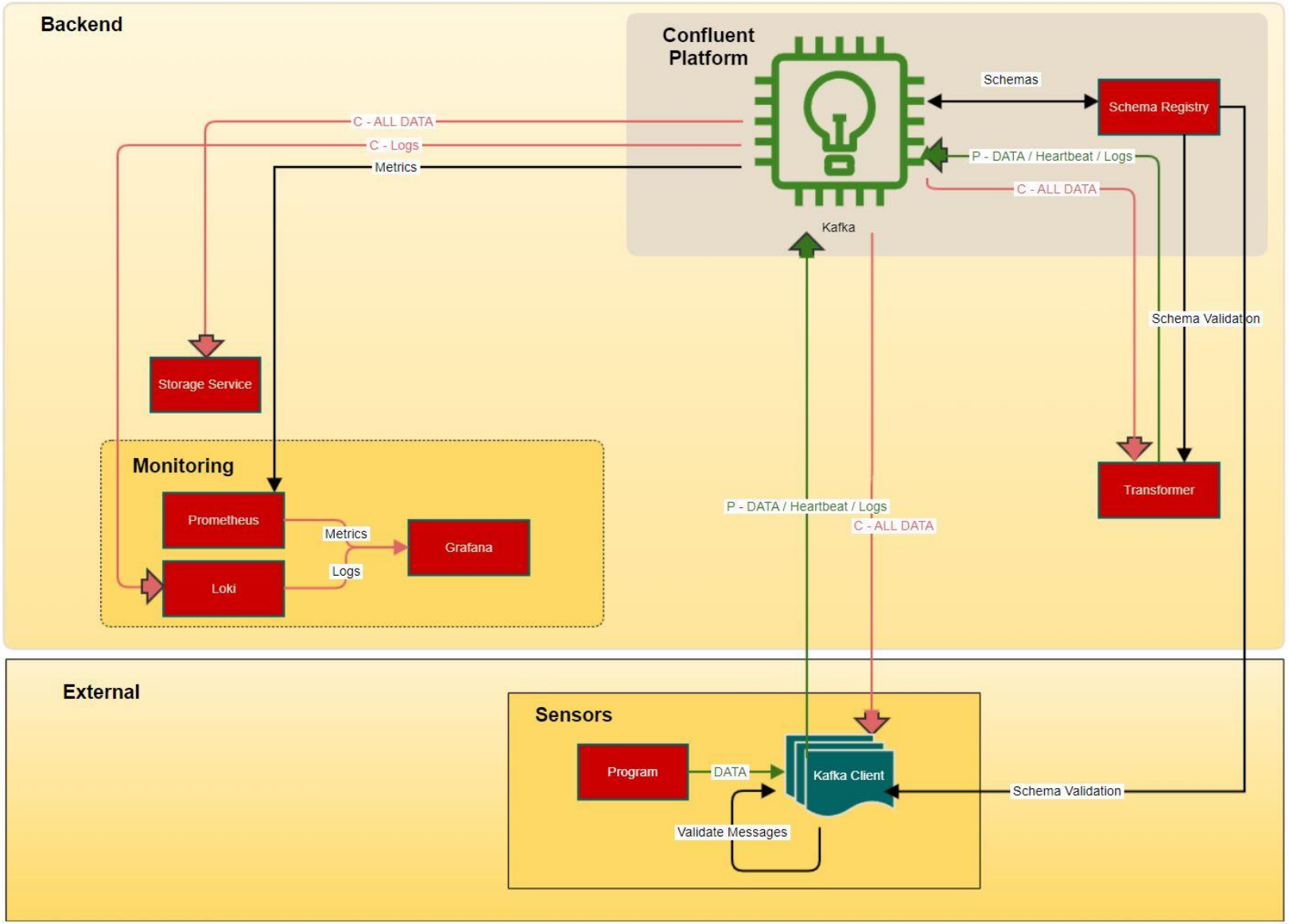
OCHRE at the Sensor Edge

- Co-placement of RaspberryPi
  - Deploy integration smarts at the edge
  - Buffering
  - Edge processing
  - Remote Sensor control



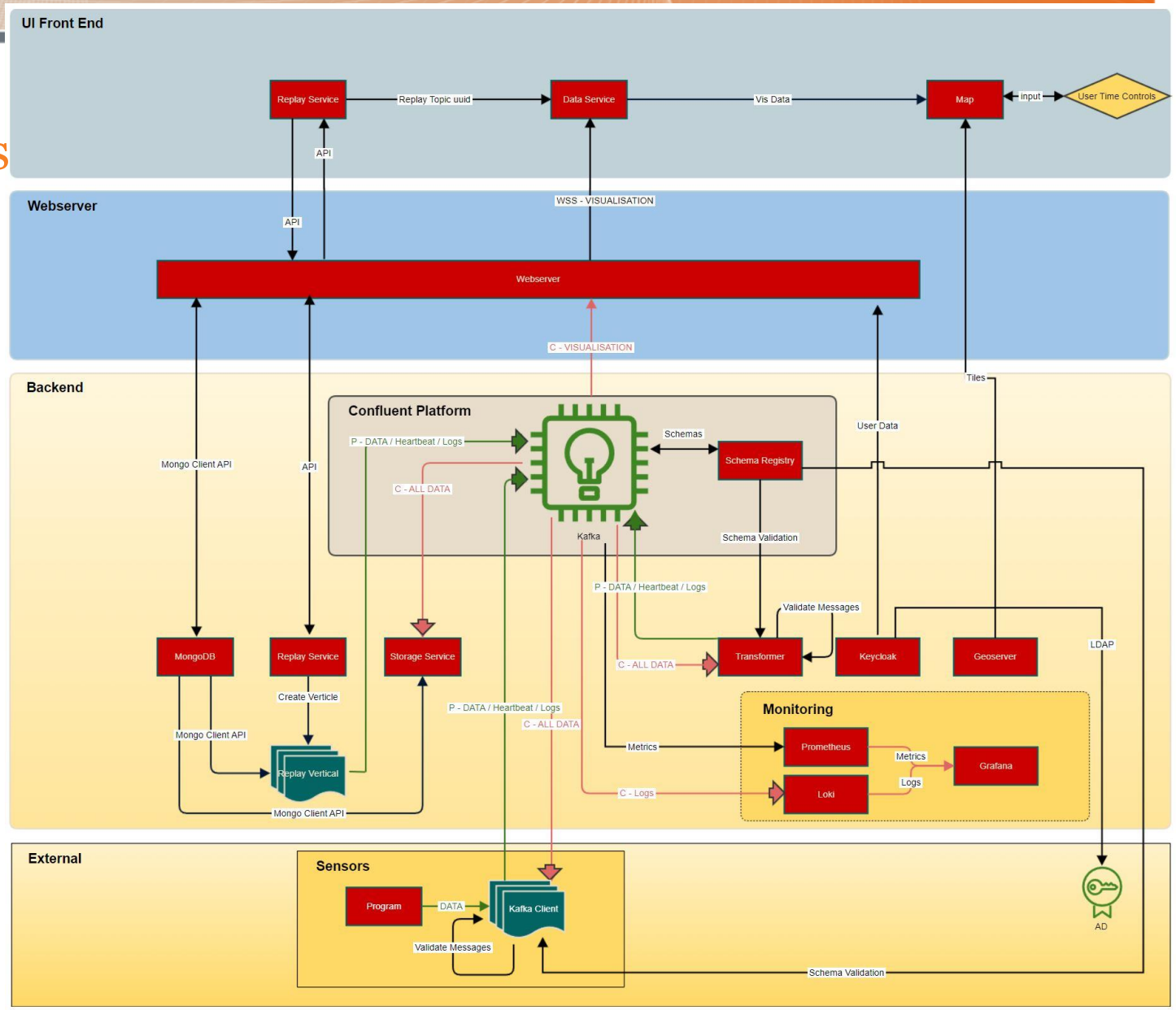
Sensor Data Validation

- Data validation
- Transformation
- Sensor Management
- Network Health
- Logging/Monitoring



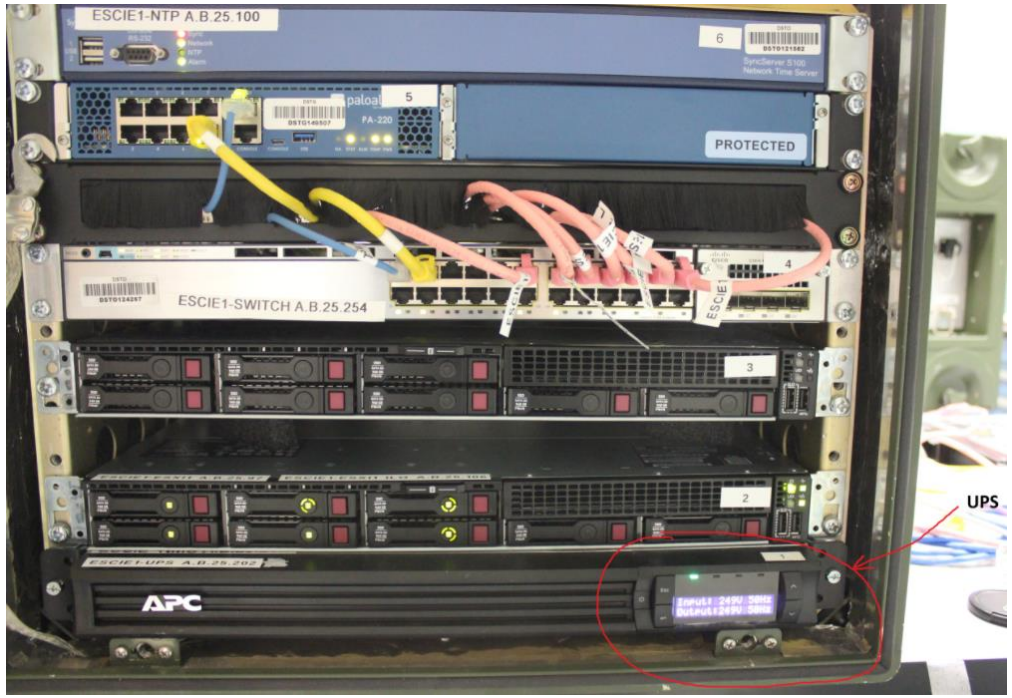
Architecture Information Flows

- High level overview of
  - Senor to processing
  - Data to user
  - Storage
  - Replay



Deployable ICT Compute Environment (DICE) Hardware Stack

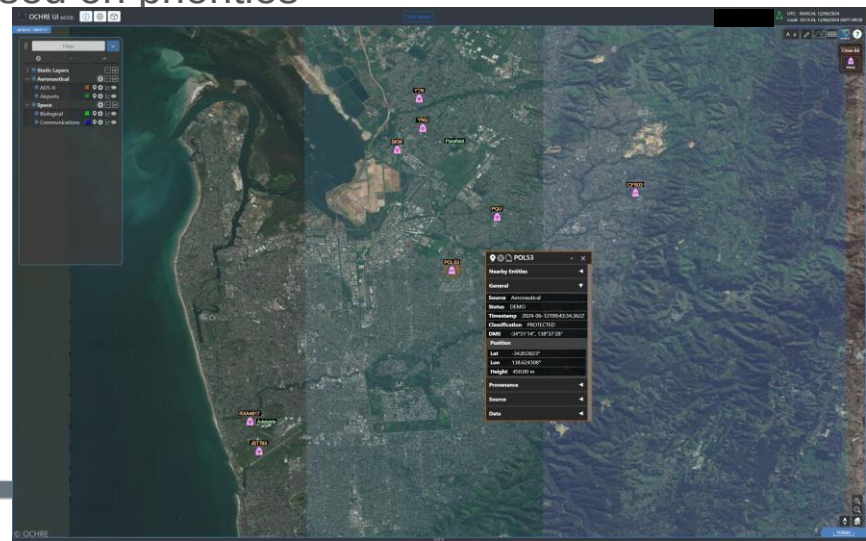
- Need to integrate a number of **distributed** sensors in austere environments with each other and key locations – also provision of distributed situational awareness depending on compute provisioned
  - Remote Locations (lack of stable power, cooling, etc.)
  - Distances (too great for point to point solutions)
  - Availability of comms (e.g. Telstra coverage, StarLink, …)
- Full size: ruggedized rackmount case
- Evolved into deployable ICT offering comprised of:
  - Crypto
  - NTP Server
  - Border Management System (BMS)
  - Network Switching
  - Compute and Storage
  - Uninterruptable Power Supply (UPS)
- Size can be scaled dependent upon what is needed
  - Could be as small as a Raspberry Pi
  - Commercial offerings

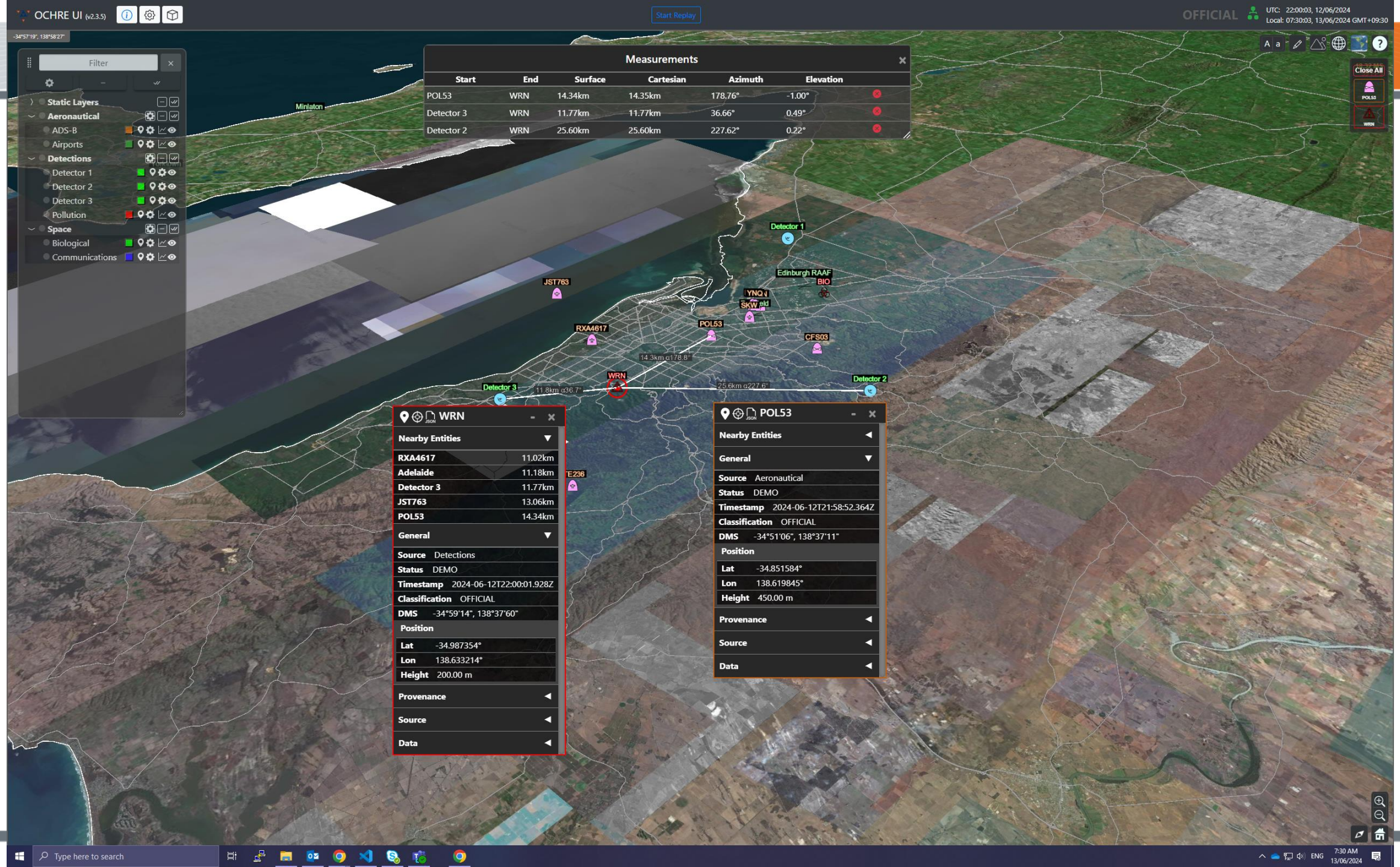


Outcomes and Opportunities

- The system as built has been able to integrate a multitude of sensor and algorithm types – been well trialled
  - From remote collection to processing to display across multiple dispersed geographic locations within <150ms
    - Includes integrating live video feeds from multiple locations
  - Containerised and deployable, utilising a range of technologies with Kafka as main messaging transport
- Would like to explore how to effectively, rapidly integrate and display large quantities of information from unattended untrusted sensors
- How small can it go – what would a Raspberry Pi configuration set look like in different circumstances
- Schema registries, bandwidth detection and cluster linking/data sharing based on priorities
- Remote tasking of sensors and platforms e.g. drones
- Development of autonomics for network, service, and overall management

- Many more ideas that can be explored and worked together on




OCHRE UI (v2.3.5)
Start Replay
OFFICIAL
UTC: 22:00:03, 12/06/2024
Local: 07:30:03, 13/06/2024 GMT+09:30
-34°57'19", 138°58'27"
Filter
Static Layers
Aeronautical
ADS-B
Airports
Detections
Detector 1
Detector 2
Detector 3
Pollution
Space
Biological
Communications
Measurements
Start End Surface Cartesian Azimuth Elevation
POL53 WRN 14.34km 14.35km 178.76° -1.00°
Detector 3 WRN 11.77km 11.77km 36.66° 0.49°
Detector 2 WRN 25.60km 25.60km 227.62° 0.22°
Close All
POL53
WRN
Minlaton
Detector 1
Edinburgh RAAF
BIO
JST763
YNQ
SKW
RXA4617
POL53
CFS03
14.3km @178.8°
WRN
Detector 3
11.8km @36.7°
25.6km @227.6°
Detector 2
E236
WRN
Nearby Entities
RXA4617 11.02km
Adelaide 11.18km
Detector 3 11.77km
JST763 13.06km
POL53 14.34km
General
Source Detections
Status DEMO
Timestamp 2024-06-12T22:00:01.928Z
Classification OFFICIAL
DMS -34°59'14", 138°37'60"
Position
Lat -34.987354°
Lon 138.633214°
Height 200.00 m
Provenance
Source
Data
POL53
Nearby Entities
General
Source Aeronautical
Status DEMO
Timestamp 2024-06-12T21:58:52.364Z
Classification OFFICIAL
DMS -34°51'06", 138°37'11"
Position
Lat -34.851584°
Lon 138.619845°
Height 450.00 m
Provenance
Source
Data
Type here to search
ENG
7:30 AM
13/06/2024

Questions

OCHRE Message Formatting

OCHRE Generic Message Format

- JSON formatted and utilises json-schema.org notation to describe the GMF attributes
- Enough info to allow OCHRE to store, transmit and visualise sensor data as a wrapped payload
- GMF will evolve over time (new fields will be added)

GMF Top Level

Field Name	Type	Mandatory
source	object	Y
dataType	string	N
aggregateClassification	string (enum)	Y
status	string (enum)	Y
data	**object**	**Y**
geoIndex	object	N
dataProvenance	object	Y

Source Info

Field Name	Type	Mandatory
name	string	Y
status	string (enum)	Y
timestamp	string	Y
geoLocation	object	N

Data Provinance

Field Name	Type	Mandatory
stepIdentifier	string	Y
classification	string (enum)	Y
timestampReceived	string	Y
timestampProcessed	string	Y
description	string	N