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SMART SIGN TECHNOLOGY FOR CONTINUOUS EASEMENT INTERFERENCE MONITORING

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Outline

- Project background
- Smart sign technology
- AI development
- Field trial
- Conclusions
- Next steps

Project background: objective

To enhance public safety by reducing risk of third-party damage to pipelines

- Australian pipeline operating standards are world leading
- Need to maintain high safety standards to avoid potentially catastrophic consequences
- Building on significant body or Energy Pipelines CRC / Future Fuels CRC research on preventing third party damage to pipelines

Background: public safety controls

External interference pose a significant risk to pipelines

- Gas transmission pipelines are buried to reduce possible interference
- Typical assurance activity is through patrolling the Right of Way, both air and ground, to monitor for threats
- Slabbing / physical protection measures used in high-risk areas
- Signage and pipeline awareness education as additional controls

Background: industry need for new technology

Current patrol methods have limitations

- Aerial and road patrols only detect threats for the duration they are in the vicinity of any section of pipeline
- Patrols are resource intensive
- As easement activity increases so do the number of possible threats

Background: alternative methods explored

Satellite Photogrammetry

- Satellite Issues with weather
- High resolution is expensive
- Economy of scale

Drones

- Need to be able to traverse 800kms in any weather
- Not yet competitive at the scale required
- Cannot inspect all innercity areas

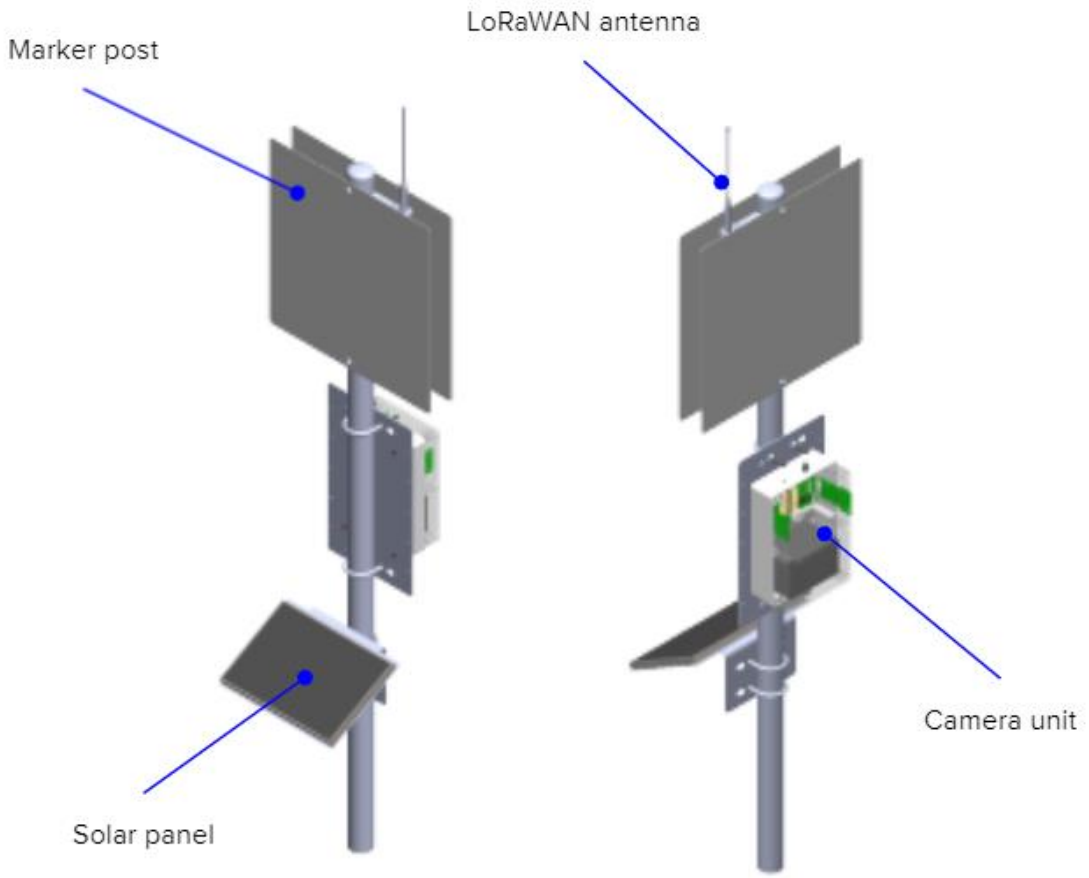
Pipeline intrusion avoidance solutions

- Project RP2.4-01 increased understanding of the effectiveness of intrusion avoidance solutions

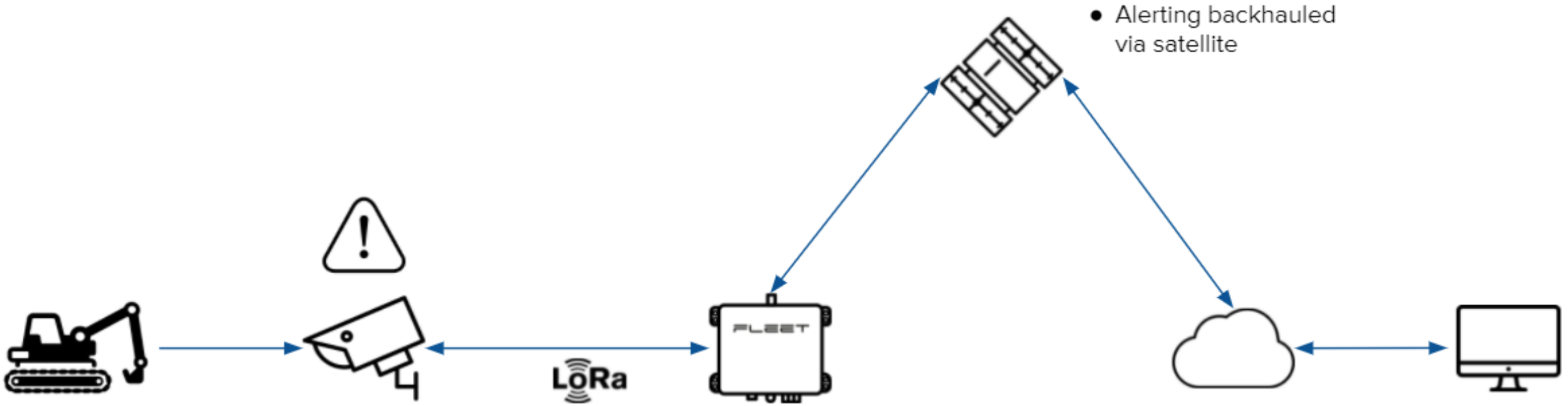
Proposed solution

A continuous and intelligent monitoring device – making the sign "smart“

- Sensors on existing pipeline easement marker signs
- Detect, analyse and identify threats using AI
- Identified threats are communicated to pipeline operatc



Threat Identification Process



- Alerting backhauled via satellite

- Camera monitoring the pipeline
- 3 images captured and processed every 15 mins
- Images initially sent to cloud during the training phase

- Data aggregated in Nebula
- Alerts surfaced in GAP

Threat Identified by the AI

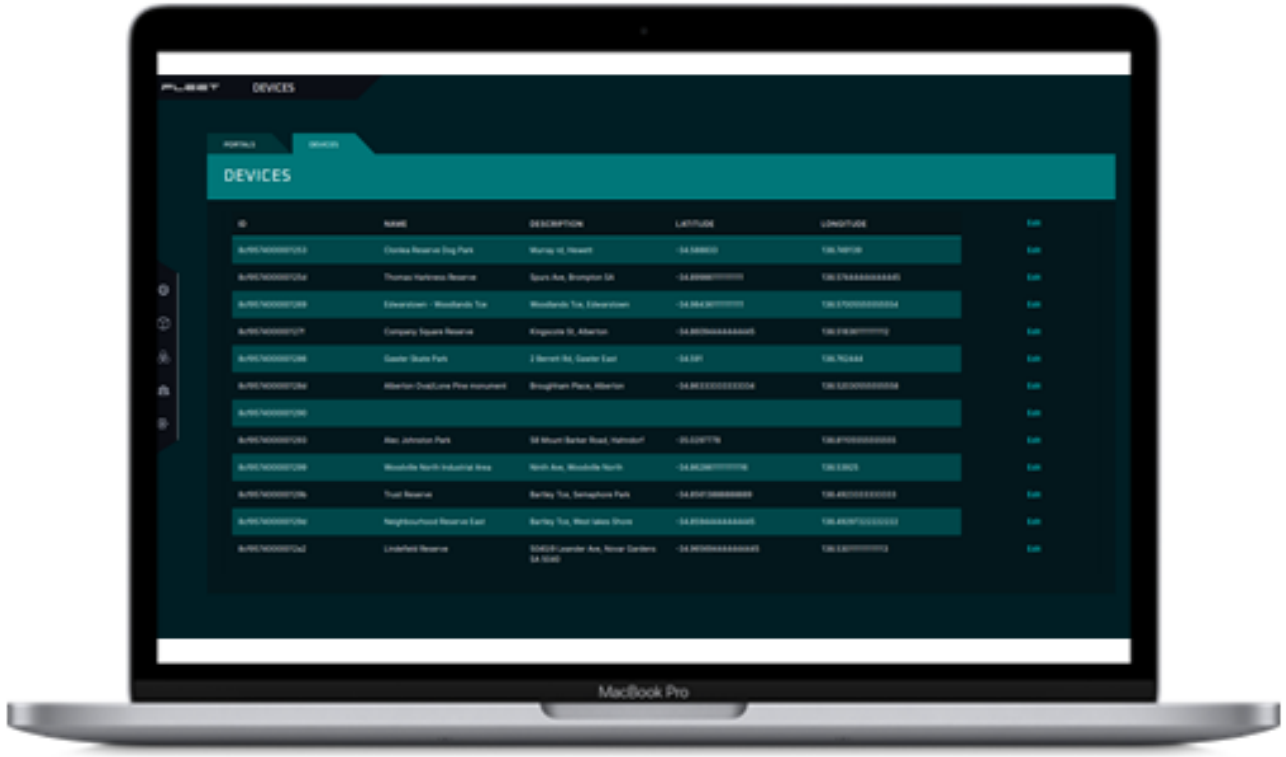
- Detection
- Confidence level calculation

Alert Data Received in the Portal

- Message aggregation
- Satellite backhaul

Alert Received in Management Platform

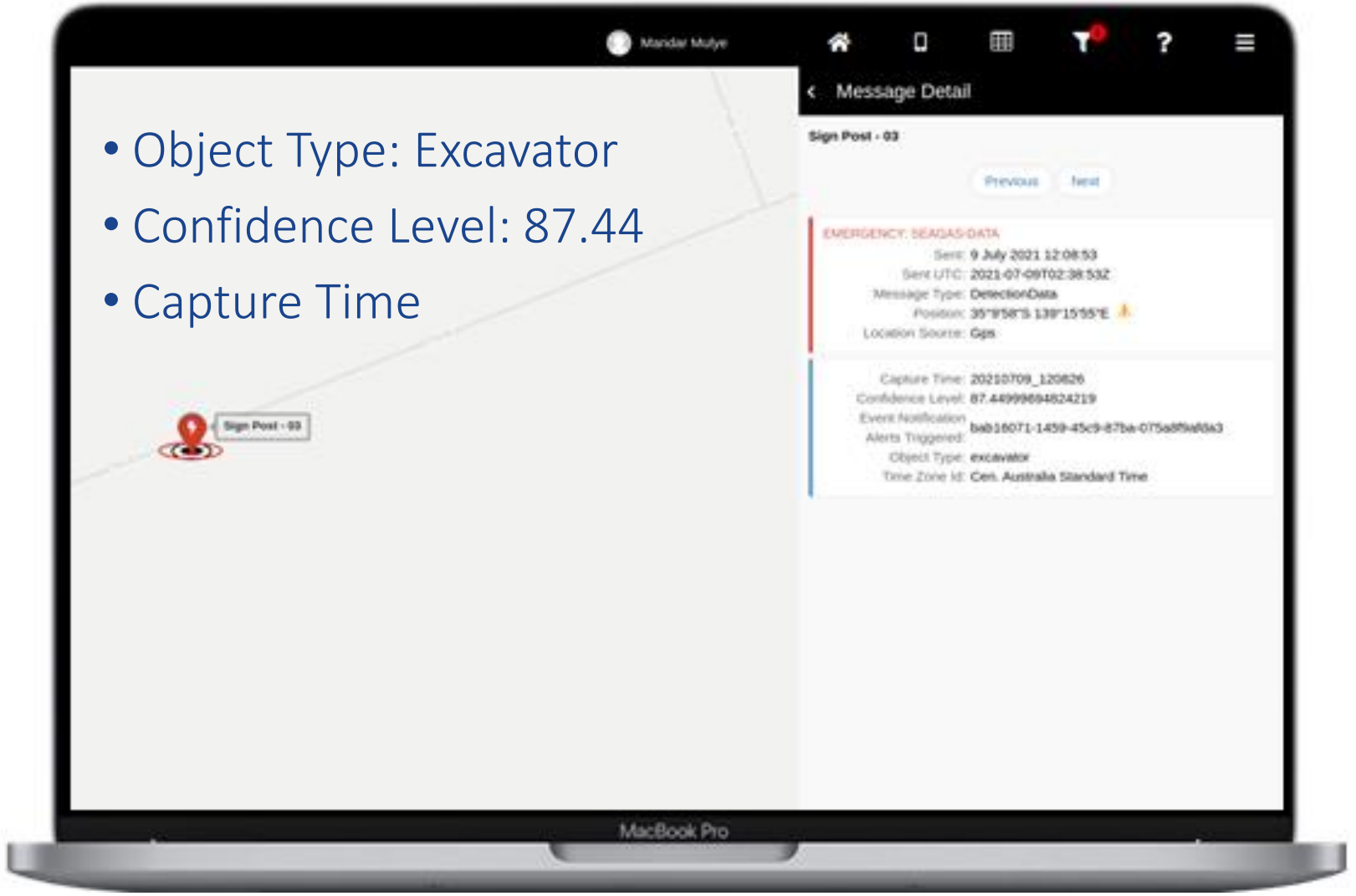
- Network management
- Downstream connectivity



*Alert delivered to operational platform/s, action to be taken as required

Alert data visualization

- Surfacing alerts for users
- Driving notifications



Mobile alert system

- Call to action

PORTAL DATA → ALERT RECEIVED → *ACTION DELIVERED

*Alert delivered to operational platform/s, action to be taken as required

End to end process

1. Threat in view

2. Camera identifies threat

3. Data transmitted to Fleet gateway

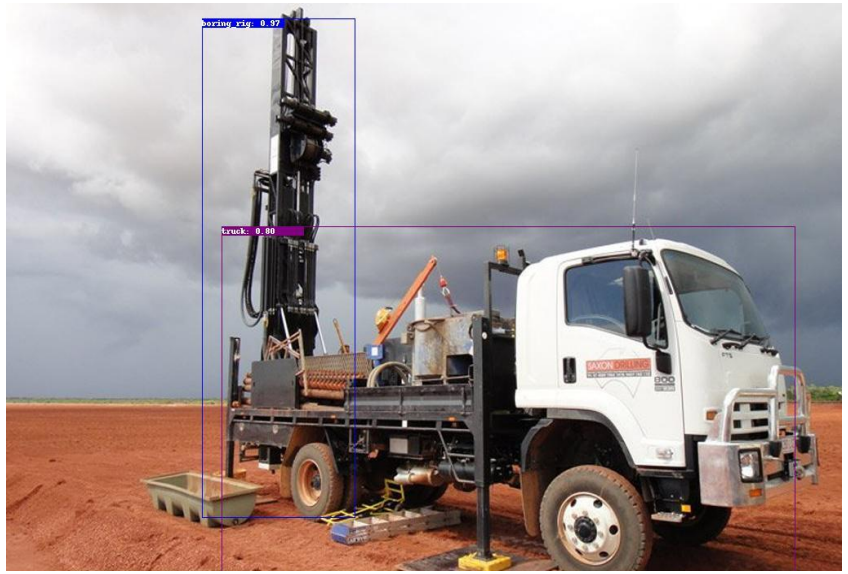
4. Received in Nebula within < 1min

5. Alert visualised in data platform

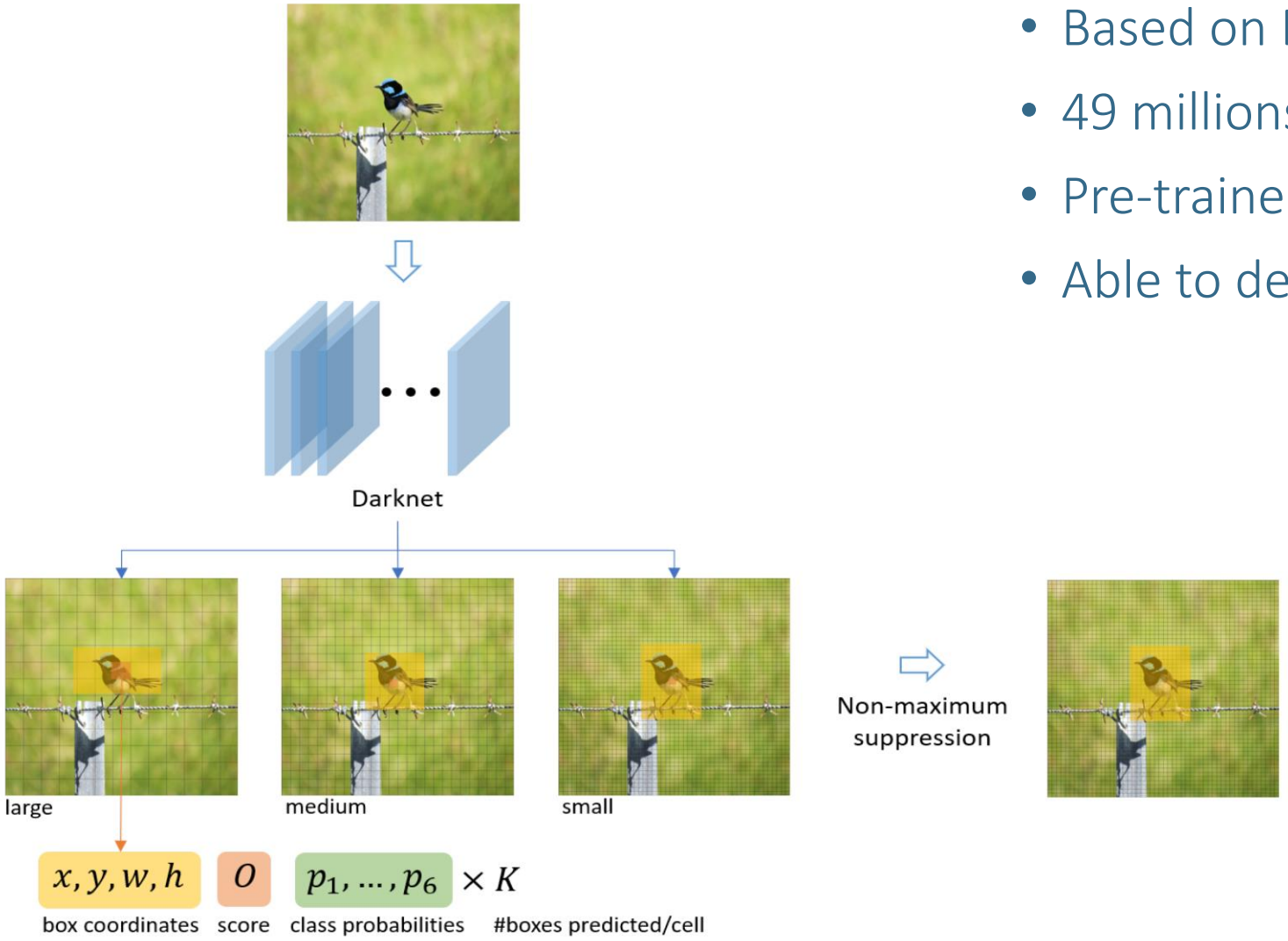
6. Staff received the alert on devices

The Artificial Intelligence - threat identification

Detecting threats in images – an object detection approach



You Only Look Once v4 – object detection approach

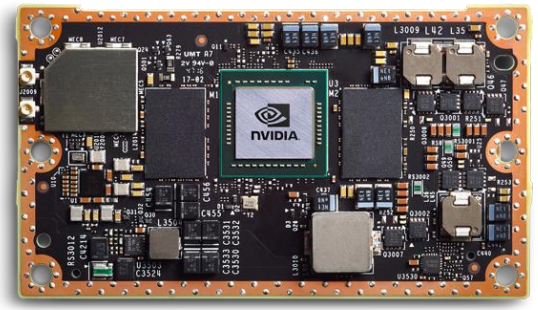


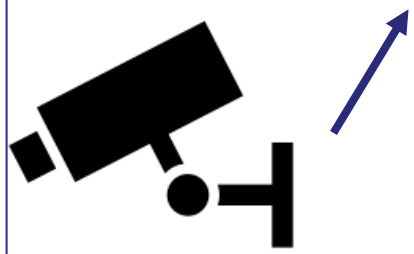
- Based on Darknet Deep Neural Network
- 49 millions parameters to optimise
- Pre-trained on ImageNet (14 million images)
- Able to detect objects on 3 different scales

Edge computing deployment

Edge computing architecture

Inference with AI on the field





Edge-computing for real-time computations

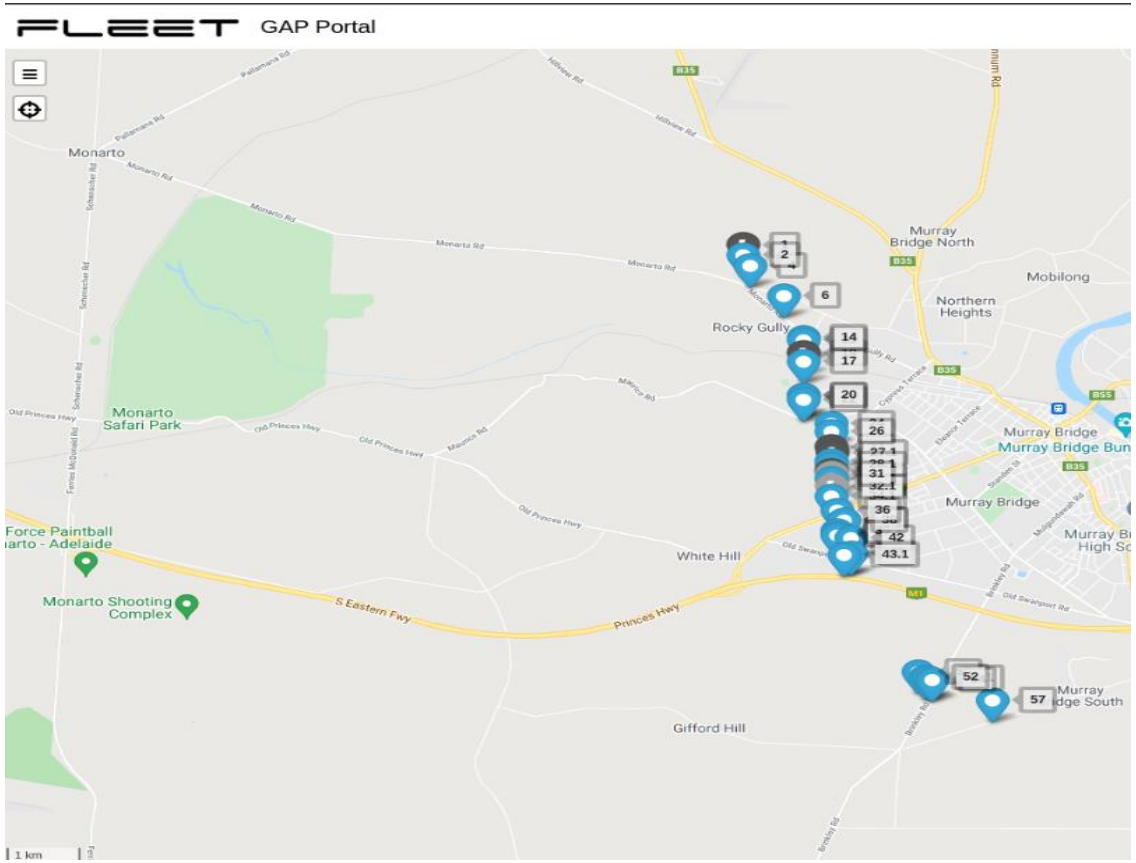
Alerts

Training

Application

Current deployment

- 48 marker signs along the 10km Murray Bridge section of the Port Cambell to Adelaide easement.



Demo


Start image capture
Captured photo 0
Captured photo 1
Captured photo 2
Done capturing, processing images now
Done Calibration
Done Calibration
Done Calibration

Conclusions

AI successfully trained

- 10k images in libarary
- mAP of 70% over 12 types of threats
- Further field validation required to improve AI performance across all threats

Proof of concept of end-to-end solution currently being tested in the field

- 48 devices and 3 portals deployed
- Long-range data transmission proven
- Power management and system durability proven

Next steps

Further training the AI

- Collecting more data (from the field) to improve real-world performance
- Installing temporary devices

Review the unit design with a focus on:

- Deployability
- Power consumption

System evaluation

- Testing in urbanised environment
- Integration of improvements and learnings into the next generation of sensor

FUTURE FUELS CRC

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Thank you for your attention.