The use of lasers and other technology to improve level crossing safety near the autonomous train route
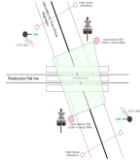
Nick Hughes
A/Principal Engineer – Systems, Signals & Telecommunications

Overview of AutoHaul®

RioTinto

1 Onboard
- Automatic Train Protection (DIVA)
- Automated Train Operation (ATO)
- Driving Strategy Engine (DSE)
- Collision Detection System (CDS)
- Video and Banker Separation Systems

2 Signalling & Wayside
- Vital connections to signal interlocking
- Active level crossings (ODS & GCP)
- Passive level crossings (gated)
- Asset Protection (DED, HBWD, SFD)

3 Ops Centre
- Vital Safety System (VSS-RBC)
- Automation Server (AS)

4 Communications Network

- Network Virtual Router (NVR Client)
  - Data Radio (primary)
  - BGAN Satellite (secondary)
  - Mobile Broadband (primary @ yards)

- Radio Base Station (RBS)
  - Data Radio
  - Mobile Broadband (yards & ports)
- BGAN Satellite (secondary bearer)
- Ground based Backhaul - RTIO networks

- Network Virtual Router (NVR)
- Network Management System (NMS)
- Core switches
- Firewalls

GUINNESS WORLD RECORDS CERTIFICATE

The heaviest robot is AutoHaul, a fully autonomous uncrewed train operated by Rio Tinto (Australia) between its mines in the Pilbara region of Western Australia and its loading docks on the coast (a distance of around 1700 km.). AutoHaul made its first trip, carrying 28,000 tonnes of iron ore, on 10 July 2018.

OFFICIALLY AMAZING

- *2015 - First ETCS Level 2 system in the Southern Hemisphere*
- *2018 - Worlds First Autonomous Heavy Haul Train (ETCS - GoA4)*
- *2020 - Guinness Book of Records (Worlds Largest Robot)*
- *2020 - Autonomous Bankers*
- *2022 - 30,000,000+ km of Fully Autonomous Operations*

© Rio Tinto 2022   2

Level Crossings

Australia Wide – Past 5 years
- 244 Collisions
- 5843 Near misses

Rio Tinto
- 57 Active Level Crossings
- 47 in AutoHaul® Territory
- Publicly accessible

- Loaded train ≈ 37,000t
- 700m+ stopping distance

ATSB - RO-2009-005 – Level Crossing collision between School Bus and Train Western Australia 23/3/09

Data source – ONRSR Published Incident Statistics

AutoHaul® - Issues

- Driver driven – tries to intervene (rarely successful)
- No driver? What now – how do we manage this?
- SFAIRP – massive investment, must do something to reduce risk

- Reputational risks – public perception if train doesn't brake?
- What if train doesn't de-rail?
- Remote locations – how would we know an event has occurred?
- Intentional acts – object left on LX?
- Vehicle stuck on LX?

Passenger Train vs Abandoned Vehicle – NSW 20/10/21

4

Obstruction Detection System (ODS)

LIDAR Scanners

LX-18-1 CAMERA 1 (WEST)

Detection zone

17:56:16.625 27 August 2013 (+8)
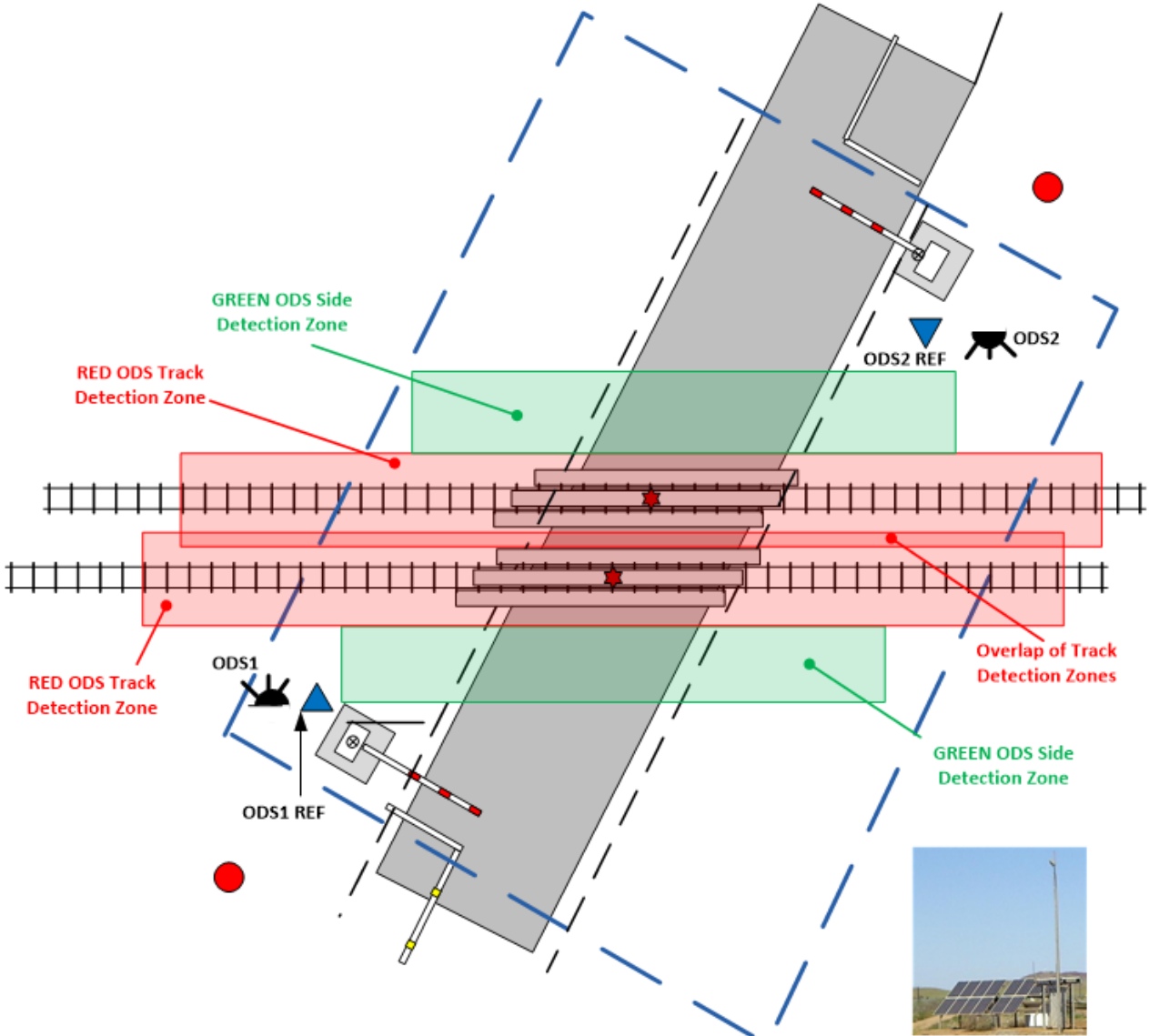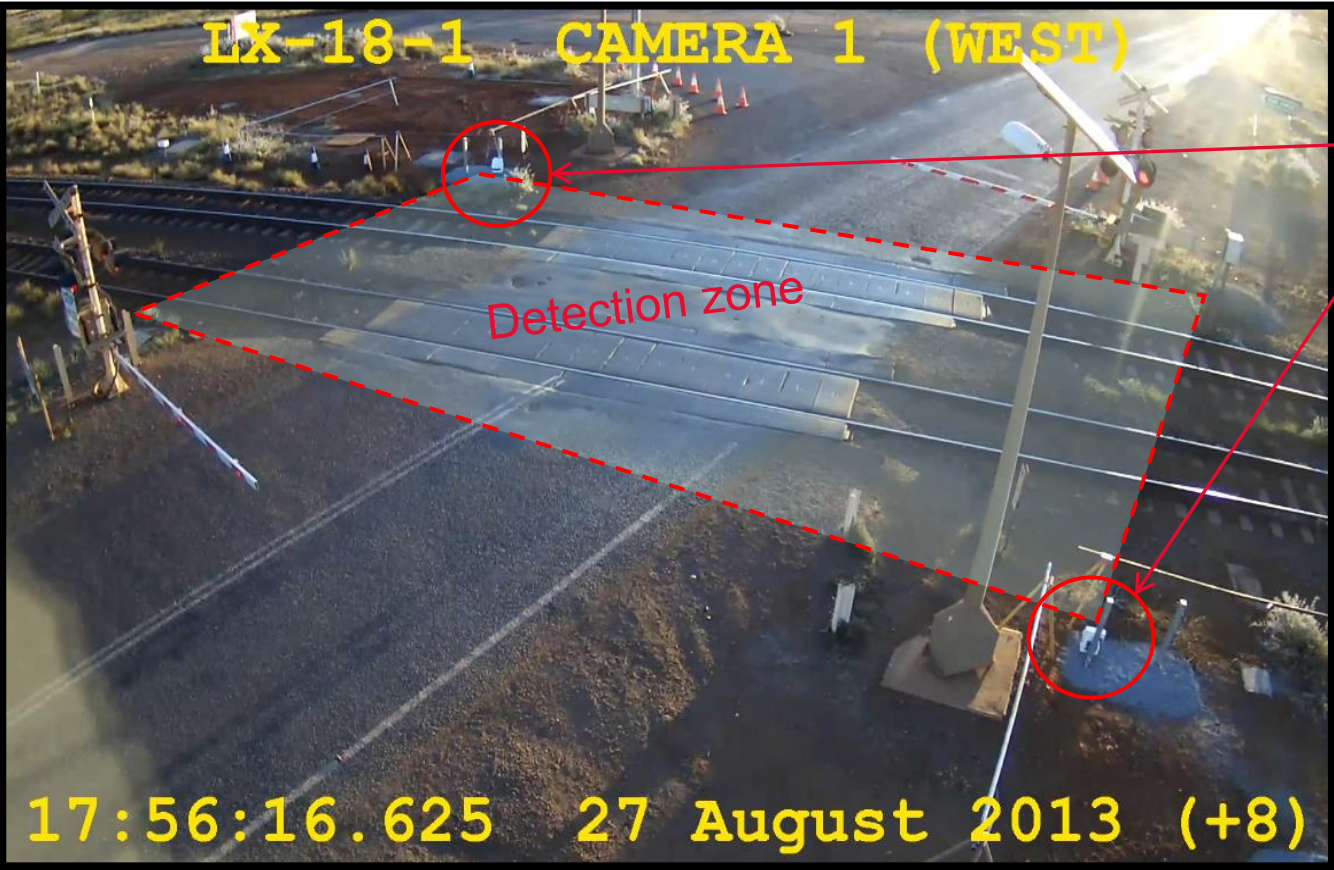
Obstruction Detection System (ODS)

Challenges
- Wildlife
- Vegetation
- The Sun
- Maintenance workers
- Reflective Objects (Boom Barriers!)
- Dust
- Trains on adjacent line

Obstruction Detection System (ODS)

Successes?
- No true success – fortunate enough not to have needed ODS

However we know it will work when needed
- Truck in Obstruction zone too long – train stopped ~55m from crossing
- Vehicle driven around barriers – automatic emergency intervention on train
- Hyrails on-tracking – cause train MA to be reduced to Whistleboard on adjacent line

Obstruction Detection System (ODS)

Future Challenges
- Obsolescence (software and hardware)
- Resilience

Still doesn't prevent a collision when a vehicle enters the LX as the train does.

CCTV

Enables authorised Train Controllers to view operations at a selected level crossing on the closed circuit television (CCTV) workstation.

Two cameras cover each level crossing from either side …

… providing the Train Controller with a good view of any obstruction.

Remote Condition Monitoring

- Flashlight health
- Barrier position including travel time
- Warning time – trending and immediate notification if short
- Extended Activation

Another success story
- Failure of flashlights on one channel (damage) – system detected and Train Stopped **before** entering LX.

🅐	2022/07/30 10:37:10	**ONE OR MORE LEDS OUT
🅐	2022/07/30 10:37:10	**LX OKR DOWN

Health Status - All Territories

Status	Territory	Location
❌ (green)	Brockman	251.3 RO - CR
❌ (green)	Brockman	285.95 CR-NJ
❌ (green)	Brockman	289.69 NJ-BF
❌ (green)	Brockman	294.0 NJ - MB
❌ (red)	Brockman	319.9 MB BF

- AutoHaul$^{®}$ Intelligent Vision (AIV)
- RADAR or LIDAR? Transition to SIL components
- Tighter integration between LX and Interlocking
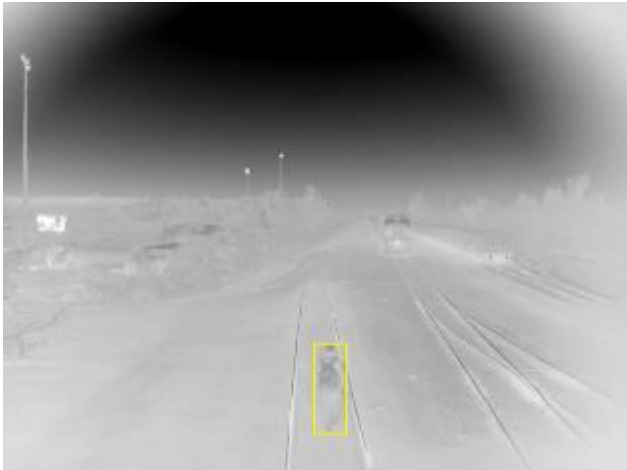- Improved monitoring of road approaches
- Grade Separation
- ???

RioTinto

Camera and Sensor Fused System
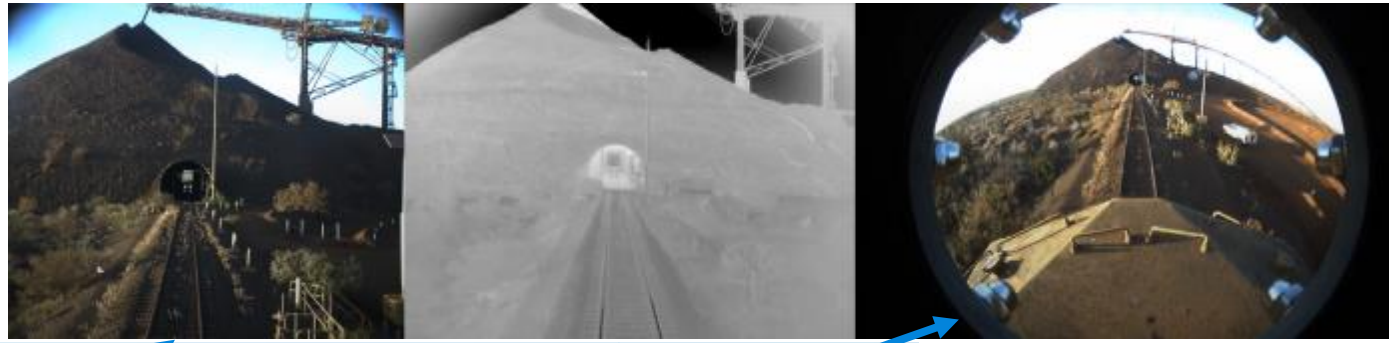
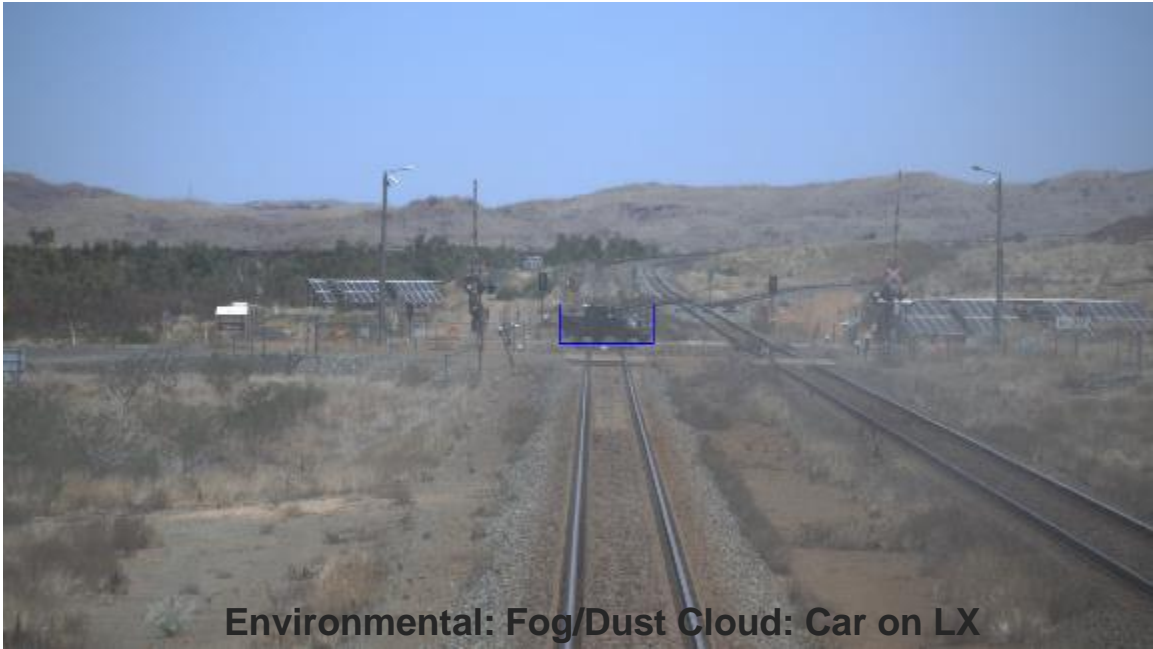## Collected Footage : Person near LX

Collected Footage : Person on Track

Environmental: Fog / Dust Cloud

Environmental: Fog/Dust Cloud: Car on LX

Questions ?

The use of lasers and other technology to improve level crossing safety near the autonomous train route

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