Beyond Interoperability

What must we do to realise ETCS across the national rail network, and why should we do it?

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What we will cover

About ETCS (European Train Control System)

Implications of ETCS for the national rail network

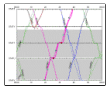
How we need to address some critical issues

Why go down this challenging road?

Conventional signalling

Interface to:
Timetable / planning systems, management / information systems, billing systems

Control System
Provides tools to manage the network and authorise train movements.



Dynamic train graph

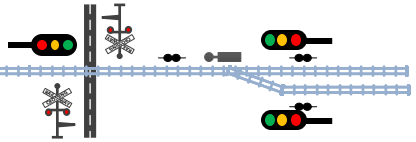
Signalling control system

Trackside

Interlocking

Centralised Equipment
The brains, to manage network safety, control the position of infrastructure and issue instructions to trains.

Onboard

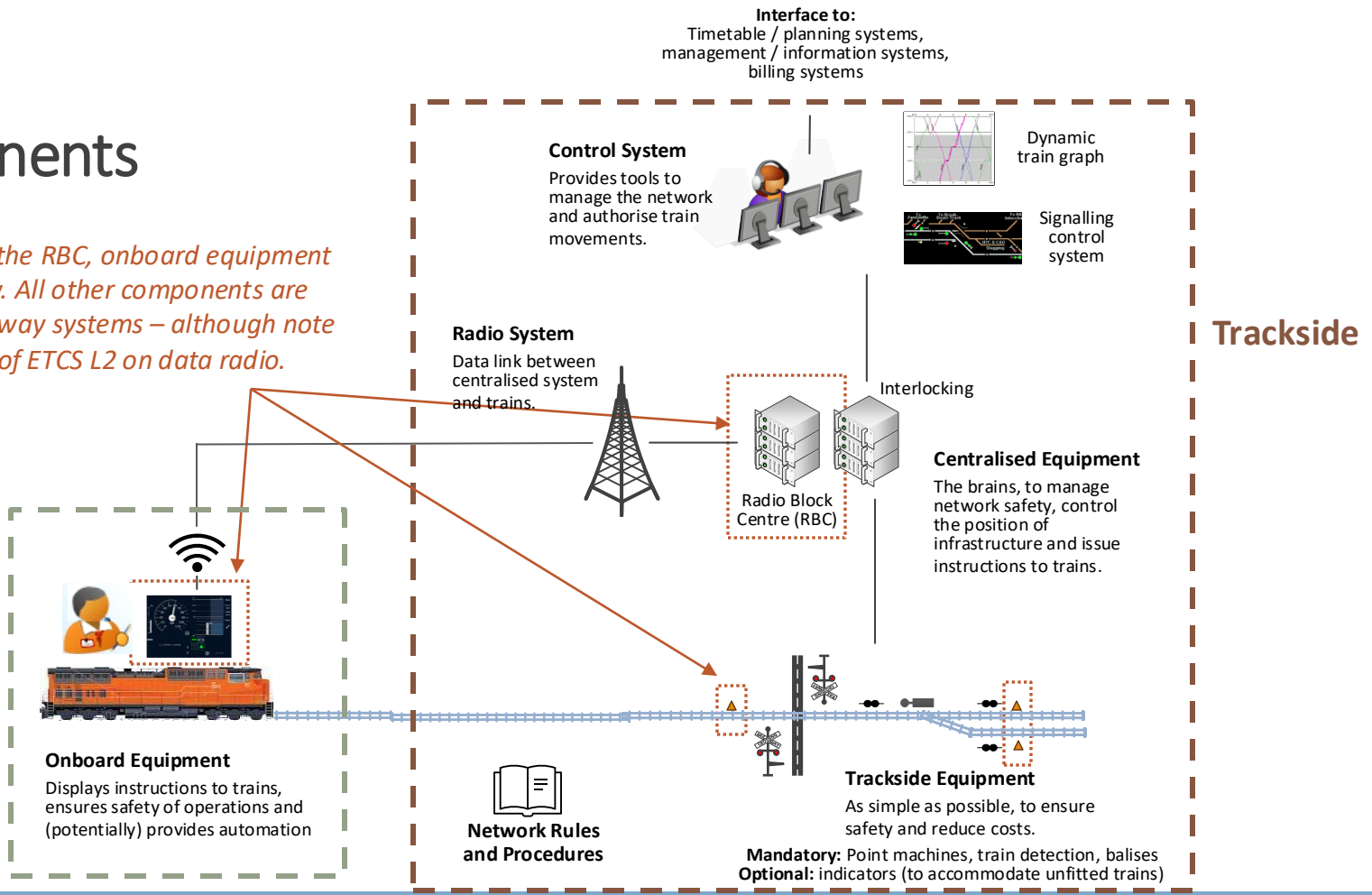


Trackside Equipment

Network Rules and Procedures

ETCS components

"ETCS" includes the RBC, onboard equipment and balise only. All other components are conventional railway systems – although note dependence of ETCS L2 on data radio.



So what does ETCS provide?

A standard onboard system

- Available from multiple suppliers (> 10 suppliers)
- Consistent behaviour based on the messages received from trackside
- Supervises speed and end of authority (i.e. prevents the train from going too far or too fast)

A standard trackside – onboard interface

- Via radio (and Radio Block Centre, RBC) or via Balise
- Components available from multiple suppliers
- Defined messages and protocols

A toolbox of functions that may be used, as required, to meet operational needs

- Typically applied at the discretion of the Rail Infrastructure Manager (RIM) / network manager

Some of the implications of ETCS

Updated signalling technology

- Move to new types of equipment

Need to ensure interoperability

- New relationship between RIMs

New rules and ways of doing things

- Train drivers
- Network controllers
- Maintenance workers

Signalling equipment on locomotives

- Different driver interface
- New equipment to maintain
- New relationship between RIM and RSO

Signalling equipment on track vehicles

Impacts for other disciplines

- Different rules and parameters for timetabling and planning
- ETCS needs to understand track geometry and speeds, and constrains changes
- Potential (longer term) need to change layouts to optimise for ETCS

Changed relationship with suppliers

- Will require an ongoing relationship; no longer ‘sell and forget’

Enhances importance of many issues across all rail entities

- Certification processes
- Safety Assurance
- Cyber Security

Ensuring interoperability

‘Interoperability’ means:

making sure that any train, no matter what network it is going over, can operate so far as practicable at the highest level of safety and productive performance the network offers.

Current NTC working definition

Work to date on interoperability (led by National Transport Commission) includes:

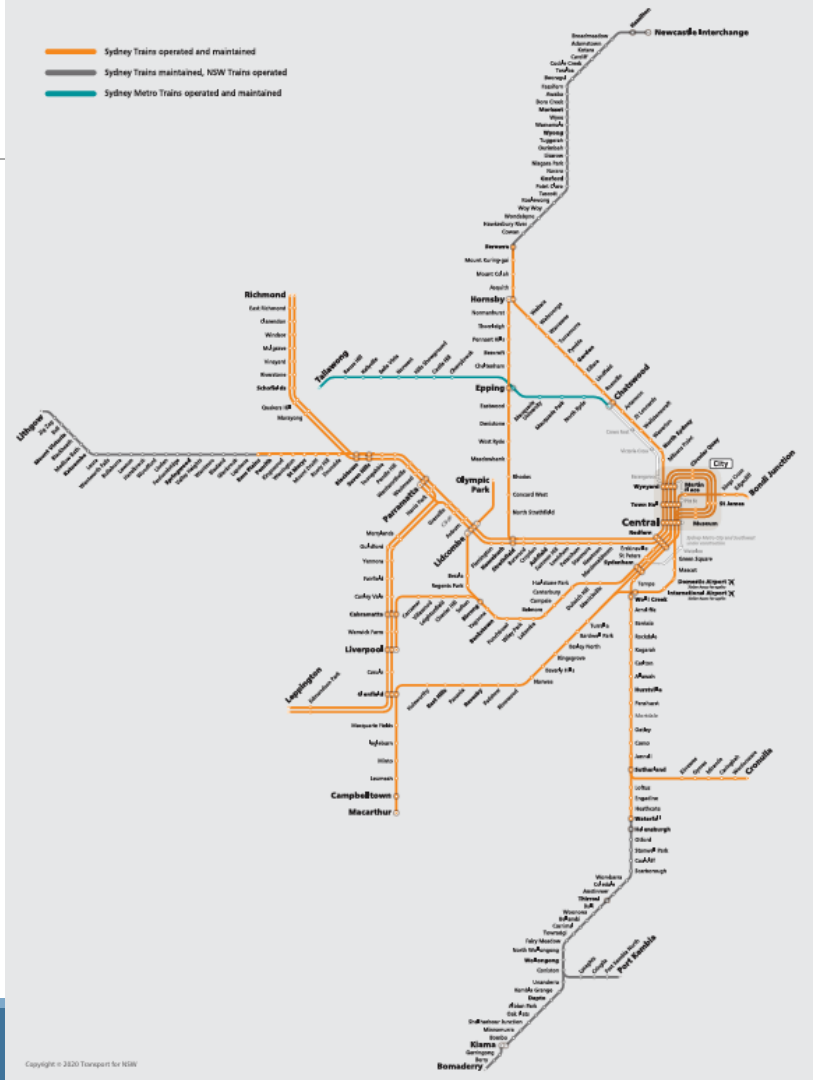
- National Network for Interoperability (NNI) defined
- Definition of mandatory DTCT standards – Discussion paper out now for consultation
- Ongoing discussion on rules and procedures harmonisation, aligned training, etc.

Interoperability is essential and will provide a solid basis for ETCS deployments, but will not be sufficient to ensure success in a national ETCS program.

Introducing ETCS in Sydney

- One network / RIM.
- One primary operator, vertically integrated.
- 7 different fleets.
- ~1500 drivers, 11,000+ people total.

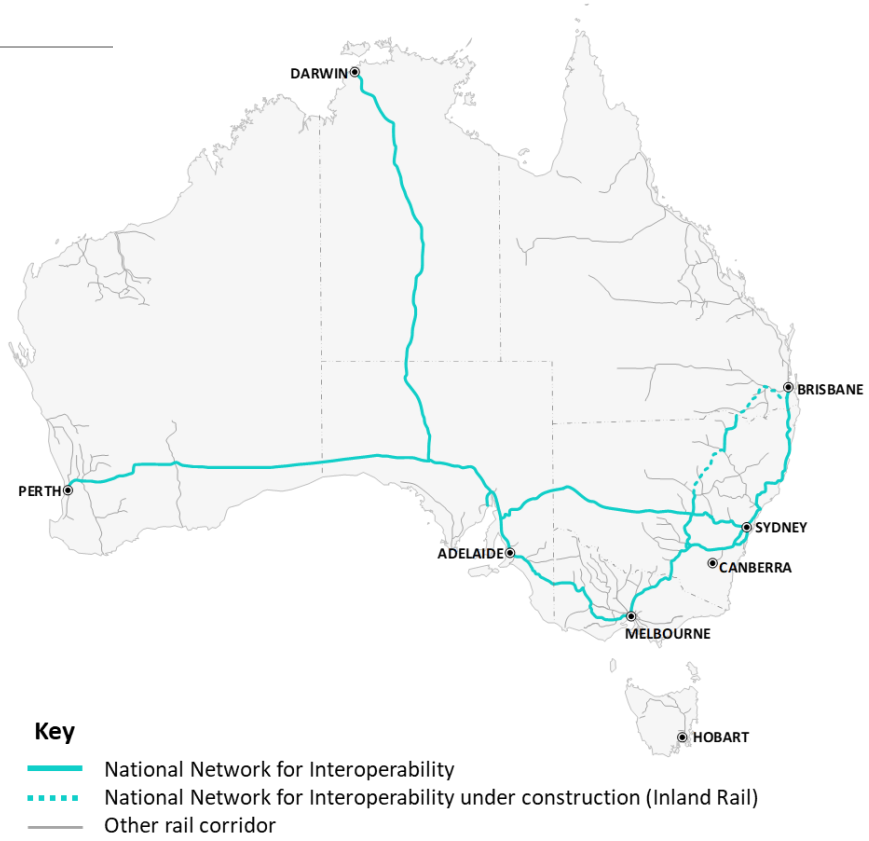
- Project is complicated and challenging.
- Implementation is taking time not because of a poor strategy or poor execution, but because it is a difficult project.



… compared to NNI

- Eight networks / RIMs (4*freight, 4*metropolitan).
- Mix of structures (integrated / separated) and ownerships (government / private).
- 15+ primary operators, plus heritage and track vehicle operators.
- 100+ different types or variants of locomotives, plus heritage and track vehicles.
- 11,000+ drivers, 165,000+ people total.

Project will be massively complicated and challenging.



Beyond Interoperability

We need to develop a national approach to ETCS deployment that works for all parties

Why move to ETCS (+ accompanying systems)?

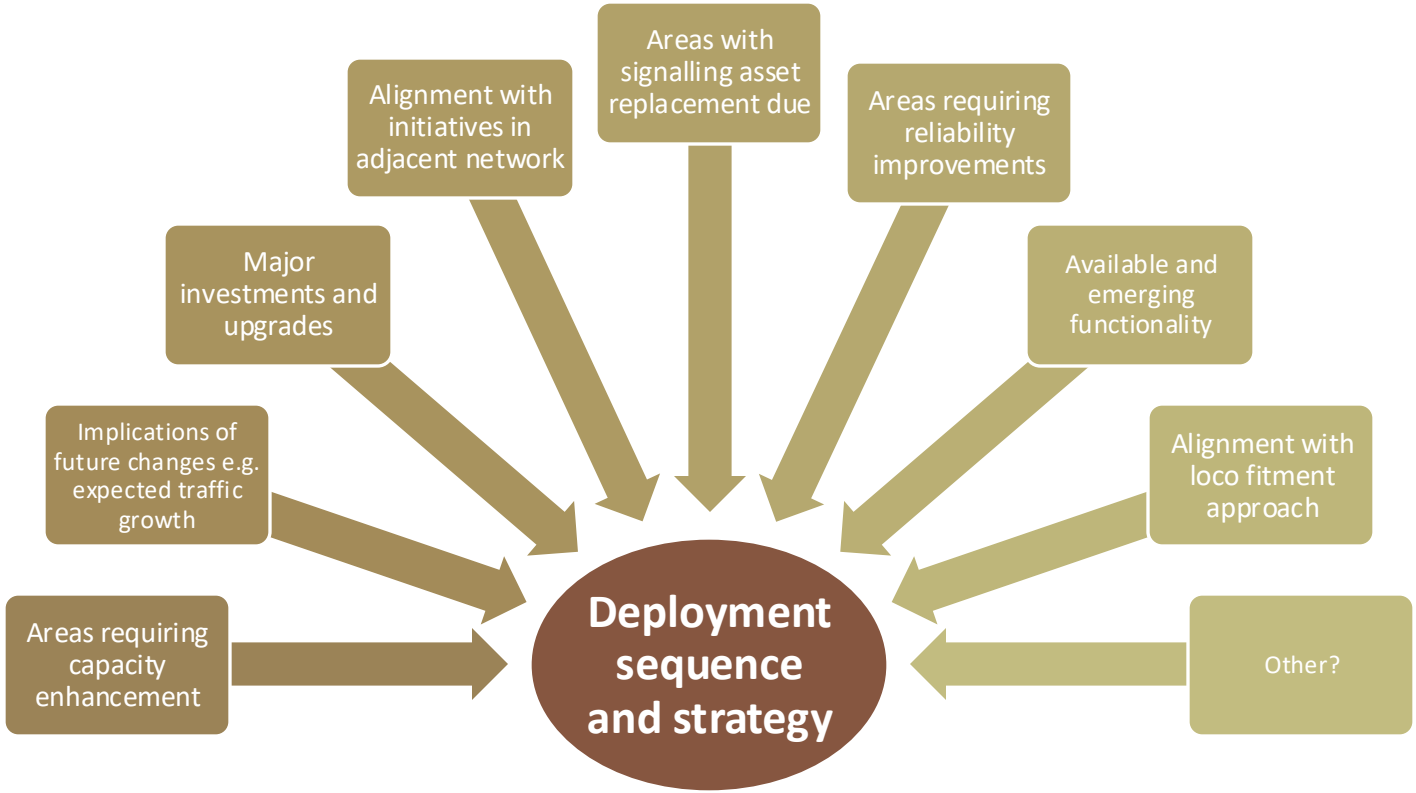
Rail Infrastructure Manager (/ Network Owner)

- Enhanced safety
  - Operations
  - Network maintenance
- Provide a lower cost base for network signalling
  - Reduce maintenance and asset replacement costs
  - Reduce costs for capital works
- Enhance network reliability – simpler and fewer items of equipment on track, remote maintenance, etc
- Greater capacity, better network utilisation
- Better information for management and planning
- A platform for further enhancements

Rolling Stock Operator (RSO)

- Enhanced safety
- Simplified and aligned network rules
- Journey time savings
- Greater reliability of journey times (fewer infrastructure failures)
- Fuel savings
- Better information for management and customers
- Opportunity to move to clever onboard systems e.g. Driver Advisory Systems, Automatic Train Operation

Planning for corridor deployment



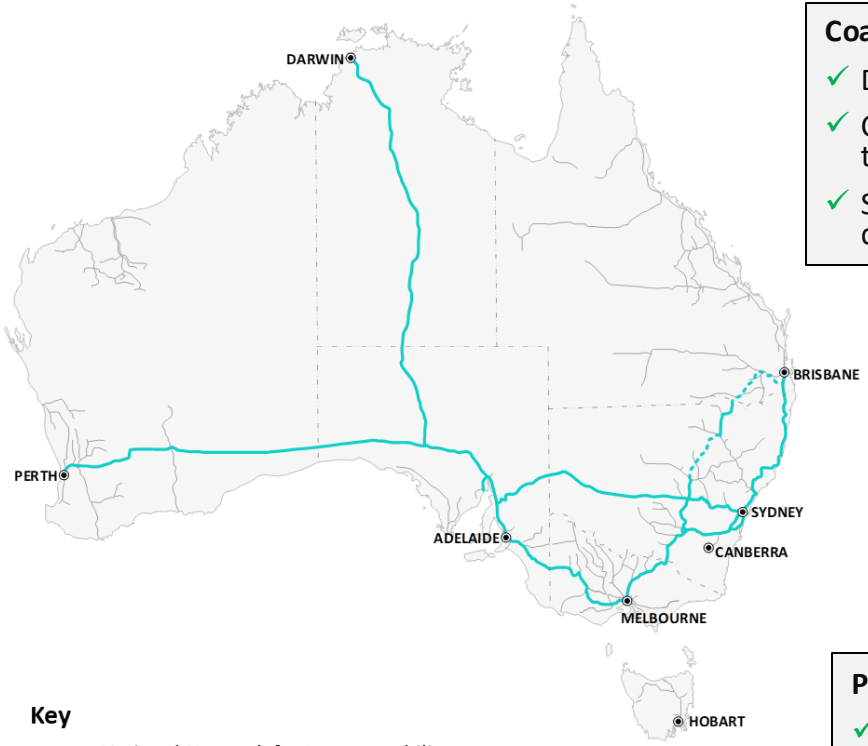
Different requirements for different situations

Interstate Network:

- ✓ Optimise movements on a single- or double-track railway
- ✓ Robust to power and communications outages
- ✓ Need to work over long distances

Regional networks:

- ✓ Focus on simplicity,
- ✓ Optimise movements on a single-track railway
- ✓ Minimise costs



Coal / mineral network:

- ✓ Dense operating environment
- ✓ Can be single, double or multiple track areas
- ✓ Systems need to work over long distances

Urban networks:

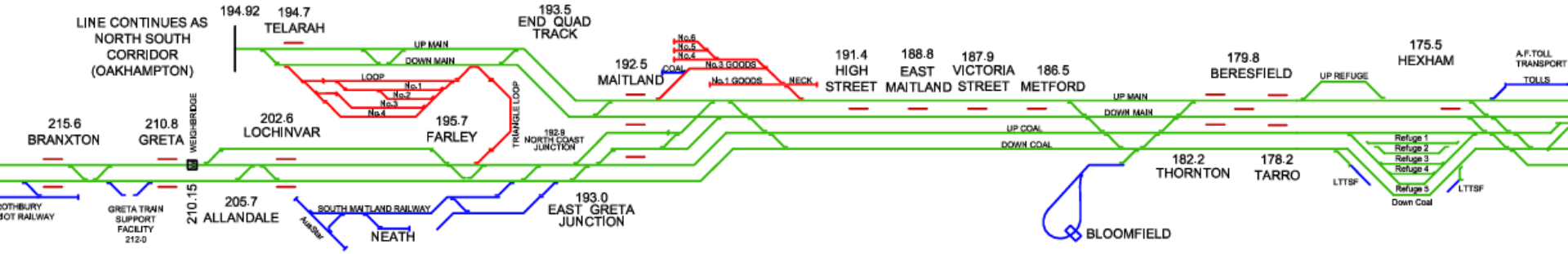
- ✓ Dense operating environment
- ✓ Optimise passenger train movements, but accommodate freight
- ✓ Provide high infrastructure reliability and availability

Peri-urban corridors

- ✓ Mix of passenger and freight.
- ✓ Can be dense traffic
- ✓ Need to optimise for both traffic types

Adapting ETCS for different situations

Densely trafficked section of the network:



Possible solution:

ETCS Level 2 solution similar to that being applied in Sydney.

Adapting ETCS for different situations

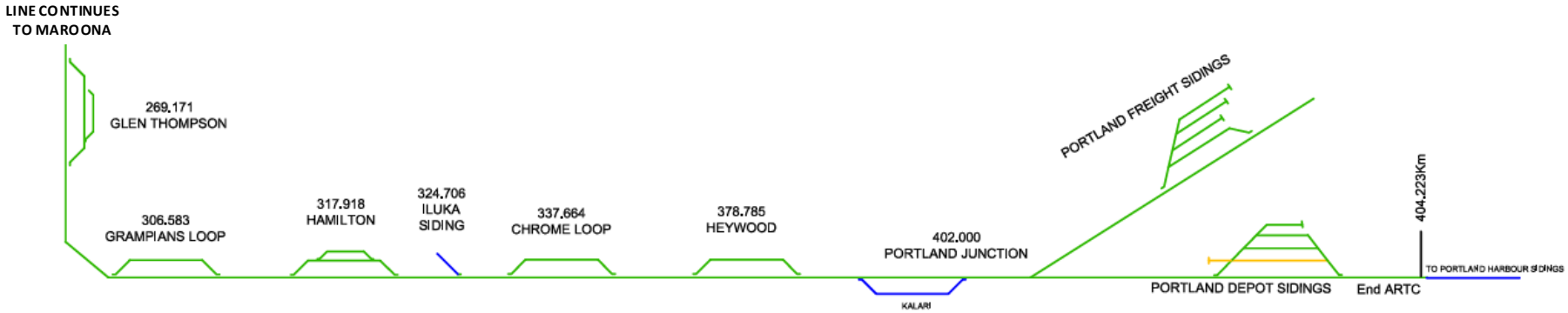
Section of the network that is currently CTC:

Possible solution:

ETCS Level 2 solution at loops, with localised radio coverage.
Use ETCS radio hole functionality between loops.

Adapting ETCS for different situations

Sparsely trafficked section of the network:



Possible solution:

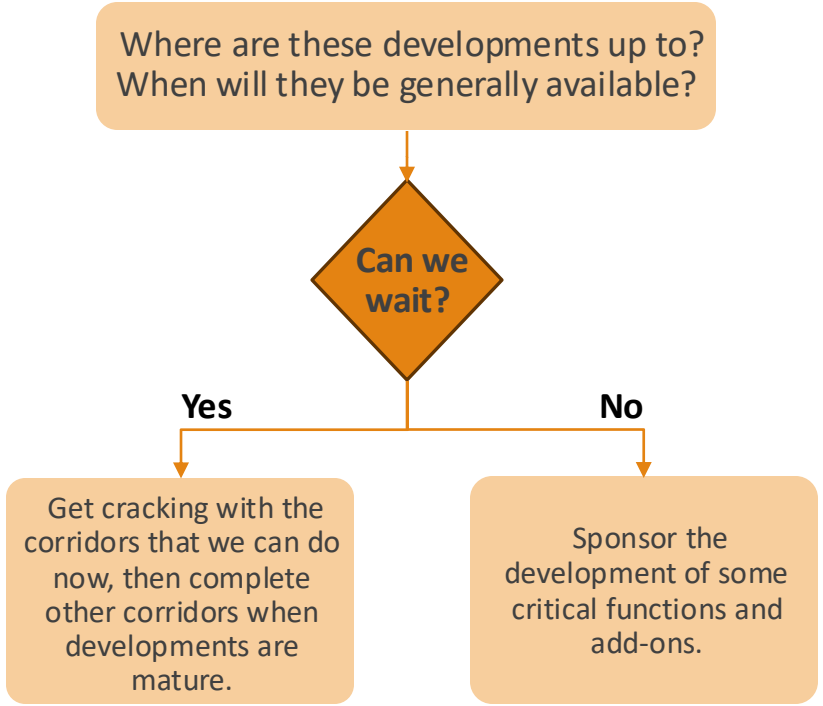
Retain current systems, use fixed ETCS balsies to enforce the permanent speed limit.
(ETCS Level 1 Limited Supervision)

Emerging functions and add-ons

- Virtual blocks
- Onboard train integrity management
- Satellite positioning (virtual balise)
- ETCS over satellite radio
- Integrated electronic track worker authorities
- Portable onboard device for unfitted train
- Integrated Driver Advisory System / automation
- …

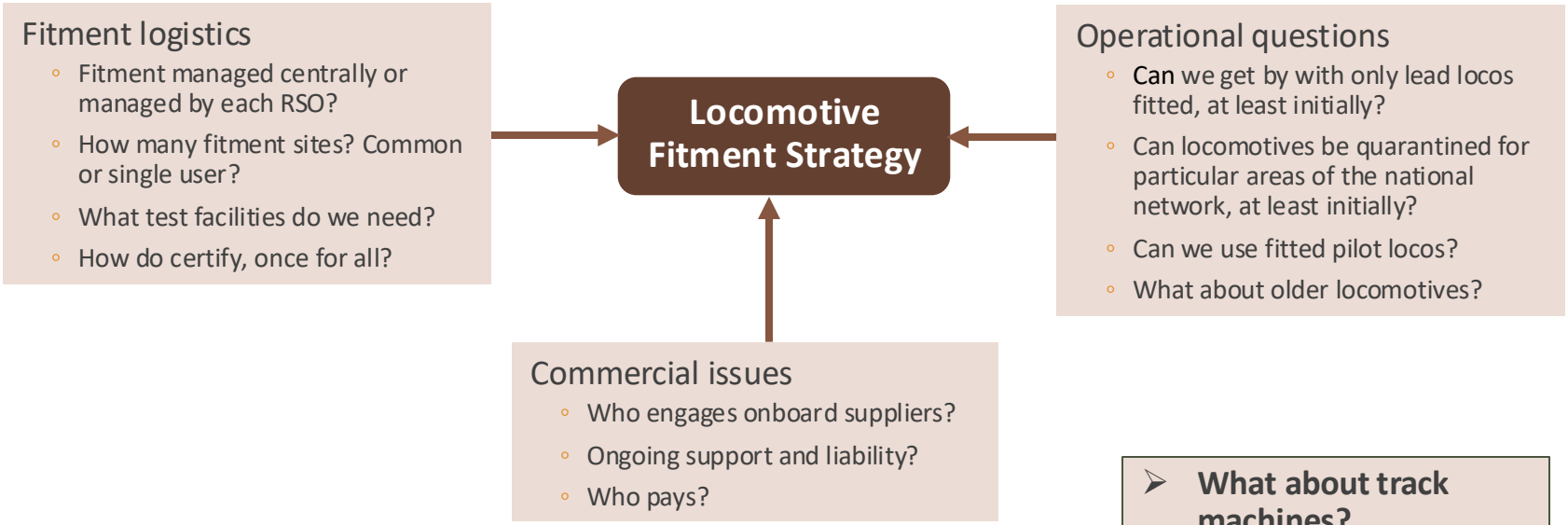
Functions such as the above will mean:

- Reduced costs, and / or
- Enhanced functionality



Planning for locomotive fitment

- The envisaged DTCT Onboard Standard will be essential, but we also need to clarify ...



- **What about track machines?**
- **What about heritage?**

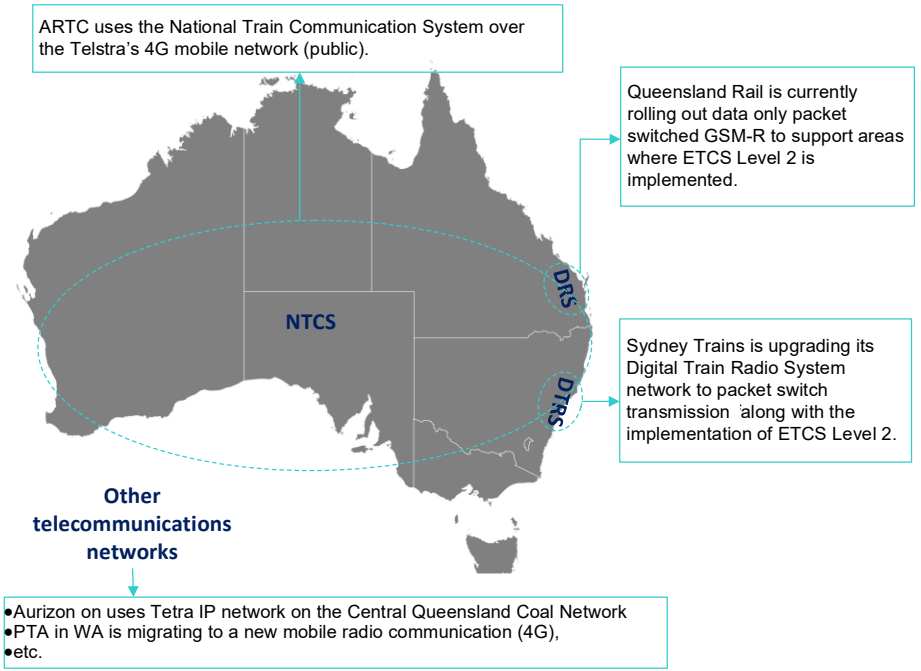
Aligning radio systems and frequencies

- ETCS (Level 2) is fundamentally dependent on radio communications.

- Need to coordinate (trackside):
  - Systems and technologies (i.e. 4G, 5G, satellite, etc)
  - Frequencies, 1800MHz, 1900MHz
  - Functions
  - Network roaming agreements
  - Approach to voice comms

- Onboard fitment will need to include appropriate radio infrastructure

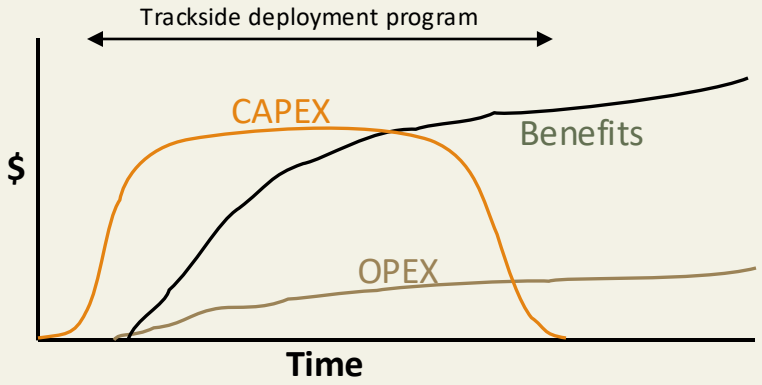
- FRMCS will assist with these issues, but is still emerging!



Picture taken from NTC discussion paper on Digital Train Control Interoperability Requirements

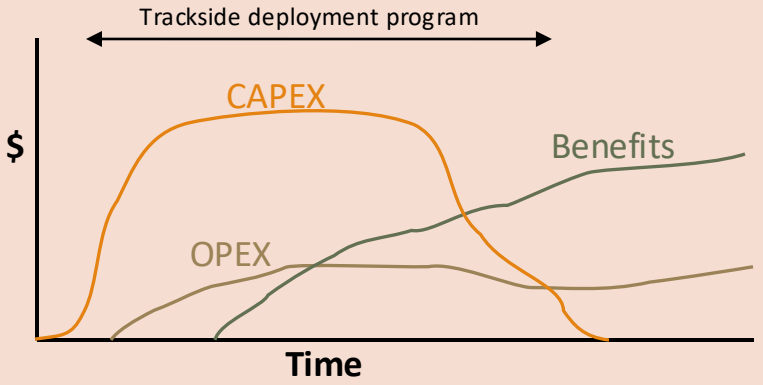
Benefits flow when both trackside and onboard are in place

Ideal outcome (for RIM)



- Trains using ETCS as it is deployed.
- Ability to retire expensive lineside signalling.
- Benefits realised progressively as each corridor is deployed.

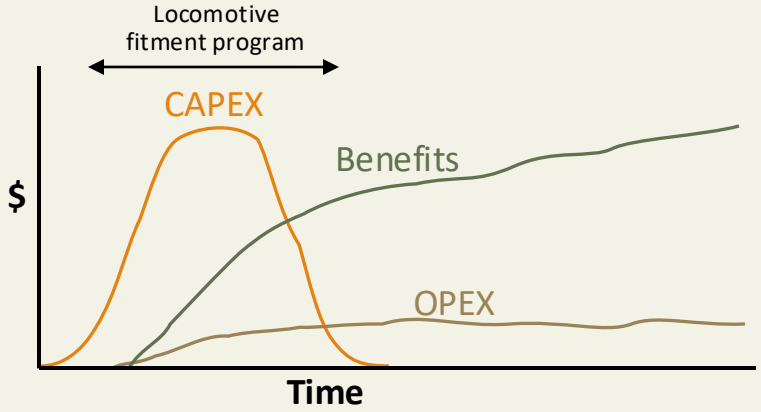
Poor outcome (for RIM)



- Trains not ready to use ETCS.
- Need to retain excessive signalling equipment (= higher OPEX) plus refit at a later stage (= additional CAPEX).
- Benefits reduced and delayed.

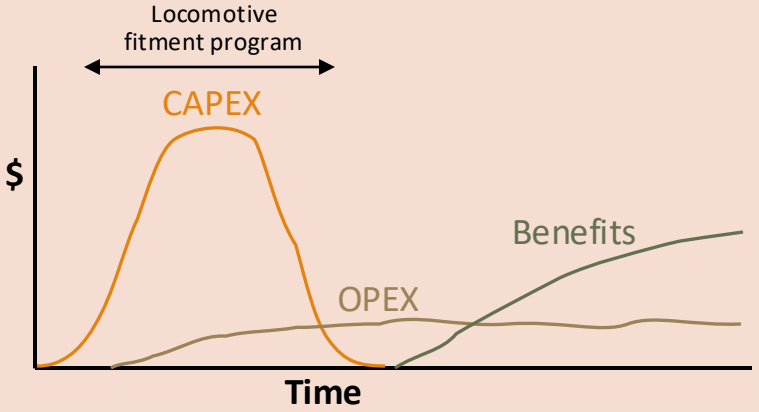
Benefits flow when both trackside and onboard are in place

Ideal outcome (for RSO)



- Trains using ETCS in meaningful areas as they are fitted.
- Benefits realised as each locomotive is fitted and expand as wider areas are deployed with ETCS.

Poor outcome (for RSO)



- Trains are fitted, but do not travel in ETCS areas until later.
- CAPEX and OPEX for ETCS is incurred, but no benefit.
- Issues of training and retained competence.

Working with trackside equipment suppliers

Supplier needs and preferences

- Want to maintain their competitive position.
- Must maintain a whole of life involvement with safety systems they are warranting.
- Would prefer continuous work rather than stop-start.
- Need to deliver a return to O/S owners – we are playing in a global marketplace.

RIM needs and preferences

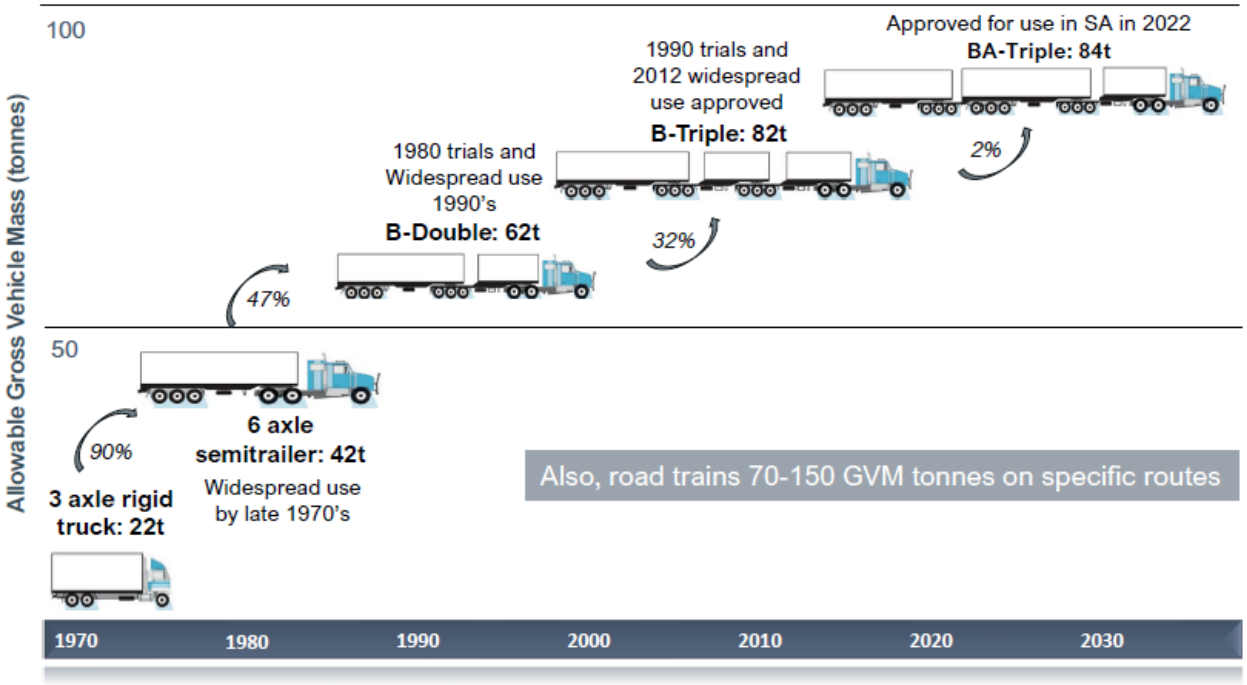
- Will need multiple equipment suppliers to complete any sizeable network.
- Don't really want supplier – supplier interfaces everywhere.
- Need all suppliers to deliver to the same operating rules and signalling principles.
- Can't let themselves be held to ransom by a supplier.

EVOLUTION OF HEAVY VEHICLE PRODUCTIVITY

Productivity growth of heavy freight vehicles has increased six-fold since 1971.

Factors include:

- Expanded network access for larger heavy vehicle combinations
- Increases in regulated heavy vehicle mass and dimension limits
- Growth in long-distance freight
- Cumulative long-term investment in major road infrastructure
- Lower average operating costs per freight tonne km (or capacity tonne km) associated with larger vehicle classes.



ARTC

Two contrasting futures

ETCS-enabled future

- We, collectively, develop and deliver a challenging and difficult program.

Outcome

- Each RIM and RSO starts to reap the benefits of deploying ETCS.
- We can solve a range of issues that exist on our networks now (tbc).
- Our national network is aligned with international development in technology and solutions.
- We are able to adopt further enhancements to ETCS as they become available on the marketplace.
- We have a digital railway platform to build on for the future.

Alternative future

- We decide, for whatever reason, not to pursue ETCS (or any national Digital Train Control Technology).

Outcome

- Any current network issues can only be solved using conventional means (i.e. more conventional signalling and trackside infrastructure).
- We have no path forward to a digital railway platform; we are stuck with existing analogue technology.
- We are internationally left behind, and left behind by other industries e.g. road transport.
- We have a limited and shrinking group of suppliers, and increasing costs for equipment.

Summary

- Deploying ETCS across the national network has many implications and many stakeholders.
- Ensuring interoperability between ETCS implementations is a vital, but will not be sufficient to ensure success in a national ETCS program.
- A credible plan is required that meets the needs of all stakeholders.
- Deploying ETCS will require alignment and engagement between rail entities and disciplines in a way we do not currently do.
- Deploying ETCS will require the skills and expertise of many across our industry.

But

- We can't afford not to do this; the only other option will miss the potential benefits and will leave the rail industry unable to take advantage of the digital revolution.

The further the rollout of ETCS continues, the more a lacking or inadequate strategy will come back to bite.

'Doc Frank' Heibel, LinkedIn comment, 16/7/2025