Metros in Wales – challenges and innovations

September 2020

Improving quality of life

Moving Metros Forward

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The case for metro-style solutions is clear….

…But how do we deliver? What are the challenges and what are the potential solutions?

A changing landscape

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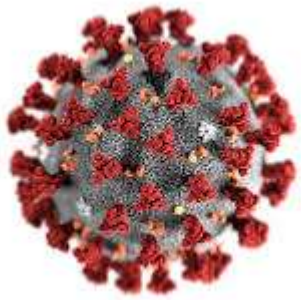
What are the emerging trends in mobility and what can we apply to the Wales Metro opportunities?



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Challenges for country-wide Metro opportunities in Wales

Desired outcomes

- Better access to employment
- Better connectivity across Wales and beyond
- Reliable and high-performing user experience
- Reduce reliance on car
- Meaningfully impact upon carbon reduction and the climate challenge
- High demand to realise the benefits and repay investment

Challenges

- Semi urban area
- Mixed traffic incorporating cross-border connectivity, local commuter routes, freight, tourism
- Lack of comprehensive rail network outside SE Wales
- Bus service viability
- Existing infrastructure constraints
- No electrification
- Disjointed multi-modal options – poor customer experience
- Money – The case has to stack up.

Trends and technology

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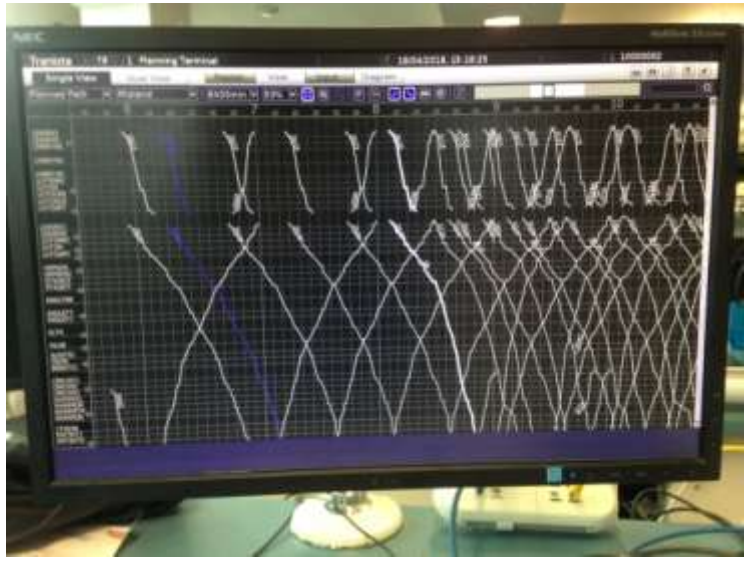
Mobility as a Service

Discontinuous Electrification

Rail TM (Traffic Management) and the Digital Railway



Mobility as a Service (MaaS)

Trend in Wales and the UK

- Prioritisation of investment in mobility between and within major urban centres – e.g. HS2, CrossRail
- What about communities in semi-urban areas outside these main hubs?
- Public transport options are limited, and often unreliable and slow. Users resort to private cars

Congestion

Single-occupant car journeys leading to overcrowding on roads, long journey times and loss of productivity

Social and Economic Exclusion

Many cannot afford a car and are effectively excluded from social and economic networks

Carbon Footprint

Too many vehicles on the road, unsustainable emissions and poor air quality

Mobility as a Service (MaaS)

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What is MaaS?

A MaaS solution allows customers to plan, book, pay for and access a wide range of multi-modal transport options via a single platform – making it much easier for them to travel without relying on a private car.

Improve connectivity and access to existing and upgraded traditional public transport infrastructure

- \+ Robust travel system
- \+ High capacity
- \+ Fast travel
- ✕ High construction costs
- ✕ Fixed routes
- ✕ Invasive infrastructure

- \+ Medium capacity, suitable for semi-urban travel demand
- \+ Flexible routes
- \+ Minimal infrastructure
- ✕ Operationally expensive (public subsidy required)
- ✕ No direct journeys
- ✕ No dedicated right of way - susceptible to delays

Mobility as a Service (MaaS)

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Example of core components

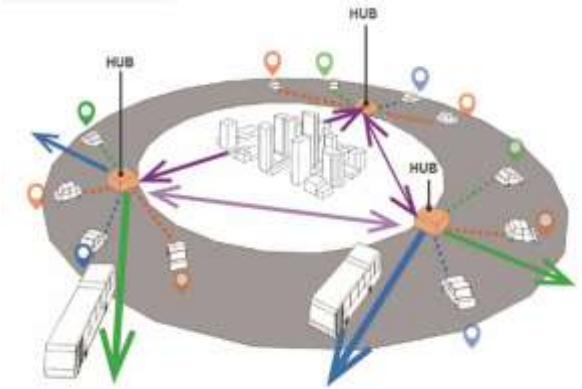
No one-size-fits-all solution; MaaS needs to be designed to suit case specific needs. It's about making existing high-density transport infrastructure such as rail, easily accessible without reliance on private cars

Digital

- Seamless platform for booking end-to-end service
- Great user experience essential
- Data-driven platform learns travel patterns and adapts to changing transport needs

Physical

- Outside of urban centres, provision of transport hubs
- Located in under-utilised areas, e.g. shopping centre carparks
- Location of hubs based on demand modelling. Low-cost, modular design



Vehicular

- On-demand vehicle provision
- Car Sharing
- EV and autonomous vehicles in the future
- Bus services off fixed-timetable
- Active Travel to/from hubs

Low demand:
Mini-vans

Medium demand:
Buses

High demand:
Double-decker or articulated buses

Mobility as a Service (MaaS)

Arcadis currently delivering MaaS in Zuidas, Netherlands

Implementation of MaaS underway. Engagement from local employers and City of Amsterdam

Discontinuous Electrification

Challenge of electrification in rail – the death of diesel

In 2018, the government announced an ambition to take all diesel-only trains off the track by 2040

Benefits of rail electrification

- Better acceleration – faster
- Quieter
- Lower fuel costs
- Better environmental credentials
- Lighter, so less wear on track infrastructure

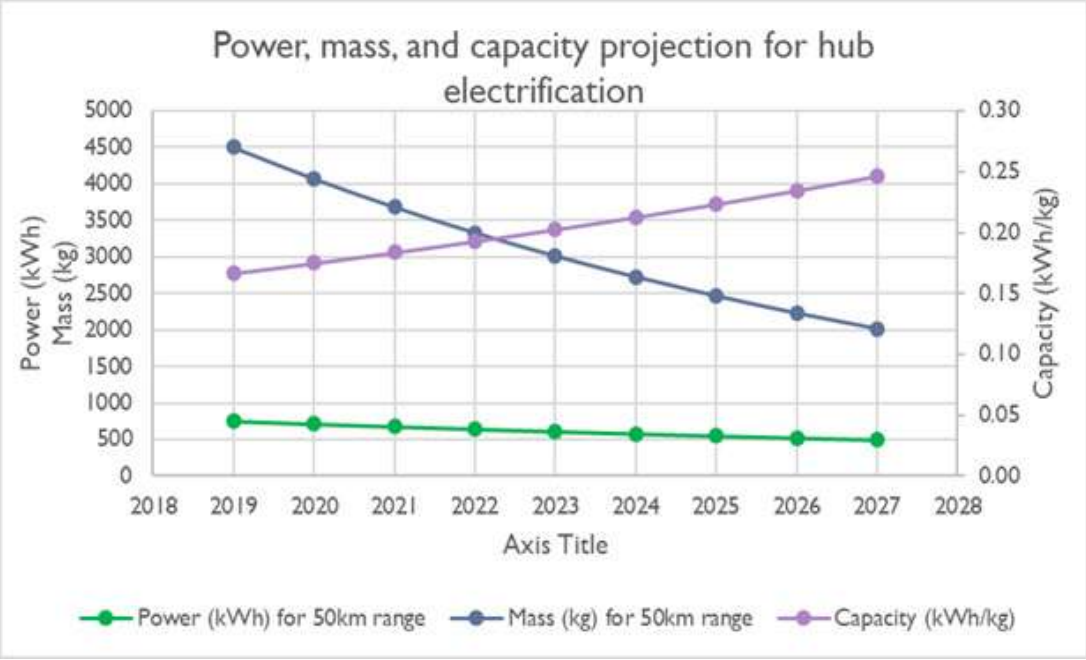
Challenges of traditional electrification

- Lots of fixed trackside infrastructure
- Supply challenges to substations from DNOs
- Impactful on sensitive areas
- Requires extensive modification of bridges and tunnels to suit gauging
- Very expensive – GWML c£3m / route km
- Poor track record in delivery

Discontinuous Electrification

Green energy production and battery energy improvement

- The UK has made significant changes over the last five years in power generation, with renewable + nuclear generating more power than gas and coal for the first time in June 2017
- Central generation of electricity will only become greener as new renewable generation site come online
- Coupled with rapid growth in battery capacity, the opportunity for de-carbonising rail traction is huge
- Hybrid diesel-electric trains a stop-gap
- Hybrid pure electric systems coming on-line



Discontinuous Electrification

Electric-electric hybrid trains limit fixed infrastructure

- Discontinuous electrification provides rolling stock with on-board energy storage capable of providing traction between recharge points
- Recharge points include existing sections of traditional fixed OLE or 3rd rail
- Outside of core electrified areas, short section of OLE, at stations for example, can provide regular recharge points, and allow acceleration under fixed equipment
- Range increasing significantly – currently up to 150km is achievable. Traffic pattern dependant
- Battery power fills in the ‘gaps’

Discontinuous Electrification

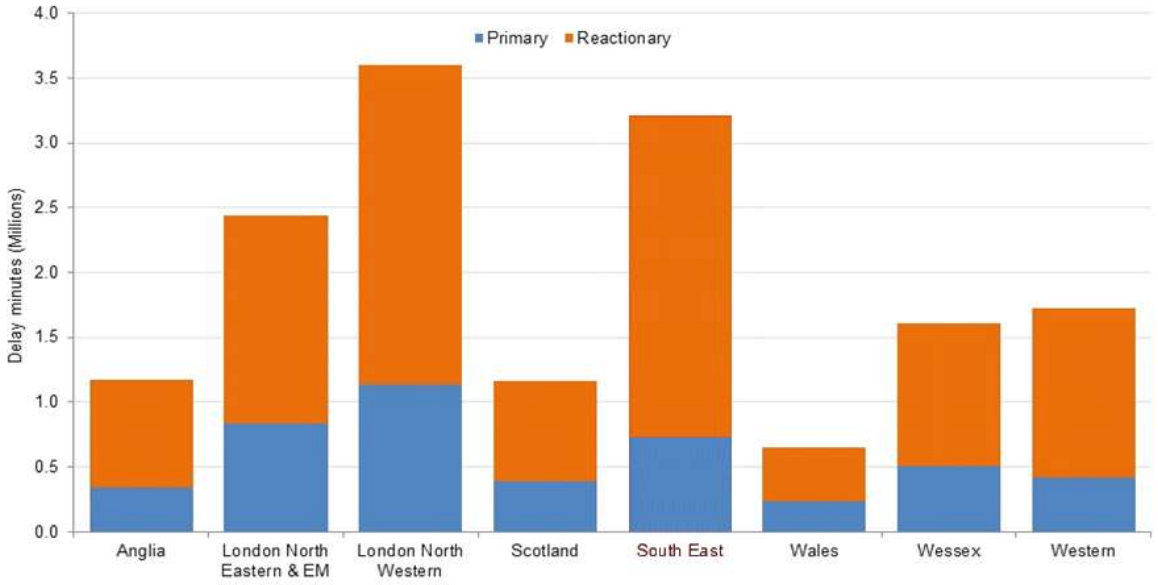
Funding and investment

- Current model of infrastructure investment relies on treasury funding
- Fleet investment can be borne by the train manufacturer through a concession or investment vehicles.
- Returns delivered across the life of the fleet
- Certainly of return across a defined timescale an attractive investment proposition – attractive investment due to sustainability and carbon reduction credentials
- Batteries becomes a new commercial asset, replicating anticipated developments in electric road vehicles
- With improved battery technology, the DMU-free map of UK rail increases without the need for more infrastructure

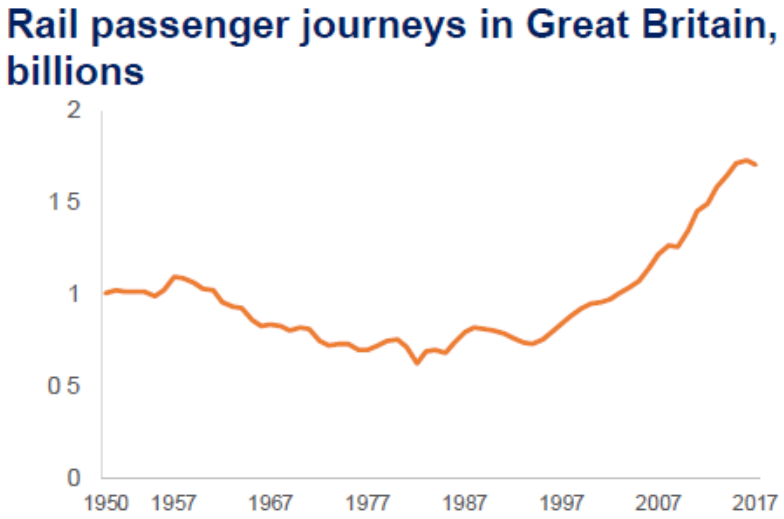
Factors	Advantages
System Availability	System efficiency, reliability and more Miles per Technical Incident (MTIN). Zero time required for empty stock refuelling movements.
Infrastructure Cost	Less Rail infrastructure (substations, foundations, steelwork and wiring) to build and maintain - this also reduces requirement for isolations to maintain critical assets. Minimises requirement to reconstruct overbridges and the planning and stakeholder management of these works and associated road closures.
Safety Case	Less live equipment on the network - also minimises requirement to provide protective provisions to workers and public. No hazards associated with refuelling or fuel storage.
Risks	Risks become operational and logistical (system failure leading to stranding) rather than safety (combustible products or live equipment / faults)

Rail TM – Traffic Management

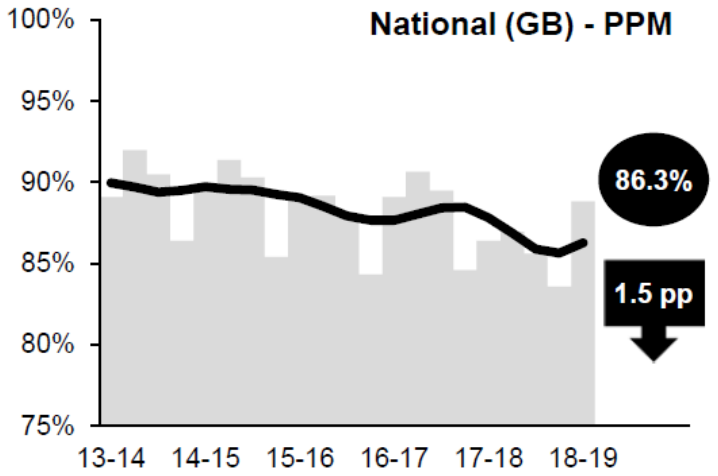
The case for traffic management



Network Rail - 2018



DfT 2018



ORR 2019 – Public Performance Measure

Rail TM – Traffic Management

To Improve Performance – Can we…?

- identify timetable conflicts in advance of them happening and correct them?
- dynamically replan the service after a disruption, automating some of the workflows to do this?
- look at options for re-planning; picking the best one?
- communicate the revised plan to those who need it?

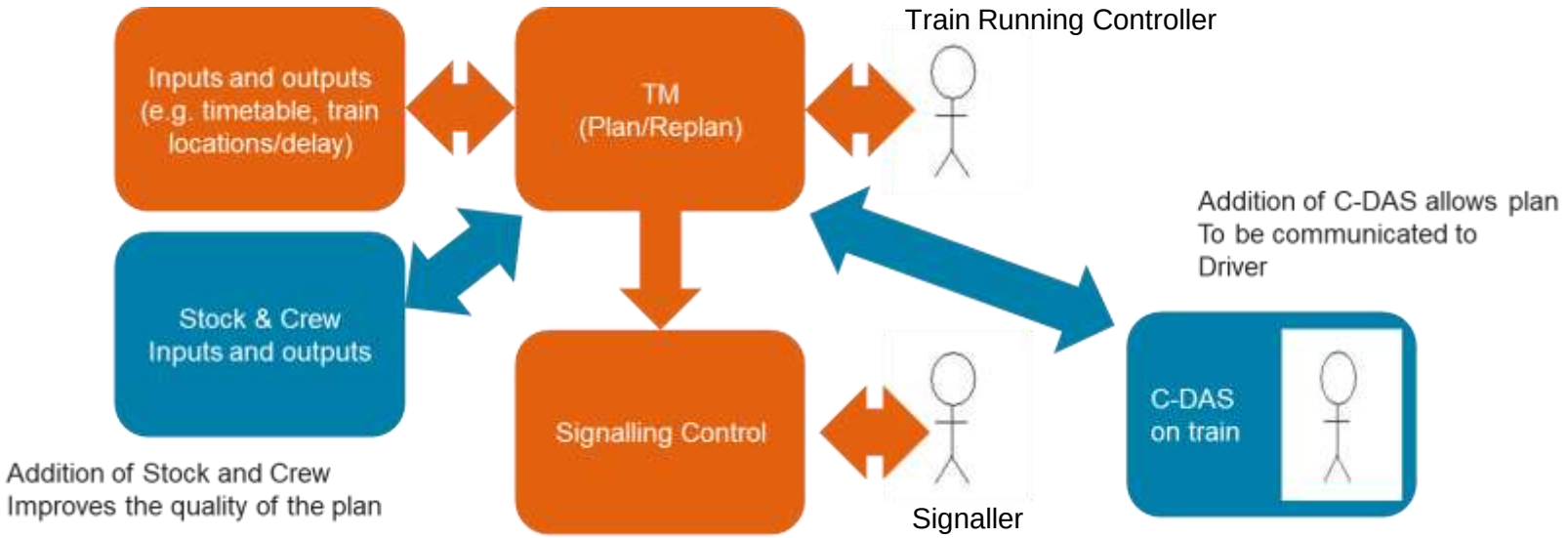
Enter TM

Use the rich data on rail plans, geography, performance and current real time status to

- Identify conflicts in future plans
- Identify conflicts in current plans
- Identify options to re-plan train service after an incident
- Communicate the new plan to a range of systems and users

Rail TM – Traffic Management

System architecture for Traffic Management and Connected Driver Advisory Systems



Benefits

- Performance – avoidance and reduction of delays
- Safety – Reduction in manual interventions in signalling systems, and track worker safety functionality
- Capacity – Does not directly improve capacity, but reduction in recovery margins allows better use of existing capacity
- Information – Single source of truth for up to date operational data for users and customers (through CIS)

Rail TM – Traffic Management

Lessons from trials underway, including South Wales, Cardiff ROC

- Works best in a collaborative, partnering environment
- Focus on operation outcomes, where operating scenarios are recognised as being able to be impactful
- Data is key to TM system learning, and wider scale implementation
- Consider the parallels to MaaS: Demand-led, real-time, adaptable, and scalable system

Closing comments

Global trends in mobility and technology will change the way we develop the opportunities from Metros in Wales

MaaS, Discontinuous Electrification, and Traffic Management are just three examples of emerging solutions which can play a part

Investment decisions need to consider the emergence of technology and the opportunities for direction changes in the future

The metro concepts are key to unlocking prosperity and opportunity in Wales and can lead the way in exploiting emerging technologies