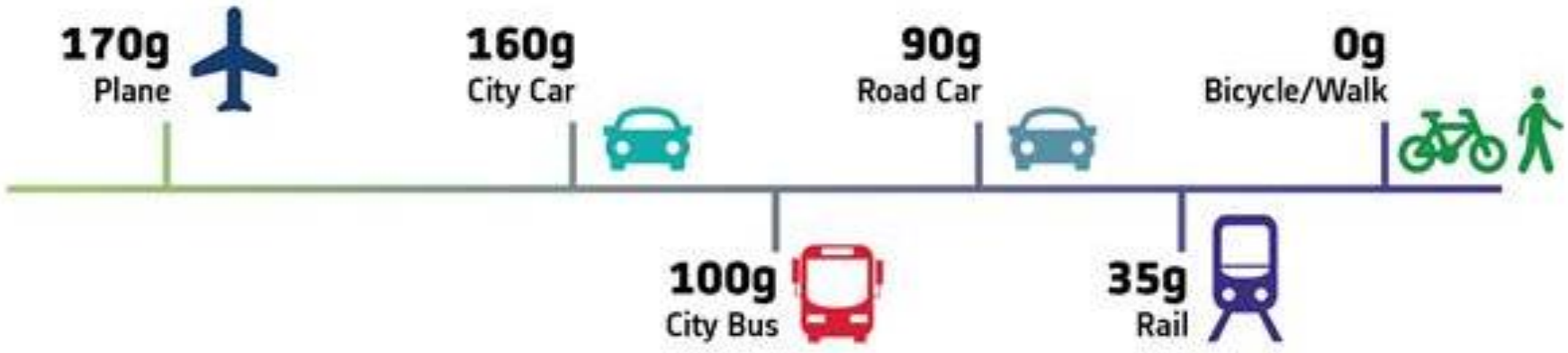
Addressing the Technical Challenges

A Whole System Perspective

UIC RailAdapt Beijing 18/06/2017

ALSTOM
Designing fluidity

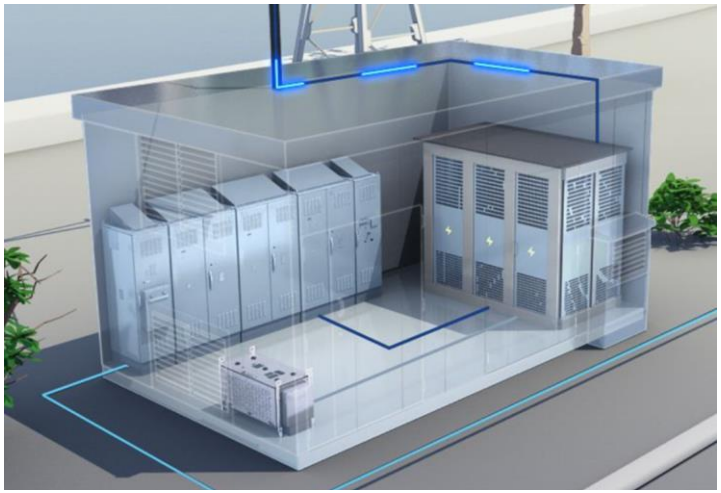
A Whole System Challenge



CO_2 emissions per passenger per km

Crucial Role of Rail in Addressing these Systemic Challenges

Reduce Systems' Needs



HESOP Reversible Substations

- 99 % of braking energy returned to power grid
- or re-used in station equipment
- Up to 40% energy savings
- Reduce tunnel and in-station ventilation

Permanent Magnetic Motors

- 15% energy savings vs asynchronous motors
- 40% lighter, contributes to train mass savings
- Dirt reduction by 15%, noise by 4%
- No cooling water consumption: self-ventilated design

- Energy recovery, mass reduction, reduced or no ventilation

Adapt to Non-continuous Electrification

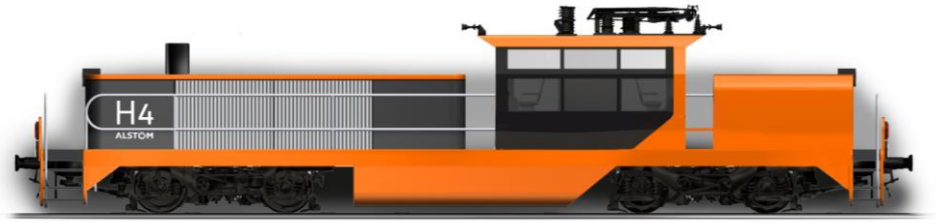
Catenary-less Trams
Three feeding systems
3rd Rail, Static Recharge,
SuperCapa

Aptis
Electricity-fuelled mobility
On the road
Dual charging modes

Coradia iLint
Hydrogen Fuel Cell
Regional Train

And reduce environmental impacts of urban transport

Adapt to Non-continuous Electrification



Prima H3
Shunting Locomotive

- **Hybrid Diesel Battery**
- **Bimode Diesel Electric**
- Diesel consumption down 50% to **full autonomy**
- Emissions down by over 50% to **emission-free**
- Max speed 100 km/h
- Traction force 240 kN

Prima H4
Shunting and Mainline Locomotive

- **Hybrid Diesel Battery**
- **Bimode Diesel Electric**
- Diesel consumption down 50%
- Emissions down by over 50%
- Driving speed 120 km/h
- Traction force 300 kN

Increase flexibility and reduce environmental impact of freight and shunting operations

Adapt to Changing Environmental Conditions

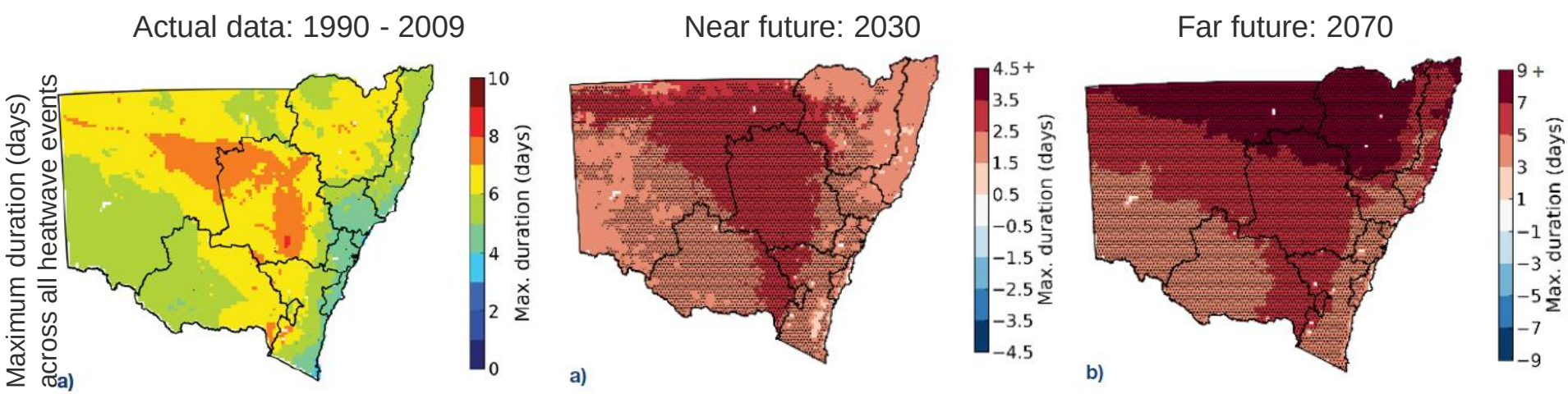
- Sizing and protection of electric and electronic equipment
- Sand protection
- Thermal isolation reinforcement
- AC reinforcement and air-flow management
- Condensation protection

Adapting to a world ~2°C hotter by 2050

Resilience to slow-onset environmental changes

Australia Tram System Project

Heatwave events across NSW actual and projections



Source: heatwaves climate change impact snapshot

Design to withstand outside T°> 40°C, >50°C in degraded mode

Resilience to Increasing Intensity of Climatic Events

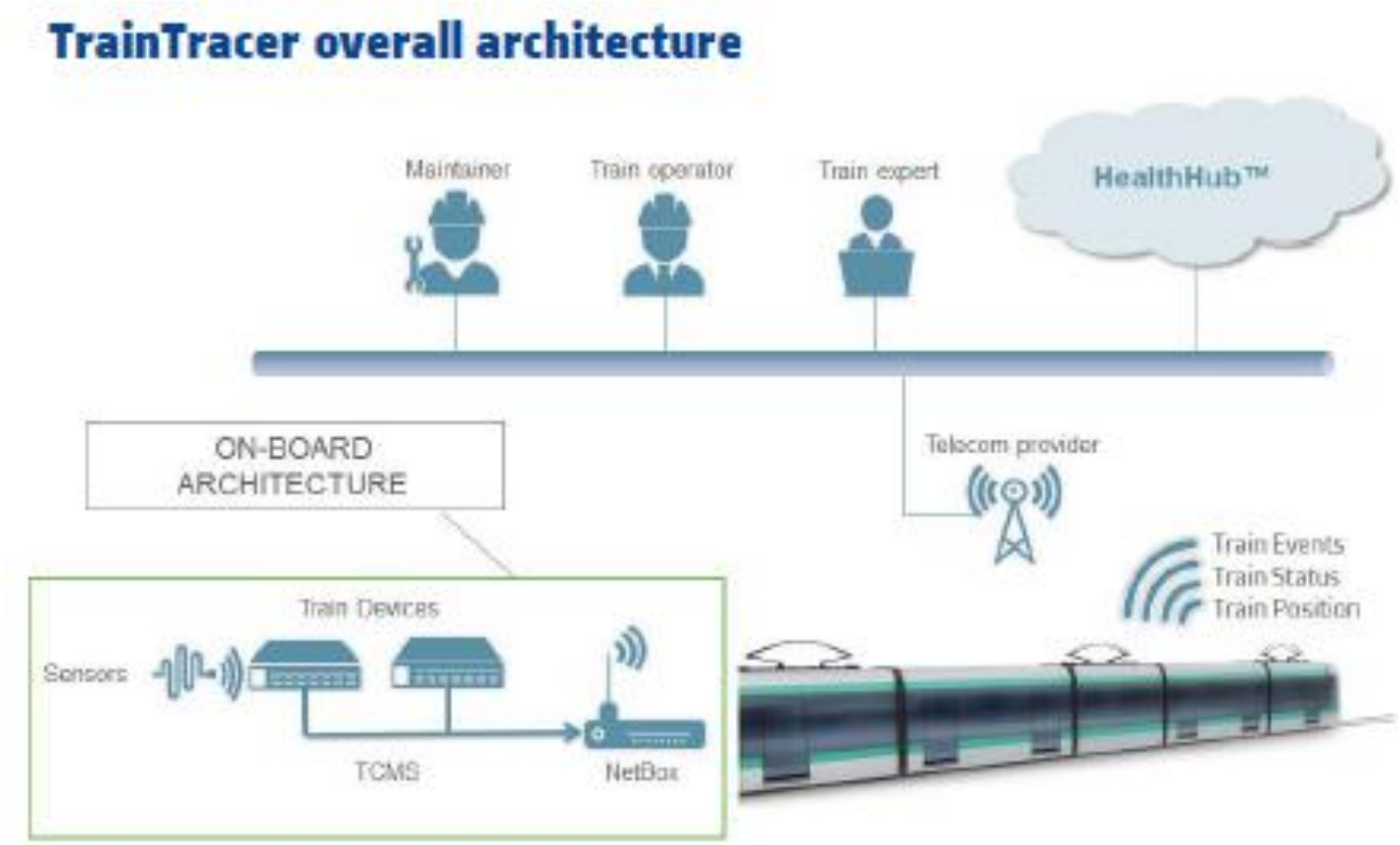
Australia Tram System Project

20% AEP* flood depth CBD (1 in 5 year event)

1% AEP* flood depth CBD (1 in 100 year event)

Climate Change Risk Assessment and Mitigation Measures

Optimize System Resilience: Real-time Condition M&D



Train, Track, Catenary and whole System detection of intrusions and theft

Optimize System Resilience and Safety: Traffic Optimization

Optimet

Metro Connectivity and real-time information for Passengers

- Real time information **about traffic conditions and service interruption**
- **Live estimation** of journey times
- **Urban life information** through social media

Mastria

Multimodal mobility advisory overlay

- **Coordinate** all public transport modes from rail to road
- **Alternative mobility solutions** rapidly offered in case of incidents
- Predicting with **data analysis** and **operational optimisation**

Sustainability and Innovation: at the core of Alstom's DNA

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