Australia’s First Fully Automated Metro Opportunities & Solutions

Oliver Fried – Technical Director, Sydney Metro
Overview

- Sydney’s rail future - Opportunities for metro
- Project features & performance
- Fully automated operations - Technical solutions
- Project challenges – Metro City & Southwest
- Skills investment
- Summary
Features of Sydney Metro

**Key Facts**
- 2019: Sydney Metro Northwest opens
- 2024: Sydney Metro City & Southwest opens
- 31: 31 Metro stations
- 10: Off-peak train every 10 minutes
- 98%: On-time running reliability
- 4000: Commuter car parking spaces (Northwest)
- Ultimate capacity: a train every two minutes anywhere under the CBD
- No timetable: just turn up and go
- Opal ticketing: like rest of Sydney
- 00:02: Maximum Sydney train customers per hour per line

**Train Features**
- Three double doors per carriage for faster loading and unloading
- Level access between platform and train
- 170 metres long platforms - longer than most of Sydney
- Clean platforms and trains
- Heating and air conditioning
- 26 CCTV cameras per train, inside you can see from one end of the train to the other and video help points
- Platform screen doors keep people and objects away from the edge and allow trains to get in and out of stations much faster

**Safety**
- Sydney Metro is Australia’s first fully-automated metro rail network
- Around the world, millions of people use these networks every day in cities like Paris, Singapore, Dubai and Hong Kong
- Constant monitoring: Expert train controllers monitor entire metro system
- Security: More than 230 tunnel cameras
- Operations Control Centre: State-of-the-art network controlled from new high-tech facility at Telford Road
- Signalling and communications systems: Control the trains, tunnels, platforms and skytrain to deliver a safe and reliable journey
- Faster journeys: System minimises the time trains are stopped at stations and the time between each train

**Additional Features**
- Two multi-purpose areas per train for prams, luggage and bicycles
- Wheelchair spaces, separate priority seating and emergency intercoms
- Real-time travel information and live electronic route maps

Customer service assistants at every station and moving through the network during the day and night

An example of a metro operations control centre
Sydney Metro

Stage 1 – 36km

8 new stations; 5 upgraded

Train Maintenance Facility

4,000 car spaces

Open first half of 2019
Line Capacity

- Sydney’s Rail Future identifies passenger demand
- Customer service “turn up & go”. Service frequency to fulfil waiting times

<table>
<thead>
<tr>
<th></th>
<th>Trains per hour in peak</th>
<th>Train Formation</th>
<th>Passenger capacity / train</th>
<th>Passengers / hour /direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sydney Metro NW at opening</td>
<td>15</td>
<td>6 car</td>
<td>1152</td>
<td>17,280</td>
</tr>
<tr>
<td>Sydney Metro NW Capacity</td>
<td>25</td>
<td>6 car</td>
<td>1152</td>
<td>28,800</td>
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<tr>
<td>Safeguarded Capability</td>
<td>30</td>
<td>8 car</td>
<td>1440</td>
<td>&gt;40,000</td>
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## KPI Performance Drivers

<table>
<thead>
<tr>
<th>Availability</th>
<th>Service Availability</th>
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<tbody>
<tr>
<td>Timeliness</td>
<td>Frequency</td>
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<tr>
<td></td>
<td>Journey Time</td>
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<tr>
<td>Service</td>
<td>Train Cleanliness, Condition and Graffiti</td>
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<tr>
<td>Quality</td>
<td>Station Cleanliness, Condition and Graffiti</td>
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<td></td>
<td>Precincts and Corridor Condition and Graffiti</td>
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<td></td>
<td>Customer information during disruption</td>
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<td></td>
<td>Gate Management</td>
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<td></td>
<td>Customer Satisfaction Survey</td>
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<td></td>
<td>Customer Complaints and complaints resolution</td>
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<tr>
<td>Asset</td>
<td>On-train environment (temperature and lighting)</td>
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<tr>
<td>Functionality</td>
<td>Station environment (temperature and lighting)</td>
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<tr>
<td></td>
<td>Lift and Escalator Operations</td>
</tr>
<tr>
<td></td>
<td>Other Assets Availability (CCTV, Help Points, PIDs Announcements and Induction Loop)</td>
</tr>
</tbody>
</table>
Performance Criteria

A design that must be capable of delivering:

- Sufficient capacity for passenger demand
- Acceptable waiting time: Peak - 4 mins in & off-peak - 10 mins
- 98% of required train services on-time
- A 37 minute journey time

- Benchmarked against proven contemporary systems & technology applications
- Aligned to systems available in the market - Minimal technical development
OTS – Operations Trains & Systems PPP

- Northwest Rapid Transit (NRT)
- Permanent physical works include:
  - Delivery of 22 x 6 car fully automated trains
  - Integrate track, power supplies, M&E systems, signalling and communications systems
  - Build the Sydney Metro Train Facility (SMTF)
  - Build 8 new stations, interchange facilities & car parks
  - Upgrade and convert the Epping and Chatswood rail link
- Operate & Maintain Sydney Metro Northwest for 15 Years
Technology - Rolling Stock

- Unattended (UTO) operation Safe & reliable in all driving modes GoA4 (IEC 62290)
- Driving, braking & door commands - Authorisation, response, accuracy & integrity
- Interfaces with signalling, platform screen doors & communications to / from OCC
- Passenger capacity – 1152 (30% seated)
- Performance outcomes underpinned by International Standards.

Product Solution: Alstom Metropolis – Proven product platform in similar metro applications

Referenced applications: Singapore NE & Circle Lines & Hong Kong MTR South Island Line
Rolling Stock
Interiors & passenger information
Technology - Signalling & Train Control

- Unattended train operation (UTO) – GoA4 (IEC 62290)
- Safe braking distance between trains.
- Interfaces with rolling stock, platform screen doors & communications
- Automatic Train Supervision:
  - Driving profile and dwell times regulated automatically to achieve run times, optimise performance & manage delays
  - Fault reporting & alarms to OCC with recording & playback
  - Vehicle / system performance captured to support maintenance

Product Solution: Communication Based Train Control (CBTC) 
Alstom Urbalis 400 – Proven in comparable metro applications

Referenced applications: Singapore NE & Circle Lines, Shanghai Line 10 & Hong Kong MTR South Island Line.
Communication Based Train Control (CBTC)

Location of preceding train communicated to following train in real time.
OPERATION MODES

- Wake Up Mode
- Unattended Train Operation (UTO)
- Protected Manual Mode (PM) – Manual with ATP supervision
- Restricted Mode (RM) – Manual with partial ATP supervision to 25 km/h
- Fallback Mode – Manual driving to procedure
- Wash Mode
Train to Lineside Communications

Signalling
- 5.8 GHz WiFi
- Low data
- High integrity
- Duel-redundant

Communications
- 5.8 GHz WiFi
- High data
- 8 video streams / train. 25 frames/s
- 32 video streams total
- Remote PA & “Help-Point” voice communications
Technology - Platform Screen Doors

- Segregation of passengers at platforms from track & moving trains
- Platform screen doors (PSDs) at 3 new underground stations
- Platform Edge Barriers (PEBs) at all other stations
- Synchronised with train doors - Authorisation, timing sequence & interdependent isolations (Interfaces via signalling system)
- Obstacle detection on both train and platform doors
- Events & failure mode indications reported to OCC. Relevant CCTV images displayed automatically
Platform Screen Doors and Platform Edge Barriers
Artists Impression of Cudgegong Road Station
Security and Intrusion Protection

- Perimeter monitored and alarms
- CCTV for stations and precincts
- Tunnel and guideway physically segregated
- Segregation of staff at SMTF
Sydney Trains Rail Facility (SMTF)

• Stabling for fleet, initially 22 trains
• Fully automated train movements
• 4 road maintenance facility. Full train lift and bogie exchange
• Dual axle wheel lathe
• Automatic train wash plant, graffiti and biological cleaning
• Stores, workshop and rail maintenance capability
• Stabling for maintenance fleet
Artists impression of Sydney Metro Trains Facility
Sydney Metro City & Southwest

Tunnel under harbour – use harbour depth slide perhaps?
Total line length 65 km
31 metro railway stations
Tunnel - Chatswood to Sydenham
The Bankstown Line
7 New Underground stations
Augmentation and Performance Targets

- Rail systems design to cater for an expanded Sydney Metro
- System reliability and availability outcomes address the extended Metro with system performance targets recognising full expansion
- The augmented Metro including additional stations, track, trains and maintenance capacity
- The SM NW performance targets are
  - 98% of Trains Services within 2 minutes of due time
  - 99.5% of Trains Services
  - Rail systems reliability and availability structured for the full line (SM NW + SM C&SW)
Skills Investment
The Changing Shape Skills in Rail

Signalling Mechanical

Signalling Electrical

Communications and Control Systems
Sydney Metro – Workforce Development Programs

Key Objectives

- Support local labour force participation
- Resolve skills shortages locally and nationally through targeted skills development
- Maintain competitiveness of the construction sector by attracting skills locally and nationally
- Ensure procurement decisions in the transaction management phase support state and federal efforts to increase workforce participation
- Encourage the next generation to pursue careers in engineering and construction
Sydney Metro Workforce Development Programs

Metro Graduates

Specialist Graduate Program targeting Communication s and Control Systems

Metro Career Pathways

Careers Development – aligning with STEM Programs in schools

Opportunity to develop world leading skills from the increase in semi and fully-automated train systems across the world

Specialised Curriculum

Development of new qualifications supporting different occupational requirements

Partnering with RTO’s to develop specialised Communications & Control Systems curriculum

Opportunity to develop world leading skills from the increase in semi and fully-automated train systems across the world
Opportunities and Solutions

- Performance based specifications – Service outcomes, frequency and reliability
- Proven solutions - Delivering Metro outcomes utilizing proven products and technologies to international standards
- Integration of trains, signalling, PSD and communications technologies
- Sydney Metro - Provisioned to extend (Augmentation)
- Shift in skills – New technologies, less bespoke, integration, operations and maintenance
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