



ALSTOM TURNKEY METRO

6/2013

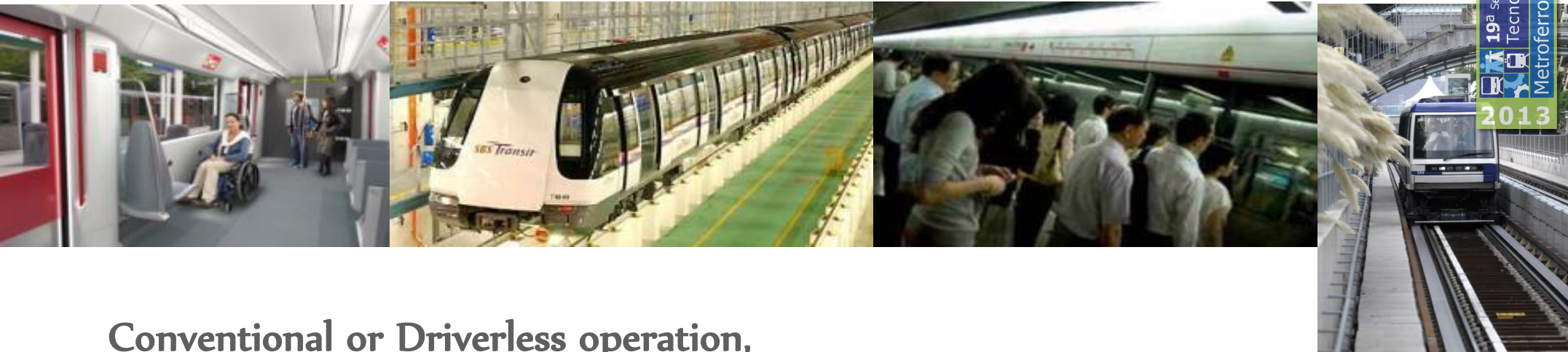
1. ALSTOM Metro Expertise

2. AXONIS

3. Customer Benefits

4. Inside the AXONIS System

Alstom: A reference in Metro Solutions



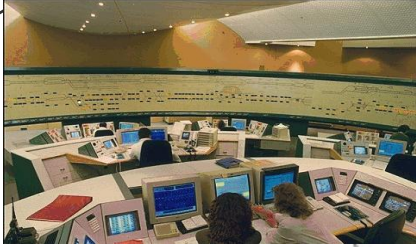
Conventional or Driverless operation,

Steel wheels or rubber tyres, large or small Capacity

- ✓ 1951: First rubber-tyred metro
- ✓ 1999: First steel-wheeled Driverless “heavy” Turnkey Metro system, and still the heaviest...
- ✓ 2008: First Driverless Metro with slope up to 12%

1/4 of metros worldwide are produced by **ALSTOM**

Metro Transport Global Solutions



Signalling and Control Systems



Depot and Maintenance Facilities



Track Works



Catenary / 3rd rail



Testing and Commissioning



Power Supply



System Engineering and Project Management







Station Equipment



Grades of Automation as defined by UITP

Fully-Driverless Operation Benefits with GoA 4 (UTO)

Grade of Automation	Type of train operation	Setting train in motion	Stopping train	Door closure	Operation in event of Disruption
GoA 1 	ATP with driver	Driver	Driver	Driver	Driver
GoA 2 	ATP and ATO with driver	Automatic	Automatic	Driver	Driver
GoA 3 	Driverless	Automatic	Automatic	Train attendant	Train attendant
GoA 4 	Driverless, unattended	Automatic	Automatic	Automatic	Automatic

ATP - Automatic Train Protection ATO - Automatic Train Operation

SINGAPORE: North-East Line & Circle Line

The World's Heaviest and Longest Driverless Metro Lines



Customer: Land Transport Authority (LTA)



System AVAILABILITY
0,998
Less two minutes lost per day



NIS - 2013



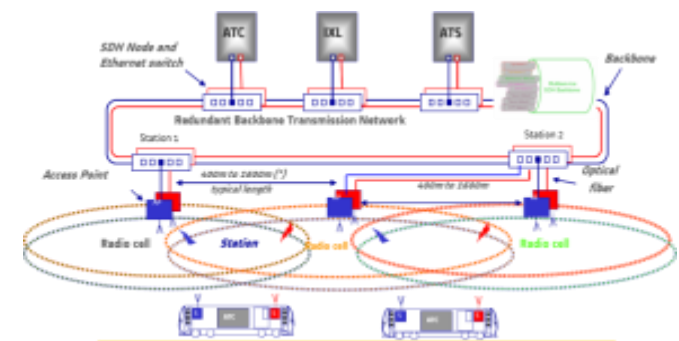
NEL Project: The Heaviest Driverless Metro - Key figures



- Line length: 20 km in tunnel
- 16 stations
- Capacity: 42,000 pphpd*
- 25 6-Car Trains (Metropolis)
- Train length: 138 m
- Train width: 3.21 m
- 300 seats per train
- 1050 Passengers per Train*

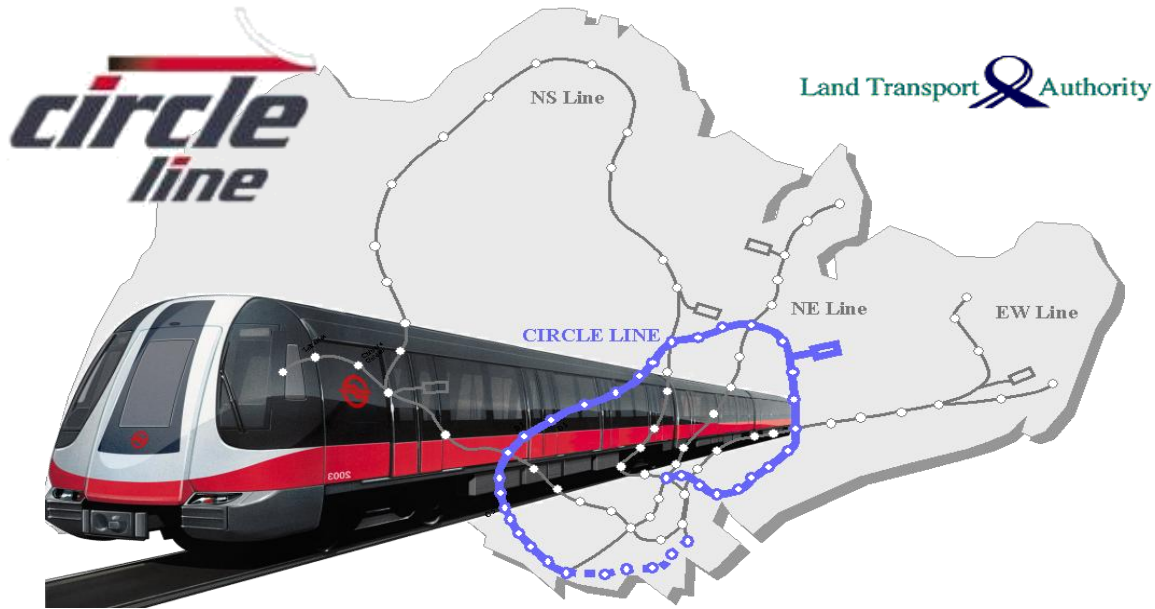
* 4 pas/m²

- Steel Wheel
- AC motors (ONIX Drive)
- OCS (1500 V)
- 90 Seconds Headway
- URBALISTM 300 CBTC
- Full moving block
- Driverless system
- Platform Screen Doors



Revenue Service started in 2003

CCL Project: The Longest Driverless Metro - Key figures



- Line length: 32 km in tunnel
- 28 stations
- Capacity: 26 840 pphpd*
- (40 + 10) x 3-Car trains (Metropolis)
- Train length: 70 m
- Train width: 3.21 m
- 146 seats per train
- 671 Passengers per Train*

* 4 pas/m²

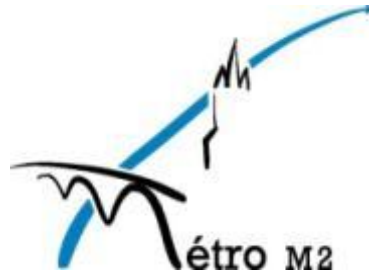
- Steel wheel
- AC motors (ONIX Drive)
- 3rd rail (750 V)
- 90 s headway
- URBALISTM 300 CBTC
- Full moving block
- Driverless system
- Platform Screen Doors



Revenue Service started in 2010

Lausanne M2 Line: The Heaviest Slope Constraints. Key figures:

- Line length : 7,5 km with 12% ramps
 - 14 stations (9 in tunnel)
 - Capacity : 6600 pphpd*
 - 15 2-Car Trains (Rubber tyres)
 - Train length : 30.7 m
 - Train width : 2.45 m
 - 62 seats per train
 - 222 Passengers per Train*
- * 4 pas/m²

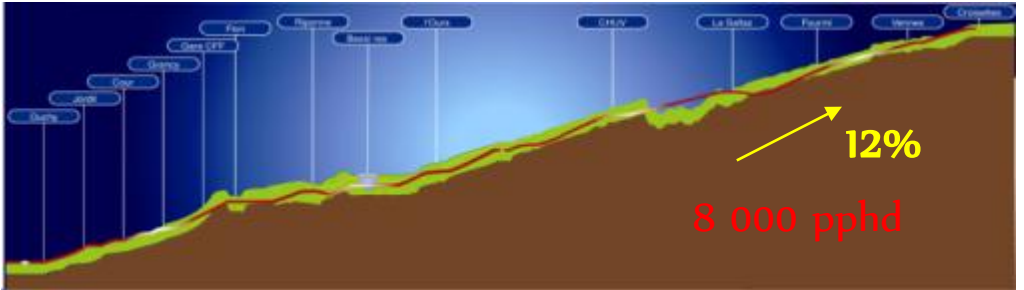


- Tyre Wheel
- Conv. motors (ONIX Driven)
- 3rd Rail (750 V)
- 120 Seconds Headway
- Full Moving Block ATC
- Leaky waveguide Link
- Platform Screen Doors



Revenue Service started in 2008

Alstom provides driverless benefits for all situations



From The Heaviest Driverless Metro

To the Heaviest Slope Constraints

ALSTOM Turnkey solution

proven driverless operation can benefit all passengers and customers

Capex Optimisation

- Smaller stations
- Less rolling stock
- Space saving



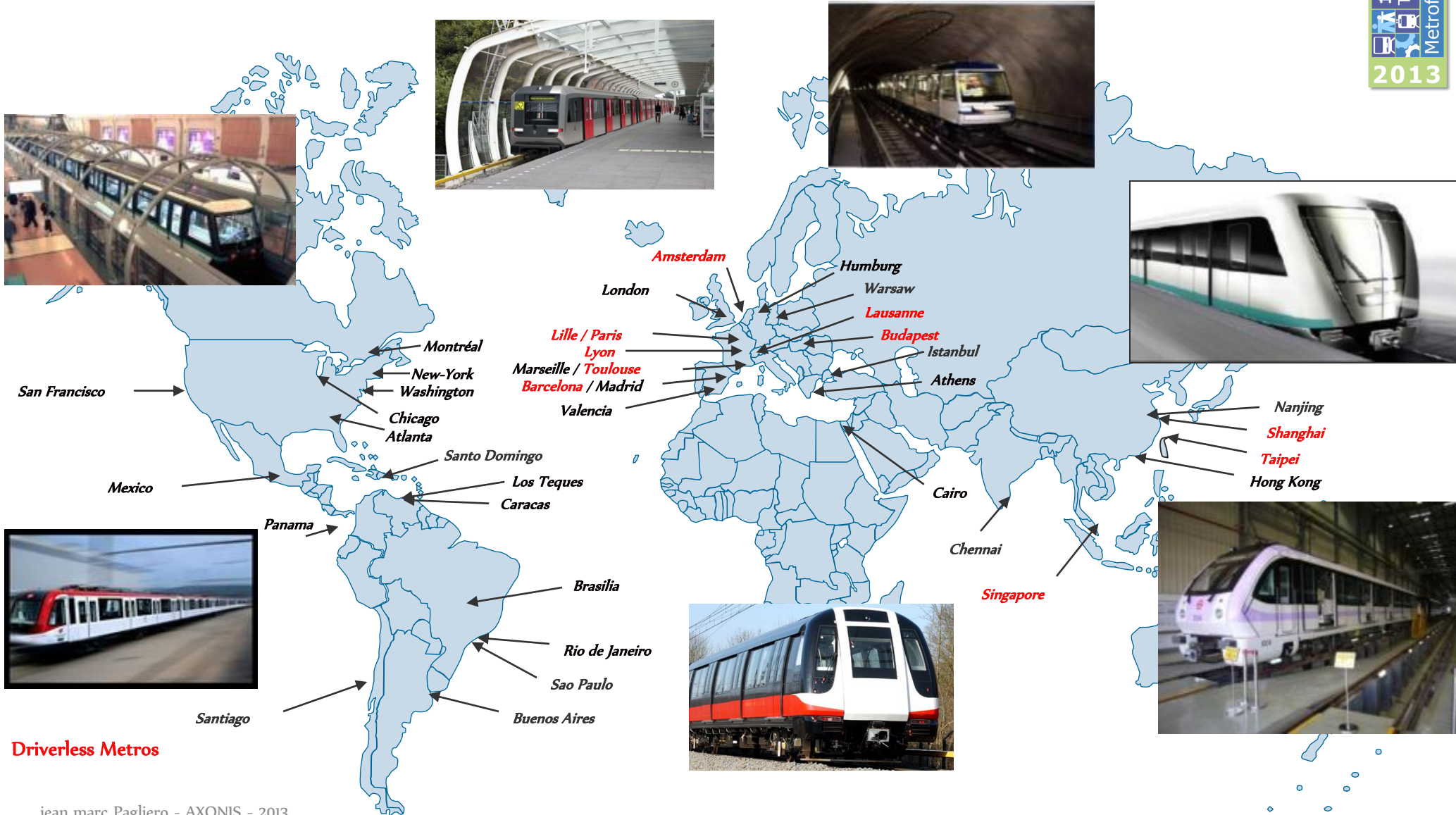
Opex optimisation

- Less energy consumption
- Optimize km/train journey
- Optimized human resources

Main Signalling references in major metros worldwide



Main Rolling Stock references in major metros worldwide



Driverless Metros

Alstom Turnkey worldwide references



Metro project

● Past

● On-going

Alstom PPP references



Arlanda Airport Link

Manchester Metro Line 1

Nottingham LRT Line 2

Rouen Metrobus Line 1

Nîmes-Montpellier High Speed line

Barcelona LRT Ph 1 & 2



Albacete-Alicante HSL Infra

Milan metro Line 5 + Ext

Florence LRT Lines 2&3

Jerusalem LRT Line 1

Reims LRT Line 1



- Participation sold
- In operation
- In construction
- Awarded to us



AXONIS

TRANSPORT

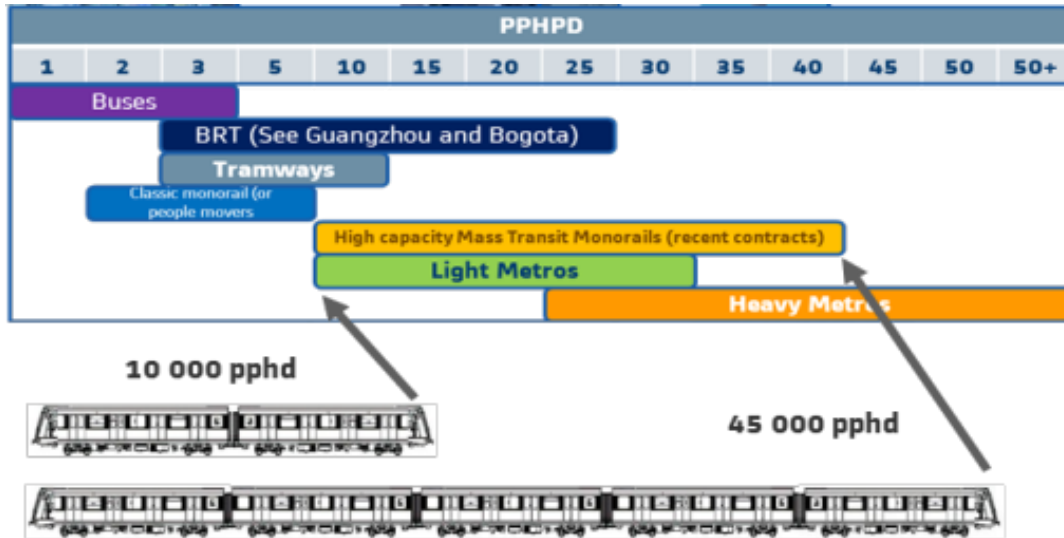
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Introduction

AXONIS is a **driveless metro system** to meet the specific transport needs of fast-growing and densely-populated cities that are seeking **quick construction, easy urban insertion** and **improved life-cycle cost**.



General description



➤ **Modularity to save fixed cost and risk**



➤ **Full Integrated system to save cost and time**

AXONIS is a **non-proprietary turnkey** metro system designed to carry between 10,000 and 45,000 passengers per hour per direction and to operate with sections on elevated viaduct, at grade level and in underground tunnels.



AXONIS CUSTOMER BENEFITS

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5 basic benefits

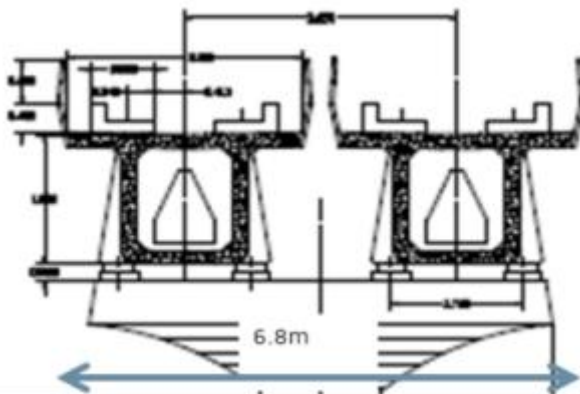
- ✓ **Elegant & Easy to insert in Cities**
- ✓ **Fast to design, build , integrate**
- ✓ **Economical to acquire and operate**
- ✓ **Available & non-proprietary**
- ✓ **Safe & Secure**



Elegant & Easy to insert in your city

AXONIS is conceived to **integrate easily** into the city, providing **effective mass-transit mobility**.

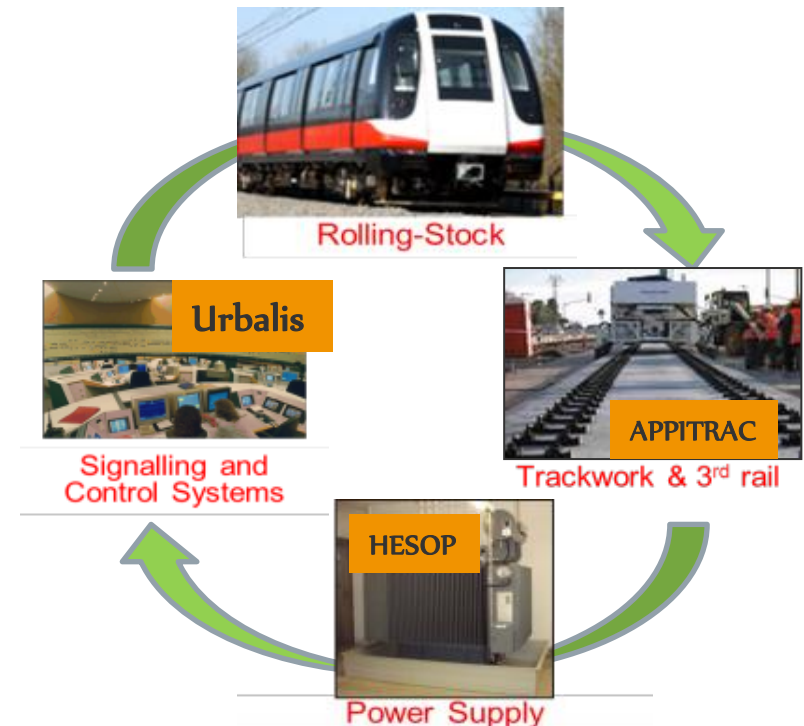
- Capacity of **10,000** to **45,000** passengers per hour per direction
- 2-car to 5-car trains
- Ability to operate on **45-m** radius curves and **6%** ramps
- System composed on sections on viaduct, at street level, or in tunnels
- Light and narrow viaducts: less than **7 meters** in width thanks to frontal evacuation system
- Minimized visual presence with 750V_{DC} 3rd rail
- Tailor-made to each city's architecture thanks to Alstom Design&Styling expertise



Fast to design, build, integrate

AXONIS reduces construction time considerably versus traditional systems – **3 to 4 years** from order to entry into service.

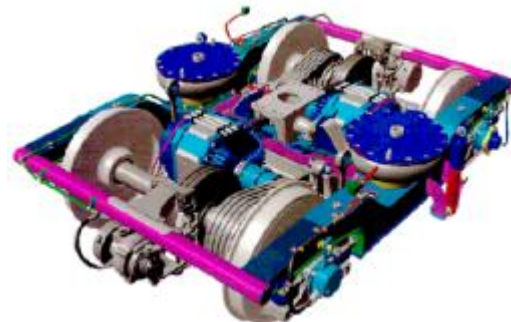
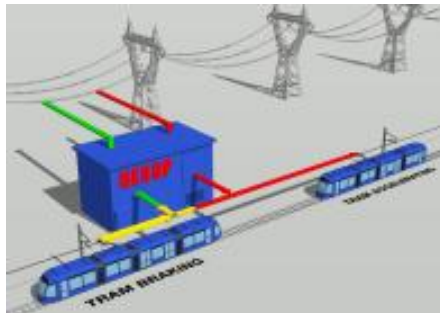
- Standard Driverless Operation mode
- Fully integrated System: track, power supply, signalling, PSD and trains
- Modular viaduct: manoeuvrable precast modules for easy transportation and swift construction
- Alstom's APPITRACK fast track-laying technology



Economical to acquire and to operate

AXONIS is designed to **lower CAPEX** and **OPEX** , with a **global system approach** to provide **high performances** for **optimised cost** .

- Less development cost thanks to system **standardisation**
- Less civil works cost and city **footprint** impact thanks to viaduct and station optimisation
- Optimised **depot and maintenance** thanks to vehicle architecture
- Less operation cost thanks to **driverless operation**
- Lower maintenance costs thanks to steel wheels & **100%** motorisation
- **30-40%** Lower traction energy consumption thanks to HESOP sub-station, motorisation and Eco-driving



Available & Non-proprietary system

AXONIS uses **standard guiding system**: steel track gauge 1435 mm (UIC)

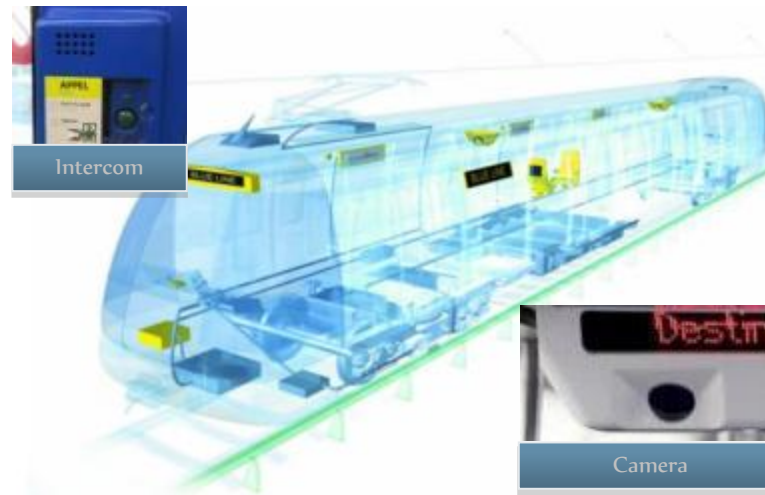
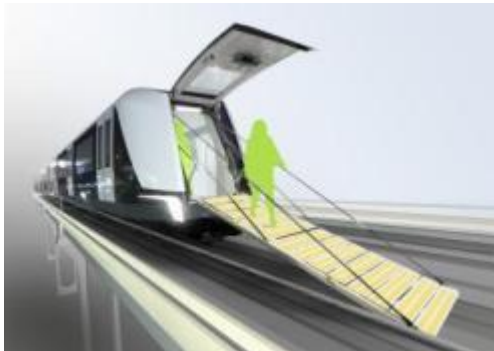
- Standard point machine and driverless operation for **99.7%** system availability
- Standard track system for easy **fleet or line extension**



Safe and Secure

AXONIS benefits from **all of Alstom's metro integration expertise** acquired worldwide, **over 50 years.**

- URBALIS Signalling system, chosen for more than **50 metro** lines worldwide (URBALIS CBTC Driverless: **11 metro** lines)
- Convenient **front-end** emergency exit door
- Possibility to use the track without sleepers for **easier passengers evacuation**
- Platform Screen Doors in station for complete passengers **safety**
- Stations and vehicles equipped with video surveillance to improve passengers **security**



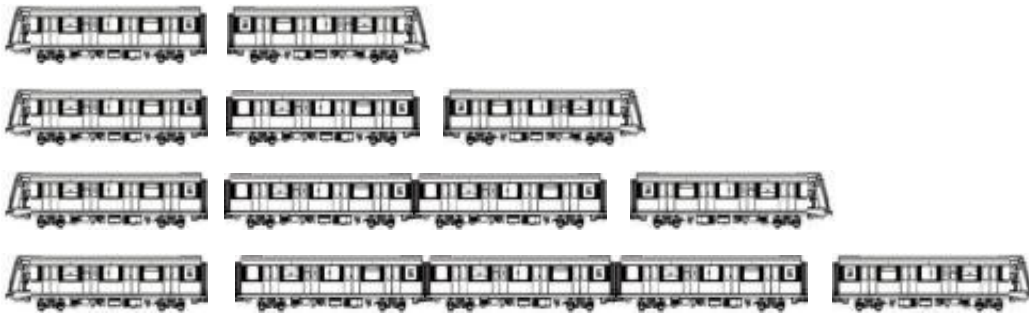


INSIDE THE AXONIS SYSTEM

Technical Focus

AXONIS: Flexible Train Configuration - Smart Metropolis

2 to 5 cars, steel wheels, 100% motorised



- Easier Transport capacity evolution
- Improved commercial speed
- Energy saving, full electrical braking, no resistor
- Reduced Maintenance costs
- 6% ramp, including recovery mode
- Reduced development and integration

- Driverless
- Steel wheels gauge 1435 standard
- 750 V_{DC} traction
- Car 2,71 * 18m
- 100% motorised
- Aluminium car body

- Severe environment (Brazil, India, MENA)
- Frontal or lateral evacuation
- Capacity about 200 pas/car at 6 pas/m²
- 3 door 1,5m large per car
- slope 6%, curve 45 m

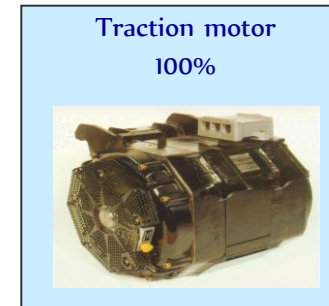
AXONIS: system optimisation transversal function 1/2

Traction Energy Saving : up to 40% & reduced maintenance

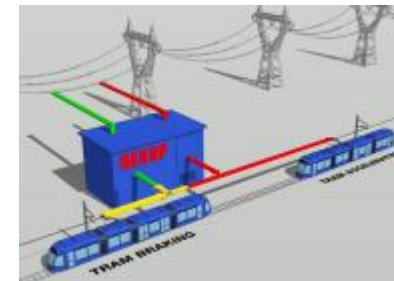
Steel wheels vs. rubber tyres:
Running resistance improved by 20/25 % *



100% motorised trains improve electrical braking 15% *



HESOP inverter substations improve braking energy reused by
18%

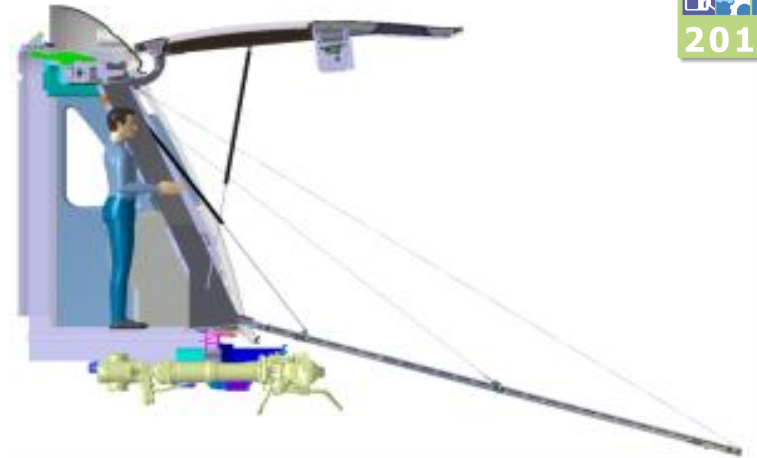


* UITP report 1997

AXONIS : system optimisation transversal function 2/2

Footprint and CW optimization

- ✓ Driverless: no driving cabin
- ✓ Trains equipped with frontal doors
- ✓ Track built using APPITRACK without sleepers



Providing wide, safe & free walkway

Savings :

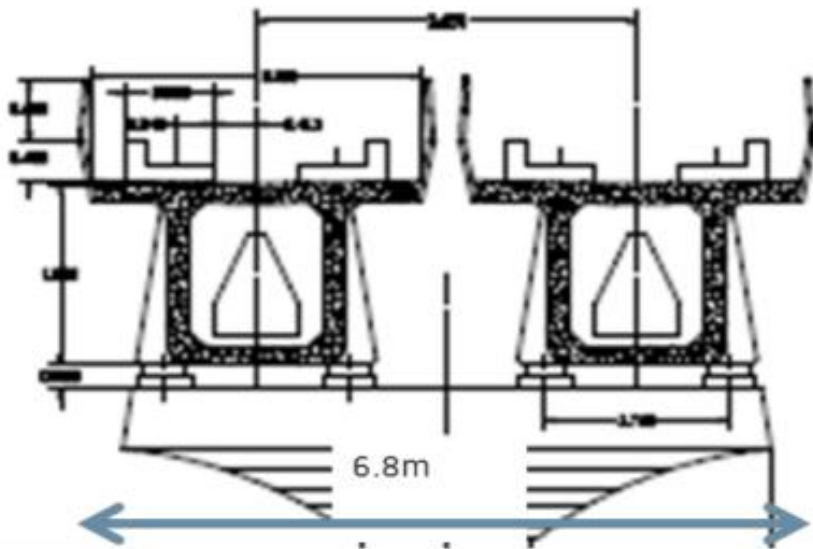
- ✓ Viaduct about 1,2m up to 1,8 m large (20-25%)
- ✓ Tunnels about 0,7m up to 1,2 m large



The viaduct and the infrastructure

To accelerate construction and reduce footprint

- Modular and standard viaduct, fast installation process : one **30-meter** long beam per day
- Designed for local precasting with **local civil works partner**
- Modules easily **transportable** into the city on road vehicles
- Standard-gauge track built with the proven **APPITRACK** precision track-laying technology



Rolling Stock and System Capacity

AXONIS
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	Intermediate car	End car
seats	32	25
Total AW2 (4p/m ²)	146	141
Total AW3 (6p/m ²)	203	200

TRAIN CONFIG	2 cars	3 cars	4 cars	5 cars
Seats	50	82	114	146
AW2 @ 4pass/m ²	282	427	572	717
ratio seat/stand	18%	19%	20%	20%
AW3 @ 6 pass/m ²	400	603	806	1009
Train lenght	36m	54m	72m	90m

CAPACITY (pphpd)	10000	15000	20000	25000	30000	40000	45000
loading criteria	4 pax/m ²	6 pax/m ²	6 pax/m ²	6 pax/m ²	6 pax/m ²	6 pax/m ²	6 pax/m ²
nb Car	2	2	3	3	4	5	5
train capacity	282	400	603	603	806	1009	1009
train headway	101	96	109	87	97	91	81

Synthesis

AXONIS: the quick-to-build, easy-to-own light Metro System

✓ Smaller footprint

- Smaller station
- Smaller trace in the city

✓ Flexible and Safe used

- Compatible with viaduct, at grade, and tunnel operation
- Frontal or lateral passengers evacuation

✓ Open System

- For line extension
- For capacity extension

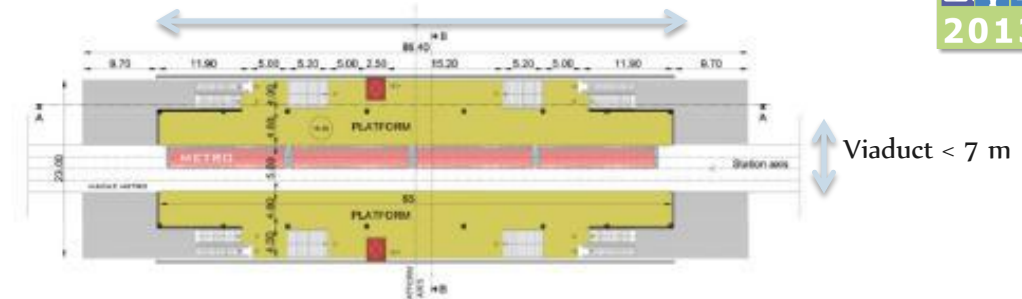
✓ OPEX reduced

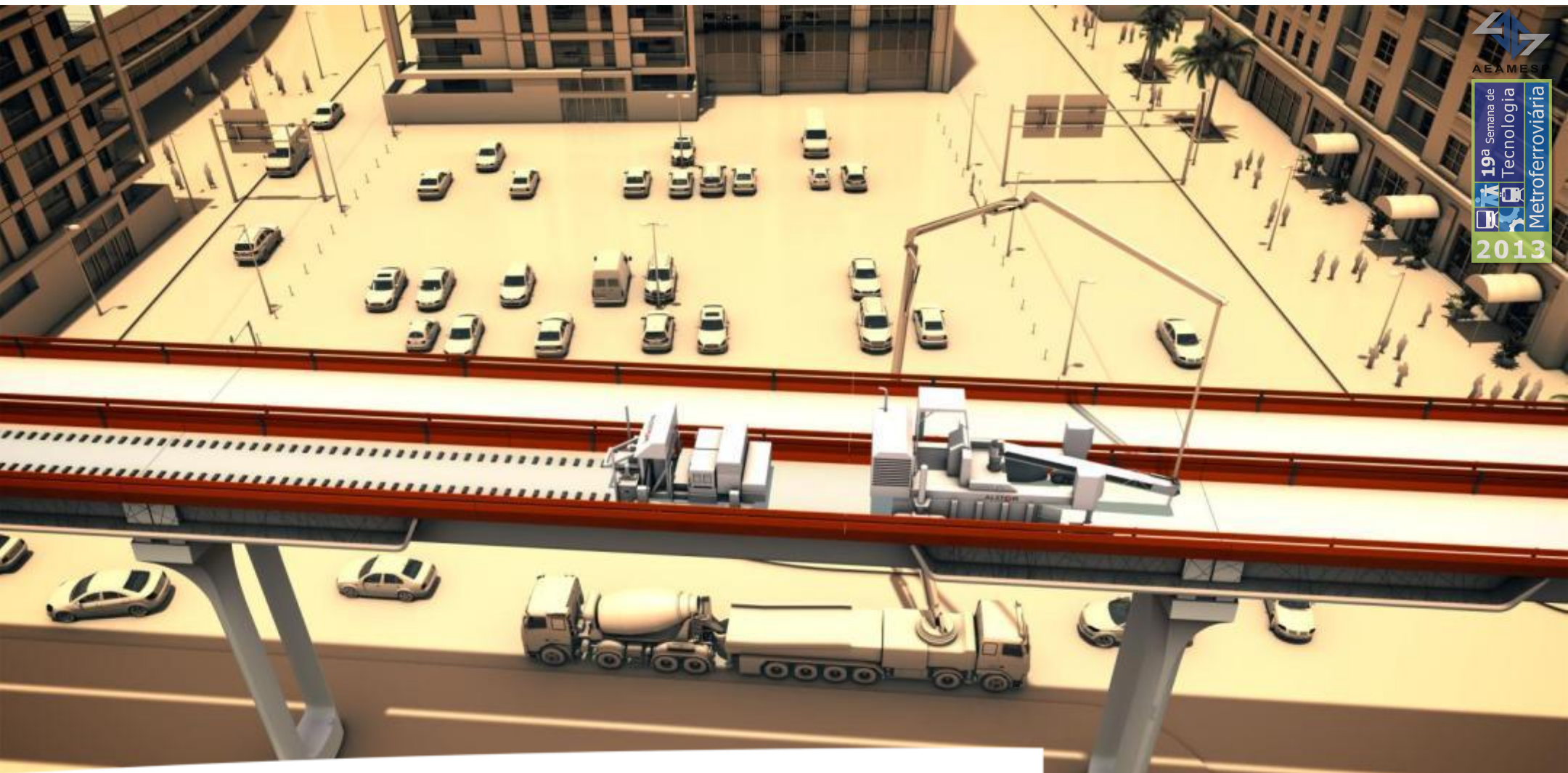
- Energy consumption
- Maintenance

✓ Full proven system performances

- **6%** Slope, **45-m** curve, capacity, availability of **99.7%**

85m for 40 000 at 6p/m²





AXONIS film



THANK YOU
FOR YOUR ATTENTION

TRANSPORT

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