

Alstom Transport @ MIIT Urban Transport

December 2, 2014

Jan C. Harder

Vice President Business Development CIS







Citadis tramway

Citadis : a track record proven in long-term service



Over 1800 Citadis LRVs sold to 46 cities

Large number of references



- **1 in 4** low-floor trams in service in the world is manufactured by Alstom

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(3)

- 99% of the catenary less mileage run worldwide has been run by Citadis

Proven track record

6 billion passengers transported over 2.7 million / day

Extensive coverage



500 million km run with Citadis fleet







Citadis X05 – The latest evolution of Citadis tram range

Latest technical advances that take into account further tram market needs

${\rm \circ}$ Improvement of passenger comfort :

- o Easier movement within the tram
- Better visibility inside and outside the tram
- Optimisation of tram operation including :
 - o Better passenger flow for tram entry / exit
 - Shorter tram stops at stations

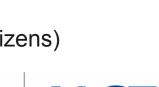
\circ Expansion of tram network (to the suburbs) :

• Higher tram max. speed and longer inter-station distances

\circ Answers to existing tram networks :

- More tram configurations with increased modularity
- Bogie solution for new and old networks

Benefits from return on experience and regular product evolutions
 (for passengers, drivers, operators, maintainers, city officials, investors, citizens)







Citadis X05 – Product benefits





Citadis X05 latest features

Better passenger & driver experience	 Larger central aisle : up to 750 mm & wider gangways Double doors all along the vehicle (also possible as option for front doors) Transparency /luminosity improved with panoramic windows & upgraded LED lighting New driver cab with improved ergonomics & comfort
More flexibility to adapt to different client networks	 Speed : up to 80 km/h Solution including bogies adapted to new and old tracks Choice of lengths ranging from 24 to 44 m long trams Multiple units (for 20m, 30m & 40 m) Extendability 20m to 30m, 30m to 40m in customer depot
Lower Opex	 18% reduction of preventive maintenance costs based on Citadis REX and technical innovation Reduced energy consumption by 4% thanks to permanent magnet motors Citadis - proven reliability on all continents
Catenary-free options	 APS Eco-mode & Citadis Ecopack (on-board autonomy) TRANSPORT

Improved passenger flow and accessibility



Wider central aisle

Up to 750 mm = + 25% increase

For all configurations

Wider gangways

Width : 1360 mm Height : 2050 mm



Depending on tram diagram

Front double doors (behind cab)



Fluidity for passengers

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Large cab (front end) offering



Standard front end enabling wider range of tram design & styling





Large cab (front end) offering : standard, partially adapted or specific

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Optimised operation with Citadis X05



Permanent magnet motor (PMM) Improved traction efficiency leading to reduced energy consumption (approx. 4 % energy saving)



Return on experience of Alstom as a maintainer

18% savings on preventive maintenance costs



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Low operating costs

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VIDEO Valenciennes





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Citadis X05 – Product flexibility (car modules)



Motor cars







With front double door

With front single door

Width : 2.40 / 2.65 m

Suspended cars



 $Short-2\ double\ doors \quad Short-1\ double\ door$





Long – 2 double doors (305 & 2.40 m width only)

Trailer cars

With pantograph

Without pantograph



Citadis X05 - Multiple configurations for the right capacity





2 standard widths still available : 2.4 m and 2.65 m
Bi-directional or uni-directional diagrams
Multiple units possible for all configurations (205*205, 305*305, 405*405)

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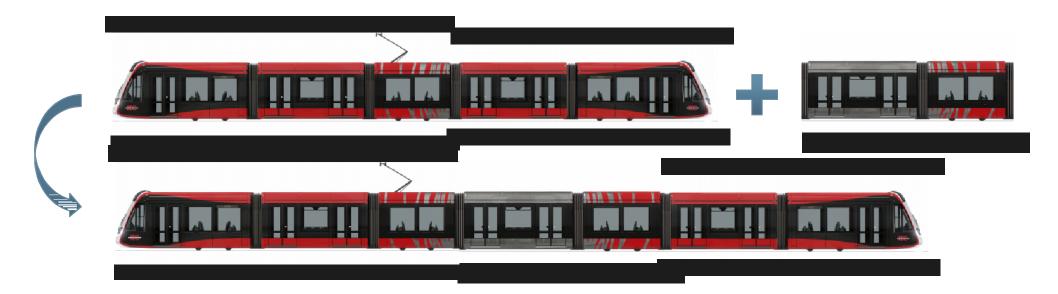


Citadis X05 - Tram extendability



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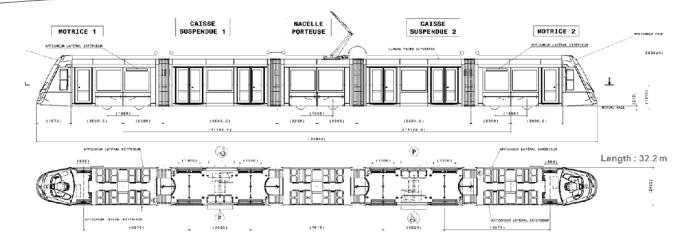
- Citadis 205 extendable to Citadis 305 in customer's depot to increase passenger capacity
- Citadis 305 extendable to Citadis 405



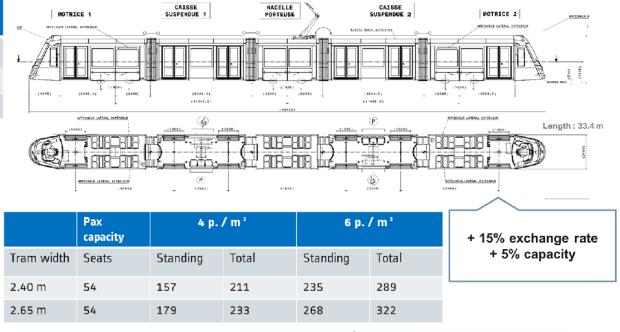
 Already successfully implemented on Citadis in Montpellier, Dublin, Bordeaux and Nice

Diagram & capacity Citadis 305 with front single doors vs. double doors





	Pax capacity	4 p. / m²		6 p. ,	/ m ²
Tram width	Seats	Standing	Total	Standing	Total
2.40 m	54	146	200	219	273
2.65 m	54	167	221	250	304



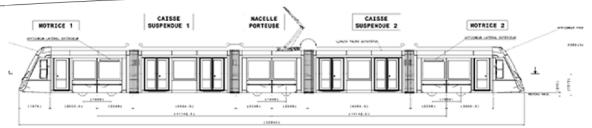
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Common factors for all Citadis X05 diagrams





Tram width	2.40 m & 2.65 m
Tram height	3,300 mm (except pantograph)
Track gauge	1,435 mm
Access height	Intermediate doors : 326 mm Front doors : 342 mm
Passenger door width	Double doors : 1,300 mm Single doors : 800 mm
Saloon height	2,180 mm 2,050 mm above bogies



Current collection height	Without APS : min : 3.61 m - max: 6.44 m With APS : min: 3.80 m - max: 6.63 m
Min horizontal radius curve (line)	25 m
Min horizontal radius curve (depot)	1 8 m
Min vertical radius (crest - up)	350 m (700 m with APS)
Min vertical radius (sag - down)	350 m
Max axle loads	< 10 t (4 p/m2) # 11 t (6 p/m2) # 12 t (6p/m2) with Ecopack

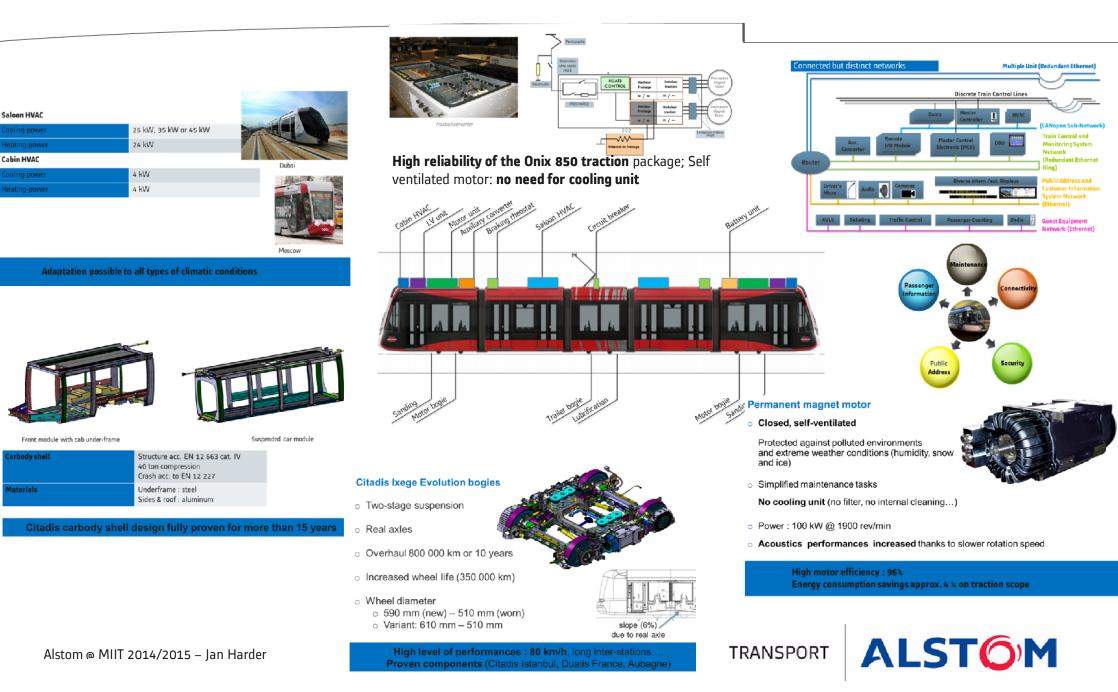


Traction performances (750 Vdc version)		
Maximum speed	Up to 80 km/h	
Line voltage	750 Vdc (600 Vdc as an option)	

Maximum acceleration	1.3 m/s²
0 to 40 km/h mean acceleration	1.1 m/s²
0 to 60 km/h mean acceleration	0.9 m/s²
0 to 70 km/h mean acceleration	0.8 m/s²
Residual acceleration at 70 km/h	0.25 m/s²
Maximum line gradient	8%
Maximum jerk	1.5 m/s³
Braking performances	
Service braking	1.2 m/s²
Emergency braking	2.8 m/s²

Citadis X05 - Lay-out (sub-systems)





Citadis X05 - Maintainability



- Easy accessibility to micro-switches and relays 0
- Maintenance steps occurring at a later stage Full Maintenance Full Maintenance Full System Maintenance (leading to lower life cycle cost) 2004, 26 Citadis 302 & 14 Citadis 401 15 BT trams 19 Citadie 202 (20 2008, 26 Citadis 401 (6years) 22 Citadis 302 (23 years) Daily maintenance checks optimized echnical Maintenance 27 Citadis 302 (8 years) 2011 - Ierusalem Full System Maintenance Wheel potential increased 46 Citadis 302 (27 years) 004 - Barcelona 2014 – Lusail between 350,000 and 400,000 km 41Citadis 302 (25 years) Full System Maintenance - Al Safouh (depending on track quality and mission profile) Full System Maintenance 11 Citadis 402 (5 years) Full System Maintenance Previous 30 Citadis 302 (10 years) X05 maintenance maintenance 2011 - Alger Full System Maintenance steps steps 55 Citadis 302 (5 years) 41 Citadis 402 (10 years) 15,000 km 25,000 km (*) 2013 - Constantine Full System Maintenance 1 out of 4 Citadis trams is 30.000 km 45.000 km 27 Citadis 402 (10 years) directly maintained by Alstom 60.000 km 75.000 km

18 % cost reduction in **preventive maintenance** leading to an improvement of 11% in total maintenance costs

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400,000 km

15 years

800,000 km (**)

0

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300,000 km

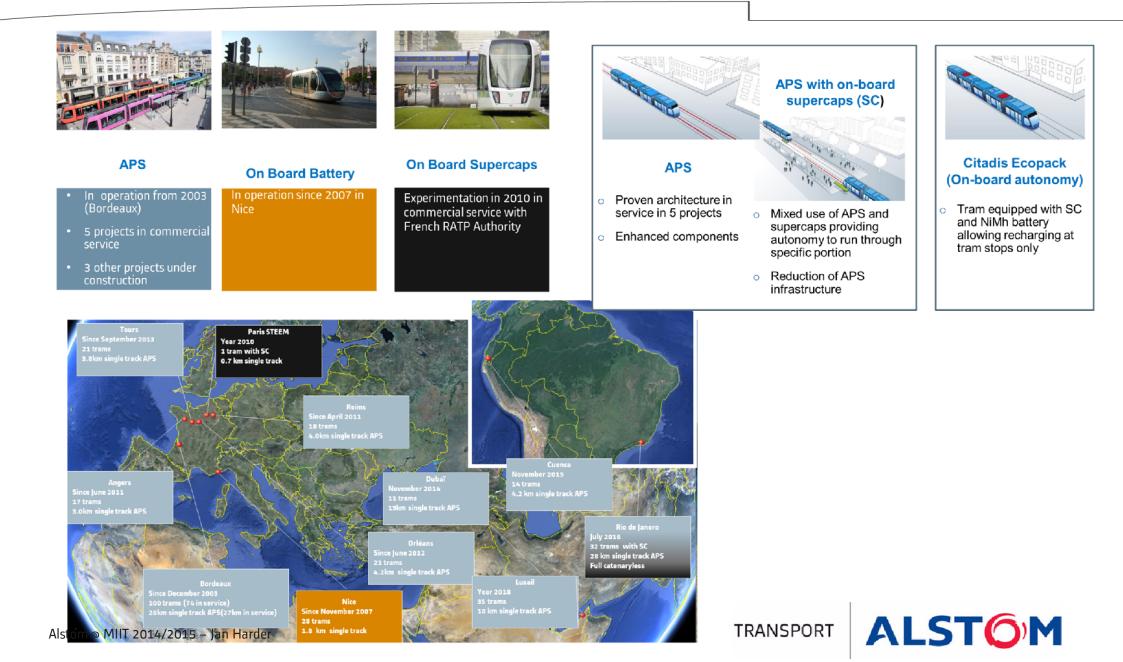
600,000 km

15 years



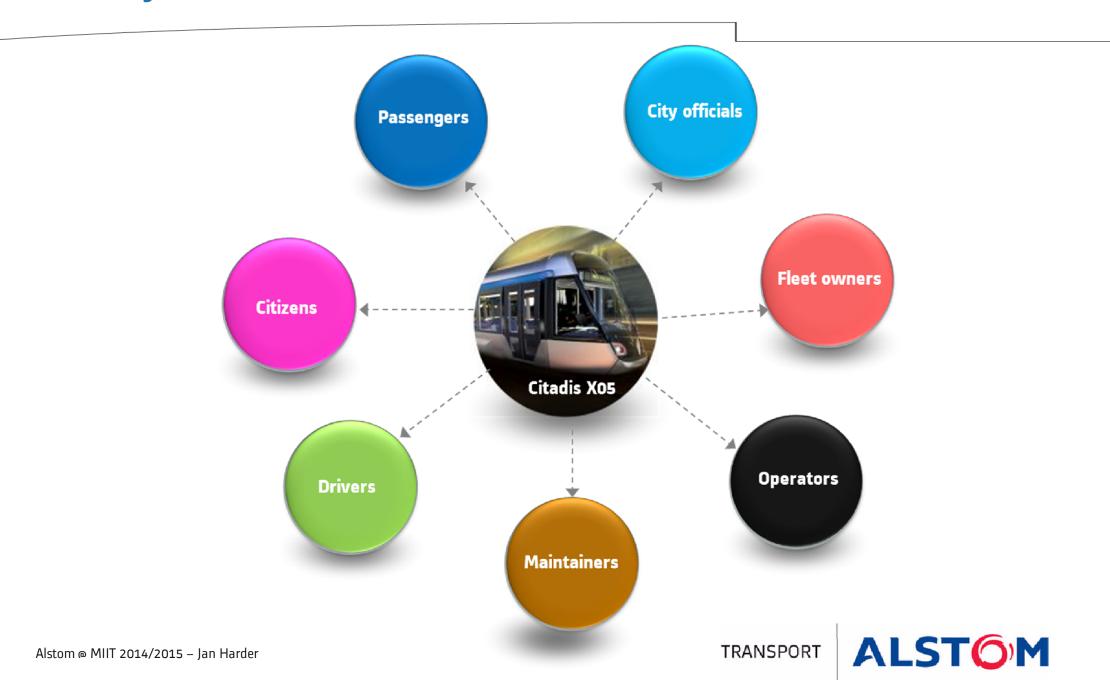
Citadis – Extensive catenary-free solutions





Citadis X05 – Benefits for all stake-holders What s your view?



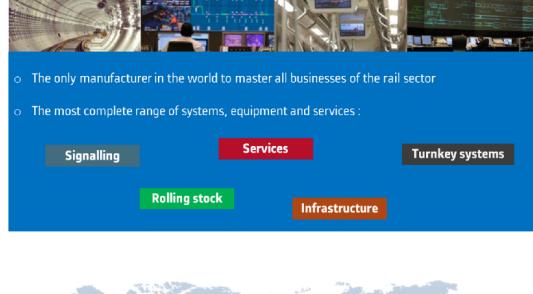




Citadis tramways turn key

Alstom: the only railway multi-specialist









o A turnkey approach ensures :

- Definition of the best choice of transport mode and Alstom system level during engineering phase
- o Strict budget control and respect for delivery deadlines
- Performance-based system integration and testing phase
- Smooth commissioning phase = faster entry into passenger service

Worldwide n°1 in full turnkey tramway

- **Tramway**: more than **25** cities equipped with turnkey solutions
- Metro: more than **25** cities equipped with turnkeys solutions
- o More than 2 000 km of single-track laid
- 3 000 km of line electrified
- **15%** of the total number of projects in concession

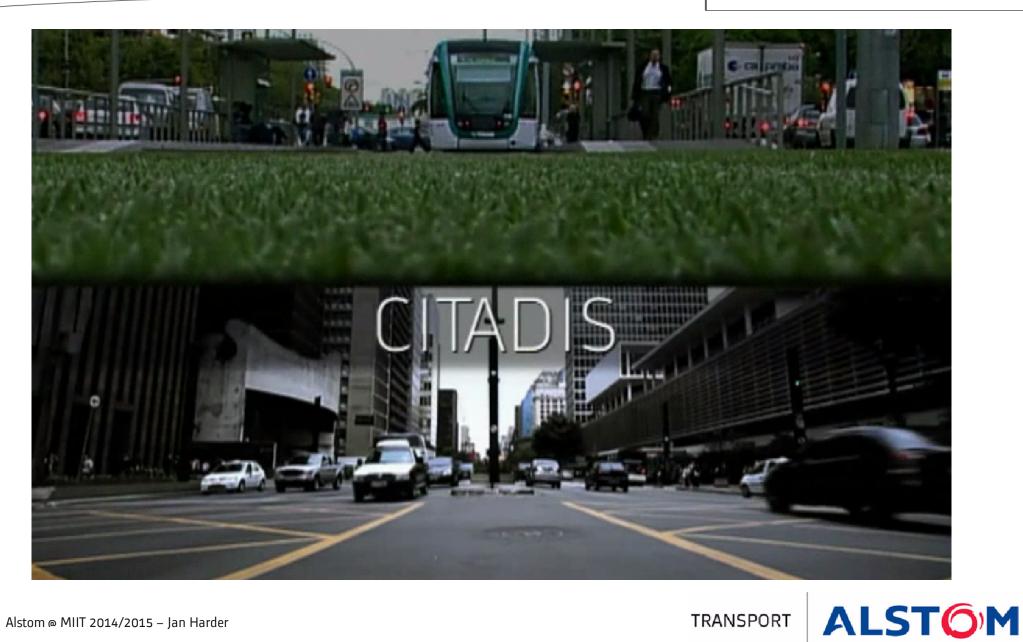
20 years experience in turnkey projects

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Other key Citadis references

Alstom Citadis references



Dubai (UAE) : the single 100% catenary-less tram line

Customer: RTA Order: 11 CITADIS - 44m Delivery: 2013-2014 Vehicle: bi-directional

- o Turnkey project
- Air conditioning reinforced
- Track works with Appitrack
- o Power supply with APS



Dublin (Eire) : extension from 30 m to 40 m

Customer: RPA Orders: 66 CITADIS - 40m Delivery: since 2004 Vehicle: bi-directional

 Full system maintenance right from the beginning



Alstom Citadis references



Nice (France) : battery system + extension from 30 m to 40 m

Customer: CANCA Order: 28 CITADIS – 30 & 40 m Delivery: since 2004 Vehicle: uni-directional

- Autonomous battery power supply solution
- o Spare parts availability contract



Rotterdam (the Netherlands) : largest fleet

- Customer: RET Order: 113 CITADIS -30m Delivery: since 2003 Vehicle: uni-directional
- Bogies with double

stage suspension



Alstom Citadis references



Istanbul (Turkey)

Customer: Ulasim Order: 37 CITADIS – 28 m Delivery: 2008 Vehicle: Bi-directional

With pivoting bogiesMultiple unit operation



Bordeaux (France) : 1rst with APS

Customer:	CUB
Order:	96 CITADIS - 30m
	& 40 m
Delivery:	since 2003
Vehicle:	Bi-directional

APS (ground power supply)



Aubagne - Citadis Compact An amazing design & styling : from dream... to reality







- Base contract : 8 trams + Options up to 10 trams
- Contract award : October 2011
- Contract signature : January 2012
- Design unveiled : June 2013
- 1rst tram delivery : February 2014
- Service start : 30 August 2014



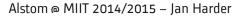












Alstom's Metropolis







Innovation, Innovation, Innovation





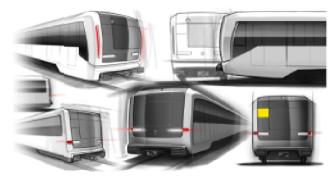
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Alstom Product Drivers



- Metro innovation to satisfy specific customers' needs
- Range of metro solutions covering whole market
- Proven Car Technology
- Design & Styling internal capabilities
- High level of comfort for passengers
- Driverless expertise
- Efficient and sustainable mobility
- Full turnkey metro system expertise

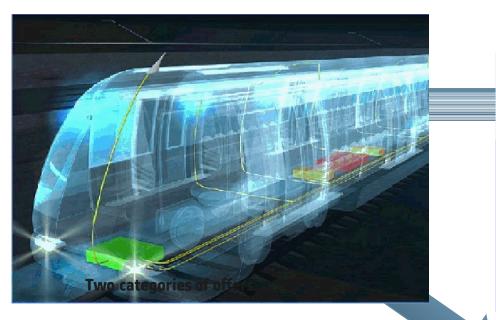




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Alstom metro portfolio





MODULAR PRODUCT

A fine blend between standardisation & customisation



SPECIFIC PRODUCTS

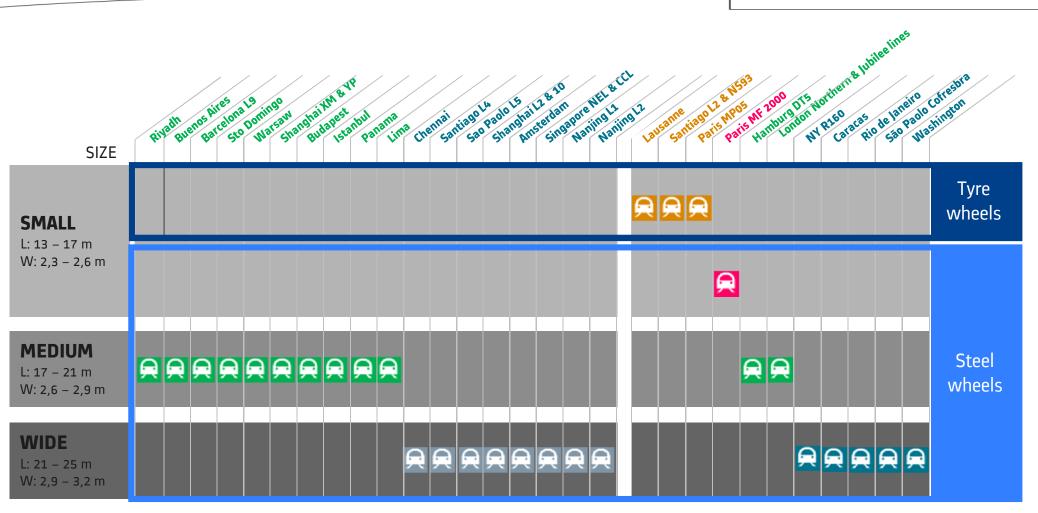
To meet the specific needs for large quantities

Standard components anyway



A metro train solution for every type of requirement

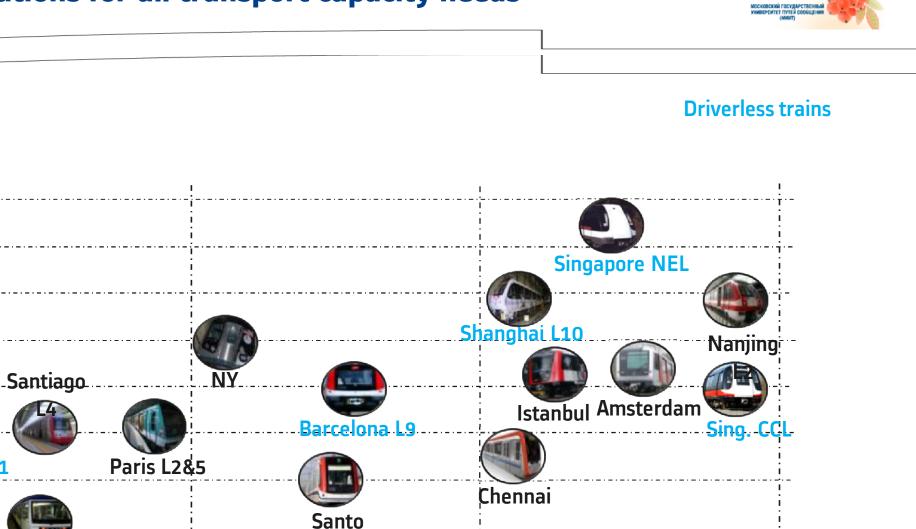




METROPOLIS STANDARD

TAILOR MADE

Metro solutions for all transport capacity needs



*PPHPD: Passenger Per Hour Per Direction with 6p/m² and 90s headway

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Lausanne M2

Small

Paris Line 1

Capacity

In PPHPD*

70000

50000

30000

10000

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Wide

ALSTOM

Metro

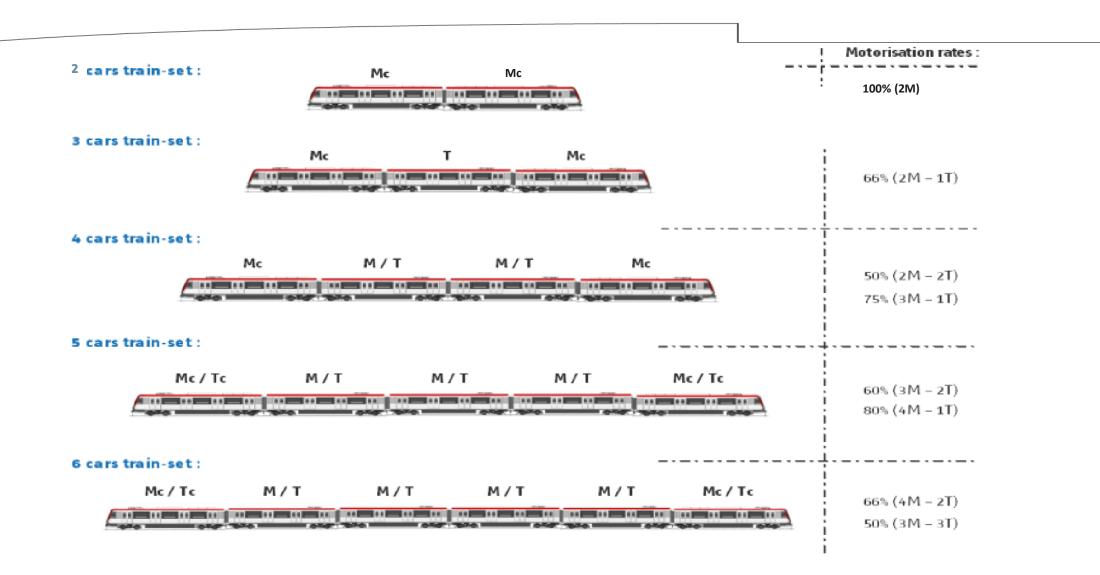
Gauges

Domingo L1&2

Medium

Large range of configurations





Customizable: from 2-cars to x-cars trainset

Flexible: extend train size during life time (ex: Chennai, Lima, Panama...)

High Level of Reliability, Availability, Maintainability and Safety

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- Design Proven components : Traction, Bogies, Motors, Brakes, Doors, Couplers, Air Conditioning (HVAC), TCMS ,Auxiliaries, Crash cellule

• Car length **2** Car width

4 Axle load

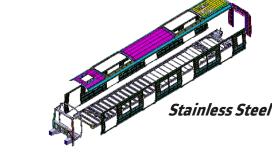
3 # doors per side

- Flexibility : Train Configuration, Carbody Shell, Interiors, Passengers Communication....

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- Customisation : Front end, External & Internal Design ...

Metropolis Concept





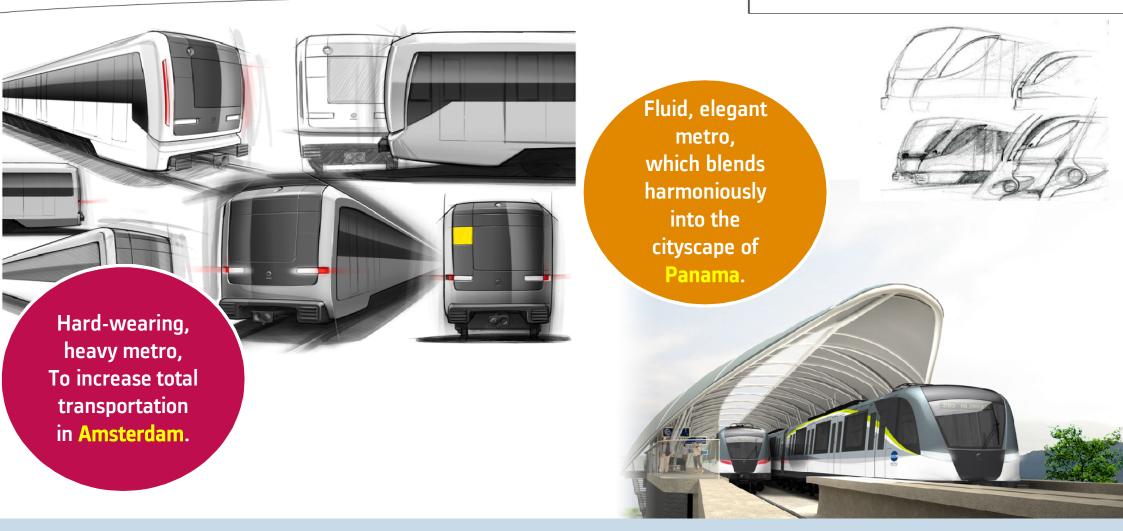
Aluminium





Shape your metro to become the city's icon





Our In-house Design & Styling: a service to reflect the identity of your city



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Delight your passenger with comfort







•



- Emotional Engineering approach:
 - Lighting ambiance
 - >Thermal comfort
 - >Air quality
 - >Vibratory comfort
 - >Acoustic comfort
 - >Real-time passenger information & entertainment
 - >Designer color schemes

Passenger flow optimized through:

- > Large doors evenly spaced along the train
- > Wide gangways
- > Flexible seating configurations
- Dedicated space for persons with reduced mobility

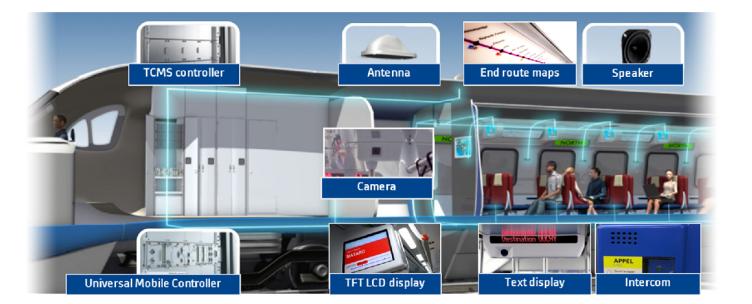
The right blend of interior elements



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Heighten your passenger security





- Fire barriers

- Fire & smoke detectors

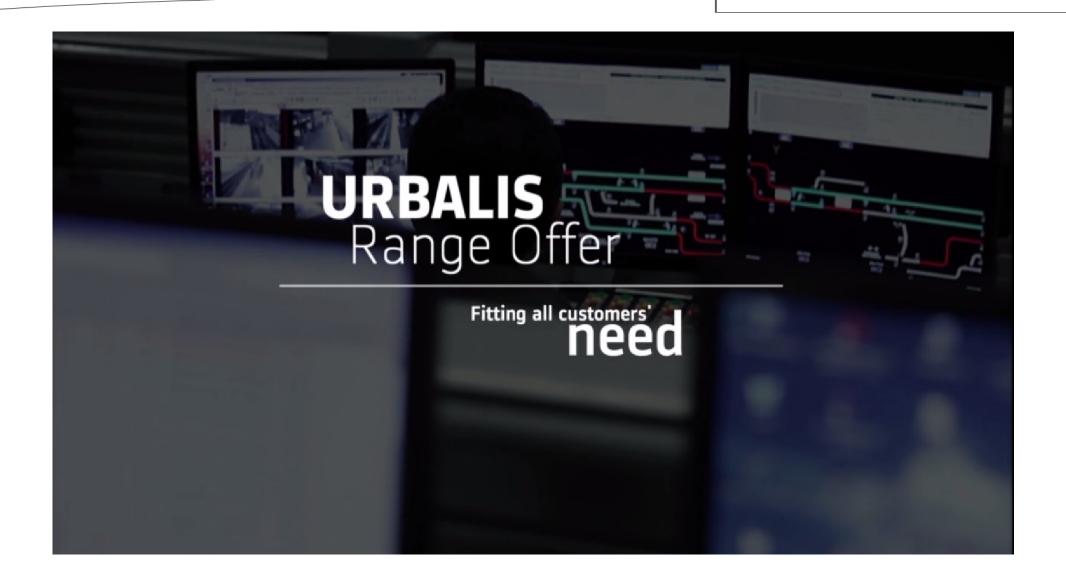
- CCTV, intercoms

- Frontal evacuation doors









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Extensive driverless experience, on all types of metro trains

• Full driverless (GoA4) expertise

- Singapore North East Line, 1999 => World's first heavy steel driverless metro
- Lausanne M2, 2008 => World's first driverless metro running on a 12% slope
- Singapore Circle Line, 2000 => Singapore, world's longest underground network in UTO

Shanghai L10

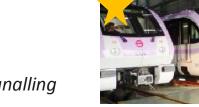
• Driverless ready solutions (removable driver cab)

- Shanghai Line 10, 2007 => First heavy driverless system in China
- Amsterdam M6, 2010 => Lower energy consumption

• Compliant with other supplier's signaling system

- Barcelona Line 9
- Paris Line 14 & 1
- Budapest Line 4

kith Alstom UrbalisTM CBTC signalling Alstom @ MIIT 2014/2015 – Jan Harder















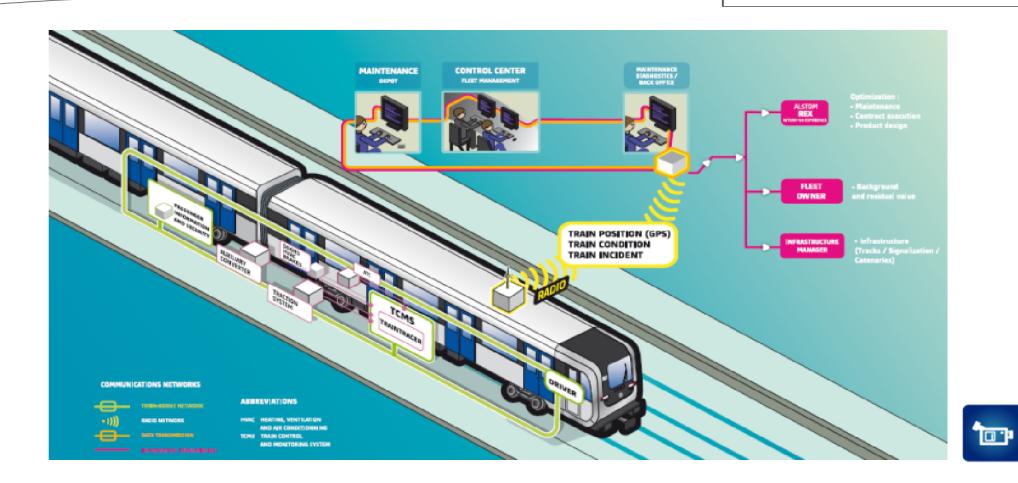






Monitor fleet condition in real-time through TrainTracerTM





Close the gap between your maintenance and operating teams

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Innovative solutions for an efficient and sustainable mobility



Sao Paulo 90% Traction energy

reused

Amsterdam

100%

Electrical braking

Riyadh 15% Energy Savings

To reduce energy consumption:

- Full electrical braking
- Weight reduction
- HVAC optimization, LED, lighting management
- Use of HESOP regenerative sub-stations (system)
- Driverless metros

To improve environmental friendliness:

- Reduced noise nuisance both inside and outside (-2 to -6dB)
- Easily accessible to PMR and smooth internal mobility
- Up to 96% of recyclability
- Water-soluble paints for easy maintenance
- REACH compliance





Eco-design policy inside Alstom



Alstom can provide full turnkey solutions to optimize system performance and life cycle





MAINTENANCE

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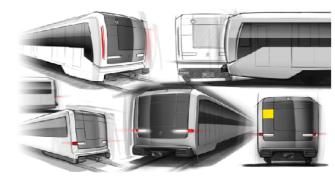
TRANSPORT

Why to consult Alstom for metro train fleet acquisition

- Metro innovation to satisfy specific customers' needs
- Range of metro solutions covering whole market
- Proven Car Technology
- Driverless functionality/ Metro with provision for driverless
- Design & Styling
- Full turnkey metro system expertise











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Alstom: one out of four metro cars operated today in the world

More than 50 cities operate Alstom metros

> More than 4000 "Metropolis" metro cars in service





Lausanne M2 (Switzerland)

- > Line length: 6 km
- > Nb. of stations: 14
- > Train length: 30.68 m
- > Car width: 2.45 m
- > Capacity (6PAX/m2): 315 pass
- > Power supply: 3rd rail/750Vdc
- > Max speed: 60km/h in straight line (47 km/h in slope 12%)
- >Traction: asynchronous type
- >Carbody: aluminium
- >Air conditioning: 13KW

12% slope, a world wide record !



- > Rolling stock
- > CBTC system
- Passenger information and security
- > Track work and power supply
- > Full maintenance



Customer: Lausanne Transport Authority Order: 15 x 2-car-trains Revenue service: 2008 Vehicle: Tailor-made, small gauge, driverless, rubber tired

Barcelona line 9 (Spain)

- > Line length: 46.6 km
- > Train length: 86.094 m
- > Car width: 2.71 m
- > Capacity(6PAX/m2): 967 pass
- >Power supply: catenary / 1500Vdc
- >Max speed: 80km/h
- >Traction: asynchronous type
- > Carbody: aluminium welded
- > Air conditionning: 35 kw per car
- > Doors: external sliding plug (4 par faces)

Fully automatic metro line 99% of availability

Alstom's Scope

- > Rolling stock
- > CBTC system
- > CCTV security
- > Disabled travelers seats
- > Bicycle spaces
- > Full maintenance in partnership with Barcelona metro



Customer: TMB Order: 50 x 5-car-trains Revenue service: 2006 Vehicle: wide gauge, driverless, steel wheel

Singapore Circle line

- > Line length: 33 km
- > Nb of stations: 29
- > Train length: 70.1 m
- > Car width: 3.21 m
- > Capacity (6PAX/m2): 931 pass
- >Power supply: 3rd rail/750Vdc
- >Max speed: 90km/h
- >Traction: asynchronous type
- >Carbody: aluminium welded
- >Air conditionning: 76 kw per car
- >Doors: external sliding (4 par faces)

World's first radio CBTC 99,96% of availability



- Rolling stock
- > CBTC system
- Passenger information
- and security
- > Track work and power supply
- > Full maintenance



Customer: LTA Order: 40 x 3-car-trains Revenue service: 2006 Vehicle: wide gauge, driverless & steel wheel

Shanghai line 10

- > Line length: 36 km
- > Nb of stations: 31
- > Train length: 140 m
- > Car width: 3 m
- > Capacity (6PAX/m2): 1 744 pass
- > Capacity (8PAX/m2): 2 440 pass
- >Power supply: Catenary/1500Vdc
- >Max speed: 80km/h
- >Traction:; asynchronous type
- >Carbody: aluminium welded
- >Air conditionning: 2 x 44 kw per car
- >Doors: external sliding (5 par faces)

China's first heavy driverless system

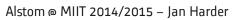
Alstom's Scope

- > Rolling stock
- > CBTC system



Customer: Shentong holding Order: 41 x 6-car-trains Revenue service: 2009 Vehicle: wide gauge, driverless & steel wheel





московский госуди-ствиный именерситет путка сосещения

Alstom's Scope

> Passenger information & Security

> Rolling stock

>Track work



Chennai (India)

> Train length: 87.9 m

- > Car width: 3 m
- > Height: 3.65 m
- > Axle load: 16 tons
- > Gangway corridor: 1.30 m
- > Capacity (8PAX/m2): 1 276 pass
- > Number of seats: 176

25 kV for a better reliability



Customer: Chennai metro Rail Limited Order: 42 x 4-car-trains Revenueservice:beginning 2013 Vehicle: wide gauge, stainless steel car body, steel wheel

Amsterdam (The Netherlands)

- > Train length: 116.20 m
- > Car width: 3.005 m
- > Height: 3.770 m
- > Axle load: 12 tons
- Gangway corridor: 1.60 m
- > Capacity (8PAX/m2): 1 360 pass
- > Number of seats: 174

Lower energy consumption High passenger comfort Safety level Easier maintenance

Alstom's Scope

- > Rolling stock
- > Passenger information & Security
- > Maintenance



ALSTOM

Customer: GVB Amsterdam Order: 23 x 6-car-trains Revenueservice: end 2012 Vehicle: wide gauge, steel wheel

