# Metro and Tramway

Limited Edition
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## Ansaldo STS

A Hitachi Group Company

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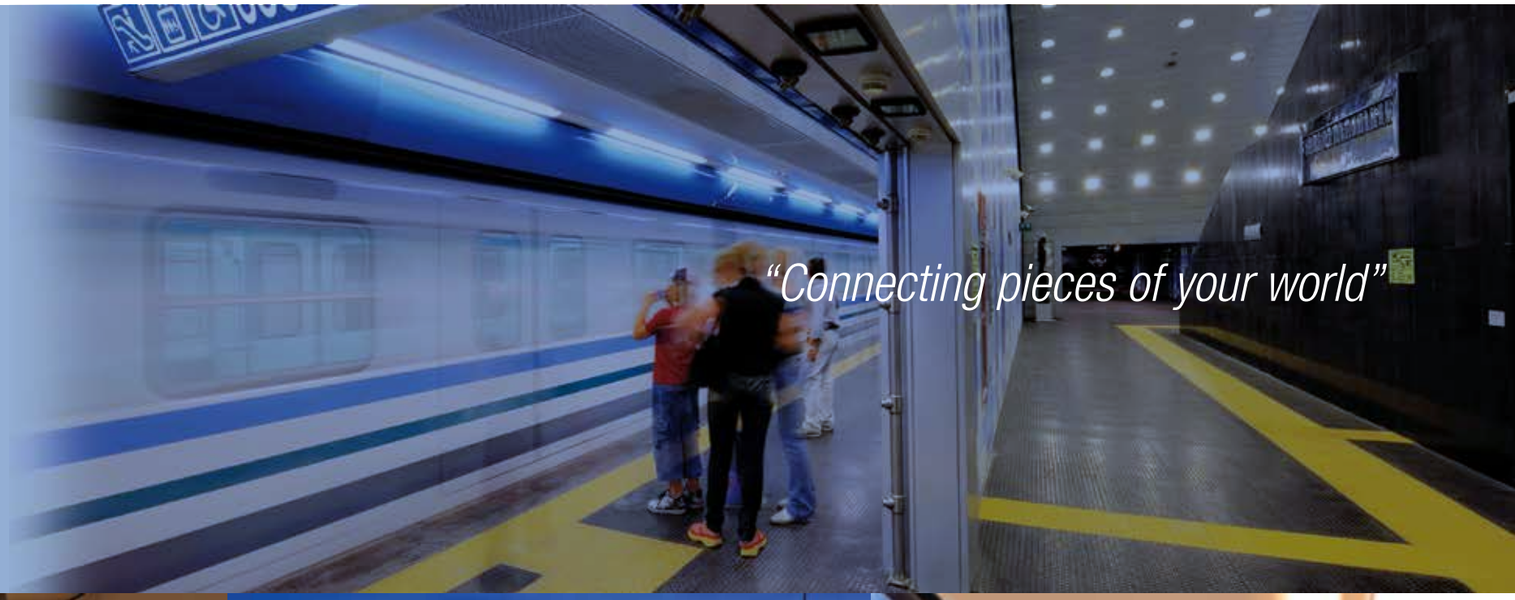




Copenhagen Metro


Genoa Metro


Brescia Metro

# Ansaldo STS in brief

## Complete Transportation Solutions - Passengers and Freight industry

All around the world, Ansaldo STS supports its clients to create and develop more reliable and sustainable networks that ease urban mobility and solve the challenges of today's population and cities rapid growth.

From passenger to freight transportation networks, from urban to intercity and cross-border high speed lines, we design and deploy cutting-edge technologies to meet operators' needs and optimize the performances independently of traffic density and complexity.

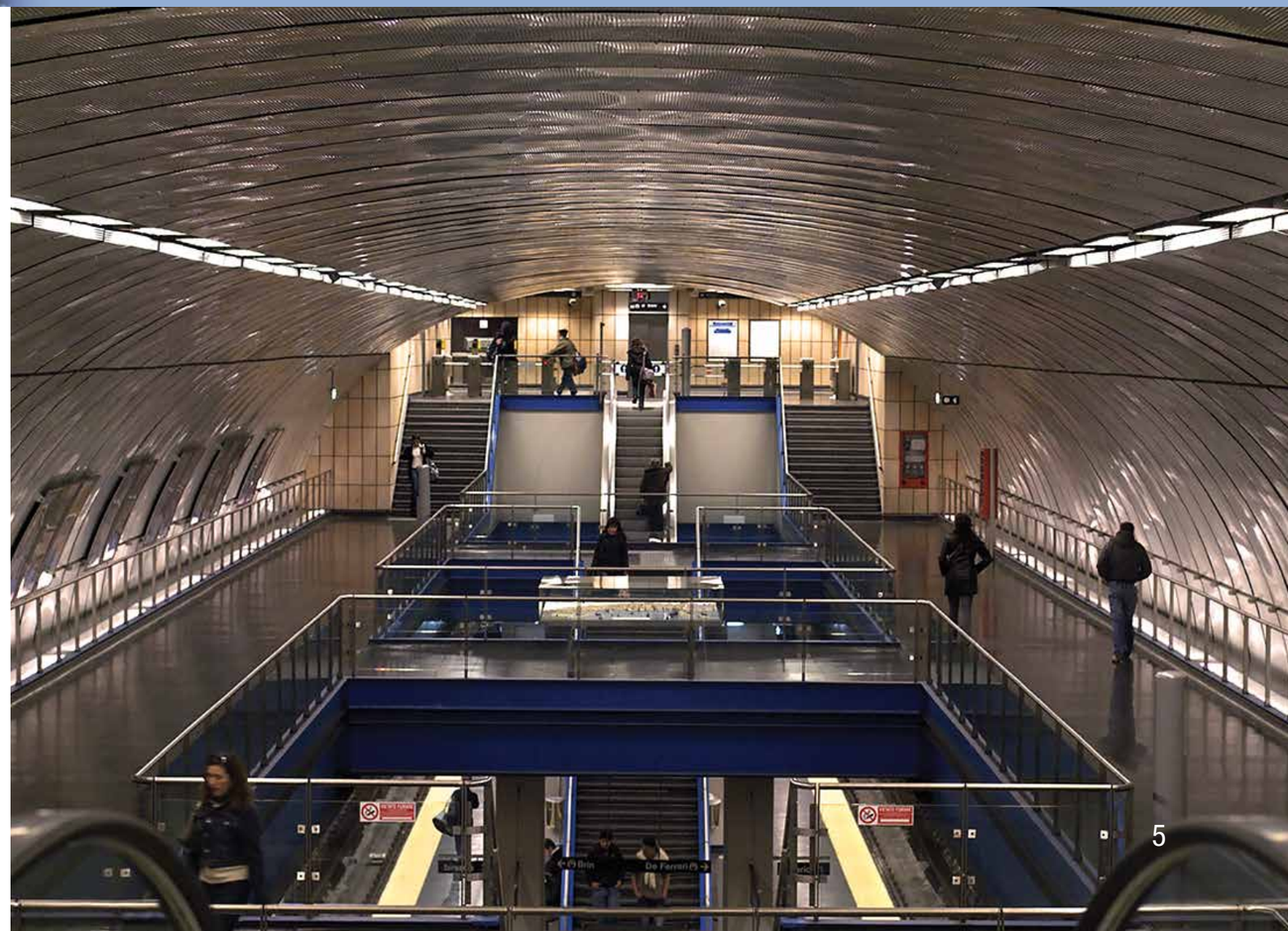
Ansaldo STS has left its mark in the rail industry by implementing cutting-edge technologies on major projects such like:

- **ERTMS/ETCS** solutions combined with High Speed Rail, Conventional lines or Heavy Haul technologies for safer and interoperable networks
- **Satellite positioning technology** for a safer and more accurate rail traffic management
- **CBTC** suitable for both driverless and conventional transport systems
- **Catenary free** technology.



# Conventional Metro

Referring to the most updated technologies, safety standards, automation levels and highest performances, Ansaldo STS designs and delivers fully integrated solutions suitable to run conventional metros. According to customer requirements, the complete portfolio allows the operation of metros where the driver runs the train up to fully ATO, where only limited actions are required by the driver as the trains are controlled by an automatic system.



# Driverless Metro

## Unattended Train Operation

Within the urban public transport sector the increase of transport demand, passengers requirements in terms of service comfort, efficiency and punctuality and the restricted budgets of regional and local Authorities to operate the mass transit infrastructures, oblige the Public Authorities.

The operators steer towards transportation systems that first offer a very high-quality, attractive and reliable service as a real alternative to the private cars and secondly an operational savings.The Unattended Train Operation improves both service and cost efficiency, supporting the economic growth of the City and the Region.

Considering that short waiting time and punctuality are essential to provide a high quality service and to attract more passengers to public transport, it is important to underline that the Unattended Train Operation allows very short headways during peak hours (down to 75 s) in compliance with the highest efficiency and safety standards.

Since they are unattended and require a very limited staff for operation, the service frequency can also be kept at an acceptable level during off-peak hours, without incurring significant operating costs. Unattended Train Operation can also respond quickly to changes in passenger-flows, operating in a ‘demand-responsive’ mode.

Safety is of course a major concern for Operators of any transport mode. Therefore it is important to highlight that the high safety record of unattended fully automated systems has been proven by many experiences and it is now widely recognized that they are much safer than conventional, as most of railway accidents are caused by human errors.



## The main advantages of Unattended Train Operation vs. Conventional can be summarized as following:

- Lower O&M expenditure, due to a significant decrease of the staff as drivers and on board personnel are not required
- There are additional savings in operating costs, since the system is operated in compliance to an optimum fully automated specification: reduction of energy consumption, components wearing, spare parts, maintenance, etc…
- Trains can be shorter (no cabs) and run more frequently without increase expenditure for staff
- The metro Operators are able to often and easily vary the service frequency to meet sudden and unexpected transport demands, without increasing the staff costs
- High level of performance, availability and reliability. Headway down to 75s. The attractiveness of public transport is increased
- High quality service with high frequencies, even when the tickets incomes don’t justify the operation, without increasing the staff costs
- If for any reason someone or an obstacle are on the tracks, obstacle detection systems are much more effective than drivers in “manually” stopping the trains
- Train turnover time at terminals can be extremely short (trains go into the holding track and return immediately back); reducing the fleet size needed for operation and consequent savings in terms of investment and maintenance costs.

# Turnkey Unattended Metro Around the World

| | Track | Stations | Headway | Capacity | Trains | O&M |
|---|---|---|---|---|---|---|
| **Copenhagen M1/M2** | **21 km** double track double tunnel | **22** | min **90** s | **12,000** (4p/m2) | **34** **3 cars** per train (39m) | **13 + 3 years** In operation since 2002 |
| **Brescia** | **13.7 km** double track single tunnel | **17** | min **90** s | **17,000** (6p/m2) | **21** **3** cars per train (39m) | **2 years** of operation **7 year**s of mainten. |
| **Thessaloniki** | **9.5 km** double track double tunnel | **13** | min **90** s | **21,000** (6p/m2) | **18** **4** cars per train (50m) | **3 years** of service assistance |
| **Rome line C** | **25 km (+17)** double track double tunnel | **30** (+12) | min **120** s | **36,000** (6p/m2) | **30 (+13)** **6** cars per train (108m) | Local existing Operator training |
| **Milan line 5** | **12.6 km** double track single tunnel | **19** | min **75** s | **28,000** (6p/m2) | **21** **4** cars per train (50m) | **27 years** as member of the Concess. |
| **Taipei (CBTC)** | **15.4 km** double track viaduct | **14** | min **90** s | **26,000** (6p/m2) | **17** **4** cars per train (70m) | Future system extension: **52 km**, **56 stations, 64 trains** |
| **Riyadh Princess Noura Univ. Campus** | **11.3 km** double track viaduct | **14** | min **90** s | **4,400** (2.5p/m2) | **22** **2** cars per train (29m) | **3 years** |
| **Copenhagen City-ring (CBTC)** | 17 km double track double tunnel | **17** | min **100** s | **12,000** (4 p/m2) | **28** **3** cars per train (39m) | **5 + 3 years** |
| **Honolulu** | 32 km double track viaduct | **21** | min **90** s | **7,200** (3.2 p/m2) | **20** **4** cars per train (38.5m) | **12 years** |
| **Milan Line 4 (CBTC)** | 15.2 km double track double tunnel | **21** | min **75** s | **28,000** (6p/m2) | **47** **4** cars per train (50m) | **25 years** as member of the Concess. |
| **Riyadh Line 3 (CBTC)** | 40.7 km double track double tunnel | **22** | min **90** s | **18,000** (6p/m2) | **47** **2** cars per train (32m) | **10 years option** In operation in 2019 |
| **Lima Lines 2-4 (CBTC)** | 35 km double track single tunnel | **35** | min **80** s | Line 2 **32,500** Line 4 **15,500** (6p/m$^2$) | **42** **6** cars per train (108m) | **30 years** as member of the Concess. |
| **Glasgow Subway (CBTC)** | 10.5 km twin subway lines | **15** | min **90** s | **4,340** (4p/m2) | **17** (39 m) | **10 years** |
| **New Taipei City (CBTC)** | 14,29 km double track viaduct | **12** | min **90** s | **8,790** (6p/m2) | **29** 2 cars per train | **8 years** |



# Turnkey Mass Transit Solutions

## Conventional Metro

Caracas Metro
Hong Kong Metro
Lyon Metro
Lysbon Metro
Naples Metro
Genoa Metro
Rome Metro
Milan Metro
Navi Mumbai Metro

## Driverless Metro

Copenhagen M1/M2
Thessaloniki
Rome Line C
Brescia
Milan Line 5
Taipei (CBTC)
Riyadh Princess Noura University
Copenhagen City-Ring (CBTC)
Honolulu
Milan Line 4 (CBTC)
Riyadh Line 3 (CBTC)
Lima Lines 2-4 (CBTC)

## CBTC

Hangzou Metro Line 2
Zhenghzou Metro Line1
Stockholm Metro Red Line
Chengdu Metro Line 2
Taipei Metro (driverless)
Xi'an Metro Line 2
Hangzou Metro Line 1
Chengdu Metro Line 1
Ankara Metro
Shenyang Metro Line 1-2
Paris Metro Line 3
Lima Metro Lines 2-4 (driverless)
Riyadh Metro Line 3 (driverless)
Milan Metro Line 4 (driverless)
Copenhagen Metro City-Ring (driverless)
Glasgow Subway (Scotland)

## Tramway

Dublin
Manchester
Birmingham
Florence
Sassari
Zhuhai (catenary free)
Aarhus LRT (Denmark)


# CBTC

Operating Conventional or Driverless Metros, CBTC signalling represents the most effective and flexible solution for both new and existing infrastructures, offering enhanced safety, greater reliability/availability and additional functionality that traditional signalling systems cannot deliver.

With CBTC now recognized as the global industry standard and mature technology, it is crucial that metros ensure successful deployment and migration to new CBTC systems, to enhance capacity, increase process automation, reduce CAPEX and OPEX and optimize lifecycle costs.

## Ansaldo STS participated in developing the IEEE Standard 1474.1 for CBTC performance and functions.

### Main advantages of the CBTC technology:

- Revamping of existing signalling systems and migration without disruption of operation (Ansaldo STS's Zone Controller is designed to be easily interfaced with existing central control room and existing interlocking (relay or computer-based)
- Improve headway (down to 60 s, constrained only by line layout and vehicle performances)
- Allows to perform a real moving block
- Reduced number of wayside equipment (track circuit, wires, signals, etc…) and centralization at controlling point:
  - infrastructure capital costs savings
  - maintenance costs savings
  - whole life cycle cost saving
- Less space required for installing the signalling wayside equipment, leading also to reduced power consumptions for the equipment itself and the Air Conditioning in the wayside closures
- Less traction power consumption optimizing the trains mission profile
- Continuous bi-directional communications between the trains and the wayside/central
- Use of radio infrastructure to transmit vital and not-vital messages (i.e.: train position, vital movement authority, passenger related information, traffic regulation, etc…). Possible reuse of such infrastructure for other PIS data as well as on board Internet services
- No particular constrains related to the topological line features and track alignment
- Operational flexibility thanks to independency from physical devices:
  - direction reversal
  - destination IDs.



# Tramway

Either traction power is provided through overhead catenary or through a catenary free system, referring to the most updated technologies, safety standards, automation levels and highest performances, Ansaldo STS designs and delivers fully integrated solutions suitable to run tramways.

### TramWave® - the Ansaldo STS's Catenary Free Solution

TramWave® is an innovative catenary free power supply solution, based on a simple electro-mechanical principle, designed and patented by Ansaldo STS, that doesn't constraint vehicular and pedestrian circulation. The core of the system is the contact line, consisting of consecutive modules, made by 50 cm long conductive steel plates (the segments), insulated from each other.

TramWave® contact line is installed in the middle of the tracks at street level and vehicles running on it are equipped, at the two ends, with two under boogies power collectors. During the operation, the collectors are released down to be in contact with the TramWave® segments.

The segment electrical activation is caused by the collector's permanent magnets, that lift up a conductive strip inside the module, allowing the segment to be energized, with no need of any electronic or induction based device.

This means that only the segments in contact with the collectors are activated to feed the vehicle and only a small portion of the module under the boogie is energized: in this way, safety inside and outside the vehicle is always guaranteed for passengers, pedestrian and road vehicles. Even in the worst climatic conditions like snow, ice, sand, heavy rain, floods and tornadoes the system is safe and can continue to run as usual.

### TramWave® - benefits for sustainable Urban Mobility

TramWave® is the answer to today's urban light rail public transportation needs. It offers high performances preserving at the same time the urban environment also from the visual impact of overhead catenaries.

TramWave® doesn't need to return current on tracks and therefore avoids all the issues related to the stray current effects.

TramWave® operation doesn't cause any electromagnetic emission and doesn't need any on board heavy and space consuming energy storage systems.

Where required, it's possible to share the TramWave® contact line with rubber tyred vehicles, like electric cars and busses or to use TramWave® just for a small section of the line, like city centre or historical areas keeping overhead catenaries in the suburbs.

TramWave® allows a continuous energy supply and regenerative braking, as the overhead catenary, with consequent saving in energy consumption.

# Why ANSALDO STS?

### The Ansaldo STS's approach

The main objectives to be achieved by a Turnkey Contractor are:

- Ensure the compliance with the overall project schedule and budget through an integrated planning management and costs control
- Ensure the compliance of the transportation system with the general requirements, standards and regulations
- Ensure that each sub-system works accordingly to its functional specifications and to the overall system requirements
- Ensure the proper interface management across all the sub-systems and the external constraints
- Ensure the compliance of the complete transportation system with its overall performance requirements
- Ensure the safety of the system in any condition of operation
- Ensure the project delivery on time and on budget.

To successfully achieve the above mentioned objectives, over the past decades of experience in mass transit Turnkey projects, Ansaldo STS has improved its Turnkey "system thinking" up to the Full System Approach.

Through the Full System Approach it has been possible to integrate all our competencies in an optimized solution, managing all the interfaces among the sub-systems (civil and track works, system technologies and rolling stock), taking into account the concept phase and during the whole project life-cycle all the possible external constraints and the needs/criticalities related to the operation and maintenance phase.

Ansaldo STS acts as lead contractor (or consortium partner) and system integrator for major projects around the world, under the following main contractual schemes:

- contracting for Design & Build
- build, Operate and Transfer (BOT)
- project Financing
- design, Build, Operate and Maintain (DBOM)
- public Private Partnerships (PPP).



# Operation and Maintenance

Ansaldo STS operates transportation systems and provides the complete maintenance to ensure full service availability and passengers satisfaction.

This demonstrates the company's commitment to maximizing the return on investment for the customers.

The Copenhagen Driverless Metro is operated by Ansaldo STS since 2002.

In this respect, the Operation and Maintenance of the Copenhagen metro provided the best opportunity to fully implement and optimize the technical solutions implemented under the Design and Construction phase, through the collection of important feedback data (customer and system based).

For the Customer, this is an added value to the service provided because contractual obligations are still lying under a unique Contractor.

Following the Copenhagen success Ansaldo STS has been awarded other Operation and Maintenance contracts (i.e. Honolulu Driverless Metro), confirming the full customer satisfaction and the added value provided.


Ansaldo STS A Hitachi Group Company

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