

Barcelona Metro: On track for a driverless future

From the world's first automatic mass transit system to the very latest control systems for modern metros, Invensys Rail is a world leader in train control systems. So when Barcelona Metro decided to invest in a driverless, automatic train control system (DTO) for its Line 11, it came to us for expert support.

Barcelona Metro transports well over 1 million passengers every day. With lines covering just under 160km of urban and suburban landscape, it integrates both underground and overground mass transit. Line 11 is a metro service that runs underground, and was seen by the Barcelona Metro team as an ideal opportunity to trial driverless transport. Given our wealth of international experience, Invensys Rail was the preferred supplier from the outset.

The project: from manned to driverless

Barcelona Metro decided to invest in a TBS500 driverless system. This control system is specifically designed for metros, and is already proving highly successful on other networks. Why Line 11? The line itself is a 2km long, singletrack line stretching out to the suburbs, with a central passing loop. It links to Metro Line 4 and the rest of the network at Trinitat Nova. Originally an attended line, Line 11 featured Automatic Train Control (ATC) between stations: the driver simply has to manually operate doors and start the train. This makes it an ideal candidate for the shift to driverless control.

The timeline: staged for success

Invensys Rail systems are developed by specialists who understand that mass transit systems can't stop for long, so complicated upgrades that demand extended periods of closure are a no go. We offer a realistic upgrade path that works with legacy systems to minimise downtime. The upgrade process is typically staggered to minimise disturbance and implementation costs.

Barcelona Metro Line 11 is a showcase example of this practical approach at work. The project began in October 2003 with the introduction of Automatic Train Protection (ATP) speed code functionality. In the next stage, Automatic Train Operation (ATO), a driver is still needed to start the train and to operate the doors but once underway, train movement is entirely under the control of ATO. A Distance-to-Go system was then added, improving performance through a reduction in intervals between trains whilst still requiring the same input from the driver.

The final step makes fully synchronised performance possible, with automated platform and train doors delivering a safe, reliable passenger experience. A train employee will remain on-board, responsible for passenger areas, but not train control.





How does it work?

What made the Invensys Rail driverless train control system stand out to Barcelona Metro is the target distance principle that drives the system. Each train is fitted with equipment that interprets track codes as free blocks in front of the train. It assesses blocks and track profile to calculate safe braking distances while maintaining optimum speed for a safe, efficient service.

Line 11 signalling is controlled by Invensys Rail's WESTRACE electronic interlockings at Trinitat Nova and Torre Baró stations. Track is divided into two blocks by FS2550 jointless track circuits that detect, monitor and transmit to trains. Furthermore, passive balises along the tracks are activated when trains pass, making accurate train positioning simple. All ATO information passes through the station ATO, including a link to central Metro control, for maximum safety.

Trains are driverless - stopping, starting, and opening and closing doors 100% automatically - though they remain completely in control. Meanwhile, ATP and ATO units are both onboard, alongside Doppler distance-indicating

equipment and a passive balise reader. The system is ultra-safe: enhanced availability is guaranteed thanks to a three-channel 'two out of three' redundant configuration. Faults are instantly logged, yet performance remains consistent as long it is safe to continue.

Other availability measures included duplicate ATO equipment, so a second channel means no interruption to service.

To be able to operate in full driverless mode at every station, a Platform Screen Door System has been installed, which allows bidirectional communication from track to train, synchronising the opening and closing of train and platform doors, ensuring they are exactly face-to-face every time.

Looking forward

Jesús Guzmán, General Manager of Invensys Rail, based in Madrid says:

"Our company has collaborated actively to provide Barcelona Metro a state-of-the-art driverless train control system that will be a reference for future lines."



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