

## Driverless metro lines worldwide

### Barcelona, Spain, Line 9

Siemens equipped Barcelona's new metro line L9 with an automatic train control system for driverless operation. It is the first fully automated metro line in Spain and, with an overall length of 49 kilometers and 50 stations, is the largest single rapid transit line in Europe. Around 333,000 passengers use the line every day. The backbone of Barcelona's entire mass transit network, it consists of five lines, six train stations and the city's airport station. Siemens installed an automatic train control system for driverless operation as a consortium leader. The scope of supply includes the trackside and the onboard equipment, which controls the train completely automatically and safely in unattended mode.

#### Project scope:

- Components for the line and for 50 trains
- Line length: 49 km/stations: 50

Commissioned: December 2009

### Budapest, Hungary, Line 2

In 2005, Siemens received an order to convert Budapest's metro line M2 to fully automated operation. The Siemens share included the control, signaling and safety systems. This conversion project shortened headways from 135 seconds to 100 seconds. The line was modernized during ongoing operations and did not impair passenger service at all. The driverless system entered service in 2008. First commissioned in 1970, Budapest's metro line M2 is ten kilometers long, serves eleven stations, and carries an average of 500,000 passengers every day.

#### Project scope:

- Signaling
- Line length: 10 km/stations: 11

Commissioned: End of 2013

### **Nuremberg, Germany RUBIN**

Germany's first fully automated metro went into operation in June 2008 with the inauguration of Rubin, the U3 metro line operated by the transit operator Verkehrs-Aktiengesellschaft Nürnberg. This was the first metro in the world that ran during the introductory phase on a section of line together with driver-controlled trains in so-called mixed running mode. Automated operation enables the trains to run at headways of 100 seconds in rush-hour traffic instead of the previous 200 seconds during off-peak periods or 150 seconds in mixed running mode. Independently of the regular timetable, extra trains can be deployed for large events. They can be sent into operation straight from the stabling tracks at the push of a button. The core of automated operation is the ATC technology (Automatic Train Control), which essentially consists of two components, the automatic train control and the automatic train protection systems. Computers along the line ensure that both systems are in permanent contact with the operations control center, where the data from the vehicle and the line is constantly compared to enable determination of each individual train's exact location at any time. At present, the U3 links the Gustav-Adolf-Strasse station in the south and the Maxfeld stop in the north. In December 2011, extension of the U3 line via Kaulbachplatz to

Friedrich-Ebert-Platz is to be commissioned in time for the change to the winter timetable. The first automated trains started providing passenger service on the U2 line in September 2008, while mainly automated metro trains have been operating on the common section of U2 and U3 lines between Rathenauplatz and Rothenburger Strasse since January 2010.

Project scope:

- Signaling
- Metro trains for the new line U3, conversion of the U2 line
- Line length: 32 km/stations: 40

Commissioned: June 2008

## Paris, France, Metro Line 1 and 14

Siemens has equipped one of the oldest and most popular Paris Metro lines for driverless operation with the Trainguard MT automatic train protection system. Line 1 is the most traditional of all the metro lines in Paris and also the most heavily frequented. It is especially popular with tourists, who travel on it to see all the major sights of French capital situated along the line. Linking the east and west of the city along 17 kilometers of track, it carries as many as 725,000 passengers every day. The trackside operations control equipment and the telecommunications system were installed during ongoing metro service without disrupting operations. By the start of 2013, all 49 vehicles were converted by Siemens for driverless operation. Until then, the local transit operator (Régie Autonome des Transports Parisien, RATP) was operating the line in mixed traffic mode. Special doors at the platforms ensure additional safety at all 25 metro stations. Thanks to the technical solution provided, it is possible to ensure shorter headways and faster passenger service than conventional driver-operated systems. Trains can now run at intervals of 85 seconds instead of the previous 105 seconds. The train headways can be adapted flexibly to suit ridership. This is particularly relevant on special occasions such as sports events or trade fairs. Trainguard MT also ensures particularly energy-efficient and environmentally friendly operation. Thanks to the automatic train control system, energy consumption on Line 1 in Paris will be cut by about 15 percent.

The Line 1 is the second Line in Paris that Siemens equipped with a driverless railway automation system. The Line 14 was commissioned in 1998.

### Project scope\_:

- Signaling
- Components for the line and for 49 trains
- Line length: 16.6 km/stations: 25

Commissioned: Line 1: 2011  
Line 14: 1998

**Sao Paolo, Brazil, Line 4**

The first fully automated, driverless metro line in Latin America commenced operation in May 2010. Line 4 in the Brazilian metropolis of Sao Paolo was equipped with a signaling system from Siemens. The line covers 12.8 kilometers of track and includes 11 stations. The metro line is designed for an ultimate ridership capacity of about 900,000 passengers per day. The fully automated line enables operation at shorter headways than conventional driver-controlled systems and under optimum safety conditions. Safety in the stations is provided by special platform doors. The scope of supply includes the trackside and onboard equipment for fully automated train operation in unattended mode. As consortium leader, Siemens also installed the operations control center, an automatic traffic monitoring solution, and an electronic interlocking.

Project scope:

- Signaling
- Headways: 81 to 127 seconds
- Line length: 12.8 km/stations: 11

Commissioned: May 2010