

**SIEMENS**

# GSM-R Projects

Realized with GSM900



# The System Solution

Railway companies in Europe and all over the world have various different communication requirements for the operation and maintenance of their railroad networks. Today, for each of the railway services needing voice or data transmission, these telecommunication requirements are, due to specific individual requirements, accomplished by different technical system solutions.

## Future-oriented demands

Modern European railway companies require a future-oriented digital radio system which fulfills existing requirements, as well as new requirements arising from internationalization of traffic, cost-effectiveness and quality of service. The railway networks under UIC will operate in their own spectrum (GSM-R) near the GSM frequencies, but only with 4 MHz bandwidth for uplink and downlink respectively. Therefore, the frequency allocation for the various railway services should be minimized, and frequency reuse optimized. Future systems will have to provide solutions for the following applications:

- Automatic train control ATC
- Train radio TR
- Group communication
- Addressing functions
- Train diagnostics
- Railroad maintenance
- Shunting team communication
- Schedule changes
- Ticketing
- Value-added services for passengers

## The MORANE test and validation project

MORANE's (Mobile Radio for Railway Networks in Europe) aim is to specify, develop, test and validate prototypes of a new radio system meeting the EIRENE system specifications defined by UIC and based on GSM technology.

Research projects are in operation in France, Germany and Italy. One of the main objectives of these projects is to test coverage (especially in tunnels and in difficult terrain) and operating conditions for both voice and data transmission when trains are travelling at high speed. This was proven by a test series performed in 1997/1998. Furthermore, the newly developed GSM-R functions, i. e.

- functional & location dependent addressing (with border crossing traffic)
- ASCI (VBS, VGCS, eMLPP)
- trainborn/trackside applications

are part of the MORANE test program.

The MORANE test networks were installed in 1997 and have been in operation ever since. Siemens has delivered all MSC/VLR and HLR/AC for these networks, as well as Base Station Subsystems.

# Current MORANE Projects

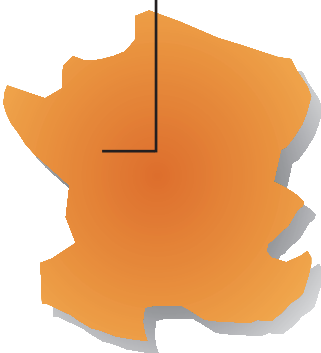


## The French Project

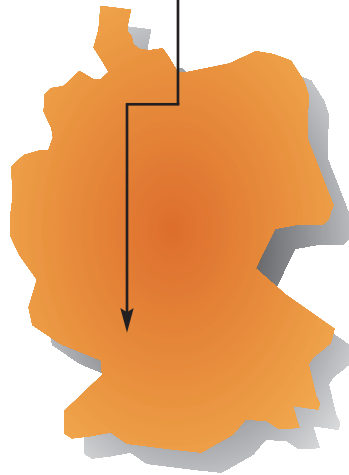
The French railway administration SNCF (Société Nationale de Chemin de Fer) is evaluating an installed GSM-R system of the track from Lille via Paris to Lyon. On this trial site trains run at a speed of up to 350 km/h. The system covers rural and suburban areas. The tunnels are covered with antennas and repeaters.

For this project, Siemens installed a Mobile Switching Center with integrated Home Location Register, Base Station Subsystem and Operation & Maintenance Center.

## Monchy – Paris – Chessy



## Stuttgart – Mannheim



## The German Project

The Deutsche Bahn AG started tests as early as 1995 with its own DIB-MOF valid project. First, a 60 km track from Stuttgart to Bruchsal was installed in order to validate the system layout. Within MORANE, this trial site was extended a further 40 km to Mannheim.

Siemens installed a MSC/VLR/HLR/AC, BSS and OMC.

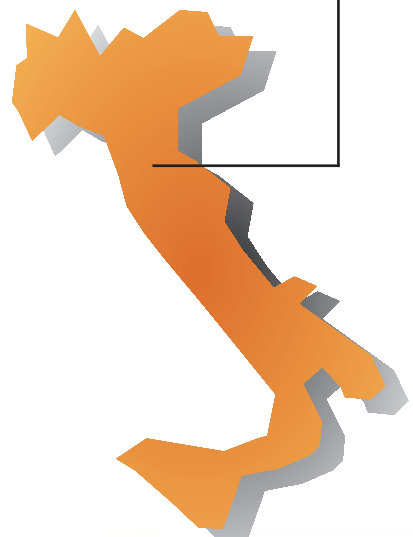
On this trial site trains run at a speed of up to 280 km/h. The system covers rural areas with mountains and cuttings as well as urban and suburban areas. Tunnels are covered with antennas. One main objective – to reuse existing sites and masts from analog technology – has already been achieved.



## The Italian Project

In 1997, the Italian railway authority FS (Ferrovie dello Stato S.p.A.) committed a trial site along the high speed line Prato – Florence – Arezzo. Siemens installed a MSC/VLR/HLR/AC, BSS and OMC and is currently the sole supplier for this project. This trial site is characterized by several tunnels very close together. These tunnels are covered with antennas and leaky feeder cable depending on the type of tunnel. Furthermore, both GSM-R and public GSM use the same mast or leaky feeder cable.

## Prato – Firenze – Arezzo



# Siemens GSM-R Projects Europe-wide

In several European countries, first commercial GSM-R networks have been submitted as projects and will be realized with Siemens GSM-R technology.

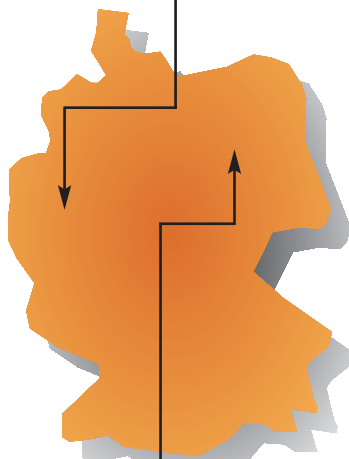
## Deutsche Bahn, Germany

In 1996, the Deutsche Bahn AG launched a pilot project to introduce and validate ETCS level 2 (DIBMOF pilot). The track for Jüterbog (near Berlin) to Halle and Leipzig (75 km) will be equipped with both ETCS and GSM-R. Siemens will deliver in AASSAA consortia one MSC/VLR/HLR/AC and BSS.

Deutsche Bahn AG decided to install the first regular operational track for ATC with GSM-R at the newly built high-speed track from Cologne to Frankfurt Airport (150 km). This track is a typical high-speed track with long tunnels, stations and crossings within tunnels. Siemens will deliver both ETCS and GSM-R.



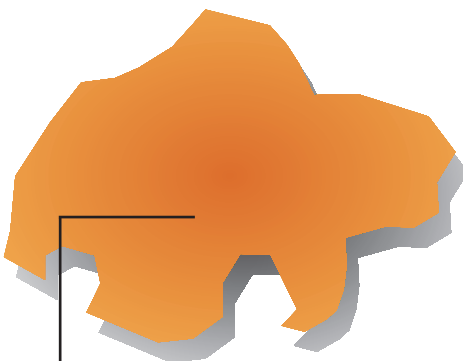
## Cologne – Frankfurt Airport



## Berlin – Halle – Leipzig

## Schweizer Bundesbahn, Switzerland

Siemens is the sole supplier of the SBB test track between Olten (a highly frequented railway network node) and Luzern (between Zofingen and Sempach – a stretch of 30 km). This track is the pilot line for ETCS level 2 for Switzerland and used for regular railway operation.



## Zofingen – Sempach

## Banverket, Sweden

Siemens is the sole supplier of Phase 1 of Banverket's SIR (Swedish International Rail) project. The total stretch of 2,400 km will be provided with GSM-R for voice and data communication. ETCS will follow at a later stage.

Three more phases will follow in order to equip the full SIR network of 7,200 km of track.



## Sweden (test track)

## Siemens projects at a glance

Country	Railway	From – via – to	Network elements delivered by Siemens	Status
France	SNCF	Chessy Gare (direction Lyon) - Roissy PRCI (Paris) - Monchi CAI (direction Lille) (95 km)	1 MSC/VLR/HLR/AC, 1 TRAU, 1 BSC, 3 BTS	MORANE trial since 1997
Germany	DBAG/ Mannesmann ARCOR	Stuttgart - Bruchsal - Mannheim (100 km)	1 MSC/VLR/HLR/AC, 1 TRAU, 1 BSC, 11 BTS	DIBMOF valid since 1995, MORANE trial since 1997
Italy	FS	Prato - Firenze SMN - PJ Arezzo (78 km)	1 MSC/VLR/HLR/AC, 1 TRAU, 1 BSC, 19 BTS	MORANE trial since 1997

## Current MORANE projects

Country	Railway	From – via – to	Network elements delivered by Siemens	Status
Germany	DBAG	New high speed track (ETCS) Cologne - Siegburg - Frankfurt/Airport (150 km)	1 MSC/VLR/HLR/AC, 1 TRAU, 2 BSC, 48 BTS, antennas and AC/DC	Network planning started, rollout planned from 7/99
Germany	PBDE/ DBAG	DIBMOF pilot (ETCS) Jüterbog - Halle/Leipzig (75 km)	1 MSC/VLR/HLR/AC, 1 TRAU, 1 BSC, 5 BTS, antennas for 15 sites	Network planning completed, rollout planned 2/99
Sweden	Banverket	Swedish International Rail (SIR) phase 1 - test track (70 km) - area (2,400 km) Total network (7,200 km) will be equipped in 3 phases	1 MSC/VLR/HLR/AC, 1 IN-system, 3 TRAU, 5 BSC, 255 BTS	Network planning ongoing, rollout started in 10/98
Switzerland	SBB	Test track (ETCS) Zofingen - Sempach (30 km)	1 MSC/VLR/HLR/AC, 1 TRAU, 1 BSC, 6 BTS	Network operation by Siemens Switzerland

## Siemens GSM-R projects



### Complete Success

The need to modernize networks is evident to all railway organizations. GSM and its derivat GSM-R have shown that they constitute a future-proof technology. Test results have also shown that the GSM-R system solution is definitely the optimal communication system of UIC for ETCS and other railway communication requirements.

The MORANE results have already convinced approximately 32 European railway authorities to sign a Memory of Understanding in order to introduce this technology in the future.

## Abbreviations

AASSAA	(Cosortium for GSM-R Jüterbog-Halle-Leibzig project)
AC	Authentication Center
AMR	Adaptive Multi-Rate coding
ASCI	Advanced Speech Call Items
ATC	Automatic Train Control
BSC	Base Station Controller
BSS	Base Station System
BTS	Base Transceiver Station
DIBMOF	Services Integrating Railway Mobile Communication
eMLPP	Enhanced Multilevel Precedence & Preemption
ETCS	European Train Control System
ETSI	European Telecommunications Standards Institute
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile Communication
GSM-R	GSM for Railways
HLR	Home Location Register
MORANE	Mobile Radio for Railway Networks in Europe
MSC	Mobile Switching Center
PLMN	Public Land Mobile Network
TRAU	Transcoding Rate Adaption Unit
TR	Train Radio
UIC	Union Internationale des Chemins de fer
VBS	Voice Broadcast Service
VGCS	Voice Group Call Service
VLR	Visitor Location Register



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