Clear CinCom
RADIO TELECOM CONSULTANCY

CASE STUDY:
GSM-RAIL FOR HIGH SPEED CONNECTION

Safely from Amsterdam to Paris in three hours, thanks to GSM-Rail

The people of Clear CinCom have worked intensively with the Dutch railway infrastructure manager ProRail to ensure that the new high speed train from Amsterdam to Paris (HSL-Zuid) will be as safe and as efficient as possible.

Project description

Since 1998 Dutch railway infrastructure manager ProRail has been working on the establishment of a high speed railway connection that allows passengers to travel from the heart of Amsterdam to the heart of Paris in a little over three hours, passing by Rotterdam and Brussels. At its peak, the HSL-Zuid (as the train is called in Dutch) will move with speeds over 330 kilometres per hour. In order to ensure safety, the railways in most European countries use an harmonized system called ETCS. This is an application that runs on top of a GSM-Rail (GSM-R) wireless network infrastructure. For safety as well as for service, a flawlessly functioning GSM-R system is a necessity.

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Partners involved

As with any project of this magnitude, a number of firms are involved. The superstructure of the railway is built by a consortium named Infraspeed, consisting of constructor firm BAM (Netherlands) and the technology firms Siemens AG (Germany) and Fluor Daniel (United States).
While ProRail is the owner of the GSM-R frequency license and thus the official operator of the GSM-R network in The Netherlands, another consortium was brought to life for the actual roll-out of the infrastructure. This consortium is called Mobirail and it combines the expertise of KPN Telecom with that of Siemens.

Government requirements

The Dutch government imposes strict requirements on all elements of the high speed train connection. This is in order to ensure safety and efficiency. To make the communication infrastructure fully compliant, the Mobirail consortium hired a specialized firm to design, verify and optimize the GSM-R network. This specialized company is Clear CinCom.

Full Spead Ahead

To validate the Quality of Service for GSM-Rail network, Clear CinCom uses both high speed and low speed measurement trains. The train is used by Clear CinCom to measure at speeds up to 350 km/h, while the train on the right can be used for railways up to 140 km/h.

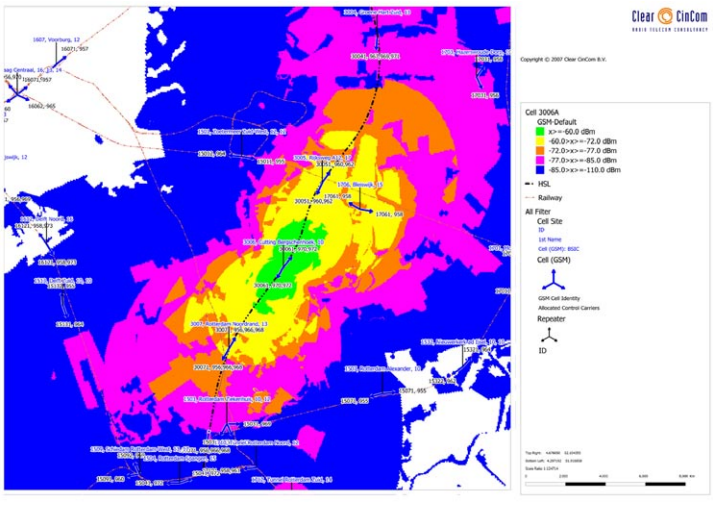
In three steps to results

Step 1: Planning and Design

The first step in the process of rolling out the GSM-R network is for the radio planners at Clear CinCom to translate the government imposed requirements to design criteria. One requirement was that travellers may only be minimally distracted by infrastructural objects outside of the train. Thus, the number of pylons used should be minimal. At the same time, safety requirements call for the network to have a high level of redundancy. Other requirements were put down to ensuring efficiency and a high level of customer satisfaction, guaranteed by high quality on-board information systems. Moreover, optimal voice communication should be available to both maintenance and railway personnel. Clear CinCom combined these (often contradictory) requirements into an initial cell plan or *nominal network design*.

Step 2: Verifying

Secondly, the drive test team of Clear CinCom went out to establish continuous wave measurements. A special car equipped with a mobile test transmitter and receiver was used to determine the optimal placement of the pylons. After this verification, the nominal cell plan was translated into a final cell plan with recommendations concerning the placement and the height of the pylons, the azimuth of the antennas, the type of antennas to be used and their vertical inclination (tilt), the initial output of the transmitters and the number of carrier units they should contain. This latter specification determines how many simultaneous connections can be made. In this case, the requirement called for 120 guaranteed ETCS-connections for security and 80 voice connections for communications at any one time, distributed equally



A Clear CinCom consultant shares information with the people of Infraspeed, while validating the HSL-Zuid GSM-Rail network from a low speed measuring train.

along the line. Considering the small frequency range that GSM-Rail is to work with (in this case the 921 to 925MHz frequency band), this is a relatively high quantity. Added the fact that this new network had to be integrated in the existing GSM-R network covering the normal speed lines and it becomes clear how this posed an interesting challenge.

Modern verification equipment combined with the expertise of Clear CinCom allowed for the final network plan to be fully compliant with all the requirements while using only three carrier units at each location.

Step 3: Optimizing

Once the network had been set up, Clear CinCom was asked to optimize the system. To this end, a special test train equipped with measuring tools was used in order to calculate optimal settings at low and high speeds. From this test train, the Quality of Service parameters were compared with the requirements put forth by the government. The Clear CinCom optimization report contained suggested changes to the BSS-parameters of the Base Station Controllers (BSC). Since the planning had been done carefully, almost no additional hardware adjustments were necessary.

Results

By the end of 2007, train travellers from Amsterdam to Paris can enjoy optimal safety and service on board. This is how Clear CinCom proves to be the European quality leader in planning, optimizing and validating cellular radio networks - including GSM-Rail.