A new safety-critical system for the railways

Providing the Rail Safety and Security Board with expert consultancy to assess a new safety-critical signaling system for the UK’s railways.
Background
The Rail Safety and Security Board (RSSB) was established to implement recommendations following the public inquiry into the Ladbroke Grove train accident. Its prime objective is to lead and facilitate the railway industry’s work to achieve continuous improvement in the health and safety of the railways in the UK. In doing so, they aim to reduce the risk to passengers, employees and the public.

Contracted by the Strategic Rail Authority, the RSSB develops rules to aid the introduction of new communication technologies to the UK’s railways. One such technology being introduced is a new signaling and management system called the European Rail Traffic Management System, or ERTMS. This system is not only being introduced in the UK, but across Europe, and will enable interoperability throughout the European Rail Network. ERTMS will reduce the equipment required on trains travelling in Europe, shorten travel times, and save on operational and maintenance costs.

The RSSB has the responsibility of defining specific rules to govern the safe working of ERTMS and to ensure the system performs well on the UK rail network.

Challenge
The introduction of ERTMS to the UK rail network is a major challenge since it involves a fundamental change in the way the UK railway operates. Rather than depending upon trackside signals, train drivers will receive signaling instructions directly to the cab. These signaling instructions will be transmitted using an adapted GSM mobile phone technology known as GSM-R.

Before implementing ERTMS, the RSSB needed to determine whether GSM-R could be used for future signaling on the UK network. It had already been established that GSM-R could technically fulfil this role, but it was not known whether it would continue to provide a full service in congested areas, such as London. As a safety-critical service, it was essential for the RSSB to determine that ERTMS would continue to operate correctly.
Solution
Roke Manor Research has an established background in mobile phone communications systems, and access to many existing tools to model these networks. Naturally we were able to model a GSM system and were able to adapt our existing tools for the GSM-R rail system. This kept the costs down for the RSSB, and allowed a flexible approach to the modelling work when different scenarios were required.

To provide an accurate and comprehensive tool we modified and integrated three models:
• A management module - which provided overall control and scenario creation.
• A protocol model - to manage how data was transferred/handled (e.g. basestation handover).
• A radio propagation model - to analyse the physics of the radio emissions in the scenario.

The modelling even included train timetable information (provided by AEA Technology Rail), which was key in defining the demand on the GSM-R network and the knock-on effect any message delays would have.

Result
Our modelling toolset was used initially to test the use of GSM-R in a relatively benign environment. The results from this gave the RSSB confidence in the radio technology and the modelling tools. These were then applied to the more complex and demanding environments of Liverpool Street and Clapham Junction, London.

We demonstrated that the ERTMS specifications for GSM-R implementation were viable and provided the RSSB with the crucial data they needed regarding the performance and limitations of the system. Arguably more important though, the RSSB gained a more complete understanding of the system as a whole - and with our tool were able to visualise the behaviour of the radio network in a complex environment.

We work in almost all areas of transportation - from CCTV monitoring algorithms to consultancy and system modelling. If you would like to find out more about our capabilities in this area, please contact us.