

# Multi Service Radio Communication for MAGLEV and Train Systems

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**ABSTRACT:** Evolution of system concepts is mostly driven by new requirements. Particularly in public transportation systems increasing demand for passenger communication as well as for safety/security purposes is characteristic. Broadband radio communication can provide the services for these requirements. The RBS network of the evolutionary TELEFUNKEN maglev radio system is IP-based. A fast and seamless RBS handover for instant routing of the radio link to a vehicle is implemented there. The system uses a digital modem with the possibility of instantaneous adaptation of the modulation scheme to propagation conditions. To handle rapid changing conditions in train communications, fast signalization with minimum protocol overhead is crucial for throughput optimization. By using decision criteria depending on the required quality of service, a high reliability is maintained.

## 1 SERVICE REQUIREMENTS

This chapter primarily describes requirements and services for MAGLEV train communication scenarios.

### *1.1 Requirements*

The evolution of traditional or existing system concepts is often - at least - influenced and sometimes even forced by new technology innovations, due to science and research discoveries. Everybody knows, these important historical examples such as the first steam machine, the first electric light bulb or the first semiconductor and their effects for future life. But more often, the evolution of products and systems is driven by a change of the requirements or by modified customer expectations resulting in new customer requirements. Especially in public transportation systems two main sectors for new requirements can be identified.

One of these sectors is the public area, with the fast growing demand for passenger communication and information possibilities. The other main sector is the non-public area of safety and security applications used for operation purposes. Both are surely not only limited to public transportation systems. But a public transportation system on one hand offers a good “platform” and occasion for passengers to communicate, but on the other hand is also a potential center for criminal threats and acts.

At first glance, it seems that both sectors are completely different and independent from each other. But both sectors are dealing with different information or data to be exchanged with moving public transportation vehicles, simply summarized by the term mobile communication.

Whereas the passenger communication sector was negligible for a long time - traveling was more an event or a time for relaxing without any disturbance. Simple communication solutions like telephones and fax machines installed in trains and aircrafts were installed at a later time. Today, terrestrial mobile telephones in trains, as well as satellite telephones in aircrafts are standard communication means.

With the rise of personal computers, small mobile cellular phones and internet access the global mobility and connectivity has reached new dimensions. Everybody wants to communicate with everyone else, anytime and everywhere. Thus, also internet access in aircrafts as well as in high speed train systems becomes more and more popular. Public transportation systems will no longer “isolate” its users during the travel. Depending on the kind of public transportation system and the duration of the travel, there are different requests by passengers and system operators which have to be considered.

## 1.2 Scenarios

On short distances and mass transit operations the focus is more on quick and simple communication as there is less time for intensive work. Besides voice communication passenger could quickly check for new text messages using small computer devices (Palm, PDA). But also in some new advertisement concepts, the usage of broadband connections to public transportation systems is groundbreaking. With promotions via video screens, consumers are faced with a new way of direct marketing for products together with up-to-date news. So, advertisement can be used for re-financing of the communication investments. Combined with wireless LAN distribution on board, tourists can also use this connection for downloading updates of site information, maps or easily modify their sightseeing and travel arrangements. Regardless of all these aspects, the operator of such a transportation system will use it primarily for passenger information and his security obligations.

Quite different on long distance travel, people can take advantage of existing infrastructure and workspace within the transportation system. Regardless of usual passenger information systems with new additional features such as online reservation or updated individual travel information for example, an access to all internet services is desired. With this internet access both amusement and work can be provided. Other passengers can enjoy themselves by chatting, surfing and VoIP communication, while business people can connect via a virtual private network (VPN) to their office servers for working in an office-like environment. Downloading files and reworking presentations, checking mail accounts and answering correspondence, instead of wasting precious working time during a trip.

Meanwhile many travelers are very sensitive in missing adequate communication possibilities regardless whether they use it just for fun or for business purposes.

The other important sector of new requirements in public transportation system has a very serious reason. The dramatic situation on September 11<sup>th</sup> has not been the initial signal of vulnerability for our daily life, but it has been a very significant one. Already before and for sure after this situation there have been attacks against exposed targets in our society, with a criminal, religious or terrorist background. From toxic gas attacks in Japanese subway system, and the bombing in the London underground trains until bombing of Spanish commuter trains, public transportation has been identified as the target number one for such terrorist activities. Combined with conventional installations of sensors for fire and smoke, permanent video surveillance is seen to

be one of the best solution to detect potential risks, protect people and avoid disasters.

Beside these rather dramatic sceneries video surveillance has proven its potential also against normal crime and vandalism in city areas as well as in public transportation systems. Available 24 hours a day, with automatic recognition and detection of potential problems it is an effective and economic solution to prevent all kind of terrorist and criminal problems in and outside of public transportation systems. Most of this surveillance is focused on stationary objects like train stations, platforms, escalators, whereas only a limited capability is available inside moving objects such as train vehicles. Fixed installation of cameras are surely the easiest way to achieve a good surveillance coverage of large sensitive areas, but moving trains must not stay a critical white spot due to limited video data transfer capabilities.

## 1.3 Services

Special communication equipment can provide high upload capabilities for all kind of data to transmit data to a central control and monitoring station.

To ensure a reliable and optimized data transmission for all services, the data shall be handled corresponding to their individual priority and quality of service (QoS). For this reason the TELEFUNKEN radio system provides different QoS values, which are handled internally on different levels. Table 1 gives an overview of this quality levels.

Table 1: Quality of service for TRainCom MAGLEV

| Quality of service description |      |                |                   |                         |
|--------------------------------|------|----------------|-------------------|-------------------------|
| ID                             | Char | Name           | Service           | Properties              |
| 1                              | RT   | real time      | propulsion        | as fast as possible     |
| 2                              | HQ   | high quality   | operation control | as reliable as possible |
| 4                              | HDR  | high data rate | video, internet   | as much as possible     |
| 8                              | TFK  | TELEFUNKEN     | ---               | special for train com   |

All these described communication services for passenger communication, as well as for security purposes require different data volumes, both, in upload and download direction. Sometimes there are concurrent transfer demands in a specific direction, but most of them are complementary. Today's mobile data communication standards are dedicated to very asymmetrical conditions with a high download and a limited upload capability. Together with technical constraints towards higher velocity and high service availability, these standard systems can hardly fulfill all customer expectations and operator requirements of the near future.

Dedicated communication systems which provide the required technical solution, but considering economical conditions and health regulations at the same time, are necessary for continued successful operation of public transportation systems.







