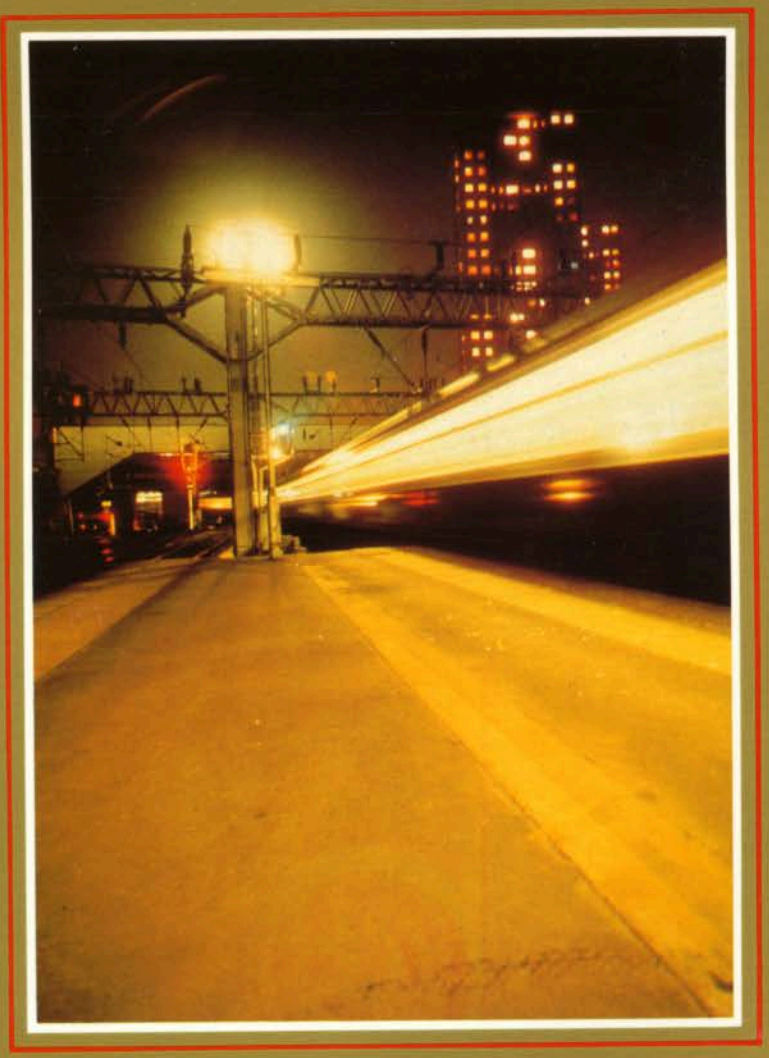

GEC

RAILWAY COMMUNICATION SYSTEMS

GEC Telecommunications Limited is a Management Company of The General Electric Company p.l.c. of England

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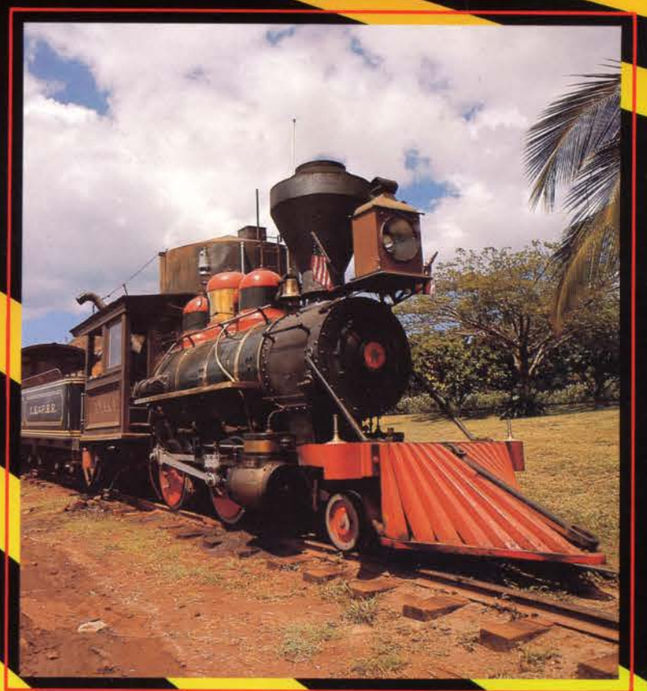
The movement of passengers and freight is a highly competitive business and to maintain their market share, railway authorities are having to improve the efficiency of their networks and increase the speed and frequency of their trains.

A number of 'new-style' main-line high-speed trains are already in service on modern inter-city routes. They have brought a new vitality to rail transport, their increased speed and comfort clearly making them far more attractive to travellers – up to 40% of the passengers on high-speed inter-city routes represent 'new' rail business.

Many of the world's mass transit networks are also being modernised and extended. The environmental and socio-economic benefits of effectively-integrated suburban feeder, and city-centre distribution systems are well established. Many newly-formed administrations are either working on their first route or involved in well-advanced planning.

In an increasing number of countries rail transport is being fostered by governments who see it as more energy-economic and less polluting to the environment than comparative road transport systems.

The readiness of railway administrations to introduce modern technology, their ability to survive difficult economic conditions, and the acquiescence of governments all point towards more effective and efficient railways in the 1990s and beyond.



Advanced technology currently being introduced into modern main-line and mass-transit rail networks is significantly enhancing their revenue earning potential. Improvements are evident in the increased speed and frequency at which trains can be operated, and in the additional comfort and facilities available to passengers.

The ever-increasing congestion of city streets has led to the introduction of many new underground mass-transit networks and to the modernisation and expansion of those already established. More than a million passengers are carried daily on each of a number of mass-transit networks around the world, easing street traffic and making city life more tenable.

The number of main-line rail networks with trains running at speeds in excess of 160km/h is still relatively small, but speeds are increasing worldwide. The new style high-speed trains linking metropolitan centres offer travellers a fast and efficient means of transport which is highly competitive both in terms of cost and comfort.

A new and competitive edge is also being introduced into main-line freight operations. Increasingly-sophisticated, computerised systems are providing facilities for the real time control, and status/location monitoring, of locomotives, freight consignments and rolling stock.

Railway modernisation is being undertaken by all advanced countries in the world. Britain, France, Italy, Canada, Japan and the Soviet Union are among those which have new style high-speed trains in operation.

The primary need of such systems is of course to provide tractive power in a form that will make the higher speeds both attainable and capable of being sustained; but a necessary prerequisite is a full appreciation of the many other factors that are involved. There are a number of different technological disciplines that must be satisfied before a high-speed service can be offered to the travelling public. *One of the most vital requirements is the efficient communication of signalling, voice, telex and data information.*

OPTICAL FIBRE

When modernising their communications systems today's fast moving railways are increasingly turning to optical fibre as a cost-effective transmission medium. Its complete immunity from the effects of external electro-magnetic radiation makes it attractive for use with electrified rail networks particularly those using thyristor-controlled locomotives.

Compared with its copper counterpart, optical fibre has a much lower transmission loss which dramatically reduces the need for intermediate repeaters – in many systems they have been eliminated completely. Its high potential bandwidth offers administrations the opportunity of installing systems which can easily be expanded as the need arises.

GEC manufactures a wide range of optical fibre systems from 2 to 140 Mbit/s. Systems have been installed on both mass-transit and main-line rail networks. British Rail is rapidly expanding its use of optical fibre systems. GEC supplied BR's first 140 Mbit/s single mode system for a 127 km route linking Bedford and Nottingham in the Midland Region. GEC systems will also be installed for BR in Scotland and the south of England.

MICROWAVE RADIO

On some rail networks where routes pass through a particularly barren or hostile environment the installation of cable systems is not always practicable. In such instances it can be more economic to use trunk microwave-radio systems. GEC manufactures a comprehensive range of analogue and digital systems operating at frequencies of 2 to 19 GHz. Narrow and broadband systems are available to meet varied requirements and as few as 30 or as many as 1920 audio channels can be provided over each radio bearer. Where highly-secure traffic, such as signalling information, is being carried, microwave channels are monitored by microprocessor-controlled switching equipment which automatically switches to a standby channel in the event of failure.

GEC has supplied a number of microwave systems for railway communications. A 2 GHz system linking Harare and Dabuka, was recently supplied to the National Railways of Zimbabwe, and work is currently in hand for a long-haul 6 GHz system for the Rede Ferroviaria Federal in Brazil.

PULSE CODE MODULATION

The communications necessary for the high-density high-speed traffic of today's railways are far more comprehensive than the limited facilities previously provided between traditional signal boxes. An increasing number of railways are now using centralised control systems which result in long stretches of track being controlled from centres separated by up to 200 km. Many of the communications systems used on such networks have been converted to digital operation. Extensive use is made of pulse code modulation (PCM) equipment which converts up to 30 audio inputs into digital form and multiplexes them into one 2 Mbit/s data stream. This is either transmitted directly to the distant terminal or, on more complex systems, multiplexed with other data streams to form a combined signal for subsequent transmission over a broadband system.

GEC manufactures an extensive range of PCM systems and the higher-order digital multiplex equipment required for broadband systems. As can be seen from the map overleaf a large number of GEC PCM systems are in service in BR's national network.

CARRIER-ON-CABLE

Low-density rail traffic serving rural and urban areas does not normally require complex communications, so that basic carrier-on-cable systems are usually adequate. GEC has manufactured such systems for many years and a full range of interface equipment is available to enable them to be inter-connected with the analogue or digital broadband systems which serve the higher-density parts of the rail network.

The optical fibre, microwave and PCM equipment described can be engineered to provide authorities with one integrated arterial system running throughout their network and capable of carrying all communications.

These highly-secure, duplicated, digital systems provide discrete circuits suitable for relaying vital signalling information as well as more routine day-to-day communications. They handle data direct without the costly and inefficient analogue-to-digital convertors previously used. The PCM equipments, which form the input and output terminals of the communications system, are highly flexible and can be arranged to accept inputs as diverse as audio signals and 338 kbit/s computer data highways.

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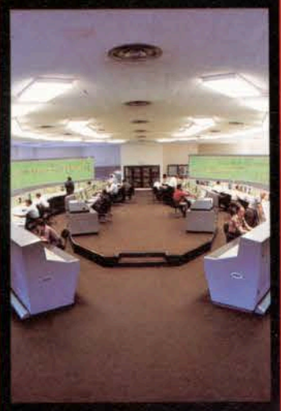
TRAIN INFORMATION SYSTEMS

Modern train information systems require increasingly complex communications links to receive and transmit the information from the rail network they monitor. The tendency toward larger



centralised control centres means that in many cases, one system monitors hundreds of kilometres of track, using wall-sized train describers and visual display units. Extensive telephone networks provide discrete communications between the despatcher, drivers, signal boxes and level crossings etc. Centres are also tending to control an increasing number of ancillary functions such as platform information services and barrier surveillance for the area under their control. The development of these large centralised control centres necessitates longer and more complex lines of communication which have to be capable of carrying signals as diverse as single channel data or closed circuit television.

ELECTRIFICATION CONTROL

To increase the cost-effectiveness of railway operations and to enable larger trains to be hauled, many of the higher-density rail networks have been electrified.

The monitoring and control of the trackside switchgear and substations is normally done from centralised control rooms using telemetry or data with dedicated discrete telephone circuits to provide voice communication.

ADMINISTRATIVE TELECOMMUNICATIONS

To meet administrative needs most rail networks have a telecommunications system that interconnects their station telephone and telex exchanges. Links with the national telecommunications

system provide communication with the general public and the service industries.

It is important that railway communications are modernised in step with emerging national digital networks.

OPERATIONAL COMMUNICATIONS

Communication between the despatcher and locomotive drivers has traditionally been provided by trackside telephones. The increasing tendency of railway administrations to

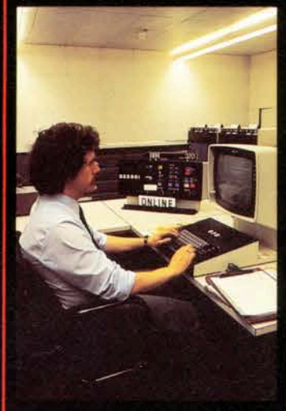
centralise their control points has meant that the possible distance between driver and despatcher has increased significantly. This fact and the desire for constant communication has led to the introduction of track-to-train radio communications.

When a number of such radios are used in the more distant parts of a rail network the signals are fed, via a remote radio base station, over trunk circuits to the central control point.

Trunk circuits which fully meet the requirements for discrete and secure channels can be provided by an integrated communications system.

FREIGHT AND PASSENGER DATA

The effective deployment of locomotives and rolling stock is one of the highest priorities of almost every railway administration. Computerised freight handling has played a



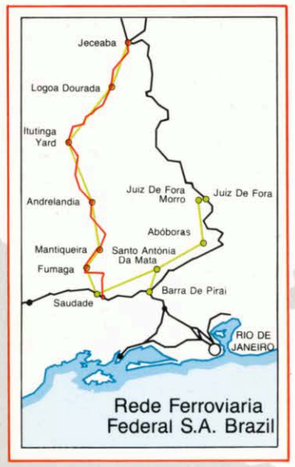
leading role in recent improvements made in railway efficiency and systems are well established in many networks.

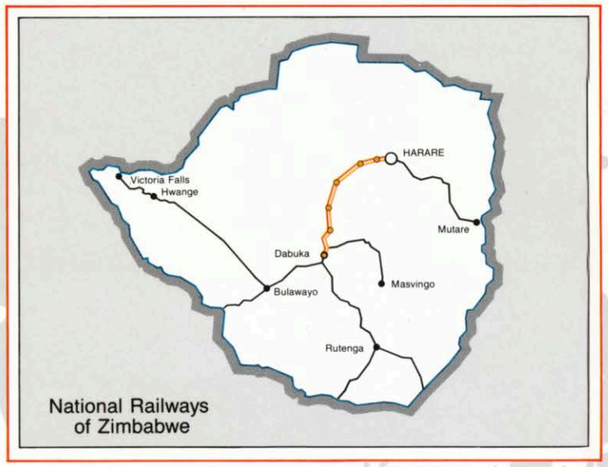
Computerised passenger handling is also becoming commonplace. The vitality of modern rail travel owes much to the immediacy with which prospective passengers can be advised of travel schedules, make seat reservations and be supplied with tickets.

The efficiency and effectiveness of these new computerised systems is directly dependent on the quality of the data highways that interconnect them.

The information for all these services can be carried over one integrated arterial communications system.

Integrated Arterial Communications





KEY

- Analogue Line Systems 960cct Coaxial Line 12cct Carrier-on-Cable
- 2 Mbit/s PCM
- 140 Mbit/s Optical Fibre
- 2GHz Microwave Radio
- 6GHz Microwave Radio

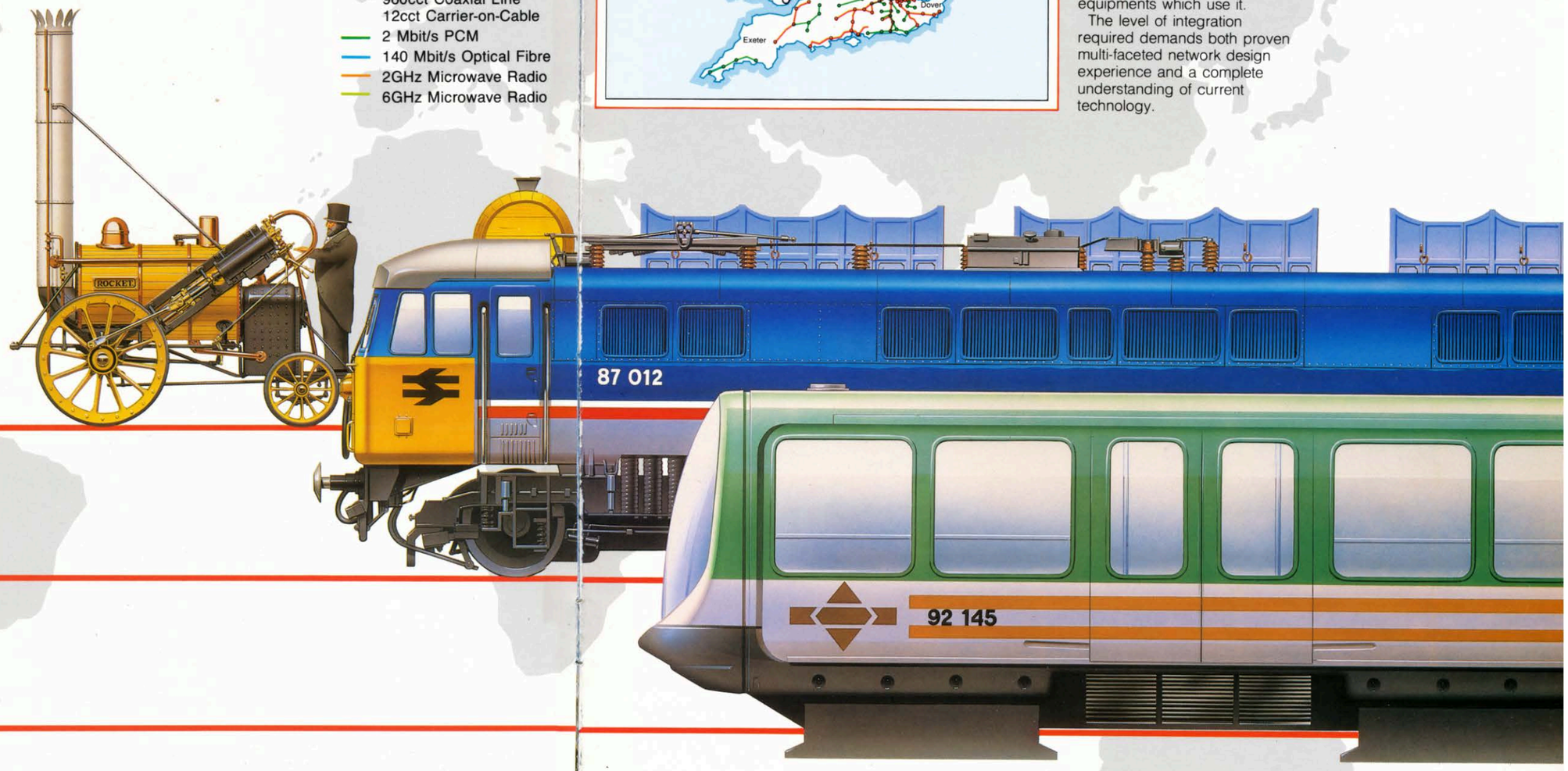
International Projects

GEC has more than 50 years experience of specifying, designing and manufacturing communications systems for major main-line rail and mass transit networks. In addition to being a principal supplier to the UK's British Rail network, GEC has supplied a wide range of systems to various overseas authorities.

The technology associated with modern rail and mass transit networks demands a high degree of integration between the various disciplines involved in providing an efficient rail network. It is essential that the communications network provides fully-compatible interfaces for the various equipments which use it.

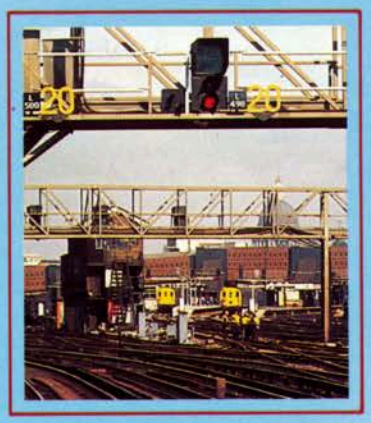
The level of integration required demands both proven multi-faceted network design experience and a complete understanding of current technology.

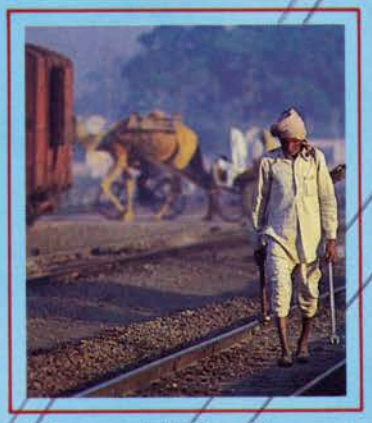
GEC Telecommunications, in association with other product-related companies in the GEC group, is fully capable of providing the high degree of integration and the specialised knowledge necessary.



GEC

Railway Communications





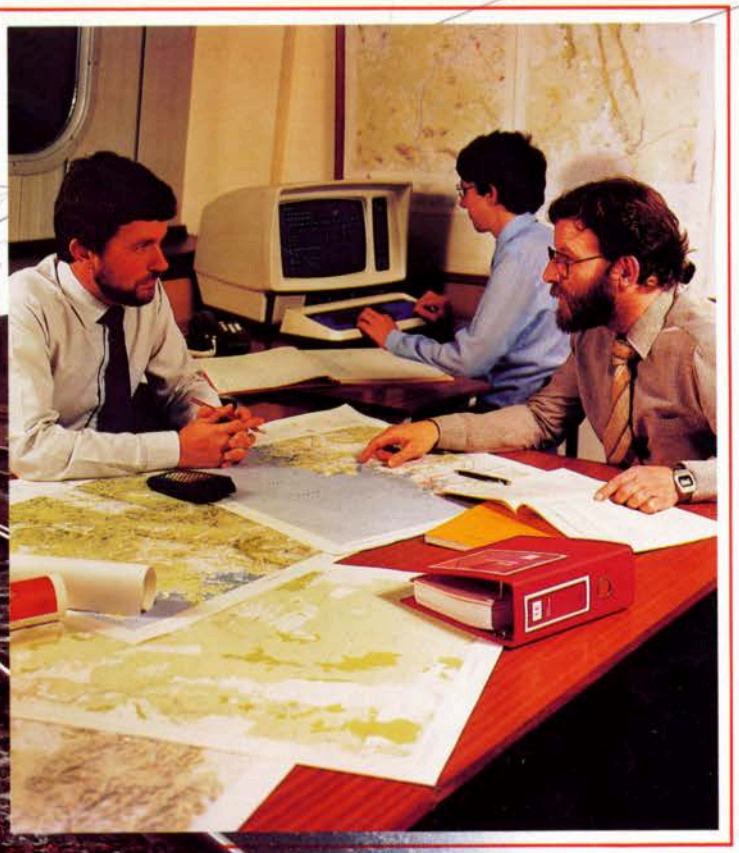
PLANNING AND ENGINEERING

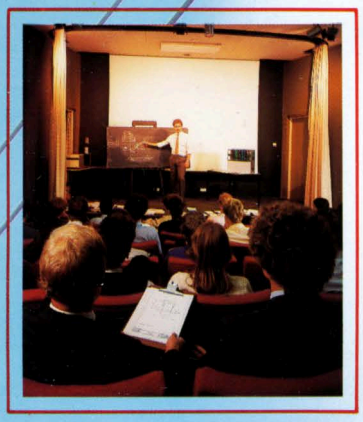
As a major manufacturer and supplier of telecommunications systems GEC has specialised design, engineering and system-planning departments staffed by senior engineers who have been chosen for their broad knowledge and experience of planning analogue and digital telecommunication networks.

Project studies are undertaken on a network or sub-system basis; they establish the feasibility of customers' proposals and result in a detailed specification of the equipment required. Where necessary these studies can include the planning and provision of telephone exchanges, telex terminals, track-side telephones and telemetry equipment. The appropriate level of technology, technical risks and economic trade-offs, with their influence on performance and availability objectives, are the factors which have the most significant impact on any proposed solution.

The systems planning department makes extensive use of CAD programs and has a comprehensive software library which caters for the fundamental network simulations and calculations for a wide range of systems. Many of the programs have been written by GEC systems planning engineers. A major element in the CAD facility is the company's on-site IBM 3081D mainframe computer.

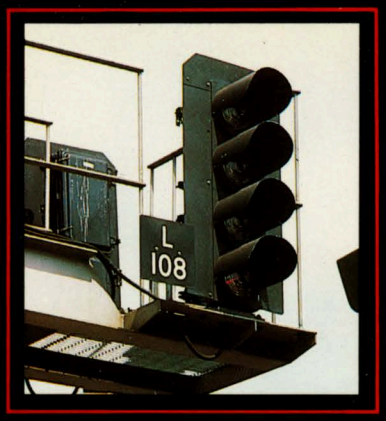
In common with other sectors of the industry, railway communications systems are being extensively influenced by the rapid advances being made in technology. Specifying the integrated arterial systems required by the rail networks of today requires a complete understanding of current technology for both the telecommunications system and the peripheral equipment, with which it has to interface.

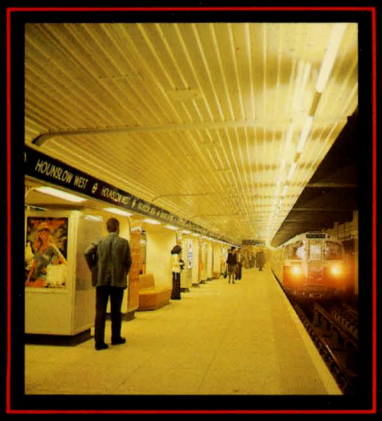




TRAINING

The efficient maintenance and hence the trouble-free and reliable operation of communications systems, is largely dependent upon the standard of training provided for engineering and technician staff. GEC Telecommunications has a large training complex at its headquarters in Coventry, much of which is devoted to training engineers and technicians in the operation and maintenance of communications systems. In addition to its extensive lecture facilities, the training department has laboratories equipped with both analogue and digital microwave-radio, multiplex and line systems on which full maintenance and fault procedures can be simulated.





MAINTENANCE

GEC provides a worldwide service for the maintenance of communications and associated peripheral equipment. This service can be either comprehensive and provide a guaranteed level of operation between defined points, or it can be supportive and form part of a larger existing maintenance organisation. GEC has extensive experience of establishing on-line monitoring systems which facilitate the prompt detection of circuit degradation. Suitable tools and test equipment can be provided and back-up resources such as service repair centres, stores, stock holding and distribution and fault-reporting procedures can be established and operated when required.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