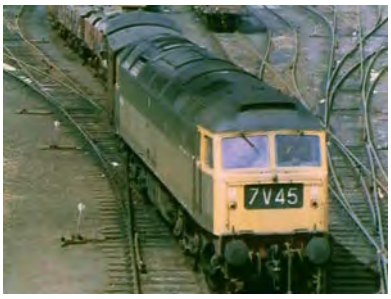
Bits Bytes and Bauds

TOPS Development

The management of a railroad operator's fleet of locomotives, coaching stock and wagons used to be a logistical nightmare. Stock could be located anywhere on the railroad network or even on another operator's track. How could locos be recalled to their depot for servicing when it was due? How could a depot manager get the right wagons for a customer's load? Even knowing how many of each type of stock they owned was difficult. It was not unknown for area managers to hoard wagons in their sidings in anticipation of regular seasonal traffic, knowing that they might well be unavailable otherwise.



The answer lay in a central computer database and a rapid communications network. By the mid-1960s computers had become reliable enough to support the 24-hour, 7-day culture of railroads and were powerful enough to handle the large amount of data needed. Telecommunications networks had become both more widespread and capable of handling such data traffic.

With these facts in mind, Southern Pacific Railroad commissioned the design of a system called Total Operations Processing System, TOPS. It was based on large IBM mainframe computers in a central locations and linked via modem circuits over the railroad's telecoms cables or public network carriers.

The success of TOPS led them to capitalise on their investment by selling the technology to other railroads. One such purchaser was Canadian National, who further developed it and licensed the results to the British Railways Board in the early 1970s.

The site chosen to house the computer system was in a newly refurbished building close to the existing Board Headquarters at Marylebone, called Blandford House. Here also was the hub of the telecoms network controlled from a huge console with a space-age appearance. It was called the Communications Data Control or CDC. [The picture shows the official opening of the CDC by the Minister for Transport, Richard Marsh]

From the CDC radiated a network of data circuits using the latest in modem technology connected to the railway's voice telephone network which was rapidly modernising with the new high capacity carrier systems and the newly introduced digital transmission. At the far end of the circuits were to reach marshalling yards, maintenance depots, certain signalboxes, area, divisional and regional managers' offices. Smaller freight yards, private sidings and collieries were not connected directly to TOPS, but reported to a TOPS-connected office by facsimile.

TOPS Implementation

TOPS was introduced gradually an area and a yard at a time. It was necessary to renumber some of the fleet to remove duplicate numbers left over from the old Regional days and to establish a standard format. The present system of class numbering for locomotives dates from this period.

The benefits grew as the implementation proceeded. The whereabouts of every piece of rolling stock could be traced instantly. Maintenance schedules on locomotives became better managed. Wagon hoarding became a thing of the past as stock could be called up when needed and dismissed when no longer required. Wagonload freight could be managed automatically in hump shunting yards without re-entering the train consists from telex messages or FAX.

The Film ‘Bits, Bytes and Bauds’

The film was commissioned from British Transport Films, by the British Railways Board Signal and Telecommunications Department in consortium with all the manufacturers of equipment used on the system and was released in 1974. As a result, many of the functions of TOPS are glossed over in the film which only shows its application to wagon load freight. The major focus is on the telecommunications network and the equipment used within it. The custody of British Transport Films has passed to the British Film Institute who have gradually released films on video for public sale. ‘Bits Bytes and Bauds’ is probably of little commercial interest and unlikely ever to see the light of day. Fortunately this print of the film was discovered in a railway office in Reading as it was being cleared. So this edition has been transferred privately to DVD by the National Motor Museum Film & Video Service. It will be of particular interest to those who were involved in TOPS.

Various pieces of hardware are illustrated: the miniature Hollerith card reader/punch, the terminal and the printer. We see the insides of the computer terminal with commentary about the various parts. There is a more detailed description of the card reader and punch. Next we see some shots of the CDC at Blandford House and the computer centre, before the film ventures onto the telecomms network itself showing the carrier telephone equipment and the trackside repeaters as well as the Lenkurt modems. There is a section about the Mufax facsimile machine, which did not form part of the core TOPS system itself but was used to receive reports from smaller, non-connected yards.

There is a great deal of technical information about the automatic management of the network from the CDC with very detailed explanation of the logic elements. This is probably too complex for a general audience, but only provides an overview for technicians maintaining the equipment.

What happened to TOPS?

TOPS was promoted on the basis of improved efficiency giving cost savings, especially in the wagon-load freight business. Indeed payload per freight train increased and cost per train-mile fell. However, with the demise of wagon-load freight, benefits were still visible, but difficult to quantify. On the other hand it spun off many subsequent database systems, including TRUST, the automatic train reporting system.

TOPS was never designed to handle the fragmentation of the rail industry that followed privatisation in the 1990s and today it struggles to cope. The simple text-based interface with clumsy command structure sits ill with today’s modern user interfaces with full colour graphics.

TOPS in the 21st century may be old and hoary, but it was the grandfather of all the automated train database systems currently in use.

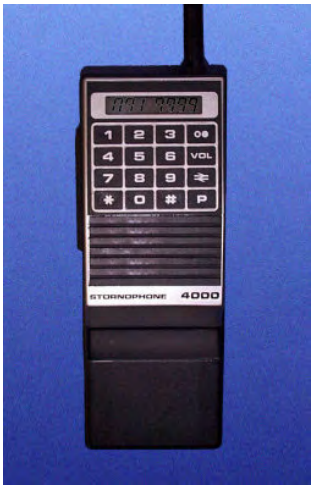
A New Way to Communicate (1987)

With modernisation of the railway's Engineering Departments in the late 1970s enhanced communications were required. The greatest need was on the 25kV electrified lines out of Euston and Glasgow.

A radiotelephone system (Private Mobile Radio PMR) was introduced covering the lines from Euston to Rugby, also from St. Pancras to Bedford, and another one from Glasgow towards Gretna. These systems were operator controlled, with the ability to call other radios, into the railways own private telephone system and to the Electrification control rooms (ECRs). These systems proved successful and a case was made, largely based on the cost-savings of reducing train delays to extend these systems nationally to be known as the National Radio Network, NRN. The Cellular networks had not been introduced at this time, but with the greater introduction of microprocessors it was becoming possible to provide automated radio networks.

A new Way to Communicate was made by British Transport Films, as a training video for users. It shows various scenarios to illustrate the facilities for the general user and how they operate. The locations used are on the Great Northern electrified lines from Kings Cross between Alexandra Palace and Stevenage and shooting took place in late 1986/ early 1987. The cast are mainly railway staff.

The film opens with a reconstruction of an incident involving children trespassing on the trackside. This is followed by an explanation of the zone structure of the NRN.



The operation of the Stornophone 4000 hand portable radio (left) is explained. This was later superseded by the Brunel hand portable radio (right) with a further increase in power, but a less efficient antenna. Despite the warning in the film on the radio's fragility the Brunel is in fact a robust piece of equipment and is considerably more powerful than its modern cellphone counterparts.

There follows a section on operating procedures and message protocol with further practical examples.

The NRN enables radio to radio calls, radio to Railway Telephone calls, and Railway Telephone to radio calls. In electrified areas there are also special codes to give direct access to the Electrification Control Room (ECR). The radios also have a short code to give access to the railway Train Control Office (TCO), with one button access from train radios, in emergency. The railway Train Control Office can also make broadcast calls to all radios in a selected area.

Although much communication now takes place using cellphones, the NRN is expected to be in service until at least 2012. Its successor, the railway adaptation of the public cellphone network, GSM-R, will be gradually implemented throughout the British rail network.