

REPORT 1158

DATA COMMUNICATION IN THE MARITIME MOBILE SERVICES
USING MF, HF AND VHF FREQUENCIES

(Question 76/8)

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1 Introduction

A service providing exchange of data between ships or oil rigs and coast stations could be provided in the MF, HF and VHF bands allocated to the maritime mobile service as an extension to existing services. This report details the results of trials conducted in the United Kingdom in providing medium speed (1200/2400 bit/s) data links using MF and VHF frequencies and of tests conducted in the German Democratic Republic carried out at a speed of 1200 bit/s on HF frequencies. Further tests will be conducted at speeds in the range of 300 to 2400 bit/s.

2. Background and Applications

Over recent years, there has been an increase in the use of computers and computerised equipment on board ships and oil rigs to handle stores, personnel and operational data. These data are sometimes required at shore based offices so it would be advantageous to provide data links to carry such information. A combination of radio link and land line can be used by employing existing MF, HF or VHF links into a coast station and interfacing to either leased lines or dial-up access to the Public Switched Telephone Network (PSTN).

PART I: Data communication on MF and VHF**1. Trials**

Trials were carried out in the United Kingdom to ascertain the viability of the service. The trials consisted of tests to establish the bit error rate followed by operational tests.

1.1 MF Data Trials.**1.1.1 Error-Rate Tests.****1.1.1.1 Details of Test.**

A synchronous duplex data link was set up between a North Sea oil drilling rig approximately 200 km offshore and an oil company's office using an MF radio telephone link to a coast station and leased line. Multi-tone PSK HF data modems capable of operating at up to

2400 bit/s and conforming to the modulation scheme described in CCIR Report 864 [Volume III] were used at each end of the link. Data were sent in 400 bit blocks at data rates of 2400 and 1200 bit/s during day and night time hours and the corresponding bit and block error rates measured. The tests were repeated using standard CCITT V.22bis PSK line modems operating at 1200 bits per second to obtain a bench mark against which the performance of the HF data modems could be gauged. To obtain a true evaluation of the link, the measurements were taken without the use of error correcting equipment.

1.1.1.2 Results

The HF data modem tests results indicated the following bit error rates :-

2400 bit/s	Day	4.8 in 10^5	to	1.3 in 10^4
	Night	1.9 in 10^4	to	2.8 in 10^4
1200 bit/s	Day	2.0 in 10^6	to	6.0 in 10^5
	Night	1.6 in 10^5	to	3.6 in 10^4

These error rates are well within the capability of any error correcting equipment and are significantly better than those measured for the standard PSK line modems for which bit error rates of between 2.2×10^{-3} and 1×10^{-2} were measured. The characteristics of the leased line caused some imbalance of the HF modem tone amplitudes which may have adversely affected the error rate so, had the HF modem been located at the coast station instead of the office, the overall error rates may have been improved.

1.1.2 Operational Tests

1.1.2.1 Details of Tests

A 1200 bit/s duplex asynchronous data link was set up between drilling monitoring equipment on a North Sea oil exploration rig approximately 250 km offshore and a computer sited in a drilling companies' office using a radio link to a coast station and a leased line as shown in Figure 1. ARQ units were used at each end of the link to provide error correction and asynchronous to synchronous conversion. In this test the land based HF data modem was located at the coast station and connected back-to-back with a V.22bis line modem. The office was equipped with a V.22bis modem. This configuration was more representative of an operational installation which would reduce the overall complexity by requiring one HF modem for the mobile and a standard line modem for the office instead of two HF modems. Access to any suitably equipped location via a PSTN link (instead of via a leased line) would then be possible.

Only limited quantitative bit error rate tests were carried out, however, subjective observations of the drilling equipment data being received in the office indicated acceptable bit error rates during the day but poor bit error rates during the night.

1.1.2.2 Results

The poor performance of the link during the night was symptomatic of the poor propagation characteristics of the radio path at the frequencies used. This fact was borne out by the complete breakdown of reliable radio telex communications using similar frequencies during the same period. A choice of different frequencies during the night hours would have helped matters but operational restrictions precluded further tests.

1.2 VHF Data Trials

1.2.1 Error-Rate Tests

1.2.1.1 Details of Tests

A synchronous duplex data link using a VHF Appendix 18 channel was set up between an oil tanker sailing from Southampton to Plymouth in the English Channel and a coast station at Niton on the Isle of Wight. Data modems used at each end of the radio link were standard CCITT V.22bis line modems employing Quadrature Amplitude Modulation (QAM) at 2400 bit/s and Phase Shift Keying (PSK) at 1200 bit/s. At various ranges, data were sent in each direction in 10^5 bit test message lengths and the received antenna voltage and number of bit errors noted at each end.

1.2.1.2 Results

The results indicated that at received antenna voltages above +10 dB(1 μ V emf) the bit error rates were generally better than 1 in 10^5 (shore to ship) and 2 in 10^4 (ship to shore). These received signal levels are similar to the minimum levels considered adequate for speech channels so it would be possible to operate speech and data services at similar ranges. It was observed during the trials that errors tended to occur in bursts due to various sources of noise interference, for example, static and adjacent channel working by nearby ships. These burst type errors can be overcome by using ARQ or forward error correcting techniques. A further problem was encountered at extremes of range when other ships tried to access the channel when they could not hear speech, thinking that the data transmission was noise. Such a problem should, however, reduce when ships become aware of the existence of VHF data transmissions.

1.2.2 Operational Tests

1.2.2.1 Details of Tests

The VHF data link described in para 1.2.1 was extended via the PSTN to the tanker company's office. Two V.22bis modems connected back-to-back were added at the coast station to regenerate the data signals at the radio/PSTN line interface. This was found to be necessary to reduce data errors caused by noise on the radio or line path and cause maximum modulation of the transmitter at the coast radio