

TECHNICAL FACILITIES REQUIRED FOR  
HANDLING COMMUNICATIONS BETWEEN  
ECMWF AND MEMBER STATES  
AND PROCESSING OPERATIONAL PRODUCTS

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## 1. Introduction

A description and the organisation of ECMWF's planned forecasting system is presented on page 311.

The part of this of particular relevance to Member States is the "post-processing" stage. During this the forecasts produced by the CRAY-1 are processed by the CYBER 175 to meet the pre-defined requirements for users in Member States and locally in the Centre. Files containing the products for each Member State are then immediately passed from the CYBER 175 to the telecommunications system for dissemination to Member States. To receive and to be able to make use of these products operationally, Member States must have the technical facilities to terminate the telecommunications link to the Centre, and be able to follow the telecommunications procedures. In addition they must be able to handle and decode the code forms , in which the products have been disseminated from the Centre. This lecture discusses these various technical aspects.

To give the appropriate background, the Centre's computer system is also briefly described as well as the sort of systems required for termination of lines and handling the operational products. However, the technical problems of using the Centre's computer complex remotely from a terminal in Member States is not covered in this lecture. It is also stressed that even when these basic technical problems have been solved, there is then the question of how the products can be used in a meteorological sense; this is discussed on page 381, 'Use of ECMWF products from a logical, functional and meteorological point of view'.

## 2. The ECMWF computer complex

The ECMWF computer complex can be divided into three linked parts :

- (i) the main computer (CRAY 1)
- (ii) the front-end computer (CDC CYBER 175)
- (iii) the telecommunications computer (RC8000).

(The full configuration of the system is shown in the lecture "General Description and Organisation of ECMWF's Planned Forecasting System", Fig. 2, page 340).

The detailed configuration of the telecommunications system is shown in Fig. 1. All parts of the complex are expected to have come into operation in the new headquarters of ECMWF at Shinfield Park by February 1979. It should be noted that none of the three computers in the system is duplicated and consequently if any one element of the system fails, then it will not be possible to carry out the forecast on that occasion.

## 3. The ECMWF telecommunications network

All Member States will eventually be connected to the Centre by a medium speed telecommunications link (i.e. 2400 or 4800 bps). However, these circuits can only be implemented gradually during the period 1979 - 1984. Member States not receiving a medium speed circuit from the start of operations have the possibility of having a low speed connection (i.e. 50 or 110 bps) as an intermediate solution. The complete network linking ECMWF and Member States will logically form a "star" network.

It should be noted that there will be only one circuit to each Member State; if other institutions than the national meteorological forecasting office are to be connected to the Centre, then this must be accomplished indirectly at the national level by use of multiplexing techniques etc. The ECMWF telecommunications computer will be connected to the WMO Global Telecommunications System via the Regional Telecommunications Hub at Bracknell, to enable acquisition of observational data; probably the same link as for the dissemination of the Centre's products to the United Kingdom will be used. The overall logical structure of the ECMWF telecommunications network and its relation to the Global Telecommunications System is shown in Fig. 2.

#### 4. Telecommunications procedures

The telecommunications procedures to be used on the medium speed circuits operated by the Centre are as follows :

- (i) data link protocol for the point-to-point data transmission interface - CCITT, X25 level 2,
- (ii) the end-to-end protocol (link access procedure B) for the connection between the users of the transmission services - based on the IFIP proposal for an end-to-end protocol, amended for X25 transmission service,

- (iii) file transfer protocol for the definition of the method of data transfer in the form of files.

The procedures are described in detail in documents, which have been distributed by the Centre to representatives in all Member States.

The existing WMO telecommunications procedures cannot be used for many reasons, the most important being that Remote Job Entry cannot be handled by these procedures. It was also required by the CEPT (coordinating body of the European PPT's) that the procedures to be used on ECMWF's telecommunication network should be compatible to those likely to be used in future public packet switching networks (i.e. based on CCITT Rec. X25).

5. Facilities required in Member States for the termination of the telecommunications circuit and handling operational products.

In the case of a low speed connection between ECMWF and a Member State, three basic solutions can be envisaged for the termination of the circuit :

- (i) teleprinter only
- (ii) teleprinter with paper-tape punch (for later, indirect entry of data into a computer).
- (iii) direct connection into a computer.

There are no special error detection and correction procedures.

As all the Centre's numerical products will be in digital form a transformation to pictorial form in some way or another seems essential. Such a transformation has to

be done manually if only teleprinter output is available and automated methods cannot be used. Thus the first solution above should only be used if it is impossible to implement a more flexible solution.

In the case of a medium speed connection between the Centre and a Member State, there are at least five basic possibilities for termination of the circuit and handling the received operational products :

- (i) a stand-alone minicomputer with a printer device (this is again an unsatisfactory possibility, as the received data would have to be processed manually);
- (ii) a stand-alone minicomputer with an indirect connection (e.g. via magnetic tape) to a main computer;
- (iii) a specially designed terminal connected by a direct link to a main frame computer;
- (iv) a connection through the normal telecommunications computer system in the Member State in question;
- (v) a direct connection to the Member State's computer main frame via a micro-processor (network control processor) of the system.

As already stressed, some sort of automated processing of the Centre's products once received (e.g. to convert to pictorial form, or to use in some statistical way) is highly desirable, and thus solutions to facilitate this are to be recommended.

The telecommunications procedures to be used on medium speed circuits of the Centre's network (as described in 4) will have to be implemented by the Member States. In view of the complexity of this problem, cooperative arrangements between groups of countries in acquiring the same type of

hardware and software to terminate the telecommunications link are recommended.

6. Proposed codes for the dissemination of ECMWF products

ECMWF products are likely to be distributed using two code types:

- (i) a subset of the WMO GRID code , basically for use on low speed circuits and in certain cases, if required by particular Member States , also on medium speed circuits;
- (ii) a bit oriented ECMWF code; this allows efficient data compression and is also quite suitable for special applications such as boundary value dissemination or transfer of data in the form of spectral components , if required.

The messages in the WMO GRID code format will be equipped with the complete WMO telecommunications envelope and will always include checksums. The ECMWF code will have basically the following structure :

```

0 2 2 2 F1 F2  n n n n n n  J J Y Y Y G  F L L L L L
(b b b b b b b .....b)

D D D D D D D D .....
.....
..... D D D D
0 2 7 7 F1 F2  n n n n n n  J J Y Y Y G  F L L L L L

```

"F<sub>1</sub> F<sub>2</sub>" identifies the originating Centre (i.e. ECMWF)

" n n n n n n " gives a unique catalogue identification for this particular products, " J J Y Y Y G " is a year/day/time group and " F L L L L L " defines the format and length of the message. "b b ... " is a bit-map showing for which grid

points data re included in a "D D ..." indicates the bit-packed grid point data.

ECMWF products will be provided in this form, which in itself is a self-contained message. However, data in this code form will also be available nested in the WMO telecommunications envelope.

A detailed description of the proposed codes is being prepared by the Centre for distribution to representatives in Member States.



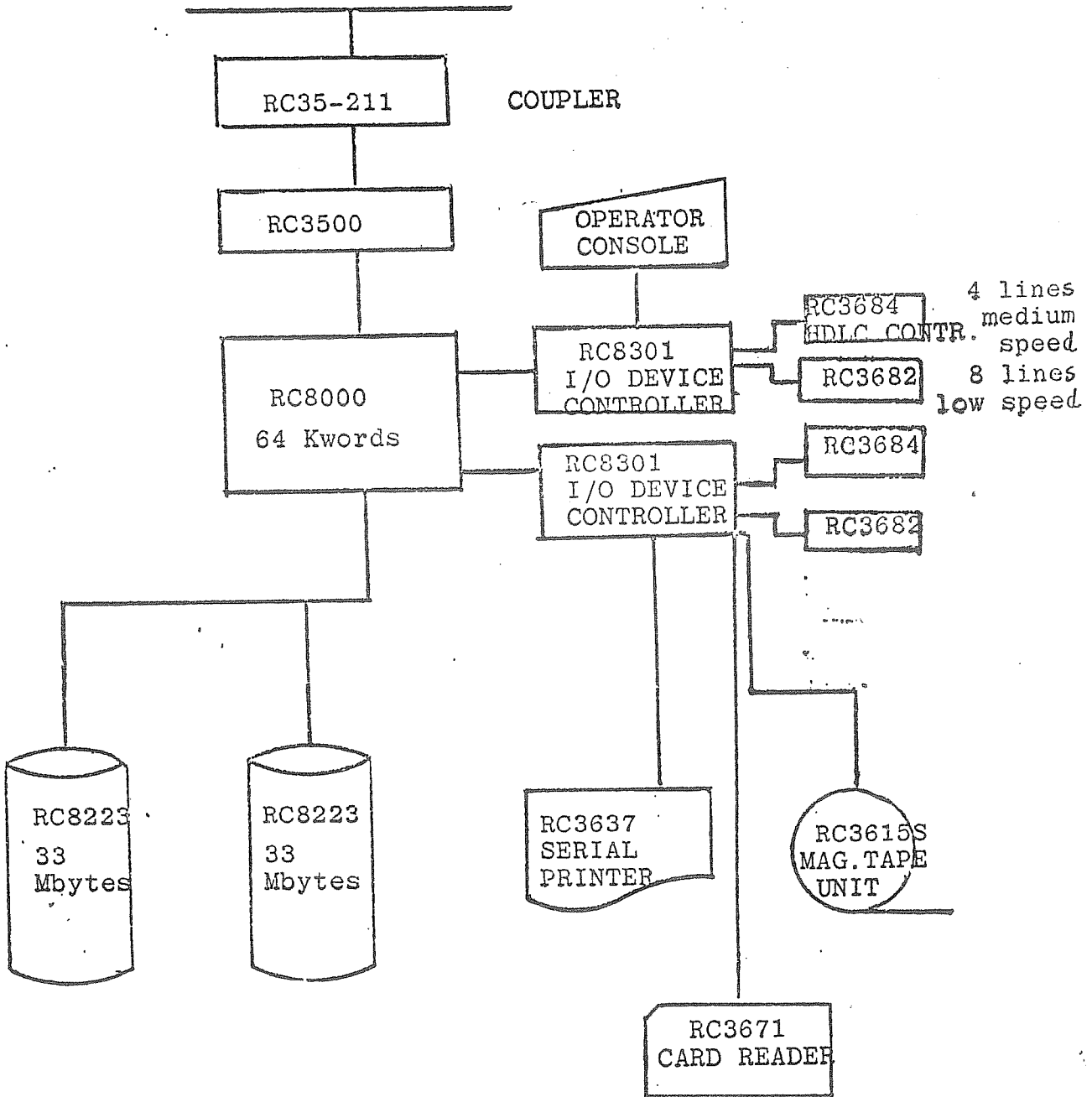


Fig. 1 : The configuration of ECMWF's telecommunication system

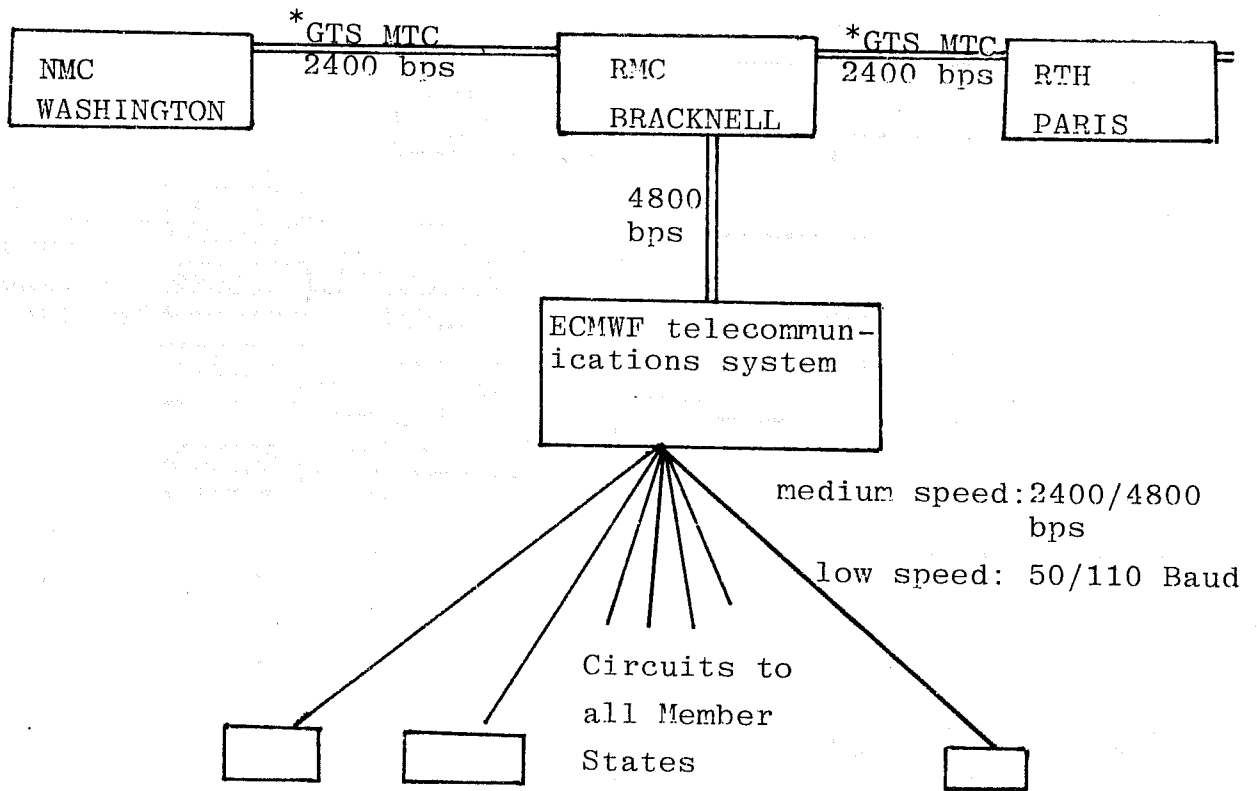


Fig. 2 : Logical structure of the ECMWF telecommunications network.

\* Global Telecommunications System -  
Main Trunk Circuit.