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COMMUNICATIONS CONTROL SYSTEM FOR A CENTRAL COMPUTER

By: P P H Smith C ENG MIEE

The talk associated with this paper outlined the need for a comprehensive communications control system when operating a centralised, multiple access, on-line computer. This paper further amplifies that discussion by providing more detailed information upon a specific example, namely, the Police National Computer.

The information is divided into three sections the contents of which are as follows:-

Section I Background information and discussion of requirement.

Section II System fault diagnosis philosophy, with possible flow chart.

Section III Outline specification of facilities.

It is hoped that this paper will help readers to a clearer understanding of the need for, and the function of, such a system.

SECTION I - COMMUNICATIONS NETWORK CONTROL

Aim

The aim of this paper is to propose, and to provide, a basis for discussion of the methods and procedures to be adopted to ensure efficient communications between the Police National Computer and its user operated terminals.

Background

The Police National Computer will be installed at Hendon. It is to service Police forces throughout the United Kingdom, providing them with rapid access to data banks of various kinds.

Interconnection will be by means of dedicated (Private Wire) lines in the first instance. The communications requirements for the Police National Computer cover two types of data transmission; low speed, 110 baud,and medium speed, 1200 baud.

Terminals connected by 110 baud lines will consist of teleprinters and associated paper tape punches and readers, using ITA5 code with parity check bit, and those connected by 1200 baud lines will be Visual Display Units, using ITA5 code with parity check bit and also Block Check Characters.

The various parts of the system, ie computer, transmission equipment and lines, teleprinters and Visual Display Units will be supplied and maintained by or on behalf of the Home Office.

The system performance must be of a high standard and continuity of service to all users is paramount; it is, therefore, necessary to have a means of assessing the quality of the communications part of the complex and to provide adequate flexibility. Facilities must be available to bring into service standby equipment and lines quickly and easily.

Discussion

Experience of other users of "on-line" computer systems, ie other Ministries and commercial users such as BOAC, indicates that the above essential capability is best provided by a Communications Quality Control, associated with the computer installation and manned continuously.

The prime function of the Quality Control is to ensure continuity of the communications service to and from the computer and its customers, the Police forces. The other main function of the Quality Control is to diagnose, as rapidly and accurately as possible, where faults in the overall system are occurring. This latter function is important because, having located the part of the system which is at fault, personnel responsible for that particular part can be alerted and requested to take the necessary action.

It follows that the Communications Quality Control area must be equipped with means to bring into, and take out of, service all transmission lines and equipment. Sufficient test equipment must be provided to enable location of faults and to carry out tests, inwards to the computer, in conjunction with the computer staff, and outwards, to the terminals, in conjunction with the terminal staff and the Post Office.

It should be noted in this context that it is vital to reduce the number of false alarms or unnecessary call-outs of Post Office or other maintenance personnel to an absolute minimum to avoid the bad feeling and degradation of servicing response time which inevitably follows an excess of such calls. The Communications Quality Control will also act as a clearing house for all reports of terminal malfunction originating either from the terminals or the computer, and effect the overall co-ordination of the different organisations responsible for maintaining equipment and lines.

An additional task, which will represent a considerable load during the first years, will be the technical proving and commissioning of the terminals. Equipment provided for this purpose in the first instance will not become redundant since, as the number of connected terminals grows, the load on the Quality Control will grow, so the usage of this equipment will change as the commissioning task reduces.

There are several ways in which system testing and monitoring may be undertaken, dependent on the amount of money and time available for implementation of the control. There are, however, certain logical steps in the procedure of system fault diagnosis which are essential. They may be elaborated or refined but cannot be reduced by any significant amount. Ideally, the Quality Control should be able to anticipate failure of parts of the system by the use of continuous monitoring equipment which will give warning when performance falls below a pre-determined level. It may be necessary to forego this facility in the first instance because of expense and lack of time. Reliance will have to be placed on check messages and the "timeout" facility provided by the computer system.

A typical method of system fault analysis is described in Section II. This method is not necessarily exactly that which would be used; the final details may be different and it may be modified in the light of experience, but the principles on which it is based should not alter. To implement this method, certain facilities will have to be provided in the Communications Quality Control area. These are listed in general terms in Section III.

Details of equipment types and quantities will follow when agreement in principle has been reached and the Quality Control area planned.

A very important aspect will be the interface with Post Office and other contracted maintenance personnel. The overall responsibility for the efficient working of the system lies with the Police National Computer Unit, but the implementation of the various parts of the system will be delegated to the Directorate of Telecommunications, Post Office, Burroughs, and possibly others.

It will be essential, therefore, that procedures for fault finding, definition of areas of responsibility, methods of call out of maintenance staff and methods of bringing back terminals into service as quickly as possible be written, agreed by all concerned, published on the widest possible scale and then kept up to date.

Conclusion

To ensure the efficient operation of the Police National Computer and to provide the best possible service to the Police forces connected thereto, it is concluded that a degree of flexibility of connections between the computer and the communications network is necessary, together with facilities for rapid diagnosis of system faults and their rectification.

Recommendations

It is recommended that:-

a. a Communications Quality Control be provided at Hendon to monitor the computer/communications network interface, diagnose system faults and to co-ordinate remedial actions, as described in this paper.

b. the following be written, agreed, widely published and kept up to date.

   i. diagnostic procedures

   ii. definition of responsibilities

   iii. standards of performance for lines and equipments.

SECTION II - SYSTEM FAULT DIAGNOSIS PHILOSOPHY

Introduction

The philosophy outlined below is based on

a. restoration of service in the event of a fault in the shortest possible time,

b. accurate location of the part of the system at fault,

c. initiation of the necessary remedial action with the minimum of "false alarms" and wasted effort by maintenance staffs.

Report of Failure

A report of failure may be received by print-out from the central installation as a result of persistent errors in messages received from a terminal, lack of response by a terminal to a polling sequence, lack of acknowledgment of a message sent to a terminal or absence of check messages.

Alternatively a report may be received from the remote terminal operator as a result of persistent errors in messages received from the computer, inability to pass messages to the computer, absence of check messages or locally generated or indicated faults.

Indications of a fault may also be given by the Communications Quality Control monitoring equipment.

First Remedial Action

The first remedial action is the restoration of service.

If a standby circuit is available, this will be substituted for the normal circuit at both terminal and computer centre.

If satisfactory service does not result, the computer Line Adaptor/Line Modem combination will be changed to a spare Adaptor/Modem combination by programme instruction and connected to the normal line.

If a standby circuit is not available, in the case of Visual Display Unit terminals, a call will be set up by the Quality Control operator to the terminal via the public switched network and then proceed as above.

If still unsatisfactory the fault is at the terminal and service cannot be restored immediately unless the terminal has a completely duplicated installation. This may be the case for the teleprinter terminals but is unlikely for Visual Display Unit terminals, and computer staff will then be informed that the terminal is out of service pending maintenance action. All traffic would then have to be passed to an associated teleprinter terminal.

Second Remedial Action

The second remedial action is system fault diagnosis.

The first remedial action will determine whether the line or equipment is at fault and possibly whether the trouble is at the computer or the terminal end.

The next step will be to determine which item is at fault.

If the line is suspect, Control will run a loop test, using data or telegraph test equipment as appropriate and determine whether its performance meets the agreed standards. If the fault is at the computer centre, computer staff will be informed and they will determine, in conjunction with the Quality Control, whether the fault is in the Data Communications Processor Line Adaptor or the Line Modem.

If the fault is at the terminal end:-

a. for teleprinter terminals, replacement of the machine will have restored service,

b. for Visual Display Unit terminals, further tests will be necessary to determine whether the terminal Visual Display Unit or the Line Modem is at fault.

Third Remedial Action

The third remedial action is the initiation of repairs to the faulty part of the system by informing the relevant maintenance organisation staff in accordance with the agreed procedure.

For example, a typical allocation of responsibilities might be:-

a. for computer line adaptors - computer engineering staff

b. for line modems - Post Office

c. for lines - Post Office

d. for Visual Display Units - Directorate of Telecommunications

e. for teleprinters - Post Office

It will be the responsibility of the Quality Control staff to ensure that the terminal operator has informed the local maintenance organisation staff of the need for repair action at his terminal location.

Fourth Remedial Action

The fourth remedial action is to bring back into service any terminal after repairs have been completed.

When a fault is reported cleared, before re-connecting the terminal to the computer, the Quality Control will initiate an overall check of the performance of the terminal and line. If the agreed standards of performance are met, re-connection will then be made and the computer staff informed that the terminal is back in service.

When the terminal service has been restored by the first remedial action, that is, equipment or lines have been replaced and subsequently repaired, the normal line connections and equipment usage will be restored at the earliest convenient opportunity. This will reduce to a minimum the amount of "change of state" information required when operators change shift and keep patching jack-fields clear.

A flow chart illustrating the above is attached as figure 1.

SECTION III - COMMUNICATIONS QUALITY CONTROL FACILITIES

General

The following facilities will be required:-

a. low speed, 110 baud, d.c. line patching jack-field for access and monitoring

b. medium speed, 1200 baud, VF line patching jack-field for access and monitoring

c. data transmission test sets

d. telegraph distortion measuring sets

e. line level measuring sets

f. group delay measuring sets

g. recording oscillograph

h. tape recorder

j. teleprinter

k. Visual Display Unit and modem

l. keyboard for termination of exchange lines

m. intercom to computer staff

n. technical monitoring console

o. terminal technical commissioning position

p. computer teleprinter terminal

q. automatic line section equipment for n. above

r. system state display board.

Patching Jack-Fields

The two patching jack-fields will each provide access for monitoring and test purposes. They will provide, by means of break jacks, facilities for bringing into service standby lines and equipments.

The low speed d.c. line access will be at the 6-0-6 volt level.

The VF line access will be at the Post Office line side of the modems, the data side of the modems will be connected direct to the computer line adaptors to minimise cable lengths.

Test Equipment

Test equipment will be provided to enable the complete checking of line and equipment performance to agreed limits by means of data and telegraph signal generators and error counting and distortion measuring equipments.

Means of measuring other signal and line parameters will be provided, together with recording instruments for easing the assessment of obscure and intermittent faults.

Technical Monitoring Positions

The technical monitoring positions will contain sufficient test equipment and access facilities to enable the operator to carry out rapid diagnosis of system faults and to completely check a terminal link before re-connection to the computer.

The technical commissioning of terminal positions will be similarly equipped and all positions will have available a teleprinter, Visual Display Unit and intercom facility.

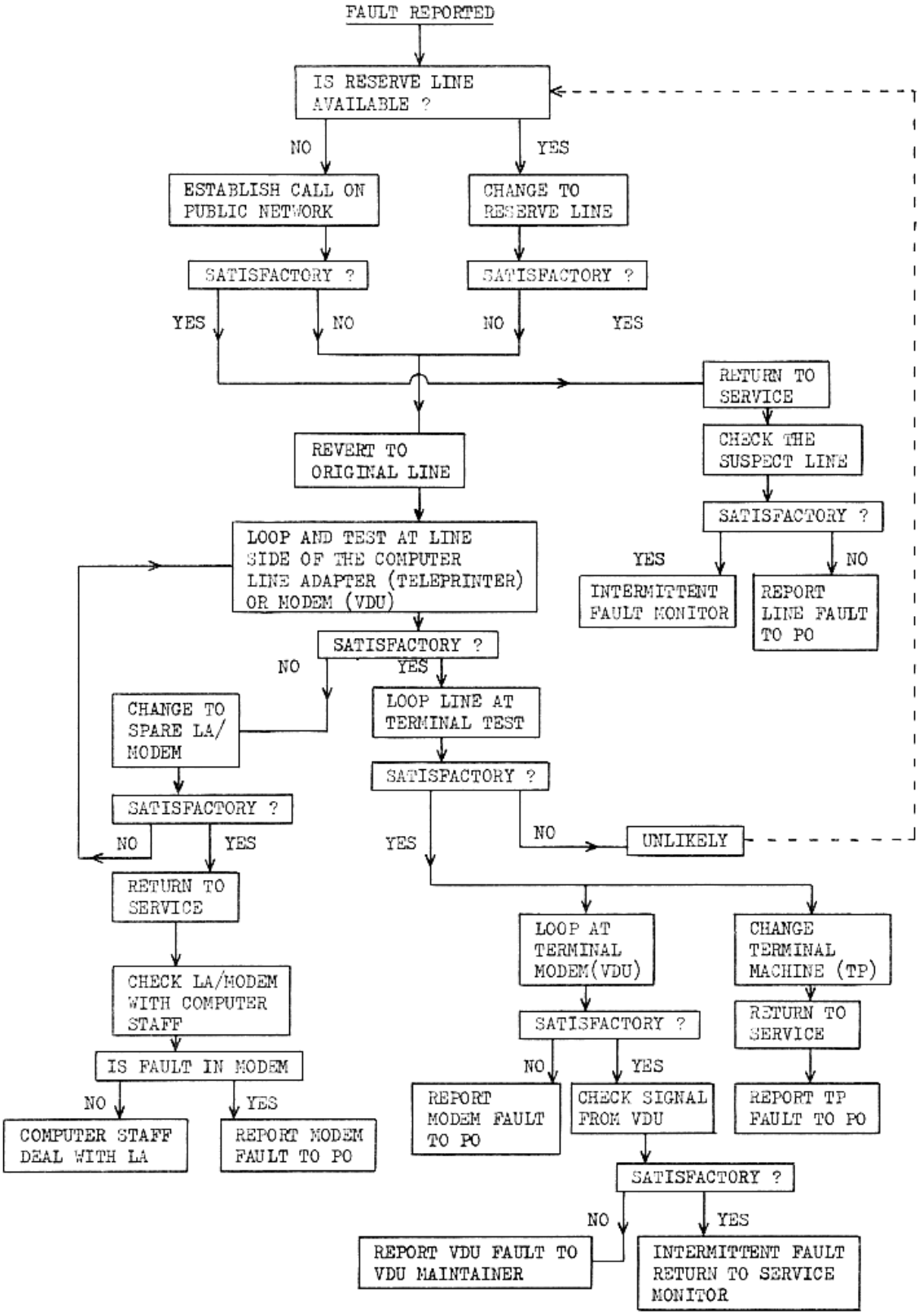
Computer Teleprinter Terminal

The computer terminal will provide printout from the computer data communications processor of fault reports resulting from lack of terminal response, persistent errors etc. It will also provide access for computer Line Adaptor/ Line Modem changeover instructions.

Supervisory Position

The supervisory position will be necessary for use during busy periods by the Officer in Charge of Quality Control for the co-ordination and allocation of tasks to control staff and to act as the focal point for initial reports from terminals. During quiet periods, if any, these functions may be carried out by one of the Quality Control operators.

Mr P P H Smith was transferred to the Directorate of Telecommunications in January 1970 after some thirty years service with the Ministry of Defence where he had been engaged on research and development, installation planning, and commissioning of strategic radio communications systems and associated radio relays. For the last ten years he specialised in communications systems engineering, message switching and long term network planning. He is presently in charge of forward planning for line and data transmission.



POSSIBLE METHOD OF SYSTEM FAULT DIAGNOSIS **FIGURE 1.**