THE ESTABLISHMENT OF A LARGE SCALE INTERNATIONAL COMPUTER FACILITY, FOR BOTH COMMUNICATIONS AND DATA PROCESSING

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Abstract

The paper describes the role of Information Services Ltd. within the IBM Corporation and describes its efforts to establish a large scale international communication network designed to rationalize the company's internal teleprocessing activities. The importance of cost-effectiveness in such a venture is emphasized.

Information Services Ltd. (ISL) is a program development house and service bureau internal to IBM. Situated at Havant on the south coast of England, it is equipped with four System/360 model 65's and five model 50's. ISL's mission is to provide a service for the various divisions of the company:

DP	Customer Engineering
DP	Manufacturing
DP	Marketing
Office	Products

Typically, it assists the Marketing Division to process its orders, design proposals, etc., and supports the Customer Engineering Division in education, information retrieval and, increasingly, in on-line fault diagnosis.

ISL is part of the IBM (U.K.) holding company but has its own board of directors (mostly the general managers of the various operating countries). Functional guidance comes from the European headquarters of the World Trade Company. Internally, it is structured into five major project areas to look after the interests of the four divisions mentioned above and telecommunications.

ISL aims to develop and process systems centrally, either to fulfil a clearing house function or to take advantage of economies of scale. The clearing house function is typified by the processing of computer system

orders which must be broken down and dispatched to the manufacturing plants in various countries. Since marketing is organized nationally, while manufacturing is multi-national, this clearing house function simplifies the communications structure within IBM. Economies are effected by the central development of applications software which is installed world-wide. Central data bases have been built and a data communications network developed to access them.

Project SWITCH (System of World Trade International Telecommunications Hub) is an attempt to build an internal teleprocessing and data communications facility for the company. Teleprocessing is used for:

(i) People talking to people,
(ii) People talking to computers,
(iii) Computers talking to computers.

In (i), more than just verbal communication and administrative message traffic is involved, since there is an increasing need for memorandum switching and text processing as a mainstream communications tool.

Included in (ii), there is a growing requirement for access to data bases, such as the customer engineers' files held at Havant, which provide a fast information collection and dissemination system for engineering changes, installation information and technical problems. The system has been extended to provide on-site computer-controlled education for customer engineers, and, after two years' operation, 20% of all new education is now done this way. In direct costs alone, this process is now paging for itself and an added benefit is that customer engineers no longer spend lengthy periods away from their sites. For the benefit of the system engineers, an APL system has been implemented, giving them design and implementation aids as well as computation and demonstration facilities. They also have aids for the configuration of the more complex pieces of equipment, and tools such as Minipert to help with installation planning.

An aspect of computer-computer communication is bulk data movement. It was found that physical data transport between major centres incurred delays of about five days, which can have serious repercussions on interplant planning, the implementation of engineering changes, etc. Each day, 250-300 files containing order entry information, engineering data (including digitized engineering drawings) and inter-laboratory communications are exchanged between processing centres on the network. These files normally range in size from 10,000-2,000,000 characters. On inception, the telecommunication network,

while providing a faster service, was more expensive than conventional forms of transport, but now breaks even on files of about 100,000 characters. Now fifty applications exploit the bulk data exchange network.

Another computer-to-computer application being developed provides installation and maintenance men with a central facility for fault diagnosis. Raleigh in North Carolina is currently linked by satellite to 16 locations in Europe and, although at present diagnostic data is fed into the network manually, it is planned to transmit register contents, core dumps, etc. automatically to the central diagnostic processor.

Today, the network serves most of the major divisions of IBM. The widest use is simple telegraph messages switching with an annual traffic of three million messages between thirty countries. There are 42 international links connecting local clusters totalling some 200 links. About $12\frac{1}{2}$ million characters of bulk data are also carried annually.

The network is centred on the south coast of England with links into various European countries and to the rest of the world. Tokyo, South America and Australia have access via the U.S.A. For historical and political reasons, the links tend to follow the traditional cable routes.

Prior to 1968, groups who wanted a teleprocessing link bought themselves a private line. In 1967-68, a breakthrough in the P.T.T. tariffs led to the establishment of a headquarters administrative network centred on Paris. In addition, ISL and other organs within IBM started to build their own networks involving many of the same countries but fulfilling different functions. It transpired that such proliferation was extremely wasteful and it was decided to rationalize the situation by putting the many applications on the same network.

During the design phase, it was recognized that most of the strategic centres were already equipped with the processors, telecommunications equipment and experience which the new network demanded. If was sufficient to give centres a network control program to run in a partition of their (System/360 or 370) processors. This enabled all aspects of network administration to be done in parallel with the centres' other jobs. The scheme is illustrated in Figure 1; the main concept is to make each processing centre act both as its country's gateway and as its telecommunication control hub. The control programs run under OS, using BTAM, in partitions varying, according to the country's need, from 40K-100K bytes. The program at Havant requires 128K. Fourteen national centres have now been established.

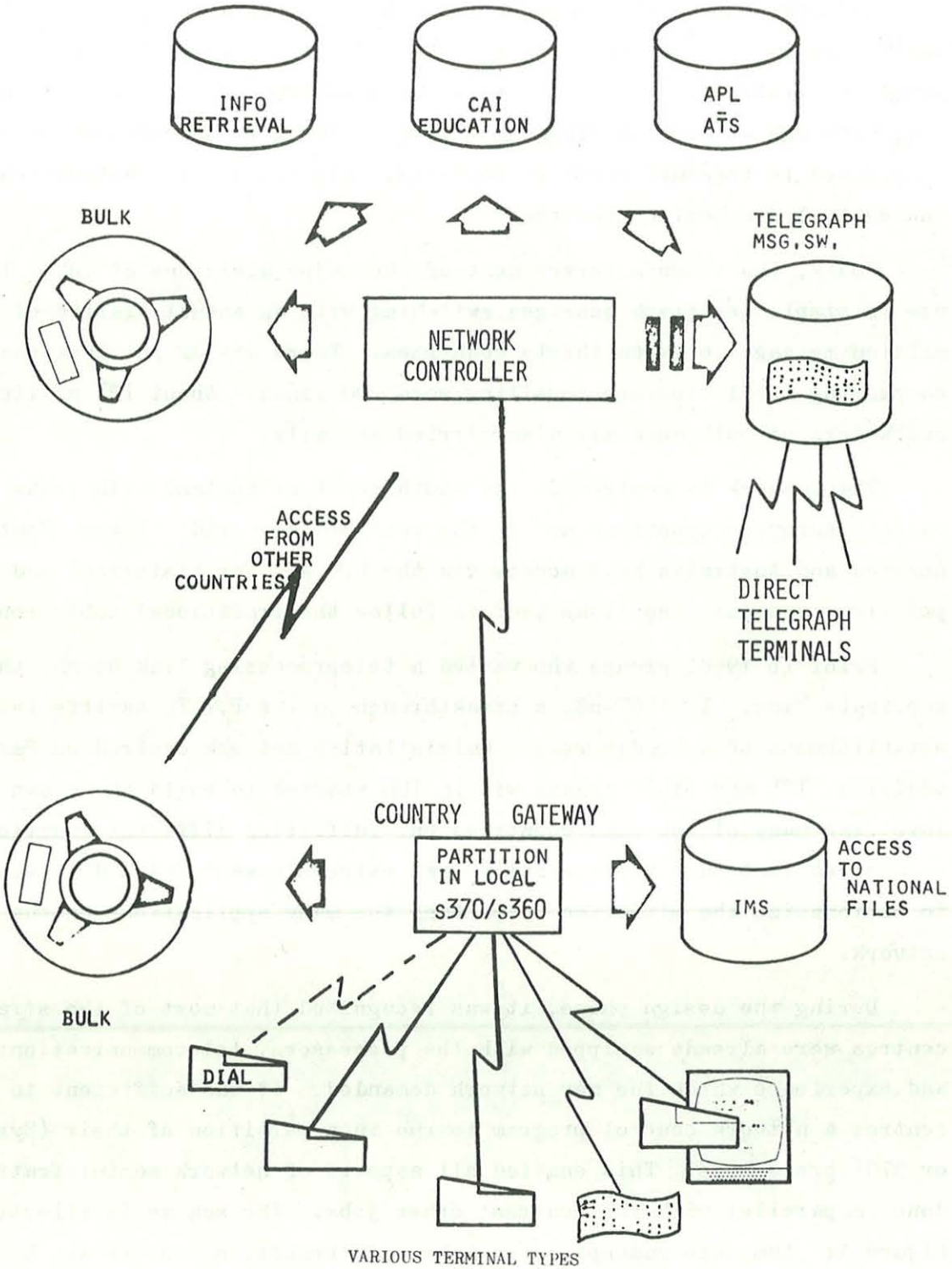

Figure 1 National Network Control Program

The chronological development of the system was as follows:

July 1971	-	integration study approved
January 1972	-	project SWITCH approved
July 1972	-	network rationalization
December 1972	-	bulk data service upgraded and implemented at Havant
January 1973	-	new on-line conversational concentrator-controllers implemented
February 1973	-	administrative message switching upgraded and implemented at Havant
March 1973	-	Havant established as centre

In a project of this nature, it is essential to adopt an attitude of sound business management. It was decided that project SWITCH must pay itself on a year-by-year basis and equipment and personnel were financed from the savings made as the project progressed. In operation, the system is run as a business in which each user is charged according to his traffic. This cost consciousness is essential if sound business decisions are to be taken and discourages wasteful use of the system.

This network is an example of how one commercial company meets its own requirements. It probably indicates the direction which various other multi-locational companies will take over the next decade.

Discussion

Dr. Browning asked for some indication of the size of the data bases maintained at Havant but Mr. Reardon was unable to provide a figure off-hand. (Rapporteurs' note: In a later communication, the following information was supplied. ISL currently maintains an active data base of approximately 1500 million characters. Approximately 300 million characters are available for immediate (2-5 seconds) access throughout the network, and this proportion is increasing rapidly; the remainder is updated and referenced chiefly via the bulk data service. These figures are very approximate and exclude facilities used for testing, system residence and indexing).

Professor Michaelson asked whether the Codasyl proposals have proved relevant to ISL's use of data bases. Mr. Reardon replied that he was not too familiar with the Codasyl proposals. He pointed out that while they wished to be 'good citizens' and used standards whenever possible this is not always practicable when new systems have to be introduced gradually without disrupting the existing service.

Professor Page enquired if all systems are run under OS/360 or whether any are run under DOS or CP67. Mr. Reardon informed him that all operate under OS. The network control package which is distributed is written to run under OS/360 or 370. A possible migration to VS is under evaluation at present.

Dr. Browning suggested that the network was heavily dependent on direct links to Havant and asked if there were plans for alternative routes. Mr. Reardon said that while alternative routes are attractive and have been considered they have not proved cost-effective. Dr. Browning then enquired about ISL's experience of failure of individual links. Mr. Reardon replied that a typical international line fails $1\frac{1}{2}$ times per month and is out of action for two to three hours on average. This is sufficiently serious on major routes such as the transatlantic and Paris links for these lines to be duplicated. Sometimes voice lines are taken over. Mr. Reardon stressed again that, subject to the maintenance of an acceptable level of service, cost-effectiveness was paramount.

Professor Randell asked to what extent the network planning tools described earlier in the seminar by Kleinrock had been applied in the choice of routes and capacities. Mr. Reardon replied that network planning programs had been used but only for intra-country layouts. Links which cross country boundaries introduced other parameters which could not be handled in this way. The design was later analyzed as a classic transportation problem but this showed no need to re-route.

Professor Randell wanted to know what level of communications engineering expertise had been called upon. Mr. Reardon answered that telecommunications engineers (network technicians) had been essential from the start to provide technical assistance in design (line constraints, distance effects, etc.) and to carry out first level fault diagnosis. The team of two good men reduced the mean time to repair from about 20 hours per fault to four hours in the very early days.

Dr. Browning requested the ratio of the cost of communications to the cost of processing. Mr. Reardon indicated that originally about 80% of the cost was on lines but that more effective use of the equipment had enabled this figure to be reduced to $\frac{1}{3}$. Professor Page asked if this was based on internal IBM prices for computing. Mr. Reardon inferred that this was the case but pointed out that, depending upon the age of the machine, this was not necessarily in his favour. The cost of manpower was also significant.