The Butler Cox Foundation

THE BUTLER COX FOUNDATION

REPORT SUMMARY

REPORT NO. 26 : TRENDS IN VOICE COMMUNICATION SYSTEMS

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I. THE USER'S NEEDS

The user's needs for telephone service can be described in terms of four factors:

Cost
Availability
Reliability
Service facilities.

In all four areas improvements are taking place. The relative cost of telephony has decreased sharply in the period 1945-1981 and will continue to do so. The availability of circuits on the Transatlantic link (for instance) permitted an increase from a few hundred calls per year in 1940 to over 6 million by 1970. In 1970 in France there were 8.5 million telephones used to make 15 billion calls a year: in 1979 there were 22 million telephones used to make 53 billion calls.

A large investment is needed to sustain this growth. Compared with postal services, voice telephony is 13 times as capital-intensive.

Reliability is a function of network architecture and the performance of network components. The biggest gains in the future will come from the trend towards digital systems and electronic switching. Yet progress towards the goals at the national level is necessarily slow. Only one major industrial nation has over 10 percent of its exchanges converted to electronic operation (the USA): only one European nation (Belgium) has over five percent.

The pattern of telephone traffic retards the growth of advanced facilities on the national networks and encourages their spread within private systems. Even in the USA local calls amount to 60 percent of all business calls. Only 8 percent are beyond 500 miles (800 km). Many large organisations can therefore provide

advanced private facilities relevant to the bulk of their traffic through their own networks. Yet steady progress towards national Integrated Services Digital Networks continues and is the only way to bring advanced services to all telephone users.

II. CHANGING OFFERINGS 1981-1990

Like computer suppliers, the telecommunications suppliers are now operating in a world of high technology, high investment and high risk. A few arbitrarily selected examples of interesting products are described in the report.

The first is an ergonomically designed terminal designed by Bell Northern Research of Mountainview, California. The system (VIMS) is designed to appeal to senior managers. A VIMS workstation has a small CRT for message reading and a 20-button extension to a standard handset. Secretarial and operator terminals are differently structured. VIMS is in use on an experimental basis and is not yet commercially available.

IBM is pursuing two parallel strategies. In the USA it has joined with other companies to create Satellite Business Systems Inc. In Europe the emphasis has been on terrestrial switching. More recently IBM has announced speechfile, on trial with a number of US customers. Speechfile offers facilities such as voice memoranda, message stacking, voice narrative associated with text and small voice message libraries.

Techniques pioneered in the management of large public systems occasionally migrate to the private user. Time Assignment Speech Interpolation(TASI) concentrators are now available for groups of trunk circuits as small as five.

Automatic Call Distribution (ACD) is a very profitable application for companies with large and costly telephone services. The workload is better balanced, the agents' performance can be better managed and customer service can also be improved.

Specialised Telephone Answering Service (TAS) bureaux abound in the USA but not in Europe. Automation in the form of ACD and similar equipment is at last finding its way into TAS bureaux.

It remains to be seen whether the advent of the same technology in Europe will create a thriving TAS industry.

The conditions favouring the growth of an active voice telephony market in the USA include anti-regulation and pro-competition actions on the part of the Government. In Europe only Britain so far is seeking to follow a similar path.

III. TOWARDS A DIGITAL WORLD

An ISDN is defined as "a public end-to-end digital telecommunications network providing for a wide range of user applications" (AT&T). ISDNs are in development now and already partially exist. From the viewpoint of the user the ISDN is best regarded as a "digital pipe" terminating at the user's site. The pipe has a large though finite capacity which can flexibly be assigned to provide voice, data, text or image channels. The ISDN will be insensitive to the nature of the traffic in the pipe: all traffic is digital.

Despite growth in non-voice traffic, voice is expected to be the major load for as far as can be foreseen. What progress is being made? In the USA there are around 1,000 time division central office switches installed. Digital local offices are also being installed. Nearly 100 million miles of T-carrier circuits exist. By 1983 a 140 Mbps digital coaxial system between Oakland and Chicago is to be installed. By 1980 a lightwave system will operate in the Boston - Washington corridor. In Europe, France is creating an ISDN based on switches from Thomson-CSF and CIT-Alcatel. In Britain, GEC, Plessey and STC are collaborating to produce System X. The world is en route for the digital revolution.

Apart from voice telephony, US researchers predict multi-million dollar markets in areas such as home security, banking at home, education, meter reading and research polls. But telephone cables are not the only contender for such services. Some 44 percent of America's 76 million TV-watching homes are now within reach of a TV cable. Half of them are already customers. The cable companies also have ambitions in the area of interactive services. As earth-station economics improve (on-site terminals now cost as little as $50,000) and as terminal-to-node links spread in the USA and in Europe, so too Satellite operators will compete with telephone operators not just on long-haul but on shorter routes.

Individual companies may decide to take a short cut to the digital future. In Pittsburgh the Westinghouse company has 65 locations with 15,000 telephones in a circle of 50 kilometres diameter. In 1983 this zone will be converted to a "digital island" at a cost of $26 million.

IV. SUBSCRIBER APPARATUS

In research laboratories in Europe advanced telephone systems are already in operation. The kinds of service provided often resemble those of a normal computerised PBX. But the problems of elaborate code sequences to trigger system functions are notorious, and as features multiply so tones become an inadequate way of telling the caller what is happening. One experimental system (Pathfinder) uses voice response to prompt and to inform the caller. A range of detailed studies has been conducted to determine which telephone functions the user really needs to be well supported.

The spread of electronic telephone handsets has been inhibited by the continuous development of conventional technology and (in the era before LSI) the relative cost of electronic components. Economically, the key to the market is to reduce the variety of components at the semi-conductor level. The first candidates for replacement are the carbon granule microphone and the rotary dial. But more functions are also now replaceable by chips. Electronic speech circuits offer much improved quality. Such extra facilities as crescendo ringing or differentiated tones for nearby handsets are also available.

In the USA the spread of electronic telephones is closely linked with the advent of new private switching systems. Three main varieties of handset are available. The first is a basic telephone with the standard 12-button keyboard or even a rotary dial. The second class of telephones is a subset of a third (described below) with fewer keys and no display. The third is the executive telephone for which a more or less standard profile now exists. The handset is microprocessor-controlled. It has local memory. It has between ten and thirty keys and associated LEDs which are programmable in function. It also has a display (12-24 positions) for messages or call information. It has a loudspeaker and either a connector for a data terminal or a link to a separate connecting unit.

The telephone handset is migrating, under the influence of advanced switching systems, towards being a fully featured "super-connective" device.

V. THE TECHNOLOGY OF SWITCHING

Report No. 26 briefly tracks (for the benefit of the non-specialist) the history of telephone switching systems from manual operations to the present day. The Stored Program Control (SPC) switch has advantages over hard-wired systems which lie in the fields of reliability, flexibility and modularity.

The advent of SPC exchanges around the world is largely dependent upon the investment programmes of the telephone administrations. The world market in telecommunications in 1980 amounted to some $40 billion, of which over 80 percent was for telephone equipment. The communication suppliers from industrialised countries are competing fiercely to secure a share of this market.

VI. CABLES OF THE FUTURE

Optical technology has developed a great deal since a 140mbps link over 9 km was installed in Britain in 1977. This experiment used a wavelength of 850nm, largely because the only available lasers and detectors operated at that wavelength. The favoured wavelength for trunk landlines is now 1.3 µm. Combined with monomode fibres, such a wavelength offers repeater spacing of up to 80 km as opposed to the 3 km of the 1977 link - a huge economic saving. There is a great deal of unexploited capability in optical technology.

Intense competition has occurred in recent years between submarine cable systems and satellites. The valve-repeater systems of the 1950s with a few dozen circuits have given way to submarine systems with transistor repeaters used over thousands of circuits. The world's submarine cable network now comprises some 200 systems totalling over 140,000 nautical miles and 136,000 circuits. Meantime however satellite circuits increased thirtyfold in 15 years to 1980 and the rate of new circuits added per annum has risen from 1,900 to 16,000. There can be no clearer example of how competing technologies benefit the user.

In the years ahead new advances are certain in satellite technology. One possible advance is the use of scanning/spot beams to sharpen the focus of satellite transmission. The shortage of space slots for more satellites using the normal 4/6 GHz frequencies has also stimulated interest in other wavebands, predominantly 12/14 GHz. It may also be agreed to allow satellites to park closer together in space, so as to allow more 4/6 GHz satellites to operate.

VII. NEW DIRECTIONS

In the future the European PTTs will arrive at the point where the American telephone companies now stand: all US businesses and 98 percent of US residences have telephones. Where does the growth of the telephone industry come from when the basic market is saturated? Since 1971 the number of telephones in the USA has grown by only 4 percent per annum, but the revenue per telephone has grown at over 11 percent. For this reason AT&T sees itself increasingly active in the fields of information systems generally, as opposed to voice telephony.

Advanced telephone services for business and residence subscribers may be provided by TAS bureaux or over the public network, as well as by means of PBXs. Such services range from the simplest form of call distribution to huge and powerful systems like the Delphi Delta.

Teleconferencing is an area long recognised as rich in promise but so far disappointing in its yield. AT&T estimates that in the USA nearly $300bn a year is spent on business meetings. AT&T is now planning a digital wideband network service known as Picturephone Meeting Service (PMS). Studio coverage will be provided in 41 cities. Revenue from PMS is planned to reach $65m by 1982 and $232m by 1986. Bell will add a $2m network of 56 T-1 lines to provide the PMS network. Both terrestrial and satellite links will be used.

Combined voice and data terminals are now beginning to penetrate the market, and are designed to be used by all levels of administrative staff and management. Report No. 26 contains a description of such a system to handle voice, text, data, graphics and image traffic.

Voice store-and-forward systems offer increased managerial productivity by abolishing the need for an end-to-end connexion for simple, non-iterative exchanges. VMS is such a service in

use in America. It operates as an adjunct to a PBX and is described in Report No. 26.

Voice recognition and response systems are potentially of enormous significance for the future. Voice response as an application is already well understood and widely used in systems, based on speech synthesis or speech reconstruction. But speech recognition is still in its infancy. Even a small-vocabulary, speaker-independent, isolated-word system currently costs $60,000 to $100,000, though the cost is expected to drop to $20,000 by 1983. Continuous and speaker-independent recognition and interpretation remains so far beyond our reach.

VIII. MANAGEMENT RESPONSIBILITIES

Four priority areas of management responsibility can be identified.

1. Self-education

The traditionally slow-moving world of voice telephony has become a maelstrom of competing technology, changing faster even than the world of data processing. The first task of the telephone manager is to keep himself briefed on the changes taking place in the technology, the market and the regulation of telecommunications. Products developed in distant countries, new ambitions nurtured by the giant companies, unpredictable decisions by regulatory bodies - all these influence the choices and decisions which eventually confront the manager. A working knowledge of these changes and an understanding of their potential strategic significance is thus a vital necessity.

2. User education

The next task is to communicate some at least of the telephone manager's knowledge to his colleagues who are substantial telephone users. They too must come to appreciate the size of the expenses they are incurring, often without their knowledge. They must understand the scale of the opportunity open to them. A first-class voice communication system is like a highly developed nervous system. Without it the corporation cannot function properly. There is plenty of evidence that user managers can grasp the significance of changes in voice telephony provided they are communicated to them in a clear and dramatic fashion.

3. Investment policy

Many telephone managers will face the need in the 1980s for a more or less complete review of investment policy. The life of equipment will change. The traditional 20 or 30 year life of an electro-mechanical switch is quite inappropriate to the SPC exchanges of today and tomorrow. Something nearer to the 5 or 7 year life of the DP world may be more appropriate. Nothing impedes progress more than investments which have been made in the past on an unrealistic timescale. Difficult as it may be to change such policies, it becomes progressively more difficult the longer a change is deferred. Another major question is the extent to which voice telephony should be expected to "pay its way". Should each investment be justified in terms of cash savings? Or should communications be treated as part of the necessary infrastructure of the organisation?

4. Integration

In the future, office systems will handle voice, data, text and image traffic in an integrated fashion - as foreshadowed by the plans of some suppliers mentioned in this report. What action is needed by telephone managers to create the possibility of such developments? The task varies according to the size of the existing facilities. Large international companies with highly developed and separate voice, data and message networks will require most of the decade to unravel their problems. Smaller organisations with less ambitious existing facilities will find it much easier. Planning tools to help such studies are just becoming available.

5. Organisation

In many companies the organisation of the computer, telecommunications and office systems departments militates against the efficient use of processing, switching and

transmission facilities. While each department may be fulfilling in an admirable fashion its own specific assignment, opportunities to benefit from the combination of all three skills may be missed. The telephone manager is in a strong position to act as the glue that binds these forces together. Everyone in the organisation is likely to be a customer of his service. The evidence suggests that major organisational upheavals are not really necessary if the departments concerned with information technology are determined to work together.

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