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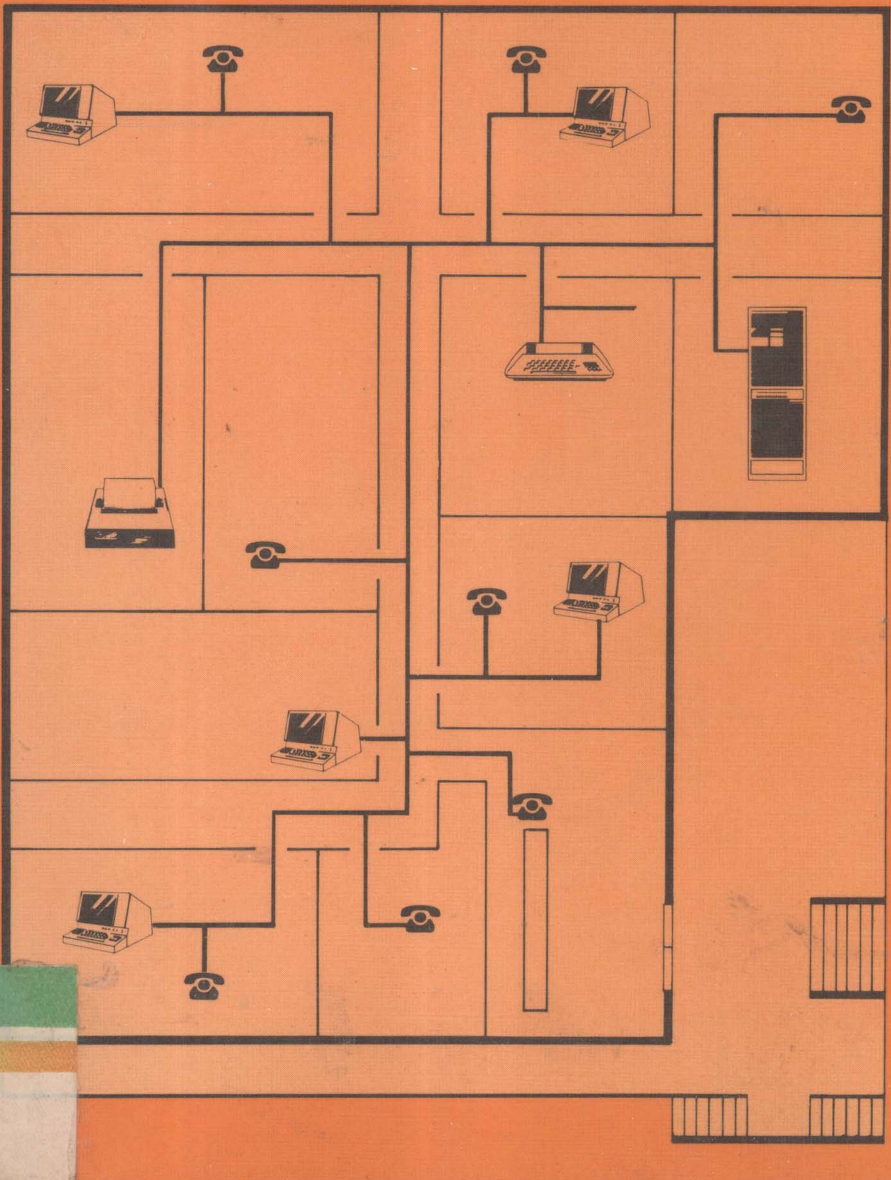
Introducing Computerised Telephone Switchboards (PABXs)



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Contents

Note: This book is based upon a seminar organised by the National Computing Centre in conjunction with the Telecommunications Managers Association, and run in Bristol, Manchester and London in May 1982.

The five presentations given at the seminar are reproduced here as four major chapters and a set of appendices; only minor editorial changes have been made to the original material.

1 PABXs – The State of the Art

P R D Scott (NCC)

INTRODUCTION

Not so long ago, calculators were the size of typewriters and wristwatches had rotating hands. In the last decade progress in digital microelectronics has transformed both these products, and all the indications are that PABXs are about to undergo a similar transformation.

The Private Automatic Branch eXchange (PABX) provides a fully automatic internal telephone system, together with access to and from the public telephone network. Incoming calls are connected via the switchboard, and outgoing calls can be made either through the switchboard or automatically (usually by dialling 9 for an outside line). The new breed of computer controlled PABXs restores to an organisation the control and many of the features that existed in the old days of completely manual switchboards.

Computer-controlled or SPC (stored program control) exchanges are not new, but recently they have become digital instead of analogue. Digital technology offers the potential for carrying all forms of information – speech, text, data and pictures – in an integrated manner.

THE TECHNOLOGY

Analogue/Digital

A conventional analogue PABX converts audible speech into a continuously varying signal in the telephone handset. The signal is maintained in that form until it reaches the handset at the destination telephone where the electrical signals are converted back to audible speech.

In a digital PABX, speech is also converted into a continuous electrical signal, but this signal is then converted into a series of noughts and ones (called binary digits or bits) before switching. After switching, the string of bits is converted back to an electrical signal, and then back to speech at the destination telephone handset. The analogue to digital (a/d) conversion process usually takes place at the periphery of the PABX switch, but in the future, a/d converters are likely to be built into the telephone instrument, permitting fully digital operation over the extension circuit. The two common methods of analogue to digital conversion are known as pulse code modulation (PCM) and delta modulation.

In PCM, the electrical speech signal is sampled 8000 times a second, and the magnitude of the sample is assessed on a scale of –127 to +127. (The scale is non-linear according to a standard companding law, there being more points at the centre than at the extremities.) The magnitude of the sample is then coded as a series of 8 bits, called an octet. Thus each analogue speech signal gives rise to a digital signal of 8 x 8000 = 64000 bits per second.

In BT's trunk network, 30 PCM speech channels and two control channels are combined for transmission over a single circuit; the data rate on this circuit is 32 x 64 = 2048 kbit/s. Digital links of this rate are the basic building block of the UK digital network, and conform to the international CCITT standard.

In the USA, a different PCM structure is used; known as the T1 system it operates at 1.544 kbit/s and is not compatible with the European system.

Delta modulation also involves sampling the analogue speech signal, but at a very fast rate of 50,000 bits per second or more. In this case it is the ***difference*** between one sample and the previous one which is coded as either a 0 or a 1 depending on whether the sampled signal has decreased or increased in magnitude.

Stored Program Control (SPC)

An SPC exchange is computer controlled: the behaviour of the exchange is governed by a program stored in the exchange computer's memory. This not only makes the exchange capable of providing many sophisticated facilities, but also means that these facilities can be tailored to meet the needs of individual users, and altered quickly and easily by amending the computer program. Extension numbers, for example, can be altered at will.

This contrasts with the non-SPC exchange whose operation is governed by the exchange wiring. Scope for providing additional facilities is limited and even the simplest alteration requires rewiring.

The use of SPC is unrelated to whether a PABX is analogue or digital, but in practice all digital PABXs are SPC exchanges.

SWITCHING

In a conventional PABX, each call is allocated a two-wire path through the exchange; the number of simultaneous calls possible depends on the number of switches provided. The technique is sometimes referred to as space division switching – to differentiate it from the newer technique of time division switching used in digital exchanges.

Over the years, PABXs have employed a variety of switching systems, ranging from Strowger switches, to crossbar, reed relay, and solid state electronic switches which have no moving parts.

TIME DIVISION SWITCHING (Figure 1)

When a speech signal has been converted into a series of 0 and 1 bits, it becomes possible to carry many conversations on a single high-speed circuit by interleaving bits from different conversations, a process known as time division multiplexing. The reverse process is known as demultiplexing and permits the individual bit strings to be retrieved.

Modifying this process by the addition of a memory turns time division multiplexing into time division switching. Interleaved pulses on the high-speed circuit are read in order into a set of memory stores. The stores are then emptied in a different order, their contents being fed out on another high-speed circuit. The effect is to switch the individual conversations from one channel to another, the routeing being governed by the order in which the

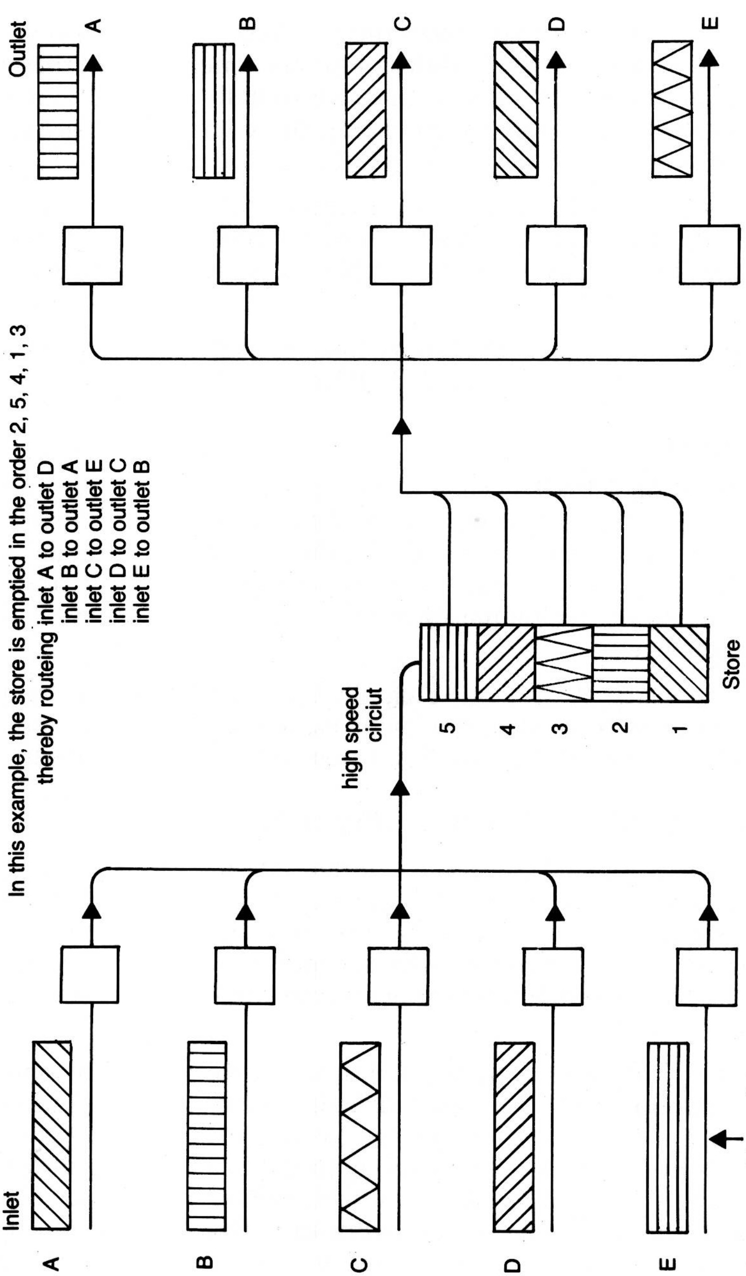

Figure 1 Time Divison Switching

memory stores are emptied. Thus there is only one path through a time division switch and this is shared in turn by elements of each call in progress. The two directions of transmission (A to B and B to A) are, however, handled separately providing '4 wire switching'.

ANALOGUE AND DIGITAL PABXs

The future certainly lies with digital SPC PABXs, if only because they will inevitably become cheaper to manufacture than analogue exchanges (Figure 2).

That is not to say that a digital PABX is necessarily the best buy for an organisation replacing a PABX today; a cheaper SPC analogue PABX can provide the same facilities as an SPC digital exchange. So what is the justification for paying extra for a digital PABX? Three reasons in favour of the digital option are:

— *The PABX will be in a city centre location likely to have access to a local System X exchange within the next five years.*

BT's programme for modernising the UK telephone network spans a period of thirty years or more, but most of the larger city centres are likely to have System X exchanges installed within the next five years. The following list (published by BT in February 1981) shows when most of Britain's towns and cities will be getting their first System X exchange, but naturally, a massive project involving the replacement of the entire UK telecommunications network takes time and money; completion won't be before the end of this century.

CENTRE	OPEN DATE	CENTRE	OPEN DATE
Aberdeen	1986	Baynard House (London)	1984
Ayr	1985	Bishop Auckland	1987
Aylesbury	1985	Blackburn	1987
Basildon	1985	Blackpool	1986
Bradford	1987	Birmingham	1983
Belfast	1986	Bournemouth	1986
Bedford	1987	Brighton	1987
Bathgate	1985		

CENTRE	OPEN DATE
Bristol	1984
Bishops Stortford	1984
Cambridge	1984
Cardiff	1986
Chester	1987
Colwyn Bay	1986
Colchester	1987
Coventry	1983
Darlington	1987
Derby	1987
Dundee	1987
Dudley	1986
Edinburgh	1984
Exeter	1985
Guildford	1983
Greenock	1987
Glasgow	1984
Hexham	1985
Honiton	1987
Haverfordwest	1987
High Wycombe	1987
Ipswich	1985
Inverness	1986
Lancaster	1987
Londonderry	1987
Leicester	1984
Leeds	1983
Luton	1985
Liverpool	1984
Maidstone	1986
Medway	1987
Maidenhead	1987
Middlesbrough	1985
Monmouth	1987
Morpeth	1985
Manchester	1983
Northallerton	1987
Nottingham	1985
Northampton	1985
Newport	1987
Newcastle	1985
Oxford	1987
Potters Bar	1987
Peterborough	1987
Plymouth	1986
Portadown	1987
Preston	1986
Portsmouth	1987
Reading	1985
Redhill	1987
Rhyl	1987
Southend	1985
Sheffield	1986
Skipton	1984
Slough	1984
Southampton	1985
Swansea	1985
Stoke-on-Trent	1986
Swindon	1987
Shrewsbury	1986
Thetford	1987
Tunbridge Wells	1986
Warrington	1986
Weybridge	1986
Whitby	1986
Wigan	1987
Wolverhampton	1987
Worcester	1987
York	1987

Note that some of these dates have since changed. The up-to-date situation should be checked with BT System X Marketing Group, ME/RCS2.2.1, 2nd Floor, Seal House, 1 Swan Lane, London EC4R 3TH. 01-357-2899.