Telecom

Austpac®

Packet Switched Data Service

Facilities

June 1986

Telecom – the major force in data communications

Telecom Australia

Better for Business

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Although correct at time of publication, the information contained herein is subject to revision and the service may be modified or added to without individual notice to customers.

INTRODUCTION

Telecom Australia's new packet switched service ushers in a new era in data communications in Australia.

The new service is known as AUSTPAC. It offers customers a nationwide service incorporating switching, transmission and network intelligence which will solve many existing and emerging customer problems. At the same time it extends, still further, Telecom's range of data communications services offering customers a choice between the Datel Service, the Digital Data Service and new AUSTPAC.

AUSTPAC will relieve many customers of the burden of designing, installing, maintaining and expanding their own private networks. AUSTPAC is available everywhere in Australia and remoteness will not carry with it the usual cost penalty because AUSTPAC prices are distance independent.

There are also many other benefits from using AUSTPAC services such as:

- high level performance;
- high reliability;
- an internationally accepted standard for interconnection of terminals and computers;
- interconnection with packet switched services in other countries.

AUSTPAC has been specially designed to meet customers' data communications needs and addresses the following problems:

- incompatibility between computerised terminals on one network with those of another. AUSTPAC facilitates multiple use of terminals, such as VDUs for different applications;
- inflexibility of customers' networks which makes it difficult to expand a network to accommodate either new applications or different types of terminals;
- high start-up costs which inhibit smaller potential users from making a commitment to develop an automated network.

Most teleprocessing applications are suitable for use with AUSTPAC. The service offers considerable cost and operational benefits where:

- terminals need to access more than one host computer;
- users transmit small volumes of data over long distances;
- widely dispersed terminals access a common host computer in an interactive mode;
- there is a need for communication between terminals with different characteristics (speed, code, protocol).

Existing users of Telecom's Datel services may find that AUSTPAC is better suited to their needs. Telecom's trained consultants are available to discuss AUSTPAC and, if desired, help with the changeover.

Finally, AUSTPAC has been designed with the future in mind. It is foreseen that many new applications will develop around the unique facilities AUSTPAC offers Australian data communications users.

WHY PACKET SWITCHING

The teleprocessing market is characterised by rapid development. In recent years, growth in data transmission requirements in Australia has been of the order of 40% per annum and the average rate of growth forecast for the 1980's exceeds 25% per annum.

Most large teleprocessing applications have traditionally been based on large private networks handling intra-corporate data flows. While this will continue to be important, there is a growing need for an advanced data communications switching facility to support emerging applications such as electronic mail and electronic funds transfer.

A further characteristic of the teleprocessing market is the large diversity of data collecting, processing and retrieval systems in addition to the wide range of protocols (codes and transmission procedures), transmission speeds and line utilisations (as low as 1% in some conversational applications).

The technique of packet switching answers more of the problems associated with developing teleprocessing applications than does conventional circuit switching techniques.

THE TECHNIQUE

Packet switching is a store and forward technique in which data is split up into small segments of variable length up to a fixed maximum, called packets, by the customer's computer or data terminal equipment (DTE). Each packet is switched and transmitted through the network, independently of other packets belonging to the same transaction. Packets belonging to different messages can travel via the same communications channel because no channel is reserved exclusively for a pair of terminals for the duration of a call. The communicating terminals are connected via a "Virtual Circuit." A virtual circuit is thus a logical association, for the duration of the call, between two communicating terminals. It emulates the facilities provided by a bi-directional, full-duplex physical circuit.

AUSTPAC SERVICE FEATURES

Terminal Support and Protocol

Data terminals which can make use of AUSTPAC services are classified into two categories:

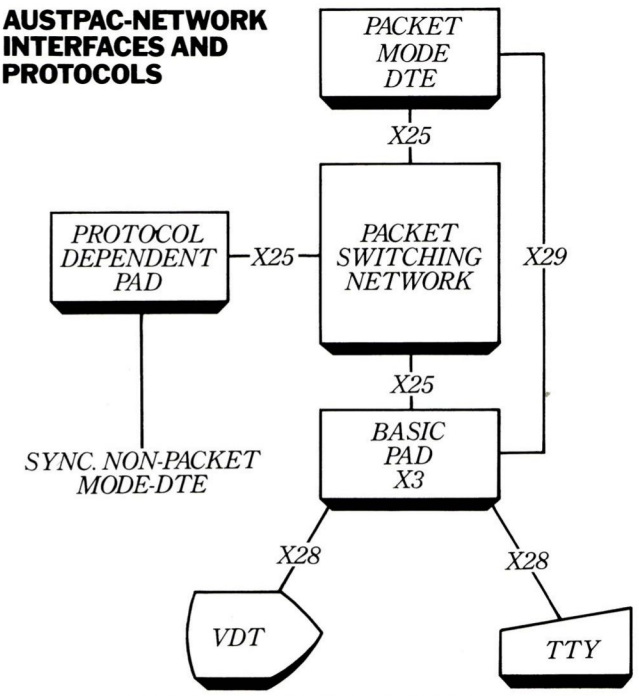
- Packet mode terminals
- Asynchronous character mode terminals

A packet mode terminal is data terminal equipment which can control, format, transmit, and receive packets. Packet mode terminals supported by AUSTPAC must interface the network in accordance with CCITT Recommendation X25. These are known as X25 data terminals and the interface is referred to as the X25 interface. One of the special features of the X25 interface is the facility allowing a packet mode terminal to simultaneously communicate with more than one terminal connected to the packet switching network using only a single physical access line to the network.

A variety of conventional **asynchronous character mode terminals** can communicate with X25 terminals connected to AUSTPAC as well as other asynchronous character mode terminals. For this purpose the network provides an adaptation facility known as a PAD (Packet Assembly/Disassembly facility) in accordance with CCITT Recommendation X3. The asynchronous terminal must establish a call via the PAD facility in accordance with the conventions described in CCITT Recommendation X28. These are known as X28 terminals.

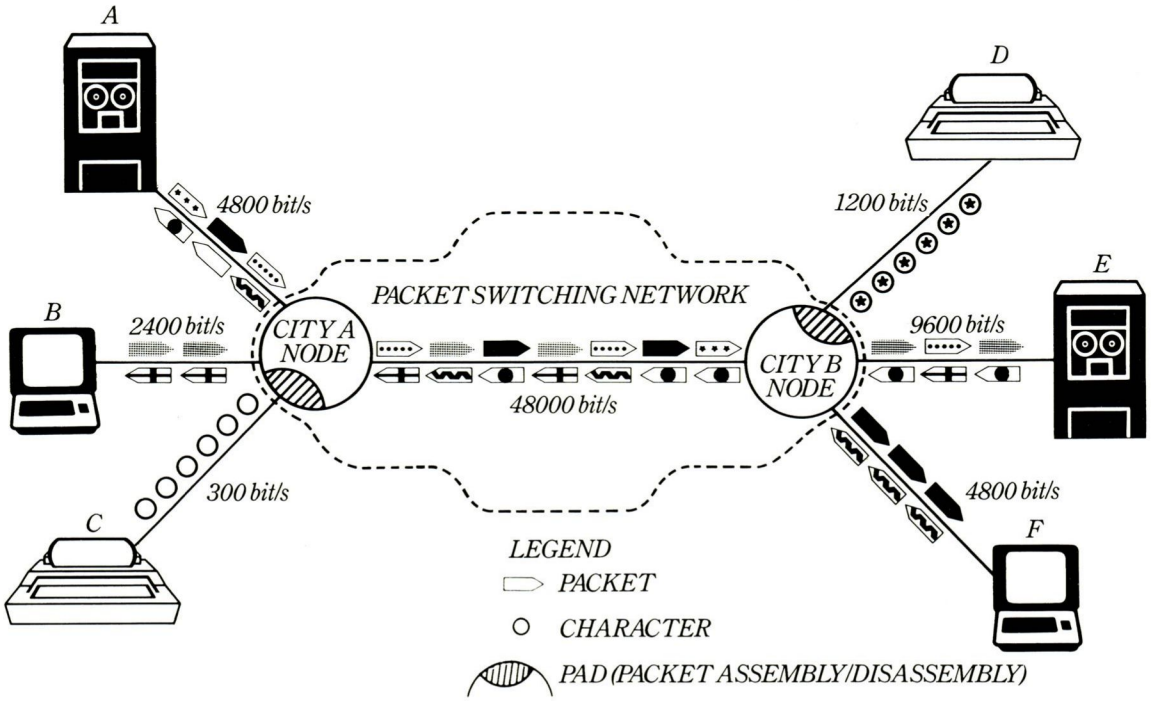
The AUSTPAC network interfaces and protocols for data terminals are shown in the diagram.

AUSTPAC-NETWORK INTERFACES AND PROTOCOLS

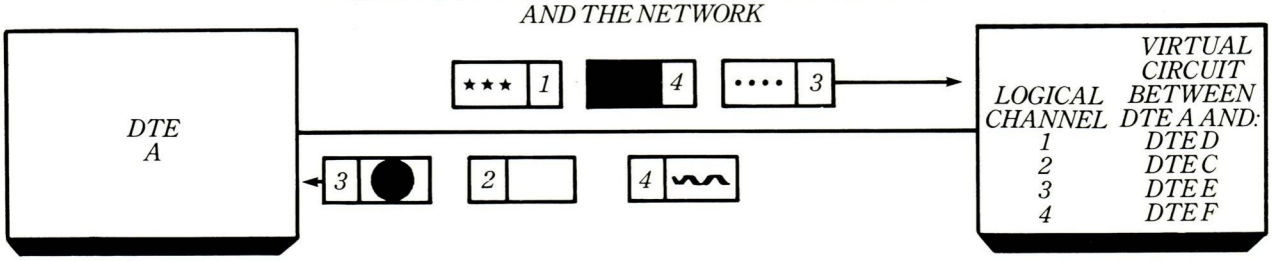


ASYNCHRONOUS CHARACTER-MODE DTE

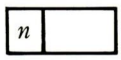
PACKET SWITCHING CONCEPTS



PACKET FLOW BETWEEN PACKET MODE TERMINAL 'A' AND THE NETWORK



LEGEND



PACKET ON LOGICAL CHANNEL 'N'

DATA PACKET FORMAT

HEADER: ADDRESSING AND CONTROL INFORMATION
USER DATA: 1024 bits (MAX.) OF USER DATA
F.C.S.: FRAME CHECK SEQUENCE (16 bits) FOR ERROR DETECTION

Data Rates and Network Access Methods

Depending on the type and operating speed of the customer's terminal, access to the network can be provided via dedicated circuits or the Public Switched Telephone Network (PSTN) as shown in Table 1.

Terminal Type	Speed(bit/s)	Network Access	
		Dedicated Circuits	PSTN
X.25 Packet Mode Terminal	2,400, sync	X	–
	4,800, sync	X	–
	9,600, sync	X	–
	48,000, sync	X	–
X.3/X.28 Character Mode Terminal	110-300, asyn	X	X
	1,200/1,200, asyn	X	X
	1,200/75, asyn	X	X

TABLE 1. Network Access Methods X = provided – = not provided

Telex Access

Access from the telex network to AUSTPAC will not be provided initially but this facility will be implemented with future enhancement of the Packet Switching Network.

International Access

International access to and from overseas packet switching networks is now available to AUSTPAC users. Calls to international destinations are billed by O.T.C. (Aust.).

SERVICE TYPES

Two basic types of service are provided in the packet switched service. These are known as Virtual Calls (VC) and Permanent Virtual Circuits (PVC).

With the **virtual call service** a call set-up and a call clearing procedure will determine a period of communication between two data terminals during which user's data will be transferred through the network in the packet mode of operation. All the user's data is delivered from the network in the same order in which it is received by the network.

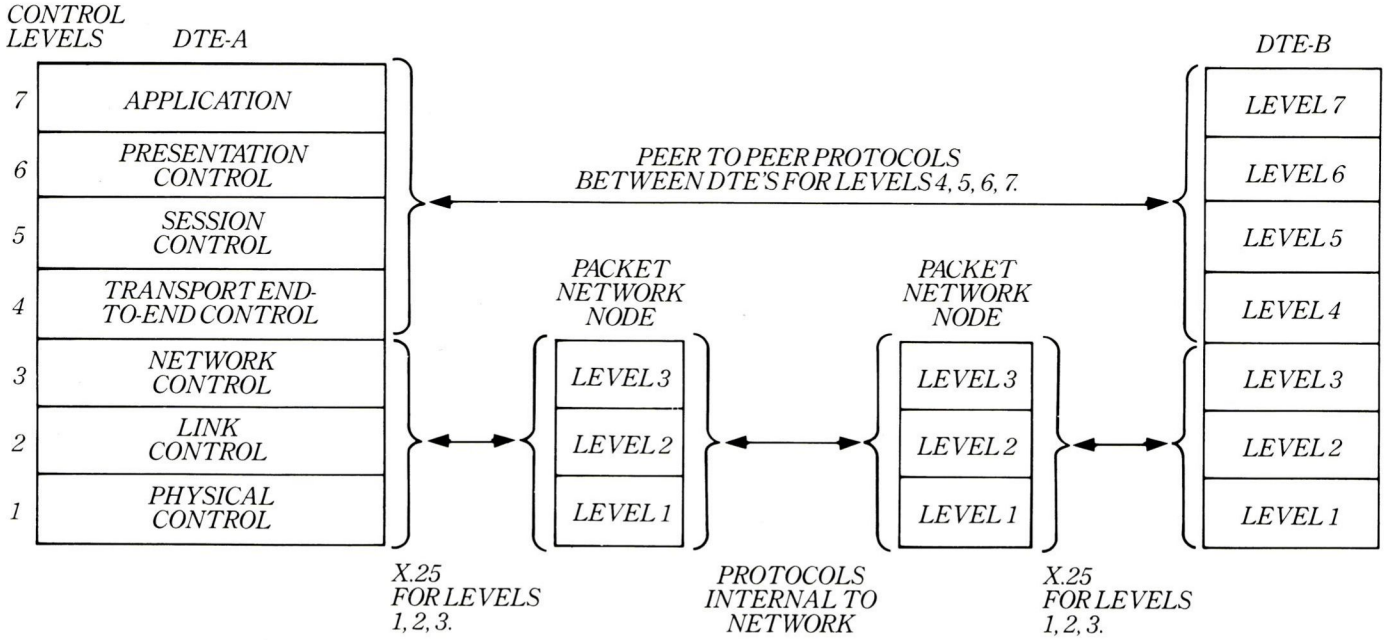
With the **permanent virtual circuit service,** a permanent logical association exists between two data terminals which is identical to the data transfer phase of a virtual call. No call set-up or clearing procedure is possible or necessary. This service is similar to the Datel Private Line Service.

PERMITTED CALL TYPES

			Austpac Access Type		
	CALLED DTE / **CALLING DTE**		X.25 PACKET MODE	X.28 ASYNC. CHAR. MODE (DIRECT)	INTERNATIONAL
AUSTPAC ACCESS TYPE	X.25 PACKET MODE		✓	✓	✓
	X.28 ASYNC. CHAR. MODE	DIRECT	✓	✓	✓
		PSTN	✓	✓	✓ (Note)
	INTERNATIONAL		✓	✓	

NOTE: Character Mode Terminals accessing Austpac via the PSTN require a Network User Identifier (NUI) to call International destinations

ISO ARCHITECTURAL MODEL FOR OPEN SYSTEM INTERWORKING



Note:

Communication between dissimilar hosts or terminals is only possible if higher level protocols than that provided by the Packet Switching Network are implemented by customers in their respective hosts and/or terminal equipments. Referring to the International Standards Organisation's (ISO) model for open systems interworking, these are levels 4-7 which are immediately above the protocol levels encompassed by X.25.

Packet mode terminals may, by means of either a Virtual Call, or a Permanent Virtual Circuit, communicate with other users as follows:
-Packet mode terminal to packet mode terminal
-Packet mode terminal to a character mode terminal.

A character mode terminal may communicate with other users by means of Virtual Calls as follows:
-Character mode terminal to packet mode terminal (from either dedicated connections or those accessing the network via the PSTN).
-Character mode terminal to character mode terminal (but only if the destination character mode terminal is permanently connected).

The following call restrictions generally apply:
-Terminals with any type of access may not initiate calls to character mode terminals accessing the network via the PSTN.
-A character mode terminal with PSTN access may not operate a Permanent Virtual Circuit.

USER FACILITIES

User facilities are optional and may be assigned for a contractual period or be requested by the DTE on a per call basis.

Following is a brief explanation of the optional user facilities that are available with AUSTPAC.

(i) Contractual facilities available to all DTE's with direct access:
- –Closed User Group. Enables a group of users to communicate with each other, but precludes communication with all other users of the network. Note that this facility is **NOT** available to customers with PSTN access.
- –Reverse Charge Accept. Authorizes the network to establish a virtual circuit to the customer for incoming calls to him for which reverse charging has been requested.

(ii) Contractual facilities available to packet mode terminals and asynchronous character mode terminals with direct access:
- –Closed User Group With Outgoing Access. A terminal belonging to one or more closed user groups will, on subscription to this facility, be able to originate calls to other terminals of the public network.

  For instance:
  - terminals that do not belong to any closed user group;
  - terminals that belong to one or more closed user groups with incoming access.
- –Closed User Group With Incoming Access. Enables a terminal belonging to one or more closed user groups to also receive calls from other terminals of the public network.

  For instance:
  - terminals not belonging to any closed user group;
  - terminals belonging to one or more closed user groups with outgoing access.

(iii) Contractual facilities available to packet mode terminals only:
- –Logical Channels. A theoretical maximum of 4096 logical channels can be assigned to a single physical X.25 line access. These logical channels are perceived by the packet mode terminal and the network as being individual, independent communications channels.

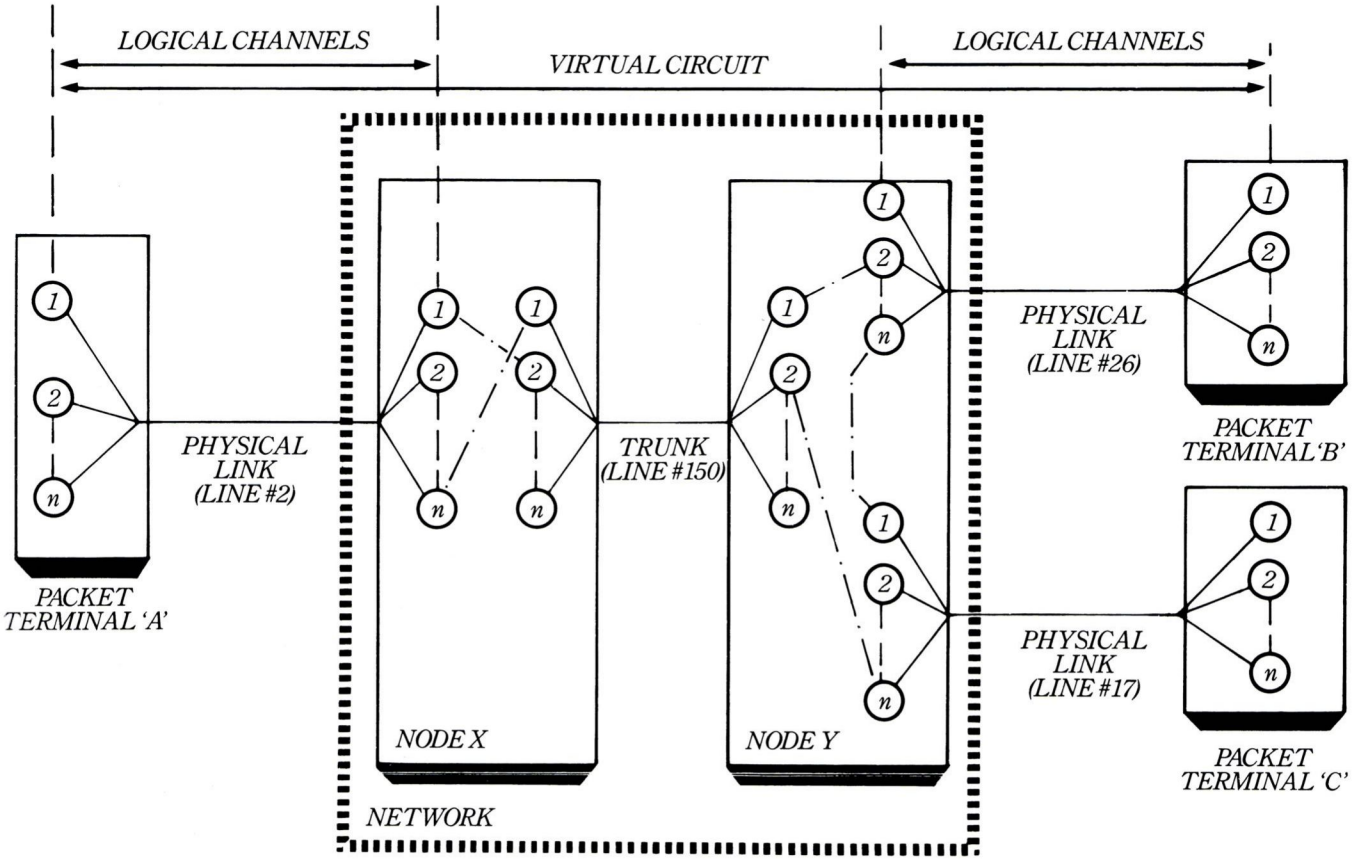
At subscription time, the individual logical channels may be designated as being either:
- a permanent virtual circuit;
- a both-way logical channel which can be used by the terminal to originate outgoing calls or by the network for incoming calls to the terminal;
- a one-way logical channel (incoming or outgoing) which limits the logical channel to incoming or outgoing calls.

It should be noted that in all instances, once a call has been established, full duplex communication facilities exist for any particular type of logical channel.
- –Incoming Calls Barred. Applicable to all of the logical channels associated with the nominated physical access line. The customer will not receive any calls from the network on this line.
- –Outgoing Calls Barred. Applicable to all of the logical channels associated with the nominated physical access line. The customer will not originate any calls to the network on this line.

(iv) Optional user facilities that may be used on a per call basis:
- –Reverse Charging. During the call establishment phase, the calling party can request that the call charges be debited against the called party. (See reverse charge accept.)
- –Flow Control Parameter Selection/Negotiation and Indication. Packet mode terminals are able to select the values of certain network parameters which influence the flow of data packets between the terminal and the network.

(v) Optional user facilities only applicable when a character mode terminal is communicating via the network-provided PAD:
- –Selection of PAD Parameter Settings. Character mode and packet mode terminals when communicating via PAD may select the value of certain PAD parameters individually. These parameters are variables which define the operational characteristics of the PAD functions.
- –Reading Values of PAD Parameters. On receipt of a request from the character mode terminal or from the packet mode terminal with which it is communicating, the network will inform the requesting terminal of the current value(s) of the PAD parameter(s) specified in the request.
- –Direct Call. Enables the establishment of a (virtual) call without the need to convey address signals to the network. The destination address is designated by the user at subscription time.

THE LOGICAL CHANNEL CONCEPT



VIRTUAL CIRCUITS (TEMPORARY LOGICAL ASSOCIATIONS) IN DIAGRAM ABOVE

TERMINAL 'A'	NODE X		TRUNK		NODE Y		TERMINAL 'C'	TERMINAL 'B'
LOGICAL CHANNEL #	LINE #	LOGICAL CHANNEL #	LINE #	LOGICAL CHANNEL #	LINE #	LOGICAL CHANNEL #	LOGICAL CHANNEL #	LOGICAL CHANNEL #
1	2	1	150	2	17	n	n	
					····17	1	1	
					···26	n		n
n	2	n	150	1	26	2		2

NOTE: $n < 4096$

SERVICE PERFORMANCE

AUSTPAC offers users the following quality of service:

(i) Availability. The objective is to provide a 24 hours a day, 7 days a week service. However, due to the current rapid expansion of the network, a "maintenance window" is necessary. Currently, this 'window' is between 11.00pm Thursday and 7.00am Friday (Melbourne time).
During the period of daylight saving, the start time of a "maintenance window" may be deferred until 0000 hours Friday. A toll-free voice announcement on telephone (03) 67 2388 and a public bulletin board on Telememo will provide one week's notice when a particular window will be used.

During these times, network services are not guaranteed on the occasions when engineering activity is necessary. In particular, major service interruptions are likely during the first hour and the last hour.
Discounting this activity, virtual circuit failure rates will be no worse than one failure per fifty hours of use.
Customer access availability includes the line and the circuit terminating equipment at each end of the line. Present failure rates and mean time to repair (MTTR) peformance indicate customer access availability better than 99%.

(ii) Transmission Quality. Network protocols ensure that data is delivered to its destination in the same order that it is received by the network entry point. Through very efficient utilization of error detection and automatic retransmission techniques, the probability of an undetected bit error, end-to-end, will not exceed 10^{-8} when both accesses are packet mode terminals using 128 Octet packets.

(iii) Transmission Delay. The transit time of a data packet through the network from the network entry node to network exit node varies according to the number of transit nodes that the packet has to be switched through. The transit delay for packets accepted by the network may be of the order of 500 milliseconds.

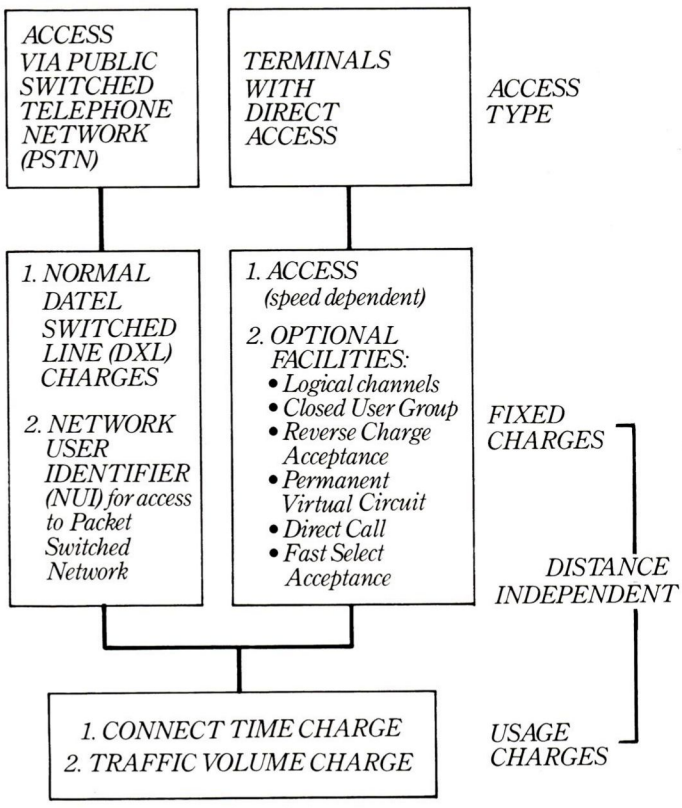
(iv) Call Set-up Delay (Virtual Call). The virtual circuit establishment time, ie. the elapsed time between network acceptance of the "call request" packet and the instant when data may be exchanged, depends also on the number of transit nodes required to establish the virtual circuit. This time will be approximately one second.

(v) Access Protection. Access protection for the "virtual call" service to restrict access to a user's system and files may be achieved by:
–the user implementing classical techniques such as identification and passwords or,
–subscription to the network facility option, "closed user group," which allows a company or any group to protect itself against access to or from the outside or,
–a combination of the above.

PRICES

AUSTPAC is a nationwide service offering distance independent, volume sensitive prices.
The elements of the charging structure are:
–An installation fee;
–An access (rental) fee;
–Fees for optional contractual facilities;
–A charge for traffic volume;
–A connect time charge;
and the charging principles are in accordance with the following:

AUSTPAC-CHARGING PRINCIPLES



Note: There is a minimum charge per call

Pricing Details

Details of charges for the service are contained in the AUSTPAC Price List brochure.

GLOSSARY OF TERMS

C.C.I.T.T.

International Telegraph and Telephone Consultative Committee. The body that formulates recommendations for standardisation.

D.T.E.

Data terminal equipment. Such terminal equipment may be either a host computer, communications controller, multiplexor, visual display unit, teleprinter or any other terminal device that interfaces the packet switching network.

Full Duplex

The mode of communication whereby simultaneous both-way transmission takes place.

Logical Channels

A packet mode terminal may, subject to capabilities, support more than one virtual call at a time. For the purpose of control, data for such calls is transmitted or received over what are termed "Logical Channels." From the customer side of the line interface and, similarly, from the network side of the line, such channels are perceived as individual communications channels and are identifiable by a number. Data for each separate logical channel is transmitted or received in sequentially numbered packets but interleaved with the packets for other logical channels active at the same time. This is a feature of the X.25 protocol and thus a character-mode terminal can only support one logical channel.

Network User Identifier (NUI)

Character mode terminals accessing the AUSTPAC service via the PSTN may have to identify themselves before the network will allow calls to be made. The identifier takes the form of an alpha/numeric sequence, some of the digits being chosen by the customer and the remainder allocated by Telecom. A customer may elect to use one or more NUI's and for each of these to be recognised at one or more network entry points.

Packet

A group of binary digits (bits) including data and call control information which is switched as a composite whole. The data, call control and error control information are arranged in a specific format. For AUSTPAC, a data packet may contain up to 1024 bits of user data.

Packet Assembly/disassembly (PAD)

Performs the packet assembly/disassembly function for simple asynchronous character-mode terminals. PAD also handles call set-up, clear and control procedures and generates service signals for transmission to the character-mode terminal.

Port

The identity of the network equipment to which a customer line connects.

PSTN

Abbreviation for the Public Switched Telephone Network.

Virtual Call

A user facility in which a call set up procedure and a call clearing procedure determines a period of communication between two DTE's in which user's data is transferred in the packet mode of operation. All the user's data is delivered from the network in the same order in which it is received by the network.
Notes:

1. The facility requires end-to-end transfer control of packets within the network.
2. Data may be delivered to the network before the call set-up has been completed but this data will not be delivered to the destination address if the call set-up is unsuccessful.
3. Multi-access DTE's may have several virtual calls in operation at the same time.

X.3

C.C.I.T.T. Recommendation for the Packet Assembly/Disassembly facility (PAD) in a Public Data Network.

X.25

C.C.I.T.T. Recommendation defining the interface between data terminal equipment and data circuit-terminating equipment for terminals operating in the packet mode on Public Data Networks.

X.28

C.C.I.T.T. Recommendation defining the DTE/DCE interface for start-stop mode data terminal equipment accessing the packet assembly/disassembly facility (PAD) in a Public Data Network situated in the same country.

LODGEMENT OF APPLICATIONS AND FURTHER INFORMATION

Further information may be obtained by contacting any of the following State Data Offices. AUSTPAC applications may also be lodged at these locations:

N.S.W.	Business Sales Section, Commercial Department, 16th Floor, 157 Liverpool Street, SYDNEY N.S.W. 2000. Telephone: (02) 267 6767.
VIC.	Business Sales Section, Commercial Department, 8th Floor, 484 St. Kilda Road, MELBOURNE VIC. 3004. Telephone: (03) 11510.
QLD.	Telegraphs and Data Branch, Operations Department, 5th Floor, Societe Generale House, Cnr. Creek and Elizabeth Sts., BRISBANE QLD. 4000. Telephone: (07) 835 6400.
S.A.	Telegraphs and Data Branch, Operations Department, 5th Floor, BP House, 30 Flinders Street, ADELAIDE S.A. 5000. Telephone: (08) 217 9367.
W.A.	Telegraph and Data Branch, Operations Department, 4th Floor, Telecom Centre, 80 Stirling Street, PERTH W.A. 6000. Telephone: (09) 420 7477.
TAS.	Telegraphs and Data Branch, Operations Department, 2nd Floor, Knopwood House, 38 Mont Pelier Retreat, BATTERY POINT TAS. 7000. Telephone: (002) 20 8800.
A.C.T.	Telegraphs and Data Section, Operations Department, 2nd Floor, 490 Northbourne Ave., DICKSON A.C.T. 2602. Telephone: (062) 45 5555.
N.T.	District Telecommunications Branch, Operations Department, 3rd Floor, Hooker Building, 47 Mitchell Street, DARWIN N.T. 5790. Telephone: (089) 89 3266.

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