TELEFILE COMPUTER PRODUCTS LIMITED

TELEPAC USER MANUAL

Proprietary Information

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TELEFILE COMPUTER PRODUCTS

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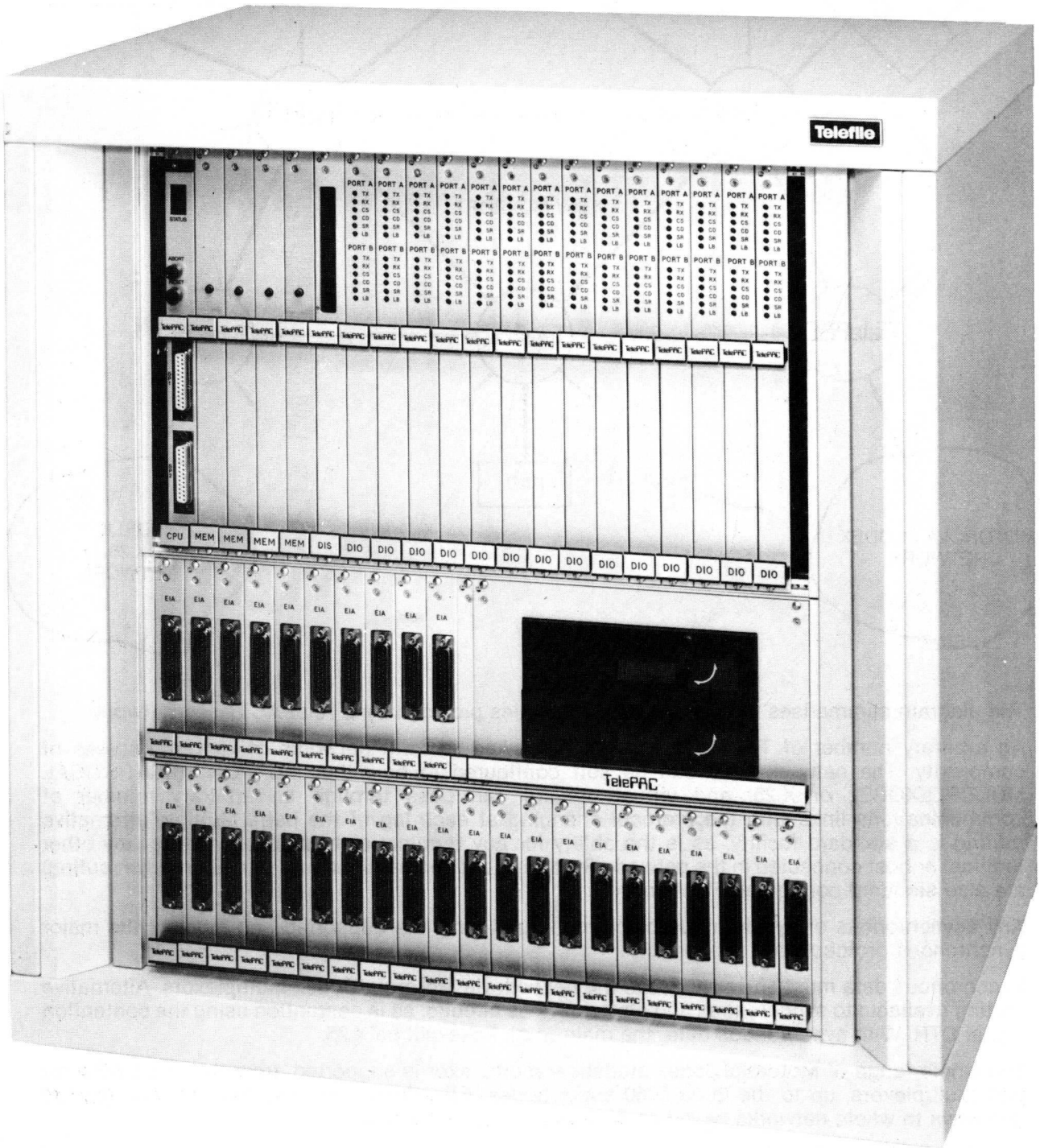
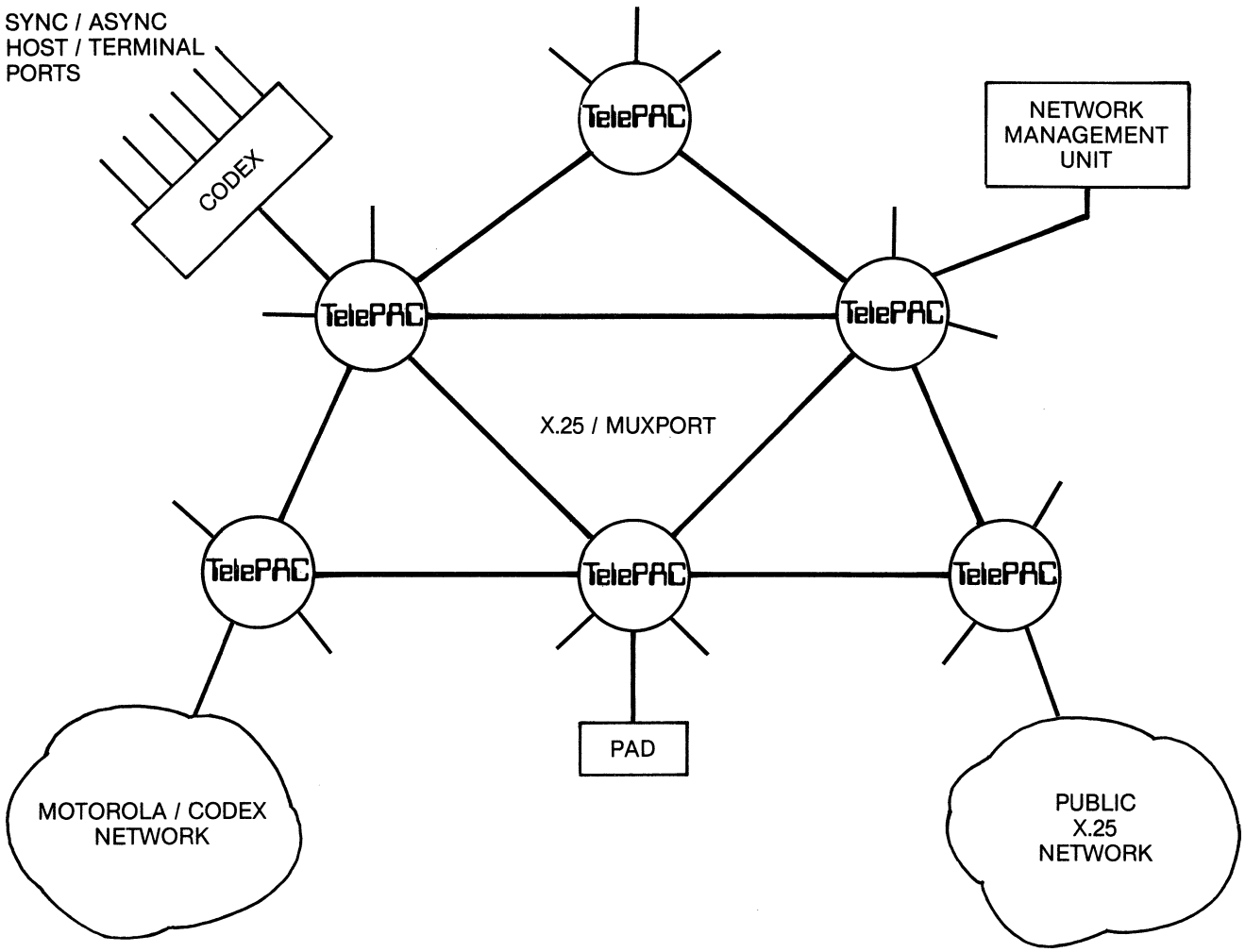
TelePAC



Telefile Computer Products Limited

GENERAL OVERVIEW



The diagram summarises the various major facilities provided by a TelePAC based network.

An arbitrary number of TelePACs can be interlinked to form networks of various degrees of complexity. The network links can be soft configured to be either MUXPORT (STATISTICAL MULTIPLEXORS), or X.25, and virtual circuits can pass through an arbitrary number of communications links with the protocol changing at each leg of the path. Multiple alternative routing is a standard facility, as is the ability for any terminal or host to connect to any other terminal or host connected in the network. Switching or fixed destinations (with alternative routing) are also standard configurable options.

Any asynchronous or synchronous block mode protocols are supported and most of the major synchronous protocols are supported.

Synchronous data must enter and leave the network via Motorola/Codex multiplexors. Alternative routing available to synchronous and asynchronous circuits, as is contention using the contention signal DTR. With synchronous data, the main trunk links will be X.25.

The whole range of Motorola/Codex statistical multiplexor is supported, from the small 6002 for port multiplexors, up to the large 6050 super nodes. Effectively, then the TelePAC can provide gateways to whole networks based on Motorola/Codex equipment.

Any X.25 PAD or X.25 host interface can be supported, and soft configuration options are available to cater for the minor vagarier of various equipment types.

X.25 public networks are supported, and formal approvals have been obtained for a number of these throughout the world.

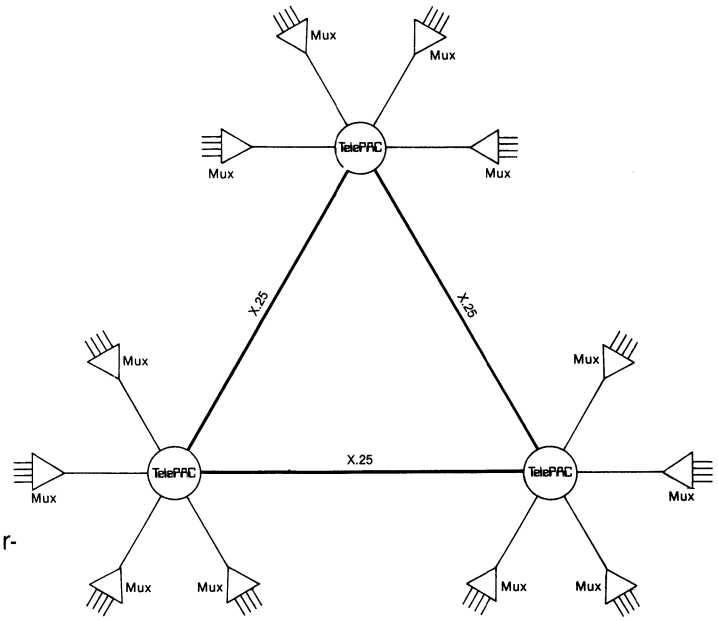
A large set of mechanisms is embodied in the software in each TelePAC to support the needs of authorised network managers; and to provide interfaces and facilities for an X.25 interfaced Network Management Presentation Service and Data Base.

The overall concept of the network is 'decentralisation', which enables the network to grow and adapt as requirements change; and this also aids diagnosis and solving of problems.

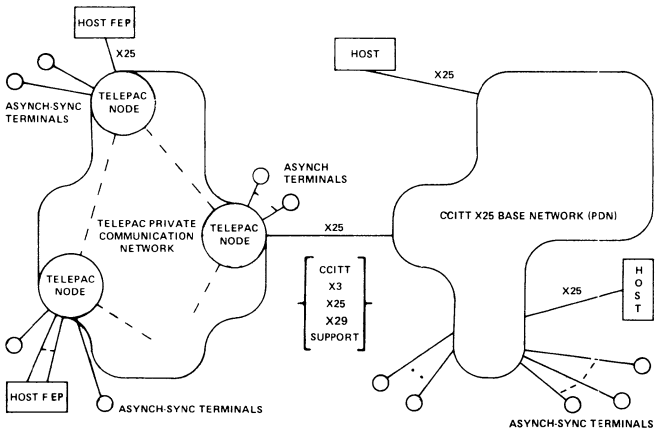
TelePAC Features

- Advanced, high-speed, communications processor
- Oriented towards CCITT X.25
- Support of X.3 parameters and X.29
- Networking node
- Switching or fixed destinations
- Alternative routing and automatic call re-establishment
- Gateway operation
- Unique combination of X.25 and statistical multiplexing of communications links
- Complete modular expansion from small four-port nodes to large PSEs
- Multi-processor design, with option for user-programmed processors supporting UNIX compatible operating system and the 'C' language

SAMPLE CONFIGURATIONS



TRIANGULATION



- Synchronous and Asynchronous data
- High throughput per £ cost
- Protocol conversion
- Network management
- User friendly, simple to configure
- Open-ended design
- Approved for use with X.25 public data networks
- Menu and queueing options
- Ethernet interface

TelePAC

Configuration

While being user friendly, the TelePAC configuration language is generalised for open-ended expansion and as a basis for the support of OSI standards.

The main TelePAC configuration parameters are summarised below:

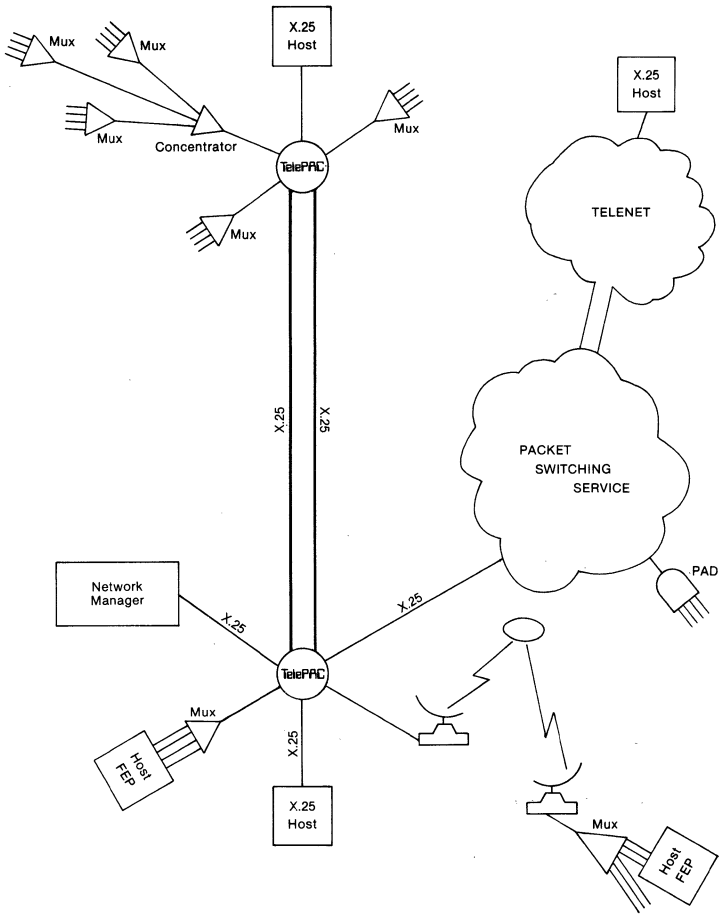
Link Level

Link type: X.25
MUXPORT
(statistically multiplexed)
Ethernet
DMA Channel-to-channel.

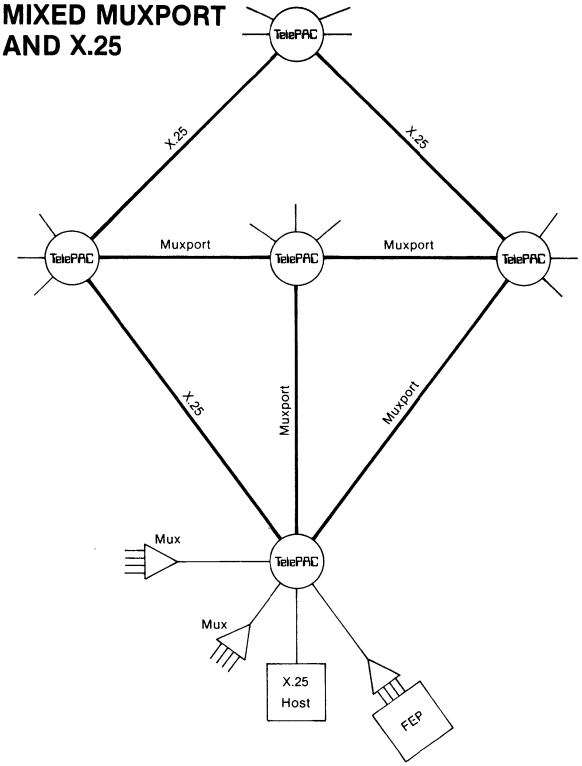
Number of logical channels per link.

DTE or DCE
LAP or LAP B; host or network interface.
Time-out and retransmission values.
Window size level 2.
Default Window size level 3.
Logical Channel Group.
Extended (0-127) or normal (0-7) frame sequence numbers.
Poll when idle (level 2 RR command with P-bit).
Remote Boot (multiplexed links).

LINE LOAD SHARING



MIXED MUXPORT AND X.25



Logical Channel Level

Routing Method Specification.
Synchronous or Asynchronous.
PVC or SVC.
Queueing.
Automatic call re-establishment and re-routing.
Compact Network Routing Option ('DIAL').
Control of EIA signals (multiplexed channels).
Buffer threshold for flow control.
Slot size for response tuning (multiplexed channels).
Flow Control thresholds and refresh values (multiplexed channels).
Disconnection Control Character.
Menu Selection.
Short form X.25 addressing.
Alternative prioritised routing.
X.3 Parameters.
Transparent mode or Integral PAD operation (multiplexed channels).

Network Management Features

- Control of any node from any point in the network.
- Control of any multiplexer or PAD from any point in the network.
- Virtual diagnostic port.
- Polled diagnostics/statistics.
- Session statistics, time-stamped, for network accounting.
- Network Management Unit for centralized control and storage.
- Time stamping of all network diagnostics.
- Extensive link and channel level diagnostic information on demand.

NETWORK MANAGEMENT FEATURES

Network Management and Management Tools

The TelePAC has been designed with a view to network management recognising two very separate aspects, and involving, normally, very different management personnel. The two aspects are discussed separately below. A large number of specifically designed tools have been built into the TelePAC, in order that it can provide comprehensive solutions to both management aspects.

Network Troubleshooter and Network Configuration Management

The person or persons who troubleshoot networks are usually those responsible for the basic network configuration and its maintenance. These are the network controllers, who need a good understanding of the subject in order to configure the basic network functions and facilities. The same people usually are responsible for isolating occasional problems, in possibly widely scattered geographical sites within the network. Quite clearly such people, who are normally relatively expensive, cannot continually be 'on the road' in order to investigate faults. They need to be able to investigate network problems centrally or from any point that is convenient at the time. Ideally, the problem should be identified remotely by the controller, and less expensive personnel dispatched to fix a physical problem once it has been identified. This problem is overcome by the concept of the 'virtual control port' which is embodied in each TelePAC and is described below.

Network Management and Management Tools

The network controllers will often be employed by OEMs or distributors, and provide a support service to end-users; or, in the case of large users, one or more such persons will be employed directly.

The concept of a 'virtual control port', together with remote access capability, is a fundamental tool for the controlling network manager. A virtual control port is actually a software module which resides in every node (TelePAC, TelePAD, PAD, or Statistical multiplexor or node). It is a 'virtual' port in the sense that it is not associated with any given physical port. The software module is responsible for providing interactive configuration and diagnostic facilities.

Within the concepts embodied in the TelePAC, a virtual control port is a resource which is accessed just like any other resource. From any network access point (dial up port; X.25 public network, X.25 PAD or multiplexor) the network controller can, simply by entering a call address (e.g. via public data network or from a private PAD), or by typing a mnemonic, gain access to the virtual control port of any TelePAC in the network. In a complicated network, the access can be directly made by automatic establishment of a multi-staged virtual circuit; or the manager can step from TelePAC to TelePAC in a deliberate fashion. Once connected to a virtual control port in a given TelePAC, he has an interactive dialogue to perform configuration and diagnostic operations.

The concept of remote access to virtual control ports, via resource selection, is taken a logical step further by using the same technique to access the virtual control ports in multiplexors or PADs. For example, take a TelePAC which has, e.g. 3 high speed X.25 links to 3 VAX computers, and 27 lower speed links to 27 remotely situated statistical multiplexors. The controller, by simply typing four characters on a terminal on his desk, can immediately talk with any one of the 27 multiplexors, for example, to look at the EIA signals on a particular terminal port, or to watch the input or output characters as the user types or receives responses. (This monitor is completely passive).

The diagnostic information available from the virtual control port of the TelePAC is extensive, including:

- Buffer counts
- Data in and Data out counts for communicating links
- Frame counts for links
- Transmit and Receive window positions
- CRC error counts
- X.25 level 2 state of link
- Current retransmission level
- Data in and out counts for individual channels
- Frame or packet counts for channels
- EIA signals In and Out
- X.25 level 3 state
- Transmit and Receive Window positions
- Logical state of link
- Flow control positions
- Virtual Circuit connection state
- Data restraint position
- And others

Network Management Presentation Service and Data Base

The other aspect of network management that needs to be covered is that with respect to the general management. Here we are talking about an almost purely administrative function, by people who are not necessarily specialists. At one level we have operational staff, who require a centralised (or multi-point) system, which 'presents' to them, information as to the state of the network, and provides an automatic method of not only generating alarms, but also of providing specific instructions as to exactly what to do. At another level we have a higher administrative function, which includes:—

1. Information on the performance of the network, for forward planning of capacity and for quality control.
2. Information on the number of problems and the time taken to fix them (i.e. performance of network support).
3. Billing information for cross-charging.
4. Achieved data for historical analysis of problems (looking back on the records).

The view taken of the Management Presentation Service is that it is linked to one or more TelePACs in a network by X.25 link(s). With this concept in mind, a number of mechanisms have been built into each TelePAC node which allows the centralised Management Presentation Service (MPS) to operate. The theory of operation and the mechanisms are outlined below.

Via its X.25 link the MPS sets up calls to each TelePAC in the network. The fact that these virtual circuits are established (or not) provide the first level of information as to the operational state of the network. If calls fail, different call addresses can be used to establish different virtual circuits to the TelePAC in question. By this method, the virtual circuits provide 'probes' by which the MPS establishes which links or which TelePAC nodes are up or down. The information is displayed graphically, and alarms are operated and recorded if required.

The destination of the probe circuit is the REPORTS channel on the TelePAC in question. The REPORTS channel is a Virtual Reports Channel, in the sense that it is a named channel which can map on to any given Virtual Circuit.

Once the MPS has attached its probe circuit to the REPORTS channel, all reports for that TelePAC are intercepted and passed through the circuit to the MPS. Only if the circuit is temporarily broken (e.g. network failure and re-routing has not yet taken place) will reports go to the reports channel itself (which is therefore a default, and could have a teleprinter or PC attached to avoid losing any reports).

Thus the MPS is receiving reports from each TelePAC in the network, on a different logical channel for each TelePAC. The reports are thus fully segregated, and, further, each report is prefixed by a level number to facilitate programming to process the reports.

There is a virtual statistics channel on each TelePAC, which can similarily be intercepted remotely by the MPS in order to gather billing statistics for each of the TelePACs.

Once the MPS is connected in this way to each TelePAC, further facilities are available to it, by means of commands that it can transmit to the TelePACs along the virtual circuits. Operations available are:—

(1) It can poll any component (link, channel, etc.) on the TelePAC and derive performance statistics (data counts; error counts, etc.).

(2) It can delete statistics (reset them) for each component (e.g. link or channel).

(3) It can pull off billing records in a handshake manner (so records are not lost or duplicated).

(4) It can delete billing records in a handshake manner.

As an example of (1) and (2) above in operation, the MPS keeps a profile of expected CRC errors on a link. It performs a poll every 30 seconds, followed by a statistics reset, and compares the error count against a profile. If the profile limit is exceeded, it displays an alarm and files a report. Similarily, by polling and resetting to data counts, and comparing the numbers against a profile threshold, it detects when link throughput is such that further line plant should be ordered.

NETWORK SECURITY

Network security in this context is intended to mean the security that the network offers against unauthorised access to resources, and network control functions such as the virtual control ports. It is also increasingly becoming a requirement that users should not even be permitted to use the network itself without authorisation. A related aspect is cross-charging for the use of the network, e.g. in the case where many different departments or divisions of a large company are sharing the same network. In this case a billing facility needs to be interlocked with authorisation to use the network.

All of these aspects are handled by the TelePAC, and are described below.

PASSWORD PROTECTION

The first level of protection, which is a soft configurable option, is provided by a password mechanism. If it is configured, then users have to type a password to gain any further access to the network. Once a password has been entered successfully, the user gains access to the network, but a further set of options defined in the password record further control or define the level of access.

These options include:—

1. Billing.
   Billing records will be produced for charging against the password (which is also a user-group identifier).
2. Destination.
   The user can be automatically routed to a particular destination, or limited to a defined subset of the total destination resources in the network.
3. Menus.
   The user can have one of 32 possible menus displayed (and hence, for example, can be made aware of only certain resources in the network. Different sections of users can have different views of the network).
4. Priority/Privilege Level.
   A priority level can be set up, which can further limit the resources which the user can access. The priority level is described further below.

RESOURCE SELECTOR

The second level of access protection is provided by the four character name used to select resources. If a user is unaware of a given resource selector name (i.e. it does not appear on his menu), then the resource name becomes, effectively, a second level of password. The Destination Resource Code mask can be further used to limit the users choice to a subset of the total destinations.

PRIORITY LEVEL

Sixteen levels of priority (or privilege) are provided. A user cannot access any resource which is at a level of priority above his own. For example, the Virtual Circuit ports will normally be placed at the highest level of priority.

FUNCTIONAL FLEXIBILITY AND EXPANSION CAPABILITY

Certain key features of the TelePAC provide client-users with a high level of flexibility in handling their current needs. These features also provide a great deal of adaptability with respect to the modifications and evolutions that any network goes through. The unique open-endedness of the software and hardware design also ensures that future needs are protected, in terms of integrating (and this is a keyword, not just 'adding on') state-of the art technology features, as and when these arise. These points are discussed at greater length in the paragraphs that follow.

Flexibility for Current Needs

The TelePAC is a 'soft' machine, in that everything that may differ from system to system is interactively configureable (configurations are kept in battery backed up RAM, and, as an option, additionally on floppy disc). Even the basic link protocol is configurable. At the same time the TelePAC, whilst achieving the very high throughput per unit cost that is required of X.25 or statistically multiplexed nodes, also acts as communications processor with a wide range of configurable options not normally found in most nodes. These options, together with a unique intermixing of X.25 and statistical multiplexing (where required), and a unique transport level 'naming' system for logical channels, make it easy to set up alternative routing networks; switching or fixed destinations; contention; mixing of asynchronous and synchronous data; menu driver or automatic routing; resource queuing, etc.

At the same time the hardware is modular, can be expanded in economically prices units and a wide range of OSI level 1 communications interfaces are available, including protocols (V24, RS232, V28, X21B1S, 1S0 2110 1B12, RS423, V10, X21, etc.).

Adaptability

No network design is static. It evolves as requirements and traffic mixes change. The configuration of the TelePAC is unique in the sense that it is decentralised minimal topology. Information is passed between nodes (call packets or resource names), and provided that simple rules are followed the configuration of each TelePAC can be taken in isolation. This means that nodes can be removed from, or added to, a network, with no impact on other nodes. Resources and terminals can be added or removed, and become accessible throughout the network, with nothing but local, minor configuration changes required.

Expansion of Capacity

The number of links supported by a TelePAC can range up to 30. To incorporate extra links, it is necessary simply to purchase a modestly priced low-port or low- port line card. An interactive dialogue is used to soft-configure the links, the machine is switched off, the new card (or cards) is incorporated, and when the machine is switched on again the extra communications links are up and running.

Resolution of Traffic Mix Problems

Sometimes the traffic types that are to be carried by a network are in conflict, either because of protocol differences, or in terms of volume versus response. Because of the total integration capability (if required) of the X.25 and statistical multiplexing protocols, there is no problem in, for example, mixing a wide number of fixed destination synchronous protocols on the same X.25 link used by switched asynchronous data.

Some data links may be high speed, dealing with, on the whole, large blocks of data. In these cases, X.25 may be soft-configured on the protocol. On other links a highly interactive response may be required (e.g. the echo of typed characters is being performed by the remote host), and in this case the statistically multiplexed protocol may be used. In complicated networks, performance requirements may dictate a structure consisting of trunk links and host interfaces running high-speed X.25 and statistical multiplexing as the network fans out.

TelePAC

Hardware

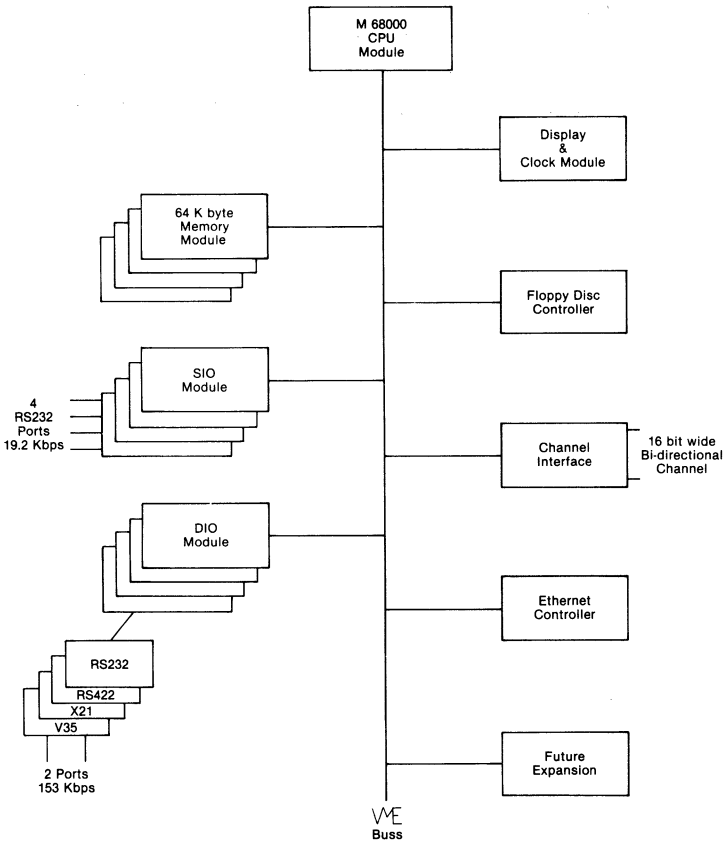
The TelePAC is based upon the M68000 range of micro-processor products and the European standard 'VME' bus. The TelePAC processor board has an internal bus for instruction fetch and stack-oriented operations. For high throughput, link input-output operations are independent of the main M68000, via separate processors running in DMA mode. High-speed DMA channels are also used to interlink TelePAC units, in order to create very large Packet Switching Exchanges; MegaPAC statistically multiplexing nodes; or a combination of both with the option of running several user-programmed processors.

Battery backed-up RAM provides the primary level of TelePAC configuration protection. A second level can be provided as an option by floppy disc drives on which copies of the configuration can be saved, and retrieved automatically by the system.

A range of link interfaces are available:

RS232 (V24), RS423/422 (V10/11), V35, X21.

Each TelePAC unit is 19 inch rack mountable.



Capacity

Each TelePAC unit can support up to 32 network links, soft configurable as X.25 or statistically multiplexed (multiplexed links support switching as well). Up to 1500 logical channels per TelePAC unit can be configured. The maximum number of TelePAC units per MegaPAC is 16.

Environment

Temperature:	0 to 50 deg C.
Humidity:	0 to 90% (non condensing)
Power:	115 VAC 60 Hz or 230/240 VAC 50 Hz.

The throughput parameters per TelePAC unit are as follows:—

Maximum individual link speed:
153,000 bps.

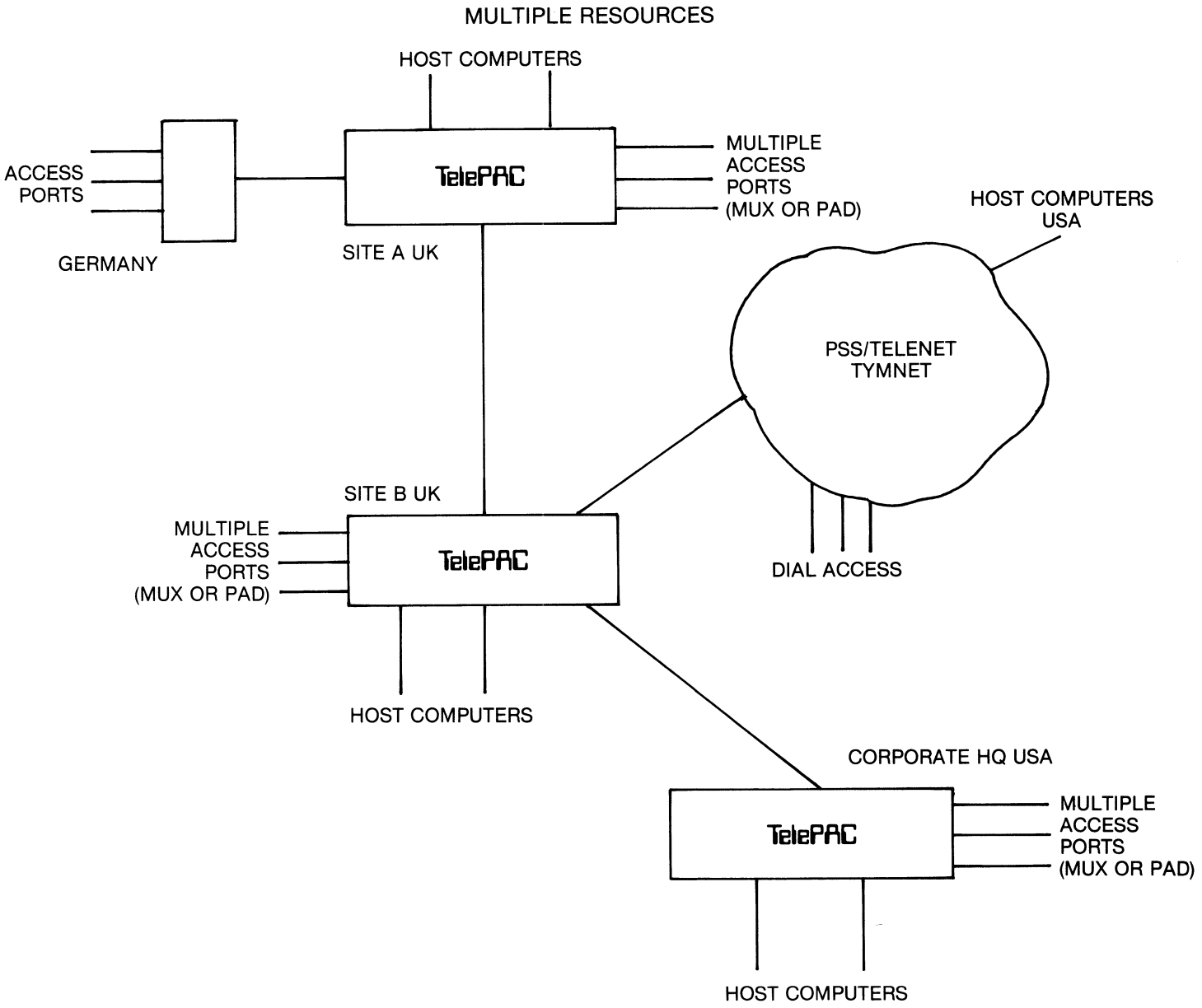
Maximum aggregate link speeds:
greater than 312,000 bps.

Maximum packets per second:
greater than 1162.

Maximum statistically multiplexed data rate:
greater than 32,000 bytes per second.

SOME EXAMPLES OF CURRENT TelePAC NETWORKS

Four possible, representative networks are illustrated. These are discussed separately in this section. All the networks illustrated are based on installed systems.



1. **Multiple Resources**

This is an example of a variety of scattered resources mostly host computers, accessed from various geographical points in a multinational organisation.

All synchronous users in this network, including those arriving through PSS, receive a menu informing them of the resources that they may select. In this case three character resource names are used.

There are two TelePAC sites in the UK, linked by a leased high-speed line. Each of these sites has two host computers (IBM), and a large number of terminals, attached via mixture of statistical multiplexors and X.25 PADs. There is also a leased line between Site A and Germany, where a 6005 multiplexor brings in 16 terminals.

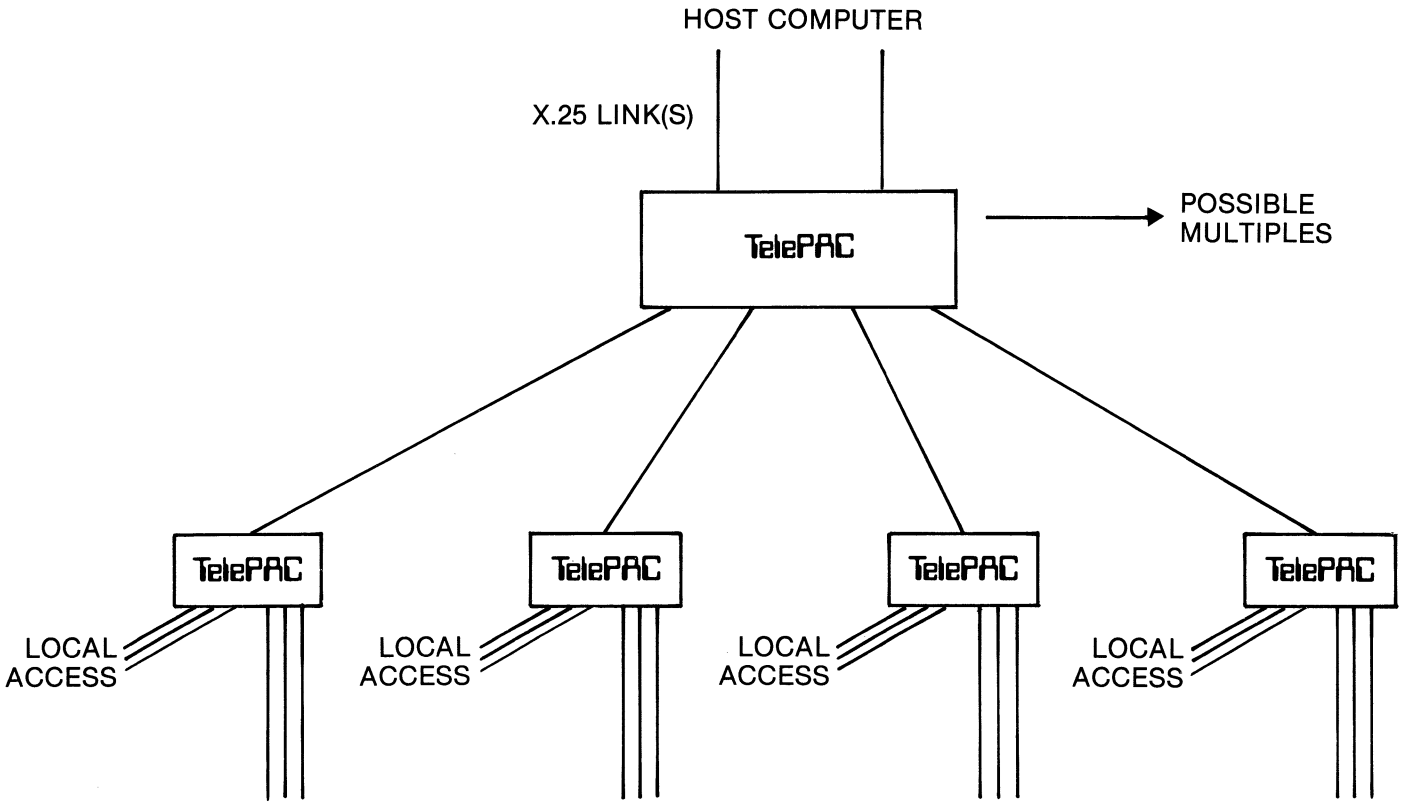
Site B is connected to PSS, both to bring in terminal users, and to provide access, via TYMNET and TELENET to external host computers in the USA. A number of 3270 protocol converters also enter the TelePAC via PSS, and in this case the routing is automatic, via the X.25 sub-address to back-end X.25/3270 converters on each of IBM hosts (thus providing switching for remote 3270 terminals).

Site B is also connected via a trans-Atlantic leased line to a TelePAC in the USA, to which are attached on IBM mainframe and a Prime, together with another group of asynchronous terminals.

All synchronous terminals, via menu selection, can, on demand, select any host computer. Wherever the users are it is invisible to them as to where the host computer is actually situated; which path user taken and whether it is on a local or remote TelePAC or on the other side of the public packet switched networks.

Any terminal in the network, with appropriate access privilege, can get access to the virtual control ports on any of the TelePACs or on any of the PADs or multiplexors.

CONCENTRATION



Access Points:
e.g. (1) VIDEOTEXT TERMINALS
(2) RTU'S (POSSIBLY WITH X.25 INTERFACES)

2. **Concentration**

This is an example of a single resource, attached to a network which is both large and geographically scattered.

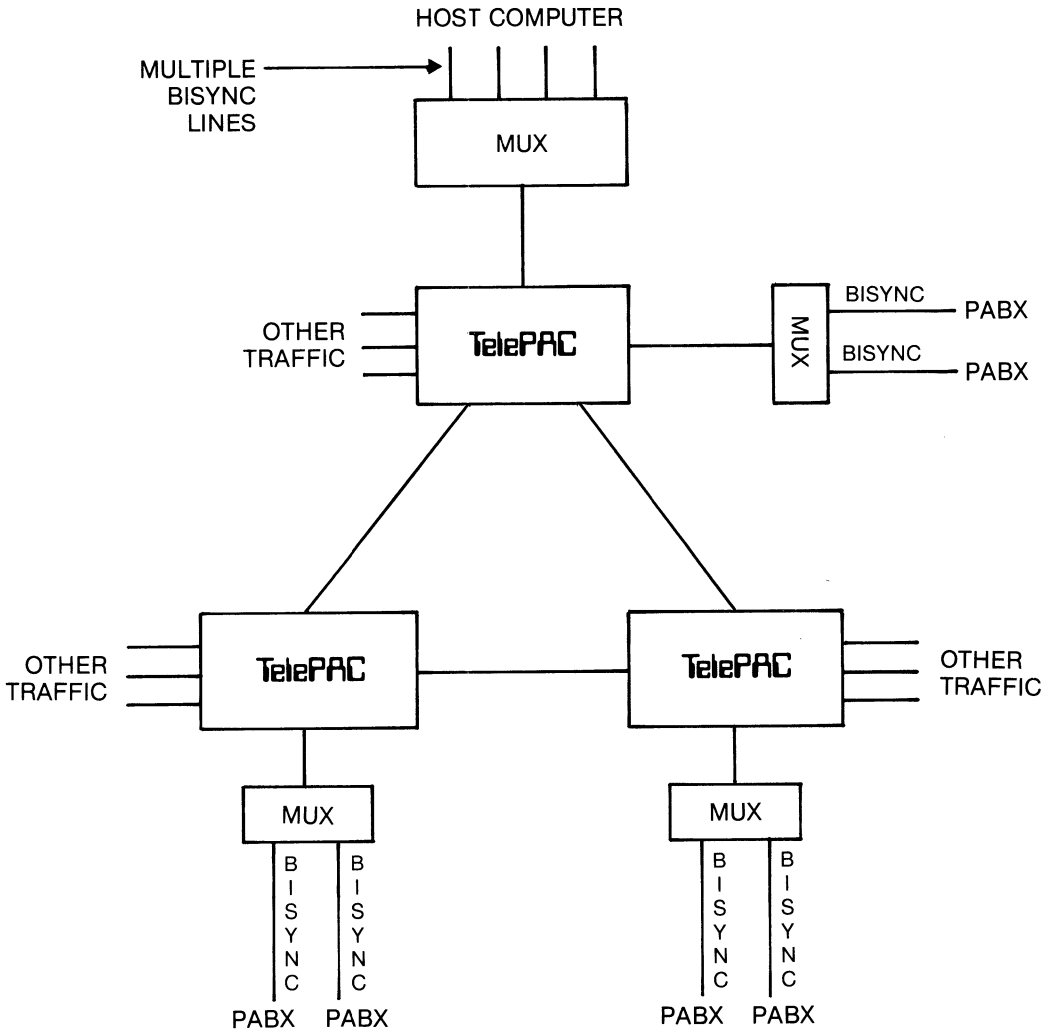
In this case the TelePACs are providing a concentration function, alternative routing between the off-site TelePACs (not shown), and a network management function.

64K bit links connect the on-site TelePAC with VAX computers. The protocol used is X.25. Off site TelePACs are connected by 9.6K or 19.2K links to the off-site TelePAC, again by means of X.25.

The off-site TelePACs have some local multiplexors for directly connected terminals. Most of the traffic however comes via remote 6030 statistically multiplexed nodes, which form hubs to which are connected remotely situated 16 port 6005 multiplexors.

All the outgoing links from the off-site TelePACs are using the MUXPORT statistical multiplexor protocol. It can be seen that the TelePACs are incidentally performing a protocol conversion function between the X.25 interface on the VAX, and the statistical multiplexors at the periphery of the network.

ALTERNATIVE ROUTING



APPLICATION: MONITORING & MANAGEMENT OF PABX's WITH BISYNC (simple protocol) INTERFACES
PLUS: MISCELLANEOUS BACKGROUND TRAFFIC (other host's and terminals)

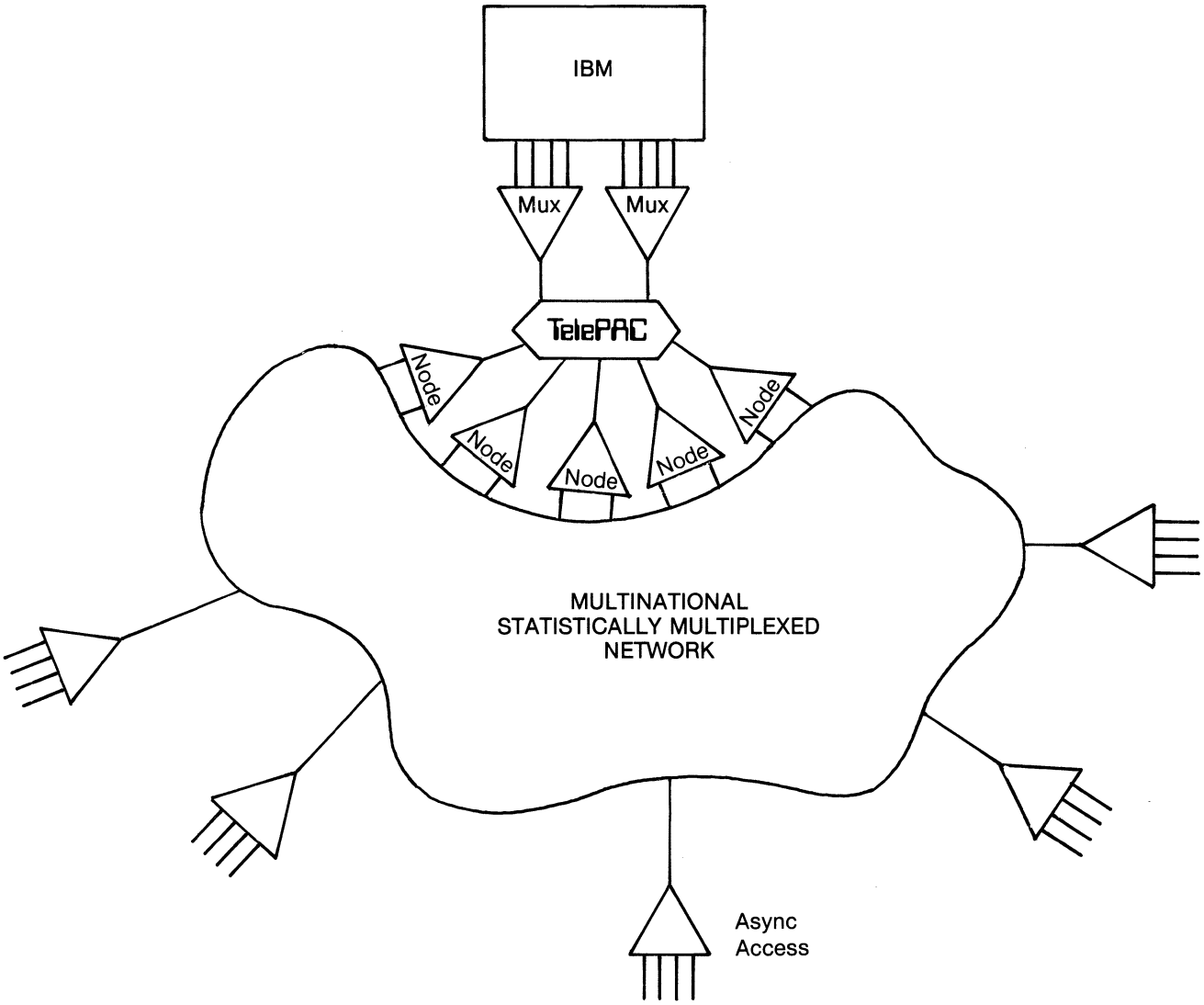
Alternative Routing Example

This example is interesting in that it illustrates a PABX network management system which is riding on the back of a telecommunications data network.

It is a triangular network, which provides alternative routing in the case of single links or node failure. There is a large amount of other traffic, and there are hosts at each TelePAC site, in addition to the host shown, which is performing the PABX management function.

A number of geographically separated PABXs are connected to 6005 multiplexor by lines which are running a simple BISYNC protocol. These lines have a fixed **destination** (but with **alternative routing**) i.e. a central host computer, shown at the top of the diagram. The lines between the host and the 6005 multiplexor are, of course, BISYNC and are effectively directly connected to the BISYNC interfaces on the PABXs.

The connections between the PABXs and the host are used to transmit alarms and fault reports to the host computer, where they are filed on disc, if appropriate, and displayed on the monitor screen or listed on a printer. Interrogation terminals (screens) on the host can request diagnostic, statistical, or accounting information from any of the PABXs.



Contention Example

This is a simple example of contention. A very large APL terminal population exists at remote geographical points in a multi-national network. The network is provided by a combination of 6050 super nodes and lesser nodes and multiplexors.

MUXPORT (statistically multiplexed) links connect this network to a TelePAC. On the other side of the TelePAC are two medium scale multiplexors, again connected via MUXPORT links, which provide a number of host connections which are considerably less than the total terminal population.

All of the terminal input logical channels at the TelePAC interface are fixed destination routed to the host ports, but no actual cross connection (virtual circuit) through the TelePAC is made until the user uses his terminal; and the connection (virtual circuit) is broken by the host 'logoff' or terminal dropping DTR.

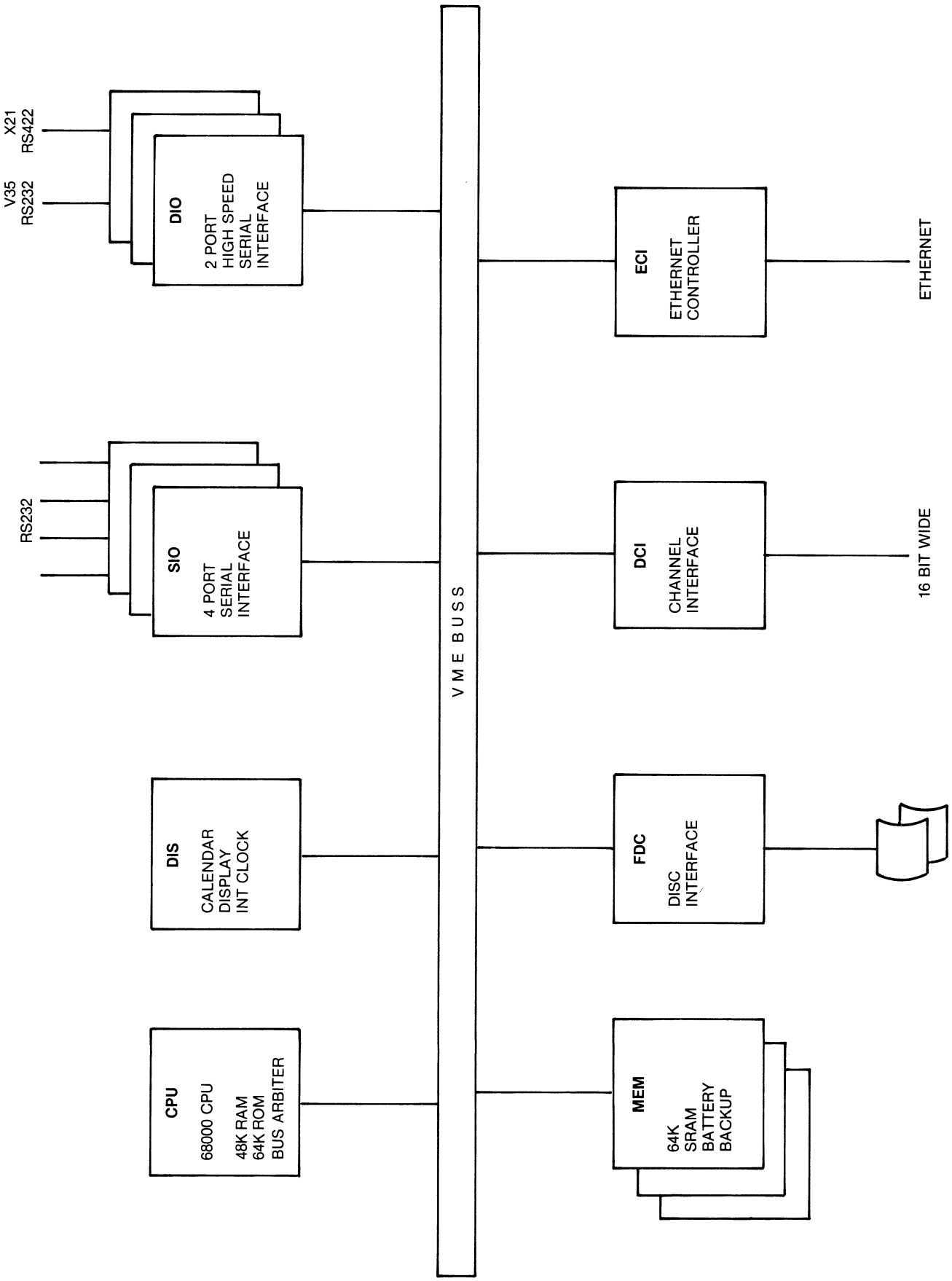
Thus host ports are necessary only for the maximum number (estimated) of the simultaneous users, not for the total number of terminals. If the number of connection requests exceeds the maximum host ports available, the TelePAC puts the users into a queue. The user is informed of his queue position, and can interrogate his queue or quit on demand.

Being a multinational company, with local preferences as to the mode of operation, differences between the connection and disconnection methods occur from country to country. These differences are catered for by the flexible soft configuration options in the TelePAC.

It is planned to rationalise this set up by replacing the front-end multiplexors with an X.25 link between the TelePAC and the host in the near future.

HARDWARE ORGANIZATION

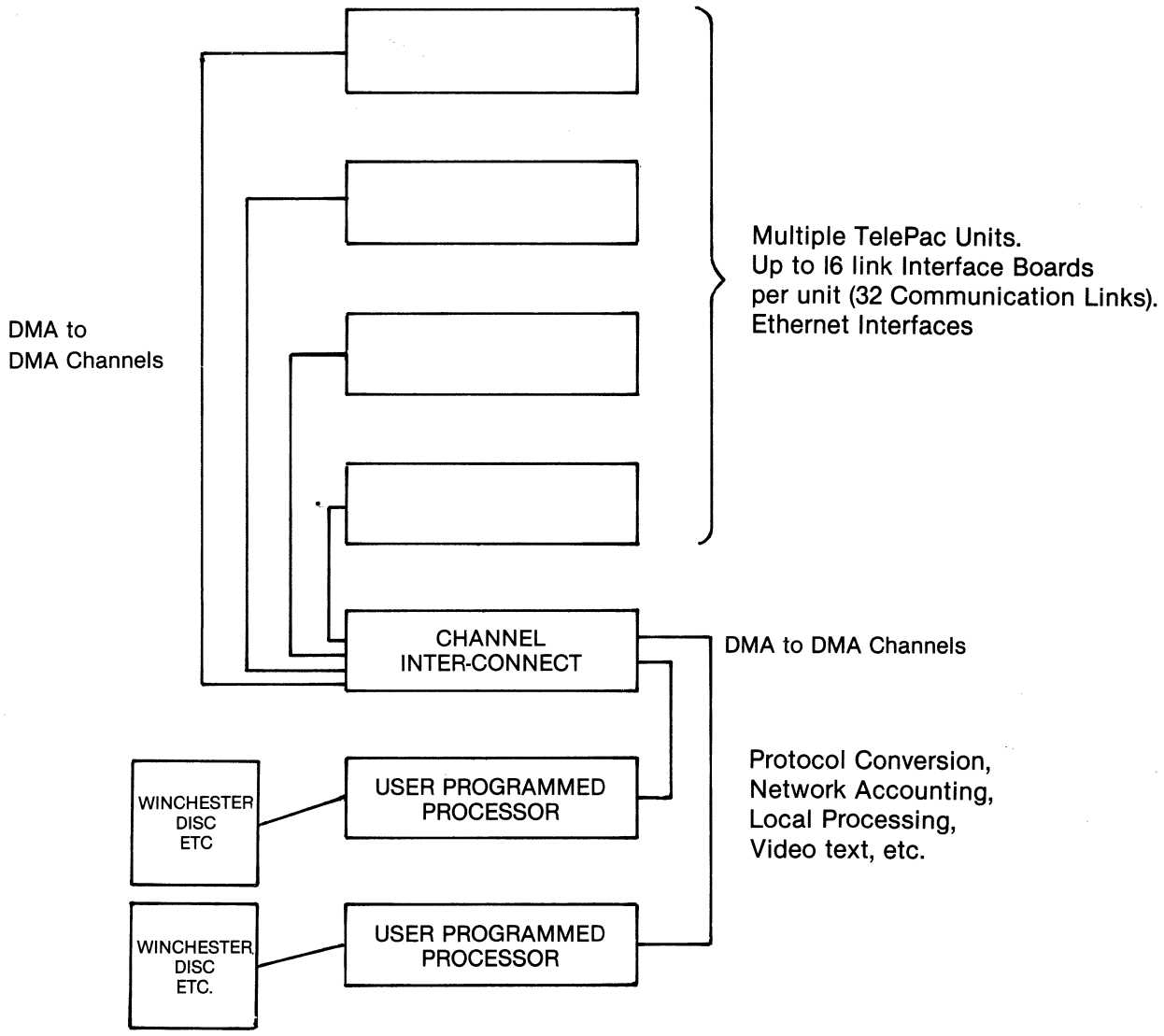
TELEPAC UNIT



HARDWARE ORGANIZATION

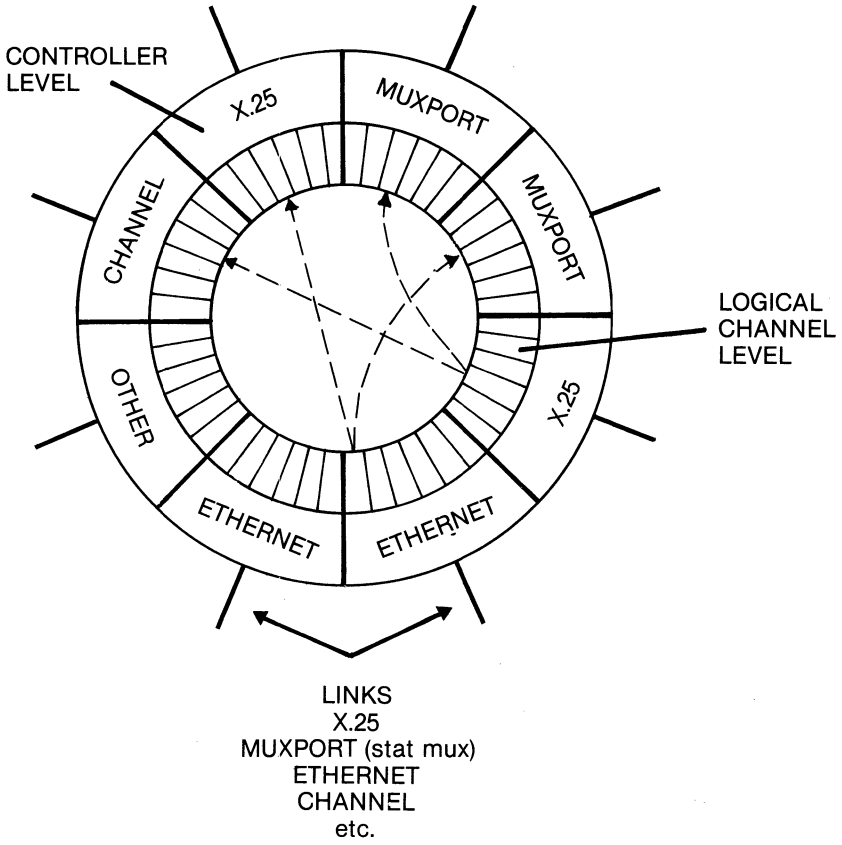
TELEPAC MODULARITY

EXAMPLE CONFIGURATION
IN MEGAPAC STRUCTURE

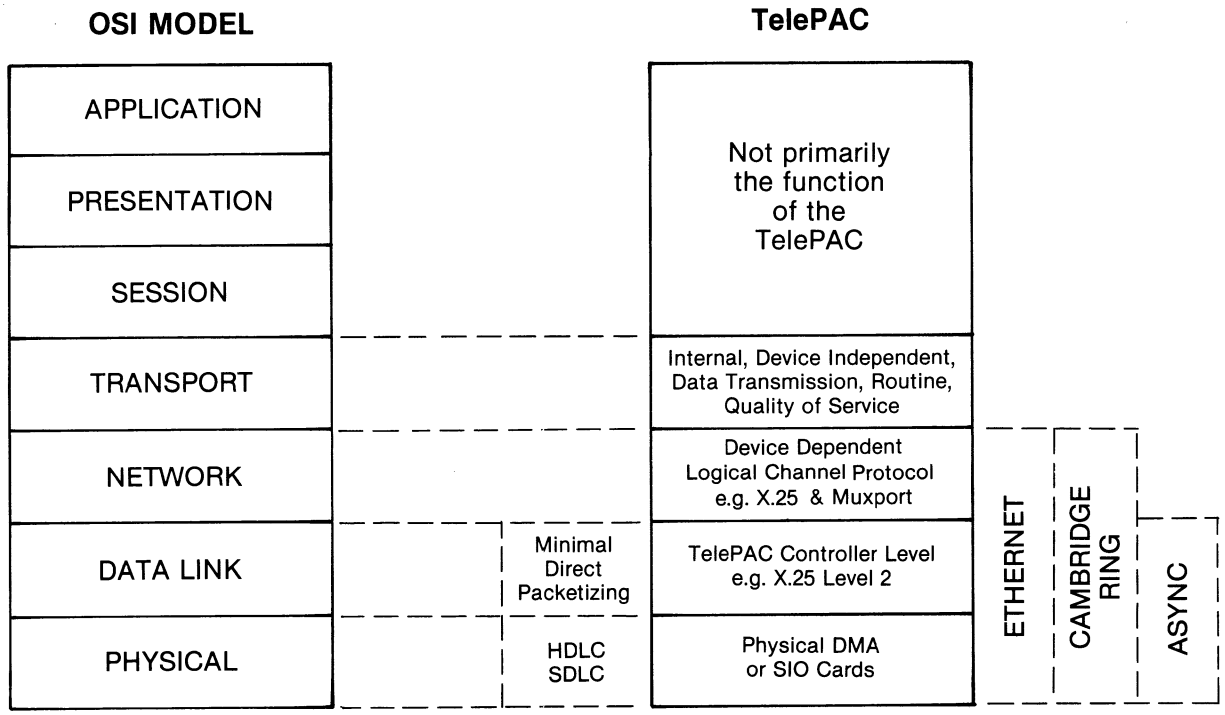


INTERNAL AND NETWORK ORGANISATION

The following pages illustrate the internal and network organisation of the TelePAC. The onion skin shaped illustration below shows the layered concept of the design. As can be seen this corresponds to the first 4 layers of the OSI reference model.



The diagram below illustrates how the onion skin structure in the TelePAC model maps on to the OSI reference model, when a cross section of the onion skin layers is taken. The diagram also shows how the proposed extensions to the TelePAC interfaces map on to the TelePAC and OSI model.



Above the physical level there are three important layers, which will exist in greater or less quantities according to device and protocol.

Controller Level

Provides the data link level control — responsible for controlling the state of the data link and for preserving the integrity of higher level data at the link level. For X.25 and MUXPORT the same controller is used (X.25 level 2), with minor parameter differences.

Channel Level

This provides the protocol dependent networking operations in terms of logical channels. For X.25 this consists of handling X.25 level 3 packets; for MUXPORT this consists of analysing and constructing multiplexed frames, (i.e. data from more than one channel is in the same level 2 frame).

Transport Level

This level is common to all current and future interfaces and provides for a device and protocol independent method of passing and flow controlling data and in particular, for referencing, routing and cross-connecting (forming virtual circuits) device independent logical channels. This scheme is based on the principle 'named' channels, and all transport level operations take place in terms of these **names** (four characters). This is discussed further below, and is illustrated extensively in the diagrams that follow.

Transport Level Names

All logical channels at the transport level are assigned names by default when a system is started for the first time. Thereafter the TelePAC manager may reconfigure these names to be anything that is meaningful to him and the stucture of the network. Many channels can have the same name (e.g. a contention group or a trunk link group). To form a virtual circuit through a TelePAC it is necessary simply to search for the requested name (routing) and then to link the initiating name (the caller) with the destination name (the resource). This simple operation is common to all protocol types, and happens invisibly to the higher and lower levels.

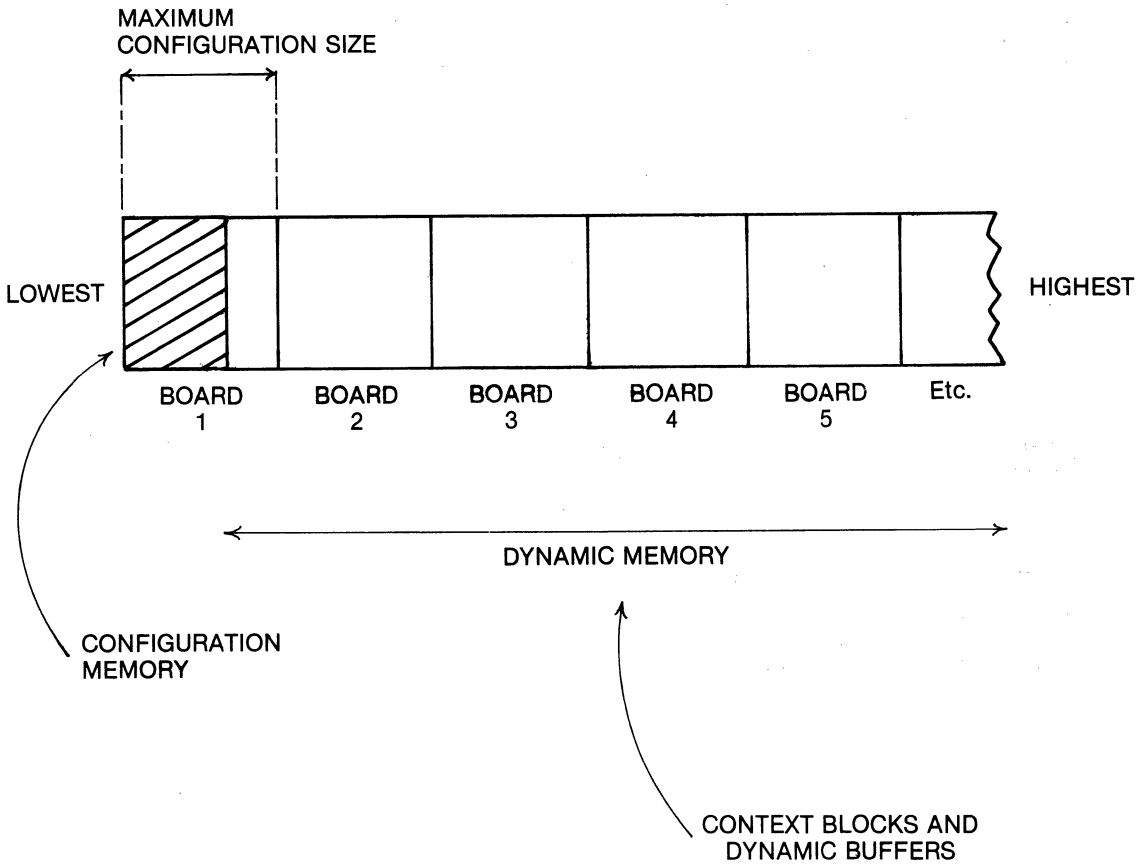
A common approach to several problems has been taken with the transport level names.

1. For configuration and diagnostic purposes, the names are used to reference channels. The concept has been extended by allowing controllers to be named for configuration and diagnostic purposes.
2. Call addresses (in X.25 call packets) are mapped to and from the transport level reference names.
3. For menu driver users, the names are the resource selectors.
4. The names are used to represent the hierarchical structure of network addressing.
5. An internal routing option, which is protocol independent and which is called the 'dial option', consists of passing names from one TelePAC to another.

To generalise the naming conventions wild characters (*) are used to 'match anything'; and multiple synonyms (" " " ") are used to simplify the expression of multiple groups on trunk links.

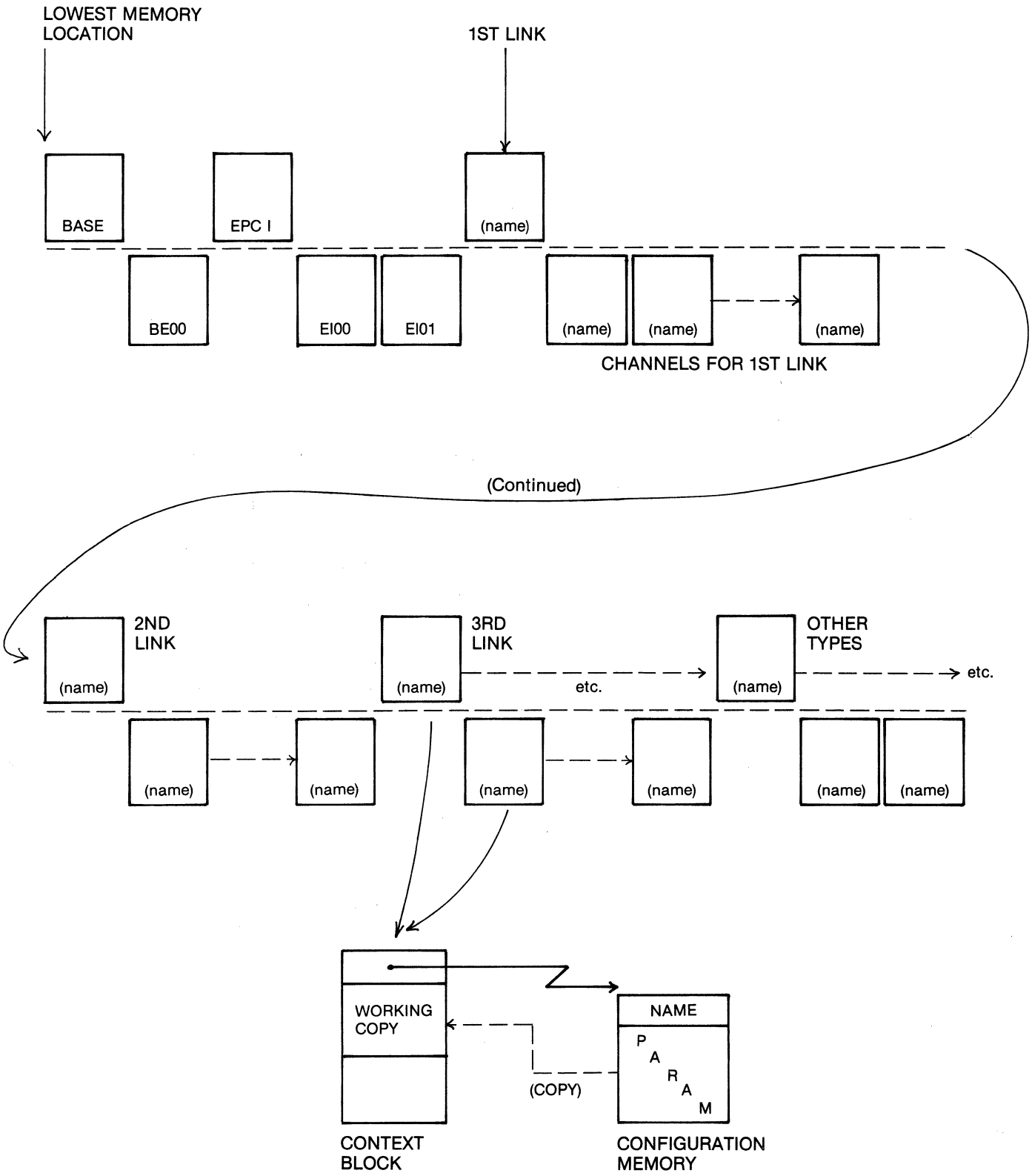
INTERNAL ORGANIZATION

MEMORY LAYOUT



INTERNAL ORGANIZATION

TWO LEVEL DATA STRUCTURE



DATA STRUCTURE CONTEXT BLOCKS

Base Contains version number of system; names of channels to which reports and diagnostics are to be directed; the greeting message or menu. Then come repeated entries in the X.25 table, specifying resource name, its X.25 address, and user data (calls out only).

BASE has one channel (default name BEOO) which is the virtual control channel. The name and priority (resource) of this channel can be configured for security.

EPCI No controller level parameters. Two channels corresponding to the two on-board asynchronous ports. The first (default name EI00) is the top port. These channels have normal configuration parameters, except some are not relevant.

Subsequent Controller Contexts Configurable names. Can be configured as X.25 or MUXPORT links, DMA to DMA channels, or Ethernet access ports. The sequential context blocks correspond to ascending addresses in the appropriate device address space (i.e. ascending communications link boards and/or ascending Ethernet or DMA channel controller boards). Unconfigured controllers have the type 'NULL'.

Channels Each controller has a group of channels, ordered in ascending sequence. Most configuration parameters are common, but some are significant only to certain controller types.

Channel O on MUXPORT links is the virtual control port of the attached multiplexer or node.

INTERNAL ORGANIZATION

MEMORY SIZING

★ First determine the configuration memory size. The rest of memory is then available for context blocks and buffers. Check that there is enough space — allow for a buffer pool of at least 100 buffers.

★ For calculating the size of configuration memory, the following equation is used:—
(Fixed overhead) + ((37 − Number of configured links) × (channel size)) + (channel size × number of configured channels)
where fixed overhead = 2656 bytes
and channel size = 48 bytes

★ For variable memory, allow:—
732 bytes per controller (link) context block.
174 bytes per channel context block.

★ Each buffer is 152 bytes long.

NETWORK ORGANIZATION

DESIGN STANDARDS

1. Network designer should impose an organized addressing structure on the network.

   (X.25 addresses and/or 'Names' organized on an area or node basis).

EVOLVE STANDARDS!

2. Each TelePac in a network is independent, and only the following information can be passed:—

   ★ The selected resource name on 'Dial' ports

   ★ The X.25 address on X.25 ports (can also use 'Dial' option)

NETWORK ORGANIZATION

CONFIGURATION PARAMETERS INVOLVED

Name — Resource names
Especially note use of * (word) and " (repeat list) characters.

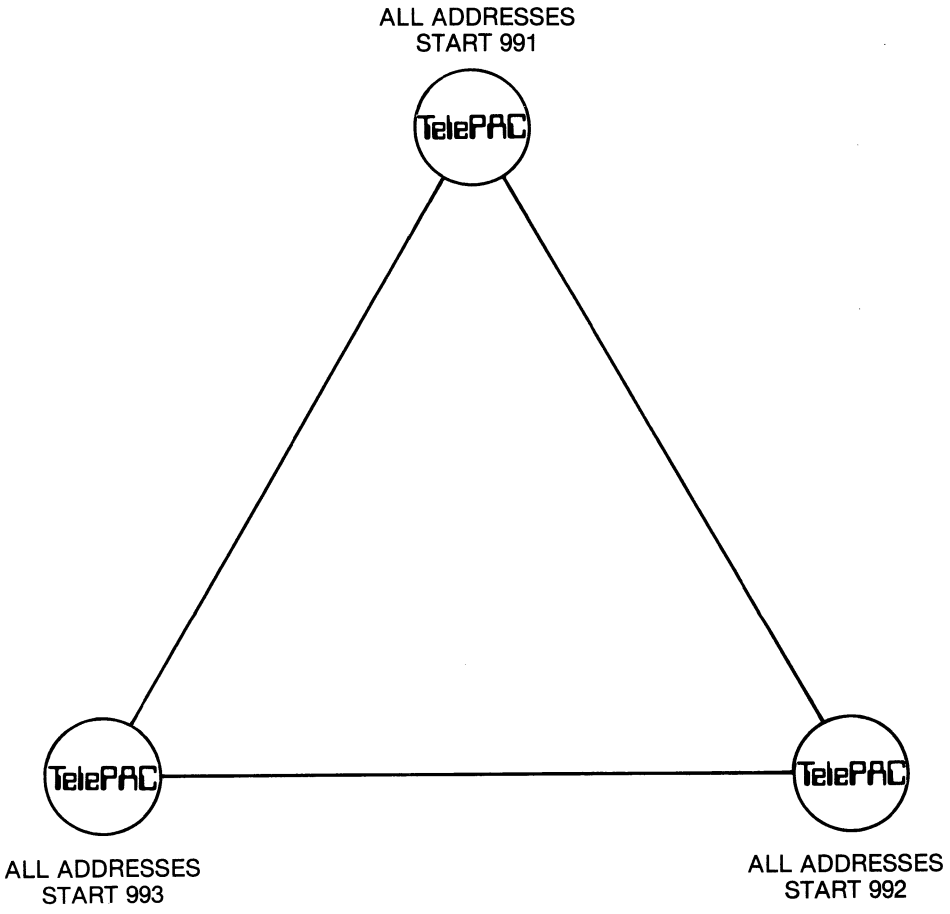
DRC — Destination Resource definition mask

DIAL — forwards resource names

X.25 Address — used in X.25 networks instead of DIAL operation.

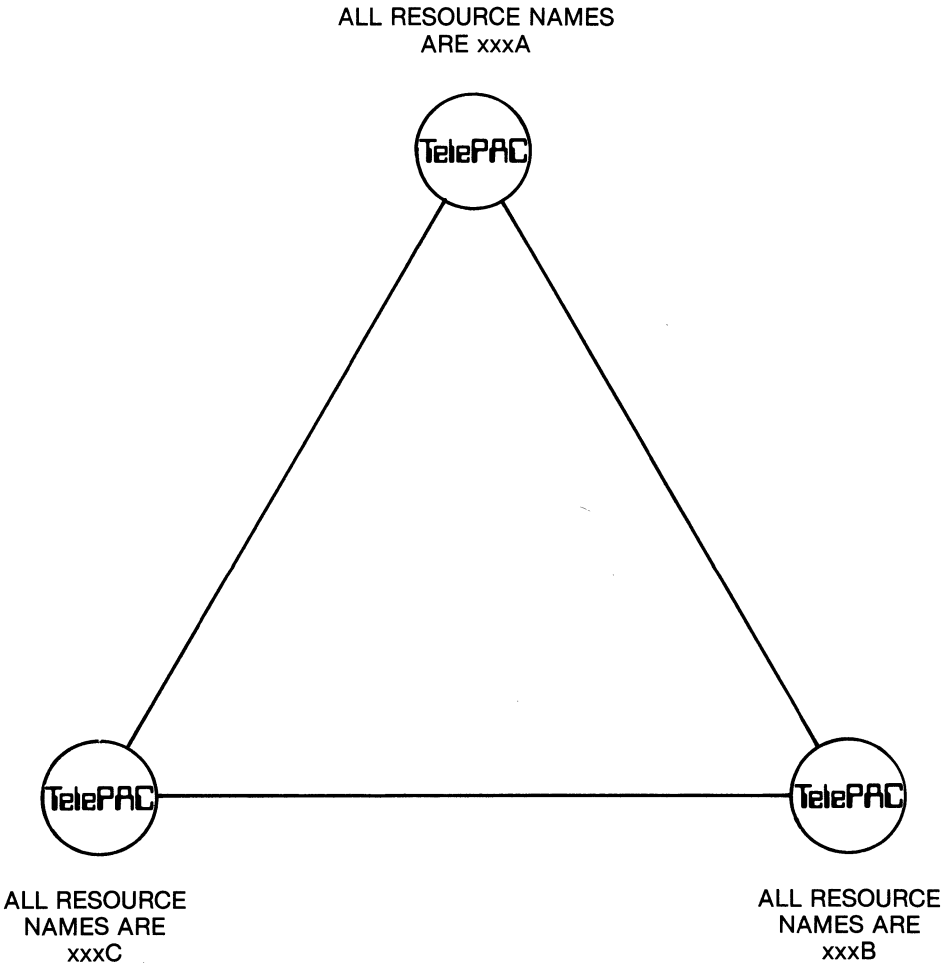
NETWORK ORGANIZATION

EXAMPLE — X.25 NETWORK



NETWORK ORGANIZATION

EXAMPLE — MUX NETWORK

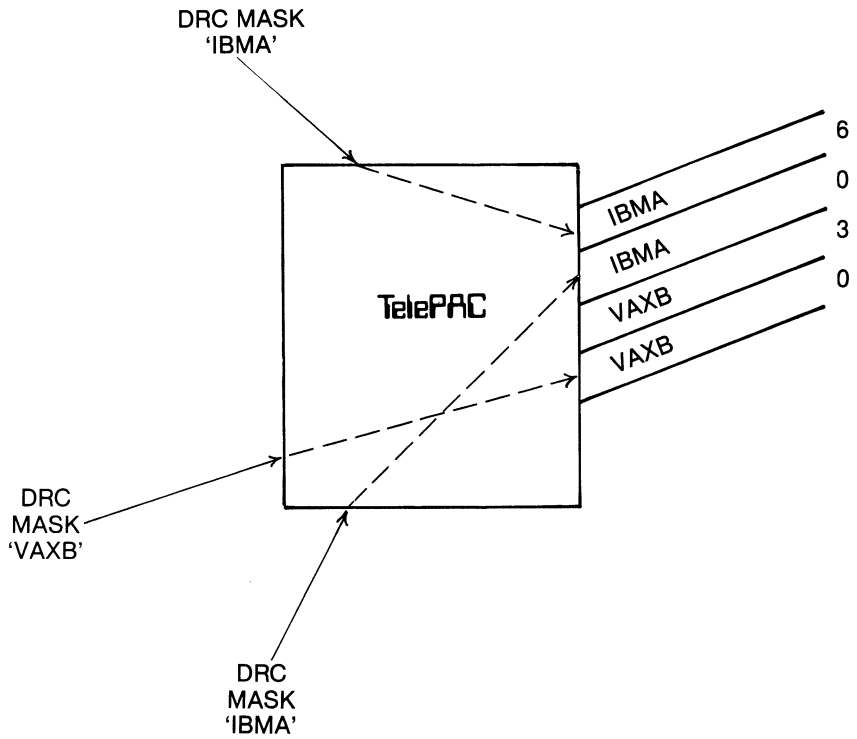


★ Combine both schemes in an X.25/MUXPORT mixed network

★ In non-triangular, multi-node networks, use " " " " (repeated resource list) feature.

NETWORK ORGANIZATION

PATH DEFINITION

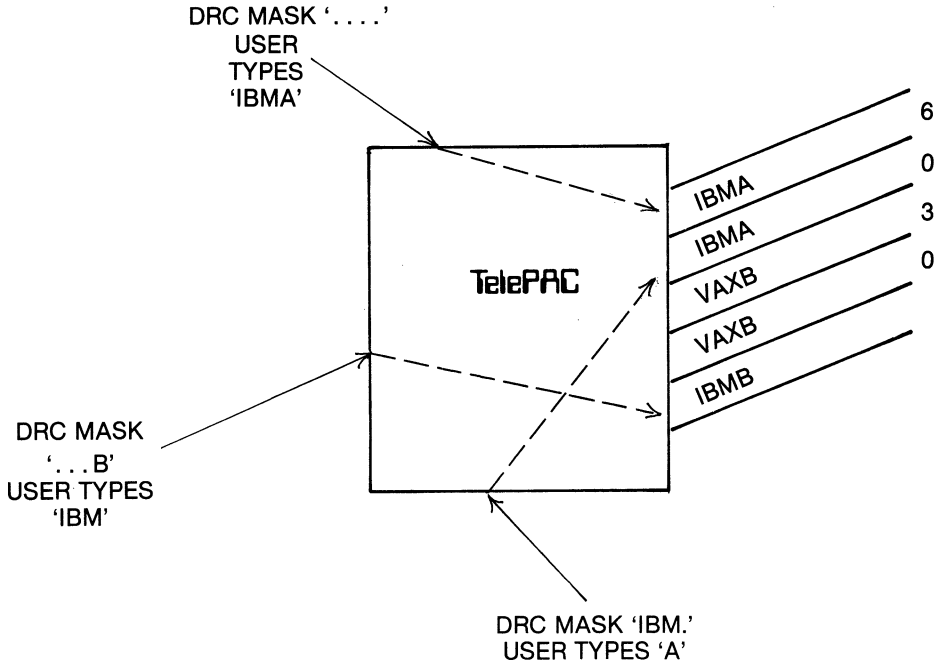


*NOTE:

We do not define routes. We define destinations (by name)

NETWORK ORGANIZATION

PATH DEFINITION

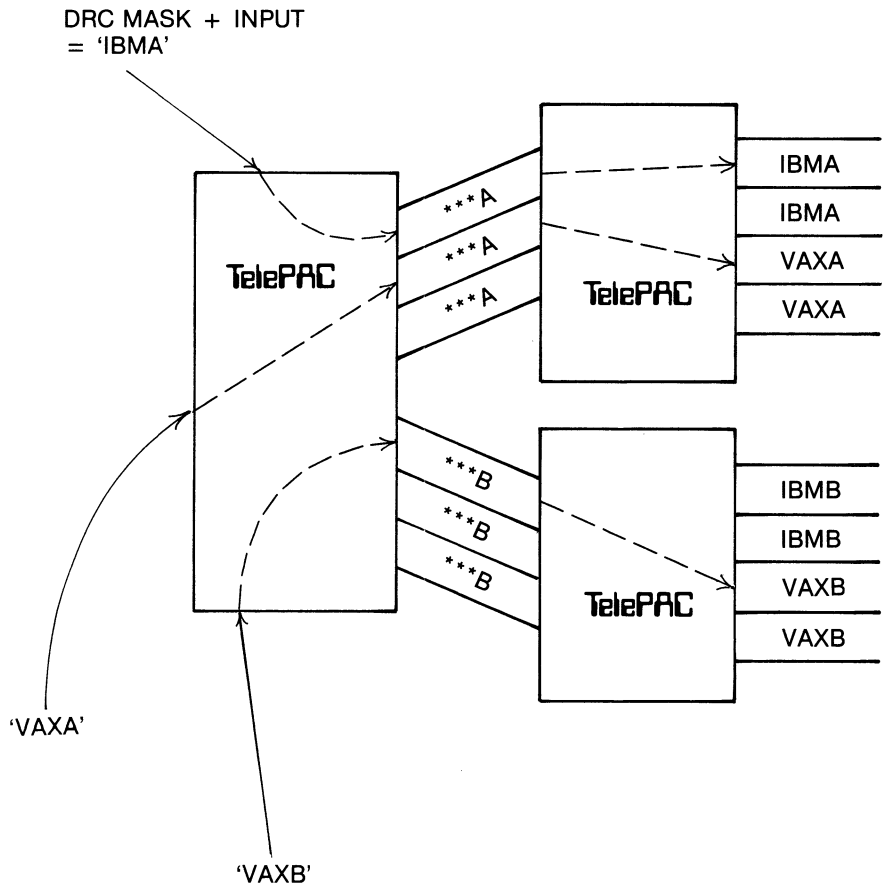


*NOTE:

'.' means 'fill this position with character from terminal'

NETWORK ORGANIZATION

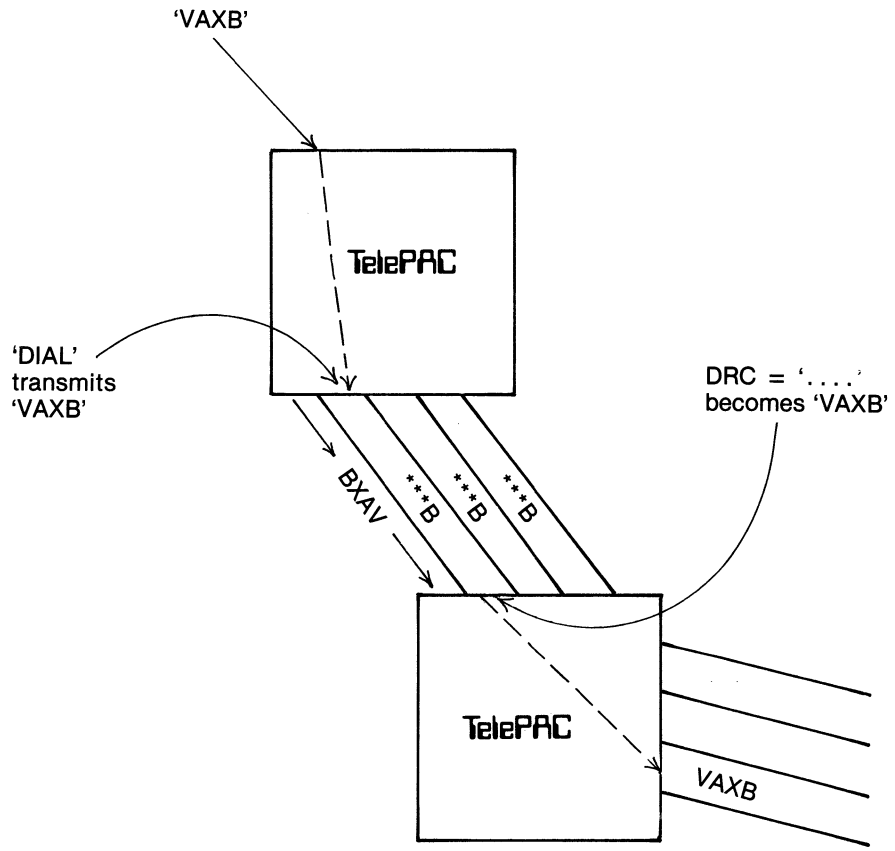
PATH DEFINITION



*Assume onward routing via dial option or X.25 call packets or both

NETWORK ORGANIZATION

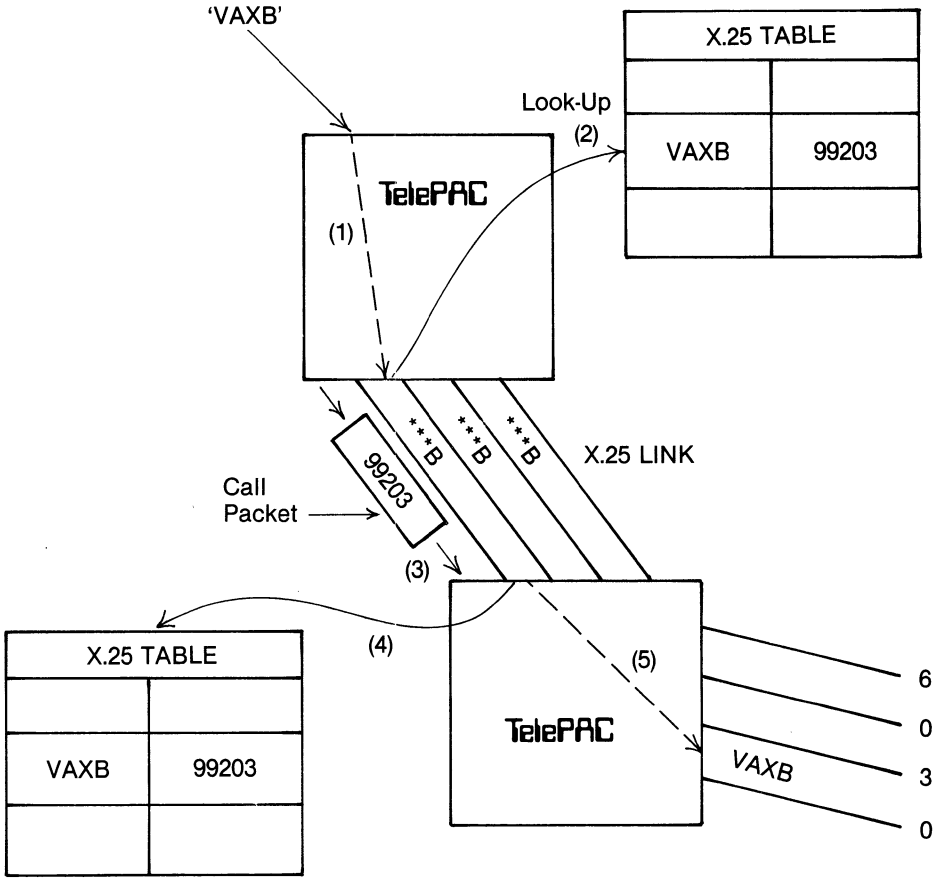
DIAL OPERATION



*Note:
Both ends of a dial channel should be specified as 'DIAL'

NETWORK ORGANIZATION

X.25 ROUTING OPERATION



*Note:
( ) Indicates step after initial submission of 'VAXB'

X.25 TABLE OPERATION

INCOMING CALL PACKET

★ Scan table in sequential order.

★ Look for match between X.25 address in call packet, and X.25 address in table.

★ To qualify as an address match:—

(1) At least one digit must match

(2) All digits specified in entry must match (for gateway routing, therefore, only a few leading address digits, e.g., country or area code, will be specified).

★ Scan stops when address match found, and the NAME in entry is used as the required resource name, and routing commences.

★ The call packet used for onward routing will be an exact copy of the received call packet.

★ If no match found, defaults to DRC style routing.

X.25 TABLE OPERATION

OUTGOING CALL PACKET

★ If outgoing channel is X.25 level 3, a search for its resource name is started in X.25 table. The search starts at the top of the table.

★ If match is found, the specified address and user data are used to build the call packet.

★ If the address ends with "—", then the caller's address is also put in the call packet. This is found by trying to find the caller's resource name in the X.25 table. It it is not found, then no address is included. **** at the end of the table could be used to force the same caller's address in all call packets.

★ User data, if specified, is usually a string of hexadecimal digits. However, the sequence (nnnn) at the front is used to specify the facility field, where nnnn is a string of hexadecimal digits.

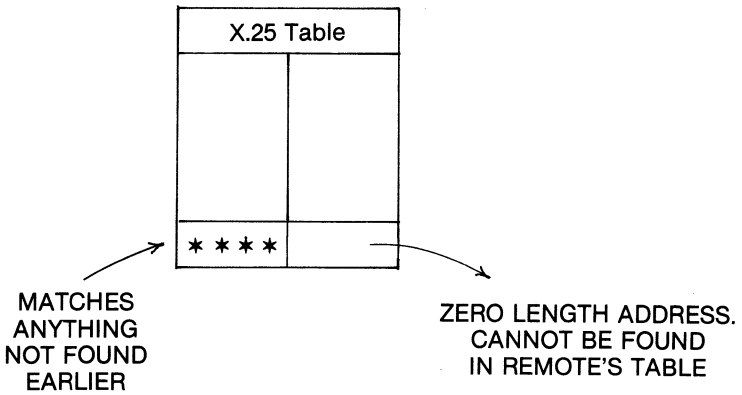
★ No match in table is a configuration error, which results in 'trying . . .' messages in quick succession at the incoming caller's port.

NETWORK ORGANIZATION

INCOMING X.25 CALLS

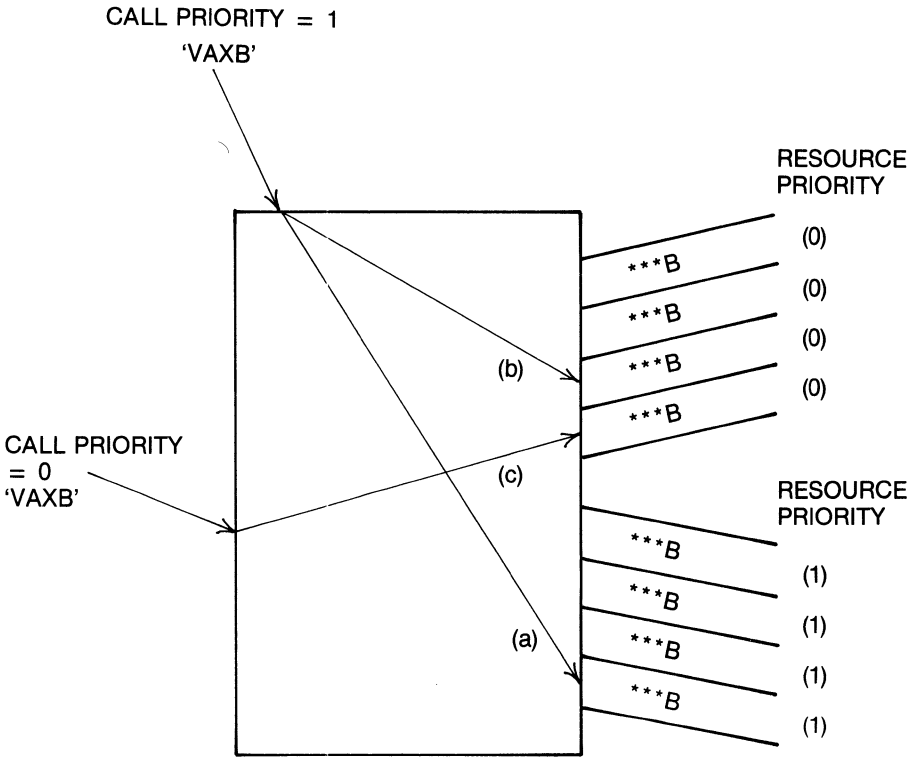
★ If incoming call address not found in table, defaults to normal DRC mode (e.g. PSS users can get menu).

★ To force this on TelePAC — TelePAC links (e.g. to use 'Dial' mode), put an entry at end of X.25 table in the call initiating TelePAC.



NETWORK ORGANIZATION

ALTERNATIVE ROUTING



(a) 1st choice set of Ports

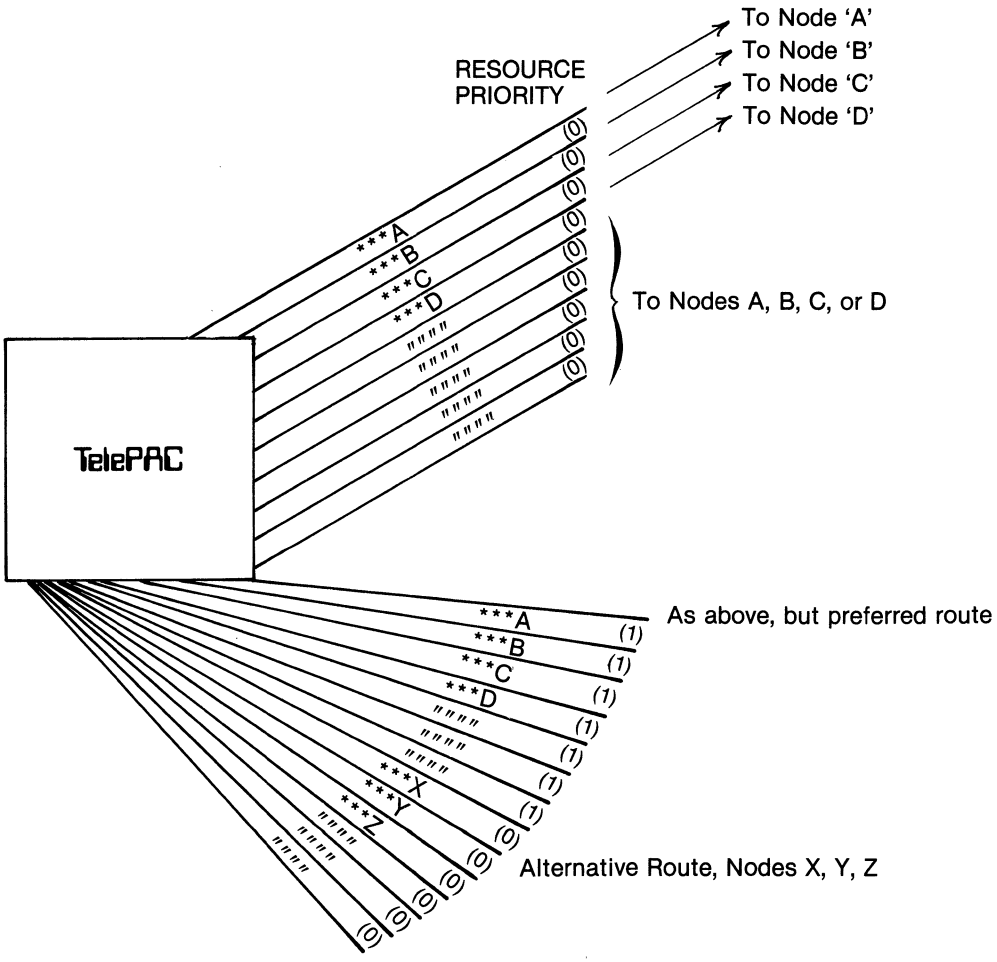
(b) 2nd choice set of Ports (all (a) are busy or down)

(c) Only choice of Ports

NETWORK ORGANIZATION

ALTERNATIVE ROUTING

Use of Resource List in Complicated Networks



Where many resources are used and many nodes, the "" "" "" "" name is used as a match for 'any resource so far listed on this controller (link)' but:—

AT THE RIGHT RESOURCE PRIORITY

NETWORK ORGANIZATION

AUTOMATIC RECONNECTION

★ If a link or node becomes inoperable, alternative routing becomes available if the network is so configured.

★ Unless otherwise configured, the call has to be consciously re-initiated by the user. An exception is fixed destination channels, acting in retransmission or polled mode, where retransmissions or polling can be used to reconnect automatically.

★ Automatic reconnection is an option, specified by the RECO specials option.

★ If a disconnection occurs owing to link failure opposite the RECO channel, then an automatic reconnection procedure will take place, normally taking an alternative route.

★ In a multi-staged network, RECO should be specified at the appropriate points, and reconnection will take place at the point nearest the link failure.

★ In pure X.25 networks a high memory overhead is involved, because the original call packet has to be saved at each point where RECO is specified.

★ So, where possible, even if X.25 is the preferred link protocol, the compact routing offered by the DIAL option should be used. The DIAL option involves no extra overhead for the RECO option.

★ 'Wake-up' refers to the ability to send automatically certain preset characters to a resource when connection is made. The selected resource name may be passed across too, either additionally, or alternatively.

★ As an example it may be required to pass HH, to ABR the channel, followed by the selected resource name (to tell the host's operating system), followed by carriage return.

★ Wake-up can be specified on OUT only ports. The DRC MASK, otherwise unused, is borrowed for this. The wake-up characters in the DRC MASK follow these rules:—

All '.'	— no effect
!	— send carriage return
;	— start sending resource code
:	— start sending resource code and follow it with carriage return
	NOTE: The code sent is that actually typed by the user.
.	Stop wake-up sequence
^N	Where N is a letter, and ^N counts as a single character, send Control-N ^^ sends ^.
All other characters	Send character as is.

Thus a DRC of HH^C: will send two Hs to the port, followed by control-C, followed by the typed resource code, followed by carriage return.

★ Can be handled through TelePAC networks.

★ If inter-node trunk links are X.25, the channel type is irrelevant, as X.25 channels are totally transparent.

★ On MUXPORT channels, the channels must be specified as SYNC, as this enforces a special transparent mode of operation.

★ Currently synchronous terminal data can only enter and leave the network via synchronous ports on MUXPORT multiplexers or nodes, as it is the latter equipment that performs the necessary hand shaking and protocol intervention.

★ Protocol converters from synchronous to X.25 do not count as synchronous, as they are handled transparently by the TelePAC.

NETWORK ORGANIZATION

RESOURCE QUEUES

★ The configuration option QUEU enables a channel to be queued when the resource selected via that channel is busy (or if all the resources with the resource name are busy).

★ When the resource becomes free, connection is made automatically.

★ The user receives a message to say that he is queued, and what his queue position is.

★ He can query his queue position by typing the space character.

★ He can type ESC to escape from the queue.

CONFIGURING THE TELEPAC

VIRTUAL CONTROL PORT

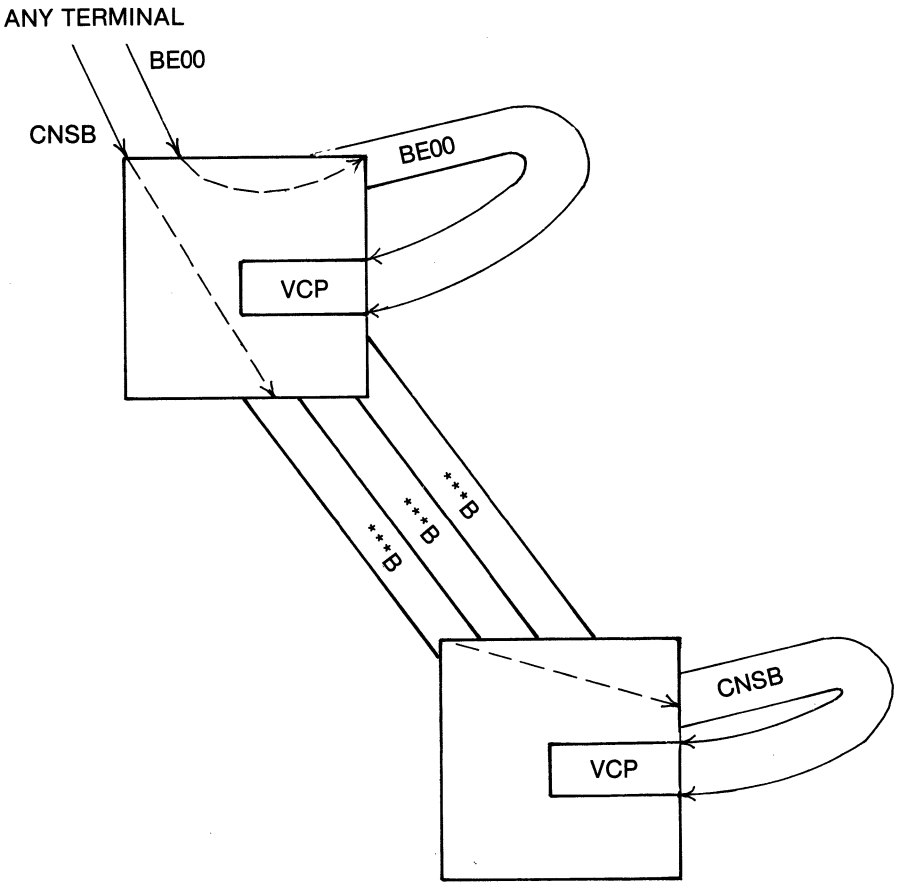
★ Each TelePAC has a 'Virtual Control Port'

★ Access the Virtual Control Port from any terminal in network by normal resource selection.

★ The Virtual Control Port may be on same TelePAC as the terminal, or on any other node in the network.

CONFIGURING THE TelePAC

ACCESS TO TelePAC VCP



★ The configured Resource Names are also the names of the configuration blocks.

★ The name of the configuration block under consideration is printed as a 'prompt'.

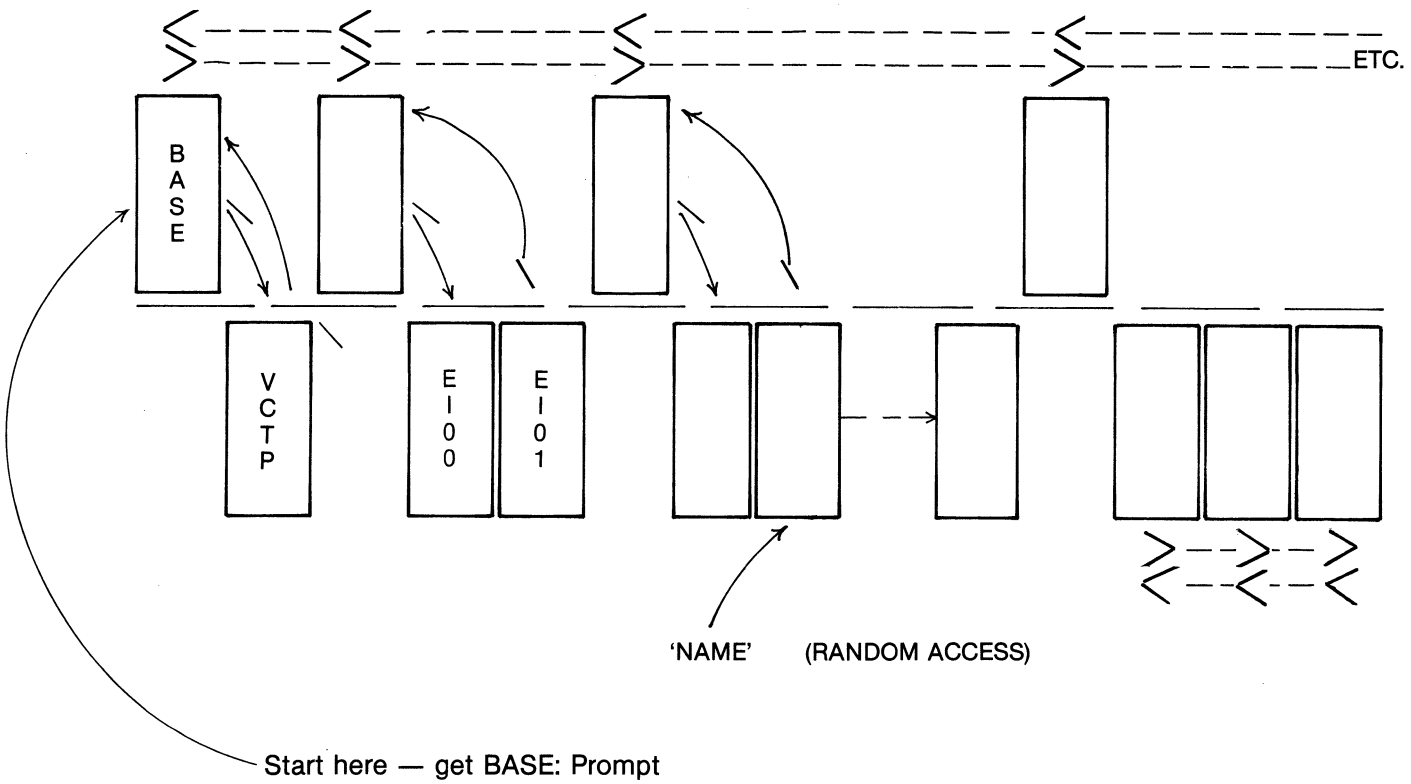
★ A syntax is used to step through the data structure, or an item can be randomly accessed by its name.

★ Commands, once issued, are remembered and automatically repeated as a move through the data structure takes place.

CONFIGURING THE TelePAC

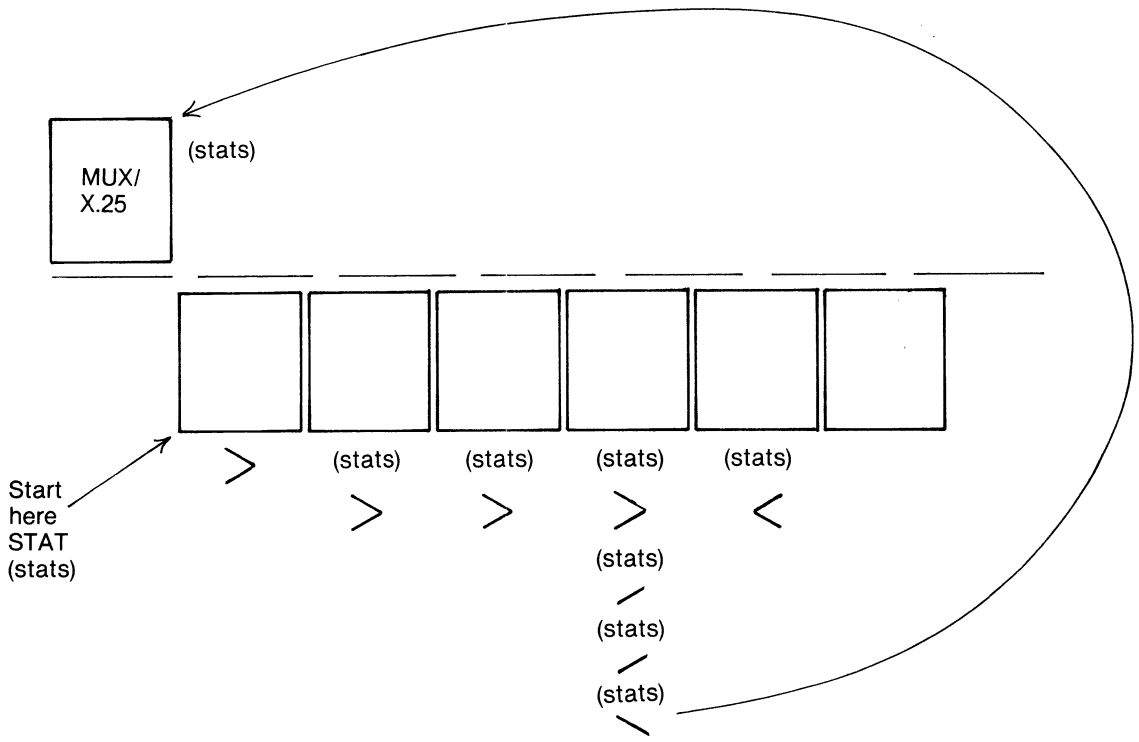
DIALOGUE WITH VCP

REMEMBER TWO LEVEL DATA STRUCTURE



Prompt changes as we move
'/' repeat command without moving

If command active, automatically executed as we move:—

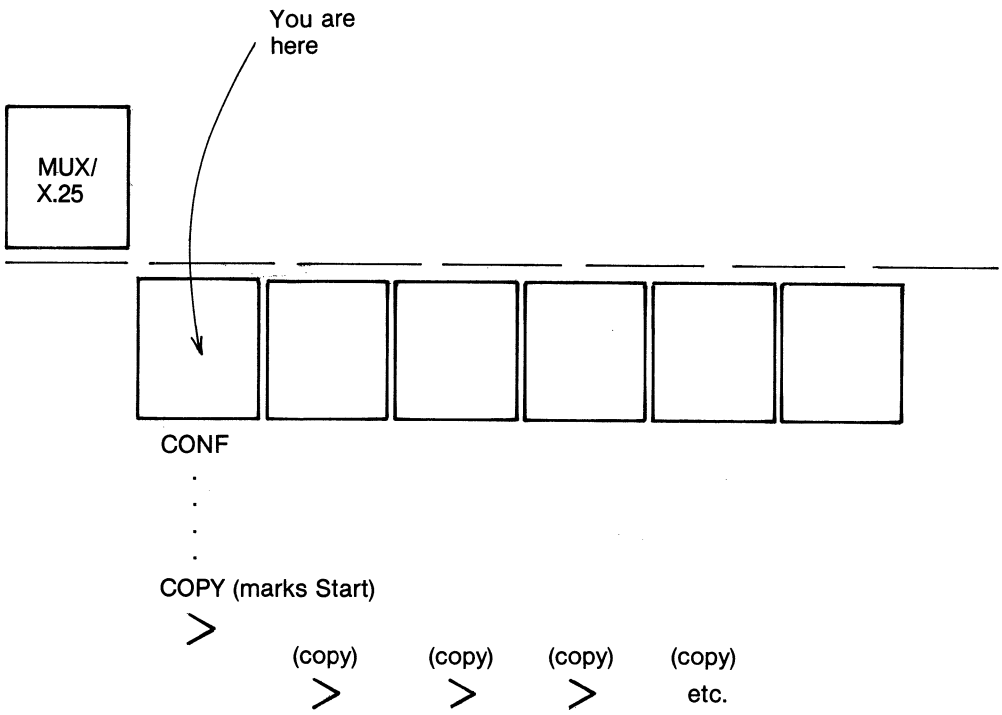


*/repeats command without moving

*ESC clears command
(ESC ESC for 'CONF')

CONFIGURING THE TelePAC

ESPECIALLY NOTE 'COPY'



*Quickly reproduces copies of same parameter block (copies name)

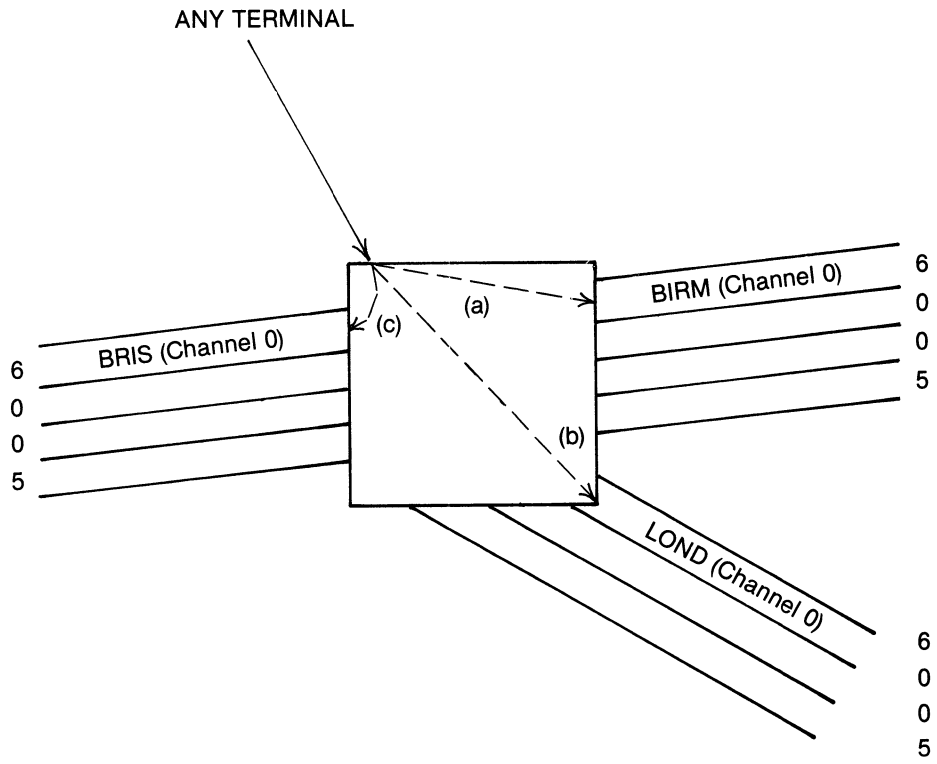
★ NOT MANY COMMANDS TO REMEMBER

EXAM	— examine parameters in battery backed-up RAM
CONF	— configure parameters in battery backed-up RAM
STAT	— current status of channel or controller
COPY	— copy channel parameters
REST	— restart controller or channel
BOOT	— boot the system
QUIT	— disconnect from the Virtual Control Port
TIME	— Display or Configure the time and date
MEM	— Display or Configure the size of battery backed-up RAM
DISK	— perform floppy disc handling function

SYNTAX CHARACTERS

>	Move forward
<	Move backward
\	Change levels (Controller to channel, or vice versa)
/	Repeat command
(name)	Randomly access context block
+	Adds together additive entries, on input and output
?	Display current options
Carriage Return	Ends NAME, command, or configuration item, or steps down configuration list
ESC	Escape from current command. Two ESCs to escape from configuration mode
Back space	Rub-out last character or If at beginning of configuration entry, go back to previous entry (goes up list)

ACCESSING MUXPORT VCP



Access VCP via name given to Channel 0

(a) BIRM — gets VCP (1)
(b) LOND — gets VCP (2)
(c) BRIS — gets VCP (3)

*NOTE
Any number of terminals can be accessing different VCPs concurrently

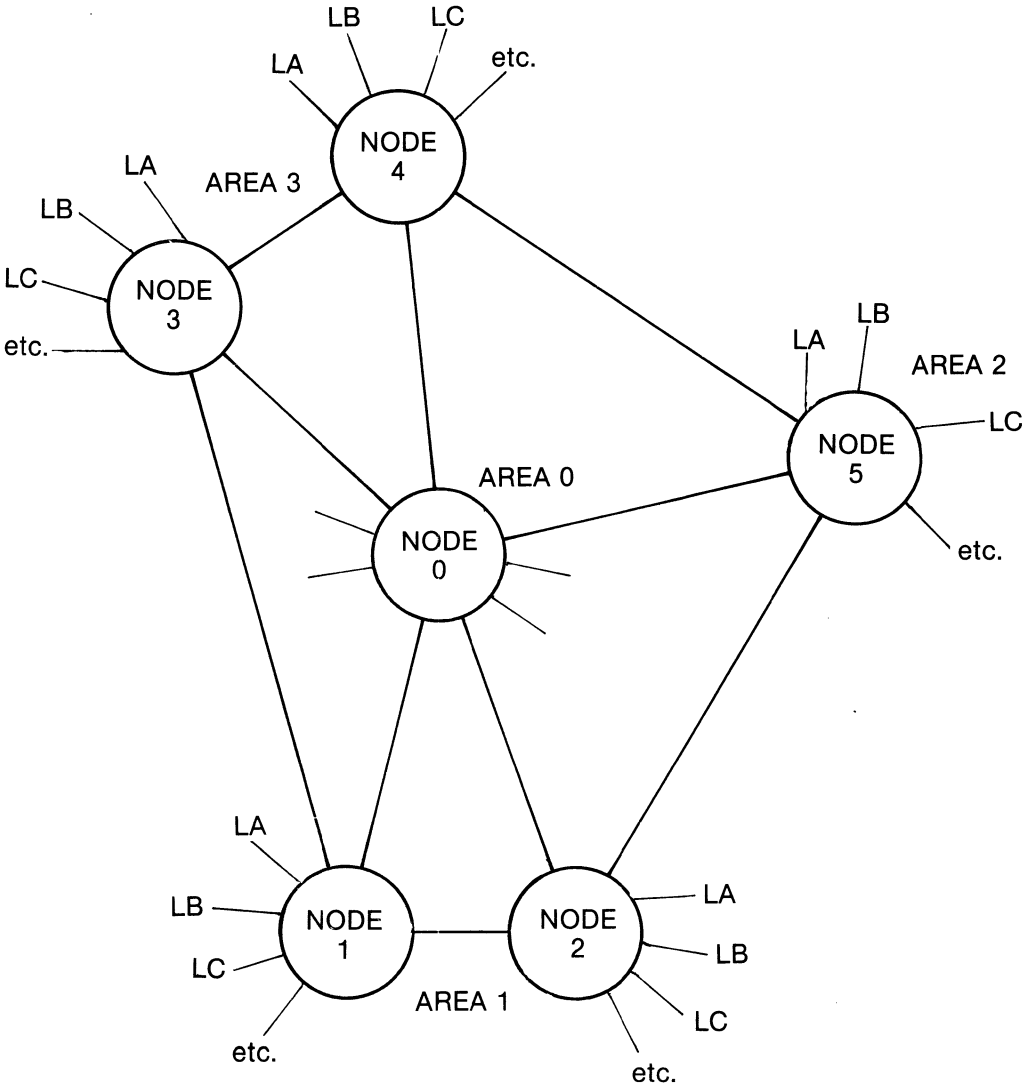
★ Accessed by normal resource selection.

★ Channel O on a MUXPORT link is used as the Virtual Control Port resource.

★ This channel is configured as normally.

CONFIGURATION EXAMPLE

A pure X.25 Network
(PADs and X.25 hosts)



LA, LB Local PADs or Hosts
AREA 1 Etc. Geographical Network Areas

X.25 Address Classification (Example)

All addresses private to the network (i.e. those not to be passed out to external networks such as PSS) are assigned '9' as the first address digit. The network is structured as a set of areas, with nodes within areas. The next two digits could therefore be chosen to represent the area number and node number respectively. In practice the node number need only be unique per area, but for reasons of clarity in this example, the node numbers are made unique over the whole network. Having defined a node in terms of network/area/node, we can, say, allocate the last two digits as the site number local to the node, where LA = OO; LB = 01; etc.

So, in accordance with the network map, the assigned addresses are:—

NODE	AREA	LA	LB	LC	LD	etc
0	0	90000	90001	90002	90003	"
1	1	91100	91101	91102	91103	"
2	1	91200	91201	91202	91203	"
3	3	93300	93301	93302	93303	"
4	3	93400	93401	93402	93403	"
5	2	92500	92501	92502	92503	"

Routing

The outgoing logical channel to select may be on a unique link, if it is a local site (PAD or host computer); or on several possible trunk links where alternative, possibly prioritized, routing is required. Sometimes it may be required to select a unique logical channel, or a unique group of such channels, among the total of logical channels on a particular link.

Trunk Link Priorities

In the example shown, three possible trunk routes sometimes exist on a given node. One route is the preferred route. The other one or two have a lesser priority than the preferred route, but the same as each other (in the case of two). So two RESOURCE PRIORITY levels are used, namely O and 1. All destination logical channels — those on LA, LB, etc. — are assigned RESOURCE PRIORITY 1. Logical channels on the trunk links will be given RESOURCE PRIORITIES of 0 or 1, where 1 is the preferred route. The CALL PRIORITY of all logical channels, including the trunk link, will be set to 1.

Naming Conventions for Route Classification

In this example, the initial letter is used to classify routes according to whether they are sites local to the node, or whether they are channels on trunk routes. 'L' indicates a local site; 'R' indicates remote site accessed via a trunk route. Because at any node there are no more than 3 routes, these are named R1, R2, and R3. The locals sites are labelled LA, LB, LC, etc. Note that R1, etc. are logical routes and can exist on more than one link (at differing priority levels).

Assignment of Trunk Link Logical Channels

For clarity, in our example, although the IN and OUT classes can be overlapped at each end of the link, on each trunk link there will be three classes of logical channel. At one end of the link these will be assigned as incoming and outgoing channels on a high/low basis; at the other end on a low/high basis. This also avoids the risk of call request clashes (i.e. both ends of the link raise a call on the same logical channel at the same time).

Incoming channels on the trunk links are assigned CALL PRIORITY one as they are intermediate forms of the original caller (CALL PRIORITY 1 also). The diagram below illustrates this.

Connection:— Node 1 to Node 3

Legend: * matches anything
as defined above, R1** and R2** are logical route classes R1 and R2. At Node 1 R1 corresponds to Area 3 and R2 to any other area. At Node 3, R1 corresponds to Area 1; and R2 to Area 0.

NODE 1	OUT R1** RESOURCE PRIORITY 1	OUT R2** RESOURCE PRIORITY 0	IN CALL PRIORITY 1	IN CALL PRIORITY 1
NODE 3	IN CALL PRIORITY 1	IN CALL PRIORITY 1	OUT R1** RESOURCE PRIORITY 1	OUT R2** RESOURCE PRIORITY 0

The alternative scheme in which input and output channels at either end of the link are overlapped, would look as follows.

NODE 1		
	R1**	R2**
	RESOURCE	RESOURCE
	PRIORITY 1	PRIORITY 0
	CALL	CALL
	PRIORITY 1	PRIORITY 1
NODE 3		
	R1**	R2**
	RESOURCE	RESOURCE
	PRIORITY 1	PRIORITY 0
	CALL	CALL
	PRIORITY 1	PRIORITY 1

If we look at an example routing table for Node 1 in the network diagram, it would look like the following if tabulated:-

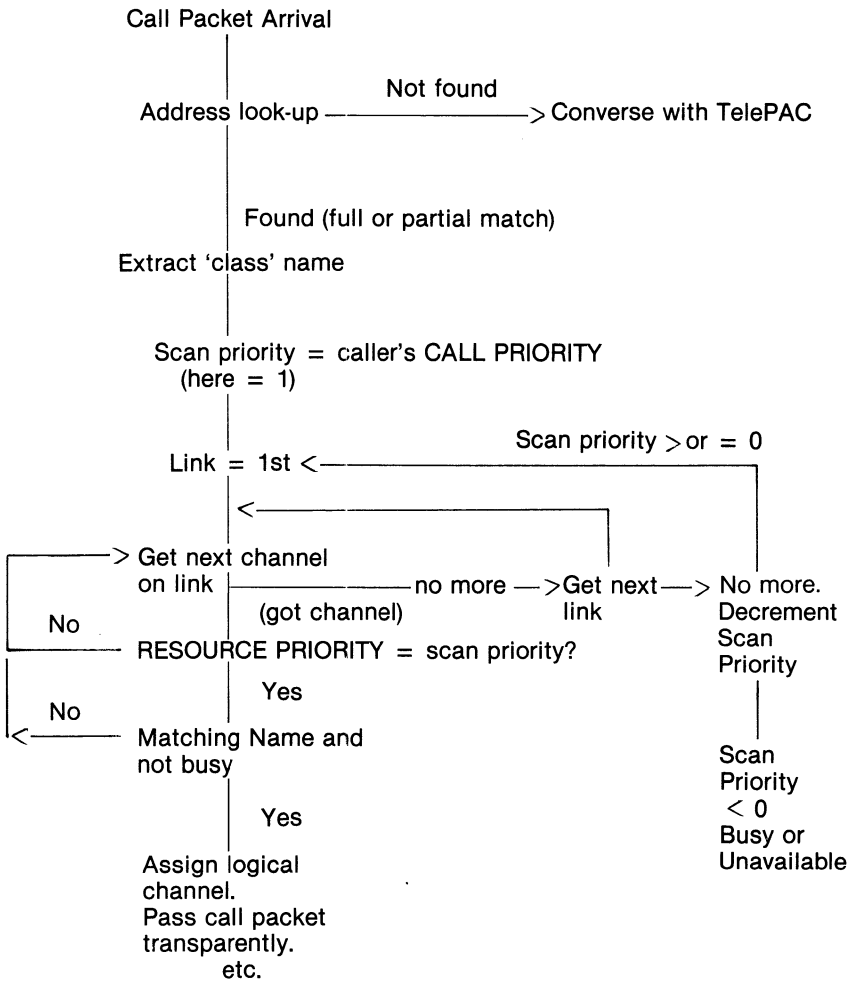
Class Name	X.25 Address Entry	
LA**	91100	
LB**	91101	
LC**	91102	
LD**	91103	
LE**	91104	
LF**	91105	
LG**	91106	
LH**	91107	
LI**	91108	
R1**	93	Area 3
R2**	90	Area 0
R3**	92	Area 2
R3**	912	This Area, but Node 2)

The above table is configured in the BASE block of the TelePAC, with entries like the following (characters after the "/" are typed as input).

```
BASE: NAME/ LA**
BASE: ADDRESS/ 91100
BASE: USER DATA/
BASE: NAME/ LB**
BASE: ADDRESS/ 91101
BASE: USER DATA/
BASE: NAME/ LC**
  etc.
```

The Routing Algorithm

The following flow diagram illustrates the manner in which the TelePAC scans for a logical channel.



Configuring the Links

We now need to assign physical links to the LA**, LB**, etc., and to the trunk links. Then we can configure the link parameters, including the number of logical channels per link. It is also a good idea to assign a meaningful name to the link, to assist in diagnostics and subsequent network control operations. Having done this, type BOOT to incorporate the configured channels into the system.

Configuring the Channels for the Local Sites

In the simple case where all logical channels on the link can receive calls, we simply configure the first channel and COPY its parameters over the others. If we assume that we have called the link for local site 'A' LSA and have decided to allocate it 6 channels called, of course, LA**, then having configured the link we proceed as follows:—

```
LSA:      \                          Note:  go down a level
P300:     CONF                       Note:  old name. Enter CONF mode
P300(0):  NAME/ P300 LA**
LA**(0):  DCR MASK/
LA**(0):  TERMINAL TYPE/ ASYN        Note:  irrelevant as transparent
LA**(0):  CIRCUIT TYPE/ CALL
LA**(0):  SPECIALS/ NONE
LA**(0):  BUFFERS/ 2 1
LA**(0):  DISC MODE/ 0
LA**(0):  MESSAGES/ D E  E           Note:  allow messages for message from gateway
LA**(0):  CALL PRIORITY/ 0 1         Note:  call request priority
LA**(0):  RESOURCE PRIORITY/ 0 1     Note:  Priority as a resource
LA**(0):  PAD ENABLE/ E  D           Note:  assume don't want to transmit PAD
LA**(0):  PAD RECALL/ 0                     parameters as PAD settings OK
LA**(0):                                       ESC typed
LA**(0):  COPY                       Note:  enter copy mode
LA**(0):  >
P101(1):  COPY
LA**(1):  >
P102(2):  COPY
LA**(2):  >
P103(3):  COPY
LA**(3):  >
P104(4):  COPY
LA**(4):  >
P105(5):  COPY
LA**(5):  >
P106(6):  COPY
LA**(6):  >
P107(7):  COPY
LA**(7):  >
```

We now have a group of logical channels of class LA**

In some cases this may not be all the channels on the link — e.g. where some are being used for special purposes.

Repeat the above process for all the local sites, namely channels LB** on link LSB, LC** on link LSC, etc.

Configuring of Trunk Links

Classification Example of Node 1 (3 trunk links)

The following table summarises the classification of channels on the trunk links from node 1. For the sake of this example 33 channels per link are assumed. Channel 0 is reserved for node to node control operations; and the remaining 32 are subdivided into 4 equal groups of 8.

Notes:

(1) '*' matches any character.

(2) As higher CALL PRIORITY is 1, setting the RESOURCE PRIORITY below to 15, completely locks out IN channels from being accessed, under any circumstances.

LINK	IN or OUT	CLASS NAME	CHANNEL NUMBERS	PRIORITY (CALL; RESOURCE)	USE
Node 1	OUT	R1**	1— 8	0;1	Area 3, etc.
to	OUT	R2**	9—16	0;0	Area 0, 2, etc.
Node 3	IN		17—24	1;15	Calls from
	IN		25—32	1;15	node 3
Node 1	OUT	R2**	1— 8	0;1	Area 0, etc.
to	OUT	R2***	9—16	0;0	Any area
Node 0			17—24	1;15	Calls from
	IN		25—32	1;15	node 0
Node 1	OUT	R3**	1— 8	0;1	Area 1 node 2
to	OUT	R***	9—16	0;0	Any area
Node 2	IN		17—24	1;15	Calls from
	IN		25—32	1;15	node 2

To configure the above set of trunk channels (having earlier configured the link level), simply configure the first channel in each group, and then copy the parameters for the required number of channels.

```
NOD3:     \
P500:     CONF
P500(0):  NAME/ P500 R1**
R1**(0):  DCR MASK/
R1**(0):  TERMINAL TYPE/ ASYN
R1**(0):  CIRCUIT TYPE/ CALL OUT
R1**(0):  SPECIALS/ NONE
R1**(0):  BUFFERS/ 1 2
R1**(0):  DISC MODE/ 0
R1**(0):  MESSAGES/ D
R1**(0):  CALL PRIORITY/ 0
R1**(0):  RESOURCE PRIORITY/ 0 1
R1**(0):  PAD ENABLE/ E  D
R1**(0):  PAD RECALL/ 0
R1**(0):  COPY
R1**(0):  >
P301(1):  COPY
R1**(1):  >
P302(2):  COPY
R1**(2):  >
P303(3):  COPY
R1**(3):  >
P304(4):  COPY
R1**(4):  >
P305(5):  COPY
R1**(5):  >
P306(6):  COPY
R1**(6):  >
P307(7):  COPY
R1**(7):  >
```

```
Note:  go down a level
Note:  old name. Enter CONF mode

Note:  outgoing only, no CALLs
Note:  highest priority route
Note:  no PAD parameters on trunk link.
           ESC typed
Note:  enter copy mode
```

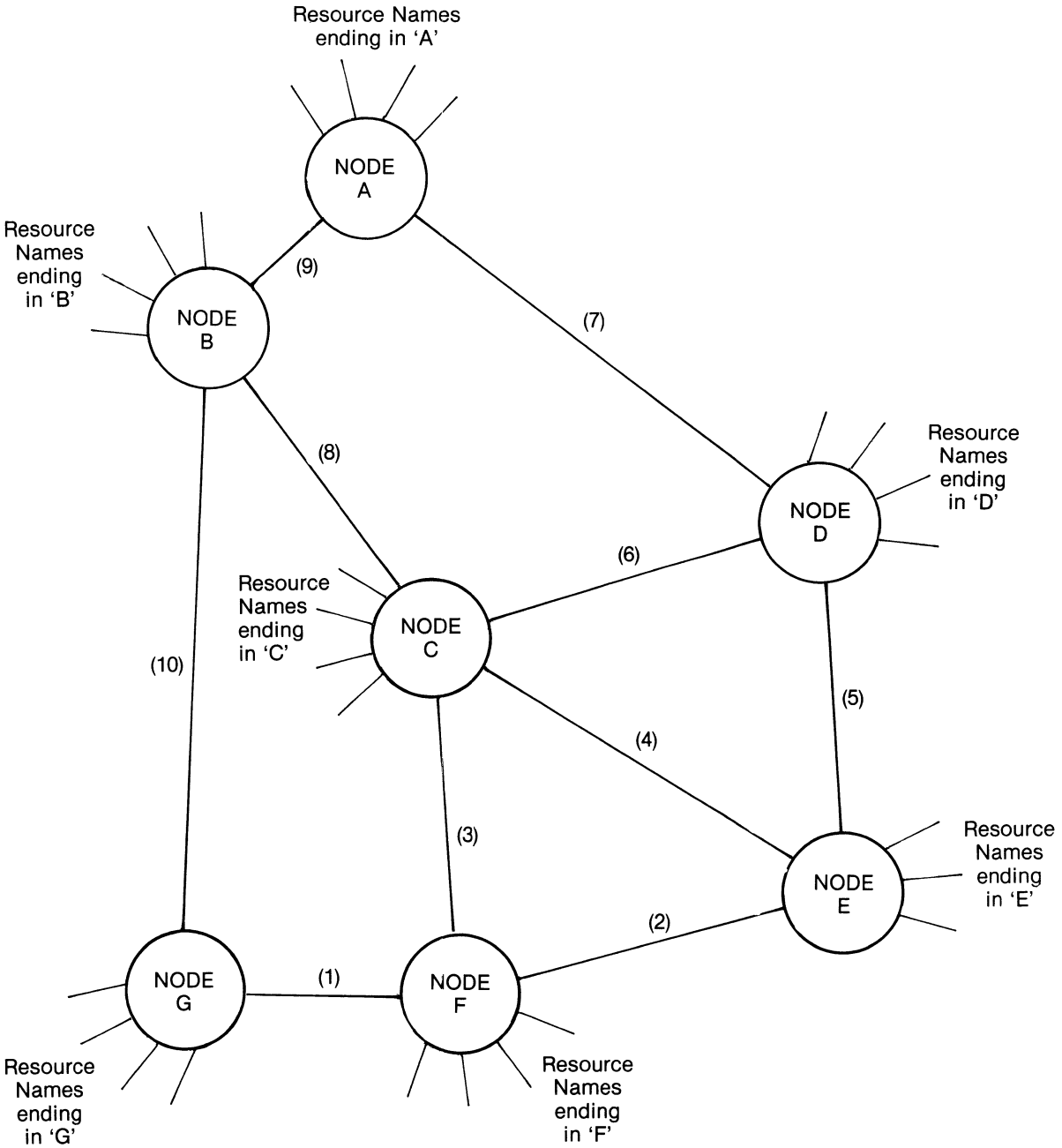
```
P307(8):  COPY
R1**(8):  >
R1**(9):  CONF

R1**(9):  NAME/ R1** R2**
R2**(9):  DCR MASK/
R2**(9):  TERMINAL TYPE/ ASYN
R2**(9):  CIRCUIT TYPE/ OUT
R2**(9):  SPECIALS/ NONE
R2**(9):  BUFFERS/ 2
R2**(9):  DISC MODE/ 0
R2**(9):  MESSAGES/ D
R1**(0):  CALL PRIORITY/ 0              Note:  outgoing only, no CALLs
R1**(0):  RESOURCE PRIORITY/ 0          Note:  lowest priority route
R2**(9):  PAD ENABLE/ D                 Note:  rest as R1**, ESC
R2**(9):  COPY                          Note:  enter copy mode
R2**(9):  >
P310(10): COPY
R2**(10): >
P311(11): COPY
R2**(11): >
P312(12): COPY
R2**(12): >
P313(13): COPY
R2**(13): >
P314(14): COPY
R2**(14): >
P315(15): COPY
R2**(15): >
P316(16): COPY
R1**(16): >
P317(17): COPY
R1**(17):
```

Now enter CONF change name to say, 'NULL' and circuit type to call, with priority 1. Then create a total of 16 copies.

CONFIGURATION OF A MUXPORT
OR
MIXED X.25 AND MUXPORT

NETWORK

- ★ Assume network more complicated than triangle, but alternative routing required.
- ★ Standardise X.25 addresses, but also standardise resource names:—
  i.e. last character of resource name will be the node ID ('A', 'B', 'C', etc.).
- ★ DIAL option used for forwarding resource selector.
- ★ * character used as 'match' anything'.
- ★ " " " " Resource name used on intermediate links as **'match anything already specified on this link at this resource priority level'.**



All Resources accessible from any Node

Alternative routing if Link or Node failure

GENERAL METHOD

★ The 4 character resource names on a given node will end with the node identifying character.
e.g. on Node A, all resources have the form xxxA, where xxx is arbitrary.

★ Users type xxxN to access resource, where xxx is the resource, and N is the node identifier. For synchronous terminals or predefined destinations, xxxN will be completely set-up in the DRC MASK.

★ DIAL option is used on inter-node links (forwards resource selection).

★ " " " " Names are used on inter-node links to simplify listing of resource names, which will take the form of ***A, etc. (* means matches anything).

Consider Node F

★ It is attached to the network via links (1), (2), and (3).

★ Link (1) will be its preferred route to nodes A, B, and G.

★ Link (2) will be the preferred route to nodes E and D.

★ Link (3) will be the preferred route to node C.

★ Link (1) will be the alternative route to node C.

★ Link (3) will be the alternative route to nodes G, B, A, D, E.

★ Link (2) will be an alternative route to nodes G, B, A, C.

★ All CALL priorities will be set to 1.

LINK 1 SET-UP

CHANNELS	NAME	RESOURCE PRIORITY	MEANING
0	***A	1	Preferred access to Node A
1	***B	1	Preferred access to Node B
2	***G	1	Preferred access to Node G
3—15	" " " "	1	Preferred access to Nodes A, B, N, G
16—31	***C	0	Alternative access to Node C

LINK 2 SET-UP

CHANNELS	NAME	RESOURCE PRIORITY	MEANING
0	***E	1	Preferred access to Node E
1	***D	1	Preferred access to Node D
2—15	" " " "	1	Preferred access to Nodes E, or D
16	***G	0	Alternative access to Node G
17	***B	0	Alternative access to Node B
18	***A	0	Alternative access to Node A
19	***C	0	Alternative access to Node C
20—31	" " " "	0	Alternative access to Nodes, G, B, A, or C

LINK 3 SET-UP

CHANNELS	NAME	RESOURCE PRIORITY	MEANING
0—15	***C	1	Preferred route to Node C
16	***G	0	Alternative route to Node G
17	***B	0	Alternative route Node B
18	***A	0	Alternative route Node A
19	***D	0	Alternative route Node D
20	***E	0	Alternative route Node E
21—31	" " " "	0	Alternative route Nodes G, B, A, D, or E

NOTE:

Access other way on each link.

This is entirely flexible if we enable CALLs in each direction, but to minimise CALL clashes we could cross-over the preferred and alternative route channels, i.e.

One way:—

Channels	0—15	High resource priority (1)
	16—31	Low resource priority (0)

Other way:—

Channels	0—15	Low resource priority (0)
	16—31	High resource priority (1)

X.25 Links between Nodes

★ If required to use DIAL option, but using X.25 Links, we need to generate call packets with no address in them (so receiver defaults to dial operation).

★ Do this by one entry in X.25 table in BASE block, namely:—

NAME

****	Matches anything

ADDRESS

(None)	Generate null address

BASE Controller Parameter Summary

FIELD NAME	POSSIBLE VALUES	MEANING
VERSION	(version number — not alterable)	Month (1st 2 digits); last digit of year; revision within year (1 digit)
REPORTS	Channel level NAME	Name of resource to which diagnostic reports are directed. Changes to this field are only effective after a BOOT or reset
SESSION STATISTICS	Channel level NAME	Name of resource to which, by default, session statistics are directed. Changes to this field are only effective after a BOOT or reset
MESSAGE	Text. prints ID of port (its NAME). Linefeed = CR, LF	Message to be echoed to terminal users with messages enabled. X, where X is a letter corresponds to Control-X
NAME	NAME of channel(s)	Incoming calls: selects resource channels with NAME. For generating outgoing calls: NAME selects call address and user data to go into call packet.
ADDRESS		Call packet address for comparison purposes (in-coming calls); or for call-packet generation (non transparent outgoing calls) If followed by '—' causes addition of caller's address in called packets.
USER DATA	Hex characters	Data to enter into user data field of generated call packets. (nnnn) at front generates facility field in generated call packets, where nnnn represents hexadecimal facility codes. The facility field length is generated automatically.

Virtual Control Channel Parameters

FIELD NAME	POSSIBLE VALUES	MEANING
NAME	4 character NAME	Resource name for accessing virtual control channel
RESOURCE PRIORITY	0 to 15 decimal	Access priority of virtual control channel

X.25 Level 2 (Level 3 and MUXPORT)

FIELD NAME	POSSIBLE VALUES	MEANING
NAME	4 character NAME	Configuration NAME for link
TYPE	NULL X25 MUXPORT	Not configured (no hardware port card) X.25 level 3 MUXPORT at level 3
CHANNELS	Decimal 1—256	Number of X.25 or MUXPORT channels at level 3
ADDRESS	A B	DTE Address DCE Address Remote/local addresses must be complementary

X.25 Level 2 (Level 3 and MUXPORT) *(continued)*

FIELD NAME	POSSIBLE VALUES	MEANING
INIT FRAM	SABM	Transmit SABM at link restart — implies LAP B
	SARM	Transmit SARM at link restart — implies LAP
	DISC	Transmit a DISC initally and then go into the disconnected state
T1	2—60 decimal	Time in 1/10th seconds between retransmissions
TRIES	2—50 decimal	Number of retransmissisons of an information frame before initiating a link restart.
K LEVEL2	1—7	Default window size level 2
K LEVEL3	1—7	Default window size level 3
LCGN	0—4	Logical channel group number
OPTIONS	POLL	Causes X.25 level 2 poll (RR command + P-bit) to be transmitted if data has not passed in last 3 second interval. 'Should be specified on lists level links on which alternative routing is required.'
	BOOT	MUXPORT only. Transmits remote boot sequence at link initialization.
FRAME SEQ	EXT	Extended mode. Sequence numbers 0 to 127; 2 control bytes.
	NORM	Normal mode. Sequence numbers 0 to 7; 1 control byte.
CALL TIME OUT	2—200	Time, in seconds, that TelePAC will wait for response on channels on this link at resource connection time.

Channel Parameters X.25 and MUXPORT

FIELD NAME	POSSIBLE VALUES	MEANING
NAME	4 character NAME	Resource name for access and configuration purposes
DRC MASK	4 characters. Note space is field separator; so use '.' to enter blank	If calls enabled (see CIRCUIT TYPE) determines resource selection method For OUT only channels Specifies, if not blank, the wake-up procedure
TERMINAL TYPE		Not relevant for X.25 channels
	ASYN	Asynchronous channel
	SYNC	Synchronous channel
CIRCUIT TYPE		Additive values describing channel characteristics
	CALL	Channels is permitted to initiate calls
	QUEU	As for CALL, but the channel will be queued if the selected resource (channel) is busy
	PVC	The channel is a tail circuit and is a permanent virtual circuit (EIA signals not relevant) for MUXPORT; for X.25 level 3 channel goes directly into the data state.

Channel Parameters X.25 and MUXPORT *(continued)*

FIELD NAME	POSSIBLE VALUES	MEANING
	SVC	The channel is on a trunk link, and must therefore be a switched virtual circuit (at the EIA signal level. Only relevant to MUXPORT
	OUT	The channel can raise outgoing calls only (i.e. it is only a selectable resource; it is not a resource selector)
	DIAL	Used to provide an onward addressing mechanism for inter-TelePAC links which are configured as MUXPORT. However, it is not restricted to MUXPORTs and can be used as a supplementary addressing mechanism for X.25 links. The DIAL option performs the equivalent function to the address in X.25 call packets. It operates differently according to whether the channel is raising or receiving a call:— **Raising a Call** The resource selector used (after source DRC processing) to select the channel is passed as the first four data characters to the port on which the call was raised, as a continuous string. These will then onward select the route at the next TelePAC node. **Interaction with Wake-Up specification** If wake up has been configured by setting the DRC mask for a channel specified as OUT only (see relevant section), the wake-up takes precedence but the DIAL option overrides the 1 second timer between wake-up characters — i.e. it goes as a continuous string. **Channel Receiving Call** Simply forces a total disconnection from the TelePAC when its adjacent (onward) channel drops its EIA signals, instead of the default of keeping the channel connected to the TelePAC for further menu selection. Thus in a multi-stage call, at (e.g.) host disconnection, the call will cascade back to the outermost TelePAC
SPECIALS		Additive values representing non-normal configuration characteristics
	RTS	RTS as well as DTR are required to enable the channel (i.e. RTS + DTR = DCD)
	HOLD	The TelePAC's record of the EIA control signals will be maintained after resource disconnection (for use with dumb terminals), unless port itself drops DTR.
	NBRK	Do not transmit a break to the channel
	RECO	Automatic call reconnection it link opposite channel is restarted
	DIAG	Put channel in diagnostic mode, so as to get extended diagnostics
	MNGE	Channel is a special control port, and can take over the reports and/or statistics channel functions for network management and can be used to initiate trial functions
BUFFERS	1—20 decimal	Number of 128 byte buffers which the channel can fill before flow control of

Channel Parameters X.25 and MUXPORT *(continued)*

FIELD NAME	POSSIBLE VALUES	MEANING
		input is put into effect. This number + the maximum X.25 level 3 window size (8), represents the max number of buffers that can be filled before the TelePAC discards data for the channel (DATA OVERRUN)
SLOT SIZE	Decimal 1—128	(MUXPORT only). The maximum number of characters that can be put into a single output frame for the channel. Enables response versus throughput tuning
FCA THRESHOLD	0—15	MUXPORT only. Level, in multiples of 16, at which input flow control is refreshed
FCA VALUE	0—15	Refresh value in multiples of 16. 0 means 'input flow control disabled'
DISC MODE	Decimal 0—31	MUXPORT only. Value of control character to be used to force disconnection
MESSAGES	D	The channel is not allowed (Disabled) to receive the greeting message/menu
	E	The channels is Enabled to receive the greeting message
CALL PRIORITY	Decimal 0—15	Priority level at which resource selection scans are initiated (looking for a RESOURCE PRIORITY equal or lower — equal takes precedence, then in decreasing priority)
RESOURCE PRIORITY	Decimal 0—15	Priority level of resource (can only be accessed by channels which have equal or greater CALL PRIORITY)
PAD ENABLE		The effect varies between MUXPORT and X.25 level 3 channels
		MUXPORT
	D	If disabled (D), of the following only ECHO, DRI and DRO are effective.
	E	If enabled (E), all the following are enabled. This includes parameter updates from remote X.25 hosts via X.29 (Q-bit data)
		X.25 Level 3
	E	Enable X.29 transmission of the parameters below (PAD RECALL to DISP) to remote in X.25 level 3 data packet with Q bit set (the following parameters are in the X.3 format)
	D	Disable remote X.29 update
		Note: in what follows (n) is the X.3/X.29 number. If followed by '*' the parameter is not currently implemented in the TelePAC but it can be transmitted to remote PAD in Qualified data packets
PAD RECALL	0	(1) No escape to 'talk to PAD' mode
	1	Control-P causes escape to 'talk to PAD'
	Decimal 2—126	Specified character causes escape to 'talk to PAD'
ECHO		(2)
	E	Echo enabled
	D	Echo disabled

Channel Parameters X.25 and MUXPORT *(continued)*

FIELD NAME	POSSIBLE VALUES	MEANING
DATA FORWARDING	Additive decimal values	(3) Data forwarding mode
	0	Forward only on buffer full
	1	Forward on A—Z, a—z, 0—9
	2	Carriage return
	4	ESC, BEL, ENQ, ACK
	8	DEL, CAN, DC2
	16	ETX, EOT
	32	HT, LF, VT, FF
	64	All other characters in 1st two columns of Ascii set plus DLE
	128	Graphic characters
DELAY	0—255	Data forwarding time-out
		Note For TelePAC this value is in 1/10 seconds. For external X.25 PADs this value is in 1/20s second
DRI		(5) Data restraint of input
	E	Enable X-ON X-OFF
	D	Disable data restraint
PAD SIGNALS		(6)*
	E	Enable PAD service messages
	D	Disable PAD service messages
BREAK		(7) (always as 1 below + purge buffered data)
	0	No action
	1	Transmit INTERRUPT packet
	2	Transmit RESET packet
	5	Transmit INTERRUPT packet and Indication Of Break PAD message
	8	Escape from data transfer state
	21	Transmit INTERRUPT packet and Indication of Break PAD message and set parameter 8 to 1 (suppress data delivery)
PADDING		(9)* Padding after carriage return
	0	Terminal speed dependent
	1—7	1 to 7 padding characters
FOLD		(10)* Line folding
	0	No line folding
	1—255	Line fold after 1 to 255 characters
DRO		(12) Data Restraint of output with Xon and Xoff
	E	Enabled
	D	Disabled
LFI		(13) Linefeed insertion after carriage return
	0	None
	1	LF in output data
	4	LF inserted in echo
	5	1 + 4 above
	6	4 + LF inserted in input
	7	1 + 6 above
LF PAD		(14)* Padding after linefeed
	0	None
	1—7	Number of padding characters
EDIT		(15)* Editing (see below) enabled or disabled
	E	Character delete, etc. enabled
	D	Disabled

Channel Parameters X.25 and MUXPORT *(continued)*

FIELD NAME	POSSIBLE VALUES	MEANING
CHAR DEL		(16)*
	0	No character delete
	Decimal 1—127	Character delete character
BUFFER DEL		(17)*
	0	No buffer delete
	Decimal 1—127	Buffer delete character
DISP		(18)*
	0	No buffer display character
	Decimal 1—127	Buffer display character
	End of X.3 compatible parameters	
FORCE	Decimal	Force data forwarding character. Logical OR with DATA FORWARDING and DELAY conditions
	0	No force data forwarding character
	1—127	Value of character to force data forwarding
BREAK CHAR	Decimal	Specify control character to simulate break.
	0	No break simulation.
	1—32	Decimal value specifying control-A to space as the break simulation character.

Statistics and Diagnostics

The TelePAC provides two types of report — those that are produced spontaneously and those that are produced on demand. The spontaneous reports are directed to the VIRTUAL DIAGNOSTIC CHANNEL or to the VIRTUAL STATISTICS channel. The on-demand reports are obtained from the VIRTUAL CONTROL CHANNEL. These VIRTUAL channels are 'virtual' in the sense that the reports channels can be mapped on to any real channel (MUXPORT channel; X.25 channel; on board asynchronous channel); while the virtual control channel can be accessed as a resource from any real channel.

To the above types of report must be added those that are obtained spontaneously or on-demand from the virtual control consoles of any MUXPORT link attached to a TelePAC. The on-demand MUXPORT reports are obtained by accessing logical channel 0 on a MUXPORT as a resource. The relevant MUXPORT product documentation should be consulted for the form of the dialogue. To disconnect from this type of resource, type Q followed by carriage return. The spontaneous reports are directed to the VIRTUAL DIAGNOSTIC CHANNEL, and are listed in the following sections.

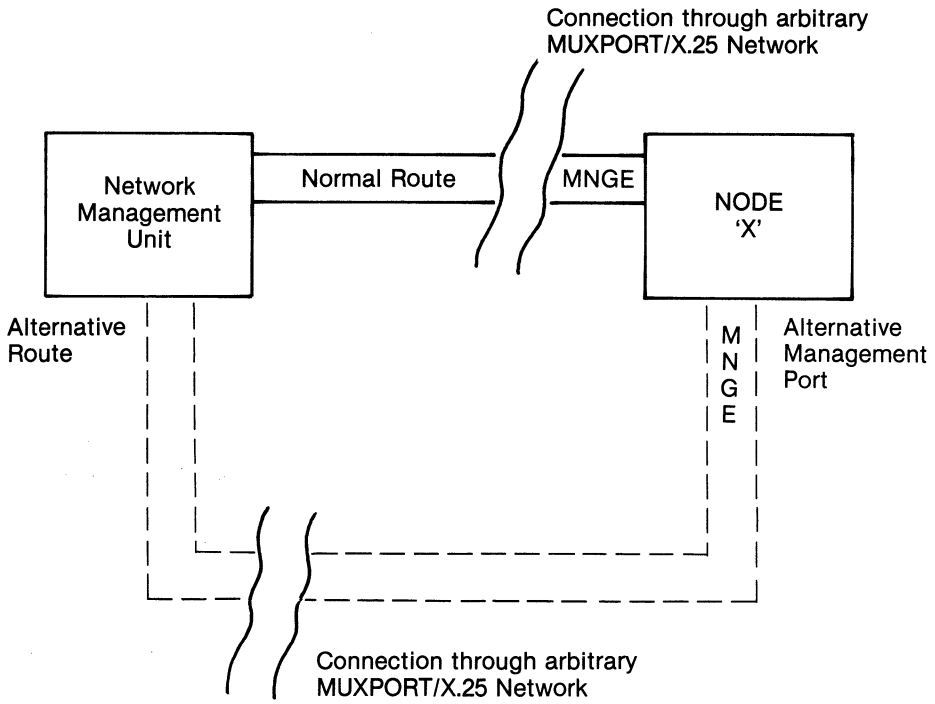
The resource name of the virtual diagnostic channel is configured in the BASE context block, parameter 'REPORTS'. The resource name of the virtual statistics channel, to which session statistics are directed for billing purposes, is also configured in the BASE context block, the parameter being 'SESSION STATISTICS'.

For network management in a TelePAC network one or more virtual channels can be nominated as network management channels (SPECIALS = MNGE).

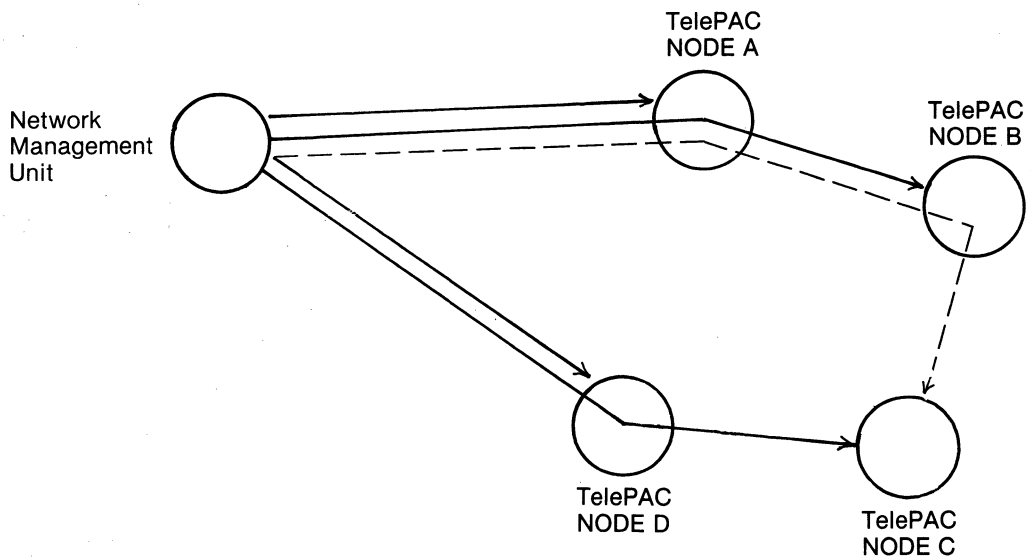
If a call through the network is made via a MNGE port to the REPORTS channel, then the reports are re-directed to the point-of-call. Similarly, if a call through a MNGE port is made to the SESSION STATISTICS port, then the session statistics are re-directed to the point-of-call. In both cases, if all disconnection takes place (e.g. through network problems), then the reports are directed back to the original channel (which is therefore a default). Additional functions are available to a MNGE port connected to the REPORTS resource, to enable it to POLL controllers or channels in the TelePAC for status or statistical information, and, optionally, to reset the recorded statistical information.

In this way, one or more network management units can take over the statistics and/or diagnostics ports of every TelePAC in a network, thus centralizing the network management operation. At the same time, if ports of the network fail, alternative routes can be taken to the diagnostic and statistics output by a given TelePAC.

EXAMPLE — PATHS TO SINGLE NODE



EXAMPLE — OVERVIEW



Main X.25 Calle to MNGE ports and alternative
to NODE C if NODE D down

For the sake of brevity, the following tables, which summarise the various reports, do not show the date and time stamp which precedes them. In the time stamp the seconds are recorded to a resolution of 5 seconds.

Note:— xxxx or yyyy are used throughout to denote an arbitrary link or channel name. A decimal number in parentheses following the name denotes the relative channel number of the channel of name xxxx or yyyy (frequently xxxx will be the name given to a whole group of channels, and it will be required to distinguish between them).

(nn) or (mm) will be used to denote an arbitrary channel number.

CONNECTION and DISCONNECTION STATISTICS

REPORT	MEANING
xxxx (nn) –> yyyy (mm)	Channel xxxx (nn) has connected to channel (resource) yyyy (mm)
xxxx (nn) <– (233; 1890; 060; 1002)	xxxx (nn) has disconnected from the resource to which it was connected. The figures in parentheses indicate:— (frames or packets in; out; characters in;out)

X.25 LEVEL 2 REPORTS

REPORT	MEANING
xxxx ADDRESS ERROR (ee)	The ADDRESS byte of a received frame is in error. (ee) is the hexadecimal value of the received address. If the value of (ee) is 01 or 03, then there is a DTE/DCE mismatch. Reconfigure the ADDRESS parameter or check whether the line is in a loop. Any other value means hardware or software problems at one end of the link.
xxxx FRAME LENGTH < 2	A frame has been received with a length less than 2 bytes (a frame must have at least an ADDRESS byte and a CONTROL byte)
xxxx BAD FRAME TYPE (hh)	A frame has been received with an unrecognisable CONTROL byte. (hh) is received CONTROL byte
xxxx RESTART (E)	The link has been successfully restarted, in the sense that the LAP or LAPB restart handshake has been completed. (E) denotes that the link is in extended mode (frame sequence numbers 0 to 127; two CONTROL bytes).
xxxx RESTART (N)	As above, but (N) denotes normal mode (frame sequence numbers 0 to 7; 1 CONTROL byte).
xxxx DISCONNECTED	The link disconnection handshake procedure has been performed, and the link is now in the disconnected state.
xxxx DM RESPONSE	A DM response has been received and the link disconnection procedure initiated.
xxxx CMDR hh hh hh hh	A CMDR or FRMR frame has been received. The first hh is CMDR/FRMR control byte. The other 3 hh represent:— (1) The control byte received by the remote (2) The remote's V(R) and V(S) (3) The error code:— 01 Bad CONTROL field 03 I-field invalid 04 I-field too long 08 Invalid N(R)

X.25 LEVEL 2 REPORTS *(continued)*

REPORT	MEANING
xxxx BAD N(R) hh hh	A bad frame acknowledgement value has been received. The first hh is the received control byte; the second hh is this end's V(R) and V(S). A CMDR/FRMR has been sent to the remote
xxxx DOWN	The I-frame retransmission counter has been exceeded, and a link restart procedure initiated
xxxx NOT RESPONDING	May occur if the POLL option is used at link level. No data was passing, but POLLs have been sent N times (where N = TRIES), with no response. A link restart procedure has been initiated.

X.25 Level 3 Reports

The following table summarises the X.25 level 3 reports. Unless otherwise stated the report is only produced if the channel is in the diagnostic mode (the SPECIALS parameter has DIAG set).

At this level xxxx represents the channel name.

X.25 LEVEL 3 REPORTS

REPORT	MEANING
xxxx BAD TYPE/LENGTH hh	(Not conditional on DIAG being set). A packet has been received which is either.— (a) less than minimum length (b) has an invalid packet type (PTI). hh is the received PTI
xxxx LCGN ERROR (hh)	A packet has been received with an LCGN (logical channel group number) which does not match that configured for the link. (Not conditional on DIAG setting)
xxxx RESTART	A level 3 restart has been performed. xxxx should be the name of the first channel. (Not conditional on DIAG being set)
xxxx CALL	Call request packet received
xxxx BAD P(S) hh	Data packet with packet number out of sequence received. A RESET has been transmitted
xxxx RESET	A reset has been received
xxxx BAD P (R)	A bad acknowledgement number has been received. A RESET has been transmitted
xxxx BAD P(K)	Window size exceeded by incoming data packet. A RESET has been transmitted

MUXPORT Channel Reports

The following tables summarise the reports produced by the Multiplexer level of the MUXPORT protocol. This is the logical equivalent of X.25 level 3. At level 2 the MUXPORT protocol is X.25 level 2. However, it is normal to operate in extended mode (frame sequence numbers 0 to 127; two control bytes).

The following report is produced only by the TelePAC.

MUXPORT REPORTS — TelePAC Significance Only

REPORT	MEANING
xxxx PROTOCOL ERROR	(here xxxx is the link name) A frame has been received which cannot be parsed. This may occur if a received frame has exceeded the maximum buffering capability of the TelePAC.

MUXPORT Channel Reports *(continued)*

The following reports are produced by the TelePAC as a result of signals passed to it via the MUXPORT virtual control channel. (The only exception to this is 'CE' which may be initiated by either the TelePAC or the remote). Normally these reports will be duplicated on the local control console of the multiplexer itself if one is connected, in slightly different forms according to the product type of the multiplexer or node).

Note: xxxx here = link name

MUXPORT REPORTS PRODUCED ON BEHALF OF REMOTE

READING	MEANING
xxxx REPORT CC	Configuration complete
xxxx REPORT FA	Framing acquired (multiplexer level active state)
xxxx REPORT FL	Framing lost (multiplexer level inactive)
xxxx REPORT CE	Configuration error. There is a mismatch in the number of logical channels configured at each end of the link
xxxx REPORT BI	Terminal input buffer overflow
xxxx REPORT BO	Terminal output buffer overlow
xxxx REPORT PE	Protocol error. The remote did not understand the received frame
xxxx REPORT RL	Reports lost. The remote could not store all the reports that it had to output
xxxx REPORT FR	Frame error

The following reports are produced by the central co-ordination, flow management, and routing level of the TelePAC.

NETWORK LEVEL REPORTS

REPORT	MEANING
xxxx (nn) INPUT OVERRUN	The number of buffers that can be allocated for storing data from channel xxxx (relative number nn) has been exceeded. Input data has been lost. This indicates a flow control or data restraint problem
xxxx (nn) NO RESPONSE	An attempt to access the specified channel as a resource failed. E.g. no response to call packet (X.25) or to raising EIA signals (MUXPORT)

Reports produced via the VIRTUAL CONTROL CHANNEL

Statistics summaries can be produced by means of the STAT command. The effect will vary according to the object under consideration (BASE context block; X.25 level 2 context block; X.25 level 3 context block; MUXPORT channel context block, etc.)

The statistics for each type of context block are summarised below. In each case an example is given, followed by a table summarising the meaning of the various values.

It should be remembered that a / will cause an automatic repeat of the current command (e.g. STAT), for the current context block. Also > < \ and xxxx (random name specification) can be specified to cause a change of context block plus automatic re-execution of the current command).

BASE STATISTICS

BASE: STAT
  BUFFER POOL MAX/ 218 BUFFER POOL NOW/ 217

BASE:

BASE STATISTICS

TYPE	MEANING
BUFFER POOL MAX/	Decimal value of maximum size of buffer pool.*
BUFFER POOL NOW/	Decimal value of current size of buffer pool.*

*Number of 128 byte buffers available

X.25 and MUXPORT Level 2 Statistics

BASE: MUXA

TYPE/ MUX	CRC ERRORS/ 2	
FRAME SEQ/ EXT	STATE/ DATA	SUB-STATE/ NORM
NR/ 92	VS/ 112	TRIES/ 0
VR/ 79	VR(SENT)/ 79	LCGN/ 0
DATA IN/ 379	DATA OUT/ 11929	
DATA FRAMES IN/ 1796		DATA FRAMES OUT/ 9926
SLOTS OUT/ 12324		

MUXA: PSS

TYPE/ X25	CRC ERRORS/ 0	
FRAME SEQ/ NORM	STATE/ DATA	SUB-STATE/ NORM
NR/ 1	VS/ 1	TRIES/ 0
VR/ 1	VR(SENT)/ 1	LCGN/ 0
DATA IN/ 0	DATA OUT/ 0	DATA FRAMES IN/ 0
DATA FRAMES OUT/ 0		SLOTS OUT/ 0

X.25 LEVEL 2 STATISTICS REPORT SUMMARY

FIELD NAME	POSSIBLE VALUES	MEANING
TYPE	X25	X.25 levels 2 and 3
	MUX	MUXPORT link
	NULL	Unconfigured link
CRC ERRORS	Decimal	Accumulated count of cyclic redundancy check errors
FRAME SEQ	EXT	Link is in extended mode (sequence numbers 0 to 127; 2 control bytes)
	NORM	Link is in normal mode (sequence numbers 0 to 7; 1 control byte)
STATE	SABM	Link restart state — LAP B
	SARM	Link restart state — LAP
	DISC	Link disconnected state
	CLS	DISC frame transmitted. No response
	DATA	Data transfer state
	WAKE	I-frame retransmitted after time-out (no response)
	BLKD	Remote receiver not ready (RNR received)
	RESP	(LAP) SARM received, UA, SARM transmitted
	WAIT	(LAP) SARM sent, UA received waiting for SARM
SUB-STATE	NORM	Normal sub-state of data transfer state
	REJ	Out of sequence frame received. Reject response transmitted
NR	Decimal	Last frame acknowledgement value received
VS	Decimal	Transmit sequence number
VR	Decimal	Receive sequence number
VR (SENT)	Decimal	Last frame acknowledgement number transmitted

X.25 LEVEL 2 STATISTICS REPORT SUMMARY *(continued)*

FIELD NAME	POSSIBLE VALUES	MEANING
TRIES	Decimal	Number of times current command has been transmitted. (e.g. I-frame, SABM, SARM)
LCGN	Decimal	Logical channel group number of link (X.25 level 3 only)
DATA IN	Decimal	Rotating count of total number of data characters received
DATA OUT	Decimal	Rotating count of total number of data characters transmitted
DATA FRAMES IN	Decimal	Rotating count of total number of received frames containing data (for MUXPORT = total frames)
DATA FRAMES OUT	Decimal	Rotating count of total number of transmitted frames containing data (for MUXPORT = total frames)
SLOTS OUT	Decimal	(MUXPORT only) Rotating count of total number of transmitted slots (a slot is a segment of data for a channel). The difference between this figure and the number of transmitted frames indicates the extent to which the frames are being multiplexed. Not only data but also control signals and supervisory information are passed in channel slots. The degree of frame multiplexing increases with link utilisation

Channel Level Statistics

MUXPORT Example

PSS: MXA4
IGDL(4):

STATE/ DISC	TOTAL FRAMES IN/ 0	
TOTAL FRAMES OUT/ 0		TOTAL CHARS IN/ 0
TOTAL CHARS OUT / 0		CONNECTED TO/
EIA/	SESSION STATUS/	
CSU IN/	CSU OUT/	PERM IN/ 0
PERM OUT/ 24576		TERMINAL TYPE/ ASYN
CIRCUIT TYPE/ CALL + STAT		SPECIALS/ NONE
BUFFERS/ 2	SLOT SIZE/ 128	FCA THRESHOLD/ 2
FCA VALUE/ 3	DISC MODE/ 0	MESSAGES/ D
CALL PRIORITY/ 0		RESOURCE PRIORITY/ 0
PAD ENABLE/ D		PAD RECALL/ 0
ECHO/ CONT	DATA FORWARDING/ 0	
DELAY/ 0	DRI/ D	PAD SIGNALS/ D
BREAK/ 1	PADDING/ 0	FOLD/ 0
DRO/ D	LFI/ 1	LF PAD/ 0
EDIT/ D	CHAR DEL/ 0	BUFFER DEL/ 0
DISP/ 0	FORCE/ 0	

MXA04: MXA2
IGDL (4): iANZ

STATE/ DATA	TOTAL FRAMES IN/ 21	
TOTAL FRAMES OUT/ 2637		TOTAL CHARS IN/ 21
TOTAL CHARS OUT/ 5862		CONNECTED TO/ BEDD (BASE, 0)
EIA/	SESSION STATUS/ CALL	
CSU IN/	CSU OUT/ DTR + RTS	
PERM IN/ 48	PERM OUT/ 24576	
TERMINAL TYPE/ ASYN		CIRCUIT TYPE/ CALL + PVC + STAT
SPECIALS/ NONE	BUFFERS/ 2	SLOT SIZE/ 128

Channel Level Statistics *(continued)*

```
FCA THRESHOLD/ 2                                FCA VALUE/ 3
DISC MODE/ 11           MESSAGES/ E             CALL PRIORITY/ D
RESOURCE PRIORITY/ D                            PAD ENABLE/ D
PAD RECALL/ 0           ECHO/ CONT              DATA FORWARDING/ 0
DELAY/ D                DRI/D                   PAD SIGNALS/ D
BREAK/ 1                PADDING/ 0              FOLD/ 0
DRO/ D                  LFI/ 1                  LF PAD/ 0
EDIT/ D                 CHAR DEL/ 0             BUFFER DEL/ 0
DISP/ 0                 FORCE/ 0
```

X.25 Level 3 Example

```
MXA2: ***S
IANZ (10): UIS*

STATE/ DISC             TOTAL FRAMES IN/ 0
TOTAL FRAMES OUT/ 0                             TOTAL CHARS IN/ 0
TOTAL CHARS OUT/ 0                              CONNECTED TO/
EIA/                    SESSION STATUS/
PNR/ 0                  PR/ 0                   PACKETS TO ACK/ 0
PR (SENT)/ 0            PS/ 0                   LEVEL 3 STATE/ DISC
TERMINAL TYPE/ ASYN                             CIRCUIT TYPE/ OUT + STAT
SPECIALS/ DIAG          BUFFERS/ 2              SLOT SIZE/ 128
FCA THRESHOLD/ 2                                FCA VALUE/ 3
DISC MODE/ 11           MESSAGES/ E             CALL PRIORITY/ 0
RESOURCE PRIORITY/ 0                            PAD ENABLE/ D
PAD RECALL/ 0           ECHO/ CONT              DATA FORWARDING/ 0
DELAY/ 0                DRI/ D                  PAD SIGNALS/ D
BREAK/ 1                PADDING/ 0              FOLD/ 0
DRO/ D                  LFI/ 1                  LF PAD/ 0
EDIT/ D                 CHAR DEL/ 0             BUFFER DEL/ 0
DISP/ 0                 FORCE/ 0

UIS* (1):
```

CHANNEL LEVEL STATISTICS REPORT SUMMARY

FIELD NAME	POSSIBLE VALUES	MEANING
STAT		Internal (network level) state of channel
	DISC	Channel is disconnected
	BUSY	Channel has been busied out either temporarily (timer), or permanently
	RUNG	Channel has received the ring indicator
	ADDR	Channel is waiting for completion of the resource selection NAME (address)
	ROUT	Channel is scanning for the selected resource (i.e. routing)
	SETU	Channel is waiting for the selected resource (channel) to complete its call set-up
	CALL	Channel was selected as a resource, and is in the call set-up state
	WAKE	Channel has been connected to its selected resource, but is transmitting wake-up characters to the adjacent channel (resource)
	DATA	Channel is in the normal data transfer state, and is connected to another channel
	MNGE	Channel is in the network management state — e.g. it is receiving reports and/or session statistics; or it is receiving POLLs for information.
	POST	The channel is in the post-processing state for received input (prior to onward

CHANNEL LEVEL STATISTICS REPORT SUMMARY

FIELD NAME	POSSIBLE VALUES	MEANING
		forwarding for output). In this state each input character is examined, whatever the protocol used. It occurs if the channel to which it is connected (i.e. the channel which will receive the input as output) is MUXPORT channel (or similar) with PAD ENABLE and certain functions set, such as line feed insertion. This state will also occur if the channel is in trace mode.
TOTAL FRAMES IN	Decimal	Total frames received in current session (previous) session if state is DISC)
TOTAL FRAMES OUT	Decimal	Number of frames sent in current session (previous session if state is DISC)
TOTAL CHARS IN	Decimal	Total chars received in current session (previous session if state is DISC)
TOTAL CHARS OUT	Decimal	Total characters sent in current session (previous session if state is DISC)
CONNECTED TO	NAME (NAME, n)	Name of resource (channel) to which channel is connected. The controller name (e.g. link name) and relative channel number are displayed in parentheses
EIA	Additive Values	Represents a set of logical EIA signals
	DCD	Carrier detected, mapped from EIA signals (MUXPORT) DTR or DTR + RTS according to configuration; or from call packet received and accepted (X.25 level 3)
	RING	Ring indicator received
	DOWN	Channel is marked down because the link level is inactive
SESSION STATUS	Additive values	
	CALL	This channel initiated the call
	DRI	Channel is data restrained/flow controlled on input
	DRO	Channel is data restrained/flow controlled on output
	TRAN	This channel initiated the call and the routing was transparent — i.e. DRC MASK specified a complete route or call packet routed via destination address
	QUEU	The channel is queued, waiting for its selected resource to become free (all channels in selected class are busy)
	STAT	The channel is in the queued state, and has asked for a queue status report
	PAD	The channel is in the PAD recall state
	DISC	Port will be disconnected when network clears (or after time out period it does not clear)
CSU IN	(MUXPORT only)	Additive values showing the last control signal update received in a frame for the channel
	DTR	DTR or DSR received
	RTS	RTS or CTS received
	RING	Ring indicator received PAD recall state
CSU OUT	(MUXPORT only)	Additive values showing the last control signal update sent in a MUXPORT frame for the channel
	DTR	DTR or DSR transmitted
	RTS	RTS or CTS transmitted
	RING	Ring indicator transmitted
PERM IN	(MUXPORT only)	Permission count, input
	Decimal	Number of characters that the remote channel has been authorised to transmit on the composite link

CHANNEL LEVEL STATISTICS REPORT SUMMARY

FIELD NAME	POSSIBLE VALUES	MEANING
PERM OUT	(MUXPORT only) Decimal	Permission count, output Number of characters that this channel has been authorised to transmit to the remote channel via the composite link. The value 24576 represents the flow control (output) disabled state (i.e. the channel is not currently running under flow control on output)
PNR	X.25 only — decimal	Last packet acknowledgement number received
PR	X.25 only — decimal	Receive packet sequence number
PACKETS TO ACK	X.25 only — decimal	Number of packets received and not yet acknowledged
PR(SENT)	X.25 only — decimal	Last acknowledgement number transmitted
PS	X.25 only — decimal	Transmit sequence number
LEVEL 3 STATE	X.25 only	Level 3 channel state
	DISC	Disconnected state
	DATA	Data transfer state
	CALL	Call request packet sent
	CLS	Disconnect packet sent
	RESE	Reset indication state
	REST	Restart packet sent (channel 0 only)

The remaining values displayed are the parameter values originally loaded as defaults from battery backed up ram — i.e. as configured by the CONF or COPY commands. If the channel is of type MUXPORT and PAD ENABLE is set to E, then the parameters which are X.3 compatible may have been modified by qualified data packets. For X.25 level 3 channels with PAD ENABLE set, the X.3 values would have been transmitted to the remote PAD.

HARDWARE CONFIGURATION

SUMMARY

TELEPAC II PHYSICAL MOUNTING DETAILS

The TELEPAC II assembly consists of two main sub assemblies.

1. The Logic Frame

   The Logic Frame is a DIN standard 19 inch rack mount assembly of 6U × 84HP (19 × 10.5 inches) with a depth of 6U and a fron projection of 4HP. An allowance of 1U both above and below the Logic Frame should be made to allow for convection cooling. The TELEPAC II normally relies upon convected air currents for the dissipation of excess heat. Where the TELEPAC II is installed in a cabinet where the ambient temperature due to other equipment may be excessive or where the installation of other equipment may limit the free circulation of air, the FAN UNIT option must be installed directly under the Logic frame.

2. The Power Supply Unit

   The Power Supply unit is mounted on a 19 inch panel of 5U height the internal depth is 2U (3.5 inches). Since the Power Supply Unit is of the switched mode type normal convected air cooling will in most cases be adequate.

TELEPAC II SERIAL NUMBERING SYSTEM

The first three digits of the serial number are the unit type indentifiers and the last three digits are the serial number.

(1) CIRCUIT BOARDS

CPU BOARD	100XXX
MEM BOARD	200XXX
DIS BOARD	300XXX
SIO BOARD	400XXX
DMA BOARD	500XXX
DMA EIA INTERFACE	510XXX
DMA X26 INTERFACE	520XXX
DMA X27 INTERFACE	530XXX
DMA X21 INTERFACE	540XXX
DMA V35 INTERFACE	550XXX

(2) MOTHER BOARDS

5SLOT MOTHER BOARD	610XXX	MB1
9 SLOT MOTHER BOARD	620XXX	MB2
20 SLOT MOTHER BOARD	630XXX	MB3

(3) POWER SUPPLY UNITS

PSU 1 100 WATT	710XXX
PSU 2 150 WATT	720XXX
PSU 3 250 WATT	730XXX

(4) CARD FRAME UNITS

FRAME TYPE 1 HALF WIDTH	810XXX
FRAME TYPE 2 19 INCH	820XXX
FRAME TYPE 3 DMA INTERFACE	830XXX

TELEPAC II MOTHER BOARD CONFIGURATIONS

The standard 19 inch rack mounted frame can be configured to accept the following combinations of mother boards.

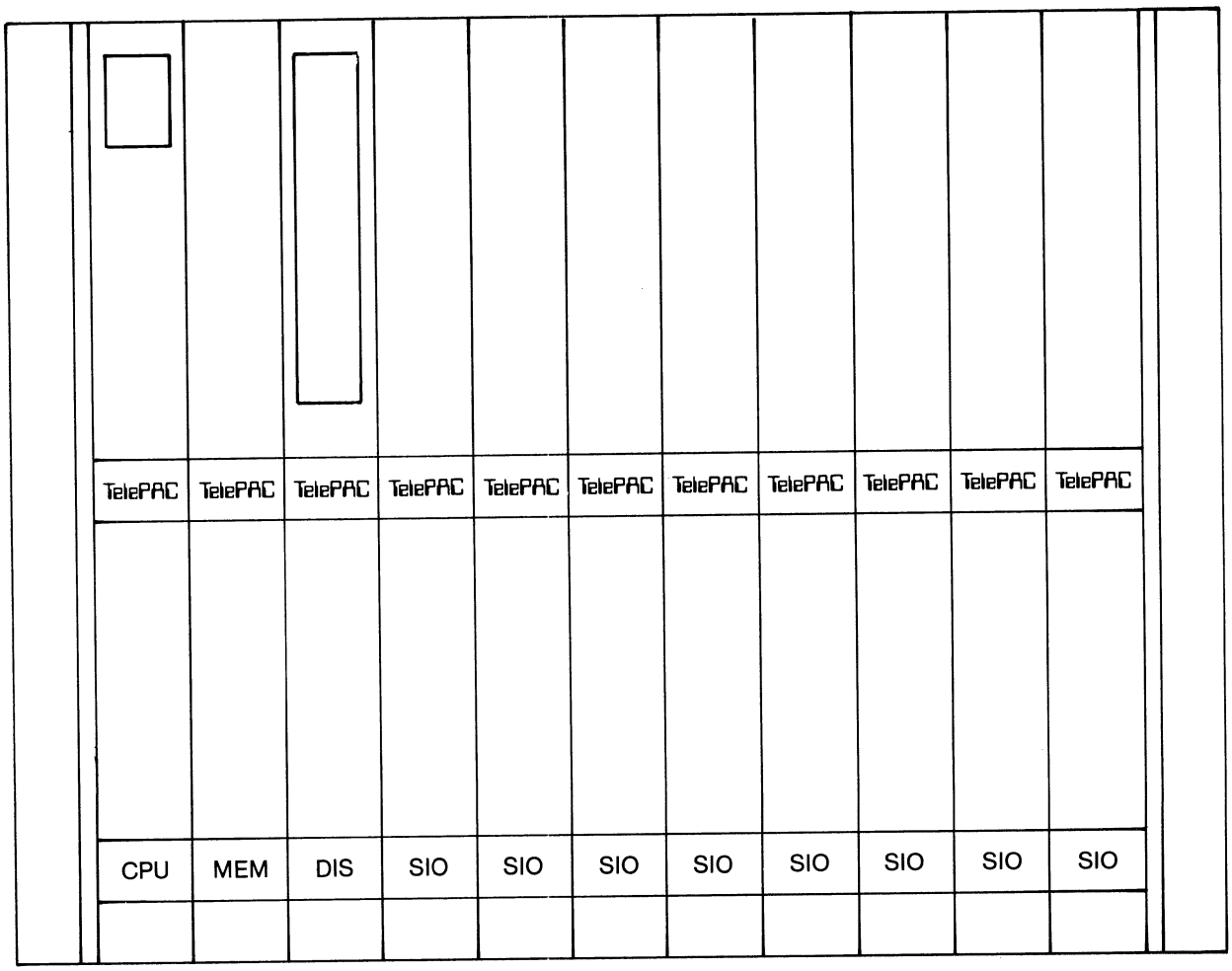
(1) 1 × 5 slot
(b) 2 × 5 slot
(c) 3 × 5 slot

(d) 1 × 9 slot
(e) 1 × 9 slot and 1 × 5 slot
(f) 2 × 9 slot

(g) 1 × 20 slot

The 20 slot mother board can either be a 64 port standard or a 32 port DMA single or double memory system.

TELEPAC II MODULE LOCATION



TELEPAC II C.P.U. MODULE STRAPPING

K1:	13—14.	15—16.						
K2:	07—08.							
K3:	01—02.	03—04.	05—06.	07—08.	09—10.			
K4:	According to EPROM speed							
K5:	01—02.	03—04.	05—06.	07—08.	09—10.	11—12.	13—14.	
K6:	01—02.	03—08.	05—10.	11—12.				
K7:	01—02.	05—06.	11—12.	13—14.	15—16.	**1		
K7:	01—02.	05—07.	10—12.	13—15.	14—16.	**2		
K9:	01—02—03.	04—05.						
K11:	01—04.	02—03.	05—06.	07—10.	09—12.	13—16.	18—21.	19—20.
K12:	01—04.	02—03.	05—06.	07—10.	09—12.	13—16.	18- 21.	19—20.
K13:	01—04.	03—06.	07—10.	08—09.	13—16.	14—17.	18- 21.	19—20.
K14:	01—04.	03—06.	07—10.	08—09.	13—16.	14—17.	18—21.	19—20.
K15:	01—02.	05—06.	11—12.	13—14.	15—16.	**3		
K15:	01—02.	05—07.	10—12.	13—15.	14—16.	**4		
K16:	NO STRAPS							

****1 PORT 01 AS A DATA TERMINAL**
****2 PORT 01 AS A DATA SET**
****3 PORT 02 AS A DATA TERMINAL**
****4 PORT 02 AS A DATA SET**

TELEPAC II MEMORY MODULE (64KB) STRAPPING

There are two strapping fields on the TELEPAC MEMORY MODULE LK1 and LK2 the strapping options for these are as follows:—

LK1 Memory Address Strapping

MEM1	MEM2	MEM3	MEM4
3—4	3—4	3—4	3—4
7—8	7—8	7—8	7—8
9—10	11—12	9—10	11—12
15—16	13—14	13—14	15—16
19—20	19—20	19—20	17—18
21—22	21—22	21—22	21—22
25—26	25—26	25—26	25—26
29—30	29—30	29—30	29—30

LK2 Memory Timing Strap

1—2 option 1
3—4 option 2
5—6 option 3 NORMAL
7—8 For factory Testing Only

TELEPAC II 4 PORT STANDARD SPEED SIO ADDRESS STRAPPING

The base address for the SIO module is wire wrapped on the rear of the J2 connector, this is normally installed by the factory.

ADDRESS LINE AND PIN IDENTIFICATION

Address	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	GND
P2 pin	6a	5c	5a	4c	4a	3c	3a	2c	2a	1c	1a	2b
SIO.01	X	X	X	X	X	X	X	X	X	X	X	X
SIO.02		X	X	X	X	X	X	X	X	X	X	X
SIO.03	X		X	X	X	X	X	X	X	X	X	X
SIO.04			X	X	X	X	X	X	X	X	X	X
SIO.05	X	X		X	X	X	X	X	X	X	X	X
SIO.06		X		X	X	X	X	X	X	X	X	X
SIO.07	X			X	X	X	X	X	X	X	X	X
SIO.08				X	X	X	X	X	X	X	X	X
SIO.09	X	X	X		X	X	X	X	X	X	X	X
SIO.10		X	X		X	X	X	X	X	X	X	X
SIO.11	X		X		X	X	X	X	X	X	X	X
SIO.12			X		X	X	X	X	X	X	X	X
SIO.13	X	X			X	X	X	X	X	X	X	X
SIO.14		X			X	X	X	X	X	X	X	X
SIO.15	X				X	X	X	X	X	X	X	X
SIO.16					X	X	X	X	X	X	X	X

The address is strapped by wire wrapping the logic O to 0 volts as indicated by the X in the above table.

TELEPAC II SIO MODULE V24 INTERFACE PIN ALLOCATION

SIGNAL	PIN
TX DATA	02
RX DATA	03
R.T.S.	04
D.S.R.	06
GROUND	07
L.S.D.	08
TX CLOCK	15
RX CLOCK	17
D.T.R.	20

TELEPAC II ADDRESS SPACE MAPPING

ADDRESS	VME DESIGNATION	DEVICES
FFFFFF FF0000	VME SHORT ADDRESS ADDRESSING	CLOCK, DISPLAY AND SIO PORTS
FEFFFF FEF000	LOCAL IO SPACE	CPU STATUS AND DISPLAY REGISTERS AND IO
FEEFFF 010000	GLOBAL MEMORY AND MAPED IO SPACE	BUFFER, CONFIGURATION AND DMA MEMORY SPACE
00FFFF 00800	SYSTEM ROM	32K X 8 ROM
007FFF 000000	SYSTEM AND VECTOR MEMORY	32K X 8 RAM

DMA SIO MODULE ADDRESS SWITCH SETTINGS

SLOTE	SW1	SW2	ADDRESS
01	3	F	FFC000
02	3	D	FFC200
03	3	B	FFC400
04	3	9	FFC600
05	3	7	FFC800
06	3	5	FFCA00
07	3	3	FFCC00
08	3	1	FFCE00
09	2	F	FFD000
10	2	D	FFD200
11	2	B	FFD400
12	2	9	FFD600
13	2	7	FFD800
14	2	5	FFDA00
15	2	3	FFDC00
16	2	1	FFDE00

RS422/RS423/V10/V11/X27 INTERFACE DETAILS

The TelePAC X27 interface conforms to the specifications:—

RS422
RS423
V10
V11
X27

The TelePAC X27 interface is configured as a DTE interface with the pin designations as follows:—

PIN	SIGNAL
22	SEND DATA –
4	SEND DATA +
35	TERMINAL TIMING –
17	TERMINAL TIMING +
25	REQUEST TO SEND –
7	REQUEST TO SEND +
30	TERMINAL READY –
12	TERMINAL READY +
24	RECEIVE DATA –
6	RECEIVE DATA +
23	SEND TIMING –
5	SEND TIMING +
26	RECEIVE TIMING –
8	RECEIVE TIMING +
27	CLEAR TO SEND –
9	CLEAR TO SEND +
31	RECEIVER READY –
13	RECEIVER READY +
29	DATA MODE –
11	DATA MODE +
19	SIGNAL GROUND
1	SHIELD