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**X.42**

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SERIES X: DATA NETWORKS AND OPEN SYSTEM  
COMMUNICATION

Public data networks – Interfaces

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**Procedures and methods for accessing a  
Public Data Network from a DTE operating  
under control of a generalized polling protocol**

ITU-T Recommendation X.42

(Previously CCITT Recommendation)

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The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, March 1-12, 1993).

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## NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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## **SUMMARY**

This Recommendation puts forth the definition and framework for providing access to a Public Data Network (PDN) by a DTE operating under the control of a generalized polling protocol, via the use of a Packet Assembly/Disassembly (PAD) device situated within (or associated with) the PDN. The PAD supporting the generalized polling protocol aspect is referred to as a "GPAD". The generalized polling environment provides support for access, along with basic requirements necessary within the PAD to enable the selection and modification of the protocol Aspect. This Recommendation has been developed in realization that a well-established base of 10s of 1000s of DTEs operating under control of a generalized polled protocol have need to access a PDN. This Recommendation enables these terminals to communicate over the public data network. This work is also an expansion on related work undertaken in Recommendations X.8 and X.28.

**PROCEDURES AND METHODS FOR ACCESSING A PUBLIC DATA NETWORK  
FROM A DTE OPERATING UNDER CONTROL OF A  
GENERALIZED POLLING PROTOCOL**

*(Geneva, 1996)*

**1 Scope**

This Recommendation defines the procedures and methods for accessing a Public Data Network (PDN) from a DTE operating under the control of a generalized polling protocol via the use of a Packet Assembly/Disassembly (PAD) device situated within (or associated with) the PDN.

This Recommendation is the first of a set of Recommendations produced to facilitate asynchronous access to a PSDN (see Recommendation X.25) via Point-to-Multipoint (PMP) circuits. This Recommendation addresses the most important aspect of communications between the PAD and a subnetwork of terminals connected via PMP circuits – the multidrop data link protocol providing medium access arbitration, data link addressing and data protection for transmission over a PMP circuit.

There exist large networks of terminals connected to PSDNs, characterized by low data throughput requirements both in terms of channel bandwidth and packet per second rate. Such a traffic profile mandates the need for a reduction of cost sensitive network architecture components, which traditionally grow as a function of the number of remote terminals. In a practical sense, this amounts to a requirement for various forms of concentration and clustering of switching equipment, tail circuits, virtual communications channels and trunks, such that the total number does not grow in direct proportion to the number of end users terminals. Major savings in cost and resource utilization can be achieved when effective sharing of data communications channels is applied.

The majority of the networks which utilize PMP technology are implemented using in-expensive analogue circuits and asynchronous data transmission. This configuration is prevalent in many transaction processing applications with request/response type traffic, consisting of a small number of short bi-directional messages.

To be economically viable, applications running over PMP circuits typically require very low unit cost data communications. Such low costs can be only achieved through major economies of scale leading to a lower telecommunications resource usage. These PSDN resources, in the case of those complying with Recommendation X.25, are:

- multidrop ports;
- Telecommunications modems;
- X.25 DTEs, with an efficient concentration ratio of PAD X.25 DTEs to the total number of terminals;
- X.25 SVCs, with an efficient concentration ratio of X.25 SVCs to the total number of terminals;
- Call Establishment Requests, with a low ratio of total number of call requests to the total number of terminals; and
- Non-informational traffic, as the request/response characteristics of the traffic inherently induces piggy-back acknowledgments.

Recommendation X.42 directly addresses these needs by providing simple, low complexity and bandwidth-efficient network resource management. Introduction of this protocol aspect enables a low cost offering, and opens PDN transport to a broad existing terminal base.

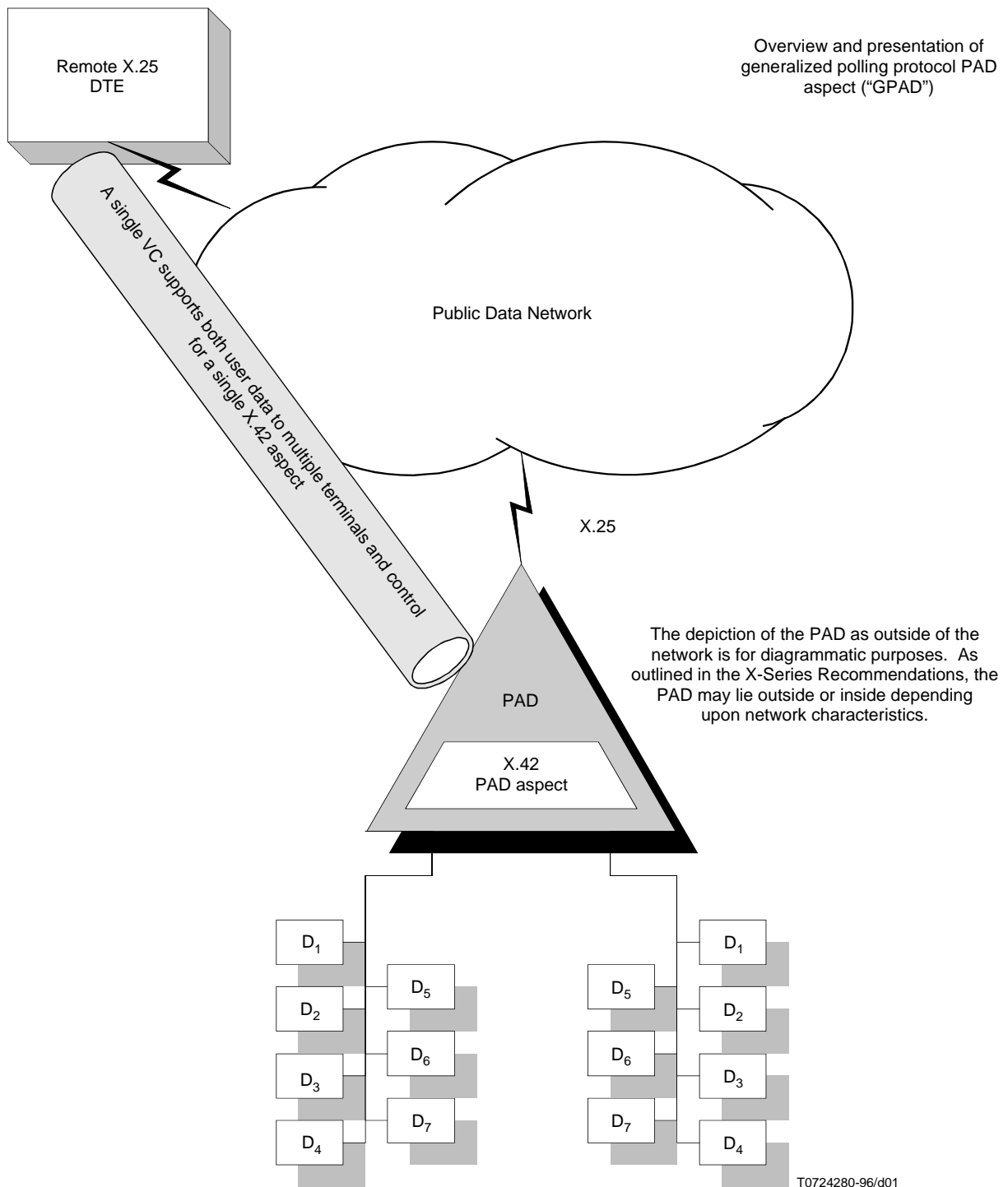


FIGURE 1/X.42  
GPAD environment



## 2 References

The following Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision: all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

- ITU-T Recommendation X.3 (1993), *Packet Assembly/Disassembly facility (PAD) in a public data network*.
- ITU-T Recommendation X.5 (1996), *Facsimile Packet Assembly/Disassembly facility (FPAD) in a public data network*.
- ITU-T Recommendation X.8 (1994), *Multi-aspect PAD (MAP) framework and service definition*.
- ITU-T Recommendation X.25 (1996), *Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit*.
- ITU-T Recommendation X.28 (1993), *DTE/DCE interface for a start-stop mode data terminal equipment accessing the Packet Assembly/Disassembly facility (PAD) in a public data network situated in the same country*.
- ITU-T Recommendation X.29 (1993), *Procedures for the exchange of control information and user data between a Packet Assembly/Disassembly (PAD) facility and a packet mode DTE or another PAD*.
- ITU-T Recommendation X.38 (1996), *G3 facsimile equipment/DCE interface for G3 facsimile equipment accessing the Facsimile Packet Assembly/Disassembly facility (FPAD) in a public data network situated in the same country*.
- ITU-T Recommendation X.39 (1996), *Procedures for the exchange of control information and user data between a Facsimile Packet Assembly/Disassembly facility (FPAD) and a packet mode Data Terminal Equipment (DTE) or another FPAD*.
- ITU-T Recommendation X.200 (1994), *Information technology – Open Systems Interconnection – Basic Reference Model: The Basic Model*.
- ITU-T Recommendation X.213 (1995), *Information technology – Open Systems Interconnection – Network service definition*.
- ITU-T Recommendation X.340 (1993), *General arrangements for interworking between a Packet Switched Public Data Network (PSPDN) and the international telex network*.

## 3 Definitions

For the purposes of this Recommendation, the following definitions apply:

- 3.1 access information path:** The communication link between a DTE and a GPAD.
- 3.2 access interface:** A physical interface where a DTE is connected to a GPAD to use the functions it provides.
- 3.3 binary numbers:** Base 2 numbers, represented by the digits 0 and 1 followed by the letter “b”.
- 3.4 broadcasting:** Global addressing or delivery of messages via the outbound information path, utilizing an address unique from all other addresses assigned to terminals on a particular GPAD port such that it is recognized by all terminals as its own. Broadcasting is always Unsolicited. Broadcasting does not generate any inbound acknowledgment traffic.
- 3.5 byte complement:** Defined by complementing all eight bits of a byte.
- 3.6 drop:** A station/terminal device connected to a PMP circuit operating in secondary mode.
- 3.7 generalized polling protocol packet assembly/disassembly facility:** A facility that provides an access to a Public Data Network for a DTE which operates under control of a generalized polling protocol.

- 3.8 hexadecimal numbers:** Base 16 numbers, represented by the digits 0 to 9 and A to F followed by the letter “h”.
- 3.9 host DTE:** The remote DTE that provides the upper layers of applications required to fully utilize the X.42 Generalized polling protocol access to the PDN (GPAD) functionality in specific application environments.
- 3.10 inbound information path:** Data transfer from the terminal to the GPAD.
- 3.11 outbound information path:** Data transfer from the GPAD to the terminal.
- 3.12 PAD aspect:** A term that represents the logical function of a PAD operating with a specific protocol used by the DTE connected to a GPAD.
- 3.13 port:** A representation of the attachment of a PMP circuit to a GPAD instance.
- 3.14 solicited exchange traffic:** Solicited exchange consisting of one inbound (request) and one outbound (response). The terminal sends a request only when it is polled (i.e. unsolicited inbound data transfer is illegal).
- 3.15 traffic:** Any data stream being sent by, or received by a terminal may be considered as “traffic”. Two types of traffic exist, Solicited Exchange Traffic and Unsolicited message Traffic.
- 3.16 unsolicited message/traffic:** Data transfer activity directed outbound to individual terminals, asynchronous with respect to the request/response exchange traffic. Individual unsolicited outbound transfer requires inbound acknowledgments.
- 3.17 upper layer information:** Defined as the actual user information conveyed in the information field of a frame.

## 4 Abbreviations

For the purposes of this Recommendation, the following abbreviations are used:

|      |                                                                          |
|------|--------------------------------------------------------------------------|
| AIP  | Access Information Path                                                  |
| BIF  | Broadcast Information Frame                                              |
| CRC  | CRC-16 16-bit Cyclic Redundancy Check                                    |
| DCE  | Data-terminating Circuit Equipment                                       |
| DRC  | Diagonal Redundancy Check                                                |
| DTE  | Data-terminating Equipment                                               |
| FCS  | Frame Check Sequence                                                     |
| GPAD | Generalized Polling Protocol Accessed Packet Assembly/Disassembly Device |
| ISIF | Inbound Solicited Information Frame                                      |
| LRC  | Longitudinal Redundancy Check                                            |
| NUA  | Network User Address                                                     |
| OSIF | Outbound Solicited Information Frame                                     |
| OUIF | Outbound Unsolicited Information Frame                                   |
| PAD  | Packet Assembly/Disassembly Facility                                     |
| PDU  | Protocol Data Unit                                                       |
| PMP  | Point-to-Multipoint                                                      |
| PDN  | Public Data Network                                                      |
| PSDN | Packet Switched Data Network                                             |

## 5 GPAD Framework

A GPAD provides the means for terminals to access a PSDN via multipoint circuits. A GPAD operates within the following framework:

- 1 to M ports are connected to one GPAD instance;
- 1 to N terminals are connected to one port and form a PMP circuit;
- a maximum of N\*M terminals access the network via one GPAD instance;
- one GPAD instance is uniquely identifiable by its NUA (X.121 address); and,
- there is exactly one X.25 SVC per GPAD instance (see Figure 2).

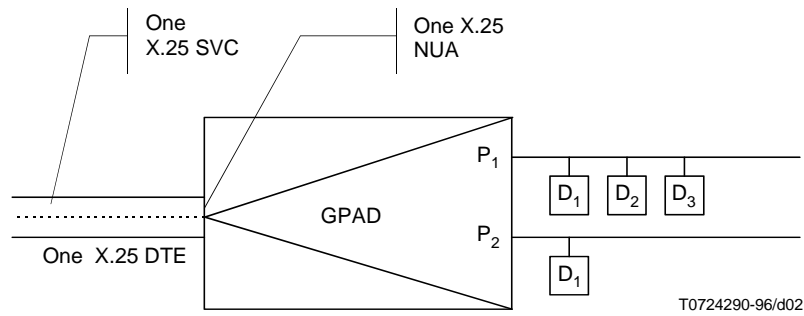


FIGURE 2/X.42  
GPAD minimal configuration

The minimum architecture of the subsystem from the GPAD point of view is as follows (see Figures 3 and 4):

- X.25 is considered a subnetwork access protocol (between the GPAD and the host);
- X.42 is considered a subnetwork access protocol (between the GPAD and the terminals);
- DTEs connected to one or more multipoint lines that all terminate at the same GPAD instance are considered one multipoint subnetwork; and
- the multipoint subnetwork associated with one GPAD instance is connected to the host via one X.25 SVC, and the GPAD instance is uniquely associated with and identifiable by one X.25 NUA (X.121 address) on the PSDN (i.e. GPAD instance = one SVC = one NUA).

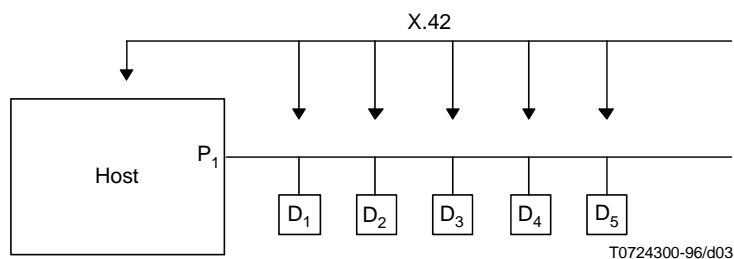


FIGURE 3/X.42  
GPAD minimum architecture – traditional multipoint

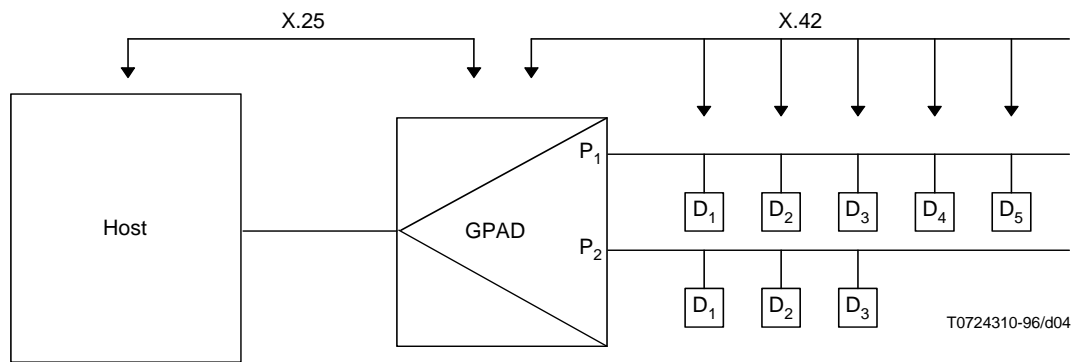


FIGURE 4/X.42  
**GPAD minimum architecture – Networked implementation**

## 5.1 Assumptions

Within the GPAD architecture, a need exists for functions, services and components which make the GPAD a complete operational unit, and facilitate a practical implementation. Such functions, services and components are presented in this Recommendation in their most fundamental form. Wherever possible, alternatives to increase the scope are referenced "...for further study...", and as such may be subject to expanded and/or additional Recommendations:

- For the purposes of this Recommendation, the provision of routing and relaying functions to the GPAD between connection end points (the host and the terminal) is based upon a simple multiplexing functionality possible over X.25. From a GPAD perspective, no restriction is placed upon the type of network layer protocol that delivers such function to higher layers (for the purpose of establishing an end-to-end communications channel). However, the reduction to a simple multiplexing function as proposed within this Recommendation (i.e. one that provides access to multiple terminals on a GPAD subnetwork over a single X.25 SVC channel) provides the foundation for more advanced capabilities.
- No inference should be taken due to the methods and procedures outlined herein in regards to data transfer link layer establishment over the PDN. This matter is left to the scope of other Recommendations and/or upper layers of National implementations.
- For the purpose of this Recommendation, no assumptions are made as regards to the protocol information frame (I-Frame) sequencing and no procedures for link establishment or termination are recommended.
- For the purpose of this Recommendation, it is affirmed that the X.25 Q-bit functionality is adopted to provide in-call signaling over which the GPAD control/management protocol PDUs can be passed. Alternative methods for the provision of a separate channel for control/management are for further study.
- Basic configuration and management/maintenance tables necessary to operate a minimum GPAD, along with suggested values can be found in Annex C. The utilization of a remote GPAD Management function to provide an interface into the GPAD configuration and maintenance tables, thus supplying access to basic parameters for the GPAD, X.25 and GPAD-PMP subnetwork entities, is presumed to be a matter left for National implementation. It is envisioned, however, that the potential support for the routing/relaying function of the Internetwork layer and its configuration parameters may be subject to future Recommendations (much in line with Recommendations X.3 and X.5).

This Recommendation provides a concise definition of the multipoint data link protocol limited in functionality to medium arbitration, data link addressing, error detection and start/stop, octet oriented transmission.

Internal organization and the information path architecture of a GPAD operating the X.42 protocol are shown in Figures 5 and 6.

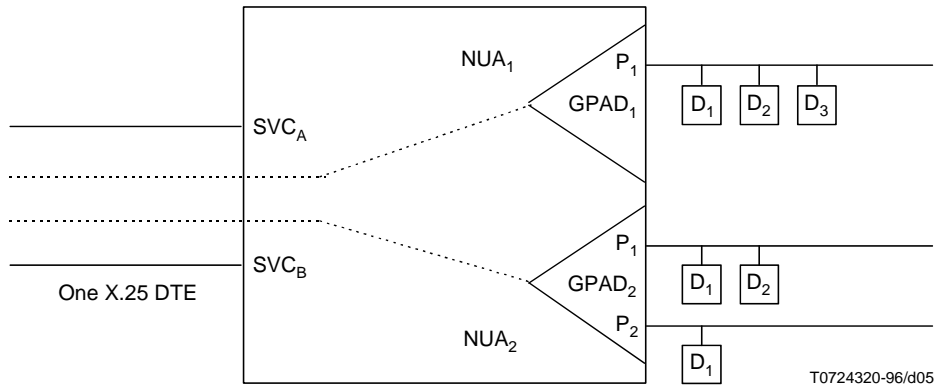


FIGURE 5/X.42  
**PAD expanded configuration – Two GPAD instances**

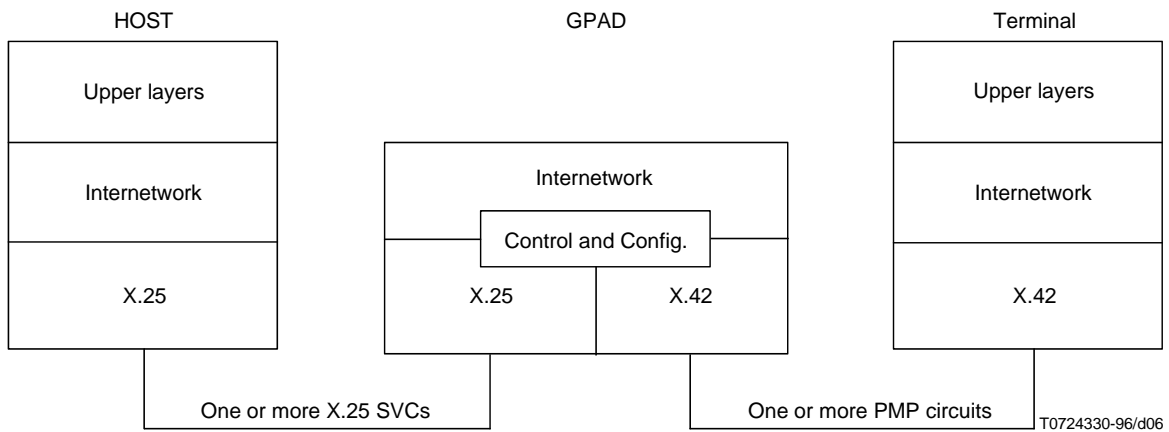


FIGURE 6/X.42  
**Internal organization of the GPAD**

## **6 General configuration**

### **6.1 Data stations**

The communication between a GPAD and its terminals exhibits the behaviour of a standard unbalanced link configuration. In such a primary/secondary architecture, two types of data stations are defined for control purposes:

- The primary station (GPAD) assumes responsibility for the organization of data flow, secondary station frame acknowledgment, error detection, and handling of the unrecoverable data flow conditions. The primary station sends command PDUs and receives response PDUs, but does not support any form of link layer connection establishment/termination and flow control to the terminals.
- The secondary station (terminal) sends response PDUs and receives command PDUs, but does not support any form of link layer establishment/termination and flow control. The secondary station supports some elements of frame acknowledgment and error detection (see 7.6).

### **6.2 Transmission considerations**

#### **6.2.1 Bit order**

All control octets (i.e. octets which are not the part of information field) are transmitted low-order bit first (i.e. the first bit of the octet has the weight  $2^0$ ). The order of bits within the octets of the information field is not specified, but shall be held transparent end-to-end.

#### **6.2.2 Start/Stop transmission**

Each octet has eight data bits, no parity bits, and is delimited by single start and stop bits. Mark-hold (continuous logical 1 condition) is used to provide inter-octet time fill.

### **6.3 Protocol sequence**

The primary station communicates with secondary stations one at a time. The atomic unit of communication between the primary station and a selected secondary station is referred to as a single protocol sequence. Only the primary station and selected secondary station are allowed to transmit during a protocol sequence. The beginning and end of each protocol sequence is delimited by LINK and/or ACK characters (see 7.1.1 and 7.1.2).

The protocol can be described as a chain of sequences, connected by linkage control characters, LINK and/or ACK. The trailing linkage character determines the validity of the sequence from the primary station's viewpoint, and also serves as the leading linkage character to the following sequence. These characters are only sent by the primary station.

## **7 Elements of procedure**

### **7.1 Definition of PDUs and PDU components**

#### **7.1.1 LINK – Begin new sequence**

The LINK character begins a new protocol sequence (an atomic protocol exchange) between the primary and the secondary stations. The LINK character may only be sent by the primary station.

#### **7.1.2 ACK – Acknowledge**

The ACK character acknowledges the last transmission from the secondary station, completes the current protocol sequence, and begins a new one. The ACK character may only be sent by the primary station.

### 7.1.3 ACB – Address Control Byte

The Address Control Byte contains the secondary station's unique poll address and the PDU type. The ACB may assume the following roles, based upon the PDU type.

#### 7.1.3.1 PAD – Poll Address

Identifies the polled or responding secondary station and the PDU type.

- |          |                                                                                                                                                                                               |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Inbound  | The secondary station responds to a poll when it is ready to send inbound information. PAD is a part of the Inbound Solicited Information Frame (see 7.1.10.1).                               |
| Outbound | The primary station seeks to initiate a new protocol sequence leading to either the transmission of an Inbound Solicited Information Frame (see 7.1.10.1) or Empty Poll sequence (see 7.2.2). |

#### 7.1.3.2 PAC – Poll Address Complement

Identifies the responding secondary station and the PDU type. PAC completes an Empty Poll sequence.

- |          |                                                                                                                          |
|----------|--------------------------------------------------------------------------------------------------------------------------|
| Inbound  | Not used.                                                                                                                |
| Outbound | The secondary station informs the primary station that it does not have any information to send at the time of the poll. |

#### 7.1.3.3 SAD – Select Address

Identifies the selected or responding secondary station and the PDU type.

- |          |                                                                                                                                                                                                                 |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Inbound  | The secondary station previously selected to receive the Outbound Solicited Information Frame (see 7.1.10.2) in this protocol sequence confirms a successful transmission. SAD completes the protocol sequence. |
| Outbound | The primary station selects the secondary station for the transmission of the Outbound Solicited Information Frame (see 7.1.10.2). SAD is a part of the Outbound Solicited Information Frame.                   |

#### 7.1.3.4 SAC – Select Address Complement

Identifies the responding secondary station and the PDU type.

- |          |                                                                                                                              |
|----------|------------------------------------------------------------------------------------------------------------------------------|
| Inbound  | Notifies the primary station that the Outbound Solicited Information Frame was corrupt. SAC completes the protocol sequence. |
| Outbound | Not used.                                                                                                                    |

#### 7.1.3.5 UAD – Unsolicited Address

Identifies the selected or responding secondary station and the PDU type.

- |          |                                                                                                                                                                                                                   |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Inbound  | The secondary station previously selected to receive the Outbound Unsolicited Information Frame (see 7.1.10.3) in this protocol sequence confirms a successful transmission. UAD completes the protocol sequence. |
| Outbound | The primary station selects the secondary station for the transmission of an Outbound Unsolicited Information Frame. UAD is a part of the Outbound Unsolicited Information Frame.                                 |

#### 7.1.3.6 UAC – Unsolicited Address Complement

Identifies the responding secondary station and the PDU type.

- |          |                                                                                                                                |
|----------|--------------------------------------------------------------------------------------------------------------------------------|
| Inbound  | Notifies the primary station that the Outbound Unsolicited Information Frame was corrupt. UAC completes the protocol sequence. |
| Outbound | Not used.                                                                                                                      |

### **7.1.3.7 BRO – Global Address (Broadcast)**

Identifies all secondary stations and the PDU type.

|          |                                                                                                                                                                                                             |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Inbound  | Not used.                                                                                                                                                                                                   |
| Outbound | The primary station selects all secondary stations associated with one PMP circuit for the transmission of an Broadcast Information Frame (see 7.1.10.4). BRO is a part of the Broadcast Information Frame. |

### **7.1.4 ESC – Escape**

Also referred to as an exception or complement character.

The ESC character is used as a means to effect binary code transparency of the information transfer. When any character of the information frame, including ACB and FCS characters, has the same value as one of the special protocol characters (see 7.4.1), the ESC character is inserted into the transmission stream preceding the data character in question, and the binary complement of the data character follows. The receiving station discards the ESC character and binary complements the following character.

### **7.1.5 ENQ – Enquire last transmission**

ENQ may be sent by the primary station if the last transmission from the secondary station was interpreted as incorrect or corrupt. ENQ shall only be sent when the expected secondary station transmission was SAD or SAC.

### **7.1.6 ETX – End of text**

This character is the last character of every PDU containing an information field.

### **7.1.7 CRC – Cyclic Redundancy Check**

A 16-bit Cyclic Redundancy Check of all octets of the information frame, including all data from ACB to ETX inclusive. The CRC is calculated on the actual data, before the binary code transparency rules are applied (see 7.1.4).

### **7.1.8 LRC – Longitudinal Redundancy Check**

Logical Exclusive OR (XOR) sum of all octets of the information frame, including all data from ACB to ETX inclusive. It is calculated on the actual data, before the binary code transparency rules are applied (see 7.1.4).

### **7.1.9 DRC – Diagonal Redundancy Check**

Logical Exclusive OR (XOR) sum of all octets of the information frame, including all data from ACB to ETX inclusive. It is calculated in succession of one bit rotation of the current value of the sum to the right. DRC is calculated on the actual data, before the binary code transparency rules are applied (see 7.1.4).

### **7.1.10 Information PDUs**

Format encoding for the PDU frames are found in 8.1.2.2.

#### **7.1.10.1 ISIF – Inbound Solicited Information Frame**

ISIF is sent by the secondary station in response to a PAD with a PAD matching secondary station address.

#### **7.1.10.2 OSIF – Outbound Solicited Information Frame**

OSIF is sent by the primary station and contains selected secondary station address. It is normally sent in response to a previous ISIF.

#### **7.1.10.3 OUIF – Outbound Unsolicited Information Frame**

OUIF is sent by the primary station and contains selected secondary station address. It may be sent asynchronously to any other ISIF or OSIF traffic.

#### **7.1.10.4 BIF – Broadcast Information Frame**

BIF is sent by the primary station and contains global secondary station address. It may be sent synchronously to any other ISIF, OSIF, or OUIF traffic.



## 7.2 Procedures

### 7.2.1 Polling

#### 7.2.1.1 Polling sequence

Polling shall be performed exclusively by the primary station. Polling is an operation which allows the primary station to interrogate selected secondary stations for inbound transmissions, and arbitrate access to the shared medium by multiple users. All inbound transmissions are initiated by a successful poll. The polling order is based on an algorithm, ideally, specific to the application being supported by the devices. The implementation of the GPAD is transparent to the specifics of the algorithm – just so as some order is adhered to. The inclusion of a standard or default algorithm (utilized when no application-specific order is provided) is for further study.

A single poll is defined as a transmission of a PAD by the primary station. It may result in one of three outcomes:

- Inbound Solicited Information Frame sequence (see 7.2.3);
- Empty Poll sequence (see 7.2.2);
- Poll Timeout sequence (see 7.4.2).

#### 7.2.1.2 Normal and slow poll

The frequency of polling individual secondary stations shall be a function of a station's consistency in responding to polls. At least two levels of priority shall be provided to distinguish between stations which responded on their last poll and those that did not (see 7.4.2). The respective secondary stations shall be grouped into normal and slow poll pools. Exclusion of the offending stations is necessary to protect the overall performance of the PMP circuit.

#### 7.2.1.3 Poll priority option

The primary station may administer a more elaborate poll priority to account for variance in the number of missed polls. Other factors may be taken into consideration to dedicate priorities between the secondary stations, for example:

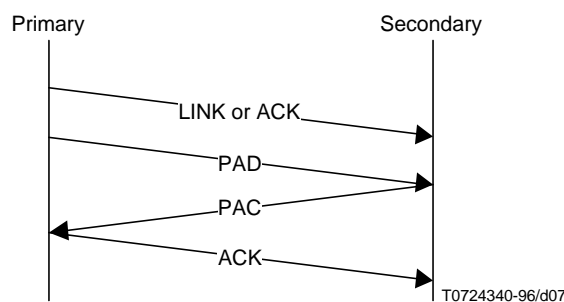
- time elapsed since last successful poll;
- total accumulated time during which the secondary station has not responded to polls;
- total number of offending stations on the PMP circuit.

#### 7.2.1.4 No Poll option

In Selective Poll mode of operation (see 9.3), the primary station shall put an individual secondary station into a no-poll pool for the duration of period of time between the transmission of ISIF and the transmission of OSIF.

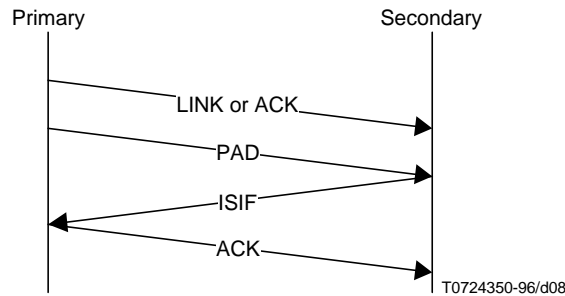
### 7.2.2 Empty Poll sequence

The secondary station uses this sequence to inform the primary station that it does not have any information to send at the time of the poll.



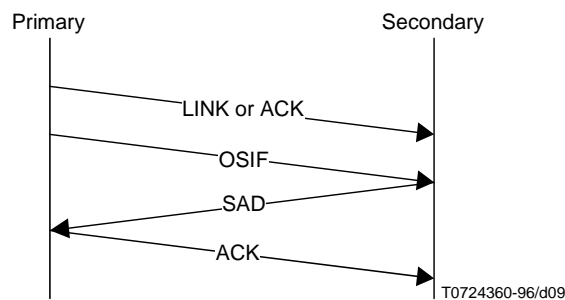
### 7.2.3 Inbound Solicited Information Frame (ISIF) sequence

The secondary station uses this sequence as a positive response to a poll, sending inbound information.



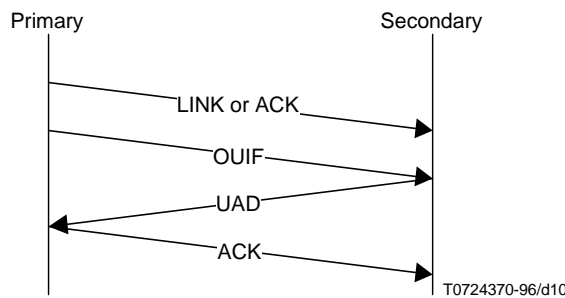
### 7.2.4 Outbound Solicited Information Frame (OSIF) sequence

The primary station uses this sequence to send outbound information to a secondary station in accordance with 9.3.1 and 9.3.2.



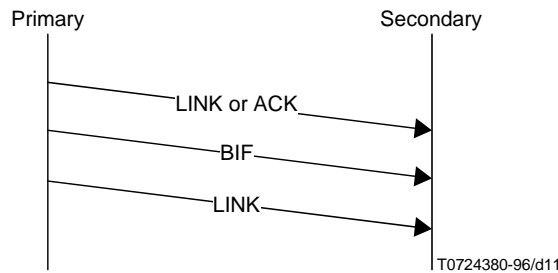
### 7.2.5 Outbound Unsolicited Information Frame (OUIF) sequence

The primary station uses this sequence to asynchronously sent outbound information to a secondary station.



### 7.2.6 Broadcast Information Frame (BIF) sequence

The primary station uses this sequence to broadcast information to multiple secondary stations.



### 7.3 Full/Half-duplex considerations

Under normal situations, the support of terminals conforming to this Recommendation will operate under half-duplex transmission mode. However, nothing within Recommendation X.42 precludes the use of full duplex transmission. Specific care and attention to order-of-receipt and protocol sequence violations/interrupts, must be realized. Accordingly, the impact in the application of full duplex technology to X.42 conforming systems is left for further study.

### 7.4 Timeout function considerata

#### 7.4.1 General

In order to detect a no-reply or lost reply condition, each station shall provide a timeout function. The expiration of the timeout function shall initiate appropriate exception handling procedures.

#### 7.4.2 Poll Timeout

The Poll Timeout value shall depend on the polling pool (see 7.2.1.2 and 7.2.1.3) the individual station is assigned to. Faster poll pool stations shall have longer Poll Timeout values, and slower poll pool stations shall have shorter Poll Timeout values. The value of this timeout is considered application specific. See also Annex C.

|                         |                                                                                                                                      |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Start/Restart condition | PAD sent by the primary station.                                                                                                     |
| Stop condition          | PAD or PAC received by the primary station. If PAD is received, it is received as a part of the Inbound Solicited Information Frame. |
| Action                  | Secondary station poll priority shall be affected. The secondary station is moved to a lower polling priority pool.                  |

#### 7.4.3 Intercharacter timeout

|                         |                                                                                                                                                                                                                   |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Start/Restart condition | A character received by the primary or the secondary station as a part of an information frame (see 7.1.10). Start/restart applies to all but the last frame character (which is the second octet of FCS).        |
| Stop condition          | The next frame character received.                                                                                                                                                                                |
| Action                  | The information frame shall be discarded. Negative acknowledgment shall be sent by the secondary station (SAC, UAC ), or a new protocol sequence shall be initiated by the primary station (LINK is transmitted). |

#### **7.4.4 Acknowledgment timeout**

|                         |                                                                                                                                                                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Start/Restart condition | An information frame transmission is completed.                                                                                                                                                                                              |
| Stop condition          | SAD or UAD received by the primary station. ACK received by the secondary station.                                                                                                                                                           |
| Action                  | The primary station shall start a new protocol sequence. The secondary station's poll priority shall be affected. The secondary station is moved to a lower polling priority pool. Secondary station shall wait for a new protocol sequence. |

#### **7.4.5 Response timeout**

The response timeout takes effect only in the Selective Poll Mode of operation (see 9.3).

|                         |                                                                                                                                                 |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Start/Restart condition | ISIF transmission is completed.                                                                                                                 |
| Stop condition          | OSIF transmission to the secondary station in question is completed.                                                                            |
| Action                  | Primary station will move the secondary station in question from the no-poll pool to the normal poll pool (of any priority which allows polls). |

#### **7.5 Link end points association**

No link establishment or shutdown is defined between the primary and the secondary stations. A protocol sequence is the only logical association between the end points of the data transmission, and lasts for the duration of the atomic data exchange. The protocol sequence is always initiated by the primary station (with LINK or ACK characters, see 7.1.1 and 7.1.2).

#### **7.6 Error detection and recovery**

All PDUs containing an information field (see 7.1.10) also contain a Frame Check Sequence (FCS) (see 8.1.2.1.3).

The FCS is recalculated by the receiving station, and upon the discovery of data corruption the entire frame is discarded. Recovery from errors is accomplished as follows:

##### **7.6.1 Inbound Solicited traffic**

Upon discovery of an FCS error, the primary station will initiate a new protocol sequence by transmitting LINK.

##### **7.6.2 Outbound Solicited/Unsolicited traffic**

Upon discovery of an FCS error, the secondary station will transmit a negative acknowledgment PDU (SAC or UAC). Upon receipt of this negative acknowledgment, the primary station will initiate a new protocol sequence by transmitting LINK.

##### **7.6.3 Broadcast**

The error detection functions are based on the FCS. There is no error recovery provision for broadcast transmission. No inbound negative acknowledgment transmission is allowed.

#### **7.7 Addressing conventions**

A station individual address uniquely identifies a station within one PMP circuit. The broadcast address shall be recognized by all secondary stations.

## 8 Structure and encoding of Protocol Data Units (PDUs)

### 8.1 PDU types

#### 8.1.1 ACB – Address Control Byte

ACB provides the means for local addressing of stations, and for qualifying polls and information frames. The ACB octet may take on any value between 20h and FFh.

|   |    |       |
|---|----|-------|
| E | SS | AAAAA |
|---|----|-------|

E = 0 Reserved (for future use)

#### ACB type:

|     |     |
|-----|-----|
| SS  | ACB |
| 10b | PAD |
| 01b | SAD |
| 11b | UAD |

#### Station address:

|          |                          |
|----------|--------------------------|
| AAAAA    | Address type             |
| 0h - FEh | Normal                   |
| FEh      | Reserved                 |
| FFh      | Broadcast (all stations) |

Given PAD, SAD, and UAD, the following ACBs are additionally defined:

|     |                          |
|-----|--------------------------|
| PAC | Binary complement of PAD |
| SAC | Binary complement of SAD |
| UAC | Binary complement of UAD |

PAC, SAC, and UAC are created by complementing all 8 bits of the ACB including bits 0 to 2.

#### 8.1.2 Information frames

##### 8.1.2.1 Basic Elements of information frames

An information frame is made up of two fields (an Address Field and an Information Field) followed by a Frame Check Sequence.

### 8.1.2.1.1 Address Field

The station address is a binary number, in the range 0-29. Value 30 is reserved for future use. Value 31 (all 1's) is designated as a global address.

### 8.1.2.1.2 Information Field

The information field is a sequence of octets. The maximum length of the information field is limited, and is implementation dependent.

### 8.1.2.1.3 Frame Check Sequence

The Frame Check Sequence is computed over all octets of the information frame, including all data from ACB to ETX inclusive. The CRC is calculated on the actual data, before the binary code transparency rules are applied (see 7.1.4).

The FCS may utilize one of two different algorithms, as a matter of local configuration:

- LRC and DRC; or
- CRC-16.

The length of the FCS is two octets.

## 8.1.2.2 Types of information frames

The information frames contain the station address, message type, information content, and the FCS section.

### 8.1.2.2.1 ISIF – Inbound Solicited Information Frame

|     |             |     |      |      |
|-----|-------------|-----|------|------|
| PAD | INFORMATION | ETX | FCS1 | FCS2 |
|-----|-------------|-----|------|------|

### 8.1.2.2.2 OSIF – Outbound Solicited Information Frame

|     |             |     |      |      |
|-----|-------------|-----|------|------|
| SAD | INFORMATION | ETX | FCS1 | FCS2 |
|-----|-------------|-----|------|------|

### 8.1.2.2.3 OUIF – Outbound Unsolicited Information Frame

|     |             |     |      |      |
|-----|-------------|-----|------|------|
| UAD | INFORMATION | ETX | FCS1 | FCS2 |
|-----|-------------|-----|------|------|

### 8.1.2.2.4 BIF – Broadcast Information Frame

|     |             |     |      |      |
|-----|-------------|-----|------|------|
| BRO | INFORMATION | ETX | FCS1 | FCS2 |
|-----|-------------|-----|------|------|

## 8.1.2.3 Sequencing of information frames

There is no frame sequence enforcement inherent to this Recommendation. It is assumed that the correct order of higher layer data will be maintained by the higher layers.

In Selective Poll Mode (see 9.3), means are provided to enforce certain inbound/outbound traffic rules.

## 8.2 Data transparency

The information field may contain octets with any bit combination. Since this Recommendation uses specific control characters for link supervisory purposes, and those control characters may occur in the data stream, a control octet escape rule is imposed to ensure binary code data transparency (see 7.1.4).

### 8.2.1 Protocol characters

The following protocol characters are recognized and are transmitted with any necessary binary code transparency:

|      |     |     |     |     |
|------|-----|-----|-----|-----|
| LINK | ACK | ESC | ETX | ENQ |
| 09h  | 06h | 0Fh | 03h | 05h |

### 8.2.2 Control character escape sequences

In place of the protocol control (see 8.3.1) characters, the following sequences are transmitted to effect binary code transparency:

|         |         |         |         |         |
|---------|---------|---------|---------|---------|
| LINK    | ACK     | ESC     | ETX     | ENQ     |
| 0Fh F6h | 0Fh F9h | 0Fh F0h | 0Fh FCh | 0Fh FAh |

## 9 Classes of procedures

### 9.1 Configuration

A GPAD may follow several polling and traffic enforcement methodologies. For the purpose of this Recommendation, it is assumed that the GPAD (primary station) and the terminals (secondary stations) may have the ability to be configured to operate with:

- multiple, simultaneous, variable intensity, polling regimes: fast poll, slow poll, no-poll, and variable priority poll;
- ISIF outstanding flag;
- ISIF outstanding timeout;
- Poll Timeout;
- Poll Priority.

### 9.2 Normal Poll Mode class

In the Normal Poll Mode of operation, neither the primary station nor the secondary stations shall infer any static or dynamic association between the polling sequence and the Information Frame traffic. The sequence of the Information Frames, as well as the intensity of the traffic in the direction of the secondary and primary stations, is fully controlled by the upper layer. The protocol activity is limited to the medium arbitration, data transfer, and error detection.

Changes in the polling method and/or schedule resulting from the no-reply conditions, apply normally.

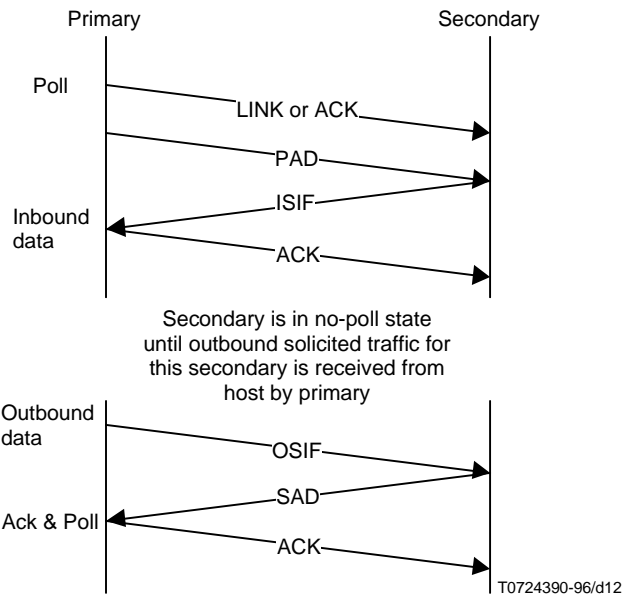
### 9.3 Selective Poll Mode class – Description of procedures

#### 9.3.1 Polling

Once a solicited inbound message is transmitted to the primary station, both the primary and the secondary stations enter an outstanding inbound message state. The primary station recognizes and maintains such state separately for every secondary station, and will put an outstanding secondary station into the no poll state. The primary station will then wait for any outbound solicited traffic to occur to that particular secondary station. Only once that takes place will the secondary station be moved back into the normal poll state, and scheduled to be polled again in its due time. Response timeout (see 9.3.5.1) is the second condition upon which the resumption of polling will take place.

### 9.3.2 Solicited Inbound/Outbound Exchange sequence

All ISIF need to be satisfied by OSIFs, one at a time.



### 9.3.3 Unsolicited Frame sequence

An unsolicited message will be accepted by the selected secondary station in any state of its inbound/outbound exchange with the primary station, and the message will be passed to the upper layer upon arrival (i.e. without waiting for the completion of the solicited exchange).

### 9.3.4 Broadcast Frame sequence

A broadcast message will be accepted by all secondary stations in any state of their inbound/outbound exchange with the primary station, and will be passed to the upper layer upon arrival (i.e. without waiting for the completion of the solicited exchanges).

### 9.3.5 Error conditions

#### 9.3.5.1 Response timeout

A response timeout is a condition resulting from the lack of OSIF transmission matching previously transmitted ISIF and allowing the ISIF-outstanding flag to be reset. When operating in the Selective Poll Mode of operation, it is primary station's responsibility to maintain the record of all ISIF transmission, ISIF-outstanding flags, and corresponding timeouts.

Upon the expiration of the response timeout the following actions shall take place:

- Primary station will move the secondary station in question from the no-poll pool to the normal poll pool (of any priority which allows polls) whereby the secondary station will become eligible for polls again.
- It is envisioned that the secondary station shall notify the upper layer that no matching OSIF arrived. The means of such notification are not a subject of this Recommendation.
- If primary station's timeout expired before the secondary station's, once the secondary station is polled, it shall stop its response timer. It is left for further study as to the potential applicability of this timer to this layer of protocol communications.
- If secondary station's timeout expires before the primary station's, the secondary station shall continue to wait for a poll.



### 9.3.5.2 FCS error

Inbound FCS error shall result in an origination of a new protocol sequence.

Outbound FCS error shall result in a negative acknowledgment and an origination of a new protocol sequence.

## 9.4 Poll priority mode class

May also apply to 9.2 and 9.3. See also 7.2.1.2 and 7.2.1.3 for further references.

Primary station will adjust the polling priority of secondary stations when they time out on polls or acknowledgments. It is left for further study if the values used in polling timers may be subject to a table entry in this Recommendation (and its annexes and/or a separate Recommendation).

## Annex A

### Point to Multipoint (PMP) Network

The following definitions apply to multipoint/multidrop technology within telephony systems:

**A.1 multipoint:** A configuration, topology or layout, designed to transmit data on a common circuit among locations served by several central offices of telephone company.

**A.2 multipoint line:** A single, interoffice communications line that connects to more than one central office.

**A.3 multidrop:** A communication arrangement whereby multiple devices share a common transmission channel, bridged at the central office.

**A.4 multidrop line:** An interoffice communication line that includes at least one central office termination which connects to more than one end-user termination.

A Point to Multipoint Network (PMP), which is also called a Multidrop Network, refers to an arrangement where multidrop lines are interconnected with multipoint lines to create a star architecture with a large number of remote drops (sometimes called legs) and a small number of main (master) circuits concentrated in one physical location. The transmit data on the main circuit are received by all remote drops. The transmit data of the remote drops are received only by the main circuit.

The multidrop network facilities can be either analogue or digital. In the analogue design, the circuits are bridged in summing amplifiers producing one out of all remote drop signals. The digital equivalent uses individual line termination units, output signal of which is logically OR'ed in local exchanges or wiring centers.

## Annex B

### Explanatory notes on the implementation of frame check sequences

#### LRC Longitudinal Redundancy Check

Assuming the first octet of data to be checksummed is in position data[0] and that the last octet of data is in position data[number\_of\_octets – 1], use the following pseudo code to calculate LRC of data[0 – number\_of\_octets].

```
residual_value = 0;
for (i = 0; i < number_of_octets; i++);
residual_value = residual_value .xor. data[i];
```

#### DRC Diagonal Redundancy Check

Assuming the first octet of data to be checksummed is in position data[0] and that the last octet of data is in position data[number\_of\_octets – 1], use the following pseudo code to calculate DRC of data[0 – number\_of\_octets].

```
residual_value = 0;
for (i = 0; i < number_of_octets; i++);
residual_value = residual_value >> .xor. data[i];
```

## Annex C

TABLE C.1/X.42

Typical X.42 GPAD configuration parameters

| GPAD configuration parameter                   | Range of considered value(s) (Note)                                                                                                                                                       |
|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Maximum number of terminals per PMP circuit | 30                                                                                                                                                                                        |
| 2. Maximum number of terminals per GPAD        | (Number of PMP circuits) (Note) 30                                                                                                                                                        |
| 3. Poll list configuration                     | An ordered list of terminal addresses                                                                                                                                                     |
| 4. Timeout values                              |                                                                                                                                                                                           |
| 4a. Normal poll timeout                        | 1 sec / (actual number of terminals on the PMP circuit)<br>It is recommended that the terminals occupying lower priority polling pools operate under shorter than the normal poll timeout |
| 4b. Intercharacter timeout                     | 10 (Note) (character transfer time)                                                                                                                                                       |
| 4c. Acknowledgment timeout                     | 1 sec / (actual number of terminals on the PMP circuit)                                                                                                                                   |
| 4d. Response timeout                           | Application specific                                                                                                                                                                      |
| 5. Checksum mode                               | LRC/DRC or CRC-16                                                                                                                                                                         |
| 6. Operational mode                            | Normal mode<br>Selective Poll mode                                                                                                                                                        |
| 7. Maximum length of X.42 information frame    | Implementation dependent                                                                                                                                                                  |
| NOTE – For further study.                      |                                                                                                                                                                                           |

TABLE C.2/X.42

**X.42 GPAD configuration and management commands**

| Action                                                                        | Comments                                                                               |
|-------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 1. Initialize port                                                            | Restart Level 1 of the PMP circuit                                                     |
| 2. Configure poll list                                                        | List order is application dependent                                                    |
| 3. Add/delete terminal to/from poll list                                      | Deletions should be preceded by disabling the terminal                                 |
| 4. Terminal polling enable/disable                                            | Should only be executed while the terminal is not participating in a protocol sequence |
| 5. Port poll enable/disable                                                   | Should allow all current protocol sequences of all effected terminals to terminate     |
| 6. Display fast poll, slow poll, no poll terminals                            | Implementation dependent                                                               |
| 7. Display poll priority                                                      | Implementation dependent                                                               |
| 8. Define poll algorithm                                                      | Implementation dependent                                                               |
| 9. Define timeouts values                                                     | Implementation dependent                                                               |
| 10. Configure X.25 DTE (Calling NUA, and other X.25 Level 2 and 3 parameters) | Implementation dependent                                                               |
| 11. Configure Internetwork protocol                                           | Implementation dependent                                                               |

**Appendix I**

The following diagrams are provided for clarification and informational purposes only. As an appendix to the Recommendation, these diagrams provide information for the reader that may be considered useful when adding support for the Recommendation to existing systems and/or when implementing new system architectures.

As Recommendation X.42 focuses on the interface between the GPAD and polled DTEs, some assumptions have been taken regarding the actual application host system (see 5.1). In the following diagrams, the assumptions have been considered and included in references to the host system. Readers should be aware that different assumptions may apply depending upon the specific application being supported by the Recommendation and/or further enhancements/promulgation of related Recommendations.

Five different scenarios are presented in the following diagrams:

Figure I.1

- Solicited inbound and outbound information exchange between a host and terminal T<sub>1</sub>
- Empty poll sequence between GPAD and terminal T<sub>2</sub>

Figure I.2

- Unsolicited confirmed information sent from host to terminal T<sub>1</sub>
- Broadcast information sent from host to terminals T<sub>1</sub> and T<sub>2</sub>

Figure I.3

- Unsolicited outbound transmission error between GPAD and terminal T<sub>1</sub>, and successful recovery

Figure I.4

- Timeout on response from host during solicited inbound information exchange between host and terminal T<sub>1</sub>
- Empty poll sequence between GPAD and terminal T<sub>2</sub>

Figure I.5

- Solicited inbound transmission error between terminal T<sub>1</sub> and GPAD, and successful recovery

Comments and clarification for each scenario are presented with the diagrams where necessary.

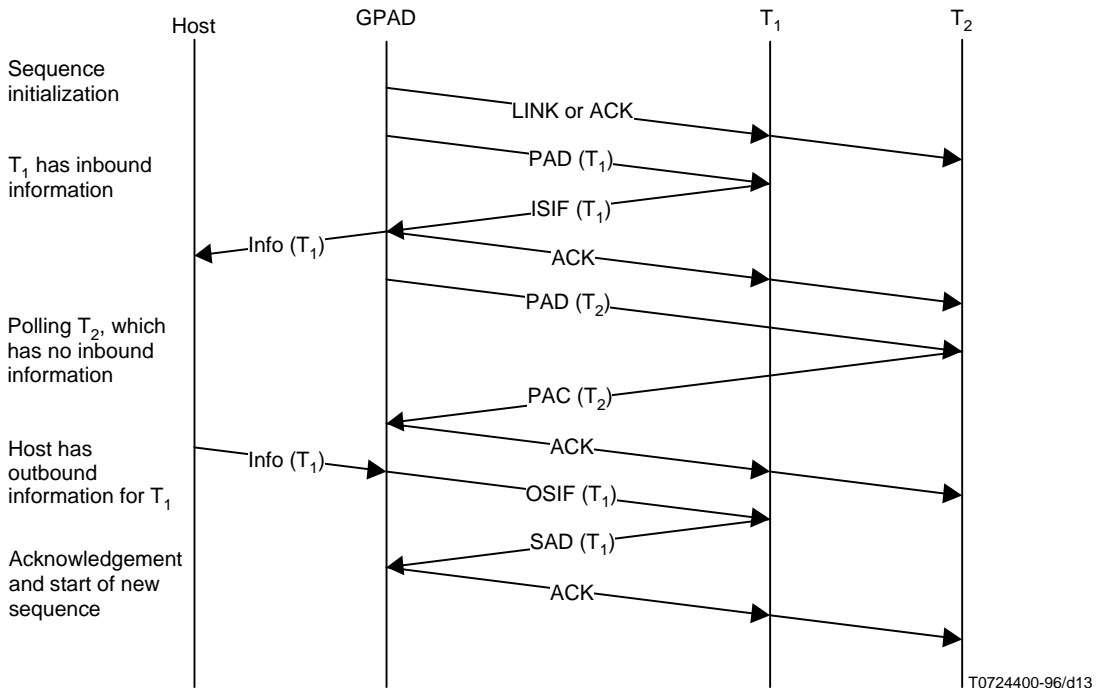


FIGURE I.1/X.42  
Solicited inbound/outbound exchange

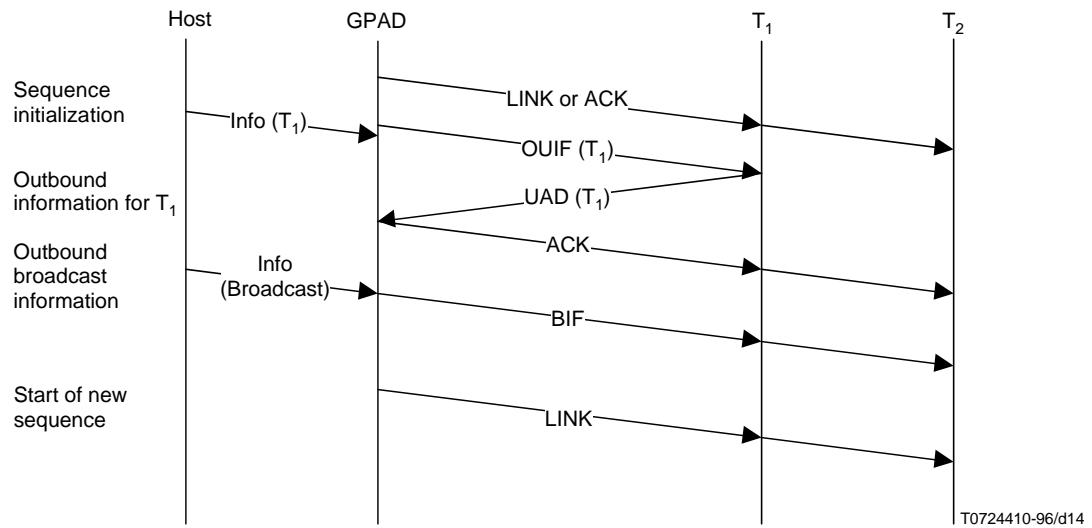


FIGURE I.2/X.42  
**Unsolicited outbound transmission**

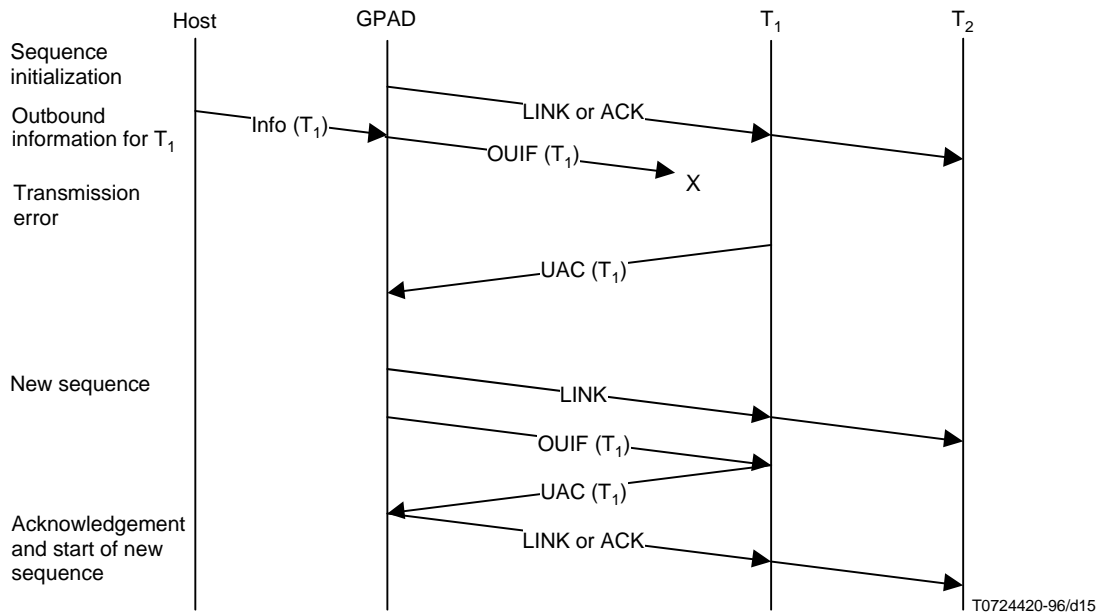


FIGURE I.3/X.42  
**Unsolicited outbound transmission error**

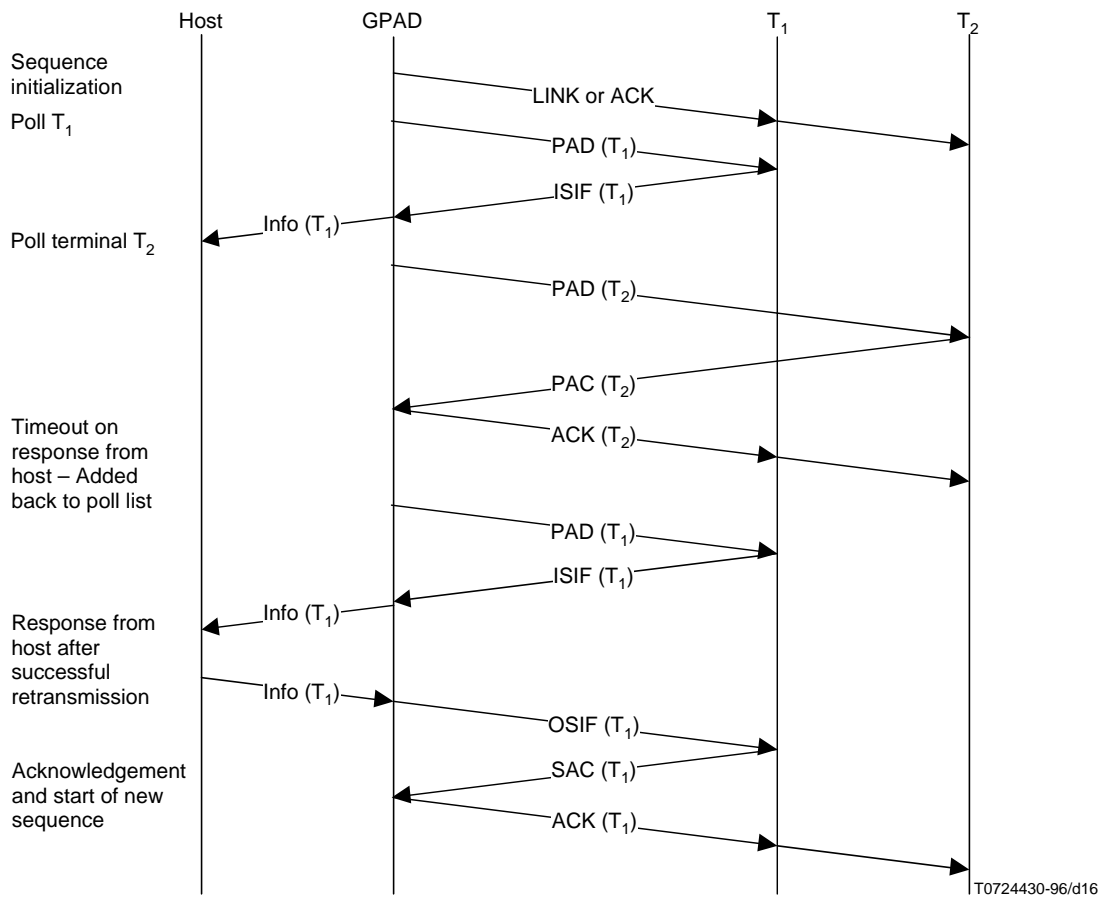


FIGURE I.4/X.42  
Solicited inbound response timeout

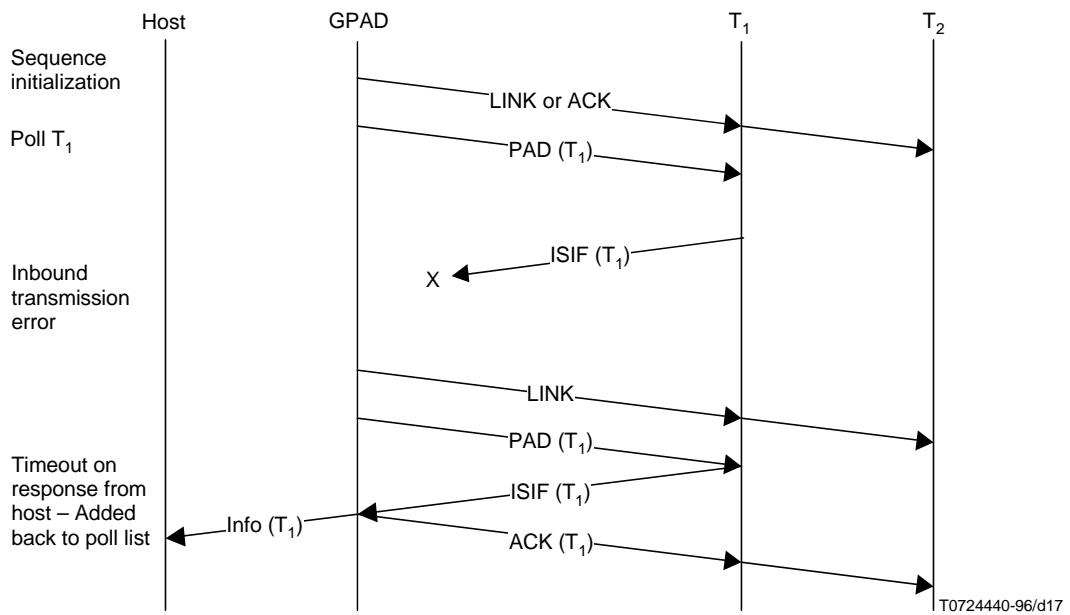


FIGURE I.5/X.42  
Solicited inbound transmission error

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