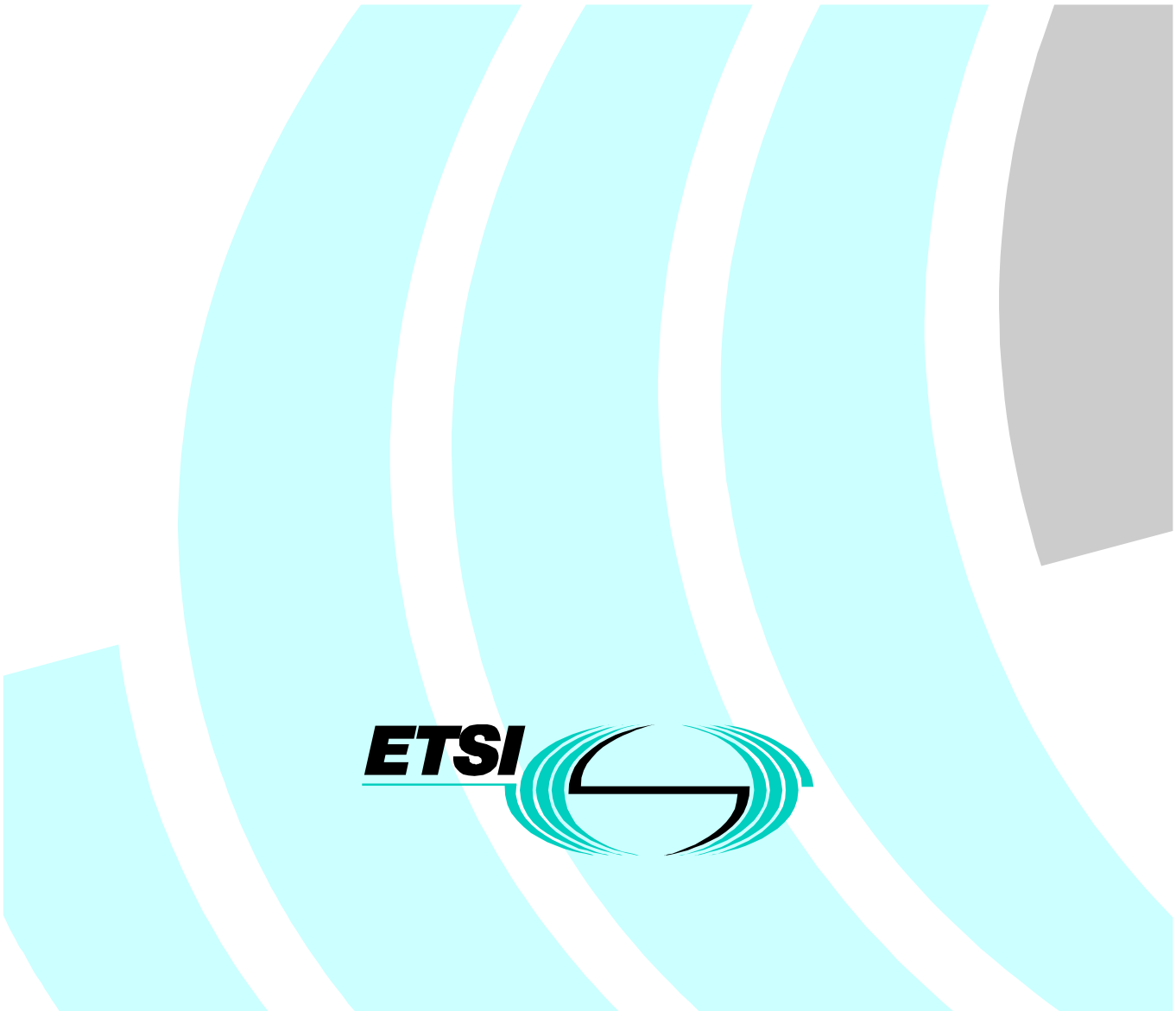
# Draft EN 301 649 V0.0.2 (1999-03)

*European Standard (Telecommunications series)*

# Digital Enhanced Cordless Telecommunications (DECT); Data Services Profile (DSP); DECT Packet Radio Services (DPRS)



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# Foreword

This European Standard (Telecommunications series) has been produced by ETSI Project Digital Enhanced Cordless Telecommunications (DECT), and is now submitted for the Public Enquiry phase of the ETSI standards Two-step Approval Procedure.

| **Proposed national transposition dates** | |
|---|---|
| Date of latest announcement of this EN (doa): | 3 months after ETSI publication |
| Date of latest publication of new National Standard or endorsement of this EN (dop/e): | 6 months after doa |
| Date of withdrawal of any conflicting National Standard (dow): | 6 months after doa |

# 1 Scope

The present document defines a profile for Digital Enhanced Cordless Telecommunications (DECT) systems conforming to EN 300 175, Parts 1 to 8 [1] to [8]. It is part of a family of profiles which build upon and extend each other, aimed at the general connection of terminals supporting non-voice services to a fixed infra-structure, private and public.

The present document contains the specification of the set of basic Data Services Profiles (DSP) for DECT Packet Radio Services (DPRS), and replaces the profiles formerly published in EN 300 435 [11], EN 300 651 [9], EN 300 701 [22] and ETS 300 699.[23].

The present document defines four basic services, identified by the service type A/B or C and by the mobility class 1 or 2. Service type A is optimized for low power and simplicity, while service type B is optimized for high speed and throughput. Both basic service types are fully compatible and can inter-work with each other. Service type C adds full Link Access Protocol (LAP-U) functionality to the basic service types.
Mobility class 1 provides for applications in closed user groups, whereas mobility class 2 is intended for use in private and public roaming applications.

Annexes C and D to the present document contain conventions for interworking to connection oriented and connectionless services respectively.

For Profile specific Implementation Conformance Statement proforma, please refer to EN 300 435 [11].

The present document defines the additional requirements on the Physical Layer (PHL), Medium Access Control (MAC) layer, DLC layer and Network (NWK) layer of DECT. The standard also specifies Management Entity (ME) requirements and generic Interworking Conventions (IC) which ensure the efficient use of the DECT spectrum.

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] EN 300 175-1: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 1: Overview".

[2] EN 300 175-2: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 2: Physical layer (PHL)".

[3] EN 300 175-3: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 3: Medium Access Control (MAC) layer".

[4] EN 300 175-4: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 4: Data Link Control (DLC) layer".

[5] EN 300 175-5: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 5: Network (NWK) layer".

[6] EN 300 175-6: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 6: Identities and addressing".

[7] EN 300 175-7: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 7: Security features".

[8] EN 300 175-8: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 8: Speech coding and transmission".

[9] ETS 300 651: "Digital Enhanced Cordless Telecommunications (DECT); Data Services Profile (DSP); Generic data link service (service type C, class 2)".

[10] EN 300 444: "Digital Enhanced Cordless Telecommunications (DECT); Generic Access Profile (GAP)".

[11] EN 300 435: "Digital Enhanced Cordless Telecommunications (DECT); Data Services Profile (DSP); Base standard including interworking to connectionless networks (service types A and B, class 1)".

[12] Void.

[13] CCITT Recommendation V.42 (1996): "Error-correcting procedures for DCEs using asynchronous-to-synchronous conversion".

[14] CCITT Recommendation V.24 (1996): "List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE)".

[15] CCITT Recommendation V.25bis (1988): "Automatic calling and/or answering equipment on the general switched telephone network (GSTN) using the 100-series interchange circuits".

[16] CCITT Recommendation V.42bis (1990): "Data compression procedures for data circuit-terminating equipment (DCE) using error correcting procedures".

[17] ETR 043:" Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Services and facilities requirements specification".

[18] ETS 300 476-2: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Protocol Implementation Conformance Statement (PICS) proforma; Part 2: Data Link Control (DLC) layer - Portable radio Termination (PT)".

[19] ETS 300 476-3: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Protocol Implementation Conformance Statement (PICS) proforma; Part 3: Medium Access Control (MAC) layer - Portable radio Termination (PT)".

[20] ETS 300 476-4: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Protocol Implementation Conformance Statement (PICS) proforma; Part 4: Network (NWK) layer - Fixed radio Termination (FT)".

[21] ETS 300 476-5: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Protocol Implementation Conformance Statement (PICS) proforma; Part 5: Data Link Control (DLC) layer - Fixed radio Termination (FT)".

[22] EN 300 701: "Digital Enhanced Cordless Telecommunications (DECT); Data Services Profile (DSP); Generic frame relay service with mobility (service types A and B, class 2)".

[23] ETS 300 699: "Digital Enhanced Cordless Telecommunications (DECT); Data Services Profile (DSP); Generic data link service for closed user groups (service type C, class 1)".

[24] ISO/IEC 8802-3 (1996): "Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements - Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications".

[25] ISO/IEC 8802-5 (1998): "Information technology - Telecommunications and information exchange between systems - Local and Metropolitan Area Networks - Specific requirements - Part 5: Token ring access method and physical layer specifications".

[26] RFC 791 (September 1981): "Internet Protocol - Darpa Internet Program Protocol Specification".

[27] RFC 1661 (July 1994): "The Point-to-Point Protocol (PPP)".

[28] RFC 1662 (July 1994): "PPP in HDLC-like Framing".

# 3 Definitions and abbreviations

## 3.1 Definitions

For the purposes of the present document, the following definitions apply:

**Access Rights Identity (ARI):** see EN 300 175-6 [6].

**mobility class 1**: local area applications, for which terminals are pre-registered off-air with one or more specific Fixed Parts (FPs), and establishment of service and user parameters is therefore implicit, according to a profile-defined list.

**mobility class 2:** private and public roaming applications for which terminals may move between FPs within a given domain and for which association of service parameters is explicit at the time of service request.

**multiframe**: a repeating sequence of 16 successive Time Division Multiple Access (TDMA) frames, that allows low rate or sporadic information to be multiplexed (e.g. basic system information or paging).

**service type A**: low speed frame relay, with a net sustainable throughput of up to 24 kbits/s, optimized for bursty data, low power consumption and low complexity applications such as hand-portable equipment.

**service type B:** high performance frame relay, with a net sustainable throughput of up to 552 kbits/s, optimized for high speed and low latency with bursty data. Equipment implementation the Type B profile inter-operates with Type A equipment.

**service type C:** non-transparent connection of data streams requiring Link Access Protocol (LAP) services, optimized for high reliability and low additional complexity. This builds upon the services offered by the type A or B profiles.

**TDMA frame**: a time-division multiplex of 10 ms duration, containing 24 successive full slots. A TDMA frame starts with the first bit period of full slot 0 and ends with the last bit period of full slot 23.

## 3.2 Abbreviations

For the purposes of the present document, the following terms and abbreviations apply:

| | |
|---|---|
| AC | Access Control |
| ACK | Acknowledgement |
| AMCI | Advanced MAC Connection Identifier |
| ARI | Access Rights Identity |
| ARQ | Automatic Retransmission reQuest |
| BPAD | Bit oriented Packet Assembler/Disassembler |
| C | higher layer control Channel (see CS and CF) |
| C/L | ConnectionLess |
| C/O | Connection Oriented |
| CC | Call Control. A NWK layer functional grouping |
| CF | higher layer signalling Channel (fast) |
| C-plane | Control plane |
| CRC | Cyclic Redundancy Check |
| CS | higher layer signalling Channel (slow) |
| CSMA/CD | Carrier Sense Multiple Access with Collision Detection |
| DCE | Data Circuit terminating Equipment |
| DECT | Digital Enhanced Cordless Telecommunications |
| DLC | Data Link Control |
| DTE | Data Terminal Equipment |
| ECN | Exchanged Connection Number |
| EDEL | End DELimiter |

| | |
|---|---|
| FC | Frame Control |
| FCS | Frame Check Sequence |
| FP | Fixed Part |
| FREL | Frame Relay |
| FS | Frame Status |
| FT | Fixed radio Termination |
| GAP | Generic Access Profile |
| GSM | Global System for Mobile communication |
| HDLC | High level Data Link Control |
| I | higher layer Information channel (see IN and IP) |
| IN | higher layer Information channel (unprotected) |
| IP | higher layer Information channel (protected) |
| IP | Internet Protocol |
| IPUI | International Portable User Identity |
| ISDN | Integrated Services Digital Network |
| IWF | Interworking Functions |
| IWU | InterWorking Unit |
| L | Lenght |
| LAN | Local Area Network |
| LAP-B | Link Access Procedure (Balanced) |
| LAP-C | Link Access Procedure (Control) |
| LAP-U | Link Access Procedure (U-plane) |
| LBN | Logical Bearer Number |
| LCE | Link Control Entity |
| LLME | Lower Layer Management Entity |
| LSB | Least Significant Bit |
| M | MAC control channel |
| MAC | Medium Access Control |
| MCI | MAC Connection Identifier |
| ME | Management Entity |
| MM | Mobility Management |
| MSB | Most Significant Bit |
| MUX | time MUltipleXors |
| N | identities channel |
| NLF | New Link Flag |
| NWK | Network |
| P | Paging channel |
| PAD | Packet Assembler-Disassembler |
| PARI | Primary Access Rights Identity |
| PDU | Protocol Data Unit |
| PHL | PHysical Layer |
| PICS | Protocol Implementation Conformance Statement |
| PMID | Portable part MAC IDentity |
| PP | Portable Part |
| PPP | Point-to-Point Protocol |
| PT | Portable radio Termination |
| PVC | Permanent Virtual Circuit |
| Q | system information channel |
| RFP | Radio Fixed Part |
| RFPI | Radio Fixed Part Identity |
| SAP | Service Access Point |
| SAPI | Service Access Point Identifier |
| SARI | Secondary Access Rights Identity |
| SDEL | Start DELimiter |
| SDU | Service Data Unit |
| SFD | Start Frame Delimiter |
| SIP | Higher layer connectionless channel (protected) |
| TAF | Terminal Adaptation Function |
| TARI | Tertiary Access Rights Identity |
| TDMA | Time Division Multiple Access |

| | |
|---|---|
| TPUI | Temporary Portable User Identity |
| U-plane | User-plane |

# 4 Description of services

## 4.1 Data services structure

The DPRS standard distinguishes six basic data profiles, based on the combination of service types A, B or C with mobility class 1 or 2, resulting in the four profile names A/B.1 , A/B.2 , C.1 and C.2. A specific implementation can be compliant to one or a combination of these profiles. Possible combinations are A/B.2 with C.2 or A/B.1 with C.1.

The service type C is a superset of the service types A and B, meaning that any implementation supporting service type C, implicitly also supports service type A or B. Service types A and B are fully inter operable, and only differ in performance. The relationship between these service types is shown in figure 4.1.1.

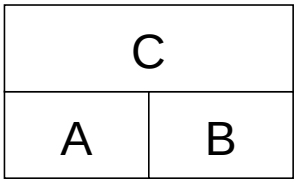



**Figure 4.1.1: Relation between service types**

These data profiles form the core standard for DECT data applications; they may either be used as basis for other data profiles, or for direct interworking to other networks. The application service type determines which of the interworking functions has to be selected (from annexes C and D). The application mobility requirements determine whether a C-plane is needed or not. The application performance requirements determine the choice of basic service (A or B).

The relation between service types, mobility class and the profile configuration is shown in figure 4.1.2.

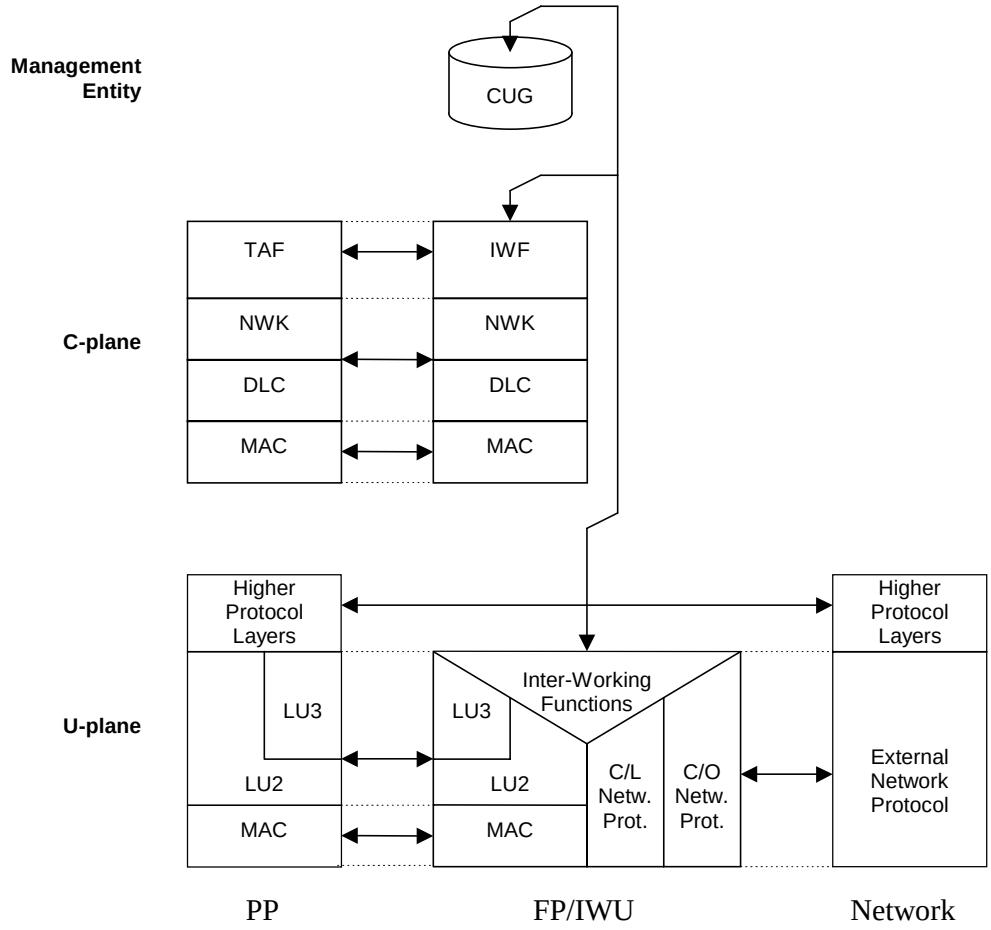



**Figure 4.1.2: Reference configuration for DPRS profiles**

Service Types A and B offer a generic Frame Relay (FREL) U-plane service, using LU2. Service type A supports only symmetrical single-bearer connections. Service type B adds MAC support for multi-bearer and asymmetric connections. Service types A and B are intended to be used mainly for the transport of connection-less services, or for connection-oriented services that incorporate its own data link control layer.

Interworking conventions for this service type are defined in annex D.

Service Type C offers a data link control U-plane service using LU3 (LAPU) as addition to the FREL service of type A or B. LAPU provides flow control, additional ARQ and in-band user signalling. Service type C is intended to be used mainly for the transport of connection oriented services that require a data link control layer.

Interworking conventions for this service type are defined in annex C.

Mobility Class 1 excludes call-setup procedures, and therefore in this case the virtual circuit is implicitly and permanently present. These applications are intended for Closed User Groups (CUG). This means that PPs are statically registered within the FP, and service parameters are configured as defined in annex F.

The service offered is analogous to a permanent virtual circuit (PVC), i.e. DECT is required to provide an appropriate bearer between the PT terminal adapter function (TAF) and the FT Interworking unit (IWU), where Interworking is performed with a network that is either connectionless or uses application-based in-band signalling for connection control.

Mobility Class 2 offers a full DECT C-plane, including call-setup procedures, mobility management and service negotiation. In this case the virtual circuit is only present within the context of a call. The applications are intended for private and public roaming, and service parameters are negotiated during the call-setup phase, and may be changed during the active phase of the call.

For all resulting profiles specific interworking conventions determine the interaction between DECT C-plane and U-plane on one side, and the external network protocol on the other side.

## 4.2 Service objectives

The service objectives for the types A/B and C are as outlined in ETR 043 [17]:

**Table 4.2.1: Service objectives**

| Offered services | A / B | C |
|---|---|---|
| Point-to-point Service Data Unit (SDU) transfer PP-FP | Yes | Yes |
| Point-to-point SDU transfer FP-PP | Yes | Yes |
| Point-to-multipoint SDU transfer FP-PP | Optional | No |
| Encryption | Optional | Optional |
| In-band user control signalling | No | Yes |
| Data streaming | No | Yes |
| PAD and BPAD support | No | Yes |
| Service change and negotiation | No | Optional |
| Maximum supported SDU size | > = 1528 octets | > = 1526 octets |

The performance is determined by the basic service types A and B; service type C inherits the performance objectives of the basic service it is built upon.

**Table 4.2.2: Performance objectives**

| Performance | A | B |
|---|---|---|
| Maximum sustainable unidirectional throughput | 24 kbits/s net | 552 kbits/s net |
| Maximum sustainable full bi-directional throughput | 24 kbits/s net | 288 kbits/s net |
| Establishment of PT to FT link (average) | <50 ms average | <50 ms average |
| Establishment of FT to PT link (average) | <160 ms average | <50 ms average |
| Undetected bit error ratio | <10-10 | <10-10 |
| Uncorrected error ratio | <10-7 | <10-7 |

## 4.3 Service definitions

For the purposes of the present document the following service definitions apply.

### 4.3.1 PHL service definitions

See PHL requirements in clause 5.

### 4.3.2 MAC service definitions

**general [M.1]:** a set of basic requirements regarding data formats, multiplexing, CRC usage, scanning and locking, which are prerequisites to communication between peer MAC entities.

**non continuous broadcast [M.2]:** a simplex service from FT to PT which allow PTs to acquire more Q-channel information (i.e. TARI) and to request a new dummy bearer.

**continuous broadcast [M.3]:** a simplex service from FT to PT whereby the FT maintains at least one bearer with continuous transmissions. The PT can use the information carried in this bearer to lock to the FT and to obtain knowledge about the FT.

**paging broadcast [M.4]:** a service whereby the identities of specific PTs can be broadcast by the FT. This service is normally used by the FT to request a specific PT to set up a link to the FT.

**higher layer connectionless U-plane point-to-multipoint service [M.5]:** a simplex service from FT to PT whereby the FT transfers a single SDU of U-plane data from one source point to one (or more) destination points. The service uses the SIP logical channel: the SIP information is protected by MAC layer error detection procedure based on 16 bit CRCs.

**advanced single bearer connection [M.6]:** a service providing connection between FT and PT consisting of one duplex bearer. Advanced connections have a common connection number, called Exchanged Connection Number (ECN) which is assigned by the ME. Therefore, more than one advanced connection may exist between a PT and one FT. The service includes the means for setting-up and releasing the required bearer.

**advanced multibearer connection [M.7]:** a service providing connection between FT and PT consisting of one or more duplex bearers. Advanced connections have a common connection number, called Exchanged Connection Number (ECN) which is assigned by the ME. Therefore, more than one advanced connection may exist between a PT and one FT. The service includes the means for setting-up and releasing the required bearer(s).

**advanced asymmetric connection [M.8]:** a MAC connection that offers an asymmetric I-channel service to the DLC. An asymmetric MAC connection need to establish at least one double simplex bearer.

**connection modification [M.9]:** a service which allows to change the bandwidth of a connection (i.e. the number of required bearer):therefore a connection modification may switch the transmission direction of a double simplex bearer, a single bearer to a multibearer connection, an asymmetric connection to a symmetric connection and viceversa.

**Ip_error_correction service [M.10]:** the IP information is protected by MAC layer procedures based on a modulo 2 retransmission scheme. The DLC layer requests the maximum allowed transmission time. Due to the retransmission mechanism, the effective throughput is variable.

**encryption activation [M.11]:** a service providing means for enabling the encryption whereby on demand all higher layer data is transferred across the DECT air interface in an encrypted form. Always initiated by the PT. A connection release automatically disables ciphering.

**encryption deactivation [M.12]:** a service providing means for disabling the encryption whereby on demand all higher layer data is transferred across the DECT air interface in an encrypted form. A connection release automatically disables ciphering.

**quality control [M.13]:** provides means for monitoring and controlling the radio link quality.

**physical channel selection [M.14]:** defines the policy for the dynamic selection of a channel, caused by the fact that an old one has to be changed or a new one is needed. Detection of bad quality on the physical channel in use (i.e. due to weak signals or interference), detection of a RFP with a stronger signal than the one of the own RFP, detection of local congestion are all criteria that can be used to select the channel.

**fast connection set up [M.15]:** a connection setup initiated by a FT, without a previous paging attempt.

**bearer replacement [M.16]:** bearer replacement is defined to be the case where an old bearer is replaced with a new bearer that has a different LBN. For bearer replacement the new bearer contains independent packet numbering for IP MOD-2 protected data. The data on a new bearer may be different data or may (still) be a duplicate of the data on the old bearer.

**CS higher layer signalling [M.17]:** a low rate connection oriented data service with ARQ using the CS channel to transfer higher layer signalling data.

**CF higher layer signalling [M.18]:** a high rate connection oriented data service with ARQ using the CF channel to transfer higher layer signalling data.

**Secondary Access Rights Identity (SARI) support [M.19]:** the ability to support, in addition to the primary Access Rights Identity (ARI), secondary ARIs that the FT broadcasts less frequently than PARIs. These may be used to reflect an inter-operators agreement allowing a portable to access more than one operator or services through FT.

### 4.3.3 DLC service definitions

**LU2 Frame RELay service (FREL) [D.1]:** a frame relay service accessed through the LU2 SAP. The LU2 shall operate on a generic field of user data that shall be transferred into and out of the DLC U-plane as a single SDU. This SDU is assumed to contain one external frame, but the operation of LU2 shall be independent of the actual contents of the SDU. LU2 shall provide mechanisms that offer reliable transport of the generic SDUs, and that preserve the SDU boundaries.

**FU6a [D.2]:** offers a defined fixed length frame structure and buffering functions for transmission of U-plane data to the MAC layer (at the transmit side) or accepts data from the MAC layer (at the receiving side) on demand and with minimum delay. Frame type FU6a is used for the forward path of unidirectional links.

**FU6b [D.3]:** offers a defined fixed length frame structure and buffering functions for transmission of higher layer U-plane control data from the DLC to the MAC layer (at the transmit side) or accepts data from the MAC layer (at the receiving side) on demand and with minimum delay. Used to carry acknowledgements for asymmetric connections. Frame type FU6b is used for the backward (control) path of unidirectional links: it contains a list of receive sequence numbers for the forward link.

**Data Link Service (LAPC+Lc) class A service [D.4]:** a single frame acknowledged C-plane data link service providing a data link between one FT and one PT. The higher layer information is segmented (if necessary) and transmitted in numbered frames. The Lc service, upon which LAPC is defined, provides frame delimiting, transparency and frame synchronization.

**Data Link Service (LAPC+Lc) class B service [D.5]:** a multiframe acknowledged C-plane data link service providing a data link between one FT and one PT. The higher layer information is segmented (if necessary) and transmitted in numbered frames. The Lc service, upon which LAPC is defined, provides frame delimiting, transparency and frame synchronization.

**Lc Service [D.6]:** a service providing channel dependant fragmentation, recombination, frame synchronization and frame delimiting transparency. Fragmentation is obtained by means of dividing a LAPC data unit into more than one service data units for delivery to the MAC layer C logical channel, whilst recombination is obtained by means of joining several service units received from the MAC layer C logical channel into a LAPC data unit.

**broadcast Lb service [D.7]:** a simplex point-to-multipoint transmission using simple fixed length DLC frames providing a restricted broadcast service in direction FP to PP(s).

**intra-cell voluntary connection handover [D.8]:** internal handover process provided and initiated by the DLC layer (as a result of a particular policy, implementers dependent, application on link management. E.g. continued poor quality of service from the MAC layer), whereby one set of DLC entities (C-plane and U-plane) can re-route data from one MAC connection to a second new MAC connection in the domain of the same cell, while maintaining the service provided to the NWK layer.

**intercell voluntary connection handover [D.9]:** internal handover process provided and initiated by the DLC layer (as a result of a particular policy, implementers dependent, application on link management. E.g. continued poor quality of service from the MAC layer), whereby one set of DLC entities (C-plane and U-plane) can re-route data from one MAC connection to a second new MAC connection not in the domain of the same cell, while maintaining the service provided to the NWK layer.

**encryption activation [D.10]:** transporting the NWK layer encryption request and the cipher key to the MAC layer, thereby enabling the encryption process in the MAC layer.

**encryption deactivation [D.11]:** transporting the NWK layer encryption deactivation request to the MAC layer, thereby disabling the encryption process in the MAC layer.

**LU3 (LAPU) Frame SWItching service (SWI) [D.12]:** a multiframe acknowledged U-plane data link service providing a data link between one FT and one PT. The higher layer information is segmented (if necessary) and transmitted in numbered frames. The LU2 service, upon which LAPU is defined, provides frame delimiting, transparency and frame synchronization.

### 4.3.4 NWK feature definitions

**outgoing call [N.1]:** a call initiated at a DECT PP.

**off-hook [N.2]:** the ability to indicate the action of going off-hook, e.g. to start call set-up or accept a call.

**on-hook (FULL Release) [N.3]:** the ability to indicate the action of going on-hook (e.g. to terminate a call) and fully release the radio resource.

**dialled digits (basic) [N.4]:** the capability to dial digits 0-9, *, #.

**register recall [N.5]:** The ability of the PP to request the invocation of the supplementary service "register recall" over the DECT interface and the ability of the FP to transmit the request to the local network. Register recall means to seize a register (with dial tone) to permit input of further digits or other action.

**go to DTMF signalling (defined tone length) [N.6]:** go to DTMF signalling with defined tone length.

**pause (dialling pause) [N.7]:** the ability to generate or indicate an dialling pause, e.g. to await further dial tone.

**incoming call [N.8]:** a call received at a DECT PP.

**authentication of PP [N.9]:** the process by which the identity of a DECT PP is checked by the FP.

**authentication of user [N.10]:** the process by which the identity of a user of a DECT PP is checked by the FP. The User Personal Identification (UPI), a personal identification of 0 to 8 digits, manually entered by the user, is used for user authentication.

**location registration [N.11]:** a facility whereby a PP can be registered with a FP or a cluster of FPs such that incoming calls, radio pages or messages may be routed to it.

**on-air key allocation [N.12]:** the capability to transform Authentication Code (AC) into User Authentication Key (UAK) using the key allocation procedure.

**identification of PP [N.13]:** the ability for the FP to request and PP to provide specific identification parameters.

**service class indication/assignment [N.14]:** assignment by the FP to PP of the service class and indication to the FP by the PP of the contents of its service class.

**alerting [N.15]:** activates or deactivates alerting at the PP using any appropriate indication.

**ZAP [N.16]:** the ability first to assign and then to re-program the account data held in the PP so that access rights may be suspended subject to the conditions set by the service provider being met, coupled with the ability to re-program the account data again to reinstate access rights once these conditions have been met. One ZAP field shall be provided per account field. The PP has the right to authenticate the FP prior to the execution of ZAP suspend.

**encryption activation FT initiated [N.17]:** the activation of the encryption process requested by FT.

**subscription registration procedure on-air [N.18]:** a standardized procedure for loading subscription registration data into a PP in real time over the air-interface.

**link control [N.19]:** the ability to request, accept, maintain and release a data link for the purposes of a NWK layer procedure.

**terminate access rights FT initiated [N.20]:** the ability of the FP to delete a subscription in the PP.

**partial release [N.21]:** the ability to release an established or in progress Call Control (CC) call whilst retaining the radio resource for the purpose of accessing further services.

**go to DTMF (infinite tone length) [N.22]:** go to DTMF signalling, indicating infinite DTMF tone duration.

**go to pulse [N.23]:** go to pulse (decadic) signalling.

**signalling of display characters [N.24]:** the transmission to the PP of characters to be displayed on the user's PP display (if provided).

**display control characters [N.25]:** characters sent to the PP to control the user's display in the PP (if provided). Such characters include cursor control, clear screen, home, flash, inverse video etc.

**authentication of FT [N.26]:** the process by which the identity of a FP is checked by the PP.

**encryption activation PT initiated [N.27]:** the activation of the encryption process suggested by PT. The real time start of ciphering is done in the MAC layer and is always initiated by the PT.

**encryption deactivation FT initiated [N.28]:** the deactivation of the encryption process requested by FT. The real time stop of ciphering is done in the MAC layer and is always initiated by the PT.

**encryption deactivation PT initiated [N.29]:** the deactivation of the encryption process suggested by PT. The real time stop of ciphering is done in the MAC layer and is always initiated by the PT.

**Calling Line Identification Presentation (CLIP) [N.30]:** the ability to provide the calling party number to the called party before accepting the call.

**internal call [N.31]:** a call between 2 users that does not make use of the local network resources. This is typically useful in residential environments.

**service call [N.32]:** a call initiated by a DECT PT for entering of FT related service and adjustment procedures in a transparent way. After having sent the service call indication, the PT behaves according to the rules of a normal call.

**in-call service change [N.33]:** the ability to modify call parameters (e.g. bandwidth, IWU parameters etc.) while the call is maintained.

**service suspension and resumption [N.34]:** the ability to suspend a call due to inactivity of the connection, and to resume it when new activity is detected.

**service negotiation [N.35]:** the ability to negotiate call parameters during call set-up.

**cost information [N.36]:** the ability to provide cost information during the call.

# 5 PHL requirements

The physical layer shall conform to EN 300 175-2 [2] and TBR 6 [10], with the following constraints:

- full slots shall be used;
- the Portable radio Termination (PT) shall be capable of operating on any one, and no more than one, physical channel in each time slot;
- all Radio Fixed Parts (RFPs) shall be capable of operating on at least any one physical channel in each time slot;
- use of the Z-field is not required by this profile.

# 6 MAC layer requirements

In case of mobility class 2, the MAC extended fixed part information message shall be used and, therefore, bit a12 of the fixed part information field shall be set to 1.

## 6.1 MAC services

For service definitions, refer to subclause 4.3.2 in the present document. Service type C includes the support for the service type it is based upon (A or B), taking into account the mobility class (table 6.1.1).

**Table 6.1.1: MAC service support for basic service types A and B, mobility class 1 and 2**

| | | Support status | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | A.1 | | A.2 | | B.1 | | B.2 | |
| Item | Name of service | PT | FT | PT | FT | PT | FT | PT | FT |
| M.1 | General | M | M | M | M | M | M | M | M |
| M.2 | Non continuous broadcast | O | O | O | O | O | O | O | O |
| M.3 | Continuous broadcast | M | M | M | M | M | M | M | M |
| M.4 | Paging broadcast | M | M | M | M | M | M | M | M |
| M.5 | Higher layer connectionless U-plane point-to-multipoint service | O | O | O | O | O | O | O | O |
| M.6 | Advanced single bearer connections | M | M | M | M | M | M | M | M |
| M.7 | Advanced multibearer connections | I | I | I | I | M | M | M | M |
| M.8 | Advanced asymmetric connections | I | I | I | I | O | O | O | O |
| M.9 | Connection modification | I | I | I | I | M | M | M | M |
| M.10 | Ip_error_correction service | M | M | M | M | M | M | M | M |
| M.11 | Encryption activation | O | O | O | O | O | O | O | O |
| M.12 | Encryption deactivation | O | O | O | O | O | O | O | O |
| M.13 | Quality control | M | M | M | M | M | M | M | M |
| M.14 | Physical channel selection | M | M | M | M | M | M | M | M |
| M.15 | Fast connection set up | M | M | M | M | M | M | M | M |
| M.16 | Bearer replacement | I | I | I | I | M | M | M | M |
| M.17 | CS higher layer signalling | I | I | M | M | I | I | M | M |
| M.18 | CF higher layer signalling | I | I | O | O | I | I | M | M |
| M.19 | SARI support | I | I | M | O | I | I | M | O |

## 6.2 MAC service to procedure mapping

**Table 6.2.1: MAC service to procedure mapping**

| | | | Status | |
|---|---|---|---|---|
| Service | Procedure | Ref. | PT | FT |
| M.1 General | | | | |
| | Bit MAPpings (MAP) | 6.2.1 | M | M |
| | Time multiplexers | 6.2.2 | M | M |
| | Scrambling | 6.2.4 | M | M |
| | Error control | 6.2.5 | M | M |
| | PP states and state transitions | 11.3 | M | M |
| | RFP idle receiver scan sequence | 11.8 | M | M |
| M.2 Non continuous broadcast | | | | |
| | Request for specific Q-channel information | 9.3.1.2 | O | O |
| | Request for a new dummy | 9.3.2 | O | O |
| | Non continuous broadcast | 9.3 | M | M |
| | Extended system information | 11.2 | M | M |
| M.3 Continuous broadcast | | | | |
| | Downlink broadcast | 9.1.1 | M | M |
| M.4 Paging broadcast | | | | |

| | | | Status | |
|---|---|---|---|---|
| **Service** | **Procedure** | **Ref.** | **PT** | **FT** |
| | Low duty cycle paging | | O | O |
| | Normal paging | 9.1.3 | M | M |
| | Fast paging | 9.1.3 | O | M |
| M.5 Higher layer connectionless U-plane point-to-multipoint service | | 5.3.2.2 | | |
| | Downlink connectionless | 9.1.2 | M | M |
| M.6 Advanced single bearer connections | | 5.6 | | |
| | C/O connection setup | 10.2 | M | M |
| | C/O connection release | 10.4 | M | M |
| | C/O bearer setup | 10.5 | M | M |
| | C/O bearer release | 10.7 | M | M |
| M.7 Advanced multibearer connections | | 5.6 | | |
| | C/O connection setup | 10.2 | M | M |
| | C/O connection release | 10.4 | M | M |
| | C/O bearer setup | 10.5 | M | M |
| | C/O bearer release | 10.7 | M | M |
| M.8 Advanced asymmetric connections | | 5.6 | | |
| | C/O connection setup | 10.2 | M | M |
| | C/O connection release | 10.4 | M | M |
| | C/O bearer setup | 10.5 | M | M |
| | C/O bearer release | 10.7 | M | M |
| M.9 Connection modification | | | | |
| | Connection modification | 10.3 | M | M |
| M.10 Ip_error_correction service | | | | |
| | MOD-2 protected I-channel operation (Ip) | 10.8.2 | M | M |
| M.11 Encryption activation | | | | |
| | Encryption process - initialization and synchronization | EN 300 175-7[7] 6.4.5 | M | M |
| | | EN 300 175-7[7] 6.4.4 | | |
| | Encryption mode control | EN 300 175-7[7] 6.4.6 | M | M |
| | Encryption (features 33 and 34) | G.3 | M | M |
| | Encryption mode control | EN 300 175-7[7] 6.4.6 | M | M |
| M.12 Encryption deactivation | | | | |
| | Encryption process - initialization and synchronization | EN 300 175-7[7] 6.4.5 | M | M |
| | | EN 300 175-7[7] 6.4.4 | | |
| | Encryption mode control | EN 300 175-7[7] 6.4.6 | M | M |
| | Encryption (features 33 and 34) | G.3 | M | M |
| | Encryption mode control | EN 300 175-7[7] 6.4.6 | M | M |
| M.13 Quality control | | | | |
| | RFPI handshake | 11.5.1 | M | M |
| | PT frequency correction procedure | 11.5.2.2 | O | O |
| | Bearer and connection quality control | 7.3.5.2 | O | O |
| M.14 Physical channel selection | | | M | M |
| | Physical channel selection | 11.4 | M | M |
| M.15 Fast connection setup | | | | |
| | C/O connection setup | 10.2 | M | M |
| | C/O connection release | 10.4 | M | M |
| | C/O bearer setup | 10.5 | M | M |

| | | | Status | |
|---|---|---|---|---|
| **Service** | **Procedure** | **Ref.** | **PT** | **FT** |
| | C/O bearer release | 10.7 | M | M |
| | PT fast setup receiver scan sequence | 11.9 | M | M |
| M.16 Bearer replacement | | | | |
| | Bearer replacement | 10.8.2.5.1 | M | M |
| M.17 CS higher layer signalling | | 5.2 | | |
| | CS channel data | 10.8 | M | M |
| | Q2 bit setting | 10.9 | M | M |
| M.18 CF higher layer signalling | | 5.2 | | |
| | CF channel data | 10.8 | M | M |
| M.19 SARI support | | 5.2 | | |
| | Downlink broadcast | 10.2 | M | M |
| NOTE: Except when stated otherwise, the reference column refers to the relevant subclause in EN 300 175-3 [3]. | | | | |

# 7 DLC layer requirements

The DLC layer shall contain two independent planes of protocol: the C-plane and the U-plane. All internal DECT protocol control shall be handled by the C-plane. All external user data and control shall be handled by the U-plane.

The DLC layer provisions shall include the following C-plane entities:

- Link Access Procedure (LAPC);
- Connection oriented link control (Lc);
- Connectionless link control(Lb);

A DLC C-plane is required only by mobility class 2 equipment. The MAC SIp Service (M.5) is not required when only service type C is supported.

## 7.1 DLC services

For service definitions, refer to subclause 4.3.3 in the present document. Service type C includes the support for the service type it is based upon (A or B), taking into account the mobility class (table 7.1.1, 7.1.2), in combination with the DLC service support defined for the C service specifically (table 7.1.2).

**Table 7.1.1: DLC service support for the service types A and B, mobility class 1 and 2**

| **A.1, B.1, A.2, B.2** | | **Status** | |
|---|---|---|---|
| **Item** | **Name of service** | **PT** | **FT** |
| D.1 | LU2 Frame RELay service (FREL) | M | M |
| D.2 | FU6a | M | M |
| D.3 | FU6b | M | M |

**Table 7.1.2: DLC service support for the service types A and B, mobility class 2**

| A.2, B.2 | | Status | |
|---|---|---|---|
| **Item** | **Name of service** | **PT** | **FT** |
| D.4 | Data Link Service (LAPC+Lc) class A service | M | M |
| D.5 | Data Link Service (LAPC+Lc) class B service | O | O |
| D.6 | Lc Frame delimiting and sequencing service | M | M |
| D.7 | Broadcast Lb service | M | M |
| D.8 | Intra-cell voluntary connection handover | M | O |
| D.9 | Inter-cell voluntary connection handover | M | O |
| D.10 | Encryption activation | M | C101 |
| D.11 | Encryption deactivation | C100 | C100 |
| NOTE: C100: if N.17 or N.27 then M else I.<br>C101: if N.28 or N.29 then M else I. | | | |

**Table 7.1.3: DLC service support for service type C**

| C.1, C.2 | | Status | |
|---|---|---|---|
| **Item** | **Name of service** | **PT** | **FT** |
| D.12 | LU3 (LAPU) Frame SWItching service (SWI) | M | M |

## 7.2 DLC service to procedure mapping

**Table 7.2.1: DLC service to procedure mapping**

| | | | Status | |
|---|---|---|---|---|
| **Service** | **Procedure** | **Ref.** | **PT** | **FT** |
| D.1 LU2 Frame RELay service (FREL) | | | | |
| | U-plane Class 1 | 14.3.3 | M | M |
| D.2 FU6a | | | | |
| | FU6a frame operation | 12.7 | M | M |
| D.3 FU6b | | | | |
| | FU6b frame operation | 12.7 | M | M |
| D.4 Data Link Service (LAPC+Lc) class A service | | | | |
| | Class A link establishment | 9.2.3.1 | M | M |
| | Class A acknowledged information transfer | 9.2.3.2, 9.2.3.3, 9.2.3.4, 9.2.3.5, 9.2.3.6 | M | M |
| | Class A link release | 9.2.3.7, 9.2.7.1.2, 10.4.2, 10.2.2 | M | M |
| | Class A link re-establishment | 9.2.3.8 | M | M |
| | General error handling | 9.2.9.1 | M | M |

| | | | Status | |
|---|---|---|---|---|
| **Service** | **Procedure** | **Ref.** | **PT** | **FT** |
| D.5 Data Link Service (LAPC+Lc) class B service | | | | |
| | Class B multiple frame establishment | 9.2.4.1, 9.2.4.2, 9.2.4.3 | M | M |
| | Class B information transfer | 9.2.5.1, 9.2.5.2, 9.2.5.3, 9.2.5.4, 9.2.5.5, 9.2.5.6, 9.2.5.7 | M | M |
| | Class B link release | 9.2.6, 9.2.7.1.2 | M | M |
| | Class B link suspension and resumption | 9.2.7.1, 9.2.7.1.1, 9.2.7.2 | M | M |
| | General error handling | 9.2.9.1, 9.2.9.2.1, 9.2.9.2.2, 9.2.9.2.3, 9.2.9.2.4 | M | M |
| D.6 Lc Frame delimiting and sequencing service | | | | |
| | Segmentation of NWK information | 5.1.1, 7.7 | M | M |
| | CS channel fragmentation and recombination | 6.1.2, 6.1.3, 6.1.4, 6.1.4.2 | M | M |
| | CF channel fragmentation and recombination | 6.1.2, 6.1.3, 6.1.4, 6.1.4.1 | O | O |
| D.7 Broadcast Lb service | | | | |
| | Normal operation | 9.4.1.1 | M | M |
| | Expedited operation | 9.4.2.1 | M | M |
| D.8 Intra-cell voluntary connection handover | | | | |
| | Class B connection handover | 9.2.7.3, 9.2.7.3.2, 9.2.7.3.3, 10.5 | C1 | C1 |
| | Class A connection handover | 9.2.1.7.2, 9.2.7.3, 9.2.7.3.1, 9.2.7.3.3, 10.5 | M | M |
| D.9 Inter-cell voluntary connection handover | | | | |
| | Class B connection handover | 9.2.7.3.2, 9.2.7.3.3 | C1 | C1 |
| | Class A connection handover | 9.2.1.7.2, 9.2.7.3, 9.2.7.3.1, 9.2.7.3.3, 10.5 | M | M |
| | Ciphering management | 10.6.1.3 | M | M |
| D.10 Encryption activation | | | | |
| | Providing a key to the MAC layer | 10.6.1 | M | M |
| | Starting the ciphering | 10.6.2 | M | M |
| | Stopping the ciphering | 10.6.2 | M | M |
| | Connection handover of ciphered connection | 10.6.3 | M | C1 |

| | | | Status | |
|---|---|---|---|---|
| **Service** | **Procedure** | **Ref.** | **PT** | **FT** |
| D.11 Encryption deactivation | | | | |
| | Stopping the ciphering | 10.6.2 | M | M |
| D.12 LU3 Frame SWItching service (FSWI) | | | | |
| | Establishing LAP-U multiple frame operation | A.5.2.2 | M | M |
| | Link maintenance and information transfer in LAP-U multiple frame operation | A.5.2.3 | M | M |
| | Release of LAP-U multiple frame operation | A.5.2.4 | M | M |
| | Re-establishment of LAP-U multiframe operation | A.5.2.5, A.5.2.5.2 | M | M |
| | Exception handling | A.5.2.6.2.1, A.5.2.6.2.2, A.5.2.6.2.3 | M | M |
| | Management procedures for LAP-U | A.6 | M | M |
| NOTE 1: C1: if D.5 then M else I.<br>NOTE 2: The reference column refers to the relevant clause in EN 300 175-4 [4], except for D.12 where it refers to the present document. | | | | |

# 8 NWK layer requirements

The NWK layer provisions shall include the following entities:

- Call Control (CC);
- Link Control Entity (LCE);
- Mobility Management (MM);
- Call Independent Supplementary Services (CISS).

A NWK layer is required only by mobility class 2 equipment. For mobility class 1 equipment configuration parameters shall be according to annex F of the present document.

Portable Part and Fixed Part CC entities will use either packet switched mode or circuit switched mode procedures. For each interworking, the appropriate interworking annex will specify which set of procedures shall be used.

CISSs required for public operations, such as charging, shall optionally be provided.

The MM requirements shall be closely aligned to the requirements of the Generic Access Profile (GAP) EN 300 444 [10].

The provisions of EN 300 175-5 [5] shall be implemented with respect to the services, procedures, messages and information elements coding listed in annexes E and F of that EN. The provisions of EN 300 175-6 [6] shall be implemented with respect to the structure and use of identities.

The Extended Higher Layer Fixed Part Information field shall be used with bit a46 and a45 indicating the support for A/B.2 and C.2 profile.

In the case that the FP is capable of supporting encryption, this shall use the DECT standard algorithm and shall be signalled to the PP by the setting of the MAC Q-channel Higher Layer Information message bit a37.

In the case that the PP is capable of supporting fast paging, this shall be signalled to the FP by the appropriate coding of the "Setup Capabilities" information element, which shall be transmitted in the "Location Request" message. In this case the FP shall always use fast paging as well as normal or low-duty cycle paging to page the PP.

The significance of the <<CONNECTION-ATTRIBUTES>> element in the {CC-SETUP} message shall conventionally signify the maximum capabilities of the sender for the requested call, and hence shall be subject to negotiation. The actual values of the connection attributes are continuously negotiated at the MAC layer. For this reason octets 4a and 4c shall not be used. Octets 5, 5a, 6, 6a codings shall be used to indicate transmit and receive capabilities respectively.

The <<IWU-ATTRIBUTES>> element shall be negotiated by the prioritized list procedure and/or the exchanged attribute procedure and/or the peer-determined procedure, as defined in EN 300 175-5 [5], subclause 15.2. Support for exchanged attribute procedures shall be mandatory and, for each interworking, the appropriate interworking annex will specify which of the other two procedure(s) may be used in addition.

The <<RELEASE-REASON>> element shall always be included in the {CC-RELEASE-COM} message. Only the given codings need be interpreted.

The release and the subsequent re-establishment of connections according to the management procedure defined for mobility class 1 in clause 9, shall be implemented by means of the Suspend/Resume procedures (EN 300 175-5 [5], subclause 9.7.4).

Should there then be an attempt to resume a cancelled transaction, through a {CC-SERVICE-CHANGE} message with the Service Change Info element coded to RESUME and an unrecognized transaction identifier, then the receiving entity shall ignore the message, as specified in EN 300 175-5 [5], subclause 17.3.2.1.

## 8.1 NWK layer features

For service definitions, refer to subclause 4.3.4 in The present document. The table contains the feature support status for mobility class 2, for all three service types A, B and C. NWK layer features are out of scope for mobility class 1.

**Table 8.1.1: NWK layer feature support for mobility class 2**

| A.2, B.2, C,2 | | Status | |
|---|---|---|---|
| **Item** | **Name of service** | **PT** | **FT** |
| N.1 | Outgoing call | M | M |
| N.2 | Off hook | M | M |
| N.3 | On hook (full release) | M | M |
| N.4 | Dialled digits (basic) | M | M |
| N.5 | Register recall | M | M |
| N.6 | Go to DTMF | M | M |
| N.7 | Pause (dialling pause) | M | M |
| N.8 | Incoming call | M | M |
| N.9 | Authentication of PP | M | M |
| N.10 | Authentication of user | M | M |
| N.11 | Location registration | M | M |
| N.12 | On air allocation | M | M |
| N.13 | Identification of PP | M | M |
| N.14 | Service class indication/assignment | M | M |
| N.15 | Alerting | M | M |
| N.16 | ZAP | M | M |
| N.17 | Encryption activation FT initiated | O | O |
| N.18 | Subscription registration procedures on-air | M | M |
| N.19 | Link control | M | M |
| N.20 | Terminate access rights TF initiated | M | M |
| N.21 | Partial release | O | O |
| N.22 | Go to DTMF (infinite tone length) | O | O |
| N.23 | Go to Pulse | O | O |
| N.24 | Signalling of display characters | O | O |
| N.25 | Display control characters | O | O |
| N.26 | Authentication of FT | O | O |
| N.27 | Encryption activation PT initiated | O | O |
| N.28 | Encryption deactivation FT initiated | O | O |
| N.29 | Encryption deactivation PT initiated | O | O |
| N.30 | Calling Line Identification Presentation (CLIP) | O | O |
| N.31 | Internal call | O | O |

| A.2, B.2, C,2 | | Status | |
|---|---|---|---|
| **Item** | **Name of service** | **PT** | **FT** |
| N.32 | Service call | O | O |
| N.33 | Service change | O | O |
| N.34 | Service suspension and resumption | M | M |
| N.35 | Service negotiation | M | M |
| N.36 | Cost information | O | O |

## 8.2 NWK layer feature to procedure mapping

**Table 8.2.1: NWK feature to procedure mapping**

| | | | Status | |
|---|---|---|---|---|
| **Feature** | **Procedure** | **Ref.** | **PT** | **FT** |
| N.1: Outgoing call | | | M | M |
| | Outgoing call request | | M | M |
| | Overlap sending | | M | O |
| | Outgoing call proceeding | | M | O |
| | Outgoing call confirmation | | M | O |
| | Outgoing call connection | | M | M |
| | Sending keypad information | | M | M |
| N.2: Off hook | | | M | M |
| | Outgoing call request | | M | M |
| | Incoming call request | | M | M |
| N.3: On hook (full release) | | | M | M |
| | Normal call release | | M | M |
| | Abnormal call release | | M | M |
| N.4: Dialled digits (basic) | | | M | M |
| | Sending keypad information | | M (note 1) | M (note 1) |
| | Sending Called Party Number (note 2) | | M (note 3) | M (note 3) |
| N.5: Register recall | | | M | O |
| | Sending keypad information | | M | M |
| N.6: Go to DTMF signalling (defined the length) | | | M | M |
| | Sending keypad information | | M | M |
| N.7: Pause (dialling pause) | | | M | O |
| | Sending keypad information | | M | M |
| N.8: Incoming call | | | M | M |
| | Incoming call request | | M | M |
| | Incoming call confirmation | | M | M |
| | PT alerting | | M | M |
| | Incoming call connection | | M | M |
| N.9: Authentication of the PP | | | M | M |
| | Authentication of PT | | M | M |
| N.10: Authentication of the user | | | M | O |
| | Authentication of user | | M | M |
| N.11: Location registration | | | M | M |
| | Location registration | | M | O |
| | Location update | | M | O |
| N.12: On air key allocation | | | M | O |
| | Key allocation | | M | M |
| N.13: Identification of PP | | | M | O |
| | Identification of PT | | M | M |
| N.14: Service class indication/assignment | | | M | M |
| | Obtaining access rights | | M | M |
| | Authentication of PT | | M | M |

| | | | Status | |
|---|---|---|---|---|
| **Feature** | **Procedure** | **Ref.** | **PT** | **FT** |
| N.15: Alerting | | | M (note 1) | M (note 1) |
| | PT alerting | | M (note 1) | M (note 1) |
| N.16: ZAP | | | M | O |
| | Obtaining access rights | | M | M |
| | Incrementing the ZAP value | | M | M |
| | Authentication of FT | | O | M |
| N.17: Encryption activation FT initiated | | | O | O |
| | Cipher-switching initiated by FT | | M | M |
| | Storing the Derived Cipher Key (DCK) | | M | M |
| N.18: Subscription registration user procedure on-air | | | M | M |
| | Obtaining access rights | | M | M |
| N.19: Link control | | | M | M |
| | Indirect FT initiated link establishment | | M | M |
| | Direct PT initiated link establishment | | M | M |
| | Link release "normal" | | M | M |
| | Link release "abnormal" | | M | M |
| | Link release "maintain" | | M | M |
| | Direct FT initiated link establishment (note 2) | | M | M |
| N.20: Terminate access rights FT initiated | | | M | O |
| | FT terminating access rights | | M | M |
| | Authentication of FT | | O | M |
| N.21: Partial release | | | O | O |
| | Partial release | | M | M |
| N.22: Go to DTMF (infinite tone length) | | | O | O |
| | Sending keypad information | | M | M |
| N.23: Go to pulse | | | O | O |
| | Sending keypad information | | M | M |
| N.24: Signalling of display characters | | | O | O |
| | Diaplay | | M | M |
| | Terminal capability indication | | M | M |
| N.25: Display control characters | | | O | O |
| | Diaplay | | M | M |
| | Terminal capability indication | | M | M |
| N.26: Authentication of FT | | | O | O |
| | Authentication of FT | | M | M |
| N.27: Encryption activation PT initiated | | | O | O |
| | Cipher-switching initiated by PT | | M | M |
| | Storing the DCK | | M | M |
| N.28: Encryption deactivation FT initiated | | | O | O |
| | Cipher-switching initiated by FT | | M | M |
| N.29: Encryption deactivation PT initiated | | | O | O |
| | Cipher-switching initiated by PT | | M | M |
| N.30: Calling Line Identification Presentation (CLIP) | | | O | O |
| | Incoming call request | | M | M |
| N.31: Internal call | | | O | O |
| | Internal call set-up | | M | M |
| | Internal call keypad | | M | O |
| N.32: Service call | | | O | O |
| | Service call set-up | | M | M |
| | Service call keypad | | M | O |

| | | | Status | |
|---|---|---|---|---|
| **Feature** | **Procedure** | **Ref.** | **PT** | **FT** |
| N.33: In-call Service change | | | M | M |
| | Bandwidth Changes (including reversals) | 9.6.2 | C6 (if multibearer M else I) | C6 (if multibearer M else I) |
| | Service re-routing | 9.6.3 | C7 (if asymmetric M else I) | C7 (if asymmetric M else I) |
| | IWU-attributes change | 9.6.1 | M (note 1) | M (note 1) |
| N.34: Service suspension and resumption | | | M | M |
| | Service suspension and resumption (circuit mode) | 9.6.4 | M (note 1) | M (note 1) |
| | Service suspension and resumption (packet mode) | 9.7.4 | M (note 3) | M (note 3) |
| N.35: Service negotiation | | | | |
| | Service negotiation | 15.2 | M (note 1) | M (note 1) |
| | Prioritized list negotiation | 15.2.2 | O | O |
| | Peer attribute negotiation | 15.2.5 | O | O |
| N.36: Cost information | | | | |
| | Cost information | 10.6.2.4 | O | O |
| NOTE 1: For circuit bearer interworking only.<br>NOTE 2: Not a GAP procedure.<br>NOTE 3: For V.24 interworking only. | | | | |

# 9 Management entity requirements

The Management Entity (ME) shall be responsible for:

- maintenance and updating of the logical associations C-plane and U-plane entities inside and among the different levels of the DECT stack: IWUs, NWK, DLC and MAC;
- management of mobility introduced with mobility class 2;
- management of link resources.

Requirements for Management Entities depend on mobility class and the type of interworking. Therefore the specific requirements for management procedures are defined as depending on the four basic profiles.

For mobility class 1 equipment the ME shall:

- contain the following procedure groups defined in EN 300 175-4 [4]:
  - MAC connection management;
  - DLC U-plane management;
  - connection handover management (optional);
  - ciphering management (optional).

For mobility class 2 equipment the ME shall:

- contain the following procedure groups defined in EN 300 175-4 [4]:
  - MAC connection management;
  - DLC C-plane management;
  - DLC U-plane management;
  - connection handover management (optional);
  - ciphering management (optional).
- contain the NWK Link Control and resources management defined in EN 300 175-5 [5] and following listed:
  - LCE, Connection Oriented link control procedures;
  - service mapping and negotiation;
  - resource management;
  - management of MM procedures;
  - call ciphering management (optional).
- support the management procedures as defined in EN 300 444 [10]:
  - management of MM procedures;
  - location registration initiation;
  - assigned individual TPUI management;
  - PMID management;
  - DCK management;
  - broadcast attributes management;
  - storage of subscription related data.

## 9.1 Link resource management

### 9.1.1 General

Some background on the meaning of the term "link"

In case of mobility class 1, there is a Permanent Virtual Circuit (PVC) which may have an active MAC connection or not. The link is controlled by the ME.

In case of mobility class 2, a link only exists within the context of an active call. The link is controlled by the higher layers, and may also have an active MAC connection or not.

The state where a link has no active MAC connection is called "suspended". The procedure to go from active to suspended is called "link suspension", and the reverse procedure is called "link resumption". The suspend and resume procedures for mobility class 1 PVCs are inherent to the service and therefore usually not explicitly named. For the sake of generality of The present document the procedures will be considered identical for both mobility classes, save for their control which is defined in subclauses 9.2 and 9.3.

Independent of mobility class, it shall be a ME decision as to when to suspend or to resume a link.

The necessity to manage the use of radio resources in the most efficient manner requires the participation of all the entities in the PP and FP. The higher layer entities are responsible for the presence or absence of the valid data at the MAC and LU2 service boundaries upon which such lower layer resource management is based. The ME shall consider that there is valid user data available to the lower layers, if a call transaction identifier exists and the call is active and not suspended, or if there are any valid LAP-C frames to transmit.

### 9.1.2 Suspend conditions

For mobility class 1 the ME in the FP shall ensure that the MAC connection is always released, together with all its bearers, if for a consecutive period of at most 5/n seconds, where n = the number of duplex plus double simplex bearers ($1 \leq n \leq 12$), no DLC-PDU has been received or sent successfully over it.

For mobility class 2, a request to suspend the call may be issued by the Interworking Functions (IWF) to the DECT NWK layer through service primitives. The ME may choose at any time to suspend the call according to implementation-specific algorithms. In any case, the ME shall suspend or release the call at least if all the following conditions are satisfied:

- the encapsulation entity in the IWF has not passed a user data packet for transmission to LAP-U for a period of 5/n seconds, where n is the number of active duplex and double simplex MAC bearers related to the LAP-U connection;
- the segmentation entity in the IWF contains no pending user data in its receiving packet assembly buffers;
- LAP-U is in an idle condition, as defined in subclause A.6.2;
- there is no peer to peer signalling procedures ongoing or pending.

A/B.2: If the ME requires a link suspension, it shall issue a MNCC_MODIFY.req primitive specifying a suspension and shall await a MNCC_MODIFY.cfm primitive. If this primitive notifies failure, the management entity need not take any action. If this primitive notifies success, it shall enter the "Link Suspended" state. If the ME receives a MNCC_MODIFY.ind primitive specifying a suspension, it shall wait until it has ceased to receive data from the U-plane and then enter the "Link Suspended" state.

### 9.1.3 Resume conditions

For mobility class 1 equipment, the ME of PP or FP shall not initiate connection establishment unless one or more DLC-PDU's are available for point-to-point transfer.

For mobility class 2 the ME of PP or FP shall not resume the call until either one of the following conditions are met:

- There is data to be sent over the U-plane;
- There is a signalling message to be send by a C-Plane entity.

A/B.2: If data is to be sent and the link is suspended then the ME shall issue a MNCC_MODIFY.req primitive, specifying link resumption, and shall await an MNCC_MODIFY.cfm primitive. If this primitive notifies success, then the ME shall enter the "Link Active" state. If the primitive notifies failure, the subsequent action of the ME shall be locally determined on the basis of the failure reason contained in the primitive. If the ME receives an MNCC_MODIFY.ind primitive, it shall enter the "Link Active" state.

## 9.2 Link establishment

For mobility class 1 equipment, link establishment shall be initiated by the ME.

For mobility class 2 equipment, link establishment shall be done according to the specifications in EN 300 444 [10].

### 9.2.1 PP initiated

There are no additional requirements for PP initiated link establishment.

### 9.2.2 FP initiated

For equipment of both mobility class 1 and mobility class 2, MAC connection establishment from the FP to the PP goes as follows.

The FP shall try to establish the connection using the fast setup procedure if the PP is known to be in idle-locked state with setup detection. The fast setup procedure should result in at least one setup attempt. If the PP is known not to be in idle-locked state with setup detection , then the fast setup is not required.

If the fast setup fails then the FP shall try to establish the connection using a fast page, if the PP is known to support fast page. The fast paging should result in at least one paging attempt.

If the fast paging fails or if the PP does not support fast paging then the FP tries to establish a connection with normal paging.

In cases where both the PP and the FP are capable of diversity switching, the default operation in the absence of other user intervention shall be for the FP diversity to remain in operation and for the PP to disable its diversity function.

For mobility class 1 equipment, the paging shall be initiated by the ME, by issuing a MAC_PAGE-req primitive. The SDU passed with the primitive shall be such that the contents of the paging message is as defined in EN 300 175-5 [5], subclause 8.2.1, short format message, using default TPUI, with the following exception:

- the LCE header field shall have the value 111 (Ip-error-correct).

Receipt of a paging message with a mobility class 1 TPUI indicates that the paging message should be handled by the ME. Upon receipt of a MAC-PAGE-ind primitive with the TPUI of the PP as parameter, the ME shall issue a MAC_CON-req primitive.

For mobility class 2 equipment, the normal NWK layer procedures for paging are followed according to the definitions in EN 300 444 [10]; and the only permitted changes are in the messages used, as indicated in the clauses 10, 11 and 12.

A/B.2: If data is to be sent but no link is established (the "No Link" state), the ME shall issue an MNCC_SETUP.req primitive and shall enter the "Link Requested" state. In the "Link Requested state", if the ME receives a MNCC_REJECT.ind primitive or a MNCC_RELEASE.ind primitive, it shall return to the "No Link" state. Its subsequent action shall be locally determined on the basis of the release reason contained in the primitive. In the "Link Requested" state, if the ME receives an MNCC_CONNECT.ind primitive it shall enter a "Link Active" state. Upon the receipt of a MNCC_SETUP.ind primitive, the ME shall determine that the service requested may be offered, and if so it will issue a MNCC_CONNECT.req primitive and enter the "Link Active" state. If the service cannot be supported, it will issue a MNCC_REJECT.req, indicating a release reason, and will return to the "No Link" state.

## 9.3 Link release

After the complete release of any connection, the PP shall pass to Idle-locked state with setup detection (fast scan mode), as defined in EN 300 175-3 [3], subclause 11.3.3.2. The PP shall remain in this state for at least the time specified in the parameter "Setup detection timer". During this time, the PP may accept FT initiated bearer setup using the procedure defined in EN 300 175-3 [3], subclause 10.5.1.3.2. After this time the PP's may pass to normal Idle-locked state with page detection (EN 300 175-3 [3], subclause 11.3.3.1).

For mobility class 1 equipment, the value of this parameter is stored in the PP configuration table (annex F).

For mobility class 2 equipment, the value of this parameter is set by means of the appropriate NWK message.

A/B.2: To release the link, the ME shall issue a MNCC_RELEASE.req primitive and shall then enter the "No Link" state. If the ME receives a MNCC_RELEASE.ind primitive, it shall enter the "No Link" state.

# 10 MAC layer procedures

## 10.1 General

For voice services all MAC requirements are according to EN 300 444 [10] GAP.

For MAC requirements concerning data applications the following shall apply.

The minimum instance shall only require the capability to establish and maintain single-bearer connections. The provisions of EN 300 175-3 [3] shall be implemented with respect to the services, procedures, messages and information elements coding listed in annexes C to F. The provisions of EN 300 175-6 [6] shall be implemented with respect to the structure and use of identities.

If the FP $\Rightarrow$ PP point-to-multipoint service is implemented, the MAC layer shall in addition implement the protected data connectionless downlink service $SI_P$, as defined in annex A.

# 11 DLC layer procedures

This clause specifies the DLC layer procedures, messages and information elements required in MMAP. When an MMAP device is used for 3,1 kHz telephony applications the requirements as specified in EN 300 444 [10] and other relevant standards shall apply.

This profile does not prevent any PT or FT from transmitting or receiving and processing any other DLC layer message or information element not specified in the profile. A PT or FT receiving an unsupported DLC layer message or information element which it does not recognize shall ignore it, as specified in EN 300 175-4 [4].

# 12 NWK layer procedures

This clause specifies the NWK layer procedures, messages and information elements required in MMAP. When an MMAP device is used for 3,1 kHz telephony applications the requirements as specified in EN 300 444 [10] and other relevant standards shall apply.

This profile does not prevent any PT or FT from transmitting or receiving and processing any other NWK layer message or information element not specified in the profile. A PT or FT receiving an unsupported NWK layer message or information element which it does not recognize shall ignore it, as specified in EN 300 175-5 [5], clause 17.

# Annex A (normative): Implementation of the LU3 service including LAP-U

## A.1 U-plane service characteristics

### A.1.1 General

The data link service (LAP-U) shall be accessed via the LU3 SAPs. A single class of service is defined allowing single or multiple frame acknowledged operation.

Each LAP-U instance shall provide a single data link between one fixed radio termination and one portable radio termination.

LAP-U multiple frame operation shall require both sides to support three phases of procedures:

- establishment of LAP-U multiframe operation;
- maintenance of LAP-U multiframe operation (including acknowledged information transfer); and
- release of LAP-U multiframe operation.

The complete service for one data link shall be provided by a couple of LU3 protocol entities, each one of them using the lower layer facilities provided by a single instance of the service type A or B mobility class 1.

NOTE: A PT may contain multiple instances of LAP-U and instances of A or B (refer to A.1.2 of this annex). However, in many cases a PT may only require the services of one LAP-U and one A or B instance. These single instances may support more than one user plane higher layer call.

LAP-U shall provide functions for:

- the provision and control of one data link;
- segmentation of long higher layer user information fields;
- error detection (time-out or protocol);
- error recovery; and
- flow control.

LAP-U shall use the functions by LU2 in the type A or B profile for:

- the provision of one or more data link;
- frame delimiting;
- checksum generation/checking;
- segmentation of LU3 frames into Protocol Data Units (PDUs); and
- routing of frames to/from logical channels.

### A.1.2 LAP-U type of operation

The defined class of operation supports the transfer of higher layer information across point-to-point links.

LAP-U acknowledged transfer: information shall be transmitted in numbered frames (I) that shall be acknowledged at the DLC layer. Error recovery based on retransmission of unacknowledged frames shall be defined. Multiple LAP-U links shall be allowed between a PT and a specific FT.

NOTE: LAP-U is based on the multiple frame operation of LAPC Class B link defined in EN 300 175-4 [4].

### A.1.3 U-plane Link Identifier (ULI)

Every separate instance of a LU3 entity shall be uniquely identified within one peer entity by the U-plane Link Identifier. This identifier, which is a local matter, shall remain constant for the complete duration of the data link.

### A.1.4 LU3 Service Access Points (SAP)

Each LU3 protocol entity has two SAPs:

- Connection Oriented User Data SAP (CO-SAP). This SAP is the entry point for the service of transport of user data;
- User Control Signalling Data SAP (SIG-SAP). This SAP is the entry point for the service of transport of signalling data.

The service offered by every SAP is the same, a LAP-U data link service, the only difference is the type of data transported.

## A.2 Data link service frame structure for LU3

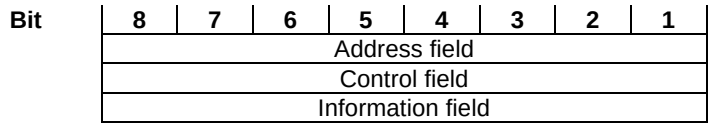



**Figure A.2.1: Frame format type FU8**

### A.2.1 General frame structure

A type FU8 frame shall contain the following fields:

- an address field of 1 octet;
- a control field of 1 octet;
- a variable length information field of 0 to 236 octets (when using Type A lower layer) or 1526 octets (when using Type B lower layer).

NOTE: The length of information field is given by the context (i.e. it is an information given by the LU2 service).

## A.2.2 LU2 frame delimiting and transparency

The begin and the end of every LAP-U frames (FU8) shall be aligned respectively with the begin and the end of a single LU2 SDU (LU2 SDU is the SDU defined in subclause 11.3.1 of EN 300 175-4 [4]).

Frame delimiting shall be provided by a combination of the MAC layer and the DLC layer LU2/FU6 entity.

NOTE: The MAC layer is expected to provide a reliable connection-orientated service, with a residual PDU error rate better than 10-4. The term PDU is kept from definition of LU2 service in subclause 11.3.1 of EN 300 175-4 [4].

## A.2.3 Transmission order

The physical transmission order shall be controlled by the MAC layer controlled by the LU2 instance used by the LU3.

NOTE 1: The use of multibearer MAC connections will mean that PDUs will not necessarily be received in the order they were sent.

The logical transmission order, that is the order in which data issued by IWU are treated by the LAP-U, is defined hereinafter in this subclause.

The order of submission of data by the IWU to the SAPs, shall be maintained across the SAPs.

NOTE 2: Therefore, if SDUa arrives to SAP before SDUb arrives to the other SAP, than SDUa should be transmitted before SDUb. At the receiving site, SDUa should be released to IWU before the SDUb.

Figure A.2.3.1 represents the flow of data; the two queues are not part of the standard but are drawn in order to explicate the sequencing of data distribution in both directions.

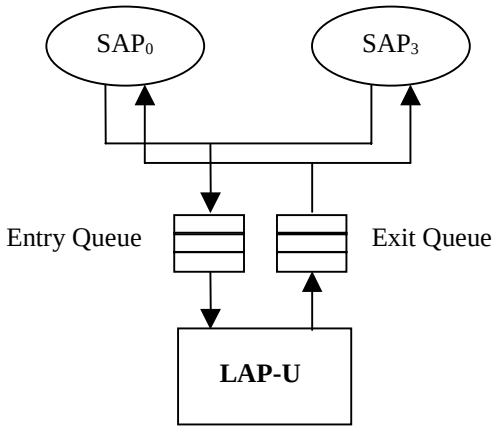



**Figure A.2.3.1: SDU data flow**

## A.2.4 Invalid frames

An invalid data link frame shall be a frame that contains one or more of the following faults:

- contains a checksum error; or
- contains an undefined Address field (subclause A.3.6 of this annex);
- contains an undefined Control field (subclause A.3.6 of this annex).

Invalid frames shall be handled using the procedures defined in subclause A.5.2.6 of this annex.

# A.3 Elements of procedures and formats of fields for U-plane peer to peer communication

## A.3.1 General

The "elements of procedure" define the commands and responses that shall be used to provide a single U-plane data link. Multiple instances of U-plane data links may exist at the same time, but these instances shall operate independently. The elements of procedure (and the related procedures described in subclause A.5 of this annex) shall only consider the operation of a single data link instance.

The "formats of fields" define the detailed coding of bits within each field of a type FU8 frame. Unless otherwise stated, all fields shall be coded according to the natural binary code. The resulting value shall be arranged with the most significant bit (msb) in the highest numbered bit position:

## A.3.2 Address field formats

| Bit: | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|---|---|
| | NLF | Spare | | M | SAPI | | C/R | RES |

**Figure A.3.2.1: Address field format**

where:

- C/R: Command/Response bit;
- SAPI: Service Access Point Identifier;
- NLF: New Link Flag;
- M: More;
- RES: REServed;
- Spare not used.

## A.3.3 Address field parameters

### A.3.3.1 Reserved bit (RES)

This bit shall be set to "1".

NOTE: This bit shall be reserved for possible use as an extended address bit. Refer to clause 7 of EN 300 175-4 [4].

### A.3.3.2 Command Response bit (C/R)

The C/R bit shall identify a frame as either a command or a response. The PT side shall send commands with C/R set to "0" and responses with C/R set to "1". The FT side shall do the opposite. Refer to clause 7 of EN 300 175-4 [4].

### A.3.3.3 SAPI field

The SAPI shall identify the higher layer SAP that is associated with each frame. There shall be a 1 to 1 correspondence between the SAP identities at both ends of the link for each peer-to-peer data link:

- SAPI = "0": CO-SAP connection oriented user data;
- SAPI = "3": SIG-SAP user control signalling data;
- All other values reserved.

### A.3.3.4 New Link Flag bit (NLF)

In both directions, this bit shall have the same meaning:

- NLF = "1": Flag set;
- NLF = "0": Flag cleared.

### A.3.3.5 More data bit; M

The more data bit, M, shall be used to indicate segmentation of higher layer user data messages into DLC frames.

M = "1" shall indicate that the information field only contains part of a higher layer user message - there is more to follow.

M = "0" shall indicate one of two things:

- that the information field contains a complete higher layer user message, provided that the M bit of the previous numbered information (I) frame was also set to "0";
- that the information field contains the last segment of a higher layer user message, provided that the M bit of the previous numbered information (I) frame was set to "1".

When the M bit is set to "1", the information field should contain the maximum number of octets.

NOTE: This rule only recommends that each frame contains the maximum amount of IWU information.

In all frames other than numbered information (I) frames the M bit shall be set to "0".

### A.3.3.6 U-plane Link Identifier (ULI)

U-plane Link Identifier (ULI): the U-plane Link Identifier shall uniquely identify each LAP-U instance within the FT and within the PT. For LAP-U, the ULI shall be identical to the Advanced MAC Connection Identifier (AMCI), refer to ETS 300 175-4 [4] subclause 10.2.4. U-plane Link MAC Endpoint Identifier (ULMEI): the U-plane link MAC endpoint identifier (ULMEI) shall uniquely identify the endpoint within one of the MAC layer MC-SAPs. This shall be a local matter, and different ULMEIs may be used in the PT and the FT. The ULMEI should be formed by the combination of two components:

- ULMEI = SAPI + ULI;

where:

- SAPI: SAP Identifier (subclause A.3.3.3 of this annex).

Every service provided by each separate instance of LAP-U entity shall be uniquely identified by the ULEI (subclause 8.4.1 of EN 300 175-4 [4]). The ULEI, which is assigned and used by the interworking unit, should be equal to ULMEI.

### A.3.3.7 Spare bits (Spare)

Left for future uses they shall be set to "00".

## A.3.4 Control field formats

The control field formats and parameters shall be identical to those defined for the C-plane, therefore subclauses 7.4 and 7.5 of EN 300 175-4 [4] shall apply, with following modifications.

**Table A.3.4.1: Modifications to base standard requirement for Control Field**

| EN 300 175-4 [4] | | Modifications |
|---|---|---|
| 7.5.2.1 | Modulus | The modulus of the frame sequence equals 8 and the sequence numbers shall cycle through the entire range, 0 to 7. No link classes are defined. |
| 7.5.2.2 | Send state Variable V(S) | The window size (k) is a value from 1 to 7. Refer to subclauses B.2 and A.5.2.2.1 for its set up. No link classes are defined. |

## A.3.5 Checksum field parameters

The checksum being a matter of the LU2 entity, no additional parameters are required.

## A.3.6 Commands and responses

The following commands and responses declared here shall be supported by each user data link. For each command and response, the definition below shall apply.

**Table A.3.6.1: LAP-U specific commands and responses**

| Format | Command | Response | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| I | I<br>Numbered Information | | N(R) | | | P | N(S) | | | 0 |
| S | RR<br>Receive Ready | RR<br>Receive Ready | N(R) | | | P/F | 0 | 0 | 0 | 1 |
| | RNR<br>Receive Not Ready | RNR<br>Receive Not Ready | N(R) | | | P/F | 0 | 1 | 0 | 1 |
| | REJ<br>Reject | REJ<br>Reject | N(R) | | | P/F | 1 | 0 | 0 | 1 |
| U | SABM<br>Set Async Bal Mode | | 0 | 0 | 1 | P | 1 | 1 | 1 | 1 |
| | | UA<br>Unnumbered ACK | 0 | 1 | 1 | F | 0 | 0 | 1 | 1 |
| NOTE: S and U bit are defined in subclause 7.4 of EN 300 175-4 [4]. | | | | | | | | | | |

Any undefined encoding of the S bits and the U bits are "invalid" and shall be handled using the procedures defined in subclause A.5.2.6 of this annex.

### A.3.6.1 Information (I) command

The information (I) command shall be used to transfer sequentially numbered frames, which contain IWU information fields, across one DLC LAP-U link.

The I command shall also be used to acknowledge previously received I-frames up to and including N(R)-1, as defined in clause A.5.

### A.3.6.2 Receive Ready (RR) command/response

The Receive Ready (RR) frame shall be used by a LAP-U entity to:

- indicate it is ready to receive an I-frame;
- acknowledge previously received I-frames up to and including N(R)-1, as defined in clause A.5;
- clear a possible busy condition that was indicated by an earlier RNR frame between the same LAP-U entities.

In addition to indicating the status of a LAP-U entity, the RR command may be used by a LAP-U entity to ask for the status of its peer entity by setting the P bit to "1".

### A.3.6.3 Receive Not Ready (RNR) command/response

The receive not ready frame shall be used by a LAP-U entity to:

- indicate a busy condition, that is, a temporary inability to accept additional I-frames;
- acknowledge previously received I-frames up to and including N(R)-1, as defined in clause A.5.

In addition to indicating the status of a LAP-U entity, the RNR command may be used by a LAP-U entity to ask for the status of its peer entity by setting the P bit to "1".

No information field shall be allowed as part of a RNR frame.

### A.3.6.4 REJect (REJ) command/response

The reject (REJ) frame shall be used by a LAP-U entity to set an exception condition that requests retransmission of I-frames starting with the frame numbered N(R). The REJ frame shall acknowledge I-frames numbered up to and including N(R)-1. The retransmitted frames shall be transmitted before any new I-frames (I-frames pending initial transmission) are transmitted.

Only one REJ exception condition shall be established at a time for a given direction of information transfer. A REJ exception condition shall be cleared upon receipt of an I-frame with an N(S) equal to the N(R) of the REJ frame.

The transmission of an REJ frame shall also indicate the clearance of any busy condition in the sending LAP-U entity that was reported by the earlier transmission of an RNR frame by the same LAP-U entity.

In addition to indicating the status of a LAP-U entity, the REJ command may be used by a LAP-U entity to ask for the status of its peer entity by setting the P bit to "1".

No information field shall be permitted in a REJ frame.

### A.3.6.5 Set Asynchronous Balanced Mode (SABM) command

The set asynchronous balanced mode command shall be used to re-establish LAP-U operation.

The receiving LAP-U entity shall confirm acceptance of the SABM command by transmitting a UA response at the first opportunity. Upon accepting the SABM command, the entity shall set the variables V(S), V(A), V(R) and the retransmission counter to 0.

Transmission of a SABM command shall indicate the clearance of a busy condition that was reported by the earlier transmission of an RNR frame by that same LAP-U entity.

Previously transmitted I-frames, that are unacknowledged when the SABM command is actioned, shall remain unacknowledged and shall be discarded. It is the responsibility of the higher layer (IWU) or the management entity to recover from this possible loss of I-frames.

No information field shall be allowed as part of a SABM frame.

### A.3.6.6 Unnumbered Acknowledgement (UA) response

The unnumbered acknowledgement response shall be used by a DLC entity to acknowledge the receipt and acceptance of the mode setting command, SABM.

The transmission of a UA response shall also indicates the clearance of a busy condition that was reported by the earlier transmission of an RNR frame by that same LAP-U entity.

No information field shall be permitted in a UA response.

## A.4 Primitives for the LU3 service

The following primitives have been declared for LU3 operation.

These primitives are defined only for the purpose of describing layer-to-layer interactions. The primitives are defined as an abstract list of parameters, and their concrete realization may vary between implementations. No formal testing of primitives is intended.

DLU-LU3_DTR{req,ind}

| Parameter | REQ | CFM | IND | RES |
|---|---|---|---|---|
| U-plane Link Endpoint Identifier (ULEI) | A | | A | |
| Stop/Go flag | A | | A | |
| A: Always.<br>O: Optional.<br>N: Not allowed. | | | | |

Parameter values:

- ULEI = local matter, refer to A.3.3.6;
- Stop/Go flag = {GO, STOP};
- DLU-LU3_DATA{req,ind}.

| Parameter | REQ | CFM | IND | RES |
|---|---|---|---|---|
| U-plane Link Endpoint Identifier (ULEI) | A | | A | |
| Message unit | A | | A | |
| Message unit length | A | | A | |
| A: Always.<br>O: Optional.<br>N: Not allowed. | | | | |

Parameter values:

- ULEI = local matter, refer to A.3.3.6.

# A.5 U-plane peer to peer procedures

## A.5.1 General

The elements of procedure, which shall apply are:

- SABM command;
- UA response;
- RR command or response;
- RNR command or response;
- REJ command or response;
- I command.

LAP-U acknowledged transfer is the operating class for U-plane connection oriented links. This class shall be immediately supported whenever a connection-oriented link is instanced. LAP-U supports both single and multiple frame operation.

## A.5.2 Point to point acknowledged operation

### A.5.2.1 Procedure for the use of the P/F bit in LAP-U acknowledged information transfer

A LAP-U entity receiving a SABM, RR, RNR, REJ or I-frame with the P bit set to "1" shall set the F bit to "1" in the next response frame that it transmits, as defined below.

**Table A.5.2.1.1: Immediate response operation of P/F bit**

| Command received with P bit = "1" | response transmitted with F bit = "1" |
|---|---|
| SABM | UA |
| I, RR, RNR, REJ | RR, RNR, REJ |

### A.5.2.2 Establishing LAP-U multiple frame operation

#### A.5.2.2.1 Overview

This subclause describes the LU3 establishment procedures, whereby a single point-to-point LAP-U link suitable for LAP-U multiple frame operation is established between two peer entities.

Refer to EN 300 175-4 [4] subclause 7.5.2 for definitions of multiple frame variables and sequence numbers.

The sequence numbers defined for LU3 are unrelated to those used by LU2.

During establishment of LAP-U multiple frame operation, the maximum number of outstanding I-frames (the window size) shall be set to "1" for both directions. Once in the "active" state, the maximum number of outstanding I-frames (k) shall be set either to the value negotiated by network layer CC set up procedures or to the lower of the values contained in fixed and portable part configuration tables.

All Lower Layer Management Entity (LLME) initiated establishment procedures also imply the discarding of all outstanding DLU-LU3_DATA.req primitives and all queued I-frames.

A subsequent LAP-U re-establishment procedure is allowed at any time using a SABM frame that has the NLF bit set. Successful re-establishment causes the sequence numbers to be re-initialized at both ends. This procedure is described in subclause A.5.2.5 of this annex.

Values negotiated by subsequent NWK layer CC procedures can be put into effect by either the link establishment or link re-establishment procedures.

#### A.5.2.2.2 LAP-U multiple frame establishment procedures

Normal establishment is initiated by a LAP-U entity, upon an LLME procedure requesting a LAP-U operation. This LLME operation shall define the ULMEI to be used.

The LAP-U entity shall respond to the initiation by setting the sequence variables V(S) V(R) and V(A) to "0" and transmitting an I-command frame, with the NLF bit set to "1".

All existing exception conditions shall be cleared, the retransmission counter shall be reset and timer <DLU.02> shall be started.

If the responding LAP-U entity is able to accept the request, it shall:

- set the sequence variables V(S) and V(A) to "0";
- set the sequence variable V(R) to "1"; and
- transmit a RR response frame with the NLF bit set to "1".

It shall clear all existing exception conditions, and the retransmission counter shall be reset. It shall then enter the "active" state.

Upon receipt of the RR response with the NLF bit set to "1", the originator of the I command shall:

- reset timer <DLU.02>;
- enter the "active" state; and
- inform the LLME of establishment success.

An RR response with the NLF bit set to "0" shall be ignored.

If timer <DLU.02> expires before a RR response with the NLF bit set to "1" is received, the LAP-U entity shall:

- if the value of the retransmission counter is less than N250:
  - retransmit the I command as above;
  - add one to the retransmission counter; and
  - restart timer <DLU.02>.
- if the value of the retransmission counter is equal to N250:
  - report establishment failure to the LLME;
  - discard all outstanding I-frames; and
  - remain in the "establish" state.

### A.5.2.3 Link maintenance and information transfer in LAP-U multiple frame operation

When a LAP-U entity has entered the "active" state, as a result of successful LAP-U establishment, I-frames and S-frames may be transmitted according to the procedures described in this subclause.

NOTE 1: If a LAP-U link re-establishment occurs, this may cause duplication or loss of IWU messages, since the procedure ignores the possible existence of unacknowledged I-frames.

If the LAP-U has previously issued a DLU-LU3_DTR-ind primitive with the stop/go flag set to "GO" then the IWF may transfer data to the LAP-U. The LAP-U may halt this process at any time by issuing a DLU-LU3_DTR-ind primitive with the stop/go flag set to "STOP".

NOTE 2: The arrival of a DLU-LU3_DTR-ind primitive shall cause all previous DLU-LU3_DTR-ind primitives to be discarded.

Information received by the LAP-U entity from IWU by means of DLU-LU3_DATA-req primitive shall be segmented (if necessary) and the resulting segments shall be transmitted in a series of one or more I-frames. At the destination LAP-U entity, a complete message shall be reassembled from a series of received I-frames, and the complete message shall be delivered to the network layer in DLU-LU3_DATA-ind primitive, provided that the IWF has previously issued a DLU-LU3_DTR-req primitive with the stop/go flag set to "GO". The IWF may halt the transfer of data at any time by issuing DLU-LU3_DTR-req with the stop/go flag set to "STOP".

NOTE 3: The arrival of a DLU-LU3_DTR-req primitive shall cause all previous DLU-LU3_DTR-req primitives to be discarded.

The order of transmission shall be maintained as stated in subclause A.2.3 of this annex.

The procedures, which apply to the transmission and reception of each I-frame, are defined below.

NOTE 4: The term "transmission of an I-frame" refers to the delivery of a complete I-frame to the LU2 instance. The term "reception of an I-frame" refers to the receipt of an I-frame by the LAP-U from the LU2 instance.

During idle periods, the LAP-U shall not generate null frames (i.e. frames with no control purpose and with zero length information fields); transmitting of supervisory/unnumbered frames during idle periods shall be limited as much as possible.

NOTE 5: This avoids causing the MAC layer to waste connection resources.

#### A.5.2.3.1 Transmitting I-frames

For each I-frame, the control field parameters N(S) and N(R) shall be assigned the values of V(S) and V(R), respectively. V(S) shall be incremented by 1 at the end of the transmission of the I-frame.

If timer <DLU.03> is not running at the time of transmission of an I-frame, it shall be started. If timer <DLU.03> expires, the procedures defined in subclause A.5.2.3.7 of this annex shall be followed.

If V(S) is equal to V(A) plus k (where k is the maximum number of outstanding I-frames - see subclause A.5.2.2.1 of this annex), the LAP-U entity shall not transmit any new I-frames, but may retransmit an I-frame as a result of the error recovery procedures as described in subclauses A.5.2.3.4 and A.5.2.3.7 of this annex.

When the network side or user side is in the own receiver busy condition, it may still transmit I-frames, provided that a peer receiver busy condition does not exist.

NOTE: Any DLU-LU3_DATA-req primitives received whilst in the timer recovery condition shall be queued.

#### A.5.2.3.2 Receiving I-frames

Independent of a timer recovery condition, when a LAP-U entity is not in an own receiver busy condition and receives a valid I-frame whose N(S) is equal to the current V(R), the LAP-U entity shall:

- append the information field of the frame to any existing unfinished message (segment assembly);
- if the More bit value is "0" (indicating that this is the last segment of a message) it shall pass the complete message to the higher layer using the DLU-LU3_DATA-ind primitive; and
- increment by 1 its V(R) and act as indicated below.

##### A.5.2.3.2.1 P bit set to 1

If the P bit of the received I-frame was set to 1, the LAP-U entity shall respond to its peer in one of the following ways:

- if the LAP-U entity receiving the I-frame is still not in an own receiver busy condition, it shall send an RR response with the F bit set to 1;
- if the LAP-U entity receiving the I-frame enters the own receiver busy condition upon receipt of the I-frame, it shall send an RNR response with the F bit set to 1.

##### A.5.2.3.2.2 P bit set to 0

If the P bit of the received I-frame was set to 0 and:

- if the LAP-U entity is still not in an own receiver busy condition:
  - if no I-frame is available for transmission or if an I-frame is available for transmission, but a peer receiver busy condition exists, the LAP-U entity shall transmit an RR response with the F bit set to 0; or
  - if an I-frame is available for transmission and no peer receiver busy condition exists, the LAP-U entity shall transmit the I-frame with the value of N(R) set to the current value of V(R) as defined in subclause A.5.2.3.1 of this annex.
- if, on receipt of this I-frame, the LAP-U entity is now in an own receiver busy condition it shall:
  - transmit an RNR response with the F bit set to 0.

When the data link entity is in an own receiver busy condition, it shall process any received I-frame according to subclause A.5.2.3.6 of this annex.

#### A.5.2.3.3 Sending and receiving acknowledgements

##### A.5.2.3.3.1 Sending acknowledgements

Whenever a LAP-U entity transmits an I-frame or a supervisory frame, N(R) shall be set equal to V(R).

##### A.5.2.3.3.2 Receiving acknowledgements

On receipt of a valid I-frame or supervisory frame (RR, RNR or REJ), even if in the own receiver busy or timer recovery conditions, the LAP-U entity shall treat the N(R) contained in this frame as an acknowledgement for all the I-frames it has transmitted with an N(S) up to and including the received N(R)-1. V(A) shall be set to N(R). The LAP-U entity shall reset the timer <DLU.03> on receipt of a valid I-frame or supervisory frame with the N(R) higher than V(A) (i.e. when the N(R) actually acknowledges some I-frames), or an REJ-frame with an N(R) equal to V(A).

NOTE 1: If a supervisory frame with the P bit set to 1 has been transmitted and not acknowledged, timer <DLU.03> should not be reset.

NOTE 2: Upon receipt of a valid I-frame, timer <DLU.03> shall not be reset if the data link entity is in the peer receiver busy condition.

If timer <DLU.03> has been reset by the receipt of an I, RR or RNR-frame, and if there are outstanding I-frames still unacknowledged, the LAP-U entity shall restart timer <DLU.03>. If timer <DLU.03> then expires, the LAP-U entity shall follow the recovery procedure as defined in subclause A.5.2.3.7 of this annex with respect to the unacknowledged I-frames.

If timer <DLU.03> has been reset by the receipt of an REJ-frame, the LAP-U entity shall follow the retransmission procedures in subclause A.5.2.3.4 of this annex.

### A.5.2.3.4 Receiving REJ-frames

On receipt of a valid REJ-frame, the LAP-U entity shall act as follows:

- if it is not in the timer recovery condition:
  - clear any existing peer receiver busy condition;
  - set its V(S) and its V(A) to the value of the N(R) contained in the REJ-frame control field;
  - stop timer <DLU.03>;
  - if it was an REJ-command frame with the P bit set to 1, transmit an appropriate supervisory response frame (see note 2, subclause A.5.2.3.5 of this annex) with the F bit set to 1;
  - transmit the corresponding I-frame as soon as possible, as defined in subclause A.5.2.3.1 of this annex, taking into account the items 1) to 3) below in this subclause and the paragraph following items 1) to 3); and
  - notify a protocol violation to the Lower Layer Management Entity (LLME) if it was an REJ-response frame with the F bit set to 1.
- if it is in the timer recovery condition and it was an REJ-response frame with the F bit set to 1:
  - clear any existing peer receiving busy condition;
  - set its V(S) and it V(A) to the value N(R) contained in the REJ-frame control field;
  - stop timer <DLU.03>; and
  - transmit the corresponding I-frame as soon as possible, as defined in subclause A.5.2.3.1 of this annex, taking into account the items 1) to 3) below in this subclause and the paragraph following items 1) to 3).
- if it is in the timer recovery condition and it was an REJ-frame other than an REJ-response frame with the F bit set to 1:
  - clear any existing peer receiver busy condition;
  - set its V(A) to the value of the N(R) contained in the REJ-frame control field; and
  - if it was an REJ-command frame with the P bit set to 1, transmit an appropriate supervisory response frame with the F bit set to 1 (see note 2 in subclause A.5.2.3.5 of this annex).

Transmission of I-frames shall take account of the following:

- if the LAP-U entity is transmitting a supervisory frame when it receives the REJ-frame, it shall complete that transmission before commencing transmission of the requested I-frame;
- if the LAP-U entity is transmitting a SABM command or a UA response when it receives the REJ-frame, it shall ignore the request for retransmission; and
- if the LAP-U entity is not transmitting a frame when the REJ is received, it shall immediately commence (re)transmission of the requested I-frame.

All outstanding unacknowledged I-frames, commencing with the I-frame identified in the received REJ-frame, shall be retransmitted. Other I-frames not yet transmitted may be transmitted following these retransmitted I-frames.

### A.5.2.3.5 Receiving RNR-frames

After receiving a valid RNR command or response, if the LAP-U entity is not engaged in a mode-setting operation, it shall set a peer receiver busy condition and indicate this to the IWF by the DLU-LU3_DTR.ind primitive with the parameter Stop/Go flag set to "STOP" and then:

- if it was an RNR command with the P bit set to 1, it shall respond with either an RR response with the F bit set to 1 (if the LAP-U entity is not in an own receiver busy condition) or shall respond with an RNR response with the F bit set to 1 (if the LAP-U entity is in an own receiver busy condition); and

- if it was an RNR response with the F bit set to 1, any existing timer recovery condition shall be cleared and the N(R) contained in this RNR response shall be used to update V(S).

The LU3 entity shall take note of the peer receiver busy condition and not transmit any I-frames to the peer which has indicated the busy condition.

NOTE 1: The N(R) in any RR- or RNR-command frame (irrespective of the setting of the P bit) will not be used to update the V(S).

The LAP-U entity shall then:

- treat the N(R) contained in the received RNR-frame as an acknowledgement for all the I-frames that have been (re)transmitted with an N(S) up to and including N(R)-1, and set its V(A) to the value of the N(R) contained in the RNR-frame; and

- restart timer <DLU.03> unless a supervisory response frame with the F bit set to 1 is still expected.

If timer <DLU.03> expires, the LAP-U entity shall:

- if it is not yet in a timer recovery condition, enter the timer recovery condition and reset the retransmission count variable; or

- if it is already in a timer recovery condition, add one to its retransmission count variable.

The LAP-U entity shall then:

- if the value of the retransmission count variable is less than N250:

  - transmit an appropriate supervisory command (see note 2) with a P bit set to 1;

  - restart timer <DLU.03>.

- if the value of the retransmission count variable is equal to N250:

  - initiate a re-establishment procedure as defined in subclause A.5.2.5 of this annex, and indicate this to the Lower Layer Management Entity (LLME).

The LAP-U entity receiving the supervisory frame with the P bit set to 1 shall respond, at the earliest opportunity, with a supervisory response frame (see note 2) with the F bit set to 1, to indicate whether or not its own receiver busy condition still exists.

Upon receipt of the supervisory response with the F bit set to 1, the LAP-U entity shall reset timer <DLU.03>, and:

- if the response is an RR or REJ response, the peer receiver busy condition is cleared and this shall be indicated to the IWF by the DLU-LU3_DTR.ind primitive with the parameter Stop/Go flag set to "GO" and the LAP-U entity may transmit new I-frames or retransmit I-frames as defined in subclauses A.5.2.3.1 or A.5.2.3.4 of this annex, respectively; or

- if the response is an RNR response, the LAP-U entity receiving the response shall proceed according to the first paragraph of this subclause.

If a supervisory command (RR, RNR or REJ) or a supervisory response frame (RR, RNR or REJ) with the F bit set to 0 is received during the enquiry process, the LAP-U entity shall:

- if the supervisory frame is an RR- or REJ-command frame or an RR- or REJ-response frame with the F bit set to 0, clear the peer receiver busy condition, indicate this to the IWF by the DLU-LU3_DTR.ind primitive with the parameter Stop/Go flag set to "GO" and if the supervisory frame received was a command with the P bit set to 1, transmit the appropriate supervisory response frame (see note 2) with the F bit set to 1. However, the transmission or retransmission of I-frames shall not be undertaken until the appropriate supervisory response frame with the F bit set to 1 is received or until expiry of timer <DLU.03>; or

- if the supervisory frame is an RNR command frame or an RNR-response frame with the F bit set to 0, retain the peer receiver busy condition and if the supervisory frame received was an RNR command with P bit set to 1, transmit the appropriate supervisory response frame (see note 2) with the F bit set to 1.

Upon receipt of an SABM command, the LAP-U entity shall clear the peer receiver busy condition.

NOTE 2: If the LAP-U entity is not in an own receiver busy condition and is in a Reject exception condition (that is, an N(S) sequence error has been received and an REJ-frame has been transmitted, but the requested I-frame has not been received), the appropriate supervisory frame is the RR-frame.

If the LAP-U entity is not in an own receiver busy condition but is in an N(S) sequence error exception condition (that is, an N(S) sequence error has been received but an REJ-frame has not been transmitted), the appropriate supervisory frame is the REJ-frame.

If the LAP-U entity is in its own receiver busy condition, the appropriate supervisory frame is the RNR-frame.

Otherwise, the appropriate supervisory frame is the RR-frame.

#### A.5.2.3.6 LAP-U own receiver busy condition

When a LAP-U entity receives a DLU-LU3_DTR.req primitive with the Stop/Go flag parameter set to "STOP" it shall enter an own receiver busy condition and it shall transmit an RNR-frame at the earliest opportunity.

NOTE: DLU-LU3_DTR.req can be sent by LLME other than by IWF, it means that it could be sent owing to internal causes of LU3 entity.

The RNR-frame may be either:

- an RNR response with the F bit set to 0; or

- if this condition is entered on receiving a command frame with the P bit set to 1, an RNR response with the F bit set to 1; or

- if this condition is entered on expiring of timer <DLU.03>, an RNR command with the P bit set to 1.

All received I-frames with the P bit set to 0 shall be discarded, after updating V(A).

All received supervisory frames with the P/F bit set to 0 shall be processed, including updating V(A).

All received I-frames with the P bit set to 1 shall be discarded, after updating V(A). However, an RNR-response frame with the F bit set to 1 shall be transmitted.

All received supervisory frames with the P bit set to 1 shall be processed including updating V(A). An RNR response with the F bit set to 1 shall be transmitted.

When a LAP-U entity receives a DLU-LU3_DTR.req primitive with the Stop/Go flag parameter set to "GO" it shall indicate to its peer LAP-U entity the clearance of the own receiver busy condition by transmitting an RR-frame or, if a previously detected N(S) sequence error has not yet been reported, an REJ-frame with the N(R) set to the current value of V(R).

The transmission of an SABM command or a UA response (in reply to an SABM command) also indicates to the peer LAP-U entity the clearance of the own receiver busy condition.

#### A.5.2.3.7 Waiting acknowledgement

The LAP-U entity shall maintain an internal retransmission count variable. If timer <DLU.03> expires, the LAP-U entity shall:

- if it is not yet in the timer recovery condition, enter the timer recovery condition and reset the retransmission count variable; or
- if it is already in the timer recovery condition, add one to its retransmission count variable.

The LAP-U entity shall then:

- if the value of the retransmission count variable is less than N250:
  - restart timer <DLU.03>; and either
  - transmit an appropriate supervisory command (see note 2 of subclause A.5.2.3.5 of this annex) with the P bit set to 1; or
  - retransmit the last transmitted I-frame (V(S)-1) with the P bit set to 1.
- if the value of the retransmission count variable is equal to N250:
  - initiate a re-establishment procedure as defined in subclause A.5.2.5 of this annex and indicate this to the Lower Layer Management Entity (LLME).

The timer recovery condition is cleared when the LAP-U entity receives a valid supervisory frame response with the F bit set to 1. If the received supervisory frame N(R) is within the range from its current V(A) to its current V(S) inclusive, it shall set its V(S) to the value of the received N(R). Timer <DLU.03> shall be reset if the received supervisory frame response is an RR or REJ response, and then the LAP-U entity shall resume with I-frame transmission or retransmission, as appropriate. Timer <DLU.03> shall be reset and restarted if the received supervisory response is an RNR response, to proceed with the enquiry process according to subclause A.5.2.3.5 of this annex.

### A.5.2.4 Release of LAP-U multiple frame operation

Release of LAP-U operation involves the release of all the LAP-U resources. LAP-U multiple frame operation is released in response to a request from the LLME (see subclause A.6.2 of this annex).

If the LLME indicates the release mode as "normal" the LAP-U entity shall first attempt to complete transmission of all outstanding I-frames and of all outstanding DLU-LU3_DATA-req primitives before releasing the link. The LAP-U shall only initiate link release if all of this outstanding data has been successfully acknowledged.

When there is no outstanding data, the LAP-U shall initiate a link release. In this event the LAP-U entity shall return confirmation to the LLME and shall then cease operation. All further frames shall be ignored.

If the LLME indicates "abnormal" release mode, the LAP-U entity shall initiate an immediate release. All outstanding DLU-LU3_DATA-req primitives and all queued I-frames shall be discarded. Confirmation shall then be sent to the LLME. This confirmation shall indicate to the LLME whether any DLU-LU3_DATA-req primitives or I-frames were discarded or were unacknowledged.

### A.5.2.5 Re-establishment of LAP-U multiframe operation

#### A.5.2.5.1 Criteria for re-establishment

The normal criteria for re-establishing the multiple frame mode of operation are defined in this subclause by the following conditions:

- the receipt, while in the LAP-U multiple-frame mode of operation, of a SABM-frame;
- the occurrence of N250 retransmission failures while in the timer-recovery condition (see subclause A.5.2.3.7 of this annex);
- the receipt of a N(R) sequence error (see subclause A.5.2.6.2.2 of this annex).

#### A.5.2.5.2 Re-establishment procedure

In all re-establishment situations, the LAP-U entity shall follow the procedures defined below. All locally generated conditions for re-establishment will cause the transmission of the SABM.

The initiating LAP-U shall transmit a SABM-command frame, with the P bit set to "1". All existing exception conditions shall be cleared, the retransmission counter shall be reset and timer <DLU.02> shall be started. The NLF bit shall be set in this SABM-command frame.

The responding LAP-U entity shall respond to the receipt of the SABM-frame by informing the LLME. It shall then transmit a UA-response frame with the F bit set to the same binary value as the P bit in the SABM-frame. It shall clear all existing exception conditions, and the retransmission counter shall be reset. The NLF bit shall be set in this UA-response frame. The NLF bit shall then be cleared in all subsequent frames.

Upon receipt of the UA response with the F bit set to "1", the originator of the SABM command shall:

- reset timer <DLU.02>;
- set the sequence variables V(S) V(R) and V(A) to "0";
- (re)enter the "active" state; and
- inform the LLME.

In the case of LAP-U and peer initiated re-establishment, the initiating LU3 entity shall also:

- issue an indication to the lower layer management entity (LLME); and
- if V(S) > V(A) prior to re-establishment, inform the LLME and discard all I queues.

### A.5.2.6 Exception handling

#### A.5.2.6.1 General

All unexpected or unknown frames shall be discarded without notification to the sender, LLME can be informed of this action. The meaning of "unknown frames" is stated in A.2.4 of this annex.

#### A.5.2.6.2 LAP-U exception condition reporting and recovery

Exception conditions may occur as the result of MAC layer, LU2 errors or LAP-U procedural errors. The following error recovery procedures are available to effect recovery following the detection of an exception condition at LAP-U.

##### A.5.2.6.2.1 N(S) sequence error

An N(S) sequence error exception condition occurs in the receiver when a valid I-frame is received which contains an N(S) value not equal to the V(R) at the receiver. The information field of all I-frames whose N(S) does not equal V(R) shall be discarded.

NOTE: The receiver should not acknowledge (nor increment its V(R)) as a result of the I-frame causing the sequence error, nor any I-frames which may follow, until an I-frame with the correct N(S) is received.

A LU3 entity which receives one or more I-frames having sequence errors, but otherwise error-free, or subsequent supervisory frames (RR, RNR and REJ), shall use the control field information contained in the N(R) field and the P or F bit to perform LAP-U control functions (for example, to receive acknowledgement of previously transmitted I-frames and to cause the LAP-U entity to respond if the P bit is set to 1). Therefore, the retransmitted I-frame may contain an N(R) field value and P bit that are updated from and therefore different from, the ones contained in the originally transmitted I-frame.

The REJ-frame is used by a receiving LAP-U entity to initiate an exception condition recovery (retransmission) following the detection of an N(S) sequence error.

Only one REJ exception condition for a given direction of information transfer shall be established at a time.

A LAP-U entity receiving an REJ-command or response shall initiate sequential transmission (retransmission) of I-frames starting with the I-frame indicated by the N(R) contained in the REJ-frame.

An REJ exception condition is cleared when the requested I-frame is received or when a SABM command is received.

#### A.5.2.6.2.2 N(R) sequence error

An N(R) sequence error exception condition occurs in the transmitter when a valid supervisory frame or I-frame is received which contains an invalid N(R) value. A valid N(R) is one that is in the range $V(A) \leq N(R) \leq V(S)$.

Upon detection of an N(R) sequence error, the LAP-U entity shall immediately initiate the link re-establishment procedures according to subclause A.5.2.5 of this annex.

The information field contained in an I-frame, which is correct in both sequence and format, may still be delivered to IWU by means of the DLU-LU3_DATA-ind primitive.

#### A.5.2.6.2.3 Timer recovery condition

If a DLC entity, due to a transmission error, does not receive a single I-frame or the last I-frame(s) in a sequence of I-frames, it will not detect an out-of-sequence exception condition and therefore will not transmit an REJ-frame.

The LU3 entity, which transmitted the unacknowledged I-frame(s), shall take appropriate recovery action as defined in subclause A.5.2.3.7 of this annex to determine at which I-frame retransmission shall begin.

## A.6 Management procedures for LAP-U

The LLME shall be responsible for the establishment, initialization and release of LU3 entities in response to service demands either from the network layer LLME or from the inter-working function and MAC LLME, according to the mobility class support provided.

### A.6.1 LAP-U establishment

When class 2 mobility functions are used, the LLME shall invoke an instance of LU3 in accordance with service demands from the network layer LLME.

When class 1 mobility functions are used, the LLME shall invoke an instance of LU3 in response to the arrival of data from the inter-working function or in response to a connection set up indication from the MAC.

In all cases, the LLME shall perform the association of the LU3 entity with an instance of LU2, which, in turn, shall be associated with a suitable open MAC advanced connection. Following a successful association, the relevant AMCI shall be reported to the LLME.

### A.6.2 LAP-U release

When class 2 mobility functions are used, the LLME shall instruct the LU3 instance to perform a release in accordance with service demands from the network layer LLME.

When class 1 mobility functions are used, the LLME shall instruct an instance of LU3 to perform a release when the inter-working function indicates that the LAP-U is no longer required or in response to a connection release indication from the MAC.

If the LAP-U is idle, that is, it is currently not transferring data and all associated buffers are empty, then it shall release immediately. If the LAP-U is busy, that is, it is currently transferring data and/or one or more buffers contain pending data, then the LAP-U will normally attempt to complete transmission of all data prior to releasing. The LLME can force the LAP-U to release immediately, if necessary, by indicating "abnormal" release. See subclause A.5.2.4 of this annex.

In all cases, when the LLME receives confirmation of release, it shall remove all associations to LU2 links and invoke release of the lower layers.

## A.6.3 LAP-U resumption

The behaviour of LLME in the resume of a LU3 instance is the same required for the establishment, therefore the subclause A.6.1 shall apply.

## A.6.4 LAP-U suspension

The behaviour of LLME in the suspend of a LU3 instance is the same required for the release, therefore the subclause A.6.2 shall apply.

# Annex B (normative): LU3 parameters

## B.1 LAP-U timer values

<DLU.02> LAP-U establish timer:

| | | |
|---|---|---|
| FT value: | 2 seconds; | |
| PT value: | 2 seconds; | |
| Start: | a request I-frame is transmitted; | |
| Stop: | an accepting RR/RNR-frame is received. | |
| <DLU.03> | Retransmission timer: | |
| | Type A routed frames | Type B routed frames; |
| FT value: | 2,0 seconds; | 1,0 seconds; |
| PT value: | 2,0 seconds; | 1,0 seconds; |
| Start: | an I-frame is transmitted; | |
| Stop: | an acknowledgement is received for that frame. | |

## B.2 Constants

Among the constants defined in EN 300 175-4 [4] clause A.3, N250 (maximum number of retransmission of a frame) shall be used where appropriate (EN 300 175-4 [4] subclause A.3.1).

Following constants are subjected either to negotiation between the CC entities present in both peer (in case of mobility class 2) or to fixed set-up (in case of mobility class 1).

| Constant | Meaning | Ref. in the present document | Info element(s) used for negotiation | Ref. in EN 300 175-5 [5] |
|---|---|---|---|---|
| k | Window size | A.3.4 | <<WINDOW-SIZE>> | 7.7.43 |

# Annex C (normative): Interworking conventions for the LAP-U service.

## C.1 Scope of this annex

This annex defines Terminal Adaptation-Functions (TAF) and Interworking-Functions (IWF) for use in Portable Parts (PP) and Fixed Parts (FP) in order to enable transmission of character oriented or bit oriented data streams.

The underlying reference configuration is depicted in figure C.1.1:

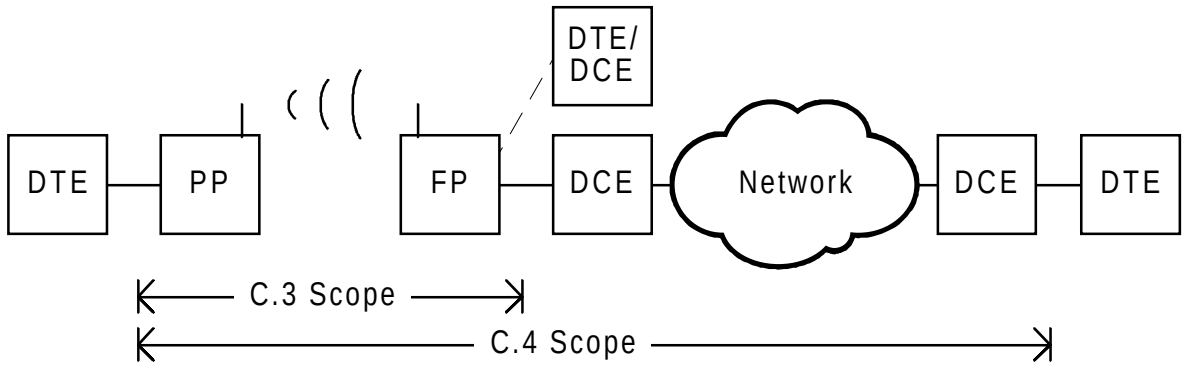



**Figure C.1.1: Overall profile reference configuration (horizontal model) for annex C**

Two different applications are described:

The first one is the interworking to the V.24 physical layer, which provides a transparent, wireless V.24 link between two pieces of DECT equipment within one DECT-system . Devices of arbitrary type (computers, modems, printers) with V.24 interface could be connected in this way.

The second one provides connections between a DECT PP and a Data Terminal Equipment (DTE) connected to a telecommunication network (e.g. a computer) by interworking to a voice band modem (see figure C.1.1).

Although in principle it is possible to achieve a similar configuration with the first application by inserting a modem between one end of the virtual V.24 connection and the external network, the user of this connection has to know about that Data Circuit terminating Equipment (DCE) and how to configure it. In contrast the second application makes this DCE invisible to the user by interworking some higher level commands (e.g. V.25bis, see subclause C.4.5 of this annex) to the DECT C-plane on both sides of the DECT-connection.

# C.2 Specific codings for mobility class 2

## C.2.1 IWU-Attribute coding

Mobility class 2 equipment, implementing the Interworking Units described in this annex, shall use the following IWU-Attribute coding:

| Bit: | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Octet: |
|---|---|---|---|---|---|---|---|---|---|
| | 0 | <<IWU-ATTRIBUTES>> | | | | | | | 1 |
| | Length of Contents (L) | | | | | | | | 2 |
| | 1 | CodeStd | | Profile | | | | | 3 |
| | | 0 | 1 | 0 | 0 | 0 | 0 | 1 | |
| | 1 | Negotiation indicator | | | Profile subtype | | | | 4 |
| | 0/1 | Stop bits | | Data bits | | Parity | | | 5 |
| | 0/1 | Data Rate | | | | | | | 5a |
| | 1 | Dup | Modem type | | | | | | 5b |
| | 0/1 | Maximum string length | | | | | | | 6 |
| | 0 | Number of codewords (Most significant 7 bits) | | | | | | | 6a |
| | 1 | Number of codewords (Least significant 7 bits) | | | | | | | 6b |
| | 1 | EUC | EEC | FBK | RES | reserved | | | 7 (note 1) |

NOTE 1: Octet 7 is optional and may be omitted if indicated by the L field.

Negotiation indicator (octet 4):

Bits 7 6 5 Meaning;

0 0 0 Negotiation not possible;

0 1 0 Peer attribute negotiation;

1 0 0 Exchanged attribute negotiation;

1 1 0 Exchanged attribute negotiation and Peer attribute negotiation;

All other values are reserved.

Profile subtype (octet 4):

Bits 4 3 2 1 Meaning;

0 0 0 0 Interworking to V.24 circuits (clause C.3);

0 0 0 1 Interworking to voice band modem services (clause C.4);

0 0 1 0 Interworking to combined voice/voice band modem services;

0 0 1 1 Interworking to PPP;

All other values are reserved.

Stop bits coding (octet 5):

Bits 7 6 Meaning;

0 0 Not used;

0 1 1 bit;

1 0 1,5 bits;

1 1 2 bits.

Data bits coding (octet 5):

Bits 5 4 Meaning;

0 0 6 bits;

0 1 5 bits;

1 0 7 bits;

1 1 8 bits.

Parity coding (octet 5):

Bits 3 2 1 Meaning;

0 0 0 Odd;

0 1 0 Even;

0 1 1 None;

1 0 0 Forced to 0;

1 0 1 Forced to 1;

1 1 1 BPAD operation;

All other values reserved.

Data Rate (octet 5a):

Bits 7 6 5 4 3 2 1 Meaning;

0 0 0 0 0 0 0 unspecified;

0 0 0 0 1 x x (xx + 1) * 50 bit/s (50 - 200 bit/s);

0 0 0 1 x x x (xxx + 1) * 300 bit/s (300 - 2400 bit/s);

0 0 1 x x x x (xxxx + 2) * 2 400 bit/s (4,8 - 40,8 kbit/s);

0 1 x x x x x (xxxxx + 1) * 8 000 bit/s (8 - 256 kbit/s) (note 3);

1 0 x x x x x (xxxxx + 6) * 9 600 bit/s (57,6 - 355,2 kbits/s) (note 3);

1 1 0 x x x x (xxxx + 11) * 24 000 bit/s (264 - 624 kbits/s) (note 3);

1 1 1 0 0 0 0 75 bit/s;

1 1 1 0 0 0 1 110 bit/s;

1 1 1 0 0 1 0 134,5 bit/s;

1 1 1 0 0 1 1 75/1200 bit/s (note 2);

1 1 1 0 1 0 0 1200/75 bit/s (note 2);

All other values reserved.

NOTE 2: The first rate is the transmit rate in forward direction of the call. The second rate is the transmit rate in backward direction of the call.

NOTE 3: Some bitrates (24, 96, 144, 192, 240, 288, and 336 kbit/s) are codeable in several different ways. These codings are all valid.

EXAMPLE:

| Bits | 7 6 5 4 3 2 1 | Meaning |
|---|---|---|
| 0 0 0 0 1 0 0 | 50 bit/s | (V.6 and X.1); |
| 0 0 0 0 1 0 1 | 100 bit/s | (V.6 and X.1); |
| 0 0 0 0 1 1 0 | 150 bit/s | (V.6 and X.1); |
| 0 0 0 0 1 1 1 | 200 bit/s | (V.6 and X.1); |
| 0 0 0 1 0 0 0 | 300 bit/s | (V.6 and X.1); |
| 0 0 0 1 0 0 1 | 600 bit/s | (V.6 and X.1); |
| 0 0 0 1 0 1 1 | 1 200 bit/s | (V.6); |
| 0 0 0 1 1 1 1 | 2 400 bit/s | (V.6 and X.1); |
| 0 0 1 0 0 0 0 | 4 800 bit/s | (V.6 and X.1); |
| 0 1 0 0 0 0 0 | 8 000 bit/s | (I.460); |
| 0 0 1 0 0 1 0 | 9 600 bit/s | (V.6, X.1, GSM HSCSD); |
| 0 0 1 0 0 1 1 | 12 000 bit/s | (V.6); |
| 0 0 1 0 1 0 0 | 14 400 bit/s | (V.6, GSM HSCSD); |
| 0 1 0 0 0 0 1 | 16 000 bit/s | (I.460); |
| 0 0 1 0 1 1 0 | 19 200 bit/s | (V.6, GSM HSCSD); |
| 0 0 1 1 0 0 0 | 24 000 bit/s | (1 C2-Bearer); |
| 0 0 1 1 0 1 0 | 28 800 bit/s | (V.34, GSM HSCSD); |
| 0 1 0 0 0 1 1 | 32 000 bit/s | (I.460, GSM HSCSD); |
| 0 0 1 1 1 1 0 | 38 400 bit/s | (GSM HSCSD); |
| 0 1 0 0 1 0 1 | 48 000 bit/s | (V.6, X.1, 2 C2-Bearers, GSM HSCSD); |
| 0 1 0 0 1 1 0 | 56 000 bit/s | (V.6); |
| 1 0 0 0 0 0 0 | 57 600 bit/s | (GSM HSCSD); |
| 0 1 0 0 1 1 1 | 64 000 bit/s | (X.1, 1 ISDN B-Channel, GSM HSCSD); |
| 1 0 0 0 0 0 1 | 67 200 bit/s | (GSM HSCSD); |
| 1 0 0 0 0 1 0 | 76 800 bit/s | (GSM HSCSD); |
| 0 1 0 1 0 0 0 | 72 000 bit/s | (3 C2-Bearers); |
| 0 1 0 1 0 1 1 | 96 000 bit/s | (4 C2-Bearers, GSM HSCSD); |
| 1 0 0 0 1 1 0 | 115 200 bit/s | (RS232 Data Rate); |
| 0 1 0 1 1 1 0 | 120 000 bit/s | (5 C2-Bearers); |
| 0 1 0 1 1 1 1 | 128 000 bit/s | (2 ISDN B-Channels); |
| 1 0 0 1 0 0 1 | 144 000 bit/s | (6 C2-Bearers); |
| 1 1 0 1 0 1 0 | 552 000 bit/s | (23 C2-Bearers). |

Modem Type (octet 5b):

| Bits 6 5 4 3 2 1 | Meaning |
|---|---|
| 0 0 0 0 0 0 | autobauding modem (note 4); |
| 0 0 0 0 0 1 | V.21; |
| 0 0 0 0 1 0 | V.22; |
| 0 0 0 0 1 1 | V.22 bis; |
| 0 0 0 1 0 0 | V.23; |
| 0 0 0 1 0 1 | V.26; |
| 0 0 0 1 1 0 | V.26 bis; |
| 0 0 0 1 1 1 | V.26 ter; |
| 0 0 1 0 0 0 | V.27; |
| 0 0 1 0 0 1 | V.27 bis; |
| 0 0 1 0 1 0 | V.27 ter; |
| 0 0 1 0 1 1 | V.29; |
| 0 0 1 1 0 0 | V.32; |
| 0 0 1 1 0 1 | V.35; |
| 0 0 1 1 1 0 | V.32 bis; |
| 0 0 1 1 1 1 | V.34; |
| 0 1 1 0 0 0 | V.110; |
| 0 1 1 0 0 1 | V.120; |
| 1 0 0 0 0 0 to | } Reserved for national use; |
| 1 1 1 1 1 1 | }. |

NOTE 4: In this case data rate specifies the target rate.

Duplex mode (Dup) (octet 5b):

| Bits 7 | Meaning; |
|---|---|
| 0 | Half duplex; |
| 1 | Full duplex; |

Maximum string length (octet 6):

This 7 bit word represents the natural binary coding of the maximum string length used for data compression, with the least significant bit in position 1 (see CCITT Recommendation V.42bis [16] annex A, parameter P2). It shall be coded with 0 when compression is not requested.

Number of codewords (octet 6a and octet 6b):

These two 7 bit words together represent the natural binary coding of the number of codewords used for data compression, with the least significant bit in position 1 of octet 6b (see CCITT Recommendation V.42bis [16] annex A, parameter P1).

End user compression (EUC) (octet 7):

Bits 7 Meaning;

0 Do not use data compression via external network;

1 Use default data compression via external network (default if octet is not present).

NOTE 5: V.42bis data compression is permitted only with the use of V.42 error correction.

End user error correction (EEC) (octet 7):

Bits 6 Meaning;

0 Do not use error correction via external network;

1 Use default error correction via external network (default if octet is not present).

Fall back (FBK) (octet 7):

Bits 5 Meaning;

0 Do not enable inband modem rate negotiation;

1 Enable inband modem rate negotiation (default if octet is not present).

Reserved for Voice/Data switching (RES) (octet 7):

This bit is reserved for the exclusive use with profile subtype 2 and shall be ignored when used with profile subtype 0 and 1.

## C.2.2 IWU attributes implemented

**Table C.2.2.1**

| Supported parameters | | | | | | |
|---|---|---|---|---|---|---|
| **Field no.** | **Name of fields** | **Reference** | **Protocol Status** | **Supp** | **Values** | |
| | | | | | **Allowed** | **Supported** |
| 1 | ID of IWU attributes of variable length | note 1 | M | | 18 | |
| 2 | Length of Contents (L) | note 2 | M | | 0 to 255 | 5 to 9 |
| 3 | Coding standard | note 2 | M | | 1 | |
| 3 | Profile | note 2 | M | | 0 to 3, to 12 | 1 |
| 4 | Negotiation indicator | note 2 | M | | 0, 2, 4, 5 | |
| 4 | Profile subtype | note 2 | M | | 0 to 7 | 0,1 |
| 5 | Stop bits coding | C.2.1 | I | M | 0 to 3 | |
| 5 | Data bits coding | C.2.1 | I | M | 0 to 3 | |
| 5 | Parity coding | C.2.1 | I | M | 0, 2, 3, 4, 5, 7 | |
| 5a | Data Rate | C.2.1 | I | O | 4 to 116 | |
| 5b | Duplex Mode | C.2.1 | I | O | 0,1 | |
| 5b | Modem Type | C.2.1 | I | O | 0 to 15, 32 to 63 | |
| 6 | Maximum string length | C.2.1 | I | M | 0 to 127 | |
| 6a,6b | Number of codewords | C.2.1 | I | O | 0 to 16 383 | |
| 7 | End user compression | C.2.1 | I | O | 0,1 | |
| 7 | End user error correction | C.2.1 | I | O | 0,1 | |
| 7 | Fall back | C.2.1 | I | O | 0,1 | |
| NOTE 1: See EN 300 175-5 [5], subclause 7.7.1.<br>NOTE 2: See EN 300 175-5 [5], subclause 7.7.21. | | | | | | |

# C.3 Generic interworking conventions

## C.3.1 PAD functionality for character oriented user data

This subclause describes the Packet Assembly/Disassembly unit (PAD) functionality for interworking to character oriented (asynchronous) protocols. It is used to pack/unpack the characters to/from LAP-U I-frames, while other IWF functions directly use LAP-U. Figure C.3.1.1 shows the relationship between the PAD, IWF and LAP-U.

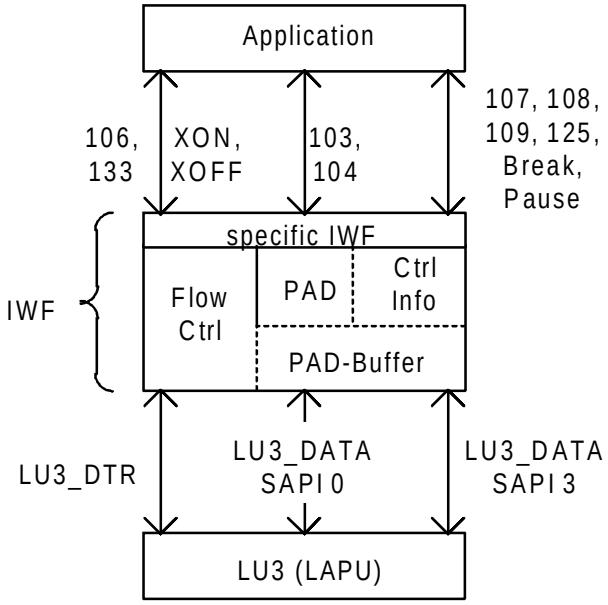



**Figure C.3.1.1: Relationship between PAD, IWF and LAP-U**

### C.3.1.1 Character formatting

Information is transferred between PAD entities using LAP-U I-frames. The LAP-U I-frame Service Data Unit (SDU) has variable length of n octets. The octets within the LAP-U SDU are numbered 0 to n-1, octet 0 is transmitted first. The bits within the octets are numbered 1 to 8, bit 1 is transmitted first. The PAD functions as follows:

Characters are coded into octets in the following way:

- the first bit of the character received/transmitted over the upper PAD interface corresponds to bit position 1 in the octet. The second bit to bit 2, and the eighth bit to bit 8;
- 8 bit characters are transmitted with no padding. Where parity is used it is generated/removed locally;
- 7 bit characters are padded with a "0" in bit position 8. Where parity is used it is inserted in bit position 8;
- 6 bit characters are padded with a "0" in bit positions 7 and 8. Where parity is used it is inserted in bit position 7 and the position 8 is padded with 0;
- 5 bit characters are padded with a "0" in bits positions 6, 7 and 8 if no parity is used. Where parity is used it is inserted in bit position 6 and the positions 7 and 8 are padded with 0s;
- all start/stop bits are generated/removed locally by the PAD;
- the character configuration (length, start, stop and parity, etc.) information is conveyed between PAD entities in the {CC-SETUP} message in the <<IWU-ATTRIBUTES>> information element during the call establishment phase;
- characters are inserted into the PAD-buffer in order of transmission in octets 0 to n-1.

## C.3.1.2 PAD operation

### C.3.1.2.1 Transmission over DECT air interface

#### C.3.1.2.1.1 Data forwarding conditions

Characters for transmission over the DECT air interface shall be assembled by the PAD for transmission as a single LAP-U SDU until one or more of the following conditions is met:

- a preset number of characters have been assembled;
- the maximum length of LAP-U SDU is reached;
- the LAP-U service is ready to accept another SDU;
- a timer value expires.

The PAD may buffer the LAP-U SDU before LAP-U transmission of that SDU begins i.e. stream mode operation of the PAD is permitted CCITT Recommendation V.42 [13].

LAP-U SDUs are forwarded to the LAP-U entity via the LAP-U primitive DLU-LU3_DATA-req for transmission in a LAP-U I-frame.

#### C.3.1.2.1.2 Transmission buffering and flow-control

Data received from an application and packetized by the PAD shall be buffered in the PAD-buffer of the IWF such that if the PT is unable to transfer the data over the DECT radio interface then data shall not be lost.

Where provided, local flow control, i.e. to the application, shall be used to prevent data loss due to PAD-buffer overflow. In addition, upon receiving a DLU-LU3_DTR.ind with the Stop/Go flag set to STOP from LU3, the IWF shall also indicate flow control to the application. However it shall accommodate latency in application recognition of the IWF not-ready indication by accepting several characters after the indication is given. These characters shall be buffered by the IWF in the PAD-buffer until LU3 indicates its ability to receive data again by issuing to the IWF a DLU-LU3_DTR.ind primitive with the Stop/Go flag set to GO. After receiving this indication, the IWF shall clear flow control to the application.

### C.3.1.2.2 Reception over DECT air interface

#### C.3.1.2.2.1 Data reception

LAP-U SDUs received from the LAP-U entity via the LAP-U primitive DLU-LU3_DATA-ind shall be disassembled by the PAD into characters and forwarded to the application. The characters shall be disassembled using the inverse of the rules in subclause C.3.1.1.

When the PAD has no further characters to communicate to the application it shall send stop bits.

#### C.3.1.2.2.2 Receive buffering and flow control

Data for transfer to the application shall be buffered in the PAD such that if the application has enabled flow control then data received from LAP-U is not lost. When an application has invoked flow control the IWF shall complete transmission of any partially-transmitted character and then cease transmitting data. Furthermore, the IWF shall stop LU3 from indicating any more data to it by issuing a DLU-LU3_DTR.req with the Stop/Go flag set to STOP.

When the application clears the not-ready condition, the IWF shall issue a DLU-LU3_DTR.req with the Stop/Go flag set to GO to LU3 and may resume the transmission of data to the application.

## C.3.2 PAD functionality for bit oriented user data

This subclause describes the BPAD unit functionality for bit oriented protocols, such as Link Access Procedure (Balanced) (LAP-B). It is used to pack/unpack bit flow to/from LAP-U I-frames, while other IWF functions directly use LAP-U. Figure C.3.2.1 shows the relationship between the BPAD, IWF and LAP-U.

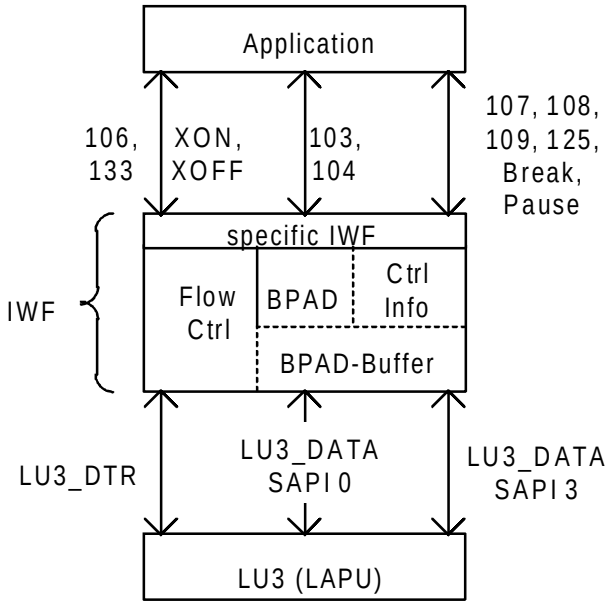



**Figure C.3.2.1: Relationship between BPAD, IWF and LAP-U**

### C.3.2.1 The character formatting

The user information flow is transferred between BPAD entities using LAP-U I-frames. The LAP-U I-frame Service Data Unit (SDU) has variable length of n octets. The octets within the LAP-U SDU are numbered 0 to n-1, octet 0 is transmitted first. The bits within the octets are numbered 1 to 8, bit 1 is transmitted first.

The user information is carried in LAP-U I-frame information octets such that the first user information bit, in any consecutive group of 8, received or transmitted corresponds to bit position 1 in the octet. The second to bit position 2, etc.

Information octets are inserted into the LAP-U I-frame in order of arrival in octets 0 to n-1.

### C.3.2.2 BPAD operation

#### C.3.2.2.1 Transmission over DECT air interface

##### C.3.2.2.1.1 Data forwarding conditions

Characters for transmission over the DECT air interface shall be assembled by the BPAD for transmission as a single LAP-U SDU until one or more of the following conditions is met:

- a preset number of characters have been assembled;
- the maximum length of LAP-U SDU is reached;
- the LAP-U service is ready to accept another SDU;
- a timer value expires.

The BPAD may buffer the LAP-U SDU before LAP-U transmission of that SDU begins i.e. stream mode operation of the BPAD is permitted CCITT Recommendation V.42 [13].

LAP-U SDUs are forwarded to the LAP-U entity via the LAP-U primitive DLU-LU3_DATA-req for transmission in a LAP-U I-frame.

#### C.3.2.2.1.2 Transmission buffering and flow-control

Data received from an application and packetized by the BPAD shall be buffered in the PAD buffer of the IWF such that if the PT is unable to transfer the data over the DECT radio interface then data shall not be lost.

Where provided, local flow control, i.e. to the application, shall be used to prevent data loss due to PAD-buffer overflow. In addition, upon receiving a DLU-LU3_DTR.ind with the Stop/Go flag set to STOP from LU3, the IWF shall also indicate flow control to the application. However it shall accommodate latency in application recognition of the IWF not-ready indication by accepting some data after the indication is given. This data shall be buffered by the IWF in the PAD buffer until LU3 indicates its ability to receive data again by issuing to the IWF a DLU-LU3_DTR.ind primitive with the Stop/Go flag set to GO. After receiving this indication, the IWF shall clear flow control to the application.

### C.3.2.2.2 Reception over DECT air interface

#### C.3.2.2.2.1 Data reception

LAP-U SDUs received from the LAP-U entity via the LAP-U primitive DLU-LU3_DATA-ind shall be disassembled by the BPAD into a bit stream and forwarded to the application. The characters shall be disassembled using the inverse of the rules in the subclause C.3.2.1.

When the BPAD has no further data to communicate to the application it shall send idle.

#### C.3.2.2.2.2 Receive buffering and flow control

Data for transfer to the application shall be buffered in the BPAD such that if the application has enabled flow control then data received from LAP-U is not lost. When an application has invoked flow control the IWF shall complete transmission of any partially-transmitted data and then cease transmitting. Furthermore, the IWF shall stop LU3 from indicating any more data to it by issuing a DLU-LU3_DTR.req with the Stop/Go flag set to STOP.

When the application clears the not-ready condition, the IWF shall issue a DLU-LU3_DTR.req with the Stop/Go flag set to GO to LU3 and may resume the transmission of data to the application.

### C.2.2.2.3 Selection of BPAD functionality

If no information for PAD functionality is available or BPAD function is requested as defined in the specification of the interworking unit, the BPAD function shall be used.

## C.3.3 Data-compression

For data-compression across the DECT air interface V.42bis over LAP-U shall be used with the following modification: Instead of using the XID-mechanism used in [16] the request for compression and the negotiation of the required parameters shall take place during call set-up via an <<IWU-Attributes>>-element utilizing the peer attribute negotiation procedure. This implies that peer-attribute-negotiation has to be implemented if data-compression is required. For interworking to V.24 circuits and voice-band modems the <<IWU-Attributes>>-element-coding defined in clause C.2 shall be used for negotiation of the V.42bis parameters.

## C.3.4 In-call Service Change

### C.3.4.1 Service Change Scope

This profile has optional support to enable In-Call Service Changes. This allows the Connection Attributes and certain aspects of the Interworking Unit (IWU) attributes to be changed during the active state of a call. These service changes are affected through the MNCC-INFO (Service Change) primitives which correspond to the {CC-SERVICE-CHANGE}, {CC-SERVICE-ACCEPT} and {CC-SERVICE-REJECT}.

The In-call Service Change procedures shall be mandatory for the connection oriented bearer service, defined in clause C.5, to allow in particular the parity bit, the start/stop bit and the number of data bits to be altered (by trial and error if necessary) during a call.

### C.3.4.2 <<CONNECTION-ATTRIBUTES>> Service Change

The Connection Attributes may be changed through the use of the MNCC-INFO (Service Change) primitives with the <<SERVICE-CHANGE-INFO>> IE parameter Change Mode = "Bandwidth Change". These primitives shall be used in accordance with the procedures set out in subclauses 9.6.1 and 9.6.2 of EN 300 175-5 [5].

### C.3.4.3 <<IWU-ATTRIBUTES>> Service Change

The IWU Attributes may be changed through the use of the MNCC-INFO (Service Change) primitives with the <<SERVICE-CHANGE-INFO>> IE parameter Change Mode = "IWU Attribute Change". These primitives shall be used in accordance with the procedures set out in subclause 9.6.1 of EN 300 175-5 [5].

The following <<SERVICE-CHANGE-INFO>> IE parameters shall be indicated in the MNCC-INFO (Service Change).req primitive:

- Coding Standard = "DECT standard coding";
- M (Master) = "Initiating side is master";
- A attributes = "Not applicable";
- R (Reset) = "Do not reset state variables";
- B attributes = "Maintain data transfer".

The MNCC-INFO (Service Change).req primitive shall also contain the requested new <<IWU-ATTRIBUTE>> IE parameters. Of these parameters only those specified in octets 5 to 7 of the <<IWU-ATTRIBUTE>> IE shall be changed. The Profile and Profile sub-types in octets 3 and 4 shall not be changed for the purposes of this service change. However such Inter-profile and Inter-Sub-profile changes may be permitted by other Service Change procedures. The Negotiation Indicator parameter (octet 4) of <<IWU-ATTRIBUTES>> shall indicate "Negotiation not possible".

# C.4 V.24 circuits

## C.4.1 Reference configuration

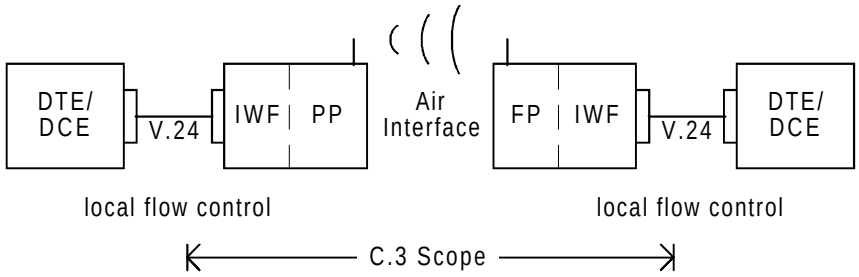



**Figure C.4.1.1: Profile reference configuration showing the interworking to a V.24 DCE/DTE**

The DTE-DCE connection shall support the functionality of CCITT Recommendation V.24 [14] link for the following V.24 lines:

- circuit 103 (TXD);
- circuit 104 (RXD);
- circuit 106 (CTS);
- circuit 107 (DSR);
- circuit 108 (DTR);
- circuit 109 (DCD);
- circuit 125 (RI);
- circuit 133 (RTR).

## C.4.2 Global assumptions

In this application, the packet mode procedures PICS conditional C.7 (see EN 300 175-5 [5], subclause 9.7, option B) shall be applied in their entirety. No other establishment or release procedures shall be used. Access shall be provided on a demand-assigned access basis (see EN 300 175-5 [5], subclause 9.7.1, option B).

The called party number is of local significance and shall define the identity of the logical port to which the PP requests to connect.

The data stop and parity bits of the FP-side-IWF shall be set according to the information elements <<data bits coding>>, <<parity coding>> and <<stop bits coding>>, respectively, of the <<IWU-ATTRIBUTES>> element in the {CC-SETUP} message. If the FP-side-IWF cannot comply with the required coding, the connection is released with release reason 05 "Incompatible service".

The DTE/DTE-side-IWF connection and the DCE-side-IWF/DCE connection may work at different data transmission speeds.

The configuration of a PP or an FP to interwork with a DTE or a DCE shall be a local matter. All data received by the PP or the FP from LU3 shall be transferred to the RXD line when interworking with a DTE or to the TXD line when interworking to a DCE. Information regarding the status of DCD and RI lines received by a DCE-side-IWF from LU3 shall be ignored. Information regarding the status of the DSR line received by a DCE-side interworking unit from LU3 shall be interworked to the DTR line. Information regarding the status of the DTR line received by a DTE-side-IWF from LU3 shall be interworked to the DSR line.

For negotiation of the service parameters, the IWU-Attributes as defined in clause C.2 shall be used. The profile subtype in octet 3 shall indicate "Interworking to V.24 circuits". Octet 5 shall describe the desired character format at the far end

IWU-interface whereby the "BPAD-operation" coding of the parity-subfield is not allowed. The data rate across the V.24-interface of the far end IWU shall be coded in octet 5a. The following octet (5b) shall not be used.

If data compression across the DECT-air-interface is to be used, the requested parameters shall be coded in octets 6 to 6b (see clause C.2 and subclause C.3.3). Otherwise the octets 6a and 6b shall be omitted and octet 6 shall be filled with a value of 0, which indicates to the receiver that no compression is requested. Octet 7 is of no use for this annex and shall therefore be omitted.

## C.4.3 Control frame for V.24 interworking

Control frames shall be sent using the SAPI indicating user control signalling data.

For the purpose of transmitting V.24 line state information the following frame format shall be used.

| Bit | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Octet |
|---|---|---|---|---|---|---|---|---|---|
| | frame type | | | | | | | | 1 |
| | 0 | 0 | BREAK | PAUSE | RI | DCD | DSR | DTR | 2 |
| | BREAK/PAUSE duration | | | | | | | | 3 |

**Figure C.4.3.1:**

Frame type coding (octet 1):

Bits 8 7 6 5 4 3 2 1 Meaning;

- 0 0 0 0 0 0 0 1 V.24 status interworking;
- All other values reserved.

DTR coding (octet 2):

Bits 1 Meaning;

- 0 DTR line OFF;
- 1 DTR line ON.

DSR coding (octet 2):

Bits 2 Meaning;

- 0 DSR line OFF;
- 1 DSR line ON.

DCD coding (octet 2):

Bits 3 Meaning;

- 0 DCD line OFF;
- 1 DCD line ON.

RI coding (octet 2):

Bits 4 Meaning;

- 0 RI line OFF;
- 1 RI line ON.

PAUSE coding (octet 2):

Bits 5 Meaning;

- 0 no PAUSE condition;

- 1 PAUSE condition occurred.

NOTE 1: For a detailed description of the PAUSE condition see annex C, subclauses C.3.3.4 and C.3.3.5.

BREAK coding (octet 2):

Bits 6 Meaning;

- 0 no BREAK condition;

- 1 BREAK condition occurred.

NOTE 2: The BREAK and the PAUSE conditions are mutually exclusive.

BREAK/PAUSE duration (octet 3):

The time duration of a BREAK or PAUSE condition is binary coded (bit 1 being the least significant bit). It defines the time in units of 10 ms. If bits 5 and 6 of octet 2 are both set to "0" (no BREAK or PAUSE condition detected) all bits of octet 3 shall be set to "0".

## C.4.4 Interworking procedures and conventions

### C.4.4.1 Procedures at the DTE-side-IWF

The interworking function shall emulate a DCE. Data is packed/unpacked for LAP-U using the PAD function described in subclause C.3.2. Data received from the PAD shall be forwarded via the RXD line to the DTE and data shall be received via the TXD line from the DTE.

#### C.4.4.1.1 DTE-Initiated link establishment

If no V.24 link is established (the "No Link" state), then the IWF shall monitor the value of the DTR line. If this goes ON, then the IWF shall monitor the activity of the TXD line. If data is detected on the TXD line, then the IWF shall issue an MNCC_SETUP.req primitive and shall enter the "V.24 Link Requested" state. Furthermore, the state of the DTR line shall be submitted to the PAD buffer prior to submitting the received character to it.

In the "V.24 Link Requested" state, if the IWF receives a MNCC_REJECT.ind primitive or a MNCC_RELEASE.ind primitive, it shall clear the PAD buffer and shall return to the "No Link" state. Its subsequent action shall be locally determined on the basis of the release reason contained in the primitive.

In the "V.24 Link Requested" state, if the IWF receives an MNCC_CONNECT.ind primitive it shall enter a "Link Active" state. Once in this state, it shall set the values of the DSR line, RI line and DCD line to the values communicated to it by LU3.

#### C.4.4.1.2 DCE-Initiated link establishment

Upon the receipt of a MNCC_SETUP.ind primitive, the IWF shall determine that the service requested may be offered, and if so it will issue a MNCC_CONNECT.ind primitive and enter the "Link Active" state. Once in this state, it shall set the values of the DSR line, RI line and DCD line to the values communicated to it by LU3. If the service cannot be supported, it will issue a MNCC_REJECT.req, indicating a release reason, and will return to the "No Link" state.

#### C.4.4.1.3 DTE-Initiated link suspension

If the management entity requires a link suspension, the IWF shall issue a MNCC_MODIFY.req primitive specifying a suspension and shall await a MNCC_MODIFY.cfm primitive. If this primitive notifies failure, it need not take any action. If this primitive notifies success, it shall enter the "Link Suspended" state.

#### C.4.4.1.4 DCE-Initiated link suspension

If the IWF receives a MNCC_MODIFY.ind primitive specifying a suspension, it shall wait until it has ceased to receive data from the U-plane and shall then enter the "Link Suspended" state.

#### C.4.4.1.5 DTE-Initiated link resume

If the management entity requires a link resumption, the IWF shall issue an MNCC_MODIFY.req primitive, specifying link resumption, and shall await a MNCC_MODIFY.cfm primitive. If this primitive notifies failure, it shall enter the "No Link" state and turn the DSR line OFF. If the primitive notifies success, then it shall enter the "Link Active" state and transmit the buffered data according to the PAD procedures.

#### C.4.4.1.6 DCE-Initiated link resume

If the IWF receives a MNCC_MODIFY.ind primitive specifying link resumption, it shall enter the "Link Active" state.

#### C.4.4.1.7 DTE-Initiated link release

The IWF may choose at any time to release the link for implementation-specific reasons. In any case, the IWF shall release the link if:

- the DTR line goes OFF for more than five seconds; and
- the IWF has been in "Link Active" state for more than five seconds.

To release the link, the IWF shall issue a MNCC_RELEASE.req primitive, shall clear the PAD buffer and shall then enter the "No Link" state, turning the DSR line, RI line and DCD line OFF.

#### C.4.4.1.8 DCE-Initiated link release

If the IWF receives a MNCC_RELEASE.ind primitive, it shall enter the "No Link" state, shall clear the PAD buffer and turn the DSR line, RI line and DCD line OFF.

### C.4.4.2 Procedures at the DCE-side-IWF

The interworking function shall emulate a DTE. Data is packed/unpacked for LAP-U using the PAD function described in subclause C.3.1. Data received from the PAD shall be forwarded via the TXD line to the DCE and data shall be received via the RXD line from the DCE.

#### C.4.4.2.1 DCE-Initiated link establishment

If no V.24 link is established, then the IWF shall monitor the value of the DSR line and the RI line. If the DSR line goes ON, then the IWF shall monitor the activity of the RXD line. If data is then detected on the RXD line, or if at any time the RI line goes ON irrespective of the state of the DSR line, then the IWF shall issue an MNCC_SETUP.req primitive and shall enter the "V.24 Link Requested" state. Furthermore, the state of the DSR, DCD, and RI lines shall be submitted to the PAD buffer prior to submitting any received characters to it.

In this state, if the IWF receives a MNCC_REJECT.ind primitive or a MNCC_RELEASE.ind primitive, it shall clear the PAD buffer and shall return to the "No Link" state. Its subsequent action shall be locally determined on the basis of the release reason contained in the primitive.

In the "V.24 Link Requested" state, if the IWF receives an MNCC_CONNECT.ind primitive it shall enter a "Link Active" state. Once in this state, it shall set the value of the DTR line to the value communicated to it by LU3.

The following functions are included in the FP IWF:

- C-plane:
  - CC procedures including service negotiation;
  - MM.

- U-plane:
  - flow control;
  - PAD function for asynchronous operation;
  - BPAD function for synchronous operation;
  - control information handling.

#### C.4.4.2.2 DTE-Initiated link establishment

Upon the receipt of a MNCC_SETUP.ind primitive, the IWF shall determine that the service requested may be offered, and if so it will issue a MNCC_CONNECT.ind primitive and enter the "Link Active" state. Once in this state, it shall set the value of the DTR line to the value communicated to it by LU3. If the service cannot be supported, it will issue a MNCC_REJECT.req, indicating a release reason, and will return to the "No Link" state.

#### C.4.4.2.3 DCE-Initiated link suspension

If the management entity requires a link suspension, the IWF shall issue a MNCC_MODIFY.req primitive specifying a suspension and shall await a MNCC_MODIFY.cfm primitive. If this primitive notifies failure, it need not take any action. If this primitive notifies success, it shall enter the "Link Suspended" state.

#### C.4.4.2.4 DTE-Initiated link suspension

If the IWF receives a MNCC_MODIFY.ind primitive specifying a suspension, it shall wait until it has ceased to receive data from the U-plane and shall then enter the "Link Suspended" state.

#### C.4.4.2.5 DCE-Initiated link resume

If the management entity requires a link resumption, the IWF shall issue an MNCC_MODIFY.req primitive, specifying link resumption, and shall await a MNCC_MODIFY.cfm primitive. If this primitive notifies failure, it shall enter the "No Link" state and turn the DTR line OFF. If the primitive notifies success, then it shall enter the "Link Active" state and transmit the buffered data according to the PAD procedures.

#### C.4.4.2.6 DTE-Initiated link resume

If the IWF receives a MNCC_MODIFY.ind primitive specifying link resumption, it shall enter the "Link Active" state.

#### C.4.4.2.7 DCE-Initiated link release

The IWF may choose at any time to release the link for implementation-specific reasons. In any case, the IWF shall release the link if:

- the DSR line goes OFF for more than five seconds; and
- the IWF has been in "Link Active" state for more than five seconds.

To release the link, the IWF shall issue a MNCC_RELEASE.req primitive, shall clear the PAD buffer and shall then enter the "No Link" state, turning the DTR line OFF.

#### C.4.4.2.8 DTE-Initiated link release

If the IWF receives a MNCC_RELEASE.ind primitive, it shall enter the "No Link" state, shall clear the PAD buffer and turn the DTR line OFF.

### C.4.4.3 PAD

The PAD-function as defined in subclause C.3.1 shall be used.

## C.4.4.4 Timing conventions

PAUSE conditions, that means consecutive stop bits send by the DTE for a time greater than 100 ms, shall be interworked by the DTE-side-IWF. PAUSE-conditions shall be transmitted to the DCE-side-IWF at the termination of the condition, together with information regarding the length (see subclause C.4.4.5). Upon receiving a PAUSE-condition, the DCE-side-IWF shall ensure that a PAUSE of at least the specified length is asserted on the link to the DCE between the character received immediately before reception of the PAUSE condition and the character received immediately after it.

## C.4.4.5 Interworking of modem status lines, BREAK condition and PAUSE condition

On any change of one or more V.24 status lines or on the detection of the BREAK condition or PAUSE condition, the current line status values and the BREAK condition or PAUSE condition respectively shall be submitted to the PAD buffer. Such information shall be passed in sequence from the PAD buffer to the user control signalling data SAP, and transmitted in an I-frame.

If such information is passed to the signalling SAP, the current I-frame shall be closed and transmitted immediately. The next I-frame to be sent shall be an I-frame with the SAPI indicating user control signalling data and with the data field containing the actual state of all listed V.24 lines and the condition which occurred. This I-frame shall be formatted as defined in subclause C.4.3 of the present document.

### C.4.4.5.1 BREAK condition

The measurement of the duration of a BREAK condition shall begin immediately upon its assertion on the TXD line at the DTE-side-IWF or the RXD line at the DCE-side-IWF. Once the BREAK condition has been terminated, the total duration of assertion measured shall be coded and transmitted as specified. The duration of the BREAK condition shall be measured for a maximum duration of 2,55 seconds, after which the BREAK condition and duration shall be coded and submitted in any case. It shall not be permitted to transmit two consecutive notifications of the BREAK condition, and the persistence of the BREAK condition beyond 2,55 seconds shall not be coded or notified to the PAD.

### C.4.4.5.2 PAUSE condition

The measurement of the duration of a PAUSE condition shall begin 100 ms after its assertion on the TXD line at the DTE-side-IWF or the RXD line at the DCE-side-IWF. Once the PAUSE condition has been terminated by any occurrence, the total duration of assertion, including the 100 ms detection interval, shall be coded and submitted as specified. The duration of the PAUSE condition shall be measured for a maximum duration of 2,55 seconds, after which the PAUSE condition and duration shall be coded and submitted in any case. It shall not be permitted to transmit two consecutive notifications of the PAUSE condition, and the persistence of the PAUSE condition beyond 2,55 seconds shall not be coded or notified to the PAD.

At the receiver, upon reception of the PAUSE command, the time for which the RXD line at the DTE-side-IWF or the TXD line at the DCE-side-IWF have been in the PAUSE condition shall be determined and if the time is less than the value indicated in the PAUSE command the PAUSE condition shall be prolonged until it is equal to the coded value. Once this value has been reached the contents of the subsequent I-frames shall be transferred to the V.24 lines.

## C.4.4.6 Interworking of flow control

### C.4.4.6.1 Flow control across the DTE/DTE-side-IWF interface

The IWF shall follow the flow control procedure which is described in subclause 10.1 of the present document.

The flow control indication should be performed using circuits 133 (RTR) and 106 (CTS), in which case:

- a DTE-side-IWF not-ready condition shall be indicated by turning circuit 106 OFF and shall be cleared by turning circuit 106 ON; and
- a DTE not-ready condition shall be recognized by an ON-to-OFF transition and cleared by an OFF-to-ON transition of circuit 133.

#### C.4.4.6.2 Flow control across the DCE-side-IWF/DCE interface

The IWF shall follow the flow control procedure described in subclause 10.1.

The flow control indication should be performed using circuits 133 (RTR) and 106 (CTS), in which case:

- a DCE-side-IWF not-ready condition shall be indicated by turning circuit 133 OFF and cleared by turning circuit 133 ON; and
- a DCE not-ready condition shall be recognized by an ON-to-OFF transition and cleared by an OFF-to-ON transition of circuit 106.

Flow control is handled locally between DTE/DCE and the IWF on both sides of a connection. The chained flow control mechanisms between DTE/DCE and the IWF on one side, the two IWFs, and the IWF and DCE/DTE on the other side respectively result in end-to-end flow control across the whole connection. Another possibility is to use DC1 and DC3 characters (XON and XOFF) for end to end flow-control. However, since the system may contain considerable buffer space and because the transmission speeds at both sides of the connection do not necessarily match, this method will work reliably only in conditions of a fully planned, co-ordinated and configured system. For applications of this profile, it is therefore strongly discouraged to work without hardware flow-control at the DTE and DCE.

## C.5 Connection oriented bearer services

### C.5.1 Scope

The provisions of this subclause shall apply if interworking to public connection-oriented network services. It is recommended for use with connection-oriented data transmission services in general.

The physical implementation of this service and the use of the interworking functions to other networks (if present) are abstracted from the user. The PP user sees a standardized wireless service which is functionally equivalent to interfacing to an auto-calling/answering DCE accessing a connection-oriented bearer service (such as modem). In addition the service can also provide the added security (authentication and encryption), call charging, flexible throughput (up to 552 kbits/s), high reliability and error correction and other features of DECT, thus making it suitable for public wireless data services.

This subclause defines the Terminal Adaptation Functions (TAF) integral to a Portable Part (PP) and the Interworking Functions (IWF) integral to a Fixed Part (FP) which enable the attachment of asynchronous or synchronous serial data applications to a PP and attachment of connection-oriented asynchronous or synchronous serial data transmission network services to an FP. The application may be a software application or a terminal, however this annex does not mandate the implementation of a specific interface between the PP and the terminal and the FP and the service/network, but specifies the air interface requirements in order to facilitate interoperability between equipment of different origin. The functions defined in this annex are applicable to both asynchronous and synchronous processes unless stated otherwise. The last part of this annex specifies interworking conventions for DTE-to-PP interfaces based on CCITT Recommendations V.24 [14] and V.25bis [15], and for corresponding conventions for FP IWUs with a nominal internal V.24 interface.

## C.5.2 Reference configuration

The reference configuration for U-plane and C-plane operation is shown in figures C.3 and C.4, respectively. The present document refers to Portable Parts (PPs) and Fixed Parts (FPs) which support applications with asynchronous or synchronous serial data transmission capabilities. The TAF is functionally a part of a PP and the IWF is functionally part of FP with an integral asynchronous or synchronous data capability of this profile.

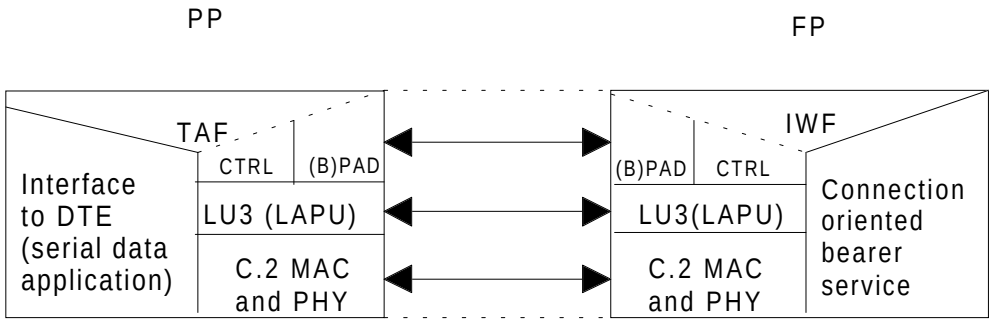



**Figure C.5.2.1: Profile reference U- plane configuration showing the interworking to a connection-oriented bearer service**

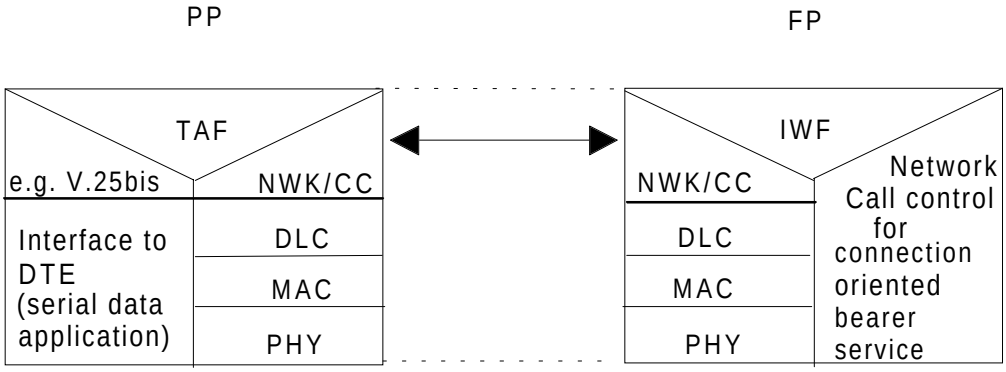



**Figure C.5.2.2: Profile reference C- plane configuration showing the interworking to the connection-oriented bearer service which supports auto-calling/answering**

The serial data application may implement any proprietary TAF-interface solution using the services provided by the TAF in order to facilitate application/terminal connection (such as V.24 or X.21). The serial data transmission service contains a network specific interworking unit using the IWF services to provide interconnection to outside networks such as PSTN, ISDN or Global System for Mobile communication (GSM). This subclause defines the TAF/IWF for a V.24/V.25bis modem service as an example in subclause C.4.5. This subclause also defines functions to support autocalling and autoanswering specified in accordance with CCITT Recommendation V.25bis [15] (although other autocalling/autoanswering procedures may also be used provided that mapping in a functionally equivalent way to DECT call control is also provided).

### C.5.2.1 PP TAF

The following functions are included in the PP TAF:

- C-plane:
  - CC procedures including service negotiation;
  - MM.

- U-plane:
  - flow control;
  - PAD function for asynchronous operation;
  - BPAD function for synchronous operation;
  - control information handling.

### C.5.2.2 FP IWF

(void).

### C.5.2.3 General Configuration

For negotiation of the service parameters the IWU-Attributes as defined in clause C.2 shall be used. The profile subtype in octet 3 shall indicate "Interworking to voice band modem services". The requested character format and data rate for the modem in the IWU as well as the requested modulation scheme and duplex mode shall be coded in octets 5 to 5b. If the IWU is allowed to negotiate lower data-rates with the far end modem this shall be indicated in bit 5 of octet 7. If data compression across the DECT-air-interface is to be used, the requested parameters shall be coded in octets 6 to 6b (see subclause C.3.3). Otherwise the octets 6a and 6b shall be omitted and octet 6 shall be filled with a value of 0, which indicates to the receiver that no compression is requested. Bit 7 and 6 of octet 7 shall be used to switch usage of error-correction and data compression across the external network. If these bits are set to [1] or octet 7 is left out error correction and data compression shall be used if implemented in the IWU.

## C.5.3 Control frame for voice band modem interworking

Control frames shall be sent using the SAPI indicating user control signalling data.

For the purpose of transmitting V.24 line state information the following frame format shall be used.

| Bit | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Octet |
|---|---|---|---|---|---|---|---|---|---|
| | frame type | | | | | | | | 1 |
| | 0 | 0 | BREAK | 0 | 0 | DCD | DSR | 0 | 2 |
| | BREAK duration | | | | | | | | 3 |

**Figure C.5.3.1:**

frame type coding (octet 1):

Bits 8 7 6 5 4 3 2 1 Meaning;

- 0 0 0 0 0 0 1 0 Voice band modem status interworking;
- All other values reserved.

DSR coding (octet 2):

Bits 2 Meaning;

- 0 DSR line OFF;
- 1 DSR line ON.

DCD coding (octet 2):

Bits 3 Meaning;

- 0 DCD line OFF;
- 1 DCD line ON.

BREAK coding (octet 2):

Bits 6 Meaning;

- 0 no BREAK condition;
- 1 BREAK condition occurred.

NOTE: The BREAK and the PAUSE conditions are mutually exclusive.

BREAK duration (octet 3):

The time duration of a BREAK or PAUSE condition is binary coded (bit 1 being the least significant bit). It defines the time in units of 10 ms. If bits 5 and 6 of octet 2 are both set to "0" (no BREAK or PAUSE condition detected) all bits of octet 3 shall be set to "0".

## C.5.4 PP Procedures

### C.5.4.1 C-plane procedures

The C-plane procedures are based on those of a GAP telephone with additional mandatory Call Control elements to cover data specific aspects of the call setup. The detailed specification of these procedures is given in EN 300 435 [11].

The service specific configuration information is carried in the <<iwu-attributes>> information element of the {CC-SETUP} message. The values in the information elements will contain the service requirements set by the user. The called user number is conveyed in <<Multi keypad>> information element of the {CC-INFO} message.

In addition, where service parameter negotiation is provided, the TAF shall be responsible for negotiating the service parameters. Service parameter negotiation is only supported during the call establishment phase. This is implemented by reflecting a modified set of service parameters to the call initiator in the {CC-RELEASE-COM} message. The initiator of the {CC-SETUP} message may then establish a new call using the modified parameters in a new {CC-SETUP} message.

### C.5.4.2 Suspend and resume procedures

The suspension and resumption of a call shall be a management entity decision according to the conditions described in clause 9.

If the management entity requires a link suspension, the TAF shall issue a MNCC_MODIFY.req primitive specifying a suspension and shall await a MNCC_MODIFY.cfm primitive. If this primitive notifies failure, it need not take any action. If this primitive notifies success, it shall enter the "Link Suspended" state.

If the TAF receives a MNCC_MODIFY.ind primitive, it shall wait until it has ceased to receive data from the U-plane and shall then enter the "Link Suspended" state.

If the management entity requires a link resumption, the TAF shall issue an MNCC_MODIFY.req primitive, specifying link resumption, and shall await a MNCC_MODIFY.cfm primitive. If this primitive notifies failure, it shall enter the "No Link" state and turn the DSR line OFF. If the primitive notifies success, then it shall enter the "Link Active" state and transmit the buffered data according to the PAD procedures.

If the TAF receives a MNCC_MODIFY.ind primitive, it shall enter the "Link Active" state.

## C.5.5 FP procedures

### C.5.5.1 C-plane

The C-plane procedures are based on those of a GAP telephone with additional mandatory elements to cover data specific aspects of the call setup. The detailed specification of these procedures is given in annex G.

The service specific configuration information is carried in the <<iwu-attributes>> information element of the {CC-SETUP} message. The values in the information elements will contain the service requirements set by the user. The called user number is conveyed in <<Multi-keypad>> information element of {CC-INFO} message.

Specific functionality is required of the IWF depending on the service which is being requested to be supported. The selection of the appropriate Interworking Unit (IWU) will be determined by the FP/IWF on the basis of information contained in the <<iwu-attributes>> information element signalled in the {CC-SETUP} request message.

In addition where service parameter negotiation is provided, the IWU shall be responsible for interworking the negotiation between the PP and the FP and between the FP and the attached network. Service parameter negotiation is only supported during the call establishment phase. This is implemented by reflecting a modified set of service parameters to the call initiator in the {CC-RELEASE-COM} message. The initiator of the {CC-SETUP} message may then establish a new call using the modified parameters in a new {CC-SETUP} message. In the case of an outgoing call the FP shall also release the associated call into the network if this is already established. In the case of incoming call the IWF shall upon receipt of an {RELEASE-COM} message either:

- attempt another {CC-SETUP} for the same incoming call provided the RELEASE-COM message contained an acceptable set of modified service parameters; or
- notify the network of the {CC-SETUP} failure giving the release reason specified in the {RELEASE-COM} message.

### C.5.5.2 Suspend and resume procedures

The suspension and resumption of a call shall be a management entity decision according to the conditions described in clause 9.

If the management entity requires a link suspension, the IWF shall issue a MNCC_MODIFY.req primitive specifying a suspension and shall await a MNCC_MODIFY.cfm primitive. If this primitive notifies failure, it need not take any action. If this primitive notifies success, it shall enter the "Link Suspended" state.

If the IWF receives a MNCC_MODIFY.ind primitive, it shall wait until it has ceased to receive data from the U-plane and shall then enter the "Link Suspended" state.

If the management entity requires a link resumption, the IWF shall issue an MNCC_MODIFY.req primitive, specifying link resumption, and shall await a MNCC_MODIFY.cfm primitive. If this primitive notifies failure, it shall enter the "No Link" state and turn the DTR line OFF. If the primitive notifies success, then it shall enter the "Link Active" state and transmit the buffered data according to the PAD procedures.

If the IWF receives a MNCC_MODIFY.ind primitive, it shall enter the "Link Active" state.

## C.5.6 Network modem interworking service using V.24 connection

### C.5.6.1 General

This subclause specifies the interworking of the DECT C.2 services with DTE connected by V.24 to the PP. It also specifies the functionality of the corresponding IWU in the FP by means of a nominal, reference V.24 interface to CCITT-specified DCE. This subclause will describe how CCITT Recommendation V.24 [14] signalling should take place in the TAF and IWU. The V.24 modem service TAF or IWU may be used independently of each other i.e. the TAF may be used in conjunction with other IWU descriptions and the IWU with other TAF descriptions, respectively.

## C.5.6.2 Reference configuration

The reference configuration is illustrated in figure C.5.6.2.1.

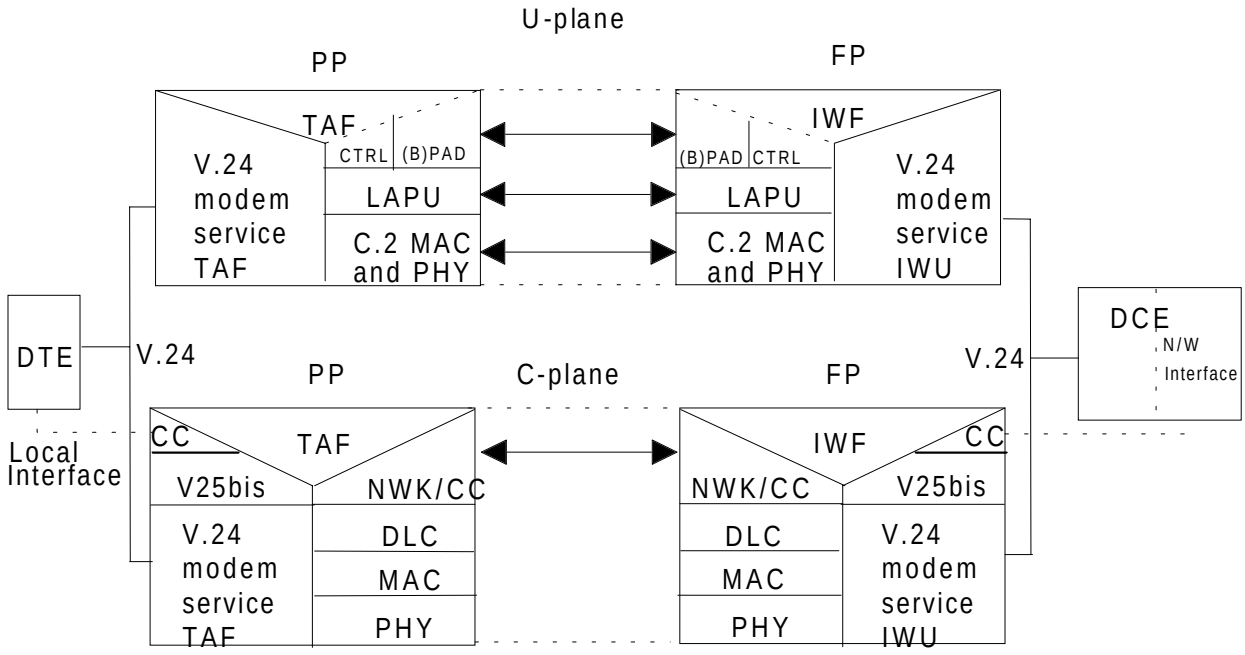



**Figure C.5.6.2.1: The reference configuration**

## C.5.6.3 TAF Interworking to V.24/V25bis

### C.5.6.3.1 General

The V.24 TAF emulates DCE towards the DTE while interworking the V.24 and V.25bis status to the CC and DLU primitives. The implementation of the V.24 interface is not mandatory in the context of this interworking annex, but if the V.24 interface is implemented physically or logically in the TAF then the provisions of this subclause are mandatory. The rules are applicable for both manual and automatic calling. The autocall/autoanswer functionality of CCITT Recommendation V.25bis [15] is described in subclause C.5.6.3.4.

### C.5.6.3.2 V.24 interchange circuit handling rules

The circuit 108/2 (DTR) is required to be in the on state before the PT/TAF may initiate call establishment (manual or automatic). The circuit 108/2 (DTR) may be used to indicate with on state to the PT/TAF that the DTE is ready to accept an incoming call.

In the active state, the 108/2 (DTR) transition from on to off state shall cause the TAF to release the connection, after an implementation-specific time-out by issuing an MNCC-RELEASE-req primitive with Release Reason "User Detached".

If 108/2(DTR) is off, the TAF shall respond to an incoming call with a MNCC-ALERT-req primitive and shall turn on circuit 125 (RI). If circuit 108/2(DTR) goes on in this condition, the TAF shall issue an MNCC-CONNECT-req primitive. It shall be an implementation-specific feature for the TAF to time-out if circuit 108/2 (DTR) does not go on in this condition, in which case it shall issue an MNCC-RELEASE-req primitive. The TAF may also issue an MNCC-RELEASE-req. primitive independently of the state of circuit 108/2 (DTR), for implementation-specific reasons.

The status change of circuit 107 (DSR) from off to on by PT/TAF shall indicate to the DTE that network call establishment has been successful, that a far-end modem has been detected and that negotiation to establish a carrier has begun.

The status change of 107 (DSR) from on to off by PT/TAF shall indicate to the DTE that the call has been released. Circuit 107 (DSR) shall be turned off when the PT/TAF receives MNCC-REJECT-ind primitive.

Circuit 109 (DCD) may be turned on by the PT/TAF only when the LAP-U link is established. Circuit 109 (DCD) turning on during the call establishment shall indicate to the DTE the successful establishment of a data carrier to the far-end modem, and the availability of service for end-to-end data transfer. PT/TAF shall turn off circuit 109 (DCD) if the value of this circuit as transferred by the LAP-U control frame is set to off, or if the call is released. PT/TAF shall be responsible for turning circuit 109 (DCD) off before circuit 107 (DSR) is turned off if it is not already off. The status of circuits 105 (RTS) and 106 (CTS) shall not be conveyed across the radio interface. The TAF shall respond to the on condition of the circuit 105 (RTS) with on condition of 106 (CTS) if no flow control is activated and the LAP-U U plane connection is present.

### C.5.6.3.3 Call establishment signalling handling

The TAF shall control call establishment by means of the relevant MNCC primitives, in accordance with the procedures of the GAP. Functions to support autocalling and autoanswering are specified in accordance with CCITT Recommendation V.25bis [15] (although the use of other autocalling/autoanswering procedures are not prohibited provided that mapping in a functionally equivalent way to DECT call control is also provided). The procedures are defined in the subclause C.5.6.3.4. Information about the state of call establishment which is additional to that conveyed by V.25bis or similar protocols may be transferred by the TAF to the DTE using locally defined means. Such information is expected to include notification of the MNCC-CALL_PROC.ind, MNCC-ALERT.ind and MNCC-CONNECT.ind primitives. In particular, the TAF shall include means to provide notification to the DTE or the user of the MNCC-CONNECT.ind primitive.

### C.5.6.3.4 V.25bis interworking to DECT CC primitives

This subclause shall applies when V.25bis is implemented on the DTE-TAF interface. The use of V.25bis is not mandatory and there is no restriction on the use of alternative call-control protocols on this interface (e.g. AT command set), for which interworking shall be carried out in an analogous manner.

The following general rules shall apply:

Auto Calling:

- this procedure is provided according to CCITT Recommendation V.25bis [15];
- a subset of CCITT Recommendation V.25bis[15] is shown in table C.5.6.3.4.1 This subset gives minimum level of control and indication;
- during the call establishment phase, i.e. after signalling, call tone according to CCITT Recommendation V.25bis[15] shall be generated in the TAF.

Auto Answer:

- this procedure is provided according to CCITT Recommendation V.25bis [15].

CCITT Recommendation V.25bis [15] indications generated by the TAF shall be even parity, even if the parity condition for the user's application is different.

**Table C.5.6.3.4.1: Minimum set of call set-up commands and indications**

| | Description | IA5 Characters |
|---|---|---|
| Commands from Application | Call Request with Number provided 0,1..9,*,#,A,B,C,D | CRN |
| | Connect Incoming Call | CIC |
| | Disregard Incoming Call | DIC |
| Indications to Application | Call Failure Indication XX = CB,AB,NT,FC (see note) | CFI XX |
| | INcoming Call | INC |
| | VALid | VAL |
| | INValid | INV |

NOTE: CB = Local MT busy;
AB = Abort call;
NT = No answer;
FC = Forbidden call. Forbidden call indication results from contravention of rules for repeat call attempts as defined by the appropriate national approvals administration. It is recommended that this is the responsibility of the PP, not the DTE.

Only those elements and messages that are of particular relevance are considered. The signalling charts have been illustrated in figures C.5.6 and C.5.7. It should be noted that not all possible signalling has been illustrated i.e. other C-plane signalling related to the CC machine requirements may take place between PP and FP during different phases of the call.

### C.5.6.3.4.1 PP originated calls

#### C.5.6.3.4.1.1 Call establishment

Upon receipt of V25bis {CRN}, {CRI} or {CRS} commands from the DTE the PP/TAF shall issue MNCC-SETUP-req primitive to the DECT NWK C-plane. The called party number (as derived from the {CRN}, {CRI} or {CRS} command) shall be conveyed in a single <<Multi-keypad>> information element parameter of the MNCC-INFO.ind primitive, in conformance with the GAP procedures. If the V.25bis command is invalid the TAF shall respond with {INV} and shall not proceed with call establishment. The acceptance of the command is acknowledged with {VAL}.

#### C.5.6.3.4.1.2 Call release

If the call was not accepted or in the case of establishment failure to the fixed network, the fixed network connection equipment may issue a Error Code. These error codes may be mapped to a CC-RELEASE-COM message reason code. Upon receipt of MNCC-REJECT-ind, the PP TAF may issue to the DTE the V.25bis {CFI} message with the error code information mapped from the MNCC-REJECT.ind primitive <<reason code>> information element before turning off 106 (CTS) and 107 (DSR).

### C.5.6.3.4.2 PP terminated calls

#### C.5.6.3.4.2.1 Call establishment

Upon receipt of MNCC-SETUP-ind primitive V.25bis {INC} indication shall be sent and circuit 125 (RI) shall be turned on by the PP TAF towards the DTE.

The DTE may answer either with {DIC} (Disregard Incoming Call) or {CIC} (Connect Incoming Call) to the call indication. With the {DIC} command the call is rejected and MNCC-REJECT-req shall be issued with hex 15 "User rejection" <<Release reason>> code as a response to the MNCC-SETUP-ind primitive. With the {CIC} answer the TAF shall clear circuits 106 and 125 (RI) and issue MNCC-CONNECT-req.

#### C.5.6.3.4.2.2 Call release

If the call is to be disconnected by the network side the PP CC machine issues an MNCC-RELEASE.ind primitive, optionally carrying the release reason code. Upon the receipt of the MNCC-RELEASE.ind primitive the PP TAF sends the {CIF} V.25bis message. The error code of the V.25bis message may optionally contain a mapping of the <<release reason>> parameter.

### C.5.6.3.5 Flow control

Flow control shall be performed as described in subclause 10. If the 133(105)/106 flow control is supported then the status of the 133 (105)/106 shall be interworked with the PAD/BPAD flow control, described in subclause C.3.2.

The flow control indication should be performed using circuits 133 (RTR) and 106 (CTS), in which case:

- a TAF not-ready condition shall be indicated by turning circuit 106 OFF and shall be cleared by turning circuit 106 ON; and
- a DTE not-ready condition shall be recognized by an ON-to-OFF transition and cleared by an OFF-to-ON transition of circuit 133.

### C.5.6.3.6 Break signalling procedures

The "BREAK" condition from the DTE shall be recognized by the TAF function and interworked to the DECT link according to the procedures in subclause C.5.6.4.5.

The measurement of the duration of a BREAK condition shall begin immediately upon its assertion on circuit 103 (TXD) at the PT/TAF. Once the BREAK condition has been terminated, the total duration of assertion measured shall be coded and transmitted as specified. The duration of the BREAK condition shall be measured for a maximum duration of 2,55 seconds, after which the BREAK condition and duration shall be coded and submitted in any case. It shall not be permitted to transmit two consecutive notifications of the BREAK condition, and the persistence of the BREAK condition beyond 2,55 seconds shall not be coded or notified to the PAD.

The TAF shall generate a "BREAK" condition towards the DTE on receipt of a BREAK condition indication from the LAP-U SAPI 3 as indicated by the coding of subclause C.5.3.

### C.5.6.3.7 PAUSE condition

The "PAUSE" condition from the DTE shall be recognized by the TAF function and interworked to the DECT link according to the procedures in subclause C.5.3.

The measurement of the duration of a PAUSE condition shall begin 100 ms after its assertion on circuit 103 (TXD) of a DTE connected to the TAF or on circuit 104 (RXD) of a DCE connected to the TAF. Once the PAUSE condition has been terminated by any occurrence, the total duration of assertion, including the 100 ms detection interval, shall be coded and submitted as specified. The duration of the PAUSE condition shall be measured for a maximum duration of 2,55 seconds, after which the PAUSE condition and duration shall be coded and submitted in any case. It shall not be permitted to transmit two consecutive notifications of the PAUSE condition, and the persistence of the PAUSE condition beyond 2,55 seconds shall not be coded or notified to the PAD.

Upon reception of a PAUSE command, the time for which circuit 104 (RXD) of a DTE connected to the TAF or circuit 103 (TXD) of a DCE connected to the TAF have been in the PAUSE condition shall be determined and if the time is less than the value indicated in the PAUSE command the PAUSE condition shall be prolonged until it is equal to the coded value. Once this value has been reached the contents of the subsequent I-frames shall be transferred to the V.24 lines.

### C.5.6.3.8 Data coding selection

The means of configuring in the TAF the use of an asynchronous or synchronous interface, and hence the use of the PAD or BPAD respectively, and where appropriate of the values of the data, stop and parity bits, shall be a local matter. These values shall be coded into the "BPAD/Parity coding", "data bits coding", "Stop bits coding" and "BPAD/Parity coding" fields respectively in the <<IWU-ATTRIBUTES>> parameter of the MNCC-SETUP, MNCC-SETUP-ACK, MNCC-CALL-PROC, MNCC-ALERT, MNCC-CONNECT or MNCC-INFO-(service change) primitives. For a PP-initiated call, these values shall be transferred from the TAF in a ".req" primitive, and for a PP-terminated call they shall be transferred to the TAF in a ".ind" primitive. These parameters shall be subject to exchanged attribute negotiation, and optionally subject to prioritized list negotiation and peer attribute negotiation.

### C.5.6.3.9 Data transmission

The data is interworked for LAP-U in the PP as described in subclause C.3.2 using the PAD or BPAD functions. The connection over the LAP-U link is always a duplex service.

## C.5.6.4 DECT FP Interworking procedures

### C.5.6.4.1 General

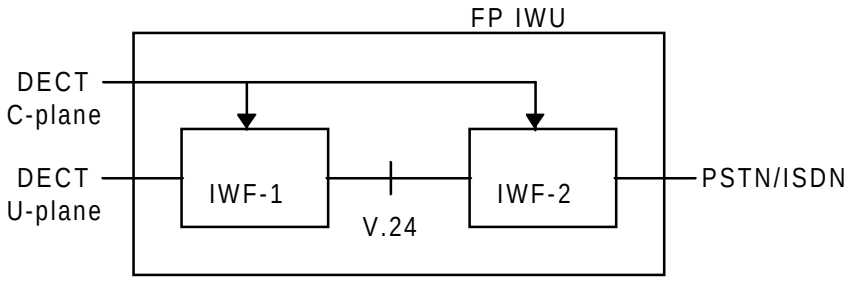



**Figure C.5.6.4.1.1: FP IWU reference configuration**

This subclause specifies the interworking procedures for the IWU of the PSTN/ISDN modem service. This IWU is split into 2 sub-functions called IWF-1 and IWF-2 as shown in figure C.5.5. IWF-2 is the only function which is attached to the local fixed network. From the perspective of this network this shall function exactly like an ITU V.series voice-band modem or an ITU V.110/120 ISDN termination.

Establishment and release of the PSTN/ISDN calls by IWF-2 shall be controlled on the DECT side by the GAP procedures. The call control primitive parameters have been extended to support the non-voice services standardized herein.

The FP IWU reference configuration defines a logical V.24 reference point between IWF-1 and IWF-2. This is used to simplify the specification of the interworking of the U-plane data to the modem data since the ITU V.series modems (incl. V.110/120) are specified with respect to the V.24 interface. This shall not in any way restrict the implementation of the FP IWU.

### C.5.6.4.2 Call establishment signalling handling

The modem call establishment is directly signalled to IWF-2 via the DECT network layer primitives and procedures standardized herein using the GAP interworking procedures.

If the selected modem service is an ITU V.series voice-band modem the signalling to the local fixed network shall be identical to a standard 3,1 kHz audio call establishment up to the point where the FP CC enters the active state. At this point the behaviour of IWF-2 towards the network shall be in accordance with the ITU V.series modem selected by the <Modem-Type>, <Data-Rate> and octet 7 parameters in the <<IWU-ATTRIBUTES>> IE.

If the selected modem service is an ITU Recommendation V.110/120 ISDN modem the signalling to the local fixed network shall follow the standard ISDN call setup procedures for the V.110 or V.120 service. The V.110/120 call setup parameters for the ISDN call shall use the appropriate parameters from octets 5, 5a and 5b of the <<IWU-ATTRIBUTES>> IE, and shall allocate the remaining V.110/120 parameters according to the capabilities of IWF-2.

The "Answer" indication from the local fixed network shall be understood when one or more of the following has been detected:

- off-hook for the called party has been detected;
- charging for this call has started;
- a CONNECT message has been received (e.g. from an ISDN network);
- the 2 100 Hz modem tone has been detected.

Depending on the attached local fixed network and the called party it may not be possible to detect any of the above. Under such circumstances the FP IWU is permitted to issue a MNCC-RELEASE-req primitive following a timeout period indicating release reason "timer expired".

#### C.5.6.4.3 V.24 Interchange circuit handling rules

Circuit 107 (DSR) is required to be in the on state before the IWF-1 may transmit data on circuit 103 (TXD).

The state of circuit 125 (RI) shall be ignored by IWF-1, since the presence of an incoming call shall be interworked to the DECT network by the IWF-2. The IWF-1 shall transfer the value of circuit 109 (DCD) and circuit 107 (DSR) in DLU-LU3_DATA.ind primitives using the codings defined in subclause C.5.3.

Data received via DLU-LU3_DATA.ind primitives shall be interworked to circuit 103 (TXD) using the PAD or BPAD functions specified in subclause 10. Data received on circuit 104 (RXD) shall be interworked to DLU-LU3_DATA.req primitives using the same PAD or BPAD functions. The selection of which PAD function and, if appropriate, the asynchronous PAD parameters - data length, stop bits and parity - shall be negotiated by the IWF-1 using the respective coding values in the <<IWU-ATTRIBUTES>> parameter of the MNCC-SETUP, MNCC-SETUP-ACK, MNCC-CALL-PROC, MNCC-ALERT, MNCC-CONNECT or MNCC-INFO-(service change) primitives during call setup.

The status of circuits 105 (RTS) and 106 (CTS) shall not be conveyed across the radio interface. The IWF-1 shall respond to the on condition of the circuit 106 (CTS) with on condition of 105 (RTS) if no flow control is activated and if the LAP-U U plane connection is present.

#### C.5.6.4.4 Flow control

If the 133(105)/106 flow control is used the status of the 106 (CTS) is interworked into the PAD/BPAD flow control, described in subclause C.3.2.

The flow-control indication should be performed using circuits 133 (RTR) and 106 (CTS), in which case:

- a IWF-1 side not-ready condition shall be indicated by turning circuit 133 OFF and cleared by turning circuit 133 ON; and
- a IWF-2 not ready condition shall be recognized by an ON-to-OFF transition and cleared by an OFF-to-ON transition of circuit 106.

#### C.5.6.4.5 Break signalling procedures

The "BREAK" condition from IWF-2 shall be recognized by the IWF-1 and passed to the LAP-U using procedures described in subclause C.4.3. The IWF-1 will generate a "BREAK" condition towards the IWF-2 on receipt of a BREAK condition indication from the LAP-U.

#### C.5.6.4.6 PAUSE condition

The measurement of the duration of a PAUSE condition shall begin 100 ms after its assertion on the circuit 104 (RXD) by IWF-2. Once the PAUSE condition has been terminated by any occurrence, the total duration of assertion, including the 100 ms detection interval, shall be coded and submitted as specified. The duration of the PAUSE condition shall be measured for a maximum duration of 2,55 seconds, after which the PAUSE condition and duration shall be coded and submitted in any case. It shall not be permitted to transmit two consecutive notifications of the PAUSE condition, and the persistence of the PAUSE condition beyond 2,55 seconds shall not be coded or notified to the PAD.

Upon reception of a PAUSE command, the time for which the TXD of IWF-1 has been in the PAUSE condition shall be determined and if the time is less than the value indicated in the PAUSE command the PAUSE condition shall be prolonged until it is equal to the coded value. Once this value has been reached the contents of the subsequent I-frames shall be transferred to the V.24 lines.

#### C.5.6.4.7 Modem selection

For an outgoing call, the modem type in IWF-2 is selected according to the "modem type" coding of the <<IWU-ATTRIBUTES>> parameter in the MNCC-SETUP.ind primitive. If this value is not supported by IWF-2, the supported service negotiation procedures shall be invoked by the IWU. If no acceptable modem can be negotiated, the call is rejected with an MNCC-RELEASE-COM.req primitive with release reason (hex) 05 "Incompatible service".

For an incoming call, a locally determined value of the modem type shall be used by the IWU in the MNCC-SETUP.req primitive. A PP-initiated peer attribute negotiation may be used to modify this value, otherwise the IWF-2 may locally determine a new value after it has received the MNCC-CONNECT.ind primitive and has consequently responded to the incoming call and has agreed the modem type to be used. It shall then communicate this in an MNCC-CONNECT_ACK.req primitive.

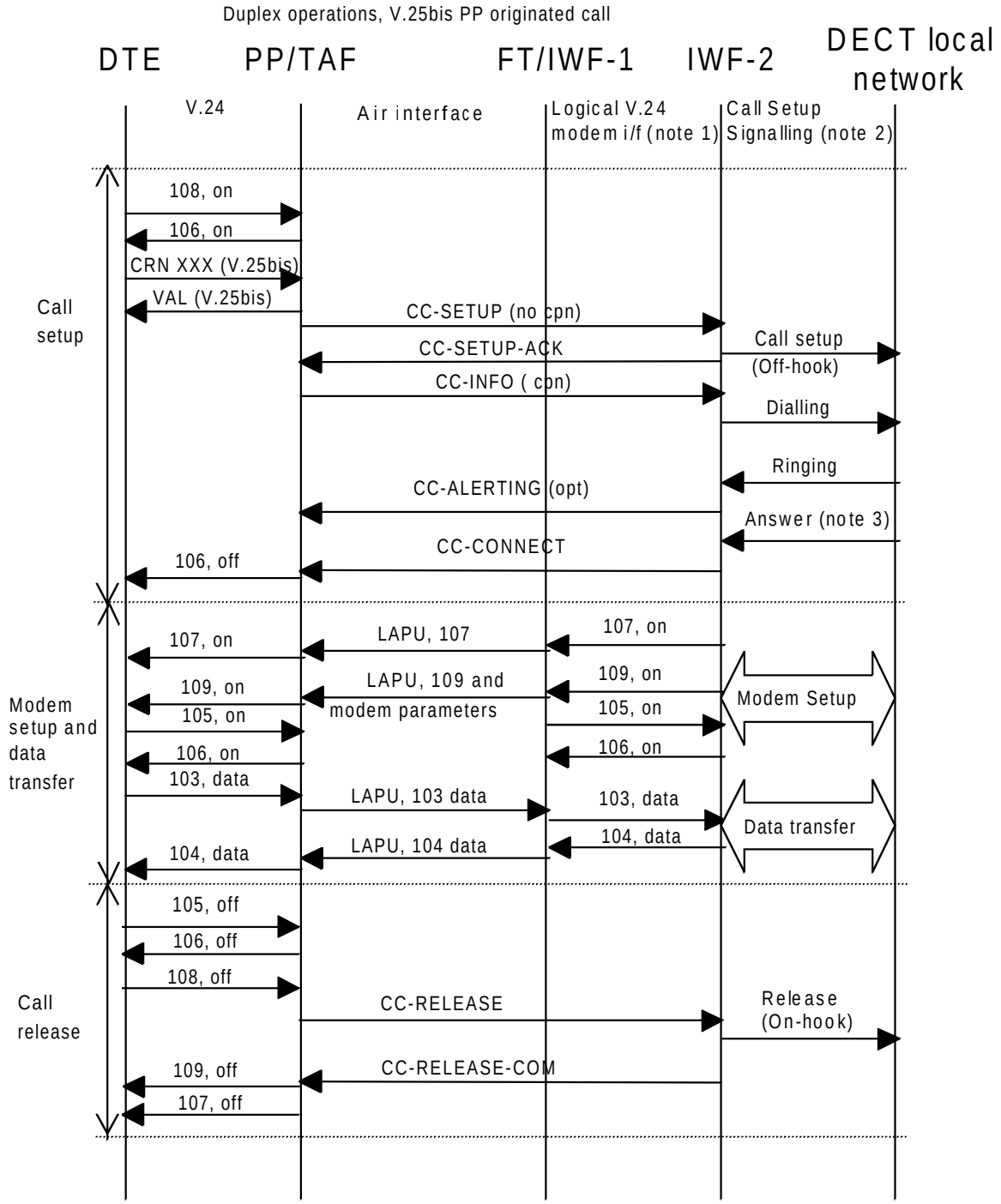
#### C.5.6.4.8 Data coding selection

For an outgoing (PP-initiated) call, the use of an asynchronous or synchronous interface, and hence the use of the PAD or BPAD respectively, and where appropriate of the values of the data, stop and parity bits, shall be selected according to the values coded in the "BPAD/Parity coding", "data bits coding", "Stop bits coding" and "BPAD/Parity coding" fields respectively in the <<IWU-ATTRIBUTES>> parameter of the MNCC-SETUP.ind primitive. If this set of values is not supported by the IWU, the supported service negotiation procedures shall be invoked by the IWU. If no acceptable service parameter set can be negotiated, the call shall be rejected with an MNCC-RELEASE-COM.req primitive with release reason (hex) 05 " incompatible service".

For an incoming call, a locally determined value for these parameters shall be used by the IWU in the MNCC-SETUP.req primitive. If this set of values is not acceptable to the PP, the supported service negotiation procedures shall be invoked by the PP. If no acceptable parameter set can be negotiated, the call shall be rejected with an MCC-RELEASE-COM.req primitive with release reason (hex) 05 "incompatible service".

### C.5.6.4.9 Data transmission

The data is formed for the LAP-U by the IWF as described in the subclause C.3.2, using the PAD or B-PAD functions. The connection over the LAP-U link is always duplex service.

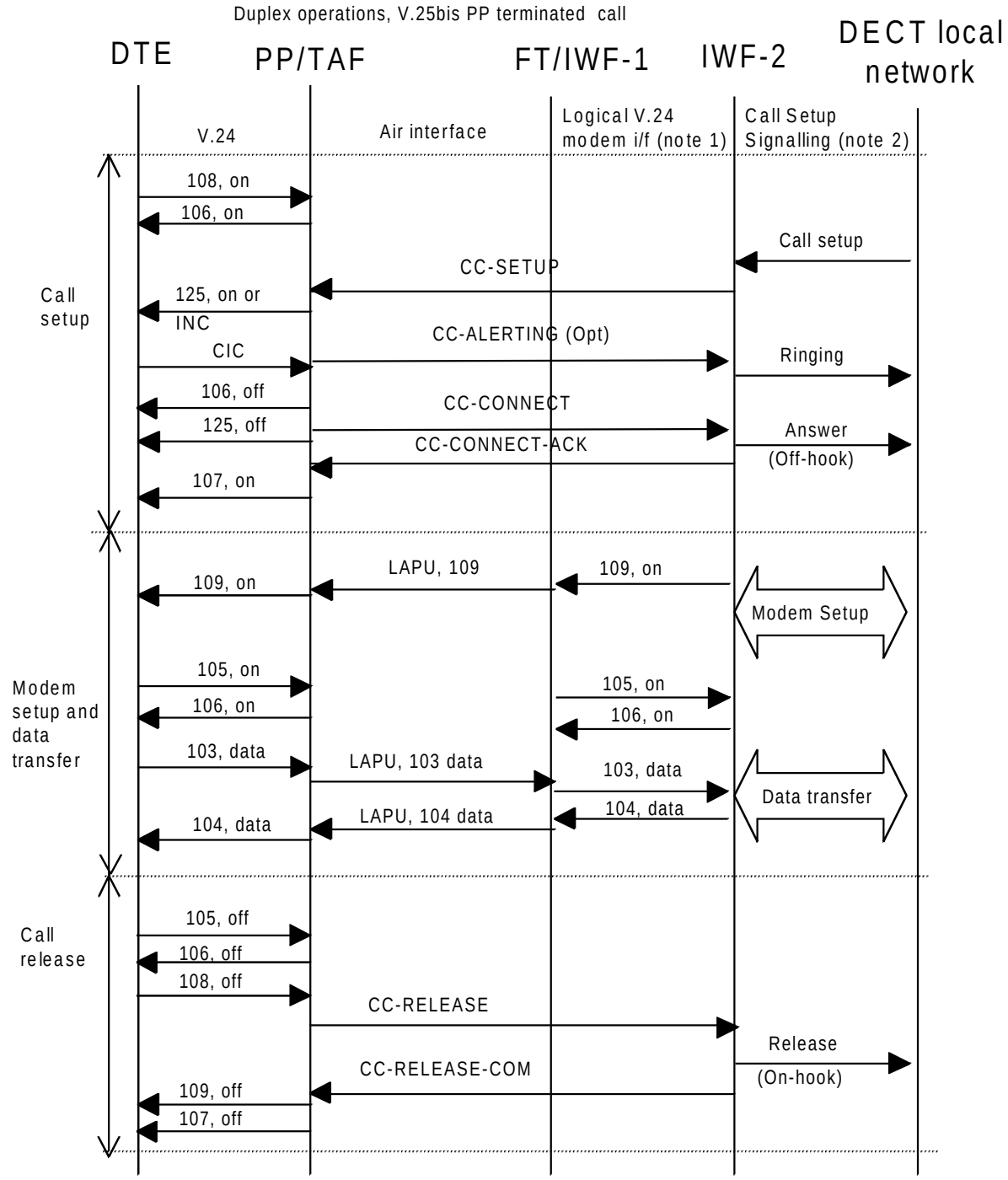



NOTE 1: The logical V.24 interface corresponds to the R reference point in the Reference Configuration shown in figure C.6. This shall result in transmission and reception of the appropriate voice-band modems tones in accordance with the relevant ITU V.series modem recommendation as selected and instantiated during the DECT call setup procedures.

NOTE 2: The call setup sequence shown here is for illustrative purposes only. The actual signalling towards the network will depend on the DECT network and it interaction with the DECT signalling shall be in accordance with subclause C.4.5.4.2.

NOTE 3: The "Answer" indication is specified in subclause C.4.5.4.2.

**Figure C.5.6.4.9.1: Duplex operations V.25bis PP originated call**




NOTE 1: The logical V.24 interface corresponds to the R reference point in the Reference Configuration shown in figure C.6. This shall result in transmission and reception of the appropriate voice-band modems tones in accordance with the relevant ITU V.series modem recommendation as selected and instantiated during the DECT call setup procedures.

NOTE 2: The call setup sequence shown here is for illustrative purposes only. The actual signalling towards the network will depend on the DECT network and it interaction with the DECT signalling shall be in accordance with subclause C.4.5.4.2.

**Figure C.5.6.4.9.2: Duplex operations V.25bis PP originated call**

# Annex D (normative): Interworking conventions for the FREL service.

## D.1 Scope of this annex

The typical configuration for interworking to connectionless networks, shall be as shown in figure D.1.1.

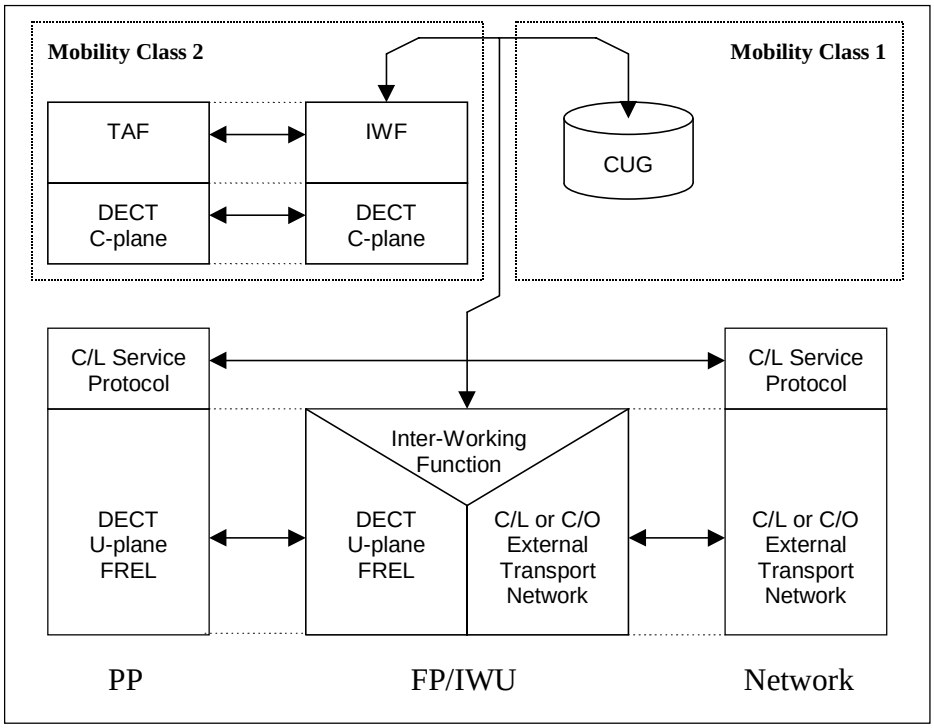



**Figure D.1.1: Reference configuration for interworking to connectionless networks**

Mobility class 2 equipment requires a full C-plane, while for mobility class 1 equipment, the C-plane is replaced by a Closed User Group administration.

The DECT U-plane Frame Relay service is provided by DLC services D.1, D.2 and D.3, as defined in subclause 4.3.3. The specific interworking functions are defined in the other clauses of this annex, and are depending on the provided connectionless network protocol.

The implementation of the external connectionless network protocol is outside the scope of this profile.

# D.2 Specific codings for mobility class 2

## D.2.1 IWU-Attribute coding

Mobility class 2 equipment, implementing the Interworking Units described in this annex, shall use the following IWU-Attribute coding:

| Bit: | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Octet: |
|---|---|---|---|---|---|---|---|---|---|
| | 0 | <<IWU-ATTRIBUTES>> | | | | | | | 1 |
| | Length of Contents (L) | | | | | | | | 2 |
| | 1 | CodeStd | | Profile | | | | | 3 |
| | | 0 | 1 | 0 | 0 | 0 | 0 | 0 | |
| | 1 | Negotiation indicator | | | A/B | Profile subtype | | | 4 |
| | 0 | Maximum SDU size (Most significant 7 bits) | | | | | | | 5 |
| | 1 | Maximum SDU size (Least significant 7 bits) | | | | | | | 5a |
| | 1 | | | | | | IP Addr Plan | | 6 (optional) |

**Figure D.2.1.1**

Negotiation indicator (octet 4):

Bits 7 6 5 Meaning;

- 0 0 0 Negotiation not possible;
- 0 1 0 Peer attribute negotiation;
- 1 0 0 Exchanged attribute negotiation;
- 1 1 0 Exchanged attribute negotiation and Peer attribute negotiation;
- All other values are reserved.

Profile Type A/B coding (octet 4):

Bits 4 Meaning;

- 0 Type A;
- 1 Type B.

Profile subtype (octet 4):

Bits 3 2 1 Meaning;

- 0 0 0 Interworking to ISO 8802-3 [24] (Ethernet) (clause A.2);
- 0 0 1 Interworking to ISO 8802-5 [25] (Token Ring) (clause A.3);
- 1 0 0 Interworking to Internet Protocol (IP) (clause A.4);
- All other values are reserved.

Maximum SDU size (octets 5 and 5a):

This 14 bit word represents the natural binary coding of the maximum SDU length in units of eight octets used for data transmission, with the least significant bit in position 1 of octet 5a.

IP address plan (octet 6) (Optional):

This octet may be optionally included only if the "Profile Subtype" is: "Interworking to Internet Protocol (IP)". If the "Profile Subtype" is: "Interworking to Internet Protocol (IP)" and this octet is omitted then the default value shall be used.

This facility has been specifically included to cater for the increasing trend of using IP networks for closed user groups, the so called Intra-nets. It allows routeing (in the fixed network) of IP packets, independent of their IP address, to either the global Internet, or service provider or customer specific closed user groups.

Bits 2 1 Meaning;

- 0 0 Global IP address (default);
- 0 1 Service provider specific IP address;
- 1 0 Customer specific IP address;
- All other values are reserved.

## D.2.2 IWU attributes implemented

**Table D.2.2.1: IWU attribute support status**

| Supported parameters | | | | | | |
|---|---|---|---|---|---|---|
| **Field no.** | **Name of fields** | **Ref.** | **Protocol Status** | **Supp** | **Values** | |
| | | | | | **Allowed** | **Supported** |
| 1 | ID of IWU attributes of variable length | note 1 | M | | 18 | |
| 2 | Length of Contents (L) | note 2 | M | | 0-255 | 5-9 |
| 3 | Coding standard | note 2 | M | | 1 | |
| 3 | Profile | note 2 | M | | 0-3,8-12 | 0 |
| 4 | Negotiation indicator | note 2 | M | | 0,2,4,5 | |
| 4 | Profile Type A/B coding | A.1.1 | I | M | 0-1 | |
| 4 | Profile subtype | A.1.1 | M | | 0-7 | 0-1, 4 |
| 5,5a | Maximum SDU size | A.1.1 | I | M | 0 - 131 064 | |
| 6 | IP Address Plan | A.1.1 | I | note 3 | -, 0-2 | |
| NOTE 1: See 2nd edition of EN 300 175-5 [5], 7.7.1.<br>NOTE 2: See 2nd edition of EN 300 175-5 [5], 7.7.21.<br>NOTE 3: "O" if "Profile Subtype" is "Interworking to Internet Protocol (IP)", or else "X". | | | | | | |

# D.3 Generic frame relay service interworking conventions

All data frames shall always be transmitted as DECT DLC layer SDUs. The Most Significant Bit (MSB) of each octet shall be transmitted first and the Least Significant Bit (LSB) last.

The DECT equipment shall be capable of supporting SDU frames of at least 1528 octets. The equipment may optionally support larger SDUs.

Where SDU sizes larger than 1528 octets are supported by either the FT or the PT the smaller value shall be used in communications, or if this is not possible, the FT equipment shall not allow PT equipment to be registered.

All point-to-multipoint and broadcast packets shall be transmitted by the FP over the connectionless downlink service (SIp), and may also be transmitted over previously established connections (refer to annex E).

# D.4 ISO 8802-3 [24] (Ethernet)

The provisions of this clause shall apply if interworking to ISO 8802-3 [24] (Ethernet) LANs is provided.

## D.4.1 Typical configuration

The typical configuration for this specific interworking convention shall be as defined in clause D.1, where the external transport network is conform ISO 8802-3 [24]. In this configuration the interworking is a bridging function.

## D.4.2 Specific interworking conventions

The conditions of clause D.3 shall be adhered to in addition to the following:

- the ISO 8802-3 [24] MAC frame shall be transmitted as a single DECT DLC layer SDU beginning with the ISO 8802-3 [24] MAC Destination Address and ending with the MAC Information field;
- for MAC frames which are less than 64 octets in length, the PAD field shall not be transmitted. This mapping is shown in figure D.4.2.1;
- in mobility class 1 equipment IPUIs of type O shall be used, where the full ISO 8802-3 [24] MAC address shall be mapped into the type O IPUI with the Least Significant Bit (LSB) of the ISO 8802-3 [24] MAC address corresponding to the LSB of the IPUI.

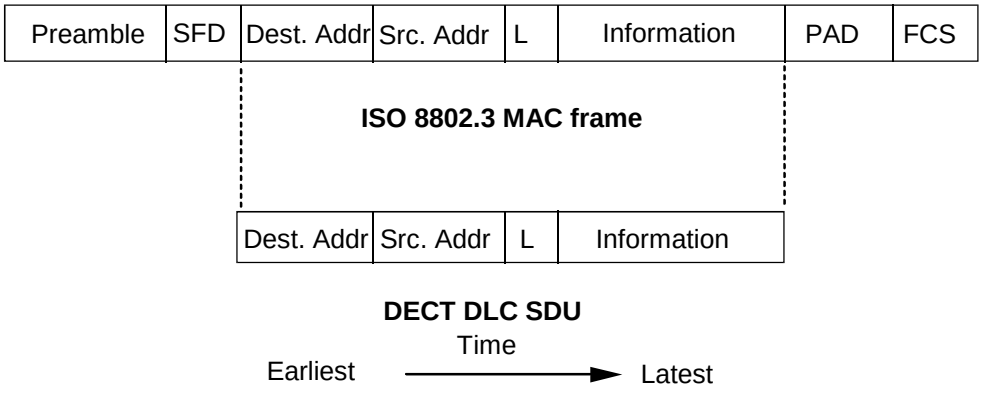



**Figure D.4.2.1: Mapping of ISO 8802-3 [24] MAC frames into DECT DLC SDU**

# D.5 ISO 8802-5 [25] (token ring)

The provisions of this clause shall apply if interworking to ISO 8802-5 [25] (token ring) LANs is provided.

## D.5.1 Typical configuration

The typical configuration for this specific interworking convention shall be as defined in clause D.1, where the external transport network is conform ISO 8802-5 [25]. In this configuration the interworking is a bridging function.

## D.5.2 Specific interworking conventions

The conditions of clause D.3 shall be adhered to in addition to the following:

- the ISO 8802-5 [25] MAC frame shall be transmitted as a single DECT DLC layer SDU beginning with the ISO 8802-5 [25] MAC Frame Control (FC) field and ending with the MAC Information field;
- the FP shall not send the token ring MAC Control frames as identified by the FC byte and it shall not send the Frame Status (FS) byte. It shall be the responsibility of the FP to inter-work these to the token ring network. This mapping is shown in figure D.5.2.1;
- in mobility class 1 equipment IPUIs of type O shall be used, where the full ISO 8802-5 [25] MAC address shall be mapped into the type O IPUI with the LSB of the ISO 8802-5 [25] MAC address corresponding to the LSB of the IPUI.

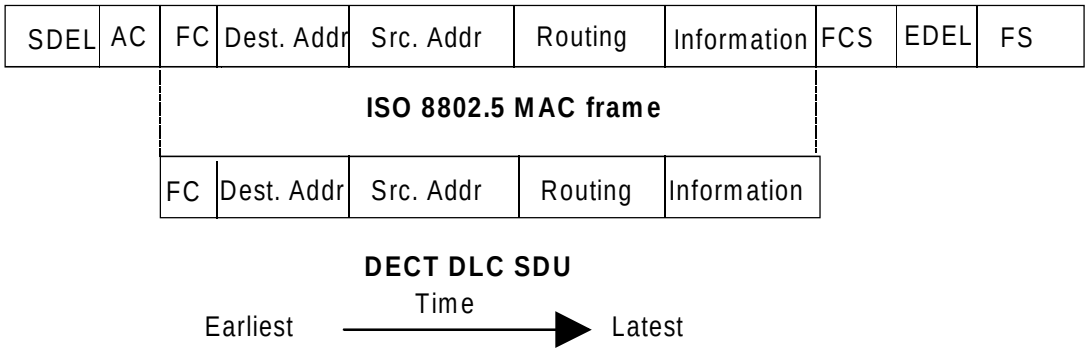



**Figure D.5.2.1: Mapping of ISO 8802-5 [25] MAC frames into DECT DLC SDU**

# D.6 Internet protocol

The provisions of this clause shall apply if interworking to Internet Protocol (IP) networks version 4 (RFC 791 [26]) or higher is provided.

## D.6.1 Typical configuration

The typical configuration for this specific interworking convention shall be as defined in clause D.1, where the external transport network is conform RFC 791 [26], version 4 or higher. In this configuration the FP interworking is an IP/datagram routing function.

## D.6.2 Specific interworking conventions

The conditions of clause D.3 shall be adhered to in addition to the following:

- IP datagrams shall be transmitted directly as a single U-plane DLC layer LU2. The SDU contains the IP header followed immediately by the IP data. Since these LU2 SDUs can be an arbitrarily short length there are no requirements for adding fill fields or padding before transmission of IP packets as LU2 SDUs;
- In mobility class 1 equipment IPUIs of type O shall be used.

# D.7 Point-to-Point Protocol

The provisions of this clause shall apply to transport data encapsulated using the Point-to-Point Protocol (PPP), as defined in RFC 1661 [27].

## D.7.1 Typical configuration

The typical configuration for this specific interworking convention shall be as defined in clause D.1. In this configuration the FP interworking transparently maps any PPP packet coming from a given DECT air interface packet-mode connection to a fixed virtual circuit at the Network interface.

## D.7.2 Specific interworking conventions

The conditions of clause D.3 shall be adhered to in addition to the following:

- The PPP packets, as defined in RFC 1661 [27] shall be transmitted directly as a single U-plane DLC layer LU2 SDU. The SDU contains the PPP "protocol field" header followed by the PPP data. The PPP framing, if used (e.g. the one defined in RFC 1662 [28] or other), shall be not transmitted over the DECT air interface.

- The Maximum PPP packet size shall be 1528 octets, including PPP protocol field.

- In mobility class 1 equipment IPUIs of type O shall be used.

# Annex E (normative): Usage of the SIP protected data connectionless downlink service

The SIP protected data connectionless downlink service is used by the FP-PP point-to-multipoint service to transfer the data frames after the LU2 (Class 1) framing and FU6a segmentation functions have been performed on the point-to-multipoint SDU (see clause 7).

The FP shall only transmit SIP data starting at the start of a paging cycle. A PP shall understand the presence of SIP data to be indicated by the coding BA = SIN and the PT MAC layer information = Dummy or C/L bearer. The TDMA frame immediately following the frame in which SIP data was received shall also be monitored to find out whether it contains SIP data. In this way SIP data shall be understood to be present in each subsequent TDMA frame until the BA and MAC layer information codings indicate that the SIP data field is no longer present. No further SIP information shall then be available until the start of the next paging cycle.

The start of a paging cycle in this context shall be that time-slot in frame 0 of a multiframe that is carrying the start of a paging message. When paging repetition is supported by the fixed part, the modulo 4 of the number of this multiframe shall be 0.

# Annex F (normative): Mobility Class 1 configuration capabilities

In order to assure reliable inter-working between devices complying with this profile in mobility class 1, it shall be possible to install the following parameters in the FPs and/or PPs of the system. The values of parameters referring to the PP shall be clearly indicated in the documentation of the PP, and means shall be provided in FPs for such values to be registered. The values of parameters referring to the FP shall be clearly indicated in the documentation of the FP, and means shall be provided in PP for such values to be registered.

**Table F.1**

| Variable parameter | Value | Fixed(F)/Portable(P) |
|---|---|---|
| Service associated with identity | Type A or B | F, P |
| Data frames | Selected from annex B | F, P |
| IPUI | Unique value within local environment | P |
| ARI | Unique value within local environment | F |
| Maximum supported SDU size | Number of octets | F, P |
| Multi-bearer capability | 1-23 | F, P |
| Asymmetric capability | Yes/No | F, P |
| Diversity capability | Yes/No | F, P |
| Fast paging available | Yes/No | F, P |
| Connectionless downlink supported | Yes/No | F, P |
| Encryption capability | Yes/No | F, P |
| Static cipher key | 64 bits | F, P |
| Setup detection timer | 0-255 DECT Multiframes | P |

A given set of values for the parameters shall be unique for the IPUI with which they are associated.

The same International Portable User Identity (IPUI) type shall be used within a given local environment. The PMID shall use the assigned PMID structure as defined in 9.1.2 of EN 300 175-6 [6]. Further the PMID shall be based upon the default value of the TPUI (see subclause 6.3.1, EN 300 175-6 [6]) which is derived from the IPUI and is always available (subclause 6.3.2, EN 300 175-6 [6]).

All IPUI's within one FP shall be assigned in such a way that the last 16 bits (which are used in the default TPUI) of the IPUI are unique.

# Bibliography

The following material, though not specifically referenced in the body of the present document (or not publicly available), gives supporting information.

CCITT Recommendation Q.921 (1988): "Digital subscriber signalling system no. 1 data link layer".

# History

| Document history | | | | |
|---|---|---|---|---|
| V0.0.2 | March 1999 | Public Enquiry | PE 9927: | 1999-03-05 to 1999-07-02 |
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