



INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

X.329

(03/2000)

SERIES X: DATA NETWORKS AND OPEN SYSTEM
COMMUNICATIONS

Interworking between networks – General

**General arrangements for interworking between
networks providing frame relay data
transmission services and B-ISDN**

ITU-T Recommendation X.329

(Previously CCITT Recommendation)

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ITU-T RECOMMENDATION X.329

GENERAL ARRANGEMENTS FOR INTERWORKING BETWEEN NETWORKS PROVIDING FRAME RELAY DATA TRANSMISSION SERVICES AND B-ISDN

Summary

This Recommendation defines general arrangements for interworking between networks providing Frame Relay Data Transmission Services (FRDTS) and B-ISDN. It includes reference configurations, protocol stacks, FR/ATM element mapping and other general arrangements required for various interworking scenarios between the two types of networks. In particular, it focuses on the cases where dedicated Frame Relay networks are involved in such interworking scenarios.

Source

ITU-T Recommendation X.329 was prepared by ITU-T Study Group 7 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on 31 March 2000.

FOREWORD

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NOTE

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GENERAL ARRANGEMENTS FOR INTERWORKING BETWEEN NETWORKS PROVIDING FRAME RELAY DATA TRANSMISSION SERVICES AND B-ISDN

(Geneva, 2000)

1 Scope

This Recommendation defines general arrangements for interworking between FRDTS provided by public data networks and B-ISDN. It includes reference configurations, protocol stacks and FR/ATM element mappings.

2 References

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

- [1] ITU-T Recommendation I.233.1 (1991), *ISDN frame relaying bearer service*.
- [2] ITU-T Recommendation I.361 (1999), *B-ISDN ATM layer specification*.
- [3] ITU-T Recommendation I.363.5 (1996), *B-ISDN ATM Adaptation Layer specification: Type 5 AAL*.
- [4] ITU-T Recommendation I.365.1 (1993), *B-ISDN ATM adaptation layer sublayers: Frame relaying service specific convergence sublayer (FR-SSCS)*.
- [5] ITU-T Recommendation I.371 (1996), *Traffic control and congestion control in B-ISDN*.
- [6] ITU-T Recommendation I.555 (1997), *Frame Relaying Bearer Service interworking*.
- [7] ITU-T Recommendation I.610 (1999), *B-ISDN operation and maintenance principles and functions*.
- [8] ITU-T Recommendation I.620 (1996), *Frame relay operation and maintenance principles and functions*.
- [9] ITU-T Recommendation Q.2931 (1995), *Digital Subscriber Signalling System No. 2 (DSS 2) – User-Network Interface (UNI) – Layer 3 specification for basic call/connection control*.
- [10] ITU-T Recommendation Q.2933 (1996), *Digital subscriber Signalling System No. 2 (DSS 2) – Signalling specification for Frame Relay service*.
- [11] ITU-T Recommendation X.36 (2000), *Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for public data networks providing frame relay data transmission service by dedicated circuit*.
- [12] ITU-T Recommendation X.76 (2000), *Network-to-network interface between public data networks providing the frame relay data transmission service*.
- [13] ITU-T Recommendation X.300 (1996), *General principles for interworking between public networks and between public networks and other networks for the provision of data transmission services*.

3 Terms and Definitions

This Recommendation defines the following term:

- 3.1 FR-SSCS:** FR-SSCS is used at the TE and AU to interworking between AAL and LAPF.

4 Abbreviations

This Recommendation uses the following abbreviations:

AAL	ATM Adaptation Layer
ATC	ATM Transfer Capability
ATM	Asynchronous Transfer Mode
AU	Access Unit
B-ISDN	Broadband ISDN
B-TE	TE subscribing to a B-ISDN
BCOB	Broadband Connection Oriented Bearer class
BECN	Backward Explicit Congestion Notification
Bc	Committed Burst
Be	Excess Burst
CI	Congestion Indication
CIR	Committed Information Rate
CPCS	Common Part Convergence Sublayer
CPCS-CI	CPCS-Congestion Indication
CPCS-LP	CPCS-Loss Priority
CPCS-UU	CPCS-User-to-User indication
DE	Discard Eligibility
DLCI	Data Link Connection Identifier
DTE	Data Terminal Equipment (as traditionally defined in X-series Recommendations)
DTP	Data Transfer Protocol
FECN	Forward Explicit Congestion Notification
FR-DTE	DTE subscribing to a network providing FRDTS
FR-SSCS	Frame Relaying Service Specific Convergence Sublayer
FRDTS	Frame Relay Data Transmission Service
ISDN	Integrated Services Digital Network
IWF	InterWorking Function
LP	Loss Priority
PDU	Protocol Data Unit
PVC	Permanent Virtual Circuit
SAR	Segmentation and Reassembly

SSCF	Service Specific Coordination Function
SSCS	Service Specific Convergence Sublayer
SVC	Switched Virtual Circuit
TE	Terminal Equipment (as traditionally defined in I-series Recommendations)
VCC	Virtual Channel Connection
VCI	Virtual Channel Identifier
VPI	Virtual Path Identifier

5 Conventions

No particular conventions are included.

6 Reference Configurations

In this recommendation two possible alternative cases below are considered.

Case A Interworking (Access) cases where a network providing FRDTS and a B-ISDN are involved.

This case will be used to set up a connection from a B-TE connected to the B-ISDN network to a FR-DTE connected to the network providing FRDTS, and vice versa.

Case B Interworking cases where two networks providing FRDTS are concatenated via (a) B-ISDN(s).

This case will be used to connect two networks providing FRDTS via a B-ISDN that is used as a backbone network.

6.1 General arrangements for Case A

Case A can be subdivided further into the following three cases:

- (A-1) Port access cases (see Recommendation X.300) where an end-to-end connection shall be set up by two stages; the first stage setting up an ATM SVC connection between the B-TE and the AU, then the second stage setting up an frame relay SVC connection end-to-end.
- (A-2) Call control mapping (see Recommendation X.300) and Network interworking cases (see Recommendation I.555) where an end-to-end connection shall be set up by one stage in which frame relay adaptation protocols are performed over the B-ISDN connection; call control signals shall be mapped one to one between both sides of the IWF and the B-TE knows that the destination DTE is a FR-DTE.
- (A-3) Call control mapping and Service interworking cases (see Recommendation I.555) where an end-to-end connection shall be set up by one stage in which the IWF shall completely convert the two native services and protocols one from the other.

Note that in case of port access, frame relay adaptation protocols shall be used at the second stage. Thus, this case can be categorized as the Network interworking cases as well. Also, such frame relay adaptation protocols shall also be used for transmitting data frames on the U-plane at the B-ISDN side in the first two cases.

6.1.1 Port access cases (Case A-1)

In this case, a B-ISDN SVC shall be set up between the B-TE and the AU using DSS2 signalling procedures as specified in Recommendation Q.2931 at the first stage (C-plane procedures). Then, the full X.36 procedures shall be performed end-to-end using the frame relay adaptation protocols over the U-plane (see Figure 1). Multiple frame relay SVCs may be multiplexed onto one B-ISDN SVC.

NOTE – B-ISDN PVC may be used instead of B-ISDN SVC. In this case the first stage does not exist. Further, X.36/Q.933 PVC may be used instead of X.36/Q.933 SVC. No X.36/Q.933 PVCs exist over B-ISDN SVCs.

The FR-SSCS, as shown in Figure 1, supports the FR core functions of Recommendation I.233.1.

The ATM layer is specified in Recommendation I.361 and the AAL composed of the SAR and CPCS sublayers is specified in Recommendation I.363.5. AAL type 5 (SAR and CPCS) shall be used for FR and B-ISDN interworking. The FR-SSCS is defined in Recommendation I.365.1. The FR-SSCS-PDU has exactly the same structure as the FR address field without the flags, zero bit insertion and FCS, as specified in Recommendation I.365.1.

Detailed procedures for this case are defined in Recommendation X.46.

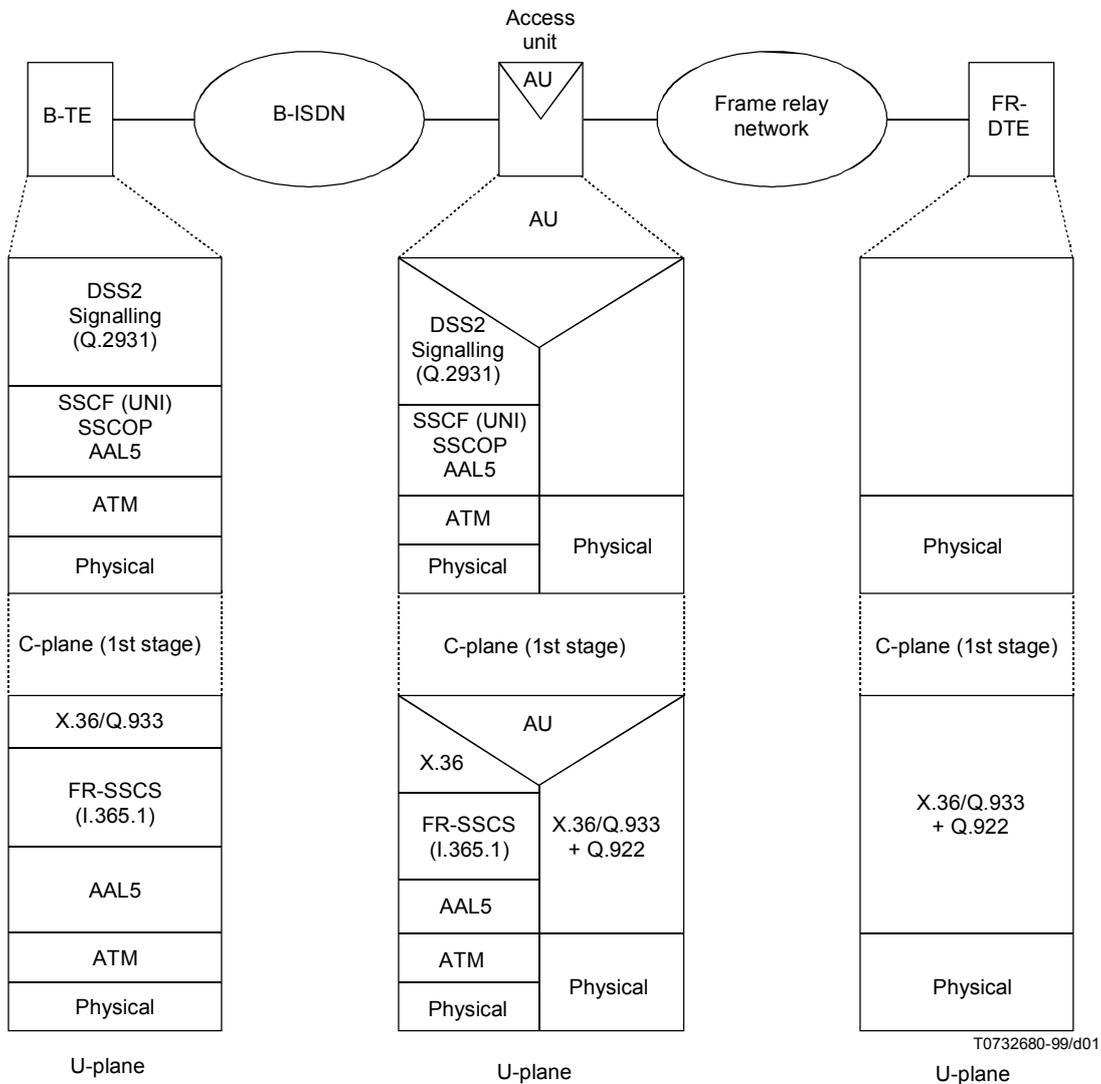


Figure 1/X.329 – Arrangement for Port access cases (Case A-1)

6.1.2 Call control mapping and network interworking cases (Case A-2)

In this case, the B-TE and the IWF perform Q.2933 signalling to simultaneously set up a B-ISDN SVC and frame relay SVC. Multiple frame relay SVCs may be multiplexed onto one B-ISDN SVC (see Figure 2).

NOTE – B-ISDN PVC may be used instead of B-ISDN SVC. Further, X.36/Q.933 PVC may be used instead of X.36/Q.933 SVC. No X.36/Q.933 PVCs exist over B-ISDN SVCs.

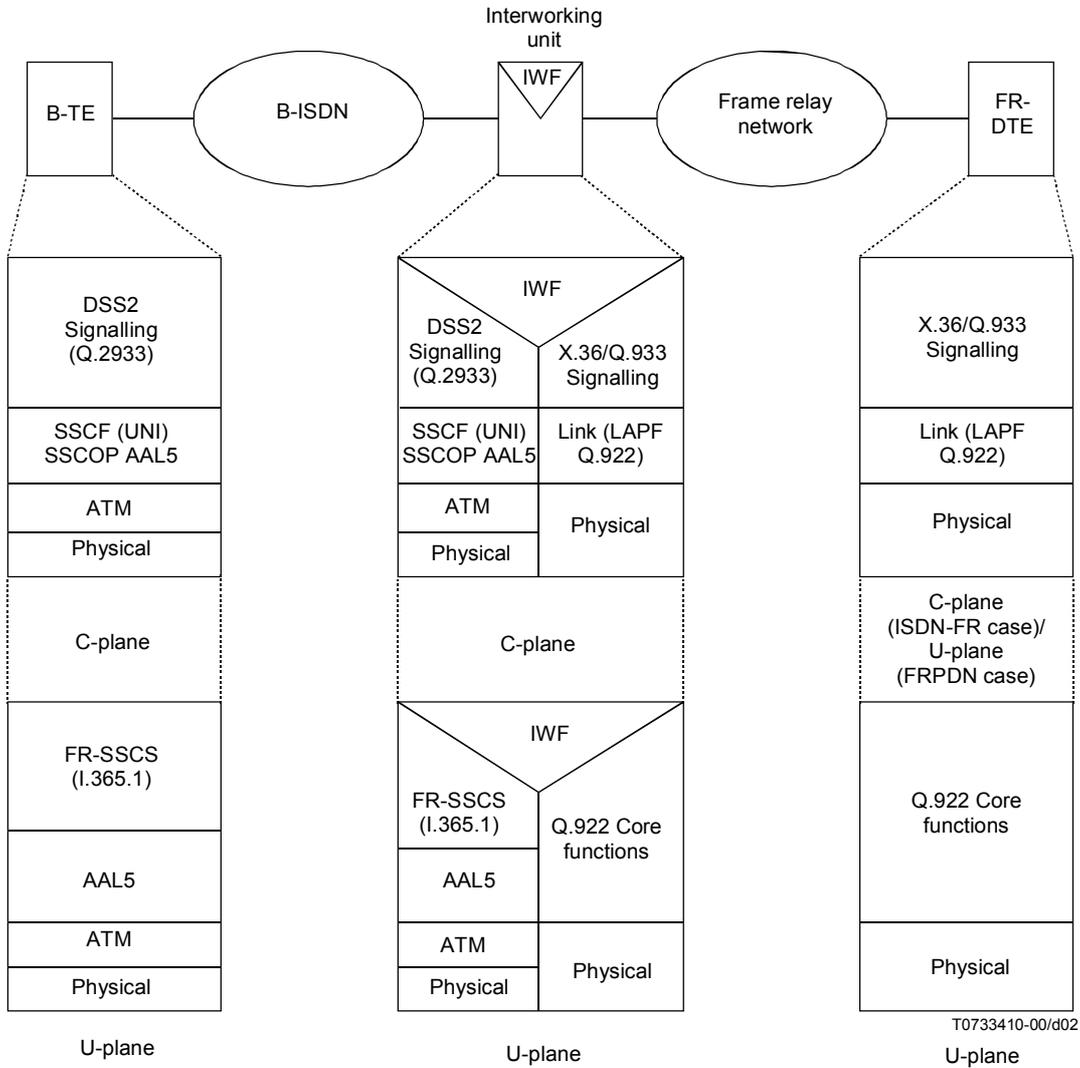


Figure 2/X.329 – Arrangement for the case of call control mapping and network interworking (Case A-2)

6.1.3 Call control mapping and service interworking cases (Case A-3)

In this case, the B-TE performs only the native B-ISDN signalling and the IWF shall completely convert the native B-ISDN signalling to the frame relay signalling (see Figure 3). Therefore, the B-TE has no knowledge about the protocols of the destination terminal. One B-ISDN SVC corresponds with one frame relay SVC.

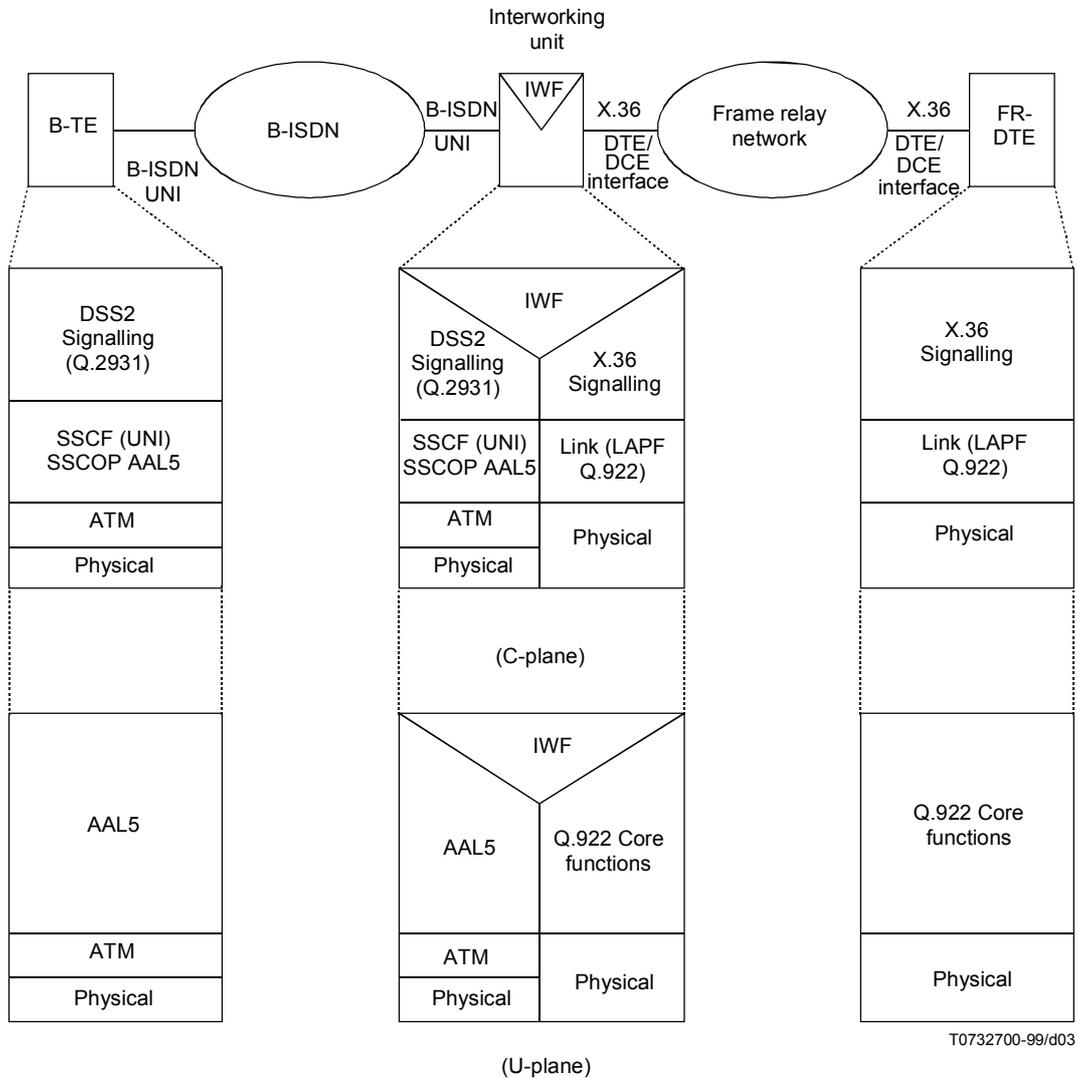


Figure 3/X.329 – Arrangement of service interworking cases (Case A-3)

6.2 General arrangements for Case B

Case B can be subdivided further into the following three cases:

- (B-1) Port access cases where a connection between the IWFs shall be set up by two stages; the first stage setting up an ATM SVC connection between the IWFs, then the second stage setting up an frame relay SVC connection between the IWFs.
- (B-2) Call control mapping and Network interworking cases where a connection between the IWFs shall be set up by one stage in which frame relay adaptation protocols are performed over the B-ISDN connection; call control signals shall be mapped one to one between both sides of the two.

(B-3) Call control mapping and Service interworking cases where a connection between the IWFs shall be set up by one stage in which the IWFs shall completely convert the two native protocols one from the other.

Note that in case of port access, frame relay adaptation protocols shall be used at the second stage. Thus, this case can be categorized as the Network interworking cases as well. Also, such frame relay adaptation protocols shall also be used for transmitting data frames on the U-plane at the B-ISDN portion in the first two cases.

6.2.1 Port access cases (Case B-1)

In this case, a B-ISDN SVC shall be set up between the IWFs using DSS2 signalling procedures as specified in Recommendation Q.2931 at the first stage (C-plane procedures). Then, the full X.76 procedures shall be performed end-to-end using the frame relay adaptation protocols over the U-plane (see Figure 4). Multiple frame relay SVCs may be multiplexed onto one B-ISDN SVC.

NOTE – B-ISDN PVC may be used instead of B-ISDN SVC. In this case the first stage does not exist. Further, X.76 PVC may be used instead of X.76 SVC. No X.76 PVCs exist over B-ISDN SVCs.

Detailed procedures for this case are defined in Recommendation X.78.

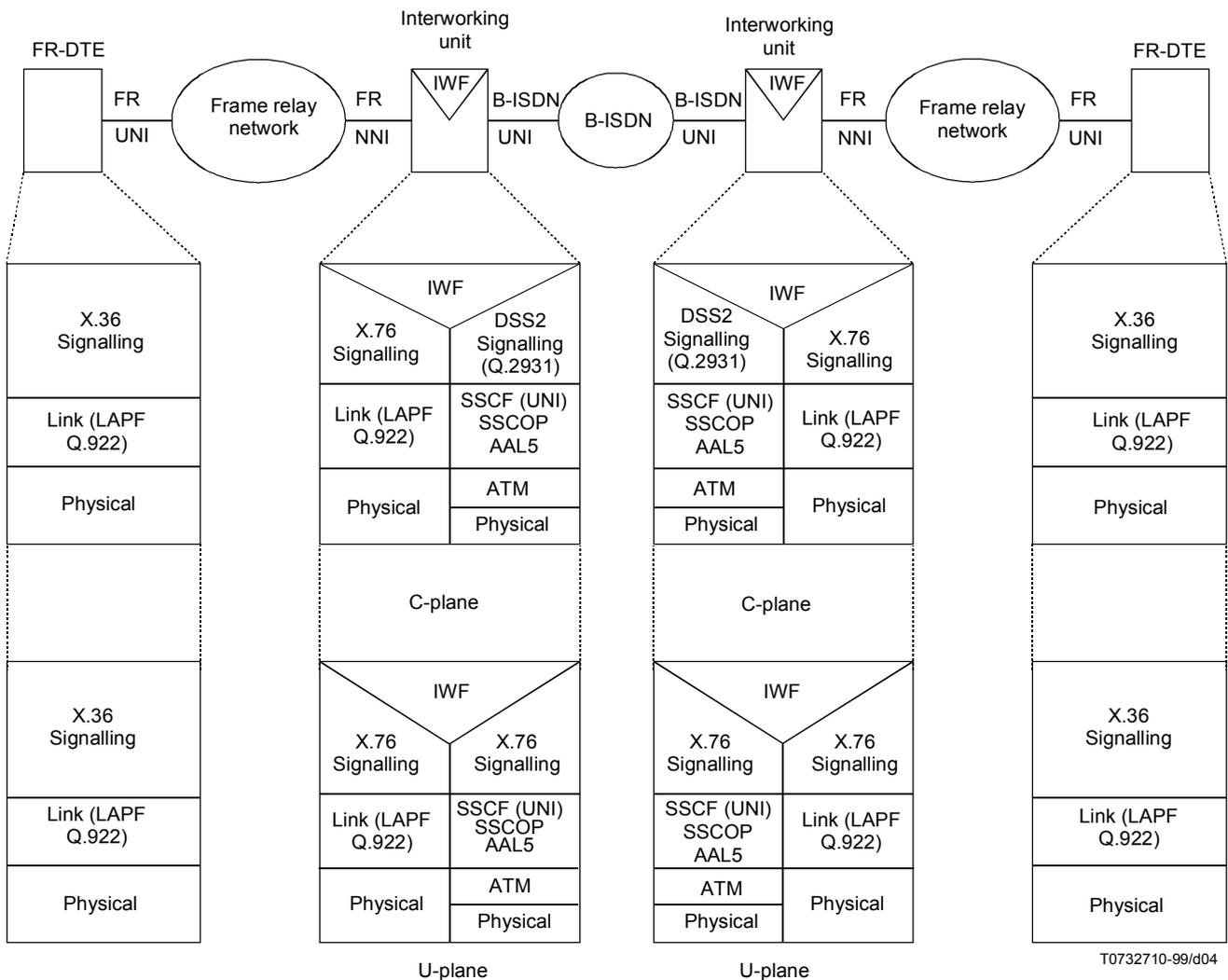


Figure 4/X.329 – Arrangement for Port access cases (Case B-1)

6.2.2 Call control mapping and network interworking cases (Case B-2)

In this case, the IWFs perform Q.2933 signalling to simultaneously set up a B-ISDN SVC and an frame relay SVC. One frame relay SVC shall be supported over one B-ISDN SVC (see Figure 5).

NOTE – B-ISDN PVC may be used instead of B-ISDN SVC. Further, X.76 PVC may be used instead of X.76 SVC. No X.76 PVCs exist over B-ISDN SVCs.

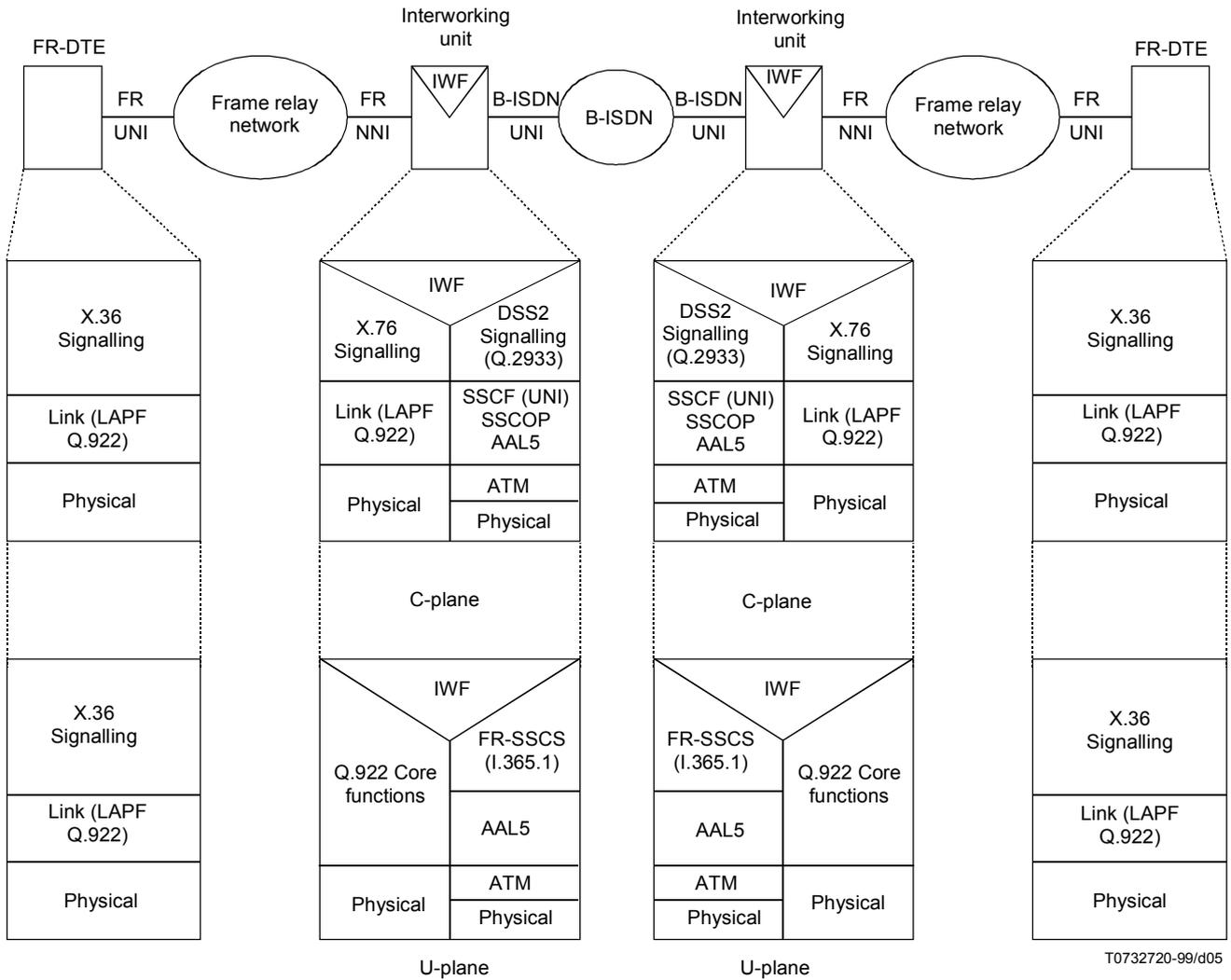


Figure 5/X.329 – Call control mapping and network interworking (Case B-2)

6.2.3 Call control mapping and service interworking cases (Case B-3)

In this case, the IWF shall completely convert the native B-ISDN signalling to the frame relay signalling and vice versa (see Figure 6). Therefore, the TE connected to the Frame Relay network has no knowledge about the existence and the protocols of the B-ISDN. One B-ISDN SVC corresponds with one frame relay SVC.

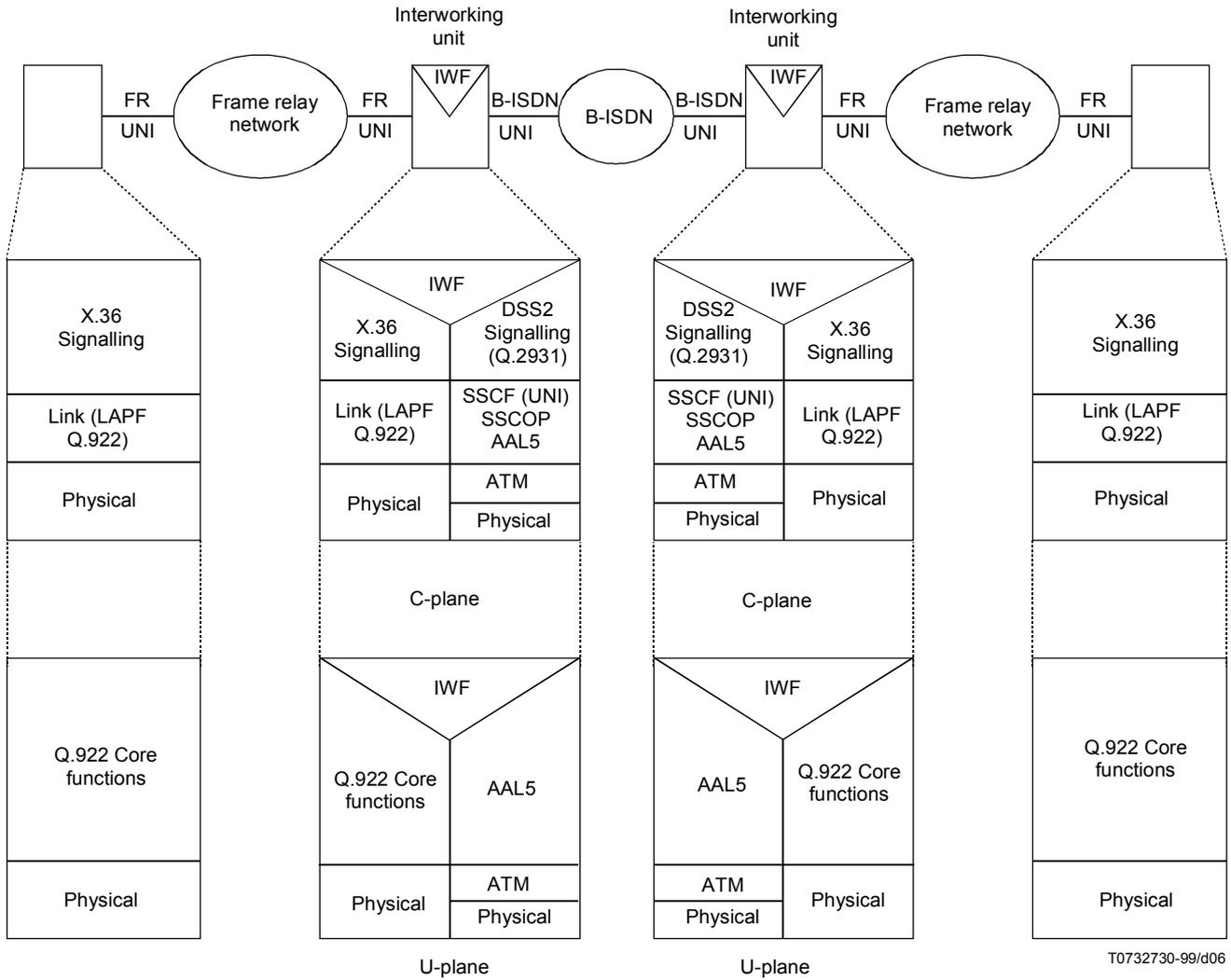
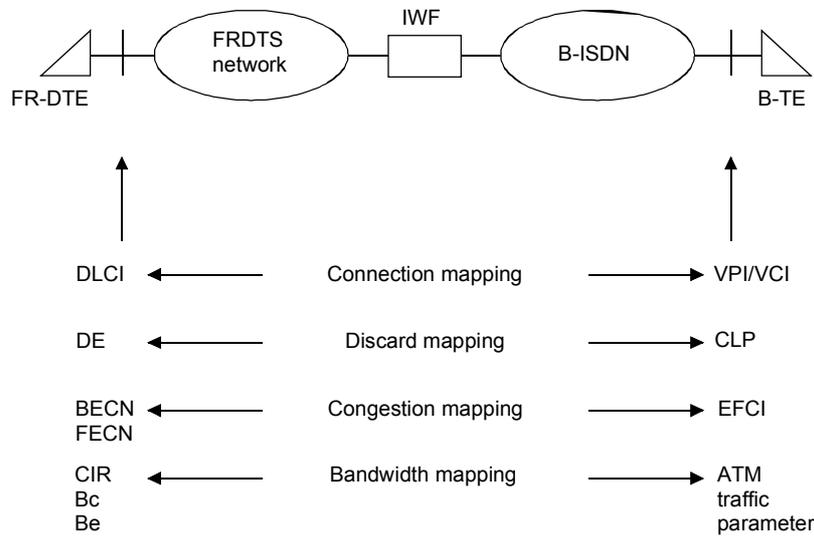


Figure 6/X.329 – Call control mapping and service interworking (Case B-3)

7 FR/ATM element mapping at IWF

7.1 Protocol mappings

Figure 7 shows the protocol parameter mappings required between FRDTS and B-ISDN Class C Service.



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NOTE – The DLCI parameter identifies FR connections at the FR interface. The VPI/VCI parameter identifies the ATM connection at the B-ISDN interface. The connection identifier only have local significance, and accordingly there is no requirement to map between the FR DLCI and the ATM VPI/VCI parameters. The DLCI is only significant on the B-ISDN side in the case of N to 1 mapping.

Figure 7/X.329 – Protocol mapping between FR and B-ISDN

7.1.1 Discard eligibility and loss priority mapping

For the network interworking scenarios the following mappings apply, as shown in Figure 8. For the service interworking case the FR-SSCS is replaced with a Null SSSC, and the upper layer protocols make direct use of the CPCS primitives.

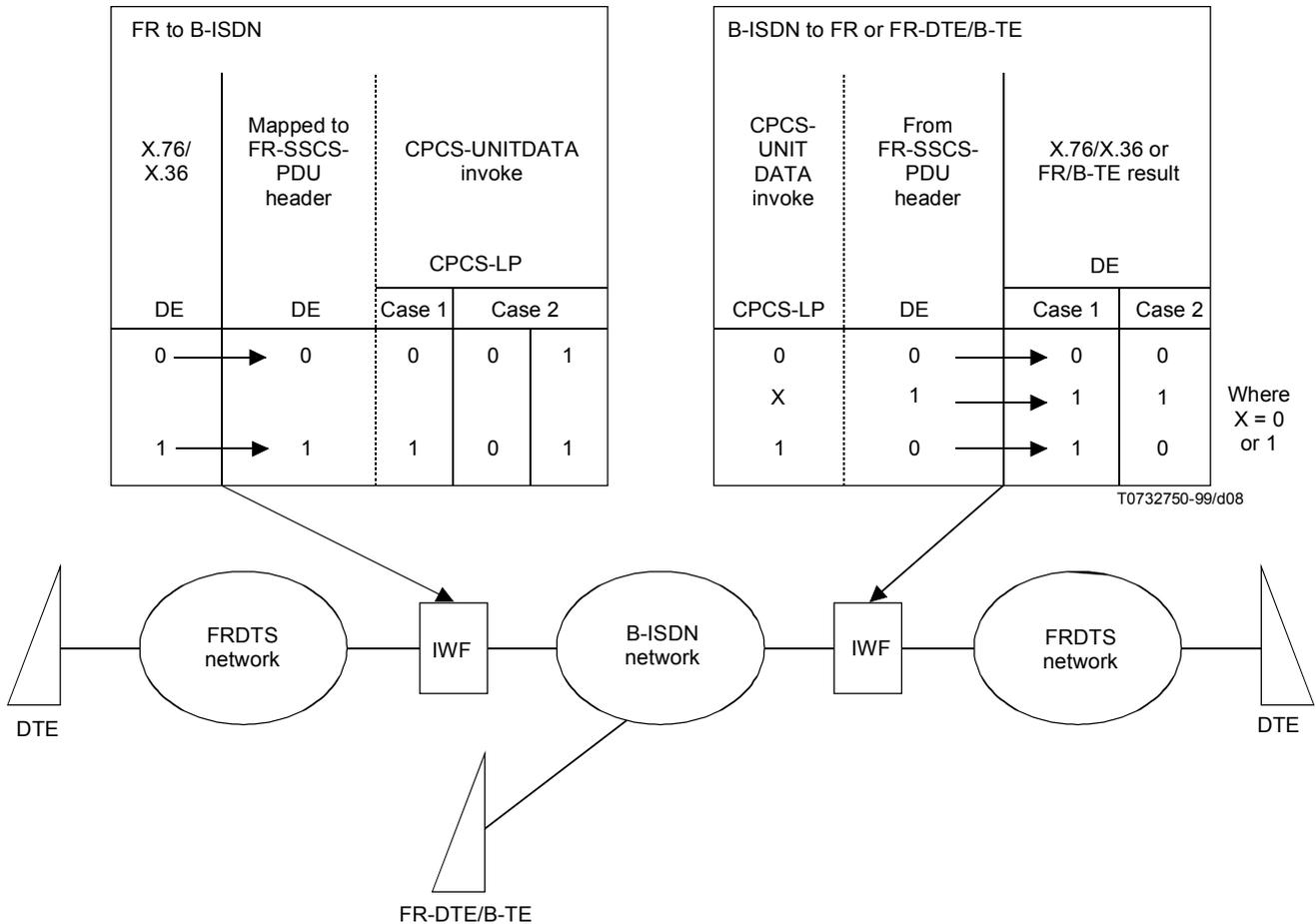


Figure 8/X.329 – DE/CLP mapping

1) *Loss priority mapping in FR – to – B-ISDN direction*

The CPCS-Loss Priority (CPCS-LP) parameter is either:

Case 1 set to the value of the parameter Discard Eligibility of DL-CORE DATA request primitive or the IWF-DATA request primitive; or

Case 2 always set to 0 or to 1.

Both cases above shall be supported so that network operators can decide at connection set-up or subscription on a CPCS connection basis which one is used. The method of selection between the two cases outlined above is outside the scope of this Recommendation.

2) *Loss priority mapping in B-ISDN – to – FR direction*

The Discard Eligibility (DE) parameter shall be set to either:

Case 1 the logical OR of the value of the DE field in the FR-SSCS-PDU and parameter CPCS-LP of the CPCS-UNITDATA signal primitive; or

Case 2 the value of the DE field in the FR-SSCS-PDU (either 0 or 1 configured at subscription time).

Both cases above shall be supported by the IWF so that network operators can decide at connection set-up or subscription on a CPCS connection basis which one is used. It is possible to apply different mapping cases for each direction. The method of selection between the two cases outlined above is outside the scope of this Recommendation.

NOTE – The mapping of CPCS-LP parameter into the CLP bit of the ATM cell is specified in Recommendation I.363.5 (AAL type 5).

7.1.2 Congestion indication mapping

For the network interworking scenarios the following mappings between the FR FECN parameter and the B-ISDN CI parameter apply, as shown in Figure 9.

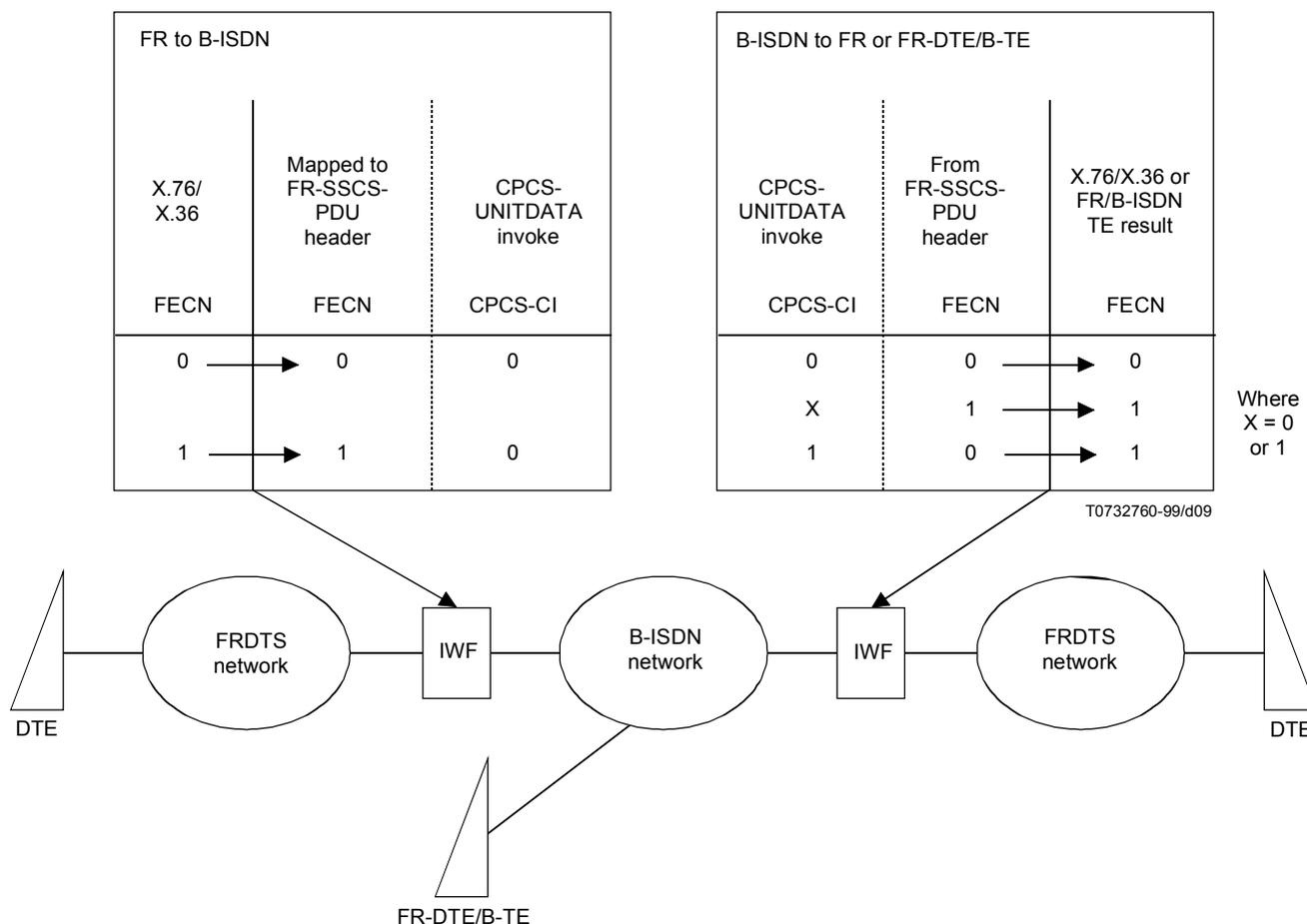


Figure 9/X.329 – Forward congestion indication mapping

1) Congestion indication mapping in FR – to – B-ISDN direction

The FECN in the frame is mapped into the FR-SSCS-PDU header FECN. The CPCS-UNITDATA invoke primitive shall be set to 0 by the FR-SSCS. Thus separate indications exist for congestion occurring in either the FR network or the ATM network.

The BECN field in FR-SSCS-PDU is set to 1 by the IWF if either of following two conditions is met:

- i) BECN is set in the FR address field, relayed in the FR to B-ISDN direction; or
- ii) the CPCS-CI parameter of most recent CPCS-UNITDATA signal primitive received for this connection if the reverse direction was set.

2) Congestion indication mapping in B-ISDN – to – FR direction

If the CPCS-CI parameter value of the CPCS-UNITDATA signal primitive is 0 and FR-SSCS-PDU header FECN = 0, then FECN shall be set to 0 in the FR address field.

If the FR-SSCS-PDU header FECN = 1, then FECN shall be set to 1 in the FR address field, irrespective of the CPCS-CI parameter value of the CPCS-UNITDATA signal primitive

If the CPCS-CI parameter value of CPCS parameter value of CPCS-UNITDATA signal primitive is 1, and the FR-SSCS-PDU header FECN = 0, then FECN shall be set to 1 in the FR address field.

The BECN field in the FR-SSCS-PDU is copied unchanged into the BECN field of the FR address field.

For the service interworking case the FR-SSCS is replaced with a Null SSSC, and the upper layer protocols make direct use of the CPCS primitives by applying the following mappings. The BECN field of the FR address field does not have an equivalent field in the CPCS frame.

3) congestion indication mapping in FR – to – B-ISDN direction

The CPCS-CI parameter shall be either:

Case 1 set to the value of the FECN bit in the FR address field; or

Case 2 always set to 0.

Both cases above shall be supported so that network operators can decide at connection set-up or subscription on a CPCS connection basis which one is used. The method of selection between the two cases outlined above is outside the scope of this Recommendation.

The value of the BECN field in the FR address field shall be ignored.

4) Congestion indication mapping in B-ISDN – to – FR direction

Case 1 The FECN field in the FR address field shall be set to the value of the CPCS-CI parameter of the CPCS-UNITDATA signal primitive.

Case 2 The BECN field in the FR address field shall always be set to 0.

It is possible to apply different mapping cases for each direction.

NOTE – The mapping of the CPCS-CI parameter into the EFCI bit of the ATM cell is specified in Recommendation I.363.5 (AAL type 5).

7.1.3 Bandwidth mapping

This mapping is done at PVC connection establishment time.

The traffic parameters used to describe a Frame Relay connection are CIR, Bc, Be and Tc (I.370). The corresponding traffic parameters used to describe the B-ISDN Class C service are dependent on the particular ATC chosen (I.371).

One conservative mapping method for service interworking using the SBR Configuration 1 ATC is described in Annex A. This one method shall be included in the set of bandwidth mapping alternatives offered by the interworking function, and is required to support the inter-operation between network operators that both offer interworking functions.

7.2 Mappings specific to service interworking

Recommendation X.76/X.36 does not specify C/R bit (see 9.3.2 and 9.3.3 Recommendation X.76/X.36). The bit intended to support C/R indication is copied directly into the LSB of the CPCS-UU byte.

7.3 OAM mappings

Recommendation I.610 covers B-ISDN OAM principles and function.

The use of OAM frames (defined in Recommendation I.620) in FRDTS is for further study.

Interworking requirement and mapping between FRDTS OAM procedures and B-ISDN OAM procedures is for further study.

7.4 PVC status management mappings

Annex B describes the FR/ATM PVC status reporting procedures for network interworking.

Annex C describes the FR/ATM PVC status monitoring procedures for service interworking.

Annex A

Mapping of traffic parameters

This annex defines the mapping of the FRDTS traffic parameters to the B-ISDN traffic parameters.

A.1 Traffic descriptor

When FRDTS traffic parameters are mapped to B-ISDN traffic parameters, the use of Usage Parameter Control (UPC) at the B-ISDN interface(s) and the use of rate enforcement at the FR interface(s) have to be considered. The B-ISDN traffic is controlled and enforced (Discarded or Tagged) dependent on the selected B-ISDN traffic descriptor. No different traffic descriptors exist for FR.

Based on I.370 and I.371, simple traffic descriptor figures for FR and for B-ISDN can be defined

The FR traffic descriptor as shown in Figure A.1 supports the differentiation for the ingress Frames with or without the DE bit set and the setting of the DE bit by the FR network. The CIR_0 controls DE = 0 frames and the EIR_1 controls DE = 1 frames.

All frames exceeding CIR_0 will be tagged with DE = 1 and given to the EIR_1 controlling. The EIR_1 controlling will discard all frames that exceed the EIR. The conforming DE = 1 and DE = 0 frames will be given to the egress side.

Based on Q.2961.2 two of the B-ISDN BCOB-C traffic descriptors can be defined as shown in the following Figures A.2 and A.3.

The Figures A.1 to A.3 are independent of the kind of interworking (Network or Service) and they can be put together via connecting an ingress with an egress side to show the FR to B-ISDN or the B-ISDN to FR direction.

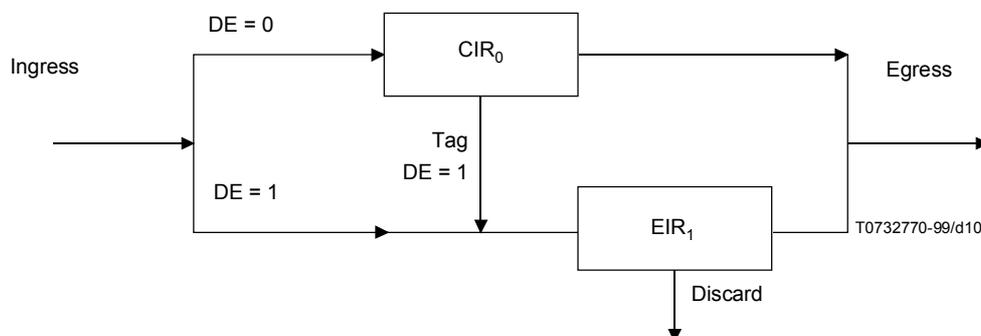


Figure A.1/X.329 – Traffic descriptor

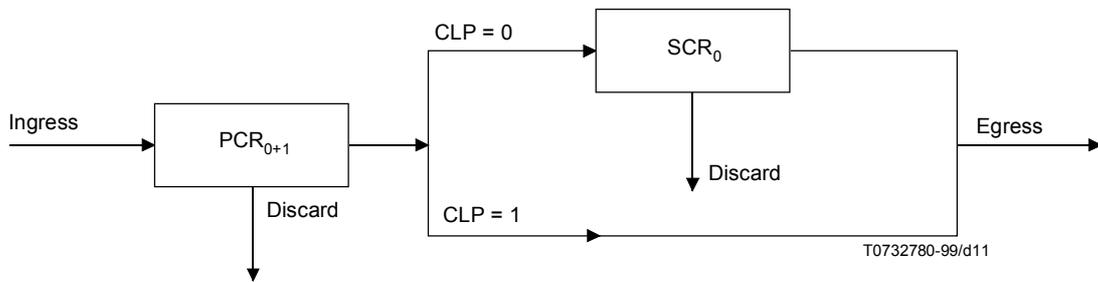


Figure A.2/X.329 – B-ISDN PCR₀₊₁, SCR₀ traffic descriptor option discard

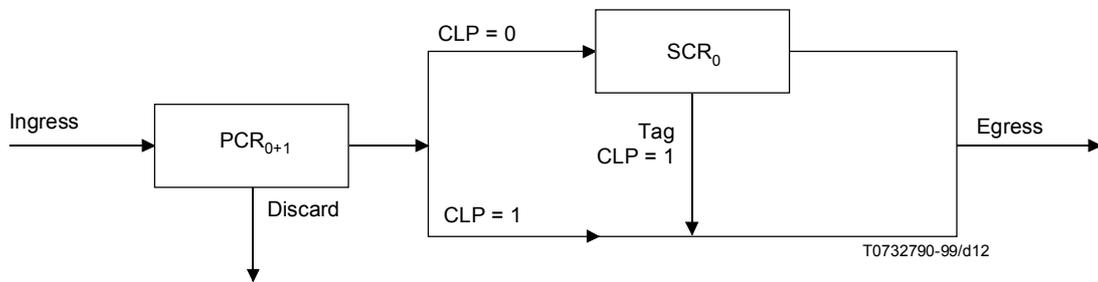


Figure A.3/X.329 – B-ISDN PCR₀₊₁, SCR₀ traffic descriptor option Tagging

These simple figures should help to understand the traffic enforcement caused by FR and B-ISDN, especially when both are applied for the direction FR to B-ISDN or B-ISDN to FR. Taking the FR/ATM IWF and its DE/CLP bit mapping (see 7.1.1) into account, the figures can be drawn as shown in the following example:

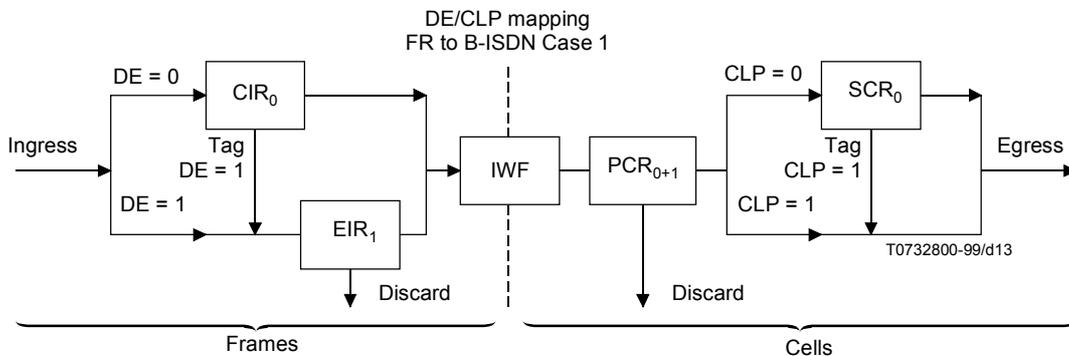


Figure A.4/X.329 – FR and B-ISDN traffic descriptor example FR to B-ISDN

Annex B

FR/ATM PVC status reporting procedures for network interworking

Additional procedures for FR permanent virtual circuits (FR PVCs) for carriage on ATM using unnumbered information frames are defined below.

This annex is based on clause 11/X.36 and describes the means for notification of outage of a FR PVC carried on ATM between two FR-SSCS layer management entities (FRLMEs), and recovery from such a condition. A FRLME is located within a FR/B-ISDN Interworking Unit or FR B-TE. For implementations where the FR side supports only FR PVCs, unacknowledged mode of operation at layer 2, the procedures given in this annex are applicable. The procedures may be initiated by any FRLME that supports FR PVCs and unnumbered information (UI) frame transfer only. These procedures are intended to be used only for operational purpose (rather than maintenance and management).

The higher layer messages are transferred across the ATM VCC using layer 2 unnumbered information frames on DLCI = 0, with the poll bit set to 0. FECN, BECN, and DE bits shall be set to 0 on transmission.

Detailed messages used for FR PVC status, information elements, procedures, error conditions, and system parameters are defined in Recommendation X.36 PVC signalling bi-directional procedures or Recommendation X.76 PVC signalling procedures.

Annex C

FR/ATM PVC status monitoring for service interworking

For service interworking between the FR and ATM networks the procedures relating to FR/ATM PVC status management are defined below.

For FR networks the status of the FR PVC may be communicated across the FR part of the network using the procedures defined in clause 11/X.36. These procedures should be applicable up to the InterWorking Function (IWF) (see Figure C.1).

For ATM networks the status of a configured ATM PVC can be inferred from the ATM Layer Management mechanisms in accordance with Recommendation I.610.

C.1 Requirements for FR/ATM PVC status management

The ATM PVC status information can be derived by the IWF from the OAM cell flows. The configuration information may require additional (out-of-band) mechanisms. It may be provided via the network management interfaces:

- 1) all PVC status information is handled by the OAM flows and procedures of clause 11/X.36;
- 2) configuration of PVCs is by administrative procedures, but may be verified by end-to-end loopback of OAM cells.

C.2 FR PVC management procedures

On the FR network side of the IWF the FR PVC management procedures defined in clause 11/X.36 is used. The bi-directional procedures apply.

The Link Integrity Verification (LIV) procedures may be used to assure the link between the IWF and the attached FR network is operational.

If the IWF detects a service affecting condition, it will indicate this to the ATM Layer Management Entity (ATMLME) which will initiate the sending of F5 (or F4) AIS on the configured ATM PVCs in accordance with I.610 procedures.

When the FR service affecting condition is cleared as indicated according to the procedures defined in clause 11/X.36, the IWF will stop sending the AIS cells downstream towards the ATM side.

C.2.1 Handling of new/deleted FR PVCs

When the FR network indicates to the IWF that a PVC is 'new', the IWF logs this information for use in subsequent PVC status monitoring.

If the end-to-end Continuity Check (CC) function is supported as an option, the IWF may initiate end-to-end CC cells on the corresponding configured ATM PVC.

If the CC option is not supported on the connection, the IWF may transfer this information to ATM Network Management System via a management interface if required.

When the FR network indicates to the IWF that a PVC is 'deleted' by removing the PVC Information Element (IE) from the full status report (and optionally by the asynchronous status message), the IWF logs this information as above.

If the CC function is supported as an option, the IWF stops sending end-to-end CC cells on the corresponding ATM PVC.

C.2.2 Active/Inactive FR PVCs

The criteria for determining 'inactive' FR PVC status are:

- 1) The FR network explicitly indicates in full status report (and optionally by the asynchronous status message) that this FR PVC is 'inactive'.
- 2) The LIV indicates the link from the IWF to the FR network is down.

NOTE 1 – When the IWF is informed a FR PVC is 'deleted' via the PVC IE no longer present in the full status report (and optionally by the asynchronous status message), the IWF may also consider the PVC to be 'inactive'.

In either case the 'inactive' state maps across the corresponding ATM PVC. The inactive state results in the sending of the F5 (or F4) AIS cells (see Note 2) by the IWF on corresponding ATM PVC if there is a configured ATM PVC available.

The IWF determines if the ATM PVC is configured by means of the end-to-end loopback cell procedures in accordance with I.610.

The criteria for determining 'active' FR PVC status are:

- 1) When a full status report (or the optional asynchronous status message) indicates a FR PVC is 'active' and
- 2) The LIV indicates the FR-to-IWF link is 'up'.

The IWF maps the active status to the corresponding ATM PVC. The active state results in the suppression of the AIS state in the IWF (no AIS cells are transmitted).

NOTE 2 – The definition of special AIS cells for tunneling of external OAM information is under study. These new AIS cells are likely to replace currently defined by the IWF in the future. It is expected that revisions to this document will be required when this definition has been finalized.

C.3 ATM PVC management procedures

The ATM PVC management procedures utilize:

- 1) AIS/RDI OAM cells to convey ATM PVC status information to the IWF.
NOTE – Absence of AIS/RDI state indicates PVC is 'up'; Presence of AIS/RDI cells indicates PVC is 'down'.
- 2) Under System Management control OAM loopback cells may be initiated by the IWF to verify ATM PVC configuration / availability, and for fault localization.
- 3) End-to-end CC cells if this option is supported on the connection.

The status and configuration information obtained by the IWF from the above procedures is then mapped to the corresponding FR status indicators and delivered to the FR network.

C.3.1 Handling of added/deleted ATM PVCs

When a new ATM PVC is configured (by management action), the IWF initiates loopback using end-to-end loopback OAM cells at interval of 5 seconds (provisional). When three consecutive loopback cells are returned to the IWF, the IWF will declare the ATM connection 'added'.

The IWF maps this to the corresponding FR PVC. The 'new' indication will be reported to the FR network in full status report.

When an ATM PVC is removed or deconfigured (by management action), the IWF maps this indication to the FR PVC management procedure.

NOTE – In the case of management action to deconfigure a remote segment of the ATM connection, this information may not be available in real time since a management (or other administrative) interfaces may be utilize to convey such information back to the IWF.

The 'deleted' indication will be reported by the IWF to the FR network in a full status report by removing the corresponding PVC IE (and optionally in the asynchronous status message). The FR network will infer that the PVC is inactive and propagate the 'deleted' status to the FR connection end point.

When the IWF and B-TE is configured to support the CC function, the IWF declares the ATM PVC 'down' when no user cells and no CC cells arrive in the interval specified in I.610.

When the CC option is not available on the connection loopback cells may be initiated under system management control to verify ATM PVC availability.

C.3.2 Active/Inactive ATM PVCs

The criteria for determining 'inactive' ATM PVC are:

- 1) A PVC is not deleted from the ATM network and the ATM network explicitly indicates via AIS/RDI OAM cells that PVC is 'down'.
- 2) A loopback procedure indicates the link from the IWF to the ATM network is 'down'.
- 3) The IWF is configured to receive end-to-end CC and absence of CC cells or user cells for the specified period indicates the ATM PVC is 'down'.

If any of the inactive criteria are met, the ATM PVC (or PVCs) are considered inactive. The mapped 'inactive' indication results in the sending of Active bit = 0 in the full status report (and optionally in the asynchronous status message) by the IWF into the FR network for the corresponding PVC configured.

The IWF knows if the FR PVC is configured since this information is conveyed by the network full status report.

After an ATM PVC has been added, the criteria for determining that this PVC is active are:

- 1) no AIS/RDI OAM cells are received from the ATM network for a time interval as defined in Recommendation I.610, and
- 2) loopback procedures indicate the link to the ATM network is up.

The IWF maps this status on to the corresponding RE PVC 'active' indication.

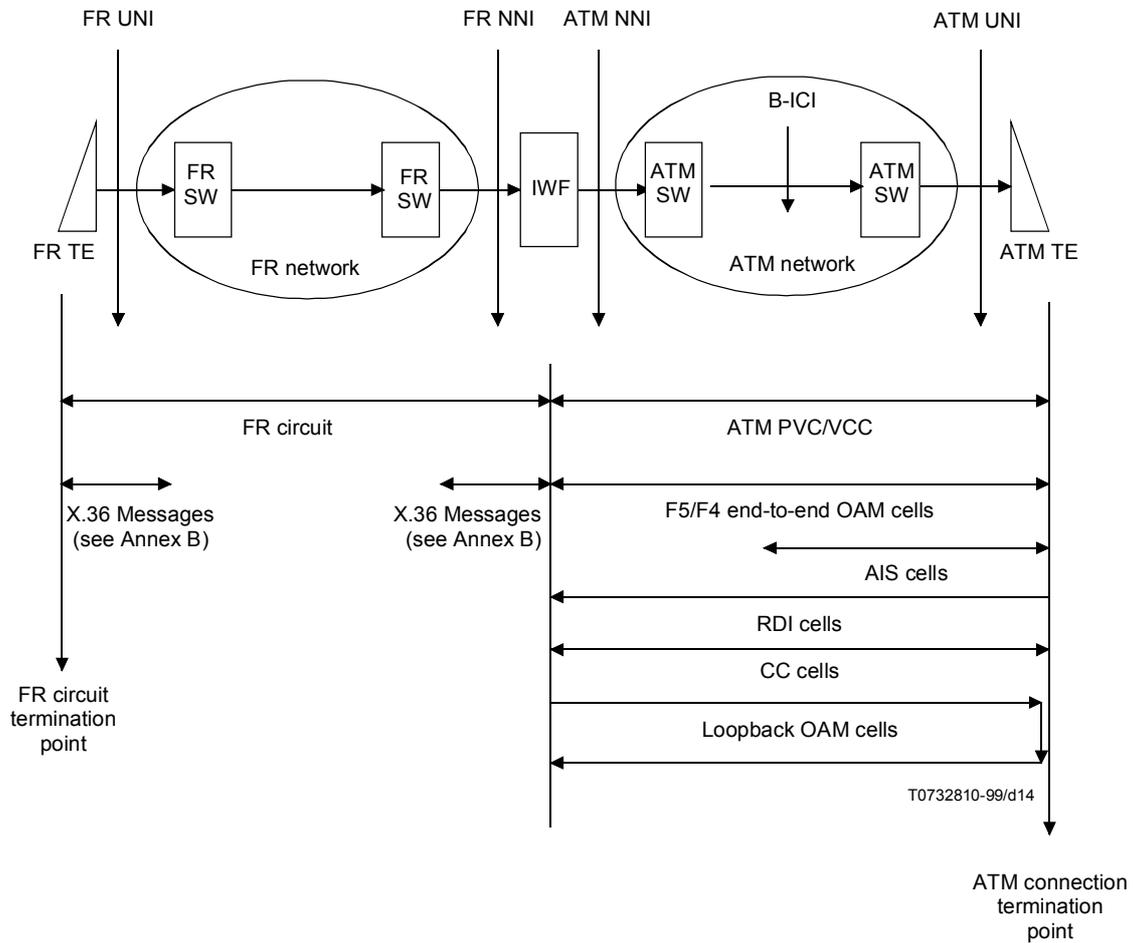


Figure C.1/X.329 – ATM/FR PVC interworking

Appendix I

Example of service interworking using translation mode

This appendix illustrates the translation mode of service interworking. The interworking function may implement the translation between Annex D/X.36 and RFC 1483¹ (Multiprotocol Encapsulation over ATM) between the FR and B-ISDN sides. Figure I.1 illustrates service interworking between FR and B-ISDN using this translation.

NOTE – Annex D/X.36 is substantially the same as RFC 1490¹.

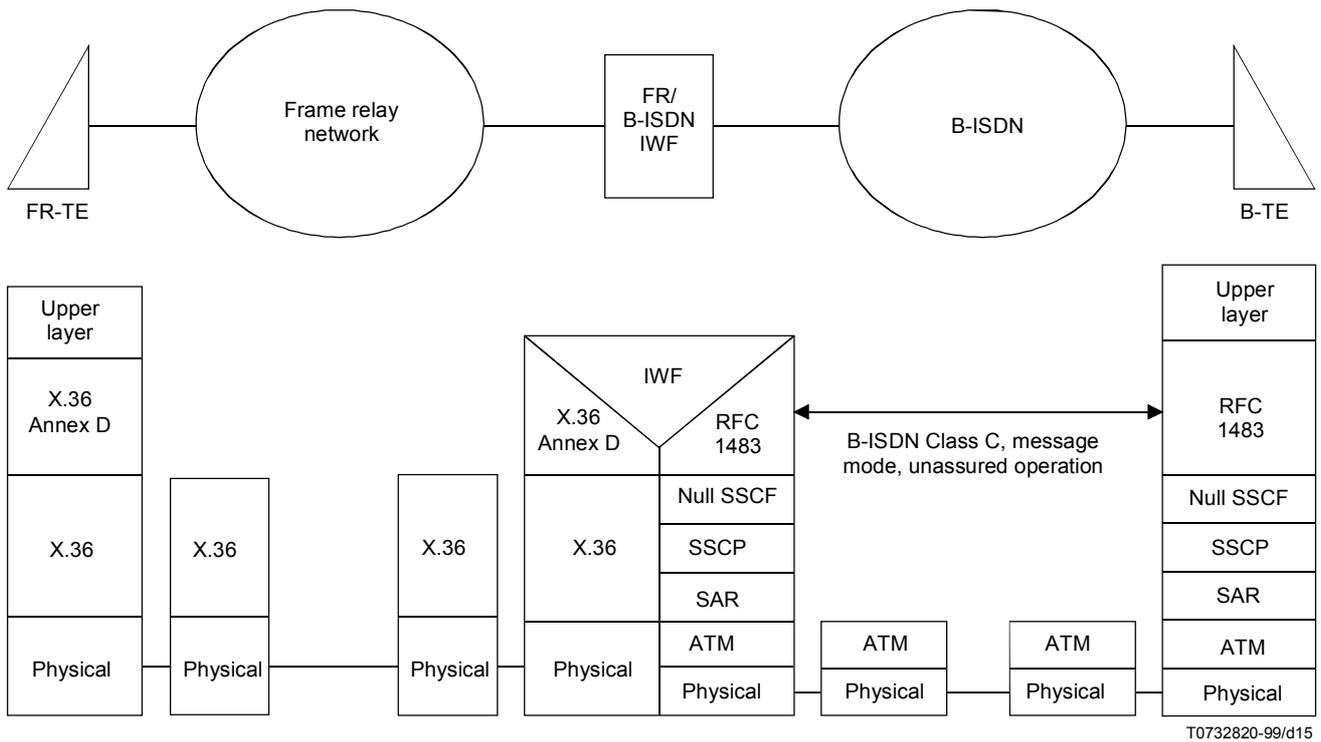


Figure I.1/X.329 – FR/B-ISDN service interworking using translation mode

¹ IETF RFC 1483, Multiprotocol Encapsulation over ATM, July 1993.
IETF RFC 1490, Multiprotocol Interconnect over Frame Relay, July 1993.

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