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SERIES X: DATA NETWORKS AND OPEN SYSTEM  
COMMUNICATION

Open System Interconnection – Protocol Identification

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**Information technology – Framework for  
protocol identification and encapsulation**

**ITU-T Recommendation X.260**

(Previously "CCITT Recommendation")



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DATA NETWORKS AND OPEN SYSTEM COMMUNICATION

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*For further details, please refer to ITU-T List of Recommendations.*

## FOREWORD

ITU (International Telecommunication Union) is the United Nations Specialized Agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the ITU. Some 179 member countries, 84 telecom operating entities, 145 scientific and industrial organizations and 38 international organizations participate in ITU-T which is the body which sets world telecommunications standards (Recommendations).

The approval of Recommendations by the Members of ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, 1993). In addition, the World Telecommunication Standardization Conference (WTSC), which meets every four years, approves Recommendations submitted to it and establishes the study programme for the following period.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC. The text of ITU-T Recommendation X.260 was approved on 5th of October 1996. The identical text is also published as ISO/IEC International Standard 14765.

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## NOTE

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

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## Summary

This Recommendation | International Standard provides a framework for explicit identification and encapsulation of Network Layer protocols.

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## INTERNATIONAL STANDARD

## ITU-T RECOMMENDATION

# INFORMATION TECHNOLOGY – FRAMEWORK FOR PROTOCOL IDENTIFICATION AND ENCAPSULATION

## 1 Scope

In a layered approach to protocol architecture, protocols have a relationship to one another such that a protocol at layer (n) uses the services of the layer below it – the (n – 1) services – which, in turn, are provided by a layer (n – 1) protocol. One of the services used by a layer (n) protocol is the *encapsulation* of its (n) Protocol Data Units (PDUs) in a way which is transparent to it. Such encapsulation is realized by the carriage of the (n) PDUs as user data in an (n – 1) Service Data Unit (SDU).

In a limited case, the operation of a particular protocol at layer (n – 1) implies the operation, above layer (n – 1), of a single layer (n) protocol or single set of related (n) / (n + 1)... protocols. However, in a more general case, there may be more than one protocol (or set of related protocols starting) at layer (n) that can operate above layer (n – 1) in a given environment. In such cases, there is a need for explicit *identification* of the protocol (or set of protocols starting) at layer (n).

There also may be a need to manipulate the (n – 1) protocol (i.e. the *encapsulating* protocol) in certain ways specific to the layer (n) protocol (i.e. the *encapsulated* protocol). Such manipulations form the basis of a set of procedures that must be specified for the layer (n) protocol.

The above observations regarding protocol identification and encapsulation are also applicable in cases where an (n) layer is further divided into sublayers.

Cases in which an (n) protocol operates for the purpose of establishing a parallel universe of protocols (regardless of the layered structure of that universe) also give rise to a need for the (n) protocol to be able to identify the protocol(s) in the parallel universe. In these cases, however, there is no encapsulating/encapsulated relationship between the (n) protocol and the parallel universe set of protocols.

The above principles lead to a need to establish a framework for protocol identification and encapsulation. These principles apply to the relationship between two protocols (recognizing that one of them may be a set of related protocols) and can be applied recursively. This Recommendation | International Standard provides a framework for explicit protocol identification and for protocol encapsulation. Implicit protocol identification (see 4.2) is beyond the scope of this Recommendation | International Standard.

## 2 Normative references

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation | International Standard. At the time of publication, the editions indicated were valid. All Recommendations and International Standards are subject to revision, and parties to agreements based on this Recommendation | International Standard are encouraged to investigate the possibility of applying the most recent edition of the Recommendations and International Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau of the ITU maintains a list of currently valid ITU-T Recommendations.

### 2.1 Identical Recommendations | International Standards

- ITU-T Recommendation X.200 (1994) | ISO/IEC 7498-1:1994, *Information technology – Open Systems Interconnection – Basic Reference Model: The Basic Model*.
- ITU-T Recommendation X.263 (1995) | ISO/IEC TR 9577:1996, *Information technology – Protocol identification in the network layer*.



## ISO/IEC 14765 : 1997 (E)

## 2.2 Additional references

- ITU-T Recommendation X.37 (1995), *Encapsulation in X.25 packets of various protocols including frame relay*.
- ISO/IEC 13515<sup>1)</sup>, *Information technology – Telecommunications and information exchange between systems – Generic Multiprotocol Encapsulation (GME): Application to frame relay and ATM*.

## 3 Abbreviations

|      |                                           |
|------|-------------------------------------------|
| EdP  | Encapsulated Protocol                     |
| EF   | Encapsulation Function                    |
| EgP  | Encapsulating Protocol                    |
| EPIF | Encapsulated Protocol Information Field   |
| IdP  | Identified Protocol(s)                    |
| IgP  | Identifying Protocol                      |
| IPI  | Initial Protocol Identifier               |
| PCI  | Protocol Control Information              |
| PDU  | Protocol Data Unit                        |
| PEM  | Protocol Encapsulation Method             |
| PId  | Protocol Identification                   |
| PIE  | Protocol Identification and Encapsulation |
| PIM  | Protocol Identification Method            |
| SDU  | Service Data Unit                         |
| SPI  | Subsequent Protocol Identifier            |

## 4 Definitions and concepts

## 4.1 Basic Reference Model concepts

The following concepts from ITU-T Rec. X.200 | ISO/IEC 7498-1 are used here:

- a) concatenation;
- b) layer;
- c) protocol;
- d) Protocol Control Information (PCI);
- e) Protocol Data Unit (PDU);
- f) protocol identification;
- g) protocol identifier;
- h) segmentation/reassembly;
- i) Service Data Unit (SDU);
- j) sublayer.

## 4.2 Additional definitions and concepts

The definitions and concepts below apply to this Recommendation | International Standard.

**4.2.1 explicit protocol identification method:** An explicit PIM is one in which Protocol Control Information (PCI) is used to identify a protocol, a set of related protocols, or a family of protocols.

<sup>1)</sup> Presently at the stage of draft.

**4.2.2 implicit protocol identification method:** An implicit PIM is one in which there is no PCI used to identify a protocol. Identification occurs through mechanisms such as coupling in a Recommendation or International Standard of an IgP with an IdP [e.g. stating that a specific (n) protocol is used above an (n – 1) protocol]; association of a physical port of a system with one or a set of related protocols; or association at provisioning of a “permanent” connection.

**4.2.3 set of alternative protocols:** Given protocols  $prot_1$ ,  $prot_2$ , etc., then  $prot_1$ ,  $prot_2$ , etc. all operate at the same layer or sublayer.

**4.2.4 set of related protocols:** Given protocols  $prot_1$ ,  $prot_2$ , etc., then  $prot_1$  operates at layer (n),  $prot_2$  operates at layer (n + 1), etc. (where the layers may also be hierarchical sublayers).

**4.2.5 family of protocols:** Given a set of alternative protocols  $prot_1$ ,  $prot_2$ , etc., a single identifier is used to identify the set of alternative protocols as a whole, thereby requiring additional methods to identify one member of the family.

## 5 Overview

### 5.1 General

As discussed above, there may exist a relationship between protocols that gives rise to a need for one protocol – the Identifying Protocol (IgP) – to identify one of a set of alternative protocols, a set of related protocols, or a family of protocols – the Identified Protocol(s) (IdP). As a result of the identification process, a second relationship may be created between an Encapsulating Protocol (EgP) and an Encapsulated Protocol(s) (EdP). In some cases, the IgP and the EgP may be the same protocol. It is usually the case that an IdP and an EdP are the same.

To provide a basis for developing the necessary relationships among specific protocols, a framework is developed here to set out the principles of Protocol Identification and Encapsulation (PIE). These principles recognize the following aspects of PIE:

- development of Protocol Identification Methods (PIMs) for identifying an IdP (e.g. the location in the IgP – such as in a particular field: header, trailer, etc. – used to identify the IdP);
- for each PIM, registration of values of IdPs;
- requirement on an IgP to specify the PIM it uses to identify IdPs and any further IgP-specific procedures involving the PIM;
- development of Protocol Encapsulation Methods (PEMs) for use by EgPs; and
- specification of operations (e.g. limitations, specific manipulations, etc.) of an EgP for a specific EdP.

The above aspects are depicted in Figure 1.

Annex A presents the current status of Recommendations and International Standards in alignment with the framework depicted in Figure 1.

### 5.2 Interworking and encapsulation

*Interworking* and *encapsulation* of protocols are two closely related concepts. For the purposes of this Recommendation | International Standard, the following distinctions are made.

*Interworking* occurs between two or more protocols at the same layer (or sublayer). It is concerned only with the semantic aspects of the (n) layer protocols. In particular, interworking is concerned with the transformation between the semantics of an (n) layer protocol used on one interface and the semantics of other (n) layer protocols used on the other interfaces. The protocols used on the different interfaces may or may not be the same. The transformation between protocols may result in the preservation of the semantic content of all protocols on an end-to-end basis. The transformation only applies to the set of abstract capabilities (or *service*) which the protocols have in common. On the other hand, the transformation may result in a loss of semantic content when crossing interfaces.

*Encapsulation* (or *tunneling* as it is sometimes called) occurs when a given protocol's PDU (or set of PDUs if the protocol provides segmentation/reassembly capabilities) is used to carry the PDUs of another protocol [that is, the user data parameter of an (n – 1) SDU is used to carry the (n) PDU(s)]. In the general case, no other relationships, such as a strict layering relationship, need exist between the two protocols (e.g. allowing for sublayering or for a given protocol to be encapsulated by protocols with different layer classifications). Encapsulation completely preserves the semantics of the EdP.

From the perspective of this Recommendation | International Standard, *port access*, as a method for interworking as defined in Recommendation X.300, is viewed as a method of encapsulation.