INTERNATIONAL TELECOMMUNICATION UNION

# ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

# Q.1225
(09/97)

SERIES Q: SWITCHING AND SIGNALLING

Intelligent Network

---

## Physical plane for Intelligent Network Capability Set 2

ITU-T Recommendation Q.1225

(Previously CCITT Recommendation)

ITU-T Q-SERIES RECOMMENDATIONS

**SWITCHING AND SIGNALLING**

| | |
|---|---|
| SIGNALLING IN THE INTERNATIONAL MANUAL SERVICE | Q.1–Q.3 |
| INTERNATIONAL AUTOMATIC AND SEMI-AUTOMATIC WORKING | Q.4–Q.59 |
| FUNCTIONS AND INFORMATION FLOWS FOR SERVICES IN THE ISDN | Q.60–Q.99 |
| CLAUSES APPLICABLE TO ITU-T STANDARD SYSTEMS | Q.100–Q.119 |
| SPECIFICATIONS OF SIGNALLING SYSTEMS No. 4 AND No. 5 | Q.120–Q.249 |
| SPECIFICATIONS OF SIGNALLING SYSTEM No. 6 | Q.250–Q.309 |
| SPECIFICATIONS OF SIGNALLING SYSTEM R1 | Q.310–Q.399 |
| SPECIFICATIONS OF SIGNALLING SYSTEM R2 | Q.400–Q.499 |
| DIGITAL EXCHANGES | Q.500–Q.599 |
| INTERWORKING OF SIGNALLING SYSTEMS | Q.600–Q.699 |
| SPECIFICATIONS OF SIGNALLING SYSTEM No. 7 | Q.700–Q.849 |
| DIGITAL SUBSCRIBER SIGNALLING SYSTEM No. 1 | Q.850–Q.999 |
| PUBLIC LAND MOBILE NETWORK | Q.1000–Q.1099 |
| INTERWORKING WITH SATELLITE MOBILE SYSTEMS | Q.1100–Q.1199 |
| Interworking with Standard-A INMARSAT system | Q.1100–Q.1109 |
| Interworking with Standard-B INMARSAT system | Q.1110–Q.1149 |
| Interworking with the INMARSAT aeronautical mobile-satellite system | Q.1150–Q.1199 |
| **INTELLIGENT NETWORK** | **Q.1200–Q.1999** |
| BROADBAND ISDN | Q.2000–Q.2999 |

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

**ITU-T RECOMMENDATION Q.1225**

# PHYSICAL PLANE FOR INTELLIGENT NETWORK CAPABILITY SET 2


**Summary**

This Recommendation describes the physical plane of the Intelligent Network (IN) architecture for CS-2. The physical plane identifies different Physical Entities (PEs), the allocation of functional entities to PEs, and the interfaces between the PEs.

Companion Recommendations include the Q.120x- and Q.122x-Series Recommendations.



**Source**

ITU-T Recommendation Q.1225 was prepared by ITU-T Study Group 11 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 12th of September 1997.

## 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. The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1.

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.

## NOTE

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

## INTELLECTUAL PROPERTY RIGHTS

The ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. The ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, the ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

## CONTENTS

**Recommendation Q.1225**

## PHYSICAL PLANE FOR INTELLIGENT NETWORK CAPABILITY SET 2

*(Geneva, 1997)*

## 1 General

This Recommendation describes the physical plane of the Intelligent Network (IN) architecture for CS-2. General IN physical plane information is contained in Recommendation Q.1205.

The physical plane of the IN conceptual model identifies the different physical entities and the interfaces between these entities.

The physical plane architecture should be consistent with the IN conceptual model. The IN conceptual model is a tool that can be used to design the IN architecture to meet the following main objectives:

– service implementation independence;

– network implementation independence;

– vendor and technology independence.

The I.130 stage 3 service description methodology may be used (which includes the functional specification of the node and detailed description of the protocol between the nodes) in developing the physical plane architecture.

The following is the list of abbreviations used in this Recommendation:

| | |
|---|---|
| AD | Adjunct |
| BRI | Basic Rate Interface |
| CCAF | Call Control Agent Function |
| CCF | Call Control Function |
| CS | Capability Set |
| CUSF | Call-Unrelated Service Function |
| DSS | Digital Signalling System |
| INAP | Intelligent Network Application Protocol |
| IP | Intelligent Peripheral |
| ISDN | Integrated Services Digital Network |
| ISDN-CPE | ISDN Customer Premises Equipment |
| ISUP | ISDN User Part (Protocol) |
| NAP | Network Access Point |
| NCP | Network Control Point |
| N-ISDN | Narrow-band Integrated Services Digital Networks |
| PBX | Private Branch Exchange |
| PRI | (ISDN) Primary Rate Interface |

| | |
|---|---|
| SCCP | Signalling Connection Control Part |
| SCEF | Service Creation Environment Function |
| SCF | Service Control Function |
| SCP | Service Control Point |
| SCUAF | Service Control User Agent Function |
| SDF | Service Data Function |
| SDP | Service Data Point |
| SMF | Service Management Function |
| SMP | Service Management Point |
| SN | Service Node |
| SRF | Specialized Resource Function |
| SS No. 7 | Signalling System No. 7 |
| SSCP | Service Switching and Control Point |
| SSF | Service Switching Function |
| SSP | Service Switching Point |
| TMN | Telecommunications Management Network |

# 2 Requirements and assumptions

## 2.1 Requirements

The key requirements of the physical plane architecture are as follows:

– the functional entities in the CS-2 distributed functional plane can be mapped onto the CS-2 physical entities; however, there is no present need to describe (or map to Physical Plane) the IN Management aspects;

– one or more functional entities may be mapped onto the same physical entity;

– one functional entity cannot be split between two physical entities (i.e. the functional entity is mapped entirely within a single physical entity);

– duplicate instances of a functional entity can be mapped to different physical entities, though not to the same physical entity;

– physical entities can be grouped to form a physical architecture;

– the physical entities may offer standard interfaces;

– vendors must be able to develop physical entities based on the mapping of functional entities and the standard interfaces;

– vendors must be able to support mature technologies and new technologies as they become available; and

– the Telecommunications Management Network (TMN) represents the system or systems associated with management of IN. As such, it is not restrained to any single physical implementation but may be implemented by distributing its functionality to one or more physical entities. This requirement is reflected in Figure 1/Q.1215 by means of the "TMN Cloud".

## 2.2 Assumptions

The following assumptions are made for the development of the physical plane architecture:

– The IN conceptual model is used as a tool to develop the IN physical architecture.

– Existing and new technologies can be used to develop the physical entities.

– The specification of functional entities in the distributed functional plane and standard interfaces in the physical plane support network vendor independence and service independence.

– For CS-2, a sufficient number of interfaces are identified for support of services. Service creation and OAM functions are not addressed.

# 3 Physical Entities (PEs)

This clause describes a selection of PEs to support IN CS-2. That selection is not intended to preclude or disallow the application of any other IN PE to support CS-2.

**a) Service Switching Point (SSP)**

In addition to providing users with access to the network (if the SSP is a local exchange) and performing any necessary switching functionality, the SSP allows access to the set of IN capabilities. The SSP contains detection capability to detect requests for IN-based services. It also contains capabilities to communicate with other PE(s) containing a Service Control Function (SCF), such as a Service Control Point (SCP), and to respond to instructions from the other PE. Functionally, an SSP contains a Call Control Function (CCF), a Service Switching Function (SSF), and, if the SSP is a local exchange, a Call Control Agent Function (CCAF). It also may optionally contain a Service Control Function (SCF), and/or a Specialized Resource Function (SRF), and/or a Service Data Function (SDF). The SSP may provide IN-based services to users connected to subtending Network Access Points.

**b) Network Access Point (NAP)**

A NAP is a PE that includes only the CCAF and CCF functional entities. It may also be present in the network. The NAP supports early and ubiquitous deployment of IN-based services. This NAP cannot communicate with an SCF, but it has the ability to determine when IN processing is required. It must send calls requiring IN processing to an SSP.

**c) Service Control Point (SCP)**

The SCP contains the Service Logic Programs (SLPs) and data that are used to provide IN-based services. The SCP is connected to SSPs by a signalling network. Multiple SCPs may contain the same SLPs and data to improve service reliability and to facilitate load sharing between SCPs. Functionally, an SCP contains an SCF and it may contain an SDF. The SCP can access data in an SDP either directly or through a signalling network. The SDP may be in the same network as the SCP, or in another network. The SCP can be connected to SSPs, and optionally to IPs, through the signalling network. The SCP can also be connected to an IP via an SSP relay function.

**d) Adjunct (AD)**

The AD is functionally equivalent to an SCP (i.e. it contains the same functional entities) but it is directly connected to an SSP. Communication between an AD and an SSP is supported by a high-speed interface. This arrangement may result in differing performance characteristics for an AD and an SCP. The application layer messages are identical in content to those carried by the signalling network to an SCP.

An AD may be connected to more than one SSP and an SSP may be connected to more than one Adjunct.

**e) Intelligent Peripheral (IP)**

The IP provides resources such as customized and concatenated voice announcements, voice recognition, and Dual Tone Multi-Frequencies (DTMF) digit collection, and contains switching matrix to connect users to these resources. The IP supports flexible information interactions between a user and the network, and may contain service-specific user interaction scripts, which allow user interactions to be grouped. Functionally, the IP contains the SRF. The IP may directly connect to one or more SSPs, and/or may connect to the signalling network.

In the ISDN stimulus protocol environment, the IP will also provide resources such as customized and concatenated Information Display and Digit collection, out of channel, and it contains the necessary coordination and multiplexing to connect users to these resources.

An SCP or AD can request an SSP to connect a user to a resource located in an IP that is connected to the SSP from which the service request is detected. An SCP or AD can also request the SSP to connect a user to a resource located in an IP that is connected to another SSP.

**f) Service Node (SN)**

The SN can control IN-based services and engage in flexible information interactions with users. The SN communicates directly with one or more SSPs, each with a point-to-point signalling and transport connection. Functionally, the SN contains an SCF, SDF, SRF, and an SSF/CCF. This SSF/CCF is closely coupled to the SCF within the SN, and is not accessible by external SCFs.

In a manner similar to an AD, the SCF in an SN receives messages from the SSP, executes SLPs, and sends messages to the SSP. SLPs in an SN may be developed by the same service creation environment used to develop SLPs for SCPs and ADs. The SRF in an SN enables the SN to interact with users in a manner similar to an IP. An SCF can request the SSF to connect a user to a resource located in an SN that is connected to the SSP from which the service request is detected. An SCF can also request the SSP to connect a user to a resource located in an SN that is connected to another SSP.

**g) Service Switching and Control Point (SSCP)**

The SSCP is a combined SCP and SSP in a single node. Functionally, it contains an SCF, SDF, CCAF, CCF, and SSF. The connection between the SCF/SDF functions and the CCAF/CCF/SSF functions is proprietary and closely coupled, but it provides the same service capability as an SSP and SCP separately.

This node may also contain SRF functional capabilities (i.e. SRF as an optional capability).

The interfaces between the SSCP and other PEs are the same as the interfaces between the SSP and other PEs, and therefore will not be explicitly stated.

**h) Service Data Point (SDP)**

The SDP contains the customer and network data which is accessed during the execution of a service. Functionally, the SDP contains an SDF.

**i) Enhanced ISDN Customer Premises Equipment (Enhanced ISDN CPE)**

Recommendation I.112 defines the ISDN CPE as "a node that provides the functions necessary for the operation of the access protocols by the user". Functionally, the ISDN CPE can contain the SCUAF (for the bearer-unrelated interactions), the CCAF, and the IAF.

j) **Call-Unrelated Service Point (CUSP)**

The CUSP provides a point of protocol interworking for Call Unrelated User Interaction. It establishes and releases call-unrelated associations between the user and the SCP or AD, carries out protocol adaptation between ROSE APDUs and TCAP transactions, and monitors the integrity of the association.

## 4 Mapping requirements

– Physical plane architecture requirements listed in 2.1 should be met.

– Functional entities should be mapped to physical entities in a manner which will support the identified benchmark CS-2 services.

– Functional entity to physical entity mapping must allow efficient implementation in existing physical entities.

– Functional entity to physical entity mapping must allow for standard communications between network functions via service independent interfaces.

## 5 Mapping the distributed functional plane to the physical plane

### 5.1 Mapping of functional entities to physical entities

This subclause gives a mapping of functional entities into physical entities for CS-2, and describes the reference points between the PEs. In so doing, an appropriate distribution of functionality for CS-2 is identified, and functional interfaces suitable for standardization are highlighted. The PEs described in this subclause are for illustrative purposes only, and do not imply the only possible mapping of functionality for CS-2.

This subclause describes a flexible physical architecture made up of several PEs. Each PE contains one or more functional entities, which define its IN functionality. PEs included in the physical architecture shown in Figure 1 are Service Switching Point (SSP), Network Access Point (NAP), Service Control Point (SCP), Intelligent Peripheral (IP), Adjunct (AD), Service Switching and Control Point (SSCP), Service Data Point (SDP), ISDN Customer Premises Equipment (ISDN CPE), and Services Node (SN).

Typical scenarios of functional entity mapping to physical entity are shown in Table 1.

**Table 1/Q.1225 – Typical scenarios of FE to PE mapping**

| **PEs** | **FEs** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | SCF | SSF-CCF | CCAF | SCUAF | SDF | CUSF | SRF | IAF |
| SCP | C | – | – | – | O | – | – | – |
| SN | C | C | O | – | C | C | C | – |
| AD | C | – | – | – | C | – | – | – |
| SSP | O | C | O | – | O | C | O | – |
| IP | – | – | – | – | | – | C | – |
| SDP | – | – | – | – | C | – | – | – |
| SSCP | C | C | – | – | C | – | O | – |
| NAP | – | C<br>(CCF only) | – | – | | – | – | – |
| ISDN CPE | – | – | O | C | | – | | O |
| CUSP | | C<br>(CCF only) | | | | C | | |
| C Core<br>O Optional<br>– Not allowed | | | | | | | | |

There is no intention that the table should disallow any other combination of functional entities that would result in a PE not shown in the table.

The above mappings are shown in Figure 1. Each PE has certain functional entities mapped into it. The solid lines on the figure show transport paths that may exist between the PEs, and the dotted lines show signalling paths that can carry application layer messages for IN-based services.

## 5.2 Mapping of FE-FE relationships to PE-PE relationships

The FE-FE interfaces that fall within the scope of CS-2 are:

1) SSF-SCF;
2) SCF-SDF;
3) SCF-SCF;
4) SDF-SDF;
5) CUSF-SCF
6) SCUAF-CUSF; and
7) SCF-SRF.

A mapping to the PE-PE interfaces is provided in Table 2.

Table 2 is not meant to be an exhaustive list of all possible PE-PE relationships that may be covered by the CS-2 Recommendations.

**Table 2/Q.1225 – FE-FE relationships to PE-PE relationships**

| **FE-FE** | **PE-PE** |
|---|---|
| SSF-SCF | SSP-SCP<br>SSP-AD<br>SSP-SN |
| SCF-SDF | SSP-SCP<br>SCP-SDP |
| SCF-SRF | SCP-IP<br>SCP-SSP-IP<br>AD-IP |
| IAF-SCF | ISDN CPE-SCP<br>(via Switch) |
| SCUAF-CUSF | ISDN CPE-SSP |
| SDF-SDF | SDP-SDP |
| SCF-SCF | SCP-SCP |

### 5.3 Selection of underlying protocol platforms

This subclause describes the candidate interfaces for CS-2 between the elements of the physical architecture. The interfaces are identified below.

– SCP-SSP;

– AD-SSP;

– IP-SSP;

– SN-SSP;

– SCP-IP;

– ISDN CPE-SSP;

– SCP-SCP;

– SDP-SDP;

– AD-IP; and

– SCP-SDP.

Existing lower-layer protocols are proposed for these candidate interfaces to carry the application layer messages required by IN-based services. As such, the focus of the standardization effort for CS-2 is on the application layer protocols. At the application layer, the message sent that the different interfaces carry should reflect the same semantic content, even though the application layer messages may be encoded or formatted differently. For example, the messages between the SSF in an SSP and the SCF in an SCP, AD or SN should contain the same information. The following subclauses give some proposed protocols for use on these interfaces.

#### 5.3.1 SCP-SSP interface

The proposed underlying protocol platform for the interface between an SCP and an SSP is Transaction Capabilities Application Part (TCAP) on Signalling Connection Control Part (SCCP)/Message Transfer Part (MTP) of SS No. 7.

### 5.3.2 AD-SSP interface

The proposed underlying protocol platform for the AD-SSP interface is TCAP. The physical interface has not been specified, but a number of alternative standard protocols could be used.

### 5.3.3 IP-SSP interface

This interface is used for communications between an IP and an SSP as well as for communication between an IP and an SCP which is being relayed through an SSP.

The proposed underlying protocol platform for the interface between an IP and an SSP is ISDN Basic Rate Interface (BRI), Primary Rate Interface (PRI) (or both), or SS No. 7.

If a BRI or PRI is used, the ISDN D-channel connecting an IP to an SSP carries application layer information between an SCF and an SRF, and supports the setup of B-channel connections to the IP. Information passed from an SCF to an SRF (e.g. announcement number and number of digits to collect) and vice versa (e.g. collected information and billing measurements) is embedded in the facility information element. The facility information element can be carried by some Q.931 messages, such as SETUP and DISCONNECT. The facility information element can also be carried by the FACILITY message of Recommendation Q.931. This possibility provides for the flexibility to convey application layer information without affecting the call connection establishment.

### 5.3.4 SN-SSP interface

The proposed underlying protocol platform for the interface between an SN and an SSP is ISDN Basic Rate Interface (BRI), Primary Rate Interface (PRI) (or both). An SN and an SSP exchange application layer messages over an ISDN D-channel using the common element procedures of Recommendation Q.932. This communication may occur on a separate D-channel from the channel that carries the common element procedure messages. Figure 1 shows the case where these channels are separate.

### 5.3.5 SCP-IP interface

The proposed underlying protocol platform for an interface between an SCP and an IP is Transaction Capabilities Application Part (TCAP) on signalling connection control part (SCCP)/MTP of SS No. 7.

### 5.3.6 AD-IP interface

The proposed underlying protocol platform between an AD and an IP is TCAP. The physical interface has not been specified, but a number of alternative standard protocols could be used.

### 5.3.7 SCP-SDP interface

The proposed underlying protocol platform for the interface between an SCP and an SDP is Transaction Capabilities Application Part (TCAP) in Signalling Connection Control Part (SCCP)/MTP of SS No. 7. For SDPs outside the network (e.g. credit card validation database at credit card company) an interworking unit can be used which is inside the network and performs translation of SS No. 7 TCAP to a public or private data transfer protocol (e.g. X.25).

### 5.3.8 User interfaces

A user is an entity external to the IN that uses IN capabilities. IN users may employ the access interfaces described below to invoke various IN service capabilities. For example, users can affect the routing of a call, send and receive information from the network, screen calls, and update service parameters. Users are served by existing network interfaces.

It is important to ensure that IN should continue to support existing services and capabilities. In addition, the current restrictions imposed by each of the interface technologies described below must be considered when deploying IN-based services. For example, calling party information may or may not be available at a given interface and, therefore, may or may not be provided to the SCF.

End users use analogue interface signalling, or ISDN access signalling arrangements. IN user-network interactions include providing stimuli, such as off-hook or DTMF digit signalling, which determine further IN action.

Out-of-band (i.e. D-channel) signalling provides ISDN users with additional capabilities for accessing potential IN-based services. When originating a call, an ISDN user identifies the bearer capability to be associated with the call. IN service logic can use this information to determine how the call should be handled (e.g. how to route the call).

The interface between the ISDN CPE and SSP is supported by DSS 1 protocols.

NOTE – The interface between the ISDN CPE and NAP is left for further study.

### 5.3.9 Enhanced ISDN CPE-CUSP interface

The CPE protocol based on Generic or Flexible Functional Protocols can make use of extensions to use ROSE APDUs to interact with the Call-Unrelated Service Point in the Out Channel Call-Unrelated User Interaction mode.

In the case where the Functional Protocol is provided from a Smart Card or PBX, user interaction may exist, which utilizes the CUSP to use an association between the CPE and the SCP. In principle, the CUSP is required to map the ROSE APDU into the TCAP/SCCP protocol elements. The SCUAF and IAF are examples of CPE intelligence, which, for the purpose of Physical Plane mapping may be seen as equivalent options.

### 5.3.10 AD-CUSP interface

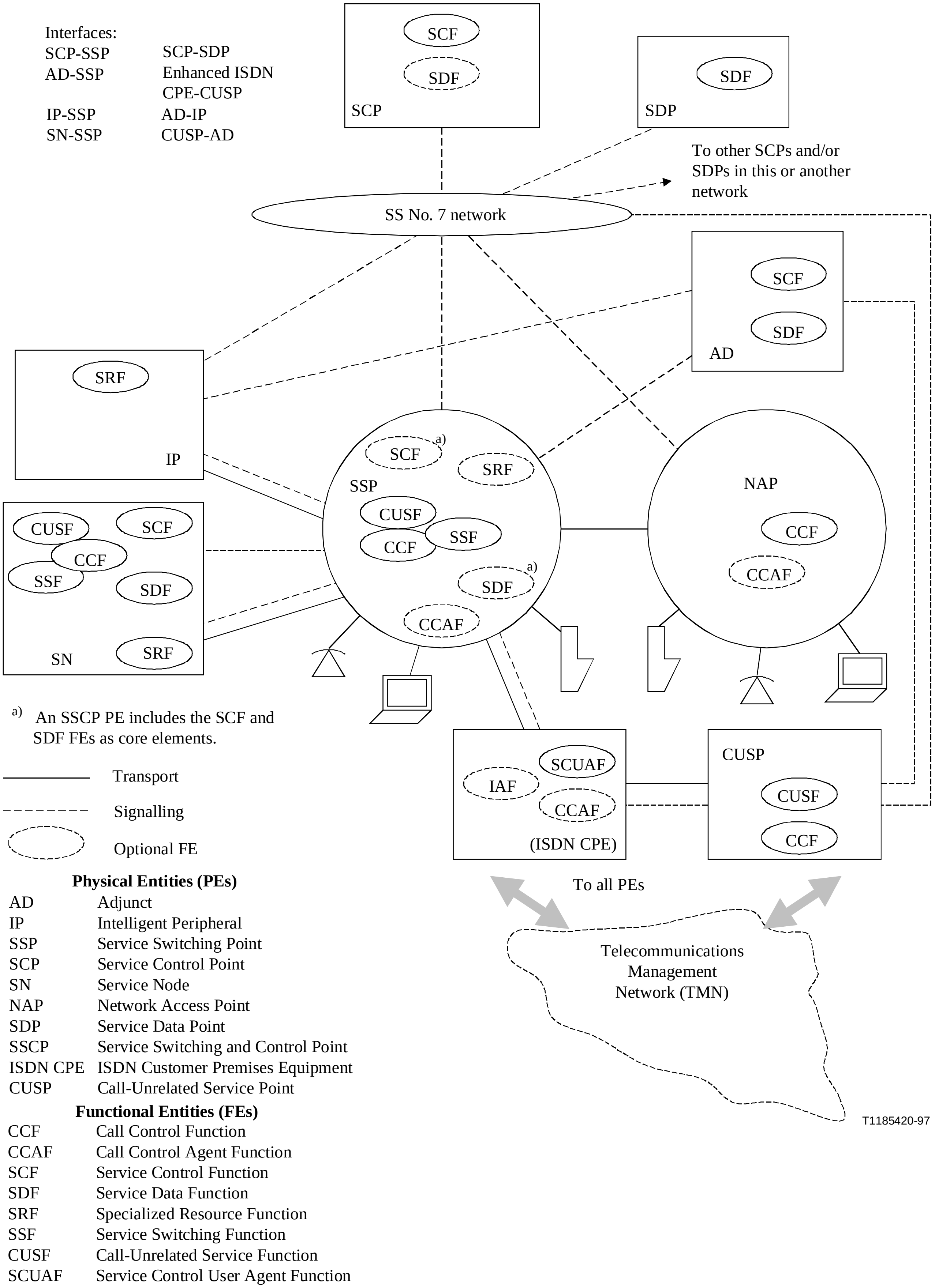


**Figure 1/Q.1225 – Physical plane architecture for CS-2**

## ITU-T RECOMMENDATIONS SERIES

| | |
|---|---|
| Series A | Organization of the work of the ITU-T |
| Series B | Means of expression: definitions, symbols, classification |
| Series C | General telecommunication statistics |
| Series D | General tariff principles |
| Series E | Overall network operation, telephone service, service operation and human factors |
| Series F | Non-telephone telecommunication services |
| Series G | Transmission systems and media, digital systems and networks |
| Series H | Audiovisual and multimedia systems |
| Series I | Integrated services digital network |
| Series J | Transmission of television, sound programme and other multimedia signals |
| Series K | Protection against interference |
| Series L | Construction, installation and protection of cables and other elements of outside plant |
| Series M | TMN and network maintenance: international transmission systems, telephone circuits, telegraphy, facsimile and leased circuits |
| Series N | Maintenance: international sound programme and television transmission circuits |
| Series O | Specifications of measuring equipment |
| Series P | Telephone transmission quality, telephone installations, local line networks |
| **Series Q** | **Switching and signalling** |
| Series R | Telegraph transmission |
| Series S | Telegraph services terminal equipment |
| Series T | Terminals for telematic services |
| Series U | Telegraph switching |
| Series V | Data communication over the telephone network |
| Series X | Data networks and open system communication |
| Series Z | Programming languages |