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Q.65

(06/2000)

SERIES Q: SWITCHING AND SIGNALLING

Functions and information flows for services in the ISDN – Methodology

The unified functional methodology for the characterization of services and network capabilities including alternative object-oriented techniques

ITU-T Recommendation Q.65

(Formerly CCITT Recommendation)

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ITU-T Recommendation Q.65

The unified functional methodology for the characterization of services and network capabilities including alternative object-oriented techniques

Summary

This ITU-T Recommendation contains the Unified Functional Methodology (UFM), superseding the existing ITU-T Q.65 (06/97), describing a common functional architecture for providing services and addressing signalling requirements for service implementation. The overall method for deriving switching and signalling Recommendations for ISDN services, consisting of three stages, is described in ITU-T I.130. The method has been generalized beyond ISDN to include services provided in and among networks of various types. The UFM combines the traditional approach of the 1988 version of this Recommendation with some of the approaches traditionally used in the Intelligent Network (IN) description method. The detailed method for deriving the Stage 2 portion of these Recommendations is described in this Recommendation. The main text of this Recommendation presents background information on the unified functional methodology, the steps of the method, the conventions used in description techniques, and guidelines for usage.

Source

ITU-T Recommendation Q.65 was revised by ITU-T Study Group 11 (1997-2000) and approved under the WTSC Resolution 1 procedure on 15 June 2000.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. 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 turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSC Resolution 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.

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As of the date of approval of this Recommendation, 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.

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ITU-T Recommendation Q.65

The unified functional methodology for the characterization of services and network capabilities including alternative object-oriented techniques

1 Introduction

This revised Recommendation contains a summary of the Unified Functional Methodology (UFM), describing a common functional architecture for providing services and addressing signalling requirements for service implementation. The overall method for deriving switching and signalling Recommendations for ISDN services, consisting of three stages, is described in ITU-T I.130. The method has been generalized beyond ISDN to include services provided in and among networks of various types. This new UFM combines the traditional approach of the 1988 version of this Recommendation with some of the approaches traditionally used in the Intelligent Network (IN) description method and those used in the Unified Functional Methodology (UFM). It gives the user of the Recommendation a choice of either using the methods described in the 1997 version of ITU-T Q.65 or of adopting techniques used in the computing industry. The detailed methods for deriving the Stage 2 portion of these Recommendations is described in this Recommendation.

The main text of this Recommendation presents background information on the unified functional methodology, the steps of the method, the conventions used in description techniques, and guidelines for usage. Appendix I presents an outline for drafting a Stage 2 service description using the SIB Methodology. Appendix II contains the Unified Functional model including Broadband Call and bearer separation. Appendix III contains "Examples of interface Classes formed from Service/Application requirements".

1.1 Unified Functional Methodology (UFM): Summary

The Unified Functional Methodology (UFM) allows for functional descriptions of services with either information flows, Functional Entity Actions (FEA) and Specification Description Language (SDL), or Interface Class Descriptions, Generic IDL descriptions and Specification Description Language (SDL), starting from a single unified functional architecture. In the former case the concept of Service Independent Building Blocks (SIB) has been adopted to address service creation needs as well as to introduce re-usable blocks of flows, SDL, and FEAs which can be catalogued. The user is also free to use the Unified Modelling Language (UML), along with a comprehensive description of Interface class descriptions to produce method invocations mapping onto APIs and IDL. This new concept better facilitates the production of SDL. The user may make use of both methods along side each other, choosing the method that better facilitates the description of a particular interface. The unified model enables all network architectures (i.e. ISDN, B-ISDN, IN, IMT-2000, and TMN) to be described in a similar manner.

The methodology needs to address current needs, but must also evolve to include improvements and new technology. The method includes many elements of the 1988 version of this Recommendation, so it can be used immediately, even as it evolves. The use of the SIB concept or Object Oriented (O-O) technique to describe the relationship between Objects streamlines the work of Stage 2 service definition. New SIBs or Interface classes will be created as needed. A SIB or Interface Class catalogue can be maintained as a reference for service creation and definition.

Principles defining the scope of UFM include:

1) The unified functional methodology allows creation of functional descriptions where Stage 1 service descriptions are available or where network capabilities are specified for service creation.

2) The methodology is based mainly on experience from using ISDN Stage 2 methodology (ITU-T Q.65 (1988)), IN methodology (ITU-T Q.1210, (1995)) and distributed computing techniques derived from Rumbaugh, Booch *et al* and refined using the UML.

   - ITU-T Q.65 (1997 version) provides much background in service description utilizing a functional model, functional entities, and functional entity actions.
   - The IN method provides the flexibility, service independence, and re-use characteristics which are desirable.
   - UML is the tool through which a comprehensive description of the Interface Classes is developed, along with their relationships. This, along with several different types of standard tools, facilitates the production of the IDL making up the Application Programming Interface (API).

3) The method is based on a unified functional model.

   - The unified functional architecture is expanded to include new requirements and may be further expanded to suit the users' needs.
   - For each service description, an appropriate set of functional entities is selected to compose the model.
   - This leads to a consistent set of flows, and/or APIs and SDLs.

4) Maintain a library of SIBs (with corresponding information flows and SDL) which are used to determine the functional architecture in the distributed functional plane (see Figure 1).

   - SIB sets are being created to support the capability sets in IN Recommendations.
   - SIBs are mapped onto the functional architecture complete with pre-defined functional entity actions, pre-defined SDL, and pre-defined information flows.
   - SIBs can be useful tools for Stage 2 creation; other aspects (e.g. SDL descriptions, information flows) can potentially be automated.

5) Maintain a library of Packages, interface classes and IDL, which defines the API across a particular interface. These are also used to determine the functional architecture in the distributed functional plane (see Figure 1).

6) The methodology addresses current needs, but must evolve to include improvements and new technology.

   - Method can be used even as it evolves.
   - Phased approach for use across the ITU-T, using the unified architecture.
   - New SIBs will be needed (existing services; new target services).
   - New API calls will be developed.
   - New relationships need to be defined.
   - New target services must be considered (e.g. multiparty calls).
   - Not yet an automated process, but re-use plays a major role.
   - New expertise must be developed for describing services from SIBs.
   - Additional verification of existing services will be useful (for accuracy of the method and learning curve).

7) The unified methodology for creating Stage 2 description should include the following:

   - identification of service or network capability;
   - functional model and functional entity definition (Unified Functional Model);
   - SIB and/or Package identification (optional);
   - functional entity actions and/or IDL-definition;
   - information flows and/or APIs;
   - SDL (Dynamic Description) (optional);
   - scenarios (physical allocation of functional entities).

8) Define physical scenarios at an appropriate time.

   - Decisions must be made as to the recommended network implementations.
   - With extension to IN, B-ISDN, IMT-2000, and other networks, the catalogue of physical entities is increased.
   - This greatly increases the number of potential scenarios.

9) Work to provide Recommendations for tool improvements and automation of the functional description process.

   - ITU-T Z.100 (SDL) and Z.120 (Message Sequence Chart – information flows) can be utilized more effectively.
   - Tools can provide validation of SDL and flows.
   - Communicate rules and conventions for SIB definition and combination; some automation of this process may be possible.

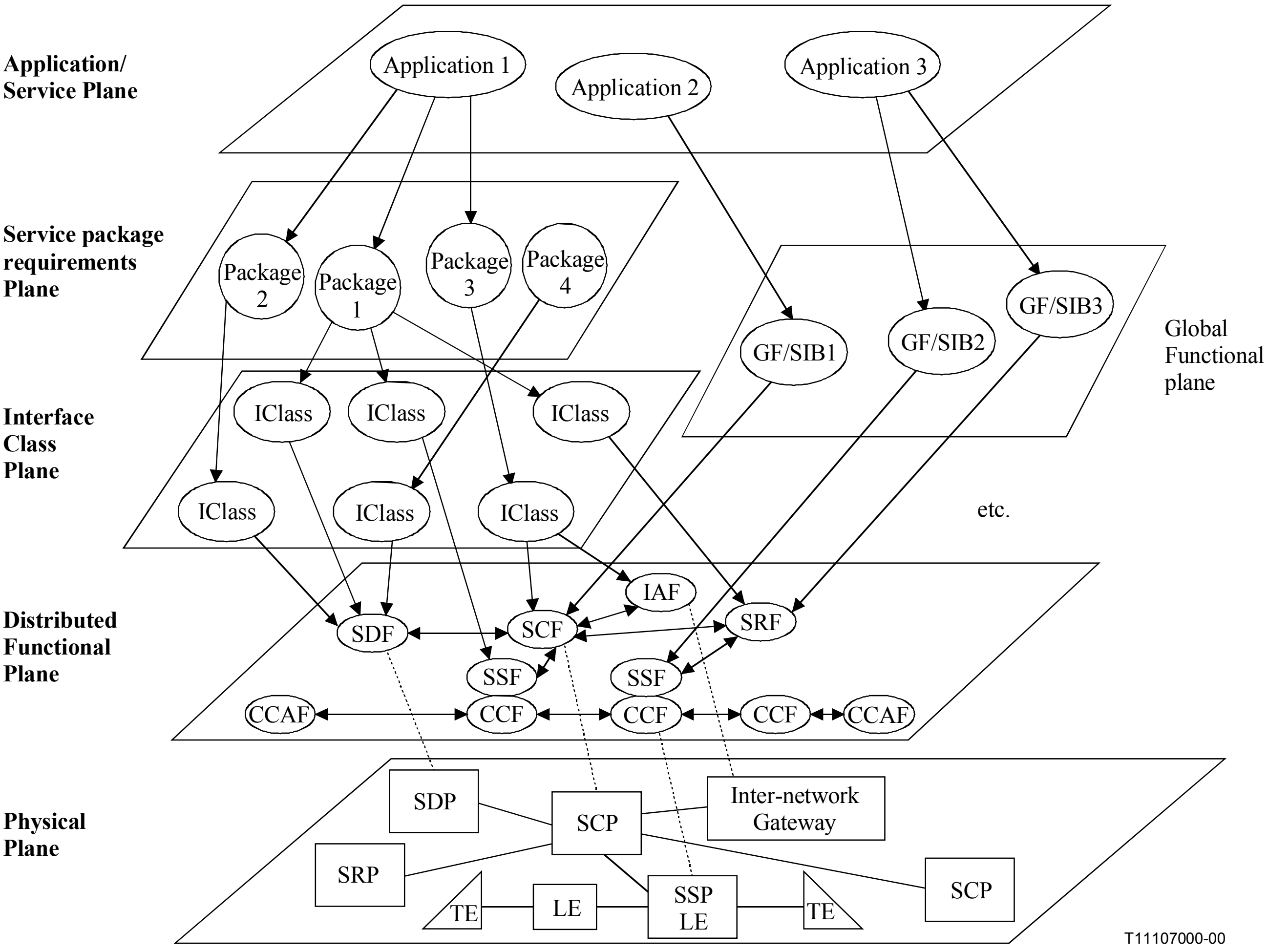


Figure 1/Q.65 – Conceptual methodology model showing relationships between services, global functions/service-independent building blocks, service packages, interface classes, functional entities and physical entities

Figure 1 above is the modified IN functional model. The functional model is designed to give the user a choice of either using the SIB approach or of using O-O methods. The results are somewhat the same. If one uses the SIB path the output results in information flows which are mapped onto functional entities, whereas using the O-O method, the result is a set of API calls which are also mapped onto functional entities. This will be explained later on in clause 3.

All of the FEs described within the DFP in Figure 1 may reside within one network domain, with the exception of the IAF. The Intelligence Access Function (IAF) may be used by another non-IN Network, to mirror the functionality provided by the SCF in the IN network. For this reason there is a necessity to provide some sort of gateway functionality to protect the division between the two networks. The Gateway functionality may provide security/firewall protection and also protocol mapping capabilities. For this reason Figure 1 shows the physical plane equivalent as an inter-networking gateway. This point of ingress or egress from the IN network also provides the access between the IN and IP networks.

1.2 The Stage 2 definition (Summary)

- specifies a functional model using Functional Entities (FEs) from the unified functional model for a specific service or network capability description;
- specifies the functional entity actions (FEAs) needed;
- specifies information flows or API calls between FEs;
- specifies the SDL description of each FE;
- recommends a small set of realistic scenarios for the allocation of FEs to physical entities.

For services and network capabilities to be standardized, Stage 2 of the method takes as its input the Stage 1 descriptions for basic and supplementary services and network capabilities. For services and network capabilities without a detailed Stage 1 description, the Stage 2 method can utilize SIB descriptions or service package requirements of service features as input. The Stage 1 description views the network (this term, in this context, could include some capability in the user equipment) as a single entity which provides these services to the user. The Stage 2 description defines the functions required and their distribution within the network. The Stage 1 user-network interactions are used and interpreted within Stage 2, as illustrated in Figure 2.

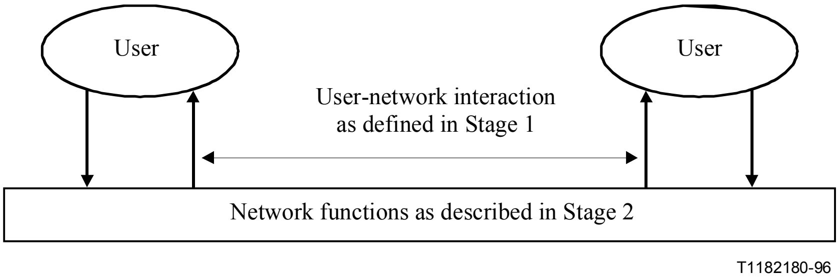


Figure 2/Q.65 – Stage 1/Stage 2 relationship

Stage 2 of the method employs techniques that provide the following desirable characteristics:

- a single functional specification which can be applied in a number of different physical realizations for providing the service;
- a precise definition of functional capabilities and their possible distribution in network equipment (and in some cases, user equipment) to support basic and supplementary services and network capabilities;
- a detailed description of what functions, information flows and API calls will be provided, but not how they are to be implemented;
- requirements for protocol and switching capabilities as input to Stage 3 of the method.

The output of Stage 2 is used by:

a) protocol designers in Stage 3 to specify the protocols to be used between separate physical entities;

b) switch (and other node) designers to specify the functional requirements of those nodes; and

c) network planners.

This Recommendation describes the six steps of Stage 2 in detail. The order of these steps represents an idealized application of the method; however, in practice there will of necessity be iterations to define fully the Stage 2 outputs. Appendix I contains an outline for a Stage 2 description utilizing the unified functional methodology.

The following steps differ slightly dependent on whether you use the SIB approach or the Object Oriented (UML) approach. Most of the aspects of Step 1 are the same, independent of the approach. Clause 3 details the UML methods and gives examples where appropriate. A working example of the use of UML is given in Appendix III.

2 Steps of the method

2.1 Step 1 – Functional model

A functional model is derived for each basic service, supplementary service, or network capability. In each case the model is matched to the requirements and characteristics of the service concerned. The functional model used in the Stage 2 description of a service identifies functional entities and the relationships between them. The refinement of the initial functional model is carried out by development and/or iteration of Steps 2 to 6, as described below. The final functional model represents a result of the completed Stage 2.

As this Recommendation provides the user with the capability of using either the SIB approach or the Object Oriented approach, alternative Steps 2-4 are provided. Figure 2.1 shows which steps should be taken when using the SIB approach and when using the O-O approach.

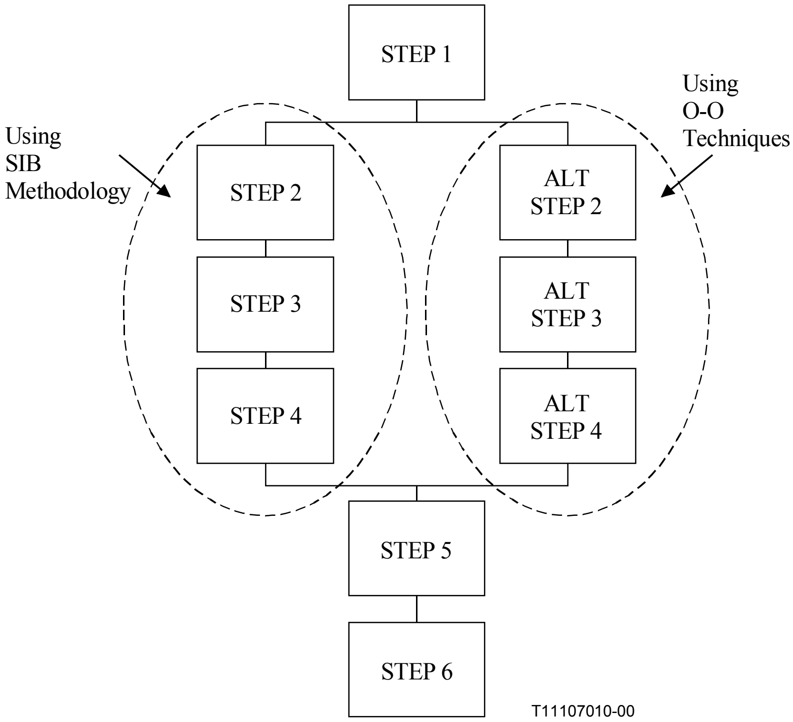


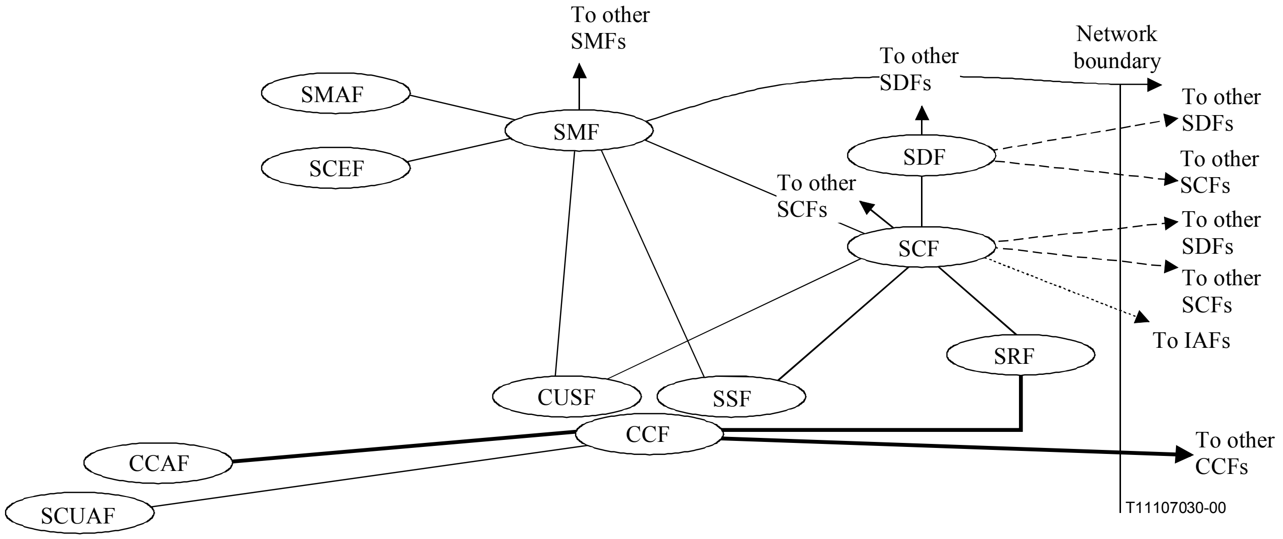
Figure 2-1/Q.65 – Use of Steps 1 to 6

2.1.1 Unified functional model

The unified functional model for the Stage 2 methodology takes account of the common functional entities, relationships, and information flows arising from ISDN, IN, B-ISDN, IMT-2000, and TMN.

Figure 3 shows an instance of the unified functional model derived from the set of FEs specified by the unified functional methodology. The functional model identifies and names the individual FEs and their types. It also identifies the relationship and relationship types between communicating FEs. Functional entities are represented by circles and the relationship between two communicating FEs is identified by a line joining them.

NOTE – The model in Figure 3 is a composite model based on basic call (Q.71), IN CS-2, IMT-2000, and B-ISDN. This model is presented as a basis from which a specific Stage 2 functional model can be constructed to support a particular service or network capability. Appendix II represents a current view on the integration of IN and B-ISDN with full separation of call and connection control. This type of model will form the basis for the evolution of this Recommendation.



CCAF	Call Control Agent Function	CCF	Call Control Function	SSF	Service Switching Function
SCF	Service Control Function	IAF	Intelligent Access Function	SDF	Service Data Function
SRF	Specialized Resource Function	SCUAF	Service Control User Access Function		

Figure 3/Q.65 – Unified functional model

2.1.2 Functional entities

Functional entities are initially derived from an overall understanding of the network functions needed to support the service. Functional entities are defined as follows:

– A functional entity is a grouping of service providing functions in a single location and is a subset of the total set of functions required to provide service.

– A functional entity is described in terms of the control of one instance of a service (e.g. one call or one connection).

– A functional entity is visible to other functional entities that need to communicate with it to provide a service (i.e. functional entities are network-addressable entities).

– A functional model may contain functional entities of different types. The type of a functional entity is characterized by the particular grouping of functions of which it is composed. Thus, two or more functional entities are said to be of the same type if they consist of the same grouping of functions.

– A separate functional entity type is normally defined for each different grouping of functions that may be distributed to separate physical devices. However, where there is a high degree of commonality between different required groupings, it may be convenient to define them as subsets of a single type rather than as different types.

– Functional entities are derived for each basic and supplementary service or network capability. The same functional entity type may occur more than once in a functional model and also may appear in the model of more than one service.

The following are definitions of the FEs used in the unified functional model. Many of these FEs have been derived from the IN studies of the support services in the network.

2.1.2.1 CCA Function (CCAF)

The CCAF is the Call Control Agent (CCA) function that provides access for users. It is the interface between user and network call control functions. It:

a) provides for user access, interacting with the user to establish, maintain, modify and release, as required, a call or instance of service;

b) accesses the service-providing capabilities of the Call Control Function (CCF), using service requests (e.g. set-up, transfer, hold, etc.) for the establishment, manipulation and release of a call or instance of service;

c) receives indications relating to the call or service from the CCF and relays them to the user as required;

d) maintains call/service state information as perceived by the functional entity;

e) interfaces to the SCUAF for call unrelated service if needed.

2.1.2.2 CC function (CCF)

The CCF is the Call Control (CC) function in the network that provides call/service processing and control. It:

a) establishes, manipulates and releases call/connection as "requested" by the SCUAF;

b) provides the capability to associate and relate SCUAF functional entities that are involved in a particular association and/or connection instance (that may be due to CUSF requests);

c) manages the relationship between SCUAF functional entities involved in an association (e.g. supervises the overall perspective of the association and/or connection instance);

d) provides trigger mechanisms to access IN functionality (e.g. passes events to the SSF/CUSF);

e) manages basic call resource data (e.g. call references).

2.1.2.3 SS function (SSF)

The SSF is the service switching function, which, associated with the CCF, provides a set of functions required for interaction between the CCF and a service control function (SCF), and associated with the NCSF for the call unrelated service handling if necessary. It:

a) extends the logic of the CCF to include recognition of service control triggers and to interact with the SCF;

b) manages signalling between the CCF and the SCF;

c) modifies call/connection processing functions (in the CCF) as required to process requests for IN-provided service usage under the control of the SCF;

d) interfaces to the CUSF for handling call-unrelated interactions;

e) supports the relay case, in which it ensures the relay of information between the SCF and SRF possibly using the out-channel call related user interaction (OCCRUI) capabilities.

2.1.2.4 SC function (SCF)

The SCF is a function that commands call control functions in the processing of IN-provided and/or custom service requests. The SCF may interact with other functional entities to access additional logic or to obtain information (service or user data) required to process a call/service logic instance. It:

a) interfaces and interacts with service switching function/call control function, Specialized Resource Function (SRF), Service Data Function (SDF), other service control functions (SCF), Intelligent Access functions (IAF) and Call unrelated service function (CUSF) functional entities;

b) contains the logic and processing capability required to handle IN-provided service attempts, both related to call and not related to call;

c) interfaces and interacts with other SCFs in a secured fashion for distributed service control and unsolicited service notifications. As a consequence of distributed service control, the result of service logic execution is transferred between two SCFs;

d) interfaces and interacts with SDFs for secured data acquisition and manipulation of data;

e) provides a point of interconnection to the network for the purpose of internetworking, effectively hiding the specific structure of the network;

f) interfaces and interacts with SRF for call-related interactions by indicating to the SRF the User Interaction script to be run, by providing to the SRF the additional information it requests during the User Interaction script execution and by waiting for the end of the User Interaction script execution;

g) interfaces and interacts with SRF for call-unrelated interactions by monitoring the availability of resources at the SRF, requesting control of some SRF resources outside the context of a call;

h) provides security mechanisms, for the purposes of inter-networking, to enable secured information transfer across the boundary between networks.

2.1.2.5 SD function (SDF)

The SDF contains customer and network data for real-time access by the SCF in the execution of an IN-provided service. It:

a) interfaces and interacts with SCFs for secured manipulation and acquisition of data through simple database requests of data management scripts;

b) interfaces and interacts with other SDFs as required, enabling the hiding of data location in the network. This knowledge can be used for data distribution transparency (e.g. to the SCF);

c) provides security mechanisms, for the purposes of inter-networking, to enable secured information transfer across the boundary between networks;

d) interfaces and interacts with other SDFs enabling copying of data together with the access rights to the data;

e) provides authentication and access control facilities for providing secure access to service data;

f) facilitates the cooperation of traffic management to prevent or solve a congestion situation in data acquisition;

g) provides data support for security services. This data support can be used by the SDF itself for secured data management;

h) facilitates the cooperation of a robust recovery mechanism for copying of data (e.g. in the case the SDF is unavailable);

i) provides data access scripts (methods) which may be invoked by the SCF in order to simplify the information transfer via the SCF-SDF interface. Such kinds of data access scripts do provide simplified data manipulation on an entry. The SCF continues to provide service specific processing logic and command call control functions in the SSF.

NOTE – The SDF contains data relating to the provision or operation of IN-provided services. Thus it does not necessarily encompass data provided by third party such as credit information, but may provide access to these data.

2.1.2.6 SR function (SRF)

The SRF provides the specialized resources required for the execution of IN-provided services (e.g. digit receivers, announcements, conference bridges, etc.). It:

a) interfaces and interacts with SCF and SSF (and with the CCF);

b) may contain the logic and processing capability to receive/send and convert information received from users;

c) may contain functionality similar to the CCF to manage bearer connections to the specialized resources.

2.1.2.7 SRF Automatic Speech Recognition (ASR)

The ASR resource allows the IN services user to input commands and data in his/her own voice. ASR can be both speaker-independent and speaker-dependent. In the case of speaker-dependent ASR, a mechanism should be provided which enables the user to directly manage his/her voice templates used for recognizing commands and data: such a mechanism should allow the user to review, update, delete and insert both:

– the voice templates; and

– the correspondences between the templates and the SRF internal format of the recognized voice (e.g. between a voice input name and the corresponding string of ASCII characters).

This mechanism could either be controlled by the SCF or directly performed by the SRF with no intervention by the SCF. In the latter case, the SRF would inform the SCF of the result of the operation, should this have been requested by the SCF. The basic ASR resource should provide for the recognition of isolated words (i.e. the ten digits and a number of basic commands such as "yes" and "no" spoken at least in the local network provider language) in a speaker-independent manner over the PSTN.

Considering that multilingual ASR could also be useful, it is recognized that the SRF should handle the indication of the requested language to be used for voice inputs, in the same way as announcement generation described above.

2.1.2.8 SRF text to speech (TTS)

The SRF can have a Text-to-Speech function. This functionality consists of two logical functions. The first function converts the input text in a phonetics-prosodic representation. The second function produces the synthesized voice signal, processing and connecting of voice elements.

2.1.2.9 IA function (IAF)

The Intelligent Access Function provides access between the SCF of an IN-structured network and an entity which is not an IN-structured network. This latter entity may be other networks or customers (private networks, simple databases used for instance in the CCR service, terminals and PABXs). It:

a) provides access to and from the SCF of the IN-structured network;

b) maps the information between the internal and external representation;

c) resides in the entity which is not an IN-structured network;

d) provides Gateway capabilities encompassing security and firewall functionality.

2.1.2.10 CUS function (CUSF)

The CUSF is the call-unrelated service (CUS) function which, associated with the CCF and the SSF, provides a set of call-unrelated service functions required for out-channel interaction with a SCUAF. It also provides the set of functions required for interaction between the SCUAF and a SCF. It:

a) extends the logic of the CCF to include recognition of service control triggers and to interact with the SCF;

b) manages signalling between the CCF and the SCF;

c) modifies the association/connection processing functions (in the CCF) as required to process requests for IN-provided service usage under the control of the SCF;

d) modifies call-unrelated interaction processing functions (in the CUSF) as required to process requests for IN-provided service usage under the control of the SCF;

e) supports call-unrelated user interaction which may be user initiated or SCF initiated;

f) interfaces to the SSF for handling call-related interactions.

2.1.2.11 SCUA function (SCUAF)

The SCUAF is the service control user agent (SCUA) function that provides access for users. It is the interface between a user and the Call Unrelated Service Function (CUSF). It:

a) provides for user access, interacting with the user to establish, maintain, and release, as required, an instance of call-unrelated service;

b) accesses the service providing capabilities of the call control function (CCF), using service requests (e.g. set-up, location registration) for the establishment, manipulation and release of an association or instance of service;

c) receives indications relating to call-unrelated services from the CCF and relays them to the user as required;

d) maintains service state information as perceived by this functional entity.

NOTE – Whether the SCUAF abstracts a new FE for call associate supplementary services is not defined in IN CS-2. As well, IN CS-2 does not define what relationship should be used to model call-related user interaction (the existing relationship between the CCAF and the CCF or an explicit relationship between some FEs).

2.1.2.12 SM function (SMF)

The SMF is the Service Management Function. This clause describes a number of IN SMF functionalities. These functions can be grouped into five categories:

1) Service Deployment Functions;

2) Service Provisioning Functions;

3) Service Operation Control Functions;

4) Billing Functions;

5) Service Monitoring Functions.

- Service Deployment Functions include:
  - Service Scripts Allocation:

    This subfunction passes the service scripts and determines for which part of the network the service scripts are relevant and manages the relevant network elements.
  - Service Generic Data Allocation:

    This subfunction passes the service generic data and determines for which part of the network the service generic data are relevant and manages the relevant network elements.
  - Signalling Routing data Introduction and Allocation:

    This subfunction passes the signalling routing data and determines for which part of the network the signalling routing data are relevant and manages the relevant network elements. It downloads the signalling routing data into the SS No. 7 network and determines the relevant SS No. 7 network elements for allocation of the signalling routing data.
  - Trigger Data Introduction and Allocation:

    This subfunction passes the trigger data and determines for which part of the network the trigger data are relevant and manages the relevant network elements. It downloads the trigger data into the PSTN.
  - Specialized Resource Data Introduction and Allocation:

    This subfunction passes the specialized resource data and determines for which part of the network the specialized resource data are relevant and manages the relevant network elements.
  - Service Testing:

    This subfunction collects the service software from the Service Creation Environment Function to be loaded into a stand-alone IN-network, in order to test the newly developed service. The function enters service and service subscriber specific data. It performs management related test operations.
- Service Provisioning Functions include:
  - Customer Specific Data Introduction and Allocation:

    This subfunction collects service subscriber specific data and administrates that in subscriber databases and contract databases. The function translates the service and subscriber data into network specific data. This subfunction determines for which part of the network the data are relevant and manages the relevant network elements.
- Service Operation Control Functions include:
  - Service Maintenance:

    Service Maintenance includes the following functionality:
    - Software Maintenance:

      Software maintenance consists of the modification of service logic (modification of service logic is a function of the SCEF). Introduction of modified script in the IN-structured network is done in service deployment.
  - Updating Service Generic Data:

    This subfunction passes the service generic data and determines for which part of the network the service generic data are relevant and manages the relevant network elements.

  - Updating Customer Specific Data:

    This subfunction provides the control functions for service subscriber specific data and administration to those subscriber databases and contract databases. This subfunction determines for which part of the network the data are relevant and manages the relevant network elements.

  - Updating Signalling Routing Data:

    This subfunction provides the control functions for the signalling routing data and determines for which part of the network signalling routing data are relevant and manages the relevant network elements. It downloads the signalling routing data into the SS No. 7 network and determines the relevant SS No. 7 network elements for allocation of the signalling routing data.

  - Updating Trigger Data:

    This subfunction provides the control functions for the trigger data and determines for which part of the network the trigger data are relevant and manages the relevant network elements. It downloads the trigger data into the PSTN.

  - Updating Specialized Resource Data:

    This subfunction provides the control functions for the specialized resource data and determines for which part of the network the specialized resource data are relevant and manages the relevant network elements.

  - Adjustment of the SMAF:

    The service subscriber/network operator interface to the SMF is provided by the SMAF. The interface to the service subscriber and network operator has to be accommodated to the adjustments in their data. For instance, a service subscriber who has changed peripheral-type (customer specific data: DTMF-telephone to VTX-terminal). This change of peripheral also may cause a change of menu options.

  - Service Reconfiguration:

    This activity consists of the reallocation of service scripts, service generic data and customer specific data. For instance, the reason for service reconfiguration could be a change in the network configuration or improvement of the performance of services.

  - Service (de)activation:

    This activity gives the network operator the possibility to (de)activate (part of) a service temporarily. For instance, for maintenance purposes a televoting service which is only used on set times.

  - Service dismantlement:

    A service will be taken out of operation.

  - Security:

    In the SMF, two types of security can be distinguished: access control and data control. Access control covers the identification, authentication and authorization (command control) of both service subscriber and network operator. Data control covers the control of the input of data by both the service subscriber and the network operator.

- Billing Functions include:

  - Generating and Storing Charging Records:

    This subfunction monitors the service usage. This function logs the call records.

  - Collecting Charging Records:

    This subfunction collects the call records and the management detail records. Then it uniforms and correlates them. This function logs the call records.

  - Modification of Tariffs:

    This subfunction determines the tariff structure and the tariff for a newly developed service or changes them for an existing one.

- Service monitoring includes:
  - Initiating Measurements and Collecting Measurement Data:

    This subfunction monitors the service usage and service performance. It also monitors network performance. Therefore, it needs measurement results from the underlying parts: the SS No. 7 management function and Network management function.

  - Analysis and Reporting of Measurement Data:

    This subfunction analyses the service usage and service performance. It also analyses the results of the initiation and collection measurement data function.

  - Receive information from fault monitoring data:

    This subfunction acts upon the receipt of fault monitoring data from Network elements. Implications and impact on Service performance will be computed and the appropriate action taken.

2.1.3 Functional entity relationships

Services are supported by the cooperative actions of a set of functional entities. Cooperation requires that communication relationships be established:

- Each communicating pair of functional entities in a specific service functional model is said to be in a relationship.
- Each interaction between a communicating pair of functional entities is termed an information flow or API call (this latter case refers to the use of UML in describing the reference point). The relationship between any pair of functional entities is the complete set of information flows or API calls between them. In the latter case this is known as the API for that reference point.
- If a communication pair of functional entities is located in physically separate devices, the information flows or API between them define the information transfer requirements for a signalling protocol between the devices.
- Different communicating pairs of functional entities may have relationships of different types. The type of a relationship is characterized by the set of information flows or API calls between two functional entities. For example the relationships between functional entities FE1 and FE2 and between functional entities FE3 and FE4 are said to be of the same type if they comprise the same set of information flows or API calls.
- Relationships may be assigned type identifiers (e.g. r1, r2, r3, etc.) which uniquely identify specific sets of information flows within the functional model of a service. The same relationship type may occur more than once in a functional model.

2.1.4 Derivation of the functional model

Based on the above definitions, the functional model for a particular service is derived using the following criteria and guidelines:

- Appropriate functional entities are chosen based on knowledge of the variety of anticipated network realizations. All reasonable distributions of functions should be considered, thus leaving the option open to an Administration as to how actually to offer the service.
- Relationship types are initially assigned based on an assessment of the probable nature of the interactions between each pair of functional entities. Revisions to the initial model may be necessary in the light of more detailed definition of functional entity actions, information flows or API calls and the range of physical locations for functional entities.

– The model for some services may require that a functional entity be replicated a number of times (e.g. tandem functions). The functional model should only describe replications up to the point where no new combinations of external relationships to functional entities are encountered by further replication. Thus, a single function entity may represent multiple physical tandem entities providing the same function.

The unified functional model is intended to capture aspects from as many network architectures as possible. For ISDN, although many of the FEs in the model are normally co-located in physical implementations, the service functionality can be separated among the functions specified. For IN and IMT-2000, the functional model and FEs are typical of IN capability set and IMT-2000 architectures (see ITU-T Q.1711). For B-ISDN, the unified functional model identifies edge-to-edge relationships between serving call control functions, and link-by-link relationships using transit call control functions. Point-to-multipoint configurations are catered for by identifying additional instances of similar functional entities and relationships as appropriate. For IP-based networks the functional model provides a link to Managed objects that can be considered to exist within FEs and can, as such, be addressed and accessed through those FEs. The functional model also provides access to functions that provide the necessary protocol mapping that may be needed between the IN and IP networks in the form of gateway functions.

2.1.5 Relationship between basic and supplementary service models

The functional model for a supplementary service shall relate to a basic service model. The following guidelines should be followed in resolving whether the functions associated with supplementary service should be co-located with existing basic service functional entities or in the form of new functional entities that are not co-located:

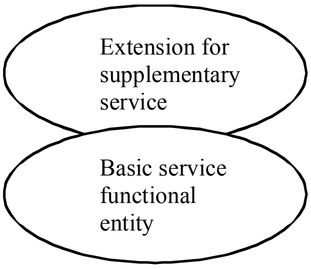
– A grouping of functions within a supplementary service model should be co-located with a basic service functional entity (e.g. see Figure 5) if it modifies an object (e.g. call connection) that is controlled by the basic service.

– A functional entity that is not co-located with a basic service functional entity typically would not require detailed call/connection state information. A separate functional entity may also be characterized by having a transactional relationship with a functional entity of the supplementary service co-located with a functional entity of the basic service (e.g. to provide number translation to the basic service functional entity).

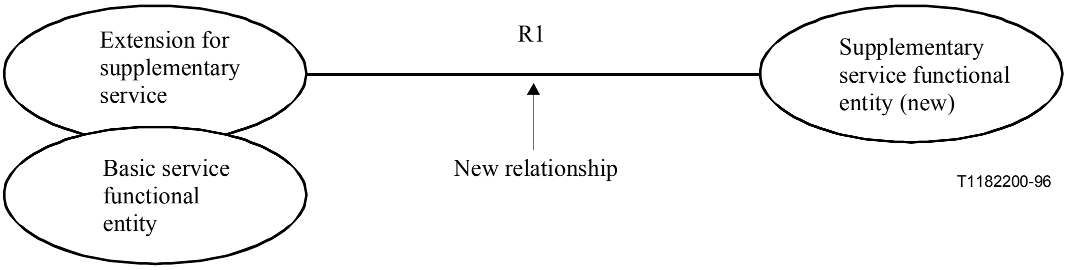
– A relationship between the functional entities for the supplementary service is defined if, and only if, the supplementary service functional entities are required to communicate and those communication needs are not met by the information flows defined within the basic service.

– The relationship between the model for a supplementary service and that for a basic service may be derived by comparing the models. How the functional entities of the supplementary service needs to take into account all scenarios defined in Step 6 for both the basic service model and for the supplementary service model.

Figure 4 illustrates these relationships.


Extension for supplementary service
Basic service functional entity

a) Additional functions for supplementary service provided as an extension to a functional entity of a basic service.


Extension for supplementary service
Basic service functional entity
R1
New relationship
Supplementary service functional entity (new)
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b) Additional functions for a supplementary service provided as a seperate non-located functional entity.

Figure 4/Q.65 – Alternative ways of adding supplementary service functions to the basic service functional model

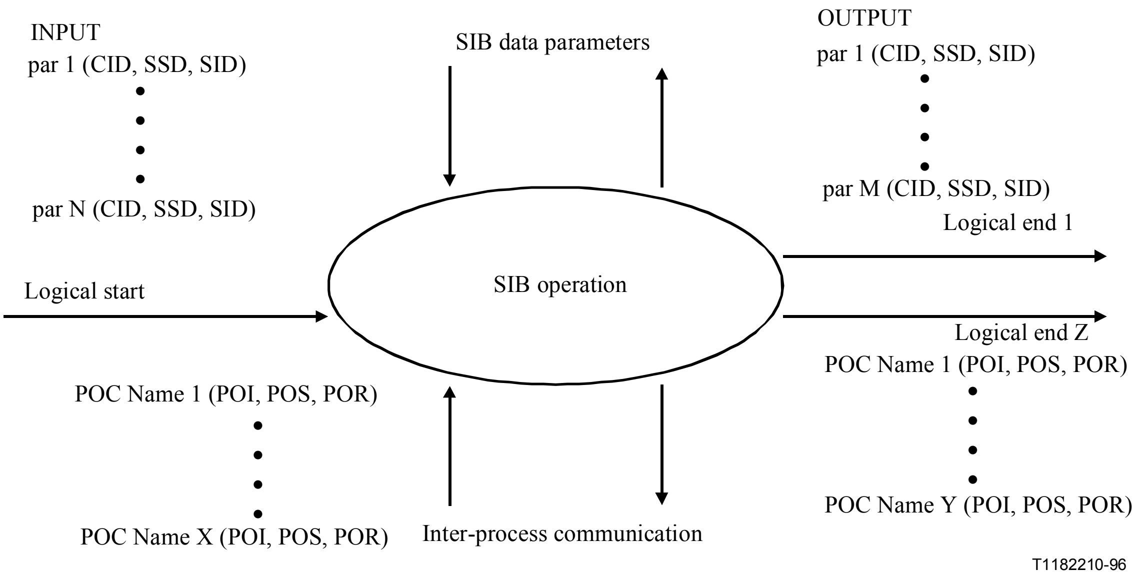


Figure 5/Q.65 – SIB operation graphical representation

2.2 Step 2 (Optional) – SIB description of service features (see 3.1 for alternative Step 2 utilizing Object oriented techniques)

Service independent building blocks

A SIB is a standard reusable network-wide capability residing in the global functional plane used to create service features (see Figure 1). SIBs are of a global nature and their detailed realization is not considered at this level but can be found in the Distributed Functional Plane (DFP) and the physical plane. The SIBs are reusable and can be combined to realize services described in the service plane. The capability offered within the SIB is described by the set of operations that may be invoked in the SIBs. The set of operations that the SIB offers constitute the SIB interface. Each operation defines a function that can be performed related to the SIB capability. Complex SIBs, e.g. those modelling persistent activities are defined on the basis of several operations that allow the control of the activity performed by the SIB. SIBs are defined to be independent of the specific service and technology for which or on which they will be realized.

Characteristics of a SIB

- SIBs are the monolithic building blocks (their detailed implementation is hidden) that the service designer will use to develop new services.
- All service features (SFs) are described by one SIB or combination of SIBs.
- All SFs can be defined by a finite number of SIBs.
- A SIB defines one complete activity.
- SIBs are realized in the DFP by functional entity actions which may reside in one or more functional entities (FEs).
- A SIB operation has one logical starting point and one or more logical end points. Data required by each SIB operation is defined by SIB operation support data parameters and call instance data parameters.
- SIBs are global in nature and their locations need not be considered as the whole network is regarded as a single entity in the GFP.
- SIBs are reusable. They are used without modification for other services.

This subclause is intended as an introduction to the use of Service-Independent Building Blocks (SIBs) in the Unified Functional Methodology (UFM) for service descriptions. The concept of SIBs has been adopted to address service creation needs as well as to introduce re-usable blocks of flows, SDL, and FEAs which can be catalogued. The addition of the SIB concept is introduced to streamline the work of Stage 2 service definition. New SIBs will be created as needed, and a SIB library will be maintained as a reference for service creation and definition.

NOTE – The use of SIBs for Stage 2 descriptions is not confined to IN-supported services only.

The IN conceptual model approach of defining and using SIBs provides the basis for a flexible service description and creation method, as well as a method for referencing pre-defined flows and SDL. The SIB concept (as referenced in ITU-T Q.1213/Q.1214 (1995)) has been chosen as a key addition to the Stage 2 methodology described in this Recommendation.

Common ground for the unified methodology exists in that SIBs are decomposed into FEAs, SDLs, and information flows. The appeal of the method is in the potential for re-use (SIBs map to predefined functional entity actions described by pre-defined information flows and SDL). It cannot be absolutely proven that SIBs may be combined in all possible ways to create new services, but several methods are being considered (e.g. extension of the SDL process to include the combination of SIBs). Verification of the existing SIBs (i.e. that each is correctly defined) is possible by analysing the SDLs which define them. Verification of SIB combinations is possible by analysing the SDLs created when SIBs are combined to describe service features and network capabilities.

There is a need for new SIBs as well as the development of combination rules and application rules. SIBs must be created "top down" from target services, but also "bottom up" from experience with service description methodology. In this way, the methodology can address current needs, but also evolve to include improvements and new technologies. With continued efforts on SIB definition and application rules, SIBs could become the primary tool for Stage 2 service description and service creation.

2.2.1 SIB definitions

Terminology:

BCP	Basic Call Process
CID	Call Instance Data
GSL	Global Service Logic
HLSIB	High Level SIB
POC	Point Of Control
POI	Point Of Initiation
POR	Point Of Return
POS	Point Of Synchronization
SID	Service Instance Data
SSD	Service Support Data

2.2.1.1 basic call process SIB

The Basic Call Process (BCP) is responsible for providing basic call connectivity between parties in the network. The BCP can be viewed as a specialized service process, which provides event processing capabilities of the basic call, as well as a specialized SIB, which provides a set of SIB operations, such as:

- connecting call, with appropriate disposition;
- disconnecting calls, with appropriate disposition;
- retaining CID for further processing of that call instance.

2.2.1.2 high level SIB (HLSIB)

High level SIBs (HLSIBs) are, as normal SIBs, a reusable part of a service feature, and are composed out of SIB operations and other HLSIBs which can be executed sequentially. HLSIBs have the following additional characteristics:

- HLSIBs can be composed out of other HLSIBs and SIB operations only.
- A certain HLSIB can not be used as a component within the same HLSIB, i.e. no recursive use is possible.
- The lowest level of HLSIBs contains SIB operations only, i.e. no further detail is visible on the GFP.
- One of the (HL)SIBs within a HLSIB is the first to be executed; therefore, HLSIBs have only one entry point (logical start), the same as with normal SIBs. But, as with normal SIBs as well, HLSIBs can have one or more exit points (logical ends).

2.2.1.3 global service logic

The GSL can be defined as the "glue" that defines the order in which SIB operations will be chained together to build service processes to accomplish service features. Each instance of global service logic is (potentially) unique to each individual call, but uses common elements, comprising specifically:

- interaction points (POI, POS and POR) of service processes, including the BCP Service Process;
- SIB operations;
- logical connections between SIB operations, and between SIB operations and service process interaction points;
- input and output data parameters, service support data and call instance data defined for each SIB.

Based upon the functionality of these common elements, global service logic will "chain together" these elements to provide a specific service.

2.2.2 SIB data parameters

By definition, SIBs are independent of the service/SF they are used to represent. They have no knowledge about other SIBs which are used to describe the service feature.

In order to describe service features with these generic SIBs, some elements of service dependence are needed.

Service dependence can be described using data parameters which enable a SIB to be tailored to perform the desired functionality. Data parameters are specified independently for each SIB and are made available to the SIB through global service logic.

Data parameters consist of input and output parameters. Two general types of data parameters are required for each SIB operation, dynamic parameters called Call Instance Data (CID) and static parameters called Service Support Data (SSD) and Service Instance Data (SID).

Differentiation of formal SIB parameters from actual parameters introduces more flexibility in assigning the SIB parameter data type. The formal SIB parameters are the parameters that will be used for SIB descriptions in this Recommendation. Actual SIB parameters only occur in SIB instances in specific Global Service Logic (GSL).

2.2.2.1 call instance data (CID)

Call instance data defines dynamic parameters whose value will change with each call instance. They are used to specify subscriber specific details like calling or called line information. This data can be:

- made available from the BCP (e.g. Calling Line Identification);
- generated by a SIB operation, (e.g. a translated number); or
- entered by the subscriber, (e.g. a dialled number or a PIN code).

2.2.2.2 service support data (SSD)

Service support data defines data parameters required by a SIB operation which are specific to the service feature description. When a SIB operation is included in the GSL of a service description, the GSL will specify the SSD values for the SIB. SSD consists of fixed parameters. These are data parameters whose values are fixed for all call instances. For instance, the "File Indicator" SSD for the translate SIB needs to be specified uniquely for each occurrence of that SIB in a given service feature. The "File Indicator" SSD value is then said to be fixed, as its value is determined by the service/SF description, not by the call instance.

If a service/SF is described using multiple occurrences of the same SIB, then fixed SSD parameters are defined uniquely for each occurrence.

2.2.2.3 service instance data (SID)

Service instance data defines data related to a service subscriber's profile, that exists before the service is invoked and can be modified and updated as a result of the service processing activity. This type of data can be read within the service execution and be stored to be used in further service invocations.

2.2.3 SIB modelling conventions

Graphical representation

A graphical representation is used to describe each operation performed by a SIB. It is illustrated in Figure 6. Each SIB operation is characterized by having input and output parameters, one input logical flow, and one or more output logical flows. These logic flows are shown by the solid arrows on the left and right of the diagram. Each logic flow is specified above each arrow. Input and output parameters are identified by the dashed arrows at the top of the diagram and are specified beside the dashed arrow. For both input and output parameters, SSD, SID and CID type is declared beside the respective parameters. Similarly, POCs are specified below the diagram.

SIBs can be defined with various degrees of granularity. By composition, SIBs can be defined out of smaller SIBs, forming a High Level SIB (HLSIB). Conversely, decomposition allows the partitioning of the granularity of a HLSIB into smaller blocks that can be re-used. Figure 6 shows several layers of granularity for HLSIBs. It may be advantageous to catalogue certain HLSIBs as well as simple SIB combinations in order to promote re-use of more complex functionality.

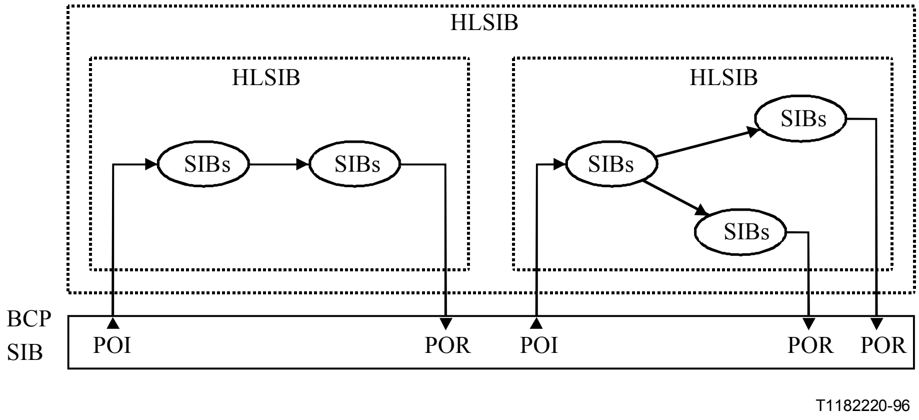


Figure 6/Q.65 – SIB combination/HLSIBs (generic example)

Figure 7 shows an example of a global service logic diagram. The global service logic diagram, which shows the SIB, or SIBs in combination, performing a particular service function is a perfect "bridge" from a Stage 1 description to the Stage 2 description. The diagram describes the service or network capability in a shorthand way that conveys a great deal of information with a relatively simple graphical means. The definitions contained in the diagram, however, contain all the SDL, information flows, and FEAs necessary to complete the Stage 2 description.

A possible definition of the terminating screening service is shown in Figure 7. From the cell arrival POI, the SCREEN SIB is used to determine if the calling user is on the list of users allowed to terminate a call at the destination. If on the list, the call is permitted, and the BCP continues call handling with existing data. If the caller user is not on the list, the USER INTERACTION SIB is used to deliver an appropriate disconnection message to the caller, at which time the BCP clears the call.

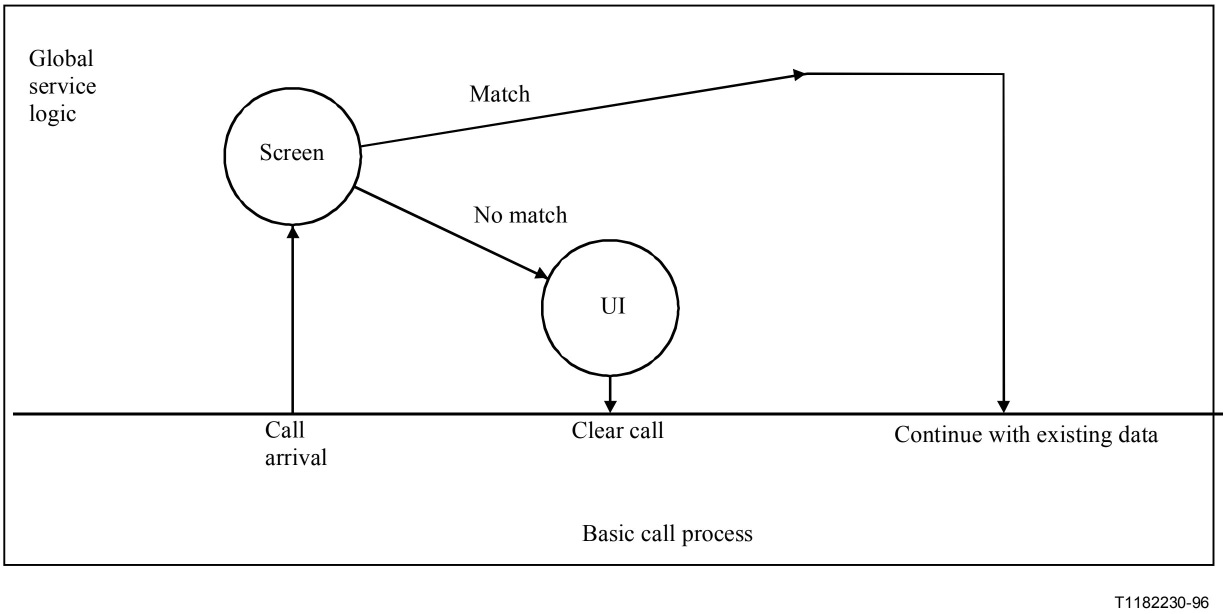


Figure 7/Q.65 – GFP terminating screening service

2.2.4 SIB modelling of service features

It is encouraged that SIBs and HLSIBs be used to describe service features and network capabilities, since it promotes the re-use of SDL, information flows, and FEAs which are already defined. The global service logic diagram, showing the SIB, or SIBs in combination, performing a particular service function is an efficient and effective means of providing the SIB input to the Stage 2 description.

The following are guidelines for the use of SIBs in the Stage 2 method:

- Provide GSL diagrams of service features including POI(s) from and POR(s) to the BCP SIB.
- Provide a mapping of the SIBs used in the description to the FEs of the unified functional model. Also, provide references for the definitions of the SIBs used (e.g. clause 5/Q.1213, (1995)). This can easily be done in tabular form (see 2.2.6).
- Provide SIB data parameters needed for the service. Identify data values within the context of the service.

If all service features can be described completely with SIBs, specific references should be provided for the supporting SDL, information flows, and FEAs in the appropriate clauses of the Stage 2 description. Explicit drafting of these clauses is not needed (provided the SIB descriptions have been proven to be accurate. These "proofs" for various SIB combinations and HLSIBs will come with experience; the SIB library will preserve this information). If there are no SIBs available to describe a particular feature, the unified functional methodology can still be used as it has always been used to explicitly derive the SDL, information flows, and FEAs. If some SIBs are identified to partially describe a service, it is suggested that the SDL diagrams and information flows be explicitly shown with indications as to which sections of flows are from SIB definitions.

2.2.5 List of available SIBs

IN CS-1R Service-Independent Building Blocks (SIBs):

1) Algorithm;

2) Authenticate;

3) Charge;

4) Compare;

5) Distribution;

6) Limit;

7) Log call information;

8) Queue;

9) Screen;

10) Service data management;

11) Status notification;

12) Translate;

13) User interaction.

Additional SIBs are defined in the Q.12x3-Series of Recommendations.

2.2.6 Mapping SIBs to FEs

Table 1 shows the mapping of SIBs to FEs.

Table 1/Q.65 – SIB/FE mapping

SIB	Functional entities			
	SSF/CCF	SCF	SRF	SDF
Algorithm		X		
Charge	X	X		
Compare		X		
Distribution		X		
Limit	X	X		
Log call information	X	X		X
Queue	X	X	X	
Screen		X		X
Service data management		X		
Status notification	X	X		
Translate		X		X
User interaction	X	X	X	
Verify		X		
Basic call process	X	X		
Authenticate		X		X

2.3 Step 3 – Information flow diagrams (see 3.2 for alternative Step 3 utilizing Object Oriented techniques)

2.3.1 Identification of information flows

The distribution of the functions required to provide a service, as defined by the functional model, requires that interactions occur between functional entities. Such an interaction is referred to as an "information flow" and will have a name descriptive of the intent of the information flow.

Information flow diagrams are created to contain all the information flows necessary for typical cases of successful operation of the service. Information flow diagrams may need to be created as appropriate for other cases. Figure 8 illustrates the general form of an information flow diagram for a basic or supplementary service.

Information flow diagrams for supplementary services should not necessarily duplicate information flow descriptions that are part of a basic service. However, it may be that a supplementary service description identifies additional information flow requirements between the functional entities of the basic service representation, and this should be described.

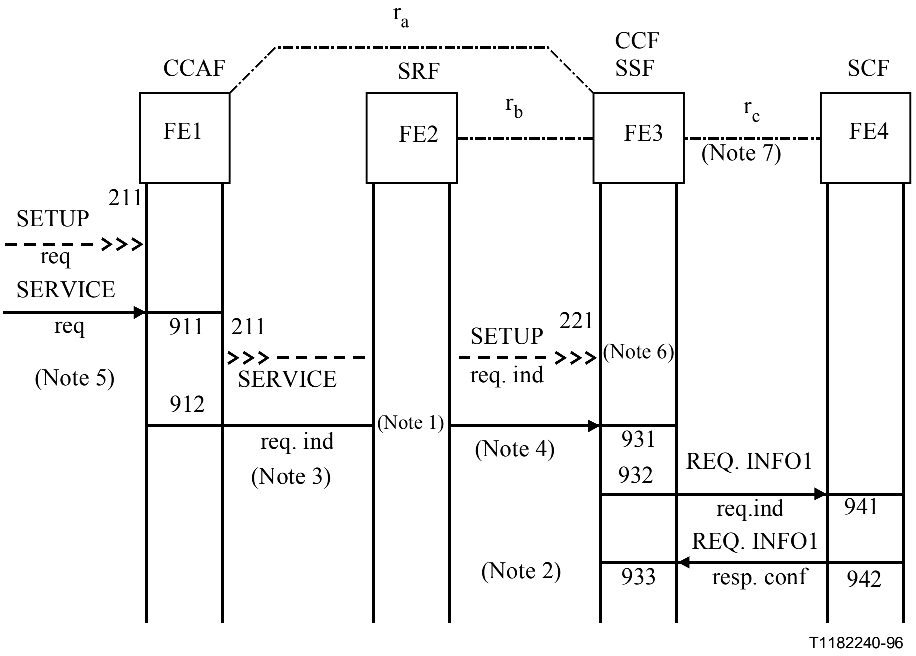


Figure 8/Q.65 – Example of information flow diagram

Notes to Figure 8:

NOTE 1 – Receipt and emission of user inputs/outputs and information flows are shown by horizontal lines across the relevant functional entity columns. Conversely, the absence of a line indicates no receipt or emission.

NOTE 2 – A reference number is assigned to each point in the overall sequence at which functional entity actions are shown.

NOTE 3 – Information flows are shown as arrows with the name of the information flow above and below the arrow. The descriptive name is written in capitals above the arrow and the label (e.g. req. ind.) is written below line in lower case. For unconfirmed information flows and the "request" part of confirmed information flows the label "req. ind." is shown in lower case below the information flow arrows. For the "confirmation" part of confirmed information flows the "resp. conf" is used.

NOTE 4 – In a particular functional entity column:

– Actions shown below a line representing the receipt of a user input or information flow are dependent upon that receipt (i.e. they cannot be carried out beforehand). Thus Action 931, for example, cannot be carried out before SERVICE is received.

– Similarly, actions shown above a line representing the emission of a user output or an information flow must be completed prior to the emission flow. Thus, REQ.INFO1 cannot be emitted until Actions 931 and 932 are both completed. No implications regarding the order of execution of Actions 931 and 932 are intended.

– Actions shown below a line representing the emission of user output or information flow do not need to be completed before emission (although in many practical implementations they may). No constraint on the relative order of the emission and the action which immediately follows it is intended. Thus Action 942 may be executed before, after or in parallel with emission of the "request" part of the REQ.INFO1 information flow.

NOTE 5 – The Stage 1 service interactions are inputs to and outputs from the Stage 2 information flow diagram. Stage 1 service interactions from the user are either of the form XXXXX.req or XXXXX.resp. Stage 1 service interactions to the user are either of the form xxxxx.ind or XXXXX.conf.

The following guidelines are observed in drafting these information flows diagrams:

- Vertical columns represent each of the functional entities identified in the functional model for the service. Information flows are shown in descending order in which they occur in the processing of a call. The order of functional entity actions shown between information flows is not significant.
- An information flow will be characterized in the arrow diagrams as being associated with the terms request/indication or response/confirmation. This is reflected in the primitive which is communicated to the underlying signalling system as illustrated in Figure 8. The primitive name is, in general, a direct derivation of the information flow name. The terms are shown in association with the information flow to show the relation between the Stage 2 SDL and the SDL of the underlying signalling system.

A reference number uniquely identifies a particular point in the Stage 2 information flow sequence and appears on the information flow diagram at that point. It also serves as a pointer to a description (see 2.4 below) of the actions required at this point in the sequence. A brief description of the functional entity actions may also appear on the relevant part of the information flow diagrams. The reference numbering scheme to be used is described below.

Each number is of the form XYZ and is a number assigned by the drafter of the Stage 2 description, which identifies a particular point in Stage 2 procedural description (arrow diagrams and SDL) at which functional entity actions are described. For supplementary service actions, X of the FEA number must be "9". Y is the number of the FE where the action is executed. Z enumerates the actions in a single FE (Z=1, ..., 9, A, ..., Z, a, ..., z). This number is unique within the Stage 2 description of a particular service (all variants).

NOTE 6 – Basic Call flows are shown by dashed lines and chevrons. Supplementary service flows are shown by solid lines and arrow heads. Information transferred "in-band" is shown by double dashed lines.

NOTE 7 – The relationships between FEs may also be shown on the diagram.

2.3.2 Definition of individual information flows

The semantic meaning and information content of each information flow is determined. An individual information flow may be identified as requiring confirmation, and if so, it requires a return information flow of the same name.

Confirmed information flows take the form of a request for an action (in one direction) and confirmation that the action has been carried out (in the return direction). Confirmed information flows are typically required for synchronization purposes. The two main cases are when requesting allocation and/or release of a shared resource.

When interacting functional entities are implemented in physically separate locations, information flows will normally be conveyed by signalling system protocols. When interacting functional entities are implemented in the same location, information flows are internal and do not effect signalling systems protocol.

Tables should be constructed to show all items in each information flow. It should be indicated whether or not each item is mandatory or optional, and along what relationship the information is passed (see Table 2).

Table 2/Q.65 – Example of definition of individual information flows

REQ.INFO1

Relationship	**Item**	**req.ind**	**resp.conf**
r_a, r_b, r_c	Request for billed number	Mandatory	–
r_a, r_b, r_c	Billed number	–	Mandatory
r_a, r_b, r_c	Request for service type	Optional	–
r_a, r_b, r_c	Service type	–	Optional

2.4 Step 4 – Functional entity actions (see 3.3 for alternative Step 4 utilizing Object Oriented techniques)

The Stage 2 actions performed within a functional entity, from the reception of each information flow to the transmission of the next resulting information flow, are identified and listed. All externally visible actions (those which are explicitly or implicitly notified to other functional entities) are included. The identified actions are then represented on the information flow diagrams and SDL diagrams by brief prose statements, or separately using reference numbers.

NOTE – The implementation of the charging principles of the D-Series Recommendations is a national matter. Therefore, FEAs which are solely for charging should be included only if there is a direct need for a signalling support, or if the service may be provided by public networks across an international boundary. In cases where the charging principles of the D-Series Recommendations need to be reflected in Stage 2 service descriptions, the following footnote should be entered for each FEA that contains charging.

"This FEA describes actions that might be adopted by Administrations to implement the charging principles of the D-Series Recommendations."

This functional entity actions subclause contains descriptions of actions required for each functional entity and each FEA is identified by a reference number.

The presentation form for functional entity actions is illustrated in Figure 9.

FEAs of FE2

921:

- Interact with user to accumulate information
- Select network access resource
- Reserve facilities, both directions as required

922:

- Interact with user to obtain call address
- Determine and indicate end of dialing

Figure 9/Q.65 – Example of descriptions of functional entity actions

2.5 Step 5 (optional) – SDL diagrams for functional entities

The system description and specification language (SDL, see ITU-T Z.100) in its graphic representation is used to describe a given service formally in terms of the actions performed in the functional entities involved in providing the service and the information flows which result from or trigger these actions. The SDL diagrams are based on (and are consistent with) the information flow diagrams generated in step 2 of the service description method and describe normal, unsuccessful and abnormal service operation in detail.

The information flows, which are fully defined in terms of their contents and of their origination and destination points as part of the SDL diagram, are supported by signalling procedures specified in Stage 3 service descriptions.

The description of SDL is contained in ITU-T Z.100. A summary of its elements is contained in the following clause.

NOTE – Step 5 (SDL) is considered optional for Stage 2 only if formal SDL diagrams are specified in the Stage 3 description.

2.5.1 SDL general aspects

The elements of a service description in SDL are systems, blocks, processes and procedures (see 2.4/Z.100 and Annex B/Z.100). Systems, blocks and processes can be defined as an instantiation of a system type, block type or process type. A system (type), block (type), process (type) or procedure is described in one or more diagrams. Procedure diagrams are present if process diagrams include procedure calls.

Information between blocks or between processes is conveyed in signals which may have parameters containing data. Data is defined in formal data type definitions.

2.5.1.1 The system diagram

In the context of the Stage 2 description of a given telecommunication service the system type diagram describes the system in terms of blocks, channels and signals. Blocks represent the set of network and network access functions that need to be performed by the system in order to provide a service. Signals conveyed over channels (see 2.5/Z.100) describe the information exchanged between blocks and between blocks and the system's environment. Channels are connected to blocks or the enclosing frame of a diagram via named *gates* if the block is defined as an instance of a block type. The list of signals carried on the channels of the system is part of the system diagram.

An example the system diagram for a system named BasicService (assumed to be the circuit switched bearer service) is shown in Figures 10a and 10b. The diagram in this case encompasses two frames named "Definition" (Figure 10a) and "Structure" (Figure 10b).

NOTE – The number of frames used to draw a diagram may be chosen arbitrarily and is usually based on available drafting space and legibility considerations.

The frame designated "Definition" contains:

a) a block type symbol which contains the name of the block type (BS_St2_BT) preceded by the keyword virtual. This signifies that block type BS_St2_BT can be redefined, e.g. when it becomes necessary to incorporate additional service logic in the basic service to support a supplementary service;

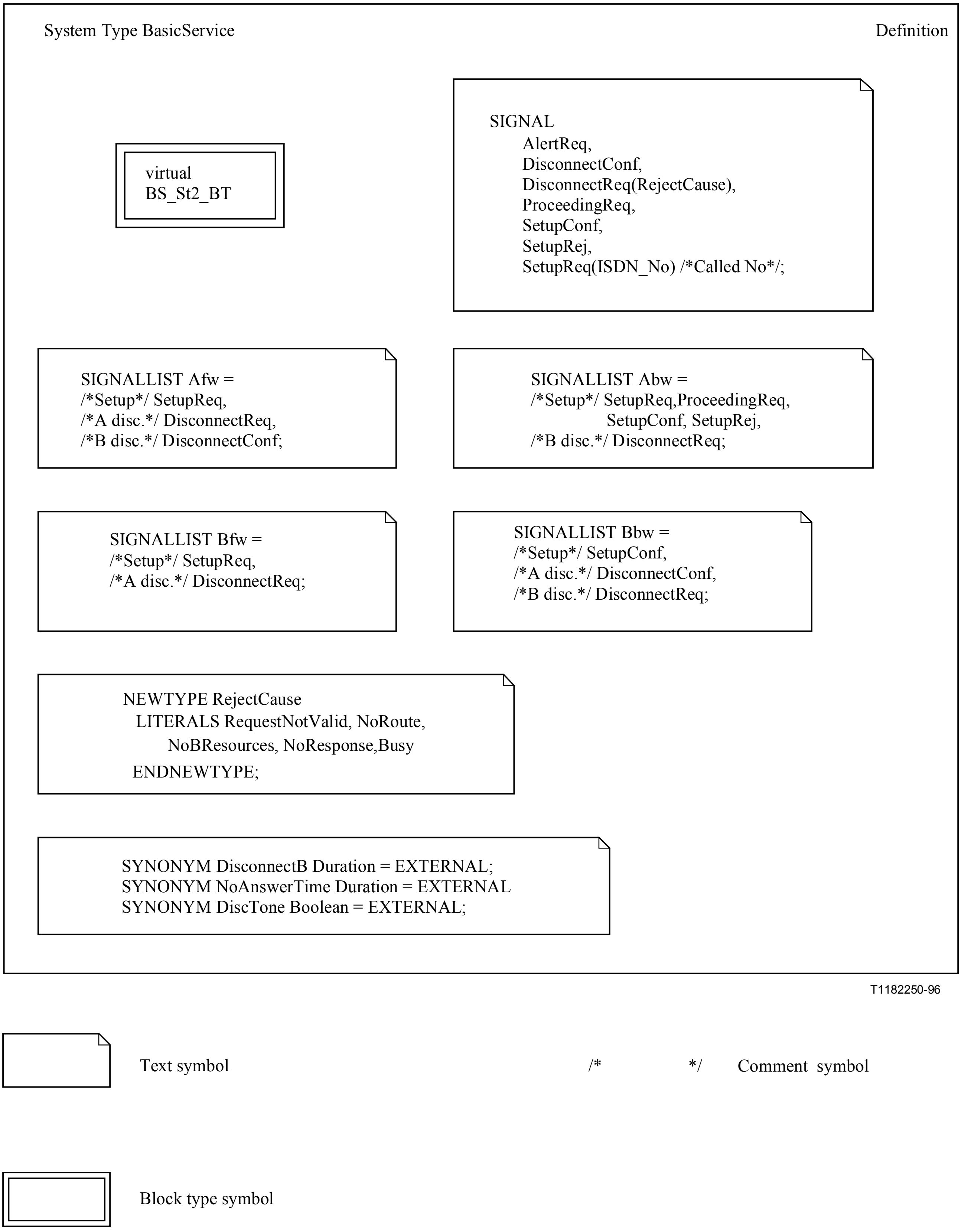
b) a text symbol containing the list, headed by the keyword SIGNAL, of the signals that can be transferred between the system and the environment;

c) text symbols containing descriptions of lists of signals (keyword SIGNALLIST) named Afw, Abw, Bfw and Bbw, respectively;

d) a text symbol containing the definition (keywords NEWTYPE, ENDNEWTYPE) of a data type RejectCause. Variables of this type can assume the values (keyword LITERALS) RequestNotValid, NoRoute, NoBresources, NoResponse and Busy. Standard data types [e.g. Boolean, Integer (see Annex D/Z.100)] need not be defined again in service descriptions;

e) a text symbol containing a list of synonyms which are not specified in the service description. The keyword SYNONYM indicates that names are given to externally defined values (keyword EXTERNAL), e.g. NoAnswerTime which is of standard data type Duration stands for a value which is defined externally.

The frame designated "Structure" describes the blocks and channels of system BasicService. In this case, the system contains an instance BS_St2 of block type BS_St2_BT which encompasses all basic service-related network actions. The users of the service are located outside the system, i.e. in the environment. Their actions are not described in Stage 2, only their interactions with the network. These are represented by the signals defined in the signal lists and are transferred over named channels to and from the environment. Thus, the signals in signal lists AFw and ABw are transferred to and from the environment over the channel called UserAInterface which is connected to block instance BS_St2 at gate To_A. Similarly, the signals in signal lists BFw and BBw are transferred to and from the environment over the channel called UserBInterface which is connected to block instance BS_St2 at gate To_B.



```
SIGNAL
      AlertReq,
      DisconnectConf,
      DisconnectReq(RejectCause),
      ProceedingReq,
      SetupConf,
      SetupRej,
      SetupReq(ISDN_No) /*Called No*/;
```

```
SIGNALLIST Afw =
/*Setup*/ SetupReq,
/*A disc.*/ DisconnectReq,
/*B disc.*/ DisconnectConf;
```

```
SIGNALLIST Abw =
/*Setup*/ SetupReq,ProceedingReq,
              SetupConf, SetupRej,
/*B disc.*/ DisconnectReq;
```

```
SIGNALLIST Bfw =
/*Setup*/ SetupReq,
/*A disc.*/ DisconnectReq;
```

```
SIGNALLIST Bbw =
/*Setup*/ SetupConf,
/*A disc.*/ DisconnectConf,
/*B disc.*/ DisconnectReq;
```

```
NEWTYPE RejectCause
  LITERALS RequestNotValid, NoRoute,
        NoBResources, NoResponse,Busy
 ENDNEWTYPE;
```

```
SYNONYM DisconnectB Duration = EXTERNAL;
SYNONYM NoAnswerTime Duration = EXTERNAL
SYNONYM DiscTone Boolean = EXTERNAL;
```

Figure 10a/Q.65 – Example of a system type definition diagram

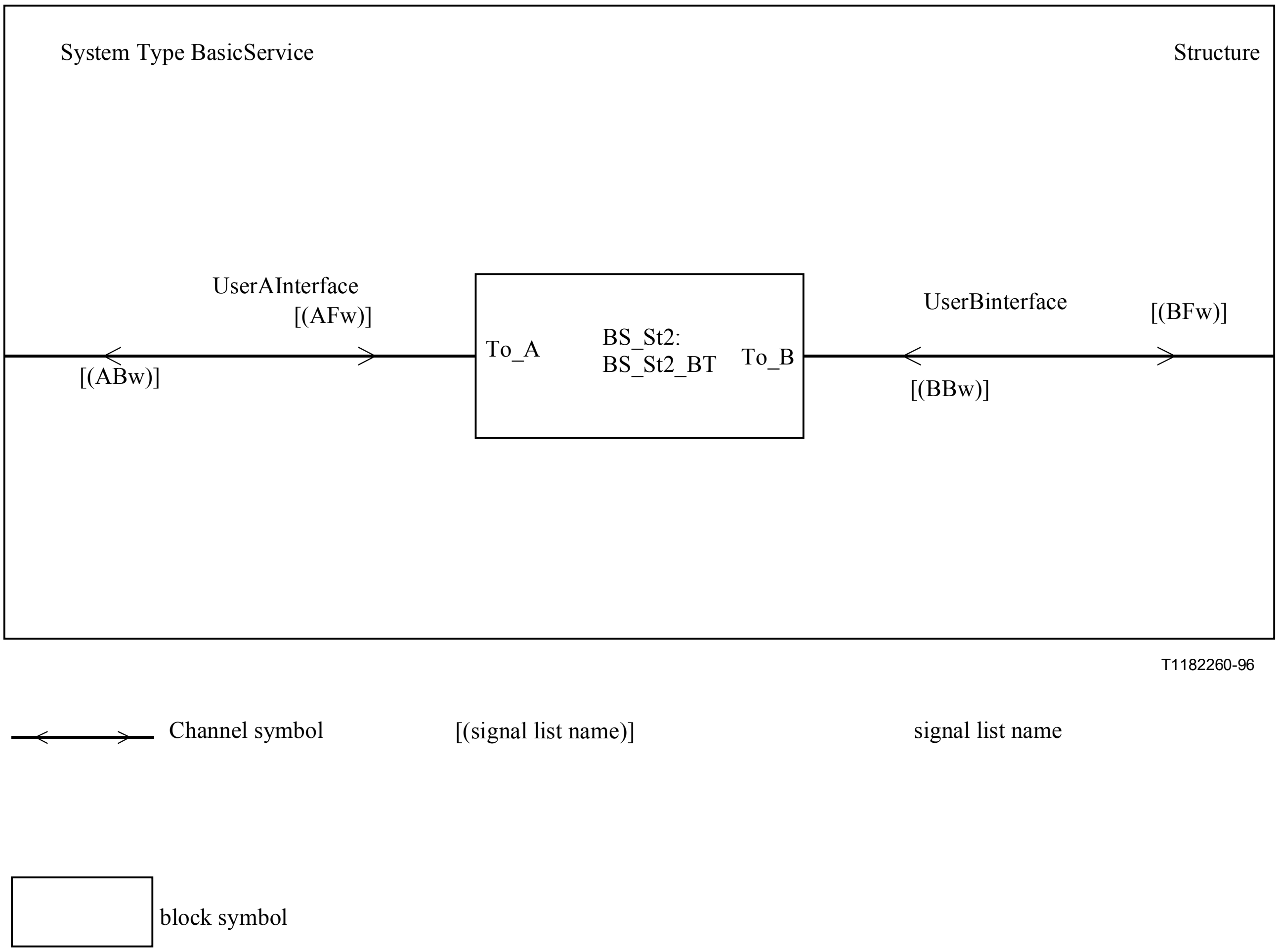


Figure 10b/Q.65 – Example of a system type structure diagram

2.5.1.2 The block diagram

In the context of a Stage 2 service description, the block type diagram defines the process types used in the system and the way in which instances of these types are structured and communicate in order to support a service. The frames of Figures 11a (Definition) and 11b (Structure) represent the diagram for block type BS_St2. As already noted in the system type diagram, this block type has been defined as a virtual type to allow redefinition if required. The block encompasses instances of five process types, located in the five functional entities (i.e. the originating and terminating call control agent functions, and the call control originating, transit and terminating functions) which are involved in initiating and terminating an instance of the basic service or, in other words, setting up and releasing a basic call.

For the basic service example, the five process types have been defined as virtual types, to allow future redefinition (e.g. to insert supplementary service logic).

In the process diagram, information transfers occur over signal routes. These either connect process instances to other process instances or process instances to channels through named gates. For example, route R1 interconnects process instances CCAFO and CCFO via gate OG in CCAFO and gate IC in CCFO and route UIA connects process instance CCAFO to channel UserAInterface via gate To_A. The signals transferred across each route are described in signal lists.

Process symbols contain the names of the process instance and type separated by a colon and two numbers, e.g. (1,1), following the process instance name. These represent the number of instances of the process which exist when the system is created and the maximum number of simultaneous instances of the process, respectively.

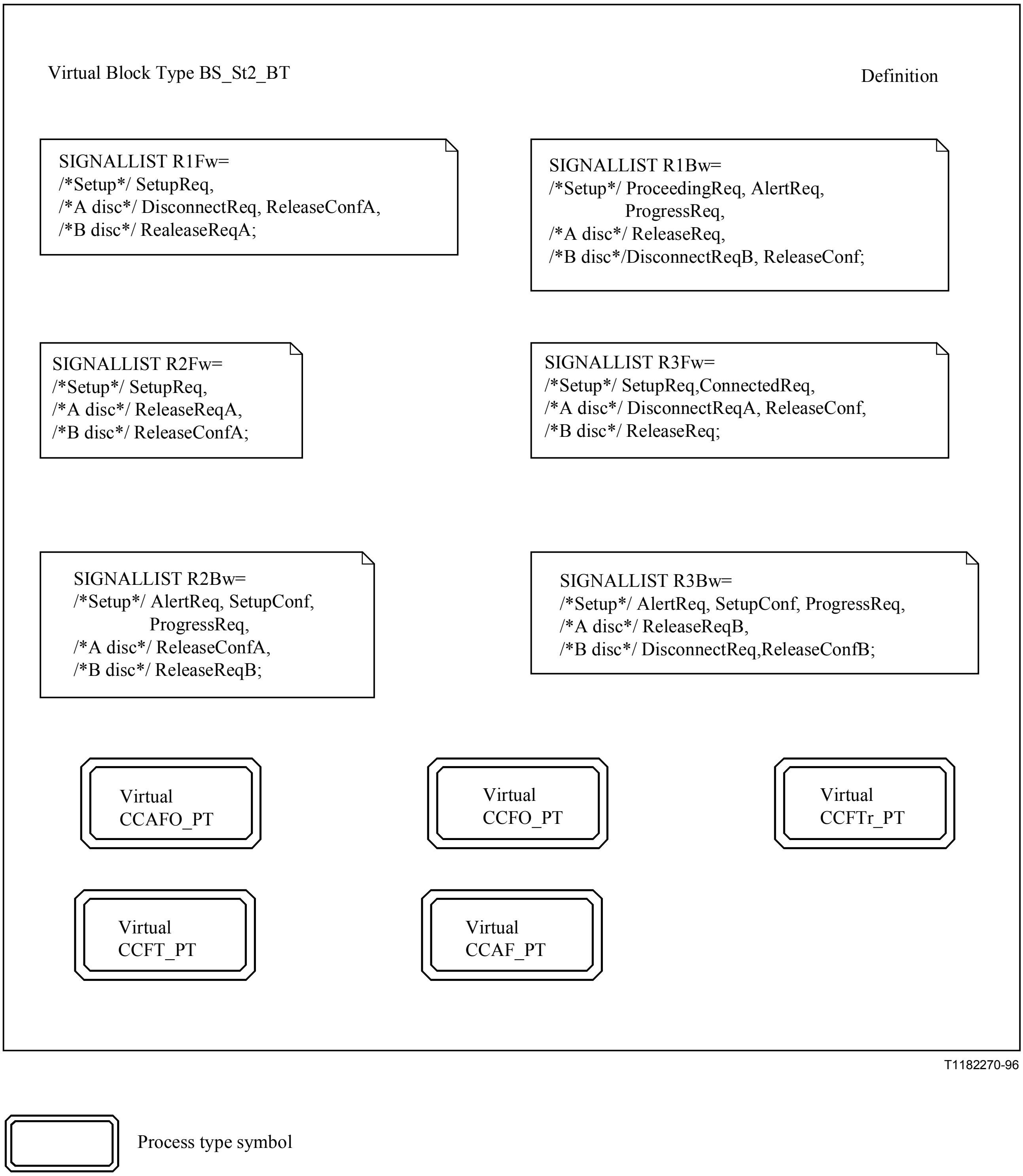


Figure 11a/Q.65 – Example of a block type definition diagram

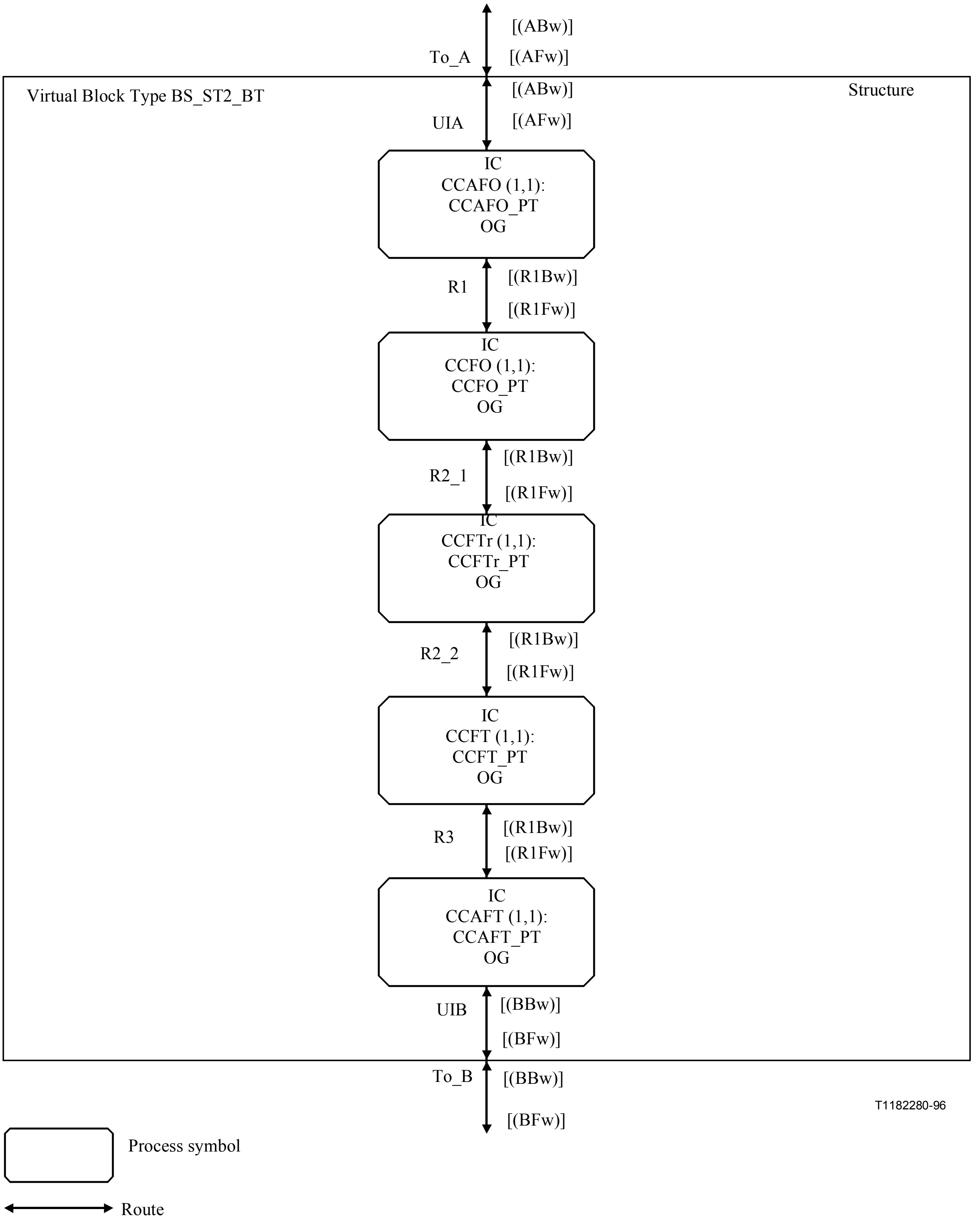
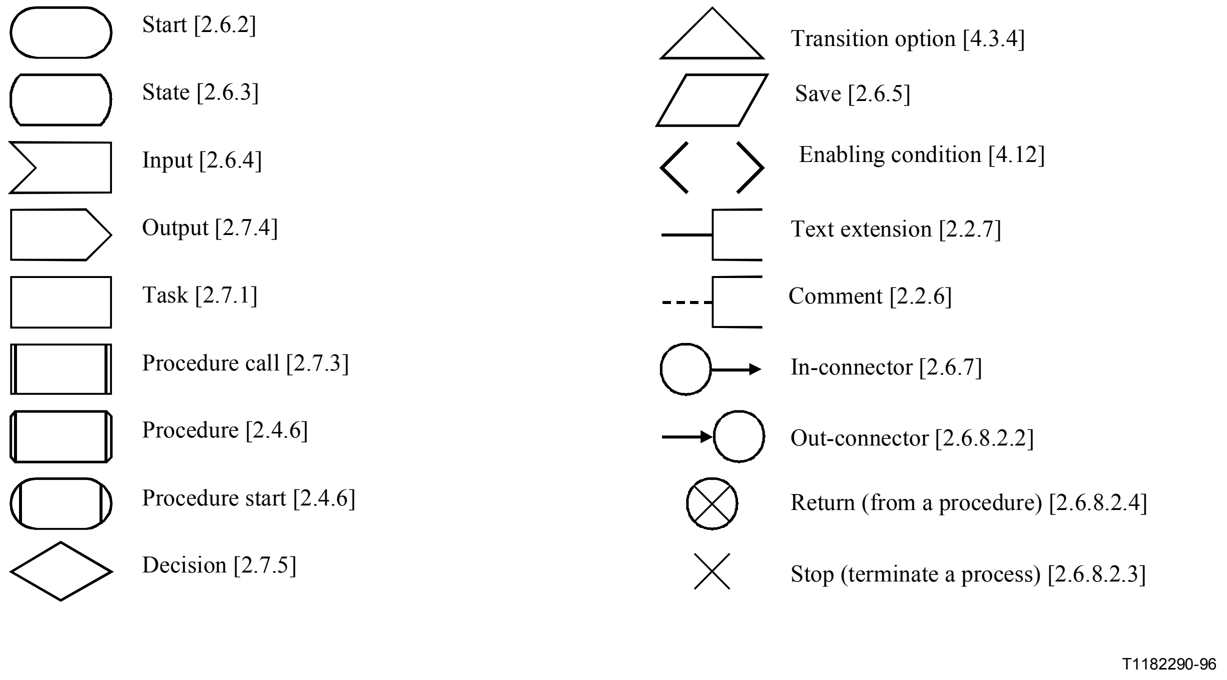


Figure 11b/Q.65 – Example of a block type structure diagram

2.5.1.3 The process diagram

A process diagram describes the sequence of actions (transactions) which are executed by a process instance when a signal is received. Table 3 shows the graphical symbols which are most frequently used in process diagrams of service descriptions. Numbers in square brackets indicate the clauses of ITU-T Z.100 in which these symbols are described further.

Table 3/Q.65 – SDL symbols



Two examples of process diagrams are shown. Figure 12a contains a fragment of virtual process type CCAFO_PT of block type BS_St2_BT and Figure 12b a fragment of virtual process type CCFT_PT (see Figures 11a and 11b).

Referring to Figure 12, the following explanatory notes apply:

a) The text symbol contains the declaration (keyword DCL) of the variables used by the process. For each variable a name and data type is defined, e.g. the variables named calling and called are of the predefined type PId (process instance identifier) and thus are used to identify a process. Also of a predefined type (i.e. Boolean) are the variables Connected and Resourcesoccupied, whereas the variables CalledNr and Reason are of the new types ISDN_No and RejectCause, respectively, which are specific to this system description.

b) Input and output symbols contain the name of the SDL signal that they represent. Bracketed expression(s) following the signal name, e.g. SetupReq (CalledNr) indicate information (a parameter) carried by the signal.

c) Sender, as e.g. in the task symbol Calling:=Sender, is a keyword used to identify the sending process of the signal that activated the current transition. In the example of Figure 13 two processes, Calling and Called, are identified in this way. In this particular case, these processes are in the environment and are not described in the example system description.

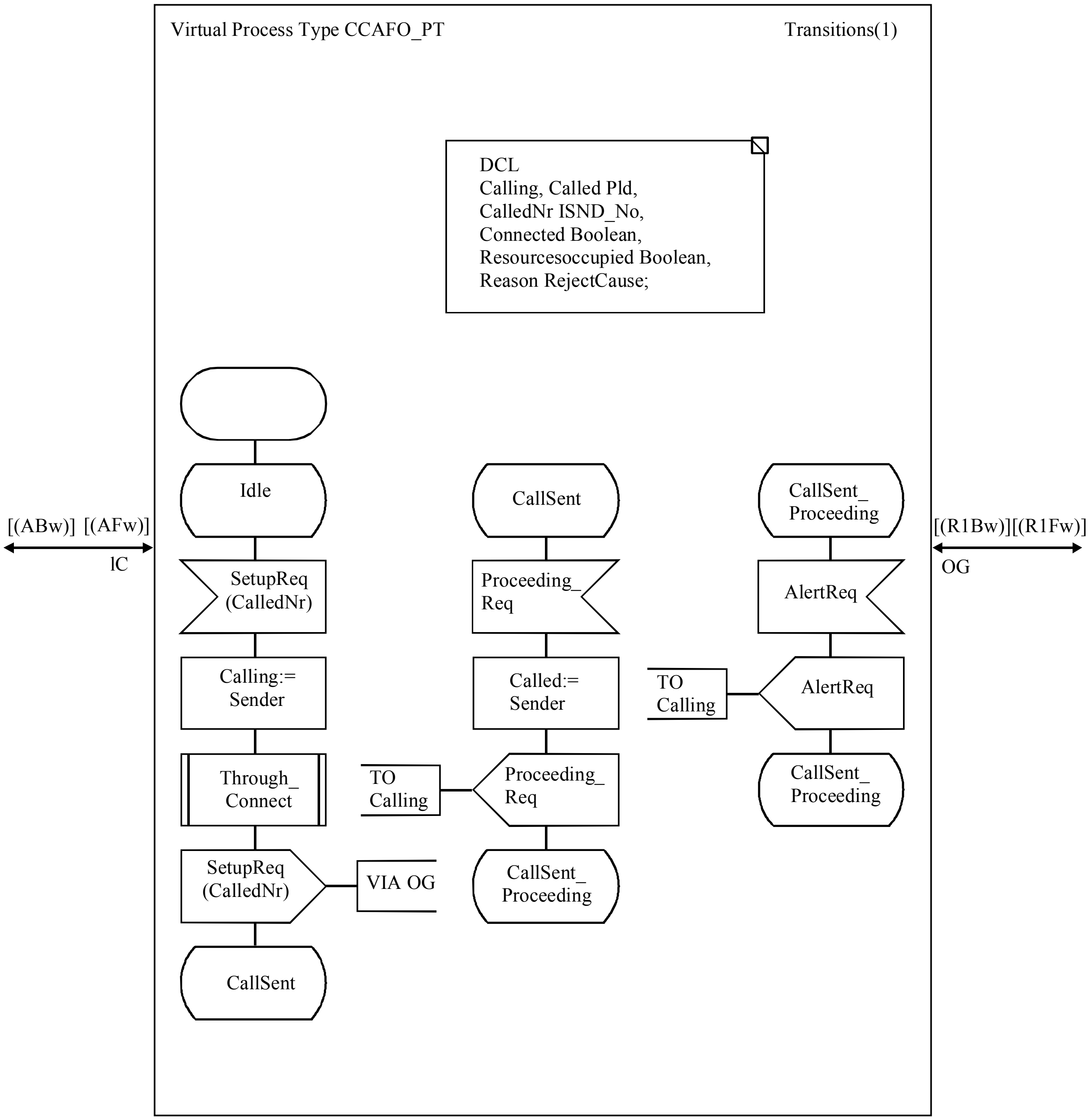


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Figure 12a/Q.65 – Example 1 of a process diagram – Fragment of the process CCAFO

Figure 12b illustrates the method of creating an opening for future enhancements in an existing transition. The opening is provided by inserting a procedure call, e.g. to procedure SupSvc1 in the example shown, at a point in the transition where the later addition of logic is anticipated. Initially the called procedure is "empty". It is redefined to provide additional logic whenever that becomes necessary (see 2.5.2) and for this reason is defined as virtual.

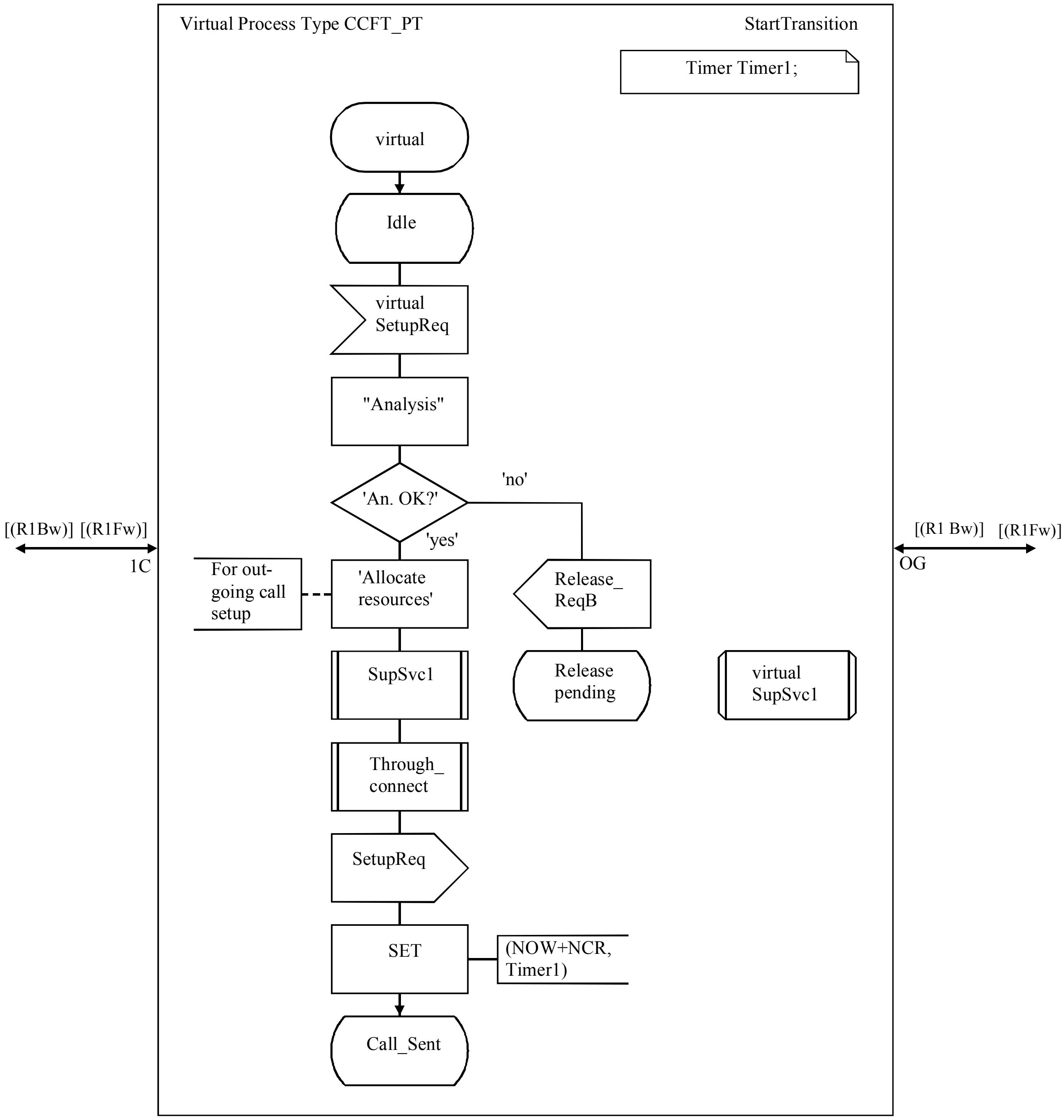


Figure 12b/Q.65 – Example 2 of a process diagram – Fragment of process type CCFT

2.5.1.4 The procedure diagram

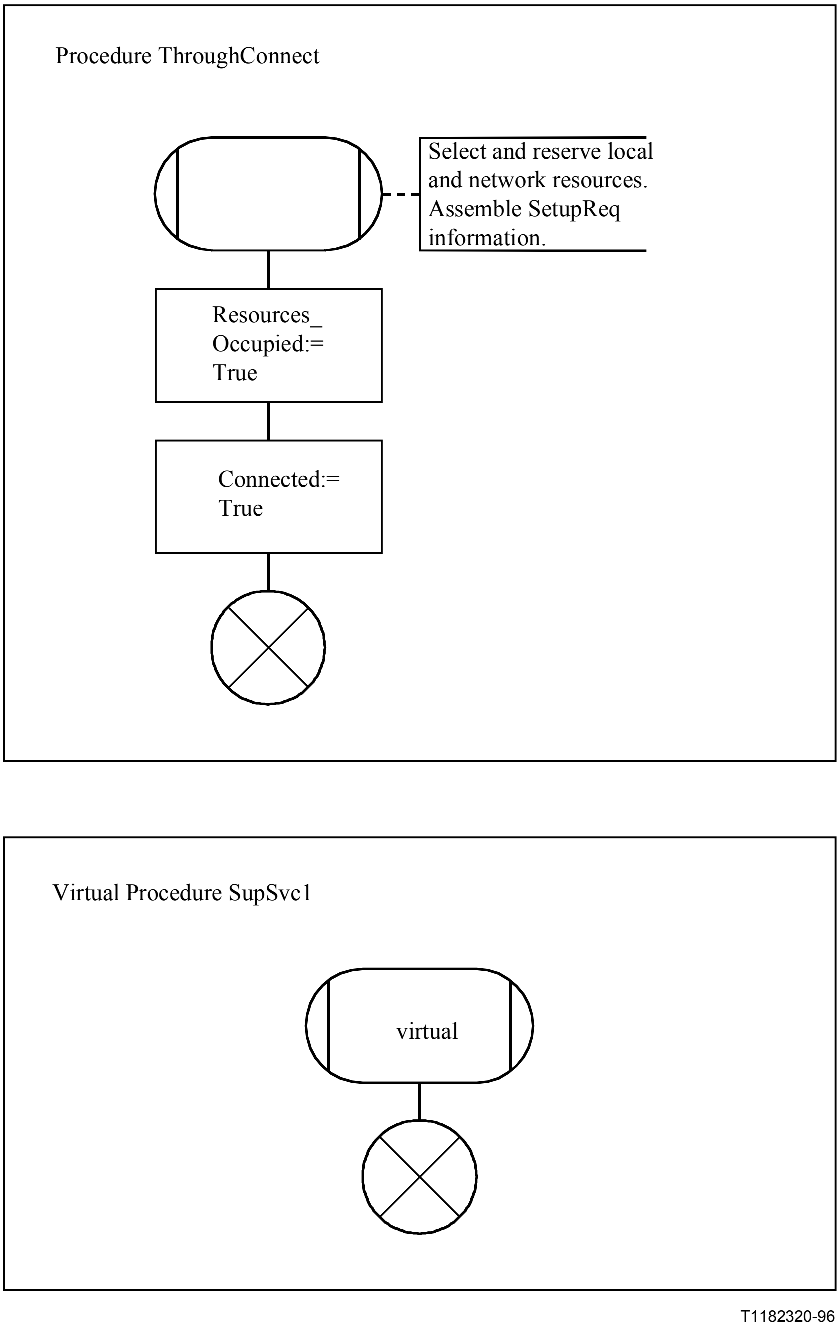

Procedure ThroughConnect
Select and reserve local and network resources. Assemble SetupReq information.
Resources_ Occupied:= True
Connected:= True
Virtual Procedure SupSvc1
virtual
T1182320-96

Figure 13/Q.65 – Examples of a procedure diagram

If procedures are called by process types of the system, then these procedures are described in procedure diagrams. The examples in Figure 13 show the procedure ThroughConnect called by process instances CCAFO and CCFT and the procedure SupSvc1 called by process instance CCFT. Since it is anticipated that the latter will undergo modification, it has been defined as a virtual procedure. As noted before, the procedure SupSvc1 is empty and acts for the time being simply as placeholder for the addition of service logic in the future.

The symbols used in the diagrams are explained in Table 3.

2.5.2 Adding functionality to existing Stage 2 service descriptions

2.5.2.1 Specialization

Occasionally the need arises for the addition of new functionality to an existing service description. A typical case is the set of modifications required to the description of the basic circuit-switched bearer service (basic service) when a new supplementary service is standardized.

Where the description of a new service (e.g. a supplementary service) requires the modifications of the description of an existing service (e.g. the basic service), the SDL concept of a specialization can be used. A specialization enables the logic procedures associated with a new service to be described without affecting the description of the existing service by providing, for instance, the capability to:

- add and/or redefine block types in system diagrams;
- add channels in system type diagrams to convey existing and/or new signals;
- add and/or redefine process types in block diagrams;
- add routes in block type diagrams to convey existing and/or new signals;
- add new states and state transitions in process type diagrams;
- add new transitions triggered by new signals to existing states;
- redefine transitions of existing states; or
- redefine procedures.

In SDL, redefinition is enabled by defining as virtual those block types, process types, procedures and transitions that are likely to undergo change as the system evolves. Examples of virtual definitions are shown in Figures 10a, 11a, 12b, and 13.

2.5.2.2 Supplementary service description

A supplementary service is described by modifying or redefining the basic service logic. For this reason the basic service block types, process types and transitions that are likely to be affected by the addition of a supplementary service are marked "virtual" (see 2.5.2.1).

The changes to the basic service caused by the introduction of a supplementary service are then described by stating that the system "supplementary service" inherits the system type "basic service" and by adding new or redefined blocks, processes, transitions, signals, etc. as required to support the supplementary service. "Inherits" is a keyword in accordance with ITU-T Z.100

The description method is illustrated in Figures 14 to 17, using a simplified malicious call identification service as an example.

The system diagram of Figure 14 indicates that:

a) system type MCID is based on (inherits) system BasicService;

b) block BS_St2 of system BasicService has been redefined;

c) channel MCIDUserB has been added over which block BS_Stage2 exchanges signals MC_req, MC_conf, and MC_rej with the environment (user B in this case);

d) a new data type MC_rejcause has been introduced which can assume the indicated values (literals).

NOTE – Since it is necessary to show where channel MCIDUserB is attached, the instance of block BS_St2 has a broken outline to indicate that it is part of the inherited system, i.e. it is not a block that has been added to system BasicService for system MCID.

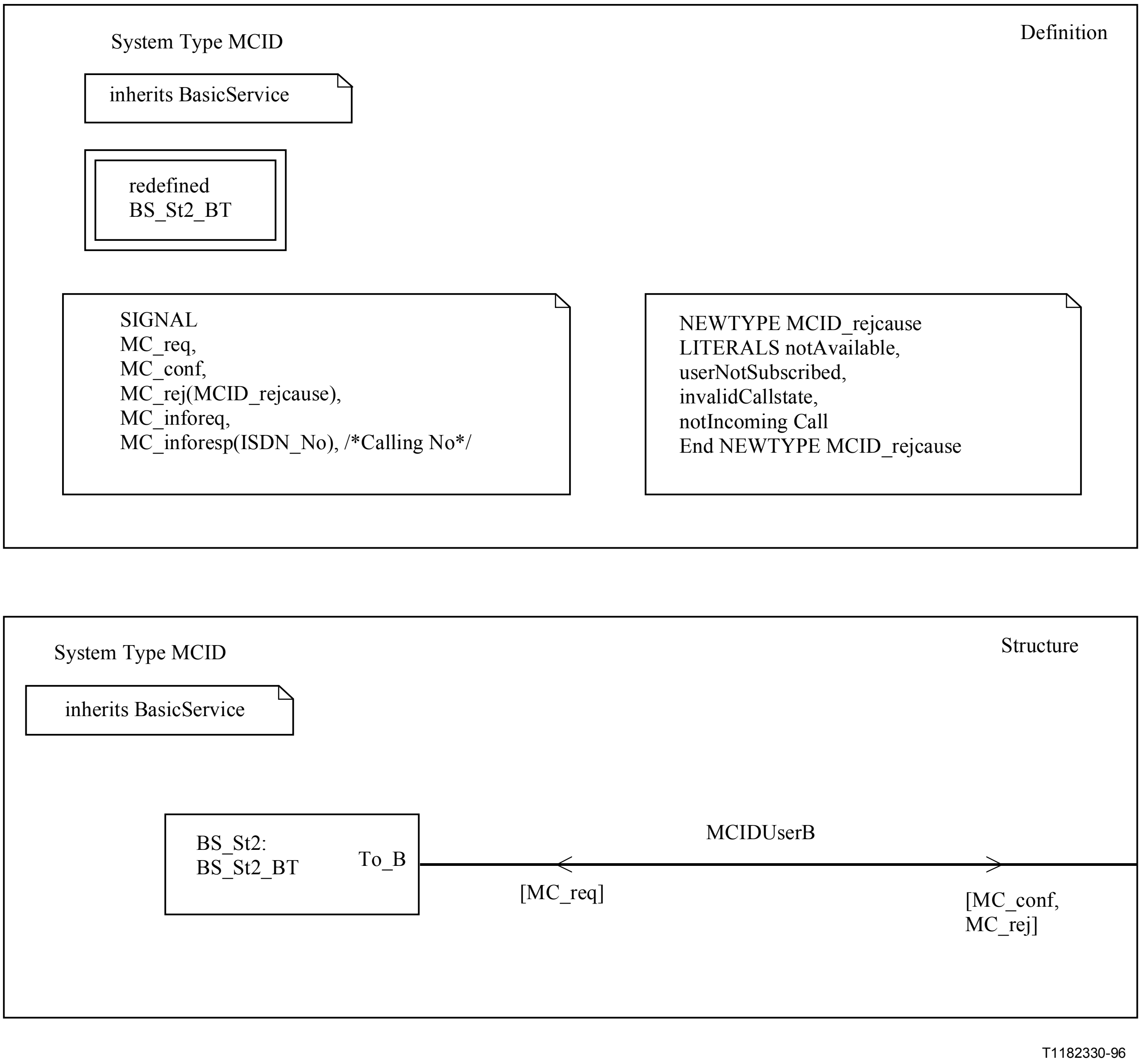
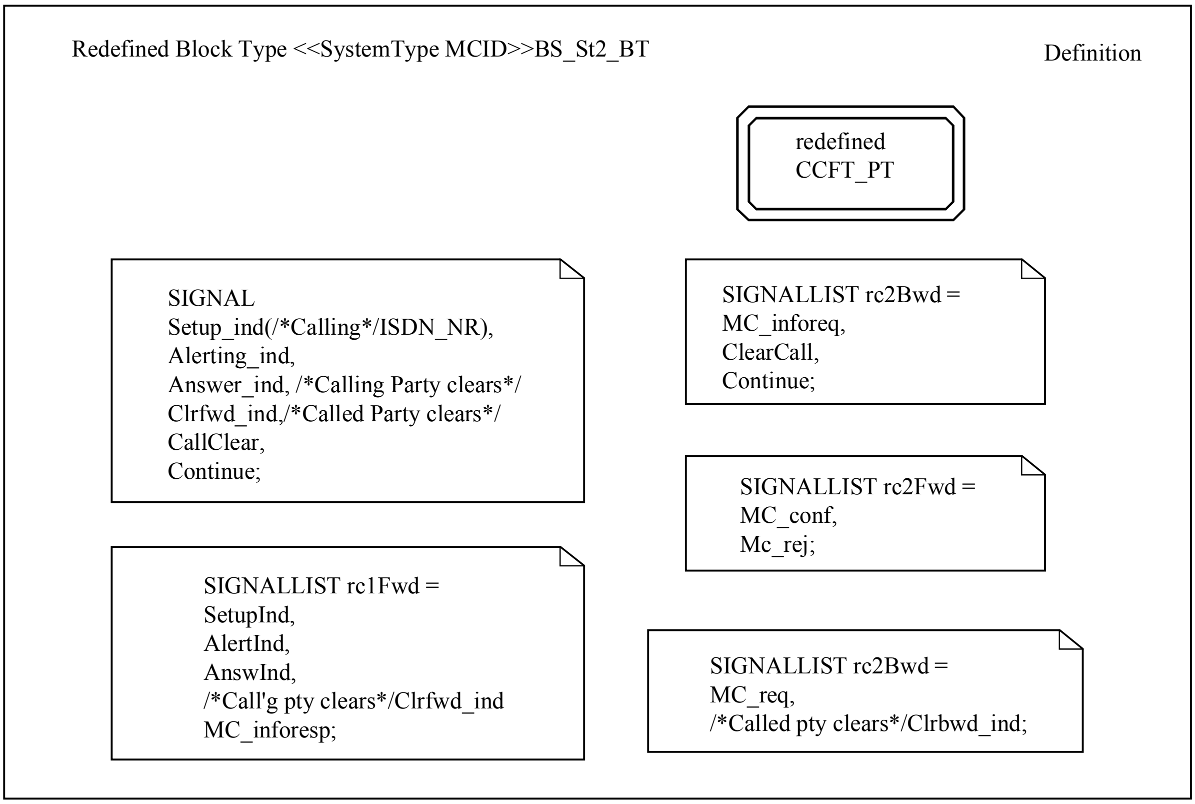


Figure 14/Q.65 – Example of a new system type (MCID) based on an existing system type (BasicService)

Figures 15a and 15b show the redefinition block type BS_Stage2_BT caused by the introduction of the MCID supplementary service. It required the addition of a process type MCID_PT and of routes RA, RC1, RC2, and MC_UIB as well as the additional signals contained in the signal lists of Figure 15.

Process types shown with broken outlines are not part of the redefinition but are shown so that it can be indicated where the added routes are attached.



```
SIGNAL
Setup_ind(/*Calling*/ISDN_NR),
Alerting_ind,
Answer_ind, /*Calling Party clears*/
Clrfwd_ind,/*Called Party clears*/
CallClear,
Continue;
```

```
SIGNALLIST rc2Bwd =
MC_inforeq,
ClearCall,
Continue;
```

```
SIGNALLIST rc2Fwd =
MC_conf,
Mc_rej;
```

```
SIGNALLIST rc1Fwd =
SetupInd,
AlertInd,
AnswInd,
/*Call'g pty clears*/Clrfwd_ind
MC_inforesp;
```

```
SIGNALLIST rc2Bwd =
MC_req,
/*Called pty clears*/Clrbwd_ind;
```

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Figure 15a/Q.65 – Block Type BS_St2 (Definition) redefined for System MCID

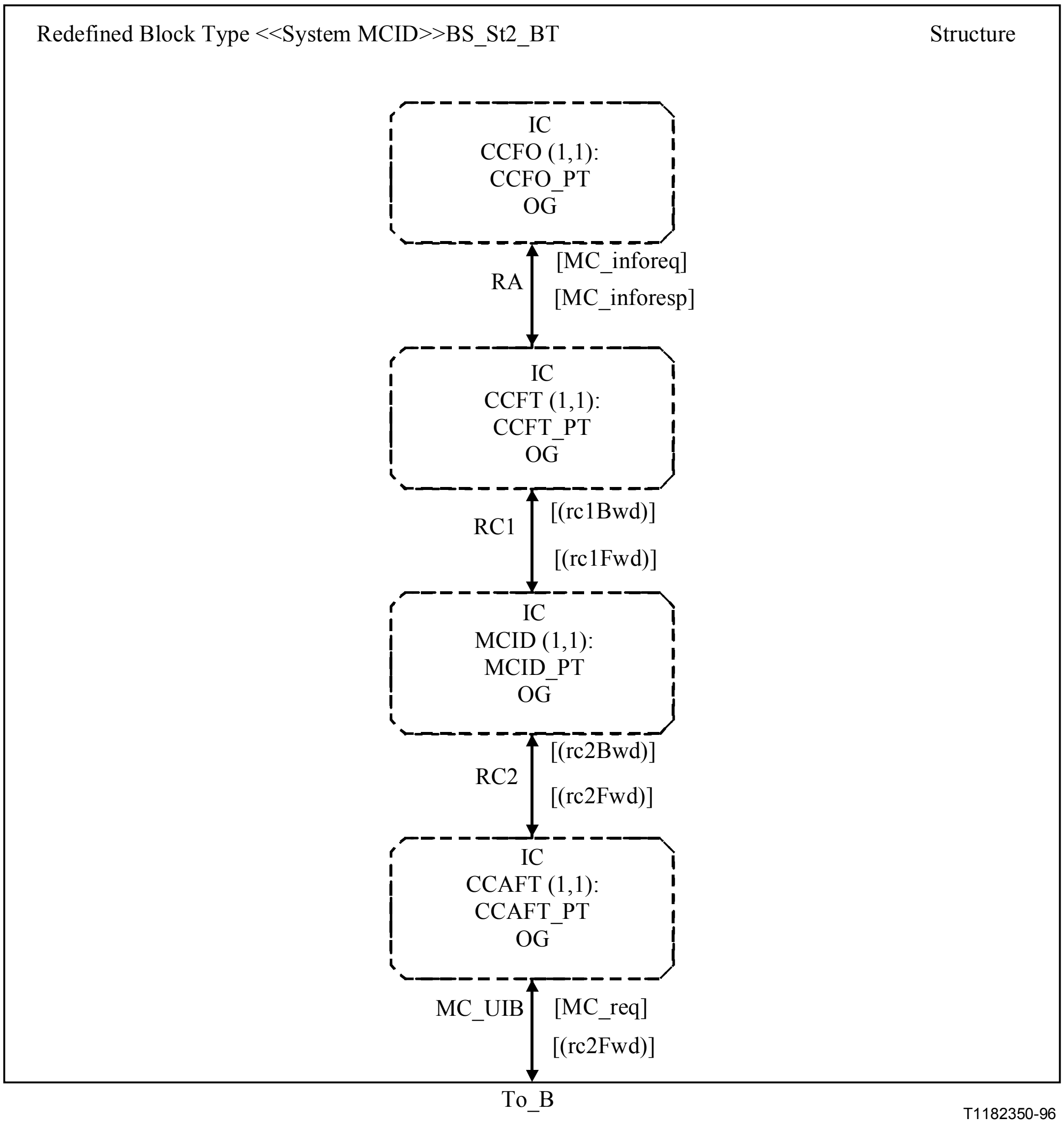

Figure 15b/Q.65 – Block Type BS_St2 (Structure) redefined for System MCID

Figure 16 shows the redefinition of process type CCFT_PT. The only change that needs to be shown here is the indication that procedure SupSvc1 which is defined as virtual in system type BasicService is being redefined. The redefined procedure is shown in Figure 17.

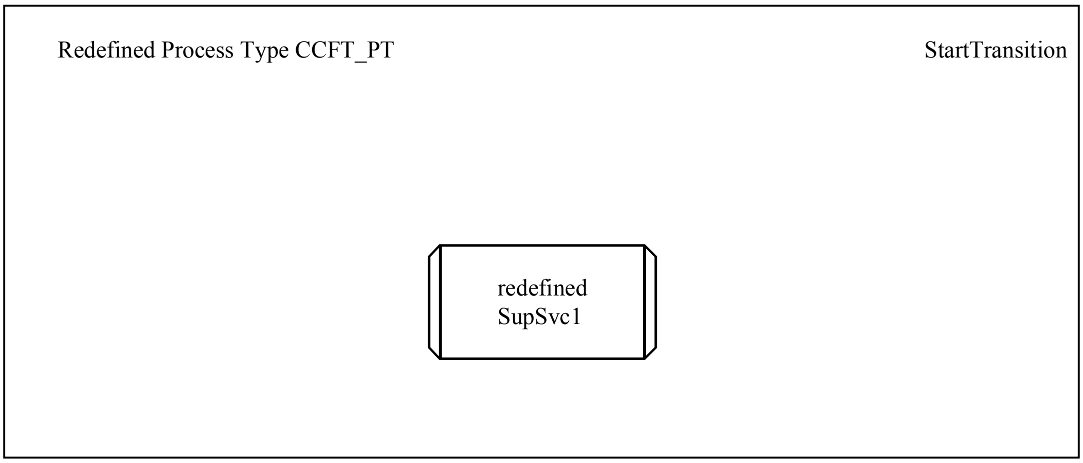

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Figure 16/Q.65 – Process Type CCFT_PT redefined for System MCID

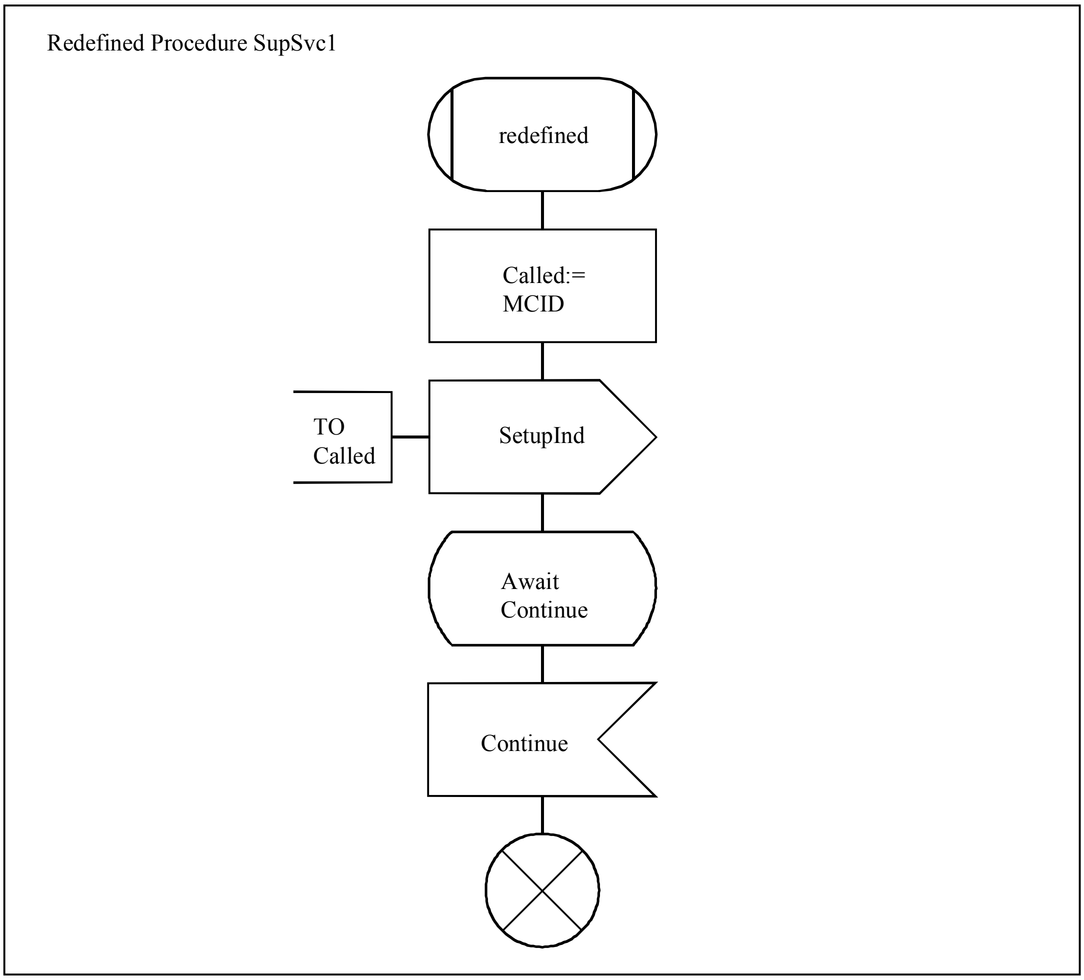

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Figure 17/Q.65 – Procedure SupSvc1 redefined for System MCID

2.5.3 Packages

SDL 92 offers the possibility to use types defined in one system in other systems as well. This is achieved by providing a package diagram which serves as a container for items such as system type definitions, block type definition, process type definitions, signals or synonyms.

The use of a type which has been defined in a package is indicated by providing, in a text symbol above a diagram, the name of the package preceded by the keyword use. An example of a package definition and the use of a type defined in the package is shown in Figure 18. The figure reflects the fact that block type B1 in system BCSystem is defined using block type Block1_BT in package BCBlocks.

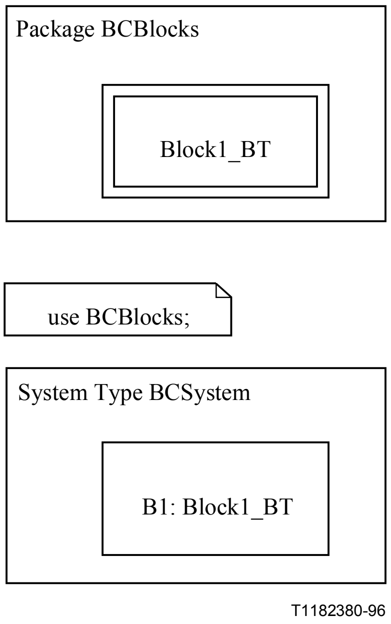


Figure 18/Q.65 – Example of the definition of a block type in a package and the subsequent use of the package in a system

2.6 Step 6 – Allocation of functional entities to physical locations (scenarios)

In Step 1, a functional model consisting of functional entities, each of which has a well-defined relationship to the others is defined for each basic and supplementary service. Step 6 is the allocation of these functional entities to physical locations and defines all relevant physical implementations, henceforth called scenarios.

More than one scenario may be defined for one functional model so that Administrations will have options as to where the service is actually provided. For example, a supplementary service functional entity could be located whether in a PBX or in an exchange.

For the allocation of functional entities, it should be noted that:

a) a functional entity may, in principle, be allocated to any physical location;

b) a number of functional entities may be allocated to the same physical location;

c) for every supplementary service, network scenarios which include the location of its basic service functional entities should be defined;

d) different physical locations of functional entities may imply minor differences in node capabilities (e.g. the transmission path switch-through actions may depend on whether the access is in an exchange or a PBX);

e) the relationship between pairs of functional entities, according to the functional model used, should be invariant for all of the recommended scenarios.

Item e) implies, for example, that the information flows from a supplementary service would not be affected by a reallocation of one or more of the required functional entities from public network exchange to a PBX or vice versa.

All identified scenarios will be considered in Stage 3 for definition of signalling protocols, switching capabilities and service capabilities.

Possible physical locations and their corresponding symbolic representation are:

– Terminal equipment: Type 1 or terminal adapter TE;

– Network termination; Type 2: NTE (typically in PBX);

– Local exchange: LE;

– Transit exchange: TR;

– Service switching point: SSP;

– Service control point: SCP;

– Database: DB;

– Intelligent peripheral: IP.

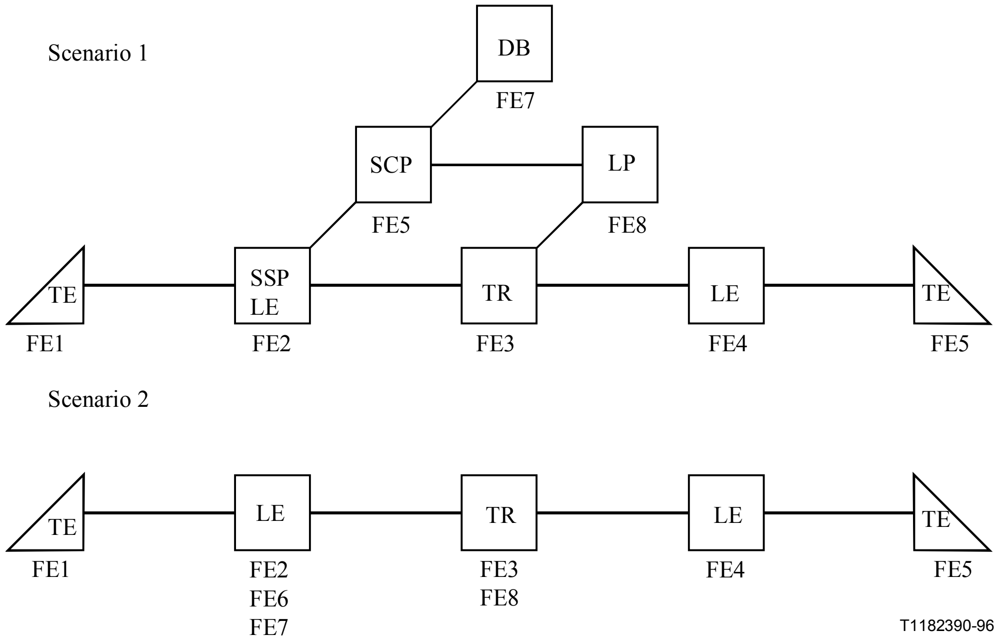


Figure 19/Q.65 – Example of two scenarios for assigning functional entities to physical locations

3 Alternative steps utilizing Object Oriented techniques

The stages or steps for developing services/applications from conception through to physical implementation (Protocol) have been described in detail in clause 2. The purpose of this clause is to describe alternative methods utilizing Object Oriented techniques. It is possible that both O-O and non O-O techniques are used in describing the IN interfaces, either by using O-O methods on some interface and non O-O methods on other. The result would be a collection of API calls (using the O-O techniques) and a collection of information flows (using non O-O techniques). This would prove quite messy although both results could be mapped onto INAP for instance. If both methods were to be used it would be better to use one method for a set of interfaces and the other method for the remaining interfaces. O-O techniques have been used in the computing industry for some time now and it is therefore appropriate that we give examples of how those methods can be used to enhance the development of IN and better facilitate the integration with distributed computing environments. There are many different O-O packages that can be used, some better than others. This clause will describe the Unified Modelling Language (UML) and will tailor it for describing alternative steps 2-4 of the Unified Functional Methodology. Step 1 remains the same.

3.1 Alternative Step 2

Applications to Packages (Optional) (see Figure 1)

In UML, the package is a general-purpose mechanism for organizing modelling elements into groups. In our methodology the Application or Service is constructed from a number of Packages. Packages are used to arrange modelling elements into larger chunks that can be manipulated as a group. Well-designed packages group elements that are semantically equivalent and that tend to change as a group.

Every package must have a name that distinguishes it from other packages. A *name* is a textual string. That name alone is known as a *simple name*; a *path name* is the package name prefixed by the name of the package in which that package lives, if any. A package is typically drawn showing only its name as in Figure 20. Just as with classes, packages may be supplemented with tagged values or with additional compartments to expose their detail.

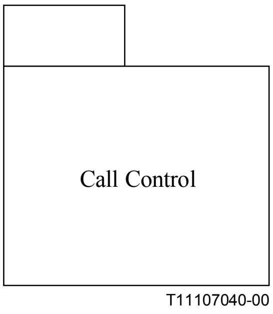


Figure 20/Q.65 – Example of a Package

The actual division of an Application or service into packages may vary. Some applications will consist of many packages, others may be only one single package. For example Application X, in Figure 21, may contain Call Control, Authentication and Messaging Packages, whereas a single Security Application may only have an Authentication package. Packages can be influenced by different Applications, for example Application X may require Authentication sub-items a, b and c whilst Application Y requires sub-items b and d, therefore the resultant Authentication Package will consist of sub-items a, b, c and d (see Figure 21).

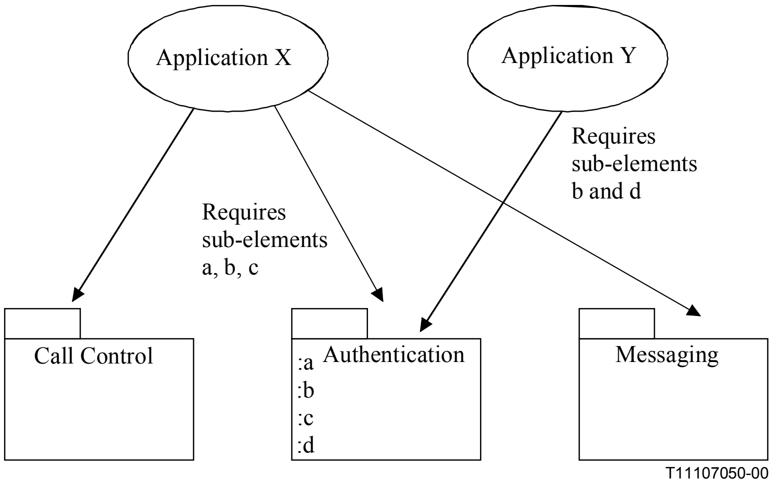


Figure 21/Q.65 – Mapping Packages to Applications

The package method is a way of describing those areas that need to be explored in order to produce the necessary Interface Classes and grouping together a number of Interface classes that will be needed for a particular interface in order to run that particular service/application (see Appendix III.3.1 for elaboration of this point).

NOTE – It is possible to omit the "Package" stage if the required Interface Classes to implement the service/application are known.

3.2 Alternative Step 3

Interface Classes and Class Diagrams

3.2.1 Interface Classes

An interface is a named collection of operations used to specify a service of a class or of a component. Unlike classes or types, interfaces do not specify any structure (so they may not include any attributes), nor do they specify any implementation (so they may not include any methods, which provide the implementation of an operation). Like a class, an interface may have any number of operations. These operations may be supplemented with visibility properties, concurrency properties, stereotypes, tagged values and constraints.

Operations may be drawn showing only their name, or they may be augmented to show their full signature and other properties, as in Figure 22:

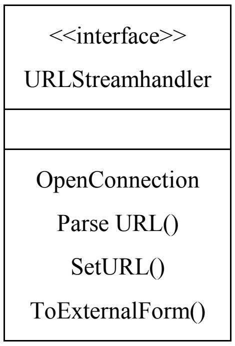


Figure 22/Q.65 – Operations in an Interface Class

An Object Class is not described, as this would provide the implementation specifics of that class i.e. it would specify how the system carries out the method that has been invoked upon it. Interface classes do not describe implementation specific methods. Therefore Interface classes can be implemented on different types of physical interfaces and can be imported from other systems for a particular interface, without compromising the procedure used to carry out the invoked method.

Depending on the functionality, the Interface classes may be described in pairs, the "Interface Class" and the "Application Interface Class". The "Basic Interface Class" would reside in the system on one side of the interface and the "application" on the other. Usually the methods invoked by the "application" would require a result which is implemented by the "Basic Interface Class".

Two useful types of interface classes are used to describe a system, the "Framework" interface Class and the "Generic Service" interface class.

3.2.1.1 Framework Interface Classes

Framework Interface Classes are those classes that describe an extensible template for applications within a domain. A Framework is a kind of micro-architecture that encompasses a set of mechanisms that work together to solve a common problem for a common domain.

Therefore it is good to think of a "Framework Interface Class" as a class that is almost always used across an interface irrespective of the Service Class that is also being invoked. An example would be "Authentication". It is almost certain that any communication across an interface would need to initially proceed with both ends of the system authenticating each other. "Event Notification" and "Integrity Management" are other examples.

Framework Interface Classes would almost always be described in pairs, for instance "Iauthentication" and "IAppAuthentication" as described in 3.2.1, where the preceding "I" indicates that it is an "Interface Class" and not an "Object Class".

3.2.1.2 Generic Service Interface Classes

The Generic Service interface classes are those classes that satisfy the service requirements of the interface in question. For instance a typical Generic Service Class would be "Call Control Manager". The resultant pairs of Interface Classes would be "ICallControlManager" and "IappCallControlManager". It is possible for this Generic Service Class to be viewed as a "Package".

Both of the different types of Interface Classes would be defined in detail, in other words one would populate them with their respective method invocations. But before this final stage there is a need to describe the relationships between each of the Interface Classes and this is done using "Class Diagrams".

3.2.2 Class diagrams

Relationships between each interface class are depicted using "Class diagrams" [see Figure 23].

A class diagram is a diagram that shows a set of classes, interfaces, and collaborations and their relationships. You can use class diagrams to model the static design view of a system. This view primarily supports the functional requirements of a system – the services the system should provide to its end users.

Class diagrams commonly contain the following things:

- *Classes*: A Class is a description of a set of objects that share the same attributes, operations, relationships and semantics. A class implements one or more interfaces.
- *Interfaces*: An interface is a collection of operations that are used to specify a service of a class or a component.

- *Collaborations*: A collaboration is a society of classes, interfaces and other elements that work together to provide some cooperative behaviour that is bigger than the sum of all its parts.
- *Dependency, generalization and association relationships*: A dependency is using a relationship, specifying that a change in the specification of one thing may effect another thing that uses it, but not necessarily the reverse. A Generalization is a relationship between a general thing (called the super-class or parent) and a more specific kind of that thing (called a subclass or child). For instance you may encounter the general class "Call Control" and a more specific kind "INAP Call Control". An Association is a structural relationship that describes a set of links, a link being a connection among objects.

Class diagrams are the most common diagrams found in modelling object-oriented systems. They are important for visualising, specifying and documenting structural models, but also for constructing executable systems through forward and reverse engineering.

The class diagram describes the types of Objects (specific implementations) or interface Classes in the system and the various kinds of static relationships that exist among them. There are two principal kinds of static relationships:

- Associations;
- Subtypes.

Class diagrams also show the attributes and operations of a class and the constraints that apply to the way objects are connected. In this Recommendation we will not consider attributes, as these are implementation specific.

Associations represent relationships between instances of classes. For example a person works for a company; a company has a number of offices. Figure 23 illustrates this example:

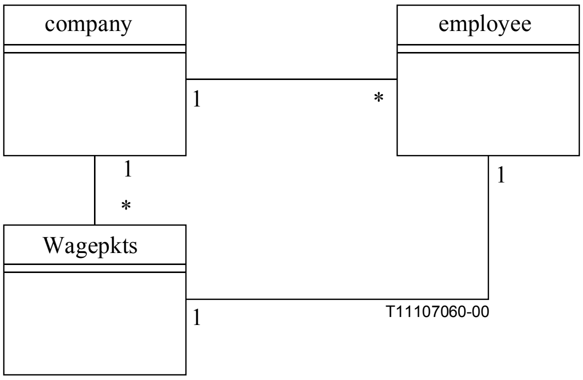


Figure 23/Q.65 – Associations of Class instances

Figure 23 shows the relationship between a company, its employees and their wage packets. In this relationship a company has many employees, and an employee has one wage packet. Alternatively one wage packet is ascribed to one employee and an employee has only one employer.

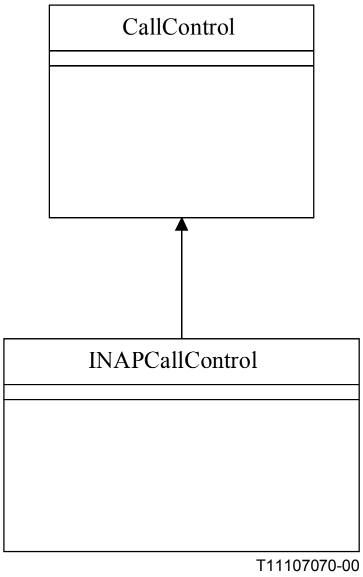


Figure 24/Q.65 – Use of subtypes or subclasses

Figure 24 explains the use of subtypes or subclasses. Here Call Control is the Generic Service, whilst "INAPCallControl" is a type of Call control specific to an INAP associated system.

3.2.3 Interface Sequence diagrams (Optional)

The use of Interface sequence diagrams is optional. Interface sequence diagrams are similar in nature to the "information flow diagrams" in 2.3.1. Interface sequence diagrams however, may also indicate API call flows (method invocations) (see 3.3 for explanation), either side of the interface being represented. As the API calls within each system are likely to be proprietary, the use of such diagrams within a Recommendation may be restricted or omitted.

Interface sequence diagrams graphically represent the method invocations (API Calls) that traverse a particular interface thereby emphasizing the time ordering of messages. From an O-O viewpoint they represent the method invocations between different Interface Classes. In doing so, some of these method invocations may not in fact flow across an interface but may also be internal to a particular system. Even so, for completeness all of the method invocations should be shown.

As Figure 25 shows, a sequence diagram is formed by placing the interface classes (objects) that participate in the interaction, at the top of the diagram, across the X axis. Typically you place the object that initiates the interaction on the left and increasingly more subordinate objects on the right. Next you place the messages that these objects send and receive along the Y axis, in order of increasing time from top to bottom. This gives the reader a clear visual cue to the flow of control over time.

Sequence diagrams have two features that distinguish them from collaboration diagrams. First there is the object life line. This is the vertical line that represents the existence of an object over time. Objects may be created during the interaction and their existence starts with the receipt of the message "New". Similarly the objects can be deleted.

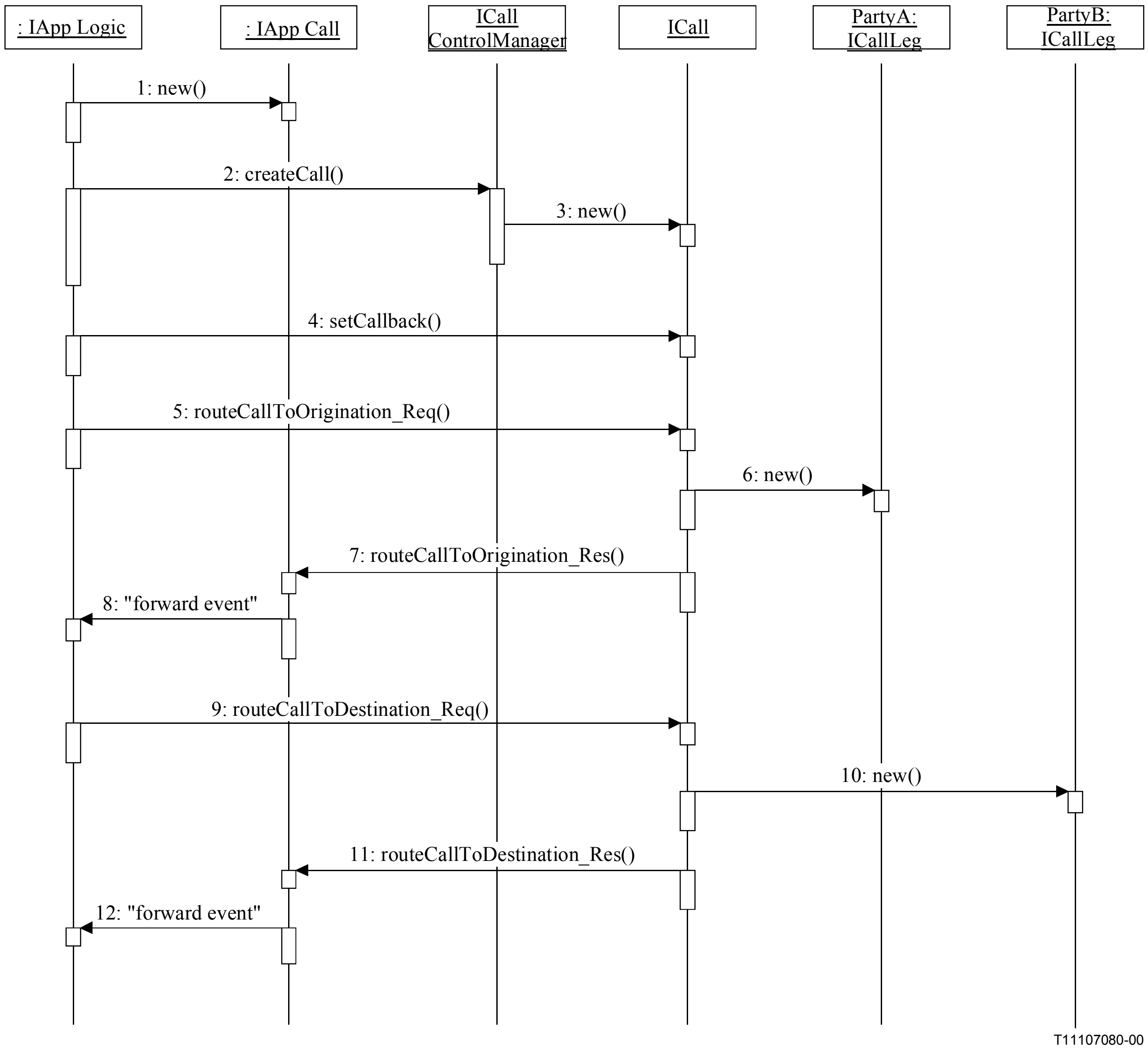


Figure 25/Q.65 – Example Interface Sequence diagram

The scenario that has been depicted above represents a "third party initiated call", which is described in more detail in Appendix III. In this example the actual interface is between the IappCall and the Icall ControlManager objects. Therefore method invocations 2, 4, 5, 7, 9 and 11 actually manifest themselves as API calls across the physical interface. The other method invocations are internal to the systems on both sides of the interface and therefore it is not always necessary to show the result of the "targeted" object as this may not impact the interface itself. From this example we can see that the API needed to implement the service/application "third party call set up" consists of API Calls 2, 4, 5, 7, 9 and 11.

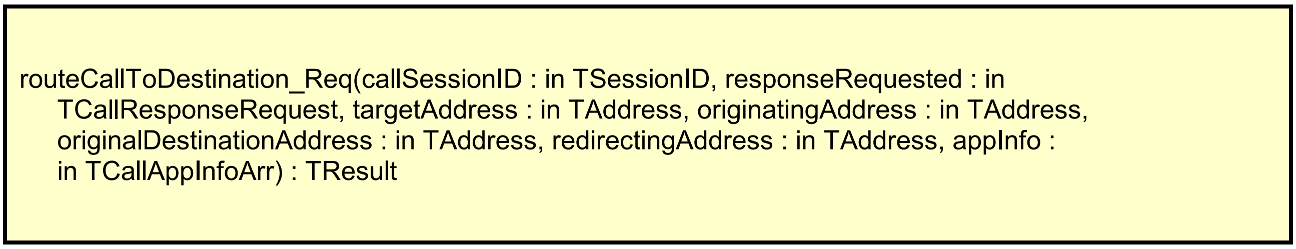
As more services and addresses, more Interface classes are examined, the API specification will grow.

3.3 Alternative Step 4

API descriptions in IDL

Having worked through the previous two steps, and having identified the Interface Classes involved in the services/applications that are needed across your interface, the next stage is to describe the method invocations in detail. Remember that the method invocations are the messages that are sent from one interface class to another and for this reason each interface class or object needs to know what information it is likely to receive. The method invocations or API calls need therefore to be described in an agreed manner, so that should the API calls become standard, then each system will know what information it is expected to act upon. The API call is described using an agreed format. This Recommendation recommends the use of a Generic Interface Description Language (IDL) to describe the API. The advantages of using such a format are that this interface description can be readily converted into any implementation specific solution such as CORBA, INAP or JAVA.

The IDL will detail each of the method invocations and describe the data parameters carried within. An example is shown below:



```
routeCallToDestination_Req(callSessionID : in TSessionID, responseRequested : in
    TCallResponseRequest, targetAddress : in TAddress, originatingAddress : in TAddress,
    originalDestinationAddress : in TAddress, redirectingAddress : in TAddress, appInfo :
    in TCallAppInfoArr) : TResult
```

In this example the name of the API call appears at the beginning (routeCallToDestination_Req). Alternative parameters are italicised so that one can see the breakdown of the method. For example the *callSessionID : in TsessionID* parameter, specifies the call session ID of the call. This means that the call session ID will be specified: *in TsessionID*, meaning that one will find the call ID defined as the standards "Type" *sessionID*. Therefore the first part of the parameter explains what is carried in the method and the second part, after the colon, shows the format in which it is carried. The exact detail of that format is not the subject of this Recommendation.

To complete the modelling process, one should return to Step 5 at 2.5.

APPENDIX I

Format and outline of a Stage 2 description using the unified functional methodology

1 Scope

2 Normative references

3 Definitions

4 Symbols and abbreviations

5 Description

6 Derivation of the functional model

6.1 Functional model description and relationship with the basic service

6.2 Description of functional entities

7 SIB-based service feature definitions

8 Information flows

8.1 Information flow diagrams

8.2 Definition of individual information flows

8.2.1 Relationship r1

8.2.1.1 Contents of information flow

8.2.1.x Contents of information flow

9 Functional entity actions

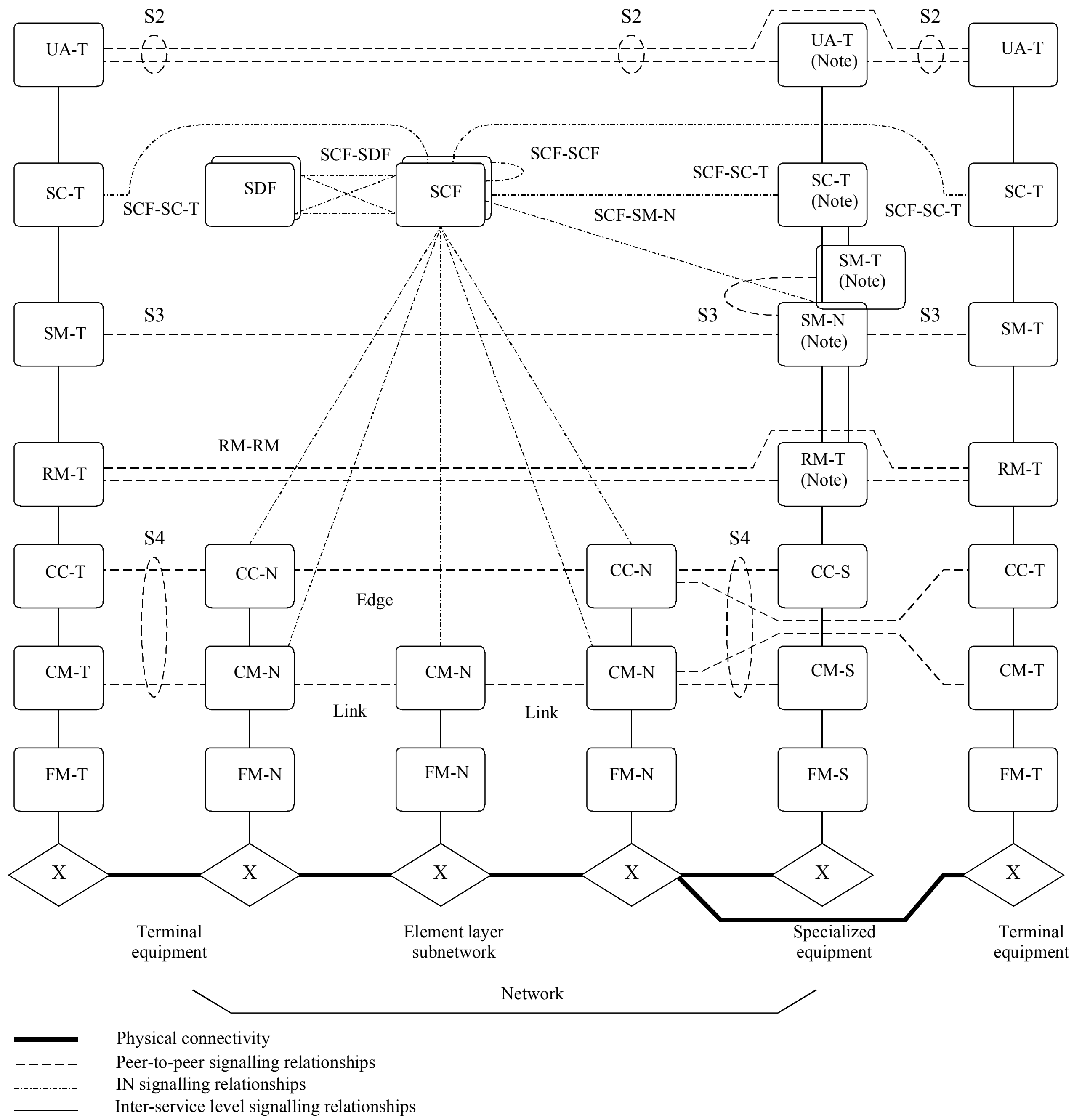
10 SDL diagrams for functional entities

11 Allocation of functional entities to physical locations (scenarios)

APPENDIX II

Functional architecture – Q.65 evolution

This diagram presents a functional entity model without reference to any physical realization or architecture. The "CM-N" entity shown corresponds to just the real-time connection control component of the NML shown in the unified functional architecture. The "FM-N" entity shown corresponds to just the real-time resource and fabric control of the EML shown in the unified functional architecture.



UA User application function, SC Service control function, SCF Service control function, SDF Service data function
SM Session management function, RM Resource management function, CC Call control function,
CM Connection management function, FM Fabric management function

NOTE – These functions could be emulated by the SCF; in such cases, the relationships towards these functions would lead to the SCF.

S2 signalling is carried by user SVC, S3 signalling may be carried by signalling SVC or user SVC, S4 signalling is carried by signalling SVC. Specialized equipment may be attached to SN (serving node) or gateway nodes.

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Figure II.1/Q.65 – Unified functional model

APPENDIX III

Examples of Interface Classes formed from Service/Application requirements

III.1 Introduction

The following Interface Class examples are produced to aid the reader in defining a system. They should not be seen as definitive and should only be used as a guide.

The methodology that was explained in clause 3, is used here to show how one derives the appropriate API for a particular interface. We will describe one type of service/application. The application will be described and the resultant Interface Classes will be identified. We will also populate each of the interface classes with the information flows (method invocations) that we identify.

III.2 Service/Application Example

III.2.1 Third Party Initiated Call

For the sake of this example, we will assume that an external service provider requires setting up a call between two parties A&B. To do this the service provider needs to communicate this to a network operator, probably the Service control Function (SCF). To enable this we need to identify the Interface classes responsible to communicate these requirements. So analysing the service we need to be able to create two separate legs, set up a call between them and be able to manage the call. The first requirement is therefore to provide a "**Call Control Manager**". This interface class will be responsible for creating a single or multiple calls. As it can manage many calls we will need to have a specific Interface Class for each individual Call, therefore we need to provide a "**Call Control**" Interface Class. As each Call will have Call Legs associated and as each leg will be independent, we need to provide a "**Call Leg**" interface class per leg. Looking at our initial run-through of the service we so far have:

- Call Control Manager
- Call Control
- Call Leg [A party]
- Call Leg [B party].

Each of these interface classes, as described earlier in clause 3, will be implemented in pairs, one running in the application and the other running in the network as it were. The terminology used to describe this is as follows:

Application Interface Classes	Network side Interface Classes
IAppCallControlManager	**IcallControlManager**
IAppCall	**Icall**
PartyA: IAppCallLeg	**PartyA: IcallLeg**
PartyB: IAppCallLeg	**PartyB: IcallLeg**

You will notice that the "I" that precedes the name indicates that we are referring here to "Interface Class" and not an Object class. Interface Classes do not have any attributes associated with them, as Object Classes do, which makes Object classes implementation specific.

Having reached this point it is now advantageous to address Class diagrams. This from a system perspective is very important.

Earlier in this Recommendation we considered the Package concept, this is further considered here.

The "Package" is important when arranging your "Interface" into relevant parts. For example one may want to group all aspects of Call Control in one package, thereby enabling the replication of these interface classes on different interfaces, without having to go through the same requirement capture over and over again. The following clause looks at a Call Control service Class diagram and shows the relationship between packages and the interface classes.

III.3 Class Diagrams

III.3.1 Generic call control service class diagram

The application generic call control service package in Figure III.1, labelled *IAppGCCS*, consists of one *IAppCallControlManager* interface, zero or more *IAppCall* interfaces and zero or more *IAppCallLeg* interfaces.

The generic call control service package in Figure III.1, labelled *IGCCS*, consists of one *ICallControlManager* interface, zero or more *ICall* interfaces and zero or more *ICallLeg* interfaces.

IApp
GCCS
IGCCS
T11107090-00

Figure III.1/Q.65 – Generic call control service packages

The class diagram in Figure III.2 shows the interfaces that make up the application generic call control service package and the generic call control service package. Communication between these packages is done via the *+uses the ICallControlManager*, *+uses the ICall* and *+uses the ICallLeg* channels.

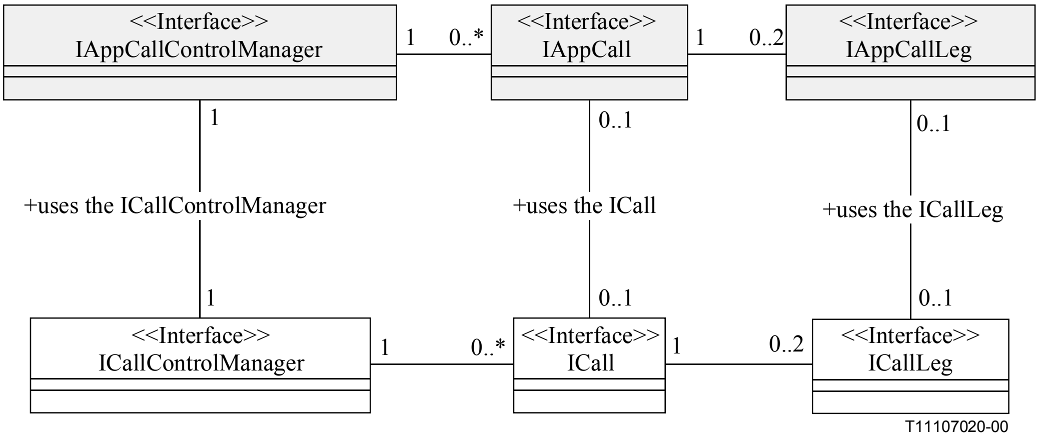


Figure III.2/Q.65 – Generic call control service class diagram

III.3.2 Method Invocations

Having reached this point it is necessary to populate the classes with operations, or as they are known, "Method Invocations". These are the messages that can be sent to the class to invoke some result. First of all let us look at the ICallControlManager.

III.3.2.1 ICallControlManager Method invocations

First of all the client will need to indicate to the network that he needs to create a call, so the first method would be:

- "createCall".

At present this will probably suffice. Note however as we look at more Services/applications, new methods will be identified.

Next we will address the Call interface class.

III.3.2.2 Icall Method invocations

The following methods would be advantageous:

- routeCallToDestination_Req;
- routeCallToOrigination_Req.

For the moment these methods will probably suffice. Lastly let us look at the CallLeg.

III.3.2.3 IcallLeg method invocations

The following methods would be advantageous:

- routeCallLegToAddress;
- releaseCallLeg.

Having made a provisional definition of the above Interface Classes, we now need to describe, in detail, the Interface Description Language, that implements the method invocations.

III.3.3 IDL

For the sake of example only two of the interface classes will be expanded upon. This process should be repeated for each class in turn.

The following Interface classes are once again, examples only.

III.3.3.1 ICallControlManager IDL

Interface Class

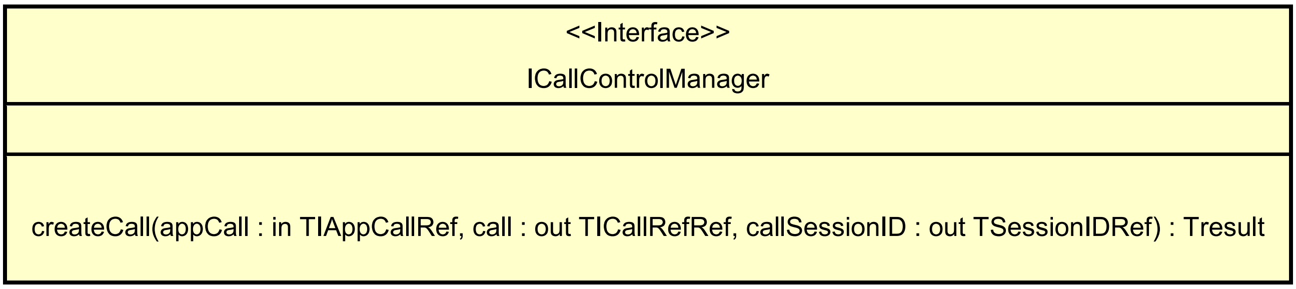

<<Interface>>
ICallControlManager
createCall(appCall : in TIAppCallRef, call : out TICallRefRef, callSessionID : out TSessionIDRef) : Tresult

Figure III.3/Q.65

The following describes the method createCall and the associated parameters.

Method

`createCall()`

This method is used to create a new call object.

Parameters

`appCall: in TIAppCallRef`

Specifies the application interface for callbacks from the call created.

`call: out TICallRefRef`

Specifies the interface reference of the call created.

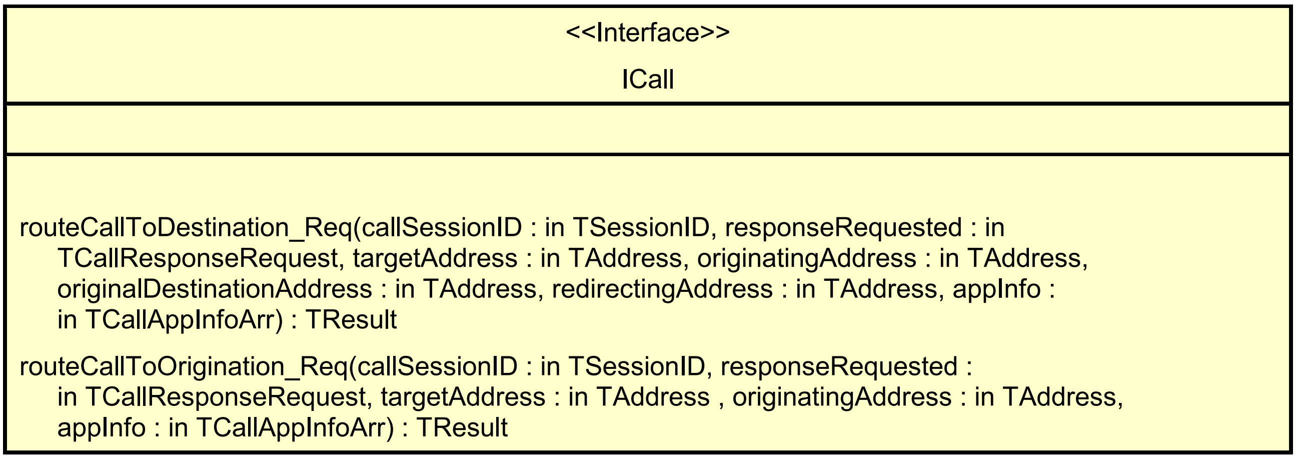
`callSessionID: out TSessionIDRef`

Specifies the call session ID of the call created.

III.3.3.2 ICall IDL

Figure III.4 is an example of the Interface Class "ICall".

Interface Class



<<Interface>>

ICall

routeCallToDestination_Req(callSessionID : in TSessionID, responseRequested : in TCallResponseRequest, targetAddress : in TAddress, originatingAddress : in TAddress, originalDestinationAddress : in TAddress, redirectingAddress : in TAddress, appInfo : in TCallAppInfoArr) : TResult

routeCallToOrigination_Req(callSessionID : in TSessionID, responseRequested : in TCallResponseRequest, targetAddress : in TAddress , originatingAddress : in TAddress, appInfo : in TCallAppInfoArr) : TResult

Figure III.4/Q.65

The following describes the methods routeCallToDestination_Req and routeCallToOrigination_Req and the associated parameters.

Method

`routeCallToDestination_Req()`

This asynchronous method requests routing of the call (and inherently attached parties) to the destination party, via a passive call leg (which is implicitly created).

Parameters

`callSessionID: in TSessionID`

Specifies the call session ID of the call.

`responseRequested: in TCallResponseRequest`

Specifies the set of observed events that will result in a **`routeCallToDestination_Res`** being generated.

`targetAddress: in TAddress`

Specifies the destination party to which the call should be routed.

`originatingAddress: in TAddress`

Specifies the address of the originating (calling) party.

`originalDestinationAddress: in TAddress`

Specifies the original destination address of the call.

`redirectingAddress: in TAddress`

Specifies the last address from which the call was redirected.

`appInfo: in TCallAppInfoArr`

Specifies application-related information pertinent to the call (such as alerting method, teleservice type, service identities, interaction indicators).

Method

`routeCallToOrigination_Req()`

This asynchronous method requests routing of a call to the first call party, via a controlling call leg (which is implicitly created). The call object must already have been created.

Parameters

`callSessionID:in TSessionID`

Specifies the call session ID of the call.

`responseRequested: in TCallResponseRequest`

Specifies the set of observed events that will result in a **`routeCallToOrigination_Res()`** will be generated.

`targetAddress: in TAddress`

Specifies the origination party to which the call should be routed.

`originatingAddress: in TAddress`

Specifies the address of the originating (calling) party.

`AppInfo: in TCallAppInfoArr`

Specifies application related information pertinent to the call (such as alerting method, teleservice type, service identities, interaction indicators).

III.4 Where to go now?

Appendix III has explained how one uses the UML tool to specify services/applications. As such we have reached a similar point in the alternative method (using SIBs) where we need to map the results onto a protocol. As with the SIB approach we should now go straight to the SDL to define the system over which these methods are invoked; there are two possible options here:

1) We can feed the above results into the SDL machine and produce the appropriate SDL.

2) Or we can specify the IDL in an implementation specific way, such as deciding whether to use a CORBA solution or other. Having made this direct mapping, it is still possible through the appropriate tool, to map the CORBA IDL solution straight into SDL.

Both of these options are not the subject of this Recommendation.

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