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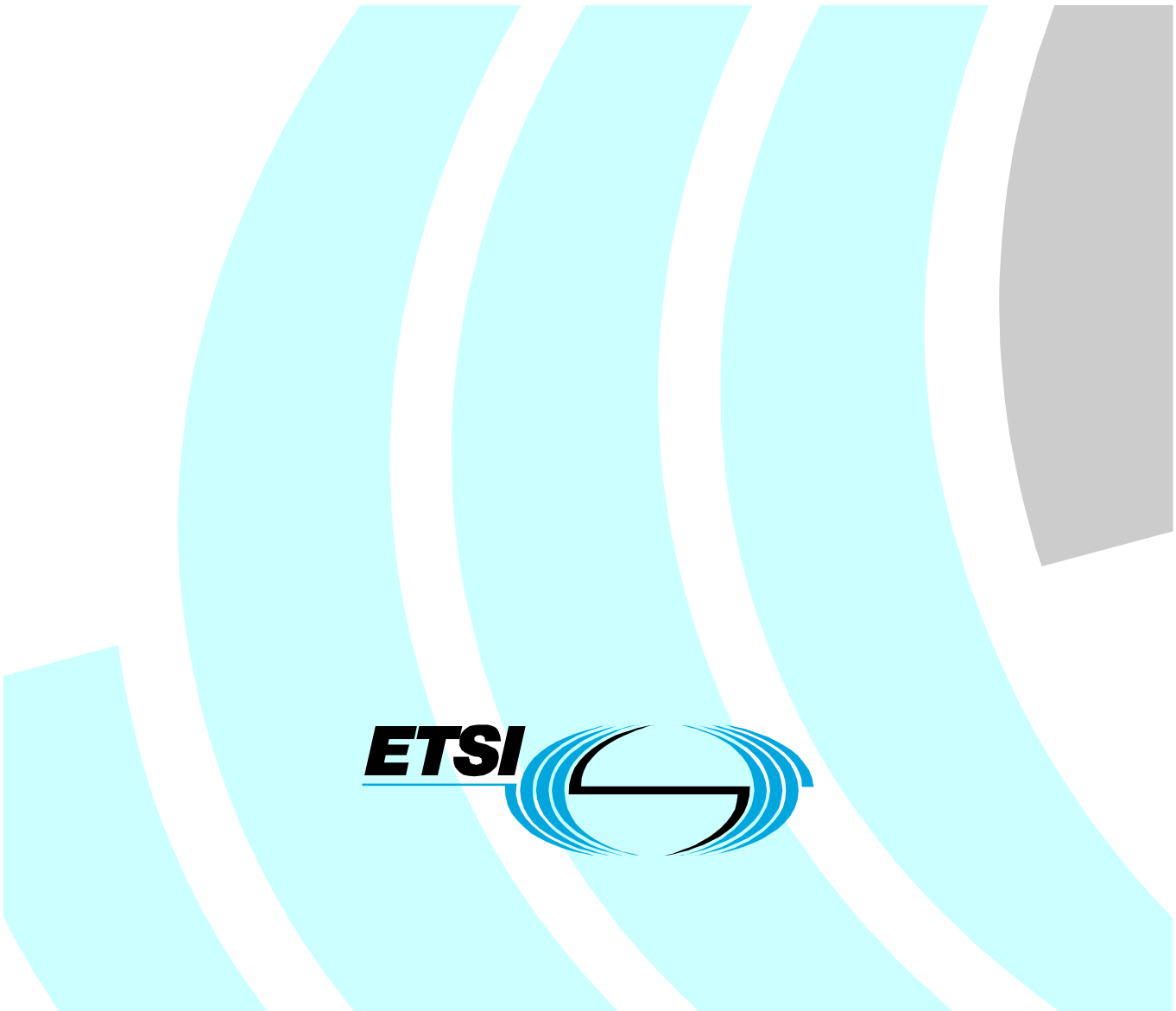
Technical Specification

Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) Release 4; Abstract Architecture and Reference Points Definition; Network Architecture and Reference Points



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Contents

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Foreword

This Technical Specification (TS) has been produced by ETSI Project Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON).

Introduction

The present document describes the network architecture and the reference configurations that are necessary for the support of services and service capabilities defined for TIPHON Release 4. The TIPHON Release 4 definition and the corresponding relationship between the core deliverables is described in TR 101 301 V4.1.1 [1].

The present document builds upon the concepts embodied in TIPHON Release 3 [8]. These concepts which are applicable to network configurations based on the range of functional and entities within the IP network, as described in the present document that are necessary to support the four scenarios of TIPHON Release 4.

1 Scope

The present document defines the TIPHON network architecture and the reference configurations that are necessary for:

- the delivery of telephone calls, which originate and terminate in IP networks;
- the delivery of telephone calls which originate in an Internet Protocol (IP) network and are delivered to Switched Circuit Networks (SCN);
- the delivery of telephone calls which originate in SCNs and are delivered in an IP network; and
- the delivery of telephone calls which originate in SCNs, routed through IP networks and delivered to SCN.

These four scenarios are part of TIPHON Release 4.

The architecture includes provision of information and facilities which are incidental to the delivery of telephone calls described above. The present document builds upon the concepts embodied in the TIPHON Release 3 network architecture and reference configurations described in TR 101 877 [8]. The present document is applicable to equipment fulfilling the roles of the functional groups identified in TS 101 878 [2]; Terminal functional group, network functional group and Gateway functional group, and also to entities within the IP network that are necessary to support the four scenarios of TIPHON Release 4.

2 References

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

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

[1] ETSI TR 101 301: "Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) Release 3; Release Definition; TIPHON Release 3 Definition".

[2] ETSI TS 101 878: "Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) Release 3; Service Capability Definition; Service Capabilities for a simple call".

[3] ETSI TS 101 329-2: "Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) Release 3; End-to-end Quality of Service in TIPHON Systems; Part 2: Definition of Speech Quality of Service (QoS) Classes".

[4] ETSI TS 101 871 (all parts): "Digital Enhanced Cordless Telecommunications (DECT); Application Specific Access Profile (ASAP); DECT Multimedia Access Profile (DMAP); Profile requirement list and profile specific Implementation Conformance Statement (ICS) proforma".

[5] ETSI TR 101 303: "Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) Release 3; Requirements definition study; Introduction to service and network management".

[6] ETSI TR 101 311: "Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) Release 3; Service Independent requirements definition; Transport Plane".

[7] Void.

[8] ETSI TR 101 877: "Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON); Requirements Definition Study; Scope and Requirements for a Simple call".

[9] Void.

[10] ETSI TS 101 303: "Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) Release 4; Service Independent Requirements Definition; Service and Network Management Framework; Part 1: Overview and Introduction".

[11] ITU-T Recommendation M.3010: "Principles for a Telecommunications management network".

[12] ITU Recommendations M.3200: "TMN management services and telecommunications managed areas: overview".

[13] ITU Recommendations M.3400: "TMN Management Functions".

[14] GB910: "Telecom Operations Map".

[15] GB921 June 1: "enhanced Telecom Operations Map (eTOM): The Business Process Framework-for the Information and Communications Services Industry".

3 Definitions and abbreviations

3.1 Definitions

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

administrative domain: collection of physical or functional entities under the control of a single administration

aggregate bearer: logical association of functional entities in an IP telephony application and transport network which creates one or more concurrent end to end media flows and which is not limited to the duration of a single call

Aggregate Bearer Admission Control (ABAC) function: functional entity that determines whether or not a flow is to be admitted as part of an established aggregate bearer

Aggregate Bearer Measurement (ABM) function: function that determines the capacity used and remaining in an aggregate bearer as a result of measuring the actual media flows after taking into account what flows were requested

application data: media or signalling information content

bearer: logical association of functional entities in an IP telephony application and transport network which creates an end to end media flow for no longer than the duration of a call

domain: collection of physical or functional entities within an administrative domain which share a consistent set of policies and common technologies

Domain IDentifier (DID): globally unique identifier of a domain. Domain identifiers may be mapped to the IP Telephony Administrative Domain (ITAD) Numbers, registered by IANA and used by the TRIP Protocol

end-user: entity using the services of an IP telephony service provider or transport network operator

end-user domain: collection of physical or functional entities under the control of an end-user which share a consistent set of policies and common technologies

functional entity: entity in a system that performs a specific set of functions

Functional Group (FG): collection of functional entities within a domain.

NOTE: In TIPHON systems functional groups are used to structure the necessary functionality to offer IP telephony services across domains

gateway functional group: functional group containing the functionality of a network functional group also the functionality necessary to connect calls to the SCN

NOTE: Gateway functional groups may be classified as originating or terminating based upon their location within the topology of a specified call.

home network functional group: functional group, which is aware of the service application subscribed to by the end-user

NOTE: Home network functional groups may be classified as originating or terminating based upon their location within the topology of a specified call.

intermediate (transit) network functional group: functional group connecting the serving network functional group to the home network functional group

NOTE: The intermediate network functional grouping is only present when the serving network functional grouping and the home network functional grouping are not directly connected.

information flow: interaction between a communicating pair of functional entities

interconnection function: functional entity connecting two networks having differing administrative policy such as Quality of Service (QoS) or addressing policy but employing the same signalling protocol, and transport technology, at the point of interconnect

interface: shared boundary between two communicating systems, devices or equipment

IP network: packet transport network comprising one or more transport domains each employing the IP protocol

IP telephony: any telephony related service that is supported on a managed IP network

IP telephony service provider: service provider who offers IP telephony services

NOTE: The same business entity may act as both a transport network operator and an IP telephony service provider.

network functional group: functional group containing the functionality required to establish a call between two terminals, a gateway and a terminal, or two gateways

NOTE: Network functional groups may be classified as originating or terminating based upon their location within the topology of a specified call.

packet flow/transport flow: stream of packets of the same type identified by common address and port numbers

NOTE: The stream may contain either signalling information or content description together with media information.

protocol: set of semantics, syntax and procedures, which govern the exchange of information across an interface

reference point: conceptual point at the conjunction of two communicating functional entities

service domain: collection of physical or functional entities offering IP telephony services under the control of an IP telephony service provider which share a consistent set of policies and common technologies

serving network functional group: functional group that enables terminal functional groups to connect to an IP telephony service provide

Switched Circuit Network (SCN): telecommunications network, e.g. Public Switched Telephone Network (PSTN), Integrated Services Digital Network (ISDN), and General System for Mobile communications (GSM), that uses circuit-switched technologies for the support of voice calls

NOTE: The SCN may be a public network or a private network.

terminal: endpoint within the user equipment on which signalling and media flows originate and/or terminate

terminal functional group: functional group representing all the IP telephony functionality within an end-user's terminal

NOTE: Terminal functional groups may be classified as originating or terminating based upon their location within the topology of a specified call.

ticket: a ticket is obtained through the registration session, when used in a call it provides the terminal/user with a means to show a valid registration exists

transport domain: collection of transport resources sharing a common set of policies, QoS mechanisms and transport technologies under the control of a transport network operator

transport function: functional entity representing the collection of transport resources within a transport domain which are capable of control by a transport resource manager

transport network: collection of transport resources, which provide IP transport functionality

transport network operator: business entity operating a transport network

transport policy entity: functional entity that maintains the policies of a transport domain

Transport Resource Manager (TRM): functional entity that applies a set of policies and mechanisms to a set of transport resources to ensure that those resources are allocated such that they are sufficient to enable transport flows with QoS guarantees across the domain of control of the TRM

user equipment: equipment under the control of an end-user

user profile: service specific information about a user of a service application

3.2 Abbreviations

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

ABAC	Aggregate Bearer Admission Control
ABM	Aggregate Bearer Management
BC	Bearer Control
CC	Call Control
CR	Call Routing function
DID	Domain IDentifier
DiffServ	Differentiated Services
DNS	Domain Name Service
DTMF	Dual Tone Multi Frequency
FCAPS	Fault, Configuration, Accounting, Performance and Security
FG	Functional Group
GSM	General System for Mobile communication
HREG	Home network REGistration function
IANA	Internet Assigned Numbers Authority
ICF	Interconnect Function
IP	Internet Protocol
IPTN	IP Telephony Network
IREG	Intermediate Network Registration function
ISDN	Integrated Service Digital Network
ITAD	IP Telephony Administrative Domain
MC	Media Control
MD	Mediation Device
MPLS	Multi-Protocol Label Switching
NE	Network Element
NEF	Network Element Function
OAM&P	Operation Adminstration Maintenance & Provision
OS	Operations System
OSF	Operations System Function
PSTN	Public Switched Telephony Network
QoS	Quality of Service

QoSM	Quality of Service Management
QoSP	Quality of Service Policy
SC	Service Control
SCN	Switched Circuit Networks
SpoA	Service point of Attachment
SREG	Service Network REGistration function
TA	Transport Accounting function
TOM	Telecommunications operations Map
TF	Transport Function
TP	Transport Policy
TREG	Terminal Registration function
TRIP	Telephony Routing over IP Protocol
TRM	Transport Resource Management
WS	Work Station
WSF	Work Station Function

4 Basic concepts

4.1 Functional planes

TR 101 877 [8] describes an environment for communications services that encompasses multiple domains of control and technology.

Figure 1 expands upon [8] by identifying the following functional planes, each containing a high level grouping of functionality:

- IP telephony application;
- IP transport;
- SCN;
- management.

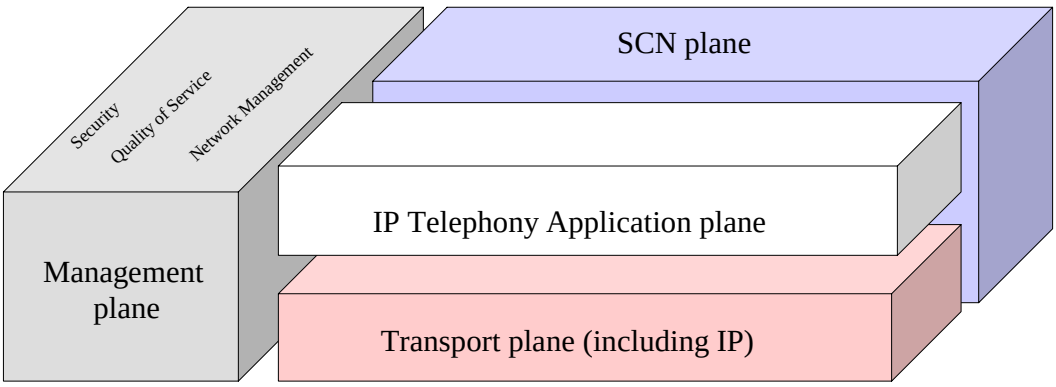


Figure 1: Functional planes

The SCN plane contains the functionality relating to the SCN. Part of the SCN plane is a component of the service abstraction layer as defined in [8], and part of the SCN plane is a component of the transport abstraction layer as defined in [8]. Architectures for SCNs are defined elsewhere, therefore, details of this functional plane are not considered further in the present document.

The IP telephony application plane makes use of capabilities provided by the other functional planes and it contains functions to support telephony. The IP telephony application plane is a component of the service abstraction layer as defined in [8]. The IP telephony application plane contains functions and has information flows that support the service capabilities defined in [2].

The transport plane (including IP) contains the functionality relating to the underlying packet transport and services in general use, e.g. DNS. The IP transport plane is a component of the transport abstraction layer as defined in [8].

The management plane contains the management functionality relating to QoS, security and network management. The details of this functional plane are considered in [5].

4.2 Domains and functional groups

TS 101 878 [2] defines a number of concepts and terms that are used in the present document.

Domains are a collection of physical entities or functional entities under the control of a single administration which shares a consistent set of policies and compatible technologies.

TIPHON distinguishes three kinds of domains: end-user domains, service domains and transport domain.

The end-user domain is controlled by the end-user, the service domain is controlled by an IP telephony service provider and the transport domain is controlled by a transport network operator.

Functional groups are the constructs used in the present document to structure functionality necessary to offer IP telephony services across domains. The mapping between domains and functional groups is shown in [2].

NOTE: There may not be a one-to-one mapping between application level domains and transport level domains.

The following functional groups are identified in the end-user domain:

- **terminal functional group:** a functional group representing all the IP telephony functionality within a user's terminal. Terminal functional groups may be classified as originating or terminating based upon their location within the topology of a specified call;
- **terminal registration functional group:** a functional group representing the registration within the user's terminal.

The following functional groups are identified in the service domain:

- **network functional group:** a functional group containing the functionality required to establish a call between two terminals, a gateway and a terminal or two gateways. network functional groups may be classified as originating or terminating based upon their location within the topology of a specified call;
- **Gateway Functional Group:** a functional group containing the functionality of a network functional group. It also has the functionality necessary to connect calls between IP and SCN domains. Gateway functional groups may be classified as originating or terminating based upon their location within the topology of a specified call.

The network functional group represents all of the functionality of an application to support a call. In fixed network environments, the originating end-user always has a contract with the service provider controlling the service domain containing the originating network functional group. The terminating user has a contract with the service provider controlling the service domain containing the terminating network functional group. For mobility considerations this may not be the case.

Although the network functional groups may contain an application plane and a transport plane, no description is provided on how (and if) this domain is related to transport functional groups. No further description of this domain is given in this clause, although details of the functional groups in the transport domain are identified later in the present document.

Network functional groups are further divided into serving network functional group, intermediate network Functional group and home network functional groups. These are defined as:

- **serving network functional group:** a functional group that enables terminal functional groups to connect to a service provider (home network functional group). Serving network functional groups may be classified as originating or terminating based upon their location within the topology of a specified call;
- **intermediate (transit) network functional group:** a functional group that connects the serving network functional group to the home network functional group or between originating and terminating home network functional groups. The intermediate network functional group is only present when the serving network functional group and the home network functional group are not directly connected. There may be more than one intermediate network functional groups supporting communications between serving and home network functional group;
- **home network functional group:** a functional group, which is aware of the service applications, subscribed by the end-user. Home network functional groups may be classified as originating or terminating based upon their location within the topology of a specified call.

The home network functional group and the serving network functional group may reside in the same network or in different networks.

Figure 2 depicts all the TIPHON functional groups identified in this clause.

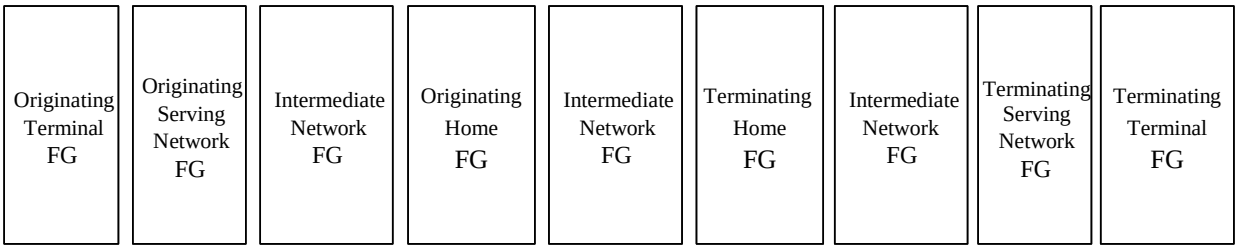


Figure 2: TIPHON functional groups

5 Functional decomposition of the IP telephony application plane

The architecture for the IP telephony application plane implements the capabilities necessary for the IP telephony application.

The IP telephony application architecture is described using objects. These objects are related to each other but may be instantiated and deleted separately.

One or more objects, taken together, exhibit the behaviour of the functional entities described in the present document. The functionality in the IP telephony application plane is distributed within functional layers based on an object's lifetime and object's ownership. Each functional layer provides capabilities to adjacent layers. This grouping is useful to understand the functionality involved but does not imply any physical implementation.

Where there is a requirement for an interface between functional entities, a reference point is defined.

5.1 Introduction to the functional layers

The IP telephony application plane has 5 functional layers: the services functional layer, the service control functional layer, the call control functional layer, the bearer control functional layer and the media functional layer.

These functional layers are shown in figure 3. For simplicity only two functions are shown in each functional layer with all of the possible communication paths within the functional layer and to the adjacent functional layers.

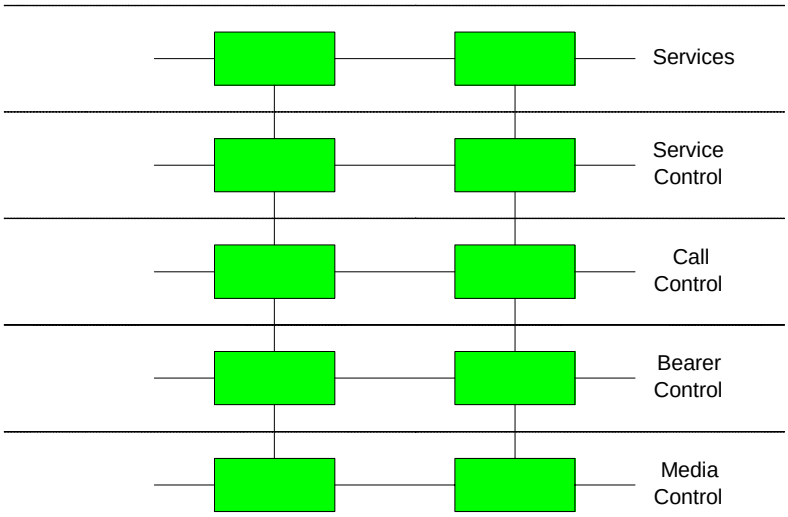


Figure 3: Functional layers in the IP telephony application plane

Each of the functional layers is introduced in the subsequent clauses.

5.1.1 The services functional layer

The **services functional layer** contains the collections of data and associated logic (e.g. scripts) that produce service functions. The services functional layer is related to the service and registration capabilities identified in [2]. A service capability may use more than one function in the Services functional layer and functions in other layers.

NOTE 1: The collections of data and logic (service functions) may be held in different places and may be owned and run by service providers who create services over networks run by other parties. These service functions may interact with each other to control registration and calls.

Call related service functions are accessed by the call control functional layer through the services control functional layer. Registration related functions, are accessed by the service control functional layer.

NOTE 2: The following illustrates the operation of the call control functional layer, the service control functional layer and the services functional layer. When a caller requests a call, the call control layer interrogates the services functional layer (via the service control functional layer) for the caller's profile and any other service functions needed. Using this information, the call control functional layer sends a request for a call towards the called party. This request may be modified by an intermediate network (e.g. re-routed) but eventually arrives at the call control functional layer of the called party. This call control functional layer interrogates the called user's profile and other relevant service functions and determines whether or not the call can be accepted and if not what response should be provided.

This functional layer has the following functions:

User-service profile function	This function is present in a terminal registration functional group. It provides information required for registration and stores information received during registration (user-related information pertaining to the services the user wants to register for as well as information on the service provider with whom the service shall be registered). It provides, on request, information needed for call establishment (such as authorization information and user preferences). The lifetime of this information is valid as long as the user has the contract with the service provider this service profile refers to.

User profile function	This function is present in the home network functional group. It holds information about the user. The lifetime of this information is valid as long as the user has the contract with the service provider this service profile refers to.

Call Routing (CR) function	This function is present in any network functional group. It provides address/number translation, number length determination and telephony routing capabilities. This function will exist as long as the service provider exists. The lifetime of the information contained in this function is as long as the call routing information is valid.

Accounting function	This function is present in any network functional group. It handles and stores call and service related information. The stored information may be used for billing the user or other operators. This function will exist as long as the service provider exists. The lifetime of information in this function is at least as long as the legal time to keep such information.

QoS Policy (QoSP) function	This function is present in any network functional group. It manages IP telephony QoS policies and provides authorization of permitted and default QoS levels. This function will exist as long as the service provider exists. The lifetime of information in this function is as long as the QoS policies stay the same.

5.1.2 The service control functional layer

The **service control functional layer** provides two classes of functions:

- management of registrations; and
- support for calls.

To manage registrations, this layer:

- receives information from the terminal about the user and generates requests for authentication from its own services functional layer or a remote services functional layer via a peer service control functional layer; and
- processes the responses from the services functional layer and generates authorization "tickets" that are stored in the user's terminal. These tickets are then used with call requests.

To support calls, this layer:

- receives requests from the call control functional layer and generates requests for information to the appropriate services functions, which may be local or remote and may also be provided by third parties; and
- processes the responses from the service functions to produce and return responses to call control.

The service control functional layer is related to service capabilities and registration capabilities identified in [2]. A service capability may use more than one function in the service control functional layer and functions at other layers.

This functional layer has the following functions:

Service Control (SC) function	This function is present in any network functional group. It provides support for calls by accessing information at the services layer. This support mainly concerns authorization and routing, including name and address translations. This function exists as long as the service provider provides this type of service application.

Terminal Registration (TREG) function	This function is present in terminal registration functional group. It registers a user at a terminal with a service provider. This function lives as long as the user has a registration session with the network.

Service Network Registration (SREG) function	This function is present in the serving network functional group. It accepts registration of a user at a terminal. This function exists as long as the user has a registration session with the network.

Intermediate Network Registration (IREG) function	This function is present in the intermediate network functional group. It accepts registration requests from user at a terminal via the serving network functional group and proxies the request towards the home network functional group. This function exists as long as the user has a registration session with the network.

Home Network Registration (HREG) function	This function is present in the home network functional group. It accepts registration of a user at a terminal. This function exists as long as the user has a registration session with the network.

5.1.3 The call control functional layer

The **call control functional layer** shall maintain a call context. The call context allows the bearer control functional layer to provide the connections and capabilities requested by the user (as permitted by the service provider). In order to achieve this control, the call control functional layer may request information from the service control functional layer.

The call control functional layer is related to the service and registration capabilities identified in [2]. A service capability may use more than one function in the call control functional layer and functions at other layers.

This functional layer has the following functions:

Call Control (CC) function	This function is present in any network functional group. It maintains the call state and, if present, provides services that change the call state e.g. call forwarding, call transfer and conferencing. This function has the same lifetime as the call it controls.
	Communication with peer call control functions for the establishment and release of calls.
	Requests services from functions in the service control functional layer.
	Request determination of, allocation of, and release of, resources from bearer control functions.

5.1.4 The bearer control functional layer

The **bearer control functional layer** manages the logical association between pairs of endpoints. Bearer control shall be responsible for mapping call topology to individual media flows (e.g. connect parties a, b and c together). These flows may be between any pair of media processing functions in the media functional layer.

The bearer control functional layer is related to the service and registration capabilities identified in [2]. A service capability may use more than one function in the bearer control functional layer and functions at other layers.

This layer has the following functions:

Bearer Control (BC) function	This function is present in any network functional group. It allows or disallows media streaming based on information from call control. This function has the same lifetime as the bearer that it controls.
Bearer negotiation	Negotiates with other Bearer Control functions.
Media resource acquisition	Communicates with the Media Control function to obtain media resources for the bearer.

Aggregate Bearer Admission Control (ABAC) function	This function is present in any network functional group. It determines whether or not a flow is to be admitted as part of an established aggregate bearer. It also keeps track of the capacity available for flows as they may change for reasons other than the admission or cessation of media flows. Interfaces to the management plane for the retrieval of aggregate bearer parameters. This function has the same lifetime as the aggregate bearer that it controls.

NOTE: The Quality of Service Manager (QoSM) functional element defined in reference [3] includes all those aspects of the media and bearer control layers, within a particular functional group, that are involved in end to end QoS specification and control.

5.1.5 The media control functional layer

The **media control functional layer** shall be responsible for the properties of the individual media flows. In this functional layer media encoding capability is determined, Quality of Service (QoS) paths are reserved and firewalls are controlled in conjunction with the IP Transport plane.

The media control functional layer is related to the service and registration capabilities identified in [2]. A service capability may use more than one function in the media control functional layer and functions at other layers.

This functional layer has the following functions.

Media Control (MC) functions	Provides IP transport addresses for media reception and transmission. This function has the same lifetime as the media it controls.
Circuit Network Media Termination	This function is present in the gateway functional group. It provides termination of for example: all lower-functional layer circuit network hardware and protocols.
Media Processing	This function may be present in any functional group. It performs signal processing functions such as voice compression, network echo-cancellation, silence suppression, comfort noise generation, encryption, codec translation, fax conversion, media insertion (DTMF, messages) filtering and analogue modem conversion (for passing analogue modem signals "transparently" through the packet network).
Media Resource Management	This function is present in any functional group. It allocates internal resources in the media plane
Packet Media Termination	This function is present in any functional group. It performs termination of application data transport protocol
Transport signalling	This function is present in any functional group. It reserves QoS paths and controls firewalls in the IP transport plane.

Aggregate Bearer Measurement (ABM) function	This function is present in any network functional group. It determines the capacity used and remaining in an aggregate bearer as a result of measuring the actual media flows after taking into account what flows were requested. It interfaces with the management plane for the retrieval of aggregate bearer parameters This function has the same lifetime as the aggregate bearer that it measures.

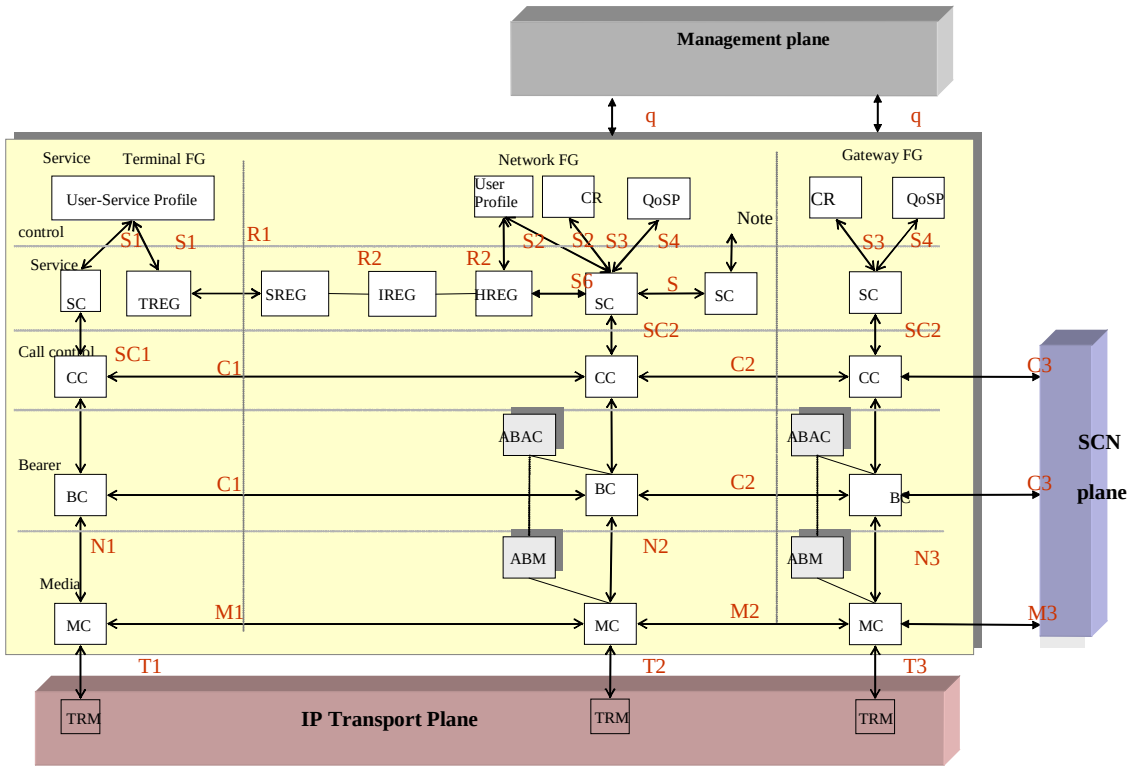
NOTE: The Quality of Service Manager (QoSM) functional element defined in [3] includes all those aspects of the Media and Bearer Control layers, within a particular functional group, that are involved in end to end QoS specification and control.

5.2 Definition of reference points

Reference points are identified for those (groups of) information flows that are subject to standardization. This clause describes the reference points, defined in the IP telephony application plane (and the relation to other planes) and shows how they can be combined to provide the telephony application over IP networks.

The internal structure of the management plane is defined in [5] and the internal structure of the IP transport plane is defined in clause 6 in the present document.

Figure 4 shows the reference points in the general functional model.



NOTE 1: All functions within the network functional group may appear more than once. In this figure, the registration function and the SC functions appear more than once to show inter domain reference points R2 and SC2'. For simplicity the reference points from SC to the service layer is not repeated but should be the same as for any other SC in the network functional group i.e. S2, S3, S4 and A_{S5}.

NOTE 2: The reference point q corresponds to the reference point A in [5] and includes reference point S5 in the present document.

NOTE 3: Parts of the Aggregated Bearer Admission Control (ABAC) and the Aggregated Bearer Management (ABM) function belongs to the management plane. Aggregate Bearer load control information flows between ABM and ABAC at N2 with the capability to provide admission control functionality based on aggregate bandwidth usage measurements and transport network QoS performance.

Figure 4: General reference configuration

Figure 4 shows the general reference configuration. In order to understand how the functions, within that general model, interact for different scenarios each scenario is described in separate figures.

Clause 5.2.1 provides the call unrelated reference point configurations and clause 5.2.9 provides the call-related reference point configurations.

5.2.1 SC-Service reference points

- **S1:** Information flows at S1 provide the capability to store, retrieve and delete the registration ticket;
- **S2:** Information flows at S2 provide the capability to obtain and update properties in the user profile. For the purposes of: user authentication, user authorization, call routing, user preferences, allowed services and service options;
- **S3:** Information flows at S3 provide the capability to obtain call routing information and address translation;
- **S4:** Information flows at S4 provide the capability to obtain QoS information;
- **S5:** Information flows at S5 provide the capability to store and receive accounting information from the management plane;
- **S6:** Information flows at S6 provide the capability to allocate a SpoA for use by a user.

5.2.2 SC-SC reference points

- **R1:** Information flows at R1 provide the capability required for a user to register and attach to service applications. They provide the capability to convey users ID, terminal ID, terminal capabilities, service application names, etc.;
- **R2:** Information flows at R2 provide the capability to exchange user registration information and the capability to exchange information related to attachment to service applications, between network functional groups;
- **SC2':** Information flows at SC2' provide the capability to respond to service related queries, e.g. to respond to access and routing requests for calls in the context of network functional groups. Input information may include called address/name, caller, calling domain. Output information may include next-hop address, preferences and constraints for the call parameters.

5.2.3 CC-SC reference points

- **SC1:** Information flows at SC1 provide the capability to get a ticket on an existing registration session;
- **SC2:** Information flows at SC2 provide the capability to answer service related queries, e.g. to answer access and routing requests for calls in the context of network functional groups. Input information may include called address/name, caller, calling domain. Output information may include next-hop address, preferences and constraints for the call parameters.

5.2.4 CC/BC-CC/BC reference points

- **C1:** Information flows at C1 provide the capability to establish, modify and terminate both calls and bearers to and from the terminal to network functional groups;
- **C2:** Information flows at C2 provide the capability to establish, modify and terminate both calls and bearers between non-terminal functional groups;
- **C3:** Information flows at C3 provide the capability to establish, modify and terminate calls and connections between non-terminal functional groups using an SCN.

5.2.5 MC-BC reference points

- **N1:** Information flows at N1 provide the capability to request, modify and delete media paths for the creation of a bearer in the context of terminal functional group;
- **N2:** Information flows at N2 provide the capability to request, modify and delete media paths for the creation of a bearer and provide the capability to control an insertion of information (e.g. tones and announcements) into media flows in the context of network functional group. Information flows at the N2 provide aggregate bearer load admission control based on aggregate bandwidth usage measurements;
- **N3:** Information flows at N3 provide the capability to request, modify and delete media paths for the creation of a bearer in the context of gateway functional group. Information flows at the N3 provide aggregate bearer load admission control based on aggregate bandwidth usage measurements.

5.2.6 MC-MC reference points

- **M1:** Information flows at M1 provide the capability to carry media flows between the terminal and the IP networks;
- **M2:** Information flows at M2 provide the capability to carry media flows over the IP Networks;
- **M3:** Information flows at M3 provide the capability to carry media flows over the SCN.

5.2.7 TR-MC reference points

- **T1:** Information flows at T1 provide the capability to permit, modify and inhibit transport capabilities for the terminal, including Quality of Service, for the creation of a media flow;
- **T2:** Information flows at T2 provide the capability to permit, modify and inhibit transport capabilities for the IPTN, including Quality of Service, for the creation of a media flow;
- **T3:** Information flows at T3 provide the capability to permit, modify and inhibit transport capabilities for the SCN, including Quality of Service, for the creation of a media flow.

5.2.8 Call unrelated reference point configurations

5.2.8.1 Registration

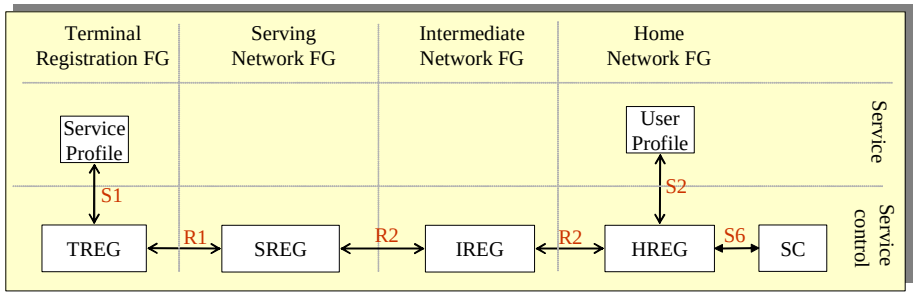


Figure 5: Functions involved during the registration of a user

5.2.9 Call-related reference point configurations

Call control functions shall be present in all networks involved in handling of a call. Instances of lower layer functions may be created or destroyed as needed for a particular call. bearer control functions shall not be created for networks that choose not to directly control functions in the IP transport plane. A bearer control function shall be created when bearer re-negotiation is required, however the media control function and IP transport plane functions may not be needed in all cases.

For the simplicity only one call control function is shown within each network. However, one network may include more than one function with a reference point similar to the inter-network reference point, e.g. C2.

See clause 6 for details about the functional decomposition of the IP transport plane and [5] for details about the management plane.

5.2.9.1 Scenario 0

Both users are using an IP terminal.

Two major traffic cases may be identified:

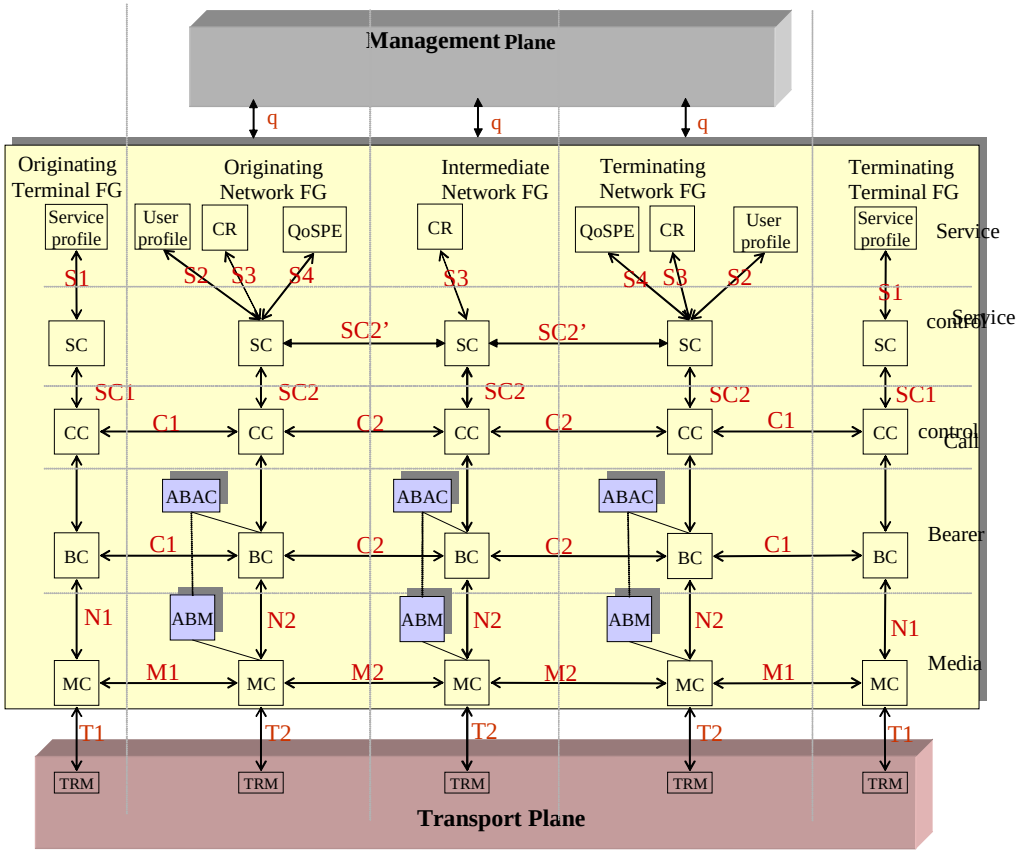
The first case: "Users at home" allows the calling user and the called user, registered directly with their home network, to obtain services from the originating network functional group.

The second case: "Roaming users", allows the calling user and called user, registered with their home network via serving network functional groups, to obtain services from their home network functional group. The serving network functional group shall in this scenario act as a proxy and forward messages from the user's terminal to the home network and vice versa. (they can be more than a proxy; modify info, etc.).

NOTE: Combinations of the above two cases can exist and may be visualized by combining one call half in figure 6 (e.g. originating terminal functional group + originating network functional group) with the other call half in figure 6 (e.g. terminating network functional group + terminating terminal functional group).

5.2.9.1.1 Users at home

The calling user is registered to the home network in the originating network functional group. The called user is registered to the home network in the terminating network functional group.



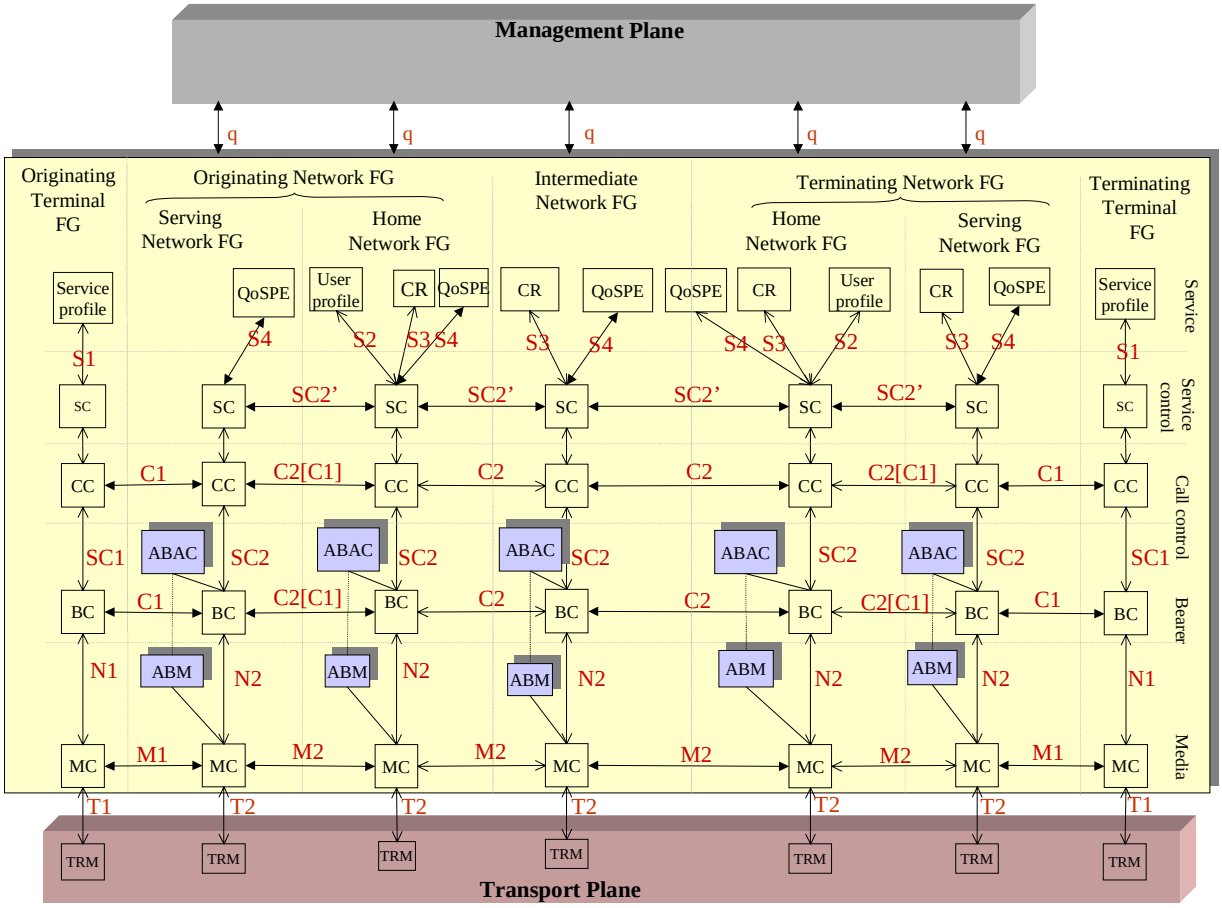
NOTE 1: The reference point q is the reference point A in [5] and includes reference point S5 in the present document.

NOTE 2: Parts of the ABAC and the ABM function belongs to the management plane. Aggregate bearer load control information flows between ABM and ABAC at N2 with the capability to provide admission control functionality based on aggregate bandwidth usage measurements and transport network QoS performance.

Figure 6: Reference points for the scenario 0 - user at home

5.2.9.1.2 Roaming users

Both the calling user and the called user are registered with their home network via a serving network.



NOTE 1: For simplicity only the serving network functional group and the home network functional group are included in the originating network functional group and the Terminating network functional group. Also an Intermediate network functional group may be present between them with reference points similar to the inter-network reference points e.g. C2.

NOTE 2: The reference point q is the reference point A in [5] and includes reference point S5 in the present document.

NOTE 3: Parts of the ABAC and the ABM function belongs to the management plane. Aggregate bearer load control information flows between ABM and ABAC at N2 with the capability to provide admission control functionality based on aggregate bandwidth usage measurements and transport network QoS performance.

NOTE 4: The C2[C1] reference point indicates that the reference point is the C2 reference point carrying transparent C1 information only understandable by the home network functional group.

Figure 7: Reference points for the scenario 0 - roaming user

5.2.9.2 Scenario 1

The calling user is using an IP terminal, the called user is connected to the SCN.

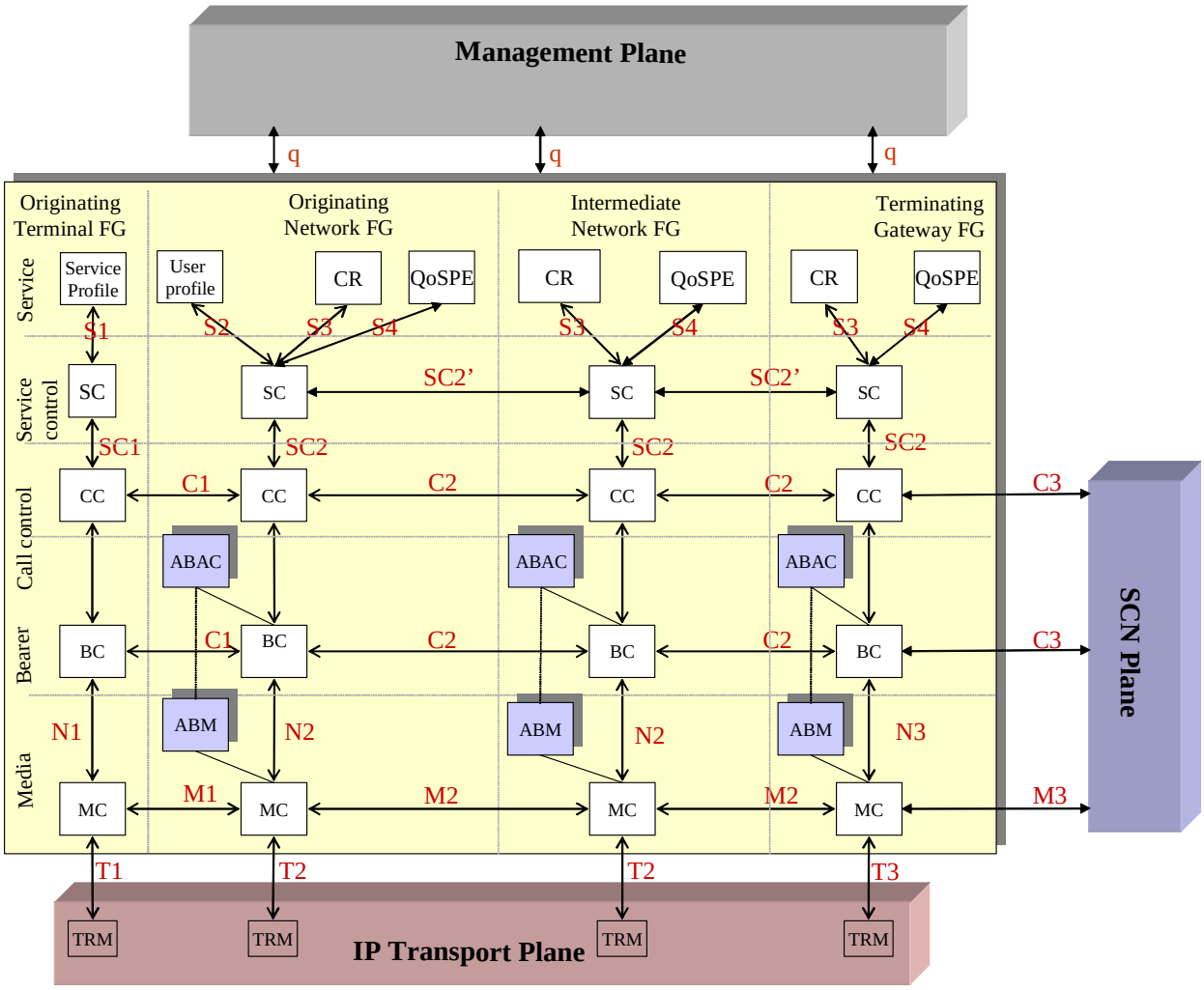
Two traffic cases may be identified:

The first case: "User at home", allows a user, registered directly to his home network, to obtain services from the Originating network functional group.

The second case: "Roaming user", allows a user, registered to his home network via a serving network functional group, to obtain services from his Home network functional group. The serving network functional group will act as a proxy, even though local services may be provided to the calling user.

5.2.9.2.1 User at home

The calling user is registered directly to his home network in the originating network functional group.



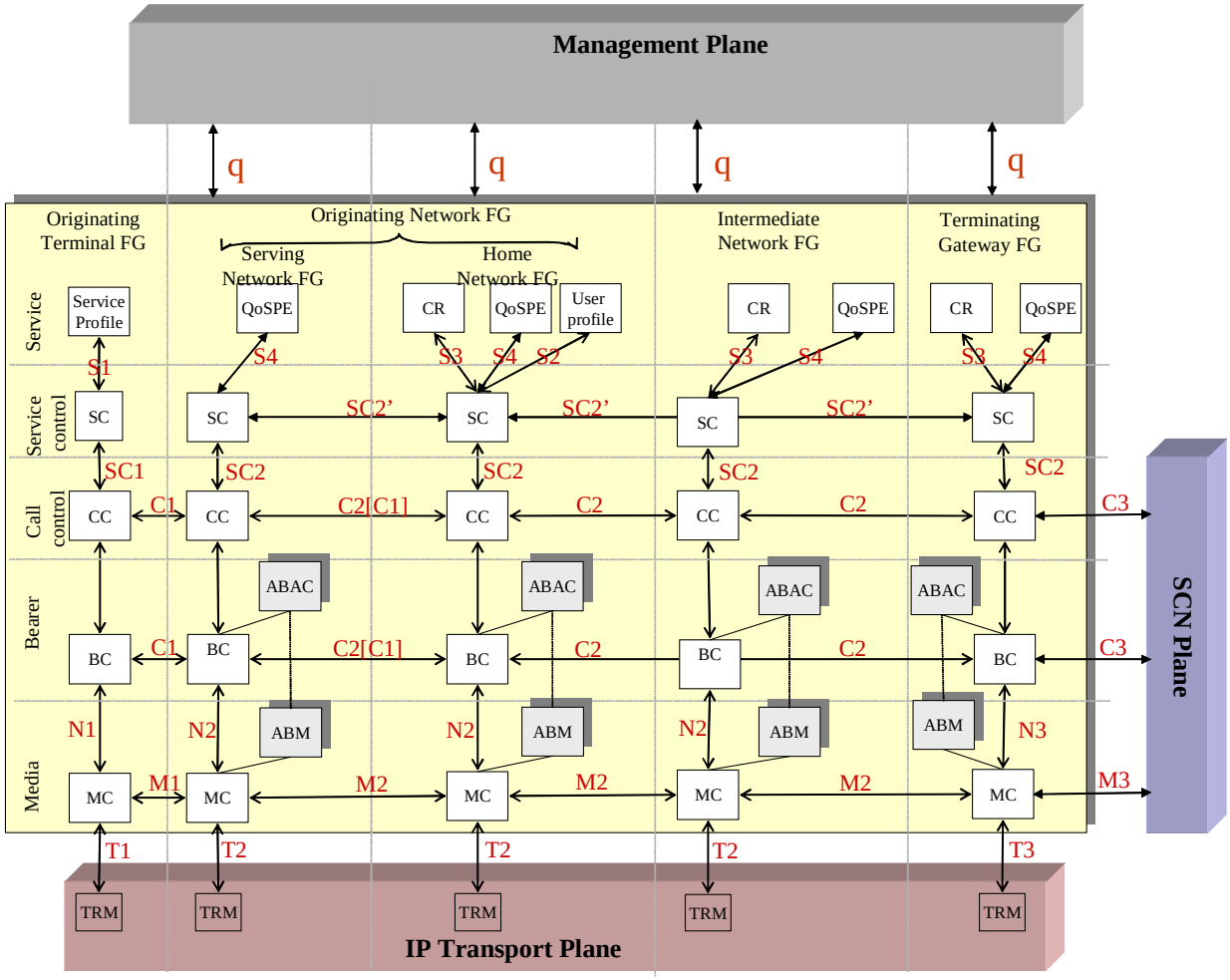
NOTE 1: The reference point q is the reference point A in [5] and includes reference point S5 in the present document.

NOTE 2: Parts of the ABAC and the ABM function belongs to the management plane. Aggregate bearer load control information flows between ABM and ABAC at N2 with the capability to provide admission control functionality based on aggregate bandwidth usage measurements and transport network QoS performance.

Figure 8: Reference points for the scenario 1 - user at home

5.2.9.2.2 Roaming user

The calling user is registered to his home network through a serving network.



NOTE 1: For simplicity only the serving network functional group and the home network functional group are included in the originating network. Also an Intermediate network functional group could be present between them with reference points similar to the inter-network reference points e.g. C2.

NOTE 2: The reference point q is the reference point A in [5] and includes reference point S5 in the present document.

NOTE 3: Parts of the ABAC and the ABM function belongs to the management plane. Aggregate bearer load control information flows between ABM and ABAC at N2 with the capability to provide admission control functionality based on aggregate bandwidth usage measurements and transport network QoS performance.

NOTE 4: The C2[C1] reference point indicates that the reference point is the C2 reference point carrying transparent C1 information only understandable by the home network functional group.

Figure 9: Reference points for the scenario 1 - (roaming user)

5.2.9.3 Scenario 2

The calling user is connected to the SCN, the called user is using an IP terminal.

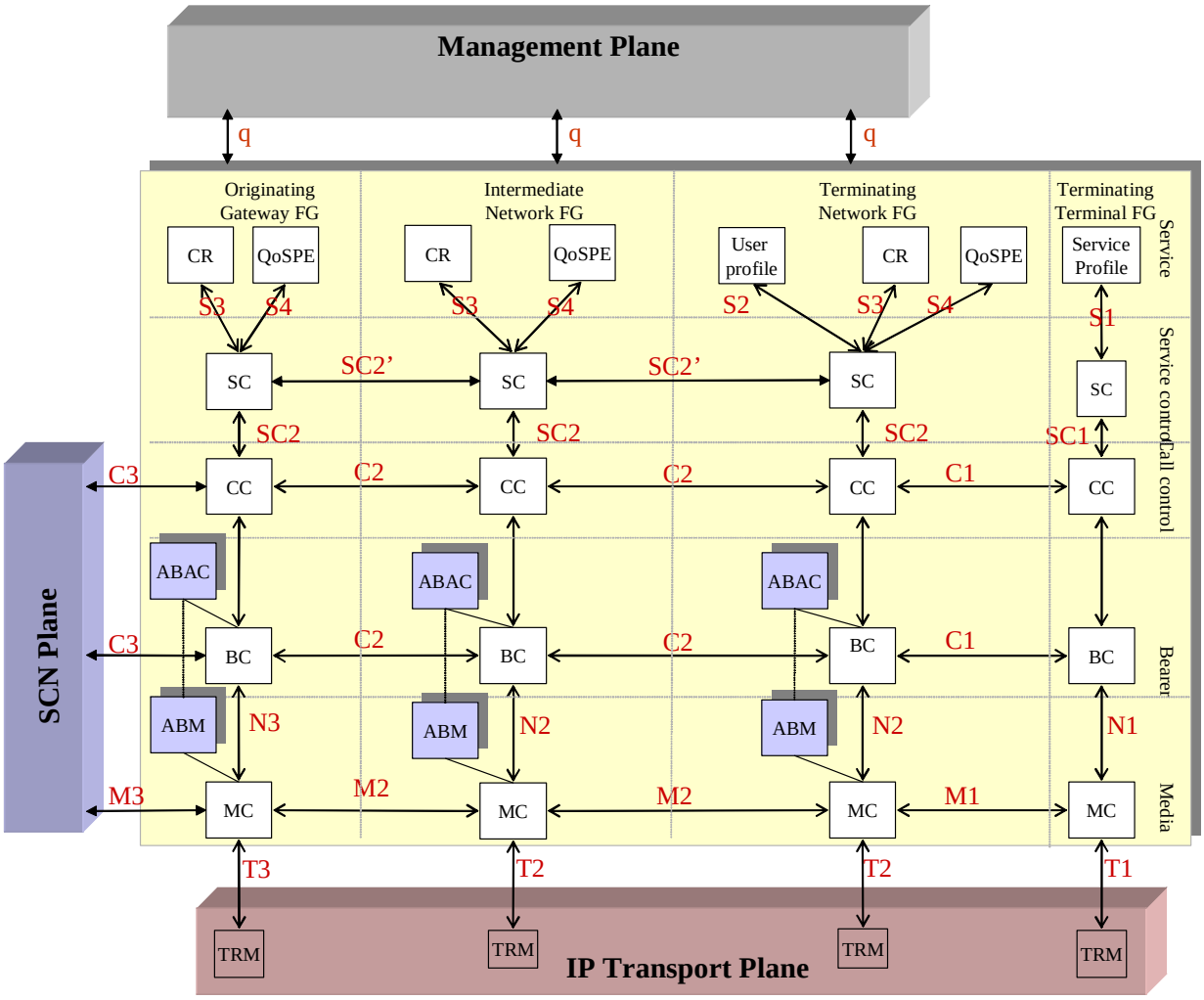
Two traffic cases may be identified:

The first case: "user at home", allows a user, registered directly to his home network, to obtain services from the terminating network functional group.

The second case: "roaming user", allows a user, registered to the home network via a serving network functional group, to obtain services from his home network functional group. The serving network functional group will in this case act as a proxy even though local services may be provided to the called user.

5.2.9.3.1 User at home

The called user is registered to his home network in the Terminating network functional group.



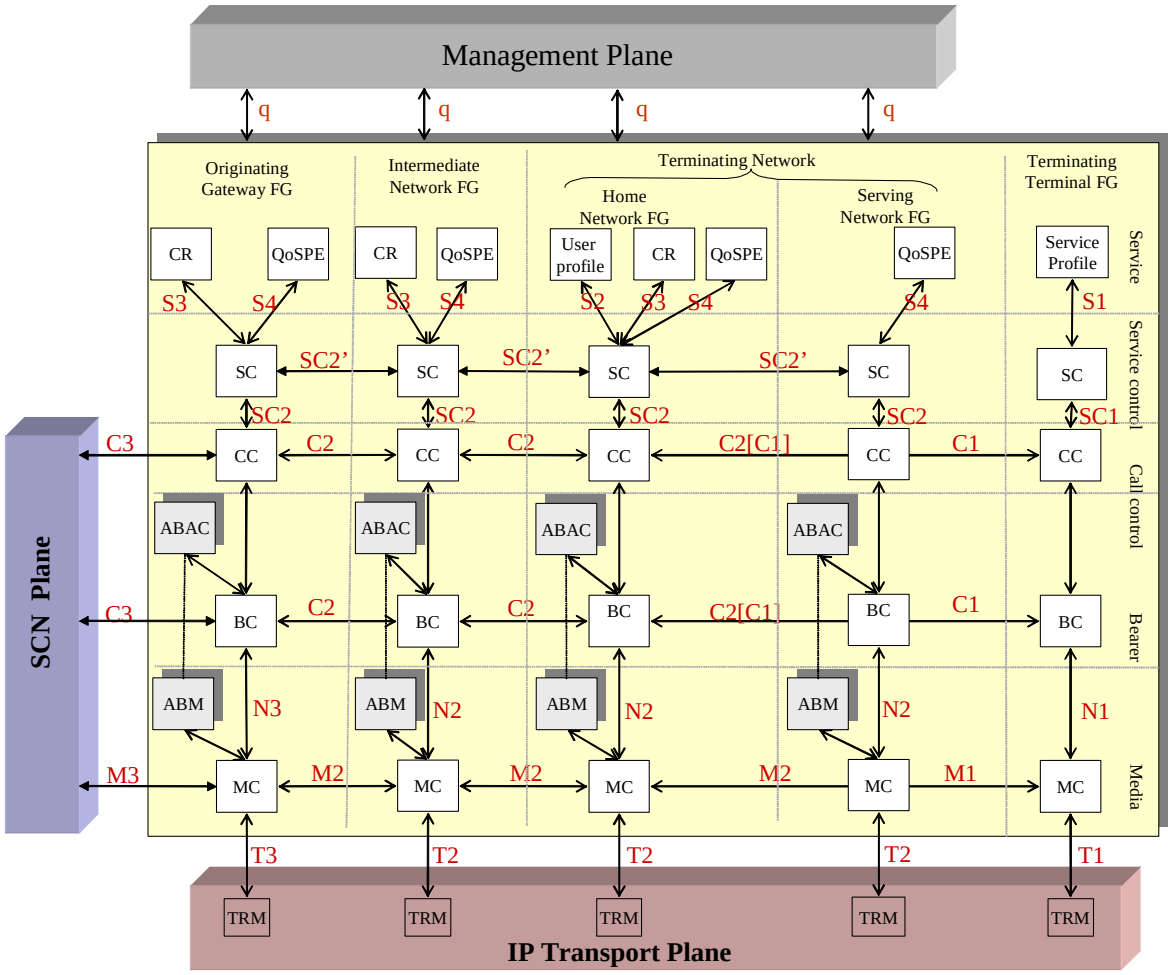
NOTE 1: The reference point q is the reference point A in [5] and includes reference point S5 in the present document.

NOTE 2: Parts of the ABAC and the ABM function belongs to the management plane. Aggregate bearer load control information flows between ABM and ABAC at N2 with the capability to provide admission control functionality based on aggregate bandwidth usage measurements and transport network QoS performance.

Figure 10: Reference points for the scenario 2 - user at home

5.2.9.3.2 Roaming user

The called user is registered to his home network via a serving network.



NOTE 1: The reference point q_5 is the reference point A in [5] and includes reference point S5 in the present document.

NOTE 2: For simplicity only the serving network functional group and the home network functional group are included in the terminating network. Also an Intermediate network functional group could be present between them with reference points similar to the inter-network reference points e.g. C2.

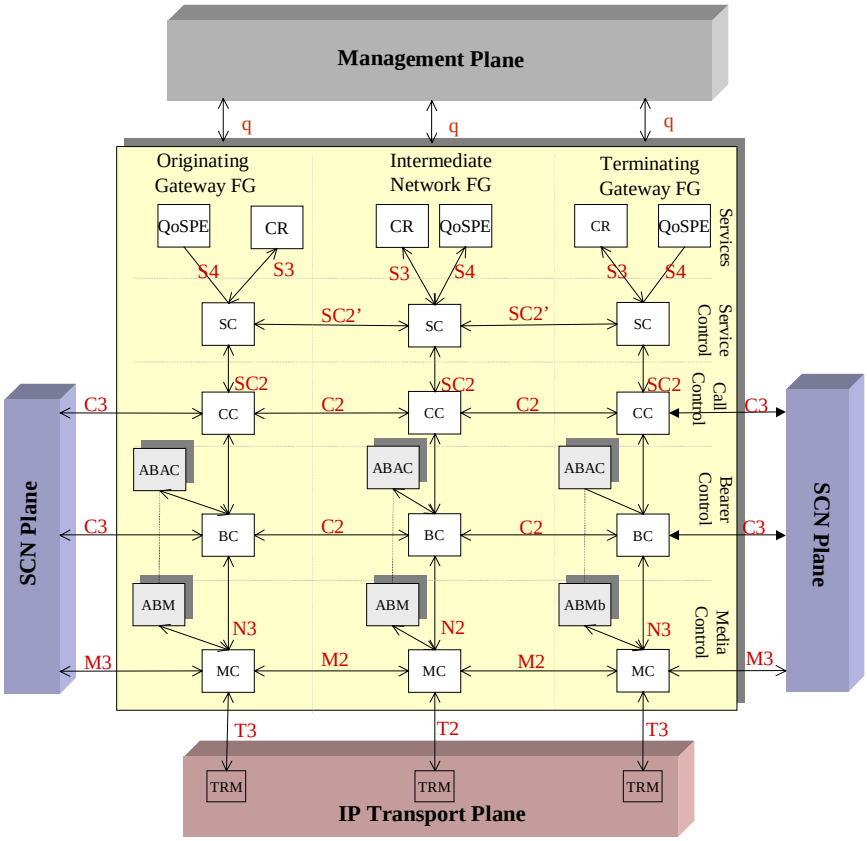
NOTE 3: Parts of the ABAC and the ABM function belongs to the management plane. Aggregate bearer load control information flows between ABM and ABAC at N2 with the capability to provide admission control functionality based on aggregate bandwidth usage measurements and transport network QoS performance.

NOTE 4: The C2[C1] reference point indicates that the reference point is the C2 reference point carrying transparent C1 information only understandable by the home network functional group.

Figure 11: Reference points for the scenario 2 - roaming user

5.2.9.4 Scenario 3

The calling user and the called user are connected to the SCN. Originating and terminating services are provided by the SCN even though local services may be provided by the IPTN.



NOTE 1: The reference point q is the reference point A in [5] and includes reference point S5 in the present document.

NOTE 2: Parts of the ABAC and the ABM function belongs to the management plane. Aggregate bearer load control information flows between ABM and ABAC at N2 with the capability to provide admission control functionality based on aggregate bandwidth usage measurements and transport network QoS performance.

Figure 12: Reference points for the scenario 3

6 Functional decomposition of the IP transport plane

Within the IP transport plane, general non-application specific parameters effecting transport and QoS must be controlled and accounted to achieve the transport requirements requested by the application.

The functionality in the IP transport plane is arranged through a number of functional entities grouped into layers. The following layers are identified within the IP transport plane:

- transport service;
- transport control;
- transport flow.

The following clauses introduce these layers and functions.

6.1 Introduction to the transport functional layers

The IP transport plane has 3 functional layers: the transport service functional layer, the transport control functional layer and the transport flow functional layer.

These functional layers are shown in figure 13. For simplicity only two functions are shown in each functional layer with all of the possible communication paths within the functional layer and to the adjacent functional layers.

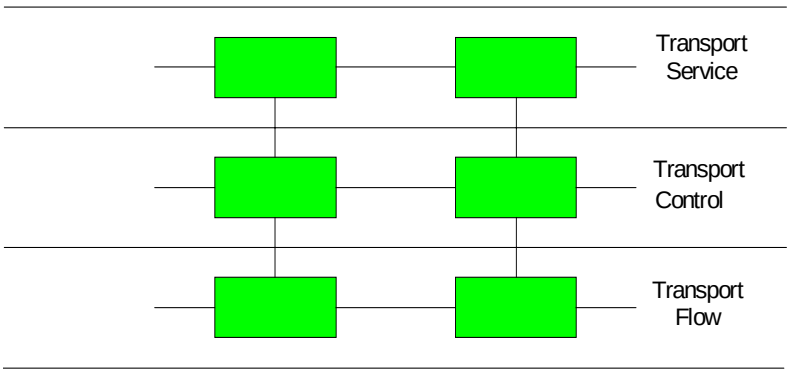


Figure 13: Functional layers in the IP transport plane

In the subsequent clauses each of the functional layers is introduced.

6.1.1 Transport service functional layer

The **transport service functional layer** shall contain functionality that is needed for the transport service as defined in TR 101 311 [6] and TR 101 877 [8], and has a life span longer or shorter than the duration of a transport session.

Transport Policy (TP) function	Maintains the policies of the transport domain in which it is situated. This function will exist as long as the service provider exists. The lifetime of information in this function is as long as the transport policies stay the same.

Transport Accounting (TA) function	Records transport usage information that may be used for accounting purposes, within the transport domain where it is situated. This function will exist as long as the service provider exists. The lifetime of information in this function is at least as long as the legal time to keep such information.

6.1.2 Transport control layer

The **transport control functional layer** shall contain functionality that is needed for the transport session.

It provides an interface to the IP telephony application plane and other transport domains.

Transport Resource Manager (TRM) function	Applies a set of policies and mechanisms to a set of transport resources to ensure that those resources are allocated such that they are sufficient to enable QoS guarantees across the domain of control of the TRM. This function has a lifetime as long as long as the transport flow communicates with ICF to enforce the policy. Communicates with other TRMs to establish the QoS profile on a stream (e.g. RSVP).

6.1.3 Transport flow layer

The **transport flow functional layer** provides the capability to transport and police (packet) flows.

Inter Connect Function (ICF)	Interconnects transport domains with entities outside of the transport domain. Enforces packet flow policy as specified by the TRM. Tags packet flows with QoS information (e.g. DiffServ/MPLS). Provides usage measurements for e.g. aggregate bearer load thresholds.

Transport Function (TF)	Transport resources within a Transport Domain capable of QoS control.

6.2 Definition of reference point

Reference points are identified for those (groups of) information flows that are subject to standardization. The rest of this clause describes the reference point, defined in the IP transport plane, and shows how they can be combined to support the IP telephony application plane with means of controlling media flows.

Figure 14 shows reference points within the IP transport plane and the relation to the IP telephony application plane.

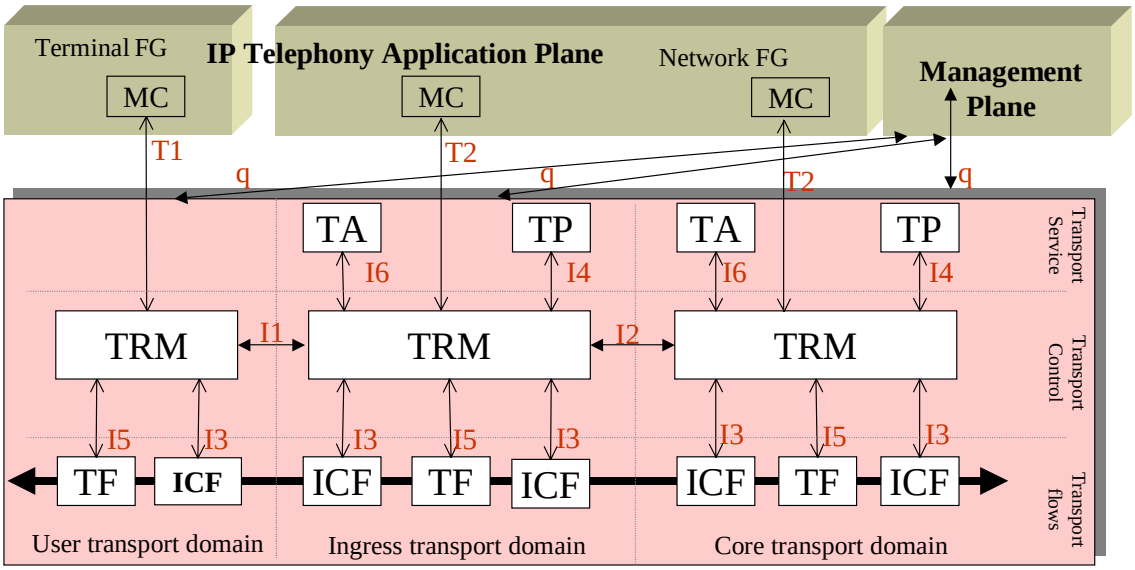


Figure 14: Reference points in the IP Transport plane

6.2.1 Transport control - transport service reference points

- **I4:** The reference point is between a TRM and its associated TP.
- **I6:** The reference point is between the TRM and the TA. The information flow across the reference point transports usage related information that enables accounting of used resources within the IP transport plane.

6.2.2 Transport control - transport control reference points

- **I1:** The reference point is between a TRM and a user equipment TRM. The QoS information flow across this reference point communicates the required QoS characteristics of the related local loop transport flows that will carry the media flow, the properties of the media flow, and possibly addressing information related to the transport flows.

- **I2:** The reference point is between two TRMs in different network transport domains. The information flow across this reference point communicates the required QoS characteristics of the related interconnect transport flows that will carry the media flow, the properties of the media flow, and possibly addressing information related to the transport flows.

6.2.3 Transport flow - transport control reference points

- **I3:** The reference point is between a TRM and an ICF. The information flow across this reference point controls the ICF and enables it to perform its interworking and policing functions.

- **I5:** This reference point is between TRM and TF. The information flow across this reference point ensures the creation and deletion of transport flows across the TF possibly with QoS.

7 Management plane

Within the management plane, activities such as the planning, installation, sales, provision, maintenance, charging/billing and customer query/control of telecommunication services and networks are performed. These are often encapsulated in the terms FCAPS (Fault, Configuration, Accounting, Performance and Security) or Operations Administration Maintenance and Provision (OAM&P).

An overview and introduction to service and network management is contained in TS 101 303 [10].

7.1 Functional decomposition of the management plane

Three basic aspects are included in the architecture of the management plane. These are:

- the management functional architecture;
- the management information architecture; and
- the physical architecture.

The functional architecture describes the appropriate distribution of functionality within the management plane, appropriate in the sense of allowing for the creation of function blocks from which a management plane of any complexity can be implemented.

The management information architecture is based on standardized open management paradigms that support the standardized modelling of the information to be communicated. TMN standardization activities will not develop a specific management paradigm but build upon industry recognized solutions, focusing primarily on object-oriented techniques.

The physical architecture describes interfaces that can actually be implemented and examples of physical components that make up the management plane.

7.1.1 Management functional architecture

Within the management plane the functional architecture, at its simplest, comprises functions connected by reference points. Functions include Network Element Function (NEF), Operations System Function (OSF) and Work Station Function (WSF). The management plane NEF can be viewed as the management aspects of the TIPHON functions. management reference points include the q reference point, between function blocks within an administrative domain, the x reference point, between function blocks in different administrative domains and an f reference point between OSFs and WSFs.

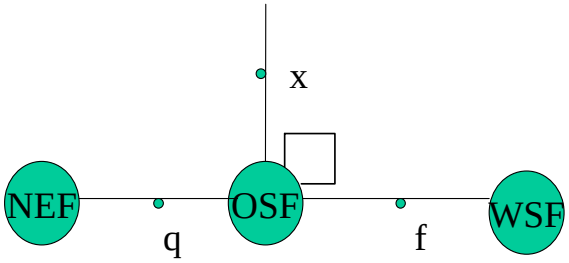


Figure 15: Management plane functional architecture

Within the functional architecture, management can be divided into a number of layers, these are element management, network management, service management and business management

The management layers are described in ITU-T Recommendation M.3010 [11].

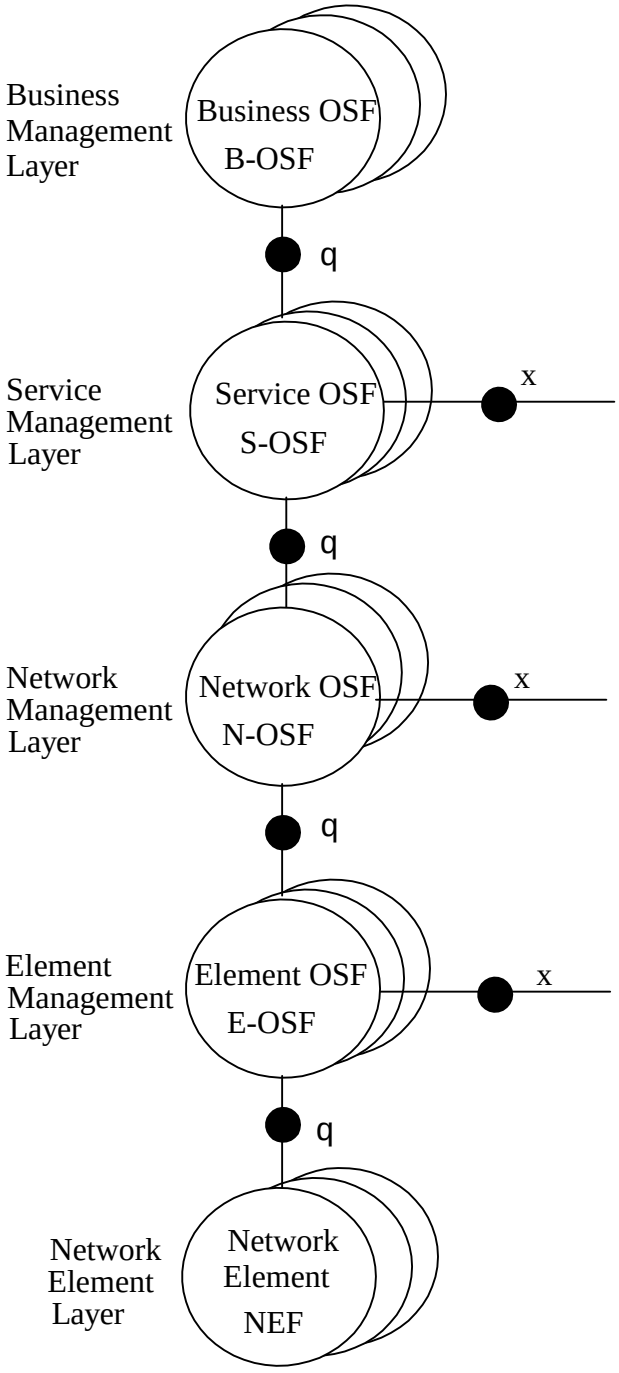


Figure 16: Management Layers

From the perspective of the TIPHON Architecture, the key management layers are the service management and the network management layers.

Service Management layer	The Service management layer is responsible for the contractual aspects of services that are being provided to customers or available to potential new customers. Some of the main functions of this layer are service order handling, complaint handling and invoicing.

Network Management layer	The network management layer provides the functionality to manage a network by co-ordinating activity across the network and supports the "network" demands made by the service management layer. It knows what resources are available in the network, how these are interrelated and geographically allocated and how the resources can be controlled. It has an overview of the network. Furthermore, this layer is responsible for the technical performance of the actual network and will control the available network capabilities and capacity to give the appropriate accessibility and quality of service.

7.1.2 Management information architecture

To effectively manage complex networks and support telecommunications business processes, it is necessary to exchange management information between management applications implemented in multiple managing and managed systems. Thus the telecommunication management environment is a distributed information processing application.

7.1.3 Management physical architecture

At its simplest, the physical architecture can be said to comprise "systems" interconnected by "interfaces". The key Telecommunications management systems are the Operations System (OS), the Network Element (NE), the Q Adaptor (QA), Mediation Device (MD) and the Work Station (WS). One or more reference points, from the functional architecture, map to an interface. Intra-domain interfaces (e.g. within a management domain) are Q interfaces (between OSs and NE and OS) and F interfaces between OSs and WSs. Inter domain interfaces (e.g. between management domains) are X interfaces. The physical architecture is not subject to standardization.

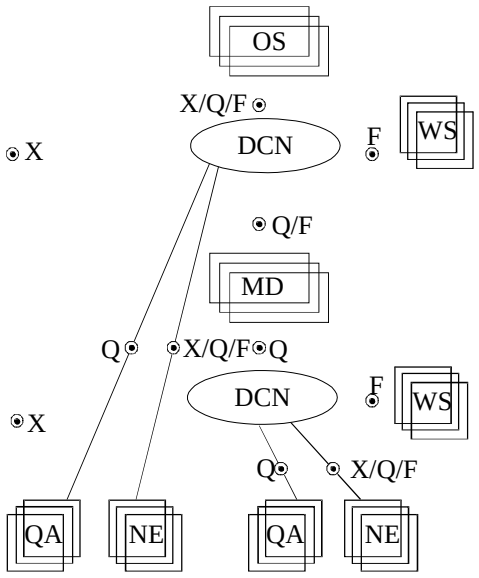


Figure 17: Example of a telecommunications management physical architecture

7.2 Management processes

Within the ITU-T Recommendations, management activities are grouped into management services. These Management Services are described from the user's viewpoint. Each management service addresses an area of management activity that provides for the support of an aspect of OAM&P of a telecommunication network.

The TeleManagement Forum built upon the work of the ITU Recommendations M.3200 [12] and M.3400 [13] and produced the Telecommunications Operations Map (TOM) [14]. This has now been extended to produce the eTOM, the enhanced TOM [15].

The Telecom Operations Map is the common framework for telecommunications operations processes and the guide for all other work within TM Forum. It builds upon the Management Services and Management Functions developed by the ITU and provides the common language and framework for supporting implementation of end-to-end telecommunications operations automation.

In defining management processes, TIPHON will exploit, whenever possible, the processes defined by the TeleManagement Forum in the TOM and eTOM.

7.2.1 Flow-though process model

In order to support this industry need, the business process model is refined the into three fundamental flow-through business processes. These support the telecom services of:

- service fulfilment;
- service assurance; and
- billing.

A representation of these flow-through business processes and the relationships to the processes in the TM Forum's BPM is shown in the figure below.

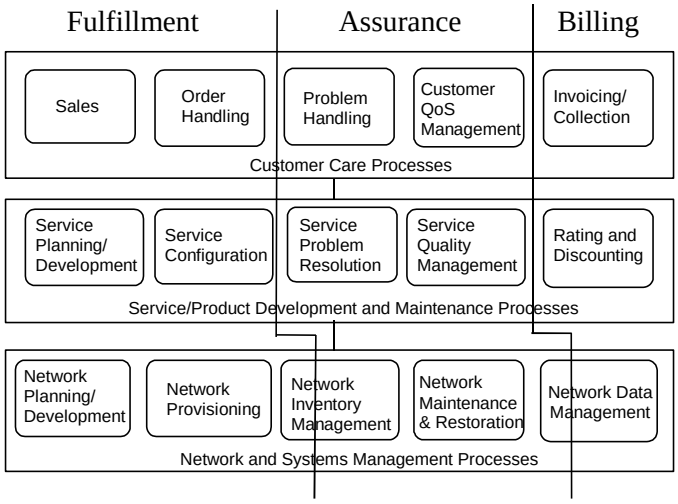


Figure 18: TOM flow-through business processes

7.3 Interconnection between management plane and TIPHON planes

The management plane functional architecture connects to the TIPHON IP telephony application plane and IP transport plane via management reference point q.

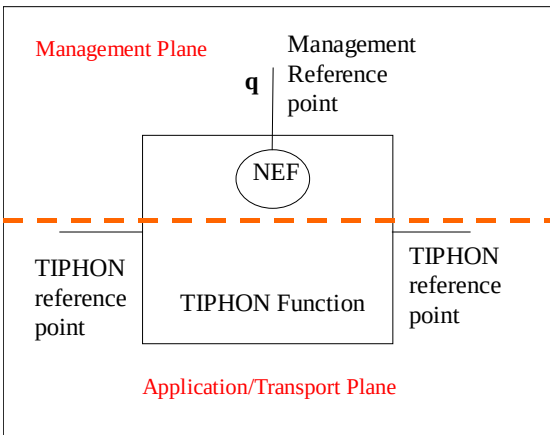


Figure 19: TIPHON Function - management reference point

Each TIPHON function will have an associated network element function which will interface with the management plane via a q reference point.

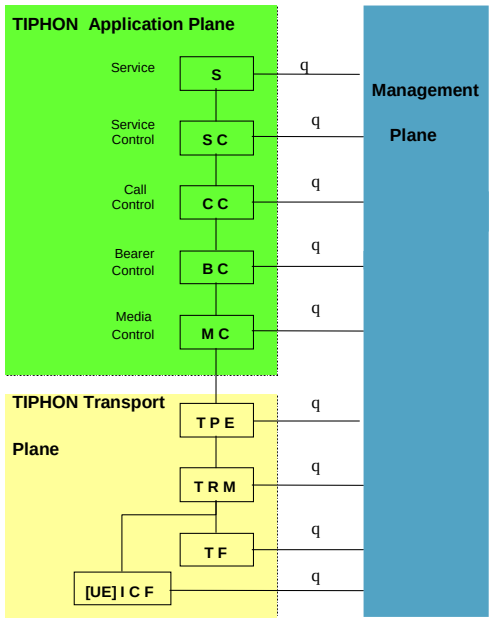


Figure 20: TIPHON planes - management plane, reference points

8 Architecture summary

Figure 21 is a combination of the functional entities in the IP Telephony application plane and the IP transport plane showing all reference points introduced in the present document.

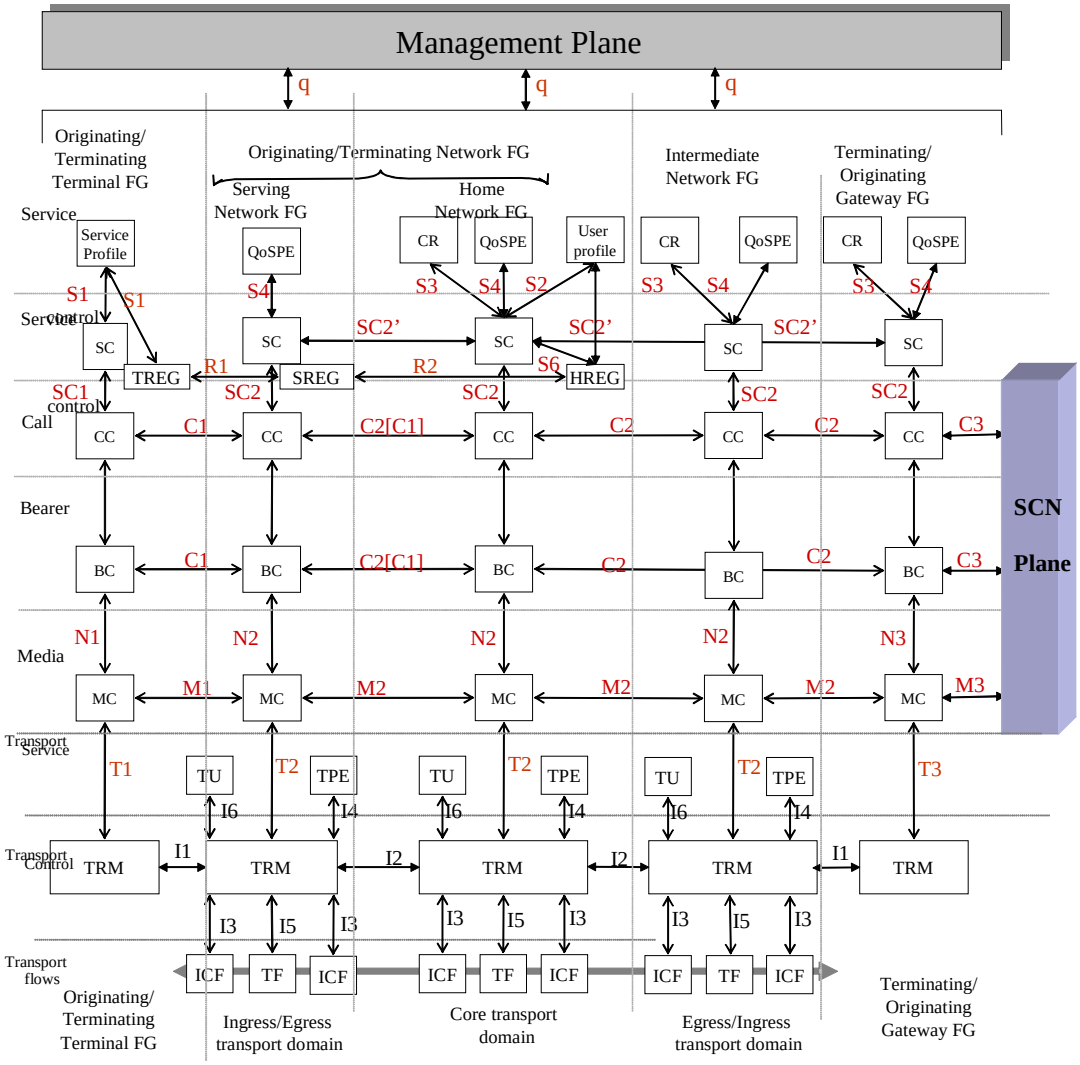
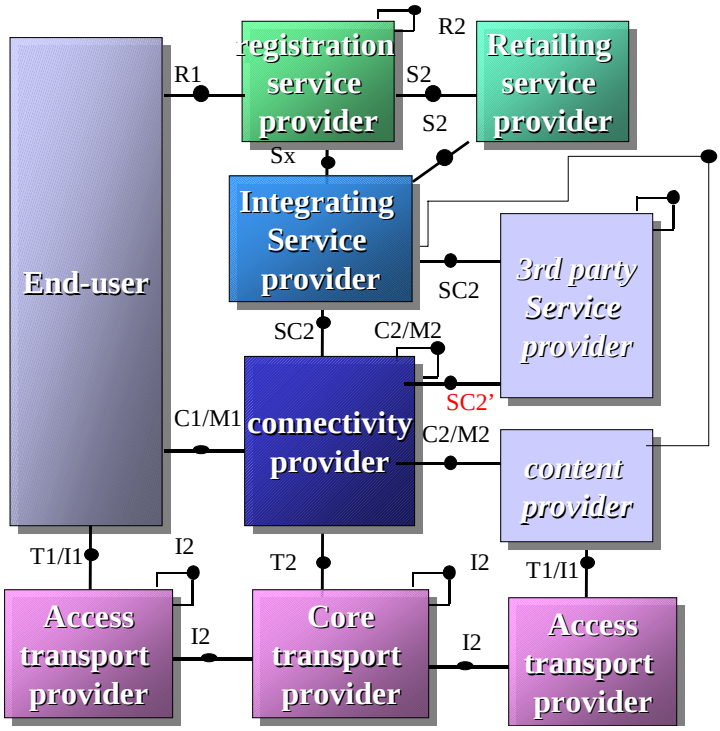


Figure 21: Architecture summary

Annex A (informative): Business roles reference configuration



NOTE: The 3rd party Service provider and the content provider are for further study.

Figure A.1: Reference points between business roles

Figure A.1. depicts the reference points between the business roles.

Interaction	Corresponding Reference point
End User-registration service provider: user registration	R1
Registration service provider – Retailing service provider: user profile access	S2
Retailing service provider – Integrating service provider: user profile access	S2
Registration service provider - Integrating service provider: SpoA allocation	S6
End User-connectivity provider: call-setup	C1 (M1)
End User-Transport Access Transport provider: transport usage accounting, first party transport flow establishment and first party transport flow reservation.	T1/I1
Access transport provider – Access/Core transport provider: transport usage accounting, first party transport flow establishment and first party transport flow reservation.	I2
registration service provider- registration service provider: user mobility (e.g. roaming)	R2
Retailing service provider- Integrating service provider: call authorization, user-specific call routing	S2
Integrating service provider – connectivity provider call authorization, user-specific call routing (and third party call setup…)	SC2
Integrating service provider – 3rd party service provider call authorization, user-specific call routing	SC2
Retailing service provider-Transport Provider: transport resource usage accounting.	I6
Connectivity provider- Connectivity provider: Inter domain call setup	C2/M2
Connectivity provider- 3rd party service providers: 3rd party call/session control	SC2"
Connectivity provider- (Core) Transport provider: transport resource usage, 3rd party transport flow establishment and 3rd part transport flow reservation	T2
Content provider- (Core) Transport provider: transport resource usage, 1st party transport flow establishment and 1st part transport flow reservation	T1
Network Provider- Transport Provider (peering and federation): transport usage accounting, and transport flow establishment	I2

History

Document history		
V1.1.1	September 2000	Publication
V2.1.1	February 2002	Publication
V4.1.1	September 2003	Publication