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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Network Aspects (NA).

1 Scope

The present document examines the relationship between the telecommunication services platform, the end user applications support platforms and the other platforms (as defined in the EII Enterprise Model [2]), and the GMM Architectural Framework [5]. The requirements of these are specified in architectural terms. The following aspects are included:

- relationship with GII as defined by ITU-T JRG GII and ISO/IEC JTC1 SWP GII;
- relationship with the EII as defined by EPIC;
- relationship with IP-based networks;
- relationship with UMTS and IMT-2000;
- support for Applications;
- service interworking;
- U and V reference points;
- information flows between platforms;
- evolution of DASH principles and extension to applications in the context of network interconnection.

This model should include current IN and TMN functions. The resulting architecture should be consistent with that proposed for the GII and should be within the context set up by regulators.

The present document represents the current state of the work. It provides a framework within which further work can be undertaken on specific aspects of the architecture. This will be covered in other documents.

1.1 Who will use the present document?

The present document will be useful for the following users:

- network operators to determine the interfaces required in future networks;
- regulators to determine the connection and interconnection points required in a future network;
- equipment manufacturers to determine the requirements of the interfaces between equipment in a future network.

1.2 Benefits of a Network Architecture

There are several benefits expected from having an agreed architecture:

- It reduces costs of development and implementation.
- It helps guarantee that new equipment can be introduced.
- It ensures that services can be evolved and added to the system.
- It gives customers confidence that smooth upgrades are possible.

In addition, a common reference configuration, containing also an inventory of referenced standards will:

- Serve as a basis for common understanding and consensus about what classes of actors that exist in the global telecommunications and information exchange market.
- Identify the possible legal and technical interfaces between these classes of actors.
- Where a legal interface is identified, point at the need for development of models for business relationships and agreements at that interface that may be needed to promote global regular business.

- Identify possible information flows between roles, in order to perform global regular business.
- Identify, where standards are linked to interfaces, which standards are available (or even mandated) as technical solutions to implement the information flows.
- Identify, where standards are not linked significant opportunities for new standards, that there are important applications that would need standards for their deployment on a global scale.

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, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] ETSI Strategic Review Committee on the European Information Infrastructure - Report to the Technical Assembly, May 1995.

[2] ETSI/EPIISG(96)4 rev 1, Final Report of the European Project on the Information Infrastructure Starter group (EPIISG), March 1996.

[3] TCR-TR 043: "Network Aspects: Recommendations towards the harmonization of architecture and service description methodologies".

[4] DAVIC Specification 1.2, available on CD-ROM from DAVIC Secretariat, c/o SIA Societa' Italiana Avionica, C.P. 3176 - Strada Antica di Collegno, 253, I-10146 Torino (Italy).

[5] ETSI/PAC16(96)16: "Global Multimedia Mobility (GMM) A Standardization Framework", June 1996.

[6] XIWT Architecture Working Team: "Service Profiles for the Current and Emerging National Information Infrastructure", Draft 1.0, July 1996.

[7] ITU-T COM 13-R 76-E, Report of the 4th meeting of the Joint Rapporteurs' Group on Global Information Infrastructure, October 1996.

[8] ETR 262: "Broadband Integrated Services Digital Network (B-ISDN); Asynchronous Transfer Mode (ATM); Video On Demand (VOD) network aspects".

[9] ITU-T Recommendation Y.110: "GII principles and framework".

[10] ITU-T Recommendation Y.120: "Global Information Infrastructure scenario methodology".

3 Definitions and abbreviations

This work starts from [9], extended by work on the EII Enterprise Model [2] and the GMM Architectural Framework [5].

3.1 Definitions

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

application: a collection of user tasks which require processing, storage and communications functions to carry them out.

service: something offered by a service provider to an end user (customer) or application.

platform: a set of capabilities that enable the provision of services to users.

function: a part of a platform providing one or more capabilities.

networking function: enables a platform to provide network capabilities for a service.

3.2 Abbreviations

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

API	Applications Programming Interface
ASP	Applications Support Platform
CNIS	Platforms supporting provision of Communication and Networking of Information Services
DASH	Description of Architecture and Services Harmonization
DAVIC	Digital Audiovisual Council
DIPSS	Platforms supporting provision of Distributed Information Processing & Storage Services
DSM-CC	Digital Storage Media - Command and Control
DSS1	Digital Signalling System No. 1
EII	European Information Infrastructure
ETSI	European Telecommunications Standards Institute
GCS	Platforms supporting provision of Generic Communications Services
GMM	Global Multimedia Mobility
HDTV	High Definition Television
HTML	HyperText Mark-up Language
HTTP	HyperText Transfer Protocol
IMT2000	International Mobile Telecommunications in the year 2000
IN	Intelligent Network
IP	Internet Protocol
ISDN	Integrated Services Digital Network
LTA	Long Term IN Architecture
MBS	Mobile Broadband System
MCU	Multipoint Control Unit
NNI	Network Node Interface
NOD	Network Operations Domain
PAC	ETSI Programme Advisory Committee
PSS1	Private Signalling System No. 1
QSIG	Unified International Corporate Network Signalling Standard (= PSS1)
SP	Service Provider
SS7	ITU-T Signalling System No 7
STB	Set-Top Box
TAPI	Telephony Applications Programming Interface
TCP-IP	Transmission Control Protocol - Internet Protocol
TETRA	Terrestrial Trunked Radio
TMN	Telecommunications Management Network
UMTS	Universal Mobile Telecommunications System

UNI	User-Network Interface
URAN	UMTS Radio Access Network
VPN	Virtual Private Network

4 Guiding Principles on Architecture

In a world of global service provisioning with multiple service and network providers working under multiple regulatory environments, it is not possible to guarantee the type of network infrastructure that will be available to provide GMM services to customers. The EII and GII are envisaged to be a seamless federation of existing and future networks. Therefore, it could be possible to provide seamless services to customers independent of the service provider, the technology used, and the type of platform available.

To do this it is necessary to describe all telecommunication services using a common description methodology independently of the network that may eventually be used to provide those services. It should be possible to offer similar telecommunication services in multiple environments (e.g. business/residential, GSM, IN, BISDN, satellite) and in multiple network operator and service provider domains.

The architecture used should not exclude the use of any specific network technology (e.g. mobile or satellite), although the ability to offer a service using any technology is obviously dependent on the technical capabilities of that technology (e.g. the bandwidth available) and the QoS requirements (e.g. delay and response time) of the required service.

These principles can be extended from services to applications. It should be possible to run an application independently of the platform providing the telecommunications functions for that application, provided that the network capabilities and QoS requirements of the application can be met.

A platform model is useful to separate technology specific issues from end-to-end service issues and standardize them independently. This requires:

- the definition of an end-to-end protocol that will run over all network technologies;
- a mapping between that protocol and the specific technology platform, including physical, link and network layer allocation and control of bandwidth for example.

Each technology platform then simply requires a single new interface (or API) to be defined to interface with the inter-networking protocol, rather than **n** gateways for interworking with **n** existing technologies.

The model in figure 1 shows a number of APIs at different layers which hide the technology specific details of the layer below.

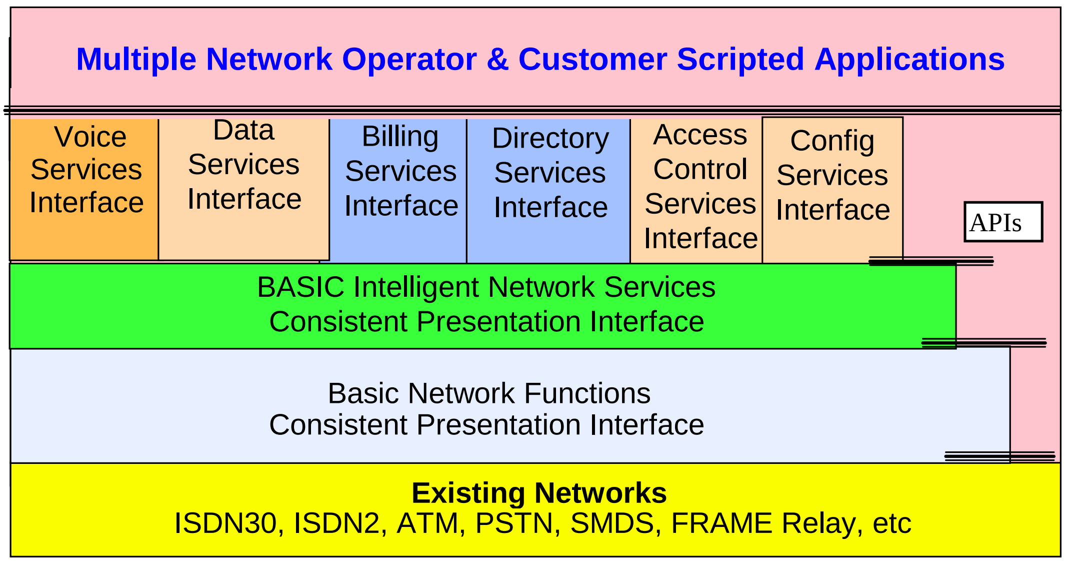

Figure 1: Example of a Platform Model

It can also be useful to distinguish between those activities within the platform that need to be subject to standardization, and those that are added value items (and open to differentiation). Clearly the most important interfaces are the APIs which need to be clearly defined to create a market.

5 Use of Enterprise Models

The definition of the GII architecture starts from the enterprise model. The primary purpose of an enterprise model is to identify interfaces which are likely to be of general commercial importance. In order to do this, a number of roles are identified which describe a reasonably well-defined business activity and which is unlikely to be subdivided between a number of players. In addition, it should be anticipated that the roles should have a reasonably long existence. The interfaces surrounding the role should persist for some time in order that customers and suppliers of the role can successfully interact with it. In addition, many players may choose to take on the same role in which case the role becomes a competitive activity, and the role needs to be reasonably stable for a successful competitive marketplace to emerge.

The GII enterprise model (derived from the EII) showing the structural roles only is shown in figure 2. A structural role is a role in the primary value chain of an industry. A structural role will therefore involve a business activity which is directed towards that industry and, in general, only towards that industry and the output goods/services of a structural role will be directed, in general, only to the next structural role in the primary value chain.

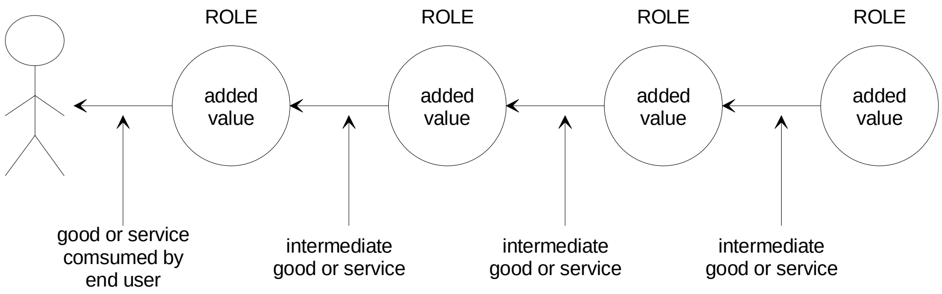

Figure 2: Generic GII Enterprise Model showing Structural Roles [9]

The GII structural roles are supported by infrastructural roles. An infrastructural role is not in the primary value chain of the industry under consideration, but supplies one or more structural roles. The output goods/services of an infrastructural role are likely to be based on reusable components in order to meet the requirements of its many customer roles. This relationship is shown generically in figure 3.

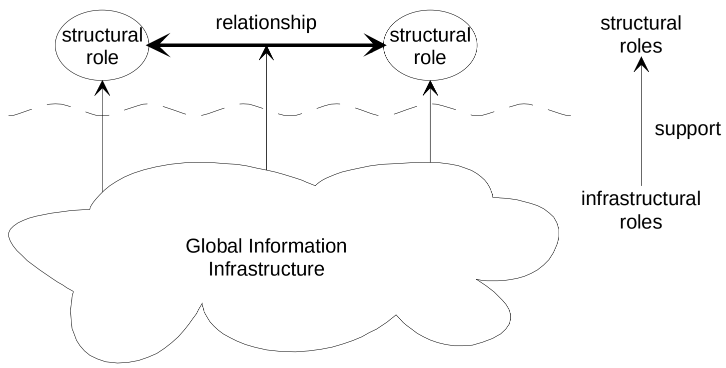

Figure 3: Infrastructure supporting the structural roles [9]

It is possible to identify a number of infrastructural roles within the GII as shown in figure 4.

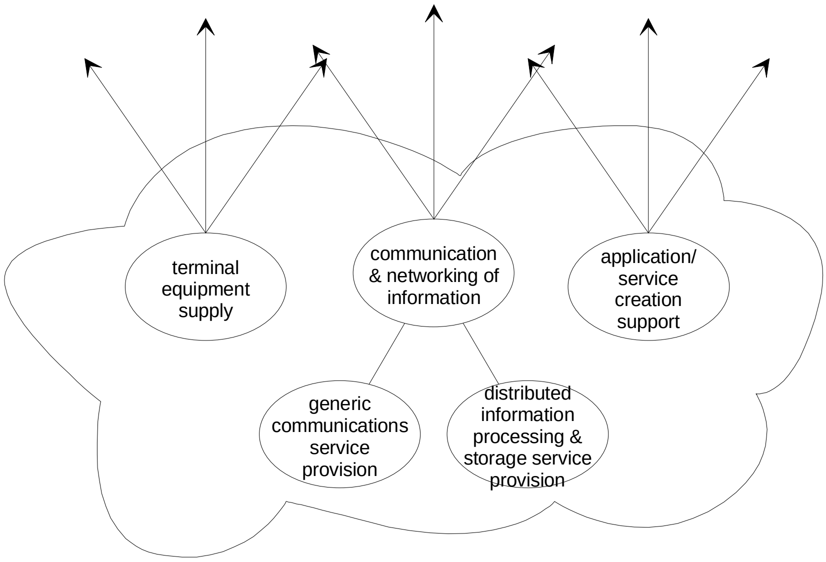

Figure 4: Infrastructural roles within the GII [9]

These roles are expanded and considered further in clause 6.

Figure 5 shows how these roles can be mapped on to a layered model relating to more familiar information and telecommunications systems.

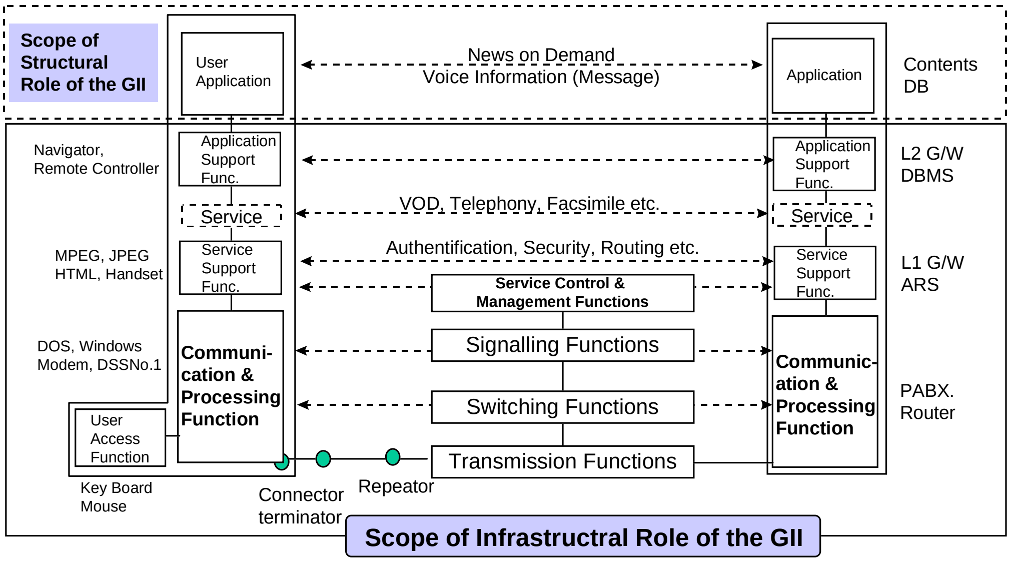

Figure 5: Example configuration of infrastructural roles in the GII [9]

6 Structural Model & Interfaces

The structural model shown in figure 6 was developed from figure 3 during work on the EII Enterprise Model [2]. This extends the concept of structural and infrastructural roles from the GII and identifies the interfaces between roles. In the present document the distinction between high priority and low priority interfaces (denoted by 'E' and 'e' in the EII model) is not used.

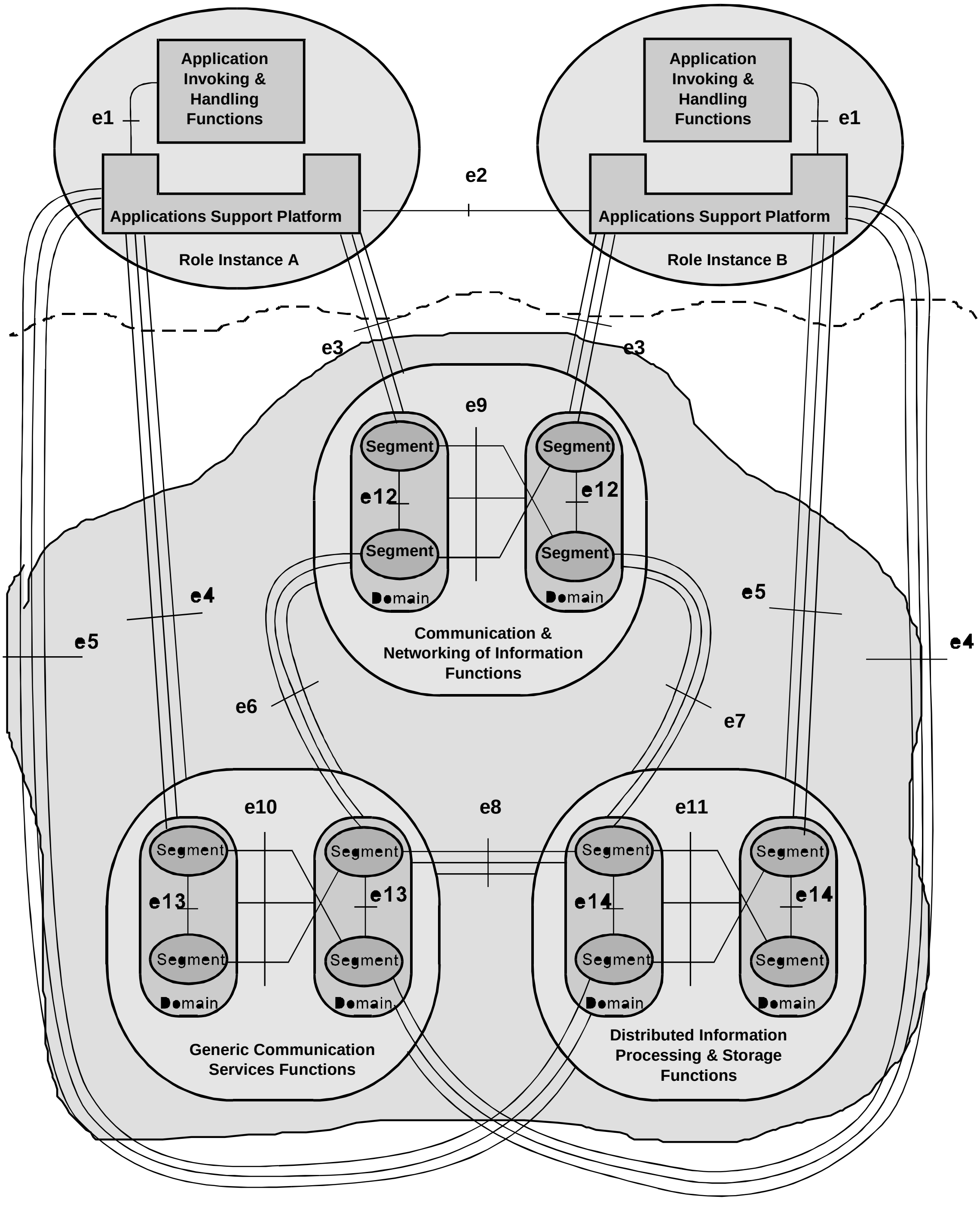

Figure 6: Structural Model Kernel and Associated Interfaces

In figure 6 the shaded area corresponds to the Infrastructural roles in figures 3 and 4. The functional areas shown in figure 6 are:

- **Application Invoking and Handling Functions** enable the invocation, use and control of applications (by human users or other means).
- **Applications Support Platforms** provide support for the above functions.

These in combination support the **Structural Roles** of the Enterprise Model (for example, a client or server in a particular usage of the Information Infrastructure). Figure 6 is generic, and so can encompass a number of instances or examples of combinations of structural roles from the enterprise model given in [1]. It is necessary to consider each combination of structural roles to derive a full set of requirements for interfaces. In particular, A & B can play different structural roles. If Role A is an end user (customer), Role B could be:

- another end-user (customer);
- a content provider;
- an information service broker.

If the user is accessing content which is located in the Content Provider database, then the role is structural and part of Role Instance B, which then corresponds to the Content Provider domain. This is analogous to the customer buying a film directly from a content provider. If the content is located in a video server which is part of the service or network infrastructure, then it is part of DIPSS (infrastructural). This is analogous to the user going to the video shop to rent a video.

The infrastructural roles provide:

- **Generic Communication Services Functions** provided by a range of (currently) separate communications platforms, e.g. public telecommunication network platforms (including IN and their Network Management capabilities), private network platforms, broadcast services platforms and/or LAN-based platforms using TCP-IP.

  The segments of a GCS platform include access and core networks, enhanced service functions and management functions (see clause 8).

- **Distributed Information Processing and Storage Functions** provided by distributed processing platforms, independently of the underlying data communication facilities.

  The segments of a DIPSS include applications, other software components and content items (which may be owned by different players).

- **Communications and Networking of Information Functions** combine the above two functions, providing a user perception of a single integrated function. The extent to which this function can be identified as a physical entity is technology dependent. In traditional information services (such as Télétel™ or CompuServe) this function often exists as a single physical system (or collection of systems). On the other hand, in the case of the Internet and the World Wide Web this function does not correspond to any physical entity and is in effect provided in a virtual manner.

  The segments of a CNIS are for further study.

6.1 Interfaces to the Telecommunications Platform

Centring on the telecommunications platform, figure 6 can be reduced to the interfaces shown in figure 7.

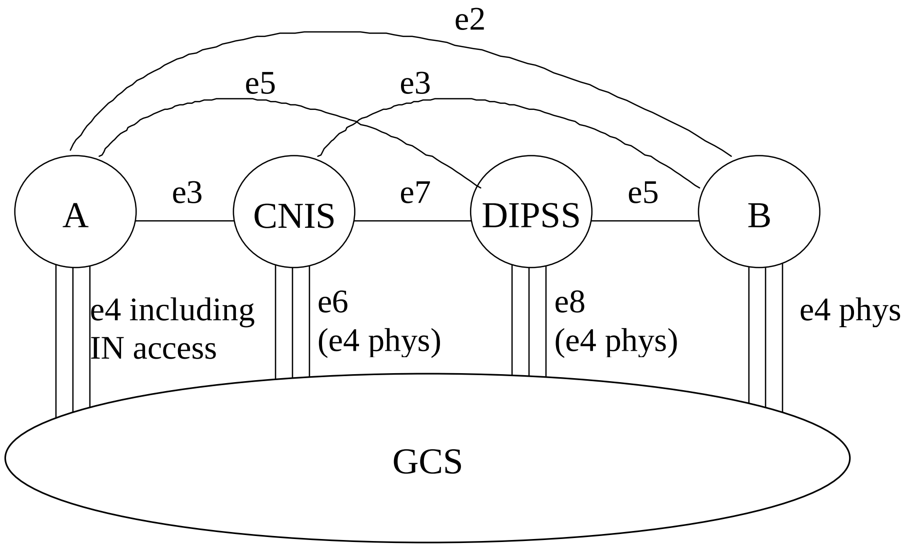

Figure 7: Essential interfaces for the telecommunications platform

All interfaces except those to GCS are logical, and rely on a physical connection provided by GCS. Therefore, e3, e5, e2 and E7 are logical interfaces only. They can be provided using IP and higher layer protocols (e.g. HTTP) but with different purposes. Logical interfaces are of two types:

- User-to-user interfaces, e.g. e2 and e5.
  These are used to complete a requested service, e.g. download of a movie.

- User-to-broker interfaces, e.g. e3 and E7.
  The are used to negotiate the requested and offered services, e.g. the DSM-CC User-Network interface.

Interfaces e4, e6 and e8 have both physical and logical parts as explained more fully in subclause 3.4. These provide the physical transport of information. Additionally, these interfaces represent the logical part of the interfaces to the telecommunications services that are part of the GCS, e.g. IN and TMN services.

6.2 Segment, Domain and Platform Interfaces

It can be seen from figure 6 that each interface, for example, e6, e4, e5, e8 can have up to 3 parts. The significance of these is described below:

- Segment - Segment
  This is the technical interface between different segments which may or may not cross domain boundaries. For example, e13 is the technical interface between the access and core network, which is specified independently of whether the access and core networks are in different domains.

  - DSS1-QSIG is an example of a segment-segment interface between different platforms. DSS1 is a protocol used for access to public network platforms. QSIG is an inter-switch protocol used for private network platforms. If private network services need to be carried over a public network then QSIG needs to be carried over DSS1. Standards are being developed for this.

  - SS7 is an example of a segment-segment (technical) interface that may or may not cross a domain boundary. However, the technical specification can contain additional information that may be required if a domain boundary is crossed.

- Domain - Domain
  Different domains are owned by different players and so contractual relationships, perhaps with regulatory implications, are involved. For example, e10 is a segment-segment interface between different domains which requires the use of international dialling codes in addition to national numbers. Single domains can span international borders (e.g. International VPN service).
  - e10 is an important domain-domain interface. This could be, for example, the N-ISDN interface between BT and Telecom Italia.
- Platform - Platform
  This can represent a service request type of interface - e.g. set up a call between two parties.
  - e6 is an important platform-platform interface. The nature of e6 is an open question. This could be a Winsock type interface which could also be applied to e4 and e8;
  - e3 is an HTML-like interface;
  - to understand e8 it is necessary to understand what is inside DIPSS.

Protocols and APIs need to be developed for each of these 3 levels. EPII Project 4.1 advises that only segment-segment interfaces are considered at this time until a comprehensive definition of the term domain is agreed.

7 Relationship to the GMM Framework Architecture

The GMM (Global Multimedia Mobility) framework architecture developed by ETSI PAC is shown in figure 8.

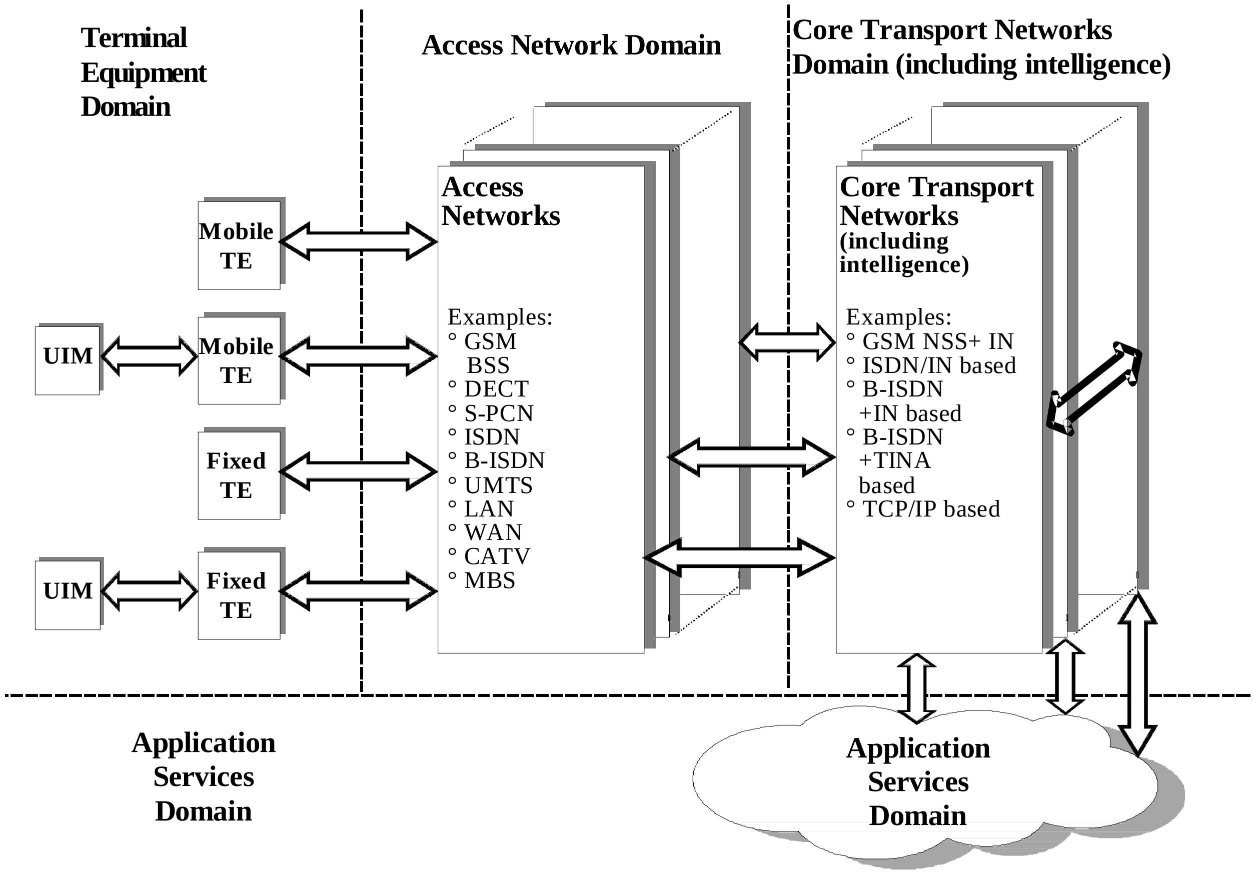

Figure 8: GMM conceptual model of network architectures

It allows services to be provided using existing, as well as new systems, including:

- PSTN, ISDN, B-ISDN;
- GSM, CTM, DECT, IN, ERMES, UMTS, Hiperlan, MBS, S-PCN;
- non-public domains including TETRA and corporate networks;
- platforms connected to the Internet (using IP);
- broadcasting and entertainment (e.g. DVB, DAB).

The model also:

- supports the provision of a wide range of services;
- enables service provision by a wide range of service providers and network operators;
- enables the same service to be accessed (provided) using different (types of) terminal(s).

It therefore meets the requirements of the guiding principles given in clause 4 as far as services are concerned. It follows that interworking should be provided between all core networks and between access networks and core networks in order to provide the maximum flexibility to provide services in multiple environments across multiple domains. However, it is recognized that there are some priority cases of interworking where standards effort can be more effectively applied.

The arrow spanning the core transport network segment in figure 8 indicates that these networks are and will continue to be interconnected to each other. Intelligence residing in one network can and will be accessible to the intelligence residing in other networks. This represents a "point of interconnection" between networks. It is implemented via a SS7 interface. The other interfaces can be "points of connection" only.

The relationship with the EII Structural Model (figure 6) is as follows:

- The Access Network and Core Transport Network shown in figure 8 correspond to two segments of the GCS in figure 6.
- The technical segment-segment part of interface e4 corresponds to the UNI between the Terminal Equipment and the Access Network.
- Interface e13 (A4 in DAVIC) corresponds to the interface between the Access Network and Core Transport Networks.

7.1 Open issues related to the GMM model

These include:

- Can switching be carried out in the Access Network?
  Where is the local exchange function in the GMM model?

  The GMM model is not regarded as satisfactory due to the presence of the V5 interface - this is the interface between a high speed access network and the core switching or leased line network. The access network can contain some switching in the case of option $Vb_{5.3}$. However, it could be realized that no call control functions will be available if switching is carried out totally within the access network. In particular, no billing or IN functions will be available.

  Reference to ITU-T COM 13-R 76-E shows that there are 3 options:

  1) Keep the GMM model as it is, with the V5 interface as the boundary between segments. The Local Exchange (LE) then straddles the two segments.
  2) Include a new "Local Network" segment containing the LE and some switching. This new segment then contains the Access Network segment.
  3) Include separate Access Network and Local Network segments in the GMM model.

- Can two terminals communicate directly other than through the Access Network or Core Transport Networks?

  Direct communication between two terminals is possible in "direct mode" TETRA. Is direct mode TETRA included in the GMM terms of reference or is this equivalent to a leased line between two users? We note that the position of TETRA is for further refinement as indicated in GMM Recommendation 1 ([5] page 93).

- Applications are accessed locally (e.g. on PCs) as well as through the Access Network. For example, a VoD server can be accessed via the access network.

  The Applications domain needs further study. [9] also makes the distinction between "locally bounded" and "distributed" applications. A key element of the GMM model is to allow (transparent) access to applications in mobile environments that are normally used in fixed environments and vice versa. The terminal segment interfaces should allow transparent access. An example is the WWW which uses the same interfaces but may have restricted bit rates when accessed from mobile locations.

- There is a difference in use of the word "domain" between the GMM model, DASH [2] and EPIC [3].

  The GMM model should use the term "domain" in the same sense as it is used in EPIC. EPIC uses the term "domain" in the sense that different domains are owned by different players and so contractual commercial relationships are involved, perhaps with regulatory implications. Therefore, domains have been replaced by segments in figure 8.

- Where is the Internet/Intranet on the GMM Conceptual Model?
  From which domain is Internet access made?

  The Internet is only accessed via the Terminal Equipment Domain in current network realizations of the GMM Conceptual Model. The EII Structural Model [2] makes this clear. Here the telecommunications platform is used to locate an Internet Access Provider (by a user dialling an E.164 number) who then provides Internet services via further use of a telecommunications platform.

- Where do functions such as a Multipoint Conference Unit (MCU) reside in the GMM Conceptual Model?

  An MCU can be either part of the Core Transport Network (as an embedded communications function) or as a service function accessed via the Terminal Equipment Domain (via an E.164 number). This is discussed further in clause 11.

- Is there a difference between UMTS and GMM?

  The relationship between the GII model and UMTS and IMT-2000 is discussed in clauses 8 and 9.

7.2 Evolution of GMM Model

Further domains are required to be added to the GMM Conceptual Model to answer some of the above questions. In particular, the question of the location of the Internet on the GMM Conceptual Model is best answered by showing a separate user domain and service provider domain. For these reasons it is clearer to re-draw the GMM Conceptual Model as shown in figure 9. Here the Access Network domain is also shown on the other side of the core network, which in turn provides access to a new "Service Provider domain".

All Service Providers (ISPs) are currently accessed via the Terminal Equipment Domain in the GMM Conceptual Model. However, for future networks there may be a direct link between the Internet and IN functions in the Core Transport Network.

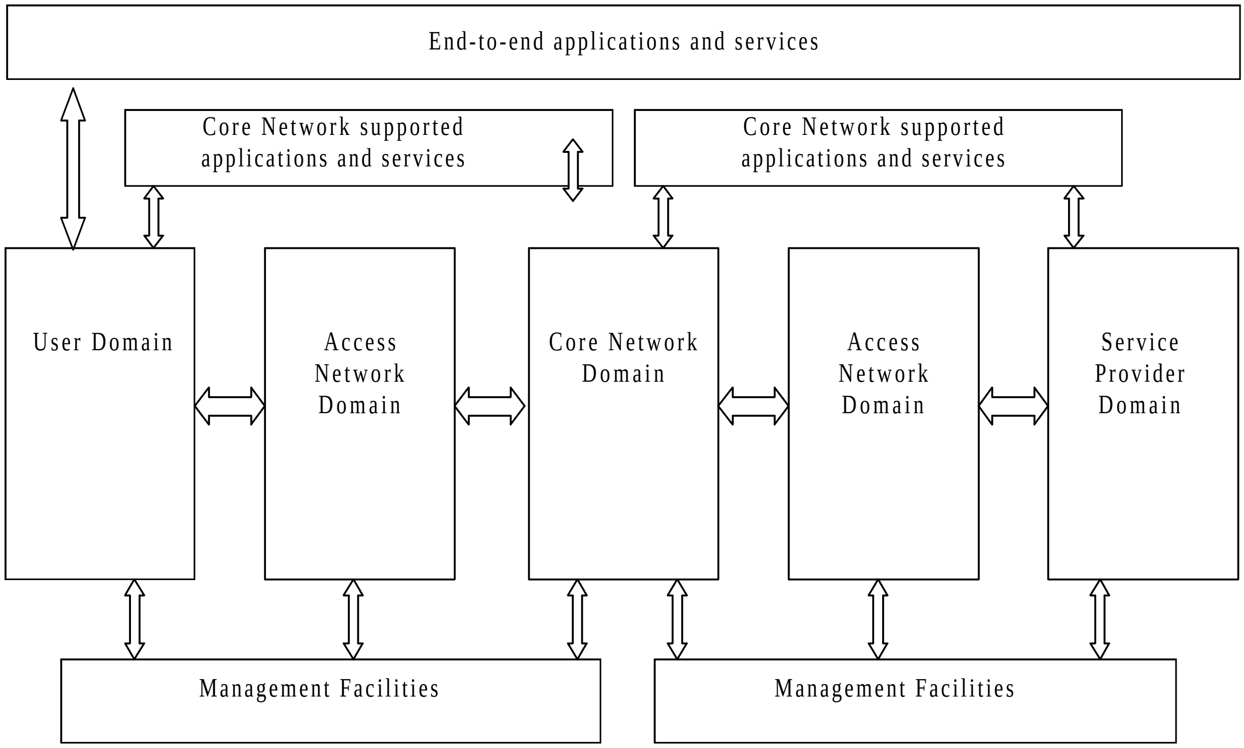

Figure 9: Extended GMM Model

Figure 9 also shows the distinction between core-network supported applications and end-to-end applications and services. The latter can be accessed via the user or service provider domains in the new model.

8 Relationship to UMTS

In figure 8, where "UMTS" is shown as an example of an Access Network segment, this should be replaced by "UMTS Radio Access Network (URAN)". Mobility management shall also be included in the core transport network functions. The URAN then allows access to core transport services to complete the UMTS functionality.

9 Relationship to IMT-2000

RAN (Radio Access Network) is the IMT-2000 radio access network component as shown in figure 10. This is the generic equivalent of the URAN as the radio access component of the GMM Model.

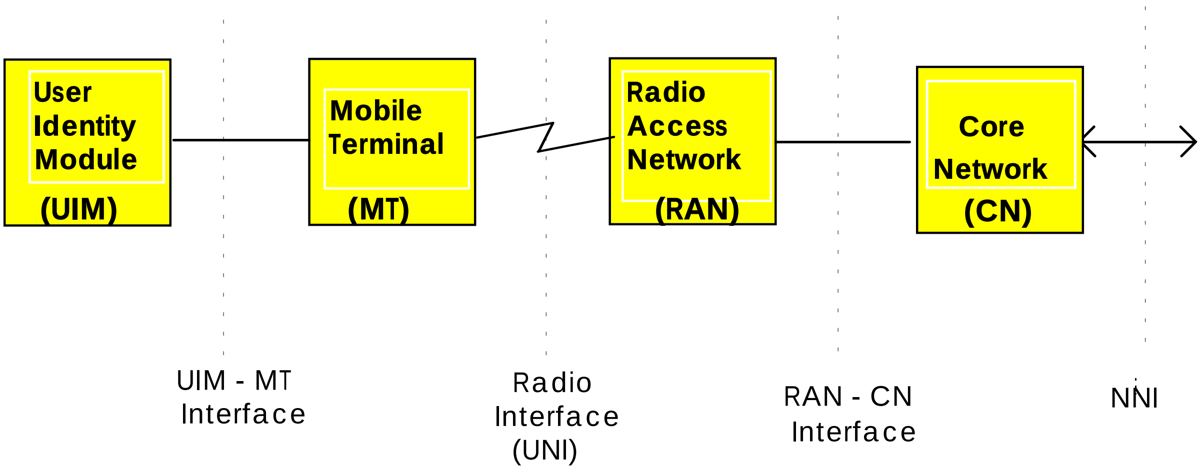

Figure 10: The IMT 2000 Family Concept architecture

10 Scenarios

The following scenarios show how GCS will be used by the other roles and platforms, and thus identify where standardization work is needed within ETSI. High value scenarios from the SRC6 report [1] include:

- Interactive Video Services including VoD;
- Distributed Processing;
- Radio Distribution;
- Computer Supported Co-operative Working including Multimedia Document retrieval;
- Electronic Commerce.

This list is not intended to be exhaustive but illustrative of the range of possible GII applications. The first three of these scenarios are elaborated in the present document. Elaboration of the Computer Supported Co-operative Working and Electronic Commerce scenarios is recommended for further study as this would provide additional useful information. It is also recognized that Web browsing and Voice over IP are worthy of further study.

NOTE: These scenarios are different in nature from the scenarios given in [7]. The ITU-T GII scenarios are essentially access scenarios used to identify different methods for the distribution of GII services to customers.

10.1 Video-on-Demand Scenario

With reference to figure 6, the following options are possible for Video-on-Demand:

1) Role Instance A is the end-user (customer). Role Instance B is the Content Provider.

2) The Content Provider creates, assembles and encodes the content (video films with soundtrack) wholly within Role Instance B.

3a) The Content Provider stores the items in a database in his own structural environment (role instance B).
The access of an end-user to a Content Provider database is made by using the physical interface e4 between role instance A and the GCS and the second e4 interface between GCS and the requested role instance B. By using the logical interface e2 negotiations take place between role instance A and role instance B regarding the service usage. After an agreement is reached the service execution starts.

3b) The Content Provider downloads the items to a Video-on-Demand server located in the Service Provider domain (infrastructural) under the control of the Service Provider. This server could be part of the DIPSS. The end-user accesses the VoD server via the GCS platform, via interfaces e4 and e8.

3c) It is also possible for an end-user to access the VoD server via the CNIS using interfaces e3 and E7.

4) The end-user interacts with the database via a set of commands which include the ability to pause, fast-forward and rewind the video. These commands are not interpreted by the network and are passed transparently to the content provider domain or video server by using the two physical interfaces e4 and the logical interface e2.

5) If a video item is not present on the local video server it should be possible to obtain the item via another video server. This may be a specialized item located on e.g. a video server in Japan or California. The interfaces should be the same for local video servers and for remote video servers in these domains.

10.2 Distributed Processing Scenario

Table 2.2 from the SRC6 report [1] provides the following examples of Distributed Processing:

- distributed manufacturing;
- real time inventory control;
- electronic funds transfer at point-of-sale (EFTPOS);
- network and service management.

For the first three items there is end-to-end user communication. Such services should be independent of the network apart from the need to set up communicating channels across the network so that the collaborating parts of the service can exchange information. This is shown by Applications communicating by Application Protocols, and this is independent of API and UNI requirements.

From an API and UNI point of view there is a generic requirement to specify bandwidth capabilities and basic signalling protocols in order for the network to react to connection requests [*SPS responsibility*]. However this should be minimal, with the proviso that certain basic capabilities may be required, such as checking of the rights of the user to use the network facilities. The communication between the users or between distributed user devices should then be transparent to the network.

Network Control is also an example of distributed processing. The network, in responding to requests via UNI etc. needs to communicate with other parts in order to respond fully to those requests, and use could typically be made of remote procedure calls. Here, there may be a need for a level of standardization which would be an ETSI responsibility; nevertheless there is probably only a requirement here for a partial definition covering basic requirements, thus allowing proprietary services to be handled competitively. The level of embedded control within communication nodes should be minimal, since the overall call control can be implemented as applications having their own API.

A similar approach may be taken with overall network and service management; these may operate as specific applications interacting with the elements which they control, but using an API to the network for intercommunication to provide an operator with the full overview and control required. Again, there may be requirements for basic levels of standardization, but there should also be room for proprietary features.

There is no major obstacle to the implementation of distributed processing to the newly evolving platforms. Clarification is required as to the level of standardization required at the application interfaces, and to what extent "external" applications should be the concern of ETSI.

10.3 Radio Distribution Scenario

Radio can be distributed to users in a number of ways:

a) Broadcasting via air waves as for traditional am and fm distribution.
Programmes to be broadcast are transmitted from a programme production platform to a broadcasting platform that is part of the GCS. The programs are directly broadcast without being stored in between. For the transmission between role instance B and GCS and the broadcasting from GCS to the role instances A the two physical interfaces e4 are used. The corresponding logical interface is e2.

b) Distribution via satellite to Set-Top Box (STB).
This scenario is similar to the broadcasting via air waves scenario. The programmes are transmitted from a program production platform to a satellite transmitter platform. The satellite transmitter platform may be part of a PTO domain or a content provider domain, but it has to be regarded as part of the GCS. The programmes are transmitted (without being stored) to a satellite and then broadcast to the STBs. For the transmission between role instance B and GCS, and between GCS and role instance A, the two physical e4 interfaces and the logical interface e2 are used.

c) Via fibre direct to the home on an individual (selected) basis.
The same physical (e4) and logical (e2) interface sets as in the previous scenarios are used. The main difference to be noticed is that there are point-to-point connections between GCS and role instance A.

d) Via the Internet.
Via the physical interfaces e4 and e6 a connection between role instance A and the CNIS is established. Internet Gateways are regarded to be part of the CNIS. The Gateway then establishes a connection to the requested radio station (role instance B) by using also the e6 and e4 interfaces. Via the two logical interfaces e3 a logical connection between the role instances A and B is established. The radio distribution occurs physically via the interfaces e4 (role instance B to GCS), e6 (GCS to CNIS), e6 (CNIS to GCS) and e4 (GCS to role instance A). The corresponding logical interface is e2.

11 Requirements on the Generic Communication Services Platform (GCS)

Requirements of other roles/platforms on GCS include (see also [6]):

a) The platform shall provide transparency of transmission to the information passing over it. Information shall not be modified due to the effect of transmission artefacts such as echo cancellation. This is OK in theory but in practise the bandwidth available to GII services will provide a limitation. Various compression methods will have to be used to overcome bandwidth limitations, and these will introduce artefacts and distortions.

b) The platform shall have global interconnectivity and interworking, so that users can access the same information at any time and from any location.

c) Very fast connection set-up and release. This is very important if communications paths are to be set up and cleared down to provide hyperlinks between information elements in, for example, WWW pages. It is necessary to set up and release paths very quickly to achieve hyperlinking. The GCS should provide hyperlinking functionality that enables additional service features to be offered prior to connection.

d) The platform shall provide a high degree of flexibility including:

- A wide range of bandwidths (bit rates) to meet the needs of a wide range of services, from broadband HDTV to telemetry. Information Networking applications require predominantly short bursts of data transmitted at high speed to provide a low end-to-end delay. It shall therefore be possible to provide increases in bandwidth "on demand" to an application after a connection has been set up.

- A wide range of QoS requirements to meet the needs of a wide range of applications used by a wide range of users in different market sectors. This includes the ability to provide both a "best-effort" service and a service "guaranteeing" delivery of information. This implies that the platform shall be inherently reliable, so that it can provide both the highest and lowest QoS required by the applications using it.

- A wide range of service configurations required by different applications including point-to-point, point-to-multipoint, multipoint-to-point, multipoint-to-multipoint, connection-oriented and connectionless services.

- A wide range of security requirements, ranging from financial transactions requiring high security, through to video distribution of publicly available material requiring little if any security. Some kind of strong encryption at the transport level is likely to be necessary to meet these requirements.

- A wide range of metering arrangements, so that service providers can put together flexible pricing packages to meet specific user needs. This implies that billing information shall be calculated off-line from the switching platforms and may also imply that it will be more difficult to provide on-line advice of charge during a service.

e) The platform shall allow for (but not necessarily provide the same bandwidth to) mobile users.

f) The platform shall integrate all its components seamlessly, allowing the integration of voice, video, data, time and geographically based services.

g) The platform should provide a simple interface to other roles/platforms (e.g. value-added service providers) in order to allow them to customize their services and "plug and play" with platform components at all levels.

h) The platform shall be able to manage the complexity arising from the above flexibility and the large number of interworking components.

12 Reference Models for GCS

Figure 11 is used in some form in both the EII and GII work. This shows the critical interfaces between the information processing and storage functions and a network operations domain as well as between two network operations domains. The transport, control, and management aspects of these interfaces are shown.

The complete telecommunications network for the GII is a federation of the different telecommunications networks run by different network operators. A telecommunications network run by an operator is a Network Operations Domain (NOD) and will form a separate administrative entity. A NOD can contain an access network only, a core network only, a core and access network of the same type, or indeed a general mixture of types of telecommunications networks.

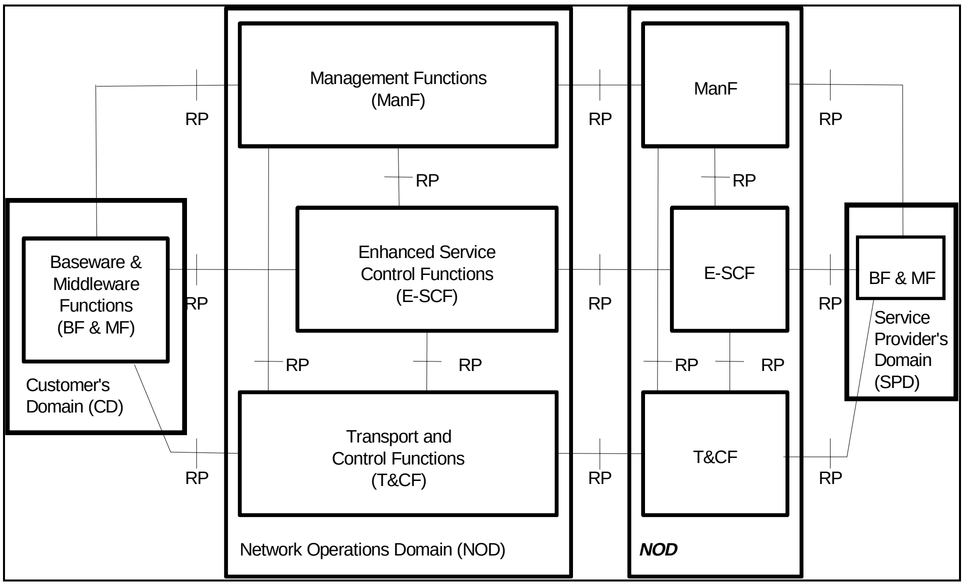

Figure 11: Example of GII network functions in two network operators' domains

A Network Operations Domain (NOD) is composed of three broad functional blocks:

- Transport and Control Functions
  These provide basic transport capabilities and the elementary connectivity control associated with bearer control and basic call control. These can be Access or Core Network functions or a combination of these.

- Enhanced Service Provisioning Functions
  These include functions for the creation and execution of enhanced services that provide enhanced control capabilities such as Personal Communications Service (PCS) and Virtual Private Networking (VPN). These sets of functions can contain, for example, IN call control, IN service creation, and IN service independent building blocks.

- Management Functions
  These provide management capabilities reflecting the service level, network level, and element level aspects of management.

12.1 Open architectural issues on the functional reference model

Open questions include:

a) The layering of functions in a future Information Network "stack".

b) The service functionality provided by IN for a future telecommunications service platform serving the Information Network. How much does IN need to do now - does it need to go beyond pure call control and handle mobility/portability issues, or are these best handled in an "intelligent server layer" outside the telecommunications platform? How should IN CS-3 be positioned to best meet the needs of the Information Infrastructure?

c) The relationship between a telecommunications service platform and the Internet. Will this involve a front end packaging or gateway to similar services with different QoS requirements or will the Internet eventually become able to provide all telecommunications services with real time guaranteed QoS requirements?

d) What are the important APIs and how do these need to be standardized?

13 Options for the Distribution of Functions

It can be seen from the above that IN functionality as currently implemented is included in the E-SCF box in figure 11. Certainly all connection-related IN functions could fit into this box. However, there are plans in ETSI and ITU to enhance IN to include a much wider range of functionality, which could either be provided in E-SCF as part if the GCS, or implemented on servers as part of DIPSS. Therefore, an open issue is what is an IN triggered service feature and what is to be a server function?

Currently, IN Service Features include number/address translation, access screening, reporting call conditions, etc. Server Functions include prompt announcement and collect digits (analogue IP), display and collect data (digital IP), database query (Internet or FTP server), access video clip (video server), etc. Servers may be within a network (i.e. connected on the NNI) or on the edge of the network (i.e. connected on the UNI). However, with enveloped protocols a server attached to the NNI of another network may be accessed using the UNI protocols of the first network. Within IN CS-2, the service to user interactions may be to a server, where the user is an application on the server. The UNI-intended message may be addressed to a virtual user embedded within another network. IN may now act as a negotiation function to third party servers and invite the user (A-Party) to interact with the intelligence outside the network that they subscribe to or have knowingly accessed.

These intelligent servers may add value to the service without the explicit knowledge of the user (A-Party did not request the server) or the network - the network SCP addresses a connect request to the server containing a script address to run and optionally may provide extra information via the service to user (server application) interaction. The server may then forward the user to another address, i.e. perform number translation.

13.1 Interoperability

There is fairly strong agreement that one of the useful call terminating functions which IN can perform within the EII is to detect incompatibilities and invoke interworking functions to provide interoperability. This requires enhancements to the basic call models planned for IN CS-3. It will include the ability to recognize different forms of access such as connecting a multimedia connection from the A-party to different connections at a B-Party (e.g. data to a computer / voice to a telephone).

The EII requires IN triggering for connection control and interoperability with existing call control systems, but requires middleware and APIs to provide access to higher level server functions and to perform negotiation (brokerage). This is not traditionally within the competence of ETSI since it falls into the domain of software and computer architectures rather than telecommunications architectures.

13.2 Mobility

There is fairly common agreement that Mobility Management will include the option to use IN operations in future, especially if the roaming is greater than the local exchange area, i.e. Location Updating, Location Registration and User Registration. Otherwise, if the mobility is "localized" Mobility Management could be solved by multiplexing at the access network.

Handover, is performance limited and so cannot be controlled by a server as this is too slow. IN may also be too slow except for inter-switch handover. 90 % of handovers will be carried out in the access network, using access network intelligence like a Base Station Controller.

Number Portability may be required in the IN, but as a "low mobility" service it could be handled by a server, depending on the cost efficiency. It is noted that the IN Number Portability service is being mandated in some parts of the world, e.g. Hong Kong and USA; thus making every call IN triggered. In this case consideration should be given to implementing IN from every local exchange. This approach would be cost effective in any case once the penetration of ported numbers exceeds 40 %.

13.3 UPT server-based implementation.

UPT provides mobility functionality in fixed networks. A user can register a unique number (UPT number) on any fixed network number and is reachable via this UPT number at the registered fixed network number.

In a server-based UPT-implementation for the data administration (follow me destination, short dial number etc.) the owner of a UPT number has to establish a connection to a server. The negotiation is carried out via this end to end connection by using an application protocol.

The calling party of a UPT number also has to call the server that maps the UPT number with the actual registered fixed network number and establishes the required connection.

13.4 IN and B-ISDN CS-3

Multi-connection and Multi-Party services are being implemented in the ITU using distributed IN (in every local switch), but is this market lead or technology lead? It is not really clear what the high penetration services are.

This is also being standardized in Servers by IETF and under consideration for future Network Intelligence by the ATM Forum and in Set Top Boxes by DAVIC [4].

It is likely that the method of provision of multiparty services will evolve through the following stages in line with economic and technology changes:

a) Using a bridge connected to a UNI and needing an E.164 address (the current situation).

b) Using bridges or Multipoint Control Units (MCUs) embedded in the network platform.

c) Using an embedded ATM function as an inherent part of the switching and transmission fabric.

14 Interfaces

The interfaces between GCS and other roles are listed in table 1 [2].

Table 1: Interfaces between GCS and other roles

Interface	Connected Functions		Explanation
e6	CNIS	GCS	Corresponds to the communications protocols used to access and control telecommunications services. This could be considered to be the e4 interface without the IN and TMN functions.
e10	GCS	GCS	Interface between domains within the telecommunications function. Corresponds to the communications and signalling protocols between, for example, public network operators.
e4	ASP	GCS	Corresponds to the communications and signalling protocols between an application platform and the telecommunications facilities. This corresponds to the UNI or DAVIC A1 interface.
e8	GCS	DIPSS	Corresponds to the communications and signalling protocols between the telecommunications and distributed processing facilities. This could be considered to be the e4 interface without the IN and TMN functions.
e13	GCS	GCS	Interface between segments within the telecommunications function. Corresponds to communications and signalling protocols within, for example, a telecommunications operator. An example could be the interface between the access and core segments of a telecommunications network at the NNI. Relevant standards are Vb_5 and G.803.

Interfaces e4, e6 and e8 connect Roles A/B, CNIS and DIPSS respectively to the GCS. The same physical connection capability (perhaps with different bandwidths for specific instances) is required for each of these and so it can be assumed that at the physical level e6 = e8 = e4, with the addition of IN capability at the Structural Role A interface.

The logical interfaces can also be shown to have a commonality of function. Therefore, it can be assumed that e5 = e2 and E7 = e3 (it may also be possible to show that e2 = e3).

Figure 7 can therefore be simplified to the interfaces shown in figure 12.

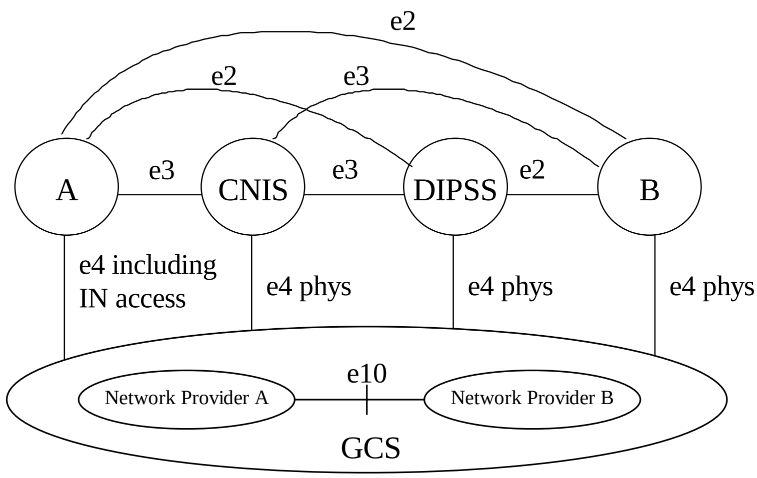

Figure 12: Simplified model of interfaces to the GCS

This means that the specification of e2, e3 and e4 is the most important. To ensure platform independence, the higher layers e2 and e3 should be fully independent of the basic communications interface e4. This means that suitable APIs need to be specified in order to achieve the different logical interfaces. An example is the use of TAPI in Microsoft Windows 95 in conjunction with IN functions in the telecommunications network.

An interface e10 is also shown between two network provider domains as part of the GCS. e10 represents a (physical) point of interconnection between networks. Implementations of interfaces e2 and e3 could also represent logical points of interconnection.

15 Functions/Protocols/APIs to be developed

The scenarios provided in clause 6 can be used to identify the characteristics of the required interfaces and the ETSI work areas should be tasked with standardization activities. It is necessary to identify which new standards (if any) are required. In addition it could be recognized that future services will be developed which have requirements over and above any "standard" interface which may be defined at present, i.e. it is actually not possible to make firm standards because of the evolutionary nature of the sorts of services which need to be supported. However there may be a justification for a minimal set of standardized items which can be added to as new variants are developed and which could themselves become *de facto* standards:

a) An API is needed between the signalling and e3/E7 to establish a connection between Structural Role A and CNIS. As an example, this could be provided using TAPI in conjunction with IN functions.

b) An API is needed for interface e2/e5 which should be independent of underlying protocols. This will allow connections to be set up between SRA and B or SRA and DIPSS. This API is well understood (for example, TAPI could be used) but it needs standardizing.

Further work is required to define these interfaces.

History

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