

**Telecommunications and Internet converged Services and
Protocols for Advanced Networking (TISPAN);
Technical Report on NGN Interconnection**

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Reference

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Keywords

TISPAN, HWI, Interconnection, NNI, Interconnect

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

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Foreword

This Special Report (SR) has been produced by ETSI Technical Committee Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN).

Multi-part documents

The following block is required in the case of multi-part deliverables. The <common element of the title> is the same for all parts, the < part element of the title> differs from part to part and, if appropriate, the < sub-part element of the title> differs from sub-part to sub-part. The paragraph identifying the current part (and sub-part, if appropriate) shall be set in bold.

For **option a)** described in clause 9 of the drafting rules, i.e. in the Foreword of **each** part belonging to the series, a reference shall be made to the titles of all other parts, one of the example texts below needs to be maintained in **all parts**.

For **option b)** (preferred) described in clause 9 of the drafting rules, i.e. **only part 1** shall provide the intended structure of the series, one of the example texts below needs to be maintained in **part 1 only**.

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The present document is part <i> of a multi-part deliverable. Full details of the entire series can be found in part 1 [Bookmark_Reference].

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<Doc type> <Doc number>: <part title>;

:

EN 301 xyz-1: <Part title>;

:

TS 101 xyz-2: <Part title>.

Sub-parts

The present document is part <i>, sub-part <j> of a multi-part deliverable covering [the] <common element of the title>, as identified below:

Part 1: "<part element of the title>;

:

Part <i>: "<part element of the title>;

Sub-part 1: "<sub-part element of the title>;

:

Sub-part <j>: "<sub-part element of the title>;

:

Sub-part <m>: "<sub-part element of the title>".

:

Part <n>: "<part element of the title>".

Introduction

As service providers move to deploy Next Generation Networks (NGN) how these networks are interconnected is becoming an important new area of study. ETSI TISPAN recognizes the importance of enabling NGNs to be interconnected. This Special Report (SR) identifies areas for further work by analysing the global pool of existing work in this area in the context of a list of NGN Interconnect scenarios.

ETSI members are encouraged to consider this report and take action necessary to raise ETSI work items and/or collaborate with other relevant Standard Development Organisations (SDO) and industry bodies in order to facilitate the development and deployment of a standards based approach to NGN interconnect.

1 Scope

Interconnection of NGNs represents a broad area of study including such areas as signalling interconnection, media interconnection, routing, address resolution, security, charging and network management. However, as with most aspects of the NGN, there are many Standards Development Organizations (SDOs) and industry bodies that are working on this topic leading to the building of a global body of work in this area.

The scope of this report is therefore twofold:

1. **Inventory of existing NGN interconnect work:** The report identifies existing NGN Interconnect related work in ETSI TISPAN and other relevant SDOs and industry forums.
2. **NGN Interconnect scenarios:** To develop a list of NGN interconnect scenarios.

The report concludes by identifying gaps in industry standards that should be filled in order to enable support of the identified NGN interconnect scenarios.

ETSI members are encouraged to consider this report and take action necessary to raise ETSI work items and/or collaborate with other relevant Standard Development Organisations (SDO) and industry bodies in order to facilitate the development and deployment of a standards based approach to NGN interconnect.

Editors note: Further alignment and some rewording requested.

Remarks from the discussion during presentation of 22WTD082:

Scope is 2 fold: inventory of existing NGN interconnect work and repository for NGN interconnect scenarios.

The 2nd part of the scope was questioned. The WI sheet should be reviewed to adapt the scope.

WG5 chairman indicated that other SDOs/fora material is subject to copyright so any cut and paste should be clearly identified.

The chairman proposed to accept Nortel's document as a basis. Modified scope with 1 part which is general to all HWI and a second part specific to the given topic.

2 References

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.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
 - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;
 - for informative references.

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

For online referenced documents, information sufficient to identify and locate the source shall be provided. Preferably, the primary source of the referenced document should be cited, in order to ensure traceability. Furthermore, the reference should, as far as possible, remain valid for the expected life of the document. The reference shall include the method of access to the referenced document and the full network address, with the same punctuation and use of upper case and lower case letters.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

Editor's note: To be provided

2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Editor's note: To be provided

- Use the **EX** style, add the letter "i" (for informative) before the number (which shall be in square brackets) and separate this from the title with a tab (you may use sequence fields for automatically numbering references, see clause A.4: "Sequence numbering") (see example).

EXAMPLE:

- [i.1] ETSI TR 102 473: "Digital Video Broadcasting (DVB); IP Datacast over DVB-H: Use Cases and Services".
- [i.2] ETSI TR 102 469: "Digital Video Broadcasting (DVB); IP Datacast over DVB-H: Architecture".

3 Definitions, symbols and abbreviations

Editor's note: To be provided.

Delete from the above heading those words which are not applicable.

Definitions and abbreviations extracted from ETSI deliverables can be useful to draft your own and can be consulted via the **Terms and Definitions Interactive Database (TEDDI)** (<http://webapp.etsi.org/Teddi/>).

3.1 Definitions

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

TISPAN IPX: The term "TISPAN IPX" summarises in one term all TISPAN's activities on IPX and should not be understood as inferring that TISPAN will look to implement a separate "TISPAN-specific IPX". No such decision has been taken and consideration of such an option remains very much dependent on further evaluation.

3.2 Symbols

Clause numbering depends on applicability.

For the purposes of the present document, the [following] symbols [given in ... and the following] apply:

Symbol format

<symbol>	<Explanation>
<2 nd symbol>	<2 nd Explanation>
<3 rd symbol>	<3 rd Explanation>

3.3 Abbreviations

Abbreviations should be ordered alphabetically.

Clause numbering depends on applicability.

For the purposes of the present document, the [following] abbreviations [given in ... and the following] apply:

Abbreviation format

<ACRONYM1> <Explanation>
 <ACRONYM2> <Explanation>
 <ACRONYM3> <Explanation>

4 Overview

The following aspects of NGN interconnection in the sense of inter-network/domain interconnection have been identified:

NNI Interconnection for interoperability
 NNI Interconnection for roaming
 NNI Interconnection for resource sharing

Editor's note: Contributions invited to determine how NNI Interconnection for resource sharing differs from NNI Interconnection for roaming.

NNI Interconnection with network unbundling

Editor's note: Contributions invited to clarify what is meant by the above scenario.

NNI Interconnection and Security
 NNI Interconnection and Numbering, Naming, Addressing, Routeing

From a more generic perspective, the following aspects of Interconnection have been identified:

NGN Interconnection services requirements
 Service Interconnection (SoIX) models and related IP connectivity requirements
 Functional architecture for interconnection
 Interoperable global NNI in NGN context (IMS and non-IMS), based at least on 3GPP and ITU-T activities
 Addressing, naming, numbering, routeing and NAR (DB, ENUM/DNS, etc.)
 Resource control (i.e. call admission control)
 QoS at interconnection and end-to-end QoS
 Security
 Accounting
 Nomadicity requirements (if any)

TISPAN supports the view that all required parties need to move forward in a coordinated manner.

The following figure illustrates how the 3 stage standards development process can be applied to NGN interconnection and the relation between key aspects of the work and the standards groups involved.

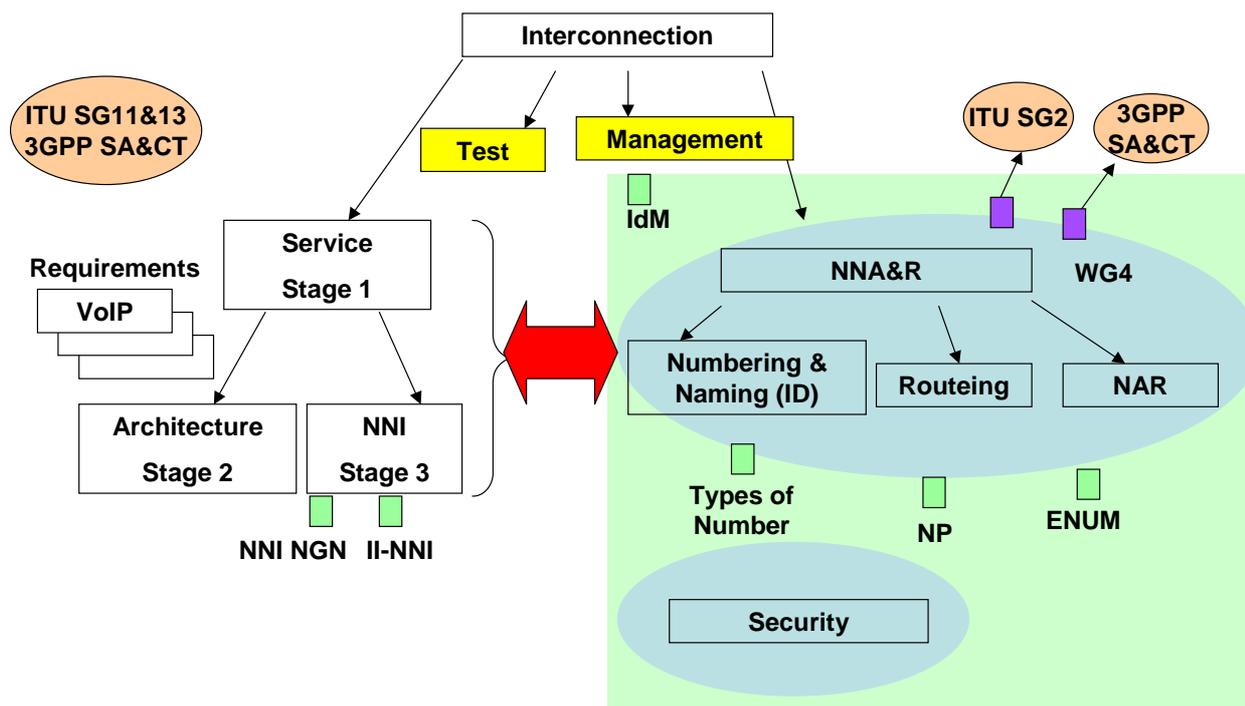


Figure 1 – Interconnection Standards Development Landscape

Editor's note: Some more text and figures may be provided.

Draft

5 Analysis

5.1 List of issues in order to define standards on interconnection

a) The Next Generation Network specifications and standardizations is evolving very quickly but a lack of a stable, complete and normative references that allows interoperable end-to-end solutions is evident:

- Need for widely recognized implementable standards for interoperability, both in IMS and “non IMS” context.
- Proliferation of partial architectures, functionalities and SIP “profiles” needs to be avoided
- ITU-T Recommendations on NNI and UNI (Q.3401 and Q.3402) are a step towards the global NGN interoperability but have no ETSI equivalent.

b) Moreover, there is a lack of European “normative” standards (ES, EN) on NGN interconnection, in charge of ETSI as ESO, coherent with ITU-T NGN Recommendations.

c) Coordination between ETSI TCs is needed for NGN interconnection standards definition for service, transport, protocols, security, quality (STQ), Lawful Interception (LI), testing (INT), etc.

d) Interconnection and NGN Architecture evolution shall be applicable to a wide set of NGN subsystems, other IP networks and PSTN/ISDN network:

- Need for proceeding with EN and ES type of documents
- Consolidate interconnection scenarios, requirements and related functionalities evolution
- Coherence with global ITU-T SG 13 NGN architecture

e) Relevant inter-domain and access reference points and, above all, “real” interfaces shall be defined:

- Need for a global normative (EN or ES) reference for NNI between NGN operators, and for interworking with CS domain
- Need for normative ETSI standards (EN or ES) for SIP NNI coherent with ITU-T Q.3401 and 3GPP activity on II-NNI

f) Numbering, Naming, Routing and NAR functionalities shall be considered:

- Need for ES and EN documents for numbers exchanged at UNI and NNI and related coding and signalling protocols also regarding interoperability with CS domains
- Introduction of NAR in NGN architecture as a functionality or a set of functionalities, which is/are common for all NGN subsystems

g) NGN Number Portability shall be considered.

h) Carrier Grade Naming Numbering Address Resolution for Routing and Roaming shall be considered.

i) Definition TISPAN IPX Service Proxy shall be considered.

j) IPv6 Service Transition shall be considered.

k) NGN SoIX with QoS shall be considered.

l) Interconnection Security Aspects shall be considered.

m) Interaction with NG Corporate Networks Interconnection shall be considered.

n) Regulatory Requirements shall be considered.

5.2 GSMA IPX requirements and gap analysis

GSMA	TISPAN
Direct or Indirect Interconnection (Service/Transport Level)	Service Interconnection SoIX architecture and use case scenarios defined for both direct and indirect interconnection. Note that IMS Direct Interconnection was tasked to 3GPP ("II-NNI") Proposal of a TISPAN IPX.
E2E QoS is a must in IPX. Use of Internet discouraged.	Both Internet and e2e QoS based models (inter-RACS signaling is under definition) TISPAN IPX includes carrier grade service interconnection
Mainly targeted to GPRS or I-WLAN roaming and interworking of data services.	Interconnection for IP services or legacy PSTN/PLMN.
Numerous requirements over IPX Proxy.	No technical definition for IPX proxy.
Some requirements over operator Border Nodes (screening, firewall, GRE tunnels)	Border Nodes: IBCF + RACS + IBGF highly defined. Gq' interface: QoS/NAT/Firewall control. No support for GRE tunnels.
Interconnection Interfaces (NNI): Radius, MMS, IMS...	NNI Definition ongoing (TR only): either IMS, SIP-I or BICC/IP

Editor's note: To be revisited if and when work progresses in GSMA. To be revisited as well when updates regarding TISPAN are needed.

GSMA	TISPAN
ENUM&DNS guidelines	<p>Complete set of requirements for Infrastructure ENUM (I-ENUM) which recommended that TISPAN adopt an approach based on the use of private DNS infrastructure for an IPX</p> <p>Further investigation on ease of interworking between the GSMA IPX and ETSI TISPAN IPX environments</p>
<p>Top Level Domain & Sub-domains (".gprs", "3gppnetwork.org", "e164enum.net", ...)</p>	<p>The exact choice of domain names to be used for the TISPAN IPX has to be defined by ETSI (i.e eE164enum.tispan.foo)</p>

5.3 Addressing, naming, numbering and routing in NGN

a) It would be very helpful for NGN developers and operators to find recommendations how to tackle the issue of translation of identifiers in NGNs as a whole

- A common understanding on Naming, Numbering, and Address Resolution in would provide benefits for NGN operators when considering Interconnection and interworking with other networks and services
- By introducing the NAR framework the gaps identified through the use cases could to be closed

b) The types of protocols to be used between requesting entities and NAR entities are unclear

- The current state of technologies provides a diversity of possible models and solutions (e.g. UPSF, SLF, DNS, ENUM, AS, ...) for translation between the various types of identifiers

c) Through the analysis undertaken and the review of the NAR requirements identified, remaining gaps can be closed.

5.4 NNI Interconnection

Editor's note: Status to be added to all following deliverables.

5.4.1 NNI Interconnection for NGN interoperability

The following TISPAN documents have been identified:

- TS 181 005: Service and Capability requirements, e.g. Intecconnection clause 12
- ES 282 001: NGN Functional Architecture, e.g. I-BGF, IBCF
- TS 182 012: NGN/IMS-PES
- ES 283 003: IP Multimedia Call Control Protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Protocol specification [3GPP TS 24.229 (Release 7), modified]
- ES 283 027: Endorsement of the SIP-ISUP Interworking between the IP Multimedia (IM) Core Network (CN) subsystem and Circuit Switched (CS) networks [3GPP TS 29.163 (Release 7), modified]

5.4.2 NNI Interconnection for NGN roaming

The following TISPAN documents have been identified:

- ES 282 004, NASS Functional Architecture, e.g. reference points e2, e5
- TS 183 020: Network Attachment, Roaming in TISPAN, use of DIAMETER at reference point e5
- ES 283 035: Network Attachment, Roaming in TISPAN, use of DIAMETER at reference point e2

5.4.3 NNI Interconnection for resource sharing

The following TISPAN documents have been identified:

- ES 282 003: RACS Functional Architecture, e.g. Gq', Ri'
- TS 183 062: RACS, Diameter protocol domains interconnection information exchange between SPDFs, Ri' reference point

5.4.4 NNI Interconnection with network unbundling

The following TISPAN documents have been identified:

- TS 182 012: NGN/IMS-PES, e.g. AGCF
- TS 183 043: NGN/IMS-PES, AGCF, stage 3
- TS 183 036: NGN/IMS-PES, AGCF, ISDN-SIP Interworking

5.4.5 NNI Interconnection and Security

The following TISPAN documents have been identified:

- TS 187 001: SEC Requirements
- TS 187 003: SEC Security Architecture
- TR 187 002: SEC Threat, Vulnerability and Risk Analysis
- TS 187 005: NGN Release 2 Lawful Interception, Stage 2 definition
- WI 07034: Prevention of Unsolicited Information

5.4.6 NNI Interconnection and Numbering, Naming, Addressing, Routeing

The following TISPAN documents have been identified:

- TS 184 006: Interconnection and Routeing requirements related to Numbering and Naming for NGN
- EG 284 004: Incorporating Universal Communications Identifier (UCI) support into the specification of Next Generation Networks (NGN)
- TR 184 007: Naming/Numbering Address Resolution (NAR)
- TR 184 008: ENUM & DNS Guidelines for Operators
- TR 184 010: Infrastructure ENUM options
- TR 184 003: Number Portability for NGN

5.4.7 NNI Interconnection for Content Delivery Networks

5.4.7.1 CDN Interconnection in ETSI and IETF

CDNs and their interconnection are being studied and specified by multiple research groups and standardization bodies. Annex C provides a brief overview of research work in the area of CDN Interconnection. The following ongoing standardization activities are identified.

ETSI TISPAN has Work Items WI02076 and WI03218 on architecture and protocol, respectively, of CDNs for IPTV. Interconnection of CDNs has been discussed in the meetings. The protocol document has been structured such that CDN interconnection could be fitted in. Moreover, TISPAN has a Hierarchical Work Item HWI0008 on Interconnection to provide an overview of interconnection-related work. The following ETSI TISPAN documents have been identified:

- Draft TS 182 019: Content Delivery Network (CDN) architecture - Interconnection with TISPAN IPTV architectures
- Draft TS 183 xxx: Content Delivery Network (CDN) protocols
- Draft SR 080 003: Special Report on NGN Interconnection (this document)

ETSI MCD has a specific Work Item WI00013 on "CDN Interconnection, use cases and requirements", in addition to a generic CDN study item WI00008 on Content Delivery Infrastructures. The scope of this Work Item is "Describing CDN interconnection Use cases and necessary CDN - CDN protocol choice to make interconnection possible, this work will result in a MCD CDN-CDN profile, reusing as much as possible existing protocols to enable identified use cases and business models. Part of the work will be to complete the interconnection chapter of the CDI Working group." The following ETSI MCD documents have been identified:

- Draft TR 102 688-9: MCD Framework - Part 9: Content Delivery Infrastructures
- Draft TS 102 990: CDN Interconnection, use cases and requirements

IETF has recently started an email list (cdni@ietf.org¹) and discussions on CDN Interconnection. It is quite likely that the scheduled IETF BOF meeting in March 2011 will result in the establishment of an IETF Working Group on CDN Interconnection. The following IETF documents have been identified:

- Draft-jenkins-cdni-problem-statement: Content Distribution Network Interconnection (CDNI) Problem Statement
- Draft-lefaucheur-cdni-requirements: Content Distribution Network Interconnection (CDNI) Requirements
- Draft-bertrand-cdni-experiments: Content Distribution Network Interconnection (CDNI) Experiments
- Draft-bertrand-cdni-use-case: Use Cases for Content Distribution Network Interconnection
- Draft-jenkins-cdni-names: Thoughts on Naming and Referencing of Data Objects within Content Distribution Network Interconnection (CDNI) solutions

Note: IETF's Internet Drafts are ephemeral in nature. All, some or none of their content may end up in an RFC.

Note: In 2003, IETF has produced three RFCs on CDN Interconnection: RFC 3466 ("A Model for Content Internetworking (CDI)"), RFC 3570 ("Content Internetworking (CDI) Scenarios") and RFC 3568 ("Known Content Network (CN) Request-Routing Mechanisms"). However, the renewed IETF CDN-I activities seem to neither build on these RFCs nor to obsolete them.

5.4.7.2 Coordination of CDN Interconnection activities

As for coordination between the groups, TISPAN and MCD have regular joint meetings, whereas the companies and persons involved in the IETF activities have a good overlap with the TISPAN and MCD participation. Moreover, ETSI has a long history of building on IETF protocols, and coordinating with IETF on an informal and personal basis. IETF

¹ IETF CDN-I email archive: see <http://www.ietf.org/mail-archive/web/cdni/current/maillist.html>

typically designs its protocols in an open, extensible fashion. ETSI has been registering several of such extensions with IANA, most recently for IPTV.

This all provides a good basis for the exchange of ideas and information between the groups, even in the absence of formal liaison relationships between ETSI and IETF. Given their historical roles, the following would be a natural division of work between the bodies involved, see also Figure 5.4.7.2-1.

- IETF: base protocols for CDN-Interconnection
- MCD: use cases and requirements
- TISPAN: architecture and associated protocol adaptations

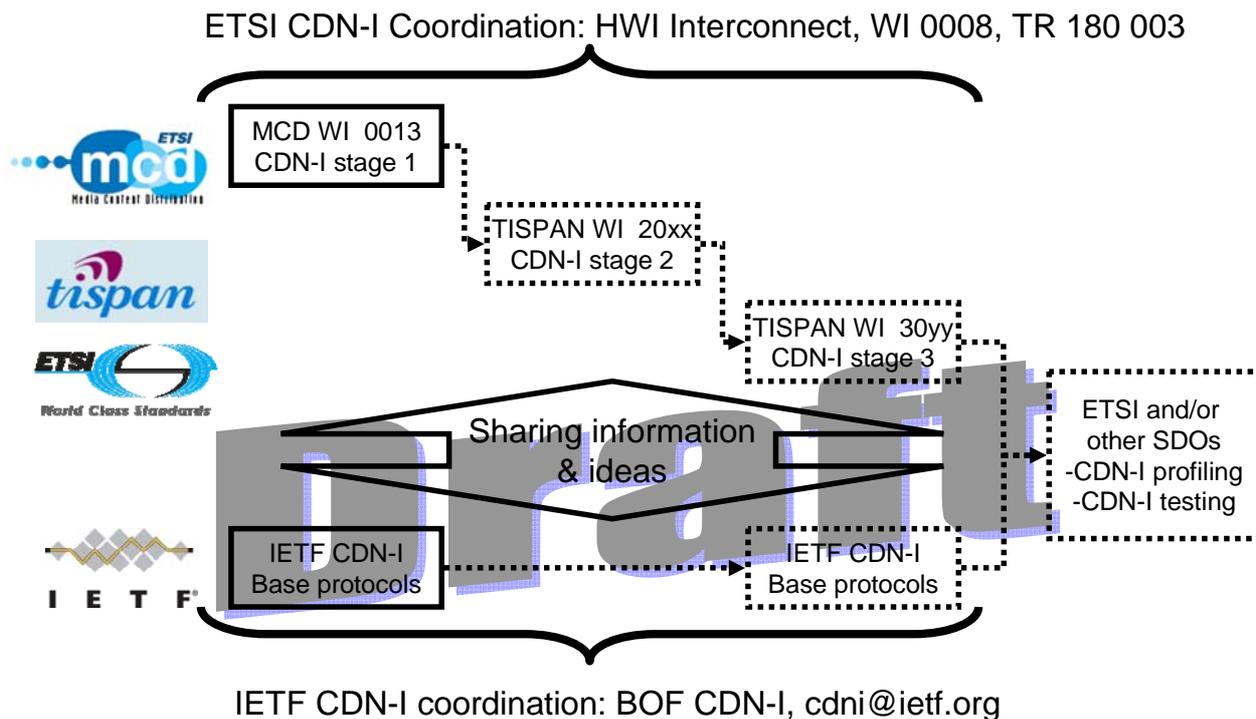


Figure 5.4.7.2-1: A view on (potential) CDN-I activities in ETSI and IETF.

5.4.8 NNI Interconnection for national IP Interconnection

Editor's note: Please note that this text was drafted as a result of subsequent Thread discussions via the ETSI mail exploder in 2010 and 2011:

- The mail archive of the discussions of Thread[124], Thread[129] and Thread[136] in 2010 can be browsed at the URL http://list.etsi.org/TISPAN_GEN.html
- The mail archive of the discussions of Thread[139] in 2011 can be browsed at the URL http://list.etsi.org/TISPAN_WG2.html.

It is noted that work on IP Interconnect is ongoing in other standardisation bodies like 3GPP and in organisations as GSMA and i3forum. The activities in those SDO's specifically deal with international interconnection. Hence the information provided in this document provides guidance on items of national IP interconnection which are not covered elsewhere.

For the subject of IP Interconnection in general (not exclusive to national IP Interconnection only) guidance is given in the following 3GPP deliverables:

- 3GPP TS 22.228: "Technical Specification Group Services and System Aspects; Service requirements for the Internet Protocol (IP) Multimedia core network Subsystem (IMS); Stage 1 (Release 11)".

- 3GPP TS 22.229: “Technical Specification Group Core Network and Terminals; IP multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3 (Release 11)”.

In 3GPP TS 24.229 stage 3 specification text can be found on general interconnection issues like:

- URIs and address assignment in clause 4.2
- Routing principles in clause 4.3
- Trust domains in clause 4.4
- Additional routing capabilities in support of transit and interconnection traffics in IM CN subsystem in Annex I.

5.4.8.1 Calling Identity

National IP Interconnection interfaces may be required to support the transfer in SIP of the Calling Identity between operators to meet national regulation matters (e.g. lawful intercept) with the following principles:

- The IP Interconnect between national operators shall be considered to be a “trusted” environment.
- In SIP the P-Asserted-Identity (P-A-Id) header shall be used to convey the Calling Identity between operator networks.
- If the Calling Identity is a telephone number it shall be conveyed either in the international format or in national format based upon national decisions.
- For redirected calls the History-Info header (or alternatively the Diversion header) shall be used to convey the redirection information.

No missing elements were identified in the SIP standards to support this national IP Interconnect item.

5.4.8.2 Number Formats

Based on 3GPP TS 29.165 clause 8 and ETSI TS 184 011 the following 2 basic practices are given as guidance on national NGN IP Interconnect interfaces to support E.164 number formats in the SIP Request URI and other SIP headers like To, From, History-Information, Diversion and P-Asserted-Identity:

1. Use of global number format only

A global number coding, as defined in RFC 3966, shall be used in a TEL URI and in the user portion of a SIP URI with the user=phone parameter. In addition, use of one or more specific National Destination Codes (NDCs) may be used in front of national-only numbers like short codes (112, 114, etc.) and service codes when no overlap with E.164 number ranges exists. In this arrangement the number coding in SIP headers is the global number as defined in RFC 3966 always starting with +<CC>, which implies that there is no need for the inclusion of the phone-context parameter to headers.

2. Use of local number format next to global number format

If bilateral agreements exist between operators to transfer national E.164 numbers and national-only E.164 numbers in the local number coding as defined in RFC 3966, then the phone-context parameter shall be added to SIP headers which transfer a local number. The phone-context parameter shall contain the E.164 Country Code digits (which must themselves start with a "+"). The number shall be used in a TEL URI and in the user portion of a SIP URI with the user=phone parameter. Headers without phone-context parameter shall be in the global format and should be conveyed as such (see practice 1 above).

Notes:

- a) Transfer of national numbers in local format between operators implies <NDC><SN> (without prefix '0') and phone-context=+<CC> (for the transfer of the global number digits). For the transfer of short codes / service codes a bilaterally (nationally) agreed coding of the phone context parameter shall be used.

- b) The use of SIP and/or SIP-I for national IP Interconnect is a bilateral (national) matter. With SIP additional transfer capabilities in specific parameters may be supported like the rn parameter according RFC 4694 for the transfer of additional Number Portability information for which the interworking to/from ISUP is specified in ETSI ES 283 027 and 3GPP TS 29.163. With SIP-I such additional capabilities are not described in ITU Q.1912.5 and in ETSI EN 383 001.

No missing elements or new capabilities were identified in the SIP standards to support this national IP Interconnect item.

5.4.8.3 Prefix Digits

Within operator domains, and sometimes based on bilateral agreements between operators on the interconnections, prefix digits may be used as extensions to B-numbers to indicate specific routing arrangements and/or indications.

Some issues/use cases could be:

1. At least during a transition period interconnect between 2 operators could have PSTN and IP in parallel. How determine which "route" to take in order to avoid unnecessary PSTN-IP conversion?
2. In current PSTN interconnect routing prefixes often point to the ingress point of the destination network (usually based on geographic location of the destination). How to reflect that in SIP?
3. Monitoring tools are crucial to operations and an end-to-end view of call is necessary. With different protocols in play, correlation of different protocol messages belonging to the same call is very important. The question is what information can be used to correlate e.g. SIP INVITE, ISUP IAM and H.248 CRCX messages?
4. For support of Number Portability in some countries via the transfer of prefix digits between PSTN and IP where in SIP prefix digits are mapped to/from the rn parameter according to RFC 4694.

For this purpose prefix digits may be passed through the MGCF in either way: i.e. from SIP to ISUP for calls from VoIP to PSTN and from ISUP to SIP for calls from PSTN to VoIP. This will require manipulations of the digit string in both the Request URI and the B-number in the ISUP Called Party Number parameter in either direction. The prefix digits may function to convey in a technology independent way specific information on a call-by-call basis. This of course implies that these prefix digits are firstly to be added and subsequently to be deleted as part of e.g. an ENUM trigger for the user part of the SIP Request URI or an INAP trigger for the B-number in the ISUP Called Party Number parameter. In the VoIP domain the prefix digits may be used to make necessary translations to e.g. the technology specific tel URI tags tgrp and trunk-context (RFC 4904), and with SIP URI encoded form of a tel URI, for the identification of incoming/outgoing routes.

No missing elements were identified in the SIP standards to support this national IP Interconnect item.

5.4.8.4 Carrier Selection

This refers to the question how to transfer calls initiated by a PSTN user with Carrier Selection over a national IP Interconnect interface? It specifically refers an appropriate and generally agreed mapping from ISUP to SIP for these calls. In this respect different mechanisms may be envisaged, e.g.:

- Use of specific trunk groups (identified in SIP by tgrp and trunk-context parameters specified in RFC4904) with the receiving Carrier Selection operator.
- Identified by the SIP cic parameter specified in RFC4694, with an agreed coding of the cic parameter with the receiving Carrier Selection operator.

No specific guidelines were concluded for this national IP Interconnection item.

5.4.8.5 Domain name conventions

Editor's note: Please note that in future this text may be replaced by or supplemented with a reference to a 3GPP deliverable when guidelines for this topic are covered in a 3GPP deliverable produced as part of the work in 3GPP on IPXS.

It is often not enough to know that a particular E.164 number is located in network X, but also it will be needed to know which of the ingress points to network X to use (assuming multiple ingress points).

For this national IP Interconnection item no definitions are proposed for domain name conventions and/or other (more elegant) solutions to reflect a network ingress point in the domain name.

5.4.8.6 Diversion header and History-Info header

Editor's note: Please note that in future this text may be replaced by or supplemented with a reference to a 3GPP deliverable when guidelines for this topic are covered in a 3GPP deliverable produced as part of the work in 3GPP on IPXS.

Though the History-Info header is the only specified way of SIP working in the IP Interconnection standards for the transfer of redirection information for redirected calls, it is noted that the Diversion header is out in the field in both implementations and networks. As a result parties should be prepared to the situation that not all networks are able to support History-Info header (for sending and/or receipt) at the start of national IP Interconnect. For national IP Interconnect the following aspects are given for considerations:

- there is an actual issue because networks may not all immediately be able to support History-Info header while networks will support Diversion header for a certain period of time, and
- absence of an end-to-end interworking solution for redirection information will likely cause unwanted, end-user initiated session loops when two users (un)willingly direct sessions to each other from different networks where end-to-end traversal of diversion information cannot be guaranteed, and
- IETF RFC 6044 provides the most appropriate direction to the interworking between the History-Info header and Diversion header.

As a consequence, for national IP Interconnect the following set of guiding principles are given for the transfer of redirection information for redirected calls.

1. History-Info header

The only standardised way for IP Interconnection to transfer information of redirected calls as specified in TS 124 229 & TS 129 163 and, as a logical consequence, should also followed as the guiding principle for national IP Interconnect. This will imply that networks should normalize to and/or from History-Info header in those cases where internally use is made of other SIP means to transfer information of redirected calls. The History-Info header is specified in RFC4244.

2. Diversion header

If parties agree on a bilaterally basis, use of the Diversion header may be used as an alternative way of operation to transfer information of redirected calls. Then such parties shall agree whether also the History-Info header may be used. The Diversion header is specified in RFC5806.

3. Interworking

If parties mutually agree to make use of the Diversion header, the normalization to and/or from History-Info header shall be performed as specified in RFC6044.

4. SIP-I

The use of SIP and/or SIP-I for national IP Interconnect is a bilateral (national) matter. With SIP additional transfer capabilities in specific parameters may be supported like the History-Info header in RFC4244 for the transfer of call forwarding information for which the interworking to/from ISUP is specified in ETSI ES 283 027 and 3GPP TS 29.163. With SIP-I such additional capabilities are not described in ITU-T Q.1912.5, ETSI TS 129 235 (3GPP TS 29.235) and in ETSI EN 383 001 and should not be used on SIP-I interfaces,.

No missing elements were identified in the SIP standards to support this national IP Interconnect item.

5.4.8.7 SIP to/from SIP-I interworking

Editor's note: Please note that in future this text may be replaced by or supplemented with a reference to a 3GPP deliverable when guidelines for this topic are covered in a 3GPP deliverable produced as part of the work in 3GPP on IPXS.

The basic model for national IP Interconnect with interworking of SIP to/from SIP-I is depicted in Figure 1, whereby the usage of the IBCF is restricted to the ingress/egress of SIP relations and the usage of the MGCF is restricted to the ingress/egress of SIP-I and ISUP relations.

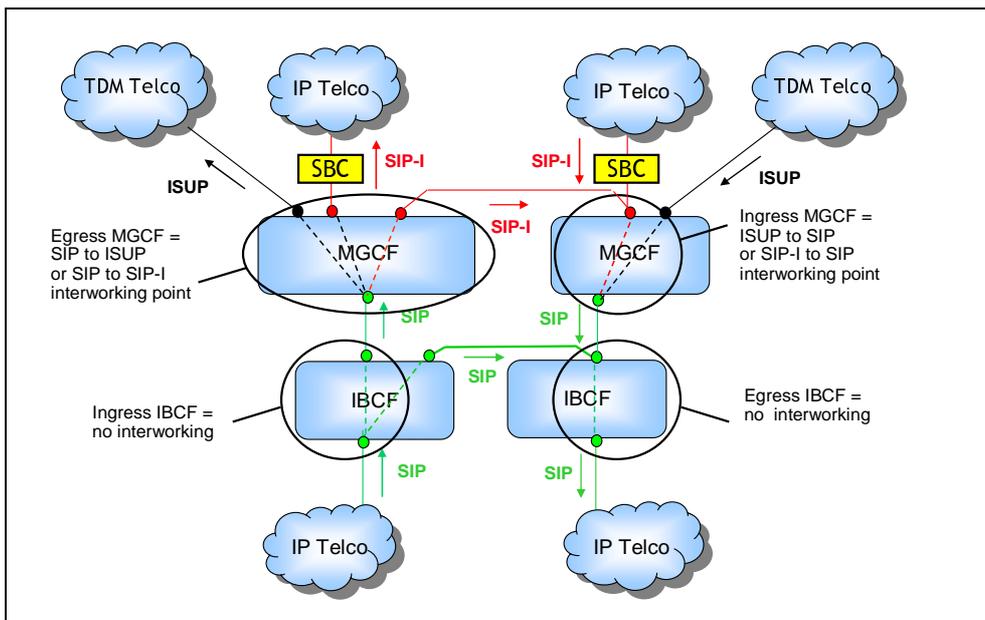


Figure 1 – basic transit model

Alternatively the IBCF may be co-located with an MGCF and/or a CS-IBCF (as defined in 3GPP TS 29.235 Annex A) to create a single physical entity that support both SIP and SIP-I relations. It should be noted that a physical entity embedding both an IBCF and a CS-IBCF does not have to support a CS call model or to terminate ISUP procedures.

Figure 2 illustrates an alternative architecture where the IBCF is co-located with a CS-IBCF and the MGCF is co-located with the InterWorking Unit (IWU) defined in TS 29.235. The MGCF with co-located IWU is used for both the SIP-I to ISUP and the SIP-I to SIP-I interworking situations. SIP-I to SIP-I interworking, can also be handled by the CS-IBCF to save MGCF resources if the type of interworking (including functions like billing and SIP screening as described in 3GPP TS 29.235 Annex A) can be determined at the ingress point (i.e. IBCF/CS-IBCF) and no actions need to be performed on the encapsulated ISUP body.

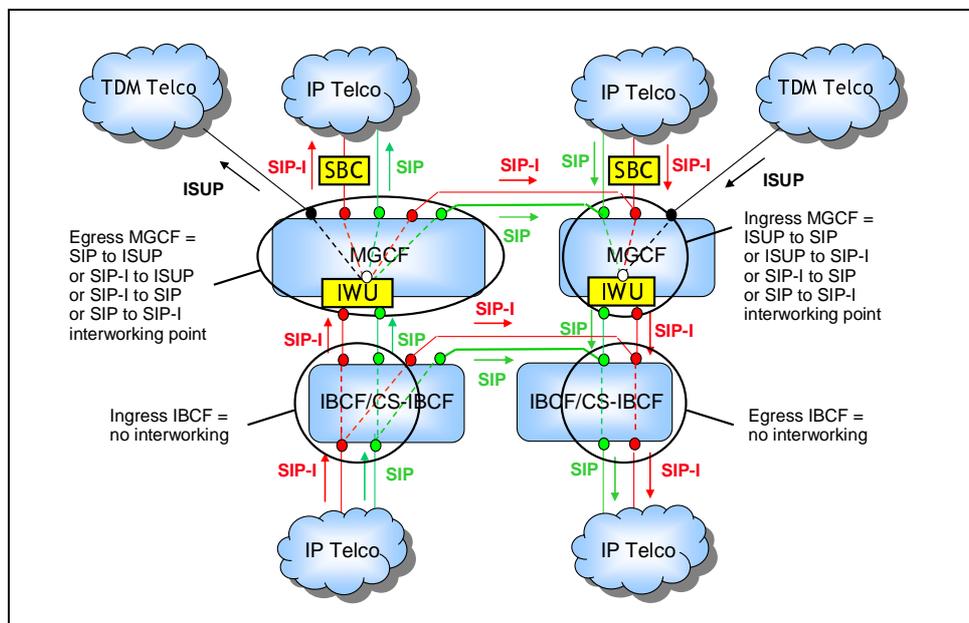


Figure 2 – alternative transit model

Remarks

- The SIP to SIP relation may also be valid for the MGCF if non-IMS scenarios are considered as well.

Editors Note: A clarification is needed about the meaning of non-IMS scenario's.

- The objective of the SIP to/from SIP-I transit model is to achieve guidelines independent of the technology of the IP Telco network whether the last being an IMS based network, a PES network, a SoftSwitch network or else.
- The interworking between SIP-I and SIP is specified in ETSI TS 129 235 (3GPP TS 29.235) wherein for a transit scenario the role of the originating network is played collectively by the originating network and the transit network.
- For the interworking to ISUP please refer to ETSI ES283 027/TS 129 163 for NGNs using IMS. Alternatively if interworking to the SIP profile(s) outlined within EN383001 then use of this document is recommended. EN383 001 is an endorsement of ITU-T Q.1912.5 whilst ES283027 and TS129163 were originally based on Q.1912.5 Profile A but have since evolved as IMS has developed.

No missing elements were identified in the SIP standards to support this national IP Interconnect item.

5.4.8.8 Number Portability

For the support of Number Portability (NP) different scenarios may be envisaged as outlined in ETSI TR 184 003 and RFC 3482. For the support in SIP these NP scenarios may be accompanied with parameters like “npdi”, “rn” and “rn-context” as defined in RFC 4694.

For the interworking between SIP and ISUP mapping between the NP information in ISUP (as defined in ITU-T Recommendation Q.769.1) and SIP is specified in ETSI ES 283 027 and 3GPP TS 29.163.

Note: The observation is made that support of the NP Query on Release (QoR) scenario is not covered (there is an equivalent SIP response code missing for ISUP cause value #14) and that more in depth descriptions may be envisaged for the support of the various NP scenarios in a mixed IMS-PSTN environment. In this context special attention should be given to situations that may result in double TDM/IP conversions with routings like PSTN-IMS-PSTN or IMS-PSTN-IMS for ported numbers (see also clause 6.1.1).

5.5 Considerations on work outside of TISPAN

Editor's note: To be provided, e.g. ITU-T, 3GPP SA “Study on Identification of Advanced Requirements for IP Interconnection of Services”, others.

6 Conclusions

Editor's note: To be provided, based on the previous clauses, includes e.g.

- identification of completed work and gaps,
- next steps in TISPAN incl. joint meetings, agendas,
- identification of new work items (with or without deliverables),
- identification of set of deliverables
- identification of issues and roadmap for cooperation with ETSI TBs and with groups outside of ETSI,
- etc.

6.1 Gaps identified w.r.t. TISPAN NGN interconnection

6.1.1 NNI Interconnection for national IP Interconnection

Editor's note: Please note that this text was drafted as a result of subsequent Thread discussions via the ETSI mail exploder in 2010 and 2011:

- The mail archive of the discussions of Thread[124], Thread[129] and Thread[136] in 2010 can be browsed at the URL http://list.etsi.org/TISPAN_GEN.html
- The mail archive of the discussions of Thread[139] in 2011 can be browsed at the URL http://list.etsi.org/TISPAN_WG2.html.

As part of the thread discussions (see for more details Annex A) no gaps in standards were identified for the majority of the national IP Interconnection items. The only issue that was concluded to require further consideration was the transfer of additional Number Portability information. This observation was made to the following specific SIP-I interworking cases:

1. Transfer of additional Number Portability information within the rn parameter in SIP-I (see clause 5.4.8.2):

The use of SIP and/or SIP-I for national IP Interconnect is a bilateral (national) matter. With SIP additional transfer capabilities in specific parameters may be supported like the rn parameter according RFC 4694 for the transfer of additional Number Portability information for which the interworking to/from ISUP is specified in ETSI ES 283 027 and 3GPP TS 29.163. With SIP-I such additional capabilities are not described in ITU Q.1912.5 and in ETSI EN 383 001.

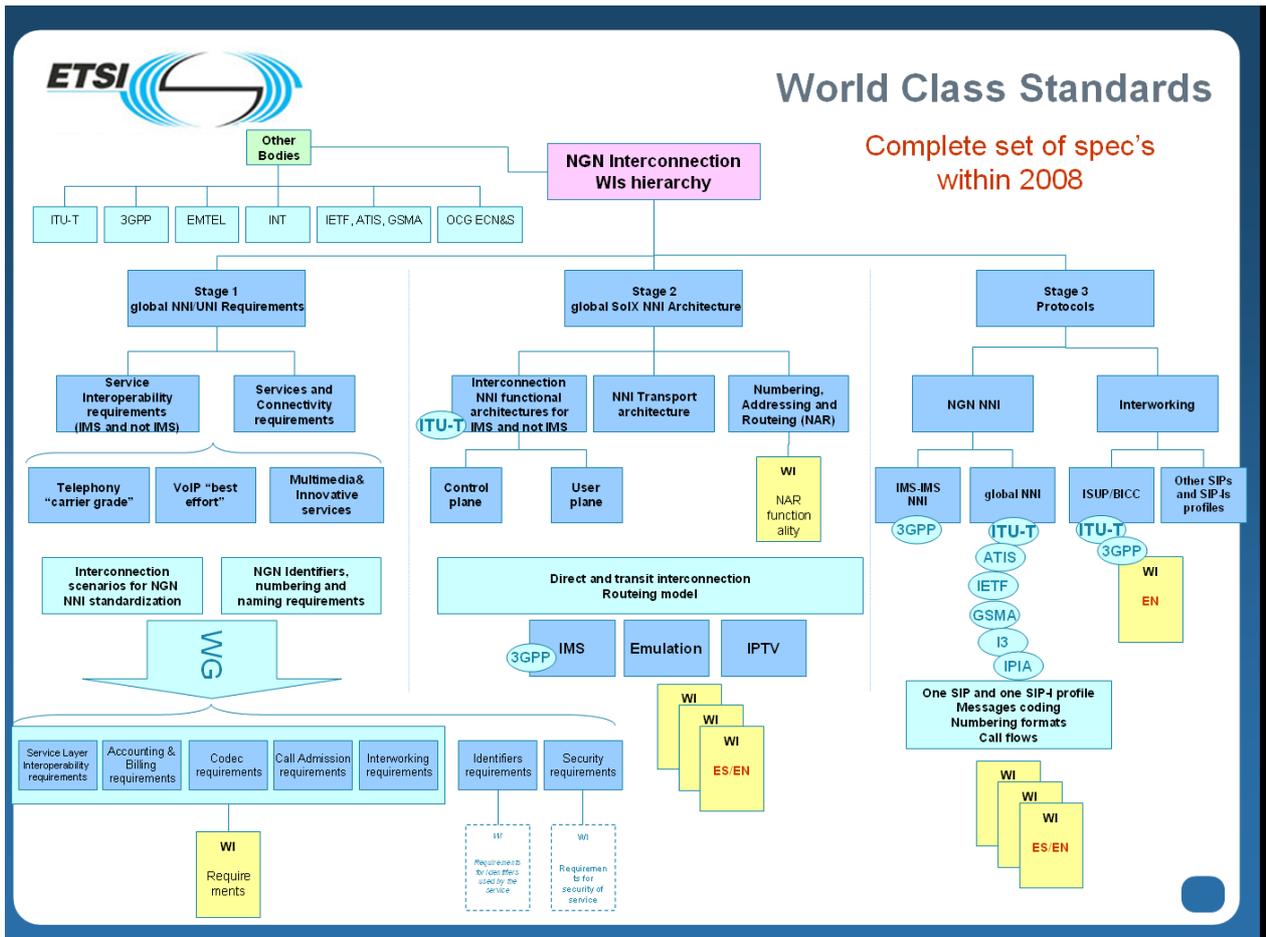
It is given for consideration to TISPAN members whether to specify the transfer of additional Number Portability information with SIP-I in an update of ITU-T Q.1912.5, ETSI TS 129 235 (3GPP TS 29.235) and/or ETSI EN 383 001.

The observation was made that the appropriate protocol handling of ISUP cause value #14 (as defined in ITU-T Recommendation Q.769.1) is missing in SIP (not covered in RFC 4694, ETSI ES 283 027 nor 3GPP TS 29.163) for the equivalent support of the NP scenario Query on Release (QoR).

In addition, to provide more in depth descriptions which describe the support of the various NP scenarios in a mixed IMS-PSTN environment. In this context special attention should be given to situations that may result in double TDM/IP conversions with routings like PSTN-IMS-PSTN or IMS-PSTN-IMS for ported numbers.

7 Summary

7.1 Identification of elements, work items and their relation



Editor's note: To be completed, e.g. relationships between work items.

7.2 Conclusions

Editor's note: Based on clause 6 Conclusions.

Annex B

NGN interconnection scenarios

Editors Note:

The intension of this Annex is to provide input to Clause 5 of this SR (the current numbering refers to clause 5.2 but could be changed with regard to the final position in the doc.).

The content of this section should describe interconnection scenarios and allocate related normative standard documents to these scenarios.

Subject of this annex is to built a discussion section finding the best way of documentation.

Contributions are welcome.

NNIs will be introduced between Networks of different Providers or Networks located in different domains. Dependent of the specific characteristic they may support an individual level of service awareness.

Editor's note: this section lists all the known scenarios for carrier interconnection and assigns the relevant ETSI standards. Further on this will lead to analyse current gaps in ETSI standardisation and to encourage for new WIs completing the standards landship.

5.2.1 NGN inter-operator direct interconnection

Direct interconnection describes a set of interconnection scenarios, where the IP Interconnection is direct between operators' networks. The relationship is a bilateral between both operators for providing e2e service for the users. Intermediate carrier networks are not involved.

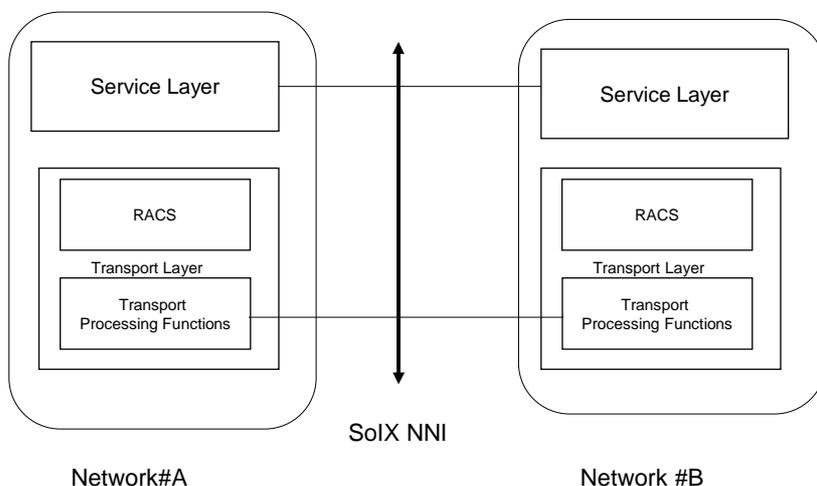


Figure 5.2-1: NGN SoIX direct interconnection scenario

NGN direct interconnection can either be a

- Service oriented interconnection (SoIX)

where one or more of the defined layers may be involved

- Service control layer
- Transport control layer and
- Transport (processing) layer

or a

- Connectivity oriented interconnection (CoIX)

supporting

- Transport control layer and
- Transport (processing) layer.

Interconnection at application layer currently is not specified.

5.2.2 NGN inter-operator indirect interconnection

Indirect interconnection describes a set of interconnection scenarios, where the IP Interconnection between operators' networks is provided not in a direct manner, but intermediate networks connecting two or more operator networks are involved. Several variants of relationship between the originating and the terminating provider networks and the intermediate provider network may apply.

Note: All the scenarios described in section for direct interconnection may also apply for indirect interconnection. Specific definitions are ffs.

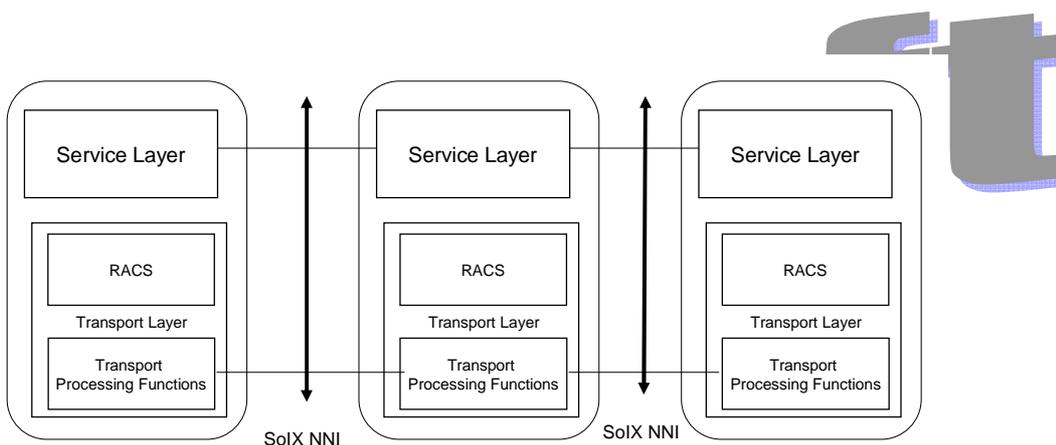


Figure 5.2-2 –NGN indirect interconnection scenario

As defined for direct interconnection, NGN indirect interconnection also can be a

- Service oriented interconnection (SoIX)
- Connectivity oriented interconnection (CoIX)

With respect to indirect interconnection, the intermediate NGN (NGN-I) need not to support all mentioned layers. For instance for a SoIX, the transport processing or the transport control can be transparent or can be delivered from a transport provider other than the service intermediate provider.

5.2.3 Types and roles of Networks for Interconnection

Interconnection of NGNs can be applied between different types of Networks. A NGN core network can become connected to access networks using NGN technology as well as to other NGN core networks. Also interconnection between NGN core networks and NG service platforms may apply, where a service platform could contain a service control function, an application function or both of these. Interconnection to non NGN networks also are in scope. These can be packet based or a non packet based legacy service networks.

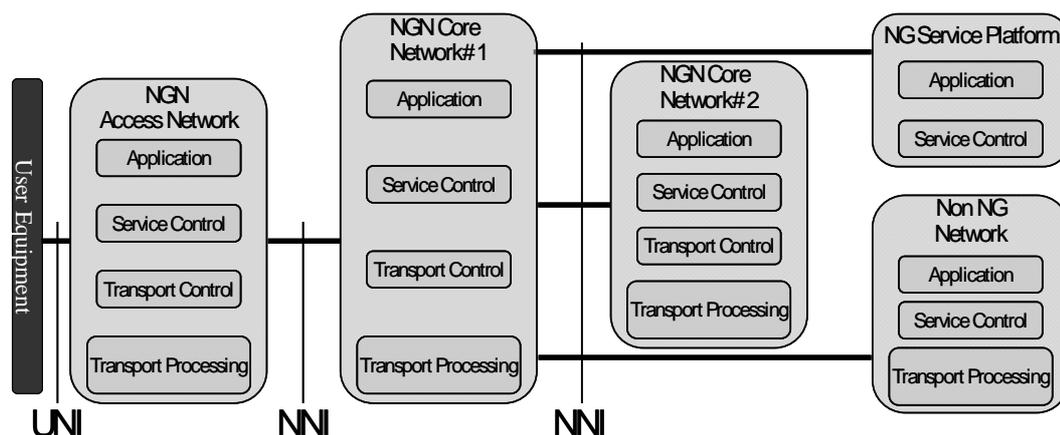


Figure 5.2-3: NGN direct interconnection - different roles of Networks

The networks shown in Fig. 5.2-3 may play following roles:

The **NGN Access Network** where the user is connected to may be AN which belongs to the network provider, he has subscribed (home access network) or the network belongs to a stranger network provider. In this case the AN is in the role of a visited network.

The **Core Network #1** either can play the role of a visited network or the home network for the user if it belongs to the network- / service provider the user has subscribed. Also it can act as an intermediate network, which provides transit functions either in a SoIX or CoIX configuration.

As defined for Core Network #1 (CN#1) the **Core Network #2 (CN#2)** also can act as visited, home or transit network, which depends on the role of CN#1. CN#1 and CN#2 may be cascaded in several configurations in case of indirect interconnection, where one of these will be the home network for the user, where one or more other core networks could act as intermediate / transit networks, either for providing transit between visited AN and home network or providing transit between NGNs of different service providers.

NG Service platforms in Figure 5.2-3 are platforms for service providers or content providers, which do not support the NGN transport control function by itself, but are allowed to connect to NGN by accepting the interconnection conditions (e.g. service or application control entities connecting to service control entities or transport control entities of other NGNs).

Non NG-Networks in this context are communication networks which do not follow the NGN definition of ETSI and ITU-T. Packet based networks without any transport control function can also be seen here as legacy service networks like the PSTN/ISDN network.

5.2.4 Service specific core network interconnection scenarios (horizontal Interconnection)

Service specific interconnection scenarios either can be in a direct interconnection or an indirect interconnection arrangement. This clause refers to the direct interconnection scenarios between core networks.

Note: Roaming scenarios refer to clause xxx

Editor's note: Indirect interconnection ffs.

5.2.4.1 Interconnection between core IMSs

Editors Note: all the following sections may become structured in similar as proposed for this clause 5.2.4.1

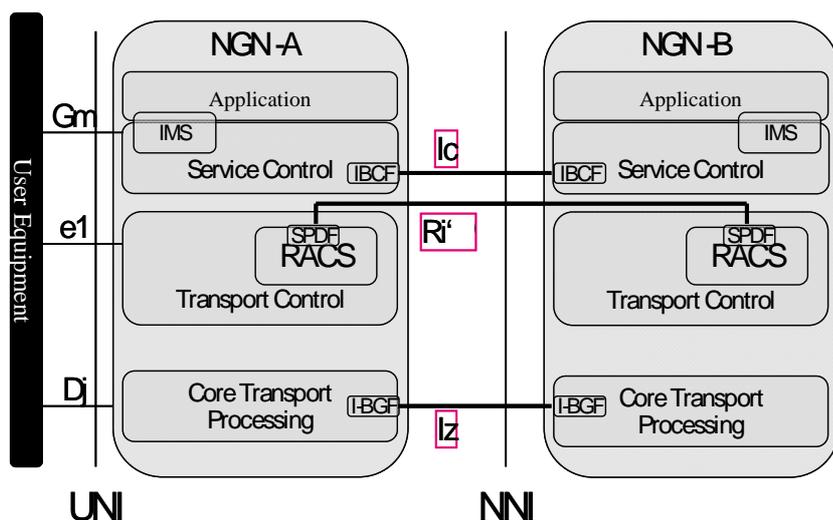


Figure 5.2-4: Interconnection between two IMS networks

IMS – IMS direct interconnection related documents

Line	Document No.	Title	Document available for			Comments
			R1	R2	R3	
Requirements (Stage1)						
1	ES 181 004	NGN Generic capabilities and their use to develop services	X	X ¹⁾		Clause 4.1.3
2	ES 181 005	Service and Capability Requirements	X	X		Clause 12
3	ES 181 010	Service requirements for end-to-end session control in multimedia networks (Release 1)	X			4.6
4	TR 181011	Fixed Mobile Convergence; Requirements analysis		X		
Architecture (Stage2)						
	ES 282 007					
Protocols and Testing (Stage3)						
Resource control						
Quality of Service						
Naming and Numbering						
Security						
Network Management						
Notes: 1) R2 Requirements are outlined in the R1 document						

Table xxx: IMS – IMS direct interconnection related documents

Editors Note: table to be completed

5.2.4.2 Interconnection between IMS and IMS based PES

5.2.4.3 Interconnection between IMS and PSTN/ISDN

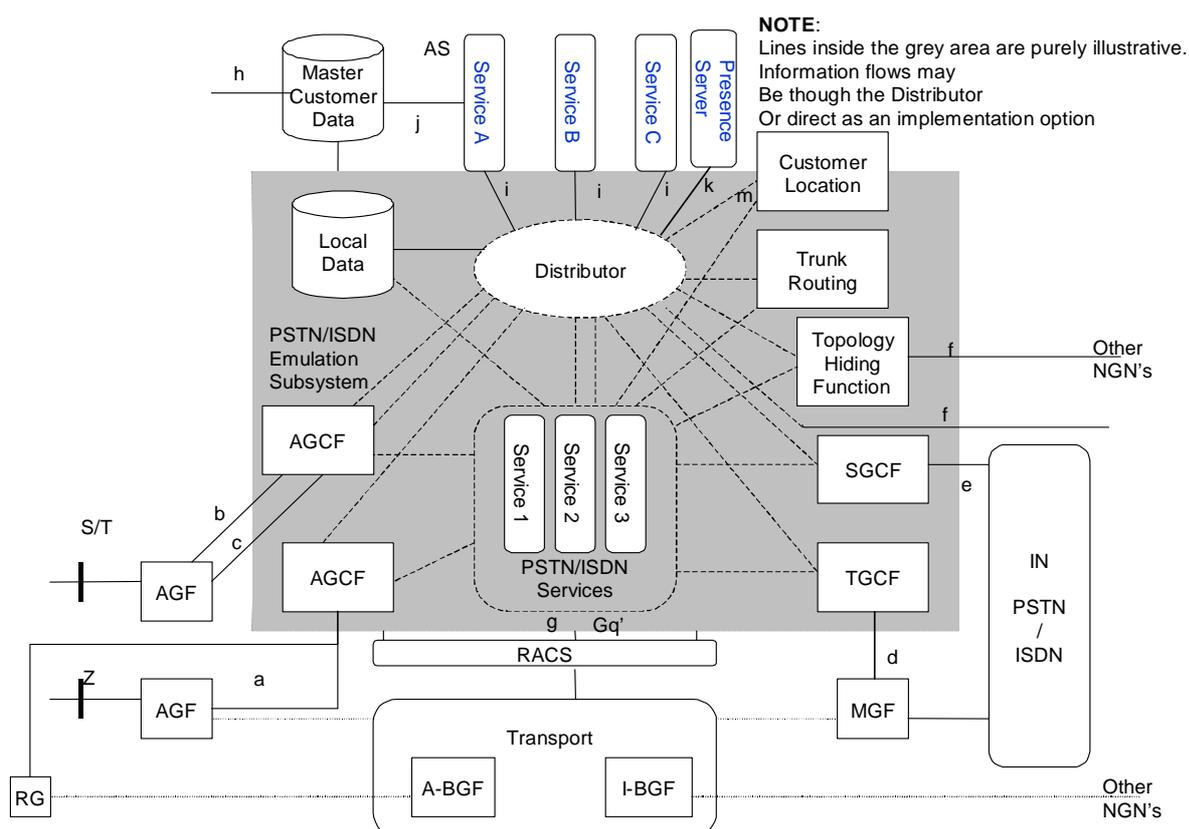
5.2.4.4 Interconnection between IMS and non IMS (SIP based) networks

5.2.4.5 Interconnection between IMS and non IMS (non SIP based) networks

5.2.4.6 Interconnection between IMS/PESs

5.2.4.7 Interconnection between IMS/PES and PSTN/ISDN

5.2.4.8 Interconnection between PES and IMS



ES 282 002, Clause 5.2.6:

Interface between Call Server/Topology Hiding Function and other NGNs (f)

This reference point appears between NGNs when a Topology Hiding Function is used by one both of the networks concerned. The information flows across this reference point are those associated with an NNI for PSTN/ISDN services including IN services where the Interconnect is based on IP.

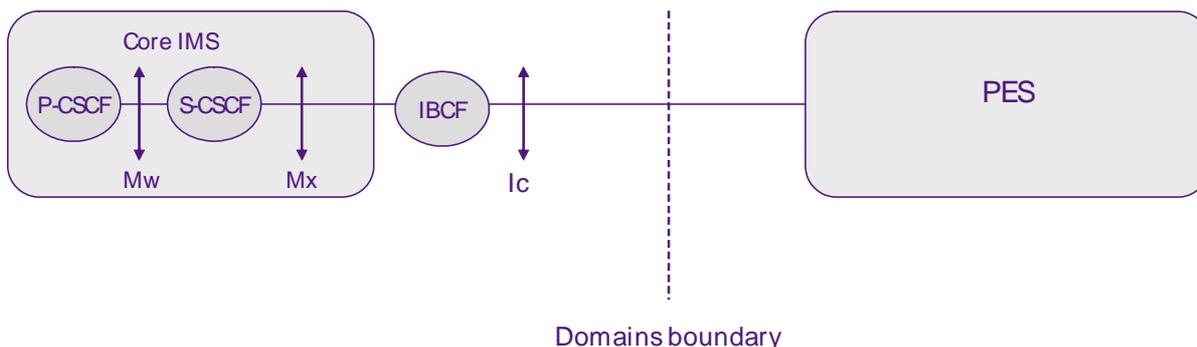


Figure xxx: Interconnection between an IMS and a PES (ES 282 007, Fig B.6)

5.2.4.9 Interconnection between PESs

5.2.4.10 Interconnection between PES and PSTN/ISDN

5.2.4.11 Interconnection between IMS based IPTV subsystems

5.2.4.12 Interconnection between IMS based IPTV subsystems and Integrated IPTV subsystems

5.2.4.13 Interconnection between Integrated IPTV subsystems

5.2.5 Interconnection scenarios for roaming

5.2.5.1 IMS – IMS interconnection for roaming

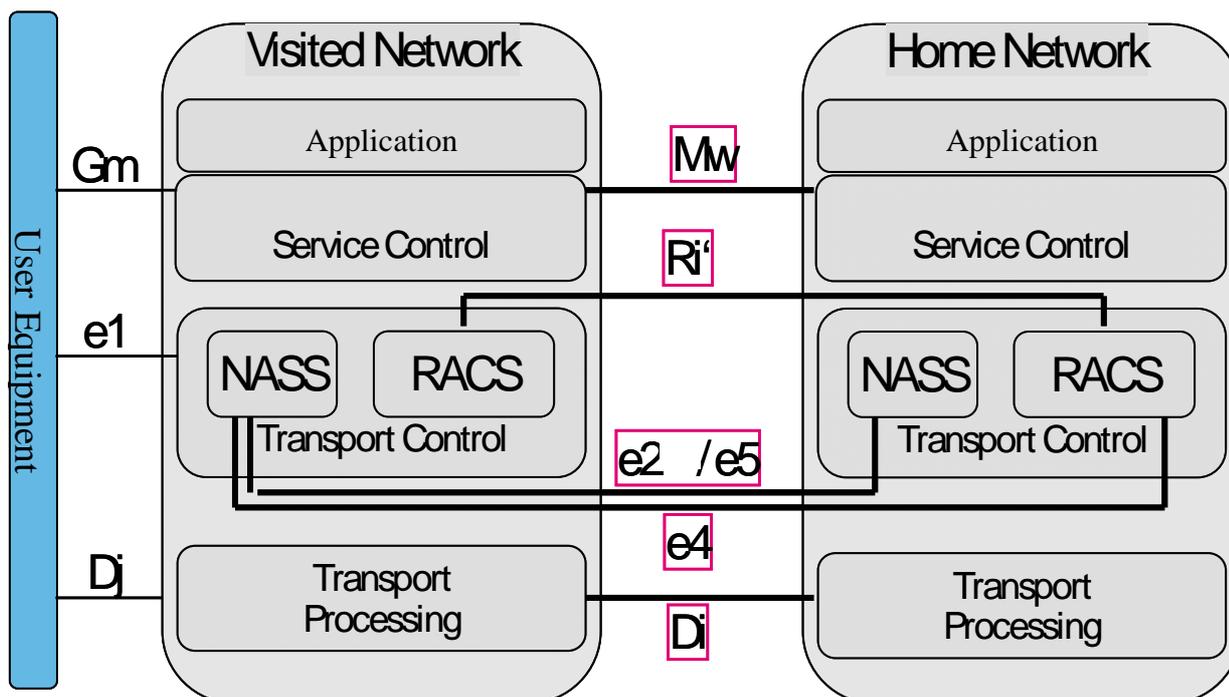


Figure yyy: IMS interconnection between visited and home network

Editors Note: further scenarios to be added.

5.2.6 Vertical interconnection scenarios

5.2.6.1 Interconnection of IMS with application servers at the ISC reference point

5.2.6.2 Interconnection of IMS with RACS at the Gq' reference point

Editors Note: further scenarios to be added.

Draft

Annex C

CDN Interconnection

This Annex provides an overview of recent and relevant work on the interconnection of Content Delivery Networks (CDN). This type of interconnect has gathered interest in several places, and this Annex serves as a placeholder for capturing this interest and the potential for future standardization in this area.

1 CDN Interconnection at CDN World Summit

From the recent CDN World Summit², we note three ongoing developments:

1. **Operator CDNs are increasingly common.** This was evident from presentations by a.o. AT&T³, AOL⁴, BT⁵, Ericsson⁶, Telefonica⁷, Telecom Italia⁸ and TeliaSonera⁹. Operators such as AT&T and BT¹⁰ consider CDN wholesale services for interconnection with other networks, and a CDN marketplace where interconnected operator-CDNs can buy/sell excess capacity from each other. Specifically, AT&T calls for technical forum for interconnecting operator CDNs. Vendors such as Ericsson look at wholesale operator CDN and federation between operator CDNs.
2. **CDNs are increasingly diversified and specialized.** For example, Ericsson focussed specifically on CDNs for mobile networks, whereas Huawei foresees the addition of transcoding functionality in CDN nodes, based on e.g. automatic device detection. Both developments can provision multi-screen/multi-device content delivery, a topic mentioned by many other CDN providers, such as AOL, Broadpeak, Cisco¹¹, LimeLight¹² and Telecom Italia.
3. The **convergence between cloud computing and CDNs** was discussed by a.o. Amazon¹³ and Cisco. CDNs are increasingly employed to provide value-added services, as seen in presentations by AOL, AT&T, Cisco and Telefonica.

Each of the developments listed above has a **strong relation with CDN interconnection**.

² The CDN World Summit was held from September 28-29, 2010 in London. It is part of the IPTV World Series, that are focused and intimate 2-day strategic conferences, drilling down in depth on specific hot issues around the IPTV market. CDN World Summit is organized by Informa Telecoms & Media.

³ AT&T, How Telcos and the Cloud Ecosystem Must Evolve; A CDN Perspective.

⁴ AOL, Major CDN Trends A view of the CDN industry from a portal perspective.

⁵ BT Wholesale, A Wholesale point of view of CDN - CONTENT CONNECT.

⁶ Ericsson, Operator Media Distribution Networks to Enable a Multi-Platform World.

⁷ Telefonica, Sustainable Internet Models.

⁸ Telecom Italia, Efficient Media Delivery Across National IP Networks.

⁹ Teliasonera, How to respond to the new challenges with live broadcasting and HD quality.

¹⁰ BT Wholesale & Cisco, - Customizing CDN for the marketplace.

¹¹ Cisco, The Evolution of Content Delivery Networks.

¹² Limelight, Delivering the 2010 World Cup.

¹³ Amazon Webservices, Amazon Cloudfront; AWS content distribution network..

For example, 1) shows that there is interest from operators to strengthen their position by interconnecting with their peers. Such interconnection provides the most capital efficient seamless global coverage, allows for more efficiently management and coordination of network resources to maximize on-net traffic and better utilize operator resources, provides greater scale and a larger platform than the leading current generation of CDN's, and facilitates the establishing of standards for content distribution and management to improve efficiencies and confidence in the distribution platforms.

Moreover, from 2) we see that CD networks diversify. If the plethora of connected device is to be reached, interconnection of hybrid CDNs, including mobile CDNs, is required.

Lastly, 3) depicts an even more diverse environment, where a CDN also constitutes a platform for innovation of online gaming, online appliances, power grid management and grid applications. In such a situation, the existence of specialized CDNs is very likely, resulting in an increased need for interconnection.

2 CDN Interconnection studied by Eurescom P1955

Editor's Note: Contributions are invited.

3 CDN Interconnection studied in EU-FP7 OCEAN Project

OCEAN (<http://www.ict-ocean.eu/>) is an EU funded research project that started in February 2010 and runs for 3 years. The OCEAN project scope is restricted to Internet network and video services. CDN Interconnection is studied in the OCEAN project. The goal of the project is to design a new open content delivery framework for audiovisual media, defining public interfaces between its major building blocks in order to foster multi-vendor solutions and interconnection between Content Networks. OCEAN has not yet published any architecture, open specifications, nor common best practices, defining how to achieve such CDN interconnection.

History

Document history		
Initial draft	31 October 2008	Revised version with respect to TISPAN#18, initial draft using the general layout, input to TISPAN#19 (6 –7 November 2008).
V0.0.2	13 Sept 2010	22WTD079, 080, 082, 083r1, included, TISPAN(10)0042 as Annex1 preliminary
V0.0.3	16 Sept 2010	TISPAN(10)122r2 and TISPAN02(10)125r2 -> Annex1
V0.0.4	27 Oct 2010	TISPAN02(10)0176r1 ->Annex C, Annexes 1.1 and 1.2 renumbered -> A, B
V0.0.5	17 Jun 2011	TISPAN02(11)0009r2, TISPAN(11)0023, TISPAN02(11)0032r1, included
V0.0.6	29 Sept 2011	TISPAN02(11)0038r1 included