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Technical Report on emergency telecommunications service (ETS) interoperability limitations

ITU-T Q-series Recommendations – Supplement 68

ITU-T



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SWITCHING AND SIGNALLING

SIGNALLING IN THE INTERNATIONAL MANUAL SERVICE	Q.1–Q.3
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FUNCTIONS AND INFORMATION FLOWS FOR SERVICES IN THE ISDN	Q.60–Q.99
CLAUSES APPLICABLE TO ITU-T STANDARD SYSTEMS	Q.100–Q.119
SPECIFICATIONS OF SIGNALLING SYSTEMS No. 4, 5, 6, R1 AND R2	Q.120–Q.499
DIGITAL EXCHANGES	Q.500–Q.599
INTERWORKING OF SIGNALLING SYSTEMS	Q.600–Q.699
SPECIFICATIONS OF SIGNALLING SYSTEM No. 7	Q.700–Q.799
Q3 INTERFACE	Q.800–Q.849
DIGITAL SUBSCRIBER SIGNALLING SYSTEM No. 1	Q.850–Q.999
PUBLIC LAND MOBILE NETWORK	Q.1000–Q.1099
INTERWORKING WITH SATELLITE MOBILE SYSTEMS	Q.1100–Q.1199
INTELLIGENT NETWORK	Q.1200–Q.1699
SIGNALLING REQUIREMENTS AND PROTOCOLS FOR IMT-2000	Q.1700–Q.1799
SPECIFICATIONS OF SIGNALLING RELATED TO BEARER INDEPENDENT CALL CONTROL (BICC)	Q.1900–Q.1999
BROADBAND ISDN	Q.2000–Q.2999
SIGNALLING REQUIREMENTS AND PROTOCOLS FOR THE NGN	Q.3000–Q.3899
TESTING SPECIFICATIONS	Q.3900–Q.4099

For further details, please refer to the list of ITU-T Recommendations.

Supplement 68 to ITU-T Q-series Recommendations

Technical Report on emergency telecommunications service (ETS) interoperability limitations

Summary

New capabilities in modern terminals and public communication networks, such as sharing multimedia, exchanging location and status information, and call transfer, could be used by emergency telecommunications service (ETS) users in cross-borders operations (i.e., between national networks). Supplement 68 to ITU-T Q-series Recommendations is a Technical Report (TR) that aims to identify how the use of such features by ETS users could be problematic because of limitations in the international interoperability of ETS, beyond technology-to-technology priority mapping.

The TR comprises:

- An initial comprehensive list of ETS-related functional requirements and capabilities analysed in the Report.
- Identification of resulting limitations of ETS interoperability:
 - Interfaces between ETS national implementations (ENIs) supporting the ETSS considered;
 - Interoperability problems foreseen due to current lack of support for such telecommunication services in ENIs with different technologies.

The description of limitations includes both a technical analysis of standardized interfaces and use cases to illustrate the involved operations.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T Q Suppl. 68	2015-12-15	11	11.1002/1000/12787

Keywords

Emergency telecommunication service, ETS, ETS interoperability, ETS limitations, multiCONF, NNI.

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FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

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Table of Contents

		Page
1	Scope.....	1
2	References.....	1
3	Definitions	3
	3.1 Terms defined elsewhere	3
	3.2 Terms defined in this Supplement	4
4	Abbreviations and acronyms	4
5	Evolution of ETS-related activities	6
6	Identification of ETS interoperability limitations.....	8
	6.1 Analysis of selected use cases	8
	6.2 Extended analysis of ETS requirements and capabilities and detected possible limitations.....	15
7	Conclusions.....	43

Introduction

Supplement 68 to ITU-T Q-series Recommendations is a Technical Report (TR) that describes the study of possible limitations in emergency telecommunications service (ETS) interoperability that may prevent ETS users from taking full advantage of new capabilities in modern user terminals (i.e., smartphones), public communication networks and applications (e.g., fourth generation (4G) mobile broadband networks using voice over long term evolution/rich communication services (VoLTE/RCS) applications).

This TR identified and analysed a comprehensive list of telecommunications services and features for ETS interoperability limitations. The identified limitations comprise not only the interfaces between ETS national implementations (ENIs) supporting the ETSs considered, but also foreseen interoperability problems due to current lack of support for such telecommunication services in ENIs with different technologies. The description of interoperability limitations includes both a technical analysis of standardized interfaces and use cases to illustrate the involved interactions.

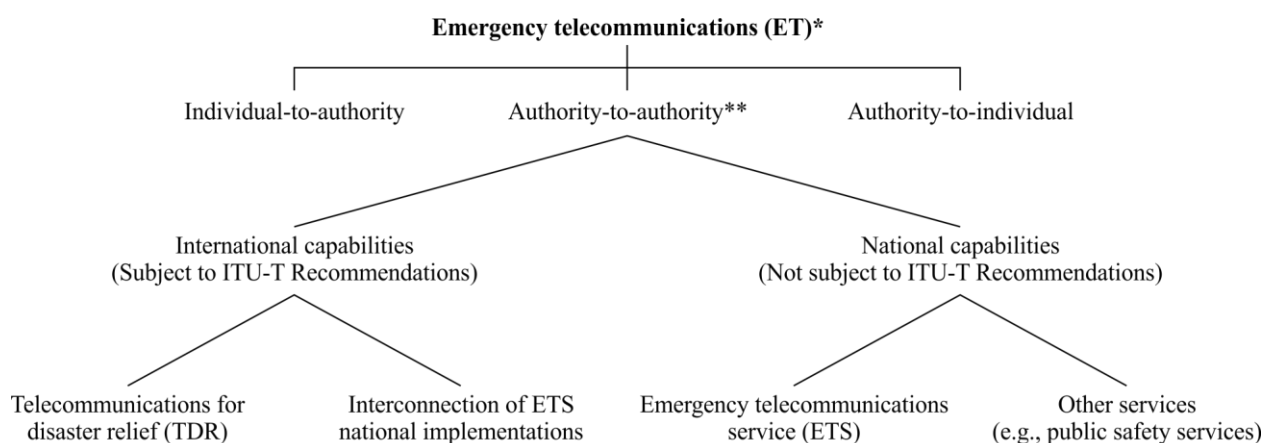
Supplement 68 to ITU-T Q-series Recommendations

Technical Report on emergency telecommunications service (ETS) interoperability limitations

1 Scope

According to ITU-T Recommendations, an emergency telecommunications service (ETS) is a national service providing priority telecommunications to the ETS authorized users in times of disaster and emergencies. Concretely, the scope of ETS involves authority-to-authority communications designed to respond to emergency situations through prioritized access to public telecommunications infrastructures [i.e., the public switched telephone network (PSTN) or public land mobile network (PLMN)] as described in [ITU-T Y.2205].

More specifically, Figure 1 of [ITU-T Y.2205] constricts the scope of ITU-T activities concerning emergency telecommunications to telecommunications for disaster relief (TDR) and interconnection of ETS national implementations (ENIs).



* Including some aspects of early warning

** May also apply to authority-to-individual telecommunications

Q Suppl.68(16)_F01

**Figure 1 – ITU-T activities concerning emergency telecommunications
(Figure 1 of [ITU-T Y.2205])**

In that sense, fostering the interconnection of different emergency-related authorities that may belong to different countries or international organizations is of utmost relevance in this type of event.

One of the challenges is how to address a common interconnection framework taking into account that the ETS national implementations (ENI) are subject to national regulations. This Supplement aims to analyse possible limitations of such a standardized framework when applied to complex multimedia services.

2 References

- [ITU-T E.105] Recommendation ITU-T E.105 (1992), *International telephone service*.
- [ITU-T E.106] Recommendation ITU-T E.106 (2003), *International Emergency Preference Scheme (IEPS) for disaster relief operations*.

[ITU-T E.107]	Recommendation ITU-T E.107 (2007), <i>Emergency Telecommunications Service (ETS) and interconnection framework for national implementations of ETS.</i>
[ITU-T H.248.1]	Recommendation ITU-T H.248.1 (2013), <i>Gateway control protocol: Version 3</i>
[ITU-T H.323]	Recommendation ITU-T H.323 (2009), <i>Packet-based multimedia communications systems.</i>
[ITU-T J.260]	Recommendation ITU-T J.260 (2005), <i>Requirements for preferential telecommunications over IP-Cablecom networks.</i>
[ITU-T J.261]	Recommendation ITU-T J.261 (2009), <i>Framework for implementing preferential telecommunications in IP-Cablecom and IP-Cablecom2 networks.</i>
[ITU-T M.1400]	Recommendation ITU-T M.1400 (1992), <i>Designations for interconnections among operators' networks.</i>
[ITU-T M.3350]	Recommendation ITU-T M.3350 (2004), <i>TMN service management requirements for information interchange across the TMN X-interface to support provisioning of Emergency Telecommunication Service (ETS).</i>
[ITU-T Q Suppl.47]	ITU-T Q-series Recommendations – Supplement 47 (2003), <i>Emergency services for IMT 2000 networks – Requirements for harmonization and convergence.</i>
[ITU-T Q Suppl.53]	ITU-T Q-series Recommendations – Supplement 53 (2005), <i>Signalling requirements to support the International Emergency Preference Scheme (IEPS).</i>
[ITU-T Q Suppl.57]	ITU-T Q-series Recommendations – Supplement 57 (2008), <i>Signalling requirements to support the emergency telecommunications service (ETS) in IP networks.</i>
[ITU-T Q Suppl.61]	ITU-T Q-series Recommendations – Supplement 61 (2010), <i>Evaluation of signalling protocols to support ITU-T Y.2171 admission control priority levels.</i>
[ITU-T Q Suppl.62]	ITU-T Q-series Recommendations – Supplement 62 (2014), <i>Overview of the work of standards development organizations and other organizations on emergency telecommunications service.</i>
[ITU-T Q Suppl.63]	ITU-T Q-series Recommendations – Supplement 63 (2013), <i>Signalling Protocol Mappings in Support of the Emergency Telecommunications Service in IP Networks.</i>
[ITU-T X.810]	Recommendation ITU-T X.810 (2004), <i>General overview of NGN.</i>
[ITU-T Y.1271]	Recommendation ITU-T Y.1271 (2014), <i>Framework(s) on network requirements and capabilities to support emergency telecommunications over evolving circuit-switched and packet-switched networks.</i>
[ITU-T Y.2001]	Recommendation ITU-T Y.2001 (2004), <i>General overview of NGN.</i>
[ITU-T Y.2011]	Recommendation ITU-T Y.2011 (2004), <i>General principles and general reference model for Next Generation Networks.</i>
[ITU-T Y.2012]	Recommendation ITU-T Y.2012 (1992), <i>International telephone service.</i>

[ITU-T Y.2111]	Recommendation ITU-T Y.2111 (2011), <i>Resource and admission control functions in next generation networks</i> .
[ITU-T Y.2205]	Recommendation ITU-T Y.2205 (2011), <i>Next Generation Networks – Emergency telecommunications - Technical considerations</i> .
[ITU-T Y.2211]	Recommendation ITU-T Y.2211 (2007), <i>IMS-based real-time conversational multimedia services over NGN</i> .
[ITU-T Y.2254]	Recommendation ITU-T Y.2254 (2014), <i>Capabilities of multi-connection to support enhanced multimedia telephony services</i> .
[ITU-T Y.2701]	Recommendation ITU-T Y.2701 (2007), <i>Security requirements for NGN release 1</i> .
[ITU-T Y.2702]	Recommendation ITU-T Y.2702 (2008), <i>Authentication and authorization requirements for NGN release 1</i> .
[ITU-T Y.2705]	Recommendation ITU-T Y.2705 (2013), <i>Minimum security requirements for the interconnection of the Emergency Telecommunications Service (ETS)</i> .
[ITU-T Y.3501]	Recommendation ITU-T Y.3501 (2013), <i>Cloud computing framework and high-level requirements</i> .
[ITU-T Y.3510]	Recommendation ITU-T Y.3510 (2016), <i>Cloud computing infrastructure requirements</i> .
[ITU-T Y.3520]	Recommendation ITU-T Y.3520 (2015), <i>Cloud computing framework for end to end resource management</i> .

3 Definitions

3.1 Terms defined elsewhere

This Supplement uses the following terms defined elsewhere:

3.1.1 border element [ITU-T Y.2701]: Network element providing functions connecting different security and administrative domains.

3.1.2 emergency telecommunications service (ETS) [ITU-T E.107]: A national service providing priority telecommunications to the ETS authorized users in times of disaster and emergencies.

3.1.3 ETS user [ITU-T E.107]: A user authorized to obtain priority telecommunications in national and/or international emergency situations.

3.1.4 international emergency preference service (IEPS) [clause 1 of ITU-T E.106]: The IEPS enables the use of public telecommunications by national authorities for emergency and disaster relief operations. It allows users, authorized by national authorities, to have access to the International Telephone Service, as described in [ITU-T E.105], while this service is restricted either due to damage, congestion or faults, or any combination of these.

3.1.5 international emergency situation [ITU-T Y.1271]: An emergency situation, across international boundaries, that affects more than one country.

3.1.6 IMS-based real-time conversational multimedia services [ITU-T Y.2211]: Multimedia services provided in real time by using an IMS-based service environment.

3.1.7 media [ITU-T Y.2012]: One or more of audio, video or data.

3.1.8 media stream [ITU-T Y.2012]: A media stream can consist of audio, video, or data, or a combination of any of them. Media stream data conveys user or application data (i.e., a payload) but not control data.

3.1.9 mediated services [ITU-T Y.2012]: Services that are based on intermediate service stratum facilities provided by one or more service providers.

3.1.10 MC-eMMTel (eMMTel service over multi-connection) [ITU-T Y.2254]: A service over multi-connection which provides real-time bidirectional conversational transfer of multiple media types (e.g., audio, video, data) between two or more terminals simultaneously.

3.1.11 network operator [ITU-T M.1400]: An operator that manages a telecommunications network. A network operator may be a service provider and vice versa. A network operator may or may not provide particular telecommunications services.

3.1.12 next generation network (NGN) [ITU-T Y.2001]: A packet-based network able to provide telecommunication services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies. It enables unfettered access for users to networks and to competing service providers and/or services of their choice. It supports generalized mobility which will allow consistent and ubiquitous provision of services to users.

3.1.13 NGN service stratum [ITU-T Y.2011]: That part of the NGN which provides the user functions that transfer service-related data and the functions that control and manage service resources and network services to enable user services and applications (see also clause 7.1 of [ITU-T Y.2011]).

3.1.14 NGN transport stratum [ITU-T Y.2011]: That part of the NGN which provides the user functions that transfer data and the functions that control and manage transport resources to carry such data between terminating entities (see also clause 7.1 of [ITU-T Y.2011]).

3.1.15 service provider [ITU-T Y.2705]: Service Provider (initial capital letters) is a public telecommunications service provider authorized to provide emergency telecommunications service (ETS).

3.1.16 trust [ITU-T Y.2701]: Entity X is said to trust entity Y for a set of activities if and only if entity X relies upon entity Y behaving in a particular way with respect to the activities.

3.1.17 trusted third party [ITU-T X.810]: A security authority or its agent that is trusted with respect to some security-relevant activities (in the context of a security policy).

3.1.18 trusted zone [ITU-T Y.2701]: From the viewpoint of a NGN provider, a security domain where a NGN provider's network elements and systems reside and never communicate directly with customer equipment. The common characteristics of NGN network elements in this domain are that they are under the full control of the related NGN provider, they are located in the NGN provider premises (which provides physical security), and they communicate only with elements in the "trusted" domain and with elements in the "trusted-but-vulnerable" domain.

3.1.19 un-trusted zone [ITU-T Y.2701]: From the viewpoint of a NGN provider, a zone that includes all network elements of customer networks or possibly peer networks or other NGN provider zones outside of the original domain, which are connected to the NGN provider's border elements.

3.2 Terms defined in this Supplement

None.

4 Abbreviations and acronyms

This Supplement uses the following abbreviations and acronyms:

4G 4th Generation wireless systems

codec	coder-decoder
CT	Call Transfer
DiffServ	Differentiated Services
DSCP	Differentiated Services Code Point
e2e	end-to-end
ENI	ETS National Implementation
eMMtel	enhanced MultiMedia telephony services
ETS	Emergency Telecommunications Service
ETSU	ETS User
ETSMS	ETS Management Service
GC	Group Communication
IEPS	International Emergency Preference Scheme
IM	Instant Messaging
IMS	IP Multimedia Subsystem
IMT-2000	International Mobile Telecommunications-2000
IP	Internet Protocol
IPSec	Internet Protocol Security
ISDN	Integrated Services for Digital Network
ISUP	ISDN User Part
MMtel	MultiMedia telephony services
MPC	Multi-Party Communication
MultiCONF	Multimedia CONFerence
NGN	Next Generation Network
NNI	Network-to-Network Interface
PII	Personally Identifiable Information
PLMN	Public Land Mobile Network
PS	Presence Sharing
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RACF	Resource Admission and Control Function
RCS	Rich Communication Services
RSVP	ReSource reserVation Protocol
RTP	Real-time Transport Protocol
SDO	Standards Development Organization
SIP	Session Initiation Protocol
SLA	Service Level Agreement
SMS	Short Message Service
TMN	Telecommunication Management Network
URI	Uniform Resource Identifier



5 Evolution of ETS-related activities

Fostering the interconnection of different emergency-related authorities who may belong to different countries or international organizations is of utmost relevance in emergency and crisis events. One of the challenges is how to address a common interconnection framework taking into account that the ETS national implementations (ENIs) are subject to national regulations.

[ITU-T E.107] is the reference document for the implementation of an international ETS interoperability framework. [ITU-T E.107] defines the criteria that such a system shall comply with (e.g., priority mapping between different ENIs, decentralized management of authorized ETS users, bilateral/multilateral agreements between institutions) and depicts the network architecture with border gateways at each ENI isle. [ITU-T E.107] is a general document that only provides guidance and main requirements on the interconnection of ENIs, without going into technical details.

Prior to the publication of the next generation network (NGN) release 1, several documents provided guidance on the interconnection of international ENIs. [ITU-T E.106] provides guidance concerning the international emergency preference service (IEPS) defined in clause 3.1.4 to implement the prioritized ETS access to network resources. Although those concepts are mainly targeted to circuit-switching networks, [ITU-T Q Suppl.47] provides information regarding the harmonization of ETS in international mobile telecommunications-2000 (IMT-2000) systems. Thus, these recommendations are applicable to both circuit-switching and packet-switching IMT-2000 connections. Also, [ITU-T Q Suppl.53] provides details for IEPS in the scope of the integrated services for digital network public land mobile network/ public switched telephone network (ISDN/PLMN/PSTN), including the PSTN-to-Internet protocol (PSTN-to-IP) gateways.

[ITU-T Y.1271] is the first document to include concepts of the NGN in the network requirements and capabilities to support ETS over evolving circuit-switched and packet-switched networks. Yet, [ITU-T Y.1271] outlines the requirements and capabilities in general and abstract terms, as a technology neutral document.

The definition of NGNs introduced new technical mechanisms to support the underlying network requirements of ETS. Therefore, [ITU-T Y.2205] provides the technical aspects (identification of issues and potential solutions) to support ETS over NGN, including both the service stratum and the transport stratum. Appendix III of [ITU-T Y.2205] provides an example of ETS call flow for NGN, based on the proposals in [ITU-T Q Suppl.57], including the use of session initiation protocol (SIP) for call signalling and the SIP resource priority header for interoperability between different ETS systems.

[ITU-T Y.2205] details the interoperability of the protocols in the service and transport strata:

- In the service stratum, different ENIs are possible and thus mapping principles between the SIP (i.e., SIP resource priority header), IEPS, [ITU-T H.323] and DIAMETER protocols are detailed.
- In the transport stratum, different quality of service- (QoS-) enforcing mechanism options (e.g., resource reservation protocol (RSVP), differentiated services (DiffServ)) are proposed to support the traffic prioritization in IP-based networks.
- The orchestration between the two strata is based in the resource and admission control functions (RACF) element, for QoS-related negotiation and reservation in the NGN architecture.

[ITU-T Y.1271] defines the basic set of functional requirements and capabilities for emergency telecommunications, further extended by [ITU-T Y.2205]; see Table 1.

Table 1 – Functional capabilities for ETS

Enhanced priority treatment	
Secure networks	
Location confidentiality	
Restorability	
Network connectivity	
Interoperability	
Mobility	
Ubiquitous coverage	
Enhanced priority treatment	
Survivability/endurability	
Voice transmission (circuit-switched and packet-switched)	
Video transmission (mainly packet-switched) ^a	
Data transmission ^a	Real-time text and imagery ^b
	Non-real-time messages and streams (audio/video) ^b
	Prioritized versions of the following commercial services: web service, file transfer, e-mail, short message service (SMS) over IP and instant messaging (IM) ^c
Scalable bandwidth	
Reliability/availability	
Preferential treatment in congestion control mechanisms ^a	
^a New items introduced in the 2014 edition of [ITU-T Y.1271].	
^b Data services defined in [ITU-T Y.2205].	
^c Cited in [ITU-T Y.1271].	

In addition to service compatibility and reliability, network- and service-level security are of utmost importance when considering the applicability of IP-based services to ETS within the scope of a NGN. In [ITU-T Y.1271], two levels of security are depicted:

- Rapid authentication of authorized users for emergency telecommunications.
- Security protection of emergency telecommunication traffic.

More specifically, [ITU-T Y.2705] analyses the security requirements for the interconnection of ENIs, including references to authentication in NGN in [ITU-T Y.2702]. Again, [ITU-T Y.2705] covers the requirements and general specifications of the security mechanisms in ENI-to-ENI interoperability, but technical details are avoided in the document.

Additionally, [ITU-T M.3350] deals with the integration of ETS into the telecommunication management network (TMN) framework, defining an emergency telecommunications service management service (ETSMS) and the required information flows between the service customer and service provider. However, [ITU-T M.3350] is focused on the IEPS and does not incorporate either NGN concepts or interoperability aspects.

Towards analysing the current status of ENI-to-ENI interoperability, two related Supplements are available:

- [ITU-T Q Suppl.62] summarizes the most relevant activities in ITU-T and other standards development organizations (SDOs) in the scope of ENIs.
- [ITU-T Q Suppl.63] addresses the protocol details of different types of ENI technologies as a step forward to implement the technical mapping between different ENIs.

The historical evolution of ETS-related standards is illustrated in Figure 2.

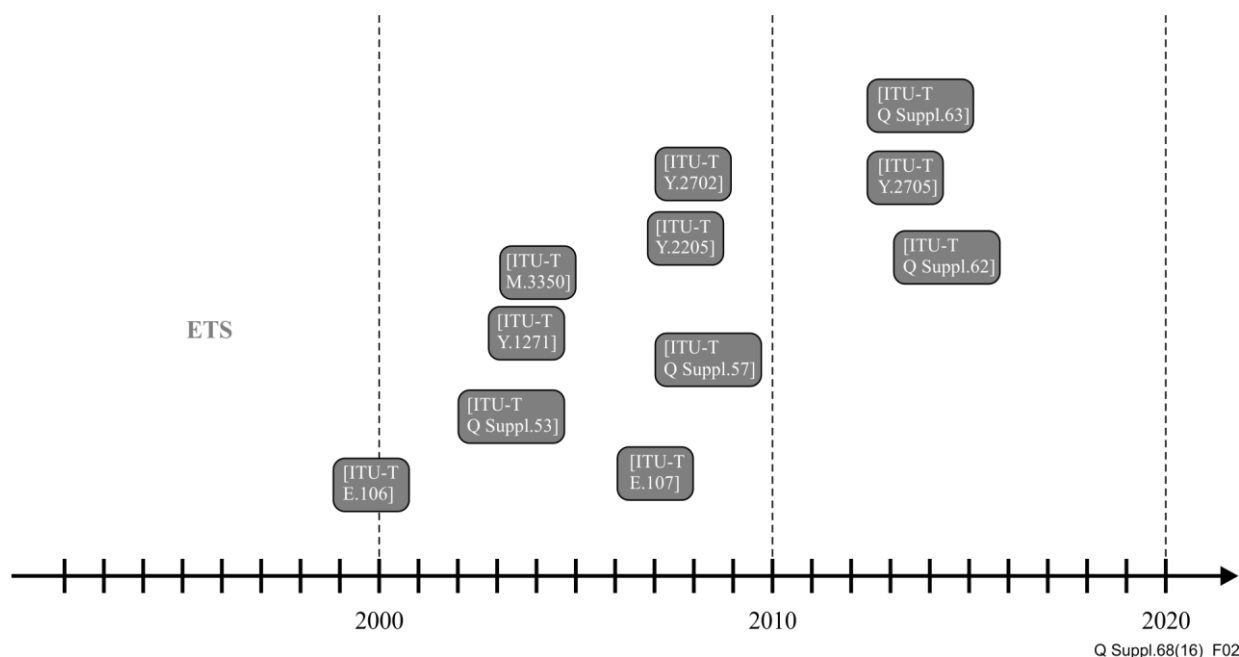


Figure 2 – Evolution of ITU ETS standardization activities and relation to IMT and NGN

Finally, ITU-T SG 13 has started to work on the applicability of future telecommunication systems to ETS. In this way, the use of cloud infrastructure resources for ETS is analysed in [ITU-T Y.3501], [ITU-T Y.3510] and [ITU-T Y.3520]. ETS functional requirements are analysed and addressed from the high-level standpoint of the cloud computing paradigm.

6 Identification of ETS interoperability limitations

Taking into account the list of ETS functional capabilities in Table 1 and the current status and trend of commercial telecommunications services, this clause identifies and analyses possible limitations in ENI-to-ENI interoperability contexts.

Considering that most interoperability limitations in multi-ENI environments could to some extent be solved either by multiple bi-lateral or multilateral service level agreements (SLAs), associated limitations are listed upfront.

This clause is organized as follows:

- Clause 6.1 presents a series of use cases to illustrate complex scenarios where possible limitations are analysed.
- Clause 6.2 summarizes ETS functional capabilities for which possible limitations have been detected and whether they could benefit from some enhancement in terms of protocol mapping or further protocol clarification.

6.1 Analysis of selected use cases

This clause introduces a subset of possible scenarios where possible limitations need to be analysed including specifically the following NGN-based real-time conversational multimedia services:

- Multimedia Telephony Services (MMtel) [ITU-T Y.2211], including:
 - Voice transmission.
 - Video transmission.
 - Real-time text/instant messaging.
- Call transfer (CT) [ITU-T Y.2211]:

- Group communication (GC) [ITU-T Y.2211].
- Multi-party communication (MPC) [ITU-T Y.2211].
- Multimedia conference (MultiCONF) [ITU-T Y.2211].
- Enhanced multimedia telephony services (eMMtel) – presence sharing (eMMtel-PS) [ITU-T Y.2254].

In this clause, security and confidentiality issues are analysed as sample use cases, which are further detailed in clause 06.2, in which a comprehensive analysis, extended to all functional requirements, is provided, see Table 2.

Table 2 – Possible inter-ENI interoperability limitations

Functional requirements	Limitations	Affected services	Sample use cases
Secure networks <ul style="list-style-type: none"> • Need for expanded encryption techniques and user authentication. [ITU-T Y.1271] • Protect the integrity of all inter-network ETS signalling traffic. [ITU-T Y.2705] • Protect the integrity of all inter-network ETS media traffic. [ITU-T Y.2705] 	Cryptographic measures may impact the interoperability between ETS users at different ENIs. <ul style="list-style-type: none"> • Signalling protection shall be compatible between ENIs. • Different ENIs may implement different encryption requirements on a media plane. Media flows may need to be cross-ciphered between ENIs so that user devices can support interoperable communication. 	MMtel	Ciphering/key agreement and security association in a multi-ENI environment. Signalling and security implications for MPC and MultiCONF servers in bilateral and multilateral ETS sessions.
	Complex technical issues due to multi-party multi-ENI communications. <ul style="list-style-type: none"> • Possible service disruption when transferring a media flow to a third party. • Possible service incompatibilities in multi-party group communications. 	CT MPC MultiCONF	
Secure networks <ul style="list-style-type: none"> • Personally identifiable information (PII): allow selected ETS users to use ETS anonymously [ITU-T Y.2705] • PII: protect the confidentiality of selected ETS user identities [ITU-T Y.2705] 	Exposition of PII issues: <ul style="list-style-type: none"> • Possible exposition of personal information (e.g., naming, addressing, transport stratum information) in call signalling and media flows. • Complex technical issues related to call transfer and group communications. 	MMtel CT GC MPC MultiCONF	Security and PII constraints in individual multimedia session. Information exchange in multimedia group session among different ENIs. Information exchange on CT.

Table 2 – Possible inter-ENI interoperability limitations

Functional requirements	Limitations	Affected services	Sample use cases
Location confidentiality: <ul style="list-style-type: none"> ETS users may need to organize emergency operations without risk of their location being discovered. [ITU-T Y.1271] PII: protect the confidentiality of the location of selected ETS users [ITU-T Y.2705] 	Location information included in presence sharing or in pre-defined group information.	GC eMMtel-PS	ALL
	Location-related information (e.g., IP address) included in signalling and media planes.	MMtel CT MPC MultiCONF	

6.1.1 Security and PII constraints in individual multimedia sessions

[ITU-T Y.2701] defines a security trust model in order to identify the security specific requirement for NGN. More specifically, for the interconnection of any NGN to other networks, [ITU-T Y.2701] suggests considering other providers as un-trusted, even under the so-called peering trust model. Moreover, specific nodes called domain border elements in the limit between trusted and un-trusted or trusted but vulnerable zones would be those considered in situations such as a network-to-network interface (NNI) between NGNs. In fact, [ITU-T Y.2705] summarizes some technical mechanisms (i.e., Internet protocol security (IPSec) tunnels for the exchange of information in the peering points or differentiated services code point (DSCP) marking for enforcing priority across domains). Although not completely specified in ITU-T Recommendations, the list of high-level requirements in [ITU-T Y.2705] covers most interoperability issues. However, the current trend of evolution in broadband mobile multimedia towards voice over long term evolution/rich communication services/Internet protocol multimedia subsystem (VoLTE/RCS/IMS) introduces new details to be considered in the exchange of information of the NNI. Example features to be considered are: location information in the session setup (i.e., SIP INVITE location and contact headers), the need for standardized border-controlling/topology hiding mechanisms and identity mapping, which will be specifically linked to the interoperable MultiCONF-enabling architecture.

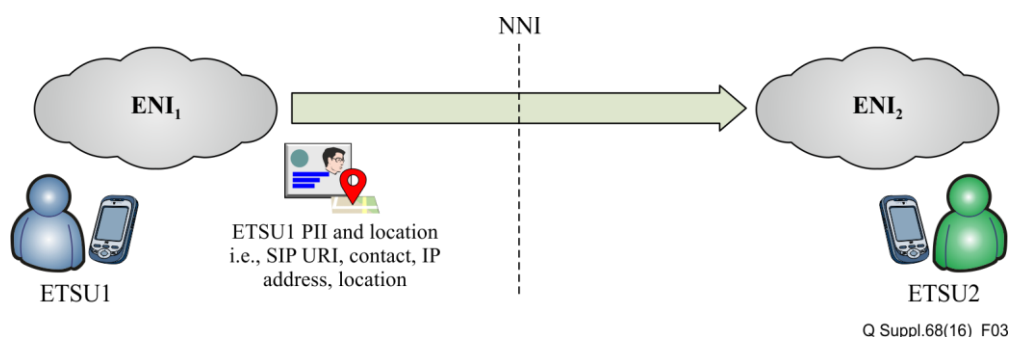


Figure 3 – Security and PII constraints in individual multimedia session

6.1.2 Information exchange on CT

As in the previous case, the initial caller should have the identity (addressing) information of the callee in ENI₂ prior to the session setup. Therefore, anonymized or controlled identifiers could be