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SERIES Q: SWITCHING AND SIGNALLING, AND ASSOCIATED MEASUREMENTS AND TESTS

Signalling requirements for IP multimedia subsystem (IMS) emergency telecommunications service in support of multiple access

ITU-T Q-series Recommendations – Supplement 72

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Supplement 72 to ITU-T Q-series Recommendations

Signalling requirements for IP multimedia subsystem (IMS) emergency telecommunications service in support of multiple access

Summary

Supplement 72 to ITU-T Q-series Recommendations specifies the signalling requirements for Internet protocol (IP) multimedia subsystem (IMS) emergency telecommunications service in support of multiple access including fixed broadband, wireless fidelity (Wi-Fi), fourth generation (4G) and fifth generation (5G) networks.

History

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Signalling requirements for multimedia subsystem (IMS) emergency telecommunications service in support of multiple access

1 Scope

This Supplement identifies and discusses the following aspects of an Internet protocol (IP) multimedia subsystem (IMS) emergency telecommunications service:

– architecture;

– signalling requirements.

2 References

[ITU-T P.10] Recommendation ITU-T P.10/G.100 (2017), *Vocabulary for performance, quality of service and quality of experience*.

[ETSI TS 122 261] ETSI TS 122 261 V16.12.0 (2020), *5G; Service requirements for the 5G system*.

[ETSI TS 123 167] ETSI TS 123 167 V16.2.0 (2020), *Universal mobile telecommunications system (UMTS); LTE; IP multimedia subsystem (IMS) emergency sessions*.

[ETSI TS 123 228] ETSI TS 123 228 V15.4.0 (2019), *Digital cellular telecommunications system (Phase 2+) (GSM); Universal mobile telecommunications system (UMTS); LTE; IP multimedia subsystem (IMS); Stage 2*.

[ETSI TS 123 401] ETSI TS 123 401 V15.11.0 (2020), *LTE; General packet radio service (GPRS) enhancements for evolved universal terrestrial radio access network (E-UTRAN) access*.

[ETSI TS 123 402] ETSI TS 123 402 V15.3.0 (2018), *Universal mobile telecommunications system (UMTS); LTE; Architecture enhancements for non-3GPP accesses*.

[ETSI TS 123 501] ETSI TS 123 501 V15.10.0 (2020), *5G; System architecture for the 5G System (5GS)*.

3 Definitions

3.1 Terms defined elsewhere

This Supplement uses the following term defined elsewhere:

3.1.1 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.

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Supplement uses the following abbreviations and acronyms:

4G fourth Generation

5G fifth Generation

5GC	fifth Generation Core
AAR	Authentication and Authorization Request
AGPS	Augmented Global Positioning System
APN	Access Point Name
DNN	Data Network Name
EC	Emergency Centre
E-CSCF	Emergency Call Session Control Function
ETS	Emergency Telecommunications Service
GPS	Global Positioning System
ID	Identifier
IMS	IP Multimedia System
IP	Internet Protocol
LRF	Location Retrieval Function
LTE	Long-Term Evolution
P-CSCF	Proxy Call Session Control Function
PANI	Private-Access Network Information
PCF	Policy Control Function
PCRF	Policy and Charging Rules Function
PGW	Packet data network Gateway
PSAP	Public Safety Answering Point
QoS	Quality of Service
RAR	Re-Authorization Request
UE	User Equipment
VoLTE	Voice over Long-Term Evolution
Wi-Fi	Wireless Fidelity

5 Conventions

None.

6 General aspects of IMS ETS for multiple access

6.1 Description of IMS ETS for multiple access

An IMS is based on an IP connection and is compatible with all kinds of access technologies, including fixed broadband, wireless fidelity (Wi-Fi), fourth generation (4G) and fifth generation (5G) networks. Users can initiate an IMS emergency call via multiple access.

If user equipment (UE) has the ability and condition to attach to several access networks, the setup of an emergency call should follow the priority strategy specified in [ETSI TS 123 401] and [ETSI TS 123 402].

In an IMS, when a proxy call session control function (P-CSCF) receives an initial emergency call request from an IMS UE, it should forward it to an emergency call session control function (E-CSCF)

directly in accordance with [ETSI TS 123 167].The E-CSCF handles the emergency call request and forwards it to an appropriate emergency centre (EC).

Figure 1 shows an overview of an emergency call initiated by IMS UE.

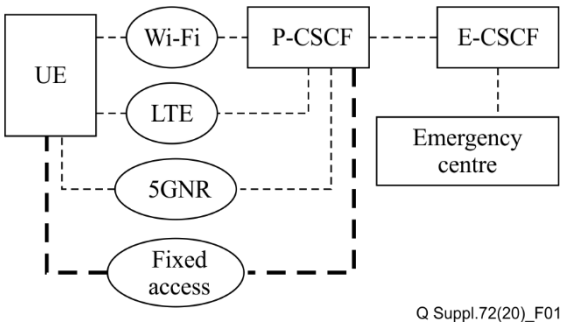

Figure 1 – Overview of an emergency call initiated by an IMS UE

6.2 Scenarios of IMS ETS for multiple access

Considering the various kinds of access technologies, there are several scenarios as follows.

– Scenario 1: When UE accesses an IMS network via long-term evolution (LTE) through an SGi interface (specified in [ETSI TS 123 401]), the signalling of IMS emergency registration, emergency call establishment and session data are transferred through an emergency access point name (APN) in accordance with [ETSI TS 123 228]. When UE accesses an IMS network via an LTE network through the Internet directly, the signalling of IMS emergency registration, emergency call establishment and session data are transferred through the Internet APN. See Figure 2.

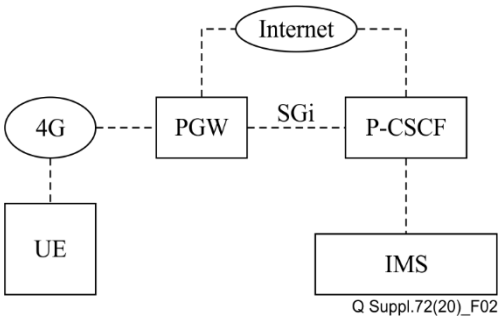

Figure 2 – UE accesses an IMS network via LTE access

– Scenario 2: When UE accesses an IMS network via a Wi-Fi connection and EPC core network through an SGi interface, the signalling of IMS emergency registration, emergency call establishment and session data are transferred through an emergency APN. When UE accesses an IMS network via a Wi-Fi connection through the Internet directly, the signalling of IMS emergency registration, emergency call establishment and session data are transferred through direct Wi-Fi access. See Figure 3.

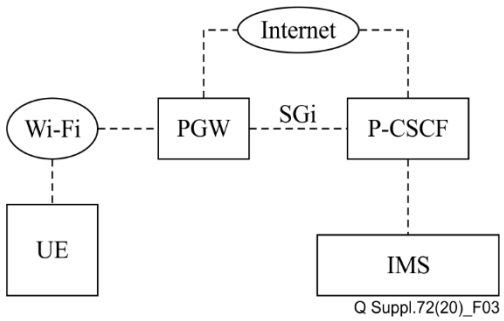

Figure 3 – UE accesses an IMS network via Wi-Fi access

– Scenario 3: UE accesses an IMS network via fixed access. The signalling of IMS registration, call establishment and session data are transferred through a fixed IP connection. See Figure 4.

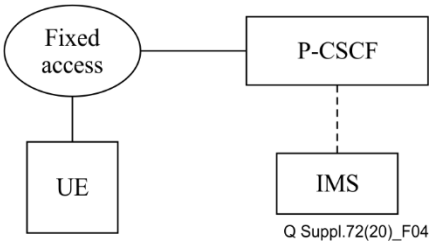

Figure 4 – UE accesses an IMS network via fixed access

– Scenario 4: UE accesses an IMS network via a 5G network. The signalling of IMS registration, call establishment and session data are transferred through an IMS data network name (DNN) via a 5G network. When the call is redirected or handed over to 4G because of EPS fall-back, the successive signalling and session data are transferred through an emergency APN in accordance with [ETSI TS 123 228]. Additionally, the signalling of IMS emergency registration and emergency call establishment are transferred through an emergency APN via a 4G network. When the call is carried in a 5G core (5GC) network, the signalling of IMS emergency registration and emergency call establishment are transferred through an emergency DNN via a 5G network. When UE accesses an IMS network via a 5G network through the Internet directly, the signalling of IMS emergency registration, emergency call establishment and session data are transferred through an Internet DNN via a 5G network. See Figure 5.

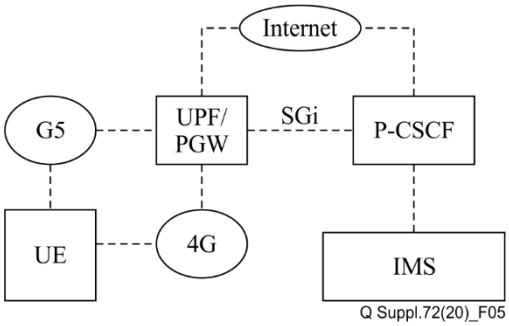

Figure 5 – UE accesses an IMS network via 5G access

7 General requirements of IMS ETS for multiple access

IMS UE and the network are required to support an emergency telecommunications service. Emergency telecommunications service is a regulatory service that is not affected by access type.

When initiating an emergency call, IMS UE conforms to the requirements of the location. If the location is required by national regulation, IMS UE conveys the actual location information in the emergency telecommunications.

When receiving an emergency call request, a P-CSCF shall add UE location information into a private-access network information (PANI) header field and route it to an E-CSCF. The E-CSCF requests the route to a public safety answering point (PSAP) from the location retrieval function (LRF) or local routing list. According to the routing information, an IMS network chooses routing solutions to the PSA for UE. When carrying an emergency call, IMS UE and the network implement solutions to assure the quality of service (QoS) of the emergency call. The related requirements are as follows:

– IMS UE and the network support different QoS control policies and QoS assurance solutions according to different access types;
– IMS UE and the network, including access network, core network and other data network, support QoS parameter mapping and translation;
– from the core network perspective, QoS policies can be controlled and managed by a policy and charging rules function (PCRF) or policy control function (PCF);
– the QoS assurance procedure needs to be triggered by entities such as a P-CSCF;
– the network needs to support consistent QoE standards (see [ITU-T P.10]), regardless of access type and maps QoE requirements to QoS parameters according to different access types;
– the QoS key performance indicators are specified in [ETSI TS 122 261], including delay, jitter, set-up time and packet loss.

An IMS network supports the detection of illegal emergency calls. When a P-CSCF identifies illegal emergency calls, it refuses them.

8 Signalling requirements for IMS ETS for multiple access

8.1 Signalling procedure for IMS ETS for multiple access

8.1.1 Signalling procedure for LTE access

In scenario 1, where UE accesses an IMS via an LTE network, the signalling procedure is as illustrated in Figure 6.

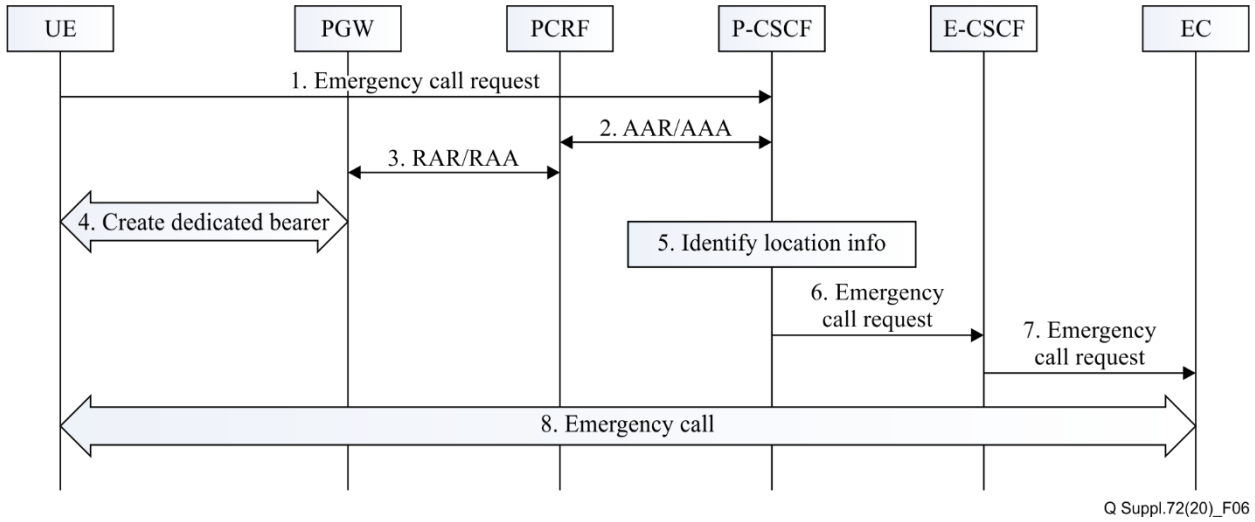

Figure 6 – Signalling procedure for LTE access

1. UE initiates a request, carrying an indication that the request is for emergency services.
2. The P-CSCF detects that the request is for emergency services. P-CSCF analyses and obtains calling and called number from the invite request, and sends the calling and called number in an authentication and authorization request (AAR) to the PCRF.
3. The PCRF sends a re-authorization request (RAR) to the packet data network gateway (PGW) to issue an IMS ETS policy and trigger the related dedicated bearer setup.
4. The PGW creates a dedicated bearer for the media data of the emergency call.
5. A P-CSCF checks the integrity and validity of the PANI header field that contains cell identifier (ID) information as location.
6. The P-CSCF sends the invite request to the E-CSCF.
7. The E-CSCF gets cell ID information in a PANI and an emergency number in a request URI, and requests the route to an EC from the LRF or local routing list. The E-CSCF loads the route information into a request URI and sends it to the EC.
8. The emergency call is established.

8.1.2 Signalling procedure for Wi-Fi access

In scenario 2, where UE accesses an IMS via a Wi-Fi connection and an EPC core network through an SGi interface, the signalling procedure is similar to that in Figure 6, except step 5. In scenario 2, where the UE accesses an IMS via a Wi-Fi connection through the Internet directly, the signalling procedure does not include steps 2 to 4 in Figure 6, and step 5 is modified as follows.

Step 5: The P-CSCF checks the integrity and validity of the PANI header field. In addition, the P-CSCF identifies the location information based on one or more of the following pieces of information: present cell ID, previous cell ID, global positioning system/augmented global positioning system (GPS/AGPS) information, IP address and access point information.

8.1.3 Signalling procedure for fixed access

In scenario 3, where UE accesses an IMS via a fixed network, the signalling procedure does not include steps 2 to 4 in Figure 6, and step 5 in signalling procedure is modified as follows.

Step 5:

– if location information is missing, the P-CSCF shall add its domain name and UE IP information to the PANI header field;
– if the PANI contains location information, the P-CSCF shall identify it, and add its domain name to the PANI header field.

8.1.4 Signalling procedure for 5G network access

In scenario 4, where UE accesses an IMS via a 5G network, when the call is carried in a 5GC network, the signalling procedure is as depicted in Figure 7.

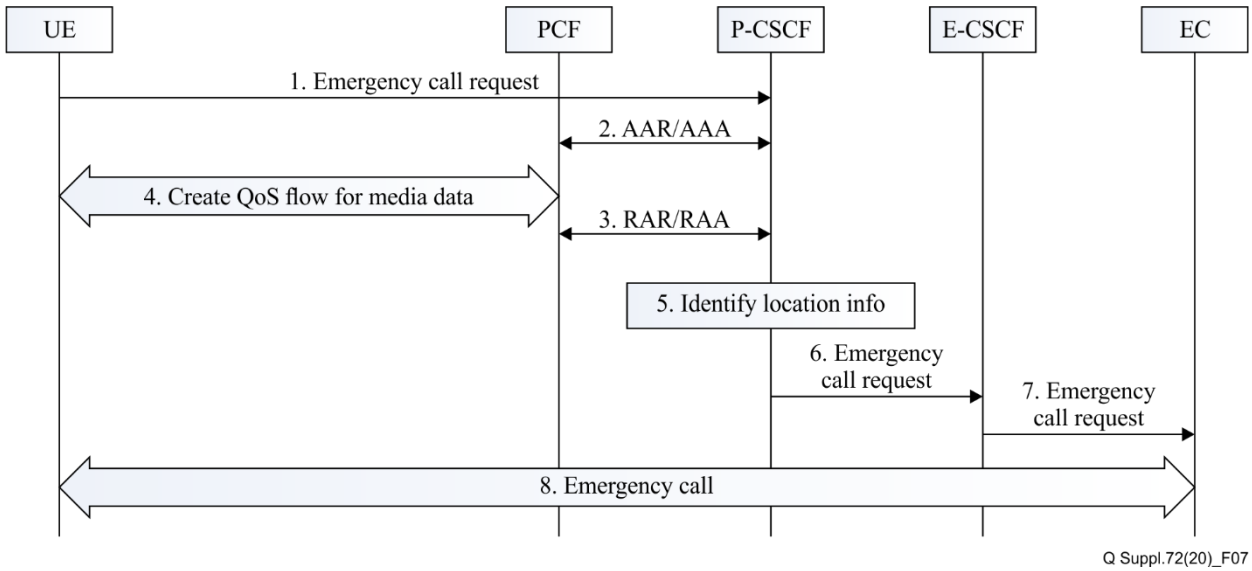

Figure 7 – Signalling procedure for 5G access

1. UE initiates a request, carrying an indication that the request is for emergency services.
2. The P-CSCF detects that the request is for emergency services and transfers it via the 5G network. The P-CSCF analyses and obtains calling and called number from the invite request, and sends the calling and called number in an AAR to the PCF.
3. The PCF triggers the 5GC network to create related QoS flow for the media data. The creation of the QoS flow procedure is in accordance with [ETSI TS 123 501].
4. The PCF sends an RAR to the P-CSCF with the UE location information.
5. The P-CSCF checks the integrity and validity of the PANI header field, obtains the location information from the RAR and adds it to the PANI header field with a network-provided parameter.
6. The P-CSCF sends the invite request to the E-CSCF.
7. The E-CSCF gets cell ID information in a PANI and an emergency number in a request URI, and requests the route to an EC from the LRF or local routing list. The E-CSCF loads the route information into a request URI and sends it to an EC.
8. The emergency call is established.

When the call is redirected or handed over to 4G because of EPS fall-back, the signalling procedure is the same as in Figure 6.

8.2 Signalling requirements for a locating scheme

8.2.1 Requirements for a locating scheme via LTE access

In a scenario where UE accesses an IMS via an LTE network, UE contains cell ID information as location information in an invite request, such as a PANI header field.

A network element, such as an E-CSCF or EC, brings an ETS-related process into conformity based on cell ID location information.

8.2.2 Requirements for a locating scheme via Wi-Fi access

In scenario 2, where UE accesses an IMS via a Wi-Fi network, when UE initiates an emergency call, it contains its present cell ID as location in the invite request if it can receive a cellular network signal.

When UE initiates an emergency call, it contains the previous cell ID and related stamp, GPS or AGPS information and IP address if:

– the UE cannot get a cell ID when it initiates an emergency call;

– the UE can get GPS/AGPS information.

When UE initiates an emergency call, it contains the previous cell ID and related stamp, and the IP address if:

– the UE cannot get a cell ID when it initiates an emergency call;

– the UE cannot get GPS/AGPS information.

When UE initiates an emergency call, it contains GPS/AGPS information, the IP address and access point information if:

– the UE cannot get a cell ID and previous cell ID when it initiates an emergency call;

– the UE can get GPS/AGPS information.

When UE initiates an emergency call, it contains the IP address and access point information if:

– the UE cannot get a cell ID and previous cell ID when it initiates an emergency call;

– the UE cannot get GPS/AGPS information.

When UE adds different location information to an invite request, it uses a different header field or different parameter names in one header field to identify different location information types.

A network element, such as an E-CSCF or EC, supports the identification of different location information types and brings an ETS-related process into conformity based on the integrated result of this information.

8.2.3 Requirements for a locating scheme via fixed access

When UE initiates an IMS emergency request, UE shall provide the access point information, and add it to a PANI header field.

If UE cannot identify emergency requests or support a PANI header field, the P-CSCF shall provide the UE IP information, and add it to the PANI header field.

The E-CSCF gets the UE location information in the PANI and an emergency number in a request URI, and requests the route to a PSAP from the LRF or local routing list.

8.2.4 Requirements for a locating scheme via 5G network access

In scenario 4, where UE accesses an IMS via a 5G network, UE contains cell ID information as location information in an invite request, such as a PANI header field. While the PCF sends an RAR to the P-CSCF with UE location information, the P-CSCF obtains the location information from the RAR and adds it to a PANI header field with a network-provided parameter.

A network element, such as an E-CSCF or EC, brings an ETS-related process into conformity based on the aforementioned location information.

8.3 Signalling requirements for QoS assurance

8.3.1 Signalling requirements for QoS assurance via LTE access

When UE accesses an IMS via a 4G network with an SGi interface, which is known as voice over long-term evolution (VoLTE), the ETS procedure and QoS assurance requirements follow the VoLTE ETS specification in accordance with [ETSI TS 123 167].

When UE accesses an IMS via a 4G network through the Internet directly, the signalling and media of the emergency call are transferred through the PGW and an Internet APN. QoS assurance can be implemented by establishing dedicated bearers on an Internet APN.

The establishment of dedicated bearers for signalling and media support different mechanisms. The dedicated bearers for signalling and media support different QoS class identifiers.

The PGW establishes a dedicated bearer for signalling of the emergency call according to a static strategy based on destination IP address and port. When UE initiates an emergency call, the P-CSCF supports analyse and obtain calling and called number from an invite request, and sends the calling and called number in an AAR to the PCRF if the called number is one for emergency calls. The PCRF sends an RAR to the PGW to issue an IMS ETS policy and trigger the related dedicated setup. The PGW establishes a dedicated bearer for the media data of the emergency call.

8.3.2 Signalling requirements for QoS assurance via Wi-Fi access

When UE accesses an IMS via a Wi-Fi connection and the EPC core network through an SGi interface, the signalling and media of the emergency call are transferred through the PGW and an emergency APN, the same as for VoLTE. So the basic QoS assurance procedure of this scenario is the same as that for VoLTE from a core network perspective. The differences are the QoS mapping method and the QoS mechanism in the access network. In this scenario, Wi-Fi access entities including AP and AC support identify the related core network QoS parameters and map them to Wi-Fi access network QoS parameters, and control the Wi-Fi access network resources for the IMS emergency call.

When UE accesses an IMS via a Wi-Fi network through the Internet directly, the signalling and media of the emergency call are transferred through direct Wi-Fi access. In this scenario, the signalling of the emergency call is not transferred through the EPC network, there is no bearer establishment from the core network perspective, so QoS assurance cannot be implemented by a PCRF policy control mechanism.

8.3.3 Signalling requirements for QoS assurance via fixed access

When UE accesses an IMS via fixed access, the signalling and media of the emergency call are transferred through direct fixed access. In this scenario, QoS assurance can be implemented by a fixed access mechanism.

8.3.4 Signalling requirements for QoS assurance via 5G network access

When UE accesses an IMS network via a 5G network and the call is redirected or handed over to 4G because of EPS fall-back, the signalling of the IMS emergency registration and emergency call establishment is transferred through an emergency APN via a 4G network. So the basic QoS assurance procedure of this scenario is the same as that for VoLTE from the core network perspective.

When the call is carried in a 5GC network, the signalling of IMS emergency registration and emergency call establishment are transferred through an emergency DNN via the 5G network. QoS assurance can be implemented by establishing dedicated QoS flow. The establishment of QoS flow for signalling and media support different mechanisms. The QoS flow for signalling and media support different 5G QoS indicators.

The SMF establishes QoS flow for signalling of the emergency call according to a static strategy based on the destination IP address and port. When UE initiates an emergency call, P-CSCF supports analyse and obtain calling and called number from an invite request, and sends them in an AAR to the PCF, if the called number is one for emergency calls. The PCF sends an RAR to the SMF to issue the IMS ETS policy and trigger the related QoS flow setup. The SMF requests the 5GC network and access network to establish a QoS flow resource for media data of the emergency call in accordance with [ETSI TS 123 501].

9 Security considerations

The signalling procedure for an IMS emergency telecommunications service is required to support security mechanisms of session control and privacy assurance, no matter how UE accesses. Sensitive information, e.g., location, should be protected and encrypted when transmitting in order to avoid leakage and falsification.

Bibliography

[b-ITU-T E.107] Recommendation ITU-T E.107 (2007), *Emergency Telecommunications Service (ETS) and interconnection framework for national implementations of ETS*.

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