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TELECOMMUNICATION
STANDARDIZATION SECTOR
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Signalling requirements and protocols for IMT-2000

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Next Generation Networks – Generalized mobility

FMC service using legacy PSTN or ISDN as the fixed access network for mobile network users

ITU-T Recommendation Q.1763/Y.2803

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ITU-T Recommendation Q.1763/Y.2803

FMC service using legacy PSTN or ISDN as the fixed access network for mobile network users

Summary

In a fixed-mobile convergence (FMC) network environment, convergence between legacy PSTN and ISDN and mobile networks is a typical example of a pre-IMS FMC network environment. ITU-T Recommendation Q.1763/Y.2803 defines the service features, service architecture, and capability requirements of the convergence service between legacy PSTN and ISDN and mobile networks. An example of the implementation of the converged service is provided.

Source

ITU-T Recommendation Q.1763/Y.2803 was approved on 29 October 2007 by ITU-T Study Group 19 (2005-2008) under the ITU-T Recommendation A.8 procedure.

Keywords

Fixed-mobile convergence, Intelligent Network, ISDN, mobile network, PSTN.

FOREWORD

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ITU-T Recommendation Q.1763/Y.2803

FMC service using legacy PSTN or ISDN as the fixed access network for mobile network users

1 Scope

This Recommendation describes the service features, service architecture and capability requirements for using the legacy PSTN or ISDN as a fixed access network for mobile network users (PAM service) and provides an example of the implementation of the PAM service.

Mechanisms to support the basic voice and video telephony services are described.

The mobile networks discussed in this Recommendation refer specifically to GSM/UTRAN [ITU-T Q.1741] networks and ANSI-41/cdma2000 [ITU-T Q.1742] networks.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T Q.1224] ITU-T Recommendation Q.1224 (1997), *Distributed functional plane for intelligent network Capability Set 2*.

[ITU-T Q.1701] ITU-T Recommendation Q.1701 (1999), *Framework for IMT-2000 networks*.

[ITU-T Q.1702] ITU-T Recommendation Q.1702 (2002), *Long-term vision of network aspects for systems beyond IMT-2000*.

[ITU-T Q.1711] ITU-T Recommendation Q.1711 (1999), *Network functional model for IMT-2000*.

[ITU-T Q.1741] ITU-T Recommendations Q.1741-series:

- Q.1741.1 (2002), *IMT-2000 references to release 1999 of GSM evolved UMTS core network with UTRAN access network*.
- Q.1741.2 (2002), *IMT-2000 references to release 4 of GSM evolved UMTS core network with UTRAN access network*.
- Q.1741.3 (2003), *IMT-2000 references to release 5 of GSM evolved UMTS core network*.
- Q.1741.4 (2005), *IMT-2000 references to release 6 of GSM evolved UMTS core network*.

[ITU-T Q.1742] ITU-T Recommendations Q.1742-series:

- Q.1742.1 (2002), *IMT-2000 references to ANSI-41 evolved core network with cdma2000 access network*.
- Q.1742.2 (2003), *IMT-2000 references (approved as of 11 July 2002) to ANSI-41 evolved core network with cdma2000 access network*.
- Q.1742.3 (2004), *IMT-2000 references (approved as of 30 June 2003) to ANSI-41 evolved core network with cdma2000 access network*.

– Q.1742.4 (2005), *IMT-2000 references (approved as of 30 June 2004) to ANSI-41 evolved core network with cdma2000 access network.*

– Q.1742.5 (2006), *IMT-2000 references (approved as of 31 December 2005) to ANSI-41 evolved core network with cdma2000 access network.*

– Q.1742.6 (2007), *IMT-2000 references (approved as of 31 December 2006) to ANSI-41 evolved core network with cdma2000 access network.*

[ITU-T Q.1761] ITU-T Recommendation Q.1761 (2004), *Principles and requirements for convergence of fixed and existing IMT-2000 systems*.

[ITU-T Q.1762] ITU-T Recommendation Q.1762/Y.2802 (2007), *Fixed-mobile convergence general requirements*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 fixed-mobile convergence [ITU-T Q.1762]: In a given network configuration, the capabilities that provide service and application to the end-user regardless of the fixed or mobile access technologies being used and independent of user's location. In the NGN environment, it means to provide NGN services to end-users regardless of the fixed or mobile access technologies being used.

3.1.2 nomadism [ITU-T Q.1761]: Ability of the user to change his network access point after moving; when changing the network access point, the user's service session is completely stopped and then started again, i.e., there is no handover possible. It is assumed that the normal usage pattern is that users shut down their service session before moving to another access point or changing terminal. This is the mobility alluded to in the case of fixed-mobile convergence.

3.2 Terms defined in this Recommendation

There are no terms defined in this Recommendation.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

2G	Second Generation
3G	Third Generation
AP	Access Point
AuC	Authentication Centre
CAMEL	Customized Applications for Mobile network Enhanced Logic
CAP	CAMEL Application Protocol
CCF	Call Control Function
CDMA	Code Division Multiple Access
CLI	Calling Line Identity
CLIP	Calling Line Identification Presentation
CLIR	Calling Line Identification Restriction
CS	Circuit Switched

CSI	CAMEL Subscription Information
DTMF	Dual Tone Multiple Frequency
FE	Functional Entity
FMC	Fixed-Mobile Convergence
FSK	Frequency Shift Keying
GMSC	Gateway Mobile Switching Centre
GSM	Global System for Mobile communications
HLR	Home Location Register
HSS	Home Subscriber Server
IMSI	International Mobile Station Identity
IMT-2000	International Mobile Telecommunications – 2000
IN	Intelligent Network
IP	Intelligent Peripheral
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part
LE	Local Exchange
MAP	Mobile Application Protocol
MD5	Message-Digest algorithm 5
MS	Mobile Station
MSC	Mobile Switching Centre
MSISDN	Mobile Station International ISDN Number
MSN	Multiple Subscriber Number
N-CSI	Network CAMEL Subscription Information
PAM	PSTN Access for Mobile users
POTS	Plain Old Telephone Service
PSTN	Public Switched Telephone Network
RAN	Radio Access Network
RNS	Radio Network Subsystem
SAC	Service Access Code
SCF	Service Control Function
SCP	Service Control Point
SHA-1	Secure Hash Algorithm 1
SHA-256	Secure Hash Algorithm 256
SLA	Service Level Agreement
SRF	Specialized Resource Function
SSF	Service Switching Function
SSP	Service Switching Point

T-CSI	Terminating CAMEL Subscription Information
UMTS	Universal Mobile Telecommunication System
UPT	Universal Personal Telecommunication
UTRAN	Universal Terrestrial Radio Access Network
VLR	Visitor Location Register
WIN	Wireless Intelligent Network

5 Conventions

In this Recommendation, references to "mobile network" should be read as applying equally to GSM/UTRAN [ITU-T Q.1741] networks and ANSI-41/cdma2000 [ITU-T Q.1742] networks.

In addition:

- "he" should be read as gender neutral, that is referring to "he" or "she" as appropriate; and
- "his" should similarly be read as gender neutral.

6 Service features

The PAM service provides a mobile user with access to voice and video telephony services utilizing the PSTN/ISDN via an available access point (AP) with an appropriate dual mode mobile terminal. Whether the AP is connected to the legacy network via a PSTN analogue or an ISDN access interface does not affect the service from the PAM user's point of view.

The dual mode dual radio mobile terminal provides the user the accesses to the legacy PSTN/ISDN and mobile networks using a single terminal.

6.1 Service numbering

The PAM service supports two types of numbering:

- The user is identified by a discrete PAM service number (referred to as a "fixed PAM service number" which may be in the form of, e.g., an UPT number). The fixed PAM service number is used separately from the user's mobile number (MSISDN). The fixed PAM service number is used to make and receive calls when the user is being provided service by means of a PSTN/ISDN access, while the mobile number (MSISDN) is used when the user is being provided service by means of a mobile network access.
- The user is identified by his MSISDN, which is also his PAM service number, independent of whether he is being provided service by a PSTN access or a mobile network access.

6.2 Service subscription

The user needs to subscribe to the PAM service in advance.

- When the fixed PAM service number is used, the subscription information is as follows:
  - a fixed PAM service number assigned by the provider;
  - a user identity assigned by the provider which links to the PAM service number of the user;
  - the user's associated MSISDN for re-routing the terminating call to the mobile network in case the call is not possible to be completed through the PSTN/ISDN;
  - the service access code (SAC) of PAM service which corresponds to the PAM service controlling point of the home network.

- When a MSISDN is used as the PAM service number, the subscription information is as follows:
  - the user's IMSI;
  - a user identity assigned by the provider which links to the IMSI of the user terminal;
  - the service access code (SAC) of PAM service which corresponds to the PAM service controlling point of the home network;
  - the PAM service subscription to be registered in the user's service profile (in the HLR/AuC (HSS)).

6.3 Registration and authentication for legacy fixed network access

The mobile user needs to register at a fixed network access point before making and receiving calls. Authentication is mandatory when a mobile user requests legacy PSTN/ISDN access.

Once the user is authenticated and registered, he is provided voice and video communication using the PSTN/ISDN via the fixed network access point at which he is registered consistent with the limitations related to the capabilities of the access point and the terminal device being used.

The mobile user deregisters when he leaves the access point.

6.4 Call handling

The service supports two different treatments for incoming and outgoing calls according to the service number used.

6.4.1 User assigned a discrete PAM service number

When using a fixed PAM service number separately assigned from the MSISDN, the handling of the call is as follows:

- *Originating call*

  If the user is currently registered at an AP, the originating call will be handled through the PSTN/ISDN when the fixed network access is available. The fixed PAM service number is presented as the calling party number to the called party, and the call is treated according to the service subscription associated with the fixed PAM service number. The call is charged against the fixed PAM service number. If the fixed network access is not available (i.e., the AP that the user is registered at encounters an all fixed access circuits busy situation), the call will be handled through the mobile network, if available, as a normal mobile originating call. The MSISDN is displayed as the calling party number and the call is treated according to the service subscription associated with the MSISDN in the mobile network. The call is charged against the MSISDN.

  If the user is currently not registered for fixed network access, the originating call will be handled through the mobile network, if available, as a normal mobile originating call. The MSISDN is displayed as the calling party number and the call is treated according to the service subscription associated with the MSISDN in the mobile network. The call is charged against the MSISDN.

  The user is provided with visibility of the selection of the radio access (PAM AP or mobile network) used for the originating call.

- *Terminating call*

  When a call is placed to a fixed PAM service number, there will first be a check for whether the PAM user is registered at an AP. If so, the call will be delivered via the PSTN/ISDN to the AP at which the PAM user is currently registered, and the call is treated according to the service subscription associated with the fixed PAM service number. If call completion through the PSTN/ISDN fails (e.g., all the access circuits to the AP are busy),

the call will be forwarded to the mobile network using the MSISDN and the call is treated according to the service subscription associated with the MSISDN.

If the user is currently not registered at an AP, a call to a fixed PAM service number will be forwarded to the mobile network using the MSISDN as the forwarded-to number and the call is treated according to the service subscription associated with the MSISDN.

Charging to the originating party will not be affected when a call is forwarded from the PSTN to the MSISDN of the terminating party.

A call to the MSISDN associated with the PAM user is delivered to the mobile network as a normal mobile terminating call.

6.4.2 MSISDN as the PAM service number

When using the MSISDN as the PAM service number, the handling of the call is as follows:

- *Originating call*

  If the user is currently registered at an AP, an originating call will be handled through the PSTN/ISDN when the fixed network access is available. If the fixed network access is not available (i.e., the AP the user is registered with is busy), the call will be handled through the mobile network, if available, as a normal mobile originating call. Whether the call is handled through the legacy PSTN/ISDN, or through the mobile network, the MSISDN is presented as the calling party number to the called party, and the call is treated according to the service subscription associated with the MSISDN. The call is charged against the MSISDN.

  If the user is currently not registered at an AP, the originating call will be handled through the mobile network, if available, as a normal mobile originating call. The MSISDN is displayed as the calling party number and the call is treated according to the service subscription associated with the MSISDN in the mobile network. The call is charged against the MSISDN.

  The user is provided with visibility of the selection of the radio access (PAM AP or mobile network) used for the originating call.

- *Terminating call*

  When a call is placed to the MSISDN of a subscriber who subscribes to the PAM service, there will first be a check for whether the MSISDN is registered at an AP. If so, the call will be delivered via the PSTN/ISDN to the AP at which the MSISDN subscriber is currently registered. If call completion via the AP fails (e.g., the access lines to the AP are busy), the call will be forwarded through the mobile network using the MSISDN. Whether the call is handled through the legacy PSTN/ISDN or through the mobile network, the call is treated according to the service subscription associated with the MSISDN. Charging to the originating party will not be affected when a call is forwarded from the PSTN/ISDN to the MSISDN on the mobile network of the terminating party.

  If the user is currently not registered at an AP, a call to a MSISDN will be delivered through the mobile network directly and the call is treated according to the service subscription associated with the MSISDN.

6.5 Extent of mobility provided by PAM service

Only nomadism is supported.

When the user is in an active call, the call is interrupted in the following cases:

- the user moves to a different AP; or
- the user changes from an AP to using mobile network access or vice versa.

7 Architecture

7.1 Architecture alternatives

The PAM service is realized by PAM-SCF, PAM access point (AP) function, and PAM terminal function for air interface selection and registration. The PAM-SCF is an intelligent network SCF containing PAM service logic and data, and provides PAM mobility management. The AP functionality manages the air interface connection between itself and the PAM functions in the terminal, and the control relationship between itself and the PAM-SCF. The PAM terminal function interacts with the AP function to manage the air interface selection process.

Two architectures corresponding to the use of a discrete PAM service number or the use of a MSISDN as the PAM service number are described in the following subclauses.

7.1.1 Architecture with a discrete PAM service number assigned

Figure 1 illustrates the functional model of the PAM service when a fixed PAM service number is used. For simplicity, mobile station functions not specific to the PAM service are omitted.

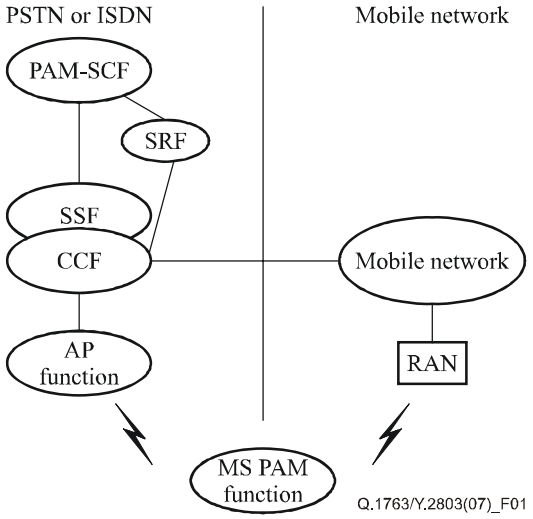

Figure 1 – The functional model of the PAM service using a discrete PAM service number

The functional model in Figure 1 follows the intelligent network functional model described in [ITU-T Q.1224]. The PAM-SCF is an SCF which supports PAM service logic and data.

The functional model shown in Figure 1 can be applied in case of different operators for the legacy PSTN/ISDN and the mobile network and requires no special SLA between the fixed and mobile operators.

7.1.2 Architecture using MSISDN as the PAM service number

Figure 2 illustrates the functional model of the PAM service using a MSISDN as the PAM service number. The PAM-SCF interfaces with HLR/AuC (HSS) in the mobile network. For simplicity, mobile station functions not specific to the PAM service are omitted.

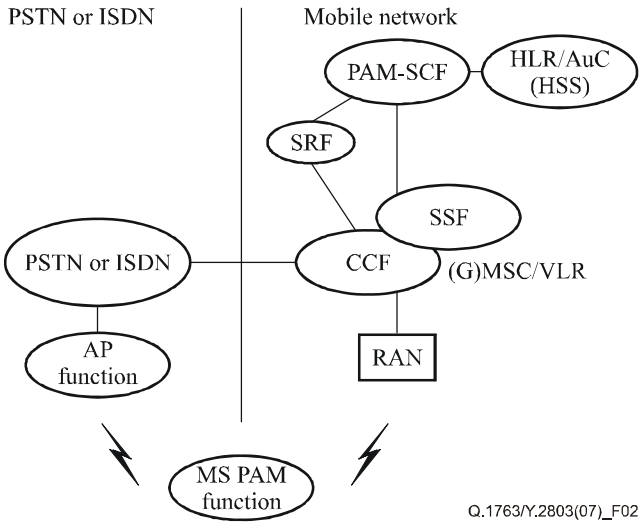

Figure 2 – The functional model of the PAM service using a MSISDN as the PAM service number

Figure 2 applies equally to the CAMEL functional entities defined for a GSM/UTRAN network in [ITU-T Q.1741] and to the equivalent WIN functional entities for an ANSI-41/cdma2000 network in [ITU-T Q.1742].

The PAM-SCF is an SCF which supports PAM service logic and data.

The functional model shown in Figure 2 can be applied in the case of the same operator for both the legacy PSTN/ISDN and the mobile network as well as in the case of different operators cooperating by appropriate interconnection and SLAs.

7.2 Functional entities

7.2.1 Mobile station PAM function

The mobile station PAM function provides dual mode radio access. It allows the user to access the public mobile network via a 3G/2G air interface and to access the fixed network via an alternative air interface to the AP.

The MS PAM function automatically initiates a registration request to the AP function when it detects an appropriate AP to which it can connect. The MS PAM function initiates a deregistration request to the AP function when the user manually deregisters through the menu in the terminal.

For a call origination, when both radio accesses (to the AP and to the mobile network) are available, the MS PAM function selects the radio access to the AP, in case the call set-up through the AP radio access fails, the MS PAM function sends the call request over the mobile network radio access.

The MS PAM function provides the user with indications of:

- whether the fixed network is available via the AP connection (reflecting the registration or deregistration status);
- the selected radio access for the originating call in the ringing and conversation phase.

For authentication of a mobile user through fixed network access via an AP, the MS PAM function provides the same network security mechanism as used in the mobile network, i.e., the same as used in another (mobile radio access) mode of the terminal. The MS PAM function supports the

GSM/UTRAN or ANSI-41/cdma2000 network access security mechanism to perform terminal/network authentication by interaction with the PAM-SCF via the AP function and the SRF.

The PAM service access code (SAC) and the user identity are to be pre-set in the terminal.

7.2.2 Access point function

The access point (AP) appears to the legacy PSTN/ISDN as a user equipment of that network. The AP appears to the MS as if it were a mobile switching centre (MSC).

The AP function supports the basic functions of a POTS terminal or an ISDN terminal appropriate to the interface to the legacy network, including support of calling line identification presentation. In addition, it supports the sending and receiving of in-band DTMF/FSK signal.

The AP function provides conversion between the wireless protocol and the analog or digital line signalling used on the PSTN/ISDN access.

The AP function provides media transcoding between the type of codec used in the terminal and the type of codec used on the PSTN/ISDN access.

In addition, the AP function supports the following functions:

- *Registration and deregistration*

  When an AP function receives a registration request from a MS PAM function, the AP function supports the following ways of identifying the terminal requesting attachment:

  – The AP function allocates a terminal identifier dynamically for that terminal in case a PSTN analogue line is used.

  – The AP function allocates a subscriber number for that terminal dynamically from a set of pre-assigned multiple subscriber numbers when ISDN interface is used (the MSN service needs to be active for the ISDN line and multiple subscriber numbers are assigned to the same ISDN line).

  The AP function sends a registration request by initiating a call request to the fixed network. In the registration procedure, the AP function acts as a "proxy" for the MS PAM function and provides, together with the SRF, the means to transfer information related to authentication between the MS PAM function and the PAM-SCF.

  When an AP function receives a deregistration request from a MS PAM function or when it detects that a terminal is no longer accessible via the AP (e.g., has moved out of range, has been turned off, etc.), the AP function frees the terminal identifier or subscriber number allocated to the terminal and sends a deregistration request by initiating a call request to the fixed network.

- *Originating call handling*

  When an AP function receives a call request from a MS PAM function via the air interface, it checks the PSTN/ISDN access line status. If a line is free, the AP function initiates a call request to the PSTN/ISDN containing the terminal identifier or the subscriber number corresponding to the terminal. If there is no line available, the AP function sends a rejection to the MS PAM function to allow the MS PAM function to automatically select and establish the call through the mobile network radio access if available.

- *Terminating call handling*

  When an AP function receives a terminating call request from the PSTN/ISDN for a mobile terminal, the AP function recognizes the terminal to be connected by using the terminal identifier (in case a PSTN line is used) or the subscriber number (in case an ISDN line is used) and completes the call to the terminal with the CLI to be presented via the air interface to the MS PAM function.

7.2.3 CCF/SSF

The CCF establishes, manipulates and releases calls/connections. The CCF provides trigger mechanisms to access IN functionality (e.g., passes events to the SSF).

The SSF extends the logic of the CCF to include recognition of service control triggers and to interact with the PAM-SCF. The SSF manages signalling between the CCF and the SCF and it modifies call/connection processing functions (in the CCF) as required to process requests for IN provided service usage under the control of the PAM-SCF. The CCF/SSF interacts with the SRF for bearer channel establishment between the SRF and the AP function under the control of PAM-SCF.

The PAM service trigger is handled in SSF as follows:

- When a PAM user requests registration/deregistration/originating call at an AP, the AP initiates a call which invokes an IN trigger based on a prescribed number plan (the SAC of the PAM service) at the SSF so that interaction with a PAM-SCF is initiated.
- A terminating call to a PAM user served with a fixed PAM service number invokes an IN trigger at the SSF based on a prescribed number plan which comprises part of the digits of the fixed PAM service number.
- For a terminating call to a PAM user served with a MSISDN, the PAM-SSF invokes an IN trigger based on the terminating service subscription downloaded in CCF (MSC/VLR) from the HLR/AuC (HSS).

The CCF/SSF sets up the bearer connection between the AP function and the SRF function under the control of the PAM-SCF to exchange the registration/deregistration/originating call parameters between the AP function and the SRF in-band.

In originating and terminating call, the SSF executes the instruction from the PAM-SCF for the call processing with updated parameters including the CLI as follows:

- In originating call, the SSF updates the CLI to represent the registered PAM user using fixed PAM service number or MSISDN as opposed to the CLI of the AP upon the instruction from the PAM-SCF.
- In terminating call, in case a PSTN analogue access line is used, the SSF updates the CLI to indicate the PAM user to be connected via updating the original CLI with additional terminal identifier information upon the instruction from the PAM-SCF.

7.2.4 PAM-SCF

The PAM-SCF provides the following functions:

- Authentication function to perform authentication when a mobile user requests fixed network access via an AP. An SRF may be needed to collect identification and authentication parameters. For both numbering types, the PAM-SCF provides the same network security mechanism as used in the mobile network corresponding to another (mobile radio access) mode of the terminal.
  - When a fixed PAM service number is used, the PAM-SCF generates the authentication data on-demand as done in HLR/AuC (HSS).
  - When a MSISDN is used as the PAM service number, the PAM-SCF requests the authentication data from the HLR/AuC (HSS).

- Mobility management to handle the user moving between different APs or moving into or out of range of an AP. This is managed via registration and deregistration procedure. When the PAM-SCF receives the registration or deregistration requests from an AP function, the PAM-SCF updates the service information as follows:
  - In case a fixed PAM service number is used, the PAM-SCF updates the PAM user's registration status and the information relevant to the user's fixed network access point in the database.
  - In case a MSISDN is used as the PAM service number, the PAM-SCF updates the PAM user's registration status and the information relevant to the user's fixed network access point in the database and updates the mobile user's PAM service subscription status in HLR/AuC (HSS) when the HLR/AuC (HSS) supports this function.
- Call control function:
  - When the PAM-SCF processes an originating call request, it modifies the CLI to the fixed PAM service number (when a separate PAM service number is used) or the MSISDN (when MSISDN is used as PAM service number) of the PAM user.
  - When the PAM-SCF processes a terminating call for a PAM user, in case the user is currently registered at an AP, the PAM-SCF instructs the SSF to complete the call via PSTN/ISDN. In case a PSTN line is used, the PAM-SCF instructs the SSF to route the call to the specific AP at which the user is registered with the updated CLI carrying the terminal identifier. In case ISDN line is used, the PAM-SCF instructs the SSF to route the call to the specific subscriber number corresponding to the terminal. If the call cannot be completed to the AP function, the PAM-SCF provides instructions to forward the call to the MSISDN of the PAM user. In the latter case, when MSISDN is used as the PAM service number, the call must be appropriately labelled to prevent circular routing. Otherwise, if the mobile user is not connected to any AP, the call is directly routed to the terminal via the mobile network.
- Service treatment function: the PAM-SCF provides the services according to the service profile associated with the service number. The service profile associated with the fixed PAM service number is statically stored in the PAM-SCF. The service profile associated with the MSISDN is downloaded from the HLR/AuC (HSS) after registration and deleted after deregistration.

7.2.5 SRF

The SRF functional entity provides the AP function in-band DTMF/FSK interaction via the SSF/CCF for the purpose of obtaining user identification and authentication parameters. The SRF accepts instructions from the PAM-SCF concerning the user interaction to be conducted and the parameters to be collected and returned to the PAM-SCF. The SRF is connected to and is disconnected from the AP function by the SSF/CCF as directed by the PAM-SCF.

An example of an implementation of the PAM service using the MSISDN as the PAM service number is provided in clause 9.

7.3 Information flows overview

This clause provides an overview of PAM service information flows. Detailed information flows are provided in clause 9.3.

7.3.1 Overview of information flows when using the discrete PAM service number

7.3.1.1 Registration

When an AP function receives a registration request from a MS PAM function containing the SAC and the user identity, the AP function assigns a dynamic terminal identifier (in case an analogue line

is used) or a subscriber number (in case an ISDN line is used) to that terminal and initiates a call carrying the SAC, the request type (registration) and the terminal identifier or the subscriber number to the CCF/SSF.

The CCF/SSF uses the CLI (subscriber number) received from the user (the AP function) if it is valid; otherwise, the CCF/SSF inserts the network provided CLI of the fixed access line to which the AP is connected, the CCF/SSF triggers and queries the PAM-SCF for instructions.

The PAM-SCF instructs the SRF to establish a bearer connection between itself and the AP function by the CCF/SSF.

During the registration, the following information is exchanged between the AP function and the SRF in-band under the control of the PAM-SCF:

- The PAM-SCF instructs the SRF to request to collect the user identification information from the AP function.
- The AP function sends the user identity to the SRF which relays the information to the PAM-SCF.
- The PAM-SCF generates the authentication data and instructs the SRF to interact with the AP function which uses the data provided by the MS PAM function to perform the authentication.
- After finishing the registration processing, the PAM-SCF instructs the SRF to send the registration result to the AP function in-band. The AP function sends the registration response to the MS PAM function.

7.3.1.2 Deregistration

When an AP function receives a deregistration request from a MS PAM function or when an AP function detects that a terminal is no longer accessible via the AP function, the AP function sends the deregistration request by initiating a call request to CCF/SSF containing the SAC, the request type (deregistration) and the terminal identifier (in case an analogue line is used) or the subscriber number (in case an ISDN line is used).

The CCF/SSF uses the CLI (subscriber number) received from the user (the AP function) if it is valid; otherwise, the CCF/SSF inserts the network provided CLI of the fixed access line to which the AP is connected, and the CCF/SSF triggers and queries the PAM-SCF for instructions.

The PAM-SCF processes the deregistration request and responses with the deregistration result to the AP function via the SRF in-band. The AP function sends the deregistration response to the terminal if the terminal is still accessible.

7.3.1.3 Originating call

Upon receiving an originating call request from a MS PAM function, the AP function sends an outgoing call request to the CCF/SSF with the information containing the SAC, the request type (originating call) and the terminal identifier (in case an analogue line is used) or the subscriber number (in case an ISDN line is used).

The CCF/SSF uses the CLI (subscriber number) received from the user (the AP function) if it is valid; otherwise, the CCF/SSF inserts the network provided CLI of the fixed access line to which the AP is connected, and the CCF/SSF triggers and queries the PAM-SCF for instructions.

The PAM-SCF instructs the SRF to collect the dialled number from the AP function and the AP function returns the dialled number received from the MS PAM function to the SRF which relays the dialled number to the PAM-SCF.

The PAM-SCF processes the originating call request accordingly and controls the modification of the CLI to the fixed PAM service number.

7.3.1.4 Terminating call

A terminating call to a fixed PAM service number is routed to the "home switch" supporting the assigned PAM service number which treats the call as an IN call and queries the PAM-SCF for instructions.

- If the user is currently registered at an AP, the PAM-SCF responds with routing instructions in the form of a specific AP to which to route the call for completion together with the updated CLI carrying the terminal identifier in case an analogue line is used, or in the form of a subscriber number corresponding to the terminal to which to route the call for completion in case an ISDN line is used. In case the call cannot be completed to the AP, the PAM-SCF provides the instructions to forward the call to the MSISDN associated with the subscriber.
- Otherwise, if the mobile user is not connected to any AP, the PAM-SCF forwards the call directly to the mobile network using the MSISDN associated with the subscriber.

7.3.2 Overview of information flows when using MSISDN as the PAM service number

7.3.2.1 Registration

When an AP function receives a registration request from a MS PAM function containing the SAC and the user identity, the AP function assigns a dynamic terminal identifier (in case an analogue line is used) or a subscriber number (in case an ISDN line is used) to that terminal and initiates a call carrying the SAC, the request type (registration) and the terminal identifier or the subscriber number to the CCF/SSF.

The CCF/SSF uses the CLI (subscriber number) received from the user (the AP function) if it is valid; otherwise, the CCF/SSF inserts the network provided CLI of the fixed access line to which the AP is connected, and the CCF/SSF triggers and queries the PAM-SCF for instructions.

The PAM-SCF instructs the SRF to establish a bearer connection between itself and the AP function by the CCF/SSF.

During the registration, the following information is exchanged between the AP function and the SRF in-band under the control of the PAM-SCF:

- The PAM-SCF instructs the SRF to collect the user identification information from the AP function.
- The AP function sends the user identity to the SRF which relays the information to the PAM-SCF.
- The PAM-SCF retrieves the authentication data of the terminal from HLR/AuC (HSS) and instructs the SRF to interact with the AP function which uses the data provided by the MS PAM function to perform the authentication.

After authentication is successful, the PAM-SCF updates the mobile user's terminating subscription status in HLR/AuC (HSS) if the HLR/AuC (HSS) supports this function.

After finishing the registration processing, the PAM-SCF instructs the SRF to send the registration result to the AP function in-band which relays the registration response to the MS PAM function.

7.3.2.2 Deregistration

When an AP function receives a deregistration request from a MS PAM function or when an AP function detects that a terminal is no longer accessible via the AP, then the AP function sends the deregistration request by initiating a call request to CCF/SSF containing the SAC of the PAM service, the request type (deregistration) and the terminal identifier (in case an analogue line is used) or the subscriber number (in case an ISDN line is used).

The CCF/SSF uses the CLI (subscriber number) received from the user (the AP function) if it is valid; otherwise, the CCF/SSF inserts the network provided CLI of the fixed access line to which the AP is connected and triggers and queries the PAM-SCF for instructions.

The PAM-SCF processes the deregistration request and updates the mobile user's terminating subscription status in HLR/AuC (HSS) when the HLR/AuC (HSS) supports this function.

After finishing the deregistration processing, the PAM-SCF responds with the deregistration result to the AP function via the SRF in-band. The AP function sends the deregistration response to the terminal if the terminal is still accessible.

7.3.2.3 Originating call

Upon receiving an originating call request from a MS PAM function, the AP function sends an outgoing call request to the CCF/SSF with the information containing the SAC of the PAM service, the request type (originating call) and the terminal identifier (in case an analogue line is used) or the subscriber number (in case an ISDN line is used).

The CCF/SSF uses the CLI (subscriber number) received from the user (the AP function) if it is valid; otherwise, the CCF/SSF inserts the network provided CLI of the fixed access line to which the AP is connected, the CCF/SSF triggers and queries the PAM-SCF for instructions.

The PAM-SCF instructs the SRF to collect the dialled number from the AP function and the AP function returns the dialled number received from the MS PAM function to the SRF which relays the dialled number to the PAM-SCF.

The PAM-SCF processes the originating call request accordingly and controls the modification of the CLI to the MSISDN.

7.3.2.4 Terminating call

A terminating call to a MSISDN is routed to the "home switch" supporting the assigned PAM service number which treats the call as an IN call and queries the PAM-SCF for instructions.

- If the user is currently registered at an AP, the PAM-SCF responds with routing instructions in the form of a specific AP to which to route the call for completion together with the updated CLI carrying the terminal identifier in case an analogue line is used, or in the form of a subscriber number corresponding to the terminal to which to route the call for completion in case an ISDN line is used. In case the call cannot be completed to the AP, the PAM-SCF provides the instructions to forward the call to the MSISDN associated with the subscriber. In the latter case, the call must be appropriately labelled to prevent circular routing.
- Otherwise, if the mobile user is not connected to any AP, the call is directly routed to the terminal via the mobile network.

7.4 Allocation of functional entities to physical nodes

For each functional model given in Figures 1 and 2, two scenarios are defined as follows:

- The functional entities of IN are allocated to different physical nodes such as SSP, PAM-SCP and IP.
- The functional entities of IN are allocated to one platform referred to as PAM service platform.

In each case, the functional architecture and information flows are the same.

7.4.1 User assigned a discrete PAM service number

Figure 3 illustrates the scenario of allocating the functional entities to different physical nodes when a fixed PAM service number is used.

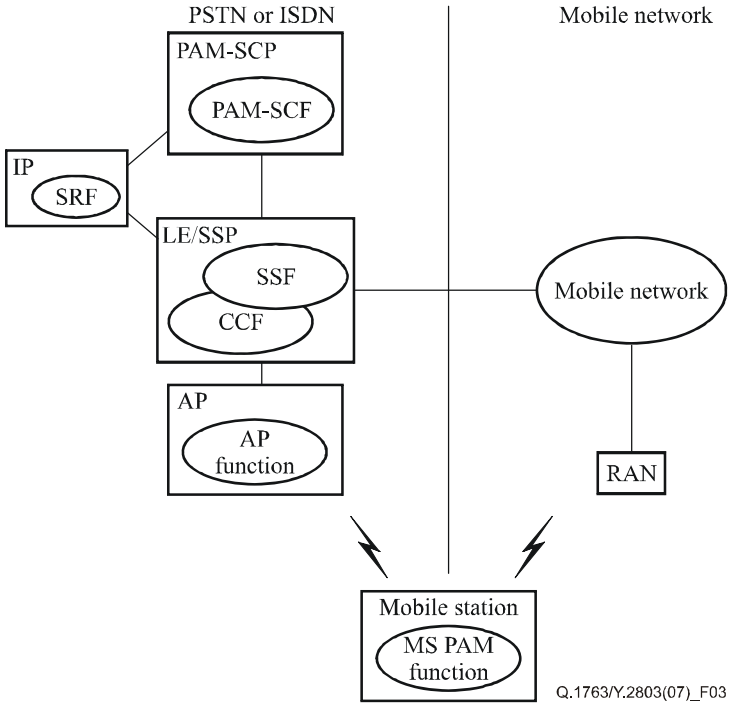

Figure 3 – Scenario for assigning FEs to different physical nodes when using a discrete PAM service number

In this scenario, the relationship of the functional entities and the physical nodes is as follows:

- the AP function maps to the AP;
- the mobile station PAM function maps to the mobile station (for simplicity, other MS functions are not shown);
- the CCF maps to the LE;
- the SSF maps to the SSP;
- the PAM-SCF maps to the PAM-SCP;
- the SRF functional entity maps to the IP.

Figure 4 illustrates the scenario of allocating all the PAM-service functional entities to the same physical node when a fixed PAM service number is used. Note that the CCF and SSF have been mapped to different nodes. This separation of the CCF and SSF is described in further detail in later clauses.

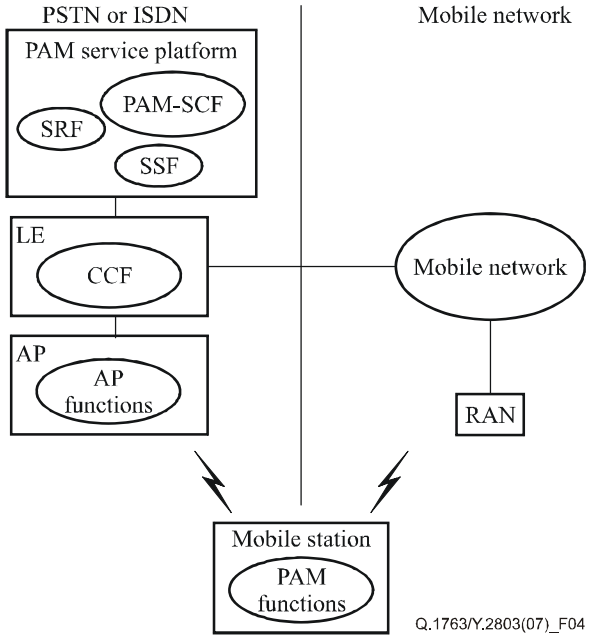

Figure 4 – Scenario for assigning functional entities to the same physical node when using a discrete PAM service number

In this scenario, the PAM service functional entities are mapped to one physical node referred to as the PAM service platform which supports the SSF, SRF and PAM-SCF functionalities.

7.4.2 MSISDN as the PAM service number

Figure 5 illustrates the scenario of allocating functional entities to different physical nodes when a MSISDN is used as the PAM service number. For simplicity, HLR, etc., functions not specific to the PAM service are not expanded.

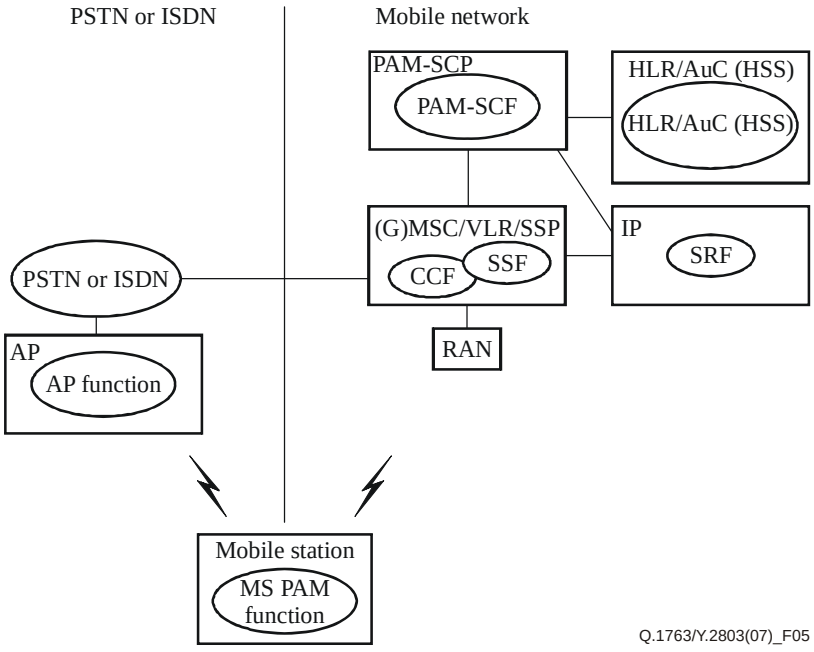

Figure 5 – Scenario for assigning FEs to different physical nodes when using MSISDN as the PAM service number

In Figure 5, the relationship of the functional entities and the physical nodes is as follows:

- the AP function maps to the AP;
- the mobile station PAM function maps to the Mobile Station (for simplicity, other MS functions are not shown);
- CCF/SSF maps to the (G)MSC/VLR/SSP;
- the PAM-SCF functional entity maps to the PAM-SCP;
- the SRF functional entity maps to the IP.

Figure 6 illustrates the scenario of allocating all the PAM service functional entities to the same physical node when a MSISDN is used as the PAM service number. Note that the CCF and SSF have been mapped to different nodes. This separation of the CCF and SSF is described in further detail in later clauses.

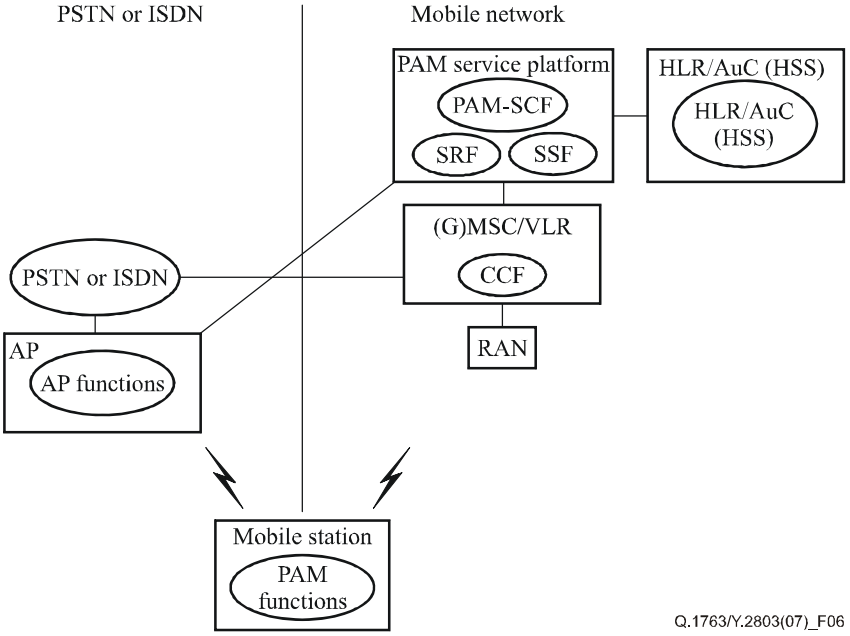

Figure 6 – Scenario for assigning FEs to the same physical node when using MSISDN as the PAM service number

In Figure 6, the PAM service functional entities are mapped to one physical node referred to as the PAM service platform which supports the SSF, SRF and PAM-SCF functionalities.

8 Capability requirements

When a mobile user requests to have legacy PSTN/ISDN access (i.e., the PAM service), the support of user registration and deregistration, authentication and call handling through the PSTN/ISDN access is required.

8.1 User authentication through PSTN/ISDN access

When a mobile user requests access to the PSTN/ISDN, mutual authentication between the MS PAM function and the AP function is required.

During registration request processing, authentication needs to be performed. To accomplish user authentication through a fixed line access, a bearer channel between the AP function via which the MS PAM function is requesting service and the SRF needs to be set up to enable the PAM-SCF to exchange necessary identification and authentication information in-band with the AP function.

The support of the same terminal authentication mechanism as used in the mobile network is required: the AP has to be able to receive the same authentication information from the mobile terminal that the mobile network RAN would receive as part of the registration procedure, and the AP must be able to relay this to the PAM-SCF so that the latter may interact with the HLR/AuC (HSS) to complete the registration.

The normal authentication procedure is illustrated as follows:

- When an AP function receives a registration request from a MS PAM function containing the SAC and the user identification information (a user identity), the AP function sends the registration request by initiating a call request to the fixed network.
- The call arrives in CCF/SSF which triggers and queries the PAM-SCF.
- The PAM-SCF instructs the SRF to establish a bearer channel between itself and the AP function.
- The PAM-SCF instructs the SRF to collect the user identification information from the AP function.
- The AP function sends the user identification information in-band to the SRF which relays the received information to the PAM-SCF.
- The PAM-SCF acquires the authentication data as follows:
  - When a fixed PAM service number is used, the PAM-SCF generates the authentication data as it is done in HLR/AuC (HSS).
  - When a MSISDN is used, the PAM-SCF requests the authentication data from the HLR/AuC (HSS) using the IMSI which is translated by the PAM-SCF using the user identity received from the AP function.
- The PAM-SCF instructs the SRF to send the authentication data to the AP function which relays the information to the MS PAM function.
- In case the terminal and network mutual authentication is required, the MS PAM function authenticates the network. If it is successful, the MS PAM function produces a response result which is sent back to the AP function.
- The AP function sends the response result to the SRF which relays the information to the PAM-SCF.
- The PAM-SCF compares the received result with the expected result. If they match, the PAM-SCF continues the registration procedure. Otherwise, the authentication is not successful and the PAM-SCF instructs the SRF to send a negative response to the AP function to end the registration. The AP relays the response to the MS PAM function and ends the registration procedure.

The secure transfer of the user identification information is required on the radio interface between the MS PAM function and the AP function as well as on the interface between the AP function and the fixed network.

The encryption of the user identification information sent over the radio access needs to be supported by the wireless technology used in the MS PAM function and the AP function.

The encryption (e.g., using SHA-1 or SHA-256 or MD5 as specified in [b-IETF RFC 3174], [b-NIST SHA-256] and [b-IETF RFC 1321]) of the user identification information over the fixed network needs to be supported by the AP function and the PAM SCF.

8.2 User identification and routing

When a mobile user is connecting to an AP with PSTN access line, the mobile user needs to be correctly identified for routing the call and presentation of the user's PAM service number. The following information is needed:

- The AP address: It is the CLI of the PSTN line to which the AP is connected.
- The terminal identifier: It is the number dynamically allocated by the AP to identify the terminals attached to it.

The correlation of the user (either with a fixed PAM service number or a MSISDN) with the AP address and the terminal identifier needs to be set-up during registration.

- When a fixed PAM service number is used:

  The corresponding relationship among the user identity, the fixed PAM service number and the associated MSISDN is statically created when the user subscribes to the PAM service, while the AP address and terminal identifier need to be dynamically updated when the user registers or deregisters with an AP.
- When a MSISDN is used as the PAM service number:

  The corresponding relationship between the user identity and the IMSI is statically created when the user subscribes to the PAM service, while the user's MSISDN, the AP address and the terminal identifier need to be dynamically updated when the user registers and deregisters. The user's MSISDN needs to be retrieved from the HLR/AuC (HSS) using IMSI which is translated by the PAM-SCF using the user identity.

Once the correlation of the mobile user with the AP address and the terminal identifier is made:

- originating calls of the mobile user through the AP function need to carry the AP address and terminal identifier and the PAM service number associated with the AP address and the terminal identifier is presented as CLI;
- terminating calls to the PAM service number need to be offered only to the mobile stations associated with the AP address and the terminal identifier.

When a mobile user is connecting to an AP with ISDN line, an individual subscriber number is assigned to the mobile station and the PAM-SCF needs to set-up mobile station-subscriber number association. Once the mobile station-subscriber number association is made:

- all calls originated by the terminal through the AP function need to carry the subscriber number of the terminal and the PAM service number associated with subscriber number is presented as CLI;
- terminating calls to the PAM service number shall be offered only to the mobile stations associated with the subscriber number.

8.3 User profile treatment

When a MSISDN is used as the PAM service number, the PAM-SCF needs to have the latest service profile of the mobile user in order to provide the set of services associated to the user when utilizing fixed access. This can be implemented in two ways at the discretion of the PAM-SCP implementer:

- the PAM-SCF requests the service profile from the HLR/AuC (HSS) whenever the data is needed; or
- the platform acts like VLR: It stores the user profile during user registration and keeps the data HLR/AuC (HSS) as long as the user does not change the AP he is registered at.

8.4 Emergency call handling

When an AP function detects that an emergency short number has been sent, the call will be treated as an emergency call from the fixed access line to which the AP is connected, irrespective of successful registration or authentication.

8.5 Video call handling

The CS video telephony service needs to be supported and requires the AP function to support the ISDN interface. Hence, this service is not available when the AP is connected to a PSTN access line.

The video phone call of the mobile user through the ISDN access is over a 64 kbit/s/56 kbit/s transparent data bearer.

A video call between a mobile user utilizing an ISDN access point and other terminals supporting the same codec is handled in the same manner as a normal voice call and is transparent to the PAM-SCF and the AP. Codec negotiation may be required and is performed in-band between the terminals.

A video phone call between a mobile user and other types of terminals supporting different codecs is possible when such kind of interworking is supported in either the underlying fixed or the underlying mobile network; otherwise, the video phone call may be downgraded to a voice call or the user may abandon the call.

9 Implementation of PAM service using IN approach

This clause provides an example of the implementation of the PAM service in convergence of PSTN and UMTS or ANSI-41/cdma2000 network. The implementation of the PAM service uses the intelligent network approach. The PAM service is realized by introducing the PAM-SCP with service logic and data to support the PAM service and with the support of the HLR/AuC (HSS). The advantage of this implementation is that there is no impact on the underlying fixed network and mobile core network. Some adaptations to the components at the application layer are required as described in clause 9.2.

In the following figures, a suitable short range air interface such as [b-Bluetooth] or [b-IEEE 802.11g] is used between the AP and the mobile station.

9.1 Network configuration

Figure 7a illustrates the network configuration of the PAM service with PSTN access to a GSM/UTRAN network using MSISDN as the PAM service number.

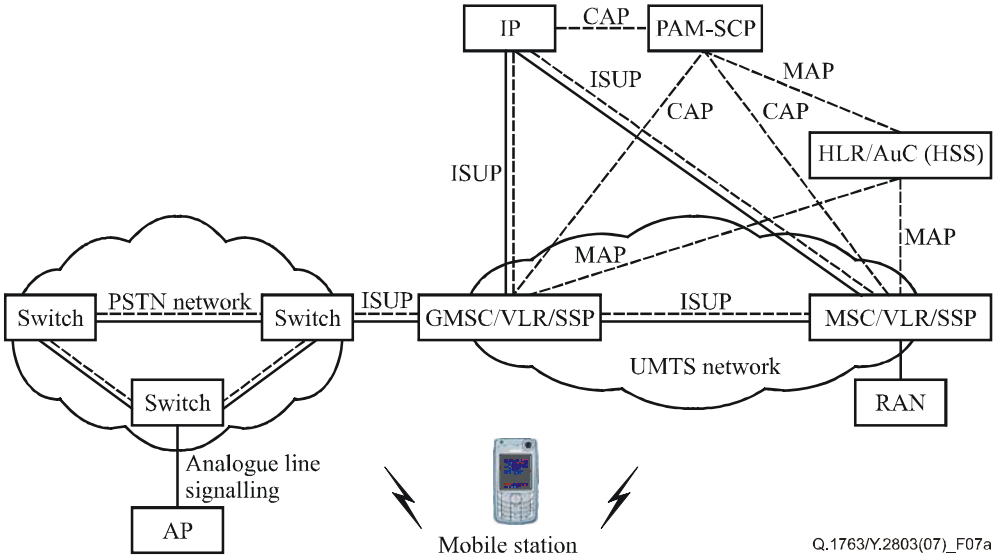

Figure 7a – The network configuration of the PAM service using MSISDN as the PAM service number for a GSM/UTRAN mobile network

Figure 7b illustrates the network configuration of the PAM service with PSTN access to an ANSI41/cdma2000 network using MSISDN as the PAM service number.

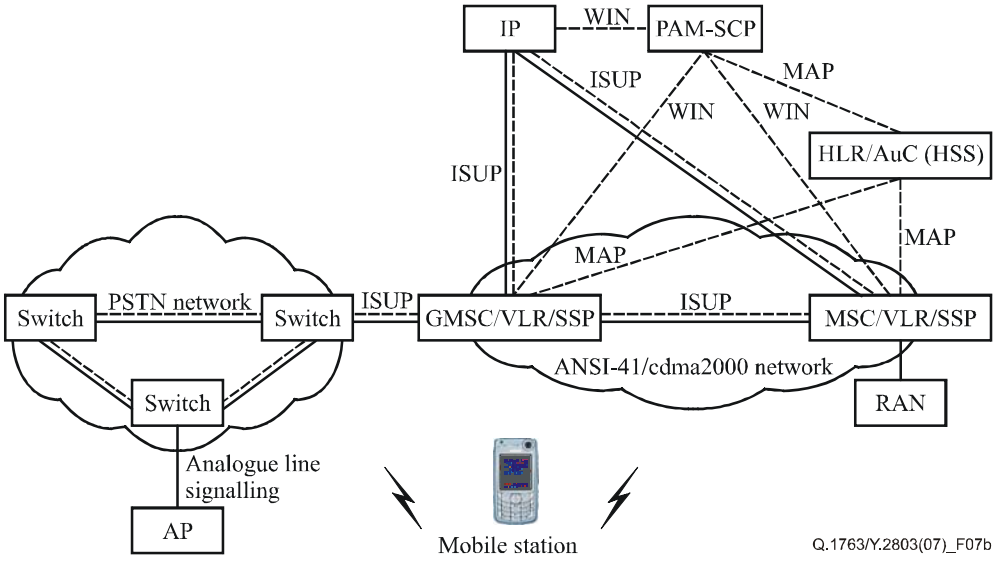

Figure 7b – The network configuration of the PAM service using MSISDN as the PAM service number for an ANSI-41/cdma2000 mobile network

The (MSC/VLR)/SSP supports the (MSC/VLR)/SSF functionalities.

An originating call through the PSTN access uses N-CSI or WIN triggers in the GMSC/VLR/SSP.

A terminating call of the PAM service uses T-CSI or WIN triggers in the MSC/VLR/SSP. (The terminating IN subscription is registered when the user subscribes to the PAM service, the initial terminating IN subscription status is set to inactive if the mobile network supports the dynamic update of the IN subscription status; otherwise, the initial IN subscription status is set to active.)

The IP supports standard SRF functionalities. The IP provides for sending and receiving of in-band DTMF/FSK signals or announcements. Specifically, in-band FSK signalling is used during the registration (authentication), deregistration and originating call procedures for the exchange of necessary information between the AP which acts as a proxy for the terminal and the IP for relay to the PAM-SCP, and for the sending of the registration/deregistration responses to the AP which relays the response to the terminal.

The PAM-SCP supports normal SCF functions per [ITU-T Q.1224]. In addition, the PAM-SCP supports:

- The authentication function: The PAM-SCP acts as a VLR to perform terminal authentication.
- Registration and deregistration: The PAM-SCP acts as a VLR to update the location information for the user when the user registers and deregisters.

  During registration, the PAM-SCP updates the terminating IN subscription status to active in the HLR/AuC (HSS) (when the HLR/AuC (HSS) supports the dynamic modification of the subscription status). After registration, the call to the MSISDN will be triggered as an IN call and be handled by the PAM-SCP.

  During deregistration, the PAM-SCP updates the terminating IN subscription status to inactive in the HLR/AuC (HSS) (when the HLR/AuC (HSS) supports the dynamic modification of the subscription status). After deregistration, the call to the MSISDN will be handled as a normal mobile terminating call.
- Originating call handling: The PAM-SCP gets the MSISDN of the user via the AP address and the terminal identifier received. The PAM-SCP handles the call connection to the called party and sets the calling party number as the user's MSISDN. The CLIR supplementary service is handled by the PAM-SCP according to the subscription of the mobile user.
- Terminating call handling: The PAM-SCP supports flexible call routing as described in the service features. When the mobile user is currently registered at an AP, the PAM-SCP gets the AP address and the terminal identifier via the MSISDN. The PAM-SCP reformats the calling line identity (CLI) received by adding the terminal identifier in predefined format and sends the newly formatted CLI in call set-up request to the AP. The PSTN will deliver the CLI to the AP during call establishment, during the first long silent interval of the ringing phase (the PSTN access line to which the AP is connected needs to have the CLIP active). The AP resolves the received CLI and establishes the call to the mobile user identified by the terminal identifier and sends the original calling party number to the mobile user in the call.

  Special treatment of the original calling party number is required when the calling party has CLIR and/or the called party (mobile user) does not have CLIP and/or the original calling party number is empty. In such cases, the PAM-SCP needs to set the original calling party number to a special number then adds the terminal identifier to it. When the AP receives the special calling party number carrying the terminal identifier, the AP only picks out the terminal identifier and will not send the calling party number to the mobile user.
- Supplementary service supporting: In originating and terminating calls, part of the mobile user's supplementary services may be handled by the PAM-SCP.

  The PAM-SCP downloads the mobile subscriber's supplementary service data during registration.

The CLIP/CLIR supplementary services of the mobile user are treated by the PAM-SCP as indicated in the preceding paragraphs. The other supplementary services provided by the PAM-SCP are limited by the capability of the access signalling system available to the AP and the capability of the call control signalling used in the PSTN/mobile network (like ISUP).

9.2 Signalling requirements

9.2.1 Requirement on the interface between PAM-SCP and IP

The PAM-SCP controls the in-band FSK interaction between the IP and the AP in the scenario of user registration and deregistration through the PSTN access.

The signalling between the PAM-SCP and the IP needs to support that the PAM-SCP could instruct the IP to conduct the sending and receiving of FSK signals.

9.2.2 Requirement on the interface between PAM-SCP and HLR/AuC (HSS)

The interface between the PAM-SCP and the HLR/AuC (HSS) needs to support the following functions:

- The PAM-SCP retrieves the authentication data from the HLR/AuC (HSS).
- The PAM-SCP retrieves the MSISDN and the user's service profile from the HLR/AuC (HSS).
- The PAM-SCP modifies the mobile user's IN service subscription status in the HLR/AuC (HSS) (optional).

9.2.3 Requirement on the interface between PAM-SCP and SSP

The signalling between the PAM-SCP and the SSP needs to allow the PAM-SCP to instruct the SSP to overwrite the calling party number in call set-up request.

The modification of the calling party number by PAM-SCP is used in the following cases:

- In originating call, the PAM-SCP needs to set the PAM service number as CLI to be presented to the called party.
- In terminating call, the PAM-SCP needs to add the terminal identifier in the CLI which will be delivered to the AP during call establishment.

9.3 Call flows

This clause provides the call flows for the PAM service.

9.3.1 User registration call flow

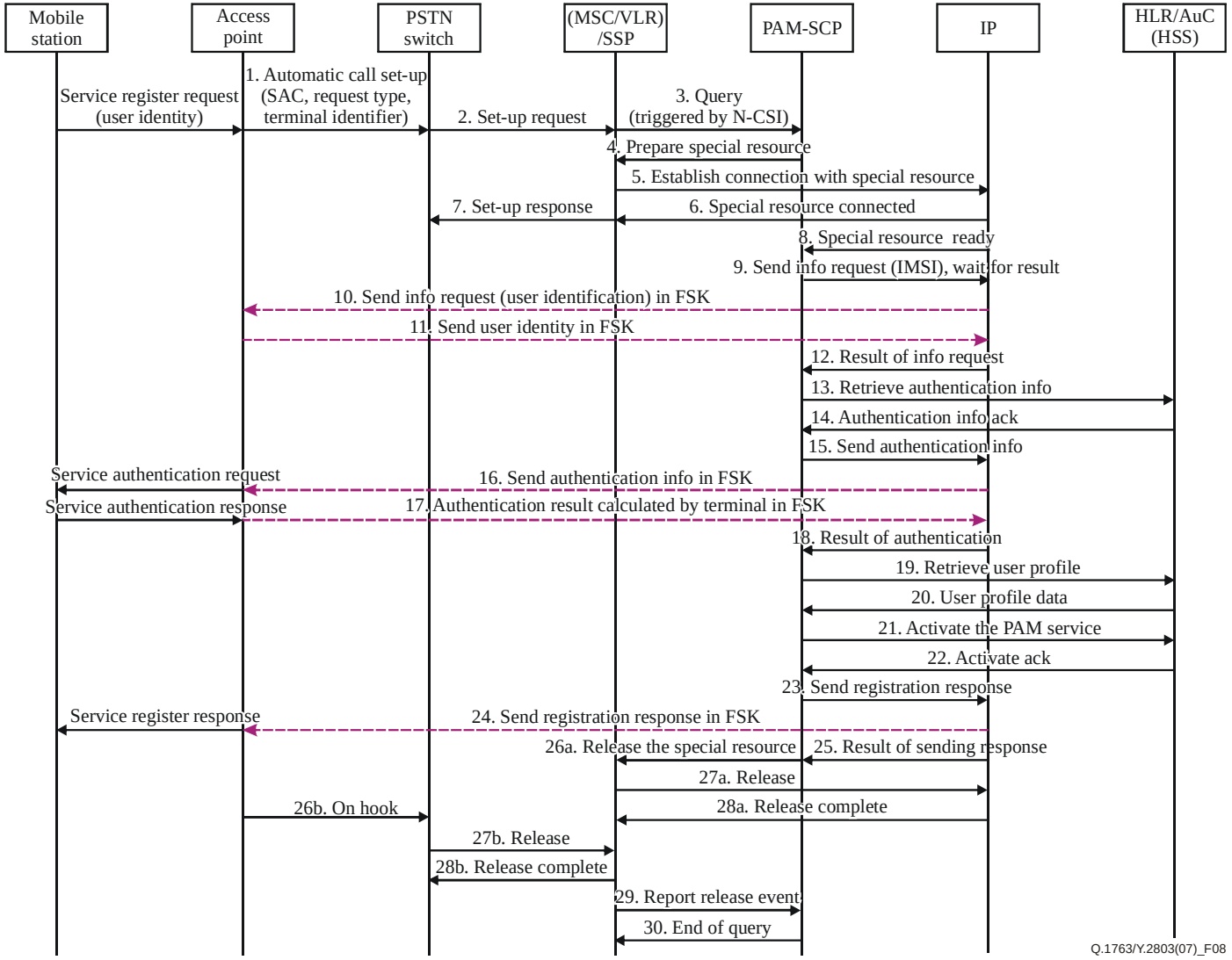

Figure 8 – User registration call flow

1. When the AP receives a user registration request, the AP automatically initiates a call to the PSTN network. The called number includes the service access code (SAC), request type (indicating the registration request) and the terminal identifier of the terminal. In this example, the user identity is sent afterwards during in-band FSK interaction to avoid the limitation of the length of the called number supported in the fixed network.
2. The PSTN switch routes the call set-up request to the (MSC/VLR)/SSP according to the SAC.
3. The (MSC/VLR)/SSP triggers and sends a query to the PAM-SCP. The node (MSC/VLR)/SSP is currently exercising IN SSP functionality only. MSC/VLR functions are not used in this scenario.
4. The PAM-SCP instructs the (MSC/VLR)/SSP to establish a connection with the IP to prepare the special resource for FSK interaction.
5. The (MSC/VLR)/SSP sets up the connection with IP via ISUP signalling.
6. The IP acknowledges the (MSC/VLR)/SSP with a connection established response.
7. The call set-up response is forwarded to the PSTN switch, and the bearer connection is established between the AP and the IP.
8. The IP informs the PAM-SCP of its availability and capability.
9. The PAM-SCP instructs the IP to send an "Info request (user identification)" (in FSK) to the AP.
10. The "Info request (user identity)" message is sent from the IP to the AP (in FSK).
11. The AP replies with the "user identity information" (in FSK).
12. The IP sends the received user identity to the PAM-SCP.
13. The PAM-SCP sends an authentication data request to the HLR/AuC (HSS) referenced by the IMSI corresponding to the user identity.
14. The PAM-SCP receives and stores the authentication vector, including a random number, an expected response, a cipher key, an integrity key and an authentication token.
15. The PAM-SCP instructs the IP to send the authentication data (random number, authentication token) to the AP.
16. The authentication data is sent to the AP in FSK, the AP converts the message to wireless signalling and sends it to the terminal.
17. The terminal verifies the authentication token and computes the result and sends the response with RES.
18. The IP sends the received authentication result to the PAM-SCP.
19. The PAM-SCP compares the received RES with the stored expected result. If equal, the authentication is successful and the PAM-SCP requests the user profile from the HLR/AuC (HSS).
20. The HLR/AuC (HSS) provides the user profile to the PAM-SCP.
21. The PAM-SCP stores the user's associated service data including MSISDN, the PSTN address of the AP and the terminal identifier in the database and sends a request to the HLR/AuC (HSS) to activate the PAM service status in T-CSI.

    NOTE – Subscription to the PAM service needs to be performed in advance, and the initial status of the PAM service is inactive.
22. The HLR/AuC (HSS) responds with a successful result for service activation.
23. The PAM-SCP instructs the IP to send the AP the successful treatment of the user registration in FSK.

24. The response is sent to the AP via FSK, the AP forwards the response to the terminal.

25. The IP sends the result to the PAM-SCP.

26a. The PAM-SCP indicates to the (MSC/VLR)/SSP to release the bearer connection with the IP.

27a. The MSC/VLR/SSP sends release to the IP.

28a. The IP responds with release complete confirmation.

26b. After the AP receives the registration response, the AP ends the registration process by releasing the call.

27b. A release call message is sent to the (MSC/VLR)/SSP.

28b. The (MSC/VLR)/SSP ends with the release complete confirmation.

29. The (MSC/VLR)/SSP reports the event to the PAM-SCP.

30. The PAM-SCP finishes the dialogue with the (MSC/VLR)/SSP.

9.3.2 User deregistration call flow

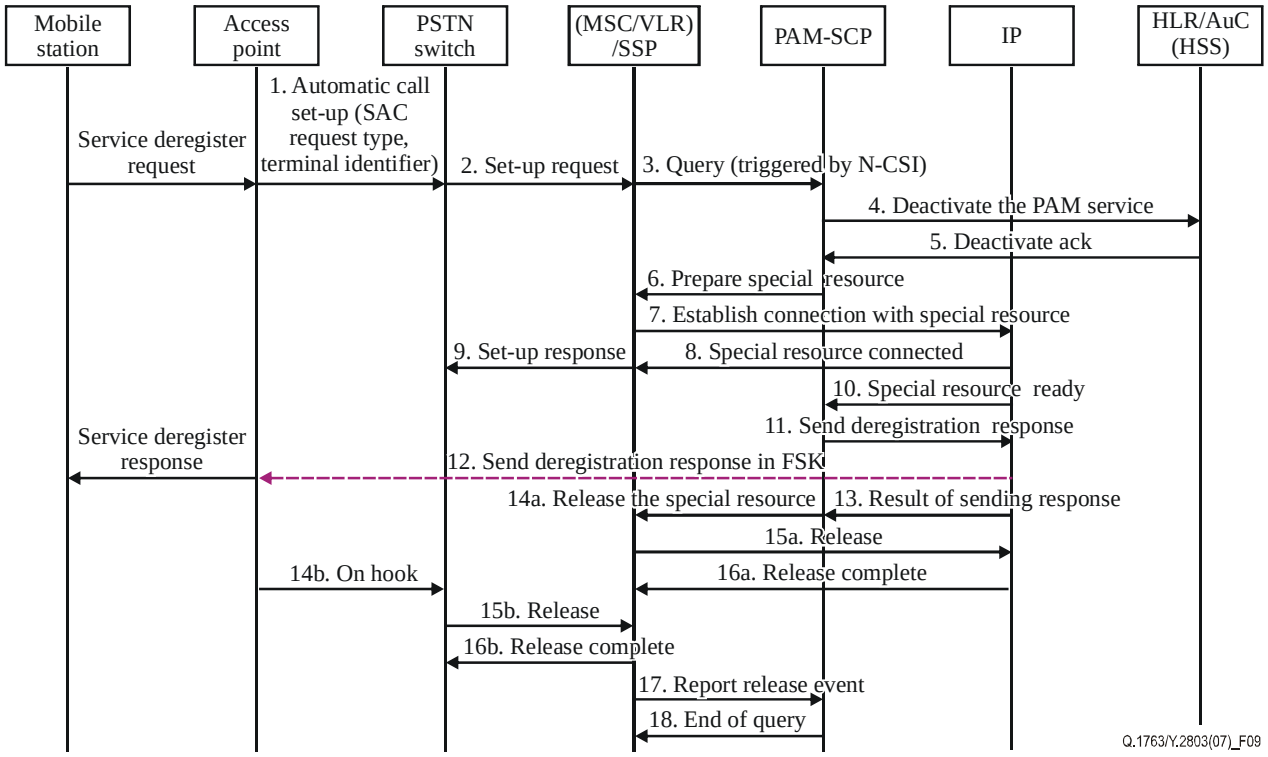

Figure 9 – User deregistration call flow

1. When the terminal leaves the wireless coverage area of the AP, the AP sends a deregistration request to the network by means of a call set-up request containing the SAC, request type (indicating deregistration) and the terminal identifier of the terminal.

2. The PSTN switch routes the call set-up request to the (MSC/VLR)/SSP according to the SAC.

3. The (MSC/VLR)/SSP triggers and sends a query to the PAM-SCP. The node (MSC/VLR)/SSP is currently exercising IN SSP functionality only. MSC/VLR functions are not used in this scenario.

4. The PAM-SCP sends a request to the HLR/AuC (HSS) to deactivate the user's PAM service.

5. The HLR/AuC (HSS) responds with the result of the deactivation and the PAM-SCP deletes the service data.
6. The PAM-SCP instructs the (MSC/VLR)/SSP to set-up a bearer connection to the IP to prepare the special resource for FSK interaction.
7. The (MSC/VLR)/SSP sets up a connection with the IP via ISUP signalling.
8. The IP acknowledges the (MSC/VLR)/SSP with a connection established response.
9. The connection set-up response is forwarded to the PSTN switch and the connection is set up between the AP and the IP.
10. The IP sends its availability and capability to the PAM-SCP.
11. The PAM-SCP instructs the IP to send a "Deregistration response" (in FSK) to the AP.
12. The "Deregistration response" message is sent from the IP to the AP, and the AP sends the deregistration response to the terminal in the wireless protocol if the terminal is still accessible.
13. After finishing the sending of information in-band to the AP, the IP sends to the PAM-SCP the result.

14a. The PAM-SCP indicates to the (MSC/VLR)/SSP to release the bearer connection with the IP.

15a. The (MSC/VLR)/SSP sends the release to the IP.

16a. The IP responds with release complete confirmation.

14b. When the AP receives the registration response, the AP ends the registration by releasing the call.

15b. The release call message is sent to the (MSC/VLR)/SSP.

16b. The (MSC/VLR)/SSP ends with the release complete confirmation.

17. The (MSC/VLR)/SSP reports the release event to the PAM-SCP.
18. The PAM-SCP finishes the dialogue with the (MSC/VLR)/SSP.

9.3.3 Originating call flow

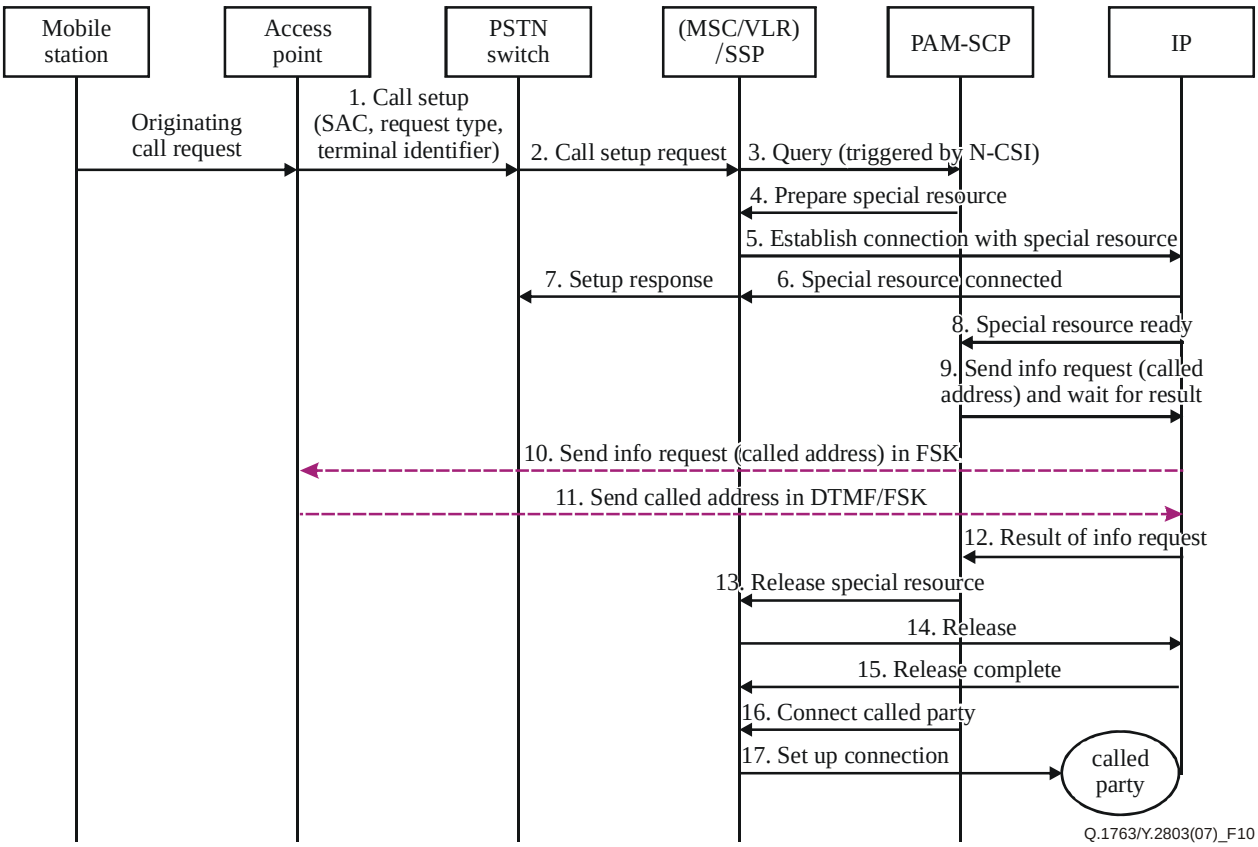

Figure 10 – Originating call flow

1. When the terminal initiates a call, the AP automatically inserts the SAC, request type (originating call request) and the terminal identifier in the called number and sends the call set-up request to the network. In this example, the dialled called address is sent afterwards during in-band FSK interaction to avoid the limitation of the length of the called number supported in the fixed network.
2. The PSTN switch routes the call set-up request to the (MSC/VLR)/SSP according to the SAC.
3. The (MSC/VLR)/SSP triggers and initiates a query to the PAM-SCP. The node (MSC/VLR)/SSP is currently exercising IN SSP functionality only. MSC/VLR functions are not used in this scenario.
4. The PAM-SCP instructs the (MSC/VLR)/SSP to prepare the special resource for FSK interaction.
5. The (MSC/VLR)/SSP sets up a connection with the IP via ISUP signalling.
6. The IP acknowledges the (MSC/VLR)/SSP with a connection established response.
7. The call set-up response is forwarded to the PSTN switch, and the bearer connection is established between the AP and the IP.
8. The IP sends its availability and capability to the PAM-SCP.
9. The PAM-SCP instructs the IP to send "Info request (called address)" (in FSK) to the AP.
10. The "Info request (called address)" message is sent from the IP to the AP.
11. The AP replies with the "called address" (in FSK).

12. The IP sends the received called address to the PAM-SCP.
13. The PAM-SCP indicates to the (MSC/VLR)/SSP to release the bearer connection with the IP.
14. The (MSC/VLR)/SSP sends the release to the IP.
15. The IP responds with a release complete confirmation.
16. The PAM-SCP processes the origination according to the user's service subscription (the user profile was stored on PAM-SCP during the registration phase) and sets up the connection with the called party.
17. The (MSC/VLR)/SSP sends the call set-up request to the called party, with the subsequent call handling being the same as normal IN service handling.

9.3.4 Terminating call flow when PAM service is active

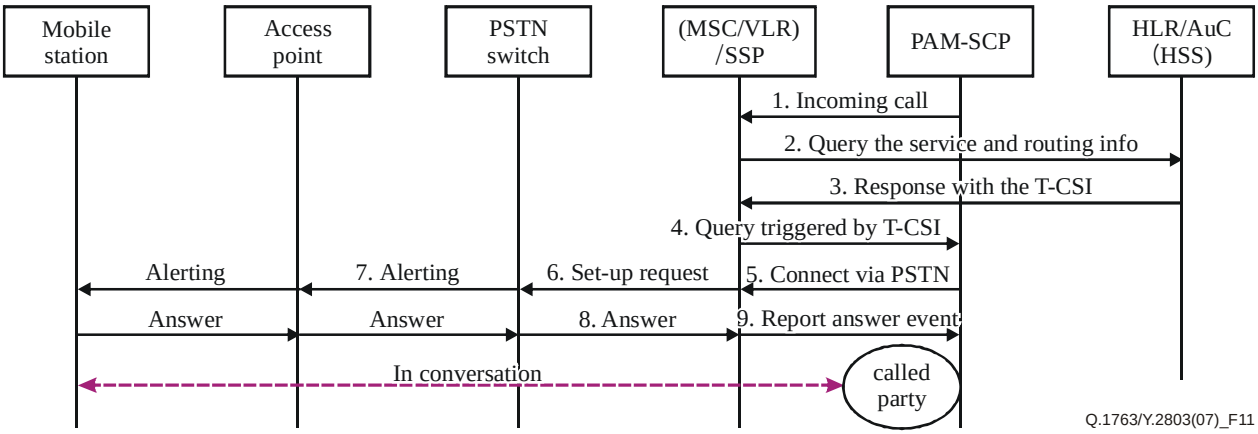

Figure 11 – Terminating call flow

1. The (MSC/VLR)/SSP receives the incoming call request (in case the calling party is a PSTN user).
2. The GMSC/SSP queries the HLR/AuC (HSS) for the called user's service and routing info.
3. Because the PAM service is active, the HLR/AuC (HSS) returns the user's PAM service attribute instead of a routing number per normal procedures.
4. The GMSC/SSP triggers on the T-CSI and sends a query to the PAM-SCP.
5. The PAM-SCP obtains the AP address and terminal identifier corresponding to the MSISDN in the service database. The PAM-SCP instructs the GMSC/SSP to set-up the connection accordingly. In the connection message, the called number is the AP address and the original calling party number plus the terminal identifier of the terminal is sent to the SSP.

   NOTE – The format of the calling party number to carry the terminal identifier may be defined by the operator. For example, the SAC + terminal identifier + original calling party number.
6. The GMSC/SSP sets up the call to the PSTN switch.
7. If the AP is idle, the AP receives the alerting signal, and the calling party number is sent to the AP during alerting. The AP subtracts the terminal identifier and sets up the call with the mobile terminal.
8. When the terminal answers, the event is sent from the PSTN switch to the GMSC/SSP.
9. The GMSC/SSP reports the answer event to the PAM-SCP, with the subsequent call handling being the same as normal IN service handling.

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