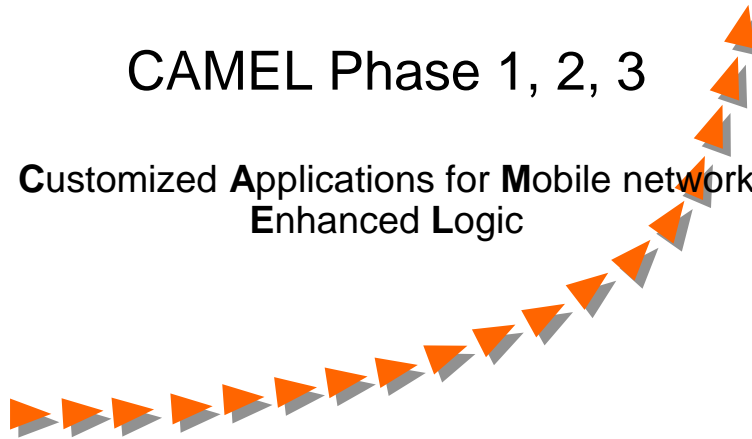
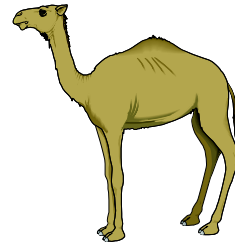


# CAMEL Phase 1, 2, 3

Customized Applications for Mobile network  
Enhanced Logic

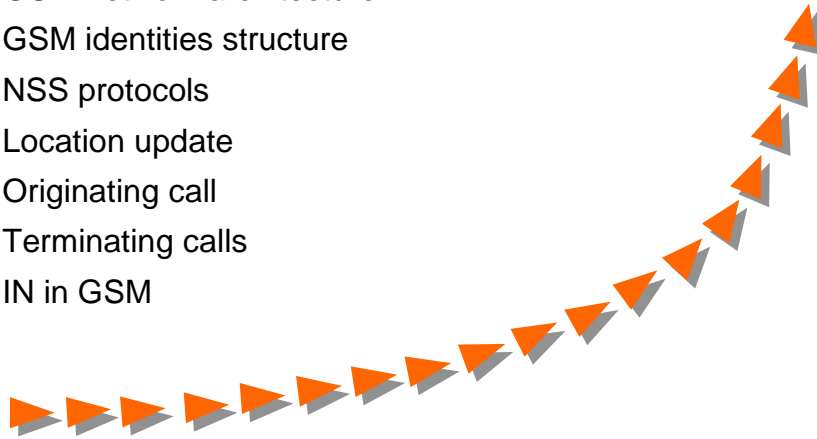


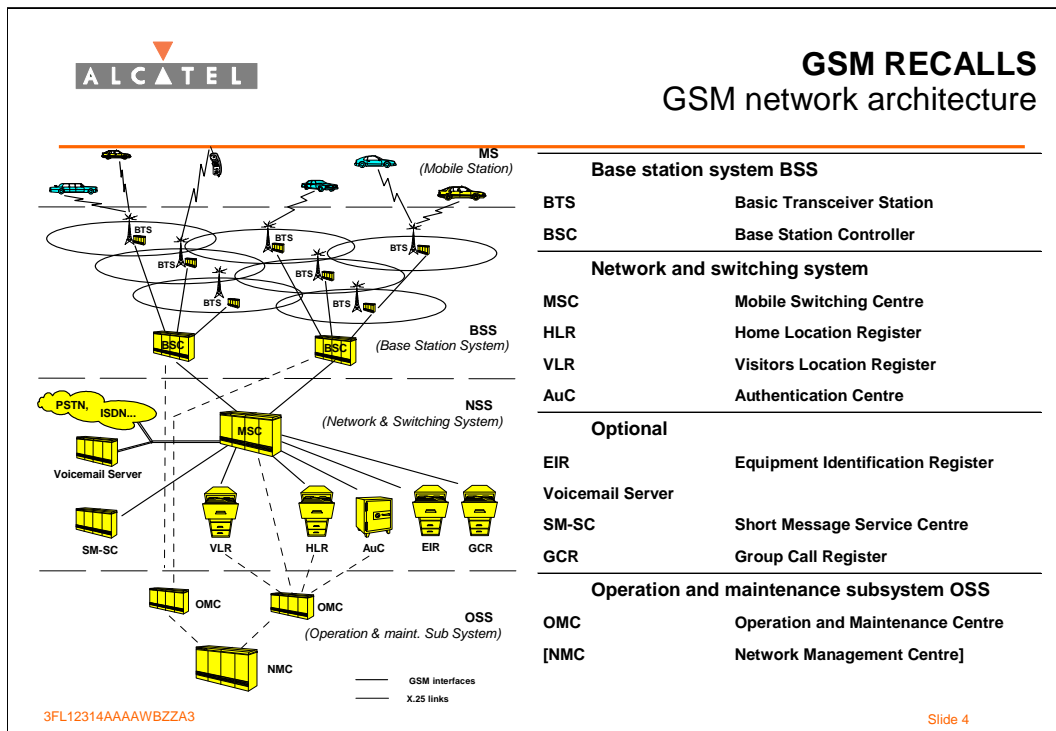
- ▼ GSM recalls
- ▼ CAMEL Phase 1
- ▼ CAMEL Phase 2
- ▼ CAMEL Phase 3



- GSM has been designed to support roaming of mobile subscribers not only within their home network but also within foreign networks. As a consequence in the past a subscriber could only use standardized services when roaming within a foreign network.
- A new Intelligent Network (IN) protocol "CAMEL" for GSM networks could change that. It can hardly be denied that the inventors of the word "CAMEL" had some marketing thoughts in mind.

- ▼ GSM network architecture
- ▼ GSM identities structure
- ▼ NSS protocols
- ▼ Location update
- ▼ Originating call
- ▼ Terminating calls
- ▼ IN in GSM





The Base Station Subsystem (**BSS**), is the radio part of the GSM network.

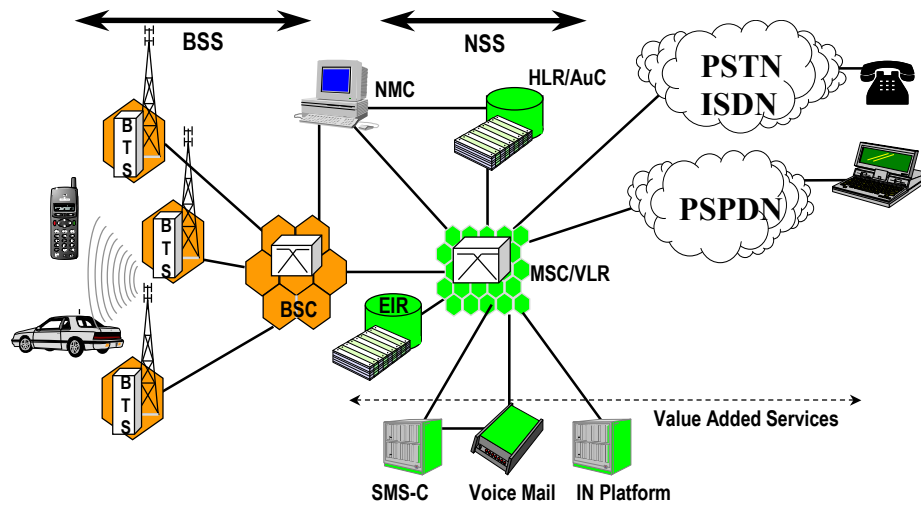
It consists of a large number of radio systems each serving a specific area.

- Base Transceiver station (**BTS**), supports the radio communication required to connect the end users to the network.
- Base Station Controller (**BSC**), is a centralized controller for a large number of base stations.

The network subsystem (**NSS**), contains the switching and databases as well as call and service related intelligence. It makes sure that mobile calls can be made and services can be delivered to the end user.

- Mobile switching Center (**MSC**), is a switching system tuned for use in a mobile environment.
- Visitor Location Register (**VLR**), is a dynamic database closely associated with the MSC. It contains information on all subscribers currently roaming in the network covered by the MSC.
- Home Location Register (**HLR**), is a large static database containing information about the subscribers who have subscribed with associated operator.
- Authentication Center (**AUC**), provides authentication and encryption parameters that verify the user's identity and ensure the confidentiality of each call. The AUC protects network operators from different types of fraud found in today's cellular world.
- Equipment Identification Register (**EIR**), screening database to verify validity of mobile equipment.

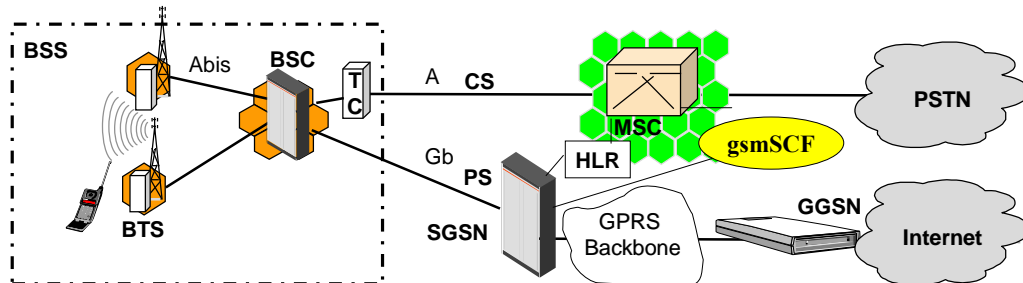
GSM network architecture with value added services



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Slide 5

- PSTN:** Public Switched Telephone Network
- ISDN:** Integrated Services Digital Network
- PSPDN:** Public Switched Packet Data Network
- SMS-C:** Short Message Service Center
- IN:** Intelligent Network Platform



GPRS General Packet Radio Service  
 CS Circuit Switched  
 PS Packet Switched  
 SGSN Service GPRS Support Node  
 GGSN Gateway GPRS Support Node

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Slide 6

**GPRS:** General Packet Radio Service represents the first implementation of packet switching within GSM, which is essentially a circuit switched technology.

- Rather than sending a continuous stream of data over a permanent connection, **packet switching** only utilizes the network when there is data to be sent. Using GPRS will enable users to send and receive data at speeds up to 115kbit/s.

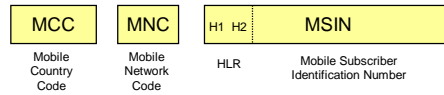
- The implementation of GPRS will bring tremendous benefits to GSM network operators. It brings Internet Protocol (**IP**) capability to the GSM network for the first time and enables connection to a wide range of public and private data networks using industry standard data protocols such as TCP/IP and X.25. GPRS is extremely efficient in its use of scarce spectrum resources and enables GSM operators to introduce a wide range of value added services for market differentiation.

- GPRS is ideal for **'bursty'** type data applications such as email or Internet access, and can also enable "virtual permanent connection" to data sources. This cannot be achieved using standard circuit-switched networks.

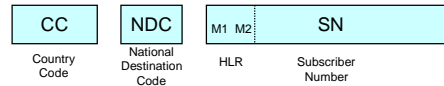
**GGSN:** The Gateway GPRS Support Node (GGSN) is one of the two new GPRS elements. The GGSN provides interworking with external packet-switched networks, and is connected to the SGSNs via an IP-based GPRS backbone network.

**SGSN:** The Service GPRS Support Node (SGSN) is one of the two new GPRS elements. The SGSN keeps track of the individual MS locations and performs some security functions and access control.

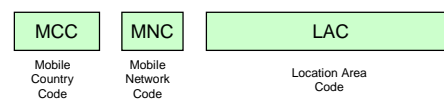
### IMSI (International Mobile Subscriber Identity), E.212



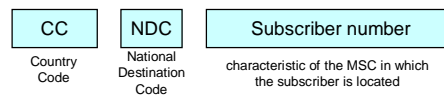
### MSISDN (Mobile Station ISDN Number), E.164



### LAI (Location Area Identity)



### MSRN (Mobile Station Roaming Number), E164



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Slide 7

### Number of digits:

- MCC: 3 digits
- MNC: 2 digits
- MSIN:  $\leq 10$  digits
- CC: 1 to 3 digits
- NDC: 2 to 4 digits
- SN:  $\leq 15$  digits
- LAC: 2 bytes, value 0 to 65536

**Cell Global Identifier** = LAI + CI (CI on 2 bytes)

IMSI: SFR example: **208** 10 42 xx xx xx xx

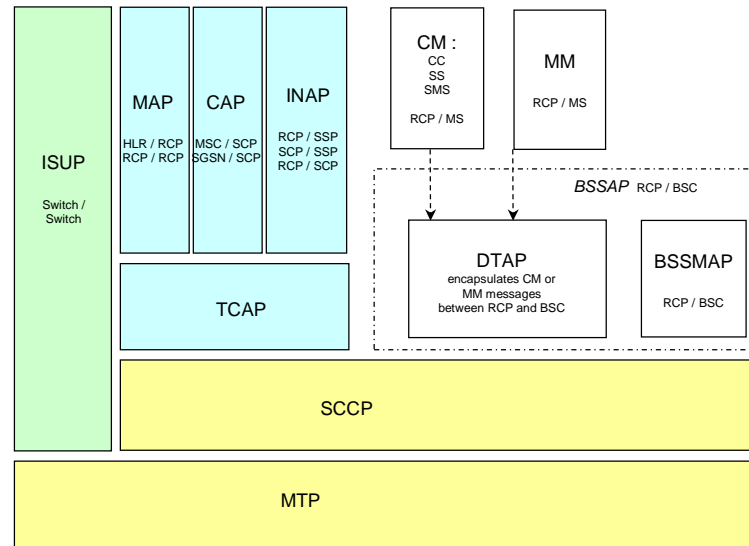
FT example: **208** 01 69 xx xx xx xx

MS-ISDN: SFR example: **33** 609 xx xx xx.

FT example: **33** 607 xx xx xx

NSMN = NDC + SN = **N**ational (**S**ignificant) **M**obile **N**umber

MSRN: In E.164 format, like the MS-ISDN.



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Slide 8

SCCP = Signaling Connection Control Part (=SSCS in French)

TCAP = Transaction Capabilities Application Part (=SSGT in French)

CM = Connection Management = Call Control + Suppl. Serv. + SMS.

MM = Mobility Management

The INAP between RCP and SCP is the **CAP** (Camel Application Part). CAP is based on CS1 protocol.

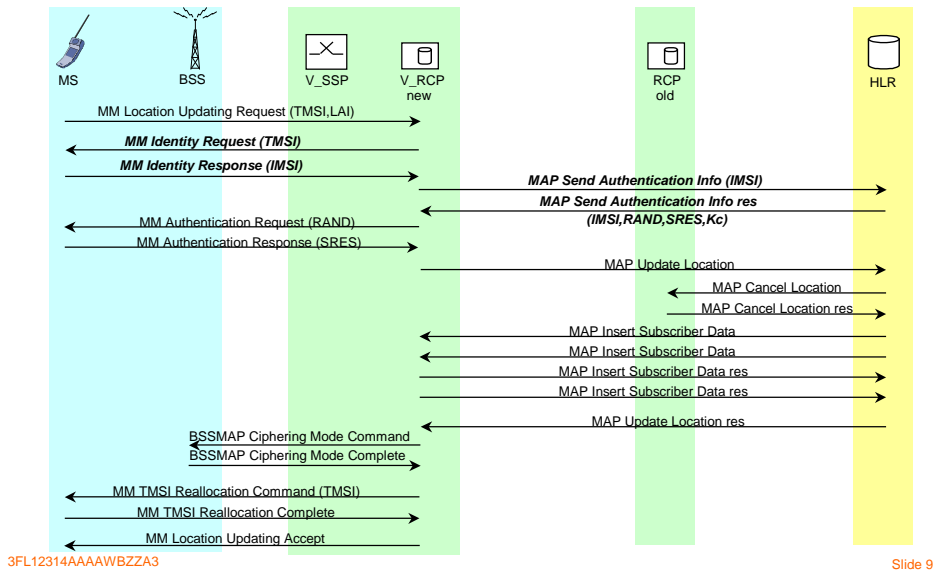
The INAP between RCP and SSP is IN-ER1 (or Alcatel INAP, ER1 = Export Release 1) containing the following operations: Provide Instruction, Create, Join, Event, Free... .

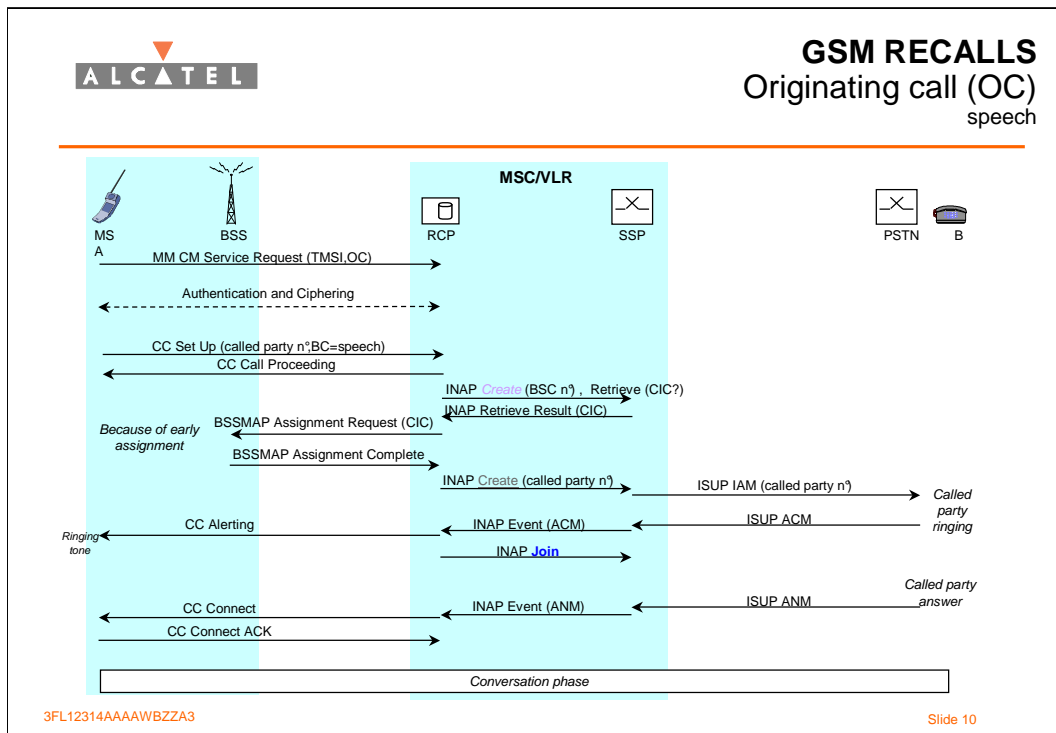
The INAP between SSP and SCP can be IN-ER1 or IN-CS1.



# GSM RECALLS

## Inter-VLR location update without inter-VLR interchanges

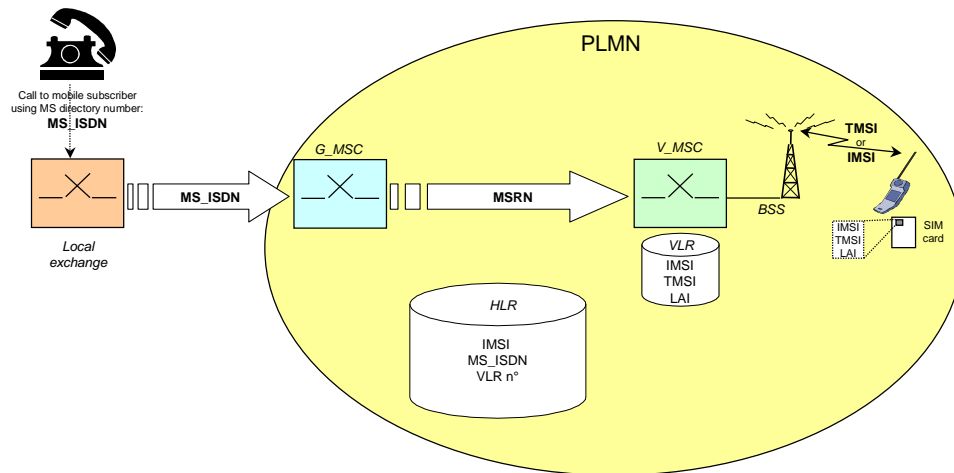


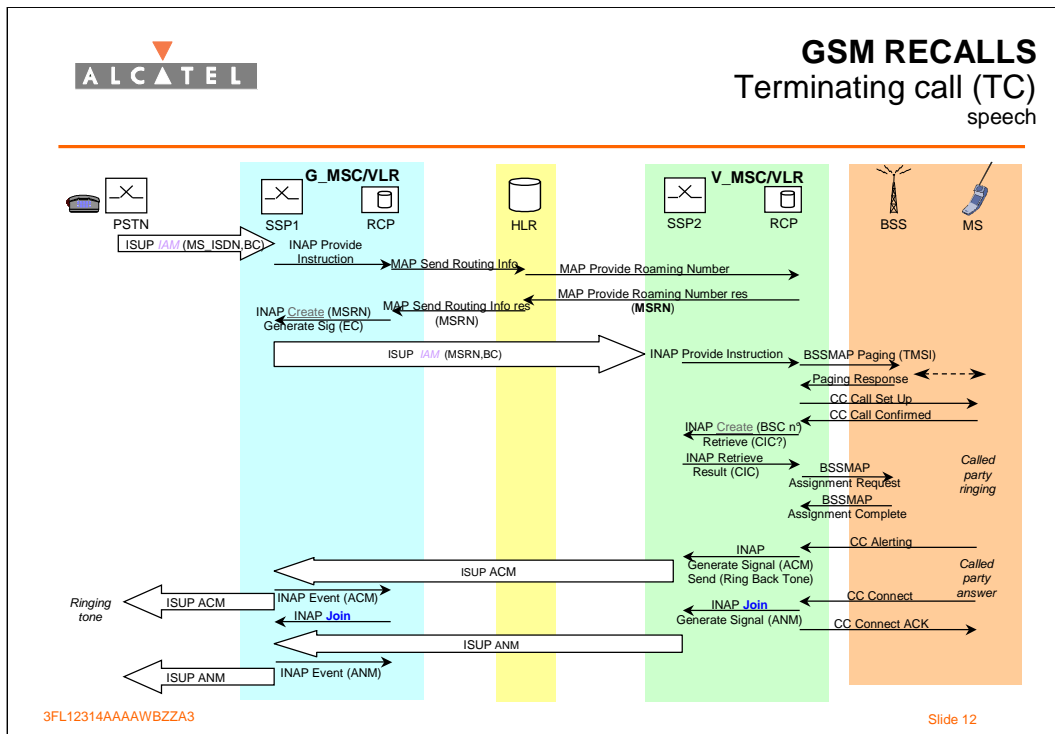


BC = Bearer Capability

BSC Nb: Logical number

Retrieve (CIC?): this is an information request: "which CIC did you reserve for the BSC ?". Once the CIC is known, the RCP sends it to the BSC in "Assignment request".



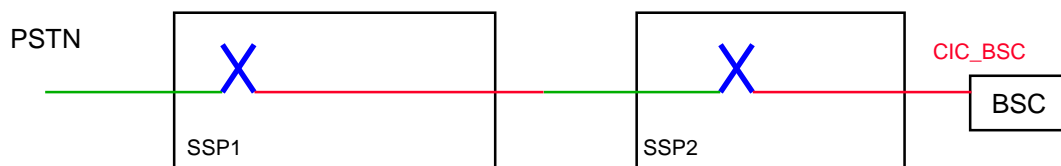


Generate signal (EC): used to notify the VMSC that echo canceller activation is necessary. (Echo cancellers are used only at the input of the PLMN). This signal is in TS 16 (and not in SS7) !

The paging response is followed by authentication, and ciphering if required.

Send: complete name **Send&Receive**, used to send recorded announcements or tones (in this case, to the fixed calling party) by connecting the "Tone Generator" at the VMSC.

"Join" at the GMSC: used to set up the connection required for the MS to correctly interpret the ringing tone.



▼ Operators and Service Providers like:

- Fast creation of new services
- Low dependency on switch manufacturer
- Reduced services operating costs

▼ Users like:

- Advanced Services everywhere

▼ Wireless application of IN as means to provide Operator Specific Services (OSS) will take the lead !

- Operator Specific Service (OSS):  
Any service offered on a PLMN that is not standardized by the GSM suite of specifications.



**IN concept** separates service logic from switch based architecture, allowing non standardized services through standardized interfaces.

This has many advantages:

**Operators like:**

Services can be rapidly created by the service provider / network operator, short reaction time to market requirements without dependence on switching equipment vendor, or system standards

CAMEL should help cut deployment costs and speed time to market.

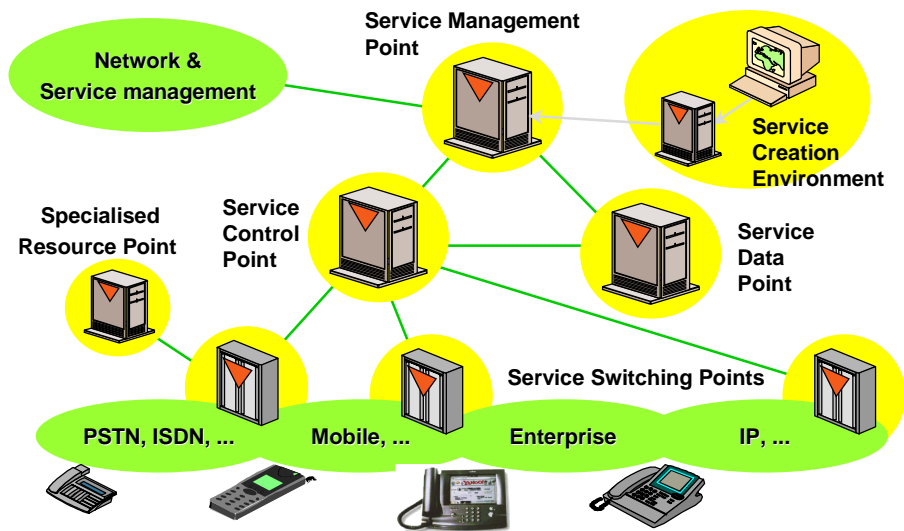
A Virtual Private Networks (**VPNs**) are one example.

Via switch-based translations, it very difficult and expensive to maintain.

**Users like:**

Access to advanced services everywhere, improved reachability with maintained privacy, tailored personalized services, easy to use services (VPN) and customer service control, flexible charging solutions (debit card, calling party pays), convergence of distinct telecommunication networks (DECT, fixed, GSM).

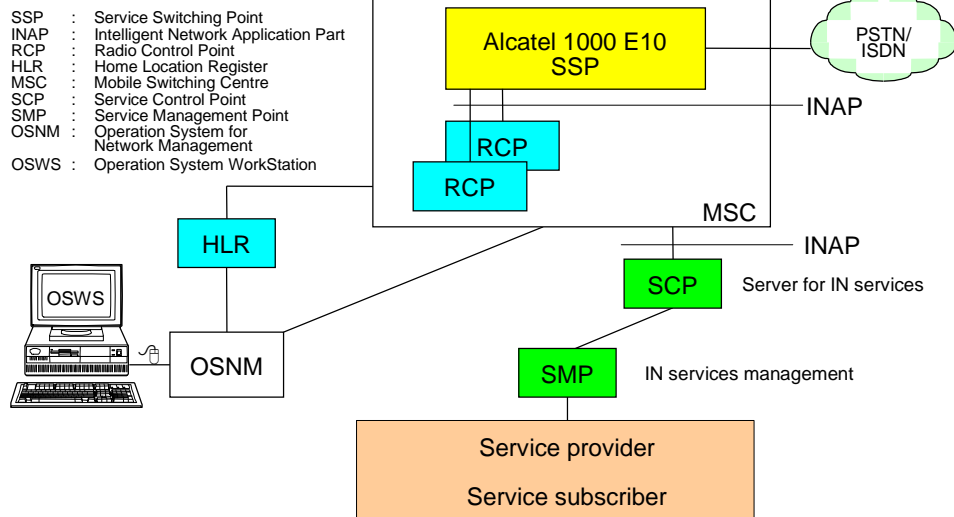
Operator Specific Service (**OSS**) is any service offered on a PLMN that is not standardized by the GSM suite of specifications.

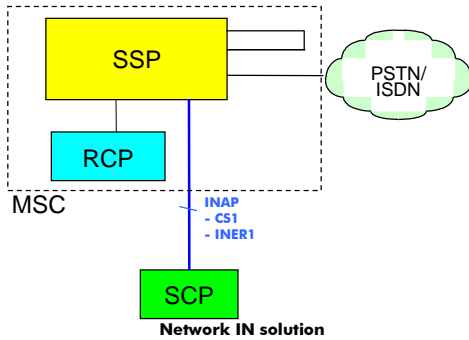


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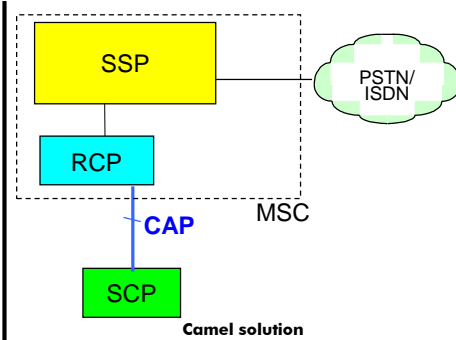
Physical Component	Distributed Component	Functional Description
Service Switching Point (SSP)	Call Control Function (CCF)	Controls call processing and provides network connection services
	Service Switching Function (SSF)	Supports IN triggering during call processing and access to IN functionality
	Call Control Agent Function (CCAF)	Supports specialized network resources generally associated with caller interaction; provides user access to the network
Service Control Point (SCP)	Service Control Function (SCF)	Executes IN service logic and influences call processing on the switch via its interface to the SSF
Specialized Resource Point (SRP)	Specialized Resource Function (SRF)	Supports specialized network resources generally associated with caller interaction
Service Management Point (SMP)	Service Management Function (SMF)	Allows deployment and provision of IN services and allows the support of ongoing operation
	Service Management Access Function (SMAF)	Provides an interface between service managers and the SMF
Service Creation Environment (SCE)	Service Creation Environment Function (SCEF)	Allows services provided in the IN to be defined, developed, tested, and input to the SMF
Service Data Point (SDP)	Service Data Function (SDF)	Manages customer and network data for real-time access by the SCF in the execution of an IN service





- SCP is connected to SSP,
- RCP translate the IN mark into an operator specific Service Access Code (SAC)
- SSP trigger the IN interchange,
- Easy to implement in HPLMN,
- Necessitate pier to pier operator agreement for inter PLMN implementation (OSS code or SAC must be analysed by the visited Network).

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- SCP is connected to RCP,
- RCP trigger the IN interchange using a 3GPP standardized Camel Subscription Information (CSI) mark,
- Facilitate IN services availability in foreign PLMNs. (As soon as the VPLMN support Camel, all camel services are supported).

Slide 16



- ▼ CAMEL provides the mechanisms to offer OSS- value added (IN) service logic to a GSM subscriber even when roaming in another network (international roaming)
- ▼ CAMEL is the first step towards integration of IN in GSM
  - CAMEL is a GSM Phase 2+ Feature
  - Standardization started in 1994
  - CAMEL evolution by means of features
  - CAMEL is based on IN Capability Sets 1 and 2
- ▼ Standardization committee:
  - 3GPP TSG SA WG1 (former ETSI SMG1) => Stage 1
  - 3GPP TSG CN WG2 (former ETSI SMG3) => Stage 2 and 3



<http://www.3gpp.org/TSG/CN.htm>

[Draft Documents: ftp://ftp.3gpp.org/TSG\\_CN/WG2\\_camel/](ftp://ftp.3gpp.org/TSG_CN/WG2_camel/)

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### **CAMEL** - Customized Applications for Mobile Enhanced Logic

CAMEL is a GSM feature name for including IN (Intelligent Network) functions into a GSM system. It uses the CAP and MAP protocols.

- CAMEL is used when roaming between networks, allowing the home network to monitor and control calls made by its subscribers. The feature allows numbers dialed to be modified during call set-up, and monitoring of call answer and clear down.
- CAMEL gives the home operator almost complete control over its subscribers activities even whilst roaming without the need for special software in the handset.

**3GPP** "Third Generation Partnership Project" is a standardization body that was created at the end of 1998. The partners within this body are **ETSI** (European Telecommunication Standardization Institute), **ARIB** (Association of Radio Industries and Business, Japanese standards body for Radio technology), **TTC** (Telecommunication Technology Committee, Japanese standards body for Core Network technology), **TTA** (Telecommunications Technology Association, Korea), **T1** (US for GSM1900) and **CWTS** (China Wireless Telecommunications standards group).

- The Organizational Partners have agreed to co-operate for the production of Technical Specifications for a 3rd Generation Mobile System based on the evolved GSM core networks and the radio access technologies that the Organizational Partners support.
- ETSI TC SMG is the Technical Committee within ETSI that has specified the GSM specifications and has started with the UMTS specifications before they were transferred to 3GPP at the end of 1998, beginning 1999.

- ▼ Each CAMEL Phase is comprising three documents:
  - stage 1 :GSM 02.78 / 3G TS 22.078
    - requirements document
  - stage 2 :GSM 03.78 / 3G TS 23.078
    - functions & conceptual data flow
  - stage 3 :GSM 09.78 / 3G TS 29.078
    - protocol , the CAMEL Application Part (CAP)
- ▼ CAMEL has been released in several phases:
  - Release 1996 = Phase 1 based on CS-1 subset
  - Release 1998 = Phase 2 based on CS-1
  - Release 1999 = Phase 3 based on CS-2

CAMEL needs to be normative, assuring 100% vendor compatibility (avoid additional testing between roaming partners).

In theory:  $n$  networks mean  $r = \frac{(n-1)n}{2}$  Roaming agreements.

Example,  $n$  today = 204;  $r = 20706$

CAMEL must define a marketing driven Set of features (subset of CS-1) in order to minimize the implementation cost imposed on networks to benefit roaming.

#### **GSM Standards Numbering.**

GSM specifications were originally started in committee GSM of CEPT.

Reference numbers are used of the form  $nn.mm$ , for example GSM 06.12

Also used after transfer to ETSI (in Technical Committee SMG).

The specifications are grouped into "Phases" and "Releases"

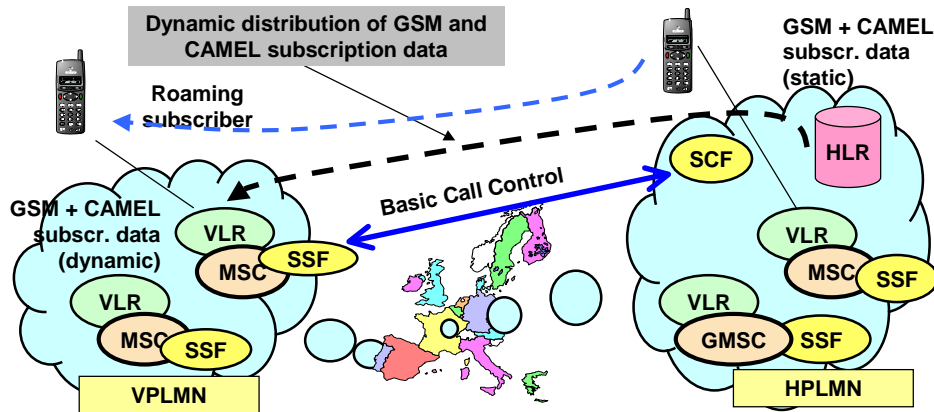
GSM Phase 1 was published in 1994

GSM Phase 2 was published in 1995

GSM Phase 2+, there have been annual GSM releases since 1996

<u>Version</u>	<u>Release</u>
3.xx	Phase 1
4.xx	Phase 2
5.xx	Phase 2+, R96
6.xx	Phase 2 +, R97
7.xx	Phase 2 +, R98
8.xx	Phase 2 +, R99

- ▼ HPLMN control of Basic Call Handling. When Roaming in a foreign Network, CAMEL gives back the switch control to the Home Network.



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Slide 19

The **Intelligent Network (IN) concept** separates service logic from switch based architecture, allowing non standardized services through standardized interfaces. These non standardized services are called Operator Specific Services (OSS).

- CAMEL is IN introduction into Mobile Networks and it supports roaming of mobile subscribers not only within their home network but also within foreign networks. It can hardly be denied that the inventors of the word "CAMEL" had some marketing thoughts in mind.

- Operators and Service Providers like:
  - Fast creation of new services
  - Low dependency on switch manufacturer
  - Reduced services operating costs

- Users like advanced services everywhere.

### The role of CAMEL:

Control of **outgoing calls** at the served subscriber's VMSC:

Number translation, selective barring or enabling of calls depending on location, time of day, ...

Control of **incoming calls** at the GMSC:

Re-routing, selective barring or enabling of calls depending on location, time of day, calling party identity, ...

**A. What is NSS?**

- 1/ Terrestrial part of PLMN
- 2/ Operation and Management part of PLMN
- 3/ Intelligent Network for GSM

**B. In which cases do we need the GMSC?**

- 1/ Incoming calls from the fixed network
- 2/ Outgoing calls to the fixed network
- 3/ Call from one Mobile Station to another Mobile Station

**C. What is the main difference between HLR and VLR?**

- 1/ In the ..... data about all subscribers belonging to a particular network is stored.
- 2/ The ..... stores data about all the subscribers that are visiting that particular MSC Service Area.



### D. Why do we need an MSRN?

- 1/ To identify the MS in the paging message
- 2/ To route calls from GMSC to the VMSC
- 3/ Used as MSISDN for the Calling Line Identification service



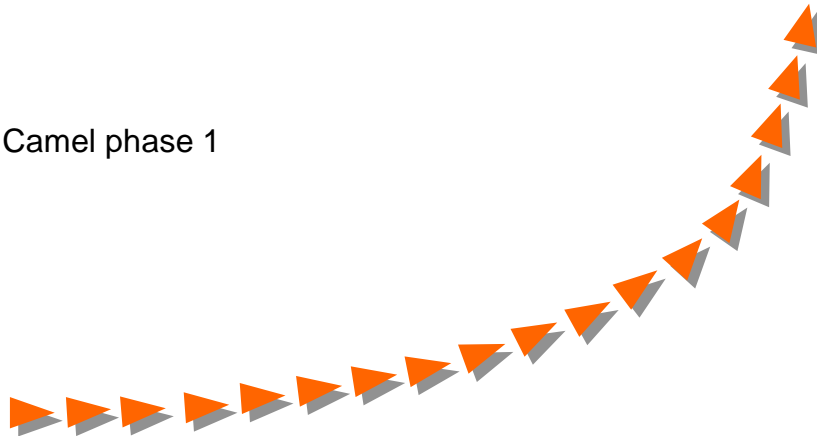
### E. What is a Camel Service?

- 1/ It is a service as e.g. Prepaid Roaming, Virtual Private Network,....
- 2/ It is specific to an operator
- 3/ It will be standardized by 3GPP

### F. What is the name of the feature used to?

- 1/ Follow a mobile during a call?.....
- 2/ Follow a mobile outside a call?.....

▼ Camel phase 1



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#### ▼ CAMEL Phase 1 - features

- Control of outgoing calls at the served subscriber's VMSC
  - number translation
  - selective barring or enabling of calls depending on location, time of day, ...
- Control of incoming calls at the GMSC
  - re-routing, selective barring or enabling of calls depending on location, time of day, calling party identity, ...
- Clearing the call at any time
  - using CAMEL control at the originating or terminating side
- Any Time Interrogation
  - Location information and subscriber state

#### ▼ CAMEL Phase 1 - services

- Translation Applications, Screening Applications
- Prepaid calling card (without announcements)



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Slide 23

### Translation Applications.

Another early CAMEL based service is Operator Controlled Number Translation. The service will allow the global usage of e.g. short access numbers for Voice Mail.

- An example, today the Swedish operator Telia uses 133 for access to Voice Mail. Within Sweden no other digits are required for a user to get access to the mailbox. When roaming, a full-length international number has to be dialed plus the user's own CLI (calling line identity) plus a four digit password.
- With the introduction of CAMEL the code to dial will be 133 even when roaming.

### Screening Applications.

With Call Screening features, you can screen both outgoing and incoming calls.

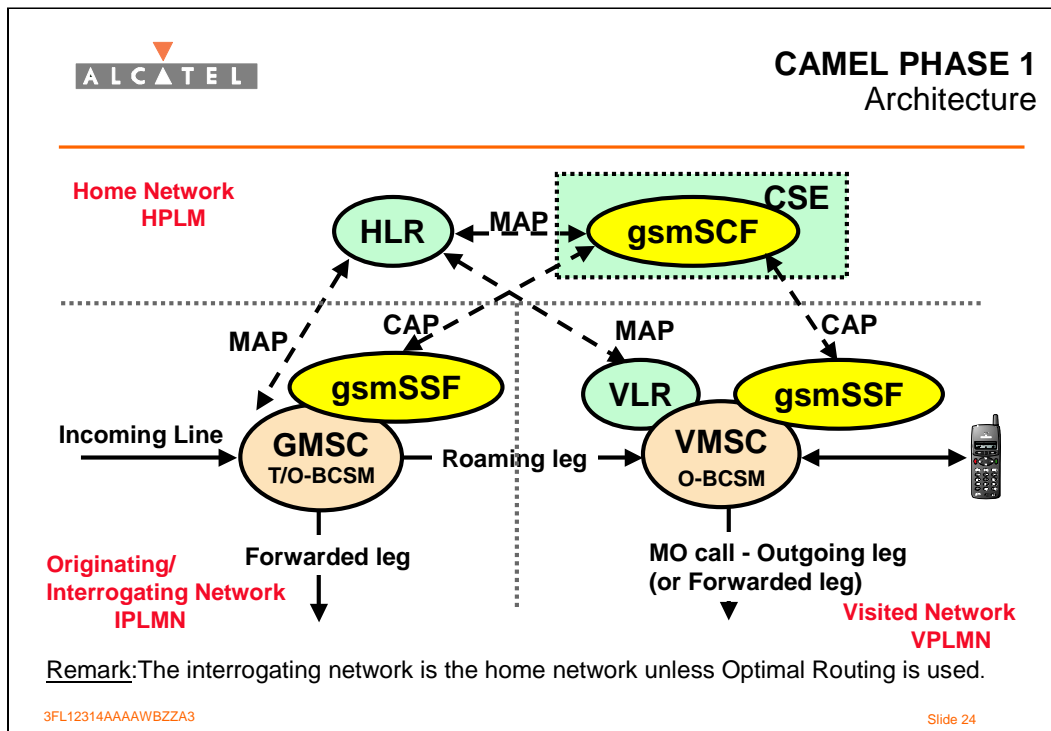
- Outgoing call screening lets you control destination numbers based on geographical location (e.g., international calls), or types of services (e.g., premium rate services).
- Incoming call screening is based on calling line identity. Incoming call screening can be based on either full number or on number prefixes, letting you screen numbers within a certain prefix range.
- Location-based screening lets you restrict calls based on the location of the mobile phone.

Organizations may want to use this feature to control telecommunication costs by barring calls made near employees' offices, to encourage them to use the less-expensive fixed line phones.

### Prepaid Roaming

A fully featured prepaid roaming service cannot be provided by CAMEL Phase 1.

- No announcements
- No subscriber interaction via USSD
- No real time rating engine



**CAMEL Service Environment (CSE):** A CSE is a logical entity which processes activities related to Operator Specific Services (OSS). CSE is the name used for SCP in the CAMEL standard.

**CAMEL Subscription Information (CSI):**

The CSI identifies the CAMEL support required for the subscriber and the identities of the CSE used for that support. The CSI is administered by the network operator in the HLR. The CSI also contains information related to the OSS of the subscriber, e.g. Service Key. The next slides give further information about the CSI.

**gsmSCF:** A functional entity that contains the CAMEL service logic to implement the Operator Specific Services (OSS).

**gsmSSF:** A functional entity that interfaces the VMSC/GMSC to the gsmSCF.

In the integrated approach, each MSC has its own SSP(gsmSSF)

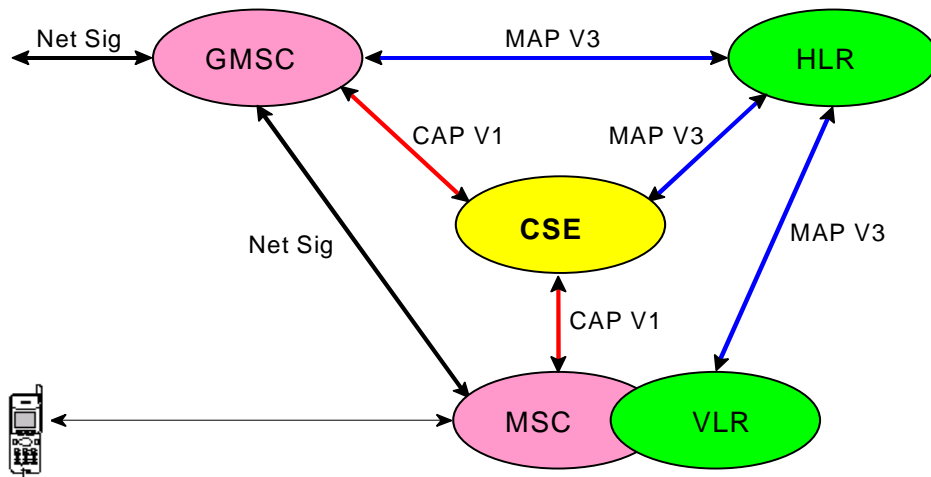
An alternative approach is overlay configuration with rerouting to specific SSPs.

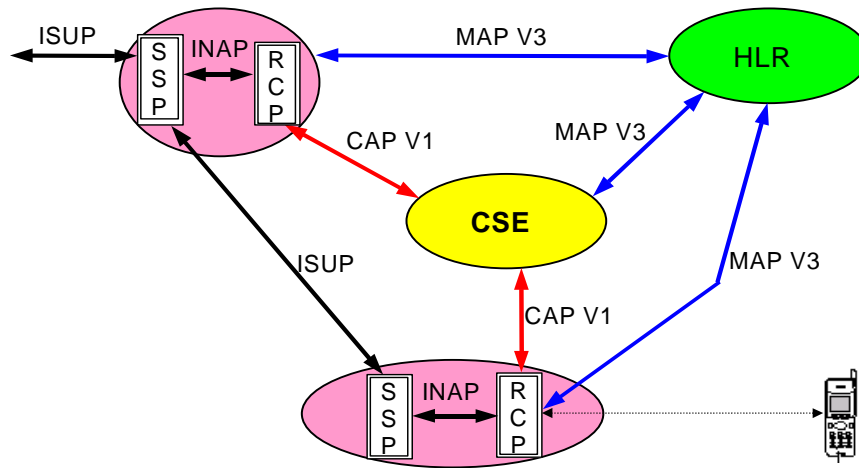
**CAP:** The CAMEL Application Part (CAP) makes use of the services offered by CCS7 to offer CAMEL specific service capabilities at the application layer.

**CCS7:** The Common Channel Signaling System no. 7 (CCS7) provides a logical, separate "out-of-band" signaling network used for remotely controlling the bearer service network from centralized dedicated CSE nodes.

**MAP:** The Mobile Application Part (MAP) is the protocol enabling the exchange of service (and mobility) related information and events between HLR and other mobile network elements. MAP was developed on top of the standardized protocol levels of CCS7 (MTP, SCCP, TCAP).



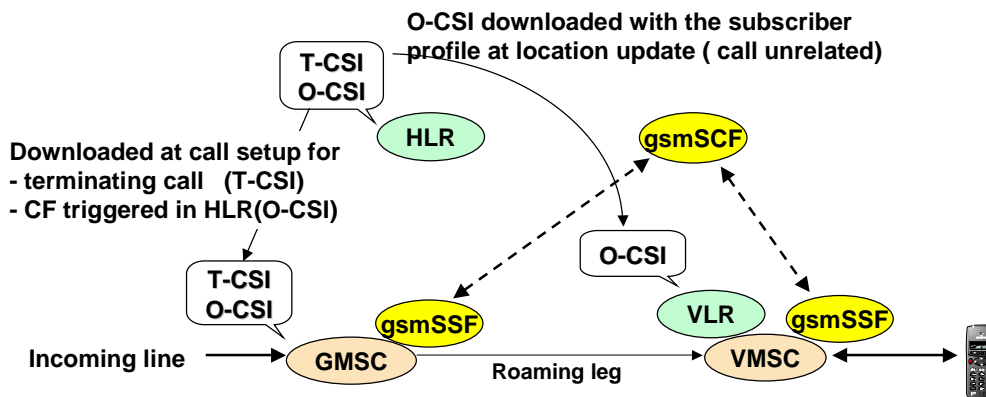




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Slide 26

- ▼ Via HLR/VLR “interrogation”, a **C**amel **S**ubscription **I**nformation (CSI) is downloaded, resulting in gsmSCF triggering during call set-up.



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Slide 27

**HLR:** The HLR stores the O/T-CSI for subscribers requiring CAMEL support. The O-CSI is sent to the VLR in case of Location Update or if the O-CSI is updated. The O/T-CSI is sent to the GMSC when the HLR responds to a request for routing information. The HLR may provide an interface towards the gsmSCF for the Any Time Interrogation procedure.

**O-CSI:** CSI applicable to mobile originating and forwarded calls. Originating (O)CSI is transported to the VLR that serves the CAMEL subscriber (MAP operation: InsertSubscriberData Invoke, ISD).

**T-CSI :** CSI applicable to mobile terminating calls.

Terminating (T-)CSI is transported to the interrogating MSC(GMSC) at the time an incoming call to the CAMEL subscriber arrives.

(MAP operation: SendRoutingInfo Result, SRI).

If the called subscriber also has originating CAMEL services, **O-CSI** may be send at the same time.

**GMSC:** When processing the calls for subscribers requiring CAMEL support the GMSC receives a O/T-CSI from the HLR, indicating the GMSC to request instruction from the gsmSSF. The GMSC monitors on request the call states (events) and informs the gsmSSF of these states during processing enabling the gsmSSF to control the execution of the call in the GMSC.

**VMSC:** When processing the calls for subscribers requiring CAMEL support the VMSC receives a O-CSI from the VLR indicating the VMSC to request instruction from the gsmSSF. The VMSC monitors on request the call states (events) and informs the gsmSSF of these states during processing enabling the gsmSSF to control the execution of the call in the VMSC.

- ▼ Administered and stored in HLR “per subscriber”!
- ▼ Different CSI's for:
  - originating calls (O-CSI)
  - terminating calls (T-CSI)
- ▼ CSI contains:
  - Address of the CSE (gsmSCF) to be contacted
  - Service Key (identifies the service logic)
  - Default call handling
  - Trigger Detection Point (TDP) list
    - This defines the detection point at which CAMEL triggering occurs  
i.e. DP2 for originating/ DP12 for terminating CSI

- **gsmSCF address** to be contacted on originating (forwarding) or terminating call attempt (E.164 number).
- **Service Key** identifies to the gsmSCF the service logic that should apply. The Service Key is administered by the HPLMN.
- **Default Call Handling** indicating whether the call shall be released or continued as requested in case of error in the gsmSSF to gsmSCF dialogue.
- Trigger Detection Point (**TDP**) List indicating on which detection point triggering shall take place. (O-CSI => DP2 ; T-CSI => DP12)

- ▼ Administered and stored in HLR “per subscriber”!
  - Location request flag
  - Status request flag
  - HLR behavior when GMSC does not support Camel phase 1
  - HLR behavior when VMSC does not support Camel phase 1

#### •Location request flag

It indicates if location information should be provided to the GMSC in SRI result and search in VLR if necessary. (HLR executes or not the PSI: Provide Subscriber Information).

Location information may be constituted with:

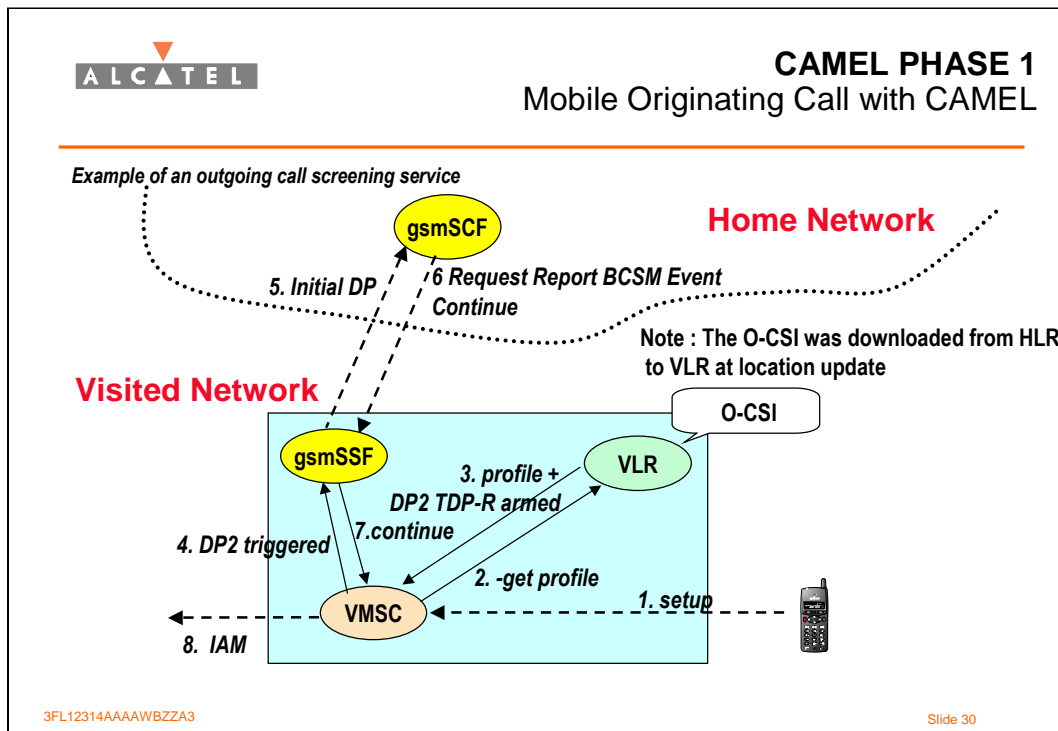
- Age of Location Information (time in minutes since the last radio contact)
- Geographical information
- VLR number
- Location number (of called party)
- Cell ID
- LAI

#### •Status request flag

It indicates if subscriber status should be provided to the GMSC in SRI result and search in VLR if necessary. (HLR executes or not the PSI).

Subscriber status takes one of the following value:

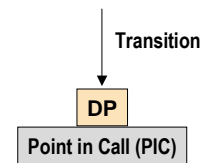
- Assumed idle
- Camel busy
- Network determined not reachable
- Not provided by VLR



The CAMEL (CSI) trigger would have been received at location update when the HLR provided the visited network VLR with the subscriber data. The CAMEL (CSI) trigger is statically armed.

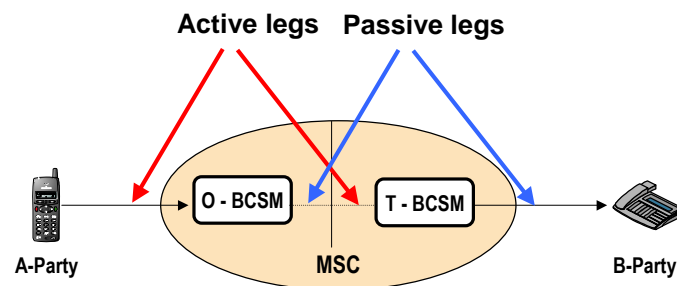
- 1.** setup message received by VMSC, The VMSC will check if the O-CSI trigger has been armed, it will then request the SSF for instructions and processing of the call will be suspended.
  - 5.** The SSF will inform the home network gsmSCF via the InitialDP operation that a call has been received.
  - 6.** The gsmSCF will then instruct the gsmSSF on how to proceed with the call. The gsmSCF has several options, a combination of the following is possible :
    - \* Instruct the SSF to monitor for Answer and/or disconnect;
    - \* Continue the Call set-up without changing any of the information received;
    - \* Continue the Call set-up with modified call information (connect);
    - \* Release the call.
  - 7.** Acting on the instructions received from the gsmSCF, the call is set up by the MSC. If the gsmSCF had asked the gsmSSF to arm the events of answer and/or disconnect as a notification, once these events are detected, gsmSSF will notify the gsmSCF and call processing will go on.
- If the gsmSCF had asked the gsmSSF to arm the disconnect event as a request, once this event is detected, gsmSSF will advise the gsmSCF and call processing will be suspended and gsmSSF waits for further instructions from gsmSCF.

- ▼ The Basic Call State Model (**BCSM**) is used to describe the actions in an MSC/GMSC during originating, forwarded or terminating calls.
- ▼ The BCSM identifies the points in a basic call processing when Operator Specific Service (OSS) logic instances (accessed through the gsmSCF) are permitted to interact with basic call control capabilities.
- ▼ The BCSM components are:
  - Points in Call (**PIC**), where interaction with service logic is possible.  
The BCSM can be seen as a flowchart for a call and the PIC's are the different states
  - In between these states you can find different Detection Points (**DP's**).  
In a DP the control of the call can be transferred to another entity, this other entity is the CSE.



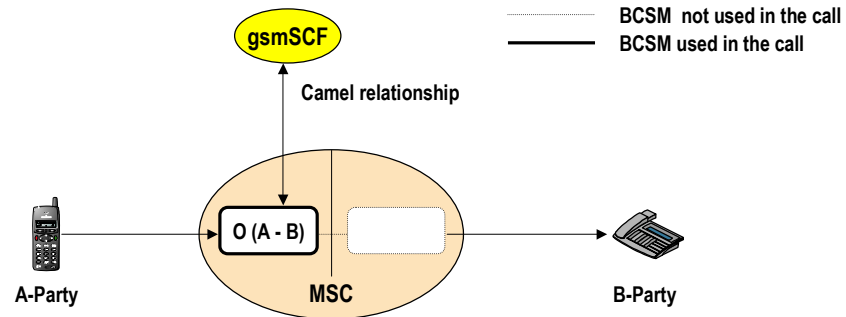
▼ Leg definition

- Pay attention: difference with CS1 standard
- Active leg: Calling party side (leg 1)
- Passive leg: Called party side (leg 2)

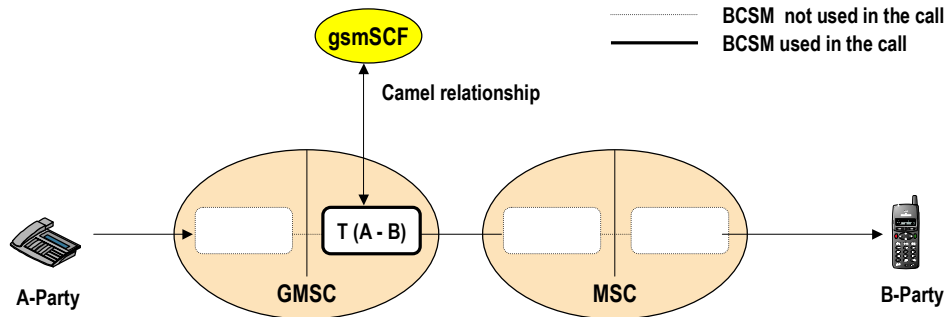




- ▼ The call from A to B
  - triggers the O-BCSM if the A-party has an active O-CSI
  - and creates a control relationship with gsmSCF

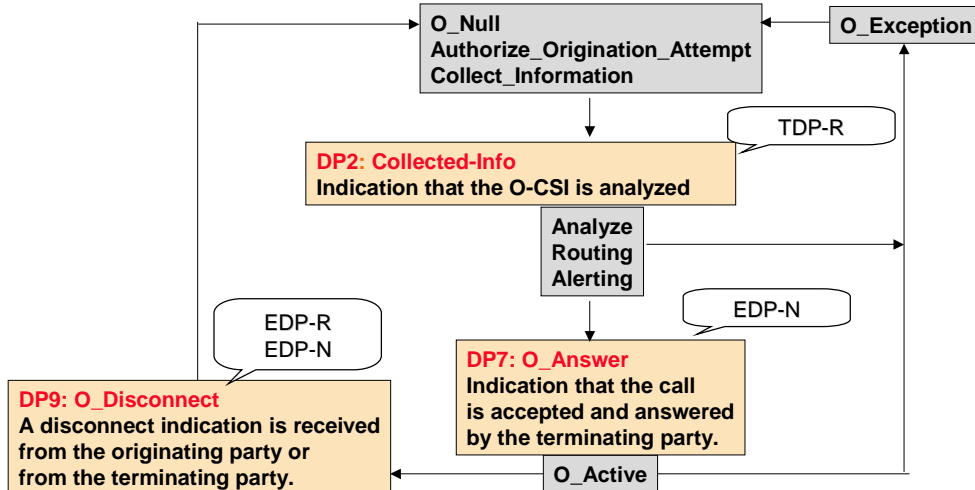


- ▼ The call from A to B
  - triggers the T-BCSM if the B-party has an active T-CSI
  - and creates a control relationship with gsmSCF



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### The description for the Points in Call (PIC):

**O\_Null:** the interface (trunk/line) is idle and supervision is performed.

**Authorize\_Origination\_Attempt:** The authority/ability of the originating party to place the call with given properties (e.g. bearer capability, line restrictions) is verified.

**Collect\_Information:** Initial information package/dialing string is being collected from the originating party. You will stay in this state until all digits are received according to the dialing plan that has to be followed.

**Analyze\_Information:** Information being analyzed and/or translated according to dialing plan to determine routing address and call type (e.g. local exchange call, transit exchange call, international exchange call).

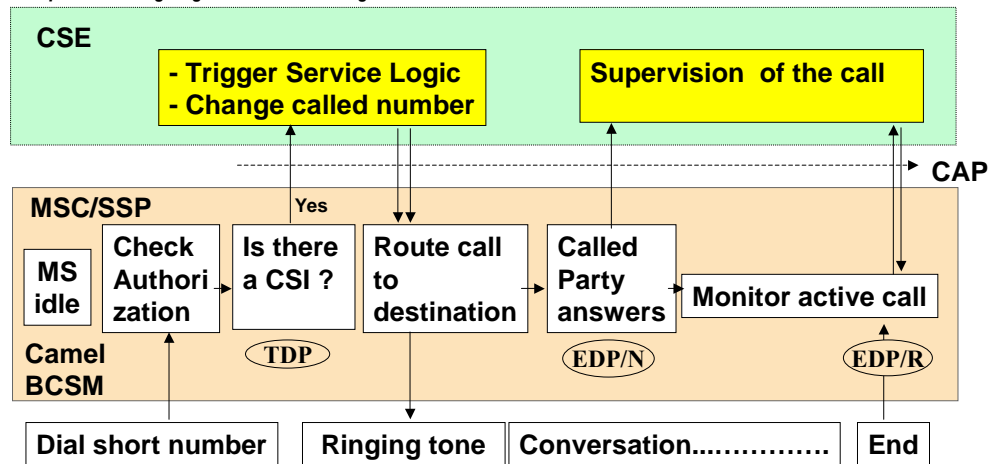
**Select\_Route:** Routing address and call type are being interpreted and the next route is being selected.

**O\_Alerting:** Wait for the terminating party to answer.

**O\_Active:** Connection established between originating and terminating party. Charging data may be being collected and call supervision is being provided.

**O\_Exception:** This state is entered when an exception condition is encountered. Default handling of the exception condition is being provided. This includes general actions to ensure no resources remain inappropriately allocated.

Example of an outgoing abbreviated dialing service



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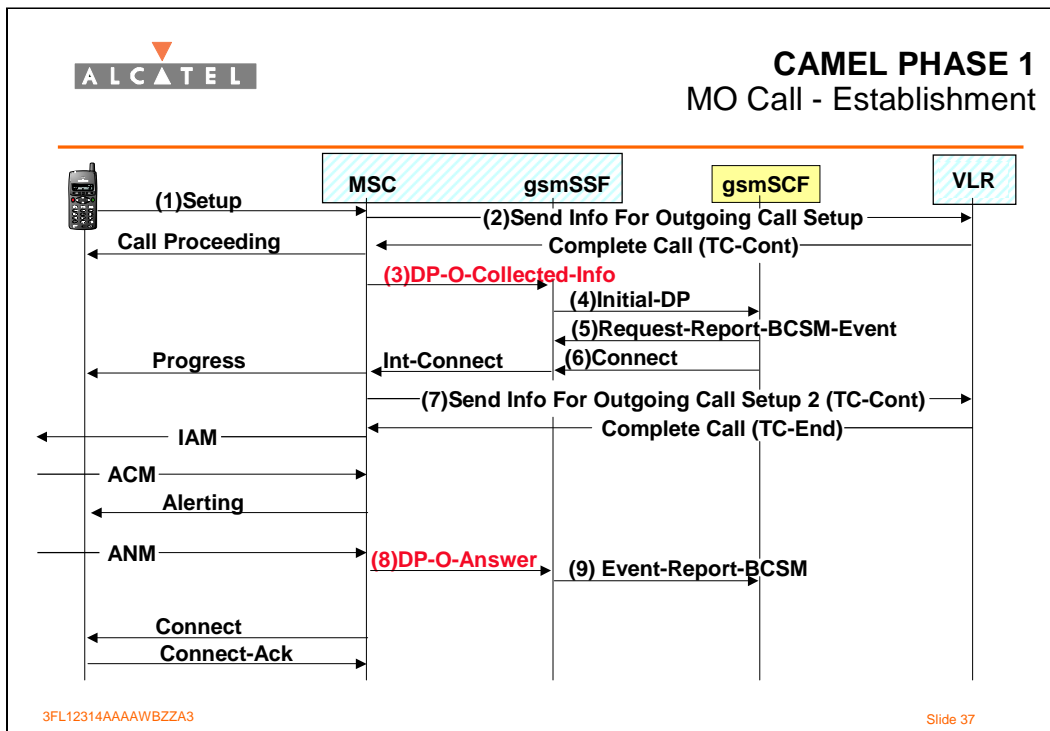
- Trigger Detection Point (**TDP**), if met in the BCSM, the CSE is contacted for the first time. A TDP is a DP that is used to initiate a control relationship towards the gsmSCF. The gsmSSF gives the control of the call to the gsmSCF when an armed TDP is encountered.

- Event Detection Point (**EDP**), if requested by the CSE, the event described by the EDP is reported. An EDP is a DP that is used to monitor a call with an already existing control relationship. In an existing IN call (triggered earlier via a TDP), if certain events happen, they have to be communicated towards the gsmSCF. This is done by arming EDPs in the gsmSSF. It is the gsmSCF who will activate or arm these EDPs during the call.

An EDP can be armed as a Request or a Notify.

- When an event is encountered as an EDP\_N (**Notify**), a notification is sent containing this event towards the gsmSCF and call processing is not suspended.

- When an event is encountered as an EDP\_R (**Request**), a message is sent towards the gsmSCF containing this event and the gsmSCF will take control over the call (call processing is suspended in gsmSSF).



**(1)** Set-up. Dialed Called Number (DCN).

**(2)** Send Info For Outgoing Call Setup.

Check for BAOC, Operator Determined Barring (ODB) not barred, O-CSI.....

**(3)** DP-O-Collected-Info.

TDP-R (DP2), indication that the O-CSI is analyzed.

**(4)** Initial-DP.

A message to request instructions from the gsmSCF.

The parameters are ServiceKey, CallingPartyNumber,...

**(5)** Request-Report-BCSM-Event.

A message to request the gsmSSF to monitor call-related events :

- O\_Answer as notification

- O\_Disconnect as request.

**(6)** Connect.

A message to request the gsmSSF to perform the call processing actions to route the call to given destination. The parameter is DestinationRoutingAddress.

**(7)** Send Info For Outgoing Call Setup 2 (TC-Cont).

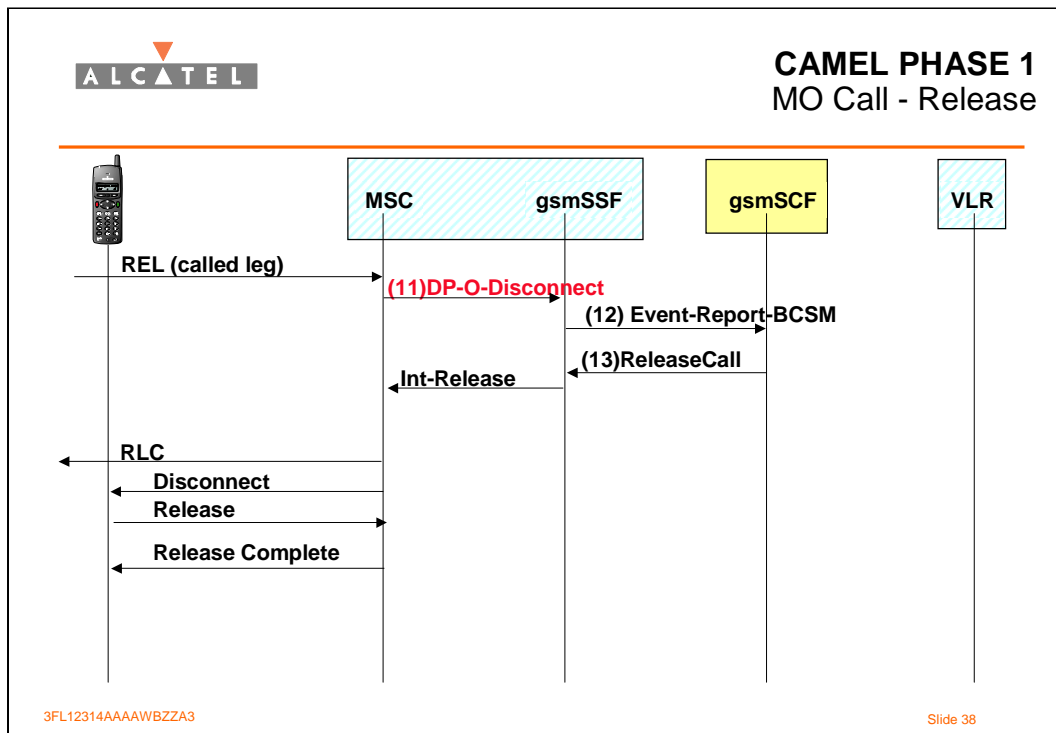
Check for BOIC,BOICexHC not barred, ODB (BOIC,BOICexHC) not barred.

**(8)** DP-O-Answer.

EDP-N (DP7), indication that the call is accepted and answered by the terminating party.

**(9)** Event-Report-BCSM.

A message to notify the gsmSSF of a call-related event (O\_Answer), previously requested by the gsmSCF in the Request-Report-BCSM-Event message.



**(11) DP-O-Disconnect.**

A disconnect indication is received from the originating party or from the terminating party.

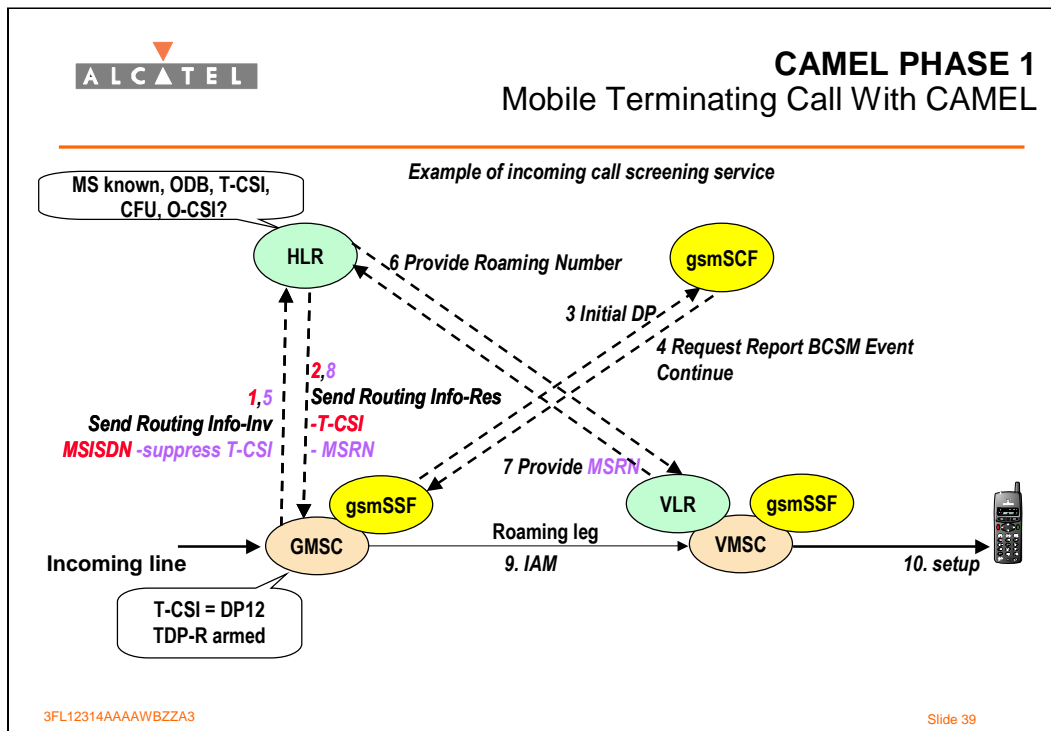
**(12) Event-Report-BCSM.**

As DP9 was armed as request, the gsmSSF sends Event-Report-BCSM message to the gsmSCF and call processing is suspended.

**(13) ReleaseCall.**

A message to request the gsmSSF to end the existing call.

This message could be replaced by a "Continue" to make the release cause management easier



T-BCSM in GMSC, not in VMSC

Two-time interrogation in GMSC

1. Result : location info, subscriber status, basic service code, CSI, .....
2. interrogation with suppress T-CSI

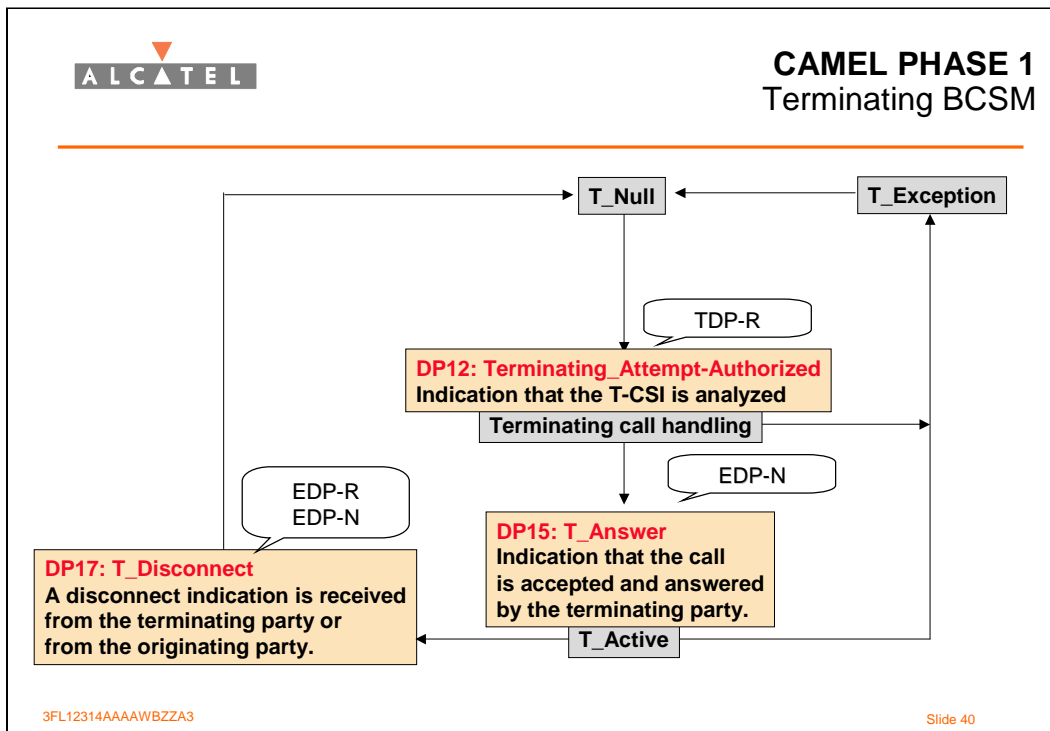
Result of 1st SRI can be:

- MSRN (no Camel, PRN message has been sent to VMSC)
- FTN (no Camel: (case of call forwarding in HLR: CFU)
- TCSI
- TCSI+FTN (case of call forwarding in HLR: CFU)
- TCSI+OCSI
- TCSI+OCSI+FTN (case of call forwarding in HLR: CFU)
- OCSI+FTN

Result of the 2nd SRI can be:

- MSRN
- FTN (if call is forwarded: CFNRc)
- OCSI+FTN (if call is forwarded: CFNRc)

According to subscriber data in HLR, a procedure to get location or status information can be made by the HLR (PSI) after reception of the first SRI



### The description for the Points in Call (PIC):

#### T\_Null:

Interface is idle and supervision is performed.

#### Terminating call handling:

The response from the HLR is analyzed.

Routing address and call type being interpreted. The next route is being selected.

The terminating party is being alerted. Waiting for the call to be answered by terminating party.

The GSM supplementary service call forwarding is invoked if necessary.

#### T\_Active:

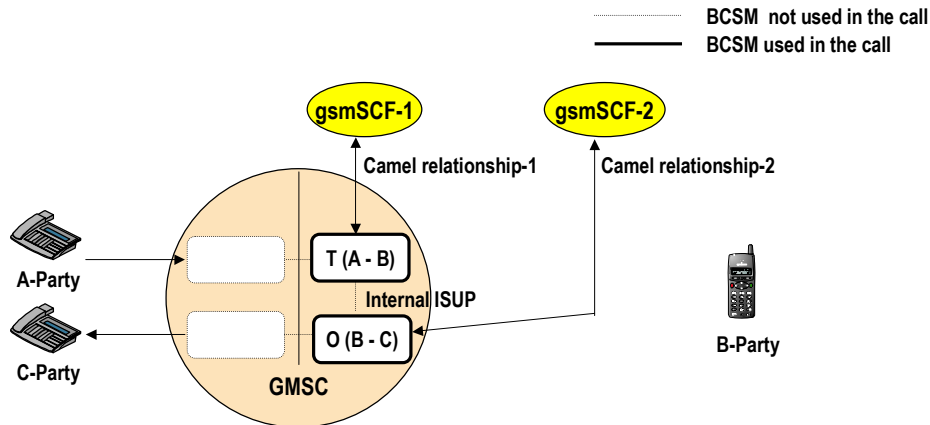
An indication is sent to the origination half BCSM that the terminating party has accepted and answered the call. Connection established between originating and terminating party. Call supervision is being provided.

#### T\_Exception:

An exception condition is encountered. Default handling of the exception condition is being provided. This includes general actions necessary to ensure no resources remain inappropriately allocated.



- ▼ The nodes gsmSCF-1 and gsmSCF-2 may be the same or different physical entities.

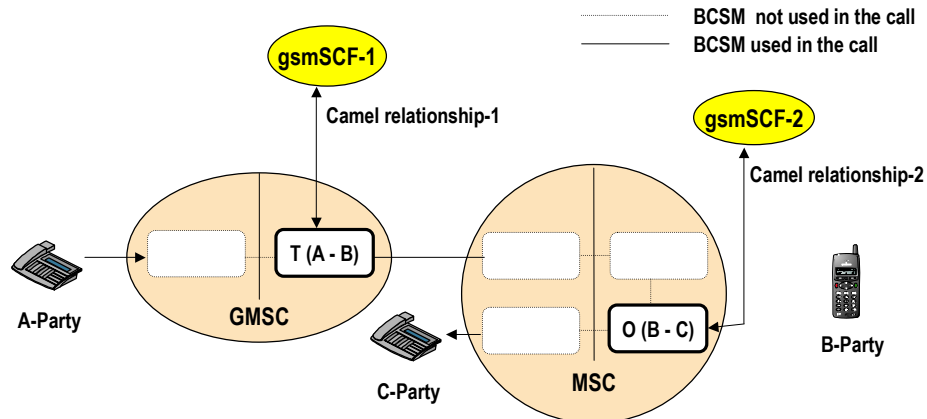


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- The T-BCSM for the call from A to B (labeled "T(A-B)") is invoked if the B-party has an active T-CSI. A control relationship with gsmSCF-1 will be created.
- A new call leg to a "C" party is created if:
  - a GSM call forwarding supplementary service forwards the call to C. In this case O-BCSM (labeled "O(B-C)") is always invoked for the forwarding party if an O-CSI has been received by the GSMC from the HLR; or
  - a CAMEL service in a control relationship with T(A-B) performs a CAMEL-based call forwarding by using a Connect information flow containing the forwarding information. In this case O-BCSM O(B-C) is only invoked for the forwarding party if O-CSI has been received by the GSMC from the HLR and "O-CSI Applicable" flag is contained in the Connect information flow.
- A control relationship with gsmSCF-2 will be created.
- The relationships with gsmSCF-1 and gsmSCF-2 may exist simultaneously. The two relationships are treated independently at the GSMC. The BCSM T(A-B) and BCSM O(B-C) are linked by an internal interface which is assumed to have similar way to an ISUP interface.

- ▼ The nodes gsmSCF-1 and gsmSCF-2 may be the same or different physical entities.



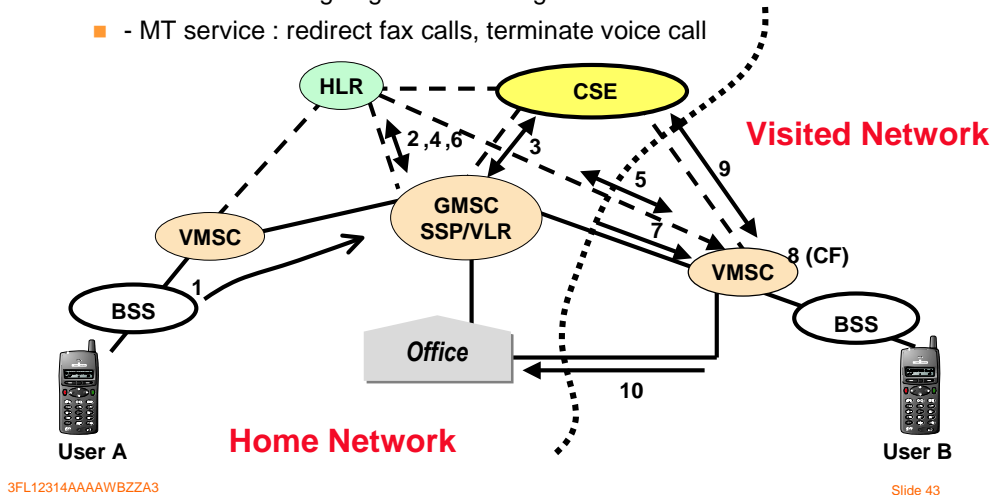
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- The T-BCSM for the call from A to B (labeled "T(A-B)") is invoked if the B-party has an active T-CSI. A control relationship with gsmSCF-1 will be created. Following processing at the GMSC the call will be extended to the MSC serving the B-party. This MSC may be physically integrated with the GMSC, but it is shown as being separate in the diagram above.
- If a GSM call forwarding supplementary service acting at the MSC forwards the call to C, a new call leg to C is established. If the B-party has an active O-CSI, the BCSM O(B-C) is invoked. A control relationship with gsmSCF-2 will be created.
- The relationships with gsmSCF-1 and gsmSCF-2 may exist simultaneously.

▼ User B has subscribed to a CAMEL service

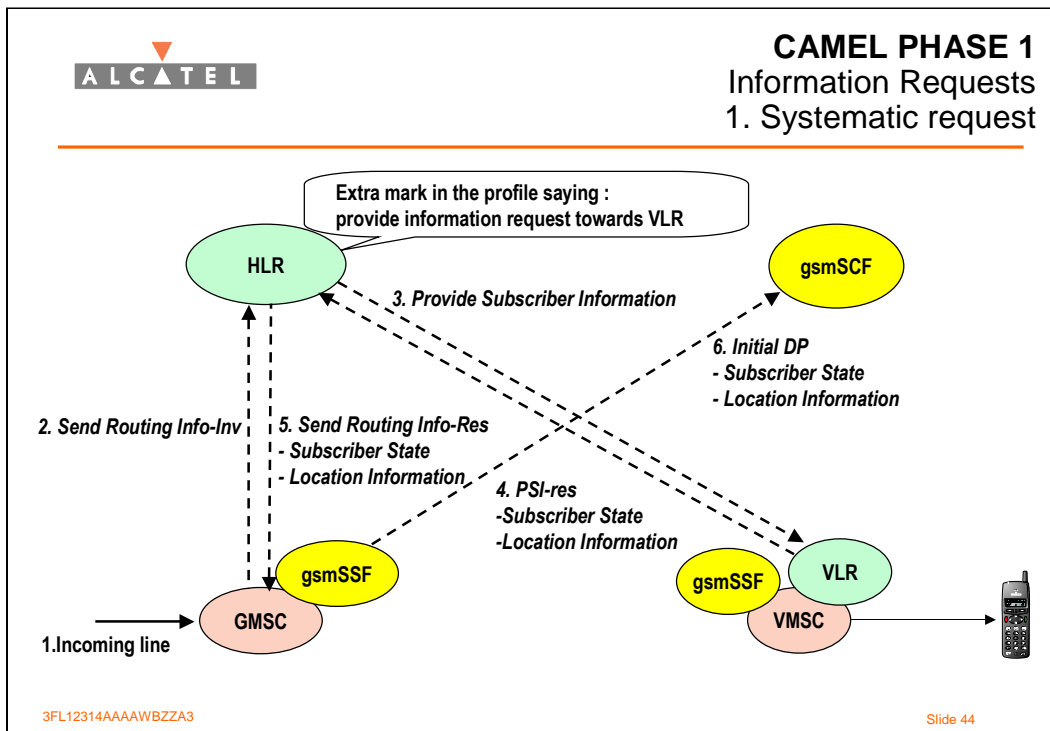
- - MO service: outgoing call screening
- - MT service : redirect fax calls, terminate voice call



Services description:

- The CAMEL mobile **terminating service** interprets the ISDN bearer capability and redirects fax calls to a fixed network number (the user's office) whereas voice calls are terminated at the B-party.
- The CAMEL mobile **originating service** checks the called number and accepts or refuses the call according to destination, date, time, ...

- MT** {
1. A (located in Germany) calls GSM B who has subscribed to a network in Germany, but is currently abroad (roaming). B has subscribed to a CAMEL mobile terminated as well as mobile originated service provided by the German operator. The A-party makes a voice call to B, the following happens: The voice call is connected from A to the GMSC in B's HPLMN.
  2. The GSMC interrogates the HLR which delivers CAMEL subscription information to the GSMC telling mobile terminated and mobile originated CAMEL services are subscribed. Furthermore, the CAMEL service environment (CSE) address is delivered to the GMSC.
  3. The GMSC suspends the call and queries the CSE. The CSE invokes the mobile terminated service, detects voice call and thus continues the call unmodified (in case of fax, the call would now be connected to the office).
  4. 5. 6. The GMSC again interrogates the HLR to get a MSRN to route the call to the VMSC.
- CF** {
7. The call is set up to the VMSC in the foreign PLMN.
  8. B doesn't answer, so a GSM call forwarding is detected in the VMSC/VLR. The address to forward the call is the fixed network office number of B.
- MO** {
9. The B-party has an active O-CSI. Again the CSE in the HPLMN is queried.
  10. The CSE accepts the call (function of called number, date, time), responds to VMSC to continue the call processing. The call is routed to the fixed network office number of B.



The information that is requested may consists of:

### 1. Location Information.

- Geographical information: The coding is performed according to GSM 03.32. Longitude, Latitude and shape are indicated with reference to the world geodetic system, WGS (also used for GPS)
- Cell ID indicates the global identity of the current or last cell which the subscriber is using or has used. The VPLMN shall update the stored Cell ID at establishment of every radio connection and whenever the subscriber is handed over between cells.
- VLR number is the number stored in the HPLMN.
- Location status indicating the time since location was last confirmed by radio contact.
- Location number.

### 2. Subscriber Status.

An indication of the status of a subscriber, determined by the state of the subscriber's MS. The subscriber status can take one of three values:

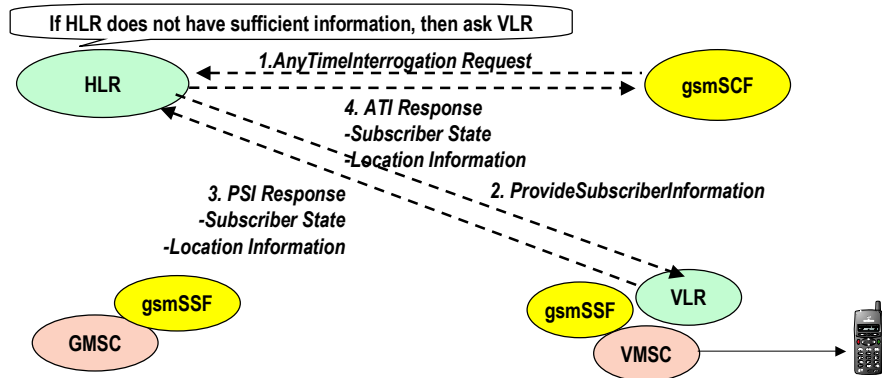
- Busy: the MS is engaged in a mobile-originated or mobile-terminated circuit-switched call.
- Network determined not reachable: the network can determine from its internal data that the MS is not reachable. This includes detached and purged mobile stations.
- Assumed idle: any MS that is not CAMEL-busy or network determined not reachable.

### Two ways for gsmSCF to retrieve subscriber information:

**First way:** Systematically, the HLR will gather all necessary information at Routing\_info\_Request due to a special classmark.

## CAMEL PHASE 1 Information Requests 2. Any Time Interrogation

- ▼ The CSE queries the HLR of a subscriber at any time for:
  - - Location Information: e.g. longitude & latitude (GSM 03.32)
  - - Subscriber Status: Network determined not reachable, CAMEL-busy



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**Second way:** Use Any-Time interrogation from gsmSCF to HLR whenever appropriate ( call related or call unrelated). At any time, it is possible for the gsmSCF to interrogate for subscriber status and/or the location information about a particular subscriber. Depending on a functional option, the HLR rejects or accepts any interrogation from any gsmSCF.

- The CSE can interrogate the HLR (if it is entitled to do so, e.g. for subscriber belonging to the HPLMN of the CSE or arrangements between operators) for information related to a particular subscriber. The HLR will pass on this request to the VLR of the subscriber, using the Provide Subscriber Information (**PSI**) MAP dialogue.

- 
- ▼ SMS charging is foreseen with Camel phase 3 implementation
  - ▼ Alcatel has made its own implementation before phase 3
    - TDP-R is DP2.
    - Initial DP with specific parameters.
    - No EDP can be armed by CSE
    - Answer of CSE is Continue or ReleaseCall.

#### ▼ gsmSSF => CSE

- Activity Test ack
- Event Report BSCM
- Initial DP

#### ▼ CSE => gsmSSF

- Activity test
- Connect
- Continue
- Release Call
- Request Report BSCM Event

The IN architecture is fundamentally based on CCS7 and its protocol architecture.

#### IN Protocol Stack:

**CAP:** The CAMEL Application Part (CAP) makes use of the services offered by CCS7 to offer CAMEL specific service capabilities at the application layer.  
CAP defines the operations required between CSE, gsmSSF and gsmSRF.

-----  
**TCAP:** The transaction capabilities application part (TCAP) provides procedures for real-time transaction control.

-----  
**SCCP:** The signaling connection control part (SCCP), augments the MTP by providing both connectionless and connection-oriented message transport, as well as enabling addressing capabilities for message routing.

-----  
**MTP:** A common signaling transport capability known as the message transfer part (MTP) handles the corresponding open systems interconnection (OSI) physical, data-link, and network layers.

### A. What is CAMEL?

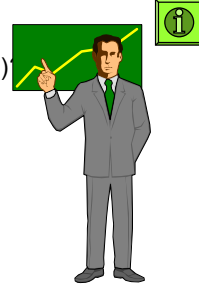
- 1/ It provides the mechanisms to offer operator specific services (OSS)
- 2/ When roaming in a foreign Network, it gives back the call control to the Home Network?

### B. The O-CSI mark is used:

- 1/ In GMSC only?
- 2/ In VMSC only?
- 3/ In GMSC and VMSC?

### C. For TC, CAMEL service can be triggered:

- 1/ In GMSC only?
- 2/ In VMSC only?
- 3/ In GMSC and VMSC?





**D. What is a CAMEL Service Environment (CSE)?**

- 1/ It is the name used for SCP in the CAMEL standard?
- 2/ It is the entity where basic call processing is executed?
- 3/ It is logical entity which processes activities related to Operator Specific Services (OSS)?

**E. What is the CAMEL Subscription Information (CSI)?**

- 1/ It is administered by the network operator in the VLR for subscribers requiring CAMEL support?
- 2/ It contains information related to the OSS of the subscriber, e.g. Service Key?
- 3/ It is downloaded at call setup in the VMSC?

**F. What is a Basic Call State Model (BCSM)?**

- 1/ It is used to describe the actions in the CSE during originating, forwarded or terminating calls?
- 2/ It can be seen as a flowchart for a call and Identifies certain Points in Call (PIC), where interaction with service logic is possible?

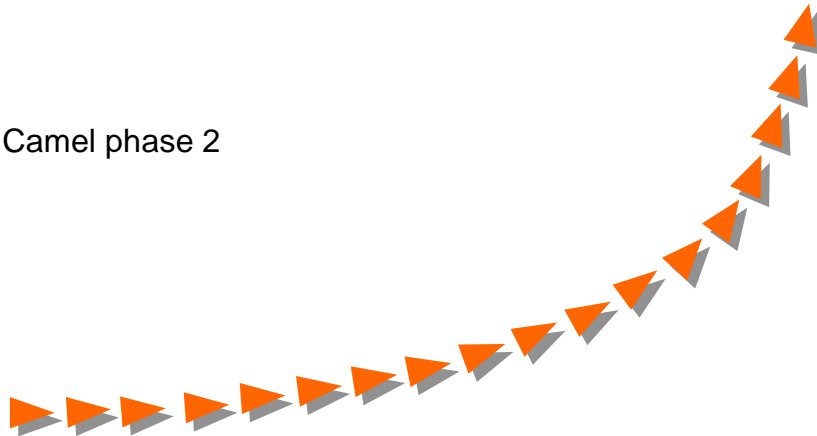
**G. What is a Detection Point (DP)?**

- 1/ It is in between the different states (PIC's) of a BCSM?
- 2/ It can give the control of the call to the gsmSSF?

**H. When an event is encountered as an EDP\_R (Request) then....**

- 1/ A CAP operation is sent towards the gsmSCF containing this event?
- 2/ The CSE is contacted for the first time?
- 3/ The gsmSCF is requested to take control over the call?

▼ Camel phase 2

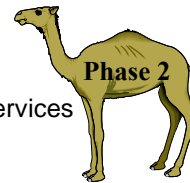


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- ▼ CAMEL phase 2 enhances the capabilities of phase 1:
  - Additional detection points for call failure conditions
  - Criteria to contact the CSE
  - New operations between RCF and CSE
  - Follow-on feature
  - Support of Specialized Resources (gsmSRF)
  - Tone insertion during active call
  - Subscriber Interaction with the CSE by using USSD
  - New handling of charging
  - CSE can be informed of invocation of Supplementary Services
    - e.g. ECT, MPTY
  - Subscribers can register short forwarded-to numbers
  - Handling of alerting pattern



- ▼ CAMEL Phase 2 - services
  - Prepaid Applications
  - Virtual Private Networks
  - Unified Messaging Applications
  - .....



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**Prepaid Applications.**

A solution that allows their customers to continue making or receiving calls to their prepaid mobile phones when they travel abroad.

The Alcatel solution permits to prepaid mobile subscribers the possibility of interrogate or replenish their account while they are abroad, giving them a full control of their expenses, thanks to a real-time billing.

These services are delivered on Alcatel's Intelligent Network platform. It is based on the CAMEL standard interface integrated between the Intelligent Network platforms and the mobile switches. The CAMEL technology enables homogeneous Intelligent Network services to be provided over multiple GSM networks.

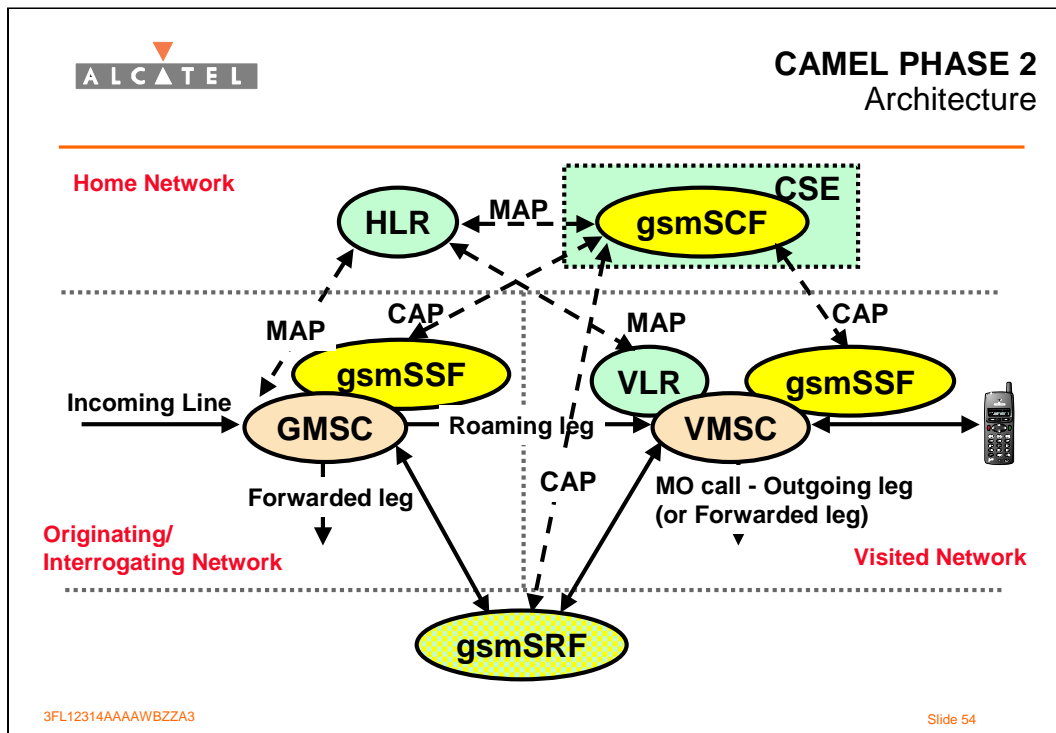
**Virtual Private Networks.**

One type of service, where the benefits can be easily seen, is Virtual Private Network. The introduction of CAMEL will allow a user to access the company short number dialing plan even if travelling abroad.

**Unified Messaging Applications.**

In the mobile environment, unified messaging means providing an individual user access, through his or her mobile terminal, to all the recognized messaging formats including voice mail, facsimile, pager, SMS and email.

In today's working environment, messages are received in a wide variety of formats from a myriad of different sources. Unified messaging brings all these different messaging formats and services under a single umbrella, giving the user the opportunity to manage his data and information services for maximum benefit.

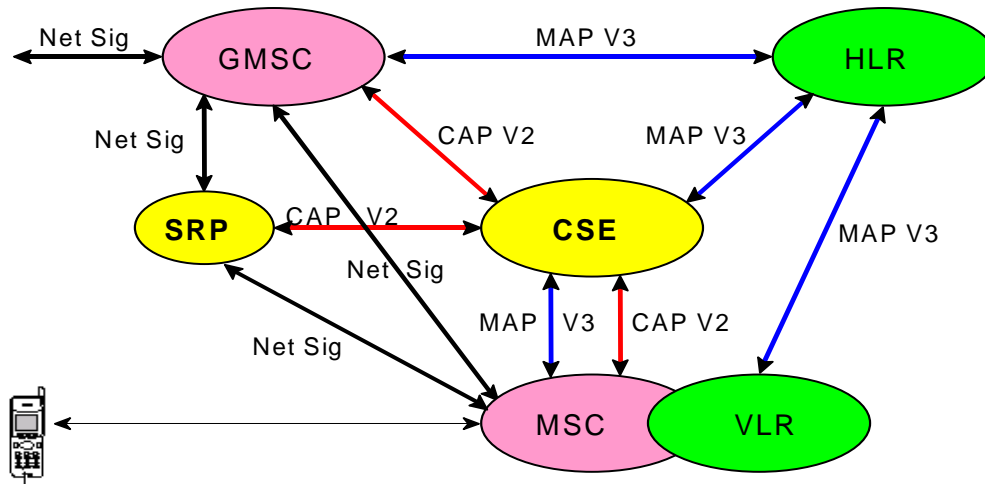


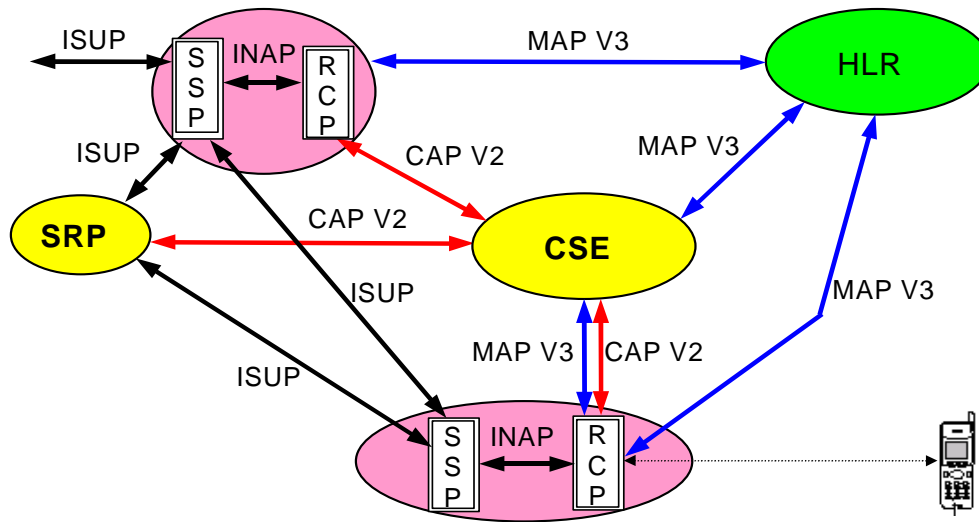
### **gsmSRF:**

The specialized resource function provides a pool of resources for access by other network entities. These resources include for example:

- sending of announcements to the parties in a call
- prompt for information using DTMF sending and receiving
- speech recognition, synthesized speech provision
- protocol conversion
- specialized connection resources (e.g. audio conference bridge or information distribution bridge) or voicemail.

**SRP:** Specialised Resource Point (SRP) is the physical node containing a specialized resource function (**SRF**).





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#### ▼ Administered and stored in HLR “per subscriber”.

##### ■ T-CSI data:

- TDP criteria on basic service (up to 5 basic service, enabling list)
- Camel capability handling

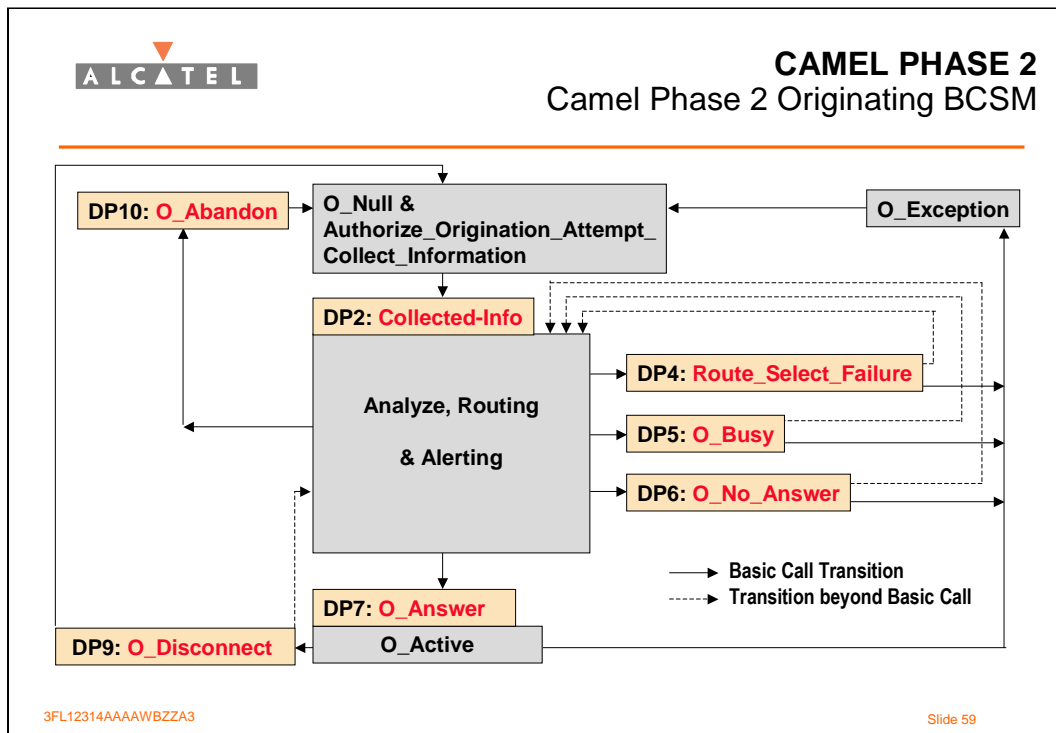
##### ■ O-CSI data

- TDP criteria
  - Destination number (10 numbers and/or 3 number lengths (enabling or inhibiting list))
  - Basic services (up to 5 basic service, enabling list)
  - Type of call (defining whether or not the call must be a forwarded call, enabling list)
- CAMEL capability handling (CAMEL phase in gsmSCF)

subscriber has subscribed to CAMEL services which require	CAMEL Capability handling (*)	GMSC minimum requirement	NO_CA_GMSC
– CAP V2. – Only CAP V2 is accepted. – CAMEL services must always be invoked (GMSC shall support CAMEL phase 2 otherwise the call is released).	02	02	Release
– CAP V2 – Only CAP V2 is accepted. – CAMEL services are not mandatory. If GMSC doesn't support CAMEL phase 2, the call goes on without CAMEL.	02	02	Continue
– CAP V2. – CAP V1 is also accepted. – CAMEL services must always be invoked (GMSC shall support CAMEL otherwise the call is released).	02	01	Release
– CAP V2. – CAP V1 is also accepted. – CAMEL services are not mandatory. If GMSC doesn't support CAMEL, the call goes on without CAMEL.	02	01	Continue
– CAP V1. – CAMEL services must always be invoked (GMSC shall support CAMEL otherwise the call is released).	01	01	Release
– CAP V1. – CAMEL services are not mandatory. If GMSC doesn't support CAMEL, the call goes on without CAMEL.	01	01	Continue

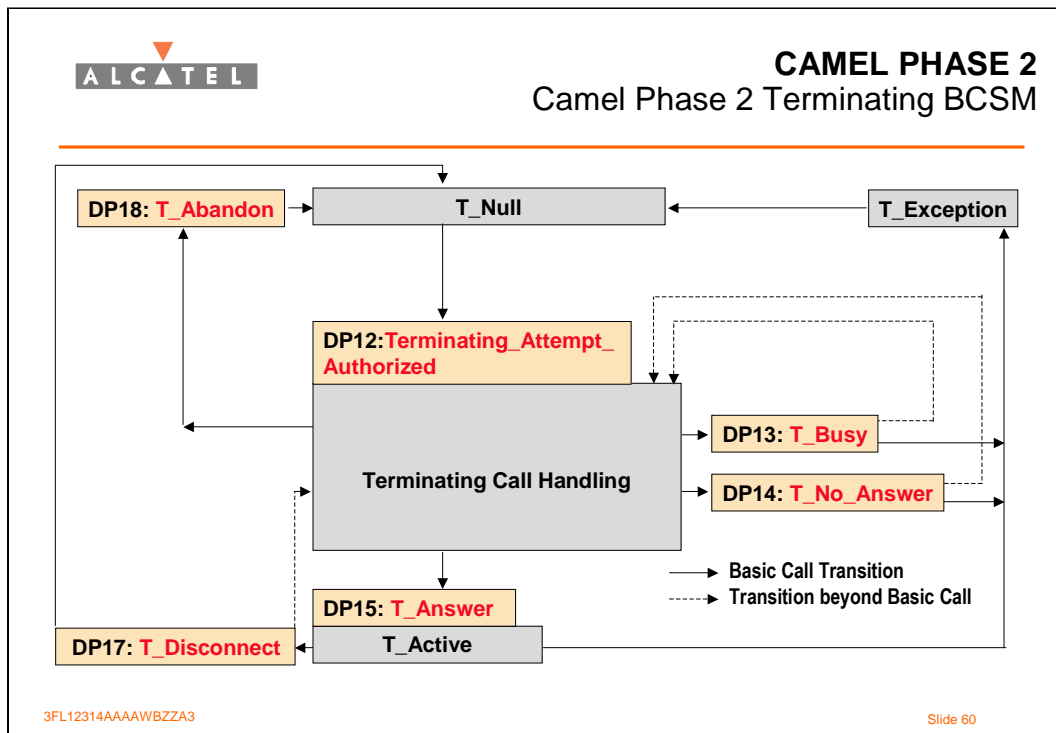
- ▼ Administered and stored in HLR “per subscriber”.
- ▼ New Camel phase 2 parameters
  - GMSC and VMSC minimum requirement
  - HLR behavior if no CAMEL in GMSC or in VMSC
  - USSD Camel Subscription Information
  - SS (MTPY and/or ECT) invocation notification service
  - Forwarded to number without HLR control (O-CSI subscriber only)

subscriber has subscribed to CAMEL services which require :	CAMEL Capability	VMSC Minimum requirement	NO_CA_VLR
– CAP V2. – only CAP V2 is accepted. – CAMEL services must always be invoked (VMSC shall support CAMEL phase 2 otherwise the location updating is refused – RRDTUF).	02	02	Release
– CAP V2. – Only CAP V2 is accepted. – CAMEL services are not mandatory. If VMSC doesn't support CAMEL phase 2, the subscriber is located without CAMEL data.	02	02	Continue
– CAP V2. – CAP V1 is also accepted. – CAMEL services must always be invoked (VMSC shall support CAMEL otherwise the location is refused – RRDTUF).	02	01	Release
– CAP V2. – CAP V1 is also accepted. – CAMEL services are not mandatory. If VMSC doesn't support CAMEL, the subscriber is located without CAMEL data.	02	01	Continue
– CAP V1. – CAMEL services must always be invoked (VMSC shall support CAMEL otherwise the location updating is refused – RRDTUF).	01	01	Release
– CAP V1. – CAMEL services are not mandatory. If VMSC doesn't support CAMEL, the subscriber is located without CAMEL data.	01	01	Continue



### Description of O-BCSM DP in the MSC

CAMEL Detection Point	DP Type	Description
DP2: Collected-Info	TDP-R	Indication that the O-CSI is analyzed
DP4: Route_Select_Failure	EDP-N,EDP-R	Indication that the call establishment failed
DP5: O_Busy	EDP-N,EDP-R	Indication that: - a busy indication is received from the terminating party, - a not reachable event is determined upon a cause IE in the ISUP release message.
DP6: O_No_Answer	EDP-N,EDP-R	Indication that an application timer associated with the O_No_Answer DP expires
DP7: O_Answer	EDP-N,EDP-R	Indication that the call is accepted and answered by the terminating party.
DP9: O_Disconnect	EDP-N,EDP-R	A disconnect indication is received from the originating party or from the terminating party
DP10: O_Abandon	EDP-N	Indication that a disconnect indication is received from the originating party during the call establishment procedure



### Description of T-BCSM DPs in the GMSC

CAMEL Detection Point	DP Type	Description
DP12: Termination_Attempt_Authorized	TDP-R	Indication that the T-CSI is analyzed
DP13: T_Busy	EDP-N,EDP-R	Indication that: - a busy indication is received from the destination exchange, - not reachable or call establishment failure event is determined from the HLR response or upon a cause IE in the ISUP release message.
DP14: T_No_Answer	EDP-N,EDP-R	Indication that an application timer associated with the T_No_Answer DP expires
DP15: T_Answer	EDP-N,EDP-R	Call is accepted and answered by the terminating party
DP17: T_Disconnect	EDP-N,EDP-R	A disconnect indication is received from the terminating party or from the originating party
DP18:T_Abandon	EDP-N	A disconnect indication is received from the originating party during the call establishment procedure

#### O\_BCSM

Encountered DP	Implicit disarmed DPs						
	DP4	DP5	DP6	DP7	DP9 leg 1	DP9 leg 2	DP10
DP4 Route_select_failure	X	X	X	X		X	
DP5 O_busy	X	X	X	X		X	
DP6 O_No_Answer	X	X	X	X		X	
DP7 O_Answer	X	X	X	X			X
DP9 O_Disconnect leg 1					X		X
DP9 O_Disconnect leg 2	X	X	X	X		X	
DP10 O_Abandon					X		X

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The table entry "X" means that if one DP occurs (independently of arming and reporting to the gsmSCF) the marked one is implicitly disarmed.

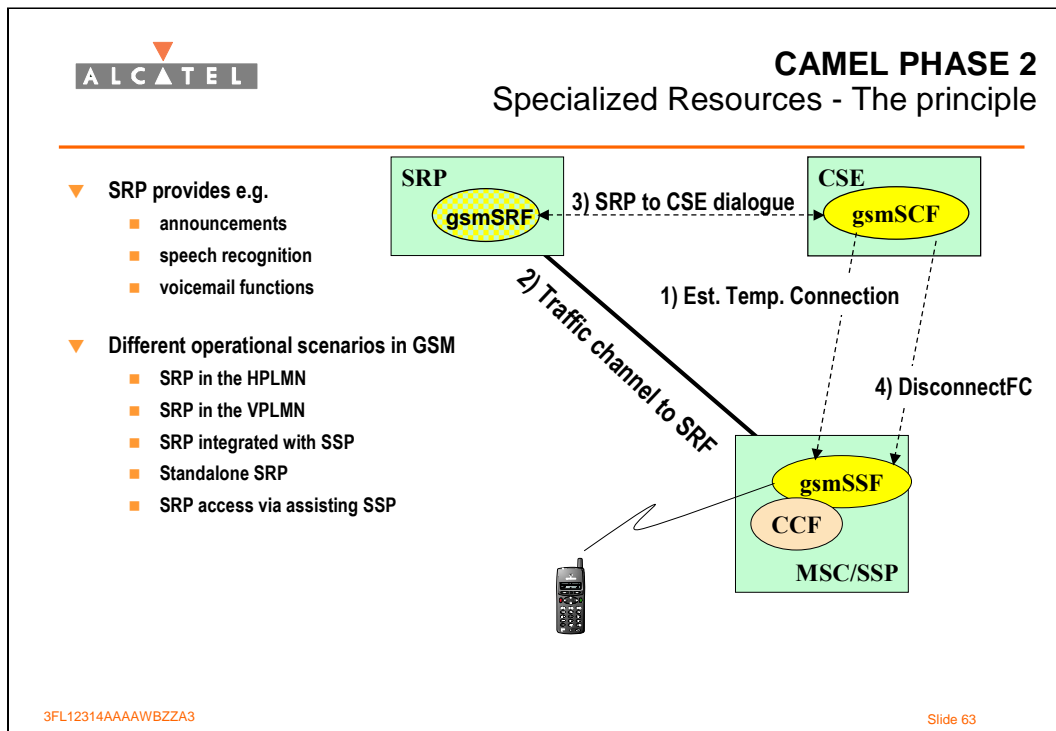
When EDP's armed with MonitorMode "Request" (EDP-R's) are encountered, any implicit EDP disarming shall take place before reporting the EDP and transiting the gsmSSF.

It shall be possible to rearm explicitly an implicitly disarmed DP, e.g. for follow on call. (connect).

T\_BCSM

Encountered DP	Implicit disarmed DPs					
	DP13	DP14	DP15	DP17 leg 1	DP17 leg 2	DP18
DP13 T_busy	X	X	X		X	
DP14 T_No_Answer	X	X	X		X	
DP15 T_Answer	X	X	X			X
DP17 T_Disconnect leg 1				X		X
DP17 T_Disconnect leg 2	X	X	X		X	
DP10 T_Abandon				X		X

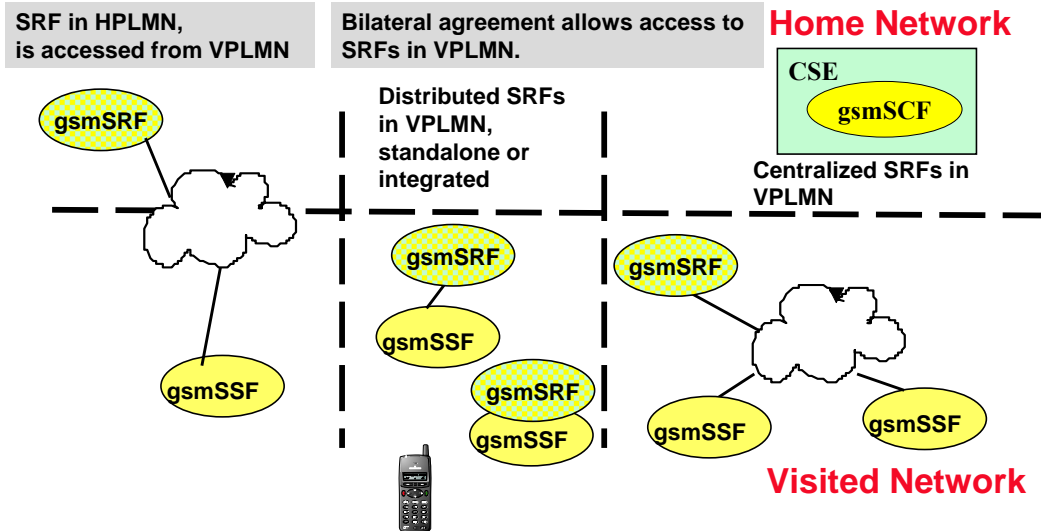




For CAMEL operating in the GSM environment, there are a number of considerations:

- In CAMEL a subscriber shall have access to the SRF independent from his location, i.e. also when roaming.
- Operator's need to design SRP functionality (e.g. record announcements) in conjunction with OSS. As a result, the SRF needs to be under the management of the home network and therefore mostly located in the home network.
- Most efficient handling (in terms of cost for signaling and traffic channel use) is however possible with local SRFs, that are located close to the subscriber.
- Networks may use centralized SRF to ease operation and maintenance, possibly with service specific functions or decentralized SRF's with basic functions in all of them for load sharing purposes.
- If possible, the physical arrangements should be transparent for the service logic to keep the service logic simple. There may also be restrictions at the international signaling boundaries.

Those considerations are partially colliding and may result in a large number of scenarios, where operators make use of bilateral agreements or even proprietary standards, if the SRF is located in the home network. However, even for scenarios in the home network the interface between SRP and CSE is specified by CAP.



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### SRF Scenarios

#### Cases without assisting SSP

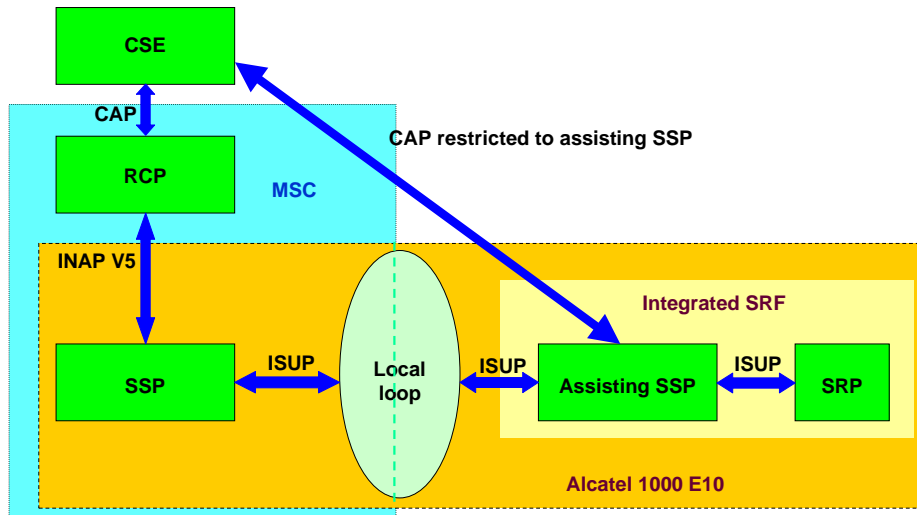
	SRF integrated with initiating SSP?	IP directly connected to initiating SSP?	Signalling procedure to establish connection to IP	Signalling to SRF
SSF Relay	Optional	Yes	ConnectToResource	Via initiating SSP
Direct path SCP to SRP	No	Yes	EstablishTemporary Connection	Direct to SRP
Assist without relay; return control to initiating SSP on completion of User Interaction	No	No	EstablishTemporary Connection	Direct to SRP

#### Cases with assisting SSP

	Signalling Procedure to Establish Connection to Assisting SSP	Signalling procedure to establish connection to IP	Signalling to SRF
Assist with relay; return control to initiating SSP on completion of User Interaction	EstablishTemporary Connection	ConnectToResource	Via assisting SSP
Handoff; retain control at assisting SSP after User Interaction completed	Connect	ConnectToResource	Via assisting SSP



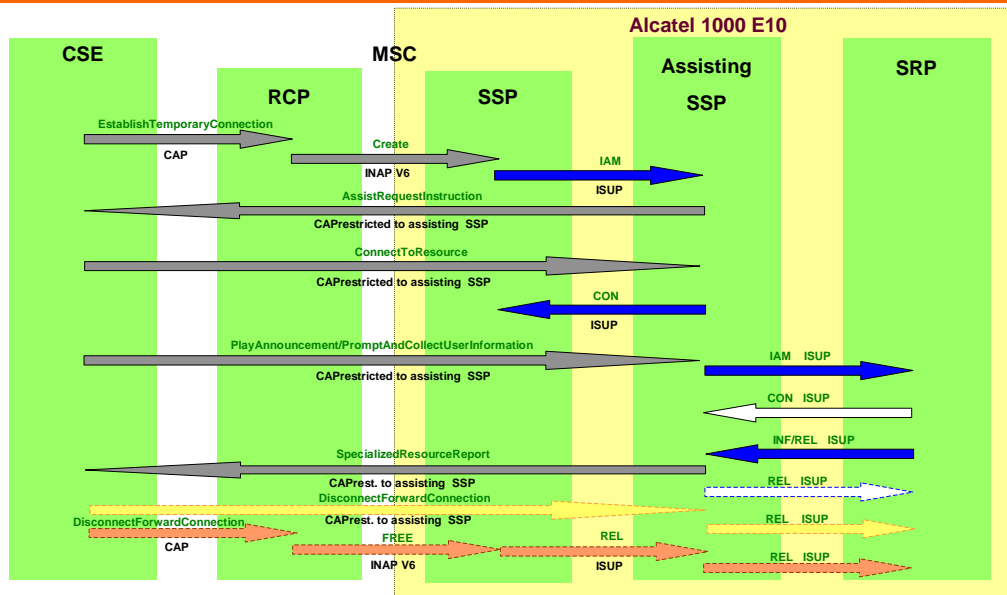
### Interfaces and organization



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## USER INTERACTION Assisting SSF (Alcatel solution)



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**Unstructured Supplementary Services Data (USSD)**

- ▼ USSD is a means of transmitting information or instructions over a GSM network.
- ▼ USSD has some similarities with SMS since both use the GSM network's signaling path.  
Unlike SMS, USSD is not a store and forward service and is session-oriented such that when a user accesses a USSD service, a session is established and the radio connection stays open until the user, application, or time out releases it.
- ▼ This has more in common with Circuit Switched Data than SMS.
- ▼ USSD text messages can be up to 182 characters in length.
  - <http://www.mobileUSSD.com/>

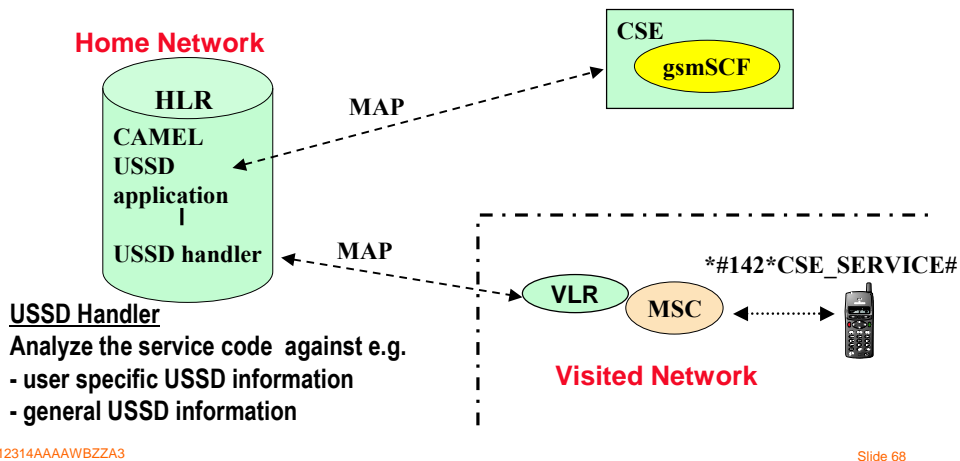
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**USSD has advantages as a tool for deploying services on mobile networks:**

- Turnaround response times for interactive applications are shorter for USSD than SMS because of the session-based feature of USSD, and because it is NOT a store and forward service.
- USSD can be up to seven times faster than SMS to carry out the same two-way transaction.
- Users do not need to access any particular phone menu to access services with USSD- they can enter the USSD command direct from the initial mobile phone screen.
- Because USSD commands are routed back to the home mobile network's Home Location Register (HLR), services based on USSD work just as well and in exactly the same way when users are roaming.
- USSD works on all existing GSM mobile phones.
- Both SIM Application Toolkit and the Wireless Application Protocol support USSD.
- USSD Stage 2 has been incorporated into the GSM standard. Whereas USSD was previously a one way bearer useful for administrative purposes such as service access, Stage 2 is more advanced and interactive. By sending in a USSD2 command, the user can receive an information services menu. As such, USSD Stage 2 provides WAP-like features on EXISTING phones.
- USSD strings are typically complicated for the user to remember, involving the use of the "\*" and "#" characters to denote the start and finish of the USSD string. However, USSD strings for regularly used services can be stored in the phonebook, reducing the need to remember and re-enter them.
- As such, USSD could be an ideal bearer for WAP on GSM networks.

- ▼ USSD can be used for user interaction
  - e.g. In prepaid service, credit inquiry and refilling



#### USSD: Unstructured Supplementary Services Data

- User Interaction with the CSE via USSD.

The support of this function is a network operator option in GSM.

The HLR acts as a transparent relay.

- There is already a mechanism in GSM that routes USSD messages to the HLR depending on the service code.

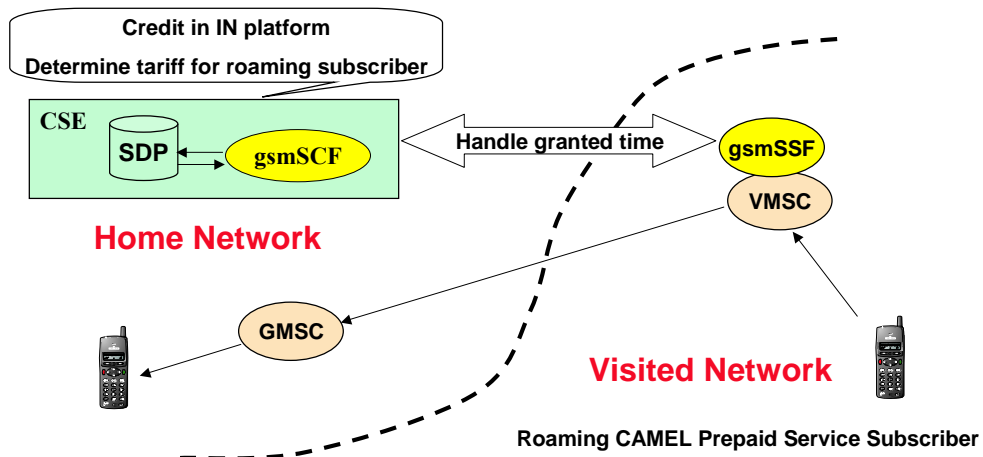
- E.g. 1, 2 or 3 digits from the set (\*, #) followed by 1X(Y),  
where X=any number 0-4, Y=any number 0-9,  
then optionally "\*" followed by any number of any characters",  
and concluding with # SEND.  
XY is the service code.

The service code may be further analyzed by the HLR and relayed to the gsmSCF if appropriate.

- The relay is likely to be controlled by the

USSD CAMEL subscription information (**U-CSI**): U-CSI stores per subscriber the service code and an SCF address to which it should be relayed.

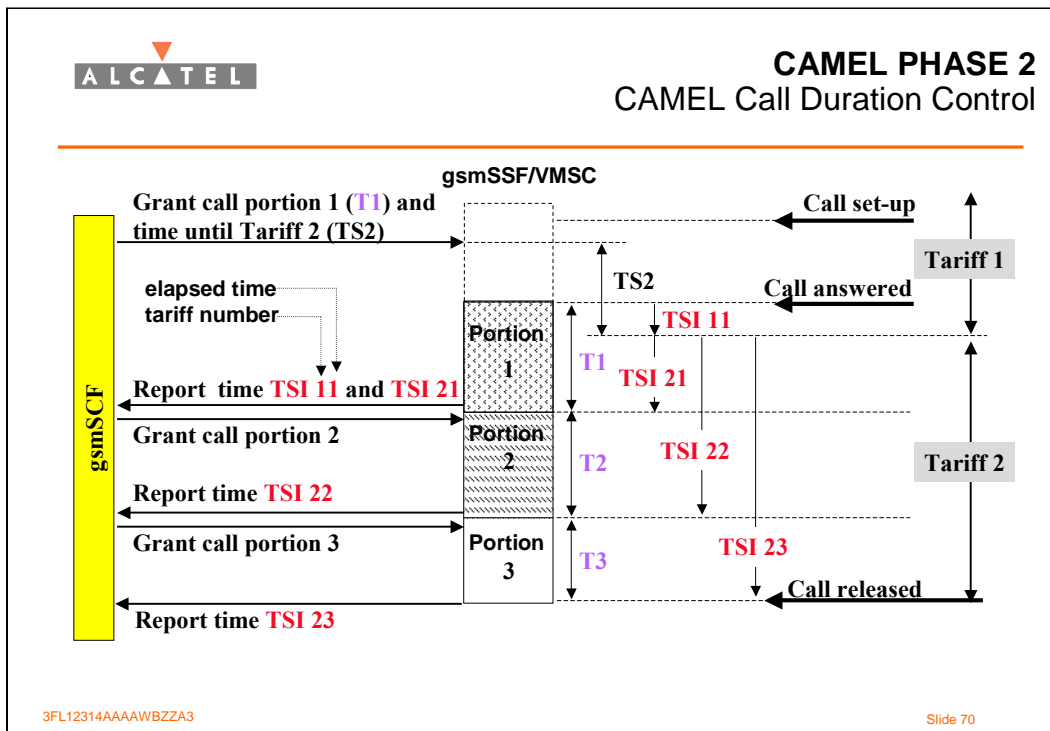
The relay can also be controlled by a general USSD subscription information that is not stored per subscriber.



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Based entirely on CAMEL phase 2 feature set.  
 Call Duration control by means of SSF timers.  
 Standardized warning tone when account runs low.  
 Announcements played in HPLMN's Resources using Assist Procedure.



### Principle of the SCF control of duration.

**CS:** Call Segment

**TS:** Tariff Switch time

**Tx:** Timers indicating the maximum duration for a call segment  
x is the number of the call segment

**TSIxy:** Tariff Switch Interval, Timers indicating the duration until the next tariff applies  
x is the number of the tariff  
y is the elapsed time since the previous reference point

To control the Call duration, the SCF sends to the MSC the duration values.

At reception of these values, the MSC starts the Call duration supervision timers.

The SCF indicates the maximum Call duration and the Tariff switch time in case a tariff switch is foreseen during the call. The call duration is given in relative time.

On SCF requests, the MSC has the possibility to send at the end of the call, information to be used for the SCF charging ticket. The list of information sent at the end of the call contains:

- Call attempt elapsed time - Call Stop time - Call connected elapsed time - Release cause

HLR subscriber data (content of T-CSI 'Capability Handling')	CAMEL Phase supported by the gsmSSF	Version choice result at 'SendRoutingInformationResult'
CAMEL Phase 2	CAMEL Phase 2	Access to CAMEL Phase 2 service
CAMEL Phase 1	CAMEL Phase 2	Access to CAMEL Phase 1 service
CAMEL Phase 2	CAMEL Phase 1	Either the call is barred or the call may proceed with service restriction, only phase 1 data are sent to the gsmSSF
CAMEL Phase 1	CAMEL Phase 1	Access to CAMEL Phase 1 service
CAMEL Phase 1 or 2	None	The call is refused or accepted depending on subscriber data

- 'CAMEL Phase 1' or 'CAMEL Phase 2' is memorized in the HLR's subscriber data. It indicates that the service associated to the ServiceKey are Phase1 or Phase 2 services.
- The version choice is done in the HLR using as basis the subscribed information and the 'CAMEL phase supported by the gsmSSF' as received from the MSC at 'Location Update' or from GMSC at 'SendRoutingInfo' for a terminated call.
- The CAMEL Phase 2 version choice permits to construct 'InsertSubscriberData' and 'SendRoutingInformationResult' messages, this to avoid the sending of Phase 2 information to Phase 1 gsmSSF. It permits also to decide if the call can be accepted or not.

HLR subscriber data (content of O-CSI 'Capability Handling')	CAMEL Phase supported by the gsmSSF	Version choice result at 'Location Update'
CAMEL Phase 2	CAMEL Phase 2	Access to CAMEL Phase 2 service
CAMEL Phase 1	CAMEL Phase 2	Access to CAMEL Phase 1 service
CAMEL Phase 2	CAMEL Phase 1	Either Location Update is refused or the call may proceed with service restriction, only phase 1 data are sent to the gsmSSF
CAMEL Phase 1	CAMEL Phase 1	Access to CAMEL Phase 1 service
CAMEL Phase 1 or 2	None	Location Update is accepted depending on subscriber data



#### ▼ gsmSSF => CSE

- Activity Test ack (1)
- Apply Charging Report (2)
- Call Information Report (2)
- Event Report BSCM (1)
- Initial DP (1)

#### ▼ CSE => gsmSRF (2)

- Cancel
- Play Announcement
- Prompt And Collect User Information-Inv
- Activity test

#### ▼ gsmSRF => CSE (2)

- Assist Request Instructions
- Prompt And Collect User Information-Res
- Specialized Resource Report
- Activity Test ack

#### ▼ CSE => gsmSSF

- Activity test (1)
- Apply Charging (2)
- Call Information Request (2)
- Cancel (2)
- Connect (1)
- Connect To Resource (2)
- Continue (1)
- Disconnect Forward Connection (2)
- Establish Temporary Connection (2)
- Furnish Charging Information (2)
- Release Call (1)
- Request Report BSCM Event (1)
- Reset Timer (2)
- Send Charging Information (2)

(1) CAP Phase 1 and Phase 2  
(2) CAP Phase 2 only

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The IN architecture is fundamentally based on CCS7 and its protocol architecture.

#### IN Protocol Stack:

**CAP:** The CAMEL Application Part (CAP) makes use of the services offered by CCS7 to offer CAMEL specific service capabilities at the application layer. CAP defines the operations required between CSE, gsmSSF and gsmSRF.

**TCAP:** The transaction capabilities application part (TCAP) provides procedures for real-time transaction control.

**SCCP:** The signaling connection control part (SCCP), augments the MTP by providing both connectionless and connection-oriented message transport, as well as enabling addressing capabilities for message routing.

**MTP:** A common signaling transport capability known as the message transfer part (MTP) handles the corresponding open systems interconnection (OSI) physical, data-link, and network layers.

**A. What is CAMEL Phase 2?**

- 1/ It does not support CAMEL Phase 1 services?
- 2/ It supports control of call duration and charge rate?
- 3/ It supports Specialized Resources Function (gsmSRF)?
- 4/ It allows subscriber interaction with the CSE by using USSD?

**B. The Specialized Resources Function provides...**

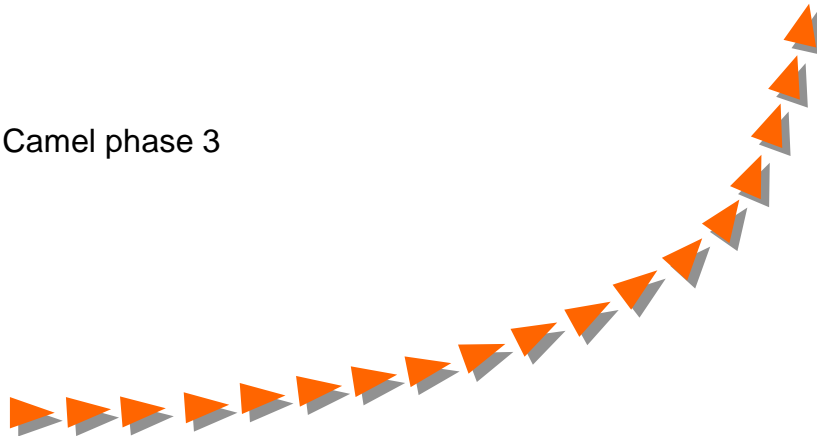
- 1/ Sending of announcements to the parties in a call?
- 2/ Subscriber State and Location Information?
- 3/ Prompt for information using DTMF sending and receiving?

**C. What is USSD?**

- 1/ It allows to transmit information or instructions over a GSM network?
- 2/ It a store and forward service for text messages up to 182 characters in length?



▼ Camel phase 3



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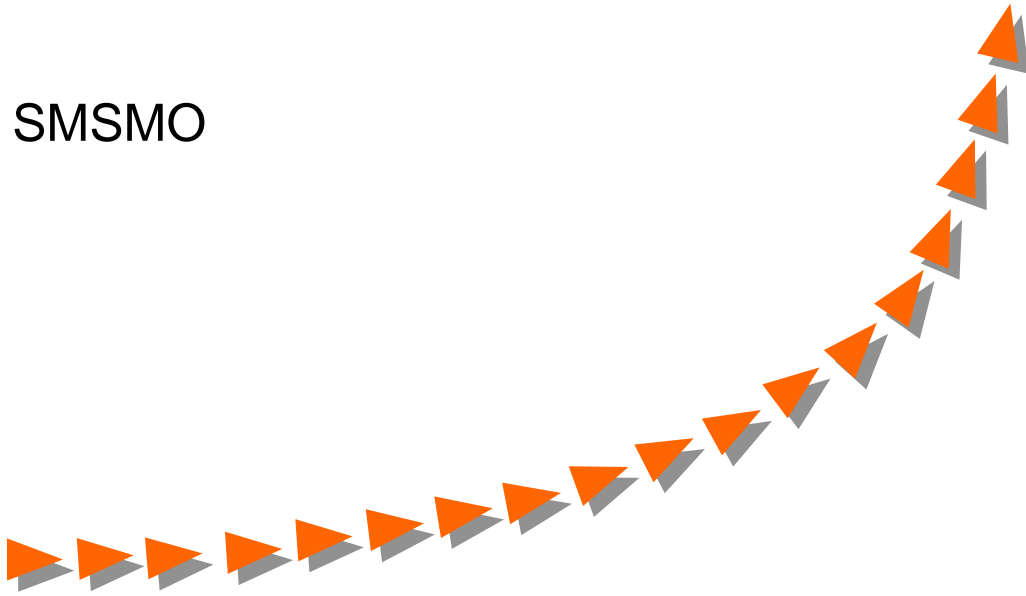
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▼ **CAMEL phase 3** is an upgraded phase of CAMEL including :

- Handling of GPRS–CSI at the HLR
- Camel inhibition in Circuit and Packet Domain
- Handling of MO Short Message Service control in Circuit and Packet Domain
- Handling of Mobility management Event notifications in Circuit Domain
- Triggering available at the HLR in case of call establishment failure for :
  - OC : route error,
  - TC : busy or not reachable subscriber, or no reply
- Active Location Retrieval function : a "Page" or "Search" procedure is used to retrieve the current location of a UE

## 3-2 SMSMO

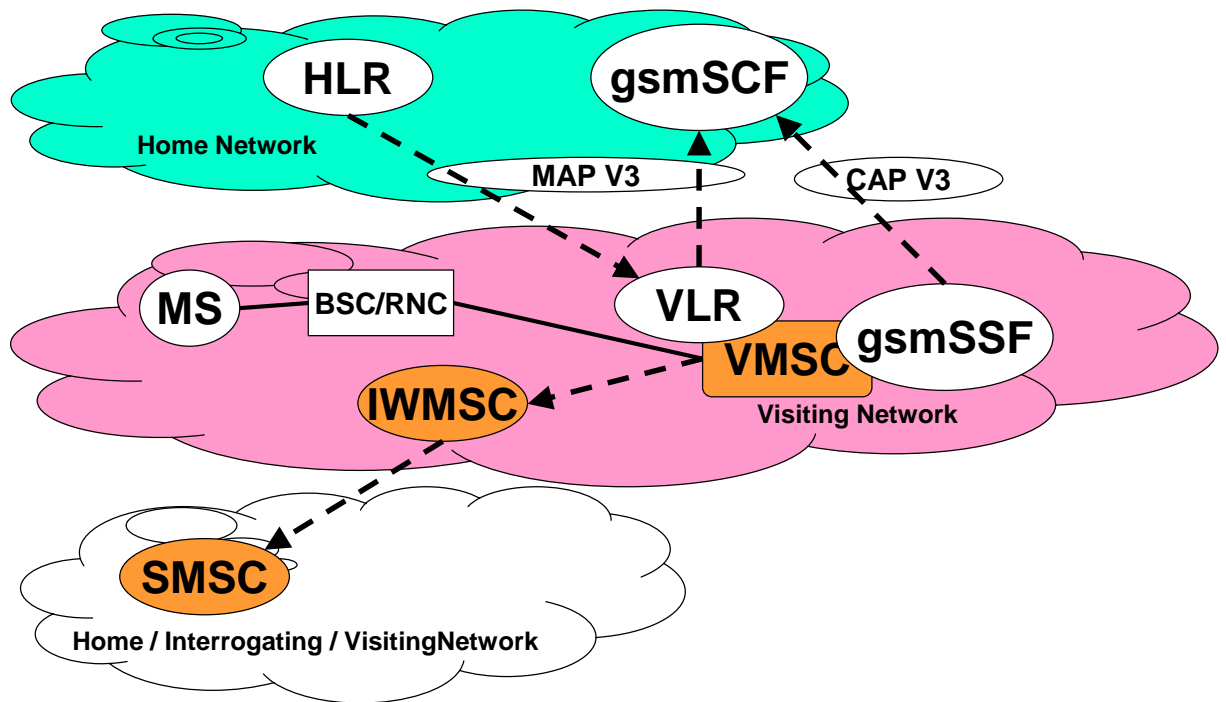


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▼ **The CAMEL SMS–MO function :**

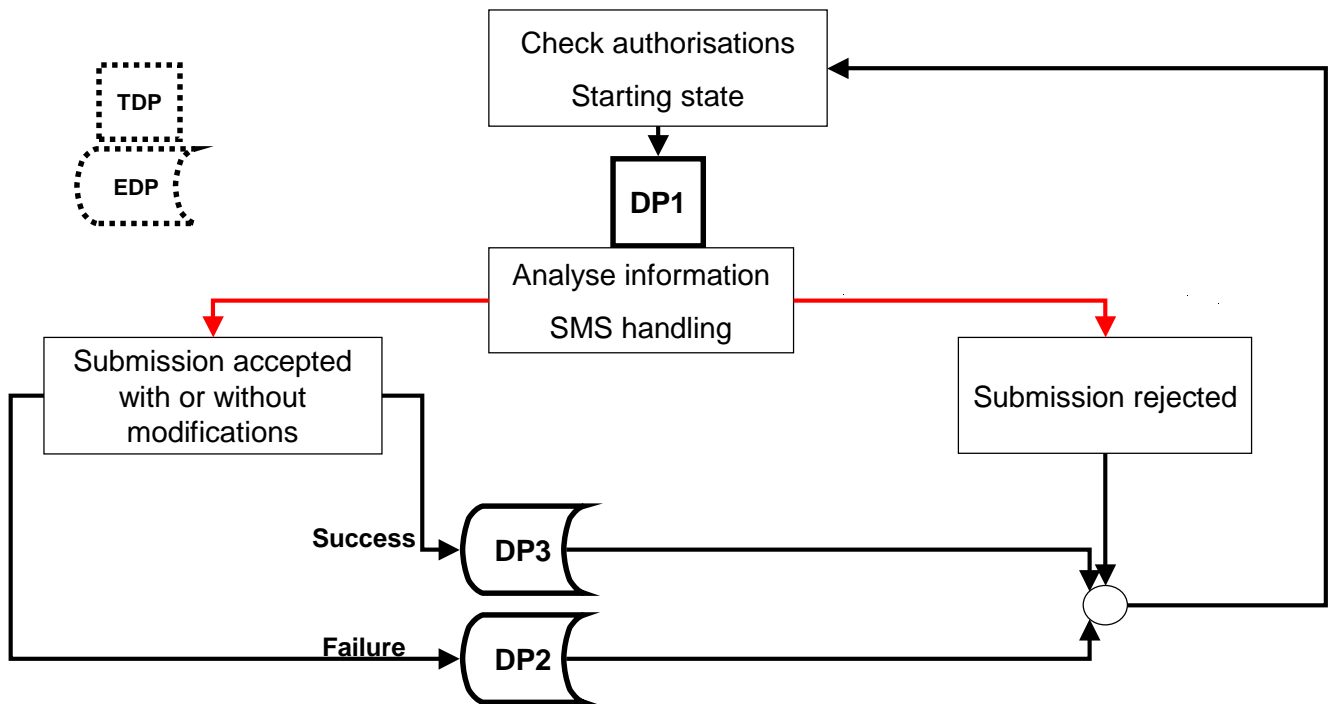
- The CAMEL service is invoked for a Short Message Originating, so it is necessary that :
  - SMO–CSI data exists for the subscriber
  - The function is supported only from CAP V3 protocol.

- A SMS MO transaction starts when the VMSC receives a **CM\_Service\_Request message** . The part related to security, channel assignment does not change for this procedure.
- After this first phase, the RCF waits for **CP\_DATA message** from the MS and the interaction with CAMEL may occur.



CAMEL DP name	DP label	DP type	Description
DP1	DP SMS_Collected_Info	TDP-R	Indication that the SMO–CSI is analysed
DP2	DP O_SMS_Failure	EDP-N, EDP-R	Indication that the submission to the Short Message Service Center failed
DP3	DP O_SMS_Submitted	EDP-N, EDP-R	Indication that the SM has been successfully submitted to the Short Message Service centre

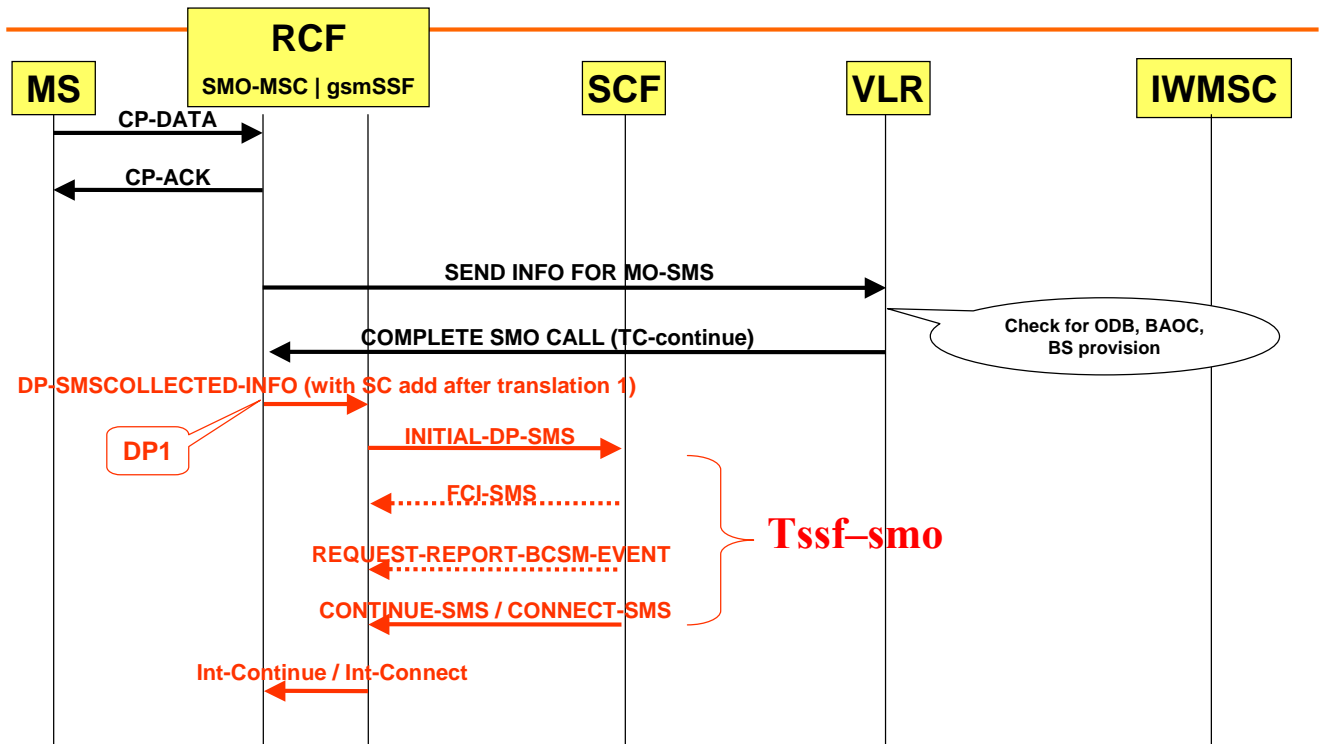




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- ▼ An SMS–MO submission can be suspended when the specific TDP is triggered, depending on subscriber data subscription. Then a dialogue is opened with the SCF which can decide to bar or continue the SMO submission.
- ▼ The SCF is able to instruct the RCF to :
  - allow the SM to be delivered to the service Center without modification
  - bar the SM submission
  - allow the SM submission with modified informations (Called Party Number, Calling Party Number and SMSC address)
  - perform charging activities
  - request for service events concerning the SM submission. The service events which shall be detected and reported to the SCF are :
    - Successful SM submission to the SMSC
    - Unsuccessful submission to the SMSC
- ▼ **N.B.** Follow on is not authorized.

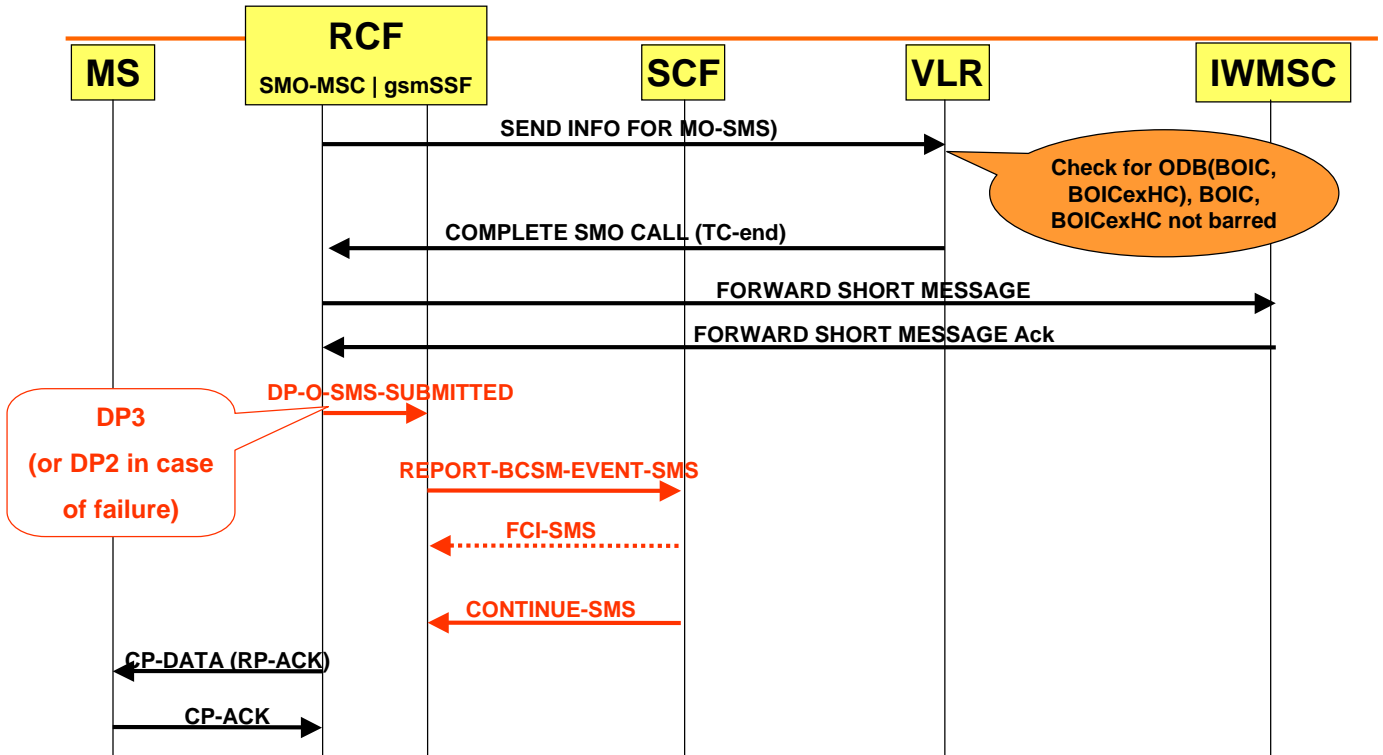


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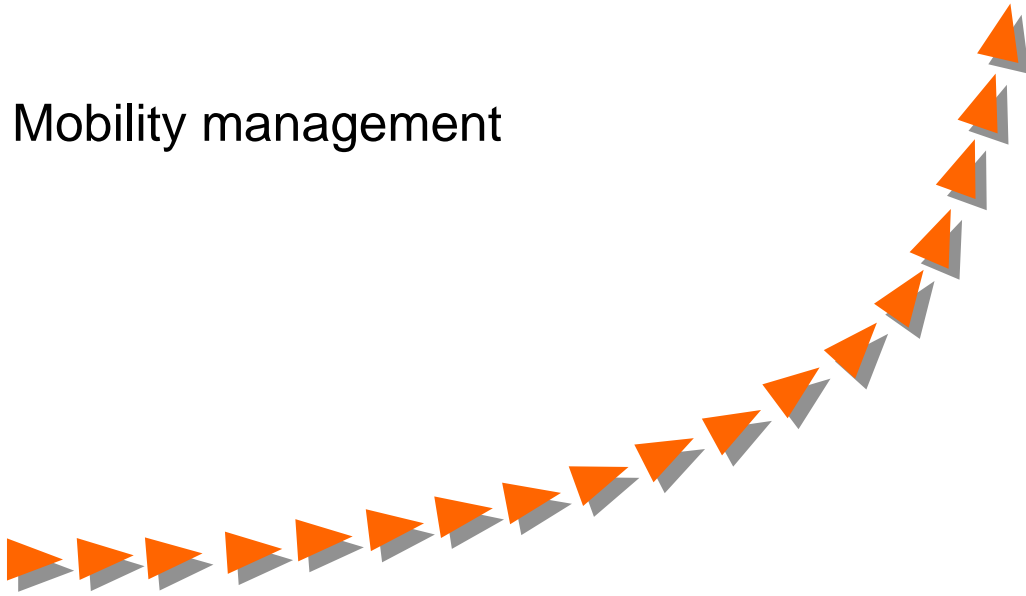
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FCI-SMS = "Furnish Charging Information" for SMS service

Tssf-smo = timer to control the decision taken by the server !



## 3-3 Mobility management



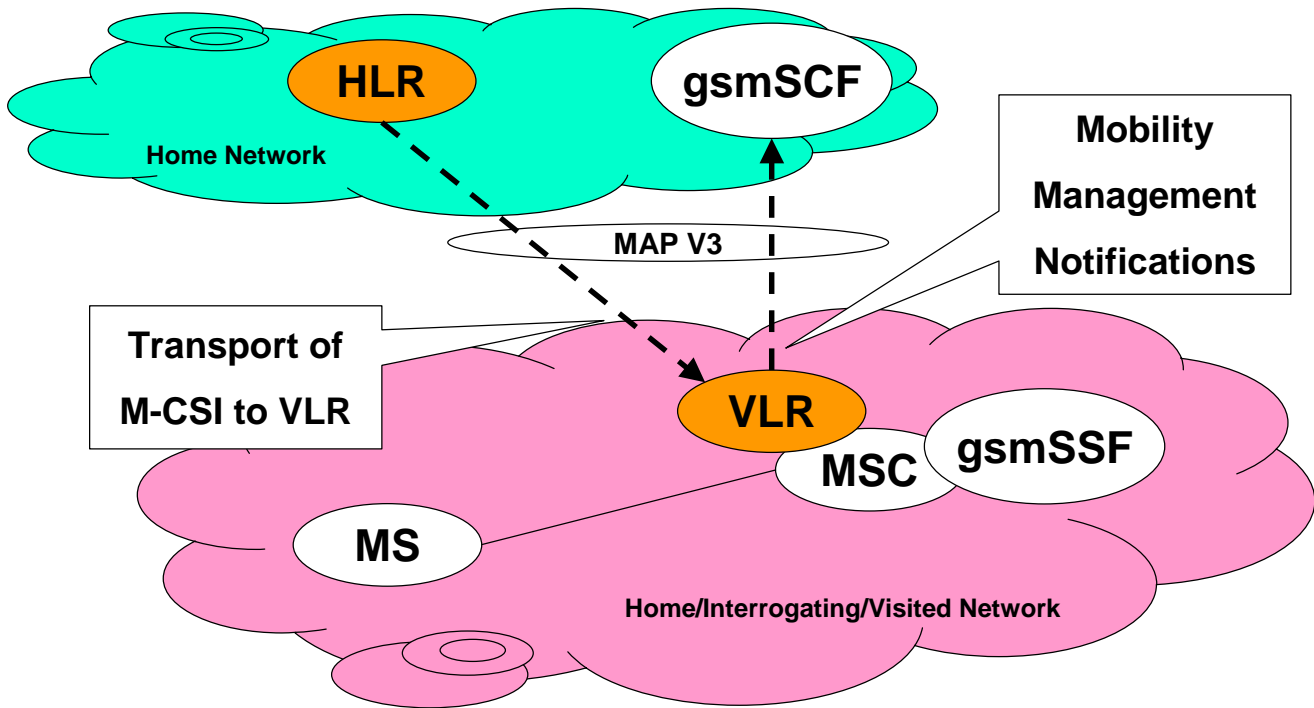
### ▼ Mobility management event notifications

- Depending on CAMEL subscription information (**M-CSI**), it is possible to notify a CAMEL service on the following events in the MSC :
  - Location update to a different VLR service area,
  - Location update within the same VLR service area,
  - MS initiated detach,
  - Network initiated detach,
  - IMSI attach,

### **M-CSI data (from CAMEL phase 3) : MobilityTriggers : Mobility Management Triggers**

These triggers define which MM events shall be reported to the SCP. The MM triggers may contain one or any combination of the following elements :

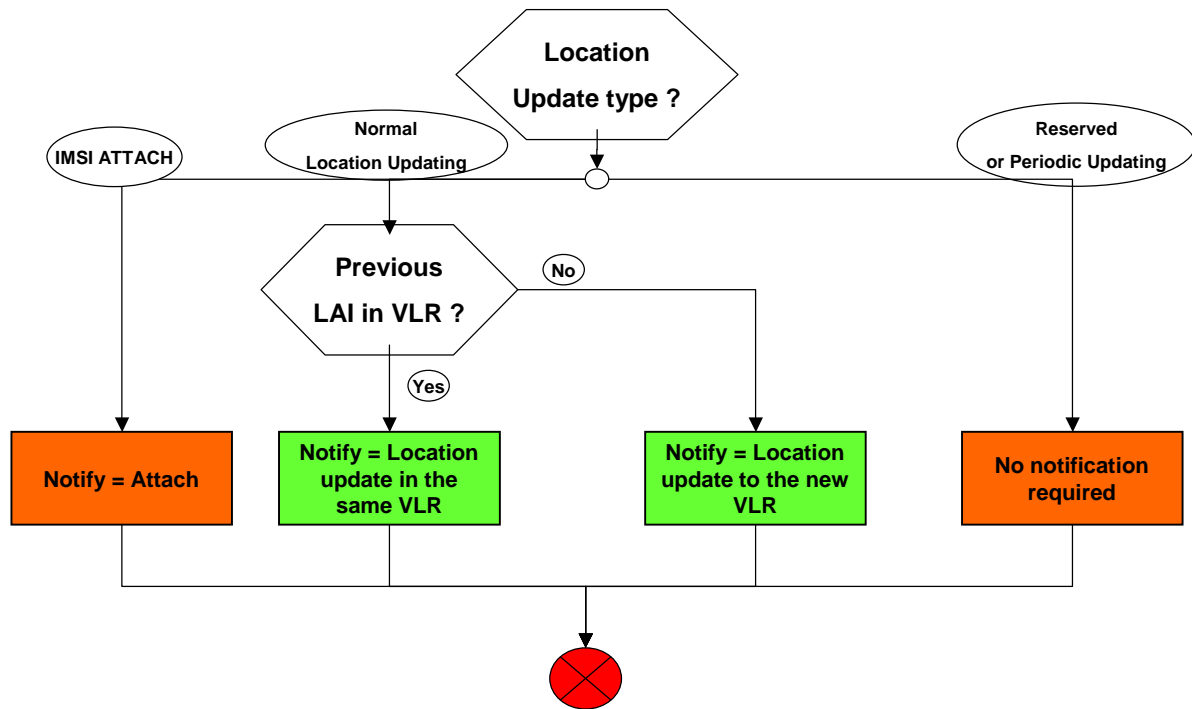
- Location update in the same VLR service area
- Location update to another VLR service area
- IMSI attach
- MS initiated IMSI Detach (explicit detach)
- Network initiated IMSI Detach (implicit detach)



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**Type of interface MAP message Ref : 3G TS 29.002**



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In VLR, the following MM events may lead to a MM notification to the SCP, after completion of the MM Event processing in VLR and if the subscriber has a subscription to MM events notification

Reception of a "Location Update" message type with "Location Update Type" parameter set to "IMSI Attach"

IMSI Attach

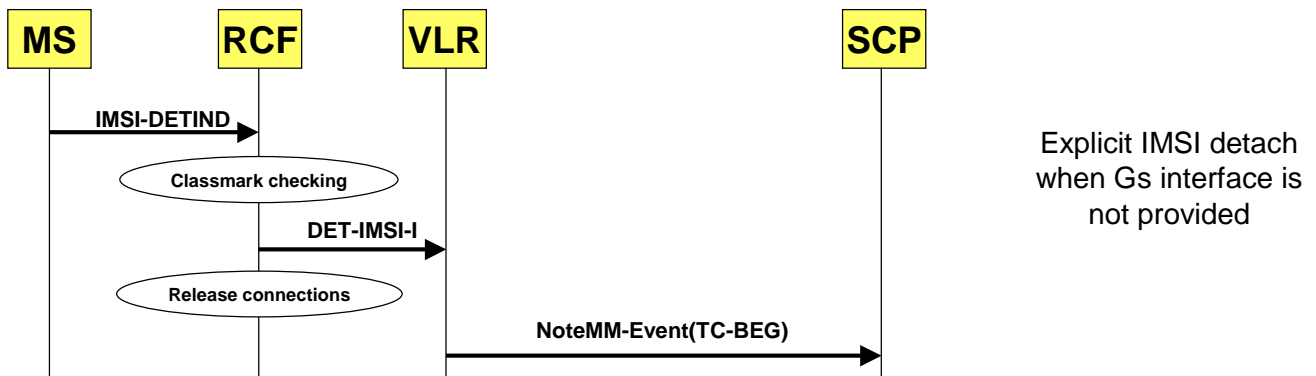
Reception of a "Location Update" message type with "Location Update Type" parameter set to "Normal Location Updating" and with or without a Follow-On request pending.

Location Update in the same VLR or

Location Update to another VLR

If an error occurs during the processing of the MM Event in VLR, no MM event notification is sent to SCP.





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In VLR, the following MM events may lead to a MM notification to the SCP, after completion of the MM Event processing in VLR and if the subscriber has a subscription to MM events notification

Explicit Detach:

- a ) Reception of an "IMSI Detach" message type from RCF:
  - with no "Reason" parameter present
  - or with "Reason" parameter present and set to "MS initiated IMSI Detach"

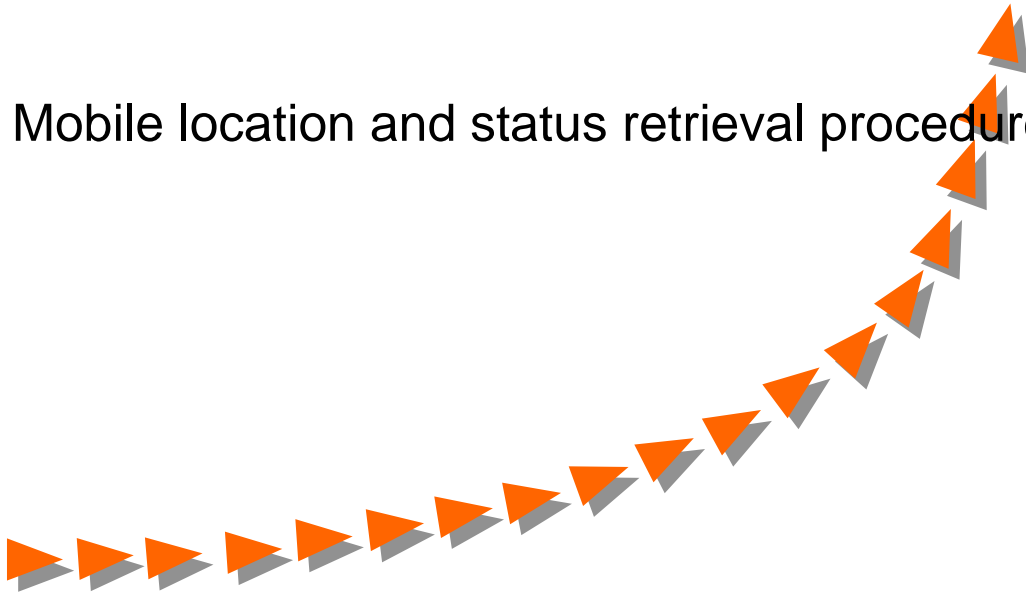
If an error occurs during the processing of the MM Event in VLR, no MM event notification is sent to SCP.

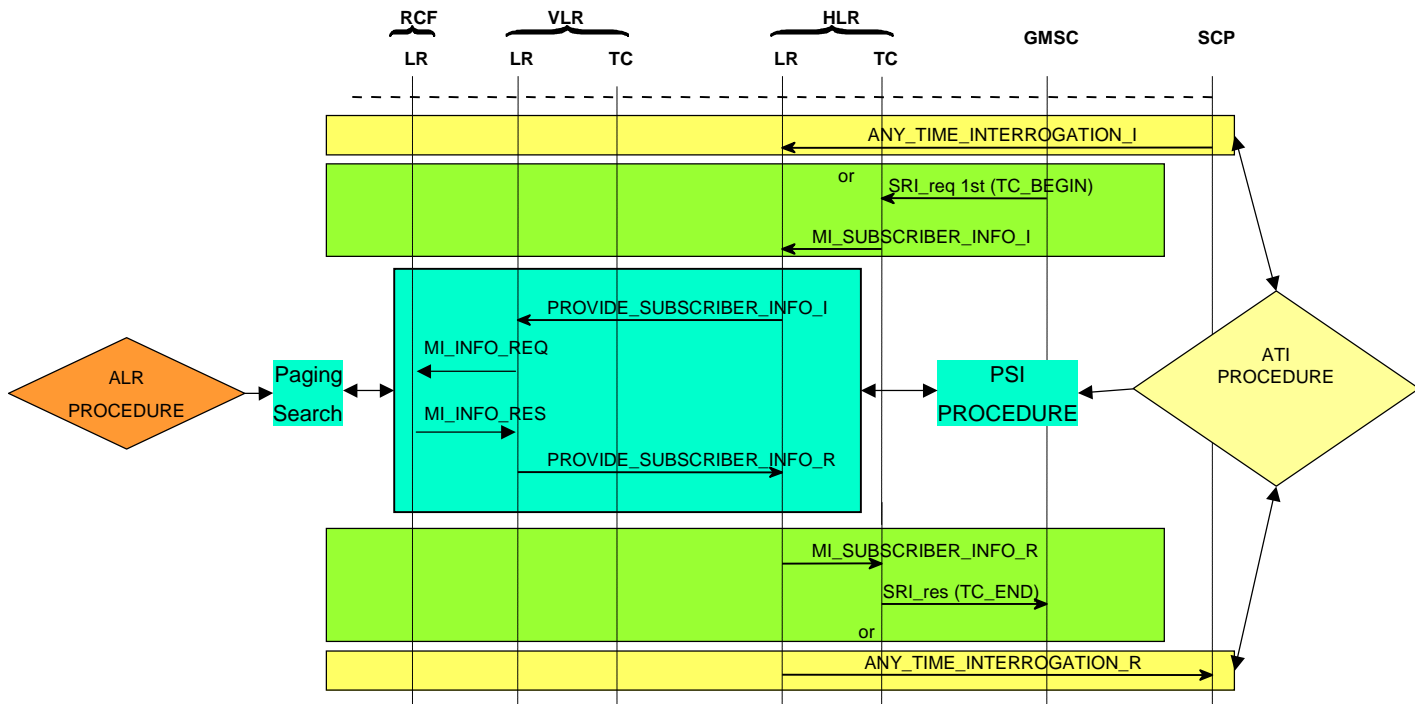
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**▼ NoteMM–Event**

- This operation is invoked by a VLR to report to SCP a MM event related to a subscriber when :
  - the MM event has been processed successfully
  - that subscriber has a subscription to the MM events notification (the subscriber is provisioned with M–CSI)
  - the relevant MM event is marked for reporting
- There is no expected response (neither ACK nor NACK) to this MM event notification, since a Pre–arranged end is used.

## 3-4 Mobile location and status retrieval procedure





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a ) At any time, the Location server may send the Any Time Interrogation MAP message to the HLR. The UE is identified by the IMSI or the MSISDN.

The location and the subscriber state (optionally) of the UE are requested. Furthermore the Location server may request the current location of the UE. This request will trigger the Active Location retrieval ALR procedure at VMSC if the current location of the UE is not known at VMSC (e.g. UE not in communication).

b ) The Process in the HLR for ATI is as follows:

It is checked the ATI is supported at HLR. The error "ATI not allowed" is returned.

It is checked if the UE is known. The error "unknown subscriber" is returned.

If the UE is not registered in HLR for circuit domain (no VMSC address), the subscriber state (if requested) is returned in ATI result with value "Network determined not reachable (not registered)".

If the UE is in roaming restriction in HLR, the subscriber state (if requested) is returned in ATI result with value "Network determined not reachable (restricted area)" and the VLR number is returned as location info.

If all previous checks are successful, the PSI message is sent to VMSC. The requested info present in ATI are transferred in PSI message, except "current location" parameter if the functional option ALR is not supported at HLR.

If negative response (PSI error component ,...),

the subscriber state (if requested) is returned in ATI result with value "Not provided from VLR".

the VLR number is returned as location info.

If PSI result is received, the data received from VLR are returned to location server except the VLR number which is retrieved from HLR database.

The HLR never derives the location number or the geographical info from the cell-ID or SAI.

### Provide subscriber information PSI procedure in MSC/VLR

a ) At any time the VLR may receive the Provide Subscriber Info MAP message from the HLR. The UE is identified by the IMSI. The requested informations are the same as received in ATI.

b ) The process in the MSC/VLR for PSI is as follows :

1 ) It is checked the IMSI is known. In negative case, the PSI result is returned with Subscriber state set to "assumed Idle" (if requested).

2) **N.B.** In the following only the case where both location info and subscriber state are requested is described. If IMSI is detached or roaming in LA is not allowed, the subscriber state is set to "network determined not reachable (IMSI detached or restricted area) and the last known location info (Cell-ID or SAI stored in VLR) are returned in PSI result.

3 ) If the UE has already a transaction with the MSC,

In GSM, the current cell-ID is available in MSC/VLR and returned in PSI result together with the subscriber state.

In UMTS, if the "report service area on change" procedure is supported by lu interface, the current SAI is available and returned in PSI result together with the subscriber state. Otherwise, the "direct report" procedure may be used on lu interface in order to retrieve the right SAI.

**N.B.** "Direct report" procedure is not used by the MSC. If "report service area on change" feature is not supported by UTRAN, the SAI of the start of the call is returned in PSI result.

4 ) If the UE is assumed to be "IDLE" for Circuit Switched domain,

a ) If the Gs interface is implemented and there is an association between the MSC/VLR and the SGSN for the UE,

The VLR sends an "MS information" message to the SGSN requesting location information. If cell-ID or SAI is received from SGSN with an UE state set to READY (GSM) or CONNECTED (UMTS), this Cell-ID or SAI is returned in PSI result together with the subscriber state. Otherwise, the handling described in b ) below applies.

b ) If it is not possible to retrieve location info from SGSN (Gs not implemented or no association between the MSC/VLR and the SGSN for the UE),

If current location is requested and the functional option "Support of ALR" is active, the ALR procedure is triggered.

If the ALR procedure obtains the current location, the current Cell-ID or SAI is returned in PSI result together with the subscriber state.

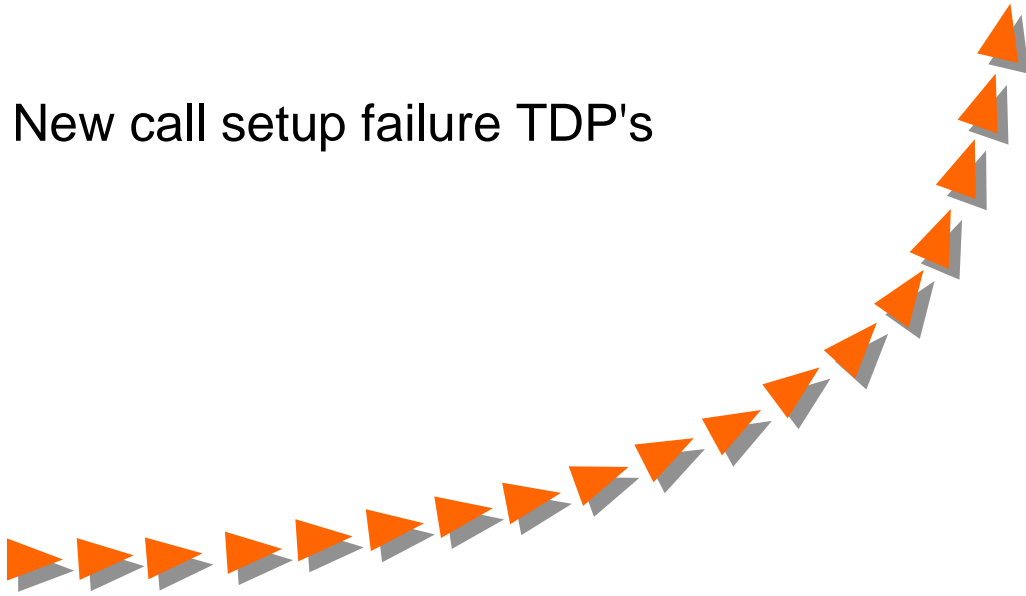
If the ALR procedure fails to obtain the current location, the last known location info (Cell-ID or SAI stored in VLR) are returned in PSI result together with the subscriber state set to "network determined not reachable (IMSI detached or restricted area)".

If the current location is not requested or the functional option "Support of ALR" is inactive, the last known location info (Cell-ID or SAI stored in VLR) are returned in PSI result together with the subscriber state.

**N.B.** In 3 ) and 4 ), the subscriber state (when not specified) is returned with "CAMEL busy" value if the MS is engaged in an OC/TC call, "Idle" otherwise.

**N.B.** An indication is given to the location server regarding the location info (current or last known location) together with the age of location in case of last known location. In addition, the VLR number is always returned by the MSC in PSI result.

## 3-5 New call setup failure TDP's



- ▼ There are new initial trigger event, related to the unsuccessful call establishment in OC calls which is :
  - in O-BCSM : "Route-SelectFailure" (TDP4)
  - then new O-CSI data : Trigger Detection Point data List
    - TDP = Indicates on which detection point triggering shall take place. Each subscriber can have at least one which are :
      - TDP2 (Collected-Info),
      - TDP4 (RouteSelectFailure)
    - To each TDP is associated a Service Key, a GsmSCF Address, a Default Call Handling and possibly criteria.
- ▼ These TDPs may induce a new dialogue towards a SCF depending on the fact whether or not there is already an existing dialogue towards any SCF relative to the same BCSM.

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The following criteria may be defined :

### relative to the TDP2

**Criteria on destination number** : a list of up to 10 destination numbers and/or up to 3 number lengths. If both destination number and number length lists are defined then both lists are either enabling or inhibiting.

**Criteria on the basic service** : a list of up to 5 basic service codes, each of which may represent an individual basic service or a basic service group or a general bearer service. The list is an enabling list.

**Criteria on type of call** : this consists of defining whether or not the call must be a forwarded call. The list is an enabling list.

### relative to the TDP4

**Criteria on the failure cause** : a list of up to 5 cause value.

This parameter stands for the ISUP cause. It contains the *CauseValue* field of the *CauseIndicator* received in the Event(REL) which triggered the sending of this message. From CAMEL phase 3 it also contains the *Diagnostic* field, if available.

If no criteria are defined, then the call is treated as if the criteria were satisfied.

## CAMEL PHASE 3

### Originating call Detection Points

CAMEL DP name	DP label	DP type	Description
DP2	Collected_Info	TDP-R	Indication that the O_CSI mark is analysed.
DP4	Route_Select_Failure	EDP-N, EDP-R TDP-R	Indication of routing failure while setting up a call. This DP deals with all abnormal cases of failure other than Busy, Abandon, No answer.
DP5	O_Busy	EDP-N, EDP-R	Indication that a called party busy signal has been received on a call.
DP6	O_No_Answer	EDP-N, EDP-R	Indication that a no answer timer has expired.
DP7	O_Answer	EDP-N, EDP-R	Indication that the called party answer has been received on the call.
DP9	O_Disconnect	EDP-N, EDP-R	Indication that a calling or called party disconnect has been received on the call.
DP10	O_Abandon	EDP-N	Indication that a call release has been received from the calling party while setting up the call.

Camel Phase 1	MSC → SCP(gsmSCF) in CAP V1
Camel Phase 2	MSC → SCP(gsmSCF) in CAP V2
Camel phase 3	MSC → SCP(gsmSCF) in CAP V3



- ▼ There are new initial trigger events, related to the unsuccessful call establishment in TC calls which are :
  - in T-BCSM : "Tbusy" (**TDP13**) and "TNoAnswer" (**TDP14**)
  - then new T-CSI data : Trigger Detection Point data List
    - **TDP** = Indicates on which detection point triggering shall take place. Each subscriber can have at least one which are :
      - TDP12 (TerminatingAttemptAuthorized),
      - TDP13 (TBusy)
      - TDP14 (TNoAnswer)
      - To each TDP is associated a Service Key, a GsmSCF Address, a Default Call Handling and possibly criteria.
- ▼ These TDPs may induce a new dialogue towards a SCF depending on the fact whether or not there is already an existing dialogue towards any SCF relative to the same BCSM.

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The following criteria may be defined :

### relative to the TDP12

**Criteria on the basic service** : a list of up to 5 basic service codes, each of which may represent an individual basic service or a basic service group or a general bearer service. The list is an enabling list; if the basic service for the call matches a service on the list or is a member of a basic service group defined on the list, the basic service criteria are met.

On receipt of a SendRoutingInfo message from the GMSC, the HLR checks the criteria. If the criteria is satisfied (or if no criteria are defined) the T-CSI data relative to TDP12, except criteria, are sent to the GMSC ; if the criteria is not satisfied they are not sent.

### relative to the TDP13

**Criteria on the failure cause** : a list of up to 5 cause value.

On receipt of a SendRoutingInfo message from the GMSC, the HLR sends the T-CSI data relative to TDP13 (including criteria if any) to the GMSC.

### relative to the TDP14

**Criteria on the failure cause** : a list of up to 5 cause value.

On receipt of a SendRoutingInfo message from the GMSC, the HLR sends the T-CSI data relative to TDP14 (including criteria if any) to the GMSC.

If criteria on TDP12 are defined but not satisfied and if no other TDP data are defined, not any T-CSI data are sent to the GMSC.

CAMEL DP name	DP label	DP type	Description
DP12	Terminating_Attempt_Authorized	TDP-R	Indication that the T_CSI mark is analysed.
DP13	T_Busy	EDP-N, EDP-R	Indication that a busy signal is received from the destination switch, or
		TDP-R	In the event of an abnormal setup failure on the call, determined from the HLR (for example, absent subscriber), or For any IE (information element) in the ISUP release message.
DP14	T_No_Answer	EDP-N, EDP-R TDP-R	Indication that a timer application linked to the DP has expired.
DP15	T_Answer	EDP-N, EDP-R	Indication that the called party answer has been received for the call.
DP17	T_Disconnect	EDP-N, EDP-R	Indication that a disconnect has been received from the calling or called subscriber in the call.
DP18	T_Abandon	EDP-N	Indication that a release has been received from the calling subscriber during call setup.

Camel Phase 1	MSC → SCP(gsmSCF) in CAP V1
Camel Phase 2	MSC → SCP(gsmSCF) in CAP V2
Camel phase 3	MSC → SCP(gsmSCF) in CAP V3

## ▼ GMSC → HLR : SRI\_inv (CamellInfo) :

## ■ new parameter : "SupportedCAMELphases"

- This parameter indicates the CAMEL phase(s) supported by the GMSC.
- It is mandatory if the GMSC supports CAMEL. If the MAP version is lower than v3, CAMEL cannot be supported.
- In GMSC :

- set to "CAMEL phase 1",
- plus "CAMEL phase 2",
- and "CAMEL phase 3".

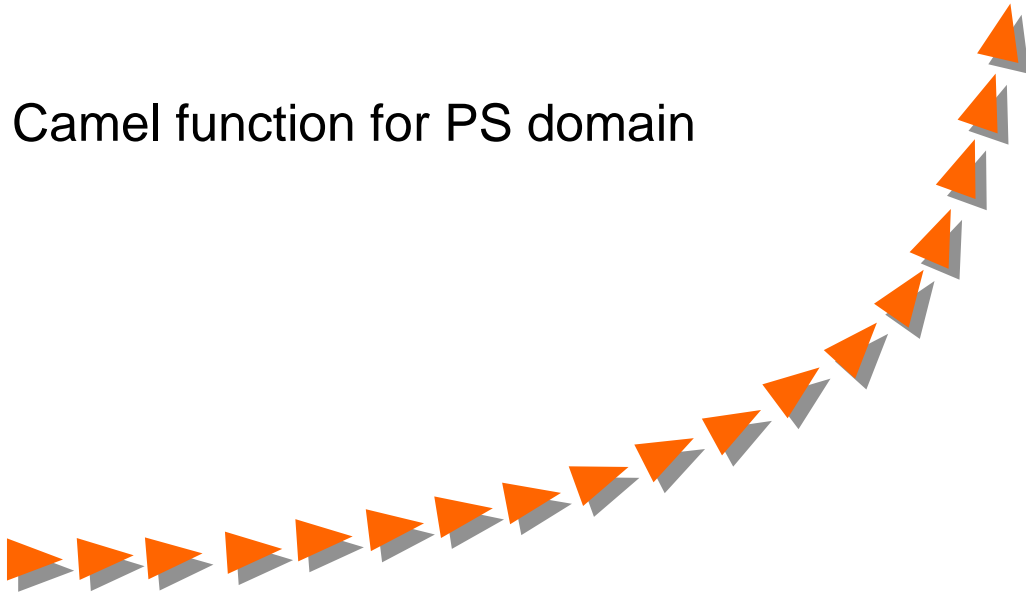
- In HLR : only CAMEL phase(s) indicated in this parameter is considered as supported by the GMSC. The *SupportedCAMELPhases* is compared to the allowed phases in the subscriber data in order to send the relevant data in SendRoutingInfoRes or send SendRoutingInfoError.

▼ **HLR → GMSC : SRI\_res (CamelRoutingInfo) :**

- From CAMEL phase 2, as SRI\_res may be split due to a large amount of criteria, this parameter (and sub-parameters) may be sent and received more than once.
- If T-CSI is present in more than one segment :
  - TDP-Data present in the last segment overwrites the previous one if related to the same TDP ;
  - TDP-Data present in the last segment is appended to the previous ones if related to a new TDP. Within one segment :

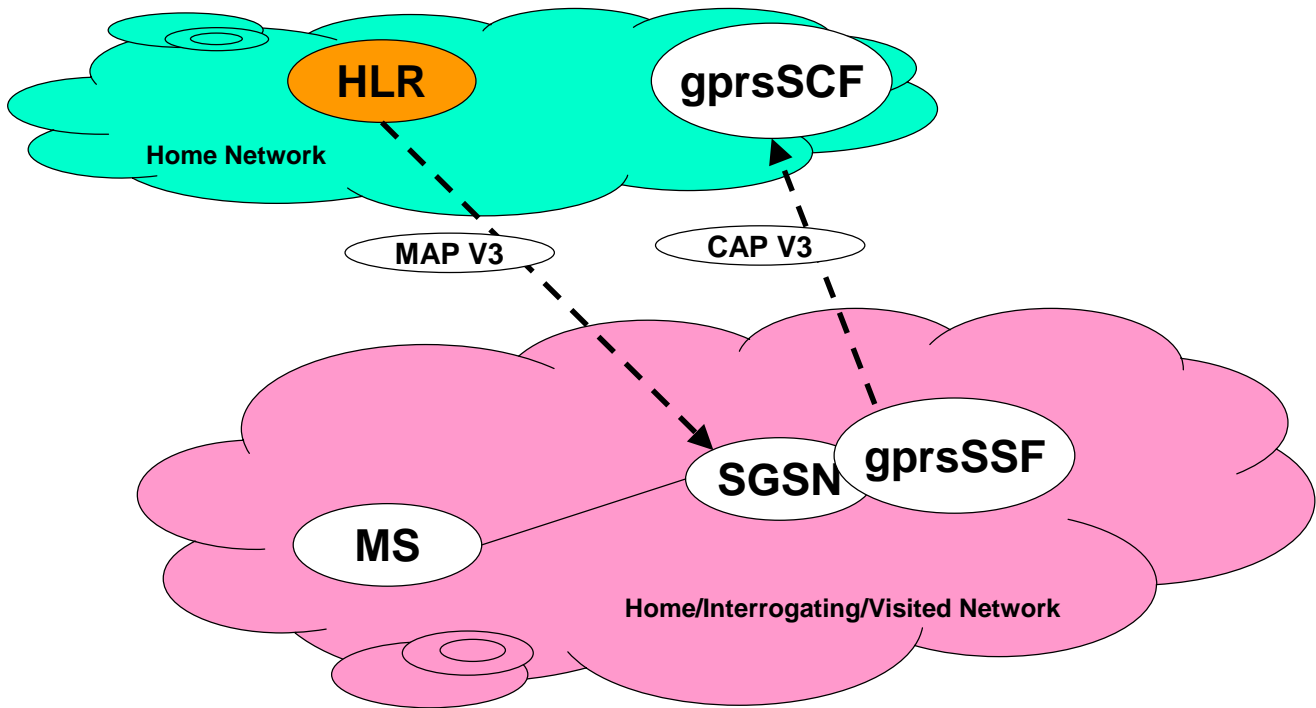
- ▼ Nevertheless if "TNoAnswer" (TDP14) or "TBusy" (TDP13) are received while CAMELCapabilityHandling is less than 3, they are ignored.

## 3-6 Camel function for PS domain



#### CAMEL function for PS Domain

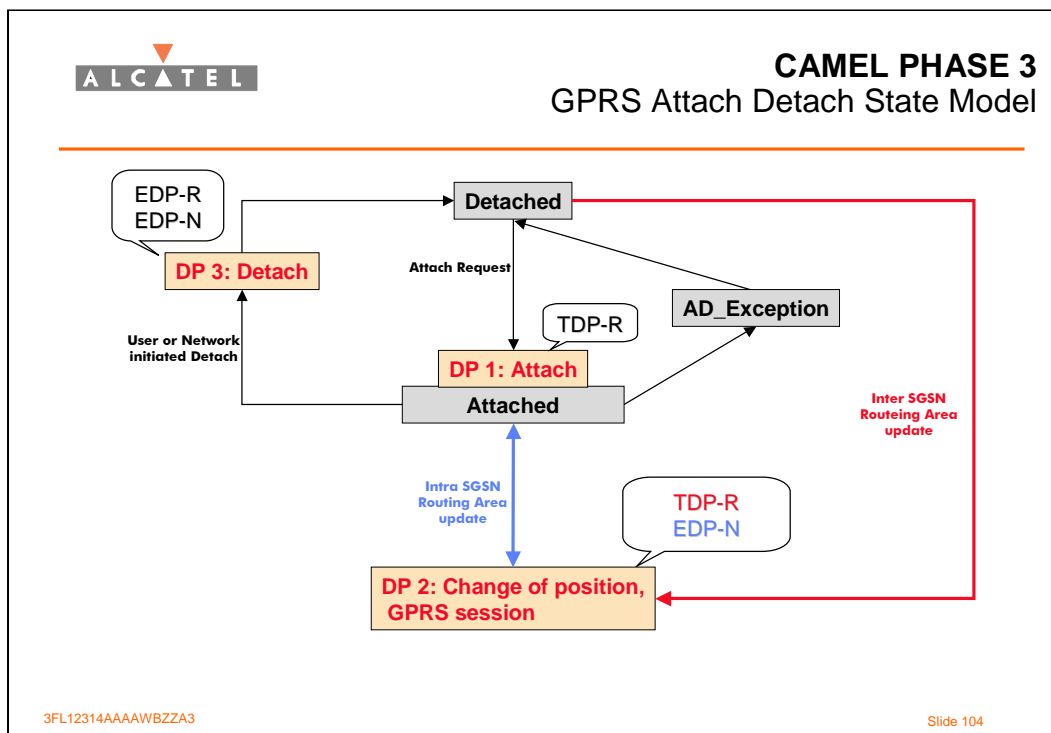
- ▼ Allow to offer CAMEL services to packet subscribers using :
  - Two trigger detection points at session level, which are :
    - Attach procedure: the subscriber requests to register to the GPRS network,
    - Change of Position: the subscriber who has an active GPRS Session changes position to another SGSN,
  - Or three trigger detection points at PDP context level, which are :
    - PDP Context Establishment: the subscriber requests the activation of a Packet Data Protocol Context;
    - PDP Context Establishment Acknowledgement: the SGSN has received an acknowledgement from the GGSN for that request.
    - Change of Position: the subscriber who has an active PDP Context changes position to another SGSN.
  - Mixing of TDPs at session level and TDPs at PDP context level is not possible.
  - To each TDP is associated a Service Key, an SCP Address and a Default Call Handling.



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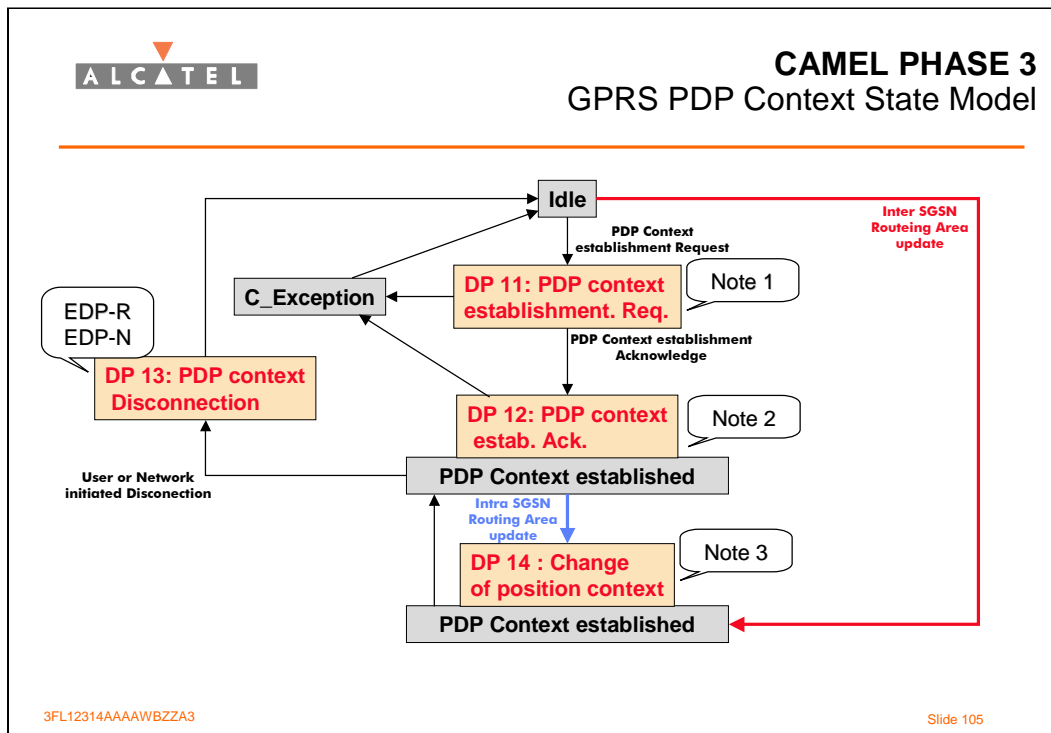
**Type of interface MAP message Ref : 3G TS 29.002**



AD: Attach, detach procedure

CAMEL Detection Point	DP Type	Description
DP Attach : DP 1	TDP-R	A request to attach is received.
DP Change of Position GPRS Session : DP2	TDP-R (note), EDP-N	Routeing Area Update is accepted.
DP Detach : DP 3	EDP-N, EDP-R	A detach request is received from the MS, the SGSN or a "Cancel Location" received from HLR or Inter SGSN Routeing update occurred in the old SGSN.
NOTE: Change of Position GPRS Session is reported as TDP-R in the case of Inter-SGSN Routeing Area Update (provided that this DP is statically armed in GPRS-CSI). Change of Position GPRS Session is reported as EDP-N in the case of Intra-SGSN Routeing Area Update (provided that this DP is dynamically armed by the Service Logic).		



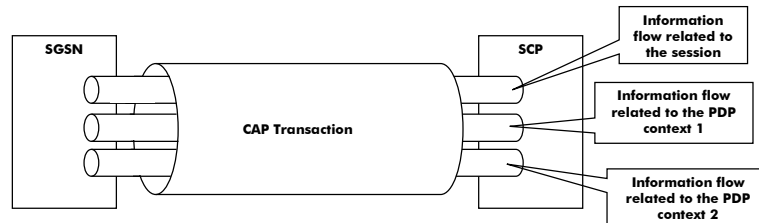


C: Context

CAMEL Detection Point	DP Type	Description
DP PDP Context Establishment DP 11	TDP-R (note 1), EDP-R, EDP-N	Activate PDP Context request is received from the MS.
DP PDP Context Establishment Acknowledgement : DP12	TDP-R (note 2), EDP-R, EDP-N	Create PDP Context response is received from the GGSN.
DP PDP Context Disconnection : DP13	EDP-N, EDP-R	Deactivate PDP Context Request is received from the MS, Delete PDP Context request is received from the GGSN. Inter SGSN Routeing update occurred in old SGSN.
DP Change of Position Context : DP14	TDP-R (note3), EDP-N, EDP-R	Routeing Area Update is accepted.
NOTE 1: The PDP Context Establishment shall be reported as TDP-R (provided that this DP is statically armed in GPRS-CSI) if there is no relationship with the gsmSCF. If there is a relationship with the gsmSCF it shall be reported as EDP-R or EDP-N if armed so. NOTE 2: The PDP Context Establishment Acknowledgment shall be reported as TDP-R (provided that this DP is statically armed in GPRS-CSI) if there is no relationship with gsmSCF. If there is a relationship with the gsmSCF, it shall be reported as EDP-R or EDP-N if armed so. NOTE 3: Change of Position Context is reported as TDP-R in the case of Inter-SGSN Routeing Area Update (provided that this DP is statically armed in GPRS-CSI) if there is no relationship with the gsmSCF. Change of Position Context is reported as EDP-N or EDP-R in the case of Inter-SGSN Routeing Area Update (provided that this DP is armed as generic EDP) if there is a relationship with the gsmSCF. Change of Position Context is reported as EDP-N in the case of Intra-SGSN Routeing Area Update (provided that this DP is dynamically armed by the Service Logic).		

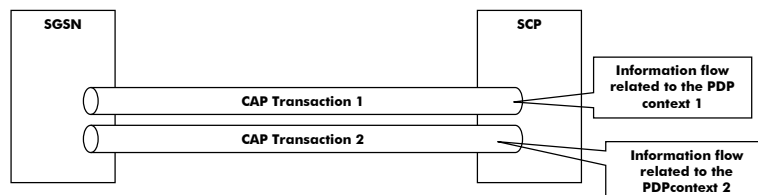
## Scenario 1:

- Attach Detach (AD) state model trigger the CAP interchange.
- Several PDP context in the same CAP Transaction.



## Scenario 2:

- One Cap transaction per active PDP context.
- Attach Detach state model can not be used.



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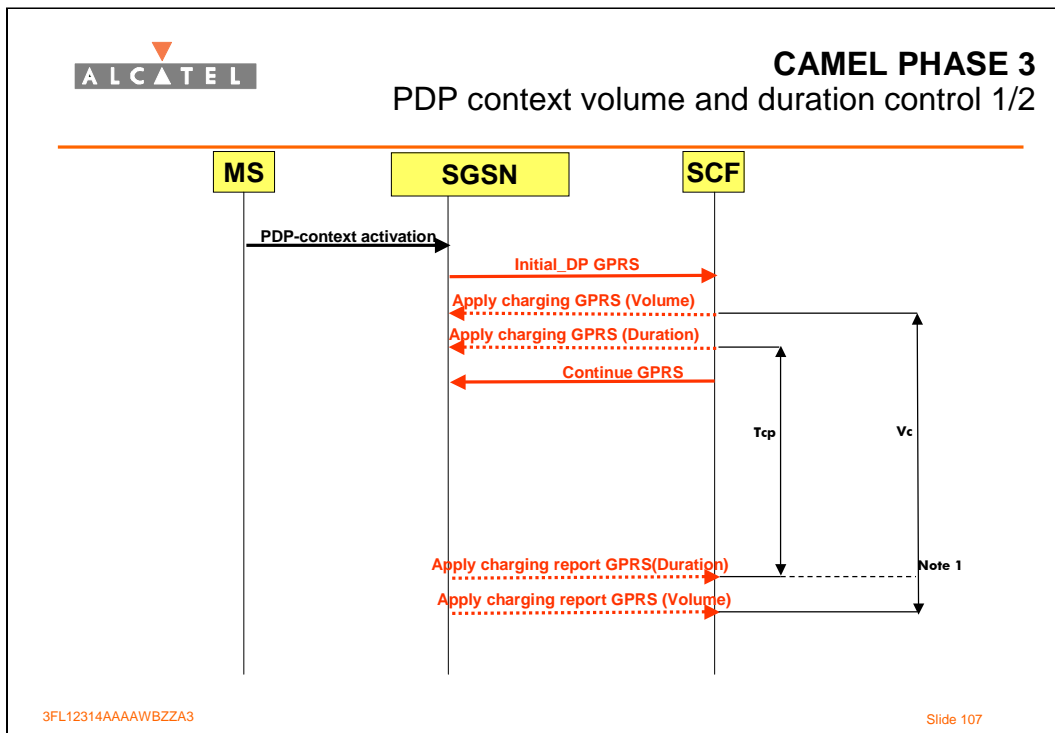
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## Scenario 1 :

- The *Attach DP* is armed to trigger the Camel transaction (TDP\_R in the subscriber profile received from HLR).
- SCP arm the *PDP\_context\_establisment* or *PDP\_context\_establisment\_ack* as Event detection point with no PDP\_ID to be informed about any PDP context establishment. (EDP\_R or EDP\_N information send by SCP to SGSN in the Request\_Report\_BCSM\_Event CAP message).
- Each information flow will be managed independently by the SCP.

## Scenario 2 :

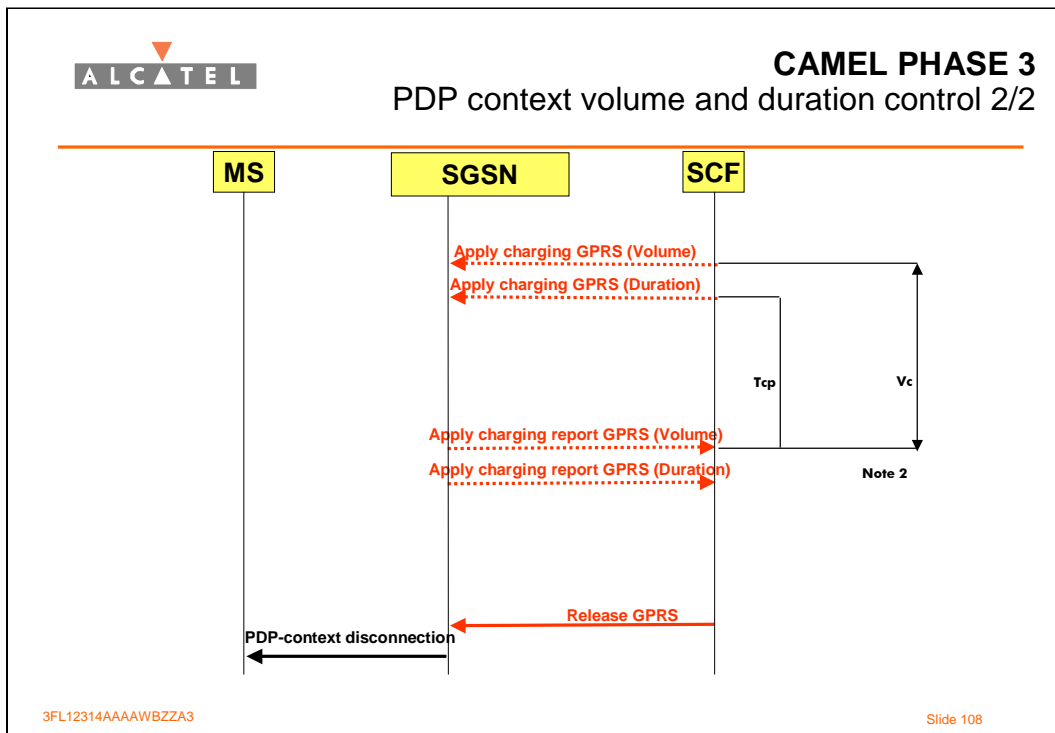
- *PDP\_context\_establisment* or *PDP\_context\_establisment\_ack* are used to trigger the CAP transaction (TDP\_R in the subscriber profile received from HLR).
- Each new *PDP\_context\_establisment* or *PDP\_context\_establisment\_ack* will trigger a new CAP transaction.
- The Attach/Detach State model is not used in this scenario, there will be neither triggering nor event reporting for A/D detection points.



GPRS charging may be done on Volume and/or Duration.

- If charging on volume is used, SCP indicates a Volume threshold (Vc) to the SGSN in the apply charging message and SGSN Reports when the threshold is reached.
- If charging on duration is used SCP indicates an amount of time (Tcp). Same process as for circuit.

Note 1 : In this exemple both duration and volume are monitored and Tcp Timer expires the first. SGSN report for both duration and volume. SPC setup a new segment (apply charging on the next page).

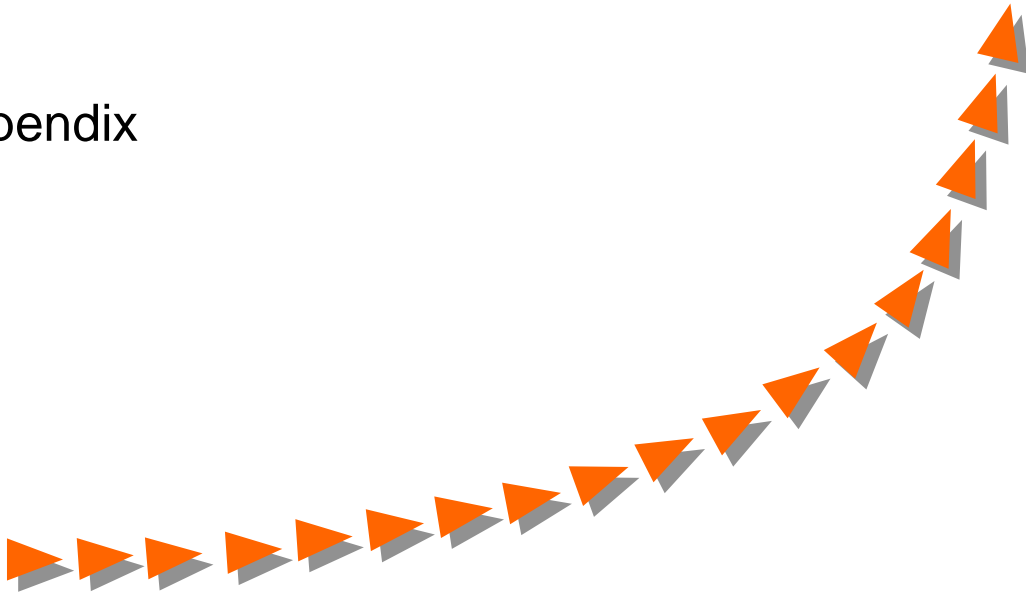


Note 2 : On this second segment, Volume threshold is reached the first and SGSN report for both Volume and duration. In this example, SCP releases the PDP context.

SCP may also :

- Release the PDP context at any time during a segment (ie no threshold reached).
- Setup a new segment whatever the threshold reached (volume or duration).
- Setup a new segment with new threshold(s) at any time (previous thresholds not reached, no reporting from SGSN). This is used if a new PDP context is activated by the subscriber.

## Appendix



**A. What is NSS?**

- > 1/ Terrestrial part of PLMN
- 2/ Operation and Management part of PLMN
- 3/ Intelligent Network for GSM

**B. In which cases do we need the GMSC?**

- > 1/ Incoming calls from the fixed network
- 2/ Outgoing calls to the fixed network
- > 3/ Call from one Mobile Station to another Mobile Station

**C. What is the main difference between HLR and VLR?**

- 1/ In the **HLR** data about all subscribers belonging to a particular network is stored.
- 2/ The **VLR** stores data about all the subscribers that are visiting that particular MSC Service Area.

**D. Why do we need an MSRN?**

- 1/ To identify the MS in the paging message
- > 2/ To route calls from GMSC to the VMSC
- 3/ Used as MSISDN for the Calling Line Identification service

**E. What is a Camel Service?**

- > 1/ It is a service as e.g. Prepaid Roaming, Virtual Private Network,....
- > 2/ It is specific to an operator
- 3/ It will be standardized by 3GPP

**F. What is the name of the feature used to?**

- 1/ Follow a mobile during a call? **HANDOVER**
- 2/ Follow a mobile outside a call? **ROAMING**

#### A. What is CAMEL?

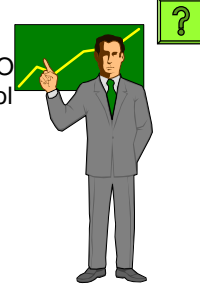
- > 1/ It provides the mechanisms to offer operator specific services (O
- > 2/ When roaming in a foreign Network, it gives back the call control to the Home Network?

#### B. The O-CSI mark is used:

- 1/ In GMSC only?
- 2/ In VMSC only?
- > 3/ In GMSC and VMSC?

#### C. For TC, CAMEL service can be triggered:

- > 1/ In GMSC only?
- 2/ In VMSC only?
- 3/ In GMSC and VMSC?





#### D. What is a CAMEL Service Environment (CSE)?

- > 1/ It is the name used for SCP in the CAMEL standard?
- 2/ It is the entity where basic call processing is executed?
- > 3/ It is logical entity which processes activities related to Operator Specific Services (OSS)?



#### E. What is the CAMEL Subscription Information (CSI)?

- 1/ It is administered by the network operator in the VLR for subscribers requiring CAMEL support?
- > 2/ It contains information related to the OSS of the subscriber, e.g. Service Key?
- 3/ It is downloaded at call setup in the VMSC?



#### F. What is a Basic Call State Model (BCSM)?

- 1/ It is used to describe the actions in the CSE during originating, forwarded or terminating calls?
- > 2/ It can be seen as a flowchart for a call and Identifies certain Points in Call (PIC), where interaction with service logic is possible?

#### G. What is a Detection Point (DP)?

- > 1/ It is in between the different states (PIC's) of a BCSM?
- 2/ It can give the control of the call to the gsmSSF?



#### H. When an event is encountered as an EDP\_R (Request) then....

- > 1/ A CAP operation is sent towards the gsmSCF containing this event?
- 2/ The CSE is contacted for the first time?
- > 3/ The gsmSCF is requested to take control over the call?



#### A. What is CAMEL Phase 2?

- 1/ It does not support CAMEL Phase 1 services?
- > 2/ It supports control of call duration and charge rate?
- > 3/ It supports Specialized Resources Function (gsmSRF)?
- > 4/ It allows subscriber interaction with the CSE by using USSD?



#### B. The Specialized Resources Function provides...

- > 1/ Sending of announcements to the parties in a call?
- 2/ Subscriber State and Location Information?
- > 3/ Prompt for information using DTMF sending and receiving?

#### C. What is USSD?

- > 1/ It allows to transmit information or instructions over a GSM network?
- 2/ It a store and forward service for text messages up to 182 characters in length?

ASE	Application Service Element	FTP	File Transfer Protocol
ASN.1	Abstract Syntax Notation 1	GERAN	GSM/EDGE Radio Access Network
BCP	Basic Call Process	GGSN	Gateway GPRS Support Node
BCSM	Basic Call State Model	GMSC	Gateway MSC
BSC	Base Station Controller	GPRS	General Packet Radio Service
BSS	Base Station (sub)System	GSM	Global System for Mobile Communications
BTS	Base Transceiver Station	gsmSCF	GSM Service Control Function
CAMEL	Customized Applications for Mobile network Enhanced Logic	gsmSRF	GSM Service Resource Function
CC	Call Control	gsmSSF	GSM Service Switching Function
CCAF	call control agent function	HLR	Home Location Register
CCF	call control function	HPLMN	Home PLMN
CDMA	Code Division Multiple Access	IE	Information Element
CDR	Call Data Record	IF	Information Flow
CN	Core Network	IN	Intelligent Network
CS	Capability Set	INAP	Intelligent Network Application Protocol
CS	Circuit Switched	INCM	IN conceptual model
CSE	CAMEL Service Environment	IP	Internet Protocol
CSI	CAMEL Subscription Information	IPLMN	Interrogating PLMN
CUSF	Call Unrelated Service Function	ISDN	Integrated Services Digital Network
DP	Detection Point	LCS	Location Services
EDP	Event Detection Point	MAC	Medium Access Control
ETSI	European Telecommunications Standards Institute	MEEx	Mobile Execution Environment
FDD	Frequency Division Duplex	MM	Mobility Management

MSC	Mobile service Switching Centre	SCCP	Signaling Connection Control Part
MSP	Multiple Subscriber Profile	SCE	Service creation environment
MTP	Message Transfer Part	SCEF	Service Creation Environment Function
O-BCSM	Originating-BCSM	SCEP	Service creation environment point
O-CSI	Originating-CSI	SCF	Service Control Function
ODB	Operator Determined Barring	SCP	Service Control Point
OSA	Open service Architecture	SCUAF	Service control user agent function
OSI	open systems interconnection	SDF	Service Data Function
OSS	Operator Specific Service	SDP	Service Data Point
PDA	Personal Digital Assistant	SGSN	Serving GPRS Support Node
PDC	Personal Digital Cellular (2G Japan)	SIB	Service Independent building Block
PDU	Protocol Data Unit	SLPI	Service Logic Program Instance
PIC	Point In Call	SMAF	Service Management Access Function
PLMN	Public Land Mobile Network	SMF	Service Management Function
PS	Packet Switched	SMP	Service Management Point
QOS	Quality Of Service	SRF	Specialized Resource Function
RAB	Radio Access Bearer	SRNC	Serving RNC
RAN	Radio Access Network	SS7	Signaling System 7
RANAP	RAN Application Part	SSCP	Signaling Connection Control Part
RNC	Radio Network Controller	SS-CSI	Supplementary Service Notification- CSI
RNS	Radio Network Sub-System	SSF	Service Switching Function
SAP	Service Access Point	SSP	Service Switching Point
SAT	SIM Application Toolkit	STP	Signaling Transfer Point

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T-BCSM	Terminating-BCSM	UTRAN	UMTS Terrestrial Radio Access Network
TCAP	Transaction Capabilities Application Part	VC	Virtual Channel
TCP	Transport Control Protocol	VLR	Visitor Location Register
T-CSI	Terminating-CSI	VoIP	Voice over IP
TD-CDMA	Time Division & CDMA	VP	Virtual Path
TDD	Time Division Duplex	VPLMN	Visited-PLMN
TDP	Trigger Detection Point	WAP	Wireless Application Protocol
TIF-CSI	Translation Information Flag-CSI	W-CDMA	Wideband Code Division Multiple Access
TINA	Telecommunications Information Networking Architecture		
TMN	Telecommunications Management Network		
U-CSI	USSD-CSI		
UDP	User Datagram Protocol		
UG-CSI	USSD General-CSI		
UICC	UMTS Integrated Circuit Card		
UMTS	Universal Mobile Telecommunication System		
Universal Radio Access Network (3GPP)			
USIM	UMTS Subscriber Identity Card		
USSD	Unstructured Supplementary Service Data		
UTRA	UMTS Radio Access Network (ETSI)		

3GPP	3rd Generation Partnership Project (WCDMA)
3GPP2	3rd Generation Partnership Project 2 (cdma2000)
3GIP	3rd Generation partnership for Internet Protocol
ANSI	American National Standard Institute (USA)
ARIB	Association of Radio Industries and Business (Japan)
CWTS	China Wireless Telecommunication Standard group
ETSI	European Telecommunication Standard Institute
IETF	Internet Engineering Task Force
IMT	International Mobile Telecommunication
ITU	International Telecommunication Union
T1	Committee T1 telecommunication of the ANSI (USA)
TIA	Telecommunication Industry Association (USA)
TTA	Telecommunication Technology Association (Korea)
TTC	Telecommunication Technology Committee (Japan)
UWCC	Universal Wireless Communications Committee
W3C	World Wide Web Consortium

