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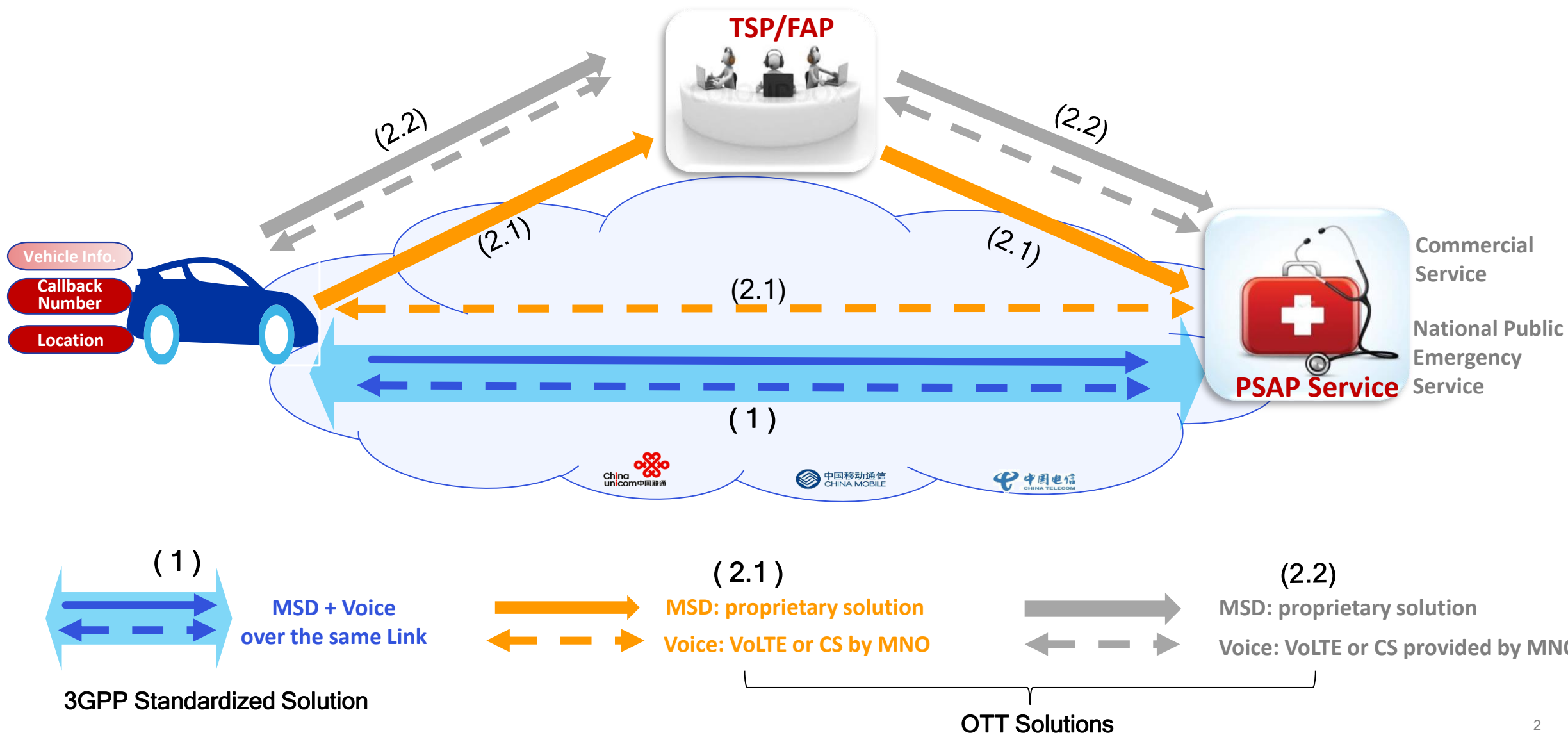
Qualcomm

# Communication Considerations for AECS

Hong Qiu



# High-Level Framework of Communications for AECS



# Basic Questions Communication Need to Resolve for AECS

Provided mobile networks are already exist...



# General Comparison for AECS Communication Solutions

## OTT & Proprietary Solution

- IVS must have subscription with an operator for using its network
- When there is no wireless signal, **can't** select another network

- Should answer which “number” IVS shall dial.
- Less of flexibility to select the most appropriate PSAP based on location.
- TSP might provide location based PSAP routing.
- Couldn't leverage other markets' solution/scale to reduce cost



## 3GPP A GLOBAL INITIATIVE Solution

- Can select a network coverage existing
- Operator could provide additional location information if GNSS missing

- Operators can provide location based routing.
- Operators can pass the call to the most appropriate PSAP based on location
- Support distributed PSAP/TSP, prevent to be locked by one company

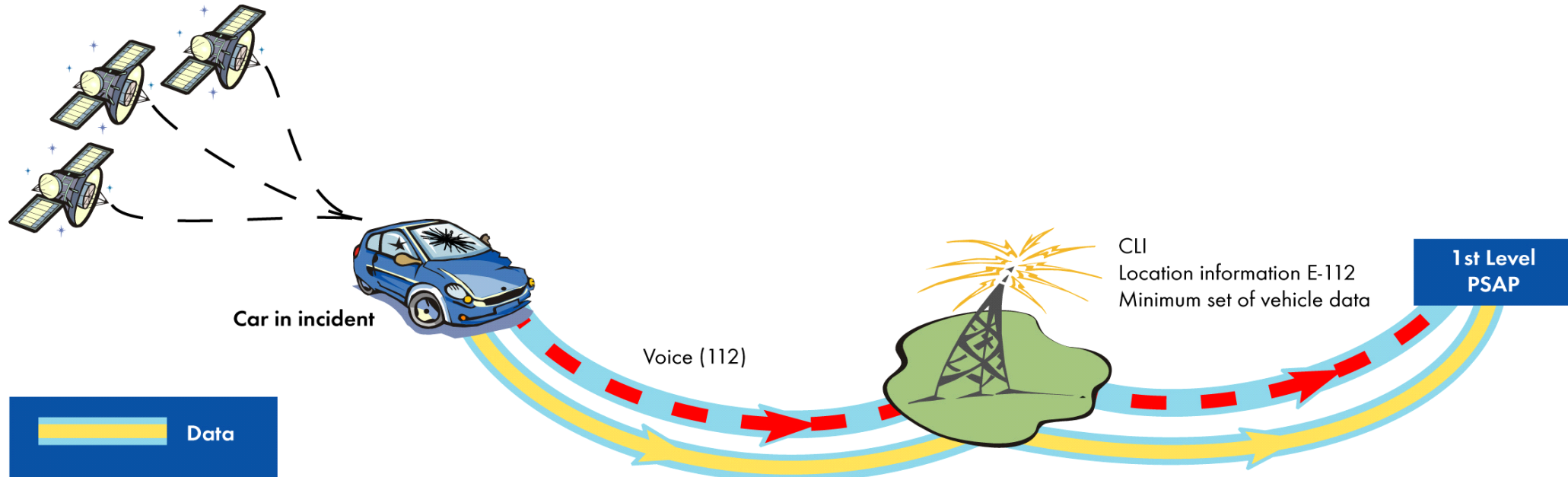
### In-band eCall

- 3GPP 2G/3G (GSM/UMTS)
- Std solution not applicable to China Telecom.
- Need to check if CMCC/CU would support
- Will fallback to ordinary emergency call if in-band not applicable

### NG-eCall (4G)

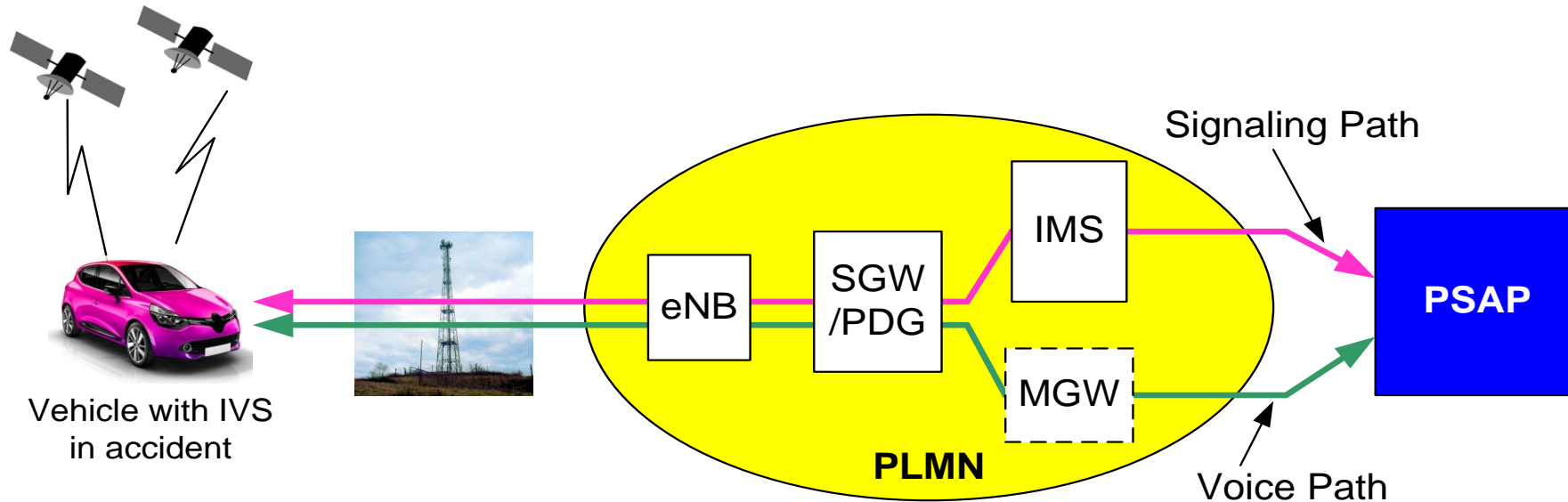
- Universal number: service.sos.ecall
- Applicable to all three operators,
- Coverage might not compared with 3GPP 2G/3G network good currently.
- When no coverage, will fall back to in-band automatically (design for EU)

# Operation of CS eCall (with Inband Modem)



- The IVS instigates an emergency (112) call following an accident (sensor trigger) or user invocation
- The emergency call carries an automatic or manual eCall indication and can be routed by the serving PLMN to an eCall capable PSAP (red)
- The PSAP and IVS use the inband modem to transfer the MSD over the voice path (yellow)
- MSD transfer interrupts voice communication for around 4-10 secs at the start of the eCall

# Operation of NG eCall



- The IVS instigates an emergency call over LTE and IMS following an accident or user invocation
- The serving PLMN establishes a call to a PSAP with a SIP/IP signaling path through an IMS (mauve) and a separate voice path (green) for transfer of VoIP
- If the PSAP uses CS access and not IP, an MGW transforms the VoIP into CS voice
- The MSD is transferred in an SIP INVITE message sent to the PSAP over the signaling path
- The voice path is not interrupted or affected by the MSD transfer

# Prioritize access for NG-eCall in MNO Network

- The MNO network can be aware of an NG eCall and can provide priority access to resources
- When an IVS establishes an LTE signaling connection to a base station (eNB) in an LTE Radio Access Network (RAN), an indication of an emergency call is provided by the IVS to the eNB
- The IVS also provides an indication of an emergency call to an MME in an LTE Evolved Packet Core (EPC) network either when the IVS attaches to the MME or when the IVS obtains an IP connection from the MME
- The indication of an emergency call enables priority access for an NG eCall from both the LTE RAN and EPC in the PLMN
- This increases the probability of successful NG eCall establishment in comparison to establishing an eCall using some other solution (e.g. an OTT solution)
- The priority access for an NG eCall is part of the 3GPP solution for IMS emergency calls and does not require additional MNO network impact

# Comparison of NG eCall with CS eCall

Characteristic	CS eCall	NG eCall
Allowed Access Types	GSM CS, UMTS CS	LTE
Voice Path	CS end to end Voice path blocked during MSD transfer	VoIP end to end for IP capable PSAP VoIP to MGW and then CS for legacy PSAP No voice path blocking with end to end IP
Call Signaling	SS7 ISUP	SIP (IMS)
Initial MSD Transfer	Inband over CS voice path Can take 4-10 seconds	Out of band SIP with IP capable PSAP Inband over voice path with legacy CS PSAP MSD transfer is almost instantaneous with SIP
Updated MSD Transfer	Supported via inband request/response	Supported via SIP INFO request/response Also supported inband for a legacy CS PSAP
Handover	GSM/UMTS $\leftrightarrow$ GSM/UMTS	LTE $\leftrightarrow$ LTE, LTE $\rightarrow$ GSM/UMTS CS (one way)
PLMN support	Transparent to PLMN except for routing based on an eCall flag	PLMN needs to support IMS emergency calls, MSD transfer, updated MSD transfer and routing based on an eCall service URN
PLMN indication	None	SIB1 indicates PLMN/PSAP support for NG eCall
eCall only mode	Supported	Supported



# Comparison of NG-eCall with OTT Solution

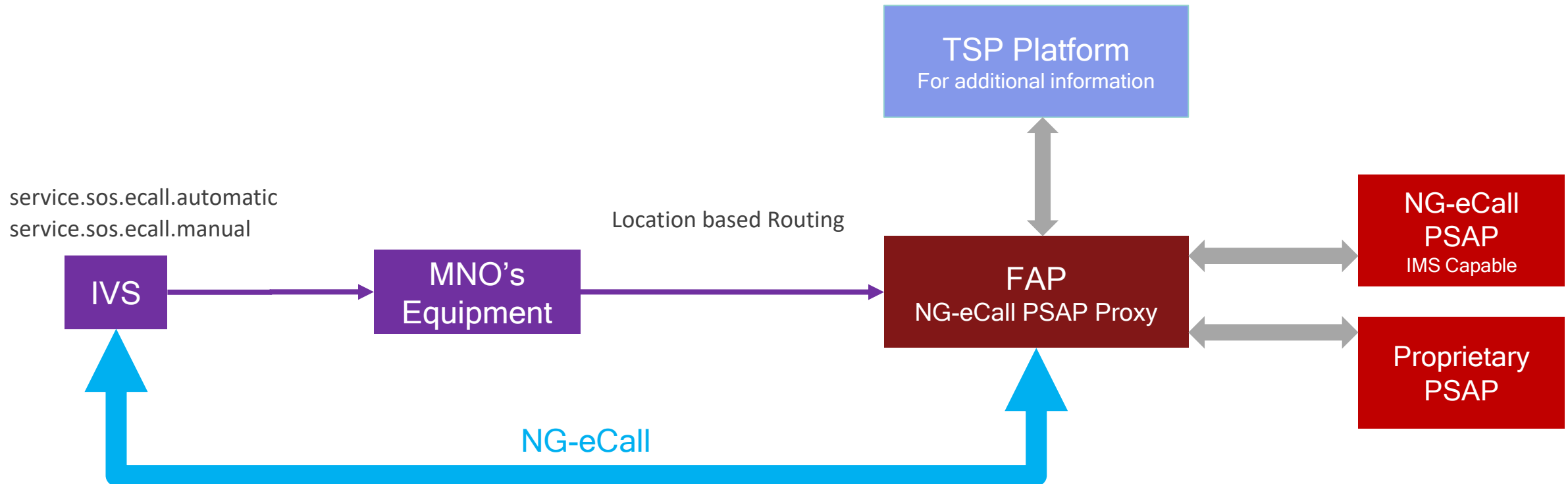
Characteristic	NG eCall	OTT Solution
Complexity	Simple: one session for data and voice	More complex: Separated data and voice session. Additional effort to correlate the two sessions as belonging to the same vehicle
Robust service	Can make the call when in limited service state, which is a state that a common call can't get through.	Cannot make the call.
Low Latency	First SIP message for MSD (~ 1-2 seconds)	Separated voice + data (several seconds) + Delay to forward to a PSAP (extra seconds)
Ecosystem	Standardized solution in IETF and 3GPP Likely supported by most vendors, OEMs and manufactures. Easy to sale	Proprietary solution, need to develop test systems specifically
Evolution	Ability to implement enhancements in future: support video and other interaction between PSAP and vehicle	Significant effort to add additional features.
Impact on operators	Small changes to operators network provided IMS emergency calls already supported for LTE	No impact on operators

# Timeline of NG eCall

- **2012:** instigated by the European Commission (EC) to provide a long-term migration path for support of eCall with 4G
- **2013-2014:** studied by the European Telecommunications Standards Institute (ETSI) who recommended a solution based on IMS as the successor to inband CS eCall
- **2013-2017:** developed by IETF Ecrit for use by 3GPP
  - The solution is based on use of IMS and conveys MSD in the control plane as part of SIP signaling
  - The solution is extensible and will be able to convey new types of data and new control information in a later version (e.g. for other World regions)
  - Completed in RFC 8147 for 3GPP Release 14 with an enhanced version for possible use later in RFC 8148
- **2015-2016:** standardized in 3GPP Release 14 based on RFC 8147
  - It is required that any UE supporting NG eCall shall also support CS eCall (but the reverse is not required)
- **2016-2017:** Standardization of IMS eCall in the European Committee for Standardization (CEN) for inclusion in the EU regulations
  - Includes requirements for the IVS, MNO and PSAP based on 3GPP and IETF specs
- **2020:** Start of Deployment (chipsets from Qualcomm with CS eCall + NG eCall will be available in 2Q2020)

# NG-eCall Routing with FAP (OTT 2.2)

One possible solution for OTT 2.2



# Suggestions on Communication for AECS

- **Network coverage depends on MNOs**
  - 4G are mature national-wide networks deployed by three operators
  - MNOs are currently upgrading to 5G networks
  - *2G/3G network being phased out. It is not expected 2G/3G networks are good enough for AECS till 2025*
    - China Mobile will phase out 3G network soon, has stopped new investment to upgrade 2G network, is reducing 2G network scale progressively
    - China Telecom will phase out 3G network in 2020, thinking to phase out 2G network in 2021.
    - China Unicom has stopped new investment to upgrade 3G network and is reducing network scale, will phase out 2G network in two years,
- **IMS emergency call over LTE (VoLTE) are ready by three operators**
  - Provide robust and richer emergency services over PS networks
  - Small changes needed to support NG-eCall
- **AECS service plan needs to be proactive**
  - Car manufactures are strongly advised to ensure that AECS will be possible over the lifetime of a car by employing common best practice and state-of-the-art technologies
  - NG-eCall is technology with standard and chipset ready
- **PSAPs need to make provisions now to support IMS**
  - IMS eCall leverages commercial IP/SIP based protocols and equipment, reducing investment upgrade costs (especially when ISDN lines gets replaced by all IP lines)



# Thank you!

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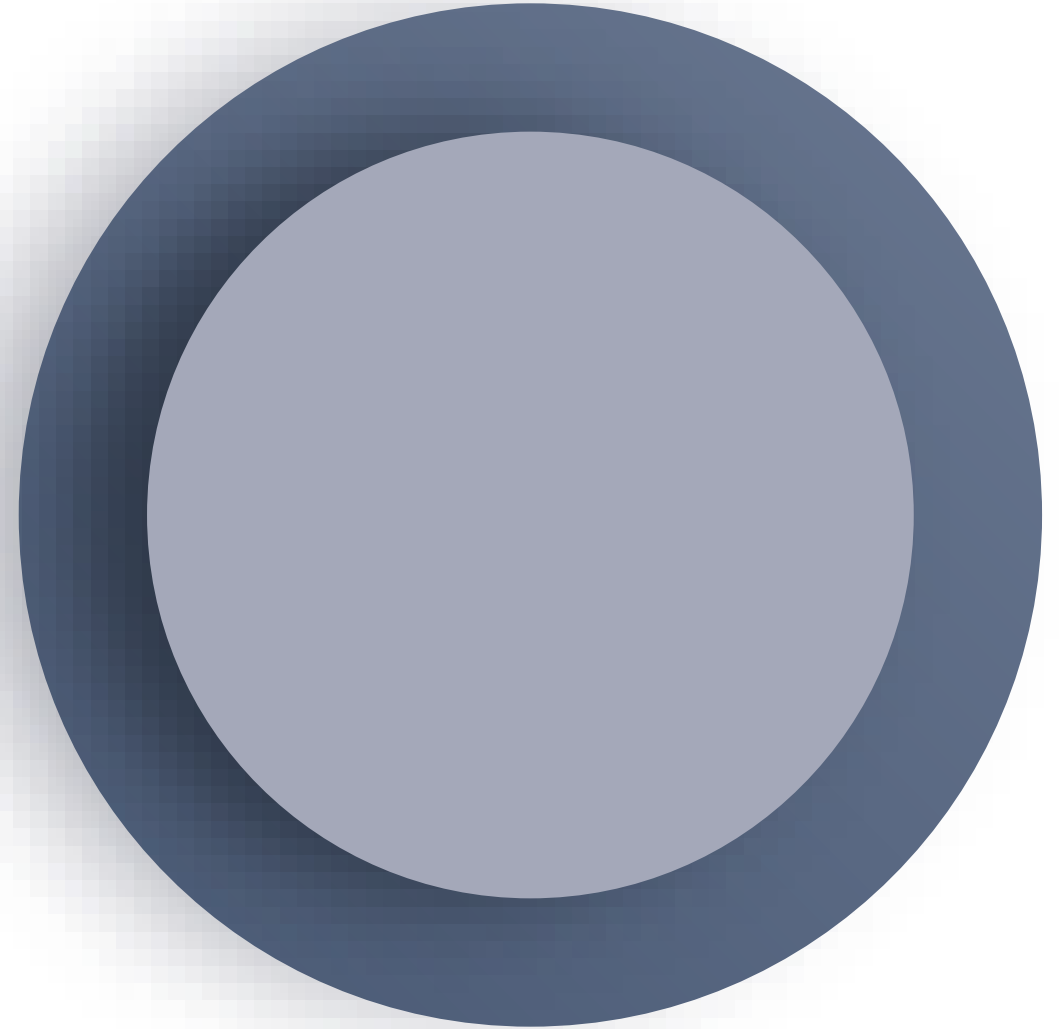
# Abbreviations

CS	Circuit Switched
EATF	Emergency Access Transfer Function
E-CSCF	Emergency Call Session Control Function
eNB	evolved Node B (for LTE access)
EPC	Evolved Packet Core
EPS	Evolved Packet System
FAP	First Access Point
IAM	Initial Address Message
IMS	IP Multimedia System
IP-CAN	IP-Connectivity Access Network
ISUP	ISDN User Part
IVS	In-vehicle system
MGCF	Media Gateway Control Function
MGW	Media Gateway
MME	Mobility Management Entity
MNO	Mobile Network Operator

MSD	Minimum Set of Data
NG	Next Generation
P-CSCF	Proxy Call Session Control Function
PDG	Packet Data Network Gateway
PLMN	Public Land Mobile Network
PS	Packet Switched
PSAP	Public-Safety Answering Point
RAN	Radio Access Network
SGW	Serving Gateway
SIB	System Information Block
SIP	Session Initiation Protocol
TSP	Telematics Service Provider
UE	User Equipment
URI	Uniform Resource Identifier
URN	Uniform Resource Name
USIM	Universal Subscriber Identity Module
VoIP	Voice over IP

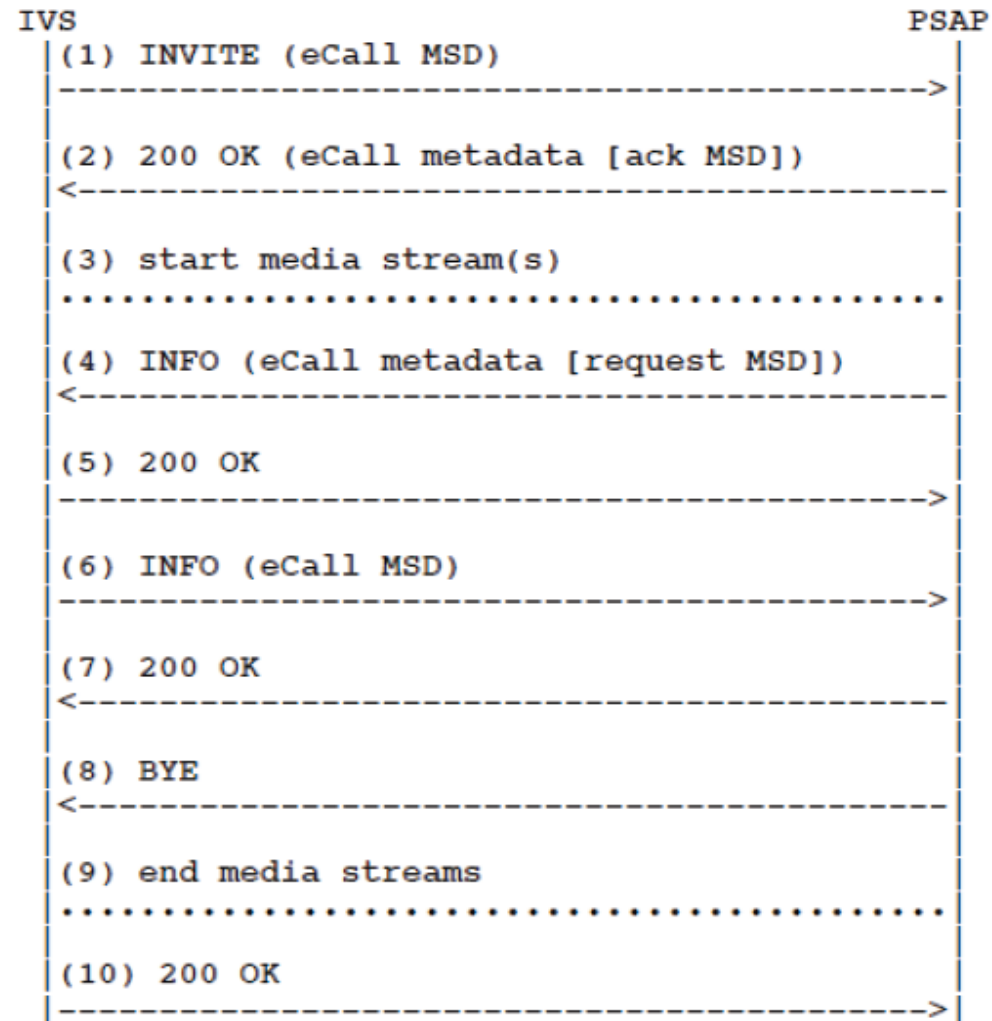
# NG eCall Basics

## NG eCall in 3GPP Release 14



# Example End to End SIP Call Flow for an IP capable PSAP

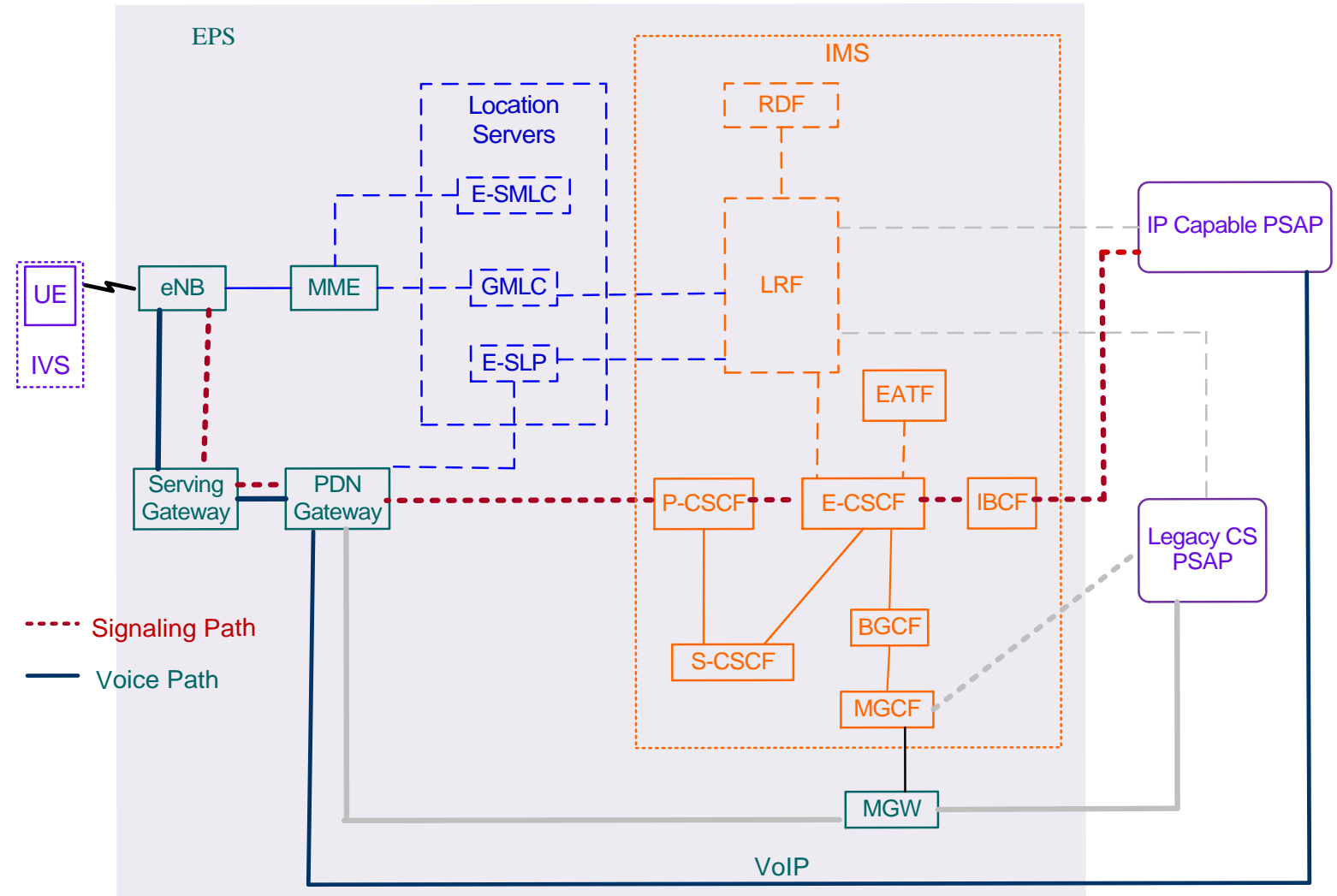
- 1) IVS initiates eCall
- 2) PSAP acks MSD reception
- 3) IVS starts media streams
- 4) PSAP requests a new MSD
- 5) IVS acks MSD requests
- 6) IVS sends new MSD
- 7) PSAP acks MSD reception
- 8) PSAP hangs up
- 9) IVS stops media streams
- 10) IVS confirms call end





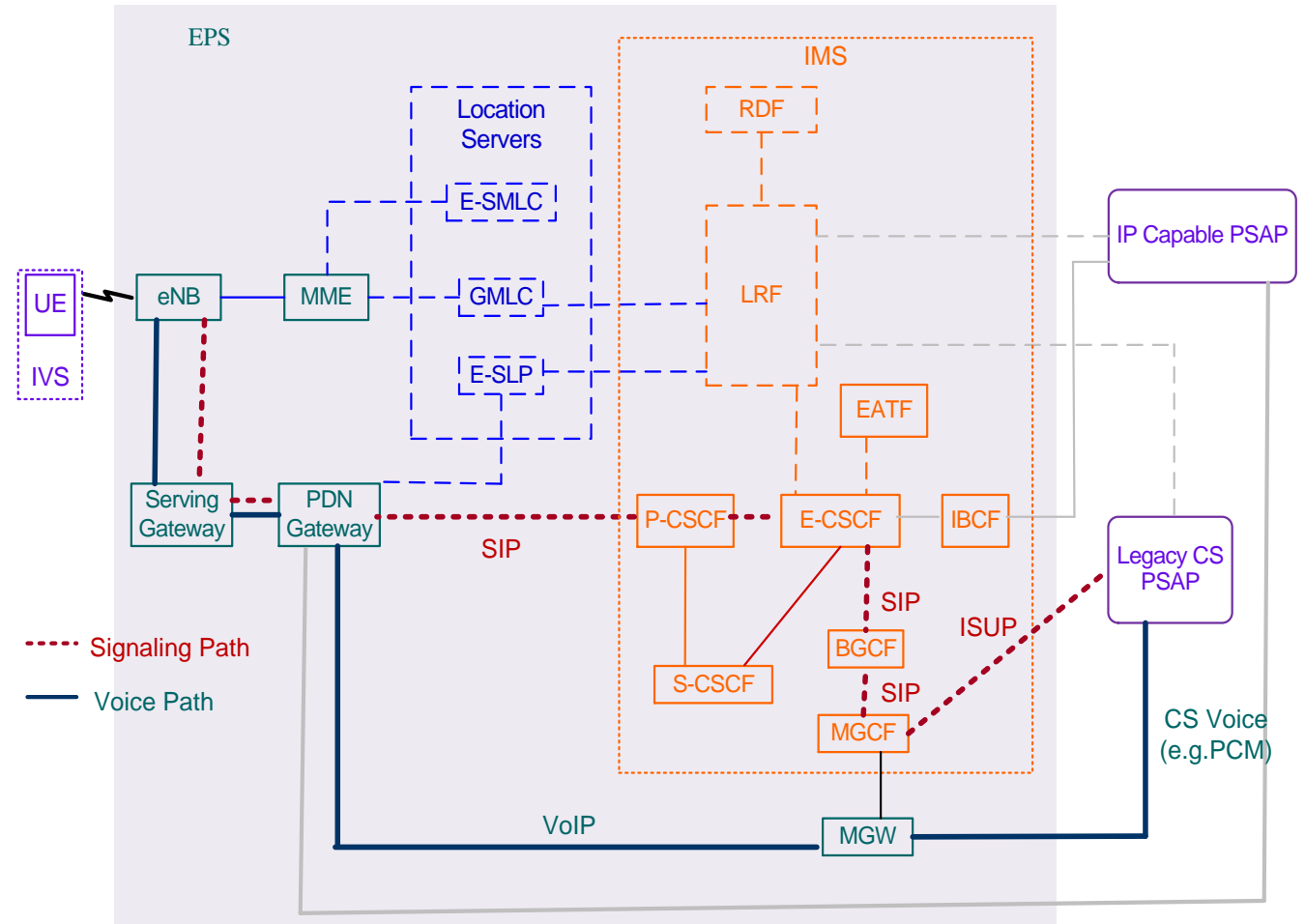
# PLMN Architecture for NG eCall with an IP capable PSAP

- Call establishment is via the P-CSCF and E-CSCF in the serving PLMN IMS
- The MSD is transferred using the signaling path (red)



# PLMN Architecture for NG eCall with a legacy CS PSAP

- Call establishment is via the P-CSCF, E-CSCF and MGCF in the serving PLMN IMS
- The MSD is transferred over the voice path using the same data modem as for CS eCall
- The transcoding from VoIP to CS voice at the MGW can degrade inband MSD transfer reliability and increase delay
- This scenario is therefore a solution of last resort



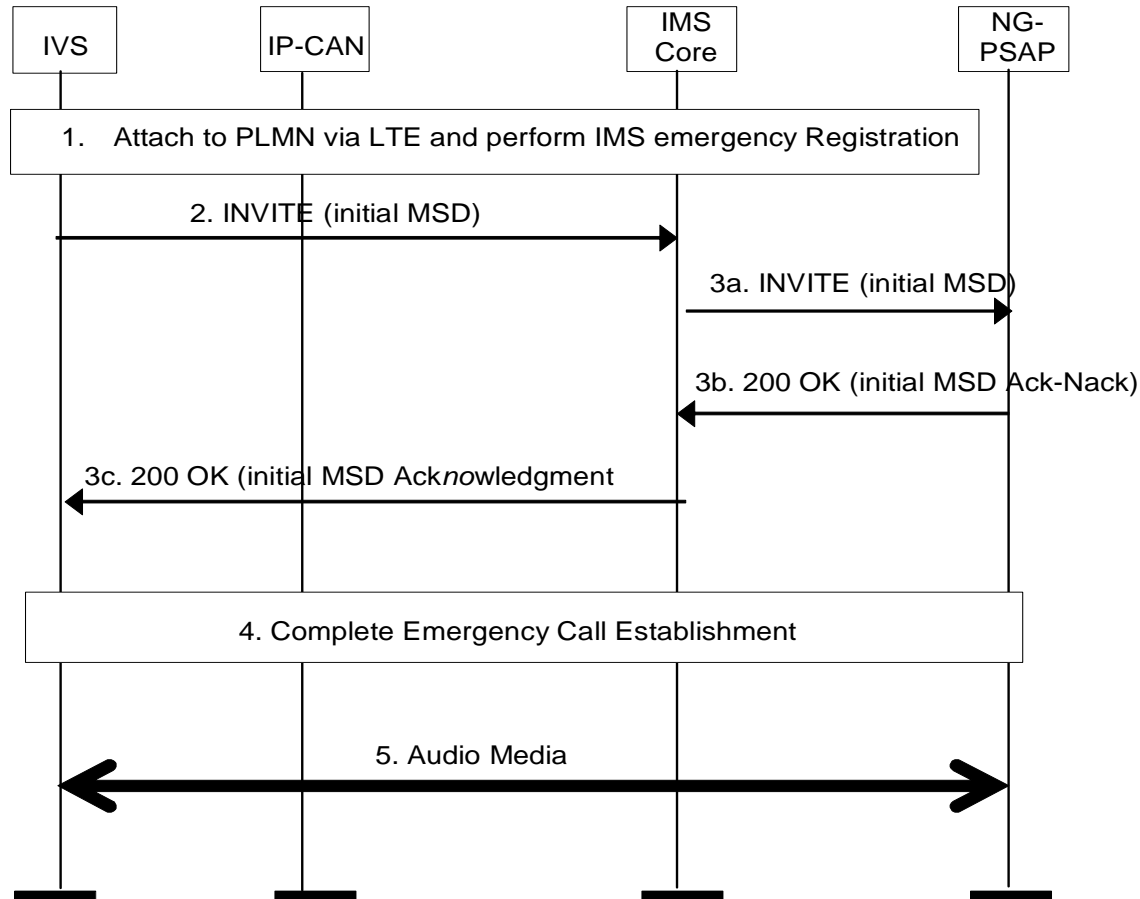
# eCall only Mode for NG eCall

- Exactly analogous to eCall only mode for CS eCall
- eCall only mode is supported in an IVS to avoid network load for an IVS configured to support eCall only and not normal services
- An IVS refrains from mobility management procedures and all signaling with a PLMN except to instigate (A) an eCall, (B) a test call or (C) a reconfiguration call to the Home PLMN
- For a short period after A, B or C (default = 12 hours), an IVS continues mobility management procedures in order to allow a PSAP or Home PLMN callback or Home PLMN reconfiguration (e.g. to remove the eCall only mode restriction in the USIM of a UE)
- Following the short period after A, B or C, an IVS ceases signaling with a serving PLMN and enters an eCall inactive substate
- An IVS in eCall Inactive state is required to find and camp on a suitable PLMN (and cell)
- The USIM is configured with the eCall only mode indication and test and reconfiguration numbers (or URIs)
- eCall only mode has no PLMN impacts
- An IVS configured for eCall only mode will still have a minimal subscription with a Home PLMN

# CS and PS Domain Selection

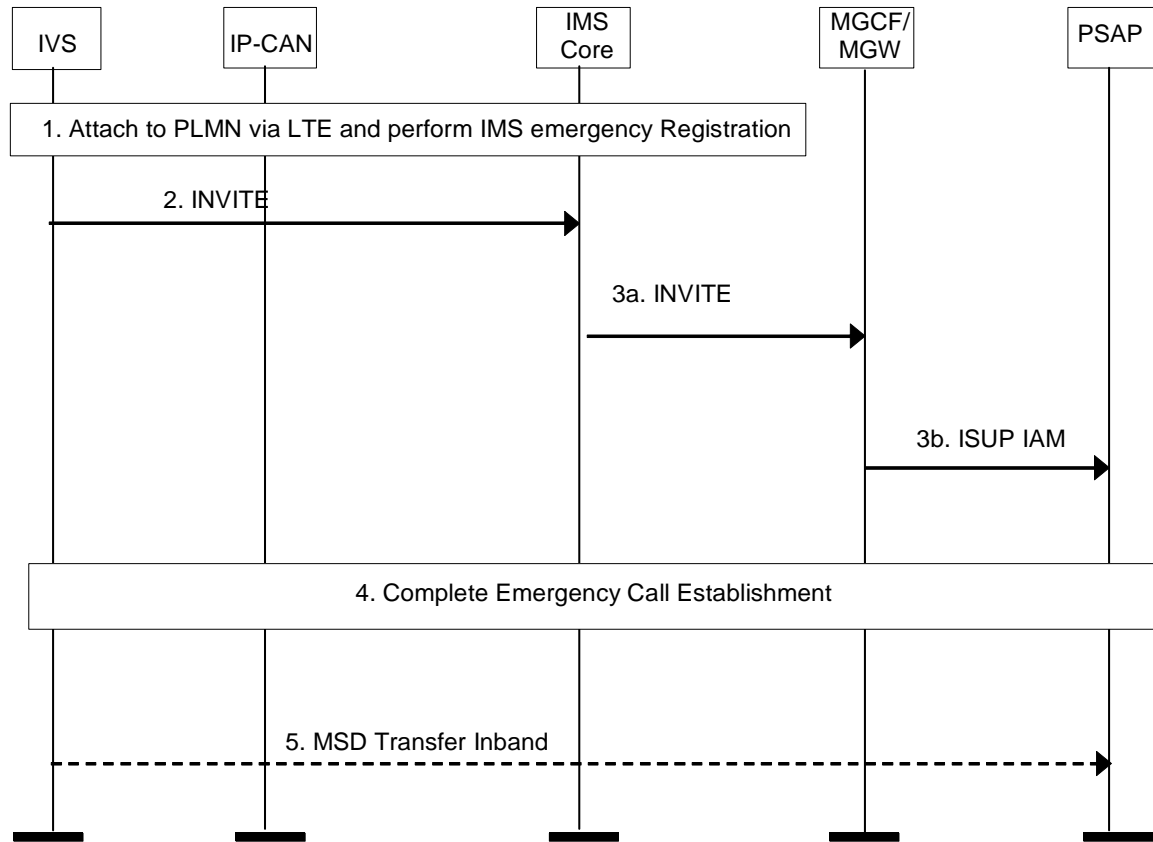
- A IVS that supports NG eCall is also required to support CS eCall
- Hence an IVS supporting NG eCall will need to perform CS vs PS domain selection
- A new NG eCall flag broadcast in an LTE cell (on SIB1) indicates whether NG eCall is supported in the cell
- A MNO can set the flag to indicate NG eCall support if:
  - The PLMN (or all PLMNs with LTE RAN sharing) supports NG eCall
  - AND
  - At least one PSAP associated with (or reachable from) the cell is NG eCall capable
- Domain selection for eCall is performed based on this preference order:
  1. LTE with NG eCall flag set
  2. GSM or UMTS CS
  3. LTE with normal IMS emergency call support but with the NG eCall flag not set

# NG eCall setup where a PSAP supports NG eCall



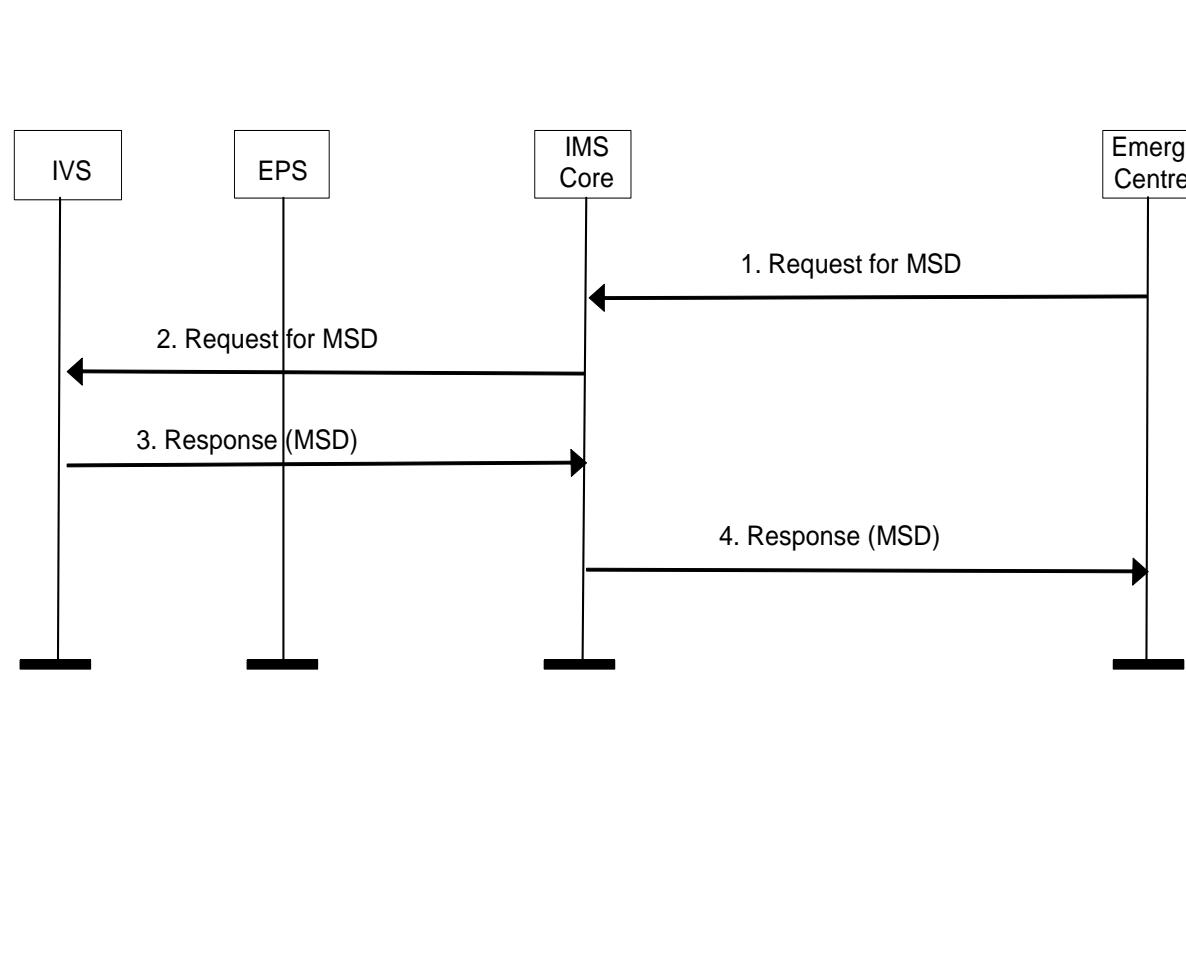
- This Figure applies when the serving PLMN indicates NG eCall support AND the PSAP supports NG eCall
- The MSD is transferred in the INVITE
- The 200 OK explicitly indicates the MSD was received

# NG eCall setup where PSAP or PLMN does not support NG eCall



- This Figure applies when (A) the PLMN does not indicate NG eCall support OR (B) the PLMN indicates NG eCall support but the PSAP does not support NG eCall
- For (A), the IVS establishes a normal IMS emergency call but with an eCall indication
- For (B), the IVS attempts to establish an NG eCall and includes the MSD in the INVITE but the 200 OK does not ack the MSD
- For (A) and (B), the IVS attempts to send the MSD inband as for a CS eCall after the voice path is established

# Transfer updated MSD for NG eCall capable PSAP



- This Figure applies when an NG eCall was successfully established with the MSD sent to the PSAP in the SIP INVITE and ack'd in the 200 OK
- The PSAP uses a SIP INFO to request an updated MSD
- The IVS acks the SIP INFO with a 200 OK and then sends an updated MSD in a SIP INFO
- The PSAP acks the MSD with a 200 OK

# eCall Indication From IVS side for NG-Call Solution

## For NG-eCall Solution

- IVS includes an sos URN in the SIP To header and Request-URI header of a SIP INVITE message
  - urn:service:sos.ecall.automatic - when the eCall is generated automatically
  - urn:service:sos.ecall.manual - when the eCall is generated manually
- The PLMN routes based on the sos URN to an IP capable PSAP if possible (otherwise to a legacy CS PSAP)



# eCall Flag from IVS side for Inband solution

## 3GPP TS 24.008

- An IVS, or other UE designed to support eCall functionality, shall include in the emergency call set-up an indication that the present call is either a Manually Initiated eCall (MleC) or an Automatically Initiated eCall (AleC).
- Optionally, PLMNs may make use of eCall indicators, received in the emergency call set-up, to differentiate eCalls from other TS12 emergency calls.
- The MleC and AleC may be used to filter or route eCalls to a dedicated PSAP operators.

2016 Apr 18 20:37:57.028 [F4] 0x713A UMTS UE OTA -- EMERGENCY\_SETUP

```
Message Direction = From UE
chan_type = 0 (0x0)
prot_disc_check = 3 (0x3)
trans_id_or_skip_ind = 0 (0x0)
prot_disc = 3 (0x3) (GSM_CALL_CONTROL)
msg_type = 14 (0xe)
prot
  call_ctrl_prot
    EMERGENCY SETUP
```

```
emerg_cat_incl = 1 (0x1)
emerg_cat
  length = 1 (0x1)
  emerg_serv_cat_val = 64 (0x40)
```

$2^{7-1} = 64$ ; Bit 7 = 1: AleC: Automatically Trigger

2016 Apr 18 20:39:27.227 [30] 0x713A UMTS UE OTA -- EMERGENCY\_SETUP

```
Message Direction = From UE
chan_type = 0 (0x0)
prot_disc_check = 3 (0x3)
trans_id_or_skip_ind = 0 (0x0)
prot_disc = 3 (0x3) (GSM_CALL_CONTROL)
msg_type = 14 (0xe)
prot
  call_ctrl_prot
    EMERGENCY SETUP
```

```
emerg_cat_incl = 1 (0x1)
emerg_cat
  length = 1 (0x1)
  emerg_serv_cat_val = 32 (0x20)
```

$2^{6-1} = 32$ ; Bit 6 = 1 MleC: Manual Trigger