

Standardization of New VoLTE Roaming Architecture

The GSM Association recently endorsed a new VoLTE roaming architecture, S8HR, as a candidate for VoLTE roaming. Unlike previous architectures, S8HR does not require the deployment of an IMS platform in VPLMN. This is advantageous because it shortens time-to-market and provides services universally without having to depend on the capability of VPLMN. This article covers the technical characteristics, basic call controls, technology trials, and future development of S8HR.

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1. Introduction

In the 3G era, operators provide voice and SMS services via circuit switch functions. However, the LTE network does not have such functions, so on LTE, operators must provide voice and SMS services via the IP Multimedia Subsystem (IMS), which is specified by the 3rd Generation Partnership Project (3GPP) [1] [2]. To replicate the 3G voice model, 3GPP and the GSM Association (GSMA) have previously specified a Voice over LTE (VoLTE) roaming architecture called Local Break Out (LBO) [3]. However, the latest demands of the operators, such as less CAPEX/OPEX

and shorter time-to-market in order to compete against OTT's VoIP services, have re-opened the debate on VoLTE roaming architecture. In response, GSMA re-evaluated the VoLTE roaming architecture and a new architecture, S8 Home Routed (S8HR). As a result, GSMA endorsed S8HR as a new candidate for VoLTE roaming architecture [4].

2. Technical Characteristics of S8HR Architecture

The architecture of S8HR is shown in **Figure 1**, where IBCF/TrGW/BGCF/MGCF refers to the functions necessary for interconnect services.

With S8HR, a VoLTE roaming service is provisioned on top of the LTE data roaming framework using a VoLTE capable terminal, as specified by GSMA PRD IR.92 [5]. The architecture has the following technical characteristics:

- (1) Bearers for IMS services are established on the S8 reference point, just as LTE data roaming.
- (2) All IMS nodes are located at Home Public Land Mobile Network (HPLMN), and all signaling and media traffic for the VoLTE roaming service go through HPLMN.
- (3) IMS transactions are performed directly between the terminal and P-CSCF at HPLMN. Accordingly, Visited Public Land Mobile Net-

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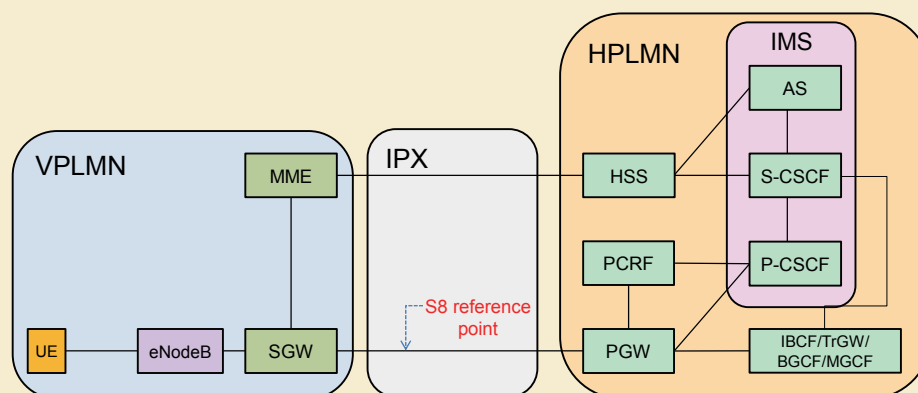


Figure 1 S8HR architecture

work (VPLMN) and interconnect networks (IPX/GRX) are not service-aware at the IMS level. The services can only be differentiated by APN or QoS levels.

These three technical features make it possible to provide all IMS services by HPLMN only and to minimize functional addition to VPLMN. As a result, S8HR shortens the time-to-market for VoLTE roaming services.

3. Basic Call Controls for S8HR

3.1 Attach Procedure

Figure 2 shows the attach procedure for S8HR VoLTE roaming. From Steps 1 to 3, there is no signif-

icant difference from the LTE data roaming attach procedure. In Step 4, HSS sends an update location answer message to MME. In order for the MME to select the PGW in HPLMN (Step 5), the MME must set the information element VPLMN Dynamic Address “Allowed,” which is included in the subscribed data, to “Not Allowed.” In Step 6, the bearer for SIP signaling is created between SGW and PGW with QCI=5. MME sends an attach accept message to the terminal with an IMS Voice over PS Session Support Indication information element, which indicates that VoLTE is supported. The information element is set on the basis of the MME’s internal configuration specifying whether

there is a VoLTE roaming agreement to use S8HR. If no agreement exists between two PLMNs, the information element will not be set.

3.2 IMS Call Control

After the attach procedure is completed, the terminal performs an IMS registration procedure. There is no difference between roaming and non-roaming VoLTE procedures, and all IMS services procedures, e.g., voice call, video call, SMS, or any kind of IMS service, are also the same as non-roaming procedures.

3.3 Emergency Call

According to 3GPP specifications, emergency calls must be connected

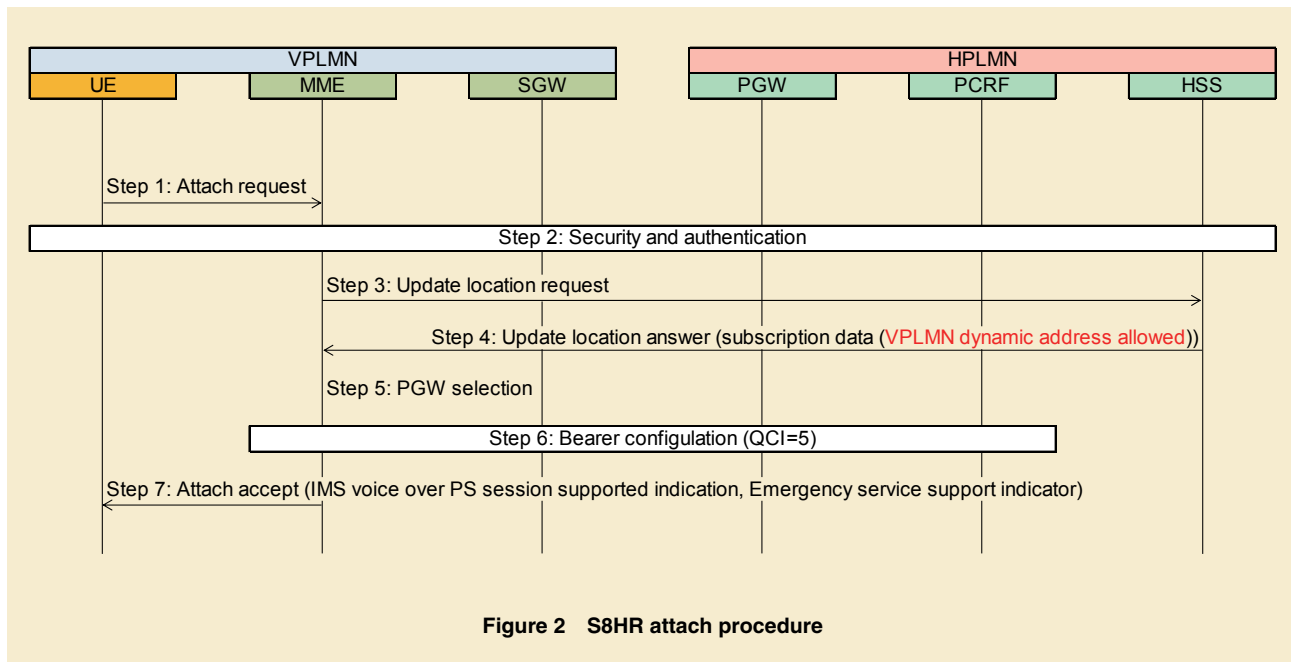


Figure 2 S8HR attach procedure

to the local emergency service. This means that the call routing procedure for emergency calls must be completed within VPLMN. To fulfill these regulations, S8HR must support at least one of the following methods:

- (1) CS fallback
- (2) IMS emergency call over LTE access

Which method to use is determined by the terminal on the basis of information about the capability of VPLMN, which is sent from MME to the terminal during the attach procedure. The terminal selects IMS emergency call with LTE network if it receives an attach accept message with an Emer-

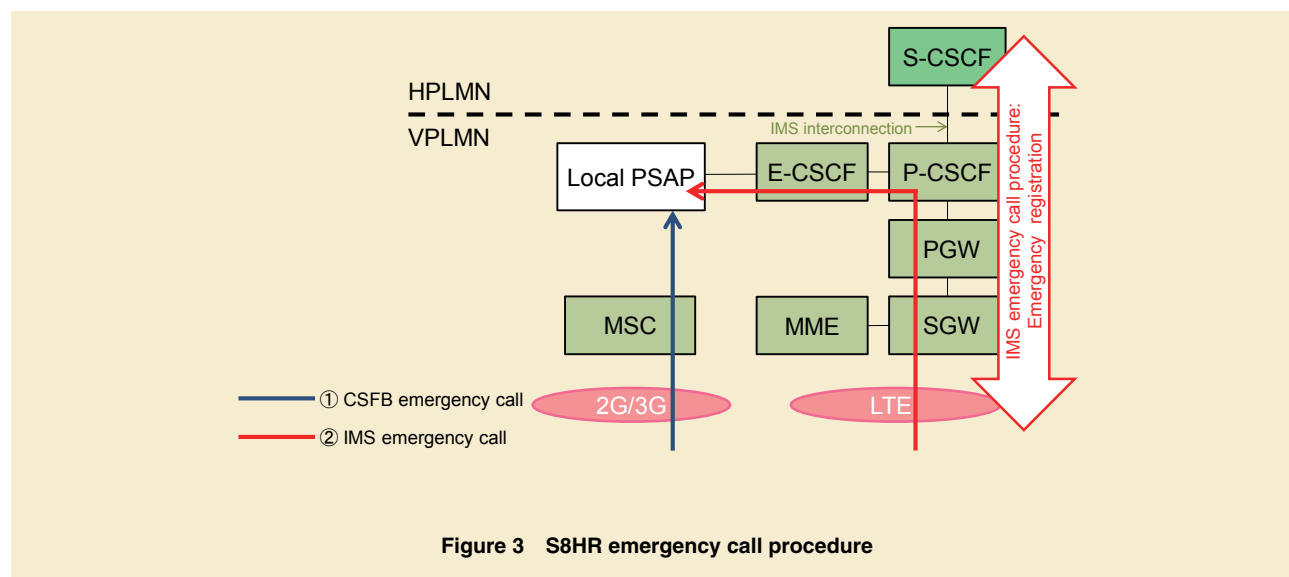
gency Service Support Indicator information element in Step 7. Otherwise, the terminal selects CS Fallback for emergency call via 2G/3G network, if it made a combined location registration to VPLMN.

When IMS emergency call is selected, the terminal is required to perform an emergency registration procedure for user authentication (**Figure 3**). For this procedure, the IMS layer connection between VPLMN's P-CSCF and HPLMN's S-CSCF is required to exchange authentication information. However, if the emergency registration fails for whatever reason, the terminal can continue the procedure by sending an INVITE message to VPLMN's P-

CSCF with the information element "Anonymous," which indicates that S-CSCF could not authenticate the user [6].

4. Trials to Validate Voice Quality

As mentioned above, with S8HR, all IMS signaling and media go through HPLMN. To investigate the effect on delays and voice quality, NTT DOCOMO, Korea Telecom, and Verizon Wireless performed experiments in cooperation with GSMA [7]. The trials were conducted in an environment that replicates commercial networks. Results showed that VoLTE calls with S8HR have better quality



than 3G roaming voice calls, even for long-distance roaming. More participation from other operators will be expected, and individual results will be used for GSMA evaluation criteria to progress the discussion on S8HR.

5. Conclusion

This article outlined the characteristics of S8HR VoLTE roaming. At the time of publication, there is no official agreement as to which roaming architecture will be the standard for the mobile industry. GSMA and 3GPP will continue technical discussions on VoLTE roaming and many operators will also

continue discussion on the basis of the trial results. NTT DOCOMO has contributed to both 3GPP and GSMA as chair to lead the discussion and will continue to drive the industry's discussion of VoLTE roaming and to develop related standards, aiming at the accelerated global deployment of VoLTE services.

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