USSI for NW Service Menu Configurations in LTE

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Unstructured Supplementary Service Data using Internet protocol Multimedia Subsystem (USSD using IMS*1), or USSI is technology to enable menu configuration for network (NW) services on LTE, such as voice mail and call waiting (Catch Phone®*2) services. Required functions have been specified by the 3GPP standardization association [1].

Since June 2014, NTT DOCOMO has been providing Voice over LTE (VoLTE) [2] services to enable voice communications on LTE. However, menu configurations have been provided using the existing 3G USSD system, which means that transitioning to 3G using Circuit Switched FallBack (CSFB)*3 is required. This raises the following three issues:

- It takes more time to complete menu configurations.
- Data throughput during menu configuration falls back to the 3G level.
- To prevent calls being cancelled by CSFB, user equipment (UE) needs to disable menu configuration during VoLTE communications.

Thus, to improve user convenience, NTT DOCOMO made a decision to support USSI on the NW and from Winter 2015 UE models. After that, USSI solved the aforementioned issues and enabled menu configurations when UE is camping on LTE cells. Regarding differences in menu configurations in LTE cells, **Figure 1** shows the user interface on UE, while **Figure 2** shows the NW connection system.

1) USSI Architecture on 3GPP Standard

USSI uses Session Initiation Protocol (SIP)*4, the same as VoLTE call control (**Figure 3**).

When a user performs a menu configuration (Figure 3 (1)), the UE sends SIP_INVITE*5 with USSI message for NW service settings/updates to the Proxy Call Session Control Function (P-CSCF)*6. P-CSCF sends SIP_INVITE to the Application Server (AS)*7 via Serving Call Session Control Function (S-CSCF)*8 (Figure 3 (2)). AS sets/updates the service status according to the USSI message in SIP_INVITE (Figure 3 (3)), and stores a result response in SIP_BYE, which is returned to the UE

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*1 **IMS:** A communication system architecture standardized by 3GPP. IMS integrates IP technologies and the SIP (see *4) used for Internet telephony to implement multimedia services on fixed telephone and mobile communication NWs.
*2 **Catch Phone®:** A registered trade mark of Nippon Telegraph and Telephone Corporation.
*3 **CSFB:** A procedure for switching to a radio access system having a CS domain such as W-CDMA/GSM, when a UE uses a circuit switching service such as voice while camped on an LTE NW.

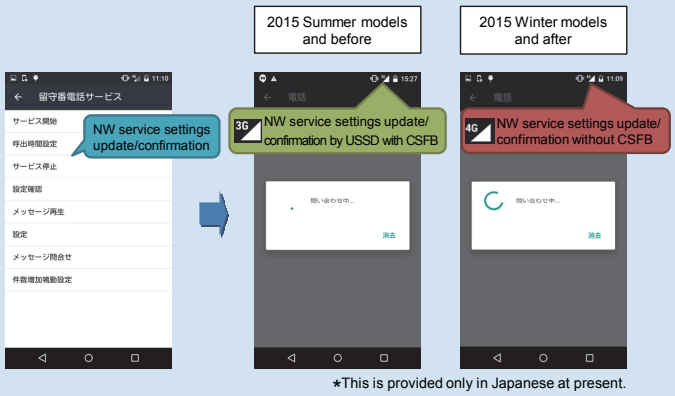

Figure 1 Menu configurations in LTE cells (screen transitions)

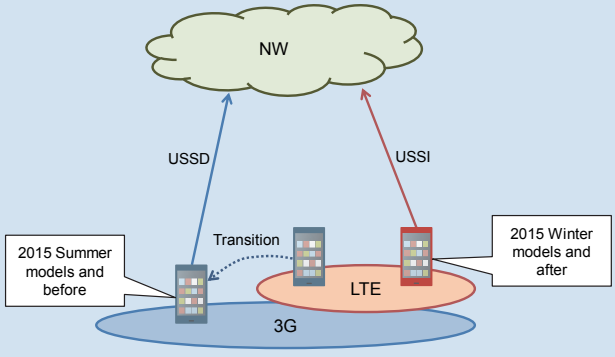

Figure 2 Menu configurations in LTE cells (NW connection systems)

(Figure 3 (4)).

2) USSI on the DOCOMO NW

Because NW service configurations are retained in AS in standard specifications, the system also terminates the USSI message in AS. However, due to design policies on the DOCOMO NW, some service configurations are retained in Front end Service Control Point (F-SCP)/Database SCP (D-SCP), which manages subscriptions. For this reason, it is necessary to send NW service settings information to a F-SCP/D-SCP. The flow of menu configuration control on the DOCOMO NW is shown in **Figure 4**.

The USSI development was achieved by devising a way to use the existing USSD interface (IF) between F-SCP/D-SCP and the Application Serving Node (ASN), which is equivalent to AS in standard specifications.

Specifically, the ASN analyzes the USSI message received, and if it is a service which settings are retained in F-SCP/D-SCP, protocol is converted to the IF similar to the existing USSD (SIP to MAP conver-

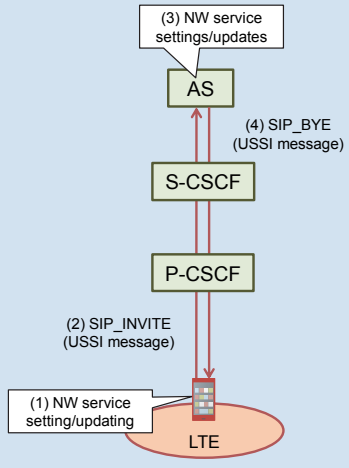

Figure 3 USSI control in standard specifications

*4 **SIP:** One of the communications control protocols standardized by the Internet Engineering Task Force (IETF) used with IP telephony etc.
*5 **Invite:** A SIP signal that requests a connection.
*6 **P-CSCF:** A function deployed at the connection point with EPC and at the UE connection point with S-CSCF and I-CSCF. It links with EPC to initiate QoS control and relays SIP signals between the UE, S-CSCF and I-CSCF.
*7 **AS:** A server that executes an application to provide a service.
*8 **S-CSCF:** A SIP server performing terminal session control and user authentication.

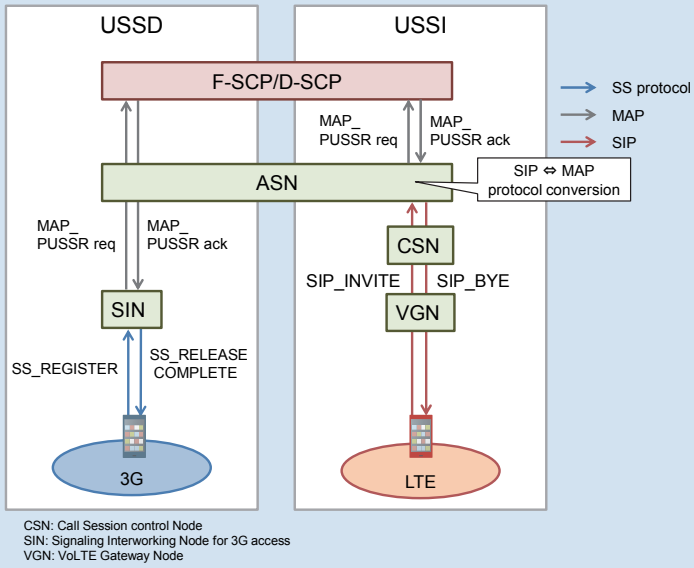

Figure 4 Menu configurations control on the DOCOMO NW

sion), and F-SCP/D-SCP is notified. Also, conversion from the existing IF to USSI (MAP to SIP conversion) is performed for the results response from F-SCP/D-SCP. This enables USSI without developing F-SCP/D-SCP.

This article has described USSI enabled on LTE for menu configurations for NW service settings/update. Supporting USSI in this way has solved the issues discussed at the beginning of this article, and improved user convenience. Also, providing NW service menu configurations when camped on an LTE cell will also assist with the future transition to the LTE-only NW from 3G.

References

[1] 3GPP TS24.390 V11.4.0: "3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Unstructured Supplementary Service Data (USSD) using IP Multimedia (IM) Core Network (CN) subsystem IMS; Stage 3," Sep. 2013.

[2] K. Tokunaga et al.: "VoLTE for Enhancing Voice Services," NTT DOCOMO Technical Journal, Vol.16, No.2, pp.4-22, Oct. 2014.