Evolution towards convergent signaling networks

By Hu Di, Sun Hongwei, and Yang Qin

The SS7 signaling network is growing increasingly outdated compared to the emerging Diameter signaling network. Carriers need a convergent signaling network that supports both SS7 and Diameter signaling to extend signaling networks’ service life, enhance network performance, and enable smooth network evolution in the future.

Telco signaling networks are constantly evolving. Carriers around the globe need a solution to smoothly upgrade their mature and stable SS7 signaling networks to advanced Diameter networks.

Network development drivers

SS7 is reaching the end of its lifecycle

Carriers across the world use public switched telephone networks (PSTN) and public land mobile networks (PLMN) to bear most of their voice calls and short messaging services (SMS). After two decades of development, the STP-based signaling system is now reaching the end of its lifecycle.

Service transformation boosts Diameter development

In the LTE era, carriers adopt policy and charging control (PCC) architectures to realize refined traffic operation. The IP multimedia subsystem (IMS) over LTE allows carriers to provide integrated multimedia communications services, improving user experience. In the future, the number of NEs, network scale, network complexity will keep growing. The connection and management of NEs and routing capability will be crucial to fast network development. The Diameter signaling network has over 85 network elements and interfaces, and utilizes the latest Diameter technologies for policy control, charging, and authentication. The increase in mobile Internet users has resulted in explosive growth of signaling traffic. Exact Ventures, an independent market intelligence firm, estimates that global Diameter signaling traffic has been growing at an average annual rate of 77% since 2012. By the end of 2017, traffic will exceed 42 million transactions per second.

Diameter Agent (DA) has been defined as the new signaling device to provide efficient routing and secure interconnection for Diameter signaling. DA supports a number of industry standards, including the Diameter Routing Agent (DRA) defined by 3GPP R8, Diameter Edge Agent (DEA) defined by GSMA IR.88, and DA defined by IETF RFC 3588.

Carriers need smooth evolution from SS7 to Diameter

As LTE replaces time division multiplexing (TDM), Diameter replaces SS7. Traditional SS7 signaling networks use call control protocols, such as integrated services digital network user part (ISUP) and bearer independent call control (BICC), as well as protocols that are not relevant to call control, such as intelligent network application protocol (INAP), CAMEL Application Part (CAP, CAMEL refers to customized applications for mobile network enhanced logic), and mobile application protocol (MAP). However, on LTE, PCC, and IMS
networks, ISUP and BICC are replaced by SIP and INAP, while CAP and MAP are replaced by Diameter.

The replacement will be a slow process, so STP-based SS7 and Diameter will coexist for a long time. Carriers must maintain legacy SS7.

Convergent signaling networks

To minimize operating expense, carriers need a convergent signaling network that supports both SS7 and Diameter, and a signaling service processing system (SPS) that functions as both the STP and DRA/DEA.

With the rapid development of LTE, quick realization of LTE roaming capability and mass deployment of LTE networks have become competitive advantages. Carriers who have urgent need for LTE deployment, yet face little pressure from old SS7 equipment, can build DRA signal networks quickly. They can use the SPS as the DEA to enable international Diameter interconnection and LTE data roaming. Alternatively, they can use the SPS as the DRA to enable efficient Diameter routing in LTE networks and cut over the existing SS7 links to the SPS based on the STP’s lifecycle plan. For carriers whose STP is reaching the end of its lifecycle, the SPS can be used to upgrade the legacy SS7 signaling networks, with the SPS configured to support Diameter signaling traffic interconnection and routing upon LTE deployment.

The integrated signaling network lowers network deployment costs, reduces the number of network devices by half, simplifies signal bearing, and enables dynamic hardware resource sharing between the SS7 and Diameter signaling networks, maximizing the return on investment (ROI). Additionally, signal integration minimizes OPEX for carriers, and improves network evolution flexibility, allowing functional NEs to change their protocols and interfaces from SS7 to Diameter. For example, integration allows evolution from the MAP-compatible home location register (HLR) to the home subscriber server (HSS), and from the INAP- and CAMEL-compatible intelligent platforms to the online charging system (OCS).

Key capability requirements

To develop such an integrated signaling network, the SPS must fully support SS7 and Diameter protocols and have the following capabilities.

High reliability

The signaling network is the central nervous system of a telecommunications network. A reliable signaling network is requisite of quality network services. The rapid expansion of mobile services, such as data and multimedia services, brings massive signaling traffic and may lead to signaling storms. A fully-meshed network architecture has no unified control point. Consequently, when such storms happen, network outages and massive economic losses are common. Infonetics reports that Diameter signaling traffic is growing at an annual rate of 50%. Therefore, carriers need an integrated signaling network that features a carrier-grade platform, multi-level (link-, router-, and network-level) disaster recovery and intelligent, large-capacity flow control to support signaling expansion in the future.

Enhanced security

Telecommunications networks are changing from enclosed, TDM-based switching systems to open and IP-based data service systems. Carriers must ensure network security and prevent user data disclosure. Network assets and user data can help carriers develop a favorable industry ecosystem that can give them a competitive edge in the market. To achieve these objectives, the integrated signaling network must support multi-level disaster recovery and multi-level security protection (embedded IP firewalls and Diameter signaling firewalls). These mechanisms allow telcos to send user and policy data to partners in a secure and reliable manner.

Flexible and efficient routing

Carriers are providing an increasing number of services, even providing them wholesale, in a constantly expanding scope. Governments are mandating new services, such as number portability, at all levels. To meet service requirements in the future, carriers need an integrated signaling solution that can work as an efficient and flexible routing engine to provide rich routing functions and support mobile number portability (MNP), flexible number routing (FNR), and subscription locator function (SLF).

Visual and intuitive management

Effective management plays a key role in efficient operation. An integrated signaling solution must support management of both SS7 and Diameter signaling networks and display all signaling data related to service control, such as end-to-end message tracing, on carriers’ core networks. This simplifies network maintenance, fault location, and new service deployment significantly.

Intelligent terminal applications bring uncertainty to signaling generated from the core network. Therefore, such applications must have complete signaling statistics indexes to analyze the signaling traffic trend, offering data support for signaling network expansion design.