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The road to LTE is paved with Diameter

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We all know mobile data traffic is skyrocketing, fueled by the rampant use of smartphones, tablets, and compelling applications such as mobile video and social networking. And there is no slowdown in sight.

Operators know that their 3G networks are not equipped to manage this high level of traffic growth. They're looking to all-Internet protocol (IP) networks such as long term evolution (LTE) and IP multimedia subsystem (IMS) to provide the bandwidth required to support data-hungry devices and applications and to cost effectively address the growing gap between traffic and revenue growth.

According to the Global mobile Supplier Association's

> **"3G networks are not equipped to manage this high level of traffic growth."**

(GSA) recent report, 180 operators in 70 countries are currently investing in LTE, with at least 64 LTE networks anticipated to be in commercial service by the end of 2012. As LTE networks are deployed over the next few years, operators will be faced with a number of challenges as their networks become more complex, including scalability and cost management. Diameter can help address those challenges.

Why Diameter Signaling?

The majority of operators around the globe still connect their networks through the exchange of well-defined SS7 messages. As networks evolve, SS7 signaling is being replaced by Diameter and SIP-based equivalents.

While LTE defines Diameter-based rather than SS7 interfaces, the majority of SS7 functionalities still have to be performed in LTE networks.

The Diameter protocol, using stream control transmission protocol (SCTP) for transport, is used widely in the all-IP, service-oriented IMS and LTE architectures. Within the IMS control and service planes, Diameter plays a central role in policy, charging, authentication, and mobility management.

Diameter Routing Challenges

The Third Generation Partnership Project (3GPP) has specified the extensive use of Diameter protocol interfaces for LTE and IMS networks, but the organization has not defined a separate Diameter signaling infrastructure.

Without a separate Diameter signaling infrastructure at the network core to facilitate signaling between network elements, endpoints such as mobility management entities (MMEs) and home subscriber servers (HSSs) must utilize direct signaling connections to each other, forming a mesh-like network architecture. Network endpoints must handle all session-related tasks such as routing, traffic management, redundancy, and service implementation. Initially, implementing an IMS or LTE network without a signaling core may be sufficient, but as traffic levels grow, the lack of a capable signaling infrastructure poses a number of significant challenges, including:

- Scalability: Each endpoint must maintain a separate SCTP association with each of its Diameter peers as well as the status of each, placing a heavy burden on the endpoints as the number of nodes grows.
- Congestion control: Diameter lacks the well-defined congestion control mechanisms found in other protocols such as SS7. For example, if an HSS has multiple Diameter front ends, the lack of sufficient congestion control increases the risk of a cascading HSS failure.
- Network interconnect: A fully meshed network may expose the operator's network topology to other operators and could lead to security breaches because there is no central interconnect point.

"Centralizing Diameter routing reduces the cost and complexity of the core network."

- Interoperability testing (IOT): Protocol interworking becomes unmanageable as the number of devices supplied by multiple vendors increases. With no separate signaling or session framework, IOTs must be performed at every existing node when a new node or software load is placed in service. IOT activities consume a considerable amount of operator time and resources, with costs increasing in proportion to the number of tests that must be performed.
- Support for both SCTP- and transmission control protocol (TCP)-based implementations: SCTP-based elements cannot communicate with TCP-based elements unless they are upgraded or all of the elements support both protocol stacks.
- Subscriber to HSS mapping: When there are multiple HSSs in the network, subscribers may be homed on different HSSs. Therefore, there must be some function in the network that maps subscriber identities to HSSs. With no separate Diameter signaling infrastructure, that task must be handled by a standalone subscription locator function (SLF), or by the HSS itself. Either approach wastes MME (or call session control function [CSCF]) processing and can add unnecessary delays. The HSS approach wastes HSS resources and may even result in the need for more HSSs than would otherwise be necessary.
- Policy and charging rules function (PCRF) binding: When multiple PCRFs are required in the network, there must be a way to ensure that all messages associated with a user's particular IP connectivity access network (IP-CAN) session are processed by the same PCRF.

Operators used to managing SS7 networks also should know that certain "common rules" no longer apply in LTE, and they will need to take other measures to get the same network behavior as with SS7. One example is network failures. In SS7, the network is designed

and configured to route around a failed path, and the signaling is optimized upon detection of a failure. For Diameter, the failed path must be re-discovered every time a request is sent over the network. In this example, Diameter signaling is less efficient.

The Need for Centralized Routing

Centralizing Diameter routing reduces the cost and complexity of the core network and enables core networks to grow incrementally to support increasing service and traffic demands. A centralized node can then proxy information for decentralized elements like HSSs, MMEs or PCRFs.

When connecting to a Diameter-based network element in another operator's network, there is always the risk that the Diameter implementations will not match perfectly, even if the elements are provided by the same vendor. Therefore, a Diameter agent is required to adapt Diameter messaging. By implementing the functionality at the central network core level, operators can perform IOTs faster and more cost effectively.

Tekelec's Diameter Signaling Router (DSR) creates a centralized core Diameter signaling layer that relieves LTE and IMS endpoints of routing, traffic management, and load balancing tasks and provides a single interconnect point to other networks. Each endpoint only needs one connection to a DSR to gain access to all other Diameter destinations reachable by the DSR. This approach eliminates the Diameter/SCTP (or TCP) mesh that is created by having direct signaling connections between each network element. Having one or more SCTP hubs that centralize the SCTP connections to all end nodes simplifies interoperability between different network elements and enhances network scalability.

The path to 4G is evident. As operators move to LTE, centralized Diameter signaling can help them better manage costs and the scalability of the network.

About Tekelec: Tekelec, the broadband data management company, enables billions of people and devices to surf, talk, and text. Our solutions allow service providers to give consumers a consistent and tailored broadband experience. We handle network complexity with a portfolio that manages and capitalizes on the exponential growth in data applications and traffic. Tekelec has more than 25 offices around the world serving customers in more than 100 countries.