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SMART SIGNALING

The Service-Enabling Diameter Signaling Controller (DSC)

A Whitepaper

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By Chris Knight
Product/Solution Engineering

Abstract: A DSC is deployed in the 4G Evolved Packet Core (EPC) to perform signaling traffic management, roaming control, vendor interoperability and legacy interworking. Another major headache for operators will be enabling their 2G/3G services for LTE. There are two approaches to this, either integrate legacy SS7-based services using Diameter-SS7 interworking or migrate the services to LTE by "Diameter-enabling" them. With the introduction of the DSC as the carrier-grade network element for Diameter in 4G, this provides the ideal point in the network that allows services to be integrated, either hosted or remote and SS7-based or Diameter-based. In addition to migrating 2G/3G services there is a new breed of service that can benefit by being hosted on the DSC that mines the wealth of information passing through the DSC. The DSC is a unique point in the 4G network to offer value-added services, both the migration of 2G/3G services and the addition of new services using policy, charging subscriber and location information.

Introduction

In this whitepaper, we explore using the Diameter Signaling Controller (DSC) as the point in the 4G network for hosting value-added services. There are two broad categories of service, the existing 2G/3G services, e.g. roamer steering, that need to migrate to the 4G network and the new 4G services, e.g. policy/location analytics, that can be offered based on using information flowing through the DSC.

Using DSC to migrate existing 2G/3G services to 4G

In the 2G/3G network there are a multitude of value-added services, mainly for voice but also some for data. Most are implemented in SS7 and there are some implemented in Diameter. There is a need to either reuse these existing services in the 4G network to maintain CAPEX or to migrate the services to the 4G network to minimize OPEX. Figure 1 shows how a DSC may be used to migrate existing 2G/3G services to the 4G network.

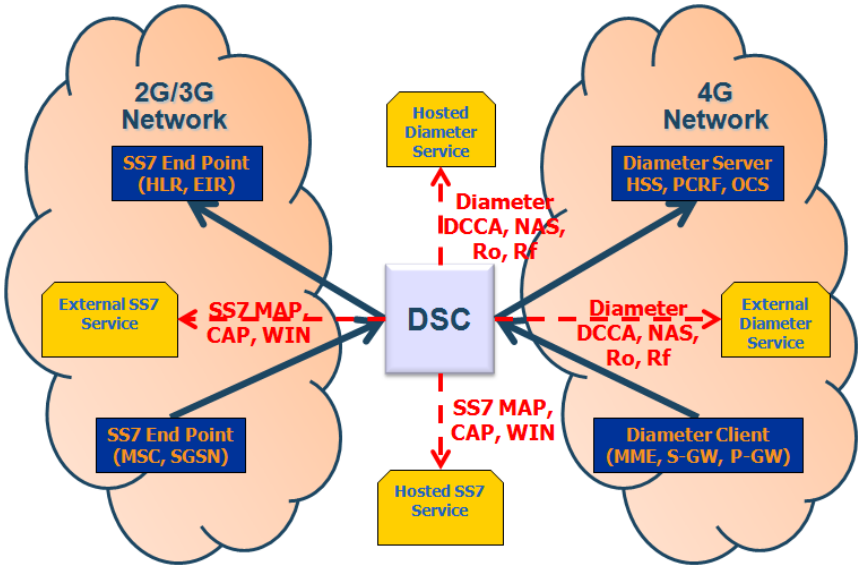

Figure 1: DSC to Migrate Existing 2G/3G Services to 4G

The DSC is deployed in the 4G Evolved Packet Core (EPC) and is used to perform traffic management, roaming control, vendor interoperability and legacy interworking. In this role the DSC handles all Diameter interfaces to the elements of the EPC, including MME, S-GW, P-GW, HSS, PCRF and OCS, and also handles SS7 interfaces to the 2G/3G network for interworking with legacy networks, including MSC, SGSN, HLR and EIR.

The DSC has all the capabilities to support Diameter, SS7 and interworking between them, so this is a natural location for integrating value-added services. Legacy services may support SS7 protocols like MAP, CAP and WIN and these may be external to the DSC or may be hosted on the DSC. Also there may be existing services that are Diameter-based like DCCA, NAS, Ro and Rf and these may also be external to the DSC or hosted on the DSC.

Using DSC to add new services for 4G

In the 4G network there are a multitude of Diameter-based interfaces that pass through the DSC with a wealth of information that provides the opportunity to improve service, provide additional revenue and profit or reduce cost. Figure 2 shows how a DSC may be used to add new services to the 4G network.

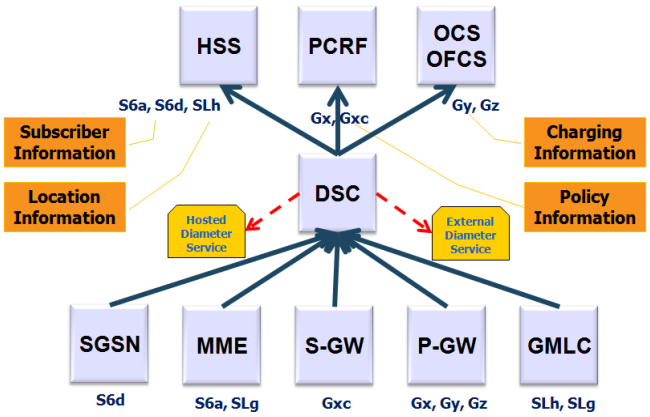

Figure 2: DSC to Add New Services for 4G

The DSC is deployed in the 4G Evolved Packet Core (EPC) and handles all Diameter interfaces to the elements of the EPC, including MME, S-GW, P-GW, GMLC, HSS, PCRF and OCS. Across these interfaces information related to subscriber, location, policy and charging is passing through the DSC and can provide value-added services to the operator by mining this data.

New services may be built using these Diameter interfaces and may be external to the DSC or may be hosted on the DSC. These can use one or more interfaces that can combine information related to the subscriber (S6a, S6d), location (SLh, SLg), policy (Gx, Gxc) and charging (Gy, Gz).

Service triggering at the DSC

Whether it is a legacy service or a new service, an SS7-based service or a Diameter based service, the DSC needs to trigger and potentially chain services from the Diameter signaling that passes thru the DSC. Figure 3 gives an example of different service that may be integrated through the DSC.

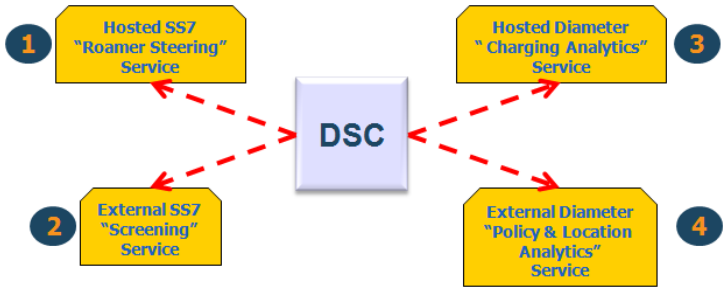

Figure 3: Example service triggering at the DSC

Different services need to be triggered for different interfaces and different parameters on the interface. Some services only need to be invoked in "notify" mode where they get a copy of the message and some services need to be invoked in "interrupt" mode where they can affect the outcome of subsequent processing at the DSC. Sometimes multiple services need to be invoked on the same message and service chaining with priority is required. Figure 4 shows an example of different services being invoked on different selection criteria or rules.

Svc	Mode	Rule	Description
1	Interrupt	App-Id=S6a & command-code=ULR	Roamer Steering
2	Interrupt	App-Id=S6a & command-code=ULR & Orig-Realm = epc.mnc123.mcc456.3gppnetwork.org	Screening
3	Notify	Command-code=272 & CC-Request-Type=1	Charging Analytics
4	Notify	App-Id=SLh or SLg or Gx or Gxc	Policy & Location Analytics

Figure 4: Example - Service Selection at the DSC

There may be an existing "roamer steering" service in the 2G/3G network that steers roaming subscribers on to a preferred visitor network. This is just as applicable in the 4G network where an LTE roaming device needs to be steered to the correct operator. In this example, the existing SS7 service is hosted on the DSC. The DSC will intercept all messages on the S6a interface, extract the information from the Update-Location-Request (ULR) message and embed it in a SS7 MAP message and send to the service in interrupt mode and wait for a response.

There may be an existing "screening" service that is used to screen calls from certain roaming regions. This may be equally applicable to 4G roaming subscribers. In this example, the existing SS7 service is used on the same external SS7 host. The DSC will intercept all S6a ULR messages that originate from the realm of the operator in network "123" of country "456" and embed it in a SS7 MAP message and send to the service in interrupt mode and wait for a response.

A new “Charging Analytics” service can be hosted on the DSC that examines all initial Credit-Control-Request (CCR) and Credit-Control-Answer (CCA) messages in “notify” mode, and a new “Policy and Location Analytics” service can be hosted on a remote server and receive all message on the SLh, SLg, Gx and Gxc interfaces in “notify” mode. Both services act as a probe into the Diameter traffic to perform offline analytics.

Summary

This paper has examined the role of the DSC in the 4G EPC and how it can be used to provide value-added services. It may be used to migrate 2G/3G services to 4G and allow the introduction of new services in 4G by mining the wealth of information that passes thru the DSC. Services may be hosted on the DSC or external to the DSC and may be Diameter-based or SS7-based. The DSC may be configured to trigger one or more services based on AVPs in the Diameter message in notify mode or interrupt mode. This gives a very flexible way of deploying and integrating services in the 4G EPC.

Definitions

Acronym	Reference	Description
3GPP	3GPP	3rd Generation Partnership Project.
CAMEL	3GPP	Customized Applications for Mobile network Enhanced Logic
CAP	3GPP	CAMEL Application Part
DCCA	IETF	Diameter Credit-Control Application (RFC 4006 Diameter Application)
DSC	General	Diameter Signaling Controller.
EIR	3GPP	Equipment Identity Register.
EPC	3GPP	Evolved Packet Core.
GMLC	3GPP	Gateway Mobile Location Center
GGSN/SGSN	3GPP	Gateway/Serving GPRS Support Node
Gx/Gxc	3GPP	Interface between P-GW/S-GW and PCRF
Gy/Gz	3GPP	Interface between OCS/OFCS and PCEF.
HLR	3GPP	Home Location Register.
HSS	3GPP	Home Subscriber Server
MAP	3GPP	Mobile Application Part.
MME	3GPP	Mobile Management Entity.
MSC/GMSC	3GPP	Mobile Switching Center or Gateway-MSC
NAS	IETF	Network Access Server (RFC 4005 Diameter Application)
OCS/OCFS	3GPP	On-line/Off-line Charging System.
PCRF	3GPP	Policy and Charging Rules Function.
P-GW/S-GW	3GPP	PDN/Serving Gateway.
Ro/Rf	3GPP	Interface between the CSCF and OCS/OFCS.
S6a/S6d	3GPP	Interface between MME/SGSN and HSS.
SLg	3GPP	Interface between GMLC and MME
SLh	3GPP	Interface between GMLC and HSS
WIN	3GPP2	Wireless Intelligent Network

About Diametriq:
Diametriq, offering LTE control signaling solutions to meet the needs of LTE network operators, was built on the assets of IntelliNet Technologies, a wireless solutions company founded in 1992. The company's application enabled Diameter Routing Engine™ (DRE) addresses traffic management, interoperability and service migration issues. The DRE includes a Diameter Routing Agent (DRA), Diameter Edge Agent (DEA), a Subscription Locator Function (SLF) and a Diameter Interworking Function (IWF). For more information, visit www.diametriq.com.