Interworking Function

Overview

The DSC operates in both SS7 and Diameter networks as SS7 STP and Diameter Signaling Controller. The InterWorking Function (IWF) is used to convert certain MAP messages to/from equivalent Diameter protocol between these two networks (refer to Interfaces Supported).

The IWF is defined in the ETSI 29.305 standard and DSC operates in Scenario One and Two.

As service providers start their deployment of Long Term Evolution/ Evolved Packet Core (LTE/EPC) and provide the associated enhanced capabilities to their subscribers, a problem arises when these subscribers roam to non-LTE/EPC based networks (that is, 2G/3G networks). The network architectures and the underlying protocols are different:

- 2G/3G uses SS7/TCAP/MAP to manage mobility
- LTE/EPC uses Diameter to manage mobility

The DSC solves the issue of subscriber roaming to disparate networks by supporting the 3GPP specification for interworking between Diameter and Mobile Application Part (MAP), therefore, allowing LTE/EPC subscribers to roam seamlessly between LTE/EPC networks and 2G/3G networks.

For more information about IWF, refer to Configuring IWF.

Interfaces Supported

The IWF standard (ETSI TS 29.305 v12.2.0) discuss One IWF and Two IWF scenarios. In each scenario, the difference is described by how many IWFs are used, but the difference may also be described by the supported interfaces.

The following figure depicts these scenarios.
Figure 1: Supported interfaces for One IWF scenario

- S6a, S13, S13a, and SGd
- Gr, Gf, and E (for SMS)

Interactions with Diameter and SS7 interfaces.
Authentication

During the authentication procedures, the Home Location Register (HLR) produces a number of authentication vectors. The type of authentication vectors returned is determined by the Attribute-Value Pair (AVP) sent by the Mobility Management Entity (MME) and/or Serving General Packet Radio System (GRPS) Support Node (SGSN), and the HLR's capabilities. Within the Diameter Authentication-Information-Request (AIR) message, the MME and/or SGSN uses one or both of two AVPs to specify the requested type of authentication it is seeking. These AVPs are the Requested-EUTRAN-Authentication-Info or the Requested-UTRAN-GERAN-Authentication-Info.

The Requested-EUTRAN-Authentication-Info AVP will request the HLR to return a EUTRAN vector (RAND, XRES, AUTN, and KASME). To return such a vector, the HLR must be capable of the feature.

The Requested-UTRAN-GERAN-Authentication-Info AVP will request the HLR to return a vector, the type of which depends upon the HLR's Application Context Version (ACV). The ACV used between the HLR and the IWF may have to be negotiated down if the HLR does not support ACV 3. ACV 3 is the highest version, and the only one to return an Authentication quintuplet.

For a combined MME/SGSN, the following two vector types may be requested and return by the HLR/HSS:

- Authentication quintuplets (RAND, XRES, AUTN, CK, and IK)
- Authentication triplets (RAND, SRES, and Kc)

As there are several variables in this process, Ribbon will work with its customers to ensure their network configurations are supported.

SS7 Called and Calling Parameters

According to the TS 29.305 specification, the Signaling Connection Control Part (SCCP) Called Party Addresses are to be set by mapping either the Destination Host or the Destination Realm and Application ID of the Diameter messages. Similarly, the SCCP Calling Party Addresses are to be set by mapping the Origination Host AVP.

The IWF contains a one-to-one mapping table for SS7 digits and Diameter IDs.

Using an E.164 address in the Called Party Address of an SS7 SendAuthenticationInformation message is somewhat unusual. Typically, an E.212 or E.214 based on the International Mobile Subscriber Identity (IMSI) is used at this point, as the GSM network will use this value to Global Title route the message to the HLR. This takes place because the IMSI is typically examined in the Diameter network to determine if it must go to IWF. In this same process, the Destination Host of the HLR is determined. Therefore, it is more efficient to use the E164 number of the HLR rather than to look up, for a second time, the IMSI to HLR mapping.

If the customer network requires the IMSI in the SendAuthenticationInformation message, contact Sales in regards to this issue.

SS7 and Diameter Destinations

Messages destined to the IWF will be sent from the MME and/or SGSN to a given Diameter ID. This Diameter ID should be considered the Destination Host.
Messages destined to the IWF from the SS7 side will either be sent to a Point Code/SSN value or will be screened and redirected using Gateway Redirection and sent to the application.

Messages leaving the IWF towards the SS7 side will be sent to a Point Code/SSN value or a Global Title Translation service on the Ribbon Signaling System or on a different STP.

IWF Data Measurements

For detailed information about the IWF data measurements, refer to IWF Data Measurements.

IWF Supported Services

The IWF supports multiple interfaces between MAP and Diameter including the following:

1. Home Subscriber Server (HSS)

2. Home Location Register (HLR)

3. Equipment Identity Register (EIR)

4. Short Message Service (SMS) [(Gateway Mobile Switching Centre (GMSC)/Interworking Mobile Switching Center (IWMSC)/Router)]

The nodes have their associated operations and conversions.

HSS Services supported in IWF

The following table lists and describes the HSS Services supported in IWF.

Table 1: HSS Services Supported in IWF

<table>
<thead>
<tr>
<th>Name (ETSI TS 29.305 scenario)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authentication Information Retrieval – One IWF (7.1.1)</td>
<td>Diameter initiated AIR to MAP-SendAuthenticationInfo</td>
</tr>
<tr>
<td>Update Location – One IWF (7.2.1)</td>
<td>Diameter initiated ULR to MAP-UpdateGprsLocation</td>
</tr>
<tr>
<td>Cancel Location – One IWF (7.3.1)</td>
<td>SS7 initiated MAP-CancelLocation to Diameter CLR</td>
</tr>
<tr>
<td>Purge – One IWF (7.4.1)</td>
<td>Diameter initiated PUR to MAP-PurgeMS</td>
</tr>
<tr>
<td>Insert Subscriber Data – One IWF (7.5.1)</td>
<td>SS7 initiated MAP-InsertSubscriberData/ ProvideSubscriberInfo to Diameter IDR</td>
</tr>
<tr>
<td>Delete Subscriber Data – One IWF (7.6.1)</td>
<td>SS7 initiated MAP-DeleteSubscriberData to Diameter DSR</td>
</tr>
<tr>
<td>Reset – One IWF (7.7.1)</td>
<td>SS7 initiated MAP-Reset to Diameter RSR</td>
</tr>
<tr>
<td>Notification – One IWF (7.8.1)</td>
<td>Diameter initiated NOR to MAP-UpdateGprsLocation / ReadyForSM</td>
</tr>
<tr>
<td>Trace Activation – One IWF (7.10.1)</td>
<td>SS7 initiated MAP-ActivateTraceMode to Diameter IDR</td>
</tr>
<tr>
<td>Trace Deactivation – One IWF (7.11.1)</td>
<td>SS7 initiated MAP-DeactivateTraceMode to Diameter DSR</td>
</tr>
</tbody>
</table>

EIR services supported in IWF
The following table lists and describes the EIR services supported in IWF.

Table 2: EIR Services Supported in IWF

<table>
<thead>
<tr>
<th>Name (ETSI TS 29.305 scenario)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMEI Check – One IWF (7.9.1)</td>
<td>Diameter initiated ECR to MAP-CheckIMEI query</td>
</tr>
</tbody>
</table>

**SMS services supported in IWF**

The following table lists and describes the SMS services supported in IWF.

Table 3: SMS Services Supported in IWF

<table>
<thead>
<tr>
<th>Name (ETSI TS 29.305 scenario)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MO Forward Short Message – One IWF (A.2.4.1.1)</td>
<td>Diameter initiated OFR to MAP-MO-ForwardSM</td>
</tr>
<tr>
<td>MT Forward Short Message – One IWF (A.2.4.2.1)</td>
<td>SS7 initiated MAP-MT-ForwardSM to Diameter TFR</td>
</tr>
<tr>
<td>Send Routing Info for SM – A.3.4.1</td>
<td>Support S6c Interface between HSS and MME</td>
</tr>
</tbody>
</table>

**Note**
A single scenario exists for the EIR service which is only valid for the One IWF.