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Oracle Communications Diameter Signaling Router Main Differentiators

Building Bullet-proof Signaling Networks

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Introduction

Diameter is the protocol used by network elements in LTE and 3G networks to enable and monetize services, such as voice, video and data. Diameter enables revenue-generating data services; including tiered data plans, loyalty programs, application-specific QoS, content provider and Internet of Things (IoT) solutions. There is a direct correlation between Diameter traffic and data revenue. As service providers begin to monetize their networks, the volume of Diameter signaling increases. Oracle Communications LTE Diameter Signaling Index forecasts a significant growth in Diameter traffic. In fact, global diameter growth is accelerating at such a high rate that it could surpass global IP traffic growth in the near future, according to Oracle Communications LTE Diameter Signaling Index[1]. Diameter signaling will continue to show aggressive growth as LTE penetration rates increase.

Today's networks are transforming to being all-IP. As a result, the need for Diameter signaling, as the vehicle for dealing not only with the tsunami of traffic caused by the explosion of smart devices and the apps they use but also with new use cases like Voice-over-LTE (VoLTE) and Voice-over-Wi-Fi (VoWi-Fi), and Internet of Things (IoT) has rapidly moved from being a nice to have to a must have in order to survive. This extraordinary growth in signaling traffic is creating the need for a new signaling infrastructure where challenges including scalability and maintainability, network resiliency, network security, interconnect and protocol interworking as well as visibility have to be addressed in order to improve network survivability. Any issues with Diameter signaling control not only have the potential for slowing networks or dropping connections that result in poor customer satisfaction, but also for the loss of important billing information. Failures in the signaling system result in subscriber churn, lost revenue and opportunity costs.

Oracle has created the Oracle Communications Diameter Signaling Router (OCDSR) to address these challenges. Oracle Communications Diameter Signaling Router is a market-leading, virtualized and cloud deployable Diameter signaling controller solution that centralizes routing, traffic management and load balancing, and helps create an architecture that enables IMS and LTE networks to be truly elastic and adapt to increasing service and traffic demands while optimizing the network resources. Oracle Communications Diameter Signaling Router is built drawing on decades of experience as a leader in signaling technology and is aligned with Oracle Communications Network Function Virtualization strategy.

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[1] Oracle Communications Diameter Signaling Index Report at Oracle.com/diameter-signaling/router

Oracle Communications Diameter Signaling Router Key Benefits

The distinctive advantages provided by the Oracle Communications Diameter Signaling Router are ::

» **Scalability**: Scales and maintains a cost-effective centralized signaling architecture with GUI driven flexible routing and load balancing for mobility management as well as policy and charging

» **Resiliency**: Optimizes the utilization of network resources with centralized intelligent routing and robust congestion control and traffic prioritization

» **Interworking / Interoperability**: Alleviates interworking and interoperability issues in a multi-vendor and multi-protocol environment with the most flexible GUI-driven mediation rules engine and integrated interworking function for protocol translation

» **Security**: Its multilayered gateway-security program ensure networks are protected against attacks, and your most sensitive data is safeguarded. Achieved through in-depth defense systems including firewalls, encryption, screening, access control, topology hiding, and threat monitoring.

» **Visibility**: Enhances network visibility by providing context and targeted reporting and with integrated troubleshooting capabilities

» **Cost-Effective**: Reduces provisioning, maintenance, and interoperability testing costs associated with network expansions

» **Flexibility**: Allows you to configure signaling control without the need for new software loads or costly professional services. Includes a framework that allows for the creation and customization of new applications, rapidly supporting the needs of your networks and market

» **Agility**: Offers a proven path towards complete orchestration and network functions virtualization (NFV), helping customers to uncover new revenue streams by quickly developing applications, as well as easily managing and operating your solution at lower costs

Oracle Communications Diameter Signaling Router Main Differentiators

Over the past two years the Diameter signaling controllers (DSC) market has become more diverse with a broader set of vendor solution. While dominated early by Oracle, there are a few more vendors offering DSC solutions[2]. Oracle Communications Diameter Signaling Router has been proven to be ahead of the competition as illustrated by the following:

» **Cloud Deployable and automation**: Our solution may be operated in a common and shared infrastructure with other telecommunications applications in private or hosted clouds. Oracle Communications DSR can be deployed fully virtualized in a variety of commercially available platforms. Oracle Communications DSR is fully operable with common hypervisors and virtualization infrastructure managers such as KVM/OpenStack, and VMware/vCenter. Oracle Communications DSR Cloud benchmarking guide[3] provides details of the infrastructure used for benchmark testing, including hardware, software, settings and recommendations on configurations. This guide helps operators to plan required resources for the cloud and deploy and manage the solution with the given performance criteria. Oracle Communications DSR APIs are designed with a very high degree of parallelism that enables instantiating and deploying several instances very quickly. Even in the cloud, Oracle Communications DSR has excellent availability and geo-diverse resiliency mechanisms that work in concert with cloud managers to eliminate any downtime.

Cloud deployable DSRs help CSPs migrate network elements to virtualized infrastructure. Such migration speeds rollout of new services, reduces OpEx, and accelerates the eventual transition to full adoption of Network

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[2] Diameter Signaling Control, Annual Market Report (IHS Technology)

[3] Oracle Communications DSR Cloud Benchmarking Guide, available in My Oracle Support (MOS)

Function Virtualization (NFV). Virtualized DSRs can also be deployed with any existing physical DSR in CSP networks. Such hybrid deployments can be used to augment capacity as required and could be the first step in conversion to an all virtualized network.

If you're to take on tomorrow, your signaling solution should offer open APIs, which can deliver automation in the configuration of new services and applications. Deep automation is a vital step before your networks become fully orchestrated. Oracle Communications DSR includes **REST MMI,** which supports operations to expose existing operations to configure and manage the Oracle Communications DSR, thus allowing for greater automation. Use of the MMI allows real-time changes in the Oracle Communications DSR that is initiated by north-bound customer management systems
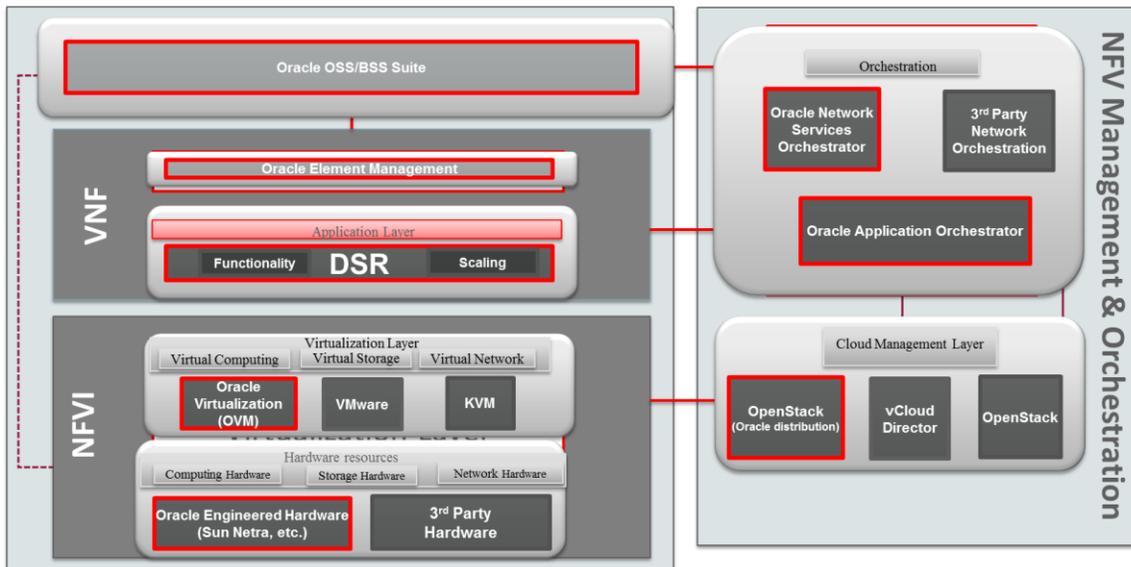

Figure 1: Oracle Communications DSR in ETSI NFV Architecture

» **Unified Signaling Solution with an integrated virtualized Signaling Transfer Point (STP VNF).** The unified signaling solution offers a simple and common infrastructure to manage SS7 and Diameter signaling. The STP VNF facilitates a smooth migration of SS7 applications from legacy systems to datacenters, enables rapid deployment and evolution of partners' interconnection point with secure and easy to turn-around signaling gateways and provides seamless transition from 2G/3G to 4G. SS7 Signal Transfer Point STP VNF is integrated in the DSR application and managed by NOAM/SOAM as "SS7 MP". A SS7 Signal Transfer Point STP VNF can also be installed as standalone.

Figure 2: Oracle Communications DSR with integrated Virtualized Signal Transfer Point (STP VNF)

» **Custom Application Framework (CAF)**: Custom Application Framework (CAF) is the call processing application development framework which allows CSP's to rapidly build and deploy value added services on DSR.

applications built using CAF will run and interface with the DSR in a manner like the native DSR applications, i.e.: ranged-based address resolution (RBAR), full address based resolution (FABR) and policy and charging application (PCA). CAF provides the GUI based at the NOAM to build the applications using Perl language. Developers can define and access configuration and maintenance data tables required for custom application business logic. CAF allows to define and access custom application state data using the DSR's high-capacity, highly-available, geo-redundant Subscriber Data Repository (SBR) subsystem. CAF also includes meta-data in DSR's Integrated Diameter Intelligence Hub (IDIH) trace records for advanced troubleshooting using IDIH. DSR delivers the following reference CAF applications which can be used by customers:

» Steering of Roaming (SoR): The SoR application lets home network operators control and distribute registration traffic of their outbound roamers. Use SoR to define static distribution roaming steering policies for each group of roaming partners that are part of the same country

» Zero Balance Application (ZBA): The purpose of the ZBA application is to detect when a subscriber, identified by a MSISDN, has a zero balance in his/her account, the ZBA application under certain configurable conditions, may respond on behalf of the online charging system (OCS) and reduce the number of queries the OCS must handle for subscribers who temporarily have no credit

» **VoLTE Ready**: A VoLTE-enabled network must be able to properly reserve and prioritize appropriate network resources. Oracle Communications DSR prioritizes traffic to give end user the best experience even during network congestion situations. It means that when a server is congested, the traffic with highest priority, typically VoLTE related traffic is allowed first.

Oracle Communications DSR can help preserve ongoing sessions on failure of a single network element, such as a PCRF. Usually in situations where a PCRF goes down, all its served sessions are lost and all the incoming calls to the affected users will be lost. To preserve these sessions, Oracle Communications DSR will tear down the subscribers' Gx sessions and report failures to the end points, resulting on a new session being established. Furthermore, DSR protects the Rx/Gx session relationship and provides improved VoLTE robustness through monitoring of all transactions.

In networks with multiple policy management servers (PCRF) and online charging systems (OCS) elements, operators need to bind subscribers' sessions to the correct policy/charging server. Oracle Communications Diameter Signaling Router provides dynamic session binding and network-wide session correlation across sites to ensure correct billing and proper application of policy. In addition, stateless routing of policy and charging transactions is also supported using subscriber address based resolution, where routing is based on subscriber's identity (ranges or individual entries) or 3GPP-Charging-Characteristics AVP. A routing entity type can be a user identity (IMSI, MSISDN, IMPI or IMPU) or an IP address associated with the user equipment (IPv4/IPv6)

Oracle DSR is the only product in the market that offers real time, geo-redundant stateful session replication for 15+ sites with 2.1M+ network wide MPS. Proven at one of the largest tier 1 operators

» **GUI-driven Mediation**: Oracle Communications DSR supports a powerful GUI front-end. This interface makes defining rules for interoperability and capability extension easy. Oracle Communications DSR's powerful mediation capabilities have been field- proven to have solved complex and multiple multi-vendor interoperability issues quickly without impacting performance. Oracle Communications DSR has advanced mediation capabilities such as: its ability to modify any group Attribute Value Pair (AVP) (level 8th), create new alarms or counters, add/modify/save/restore any AVP, and modify headers. More than 148K mediation rules are supported

The mediation GUI and "formatting value wizard' simplify the creation of the new mediation rules guiding the user through the steps. Furthermore, a diagnostics tool is available to test mediation rules before they are subjected to live traffic in the network
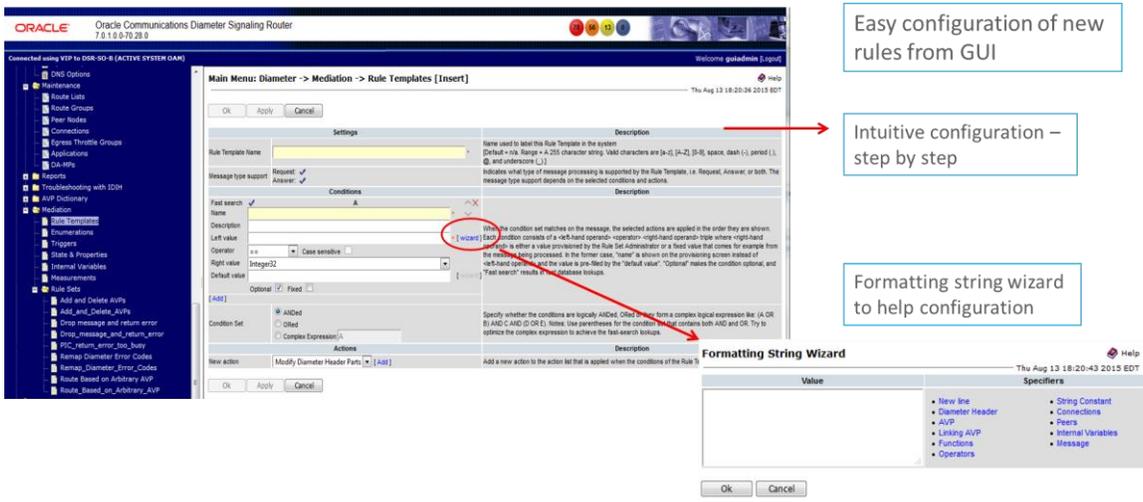
Easy configuration of new rules from GUI

Intuitive configuration – step by step

Formatting string wizard to help configuration

Figure 3: Mediation GUI and Formatting String Wizard

» **Diameter Routing Message Priority (DRMP) -** OCDSR supports IETF RFC 7944 Diameter Routing Message Priority (DRMP) to allow Diameter end points to indicate the priority of the Diameter transactions which shall be used by Diameter nodes for routing, resource allocation and overload abatement decisions. First responders, emergency calls and differentiated services are some of the use cases enabled by this functionality. The Oracle Communications DSR can assign message priorities based on DRMP AVP received in diameter messages as well as static message priorities configured using message priority configuration sets. The message priorities are used for message throttling decisions during congestion conditions

» **Diameter Overload Indication Conveyance (DOIC) Congestion Control with Traffic Prioritization**: Using its robust congestion control capabilities, Oracle Communications DSR can prioritize traffic in order to throttle intelligently when required. Traffic flow is managed in the ingress (from client to DSR) and in the egress (from DSR towards servers).

   » In the ingress, Oracle Communications DSR guarantees minimum capacity, colors traffic when configurable threshold are reached and limits traffic to the max allowed

   » In the egress, Oracle Communications DSR can load-balance traffic across servers in a group ensuring none of the servers is overloaded and optimum utilization of each individual server. In compliance with DOIC IETF standard, Oracle Communications DSR supports dynamic overload controls between clients and servers and allows for traffic throttling based on priority, message color or a combination

Oracle Communications DSR has proven to stop outages at the largest LTE deployments today
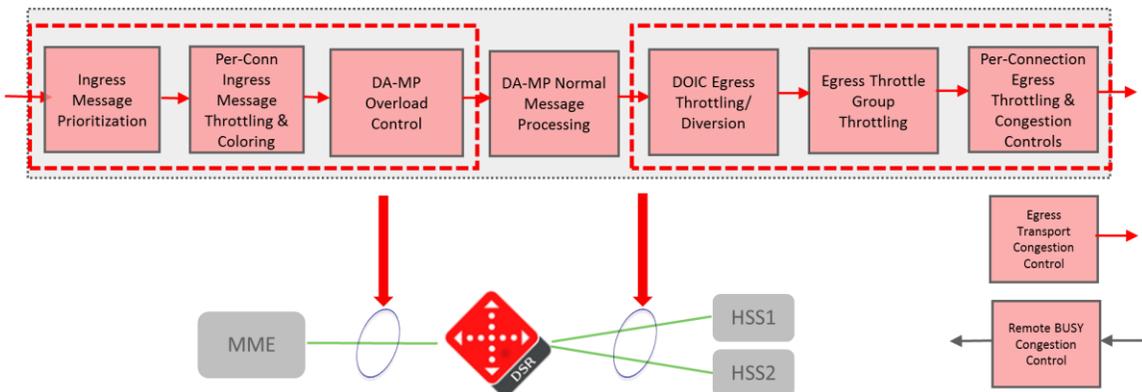

Figure 4: DSR Congestion Control

» **Security**: Oracle Communications DSR complies with GSMA Diameter Interconnect Security (FS.19) and LTE and EPC Roaming Guidelines (IR.88) guidelines for LTE/IMS roaming and network security. Most of the Diameter security vulnerabilities happen in the interconnect from roaming networks through IPX or directly from roaming partner networks. It's imperative for service providers to deploy security mechanisms in their signaling gateways to ensure that traffic is managed both securely, and efficiently. Oracle Communications DSR offers security in depth. A defense in depth implies that security policies are deployed and target all layers and access points: A multilayer protection – from network layer to transport layer and moving up to application layer.

» At network level, servers are hardened and traffic separated (signaling from administration). In addition, a Diameter firewall protects the system against traffic from unauthorized sources

» At transport level, encrypting the signaling between network connections is paramount to preventing man-in-the-middle attacks, eavesdropping on signaling sessions, and other common forms of intrusion in IP domains. While it is difficult to implement encryption within the network, encryption should be a requirement when interconnecting with another service provider

» An Access Control List (ACL) can be used to determine if the originating or sending IP address is known to the network. If the IP address is not known, and therefore not entered in the ACL, then access to the network is denied, and the message is discarded.

» At the application layer, mediation provides the ability to create rules to screen the Diameter message based on any AVP contained in the message. If mediation is not required, the application routing table (ART) includes screening capabilities to determine the validity of the message

» Topology Hiding method prevents outside networks from learning the identities used in the network, and makes it more difficult to determine how many nodes are in the network since every host name is assigned multiple generic host names.

» Another important security consideration is congestion control. By using a centralized DSR, the operator can prevent signaling storms from reaching end nodes, such as the HSS. Since this is typically the intent of a DOS, having a mechanism for handling the DOS – should one occur – is a wise part of any security strategy

Best practice to secure your Diameter network is to use single points of interconnect, controlling access permission for all incoming requests. Oracle Communications DSR protects the interconnect and the core networks, is ideal for Service Providers who need Diameter Edge Agent with sophisticated routing and screening capabilities.
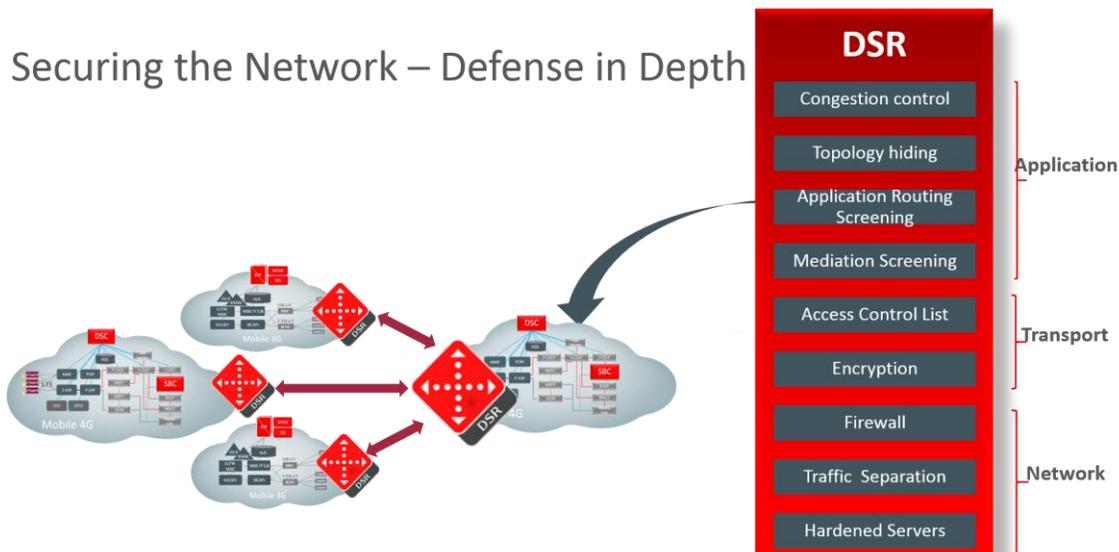
. Figure 5: Multilayer Diameter Network Security with Oracle Communications DSR

» **Operations and network surveillance**: Oracle Communications DSR's **GUI** driver operations capabilities allow operators and administrators to perform any operation easily keeping operational costs down. Complex operations such as automated upgrading, avoids human errors, and a configurable GUI **dashboard** provides a view of operational metrics associated with the health of the elements across the entire network. From one single point, operators are able to view the operational metrics on any signaling node in the network (via drill down hyperlinks) and a vast range of targeted metrics and measurements with automatic generated reports that help to monitor Diameter network elements behavior and traffic patterns

Oracle Communications DSR's **IP Front End** (IPFE) with port management and connections distribution allows improving performance and simplifying network operations and maintenance. It reduces the number of IP addresses to be configured in the clients and servers and distributes TCP or SCTP (uni-home or multi-home) traffic. The IPFE connects to clients or servers and can be configured to act as "responder only", "initiator only", or "initiator and responder", facilitating communication with roaming partners, eliminating the need for roaming partners to negotiate initiator/responder responsibilities and lowering the operational and maintenance impact.

» **Network-wide integrated troubleshooting:** Oracle Communications DSR enhances network visibility with a powerful network-wide integrated troubleshooting tool that displays end-to-end call flows and internal processing details such as: routing rule used for routing, if a mediation rule has been applied, etc., with easy to read ladder diagrams . It enables data to be correlated across multiple sites and reviewed from any site if multiples signaling nodes are deployed in the network. Visualization capabilities for post-capture filtering and analysis include:

   » List of transaction records: requests and answers
   » Ladder diagrams with traffic flow
   » Details on internal DSR message processing (routing rule, mediation rules, etc)
   » Decoding of AVPs associated with the Diameter interfaces
   » Ability to filter captured traffic for further analysis
   » Ability to export PCAP or report in html format

Oracle Communications DSR's **Integrated Diameter Intelligence Hub** (iDIH) allows for a centralized, end-to-end troubleshooting of Diameter transactions in the network,
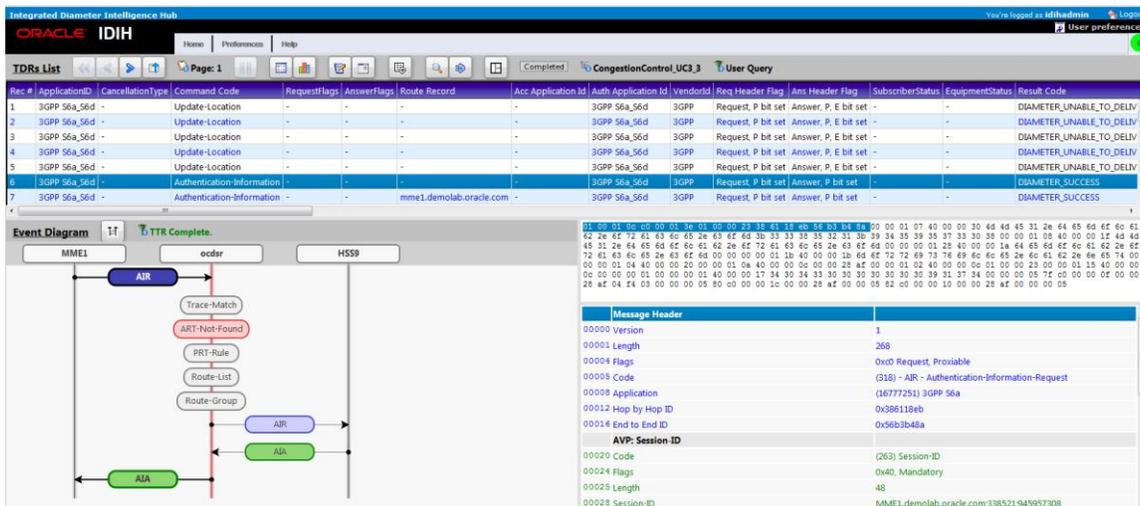

Figure 7: Integrated Diameter intelligence hub (IDIH)

Conclusion

CSPs need to carefully design their networks so that it is adequately protected and is able to handle current and anticipated increase in traffic effectively. The cloud deployable Oracle Communications Diameter Signaling Router has unique characteristics to create a centralized and secure signaling architecture that enables core networks to become elastic and adapt to increasing traffic and service demands. It provides service providers with the best tools to manage Diameter signaling while optimizing network resources, therefore maximizing the return on network and technology investment

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