Effective Diameter Routing Control will be a key component of future success in communications

In the communications industry, networks, services, business models and monetization paradigms are all changing. Phrases like *"the data storm"* and the *"signaling storm"* are becoming common, and reflect this reality. To succeed, these and other storms must be navigated. In this respect, Diameter Routing control is an increasingly critical application and will be a key component of future service provider success.

DigitalRoute
Every bit counts.

A management summary

Today, Communications Service Providers have a new established requirement to address signaling challenges created by the rapid evolution of their networks. As a result, Diameter Routing Agents have become established components in the infrastructure landscape.

However, the first generation of "static" DRA solutions that we commonly see today is embryonic. Service Providers are rapidly discovering that these boxes cannot adequately meet the multi-source, multi-destination signaling challenge they face. Static routers perform effective signaling control only in a static environment where everything is known in advance. But when new destinations and sources often reliant on protocols other than diameter come into play there is an inherit resistance in static boxes to enable them.

The consequential risk is that as a result, new services may take a long time to be supported, leaving operators to try to find workarounds that, even if they succeed in the short term, ultimately put service availability at risk. This is because static routers cannot manage service node signaling.

We believe that effective Routing Control requires as standard the flexibility to mitigate different flavors of diameter specific to the service delivery system in question. It requires the modularity to support and quickly introduce new Application Function platforms (such as SPRs, UDRs, SPRs, OCSs and RealTime analytics) without software updates and it requires logical extendibility to implement enrichment, degraded mode, ocf, micro quota strategies, etc. at a later stage or where necessary. The flexibility to bridge and translate into different signaling protocols like Diameter, Radius, SS7, Web Services, and others is mandatory.

We will demonstrate that Routing Control from DigitalRoute enhances and augments existing DRA solutions by enhancing integration modularity. In this way, CSPs can leverage DigitalRoute Routing Control to achieve the ability to be flexible in deploying logical use-cases where a very short turnaround time is required.

With DigitalRoute Routing Control, users can keep their service delivery chains healthy with a tool that protects the delivery process and mitigates the differences that may be inherent in existing IT architectures.

Routing Control from DigitalRoute enhances and augments existing DRA solutions by enhancing integration modularity

State of the network

Surging mobile data traffic volumes are redefining the communications landscape. The numbers are staggering, and cannot be ignored.

Cisco's Visual Networking Index predicts an 18-fold increase in traffic over the next five years, reaching 10.8 Exabyte's per month – an annual rate of 130 Exabyte's, by 2016. At this point mobile data will have outpaced fixed data traffic by a factor of 3.

ABI Research, another analyst firm, predicts a 39% compound annual growth rate during the same period, increasing to 100% by 2020. A third analyst firm, iGR, forecasts 11x growth to 2017, not including Wi-Fi traffic offloaded from the macro network.

The point is, there's no dispute in which direction things are heading. And these predictions are unlikely to be off the mark given generally accepted estimates that by 2016, the number of connected devices will outstrip the number of people on earth (7.3 million – source: United Nations.)

While the numbers are impressive, they create serious challenges as well as opportunities for the Service Provider. On the one hand, yes, the opportunity for innovative services and increased revenues are dramatically increased. But on the other hand if, for instance, the number of cars on the road quadrupled overnight, there'd be a sudden and serious shortage of traffic lights and other safety and control devices.

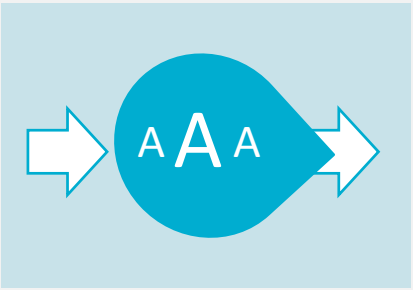
Car manufacturers would be in profit…but hospital Accident & Emergency rooms would likely be full.

The communications industry faces exactly this problem. In order to accommodate the traffic growth (good) while maintaining the health of the infrastructure (the network), various elements have to be put in place urgently.

Among these, Diameter Routing Control is to the fore.

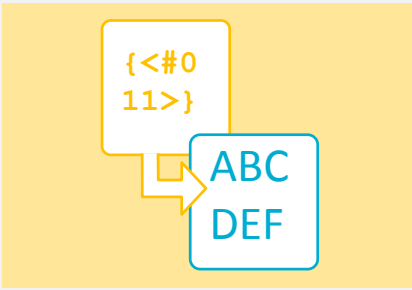
Why this is driving a need for Diameter Routing

To accommodate the dramatic rise in data traffic and in particular to enable the intelligent and in-demand new generation services that operators need to deliver to maintain market share and minimize churn, mobile networks must evolve. The required shift is happening most particularly towards all IP IMS and, today, LTE backbones. These new networks, designed to transport higher loads, utilize the Diameter protocol to both manage and monetize traffic. Diameter is responsible for key functions in both 3rd and 4th Generation mobile networks:



It provides the Authentication, Authorization and Accounting (AAA) framework that gives subscribers permission to access services, and operators the ability to bill them based on usage characteristics (for instance, time of day).

It is a critical component of roaming enablement, allowing one service providers subscribers to freely access partner networks.



It provides the common language that multiple network elements, databases, billing systems, and both internal and external (i.e. OTT,VNO) application servers use to communicate with each other.

Put simply, more or less all the key network nodes relevant to service monetization perform diameter routing and signaling. By centrally controlling diameter, the configuration changes necessary to both drive new services and, equally importantly, to enforce policy and security are made possible.

In order to accommodate data traffic growth while maintaining the health of the network, Diameter Routing Control is critical.

What is Diameter Routing Control?

At a high level, the function of Diameter Routing Control makes this possible. Routing Control solutions typically provide:

Within IMS and broadband networks-

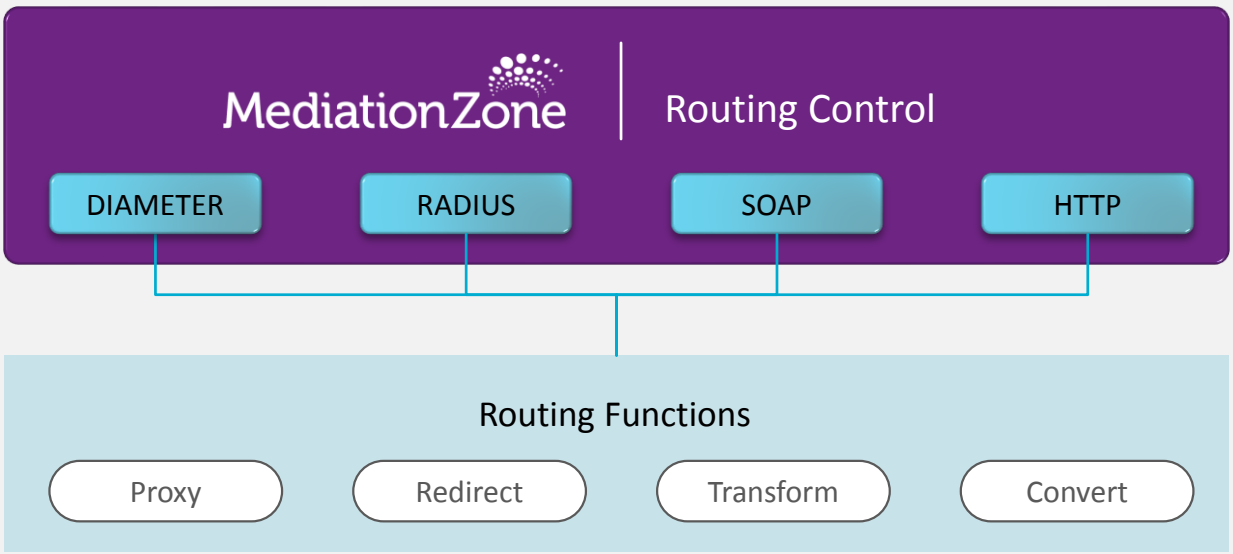
- Centralized routing
- Traffic management
- Load balancing between diameter and non-diameter elements

Between carrier networks-

- Protocol mediation
- Network interworking functionality
- What makes Routing Control both interesting and somewhat unusual are the consequences of ignoring it. Put another way, there are consequences.

Where many vendor solutions offer a functional improvement that can provide an upside but is absent a compelling downside (the service provider stands to win if he buys the product but nothing much will happen, at least immediately, if he doesn't), an absence of Routing Control, as has already been established, can cause significant problems. A number of leading global operators including O2 in the UK and Orange in France have already experienced signaling storms in their LTE networks that, in some cases including those aforementioned, have resulted in network outages. In North America, Verizon experienced an LTE-related outage directly related to poorly managed diameter routing and interoperability problems between IMS and the packet core.

While these failures have in part been caused by usage that has outstripped capacity, another key reason has been architectures that allow diameter signaling to occur on a peer-to-peer basis. Absent routing control, the latter leads to a doomsday scenario.



How Routing Control delivers network control

Typically, operators address growing traffic demand by deploying additional Internet Offload Gateways such as MME and HSS front ends in their networks. This action, in principle, is correct but it creates a problem. Every new node added requires a diameter-ready transport connection that in turn requires both configuration and updating at every downstream network element. This process is time-consuming, expensive, critical, and difficult.

This also highlights that that the presumed need for the static routing control boxes is over-estimated while the need for the extended Routing Control provided by DigitalRoute is even more important and critical. It is here that our the Routing Control agent steps in.

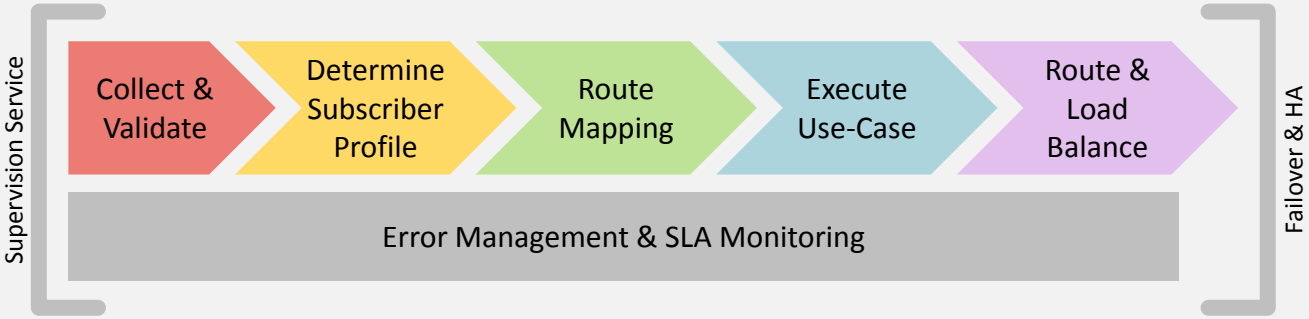
Implementation of Diameter Routing Control delivers:

- Relief in the number of diameter routing association points within the network.
- Simplification of routing table updates and status updates
- Centralized proxies for decentralized network elements.

The implementation of routing control therefore provides immediate relief from signaling storm issues via the realization of a more scalable and less complex network. Furthermore, these benefits are accrued in a way that reduces OPEX.

The implementation of Diameter Routing Control and as a consequence the creation of separate diameter signaling core within the network enables operators to overcome a variety of mission-critical problems related to routing, traffic management, and load balancing. The resulting network architecture; more flexible and more scalable despite the proliferation of data-hungry devices, enables the signaling and other network storms to be weathered with confidence.

Routing Control Procedure



But Routing Control is not that simple

So far, we have seen an explosion in IP traffic and a knock-on effect on Diameter-based, intra-network signaling. However, it is important to understand, and Service Providers are rapidly discovering, that this multi-source, multi-destination challenge is not as simple to address as it appears.

One reason is that it is not only the Evolved Packet Core (EPC) - a framework for providing converged voice and data on a 4GLong-Term Evolution (LTE) network by unifying voice and data so they can be treated as just another IP application - that is affected. Multiple service delivery nodes are also involved, such as those for online charging systems (OCS), mobile and fixed PCRFs, IMS, Value Added Services, and others.

Absent flexible Diameter Routing Control, end-to-end service delivery is at risk. This is particularly the case where – as is now common – network signaling is managed by static DRA routers.

The reality is that the network signaling chain for each of these different applications is interlinked with their own service delivery nodes meaning that in simple terms, the homogenous EPC is far from the same environment as the heterogeneous service layer.

What does this mean to the service provider (as well as for Routing Control)?

Put bluntly, absent flexible Diameter Routing Control, end-to-end service delivery is at risk. This is particularly the case where – as is now common – network signaling is managed by static DRA routers configured to address only a static set of requirements. In simple terms, service node signaling cannot be managed by static routers, a reality about which DigitalRoute is hearing from a growing number of CSPs with inflexible Diameter Routing Agents that are proving inadequate for their involving requirements.

Effective Routing Control requires as standard the flexibility to mitigate different flavors of diameter specific to the service delivery system in question. It requires the modularity to support and quickly introduce new service nodes (such as SPRs, UDRs, TDFs, ARP, OCSs) without software updates and it requires logical extendibility to implement enrichment, degraded mode, ocf, micro quota strategies, etc. at a later stage or where necessary.

With the above in mind, is also necessary to note that signaling over multiple access networks invariably means signaling over non-diameter (such as Radius) as well as diameter protocols. Where this is the case, it is likely that multiple PCRFs and SPRs will be required with different front-ends for the charging system involved. Often, this means one is required for Radius (e.g. for Wifi hotspots, fiber to the home) networks and another for diameter (3G, 4G) networks. Where this is the case, maintaining and synchronizing multiple control planes without an adequate DRA solution equates to high costs, high maintenance, and extended Times To Market resulting within the service delivery process. Signaling in these scenarios cannot be managed by static DRA routers. The flexibility to bridge and translate into different signaling protocols like Diameter, Radius, SS7, Web Services, and others is mandatory.

Diameter Routing Control from DigitalRoute

Diameter Routing Control from DigitalRoute is designed to enable operators to consolidate and synergize their network and commercial infrastructures. Particularly in today's time of hybrid networks, this means bridging Radius and Diameter signaling and re-using diameter infrastructures for Radius-enabled services, creating a fully flexible Routing Control solution.

Diameter Routing Control is delivered as a pre-built solution package that is intended to quickly enable the user to make default implementations of a number of predefined use cases. These templates can also be used as reference configurations for services and partners, and they includes best practices based on DigitalRoute's extensive experience.

With Routing Control from DigitalRoute, signaling architectures are simplified with control logic centralized and stateless and stateful logic housed in a single platform.

Furthermore, with intelligent load-balancing, overload protection and failover handling, service availability is upgraded and new signaling services can be accommodated via DigitalRoute's highly configurable architecture. This minimizes turn-around times and supports new services including those related to roaming, policy, analytics and OCS integrations as well as others.

With Routing Control from DigitalRoute, signaling architectures are simplified with control logic centralized and stateless and stateful logic housed in a single platform. As a result, both transformation and network renewal projects can be handled in a controlled manner with regard to where traffic is terminated. It also means critical business changes like the introduction of a new online charging system, the consolidation of Policy solutions, or the removal of AAA platforms is easy to achieve.

The template provides the base for routing control over any supported MediationZone interface, where for example diameter specific functions like the DRA (Diameter Routing Agent) and DEA (Diameter Edge Agent) according to 3GPP, are supported.

Routing Control from DigitalRoute enables the user to:

- ✓ Route based on any combination of attributes available in the signaling interface
- ✓ Route based on information maintained internally in a profile repository (subscriber attributes, system topology, load, etc.) or by using external data.
- ✓ Route on "any" supported interface (Diameter, Radius, HTTP, SOAP, etc.)
- ✓ Configure and execute routing based on Proxy, Redirect, Transformation and Conversion scenarios.

This enables the user to addresses all of the challenges identified in the previous section via a solution that can either replace, or augment, more limited static Diameter Routing Agents that may already be in place.

Who should use Diameter Routing Control from DigitalRoute?

The DigitalRoute Diameter Routing Control solution is for:

- ✓ Those who need Diameter Routing Control due to signaling complexity
- ✓ Those who need to Convert, Transform, Proxy, Redirect or Route online signaling
- ✓ Those who want to bridge legacy and next-gen signaling technologies and networks via support for multiple protocols rather than just diameter

It delivers the following benefits:

- ✓ The management of a wide number of mission critical network interfaces in a single platform
- ✓ Simple graphical configuration of message interfaces

Improve service availability:

- ✓ Via intelligent load-balancing, over-load protection and failover handling.

Deliver new signaling services with a system that is configurable in a very short turn-around time:

- ✓ ARP-EU Roaming Regulations, Policy over S9, Network analytics feeder, OCS integrations.

Simplify signaling architectures:

- ✓ Control routing logic in one place.
- ✓ Handle state-less and state-full routing logic in one platform.

Routing Control from DigitalRoute manages a wide number of mission critical network interfaces in a single platform.

- ✓ Open configuration of message processing rules
- ✓ Any-to-any protocol conversion within a single transaction (such as Radius to Diameter)
- ✓ Multithreaded processing that enables scaling over many CPU's
- ✓ Distributed processing that enables scaling over many servers
- ✓ Session persistence
- ✓ One, single point of routing control

With flexible Diameter Routing Control from DigitalRoute, communications service providers will be enabled to:

- ✓ Consolidate lines of business and synergize infrastructures by:
  - Bridging Radius and Diameter AAA signaling.
  - Re-using the diameter infrastructure for Radius-enabled services.

Handle transformation/renewal projects in a safe and controlled manner, by controlling where the traffic is terminated:

- ✓ Introduction of a new OCS, consolidate existing PCRF's, Removal of AAA platforms, etc.

Support Multi Source/Vendor environments:

- ✓ With rapid enablement of new sources/vendors through configuration.
- ✓ Promote technology evolution rather than preventing it.

Achieve multi target integration:

- ✓ Easily add new online target systems through configuration (OCS, PCRF, Realtime Network Analytics)

Quickly address key Use-Cases without constraint:

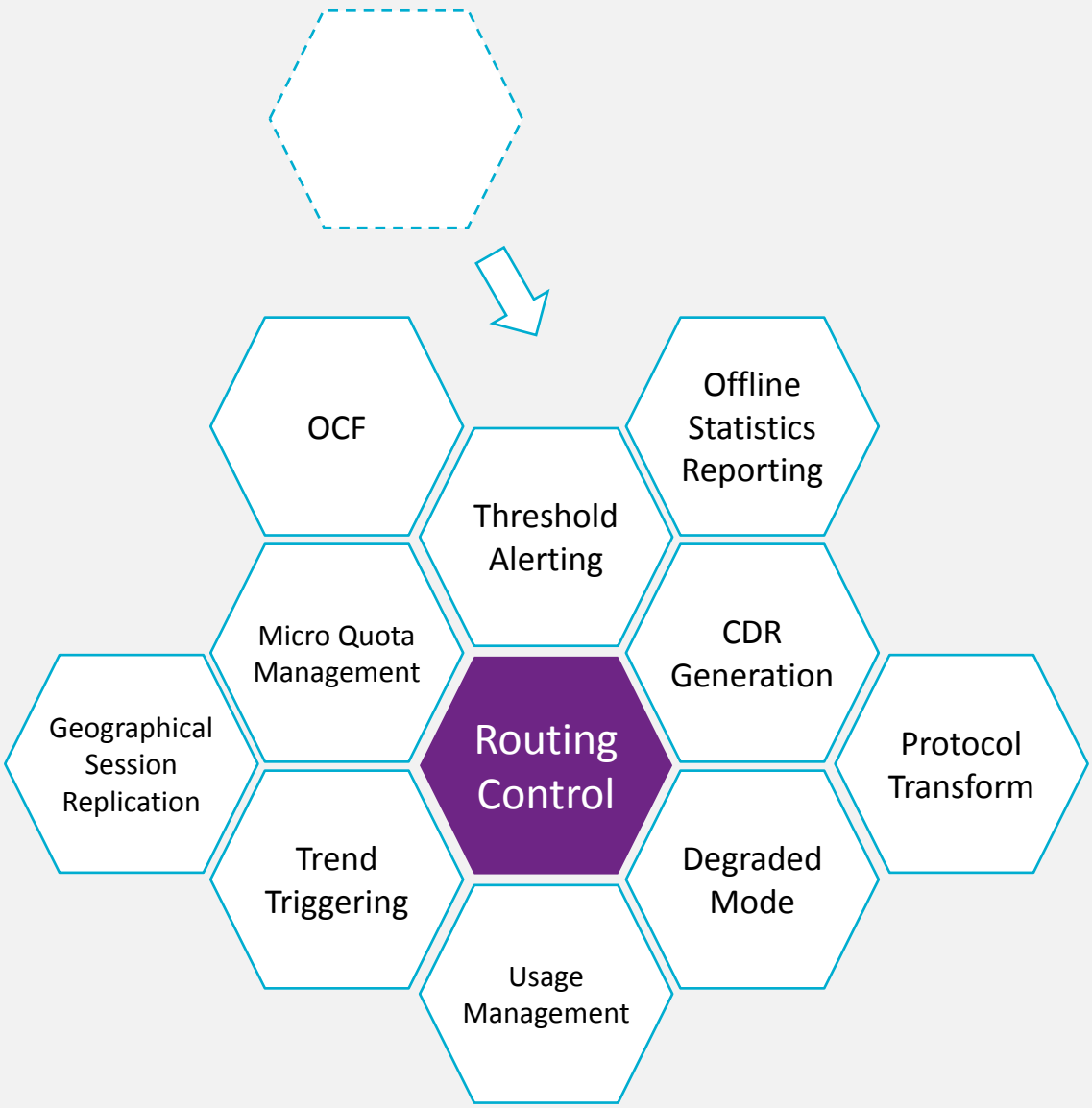
- ✓ Such as ARP-Roaming Regulations, OCS integration, Weight based load balancing, etc.

DigitalRoute Diameter Routing Control provides access to support near unlimited use case

Core Diameter Routing Control from DigitalRoute can be extended to support a multitude of use-cases. These include:

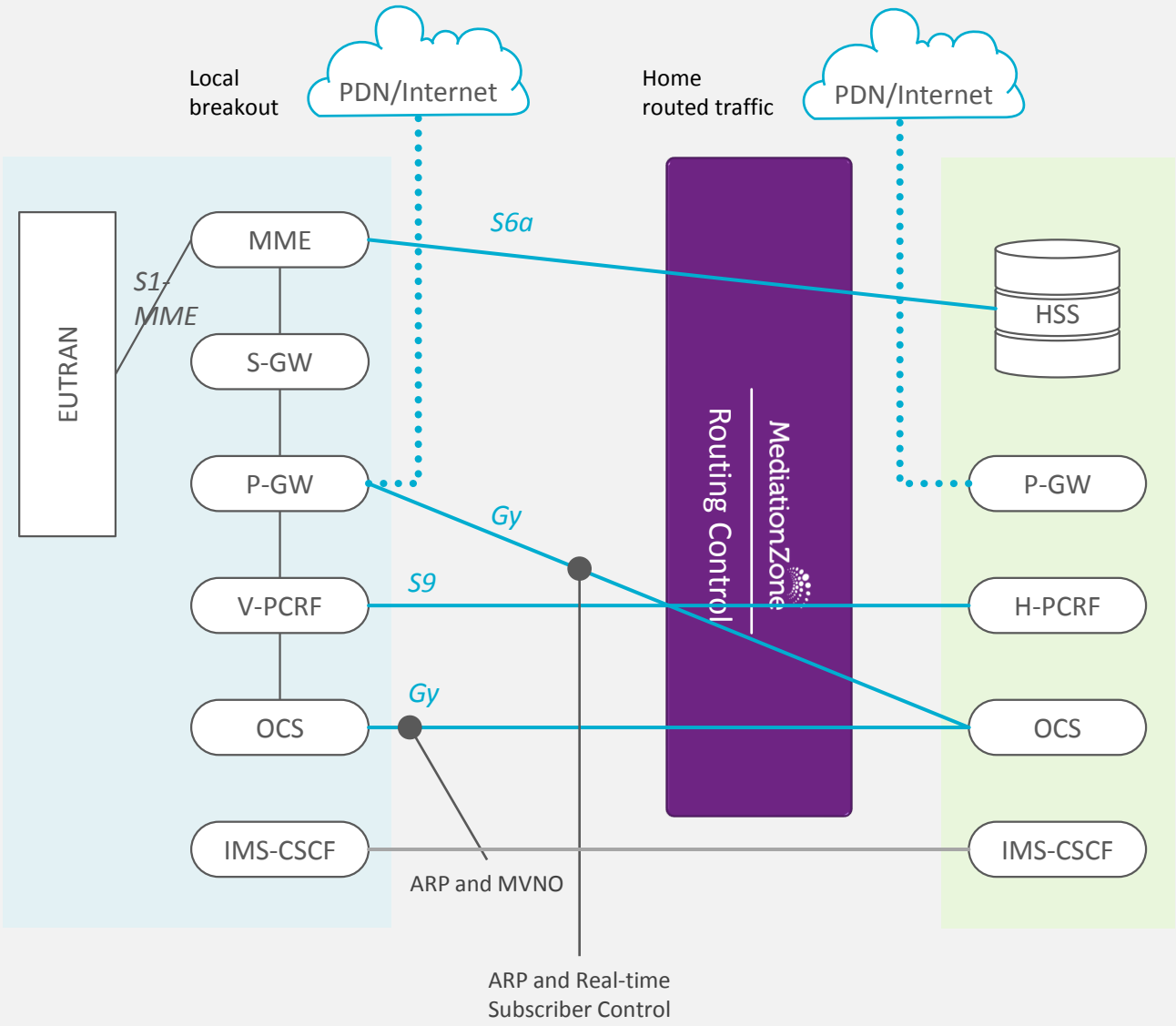
- Micro quota management -> BSS Offload
- Usage Management
- Threshold alerting
- Trend Triggering
- CDR Generation
- Offline statistics reporting
- Online Charging Function
- Degraded Mode Service Availability
- Geographical Session Replication
- …and others.

Open Configurable Use-Cases



Example LTE roaming use case for DigitalRoute Routing Control

A roaming user is connected to the E-UTRAN, MME and S-GW of the visited LTE network. However, LTE/SAE allows the P-GW of either the visited or the home network to be used, as shown in the diagram below:



The home network's P-GW allows the user to access the home operator's services even while in a visited network. A P-GW in the visited network allows a "local breakout" to the Internet, also in the visited network.

The online charging interfaces, as depicted in the picture, are not part of the LTE roaming standard architecture, but based on customer needs, such as alternative roaming partner, virtual operator or simply enabling real-time subscriber information in home network, creates an extension to the default architecture.

LTE Roaming Policy Scenario

Home operator controlled Policy will be required in both local breakout and home-routed scenarios. This means that the home-defined policy profile that the subscriber has will be interrogated when the subscriber is roaming. This is controlled by the S9 reference point.

LTE Roaming Charging Scenario

The complexities of the new charging mechanisms required to support 4G roaming are much more abundant than in a 3G environment. For example:

Prepaid Charging: The CAMEL standard, which enables prepaid services in 3G, is not supported in LTE; therefore, prepaid customer information must be routed back to the home network as opposed to being handled by the local visited network. As a result, operators must rely on new accounting flows not yet standardized to access prepaid customer data.

Postpaid Charging: Postpaid data-usage charging works the same in LTE roaming as it does in 3G, using TAP.

Operators do not have the same amount of visibility into subscriber activities as they do in home-routing scenarios in case of local breakout scenarios because subscriber-data sessions are kept within the visited network; therefore, in order for the home operator to capture real-time information on both pre- and postpaid customers, it must establish a Diameter interface between charging systems and the visited network's PDN-Gateway (Gy?).

Summary

There are several diameter signaling flows between the operators that must be enabled in order to have proper LTE roaming functioning. This environment is very hard to address with a static box, since it will require not only diameter version/flavor mitigation but also logical use-case extensions applied to the routing scenarios where the content of the signaling is altered or enriched in different ways depending on the source and destination system characteristics.

Why Diameter Routing Control from DigitalRoute is unique

Critical in understanding the value of Routing Control from DigitalRoute is the flexibility of our approach. Whereas many “black box” solutions from other vendors in this area are “stupid” to the extent that they are inflexible and therefore their fixed business logic dictates what the operator can achieve, the configurable nature of DigitalRoute’s approach means that it can accommodate and adjust to the operators business drivers, rather than imposing its own limitations on the user.

However, Routing Control from DigitalRoute enhances and augments existing solutions, rather than replacing them. We recognize that static DRA boxes serve a purpose, and position our own solution to give the existing DRA box enhanced integration modularity. In this way, CSPs can leverage DigitalRoute Routing Control to achieve the ability to be flexible in deploying logical use-cases where a very short turnaround time is required.

The result? Users keep their service delivery chains healthy with a tool that protects the delivery process and mitigates the differences that may be inherent in existing IT architectures.

Routing Control from DigitalRoute enhances and augments existing solutions to enable the deployment of logical use-cases where a very short turnaround time is required.

DigitalRoute
Every bit counts.