

FIXED-MOBILE CONVERGENCE: CREATING A SEAMLESS SUBSCRIBER EXPERIENCE

- Meeting authentication and subscriber management demands for converged fixed-mobile networks

As the industry begins taking the next steps towards converged network solutions over fixed and mobile networks, including WLAN, Wi-Fi, 3G, WiMAX, 4G, and, ultimately, IMS, Service Providers will need a subscriber policy management solution as versatile and intelligent as their networks to successfully launch and sustain infrastructure investments and new services while ensuring a seamless subscriber experience.

INTRODUCTION

Subscriber ownership used to be simpler. A mobile subscriber making calls over a mobile network generated revenues for the mobile Service Provider, while subscribers making calls on cable or phone lines generated revenues for the telco that operated the fixed lines.

Within the last few years, fixed-mobile convergence (FMC) has set in motion profound changes in the telecom industry, including making subscriber ownership much more complex. With the maturation or introduction of disruptive new radio network technologies like Wi-Fi and WiMAX as well as the surge in demand for anywhere any time access to IP applications (of which VoIP is likely only the beginning), it will become only more complex.

Service Providers face a number of key challenges in tracking and managing the subscriber experience over a number of different networks. To date, they have concentrated on ensuring that subscribers can always make a voice call regardless of which network they're using, since voice has always been their biggest revenue

stream. This will have to change, as FMC networks will require a broader perspective.

FMC is a mixed blessing for mobile, fixed, and mobile-fixed hybrid Service Providers. Although it opens up new markets and opportunities to cut costs, it also opens up more competition and a more mixed industry, as customers have many more options for both voice and data traffic, and IP-based networks allow them to bypass the more costly access and backhaul infrastructures while receiving a better user experience, which can lead to higher loyalty and reduced churn.

ARCHITECTURAL APPROACHES TO FMC

The goal of an FMC architecture is to allow a mobile subscriber to use wide-area macro wireless infrastructure and local-area wireless infrastructure with a single (dual-mode) device. This requires seamless active handoff between the different wireless access technologies in a way that is transparent to all applications and services, including voice, data, and SMS.

The key architectural approaches to FMC that are being seriously addressed today are based on standards from the Third-Generation Partnership Project (3GPP) to ensure interoperability and move towards the ultimate goal of pure IP Multimedia Subsystem (IMS) networks. These three approaches have led to three major 3GPP standards:

UMA/GAN

UMA provides standard, secure, scalable, and cost-effective IP-based access into core mobile service networks. Service Providers can extend all existing and future circuit, packet, and IMS-based services over any IP-based access network, including the internet. UMA technology (defined by 3GPP in 43.318) enables the delivery of high-quality mobile voice and data services over GSM and broadband connected Wi-Fi / Bluetooth® wireless networks at a significantly lower cost than existing 2.5/3G mobile network technologies.

The UMA standard defines a new core network element (the UMA Network Controller (UNC)) and associated protocols that provide for the secure transport of

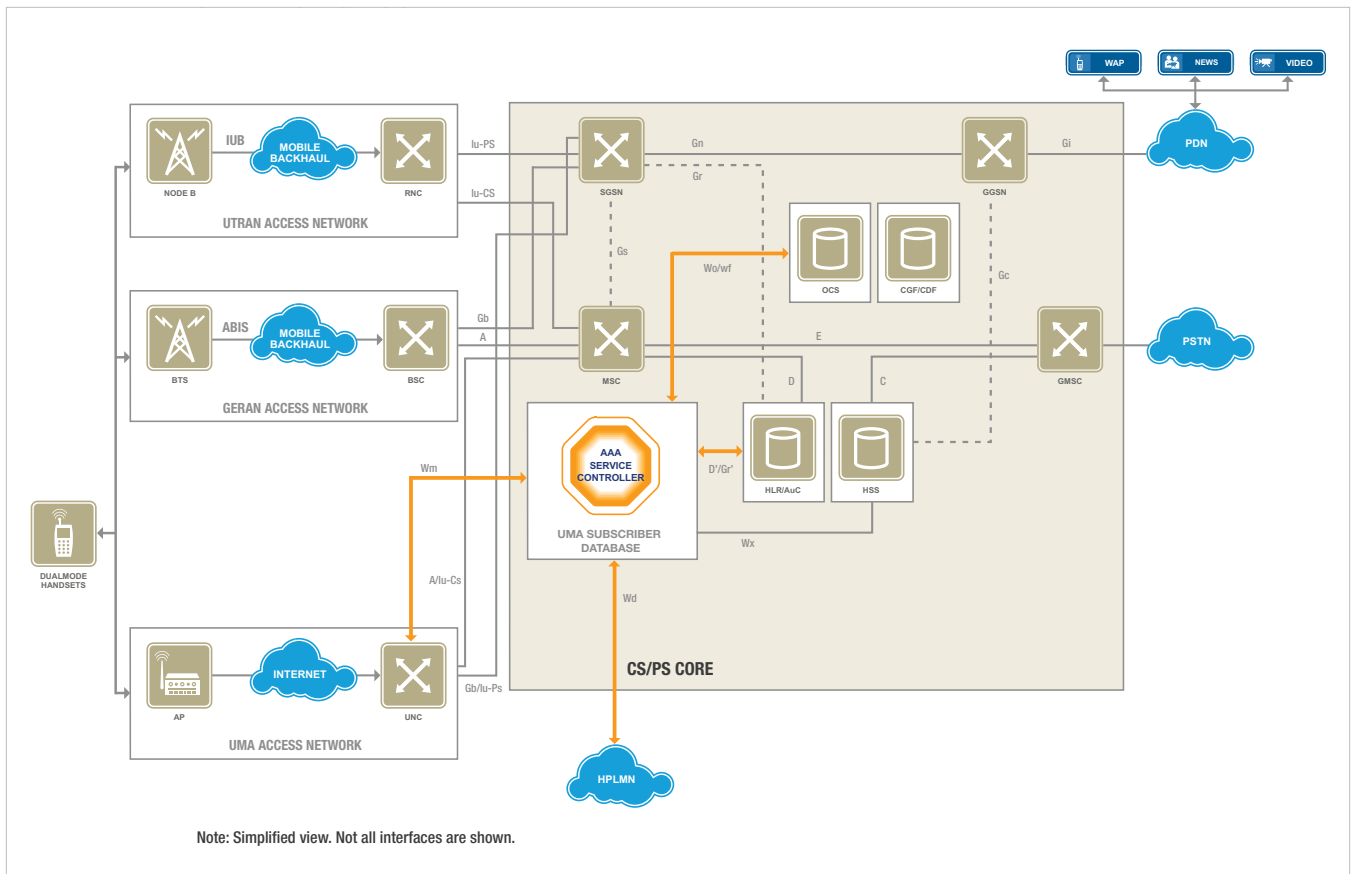


Figure 1: UMA/GAN Reference Architecture: 3GPP R7

SERVICE PROVIDERS THAT CAN TAKE ADVANTAGE OF THE OPPORTUNITIES OF FMC WILL BENEFIT FROM BETTER NETWORK COVERAGE, HIGHER DATA ACCESS RATES, AND LOWER ACCESS COST TO INTRODUCE NEW SERVICES LIKE GAMING, MOBILE TV, AND SOCIAL NETWORKING APPLICATIONS WILL BE BETTER ABLE TO COMPETE AND SUCCEED IN THIS NEW COMPETITIVE LANDSCAPE.

mobile signaling and user plane traffic over IP. While initially developed to enable dual-mode cellular/Wi-Fi handset services, the UMA standard can be leveraged to deliver a number of compelling new fixed-mobile convergence services. By far the most well-known UMA service is support for dual-mode cellular/Wi-Fi handsets (DMH), which enables Service Providers to provide high-performance, low-cost mobile services to subscribers when in range of a home, office, or public Wi-Fi network. With a UMA-enabled dual-mode Wi-Fi handset, subscribers can automatically roam and handover between cellular and Wi-Fi access, receiving a consistent set of services as they transition between

networks. UMA-enabled femtocells also represent an upcoming opportunity as a low-cost licensed solution to indoor mobile network coverage, which has been a longstanding industry challenge.

WLAN Interworking (I-WLAN)

Defined in the 3GPP standard TS 23.234, the goal of this initiative is integrating WLAN with the 3G infrastructure; this initiative defines a phased approach that contains multiple scenarios. The basic scenario includes reuse of SIM authentication and billing infrastructure for public/private WLAN hotspots; the advanced scenario includes seamless

mobility between radio bearers and access to the GSM circuit-switched domain for voice similar to UMA. The current focus of I-WLAN is on user authentication in public WLAN hotspots with no overlaps with UMA, although this user-transparent authentication via the SIM card can complement UMA for public hotspot use.

IMS/VCC

Voice call continuity (currently under development in 3GPP TS 23.206) extends an IMS network to cellular coverage and addresses handover between WLAN and 3G networks. It provides seamless voice call continuity between the cellular domain

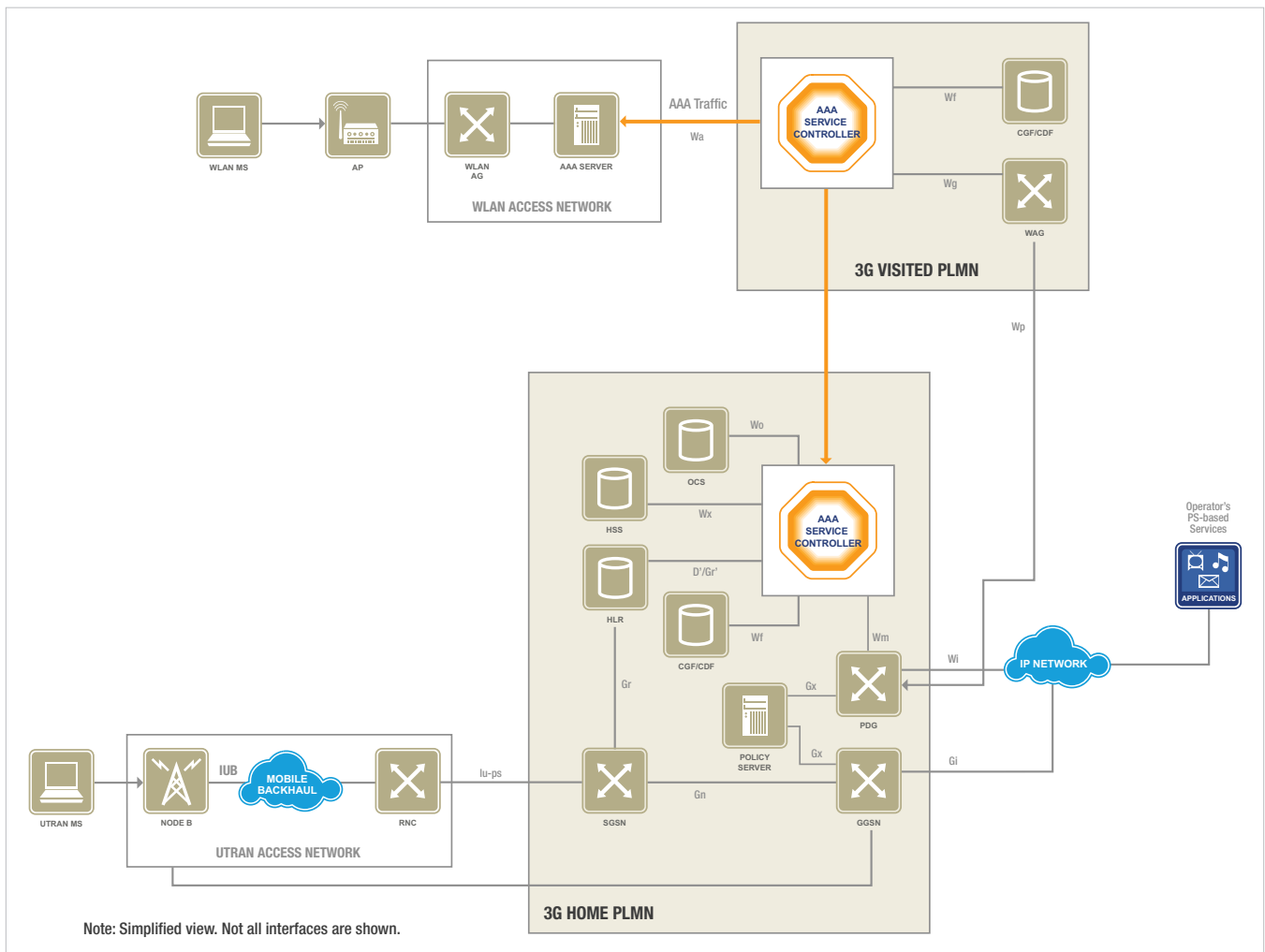


Figure 2: 3G-WLAN Interworking with Roaming; Reference Architecture: 3GPP R7

and any IP-connectivity access networks that support VoIP. It's the most comprehensive converged service approach, working between any cellular technology (GSM, UMTS, and CDMA) and any VoIP-capable wireless access. IMS-VCC provides for the use of a single phone number (or SIP identity) as well as handover between WLAN and cellular.

VCC specifications were developed by the 3GPP to describe how a voice call can be persisted as a mobile phone moves between circuit-switched and packet-switched radio domains. While UMA standards were ratified in 2005, VCC is still in the final stages. VoIP calls from mobile devices are controlled by IP infrastructure via SIP, with calls to and from a cellular phone in the circuit-switched domain also anchored in an IP domain.

SUBSCRIBER DATA MANAGEMENT CHALLENGES IN FMC DEPLOYMENTS

As Service Providers prepare to provide converged fixed and mobile data services to subscribers, they need a strategy that tackles how information about subscribers, their service packages, and their entitlements is stored, updated, accessed, and managed — in real time. The core components for an integration strategy include cross-network and service solutions for mobility, authentication, subscriber administration, and consolidated accounting and billing. These are all areas where existing Service Providers have considerable expertise, particularly cellular, but each player's expertise is limited to the realm of its own network.

Subscriber authentication

Subscriber authentication varies across different access networks, and enabling roaming across several of them can be quite complex. HLR or existing authentication engines may not recognize subscribers if they access applications as they roam from a 2G GSM network, to a local Wi-Fi network, and back to a 3G UMTS network. Without the right authentication, authorization, and accounting (AAA) function that can identify and follow users across heterogeneous networks, Service Providers will be faced with the choice between relinquishing monetization of subscriber activity or negatively affecting the subscriber experience with inconsistent or limited service.

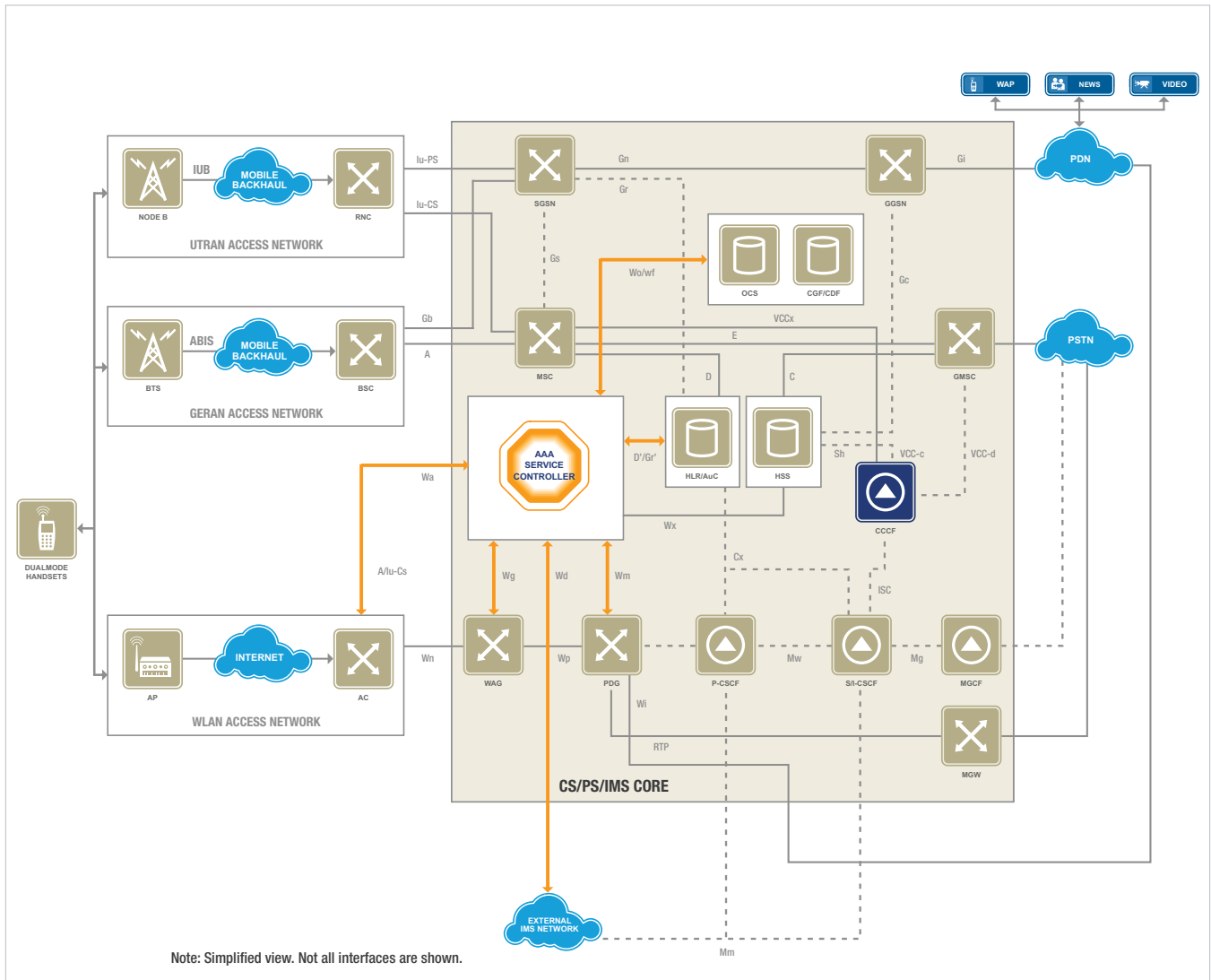


Figure 3: VCC/IMS Reference Architecture: 3GPP R7

Duplicated infrastructure

A danger of multi-access-network architectures is that subscriber authentication database silos may remain separate, negatively affecting cost and management overhead. Non-standards-based or non-modular network elements may force a decision between making do with existing capabilities or attempting a disruptive replacement approach.

Performance issues

The increased performance load on the HLR from data traffic, session information, and support for multiple applications may negatively affect the subscriber experience, promoting the need for fast re-authentication. Service Providers do not want to have to choose between meeting their quality of service (QoS) standards for voice and the success of lucrative new IP-based services: a positive subscriber experience will be a key to retention.

Intra-network compatibility

Many Service Providers already have some form of RADIUS or AAA server for generation of RADIUS accounting messages. So far, it is doubtful whether this can provide the right functionality or performance for WLAN interworking authentication requirements. The risk is that the Service Provider may be unable to sustain FMC services once they are launched.

Charging

Service Providers must also plan how their converged network will interact with those arriving from or going to outside networks. Subscriber session records must be managed, with requirements for correlation, aggregation across multiple network types. There is a risk that an inability to support revenue-sharing models with other Service Providers will result in revenue leakage.

NEXT GENERATION AAA CAPABILITIES TO SUPPORT FMC NETWORKS

As consumer-managed applications become more numerous and sophisticated, the authentication, authorization, and accounting requirements will become increasingly complex and demanding. Enterprise applications will in

turn become much more demanding on networks as mobile enterprise applications, remote network access and management, wireless security, VoIP, guest/client access, and role-based access control (RBAC) all continue to gain ground rapidly.

Compounded with roaming across multiple access networks per Service Provider, handoffs within carrier networks and across different carrier networks, the AAA requirements for any modern network will be phenomenal. The available network will expand to include radio networks, enterprise networks, ISPs, public access hotspots (airports and shopping malls), private hotspots, and home networks.

Service Providers will need to take all of these aspects into account when planning the future of their networks. The HLR, well-known for its carrier-grade characteristics, was never built to handle traffic from data as well as voice, but that's what Service Providers are asking it to do. FMC migrations will require much more sophisticated AAA solutions that can handle tier-1 levels of traffic for data and voice across multiple networks while still remaining complementary with existing HLR infrastructure for cost-effective, evolutionary rollouts. The ideal AAA solution for FMC will enable Service Providers to make extensive use of policy, driving granular decisions regarding what subscribers can do on the network and under which circumstances and what action to take to manage the subscriber experience in real time to drive their business models.

AAA FOR FMC NETWORKS WITH BRIDGEWATER SYSTEMS

Bridgewater Systems 3GPP AAA solution is based on established AAA technology and standards — widely deployed and understood — to provide a modular and evolutionary approach that is easy to implement.

Bridgewater Systems AAA Service Controller enables Service Providers to offer new high-performance mobile voice and data services over wireless IP access networks, facilitating roaming between networks by enabling the use of the same mobile identity across unlicensed wireless networks as well as the mobile cellular network.

FMC IN THE BALANCE

OPPORTUNITIES

Mobile Service Providers

- > Reduced subscriber churn.
- > Improved coverage.
- > Fixed-line replacement.
- > Increased ARPU.

Fixed-Line Service Providers

- > Leveraged assets for access to mobile services (MVNO).
- > One-stop shopping for fixed and cellular.

Mobile/Fixed-Line Service Providers

- > Integrated data/voice/application service offering.
- > Higher ARPU.
- > Single source for fixed and cellular service.

Consumers

- > Lower service prices.
- > Single device for all access needs.
- > Application-aware access for better user experience.
- > Better coverage at home.

Enterprise Users

- > Toll-free calls over enterprise networks.
- > Single number and device for all calls.

CHALLENGES

- > Total cost of ownership
- > Mobility
- > Security
- > Voice/data over WLAN

The AAA Service Controller solution implements all the required 3GPP-AAA server interfaces specified in the 3GPP TS 23.234 to support the UMA/GAN, I-WLAN, and VCC approaches to FMC while remaining access network agnostic.

Key interfaces

- > The D'/Gr' interface allows subscriber information to be passed via the IP network to the HLR/Authentication Center (AuC), bridging RADIUS and IP-based WLAN infrastructures and allowing

THE RIGHT CHOICE FOR AAA FUNCTION WILL MAKE THE DIFFERENCE BETWEEN ALLOWING SERVICE PROVIDERS TO FOCUS ON SOLVING PRESSING BUSINESS AND OPERATIONAL REQUIREMENTS TODAY FOR INCREASED DATA TRAFFIC AND NEW SERVICES AND STRUGGLING WITH THE NEED FOR A COMPLETE REPLACEMENT OR EXPANSION OF EXISTING HLR CAPACITY.

for granular control of subscriber services and supporting authorization according to stored service/privilege profiles.

- > The Wm interface carries authentication and authorization information and allows for the establishment of UE-initiated secure communication tunnels between the UE and a PDG or an UNC security gateway, protecting user traffic and enabling secure access to the Service Provider's core 3GPP IP network for WLAN subscribers.
- > The Wo and Wf interfaces enable the charging for WLAN sessions and allow for the integration of the solution with the Service Provider's online and offline charging systems.

require support of the generic EAP-SIM/AKA based-authentication and authorization for voice and data calls via a MAP/Diameter interface with the HLR/HSS to ensure interoperability and seamless authentication between the cellular and WLAN access networks.

- > EAP-SIM – GSM authentication and key agreement, which provides message integrity protection along with mutual authentication.
- > EAP-AKA – an improved 3GPP authentication and key agreement (AKA) protocol for use in UMTS networks.
- > Next Generation Authentication – support for HLR/AuC interworking to connect PTSN and GSM/UMTS/WCDMA networks via MAP/SS7.

based AAAs unable to support growth beyond 1,000 subscribers.

Granular subscriber management - across multiple network types

A single subscriber data warehouse as a subscriber policy/profile repository that can manage subscribers across multiple networks simultaneously with extensive hierarchical modeling capabilities will allow for maximum interoperability, the launching of new services, and the flexibility to respond to network loads or specialized services. Service Providers will need to drive decisions regarding what subscribers can do on the network in real time, also allowing service creation to accelerate revenue-generation opportunities.

KEY FEATURES OF THE BRIDGEWATER SYSTEMS AAA SOLUTION

Multi-network authentication

AAA solutions deployed in the context of FMC for secure 802.1x WLAN hotspots

Robust performance, proven reliability, and scalability

Service Providers will have to move away from free or default AAA functions as the number of IP network transactions skyrocket. HLRs and legacy RADIUS servers are often unable to scale to support subscriber and high transaction growth – with reports of open source-

Standards-based and access network-agnostic

Choosing a standards-based solution will ensure a smooth evolutionary approach towards IMS and next-generation networks, supporting different handover types and devices. The modular AAA function will need to co-exist with existing infrastructure elements, including BSS, OSS, existing legacy AAA/RADIUS servers, and the HLR. In complex heterogeneous networks as envisioned in FMC, custom development and integration with network elements will result in time-to-market issues and increased management costs with new technologies, to compatibility and performance issues over the long term.

Statefulness

Subscriber state-awareness is not typically supported in legacy AAA solutions and will be a key differentiator in FMC service provisioning. The ability to maintain an integrated state repository and make policy decisions based on state of subscribers will be crucial for subscriber management between IP access and cellular networks in FMC scenarios. The use of subscriber state provides more flexibility to manage the subscriber experience by bringing subscriber context to policy decisions that govern the subscriber interaction with the networks – based on real time or state parameters.

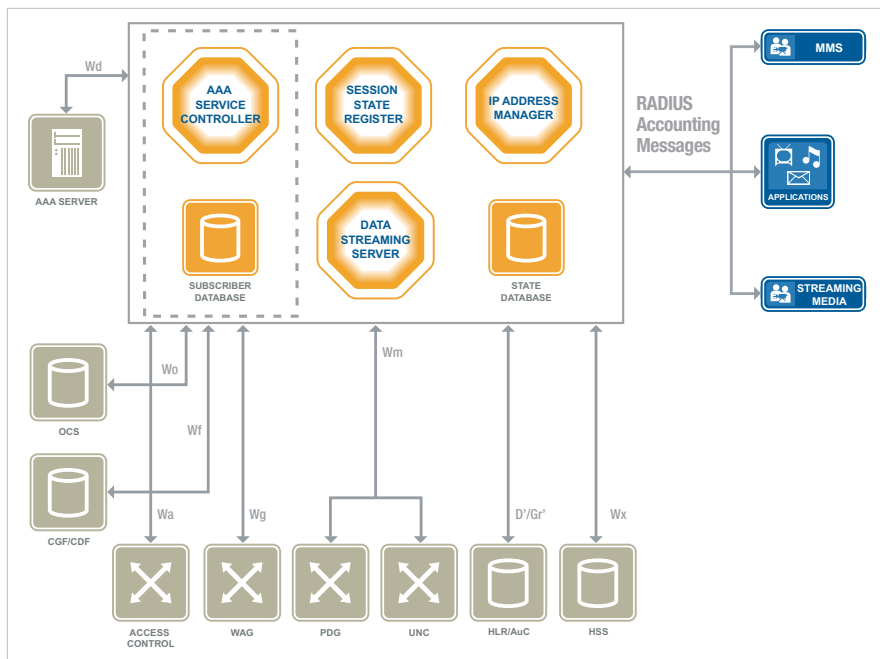


Figure 4: Bridgewater Systems 3GPP AAA Architecture

Handoff between networks

Heterogeneous networks will mean more frequent exchanges between networks. An effective AAA solution will help enable different kinds of networks and subscriber services that may include access to one or more networks.

RADIUS/Diameter accounting

Record generation and intelligent streaming of session records will be required to support common data streaming to applications. The accounting server must also be able to generate multiple accounting record formats simultaneously to applications and other systems to enable more efficient network utilization.

Multi-protocol support – AAA technology has traditionally been primarily RADIUS-based. Bridgewater Systems solutions incorporate native Diameter support, in addition to RADIUS — from the same platform; providing an evolutionary approach to IMS frameworks.

Mobile IP address management

Distributed DHCP IP address assignment at the GGSN level or in access-network silos will quickly become unwieldy as FMC networks evolve and need to include public and private IP addresses, using IPv4 and IPv6. Rapid RADIUS-assigned IP address assignment allows for a AAA rules/policy engine to make intelligent address assignments based on multiple criteria: service level, service packaging, APN, roaming profile, or other subscriber-centric attributes, while keeping up with performance demands. Subscriber awareness across the entire network instead of in divided local areas enables more efficient use of precious IP address resources. Servers that can accomplish this will need not only to be RADIUS based, but also to have native support for DIAMETER.

WHY CHOOSE THE BRIDGEWATER SYSTEMS AAA SOLUTION FOR FMC?

Bridgewater is uniquely positioned to support Service Providers planning the rollout of new IP-based services and WLAN access networks with carrier-grade performance and scalability. Widely deployed and proven in the most demanding tier-1 environments, the

Bridgewater Systems AAA Service Controller is also based on standards-compliant, access network-agnostic technology that will support any FMC initiative.

The Bridgewater Systems AAA Service Controller platform:

- > Is based on 3GPP standards for future-proof multi-network reliability.
- > Offers a broad modular portfolio, including session state, mobile IPAM, and subscriber management across networks.
- > Expands as requirements evolve to support application and network policy control with dependable policy management footprint.
- > Authorizes customers for specific services based on existing HLR/AuC profiles.
- > Reliably handles the busiest networks, backed by Bridgewater Systems' international mobile IP and mobility management pedigree and experience.
- > Integrates seamlessly into existing mobile infrastructure and next-generation IP-based signaling networks.
- > Enables IP-based services without requiring upgrades to existing customer care infrastructure.
- > Extends services into WLAN networks (Wi-Fi, WiMAX, and Bluetooth).
- > Supports multiple access networks: GSM, UMTS, WCDMA, 802.1X, and UMA/GAN/femtocell.
- > Lays a foundation for SIP-based IMS and RADIUS to DIAMETER migration.
- > Offers multi-network authentication – EAP-SIM, EAP-AKA, and HLR/AuC interworking through MAP/SS7 interworking.
- > Supports multi-vendor, multi-network environments – provides a future-proof solution that avoids vendor lock-in, enables easy integration into existing legacy environments, and allows Service Providers the flexibility to implement best-of-breed deployments.

PURE IMS AND THE FUTURE

At one level, FMC and the coming of IMS is very good news, as it represents choice to the customer and also the opportunity for Service Providers to mix and match to achieve the most appropriate blend to meet user requirements. The obvious challenge, though, is how to manage the complexity and flexibility of these new architectures.

Although IMS is a clear way forward, its lack of adoption up to now has been largely a consequence of how potentially disruptive such a network migration would be, and the fact that clear business cases were slow to come to light. Solutions are now available that offer a more gradual path to IMS, allowing for deployment of HSS functionality but without a complete displacement of the existing HLR required in a pure IMS architecture.

The Bridgewater Systems AAA Service Controller is designed to support new industry standards and network types as they are developed, allowing Service Providers to support new business opportunities enabled through network innovations. As Service Providers evolve their businesses to 4G networks and IP multimedia subsystem (IMS) architectures to address new service demands, the AAA Service Controller provides simultaneous support of multiple networks and protocols while leveraging a common subscriber database/profile repository. As a result, Service Providers can accelerate time to market and realize operational efficiencies with a common platform and subscriber repository serving multiple networks.

ABOUT BRIDGEWATER SYSTEMS

Bridgewater Systems develops the industry's most advanced subscriber-centric policy management software for fixed, mobile, and converged networks. Its solutions help global Service Providers launch new services faster and maximize profits by creating a subscriber-centric policy decision point to control and monetize the dynamic subscriber interaction with IP-based services. Vendor-neutral and access-network agnostic, Bridgewater Systems' comprehensive policy management portfolio features network access control products, including authentication, authorization, and accounting (AAA) and dynamic host configuration protocol (DHCP) systems; entitlement control products to manage subscriber access to applications and network resources; and robust subscriber management via a centralized policy and profile repository solution. Bridgewater Systems' proven carrier-class products help Service Providers enrich the subscriber experience and enable extensive revenue capture capabilities and out-of-the-box value that can be deployed in weeks — instead of months.

More than 90 leading Service Providers around the globe, including Verizon Wireless, Sprint, Bell Mobility, and SmarTone-Vodafone, trust Bridgewater's technology and business insight to help them deliver world-class services.

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WWW.BRIDGEWATERSYSTEMS.COM

HEADQUARTERS

303 Terry Fox Drive, Suite 500
Ottawa, Ontario
Canada K2K 3J1
Phone: +1 613 591 6655
Fax: +1 613 591 6656

EUROPEAN OFFICE

324/326 Regent Street, Suite 404
London, United Kingdom
RG2 6UB
Phone: +44 (0) 118 925 3298
Fax: +1 613 591 6656

ASIA PACIFIC OFFICE

04–13 Technopreneur Centre
Block 1003 Bukit Merah Central
Singapore 159836
Phone: +65 6276 3447
Fax: +65 6270 3781

U.S. OFFICE

280 Madison Avenue, Suite 912
New York, NY
United States 10016
Phone: +1 866 652 0471
Fax: +1 613 591 6656