Kineto WIRELESS

How Mobile and Wi-Fi Converge

The Role of UMA in Mobile Network Evolution

UMA • Mobile VoIP • Broadband IMS

How UMA fits with the long-term evolution of mobile core and radio access networks.

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A Kineto White Paper

Kineto Wireless, Inc.
1601 McCarthy Blvd.
Milpitas, CA 95035
Tel: +1 408 546 0660
info@kineto.com

Executive Summary

Amidst the hype of new technologies and industry-altering inventions, Unlicensed Mobile Access (UMA) has made its way to the top of the list among operators looking to deploy fixed-mobile convergence (FMC) services. The technology, which expands the 3GPP mobile network architecture to include new IP access technologies like broadband and Wi-Fi, is a straightforward way to achieve convergence. However, with the technology beginning to see widespread deployment in 2006, mobile and integrated operators are asking how UMA fits with other evolutions happening within the mobile network.

This paper assesses the relationship between UMA and a number of other mobile network evolutions initiatives, i.e. UMTS, Soft MSCs, IP Multimedia Subsystem (IMS) and WLAN Interworking. The conclusion of the paper is that UMA shares significant synergies with these initiatives and plays a valuable role in the overall long-term evolution of mobile networks.

Introduction

During the past year, mobile and integrated fixed/mobile operators announced an increasing number of fixed-mobile convergence initiatives, many of which are materializing in 2006. The majority of these initiatives are focused around UMA, the first standardized technology enabling seamless handover between mobile radio networks and WLANs. Clearly, in one way or another, UMA is a key agenda item for many operators.

Operators are looking at UMA to address the indoor voice market (i.e. accelerate or control fixed-to-mobile substitution) as well as to enhance the performance of mobile services indoors. Furthermore, these operators are looking at UMA as a means to fend off the growing threat from new Voice-over-IP (VoIP) operators.

However, when evaluating a new 3GPP standard like UMA, many operators ask themselves how well it fits with other network evolution initiatives, including:

- UMTS
- Soft MSCs
- IMS Data Services
- I-WLAN
- IMS Telephony

This whitepaper aims to clarify the position of UMA in relation to these other strategic initiatives. For a more comprehensive introduction to the UMA opportunity, refer to "The UMA Opportunity," available on the Kineto web site (www.kineto.com).

Mobile Network Reference Model

To best understand the role UMA plays in mobile network evolution, it is helpful to first introduce a reference model for today's mobile networks. Figure 1 provides a simplified model for the majority of 3GPP-based mobile networks currently in deployment. Based on Release 99, they typically consist of the following:

- GSM/GPRS/EDGE Radio Access Network (GERAN): In mature mobile markets, the GERAN typically provides good cellular coverage throughout an operator's service territory and is optimized for the delivery of high-quality circuit-based voice services. While capable of delivering mobile data (packet) services, GERAN data throughput is typically under 80Kbps and network usage cost is high.

- Circuit Core/Services: The core circuit network provides the services responsible for the vast majority of mobile revenues today. The circuit core consists of legacy Serving and Gateway Mobile Switching Centers (MSCs) providing mainstream mobile telephony services as well as a number of systems supporting the delivery of other circuit-based services including SMS, voice mail and ringtones.

- Packet Core/Services: The core packet network is responsible for providing mobile data services. The packet core consists of GPRS infrastructure (SGSNs and GGSNs) as well as a number of systems supporting the delivery of packet-based services including WAP and MMS.

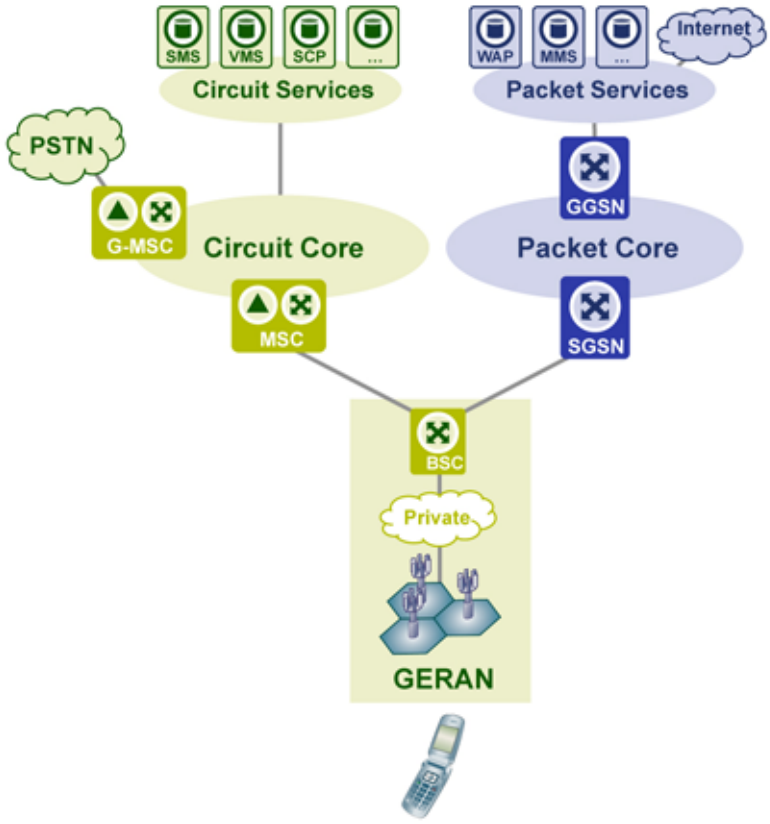

Figure 1. Mobile Network Reference Model

Introducing UMA into Mobile Networks

For mobile and integrated operators, adding UMA to existing networks is not a major undertaking. UMA essentially defines a new radio access network (RAN), the UMA access network. Like GSM/GPRS/EDGE (GERAN) and UMTS (UTRAN) RANs, a UMA access network (UMAN) leverages well-defined, standard interfaces into an operator's existing circuit and packet core networks for service delivery.

However, unlike GSM or UMTS RANs, which utilize expensive private backhaul circuits as well as costly base stations and licensed spectrum for wireless coverage, a UMAN enables operators to leverage their subscribers' existing broadband access connections for backhaul as well as inexpensive WLAN access points and unlicensed spectrum for wireless coverage (Figure 2).

A UMA deployment is comprised of UMA-enabled mobile handsets connected over any IP access connection to a UMA Network Controller (UNC) located in an operator's core network. UMA uses IP tunneling techniques between mobile handsets and a UNC to transparently extend all circuit, packet and IMS-based services over IP access networks.

From a subscriber perspective, UMA enables operators to provide high-performance, low-cost mobile voice and data services in the exact locations they spend most of their time, at home and the office. For mobile operators, UMA enables increased revenues through the acceleration or control of fixed-to-mobile substitution while at the same time addressing the growing threat from new VoIP service providers.

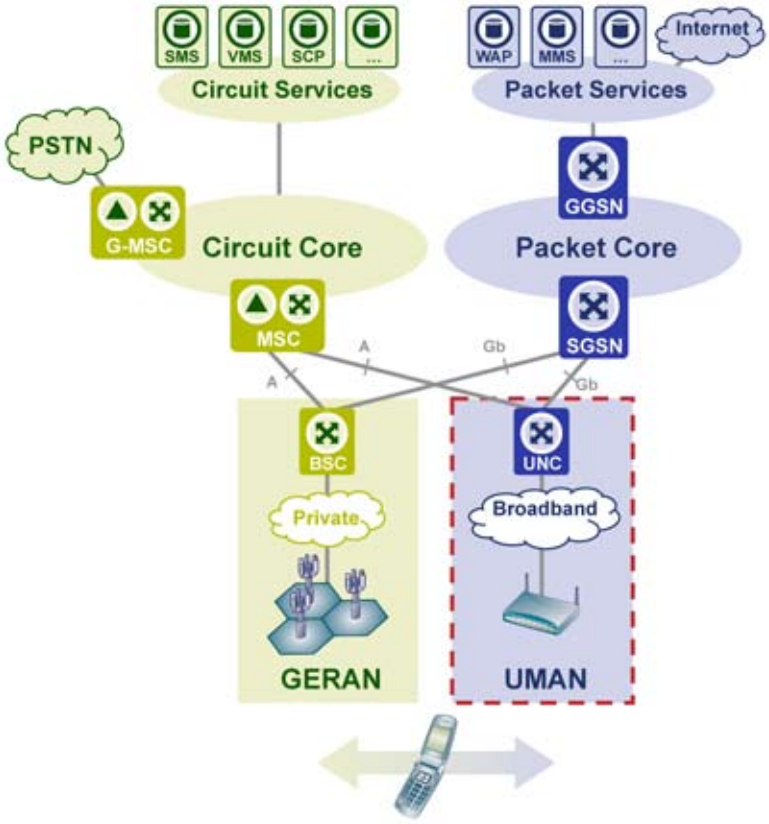

Figure 2. Introducing UMA into a GSM Mobile Network

Defined by major mobile and integrated operators as well as telecom equipment suppliers, UMA provides a number of critical advantages as an FMC technology (Table 1).

UMA Feature	Operator Advantage
Operator Control	With UMA, mobile operators maintain control of services delivered to subscribers when connected via Wi-Fi. Unlike other approaches to FMC which transfer service control to another network/operator, with UMA service traffic and revenue is maintained by the operator.
Full-Service Transparency	UMA ensures that all mobile services available to subscribers over GSM/UMTS networks are also available over UMA. Unlike other FMC approaches which solely provide for a non-seamless voice service between networks, UMA delivers subscribers the entire mobile service experience when on Wi-Fi, including voice, SMS, MMS, Mobile TV, WAP, ringtones, PoC,…
Seamless Handover	UMA provides for full seamless mobility between the mobile and Wi-Fi networks. Unlike other FMC approaches which solely transfer control of a voice call between two different core networks, UMA is the only approach that provides true voice call and data session continuity between networks.
Core Network Investment Protection	UMA interfaces to an existing mobile core network through well defined, standard interfaces. Unlike other FMC approaches which require deployment of an entirely new service core voice network and associated operational support and billing systems, UMA enables operators to leverage existing and future core network investments.
Support for all WLAN locations	UMA was designed to operate in any WLAN environment: the home, office, hotspot, coffee shop, campus, airport or even airplane.

Table 1. Advantages of UMA for FMC for Mobile and Integrated Operators

UMA in Relation to Other Major Evolution Initiatives

UMA Complements UMTS

In recent years, a primary focus within the mobile community has been the implementation and market introduction of UMTS radio access networks (UTRAN) (Figure 3). Many operators have launched a UMTS network as a complement to an existing GSM network, however there are also stand-alone UMTS operators (e.g., Hutchison 3G). While the market drivers behind UMTS deployment are numerous, two primary drivers include the ability to deliver higher-speed mobile data services as well as increasing the voice capacity of macro radio networks.

UMA supports UMTS

As UMA was standardized in 3GPP TSG GERAN, many operators ask themselves how UMA will work in concert with a UMTS network. One key aspect to consider is mobility between UMA/Wi-Fi and UMTS coverage areas. From an overall network perspective, seamless handover between UMA and UMTS networks is supported in the UMA standard today. From the GSM core network's perspective, the UNC is perceived as an additional BSC. Thus, when a call currently handled by the UNC is handed over to the UMTS RNC, the process is the same as for calls being handed over from a GSM BSC to the RNC.

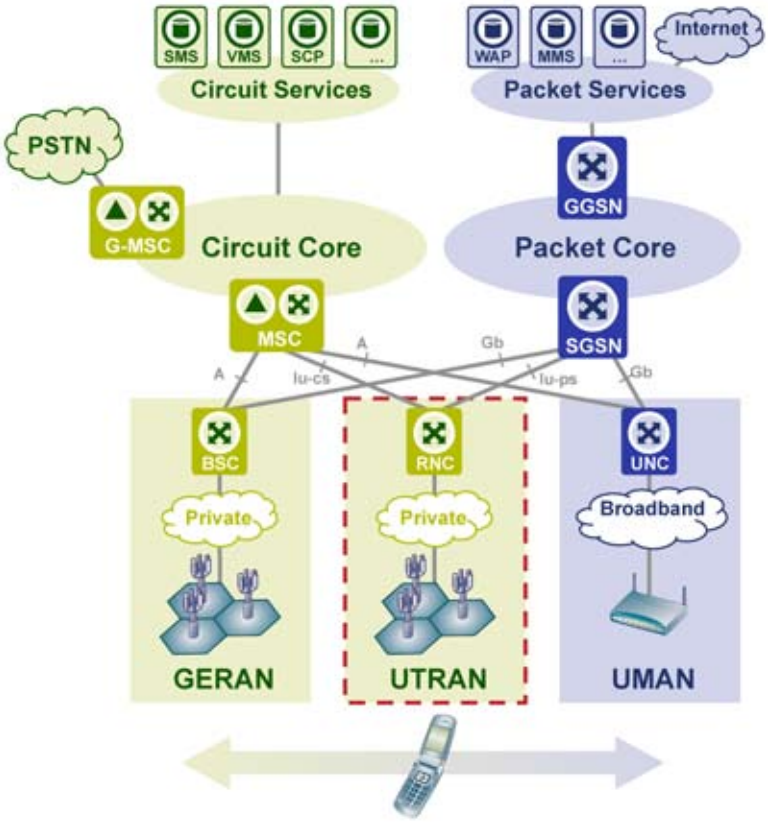

Figure 3. Introducing UMTS into a GSM, UMA Mobile Network

UMA complements UMTS

Due to the radio characteristics of 2 GHz spectrum, UMTS is susceptible to higher signal loss inside buildings, so providing acceptable UMTS coverage for high performance mobile services within subscriber home and offices is a significant challenge for operators. As UMA enables the delivery of high-performance, low-cost mobile services within homes and offices, it provides a very effective complement to UMTS network rollouts. As it leverages broadband access, UMA (like UMTS) is capable of supporting high-performance 3G services. In addition, as it leverages existing in-building Wi-Fi networks, UMA enables operators to address coverage and range issues of their UMTS network rollouts.

UMA Will Support the UMTS Core Network Interfaces

Another question asked by operators is whether there is a need for 3G Iu interface support within the 3GPP UMA standard. As mentioned above, Iu interface support is not required to accommodate handover between UMA and UMTS networks. Moreover, operators with UMTS networks can support 3G services today through UMA using the existing A and Gb interfaces. However, as there are several UMTS-only operators, and operators with combined GSM/UMTS networks are looking to migrate more traffic to their 3G SGSNs and MSCs, it is logical for the UMA standard to evolve (E-UMA) to incorporate Iu interface support. Such a standardization effort is already in process and supported by major mobile operators and vendors (Figure 4).

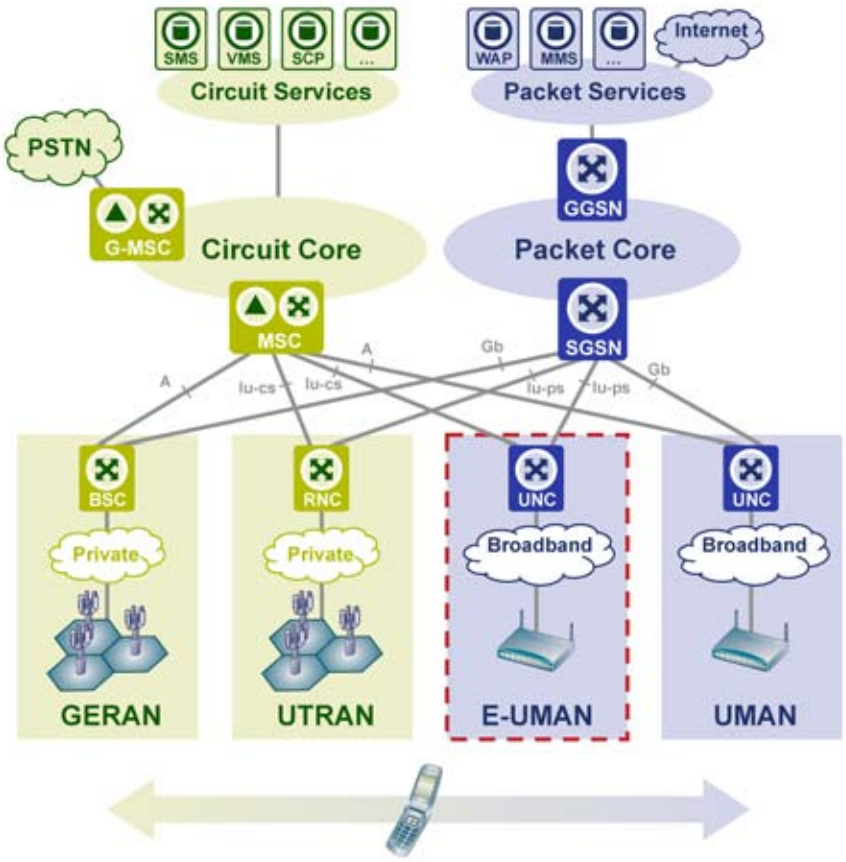

Figure 4. Adding Iu Interface Support to UMA Standard

In conclusion, UMA and UMTS are synergistic technologies, where UMA can provide significant benefits to a UMTS deployment including high-performance in-building coverage.

UMA Benefits from SoftMSC Deployment

SoftMSCs, as defined in the 3GPP Release 4, enable the separation of a classic MSC into an MSC-Server (MSS) to handle call control and a Media Gateway (MGW) to switch user-plane traffic (Figure 4). Several reasons for operators to implement SoftMSCs are transmission capacity savings as well as much lower cost voice-switching capacity. For example, the distribution of Media Gateways to radio network concentration points enables local switching of mobile-to-mobile calls and local breakout to PSTN. This is also a critical step in enabling the transition of today's circuit switched domain to IP-based next-generation networks.

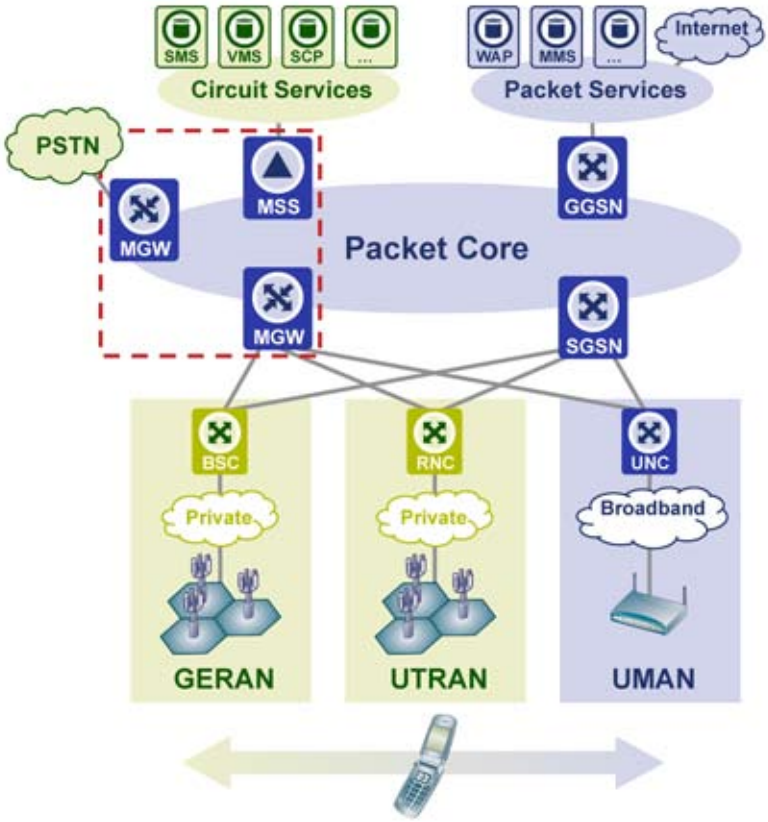

Figure 5. Introducing SoftMSCs into a GSM, UMA and UMTS Mobile Network

Operators considering implementing UMA are interested to understand how UMA will fit together with SoftMSC deployment. As UMA is an access network technology and SoftMSCs are part of the core network architecture, there is no direct impact between the solutions. However, it is expected that UMA deployments will add significant minutes of use into the mobile core network, therefore growing that voice capacity on new SoftMSCs versus the existing MSCs may result in significant capital savings.

In addition, UNC vendors have the option to leverage SoftMSCs to enable the UNC to connect directly to the packet-switched core network without going through an intermediate UMA media gateway. In this case, the voice traffic originated on the handset and carried over to the UNC via IP does not have to be transcoded to a circuit-switched call for transport to the media gateway, where it is transcoded back to IP. This eliminates two transcoding sessions, thus reducing the use of media gateway resources and TDM trunking over the A interface. The potential savings in media gateways and transcoding capacity by deploying UMA in a SoftMSC environment is dramatic.

UMA Enables Handsets to Access IMS Services over Wi-Fi

For mobile operators looking to capitalize on new revenue streams, the IP Multimedia Subsystem (IMS) architecture introduces a new platform upon which to rapidly build and introduce compelling new IP-based multimedia services including Presence, Push-to-Talk over Cellular (PoC), Video Conferencing and Interactive Gaming. By definition, IMS is a service layer technology and is dependant on various packet-based access layer technologies to enable subscriber access to services.

Within mobile networks, that access layer consists of GPRS infrastructure (SGSNs and GGSNs) along with GSM/GPRS/EDGE and/or UMTS radio access networks. As UMA is a packet-based radio access layer technology, like GERAN and UTRAN, it is entirely complementary to IMS (Figure 6).

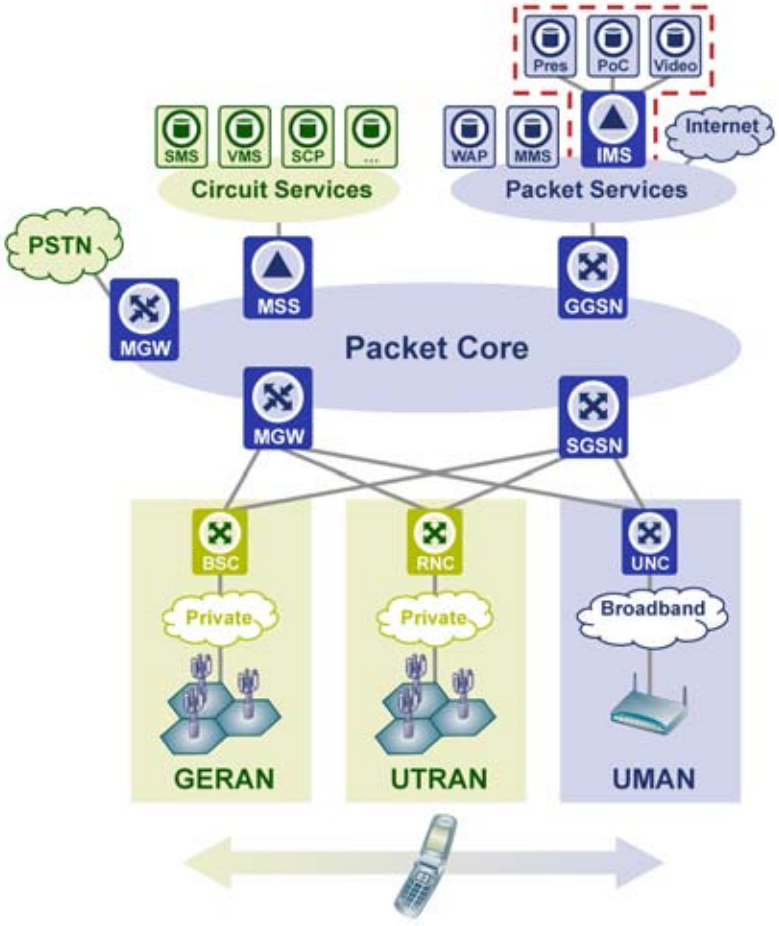

Figure 6. Introducing IMS into a GSM, UMA and UMTS Mobile Network

UMA provides all the needed functions for a mobile operator to provide access to packet/IMS services over broadband IP access networks. With UMA, any IMS service available to a subscriber on the macro cellular network can now be accessed over a broadband IP access connection. UMA enables access to IMS services from any WLAN location and manages the automatic handover of IMS sessions between the cellular network and WLAN, and vice-versa.

I-WLAN and UMA Provide Complementary FMC Services

Interworked-WLAN is a standard initiative within 3GPP with the goal of integrating Wi-Fi networks with the GSM infrastructure. The initiative defines a stepwise approach through six scenarios with increasing complexity. The most basic scenarios focus on reusing the SIM authentication and billing infrastructure for laptops to gain access to public WLAN hotspots. More advanced scenarios include access to the mobile services.

One must look further than the I-WLAN standardization path to understand whether overlaps between UMA and I-WLAN exist. It is Kineto's position that the two technologies are not in conflict, but instead provide complementary FMC services. UMA was developed specifically for use by mobile handsets to enable complete transparency of mobile circuit, packet and IMS-based services between access networks, including handover. I-WLAN, on the other hand, was developed specifically for use by fixed and nomadic devices to enable access to operator packet services when on Wi-Fi. (Figure 7).

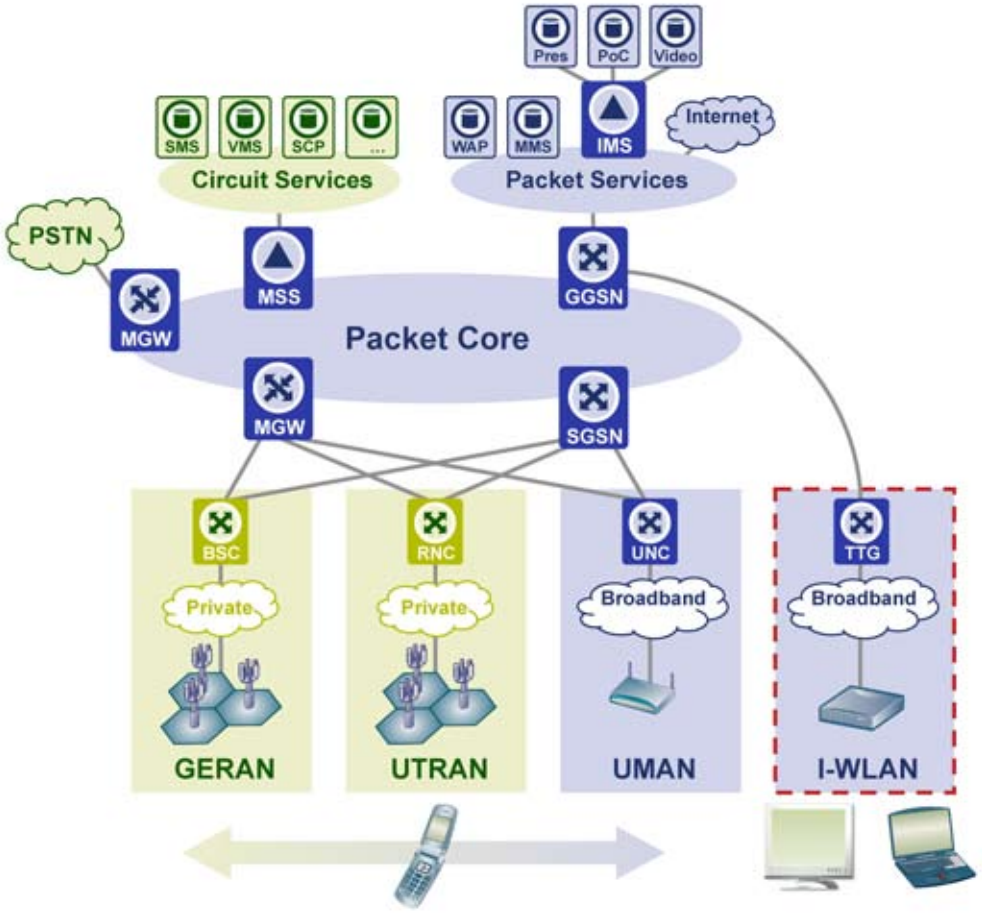

Figure 7. Introducing I-WLAN into a GSM, UMA and UMTS Mobile Network

For example, if an operator were to deploy an IMS-based video conferencing application, UMA would enable an IMS-enabled handset to continue to receive that video conference service as it seamlessly transitions between cellular and Wi-Fi networks. I-WLAN, on the other hand, would enable laptops, PCs and other non-mobiles to now also participate in that video conferencing session, but moving the device outside the range of Wi-Fi would cause the session to end. In summary, from a service access perspective, UMA is for mobile handsets or devices in need of seamless mobility between networks while I-WLAN is for fixed and nomadic devices.

UMA Enables Access and Mobility for IMS Telephony

While mobile operators are not looking to transition their mainstream voice telephony service to an IMS infrastructure in the near to mid-term (based on when it becomes technically and economically feasible to deliver real time VoIP services over the macro cellular network), they realize they will eventually make that transition. As a result, they are interested in the role UMA will play in that eventual transition to IMS Telephony.

As UMA provides seamless mobility for circuit, packet and IMS-based services, the answer is quite simple. UMA enables access to, and mobility of, IMS telephony services between cellular and Wi-Fi networks (Figure 8). The value UMA currently provides continues to be required as telephony services are migrated to the IMS services platform.

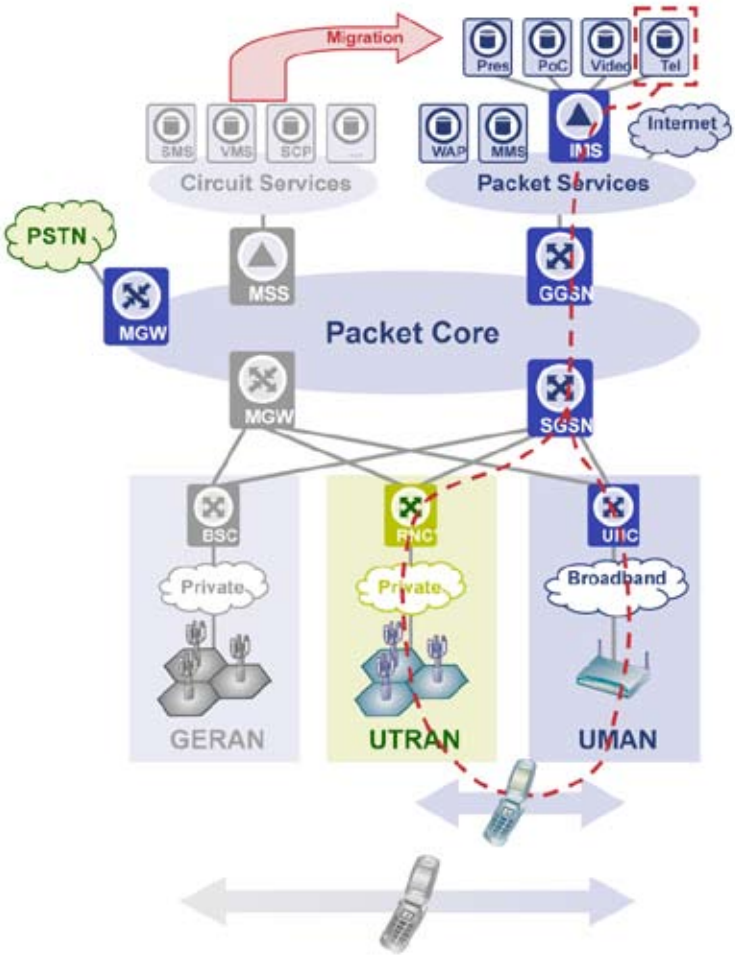

Figure 8. The Role of UMA After the Transition to IMS Telephony

Conclusion

The goal of this paper has been to analyze how the 3GPP UMA standard fits within the long-term evolution of mobile networks. Some have argued UMA to be a short-term solution, potentially to be replaced by future alternatives. With consideration to most major technology steps, this paper illustrates that UMA fits well into 3GPP-based operators' long-term network evolution plans.

We have concluded that the main network evolutionary steps such as SoftMSCs, UMTS and IMS support the UMA evolution well, and vice versa. Interworked-WLAN is also a good complement to UMA for use at public hotspots, although it does not have nearly the breadth of the strategic impact as those mentioned above.

With UMA, Wi-Fi becomes a viable indoor mobile access network solution, and is able to complement a mobile operator's GERAN and UTRAN deployments by providing high-performance, low-cost mobile voice, data and IMS services in places where subscribers spend most of their time.