UMA (Unlicensed Mobile Access): A New Approach towards Mobility

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***Abstract* - The purpose of this document is to describe the fixed-mobile convergence solution using Unlicensed Mobile Access (UMA) technology. This document describes elements for UMA access and convergence solution and the evolution towards the IP based network.**

UMA technology offers an alternative to the cellular radio access network (RAN), which uses the Global System for Mobile Communications (GSM) and General Packet Radio Service/Enhanced Data rates for Global Evolution (GPRS/EDGE) core circuit, data, and IMS services through IP-based broadband connections. To deliver a seamless user experience throughout these various access networks, the UMA specifications define a new network element, the UMA Network Controller (UNC), together with associated protocols for the secure transport of GSM and GPRS/EDGE, signalling, and bearer traffic over IP.

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I. INTRODUCTION

UMA is a technology to provide access to GSM and GPRS mobile services over unlicensed spectrum technologies, including Bluetooth and 802.11. By deploying UMA technology, service providers can enable subscribers to roam and handover between GSM/EDGE radio network and public/private unlicensed wireless networks using dual-mode mobile handsets. Subscribers receive a consistent user experience for their mobile voice and data services as they transition between networks.

A. Challenges: Introduction to Unlicensed Mobile Access (UMA)

Evolution of telecom network from early analogue networks to digital circuit switched network has already taken place. The next major trend in network evolution will be the change from circuit switched networks with centralized control towards packet switched next generation network with distributed control separated from media connectivity is UMA.

The change to next generation networks (NGN) will be evolutionary, using network elements from the legacy network and gradually introducing new network elements that deliver new and converged services. The next generation packet voice networks will serve multiple end user terminal types, legacy terminal as well as advanced terminals supporting both voice and data applications.

A phased approach will spread the investment over different technology and service cycles. In addition, more reliability in the network during the transition period and continuous delivery of service quality, with gradual integration of new services into a single IP platform, allows the formation of truly converged applications.

Unlicensed Mobile Access technology enables intermediate solutions on the way towards ultimate packet switched next generation network. UMA utilizes unlicensed radio technologies, broadband access to customer premises and current 2G/GSM circuit and packet switched core network capabilities in order to realize Voice over IP (VoIP) and packet based services solutions. Integration of UMA technology with bearer independent circuit switched core network – i.e. MSC Server system – provides the operator with machinery that combines globally widely deployed GSM voice and messaging services as well as with cost efficient transmission techniques. UMA will provides an access to GPRS core and therefore it can be used as one access method to IMS based services too.

Finally after the evolutionary period, the operator network will have migrated to a full service network, aiming at lower operational costs and enhanced service delivery. Multiple converged services to all end users mean higher revenue potential. UMA's vision of the NGN spans both fixed and mobile networks.

II. ADVANTAGES OF UNLICENSED MOBILE ACCESS (UMA)

A. Indoor coverage with capability to hand-overs to macro network for places where building coverage is not feasible with macro/micro BTS's

B. Basis for differentiated charging to subscribers by leveraging unlicensed radio access

C. MVNO's, ISP's and fixed operators entry to mobile business

D. High speed packet access with handovers to macro network over the UMA's Gb interface

E. Dual transfer mode service at hotspots

III. UMA TECHNOLOGY

Unlicensed Mobile Access (UMA) technology enables access to GSM and GPRS mobile services over unlicensed spectrum, including Bluetooth and WiFi. Highlights of UMA Technology:

A. Seamless delivery of mobile voice and data services over unlicensed wireless networks.
B. Provides the same mobile identity on Cellular RAN and unlicensed wireless networks.
C. Seamless transitions (roaming and handover) between Cellular RAN and unlicensed wireless networks.
D. Preserves investment in existing/future mobile core network infrastructure
E. Independent of underlying unlicensed spectrum technology (e.g. WiFi™, Bluetooth™)
F. Transparent to existing, standard CPE devices (e.g. access points, routers and modems)
G. Utilizes standard "always on" broadband IP access networks (e.g. DSL, Cable, T1/E1, Broadband Wireless, FTTH…)
H. Security equivalent to current GSM mobile networks
I. No impact to operations of Cellular RAN (e.g. spectrum engineering, cell planning,…)

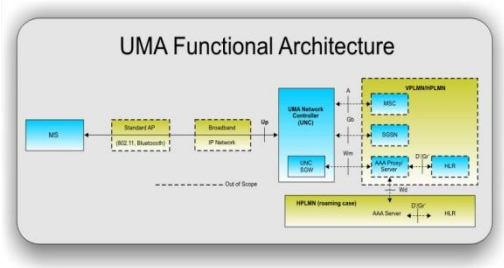

Fig 1. UMA Technology Operation

UMA technology provides alternative access to GSM and GPRS core network services via IP-based broadband connections. In order to deliver a seamless user experience, the specifications define a new network element (the UMA Network Controller, UNC) and associated protocols that provide for the secure transport of GSM/GPRS signalling and user plane traffic over IP. The UNC interfaces into the core network via existing 3GPP specified A/Gb interfaces.

IV. NEXT GENERATION NETWORKS: A NEW VISION OF NETWORKING

Fixed Network is converging to a broadband network

A. Mobile Terminals are being widely adopted instead of fixed terminals

B. Multiple Radio Access technologies will coexist in networks and terminals

C. Mobile Services will be provided from the new converged networks

D. From circuit-switched networks with centralized control to packet-switched networks with decentralized control

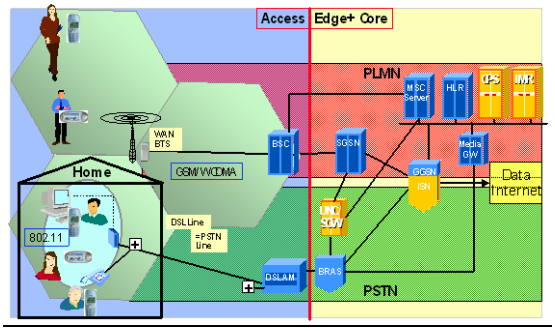

Fig. 2 New Converged Network Current Separate Networks

V. SPECIFICATIONS

In order to promote the widespread adoption of UMA technology, a number of leading companies within the wireless industry will have to jointly developed a set of open specifications. These specifications should be made available through the Web site, and may be used by vendors and carriers of wireless communications systems and applications to develop and deploy interoperable solutions.In addition to developing and maintaining the initial specifications, the participating companies are actively working with the 3GPP standards organization to use the specifications as the basis for the development of a formal standard.

VI. WORKING

Unlicensed Mobile Access (UMA) technology provides access to GSM and GPRS mobile services over unlicensed spectrum technologies, *including Bluetooth and 802.11*. By deploying UMA technology, service providers can enable subscribers to roam and handover between cellular networks and public and private unlicensed wireless networks using dual-mode mobile handsets. With UMA, subscribers receive a consistent user experience for their mobile voice and data services as they transition between networks.

a. A mobile subscriber with a UMA-enabled, dual-mode handset moves within range of an unlicensed wireless network to which the handset is allowed to connect.
b. Upon connecting, the handset contacts the UMA Network Controller (UNC) over the broadband IP access network to be authenticated and authorized to access GSM voice and GPRS data services via the unlicensed wireless network.
c. If approved, the subscriber's current location information stored in the core network is updated, and from that point on all mobile voice and data traffic is routed to the handset via the Unlicensed Mobile Access Network (UMAN) rather than the cellular radio access network (RAN).
d. *ROAMING*: When a UMA-enabled subscriber moves outside the range of an unlicensed wireless network to which they are connected, the UNC and handset facilitate roaming back to the licensed outdoor network. This roaming process is completely transparent to the subscriber.
e. *HANDOVER*: If a subscriber is on an active GSM voice call or GPRS data session when they come within range (or out of range) of an unlicensed wireless network, that voice call or data session can automatically handover between access networks with no discernable service interruption. Handovers are completely transparent to the subscriber.

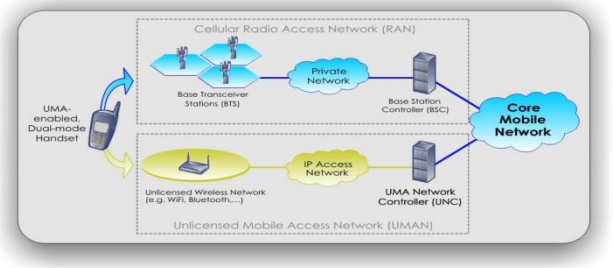

Fig 3 Working of UMA

VI. INTERFACES IN THE UMA SYSTEM

Two new interfaces which can be standardized for UMA. These are:

A. Up - Connecting the MS to the UNC for user data and signalling for the CS and PS

B. Up CS UP – Connecting the UNC to the CS network for user data

All of the other interfaces are not UMA-specific, although they may have incorporated some extensions for UMA. These are the following:

A. A+ - Used for CS Core network signalling

B. Gb – Used for PS core network signalling and user data

C. Wm – Used in authentication between SGW and AS

D. D'/Gr' – Used in authentication between AS and HLR/HSS

VII. PROTOCOLS IN THE UMA SYSTEM

In the UMA system, only two protocols have been standardized specifically for the purpose of providing UMA access to the mobile network.

UMA Radio Resource protocol (Generic Access – Resource Control and Generic Access Circuit Switched Resources)

UMA Radio Link Control protocol (Generic Access – Packet Switched Resources

These help in :

GSM Services supporting abilities by UMA.

CS Telephony

CS Supplementary Services

CS Emergency call

Short Message Service (SMS)

General Packet Radio Service (GPRS)

Location Services (LCS)

Multimedia Messaging Service (MMS)

UMA provides an access to GPRS core and therefore it can be used as one access method to IMS based services too. Depending on terminal implementations IMS services can be used to enrich CS voice which provides potential for increasing revenue from longer calls when additional value added services are used simultaneously. UMA network enables simultaneous CS and PS services. Service continuity between UMA and GSM may involve some limitation due to lower bandwidth in GSM GPRS, and potentially limiting active service being CS voice call in case dual transfer mode is not supported in GSM access. In terminal side, convergence can be implemented at least in the following elements:

Multi-radio Mobile Terminal: This type of future device is capable of being connected both on cellular networks, as well as on local WLAN type networks. This means that the operator can move part of the traffic to local area networks, e.g. in homes and in public hot spots.

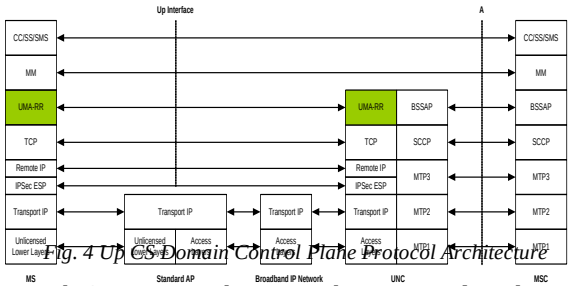

Fig. 4 Up CS Domain Control Plane Protocol Architecture

Personal Computer: These can be equipped with WLAN cards, WAN mobile cards (GPRS/EDGE/WCDMA) etc, and thus be semi-mobile. A special software (Client) is typically needed to be interoperable with the operator services e.g. SIP Client to implement real time services using CPS.

Legacy POTS terminals via IAD and D500 access node.

VIII. CONCLUSION: UMAAUTHENTICATION PROCEDURE

The UMA solution designing should kept in mind providing mechanisms for automatic roaming between the GSM and UMA systems.

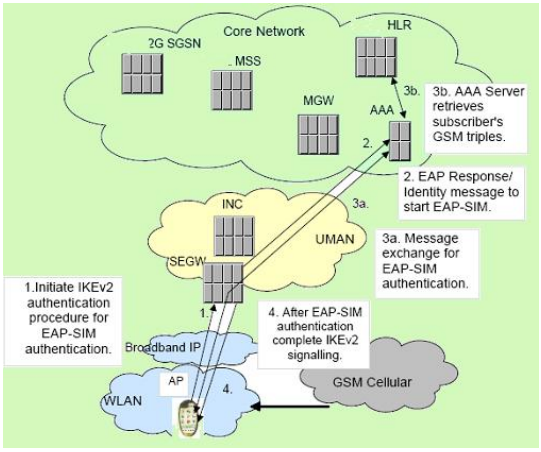

Fig. 5 UMA Authentication Procedure

A. Roaming from GSM to UMA consists of two elementary procedures: UMA Authentication, and UMA Discovery and Registration. Roaming from UMA to GSM is basically a UMA De-Registration procedure

B. 1 The MS attempts to roam into1.) the UMA access and joins a WLAN access point. As a first step of roaming to UMA, the MS needs to initiate the IKEv2 authentication procedure for EAP-SIM authentication.

C. The SEGW sends an EAP Response/Identity message to the AAA Server, which in turn triggers the starting of EAP-SIM authentication.

D. First, mutual EAP-SIM authentication procedure messages are exchanged between the AAA Server and the MS, where the SEGW relays the messages. Second, within the EAP-SIM procedure the AAA Server may need to retrieve the subscriber's GSM authentication data from the HLR, unless this information is cached from earlier EAP-SIM authentications.

After successful EAP-SIM message exchange, the SEGW and the MS complete the IKEv2 signalling. The Extensible Authentication Protocol (EAP) is used to perform SIM authentication of WLAN subscribers to the network. The IEEE 802.1x standard utilizes the EAP protocol for general authentication. The EAP supports multiple authentication mechanisms and handling of new authentication mechanisms as extension EAP types or EAP methods one of which is the EAP SIM.

IX. SUMMARY

An Open test specification is under development that can be used to facilitate interoperablility testing between implementations. The test specifications will be available through web site.Companies planning to implement products based on the UMA specifications should seek bilateral compliancy testing agreements directly with other vendors.

In principle, the UMA specifications ensure interoperability similar to any other industry specifications, but the specifications may include options and parameters that have to be agreed bilaterally with other vendors. The UMA participating companies do not guarantee interoperability and the specifications may be upgraded without notice.

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