WHITE PAPER

LTE Inter-technology Mobility

Enabling Mobility Between LTE and Other Access Technologies

Abstract

This paper discusses inter-technology mobility functionality being defined for emerging broadband wireless technologies and explains how this new functionality will add value to operator's networks. It explains the difference between various types of inter-technology mobility and then explores how LTE exploits inter-technology mobility to support a variety of access technologies including 3GPP legacy technologies as well as EVDO, WiFi and WiMAX. This paper also provides examples illustrating how to use inter-technology mobility to enhance existing services and provide new ones.

Introduction

The Internet revolution and the wide availability of broadband access are creating a tremendous new appetite for mobile data services. Subscribers want the same Internet experience that they have at home, anytime, anywhere. Existing wireless access technologies such as HSPA and EVDO go part of the way in meeting this need; but spectral efficiency, cell-edge performance and high latency prevent them from providing the bandwidth, capacity and QoS to enable a true broadband service that is reasonably priced for subscribers and profitable for operators. The overall telecommunications market continues to grow at a measured pace, but mobile data revenue (excluding SMS revenue) is reported to have grown by ~25 % during 2006 and is generally projected to continue on a rapid growth path. While the data revenue is seeing a steady growth the data usage on current 3.5G network is exploding with reports of 6-25x growth year on year, fuelled by flat rate tariffs, better devices and USB dongles providing connection to laptops. In response to these dynamics, the wireless industry is anticipated to shift toward LTE and WiMAX technologies (as Figure 1 illustrates) to be able to support cost effectively the capacity required for operators to accommodate mass market adoption of mobile data services.

[1] Based on calculation made from Informa Telecom, 2007 figures

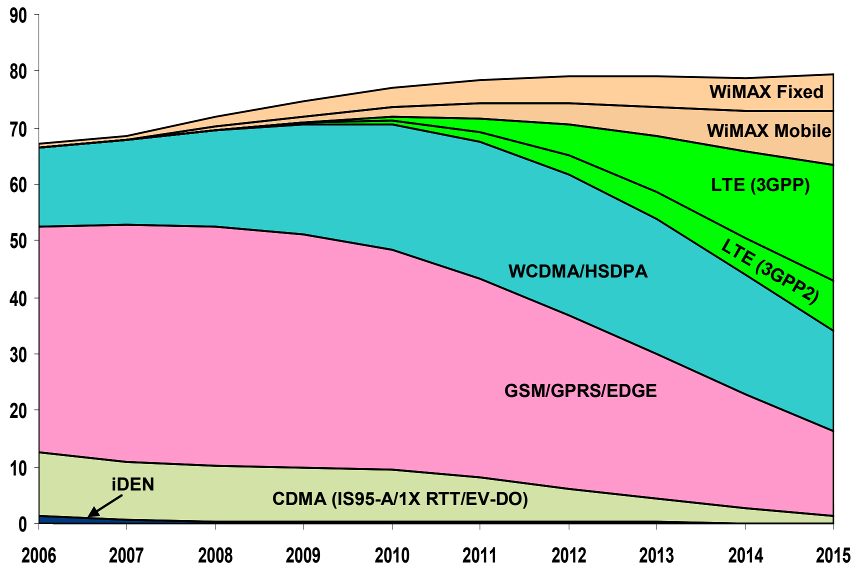

Figure 1. Wireless Market TAM Forecast

Operators need strategies for incorporating new services that take advantage of the speed and affordability provided by new access technologies. A fundamental component of this strategy should be to capitalize on the unique advantages that mobility can bring to a user's broadband experience. For LTE in particular, inter-technology mobility will be a key component of any strategy for new services to market. Inter-technology mobility provides the ability to tie together disparate radio access network assets, based on different access technologies, into a single integrated bandwidth delivery vehicle. Just as importantly, inter-technology mobility can also simplify LTE deployments and should be a key element of the deployment and rollout strategy for any new LTE network.

This paper looks potential approaches to inter-technology mobility that are becoming available and then discusses how these approaches can be used to solve operator problems in service deployment, access technology integration and smooth migration to LTE by maximizing the use of legacy networks coverage.

What is Inter-Technology Mobility and How Does It Work.

Simply put, inter-technology mobility is the ability to support movement of a device between differing radio access network types. There are many variations of this definition. In particular, the LTE standards body, 3GPP, defines two: Inter-RAT (Radio Access Technology) mobility, which refers to mobility between LTE and earlier 3GPP technologies and Inter-Technology mobility which refers to mobility between LTE and non-3GPP technologies. For the discussions in this paper, the general term inter-technology mobility should be assumed to include both 3GPP variants.

Inter-technology mobility can be supported in a variety of ways. The most basic form of inter-technology mobility can be provided by a multi-technology device without any inter-technology support from the operator's network(s). In this case, the user or the device selects which technology to use and initiates access to that technology. If the selected technology becomes unavailable, the user or device must select another technology, initiate access to it and re-establish communications with the applications that were in use. This primitive form of inter-technology mobility can be marginally acceptable for some applications (e.g. email and web browsing) and works for nomadic users. For other session-based applications (e.g., web-based financial transactions and VPN access), it seriously degrades the user experience since it typically results in loss of intermediate application results and requires users to re-authenticate themselves with the applications.

For high bandwidth applications such as video on demand or video streaming and for applications with stringent QoS requirements, this basic inter-technology capability is completely unacceptable. For example when using this simple form of inter-technology mobility, a streaming video application would require the user to reinitiate the stream from the beginning whenever the boundary between two access technologies is crossed. Or for a video telephony application, video calls would be dropped whenever a boundary between access networks is crossed and would have to be reinitiated in the new access network.

A much more useful form of inter-technology mobility supports data session continuity across multiple technologies. With data session continuity, users are able to maintain their application sessions as they move between different access technologies. Unlike the primitive form of inter-technology mobility described above, no user actions are required to support the change in access technology. In general, applications are unaware that an access network change has occurred when data session continuity is supported and thus there is no impact on the user's log-on status or other applications data.

The IETF (Internet Engineering Task Force) Mobile IP (MIP) protocol, which was defined over five years ago, was intended to address the data session continuity issue. Unfortunately it functions completely at the IP level and has no way to address the time required for authentication and log-in when moving into a new access network. These functions can require a considerable amount of time (on the order of several seconds). Without some form of mitigation this will cause severe disruption of many applications and thus significantly degrading the user experience.

Four general approaches to providing inter-technology mobility with session continuity are described below and summarized in Table 1.

Single Transmit Device – MIP-based

This is simple MIP-based mobility using a device that is only capable of communicating in one technology at a time. Two examples of this approach are the single transmitter versions of the non-optimized inter-technology handover procedure defined in the 3GPP standards for inter-technology mobility between WiMAX and LTE and between EVDO and LTE. Since the device can only communicate with one technology, it must break its connection with the source network before it can establish a connection with the target. Depending on the technology, the signaling associated with getting access to and authenticating on the target network can be quite time consuming (on the order of several seconds) and cause a significant gap in the user's session.

Access Network Interconnect

Access Network Interconnect, requires the source and target access networks to be intimately connected in some way so that they can exchange control messages to help guide the movement of the device from one access technology to the other and to reduce the time that device is unavailable on either network. Historically this approach has been available for different generations of the same root technology such as cdma2000 and EVDO or UMTS and GSM, and this approach is being carried forward to provide mobility between LTE and GSM or UMTS. In all these cases the old and new technologies were controlled by the same standardization body, and the interworking can be just as easily viewed as a backwards compatibility requirement as an inter-technology mobility requirement. With the introduction of LTE however, the limitation of access network interconnection to technologies covered by the same standards body is changing. With the help of its member organizations, the LTE standards body, 3GPP, is working closely with the EVDO standards body, 3GPP2, to define inter-technology handover procedures that include mechanisms for interconnecting the LTE and EVDO RANs. Handover mechanisms that include exchange of information between the source and target RANs are generally referred to as optimized handover in the LTE standards. Optimized handover will support low-delay inter-technology handovers that can support demanding applications such as VoIP and video streaming. Currently LTE-EVDO optimized handover has made the most progress in the standards process, but optimized handover between LTE and WiMAX is also under investigation.

Dual-Transmit Devices – MIP based

For environments where the level of inter-standards cooperation is less pronounced or where there is an urgent need to get inter-technology mobility deployed quickly, the Dual-Transmit Device (DTD) approach is attractive. In this approach the device does a true make-before-break handover to prevent data loss or the need for retransmission. The device uses its second transmitter to register and authenticate on the target network while maintaining its existing data session on the source network. Once the preliminary work is completed, and the device is ready to receive data on the new network, it uses a supported Internet protocol such as Mobile IP to move the data stream from the source to the destination network. The LTE standards accommodate the use of MIP in combination with DTDs to support efficient inter-technology mobility between LTE and WiFi. The WiMAX Forum is also standardizing the use of DTDs with MIP with the primary goal of supplying mobility between EVDO and WiMAX.

Approach	Description	Primary Applicability	Major Strength	Major Weakness
Single Transmit Device: MIP-Based (3GPP Non-Optimized HO)	Break-before-make HO. Access networks are not interconnected and devices only transmit on one technology at a time	Between access technologies with limited standards coordination	Least complex to implement. Provides network controlled HO	Unsuitable for real-time and other applications that are intolerant of significant interruptions (i.e. several seconds)
Access Network Interconnect: Single or dual transmit device (3GPP Optimized HO)	Access networks are interconnected and support exchange of control messages. HO is break-before-make, but can still be very fast	Between access technologies controlled by one stds body or multiple stds bodies that agree on a common interface approach	Supports any type of device (single-transmit, hybrid or dual-transmit) Provides network controlled HO	Requires extensive standards work and in many cases modification of deployed access equipment. Requires complex HO processing logic in the mobile including inter-stack communications
Dual Transmit Device: MIP Based (3GPP Non-Optimized HO)	Device supports make-before-break HO between technologies and uses MIP to move bearer stream	Between access technologies lacking standards coordination	Impact on existing access networks is minimized, enabling quick deployment	Dual transmit devices have expense, power usage and interference issues. Requires substantial coverage overlap of access networks for seamless HO
Dual Transmit Device: SIP Based	Device supports make-before-break HO between technologies and uses SIP to move bearer stream	FMC and other applications where MIP unavailable or where inter-device mobility is also required	Supports movement of sessions between devices as well as between access networks	Dual transmit devices have expense, power usage and interference issues. Requires substantial coverage overlap of access networks for seamless HO. Only supports SIP-based applications and is not fully standardized

Table 1. Approaches for Inter-Technology Mobility with Session Continuity

Dual Transmit Device – SIP based

Due to a variety of practical, technical and business factors, MIP can be difficult to implement in some environments leading to the fourth approach of DTDs coupled with the Session Initiation Protocol. SIP can often be used in conjunction with dual-transmit devices instead of MIP. Additionally, SIP is the only choice if there is a need to move data sessions between devices as well as between technologies – e.g. a requirement to move a video session from a plasma screen supported by a set-top box connected to a DSL link to an LTE mobile device. An obvious drawback to this approach is that it is only applicable for those applications based on SIP. Also it will not work for any application that is sensitive to a change in a correspondent's IP address (e.g. many applications based on TCP). Some additional standardization effort is needed to support inter-device and inter-technology mobility with SIP and IMS. The complete set of standards is slated to be completed in 3GPP Release 9, which is projected to be finished by the end of 2009.

Using Inter-technology Mobility to Support Legacy Services and to Simplify Network Rollout

A fundamental user requirement for LTE deployments is that users expect the new network to provide not only exciting new services but also to support all the services from the legacy network. Also operators want to leverage their existing coverage and existing investments in applications and services to support their broadband subscribers. Inter-technology mobility is an important tool for meeting these needs.

From a standards perspective, the assumed solution for voice service over LTE has been IMS-based VoIP. Because LTE is a packet data network and VoIP is the preferred solution for supporting voice on packet networks, IMS-based VoIP appeared to be a very reasonable approach. However as LTE has begun to move from advanced technology trials to a commercial reality, other considerations have come into play; and many operators are now thinking differently about voice services.

Early adopters are concerned that several key capabilities required for commercial voice services are not fully standardized for LTE in 3GPP Release 8 (e.g. emergency service support) and that IMS may not be ready for full-scale deployment in large mobile networks. In addition, many operators have adequate 2G capacity for voice and are planning to use that for their voice services for the foreseeable future. And other operators are planning to deploy or have recently deployed softswitches and other "modernized" 2G network elements. These operators want to accrue the OPEX benefits of this investment and to leverage it into their LTE networks rather than investing in a new voice infrastructure.

Inter-technology mobility also aids in the introduction of new services. Using inter-technology mobility, a new service can be rolled out network-wide even though the wireless broadband access technology that best and most efficiently supports it has only been deployed in the highest traffic areas. Inter-technology mobility provides a bridge between the old and new access networks enabling seamless service continuity over a wide area.

The remainder of this section examines three scenarios that illustrate how an operator could use inter-technology mobility to provide service continuity and support legacy services.

Scenario 1:

Rollout of a basic data services LTE network along-side/over an existing HSPA network

Consider an operator who has a deployed an HSPA network and is beginning the process of upgrading this network with LTE. Now assume this operator has determined that the LTE's 250% improvement in spectral efficiency over HSPA is an important factor in building a viable business case for a new suite of mobile video streaming services. The operator's market research has determined that subscribers are receptive to the new mobile video service but quickly become disillusioned with it if it is not available wherever they are and whenever they want it or if it performs poorly. If the new service could only be available over LTE, the operator would have to wait until the entire network has been upgraded before the video streaming service could be rolled out. On the other hand if the service is just provided on HSPA, capacity restrictions would often make it unavailable or cause it to perform unacceptably in the busiest parts of the network. However using inter-technology mobility the operator can rollout the service and begin generating revenue with it as soon as the network hotspots have been upgraded to LTE. Subscribers can access the service throughout the operator's coverage area. In low usage areas, the limited capacity of HSPA for video streaming should not hamper the performance of the service in the way that it would in high usage areas. In high usage areas, the enhanced bandwidth of LTE would allow a much larger number of subscribers to access the service and/or a higher quality video stream to be used. Inter- technology mobility allows users of the service to move between these areas seamlessly, without even noticing that a change in access technology is taking place. In short, inter-technology mobility provides operators with a powerful tool for matching the network resources they have with the needs of their applications.

[2]The 250% improvement in spectral efficiency is based on internal Motorola simulation results. Spectral efficiency of 1.70 to 1.81 bps/Hz for LTE vs. 0.658-0.683 bps/Hz for HSDPA (4x2 CL SU-MIMO with precoding and MMSE with SIC receiver for LTE. Similar channel conditions assumed for LTE and HSDPA)

Scenario 2:

Rollout of a full service LTE network over a legacy GSM/UMTS/HSPA network with voice support remaining on the legacy network.

In this scenario, the operator intends to roll out LTE as a full voice and data service offering. The legacy network has sufficient capacity to support voice services for all the operator's subscribers, and the operator wants to leverage this asset to provide voice service along side LTE. For this operator, inter-technology mobility in the form of Circuit Switched Fallback (CS Fallback) offers an attractive solution.

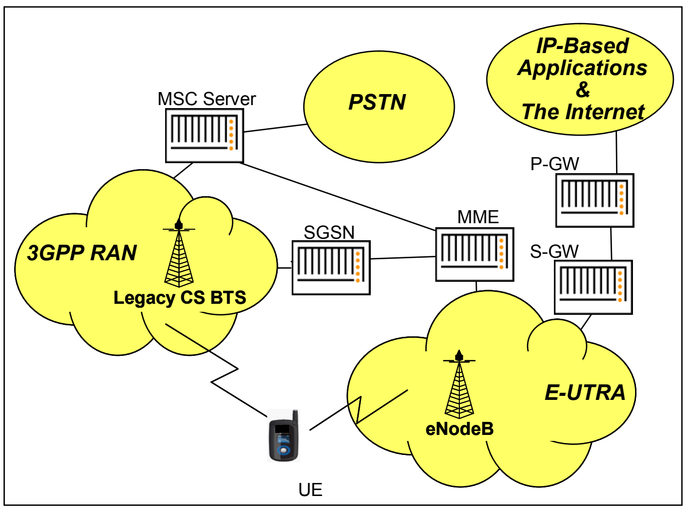

Figure 2. CS Fallback Architecture for 3GPP CS networks

CS Fallback defines a mechanism for using a circuit switched network to provide voice services along side of an LTE network. Using the inter-technology mobility capabilities of LTE, CS Fallback allows subscribers to transition to a legacy circuit network to receive voice services and then return to LTE when finished.

Figure 2 illustrates the architecture for CS Fallback to a legacy 3GPP network. When a subscriber wishes to make a voice call, the UE makes a service request to the LTE network, which coordinates with the legacy 3GPP network to redirect the UE to the legacy CS network. If the legacy network supports concurrent circuit and packet services, the subscriber's packet session is also handed over; if not, the session is suspended until the subscriber returns. For mobile terminated calls, the subscriber is paged in the LTE network and is only moved to the legacy CS network if the subscriber decides to accept the call. Similarly, the subscriber can send and receive SMS messages without leaving the LTE network.

Operators who initially roll out their LTE networks using CS fallback for voice services have the option to migrate to native LTE VoIP services at a future date. An operator choosing to follow this approach could rely on CS Fallback for voice services until its LTE network provided full coverage, then migrate subscribers from circuit switched voice to VoIP at a pace that is consistent with business requirements & service offering. CS Fallback is designed for coexistence with VoIP-based voice services, so if migration to VoIP is started before LTE coverage is ubiquitous, the circuit-packet interworking solution described in the next scenario could be used to work around coverage gaps.

Scenario 3:
Rollout of LTE over a legacy 2G/3G network for IMS-based VoIP service

As another example of the way in which inter-technology mobility can simplify rollout of a new LTE network consider an operator who has decided to move voice services to VoIP over IMS in conjunction with the deployment of an LTE access network. In the absence of other options, this operator would need to provide ubiquitous LTE coverage on day 1 to have a competitive VoIP service. However by using inter-technology mobility and a new functionality called, Single Radio Voice Call Continuity (SRVCC) a less ambitious, more risk-averse rollout plan could be followed.

SRVCC provides the ability to transition a voice call from the VoIP/IMS packet domain to the legacy circuit domain (the ability to transition from the circuit domain to the packet domain is not addressed in the current generation of LTE standards). Variations of SRVCC are being standardized to support both GSM/UMTS and CDMA 1x circuit domains. For an operator with a legacy cellular network who wishes to deploy IMS/VoIP-based voice services in conjunction with the rollout of an LTE network, SRVCC offers provides their VoIP subscribers with coverage over a much larger area than would typically be available during the rollout of a new network.

SRVCC functions as follows. As an SRVCC-capable mobile engaged in a voice call determines that it is moving away from LTE coverage, it notifies the LTE network. The LTE network determines that the voice call needs to be moved to the legacy circuit domain. It notifies the MSC server of the need to switch the voice call from the packet to the circuit domain and initiates a handover of the LTE voice bearer to the circuit network. The MSC server establishes a bearer path for the mobile in the legacy network and notifies the IMS core that the mobile's call leg is moving from the packet to the circuit domain. The circuit-packet function in the IMS core then performs the necessary interworking functions. When the mobile arrives on-channel in the legacy network, it switches its internal voice processing from VoIP to legacy-circuit voice, and the call continues.

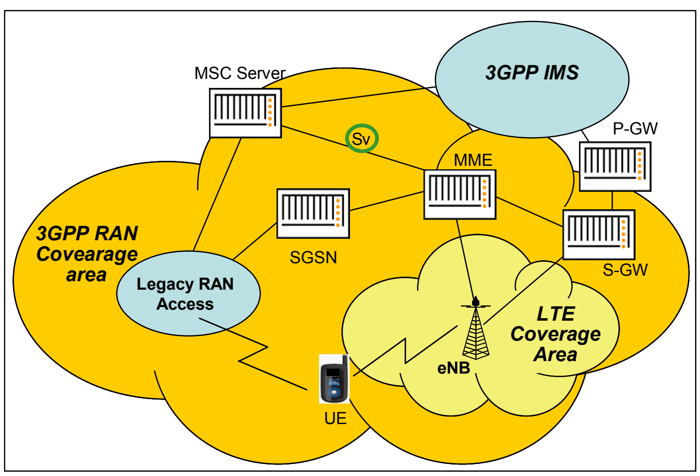

Figure 3. SRVCC architecture with a 3GPP circuit domain

If the legacy circuit network also has an associated packet capability and is capable of supporting concurrent circuit/packet operations, the subscriber's data sessions can be handed over to the legacy network in conjunction with switching the voice call from the packet to the circuit domain. In this case when the voice call finishes and the mobile re-enters LTE coverage, these packet sessions can be handed back to the LTE.

The success of, and correspondingly the need for, SRVCC will be largely determined by operator's long-term business plans for LTE. If operators look to limit LTE deployments to high traffic areas and at the same time wish to transition voice service in those areas to VoIP, then SRVCC is exactly what they need.

If on the other hand operators do not plan to migrate their voice service to VoIP, then SRVCC is not for them. If an operator does plan to migrate to VoIP and also plans to roll out ubiquitous LTE coverage, then the question of whether or not to adopt SRVCC is more complicated. While SRVCC does not require modifications to what is certainly the operator's largest legacy investment, the RAN, it does require a significant modification of the operator's legacy core and also requires full deployment of IMS circuit-packet continuity services. Given the cost of these changes, deployment of SRVCC purely as an interim measure to allow early rollout of VoIP-based services may not make financial sense.

Using Inter-technology Mobility to Bridge Disparate Network Assets.

The fragmentation of the mobile data market across multiple network technologies slows down development and deployment of new mobile data services and applications. IMS, which has an inherent ability to support multiple access network types, has typically been put forth as a potential solution for this problem. But, IMS is not the total solution; and, while it does offer a powerful long-term tool for operators, its rollout has been slow. Today, IMS does not provide session continuity if a mobile changes its IP address when it moves between access networks. This problem is being addressed in standards, but even when it is resolved, there are still many applications that cannot tolerate a change in IP address. To avoid these problems, inter-technology mobility must be implemented at the IP-level. IMS is best suited to those applications that have been specifically designed to work in an IMS environment, and this gives rise to a chicken-and-egg like problem. The rollout of IMS can't be justified without applications to support it, and the development of IMS-compatible applications can't be justified without an installed base of systems that can support them.

Meeting the strict QoS requirements that are characteristic of certain applications (e.g. VoIP) is particularly challenging for IMS-based mobility since the mobility anchor point is located near the top of the network hierarchy. New access technologies such as WiMAX and LTE aim for audio gaps of less than 50 ms when moving between access points of the same technology, and it is well know that audio gaps of more than 200-300 ms significantly degrade the user experience. These tight requirements on handover performance are difficult if not impossible to meet when moving between access networks unless the transition is supported at a low level in the network hierarchy and incorporates either dual-transmit devices or interconnection of the access networks.

LTE standards for HSPA, UMTS, GSM and EVDO mobility are all based on RAN level interconnection that maintains session continuity at the IP level. For LTE-WiMAX and LTE-WiFi mobility, standards supporting single- or dual-transmit devices are also in development. These functions also maintain session continuity at the IP level. All these standards are due to be completed by the end of 2008. Using network elements based on these emerging standards along with dual-transmit devices in some cases, it should be possible in the near future to use IP-level inter-technology mobility to bridge virtually any combination of broadband access networks with high quality service. Furthermore since the interconnection of these access technologies occurs at the IP level of the protocol hierarchy, inter-technology mobility can be provided for virtually any application regardless of whether or not the application is IMS-based.

In addition to the LTE work, other standards organizations are looking at generalized (i.e. not focused on specific technology pairs) IP-level inter-technology mobility issues. The IEEE 802.21 body is attempting to model an access-network-independent abstraction of inter-technology handover that could be used with any pair of access network types. Concepts developed by IEEE 802.21 for solving general inter-technology mobility problems (e.g. helping devices locate access networks they are allowed to access), are being carried over into other standards bodies where they are adapted to resolve problems specific technologies. Also the Internet standards body, IETF, has been working closely with the wireless standards community to ensure that new internet protocols are well suited for wireless inter-technology applications (e.g. Proxy Mobile IP version 6 – PMIPv6 – and DIAMETER).

With these new devices and standards available, an operator with virtually any combination of broadband access assets will be able to extend existing applications across all of those assets. By making these applications available to new groups of subscribers, operators can quickly create new revenue streams with virtually no additional investment in their applications. Also by expanding the available market to an operator's entire subscriber base, multi-mode devices and inter-technology mobility can go a long way toward making a marginal business case for a new application into a compelling one.

Inter-Technology Mobility As An Indoor Coverage Tool

Much of the spectrum being made available for the emerging wireless broadband technologies is located in higher frequency bands (above 2GHz) where providing high quality indoor coverage is a significant challenge. One possible solution to this problem is to use inter-technology mobility to provide access to existing indoor WiFi networks. The basic concept of using WiFi to extend/complement cellular access has been in use for several years. The most prominent example of this is UMA/GAN, which allows devices to use WiFi to access GSM voice and data services.

While the implementation approach will be fundamentally different, the basic concept behind UMA/GAN can be applied to support emerging broadband networks. Sessions can be handed over between WiFi and LTE as a subscriber moves between indoor and outdoor and outdoor environments. Services continue uninterrupted, with the network and device working together to adapt dynamically the service delivery to the technology that is best suited for the subscriber's immediate environment. Since this approach leverages existing wireless networks and existing backhaul resources, it can often be provided at a significantly lower cost than other approaches to indoor coverage and can be rolled out much more quickly.

Another approach being pursed for enhanced indoor coverage for may wireless broadband technologies including LTE is deployment of access nodes directly in indoor environments. There are two basic categories of indoor eNodeBs for LTE – pico/micro cells and femto cells. Pico cells and micro cells are simply small, lower-capacity eNodeBs that can be deployed indoors or outdoors. For indoor applications they are typically used to support large spaces such as shopping malls or office buildings. Femto cells, which are also referred to as "Home eNodeBs", have very low power and extremely limited capacity and are specifically designed to be deployed in a customer's home or small business. Femto cells are typically be owned or leased by the customer and are targeted to have a cost in the range of a few hundred dollars or less. Femto cells normally use customer-provided backhaul such as DSL or cable and connect to the operator's LTE network through a gateway. Micro and pico cells on the other hand adhere to the same deployment and ownership models that are use for macro ENodeBs – i.e. the operator owns them and provides the backhaul for them. As a consequence of this difference, femto cells typically restrict their services to small groups of users (closed user group) that are associated with the home or small business where the femto cells are located while micro and pico cells typically provide open service to all of an operator's customers.

Since the LTE femto cell air interface is identical to that of a standard eNodeB, femto cells provide two inherent advantages over WiFi access points in regards to inter-technology mobility:

- Faster handovers
  They use the LTE intra-technology handover rather that LTE-inter technology handover to move between indoor and outdoor coverage. Intra-technology handovers are simpler and faster than inter-technology handovers.

- Less expensive mobiles
  Standard LTE mobiles that do not have WiFi handover capability can use femto cells. Dual-transmit WiFi/LTE mobiles that can support low latency / low delay handover while providing competitive battery life will probably be more expensive than comparable LTE-only devices (or LTE devices that provide WiFi functionality but not support dual-transmit, low latency handover).

The advantages of LTE femto cells are offset somewhat by the complexity they can add to the operator's network, the additional CAPEX (WiFi access points are cheap are many homes are already equipped) and the need for the operator to provide a deployment service to support customer-installation. The details of these complications are too involve to discuss at length here and are worthy of a paper of their own. Suffice is to say that the market will decide whether their advantages will outweigh their disadvantages.

Conclusion

Inter-technology mobility offers operators the promise of extracting more value from their access networks and provides them with a powerful set of tools for matching network resources to application requirements. Inter-technology mobility is a key facilitator for the incremental rollout of an LTE network. It can serve as a powerful tool for maximizing the value of existing access resources and assist in quickly realizing revenue from the deployment of new wireless broadband access technologies. Inter-technology mobility can help operators who own multiple access network technologies rationalize their existing applications portfolio and also help them shorten the time needed to bring new applications to profitability.

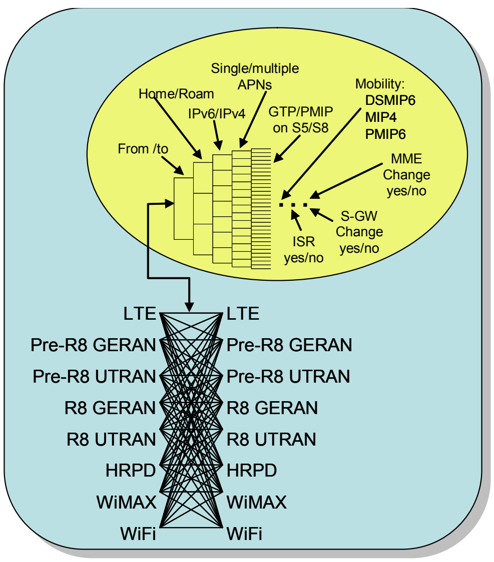

Figure 4. Combinatorial Explosion Of LTR Mobility Scenarios

LTE offers many options for inter-technology mobility. When these are considered in combination with the wide array of approaches and variations on those approaches that are available for intra-technology mobility in the LTE standards, the result is a list of possible mobility scenarios that numbers well into the thousands. Only a few of these options are appropriate for any one operator. Motorola's expertise in mobile broadband innovation, its broad wireless portfolio and its extensive experience with wired and wireless video and other broadband applications uniquely position us to help guide operators through the complex maze of choices and enable them to realize the promise of inter-technology mobility.

For more information on LTE inter-technology mobility, please talk to your Motorola representative.

Glossary

CS Fallback (CSFB).
An LTE functionality that allows LTE users the obtain legacy circuit switched services.

Dual Transmit Device (DTD).
A multi-technology mobile device that is capable of transmitting two technologies concurrently.

Evolution Data Optimized (EVDO)
3GPP2 third generation wireless access data technology

High Speed Downlink Packet Access / High Speed Uplink Packet Access (HSDPA/HSUPA).
3GPP third generation wireless access data technology

Long Term Evolution (LTE).
Common term for 3GPP's next generation wireless access data technology

Mobile IP (MIP).
IETF protocol for moving data sessions between access networks.

Short Message Service (SMS).
Second generation cellular text messaging protocol

Single Radio VCC (SRVCC).
An LTE functionality that allows a VoIP/IMS call in the LTE packet domain to be moved to a legacy voice domain (GSM/UMTS or CDMA 1x).

Unlicensed Mobile Access / Generic Access Network (UMA/GAN).
Protocols and techniques for connecting for connecting mobile devices to 3GPP 2G/3G networks via WiFi networks.

Voice over Internet Protocol (VoIP)
Worldwide interoperability for Microwave Access (WiMAX)

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