

Fixed Mobile Convergence for the Enterprise: Understanding Technology and Deployment Options for Voice and Unified Communications Applications

This paper discusses the trend towards fixed mobile convergence, along with the various technologies and deployment options that enterprises may choose.

Summary

The term **fixed mobile convergence** is used increasingly by industry press, service providers, and vendors. Unfortunately, the term is not well defined and is often used loosely. This paper will define fixed mobile convergence. It will then focus on solutions that provide fixed mobile convergence for voice and unified communications applications. It will discuss the challenges a business may face and the associated benefits to be gained, as well as the technologies and deployment options that exist to implement solutions today.

Defining Fixed Mobile Convergence

What exactly is fixed mobile convergence, and what does it mean for the enterprise? The dictionary defines **convergence** as the act of moving towards union or uniformity. **Fixed mobile convergence**, then, is the coming together of wired and wireless technologies.

There are three separate aspects to this convergence: the networks, the device, and the applications. At the network level, much of this convergence is driven by the build out of IP networks, which enables the unification of multiple services on a common network platform. Inside the enterprise, networks are largely IP-based, relying on Ethernet and wireless LAN technologies. Outside the enterprise, increasingly there is also a movement towards IP-based networks. Both incumbent and new service providers are looking to deliver more powerful, personalized services to stay ahead of the competition, both over cellular and new WiMAX networks.

At the device layer, our anytime, anywhere world demands ubiquitous connectivity and device manufacturers are heeding that desire with new innovations. In terms of network access, manufacturers continue to incorporate more and more capability by incorporating multiple wired and wireless connectivity options. As an example, increasingly cellular phones now come with wireless LAN connectivity as an option as well. In addition, manufacturers are responding to the convergence in applications by delivering powerful processing and display capabilities. Collaborative applications are on the rise, in particular. For instance, simple instant messaging applications have evolved to now incorporate image sharing, as well as real-time voice and video sessions.

Benefits to the Enterprise

While the underlying technology trends are clear, the case for implementing fixed mobile convergence—and **what** to implement—for the enterprise is much less so. What is known is that the workforce is increasingly mobile, now verging on 40 percent of the total workforce population worldwide, as reported by analyst firm IDC. When you start with the fact that close to a majority of the employee population do not remain at a fixed location during their work day, you can begin to

see the benefits of fixed mobile convergence. Employees are mobile in a variety of locations—both within the business but away from their desks, as well as outside the office at various locations, including client and partner sites, hotels, airports, and at home. In all of these locations, the network used and the preferred device may vary based on the environment. As an example, it may be easier to use a smartphone in the airport to check e-mail before boarding a flight, but preferable to use the larger keypad and a laptop display after reaching the hotel. Thus, a benefit of fixed mobile convergence is to come as close as possible to providing the same services in any environment. Making applications context-aware—knowledgeable of the location, network type, and even device type—will improve the user's experience.

By far the most widely used mobile application today is voice telephony. And with more and more employees relying on their cell phones as a primary voice communications tool, the ability for the enterprise to have some control over its use—for both regulatory compliance (including HIPAA, Sarbanes Oxley, and Basel II) and cost reasons—is a good place to start. From a user perspective, the need to simplify communications in a world where multiple devices and multiple voice mailboxes are now common is increasingly important. For example, users want to have the same contact list on the desktop and on the mobile phone, without having to enter or remember to synch them. They also want common deskset capabilities, such as four-digit dialing. To address both business and employee concerns, voice—and the broader area of business communications—is a practical place where many businesses are beginning their first fixed mobile convergence solution deployments.

Practical Capabilities Enabled through Fixed Mobile Convergence Solutions

Starting with voice as the first application, following is a list of fixed mobile convergence solutions from simplest through more feature-rich, and complex.

Single-Number Reach

One of the largest challenges for any mobile employee—and the business as well—is being responsive to customers, colleagues, and partners alike. In today's fast-paced world, often the people who respond quickest win the business. With many employees away from their desks much of the day, missing a phone call can have a measurable negative impact on profitability. Single-number reach solutions address this problem by enabling calls coming into the business line to be redirected to one or more additional phones. These might be cell phones, home office phones, or remote office phones. This feature provides a single business number for the caller and increases enterprise control by helping to ensure that if the employee leaves, customers are calling the business, not the employee's personal phone.

Single-number reach solutions may also have the desirable feature of enabling single-button transfer from the employee's desk phone to any cell phone, whether it's a standard phone, smartphone, or dual-mode phone. Often, during an extended conversation, the employee may need to leave the office. However, using the cell phone for the entire call is undesirable both from a comfort and a minute-usage perspective. With single-button transfer, the user can use the speaker phone capabilities of the desk set for when in the office, yet seamlessly transition the call to the cell phone when the time arrives to leave.

Single-Number Reach with Single-Number Voicemail

Building on the above solution, many businesses want to go a step further by creating a single voice mailbox that minimizes communications complexity. Instead of employees having to manage multiple voice mailboxes with different numbers and passwords (for both a business desktop phone and their mobile phone), more advanced single number reach solutions also incorporate the ability to have a single voice mailbox. Calls sent to the alternative phone lines—home office, mobile, and remote office—that go unanswered are directed to a single business voicemail system, so that all messages can be picked up in one place. What's more, because single-number reach calls are anchored through the business IP private branch exchange (PBX), there is no requirement for a special agreement with the cellular carrier. Calls come into the IP PBX, are forwarded to the designated remote phone, and if they go unanswered, are directed into the business IP PBX voicemail system.

Mobile Unified Communications: Full Extension of Office-Based Business Communications

Beyond voice calls and voicemail, many mobile employees use instant messaging with presence and a corporate directory to look up and dial contacts within the organization. **Presence** is the ability to see the availability status of colleagues who have indicated in their own instant messaging application that they are available, in a meeting, not available, or some other state. Integrating these capabilities into the devices that are used on-the-go within and outside the business is critical to maintaining collaboration and productivity with other colleagues. Applications are now available for both mobile phones and laptops to extend these key collaboration tools in addition to enabling single-number reach and single-number voicemail. In addition, depending upon the device and the application, video conferencing, a shared workspace environment, and visual voicemail may also be supported.

Separating Device Options from Applications that Enable Fixed Mobile Convergence

Multiple mobile device options are available for enabling mobile collaboration across fixed and wireless networks. Appropriate device choice depends upon the types of applications, environments and roles the different members of the workforce require. Readily available options today include:

- **Wireless IP phones:** These types of phones, which can work over a wireless LAN network only, extend IP communications to anywhere inside a business site that a wireless LAN exists. These types of phones tend to be appropriate for workers who are mobile solely within the business site.
- **Laptops with a soft phone:** For employees who work remotely, a laptop equipped with wireless LAN functionality can become a complete extension of the office voice and unified communications capability. With the addition of a high-speed wireless WAN card, users can extend communications to almost any environment, including hotel rooms, wireless Internet cafes, and home. Laptops are a good choice for employees who have need to use applications intensively and must work remotely either within the office or away.
- **Dual mode smartphones:** Increasingly popular, cell phones are now being delivered with both cellular and wireless LAN capability. With the proper software, these devices can interoperate with business IP PBXs to extend the office desktop phone capability to mobile handsets. Dual-mode phones are best for those workers who travel frequently on and off campus.

- **Ruggedized dual-mode PDAs:** Similar to dual-mode smartphones but optimized for operation in harsher environments, these types of devices provide voice and unified communications capability to warehouses, distribution centers, and manufacturing sites where cellular coverage can often be unreliable or unavailable. Ruggedized dual-mode PDAs can be best utilized by field force workers who frequently move between the wide area cellular network and a campus or branch office site.

Dual-Mode Phones and their Role in Fixed Mobile Convergence Solutions

Much of the current focus of fixed mobile convergence discussion is on a relatively new device—a cell phone that is also equipped with a wireless LAN radio, commonly called a **dual-mode phone**. The irony is that hand-off of services between cellular networks and wireless LAN networks is not fixed to mobile convergence, but instead is mobile to mobile convergence. That being said, dual mode phones are an increasingly important example of the trend toward the convergence of services across different network types.

As discussed earlier, single-number reach, single-number voicemail, and the extension of business communications can all be accomplished today with existing technologies. These solutions converge voice and other business communications to **any** cellular phone, whether with or without a wireless LAN radio. The presence of a wireless LAN radio in the cell phone adds a new twist to the discussion by potentially off-loading calls from the cellular network to a wireless LAN network when the phone is in-building. Thus, dual-mode phones are not a replacement for other fixed mobile convergence solutions, but can be used in conjunction with single-number reach or mobile unified communications to deliver additional benefits. In other words, a mobile unified communications application can be used either on a standard smartphone or a dual-mode phone with a wireless LAN radio in it. If used on a dual-mode phone, the application capabilities do not change, but rather, there is a new transport option for voice calls available over the wireless LAN radio when inside the business.

Understanding Dual-Mode Device Benefits

Let's examine each of the commonly discussed benefits.

- **Reduced cell phone costs:** This is often cited as the primary reason that dual-mode solutions are intriguing. The idea is that the phone is off the cellular network when in-building. When you consider that up to 30 percent of all cellular calls may be made in-building to a colleague, you get a sense that there is indeed a significant cost reduction opportunity. On closer examination, however, this is not always the case. Many businesses enjoy flat rate voice service plans with generous numbers of minutes from their mobile operator. And even in more fragmented geographies such as Europe and Asia, where the main concern is the cost of international calls, businesses are now seeing a surge in “home zone” plans from mobile operators. These rate plans allow the business to designate a certain geographical range for which calls are considered local. So, while there is some opportunity for off-cellular network calling, the benefits must be examined case-by-case for each individual business, taking into consideration both the cellular rate plan as well as the types of calls made by employees, and specifically whether the calls are international or not.
- **Improved productivity and responsiveness:** Single-number reach and the extension of business communications is also cited as a benefit of dual-mode phones, but as noted

earlier, these capabilities are not dependent upon wireless LAN radio access and can be implemented for any cell phone today.

- **Improved IT control and management:** Again, while featured as a benefit for dual-mode phones, the IT organization's ability to manage and control cellular devices is not dependent on the handset having a wireless LAN radio. Many solutions are available today for any cellular phone to enable IT to better control security and software loads. Third-party companies as well as mobile operators offer software and services that enable an IT organization to monitor and maintain their cellular devices.
- **Better reachability due to comprehensive in-building coverage:** While often secondary initially, this benefit often rises to the top of the list of reasons to deploy a dual-mode solution. Other capabilities, including single-number reach and the extension of other business collaboration tools such as IM and the corporate directory, can be accomplished, as noted earlier, on a standard cell phone. However, with an integrated wireless LAN radio, it is possible to create truly excellent, seamless voice and data coverage at every location within a building. This enables reachability in places where previously coverage was spotty or nonexistent. For many customer-facing mobile employees, the ability to be reached the first time can make or break a relationship and have direct impact on profitability. Softer benefits for calls made among employees may include faster business decision making.

Dual-Mode Phone Usage Models

There are four basic usage models for dual-mode phones. The following sections describe these models, from simplest and most common to most advanced.

Data Only

Dual-mode devices are most commonly used today for data connectivity. Ruggedized PDAs, tablets, or laptops are commonly used in this way by field force personnel. Typically containing two, three, or even four separate radio types to maintain ubiquitous connectivity in any indoor or outdoor environment and deployed in the transportation, logistics, and utilities industries, the wireless LAN radio provides data connectivity when the person returns to the warehouse or depot to upload or download customer trouble-ticket reports, schedules, or inventory status.

Voice Capable, but without Handoff

After data connectivity, the next usage model for a dual-mode device is supporting voice calls on either the cellular network or the wireless LAN network, but with no connection between the two networks. In other words, the user can place calls either over the cellular or a wireless LAN network, but cannot transition calls from one network to the other. This capability may be useful for many situations in which it is desirable to have excellent in-building voice coverage, but it is also rare for the user to move in and out of the campus.

Manual Voice Handoff

The next level of capability is the ability to manually hand off calls from one network to another. In this situation, the user initiates handoff from the wireless LAN network to the cellular network. The cell phone number is associated in the business PBX such that when the user initiates the handoff, the PBX creates a three-way conference, places a call to the cellular phone number, bridges the calls, and then after verifying that the cellular call is in place, drops the call over the wireless LAN network. This functionality enables excellent voice coverage in-building, and allows users to

transition calls to the cellular network as they leave the campus. The call is put on hold momentarily while this occurs, but the user does not need to redial the other party.

Automatic Voice Handoff

The most advanced usage model is the ability to automatically transfer the call from the wireless LAN to the cellular network. In this case, intelligence must exist in the network and the device to know when the call should be transitioned from one network to another. This is not a trivial problem—one set of challenges is in the way the signal strength of the WLAN connection is monitored by the phone, the wireless LAN network, or both. As the wireless LAN signal strength reaches a low point, the device or network, or a combination of the two, signals the business PBX to initiate a call to the cellular phone and then bridges the two calls. This occurs without the knowledge of the user or the calling party.

Deploying Dual-Mode Solutions Today

There are prerequisites for enabling dual-mode solutions for any business. In the data-only usage model, wireless LAN coverage is required where the devices will be used inside the business. If the aim is to use the wireless LAN radio for voice calls, the baseline requirements include both an IP telephony deployment and a pervasive wireless LAN designed for voice applications. For the IP telephony deployment, all employees who are provided dual-mode phones must also have an IP-based line. This enables the tie-in into the business PBX over the wireless LAN network. And to be effective as a network for voice applications, the wireless LAN deployment must be pervasive throughout the campus or buildings that the employees work in. In contrast to users of data applications who do not perceive intermittent connectivity, voice users are highly sensitive to degradation in the quality of the connection—unlike data applications, voice applications are latency-sensitive. This means that if the voice packets are not received in a regular, timely manner, the end user will experience marginal to unintelligible voice quality due to drop-outs. Without a voice-ready wireless LAN that provides continuous coverage, dual-mode devices will not meet user expectations and are likely not to be used.

In addition to an IP telephony system and a voice-ready wireless LAN, seamless handoff of voice calls from the cellular network to the enterprise wireless LAN entails several other considerations. There are two architectural approaches to determining handoff of a call from a wireless LAN network to the cellular network. First we'll examine the simpler situation of handing off a call from the enterprise network to the cellular network.

Approach One: Wireless LAN Infrastructure Controlled

One approach to seamless roaming uses the wireless LAN network to monitor the signal strength of the wireless LAN radio in the device. As the signal strength declines, the wireless LAN infrastructure indicates to the IP PBX that the call should be transferred to the cellular network. The wireless LAN infrastructure is in a good position to know the signal strength of the wireless LAN client and can prevent "ping-ponging," the scenario in which a client is simply roaming between one access point and another access point and is experiencing momentary drops in signal strength, but quickly recovers. Ping-ponging occurs when the client is switched from the wireless LAN network to the cellular network prematurely, or worse, comes back to the wireless LAN network as the solution realizes that the wireless LAN strength is still high and therefore switches it back to the enterprise network.

In order for the wireless LAN infrastructure to control seamless roaming, there has to be a method for the infrastructure components to identify voice flows within the network. This can be

accomplished in two ways: through the WLAN infrastructure devices monitoring the data flowing through the network or via a mechanism to obtain that information from the client or the IP PBX. A significant disadvantage of architectural approaches that rely solely on wireless LAN infrastructure devices monitoring traffic flows is that there is no visibility into the data stream when strong encryption is used, such as Wi-Fi Protected Access (WPA) or WPA2 or if the voice session is running inside a VPN tunnel.

Approach Two: Wireless LAN Infrastructure Assisted and Client Controlled

A better architecture to address this problem is one that is infrastructure assisted, but enables the client to make decisions about network handoff. In this approach, information about the client radio signal strength from the wireless LAN network is delivered to the client, which uses it to make an appropriate decision about network handoff. This requires a software agent on the client to act upon the information, but results in an architecture that is applicable for any business application, not simply voice calls.

The seamless transition begins in much the same manner, with the software agent receiving information from the wireless LAN infrastructure on signal strength. If the device is actively engaged in a voice call, the client can direct the IP PBX to set up a three-way conference and transition the call to the cellular network. However, if the device is engaged in a data application, such as e-mail, Internet browsing, or any other business application, the IP PBX has no role in the seamless transition. In this case, the client should switch to an appropriate wide area network—(Enhanced Data rate for GSM Evolution) EDGE, General Packet Radio Service (GPRS), Evolution Data Optimized (EVDO) or even WiMAX—and continue the data application processing. Clearly, with the investment required, it is much more beneficial to have an architectural approach that enables seamless mobility for the broad range of business applications that the mobile workforce uses today.

The Outside-In Roaming Problem

As discussed earlier, when the device is in the enterprise, the enterprise infrastructure can be used to sense wireless LAN signal strength on the client and use this information to make an intelligent handoff. To handle the opposite situation, however—that is, to transition from the cellular network to the enterprise wireless LAN—the challenges are different. If the call is made to the cellular phone number, the mobile operator would need to participate in a handoff from the cellular network to the enterprise wireless LAN network. Today, few solutions worldwide exist to do so, and are primarily consumer-oriented, not business-oriented. That is, the solutions available allow consumers to have seamless handoff from their personal cell phone to a Wi-Fi router within their home. One proposed enterprise solution to this problem is based on a standard called Unlicensed Mobile Access.

Unlicensed Mobile Access

Unlicensed Mobile Access (UMA) is a vendor-supported standard that enables handoff between the carrier network and an enterprise wireless LAN network. On the cellular network, the mobile handset communicates over the air with a cellular base station—through a base station controller—to servers in the core network of the carrier. With UMA, when the handset detects a wireless LAN, it establishes a secure IP connection through a gateway to a server called a UMA network controller on the carrier's network. The UMA network controller translates the signals coming from the handset to make it appear to be coming from another base station. Thus, when a mobile handset moves from a Global System for Mobile Communications (GSM) network to a

wireless LAN network, it appears to the core network as if it is simply on a different base station. This helps to ensure that it has the same access rights and subscription to applications and that billing is still through the carrier.

An UMA-based architecture always anchors the voice call to the cellular network. Where a wireless LAN network is available, it is used only as transport. Because the secure link is established between the UMA client on the handset and the UMA network controller (UNC) on the cellular network, there is no way to provide enterprise IP PBX features with an UMA-based solution. In addition to the lack of enterprise IP PBX capabilities, an additional disadvantage is the change in the features and functionality when the call moves from the wireless LAN network within the enterprise to the cellular network. Any extended business communication capabilities that the device had within the enterprise are lost. Because the call is now anchored in the carrier network, there is no connection between the phone and the enterprise IP PBX. When this connection is lost, abilities such as four-digit dialing or call forwarding are no longer available. This reduces productivity and may confuse users, because the phone has different capabilities in different environments. However, an UMA-based architecture may be attractive to businesses that don't own their own IP-PBX and rely on service-provider-hosted, IP Centrex services.

IP Multimedia Subsystem

An alternative architecture is based on IP Multimedia Subsystem (IMS) which is a framework designed to deliver IP multimedia to mobile users. This standard has now been adopted by the 3rd Generation Partnership Project (3GPP) and has been extended to include support for networks beyond GPRS, including wireless LAN, CDMA2000, and wired networks. IMS uses standards such as Session Initiation Protocol (SIP) to offer fixed mobile convergence services. In practice, execution of IMS in mobile operator networks is not complete and will not be so for several years at best.

Single-Number Reach: A Solution that Business Controls

A solution to the outside-in roaming problem is to enable business single-number reach. This has two benefits.

First, if an employee cell phone is in the cellular network, calls placed to the business number will be anchored to the business IP PBX and then forwarded to the cell phone. If the dual-mode handset then roams back onto the enterprise WLAN, because the call is anchored in the IP PBX, the wireless LAN can signal to the IP PBX to create a three-way bridge and transition the call off of the cellular network and onto the enterprise WLAN.

Second, users can separate their personal and business calls. Business associates can be given the office phone number, with no concern that calls will be missed. Employees, on the other hand, can continue to provide their cell phone number to personal associates, which enables them to easily separate personal calls from business ones. Businesses further benefit by having all business calls anchored through the IP PBX, which enables greater compliance and control measures.

Deployment Options: Enterprise Owned or Service Provider Hosted?

Enterprises today also have varied deployment options for fixed mobile convergence solutions for their business. Solutions can be owned and managed by the enterprise, or alternatively, businesses can turn to a service provider to provide and manage the solution for them. Some considerations when making this decision include:

- Which deployment options fits best with IT priorities, and which one will contribute more to profitability?
- Does the business have in-house IT support staff who have expertise in telephony and business communications?
- What type of solution is desired—single-number reach or mobile unified communications—and is there a need or requirement to anchor to business infrastructure for regulatory compliance?
- What scale of solution is needed: single country, multi-country, or truly global?

Summary

Fixed mobile convergence solutions are available today to help businesses maintain and increase productivity of their most important assets—people—as they move within and outside the main sites of the business. For mobile collaboration, solutions that enable single-number reach, single-number voicemail, and extended business communications can be deployed today to help ensure that customer calls are received the first time, that timely responses are given to colleagues, and that partners and employees spend time on moving the business forward, not managing multiple mailboxes. Solutions exist to meet the mobile-device needs of different mobile workforce types, job requirements, and environmental situations; these devices include laptops, PDAs, mobile phones, smartphones and ruggedized computers. One of these types of devices, dual-mode handsets, is an option to consider for those that will roam frequently in and off the business site. Dual-mode devices are not a prerequisite to the benefits of enterprise fixed mobile convergence solutions, but may provide additional benefits such as improving in-building call coverage. Enterprises can deploy fixed mobile convergence solutions for voice and unified communications themselves, or may wish to consider the benefits of having a service provider implement and manage the solution, depending upon the business' own IT priorities and expertise.



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