



Fixed Mobile Integration

Realising the potential of Private GSM Networks

White Paper

Abstract

Convergence is dissolving network boundaries and enabling the development of new service concepts, e.g. the ability to create private mobile GSM networks. This development allows intelligent communications applications to be employed on both conventional Time Division Multiplexing (TDM) and Internet Protocol (IP) devices. Private Mobile Network's unique ability to replicate the functional of a cellular network in software also allows the same applications to be used on regular mobiles. The combined result is the ability to create private mobile networks where regular mobile devices function as fully featured Private Branch Exchange (PBX) extensions.

This is a groundbreaking concept that opens up the enterprise and Small Medium Business (SMB) market for mobile network operators. In a nutshell, it allows Mobile Network Operators (MNOs) to deliver innovative, but meaningful functionality *now*: there is no need to wait for IP Multimedia Subsystem (IMS) trials to be completed, for IMS services to be created and marketed over converged networks.

Enabling mobile phone networks to integrate into corporate telephony networks can be seen as a Fixed Mobile Convergence (FMC) development, but the implications go well beyond network convergence. In this paper we therefore use the term Fixed Mobile Integration (FMI) to encapsulate a MNO service offer based on the company's private mobile network technology.

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Executive summary

Mobile network operators (MNOs) have focused their attention on the large consumer markets. They have provided them with competitive calling rates and messaging services and have been introducing new services (such as mobile multimedia and mobile television and movie services). It is the desire to compete in this market space that has led to MNOs cutting prices to the consumer market and leaving the business user on more expensive, less service rich, tariff options. At the same time, businesses have found that there is an ever increasing drive for mobile and flexible working practises. Perhaps, the biggest change in working practises in this area has been introduced not by the MNO but by a technology company. The rise in mobile email delivery is still increasing; the primary technology in use today is based on Blackberry devices, with push email to smart phones rapid catching up. The use of smart phones also opens up another method of communication for the mobile worker. Most smart phones are equipped with a dual air interface, conventional GSM and WiFi. The WiFi interface allows users to use these devices to make VoIP (Voice over IP) calls. VoIP clients often use open standards, like Session Initiation Protocol (SIP), to enable calls at little or, often, no cost when used in a WiFi coverage area. These factors have lead the MNO into a position where ARPU (Average Revenue per User) is declining and the increasing use of mobile VoIP is only going to reduce this further. To compound matters, the business users have made large investments in legacy and IP based PBX infrastructures.

- The business user is not as concerned with receiving multimedia content.
- The business user is extremely price aware and will change operator if there is a compelling cost case.
- The business user is interested in saving costs now and not in waiting for services to be delivered in several years time.

The implementation of a true fixed mobile integration solution will provide the business user with services that integrate processes in use on their office telephony platform with their mobile handsets. For the mobile network operator, a fixed mobile integration solution provides them with true customer stickiness as the solution is geared towards the demands of today's business.

FMI: a logical development

Fixed mobile integration (FMI) is the next logical step in the evolution of the convergence story, enabling mobile phone users to access the same services and features as users of a PBX extension. Private Mobile Networks are overcoming many of the commercial objections. There are many different approaches to providing an FMI solution to the end user. However, they all have one thing clearly in common – they will all need to integrate today's existing fixed phone infrastructure with today's existing mobile technologies and services. Additionally, any technology selected will have to enable these services to be accessed seamlessly from both PBX and mobile extensions. In practise, this could be delivered through two alternative or hybrid approaches:

- Replacement of the private branch exchange (PBX) with a private GSM network at a specific location or inside a building
- Solutions enabling integration between the MNO's national networks and existing PBX infrastructures

For mobile operators, FMI offers an opportunity to target business customers by offering a 'converged' bundle of services that would provide the user with the best of both mobile and fixed network worlds.

With data traffic set to lead telecom growth well into the next decade, mobile operators are looking for growth through data offerings. Operators are working hard to enhance the data-carrying capabilities of their own systems through technologies like GPRS and 3G. If implemented as an FMI solution, MNOs would realise a way to offer customers access to faster, fixed-line services that will support high-speed access to online games, e-commerce, entertainment services and location-based services.

For the MNO, a key consideration is how the solution selected should be delivered and deployed. This can be covered in three ways:

- On premise solutions
- Off site hosted or
- A combination of on premise equipment and hosted services (aka hybrid solutions)

Each solution has its own challenges and rewards and the selection of the delivery method will be influenced heavily by: the size of the investment; the timeline in which services should be marketed and the technical expertise available within the MNO's organisation.

The technologies needed to deliver these types of solutions are available, but until recently they were technologies looking for an application. However, that situation has changed due to the development of the FMI concept by Private Mobile Network.

The key pain points

Perhaps the best way to gain the respect of the business customer is to understand what is causing them the most pain at the moment. There are many factors that are focusing the mind of the IT/telecoms manager today. The majority of them can be summed up in two words - cost and control. Most of the pressing issues are a combination of both. Other issues would include mobility, reliability and quality of user experience.

Controlling mobile phone calls

The mobile handset is becoming the communications tool of choice for many people. People use them out of the office and naturally reach for the same device in the office. Estimates range up to as high as 40% of business calls being made from within the office which is a significant proportion of the overall mobile spend. Having phone books on the mobile is often more convenient than looking up a number in the corporate directory or e-mail system and so the mobile becomes the preferred device, even when standing next to a fixed telephony handset, which means that calls do not take advantage of negotiated corporate call rates. This can lead to an increase in mobile use in the office and, therefore, it could become an issue of escalating cost to the business.

The perceived high cost of the mobile calling rate is one of the prime reasons that businesses are implementing VoIP solutions. VoIP give them flexibility to provide home and some mobile workers with calls over a standard IP network with either free or extremely low per minute call charges. However, this will require new hardware; this could be laptops, handheld PDAs or the new dual mode WiFi phones. Therefore, a solution that allows the business to use existing assets and still gain the benefits of reducing or managed call cost is more likely to be favoured.

PBX functionality delivered to the mobile

A number of key enterprise features delivered on enterprise PBXs and accepted as standard are not yet available in mobile solutions – for example: hold, transfer and swap calls. There is one key service that a business wants to control – voicemail. Any FMI solution needs to include this at its core. In addition, applications running on the PBX, such as IVR (Interactive Voice Response) systems, team working and call escalation procedures are not easily available to mobile users.

Integration into the corporate voice network

Solutions based on VoIP and SIP (Session Initiation Protocol) are bringing productivity-enhancing functionality to the workplace, e.g. presence information, managed availability as well as the ability to link calls to emails and emails to calls. As a result, control of calls from mobiles will have less functionality than calls made from fixed line devices, unless the mobile phone can be integrated as a fully functional part of the corporate network. However, many businesses are not prepared to replace their 2G/2.5G phones with the WiFi enabled smart phones.

What services do businesses need?

Over the years, the feature sets of conventional PBX platforms have increased to encompass a large array of features and services. However, with the deployment of newer IP-PBXs, often only the most used features have been ported over. This gives a clear indication of the features that are most used and that provide the most benefits to the end users. In turn, this has allowed us to easily select which PBX capabilities most rapidly need to be transferred to the mobile.

An FMI solution should be able to switch calls transparently, to apply call routing and/or call control. In this way the FMI solution adds value to the core network via

the ability to deliver additional call handling and application services functionality. In collaboration with the MNO network infrastructure, the features listed below can be delivered. The ability to direct calls to any device following a set of rules regarding primary and secondary / alternative contact points enables the fixed / mobile integration. Such an approach allows for the rapid deployment of complex application services once basic connectivity is established, as an “edge of network” service.

The services required by most businesses are:

- Single direct dialling inbound and outbound
- Single mailbox for voice and fax
- Message waiting indication
- Hold
- Transfer – blind and consultation
- Calling line identification presentation
- Call screening
- Call recording options
- Manager/Secretary working
- Virtual call centre

This list represents a base line of functionality commonly used by businesses to improve reach and productivity.

Even when all these features and functionality are ported to the mobile network, a major sticking point still exists for the enterprise: the cost of mobile calls is, today, substantially higher than the cost of fixed line calls. Even if all device services are the same, the cost issue would normally be a constraint, but it disappears when the functionality is enabled by a private mobile GSM network that is fully integrated into both the corporate network and into the mobile operator’s network. At times it appears as though the only option to the MNO is to simply cut the cost of calls on their network to retain customers and to gain new business. However, by providing the business user with a service that they are requesting allows the operator to adopt innovative charging plans using an FMI solution. This could be a flat monthly fee for the service or a fee based on monthly usage.

A Private Mobile Network (PMN)

The key to enabling a cost-effective, enterprise FMI solution is the PMN. In its simplest terms, this is a local (often in building) GSM network that is only accessible to the company’s employees. When an employee walks into the area covered by this network the mobile phone becomes an extension of the PBX: TDM or IP. This is a simple, secure, automatic process; no complicated login is needed and only registered mobile phones can access the network. Once registered, all the functionality of the corporate telephony platform can be employed on these mobile devices.

What is needed to create a PMN?

A PMN is a mini GSM network that replicates the key components of the GSM networks that are deployed and managed by the large, national MNOs. It uses similar technologies but deployment is obviously on a much smaller scale. One important consequence of adopting this approach is that today’s 2G/2.5G mobile phones can use the PMN and become PBX extensions. Other solutions on the market today rely on devices that use Bluetooth or WiFi protocols. The ability to extend the functionality of the company’s legacy handsets is an important feature for businesses looking to minimise operating costs.

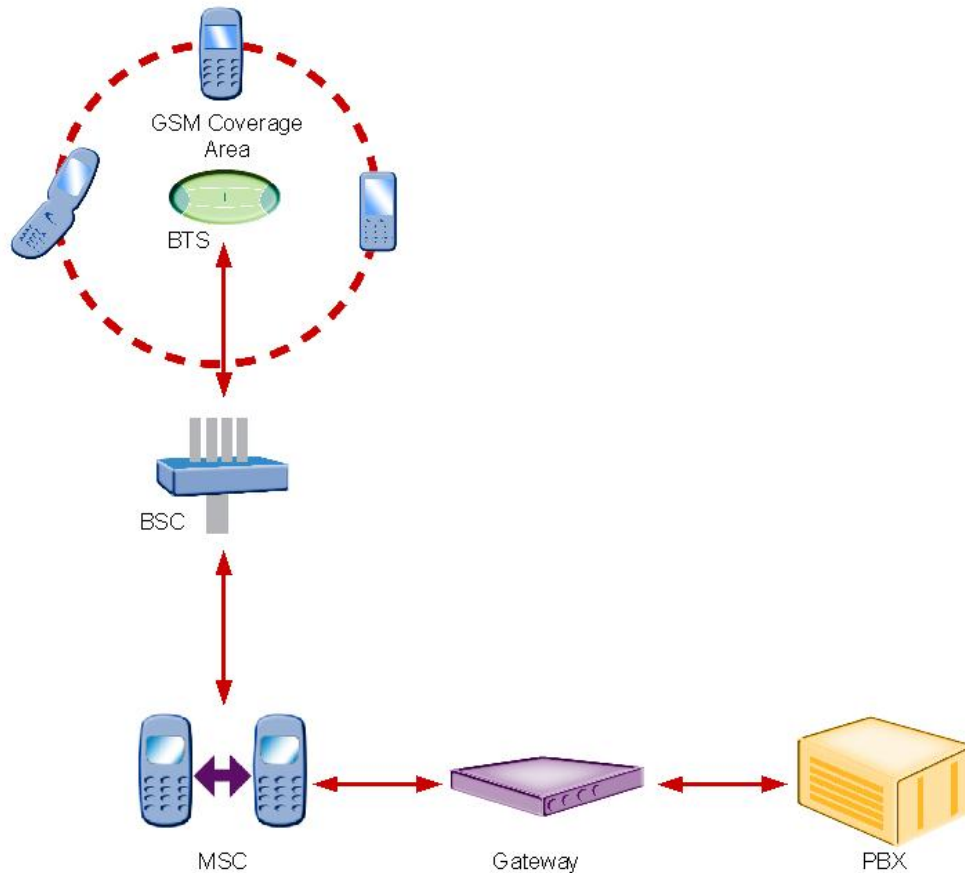


Figure 1

A schematic representation of the network elements required to build a GSM network that provides integration into a business's PBX. The elements in this type of network are common to both the macro and the private network; the main difference is one of scalability. The macro networks rely on larger and more expensive hardware components than would be required for an FMI solution in a business.

The network shown in figure 1 could be a private mobile network; in this situation it would employ low-power GSM pico cells to provide coverage for mobiles within the office environment. The base transceiver stations (BTSs) are connected to a mobile switching centre (MSC) via the base station control (BSC). This is the same architecture that is employed in public networks. Where the macro networks are built around large and expensive pieces of specific hardware, a private GSM network can be built in software and run on standard server technology. When the short message service (SMS) is added, the end result is a fully-functional, private network that is dedicated to meeting its mobile communications requirements. In addition, this private mobile network can be integrated into the corporate voice network using industry standard gateways. ***This allows mobile phones to function as standard extensions to the corporate PBX.***

Call making and ending procedures are controlled by the system controller and this provides a point of presence. It knows which authorised mobiles are in the coverage area as well as the status, i.e. in a call or diverted to another extension. This information can be used to enable the system to route calls. For example, there will be transparency for the user making a call. They do not need to know the location of the mobile they are dialling because the same number will reach its destination whether on the macro or the private network. This will ensure that the calls are

presented to the correct location without using MNO bandwidth and, therefore, without incurring MNO call charges.

How can the FMI be achieved?

A PMN represents the first step towards a fixed mobile integration solution. The next question that needs to be addressed is the way it is deployed. The flexibility of the solution means that there are various options but they broadly divide into these three categories:

- Local integration of mobiles with customer's PBX(s)
- Local integration of the private GSM network into the MNO network
- Centrally hosted PBX connected into the MNO network

Local integration with PBXs

As shown in figure 2, on-site installation uses a gateway to connect the PMN to the company's PBX. Thus, the network operator owns both networks: mobile phones are managed the same way as the PBX's handsets. For the MNO who does not want to commit the resources to support an in-house managed service, there are opportunities from 3rd parties to provide management services in the same way that PBXs and PBX services are managed today.

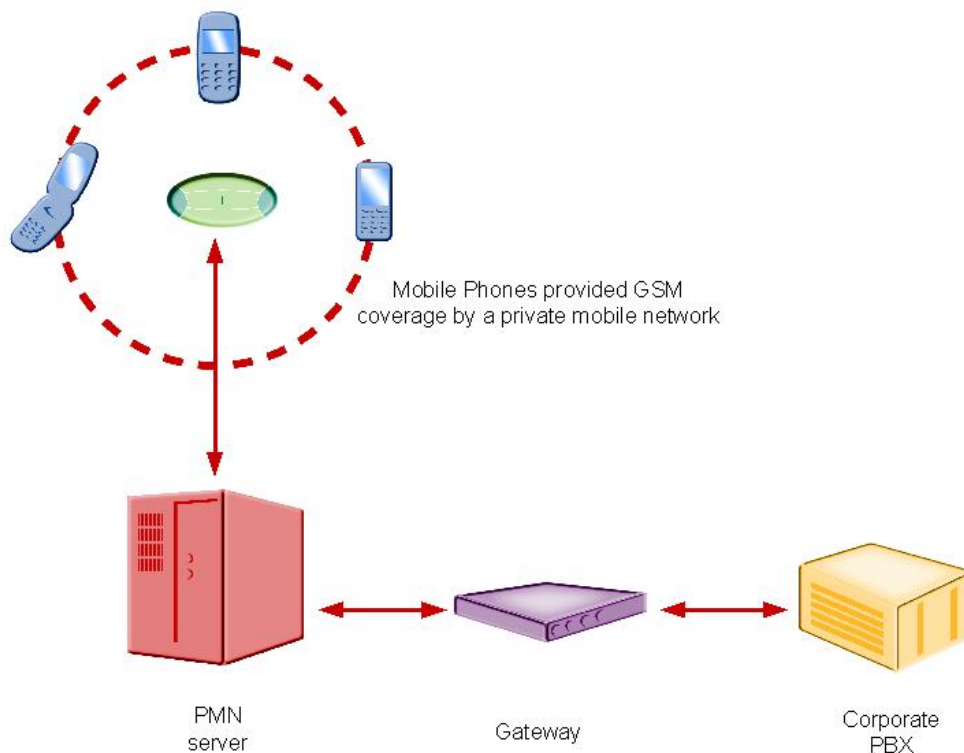


Figure 2

As the PMN is a software based GSM network it will be installed on standard server technology. Communication between the GSM base transceiver station (BTS) and the gateway will be over a standard LAN or WAN IP based network. The gateway will convert between the IP telephony protocol and one of a range of protocols used by a digital PBX. This will provide GSM coverage at a specific location built of one or more low power cells and enable calls to be made between mobiles and PBX extensions.

Local integration of a Private Mobile Network into the MNO network

One possibility is the connection of the PBX to the MNO macro network using a gateway. In effect, this would give the PBX access to the mobiles on the MNO

network without a break out to the standard PSTN. This solution requires that the MNO network is able to route calls correctly using features such as short code dialling.

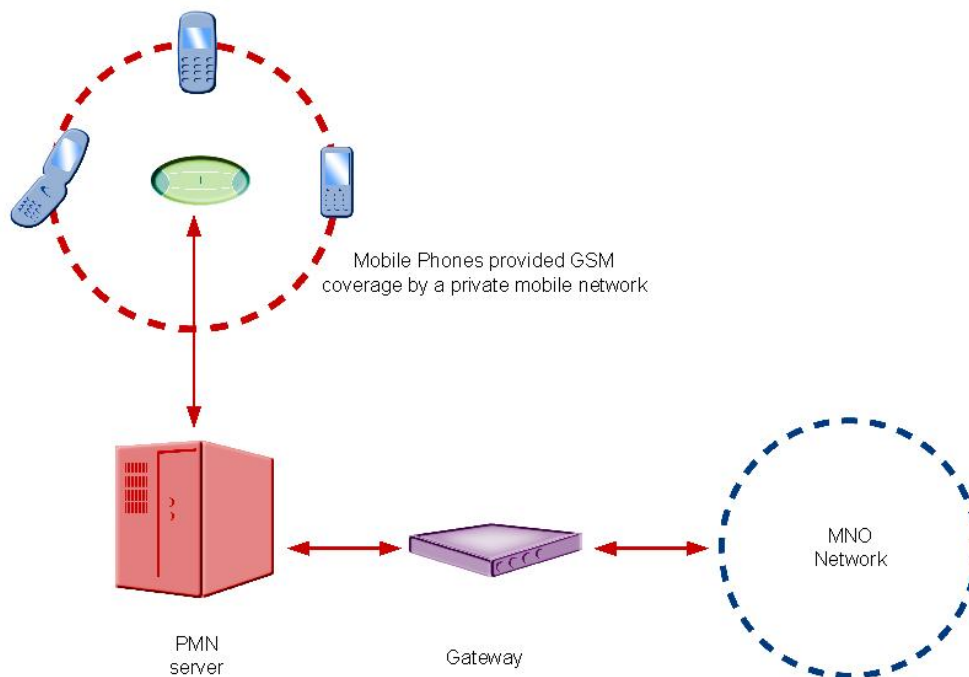


Figure 3
The PMN server would be installed at the business's site(s) and, instead of connecting to an on premise PBX, the gateway would be used to connect to the MNO's macro network. For the business, this would provide them with an on premise PBX based on GSM handsets instead of fixed line handsets, enabling them to have a true wireless office. The MNO would be able to provide this service without having an impact on the capacity of the macro networks in the business's location(s).

Centrally hosted PBX connected into the MNO network

We have seen a dramatic growth in the availability of fully featured managed communication services. These solutions are typically delivered by a large, scalable, multi-tenanted telephony platform. This concept allows network operators to provide the appropriate services to all market sectors, i.e. SMBs and large organisations. Aside from the business advantage of transferring costs from capital expenditure (CAPEX) to operational expenditure (OPEX), a key benefit for the company is the fact that there is no additional on-site hardware. All the switching and interconnects to other networks are hosted and supported off site. In addition, resilient systems will ensure service availability at all times and a remote disaster recovery option will provide five nines availability. This is something that is impractical and expensive for smaller companies to install and support on a premises-based solution, but when the service is hosted it becomes affordable.

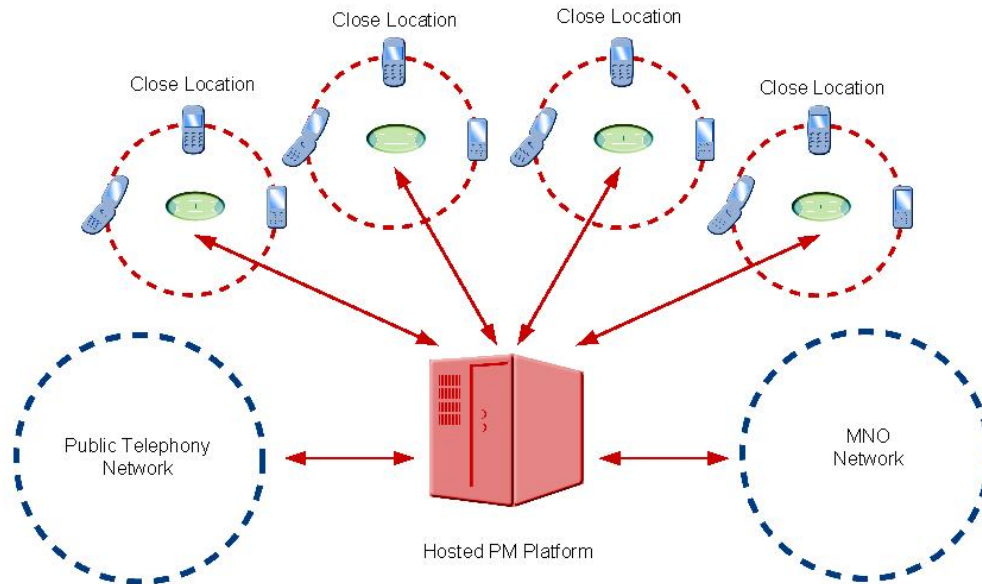


Figure 4
The concept of managed communications services can be extending to include GSM handsets. This provides the SMB market with access to an FMI solution without the need to deploy an on premise server to control the network.

A hosted PMN service run from a centrally hosted PBX connected to the MNOs network provides all the benefits of hosting plus the capabilities of the PMN. GSM aerials are needed, sited locally, to provide the PMN coverage areas, but all telephony switching functionality and control can be sited at a secure hosted premise.

The onsite aerials use standard IP to communicate with the PMN control unit. This means that the aerials can be deployed on the customer's premise with all the other telephony being supplied by the hosting centre and standard IP links provided between the devices.

The ability to offer fixed mobile integration provides the MNO with a clear differentiator and ensures a very compelling solution for a lot of smaller enterprises, as well as remote offices of the large enterprise. The businesses benefit from the ease of use and convenience of a mobile while out of the office but are not 'penalised' for using one in the office

How agnostic should the FMI be?

In order to address the marketplace, an FMI solution must be able to interoperate with as many different PBXs as possible. This is normally achieved using a gateway, a device that converts communication from one protocol to another. There are three broad types of gateway needed for FMI solutions:

- Between the PBX and the private mobile network
- Between the PBX and the mobile network operator's network and/or
- Between the PBX and the hosted IP PBX

These gateways do not need to be physical devices. If the PBX has an interface that uses a standard IP protocol (e.g. SIP) then gateway functionality can be done in software. A software-based solution provides flexibility and scalability and also allows the solution to evolve to changing market or operator needs. The gateways will also provide some of the necessary address translations and thereby provide a linked numbering scheme.

Protocol Agnostic Solutions

The rapid pace of development of telephony protocols, particularly those using IP, might mean that an FMI solution would be outdated when it goes into full operation. This possibility can be prevented when open standards protocols are employed. They will also minimise interoperability issues and, because they are open, more manufacturers will produce equipment based on these standards, increasing end user choice. A software solution also aids responsiveness to changing user requirements, industry compliance and protocol developments (see separate section below).

Most PBXs in the UK have adopted DPNSS as the protocol used for connecting a PBX to a trunk line or to connect to another PBX(s). Other countries employ Q.931 and QSIG. Using these standard protocol interfaces allows the FMI solution to interoperate with the majority of mainstream PBXs.

IP-PBXs allow traffic to be transported over converged voice-data networks. They use a variety of different protocols, some of which are proprietary or semi proprietary. However, the majority either employ open standard protocols or offer an interface based on open standard protocols. First generation IP-PBXs will, typically, use H.323, MGCP and Megaco. Second generation PBXs are usually based on SIP.

SIP is rapidly becoming the IP telephony protocol of choice. Most of the large PBX manufacturers are offering SIP interfaces to their equipment. Independent manufacturers of software PBXs, telephones and other communication equipment are also using SIP as their communication protocol of choice.

The next step in the evolution of communication protocols will be based on SIP and IMS. This development promises to ease the issues associated with interoperability. IMS was designed to offer support for every form of electronic communication available today, as well as supporting future developments. Currently, IMS is being developed to support communications based on both wireless and wireline technologies and features such as voice, video, instant messaging, videoconferencing and video on demand. Any FMI should support IMS infrastructure or be field upgradeable.

The PMN Solution

A separate paper outlines the PMN offering in the FMI area. The Private Mobile eXchange (PMX) product provides a comprehensive standard based solution based on open standards and utilising a tried and tested architecture. The following table shows the levels of inter-working:

Feature	PBX Extension	IP Extension	PSTN Line	Mobile
Single DDI	√	√	√	√
Outbound	√	√	√	√
Hold	√	√	√	√
Transfer	√	√	√	√
CLI Presentation	√	√	√	√
Single Mailbox	√	√	√	√
Call Recording	√	√	√	√
Manager/Secretary	√	√	√	√
Virtual Call Centre	√	√	√	√
Call Screening	√	√	√	√
Message Wait	√	√	√	√

A full description of the services listed above is available at www.privatemobilenetworks.com

A final word

Convergence allows a comprehensive range of services to be delivered to all users, e.g. personal number, telephony services, data services like fax and e-mail, Internet access, etc. It is clear that equally integrated billing and customer care systems must match integrated service offers. And other key elements in fixed mobile integration include customer care, sales networks and distribution channels.

MNOs can provide both fixed and mobile services to their subscriber base today as a full service moving beyond today's service bundles. For valid commercial reasons these are currently limited to bundles designed to minimize churn. They include broadband access, fixed voice, mobile voice, and long distance at reduced tariffs and everything comes on a single bill, which is typically 10 to 20% lower than unbundled services. While this tactic has worked well, consolidation and aggressive competition means that more is needed, e.g. value-added services and the ability to deliver a differentiated offer.

To take bundling to the next level and provide true converged services that deliver subscriber value "beyond the bill", MNOs must coalesce their fixed and mobile service environments into a compelling value proposition for enterprises and consumers alike. This may sound like a tall order, but it is one that PMN has the proven ability to deliver.

Abbreviations

2G – Second Generation Mobile Network
2.5 G – Second Generation Mobile Networks with GPRS capabilities
3G – Third Generation Mobile Network
ARPU – Average Revenue Per User
BSC – Base Station Controller
BTS – Base Transceiver Station
FMC – Fixed Mobile Convergence
FMI – Fixed Mobile Integration
GPRS – General Packet Radio Service
GSM – Global System for Mobile Communication
IP – Internet Protocol
MNO – Mobile Network Operator
MSC – Mobile Switching Centre
PBX – Private Branch Exchange
PDA – Person Data Assistant
PSTN – Public Switched Telephony Network
SIP – Session Initiation Protocol
SMB – Small Medium Business
SMSC – Short Messaging Service Centre
WiFi – Wireless Fidelity

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