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**From Macro to Micro:**  
***Cellular Based Convergence for the Enterprise***

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### About This White Paper

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### Intended Audience

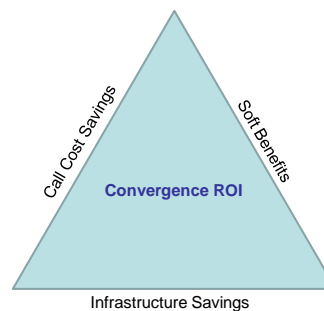
This white-paper is targeted at enterprises considering deploying fixed-mobile convergence (FMC) services across one or more sites either through their mobile or fixed network operator, or an alternative FMC provider.

This paper is not targeted at mobile or fixed network operators wishing to create an FMC proposition.

## Executive Summary

Cellular based convergence shifts minutes usually accounted for on mobile networks and moves them into an enterprise owned 'micro' cellular network. External calls using the micro cellular network connect to the company's fixed line services and leave as fixed line minutes. This gives enterprises the ability to control, monitor and selectively decrease mobile spend. Micro-network convergence forms one half of a two stage voice communications convergence strategy, with the other half being provided through the provision of additional functionality to mobile handsets that can be used while out of the office, or even roaming.

Organisations considering deploying convergence solutions must consider a trinity of benefits when determining an expected ROI:



- Call cost savings are specific to and dependent on the type of employee using the solution, from their job role through to their calling profile
- Enterprises considering rolling out greenfield sites such as branch offices or new headquarters, or upgrading existing fixed infrastructure have the potential to make significant savings on the deployment of communication infrastructure
- Increased in-building coverage and mobile handsets operating as PBX extensions increases overall ability to contact employees, lessens time to respond to customer and colleague queries, and provides a platform for quicker decision making

It is imperative that a total communications strategy is considered when deploying micro-networks. Enterprises must consider the total cost of deploying convergence; for micro-network based solutions this means antennae (access points), handset, deployment and ongoing management costs. The ability to use ubiquitous handsets as opposed to specialist devices can help ensure monetary payback on deployment. Furthermore, dependant on an organisations communication strategy, selective distribution of micro-network enabled handset can help to ensure cost control, while ubiquitous deployments can assist in overall communication efficiencies. Non-call related savings such as infrastructure, maintenance and productivity are becoming an increasingly important component of the enterprise business case as mobile operators use increasingly aggressive pricing as a tool to combat micro based solutions.

Cellular micro-networks can have distinct benefits over alternate access technologies, ranging from;

- A lessened need for wired access points thanks to better penetration characteristics, reducing the need for wiring and fixtures
- Enhanced handset battery life through the use of a single radio for both micro and macro-networks
- No requirements to deploy dual-mode handsets, allowing convergence to be achieved with an enterprises existing handset base
- 'Green' effects such as reduced handset transmission power

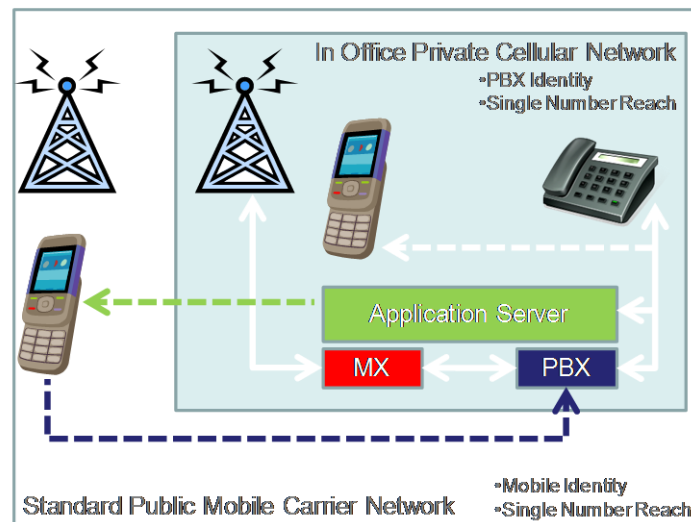
## Defining voice focused convergence

*Convergence marries together the best aspects of fixed and mobile services and simultaneously alleviates the negative associations of disparate telephony services. Convergence means access to traditional fixed-line services on the mobile handset, making internal*

There are two principle elements to voice focused convergence: routing mobile calls through a fixed network and extending features/applications to mobile handsets. Voice focused convergence solutions are designed to deliver companies cost savings, make employees easier to contact, and extend fixed line call features to mobile handsets.

Routing mobile calls through a fixed network is possible by deploying a micro wireless network within an office, which creates a “private” internal network (see Figure 1). Mobile calls to external numbers are carried as outbound calls originating through a company’s fixed dial plan, while internal calls are routed via the Mobile Exchange (MX) to the corporate network and PBX and onto the intended recipient. Internal mobile calls also terminating on an internal mobile do not need to be transferred to the PBX, opening up the opportunity for the Mobile Exchange to serve as a complete PBX replacement in completely mobile organisations.

Figure 1 - Private Network Overview



Extending calling features from a company’s PBX to a mobile handset means these features and functions are no longer the sole preserve of the office and are available when away from the desk or out of office. Other benefits of this form of voice focused convergence include the provision of single number reach and single voicemail. Subscribers may use a single fixed line number which will also reach them via their mobile, with all voicemail terminating at the company PBX. Enhanced calling services such as call recording and call tracking may also be extended to mobile handsets, which were previously only available on fixed lines.

Combining local network routing and PBX extension to the public GSM network allows for almost all PBX features and benefits to be accessible via mobile both in and out of the office.

While this paper is focused on voice convergence, data elements can be introduced into the holistic convergence solution. In cases where macro-cellular data connections become congested, micro-cellular networks can provide an independent data connection, with bandwidth that is not shared with the macro-cellular community. Furthermore, the micro-network can act as a platform for the internal deployment of mobilised productivity applications.

## Convergence via Micro-Networks

Using a micro-network to route cellular calls via a company's LAN and PBX, rather than the public GSM network, enables call cost savings for certain types of calls. There are three deployment technologies available today: GSM, Wi-Fi and DECT.

- A **GSM**-based micro-network uses a low power miniature/local base station to communicate with a traditional mobile handset. The local base station (picocell or femtocell) will not interfere with public GSM networks and only provides coverage within the confines of an office or campus. GSM bands are licensed, and as such any deployment must be performed by or with a licensed GSM carrier
- A **Wi-Fi** based micro-network leverages an enterprises Wi-Fi network to create a micro-network, using dual-mode mobile handsets (with both GSM and Wi-Fi radios). The Wi-Fi radio is used to connect to the micro office network, while the GSM radio is used to connect with the public GSM network when the micro-network is out of range
- A **DECT** deployment uses a single-mode handset connected to the PBX via the DECT standard. Traditionally used in campus based environments such as universities and retailers, the solution generally requires a user to have a separate GSM handset for use off-campus

## Extending PBX Features to Mobile Handsets

A converged network may provide users with the capability to access additional functionality when away from their desk and out of office. This means workers have more control over how they communicate with customers, suppliers and colleagues, making them more responsive, and increasing contactability. Enabling workers to access converged voice and PBX features from any location can include control over:

- **Conference calling:** setting-up multi-participant calls from any location on a mobile device (dialling out multiple parties from the same handset / PBX pairing, or coherently joining an existing teleconference without dial-in access codes)
- **Corporate directory:** Searching colleague contact details using the corporate directory stored in the organisations PBX or E-mail system. Access can be extended to external contact directories though network federation
- **Call logging and tracking:** Mobile call profiles, historical calling data and split billing solutions can be more easily established. Mobile calls can also be recorded when in and out of the office by ensuring that all mobile calls are routed via the PBX
- **Multiple identities:** Enables a mobile user to switch between personal and corporate identities, where the employee uses the mobile CLI as their personal number, and fixed CLI as their corporate number
- **Presence:** The ability to identify if colleagues are available and their current status, enables a caller to select the most appropriate colleague to contact using the best form of communication

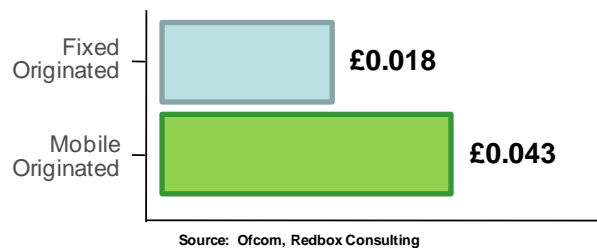
The focus of this white paper is on local network routing via a micro-network, and providing fixed line functionality to a mobile handset whilst in the office.

## Issues and benefits that enterprises seek to address with voice based convergence

*Escalating monthly carrier expenses are driving wireless cost management initiatives among 57% of enterprises (Aberdeen Group, June 2007; Wireless Mobility Cost Management)*

Analysts estimate that 40% to 60% of corporate mobile minutes are used in building, highlighting an under-appreciated pain point. Mobile phones tend to be used more often due to convenience - they are close at hand at all times, provide easy access to stored contact numbers and are more personal; as such a mobile handset makes employees easier to contact. With UK geographic mobile minutes costing up to 133%<sup>i</sup> more than fixed line minutes, there is a clear and compelling reason for enterprises to encourage change in mobile usage back towards fixed desk phones. However, this is in direct opposition to the increasing use of mobile phones as the communications device of choice.

Figure 2 - Geographic Call Costs



Increasing call spend is further exacerbated by a marked increase in mobility, as organisations increasingly move towards hot-desking, and flexible working. Mobile penetration within organisations is also increasing, exposing enterprises to inflated mobile spending.

Voice focused convergence delivers many of the benefits demanded by enterprises; delivering call cost savings, assisting time critical decisions by improving contactability, and ensuring that compliance legislations can be met. These benefits only come alive when enterprises are able to highlight real-life advantages through actual FMC deployments.

### Reducing Call Costs

Controlling communications costs is a perennial concern for all businesses, exacerbated by the increasing need to provide employees with mobile devices. Overall the percentage of employees using mobile devices in Europe is expected to increase from 49% in 2006 to 72% in 2009<sup>ii</sup>. The cost of calls is further aggravated by increasing usage of mobile phones. Voice focused convergence, when targeted at appropriate end users who will best benefit from fixed vs. mobile call arbitrage, has the potential to help enterprises curb their call spend.

### Improving In Building Coverage

Providing employees with consistent and ubiquitous mobile coverage is imperative to ensure that clients and colleagues can reach the appropriate staff member as needed. Micro-cellular networks help ensure calls can be consistently made and received when in-building by deploying a wireless signal in areas which are difficult for public GSM/3G networks to penetrate.

Many enterprises, typically those with large campus environments, are now deploying picocell networks to overcome coverage issues. Key verticals include hospitals, education, manufacturing and verticals that set up temporary offices (e.g. the construction industry).

**Improving Responsiveness**

With only 25% of calls reach their intended participant first time<sup>iii</sup>, improving communications is one of the top three reasons for deploying FMC services<sup>iv</sup>. In order to enhance customer service, enterprises seek to improve the responsiveness of employees through quicker access to voicemail, picking up more calls, and allowing customer enquiries to be passed on to the most appropriate employee or team member. Enhancing internal communication is also important as enterprises seek to speed up decision making and boost colleague collaboration in an effort to reduce lead times.

**Delivering Compliance**

*The growing importance of compliance is demonstrated by cases of penalties and legal suits against companies that fail to produce appropriate records. In June 2007 the FSA fined Kilminster Financial Management Limited £42,000 for not keeping appropriate training and competence records*

Enterprises record calls for a variety of reasons: to assist with training, to provide evidence of a business transaction, or to ensure that a business complies with regulatory procedures. Call recording is particularly relevant to certain industry verticals such as financial services and healthcare.

The Financial Services Authority (FSA) requires financial institutions to keep records of all trades and transactions. The safest and easiest way of achieving this is to record telephone conversations between traders and customers. Further call recording legislation is currently under investigation by the FSA.

Voice recording in the Healthcare sector has become an imperative to provide protection against liability and incident investigation, in cases when inaccurate information has been given to a call handler.

Call recording is a feature of many PBXs but is usually only available on calls made from desk phones. Using a voice focused converged solution enables the call recording feature to be accessible via the mobile handset, allowing mobile calls to become regulation compliant.

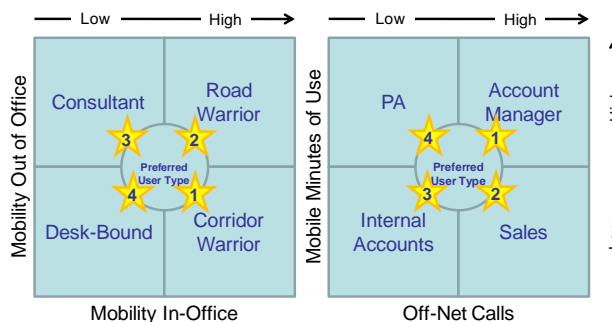
**The benefits of convergence by job functions and industries**

**Relevance to Individuals**

The benefits that employees and enterprises achieve through deploying voice focused convergence will vary across different employee and company profiles. Highly mobile employees (e.g. account managers), and vertical industries with a large percentage of location-flexible employees will experience the greatest benefits.

Figure 3 demonstrates that organisations must consider internal deployment across four dimensions: degree of mobility in the office, degree of time out of the office, expected usage and number of off-net calls. The higher the degree of internal mobility or off-net calling, the greater the applicability of convergence, while high amounts of time out of the office or low aggregate usage, the less desirable it is to deploy the solution to a particular user.

*Figure 3 - Determining User Profiles Suited to Convergence*



It is also important to consider the overall criticality that mobile plays in the context of an employee’s total communication requirements. If the mobile is supplementary to their job role it may be best to leave their deployment as-is, as call spend will likely increase through fixed line substitution even when out of the office. However, if a mobile is a critical business tool (e.g. for a sales manager) convergence can help to improve the job function as well as monitor and maintain calling costs.

The benefits experienced by different types of employees when using a converged solution are shown in Figure 4.

Figure 4 - Horizontal Requirements and Benefits from Convergence

Senior / Middle Manager	<b>Degree of Mobility</b>	Regularly away from their desk and out of the office
	<b>Communications Requirements</b>	Need to be in frequent contact with colleagues and clients; mobile is critical to performing their role effectively with reliance on their mobile handset to make and receive the majority of calls
	<b>Benefits of Converged Solution</b>	Quicker access to appropriate colleagues to speed decision making via one number and presence capability; minimise downtime and save time through improved voicemail and call management (via call filtering and routing)
Estate Manager	<b>Degree of Mobility</b>	Manages multiple company owned sites, so regularly away from their desk and permanent office
	<b>Communications Requirements</b>	Needs to make many outgoing calls to consult suppliers, freeholders, insurance companies, in addition to many internal calls (back to home office, or to offices soon to be visited)
	<b>Benefits of Converged Solution</b>	The cross site nature of this position, combined with multiple private cellular deployments ensure that the estate manager maintains contact, with a single identity, whilst benefiting from reduced call spend (no longer calling on-net extensions at mobile rates)
On-Site Facilities Manger	<b>Degree of Mobility</b>	Focal point for managing telephones, lighting, heating, distribution of post, taking and distributing deliveries; mostly away from desk working across the campus environment
	<b>Communications Requirements</b>	Poor in-building / on campus coverage, limited opportunities to visit desk phone to check messages and regular delays in responding to voicemails
	<b>Benefits of Converged Solution</b>	Picks up a higher percentage of calls first time, respond to colleagues’ needs more quickly; increased work rate, eliminating need to return to office for job schedules

### Relevance to vertical industries

The type of organisation will also determine the extent to which enterprises will benefit from deploying a voice focused converged solution. Solution requirements will vary depending on number of mobile employees and existing pain points with mobile services. Figure 5 illustrates select challenges facing different verticals and the benefits of deploying voice focused convergence.

Figure 5 - Challenges Facing Verticals and Benefits from Convergence

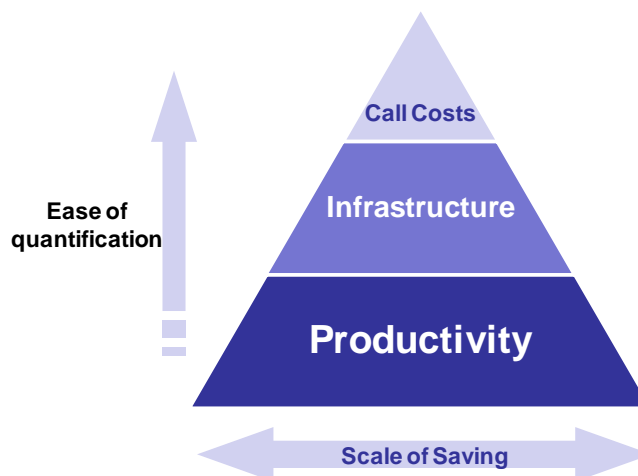
Healthcare	<b>Business Needs and Challenges</b>	<ul style="list-style-type: none"> <li>• Poor in building coverage and restrictions on mobile usage</li> <li>• Inefficiencies / downtime associated with current communications and processes</li> <li>• Multiple methods to reach colleagues (e.g. office, departmental and mobile phones, paging)</li> <li>• Need to quickly access staff on-site and off-site</li> <li>• Increasing demands to reduce costs (e.g. headcount)</li> </ul>
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	<b>Voice Focused Solution Benefits</b>	<ul style="list-style-type: none"> <li>• Efficiencies in managing patient results and locating relevant medical staff; increased focus on patients</li> <li>• Ability to record patient calls for compliance</li> <li>• Improved work rate as facilities staff are always reachable (potential for reduction in head count)</li> </ul>
Retail	<b>Business Needs and Challenges</b>	<ul style="list-style-type: none"> <li>• Workforce needs to be reachable anywhere in store, the office or store room</li> <li>• Management to spend more time in store front, not the office</li> <li>• Enable greater number of employees to take more customer calls</li> </ul>
	<b>Voice Focused Solution Benefits</b>	<ul style="list-style-type: none"> <li>• Improved customer communications enabling employees able to answer external calls and liaise more easily with customers</li> <li>• Ubiquitous contactability in office and an on the shop floor</li> </ul>
Construction	<b>Business Needs and Challenges</b>	<ul style="list-style-type: none"> <li>• On-Site communication is paramount to safety and efficiency, but can be hindered by GSM signal penetration, and fear of unauthorised call usage</li> <li>• DECT and Analogue radio solutions require employees to constantly carry two devices</li> </ul>
	<b>Voice Focused Solution Benefits</b>	<ul style="list-style-type: none"> <li>• Staff can be provided with a mobile handset or have a current handset upgraded to utilise the micro-network, while providing management the ability to curb outside calls</li> <li>• Staff are easier to contact for job updates, while emergency calling is available wherever a mobile handset is present</li> </ul>
Hotel and Hospitality	<b>Business Needs and Challenges</b>	<ul style="list-style-type: none"> <li>• Staff need to spend higher proportion of time in client facing environment</li> <li>• Mobile staff unable to field and respond to customer calls due to expense of supporting widespread mobile calls</li> <li>• Hotels in rural locations suffer from poor coverage, unable to provide sufficient coverage to staff internally</li> </ul>
	<b>Voice Focused Solution Benefits</b>	<ul style="list-style-type: none"> <li>• Facilitates increased flexibility, spending more time in a client facing capacity</li> <li>• Improved customer responsiveness, both face-to-face and phone-based. Staff can be contacted via a no-cost internal link even without access to a staff fixed phone</li> </ul>

## Developing a business case for cellular converged voice

It's imperative that a business considering the deployment of a micro-cellular network understand the return on investment (ROI) they are likely to derive. There are three types of savings an organisation can make from a convergent solution: call costs, infrastructure and productivity.

Figure 6 - Savings delivered through convergence



Call cost savings, whilst the easiest to measure, provide the least scale for savings. More benefits can be derived through infrastructure efficiencies and productivity. Infrastructure savings are delivered through fixed-line replacement strategies and greenfield site deployments, and impact the CAPEX and ongoing OPEX requirements of owning a fixed and mobile fleet. Productivity and improved business processes, whilst providing the greatest opportunity for organisations to derive benefits from convergence, are also the hardest to quantify (E.g. while a converged voicemail solution may save an employee five minutes of effort a day, the benefit may not directly be derived through having an extra five minutes for 'productive' work). The benefits may, in fact, be delivered through customer satisfaction and repeat business as a result of improved response times.

The framework below outlines the different types of saving that should be considered as part of the decision making process when considering convergence.

**Call cost savings**

Since cellular converged voice shifts mobile minutes onto the fixed line network, a logical starting place for developing an ROI framework lies in the cost differences between fixed and mobile calls.

Figure 7 - Comparison of fixed and mobile call costs

	Fixed		Mobile	Opportunity for FMC
	Ofcom	BT		
UK Geographic	£ 0.018	£ 0.029	£ 0.043	✓✓
UK Company Fixed	£ -	£ -	£ 0.018	✓
UK Company Mobile			£ 0.018	
UK On-Net Mobile	£ 0.097	£ 0.071	£ 0.043	
UK Off-Net Mobile			£ 0.098	✓
International (F+M)	£ 0.069	£ 0.051	£ 0.189	✓

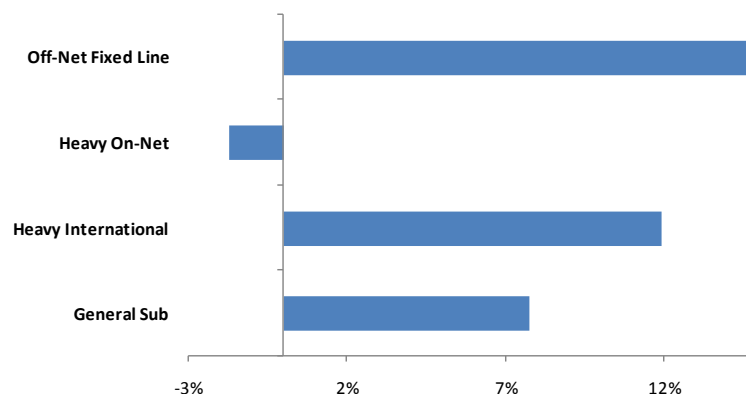
Note: analysis based on SME rates and excludes use of diallers

Fixed lines have an inherent benefit (cost positive) when dialling other fixed lines (whether on-net PBX extensions, national geographic or international), but are less attractive (cost negative) when calling intra-company and on-net mobile numbers. This implies that the calling profile of both the individual and organisation as a whole must be considered when determining potential savings.

The potential for additional call spend control can be achieved when an enterprise subscribes to fixed and mobile voice services from the same provider. Specifically, several operators offer reduced rate fixed to intra-company mobile calling plans (e.g. BT Calling Circle, Vodafone Office 2 Mobile) that can be used in conjunction with a voice converged proposition.

The calling profile of the user will directly impact whether the solution will be cost saving positive or negative, as outlined in Figure 8.

Figure 8 - Call Cost Savings



By examining Figure 8, enterprises can intuitively understand that a subscriber calling many mobiles from within the micro-cellular network is unlikely to see a great degree of savings, while a heavy international caller will likely see significant returns.

Based on the assumption that 50% of mobile calls are made within the micro-network, an average UK calling profile will deliver an estimated 8% saving, compared to a heavy international caller who will save 12%. However, a heavy On-Net caller (with the same Fixed / Mobile / International call profile as the average user) will see a slight increase in call spend of 2%, due to higher fixed to mobile calling rates.

### Infrastructure and management savings

Delivering other cost savings will become increasingly important as mobile operators counter the threat of micro-networks with attractive pricing plans.

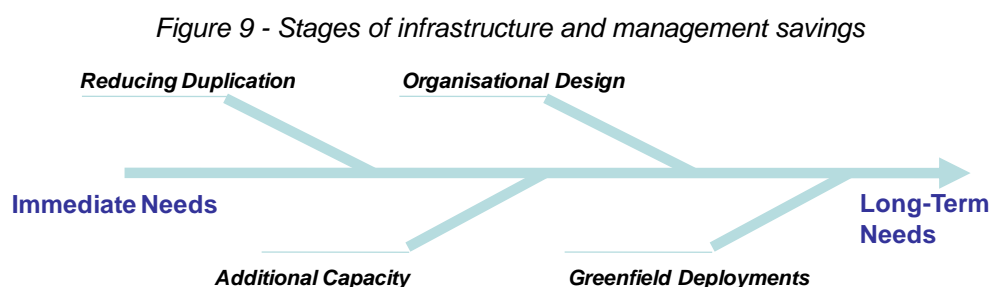
Mobile extension can be seen as a fully flexible and instantly re-locatable desk phone replacement. Depending on the type of subscriber and their role, an organisation may choose to selectively replace fixed line PBX extensions with mobile handsets, providing the potential to deliver savings on Moves, Adds and Changes as the organisation grows, as well as the cost to deploy new fixed infrastructure during a PBX upgrade.

Within an existing business environment, adding further users to a PBX will incur the costs of cabling and installation as well as the basic cost of procuring the handset. In comparison, once the micro mobile network is deployed, adding users to a cellular-based network limits these expenses to:

- The cost of a mobile handset (between £10 and £400 dependant on form and function)
- GSM Base Transceiver Stations (approximately one per 50 handsets, handling seven concurrent calls, equivalent to £35 per handset)

One caveat, however, is that the average lifetime of a mobile handset is far shorter than that of a deskphone and as such multiple purchases may be necessary. In addition, there may be management and maintenance fees associated with the service.

Redbox has identified four stages where an organisation can derive infrastructure and management savings through the deployment of a converged voice solution, as illustrated in Figure 9.



### Reducing Duplication

Enterprises currently suffer from duplication of management fees, with many employees incurring both a fixed and mobile management service charge. While fixed line management charges vary significantly with organisational size and vendor, many organisations will be paying around £250 per year for a fixed line extension, while also paying a mobile service management fee (Figure 10). Clearly in any organisation of scale, immediate savings can be delivered through the removal of a fixed line extension, with the PBX functions becoming extended to the mobile.

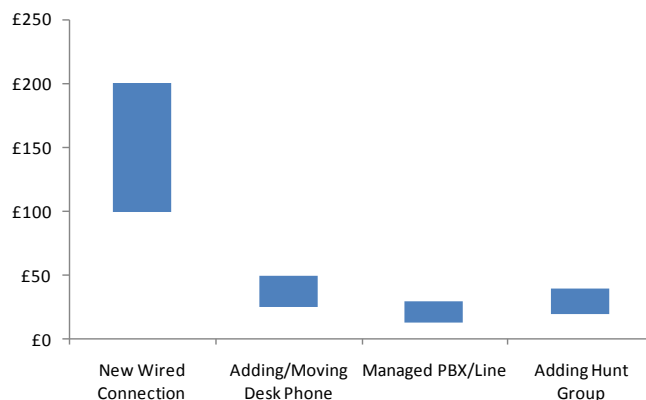
Furthermore, removal of a fixed-line handset can effect an organisation's power consumption and increase its 'green' credentials.

### Additional Capacity

As an enterprise grows a cellular converged voice solution can help ease the pain of incremental changes to a telephony system.

First of all it saves on the cost of individually wiring and deploying a fixed line deskphone, which can cost in excess of £350 depending on factors such as building layout, technology and handset type. With a converged mobile handset provisioning is much simpler, requiring little beyond the installation of a SIM or thin client, and the activation of a users account in the MX.

Figure 10 - Costs to deploy or modify PBX infrastructure



Secondary is the boundary case where an enterprises PBX experiences capacity restraints. Instead of replacing the PBX or adding additional cards (along with the associated deployment costs) a MX can be added. The MX will integrate with the PBX, servicing as virtual fixed line extensions without requiring PBX hardware extensions.

### Organisational Design

Enterprises may wish to move towards flexible working practices such as hot-desking, yet may not have an IP-PBX deployment immediately in mind. A MX can help facilitate this by providing the hot-desking flexibility of an IP-PBX solution without the need for significant (and costly) infrastructure deployment. Since a MX enabled mobile is active as soon as it has detected the micro cellular network, employees are not faced with the challenge of constantly changing their telephone location. As a result, the MX can serve as a substitute for IP-PBX deployment, or a compliment if an enterprise wishes to derive other benefits of an IP-PBX deployment.

Redbox research has identified that enterprises that have deployed converged voice solutions have been able to achieve up to 50% reduction in annualised Moves, Adds and Changes (MACs). This is achieved as they provide new employees with mobile handsets and gradually moved across to flexi-desking where employees were not provided their own desk phone.

### Greenfield Deployments

For greenfield sites, either as part of a new office deployment or a new satellite branch, the potential to completely replace the traditional PBX is much greater. Delivering all office based calls via the micro-cellular network massively reduces the need to wire and integrate fixed phone systems into new premises.

Another cost that can be avoided by deploying a micro-cellular network is that of upgrading the existing PBX. The average lifetime of a corporate PBX is 5-10 years. With many companies now planning and upgrading from their current TDM PBX estates to VoIP, the opportunity is ripe for these enterprises to consider micro-network solutions.

## Improving Productivity

*52% of employees need to use multiple methods to reach colleagues on a weekly basis*

*(Sage Research 2006; Unified Communications Applications, Features and Benefits)*

Financial benefits can also be derived from increased employee productivity and contactability. With improved coverage and the near-ubiquitous presence of mobile devices, employees are able to answer and respond to customer queries and requests, with fewer calls terminating at the voicemail system. Furthermore, increases in communication efficiencies can shorten the decision making cycle, allowing management to be more responsive and faster acting.

The use of converged solutions also enables the workforce to be more productive through functions such as mobile access to direct dial extensions and conferencing.

Employees are able to respond faster to voicemails, and benefit from reduced telephone tag due to increased percentage of calls answered first time. This is enabled through single number contactability in the office, providing 'deskphone anywhere' contactability even when away from the desk, and increased in-building mobile coverage. Specific productivity gains are illustrated by the following examples, collected by Redbox Consulting:

- Consultants within a **Healthcare Consulting** company achieved 10 to 15% productivity gain as a result of reduced telephone tag
- Care givers **Home Care Services** company achieved time savings of 60 minutes each day per employee due to reduced number of voicemails, increased number of calls answered first time and reduced telephone tag
- A specialist call centre within a **Travel Insurance** company handled 25% more calls as a direct result of increased responsiveness of staff
- A **University** achieved one hour time saving per day for IT support staff, minimising delays in reaching colleagues to issue job instructions or resolve issues
- Within a **Hospital** nurses were able to save at least 10 minutes each time they retrieved patient results, by being able to access and check results irrespective of location within the hospital

Productivity benefits can be relatively difficult to quantify and are best addressed on an individual basis. However, financial savings can be found by calculating for example, the number of minutes saved per day through enhanced communications and business processes (e.g. time wasted unnecessarily visiting office to pick up desk based voicemails or job schedules if unreachable on campus). In addition, the ability to rapidly and consistently answer enquiries and client calls can ensure that a client is gained and maintained owing to a better standard of service.

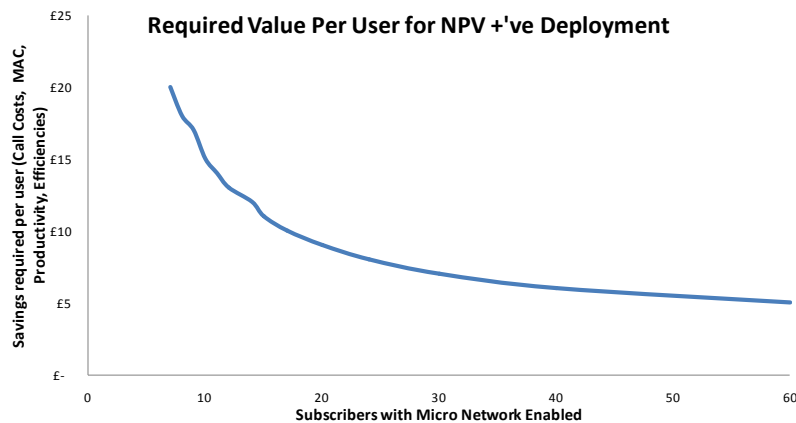
Although more difficult to measure, Redbox believes it is imperative for organisations to incorporate softer benefits into the ROI evaluation. Our research has shown that softer benefits can lead to quantifiable revenue, customer retention, and work rate or cost saving improvements for enterprises.

## Operational Scale of Convergence

Understanding that not every converged subscriber will derive the same benefits from a micro-cellular network, it is necessary that an organisation deploying the solution understands the minimum efficient scale of the system.

Figure 11 illustrates an example of the minimum number of subscribers and the minimum monthly saving each user must derive from the deployed solution in order to ensure that the deployment is Net Present Value (NPV) neutral. Additional subscribers with the similar return characteristics will deliver further returns for the organisation. These numbers are

*Figure 11 - Breakeven analysis based on scale of deployment*



based on amortising hardware and software CAPEX over a five year period, including any ongoing licensing fees as part of operational expenses.

### Organisational Characteristics Matter

We can conclude that there are certain types of organisations for whom cellular based convergence is a ripe opportunity:

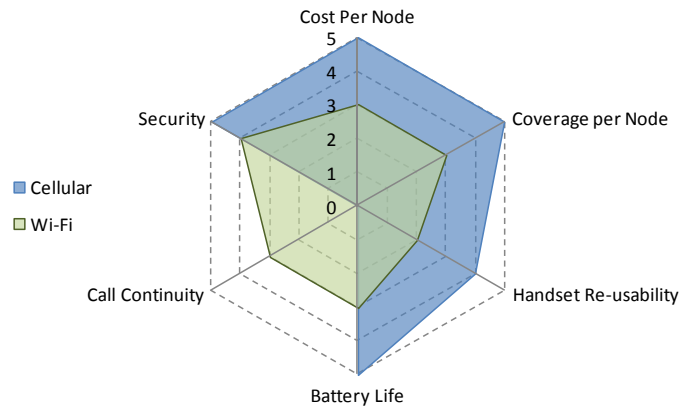
- Companies deploying new or satellite offices can benefit from massively decreased infrastructure and deployment costs
- Companies with rapidly growing or cyclical organisations can save on Moves, Adds and Changes
- Companies deploying hot-desk solutions can save the cost of deploying and managing IP based PBX systems
- Companies planning to upgrade existing PBX and telephony infrastructure
- Companies with high international or landline spend can save on calls
- Companies with a need for rapid response times and contiguous connectivity can save on employee downtime and communication inefficiencies

## The relative advantages of GSM in a micro-network

There are many issues that enterprises must consider when deploying a private wireless network - regardless of access technology. The type of deployment will depend heavily on the number of users, number and distribution of sites, calling profiles, existing infrastructure deployment (WLAN, LAN, WAN and PBXs), PBX interoperability, and the existing handsets used within the organisation.

As shown in Figure 12, cellular based private networks have some distinct advantages over other access technologies:

Figure 12 - Attribute Comparison of Cellular and Wi-Fi Micro-Network Deployments

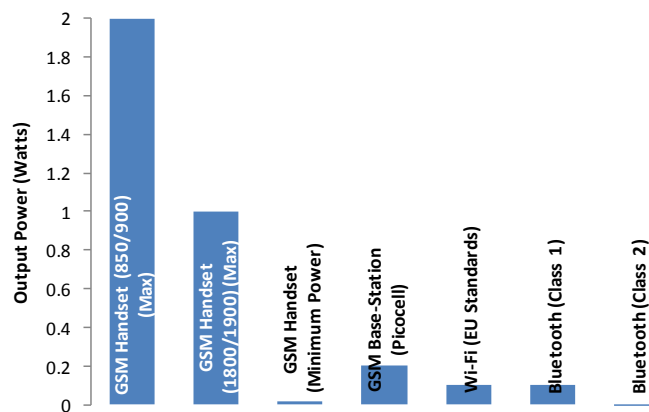


### Battery Life and Green GSM

One of the strongest comparative advantages of picocells when compared to Wi-Fi deployments is superior battery life. While smarter software and low-power states have greatly improved Wi-Fi battery life, dual-mode deployments still require two network connections to be active within a device, resulting in a dual drain on the battery. In comparison, cellular based convergence relies on one network connection. Battery life is managed more efficiently when connected to a picocell, as a handset will not need to transmit on higher-power bands whilst in the office that are necessary when connecting to public GSM.

Installing a mobile base station may initially appear undesirable due to perceived health concerns. The opposite is, in fact, the case. For example, a mobile device close to a picocell transmits at a fraction of the power required compared to the power required to connect to public GSM in a low coverage area.

Figure 13 - Output Power for GSM and Alternate Access Devices



### Handset Replacement and Reach

Picocell based convergence can be deployed with most mobile device produced after 2000. There are two upsides to a picocell-based convergence solution:

- An enterprise does not need to upgrade its mobile fleet for a convergence deployment
- An enterprise can choose to enable an employee’s personal mobile phone on the private network, allowing the organisation to derive convergence benefits without the need to issue a company provided mobile or cover employee’s personal mobile calls

## Security

GSM security has been tried and tested over 17 years across a base of two billion users. Private cellular networks use the same authentication and encryption as macro public GSM networks, leveraging inherent security benefits. Using other converged solutions, such as dual-mode Wi-Fi, requires the implementation and use of additional authentication software, when moving from a macro to a micro-network.

## Usability

Pieces of software, known as clients, are normally required to manage network connections in a voice focused converged solution environment. Picocell-based solutions may require a low specification client which requires no interaction from the user and simply makes decisions about which network the device should be connected to. This means that the end users can continue to use their mobile as normal. While enhancements to the user experience and functionality can be made through the deployment of an additional high-level client, such a client requires users to learn to use this additional software.

## Ease of deployment / Implementation costs

Uncertainty about actual implementation costs of convergence provides a significant barrier to entry. IT departments' experiences with deploying existing IP telephony networks and Wi-Fi infrastructure provide a basis of judgement before analysis. This challenges FMC vendors to ensure deployment and implementation costs are kept reasonable, and deployment times low.

Ease of deployment is, in fact, a major advantage of a picocell solution relative to a Wi-Fi network. The number of access points required for a picocell system can be **ten times** lower than those required for Wi-Fi and **five times** fewer than DECT. This has a positive impact on both the frequency/network planning and installation of the solution, resulting in lower deployment requirements in terms of time, disruption and cost.

A private cellular network can be deployed either integrating into an existing PBX, or serve as a stand-alone wireless PBX. A standalone deployment, whether in a greenfield site or as an alternative for a PBX upgrade, it massively reduces the need for fixed phone wiring (particularly if the choice was made to eliminate fixed lines). In addition, deployment of a standalone picocell network does not require integration with existing PBX hardware. This negates any potential feature transparency issues with multi-vendor legacy systems, reducing the complexity, and thus costs, of implementation.

## Data

With many enterprise devices accessing the internet (either through web browsing or e-mail systems such as Microsoft Exchange) some enterprises may find wireless data connections congested as more subscribers utilise bandwidth from a single MNO base-station. Micro cellular networks can provide an independent data connection, with bandwidth that is not shared with the macro cellular community. Furthermore, due to the private nature of the connection it is possible to use micro-networks as a platform for the internal deployment of mobilised productivity applications with contiguous access to corporate data sources.

## Challenges facing convergence deployments

A number of challenges still face many convergence deployments. While these are currently being addressed by service providers and vendors, enterprises need to consider their impact on their communications strategy. For example:

- Text messages originating from the micro-network will appear to originate via a gateway number, requiring employee vigilance in ensuring that direct contact details are supplied within each communication

- Outbound calls can be masked by a gateway CLI, dependant on the fixed line provider used. This is particularly relevant for employees that screen their calls using the CLI prior to answering
- Mobile handsets present in the micro-network are effectively disconnected from the macro network, requiring call forwarding be correctly implemented on a per handset basis. If not, incoming calls to the user's mobile number will be directed to voicemail

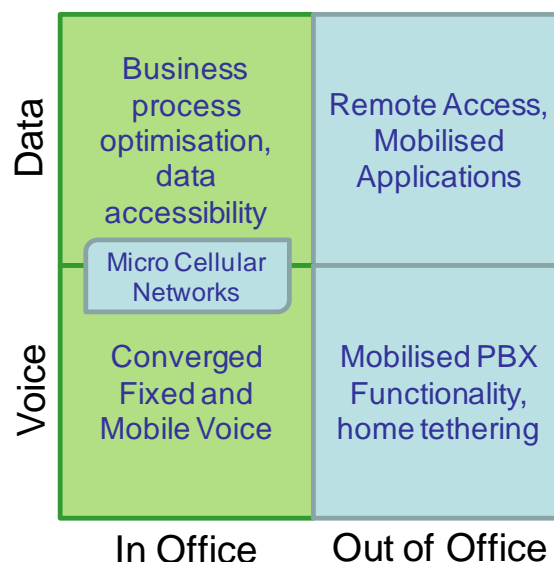
## Closing remarks

Voice focused convergence, when thoughtfully considered and deployed with an overall communications strategy in mind can be a powerful enabling toolkit for an enterprise. Convergence benefits range from and beyond call cost savings though to other hard costs such as simpler deployments and fixed handset substitution, through to softer benefits such as increased contactability, quicker decision making, less downtime, and improved productivity. Depending on the enterprise requirements, cellular convergence can have a marked benefit above alternate access technologies, ranging from maintaining/improving handset battery life through to an overall decrease in infrastructure required to deploy PBX functionality in a greenfield site or PBX replacement scenario.

### The Beginning of Convergence

Converging voice in the office is one of four steps to complete convergence, but it serves as a platform for all. While the main benefits of a micro cellular network are voice related, the same network is an enabling platform for mobilising business process enhancement software within the office. Furthermore, it serves as a stepping stone to providing enhanced voice functionality such as PBX extension, presence enabled services and low-rate international dialling to mobile handsets while outside of the micro-network. Since micro-networks are application (voice and data) indifferent, any further application enhancements will run over the top, paving the way for enterprises to deploy totally converged communications (illustrated in Figure 14 below).

Figure 14 - Four steps to total convergence



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### About Redbox:

Redbox Consulting is a specialist telecoms and media company delivering focused consultancy advice. We assist mobile, broadband and fixed line clients shape, execute and manage their growth strategies. In addition, Redbox delivers bespoke benchmarking and research to enable clients to make robust business decisions based on reliable market intelligence.



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### About Private Mobile Networks Ltd

Private Mobile Networks (PMN) is a privately owned PLC registered in Thirsk, North Yorkshire, United Kingdom. Founded in January 2006 PMN develop and own all rights to the Private Mobile eXchange (PMX) product. The company is focused on providing private cellular network solutions for enterprise and service provider customers.

Private Mobile Networks Ltd provides business users with the ability to add existing mobile telephones to a corporate voice network irrespective of PBX type. The mobile phone becomes an extension of the company PBX.



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<sup>i</sup> Redbox Consulting, 2008

<sup>ii</sup> Economist Intelligence Unit, February 2007

<sup>iii</sup> Cisco 2007; "Presence Boosts Mobile Phone Productivity"

<sup>iv</sup> IDC, 2007; European Vertical Market Study