



Making the most of mobile broadband with HSPA and Femtocells



Stewart Baines, Futurity Media interviewed ip.access and the Femto Forum

Mobile operators have proved incredibly successful at delivering essential and appealing voice and data services to people on the move. Now the focus is moving indoors. Thanks to a new convergence technology known as femtocells - tiny, low-powered 3G base stations - mobile operators are able to bring their services right into the home. With HSPA-enabled femtocells there is now a compelling alternative to fixed-line telephony with DSL based broadband, digital television and PC downloads.

HSPA-capable femtocells will drive fixed-mobile substitution to record levels; give subscribers an improved environment for trying out broadband content services; and provide operators with an opportunity to significantly reduce operational expenditure.

Extending the network - coverage and services

Delivering high-quality mobile broadband inside buildings is a tough challenge for the macro network because walls, metal and even some glass attenuate the radio signal. This is a particular problem for 3G/HSPA because it uses higher spectrum bands where radiofrequency signals attenuate more rapidly and because the faster/fastest data rates are only possible when the quality of the signal is strong. The femtocell tackles this problem by bringing the mobile network indoors.

Femtocells are low-power wireless access points that operate in licensed spectrum with a range of around 30 metres. They backhaul

mobile voice and data to an operator's 3G network via a broadband Internet connection, typically DSL. Femtocells operate only within an operators' licensed spectrum so can be used to complement macro networks, providing indoor coverage where it is currently poor or non-existent. Because of the improved propagation from having an indoor-only base station, the reduced contention means the femtocell could offer data rates as fast as the DSL that backhauls it.

Femtocells tackle the problem of delivering very fast mobile data services without significantly increasing capital expenditure.

Plug and Play Mobile Broadband / Simple to install

The femtocell does not require an engineer visit to install or configure. Typically the size of a WiFi access point, it simply plugs into an existing DSL modem much as a PC or laptop would. In the future femtocells may even be combined with WiFi, DSL modem and router in a single home gateway.

Unlike existing fixed-mobile convergence solutions utilising dual mode WiFi and GSM handsets, femtocells do not require a dual mode mobile device to support yet another air interface, with corresponding impact on mobile battery life. A femtocell is a fully functioning 3G base station (Node B) or 2G BTS, supporting any 2G/3G/3G+ device.



Mobile broadband demands more capacity

With the emergence of HSPA software upgrades to 3G mobile networks, operators can now offer affordable broadband bundles and a range of compelling content services such as video downloads at speeds up to 3.6Mbps (typically 700kbps to 1.8Mbps).

“Currently, most 3G networks are running well below capacity, but even a moderate level of adoption of mobile broadband services could quickly impose strains on the radio network and backhaul,” says Simon Saunders, chairman of the Femto Forum, an industry body comprising vendors and operators.

The problem of network capacity is exacerbated by the challenge of providing indoor coverage. A macro base station typically uses up 40 times more power providing coverage for a device used indoors than one used outdoors. Because of the way that 3G works, power is shared amongst all users in a cell. If some of the users are indoors, it reduces the capacity of the macro cell as a whole and so quality of service suffers for all users.

If more high-bandwidth sessions, such as a music track download, can be moved from the macro network to a femtocell, extra capacity is available on the macro network for outdoor users. (See Figure 1: Annual Femtocell Saving Per Customer – Effect of Data Rate.)

Reducing operational expenditure

An interesting approach for mobile operators would be to have a combined macro and femto access strategy which could deliver considerable financial advantages even without increased usage of voice or data services.

A study by femtocell technology developer, ip.access, found that an average city of around 90,000 people requires about 202 macro cell sites, to provide it with widespread 3G coverage. Each site costs on average €4900 per month to maintain. (see Figure 2: Monthly Cost of Operating a Macro Cell)

If 20% of subscribers had access to a femtocell, the mobile operator would only need 164 macro sites to cover the entire city, saving around \$186,000 per month. The cost of supporting 9,000 femtocells (taking into account that some will be shared between subscribers) is roughly \$96,000, thus delivering a net saving of around \$90,000 per month.

According to Analysis Research, the more femtocells are deployed, the more impact it has on reducing the cost of delivering mobile broadband. (see Figure 3: Annual Cost Saving Per Customer For A Small Operator Deploying 3G Femtocells)

“Deploying femtocells could potentially help an operator reduce its cost of delivery and also provide a significantly improved user experience, allowing subscribers to try new services with confidence,” says Chris Cox, marketing manager, ip.access. “The femtocell can be a major factor in making the mobile phone an effective complement to the PC and TV for accessing entertainment and information services at home.” In trials, 35% watched mobile TV at home, not on the move.

Furthermore, the PC is sometimes an unnecessary intermediary between the phone and the web. Much of the user-generated content shared on the Internet is captured on mobile phones, and RSS feeds and podcasts are often consumed on portable devices. It is much easier to upload videos and photos directly from the mobile phone to websites like YouTube and Flickr, and also to download podcasts and music directly to the 3G/HSPA phone from the web, rather than having to sync files with the PC.

A truly mobile Internet experience

Imagine an application on the handset that is aware of being on the home femtocell, and automatically starts to upload user-generated content to websites like YouTube and Flickr, as well as downloading podcasts and other content from the Internet. This would be bandwidth intensive for the operator to offer as a service on the macro network, but could be realistically provided at home using a femtocell.

Because the data is being transferred over DSL, the service could be offered free to the subscriber. Operators could also use the “free” backhaul to offer cheaper downloads from its own portal if downloaded whilst in the femto zone. If a music track is downloaded at home it could be priced at the same level as if downloaded to a PC, but without the hassle of side loading and keying in credit card details.

For the integrated operator – offering both mobile and domestic broadband services – the femtocell allows them to offer fully bundled ‘at home’ services that encourages the use of premium-content services only available through the mobile portal. This is a cost-effective solution that creates synergy between the fixed and mobile services, and differentiates the operator’s broadband service from fixed-only competitors.

The femto cell also improves the quality of voice calls, particularly important to subscribers with poor indoor coverage or who live in very rural locations. The cost of providing adequate coverage from the macro network may prove too onerous for the operator. In this sense, the femto cell is a win-win for customer and operator.



Business case based on substitution

If an operator is concerned solely with boosting voice revenues through fixed-to-mobile substitution, the business case for deploying femtocells is clear. Femtocells reduce the cost of delivering calls at home, allowing mobile operators to compete on a level playing field with fixed-line providers.

Research by Analysys shows that if mobile operators simply cut all mobile tariffs to be in line with fixed line calls, revenues from mobile calls made at home – at the expense of the fixed line – will increase. But this will be negated by the fall in gross revenues made from calls outdoors – currently around 60% of calls. These indoor calls may increase in volume and duration, but lower tariffs means lower gross revenues.

Where operators have used ‘homezone’ pricing, the use of the fixed line has fallen dramatically. Consequently, revenues from calls made in the home have boomed, while outdoor call revenue remains unchanged as customers continue to pay the premium for being mobile.

There has been a measure of success to ‘homezone’ pricing based on cell ID. However, the increased revenues from calls made at home do not reduce the operational cost of the delivering those calls. Operators still need the same macro network irrespective of whether the calls are made at home or not.

Femtocells give operators the opportunity to redress this distortion. Low tariff calls made indoors can be matched with a low cost infrastructure; outdoor calls remain premium rated to match the more capital intensive macro-network infrastructure.

And those previously without coverage at home would provide a significant stream of new revenue. ip.access estimates that a subscriber with no mobile coverage at home whose monthly bill is €45 - 80% of which is from voice services - could be expected to spend around €11 more each month if they had a femtocell.

Faster, cheaper, better

There are a number of ways to build a business case for deploying femtocells. An operator can look at the merits of delivering its existing services at a lower cost; it could also look at how the improved user experience promotes the uptake of new content services and further use of the mobile instead of the fixed line services.

The technology is mature and proven as most of the standards are already defined for use with the macro networks. The Femto Forum, an industry body representing operators, hardware manufacturers and OSS vendors, is ensuring that product development and deployment happens in a joined up way so that operators can confidently pursue a multi-vendor strategy. The unit cost of a femto access point is currently about \$200 – compared to \$60,000 for a macro base station - but analysts believe this will fall significantly when the first services launch in the second half of 2008. ABI Research predicts that there will be 102 million users on 32 million femtocells by 2011 .

“Operators must decide how they will charge users – if at all – for the femtocell,” comments Femto Forum’s chairman, Simon Saunders. “In some markets, where indoor coverage is known to be poor, there may be a certain tolerance among users to pay for the femtocell on the basis of improved service quality. In other markets, operators may need to subsidise a portion of the cost of the femtocell against cost savings and future ARPU increases.”

There will be many opportunities to increase ARPU. With a femtocell offering HSPA, the mobile device will be able to compete not just with a fixed line phone with DSL based broadband but also the TV and PC as a means of entertainment and information. The macro network alone cannot provide a good enough user experience for high speed data at home.

Ultimately the success of femtocells depends on operators finding the right combination of discounts and new services to attract end users and by incorporating HSPA mobile broadband these can be significant for operators.

Figure 1: Annual femtocell saving per customer - effect of data rate

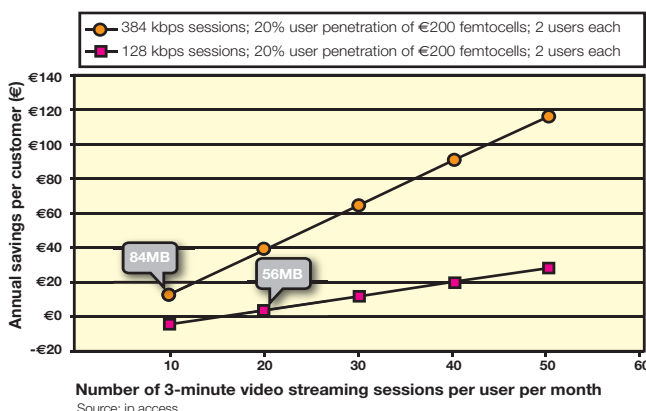
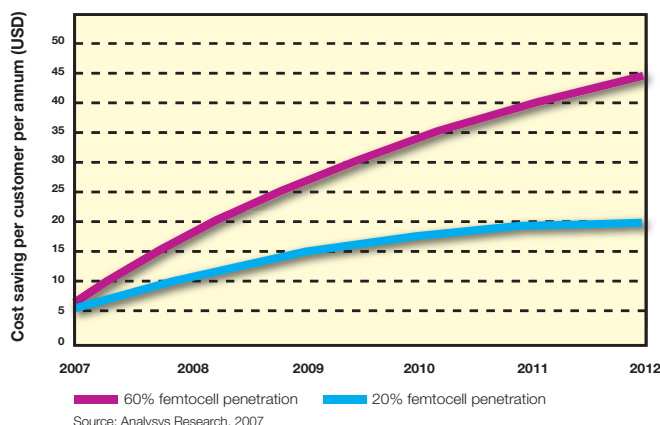


Figure 2: Monthly cost of operating a macro cell

Cell site spec	
2+2+2 HSDPA configuration	
Spectral efficiency of 2 Mbps/cell	
Busy hour utilisation is 80%	
Busy hour share of daily traffic is 20%	
Radio capex costs (includes TRX, RNC and core network)	
Cost per sector per carrier	€ 16,000
Number of sectors	6
Capex cost	€ 96,000
Cost per month (with amortisation over 6 years)	€ 1,333
Cell site costs	
Macro site acquisition	€ 37,000
Macro site construction	€ 88,000
Cost per month (with amortisation over 15 years)	€ 694
Opex	
Power (3 kW at €0.10 per kwh)	€ 216
Cooling	€ 69
Site rental	€ 750
Site maintenance (1 visit per annum)	€ 42
Opex per month	€ 1,077
Backhaul costs	
Cost of E1 backhaul line per month	€ 600
E1 bandwidth (Mbit/s)	1.9
E1 full capacity (MB/month)	615,600
E1 actual max capacity (MB/month)	225,720
Number of E1 lines required (at full capacity)	3
Total backhaul cost per month	€ 1,800
Total monthly radio cost per cell site	€ 3,105
Total monthly backhaul cost per cell site	€ 1,800
Monthly cost of a cell site at full capacity (capex + opex inc backhaul)	€ 4,905

Source: ip.access & HSDPA / HSPA for UMTS, edited by H. Holma & A. Toskala, 2006, p144-153.

Figure 3: Annual cost saving per customer for a small operator (with 5 million customers) deploying 3G femtocells



Source: Analysys Research, 2007

