Business Case (Investor / Mobile Operator)

Site Acquisition Proposition for Small Cell/3G Data Offload

1. Executive Summary

The massive growth in mobile data applications and resultant broadband traffic has placed severe pressure on mobile operators. Put simply, 3G networks are completely overloaded, especially in high-density environments such as urban centres, transport hubs and public locations.

Today with network capacity being stretched to the limit, causing degradation in the service experience for millions of users and average revenue per user (ARPU) falling, the mobile operators must adopt a new network model.

In addition, with data consumption forecast to grow exponentially for the foreseeable future and flat rate data tariffs fast becoming the norm, mobile operators will have to consider how to carry more data for less revenue per user.

So while network upgrades would seem unavoidable, there is no clear revenue growth justification for the capital investment. As mobile broadband volumes grow, the profitability of mobile networks will shrink because of increased network costs and falling ARPU.

Currently a number of mobile operators are upgrading their 3G networks and have announced 4G strategies. But while 4G technologies, such as LTE will provide more capacity in terms of bandwidth, they will require significant investment and additional macro sites. However, even with such investment, industry research forecasts that any network capacity growth will be insufficient to keep pace with demand.

In the UK Ofcom are preparing to auction 4G spectrum in the 4th quarter 2012, but this is not without controversy.

Ofcom revealed in its proposals for the perpetually delayed auction of 4G spectrum that Three, the UK's smallest mobile operator, would be the only network guaranteed bandwidth. However rivals such as Vodafone have disputed Three's claims that its business would be unsustainable otherwise and that it would have plenty of opportunities to gain enough spectrum in the process, meaning it shouldn't be entitled to cheap spectrum

It was previously believed that Everything Everywhere, the UK's largest mobile network in terms of subscribers, would also be guaranteed bandwidth, but this is no longer the case. The operator has instead announced plans to create a 4G network on its existing spectrum, a move which has caused Three to threaten legal action, arguing that EE should not be allowed to launch it before the auction

Source: Sunday Times May 2012.

Everything Everywhere has the biggest third-generation mobile network in the U.K., competing against Vodafone Group PLC, Telefonica SA's U.K. arm O2 and Hutchison Whampoa Ltd.'s Three U.K.

Scaling network capacity will only mask the problem, so if mobile operators are to avoid a capacity crisis and the subsequent financial implications, they will need to adopt a radically different approach.

Fortunately, much of this increased data traffic is directly attributable to dual-mode smart phones, many of which now are Wi-Fi enabled. According to research at In-Stat, “the next 5 years will see an increase in the number of Wi-Fi-enabled devices, from over 500 million in 2009 to nearly 2 billion by 2014”.

Using Wi-Fi to offload data from 3G/LTE networks will allow operators to take mobile broadband traffic off their cellular networks and onto cheaper wireless access networks. Adopting Wi-Fi technology will not only reduce network costs whilst maintaining customer revenues, but will provide much greater capacity in areas of high user concentration.

Importantly Wi-Fi networks deployed as 3G data offload networks today will continue to serve as 4G data offload networks in the future

3G offloading can take several forms, indoor WiFi ‘Hot spots’ typically installed in retail premises and cafes and outdoor ‘Small Cells’ consisting of a mix of technologies including WiFi/Femtocells/3G/LTE micro cells.

These outdoor WiFi based networks are usually installed on street assets, including lamp and CCTV columns, bus shelters and buildings. The business case for these includes leasing portions of the infrastructure to mobile operators, allowing them to roll-out citywide Wi-Fi networks for a fraction of the cost of 4G networks with much higher capacity where it is needed in busy urban areas.

AWTG is a leading technology player in the design deployment and operation of outdoor Small Cell networks having built and operated networks in the busiest areas of the UK. AWTG is building networks for offload of 3G data onto the Internet and is also integrating WiFi networks into the core network architecture of existing UK Mobile Network Operators.

2. Market Analysis & Commentary

The predictions…

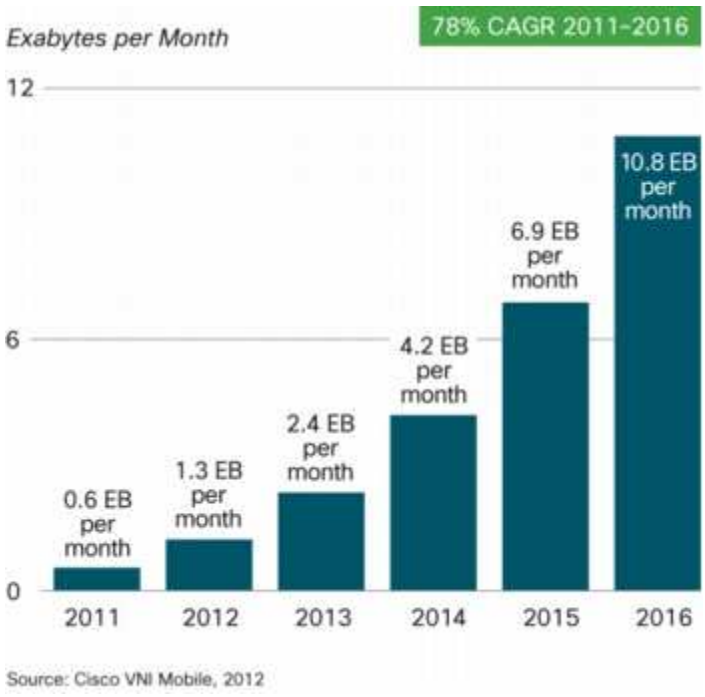
- Internet infrastructure equipment maker Cisco Systems predicts that by 2014 there will be more than 5 billion personal devices connecting to mobile networks, as well as billions of machine-to-machine devices also connecting to networks (Smart Money 2010)
- In an interview with the Financial Times, O2 Chief Executive Ronan Dunne said that he had been disappointed with the performance of O2's network since the summer, explaining that the company was struggling to cope with the rising number of mobile apps, particularly those associated with Apple's iPhone. (PC Advisor 2010)
- "A laptop equipped with a dongle consumes 450 times more bandwidth than a classic mobile phone", said Pierre-Alain Allemand, who oversees the mobile network at France's second largest operator SFR (Cellphone ATL News 2010)
- The proportion of Wi-Fi enabled mobile phone owners who use the facility on their devices will reach 80% in 2015 (Telecoms Market Research 2010)
- Researchers predict that more than one billion people around the world will be using mobile broadband by 2012; however some European mobile operators claim that current levels of use are already crippling their networks (BBC 2009)
- Chief Operating Officer John Stankey said AT&T plans to spend between $18 billion and $19 billion in 2010 upgrading its wireless and backhaul networks to handle the onslaught of new traffic. This is roughly $2 billion more than the company had invested in the previous year (CNN 2010)
- "You can easily lose money on mobile broadband if you do it in the wrong way," warns Bjorn Amundsen, director of mobile network coverage at Telenor in Norway. "We have had to be careful not to invest too much, because the only thing that would happen if we did would be to increase data traffic without an increase in our profits." (BBC News 2009)

. . . have become the reality

Global Mobile Data Traffic, 2011 to 2016

Overall mobile data traffic is expected to grow to 10.8 exabytes per month by 2016, an 18-fold increase over 2011. Mobile data traffic will grow at a CAGR of 78% from 2011 to 2016 (Figure 1).

Figure 1. Cisco Forecasts 10.8 Exabytes per Month of Mobile Data Traffic by 2016



The dramatic growth in the number of Smart phones and tablets with the consequent rise in the mobile 'Apps' industry means that the predicted demand for mobile bandwidth is being confirmed by every survey and industry statistic.

3. Why Mobile Operators need a New Network Model

With this explosion of smartphone sales, data traffic on today's 3G networks has spiked drastically to the point where data traffic is outpacing new revenue for the mobile operators.

As noted by Disruptive Wireless, while operator's revenues have increased by 50-100%, data services have increased 3G traffic by anywhere from 500-1000%. This has created a serious problem for the mobile operators, as their 3G networks are overloaded, especially in high-density environments such as urban centres, transport hubs and public locations.

This has led to degradation of 3G data services in congested areas and operators that are not recouping anywhere near as much in revenue as they are being forced to provide in network capacity.

Mobile broadband is now rapidly expanding into the broader consumer market. The number of devices connecting to mobile networks is projected to grow significantly over the coming years, with Ericsson predicting there will be 50 billion internet connected devices by 2020.

At the same time, the volume of data consumed per device is growing at very significant rates and this trend is expected to continue with the growth of media devices and Internet applications. As a consequence mobile operators will need to make substantial capital investments, not only to satisfy existing customer demands but also to accommodate new users.

Unfortunately capital investment in mobile broadband is much less scalable than with the voice model. Some studies suggest that the network costs of 1Mb of data may be 7 times the cost of 1 voice minute. Because of increasing traffic levels per user, each unit of mobile broadband network investment supports a proportionally smaller number of incremental users.

Whilst wireless technology developments in HSPA and LTE provide increased capacity, the rate of data growth will outpace any gains delivered by these technologies. As well as the investment required for these upgrades, greater demand for capacity will also result in increased backhaul costs.

The financial consequences are serious. Mobile broadband operators will see CAPEX lifetime reduced alongside increased capital investment, with depreciation costs increasing as a consequence. The outcome will mean higher costs, lower margins and free cash flow.

Increasing prices to offset rising costs is not an option, as mobile broadband has driven operators to adopt a model similar to fixed line internet access – flat-fee subscriptions with “all you can eat” usage. This is totally different to the traditional voice and SMS model, where revenues and costs maintain a relation to traffic. The mobile broadband business model offers less scalability and sees cost per customer increase with usage, while revenue per customer remains constant or even declines.

Stepping back from the fixed fee model will be difficult, as users are unlikely to accept megabyte based charging with associated ‘bill shocks’. Even where operators apply usage caps or ceilings, this can’t be relied on to constrain demand, as the “all you can eat” model is now well established for mobile broadband services.

Increasingly in the UK, mobile operators are unable to provide the capacity requirements in high demand areas such as central city zones and suburban high streets. Increased traffic coupled with capacity constraints has very significant effects. It leads to degradation of data services, reduces the number of new customers an operator can secure, increases the churn rate (as dissatisfied customers move to other operators) and prompts demand for increased investment, affecting cash flow.

As mobile broadband is now a mass consumer proposition, 3G operators are faced with ever increasing costs, an immediate need for significant capital investment to upgrade their existing networks and decreasing revenues per user.

And while there are clear benefits to co-operation between the operators, policy control and network optimisation, continued traffic growth will mean that at best, the problem is postponed. If mobile operators are to meet the challenges of the mobile broadband market, they will need to adopt a network model that will allow them to offload data traffic onto a cost effective, time-to-capacity technology such as Wi-Fi.

4. The Case for Wi-Fi Offload

With mobile broadband services set to continue consuming large amounts of 3G network capacity, there are a number of ways mobile operators can combat the capacity crunch. These include traditional approaches such as building new cell sites, policy control and network optimisation. However all these proposed solutions has their limitations.

Scaling network capacity or addressing traffic demands with technology upgrades is an expensive value proposition. Other innovative solutions, such as data throttling (used to punish the biggest consumers of data), are likely to alienate the section of subscribers that are singled out. While radio technology continues to improve the efficiency of transmission and reception, there are limits as to how many bits can be compressed into a radio stream.

Offload on the other hand provides an alternative to alleviating data congestion in mobile networks. If data traffic from a bandwidth-hungry user is offloaded to an alternate overlay network, it will release capacity for other users on the mobile network. Alternatively, a user competing for capacity from a loaded macro cell can be offloaded to an alternate network. These networks can function with the existing macro cellular network, either operating independently or as an overlay solution.

Wi-Fi and Femtocells are possible contenders for offload, while they were previously viewed as competing technologies, there is an now an increasing use of mixed 'Het Nets' (Heterogeneous Networks) mixing WiFi/Femtocells with 3G/LTE devices and complex backhaul.

Wi-Fi based Small Cells offer the following key advantages for offload today:-

- Millions of subscribers are already using Wi-Fi as their primary source of data and Internet access. Offloading data from 3G to Wi-Fi will preserve this experience

- Where the requirement is to meet high capacity demands in congested areas such as urban centres, transport hubs and public locations, Wi-Fi's cost-to-capacity advantages are

substantial. Using 802.11g, Wi-Fi Small Cells can provide 15 times the capacity of HSPA and using 802.11n can result in 20 times the capacity promised by LTE

- Given the urgency with which data capacity is required, Wi-Fi offers time-to-capacity advantages that can't be matched by deploying 3G/4G capacity

- Whereas availability of spectrum is often the limiting factor for mobile operators, Wi-Fi allows data traffic to be shifted off expensive, licensed bands to exploit the 2.4GHz and 5GHz unlicensed spectrum

- Wi-Fi is globally standardised and royalty-free, making it possible for device manufacturers to build the technology in at source and ship devices worldwide, driving substantial economies. As a result, the technology has become ubiquitous in consumer electronics, laptop devices and is fast becoming standard in smartphones and other devices

In order for Wi-Fi offload to work, operators will need to take a number of crucial steps. Firstly, it is not practical to move all traffic onto Wi-Fi networks, so operators will need to decide where to use Wi-Fi and where to keep traffic on the cellular network.

The handover between cellular and Wi-Fi networks needs to be seamless, so that users notice no interruption of service. An important development to enable this is in the incorporation of authentication in mobile handsets. The Apple iPhone and Blackberry both currently support EAP-SIM authentication, which means that MNOs can automatically recognise their users within range of a Small Cell and join them to the network if desired. Android handsets are currently limited to Wispr authentication, this can also be automated if desired.

With increasing Wi-Fi penetration and the ability of the technology to provide high capacity at a low cost, in high traffic public locations, Wi-Fi offers mobile operators the opportunity to offload data traffic, releasing expensive cellular capacity for future growth and ensuring service expectations are met.

5. The Solution - Next Generation Small Cell Wi-Fi Networks: Metro Wireless revisited

Today hotspot networks do not provide ubiquitous Wi-Fi coverage in even the largest metro areas, so if 3G offload is to prove effective, mobile operators need customers to stay within the confines of the designated hotspots (which they of course they do not).

So if mobile operators are to offload traffic onto Wi-Fi but they can't rely on users to remain within the current network of small, distributed hotspots – what can they do? This brings us back to the

original metro Wi-Fi model that was conceived several years ago but failed due to the inability to generate sufficient revenues to fund the networks or payback the initial investments.

The objective of metropolitan Wi-Fi networks was to deliver ubiquitous wireless broadband access across entire boroughs or cities. The model was based on the premise that Wi-Fi would be provided free to the local community, business and visitors with the costs being picked up by the local authority or paid back through advertising that users would be exposed to every time they logged onto the service. The problem was that the users did not come in volumes and the lack of revenue meant that cities could not afford to complete the network builds or were forced to shut them down due to the operating losses incurred.

So if the original concept failed, why would the next generation of metro Wi-Fi networks succeed? The answer lies in understanding that the proposition to build city Small Cell/Wi-Fi networks to offload 3G data traffic is fundamentally different to the proposition of deploying networks to provide free wireless access. And in particular, the problems they are aiming to solve, the business model and the return.

While we have summarised the flaws and limitations of the original metro Wi-Fi model, outlined below is the justification as to why second generation city Small Cell networks can immediately offer a solution to the capacity and financial dilemmas facing the mobile industry.

<u>Small Cell Wi-Fi Networks - The 3G Offload Model</u>

The problem...

- Massive growth in mobile data applications has placed severe pressure on mobile networks, especially in high-density areas such as urban centres, transport hubs and public locations
- Congestion on 3G networks is causing degradation of data services and an increase in the churn rate of subscribers
- 3G operators are faced with ever increasing costs, an immediate need for significant capital investment to upgrade their existing networks and decreasing revenues per user
- Mobile operators need to adopt a new network model that will allow them to offload data traffic onto a cost effective, time-to-capacity technology

The business model...

- When the original metro wireless networks were deployed, there was little demand for ubiquitous Wi-Fi coverage. Today millions of subscribers are using Wi-Fi enabled devices and demanding to be able to access data everywhere they go
- Rather than expecting public authorities to pick up the bill, the mobile operators would fund the roll-out of city Wi-Fi networks, providing Wi-Fi access for all

- Operators will be able to deploy metro Wi-Fi networks for a fraction of the cost of 4G networks
- Existing paid subscribers, will in effect, be subsidising the build-out costs for the 3G offload Wi-Fi networks

The return...

- Greater network capacity available for consumers to access data hungry applications
- Improvements in the user experience leading to a reduction in customer churn (and the prevention of the loss of millions in revenues)
- Substantial CAPEX and OPEX savings as a result of deploying Wi-Fi technology and eliminating the need to expedite the roll-out of 4G networks
- Wi-Fi networks deployed as 3G data offload networks today will continue to serve as 4G data offload networks in the future

6. Site Acquisition Strategy

In the last 12 months, interest in Small Cells and Metro Wireless has grown dramatically in the UK.

BskyB/The Cloud, BTOpenzone have been joined in an aggressive campaign by O2 to sign up many hundreds/thousands of retail and café 'Hot Spots'. These WiFi hot spots are also being marketed to MNOs for 3G data offload with varying tariff incentives to the MNOs. O2 was a client of this offload model, but has now decided that it should become a major provider in its own right.

The 'outdoor' Small Cell model is now being added to the 3G offload strategy of these firms.

The recent tendering of Street Assets by Westminster City Council and the Royal Borough of Kensington and Chelsea has kick-started a process the MNOs are describing as a 'land grab' for the rights to Local Authority streetlighting and buildings.

AWTG is a leading player in this new and rapidly developing UK market, some AWTG experiences are included in the table below.

Location	AWTG role	Client
Barnsley MBC, Yorkshire	Design, deploy and run a complete managed service including the UK's largest Free Public WiFi service and MNO's 3G offload	Barnsley MBC
Royal Borough of Kensington, Exhibition Rd	Design and build a free public WiFi and MNO 3G offload service	MNO/O2
Royal Borough of Kensington, Kensington High St	Design and build a free public WiFi and MNO 3G offload service	MNO/O2
Westminster City Council, Parliament Square	Design and build a free public WiFi and MNO 3G offload service	MNO/O2
Westminster City Council, Trafalgar Square	Design and build a free public WiFi and MNO 3G offload service	MNO/O2
Westminster City Council, Oxford Street	Design and build a free public WiFi and MNO 3G offload service	MNO/O2
Westminster City Council, Leicester Square	Design and build a free public WiFi and MNO 3G offload service	MNO/O2
Westminster City Council, Regent Street	Design and build a free public WiFi and MNO 3G offload service	MNO/O2