

# Small Cells Big Opportunities

A Huawei White Paper by  
Dr. Yan Q Bian, Deepak Rao

February, 2014



# CONTENTS

1 Introduction.....	1
2 The Need for Small Cells.....	2
2.1 Exponential traffic growth .....	2
2.2 Network evolution towards HetNet.....	3
3 The Small Cells Strategy .....	3
3.1 Enhancing coverage and capacity.....	4
3.2 Integrated broadband networks synergising small cells and WiFi .....	5
3.3 Small Cell business case .....	6
4 Save TCO while improving coverage and capacity .....	7
4.1 Small Cell Backhaul .....	7
4.2 Site acquisition and maintenance.....	9
5 Increase traditional revenue through prioritised rollout.....	12
6 Improve customer experience through integrated broadband.....	14
7 Explore new revenue streams through innovative services.....	16
8 Huawei's Small Cell Solutions and product portfolio .....	19
9 Summary .....	21
10 References.....	22
11 About the Authors.....	23

# 1 Introduction

---

Mobile data traffic is experiencing an exponential growth, driven by data capable devices and high bandwidth applications (APPs). Many operators are evaluating their options, and small cells deployment figures high in their priorities with 60% of operators considering them to be an important part of their 4G service<sup>[1]</sup>. Leading operators such as AT&T, Vodafone, and Softbank have leveraged their macro networks and are creating differentiation through small cell solutions. By 2016, small cells will service up to 25% of all mobile traffic<sup>[2]</sup> and small cells shipments are likely to reach 36.8 million units worth \$20.4 billion<sup>[3]</sup>.

Industry recognized Small Cell Forum defines small cells as “... low-power wireless access points that operate in licensed spectrum, are operator-managed and feature edge-based intelligence. They provide improved cellular coverage, capacity and applications for homes and enterprises as well as metropolitan and rural public spaces. They include technologies variously described as femtocells, picocells, microcells and metrocells.”<sup>[3]</sup>

An holistic small cell strategy addresses both the short term challenges such as cost savings in providing service and the longer term challenges such as improving customer loyalty and exploring new revenue streams. Most small cell strategies follow a phased approach

- Saving in TCO (Total Cost of Ownership) while enhancing coverage and capacity
- Increasing traditional revenue through prioritised rollout
- Improving customer experience through integrated broadband
- Exploring new revenue streams through innovative services

However, the challenges to small cells technology still remain, particularly

- Availability of suitable backhaul
- Acquisition and operation of small cell sites



- integration and monetization of small cell technology

With the additional complexity of adding and maintaining thousands of sites, operators have to address both technical and commercial challenges, ensuring ease to deployment and profitability.

## 2 The need for Small Cells

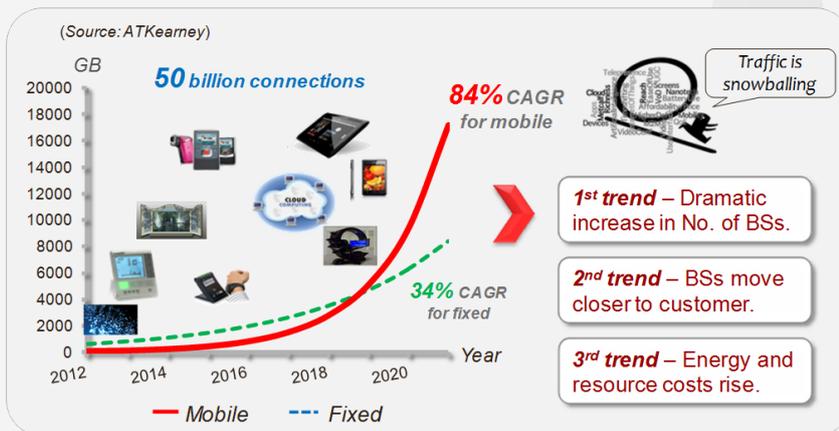


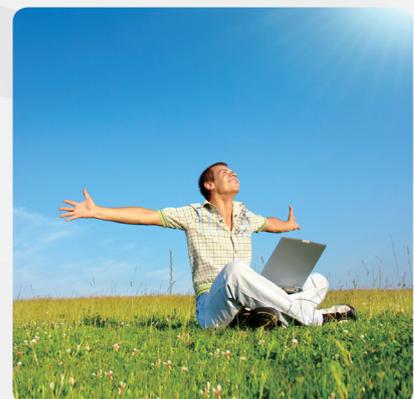
Figure 1: Data traffic forecast and industry trend

### 2.1 Exponential traffic growth

By 2020 there will be 50 billion connected devices across the world. Mobile traffic will grow globally with a CAGR of 84% over next 7 years, and will overtake fixed data traffic in 2019. It is forecast that by as early as end-2013 bandwidth demands will begin to outstrip supply from macro networks<sup>[4]</sup>, resulting in poor service quality for customers. A loss in service quality is likely to lead to higher churn rate and hence to higher customer retention costs.

Addressing capacity needs is complicated, as mobile data traffic varies unevenly across different locations and time:

- **Locations:** 80% of data traffic is generated from indoor locations, and 90% of traffic is handled by only 10% cells that serve all dense areas<sup>[5]</sup>.
- **Time:** Cellular data consumption is higher than WiFi during the daytime, while during night data consumption on WiFi is higher than cellular. For example, in the UK cellular data traffic at mid-day can be 6x more than the off-peak traffic<sup>[6]</sup>.





## 2.2 Network evolution towards HetNet

Operators have multiple options to deal with coverage and capacity issues:

- Purchase additional spectrum (up to 3x capacity gain), which can be expensive,
- Migrate 3G users to 4G so as to capitalise on 4G's spectral efficiency (up to 6x capacity gain), or
- Deploy small cells for spatial efficiency (up to 56x capacity gain respectively, over the next 10 years<sup>[5]</sup>).

It is financially prohibitive to build enough macro cells to service all the demand; small cells are a cost-effective solution to plug the gap between data demand and capacity. The business case for a high QoE (Quality of Experience) network that is “always-on, and available anywhere, any time” is driving the network evolution towards HetNet (Heterogeneous Network) – an integrated network consisting of macrocells, small cells and WiFi AP (Access Points). HetNet architecture allows for capacity expansion to be based on actual, instead of forecast, values of demand in data traffic.

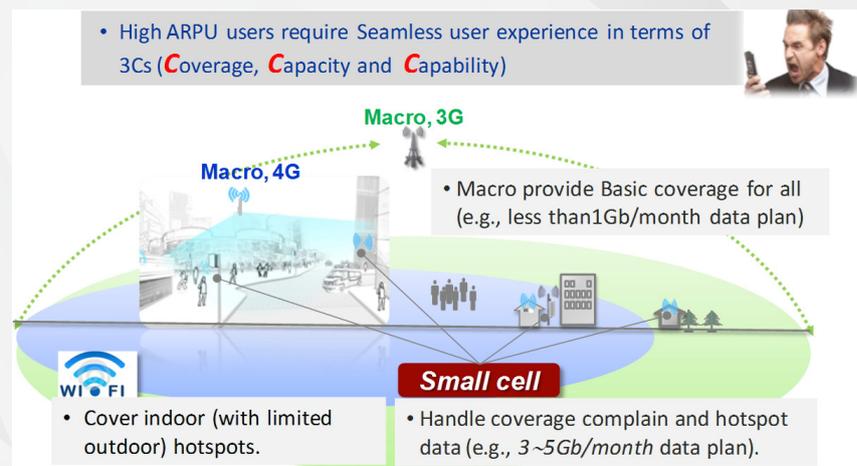


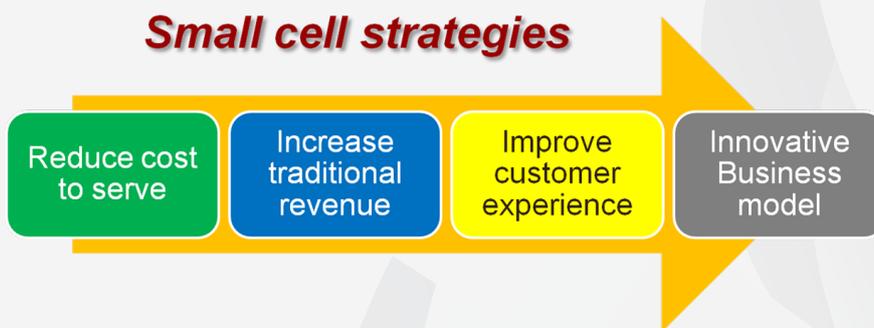
Figure 2: HetNet architecture

## 3 The small cell strategy

The fundamental challenge for an operator is to leverage its strengths in Macro networks and extend them to small cells. Operator's strengths in subscriber mix (consumer vs. enterprise, fixed vs. mobile) and in cost

structure of its network assets (MNO/MVNO, RAN or/and core network sharing, etc.) frequently determine the appropriate small cell strategy.

An holistic small cell strategy addresses both the short term challenges such as savings in network TCO and the longer term challenges such as improving customer loyalty and exploring new revenue streams. Most small cell strategies follow a phased approach (see Figure 3).



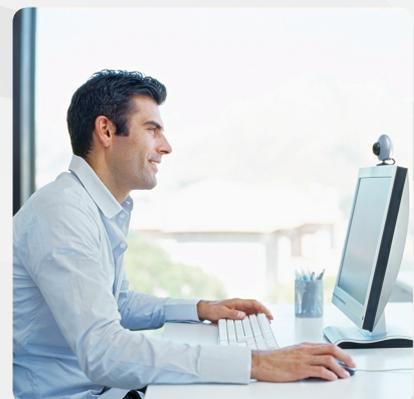
**Figure 3: Small cell rollout should focus on reducing network costs and explore new revenue opportunities**

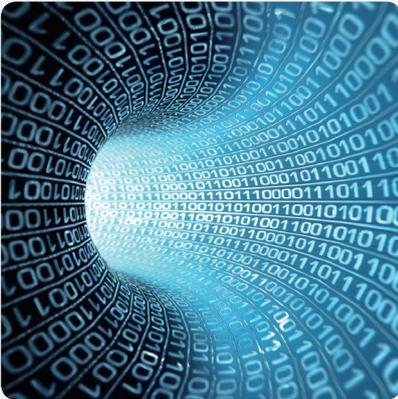
### 3.1 Enhancing coverage and capacity

The key drivers for deploying small cells are to enhance coverage and capacity<sup>[7]</sup>. Small cells are widely deployed to provide

- **Coverage infill:** A tall corporate tower can create a large coverage blind spot in quadrangle area, which can be serviced by an outdoor small cell.
- **Extended coverage at cell edges:** To service SME (Small Medium Enterprise) offices or apartment buildings at the cell edge.
- **An alternative to cell split:** Uneven and peaky demands on capacity are cost-effectively addressed using a combination of outdoor and indoor small cells.

However, QoE improvements can only be realized by delivering the right customer experience in the right place at the right time, similar to marketing principle of making the right product available to the customer at the right price. Improved QoE leads to right kind of revenues focusing on enterprise and consumers.





This need to deliver the right QoE is driving worldwide investments in small cells[3]. Small cells are poised to not only supplement, but also substitute macro networks to plug the gap between capacity and demand for data. For instance an incumbent Fixed Broadband provider with a vast FTTX network and no spectrum assets will be interested in rolling out outdoor WiFi in hotspot locations.

This strategy can be expanded to provide FaaS (Fibre as a Service) or SCaaS (Small Cell as a Service) to MNOs in exchange for an MVNO deal to enter the mobile service market (with Small Cells offloading to FTTX).

We believe the boundaries between a mobile and fixed operator will soon disappear with prevalence of small cell enabled integrated broadband.

	Enterprise	Public hotspots	Residential
<i>Small Cell solution</i>	<ul style="list-style-type: none"> <li>• Pico for large buildings (in range of 200m or less).</li> <li>• Femto for smaller buildings (on the order of 10m).</li> </ul>	<ul style="list-style-type: none"> <li>• Pico, or</li> <li>• Micro/metrocell (in range of few hundred meters), or</li> <li>• DAS.</li> </ul>	<ul style="list-style-type: none"> <li>• Femto, or</li> <li>• Pico.</li> </ul>
<i>Motivation</i>	<ul style="list-style-type: none"> <li>• Improve in-building coverage</li> <li>• Target on high value business users.</li> <li>• Provide High quality and secured service.</li> </ul>	<ul style="list-style-type: none"> <li>• Boost coverage and capacity.</li> <li>• Offload users from Macro.</li> <li>• Manage network efficiency and QoE.</li> </ul>	<ul style="list-style-type: none"> <li>• Improve indoor coverage.</li> <li>• Increase data consumption from consumers.</li> </ul>
<i>Service examples</i>	<ul style="list-style-type: none"> <li>• High quality voice and video call</li> <li>• "Follow me" app</li> <li>• Company ID</li> <li>• VPN</li> </ul>	<ul style="list-style-type: none"> <li>• M-advertising</li> <li>• M-wallet</li> <li>• Location based services</li> </ul>	<ul style="list-style-type: none"> <li>• Surveillance</li> <li>• Eldercare</li> <li>• Multi-devices sharing</li> </ul>

**Figure 4: Small cell solution for enterprise, public hotspot and residential home**

### 3.2 Integrated broadband networks synergising small cells and WiFi

Integrating Wi-Fi with small cells can offer cost-effective capacity and additional coverage for delivering seamless data services. Benefits from such integration lead to increases in revenue and savings in TCO:

- **Increased revenues**
  - Intelligent offload policies enable “premium” data service and allow monetisation of WiFi
  - Extend data services to non-cellular devices (e.g., laptop, tablet, camera, etc.) increase data use

- Carrier-managed VAS and hosted WiFi service lead to new revenue from venues and enterprises
- **TCO savings**
  - WiFi can also be used as an effective wireless backhaul
  - Lower site rental and CAPEX
  - Improved service quality (such as voice quality, coverage, and so on) lead to savings in SAC (Subscriber Acquisition Cost) & SRC (Subscriber Retention Cost)

Small cells and WiFi can be integrated either in the RAN or in the Core; each integration option presents a trade-off between the complexity of integration and the ease of monetisation. There are three major integration options to increase revenues:

- RAN integration with automatic WiFi authentication, allows operator to bundle WiFi service with existing 3G/4G data plan
- Core integration with Hotspot2.0 and ANDSF (Access Network Discovery and Selection Function), allows operators to introduce innovative pricing strategies; limited by the functionality of billing engines
  - Advanced integration with policy control for selected traffic flows, allows operator to offer carrier-managed VAS with fully capable WiFi/4G devices

### 3.3 Small cell business case

Our analysis indicates that small cells business case is driven in part by revenue from increased data usage and revenues from new applications such as mFinance, and location-based apps. Additionally, a significant portion of the business case relies on increased CLV (Customer Lifetime Value) and savings in SAC & SRC from improved loyalty due to high QoE.

To reduce CAPEX and OPEX, operators are increasingly sharing their macro network infrastructure, for instance as MORAN (Multi Operator Radio Access Network). Small cells, when deployed judiciously, can be a great source of competitive advantage & differentiation. Thus can provide an uplift in customer experience and revenue while simultaneously reducing TCO by 40% or more (see Figure 5 in the next section).





So, the key to achieving the small cells competitive advantage and to making the business case for the operator is to determine where, when and how to deploy small cell solutions, and aligning them with customer requirements in the marketplace. Equally important is the pace of transition from “reduce cost to serve” to “improve customer experience” (see Figure 3), as CLV and loyalty drive the business case.

## 4 Save TCO while improving coverage and capacity

TCO savings from small cells can be highly sensitive to variations in backhaul and site rental costs. When compared to the TCO of macro deployment, the small cell TCO is attractive due to savings from the choice of cell sites and backhaul solution (see Figure 5).

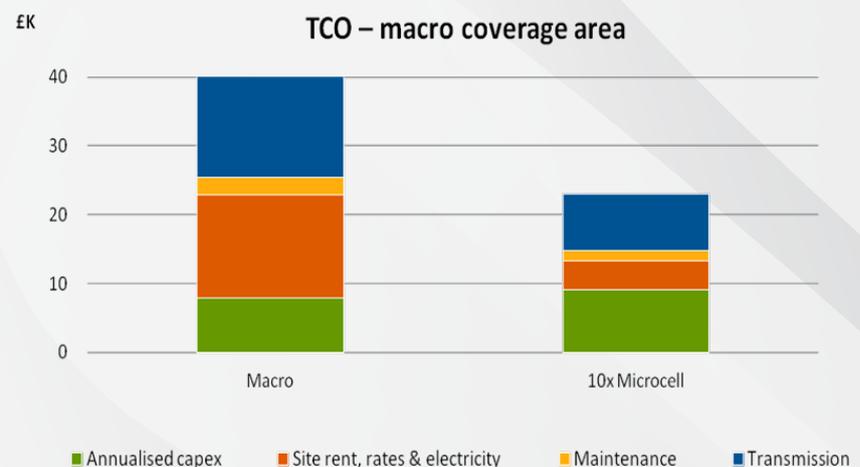
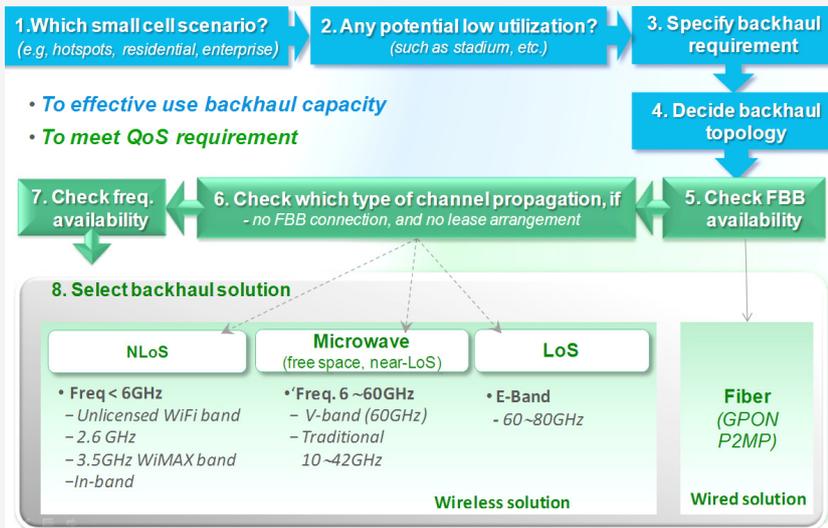


Figure 5: TCO analysis of small cell deployments<sup>[B]</sup>

### 4.1 Small Cell Backhaul

Diversified deployment scenarios present unique challenges for Backhaul. It is critical to get the right solution for each case, especially in public access small cell, where introducing a fibre backhaul can be prohibitive. In order to reduce TCO, operators can leverage their assets by plumbing existing backhaul technologies/capabilities together (see Figure 6):



**Figure 6: Flow chart to select the backhaul solution**

- **Wireline backhaul solution** could be via copper or fibre. Fibre provides very high performance, using GPON (Gigabit Passive Optical Network).

- The NG (Next-Generation) PON now attracts more attention from operators for delivering high-speed apps. Bandwidth requirements are targeted at 100Mbps for residential users and 1Gbps for commercial users. The NG PONs are divided into two phases: NG-PON1 can offer 10G downstream and 2.5G upstream, while NG-PON2 would achieve 40G access based on WDM (Wavelength Division Multiplexing)<sup>[9]</sup>. Rapid small cell roll-out will facilitate the NG PON evolution.
- Operators without existing wire line assets, such as fibre, may elect to install or to lease. Installing any wired infrastructure can be costly and time consuming, and leasing fibre to carry additional bandwidth can be quite expensive, so fibre-complementing wireless backhaul solutions can be an attractive option for many operators.

- **Wireless backhaul solution** has advantages of reducing costs and reducing time to market of a small cell roll-out.

- A number of wireless solutions (such as LoS, NLoS and microwave) are available; each solution presents a trade-off in propagation, frequency and topology it supports. For example, in cases such as street level coverage with a short range, it makes sense to use spectrum bands that either require little





or no licensing fees in order to reduce costs.

- ABI research predicts that, outdoor small cell units will grow at 52.7% CAGR to reach over 3.5 million units by 2018<sup>[10]</sup>. As outdoor small cells emerge, much of the focus will be on the unlicensed 60GHz (V-band) which could be an optimal micro/metro solution at a street level. The benefits of V-band backhaul are
  - Low TCO per Mbps<sup>[11]</sup> (compared to sub 6GHz band)
  - Low skilled labour for installation
  - Environment-friendly (low power, zero-footprint)
  - High capacity
  - Low latency

Therefore it is clear that a combination of wired and wireless solutions could be needed for both outdoor and indoor public hotspots. Using existing fibre can serve as local aggregation points, although some technologies allow “self-backhaul” capability such as WiFi APs.

## 4.2 Site acquisition and maintenance

In order to achieve small cells’ potential lower cost per bit, operators need to be very precise about where capacity is deployed. A number of options exist to address the demand for data services, and for each of these a number of operational deployment pain-points exists.

Unlike macro site acquisition and installation/commissioning, small cell deployments have to manage an order-of-magnitude increase in number of cell sites, hence are required to follow a different flow of events (see Figure 7). Deploying large number of small cells creates new challenges in interference management, handover configurations, and operation/maintenance processes. Interference and handover issues can be solved using technological solutions such as SON (Self Organizing Network) and CoMP (Coordinated Multi-Point), so as to reduce OPEX and ease the commissioning processes.

We believe most of the operational risks can be mitigated with clever contract management with third party installation & commissioning companies.

The key focus for an operator is to amend existing deployment processes and to determine the set of activities that create differentiation in QoE, such activities should ideally be in-sourced while the remaining activities could be out-sourced to a third-party. Below, we focus on more practical and non-technological deployment challenges.



For commercial buildings in downtown areas (i.e. tall towers), working with landlords to deploy small cells that can be activated on demand is an effective way to provide high speed data connectivity. Commissioning and maintenance activities need extended access to building premises such as secure areas of the building and access out of business hours, these additional access requirements must be carefully negotiated if the vendor is to meet strict SLAs (Service Level Agreements) – in many cases having a single vendor for end-to-end commissioning and maintenance is the simplest option.

For non-enterprise customers, site acquisition challenges vary depending on micro-population densities in that location and on whether the deployment needs to be indoors or outdoors:

- **Public indoors** (e.g., shopping malls, airports): Local authorities and owners should be persuaded to expand and maintain in-building backhaul. Operators can purchase backhaul capacity from, and enter into maintenance contracts with local authorities to close the business case. SCaaS and DAS (Distributed Antenna System) sharing among operators help the business case and operations of small cells in such hotspot locations.



**Figure 7**

**Flow of events for installation and commissioning of Small Cells**

- **Public outdoor** (e.g., downtown, university campus): Two main options exist for an operator, either self-deployment or contract out, both present their own pros-cons. While contracting out combined FaaS/SCaaS agreements with a fixed broadband operator provides easy access to sites and backhaul/power, it creates little competitive advantage.

- Sites selection is the main driver for market penetration, and these need to be negotiated with municipalities for access to street furniture (such as lampposts). Multiple “backup” options need to be planned, such as engaging a real estate agency to gain agreements for installing on outer walls of buildings, or billboards at street intersections etc. such agreements should include access to both power and in-building fibre to service the small cells.
- Physical deployment of small cells can be contracted out to a utility maintenance company who has access to the relevant installation facilities

- **Suburban and Rural:** The business case for small cells in suburban and rural areas can be challenging due to low data demand, therefore horizontal pico-cell solution is an attractive option as long as there is no regulatory mandate for wider coverage. In general, providing rural broadband in small towns and villages with low population densities changes the nature of the problem from reach-constrained to capacity-constrained, i.e. backhaul is often the bottle-neck in providing service to a village<sup>[12]</sup>.

- Low demand and mandatory coverage edicts make RAN sharing a key contender for remote areas, in some extreme scenarios do-nothing can be an option!
- Lack of street furniture in sub-urban areas can be overcome by use of Telescopic towers such as RDS (Rapid Deployment Sites) to provide a small footprint for outdoor coverage<sup>[14]</sup>.
- A number of technology options exist to mix and match access infrastructure, such as fibre, copper, wireless and satellite (for coverage), however the economics of using such access technologies can be difficult to absorb.



- Sparse cell sites mandate contracting the installation and maintenance to utility companies (such as power company technicians) and encourage increased stock keeping at field support centres closer to the villages, especially in areas where adverse weather conditions exist.

## 5 Increase traditional revenue through prioritised rollout

Operators can increase traditional revenue streams by:

- Increasing gross adds and reducing churn through enhanced coverage
- Increasing data usage through enhanced capacity and smart tariff plans

Our analysis shows an increase in outdoor data use (by around 30%) when QoE is improved with small cells solutions. Improved customer experience also leads to better loyalty (increase CLV, reduced SRC) and to easier new subscriber acquisitions (reduced SAC). Hence the decision on “which segment to target” is of paramount importance.

**Enterprise** (corporate, SME) is an attractive market to operators due to its higher ARPU, with growing smartphone use and the growing trend in BYOD (Bring Your Own Device). A good service experience in the enterprises influences the employees to switch their personal contracts (and those of their family members with family bundle offers) to the operator. Hence the enterprise segment should be a primary target for small cell rollout.

- Corporate offices with poor in-building voice coverage strengthen the business case for small cells, as they offer an excellent voice quality and advanced voice/presence/video services for corporate users. Business premises vary widely in terms of building sizes, 39%-61% of offices suffer from poor in-building coverage and 87% of businesses would switch provider to guarantee coverage<sup>[13]</sup>. To match varying building sizes, operators can deploy Picocells in large buildings, and Femtocells in smaller buildings.

- SME is a vast market, and SME businesses are looking for a ‘single solution’ to address their communication needs<sup>[7]</sup>. In cases where





small businesses have fixed broadband, the operator strategy should integrate the WiFi access point and the small cell in a single compact box. Operators should further sub-segment the SMEs to identify businesses where consumers spend their idle time and subsidise small cell solutions to these businesses, for example, laundrettes and hairdressings.

**Public hotspots** (e.g., shopping mall, airport, transport hub, etc.) have regular 'peaky' traffic; this higher demand for data is expected to continue in the future, and over 500,000 public small cells are expected to be deployed worldwide by 2015<sup>[10]</sup>. Improved data access in the public areas contribute to better QoE and to longer term CLV for all segments, thus making the public small cells rollout the second most important priority.

User (i.e. smartphone) densities and data demand in hotspots determine the type of small cell deployment in public areas. Deploying Picocells or Micro/Metrocells in such areas can alleviate capacity bottlenecks as well as provide cellular coverage in places that suffer from poor macro coverage. DAS can be jointly deployed by multiple operators to service malls and other public indoor spaces.

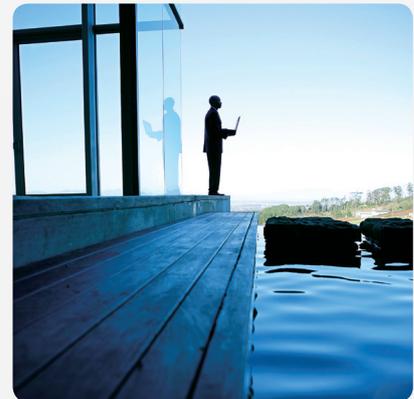
- Data demand analysis helps operators to identify places with regular 'peaky' traffic. Such places allow operators to optimise the use of shared resources such as backhaul and macro coverage. For instance, macro beam-forming technologies can be configured to focus on the street during rush hour and on the buildings during office hours.

- Small cells not only supplement macros by enhancing capacity, but also can substitute macros to address sparse & peaky traffic. Crowd-sourcing can be used to determine the potential revenue increase from small cell deployment. For instance, BBC was able to map 3G coverage across the UK<sup>[15]</sup>, a similar crowd-sourced data demand cross referenced with average spend in the area will create heatmaps that maximize small cell ROI in different 'postcode' areas.

**Residential properties** (both in urban and rural areas) with poor macro coverage could be enhanced using Femtocells. However, deployment of residential Femtocells has failed to address capacity concerns in the mobile industry, due to the high dependence on existing backhaul solutions and lack of sustainable business model (i.e. lacking new revenue streams).

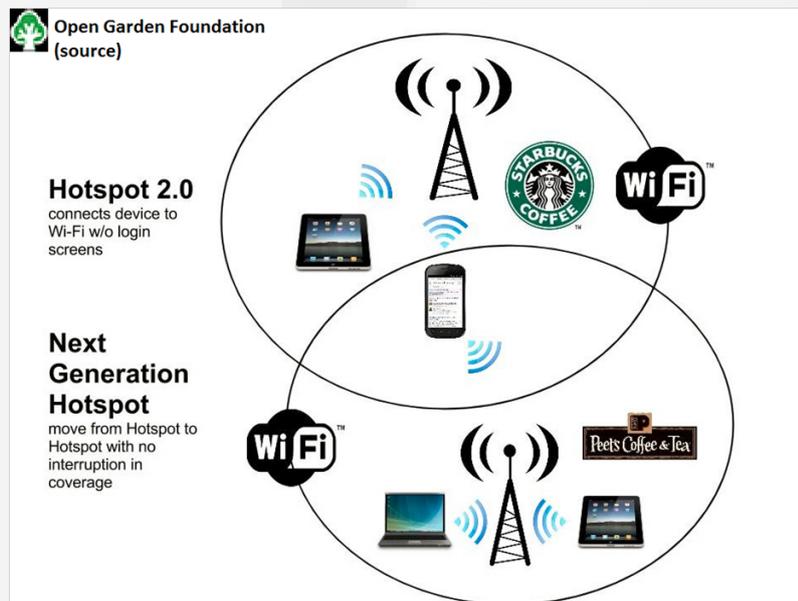
## 6 Improve customer experience through integrated broadband

With the proliferation of OTT APPs in mobile market, operators must think about network capability beyond coverage and capacity. We believe improvements in QoE will encourage consumers to pay for services such as combined WiFi & cellular broadband, mobile TV and uploading/downloading UGC (User Generated Content).



**Monetise WiFi services:** Integrating WiFi network with Small and Macro cells enables operators to monetise WiFi in conjunction with 3G and 4G services. Operators can choose a wide range of integration options, but often the go-to-market strategy and policy controls determine the extent of integration. Operators can set up seamless WiFi offload policies based on user segment, type of APPs, network congestion or QoS.

Intelligent policy controls such as Hotspot 2.0, Next Generation Hotspot and ANDSF improve the overall end user experience, allowing users to automatically connect to WiFi, wherever & whenever available. Such integrated broadband solutions bundle WiFi data services with the existing 3G/4G data plans for smartphone and dongle packages.



**Figure 8: Hotspot 2.0 and Next Generation Hotspot enables seamless WiFi experience at both the access and the core**

Core network integration, for separate small cells & WiFi access networks, allows data from WiFi and cellular to be monetised separately; for instance through packages such as pay-as-you-go WiFi, prepaid pass, etc. This approach to WiFi monetisation requires extensive WiFi rollout strategies, so the nomadic-WiFi network is able to compete with full mobility 3G/4G cellular network. Besides the revenue from 'pure' WiFi packages, the improved data service experience will make it easier to attract new customers and reduce subscriber churn (by 15%<sup>[16]</sup>). To realise this benefit, operators can also offload to partner or federated WiFi networks that provide the desired service quality, for instances where a highly resilient connection (acting as a single large pipe) is needed for HD media.

**Mobile TV subscription:** With improved broadband speed and coverage, live mobile TV consumption is forecast to grow aggressively. Technologies such as eMBMS (enhanced Multimedia Broadcast Multicast Service) and DMB (Digital Multimedia Broadcast) that help deliver rich media services to masses are once again eliciting operators' interest.

South Korean operators (KT, SKT and LGU+) are one of the early adopters of DMB technology, and these companies are in a race to increase their mobile TV subscriber base to rival the traditional IPTV. South Korean market, with better network, large screen tablets / devices and content solutions (YoY growth of 16.17% between 2012 & 2013), has seen significant shift in user behaviour. Mobile TV consumption is very popular, with catch-up TV constituting more than half of total viewing<sup>[18]</sup>.

KT's ABC (Always Best Connectivity) solution intelligently switches between WiFi and 3G/LTE to access the Internet; ABC solution selects optimal network to service video including buffering the video while a second bearer is used to continue download. ABC solution enhances QoE, users no longer need to check the access speed to watch a video, and improves battery usage by 40% while reducing cellular data charges by 80%<sup>[17]</sup>.

**User generated content:** The instant nature of most user generated content creates the ripple-effect of multiple downloads on mobile devices, anywhere, anytime.



At the core of revenue opportunities in consumer segment is the amount of information created and shared by consumers, typically in the age group of 16-34 years. It is forecast that content generated by these users will double in the next two years, continuing the growing trend in video uploads, for instance YouTube uploads have increased 10x in the last 6 years<sup>[19]</sup>. Owing to the trends below, we surmise that QoS guarantees for UGC could be a source of revenue in not too distant future:

- Capture and upload of real-time video in concerts and events, (In 2010 the Economist reported the worldwide number of camera phones totalled more than a billion)
- Social sites such as Instagram and Facebook note a growing trend in “selfies”, with growing uplink bandwidth this trend will extend to videos
- Platforms such as Snapchat allow users to chat using multimedia (pictures and videos) and ‘expired’ messages encourage users to post new selfie videos



## 7 Explore new revenue streams through innovative services

The future without ubiquitous high speed data connectivity is as difficult to imagine as today’s life without mobile phones. Growing consumption of multimedia on mobile devices and increasing interest in personalised sales present new revenue opportunities for quicker small cell ROI. However consumers will expect businesses to offer & sponsor services such as video conferences, video phone-ins that blend into consumer’s usage & context.

**Video sousveillance<sup>1</sup>, phone-ins and conference calls:** Sectors such as education, insurance, health and news media are increasingly adopting mobile technologies to improve QoE and reduce cost. Operators can establish a two-sided business model to increase data revenues; widespread deployment of small cells and enterprise sponsored data packages encourage users to upload recorded video and to use video call services:

<sup>1</sup> “Personal sousveillance is the art, science, and technology of personal experience capture, processing, storage, retrieval, and transmission, such as lifelong audiovisual recording by way of cybernetic prosthetics, such as seeing-aids, visual memory aids, and the like”

- **Insurance:** Dashcams (cameras mounted on dashboards in a car) are very popular in Russia and their recorded footage of traffic accidents is permissible (and often preferred) witness in Russian courts. Widespread use of dashcams is enabling insurance companies to fight insurance scamsters.

- **Smart connected homes:** Small cells enable home automation to improve living with location sensitive features. Furthermore, small cells enable use cases such as home surveillance, eldercare and for parents to monitor their children.

- **Education:** Blended learning, a combination of classroom, online and mobile learning, is set to revolutionise classroom education. The traditional model of learning in class with supplemental exercises at home will be inverted: watch lecture online or on mobile (anytime & anywhere), while the classroom will focus on activities and discussions from the lecture. Younger generations not only learn through multimedia, but also interact with teachers using video phone-ins and conferences.

- **Health and emergency services:** Micro location information from small cells allows emergency and health services to locate the emergency. Simple applications include a 'panic button' that patients with dementia can press to call for help. For mass consumers, video phone-ins for doctor consultations can improve efficiency and convenience of health services.

- **Automated news feeds** can sponsor users to report (i.e. upload) news at no cost. For instance operators can charge CNN for every iReport uploaded using cellular network.

- **Customer service** over video call for products and services lead to quicker resolution of problems and improve the QoE of end customers.

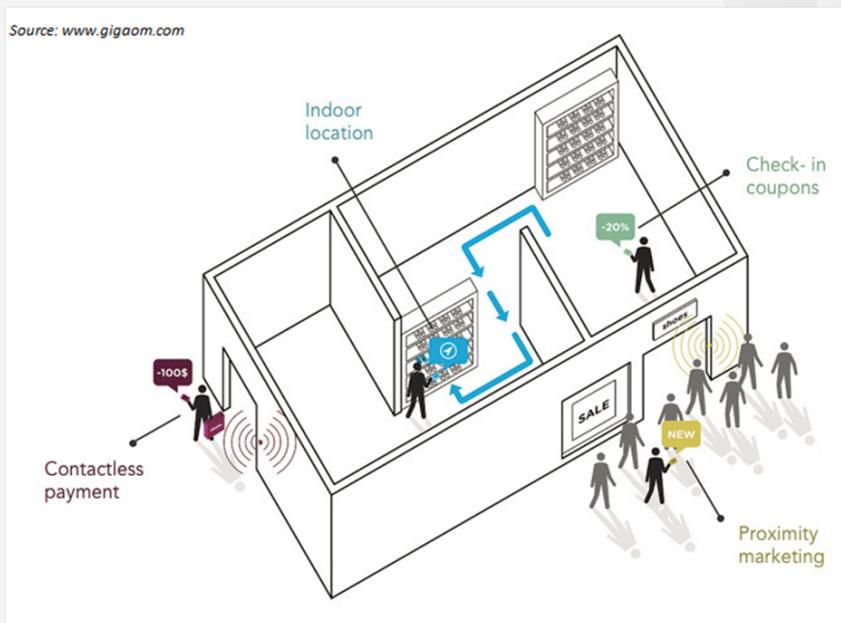
**Personalised services:** Increasingly, customers are demanding personalised experience from their products and services. Location and presence information is a critical part of enabling personalized services, which has to blend into user's context, i.e. the activity the user is performing or is thinking of. Providing personalisation requires operators to secure the best sites to deploy small cells and introduce position/location and presence aware solutions, for instance:

- **Enterprises:** Real-time location services can enable employees to use their smartphone as ID to access office, or have video conferences on the device of their choosing (i.e. BYOD).



- **SME:** Small cells in SME premises can alert the SME of frequently visited customers. For instance, commuters can order a coffee on their mobile, when they are close to the coffee shop, small-cells will flag this proximity information to the shop assistant, who then prepares the customer order, which the commuter picks up as they 'swing by' their coffee shop.

- **Wearable devices:** New AR (Augmented Reality) applications on wearable devices such as Google Goggles and Samsung Gear need micro-location information that small cells provide; such applications should not only use location information, but also the wearer's interests, place (tourist places such as museums) and context (i.e. activity) to present the right information of interest.



**Figure 9: Apple's iBeacon uses Bluetooth Low Energy to detect presence of and transmit data to iPhones**

- **Presence APIs:** Coupons, offers and mobile advertising can be better targeted to users entering or leaving a retail environment. Presence APIs allow third parties (such as L'Oréal) to personalise product advertisements and deliver these mAds as zero-rated content to the users.

- **Proximity APIs:** Businesses will be interested to know whether their (potential) customers are close to their shops. For instance, a simple Evernote grocery list on a user's device could trigger the department store to send coupons to the user, when the user walks past the store.

- **Location tracking APIs:** Operators can combine the positioning information from small cells to make a wide range of positioning APIs available to retail businesses. Bluetooth based technologies such as iBeacon<sup>[20]</sup> allow much precise tracking of user's location, however their range is limited to few tens of meters. Small cells could provide a more contiguous ability to track user location, handing over to Bluetooth based tracking in closer range. Integrated APIs can provide user's identity and location within the store; such information will help retailers to offer products and services depending on the aisle the shopper is in.

- **Social APIs:** The presence information from small cells can help users to find their contacts in nearby places. Local businesses can combine nearby contacts with user interests to target offers, for instance a nearby sports bar can advertise early-bird offers to two friends interested in football.

## 8 Huawei's Small Cell solutions and product portfolio

Huawei's small cell solution has been deployed globally in more than 40 networks. We provide a full range of small cell products including micro BTs/RRU and Pico BTs/RRU with SingleSON and HetNet CA (Carrier Aggregation) solutions. The product portfolio comprises of:

- DAS for targeted in-building coverage, as well as for streets, squares and other outdoor hot zones to eliminate macro coverage blind spots and increase overall network capacity. Huawei's SingleDAS solution is suitable for multiple operator and multiple vendor deployments.

- AtomCell was designed to meet challenges stemming from limited spectrum resources and complex network environments, and to realize HetNet evolution. This solution maximizes spectrum resource efficiency in indoor/outdoor hotspot and enterprise, and provides a smoother user experience even in weak macro coverage areas.



- LampSite is a multi-mode, easy-to-install deep indoor coverage solution that provides flexible capacity expansions while sharing BBU resources with a macro network.

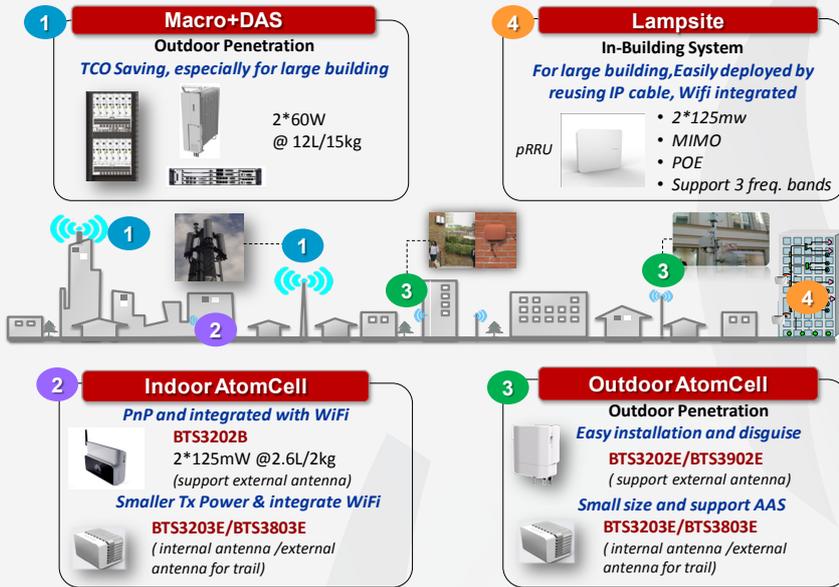


Figure 10: Huawei's Small Cell Portfolio





## 9 Summary

---

The future of small cells looks promising, and the opportunities will favour those operators who understand how, where and when to deploy them. Small cells not only address coverage infill and capacity boost scenarios, but also improve user's QoE. We believe there are four phases to small cell rollouts: reduce network TCO, increase traditional data revenues, improve customer experience (QoE), and explore new revenues beyond connectivity.

Today, successful small cells business cases rely on increase in CLV and savings from SAC and SRC due to improved customer loyalty. Such loyalty can only be achieved by delivering the right QoE to customers at the right place and the right time. This means operators need a different approach to deploying small cells, i.e. understand how to amend & manage the deployment process and address the lack of pervasive fibre backhaul. Small cells site selection and operation & maintenance models will be the key to competitive advantage.

Operators would gain indirect revenue from improved churn and loyalty. Better service experience will drive up traffic usage and increase data revenue. Operators can further enrich the user experience by offering new VAS (Value Added Services) based on location and presence information; new VAS will boost traffic usage and new VAS revenue will help faster investment return.

## 10 References

---

- [1] "Small Cell Vendors Race to Fulfill Operator Demand for LTE", Press Release on 7-Feb-2012
- [2] "In-building, outdoor small cells to handle quarter of mobile traffic by 2016", Infonetics, Jan 2013
- [3] "Small cells – what's the big idea?", by SmallCellForum, Feb 2012
- [4] "Technology, Media & Telecommunications predictions", Deloitte, 2013
- [5] "Optimizing small cells and the heterogeneous network (HetNet)", JDSU
- [6] "Understanding today's smartpone user: Demystifying data usage trends on cellular & Wi-Fi networks", Informa, 2012
- [7] "Small Cell Market Status Q2 2012", Informa
- [8] "TCO Analysis Small Cell deployment", Huawei Business Consulting, 2011
- [9] "Next generation PON", Huawei, 2010
- [10] "Market Gets Primed to Rollout Half a Million Outdoor Small Cells in 2013", ABI Research news on 22-Jan-2013
- [11] "Small-cell backhaul: Industry trends and market overview", Senza Fili, 2013
- [12] "Rural Broadband - Technical Solutions, TCO and the Real World", Huawei, Sep 2012
- [13] "Enterprise Small Cells: The Business Case", by Small cell forum
- [14] "Small cell backhaul: what, why and how", Heavy reading, July 2012
- [15] "3G mobile data network crowd-sourcing survey by BBC News", <http://www.bbc.co.uk/news/technology-14582499> [URL checked on 06-Nov-2013]
- [16] "Monetize SP Wi-Fi to Gain Business Advantages", Cisco, 2013
- [17] "KT announces ABC solution reduces LTE data charges by 80%", <http://www.it.co.kr/news/mediaitNewsView.php?nSeq=2468671> [URL checked on 11-Nov-2013]
- [18] "A Glimpse into the Future: South Korea", BBC Internet Blog by John Tate, 31st May 2012
- [19] "Internet Trends D11 Conference", by Mary Meeker & Liang Wu, KPCB, 29th May 2013
- [20] "Apple's Location-Tracking iBeacon Is Poised for Use in Retail Sales", <http://www.businessweek.com/articles/2013-10-24/apples-location-tracking-ibeacon-poised-for-retail-sales-use> [URL checked on 12-Nov-2013]

# 11 About the Authors

---



**Dr. Yan Q Bian**

## Marketing expert, Global Business Consulting

Dr. Bian has 28 years experience in telecom across industry, academy and government. Since joining Huawei in 2011, she is leading research program within the UK competence centre. Yan has been involved in a number of consulting projects covering MBB, LTE and Small Cells.

Prior to joining Huawei, Yan worked for Alcatel-Lucent and managed a large LTE/WCDMA organization. She holds several International granted patents, authored many IEEE/IET journals and books in areas of network and wireless communications. Yan received her PhD from University of Bristol, UK. Dr. Bian has been recognized as a national distinguished expert by “Chinese 1000 high-level overseas talents program”. She is a visiting professor at UESTC, China.



**Deepak Rao**

## Principal Consultant, Global Business Consulting

Deepak is an experienced consultant in the LTE team within the MBB Consulting practice in the UK. He is involved in projects for operators in Europe, Middle East and Asia, focussing on MBB data traffic monetisation and LTE business case & go-to-market design. He holds an MBA from London Business School, UK and an MS from Virginia Tech, USA.

Prior to joining Huawei, Deepak worked for Nokia in the handset business, Motorola in the Core network technologies and HP in the Cloud Computing area.



[www.huawei.com](http://www.huawei.com)