



White Paper  
**Metro Zone Wi-Fi  
for Cellular  
Data Offloading**

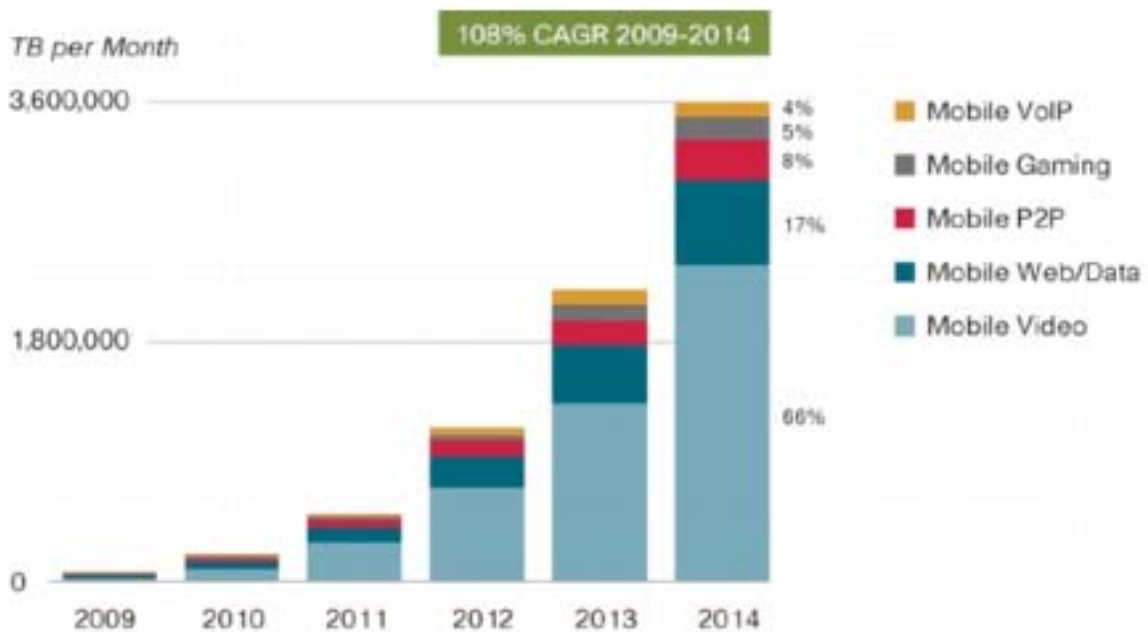
## Executive Summary

The explosion of smartphones, 3G dongles and 3G capable laptops coupled with the growing demand for bandwidth hungry, real-time video and data applications have spiked the data traffic on mobile networks across the world. The increase in smartphone usage and the subsequent explosion of data traffic on cellular networks has caused an immediate need for carriers to offload the data traffic from their cellular networks, so that both voice and data services perform optimally. Due to the built-in Wi-Fi capabilities of millions of smartphones and other devices on the market, Wi-Fi emerged as a natural technology solution for operators struggling to adapt to the surge towards mobile internet services. Operators are rapidly increasing the use of Wi-Fi as a key data-offloading strategy.

Wavion's solution for metro cellular data offloading includes a line of products designed for providing optimal carrier grade outdoor Wi-Fi coverage. It is complemented by built-in networking features and optional hardware appliances and software applications that are easily integrated with operators' networks, supporting diverse service and customer management options. Leveraging its' unique adaptive Beamforming and SDMA technologies, Wavion offers best-of-breed Wi-Fi base stations presenting an exceptionally effective offloading solution for metro zones and other challenging environments with a large concentration of users. Wavion's solution allows operators to use the same customer and service management systems for both 3G and Wi-Fi networks, while offering customers the best user experience with seamless handover and automatic fallback to cellular network once Wi-Fi is not available.

# 1. The Mobile Data Explosion

Following the introduction of smartphones several years ago, the cellular telecommunications landscape has changed dramatically, opening new channels of revenue for operators and offering enhanced services for users. The number of smartphone users is expected to grow rapidly in the coming years and is predicted to exceed the one billion mark by 2013<sup>1</sup>. The extremely fast growth in smartphones and other Internet-enabled mobile devices, combined with a rapidly increasing demand for bandwidth-hungry applications, will lead to a staggering growth rate of data traffic over cellular networks. Globally, mobile data traffic is expected to double every year through 2014, increasing 39 times between 2009 and 2014 with a compound annual growth rate (CAGR) of 108 percent between 2009 and 2014, reaching 3.6 exabytes per month by 2014<sup>2</sup>.



**Figure 1: Cisco Forecast for Mobile Data Traffic (VNI Forecast, February 2010)**

As can be seen in Figure 1 above, video streaming is expected to be the major consumer of the bandwidth resources, reaching in 2014 66% of total user’s demand for bandwidth<sup>3</sup>.

<sup>1</sup> Informa Telecoms & Media, September 20th, 2010

<sup>2</sup> Cisco VNI Forecast, February 9<sup>th</sup>, 2010

<sup>3</sup> Data traffic is definitely not the only consumer of bandwidth resources. As pointed out by Michael Thelander, CEO and founder of Signals Research Group LLC, during a webinar held by FierceWireless in April 2010, the majority of network congestion today on HSPA networks is related to signaling traffic. This traffic is coming from devices making constant queries over the network to push email, access social networking tools and conduct other repetitive actions. According to Thelander, signaling traffic is outpacing actual mobile data traffic by 30 to 50 percent, if not higher.

## 2. The Business Challenge

The rapid growth in mobile broadband demand is stretching network capacity. Operators' ability to capitalize on the data market is threatened by the deterioration of services caused by data overload. The central challenge is that 3G cellular technologies were designed as the next generation of the older cellular voice networks, long before any sizeable mobile data traffic really existed, and it was very difficult to predict the sheer volume and extremely fast growth in demand for mobile data. Although there is a lot of hype around next generation networks, such as LTE, it is commonly agreed that these technologies cannot scale up enough to support the exponential growth in demand for mobile data bandwidth, and the most optimistic prognoses admits it will take a few years until they materialize.

Already some networks are crumbling under the stress. The extra traffic, particularly in densely populated regions, has caused issues for consumers in the way of dropped calls and slow access to the Internet. Even networks that don't support the iPhone are feeling the pinch as a generation of new wireless devices offering bandwidth-hungry web applications are hitting the networks. The result, as already experience by many users of smartphones and other internet-enabled mobile devices in major cities such as New York City and San Francisco, is a network that drops calls and offers net surfing at intolerable speed.

To reduce the burden on their network, in June 2010, O2 in Britain announced it will cut unlimited data plans to ensure network performance, following a similar move by AT&T in the US. However, reducing the level of service is a dangerous approach for operators to take, as they risk losing a significant growing market – smartphone users, looking for value added services. Even though some of the mobile operators are moving towards usage-based pricing models, they will refrain from drastic changes that will significantly impact traffic, and will try to offload the data traffic so as to relieve the network congestion.

### 3. Data Offloading

Data offloading is the use of complementary network technologies for delivering data, originally targeted for cellular networks, in order to save money and relieve network traffic. Mobile data offloading is forecasted to triple in the next five years, according to a recent study from ABI Research<sup>4</sup> and is expected to reach about 48 percent by 2015, from today's rate of about 16 percent. Since data traffic itself is expected to grow by a factor of 30, the total offloaded data will expand 100-fold!

Several approaches and technologies will play key roles in relieving mobile network congestion. These include Wi-Fi, femtocells, mobile content delivery networks or “CDNs”, media optimization, and others. Each of these offload and optimization technologies is aimed at a particular market segment and they will all coexist. Wi-Fi offloading leverages the fact that most laptops and smartphones have embedded capability for wireless communication using the IEEE 802.11 standards. Wi-Fi base stations are effective in covering indoor areas as well as outdoor areas containing many users such as city centers. A femtocell<sup>5</sup> is a small cellular base station with a very limited range, typically designed for use in a home or small business. A femtocells could be a viable solution for serving a small number of collocated users in indoor environment, especially where access would otherwise be limited or unavailable. Mobile CDNs, on the other hand, deal with the problems associated with frequently used content, for example a video that has ‘gone viral’- by caching the file locally rather than loading it onto the network for each download request. Media optimization, another effective tool to improve compression and reduce bandwidth, is already being used widely. However, CDN and media optimization present a limited improvement and do not address the issue of increased radio signaling overload and should be complemented by other solutions for properly covering areas with high traffic.

Data offloading saves money as well as relieves network traffic. According to ABI's report, moving data costs a surprising amount while “Wi-Fi and femtocells in particular do that at a tiny fraction of the per-Gigabyte cost of a 3G network”.

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<sup>4</sup> Mobile Network Offloading, ABI Research, Q3 2010

<sup>5</sup> 3GPP refers to 3G femtocells as Home Node Bs (HNBs).

## 4. Using Wi-Fi for Mobile Network Offload

Wi-Fi has emerged as a natural technology solution for operators struggling to adapt to the surge towards mobile internet services. One of the biggest benefits of Wi-Fi is the fact that it's already embedded in most devices – laptops and smartphones come with embedded Wi-Fi.

Mobile subscribers with Wi-Fi-enabled devices have already been seeking out Wi-Fi hotspots for their Internet surfing, music-streaming, and video watching. But as more devices, such as the Apple iPad come online and the forecast for wireless data shoots through the roof, wireless operators are looking at Wi-Fi as a way to offload some data traffic from their overburdened 3G networks. And as wireless data is expected to continue to grow rapidly over the next several years, they're looking at Wi-Fi as a part of their long term wireless strategies, complementing their 4G wireless networks. Since Wi-Fi uses unlicensed spectrum that does not exploit the precious operator licensed spectrum, and since the amount of unlicensed spectrum is far greater than the typical operator's licensed spectrum, much more traffic can be served using Wi-Fi. Also, instead of asking subscribers to buy, install and learn to operate a new device (femtocell), service challenges can be solved by a "software only" approach that requires very little (if any) of the subscriber's attention.

Operators have begun to recognize the value Wi-Fi offers. AT&T was the pioneer in this approach with its buy of Wi-Fi hotspot provider Wayport in Q4 08. The company already has more than 20,000 Wi-Fi hotspots around the U.S. in retail locations like Starbucks coffee shops, hotels, and airports. "Wi-Fi is a very important technology for us," said Mark Siegel, a spokesman for AT&T. "And it will be considered as a factor in our network plans in the future". In 2009, AT&T consumers connected to an AT&T Wi-Fi hotspot four times more often than they did in 2008. Moreover, in May, 2010, AT&T announced the launch of an AT&T Wi-Fi "hot zone" in New York City's Times Square, providing coverage for AT&T customers who use Wi-Fi enabled smartphones. This was immediately followed by setting up special Wi-Fi hot zones in other busy downtown areas such as in Chicago and Charlotte. The hot zones are part of a pilot project to bolster wireless coverage for AT&T customers in busy areas with high levels of 3G traffic. In May 2010, Deutsche Telekom also announced Wi-Fi offload plans in the struggle to alleviate capacity on its 3G networks.

More and more carriers around the world are adopting Wi-Fi as a leading solution for data offloading:

- **John Stankey**, AT&T's President and CEO: *"Focusing on how we make Wi-Fi and licensed spectrum a more seamless experience for customers."*
- **Masayoshi Son**, SoftBank's CEO and Chairman: *"Wi-Fi is the mouth – it helps you breathe better. We need Wi-Fi to serve that traffic and give our customers a rich media experience."*
- **René Schuster**, Telefónica CEO: *"We are looking forward to offering customers the ability to enjoy iPad with Wi-Fi + 3G on our network."*
- **Yves Maitre**, Orange senior vice president of mobile multimedia: *"Wi-Fi offload is becoming more and more of a reality and it is the number one priority for my team for 2010."*

## 5. Wavion's Solution for Metro Cellular Data Offloading

Wavion's offering includes a line of products designed for providing optimal 'Carrier Grade' outdoor Wi-Fi coverage. It is complemented by built-in networking features and optional hardware appliances and software applications that are easily integrated with operators' networks, supporting diverse management and billing options.

### 5.1. Best-of Breed Wi-Fi Technology

Wavion offers the best-of-breed solution for efficient Wi-Fi coverage in congested metro areas and other places with a large amount of users such as city centers, amusement parks and transport stations. It is particularly effective in challenging environments where other Wi-Fi solutions fail to efficiently overcome non-line-of-sight conditions, multi-path and interference effects.

There are a number of key challenges that need to be met in order to create a truly effective outdoor and metro Wi-Fi solution. The standard Wi-Fi base stations use a technology designed for indoor conditions that is adequate for relatively short range and is adversely affected by multipath and interference. As a result, proper coverage requires dense access point deployment and costly infrastructure in addition to a low service quality and spotty coverage. Outdoors metro Wi-Fi environments present much tougher electromagnetic challenges than indoors environment, including much higher levels of interference, much higher multipath delay-spread, and much faster moving objects and users.

To overcome these challenges, Wavion has developed outdoor-optimized Wi-Fi base stations, based on a unique ASIC, that utilize unique and powerful Beamforming and SDMA technologies. Leveraging six highly sensitive radios and antennas, it exploits multi-path and coherently combine all reflections to create optimal signals at both the base station and the clients, resulting in an average increase of 10 dB in link budget in both uplink and downlink. This advantage is achieved with standard 802.11a/b/g/n Wi-Fi CPE. Additionally, Spatial Division Multiple Access (SDMA) is utilized for simultaneously transmitting different traffic to multiple users, delivering up to two-fold downlink capacity increase.

The result is the best performance in terms of throughput, range, outdoor-to-indoor penetration and interference mitigation, which ensures that service providers are able to offer cost effective, top quality service. Service providers can save on capital and operating expenses with fewer base-station sites serving larger areas and providing higher capacity, thus accelerating return on

investment. Better user experience is achieved through ubiquitous coverage with fewer dead spots, higher throughputs and lower delays.

### **5.1.1. Improved Coverage**

The coverage area provided by Wavion's technology is up to three times that of conventional Wi-Fi Access Points. The extended coverage means that the network can reach a larger group of users, which in turn yields higher subscriber revenues at lower costs. Wavion's technology provides users with a powerful, high quality signal that is not dependent on line-of-sight and is highly resistant to interference. This results in a much improved uniform coverage with fewer dead spots, which allows the operator to provide high-quality service to all the customers in the area.

### **5.1.2. Increased Capacity**

The spatially adaptive Beamforming technology improves the link budget, which significantly increases the throughput of the Wi-Fi clients. The technology also minimizes the "fading phenomena" where Wi-Fi clients experience rate drops from time to time. This provides further improvement to the effective capacity of the infrastructure. With additional capacity increase achieved through the unique SDMA technology, the operator can offer a much higher grade of service to clients.

### **5.1.3. Superior Indoor Penetration**

Indoor penetration is very susceptible to multipath and signal reflection. Wavion's spatially adaptive Beamforming technology increases the bi-directional link budget and exploits multipath to its advantage, providing superior ability to overcome obstacles and penetrate buildings.

### **5.1.4. Enhanced Interference Immunity**

Wavion's incorporated advanced mechanisms for interference handling. Its powerful Beamforming technology directs the beam to the users, thus increasing the signal level and reducing the noise influence. Its unique Dynamic Interference Handling (DIH) technology continuously adapts the system parameters to the prevailing noise level, thus maximizing the air-access time. Its Automatic Channel Selection (ACS) enables selecting the clearest radio channel with best radio performances. And last but not least, specially designed omni directional and sector antennas reduce significantly the received noise level.

## **5.2. Integration with Cellular Network**

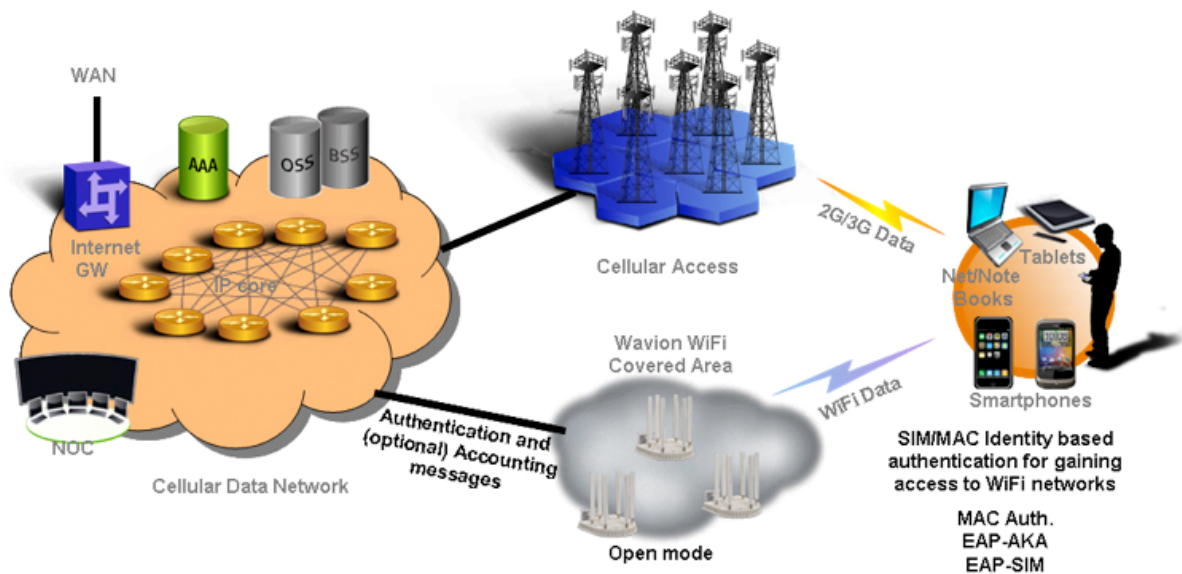
When two networks are used by the same operator to provide services to the same users, it is essential to satisfy the challenge of efficiently integrating the two networks. This means the ability

to use the same management systems (Authentication, Accounting, Billing, Services Managements, etc) while offering customers the best user experience through seamless handover and automatic fallback.

Wavion offers several ways of integrating its Wi-Fi base station with the Carriers' cellular network.

### 5.2.1. Transparent Mode

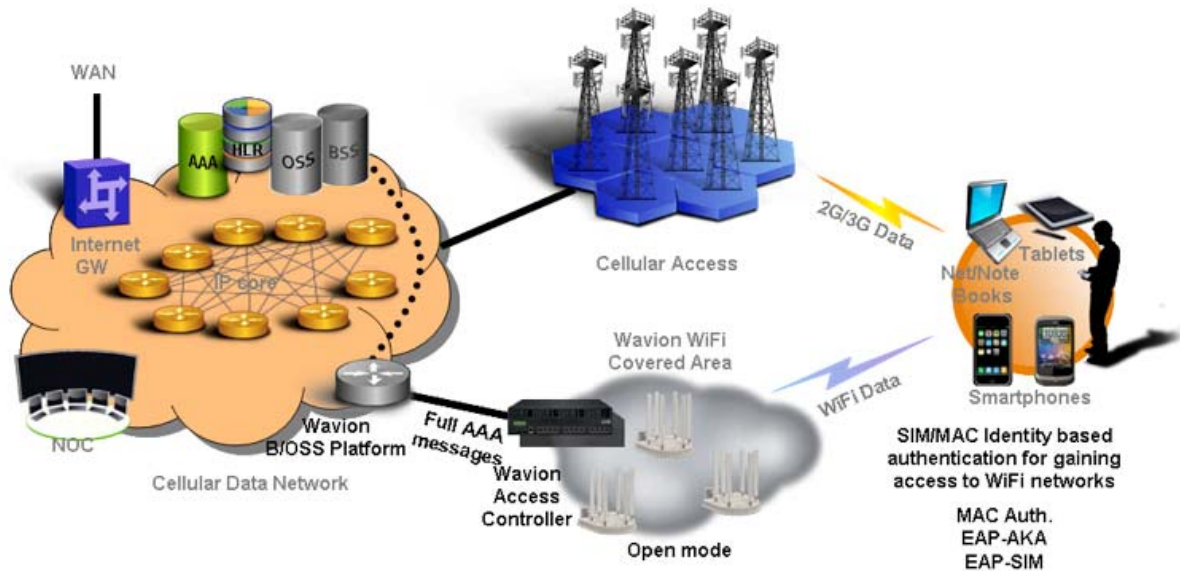
In this mode the base stations operate in open Wi-Fi security mode as typical used in public places, and provide support for authentication by the operator's AAA system using the same standard SIM based credentials as used in the cellular network are used over Wi-Fi with EAP-AKA for 3G and EAP-SIM for 2G devices. (Devices without SIM cards may also be authenticated using MAC authentication). Standard RADIUS is used to convey the authentication messages between the operators AAA server and Wavion base stations.



### 5.2.2. Accounting Mode

Accounting mode is similar to the Transparent mode, with the additional support of time and traffic per user session accounting RADIUS messages, generated by Wavion base stations for the operator's service management platforms (SLA enforcement, billing, etc.).

### 5.2.3. End-to-End (E2E) Mode



In this mode Wavion provides additional hardware and software with flexible options to support diverse operator's networking needs. Wavion's Access Controller (distributed or centralized architecture) enables per session QoS and other policy enforcement, and full support for standard AAA capabilities. Wavion's B/OSS server is a carrier grade software platform that includes a full AAA server and/or integrates with the operator's SS7 HLR systems, supports convergent and standalone billing, real-time rating & charging, access & service management and subscriber management. Also available is an application for end-user devices for seamless hand-off of data traffic from cellular to Wi-Fi, with fallback to cellular when Wi-Fi is not available.

## Summary

- The expected mobile data traffic load far exceeds the capacity supported by the cellular networks. This is particularly true in areas with dense users' concentration, as already seen in major city centers, where this load causes degraded level of service.
- Data offloading is becoming a "must have" capability to augment 3G/4G strategy. Wi-Fi is the most effective offloading solution for serving areas containing many users such as city centers.
- Wavion offers Wi-Fi base stations with the best-of-breed technology, presenting the best offloading solution for metro zones and other challenging environments with a large concentration of users.
- Wavion offers built-in networking features and a wide range of software and hardware components supporting diverse networking needs and enabling seamless data hand-off between cellular and Wi-Fi networks.

## About Wavion

Wavion Wireless Networks, a worldwide leader in metro and rural outdoor Wi-Fi applications, with deployments in more than 60 countries is transforming the unlicensed broadband wireless access market. Wavion exclusive technology combines true adaptive Beamforming for improving coverage and capacity, Spatial Division Multiple Access (SDMA) for transmitting to two users simultaneously over the same channel and Dynamic Interference Handling (DIH). With superior coverage and greater capacity, Wavion's solutions enable fix operators, mobile operators, ISPs, communities and enterprises to deliver high quality services while reducing CAPEX and OPEX by more than 50%. Featuring the WBS omni-direction and sector base stations, in 2.4 GHz, 5 GHz and 700 MHz, Wavion provides end-to-end solutions including access, backhaul, CPEs, NMS, service provisioning and billing solutions.

Wavion headquarters are located in Yoqne'am, Israel, and the company has worldwide offices in Miami, Florida, Dallas, Texas, Sao Paulo, Brazil, Buenos Aires, Argentina, Lima, Peru, Bogotá, Colombia, Moscow, Russia, and New Delhi, India.

Additional information about Wavion is available at [www.wavionnetworks.com](http://www.wavionnetworks.com).