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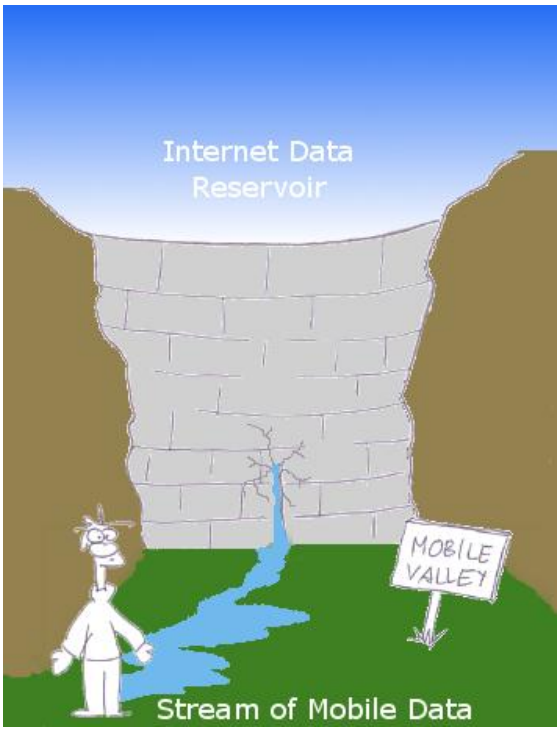

Operator's Dilemma

How to take advantage of the growing mobile Internet

Notava uAxes White Paper

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Executive summary

In recent years several simultaneous transitions has happened. 3G network evolution with HSPA have reached the level that mobile broadband offering with flat rate pricing start to be a competitive alternative for the fixed broadband offers. Internal 3G modems and USB dongles are enabling mobile broadband communication in new laptops and notebook PCs. New generation smartphones like iPhone are bringing the Internet experience for the mobile device users. In addition, the use of new Internet services is gaining popularity among mobile users. Long touted and predicted phenomenon is finally happening – Internet goes mobile.

Internet has been growing steadily – 2010 Internet is globally transporting 21 400 000 TB of data per month. Until 2009 traffic in mobile networks was mostly originated from voice service but in 2009 the amount of data bits has been surpassing the voice originated bits in cellular networks. With growing numbers, Internet data bits have started to flow into the mobile networks. In 2007 the monthly data traffic in mobile networks was 15 000 TB while the monthly data traffic in 2014 is estimated to be 3 600 000 TB – traffic more than doubling every year leading to 240-fold growth in seven years!

This disruptive growth will change the mobile industry. Moreover, evolution is not able to cope with the growth of that size. New thinking and new solutions are needed. Technology wise WiFi technology seems to be one of the key solutions to help operators to survive and turn this disruption into a lucrative business opportunity.

In this paper we are giving further insight to this spectacular growth of the mobile data and discuss about how the WiFi technology can help the operator to turn this overwhelming growth to be an opportunity instead of a threat.

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1 Internet grows and goes mobile

Recently Internet global traffic growth has been around 50% per year. During 2009 more than 120 Exabytes (10^{18}) of data has been transferred in Internet. It has been estimated that the fast growth continues and 500 Exabytes milestone will be passed in 2013 and Zettabyte (10^{21}) per year landmark will be achieved the year later. Most of that data is coming from consumer devices or services, with video being the number one application to generate the traffic [1][2].

Along the growth of the traffic in Internet, the penetration of Internet access is increasing – in the developed countries the penetration is approaching 70% while in the developing countries the penetration is close to 20% (2009). In the developing countries the subscription plans for the fixed broadband access are relatively expensive in relation to the average income and thus the fixed broadband growth rate has been moderate. However, the lower cost of mobile broadband access is driving people to use mobile broadband subscriptions to utilize Internet services. It is predicted that in India in 2014 over 300 Million subscribers will be mobile only Internet users and the trend is the same in many other developing countries. At the same time tempting flat rate mobile data plans together with the Internet optimized mobile devices drive increasing mobile usage of the Internet in the developed countries as well. [3][11]

It is predicted that in 2011 mobile Internet users will outnumber the fixed Internet users and majority of Internet users in the developing countries will have mobile only access to the Internet. Along the growth of smartphone penetration also the number of mobile Internet users will increase. Compared to the 1.8 Billion Internet users 4.5 Billion mobile subscribers form a huge source for the growth of the Internet. The global yearly smartphone penetration growth rate outpaces the growth of the Internet and the process is accelerating. UMTS Forum in its report has estimated the growth of mobile Internet user penetration as shown in Figure 1.

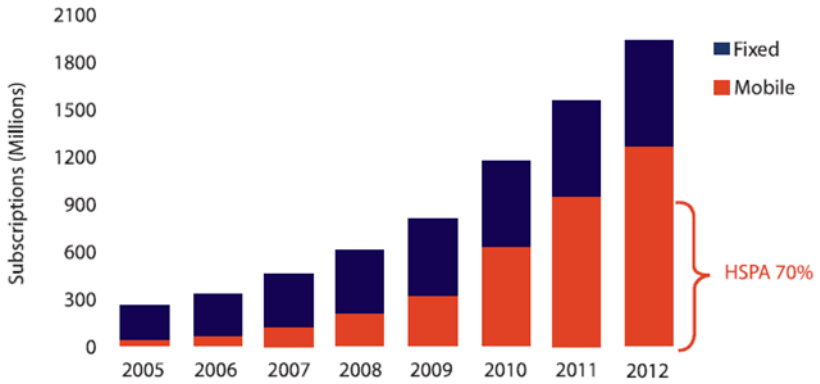

Figure 1. Growing number of mobile broadband Internet users will outnumber the fixed broadband users during the year 2010 [9]

The process of Internet going mobile does not mean that Internet is adopting the nature of mobile communication but more vice versa. The big shift is happening in the use patterns of mobile devices. Internet users are expecting to have access to those very same services that

they are using with their laptop and desktop PCs. Social media services, streaming video and music, e-commerce, online gaming are growing their popularity also in mobile use of the Internet. With new Internet enabled smartphones, Internet experience is starting to be close enough to fixed broadband experience and end users are able to start fully exploit Internet through wireless access. In addition, there is growing number of new innovative location based mobile services that are pushing further the mobile use of Internet.

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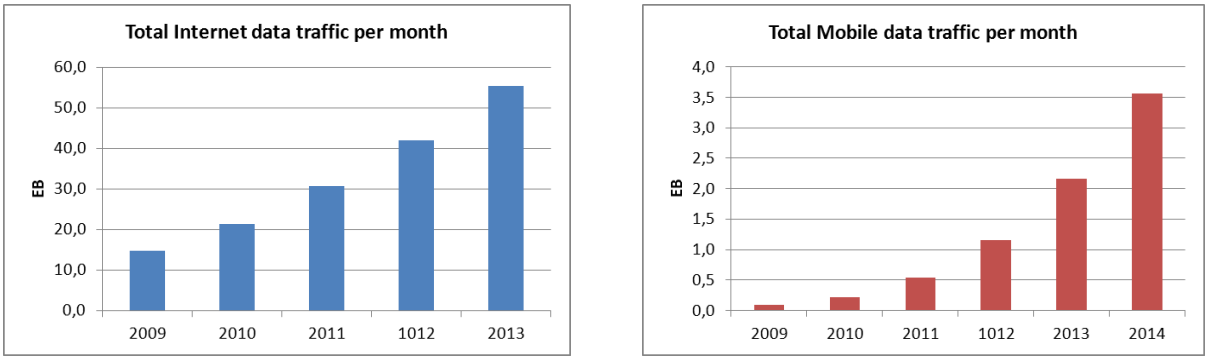

Figure 2. Global monthly IP traffic in the whole Internet and in the Cellular networks

In 2007 Internet total traffic volume was 5 Exabytes of data per month. In mobile networks the corresponding figure was pretty modest being 15 Petabytes (10^{15}) per month and representing only 0.3% of the Internet traffic volume. However, the annual growth rate of mobile data is over 100% beating clearly the overall Internet growth figures. According to Cisco report [1], in 2014 the yearly mobile data traffic will reach the level of 43 Exabytes while the total Internet yearly traffic volume will be on the level of 670 Exabytes [3] - mobile data representing 6.5% of the total volume of yearly Internet traffic. According to Cisco prediction mobile data traffic will increase **240** times during the period of 2007-2014 and the portion of mobile data in the Internet is growing steadily as shown in Figure 3.

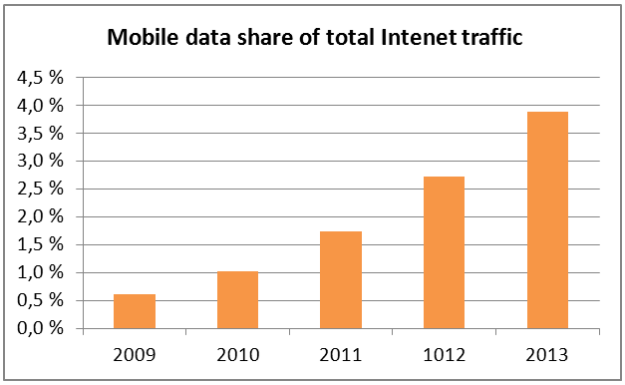

Figure 3. The share of mobile data in Internet

It is obvious that in the beginning, mobile data is not going to explode the Internet but the Internet data will do so in the wireless networks. The situation is like breaking the wall between mobile networks and the Internet. Adoption of use patterns, applications and services from the main stream Internet to the mobile use is really rewriting the rules how data will be consumed in the mobile networks. This phenomenon is not just prediction of the future – the described rapid growth is taking place in many mobile networks today. This is

true especially in developed markets and in densely populated areas where 3G modems and devices like iPhones are gaining growing popularity. The impact of iPhone is depicted in the following diagram (Figure 4.).

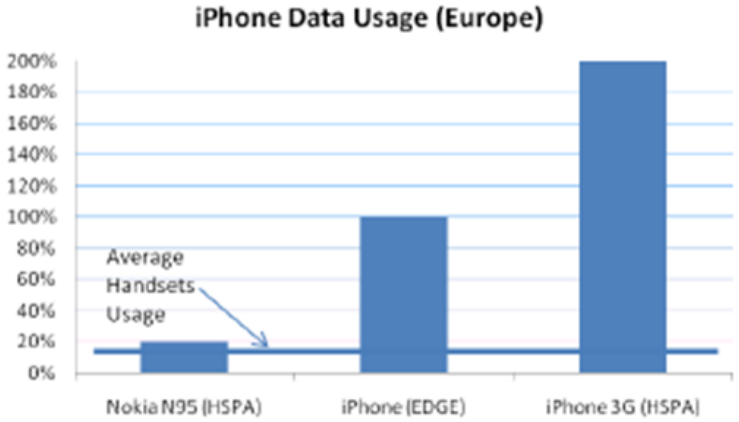

Figure 4. New generation smartphones are shifting the mobile data usage to the new level [8]

2 New landscape for mobile network operators

Disruptive growth of mobile data will be both an opportunity and a threat for companies in the telecom business. For operators the increasing number of mobile broadband subscriptions is providing steady path for revenue growth. Growing data traffic is also an opportunity but much more cumbersome to benefit from.

One root cause for the growth of mobile broadband subscriptions has been the adoption of internet way to operate, and more specifically the adoption of flat rate pricing. Along the coming disruptive mobile data growth there is a huge demand for new network capacity although the flat rate pricing is not giving the promise for the operators of corresponding return on investment. With the current business models and the cost structure of the telecom industry, it seems that the investment in new cellular capacity to fulfill the demand may not be so straightforward business decision. The analysis of Chetan Sharma Consulting shows that the cost of required new capacity will exceed the anticipated revenue growth obtained from the growing mobile data business [6]. Unsustainable business impact is illustrated in Figure 5.

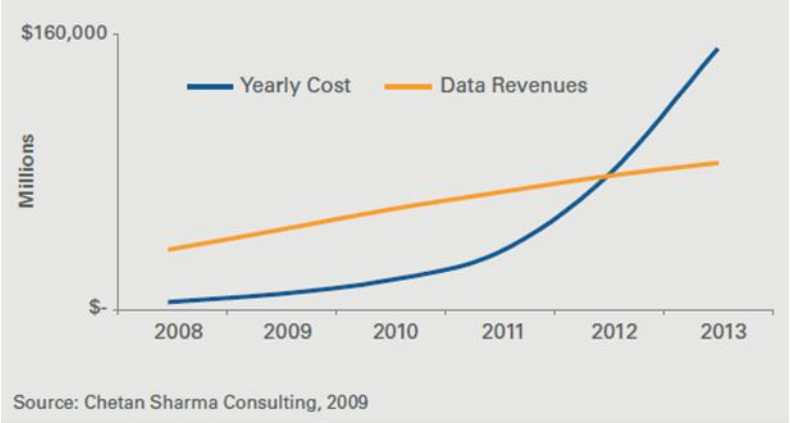

Figure 5. Estimated revenue growth vs. required new capacity investments in mobile broadband business [6].

Another big challenge is that the coming growth on demand is so overwhelming that cellular wireless networks with limited available spectrum and practical cell sizes can supply only partial solution for the growing demand. To provide enough capacity to meet the expanding demand, also other wireless technologies need to be utilized. Majority of smartphones and portable PCs are already providing an option to use WiFi connections to access the Internet. Growing number of data bytes from smartphones go through WiFi access points instead of 3G networks. It is even claimed that already now 60% of iPhones' Internet traffic is routed through WiFi connections.

2.1 Operators' challenge

End-users are both willing and ready to start using all the Internet services with new generation mobile devices. This creates a very lucrative business landscape for MNOs. However, to reach the full potential of new opportunities, operators need to adapt their current strategies, business models and operational modes to match the new environment.

Today operators' own the mobile data business by exploiting the ownership of cellular networks. The outlook that mobile data shall grow far beyond the capacity of cellular networks, put challenge to operators, whether they want to stick to the known profitable cellular business or do they want to be in the driver seat of the mobile data business also in the future. The challenge is both in the selections of utilized technologies and in the applied business models.

Technology wise most of the operators are betting on the new generation cellular technologies together with complementary technologies like WiFi. Both solutions have their pros and cons. 4G or LTE will transfer operators from voice centric cellular networks to the data centric networks with additional capacity and appropriate coverage. The cost of this additional capacity comes with high price tag and it will take time to achieve high enough penetration of 4G capable devices. At the same time WiFi seems to be the technology to supply most of the required last mile capacity for the future mobile Internet. Furthermore, the great majority of new smartphones are already WiFi enabled providing excellent basis for immediate WiFi utilization. However, the heterogeneous and fragmented nature of Wifi capacity is making its utilization difficult. Nevertheless, if operators do not adopt the WiFi

technology, they at the same time give up the control of significant part of the mobile data traffic and related business.

There are three main challenges in the WiFi usage:

- How to use WiFi with existing networks
- How to have access to the existing but fragmented WiFi capacity
- How to create an economically viable business model

Majority of the operators are currently setting up their plans regarding WiFi usage. The first approach appears to be a simple cellular data offloading to the existing WiFi networks to relax the data congestion in cellular networks. However, lack of appropriate interworking schema is slowing down the adoption of the WiFi technology.

Building dedicated WiFi capacity from scratch is neither much cheaper nor easier than building new cellular capacity: site contracts and costs, backhaul costs, indoor coverage, and many other practical challenges while building small cell networks in populated areas. The strength of WiFi solutions will be in the existing capacity: in public places, community networks, in new buildings infrastructure, homes – WiFi access points are part of the Internet society infrastructure that diversity of different stake holders are installing in their neighborhoods. The challenge is how to harvest this ubiquitous capacity to be used in a managed and secure way and how to setup scalable business model and market place to make business based on this capacity.

There are many businesses, communities, organizations, and authorities who are offering open and free WiFi capacity for the use of their associates. For operators the use of this kind of capacity for business purposes is legally and contractually pretty cumbersome. To guide subscribers to use open WiFi access points can be a serious security risk for customers and a big liability risk for operator itself. However, this kind of widely spread capacity can be very useful for offloading purposes as well if there was an appropriate framework to set up the contracts to allow utilization of these community type WiFi networks. Probably the owners of these open WiFi networks would be eager to earn some additional money for the maintenance and development of their networks if only the contractual setup would be simple enough.

Business wise operators' main challenge is how to match the required investment to the anticipated revenue growth. There are three ways to address the issue:

- Reduce the cost of the investment by using cheaper technology
- Accelerate the revenue growth using more diverse pricing models
- Find new customer segments to finance at least part of the required investment

WiFi technology seems to be a very promising technology to provide solution to these challenges. By exploiting the existing ubiquitous WiFi capacity the cost structure of new data capacity will be much lower than the traditional way to expand cellular networks. Currently the use of flat rate pricing is limiting the growth of operators' revenue stream. To maintain the freedom and flexibility to design business wise sensible pricing plans, it is required that also WiFi solutions with included business models support that goal. The managed Wifi offloading of cellular networks will maintain operators' freedom to set up pricing models also beyond flat rate pricing to enable planning of profitable business.

2.2 The first step - WiFi offloading

WiFi offloading is a good alternative to provide extra capacity. Firstly, the PC and smartphone clients, that are generating most of the mobile traffic, are almost all WiFi enabled. Secondly, most of the data traffic is best-effort "bulk IP"- data being well supported by the WiFi networks. Thirdly, the installed base of indoor WLAN APs is phenomenal and the traffic is manly generated indoors. Fourthly, there are standardization efforts specifying how WiFi networks can be integrated with the cellular core networks in order to support operators' value added services and seamless interworking.

Although having several good arguments to use WiFi offloading there are a few major obstacles that have so far hindered the widespread usage of WiFi offloading by the mobile operators.

- how to acquire sufficient WiFi capacity and coverage for offloading
- how to enable flexibility and diversity in data plan pricing schemes
- how to provide simple but secure access with automatic credentials delivery
- how to control congestion of WiFi networks

Securing sufficient coverage and capacity using the WiFi technology has doubted many operators. As WiFi technology operates in the unlicensed 2.4 GHz band with limited maximum transmission power, the traditional deployment approaches has not resulted in proper capacity and coverage for efficient offloading. Building broadband capacity using the WiFi technology practically requires indoor access point deployment, which is a cumbersome operation as most of the office and many residential building already have multiple WiFi networks installed. In order for the WiFi offloading to really take-off there must be a solution that allows operators to integrate own and 3rd party WiFi networks into a single offloading pool.

Users prefer flat rate data plans but for an operator such pricing is not always economically sustainable solution. Nevertheless, when the operator chooses the WiFi offloading scheme it should not be forced to fix its future data plan pricing options. Therefore, the WiFi offloading scheme should allow an operational mode where the operator dynamically pin points the clients for off-loading and on-loading.

Along the growth of mobile data also WiFi networks shall suffer from congestion. To manage the situation operator needs to have sufficient means to monitor the WiFi network and control traffic flows to be able to balance the load between different networks. For end users it is not acceptable that offloading would degrade the quality-of-service they are experiencing – therefore it is vital for operator to have appropriate tools to monitor also the QoS their subscribers are experiencing when they are offloaded.

2.3 Impacts to the business models

With WiFi on board the operator business landscape will have some new elements and stake holders. Utilization of 3rd party WiFi networks means in practice that the operator is buying WiFi capacity and selling it to its customers. Globally WiFi capacity is spread around and its

ownership is very fragmented which means that some kind of brokering entity is required to harvest the heterogeneous WiFi capacity and to sell it further, as a bigger chunk of capacity.

In practice this would mean a birth of new business ecosystem to trade WiFi capacity. Stake holders of the new ecosystem would be WiFi capacity owners, brokers, service providers, and end users. There could be a diversity of capacity owners starting from private access point owners up to well organized WiFi operators. In offloading case the service provider would typically be mobile operator. However, it is easy to see that also other service providers would benefit from the opportunity to sponsor the access to their value added services.

New approach of trading WiFi capacity can disrupt the way how operators are extending the capacity in their mobile data networks. It will also enable the birth of profitable WiFi brokering business which in turn will create a totally new business model and market place to make business with wireless access capacity. One can easily predict that we are currently witnessing the birth of a new business segment in the telecommunication industry.

3 WiFi offloading in cellular networks

Offloading cellular traffic to other networks is not a new topic in mobile communication. In 3GPP standardization the utilization of WiFi access in mobile networks has been on agenda of many workgroups. Tight integration approach is called Generic Access Network (GAN) architecture in which all the traffic and cellular network signaling is routed through the WiFi network. The technology is better known as Unlicensed Mobile Access (UMA) which was, in the beginning, targeted to improve indoor coverage for the voice service in 2G networks. In 3GPP later releases GAN architecture has been extended to cover also 3G packet data protocols, and is called now as Enhanced Generic Access Network (EGAN) architecture.

In EGAN architecture WiFi is providing an alternative radio access for standard 3G RAN. In the core network side there is a new gateway element called Enhanced Generic Access Network Controller (EGANC) which is a termination point for an IP-tunnel between the mobile device and the network. If the mobile device is EGAN capable and have an IP access it can connect itself to the EGAN enabled cellular core network using WiFi access as a route to Internet.

3GPP has also specified an alternative loosely coupled architecture to utilize WiFi networks. The approach is called Interworking Wireless LAN (IWLAN) architecture and it is a solution to transfer IP data between mobile device and operator's core network through the Wifi access. In the IWLAN architecture mobile device opens VPN/IPsec tunnel from the device to the dedicated IWLAN server in the operator's core network to provide the user either an access to operator's walled-garden services or gateway to the public Internet. With loose coupling between the networks the only integration and interworking point is the common authentication architecture - IWLAN clients are using the SIM authentication to create a secure IP tunnel from mobile device to the operator network and therefore the operator can be sure that it is providing service only for its own authenticated cellular subscriber.

The most straightforward way to offload data to WiFi networks is to have direct connection to the public Internet. For majority of the WEB traffic there is no added value to route the data through the operator core network. In this case the offloading can simply be carried out in the mobile client by switching the IP traffic to use WiFi connection instead of the 3G data

connection. In this approach these two networks are in practice totally separated and the network selection is done by the client application.

Although the level of integration is different between these three approaches, the basic challenge is the same: how to get WiFi access when offloading is assumed to happen? To have a complete offload solution the availability and seamless access to the Wifi network needs to be solved and it is obvious that the same solution would server all the above cases.

4 Conclusions

The mobile use of Internet services is spreading. New generation smartphones together with 3G enabled laptops and notebooks are bringing Internet use patterns and services into the mobile devices. This means a disruption in the mobile networks. Anticipated growth figures are beyond anything we have seen in the history of telecommunication. 240 times growth of data traffic volumes in a couple of years is both a great opportunity and a big challenge for the mobile communication industry.

By extrapolating the past operators are likely not to be able to meet the challenge. Out-of-box thinking is required both in the technical solutions and in the selection of business models. Utilization of the Internet domain solutions in all areas of mobile communication is required. Already know most of the converged mobile devices have an option to use several wireless technologies in addition to cellular access. Today about 50% of smart phones are WiFi enabled and by 2014 the WiFi penetration in smartphones is exceeding 90% [12]. It seems that the WiFi technology is going to be one of the key technologies to enable full Internet experience in mobile devices and also one of the solutions to help cope with the phenomenal growth of Internet data in smartphones and other intelligent portable devices.

For mobile network operators this is a big challenge – how to incorporate WiFi to be a beneficial part of their strategy, business and service offering. Due to mobile Internet data explosion, data offloading seems to be the first step for operators to start seriously exploiting WiFi in their business. With innovative new solutions [13] WiFi offloading will help mobile operators to survive Internet data explosion in mobile networks. Furthermore, the new approach towards ubiquitous WiFi capacity is also opening the door for lucrative new business opportunities.

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