Carrier Wi-Fi Offload

Building a Business Case for Carrier Wi-Fi Offload

Wireless 20/20 WiROI™ Wi-Fi Offloading Business Case Tool enables mobile network operators to analyze the commercial and financial benefits of implementing a Carrier Wi-Fi Offload Network

By Randall Schwartz and Haig Sarkissian | December 2015

Executive Summary

One of the critical challenges facing 3G and 4G Mobile Network Operators (MNOs) is how to deal with the anticipated mobile data tsunami. One technology that is getting the most attention is Wi-Fi Offloading. Network equipment vendors are rushing to develop carrier-grade Wi-Fi infrastructure solutions, while MNOs are analyzing how to integrate Wi-Fi capabilities into their networks in order to offload data traffic from their primary 3G/4G network. But there has been a lack of analysis to examine where, when, and if using Wi-Fi offload actually helps an operator's business case.

The WiROI™ Wi-Fi Offloading Business Case Tool was developed to offer the capability to analyze the economic tradeoffs of deploying a Wi-Fi offload network compared to expanding capacity by deploying primary 3G/4G network hardware. The Tool enables MNOs to analyze the conditions where Wi-Fi deployment can help the operator's business case, determine the investments required, and optimize the configuration of the Wi-Fi offload network to maximize Return On Investment (ROI).

Utilizing the latest WiROI™ Tool, Wireless 20/20 conducted an analysis of two 4G-LTE deployments and examined the impact of Wi-Fi offloading: one in New York City, a dense urban market, and a second case in San Diego, a market of lesser population density. The case studies showed that although both markets would benefit from implementing a carrier Wi-Fi offload network, the economic impact on the business case and the optimum configuration for the Wi-Fi network varied drastically.

The key findings from these analyses show that OpEx-related costs, such as monthly site rental and backhaul expenses, determine the viability of a Wi-Fi offload network. It is extremely important to pay great attention to the right balance of Wi-Fi coverage area and the density of Access Points (APs) in order to offload the optimum amount of traffic while maintaining or improving the user experience. Implementing too few APs could result in not capturing enough data traffic. On the other hand, implementing too many APs per square kilometer would increase OpEx significantly and drive the business case into a negative ROI.

For very dense urban markets such as New York City, positive ROI is achieved with as little as 20% geographical coverage and an AP density of 24 APs per square kilometer. The maximum savings in the Total Cost of Ownership (TCO) occurred at 100% coverage and a density of 42 APs per square kilometer. By deploying the Wi-Fi offload network at this optimal balance between coverage and density, an operator could reduce the number of macro LTE capacity sites from 1,879 to 432, a saving of 1,447 LTE sites. In financial terms, this translates into a cumulative TCO savings of over $250M, a significant 7.2% reduction in the TCO over 10 years. In this case, an operator has greater flexibility in implementing a Wi-Fi offload network because of a positive TCO, as long as the total OpEx per AP is less than $40/ month. When monthly OpEx per AP exceeds $100, the business case becomes challenging.

For very dense urban markets such as New York City, positive ROI is achieved with as little as 20% geographical coverage and an AP density of 24 APs per square kilometer.

New York City Analysis: Optimal 10-Year TCO Results			
	LTE Only	Wi-Fi Offload	Delta %/$M
Total CapEx	$514M	$284M	44.7%/$230M
Total OpEx	$3,006M	$2,983M	0.90%/$23M
TCO	$3,520M	$3,267M	7.20%/$253M
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Cumulative Free Cash Flow	$6,680M	$6,967M	4.3%/$287M

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In less dense urban markets such as San Diego, the case for Wi-Fi offload is not as straightforward. The maximum savings in the Total Cost of Ownership (TCO) occurred at 40% Wi-Fi coverage with a density of 24 APs per square kilometer. Deploying beyond 40% coverage or a density over 24 APs per square kilometer will result in a negative impact on the business case, increasing TCO beyond the baseline case of a 4G-only deployment.

In less dense urban markets such as San Diego, the case for Wi-Fi offload is not as straightforward.

San Diego Analysis: Optimal 10-Year TCO Results			
	LTE Only	Wi-Fi Offload	Delta%/$M
Total CapEx	$69M	$55M	20.3%/$14M
Total OpEx	$396M	$394M	0.01%/$2M
TCO	$465M	$449M	3.40%/$16M
	LTE Only	Wi-Fi Offload	Delta %/$Mtha
Cumulative Free Cash Flow	$869M	$888M	2.2%/$19M

Wireless 20/20 recognizes that each operator has its own unique parameters and that every market is different. Although Wi-Fi offload could have a positive impact on many operators' business cases, it is recommended that operators build a customized business case for their specific markets in order to analyze the exact parameters which yield an optimized ROI for the deployment of a carrier Wi-Fi offload solution.

For information on the WiROI™ Wi-Fi Offloading Business Case Tool, visit www.wireless2020.com.

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FierceBroadband Wireless

Phil Marshall, head of Tolaga Research, estimates that about 20 percent of iPhone traffic on AT&T Mobility's network is landing on the public Wi-Fi network and it's likely that another 60 percent is landing on home Wi-Fi networks now that the operator has instituted tiered data plans.

comScore

ComScore found that more than one third (37.2 percent) of U.S. digital traffic coming from mobile phones occured via a Wi-Fi connection.

by Karl Bode Thursday 27-Oct 2011

INTRODUCTION

Operators of 3G and 4G cellular data networks face an uphill battle against increasing data usage and declining ARPU. Increased sales of iPhones, Android smartphones, tablets and notebooks with embedded 3G/4G capabilities are all taxing the macro network for scarce capacity resources. This exponential growth of data traffic is forcing operators to evaluate mid to long-term migration strategies to LTE while in need for short-term strategies to relieve their congested macro networks. On top of these clear and present dangers to the day-to-day operations of the network, operators are faced with increased scrutiny from shareholders to prove that a pure LTE overlay deployment will provide a positive ROI as well as an improved customer experience.

Recent market research indicates that even though very few dedicated carrier Wi-Fi offload networks exist, a lot of data traffic is already being offloaded to existing private and public Wi-Fi networks in homes, at work and public hotspots. Research companies Comscore, Fierce Wireless and Heavy Reading estimate that between 20% and 80% of a smartphone subscriber's mobile data traffic traverses these private/public Wi-Fi networks.

Equipment vendors, industry analysts and pundits are all pushing for a move towards Wi-Fi offload, describing universal benefits for all operators as a means to offset the increasing data demands. Yet there has been a lack of industry analysis around the business case implications of Wi-Fi offloading. In response, Wireless 20/20 has built a special purpose version of its award-winning WiROI™ Business Case Tool to conduct in-depth business case analysis of Wi-Fi offload overlay networks. The goal was to identify the conditions where Wi-Fi offload can help an operator's business case and to pinpoint the optimal scenario where a Wi-Fi offload network deployment produces the best financial ROI. In addition, the analysis provides guidance to operators on how to deploy the Wi-Fi offload network with the optimal configuration of coverage and density of Access Points (APs) to capture the ideal amount of mobile data traffic that balances the cost savings of the primary network with the cost of the Wi-Fi overlay network while delivering a great experience for customers.

ANSWERING THE CRITICAL QUESTIONS

Wireless 20/20 has developed a comprehensive business case methodology to look beyond the Wi-Fi offload headlines into an economic analysis that will aid an operator in the decision process. The process begins by asking these critical questions that most operators would like to have answered before making a decision to invest time and money deploying a Wi-Fi offload network:

1. Is Wi-Fi offloading viable for my market?
2. What is the optimum coverage and density of Wi-Fi access points to capture optimal offload traffic and maximize ROI?
3. How many access points are needed to replace a single capacity LTE cell?
4. How much savings can an operator expect using Wi-Fi offloading?
5. How much traffic can the Wi-Fi offload network support?

METHODOLOGY SUMMARY

For the analysis, Wireless 20/20 selected New York City and San Diego as the scenarios for the case studies. A complete LTE network was modeled for each of these markets using the WiROI™ Business Case Tool to output investment-grade, 10-year business cases including full income statements to establish the baseline TCO, NPV and IRR. The WiROI™ Tool's easy-to-use Graphical User Interface (GUI) dashboard allows operators to do real-time sensitivity analysis to help optimize the network solution. The Wi-Fi offload module was used to simulate how a Carrier Wi-Fi network would affect the economics of an LTE business case, using CapEx and OpEx assumptions based on current market, technical and cost parameters gained from industry sources.

Figure 1

WiROI™ Wi-Fi Offloading Tool

Dashboard Graphical User Interface

To calculate the costs and revenue of the business case, the WiROI™ Tool gauges the anticipated traffic requirements year-on-year, based on the services offered. In the base case, the Tool can estimate how many additional cells are needed in the LTE network to support the capacity demands of the subscribers over the 10-year span of the business case. In addition to the CapEx needed to build the necessary additional cells, the Tool adds all of the OpEx to operate the capacity cells. When the Tool adds the Wi-Fi offload option, it allows the user to select the percentage of Wi-Fi coverage as well as the density of Wi-Fi access points. These two parameters are presented as sliders on the GUI dashboard, which can be controlled by the user. The Tool then calculates the number of Wi-Fi access points that correspond to the selected area of coverage using the desired density of access points. Both the CapEx and OpEx for the Wi-Fi offload network are shown on the dashboard along with the cost savings for the 4G network due to the reduction in the number of additional LTE capacity cells. The WiROI™ Tool assumes that the Wi-Fi access points are strategically placed in high traffic density areas in order to maximize the effect of data offloading from the LTE network. This feature gives the Tool the capability to analyze the diminishing returns of access point placement to optimize the best configuration for the Wi-Fi offload network.

Finally, depending on the traffic density expressed by the number of users per square kilometer times the traffic generated per user at the busy hour, the model calculates the amount of traffic that can be offloaded to a Wi-Fi network. By allowing the user to vary the coverage percentage of Wi-Fi access points, as well as the density of Wi-Fi access points, the model will allow the user to determine the optimum amount of coverage and access point density.

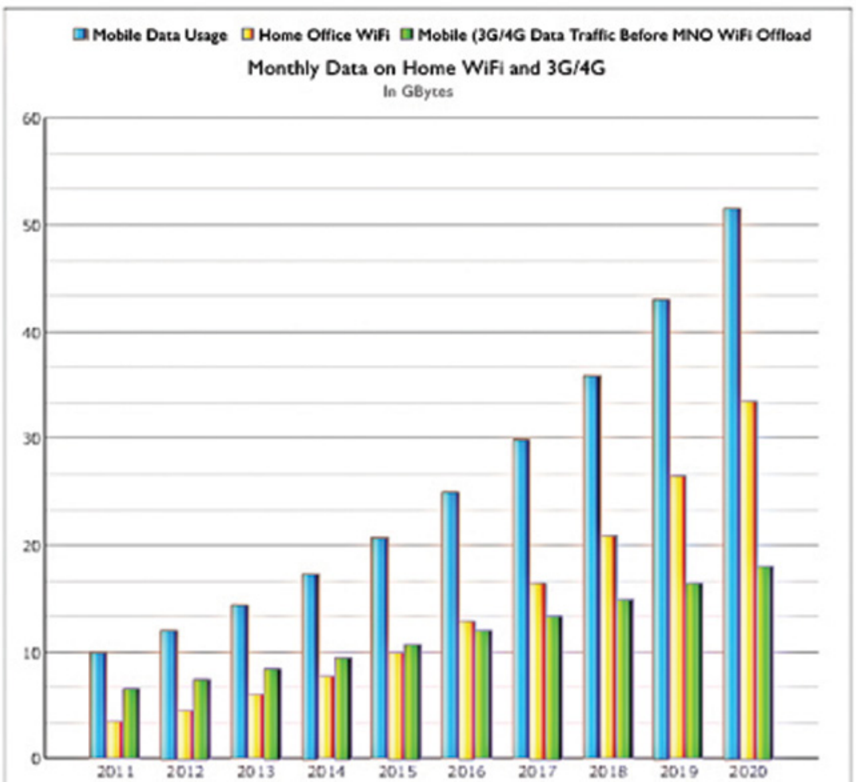
A. TRAFFIC CONSIDERATIONS FOR THE MNO NETWORK

The initial assumption any operator must make is the total amount of data consumed by an average mobile data subscriber over time. Once this baseline is established for the total capacity requirements of the 4G network, the WiROI™ Tool can calculate, based on the input parameters for the Wi-Fi offload module, the amount of traffic that can be offloaded from the primary 3G/4G network and onto the Wi-Fi network.

Research that has been publicized by Light Reading, Comscore and Fierce Wireless indicates that in developed urban markets with dense public/private Wi-Fi coverage, a typical mobile data user already sends between 20% and 80% of the mobile data traffic to these public/private Wi-Fi networks. Wireless 20/20 assumed that 65% of a smartphone user's traffic is already being offloaded to a home/office/public hotspot Wi-Fi network and therefore allocated the remaining 35% of the traffic to the MNO network.

Figure 2

Total Monthly Mobile Data Usage per Subscriber over Home/Office Wi-Fi and 3G/4G Networks



In addition, to determine the amount of traffic that is traversing public/private Wi-Fi networks, an operator must analyze the traffic usage patterns of its mobile network as the yardstick for determining where additional capacity will be needed and how it could be mitigated either by macro 3G/4G sites or Wi-Fi offload coverage. For Wi-Fi, there are two dimensions to consider: 1) percentage of area coverage; and 2) density of Access Points (APs) per sq km which in turn will determine the amount of data traffic that could be offloaded.

Wireless 20/20 has developed three mathematical formulas based on available research to simulate the correlation between coverage and the amount of traffic that can be offloaded when Wi-Fi is deployed. As depicted, the lines yield the highest ratio of traffic offload to coverage for the initial coverage areas, which are assumed to be those with the higher traffic density. For example, with 20% coverage — yielded 30% to 50% data offload, and tapering out to 50% coverage — yielded 65% to 80% data offload.

Figure 3

Typical Traffic Density in Urban Environment

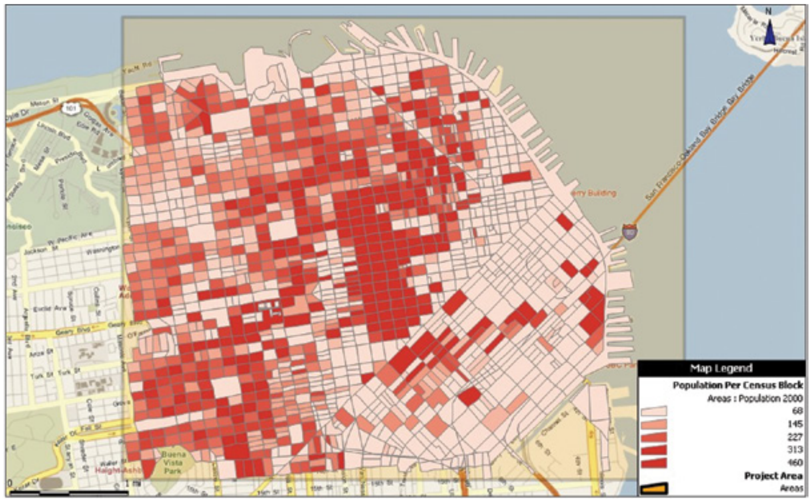
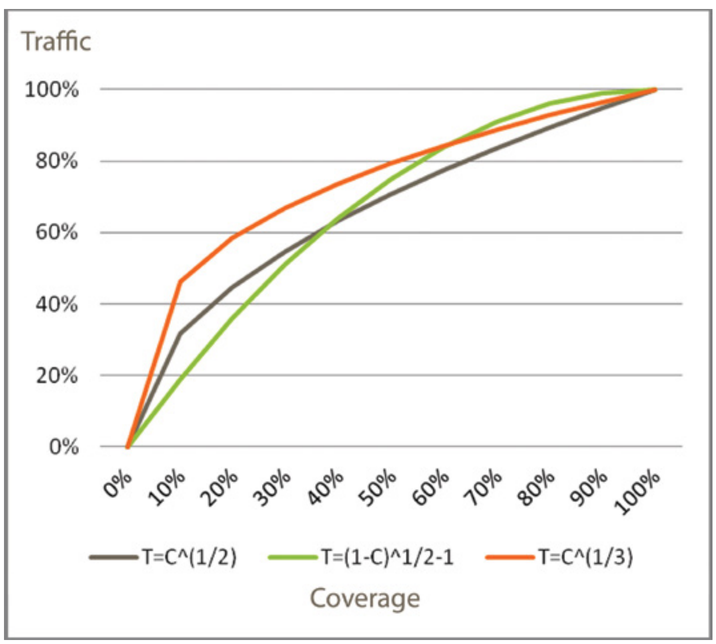


Figure 4

Relationship Between Wi-Fi Coverage and Data Traffic Offload



B. DEVELOPMENT OF THE BASELINE BUSINESS CASE

The base business model used in the case studies assumes a mobile operator with a 3G network is looking to upgrade and expand the network using LTE. The case study analyzes the financial impact of a Wi-Fi offload network on the operator's 3G/4G business case.

In the case study, the operator is assumed to have a single 10 MHz channel of FDD-LTE at 1800 MHz spectrum. They want to simulate and analyze the hypothesis that the macro LTE network, although it has better capacity characteristics than the current HSPA network, will not be able to be expanded in the most cost–effective way to handle the anticipated exponential growth in mobile data traffic. The WiROI™ Wi-Fi Offload Tool enables an operator to determine the circumstances under which a Wi-Fi offload network is financially viable and the ideal deployment scenario that will realize the optimal ROI while maintaining and improving the customer experience.

The WiROI™ Tool and process enables analysis of the TCO tradeoff between the need for additional capacity cells within the primary 4G network and building a parallel Wi-Fi offload network to help compensate for the extra capacity requirements. Though the WiROI™ Tool can also be used to analyze suburban and rural networks, the examples here address urban networks.

The starting point is to select the market(s) to deploy using GIS data to determine the coverage geography. Based on the coverage requirements, spectrum holdings, channel size and technology solution, the Tool calculates the number of LTE cells required for coverage. The WiROI™ Tool then calculates the complete end-to-end CapEx to build out the network, including the cell sites for the radio access network, the backhaul network, and the core network. Based on the market and service model which defines the subscriber growth and revenues, the WiROI™ Tool calculates the complete OpEx for operating the network, taking into account marketing and organizational growth to support the expected business growth. The output of the model is a complete 10-year income statement calculating the EBITDA, Net Income, Free Cash Flow, Cumulative Free Cash Flow, NPV and IRR.

As discussed, the assumed exponential growth in subscriber mobile data usage is becoming one of the most critical inputs to the business case. The WiROI™ Tool calculates the anticipated traffic requirements year-on-year based on the services to be offered and translates the traffic growth into the number of additional macro cells that will be needed in the network to support the capacity demands. The additional CapEx and OpEx for building and operating the necessary additional cells are automatically calculated and added to the overall business case.

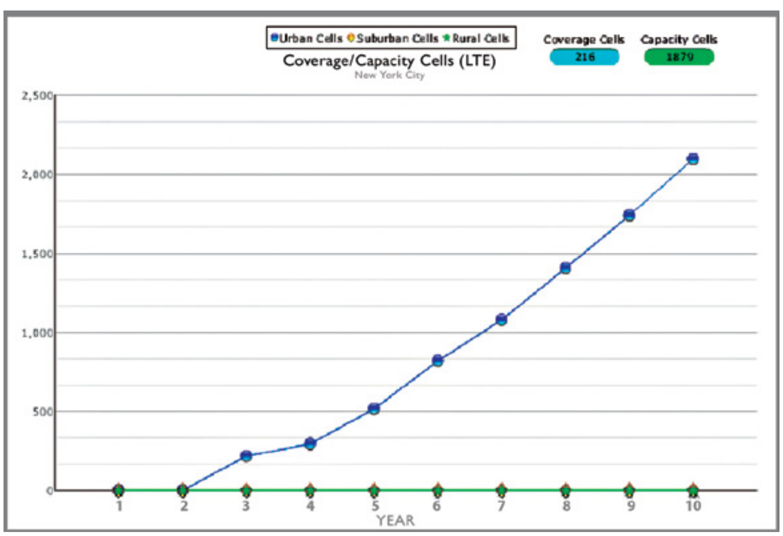


Figure 5

WiROI™ Tool Dashboard Chart of LTE Coverage Cells and Capacity Cells

C. DETAILING THE Wi-Fi OFFLOAD ASSUMPTIONS

The WiROI™ Wi-Fi Offloading Tool allows the user to control several important parameters to determine the extent of the Wi-Fi network to deploy. The first consideration is coverage percentage of geographical area and the second is density of access point per square kilometer. The optimal balance between coverage and access point density depends on a market's density of subscribers and their assumed data consumption. Being able to identify the optimal coverage percentage and access point density for a particular scenario is one of the key outputs from the WiROI™ Wi-Fi Offload Tool.

The traffic density formulas have been applied to the coverage and density calculations. Additional factors in the business case are compiled to calculate the probability that a particular user will push his traffic onto the Wi-Fi network. These include:

- Probability that a user's device has Wi-Fi (likely very high)
- Algorithm that the operator uses to switch users to Wi-Fi
- Availability of a Wi-Fi channel resource (likely high, but not 100%)

Once the number of access points is determined, the CapEx and OpEx for the Wi-Fi network are calculated. The Wi-Fi CapEx calculations include the cost of the access points and installation costs, the backhaul and the core network associated with the Wi-Fi network. The following key CapEx assumptions are built into the model and these costs can be adjusted depending on the vendor selection. The key components of the Wi-Fi CapEx are:

- Cost of Wi-Fi Access Point
- Cost of Wi-Fi Access Point Installation
- Cost of Backhaul Equipment
- Cost of Backhaul Equipment Installation and Provisioning
- Wi-Fi Core Network Equipment (Servers, Gateways, and Portals)

Figure 6

High Density vs Low Density Wi-Fi AP Coverage

The WiROI™ Tool accommodates the accumulation of additional CapEx as required for the core network to manage the traffic as well as the growth of subscribers over the 10 years of the business case analysis. The key components of the OpEx are:

- Monthly Wi-Fi and Backhaul Site Rental
- Monthly Wi-Fi and Backhaul Maintenance
- Monthly Traffic Backhaul Cost

As the number of Wi-Fi access points increases, the OpEx costs typically overshadow the CapEx costs. Even a small increase in monthly OpEx can make a Wi-Fi offload business case not viable. The combination of monthly site rental for an AP, monthly backhaul cost, and maintenance cost can make or break the Wi-Fi offload business case. The case studies show that when monthly OpEx is less than $40/month per AP, the ROI impact of Wi-Fi offload becomes positive.

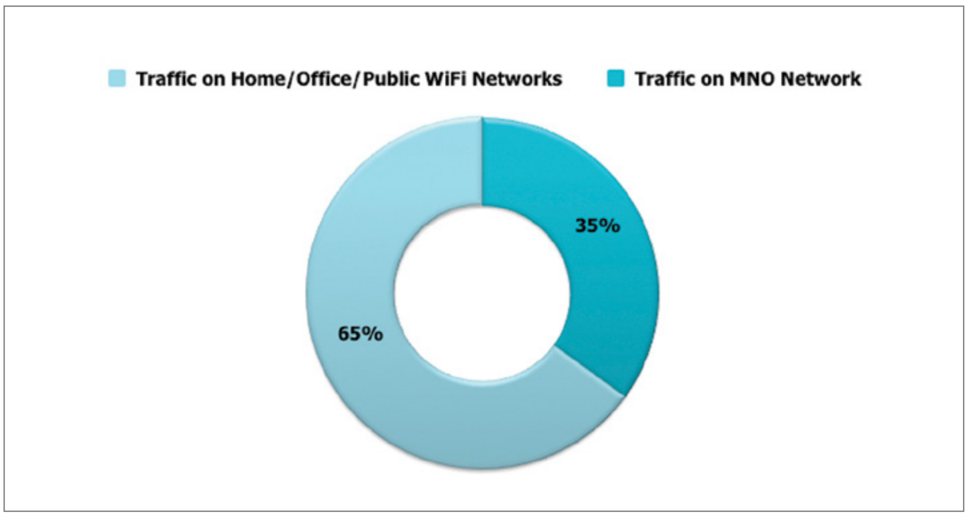
CASE STUDIES

Wireless 20/20 has developed over 60 business cases using the WiROI™ Business Case Tool for clients all over the world. In typical mobile broadband deployments, most urban networks quickly become capacity limited versus coverage limited, especially in urban areas. For this white paper analysis, case studies are examined on two urban deployment scenarios, using New York City and San Diego as our exemplary markets. With a few clicks of radio buttons and sliders on the WiROI™ Tool dashboard, the optimal combination of Wi-Fi access points and LTE capacity cells are identified. The two case studies highlight the difference in the impact of a Wi-Fi offload network on the business case for a large dense urban market and a midsized urban market. The case studies demonstrate how the WiROI™ Tool can pinpoint the combination of coverage and density of APs that will provide the maximum ROI while maintaining an equal or better user experience.

As was discussed earlier, approximately 65% of a subscriber's total data usage is assumed to be already offloaded over public and private Wi-Fi networks and is not included in the calculations. The model assumes that data usage on the 3G/4G network will continue to grow over the 10 years of the business case, beginning with 4 GB/subscriber per month, growing to 20 GB/month by Year 10 of the business case.

Figure 7

Wi-Fi Offload Traffic Assumptions



For more information, visit the Wireless 20|20 website www.wireless2020.com or call +1-408-884-1561.

The GIS information, input parameters, and the LTE & Wi-Fi CapEx and OpEx assumptions used for these case studies are depicted below.

For each case, the Wi-Fi coverage area was analyzed from 0% to 100% in 20% increments and the TCO results were compared to the TCO without Wi-Fi offload results.

Figure 8

Assumptions for the Case Studies

Baseline: New York City	Baseline: San Diego
Population: 8 Million	Population: 1.07 Million
LTE using 1800 MHz	LTE using 1800 MHz
10 MHz Channel	10 MHz Channel
Coverage 789 sq km	Coverage 250 sq km
2,194,000 Subscribers	206,330 Subscribers
216 Coverage Sites	69 Coverage Sites
1,879 Capacity Sites	206 Capacity Sites
Cumulative CapEx $514M	Cumulative CapEx $69M
Cumulative OpEx $3,006M	Cumulative OpEx $396M
TCO $3,520M	TCO $465M

Figure 9

Cost Assumptions for the Case Studies

LTE	Wi-Fi
CapEx Assumptions	
Cost of 3-Sector BTS $45,000	Cost of Wi-Fi Access Point $500
New Site Acquisition $150,000	New Site Acquisition $600
Co-location $150,000	Co-location $0
Backhaul $5,000	Backhaul $300
OpEx Assumptions	
Monthly Site Rental $1,000	Monthly Site Rental $20
Monthly Site Maintenance $200	Monthly Site Maintenance $10

CASE STUDY 1 - NEW YORK CITY LTE DEPLOYMENT WITH Wi-Fi OFFLOAD

In the case of New York City, because of the density of users and hence high density of user traffic, the complete LTE network base case modeled with the WiROI™ Business Case Tool needed to deploy 216 sites for coverage and 1,879 sites for capacity which required significant CapEx investments and high OpEx. The analysis of the impact a Wi-Fi offload network shows that the greater the Wi-Fi coverage, the better the financial return. The optimal financial return is accomplished with 100% coverage of the defined area of New York City, using over 33,000 access points with a density of 42 access points per square kilometer.

Figure 10

New York City Analysis: Optimal TCO Results

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	LTE Only	Wi-Fi Offload	Delta %/$M
Total CapEx	$514M	$284M	44.7%/$230M
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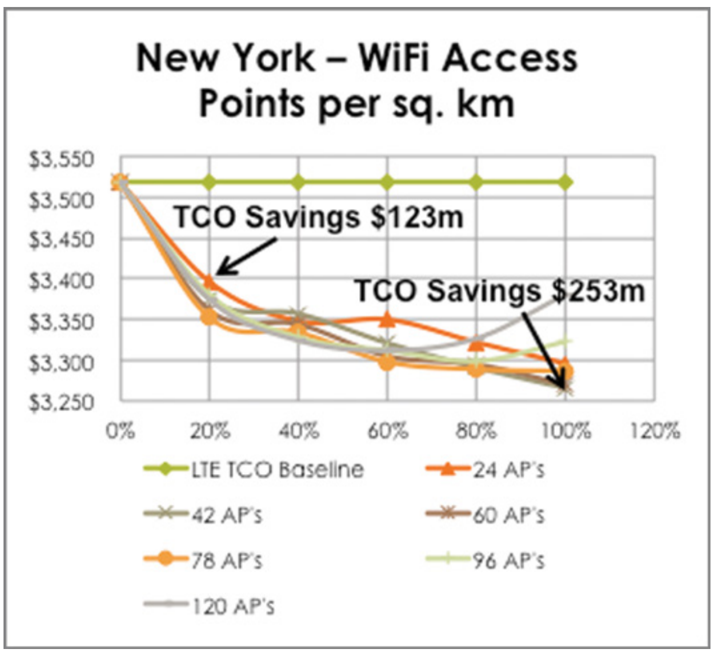

Figure 11

TCO Savings in $M Based on Optimal Coverage % and AP Density Per Square Kilometer

By deploying a Wi-Fi offload network at this optimal balance between coverage and density, the operator would reduce the number of macro LTE capacity sites from 1,879 to 432, a saving of 1,447 LTE sites. In financial terms, this translates into a cumulative TCO savings of over $250M, a significant 7.2% reduction in the TCO over 10 years. Cumulative cash flow is improved by 4.3%, or $287 million over the 10-year period.

Analyzing the numbers further, the cumulative CapEx is reduced by 44.7%, or $230 million, while the cumulative OpEx reduction is a moderate 0.9%, or $23 million over the 10 year period. It should be noted that since New York City is a very dense urban area, an operator would start to see significant TCO improvement at 20% Wi-Fi coverage, leaving an operator great flexibility in Wi-Fi offload network implementation.

CASE STUDY 2 - SAN DIEGO LTE DEPLOYMENT WITH Wi-Fi OFFLOAD

The Wi-Fi offload case for a less dense city like San Diego is not as straightforward. An operator has to pay even more attention to the network planning and implementation of a Wi-Fi offload network. The analysis discovered that there are scenarios where deploying too many Wi-Fi access points can actually hurt the business case.

Figure 12

San Diego Analysis: Optimal TCO Results

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	LTE Only	Wi-Fi Offload	Delta %/$M
Total CapEx	$69M	$55M	20.3%/$14M
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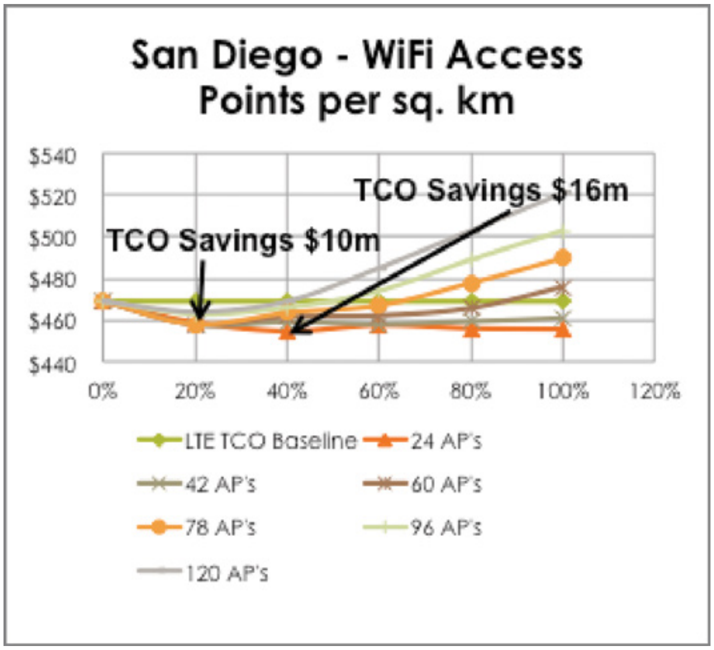
Figure 13

TCO Savings in $M Based on Optimal Coverage % and AP Density Per Square Kilometer



In San Diego, the macro LTE network will need 69 coverage sites and 206 capacity sites. In this scenario, the analysis pinpoints the optimal Wi-Fi offload coverage to 40% coverage with a density of only 24 access points per square kilometer using 2,400 Wi-Fi access point. By deploying a Wi-Fi offload network at this optimal balance between coverage and density, the operator would reduce the number of LTE capacity sites from 206 to 110, a saving of 96 LTE sites. The overall financial improvements are less impressive than in the New York City case, but they still yield a cumulative CapEx reduction of 20.3%, or $14 million, and a cumulative OpEx savings of $2 million over the 10-year period. If coverage is increased beyond 80%, or the access point density is over 42 access points per square kilometer, the TCO increases above the baseline cost of a 4G-only network.

The San Diego case shows that a detailed analysis can pinpoint an optimum balance of coverage and density of Wi-Fi offload for maximum ROI.

CONCLUSIONS

The analysis points to several key factors that could lead to determining the economic viability of a carrier Wi-Fi offload network. One key factor is future traffic growth assumptions. The more traffic that one assumes must be supported by the 3G/4G network, the more economically feasible Wi-Fi offloading will become using Wi-Fi offload. The WiROI™ Tool allows for increasing traffic assumptions by up to 10X from the baseline assumption to test the corresponding impact on a carrier's business case.

The case studies showed that the most critical parameters of the business case are the assumptions around OpEx for the Wi-Fi offload network. The WiROI™ Tool allows operators to simulate and adjust the coverage range of an access point, the coverage area percentage and the access point density which impacts the total number of access points being deployed. This simulation pinpoints the optimal configuration to help reduce CapEx and OpEx over the timeframe of the business case in order to greatly enhance the financial results.

In New York City, a dense urban environment with a high traffic profile, Wi-Fi offload is optimal at 100% coverage with a density of 42 access points per square kilometer, but significant TCO reduction can be realized with as little as 20% coverage and a density of 24 access points per square kilometer.

On the other hand, in San Diego, an urban environment with a high traffic profile, Wi-Fi offload is optimal at 40% coverage and a density of 24 APs per square kilometer with a diminishing return beyond 80% coverage. It is clear that Wi-Fi offload makes a compelling business case under the right circumstances. The main driver is OpEx, especially the Wi-Fi site rental and backhaul costs, as well as the assumed growth of the traffic demand on the 3G/4G network.

The New York City and San Diego analyses conclude that a Wi-Fi offload network with OpEx less than $40 per month is highly attractive. If OpEx exceeds $100-$150 per month, it becomes more challenging. Depending on the baseline assumptions that are used for a particular operator's business case, the results could be very different. Any operator considering deploying a Wi-Fi offload network should conduct a detailed network simulation and analysis, such as the one enabled by the WiROI™ Wi-Fi Offloading Business Case Tool, before making any commitments.

About Wireless 20/20

Wireless 20/20 is an independent research and consulting company focused on the dynamic broadband wireless market with clients spanning the entire 3G and 4G value chain, including semiconductor vendors, equipment vendors, service providers and investors. Wireless 20/20 is the developer of the industry-leading WiROI™ Wireless Networks Business Case Analysis Tool. This dashboard-style, easy-to-use, wireless ROI business planning tool has been licensed to operators and is being used extensively by leading LTE™, WiMAX™ and 4G operators around the world to develop comprehensive, business cases.

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