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## **Total Economic Impact™ Of Meru Networks' Virtualized Wireless LAN Solution**

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## **Executive Summary**

In November 2009, Meru Networks (Meru) commissioned Forrester Consulting to examine the total economic impact and potential return on investment (ROI) that enterprise customers may realize by deploying its "Virtual Cell" wireless LAN solution. This solution is a centrally managed (controller) wireless infrastructure with all access points operating on a single channel using the controller to load balance between access points and coordinate client movement from one access point to another, eschewing the decision-making burden on the client device. This study illustrates the financial impact of implementing Meru's single-channel wireless LAN solution, as compared with other "traditional" wireless LAN implementations that rely on assigning different channels to various access points.

In conducting in-depth interviews with an existing Meru customer in the healthcare industry, Forrester found that this organization achieved significant benefits — some easily measured for this ROI study and others that may be equally valuable but could not be quantified.

Specifically, the benefits of Meru Networks single channel architecture fall into the following categories:

1. Reduced need for sophisticated site surveys and RF (radio frequency) engineering.
2. Fewer number of access points required — equipment and cabling.
3. Lowered wireless network management and support labor costs.
4. Avoided cabling for deploying new technologies.
5. Increased productivity for medical staff.
6. Enhanced network and quality of service — particularly for voice traffic.
7. Improved patient care and user experience.
8. Increased network security compared with previous wireless solution.

The customer was able to provide metrics to quantify the first four benefits. Forrester found an anticipated ROI of between 43% (risk-adjusted) and 35% (non-risk-adjusted) with single-channel wireless LAN. The risk-adjusted net present value (NPV) of the investment is \$1.1 million with a payback period of 25 months.

The ROI portion of this study encompasses the first three years of the customer's wireless network rollout and an additional two years of ongoing support and benefits. This was done to make the study more readable. In actuality, the customer has continued with its steady rollout for six years and will continue to do so for the immediate future. The additional costs and benefits associated with any additional rollout in years 4 through 6 are discussed in the flexibility section of this study.

## **Purpose**

The purpose of this study is to provide readers with a framework to evaluate the potential financial impact of Meru's wireless LAN solution on its organizations. Forrester's aim is to clearly show all calculations and assumptions used in the analysis. Readers should use this study to better

understand and communicate a business case for investing in Meru's "Virtual Cell" wireless LAN solution.

### Methodology

Meru selected Forrester for this project because of its expertise in the deployment and management of Wireless LAN (WLAN) technology and the hundreds of inquiries Forrester fields from end users of WLAN technology each year, along with Forrester's Total Economic Impact™ (TEI) methodology. TEI not only measures costs and cost reduction (areas that are typically accounted for within IT) but also weighs the enabling value of a technology in increasing the effectiveness of overall business processes. The economic value assessed in this study is relative to other alternatives considered by the customer including solutions based on traditional architecture.

For this study, Forrester employed four fundamental elements of TEI in modeling the wireless LAN solution:

1. Costs and cost reduction.
2. Benefits to the entire organization.
3. Flexibility.
4. Risk.

Given the increasing sophistication that enterprises have regarding cost analyses related to IT investments, Forrester's TEI methodology is useful in providing a clear and simplified picture of the total economic impact of purchase decisions. Please see Appendix A for additional information on the TEI methodology.

### Approach

Forrester used a four-step approach for this study:

1. Forrester gathered data from existing Forrester research relative to wireless networking.
2. Forrester interviewed Meru marketing and sales personnel to fully understand the potential (or intended) value proposition of single-channel wireless LAN.
3. Forrester conducted a series of in-depth interviews with one customer organization that has implemented the solution.
4. Forrester constructed a financial model representative of the interviews. This model can be found in the "TEI Framework" section below.

### Key Findings

Forrester's study yielded the following key findings:

- **ROI.** Based on the interviews with an existing healthcare industry customer, Forrester constructed a TEI framework and the associated ROI analysis illustrating the financial

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impact areas. As seen in Table 1, the risk-adjusted ROI for this customer is 35% with a breakeven point (payback period) of 25 months.

- **Benefits.** For the purposes of the ROI analysis, only benefits associated with reduced need for site surveys, reduced number of access points, lowered labor costs, and avoided cabling for special projects were quantified. The risk-adjusted present value (PV) of the benefits amounted to \$4.2 million over a five-year period.
- **Costs.** The majority of the costs consisted of infrastructure hardware that made up wireless LAN, along with the cost of labor to manage the solution. The risk-adjusted PV of the costs amounted to \$3.1 million over a five-year period.

Table 1 illustrates the risk-adjusted cash flow for the customer based on data and characteristics obtained during the interview process. Forrester risk-adjusts these values to take into account the potential uncertainty that exists in estimating the costs and benefits of a technology investment. The risk-adjusted value is meant to provide a conservative estimation, incorporating any potential risk factors that may later affect the original cost and benefit estimates. For a more in-depth explanation of risk and risk adjustments used in this study, please see the “Risk” section.

**Table 1: ROI Summary, Risk-Adjusted**

Summary of financial results	Unadjusted (best case)	Risk-adjusted
ROI — three years	43%	35%
Payback	12 months	25 months
Total three-year costs (PV)	\$3,068,563	\$3,142,360
Total three-year benefits (PV)	\$4,396,391	\$4,227,784
Total three-year net savings (NPV)	\$1,327,828	\$1,085,424
Internal rate of return (IRR) †		234%

† An IRR could not be calculated for the unadjusted case because the payback period was just under 12 months. Therefore, on an annualized basis there was no initial investment to compare against.

Source: Forrester Research, Inc.

Based on interviews with a single customer organization, Forrester believes that higher ROIs may be associated with companies that are rolling out larger wireless LANs since there is a greater potential savings in support labor costs. Organizations that are expanding the size of their facilities significantly should also see a greater ROI. These factors should be considered by the reader when considering how the benefits described in this study relate back to their own organization.

## Disclosures

The reader should be aware of the following:

- The study is commissioned by Meru and delivered by the Forrester Consulting group.

- Meru reviewed and provided feedback to Forrester, but Forrester maintains editorial control over the study and its findings and does not accept changes to the study that contradict Forrester's findings or obscure the meaning of the study.
- The customer for the interviews was provided by Meru.
- Forrester makes no assumptions as to the potential ROI that other organizations will receive. Forrester strongly advises that readers should use their own estimates within the framework provided in the report to determine the appropriateness of an investment in Meru's "Virtual Cell" wireless LAN solution.
- This study is not meant to be used as a competitive product analysis.

## Single-Channel Wireless LAN: Overview

According to Meru, its "Virtual Cell" wireless LAN (WLAN) solution pools physical resources and then partitions them in ways tailored to match each individual user or application. By comparison, traditional networks cover large areas using a variety of channels assigned to various access points in the network, which require intelligence on the side of the client device to determine which channel, and therefore, access point, to connect to. Meru offers what it calls a Virtual Cell, a single-channel network of one or multiple Base Station Session IDs (BSSIDs) that create an enterprise-wide coverage area. This results in a blanket of coverage that appears seamless to Wi-Fi clients, as they do not have to switch channels as they migrate from access point to access point. The solution partitions the coverage area into Virtual Ports, providing port-level control to IT management over the various devices and users on the WLAN.

### Virtual Cell

Because the Virtual Cell pools radio resources into a single-channel layer of coverage, Meru avoids the channel-based boundaries germane to traditional WLAN systems. All access points use the same radio channels and appear as one, letting client devices move freely throughout a network without handoffs between access points.

### Virtual Port

By partitioning the network into Virtual Ports, each client gets its own Ethernet-port-like link to the network. The Virtual Port is the wireless LAN equivalent to switched Ethernet allowing for client and users level control and experience monitoring, allowing for IT to troubleshoot and monitor use with much more granular information than at the access point or BSSID level.

## Analysis

As stated in the executive summary, Forrester took a multistep approach to evaluate the impact that implementing single-channel wireless LAN can have on an organization:

- Interviews with Meru marketing and sales personnel.
- In-depth interviews with one organization that has implemented single-channel wireless LAN.
- Construction of a common financial framework for the implementation of a single-channel wireless LAN Solution.

## **Interview Highlights: Healthcare Industry Customer**

The customer interviewed for the TEI study was a large healthcare network operating multiple hospitals, clinics and teaching facilities. There are more than 750 physicians and other healthcare professionals and a total of 6,000 employees. In addition to the main facility, there are more than a half dozen smaller hospitals, clinics, and primary care facilities across a wide geographic area. In total, there are more than 30 locations using the Meru solution.

The individual interviewed for the study is the IT Director and Information Security Officer and is responsible for Network Operations and information security across all facilities. Their "vision is to enable appropriate access to any network or information resource for anyone, anywhere, at any time."

After implementing and operating a small wireless network for medical students in 2002, the customer decided that it needed a controller-based solution if it was to be deployed for all users across all facilities. They explained that, "We could not complete a deployment of this size and complexity with traditional wireless technology that is not controller-based for the management of the individual access points. We could not afford the size of team that would be needed to run the solution. And if we could, it still would never work properly. Centralized control makes it easier because you do not have to configure the access point anymore."

The evaluation criteria for selecting a controller-based WLAN solution included: ease of deployment and support; minimal site surveys required; real-time rogue access point (AP) detection and mitigation capabilities; standards-based, scalable, and extensible hardware; and the ability to support constant shifts in density and coverage requirements.

In 2003, the customer conducted a trial of the Meru solution at an 86,000 square foot facility. The implementation consisted of six APs on each of the seven floors. After completion of the trial, the decision was made to initiate an ongoing rollout of the Meru solution at all facilities. This has grown over time as locations expand and hospitals are acquired. The capital budget allowed for approximately 500,000 square feet per year to be added to the wireless network coverage area. This ongoing process of deployment and management continues to this day.

The interviews with the customer uncovered the following relevant points:

- The first and most important step in deploying the solution was "designing the system controller to make sure it could scale as needed. We considered the various support parameters needed for the different tasks or applications and kept security in mind at all times."
- The need for complex site surveys by RF professionals was eliminated at the time of installation, as was the need for quarterly review surveys. "All we had to do was look at the building blueprints to mark and identify access point placement."
- Elimination of co-channel interference was a significant benefit. There was no need to "tune the radios down from 100 milliwatts, so fewer APs were needed and placement was much easier." This is innate to the single-channel design of the Meru solution.
- Handoffs between APs were transparent to users because of the single-channel design, allowing medical staff to move throughout a facility without losing data and/or voice connections.

- The customer's high-density deployment covers:
  - Voice for Vocera voice badges, IP phones, and smart phones.
  - IP-based video communications and streaming video content.
  - Data for Workstation on Wheels (WoWs), PDAs, and an InTouch Health RP-7 robot.
  - Wireless network access for visitors, patients, and medical staff.

## **TEI Framework**

### *Introduction*

Based on the information provided in the in-depth interviews, Forrester has constructed a TEI framework for those organizations considering implementation of a WLAN network. The objective of the framework is to identify the cost, benefit, flexibility, and risk factors that affect the investment decision. Most monetary values shown in this study are rounded to the nearest dollar for simplicity of presentation. Actual financial calculations might be based on figures carried to more decimal points than shown here and therefore not entirely match the resultant figures presented in the tables.

This study is focused on the benefits of Meru's solution compared with similar enterprise-class WLAN solutions. Additional benefits comparing this solution to building out a wired network or a wireless network based on APs that cannot be centrally administered via a controller are not included. The reader is encouraged to consider these additional benefits when determining the potential impact on their organization.

At the time of writing this study, the customer had been rolling out Meru's WLAN solution for six years. The ROI component of this study only takes into consideration the costs and benefits associated with the first three years of deployment. This was done to create a study that is more readable and to reflect a smaller implementation more in line with what most readers will be considering. Therefore:

- Deployment costs are included for years 1 through 3.
- Support costs are included for years 1 through 5 (two years after deployment).
- Benefits attributable to the deployment are included for years 1 through 5 (two years after deployment).

### *Framework Assumptions*

Table 2 lists the discount rate used in the PV and NPV calculations and time horizon used for the financial modeling.

**Table 2: General Assumptions**

Ref.	General assumptions	Value
A1	Discount rate	8%
A2	Length of analysis	Three years

Source: Forrester Research, Inc.

Organizations typically use discount rates of between 8% and 16% based on their current environments. Eight percent was used in this study because hospitals often have lower cost of capital due to public funding sources and bond issuances. Readers are urged to consult with their finance organizations to determine the most appropriate discount rate to use within their own organizations.

In addition to the financial assumptions used to construct the cash flow analysis, Table 3 provides salary assumptions used within this analysis.

**Table 3: Salary Assumptions**

Ref.	Metric	Calculation	Value
B1	Fully burdened salary <sup>†</sup> per IT manager	\$90,000 + 30% benefits	\$117,000
B2	Fully burdened salary <sup>†</sup> per IT staff	\$75,000 + 30% benefits	\$97,500

<sup>†</sup>Includes salary, variable compensation, and all direct benefits (e.g., health insurance)

Source: Forrester Research, Inc.

## Costs

This section describes the direct costs of implementing a single-channel wireless LAN and the ongoing incremental management costs.

The customer's implementation plan is very consistent from year to year. Approximately 500,000 square feet of coverage are added each year, and this size of deployment was chosen based on available budget and manpower. In some years WLAN is installed at multiple, smaller facilities, and in other years a single large facility such as a hospital may be added. For simplicity, the model considers a single site installation in any given year. Table 4 provides an overview of the number of APs and square footage of coverage added during the first three years of this effort.

**Table 4: WLAN Expansion — Access Points And Coverage**

Ref.	Metric	Calculation	Year 1	Year 2	Year 3	Year 4	Year 5
C1	Number of access points added		500	500	500	0	0
C2	Total number of access points	Sum C1 (through current year)	500	1,000	1,500	1,500	1,500
C3	Sq. ft. of coverage added		500,000	500,000	500,000	0	0
C4	Total sq. ft. covered	Sum C3 (through current year)	500,000	1,000,000	1,500,000	1,500,000	1,500,000

Source: Forrester Research, Inc.

### *Meru Costs*

Costs paid to Meru are based on the number of access points deployed. On average, 500 access points are deployed each year. Over time, the specific model being deployed has evolved. The overwhelming majority of APs are the AP201 (802.11 b/g) model. About 10% of the APs deployed are the AP208, an 802.11a/b/g model. The newest installations are largely composed of the AP320 (802.11a/b/g/n) access point. Other components of the solution include controller hardware such as the Meru 1500, E(z)RF Application Suite, Network Manager, Location Manager, and Service Assurance Manager (SAM). For the purposes of estimating costs, the customer uses \$1,000 per AP as an all-inclusive cost for the Meru solution.

The customer did not contract for any professional services as part of the implementation. It determined AP placement on its own and learned to configure and manage the solution from the first day. Meru did provide one week of consulting during the initial pilot at no charge.

Service and support contracts are based on the number of controllers deployed. Originally, the customer deployed the MC 1100 and MC 3100 Series controllers. They were capable of supporting 75 and 150 access points, respectively. The customer is now deploying MC 5000 controller chassis. Each chassis can house five blades, and each blade can control 300 APs. Currently, they have two or three blades in each chassis — based on access point load — and have a plan to consolidate all controllers into the MC 5000 chassis. Support costs vary by controller model. For simplicity, an average cost of \$8,000 per controller was used in this study.

In year 1, 500 APs were deployed at a total cost per AP of \$1,000. This resulted in hardware and software costs of \$500,000. Additionally, three controllers were added at an average cost of \$8,000, resulting in \$24,000 in support and service costs. Combined, these two cost categories resulted in a total payment to Meru of \$524,000 in year 1 of the study.

**Table 5: Meru Costs, Non-Risk-Adjusted**

Ref.	Metric	Calculation	Year 1	Year 2	Year 3	Year 4	Year 5
D1	Total costs per access point deployed (incl. APs, controllers, etc.)		\$1,000	\$1,000	\$1,000	\$1,000	\$1,000
D2	Meru hardware and software costs	$C1 * D1$	\$500,000	\$500,000	\$500,000	\$0	\$0
D3	Number of controllers	$C2 / 150$ APs per controller	3	7	10	10	10
D4	Support and service per controller		\$8,000	\$8,000	\$8,000	\$8,000	\$8,000
D5	Total support and service costs	$D2 * D3$	\$24,000	\$56,000	\$80,000	\$80,000	\$80,000
Dt	Meru costs	$D1 + D2$	\$524,000	\$556,000	\$580,000	\$80,000	\$80,000

Source: Forrester Research, Inc.

### *Cabling*

Each wireless access point needs to be connected to the wired network. If more than one wireless AP is being placed in the same location, it may not require a separate cable to be pulled. For simplicity, the assumption was made that each wireless AP requires a cable to be pulled.

Cabling is a shared resource used for the wireless and wired networks along with other hospital infrastructure. An average of \$300 per cable drop to connect a wireless access point was used for this study. Included in this is running the cable and connecting the AP to the data cable and a power source. Once this was completed, IT would connect the cable in the data network closet, and the AP would be automatically configured remotely by the management software. After installation, it would take approximately 5 minutes for it to be fully configured and come online as part of the wireless network.

**Table 6: Cabling**

Ref.	Metric	Calculation	Year 1	Year 2	Year 3	Year 4	Year 5
E1	Number of cable drops	$= C1$	500	500	500	0	0
E2	Cost per cable drop		\$300	\$300	\$300	\$300	\$300
Et	Cabling	$E1 * E2$	\$150,000	\$150,000	\$150,000	\$0	\$0

Source: Forrester Research, Inc.

*Additional Hardware Costs*

In addition to the Meru hardware, in some cases the customer needed to add other hardware to complete the network. Examples of the hardware needed include additional switch-port density, power injectors for older switches not capable of delivering Power Over Ethernet (PoE), and external access point antennae. In the first three years of the deployment, it is estimated that \$200,000 was spent on this additional hardware. The cost is equally divided over the three years.

**Table 7: Additional Hardware Costs**

Ref.	Metric	Calculation	Year 1	Year 2	Year 3	Year 4	Year 5
F1	Additional hardware costs	\$200,000 / 3 years	\$66,667	\$66,667	\$66,667	\$0	\$0
Ft	Additional hardware costs	= F1	\$66,667	\$66,667	\$66,667	\$0	\$0

Source: Forrester Research, Inc.

*Wireless Network Management*

Managing and supporting the Meru solution requires very little effort. Spread across several individuals, one FTE is responsible for monitoring and diagnosing problems. They are also responsible for planning additional deployments. Two and a half FTEs work in the field to fix problems with individual APs when they do arise. The most common problems that need to be addressed are lost power and APs becoming damaged by construction crews unaware of their presence.

This level of effort is significantly less than what would be required to manage a solution that consists of autonomous access points not managed by a central controller. This corresponding benefit is discussed in the benefits section below.

**Table 8: Wireless Network Management**

Ref.	Metric	Calculation	Year 1	Year 2	Year 3	Year 4	Year 5
G1	Number of FTEs - management		1	1	1	1	1
G2	Fully burdened salary - management	= B1	\$117,000	\$117,000	\$117,000	\$117,000	\$117,000
G3	Number of FTEs - field		1.0	1.5	2.0	2.0	2.0
G4	Fully burdened salary - support	= B2	\$97,500	\$97,500	\$97,500	\$97,500	\$97,500
Gt	Wireless network management	(G1 * G2) + (G3 * G4)	\$214,500	\$263,250	\$312,000	\$312,000	\$312,000

Source: Forrester Research, Inc.

*Total Costs*

Table summarizes the costs to implement and manage Meru's single-channel wireless LAN.

**Table 9: Total Costs Of Meru's Single-Channel Wireless LAN, Non-Risk-Adjusted**

Ref.	Costs	Year 1	Year 2	Year 3	Year 4	Year 5	Total	PV
Dt	Meru costs	\$524,000	\$556,000	\$580,000	\$80,000	\$80,000	\$1,820,000	<b>\$1,475,945</b>
Et	Cabling	\$150,000	\$150,000	\$150,000			\$450,000	<b>\$373,028</b>
Ft	Additional hardware costs	\$66,667	\$66,667	\$66,667			\$200,000	<b>\$165,790</b>
Gt	Wireless network management	\$214,500	\$263,250	\$312,000	\$312,000	\$312,000	\$1,413,750	<b>\$1,053,800</b>
	<b>Total</b>	<b>\$955,167</b>	<b>\$1,035,917</b>	<b>\$1,108,667</b>	<b>\$392,000</b>	<b>\$392,000</b>	<b>\$3,883,750</b>	<b>\$3,068,563</b>

Source: Forrester Research, Inc.

**Benefits**

The first half of this section details the quantitative benefits included in the ROI. The second half describes qualitative benefits that the customer discussed but could not be quantified for this study. These are not included in the ROI analysis. Readers should take the qualitative benefits into consideration when analyzing the total benefits their organization may realize by implementing a single-channel WLAN.

*Avoided Site Surveys*

Traditional wireless solutions based on traditional architecture, and even other centrally managed solutions, require complicated radio frequency (RF) surveys at the time of deployment. This need is largely eliminated with the Meru solution because all APs are on the same frequency. In the case of this customer, no site surveys were required. They explained that with other solutions "it is necessary to do a survey prior to the deployment to determine access point placement, power setting, and type of antenna." At the pilot location, which had a wireless network implement prior to the adoption of Meru, this cost more than \$150,000.

In addition to initial surveys, follow-up surveys are required to ensure that there have been no changes to the WLAN signal propagation as a result of changes to the building layout that require the wireless network to be reconfigured. This could be something as simple as a large metal filing cabinet being moved. "For traditional wireless networks, these re-inspections should be completed every three months or sooner if there is a major change." There should be less of a need for re-inspections compared with a traditional solution.

For the purpose of this study, a benefit is realized by avoiding an initial site survey for each additional 500,000 square feet of coverage implemented. It is also assumed than one annual re-survey checking for layout changes at each location is also avoided. This latter benefit is less than the potential quarterly need to re-survey a location because other enterprise-class centrally

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controlled solutions may have a greater tolerance to change than wireless networks built on traditional technology. In reality, more than 30 individual locations were covered by the wireless network by the end of the third year, so the actual survey costs were most likely higher than included in this study.

**Table 10: Avoided Site Surveys, Non-Risk-Adjusted**

Ref.	Metric	Calculation	Year 1	Year 2	Year 3	Year 4	Year 5
I1	Number of initial 500,000 sq. ft. surveys		1	1	1	0	0
I2	Cost per initial survey		\$150,000	\$150,000	\$150,000	\$150,000	\$150,000
I3	Number of re-surveys	Sum I1 (through previous year)	0	1	2	3	3
I4	Cost per follow-up survey		\$75,000	\$75,000	\$75,000	\$75,000	\$75,000
It	Avoided site surveys	$(I1 * I2) + (I3 * I4)$	\$150,000	\$225,000	\$300,000	\$225,000	\$225,000

Source: Forrester Research, Inc.

### *Avoided Additional Access Points*

This benefit looks specifically at the additional number of access points that may be required by another enterprise-class, controller-based WLAN solution. A comparably sized traditional wireless network would most likely require significantly more access points than included in this study.

“The greatest reason fewer access points are needed with Meru is because there are no co-channel interference concerns. All Meru access points can be deployed at full radio capacity (100 milliwatts). With our previous solution, the site survey had some APs turned all the way down to 5 milliwatts. With Meru I never have to do that.” The customer estimated that another, comparable traditional architecture based solution would require up to 50% more access points because they do not all operate on a single channel.

Each additional access point requires the purchase of hardware, software, and maintenance from the vendor. An assumption was made that the total hardware and software costs for a comparable solution is the same as Meru on a per access point basis. No maintenance contract costs were included since these can vary widely across vendors.

Also included is the cost of dropping a cable to each wireless access point and deploying the access points. The same \$300 per cable pull is used in this calculation. In the case of solutions not centrally managed, the customer estimated that it would take an additional 20 minutes per AP for configuration. This additional configuration cost is not included in ROI analysis.

**Table 11: Avoided Additional Access Points, Non-Risk-Adjusted**

Ref.	Metric	Calculation	Year 1	Year 2	Year 3	Year 4	Year 5
J1	Number of access points not added	$C1 * 50\%$	250	250	250	0	0
J2	Total costs per access point deployed	= D1	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000
J3	Cost per cable drop	= E2	\$300	\$300	\$300	\$300	\$300
Jt	Avoided additional access points	$J1 * (J2 + J3)$	\$325,000	\$325,000	\$325,000	\$0	\$0

Source: Forrester Research, Inc.

### *Wireless Network Labor Savings*

The customer described the Meru solution as an extremely efficient solution to manage. “If you have a campus cloud as big as ours, you have signals all over the place. I can’t imagine how much staff you would need to manage something like that. I know of companies with 150 traditional architecture based access points that require a team of six to administer.” The customer does not believe that they could afford a team to manage a wireless network built on APs deployed in a traditional, multi-channel fashion. Additionally, it is estimated that any other comparable solution available on the market would require at least eight additional FTEs to manage and troubleshoot the network by the end of year 3. The number of FTEs required would continue to grow as additional locations are rolled out.

**Table 12: Wireless Network Labor Savings, Non-Risk-Adjusted**

Ref.	Metric	Calculation	Year 1	Year 2	Year 3	Year 4	Year 5
K1	Number of FTEs not added		5	6	8	8	8
K2	Annual fully burdened cost per FTE		\$97,500	\$97,500	\$97,500	\$97,500	\$97,500
Kt	Wireless network labor savings	$K1 * K2$	\$487,500	\$585,000	\$780,000	\$780,000	\$780,000

Source: Forrester Research, Inc.

### *Avoided Cabling For Deploying New Technologies*

By deploying a wireless network instead of a wired data network, the customer has created an infrastructure that can easily expand and adapt to changing needs. This topic, in general, is discussed in the Flexibility section of this study. There was one specific example that could easily be quantified, so it is included in the ROI analysis. Readers are encouraged to consider cost

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avoidance opportunities that may exist in their organizations by leveraging a flexible wireless infrastructure.

The customer needed to deploy bar code readers in each patient room to confirm that the medications being dispensed matched pharmacy records. The original estimate to complete this effort included dropping three cables into 500 patient rooms. A wired network solution would have also required 10 48-port switches. The IT team demonstrated to hospital administrators that the wireless network could be used for this new application, thereby eliminating these costs.

**Table 13: Avoided Cabling For Deploying New Technologies, Non-Risk-Adjusted**

Ref.	Metric	Calculation	Year 1	Year 2	Year 3	Year 4	Year 5
L1	Number of cable drops avoided						500
L2	Cost per drop						\$500
L3	Wired networks hardware avoided						100,000
Lt	Avoided cabling for special projects	$(L1 * L2) + L3$	\$0	\$0	\$0	\$0	\$350,000

Source: Forrester Research, Inc.

### *Total Quantified Benefits*

Table 14 summarizes the total quantified benefits realized after three years of deploying Meru's single-channel wireless LAN solution.

**Table 14: Total Quantified Benefits Of Meru's Single-Channel WLAN, Non-Risk-Adjusted**

Ref.	Benefits	Year 1	Year 2	Year 3	Year 4	Year 5	Total	PV
It	Avoided site surveys	\$150,000	\$225,000	\$300,000	\$225,000	\$225,000	\$1,125,000	<b>\$841,094</b>
Jt	Avoided additional access points	\$325,000	\$325,000	\$325,000			\$975,000	<b>\$808,227</b>
Kt	Wireless network labor savings	\$487,500	\$585,000	\$780,000	\$780,000	\$780,000	\$3,412,500	<b>\$2,529,748</b>
Lt	Avoided cabling for deploying new technologies					\$350,000	\$350,000	<b>\$217,322</b>
	<b>Total</b>	<b>\$962,500</b>	<b>\$1,135,000</b>	<b>\$1,405,000</b>	<b>\$1,005,000</b>	<b>\$1,355,000</b>	<b>\$5,862,500</b>	<b>\$4,396,391</b>

Source: Forrester Research, Inc.

## *Qualitative Benefits*

### **Medical Staff Productivity**

Medical staff productivity has improved by delivering data and voice to the user, wherever they are. Several examples of greater productivity were provided, including:

- Using Workstations on Wheels (WOWs) so all patient information is at doctors' fingertips so they need not wait to receive the information from someone else nor search a lengthy chart.
- A doctor remotely operating a robot that roams the halls visiting and checking on patients.
- VoIP services wirelessly connecting nurses wherever they are on the floor instead of paging them to come back to the nurses' station to receive a call.

In the last example, it was estimated that each time a nurse or doctor has to return to the station for a call and then go back to where they were would take 15 to 20 minutes. There are more than 1,000 doctors and nurses across all of the facilities, so although this benefit could not be quantified in this study, it is quite substantial in terms of financial impact to the organization.

### **Network Quality of Service**

As a medical facility, availability and reliability of the data and voice services is critical and can literally mean the difference between life and death. "Our data, voice, and video traffic work perfectly. Additionally, the Quality of Service component of the solution ensures that voice traffic has higher priority and sounds perfect."

In addition to standard measures such as throughput and error rates, with which the customer has had no problems, flawless handshakes between APs were highlighted as a very important performance benefit. All "handoffs are seamless," so doctors and nurses can move throughout the facility and stay connected. If a specific AP winds up with too much traffic and too many users due to convergence on a location, "the built-in load-balancing algorithm automatically addresses over subscription and reassigns clients as needed."

If there is a problem, "the network group engages immediately. We receive an automated notification from management software immediately if there is a problem with the network or an access point. Our service level agreement (SLA) specifies 5 minutes for completion of the initial diagnosis and establishment of an estimated time to repair. Any repairs can be done very quickly."

### **Improved Patient Care And User Satisfaction**

The customer explained that, "We recognized early on the significant role of wireless networks in supporting the delivery of healthcare, education, and research activities. By enabling timely communications and a mobilized workforce and providing real-time access to patient data, WLANs could improve overall patient care and increase the efficiency of healthcare delivery through better resource management and more streamlined administrative procedures." Improved patient care and better access to information reduces medical mistakes and should reduce medical malpractice liability. Specific examples cited include:

- Better screening of medications being dispensed to ensure there are no errors.
- Medical records are now available bedside and even in the operating theaters.

- Greater mobility for nurses and doctors allowing for more “face time” with patients.

There are many types of users other than medical staff and they have benefited as well. As a teaching hospital, students are a very important constituency. They use the wireless network to access teaching materials at the desk or wherever they may be studying. “Surveys indicate that students, visitors, patients, and medical staff all have improved satisfaction levels with IT services and network availability.”

### ***Enhanced Network Security***

The Meru solution includes all of the latest wireless network security features and is substantially better than the customer's previous wireless infrastructure. They use the “appropriate security protocols when and where needed. Security is centrally administered so there are no mistakes in configuration of security parameters at the AP level.” The customer was also able to eliminate rogue wireless access points by using tools built into the Meru solution to locate them. One other network security benefit is the ability to provide wireless connectivity to visitors outside of the firewall, which allows required authentication for all internal users.

## **Risk**

Risk is the third component within the TEI model; it is used as a filter to capture the uncertainty surrounding different cost and benefit estimates. If a risk-adjusted ROI still demonstrates a compelling business case, it raises confidence that the investment is likely to succeed because the risks that threaten the project have been taken into consideration and quantified. The risk-adjusted numbers should be taken as “realistic” expectations, as they represent the expected values considering risk. In general, risks affect costs by raising the original estimates, and they affect benefits by reducing the original estimates.

For the purpose of this analysis, Forrester risk-adjusts cost and benefit estimates to better reflect the level of uncertainty that exists for each estimate. The TEI model uses a triangular distribution method to calculate risk-adjusted values. To construct the distribution, it is necessary to first estimate the low, most likely, and high values that could occur within the current environment. The risk-adjusted value is the mean of the distribution of those points.

For example, take the case costs paid to Meru. The \$524,000 value used in year 1 of this analysis can be considered the “most likely” or expected value for an implementation of this size and nature. Initial implementation costs vary based on duration and number of resources involved. This variability represents a risk that must be captured as part of this study. In this particular case, the risk level was judged as “medium,” since other organizations may pay more on a per AP basis because of the volume discounts the customer received.

In this example, Forrester uses a risk factor of 120% on the high end, 100% as the most likely, and 95% on the low end. This has the effect of increasing the cost estimate to take into account the fact that original cost estimates are more likely to be revised upward than downward. Forrester then creates a triangular distribution to reflect the range of expected costs, with 105% as the rounded mean (105% is equal to the sum of 120%, 100%, and 95% divided by three and rounded to the nearest whole percent). Forrester applies this mean to the most likely estimate (\$524,000) to arrive at a risk-adjusted value of \$550,200.

Risk adjustments for benefits reduce the original benefits estimates. For example, Forrester applies a risk range of 90% on the low end of the estimate, 105% on the high end, and 100% on the most likely scenario for avoided survey costs. This reduces the benefit estimate by 2%, or 98% of the original value.

## Total Economic Impact™ Of Meru Networks' Virtualized Wireless LAN Solution

The following general management and process risk was considered in this study:

- The risk of cost and time overruns associated with any large IT initiative. This risk was mitigated through proper planning and realistic scoping of what could be completed in any given year. The customer has an internal team for pulling cable, which reduced the risk of significant cost overruns by a third party.
- The risk that a large network would be built that did not meet user needs or users were unwilling to use because of change adversity. This risk was mitigated by completing a large-scale pilot using an entire building as the test site.

Each cost and benefit was assigned either a “low,” “medium,” “high,” or “none” risk rating. The following benefits and costs were rated as either low, medium, or high risk:

- **Meru costs (cost) — medium risk.** As discussed earlier, an organization with a smaller implementation can expect to pay more on a per AP basis for the necessary hardware and software.
- **Avoided site surveys (benefit) — low risk.** Most organizations should expect to pay for site surveys with other solutions that experience co-channel interference. If the implementation is very small, the initial survey may cost less and there may be no need for follow-up surveys.
- **Wireless network labor savings (benefit) — medium risk.** The customer has deployed an extremely large and complex wireless network. Smaller deployments may not require as large a support team if using another solution, in which case this cost avoidance benefit would be smaller.

The following tables show the values used to adjust for uncertainty in cost and benefit estimates. Readers are urged to apply their own risk ranges based on their own degree of confidence in the cost and benefit estimates.

**Table 15: Risk Adjustments To Costs**

Ref.	Risk adjustments to costs	Low	Most likely	High	Risk-adjusted
M1	Meru costs (medium risk)	95%	100%	120%	105%
M2	Cabling (no risk)	100%	100%	100%	100%
M3	Additional hardware costs (no risk)	100%	100%	100%	100%
M4	Wireless network management (no risk)	100%	100%	100%	100%

Source: Forrester Research, Inc.

**Table 16: Risk Adjustments To Benefits**

Ref.	Risk adjustments to benefits	Low	Most likely	High	Risk-adjusted
N1	Avoided site surveys (low risk)	90%	100%	105%	98%
N2	Avoided additional access points (no risk)	100%	100%	100%	100%
N3	Wireless network labor savings (medium risk)	80%	100%	103%	94%
N4	Avoided cabling for deploying new technologies (no risk)	100%	100%	100%	100%

Source: Forrester Research, Inc.

## Flexibility

Flexibility, as defined by TEI, represents an investment in additional capacity or capability that could be turned into business benefit for some future additional investment. Flexibility would also be quantified when evaluated as part of a specific project (described in more detail in Appendix A).

In general terms, the Meru solution has made the customer a much more flexible organization. Medical staff can move throughout a facility without losing connectivity because of seamless client handoff between APs due to the single-channel based deployment. If there is a need to support more users in a particular area, the network team can simply connect another wireless access point to handle the additional traffic without the need to re-assign channels to new and existing APs to avoid co-channel interference. There were several cases in which the wireless network administrator noticed higher than expected traffic and quickly had the added APs in place.

Implementing a WLAN has also allowed the customer to quickly deploy new technologies not planned for in the WLAN installations. There are many new technologies that are currently being brought online including patient monitoring devices, infusion pumps, EKG machines, and smartphone/PDA clinical applications.

The medical system continues to grow throughout the geography it operates in, and the Meru solution allows these new facilities to be brought online more quickly. At the time of writing, the customer is upgrading an existing 500 bed hospital that was acquired. A WLAN is being deployed throughout the facility to offer all of the services described throughout this study. There are also plans to build a 1.3 million square foot life sciences research facility. It is likely that the WLAN will be extended to this campus over the next few years.

As described at the beginning of this study, the ROI analysis only covers the first 3 years of deployment and the subsequent 2 years of support and benefits. In reality, the customer has never stopped with their WLAN deployment. This can be viewed as an option on top of the original 3 years of deployment. In this latter three-year period, the customer deployed another 1,500 APs and covered another 1.5 million square feet with wireless connectivity. By extending the financial model to cover six years of implementation effort and a subsequent 2 years of ongoing support and benefits, the risk-adjusted NPV would increase by \$1.3 million and the risk-adjusted ROI by six percentage points.

## TEI Framework: Summary

Considering the financial framework constructed above, the results of the Costs, Benefits, Risk, and Flexibility sections using the representative numbers can be used to determine an ROI, NPV, and payback period.

Tables 17 and 18 below show the risk-adjusted values, applying the risk-adjustment method indicated in the Risk section and the values from Tables 15 and 16 to the numbers in Tables 9 and 14.

**Table 17: Risk-Adjusted Costs**

Ref.	Costs	Year 1	Year 2	Year 3	Year 4	Year 5	Total	PV
O1	Meru costs	\$550,200	\$583,800	\$609,000	\$84,000	\$84,000	\$1,911,000	<b>\$1,549,742</b>
O2	Cabling	\$150,000	\$150,000	\$150,000			\$450,000	<b>\$373,028</b>
O3	Additional hardware costs	\$66,667	\$66,667	\$66,667			\$200,000	<b>\$165,790</b>
O4	Wireless network management	\$214,500	\$263,250	\$312,000	\$312,000	\$312,000	\$1,413,750	<b>\$1,053,800</b>
<b>Ot</b>	<b>Total</b>	<b>\$981,367</b>	<b>\$1,063,717</b>	<b>\$1,137,667</b>	<b>\$396,000</b>	<b>\$396,000</b>	<b>\$3,974,750</b>	<b>\$3,142,360</b>

Source: Forrester Research, Inc.

**Table 18: Risk-Adjusted Benefits**

Ref.	Benefits	Year 1	Year 2	Year 3	Year 4	Year 5	Total	PV
P1	Avoided site surveys	\$147,000	\$220,500	\$294,000	\$220,500	\$220,500	\$1,102,500	<b>\$824,272</b>
P2	Avoided additional access points	\$325,000	\$325,000	\$325,000			\$975,000	<b>\$808,227</b>
P3	Wireless network labor savings	\$458,250	\$549,900	\$733,200	\$733,200	\$733,200	\$3,207,750	<b>\$2,377,963</b>
P4	Avoided cabling for deploying new technologies					\$350,000	\$350,000	<b>\$217,322</b>
<b>Pt</b>	<b>Total</b>	<b>\$930,250</b>	<b>\$1,095,400</b>	<b>\$1,352,200</b>	<b>\$953,700</b>	<b>\$1,303,700</b>	<b>\$5,635,250</b>	<b>\$4,227,784</b>

Source: Forrester Research, Inc.

It is important to note that values used throughout the TEI framework are based on in-depth interviews with one organization. Forrester makes no assumptions as to the potential return that other organizations will receive within their own environments. Forrester strongly advises that readers use their own estimates within the framework provided in this study to determine the expected financial impact of implementing the Meru “Virtual Cell” wireless LAN solution.

## Study Conclusions

Forrester's in-depth interviews with an existing health care industry customer yielded several important observations about Meru's “Virtual Cell” wireless LAN solution:

- Forrester found that organizations using the Meru solution can benefit from potentially avoiding repeated site surveys, reducing the number of access points deployed and the staff to manage them, reusing the wireless network for new technologies, increasing user productivity, delivering greater network quality of service, improving patient care, and improving security compared to previous-generation WLAN infrastructure.
- Key ROI drivers include the physical space and complexity of the wireless deployment and rapid growth.
- Single-channel wireless LAN creates an inherently more flexible IT infrastructure by allowing organizations to easily move resources around, bringing new facilities online more quickly. The customer realized a flexibility of an additional NPV of \$1.3 million over a subsequent three-year period.

The financial analysis provided in this study illustrates the potential way in which an organization can evaluate the value proposition of Meru's “Virtual Cell” wireless LAN solution. Based on information collected in customer interviews, Forrester calculated a three-year risk-adjusted ROI of 35% with a payback period of 25 months. All final estimates are risk-adjusted to incorporate potential uncertainty in the calculation of costs and benefits.

Using the TEI framework, many companies may find the potential for a compelling business case to make such an investment.

**Table 19: ROI, Original And Risk-Adjusted**

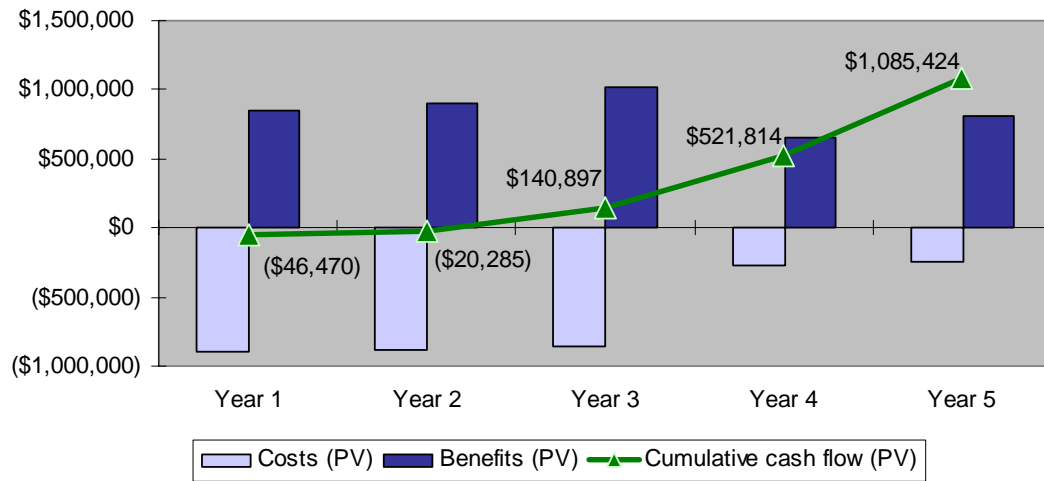
Summary of financial results	Unadjusted (best case)	Risk-adjusted
ROI — three years	43%	35%
Payback	12 months	25 months
Total three-year costs (PV)	\$3,068,563	\$3,142,360
Total three-year benefits (PV)	\$4,396,391	\$4,227,784
Total three-year net savings (NPV)	\$1,327,828	\$1,085,424
Internal rate of return (IRR) †		234%

† An IRR could not be calculated for the unadjusted case because the payback period was just under 12 months. Therefore, on an annualized basis there was no initial investment to compare against.

## Total Economic Impact™ Of Meru Networks' Virtualized Wireless LAN Solution

Source: Forrester Research, Inc.

**Figure 1: Summary Financial Results, Risk-Adjusted**



Source: Forrester Research, Inc.

## Appendix A: Total Economic Impact™ Overview

Total Economic Impact is a methodology developed by Forrester Research that enhances a company's technology decision-making processes and assists vendors in communicating the value proposition of their products and services to clients. The TEI methodology helps companies demonstrate, justify, and realize the tangible value of IT initiatives to both senior management and other key business stakeholders.

The TEI methodology consists of four components to evaluate investment value: benefits, costs, risks, and flexibility. For the purpose of this analysis, the impact of flexibility was not quantified.

### Benefits

Benefits represent the value delivered to the user organization — IT and/or business units — by the proposed product or project. Often product or project justification exercises focus just on IT cost and cost reduction, leaving little room to analyze the effect of the technology on the entire organization. The TEI methodology and the resulting financial model place equal weight on the measure of benefits and the measure of costs, allowing for a full examination of the effect of the technology on the entire organization. Calculation of benefit estimates involves a clear dialogue with the user organization to understand the specific value that is created. In addition, Forrester also requires that there be a clear line of accountability established between the measurement and justification of benefit estimates after the project has been completed. This ensures that benefit estimates tie back directly to the bottom line.

### Costs

Costs represent the investment necessary to capture the value, or benefits, of the proposed project. IT or the business units may incur costs in the forms of fully burdened labor, subcontractors, or materials. Costs consider all the investments and expenses necessary to deliver the proposed value. In addition, the cost category within TEI captures any incremental costs over the existing environment for ongoing costs associated with the solution. All costs must be tied to the benefits that are created.

### Risk

Risk measures the uncertainty of benefit and cost estimates contained within the investment. Uncertainty is measured in two ways: the likelihood that the cost and benefit estimates will meet the original projections and the likelihood that the estimates will be measured and tracked over time. TEI applies a probability density function known as "triangular distribution" to the values entered. At a minimum, three values are calculated to estimate the underlying range around each cost and benefit.

### Flexibility

Within the TEI methodology, direct benefits represent one part of the investment value. While direct benefits can typically be the primary way to justify a project, Forrester believes that organizations should be able to measure the strategic value of an investment. Flexibility represents the value that can be obtained for some future additional investment building on top of the initial investment already made. For instance, an investment in an enterprise-wide upgrade of an office productivity suite can potentially increase standardization (to increase efficiency) and reduce licensing costs. However, an embedded collaboration feature may translate to greater worker productivity if activated. The collaboration can only be used with additional investment in training at some future point in time. However, having the ability to capture that benefit has a present value that can be estimated. The flexibility component of TEI captures that value.

## **Appendix B: Glossary**

**Discount rate:** The interest rate used in cash flow analysis to take into account the time value of money. Although the Federal Reserve Bank sets a discount rate, companies often set a discount rate based on their business and investment environment. Forrester assumes a yearly discount rate of 10% for this analysis. Organizations typically use discount rates between 8% and 16% based on their current environment. Readers are urged to consult their organization to determine the most appropriate discount rate to use in their own environment.

**Net present value (NPV):** The present or current value of (discounted) future net cash flows given an interest rate (the discount rate). A positive project NPV normally indicates that the investment should be made, unless other projects have higher NPVs.

**Present value (PV):** The present or current value of (discounted) cost and benefit estimates given an interest rate (the discount rate). The PV of costs and benefits feed into the total net present value of cash flows.

**Payback period:** The breakeven point for an investment. The point in time at which net benefits (benefits minus costs) equal initial investment or cost.

**Return on investment (ROI):** A measure of a project's expected return in percentage terms. ROI is calculated by dividing net benefits (benefits minus costs) by costs.

### *A Note On Cash Flow Tables*

The following is a note on the cash flow tables used in this study (see the Example Table below). The initial investment column contains costs incurred at "time 0" or at the beginning of Year 1. Those costs are not discounted. All other cash flows in Years 1 through 3 are discounted using the discount rate shown in Table 2 at the end of the year. Present value (PV) calculations are calculated for each total cost and benefit estimate. Net present value (NPV) calculations are not calculated until the summary tables and are the sum of the initial investment and the discounted cash flows in each year.

### **Example Table**

<b>Ref.</b>	<b>Category</b>	<b>Calculation</b>	<b>Initial cost</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Total</b>

Source: Forrester Research, Inc.