Carrier Ethernet Is Ready for Expanding Ethernet Services

The US Out of Franchise Opportunity

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INFONETICS RESEARCH

Table of Contents

List of Exhibits

I. Introduction

To reduce costs and increase efficiency, service providers are reducing the number of networks needed to support the delivery of customer services. With fewer networks, carrier incurs less maintenance and overhead expense. With the reduction of overlay networks, service interworking at the edge of the network becomes a significant service enabler, facilitating the interconnection of multiple disparate service islands.

Carrier Ethernet technology is a primary enabler for service integration at the edge of the network, facilitating the economic transport of Layer 2 and Layer 3 services. MPLS, as an enabling universal control plane, allows service providers to deploy Carrier Ethernet as a reliable, carrier grade transport medium and to extend the benefits of the Ethernet cost curve from the LAN into the metro. Service providers can reap cost efficiencies and expand their service offerings by moving older networks to packet-switched network cores.

Traditionally, Layer 2 services from service providers have been predominantly point-to-point. With new Layer 2 architectures like Carrier Ethernet, the multipoint nature of the Ethernet LAN can be extended over a WAN. Carrier Ethernet solutions appeal to subscribers who run their own Layer 3 networks over the wide area and require Layer 2 transport to connect Layer 3 endpoints.

Through 2001, Ethernet platforms were predominantly designed to meet the requirements of the Enterprise. The lack of appropriate resiliency mechanisms and mission critical redundancy limited its deployment within the exacting environment of the metro network.

The dot.com revolution assisted a number of Ethernet LECs (or ELECs), such as Yipes and Cogent, to enter the market. The ELECs and others used the most robust LAN equipment available to form metro Ethernet networks. While this approach had limited success, due primarily to the small scale of the deployments, many challenges emerged that could be traced to the enterprise origins of the deployed equipment.

Meanwhile, IXCs, RBOCs, and other large providers chose to meet their enterprise customer demands for Ethernet services by deploying Ethernet interfaces and services on existing SONET networks to supply the QoS, resiliency, and connectivity required for mission critical applications. The large carriers found that SONET was a great solution, but with significant limitations. The design center of SONET is connection-oriented TDM, which is suitable for voice and private line TDM traffic, but it is not the most cost effective technology to deliver Ethernet services, especially when customers expect Ethernet services at higher bandwidth and at lower prices per bit.

As Ethernet and Ethernet services more strongly permeated the metro network, the need arose for a new type of Ethernet product that is purpose built for service providers, with features such as high availability, resilient link / mesh / ring configurations, QoS options, and the ability to carry legacy frame relay, ATM, and private line traffic. Many manufacturers over the past two years have met this challenge by producing a new genre of carrier class Ethernet products. The industry variously calls these products optical Ethernet, carrier Ethernet, or carrier class Ethernet—we choose for the purposes of this white paper to call them Carrier Ethernet products. We believe this new class of product is proven in carrier production networks around the globe, and is undeniably ready for prime time deployment.

II. Service Evolution

Major service providers, including RBOCs and IXCs in North America, currently support a large entrenched base of SONET, frame relay, ATM, and IP networks, built over many years to provide voice services to businesses and residential customers and data services to business customers. These providers are aggressively entering the fray for residential data services, served up over DSL and FTTP, and moving toward using Gigabit Ethernet (GE) as the principal aggregation technology. We also see many service providers taking their competitors' enterprise data customers as opposed to cannibalizing traditional DS-3 enterprise data service within their own operating areas.

These service evolution trends accentuate the urgency and necessity of a new Ethernet-oriented in-region metro network, and, as we argue in this paper,

Carrier Ethernet is the most promising universal transport solution in support of out of franchise (OOF) solutions. As providers accelerate the deployment of OOF solutions, it becomes compelling to examine Carrier Ethernet as the basis for new OOF networks.

III. Service Provider Strategies for Expanding Ethernet Services

Service providers around the world are offering Ethernet services, expanding the variety of offerings, target customer sets, and locations every year. Whether expanding Ethernet services in-region or into OOF areas, service providers have a number of strategic options to examine, and there are some basic principles to consider in selecting the most appropriate strategic option.

A prudent principle is for service providers to select solutions that support creative access and a consistent, deterministic core. Access needs to be flexible to support the many legacy options, including frame relay, ATM, and private lines, and non-traditional data services, such as IPTV, VoIP, Ethernet, and IP VPN services, which are increasingly necessary to satisfy emerging enterprise computing requirements. The core must be dependable; therefore, the services that it carries must be consistent and deterministic to provide predictable bandwidth and end-to-end service levels. This framework of service level management can be created by deploying Carrier Ethernet products as an access technology facilitating an end-to-end MPLS control plane across the metro core.

A. Wholesale or Leasing from Other Providers

Service providers of all sizes and footprints populate the landscape, from national and international, to large regional, small regional, and city-centric carriers. One option to expand services OOF is to buy connectivity or services wholesale from other operators, with the targeted advantage of speed; i.e., reaching a new customer location or a new region within a reasonable amount of time, with little up-front investment, and targeted to specific revenue opportunities. Although this may be the only option in many situations, the downside of adopting this strategy is clear: the possibility that the provider's

gross margin potential is punished, and the customer satisfaction risk occasioned by the lack of control over QoS and other key service attributes.

B. Build Your Own Network

Financial considerations and technical expertise vary by service provider, and many prefer to build their own network, with the obvious cost and operational advantages of owning and operating the network—no one to pay, no one to interface with in the customer-facing relationship, no third party service order process to get services provisioned, and no third party to deal with when network degradations or outages occur. Depending on many variables, considerations of time to market may dictate leasing, including but not limited to the PDIO process, the process to obtain right of way, install and test the network, and the incursion of capex and opex for the greenfield Ethernet services network (as compared to an extension of the existing network).

C. The OOF Opportunity

Service providers face the demands of revenue growth and profitability, and they face many challenges: pressures on existing revenue streams (e.g., falling fixed line revenues for RBOCs), the advance of competitors against existing customer bases, and customer demand for lower pricing associated with growing bandwidth needs. Technology substitution is a common theme: mobile or broadband for access lines, IP for ATM. Carriers must adopt new approaches to increase revenue, since the option of increasing prices for existing services is certain to send customers to the competition.

Many service providers, in the frenzy to increase top line revenue, are not keeping to the entrenched homeland of their classic franchise boundaries (e.g., RBOCs, IXCs, IOCs), but are moving out of franchise (OOF) to create new markets and add new customers, and to serve existing customers that have OOF locations—and there is a hidden opportunity in using Carrier Ethernet to facilitate the OOF movement described in following sections of this paper. Initial target customer segments include, but are not limited to, the government, education, and medical sectors.

It is difficult for a provider to support legacy services within a new region by replicating the existing home region SONET and IP networks; in fact this strategy significantly increases the financial risks of the provider, as it would take enormous capital expenditure and network replication effort, while considerably delaying precious time to revenue, likely by many quarters.

We contend that a realistic—and cost effective—approach is to deploy Carrier Ethernet. It is realistic to lead with traditional Ethernet services, but the Carrier Ethernet alternative supports not only new services over Ethernet, but also legacy services, certain VPNs, and non-traditional data services over a single converged network.

Once Carrier Ethernet is deployed in the OOF region, service providers gain valuable experience with network equipment, network design, operating procedures, market programs, and customer feedback. Now the hidden benefit emerges: these OOF experiences and the knowledge gained can be brought back and applied in-region, to offer new services to attract new customers and retain the existing base of customers, while experiencing lower operational expenses.

IV. Problem, Background, and Opportunity

A. Ethernet Services, a Growing Addressable Market

The telecom industry buzz surrounding the growing Ethernet service market is not just hype; it can be measured in at least two ways: growth in expenditures on the carrier equipment necessary to offer Ethernet services and transport Ethernet traffic, and in Ethernet service revenue itself.

In Infonetics' March 2005 *Metro Ethernet Equipment* biannual worldwide market share and forecast report, we reported that spending on all types of metro Ethernet equipment hit $3.8B in 2004, and will double by 2008 to $7.6B. Within this equipment is the Carrier Ethernet switch and router category, with $61M in spending in 2004, reaching $2.6B in 2008.

In Infonetics' April 2005 *Ethernet Services* biannual worldwide market size and forecast report, we report that spending on all types of North American Ethernet

services hit $523M in 2004, and will increase ten-fold by 2009 to $5.7B, a 5-year accumulation of over $16B.

Ethernet services are a growing market, important not only for the revenue they represent, but for their ability to retain customers. Or, said another way, since many service providers are offering Ethernet services and using them to win the customers of other providers, it is important to be able to have Ethernet services in your stable of offerings, at a minimum as a defensive strategy against competitors. There are many types of Ethernet services, and they can be used to serve a variety of applications.

B. Business Applications

The two basic types of Ethernet services for businesses are point to point, or P2P (a single connection between two locations) and point to multipoint, or P2MP (the interconnection of three or more sites).

P2P business applications include the popular Internet / WAN access (customer site to service provider), site to site LAN or extranet connection, and storage backup site connections for BC / DR (business continuity, disaster recovery).

Ethernet can also be used for multicast services (non-video) and video distribution by MSOs and IOCs (and soon RBOCs). The most popular use of P2MP is for extended LAN or transparent LAN service to deploy customers' multi-site LANs.

C. Wholesale and Applications

Service providers are buying wholesale Ethernet services from other providers, usually in a P2P mode, using GE for POP-to-POP or COLO-to-COLO connection.

Residential markets are served over DSL and FTTP, which are aggregated using GE uplinks. This traffic tends to be inefficiently transported over SONET; the statistical multiplexing and SLA characteristics of Carrier Ethernet are more suitable as a transport medium for this traffic, and this helps to establish Carrier Ethernet as a viable choice for a universal transport architecture, or EAN (Ethernet aggregation network), as defined by ITU Draft TR123.qos[4].

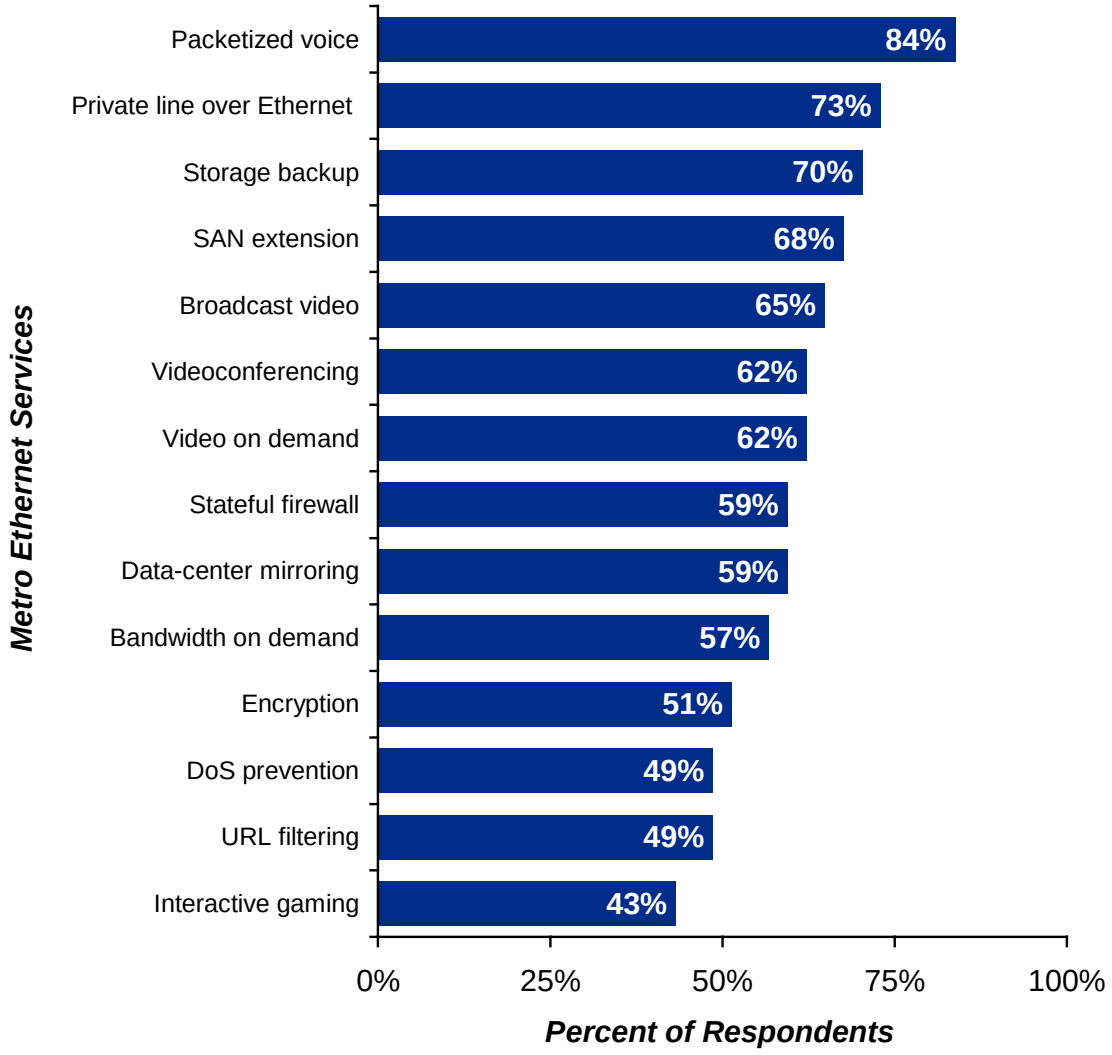
By far, most Ethernet services are sold to business, yet there is a small, growing market for residential services, today typically served by IOCs or by local city or county governments. These are almost all for DIA (direct Internet access), a P2P connection from the residence to the provider. What makes the residential segment interesting is the opportunity to add other services on top of basic Ethernet connection, including VoIP, broadcast video, video on demand (VOD), and gaming, which is becoming increasingly popular, even in North America.

D. Services over Ethernet for Business and Residential

The business and the residential segments are ripe for additional services riding over the basic Ethernet connection for Internet / WAN. This is not lost on most carriers, as we can see in Exhibit 1, as measured in *Service Provider Plans for Metro Optical and Ethernet: North America, Europe, and Asia 2005*, our study of 37 service providers worldwide.

We asked respondents what Ethernet network-based services, in addition to connectivity and bandwidth, they sell to their business and residential customers. Nearly all applications are growing, with packetized voice the leader, offered by 84% in 2006, followed by private line over Ethernet at 73%. The leading services, including storage and video, indicate that service providers are reacting to the business challenge of revenue growth, and seeking the payback / benefit of customer satisfaction.

Exhibit 1 Ethernet Services for Business and Residential Customers



Source: Service Provider Plans for Metro Optical and Ethernet: North America, Europe, and Asia 2005 *by Infonetics Research, Inc.*

Bandwidth on demand (the ability to turn up / down bandwidth as desired) can be offered to business and media-intensive residential users. Video services grow appreciably, and although technologically challenging, offer sexy new revenue sources. Security applications grow, as operators prioritize the rollout of potential value-added services.

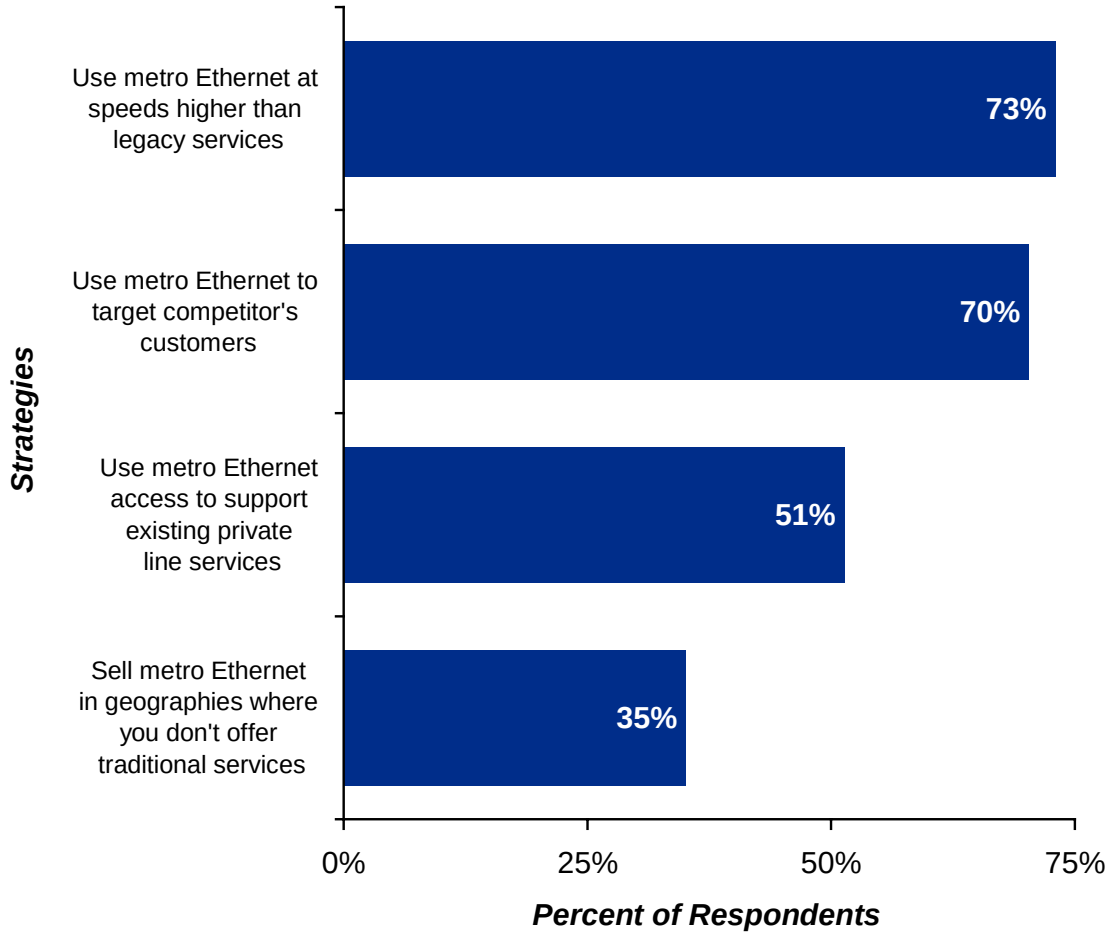
E. Drivers in the OOF

Technical and business considerations for service providers within their region are typically different from those encountered within an OOF strategy. The most

striking difference is the stable revenue base of the current customers using a plethora of existing legacy data services (frame relay, ATM, and private line services). It is not natural for the incumbent to offer new Ethernet services without fear of cannibalizing their major revenue sources, so carriers tend to be more comfortable going after their competitors' customers within the context of an OOF strategy.

Carriers use two main Ethernet strategies to offset cannibalization: 1) overcome a legacy limitation by using metro Ethernet at higher speeds than those available to the legacy services, and 2) increase revenue by targeting competitors' customers.

Exhibit 2 **Provider Strategies for Countering Cannibalization**



Source: Service Provider Plans for Metro Optical and Ethernet: North America, Europe, and Asia 2005 *by Infonetics Research, Inc.*

Using Ethernet services to lead entry into OOF territories can gain the service provider multiple revenue opportunities for the price of one deployment. A well-thought out OOF deployment can be the learning ground and model for the deployment of business class and residential Ethernet services in-region, with services offered on top of the Ethernet service. This approach optimizes the learning curve and builds competency, while mitigating the risks of a first deployment in-region.

When deploying Carrier Ethernet in-region, there is an obvious draw to reuse and repurpose equipment within the existing network, and this can be a risk mitigation factor. Carriers are doing this now; one, for example, is gradually dedicating its SONET gear to TDM voice traffic over time, as the Carrier Ethernet equipment is used to carry Ethernet, IP, and legacy services, retaining existing revenue and adding new services, including video on demand.

V. Expansion of Ethernet Services: Value Proposition and Technical Status

A. Why Carrier Ethernet Is Ready for Prime Time

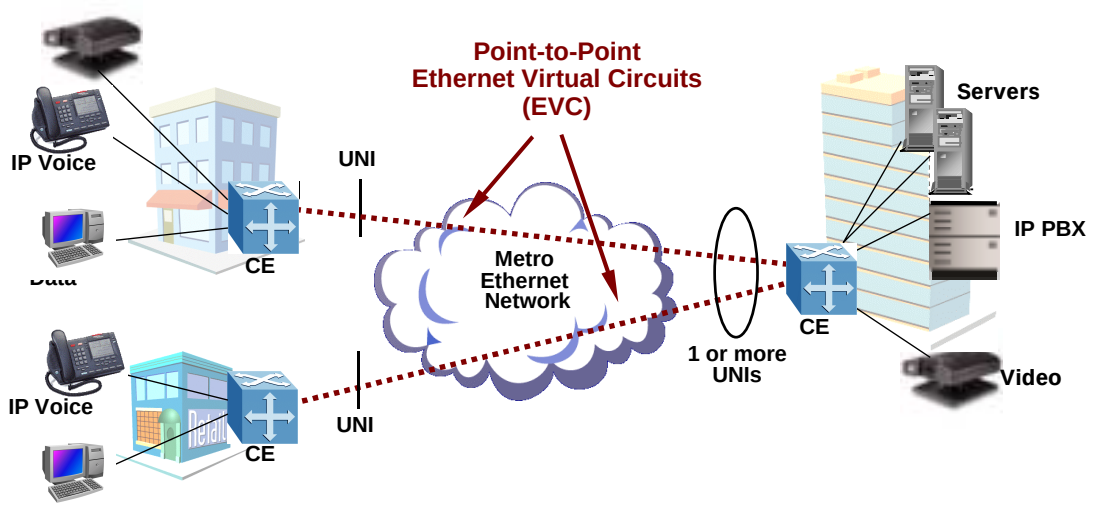
The focused efforts of service providers, manufacturers, and industry groups have combined to produce momentum behind a substantial body of work that defines Ethernet services, Carrier Ethernet equipment, and operational support tools.

The MEF (Metro Ethernet Forum) plays the key role in this work. The MEF is in the leadership position by virtue of the major service providers and manufacturers that populate its membership and help define common Ethernet services (e.g., E-LINE and E-LAN), service attributes (e.g., to define QoS, CoS, CIR, EIR), OAM&P functions, and Carrier Ethernet equipment requirements. Virtually all manufacturers of metro Ethernet gear, test equipment, and OSS/operations software are contributing members. Service providers are represented on the MEF by SBC, BellSouth, Verizon, France Telecom, NTT, Bell Canada, Korea Telecom, and many more.

Carrier driven MEF basic services, illustrated in Exhibits 3 and 4 (courtesy of the MEF) are:

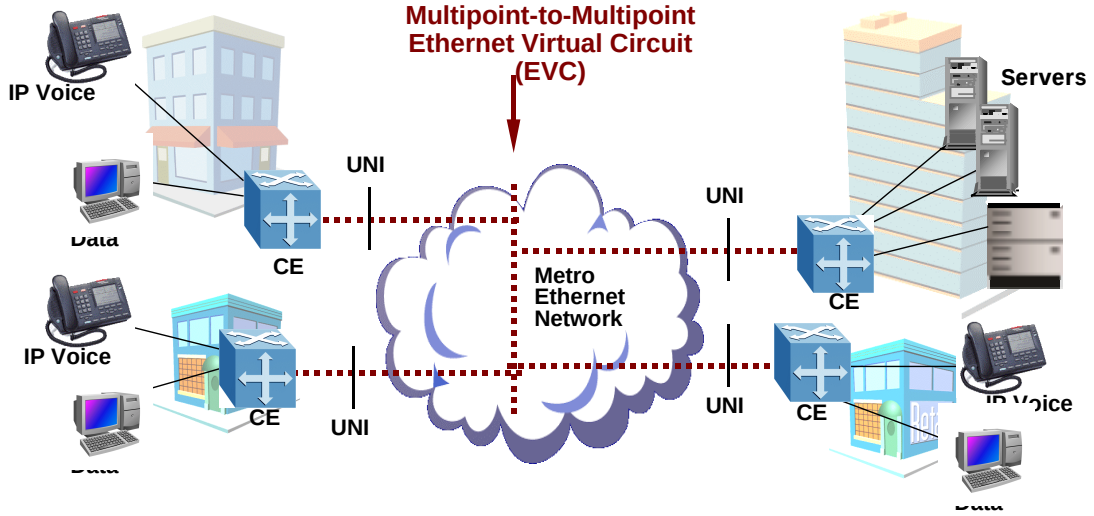
1. Ethernet line (E-Line) service, a P2P service
2. Ethernet LAN (E-LAN) service, a P2MP service

Exhibit 3 Ethernet Line (E-Line) Service



Source: The MEF (written permission granted)

Exhibit 4 Ethernet LAN (E-LAN) Service



Source: The MEF (written permission granted)

These are the umbrella categories, since providers can create a large variety of distinctly different services based on one service type, say, E-Line, by assigning service attributes (more about attributes in the next subsection).

Once a provider defines a service with attributes and Ethernet service definitions, the next area for standardized agreement is how to operate a metro Ethernet network. The carriers in the MEF, ITU, and IEEE helped define the OAM&P (operations, administration, maintenance, and performance) functions necessary to deploy carrier class metro Ethernet services. Categories of the Ethernet OAM&P cover the service layer, the connectivity layer, and the access link layer, and include functions such as link quality and performance, traffic classes, discovery, remote fault detection and isolation, traceroute, continuity checking, etc. Many of these same facilities are standardized in the ITU, a bastion typically controlled by large European service providers.

The final cog in a working carrier class metro Ethernet is the equipment itself. The MEF defined a category of Carrier Ethernet with the qualities, capabilities, and functions that service providers require for a successful metro Ethernet network and services. Carrier Ethernet switches and routers have MPLS functions that offer:

- Ability to deploy end to end SLAs
- End-to-end sub-50ms protection
- Layer 2 point-to-point MPLS VPNs (Martini / PWE3)
- VPLS: Layer 2 point-to-multipoint MPLS VPNs (Kompella / PPVPN)
- Ability to transport TDM (e.g., private line, voice) over Ethernet

A number of manufacturers produce Carrier Ethernet products, and operators around the globe use many of these products in production networks.

Carriers have become operationally familiar over the past few years with Ethernet switches, Ethernet on routers, and MPLS functions; meanwhile, their customers are familiar with Ethernet. This familiarity with the many aspects of Ethernet, along with carrier defined Ethernet services, OAM&P, and carrier class Ethernet products, provides the necessary proof points to establish that Carrier Ethernet is ready for prime time deployment.

B. Service Attributes Driven by Service Providers

We introduced the topic of carrier defined MEF service attributes that are used to define differentiated services and potential pricing advantages. To completely define an E-Line or E-LAN Ethernet service, the service provider defines a unique service by choosing from an array of service attributes for the UNI (user network interface) and for the EVC (Ethernet virtual circuit). Ethernet service attributes include:

- Ethernet physical interface
- Traffic parameters
- Performance parameters
- Class of service (CoS)
- Service frame delivery
- VLAN tag support
- Service multiplexing
- Bundling
- Security filters

These attributes implemented in products make tasks and activities easier, for example, to define services quickly, to provision quickly (shorter time to revenue), and report on SLAs to customers.

Metro Ethernet services can be designed using the MEF mechanisms to support many types of applications more easily, cost effectively, and efficiently than other network services such as frame relay, ATM, and private lines. Standard Ethernet interfaces (10/100M, GE, 10GE) can be used for secure, private Ethernet VCs across a city or a country to interconnect many corporate sites, or connect business partners, or access the Internet. E-Line P2P and E-LAN MP2MP services can be used to connect one site or many. The attributes can be used to define bandwidth on demand, a way for customers to easily and quickly buy the amount of bandwidth they need for the duration they need.

The flexibility of MEF service definitions and service attributes gives service providers carrier class tools to create, deploy, provision, and operate Ethernet

services that create competitive advantage, lower cost of operations, and attract long-term customers.

VI. Carrier Ethernet versus Alternatives

A. Entering the OOF: Business Case Introduction

In the business case of Carrier Ethernet, there are two common alternatives for delivering Ethernet services: Ethernet over IP / MPLS and the tried and true Ethernet over SONET. In this representative analysis of Carrier Ethernet versus the alternatives, we discuss equipment capex, operational expenses, and typical revenue generation. The analysis and business case presented in this paper was generated through the cooperative efforts of Infonetics Research, Fujitsu, and Atrica.

Providers invading an OOF region will never win if they bring to market the same value as the incumbents in the OOF area: it is necessary to bring a niche or a stronger value proposition. Recognizing the necessity to address a variety of unique demands, the strategic decision must be made for the choice of technologies to make an OOF business offering financially successful.

Most providers have different in-region networks for different types of services or applications. But in the OOF invasion, there is neither time nor money to deploy multiple networks; if a single network solution can satisfy multiple customer needs, it is a better choice.

B. Business Case Applications and Equipment

We look at large, medium, and small businesses, and assume each has needs for Ethernet access. We examine three typical types of services, listed here from most to least stringent requirements:

A. **Dedicated SONET equivalent:** 100% guaranteed bandwidth, protection
B. **Mixed QoS and CoS:** CIR / EIR mix, protection
C. **Best effort:** with or without rate-limiting, no protection

Three technologies, using industry representative platforms, can satisfy services A, B, and C:

- **Carrier Ethernet** (Atrica optical Ethernet) to satisfy to all three, A, B, C
- **Next-gen SONET** (Cisco, Fujitsu mix of next gen SONET) to satisfy A and B
- **Ethernet over MPLS** (Cisco OSR / Catalyst) to satisfy C only

C. Capital Costs and Operational Expenses

In capital costs, we include equipment, element management systems, and spares, as well as installation costs. Operational expenses include:

- Cost of sales (equipment & cable, network / customer operations)
- Corporate operations (G&A), customer operations (S&M)
- Customer service expense
- Environmental expense (power, land and building)
- Access charges
- Depreciation

We use standard definitions of:

- Operational P&L: revenue – opex
- ROI: operational P&L + depreciation) / capex

D. Customer and Service Models

In our business case, 50 successful deals are expected in three years. Each customer will have access to dedicated network assets not shared with other customers. The table below shows our customer model / requirements forecast matrix to reach the 50 deals. We have 6 network models, each of which represents a customer network configuration (# sites, types of sites). Two of these models are described in Appendix A.

Exhibit 5 **Revenue Model for Business Case**

		Number of Customers						
Requirements		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	**Total**
A: Dedicated SONET equivalent (100% guaranteed bandwidth, protection)	1st year					1	2	**3**
	2nd year	1				2	3	**6**
	3rd year	1				2	4	**7**
B: CIR/EIR mix (protection)	1st year				2	1		**3**
	2nd year	2		2	4	1		**9**
	3rd year	2		4	4	2		**12**
C: Best effort (w/ or w/o rate limiting, no protection)	1st year		1					**1**
	2nd year		1		1	1		**3**
	3rd year		2		2	2		**6**
Year-by-year total	**1st year**	**0**	**1**	**0**	**2**	**2**	**2**	**7**
	2nd year	**3**	**1**	**2**	**5**	**4**	**3**	**18**
	3rd year	**3**	**2**	**4**	**6**	**6**	**4**	**25**
3-year total		***6***	***4***	***6***	***13***	***12***	***9***	***50***

Source: Infonetics Research, Fujitsu Network Communications, and Atrica

VII. OOF Business Case

A. Start Small and Grow

It makes sense for a service provider entering an OOF area to start with a small set of customers and grow to full deployment in leveraged increments. Our

business case reflects this pragmatic approach, as we add more customers and applications each year.

B. Capital Requirements for Three Years

The table below shows the total capital cost required for each technology option over a three-year period:

1. Carrier Ethernet for 50 deals responding to the three types of service requirements (A, B, C)
2. Next gen SONET for dedicated SONET and CIR/EIR mix type (B, C) of service requirements for total 40 deals
3. EoMPLS for best effort (C) service requirements 10 deals

Exhibit 6 **Total Capital Cost for Business Case**

Technology		Total Capital Required	# Deals	Capital per Deal
Optical Ethernet	1st year	$3,224,872	7	$460,696
	2nd year	$10,638,886	18	$591,049
	3rd year	$23,470,408	25	$938,816
	Total	***$37,334,165***	***50***	***$746,683***
Next gen SONET	1st year	$3,754,435	6	$625,739
	2nd year	$13,227,132	15	$881,809
	3rd year	$27,475,607	19	$1,446,085
	Total	***$44,457,174***	***40***	***$1,111,429***
EoMPLS	1st year	$893,776	1	$893,776
	2nd year	$2,993,665	3	$997,888
	3rd year	$7,566,158	6	$1,261,026
	Total	***$11,453,599***	***10***	***$1,145,360***

Source: Infonetics Research, Fujitsu Network Communications, and Atrica

C. Business case

Combining the capex, opex, and revenue models, we see the obvious advantages of choosing Carrier Ethernet to enter the OOF in total operation expenditures, the operational P&L, the all-important ongoing business success measure of operational P&L as a percentage of revenue, in capital investment, and finally in

the decision-makers metric—ROI. One of the principal ingredients in the success of Carrier Ethernet is its ability to handle the range of requirements from best efforts to the most stringent SONET-like resilient, high performance applications that bring in high revenue. A single network with this versatility not only brings in more revenue, it brings the operational efficiencies of a simpler network. Please see Appendix B for a detailed table showing these metrics. Carrier Ethernet can be used to capture all the revenue cases shown in that table, and neither next gen SONET or EoMPLS can be used alone to do so. Carrier Ethernet takes less capital investment, and returns positive triple-digit (160% to 377%) ROI in all three years, easily superior to both next gen SONET (-17% to 170%) and EoMPLS (-124% to 29).

D. Network and Service Upgrades

Networks are not static—it is only a matter of time until a newly built network needs upgrading due to higher traffic capacities, new types of traffic, new applications and services to support them, or new technology that can reduce opex. In an expansion of our business case, we follow this fact of life into the third year.

We assume that network and service upgrades begin to occur in the third year of the deployment. For some networks, upgrades may begin in the fourth or fifth year, but the point is that they will occur, and it is convenient for our examination to show their somewhat dramatic effect on the life cycle costs of the three technology choices: Carrier Ethernet, next gen SONET, and Ethernet over MPLS.

Service upgrade happens in many ways, and in particular for our models, activating new user ports and/or bandwidth upgrade on existing active ports. We assume that each of the six models has unique service demands which are typical to the industry vertical it is representing. There are times when no service demands are expected for the specific model. We assume no new customers after the third year. As shown in Exhibit 7, the capital costs of Carrier Ethernet continue to be lower, and can fulfill all customer applications, rather than the alternative of using both next gen SONET to fulfill part of the customer applications and Ethernet over MPLS to fulfill the rest.

Exhibit 7 **OOF Capital Expenses Including Upgrades**

		Initial + Upgrade Total						
		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Total
Carrier Ethernet	1st year	$0	$458,883	$0	$1,092,295	$1,356,600	$317,094	**$3,224,872**
	2nd year	$700,880	$458,883	$3,559,545	$2,730,738	$2,713,200	$475,641	**$10,638,886**
	3rd year	$700,880	$3,434,620	$7,119,090	$6,668,405	$4,715,940	$831,473	**$23,470,408**
	4th year	$6,946,410	$2,516,855	$2,881,100	$8,478,800	$1,292,280	$295,928	**$22,411,373**
	5th year	$6,946,410	$5,033,710	$5,762,200	$10,174,560	$1,938,420	$394,570	**$30,249,870**
	Total	**$15,294,579**	**$11,902,950**	**$19,321,935**	**$29,144,798**	**$12,016,440**	**$2,314,706**	**$89,995,407**
Next gen SONET	1st year	$0	$0	$0	$1,666,474	$1,801,646	$286,314	**$3,754,435**
	2nd year	$1,376,773	$0	$5,446,135	$3,332,949	$2,641,804	$429,471	**$13,227,132**
	3rd year	$1,376,773	$0	$10,892,271	$8,980,695	$4,915,422	$1,310,447	**$27,475,607**
	4th year	$8,551,053	$0	$3,314,367	$11,295,493	$1,977,930	$1,106,728	**$26,245,571**
	5th year	$8,551,053	$0	$6,628,734	$11,295,493	$2,624,259	$1,475,637	**$30,575,175**
	Total	**$19,855,651**	**$0**	**$26,281,507**	**$36,571,103**	**$13,961,061**	**$4,608,598**	**$101,277,920**
EoMPLS	1st year	$0	$893,776	$0	$0	$0	$0	**$893,776**
	2nd year	$0	$893,776	$0	$988,174	$1,111,715	$0	**$2,993,665**
	3rd year	$0	$3,366,381	$0	$1,976,347	$2,223,430	$0	**$7,566,158**
	4th year	$0	$1,578,828	$0	$1,180,825	$245,795	$0	**$3,005,449**
	5th year	$0	$3,157,657	$0	$2,361,651	$491,590	$0	**$6,010,898**
	Total	**$0**	**$9,890,418**	**$0**	**$6,506,997**	**$4,072,530**	**$0**	**$20,469,945**

Source: Infonetics Research, Fujitsu Network Communications, and Atrica

VIII. Conclusions

There are two principal considerations in moving service offerings to OOF areas. First, it is mandatory for survival, for in these days of constant change and jockeying for position among RBOCs, IXCs, and MSOs, service providers with

major in-region territories cannot sit still. Other players present in-region competitive threats, and, though the battle of the in-region threat must be countered, the war will also continue in the OOF.

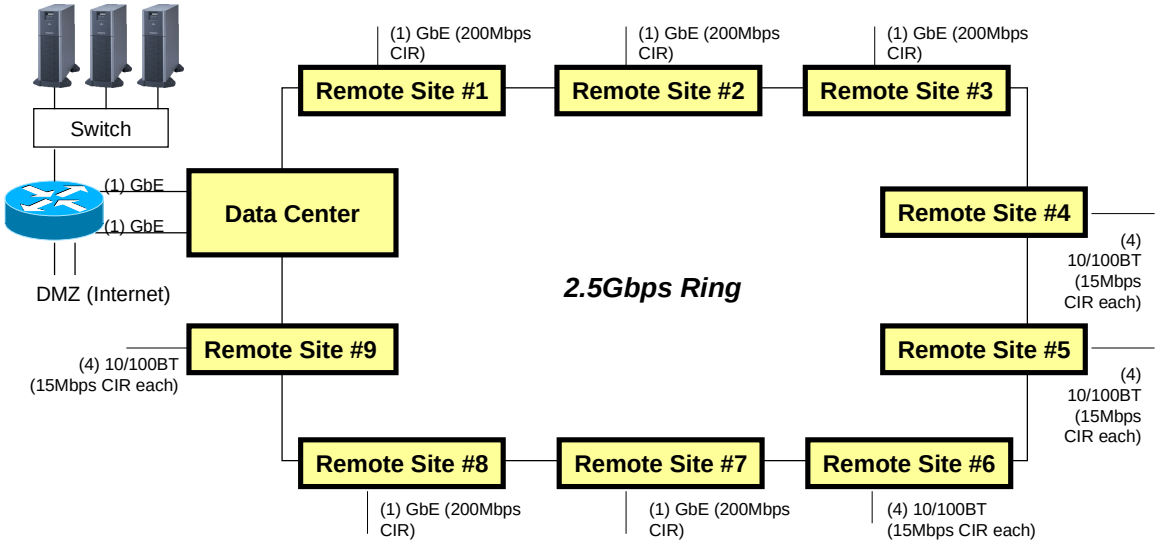
Secondly, providers are faced with the problem of moving to the next gen metro, where customers are demanding higher bandwidth Ethernet services at lower costs per bit, where data traffic overwhelms TDM voice, and where current and future competitive threats bring great pressure to significantly reduce operations costs.

In our estimation, it is a smart move borne out by our business case to use the OOF entry as the proving ground for transition to the next gen metro network. Carrier Ethernet is ready for prime time, and in our calculations, it is the practical, cost efficient weapon of choice. As an added benefit, all the experience and knowledge of deploying Carrier Ethernet in the OOF can be brought in-region, after the wrinkles have been worked out, mitigating any risk of disturbing the revenue streams of the home crowd when deploying the next generation metro network.

Appendix A: Network Diagrams

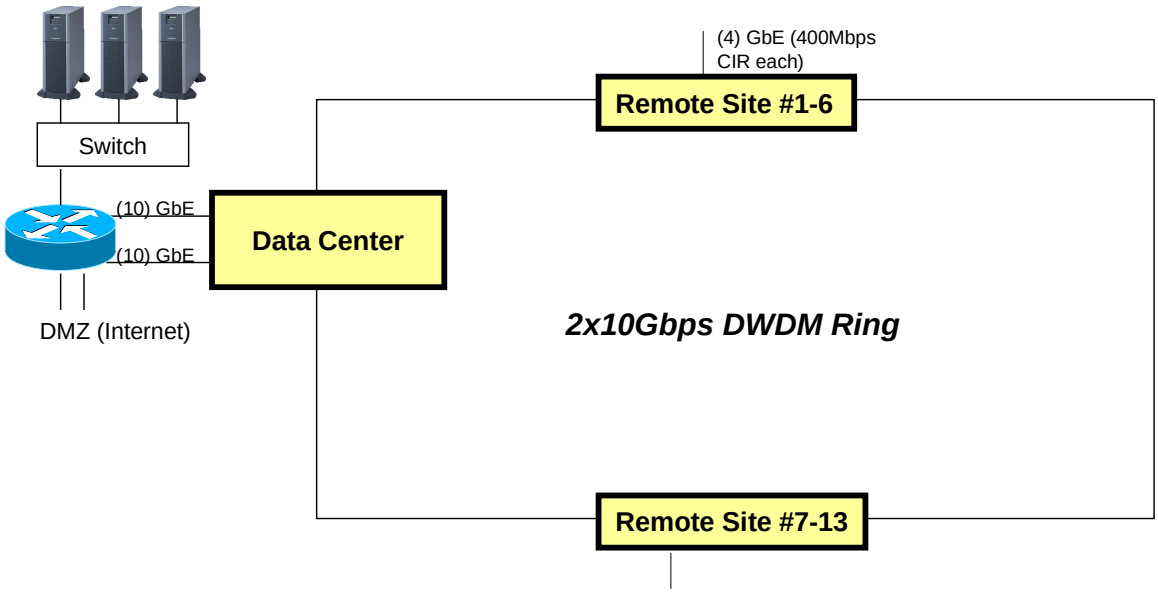
Model 1 Network

- 10 sites (1 data center, 9 remote sites)
- All remote traffic goes into data center for application access and Internet hand-off
- Own fiber to be used



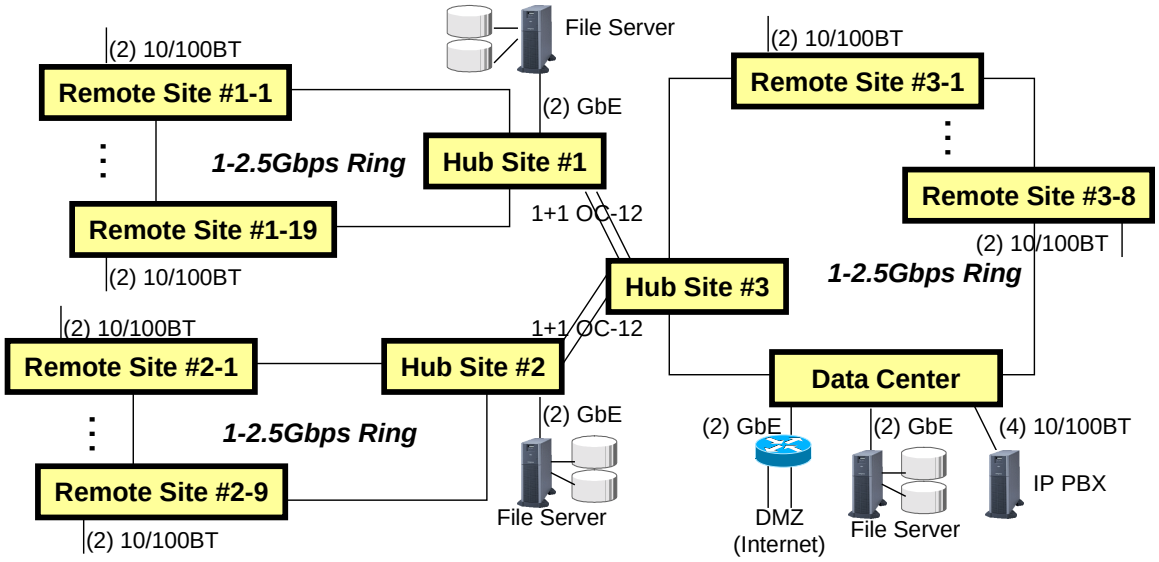
Model 1 Network Upgrade

- Additional 4 remote sites to existing 10 sites (1 data center, 13 remote sites)



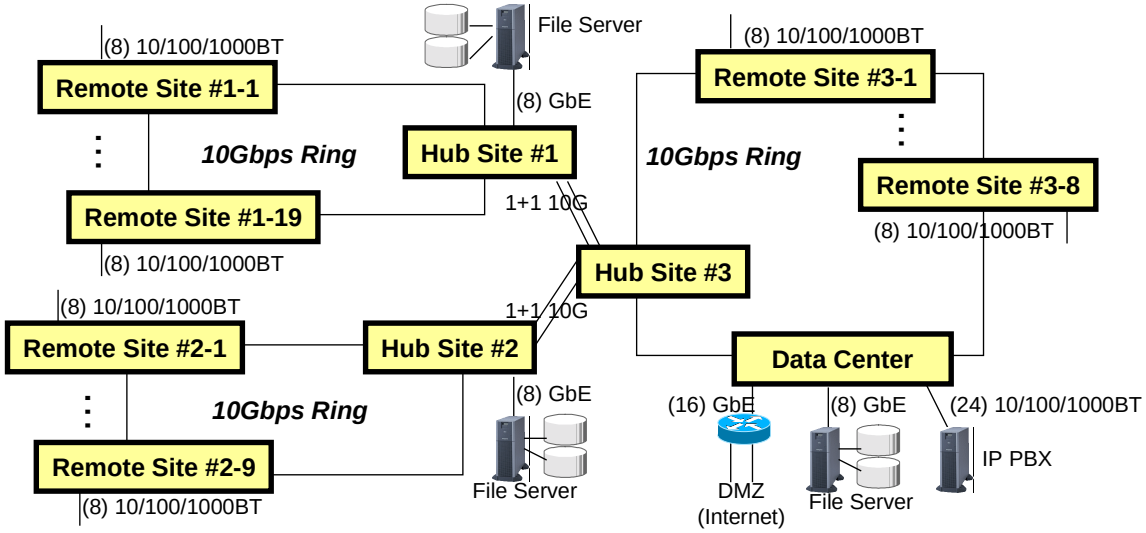
Model 2 Network

- 40 sites (1 data center, 3 hub and 36 remote sites)
- Each remote site is equipped with (2) 10/100BT drops for aggregation switch (Best effort or CIR/EIR)
- Data backup (SAN) at hub #1/2 and data center
- IP PBX and Internet hand-off at data center
- Own fiber to be used



Model 2 Network Upgrade

- No additions to the existing 40 sites (1 data center, 3 hub and 36 remote sites)
- Each remote site is equipped with (8) 10/100/1000BT drops for aggregation switch (Best effort or CIR/EIR)



Appendix B: OOF Business Case

	Optical Ethernet			US$K Next Gen SONET			EoMPLS		
	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3
Revenue									
Implementation	$89	$307	$628	$70	$268	$487	$19	$40	$142
Dedicated transport charge	$14,593	$59,355	$167,974	$12,934	$53,010	$135,693	$1,659	$6,345	$32,282
Bundled Internet service charge	$2,189	$8,903	$25,196	$1,940	$7,951	$20,354	$249	$952	$4,842
NOC remote maintenance service	$547	$2,226	$6,299	$485	$1,988	$5,088	$62	$238	$1,211
Total	***$17,418***	***$70,791***	***$200,098***	***$15,429***	***$63,217***	***$161,622***	***$1,989***	***$7,575***	***$38,476***
Operation Expenses									
Cost of Sales									
Equipment and cable	$419	$1,802	$4,853	$488	$2,208	$5,779	$116	$505	$1,489
Network operations	$635	$680	$730	$1,729	$1,865	$2,014	$635	$680	$730
Customer operations	$5,072	$14,664	$36,675	$8,162	$21,082	$42,236	$2,692	$4,457	$9,901
Access charges	$1,776	$8,826	$23,218	$1,676	$8,029	$20,033	$100	$797	$3,186
Environmental cost	$1,424	$5,242	$13,795	$1,462	$7,538	$18,764	$340	$1,084	$3,537
Other (support contracts)	$286	$945	$2,099	$219	$849	$1,812	$65	$218	$552
Total	$9,612	$32,160	$81,370	$13,736	$41,571	$90,638	$3,948	$7,741	$19,394
Other Operation Expenses									
Corporate operations (G&A)	$1,568	$6,371	$18,009	$1,389	$5,690	$14,546	$179	$682	$3,463
Customer operations (S&M)	$1,045	$4,247	$12,006	$926	$3,793	$9,697	$119	$454	$2,309
Other expenses (training)	$35	$63	$126	$35	$70	$98	$35	$35	$35
Depreciation	$645	$2,773	$7,467	$751	$3,396	$8,891	$179	$777	$2,291
Depreciation, % of revenue	3.7%	3.9%	3.7%	4.9%	5.4%	5.5%	9.0%	10.3%	6.0%
Total	$3,293	$13,454	$37,608	$3,100	$12,949	$33,233	$512	$1,949	$8,097
Total	***$12,905***	***$45,615***	***$118,978***	***$16,836***	***$54,520***	***$123,871***	***$4,460***	***$9,690***	***$27,491***
Operational P&L									
Dollars	$4,513	$25,177	$81,120	-$1,408	$8,697	$37,751	-$2,471	-$2,115	$10,985
% of Revenue	26%	36%	41%	-9%	14%	23%	-124%	-28%	29%
Capital Investment	**$3,225**	**$10,639**	**$23,470**	**$3,754**	**$13,227**	**$27,476**	**$894**	**$2,994**	**$7,566,158**
Return on Investment	**160%**	**263%**	**377%**	**-17%**	**91%**	**170%**	**-256%**	**-45%**	**175%**

Source: Infonetics Research, Fujitsu Network Communications, and Atrica

Service providers interested in obtaining more details of the business case may contact FNC in the following ways:

- http://www.fujitsu.com/us/services/telecom/categ/datasolutions
- E-mail John Cupit, Principal Network Architect of Fujitsu Network Communications, at john.cupit@us.fujitsu.com

About Infonetics Research

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