ISG Research™

AGILE, ASSURED AND ORCHESTRATED SERVICES

THE BUSINESS CASE FOR TRANSFORMATION TO ETHERNET

This white paper sponsored by

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GLOBAL MARKET SITUATION

Time Division Multiplexing (TDM) is a proven technology — it is reliable and delivers well established performance characteristics across the world. So, why is it that many TDM services are being sunset globally or, as recently suggested by an electric utility operator, that "end-of-life notices are raining down like confetti?" Why would carriers introduce such disruptive measures to their long-established portfolios?

Time Division Multiplexing (TDM) is a proven technology - it is reliable and delivers well established performance characteristics across the world.

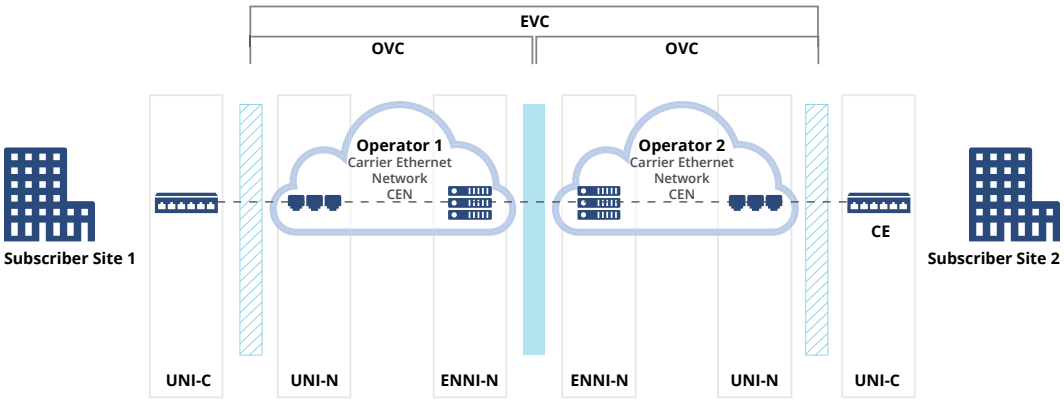
Over a decade ago, multiple operators, service providers and even network hardware manufacturers realized that to remain competitive and meet the ever-growing demand for bandwidth, it was incumbent upon them to address several key barriers that were impacting their bottom line as well as their customers. The solution was to extend the successes of the Ethernet LAN into the Wide Area Network and hence, the Metro Ethernet Forum ("MEF") was born.

A long-term project, the nascent MEF quickly grew its membership, authoring and standardizing frameworks for the **"Carrier Ethernet Network**,**"** commonly abbreviated as "CEN," and often labeled simply as *Metro Ethernet*.

What is a CEN? While succinctly defined by the MEF as "a network from a service provider or operator supporting the MEF service and architecture models," let's demystify that a bit...

As seen graphically in *FIGURE 1* below, the experienced telecom professional will certainly begin to feel a sense of "déjà vu." How is this any different from the countless charts seen from providers before? The Carrier Ethernet differentiator is the agreed-upon framework established within the MEF, which ensures that established and tested parameters for interoperability are used ("**assured**"), enabling the "retail" provider to reliably deliver a wide array of services over a converged infrastructure (as seen in *FIGURE 2*).

Figure 1 - Carrier Ethernet / Metropolitan Ethernet Network



Each of the services below has its own use-case scenarios and, ultimately, allows the enterprise to choose the most effective solution for a particular location.

Figure 2 - CenturyLink Ethernet Services

CenturyLink Product	Topology	Technology Transparency	Speeds	Access Options	Class of Service	Billing Configuration	Best Use Case
E-Access		Ethernet over MPLS/Layer 2	50 speeds; 2Mbps-6Gbps	On-net Ethernet; Off-net Ethernet	Basic, Enhanced Dedicated	Nationwide Flat Rate or Metro Flat Rate + Intercity Flat Rate	Used in a wide array of scenarios, the most simple being MPLS port over Ethernet access
E-Line EVPL		Ethernet over MPLS/Layer 2	50 speeds; 2Mbps-6Gbps	On-net Ethernet; Off-net Ethernet	Basic, Enhanced Dedicated	Metro Flat Rate + Intercity Flat Rate	Available in both P2P and Hub & Spoke configurations for both transitional private line replacement or for scenarios in which multiple end points require access to the services at the hub
Ethernet Private Line		Ethernet over SONET, DWDM or MPLS*	15 speeds; 3Mbps-1Gbps	On-net Ethernet; Off-net Ethernet	Full Transparency	Metro Flat Rate; Intercity variable by mileage	Cross-connecting PBX, Dedicated Internet, Ethernet LANs
VPLS		Ethernet over MPLS/Layer 2	37 speeds; 1Mbps-10Gbps	On-net Ethernet; Off-net Ethernet	Basic/Basic Plus Enhanced/ Enhanced Plus, Premium/ Premium Plus	Flat Rate of Commit Plus Usage	A layer 2 alternative to MPLS commonly used to connect to data center resources, or connecting larger sites are note part of a meshed network
MPLS/IP VPN		IP over MPLS/ Layer 3	37 speeds; 1Mbps-10Gbps	On-net Ethernet and TDM; Off-net Ethernet and TDM	Basic/Basic Plus Enhanced/ Enhanced Plus, Premium/ Premium Plus	Flat Rate, Usage or Comit Plus Usage	Layer 3 private networking for meshed, multi-site networks
Wavelengths		Ethernet over DWDM/Full Layer 2 Transparency	Ethernet: 1, 10, 40 (ICB) and 100Gpbs SONET/ SDH:2.5, 10 and 40Gpbs	On-net; Off-net (ICB)	Full Transparency	Metro Flat Rate by building category; Intercity variable by mileage	Requires an existing ring service, an extremely effective means to supply bandwidth to specific business units

First and foremost, clients need to consider their current state and how much exposure they may have to TDM sunsetting.

The result is:

1. Decreased access service installation intervals (15 business day average for CenturyLink on-net installations vs. overall market average of 75 days).
2. Overall improved performance to the agreed-upon service levels (**Assured**).
3. Changes in port configurations that can be handled at the same speed as any other virtualized services (now nearly ubiquitous in other areas of the proverbial "IT Stack"). This affords enterprise network teams the opportunity to embrace true **agility** (the lack thereof has seemingly made "network" the last-to-the-table in nearly every IT or business endeavor).

4. Ethernet standards are universal and do not vary by country. On the other hand, the type of TDM service (e.g., DS-1 vs. E-1) varies from country to country, and some operators within a country will support both (but are typically silent about alternative option availability).

Many of the advantages may have been communicated before, but perhaps many customers were stymied by the high cost of Ethernet services compared to TDM services. The cost performance gap pendulum has, as widely expected, swung in favor of Ethernet service, as illustrated in *FIGURE 3*. And notably, not considered in this table is the relative total cost of ownership, which as described further below, is decidedly in favor of Ethernet-based services.

Next, clients need to consider their bandwidth requirements in the near-to-mid-term and answer this question: Are we delivering a consistent user experience across the globe?

Figure 3 - TDM vs. Ethernet Cost / Mbps*

	Cost Per Mbps		
Comparable Speeds	TDM	Ethernet	On-Net Ethernet
T1(1.544Mbps)/2Mbps	$ 120.77	$ 115.64	$ 92.85
E1(2.048Mb)/2Mpbs	$ 490.02	$ 325.89	$ 92.85
9.264 (6xT1)10Mbps	$ 137.75	$ 62.01	$ 43.10
DS3 (45Mb)/50Mbps	$ 101.96	$ 21.76	$ 31.49

* Source data is from ISG projects over the past 6 months.

The changes outlined above may largely seem like "carrier" problems, and while most enterprise clients are probably not overly interested in a migration effort and potentially raising the existing cost structure in favor of agility and improved service levels, there are other fundamental forces driving the TDM sunset, and they are the client's problems, too:

1. The number of manufacturers building and maintaining TDM equipment, such as CSU/DSU multiplexers, has dropped precipitously. Simple supply-versus-demand economics is driving up cost and with it the TCO.

2. Education and training has, for some time, been almost exclusively focused on Ethernet-centric services. Based on the Federal Bureau of Labor statistics, baby boomers comprise nearly 40 percent of all telecommunications workers, making the last of the workers who "grew up" in a TDM world at or near retirement age. The capability for both carriers and enterprises to manage, maintain, and troubleshoot TDM services in a time-effective manner has and will continue to diminish with their exit from the workforce.

3. In 2017, the U.S. Federal Communications Commission (FCC) deregulated business data line services (BDS). Rising third-party carrier TDM prices, assessed to service providers and passed through to business customers for off-net services, may cause some companies to consider accelerating the migration from TDM to Ethernet and other services.

Combined with the inherent advantages of Ethernet-based services, a "perfect storm" of external and internal forces are driving TDM services out of carrier and client networks.

WHAT CLIENTS NEED TO CONSIDER

First and foremost, clients need to consider their current state and how much exposure they may have to TDM sunsetting. An unhealthy TDM population should be creating cause for concern, as both service interruptions and budget increases are visible on the horizon.

ISG anticipates that enterprise digitalization efforts will continue for at least the next five years, and ISG service providers' clients anticipate these efforts will result in demand for increased bandwidth by more than 800%.

Let's examine the situation across the globe, as well as specific regions, by reviewing the last 50 customers in ISG's market-leading network database. As seen in *FIGURES 4 AND 5*, compared to their peers, many clients may not feel all that isolated. The march toward Ethernet varies widely by region. Our research also indicates that the longer a service has been installed, the more likely said service is to be provided over legacy TDM technology. Conversely, as multinationals expand into new markets, they are more likely to employ Ethernet-based technologies. Newly created companies in the SMB (Small, Medium Business) segment are also now more likely to employ Ethernet based technologies.

Rhetorically, what are the forces that cause customers to leave legacy services in place, when more effective options are available? And more importantly, which side of the technology "tsunami" do they wish to be on? These questions are examined under "**Inhibitors to Transformation.**"

Figure 4 - Global Access Technologies

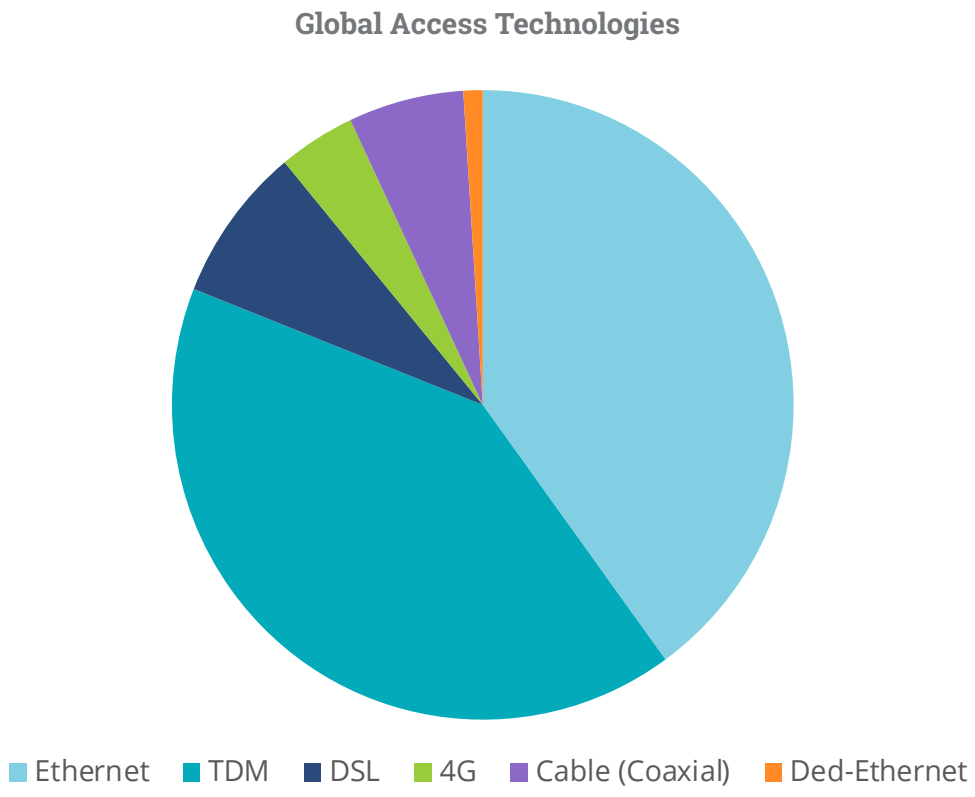
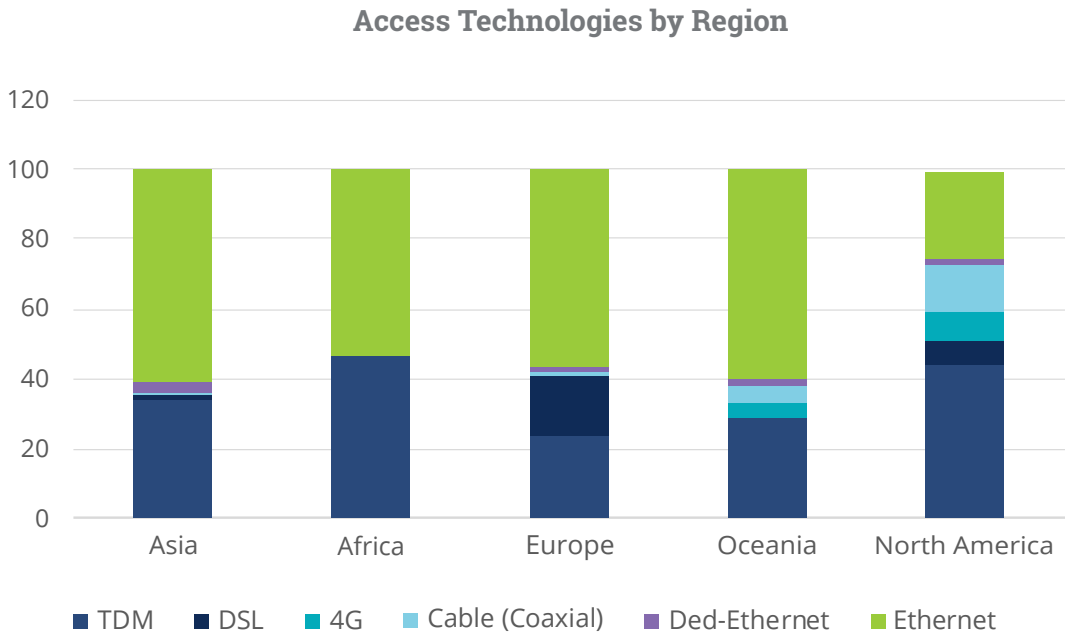


Figure 5 - Access Technology by Region



Ethernet transformation will enable the corporate network to respond and keep pace with the rest of the Agile Enterprise.

Next, clients need to consider their bandwidth requirements in the near-to-mid-term and answer this question: Are we delivering a consistent user experience across the globe? While everyone knows that bandwidth requirements are increasing, are all the organization's users benefiting from corporate-wide deployments of services such as Voice Over IP, Unified Communications, or desktop virtualization?

Odds are that not all users are benefiting from these productivity tools and other solutions due to cost-prohibitive bandwidth limitations imposed by the TDM access.

Additionally, are we prepared for shifting workloads and usage spikes stemming from the organization's cloud and digitalization efforts? ISG anticipates that enterprise digitalization efforts will continue for at least the next five years, and ISG service providers' clients anticipate these efforts will result in demand for increased bandwidth by more than 800 percent.

Other factors that a client should also include when considering Ethernet providers are:

1. **Availability** – Does the provider being considered have the inter-carrier relationships (both foreign and domestic) to reach all corporate locations? Can the provider aggregate multiple traffic types over a single connection?

2. **Service Levels** – Does the provider offer acceptable service levels, including installation intervals?

3. **Network Management** – Does the provider offer network monitoring and support, including SD-WAN and Network Function Virtualization? Orchestration Platforms, a relatively new concept, also needs to be considered. As a new capability, there should be added emphasis on road map transparency.

4. **Legacy / Synchronization Equipment Support** – Does the provider's Ethernet network support Circuit Emulation and/or Packet-Based Clock Synchronization? Most networks, and even modern mobility networks, contain equipment that depends on synchronization (e.g., PBX, SCADA). Can the provider support these critical services until such a time that technology replacements are developed or deployed?

5. **Reputation** – Does the provider's current customer base consider the provider a business partner? Can the provider readily provide **relevant** references and case studies?

6. **Governance** – Does the provider include any resources to help support our business, or does it offer an endless list of support up-charges? Can **relevant** sample reports be provided, and do those reports meet expectations? Potential clients should consider their respective capabilities to support internally and how much support is effectively needed from the provider.

The leading inhibitor is simply inertia. Does the typical enterprise organization have the resources and expertise to dedicate to such an effort? Usually the answer is "no."

INCENTIVES FOR TRANSFORMATION

We have previously discussed the many advantages of an Ethernet transformation, including decreased installation and change intervals, improved network performance, cost performance, and supportable service levels compared to TDM.

We also briefly mentioned Orchestration Platforms as a strategic differentiator. While it may take time and effort to fully realize, the well-rounded Orchestration Platform is the "single-pane of glass" that the Network Operations Center pursued for decades.

Other advantages include a lower total cost of ownership, as the organization will no longer have to acquire and maintain equipment required to support TDM services or deal with the impending shift of the labor forces trained in supporting TDM services.

In summary, an Ethernet transformation will enable the corporate network to respond and keep pace with the rest of the Agile Enterprise.

INHIBITORS TO TRANSFORMATION

In many markets, especially those outside the enterprise client's home country, a lack of familiarity introduces fear, uncertainty, and doubt. Substantive inhibitors to an Ethernet transformation cause legacy networks to be left in place. As noted earlier, Ethernet is an equalizer. The exact type of TDM (e.g., T-1, vs. E-1) varies country by country. It is very

difficult for the average customer to know what types of services are available in more than 250 countries, and the situation is further complicated when some of those providers are beginning to sunset TDM. In many cases, a client decides that a like-for-like sourcing event is the path of least resistance.

A superior combination of Ethernet services, combined with flexible pricing methodologies, cannot be realized without the professional transition support and assistance ISG has seen CenturyLink provide to its customers.

As an example, the availability of Ethernet services in LATAM is far greater than FIGURE 5 above suggests. Most people will not reasonably know that Uruguay is quickly emerging as one of Latin America's most densely "wired" countries, or that there are a considerable number of MEF-certified providers in countries like Mexico and Brazil and others. In the United States, some carriers are still required by law to post publicly available pricing lists. Those lists, to the trained reader, are organized by the type of MEF-certified connection available in the carriers' respective access portfolios. To the more likely reader though, the only "actualized" information is a cost differential. In general, lack of knowledge on the vast portfolio of providers across the globe poses a significant challenge — a complexity that helped drive the popularity of single-provider sourcing. A newer trend, "regional sourcing," is partially intended to overcome performance challenges that are largely associated with the preponderance of TDM in legacy networks. The utilization of regional sourcing allows a customer to effectively source Ethernet access across the entirety of its network. The use of MEF-certified providers like CenturyLink invigorates the more manageable sole-source model as the most prevalent model (see "**How CenturyLink can Help**").

Another hurdle clients often face is a lack of understanding about the myriad of applications and corresponding network traffic each application requires. Cloud services, including Software-as-a-Service, and especially the concept of workloads, including seasonal, promotional, or other types of event-driven consumption spikes, further complicate the waters. Many clients' telecom expense management programs, underlying accounts payable systems, and even established budgetary processes, aren't prepared to support a consumption-based charge-back model.

Migration risks are many, including:

- Actual Availability of Ethernet Service – Many providers do not perform a stateful qualification check; pre-qualification is not the equivalent (i.e., a desktop survey vs. a physical site survey). Many providers cannot even perform a stateful qualification until a service order is submitted. A detailed and transparent process is required. For established, trusted partners, a client should absolutely consider including known future sites in the analysis.
- Special Construction – Also commonly referred to as "excess construction," these potential costs is related to the above exercise. It is time-consuming, and often impossible, for a prospective provider to identify any special construction cost prior to a bona fide service order. Many clients walk away at this point in a negotiation; they simply can't absorb the potential for a large TCO variance. Fortunately, there are numerous options, even sharing the cost of construction.

- Engagement – Identifying and bringing stakeholders and decision makers to the table can often be a complicated, protracted exercise. Even using well-proven models like **RACI** (Responsible, Accountable, Consulted, and Informed), bringing all the identified resources to bear, and keeping those resources engaged throughout the process is difficult.
- "Dangling" Early Termination – Understanding which existing services are subject to a minimum service period, and how to best organize a roll-out of the transformed network around such considerations, is a time-consuming exercise for most clients, whose service management and contracting processes lack the prerequisite process harmonization to effectively support complex network sourcing events.
- Service Management and Double Billing – There will be a period of time that both services are billing. Understanding this fact, documenting the impact to budget and TCO, and finally organizing a roll-out to minimize this window is time-consuming. It is also subject to external forces beyond both parties' control, and the client and provider need to be prepared to make adjustments.

Earlier adopters gain the benefit of fewer carrier resource constraints, and arguably, the benefit of an improved cost structure, as providers are highly incented to add customers to the newer network to realize an earlier ROI.

The leading inhibitor is simply inertia. Does the typical enterprise organization have the resources and expertise to dedicate to such an effort? Usually, the answer is "no." Any provider worthy of consideration should be able to respond in a reasonable time frame to a service pre-qualification request, both foreign and domestic. With the amount of planning, effort and manpower required, your provider should offer substantive resources to help capture your business, which includes the transformation of your incumbent legacy services.

HOW CENTURYLINK CAN HELP

First and foremost, CenturyLink will not be sunsetting its existing TDM service portfolio in the markets where it is the dominant ILEC. However, this does not insulate customers from such changes across their respective global footprints. MEF certification has become recognized as a significant competitive differentiator. Notably, 64 percent of the current global Ethernet market leaders (as measured by the Vocus Leadership Boards) are MEF-certified. With a single exception, non-MEF-certified providers have experienced downward pressure on their captured percentage of Ethernet-based market, and this trend is expected to continue.

Our sponsor for this white paper, CenturyLink, recently won a total of seven awards from the MEF in 2017, including Retail Provider of the Year (United States), Retail Provider of the Year (Global), Lifecycle Service Orchestration (Global), and of special significance, Best SD-WAN Managed Service (Worldwide). CenturyLink has been recognized by MEF as a consistent leader in Ethernet services, having won multiple MEF awards over the last consecutive five years.

Of special note, in 2017, CenturyLink surpassed AT&T as the largest Ethernet provider in the United States, according to Vertical Systems Group, Leaderboard report. This new ranking is the result of both inorganic (merger) and organic growth. It is also very likely that CenturyLink will surpass AT&T and Verizon as having the most "lit-buildings" in the United States. A lit-building obviates special construction costs and ultimately leads to highly competitive pricing.

CenturyLink maintains portfolios with other MEF-certified providers across the globe, including many of the smaller ILECs and Independent Operating Companies (IOC) operators peppered across the United States (e.g., Cincinnati Bell, Frontier, Consolidated Communications, TDS Telecom, Mammoth Networks, and many more). Many clients have a significant presence in these markets and have long struggled to maintain competitively priced and reliable services within the confines of a sole-sourcing or even a regional strategy. Customers of CenturyLink can leverage its MEF certifications and relationships to both simplify global sourcing and service delivery and, in turn, deliver leading-edge services to its customers and partners. As previously mentioned, customers are often challenged to document and project usage over the network. Fortunately, CenturyLink's E-line products support a usage feature called "Dynamic Capacity," which enables the customer to select a lower committed port speed, while providing the capability to burst up to three times committed speed. The combination of Ethernet-based WAN and Managed SD-WAN affords CenturyLink customers a service that few operators can match.

A superior combination of Ethernet services, combined with flexible pricing methodologies, cannot be realized without the professional transition support and assistance ISG has seen CenturyLink provide to its customers. CenturyLink Project Management (CPM) adheres to Best Practices Methodology as prescribed by the Project Management Institute standards. The CPM charter underscores CenturyLink's commitment to facilitate a seamless transition for our customers' communications services to CenturyLink's network, ensure compliance with the terms of the contract, and maintain customer satisfaction throughout the project lifecycle. By following these proven project management practices, the project milestones can be successfully achieved.

CenturyLink is committed to providing an efficient service delivery process for all contracted products and services. This commitment extends from initial design validation through confirmation of billing accuracy once services are accepted. Through coordination among sub-teams and consistent and accurate communication of status, CenturyLink ensures a positive and meaningful customer implementation experience.

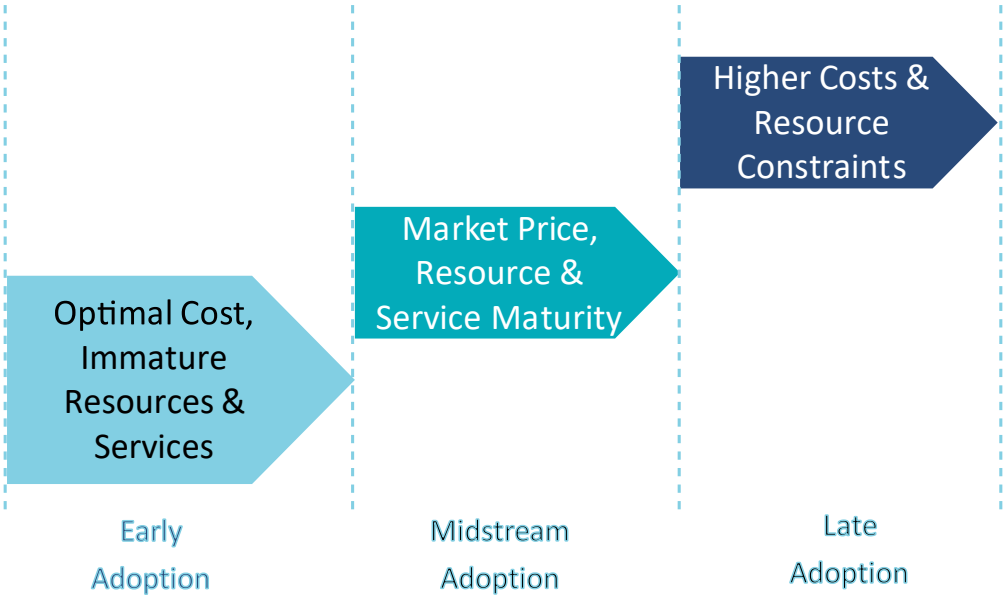
SUMMARY & RECOMMENDATIONS

ISG has examined the many advantages of an Ethernet-based network, as well as many of the barriers to such a transformation, and asked the question: What side of the sourcing tsunami does a client wish to be on?

As the TDM sunset draws ever closer, more and more clients will join the fray, competing for the time and energy of carrier resources to help them transform legacy TDM to agile, assured, and orchestrated Ethernet-based networks. Early adopters gain the benefit of fewer carrier resource constraints and, arguably, the benefit of an improved cost structure as providers are highly incented to add customers to the newer network to realize an earlier ROI.

Once the optimal transformation window has passed, however, history has demonstrated that securing the aforementioned resources face additional constraints, and the costs of both sunsetting and new services begin to rise under the pressures of supply and demand.

Phases & Impact of Service Sunsetting



Hence, we strongly encourage enterprises to take action now and transform networks under the more optimal conditions available today, realizing the advantages of Carrier Ethernet in your network sooner, rather than later, and before the market enters the "Late Adoption" phase.

FOR FURTHER INFORMATION:

Customer Segment	CenturyLink Resource Contact
Medium Business and Enterprise	http://www.centurylink.com/business/networking/ethernet.html

GLOSSARY

Carrier Ethernet Network (CEN) – CEN is described as "a network from a service provider or operator supporting the MEF service and architecture models"

User Network Interface (UNI) – The physical demarcation point between the responsibility of the subscriber (**UNI-C**, the Customer Edge or **CE**) and the responsibility of the service provider (**UNI-N**)

UNI-C – The UNI-C provides the CE side functions, which can be implemented on a switch or a router that connects to the CEN

UNI-N – The UNI-N is the service provider or operator side of the UNI. It can be implemented in a single network element or can be distributed between several network elements within the CEN

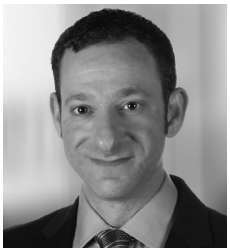
External Network-Network Interface (ENNI) – Is the network interface between operators and service providers

Ethernet Virtual Connection (EVC) – Carrier Ethernet Services operate over Ethernet Virtual Connections or EVCs. An EVC is an association of two or more UNIs that limits the exchange of service frames to UNIs in the EVC. A given UNI can support more than one EVC via the service multiplexing attribute

Operator Virtual Connection (OVC) – An association or collection of operator end points

ABOUT THE AUTHORS

DIGITAL TRANSFORMATION: Three Areas of Focus to Enhance Business Value



DAVID LESSIN

Director

David is an information technology professional possessing a unique multi-disciplinarian skill set, a strong business acumen, and an insatiable passion to improve organizational performance. In his career, David has never accepted a position with a pre-defined role, always bringing an entrepreneurial and innovative spirit that improves operations and generates new opportunities. David has won several industry awards for business intelligence and resource management. David leverages his broad experience and research capabilities to help clients realize untapped potential of people, processes, technology, and relationships.

MARGOT WALL

Consulting Manager

Margot has been a principal consultant with ISG since 2007, directly responsible for production and development of ISG Provider Services Carrier Deliverables, including Market Trends, Win/Loss Reports and additional ISG Research. With more than 25 years' experience in telecom, she brings considerable depth and breadth in network technologies and solutions, having represented all facets of both the client and carrier side of the equation.

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ABOUT ISG

ISG (Information Services Group) (NASDAQ: III) is a leading global technology research and advisory firm. A trusted business partner to more than 700 clients, including 75 of the top 100 enterprises in the world, ISG is committed to helping corporations, public sector organizations, and service and technology providers achieve operational excellence and faster growth. The firm specializes in digital transformation services, including automation, cloud and data analytics; sourcing advisory; managed governance and risk services; network carrier services; technology strategy and operations design; change management; market intelligence and technology research and analysis. Founded in 2006, and based in Stamford, Conn., ISG employs more than 1,300 professionals operating in more than 20 countries—a global team known for its innovative thinking, market influence, deep industry and technology expertise, and world-class research and analytical capabilities based on the industry's most comprehensive marketplace data. For more information, visit www.isg-one.com.

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