

# CARRIER SERVICE INFRASTRUCTURES: ESSENTIAL COST ELEMENTS FOR GLOBAL E-COMMERCE

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## ABSTRACT

*Companies seeking to engage in global E-commerce must partner with Network Service Providers (NSPs) to obtain the necessary network transport services for global E-commerce. NSPs are in the business of leasing the entire range of network transports, as needed, to their customers. The challenge is to keep pace with the increasing number of network types. Bandwidth options and competitive pricing models (always kept confidential) are typically used by both the customer company and their NSP to formulate a network design which makes the company a competitor in the E-commerce marketplace. The purpose of this exploratory research is to identify network transport options by their corresponding bandwidth, generalized cost-levels and Carrier Services Infrastructure (CSI) type. The relationship of global E-commerce to each of the CSIs and five leading NSPs will be examined.*

**Keywords:** Bandwidth, E-commerce, Network Service Provider, Network Carrier Services

## INTRODUCTION

Since the standardization of computer networks in the late 1980's and the passage of the Telecommunications Act of 1996, the number of network transport types (i.e. lines, channels) and their bandwidth capacity has increased dramatically. Along with the increase in network types a corresponding decrease in the cost of bandwidth is evident. Though the Telecommunications Act of 1996 primarily dealt with the Public Switched Telephone Network (PSTN), more Carrier Service Infrastructures (CSI) have since emerged. Today we have four additional, newer and evolving CSIs. These newer CSIs have increased the total number of available transports and transport services. Each CSI provides a variety of transport services that support networking at varying cost levels and bandwidth speeds [8].

In addition, the Act created the Incumbent Local Exchange Carrier (ILEC) and the Competitive Local Exchange Carrier (CLEC). For our purposes here,

we need not consider the differences between the two types of carrier service companies. However, it is useful to understand that the ILECs and CLECs and the many CLECs that have emerged since 1996, have all become the network service providers (NSPs) of today [8; 13].

## Carrier Service Infrastructures (CSIs)

At no time in history have we had as many CSIs or network transport options for support of global E-commerce networking. Following are the five CSIs:

1. Public Switched Telephone Network(PSTN)
2. Digital Service Network (DS)
3. Optical Carrier Network (OC)
4. Hybrid – Fiber Cable (HFC)
5. Wireless

CSIs are used to categorize all available network transports used in global E-commerce. Each of the five CSI network types independently connect to the global E-commerce network. Each of the individual transports operating within each CSI is also capable of connecting to the global E-commerce network through its parent CSI [3].

Each CSI operates multiple network transport types. For example, if we are employing a Plain Old Telephone Service (POTS) transport line, the POTS line is inextricably tied to and inherits the operational characteristic elements of the PSTN. Each CSI includes a specific subset of network transports that are available for lease through an appropriate NSP. The one exception at this time is with the HFC network. The HFC leases only the Cable Modem transport that can be used primarily by the residential market for Internet and E-commerce access [13].

## Partnering with the NSP

A company seeking to engage in global E-commerce will work with their existing NSP in cases where the company has a preexisting network and is under contract with an NSP. The NSP will provide the design services needed and propose a solution that would reinforce or replace the company's Internet

infrastructure. Accordingly, there would be an increase in the monthly recurring charges (MRC) and most likely a modification to the preexisting contract. The gains for the company are numerous and varied. The company can now increase their revenues through the global E-commerce applications now accessible to them [3; 13].

For a new company with no external or wide area networking (WAN) capabilities, the company will need to seek out, evaluate and select a competent NSP partner. The selected NSP should be familiar with all CSIs. The NSP will provide one or more options that would enable the company to get connected to the applications and the customers accessible through the global E-commerce network. If necessary, in the case of a brand new company with no network facilities at all, the NSP may also put in the required Local Area Network(s) (LAN) at each of the company's site locations. A LAN is required before a company can connect to the global E-commerce network [7; 10].

In both cases above the importance of the role that is played by the NSP cannot be underestimated. In the case of a company with an NSP partner, the NSP's design team will want to review all monthly network and telecommunications billings pertaining to the company's information technology infrastructure, including computer data, voice and video transport lines, monthly recurring telephony usage costs and videoconferencing charges (if any). The team will also want to discuss the company's specific requirements for global E-commerce. With the monthly billing invoices and the requirements list, the NSP will be able to develop and present one or more E-commerce solution options [3; 13].

Some modifications, such as an increase in bandwidth to the existing network, may be indicated. Since the company's NSP is already familiar with the network infrastructure, any changes would not be difficult to integrate. For example, upgrading from a DS-3 transport to an OC-3 transport line more than triples existing bandwidth while minimizing labor costs (See Table 1). At the same time, such an increase in bandwidth enables the company to consider integrating their telephony services using the same OC-3 transport line. Though there would be an increase in monthly costs for the new OC-3 line, by integrating other services on the new line, the company can save other service costs. However, as in most business dealings the specific item, services and component costs are kept confidential [2; 12].

<Insert Table 1 Here>

## Essential Cost Elements of E-commerce Networks

It is not possible to provide complete and accurate cost details for global E-commerce networks. Total cost of operation (TCO) for a corporate network is held in confidence between the company and its NSP. However, from the Act of 1996, we can derive some essential cost elements that help us estimate the cost of networks [8]. Following is a list of known essential cost elements and how they may impact a company's TCO.

1. Access versus usage costs. The NSP will typically lease the network transport(s) on a monthly rate basis for the access. Dedicated transports are based on mileage to obtain the base-cost. The NSP has the power to mark up or down what the final monthly cost will be. Elements that influence the monthly rate are term of contract (i.e. 1, 2, 3, 4, or 5 year term). The longer the term the lower the monthly access rate. With longer terms the NSP is more likely to reduce or eliminate the installation costs and the costs of terminating hardware. Three examples of this are no cost for routers, firewalls or switching devices [8; 13].
2. If a dedicated transport is used for E-commerce there are typically no monthly usage costs. If a switched transport is used for voice (i.e. telephone calls), then the usage rates are based on the call zones established in the 1996 Act. There are five cost zones including local, intralata, intrastate, interstate and international. The problem with these zone names is that the NSP can call them whatever they want to call them. For example, one NSP may bill intralata calls as "extended long distance" while another may bill these types of calls as "regional toll". Thus it may become more difficult for the customer company to manage the monthly billing cycles. It also complicates understanding of the rate-per-minute cost element for each of the five cost zones for each POTs line in use throughout the company [8; 13].
3. Access costs for network transports in the PSTN are generally low. The company pays a different per minute rate for each type of zone usage. The POTs line is the lowest access cost transport among all other transports. However, POTs lines used for data networking are impractical for corporate E-commerce applications. POTs lines continue to support voice telephony

applications in company's with traditional, non-converged networks (i.e. computer network and telephony network are on separate networks). POTS lines have monthly recurring zone usage charges when used for voice. That is, monthly usage is based on total minutes per call by zone, for each POTS line in the company. International calls are the most expensive type and include add-on charges for regulatory fees and taxes. POTS line usage costs can add up to a very large cost factor for a company engaged in global E-commerce. Because of the high usage, cost factors associated with POTS lines, companies using traditional networks to support global E-commerce are moving toward network convergence. Network convergence means that the company's computer network; telephony network and videoconferencing network (if used) are fully integrated on the same network. As such, international calls would be carried on the company's private, converged network and have little or no usage charges. For a larger company with many telephones this amounts to a considerable savings each month [2; 5; 12].

4. As with the POTS line, any switched transport is going to have a lower monthly recurring access cost (MRC) compared to most dedicated transports. However, except for residential use, any of the switched transports will prove to be impractical or too costly for a company engaged in global E-commerce. Switched transports operate in the PSTN or the Wireless CSI. For telecommuters from home or mobile users on a wireless cell phone service quality will be adequate. However, there is not enough bandwidth in such applications to support a whole company. That is one of the major reasons why many companies are moving to converged networks with a Virtual Private Network (VPN) service included. VPN service makes it easier and more cost-effective for individual users to interface with their company's main network [3; 9].
5. Dedicated, high bandwidth transports that operate in the DS or OC network infrastructures have the highest monthly access costs. E-commerce companies working with their NSP can develop a fully functioning network that supports the internal needs of the company, including all of its locations, as well as provide highly

functional global E-commerce services to both their employees and customers. Such transports include: DS-1, DS-3, OC-3 and OC-12. The larger NSPs are capable of providing any of the transports carried in the DS and OC CSIs. Smaller companies working with smaller NSPs should try to work with an NSP that has a partnership with a larger NSP. Because larger NSPs will buy transport bandwidth in blocks and can resell transport services to smaller NSPs at a lower cost. The cost of dedicated transports is much higher than switched transports. However, the benefits are much greater when compared to switched transports, including providing the capability to converge the company's traditional telephone network onto the computer network thereby providing both computer and telephony access to the global E-commerce network. Though the access costs are higher with dedicated transports, when your company can eliminate most if not all of its monthly telephone bill, the TCO is greatly improved. Unlike switched transports, dedicated lines are not shared with other customers. Dedicated means the customer has the full bandwidth 24 hours a day, seven days a week. None of the switched transports are capable of providing bandwidth in the same manner [7; 13].

#### LEADING NETWORK SERVICE PROVIDERS

The Gartner Research Report for 2006 evaluated the major network service providers on their "Ability to Execute" and their "Completeness of Vision". The execute category used nine criteria. These criteria included elements such as Product Service, Overall Viability, Track Record and Operations. The vision category used eight criteria. These criteria included elements such as Market Understanding, Strategy and Innovation. After the survey data is analyzed each of the participating companies are categorized into Gartner's familiar research model known as the "Magic Quadrant for U.S. Managed and Professional Network Service Providers. The top companies are those that make it into the leader's quadrant" [6, p.1].

"Vendors in the Leader's quadrant are performing well today, have a clear vision of the market direction and are building competencies to sustain their leadership positions in the market" [6, p. 4]. From the Gartner analysis of 2006, the top five leading NSP companies ten years after the passage of the Telecommunications Act of 1996 are:

1. AT &T
2. Computer Sciences Corporation
3. IBM Global Technology Services
4. Unisys
5. Verizon Business

Of the five vendors two have evolved from ILEC companies and the other three are CLECs. The SBC purchase of the former AT &T now gives them a global reach via the AT &T's network. AT &T holds a major presence in four of the five CSIs. As an ILEC they have a major presence in the PSTN. They also have a major presence in the OC, DS and wireless CSIs. It is no surprise that SBC chose to call their new entity AT &T [1, 6].

If a company is seeking to expand its site-locations globally and to increase its presence in the global E-commerce network, the probability is high that the company's NSP will need to partner with AT &T for part or all of the global transports to be used in the expansion [1; 13].

Verizon evolved out of the former Bell Atlantic. Bell Atlantic was also one of the largest ILECs in the United States. Just as SBC did to gain a global network transport service capability, Verizon purchased the former MCI [6].

The other three leading companies described including IBM Global, Unisys and Computer Sciences Corporation are large CLECs. They use their CLEC status to partner with other ILEC companies to provide network transports. In addition, they can provide the complete range of inside network services that are required to complete a global E-commerce network. Because they also provide other services and have large client company bases they are each highly regarded in the global telecommunication sector [1; 6].

All five of the above leading NSP companies can provide any of the transports identified in Table 1. With the exception of the HFC network, these companies can provide these transports in any number needed by any prospective customer company [1; 6].

Each of these five companies have their own telecommunications facilities with various types of ultra-high bandwidth transport access for supporting private networks and providing tier one access to the Internet via any of the CSIs (excepting the HFC network). Tier one means that a customer company's E-commerce network traffic merely needs to travel from the company's network directly into the Internet. A technical term known as one-hop is often used to describe tier one Internet access. Such

companies can provide direct access to the Internet that enables expedient access and usage of the global E-commerce network [1;6].

## CONCLUSIONS

Since the Telecommunications Act of 1996, the number and type of network transport services has increased substantially (See Table 1). At the same time, the overall cost of network bandwidth has declined. The Act created a market environment in which for the first time companies, other than the local exchange carriers, could get into the business of reselling or leasing network transport services. The Act labeled the former exchange carriers as ILECs and the new carrier companies are called CLECs. Today we know them all as Network Service Providers or NSPs.

For a company to engage in global E-commerce, it needs to partner with an NSP. The NSP can provide the needed network transports and services to connect the company to the E-commerce network. NSPs typically lease network transports and services on a monthly basis. Variations of how NSPs can modify the cost elements involved with connecting a company to the global E-commerce network have been identified [3].

In addition, the five carrier service infrastructures (CSIs), which provide the gateways to the global E-commerce network, have been listed CSI and network type and summarized in Table 1. Each network transport leased must operate through one of the five CSIs. The NSPs are the companies that lease the various network transport services. It has been suggested, that any company seeking to engage in business over the global E-commerce network should consider identifying, evaluating, selecting and partnering with an NSP. As a result of the Act of 1996, there are now over one thousand NSPs operating in the United States. Since the NSP will have some control over the cost to the customer company of any network transport, it is in the company's interest to consider partnering with an NSP [1; 3; 6; 13].

Finally, the cost of engaging E-commerce to a company operating with a traditional network is considered to be higher and less effective than a company operating with a converged network. The differences between the two types of networks have been underscored in this research. If a company were to consider partnering with an NSP that does not provide converging technology network services, the cost elements involved would be much higher than if convergence was a part of the ultimate solution. Having a single, converged network rather than a

traditional network where the computer data network and the telephone network are separate is more cost-effective. When a company substantially engages the global E-commerce network, having a converged network eliminates much of the recurring usage costs and provides more operational features [2; 4; 11; 12].

## REFERENCES

1. AT &T Global Networking (2007). *News and Events of Interest – Magic Quadrant for 2007*. Retrieved on March 16, 2008 from <http://www.corp.att.com/globalnetworking>.
2. Audin, Gary. (2004). Architectures for Convergence. *Business Communications Review*. Oct., 4-8.
3. Birchall, Jonathan (2008). Wal-Mart Plans to go Global with E-commerce Platform. *Financial Times*, p. 26.
4. Bohlin, E., Brodin, K., Lundgren, A. and Thorngren, B. (2000). *Convergence in Communications and Beyond*. New York: Elsevier.
5. Freidman, T. (2005). *The World is Not Flat: A Brief History of the 21<sup>st</sup> Century*. Farrar, Strauss, and Giroux. New York.
6. Goodness, Eric (2006). Magic Quadrant for the U. S. Managed and Professional Network Service Providers. *Gartner Research Report*. Retrieved on March 16, 2008 from <http://www.corp.att.com/globalnetworking>.
7. Mutch, A. (2001). Information Technology and Organizations: Strategies, Networks and Integration. *Journal of Management Studies*, 38(2), 317-319.
8. National Institute of Technology and Standards (NIST), United States Department of Commerce (1996). *The Telecommunications Act of 1996*. Pages 246-364. Retrieved on November 17<sup>th</sup>, 2007From <http://www.chron.com/content>.
9. Passmore, D. (1999). A bandwidth glut. *Business Communications Review*, 29(9), 18-20.
10. Passmore, D. (2000). Building Wrong Infrastructure *Business Communications Review*, 30(9), 22-25
11. Schulte, Erin. (2004). “Though VoIP Rally is Mature, Analysts Still See Opportunity”. *Wall Street Journal*, January 10, B7.
12. Suitor, Kevin. (1998). Convergence to Make Networks Simpler and Faster. *Computing Canada*, Vol. 24, Pages 31-32.
13. Swann, Christopher (2005). Competition in Local Telecommunications. *Business Economics*. Vol. 40, Pages 18-28

**Table 1.** Network Transport Access Cost-Levels for Global E-commerce

<b>Carrier Service Infrastructure Type</b>	<b>Network Transport Service Type</b>	<b>Bandwidth (bits-per-sec.) K=thousand M=million G=billion</b>	<b>Generalized Access Cost-Levels For E-commerce Transports</b>
	SWITCHED		
Public Switched Telephone Network (PSTN)	Plain Old Telephone Service (POTS)	56 Kbps	lowest
	Basic Rate Interface (BRI)	128 Kbps	low - average
	Primary Rate Interface (PRI)	1.47 Mbps	low - average
	Digital Subscriber Line (DSL)	3 - 51 Mbps	low - high
Wireless	Cellular	256 Kbps	low
	Wi-Fi	evolving	low - average
	Satellite	evolving	low - highest
	Wi-MAX	evolving	high - highest
	DEDICATED		
Digital Service (DS)	DS-0	64 Kbps	average
	DS-1	1.5Mbps	average
	DS-3	45 Mbps	high
Optical Carrier (OC)	OC-3	155 Mbps	average - high
	OC-12	622 Mbps	high
	OC-48	2.5 Gbps	high - highest
	OC-192	10 Gbps	highest
	OC-768	40 Gbps	highest
Hybrid Fiber-Coax (HFC)	Cable Modem	3 Mbps	low