

Broadband Services, Applications, and Networks: Enabling Technologies and Business Models

Comprehensive Report

Presented by the
International Engineering Consortium



Copyright © 2004 by Professional Education International, Inc. All rights of reproduction, including that of translation into foreign languages, are reserved. Requests for republication privileges should be addressed to Publications Department, International Engineering Consortium, 549 West Randolph Street, Suite 600, Chicago, Illinois 60661-2208, USA.

All opinions expressed in *Broadband Services, Applications, and Networks: Enabling Technologies and Business Models* are those of the authors and are not binding on the International Engineering Consortium.

ISBN: 0-931695-24-5

International Engineering Consortium
549 West Randolph Street, Suite 600
Chicago, Illinois 60661-2208, USA
+1-312-559-4100 voice • +1-312-559-4111 fax
publications@iec.org • www.iec.org

About the International Engineering Consortium

The International Engineering Consortium (IEC) is a nonprofit organization dedicated to catalyzing technology and business progress worldwide in a range of high-technology industries and their university communities. Since 1944, the IEC has provided high-quality educational opportunities for industry professionals, academics, and students. In conjunction with industry-leading companies, the IEC has developed an extensive, free, on-line educational program. The IEC conducts industry-university programs that have substantial impact on curricula. It also conducts research and develops publications, conferences, and technological exhibits that address major opportunities and challenges of the information age. More than 70 leading high-technology universities are IEC affiliates, and the IEC handles the affairs of the Electrical and Computer Engineering Department Heads Association.

The Killer Application for Broadband Voice: The Voice Peering Fabric

Hunter Newby
Chief Strategy Officer
tel^x

Introduction

This paper seeks to introduce a new phenomenon in the field of broadband telephony. That phenomenon is known as a voice peering fabric (VPF). The paper will touch on the past and present methods of voice communications and what is necessary for a shift in thinking about the way telephony will operate in the new world of voice over Internet protocol (VoIP) as well as a new commercial model for wholesale voice minutes.

There are generally three things “wrong” with the traditional wholesale voice-minutes market that cause the business to be costly, inefficient, and frustrating.

1. The traditional time division multiplexed (TDM) voice-minute is circuit-switched and requires equipment that is costly to purchase, manage, and house.
2. That equipment requires TDM local loops to interconnect that can involve all sorts of provisioning issues that cost time and money and delay revenue realization. In addition, other transport methods today provide greater bandwidth for a similar price.
3. There is no single transparent market for wholesale buyers and sellers

These issues are only brought to light today due to partial solutions for each point that currently exist independently. The fact that anyone can even hope to improve upon the inefficiencies of wasted synchronous optical network (SONET) ring bandwidth, TDM provisioning intervals, TDM cost per port, and telecom trade shows to find buyers and sellers is based on advances in technology and society. It is not necessarily a criticism of the way the system functions today, which is a marriage between technology, people, and process, as that is the only way it could have been done—until now.

Former New York Yankee Yogi Berra once said of baseball, “Half of this game is 90 percent mental.” The same holds true about telecoms. Buyers and sellers form behavioral patterns and therefore psychological boundaries are manufactured. Routines and processes are certainly necessary to have a smooth flowing, multioperational industry, but innovation is sometimes discredited or outright ignored since it is a shift from the defined lines of the status quo box. This is where early adopters get their name

The Killer Application for Broadband Voice: The Voice Peering Fabric

and revolutionary ideas are born. The way things are and have been are kept not only by physical limitations, but also by psychological forces as strong as gravity.

What is wonderful about the shift from circuit- to packet-switched voice minutes is that the idea, or change in thinking, has already been largely accepted. There are enough people on the believer side that a tipping point has been reached. Those who have already made the mindset shift are not outsiders to those who have not, but rather they are the insiders. This psychological force will grant innovative ideas about solving VoIP commercial issues instant approval for consideration. As long as the masses have a general positive consensus about adoption, streamlining the commercial aspect of VoIP can be more easily implemented. This invisible force is the most important component of the concept and basically means that the timing is right.

In addition to the invisible force and good timing, the business case needs to be sound. To understand the business of voice peering both from the technical and commercial perspectives, one should have an understanding of the history and relevance of its components. This will explain how collectively those pieces solve multiple problems and create a new market in a void.

VPF Background

The VPF is a collection of several independent components and leverages technologies recently accepted by businesses dependent on communications for daily use. Each of the following elements deserves more detailed and fitting tributes to their development and significance than will be found here. What each element does get is a brief synopsis and its relevant lessons learned leading to the possibility of a VPF. The VPF is mainly composed of the existence and developments of the following:

- The Internet
- Common physical interconnection points
- IP peering
- VoIP
- Metro and long-haul Ethernet transport
- E-commerce
- Marketplace transparency
- Member-provided feedback

The Internet

The commercialization of the public Internet from a private government, educational, and research network introduced the world to many new ideas and moreover a new way of communicating and thinking. What was underlying this brand-new means of communication was a shared-data network and that in and of itself was a major transition from the traditional concept of a WAN. It also created a new service-provider category, the Internet service provider (ISP), with new products called Internet access and a revenue model for switch ports never previously seen. Although the initial introduction of the Internet and this shift in thinking and revenue took several years to become accepted, it is now part of everyday life for many. One of the deepest impressions made on each of us is that we now know how to understand the concept of a shared network and what it can do for us. We also can adapt to new developments such as e-mail, chat, instant messaging, file sharing, and other communications enablers more rapidly because of what we have learned. The enlightened masses are primed for innovation.

Common Physical Interconnection Points

The original common interconnection points for the commercial Internet in North America were MAE East, MAE West, Sprint NAP, and the Ameritech NAP. *NAP* is an acronym for *network access point* and MAE stands for *metropolitan-area Ethernet*, and they define what the builders of the Internet were trying to accomplish at Layer-2. Their goal was to avoid TDM, circuit-switched local loops from the local-exchange carrier (LEC), and move toward packet-based Ethernet transport in the form of a direct connection. This was due to the time and costs of provisioning LEC local loops to interconnect their Internet networks, but also the component cost increase of TDM over Ethernet ports on IP routers. The need for close physical proximity was also driven by the distance limitations of LAN-based Ethernet, which is measured in feet and not miles. What this has taught those involved in building new, competitive networks is that, in order to succeed, common interests must be found and everyone must pay the price of admission, so use technology to keep costs down and share physical space to reduce capital expense.

There is an interesting parallel to these highly concentrated Internet interconnection points and it is the core interconnection points of the legacy TDM voice networks. Aside from the desire to use Ethernet as a standard interface between the networks present at the common point, all of the same networking and economic drivers existed for the SONET/WDM (wavelength division multiplexing) pure transport and TDM voice networks to form common points. These common points are known today as core interconnection facilities, or meet-me rooms, and they are physically located within buildings known as carrier hotels. Buildings having multiple carriers have been in existence since the mid-1980s, but the core interconnection points within them were not necessarily planned. They occurred more as an evolution to solve in-building interconnection problems within the last five to eight years.

Although these core interconnection facilities are not currently core Internet peering points, that is changing quickly. The reason for the change isn't that TDM voice is on the rise; actually it is declining rapidly. The reason is that the core interconnection facilities in North America are where the bulk of the international undersea fiber cables terminate. It is also at these points where the metro and long-haul domestic fiber comes to meet and interconnect. The most important thing in the economics of networking is where the fiber is. That location is as specific and unchangeable as longitude and latitude. Then the equipment follows.

What this also means is that this is where the most choices for transport routes exist. Therefore the lowest cost-per-bit at the transport layer exists as a result of the highest level of competition for those routes anywhere. The elimination of the necessity for local loops at these points also helps tremendously, as that dramatically reduces the total cost and time of delivery helping carriers realize more profitable revenue sooner. As the shift from TDM voice to VoIP continues to occur, the Internet itself will experience a shift. Where the lowest cost-per-bit exists at Layer-2, so will IP at Layer-3.

IP Peering

The concept of peering was born from an imbalance in cost of data delivery and sought fairness and equality through reciprocal data transfer between networks of relative size, or peers, for operational expense reduction. In other words, one network operator doesn't have to pay another for transit of data to its destination on their respective networks. Rather than pay for IP transit to another ISP, the peers extended their networks to common physical points, MAEs and NAPs, where they would physically cross-connect cables to their respective routers. This multiplicity of cross-connections gave rise to another new concept, the common Ethernet switch fabric. The idea of one connection to a common switch gives each connected network potential access to the others connected to the switch, thus eliminating the need for multiple physical connections and ports. The rules, policies, procedures, and costs surrounding the virtual or physical network extension to the common points, the connection to the switch fabric, and the management of sending and receiving data from the other fabric members have also all become new

The Killer Application for Broadband Voice: The Voice Peering Fabric

business models. The creation of these fabrics also gave rise to a new role within the ISP known as the peering manager. They are responsible for managing the relationships with the other peers and have become a subcommunity with their own set of rules.

In addition to “free” peering, there is also paid peering. This is a situation where a network operator connected to a switch fabric wants to send data to another network on the fabric at a rate higher than they will receive back. This would result in an imbalance in data transfer and would be identified during negotiations prior to either operator’s allowing throughput on their peering fabric switch ports. In this instance, it would still make economic sense for the sending party to pay the receiving party, due to the ease of interconnection through the fabric and the associated port and cross-connect cost-savings. In most cases, paid peering is still less than the cost of IP transit.

There are many lessons learned within the IP peering concept, one of which is the natural, intelligent progression from physical layer interconnections to a community-style switch fabric. There are new revenue opportunities for networks that sell data transfer on their networks through the increased reach of a common fabric. There is also the economic result of networks that do not seek to charge for sending data to each other—in this case, because they have an equal amount of data and it would otherwise balance out—so they save the accounting measures. This inter-networking framework paves the way for other networks, which do not currently have an economic model to charge for receiving data, to give it away once they are connected to a fabric.

VoIP

Since the transition of voice calls from analog waves to digits, voice became a data application. Local and long-distance voice carriers upgraded their equipment to carry digital voice service to improve quality, and their margins as data can be statistically multiplexed, or in other words, they could create more time in the same space and make more money. This is also referred to as compression and correlates to fitting 20 pounds of something into a 10-pound bag and getting paid for the 20 at the 10-pound cost.

As innovation would have it, this voice data made its way onto the Internet due to the natural fit of data to packets and the overwhelming economic benefits of lower-cost transport and port costs. Now what had been reserved for the largest of traditional voice carriers has become available to the smallest and most aggressive of providers. Arbitrage opportunities exist everywhere, but there is much disparity and lack of a common resource for information to bring together all of the components. Overall the efficiencies outweigh the inefficiencies at this point, but again, solving those remaining problems creates new opportunities. Regardless of the issues, this development was clearly for the good of the many and not of the few.

VoIP gateways are what enable voice over the public Internet or a private IP network. Gateways are essentially a combination of a traditional voice switch and an IP router. The gateways that connect to the public Internet are predominantly located at core interconnection facilities and not IP peering points, due to their need to interconnect to the legacy TDM voice networks for full coverage. This firmly positions VoIP within carrier hotels.

Metro and Long-Haul Ethernet Transport

It is commonly understood that as a LAN protocol, Ethernet dominates the market. Ease of use, scalability, interoperability, and cost are what give it its standing. Ethernet is also the standard for IP-peering interfaces and the protocol of choice for VoIP providers. The benefits of Ethernet have been confined to certain limited distances from a defined common physical point for a long time, but that has now changed. Several transport carriers in North America and Europe are now offering Ethernet in metropolitan areas and even long haul between cities such as Los Angeles, New York, and London. Currently 10 Mb of transatlantic fast Ethernet goes for \$1,000 monthly. That’s one thousand dollars.

This development is particularly interesting. If the MAEs and NAPs were established to avoid local loops and take advantage of Ethernet for direct connections and that then extended into Ethernet switch–peering fabrics, what would happen when the network has the transport and switching qualities of the peering fabric? Essentially one big MAE, but potentially a world-area Ethernet. Can the network become the fabric?

In some cases where traffic flow between two parties justifies a dedicated link, the answer is yes and that happens today. Certain peers will migrate back off of the fabric to connect on a private network where traffic levels are cost-justified to do so. The financial comparison for the business case is between the cost of the peering port and the cost of a private connection. If the private connection is less, it makes sense. As Ethernet transport becomes more available at similar price points to the preceding transatlantic example, the business case to come off of the peering switch becomes easier to make sooner.

Although the economics don't lie, there is a component of the fabric concept that cannot ever be replaced. One of the greatest strengths of a peering fabric is the transparency of its members. Knowing who is in the switch with you, how to contact them, and the set of rules for interconnection is critical. Without the knowledge, disparity would reappear and the maximum benefits of the common interface would not be realized. Management of the members is the uniformity that creates efficiency. Even if the network replaces the common site switch, it is still a fabric.

Applications drive bandwidth demand, but without access to bandwidth that can support the applications, the ideas never happen. In addition to metro and long-haul Ethernet for carriers and large corporate clients, cable modem, digital subscriber line, and Wi-Fi serve the same purpose of enabling high-speed transport for the small to medium business and residential users. The different methods of broadband access all have the same end result of enabling users and applications to thrive.

E-Commerce

A colleague built a Web site in 1995 and posted many items that he wanted to sell. He tried for months and never sold a thing. One day I asked him how it was going, and he told me, "There are a lot of people on the Internet, but they're not all in the same place. No one can really sell things on the Web." A problem in need of a solution, and now there is eBay.

Electronic commerce was again a natural evolutionary step. As more and more people moved away from cash to credit cards, we all became numbers, or digits, ourselves. The actual plastic card is irrelevant on the Web. The creditworthiness of your digits is all that matters. Seeing the trend develop was one thing, but filling the void and creating all of the pieces of the puzzle and fitting them all together took years and billions of dollars. Creating an entirely new world, a new collective understanding, is not easy, but well worth the investment.

Marketplace Transparency

The benefit of marketplace transparency has been described in relation to a peering fabric, but beyond that there is also a dimension of individual, retail commerce that has primed the minds of the common buyer. Now we can search the Web for whatever we want to buy and usually find three of the same, get competitive prices, and even negotiate all in a matter of minutes. It is easy to forget the days of going to the mall and department stores shopping all day to try and accomplish the same thing. On the Web and certainly eBay, the middleman role is diminished. The savings goes to the buyer, transactions are completed immediately, and products and services are delivered to where the buyer wants them. The point is this is all commonly understood today. It is expected.

The Killer Application for Broadband Voice: The Voice Peering Fabric

Member-Provided Feedback

The growth of networks globally should be no surprise to anyone. The reason is due to a force of nature, which is people and their need and desire to communicate, interact, and transact with other people. That said, there are certain on-line communities that require fair and easily accessible credibility reports of the members. A self-policing community is a very efficient and effective means to this end. An example would be if IP-peering managers were to post their dealings with each other in a format of positive, neutral, and negative. This would give others the benefit of knowing what type of business partner they might be. Aside from the Internet, which is a collection of shared networks, and the World Wide Web, which exists within the Internet and is a place of interlinked images and sounds, eBay is the best example of interlinked individuals with common yet unique commercial interests in this world. This is a community with many subcommunities. These are real people, digital people, who for the most part fairly and accurately report on their dealings with each other.

The VPF

The VPF is a Layer-2 Ethernet peering fabric built and operated specifically for VoIP networks. The concept of a VPF leverages these four elements of the previously described components.

1. Their inherent physical and virtual attributes
2. The valuable lessons learned about the economics of networking
3. The psychological effects each have had on the users
4. Virtual communities and “Town Watch”-style neighborhood reportings within it

The VPF is physically located in a core interconnection facility, giving it greater reach to more metro, domestic, and international long-haul core fiber routes. The core sites are also where the highest concentration of VoIP carriers are located. The location has a perfect mix of multiple access providers to the site and service providers within it for a transparent marketplace to exist. Due to the density of network access and services, there is greater choice and therefore the most competitive rates, and this is well-known throughout the industry. Even with the almost limitless availability of broadband and the efficient and low-cost VoIP, there are still issues related to the wholesale VoIP business at the core.

1. Finding the actual buyers and sellers
2. Identifying available routes, rates, available capacity, quality, and billing terms
3. Finding and contacting the right person to negotiate and transact with
4. Verifying credibility
5. Accessing the carrier’s routes with ample connectivity
6. Testing the route for quality assurance
7. Coming to terms and then connecting networks to send traffic
8. Being able to increase traffic easily to that supplier
9. Changing emergency routes
10. Settling financial transactions

The VPF creates a transparent marketplace for VoIP buyers and sellers to help solve these problems. How does the VPF help solve these issues?

1. The VPF’s Ethernet switch has “members.” They pay a monthly port fee to the manager of the VPF for a fast Ethernet (10/100 Mb), or gigabit Ethernet port (1,000 Mb). When they register, they get to list their company name on a public Web site for the VPF.
2. In addition to listing their company name, members get to list primary contact, rates, routes, available capacity, call-completion percentage, and billing terms on the same Web site. This Web

site acts as the facilitator and front end of the Ethernet switch, giving complete transparency to all of the members and what they are looking to buy and sell.

3. The primary contact listed on the Web site becomes the voice-peering manager for that organization. That person, or group, has the authority to establish business relationships.
4. Through a member feedback page, members can leave feedback on other members based upon transactions that have taken place. This section of the Web site serves as a guide for others to know what to expect from that member in a business deal.
5. Most new connections to a fabric are driven by a business case. The interconnection must have new revenue greater than its cost or provide operational savings within a certain period of time, or it probably won't happen. By having the level of visibility the VPF provides, new members should be able to make that business case without all of the usual information-gathering efforts. The fact that the VPF has so many interconnection methods and choices help it grow. The greater the number of choices, the easier it is to make the case and get connected. The connection methods are as follows:
 - Direct Category-5 cable (Cat-5) connection to the VPF at the core interconnection facility
 - Transparent LAN service (metro, or long-haul Ethernet) circuit into the core site and then a Cat-5 cross-connect to the VPF
 - Traditional TDM circuit into the core site, requiring a router, or gateway, to be co-located at the core site and a Cat-5 cross-connected to the VPF
 - IP tunnel through the VoIP carrier's ISP, requiring a special configuration with an ISP at the core interconnection facility already connected to the VPF
6. Once connection to the VPF has been made, testing potential routes is very easy. Contact the voice-peering manager, express an interest in testing, agree to test, and open respective ports to send and receive traffic from the other party—very efficient and easy to use.
7. Once business terms are reached between parties, the full connection can be established through the VPF in the same manner as just previously outlined. Once the connection method is determined and created, the scalability and multiuse function of that connection is very high.
8. As is usually the case, when a supplier provides a good-quality route with a competitive rate, the buyer uses all of the capacity provisioned. The customer would then need more capacity and have to order another local loop that could take days or weeks. In the VPF, this capacity increase can happen in minutes.
9. There are certain instances where a route from a new supplier may be necessary. Two such instances are when the route failed and the buyer can no longer send traffic, or when the quality of the route has decreased dramatically. Another would be if the seller's rate is no longer competitively priced. In each case, a new route to a new supplier must be established. In the circuit-switched world, this is accomplished by overbuilding local transport and therefore having to pay for it, but not always having to use it and also possibly occupying switch ports for just-in-case second routes. The VPF allows the buyer to be in a fabric of multiple providers so that the access to the VPF is not limited to only one provider as it is in TDM, but rather the access is a multifunctional component of the buyer's network.

The Killer Application for Broadband Voice: The Voice Peering Fabric

10. The financial settlement of transactions is currently handled by each buyer and seller independently. There are many different methods of payment, and one of the future goals of the VPF is to create a standard payment process for all buyers and sellers. This additional feature will also help increase the flow of business and the size of the industry.

Summary

The VPF can exist today only because of the elements it comprises and their own maturity. The VPF is meant to solve many issues related to wholesale voice communications, and it begins where the wholesale market is created. This is the only logical place for it to be. The rate at which people communicate telephonically has never stopped growing, and with new voice-enabled broadband networks being built around the world enabling millions of people to have access to telephones for the first time, there is no foreseeable decline in the growth of the voice market. It is for this reason that the services the VPF provides are necessary and valuable to the market.