

## eSubnet Fragment Article

### What's in the WAN

As ICT professionals, we know how LAN technology works. Basic LAN technology hasn't changed since the Ethernet patent was granted December 13, 1977. The speeds have improved. For many of us in ICT, the WAN is more of a mystery, and after more than a decade of working with them, I've seen change.

If you've been involved in deploying LAN-to-LAN networking, you may be tempted to compare these newer technologies to those, but this will lead you astray. And if the changes are confusing enough, marketing professionals continue to change their product messages about these systems.

So let's look at how WAN technology has changed.

#### The circuit-switched era

Originally, WAN deployments relied on serial connections over copper. In the mid 1950s the North American Air Defense invented the modem, inspired by news wire services. The first publically available modem, the Bell 103, went to market in 1962. Invented at AT&T it was a full-duplex modem that was capable of 300 bps. By 1969 when the Internet's precursor ARPANET came online, modem communications speeds of 9600 bps were considered fast. As data transmission grew, these speed limits become noticeable. Communications appeared slow, and the problem of link diversification became more apparent.

The original links for the ARPANET and other networks of that time were based on circuit switched technology over the PSTN. This meant that a phone call was required between two nodes wishing to communicate. Every time data needs to be sent between nodes, a phone line is required at each end of the connection, as in Diagram 1:

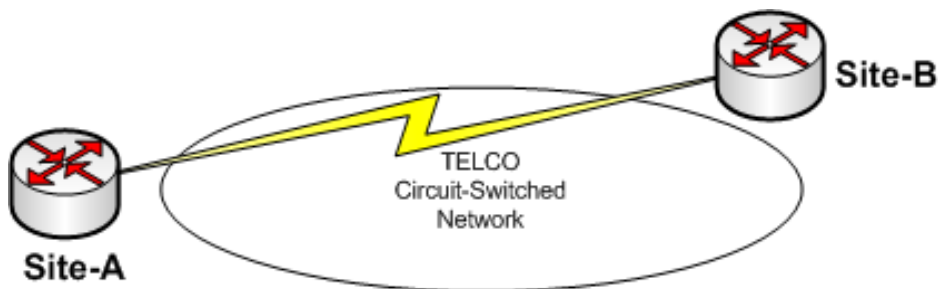


Diagram 1: 2 node circuit-switched network

If a third point (C) was to be added to the network there were only two options:

1. Allow one node (A) of the original two to 'talk' to the new host while forcing the other node (B) to 'talk' only through the first. This required four phone lines as in Diagram 2:

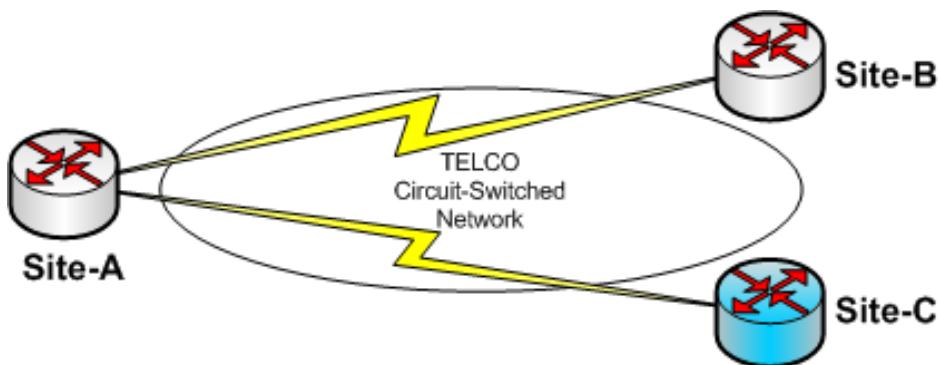


Diagram 2: 3 node circuit-switched network

2. Allow both original nodes (A, B) to talk directly to the new node (C). This required six phone lines as in Diagram 3:

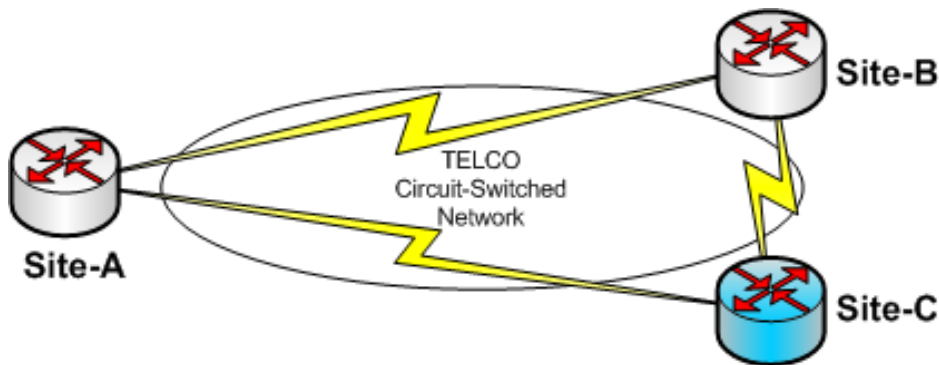


Diagram 3: 3 node circuit-switched network

Today, this limitation of circuit switched technology remains for all point-to-point connection methods.

### The packet-switched era

In 1976, X.25 was introduced to the world by the International Telecommunication Union. The X.25 system provided a means by which multiple nodes could be connected simultaneously to each other. This allowed for packet-switching which began to replace circuit-switching.

With X.25 packet-switched networks, all nodes in an organization's networks shared a common network identifier; and each node had its own unique identification number. Calls could either be on-demand or always up, referred to as Virtual Calls (VC) or Permanent Virtual Circuits (PVC) respectively. In our three node scenario, only three lines are required as in Diagram 4:

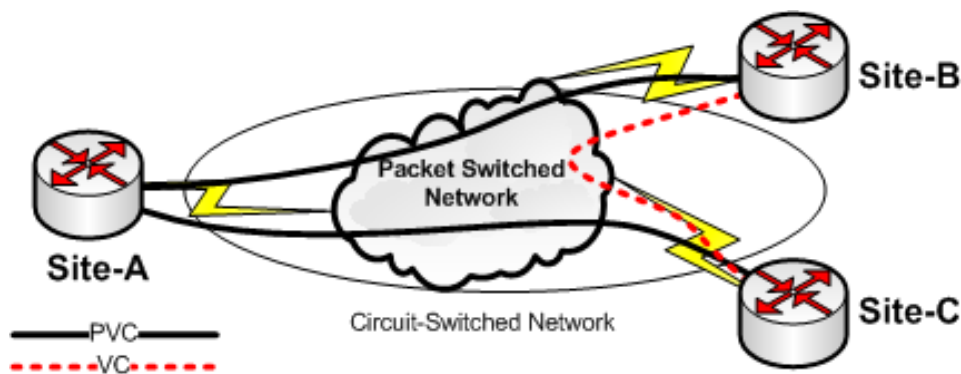


Diagram 4: 3 node packet-switched network

X.25 and its close relative Frame-Relay became popular throughout the 70s and 80s because it could be provisioned over standard phone connections or ISDN. Additionally, a single connection point at the one end could communicate to multiple nodes on the same network. Provisioning a network of this type required fewer connections to the telco.

With the introduction of high speed WAN connections, the ubiquity of IP based networks, and the reduction in per-port costs, X.25 and Frame-Relay have become relics of the past.

Bell Canada Enterprises has marked December 2009 as the end-of-life date for DataPac, their X.25 network.

Of course, copper is still in use in provisioning POTS lines, ADSL and ISDN lines. ADSL though cheaper than ISDN has drawbacks such as line length limitations and its asymmetric data transmission characteristics. The stability and symmetric nature of ISDN BRI and PRI coupled with the longer line length means that they haven't died off yet.

### The fiber era

Where does that leave us today and what can we expect to deploy tomorrow?

The other big news is in new types of cabling. On April 22, 1977 live telephone traffic was passed through fiber optics at 6 Mbps in Long Beach, California by General Telephone and Electronics. This began the exodus from copper to fiber optics. Today fiber optics supports speeds greater than 40 Gbps, and it will only get faster.

For organizations in major cities like Toronto, fiber optic connectivity is easy and relatively cheap. Fiber optics is ideal for extending the LAN by creating a CAN, MAN or a WAN

There are two options for the deployment of a fiber-based network, managed and unmanaged. These options differ based on the provider's involvement.

1. With unmanaged or dark-fiber the Telco or other provider splices cables to provide a continuous physical path from one point to another. This is sometimes feasible for smaller CAN and MAN deployments, but is typically cost prohibitive in a country wide WAN scenario. And the availability of dark-fiber is being reduced by providers since their recurring revenue earned through dark-fiber leasing is significantly lower than through the sale of managed services.
2. For MAN, and WAN environments, the managed service solution works well. Levels of management available depend on the provider and the underlying technology. The two predominant types of managed solutions rely on packet tagging. Telco providers such as Bell Canada Enterprises, MTS Allstream Inc, and Telus, favour MPLS. Others like Cogeco rely on pure Ethernet networks segmented at Layer-2 of the OSI Reference Model for network architecture. This segmentation technology is also known as VLAN tagging.

### MPLS vs. VLANs

The one advantage MPLS has over Layer-2 VLANs is its technology independence; it belongs to the family of packet-switched networks. The MPLS protocol wraps an additional layer around the data packet (or frame) which can be carried over a range of underlying technologies. The MPLS protocol doesn't care about what the original packet or frame contained. This means that MPLS can be run over Ethernet, SONET, FDDI, ATM, ISDN, or any other telco technology. Considering the wide range in age of telco gear, this adaptability is important to the telco. Legacy technology use can be extended until it truly runs out of life. This seeming strength of MPLS is also its major flaw as it does run over these diverse media; as a result, every time the media characteristics change, the packet has to be reprocessed, introducing latency into the traffic path, which can slow down the communication process.

Layer-2 VLANs tag each frame inside the Ethernet header. Layer-2 VLANs can be point-to-point or point-to-multipoint. This allows Layer-2 solutions to behave like either a circuit-switched or packet-switched technology. The diverse media advantage of MPLS is not a limitation for switched Layer-2 technology. It is a bonus. Without the need to rewrite packets into ATM cells or the serial signaling of ISDN, switched Layer-2 has a potentially lower latency and therefore greater overall throughput compared with MPLS. Without the burden of the legacy networks, the newer switched Layer-2 providers are not burdened with the expenses of maintaining legacy technology. This allows them to provide better pricing.

### Choosing your WAN technology today

Many of the WAN technologies mentioned here are carrier-grade. Selecting either MPLS or Layer-2 means the end user will receive Ethernet. The carrier-grade underpinning used by the provider isn't relevant. Whether your telco uses logical or mechanical switches to complete the call for you, what is important is that the call gets through. And that your data flows. With many companies migrating to VOIP, network latency (the time it takes to get the data from A to B) and packet loss are important and should be kept front of mind.

What should you look for in choosing a WAN provider? Price is usually the main factor, but don't stop there. You want long-term value not just initial cost savings. Factors to keep in mind include: customer service, quality and service-level agreements, access to global coverage, and management and monitoring capabilities.

One last word of advice; beware of provider grooming. Grooming is when the provider moves circuits running over multiple cable paths onto the same cable. When this is done they remove any redundancy benefits that resulted from the diverse path.

### Glossary of Terms

ADSL	Asymmetric Digital Subscriber Line		OSI	Open Systems Interconnection
ATM	Asynchronous Transfer Mode		POTS	Plan Old Telephone System
BRI	Basic Rate Interface (ISDN)		PRI	Primary Rate Interface (ISDN)
ADSL	Asymmetric Digital Subscriber Line		OSI	Open Systems Interconnection
CAN	Campus Area Network		PSTN	Public Switched Telephone Network
FDDI	Fiber Distributed Data Interface		PVC	Permanent Virtual Circuit (X.25 & Frame-Relay)
ICT	Information Communication Technology		ROI	Return On Investment
IP	Internet Protocol		SONET	Synchronous Optical Network(ing)
ISDN	Integrated Services Digital Network		VC	Virtual Circuit (X.25 & Frame-Relay)
LAN	Local Area Network		VLAN	Virtual LAN (Layer-2 Ethernet tagging technology)
MPLS	Multiprotocol Label Switching		VOIP	Voice Over IP
			WA	Wide Area Network

**About the Author**

Richard Danielli is the founder and President of eSubnet Enterprises. He has broad expertise in the fields of networking and data security. Based in Toronto, eSubnet provides superior customized solutions for networking and data security. Additional articles are available at <http://www.esubnet.com/fragment.html>.

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