



Position Paper

Behind the scenes of the first all-IP converged network for the Vancouver 2010 Olympic and Paralympic Winter Games

Authors: Simon Edgett, Bell Canada; Dean Frohwerk and Tony Rybczynski, Nortel

On February 12, 2010, the opening ceremonies will take place for the XXI Olympic Winter Games, and Vancouver will open its doors to 5,000 Olympic Games athletes and officials from over 80 countries. Over the next 17 days, 10,000 media representatives will deliver the Olympic Games across seven sports — including news, features and over 10,000 hours of dedicated coverage — to three billion television viewers in 160 countries, 20 times more viewers than for the U.S. Super Bowl. This will be followed 12 days later by 10 days of Paralympic Games events. Overall, over one million visitors are expected to participate in the unfolding drama on the slopes, racing ovals and skating rinks and celebrations of the medal ceremonies at the Games venues, while a small army of over 20,000 volunteers will be working to ensure smooth operations.

The mission of the Vancouver Organizing Committee for the 2010 Olympic and Paralympic Winter Games (VANOC) is “to touch the soul of the nation and inspire the world by creating and delivering an extraordinary Olympic and Paralympic experience with lasting legacies.” To help realize this mission, VANOC selected Bell Canada as its Telecommunications Provider to plan

and deliver an all-IP converged network. Bell Canada selected Nortel as its core network equipment supplier and to optionally assist in its deployment, through Nortel Global Services. In addition, VANOC also selected Nortel as its Converged Network Equipment Provider to deliver the converged LAN equipment within each Olympic venue. As a result of these two wins, Nortel equipment will form the end-to-end infrastructure for the 2010 Winter Games. This network must provide always-on, always-secure connectivity and voice services across the Games venues, spanning 120 kilometers, from greater Vancouver to the Canadian coastal mountain resort of Whistler.

Meeting “all eyes on Vancouver” expectations

An all-IP converged network architecture was proposed by Bell to VANOC as the foundation of its communications infrastructure. The two primary advantages of deploying an all-IP converged network for the Olympic and Paralympic Winter Games are lower costs and increased agility. Lower costs can be achieved by eliminating the need for multiple networks and enabling the centralization of telephony services, routing, security and management. Increased agility can be achieved by allowing anytime, anywhere connectivity over any device and by being highly adaptive to application traffic fluctuations.



Bell, with agreement from VANOC, also established five key requirements for the converged network infrastructure for the most important, most visible and most watched sporting event in the world:

- **Capacity:** The network spans 15 Games venues and numerous non-competitive sites (e.g., two data centers, two media centers, two athlete villages, two ceremonial sites, VANOC headquarters). It will support in excess of 10,000 voice over IP (VoIP) phones and up to 40,000 wired and wireless Ethernet ports on a 10-Gbps core network.
- **Reliability:** Carrier-class core network switches will include redundant power, common control and switching fabrics to guard against single points of failure. Competition sites on the Games network will also be designed to operate in a self-sustaining mode in case of a catastrophic failure (e.g., natural disaster simultaneously effecting redundant systems).



Services enabled by Bell's technology solution supported by Nortel equipment

Telecom services

- Feature-rich IP telephony
- Transparent LAN connectivity
- Wireless LAN services
- Internet access
- Security services

IT services

- Business services
- Administrative services
- Operational services

Games applications

- Instantaneous event results and tracking
- Accreditation and venue access-rights management
- Staff and volunteers management

Table 1. Services delivered and applications supported by the network

“I used to work in IT for a very large bank. The infrastructure that we’re building for the Games is roughly the same complexity and size as what we had deployed there. But what we’re doing here for the Games is like opening all the branches on the same day, with all the systems working. And it has to run perfectly. Customer transactions can’t go wrong, and we have to balance every night.”

— Andy Platten, Vice President of Technical Infrastructure, VANOC

- **Redundancy:** Redundant Ethernet switches deployed at each venue will support the entire capacity with sub-second failover in case of catastrophic failure of one of the switches. For the Sea to Sky network, protection at the Ethernet layer will also have the optional resiliency of the redundant optical core providing sub-50msec restoration.
- **Survivability:** Survivability will be provided through a physically diversified access and core network.
- **Security:** The entire networking infrastructure will provide secure logical partitioning across up to 20 classes of traffic [e.g., VANOC Games applications, VANOC IT services, Bell’s Telecom services (VoIP etc)].

Network architecture

To meet established requirements, a layered architectural approach has been adopted consisting of a carrier-grade core network, a highly robust venue network and dual data centers — all optimized for IP.

The end-to-end network is designed to support multiple levels of Quality of Service (QoS). The network will support high-priority, low-latency VoIP traffic and dedicated and best-effort data services. QoS levels are used to control traffic switching and queuing within the Ethernet and IP network. Voice traffic is the most sensitive to delay and jitter, followed by dedicated LAN, burstable LAN and Internet access traffic.

The following table is presented to illustrate how previous Games services were offered and how that differs from Bell’s proposed architecture:

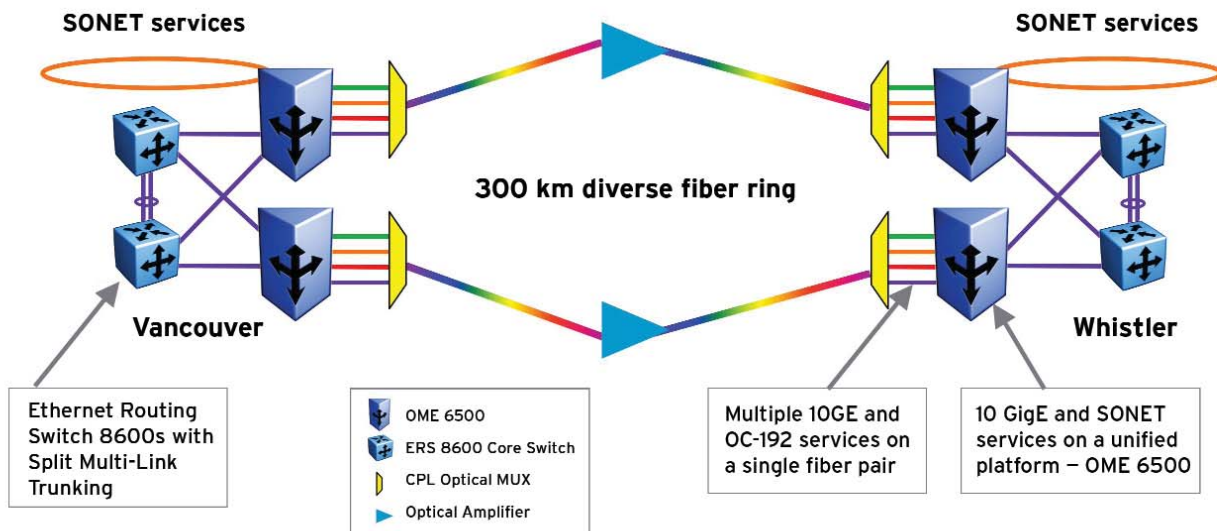


Figure 1. Optical Ethernet architecture — Connecting core sites with redundant, high bandwidth links
(Source: Bell Canada 2010 plan)

Table 2.

Functionality	Previous Olympics	Vancouver Olympics
Phone and fax	Analog lines connected through a PBX	IP telephony
Casual Internet access	Wi-Fi hot spots	Broad deployment of Wi-Fi and wired Ethernet
Dedicated Internet access	DSL, T1 or Ethernet	Ubiquitous 10/100/1000 BaseT Ethernet
Broadcast video	Fiber/coax	Fiber/coax

The core network

The core network provides Optical Ethernet interconnection across all venues and the data centers. The core network also provides connectivity for the majority of the telecom services offered, including voice, data, broadcast TV and other services. They are delivered logically over segregated networks for security and performance purposes and to prohibit intermingling of traffic.

The core network consists of regional hubs with fully redundant hub-and-spoke 10-Gbps links to over 20 venue points of presence (POPs). The regional hubs are connected to each other by a backbone OC-192/10-Gbps optical ring.

The long-haul optical network uses next-generation Synchronous Optical Network (SONET) and DWDM technology running on a 450 route-kilometer

dedicated fiber optic network. The foundation of this network is the Nortel Optical Multiservice Edge (OME) 6500 Multiservice Provisioning Platform (MSPP) for resilient, high-bandwidth transport.

Each regional hub consists of dual Nortel Ethernet Routing Switch (ERS) 8600s (in Vancouver and Whistler). The regional hubs are interconnected with 10 GigE connections across the optical Sea to Sky core ring. At each venue POP, dual Nortel Ethernet Routing Switch 8600s provide 10 GigE uplink Ethernet connectivity to the regional hubs. The uplinks between the venue and hub site use Nortel’s Split Multi-Link Trunk (SMLT) technology to achieve load-sharing and sub-second restoration from faults.

Each venue will also have a Nortel OME SONET node connected to a redundant SONET ring to provide traditional TDM services where applicable.

Venue architecture

The challenge at the venue sites is to provide wired and wireless Ethernet connectivity wherever it’s required. To provide this, dual fiber-fed wiring closets are built out with the 100m copper range close to the Ethernet users and to the Wi-Fi access points. These wiring-closet switches are protected using Nortel SMLT to the dual venue ERS switches.

The heart of the venue architecture is hundreds of Nortel Enterprise Routing Switch 5500s to converge communications at all locations and to deliver PoE over a mix of fast Ethernet and GigE copper circuits. Both individual switches and stacks are dual home-connected via SMLT to the venue POPs.

The VANOC diverse access network, supplied by Nortel, is used by Bell to deliver the in-venue network component of the IP services, including telephony, transparent LAN and Internet services.

The Wi-Fi network, consisting of hundreds of Wi-Fi access points supports Internet access services. It uses the IEEE 802.11g standard, providing 54 Mbps on each of three radio channels.

“With Nortel joining our team, we will provide a positive human experience through reliable, secure and mobile communications. We are delighted to welcome Nortel’s employees to our team and invite them to help us celebrate the true spirit and potential of our country.”

— John Furlong, VANOC CEO

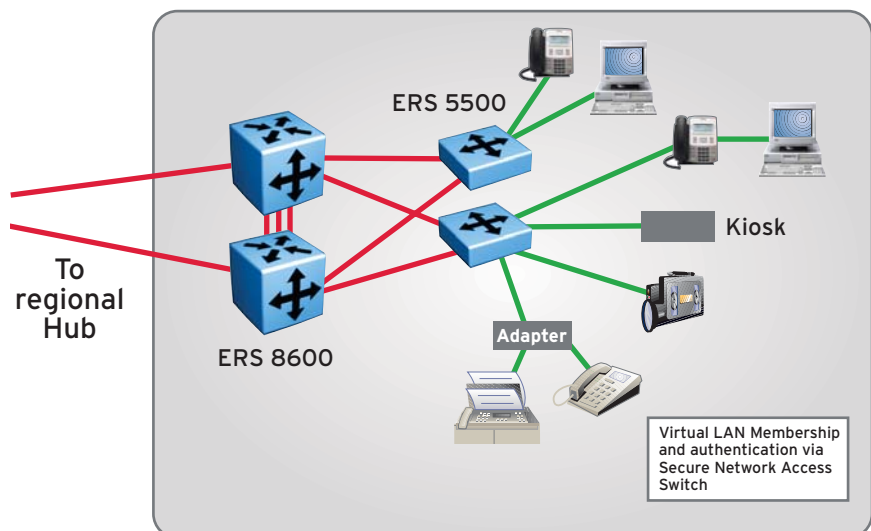


Figure 2. Venue architecture

Nortel's Wireless Security Switch (WSS) provides dynamic management of Wi-Fi radios, security and operational capabilities. A key advantage of this architecture is that the Nortel WSS can be located in the data center while managing the wireless LANs at all the Olympic competitive and non-competitive venues.

Data center architecture

The data centers in Vancouver are the focal points for running the Games and are the primary interconnection point (data POP) between the core and venue converged network and the Layer 3 IP services network — providing secure access to the Internet and the rest of the world.

The data POP provides termination of Layer 2 VLANs and interconnection to the appropriate infrastructure to support each service network. The venue POP is comprised of Bell's two Nortel Ethernet Routing Switch 8600s connected to Bell's Optical Ethernet core network. Dedicated Ethernet Routing Switch 8600s for

"Nortel is being trusted to supply the network infrastructure for the most important, most visible and most watched sporting event in the world."

— Mike Zafirovski
President and CEO, Nortel

Layer 3 routing will be deployed in a centralized routing model by Bell for VoIP and Internet networks and by VANOC for Games and administration networks.

Centralized Wi-Fi Wireless Security Switches located in the data center provide centralized authentication of users, dynamic radio channel and power management, and automated load balancing of wireless users across Wi-Fi access points provided by Bell at all venues.

Security is in the DNA of the Games network, and VANOC will make extensive use of Nortel's security portfolio. An example of this is Nortel Secure Network Access, which is designed to inspect, assess, ensure compliance to security policy and remediate connecting devices prior to granting network access. It will also be using this for dynamic VLAN provisioning as part of the flow-through provisioning model. Another example is Nortel's intrusion detection platform, which helps defend the network against hacks, attacks, worms and viruses.

This will also be the first Winter Games to exclusively use voice over IP for all event locations. IP telephony enables a high degree of centralization and will enable Bell Canada's Telecom Services flow-through provisioning model. The data center therefore also provides IP telephony across the Games venues with interworking with the public network. Bell Canada will accomplish this through the fully redundant Nortel Communica-

"We are working together closely to create a network for VANOC that delivers uncompromised performance, and simplicity, from the core infrastructure down to the individual user."

— Justin Webb, VP 2010 Olympic Services, Bell Canada

tion Server 2000, supporting over 10,000 Nortel IP phones, telephone services within and between the Games venues, and telephone connectivity to the PSTN for direct-dialed long distance or calling cards.

Conclusions

Bell Canada is delivering the first all-IP converged network at a Winter Games. In selecting partners, Bell Canada and VANOC were looking for a high degree of commitment and proven capabilities in designing and deploying some of the world's most reliable and robust converged communications networks. They found those characteristics with Nortel.

The Games are about excellence in performance. The Vancouver 2010 Winter Games will have the most technologically advanced network in the history of the Olympics and Paralympics.



For more information, visit Nortel on the Web at www.nortel.com.

For more information, contact your Nortel representative, or call 1-800-4 NORTEL or 1-800-466-7835 from anywhere in North America.

Nortel, the Nortel logo, Nortel Business Made Simple and the Globemark are trademarks of Nortel Networks. All other trademarks are the property of their owners.

Copyright © 2007 Nortel Networks. All rights reserved. Information in this document is subject to change without notice. Nortel assumes no responsibility for any errors that may appear in this document.



BUSINESS MADE SIMPLE