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Application Note

Metro Packet Optical Transport for Differentiated Triple Play Services

EXECUTIVE SUMMARY

Facilities-based providers and ISPs taking advantage of local loop unbundling recognize the strategic and economic value of bundling broadband video, voice, and Internet access services to home subscribers. Bundling Triple Play services reduces subscriber churn by lowering basic monthly expenses, simplifying customer service, and rendering it more disruptive for customers to switch to alternate providers. At the same time, Triple Play allows new cross-service application offerings that increase both provider revenue and the "stickiness" of the bundle.

However, bundling also raises the risk that, if any one service fails to meet expectations, consumers may choose to purchase all services elsewhere, despite the inconvenience. Growing and retaining the Triple Play customer base is desirable only if the service is profitable—a condition that requires a cost-effective and reliable metro aggregation and distribution network with guaranteed service quality and resource efficiency. Ciena's CN 4200® FlexSelect™ Advanced Services Platform Family provides service-aware Ethernet transport to enable a robust and economical Triple Play infrastructure.

CIENA'S SOLUTION FOR TRIPLE PLAY TRANSPORT

The CN 4200 addresses the key requirements of a Triple Play metro network by integrating connection-oriented Ethernet with Optical Transport Network (OTN) technology and a 40-wavelength Fixed or Reconfigurable Optical Add/Drop Multiplexer (F/ROADM). Triple Play network requirements include:

- Guaranteed Quality of Service (QoS)
- Service scalability
- Flexible and efficient bandwidth
- High availability
- Robust management

The CN 4200 is deployed at both the metro hub office—either the Telco Video Headend/Hub Office (VHE/VHO) or the cable MSO headend—and the end office—either the Telco Video Serving Office (VSO) or the cable MSO distribution hub. Both deployments provide service-aware transport between one or more Service Edge Routers (SER) and the broadband Access Nodes (ANs). At the VHE/VHO, the CN 4200 G10 module provides a Gigabit Ethernet (GbE) or 10GbE connection to the SER, offering comprehensive Layer 2 Ethernet switching for non-blocking exchange of packets with other G10 and OTN transport modules.

Based on the address of the destination access node, the G10 module switches traffic from the SER to the appropriate connection-oriented Ethernet transport tunnel. All Ethernet tunnels destined for a particular VSO are multiplexed into a "right-sized" Nx155 Mb/s OTN container also known as an Optical Payload

BENEFITS

- Provides cost-effective integrated packet-optical transport
- Leverages connection-oriented Ethernet to simplify the IP/Ethernet service architecture
- Guarantees QoS
- Features flexible, efficient bandwidth management including L1/2 multicast
- Provides high availability through dual-homing and multi-layer protection

Virtual Channel (OPVC). Several such OPVCs are multiplexed into a channelized OTU-1 (2.7 Gb/s) or OTU-2 (10.7 Gb/s) wavelength, which is further multiplexed with other wavelengths by the OADM function. However, if there is sufficient traffic to a particular location, an unchannelized 10GbE/OTU-2 may be dedicated to that site. The correct wavelengths and OPVCs are dropped off at the appropriate VSO, and then each Ethernet tunnel is switched to the appropriate GbE port connected to the corresponding access node, as shown in Figure 1.

All unicast traffic—such as Voice-over-Internet Protocol (VoIP), Video On Demand (VOD), or Internet access—is handled in this manner. Broadcast video traffic may be switched into its own OPVC at the VHE/VHO and delivered to every VSO efficiently with Layer 1 multicast. Specifically, a designated OPVC is sent once, and then dropped-and-continued at every CN 4200 node. At the CN 4200, each individual broadcast video stream may be multicast to the appropriate GbE ports connected to the access nodes, based on Internet Group Management Protocol (IGMP) snooping* to be added in a future release.

ENSURING QUALITY OF SERVICE

The CN 4200 ensures QoS by using connection-oriented Ethernet Virtual Connections (EVCs). These connections make Ethernet transport deterministic by replacing the unpredictable and potentially unstable mechanisms of traditional 802.1D/Q connectionless Ethernet—such as spanning tree, Media Access Control (MAC) learning, and broadcast of unknown packets—with explicit provisioning of the forwarding information database and primary/backup paths. The CN 4200 supports up to 16,000 EVCs per module, with hierarchical traffic policing for flexible application of committed and excess information-rate and burst-size (CIR/EIR, CBS/EBS) profiles. This capability (see Figure 2) allows the operator to guarantee transport bandwidth from one or more SERs, per:

- Access node
- Service, per access node
- Customer, per access node
- Service, per customer, per access node

Class-based queuing using 802.1p bits or IP DiffServ Code Point (DSCP), Drop Eligible Indicator (DEI)-marking and color awareness ensure appropriate traffic management across the network. Two strict priority queues and six weighted fair queues per EVC ensure constrained latency and jitter for video and VoIP traffic, regardless of the magnitude of bursty data traffic. Determination of the appropriate mechanisms depends upon AN and SER capabilities, and the admission control policies of the Session and Resource Management systems (SRMs).

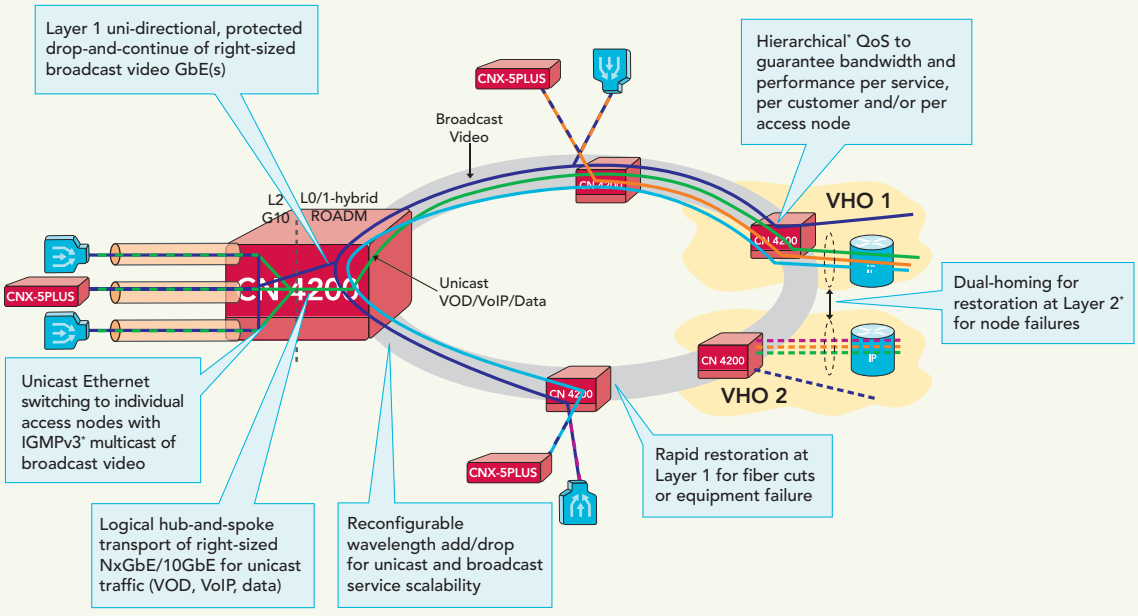

Figure 1. Minimize cost, maximize performance for IP-based service delivery

*Denotes capability to be added in future release

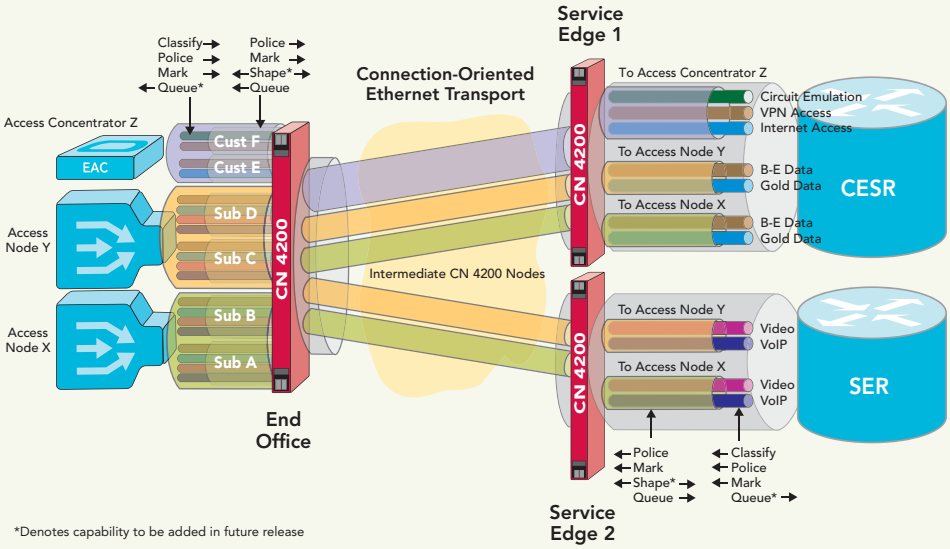

Figure 2. Hierarchical QoS provides flexible guaranteed bandwidth

ENSURING HIGH AVAILABILITY

The CN 4200 possesses several mechanisms to ensure high availability. To protect against module or port failure, including port failure on the attached access node or SER, the CN 4200 will add future support for link aggregation of up to eight ports across modules.* If a port/module fails, the traffic will be redistributed among the remaining in-service ports. To protect against trunk or facility failure, or the failure of a transit node, the CN 4200 supports 1+1 protection of the OPVCs—including the broadcast video drop-and-continue OPVC—transported between the VHE/VHO and VSO with rapid restoration. To protect against CN 4200 or SER node failure, the solution supports dual-homing of access nodes to two different, potentially geographically distributed, "headend" CN 4200 nodes on a per-service basis.

To detect hard failures or soft degradation quickly, the CN 4200 leverages the OTN transport layer and/or the circuit-like nature of connection-oriented Ethernet tunnels, with future support for Y.1731 Operations, Administration and Maintenance (OAM) to trigger a tunnel protection switch using G.8031 techniques.* Together, these capabilities provide real-time SONET/SDH-like performance monitoring, with threshold-crossing alerts and actions, to restore connectivity rapidly after failures. In addition, historical Performance Monitoring (PM) data allow the operator to plan capacity proactively to avoid any adverse impact on service availability due to a lack of resources.

SUMMARY

By integrating Ethernet switching with programmable optical transport, the CN 4200 minimizes the capital and operational expense of robust Triple Play aggregation and distribution. The CN 4200 eliminates the need to deploy a standalone Carrier Ethernet Switch/Router at the VSO; maximizes the utilization of expensive SER resources at the VHE/VHO; and optimizes the performance, flexibility, and efficiency of service-aware transport across the metro network. Together, these capabilities improve customer satisfaction and service profitability.

* Denotes that the feature is not currently generally available.
Please speak with your Ciena Sales representative for more information.

ciena®

1201 Winterson Road
Linthicum, MD 21090
p: 1.800.207.3714 (US)
p: 1.410.865.8671 (outside US)
p: +353.1.2436711 (international)
www.ciena.com

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