Delivering Business Services over Cable

Capitalizing on Exponential Growth Opportunities In the SMB Marketplace

Executive Summary

Cable operators trying to deliver services to the business market have faced significant challenges due to design limitations of cable modem termination systems (CMTS). The Juniper Networks G-series CMTS has conquered these challenges, enabling cable operators to leverage their existing infrastructure to deliver a rich portfolio of services to the small and medium business (SMB) market.

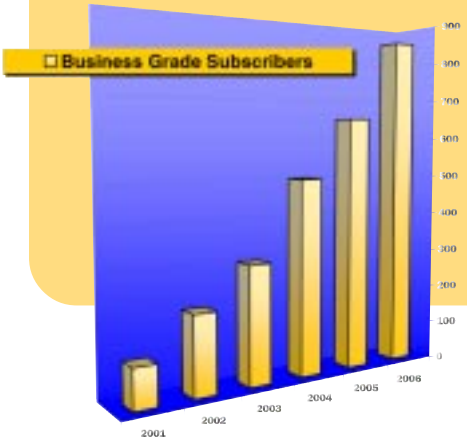
Cable operators offering data services to the SMB market can now benefit from the Juniper Networks Model for Integrated Network Transformation (MINT), a new approach designed to enhance service provider profitability. The Juniper Networks Cable Solution is a MINT-aligned strategy that can help cable operators successfully enter the SMB marketplace by offering business-critical, high-value, differentiated services.

Introduction

Small and medium businesses, including small-office and home-office (SOHO) users, are realizing that efficient communications services are critical in today's competitive marketplace. SMB customers understand they need the same services that are typically delivered to large enterprises, including Internet access, site-to-site LAN connectivity, data hosting, remote storage, and other services.

However, this SMB customer segment has been tremendously underserved while the incumbent service providers focused on large enterprises. In fact, according to CIMI group, there are approximately 6 to 8 billion dollars in potential SMB data revenues that go untapped on an annual basis. Additionally, according to the Yankee Group, 10% of the SMB market for data and voice communications services is currently being served by cable operators in North America. The business services over cable subscriber base should grow over 13% annually for the next five years.

The Opportunity



The Challenges

- Lack of Guarantees and SLAs
- Limited Upstream Bandwidth
- Network Security
- Service and Subscriber Provisioning
- Legacy Billing and Operations Support Systems
- Layer 2 Protocol Support

Juniper NETWORKS

Model for Integrated Network Transformation (MINT)

The MINT strategy delivers a new viewpoint for increasing service provider profitability. By changing the focus from commoditized, flat-rate data transport, cable operators can transform their existing networks into a high-speed converged IP/MPLS infrastructure capable of delivering value-added services. Service providers have traditionally focused on Level 1 of the MINT strategy, bit transport and connectivity. However, discounted pricing on bandwidth delivery is no longer enough to deliver the competitive edge.

MINT delivers a four-level approach to delivering enhanced services and improving profitability:

1. Bit Transport and Connectivity
2. Resource Segmentation
3. Packet Processing
4. Policy and Control

By addressing each of these key areas, MINT provides a roadmap to creating differentiated service offerings that provide a better end-to-end user experience and decreased customer churn.

Level 1: Bit Transport and Connectivity. The key enhancement provided by MINT at Level 1 is the introduction of the Broadband Cable Processor ASIC, a custom chip designed for the G-series CMTS. This customized ASIC provides support for the 16 QAM protocol, offering 10 Mbps of upstream throughput on a single channel. With 4 downstream channels and 16 upstream channels, the G-series CMTS can support up to 160 Mbps of symmetrical bandwidth, breaking the throughput bottleneck that has restricted delivery of business-class services over cable.

Level 2: Resource Segmentation. The predominant Level 2 MINT benefit is support for per-customer Layer 2 virtual local area networks (VLANs) with 802.1Q tagging. This approach provides secure, private data transmission for multiple clients from a single network infrastructure, enabling cable operators to provide these key services on a cost-effective basis. Service level agreements are easily implemented for individual clients because all of their traffic, both IP and non-IP, is funneled onto the same VLAN.

Level 3: Packet Processing. Security is a critical concern, and Level 3 of the MINT solution focuses on network security through enhanced packet processing techniques such as end-to-end classification, filtering, and encryption. The G-series CMTS also supports Broadband Privacy Interface Plus (BPI+), a robust encryption algorithm specified by DOCSIS which protects data traversing the HFC plant.

Level 4: Policy and Control. High-value services are ensured by Level 4 of the MINT solution, which focuses on delivering traffic prioritization to latency-sensitive applications. Tapping into the high-revenue, high-value business market demands more than best-effort data delivery. Instead, providers need to be able to provision and verify service level agreements, ensure that Quality of Service (QoS) levels are met, and generate accurate bills for premium services.

The expanding SMB marketplace presents an enormous growth opportunity for cable operators. With the Juniper Networks Cable Solution, cable operators can now leverage their existing HFC infrastructure to penetrate this market, dramatically increasing profitability by tapping into the premium prices that can be charged for providing high-end services to business customers.

Innovative new solutions from Juniper Networks have opened the door for cable operators to increase their presence in the high-revenue business services marketplace. These solutions include Juniper Networks G-series CMTS and the industry leading E-series, M-series, and T-series routing platforms. Alignment with the MINT framework gives cable operators a cost-effective strategy for increasing revenues by delivering a wide range of compelling broadband services.

Meeting SMB requirements with the Juniper Networks Cable Solution

In order to successfully serve the SMB marketplace, cable operators need to deploy a network infrastructure that is capable of meeting customer requirements. Until now, DOCSIS-based CMTS offerings have been focused on consumer applications, preventing cable operators from capitalizing on the SMB market via their existing HFC cable plant. Furthermore, with most

vendors providing CMTS-only solutions, operators have not been able to deploy end-to-end business services, such as a secure LAN interconnect across a routed IP/MPLS infrastructure.

The Juniper Networks product portfolio, including the G-series CMTS and the E-series, M-series, and T-series routers, have been designed to support service delivery to both business and residential customers with a single network infrastructure. Leveraging this capability to layer services across a consolidated infrastructure is a key element of the Juniper Networks MINT framework for increased profitability.

The Juniper Networks Cable Solution is designed to meet the following key business requirements:

- Symmetrical bandwidth. While asymmetrical service offering fast downloads and limited-speed uploads makes sense for consumers, businesses need symmetrical service with high-bandwidth upload capabilities. The enhanced RF performance offered by the G-series CMTS supports 160 Mbps downstream and 160 Mbps upstream on each DOCSIS module. Up to 10 Mbps of symmetrical throughput can be delivered to a single DOCSIS 1.0 or 1.1 modem, providing more bandwidth than four T1 or E1 leased lines at a fraction of the cost. With a DOCSIS 2.0 modem, up to 30 Mbps of symmetrical bandwidth can be delivered.
- Layer 2 Multiprotocol Support. Many businesses run non-IP protocols on their networks, such as IPX, SNA, NetBUI, NetBIOS, and AppleTalk. The Juniper Networks G-series CMTS provides Layer 2 forwarding capabilities to support the transport of these non-IP protocols. Multiprotocol support is a key service provider differentiator, enabling cable operators to enter previously closed markets. In addition, each customer's traffic can be forwarded via separate Layer 2 802.1Q VLANs and mapped into Layer 2 MPLS-based VPNs for routing across an IP core network. Only the Juniper Networks G-series CMTS supports Layer 2 traffic forwarding with 802.1Q VLANs. Juniper Networks also leads the industry with MPLS solutions for VPN transport over IP.
- Dynamic Channel and Bandwidth Allocation. Businesses expect services to be provisioned quickly once their order is placed, and Juniper Networks makes this expectation a reality. Only the G-series CMTS has the capability to dynamically create and assign a full 10 Mbps upstream channel to any physical upstream port via simple CLI commands. This enables a full or fractional channel to be quickly provisioned without the need for physical recombining of head-end cabling.
- Network Security. End-to-end network security is essential for serving business customers. Security for multiple business customers is implemented through seamless integration of BPI+ and VLANs at the network edge with VPNs at the network core. This approach provides secure site-to-site interconnects for multiple customers from a single, cost-effective network infrastructure. Per-customer and per-VLAN classification, source address verification, and line-rate filtering can be used to automatically eliminate denial of service (DoS) attacks and other security threats. Requiring user logins to prevent unauthorized network access creates an additional layer of security to the network.
- Layered Services. Traffic can be prioritized on a per-flow basis to deliver multiple revenue-generating services to each business customer, including VoIP, remote storage, dynamic bandwidth, and more. Per-flow and per-VLAN packet processing and policy-based control extend QoS capabilities across the network. Layered services provide complete separation for each customer, protecting the integrity and reliability of their user experience. This allows new services for business subscribers to be deployed without negative impacts on existing services being delivered to residential subscribers.
- High Dependability. Industry-leading active noise cancellation and powerful RF performance capabilities enable the G-series CMTS to deliver assured user experiences even in the most demanding cable plants. Automatic hardware failover allows the G10 CMTS to provide N:1 DOCSIS module redundancy.
- End-to-end solution. Juniper Networks provides business customers with a high-bandwidth, symmetrical cable solution based on the G-series CMTS as the access device, supported by the high-performance E-series, M-series, and T-series edge and core routers. By leveraging this powerful and flexible network architecture, highly desirable business cable services can be delivered to customers based in single metro environment, or spread across multiple metro areas.

Breaking the Upstream Bottleneck To Deliver Symmetrical Bandwidth

Until now, CMTS platforms have had limited upstream bandwidth, preventing cable operators from offering business-class broadband services. These systems use third-party CMTS chips that are not optimized to deal with noise and interference typically encountered in the upstream spectrum of the cable plant. As a result, competing CMTS products can often only support QPSK modulation in 1.6 MHz channels, which results in an unimpressive 2.5 Mbps of upstream throughput on a single channel to DOCSIS 1.0 and 1.1 modems.

The Juniper Networks G-Series CMTS is available in two form factors:

- G1 CMTS is a compact unit designed for small- to medium-size cable systems servicing fewer than 10,000 subscribers. Occupying only a single rack-mount unit, the device provides support for two downstream channels and eight upstream channels, and can be deployed into DOCSIS and EuroDOCSIS environments.
- G10 CMTS is a chassis-based platform that can support medium-to-large cable modem deployments. The flexible, modular system supports redundancy options that provide total availability, and can be expanded to support up to 32 downstream and 128 upstream channels. Designed for deployment into DOCSIS and EuroDOCSIS environments, the G10 is ideal for large metro hubs and headends.

To handle this challenge, Juniper Networks developed the Broadband Cable Processor ASIC exclusively for the G-Series Cable Modem Termination Systems (CMTS). Focused on enhancing the first layer of the MINT framework, bit transport and connectivity, this customized ASIC enables the G-Series CMTS to support the advanced 16 quadrature amplitude modulation (16 QAM) protocol over 3.2 MHz channels, resulting in 10 Mbps of upstream throughput on a single channel.

This performance increase can be realized over upstream return path channels at signal-to-noise ratios of as little as 18 dB. With four downstream channels and 16 upstream channels, each G10 DOCSIS module is capable of supporting an astounding 160 Mbps of symmetrical bandwidth. When fully configured, the G10 CMTS delivers 1.2 Gbps of symmetrical bandwidth capacity.

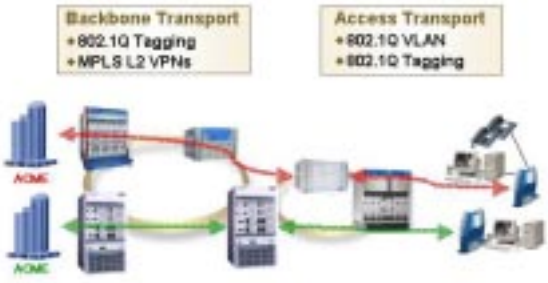
Leveraging symmetrical bandwidth into increased service provider profitability

For the first time, symmetrical broadband services can be provided in a cost-effective, standards-based manner over the existing cable infrastructure, using certified and tested DOCSIS 1.x modems. As a result of this technological advance, vast areas of the network that were unsuited for business-class broadband can now be capitalized upon, opening profitable new markets for cable providers.

For customers who require even higher levels of data throughput, the G-series CMTS provides a smooth migration path to DOCSIS 2.0. Only the Juniper Networks Cable Solution has the ability to enhance the performance of all DOCSIS 1.0 and 1.1 modems, while simultaneously providing an upgrade path to support high-bandwidth DOCSIS 2.0 modems.

End-to-End Support for Non-IP Layer 2 Traffic

Juniper Networks G-series CMTS provides support for non-IP protocols via Layer 2 forwarding. Competing DOCSIS CMTS products that only support IP forwarding block all non-IP traffic. This presents a problem for potential business customers that have non-IP traffic on their network, such as government and municipal entities, research and education customers, healthcare organizations, financial institutions, insurance companies, and other entities that require support for non-IP protocols. Many of these companies rely on IBM-based systems which use the SNA protocol. In addition, small- and medium-size businesses frequently use other protocols such as Novell IPX, NetBUI, NetBIOS, and AppleTalk to access servers and other resources within their networks.



The Juniper Networks Cable Solution leverages the second level of the MINT framework to segment the network in order to keep customer traffic private. Traffic is separated on a per-customer basis by setting up independent Layer 2 VLANs with 802.1Q tagging. VLANs are ideal for providing high levels of security, and service level agreements are easily implemented on a per-client basis because all traffic, both IP and non-IP, can be funneled onto the same VLAN. Only Juniper Networks G-series CMTS deliver 802.1Q VLAN support.

As switched VLAN traffic leaves the customer's DOCSIS cable modems, it is aggregated by the Juniper Networks G-series CMTS and forwarded to Juniper Networks E-series or M-series edge routers. All Juniper Networks routers are capable of mapping 802.1Q VLAN-tagged packets into Layer 2 MPLS VPNs. Juniper Networks supports MPLS Layer 2 VPNs based on draft Kompella or draft Martini, VPLS domains for multipoint-to-multipoint inter-metro connectivity, and L2TP tunneling. These mechanisms allow cable operators to leverage a single infrastructure for multiple customers and services, maximizing revenues and minimizing operational costs.

Creating Competitive Advantages Through Dynamic, Flexible Channel and Bandwidth Allocation

The G-series CMTS delivers important competitive advantages to service providers who adopt the Juniper Networks Cable Solution, including dynamic channel allocation. The unique DOCSIS PHY capabilities enable the cable operator to quickly provision an additional full 10 Mbps upstream channel to any physical upstream port on the G-series CMTS. For example, if an order is placed for a 3 x T1 service that would have oversubscribed an existing upstream channel, the cable operator can quickly meet bandwidth demands by allocating an additional upstream channel to that node via simple CLI commands.

Group delay equalization techniques enable the use of spectrum in the upper band from 38 to 42 MHz for DOCSIS networks (60 to 65 MHz for EuroDOCSIS), and in the lower band from 5 to 15 MHz. The G-series CMTS can accommodate group delay variation of up 500 ns in a 3.2 MHz bandwidth, enabling a 3.2 MHz, 16 QAM channel to run at center frequency of either 6.6 MHz or 40.4 MHz. This enables cable operators to dynamically turn up new channels and deliver services over frequencies where competing CMTS products are unable to operate.

Increasing Network Reliability with ServiceGuard Management System

ServiceGuard Management System enhances network reliability and resiliency by providing continuous monitoring of the entire return path on all upstream ports, an industry first.

Return path issues are frequently the cause of service interruptions, and until now have been difficult and costly to monitor and troubleshoot. ServiceGuard delivers an easy-to-navigate, Java-based tool that does not require additional hardware or cabling into headends. The software displays real-time noise measurement under the active upstream carrier signals, and provides a full range of advanced diagnostic capabilities.

Management personnel can run the application from anywhere on the network, either from their desktop PC or a laptop, dramatically increasing efficiency by eliminating the need to visit the headend of the suspect return path.

This key capability means that services can be quickly provisioned without causing downtime for existing customers. By eliminating downtime caused by recombining physical links, an unacceptable characteristic typical of other systems, available bandwidth can be efficiently redistributed without causing service disruptions. Dynamic and flexible bandwidth allocation also allows cable operators to quickly provision additional throughput, delivering the capability to market bandwidth-on-demand services as well as rapid SLA upgrades. By removing the provisioning bottleneck, cable operators can realize a key competitive advantage over incumbent service providers.

Network Security Features

With the growing threat of DoS attacks and the ever-present need to protect sensitive data, security is a critical concern for business customers and service providers alike. To address this issue, the Juniper Networks Cable Solution aligns with the third level of the MINT framework, providing secure packet processing with uncompromising performance for end-to-end classification, filtering, and encryption. The G-series CMTS also supports Broadband Privacy Interface Plus (BPI+), a robust encryption algorithm specified by DOCSIS which protects data traversing the HFC plant. The E-series, G-series, M-series, and T-series routers provide an additional layer of security through the use of extensive filter lists, which can be implemented without degrading overall forwarding performance. When combined with source address verification and the ability to rate-limit SYN packets, DoS attacks can be mitigated.

Juniper Networks E-series, M-series, and T-series routing platforms support IPsec traffic encryption to further ensure network security. In addition, user authentication can be extended on a per-subscriber basis for cable commuters and SOHO users when the E-series platform is deployed.

Authorized logins are achieved in three ways:

- Upon starting their computers, clients are issued a dynamic IP address that brings them to a generic login page. If the challenge is not answered within a short, specified period of time, access is automatically denied.
- Clients can also login via a secure Web page generated by the Juniper Networks SDX-300 Service Deployment System.
- A VPN client that supports either PPPoE or L2TP can be loaded onto the user's PC or laptop, which is then used to support a secure login process and tunnel into the network.

The RADIUS AAA authentication server can either be maintained at the customer's premises or in the cable operator's network. RADIUS is a well-known and widely deployed solution, enabling cable operators to easily deploy and manage the AAA servers. Once the user's identity has been authenticated, an appropriately provisioned IP address is issued dynamically to provide authorized access to the network.

Security is tightened by providing customers with the option of having complete control of the authentication lists, which can easily be updated as personnel and access privileges change. The cable operator is freed from the responsibility of handling authentication updates, and in turn the customer is not granted management access to any of the devices within the cable operator's network infrastructure.

Solutions offered by third-party vendors require the purchase of separate platforms to implement the RADIUS authentication server, which adds additional hardware costs as well as management complexity to the network. These additional expenses are eliminated by using the Juniper Networks E-series edge router to perform IP routing, handle VLAN/VPN termination, and act as the authentication gateway. In addition, Juniper Networks is the only vendor that offers Web-based authentication and authorization with dynamic IP address generation via DHCP.

Business-Critical Reliability

In today's competitive environment, the success or failure of a business can depend on the reliability of their network. Many businesses are willing to pay premium prices to ensure mission-critical service, thus opening opportunities for cable providers to generate additional revenues. Until now, cable service has been challenged by downtime caused by disconnects resulting from RF impairments in the cable plant.

The Juniper Networks G-series CMTS is designed to overcome this challenge by providing industry-leading active noise cancellation and superior RF performance. In recent tests, the G-series CMTS was able to operate reliably at a Carrier-to-Interference (C/I) ratio of 3 dB, compared with competing CMTS platforms that experienced failure at signal levels below 29 dB. This key capability to deliver reliable operation at one tenth the signal strength enables cable operators to use their existing HFC plant to extend business-class service into previously untapped markets. The G-series CMTS extends the market reach of the cable operator by providing an assured user experience all the way to the cable modem, even in the most demanding cable plants.

In addition, the G-series CMTS can be configured with optional RF switch cards that support hardware-based automatic failover. This enables N:1 DOCSIS module failover to be activated via a simple software upgrade.

The Juniper Networks E-series, M-series, and T-series routers are mission-critical platforms that have been proven in the

world's largest and most demanding environments. All three platforms leverage the modular JUNOS operating system, which extends consistent performance across the network. Easy to activate and bring online, the Juniper Networks routing platforms are world-renowned for stability and ease of use. This is in stark contrast to competitive offerings which use a monolithic code base with multiple release trains that must be managed on a complex combination of platforms and interface modules, with varying feature sets that interfere with consistent SLA delivery.

Layering a Broad Range of Value-Added Services

Finally, by leveraging all four layers of the MINT framework, a wide array of value-added services can now be offered to customers for revenue generation. By moving away from the flat-rate, commoditized price structure to a differentiated offering based on profitable, high-value services, customer loyalty and retention are increased.

Enhanced service offerings include:

- Internet Access - SMBs can be offered high-speed symmetrical Internet access to support Web site access and e-commerce.
- Metro Interconnect - Cable operators can leverage the end-to-end capabilities of the Juniper Networks solution to enable point-to-point connections or multipoint-to-multipoint connections on both an intra- and inter-metro basis.
- Extranet - Business partners can achieve secure access to a SMBs' extranet by tying into the customer site via a separate VLAN.
- Disaster Recovery - The ability to flexibly and dynamically allocate channels and quickly provision bandwidth now allows cable operators to support remote storage solutions. High-bandwidth, best-effort prioritization can be provided (10 Mbps) for initial systems backup, and then reduced to more cost-effective 1.5 Mbps throughput for daily backups. If a system restoration is required, bandwidth can be returned to 10 Mbps and traffic can be placed into a high-priority queue.
- Content Hosting - Cable operators can provide different classes of traffic prioritization based on the application needs. For example, voice and video content can be given high priority to ensure low latency and guaranteed throughput.
- QoS Support - Stable, high-bandwidth connections and extensive QoS capabilities enable cable providers to offer reliable delivery of latency-sensitive applications, such as VoIP and multicast streaming media.

By delivering key services that are specifically targeted at the SMB market, cable operators can develop solid, value-added relationships that are far less vulnerable to customer churn. Unlike customers who merely subscribe to a "best effort" ISP, customers who have a relationship based on the delivery of enhanced services are far less likely to change providers. Even if the pricing structure is slightly higher, the value added by supplying differentiated services increases both customer retention and overall profitability.

Opening New Markets With the Juniper Networks Cable Solution

By aligning with the MINT framework, the Juniper Networks Cable Solution can help cable operators transform their existing IP transport networks into a high-margin service delivery system. This network transformation is opening the untapped SMB market to development, delivering a significant opportunity for cable operators to substantially increase revenues through a relatively modest network upgrade.

By deploying the Juniper Networks Cable Solution, cable operators can deliver services that are targeted at the SMB market, including symmetrical bandwidth, support of non-IP protocols, end-to-end security, and the ability to layer multiple services for maximum revenue generation. By supporting these differentiated services from a single, resilient network, cable operators can provide business customers with an assured user experience while simultaneously containing their costs and maximizing return on investment.

www.juniper.net

CORPORATE HEADQUARTERS AND SALES HEADQUARTERS FOR NORTH AND SOUTH AMERICA
Juniper Networks, Inc.
1194 North Mathilda Avenue
Sunnyvale, CA 94089 USA
Phone: 888-JUNIPER (888-586-4737)
or 408-745-2000
Fax: 408-745-2100

EAST COAST OFFICE
Juniper Networks, Inc.
10 Technology Park Drive
Westford, Massachusetts
01886-3146 USA
Phone: 978-589-5800
Fax: 978-589-0800

ASIA PACIFIC REGIONAL SALES HEADQUARTERS
Juniper Networks (Hong Kong) Ltd.
Suite 1601-06, Natwest Tower
Times Square, 1 Matheson Street
Causeway Bay, Hong Kong
Phone: 852-2332-3636
Fax: 852-2574-7803

EUROPE, MIDDLE EAST, AFRICA REGIONAL SALES HEADQUARTERS
Juniper Networks (UK) Limited
Juniper House
Guildford Road
Leatherhead
Surrey, KT22 9JH, U.K.
Phone: 44(0)-1372-385500
Fax: 44(0)-1372-385501

Part Number 351026-001 Apr 2003