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MOTOROLA

A Path to Ultra Broadband

Motorola Cable PON

WHITE PAPER

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The Path to Cable PON

Cable operators are increasingly competing with telecommunications carriers, and the winners in the long-term will be those service providers that build the infrastructure capacity to deliver Ultra-Broadband services. Commonly defined as greater than 50 Mbps symmetrical throughput, Ultra-Broadband solutions such as Fiber-to-the-Premises (FTTP) for the home, business, or Multi-Dwelling Units (MDUs) can easily service today's broadband needs and gracefully scale to Ultra-Broadband access networks that support hundreds of megabits of symmetrical throughput to each subscriber.

While carriers are building out their fiber infrastructure to support higher-speed services, cable operators wrestle with the challenge of balancing the need to optimize the return on existing investments in HFC networks and applications with the need to deliver ever-increasing bandwidth requirements. As this balance is achieved, it will also be important to consider the ease in which new FTTP architectures could be incorporated into your existing network-facing Operational Support System (OSS) and Backoffice Support System (BSS) environments and how you can accomplish seamless delivery of services over combined Hybrid Fiber Coax (HFC) and Passive Optical Networking (PON) network architectures.

Motorola offers the products and services that provide cable operators the ability to deploy fiber deeper into the network and deliver higher-speed services. This white paper provides an overview of our approach to FTTP solutions for cable operators. To learn more details on our strategy, please contact your Motorola representative.

The Motorola Difference

Motorola uniquely offers HFC, DOCSIS®, and PON solutions that allow service providers to deliver flexible and scalable broadband residential and commercial services. Most cable operators today deliver services over coax, but Cable PON offers tremendous opportunities to support Ultra-Broadband services and successfully compete with incumbent carriers. Motorola does not suggest a strict migrate-now-to-PON strategy, but rather provides a range of solid alternatives that allows cable operators to select the optimum technologies for meeting the capacity requirements of tomorrow's Ultra-Broadband services.

Regardless of the type of access network or networks an operator selects, Motorola supports the growing demand for increased bandwidth to the video-centric connected home and the increasingly bandwidth-consuming commercial subscriber. Motorola offers:

- Seamless evolution to 1 GHz service delivery to increase the capacity of existing RF infrastructure.
- Fiber deep deployment solutions for HFC networks.
- Direct optical access via Gigabit PON (GPON) FTTP solutions.
- DOCSIS and EuroDOCSIS 3.0 Channel Bonding that provides downstream throughput of over 145 Mbps and 200 Mbps respectively.
- MPEG 4 and switched digital solutions.
- Switched Digital Video (SDV) solutions that allow operators to more efficiently utilize bandwidth and deliver highly targeted content to subscribers.
- Solutions for reclaiming bandwidth allocated to the current analog programming tier by transitioning subscribers to the digital tier.

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Cable PON is an additional powerful solution that allows MSOs to cost-effectively increase capacity, more effectively compete with incumbent providers and deliver Ultra-Broadband services that reduce churn and more closely bind subscribers to the network. As you evaluate architectural solutions to address business concerns, customer demands, and economic opportunities, Motorola will continue to offer a range of HFC and Cable PON solutions that can help you evolve your network and compete effectively in the market for Ultra-Broadband services.

Key Considerations for Cable PON

The following are some of the relevant top of mind concerns that we have found after discussions with many cable operators.

Service Capacity Demands Will Continue to Increase

In our many discussions with cable operators, we have yet to find one who believes that subscribers will want less bandwidth in the future. The trends driving the shift toward Ultra-Broadband services are inexorable. Cable operators need to deploy cost-effective, high-bandwidth solutions that co-exist with existing HFC solutions and support the rapid deployment of competitively differentiated services to subscribers.

Cable Operators Need to Continue to Leverage Existing Infrastructure

As operators manage the natural evolution to more bandwidth they need to fully leverage existing HFC infrastructure. This includes maintaining solutions at the headend/hub and leveraging existing investments in CMTS platforms, softswitches, Digital Addressable Controllers (DACs), etc. It also means leveraging deployed cable modems, eMTAs, and set-tops at subscriber locations and continuing to derive maximum value from deployed BSS/OSS infrastructure.

Cable PON Solutions Must Support Future FTTx Solutions

There are several PON standards currently deployed on carrier networks, including Broadband PON (BPON), which adds support for wave division multiplexing, and GPON, which is an evolution of the BPON standard that supports higher data rates and enhanced security. Cable operators that deploy PON solutions want the ability to support cost-effective migration to future PON standards to enhance FTTx Ultra-Broadband services.

OpEx Savings Are Attractive

Perhaps the most attractive benefit to Cable PON is the ability to reduce operational costs. The term "passive" simply describes the fact that optical transmission has no power requirements or active electronic parts once the signal is going through the network. PON deployments reduce the amount of fiber and distribution hub equipment needed to deliver Ultra-Broadband services. Unpowered optical splitters are used to enable a single optical fiber to service multiple premises locations. The lack of active equipment on the network delivers lower per-subscriber maintenance costs and reduces the cost of serving residential and corporate subscribers, while enabling new revenues from Ultra-Broadband services.

Consumer Demands

An independent Motorola research effort identified several key consumer broadband trends that cable operators should consider as they evaluate architectural alternatives for their networks. Where in the past price has been the key factor, this survey identified that:

- Speed is now the top concern, with approximately 58 percent citing this as their reason for subscribing to their selected broadband service.
- Quality is the second most important factor, and it was selected by approximately 17 percent of respondents.

Merely achieving parity with carriers in service delivery capacity is not enough for a cable operator to gain a true competitive advantage, but the ability to deliver higher access speeds than those offered by competitors will provide dramatic competitive advantages.

- The freedom broadband brings to effortlessly access content such as movies and games were of top concern to 14 percent of respondents.
- Price was only a top concern for approximately 9 percent of respondents.

The great demand for consumers is for more and more bandwidth. Merely achieving parity with carriers in service delivery capacity is not enough for a cable operator to gain a true competitive advantage, but the ability to deliver higher access speeds than those offered by competitors will provide dramatic competitive advantages. By building out access infrastructure to support the potential to offer increasingly higher-bandwidth access, cable operators can achieve "parity plus" by establishing their solutions in the minds of consumers as being able to deliver higher-bandwidth and more services than are available from competitors.

Customer churn is a major problem facing every cable operator, and consumers worry whether their existing bandwidth providers will be able to support their future needs. By achieving parity plus and developing the ability to offer high-quality, high-speed services now and in the future, cable operators can establish and enforce brand preference and build longer-lasting relationships with both commercial accounts and consumers.

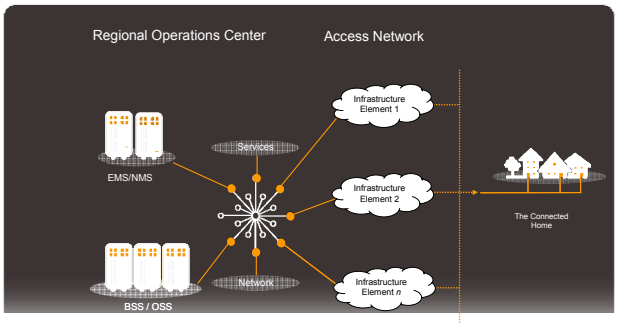
The greatest challenge is to determine how much bandwidth capacity is needed for infrastructure upgrades. Some service providers will design buildouts to support 20–30 Mbps to each subscriber, while others will design Fiber-to-the-Home (FTTH) infrastructure that will be able to potentially support the delivery of hundreds of Mbps of bandwidth to the home. Cable operators have to consider not only the amount of capacity needed in the next couple of years, but also the amount of bandwidth that will be needed in the not-too-distant future to meet service capacity demands.

Deploying 50 Mbps or more bandwidth to consumers allows providers to capture leadership positioning by offering the promise of exciting new services that can't possibly be met by networks not designed to support them. Even if customers are unlikely to utilize all of the bandwidth available in a high-speed service offering, they will still have a preference for providers that can best meet potential service requirements in the future. No consumer wants to select services that have bandwidth limitations that will restrict their online experience, and cable operators that offer higher bandwidth will capture customers from service providers that are perceived as offering limited options.

Seamless BSS and OSS Infrastructure

When deploying Cable PON to deliver Ultra-Broadband services, it is crucial to leverage existing BSS and OSS infrastructure so cable operators can preserve existing investments in provisioning, administration, billing, troubleshooting, and administrative applications while introducing services delivered over fiber.

The Key: Seamless BSS and OSS



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Existing business processes and operational procedures must be efficiently leveraged so that cable operators can cost-effectively deploy Cable PON and support both HFC and fiber access infrastructure.

Existing business processes and operational procedures must be efficiently leveraged so that cable operators can cost-effectively deploy Cable PON and support both HFC and fiber access infrastructure. Adding new BSS and OSS applications, workflows, and processes would be redundant and inefficient, and it would result in increased operational costs and decreased customer service levels.

Motorola offers expertise in DOCSIS OSS and BSS infrastructure and applications, and provides seamless BSS and OSS solutions that support both PON and HFC access networks. Cable operators can deploy flexible fiber access solutions with upstream signaling information transported to existing DOCSIS OSS and BSS applications for integration with existing workflows and business processes.

Greenfield FTTP Builds

Greenfield cable opportunities become immediate candidates for running fiber directly to the premises of residential or commercial subscribers. Fiber deep equals short coax, and the benefits to building out a fiber deep access network include increasing reliability while reducing network maintenance costs associated with fewer active components and the inherent maintenance-free aspects of an all-fiber Cable PON network.

Motorola offers Cable PON solutions today that support FTTP service delivery. The AXS2200 and the AKS1800 Optical Line Terminals (OLTs) are designed to deliver a full range of high-speed, fiber-fed voice, data, and video services to residential and commercial customers using the power of GPON.

Motorola Optical Line Terminals: MSO Network Ready

- **High capacity**
  - AXS2200: 72 PON ports → 4,608 single-family homes per chassis (1:64)
  - AXS1800: 56 PON ports → 3,584 single-family homes per chassis (1:64)
- **Unparalleled scalability with line rate performance**
  - 200 Gbps chassis backplane capable of 10 Gbps per slot
  - 200 Gbps switch fabric for GPON applications
- **Flexible and high-capacity WAN uplinks**
  - Integrated GE and 10GE WAN
  - Standalone GE WAN for additional capacity
  - Line rate Layer 2 switching performance
  - Q-in-Q stacked VLANs
- **Highly-reliable architecture**
  - 1+1 protection for all key cards
  - Link Aggregation
- **Multiple Options for Video Services**
  - Analog/QAM with standard DCT return path and integrated RPD function
  - Analog/QAM with MoCA return path
  - Fully IP Switched Video
- **Integrated Voice Gateway**

AXS2200

AXS1800

As broadband cable operators strive for new means of generating revenue to maximize the return on infrastructure investments, opportunities to offer enterprise access services leap out as perhaps the fastest way to increase both revenues and profits.

Motorola also offers a full suite of Optical Network Terminals (ONTs) designed for the home, business, and MDU settings that bridge the gap between the PON and the customer premises. For example, the ONT1000GT can be deployed at customer locations to support the delivery of hundreds of megabits per second of QoS-managed throughput and provide a direct interface to in-home coax networks via MoCA, supporting simple and straightforward installations of next-generation service delivery.

Motorola Optical Lines Terminals: MSO Service Ready

- **ONT Leader**
  - Global supplier of high-quality, affordable CPE
  - Portfolio of ONTs for different applications
    - *Single Family*
    - *Small Office*
    - *Small Business*
    - *Multiple Dwelling*
  - Video Optimized
    - *RF Overlay*
    - *IPTV*
  - Embedded SIP Client
  - Integrated Voice, H.248 Enabled
  - Simple to upgrade
- **Proven Deployments**
  - 7+ years deploying PON
  - Supplying BPON and GPON to Verizon
  - Major contributor to PON standards G.983 and G.984

ONT1000 SFU

ONT2000 SBU

ONT1500 SOHO

ONT6000 MDU

To capitalize on Cable PON opportunities, operators need the ability to successfully address PON challenges. Today's PON solutions limit the ability to utilize existing DOCSIS infrastructure deployed in residential homes, headends, and hubs as well as the ability to utilize existing OSS infrastructure for provisioning, billing, and troubleshooting. Many operators also have a limited amount of fiber currently available to support a PON implementation, and it is expensive to lay new fiber.

Another major challenge is overcoming distance restrictions, since BPON and GPON deployments have a 20 km distance limit which works well for telephone company Central Offices but is beyond the distance between many hubs and their served homes. Many operators will want to overlay PONs over existing HFC networks, but this can be troublesome when operators only want to deploy PONs to greenfields that may be nearby older neighborhoods already served with HFC connections.

Commercial Services

As broadband cable operators strive for new means of generating revenue to maximize the return on infrastructure investments, opportunities to offer enterprise access services leap out as perhaps the fastest way to increase both revenues and profits.

Small, medium, and large businesses traditionally rely on telephone companies for providing their voice and data services, but with the recent development of fiber optic networks to provide two-way, high-bandwidth services, cable operators can now offer competitive services that are far more flexible than those offered by incumbent carriers. The opportunities are enormous, because MSOs can offer a broad spectrum of services with greater flexibility to adjust bandwidth speeds than possible from incumbent providers.

With Motorola's Cable PON solutions, cable operators can utilize their existing set-top and DOCSIS equipment currently located in the homes and in the headends and the same OSS systems can be used for provisioning, billing, and troubleshooting.

The opportunities are enormous, because MSOs can offer a broad spectrum of services with greater flexibility to adjust bandwidth speeds than possible from incumbent providers. They can offer integrated bundles of voice, data, and video services with tiered pricing plans that entice enterprise networks to migrate their entire telecommunications requirements to the broadband HFC network.

For smaller enterprise networks, operators can leverage the existing DOCSIS infrastructure to provide business-class services. The Broadband Services Router 64000 (BSR 64000) Cable Modem Termination System (CMTS) aggregates DOCSIS traffic flows for routing across the metropolitan network. It can establish secure Virtual Private Networks (VPNs) using MultiProtocol Label Switching (MPLS) or Virtual Local Area Networks (VLANs) using the 802.1 Q standard, and it can also be used for Small Office/Home Office (SoHo) services so operators can easily leverage existing HFC infrastructure investments to support small business users.

Motorola is developing Cable PON commercial services solutions that will allow MSOs to provide Ultra-Broadband enterprise services to small, medium, and large businesses while leveraging existing OSS/BSS infrastructure. To find out more about products for Cable PON commercial services that are currently in development, contact your Motorola account representative.

Outside Plant Rehabilitation/Overbuild

As cable operators refurbish existing plant and add fiber, they set the stage for FTTH. Brown field economics continue to improve, and recent interest in overbuilding has arisen with OpEx savings a primary driver. Outside plant rehabilitation is an evolutionary strategy, and Motorola offers several methods to increase access network capacity.

When evaluating outside plant rehabilitation, cable operators should carefully evaluate costs, especially in regions with high levels of competition for FTTH.

Motorola is developing overbuilding solutions that will allow cable operators to implement Cable PON while leveraging existing OSS/BSS infrastructure. To find out more about products for Cable PON that are currently in development, contact your Motorola account representative.

Find Out More About Cable PON Solutions From Motorola

Because Cable PON solutions are in the very early stages, much of our new products capabilities and professional services offerings are not yet announced. This white paper is meant to provide general insights into our strategy and to make it clear that Motorola's strategy is based on continuing to leverage our HFC and PON capabilities to provide cable operators worldwide with maximum flexibility in building out infrastructure to support Ultra-Broadband services.

All of Motorola's Cable PON products under development will support the same OSS/BSS infrastructure that supports current HFC DOCSIS network solutions, so operators gain maximum flexibility in selecting the right infrastructure upgrade options.

With Motorola's Cable PON solutions, cable operators can utilize their existing set-top and DOCSIS equipment currently located in the homes and in the headends and the same OSS systems can be used for provisioning, billing, and trouble-shooting.

Motorola offers solutions for BPON and GPON as well as the professional services expertise to help cable operators analyze deep fiber options and select and deploy the right solution for delivering Ultra-Broadband services. Motorola offers expertise not only in DOCSIS and HFC infrastructure but also provides PON-based FTTP solutions for leading carriers.

We can help you design and build the right optical solution for your needs. Find out more about our Cable PON solutions currently under development by contacting your Motorola account representative. We will present a product roadmap under non-disclosure protection to existing customers, and discuss the HFC and Cable PON solutions that can help you deliver Ultra-Broadband services and successfully compete with carriers and increase revenues and market share.

About Motorola Home & Networks Mobility

Motorola Home & Networks Mobility (formerly known as Motorola Connected Home Solutions) provides integrated, end-to-end systems that reliably deliver digital entertainment, information, and communications services over a variety of wired and wireless broadband network architectures. The world's leading provider of digital video set-tops and cable modems, Home & Networks Mobility empowers consumers by connecting their homes, keeping the people, content, and services important to them always within their reach. For more information, visit http://broadband.motorola.com/index.html.

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