# Cable Modem Termination System (CMTS)

Overview

The hybrid fiber/coax (HFC) network is moving from simply providing television programming to serving as a multimedia, broadband network for both consumer and business data access. Cable multiple system operators (MSOs) are well positioned to provide both businesses and homes with a unified gateway supporting data, Voice over IP (VoIP), and streaming video/audio that goes well beyond simple cable modem deployment. This growth will drive demand for cable modem termination systems (CMTSs) that provide connectivity, basic routing/switching of protocol data units (PDUs), protocol conversion, traffic management, and other services.

Key Benefits

> Single platform architecture for DOCSIS, Ethernet, SONET, or other interface types

> Fully reprogrammable solution for in-field software upgrades of devices

> Consistent software architecture from distribution points through headend systems

> True, fine-grained, multiservice support for high numbers of downstream users

> May be used in wide range of environmentally challenging locations, including pole-top devices

CMTS LINE CARD SOLUTION PROVIDING MULTI-PROTOCOL TRAFFIC MANAGEMENT
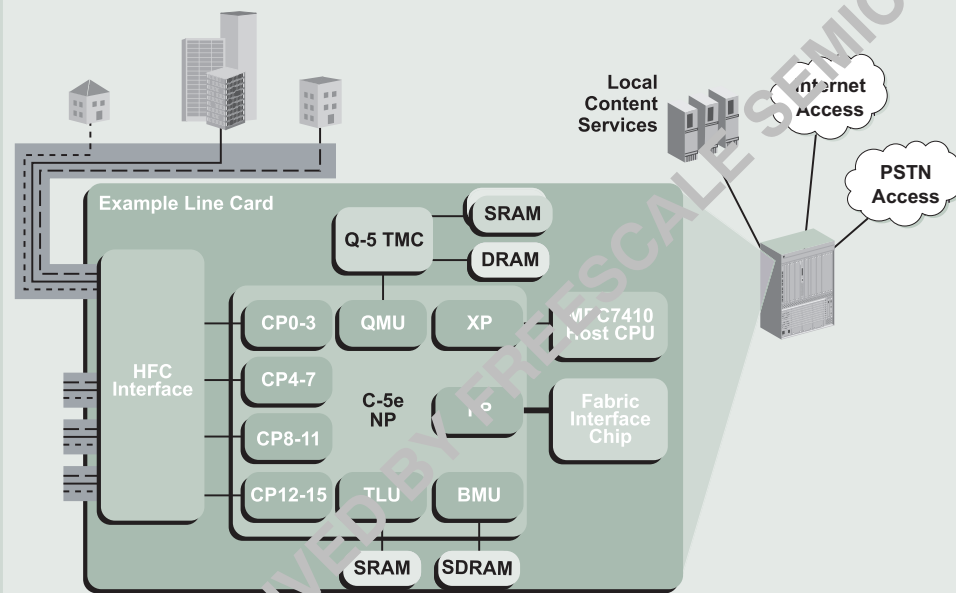
Freescale Ordering Information			
Part Number	Product Highlights		Additional Information
PCC3E0RX180WA0A	5.5W @ 180 MHz		www.freescale.com/networkprocessors
PCC5E0RX266WA0A	9W @ 266 MHz		www.freescale.com/networkprocessors
PCQ300ZPWA0A	3W @ 100 MHz		www.freescale.com/networkprocessors
PCQ500ZPTA0A	4.5W @ 133 MHz		www.freescale.com/networkprocessors
MPC7410	Performs control plane processing within the CMTS		www.freescale.com/PowerPC

Design Challenges

CMTS equipment vendors are under tremendous pressure to support an expanded level of functionality while adapting to evolving standards and new application requirements. The CMTS serves as the backbone of the HFC network, bridging WAN interfaces with RF-based cable modems typically built around Data Over Cable Service Interface Specification (DOCSIS®)/EuroDOCSIS. The evolution of DOCSIS standards has added Quality of Service (QoS) functionality in order to support real-time applications such as IP telephony. This requires CMTS to support classification and traffic management on many thousands of flows. Continued DOCSIS evolution is increasing the bidirectional bandwidth and QoS requirements of these systems.

The headend equipment also requires a full array of WAN interface support, including varieties of Ethernet, SONET, and ATM. Additionally, with fiber installations moving closer and closer to the end-users, CMTS functionality is migrating outside the headend to the neighborhood nodes. This constrains system power and cost budgets and imposes stricter requirements on the mechanical and environmental aspects of the design.

This combination of protocol evolution and diversity, higher performance, and advanced QoS requirements makes CMTS equipment design challenging, especially when combined with the cost and time-to-market pressures of today's market. No longer adequate are the traditional design approaches where each interface line card is implemented using a separate set of application specific integrated circuits (ASICs) or application specific standard products (ASSPs). With the trend toward more distributed implementations, a "platform" approach to design, where the same software can be leveraged everywhere from the distribution points to the cable headend, offers significant benefits.

Freescale Semiconductor Solution

Freescale Semiconductor's C-Port™ Network Processor (NP) family brings the high-service, high-functionality requirements of the CMTS together in a highly integrated silicon solution. Perfect for both high-end headend or power/cost-sensitive industrial temperature environments, the C-Port NP family is well suited to serve as a base architectural platform for CMTS equipment applications.

The C-Port network processor is distinguished from other NPs by its fully software-programmable Layer 2 interfaces. This makes it capable of supporting virtually any L2 protocol, including Ethernet, SONET, and even DOCSIS implementations. Further, as protocols evolve, the NPs can be reprogrammed in software to support new requirements. The C-3e NP, with up to 3 Gbps bandwidth, is aimed at lower bandwidth applications such as HFC distribution nodes, while the C-5e NP, with up to 5 Gbps bandwidth, is well suited for headend use. In addition to the L2 protocol programmability, C-Port NPs support higher-level programming in C-language, enabling fast development of advanced features by which equipment vendors may differentiate their products from the competition.

With so much flexibility, a single line card can be designed to interface to numerous types of PHY modules. This greatly simplifies system architecture because nearly every interface that a CMTS needs to support can be based on a common hardware platform.

Traffic classification is performed in the on-chip Table Lookup Unit, which performs up to 133M lookups/sec. Flows are organized in the Queue Management Unit (QMU), which provides application support for 512 queues. Traffic management functions can be scaled to much greater sophistication with the addition of the C-Port Q-5 Traffic Management Coprocessor (TMC), supporting up to 256k independent queues and a powerful three-level scheduling hierarchy. The Q-5 supports policing, monitoring, and shaping of 256k unique flows, and offers up to 4K virtual channels with multiple QoS levels per virtual channel. On a CMTS line card, each virtual channel may be assigned to a different downstream destination, enabling true multiservice access. The Q-3 TMC is also available, which provides 64k independent queues and addresses power and cost-sensitive applications.

The C-Port family of network processors and traffic managers share an architecturally unified C-language application programming interface (API) that abstracts chip subsystems, allowing your application to migrate easily to future generations of C-Port network processing silicon.

Development Environment

The C-Port family development environment consists of the following components:

> **C-Ware Software Toolset (CST)**. Functional and performance accurate simulation environment, standard GNU-based compiler and debugger, GUI-based performance analysis tools, traffic scripting tools, C-Ware APIs, and a full library of tested, documented reference applications.

> **C-Ware Development System (CDS)**. Compact peripheral component interface (PCI) chassis with Freescale Semiconductor MPC750 Host Application Module, which can also include NP switch modules, TMC daughter cards, and various physical interface modules (PIMs). Complete hardware reference designs are also available.

Additionally, the C-Port family development environment supports host software integration with:

> Comprehensive host-side API

> Integration with signaling protocols in shipped software

Vendors may also select Wind River Tornado® for Managed Switches (TMS) to program the host processor/control plane software. Freescale Semiconductor has established an alliance with Wind River Systems to provide integration of C-Port family NPs with TMS 2.0 supporting both Layer 2 and Layer 3 services. This represents the first network processor supported by TMS. In addition, the host application module in the CDS runs VxWorks® on the MPC750.

Development Tools

Tool Type	Product Name	Vendor	Description
Software	C-Ware™ Software Toolset (CST) CSTC501W	Freescale Semiconductor	Includes software development tools, APIs, and reference applications. The CST can be downloaded from www.freescale.cportcorp.com/support.
Development Kit	C-Ware Development System (CDS) CDEV101A	Freescale Semiconductor	Includes NP switch modules, host modules, and physical interface modules (PIMs), as well as complete hardware reference designs. Ask your sales representative or distributor for details and availability of system modules.

Third Party Support

Vendor	Description	Contact Information
Corrent	For High-Performance Security Processing	Tel: 480-648-2300 sales@corrent.com
IBM	For Switch Fabric Solutions	Tel: 33 4 92 11 56 40 Fax: 33 4 92 11 00 23 garciag@fr.ibm.com
Solidum	For Advanced Classification	Tel: 613-724-6004 Fax: 613-724-6008
Wind River Systems	For Tornado for Managed Switches and RTOS	Tel: 800-545-9463 Fax: 510-814-2010

Notes

Learn More: Contact the Technical Information Center at +1-800-521-6247 or +1-480-768-2130.

For more information about Freescale products, please visit **www.freescale.com**.

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