



## C2200

CMTS  
Pre-DOCSIS 3.0  
Release

## Overview

The C2200 Cable Modem Termination System (C2200) is a new class of cable edge device that combines a third generation DOCSIS CMTS and an MPEG video Edge-QAM in a single compact 1RU platform. The broadband access over cable market has experienced two generations of DOCSIS CMTS.

All of the products on the market today are either first generation CMTS or second generation CMTS that upstream ratio, instantaneous bandwidth per subscriber limited to a single RF channel, very low downstream channel density per rack unit and high cost per unit bandwidth. The legacy CMTS does not have any MPEG video processing capability and thus have any MPEG video processing capability and thus makes it necessary to implement two parallel access networks for MPEG video and DOCSIS IP.

With those limitations, the legacy CMTS is not economically viable in the new market of high bandwidth applications such as IPTV or IP video delivery and is not competitive to other broadband access methods such as FTTH. As a third generation CMTS, the C2200 has several unique capabilities beyond DOCSIS 3.0 features.

First, the C2200 supports complete separation of downstream channel capacity and upstream channel capacity in a single physical chassis and thus provides flexible downstream to upstream channel ratio. Cable operators can add downstream channels and upstream channels completely independently. Business users may require more symmetric downstream to upstream traffic ratio. Residential broadband access has more asymmetric traffic patterns. For IPTV or video-over-IP applications, significantly more downstream traffic is required than the upstream traffic which is mostly for control plane applications.

Second, the C2200 has significantly higher channel density than a second generation CMTS. The C2200 can support up to 48 downstream QAM channels in 1RU while second generation CMTS typically has 1 or 2 downstream channels in 1RU. The extremely high downstream channel density makes it economical to provide video-over-IP service today.

Third, the C2200 can support both DOCSIS and MPEG/DVB traffic in a single platform. This unique feature is very important for cable operators to manage their HFC spectral resources in a single platform. It also allows the spectral resources to be shared dynamically between MPEG video, DOCSIS business users and DOCSIS residential users. For example, more bandwidth can be allocated to DOCSIS business traffic during the day while more bandwidth can be allocated to MPEG/D VB video traffic at night to efficiently utilize the spectral resource.

Fourth, The C2200 has the most extensive DOCSIS 3.0 features on the market today. It offers the highest channel bonding capability in both downstream and upstream on the market today. The revolutionary DOCSIS bandwidth capacity and cost per-bit of DOCSIS bandwidth of the C2200

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provides an unprecedented opportunity for cable operators to cost-effectively provision high-bandwidth IP services such as IPTV or video-over-IP and interactive gaming in addition to traditional broadband access and VoIP services. The integrated MPEG video capacity of the C2200 provides cable operators the flexibility to offer MPEG or DVB-based broadcast digital cable TV, video-on-demand (VOD), and interactive services in the same platform. The flexibility, multi-functionality and economics of the platform eliminate the need to deploy multiple parallel systems for MPEG TV, IPTV bypass and DOCSIS broadband access. The following sections detail the unique capabilities of the C2200.

## Features

- Pre-DOCSIS 3.0 Features – Channel bonding of 16 downstream channels today, firmware upgradeable to upstream channel bonding of 8 channels, AES encryption, IPv6 for Cable Modems.
- Separate Downstream and Upstream Modules – Unlike traditional CMTS with fixed downstream to upstream ratio, C2200 has separate downstream modules and upstream modules that provide flexible downstream to upstream ratio.
- Integrated CMTS & Video QAM – DOCSIS traffic and MPEG/DVB video traffic can share the same RF channel
- Cost Effectiveness–Offers the lowest cost per channel in the industry. The only economical solution for high bandwidth IP applications.
- High Density – Offers the highest channel density per 1RU space in the industry.
- Best Multi-channel RF performance– Exceeds DOCSIS DRFI specification.
- Extended Frequency Range – Downstream – Downstream frequency range up to 1GHz (52~1002MHz).
- DOCSIS 1.1 and 2.0 Features – Complete DOCSIS/ EuroDOCSIS 1.1 and DOCSIS/ EuroDOCSIS 2.0 (A-TDMA) feature sets.
- Rich Operational Features– Rich operational features such show cable modem, flap list, spectral management and IP bundling ready for deployment.

## Modular and Flexible Architecture

The C2200 CMTS comes in a compact 1RU form factor. It is based on a modular architecture that gives cable operators the maximum flexibility in tailoring their networks according to the requirements of their services. The C2200 consists of a base system with built-in L2/L3 switch and 4 GbE (SFP) ports and four slots for DOCSIS interface modules (downstream modules or upstream modules).

Any combination of downstream modules and upstream modules are supported by the platform. This enables flexible downstream to upstream channel ratio. The DOCSIS QAM Module (DQM) is a complete DOCSIS downstream unit that includes DOCSIS packet processing and QoS, DOCSIS downstream MAC, PHY, and RF upconversion. There are two versions of downstream modules, 8-channel DQM08 or 16-channel DQM 16 Both types of downstream modules have four output ports.

The DOCSIS Control and Upstream module (DCU) is a complete DOCSIS upstream unit that includes DOCSIS packet processing, DOCS IS upstream MAC and burst mode receivers. There are two version of DCUs, 8-channel DCU08 and 4-channel DCU04.

In aggregation, the C2200 supports from 8DSx24US to 48DSx4US configurations in a 1RU chassis. A typical configuration for channel bonded deployment can be 32DSx16US. Each downstream QAM channel can be configured to support DOCSIS or MPEG/DVB-C video or a combination.

In the minimum configuration, C2200 can have one DQM08 downstream module (8 channels of QAM) and one DCU04 upstream module (8 channels of burst modereceivers).

## Full DOCSIS 3.0 Features

As a Full featured DOCSIS 3.0 CMTS, the C2200 offers the highest channel bonding capability on the market today. In the downstream direction, up to 16 QAM channels can be bonded yielding up to 800Mbps of instantaneous bandwidth per subscriber (Annex A). In the upstream direction, up to 8 channels can be bonded to yield 240Mbps instantaneous bandwidth. The C2200 also supports IPv6, AES encryption and decryption, and dynamic load balancing.

## High Performance Video QAM

The C2200 downstream channels can also function as a MPEG or DVB-C compliant MPEG video Edge-QAM for digital video applications such as broadcast digital cable TV, video-on-demand, interactive TV, and network DVR. The C2200 receives MPEG-2 over IP/Ethernet packets in multiple program transport streams (MPTS) or single program transport streams (SPTS) through its multiple Gigabit Ethernet ingress interfaces, it then de-multiplexes MPTS and routes the native MPEG-2 packets to its egress QAM interfaces. At the egress interfaces, the re-multiplexing function generates multiple program transport streams (MPTS) for the designated cable channels.

The C2200 performs PSI/SI table processing, PID filtering and substitution, and PCR de-jittering to satisfy the most demanding needs of various video networks. The C2200 supports both CBR traffic and VBR traffic for narrowcast applications and broadcast applications. The C2200 is the only product that can make the most efficient use of the RF bandwidth and maintains video quality at the same time through concurrent use of tools such as statistical multiplexing of all MPEG video traffic and DOCSIS traffic, and dynamical scheduling of MPEG and IP traffic.

## Rich Operational Features

The C2200 supports industry standard Command Line Interface (CLI) and SNMP for configuration and management. Operational features such as show cable modem, show ARP, spectral management, CPU and memory resource reporting, user privilege management. Advanced features such as load balancing for bonded channels is also available in the current release. Extensive IP features such as DHCP Relay and option 82, multiple DHCP servers, proxy ARP, IP subnet bundling, IGMP snooping, IGMP v2 and v3, access control list (ACL) are also available in the current release. In the current release, the C2200 is functioning as a Layer 3 routing device.

Static routes and default route are supported. For route redundancy, multiple default routes can be configured. In subsequent software releases, Layer 2 bridging, VLAN, RIP, OSPF, and PIM-SM will be supported through firmware upgrade.

## Applications

The applications of the C2200 in a cable network can be divided into two categories. The first category the C2200 provides is DOCSIS-based IP applications, such as broadband access, VoIP, and IPTV and video-over-IP etc.

The second category the C2200 provides is digital video applications that include SDTV Broadcast over Cable, HDTV broadcast over Cable, VOD, Network Digital Video Recorder (nDVR), interactive gaming, and switched digital video.

## Specifications

C2200	
PARAMETERS	SPECIFICATION
<b>System</b>	
	12x2 Gbps switching capacity
	MPEG switching from any port to any port
	CLI and SNMP management
	Four DOCSIS interface slots per system
	1~3 Downstream modules per system
	1~3 Upstream modules per system
<b>DOCSIS Features</b>	
	DOCSIS 3.0 downstream channel bonding up to 16channels
	DOCSIS 3.0 upstream channel bonding up to 8 channels
	DOCSIS 3.0 AES encryption IPv6
	DOCSIS 3.0 Multicast QoS
	Complete DOCSIS /EuroDOCSIS 1.1 features
	DOCSIS /EuroDOCSIS 2.0 A-TDMA (standard)
	DOCSIS /EuroDOCSIS 2.0 S-CDMA (optional)
	Dynamic upstream and downstream load balancing
	Spectral Management
<b>IP Features</b>	
	DHCP Relay and option 82
	Multiple DHCP servers
	Proxy ARP
	IP subnet bundling
	Static IP routing
	IGMP snooping
	IGMP v2 and v3
	Multiple default routes
	Access Control List
	RIPv2
	OSPFv2

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<b>MPEG Stream Processing</b>	
	MPEG de-multiplexing and re-multiplexing
	Unicast to Multicast conversion
	PAT and PMT extracted on and regeneration
	PID filtering and remapping
	PCR jitter removal and re-stamping
	SI table generation and insertion
	DVB Simulcrypt scrambling
	Session-based Encryption
	Program insertion and splicing
<b>Management</b>	
	RS232 Serial port (DB9)
	10/100BaseT management port
	Command Line Interface (CLI)
	Telnet
	SNMPv1, v2, and v3
	Standard DOCSIS and IETF MIBs
	IPDR
	Enterprise MIBs
	Event logging through Syslog
	Event logging through Syslog
	Resource usage reporting
<b>GbE Interfaces</b>	
	10/100/1000 Mbps
	4-port copper or fiber SFP
	CWDM
	Full line-rate support
<b>DOCSIS QAM Module (DQM)</b>	
Number of ports	4 ports per module
DQM04	4 channels, 1 channel per port
DQM08	8 channels, 2 channels per port
DQM16	16 channels, 4 channels per port
Channel bonding	All channels on a DQM
Channel bonding	Annex A, B or C
QAM constellations	64 & 256 QAM
Data Rates (DOCSIS)	27 Mbps @ 64 QAM / 38 Mbps @ 256 QAM
Data Rates (EuroDOCSIS)	36 Mbps @ 64 QAM / 56 Mbps @ 256 QAM
Connector	F- type, 75 $\Omega$
Frequency range (edge)	type, 75 $\Omega$
Frequency step size	5 kHz
Channel width	6 to 8 MHz (tunable)

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<b>DOCSIS QAM Module (DQM)</b>	
Maximum output power Per Channel	61 dBmV @ 1-ch/port 57 dBmV @ 2-ch/port / 53 dBmV @ 4-ch/port
Output step size	0.1 dB
Output stability	± 0.3 dB
Output stability	50 ~ 870 MHz, 14 Db / 870 ~ 1002 MHz 10 dB
Modulation Error Rate	44 dB (equalized)
Wideband Noise	-73 dBc
<b>DOCSIS Control and Upstream (DCU)</b>	
DCU04	4 channels in 4 ports
DCU08	8 channels in 8 ports
DCU16 (R2.0)	16 channels in 8 ports
Channel bonding	All channels on a DCU
Modulation A-TDMA or S-CDMA	QPSK, 16, 32 64 QAM
Data rate per channel	0.32 - 30.72 Mbps
Input frequency range	5 - 42 MHz (DOCSIS) / 5 - 65 MHz (EuroDOCSIS)
Connector	F - type, 75 Ω
Input range	-4 to 26 dBmV
<b>Mechanical</b>	
Form Factor	1RU
H x W x D	1.75 x 19 x 23.5 (in.) / 44.45 x 482.6 x 597 (mm)
Weight	30 lbs / 13.62 kg
Mounting	19 inch, 1 rack unit high
Front Panel LED	power, alarm, I/O status
<b>Environmental</b>	
Operating temperature	0° to 50° C
Storage temperature	-40° to 70° C
Operating humidity	5% to 95%, non-cond.
Power supply	AC operating range:90 to 264 V ; (Option) DC: -36 to-60 V (redundant )
Power consumption	< 400 W (nominal)
<b>Regulatory Compliance</b>	
Safety	UL / IEC / CSA 60950-1
EMC	FCC Part 15 Class A and CISPR Class A
Immunity	EN61000-4