**DATA SHEET**

CISCO UBR7200 SERIES MC28U, MC16U, MC28X, AND MC16X BROADBAND PROCESSING ENGINES

Cisco Systems® introduces four new cable line cards—the Cisco uBR7200 Series MC28U, MC28X, MC16U, and MC16X Broadband Processing Engines (BPEs)—that bring new choices and capabilities to the Cisco uBR7246VXR Universal Broadband Router. With their flexible, all-inclusive product design, the line cards offer:

- An advanced physical layer (PHY) to provide ingress noise cancellation
- Advanced time-division multiple access (A-TDMA) capabilities
- Advanced spectrum management
- An onboard processor for improved performance to support additional subscribers and services
- Integrated upconverters for Cisco uBR7200 Series MC28U and MC16U line cards
- Flexible software Media Access Control (MAC) domain configuration or virtual interfaces
- Reduced cable wiring through frequency stacking
- Data Over Cable Service Interface Specifications (DOCSIS®), European DOCSIS (Euro-DOCSIS), and J-DOCSIS support on one line card.

The Cisco uBR7200 Series MC28U, MC28X, MC16U, and MC16X line cards address the expanding service and operational needs of multiple system operators (MSOs). An unmatched set of advanced features and a scalable architecture make these line cards an ideal choice for cable operators facing the challenge of delivering carrier-class IP-based data, voice, and video services to a growing number of subscribers. The line cards provide unparalleled flexibility and improved robustness to the Cisco uBR7246VXR, further enhancing this communications-grade cable modem termination system (CMTS). The DOCSIS and Euro-DOCSIS 2.0-qualified and PacketCable 1.1-qualified technology help cable operators accelerate deployment of advanced IP services. By upgrading existing Cisco uBR7246VXR CMTSs with new Cisco BPEs, cable operators can improve overall bandwidth availability and increase their signal quality and reliability. This evolutionary upgrade to existing Cisco CMTSs adds processing power and hardware-accelerated quality of service (QoS) capabilities without requiring a chassis upgrade, and therefore delivers exceptional investment protection. Figure 1 depicts the Cisco uBR7200 Series MC28U BPE.

Figure 1.   Cisco uBR7200 Series MC28U Broadband Processing Engine
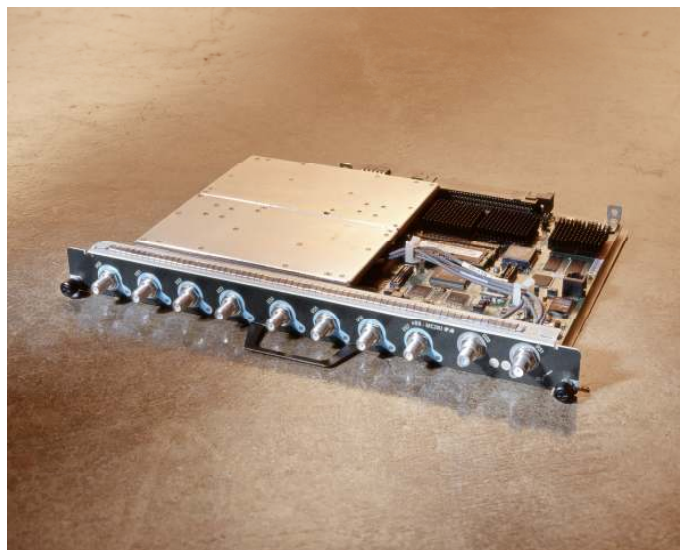
PRODUCT OVERVIEW

The Cisco uBR7200 Series MC28U, MC28X, MC16U, and MC16X BPEs deliver advanced CMTS functions, such as:

- PHY RF interface (upstream burst demodulation, downstream modulation, RF allocation)
- MAC processing (modem registration, transmission opportunity scheduling, and hardware-accelerated Layer 2 QoS)
- On-board packet processing

Featuring a highly integrated and robust RF front end and superior processing engine for DOCSIS- or Euro-DOCSIS-based networks, the Cisco uBR7200 Series MC28U, MC28X, MC16U, and MC16X BPEs enable high-performance, reliable, and secure bidirectional transmission of IP packets over the cable plant for data, voice, and video services. The cards support:

- 6 MHz National Television Systems Committee (NTSC) channel operation, using standard (STD), Harmonic Related Carrier (HRC), or Incremental Related Carrier (IRC) frequency plans conforming to EIA-S542, Annex B. The card supports downstream channels in the 88 to 860 MHz range, and upstream channels in the 5 to 42 MHz range.
- 8 MHz Phase Alternating Line (PAL) and Systemme Electronique Couleur Avec Memoire (SECAM) channel plans conforming to the International Telecommunications Union (ITU) J.83 Annex A standard. The card supports a greater upstream spectrum range of 5 to 65 MHz and an increased downstream channel width of 8 MHz.
- 6 MHz J-DOCSIS channel operation (extensions for Japan and select regions): 6 MHz Annex B extension support with a downstream extended frequency range of 70 to 860 MHz and an upstream frequency range of 5 to 55 MHz.

Table 1 summarizes the features and benefits of these line cards.

Table 1. Features and Benefits

Feature	Benefit
Industry-leading port density	Reduces per-port cost
	Maximizes plant capacity (frequency reuse)
Advanced RF front end that includes technology patented by Cisco	Optimizes RF performance and robustness
Integrated upconverter for Cisco uBR7200 MC28U and MC16U models	Reduces operational cost and complexity
Onboard spectrum analyzer hardware	Reduces return-path monitoring costs
	Enhances remote troubleshooting capabilities
Dedicated MAC layer hardware	Provides hardware acceleration of DOCSIS 1.1 features
	Enables scalability of data and voice deployment
	Optimizes cable modem registration time
	Provides hardware-based Layer 2 QoS
	Allows use of best-of-breed PHY
DOCSIS, Euro-DOCSIS, and J-DOCSIS support on one line card	Provides operational savings
	Lowers capital expenditures (CapEx)
PacketCable 1.1-qualified, Euro-DOCSIS 2.0-qualified, DOCSIS 1.1-qualified	Maximizes return on investment to support converged services
	Provides advanced PHY robustness for 1.x and 2.0 deployments

Advanced RF Front End

The Cisco uBR7200 Series MC28U, MC28X, MC16U, and MC16X line cards combine the highest level of integration with enhanced RF robustness and performance for the Cisco uBR7246VXR. The innovative design uses leading PHY chips from multiple vendors. Advanced RF features include direct sampling of the upstream channels and automatic ingress noise cancellation.

The Cisco uBR7200 Series MC28U, MC28X, MC16U, and MC16X use technology patented by Cisco to determine carrier-to-noise ratio (CNR) values for selected upstream channels. This technique, not offered by any other CMTS vendor, is a Cisco differentiator. Cable operators routinely measure CNR as one means of characterizing the health of their cable networks. Understanding CNR, how it degrades through a cascade of devices, and how it affects all the signals carried on the network are critical to ensuring reliable network operation.. Cisco's revolutionary technique offers a higher degree of accuracy and flexibility when calculating this value. Conventional techniques for estimating CNR of selected upstream channels are based upon Error Vector Magnitude (EVM) calculations. Cisco's patented technique achieves precise CNR measurements by scheduling timeslots on selected channels specifically for collecting signal and noise information. The technique supports measurements on a node-by-node basis to analyze CNR on one or more specific modems of an upstream channel—not supported using EVM-based calculations. Cisco uBR7200 Series MC28U, MC28X, MC16U, and MC16X meet or exceed DOCSIS specifications for downstream CNR of 35 dB and 25 dB for upstream operation.

In addition, the Cisco uBR7200 Series MC28U and MC16U feature integrated upconverters. Depending on the specific model, either one or two downstream (DS) modulators and eight or six upstream (US) burst receivers are offered on a single line card.

Superior MAC

The Cisco uBR7200 Series MC28U, MC28X, MC16U, and MC16X line cards feature dedicated MAC layer hardware for maximum performance in large-scale deployments. The MAC layer hardware enables scalability to thousands of cable modems, simultaneously providing hardware acceleration for sophisticated security features, such as DOCSIS 1.1 extensions to baseline privacy interface (BPI+), or processor-intensive functions, such as concatenation, fragmentation, and payload header suppression (PHS) necessary to deploy advanced data and voice services.

Flexible Software MAC Domain Configuration or Virtual Interfaces

Cisco BPEs support flexible upstream allocation and usage—known as software MAC domain configuration or virtual interfaces. Cable operators can associate differing combinations of upstreams to downstreams. Upstreams are no longer fixed by their physical location, but can be assigned to virtual upstream channels. For instance using a Cisco MC28U or MC28X, a cable operator can associate any combination of upstreams (up to eight) to each of the two downstreams. Operators can configure one downstream, six upstreams, plus one downstream and two upstreams, or can configure two independent 1x4 CMTS MAC domains. MAC domains can be configured according to a particular class of service that groups downstreams and upstreams by application; e.g., commercial service requiring a higher QoS or flat-rate residential service. Cable operators can configure MAC domains in a more flexible and dynamic manner to meet differing customer demands and usage. If more capacity is required in one MAC domain, operators can reconfigure the BPE, as opposed to creating a new MAC domain by installing a new cable line card.

Table 2. Specifications

Item	Description
Physical	Occupies a single slot in the Cisco uBR7246VXR chassis
	Hot-swappable; no slot dependency
	Dimensions (H x W x D): 1.35 x 13.5 x 10.56 in. (3.43 x 34.29 x 26.82 cm)
	Weight: MC28U: 6 lbs (2.72 kg), MC28X: 4.75 lbs (2.15) kg) MC16U: 5.25 lbs (2.38 kg), MC16X: 4.75 lbs (2.16 kg)
Power Consumption	MC28U: 80 Watts (273 BTU/h), MC28X: 50 Watts (170.6 BTU/h), MC16U: 62 Watts (211.6 BTU/h), MC16X: 47 Watts (160.4 BTU/h)
Power Output	MC28U and MC16U: +50 to 61 dBmV at RF
	MC28X and MC16X: +42 dBmV at IF (+/-2 dB)
RF Output Power Range	50 to 61 dBmV
Modulation	Downstream: 64-QAM, 256-QAM
	Upstream: QPSK 8-, 16-, 32-, 64-QAM
Downstream Frequency Range	DOCSIS: 6 MHz Annex B, 88-860 MHz
	Euro-DOCSIS: 8 MHz Annex A, 85-860 MHz
	J-DOCSIS: 6 MHz Annex B extension, 70-860 MHz
Upstream Frequency Range	DOCSIS: 6 MHz Annex B, 5-42 MHz
	Euro-DOCSIS: 8 MHz Annex A, 5-65 MHz
	J-DOCSIS: 6 MHz Annex B extension, 5-55 MHz
Environmental	Operating altitude: -197 to 13,123 ft (-60 to 4000 m)
	Storage temperature: -4 to 149°F (-20 to 65°C)
	Operating temperature, nominal: 41 to 104°F (5 to 4 0°C)
	Storage relative humidity: 5 to 95 percent
	Operating relative humidity: 10 to 90 percent
Safety	UL 1950, Third Edition (Safety of Information Technology Equipment, Including Electrical Business Equipment), with No D3 Deviations
	CSA 950 \Q95 Third Edition (Safety of Information Equipment Technology, Including Electrical Business Equipment)
	EN 60950 (Safety of Information Equipment Technology, Including Electrical Business Equipment)
	IEC 60950
	ACA TS001, 1997 Test Report and Statement of Compliance AS/NZS3260
Electromagnetic emissions	EN55022: 1998 Class B
	CISPR 22: 1997 Class B
	CFR 47 Part 15 Class B
	ICES -003, Issue 2, Class B, April 1995
	VCCIV-3/2000.04
	AS/NZS 3548: 1995 Class B
	CNS-13438 Class B—BSMI (BCIQ) in Taiwan

Item	Description
Electromagnetic Immunity	EN50082-1: 1992
	EN50082-1: 1997
	EN55024: 1998
	EN61000-3-2: 1995
	EN61000-3-3: 1995
	EN61000-4-2: 1995 [including AMD1 + AMD2] ESD immunity
	EN61000-4-3: 1997 Radiated RF field immunity
	EN61000-4-4: 1995 Immunity to electrical fast transients
	EN61000-4-5: 1995 Surge immunity
	EN61000-4-6: 1996 [including AMD1] RF conducted immunity
Network Equipment Building Systems (NEBS) - Level 3	Designed and tested to meet requirements of GR-1089-CORE - Issue 2, December 1997
	Revision 1, February 1999
Mechanical	IEC 68-2-1, IEC 68-2-2, IEC 68-2-56: Operational temperature
	and humidity
	IEC 68-2-27: Operating Shock
	IEC 68-2-64, IEC 68-2-6, IEC 68-2-47: Operating and nonoperating vibration
	IEC 68-2-32: Nonoperating free-fall drop
	IEC 68-2-40: Nonoperating altitude
	IEC 68-2-27, IEC 68-2-32: Nonoperating mechanical shock
	IEC 68-2-3: Nonoperating humidity
	IEC 68-2-14, IEC 68-2-33: Nonoperating temperature shock
LEDs	One power LED (green)
	One status LED (green/yellow): solid green indicates the processor has booted and passed its diagnostics, LED blinks green on a protect card, yellow when in one of the booting states.
	Maintenance (yellow): indicates the line card can be removed
	One upstream-enabled LED on each upstream port (green): upstream path is configured and able to pass traffic
	One downstream-enabled LED on each downstream port (green): downstream path is configured and able to pass traffic through the upconverter at the radio frequencies
Minimum Cisco IOS® Software Release	Release 12.2(15)BC2
Compatible Cisco Network Processing Engines (NPEs)	To operate Cisco uBR7200 Series MC28U, MC28X, MC16U, and MC16X BPEs, the Cisco uBR7246VXR must contain a Cisco NPE-400 or uBR7200-NPE-G1 processor. The NPE-400 must have at least 128 MB of DRAM memory (see recommendation that follows). The uBR7200-NPE-G1 must have at least 256 MB of DRAM memory (see recommendation that follows). If the Cisco uBR7246VXR contains more than one BPE, Cisco recommends installing 256 MB of DRAM memory on the NPE-400, and installing either 512 MB or 1 GB of DRAM memory on the uBR7200-NPE-G1, to ensure best performance.

Item	Description
Standard Management Information Bases (MIBs)	IF-MIB (RFC-2233)
	ENTITY-MIB (RFC-2737)
	MIBII (RFC1213)
	EtherLike-MIB (RFC-2665)
	IGMP-MIB (RFC-2993)
	RMON-MIB (RFC-1757)
Expression MIBs	Simple Network Management Protocol (SNMP)v2-CONF
	SNMPv2-SMI
	SNMPv2-TC
	SNMPv2-MIB
	IANAifType-MIB
SNMPv3 MIBs	SNMP-FRAMEWORK-MIB (RFC-2571)
	SNMP-MPD-MIB (RFC-2572)
	SNMP-NOTIFICATION-MIB (RFC-2573)
	SNMP-TARGET-MIB (RFC-2573)
	SNMP-USM-MIB (RFC-2574)
	SNMP-VACM-MIB (RFC-2575)
DOCSIS and Euro-DOCSIS MIBs	DOCS-IF-MIB (v2 Rev04)
	DOCS-CABLE-DEVICE-MIB (RFC2669)
	DOCS-BPI-PLUS-MIB (Rev 5)
	DOCS-QOS-MIB (Rev 4)
	DOCS-CABLE-DEVICE-TRAP-MIB
	DOCS-SUBMGT-MIB (Rev 2)

Item	Description
Cisco Generic MIBs	CISCO-SYSLOG-MIB
	CISCO-SMI-MIB
	CISCO-TC-MIB
	CISCO-PRODUCTS-MIB
	CISCO-FLASH-MIB
	CISCO-CONFIG-MAN-MIB
	CISCO-CONFIG-COPY-MIB
	CISCO-MEMORY-POOL-MIB
	CISCO-BULK-FILE-MIB
	CISCO-SONET-MIB
	CISCO-TCP-MIB
	CISCO-RTTMON-MIB
	CISCO-FTP-CLENT-MIB
	CISCO-IPMROUTE-MIB
	CISCO-QUEUE-MIB
	CISCO-IMAGE-MIB
	CISCO-ENVMON-MIB
	CISCO-ENTITY-VENDORTYPE-OID-MIB
	CISCO-PRODUCTS-MIB

Table 3.   Maximum DOCSIS and Euro-DOCSIS 1.1 Data Rates

Upstream Channel Width	Modulation Scheme	Baud Rate Sym/sec	Maximum Raw Bit Rate Mbit/sec
3.2 MHz	16-QAM	2.56 M	10.24
	QPSK		5.12
1.6 MHz	16-QAM	1.28 M	5.12
	QPSK		2.56
800 kHz	16-QAM	640 K	2.56
	QPSK		1.28
400 kHz	16-QAM	320 K	1.28
	QPSK		0.64
200 kHz	16-QAM	160 K	0.64
	QPSK		0.32

Table 4.   Maximum DOCSIS and Euro-DOCSIS 2.0 (A-TDMA mode) Data Rates

Upstream Channel Width	Modulation Scheme	Baud Rate Sym/sec	Maximum Raw Bit Rate Mbit/sec
6.4 MHz	64-QAM	5.12 M	30.96
	32-QAM		25.80
	16-QAM		20.64
	8-QAM		15.48
	QPSK		10.30
3.2 MHz	64-QAM	2.56 M	15.48
	32-QAM		12.90
	16-QAM		10.30
	8-QAM		7.68
	QPSK		5.12
1.6 MHz	64-QAM	1.28 M	7.68
	32-QAM		6.45
	16-QAM		5.12
	8-QAM		3.84
	QPSK		2.56
800 kHz	64-QAM	640 K	3.84
	32-QAM		3.20
	16-QAM		2.56
	8-QAM		1.92
	QPSK		1.28
400 kHz	64-QAM	320 K	1.92
	32-QAM		1.60
	16-QAM		1.28
	8-QAM		0.96
	QPSK		0.64
200 kHz	64-QAM	160 K	0.96
	32-QAM		0.80
	16-QAM		0.64
	8-QAM		0.48
	QPSK		0.32

Table 5. Ordering

Part Number	Description
UBR-MC28U	Cisco uBR7246VXR Line Card, 2 downstreams with upconverter, 8 upstreams, A-TDMA, Adv PHY, CPU
UBR-MC28X	Cisco uBR7246VXR Line Card, 2 downstreams, 8 upstreams, A-TDMA, Adv PHY, CPU, no upconverter
UBR-MC16U	Cisco uBR7246VXR Line Card, 1 downstream with upconverter, 6 upstreams, A-TDMA, Adv PHY, CPU
UBR-MC16X	Cisco uBR7246VXR Line Card, 1 downstream, 6 upstreams, A-TDMA, Adv PHY, CPU, no upconverter

CISCO SYSTEMS

Corporate Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-4000
      800 553-NETS (6387)
Fax: 408 526-4100

European Headquarters
Cisco Systems International
BV
Haarlerbergpark
Haarlerbergweg 13-19
1101 CH Amsterdam
The Netherlands
www-europe.cisco.com
Tel: 31 0 20 357 1000
Fax: 31 0 20 357 1100

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-7660
Fax: 408 527-0883

Asia Pacific Headquarters
Cisco Systems, Inc.
168 Robinson Road
#28-01 Capital Tower
Singapore 068912
www.cisco.com
Tel: +65 6317 7777
Fax: +65 6317 7799

Cisco Systems has more than 200 offices in the following countries and regions. Addresses, phone numbers, and fax numbers are listed on
the Cisco Web site at www.cisco.com/go/offices.

Argentina • Australia • Austria • Belgium • Brazil • Bulgaria • Canada • Chile • China PRC • Colombia • Costa Rica • Croatia • Cyprus
Czech Republic • Denmark • Dubai, UAE • Finland • France • Germany • Greece • Hong Kong SAR • Hungary • India • Indonesia • Ireland
Israel • Italy • Japan • Korea • Luxembourg • Malaysia • Mexico • The Netherlands • New Zealand • Norway • Peru • Philippines • Poland
Portugal • Puerto Rico • Romania • Russia • Saudi Arabia • Scotland • Singapore • Slovakia • Slovenia • South Africa • Spain • Sweden
Switzerland • Taiwan • Thailand • Turkey • Ukraine • United Kingdom • United States • Venezuela • Vietnam • Zimbabwe