

# **Cisco DOCSIS 2.0 Overview**

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# DOCSIS 2.0 Public Position Statement

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**Cisco fully supports DOCSIS 2.0 as part of our ongoing commitment to the success of the cable industry and to open standards**

- **We have been committed to the success of the DOCSIS standards process from the beginning, and we continue to be**
- **We actively participated in and contributed intellectual property to the DOCSIS 2.0 specification process**
- **We are currently working on DOCSIS 2.0-based line cards for both our uBR7246VXR and uBR10012 platforms**
- **MC520s card will be the *\*first\** DOCSIS 2.0 capable cards for *\*production\** networks – at least *\*6 months\** before competition**

# DOCSIS 2.0 Spec Overview

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- Spec enables both A-TDMA & S-CDMA upstream
  - ✍ Advanced PHY technologies expand upstream capacity
    - Improves throughput at current data rates of 2.5 to 10 Mbps
    - Increases max data rate to 30 Mbps
- **Most customers & vendors prefer A-TDMA**, but spec requires dual-mode at CPE and CMTS
  - ✍ Some customers believe S-CDMA may offer future advantages, so dual-mode CPE is an insurance policy
  - ✍ No known advantage to dual-mode CMTS, CableLabs may grant waivers for compliance with single-mode
- Current base of S-CDMA modems (from Terayon) are **not compatible OR upgradeable** with DOCSIS 2.0 and **cannot** interoperate with any DOCSIS 2.0-compliant CMTS

# DOCSIS 2.0 Spec Status

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- Spec is still a work in progress
  - ✍ Initial spec release 12/31/01
  - ✍ ECR/ECNs have historically peaked 24 months after the first spec is released (for DOCSIS 1.0 and 1.1)
- Cisco contributed a critical piece of DOCSIS 2.0:
  - ✍ DOCSIS MAC-PHY Interface (**DMPI**) enables interchangeable PHYs from chip vendors
  - ✍ **Already built in to Cisco 3G MAC, giving us a significant time-to-market advantage**
- No vendor yet has DOCSIS 2.0 compliant CMTS
  - ✍ Terayon's current CMTS **DOES NOT** comply on A-TDMA
  - ✍ Other vendors do not comply on S-CDMA

# Cisco DOCSIS 2.0 Product Plan

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- **Implementing A-TDMA PHY 3G MAC in line cards**
  - ✍ MC520S for ubr10K, FCS in Q3-4 CY'02
  - ✍ MC28U for VXR, FCS in Q1 CY'03
  - ✍ Software support will follow by one to two quarters
- **Working with chip vendors for dual-mode support**
  - ✍ Vendors include Broadcom, TI, Imedia (Terayon spinoff)
  - ✍ Production chips targeted for Q4 CY'02, product availability likely in 2H CY'03, if demand warrants
- **Cisco a huge lead on other vendors**
  - ✍ We are only buying PHY chips, others need MAC/PHY
  - ✍ MAC/PHY more complex, lagging PHY by 6 months (minimum)

# Complexity of DOCSIS 1.0 vs DOCSIS 1.1 vs 2.0

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**Do you really need DOCSIS 2.0 today?**

## DOCSIS 1.0

- Specification = 208 pages
- Section on Cable Modem CMTS Interaction = 17 pages
- Single QOS per CM
- One SID
- One Class of Service
- All traffic is the same
- Not suitable for simultaneous Data/Voice/Video traffic

## DOCSIS 1.1

- Specification = 432 pages
- Section on Cable Modem CMTS Interaction = 75 pages
- Multiple SIDs
- Multiple Classes of Service
- Increased Security
- Different traffic types can be treated differently.
- Flexible QOS
- Configuration and Signaling.

## DOCSIS 2.0

- Specification = 480 pages
- Section on Cable Modem CMTS Interaction = 100+ pages
- DMPI
- DCC
- Advanced PHY
- A-TDMA and S-CDMA
- Increased US Bandwidth

# CISCO CMTS Qualification History = Industries Most DOCSIS Experience

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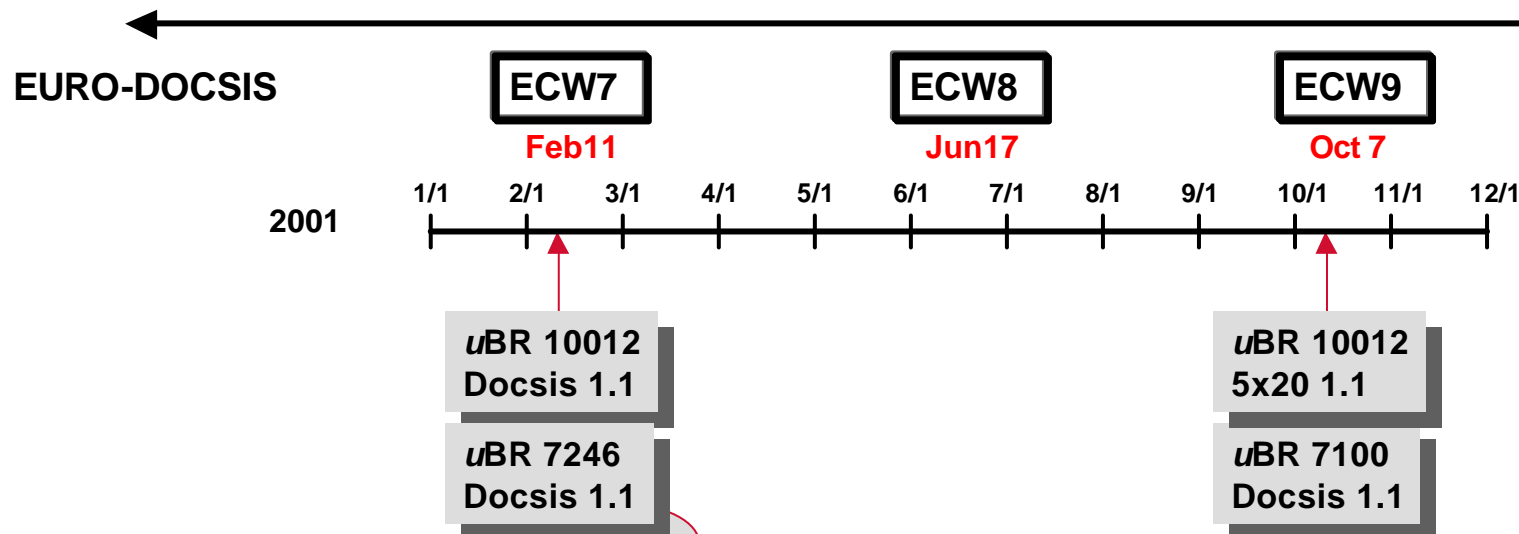
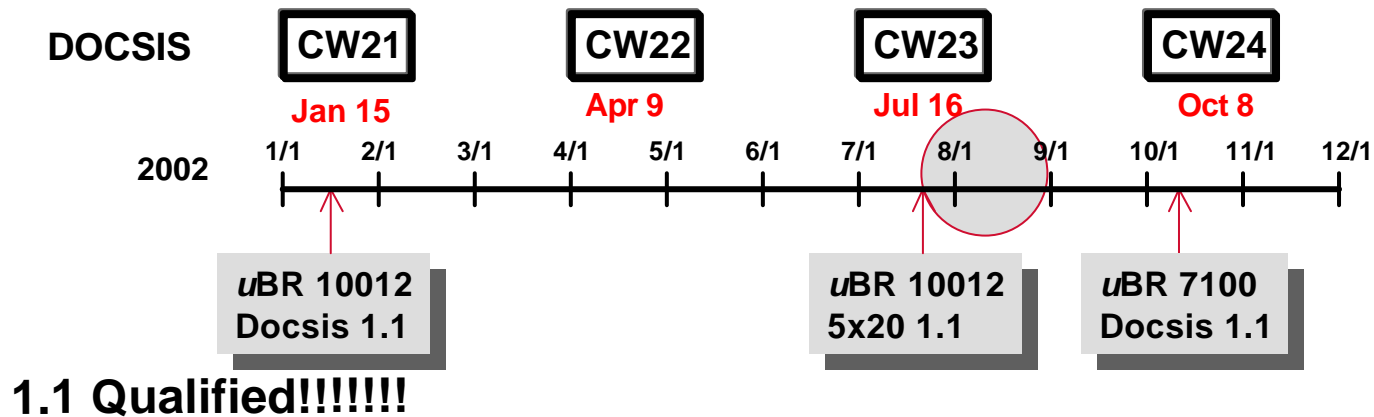
- Cisco has submitted more CMTS equipment to CableLabs than any other vendor
- Cisco has certified more CMTS products than any other vendor
- Cisco has passed CableLabs certification for every product on the 1<sup>st</sup> or 2<sup>nd</sup> try

	Product	Cert Wave	Attempts	Comments
Docsis 1.0 - NA	uBR10012	20	3	Passed
	uBR7246 MC11-fpga	7	1	First CMTS ever passed
	uBR7246 MC16c	11	2	Passed
	uBR7246VXR MC16c	14	1	Passed
	uBR7246VXR MC16c	15	1	Passed
	uBR7246VXR MC16c	16	1	Passed
	uBR7100	17	1	Passed
Docsis 1.1 - NA	uBR7246VXR	20	2	First Layer 3 to Pass
	uBR10012	21	1	<b>DOCSIS 1.1 QUALIFIED!</b>
Docsis 1.0 - Euro	uBR10012	6	1	Passed
	uBR7246	2	2	<b>No Euro CMs</b>
	uBR7246VXR	N/A	1	Passed
	uBR7100	4	1	Passed

**Green** = CableLabs Certified

# CMTS Qualification Roadmap 2002

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# Key Features of DOCSIS

# DOCSIS Data Rate Upstream

US Channel Width	Modulation Scheme	Baud Rate Sym/sec	Raw Bit Rate Mbit/sec
6.4 MHz	64 QAM	5.120 M/sym	30.72
	16 QAM		20.48
	QPSK		10.24
3.2 MHz	64 QAM	2.560 M/sym	15.36
	16 QAM		10.24
	QPSK		5.12
1.6 MHz	64 QAM	1.280 M/sym	7.68
	16 QAM		5.12
	QPSK		2.56
0.8 MHz	64 QAM	640 K/sym	3.84
	16 QAM		2.56
	QPSK		1.28
0.4 MHz	64 QAM	320 K/sym	1.92
	16 QAM		1.28
	QPSK		0.64
0.2 MHz	64 QAM	160 K/sym	1.28
	16 QAM		0.64
	QPSK		0.32

# Annex G - DOCSIS 2.0 and 1.0/1.1 Interoperability

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- **DOCSIS 2.0 is the third generation of the DOCSIS specification.**
- **The DOCSIS 2.0 specification primarily aims at enhancing the limited upstream physical layer performance of a DOCSIS 1.0 or 1.1 based cable access system.**
- **Two new MAC Management Message Types have been defined, and several new parameter encodings have been defined in the existing MAC messages.**
- **A DOCSIS 2.0 CMTS is capable of supporting a higher upstream throughput for a given channel bandwidth, as well as, increased tolerance to noise experienced in the upstream.**
- **As well as supporting DOCSIS 2.0 capable CMs, the DOCSIS 2.0 CMTS must be backwards compatible with DOCSIS 1.0 and DOCSIS 1.1 CMs.**
- **Furthermore, it is necessary for a DOCSIS 2.0 CM to function like a 1.0 CM when interoperating with a 1.0 CMTS and to function like a 1.1 CM when interoperating with a 1.1 CMTS.**

# DOCSIS 2.0 Modulation Format Requirements

- The upstream modulator **MUST** provide QPSK and 16QAM differential encoded modulations for TDMA.
- The upstream modulator **MUST** provide QPSK, 8QAM, 16QAM, 32QAM, and 64QAM modulations for TDMA and S-CDMA channels.
- The upstream modulator **MUST** provide QPSK, 8QAM, 16QAM, 32QAM, 64QAM and 128QAM TCM encoded modulations for S-CDMA channels.
- The upstream demodulator **MAY** support QPSK and 16QAM differential modulation for TDMA.
- The upstream demodulator **MUST** support QPSK, 16QAM, and 64QAM modulations for TDMA and S-CDMA channels.
- The upstream demodulator **MAY** support 8QAM and 32QAM modulation for TDMA and S-CDMA channels.
- The upstream demodulator **MAY** support QPSK, 8QAM, 16QAM, 32QAM, 64QAM, and 128QAM TCM encoded modulations for S-CDMA channels.

# How will Cisco deliver 2.0 Advanced PHY?

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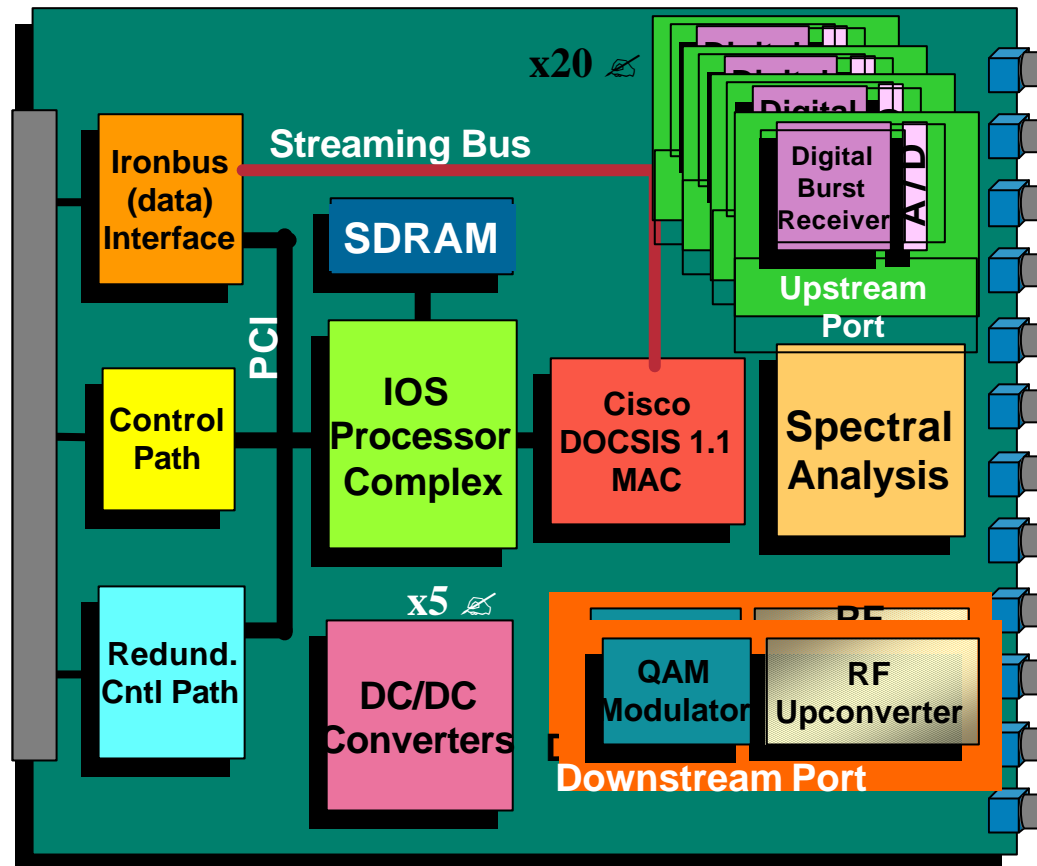
**Answer: MC520s and MC28u**

- **MAC**
  - ✍ Cisco JIB MAC (DMPI Interface – 2.0 Requirement)
- **Phys**
  - ✍ TI ATDMA Upstream / Broadcom Downstream
- **Integrated Upconverter**
- **Integrated Spectrum Management**
- **Distributed Processing**
- **Flexible Upstream/Downstream Assignment**
- **Dense Connector**

**DMPI = Distributed Mac Phy Interface**

# What is the MC520?

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- 5 Downstream/20 Upstream
- Local processor for MAC management (**Does not touch the data**)
- Hardware acceleration of DOCSIS 1.1 functions
- Integrated MAC level HW & SW
- Cisco optimized advanced MAC / PHY technology(**DMPI**)
- Embedded Spectrum Management
- Optional Integrated Upconverters
- Flexible/scalable to higher densities
- Native ubr10012 LineCard

# DOCSIS 1.1 Software

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- 12.2(x)BCx ✍ today is 12.2(8)BC1(On CCO May 20<sup>th</sup>)  
DOCSIS 1.1 from day one  
**Single Image for ubr7100, ubr7246vxr, ubr10k**  
Supports 1.0 and 1.1 **simultaneously**  
Supports BPI/BPI+  
Supports Fragmentation, PHS, Concatenation, etc  
Enhanced advanced DOCSIS Scheduler  
**Extensive DOCSIS troubleshooting info**

# DOCSIS C/N Requirements

<b>System/Channel</b>	<b>MCNS Specifications</b>	<b>Recommended Settings</b>
Carrier to noise (upstream)	> 25 dB (QPSK) > 25 dB (16 QAM)	> 15 dB (QPSK) > 18 dB (16 QAM)
Carrier to interference (upstream)	> 25 dB (QPSK) > 25 dB (16 QAM)	> 15 dB (QPSK) > 18 dB (16 QAM)
Carrier to noise (downstream)	> 23.5 dB (64 QAM) > 35 dB (256 QAM)	> 25 dB (64 QAM) > 33 dB (256 QAM)
Carrier to hum	< -26 dBc	< -26 dBc
Carrier to second order	< -50 dBc	< -50 dBc
Amplitude variation	0.5 dB in 6 MHz	0.5 dB in 6 MHz
Group delay	75 ns in 6 MHz	75 ns in 6 MHz
<b>Digital Signal Levels</b>	<b>MCNS Specifications</b>	<b>Recommended Settings</b>
From cable modem (upstream)	8 to 58 dBmV	35 to 55 dBmV
Input amplitude to modem card (upstream)		-8, 0, or 8 dBmV
From headend (downstream)	-15 to 15 dBmV	-15 to 15 dBmV
Signal as relative to adjacent video signal	-6 dB or -10dB	-6 dB or -10 dB

# DOCSIS 1.0 vs 1.1 vs 2.0 C/N and BER

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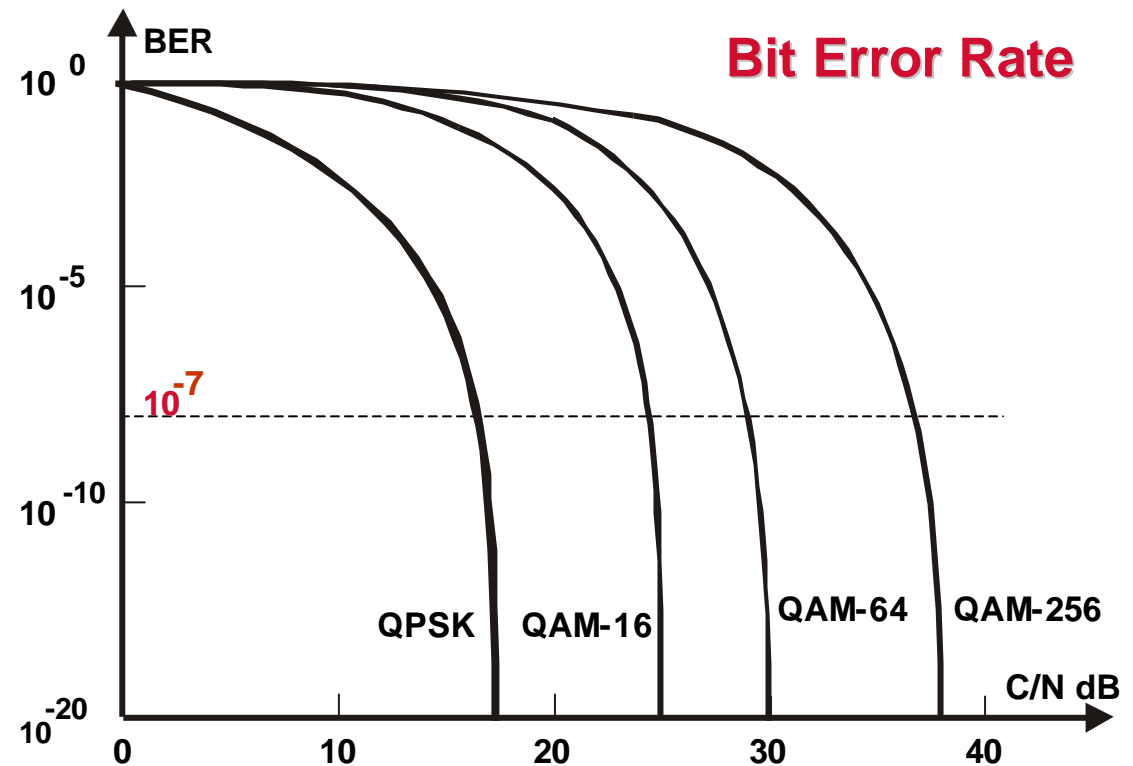
- **BER(bit error rate)**

- ✍ Erred bits among total transmitted payload

- ✍ BER of 1 in 10 million payload bits acceptable

- ✍ **Main cause is low C/N**

- ✍ **Sharp threshold**



**DOCSIS 2.0** will require **SIGNIFICANT** improvements on upstream Carrier-to-Noise

# Cisco DOCSIS 2.0 Summary

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- Cisco strongly supports DOCSIS 2.0
- DOCSIS 2.0 CMTS's will be deployed in two phases
  - ✍ Phase 1: single-mode, most vendors (except Terayon) will start with A-TDMA
  - ✍ MC520S will be first production implementation
  - ✍ Phase 2: dual-mode S-CDMA & A-TDMA
- Cisco leads the market in both phases
  - ✍ MC520S will be first production A-TDMA implementation
  - ✍ At least 6 month lead in dual-mode chips

**DOCSIS 2.0 is a good thing for Cisco, and helps us debunk “NextGen” myth and shift to “3<sup>rd</sup> Generation” where we lead with our “3G” MAC technology**



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