WIDEBAND PROTOCOL FOR DOCSIS NETWORKS

A NEW BROADBAND FUTURE FOR CABLE

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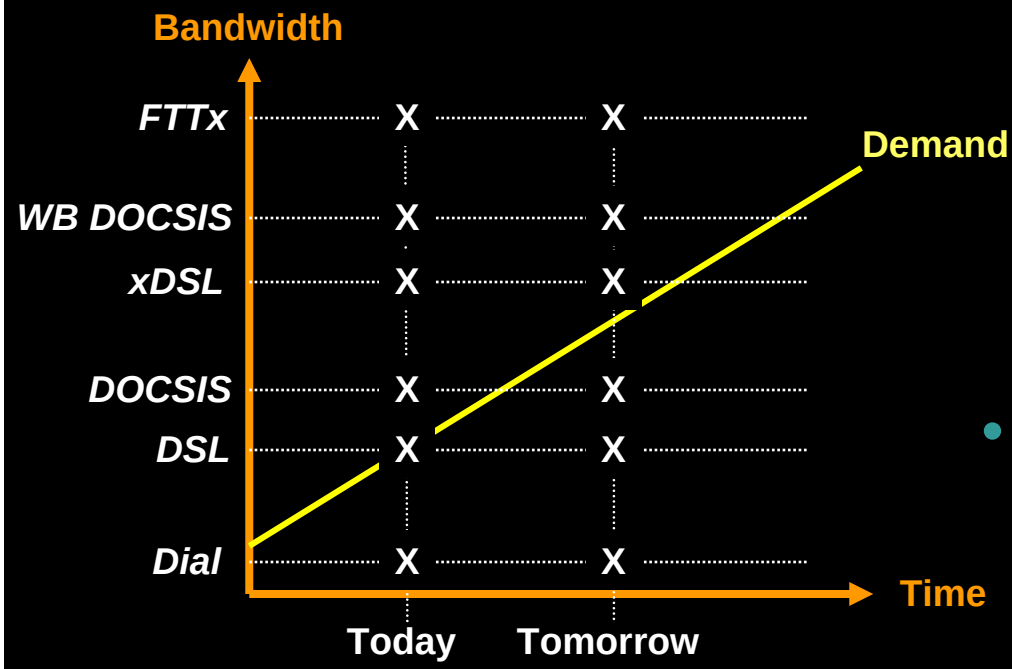
The Upward Bandwidth Trend



- **Today**
  - DOCSIS is ahead of the curve
  - DSL is at the wall
  - Dial is behind the curve
- **Tomorrow**
  - DOCSIS will fall behind the curve unless bandwidth can be increased 10x to 100x and eventually 1000x

Bit Capacity of the HFC Plant

HFC Downstream is ~131 channels. At 256QAM: 131 channels * 38 Mbps =	~ 5 Gbps per FN
At one optical transmitter per 500 HHP FN: 5 Gbps / 500 HHP =	~ 10 Mbps per HHP
# of HDTV streams per HHP with H.264 (AVC): 10 Mbps / 7 Mbps =	~ 1.4 HD streams per HHP
Data Capacity in a 100K HHP plant: 5 Gbps per FN * (100K HHP/500 HHP per FN)= 5 Gbps per FN * 200 FN =	~ 1 Tbps per small plant

Cable's Upside Bandwidth Potential

Case Study:

- 100K HHP HFC plant with 500 HHP per Fiber Node
- Service Group (SG) is the # of FN with the same service offering

Service	Channels		Digital BW	# SG	Capacity	
Analog	79	60%	x 3.75 Mbps	x 1 SG =	0.3 Gbps	3%
Digital	43	33%	x 38 Mbps	x 1 SG =	1.7 Gbps	15%
VOD	8	6%	x 38 Mbps	x 50 SG =	15 Gbps	72%
DOCSIS	9	7%	x 38 Mbps	x 50 SG =	2 Gbps	10%
Total	131				19 Gbps	

Bandwidth Used Today

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Total available Bandwidth

Capacity	131	x 38Mbps	x 200 SG =	1000 Gbps

Efficiency **1.9%**

✗ **Change the Plant Infrastructure**

✓ **Re-organizing the bits on the plant**

The Wideband Protocol

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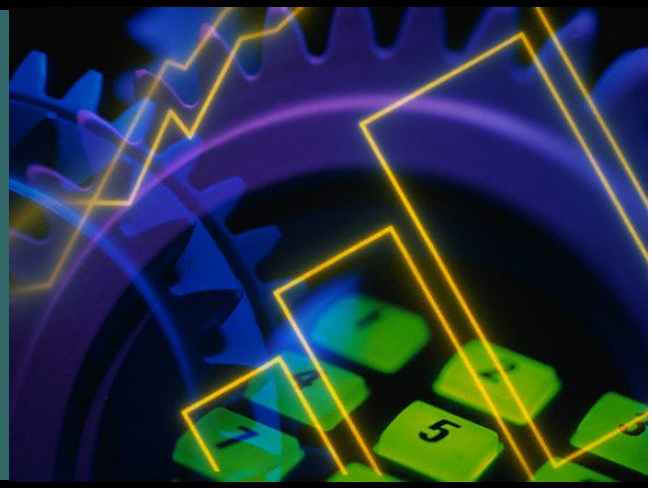
A New Broadband Future for Cable

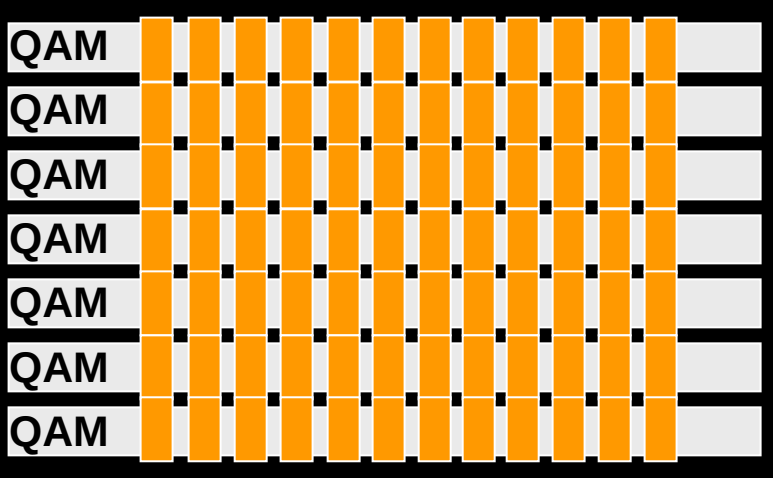


The Wideband Protocol does just that …

Traditional DOCSIS Downstream Channel

Single QAM

Wideband Downstream Channel



Multiple QAMs

Wideband Architecture on Existing Deployments

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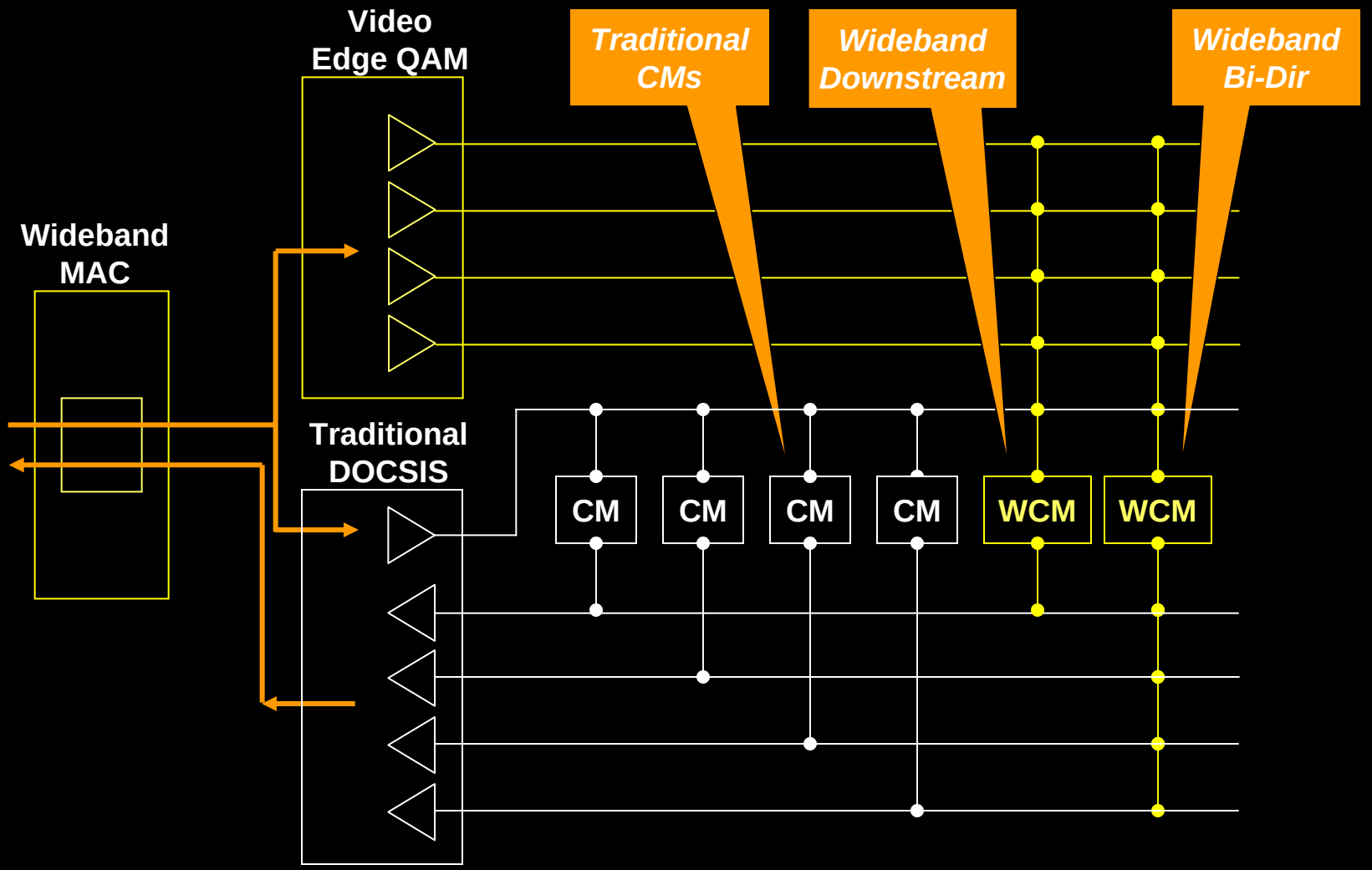
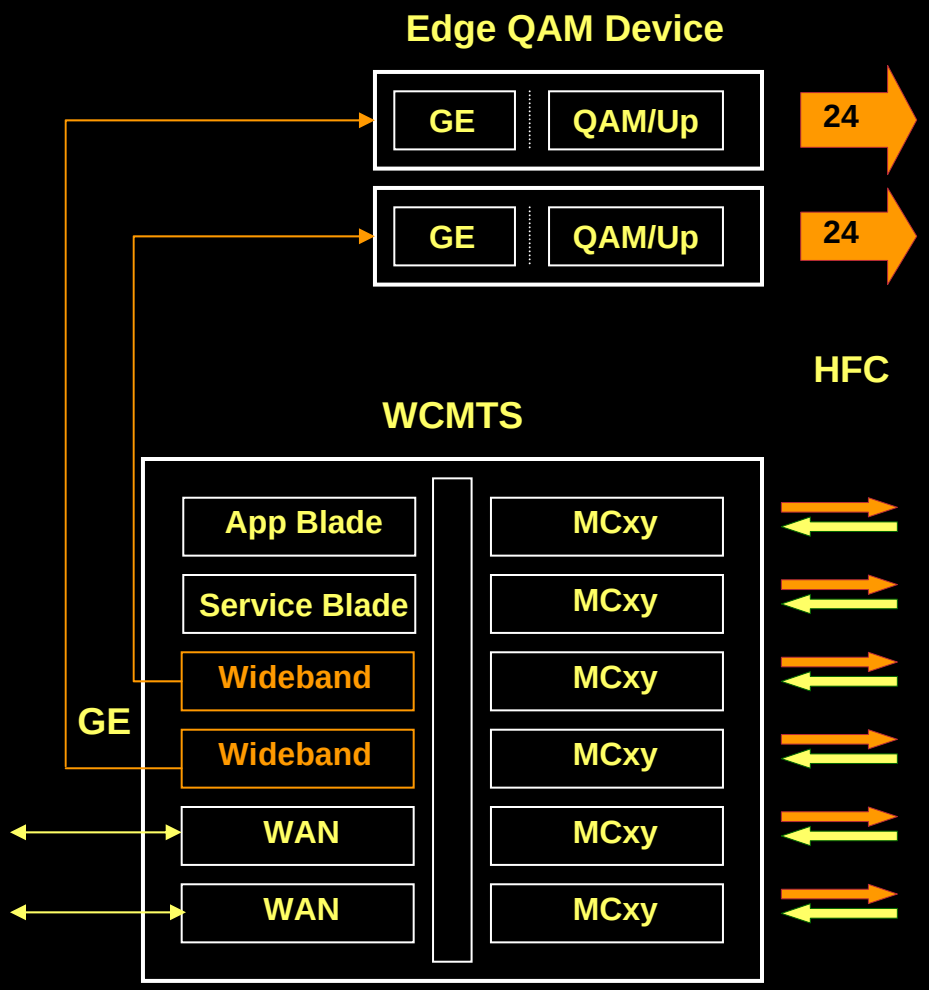


Wideband CMTS

- WB MAC fits into CMTS
- Interfaces to external Edge QAM devices for downstream
- Interfaces to traditional DOCSIS cards for upstream.



5 Year Goal

Downstream: 1 Gbps per FN
Upstream: 100 Mbps per FN

- **Downstream**
  - **~ 24 QAMs. 20% of downstreams for IP.**
  - **Lines up nicely with GE backhauls.**
- **Upstream**
  - **4 to 8 QAMs.**
  - **Expansion of RF BW to 65 MHz or 85 MHz helps.**
- **Asymmetrical BW is okay.**
  - **HFC Plant bandwidth is 22:1**
  - **Revenue generating BW is downstream BW.**

Scaling to 100x

CMTS to Plant Connectivity	Relative Capacity	
1 DOCSIS DS across 24 FN	--	1x
1 DOCSIS DS across 4 FN	1 x	6x
4 DOCSIS DS across 4 FN	4 x	24x
4 DOCSIS DS across 1 FN	16 x	100x
24 DOCSIS DS across 1 FN	100 x	600x

- A 100 times increase in downstream data capacity from today can be achieved without any impact to the outside plant and with only 20% of the downstream RF BW.
- A 100 times increase in downstream data capacity from 1998 (1x6 card, 4 FN per US) could be achieved with 4 DOCSIS DS per FN. If done by 2008, that would be a factor of 100x over a period of 10 years!

Summary

- The goal of the Wideband Protocol for a DOCSIS Network is to provide 10x the throughput at 1/10th the cost.
- There is an incredible amount of bandwidth on today's HFC plant. The challenge is to mine this bandwidth by re-organizing the bits on the HFC plant.
- Downstream Wideband is first priority

- Round 1 was dial-up: telcos won the transport
- Round 2 is broadband: Cable initially won.
- Round 3 will be wideband: Who is going to win?