

100BASE-Cu Details

Proposed Copper EFM PHY



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Propose that the 100BaseCu PHY, as described by Elastic Networks in March [1], and May [2], be studied as a candidate for the copper based EFM, to bridge the gap from the Optical MAN to the subscriber LAN when the infrastructure does not support optical EFM options

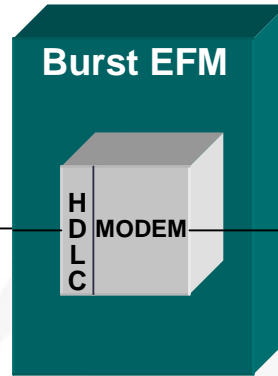
100BaseCu IS NOT VDSL. It is a half-duplex, burst mode, frequency agile, symmetry agile, spectrally compatible access technology that builds on successfully deployed technology, and was shown in [1] to provide superior rate and reach performance compared to VDSL and ADSL.

This symmetry agile Time Division Duplexing technology does NOT require central synchronization, or common timing between carriers

Burst Mode vs. Constant Transmissions

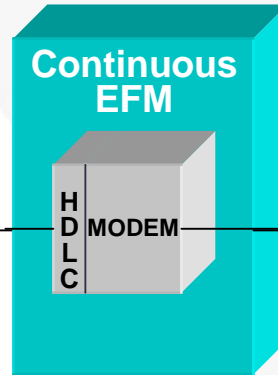


10/100BASE-T LAN



Silent Periods:
No Crosstalk Generated
Can measure SNR
Can Identify Crosstalk Coupled Systems

10/100BASE-T LAN



Idle Packets:
Crosstalk Generated
No measurement possible

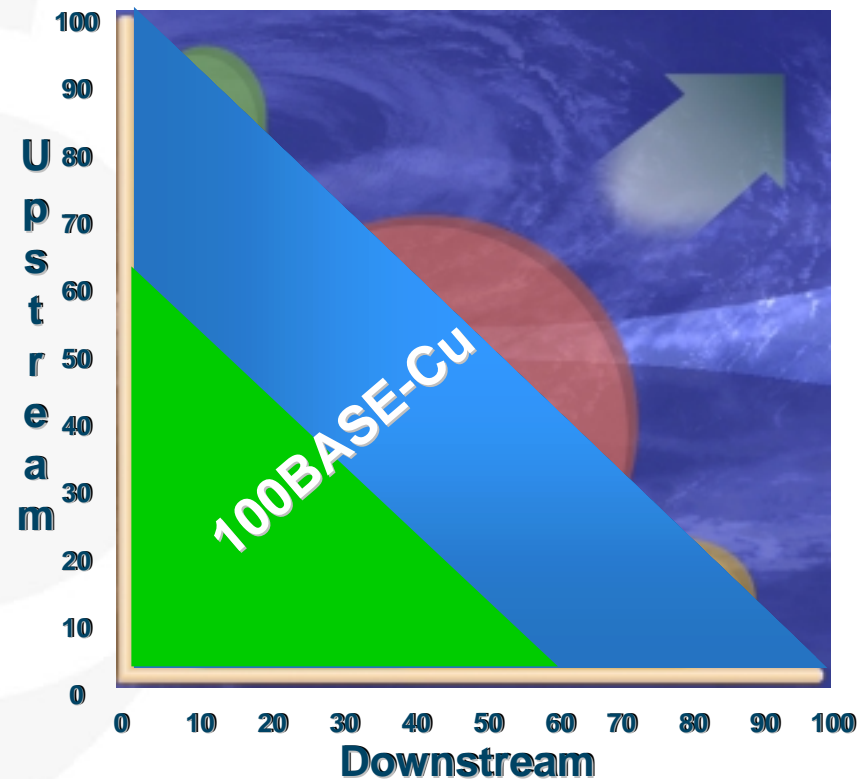
100BASE-Cu:

Dynamically allocated

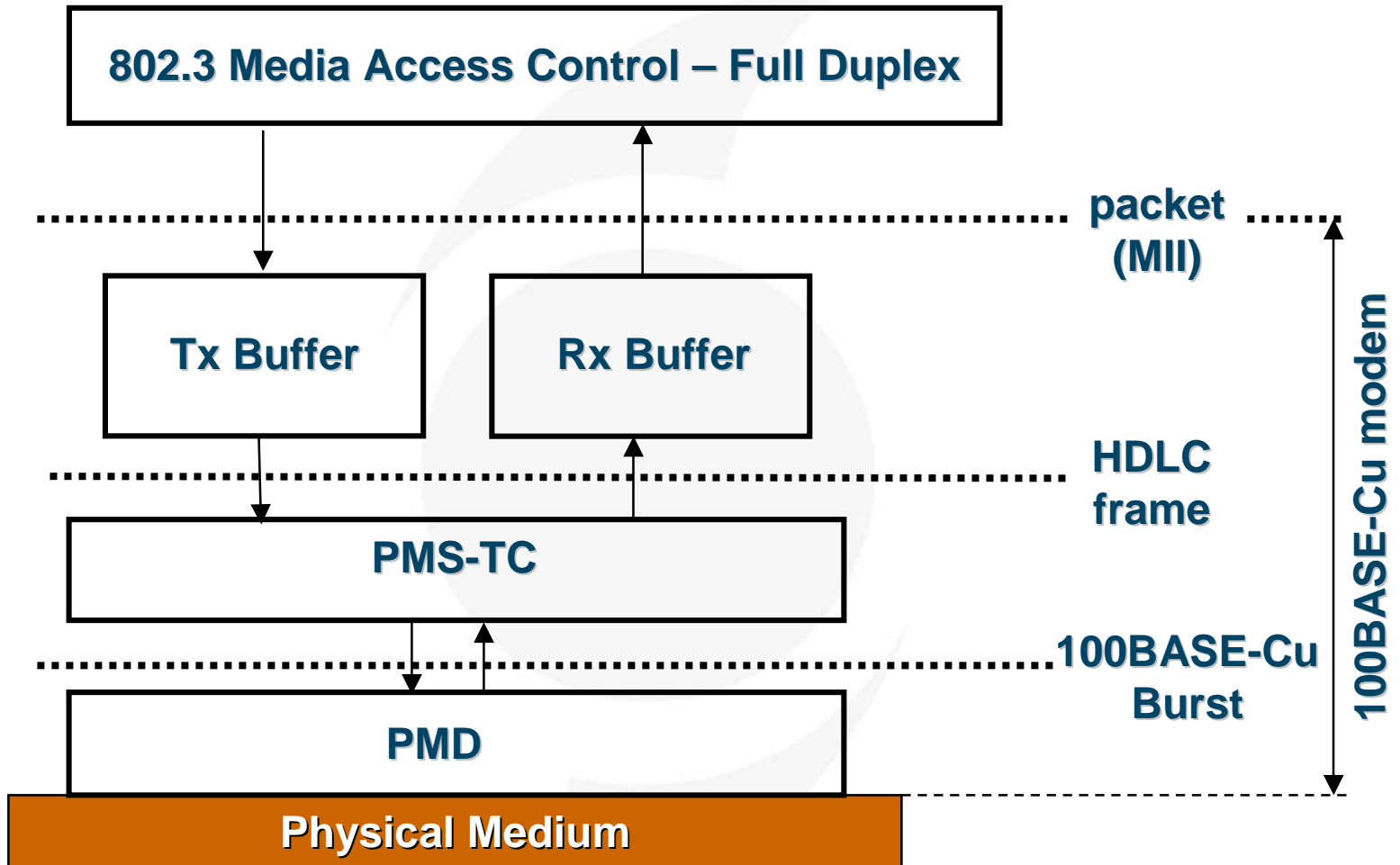
Based on Traffic Demand

The percentage of transmit time in each direction is proportional to offered traffic

Bandwidth for the Interactive Internet



100BASE-Cu PHY



Buffer Fill Ratio Determines Symmetry



Each Burst contains up to a maximum number of bytes per burst

Based on ratio of Tx Buffer fill, one side or the other may be limited to less than this maximum in order to dynamically adapt the symmetry

If Tx Buffer fill is below a traffic threshold, then the 100BaseCu modem idles down to the lowest frequency speed, which minimizes crosstalk

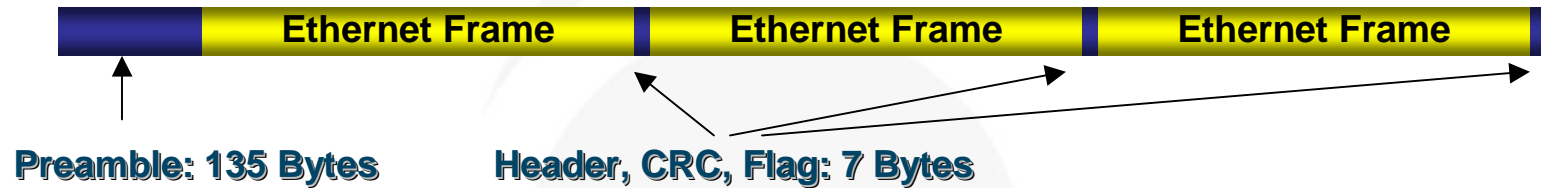
100BASE-Cu could issue PAUSE MAC Opcode when buffer is full, or to regulate speed to match loop-side speed

Speed changes and symmetry data communicated via management packets, which have a special Ethertype

Ethernet encapsulated in HDLC

HDLC Frames concatenated into burst

100BASE-Cu Burst:
31 1518 Byte Frames per Burst
Max



Preamble contains BPSK for timing recovery

HDLC inserts '0' bits

“Polling” packets, which report buffer fill, piggy back onto user data bursts

Fully compliant with T1.417 Spectrum Management Standard

- ◆ Including Short-Term Stationary (Burst Mode) Conformance Criteria
- ◆ Deployable without restrictions

Current FCC regulations treat in-building loops as unbundled

Current NRICV FG3 recommendation limits non-frequency agile systems to FSAN 998 Band Plan above 1.1MHz (undefined above 12MHz)

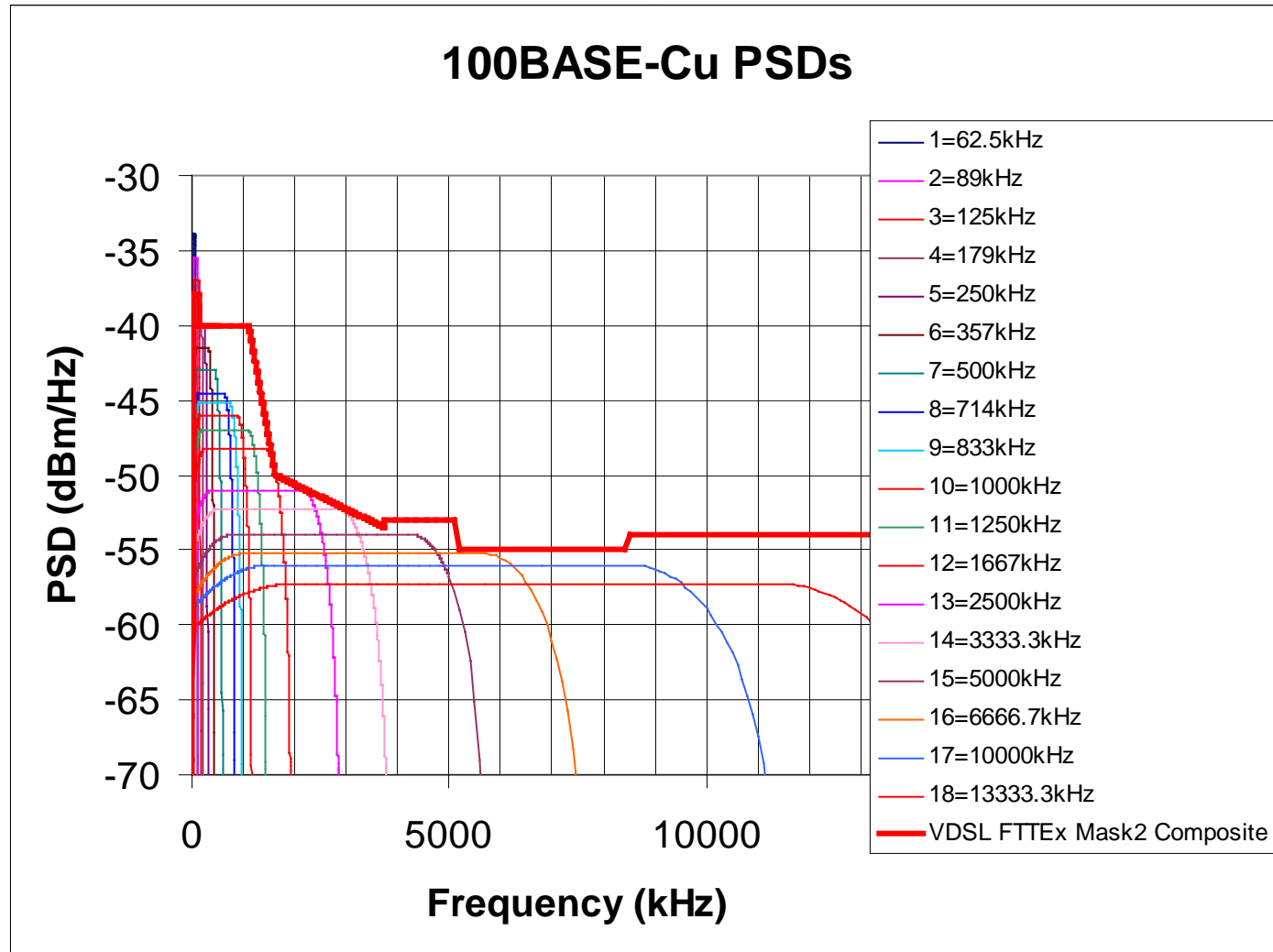
Silent periods allow crosstalk to be continuously monitored, and allows Spectrum Manager Function[1] to automatically ensure spectral compatibility

Compliant with T1E1.4 draft trial use VDSL PSD Mask when significant coupling exists with FDD systems

Lower emissions than VDSL

Total Power reduced on 4 mid rate symbol rates to comply with composite mask in draft Trial Use T1E1.4 Standard

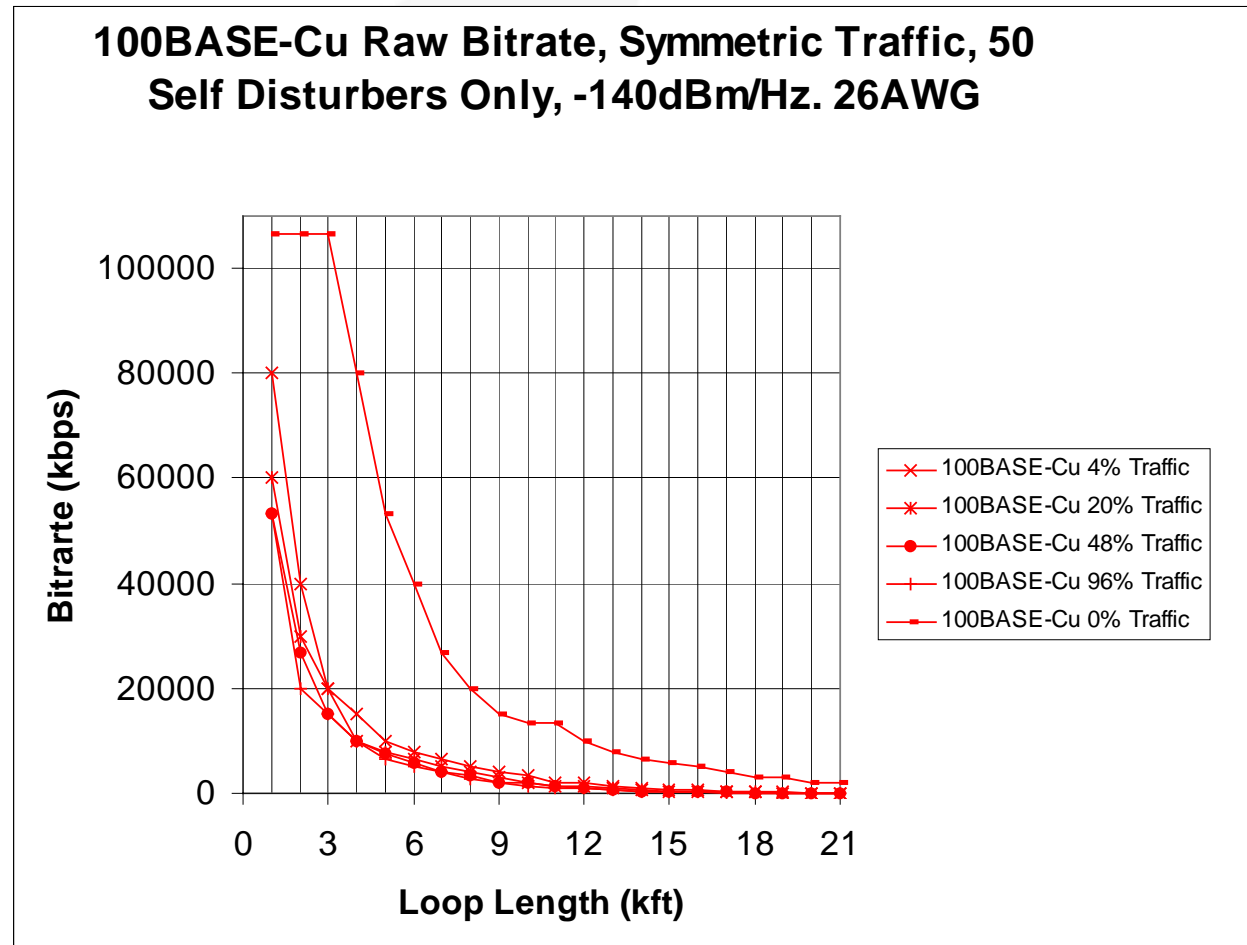
PSD of lowest symbol rates within T1.417 Spectrum Management Class PSDs



Self-Disturber Rate vs. Reach

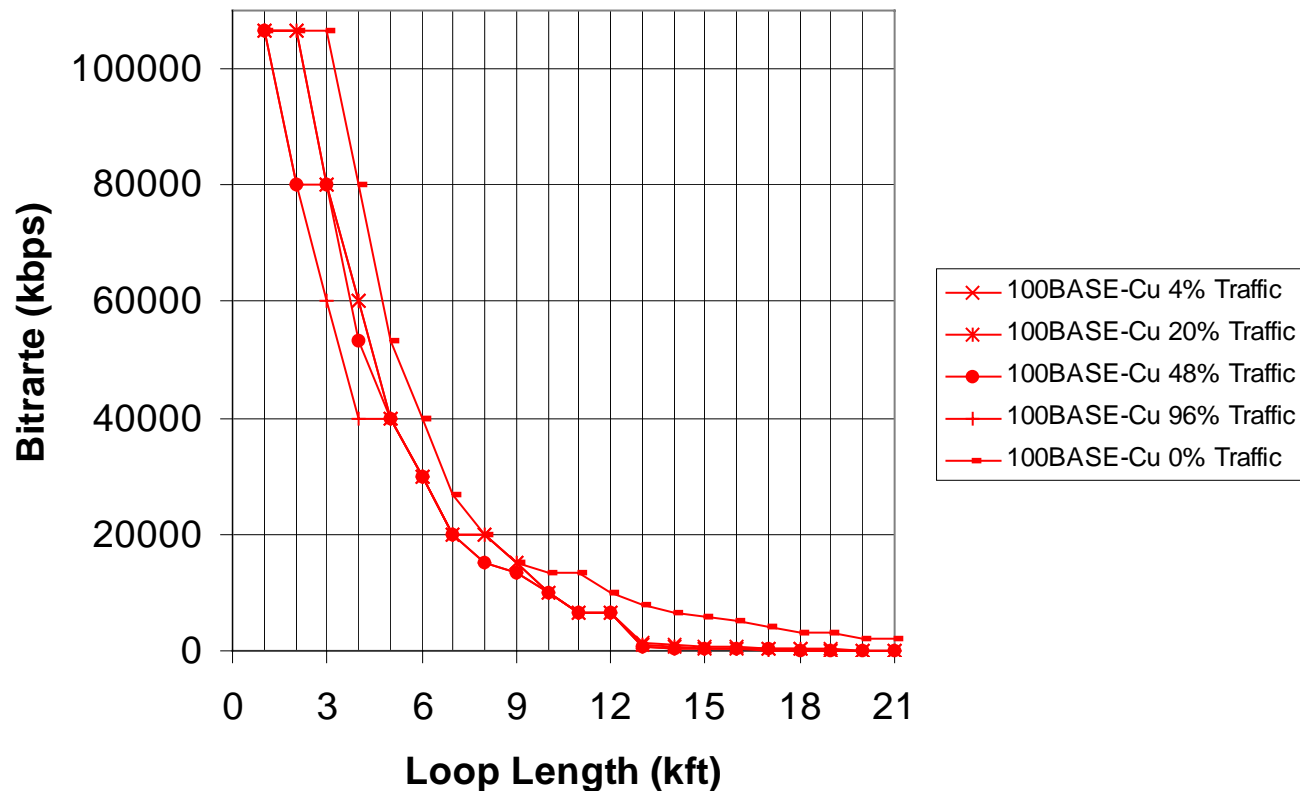
Simulation update from March Presentation [1].

- ◆ Loop model refined
- ◆ Reduced total power on 4 midrange speeds to comply with composite VDSL Mask

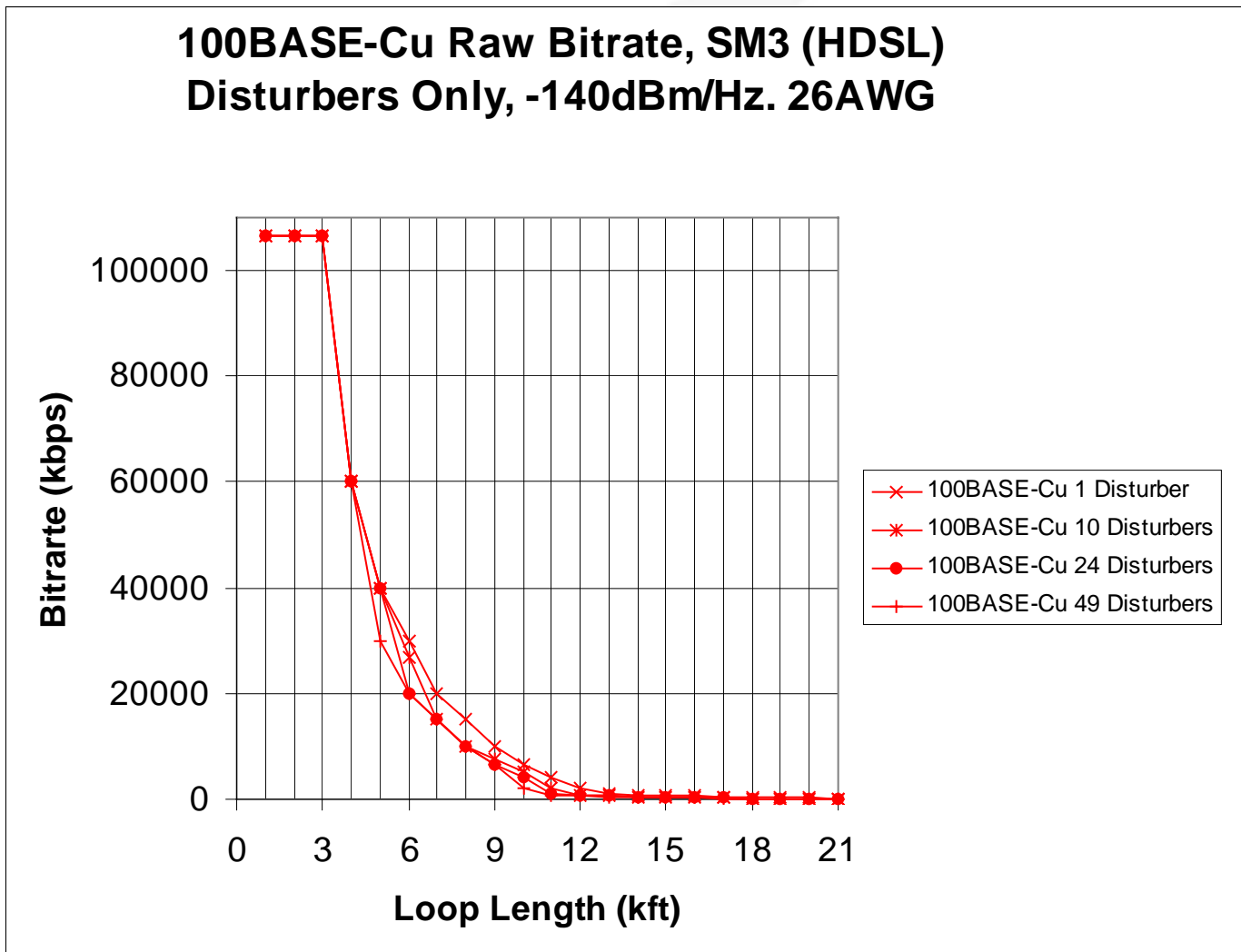


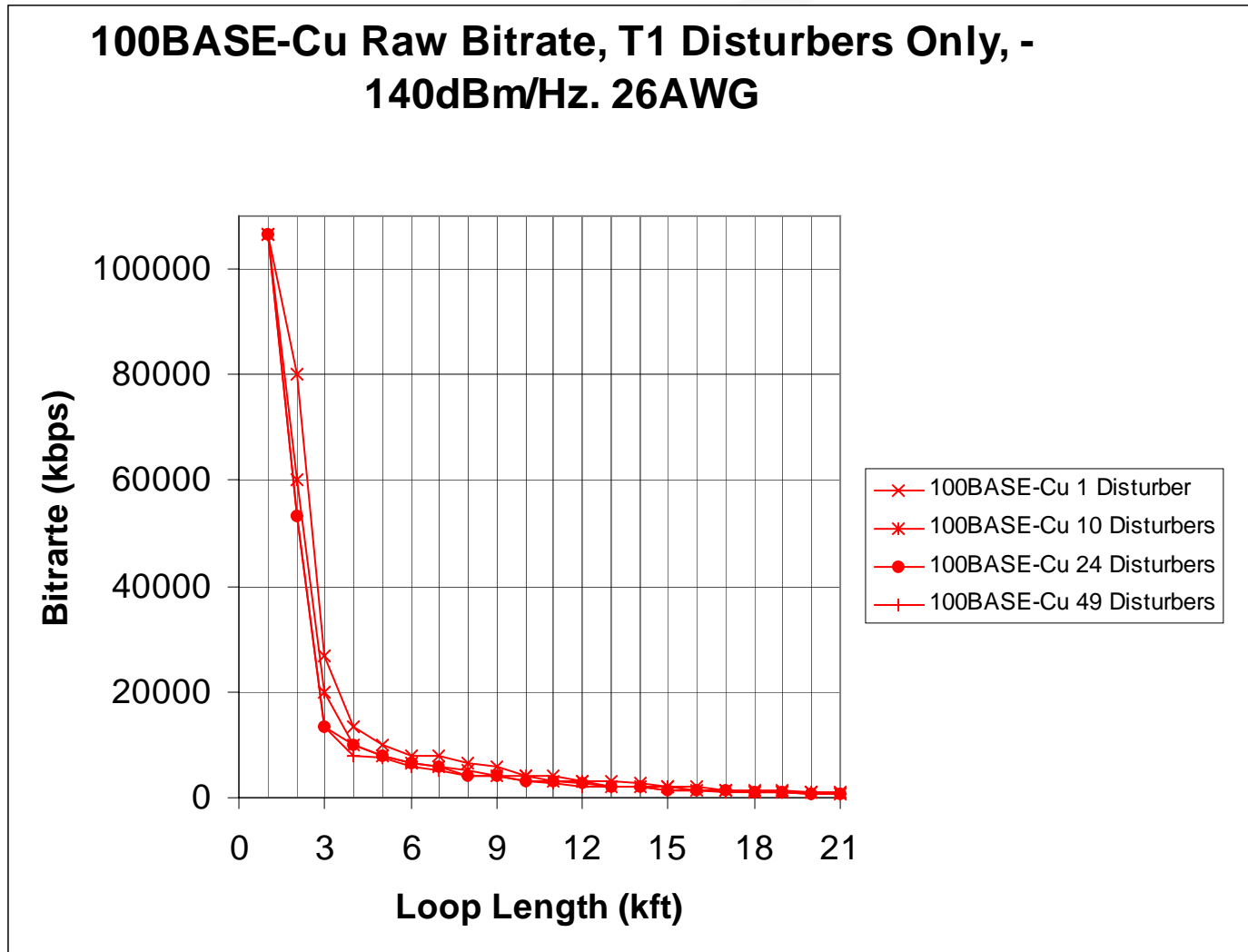
100BASE-Cu tuned to video delivery: upstream limited to 1.8Mbps

**100BASE-Cu Raw Bitrate, Asymmetric Mode, 50
Self Disturbers Only, -140dBm/Hz. 26AWG**



T1.417 Spectrum Management Class 3 (HDSL)

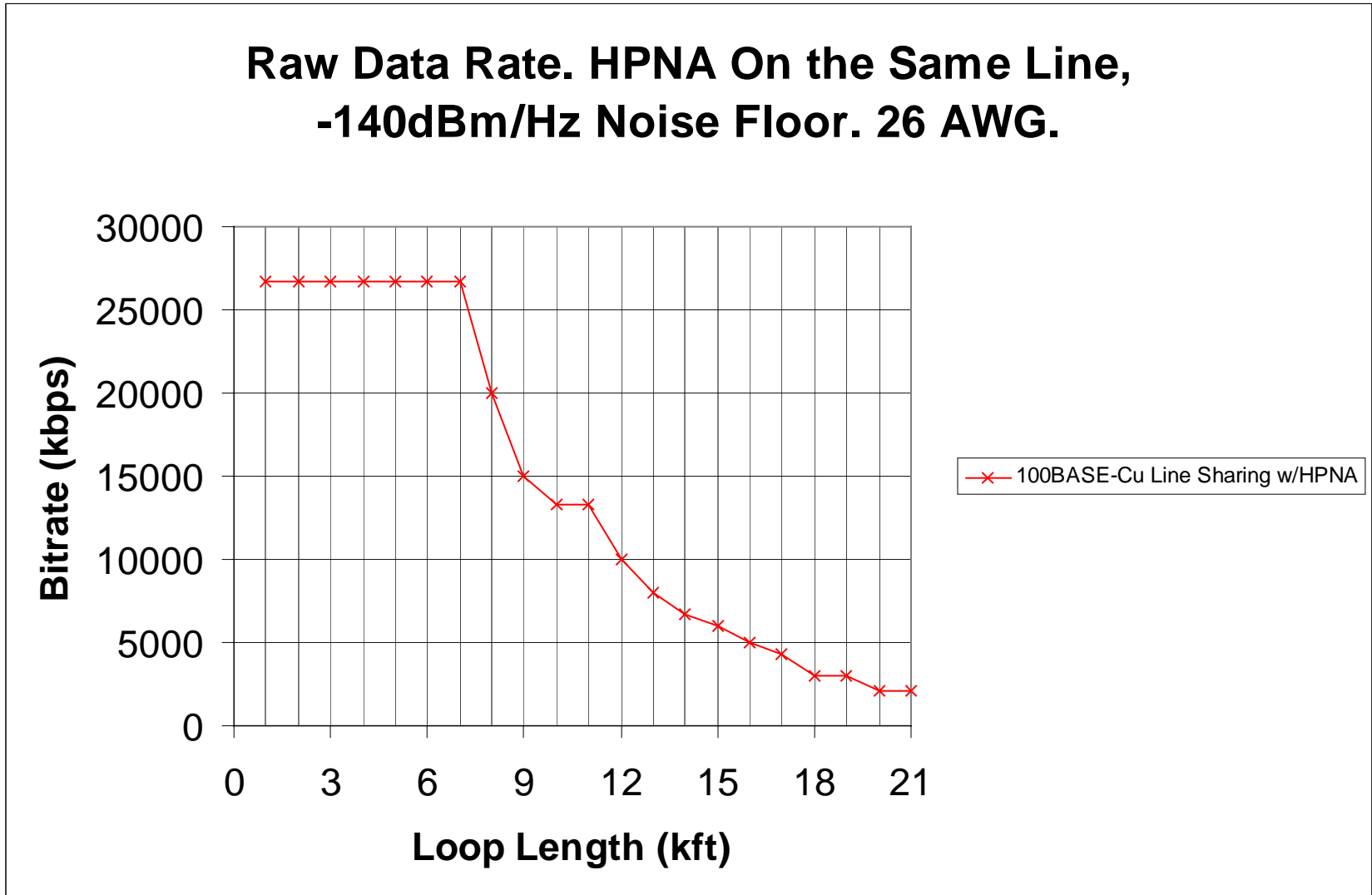




HPNA Line Sharing Rate vs. Reach



**Raw Data Rate. HPNA On the Same Line,
-140dBm/Hz Noise Floor. 26 AWG.**



Robust

Much larger addressable market due to greater rate vs. reach [2]

One technology that covers both in-building and outside plant

Spectrum Manager Function gives visibility of binder conditions [1]

[1] “Fast Robust EFM,” Elastic Networks, IEEE 802.3 EFM Study Group, Plenary, March 2001

[2] “Carrier Grade Ethernet ,” Elastic Networks, IEEE 802.3 EFM Study Group, Interim Meeting, May 2001