

A New Rate/Reach Objective for EFM-Copper

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Outline

- Review the current rate/reach objective and its associated PHY
- Emphasize the importance of longer reach coverage
- Propose to add a new rate/reach objective to address the need for broader market potential

Current Rate/Reach Objective

- **PHY for single-pair non-loaded voice-grade copper with distance ≥ 750 m and speed ≥ 10 Mbps full duplex**

Interpretations of the Objective

- The objective is a minimum performance point on the rate/reach curve of the PHY
- The PHY, in addition to the 750 m / 10 Mbps point, may support any combination of higher/lower data rates at longer/shorter distances

Interpretations of the Objective

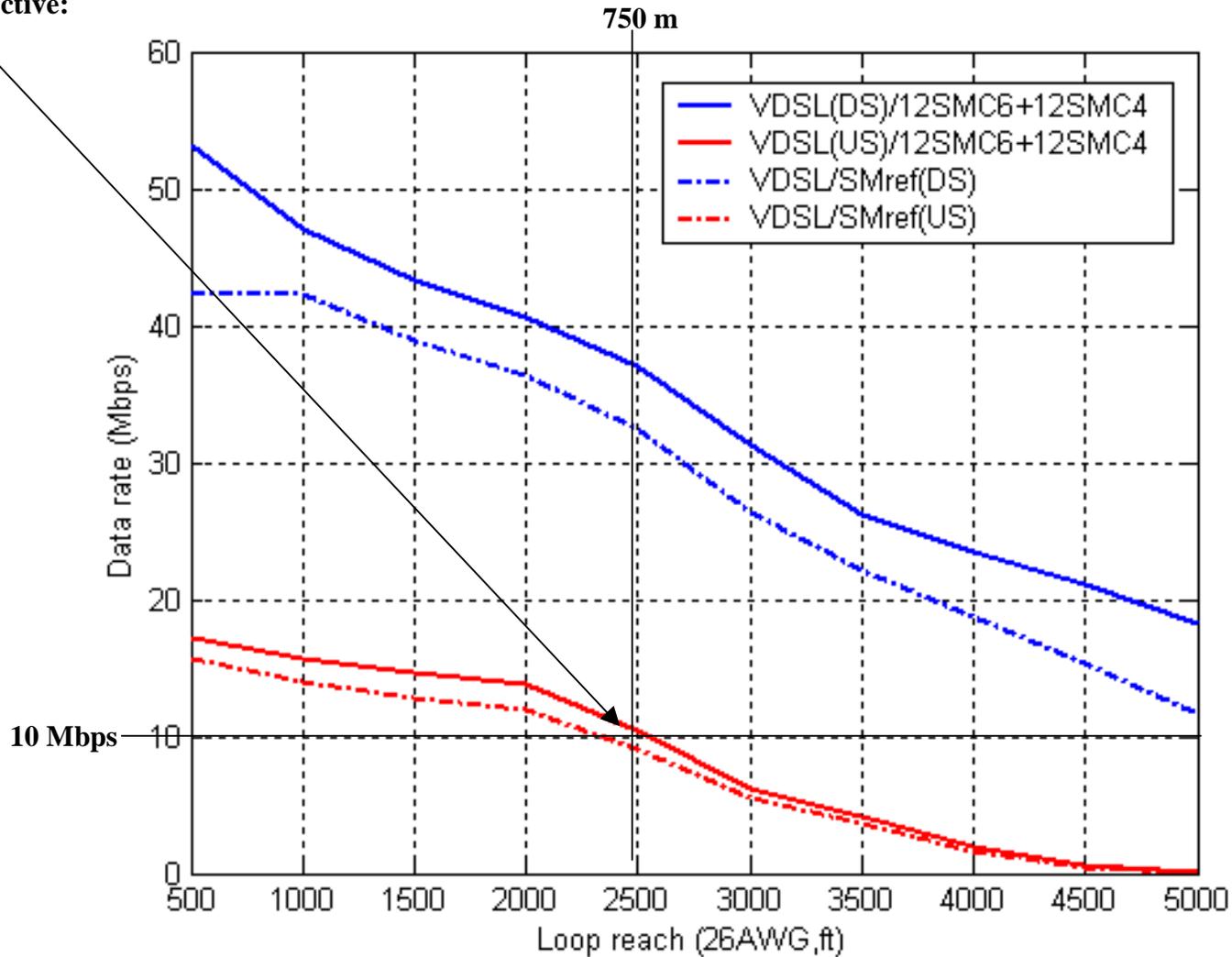
- The objective is a minimum performance point that happens to be symmetric in terms of upstream and downstream rates
- The PHY, in addition to symmetric data services, may support asymmetric services

VDSL as Short-Reach PHY

- Standardized technology
- Achieve high data rates on short loops
- Meet the current rate/reach objective
- Meet the spectral compatibility objective
- Tested in labs and field trials

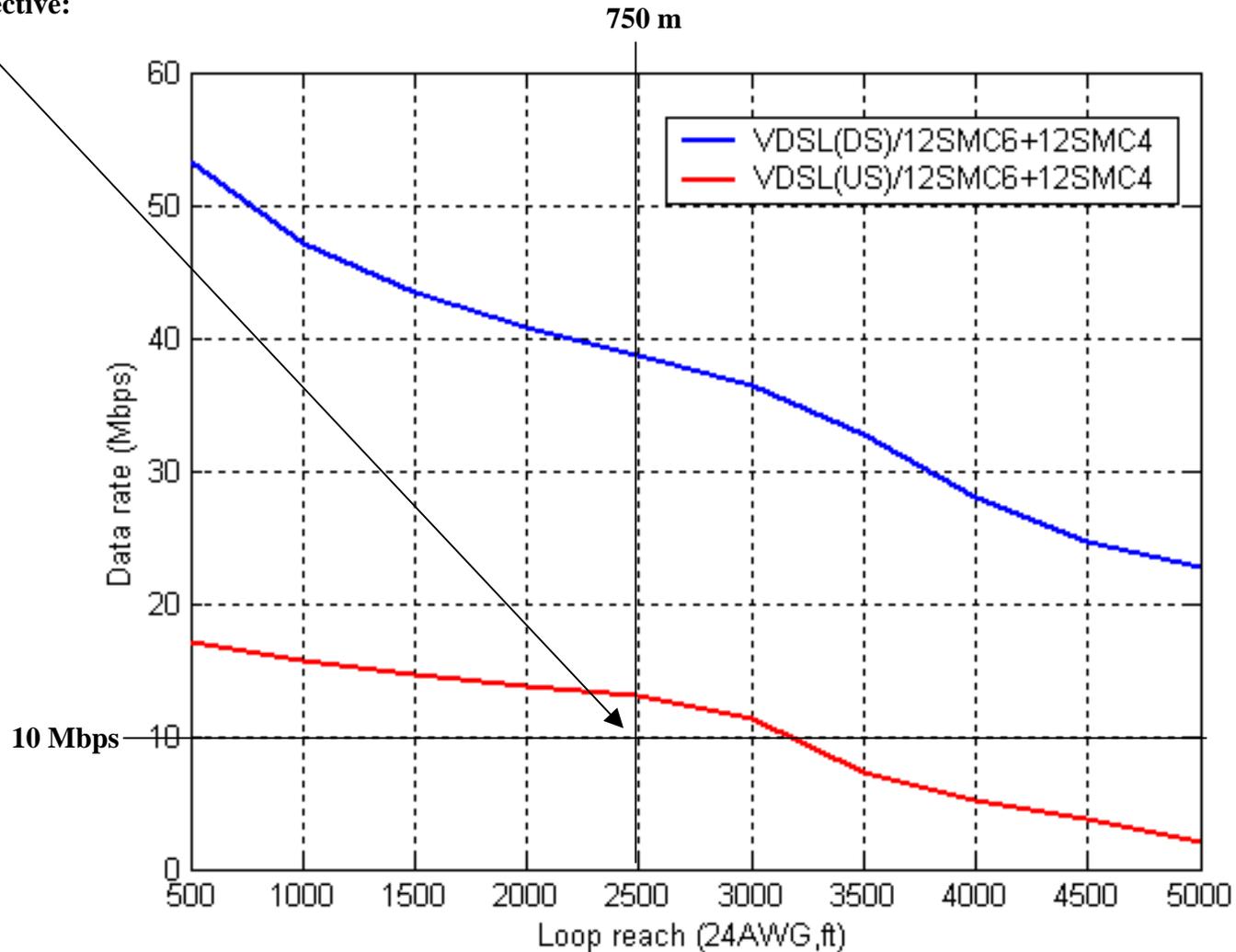
998-VDSL Performance (26 AWG)

EFM Objective:



998-VDSL Performance (24 AWG)

EFM Objective:



Simulation Assumptions

- Simulation parameters (same as T1E1.4/2002-159R0,R1,R2):
 - VDSL DS PSD: minimum of -50 dBm/Hz and FTTE_x_M2_PSD in “T1.424/Trial-Use”
 - VDSL US PSD: M2_PSD in “T1.424/Trial-Use” with UPBO incorporated
 - optional band 0 not used

Simulation Assumptions

- VDSL_SM_ref:
 - T1E1.4 provisionally agreed VDSL spectral conformance criteria per 06/13/02 interim meeting via conference call
 - based on worst-case crosstalk combinations and some additional reduction
 - only specified for 26 AWG loops

Simulation Assumptions

- VDSL/12 SMC6 + 12 SMC4:
 - moderate crosstalk model
 - SMC6: primarily accommodates VDSL, chosen to represent FDD systems
 - SMC4: primarily accommodates HDSL2, chosen to represent EC systems

Limitation of 998-VDSL

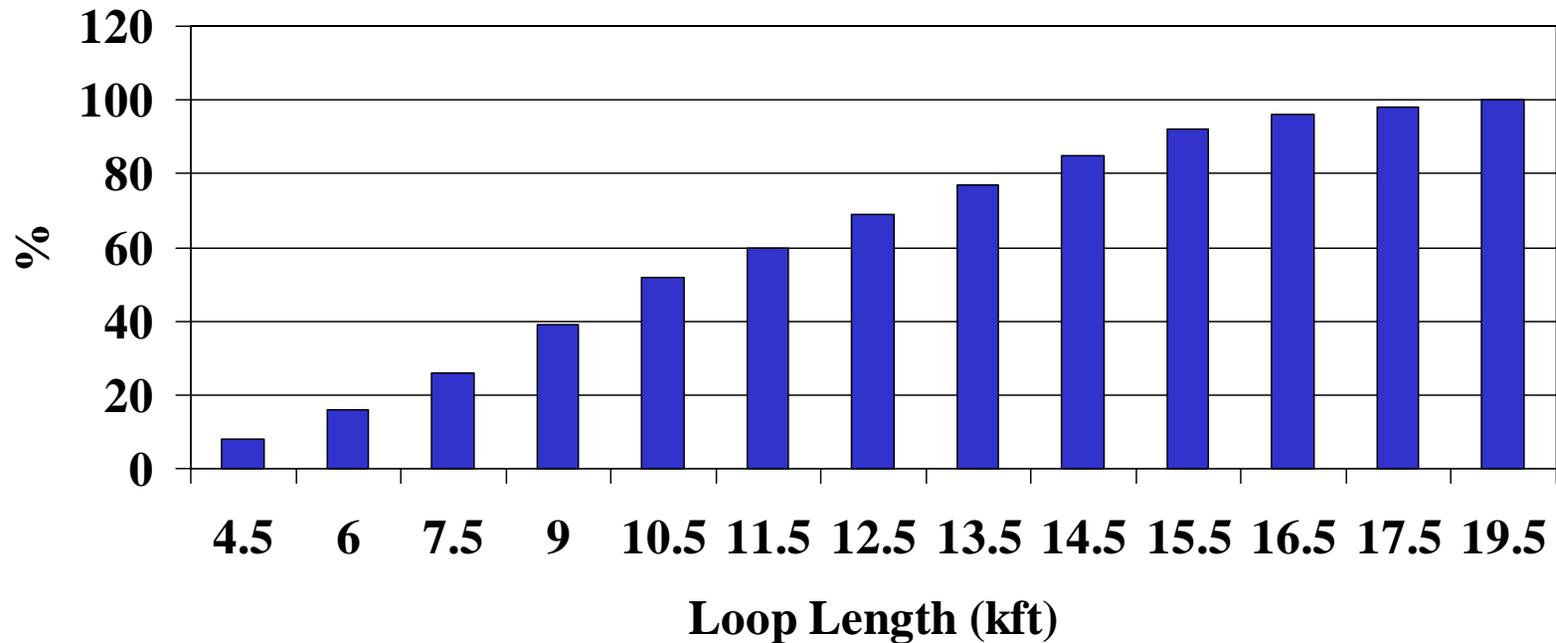
- Not suitable for symmetric transmissions on longer loops:
 - upstream data rate drops rapidly as distance increases
 - poor scalability: even with a reasonable number of bonded pairs, upstream data rate is still low
- Using optional Band 0 increases upstream rate by about 1 Mbps: not enough

Extending Band 0 for Upstream?

- Stretch Band 0 towards higher frequencies to increase upstream rates
- Result in non-standard and untested systems
- Require deployment guidelines to maintain spectral compatibility
- Reach limited by deployment guidelines

Cumulative Distribution of North American Loop Length

(Source: TIA/EIA-876)



Source of Data

- Table A1 in TIA/EIA-876 “*North American Network Access Transmission Model for Evaluating xDSL Modem Performance*”, which was published in June 2002
- TIA: *Telecommunications Industry Association*
- EIA: *Electronics Industry Association*

Remarks

- Likelihood of occurrences were compiled from three recent North American Surveys that include samples as large as 14 million loops
- The surveys included both central office deployed and digital loop carrier deployed loops
- Loops are of mixed 24/26 AWG

Limitations of Current Rate/Reach Objective

- A Fact: among existing DSL technologies, it only allows VDSL as a PHY
- VDSL can cover no more than 16% of the North American loops
- This will limit the applicability of EFM-Cu
- It does not meet the criterion of “**Broad Market Potential**”

Importance of Longer Reach Coverage

- Provide service providers more and better opportunities to deploy EFM-Cu
 - utilize more existing loop plants
 - reduce extensive re-engineering of copper infrastructure
- Bring EFM-Cu to more customers
- Bring EFM-Cu to market faster

Service Provider's Perspective

- SPs proposed longer reach coverage:
 - OTI: miller_1_0701.pdf
 - Qwest: cook_1_0901.pdf
 - GWI: kittredge_1_0901.pdf
 - SBC: starr_1_0102.pdf
 - SBC/Qwest: wei_1_0302.pdf
 - SBC/Sprint/Qwest: wei_1_0502.pdf

Another Solution Needed

- Both shorter and longer loops are important to the success of EFM-Cu
- Two distinct technical solutions are required for shorter and longer loops, respectively
- Therefore, besides the short-reach objective, we need a rate/reach objective for longer loops

Targeting Business Markets

- Business customers are more likely to order higher-speed services such as EFM-Cu
- Scalable broadband services enabled by the combination of long-reach PHY and multi-pair bonding are highly desirable to business customers rather than to residential customers

Targeting Business Markets

- Business-oriented applications require symmetric data rates:
 - video conferencing
 - web hosting
 - multiple voice channels (10 or more)
- Supporting POTS is not a requirement for business-oriented services

Proposed New Objective

- **PHY for single-pair non-loaded voice-grade copper with distance ≥ 2700 m and speed ≥ 2 Mbps full duplex**

Advantages of the New Objective

- Significantly increase the loop coverage of EFM-Cu
- Allow scalable broadband services with multi-pair bonding
- Provide EFM-Cu much broader market potential

Feasibility of the New Objective

- There exists a standardized technology that has been proven in testing labs and fields to meet the new objective and to be fully compliant to T1.417: **SHDSL**
 - ITU G.991.2 (G.shdsl)
 - ANSI T1.422-2001
 - ETSI TS101-524

Conclusions

- The addition of the new objective is critical to the success of EFM-Cu
- Adopting the new objective will keep Copper Sub-TF moving forward