Optimal Transmission System

B. Rezvani: Ikanos Communications

Optimal_EFM_System

EFM VDSL Base Line Proposal

PAR Objectives, where are we?

- Rate objectives are too timid for short loops
  - 10 Mbps total at 765m or 2.5 kft
- Ethernet as link layer is independent of PHY but needs work
  - Multi-pair operation
  - Rate adaptation
- New Reach objectives covers distance above 12 kft potentially to 15 kft or 4.6 km

What is driving EFM-Copper

Applications

- In building
  - High-end: 100 base-T over 2-4 coppers, Metro Fiber Extension,
  - Low-end: 10 Mbits total, Video channel in MHU
- Outside loop plant
  - High-end: Business 2-10 Mbits symmetric/12 kft
  - Low-end: residential 6/1-13/1 Mbits asymmetric /12kft

Optimal Transmission System Option 1: Fast Track

- **Option1 : Fast Track covered by others in this session: EoXDSL**
- **Define EFM PHY-independent specifications**
  - Choose xDSL, including VDSL as PHY layer in its entirety
  - Standards can move very quickly at higher layers
- **Advantages**
  - Can get standard quickly
  - Move Ethernet in the public network without much effort
- **Disadvantages**
  - VDSL and ADSL are asymmetrically oriented,
  - SDSL and SHDSL are low data rate systems

Optimal Transmission System
Option2: Optimal System for all reaches

IKANOS communications

Option 2: Original New System

- Make modifications to VDSL standards for high data rates
  - Allow operation on long loops
  - Allow higher symmetric data rates
- 2 line codes: MCM and SCM
  - Don't start a war
  - Develop handshake to choose the modulation
- **New Actions**
  - New PSD
  - TCM

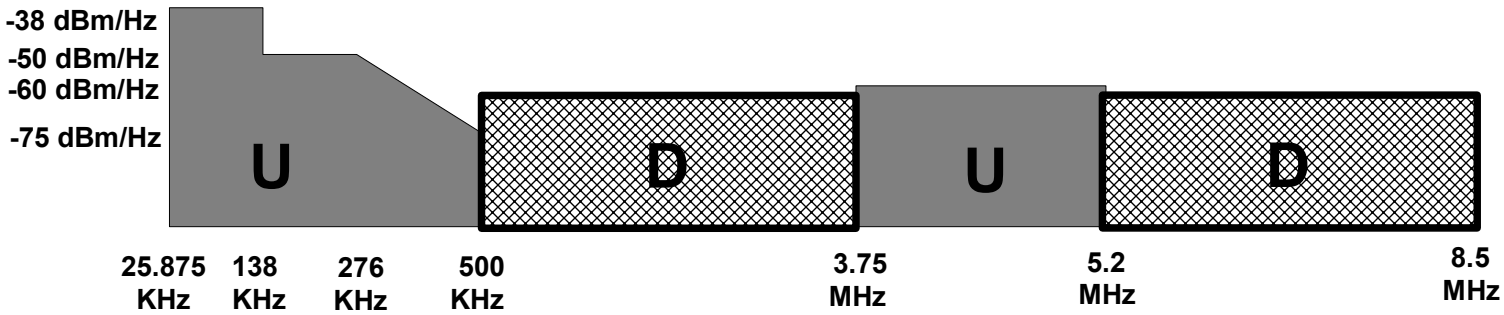
Current VDSL Status

- **VDSL at T1 Committee**
  - Trial use standard will be formally accepted in Feb meeting of T1.E1.4
  - Two years trial period for DMT and QAM
  - Plan 998, US only specifications
- **VDSL at ITU-T**
  - Focused on defining packet over VDSL
  - Support plans 998,997, and Fx
- **VDSL at ETSI**
  - Similar to .4
  - Supports plans 998, 997 and Fx

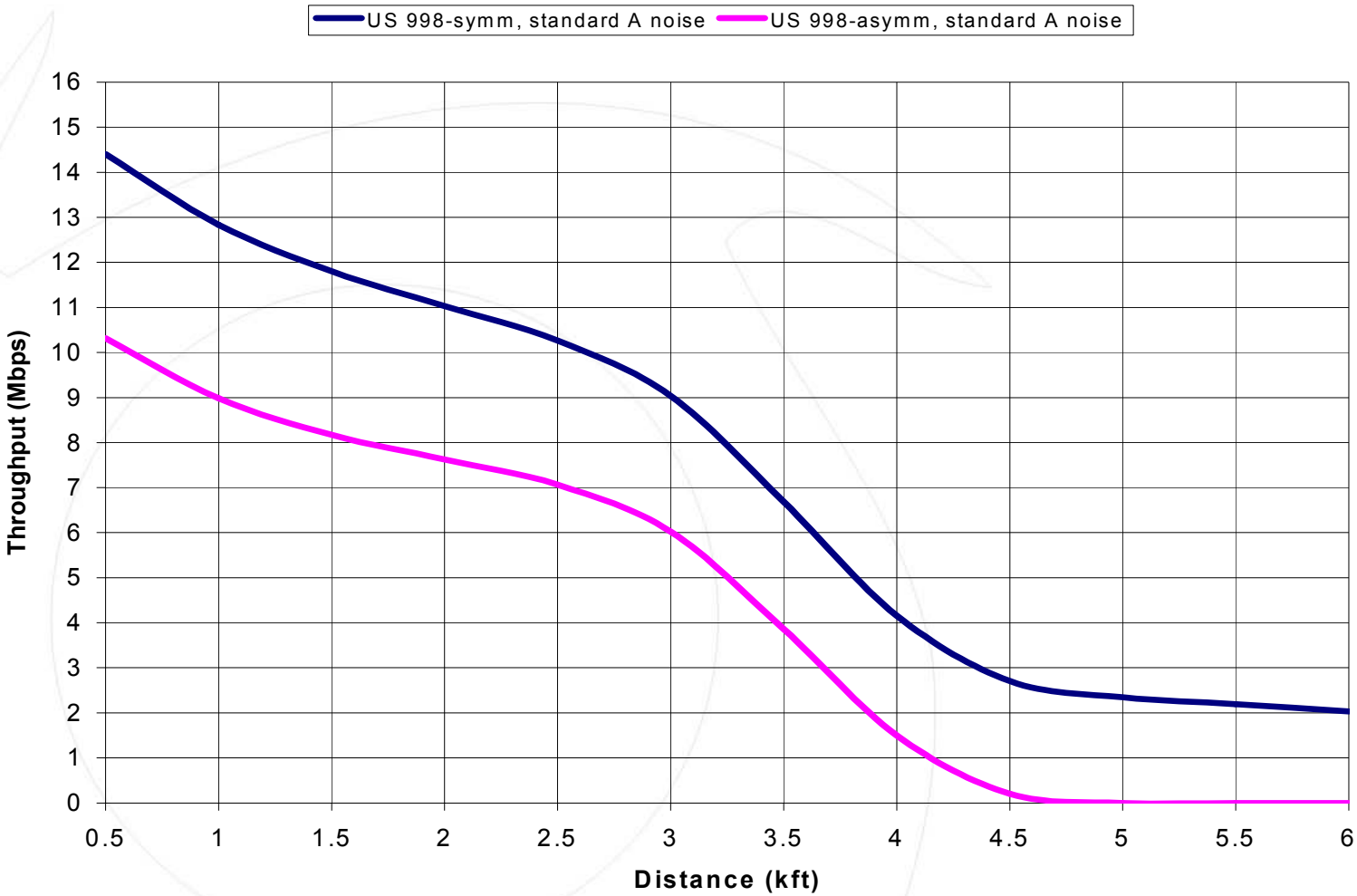
New EFM Optimal System Variable Band Plans- short reach

750m reach app

- **Short loops for symmetric applications to deliver up to 20 (10 Mbits symmetric) Mbps total up to 2500 ft.** see paper on symmetrical VDSL, Nov-01

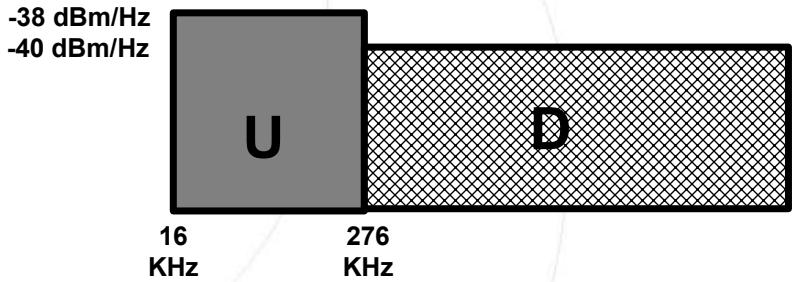


Upstream data rate short reach Optimal system and VDSL 998

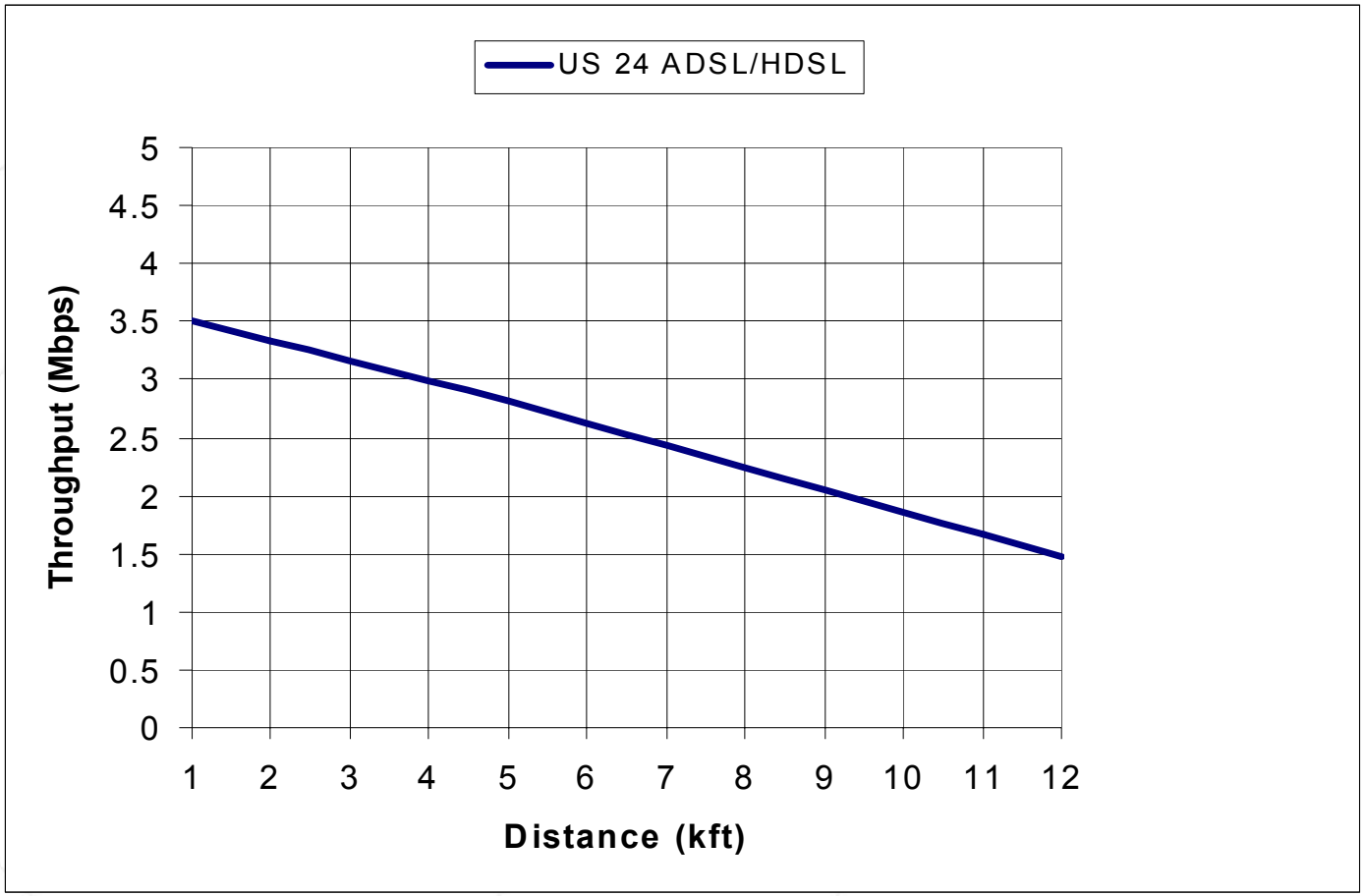


New EFM Optimal System Variable Band Plans –medium reach

- 3600m medium reach app
  - For Medium loops there is a restriction of T1.417 that everything has to be spectrally compatible with ADSL. This forces all systems to limit their upstream transmission up to 276 KHz, regardless of modulation. Downstream is not limited.

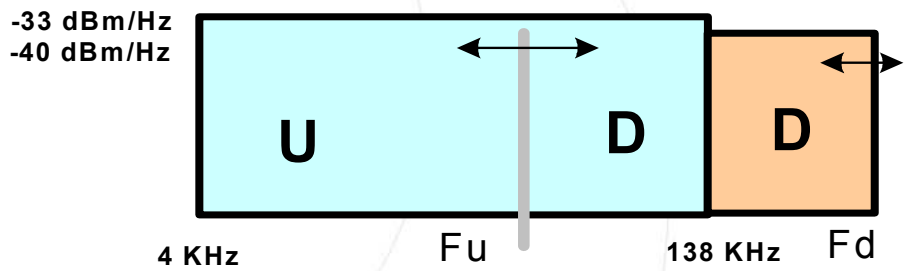


Optimal system Medium Reach
Upstream Data Rate



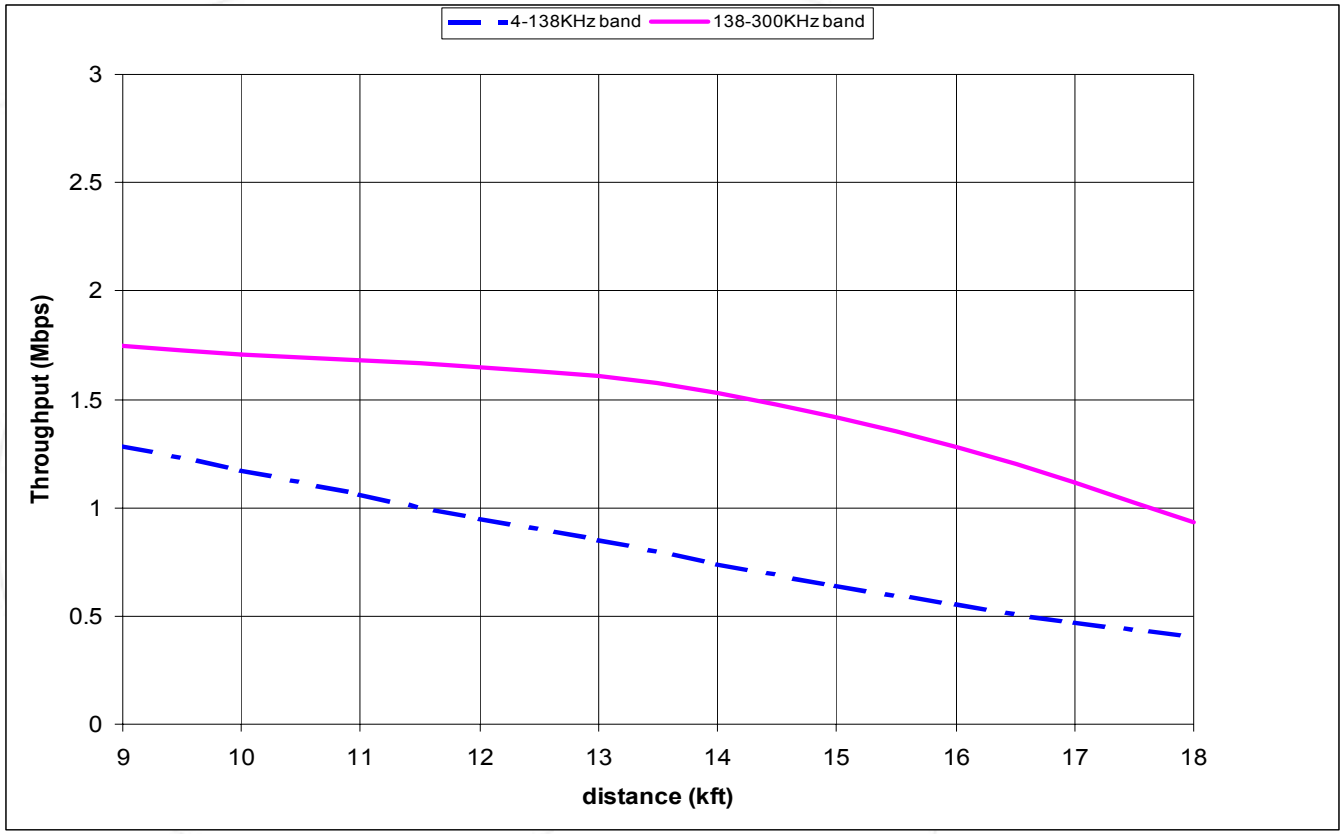
New EFM Optimal System Variable Band Plans - Long reach

- 4600m Long reach app
  - For long loops there is a restriction of T1.417 for the operation beyond 138 KHz which (i.e. echo-cancelled mode or upstream). This band can be used in either direction simultaneously in VDSL mode as well



Optimal system Long Reach
Data rate

- Band 0: 4-138 KHz, ~ -33 dBm/Hz, AWG-26, in presence of EC systems. Can be split in 2
- Band 1: 138-300 KHz, ~-40 dBm/Hz, AWG-26, self systems



Summary
One PHY system can meet all requirements

- One PHY system that can address all distance and rate requirements
- Modulation techniques (i.e. MCM or SCM or EC) was left out of this presentation
- Optimal system
  - FDD systems that perform digital duplexing of operating over the entire rate reach curve

Summary
Current xDSL systems

- **ADSL**
  - asymmetric, works on long loops
  - 5.5 dB coding gain
  - has burst noise protection mode with interleaver
- **SHDSL**
  - symmetric, works on longer loops
  - 5.1 dB coding gain and
  - does not have burst noise protection mode or interleaver
- **VDSL**
  - Becomes very asymmetric over 2500 ft
  - Less than 3.5 coding gain
  - has burst noise protection mode with interleaver

Summary
Characteristics of Optimal systems

- **Long loops > 3600 m.**
  - Band 0: 0-138 KHz, (Upstream/Downstream/Echo Cancelled mode)
  - Band 1: 138 ~ 300 KHz Downstream only
- **Medium Range loops <3600 m and >750m**
  - Band 0+1 ~ (Upstream/Downstream/Echo Cancelled mode)
  - Band 2: (~300 KHz- 3.75 MHz Downstream only)
- **Short Range Loops < 750 m**
  - Band 1: Upstream only
  - The rest similar to Plan 998 or 997
- ***System Requirements:***
  - Coding gain > 5.5 dB (RS+TCM)
  - Programmable PSDs