EFM Evaluation for first rate/reach Cu objective

IEEE 802.3ah EFM Task Force

6-12 July 2002

Vancouver, B.C.

June 25, 2002

Supporters

- **Barry O'Mahony**   **Intel**
- **Hugh Barrass**   **Cisco**
- **John Cioffi**   **Stanford University**
- **John Eagan**   **Infineon**
- **Craig Easley**   **Extreme Networks**
- **Georgios Ginis**   **Texas Instruments**
- **Tariq Haddad**   **Zarlink**
- **Steve Jackson**
- **Daun Langston**   **Metanoia Technologies**
- **Amir Leshem**   **Metalink**
- **Vladimir Oksman**   **Broadcom**
- **Behrooz Rezvani**   **Ikanos Communications**
- **Matt Squire**   **Hatteras Networks**
- **Dong Wei**   **SBC**

Purpose

- **Define selection criteria for evaluating technologies proposed to meet the 10Mbps duplex @ 750m Objective**

- **Criteria for other rate/reach objectives TBD,**

  - **In potential separate presentation**

PMD Selection Process

- **802.3ah agrees on specific evaluation methods to verify compliance with Objectives**

- **802.3ah generates any test plans, etc. needed**

- **Set deadline for submission of candidates that satisfy ratified Objectives**

- **Candidates undergo evaluation process; results presented at subsequent meeting(s)**

- **Result is set of candidate(s) that meet Objectives**

Evaluation Method

- **Compliance with spectral compatibility objective have often been demonstrated via analysis and simulation**

- **Rate/Reach Compliance verification to be done via third-party testing, verifiable test results, etc.**

- **Timeframe for candidate submission TBD**

Evaluation Criteria

- **Keep it simple!**
  - **Enough to ensure compliance with ratified Objectives and industry specification requirements**

  - **No Heroics: Reasonable, Industry-accepted performance standards**
    - **Keeps us from going down subjective rathole**

Spectral Compatibility Objective

- **North America**
  - Demonstrate compliance with Plan 998 & T1.424 FTTCab power levels,
  - *OR,* otherwise show compliance with T1.417 Issue 2 and relevant deployment guidelines
- **Europe / ROW**
  - Demonstrate compliance with Plan 997 and relevant deployment guidelines,
  - or otherwise as specified in ETSI TS 101830
  - If 25-138KHz band is used, also report results without its use (for ISDN compatibility)
- **Must be compliant in all operating modes**

Rate/Reach Criteria

- **Demonstrate compliance with Objective**

  - **operation at 10 Mbps duplex @750m**

- **Evaluate performance at other lengths in same approximate range**

  - **2 to 1,600m in 45.72m (150 ft.*) steps**

* 150 ft. step size defined in T1.424

8

Rate/Reach Criteria *(cont'd)*

- **Noise Model - Is there one which:**

    - **Covers this rate/reach range,**

    - **Is an approved standard,**

    - **Developed by an ANSI-accredited, consensus-based group?**

- **Yes!**

    - **T1.424**

        - **Part 1, § 12 defines test conditions and methods**

Rate Reach Test Summary

- ## 10 Mbps tests from Table 12.9 / T1.424 Part 1

Test name	Loop no.	Target Downstream rate	Target Upstream rate	Noise(s)
1.4 Symmetric 10/10	Loop 1, TP1 x = 2 – 1600m, TP2 y = 2 – 1600m	$\geq$10 Mbps for x, y $\leq$ 750m	$\geq$10 Mbps for x, y $\leq$ 750m	AWGN 20 self-disturbers*
2.4 Symmetric 10/10	Loop 1, TP1 x = 2 – 1600m, TP2 y = 2 – 1600m	$\geq$10 Mbps for x, y $\leq$ 750m	$\geq$10 Mbps for x, y $\leq$ 750m	AWGN, RFI 20 self-disturbers*
3.4 Symmetric 10/10	Loop 1, TP1 x = 2 – 1600m, TP2 y = 2 – 1600m	$\geq$10 Mbps for x, y $\leq$ 750m	$\geq$10 Mbps for x, y $\leq$ 750m	AWGN Noise A 20 self-disturbers*
4.4 Symmetric 10/10	Loop 1, TP1 x = 2 – 1600m, TP2 y = 2 – 1600m With 50 ft BT	$\geq$10 Mbps for x, y $\leq$ 750m	$\geq$10 Mbps for x, y $\leq$ 750m	AWGN 20 self-disturbers*

*Or 20 VDSL disturbers if "Method B" spectrum compatibility is used

Test Loops

- **Seven Loops (+ null calibration loop) are defined**
- **But tests are only defined for Loop 1**
  - **With and without a Bridge Tap**
  - **Use of others in T1.424 'for further study'**

2 - 1600 m, 0.4 or 0.5mm dia.

Loop 1

45.7 - 1534.8 m

15.2 m

**15.2 m**

Loop 1 w. BT
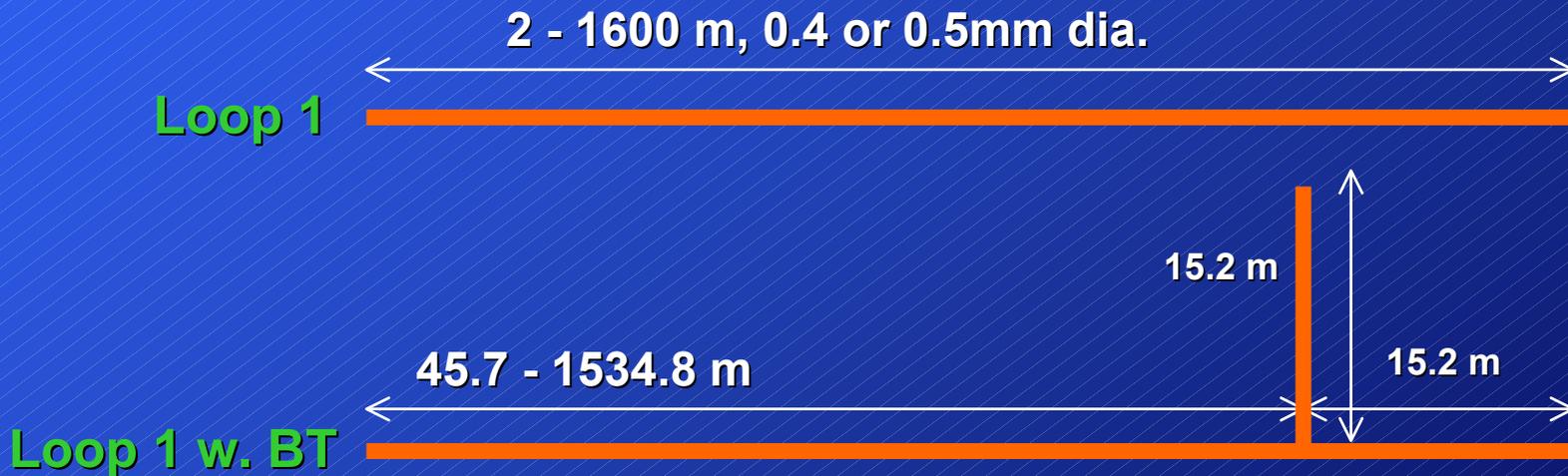
T1.424 Noise Model

- **Already agreed to by QAM and DMT proponents in T1E1.4**

- **Use a subset relevant to EFM Objectives**

  - **Type A (FTTC) model**

  - **10 Mbps symmetric tests from Table 12.9 / T1.424 Part 1**

  - **Model 2 (worst-case) AM radio noise**

  - **Ham radio ingress as defined in § 12.2.3.2**

  - **AWGN = -140 dBm/Hz**

Type A Noise Model

- **Type A (FTTC) model is most appropriate**
  - **20 self-disturbers**
  - **Alien disturbers from Exchange 1 Km upstream**
    - **10 ADSL + 16 ISDN-BA + 4 HDSL**
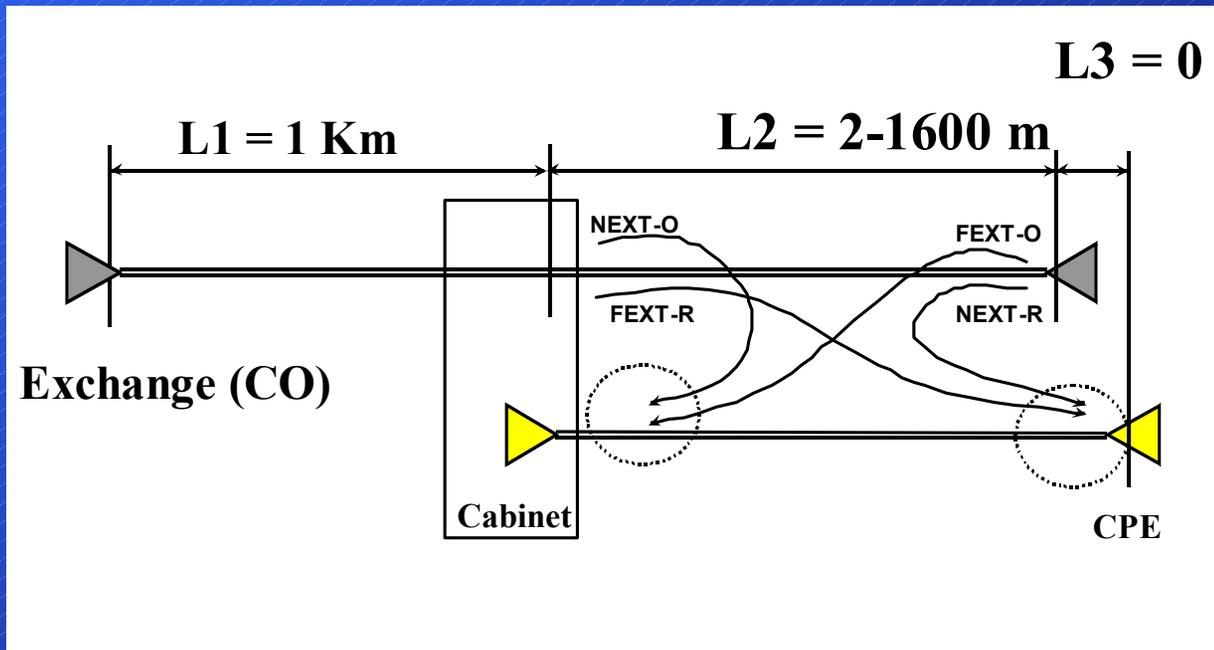
POTS Overlay

- **Requirement for short-reach market segment**
  - **Needed for "Broad Market Potential" criterion**
- **Therefore, must meet objectives without using 0-25KHz**
  - **Does not rule out optional use of POTS band**

Note: See also slide 6 for ISDN compatibility

Impulse Noise Tolerance

- **Verifies FEC / interleaver**

- **Applied as defined in T1.424 § 12.2.2**
  - **i.e. short & long loops in presence of other noises**

- **Immunity levels specified in § 9.3 / G.993.1:**
  - **Tolerate 250 μsec. burst with $\leq$10 msec. interleaver delay,**
  - **And 500 μsec. burst with $\leq$20 msec. delay**

Egress Control

- **PHY shall have capability to reduce PSD level HAM band(s) below –80 dBm/Hz**

- **See § 6.2.4 / G.993.1**

- **Rate/reach testing done with Egress Control, and optionally without it**

Upstream Power Backoff

- **Capability Test Defined in T1.424 § 12.3.2**

- **Not applied during rate/reach testing**

Additional evaluation criteria

- **presently not well-defined, whose use should be investigated**

  - **Other Noise Models,**

  - **In-building wiring model,**

  - **Different self-disturber loop lengths,**

  - **Efficiency:**
    - **Gate count,**
    - **MIPs count,**
    - **Footprint,**
    - **etc.,**

  - **Flexibility,**

  - **etc.**