EFM Copper

The copper baseline: What, how and why

EFM May, 2002

Hugh Barrass (Cisco Systems),

On behalf of IEEE 802.3ah copper sub task force

Reviewed by…

- Dong Wei, SBC
- Michael Beck, Alcatel
- Behrooz Rezvani, Ikanos
- Howard Frazier, Dominet
- Barry O'Mahony, Intel
- Vladimir Oksman, Broadcom
- Krista Jacobsen, TI
- Amir Leshem, Metalink
- Peter Linder, Ericsson
- Steven Haas, Infineon
- … and many Cisco people

Summary

- **During the March meeting the copper sub task force adopted a baseline**
  - **4 baseline presentations**
  - **Ethernet over VDSL with loop aggregation**
- **Main task force did not ratify the choice of the copper track**
  - **Confusion reigned (& still reigns)**
  - **Abstentions gained majority of votes**
- **This presentation will cover:**
  - **What the copper track has adopted**
  - **How this fits in with EFM**
  - **Why the choice was made**

The Copper Objectives

- **PHY for single pair non-loaded voice grade copper distance >=750m and speed >=10Mbps full-duplex**
- **Include a specification for combined operation on multiple copper pairs**
- **The point to point copper PHY shall recognize spectrum management restrictions imposed by operation in public access networks, including:**

  Recommendations from NRIC-V (USA)

  ANSI T1.417-2001 (for frequencies up to 1.1MHz)

  Frequency plans approved by ITU-T SG15/Q4, T1E1.4 and ETSI/TM6

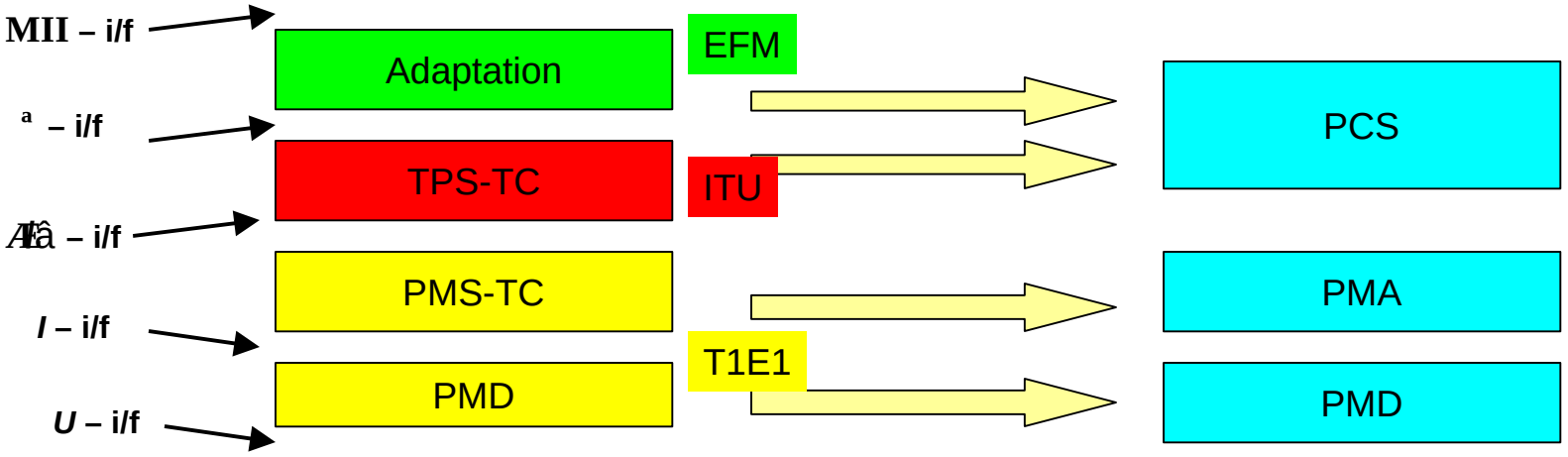
Copper: Baseline

- **Ethernet over VDSL**

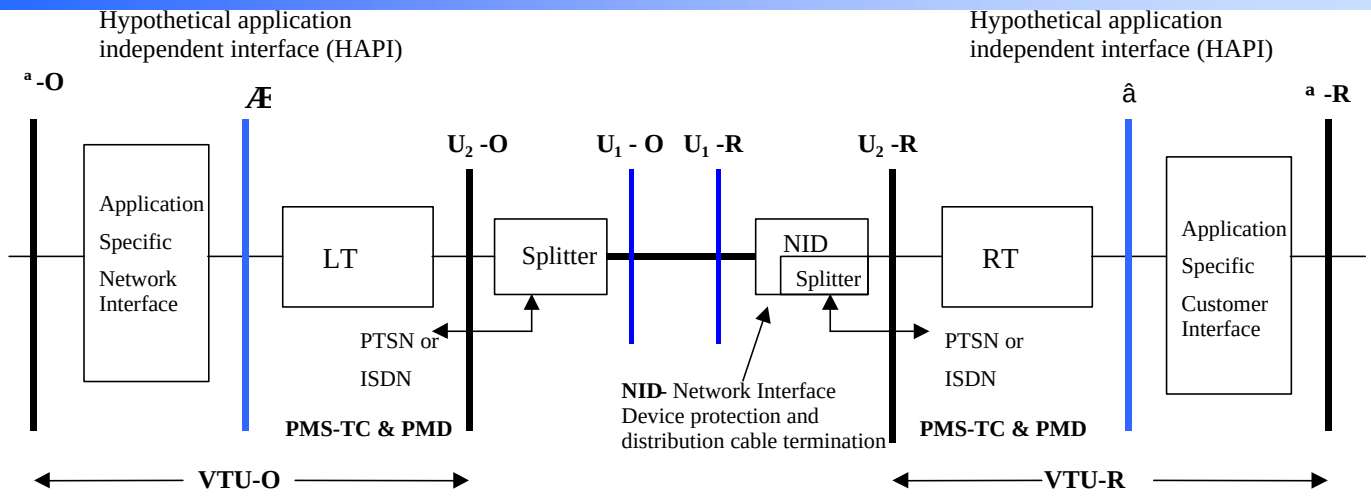
  Re-use T1E1.4 VDSL, T1.424 – keeps alpha/beta i/f

  Re-use ITU-T SG15/Q4, G.993 – keeps gamma i/f

  Add MAC-PHY, Loop aggregation & PMD control



The VDSL picture



- **VDSL defined by ANSI T1E1.4 and ETSI TM6**

  EFMCu baseline references T1E1.4

- **There are 2 types of devices:**

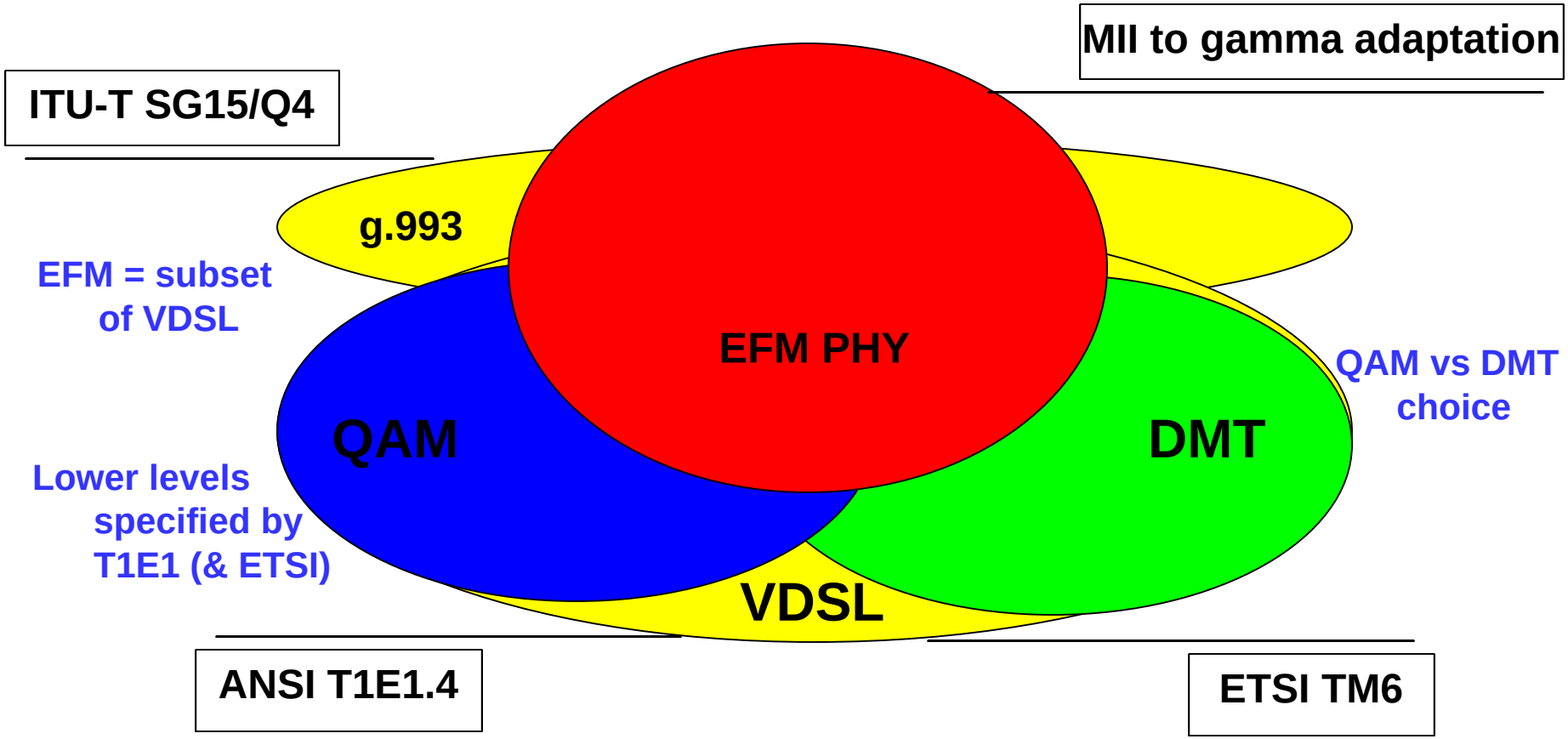
  VTU-O: The master device, LT, located in the switch/line card

  VTU-R: The slave device, RT, located in customer's premises (such as a NIC or CPE)

- **Splitter allows the loop to be shared with POTS or BR-ISDN**

EFM and Standards

EFM defines “a point in DSL space”



Baseline components

- **VDSL main part – references T1E1.4 and ITU SG15/Q4**
  - Covers all of PMD, PMA & half of PCS layers
  - Some simplification (fewer options)
- **MAC-PHY rate matching**
- **Loop aggregation**
- **PMD control**
  - Includes some of MIB function
- **Set of presentations from March**
  - fosmark_1_03_02.pdf, marris_1_0302.pdf, simon_1_0302.pdf, rezvani_1_0302.pdf (with notes)

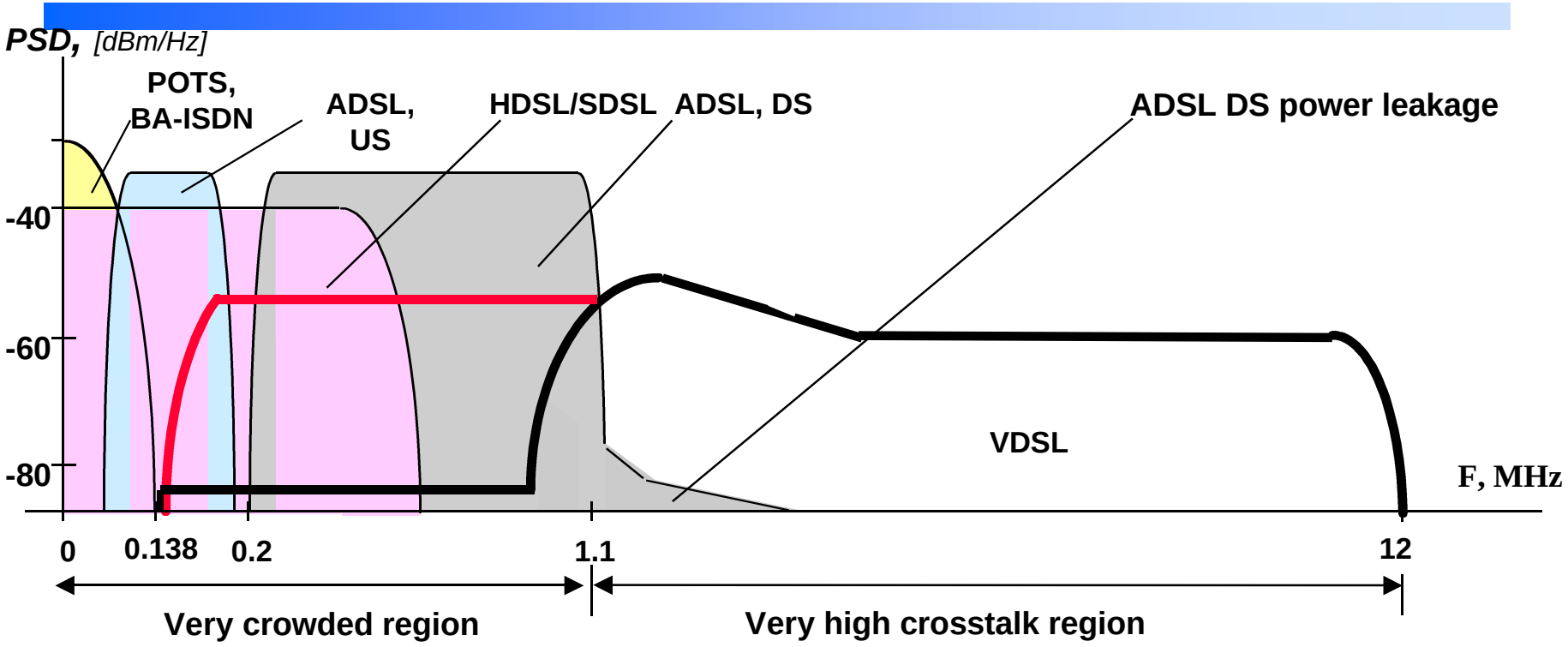
What is done…

- **Almost all of PMA, PMD from T1.424**
  - **> 5 years of work**
  - **Some small refinement still ongoing**
- **PCS – TPS-TC sub-layer from g.993.1**
- **MAC-PHY rate matching – fully defined**
- **Loop aggregation – main functionality**
  - **Still some discussion**
- **Basic principles of PMD control**
  - **Refers to g.994, g.997, RFC 2026 – interface to Ethernet MIB**

What is to do…

- **Choose line code**
  - QAM or DMT both fully specified in t1.424
  - Silicon available for evaluation
- **Some discussion ongoing**
  - Encapsulation, dual latency, power back off
  - Loop aggregation – startup and failover
- **Acceptance and test criteria**
  - How to prove baseline meets the objective
  - Also will become conformance criteria
- **MIB and OAM**
  - Details of objects, mechanisms and transport
  - How to define bandplans and profiles

Bandplan background



- Some bandplans must be supported (e.g. 998, 997)
- Possibility of defining new bandplan (better for symmetric)
  - –For private, or choice for regional regulators
- Use of “band 0” (crowded region)
  - –How much must be specified in EFM (or refer to spectral regulations)
- How to specify in standard?
  - –Flexible support required – or annex for each plan?

Flexibility

- **Flexibility is both a solution and a problem!**
  - The ability to solve multiple solutions
  - A headache for interoperability
- **We will be required to support multiple bandplans**
  - The standard will have to allow flexibility
  - One system may support a single bandplan or many
- **We will be required to support many installation scenarios**
  - VDSL has flexibility to support very high bit rates
    - > 50Mbps for short reach, clean wiring
  - VDSL may also support longer reach
    - > 6kft at low bit rates (with use of band 0)
- **We will need to define profiles and control mechanisms**
  - Plug and play must be supported – universal startup (g.994?)
  - This is new to Ethernet!

How does EFMCu fit in .3ah?

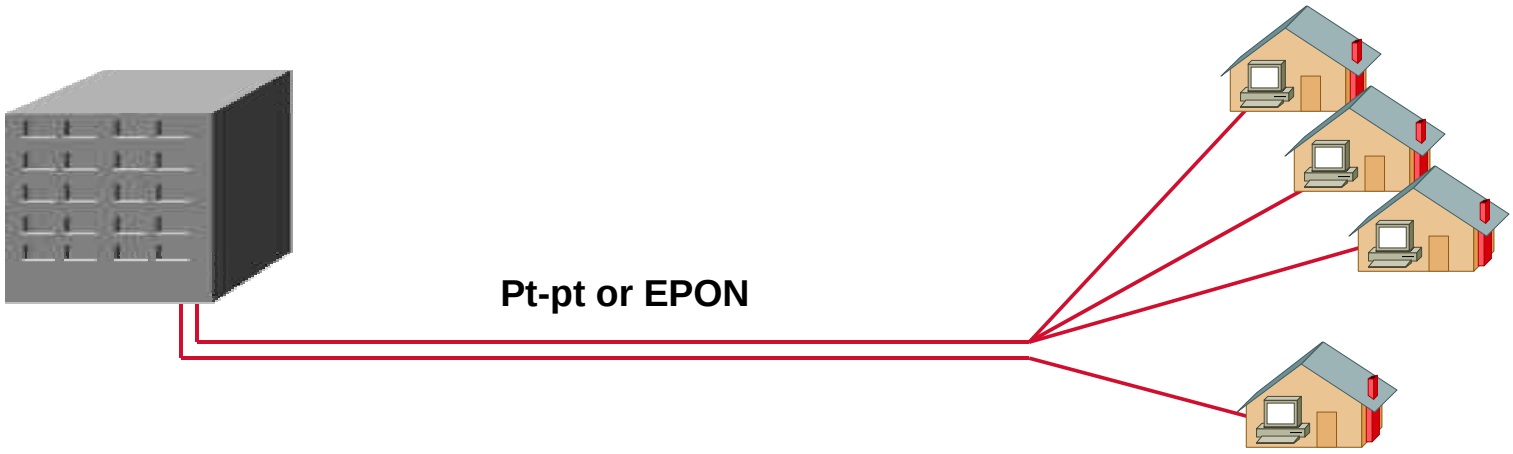
- **Why 1 copper PHY amongst many optical?**
- **Why VDSL and not other DSL?**

- **We need to go back to “EFM basics”**

  Items presented and discussed in study group

EFM – why we love it

- **Ethernet in the First Mile means bringing Ethernet home**
  - **High bandwidth, simple networking, ubiquitous interfaces**
  - **We all dream of Fibre to every home**



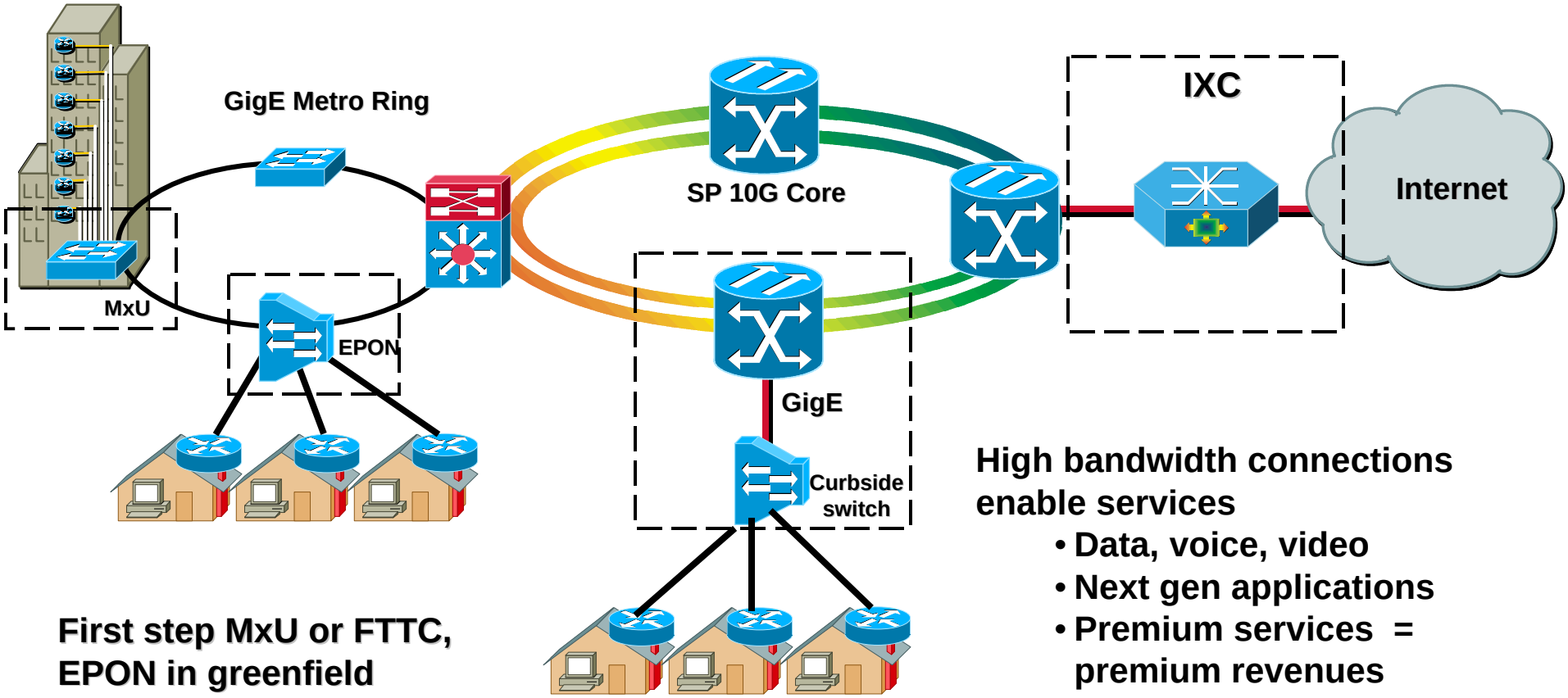
Optical pipe dream: how do we get there?

- **Fibre to every home needs massive investment**
  - Reasonable for greenfield sites
  - Full coverage requires proof of return on investment (and revenue stream)
- **More fibre buildout = better**
  - The closer fibre gets to the user, the better the service
  - Steps closer to all fibre architecture

Step by step

- **Stepwise approach bridges the optical gap**
  - Caters for differences in geography
  - Demand varying according to infrastructure architecture, economic cycle, local competition, regulatory peculiarities
  - Early deployments act as proving ground for service
- **Some areas (regions, countries etc.) deploy earlier**
  - Fibre to the building – copper in-building
  - Fibre to the curb – copper last (1/2) mile
- **Some areas (regions, countries etc.) non-homogenous**
  - Copper for short loops – early adopters (easy geography)
  - Fibre buildout follows

Optical (Fat) Pipe Dream



First step MxU or FTTC, EPON in greenfield

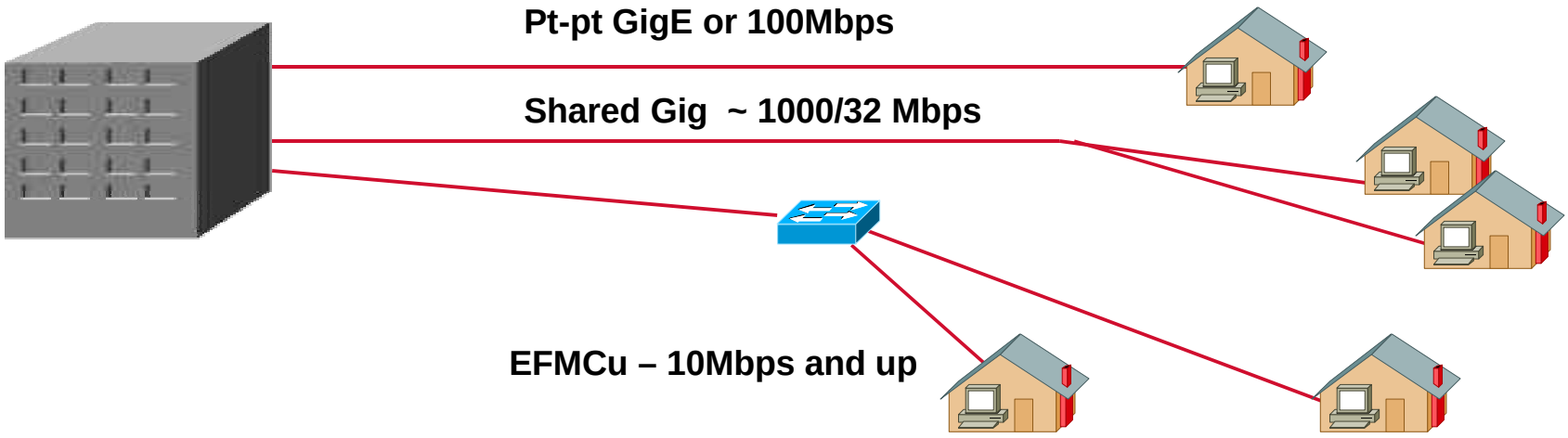
High bandwidth connections enable services

- Data, voice, video
- Next gen applications
- Premium services = premium revenues

Bottom line: Copper needed now to enable future fibre

What sort of copper solution?

- **EFM is about next generation, high speed architectures**
  - **Copper solution should fit in with that**
  - **Minimum 10Mbps – higher if possible**
  - **High d/s bandwidth for entertainment – client/server**
  - **For stepwise buildout to work, EFMCu must support NG applications**



What about other applications?

- **VDSL clearly meets the needs of EFM, but there are other DSL applications – particularly longer reach**
  - **Service from RT or CO – distances >= 12kft**
- **Problem with Physics…**
  - **Longer distances mean lower bit rates**
  - **Lower speed PHYs don't fit with EFM**
    - **Reduced services, no promotion of fiber buildout**
- **Does not fit within EFM**
  - **How is it handled elsewhere?**

We are not alone…

- **All networking good – Ethernet networking better!**
  - **Always support Ethernet everywhere!**
- **More Ethernet over xDSL possible – outside EFM**
  - **Use ITU framework (g.993/4/5)**
  - **Other body reuses EFM work – or new PAR for new TF**
- **Maximize common ground**
  - **Liaise, liaise, liaise!**
  - **Other standards will (probably) follow later**

Liaisons

- **Two main (copper) liaisons**
  - **T1E1.4**
  - **ITU-T SG15/Q4**
- **Indirect liaisons**
  - **ETSI TM6 and FSAN, FS-VDSL**
  - **Liaise through other groups and common membership**
- **Industry consortia**
  - **EFM Alliance – formed for 802.3ah**
  - **DSL Forum – covers all DSL (including EFMCu!)**

T1E1.4

- **All EFM-Cu baselines reference T1 VDSL trial use std.**
  - **Some simplifications (less flexibility)**
  - **Possibility of minor changes (none known yet)**
  - **Close liaison with T1E1.4 to maintain compatibility**
- **Group demarcation**
  - **EFM is short-lived body, focus on high rate (short reach) application**
  - **T1E1.4 has long term view, look at generic xDSL – including "unified PHY"**
  - **EFM will define a point solution, T1E1.4 remains owner of voice grade copper application space**

ITU-T SG15/Q4

- **All EFM-Cu baselines include Gamma interface**
  - Compatibility with G.993.1 maintained
  - Possible modifications to TPS-TC for Ethernet
  - Other “Ethernet over” devices could reuse .3ah definitions
  - Close liaison with SG15/Q4 vital
- **Loop aggregation**
  - Relation with g.bond to be defined – expected to be orthogonal
  - Ethernet aggregation may be re-used by any G.995 PHY
- **More liaison**
  - EFM codepoints to be defined for G.994
  - EFM management relation to G.997

In conclusion…

- EFM needs copper track for complete story
- High speed (>= 10Mbps) copper objective is necessary – copper track has chosen VDSL
- EFM copper standard should maximize compatibility to allow reuse for non-EFM standards
- EFM  Copper!

EoVDSL – the copper baseline

- **Questions?**

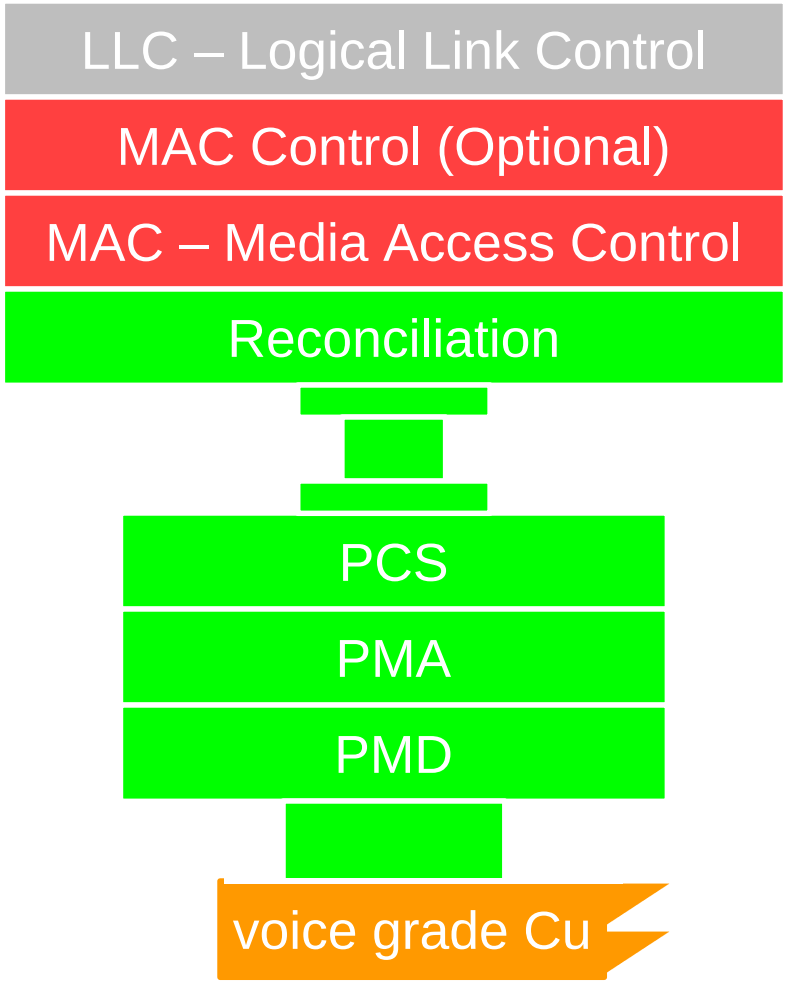
Motion to adopt (2nd half)

- **Adopt presentation rezvani_1_0302.pdf (with addition of comments document, "notes_to_editor_1_0302.doc", with the exception of note 13) as the basis of the first draft**

The Copperheads march on…

- **Spare slides**

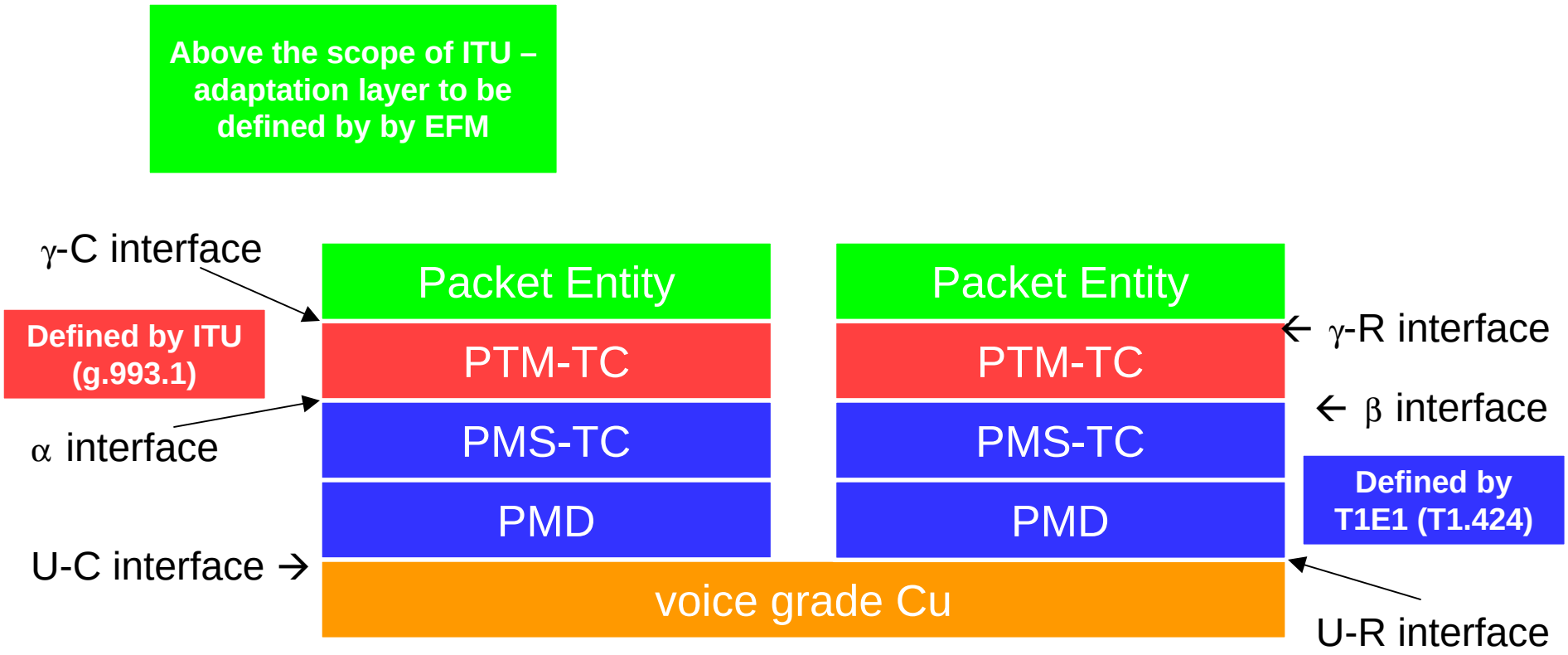
Architectural layers (IEEE view)



"Minimal changes" are allowed here if necessary.

The approved PAR authorizes the EFM Task Force to specify these layers.

Architectural layers (ITU & T1E1 view)



EFMCu Architecture