Optical PMD Sub Task Force Report

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IEEE P802.3ah
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Optical PMD STF Report

- Resolved 334 comments (163 technical). In doing so, made progress on four key issues.
- Adopted a consistent method and values for specifying cable plant.
- Achieved substantial harmonization with TTC (Japan) 100M specs.
- Worked with P2MP group to narrow down choices on PON burst-mode timing parameters.
- Examined optical link test results for high BER environment expected to exist when FEC is used.
- One liaison letter to ITU-T SG15.

Comments resolved

- Resolved all 334 comments submitted against D1.1. (163 T and TR; 171 Editorial). 7 were addressed, discussed, but remain unsatisfied, and are carried forward with assignments for ad-hoc groups. (TDP, PON timing, signal detect).

Optics track Motion #1

- Adopt swanson_optics_1_1102.doc as the basis for P802.3ah Draft 1.2.

- M: S. Swanson S: W. Diab
- Technical (75%)
- For: 31 Against: 0 Abstain: 2

Optics track Motion #2

- Resolved that the Optical PMD STF editor is hereby given the license to resolve all Editorial comments, in accordance with proposed responses, as the basis for P802.3ah Draft 1.2.

- M: W. Diab S: T. Murphy
- Technical (75%)
- For: 16 Against: 0 Abstain: 1

Optics track Motion #3

- Motion to charter the editor to create D1.2 of Clauses 58, 59, 60 and Annex 64A based on the comment resolution from D1.1 as recorded in the comment database.

- M: W. Diab S: P. Dawe
- Passed unanimously

Burst-mode timing parameters

What is the issue?

Selection of maximum permissible values of the following parameters:

- Laser turn-on delay
- Laser turn-off delay
- Optical receiver AGC settling time
- PMA CDR lock time

Should these values be tight, loose, or left to implementation?

Why is this a big-ticket item?

- These parameters affect system performance and vice versa – cycle time, efficiency, ease of FEC adoption, MPN/BER, latency.
- Costs and benefits are spread system-wide - PMD, PMA and possibly in MAC Control. Costs are hard to extract and quantify.
- It asks us to define the extent to which we see the role of legacy Ethernet hardware in P2MP.
- It requires us to agree on an (as yet) undefined goal – P2MP system efficiency. How much efficiency do we expect and desire?

By when do we have to decide?

- On or before January 2003 Interim, to facilitate going to WG Ballot in March 2003.
- Your feedback in this (November 2002) meeting will tell us in which direction we should head. We will plan for the January meeting accordingly.
- Four options are presented here – A, B, C and D. The fifth option is implicit - if you show less than 75% support for each of these four options, you will have effectively deferred the decision till January.

Option A: Select tight values

- Value of each parameter will be no more than a few dozen nanoseconds. (Suggested values*: laser on + off 32 nsec, AGC 50 nsec, CDR lock 50 nsec.)
- Economies of scale by increasing overlap (in design and implementation) with FSAN transceivers.
- Arguments: Tight values can be achieved as cost-effectively as loose values. Tight values improve system efficiency, which is a Good Thing because efficient systems are scalable. Legacy PMA devices are irrelevant because this is a new system.

** All suggested values in this presentation are subject to approval by the members of the Optical PMD STF on 11th and 12th November, 2002.*

Option B: Select loose values

- Value of each parameter will be of the order of hundreds of nanoseconds or a microsecond. (Suggested values*: laser on + off 800 nsec, AGC 400 nsec, CDR lock 800 nsec.)
- Economies of scale – far greater than FSAN - by increasing overlap with EFM P2P and 802.3z transceivers.
- Arguments: Loose values can be achieved more cost-effectively than tight values. EFM P2MP has a larger cycle time; efficiency improvement with tight values is small, therefore not worth the additional complexity. Loose values permit legacy PMA devices to be cost-effectively deployed with minor (bond-wire) changes. FEC (high BER) needs longer CDR lock times.

Option C: Select tight Tx, loose Rx values

- Values will be tight for ONU-Tx, and loose for OLT-Rx. (Suggested values*: laser on + off 32 nsec, AGC 300 nsec, CDR lock 600 nsec.)
- Economies of scale for both Tx and Rx ends, through overlap with different markets.
- Arguments: Permits use of legacy PMA devices, and permits FEC (high BER) link environment. It is better to specify than not specify (see option D). Option C is argued as an equitable compromise between options A and B. But some disagree, pointing out that ONU volumes will be much larger, therefore ONU should enjoy loose specs.

Option D: Leave it to implementers

- PON timing parameters depend on implementation, so leave them to implementers. But do specify startup values. Replace parameter entries in Clause 58 with a suitable note.
- Economies of scale by allowing the post-standard market to converge on the most cost-effective solution.
- Arguments: P2MP startup values and registered (implemented) values can be different. As long as we specify some safe startup values, our job is done. Implementers will find ways to build systems with optimum cost-efficiency tradeoffs, as technology evolves. This is the bit-level counterpart of the system-level bandwidth allocation, which is left to implementers.

What's the difference between options B and D?

- A subtle but important one. By specifying only the startup values, Option D sends the message that implementers have the freedom to adopt premises of either option A or option B.

Report on straw poll (P2MP-Optics session)

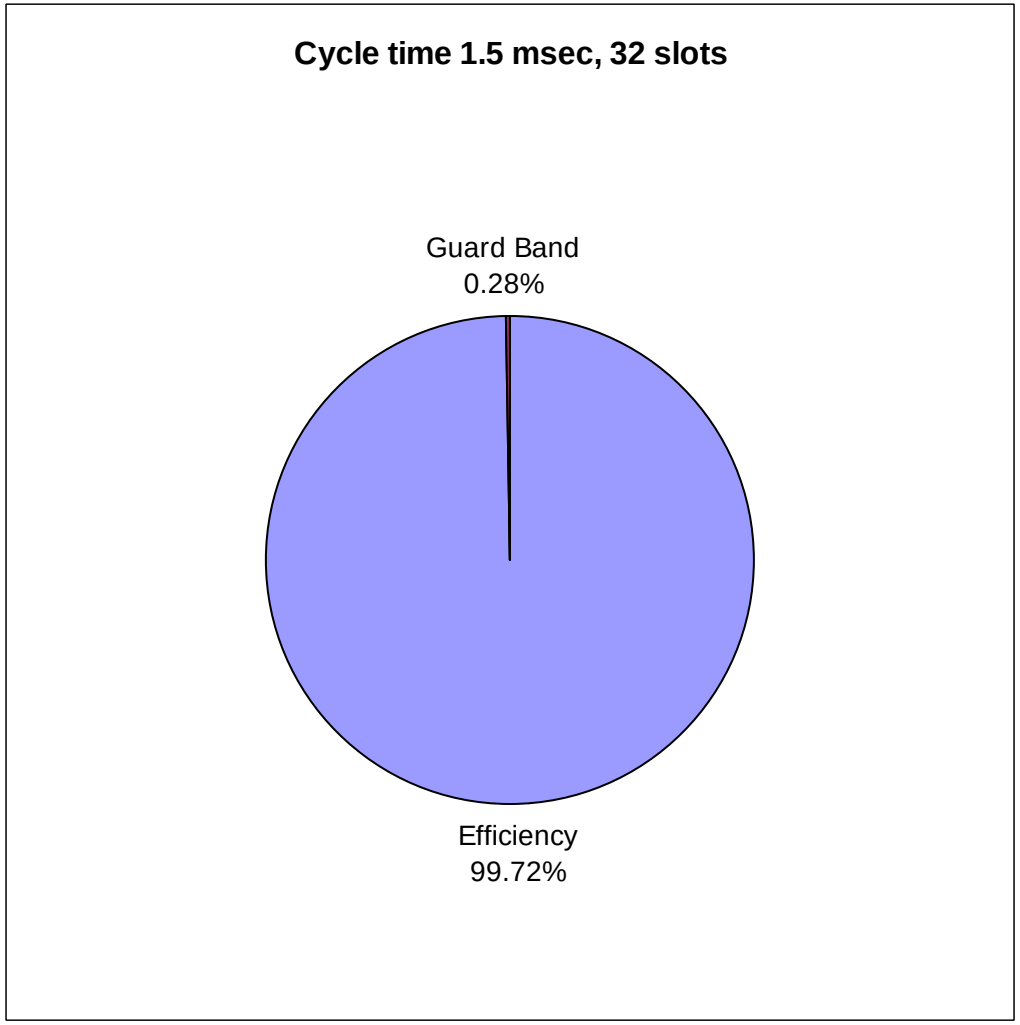
- Option A – Specify tight (a la FSAN) timing parameters.
- Option B – Specify loose (a la 802.3z) timing parameters.
- Option C – Specify tight parameters for ONU-Tx, and loose parameters for OLT-Rx.
- Option D – Don’t specify timing parameters. Specify only the startup values, and leave operational values to implementers.
- Chicago style: A: 23, B:15, C:11, D:18
- Choose one: A:13, B:6, C:5, D:14
- Choose between A and D: A:17, D:22
- If offered D only, for:26, against:11

PON timing - TF straw poll

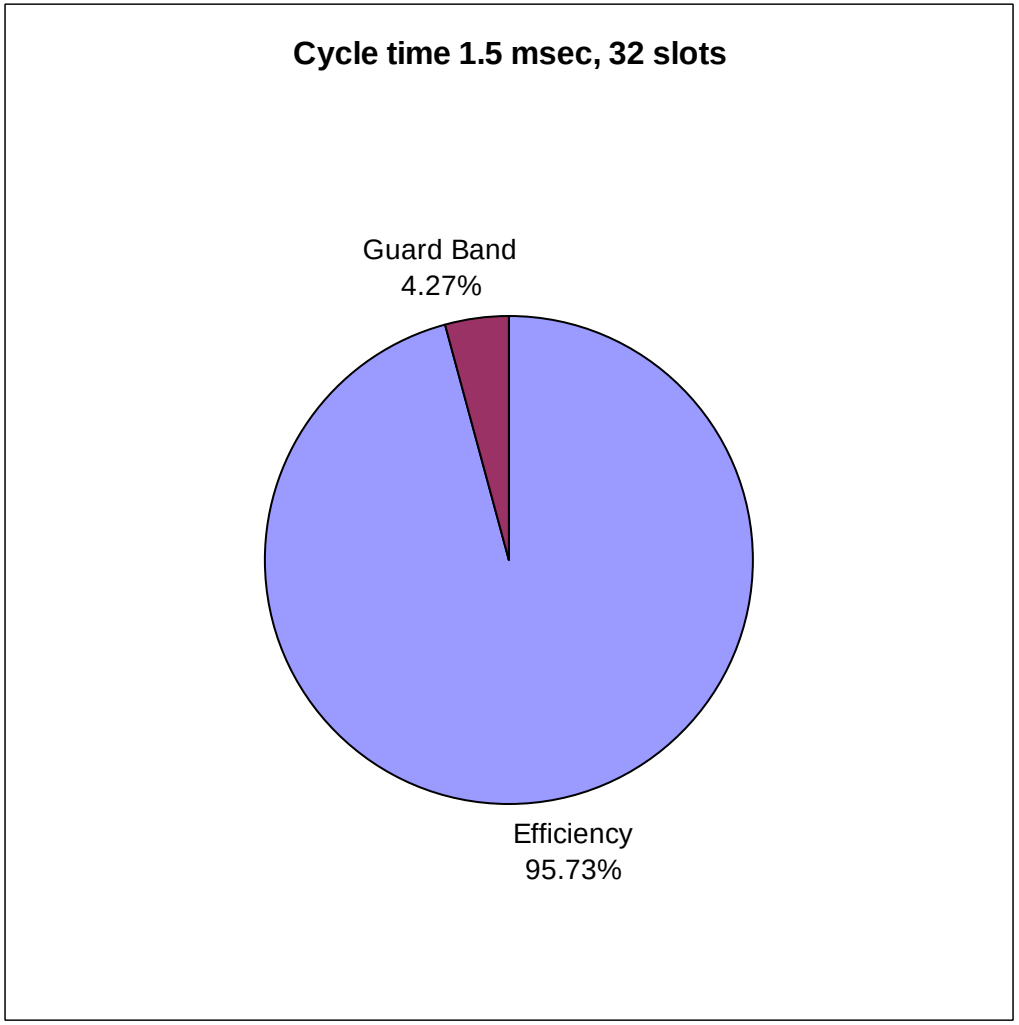
- Option A – Specify tight (a la FSAN) timing parameters. 22
- Option B – Specify loose (a la 802.3z) timing parameters. 6
- Option C – Specify tight parameters for ONU-Tx, and loose parameters for OLT-Rx. 2
- Option D – Don’t specify timing parameters. Specify only the startup values, and leave operational values to implementers. 35

(This straw poll was followed by a motion, the results of which will be recorded in the minutes of the meeting.)

Guard Band 132 nanoseconds



Guard Band 2 microseconds



FEC: optics group's observations

Background

- The Optical PMD STF reviewed two presentations concerning FEC, one concerning the performance of links under MPN, and another concerning the increase in PMA CDR lock time.
- This report limits itself to those two considerations only. It is recognized that there are additional considerations before a comprehensive review of the case for FEC can be made.

What FEC can do for optical links

The following two conclusions were based on results of experiments conducted by the members of the FEC group:

- For P2MP upstream transmission (that uses low-cost FP lasers), it can extend distance by 40% to 60%.
- For all links, it can add between 2.5 dB to 3.5 dB of power margin.

Can FEC support 20 km P2MP?

There are three questions here:

1. Can we take existing 10 km ONU Tx and expect it to support 20 km distance with FEC?
   - No. Current ONU Tx will support ~15 km with FEC, give or take a km.
2. Can we take a more expensive subset of ONU Transmitters with smaller spectral width and with better tolerances on center wavelength, and expect it to support 20 km distance with FEC?
   - Yes. The enhanced ONU Tx can support 14 km without FEC, hence 20 km with FEC.

Can FEC support 20 km P2MP? (contd.)

3. If we take existing 10 km ONU Tx and tighten the spectral width with a modest burden on cost-effectiveness, what is the longest distance we can support by adding FEC?
   - About 18 km.

What else can we do with FEC?

- We can use the ~3 dB power margin to
  - Add more splits to P2MP, even with DFB Tx.
  - Use PIN receiver instead of APD in OLT Rx
  - Use more relaxed spectral width and wavelength range for 10 km P2MP parts
  - Adds an inherent link quality monitor at very low BER

Effect of FEC on PMA

- Increased CDR lock time. One brand of PMA device tested by UNH IOL showed an increase from ~170 nsec (max) to ~650 nsec (max) in presence of BER = 10^-4.

Optics group Straw Poll

The Optics STF accepts and acknowledges the following FEC related conclusions based on the MPN and CDR testing conducted by the FEC Group:

1. For MPN limited links, a ~40% to 60% increase in range (or spectral width) for an MPN penalty of 2dB.

2. For attenuation limited links, a minimum 2.8 to 3 dB coding gain.

3. An increase in CDR lock time was discovered based on a limited set of devices.

Y: 12 N:0 A: 6