OAM&P for EFM

(Operations, Administration, Maintenance & Provisioning for Ethernet in the First Mile)

May 21st – 23rd 2001

IEEE 802.3 EFM Study Group

St.Louis, MO

Robert Muir, David Sutherland

Starting point – definite OAM&P requirement

- Requirement for EFM OAM&P frequently stated by (1) previous presenters, (2) and on the EFM reflector, (3) and by broadband service providers/operators
- Justification of this requirement is not an issue – acceptance is assumed

Questions are

- **Which OAM&P feature set will satisfy the broad market and still be cost effective to provide, from an Ethernet hardware point of view, and operational point of view?**

and

- **Which mechanism will be employed to deliver this OAM&P capability?**

Choice of OAM&P features

- Is it possible to define a single set of OAM&P features that will operate over EPON, EoVDSL and Pt-Pt Ethernet ?
- Take OAM&P feature set from e.g. VDSL, SONET, etc and support one common set…
- Noting that EFM (since it is an end-node) will probably require *less* OAM&P features (subset) than those required for the carrier backbone

OAM&P options

- **Need to decide which OAM&P features are needed**

OAM&P feature	EoVDSL	EPON	Pt-pt Fiber	Comment
Loss of Signal	yes	yes	yes	Indicates either not receiving or not synchronized
Performance monitoring	yes	yes	yes	Either calculates BER or SNR continuously
Loop back (phy)	yes	yes	yes	Control signal puts far-end phy into loop-back mode
Self-test	yes	yes	yes	Near-end/far-end performs internal test and reports result
Far-end status	yes	yes	yes	Interrogates far-end for power status and operational mode info
Remote options provisioning	yes	yes	yes	Capability to reset and change configuration of remote equipment
Firmware download	yes	yes	yes	Update remote s/w without site visit

OAM&P options (cont)

- **Choose OAM&P requirements from checklist**

OAM&P feature	EoVDSL	EPON	Pt-pt Fiber	Comment
Dying gasp	yes	no	no	Senses loss of local power and reports
Fault detection	yes	yes	yes	Head-end monitors activity and flags fault
Fault isolation	yes	!	yes	Fault can be isolated automatically
Bandwidth provisioning	yes	yes	yes	Bandwidth can be assigned by operator at head-end
Auto-discovery	Yes	Yes	Yes	Facility to configure equipment automatically
Billing for services	no	no	no	Out of the scope of OAM&P requirements for EFM

Which mechanism can be used to exchange OAM&P information?

- **IEEE802.2 LLC XID**
  - This provides an already standardized way of conveying varying sized messages between MAC Client's
  - Would allow early set up of CPE device properties without the need for higher protocol layers. Could be used at start up
  - Issue is that currently MAC does not need to be able to transmit these messages
- **SNMP/MIB**
  - Standards based, interoperable solution for managing the network using MIB's etc.
  - Would clearly be the option of choice for several OAM&P features such as Performance Monitoring, Fault Detection
  - 802.3 would define required hardware register bits. IETF would create managed objects and MIB definitions
- **MAC Control Frame**
  - Presently specified for PAUSE control in 802.3 flow control
  - Possible to extend functionality by using reserved opcodes
  - Can be easily adapted to perform all basic functions required

Issues with a single OAM&P Management structure- there are always exceptions!

- **EoVDSL and Pt-Pt Fiber**
  - Both of these options are point to point architectures by design. While both provide transport across different media they look logically the same from a management point of view
  - Both of these media transport types already have mechanisms and protocols to deliver management messages. In the 802.3 EFM standard we only need to create definitions for the extensions required to provide the features that will be required to make this acceptable to the system infrastructure and service providers and a success in the market place
- **EPON**
  - EPON by it's definition, structure and design is a shared medium, but not a collision detection protocol domain
  - In order to ensure that we have similar, if not identical, control over the CPE device in a EPON, we will need to look at adding some new ways of delivering the same information

Exceptions for OAM&P in an EPON architecture

- **EPON Discovery or auto-discovery**
- **EPON CPE Isolation**
- The examples mentioned above are dealt with in more detail on the following slides.
  - The issue has been defined in broad terms
  - A possible solution has been suggested
  - For the purposes of these examples it was decided to select an addition to the function of one of the currently standardized control frame formats, in this case the PAUSE frame, it could be any existing format, a newly defined control frame format, 802.2 XID, etc

Example - Using MAC Control Frame to address EPON Discovery

- **Problem: When a CPE is installed on an EPON segment some mechanism is required to inform the head-end of the CPE MAC address**

- Configuration of CPE will be either manual, automatic or semi-automatic
  - **Manual configuration** implies that a human network administrator must configure the two ends of the link as desired – i.e. the CPE MAC address is obtained manually
  - **Automatic configuration** implies that the CPE can be installed on a live (operational) EPON segment – i.e. the CPE MAC address is obtained automatically
  - **Semi-automatic** implies that the administrator switches on an auto-configuration mechanism, as above, when the user calls to register, then switches it off after registration

- The above configuration operations should not affect the performance of other CPEs' presently operating on the system

Automatic EPON Discovery

- Propose a new MAC Control opcode e.g. 0x0002 based on existing PAUSE MAC control frame

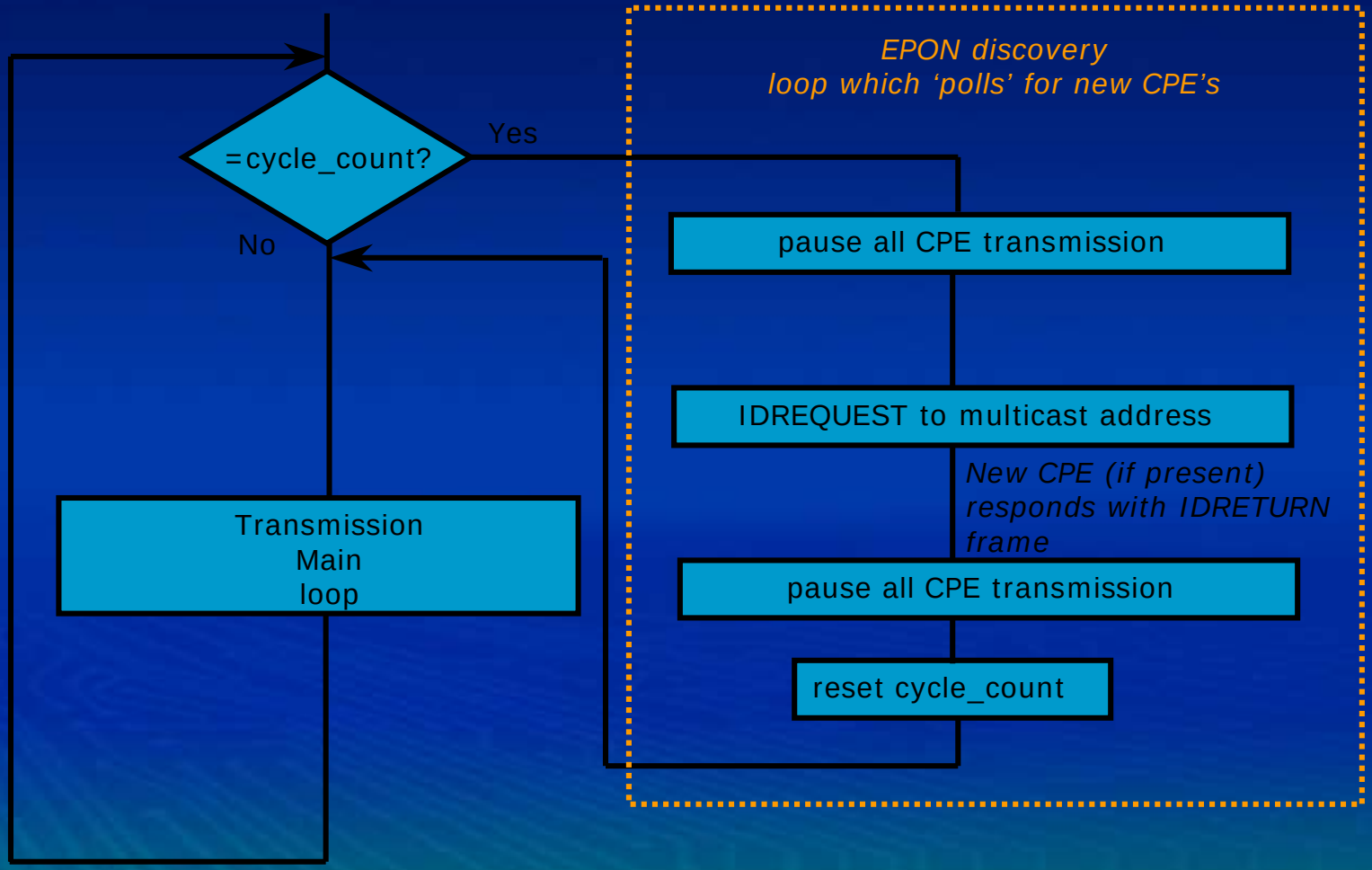
Opcode (Hex)	MAC Control function	Specified in annex	Value/comment
00-00	Reserved		
00-01	PAUSE	31B	Requests that the recipient stop transmitting non-control frames for a period of time indicated by the parameters of this function
00-02	IDREQUEST	TBD	Requests that the recipient send its MAC address – if not already registered
00-03	IDRETURN	TBD	Acknowledgement frame containing source MAC address of CPE – in response to IDREQUEST
00-04	Reserved		

Automatic PON Discovery (cont)

Start-up description

- A cycle counter is incorporated at the head-end
  - This counter allows a start-up branch to be entered periodically instead of the main EPON transmission loop
    - The head-end MAC sends a PAUSE control frame, for example, to stop all CPE's transmitting
    - The head-end MAC now sends a multicast IDREQUEST frame
    - A new CPE (i.e. newly installed), or an installed CPE which has been powered-on, receives the frame, and responds with a IDRETURN frame
    - The head-end MAC receives the IDRETURN frame and passes the CPE MAC address upward for processing
    - The newly configured CPE is given a time slot in the EPON transmit cycle
- Once the CPE has responded to the IDREQUEST frame, it sets a register bit and will not respond to a multicast IDREQUEST unless it has been power cycled, or until it timeouts, etc

Automatic EPON Discovery algorithm



Example - EPON CPE Isolation after a fault

- **Problem: A misbehaving CPE has the capability to 'hang' all EPON segments – everyone suffers**

- Ability to isolate CPE on fault detection would be a nice feature
  - If receive side of CPE is faulty it is impossible to send it a message to turn off (or other control message)
  - If the transmit side is faulty it may continually send data. Even if the receive side is being told to switch off

- By utilizing the PAUSE MAC frame mechanism, a stay-alive unicast frame can be sent to individual CPE's during the preceding time when the CPE is functioning properly
  - The stay-alive frame specifies to the CPE to set a timer for a given period (Watchdog Timer)
  - If after the set period the CPE has not received a further stay-alive frame (due to a CPE receiver-side fault or a head-end detection of a transmitter fault) the CPE MAC will take action, e.g. will switch off the laser driver or power-down the TX side, etc

Summary

- The provision of OAM&P will be an important factor if broadband service providers are to adopt and deploy EFM technology
- It is desirable to define a common set of OAM&P features which will be supported by all the likely EFM technologies, i.e. EoVDSL, EPON and Pt-Pt fiber
- In the case of EPONs, implementation of OAM&P will make it possible to overcome some of the inherent problems of a shared broadcast topology – e.g. by reusing the PAUSE frame format and enhancing its functionality to implement EPON discovery and EPON fault isolation
- It seems that it is possible to define a concise set of features that would provide robust management yet allow the fundamental ease of use associated with Ethernet