EPON over Coax

Project Authorization Request (PAR) Recommendations

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Introduction

- This presentation provides recommended text for some of the key fields in the IEEE Project Authorization Request (PAR) Form
- The second half of the presentation provides explanations for the recommended PAR wording

PAR Recommendations

PAR Field	Recommendation
2.1 Title	Amendment – Physical Layer Specification and EPON Multipoint Control Protocol Extensions for EPON Protocol Operation over Coaxial Cable
5.2 Scope	This project adds a radio frequency (RF) physical (PHY) layer specification to the IEEE 802.3-2008 standard for operation over coaxial cable. The PHY layer specification supports both frequency division duplex (FDD) and time division duplex (TDD) modes of operation. The project specifies extensions to the EPON multipoint control protocol (MPCP) to support the RF PHY operation over coaxial cable. The PHY layer will support upstream data rates of up to X Gb/s and downstream data rates of up to Y Gb/s.
5.4 Purpose	The purpose is to develop an RF PHY layer specification, with MPCP extensions, to extend the EPON network over coaxial cable.

- NOTE: The values of the upstream and downstream data rates will need to be set by the study group. We provided placeholders (e.g. X and Y) for now.

PAR Recommendations

PAR Field	Recommendation
5.5 Need for the Project	In many locations around the world EPON fiber does not reach the end user. There is a need to extend the EPON network over commonly available coaxial cable, in order to reach the end user.
5.6 Stakeholder for the Standard	Stakeholders include, but are not limited to, cable industry multiple system operators (MSOs), original equipment manufacturers (OEMs) and semiconductor manufacturers.
8.1 Explanatory Notes	2.1 EPON is an acronym for Ethernet over Passive Optical Networks

Explanation of Key Points

Key Point	Comment
RF PHY	The EPOC PHY will need to share spectrum on the coaxial cable with other services (e.g. cable TV) so the spectrum that will be available for EPOC will require the PHY to modulated up to RF frequencies
FDD Mode	FDD is appropriate for active cable plants which divide upstream and downstream traffic by frequency. In some regions (e.g. North America) the operators prefer FDD.
TDD Mode	TDD is appropriate for passive cable plants. Also, TDD provides flexibility in the upstream/downstream split. In some regions (e.g. China) the operators prefer TDD.
MPCP Extensions	The EPOC RF PHY will be very different than the EPON optical PHY, hence the MPCP will need to be extended to support the RF PHY. Some examples of the differences between an RF PHY and an optical PHY are provided on a subsequent slide.

Explanation of Key Points

Key Point	Comment
Upstream Rate	Since EPOC is an extension of an EPON network, which supports both 1 and 10 Gb/s data rates, the EPOC upstream should support data rates up to at least X Gb/s, in order to provide sufficient throughput to the end user.
Downstream Rate	Since EPOC is an extension of an EPON network, which supports both 1 and 10 Gb/s data rates, the EPOC downstream should support rates up to at least Y Gb/s, in order to provide sufficient throughput to the end user. This value is higher than the upstream rate for several reasons. First, in many applications the downstream throughput requirements are higher than those of the upstream rate. Second, in FDD networks it is expected that the MSOs will provide more bandwidth for the downstream than the upstream. For TDD networks, the higher downstream rates can be supported by allocating more time to the downstream.

Differences Between Optical and RF PHYs

Characteristic	Optical PHY	RF PHY
Channel Bandwidth	Fixed (single wavelength)	Variable
Channel BW for upstream versus downstream	Same	Different (FDD)
PHY Data rate	Fixed	Variable
PHY Rate to/from Different CNUs	Same	Maybe Different, or limited to worst case if it must be the same
PHY Rate versus Time	Fixed	Slowly Changing
Carrier Frequency to/from each CNU	N/A	Maybe Different

EPON Control Messages

- MPCP Contains Five Control Messages

MPCP Message	Brief Description
GATE	Grant Transmission Window to an ONU on Upstream
REPORT	Provide OLT with information about Queue Length at ONU
REGISTER_REQ	ONU requests registration during Discovery Window
REGISTER	OLT grants registration to the ONU
REGISTER_ACK	Acknowledgement reception of the REGISTER message

- These messages may not be sufficient to deal with operation of an RF PHY which is very different than an optical PHY

Extension of MPCP Control Messages

- During operation the MPCP control messages are limited to time allocation
- In an RF PHY there are several degrees-of-freedom that can be allocated
  - Time
  - Frequency
- By having control over both time and frequency network performance can be improved
- For example, by allowing multiple CNUs to transmit at the same time, but on different frequencies, network latency can be reduced

Extension of MPCP Control Messages

- The EPOC RF PHY will likely support multiple data rates, using different modulation and coding schemes (MCS)
- It may be necessary to extend the current MPCP to include control messages for controlling the modulation and coding scheme
- The project scope needs to allow for MPCP extensions to support the RF PHY

Conclusions

- Recommended wording for the PAR has been provided, along with explanations for key points
  - RF PHY
  - FDD and TDD Modes
  - Extensions to MPCP
  - Up to X Gb/s upstream
  - Up to Y Gb/s downstream
- The study group can begin with this as a starting point in developing the official PAR