IEEE 802.3 EPON Protocol over Coax (EPoC) PHY Study Group Opening Report

IEEE 802.3 Ethernet Working Group

16-July-2012

San Diego, CA

Reflector and web

- email reflector and archive established
  - stds-802-3-epoc@listserv.ieee.org
- Web page
  - http://www.ieee802.org/3/epoc/
- Private web area (for draft documents)
  - T.B.D.

Activities since March plenary

- Met for 2 days in May
- 56 attendees
- Heard 20 presentations
- Adopted 9 objectives
- Adopted text of 5 Criteria responses
- Adopted text of Project Authorization Request
- Responded to a letter from Chinese interests

Draft Objectives (1/3)

- **Specify a PHY to support subscriber access networks capable of supporting burst mode and continuous mode operation using the EPON protocol and operating on point-to-multipoint RF distribution plants comprised of either amplified or passive coaxial media.**
- **Maintain compatibility with 1G-EPON and 10G-EPON, as currently defined in IEEE Std. 802.3 with minimal augmentation to MPCP and/or OAM if needed to support the new PHY.**
- **Define required plant configurations and conditions within an overall coaxial network operating model.**

Draft Objectives (2/3)

- **Provide a physical layer specification that is capable of:**
  - **A baseline data rate of 1 Gb/s at the MAC/PLS service interface when transmitting in 120 MHz, or less, of assigned spectrum under defined baseline plant conditions;**
  - **A data rate lower than the baseline data rate when transmitting in less than 120 MHz of assigned spectrum or under poorer than defined plant conditions;**
  - **A data rate higher than the 1Gb/s baseline data rate and up to 10 Gb/s when transmitting in assigned spectrum and in channel conditions that permit.**
- **PHY to support symmetric and asymmetric data rate operation.**

Draft Objectives (3/3)

- **PHY to support symmetric and asymmetric spectrum assignment for bidirectional transmission.**
- **PHY to support independent configuration of upstream and downstream transmission operating parameters.**
- **PHY to operate in the cable spectrum assigned for its operation without causing harmful interference to any signals or services carried in the remainder of the cable spectrum.**
- **PHY to have:**
  - **a downstream frame error ratio better than 10^-6 at the MAC/PLS service interface;**
  - **an upstream frame error ratio better than 5x10^-5 at the MAC/PLS service interface.**

Broad Market Potential

I. Broad sets of applicability

II. Multiple vendors and numerous users

III. Balanced costs (LAN versus attached stations)

- Given the success of DOCSIS-based services, service providers are looking for cost-effective, high performance means to provide higher data capacity, addressing their CapEx and OpEx, growing market competition and future-proofing their existing coaxial plant, while expanding service portfolios for business and residential customers.
- Service providers have seen unabated growth in both offered capacity and consumption of broadband IP services over the course of 15 years for residential, and recently, business services
- The proposed project would result in a new PHY with the widest possible applicability
- Interest and support from a worldwide array of operators, system vendors, optical and RF component manufacturers, and silicon suppliers has already been demonstrated at CFI and SG stages
- The proposed project will result in the use of the existing EPON architecture by extending its capabilities to support point-to-multipoint RF distribution plants comprised of either amplified or passive coaxial media.
- This approach will allow the project to optimize the cost balance between the network infrastructure components and attached stations in the cable network.

Compatibility

IEEE 802 defines a family of standards. All standards should be in conformance with the IEEE 802.1 Architecture, Management, and Interworking documents as follows: IEEE 802. Overview and Architecture, IEEE 802.1D, IEEE 802.1Q, and parts of IEEE 802.1F. If any variances in conformance emerge, they shall be thoroughly disclosed and reviewed with IEEE 802.1.

Each standard in the IEEE 802 family of standards shall include a definition of managed objects that are compatible with systems management standards.

I. Compatibility with IEEE Std 802.3

II. Conformance with the IEEE Std 802.3 MAC

III. Managed object definitions compatible with SNMP

- As an amendment to current IEEE Std 802.3, the proposed project will remain in conformance with the IEEE 802 Overview and Architecture, as well as the bridging standards IEEE Std 802.1D and IEEE Std 802.1Q.
- Moreover, the proposed project will build on 1G-EPON and 10G-EPON architecture, extending coverage of Multi Point Control Protocol (MPCP) to amplified and passive coaxial media.
- The proposed amendment will conform to the full-duplex operating mode of the IEEE 802.3 MAC, as defined in Annex 4A.
- EPoC will reuse the MAC Control and OAM as defined in the current IEEE Std 802.3 for EPON, with minimal augmentation if necessary, while developing new PHY specifications.
- The project will include a protocol independent specification of managed objects with SNMP management capability to be provided in the future by an amendment or revision to IEEE Std 802.3.1.

Distinct Identity

I. Substantially different from other IEEE 802 standards

II. One unique solution per problem (not two solutions to a problem)

III. Easy for the document reader to select the relevant specification

IV. Substantially different from other IEEE 802.3 specifications/solutions.

- There is no existing 802 standard or approved project appropriate for operation up to 10 Gb/s over point-to-multipoint active and passive coax plants in symmetric and asymmetric configurations.
- The proposed project is an evolutionary extension of the coverage of Multi Point Control Protocol (MPCP) and OAM, specified for IEEE Std 802.3 EPON, onto coax medium.
- The solution will include a PHY specification.
- The proposed amendment to the existing IEEE Std 802.3 will be formatted as a set of new clauses and changes to existing clauses, making it easy for the document reader to select the relevant specification.

Technical Feasibility

I. Demonstrated System Feasibility

II. Proven Technology

III. Confidence in reliability

- Widely deployed data transport technology in the form of DOCSIS & Digital Video services demonstrates the capacity of coaxial networks to support multi-gigabit/second data rates over existing infrastructure when sufficient spectrum is allocated.
- Wideband communication techniques can provide necessary granularity and flexibility of bandwidth assignment in upstream and downstream.
- Millions of successfully deployed and operating 1G-EPON & 10G-EPON devices clearly demonstrate the reliability factor of MAC and PHY layers standardized by 802.3.
- Millions of Cable Modems deployed and operating demonstrate the reliability of high speed data over access cable plants.

Economic Feasibility

I. Known cost factors, reliable data

II. Reasonable cost for performance

III. Consideration of installation costs

- The cost factors for EPON components and systems are well known and there is a broad and healthy industry ecosystem associated with these technologies.
- EPoC components are expected to be similar to those used in EPON, and CNUs developed for RF networks should have comparable cost structure as EPON ONUs
- The proposed project might introduce new cost factors which can be quantified and accounted for during the course of the project.
- EPON has been established as an attractive access technology in terms of cost/performance.
- This project is intended to bring these benefits to RF distribution plants comprised of either amplified or passive coaxial media.
- EPoC is expected to follow the same cost/performance trend line, established for all major Ethernet technologies developed by 802.3 in the past.
- Installation, maintenance and operations costs for the new technology are expected to be similar to those of DOCSIS equipment.
  - OLT installation costs should be comparable to the DOCSIS CMTS
  - CNU installation costs should be comparable to the cable modem
  - New optical-to-RF equipment installation costs should be comparable to other hybrid fiber-coax amplifier or node installation costs

Draft PAR (IEEE P802.3bn)

- http://www.ieee802.org/3/epoc/P802_3bn_PAR_170512.pdf

Plan for the week

- Meet Tuesday and Wednesday
- 9:00 am – 6:00 pm
- 19 presentations
- Respond by 5 pm Wednesday to any comments about our project documents (PAR and 5 Criteria)

Presentations - Tuesday

Tuesday, July 17			Duration	Start time
Howard Frazier	Broadcom	Agenda and General Information	0:45	9:00 AM
Marek Hajduczenia	ZTE	EPoC Draft Structure	0:20	9:45 AM
Marek Hajduczenia	ZTE	Data rate adaptation	0:30	10:05 AM
Break			0:15	10:35 AM
Rick Li	Cortina Systems	MPCP extension for EPoC	0:30	10:50 AM
Rick Li	Cortina Systems	Concurrent Upstream Transmission from Multiple CNUs in Single EPoC Coax Segment	0:30	11:20 AM
Jim Chen	Huawei	An example of designing a Coax Convergence Layer in EPoC	0:20	11:50 AM
Lunch			1:00	12:10 PM
Eugene Dai	Cox	Delay analysis of Ethernet Passive Optical Network over Coax	0:20	1:10 PM
Eugene Dai	Cox	EPON over Coax System reference Models	0:20	1:30 PM
Eugene Dai	Cox	Duplexing Methods for Ethernet Passive Optical Network over Coax – FDD or TDD?	0:20	1:50 PM
Jorge Salinger, Hesham ElBakoury, David Barr, Nicola Varanese, Christian Pietsch, Juan Montojo	Comcast, Huawei, Entropic, Qualcomm	Feasibility of TDD in EPoC	1:30	2:10 PM
Break			0:15	3:40 PM
Xiao-Jun Gao	Jiangsu Cable	The status of bidirectional network transformation in China MSOs	0:30	3:55 PM
Mark Laubach	Broadcom	Evaluation Criteria Beyond Objectives	0:30	4:25 PM
Mark Laubach	Broadcom	Comments on Channel models	0:30	4:55 PM
Leo Montreuil	Broadcom	Examination of Spectral Limitations in HFC plants	0:30	5:25 PM
Break for the day				5:55 PM

Presentations - Wednesday

Wednesday, July 18			Duration	Start time
Avi Kliger	Broadcom	FDD vs. TDD Comparison	0:30	9:00 AM
Ed Boyd	Broadcom	EPoC Delay	0:30	9:30 AM
Yong Yao	Technical Working Committee, China Radio & TV Association	Consideration on EPoC architecture	0:20	10:00 AM
Break			0:15	10:20 AM
Yong Yao	Technical Working Committee, China Radio & TV Association	Feasibility of TDD & China Market Demand on EPoC	0:20	10:35 AM
Marek Hajduczenia	ZTE	Energy Management in EPoC	0:20	10:55 AM
Howard Frazier	Broadcom	Review of comments submitted on our documents	0:45	11:15 AM
Lunch			1:00	12:00 PM
Respond to comments submitted on our documents			2:30	1:00 PM
Break			0:15	3:30 PM
Any other business			2:00	3:45 PM
Future meetings			0:15	5:45 PM
Adjourn				6:00 PM