EPoC Channel Model Ad Hoc

IEEE p802.3bn EPoC

Channel Model Ad Hoc committee

Teleconference

Nov 1, 2012

Agenda

- Patents
- Minutes from 10/18 and Attendance
- Tools
- Action Items & Progress Update
- Plans
  - Review of Objectives
- Assignments and Action Items

Instructions for the WG Chair

The IEEE-SA strongly recommends that at each WG meeting the chair or a designee:

- **Show slides #1 through #4 of this presentation**
- **Advise the WG attendees that:**
  - The IEEE's patent policy is described in Clause 6 of the *IEEE-SA Standards Board Bylaws*;
  - Early identification of patent claims which may be essential for the use of standards under development is strongly encouraged;
  - There may be Essential Patent Claims of which the IEEE is not aware. Additionally, neither the IEEE, the WG, nor the WG chair can ensure the accuracy or completeness of any assurance or whether any such assurance is, in fact, of a Patent Claim that is essential for the use of the standard under development.
- **Instruct the WG Secretary to record in the minutes of the relevant WG meeting:**
  - That the foregoing information was provided and that slides 1 through 4 (and this slide 0, if applicable) were shown;
  - That the chair or designee provided an opportunity for participants to identify patent claim(s)/patent application claim(s) and/or the holder of patent claim(s)/patent application claim(s) of which the participant is personally aware and that may be essential for the use of that standard
  - Any responses that were given, specifically the patent claim(s)/patent application claim(s) and/or the holder of the patent claim(s)/patent application claim(s) that were identified (if any) and by whom.
- The WG Chair shall ensure that a request is made to any identified holders of potential essential patent claim(s) to complete and submit a Letter of Assurance.
- It is recommended that the WG chair review the guidance in *IEEE-SA Standards Board Operations Manual* 6.3.5 and in FAQs 12 and 12a on inclusion of potential Essential Patent Claims by incorporation or by reference.

Note: **WG** includes Working Groups, Task Groups, and other standards-developing committees with a PAR approved by the IEEE-SA Standards Board.

(Optional to be shown)

Participants, Patents, and Duty to Inform

All participants in this meeting have certain obligations under the IEEE-SA Patent Policy.

- Participants [Note: Quoted text excerpted from IEEE-SA Standards Board Bylaws subclause 6.2]:
  - "Shall inform the IEEE (or cause the IEEE to be informed)" of the identity of each "holder of any potential Essential Patent Claims of which they are personally aware" if the claims are owned or controlled by the participant or the entity the participant is from, employed by, or otherwise represents
    - "Personal awareness" means that the participant "is personally aware that the holder may have a potential Essential Patent Claim," even if the participant is not personally aware of the specific patents or patent claims
  - "Should inform the IEEE (or cause the IEEE to be informed)" of the identity of "any other holders of such potential Essential Patent Claims" (that is, third parties that are not affiliated with the participant, with the participant's employer, or with anyone else that the participant is from or otherwise represents)
- The above does not apply if the patent claim is already the subject of an Accepted Letter of Assurance that applies to the proposed standard(s) under consideration by this group
- Early identification of holders of potential Essential Patent Claims is strongly encouraged
- No duty to perform a patent search

Patent Related Links

All participants should be familiar with their obligations under the IEEE-SA Policies & Procedures for standards development.

Patent Policy is stated in these sources:

IEEE-SA Standards Boards Bylaws

http://standards.ieee.org/develop/policies/bylaws/sect6-7.html#6

IEEE-SA Standards Board Operations Manual

http://standards.ieee.org/develop/policies/opman/sect6.html#6.3

Material about the patent policy is available at

http://standards.ieee.org/about/sasb/patcom/materials.html

If you have questions, contact the IEEE-SA Standards Board Patent Committee Administrator at patcom@ieee.org or visit http://standards.ieee.org/about/sasb/patcom/index.html

This slide set is available at https://development.standards.ieee.org/myproject/Public/mytools/mob/slideset.ppt

Call for Potentially Essential Patents

- If anyone in this meeting is personally aware of the holder of any patent claims that are potentially essential to implementation of the proposed standard(s) under consideration by this group and that are not already the subject of an Accepted Letter of Assurance:
  - Either speak up now or
  - Provide the chair of this group with the identity of the holder(s) of any and all such claims as soon as possible or
  - Cause an LOA to be submitted

Other Guidelines for IEEE WG Meetings

- **All IEEE-SA standards meetings shall be conducted in compliance with all applicable laws, including antitrust and competition laws.**
  - **Don't discuss the interpretation, validity, or essentiality of patents/patent claims.**
  - **Don't discuss specific license rates, terms, or conditions.**
    - Relative costs, including licensing costs of essential patent claims, of different technical approaches may be discussed in standards development meetings.
      - Technical considerations remain primary focus
  - **Don't discuss or engage in the fixing of product prices, allocation of customers, or division of sales markets.**
  - **Don't discuss the status or substance of ongoing or threatened litigation.**
  - **Don't be silent if inappropriate topics are discussed … do formally object.**

See *IEEE-SA Standards Board Operations Manual*, clause 5.3.10 and "Promoting Competition and Innovation: What You Need to Know about the IEEE Standards Association's Antitrust and Competition Policy" for more details.

Minutes

- Any corrections for the minutes posted for
  - 10/18 Call

Attendees (10/18)

Name	Affiliation
Blake, Victor	Victor Blake
Brown, Alan	Aurora Networks
Hajduczenia, Marek	ZTE
Hart, George	Rogers
Hewavithana, Thushara	Intel
Laubach, Mark	Broadcom
Ng, Lup	Cortina
Powell, Bill	Alcatel-Lucent
Ravikiran Rajagopal	Broadcom
Shellhammer, Steve	Qualcomm
Solomon, Joe	Comcast
Remein, Duane	Huawei

Tools

- Simulation
  - GNU Octave
  - MatLab
- Static Model (Excel)
- Parameter List(Excel)

Parameter List

Channel Param	DS			US			Units	Notes
	Min	Max	Nom	Min	Max	Nom		
Modulation Error Ratio (MER)							dB	
Noise Power Ratio								(dB/dB dynamic range)
Phase Noise								
@10Hz		x1			y1		dBc/Hz	
@100Hz		x2			y2		dBc/Hz	
@1kHz		x3			y3		dBc/Hz	
@10kHz		x4			y4		dBc/Hz	
@100kHz		x5			y5		dBc/Hz	
Microreflections								
≤ 0.5 µsec							dBc	suggeseted in noll_01a_0312.pdf
<= 1.0 µsec							dBc	
<= 1.5 µsec							dBc	
> 1.5 µsec							dBc	
Group Delay Ripple							ns/MHz	
Impulse Noise							dB/MHz	
Sub-Carrier to Discrete Interference							dB	
Amplitude Ripple							dB/MHz	
Non Linear Amplifier Output Backoff							dB	
-	-	-	-	-	-	-	-	

Parameters to consider

Channel Param	Units	Notes
Tilt		noll_01_0112.pdf
Attenuation	dB/unit Length	noll_01_0112.pdf
Group Delay		noll_01_0112.pdf
Phase Delay		noll_01_0112.pdf
Impedance	Ohm	noll_01a_0312.pdf
Equivilent distance	km	noll_01a_0312.pdf
CNR in 6MHz band	dB	noll_01a_0312.pdf
Carrier to Composite Triple Beat	dB	noll_01a_0312.pdf
Carrier to Composite Triple Beat	dBc	SCTE-40 Table 4 Not greater than -53 dBc referenced to inband carrier levels for analog channels.
Carrier to Composite Second Order	dB	noll_01a_0312.pdf
Carrier to Cross Modulation	dB	noll_01a_0312.pdf
Carrier to any other Discrete Interference (ingress)	dB	noll_01a_0312.pdf
Carrier Hum Modulation	dBc	noll_01a_0312.pdf
Burst Noise @ 10Hz avg. rate	us	noll_01a_0312.pdf
CNR in 8MHz band	dB	noll_01a_0312.pdf
Composite Triple Beat	dBc	noll_01a_0312.pdf
Composite Second Order Distortion	dBc	noll_01a_0312.pdf
Carrier to Interference (broadband+discrete ingress)	dB	noll_01a_0312.pdf
Maximum Analog Video Carrier at Input to Customer Equipment	dBmV	noll_01a_0312.pdf
Seasonal and diurnal signal level variation	dB	noll_01a_0312.pdf
Signal level slope	dB	noll_01a_0312.pdf
narrowband beats		Ref[1] pg 38 Section 4.4
bandwidth peaks	kHz	Ref[1] pg 38 Section 4.4
average signal level above noise floor	dB	Ref[1] pg 38 Section 4.4
Amplitude Variation	dB/MHz	Same as Amplitude Ripple

Parameters to consider

Channel Param	Units	Notes
Transit delay from headend to most distant customer	ms	SCTE-40 Table 4 / SCTE-22-1
Carrier-to-noise-plus-interference ratio		SCTE-40 Table 4
64 QAM	dB	SCTE-40 Table 4
256 QAM	dB	SCTE-40 Table 4
Carrier to Noise (AM-VSB analogue channels)	dB	SCTE-40 Table 4
Composite Second Order	dBc	SCTE-40 Table 4 Not greater than -53 dBc referenced to inband carrier levels for analog channels
Carrier-to-any other discrete interference (ingress)	dBc	SCTE-40 Table 4 Not greater than -53 dBc
AM Hum Modulation	%	SCTE-40 Table 4 Not greater than 3% p-p
Group Delay Variation	us/Hz	SCTE-40 Table 4 < 0.37 ms/MHz across the 6-MHz channel
Chroma / Luma Delay	ns	SCTE-40 Table 4 £ 170 ns (AM-VSB analog)
Phase Noise	dBc/Hz	SCTE-40 Table 4 < -86 dBc/Hz @ 10 kHz offset (relative to the center of QAM signal spectrum)
Maximum Amplitude Variation across the 6-MHz channel (digital channels)	dB	SCTE-40 Table 4 < 6 dB p-p
Maximum Amplitude Variation across the 6-MHz channel (analog channels)	dB	SCTE-40 Table 4 < 4 dB p-p
Bound for a single dominant micro-reflection		SCTE-40 Table 4 Micro-reflections longer than 4.5 microseconds are included under item 4 (of this table) as a contributor to the interference I in C/(N+I)). Micro-reflections, if present, shall not cause the channel Group Delay Variation and Maximum Amplitude Variation in Table 4.9 and 4.12 respectively to be exceeded.
@ < 0.5 ms	dB	SCTE-40 Table 4
@ < 1.0 ms	dB	SCTE-40 Table 4
@ < 1.5 ms	dB	SCTE-40 Table 4
@ < 4.5 ms	dB	SCTE-40 Table 4
Carrier level at the terminal input		SCTE-40 Table 4
64 QAM: -15 dBmV to + 15 dBmV	dBmv	SCTE-40 Table 4
256 QAM: -12 dBmV to +15 dBmV	dBmv	SCTE-40 Table 4
Analog Visual Carrier (c):	dBmv	SCTE-40 Table 4
Analog Aural Carrier:	dBc	SCTE-40 Table 4
Adjacent Channel Characteristics Desired Ch Mod - Undesired Adjacent Ch Mod)		SCTE-40 Table 6
Analog NTSC - 64 QAM	D/U Ratio	SCTE-40 Table 6

Parameters to consider

Channel Param	Units	Notes
Analog NTSC - 256 QAM	D/U Ratio	SCTE-40 Table 6
Analog NTSC - QPSK FDC	D/U Ratio	SCTE-40 Table 6
64 QAM FAT - Analog NTSC	D/U Ratio	SCTE-40 Table 6
64 QAM FAT - 256 QAM	D/U Ratio	SCTE-40 Table 6
64 QAM FAT - QPSK FDC	D/U Ratio	SCTE-40 Table 6
256 QAM FAT - Analog NTSC	D/U Ratio	SCTE-40 Table 6
256 QAM FAT - 64 QAM	D/U Ratio	SCTE-40 Table 6
256 QAM FAT - QPSK FDC	D/U Ratio	SCTE-40 Table 6
QPSK FDC - Analog NTSC	D/U Ratio	SCTE-40 Table 6
QPSK FDC - 64 QAM	D/U Ratio	SCTE-40 Table 6
QPSK FDC - 256 QAM	D/U Ratio	SCTE-40 Table 6
Analog NTSC - Analog NTSC	D/U Ratio	SCTE-40 Table 6
64 QAM FAT - 64 QAM	D/U Ratio	SCTE-40 Table 6
256 QAM FAT - 256 QAM	D/U Ratio	SCTE-40 Table 6
QPSK FDC - QPSK FDC	D/U Ratio	SCTE-40 Table 6
Carrier-to-noise ratio in a 6-MHz band (analog video level)	dB	SCTE_22-1 Table 2-1 Not less than 35 dB (Note 4)
Carrier-to-interference ratio for total power (discrete and broadband ingress signals)	dB	SCTE_22-1 Table 2-1 Not less than 35 dB within the design bandwidth
Composite triple beat distortion for analog modulated carriers	dBc	SCTE_22-1 Table 2-1 Not greater than -50 dBc within the design bandwidth
Composite second order distortion for analog modulated carriers	dBc	SCTE_22-1 Table 2-1 Not greater than -50 dBc within the design bandwidth
Cross-modulation level	dBc	SCTE_22-1 Table 2-1 Not greater than -40 dBc within the design bandwidth
Amplitude ripple	dB	SCTE_22-1 Table 2-1 0.5 dB within the design bandwidth
Group delay ripple in the spectrum occupied by the CMTS	ns	SCTE_22-1 Table 2-1 75 ns within the design bandwidth
Micro-reflections bound for dominant echo	dBc	SCTE_22-1 Table 2-1
@ ≤ 0.5 µsec	dBc	-10 dBc @ ≤ 0.5 µsec
@ ≤ 1.0 µsec	dBc	-15 dBc @ ≤ 1.0 µsec

Parameters to consider

Channel Param	Units	Notes
@ ≤ 1.5 µsec	dBc	-20 dBc @ ≤ 1.5 µsec
@ > 1.5 µsec	dBc	-30 dBc @ > 1.5 µsec
Carrier hum modulation	dBc	SCTE_22-1 Table 2-1 Not greater than -26 dBc (5%)
Burst noise	uS	SCTE_22-1 Table 2-1 Not longer than 25 µsec at a 10 Hz average rate
Seasonal and diurnal signal level variation	dB	SCTE_22-1 Table 2-1 8 dB
Signal level slope, 50-750 MHz	dB	SCTE_22-1 Table 2-1 16 dB
Maximum analog video carrier level at the CM input, inclusive of above signal level variation	dBmV	SCTE_22-1 Table 2-1 17 dBmV
Lowest analog video carrier level at the CM input, inclusive of above signal level variation	dBmV	SCTE_22-1 Table 2-1 -5 dBmV
Carrier-to-noise ratio	dB	SCTE_22-2 Table 2-1 Not less than 25 dB
Carrier-to-ingress power (the sum of discrete and broadband ingress signals) ratio	dB	SCTE_22-2 Table 2-1 Not less than 25 dB (Note 2)
Carrier-to-interference (the sum of noise, distortion, common-path distortion and cross-modulation) ratio	dBc	SCTE_22-2 Table 2-1 Not less than 25 dB
Carrier hum modulation	dBc	SCTE_22-2 Table 2-1 Not greater than -23 dBc (7.0%)
Burst noise	us	SCTE_22-2 Table 2-1 Not longer than 10 µsec at a 1 kHz average rate for most cases (Notes 3, 4 and 5)
Amplitude ripple	dB/MHz	SCTE_22-2 Table 2-1 5-42 MHz: 0.5 dB/MHz
Group delay ripple	ns/MHz	SCTE_22-2 Table 2-1 5-42 MHz: 200 ns/MHz
Micro-reflections -- single echo		SCTE_22-2 Table 2-1
@ ≤ 0.5 µsec	us	-10 dBc @ ≤ 0.5 µsec
@ ≤ 1.0 µsec	us	-20 dBc @ ≤ 1.0 µsec
@ > 1.0 µsec	us	-30 dBc @ > 1.0 µsec
Seasonal and diurnal signal level variation	dB	SCTE_22-2 Table 2-1 Not greater than 8 dB min to max

Action Items

Item	Date	Assigned to	Status	Description	Response/Update
5	121004	S Rahman	O	Distribute the channel model output information collected by the informal group.	Expected ~10/17
7	121010	D Remein	O	Start Parameter List	Initial version distributed 10/18
8	121010	S Rahman / B Powell	C	Provide definitions of parameters	Included in Parameter List
9	121018	Marek Hajduczenia	O	Capture static model in Excel	

Progress update

- Review Parameters List

Plan Going Forward

- Add tentative values to Parameter List

NEW ACTION ITEMS & OTHER BUSINESS

THANK YOU

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.

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.**

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.

Ad Hoc Mission Statement

- Ad Hocs purpose/deliverables are to:
  - Make Channel Model recommendations to the Task Force, including
    - "The Model", "How to use" documentation, Any tools, templates, etc.
  - Maintains & updates the Channel Model for TF use
- Other requirements
  - Does not create "The Model"
  - Act's as focus for input from MSOs: e.g.,
    - North American
    - European
    - China
- Evaluate need/desire for a channel model informative annex

Ad Hoc Mission Statement (cont)

- Channel Model Purpose
  - Purpose 1: To facilitate the evaluation of multiple PHY modulation proposals for use in 802.3bn
  - Purpose 2: To facilitate the selection of a range of PHY parameters within the selected PHY proposal to allow adaption to changing PHY conditions within the coax environment
- Channel Model Scope
  - Model should be limited to the minimum set of critical parameters necessary for above purposes.