802.3bn Link Ad Hoc

Meeting Notes & Baseline

Agenda, Notes – 10/4/12

- 10am - 11am Pacific
- IEEE Patent Policy Reviewed – Agreed and no known patents
- Attendance Taken – See Attendance slide
- Possible Dates/Times for this meeting – Doodle Poll will be sent out
- Overview – see slides for latest
- Link Topics – see slides for latest
- Parameters & Status Indicators
- Evaluation Criteria

Agenda, Notes – 10/11/12

- IEEE Patent Policy Reviewed – Agreed and no known patents
- Attendance Taken – See Attendance slide
- Implications of PHY Initialization Procedures – Nicola
  - Slides attached at end.
- Added MAC Discovery Compatibility
- Transport Options
  - Added slide with questions for next week and evaluation

PATENTS

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.

ATTENDEES

Attendance – 10/4/12 Conf Call

- Ed Boyd, Broadcom
- Avi Kliger, Broadcom
- Bill Powell, Alcatel-Lucent
- Charley Moore, CTDI
- David Barr, Entropic
- David Law, HP
- Duane Remein, Huawei
- George Hart, Rogers
- Hal Roberts, Calix
- Victor Blake
- Marek Hajduczenia, ZTE
- Mark Laubach, Broadcom
- Nicola Varanese, Qualcomm
- Patrick Stupar, Qualcomm
- Tom Staniec
- Kevin Noll, TWC
- Lup Ng, Cortina
- Rick Li, Cortina

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- Ed Boyd, Broadcom
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- Duane Remein, Huawei
- Kevin Noll, TWC
- Steve Shelhammer, Qualcomm
- Avi Kliger, Broadcom
- David Barr, Entropic
- Victor Blake, Ind Consultant
- Nicola Varanese, Qualcomm
- Patrick Stupar, Qualcomm
- Hesham ElBakoury, Huawei
- Tom Staniec
- Michael Peters, Sumitomo
- Ron Wolfe, Aurora Networks
- Rannan Ivry, WidePass
- Chris Pietsch, Qualcomm

OVERVIEW & TOPICS

Overview

- Objective
  - Define the process for the CLT PHY to connect to CNU PHY before the MAC is enabled.
  - Define any re-negotiation or PHY parameter procedure.
  - Define the PHY parameters to be configured over MDIO & Auto-Negotiation
  - What happens after CLT PHY & CNU PHY power up?
  - What parameters are PHY? (others are MAC)

- Output of the Ad Hoc
  - Baseline proposal
    - A single agreed solution is best.
    - Two or more options with pros and cons is the other option.
  - Joint Presentation for next meeting

Link Topics

- Link Transport Methods
  - Upstream
  - Downstream
  - e.g. Time Inserted or Frequency Inserted, or other
  - Protocol
- Auto-negotiation-Link state machine
  - Finding the Downstream
  - Speeding up the process
  - Initial Upstream
- Message Format & Addressing
  - e.g. Address + Register Pages
- Protocol
  - Dynamic or Static: Master or Slave, who makes change
  - e.g. Echo Protocol
- Parameters and Status Indicators
- MAC Discovery Compatibility

Parameters & Status Indicators

- Sub-Carrier Location (Downstream)
- Sub-Carrier Modulation Order (Downstream)
- Sub-Carrier Location (Upstream)
- Sub-Carrier Modulation Order (Upstream)
- Transmit Power Level
- Transmit Offset

Evaluation Criteria

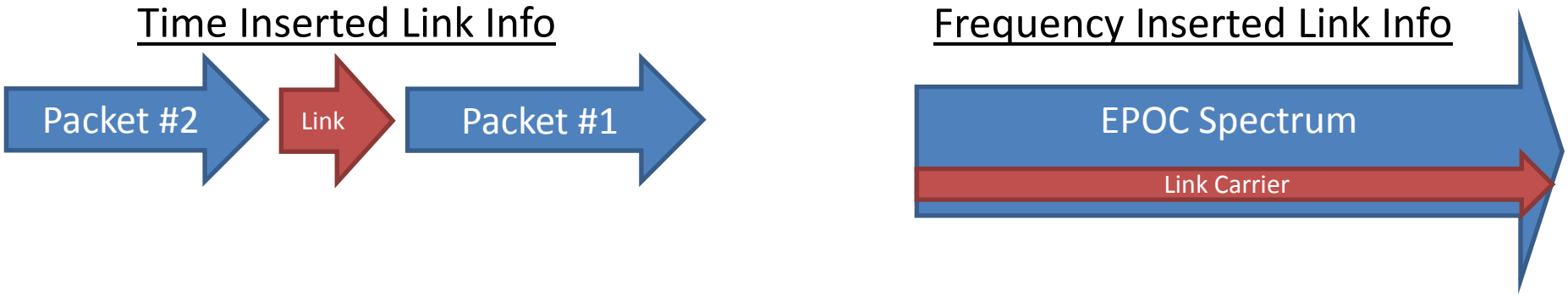
- Link establishment time. First and other
- Simplicity
- Must work all of the time

LINK TRANSPORT

Link Transport Notes

- How many CNUs are supported?
- We need a Link profile on the CLT PHY for every CNU PHY.
- How wide is the frequency transport?
- How fast does it need to be? What is the data rate?
- How is the initial contention handled?
- Do we need to detect collisions or just provide avoidance?
- How do we find the initial channel?

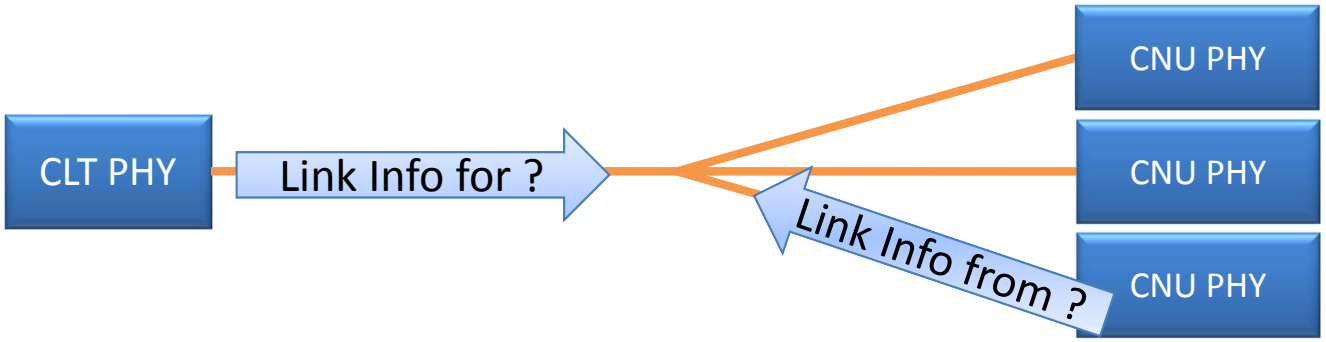
Link Transport Options



- Time Inserted Link Info (Between Packets)
  - Traditionally, Link Info (pulses) have been transported in the IPG.
  - Downstream is challenged by long symbols and streaming FEC so IPG is not possible.
  - Downstream insertion between symbols is possible but complicated.
  - Upstream between symbols or packets would be very difficult without MAC slots.
- Frequency Inserted Link Info (Dedicated Sub-Carriers)
  - A small number of carriers would be dedicated to carry link information.
  - Easy to have a high SNR modulation order for reliability.
  - Coordination with Ethernet MAC for upstream transmission is not required
  - Easier to find and lock onto at discovery.

Frequency Inserted Link Info will be the focus of this proposal

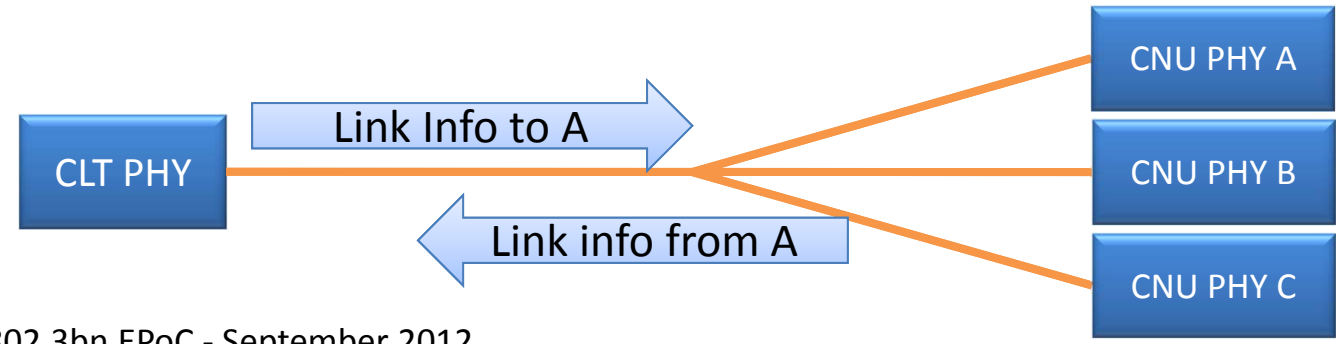
Link Information Addressing



- Point-to-Multipoint Requires an address
  - Traditionally Link Information has been sent on point-to-point network so the source and destination is clear.
  - In the case of EPOC, the CLT needs to send information to a particular CNU.
  - The CLT also needs to know the source of link information that it received.
- What is the address?
  - The address should be the first field in the link information.
  - It can be configured in the PHY through the MDIO
  - The Ethernet MAC address is a possible choice
  - The LLID can't be used since auto-negotiation happens before MAC layer discovery.

Echo Protocol

- Shared Upstream
  - Access to the shared upstream can be simple with an echo protocol.
  - The CLT PHY will simply send the Link Information to the CNU PHY and the CNU PHY will respond with the same message in a fixed time later.
  - A downstream time reference (i.e. MPCP timing from the MAC), GATE frames, etc are not required.
  - The Echo protocol also provides an acknowledge function to the CLT PHY.
- Broadcast Echo
  - Using a broadcast address on the link information allows for a new CNU PHY to be configured.
  - A CNU PHY that has not reached the Linked state, would respond to a Broadcast Echo
  - A random back off in time or Broadcast Echo opportunities should be considered to resolve contention.



Implications of PHY Initialization Procedures

Qualcomm – 11 October 2012

PHY Control Channel and Procedures /1

- Need for PHY Control Channel: conveying L1 control information, e.g.
  - Downstream: bit-loading profiles for DS and US
  - Upstream: supported bit-loading profile in DS for a specific CNU

- Coordinated PHY initialization and MPCP registration
  - MPCP is aware of start time of OFDM symbols (PHY framing)
  - Only way to enable bit-loading in US
    - Could use 1D-to-2D map to perform frequency-aware US resource allocation
    - Could use extended MPCP gate message to perform frequency-aware US resource allocation
  - Requires some interaction between MAC and PHY
    - Extensions to MAC/PHY interface ? (additional synch procedure between MAC and PHY)
    - Additional MDIO communication ? (MAC needs to be aware of bit-loading maps)

PHY Control Channel and Procedures /2

- Need for PHY Control Channel: conveying L1 control information, e.g.
  - Downstream: bit-loading profiles for DS and US
  - Upstream: supported bit-loading profile in DS for a specific CNU

- Independent PHY initialization and MPCP registration
  - OFDM symbols and MPCP timing are not aligned
  - This prevents from using bit loading in US: data rate supported by each CNU depends on the frequency resources used to transport its frames
    - This choice forces to use either a single MCS for each CNU or a single MCS for the whole plant
    - In fact, only in this way each CNU would support a fixed data rate no matter on which frequencies its packets are transmitted

The way we do PHY initialization and MPCP registration has a dramatic impact on US system design and MAC/PHY interface !!!