Canova Tech

The Art of Silicon Sculpting

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IEEE802.3cg TF

PLCA – MAC compatibility

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Outline

- Some concerns were raised in 802.3cg about PLCA compatibility with clause 4 (MAC) specifications.
  - What about frames received during a (logical) collision?
  - PLCA relies on the MAC to successfully receive a frame being received even in case the PHY signals a local collision via MII interface (COL = 1)
    - This has been carefully evaluated when PLCA was first designed, reading clause 4
- Regardless of above concern, there are some MAC implementations that discard frames received during a collision in half-duplex mode
  - Not clear how many exist
- Scope of this presentation is twofold:
  - Clarify that a IEEE 802.3 compliant MAC shall keep valid frames
  - Provide a simple implementation work-around to have PLCA work with non compliant MACs as well
    - Negligible impact on performance

- Debated text
  - **4.2.3.2.4 Collision detection and enforcement (half duplex mode only)**
    - Collisions are detected by monitoring the collisionDetect signal provided by the Physical Layer. When a collision is detected during a packet transmission, the transmission is not terminated immediately. Instead, the transmission continues until additional bits specified by jamSize have been transmitted (counting from the time collisionDetect went on). This collision enforcement or jam guarantees that the duration of the collision is sufficient to ensure its detection by all transmitting stations on the network. The content of the jam is unspecified; it may be any fixed or variable pattern convenient to the Media Access implementation; however, the implementation shall not be intentionally designed to be the 32-bit CRC value corresponding to the (partial) packet transmitted prior to the jam.

- Dispute
  - According to one interpretation the highlighted text **implies** that the MAC is supposed to **always** discard a frame when a collision is detected
  - In our understanding this sentence is specified because the MAC shall actually rely on FCS mismatch to detect incoming frames which have been (possibly) corrupted by a physical collision
    - If the MAC was not supposed to receive the packet, this 'shall not' would be useless
   - This is indeed specified in subclause 4.1.2.2 , see next slide...

- **4.1.2.2 Access interference and recovery**
  - [...] At the receiving end, the bits resulting from a collision are received and decoded by the PLS just as are the bits of a valid frame. Fragmentary frames received during collisions are distinguished from valid transmissions by the MAC sublayer's **Receive Media Access Management** component

- **4.2.4.2 Receive media access management**
  - Discards frames with invalid FCS and...
    - **4.2.4.2.2 Collision filtering**
      - In the absence of a collision, the shortest valid transmission in half duplex mode must be at least one slotTime in length [...]. Anything less is presumed to be a fragment resulting from a collision, and is discarded by the receiver. [...]

- Comments
  - Rejection of frames that have been possibly corrupted by a collision is performed **by the means** of these two rules:
    - MAC shall filter frames which length is less than slotTime (i.e. 512 bits for 10 Mbit/s operation)
      - Supposed to be fragments resulting from physical collisions
    - MAC shall filter frames with invalid FCS
      - Jammed frames longer than one slotTime

- We deduce that frames longer than one slotTime with valid FCS shall not be discarded

Dispute resolution

- Clause 4 specifies a way to resolve apparent ambiguities and misinterpretations
  - **4.2 CSMA/CD Media Access Control (MAC) method: Precise specification**
    - **4.2.1 Introduction**
      - A precise algorithmic definition is given in this subclause, providing procedural model for the CSMA/CD MAC process with a program in the computer language Pascal. [...] Note whenever there is any apparent ambiguity concerning the definition of some aspect of the CSMA/CD MAC method, it is the Pascal procedural specification in 4.2.7 through 4.2.10 which should be consulted for the definitive statement. [...]
    - **4.2.2 Overview of the procedural model**
      - [...] This procedural model is intended as the primary specification of the functions to be provided in any CSMA/CD MAC sublayer implementation. [...]
    - **4.2.2.4 Layer management extensions to procedural model**
      - [...] The Pascal procedural specification shall be consulted for the definitive statement when there is any apparent ambiguity concerning the definition of some aspect of the CSMA/CD MAC access method. [...]

- Frame reception is specified in subclause 4.2.9
  - No reference, either direct or indirect to any function, variable or expression affected by collision detect and carrier sense mechanisms can be found in the Pascal code (!!)
    - Received frames are validated against max/min allowed length and FCS, regardless of collisions

- Countercheck: Frame transmission is specified in subclause 4.2.8
  - Frame transmission is affected by carrierSense and collisionDetect variables, as expected
    - **Besides → 4.1.2 CSMA/CD operation**
      - [...] Transmit frame operations are independent from the receive frame operations [...]

Real world situation

- At least one MAC discarding valid frames during a collision exists, as well as one **not** discarding valid frames
  - Have been found during lab tests on real hardware
- For MACs discarding valid frames (supposedly out of specs), a simple work-around can be adopted in the PLCA gRS
  - Add a small delay in the RX path to avoid the situation of signaling a collision when the PLS is already receiving a frame
    - Adds an RX latency of ~8-16 bytes (depending on collision detection implementation within the PHY)
  - Works because a logical collision can only happen at the very beginning of a transmission
    - Reason is that CRS still works as in normal CSMA/CD, having the MAC defer the transmission until the line is free

generic Reconciliation Sublayer (gRS)
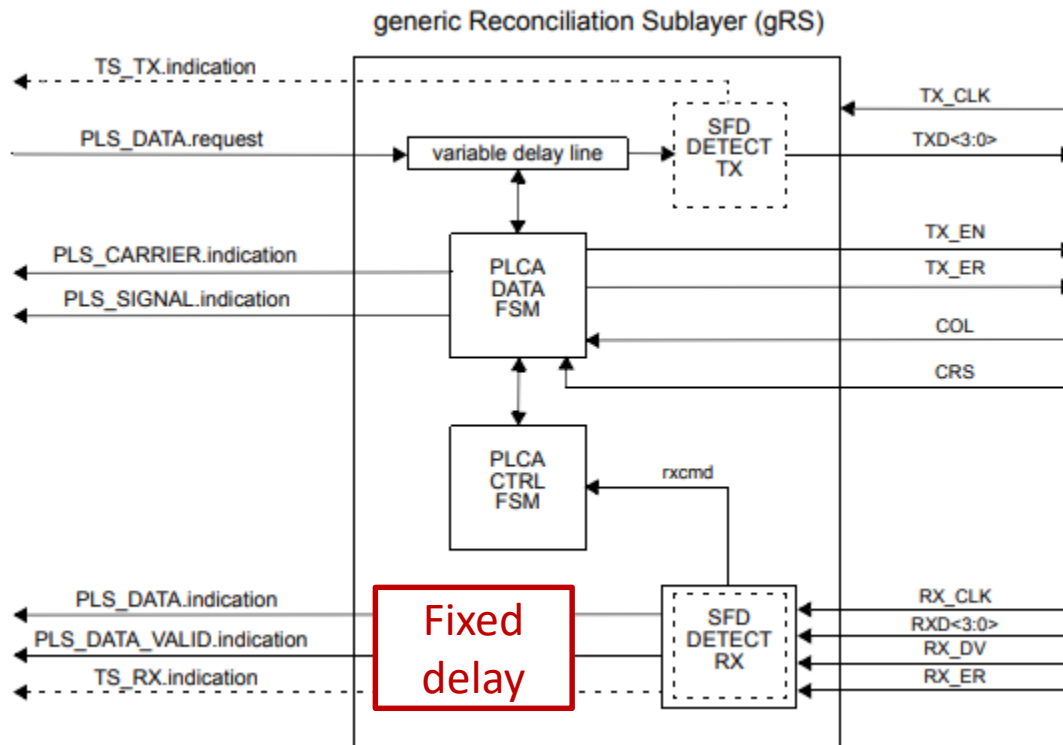
- Was tested successfully on CT evaluation board

- Impact on performance is negligible

- IEEE802.3 compliant MAC implementations **shall not** discard valid frames even during a collision
  - MAC which exhibits a different behavior are non fully conformant to clause 4
    - Maintenance request needed?

- In practice it's possible to implement a simple work-around in a PHY featuring PLCA to be compatible with non compliant MACs
  - No changes to clause 148

Thank You !

- Collision concept in PLCA
  - PLCA is designed to avoid **physical** collisions, meaning that packets on the line are never corrupted.
  - Logical collisions are raised via MII interface under certain conditions to force the MAC to hold a frame while waiting for a transmit opportunity
    - Mechanism to apply back-pressure on the MAC
    - No corruption of received frames in possible
  - What collisions are possible?

Type / Access method	Plain CSMA/CD	PLCA
Physical Collisions	YES	NO
Single Collision	YES	YES (Logical)
Multiple Collisions	YES	NO
Late Collisions	YES (errors)	NO

  - Multiple / Late collisions are not possible with PLCA
    - Guarantee to get access to the media after at most one logical collision
    - Maximum latency bounded