LSS for Link Status Mechanism

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Presentation Purpose

- Review of Sept'00 LSS Proposal*

  * Link Signaling Sublayer Proposal by 47 individuals from 25 companies
  http://grouper.ieee.org/groups/802/3/ae/public/sep00/ishida_1_0900.pdf

  - Concept of Link signaling
  - Mechanism of Break Link (BL) and Remote Fault (RF)

- Update receive detection state diagrams for LSS
  - Improve robustness by adopting a watchdog timer and hysteresis

- Propose overall link status mechanism with LSS
  - Define RF&BL mechanism in Reconciliation Sublayer
  - Up-the-stack BL signaling by pure Idle generation in PCS/XGXS

What is Link Signaling?

- Convey status/control register bits to its Link Partner
  - RF (remote fault) : fault detected on the receive path
  - BL (break link) : link_reset by STA
  - optional OAM&P* : WAN-PHY compatible trace identifier, e.t.c.

    * Operations, Administration, Management, and Provisioning
- Use an Idle Column as the vehicle
  - Signal on the data path, not on the MDIO nor on “Pins”
  - Replace an Idle Column with an Link Signaling Column
- Signal repeatedly once every time frame (e.g. 125 us)
  - Independent of PCS/XGXS varieties
  - Less frequent to avoid XAUI EMI
  - Sufficiently frequent for robust detection

Link Signaling Example

PHY stream after RS

Lane 0	...	I	LS	I	I	...	...	I	I	LS	I	...	...	I	LS	I	I	...
Lane 1	...	I	d_1	I	I	...	...	I	I	d_1	I	...	...	I	d_1	I	I	...
Lane 2	...	I	d_2	I	I	...	...	I	I	d_2	I	...	...	I	d_2	I	I	...
Lane 3	...	I	d_3	I	I	...	...	I	I	d_3	I	...	...	I	d_3	I	I	...

after XGXS or X PCS (8b/10b)

Lane 0	...	A	LS	K	R	...	...	K	K	LS	R	...	...	K	LS	A	R	...
Lane 1	...	A	D_1	K	R	...	...	K	K	D_1	R	...	...	K	D_1	A	R	...
Lane 2	...	A	D_2	K	R	...	...	K	K	D_2	R	...	...	K	D_2	A	R	...
Lane 3	...	A	D_3	K	R	...	...	K	K	D_3	R	...	...	K	D_3	A	R	...

after R PCS (64b/66b*)

header		10		10				10		10				10		10		
Lane 0	...	2d	0000	1e	I	...	...	1e	I	4b	0000	...	...	2d	0000	1e	I	...
Lane 1	...	I	d_1	I	I	...	...	I	I	d_1	I	...	...	I	d_1	I	I	...
Lane 2	...	I	d_2	I	I	...	...	I	I	d_2	I	...	...	I	d_2	I	I	...
Lane 3	...	I	d_3	I	I	...	...	I	I	d_3	I	...	...	I	d_3	I	I	...

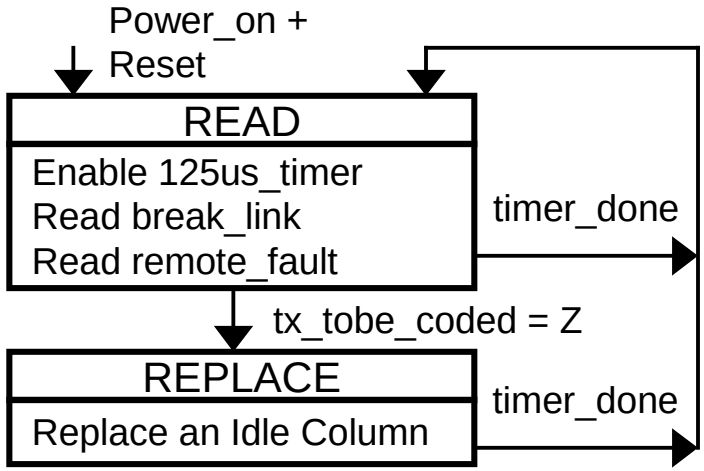
LS: Link Signaling Identifier K28.4 (0x9c,1)

* See Page 19 (Optional Code Features) of http://www.ieee802.org/3/ae/public/jul00/walker_1_0700.pdf

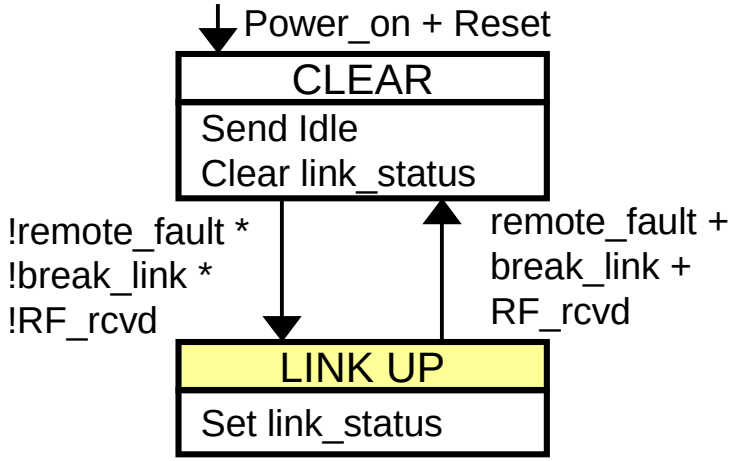
BL&RF Mechanism on LSS (1/2)

- Transmit the Link Status Column once every 125 us
  - Covey BL/NoBL and RF/NoRF simultaneously
  - Assert BL when STA triggers link_reset
  - Assert RF when failure is being detected on the receive path
- Define Link Status simply as a Boolean variable
  - link_status = !(!rx_in_sync + BL_rcvd) * !(RF_rcvd + break_link)
    - !rx_in_sync + BL_rcvd : failure on the receive path
      - And hence RF is being sent on the transmit path
    - RF_rcvd + break_link : failure on the transmit path
      - That's why RF is being or will be detected on the receive path
- Send Idles whenever link_status is False
  - Use Idle stream for link initialization

BL&RF Mechanism on LSS (2/2)



LS Code Transmit State Diagram



Link State Diagram

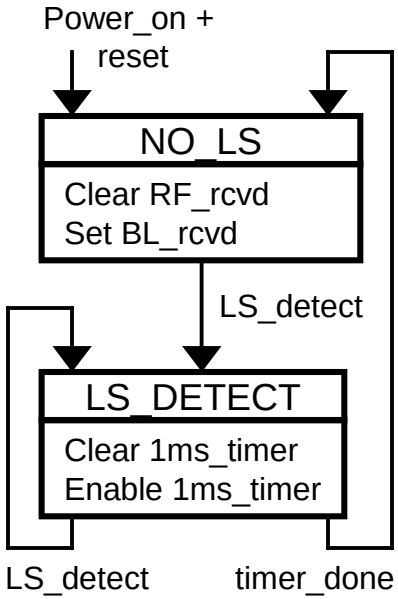
Notes: break_link = link_reset + power_down
remote_fault = !rx_in_sync + BL_rcvd

In this mechanism RF is sent whenever the local receiver is not ready to use.
Receiving break link (BL_rcvd) asserts remote_fault since Link Partner wants to reset Local Device's PHY.
Whether or not resetting the receiver sync status is an implementation.

What is Updated from Sept'00 ?

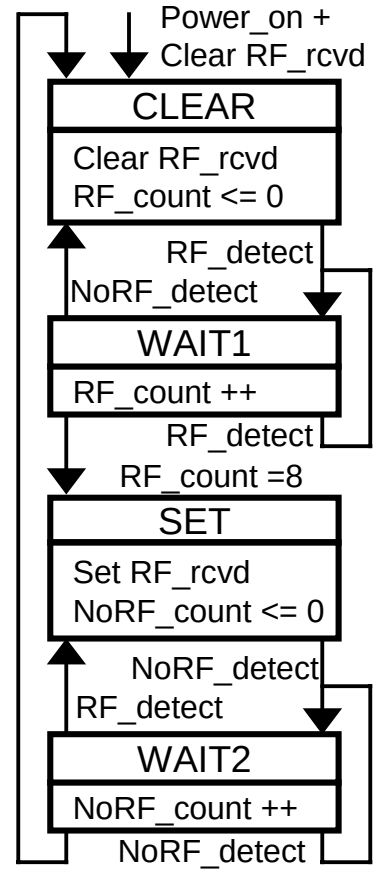
- Improved robustness in Link Signaling Detection
  - Add a watch dog timer
    - Link Signaling Failure should be detectable
    - Clear link_status if the Link Status Column is not detected for greater than 1 millisecond
  - Adopt hysteresis for BL&RF detection
    - Protect from misdetection during error burst
    - Require 8 consistent Link Status Column detection before setting/clearing the BL/RF received status

Rx Detection State Diagrams; Updated

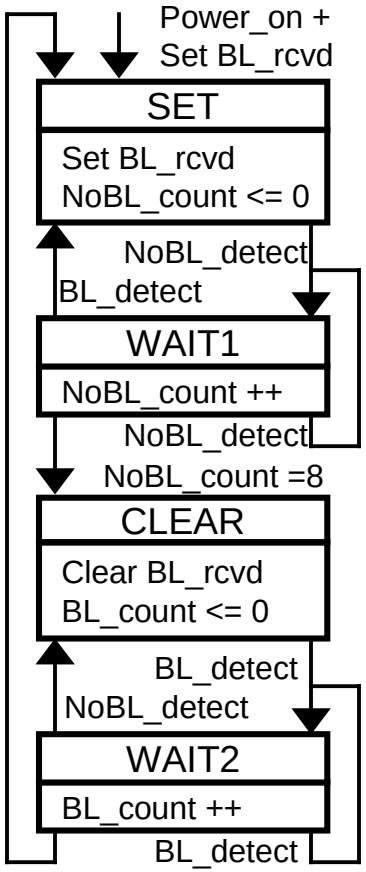


RX LS Detection S. D.

LS_detect = (TYPE=Z)
(lane0=K28.4) +
(lane1=D18.2) +
(lane2=D18.2) +



RX RF Detection S. D.



RX BL Detection S. D.

RF_detect = LS_detect *
(lane3 = RF);
NoRF_detect = LS_detect *
(lane3 = NR);

RF = (D14.6 + D9.2 +
D10.1 + D13.5);
NR = (D18.2 + D21.6 +
D22.5 + D17.1);

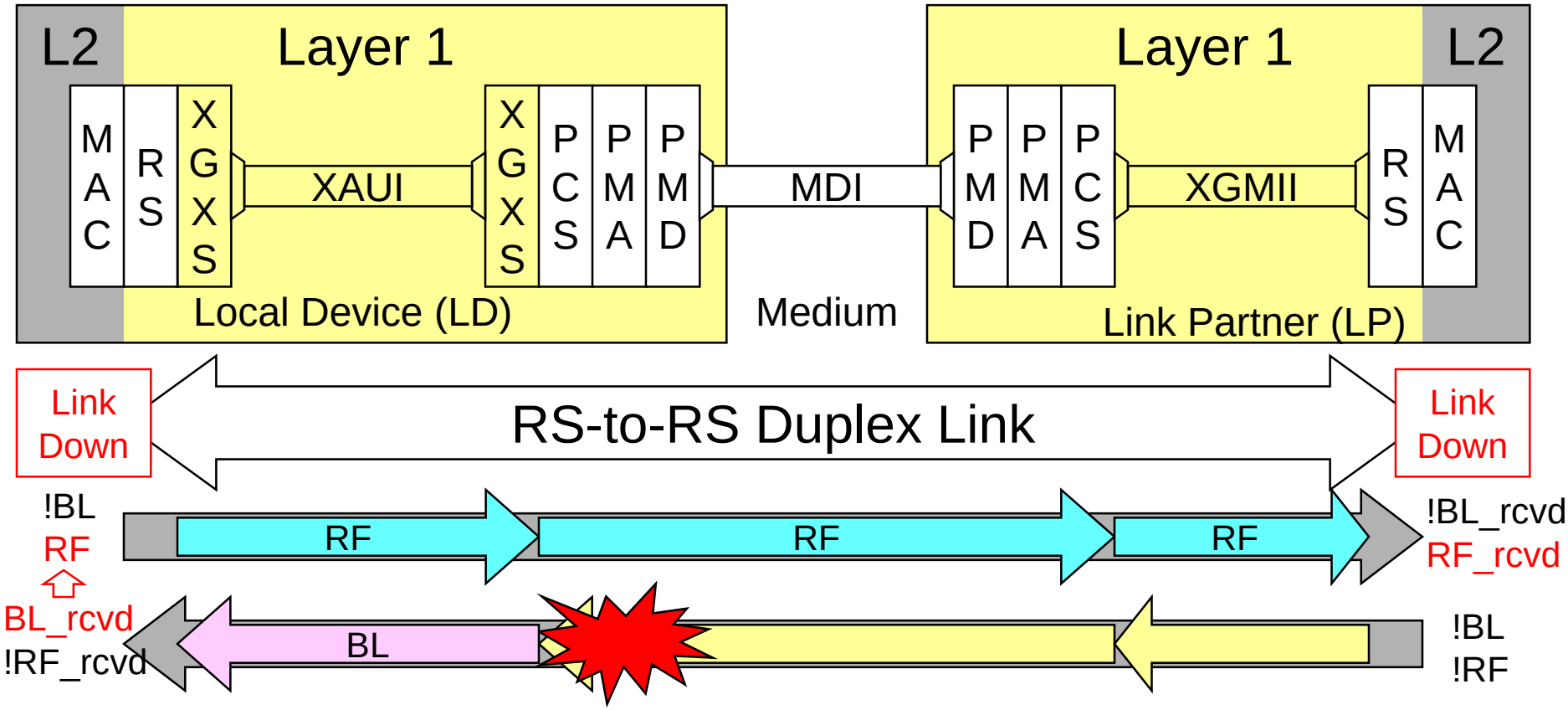
BL_detect = LS_detect *
(lane3 = BL);
NoBL_detect = LS_detect *
(lane3 = NB);

BL = (D21.6 + D9.2 +
D17.1 + D13.5);
NB = (D18.2 + D14.6 +
D22.5 + D10.1);

Overall Link Status Bit

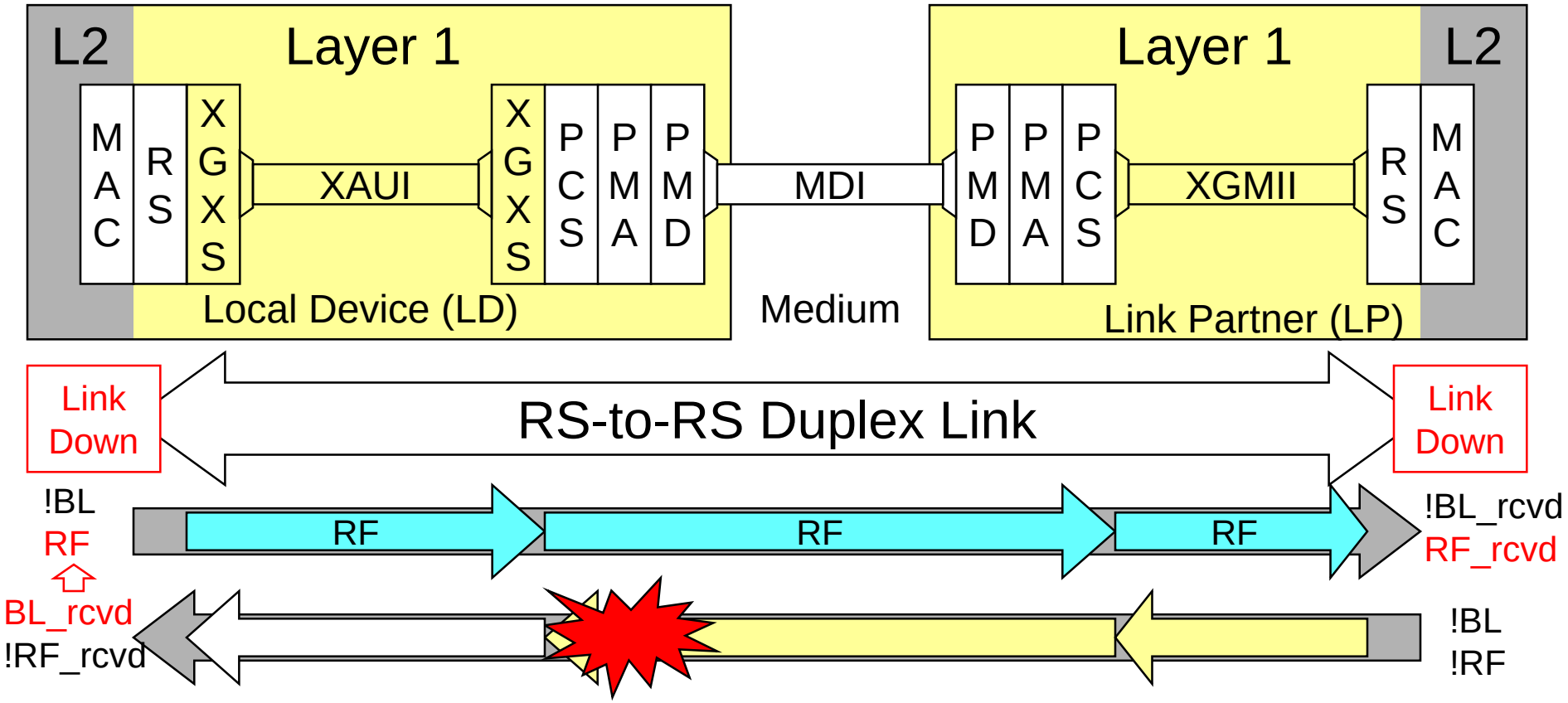
- Requirement
  - Link Aggregation refers to the unique link status bit
  - This status bit should be cleared in real time whenever
    - something wrong on the entire receive path, such as
      - Rx can not establish the synchronization
      - Break Link is received
    - something wrong on the entire transmit path, such as
      - Remote Fault is received
      - Break Link is transmitted (e.g. STA is resetting the link status)
  - MDIO is less useful for this real time management
    - while it provides fault debugging capability within the Local Device
- Issue in 802.3ae
  - Cumulative link status over multiple intermediate links
    - XGXS-to-XGXS, PCS-to-(WIS-to-WIS)-to-PCS,XGXS-to-XGXS

How About Up-the-stack BL Signaling?



- Local Device's PCS detects !rx_in_sync, then asserts BL on the receive path
  - PCS generates Idle stream with interspersed BL-asserted Link Status Column
- RS receives BL, then asserts RF on the transmit path based on the BL&RF mechanism

Simpler PCS Still Works!



- Local Device's PCS detects !rx_in_sync, then just generates Idles on the receive path
  - Idle stream with no Link Status Column yields BL_rcvd in RS
- Local Device's RS then asserts RF on the transmit path based on the BL&RF mechanism

Link Status Mechanism Proposals

- Adopt LSS and its BL&RF mechanism in Reconciliation Sublayer
  - This does not preclude BL&RF mechanism in XGXS/PCS instead of RS as far as no exposure interface is implemented between them
  - Generate a Link Status Column for BL/RF on the transmit path
  - Detect BL/RF on the receive path with a watchdog timer and hysteresis
  - Set or clear link status simply as a Boolean variable as
    - link_status = !BL_rcvd * !RF_rcvd
- Minimize the requirement in the other PHY sublayers
  - Just be transparent to the Link Status Column
  - Produce Idles out when they do not have input sync
    - None of LSS, Idle equivalent, and its translation is required in XGXS/PCS
    - This does not preclude intelligent XGXS/PCS/PMA that could process the Link Signaling Column for optional OAM&P
    - OAM&P would also be useful for remote fault-debugging