



# Presentation Purpose

- Describe why RF and BL are needed for 10GE
- Evaluate two candidate proposals
  - Link Signaling (LSS) - Ishida, et. al.
  - RF and BL only - Muller, et. al.
- Consider “classic” Ethernet architecture
  - Link Pulses
- Consider P802.3ae direction
- Select the best proposal

# Why BL & RF for 10GE?

- Remote Fault
  - Indicates a problem at the remote receiver
  - Fault source may be:
    - Local transmitter
    - Link
    - Remote receiver
- Break Link
  - Reset/Restart remote PHY, Offline warning
- Both conditions are serious
  - Link is unusable by the MAC
- BL and RF seem to be a “defacto” objective

# LSS RF & BL

- Supports BL & RF, simple protocol
- Link Pulse style “heartbeat” for transport
- Not Auto-Negotiation like. No handshakes.
- Compatible with simple 10GE Idle protocol
  - No special initialization protocol required
- Compatible with all 10GE baseline PCSs
- EMI friendly protocol
- Flexible, extendable, scalable link management transport
- No state machines, timers or counters

# RF & BL Only

- Supports BL & RF only; complex protocol
- No Link Pulse style “heartbeat” for transport
  - No indication that transport is operational
- Auto-Negotiation like. Handshake driven.
- Separate protocol for 10GE Idle, BL & RF
- Breaks receiver deskew protocol
- Breaks clock rate compensation protocol
- EMI unfriendly protocol
- Non-extendable dead-end transport
- State machines, timers and counters, oh my!

# Link Pulses - Classic Ethernet

From 802.3-1998:

- 1.4.145 **link pulse**: Communication mechanism used in 10BASE-T and 100BASE-T networks to indicate link status.
- Auto-Negotiation, optics complicated this simple protocol

Proposal: Go back to **link pulses!**

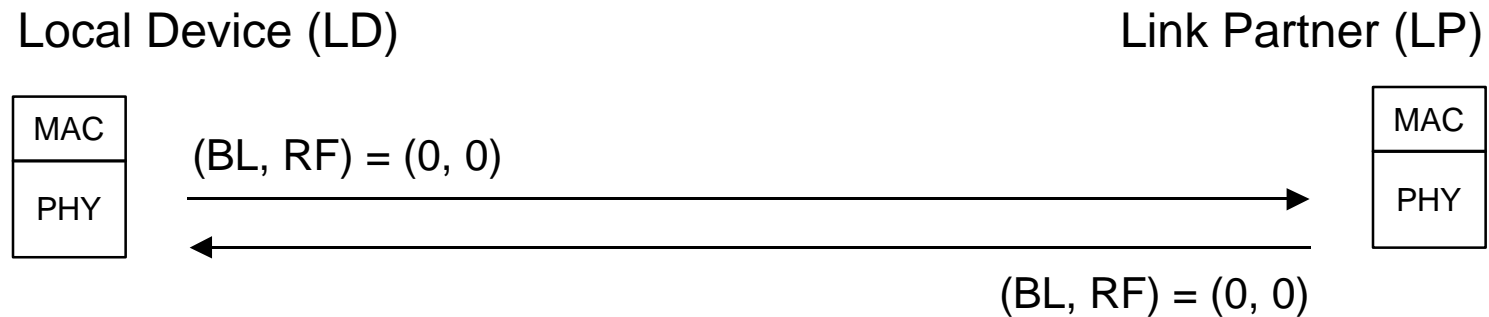
- Specify simple robust link initialization & recovery
- Periodically signal heartbeat to remote PHY
- Normal heartbeat = ~~RF~~ and ~~BL~~
- Superior protocol to no heartbeat

# P802.3ae Directions

- Mandatory support of RF and BL
- No Auto-Negotiation
- Cable plants to 40 km: 8X 1GE 5 km
  - Suggests OAM&P support for WAN & LAN
- 10 Gbps rate requires more complex PHYs
  - WDM, WAN PHY, inter/intra-cabinet clockless serial multi-lane links, etc.

Need flexible, extendable link mgmt transport

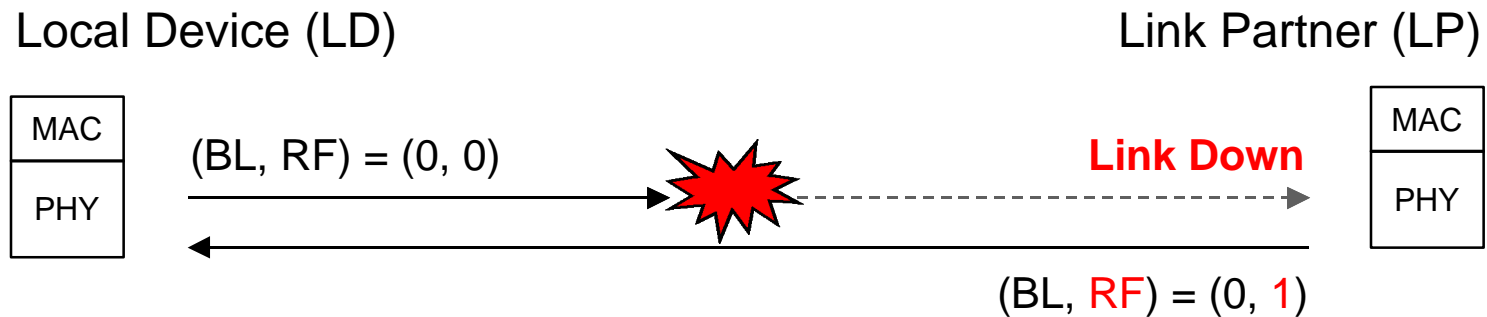
# Normal Operation/Initialization



- Periodically report link status and reset conditions from local device to link partner
- Reporting unchanged during abnormal operation
- Link\_status=OK in Status reg in both LD and LP
- MAC transmission enabled in both LD and LP
- Asynchronous LD and LP power up and reset
- No handshakes or negotiation



# Remote Fault

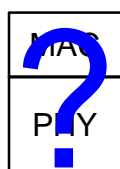


- Remote fault detected by link partner
- Link partner sets link\_status=FAIL bit in its Status reg
- Link partner signals RF to local device
- Local device asserts remote\_fault in its Status reg
- MAC transmission halted in both LD and LP

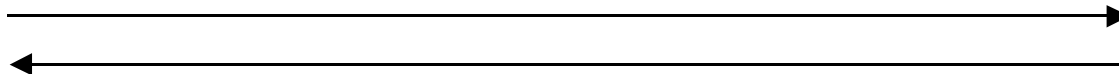
# Break Link

Local Device (LD)

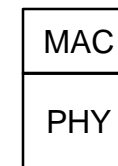
Link Partner (LP)



(BL, RF) = (0, 0)



(BL, RF) = (1, 0)

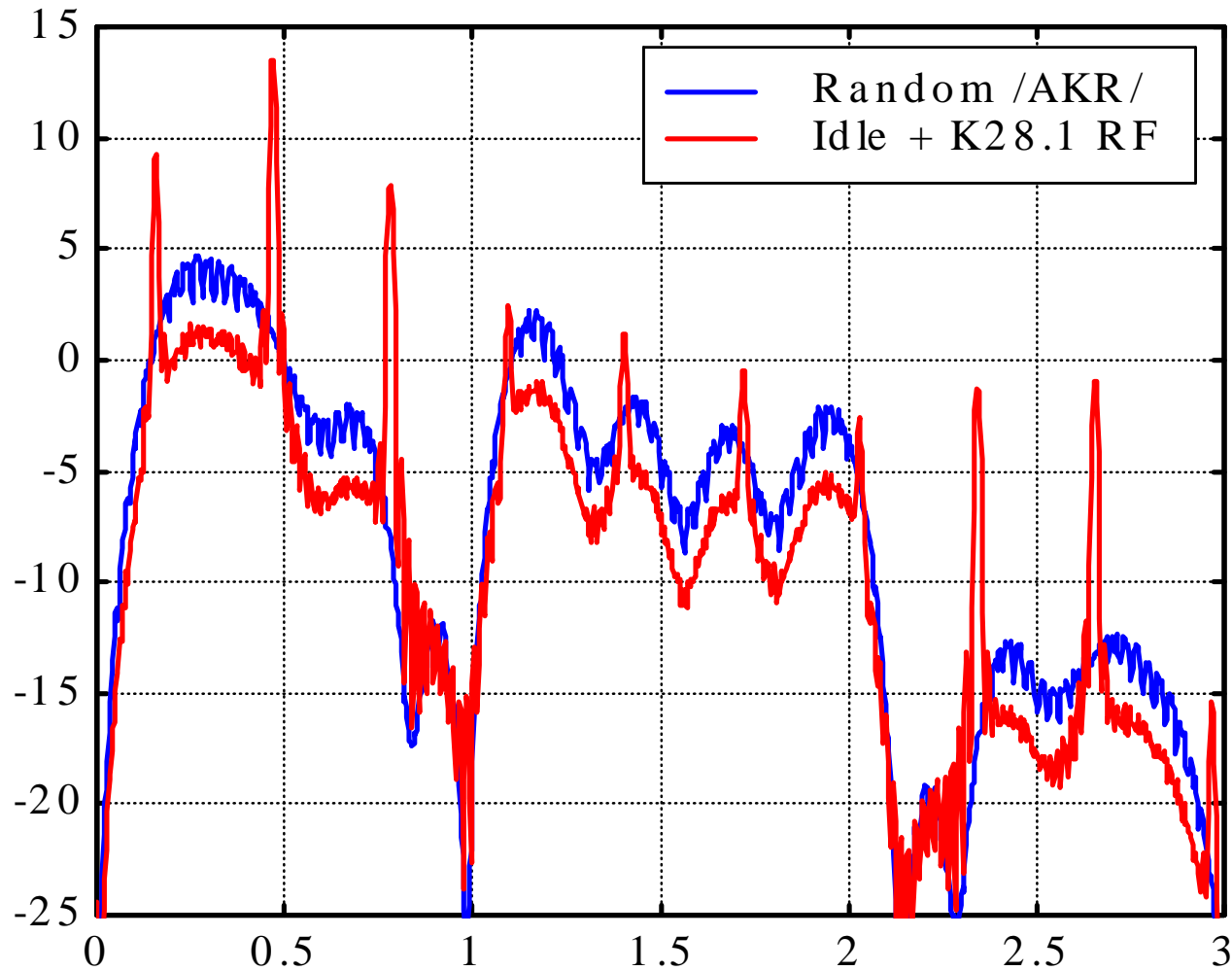


- Link partner not receiving MAC frames reliably from local device, powering down, etc.
- Link partner signals BL to LD while condition exists
- Local device sets link\_status=FAIL bit in its Status reg
- MAC transmission halted in both LD and LP
- Either/both sides may chose to reset their PHYs in an attempt to make the link operational

# Protocol Points

- Resetting synchronization and deskew logic
  - Not helpful, requires additional reset logic
  - Existing PHY Reset is adequate
  - Break Link = Remote PHY Reset
- K28.1/K28.7 Signaling
  - Breaks lane-to-lane alignment
  - Difficult clock tolerance compensation
    - K28.1 alternates running disparity
  - K28.7 easily mistaken for lower frequency signal
    - 0b1111100000 pattern can be mistaken for 2 Gbps

# EMI Comparison



Source: John Ewen, IBM

# Summary

- LSS provides the simplest transport for Remote Fault and Break Link
  - No state machines, timers or counters
  - No handshakes or negotiation
  - Robust predictable behavior
- LSS meets all P802.3ae requirements
  - Flexible, extendable, scalable link mgmt transport
  - Runs atop continuous, aligned Idle stream
- *Recommend adopting LSS as a baseline P802.3ae proposal to add RF & BL support*