Proposed
SpaceWire
Redundancy Mechanism

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Proposed Redundancy Mechanism Update

- Presentation made at 2006 MAPLD SpaceWire Seminar
- Proposal discussed at SpaceWire Steering Committee meeting at 2006 MAPLD
  - Action: Provide reliability rationale for proposal
- Reliability for of interconnection approach needs to be view at system level
- Cross-connected systems are common for redundant components
- Steve Parkes at 2006 MAPLD SpW Seminar also presented architectures that showed redundancy at physical level for a single protocol handler
  - There is some consensus for SpW Physical level redundancy
  - But no standardized mechanism for how to switch between redundant links
  - Question – What makes decision as to when to switch between redundant links?
    - Upper layer?
      - Based upon packet activity or acknowledgment (outside SpaceWire standard)
    - SpaceWire?
      - Based upon connection status
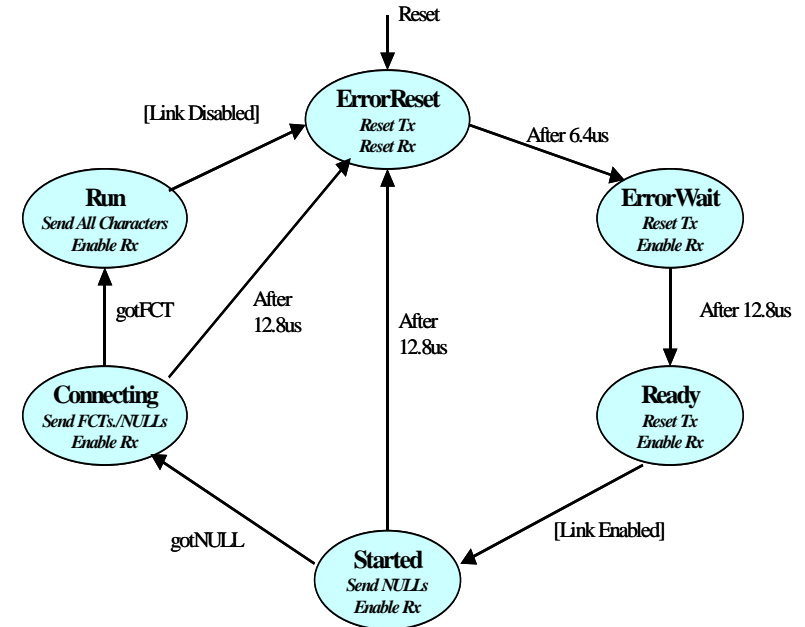
Cross-Connected Redundancy Model
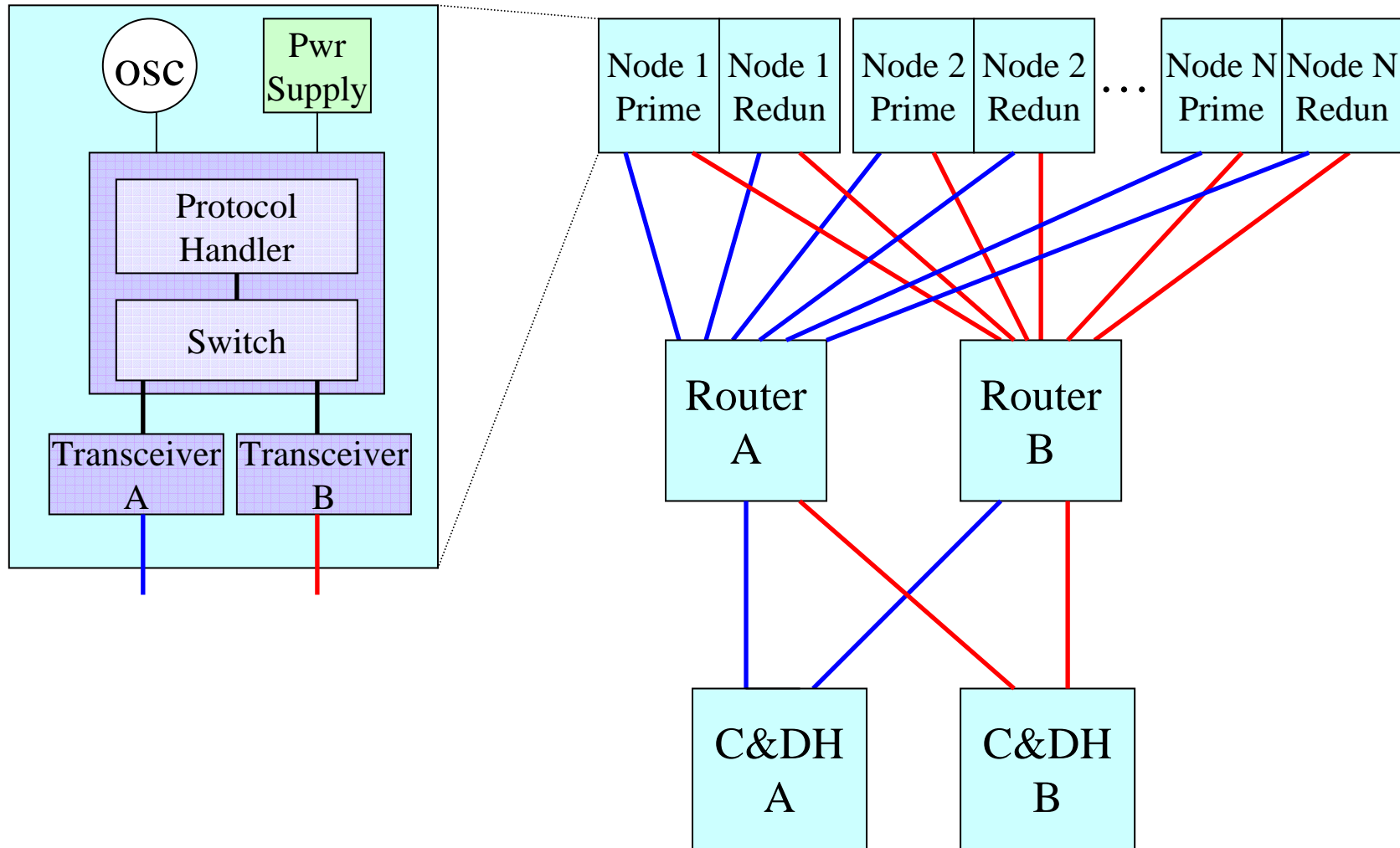
Rationale

- The proposed (or similar) SpW redundancy mechanism will be necessary for SpW cross-connected systems if a single protocol handler is multiplexed over 2 redundant links
  – Reduces the amount of logic
  – Simpler from an application viewpoint
- Scenario (refer to diagram on previous slide):
  – A) C&DH A is on and C&DH B is off
  – B) Failure causes C&DH to switch from A to B
  – C) SpW I/F at Router will need to detect switch over from C&DH A to B
  – SpaceWire requires hand shaking between both sides of link to connect and must have a mechanism to switch connections at Router SpW I/F
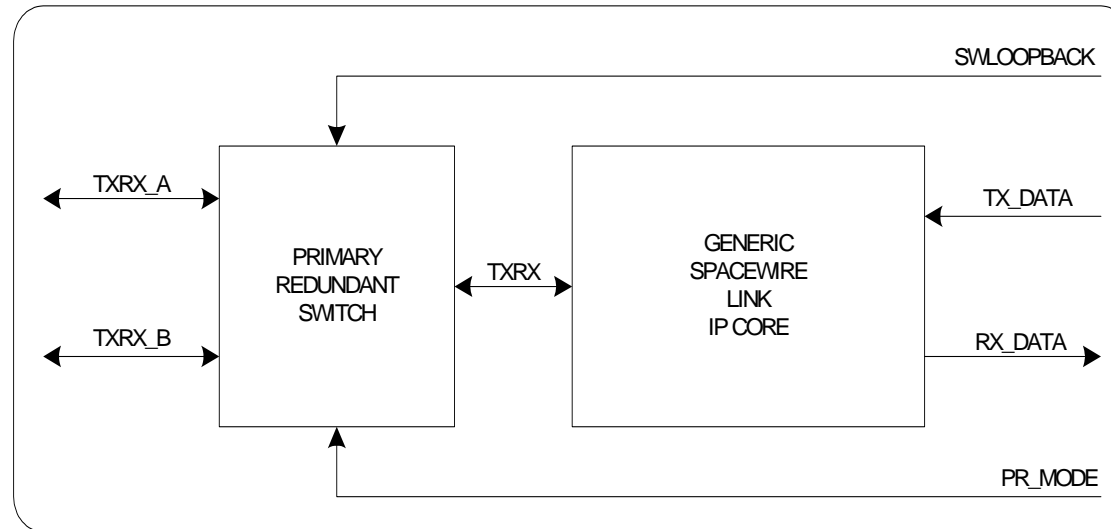
Backup - Link Initialization (Background)

- SpW initialization is important for understanding redundancy mechanism
- SpW initialization State Machine (SM)
  - Resets
  - Then..waits
  - Then..listens
  - If enabled - attempt to synchronize
    - Transmits synchronization characters
  - If synchronized
    - Exchanges flow control information
      - Rx buffer size
  - Then..exchanges Data and all other necessary characters
- SpW SM has 2 end results
  - Connection established
    - Run State
  - Connection failed
    - Back to Error Reset

Reset

ErrorReset
Reset Tx
Reset Rx

[Link Disabled]

After 6.4us

Run
Send All Characters
Enable Rx

ErrorWait
Reset Tx
Enable Rx

gotFCT

After 12.8us

After 12.8us

After 12.8us

Connecting
Send FCTs./NULLs
Enable Rx

Ready
Reset Tx
Enable Rx

gotNULL

[Link Enabled]

Started
Send NULLs
Enable Rx

Backup - Primary Redundant Block Diagram

- Redundancy does not replicate protocol logic
  - Less logic
  - Same user (back-end) interface as if there were no redundancy
    - Tx FIFO & Rx FIFO
    - Transparent to user interface
  - Multiplexer (switch) to steer serial stream between cables

SWLOOPBACK

TXRX_A

TX_DATA

PRIMARY
REDUNDANT
SWITCH

TXRX

GENERIC
SPACEWIRE
LINK
IP CORE

TXRX_B

RX_DATA

PR_MODE

Backup - Multiplexer Steering Mechanism

- The multiplexer is controlled by a new SM
  - Primary/Redundant (Prim/Redun) SM
  - No user intervention

- Prim/Redun SM keeps track of how many times "connection failed" for the Link Initialization SM

- Prim/Redun SM switches multiplexer after X number of "connection failed" attempts for the same cable
  - Toggles cables
    - Primary
    - Redundant
  - X equals
    - 2
    - 5

Backup - Search Modes

- Prim/Redun SM may be programmed to operated in 4 different modes

- 2 modes compatible with SpW standard
  - "00" - Always Select Primary Link
  - "01" - Always Select Redundant Link

- 2 search modes not compatible with SpW standard
  - "10" – Ping-pong every 2 attempts to connect
  - "11" – Ping-pong every 5 attempts to connect

- Search modes are used to ping-pong between cables if connection fails to establish

PR Mode	Description
"00"	Always Select Primary Link.
"01"	Always Select Redundant Link.
"10"	Ping-pong every 2 attempts to connect.
"11"	Ping-pong every 5 attempts to connect.

End