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PCS

Update to
Protocol Proposal
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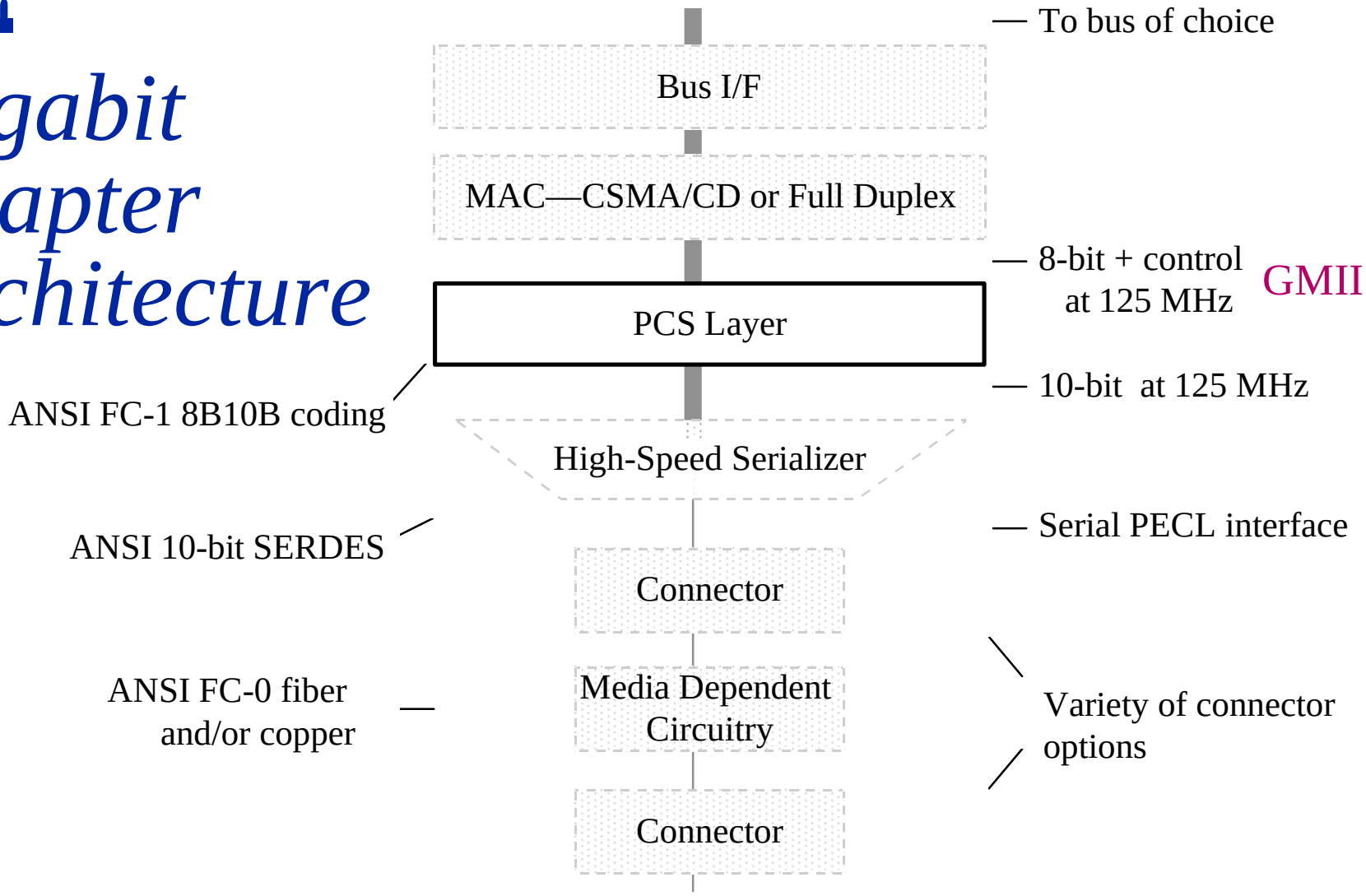
- Link startup protocol
- Automatic link configuration
- SOP/EOP codes
- Idle pattern

Major change to this version:
strike “defer” bit from IDLE pattern, per decision reached in Enschede to use frame-based flow control

The following companies have indicated their support for the concepts outlined in this proposal (in alphabetical order):

3Com	Packet Engines
Amdahl	Sun
Cisco	VLSI Technology
Compaq	Xaqti
Granite	

Gigabit Adapter Architecture

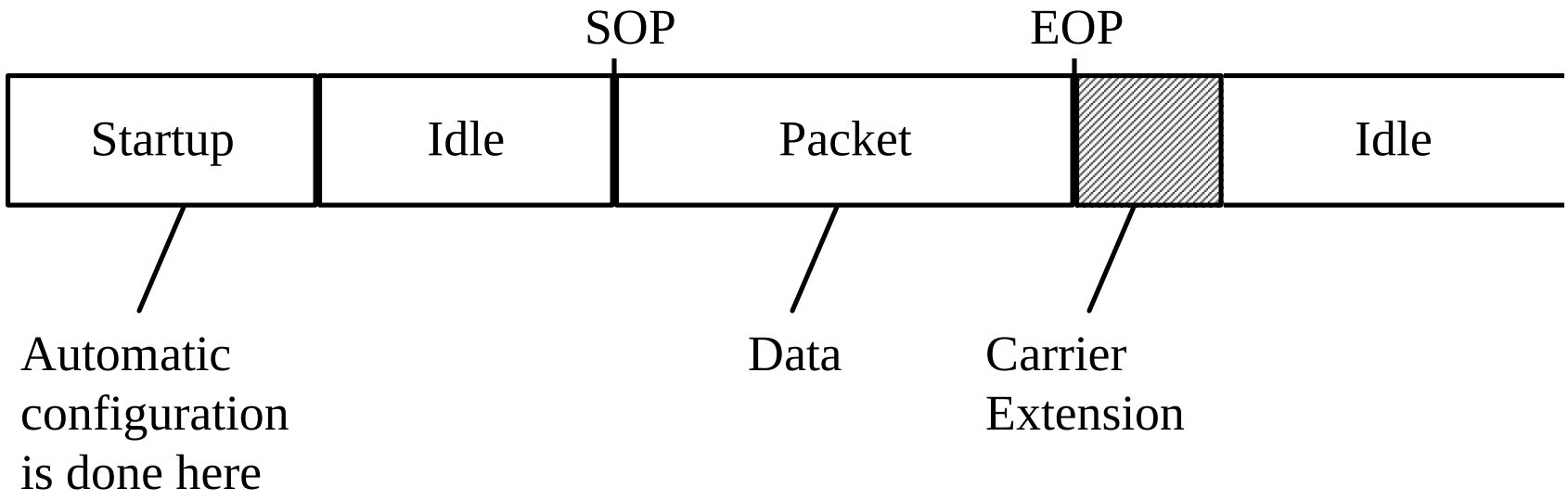


High-Level Assumptions

- All links are point-to-point
- Coding is based on ANSI X3.230 FC-1 (8B10B)
- PHY is full duplex

- We need...
  - A link-startup protocol (link integrity)
  - To provide for automatic feature configuration
  - A set of SOP/EOP codes to delineate packets

The Big Picture



Protocol Overview

- After power-on, link reset, etc. execute a basic link startup procedure (link integrity).
- Automatic feature configuration is part of the link startup sequence.
- After automatic configuration is complete, send idle interspersed with packets.
- Each packet is delineated with SOP/EOP codes.
- Each packet can include a carrier extension.

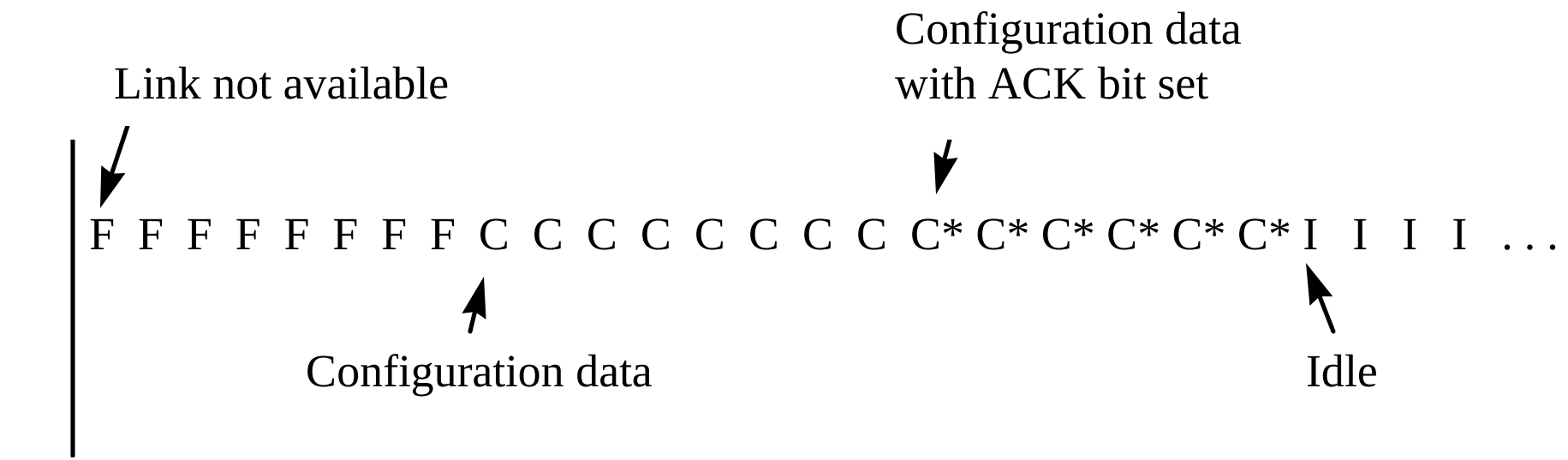
Use of Control Codes

Startup . . . . . Idle . . . . Packet . . . . . Extend Idle . . . . . .

FFFFFFCCCCCCC I I I I I I I SDDDDDDDDDDDDTRRRRR I I I I I I I I I I

F - Link fail indication
C - Automatic configuration information
I - Idle pattern contains K28.5 control codes (word sync. pattern)
S - start-of-packet indication
D - packet data (using 8B10B code as defined in ANSI X.230)
T - end-of-packet indication (goes after FCS)
R - always follows T; used in half-duplex mode to extend carrier

Link Startup



F - Link not available primitive

C - Configuration primitive

I - Idle pattern

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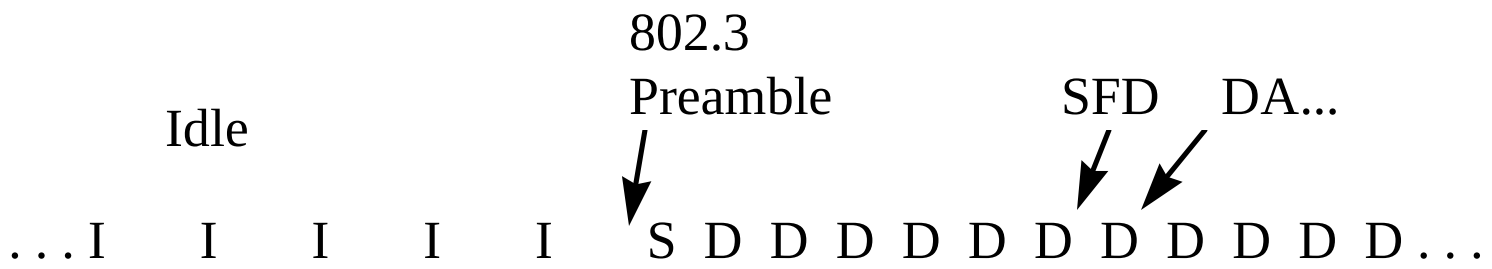
Automatic Feature Configuration Highlights

- An integral part of the link startup protocol
- Exchanges a 16-bit feature register three times (like clause 28)
- Uses table-driven priority resolution
- The feature register has an ACK bit, and an expansion bit
- Can be restarted by either end of a link
- Defined as a simple handshake
- Only 4 states are required for implementation

* Automatic Feature Configuration is Mandatory *

Start of Packet



Substitute S for first octet of preamble

Remainder of preamble and SFD is coded as ordinary data (same as 100BASE-X)

I - idle pattern

S - start-of-packet indication

D - packet data

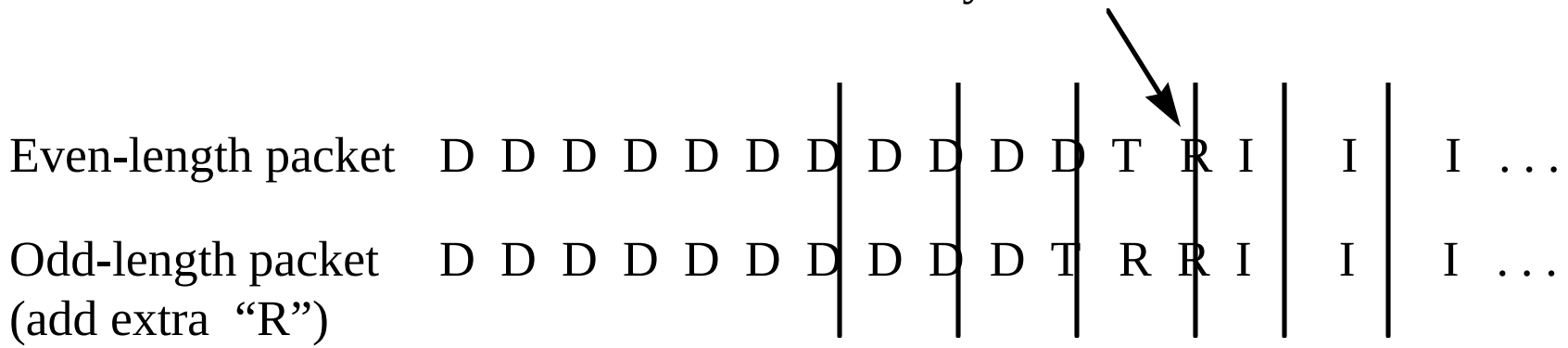
SOP/EOP Highlights

- S, T, and R are all single-octet 8B10B control words

  (See details in presentation by Richard Taborek)

End of Packet

For maximum compatibility with existing 8B10B serializers, the idle pattern must start on an even 16-bit boundary



D - packet data

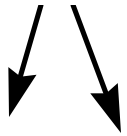
T - end-of-packet indication

R - always follows T

I - idle; 16-bit entity; includes word sync pattern K28.5

Carrier Extension

Add more “R” octets to extend carrier



. . . D D D D D D D D D D D T R R R R R R I I I . . .

D - packet data
T - end-of-packet indication
R - at least one R always follows T
I - idle

Idle Pattern Highlights

- Idle pattern is transmitted between packets during LINK_OK state
- We need idle codes that can either *preserve* or *change* the running disparity

☞We need two distinct idle codes

changes disparity	*preserves disparity*
I1	I2

Propagating Code Violations

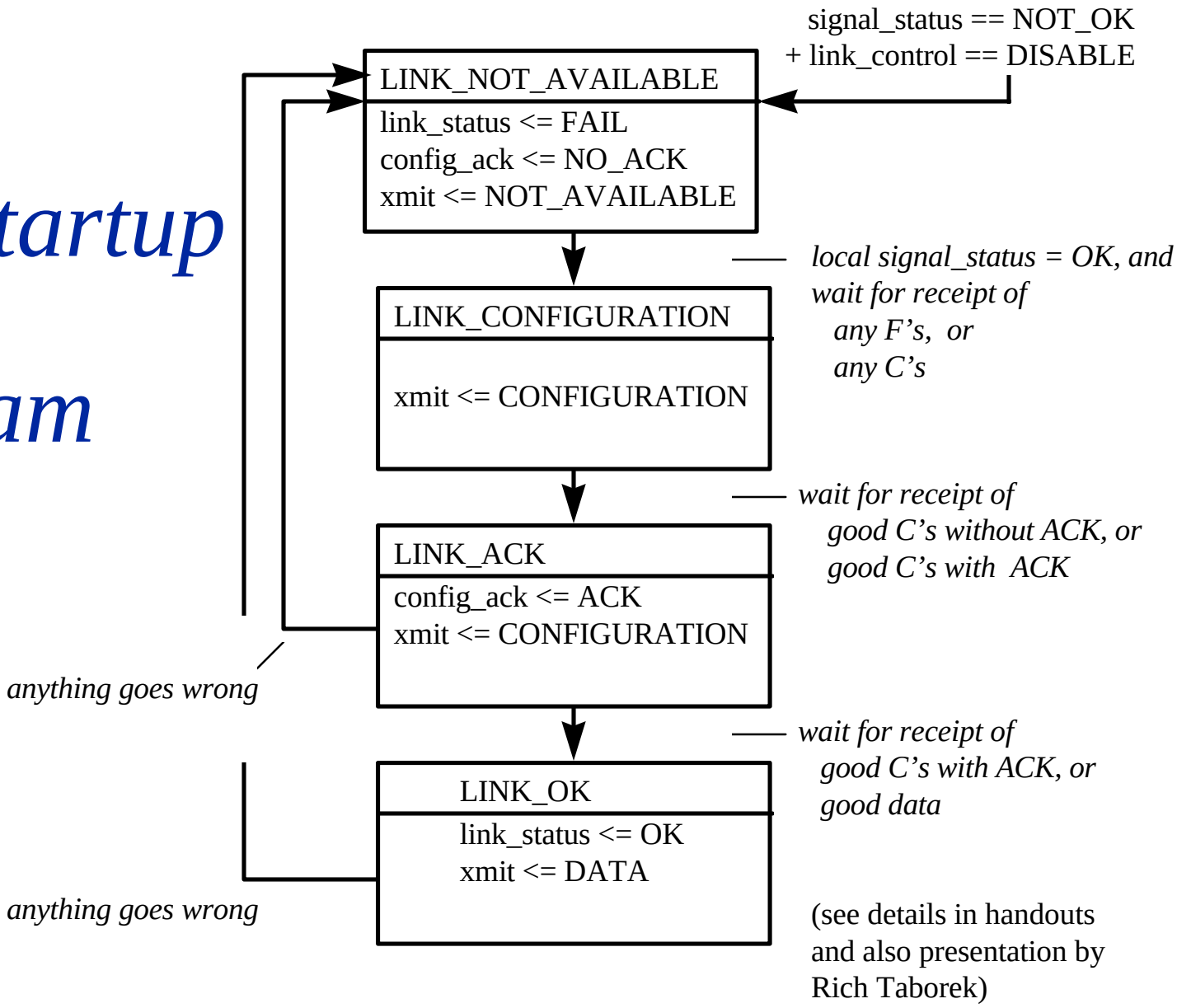
- Bad-code (*H*) is a special control code used to propagate errors.
- A known-bad packet is filled to the end of the data field with*H* symbols.
- No *TR* is appended to the packet.
- The *H* symbols do not fill the carrier extension region, if any.
- Any detectable error in the TRR (or TRI) end-of-packet pattern is replaced with H in each errored octet position.

D - packet data
H - bad code indication (code violation)
I - idle

Link Primitives

- xmit ⇐ NOT_AVAILABLE
  - Transmit control code *F*
  - Indicates the local PHY has not come up yet or a serious error condition exists internal to the PHY or its local client
- xmit ⇐ CONFIGURATION
  - Transmit control code *C*
  - This primitive conveys the 16-bit configuration register
  - The register includes an ACK bit, and a remote-fault bit
- xmit ⇐ DATA
  - Transmit control code *I* (IDLE) interspersed with packets

Link Startup State Diagram



Carrier Processing

- Rule for carrier on:

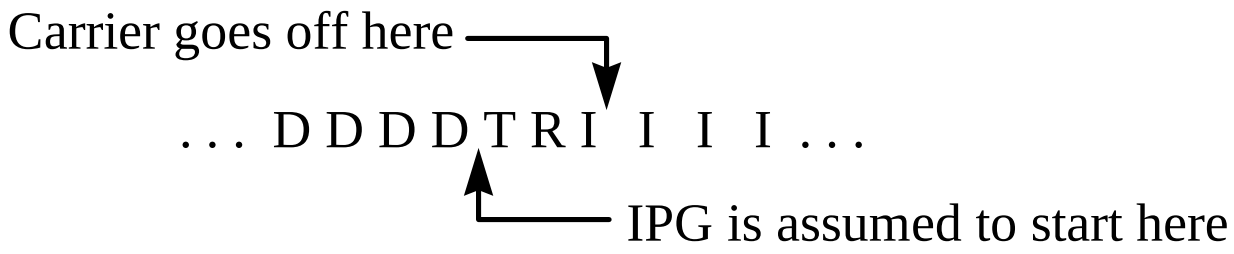
  After link startup, any even-numbered octet at least two bits different from K28.5 turns on carrier.

- Rule for carrier off:

  After link startup, any even-numbered octet equal to K28.5 turns off carrier.

- IPG processing:

  IPG is assumed to start three octets prior to detection of the K28.5 idle pattern. Example (even-length packet):



Packet Qualification

- SOP must be perfect: S<1010..><SFD>
- EOP must perfect*: TRI - or - TRR

else, signal RX_ER to the MAC

* We must check three octets for error robustness

Conclusion

- This presentation proposes:
  - A link-startup protocol (link integrity)
  - A basic protocol for automatic feature configuration
  - A set of SOP/EOP codes to delineate packets
- Rich Taborek will present:
  - A specific implementation of these protocol features using 8B10B control codes