OAM Requirements for 40/100 GE Ethernet AIS ?

Gary Nicholl

Cisco Systems

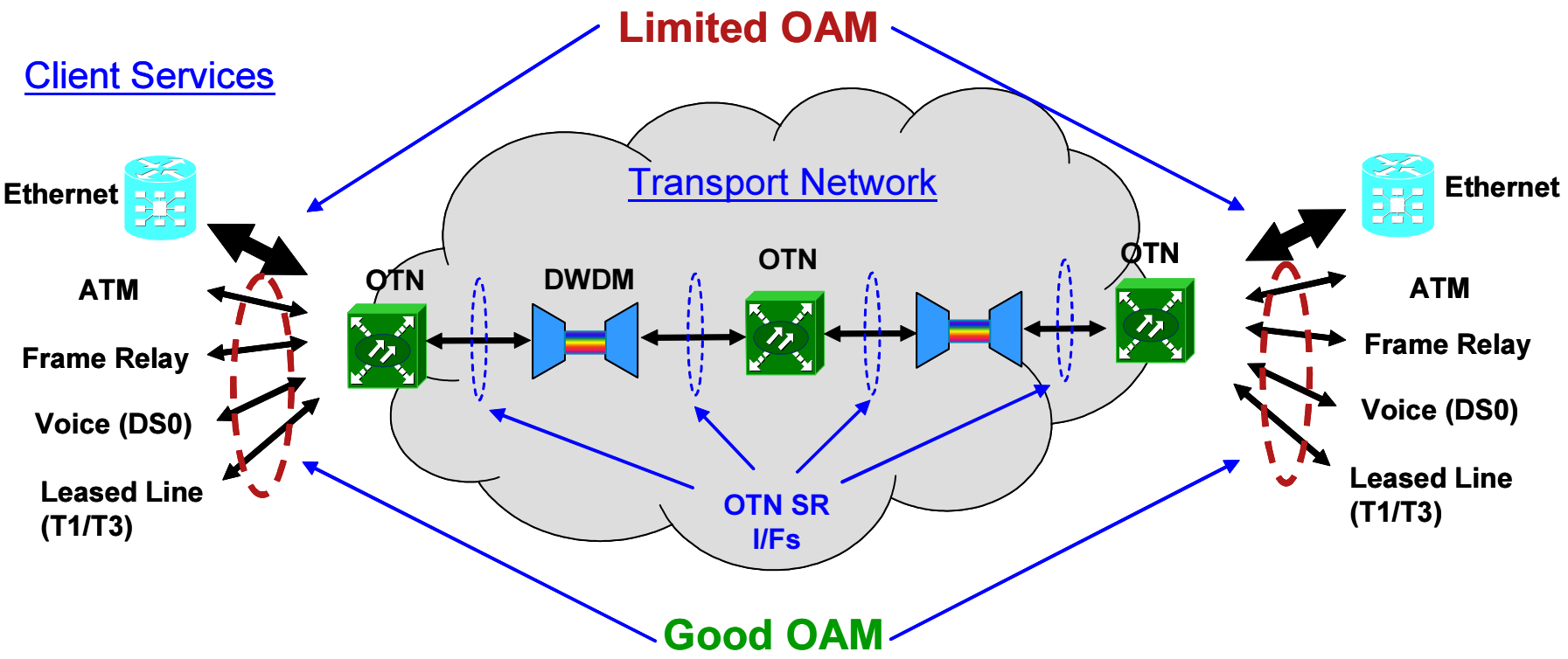
IEEE 802.3ba Task Force

March 18, 2008

Orlando, FL

Background

- Ethernet is rapidly becoming the dominant client interface into the (OTN) transport network
- but the limited OAM capabilities of Ethernet is becoming an issue for carriers



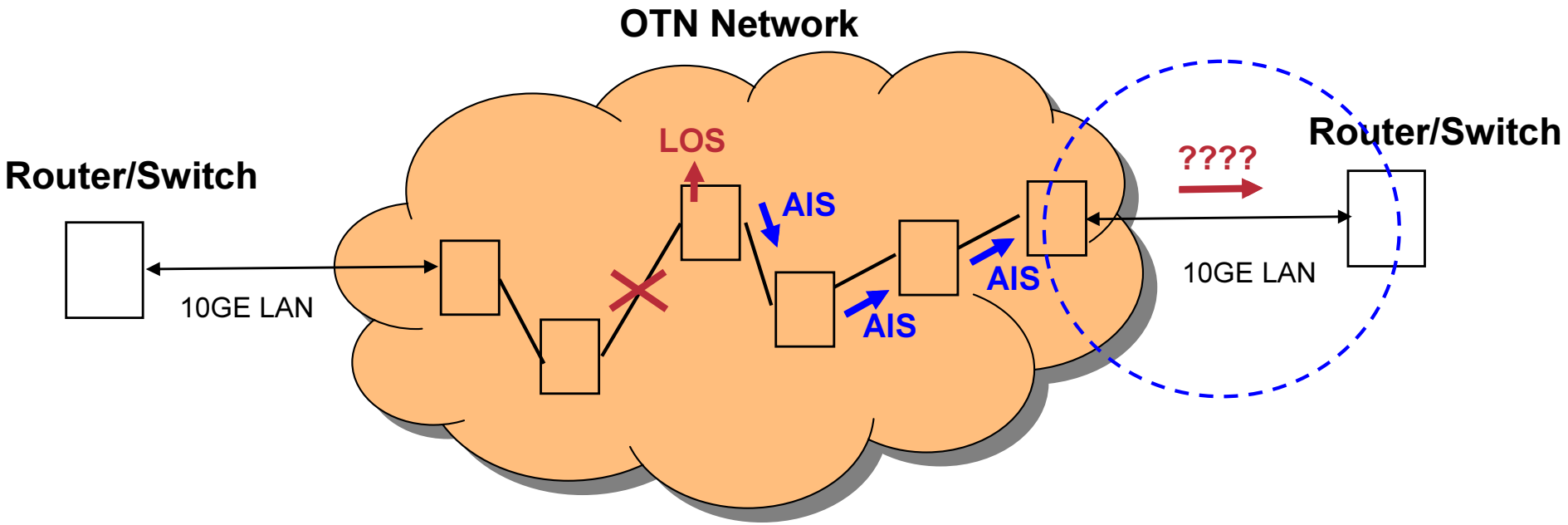
Addressing the OAM gap in Ethernet

- **Two standardized types of Ethernet OAM exist today**
  - **802.3ah**
  - **802.1ag**
  - **both are located above the MAC**
  - **Breaks the transparency requirement for transport**
- **Need to monitor at the physical layer below the MAC to maintain transparency**
- **Much of the required OAMP functionality already exists in Ethernet physical layer**
  - **HW hooks exist – but not typically implemented in SW today**
  - **the main omission would appear to be a mechanism to signal OTN failure conditions across an Ethernet interface (i.e AIS)**

Alarm Indication Signal (AIS)

- **AIS (Alarm Indication Signal) is commonly used in transport systems to signal downstream equipment of an upstream failure**
- **It serves two primary purposes:**
  1. **Squelch downstream alarms (Alarm Correlation)**
  2. **Fast trigger for restoration**
- **Lack of such a capability in Ethernet is becoming an issue as carriers start to use Ethernet LAN interfaces to directly connect core routers/switches over long-haul OTN based transport networks.**

The Fundamental Issue



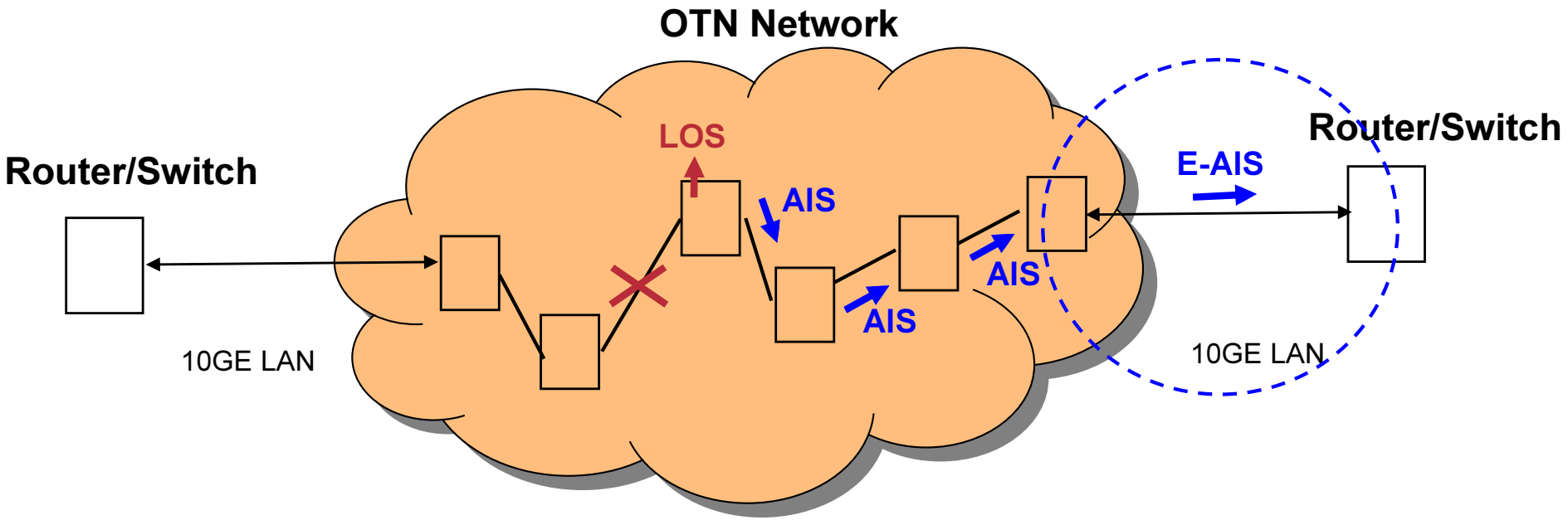
What does the OTN transponder send on the 10GE LAN Interface in this case?

- no light ?? (causes LOS on router/switch)
- garbage ?? (causes PCS block loss on router/switch)
- valid PCS framing ?? (no physical layer indication, only frame CRC errors)
- continuous Local Fault (LF) ?? (cause LF to be detected at router/switch)

Two problems with this:

- in all cases an alarm will be raised at the router/switch (even though the problem is elsewhere)
- since behavior is not defined, there may be no fast physical layer indication to trigger restoration

A Potential Solution



Define an physical layer Ethernet AIS signal: E-AIS

- will be used to squelch alarms in router/switch
- will keep all higher layers in router/switch happy (no LOS, no PCS alarms, no frame CRC errors, etc)
- will provide a fast physical layer trigger for restoration

E-AIS can be easily supported using one of the unused codes in the LF/RF Sequence ordered_set

Proposal

10GE Sequence Ordered Sets (Clause 46)

Table 46–5—Sequence ordered_sets

Lane 0	Lane 1	Lane 2	Lane 3	Description
Sequence	0x00	0x00	0x00	Reserved
Sequence	0x00	0x00	0x01	Local Fault
Sequence	0x00	0x00	0x02	Remote Fault
Sequence	≥ 0x00	≥ 0x00	≥ 0x03	Reserved

NOTE—Values in Lane 1, Lane 2, and Lane 3 columns are in hexadecimal, most significant bit to least significant bit (i.e., <7:0>). The link fault signaling state machine allows future standardization of reserved Sequence ordered sets for functions other than link fault indications

Propose to signal an Ethernet AIS condition as follows:

- sequence control character in lane 0
- data characters of 0x00 in lanes 1 and 2
- data character of 0x03 in lane 3.

How to respond to E-AIS ?

What does a router/switch do when it receives an E-AIS signal ? There are two options:

1. **Do nothing**
    - **just report the condition over the mngt interface**
    - **this is probably sufficient**
2. **Signal condition to the remote end**
    - **define another ordered_set code to signal condition to remote end. Could call it E-BDI (Backward Defect Indication)**
    - **AIS/BDI would operate in a similar fashion to LF/RF**
    - **LF/RF would indicate a failure at the Ethernet PHY level. AIS/BDI would indicate a failure within the OTN network over which the ethernet signal is being carried.**

Are there any other options ?

- **Perhaps we could use the existing LF/RF fault signaling as is ?**
  - **LF is signaled due to either an Ethernet phy failure or an OTN network failure**
  - **but unable to determine the source of the LF.**
- **Define a completely new signal such as an unframed PRBS. Such signals are used in OTN today and are called G-AIS (Generic AIS)**
- **Eliminate the ethernet client interfaces altogether, and move the OTN mapping function onto the router/switch.**

Recommendation

- **Ethernet's economy of scale has significant commercial attraction.**
- **Ethernet is rapidly becoming the dominant client interface into the (OTN) transport network**
- **802.3ba TF needs to work closely with the ITU to ensure that any OAM issues associated with OTN interworking are clearly understood and addressed.**

Backup

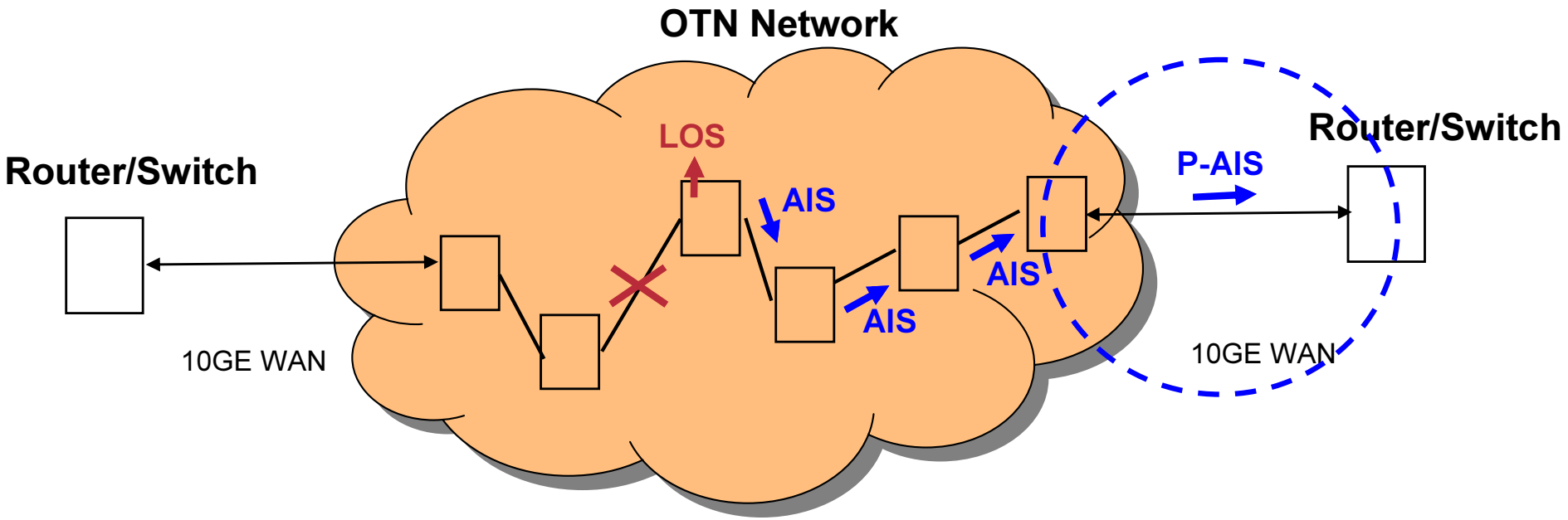
802.3ae Link Fault Signaling

46.3.4 Link fault signaling

Link fault signaling operates between the remote RS and the local RS. Faults detected between the remote RS and the local RS are received by the local RS as Local Fault. Only an RS originates Remote Fault signals.

Sublayers within the PHY are capable of detecting faults that render a link unreliable for communication. Upon recognition of a fault condition a PHY sublayer indicates Local Fault status on the data path. When this Local Fault status reaches an RS, the RS stops sending MAC data, and continuously generates a Remote Fault status on the transmit data path (possibly truncating a MAC frame being transmitted). When Remote Fault status is received by an RS, the RS stops sending MAC data, and continuously generates Idle control characters. When the RS no longer receives fault status messages, it returns to normal operation, sending MAC data.

How this works today for WAN PHY



For WAN PHY, Path-AIS at the WIS layer provides the required function.