OTN Support – OAM Signaling

Interworking of IEEE 802.3ba Ethernet & ITU SG15 OTN – OAM

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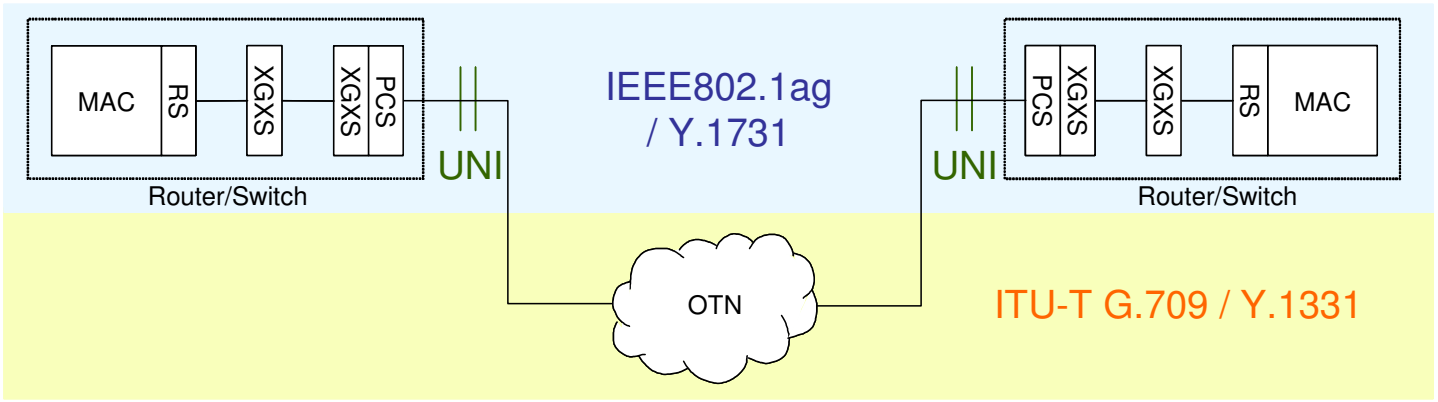
OTN Support – OAM Signaling
Motivation, Scenario, and Overview.

- **Currently missing OAM interworking capabilities between packet and transport infrastructures limits a carrier grade applicability of Ethernet client interfaces.**



Managed by

⇨ **User (e.g. ISP)**

⇨ **Network Carrier**

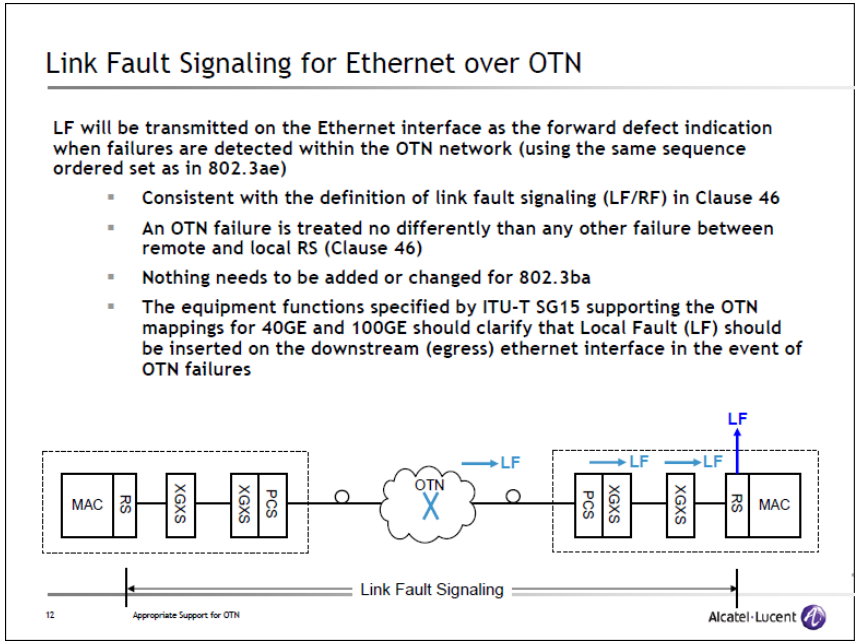
⇨ **Consider Link Degradation signaling for Ethernet over OTN**

⇨ **Reconsider Link Fault signaling for Ethernet over OTN**

Carrier Requirement

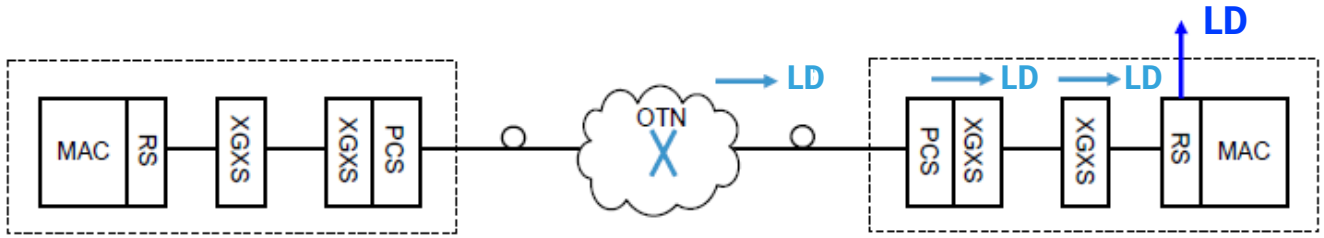
Link Fault/Degradation Signaling for Ethernet over OTN.

- **Cost efficient Ethernet interfaces will become the most important client interfaces for WDM/OTN transport & IP networks.**
- **High bandwidth, resilient end-to-end transport of best quality IP signals via Ethernet interfaces across the OTN platform has to be provided.**
- **A complete end-to-end recovery must be accomplished in less than 50 milliseconds.**
- **Link Fault Signaling for Ethernet over OTN is a good basis as adopted by the IEEE 802.3ba TF base line (trowbridge_01_0508.pdf).**



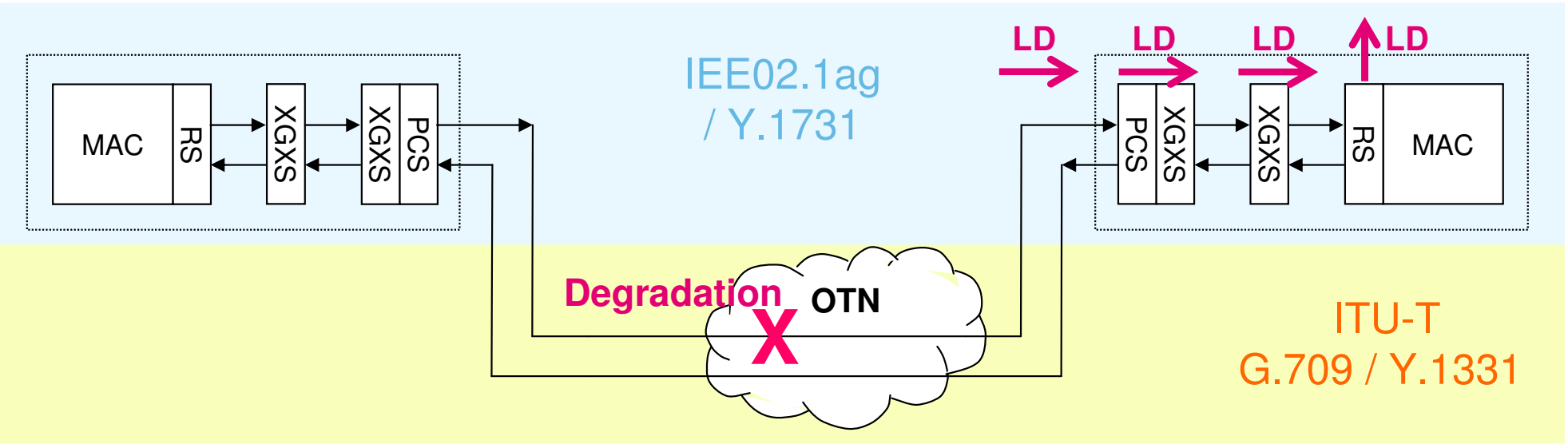
trowbridge_01_0508.pdf

- **Additionally, a carrier requirement is a fast failover in case of an OTN link degradation, e.g. triggered by a pro-active Link Degradation (LD) Signaling for Ethernet over OTN.**



Carrier Requirement

Link Degradation Signaling for Ethernet over OTN.



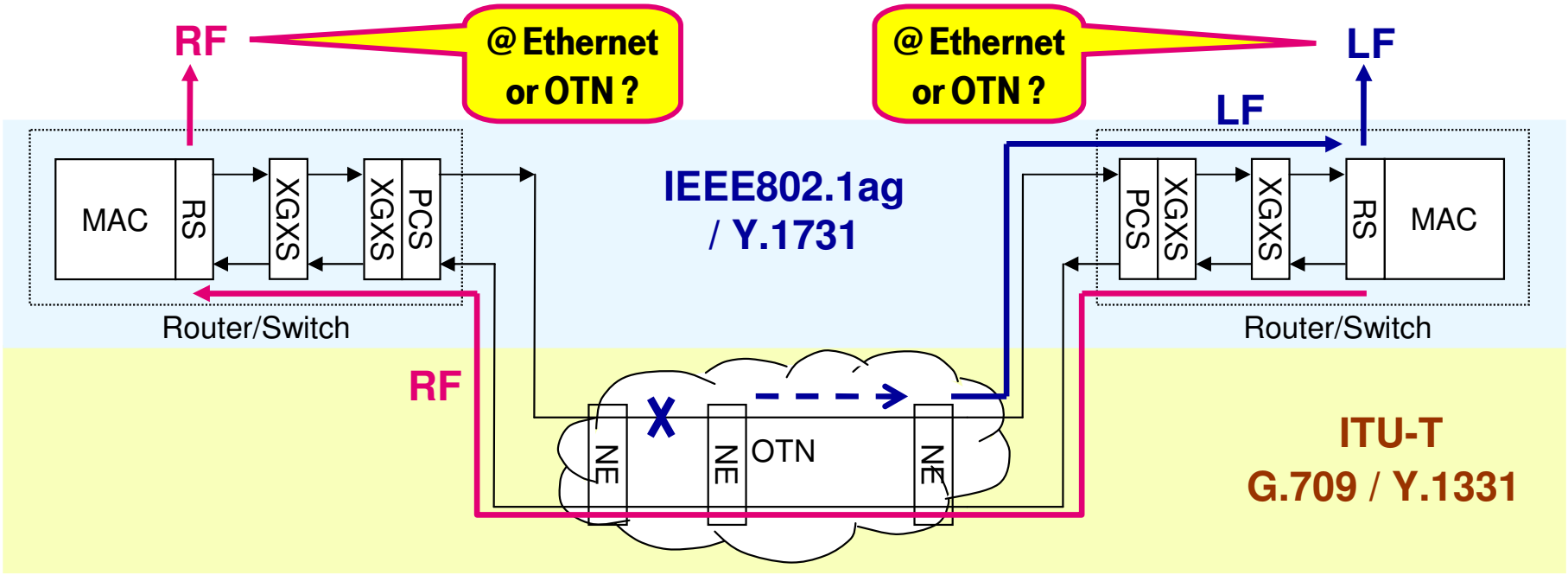
- An equipment function should insert a Link Degradation (LD) on the downstream Ethernet interface in the event of an OTN degradation, to alarm end nodes (routers / switches).
  - ⇨ This would also need some work in ITU-T, in analogy to the Local Fault OTN – Ethernet interaction (trowbridge_01_0508.pdf).
  - ⇨ This may also need some work in 802.1.
  - ⇨ This would allow to pro-actively trigger a protection/restoration event in the end node before the link has actually failed, supporting a pro-active carrier grade failover.

OTN Support – OAM Signaling
Overview.

- Link Degradation Signaling for Ethernet over OTN
- Link Fault Signaling for Ethernet over OTN
- Summary

Carrier Requirement

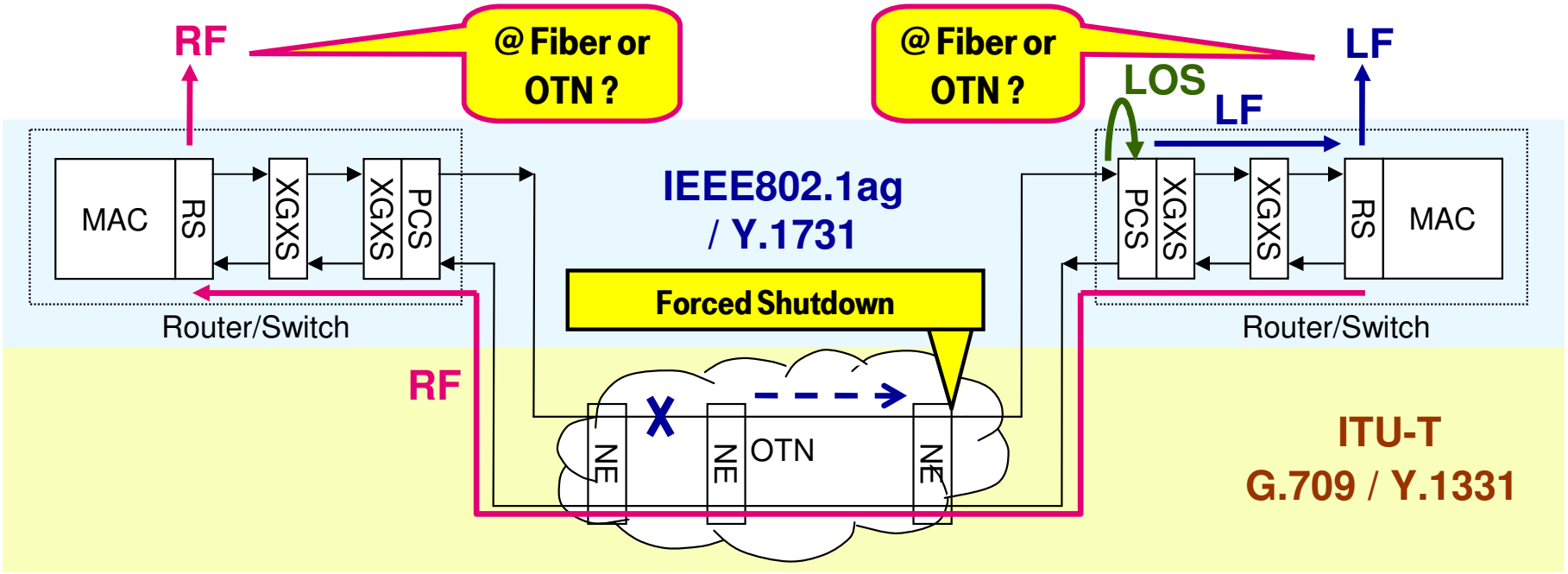
Link Fault Signaling for Ethernet over OTN.



- An equipment function should insert a Local Fault (LF) on the downstream Ethernet interface in the event of an OTN fault, to alarm end nodes (routers / switches), adopted baseline, trowbridge_01_0508.pdf.
  - ⇨ Pros: User node can detect the occurrence of a fault with LF / Remote Fault (RF).
  - ⇨ Cons: User node cannot identify the fault location.
    - ⇨ @ Ethernet or OTN ?
    - ⇨ Cost intensive due to fault localization processes and much recovery time.

Link Fault Signaling for Ethernet over OTN

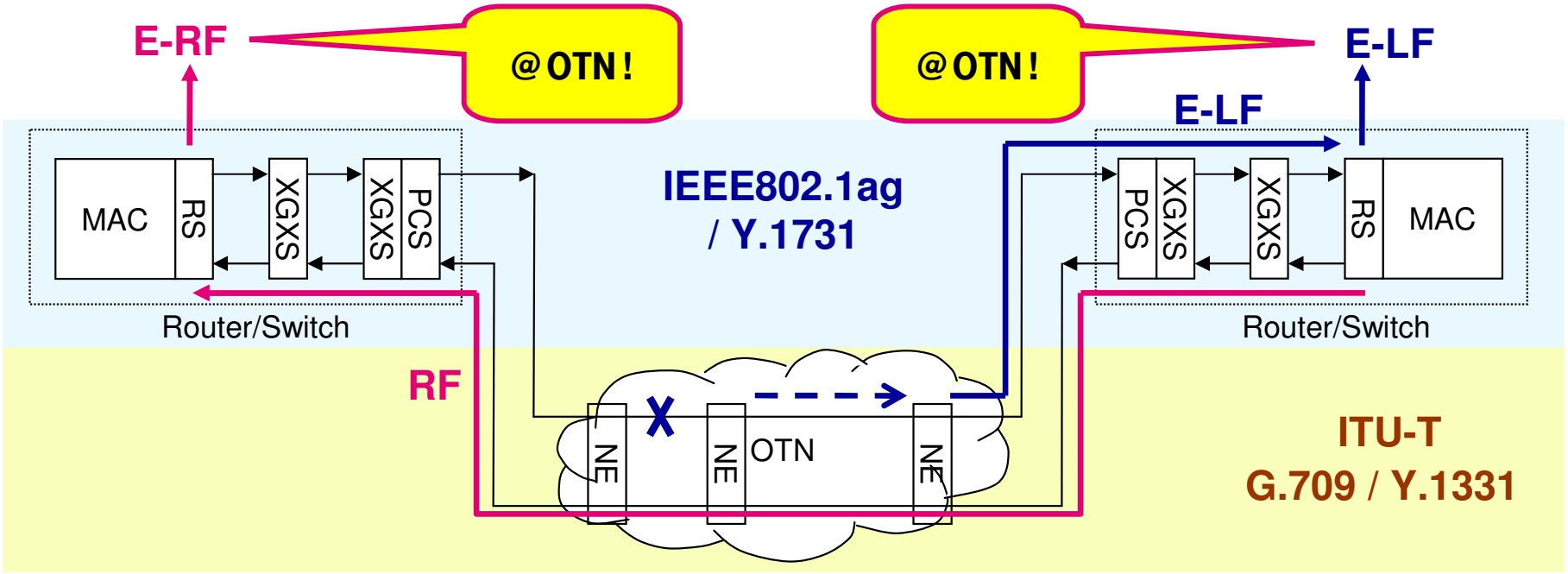
Actual NTT Operation in a 10GE-LAN Transport Service.



- NTT uses a forced shutdown function resulting in a Loss of Signal (LOS) at the end node which triggers a LF / RF at the end nodes (routers / switches).
  - ⇨ Pros: User node can detect that a fault occurred outside of Ethernet, resulting in a LF / RF.
  - ⇨ Cons: User node cannot identify the fault location.
    - ⇨ @ fiber infrastructure or OTN?
    - ⇨ Cost intensive due to fault localization processes and much recovery time.

Link Fault Signaling for Ethernet over OTN

Proposal for an External Local Fault and an External Remote Fault.



- An equipment function should insert an External Local Fault (E-LF) on the downstream Ethernet interface in the event of an OTN fault, to alarm end nodes (routers / switches).
  - ⇨ Pros: User node can detect the occurrence of a fault with E-LF / External Remote Fault (E-RF).
    - ⇨ User node can detect that the fault occurred in the OTN !
    - ⇨ Cost effective due to reduced fault localization processes and fast recovery time.
  - ⇨ Con: Need some work in ITU-T, in analogy to the Local Fault OTN – Ethernet interaction (trowbridge_01_0508.pdf).

Link Fault Signaling for Ethernet over OTN

Proposal for new Sequence Ordered Sets.

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

Proposal for a signaling of Link Fault / Link Degrade conditions:

- **Sequence control character in lane 0**
- **Data character of 0x00 in lane 1 and 2**
- **Data character of 0x03 in lane 3 for E-LF**
- **Data character of 0x04 in lane 3 for E-RF**

Link Fault Signaling for Ethernet over OTN
Proposal for new RS Output Processes.

The RS output onto TXC<3:0> and TXD<31:0> is controlled by the variable link_fault.

a) **link_fault = OK**

The RS shall send MAC frames as requested through the PLS service interface. In the absence of MAC frames, the RS shall generate Idle control characters.

b) **link_fault = Local Fault**

The RS shall continuously generate Remote Fault Sequence ordered_sets.

c) **link_fault = Remote Fault**

The RS shall continuously generate Idle control characters.

Proposal for new RS Output Processes

d) **link_fault = E-LF**

The RS shall continuously generate E-RF Sequence ordered_sets.

e) **link_fault = E-RF**

The RS shall continuously generate Idle control characters.

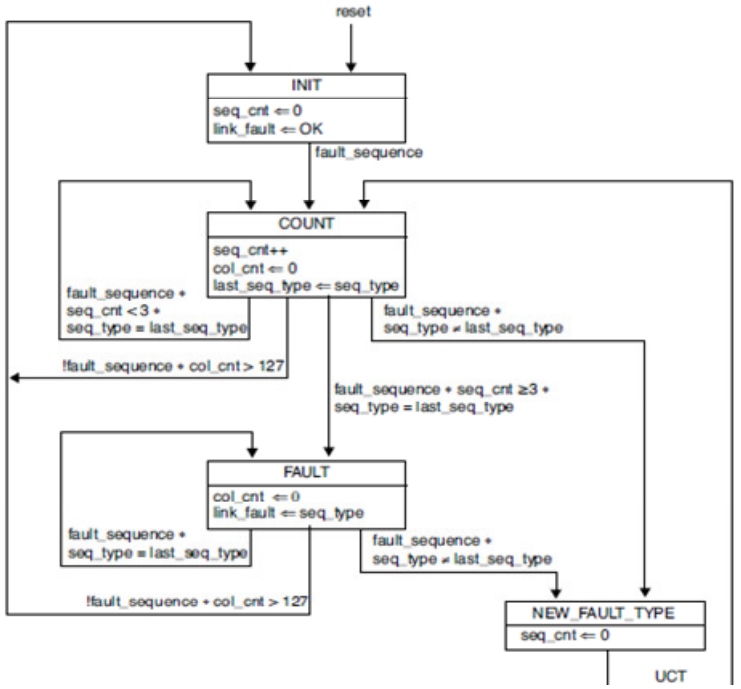


Figure 46–9—Link Fault Signaling State Diagram

⇨ No change in the State Diagram

OTN Support – OAM Signaling
Summary.

- **Link Degradation Signaling for Ethernet over OTN.**
  - **A Carrier requirement is to provide pro-active failover solutions for signal degradation events.**
    - ⇨ **More stable and high-quality carrier grade Ethernet transport services.**
    - ⇨ **Consider Link Degradation Signaling for Ethernet over OTN support.**

- **Link Fault Signaling for Ethernet over OTN.**
  - **To ensure cost effective service and network recovery.**
    - ⇨ **Define E-LF (External-LF) / E-RF (External-RF) for a link fault signaling for Ethernet over OTN support.**
    - ⇨ **Propose E-LF / E-RF as new Sequence Ordered Sets and RS output processes.**

Thank you!

References: nicholl_01_0308.pdf,
trowbridge_02_0308.pdf,
nicholl_02_0508.pdf, jiang_01_0508.pdf,
trowbrige_01_0508.pdf, Ishida_01_0708.pdf

http://grouper.ieee.org/groups/802/3/ba/public/index.html