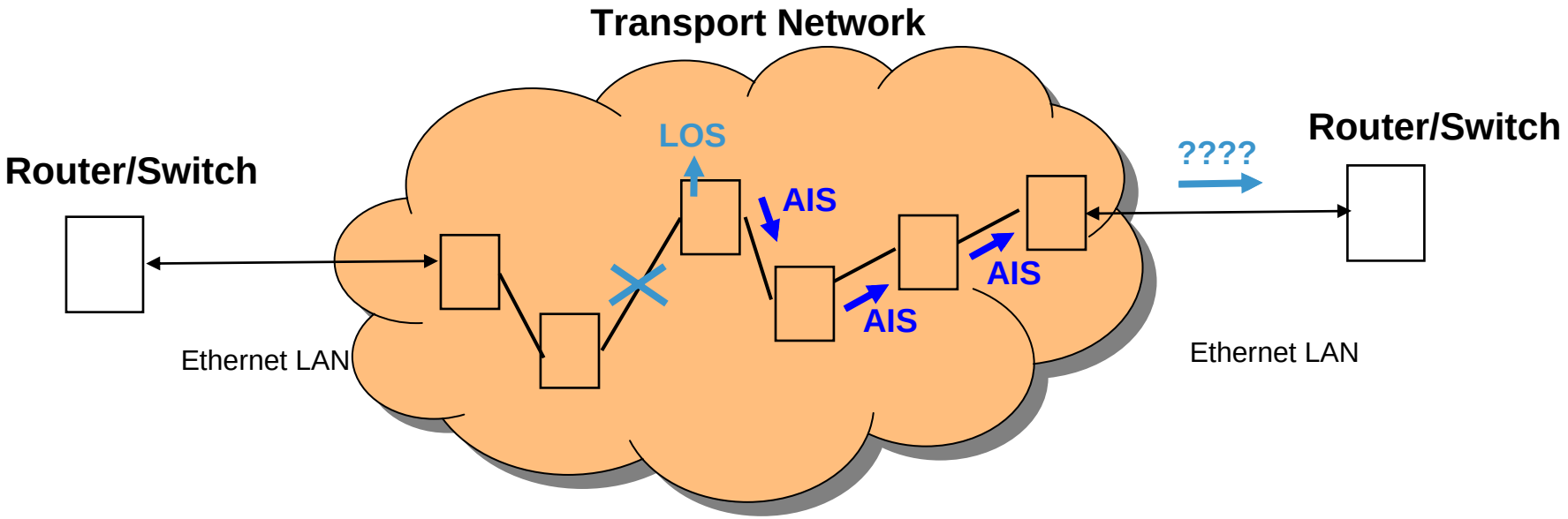
Flavors of AIS (Alarm Indication Signal) applicable to 40 GbE and 100 GbE

Stephen J. Trowbridge
Alcatel-Lucent

Purpose of AIS - Avoid downstream alarms for problems already detected and alarmed at the correct place in the network

Adapted from nicholl_01_0308



What should the egress NE transmit in the case of a failure in the transport network?

- 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)

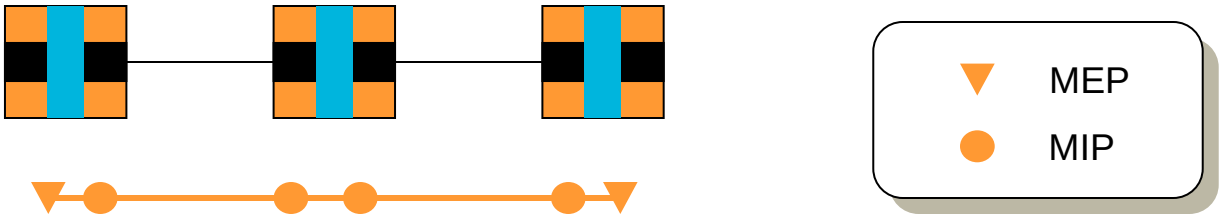
Two problems with this:

- 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

Flavors of AIS that might be applied to Ethernet

- Ethernet AIS (per ITU-T Y.1731/IEEE 802.1ag Connectivity Fault Management
  - Monitoring of Maintenance Entity Group (LAN, VLAN, or group of VLANs with common administrative boundary)
  - Signaled with OAM PDUs – no physical layer indication
  - May only apply to certain VLANs on interface
- Physical Layer AIS
  - Specific to Client signal type. One proposal (nicholl_HSE_02_0208) would be to define a new sequence ordered set for the case of an Ethernet client
  - Is there any difference between the proposed physical layer AIS and the already defined LFI signal? Is there a reason not to reuse the existing codepoint?
- Generic AIS
  - Specific to (client agnostic) Server layer (constant bit-rate mapping of client)

Ethernet AIS - Definitions
OAM entities and maintenance levels



Maintenance Entity (ME): an entity that requires management

- Ethernet traffic flow/trail between ingress and egress of a SP or Operator domain

Maintenance Entity Group (MEG) (MA in IEEE 802.1ag): a set of MEs that

- Exist within the same administrative boundary
- Have the same "MEG Level" (8 MEG levels are available)
- Belong to the same connection: p2p {1xME} or multipoint {Nx(N-1)/2 MEs}

MEP: MEG End Point

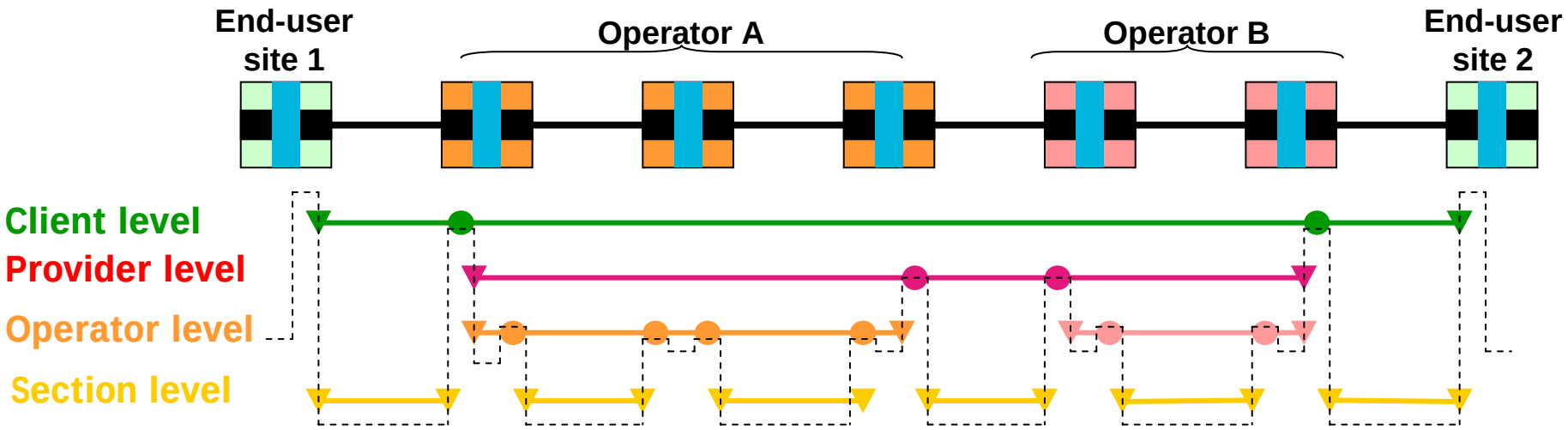
- End-point of an ME, at the edge of a domain
- Generates/terminates OAM PDUs

MIP: MEG Intermediate Point

- Between 2 MEP, in the middle of a ME (inside a domain)
- Can only pass or intercept and reply to OAM PDUs from MEP

Ethernet OAM Hierarchical Model

MEG Levels



Model allows for multiple OAM levels, via MEG Levels, e.g.:

- Customer (5, 6, 7)
- Service provider (3, 4)
- Network Operator (0, 1, 2)

▼ MEP

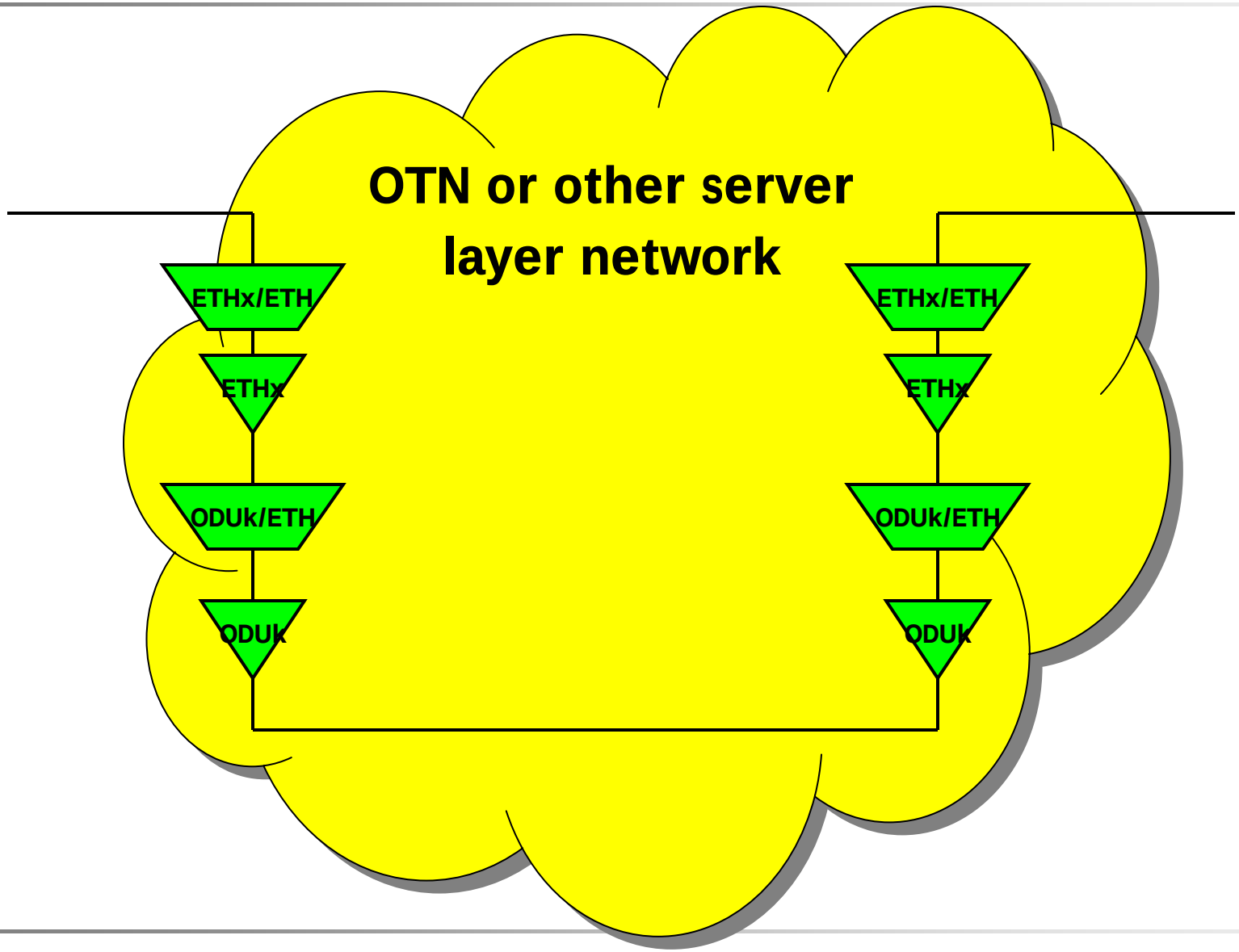
● MIP

The model applies to an end-to-end Ethernet service. Since each MEP and MIP can be individually identified, end-user, service provider and operator(s) can insert and intercept OAM signal to monitor a particular segment

More levels available with QinQ or MACinMAC encapsulations

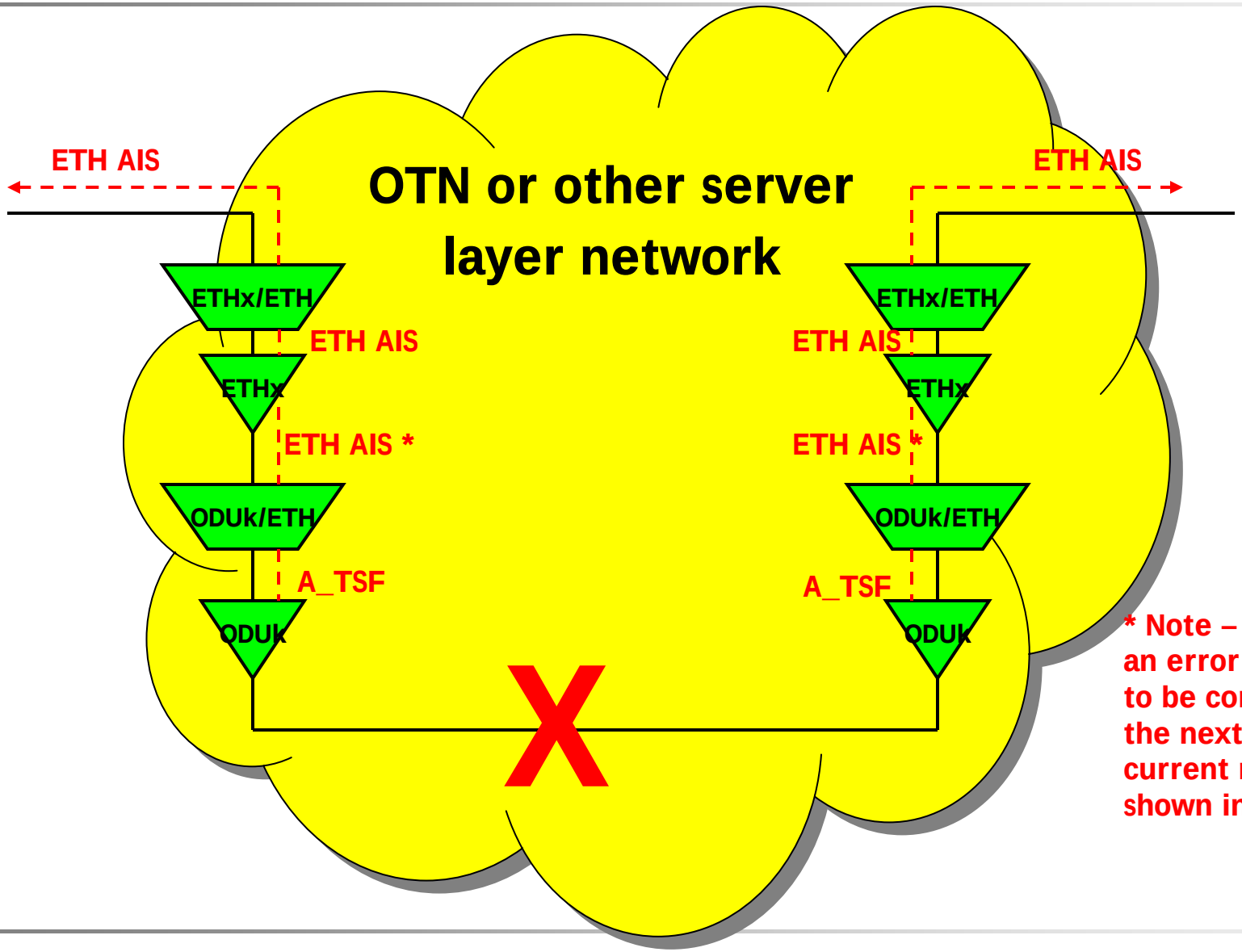
Ethernet AIS Illustration

(simplest case)



Ethernet AIS Illustration

OTN server layer failure

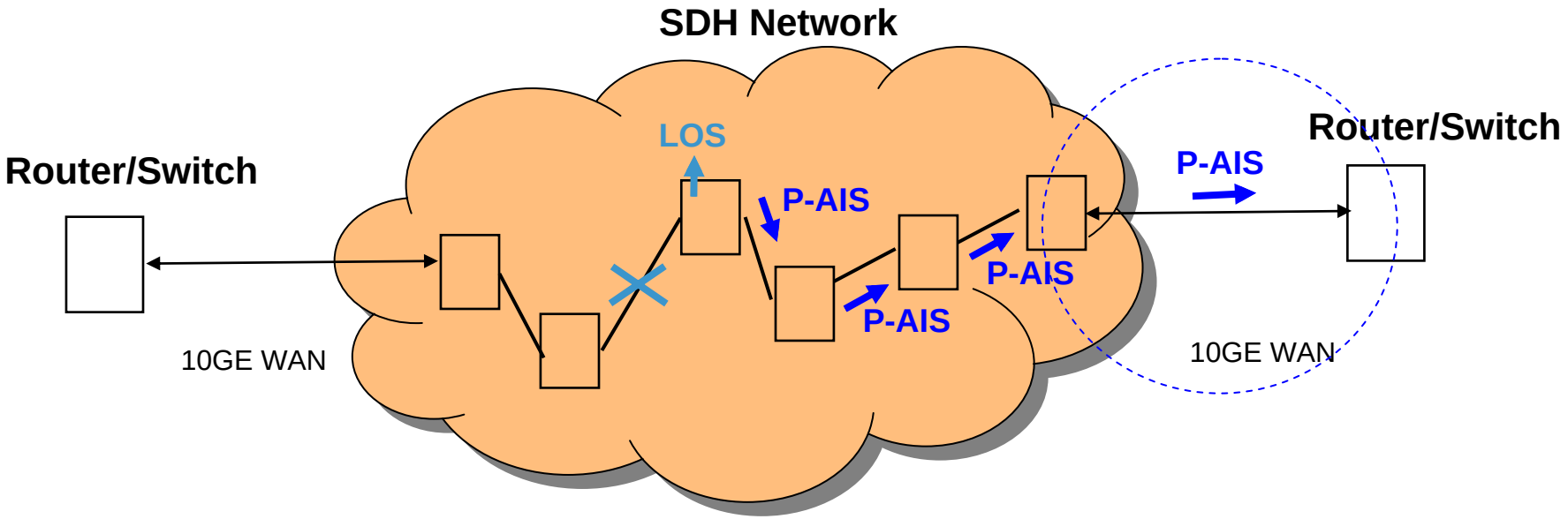


*** Note – there is an error in G.8021 to be corrected in the next revision- current model shown in backup**

Alcatel·Lucent

Client Specific Physical Layer AIS

Example for 10G Base-W (WAN PHY) over SDH network

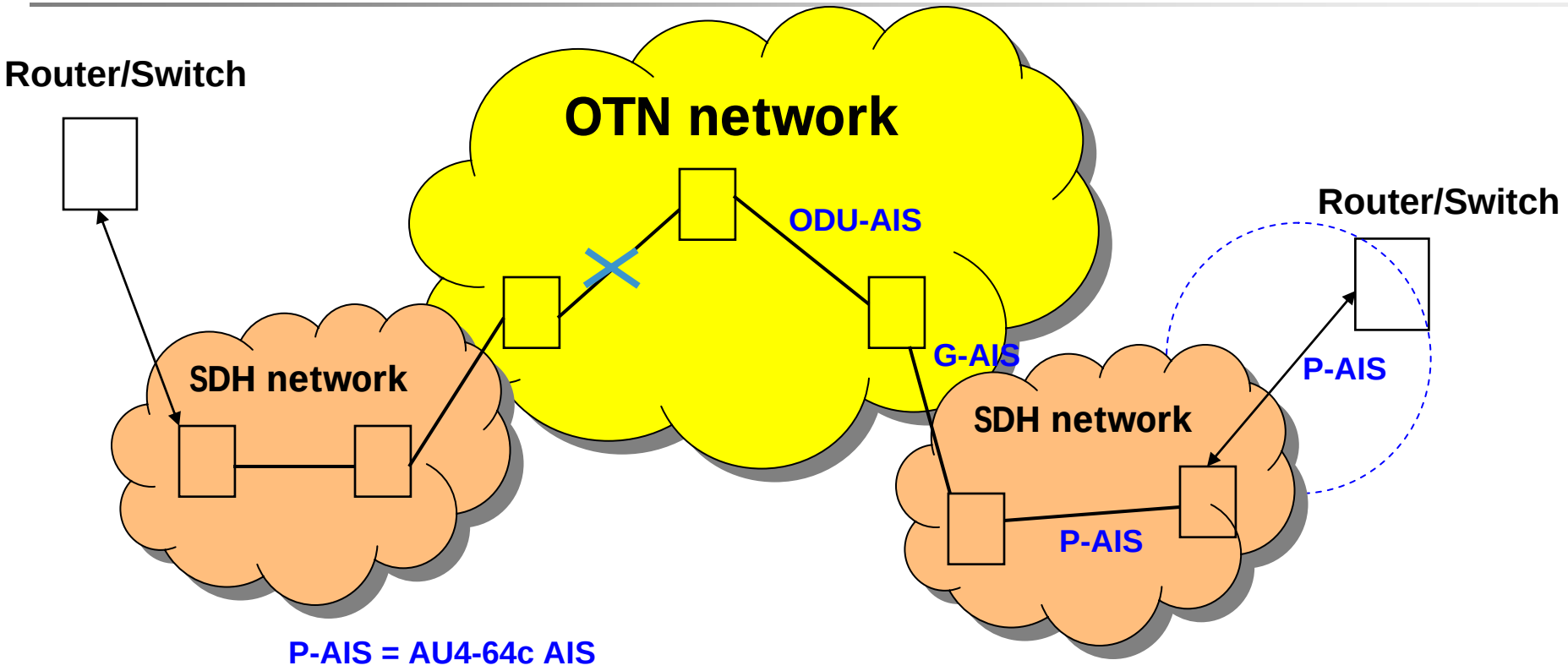


P-AIS = AU4-64c AIS

For WAN PHY, Path-AIS at the WIS layer provides the required function when transported over an SDH server layer network. This is simple because the client and server are essentially the same.

Client Specific Physical Layer AIS

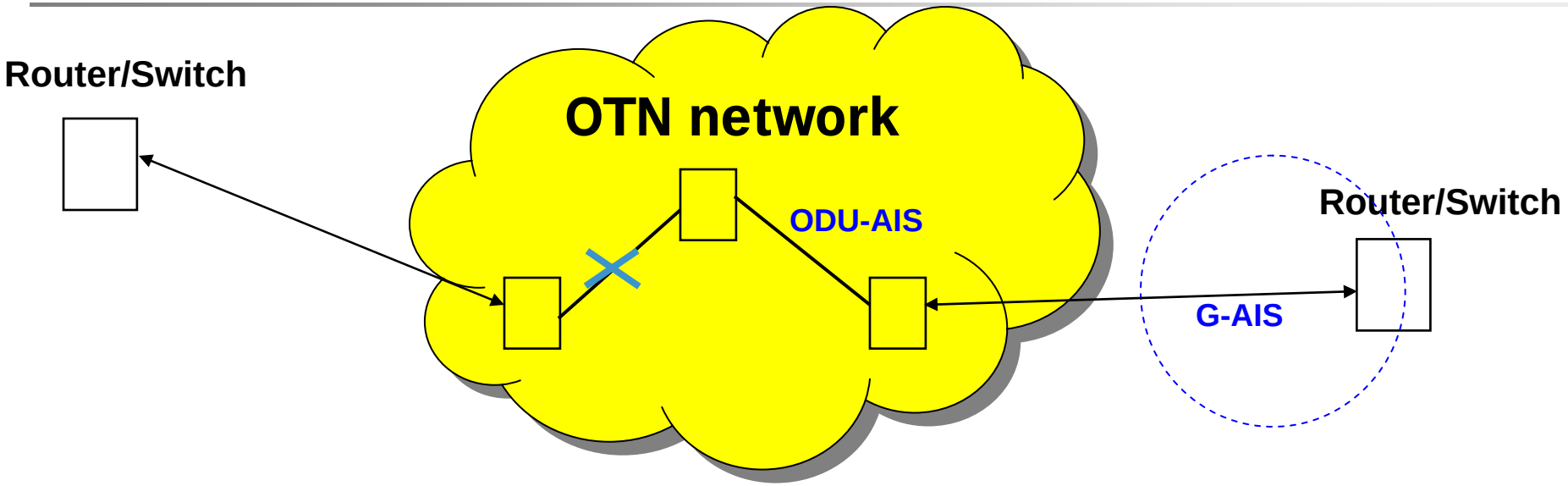
Example for 10G Base-W (WAN PHY)



For WAN PHY over SDH networks interconnected by OTN, no difference observed by router/switch since SDH Network Elements recognize OTN generic AIS and translate to SDH path AIS.

Generic AIS

Example for 10G Base-W (WAN PHY)

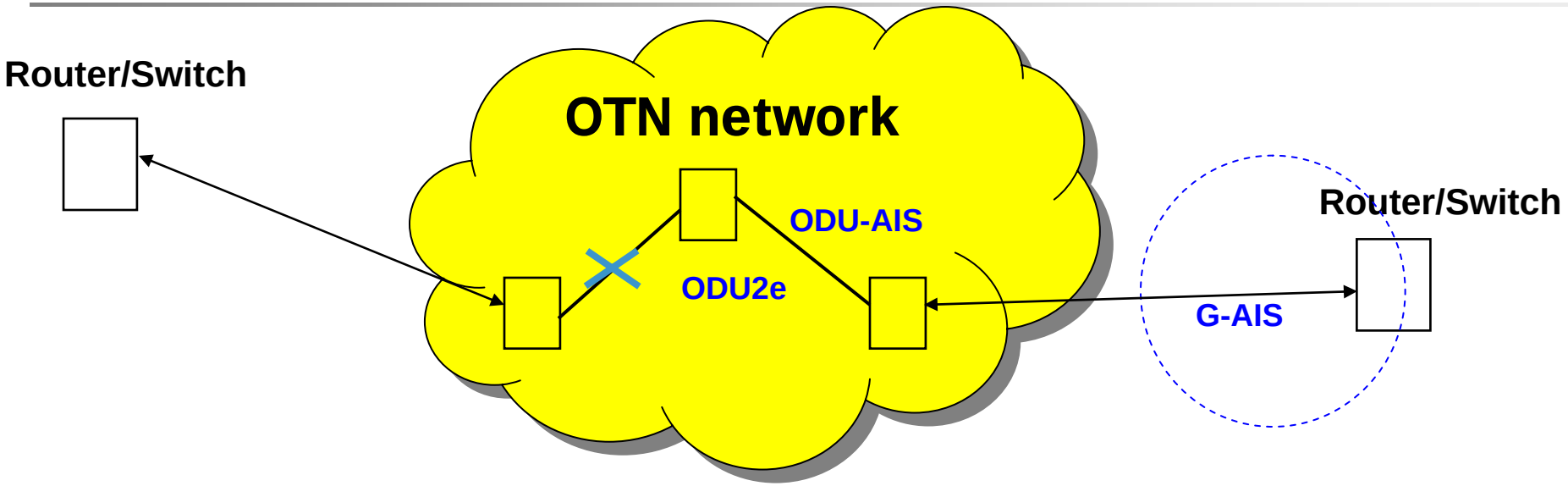


G-AIS = OTN Generic AIS = PN11 (2047-bit repeating sequence $1 + x^9 + x^{11}$)

If WAN PHY is carried directly over OTN using the CBR10G mapping into ODU2, the OTN NE does not have enough knowledge about the client signal format to generate client specific AIS. Here, the only alternative is for the client device (the router/switch) to know enough about the server (OTN) to recognize the server layer generic AIS pattern. This is NOT currently specified in IEEE 802.3 clause 50.

Generic AIS

Example for 10G Base-R using proprietary ODU2e over-clocked interface



G-AIS = OTN Generic AIS = PN11 (2047-bit repeating sequence 1 + x^9 + x^{11})

Over-clocking of transponders designed for STM-64 and mapping into ODU2e results in OTN generic AIS emitted at the egress in the case of upstream failures in the server layer – do routers expect this bit pattern as a consequence of asking for “bit transparency”?

Note: this is one of several reasons the overclocked mappings are only used in point-to-point applications (rather than networked applications)

Summary of OAM/AIS approaches

- Ethernet (Y.1731/801.1ag) AIS
  - \+ Existing standards
  - \+ Very flexible, applicable to many service architectures (LAN, VLAN, VLAN group, p2p, p2mp)
  - \+ Can be run at the section layer by configuring the MEG level
  - \- AIS is transmitted as a PDU rather than at the physical layer
  - \- Applicable only to Frame based services as opposed to "transparent" services
- Physical layer AIS – for client/server situations, either the server must know something about the client (client specific AIS), or the client must know something about the server (generic AIS)
  - \+ Could the existing LFI sequence ordered set serve as the needed AIS signal by specifying more of the behavior?
  - \- If not, a new standard would be required to specify Ethernet physical layer AIS (e.g., an additional sequence ordered set)
  - \+ As mapping of 40GbE into ODU3 using transcoding is client specific, OTN generic AIS is not applicable to this situation. Could choose between several alternatives (OTN generic AIS at client bit-rate, some new pattern like a sequence ordered set)
  - ± For 100GbE, a choice must be made whether the mapping into OTN is client specific and OTN should provide an Ethernet specific AIS at the egress, or whether a CBR mapping is used and the Ethernet equipment should recognize OTN generic AIS

BACKUP

G.8021 currently specified behavior for Ethernet AIS

Same externally observed behavior for equiment that implements Ethernet flow functions