Pre-FEC Signaling

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Motivation

400GbE has mandatory Forward Error Correction (FEC) to base new features

Pre-FEC BER statistics provide means to base fault signaling with fast response time

Early fault warning based on the same pre-FEC BER statistics can pre-emptively move traffic away from a link

For example, in the case of a router, this can trigger fast re-route (FRR) in order to move the traffic onto another link

Depending on the rate of change of the pre-FEC BER, re-routing may be achieved without losing any user traffic

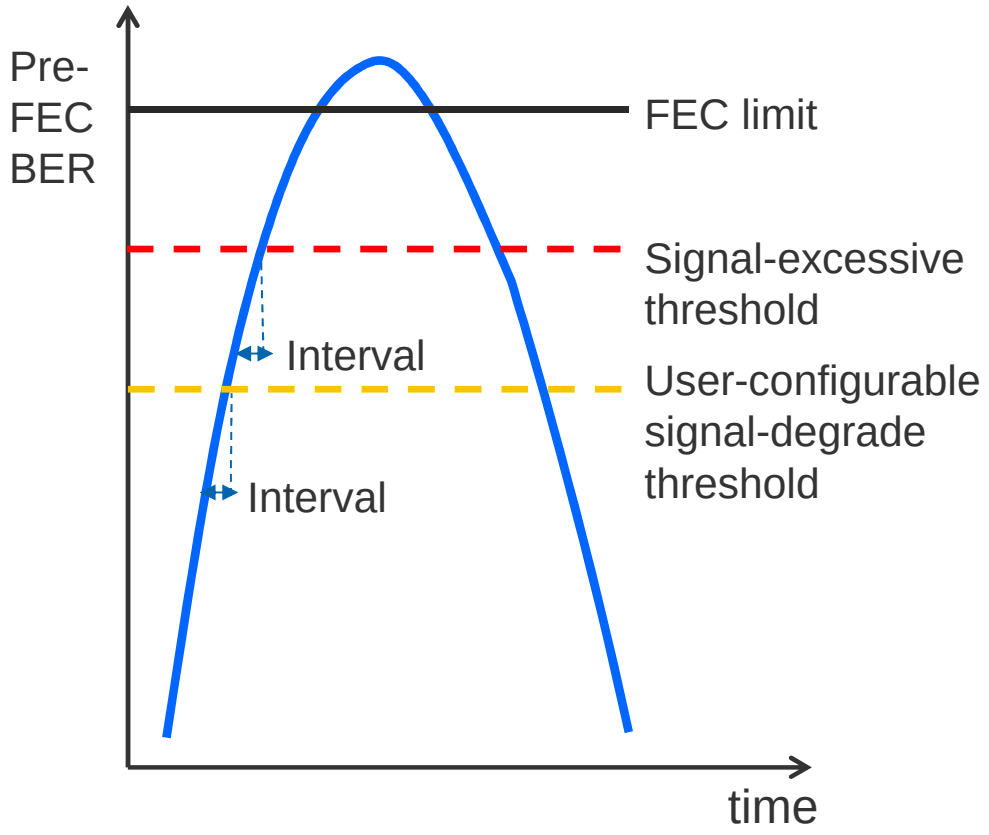
Threshold Crossing

FEC excessive threshold

- If the pre-FEC BER exceeds this mandatory threshold for longer than the *Interval*, link fault signaling is generated

FEC degrade threshold

- If the pre-FEC BER is higher than this optional threshold for longer than the *Interval*, a link degrade signal is generated



400GbE PMD

FEC1 is the mandatory FEC defined in P802.3bs

- Point of FEC decode to extract pre-FEC BER statistics

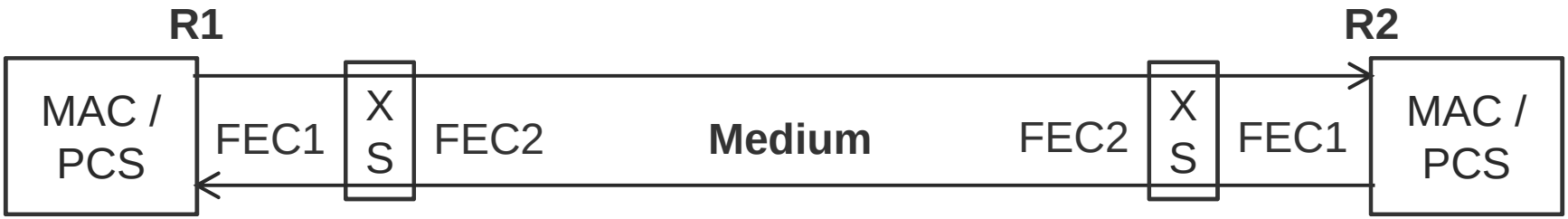
Excessive pre-FEC BER threshold crossing is treated the same as a sync header error threshold crossing

- Fast mechanism to bring down a bad link
- LF/RF generated as is already common in 802.3

Degrade pre-FEC BER threshold crossing provides potential for advance-in-time information of link failure

- LD/RD (local degrade/remote degrade) can be generated

400GbE PMD with New FEC supported by Extender Sublayer



FEC2 is a new FEC required by a new PMD

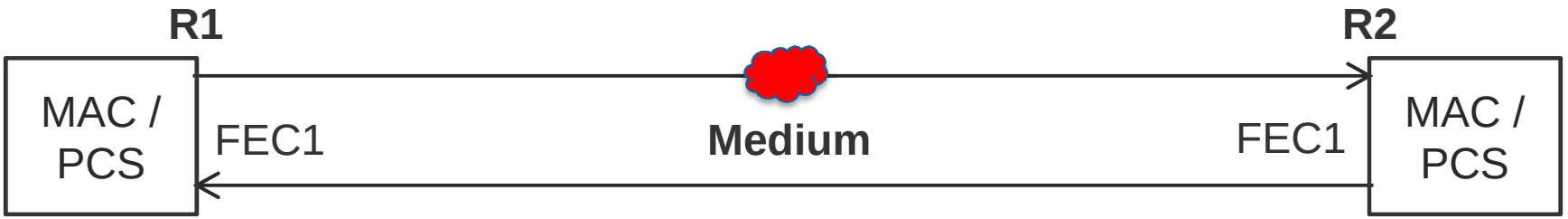
Extender sublayer (XS) converts between FEC1 and FEC2

- Point of FEC decode to extract pre-FEC BER

FEC2 based pre-FEC BER can importantly generate LD/RD

- Can occur when FEC1 excessive threshold and not even degrade threshold have yet been crossed

400GbE PMD – FEC Excessive



Impairment in eastbound direction results in mandatory FEC1-excessive threshold being crossed at R2

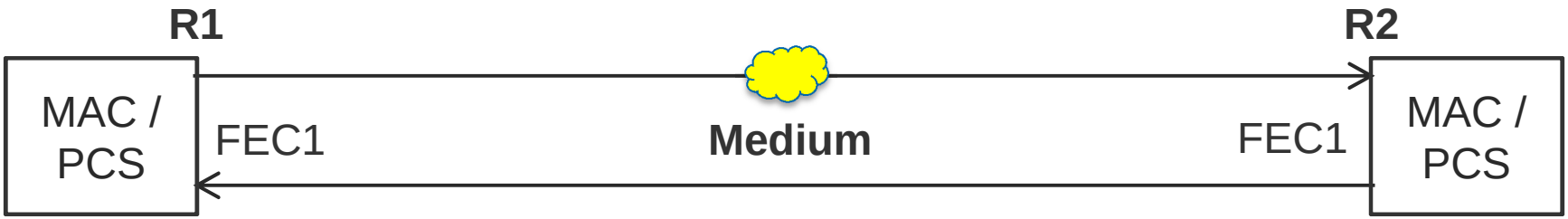
R2 stops using link for forwarding of user-traffic, and stops accepting user traffic arriving from R1

- R1 will still be sending traffic until it is notified of the fault

R2 sends Remote Fault (RF) to R1

- This triggers R1 to stop using the link for forwarding of user traffic

400GbE PMD – FEC Degrade



Impairment in eastbound direction results in FEC1-degrade threshold being crossed at R2

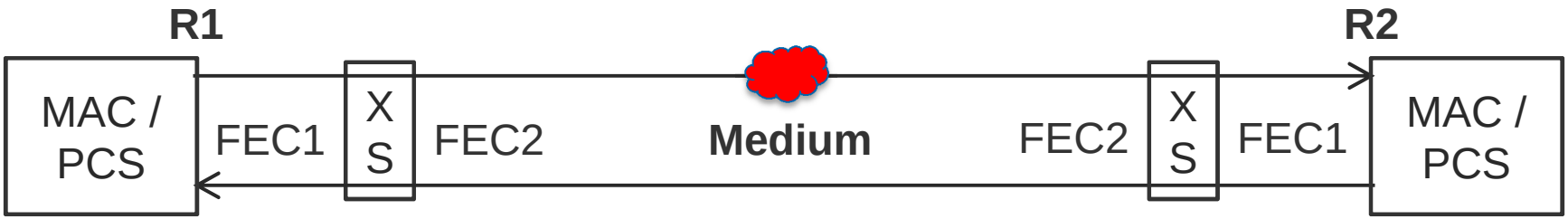
R2 optionally stops using link for forwarding of user-traffic according to user policy, but still accepts user traffic arriving from R1

- R1 will still be sending traffic until it is notified of the degradation

R2 sends Remote Degrade (RD) to R1

- This optionally triggers R1 to stop using the link for forwarding of user traffic

400GbE PMD with Extender Sublayer – FEC Excessive



Impairment in eastbound direction results in mandatory FEC2-excessive threshold being crossed at XS of R2, yet FEC1-excessive threshold may not yet be crossed

- XS, which could be in a module, transmits Local Fault (LF) to R2

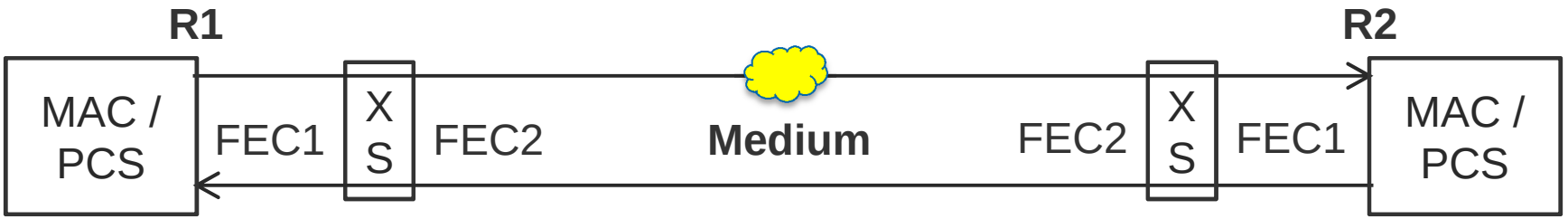
R2 stops using link for forwarding of user-traffic, and has lost traffic arriving from R1

- R1 will still be sending traffic until it is notified of the fault

R2 sends Remote Fault (RF) to R1

- This triggers R1 to stop using the link for forwarding of user traffic

400GbE PMD with Extender Sublayer – FEC Degrade



Impairment in eastbound direction results in FEC2-degrade threshold being crossed at XS of R2, yet FEC1-degrade threshold may not yet be crossed

- XS, which could be in a module, transmits Local Degrade (LD) to R2

R2 optionally stops using link for forwarding of user-traffic according to user policy, but still accepts user traffic arriving from R1

- R1 will still be sending traffic until it is notified of the degradation

R2 sends Remote Degrade (RD) to R1

- This optionally triggers R1 to stop using the link for forwarding of user traffic

Need new feature of FEC Degrade Signaling

Use of FEC degrade to enable advance features requires local degrade and remote degrade signaling optionally to be communicated without disrupting traffic

- Do not want to send code words in place of data as is done for LF/RF
- Need in-band communication channel with the data

Should the extender sublayer (XS) be cable of generating LF/RF signaling?

Should the XS be transparent to LF/RF code words?

What should be done if the XS does not terminate FEC1 but wraps it in FEC2?

Conclusions

400GbE has mandatory Forward Error Correction (FEC) to base a rich set of new features

Need addition of counters and control to enable these features