

# FEC degrade signaling using service interface

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# Introduction

- In 800 Gb/s physical layer, “FEC degrade” state is transferred between PCS and XS sublayers by reference to status variables within the other sublayer rather than using conventional signaling across the service interface (SI).
- The lack of abstraction makes it difficult to understanding the relationships and may lead to custom approaches for each new PCS type.
- This presentation proposes to replace the references to status variables in other sublayers with conventional SI signals.

# Related comments (I-3, I-102, I-105, I-106)

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Cl 171	SC 171.6	P12	L12	# I-3
Brown, Matthew		Alphawave		
Comment Type	E	Comment Status	D	FEC degrade
Signaling of FEC degrade (local and remote) as currently defined requires the PHY XS and PCS to snoop signals in the other sublayer rather than using the more conventional method of sending signals using the inter-sublayer service interface. This makes it hard to trace the signaling between sublayers and to abstract that signaling so that different PCS types looks the same to the PHY XS.				
<i>SuggestedRemedy</i>				
Change the FEC Degrade signaling between sublayers such that it uses common signals on the PCS service interface rather than signals within the other sublayer. A presentation with a full proposal will be provided.				
<i>Proposed Response</i>		<i>Response Status</i> W		
PROPOSED ACCEPT IN PRINCIPLE. Pending review of the consensus presentation.				

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Cl 169	SC 169.6	P185	L51	# I-102
Dawe, Piers J G		NVIDIA		
Comment Type	TR	Comment Status	D	FEC degrade
This says "... FEC degrade functionality is identical to that defined ... in 116.6." But 116.6 is just non-normative introduction, it contains no definition and not even any cross-references.				
<i>SuggestedRemedy</i>				
Change "Optional FEC degrade functionality is identical to that defined for 200 Gigabit Ethernet and 400 Gigabit Ethernet in 116.6." to "Optional FEC degrade functionality is as described for 200 Gigabit Ethernet and 400 Gigabit Ethernet in 116.6. For the 800GBASE-R PCS, it is defined in 172.2.5.3 (see 119.2.5.3), 172.2.5.3 (see 119.2.5.3) and 172.2.6 (see 119.2.6.2). For the 800GMII Extender, see 171.2, 118.2.1, 171.3, 118.2.2, 171.6, and 118.2." In 116.6, insert a second sentence "For the 200GBASE-R or 400GBASE-R PCS, it is defined in 119.2.5.3, 119.2.5.3, and 119.2.6.2. For the 200GMII Extender and 400GMII Extender, see 118.2.1, 118.2.2, and 118.2."				
<i>Proposed Response</i>		<i>Response Status</i> W		
PROPOSED ACCEPT IN PRINCIPLE. Resolve using the response to comment #I-3.				

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Cl 171	SC 171.2	P195	L46	# I-105
Dawe, Piers J G		NVIDIA		
Comment Type	T	Comment Status	D	FEC degrade
Now that we have agreed that FEC degrade is optional, the same in the XS as in the PCS, there's no difference between the DTE 800GXS and the 800GBASE-R PCS. FEC degrade *signalling* in 118.2.1 (200G and 400G XS) seems to apply, but it's not an exception, and 118.2 is referenced 171.6. We need 172.2.5.3, Reed-Solomon decoder, with the two flows. More references could be useful, somewhere, as the information seems to be scattered between 118, 119, 171 and 172. I wonder if tx_am_sf should get a mention somewhere.				
<i>SuggestedRemedy</i>				
Delete "with the exception that the FEC degrade signaling is defined in 118.2.1"				
<i>Proposed Response</i>		<i>Response Status</i> W		
PROPOSED ACCEPT IN PRINCIPLE. Implement the suggested remedy with editorial license. See also comment #I-3.				

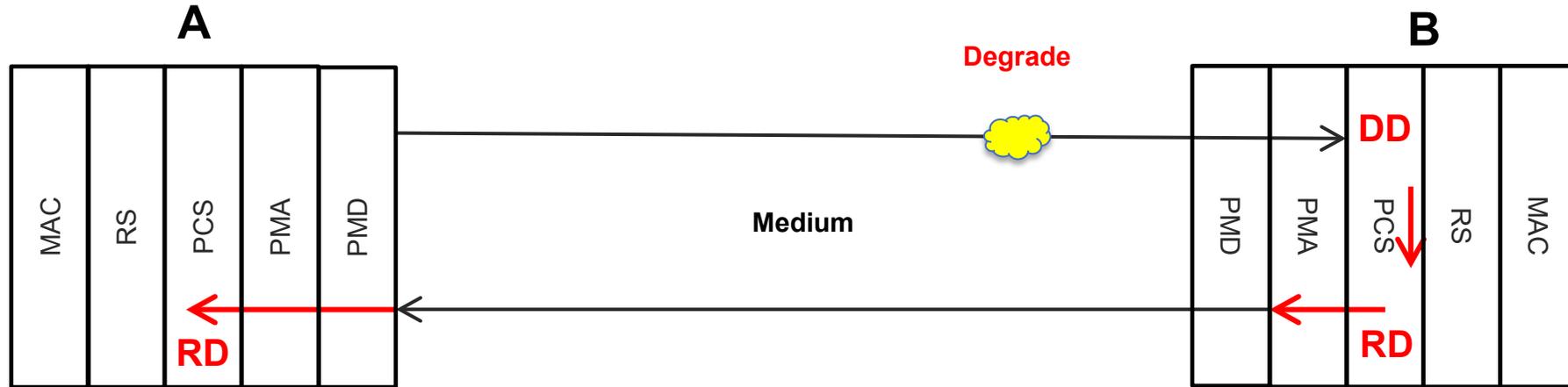
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Cl 171	SC 171.3	P196	L8	# I-106
Dawe, Piers J G		NVIDIA		
Comment Type	T	Comment Status	D	FEC degrade
Now that we have agreed that FEC degrade is optional, the same in the XS as in the PCS, there's no difference between the DTE 800GXS and the 800GBASE-R PCS. FEC degrade *signalling* in 118.2.2 (200G and 400G XS) seems to apply, but it's not an exception, and 118.2 is referenced 171.6. We need 172.2.5.3, Reed-Solomon decoder, with the two flows. More references could be useful, somewhere, as the information seems to be scattered between 118, 119, 171 and 172. I wonder if tx_am_sf should get a mention somewhere.				
<i>SuggestedRemedy</i>				
Delete the line "-- FEC degrade signaling is defined in 118.2.2."				
<i>Proposed Response</i>		<i>Response Status</i> W		
PROPOSED ACCEPT IN PRINCIPLE. Implement the suggested remedy with editorial license. See also comment #I-3.				

# FEC Degradate Background

Ref: [ofelt 3cd 01 0716](#)

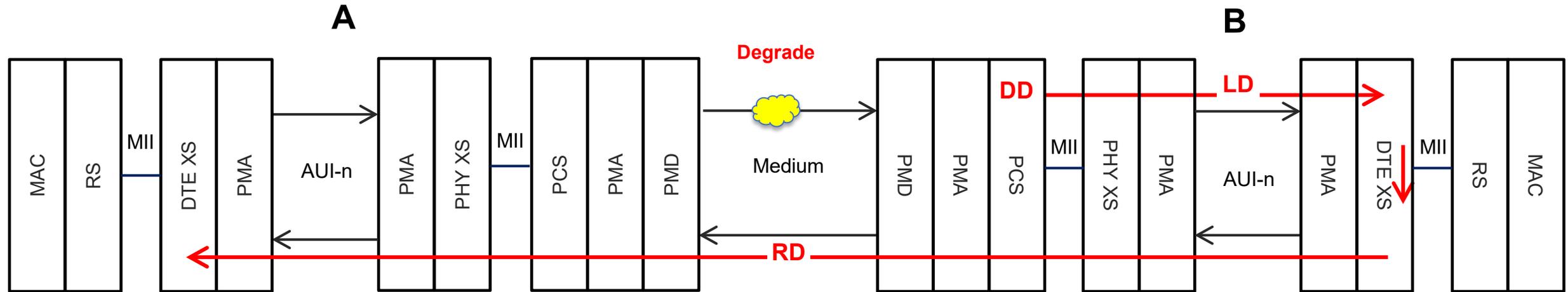
# FEC degrade signaling example (without MII Extender)



- PCS at B detects degrade condition (DD)
  - DD means pre-FEC SER (symbol error ratio) exceeds a user configured threshold
- PCS at B sends remote degrade (RD) to PCS at A
- FEC degrade signaling does not affect traffic

Note: This is only one example to communicate the basic concept.

# FEC degrade signaling example (with MII Extender)



- PCS at B detects degrade (DD) and sends local degrade (LD) to DTE XS at B
- DTE XS at B detects LD and sends remote degrade (RD) to DTE XS at A
- FEC degrade signal does not affect traffic

Note: This is only one example to communicate the basic concept. There are other examples, for example if the degrade is on the AUI-n (see ofelt\_3cd\_01\_0716) or there may only be an MII Extender on one end.

# FEC degrade physical signaling

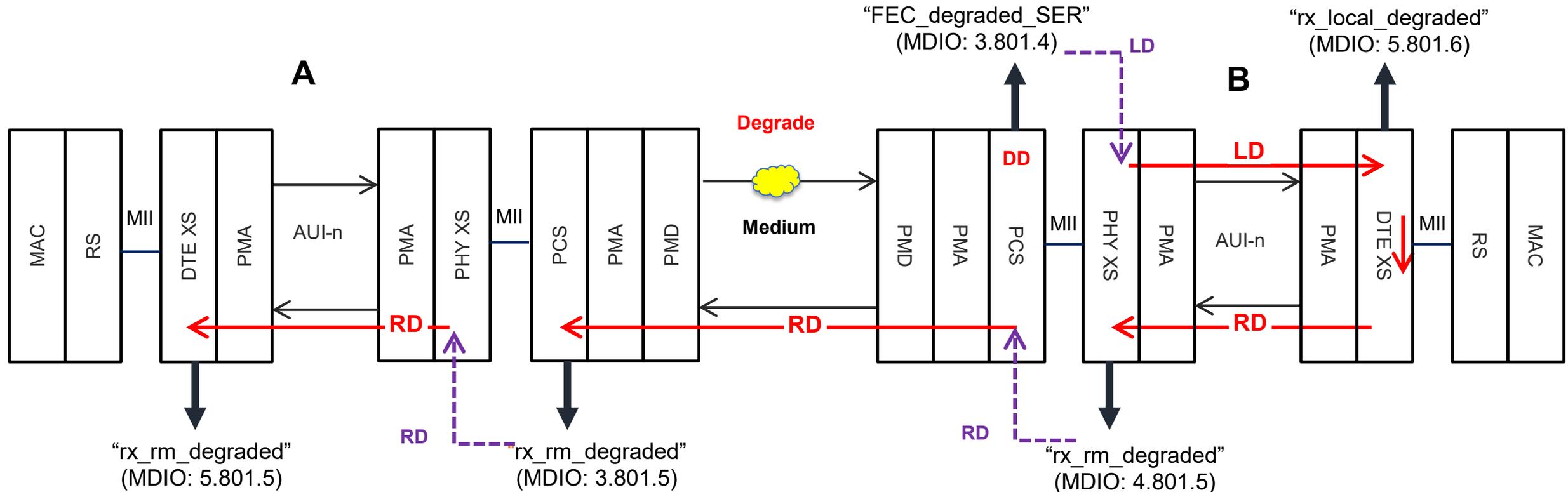
FEC degrade conditions (LD and RD) are signaled across the medium and the AUI, via a 3-bit status field (tx\_am\_sf<2:0>) in the alignment markers.

These three bits are defined as follows:

- tx\_am\_sf<2> = RD (remote degrade)
- tx\_am\_sf<1> = LD (local degrade)
- tx\_am\_sf<0> = 0 (unused, reserved for future expansion)

# FEC degrade signaling example (with MII Extender)

## Detailed view - current specification



**LD** → = LD signaling by setting tx\_am\_sf<1>

**RD** → = RD signaling by setting tx\_am\_sf<2>

-----> = signaling "out-of-band" (not defined in standard) using sublayer status variables

# FEC degrade signaling example (with MII Extender)

## Detailed view - current specification

The PHY XS sets the alignment marker status field based upon status variable in the PCS below, rather than through service interface signals from the PCS.

### 118.2.1 DTE XS FEC Degrade signaling

The variable `tx_am_sf` is set as follows:

```
tx_am_sf<2:0> = {FEC_degraded_SER + rx_local_degraded,0,0}
```

### 118.2.2 PHY XS FEC Degrade signaling

The variable `tx_am_sf` is set as follows:

```
tx_am_sf<2:0> = {PCS:rx_rm_degraded, PCS:FEC_degraded_SER + PCS:rx_local_degraded, 0}
```

Where `PCS:rx_rm_degraded`, `PCS:FEC_degraded_SER`, and `PCS:rx_local_degraded` are the `rx_rm_degraded`, `FEC_degraded_SER`, and `rx_local_degraded` variables from the adjacent PCS.

The PCS sets the alignment marker status field based upon status variables in the PHY XS above, rather than through service interface signals from the PHY XS.

### 119.2.4.4 Alignment marker mapping and insertion

The transmit alignment marker status field allows the local PCS to communicate the status of the FEC degraded feature to the remote PCS. If there is no extender sublayer between the PCS and the MAC, it is set as follows:

```
tx_am_sf<2:0> = {FEC_degraded_SER + rx_local_degraded,0,0}
```

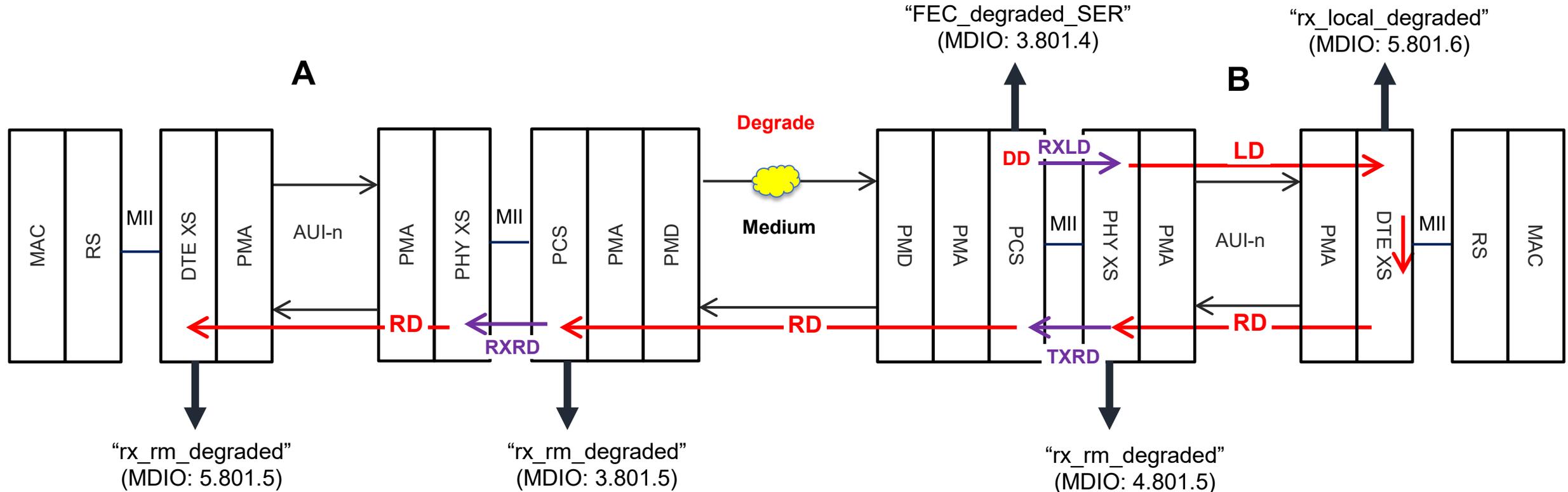
If there is a Clause 118 extender sublayer between the PCS and the MAC, it is set as follows:

```
tx_am_sf<2:0> = {PHY_XS:rx_rm_degraded, PHY_XS:FEC_degraded_SER, 0}
```

Where `PHY_XS:rx_rm_degraded` and `PHY_XS:FEC_degraded_SER` are the `rx_rm_degraded` and `FEC_degraded_SER` variables from the adjacent PHY\_XS sublayer.

# FEC degrade signaling example (with MII Extender)

## Detailed view - Proposal



**LD** → = LD signaling by setting tx\_am\_sf<1>

**RD** → = RD signaling by setting tx\_am\_sf<2>

**RXLD** → **TXRD** → **RXRD** → = signaling using new "PCS service interface" signals (between PCS and PHY XS)

# Proposal Summary

Add four new signals to the “PCS service interface” when the sublayer above the PCS is a PHY XS.

These signals are defined as follows:

- TXLD = PHY\_XS:FEC\_degraded\_SER
- TXRD = PHY\_XS:rx\_rm\_degraded
- RXLD = PCS:FEC\_degraded\_SER + PCS:rx\_local\_degraded
- RXRD = PCS:rx\_rm\_degraded

When there is a RS above the PCS, the PCS sets the FEC degrade signaling in the alignment marker status field (towards the medium) as follows (no change to the current draft):

- tx\_am\_sf<2> = PCS:FEC\_degraded\_SER + PCS:rx\_local\_degraded
- tx\_am\_sf<1> = 0

When there is a PHY XS above the PCS, the PCS sets the FEC degrade signaling in the alignment marker status field (towards the medium) as follows:

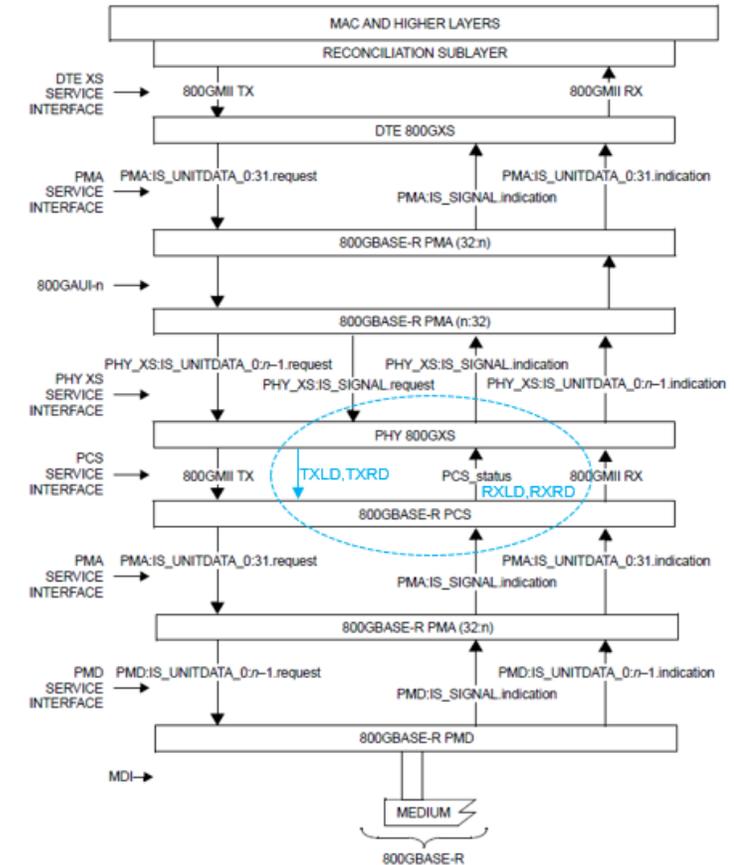
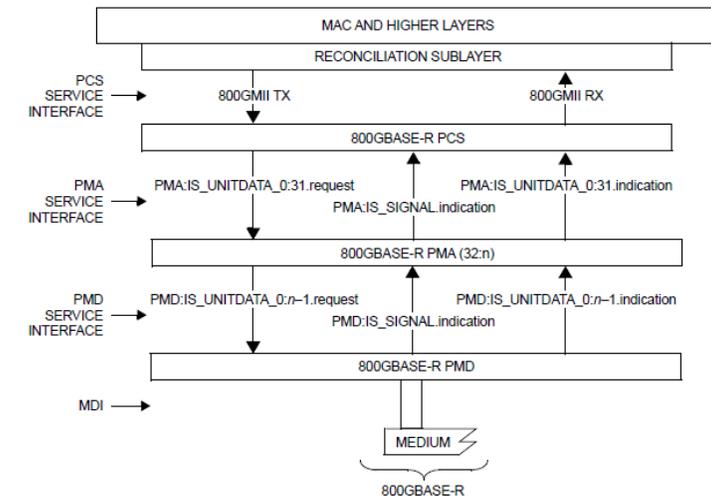
- tx\_am\_sf<2> = TXRD
- tx\_am\_sf<1> = TXLD

The PHY XS sets the FEC degrade signaling in the alignment marker status field (towards the MAC) as follows:

- tx\_am\_sf<2> = RXRD
- tx\_am\_sf<1> = RXLD

The DTE XS sets the FEC degrade signaling in the alignment marker status field (towards the medium) as follows (no change from current draft):

- tx\_am\_sf<2> = DTE\_XS:FEC\_degraded\_SER + DTE\_XS:rx\_local\_degraded
- tx\_am\_sf<1> = 0



# Proposed changes to the Draft

# Clause 169

Update Figure 169-2 as follows, showing the new service interface signals indicating remote degrade (TXRD, RXRD) and local degrade (TXLD, RXLD).

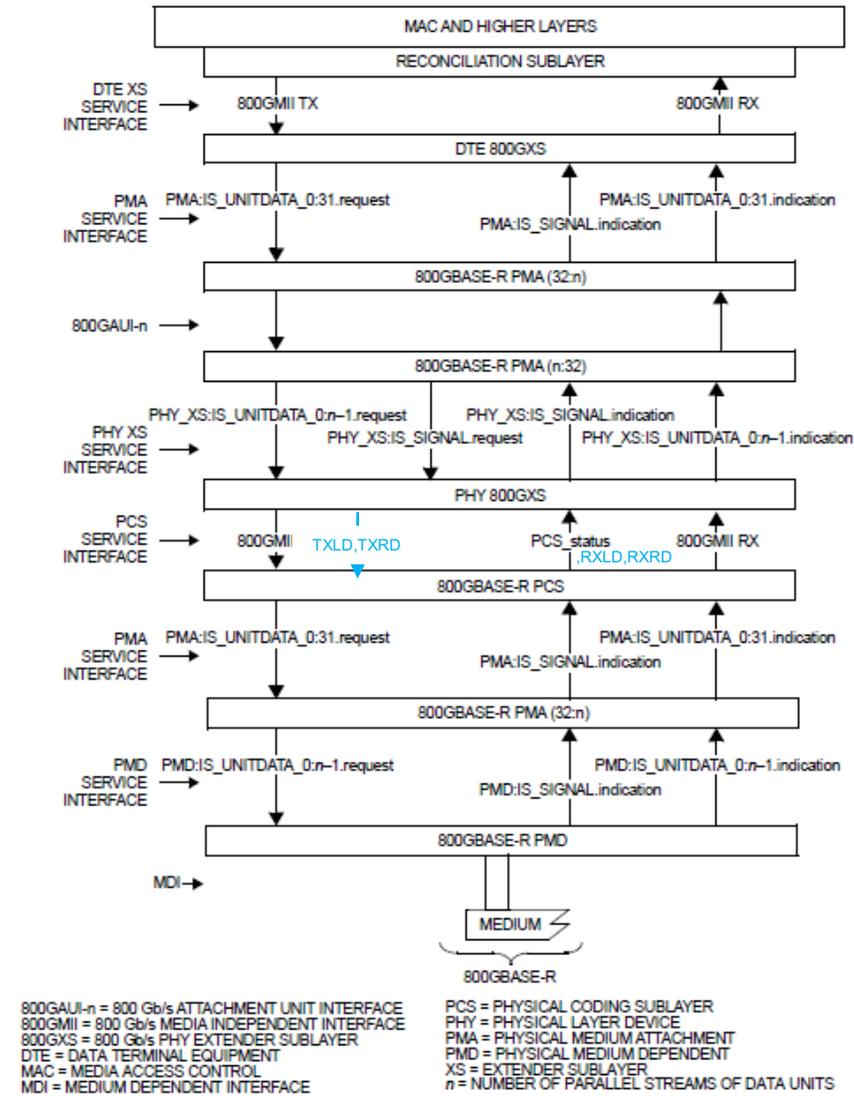


Figure 169-3—800GBASE-R inter-sublayer service interfaces including 800GMII

# Clause 172 : PCS Functional block diagram

Update Figure 172-2 as follows, showing the new service interface signals indicating remote degrade (TXRD, RXRD) and local degrade (TXLD, RXLD).

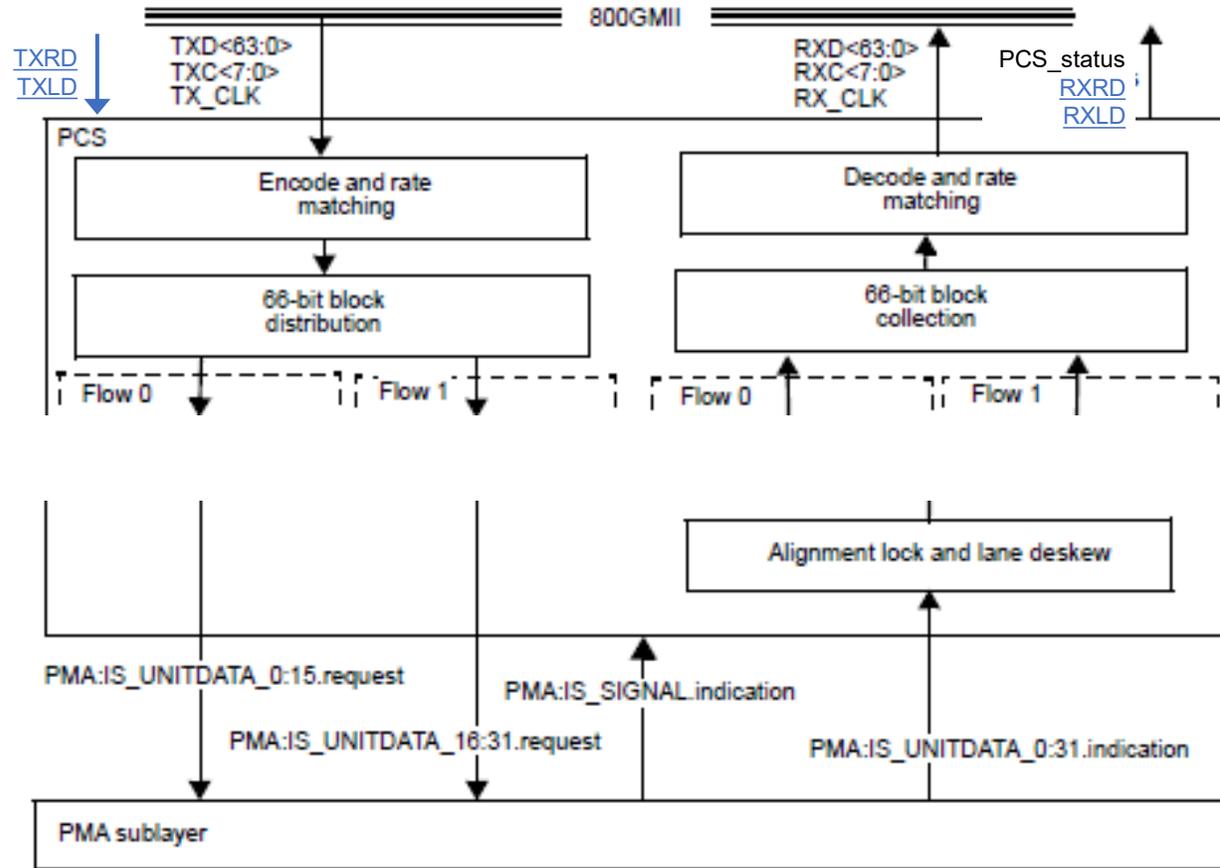


Figure 172-2—Functional block diagram

# Clause 172: PCS service interface

Change 172.1.4.1 as follows:

## 172.1.4.1 PCS service interface

The PCS service interface allows the 800GBASE-R PCS to transfer information to and from a PCS client. The PCS client is either the Reconciliation Sublayer or the PHY 800GXS sublayer.

When the client [sublayer](#) is the Reconciliation Sublayer, the PCS Service Interface is the Media Independent Interface (800GMII) in Clause 170.

~~When the client is the PHY 800GXS sublayer, the PCS Service Interface is the 800GMII in Clause 170 with an additional signal, PCS\_status, in the receive direction. The PCS\_status signal indicates the state of the PCS\_status variable (see 119.2.6.2.2).~~

When the client sublayer is the PHY 800GXS Sublayer, the PCS Service Interface is the Media Independent Interface (800GMII) in Clause 170 with additional signals TXRD, TXLD, RXRD, RXLD and PCS\_status.

The TXRD and TXLD status signals indicate the state of the remote degrade and local degrade, respectively, as detected by the PHY 800GXS in the transmit direction (see 171.3.3).

The RXRD signal indicates the state of the rx\_rm\_degraded variable (see 172.2.6.2.2) as detected by the PCS in the receive direction.

The RXLD signal is the logical OR of the FEC\_degraded\_SER and rx\_local\_degraded variables (see 172.2.6.2.2) as detected by the PCS in the receive direction.

The PCS\_status signal indicates the state of the PCS\_status variable (see 119.2.6.2.2) as detected by the PCS in the receive direction.

# Clause 172: Alignment marker mapping and insertion

**Add the following exception to 172.2.4.6 “Alignment marker mapping and insertion”**

tx\_am\_sf<2:0> is assigned as follows:

When the client sublayer is the Reconciliation Sublayer:

$\text{tx\_am\_sf}\langle 2:0 \rangle = \{\text{FEC\_degraded\_SER} + \text{rx\_local\_degraded}, 0, 0\}$

where FEC\_degraded\_SER and rx\_local\_degraded are defined in 172.2.6.2.2

When the client sublayer is the PHY 800GXS:

$\text{tx\_am\_sf}\langle 2:0 \rangle = \{\text{TXRD}, \text{TXLD}, 0\}$

where TXRD and TXLD are signals from the PHY 800GXS on the PCS service interface (see 172.1.4.1)

# Clause 171: Functional block diagram for the PHY 800GXS

Update Figure 171-2 as follows, showing new signals indicating remote degrade (TXRD, RXRD) and local degrade (TXLD, RXLD).

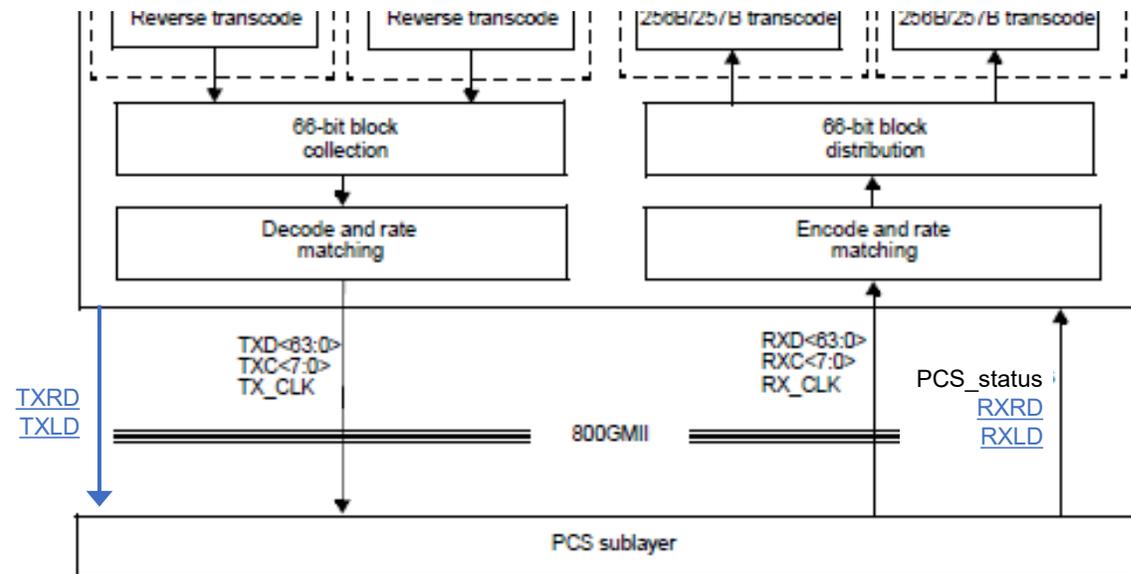


Figure 171-2—Functional block diagram for the PHY 800GXS

# Clause 171: PHY 800GXS Sublayer

## Change 171.3 as follows:

The PHY 800GXS shall be identical in function to an 800GBASE-R PCS (see Clause 172) with the following exceptions:

- The PCS is inverted with the transmit function used for the receive direction and vice versa.
- The service interface signals are remapped as defined in 171.3.2 and 171.3.3.
- FEC degrade signaling is defined in ~~118.2.2~~ [171.6](#)

Figure 171–2 provides a functional block diagram of the PHY 800GXS.

# Clause 171: Service interface below PHY 800GXS

Change 171.3.3 as follows:

## 171.3.3 Service interface below PHY 800GXS

The service interface below the PHY 800GXS allows the PHY 800GXS to transfer information to and from the PCS below.

The service interface below the PHY 800GXS is defined as the Media Independent Interface (800GMII) in Clause 170, ~~except~~ with some exceptions and additional signals as follows:

- TX\_CLK is used in place of RX\_CLK, and vice versa
- TXD<63:0> is used in place of RXD<63:0>, and vice versa
- TXC<7:0> is used in place of RXC<7:0>, and vice versa
- ~~— An additional signal, PCS\_status, is provided in the receive direction (see 172.1.4.1)~~
- Additional signals, RXRD, RXLD and PCS Status are provided in the receive direction (see 172.1.4.1)
- An additional signal, TXRD, which indicates the state of the rx\_rm\_degraded variable (see 171.6.2) as detected by the PHY 800GXS in the transmit direction.
- An additional signal, TXLD, which indicates the state of the FEC\_degraded\_SER variable (see 171.6.2) as detected by the PHY 800GXS in the transmit direction.

# Clause 171: FEC degrade signaling

Replace 171.6 with the following:

## 171.6 FEC degrade

The propagation of FEC degrade signaling across PCS and XS sublayers is described in 116.6 and is based on the optional FEC degrade signaling described in Clause 172 with the changes described for the DTE XS in 171.6.1 and for the PHY XS in 171.6.2. FEC degrade signaling is optional.

### 171.6.1 DTE XS FEC degrade signaling

The variable `tx_am_sf` is set as follows:

$$\text{tx\_am\_sf}\langle 2:0 \rangle = \{\text{FEC\_degraded\_SER} + \text{rx\_local\_degraded}, 0, 0\}$$

### 171.6.2 PHY XS FEC degrade signaling

The variable `tx_am_sf` is set as follows:

$$\text{tx\_am\_sf}\langle 2:0 \rangle = \{\text{RXRD}, \text{RXLD}, 0\}$$

where RXRD and RXLD are signals from the PCS on the PCS service interface (see 172.1.4.1).