

DWDM SIGNAL_DETECT behavior

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Relevant text

- Signal Detect is defined in 802.3ct D2.0 154.5.4
- Signal Detect maps to SIGNAL_OK to indicate a failed signal

154.5.4 PMD global signal detect function

The PMD global signal detect function shall report the state of SIGNAL_DETECT via the PMD service interface. The SIGNAL_DETECT parameter is signaled continuously, while the PMD:IS_SIGNAL indication message is generated when a change in the value of SIGNAL_DETECT occurs. The SIGNAL_DETECT parameter defined in this clause maps to the SIGNAL_OK parameter in the inter-sublayer service interface primitives defined in 154.2.

SIGNAL_DETECT shall be a global indicator of the presence of the optical signal. The value of the SIGNAL_DETECT parameter shall be generated according to the conditions defined in Table 154-5. The PMD

Various implementations of the Signal Detect function are permitted by this standard, including implementations that generate the SIGNAL_DETECT parameter values in response to the average optical power of the modulated optical signal.

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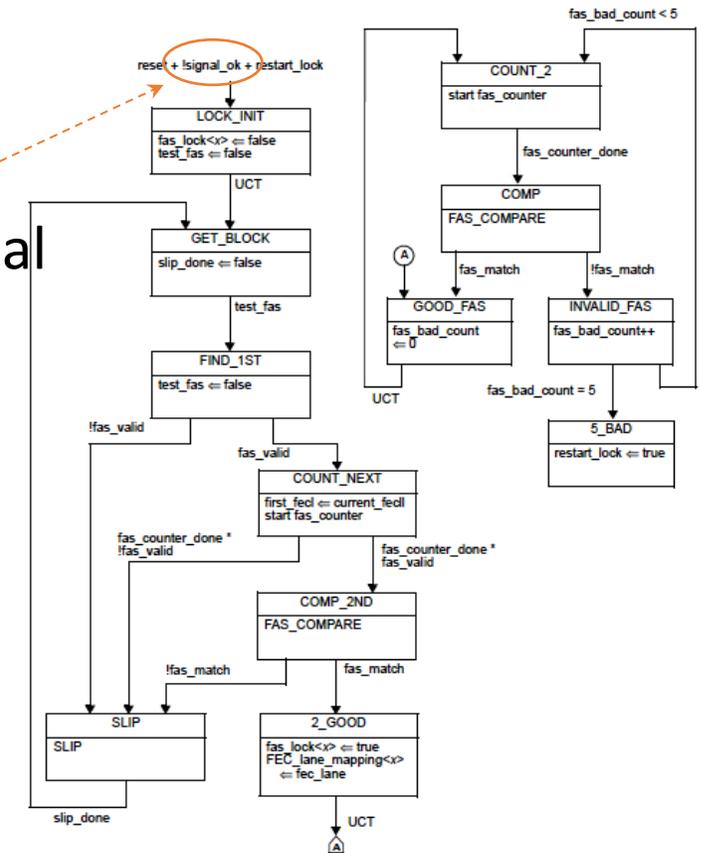


Figure 153-7—SC-FEC synchronization state diagram

Comments related to SIGNAL_DETECT

CI 154 SC 154.5.4 P104 L32 # 104

Maniloff, Eric Ciena
 Comment Type T Comment Status D

For the OSNR allowed by this specification, the integrated noise power after the demux may be only ~7dB lower than the signal power. As such a note in Table 154-5 indicating that SIGNAL_DETECT may not be a reliable indicator of the optical signal if average power detection is used should be added.

SuggestedRemedy

Add note to Table 154-5 indicating "For amplified systems using average power for Signal Detect, the Signal Detect value may not indicate FAIL when the Optical Signal is below its specified threshold in Table 154-9"

Proposed Response Response Status W

PROPOSED ACCEPT IN PRINCIPLE.
 For TF discussion.
 See resolution to comment #69.

CI 154 SC 154.5.4 P104 L43 # 80

Schmitt, Matt CableLabs
 Comment Type T Comment Status D

As pointed out in deandrea_3ct_01_200611, when an optical amplifier (EDFA) is a part of the black link, the noise floor could be amplified above the power threshold for signal detect. To account for that, while not mandatory, an implementer may wish to consider the presence of a valid 100GBASE-R signal in determining whether or not to set the SIGNAL_DETECT value to OK. Some additional text to point that out could be helpful for implementers.

SuggestedRemedy

At the end of the 3rd paragraph in 154.5.4, add an additional sentence that reads: "In addition, as the presence of optical amplifiers in the black link could raise the noise floor above the value of minimum average input power [unamplified] in Table 154-9, implementations may wish to consider the presence of a compliant 100GBASE-R signal in determining the setting of the SIGNAL_DETECT value.

Proposed Response Response Status W

PROPOSED ACCEPT IN PRINCIPLE.
 See resolution to comment #69.

CI 154 SC 154.5.4 P104 L32 # 69

Stassar, Peter Huawei
 Comment Type T Comment Status D

The signal_detect level of -30 dBm at TP3 is too low in the presence of optical noise (ASE) due to the presence of one (or more) optical amplifier(s) inside the black link. In order to get a sufficiently reliable signal_detect level in the case of amplified operation, this threshold should be increased to -23 dBm, which is still sufficiently below the Minimum average input power [amplified] of -16 dBm specified for the amplified operation. On the other hand for unamplified operation, being a side application supported by this specification, a signal_detect level of -30 dBm is right on the level of Minimum average input power [unamplified] of -30 dBm and therefore too high for the unamplified operation. Defining a single signal_detect level appropriate for both amplified and unamplified operation is therefore not possible. Because the amplified operation is the "normative" application consistent with the agreed objective of 80 km, this specification needs to focus on that application. A suitable signal_detect in an unamplified application should be addressed in a note.

SuggestedRemedy

In Table 154-5 modify the signal_detect level of -30 dBm to -23 dBm and address unamplified operation in a Note, with content TBD, pending further discussion

Proposed Response Response Status W

PROPOSED ACCEPT IN PRINCIPLE.
 For Task Force discussion.

CI 154 SC 154.5.4 P104 L32 # 105

Maniloff, Eric Ciena
 Comment Type T Comment Status D

Rather than Optical Power the Receive Condition should refer to Signal Power

SuggestedRemedy

Change "Average Optical" to "Optical signal"

Proposed Response Response Status W

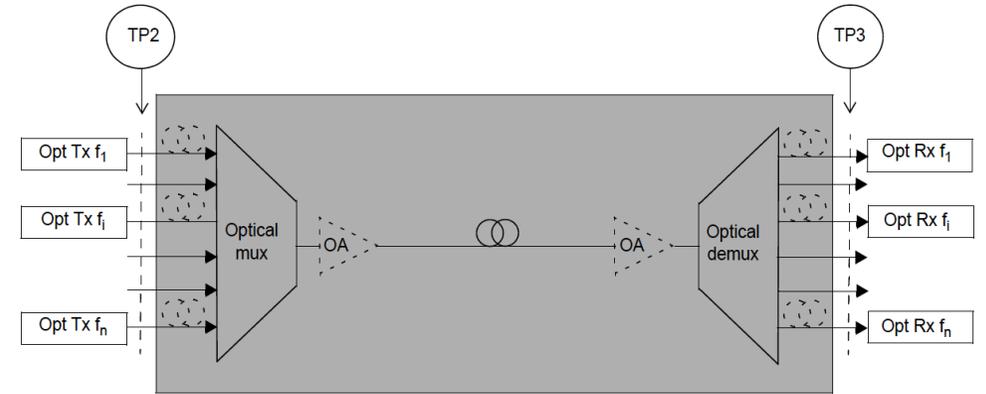
PROPOSED REJECT.
 The commenter has made insufficiently clear why changing "average optical power" to "optical signal power" resolves the issue, also raised in other comments, on SIGNAL_DETECT and how this would improve the quality of the draft.
 See also resolution to comment #69

Full Comment list on this topic: 111, 110, 69, 104, 105, 79, 80

Issues

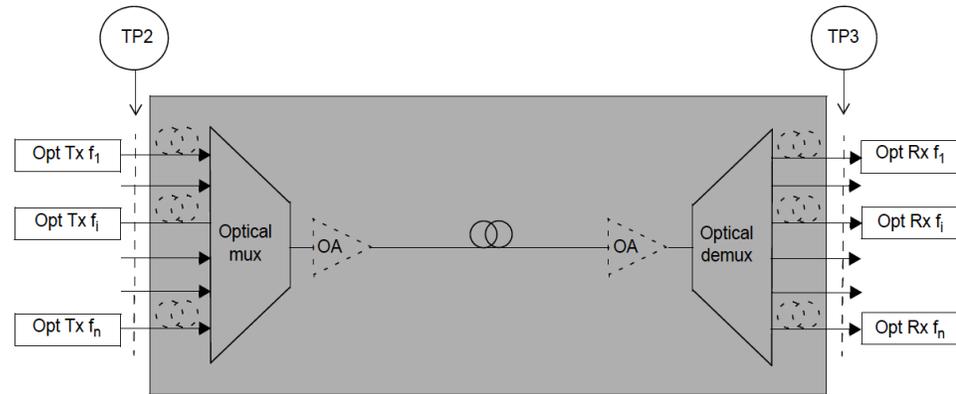
- For an amplified system, ASE may prevent Signal Detect from indicating Failure at the currently defined threshold of -30dBm
 - Complete loss of the transmit signal may leave SIGNAL_DETECT = OK
- 802.3ct includes both an amplified and unamplified specifications
 - The amplified application is the primary application with the objective of “supporting 100 Gb/s operation on a single wavelength capable of at least 80 km over a DWDM system”
 - Specifications are included in 802.3ct for an unamplified application → this is not intended to be a separate PMD.
 - The power and OSNR specifications are different for these two applications
 - If the signal detect threshold for the amplified system is increased, it may result in SIGNAL_DETECT = FAIL for an operational system meeting the unamplified specification

Total Power vs Signal Power



- The term "Total Average Power" is used to refer to the Total Power measured at TP3, such as by a power meter
 - This may include both the data signal and optical noise.
- The term "Signal Power" is used to refer to the average power of the data carrying signal

Amplified systems



- OSNR is the ratio of total signal power to noise in an 0.1 nm (12.5GHz) BW
 - Total Average Power at TP3 includes both the Optical Signal and ASE noise power
- The integrated noise power at TP3 is $10 \cdot \log_{10}(\text{Noise Spectral Width (GHz)}/12.5)$ higher than the noise in 12.5GHz BW
 - For example, for a 70GHz Demux BW: Total noise power is ~ 7.5 dB larger than the noise used to calculate OSNR
 - For an OSNR of 19.5dB/0.1nm (100GBASE-ZR min spec), the Noise Power for a 70 GHz demux BW is 12 dB lower than the signal power
 - Receive power range for 100GBASE-ZR (amplified) is from -16dBm to 0 dBm
 - For Total noise 12dB < Signal Power \rightarrow Noise Power is between -28 and -12dBm
- If total average power at TP3 is used for signal detect, Signal_Detect may indicate OK despite the signal power being less than -16dBm \rightarrow Setting the threshold for SIGNAL_DETECT close to the minimum Rx power spec reduces this probability
- Although Signal_Detect may fail to indicate the failure, digital framing will still alarm and condition properly
- Note: The concern here is SIGNAL_DETECT Failing to indicate an out of range Signal power

Signal Versus Average Power Detection

- Although total average power may not provide a reliable SIGNAL_DETECT indication, in coherent receivers the signal power is often measured independently
 - Signal Power in this context is the average optical power of the data signal, not including any additional sources of optical power (ie ASE, out of band channels' crosstalk, etc)
- Signal_Detect is intended to indicate the presence of the DWDM channel
- For cases where the receiver monitors both total and signal power, using signal power for SIGNAL_DETECT resolves the issue of ASE causing SIGNAL_DETECT to fail to indicate an out of range power
- SIGNAL_DETECT should be defined based on Signal Power, with total average power used only when necessary
 - Informative text indicating that “total integrated power may not indicate a fail condition reliably” should be added

Various implementations of the Signal Detect function are permitted by this standard, including implementations that generate the SIGNAL_DETECT parameter values in response to the average optical power of the modulated optical signal.

Amplified and Unamplified applications

- Rx Optical Power specs:
 - Amplified: -16dBm
 - Unamplified: -30dBm
- Rx OSNR specs:
 - Amplified: 19.5dB/.1nm
 - Unamplified: 35dB/.1nm
- A SIGNAL_DETECT level set higher than -30dBm may result in SIGNAL_DETECT = FAIL for an unamplified application operating within power specs
 - As currently defined, this would result in the traffic being squelched
- Even setting to -30dBm may result in a false fail for unamplified applications due to power monitor accuracy.

Unamplified applications

- In order to prevent traffic being removed from applications within operating specs there are several alternatives:
 1. Allow separate thresholds for SIGNAL_DETECT for the two applications
 2. Modify the behavior of SIGNAL_DETECT to prevent it from squelching traffic
 - SIGNAL_DETECT = FAIL would not map into LOCK_INIT in Figure 153-7 and related text
 3. Change definition of SIGNAL_DETECT to (Signal Power < threshold AND !all_locked)
- Note:
 - 1-3 are not mutually exclusive.
 - Monitor accuracy may be challenging covering the full power range for both applications.

Thanks!