FEC based AM unlock (Comment #??)

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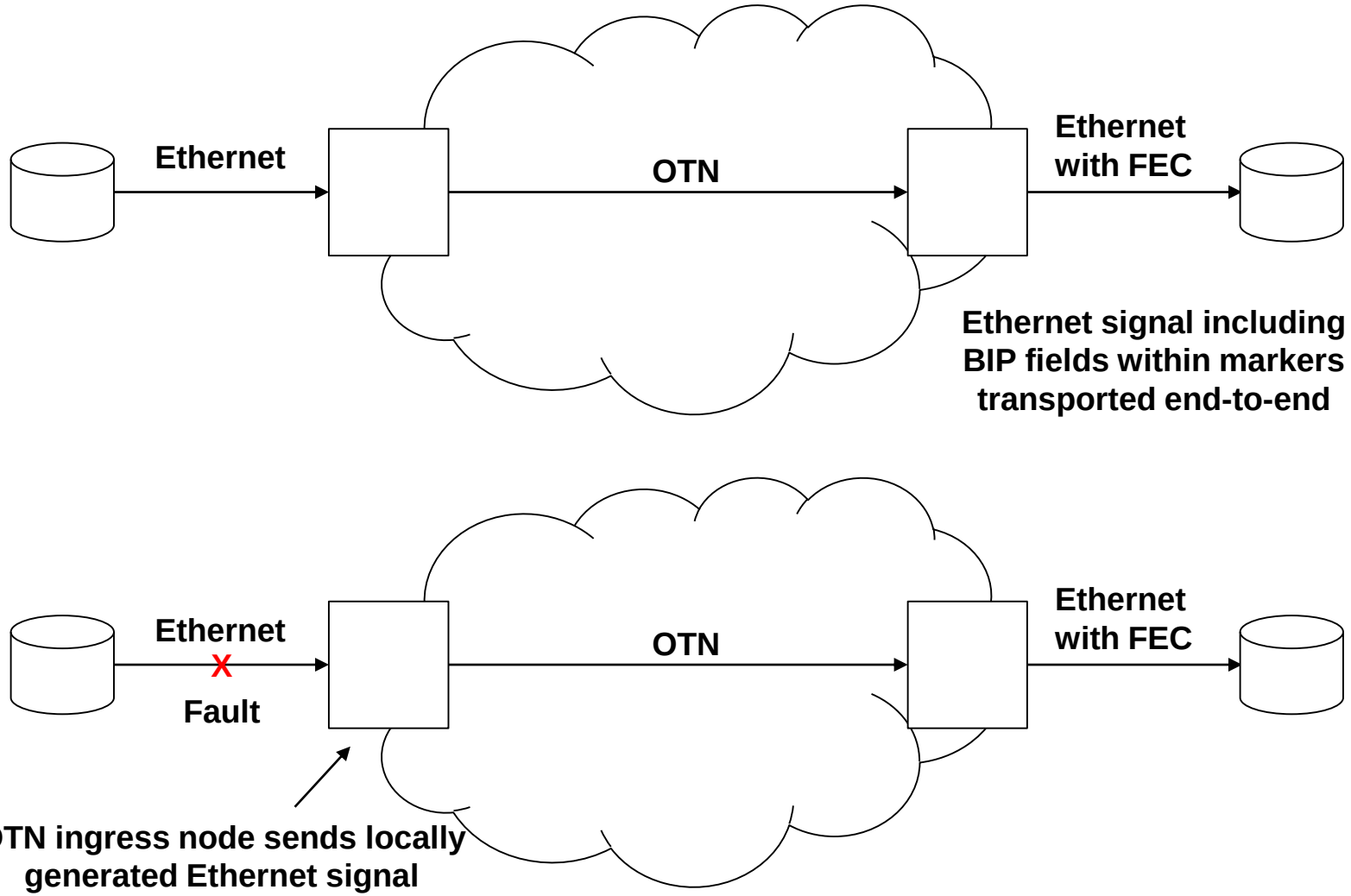
AM unlock

For the Clause 91 and Clause 119 FEC receivers, AM lock is found according to Figure 91-8 or Figure 119-12. These state machines look for two consecutive valid alignment markers in a row.

Once AM lock is achieved, these state machines did not continue to look at the AMs, but only go out of AM lock when 3 consecutive FEC codewords are uncorrectable (Figure 91-9 and Figure 119-13).

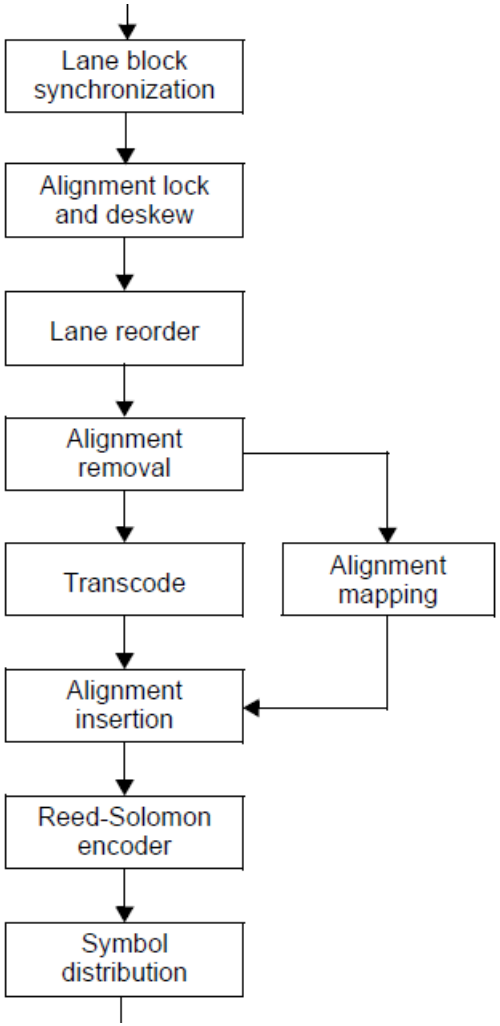
Ethernet signal transported via OTN



OTN egress node

When fault is repaired, signal here changes from Ethernet containing LF generated at ingress node to Ethernet from remote client

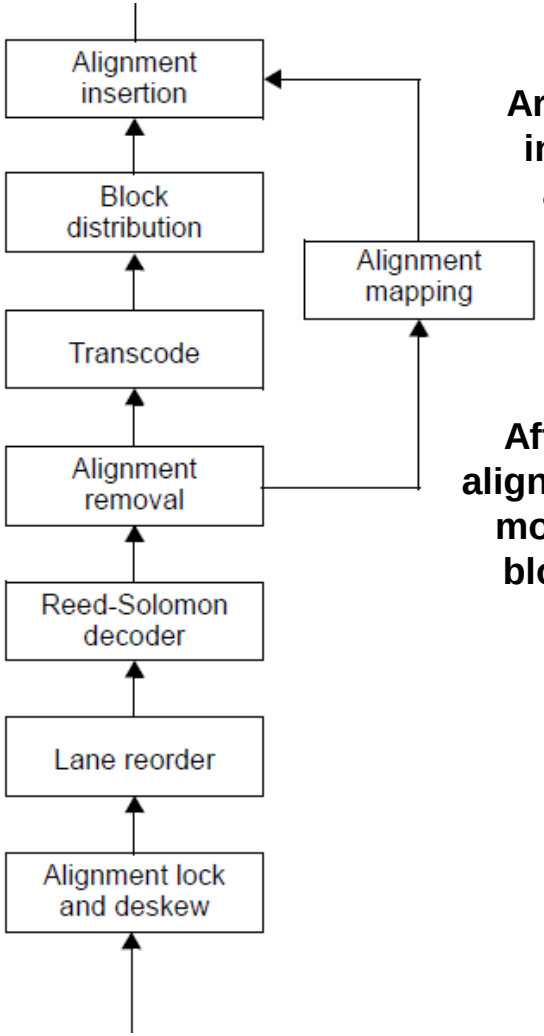
Position of the AMs in the two signals is different



Reed-Solomon encoder may continue to send valid codewords throughout transition

Ethernet receiver

PCS sees sync header violations from transcoder, an invalid BIP ratio of 0.996 and loses some frames, but the link stays up



Arbitrary BIP fields are inserted in corrected alignment markers

Transcoder "decodes" the AM block

After the transition, the alignment marker block has moved, so 5 transcoded blocks out of 81915 are removed

Reed-Solomon decoder see continuous stream of valid codewords

Alignment lock is only lost for 3 consecutive uncorrectable codewords

Implemented Solution for 802.3bs in Draft 2.1

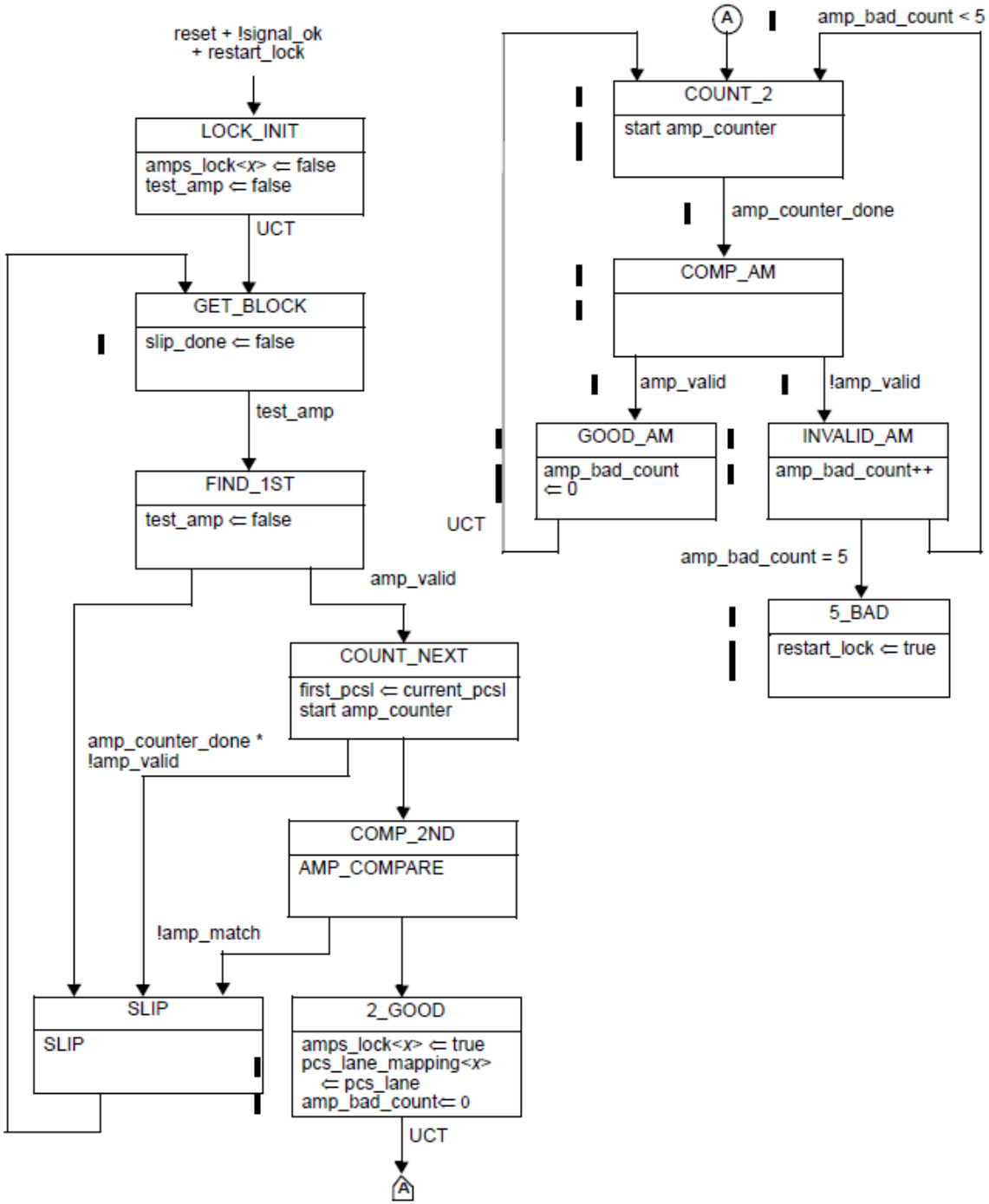


Figure 119–12—Alignment marker lock state diagram

Implemented Solution for 802.3bs Cont

restart_lock

Boolean variable that is set by the PCS alignment process to reset the synchronization process on all PCS lanes. It is set to true after 3 consecutive uncorrected codewords are received (3_BAD state) or when 5 Alignment Markers in a row fail to match (5_BAD state) and set to false upon entry into the LOSS_OF_ALIGNMENT state.

amp_bad_count

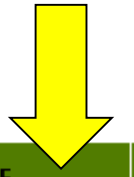
Counts the number of consecutive alignment markers that don't match the expected values for a given PCS lane.

119.2.6.3 State diagrams

The 200GBASE-R PCS shall implement eight alignment marker lock processes and the 400GBASE-R PCS shall implement sixteen alignment marker lock processes as depicted in Figure 119–12. An alignment marker lock process operates independently on each lane. The alignment marker lock state diagram shown in Figure 119–12 determines when the PCS has obtained alignment marker lock to the received bit stream for a given lane of the service interface. Each alignment marker lock process looks for two valid alignment markers $i \times 10$-bit Reed-Solomon symbols apart (on a per PCS lane basis, where $i = 139\,264$ for a 200GBASE-R PCS and $i = 278\,528$ for a 400GBASE-R PCS) to gain alignment marker lock. Once in lock, a lane goes out of alignment marker lock only when restart_lock is signaled. This occurs when the PCS synchronization process determines that three uncorrectable codewords in a row are seen, or when the alignment marker lock process sees five alignment markers in a row that fail to match the expected pattern on a given lane. When the alignment marker lock process achieves lock for a lane, and if a Clause 45 MDIO is implemented, the PCS shall record the number of the PCS lane received on that lane of the service interface in the appropriate lane mapping register (3.400 to 3.415).

Why Look for 5 in a row?

- **Wanted to reuse pre FEC AM detection logic**
- **Triggering after 5 mismatches in a row give you a mean time to false unlock of > AOU**



Scheme		A	B	C	D	E	F	G	H	I
MTTFU	Years	1.1e7	5.2e8	2.0e8	3.2e9	5.8e12	3.5e13	5.5e14	2e16	1.1e39
	AOU	8e-4	3.8e-2	1.4e-2	2.3e-1	4.2e2	25e3	4.0e4	1.45e6	8.0e28
Pre/Post FEC		Post One Lane	Pre All Lane	Pre Any Lane	Pre One Lane	Pre All lane	Pre Any Lane	Pre One Lane	Post One Lane	Post One Lane
Number of AM checked		2	5	4	4	6	5	5	3	2
Mechanism Details		No FEC Decode Failure check							No FEC Decode Failure check	With FEC Decode Failure Check
Pros								Easy		
Cons				One bad Lane	One bad Lane		More counters			Works for FEC Mode A only
		← Shorter than AOU				Longer than AOU →				

More Notes

A Maintenance request has been submitted to add an optional state machine change to Clause 91 for 802.3bj interfaces in 802.3-2015

I will submit a comment to make mandatory changes to Clause 91 and Clause 134 for 802.3cd interfaces

Comment #143 against 802.3bs D2.1 suggests a small tweak to the SM to make it identical to the version that is submitted against 802.3-2015

Thanks!