SEND_S – ‘mode’ vs. ‘signal’ reconciliation

IEEE P802.3ch Multigig Automotive Ethernet PHY Task Force

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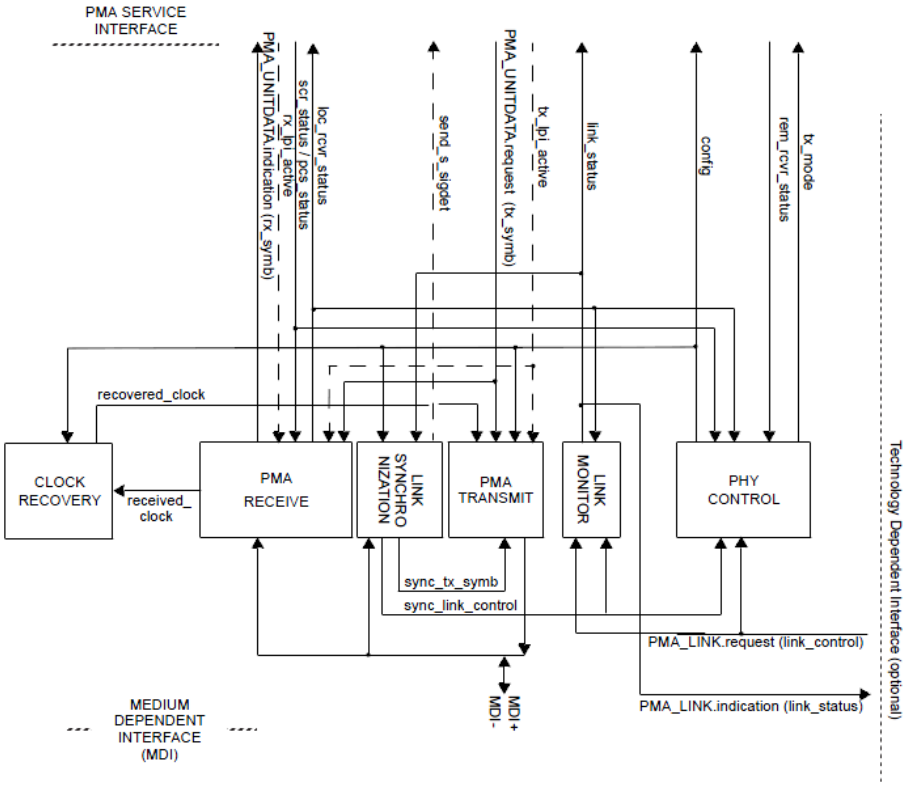
Action Item

- Editor's note flagged review of SEND_S
  - Used as a name for a signal pattern, primarily used for Link Synchronization in most places
  - Described as a transmitter 'mode' in 149.5.2.5
- Reviewed all occurrences of "send_s" (case insensitive).
  - Results attached with recommendation on each
- Most references to send_s are as a signal
  - Minor language clean up, clean up in 149.5.2.5
- Review uncovered root cause is in Link synchronization state diagram
  - Link synchronization signalling isn't properly communicated to the PMA PHY control
    - Also an issue in text of Clause 97

Link Synchronization and Transmitter

- Link Synchronization is a separate function from PMA Transmit
  - When Link Synchronization is active, PMA Transmit takes sync_tx_symb as input
    - This passes SEND_S and SEND_Z to the PMA Transmitter

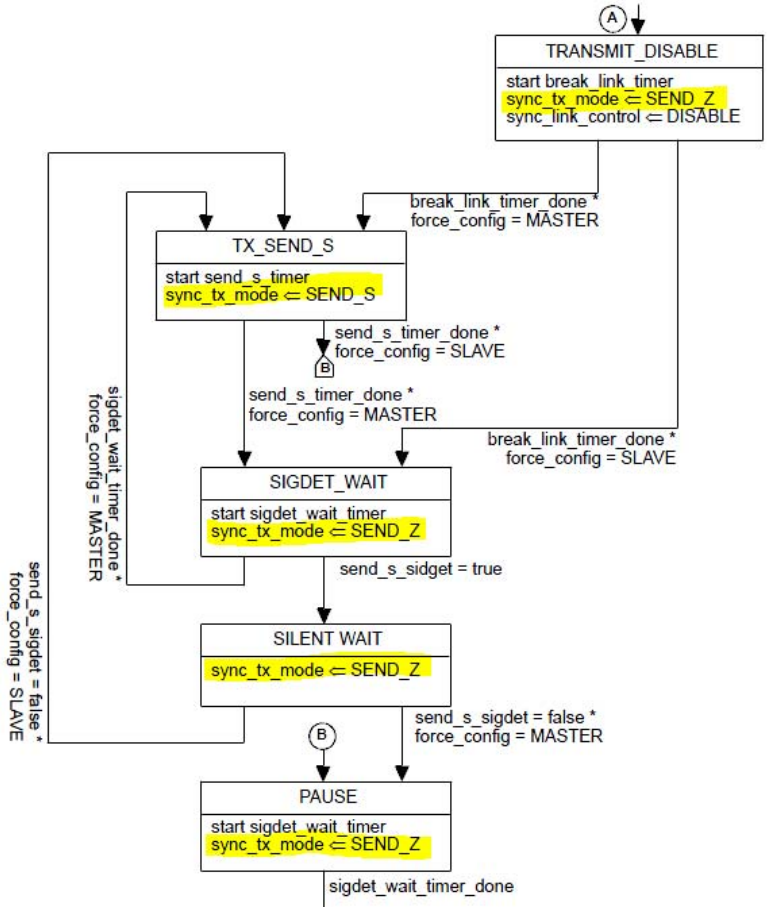


NOTE—The recovered_clock arc is shown to indicate delivery of the recovered clock signal back to PMA TRANSMIT for loop timing.

Figure 149–26—PMA reference diagram

Confusion in Link Synch & PHY control

- SEND_S and SEND_Z are set in sync_tx_mode
  - Defined as a variable in the state diagram
  - NEVER used (only set) and not sent to the PHY control
- sync_tx_symb is NEVER set in the state diagram
  - Defined as the message in the primitive and used in the PHY Control diagram
- Solution:
  - Set sync_tx_symb, eliminate sync_tx_mode



Excerpt from PHY Link Synchronization state diagram

New Description of synch_tx_symb

Replace:

“A signal sent from Link Synchronization block to PMA Transmit indicating that a PAM2 (SEND_S) or zero (SEND_Z) symbol is available.” (P143 L47-48)

With (modified text from P143 L21-25):

“The value of sync_tx_symb is set by the Link Synchronization state diagram and indicates the symbols sent from the PHY Link Synchronization block to PMA Transmit.

Values:

SEND_S: this value is asserted to enable transmission of the SEND_S signal defined in 149.4.2.6.

SEND_Z: this value is asserted to disable transmission (send zero).”

Miscellaneous other fixes

- Major fixes related to ‘mode’ are highlighted orange:
  - Fix the synch_tx_symb / synch_tx_mode issue
  - Realign language in 149.5.2.5
- Minor fixes:
  - Consistent language describing SEND_S as a ‘signal’ (not pattern or mode, but signal)
  - Full description of all Link Synch does with SEND_S

Detail of references (1 of 4)

References to SEND_S (case insensitive) and recommended action				
Page	Subclause - title	Text in draft1p2	Description of usage	Recommendation
71	Figure 149–2—Functional block diagram	send_s_sigdet	Name of signal indicating that the SEND_S signal has been detected	No change needed - SEND_S is a signal
96	149.3.2.3 PCS Receive function	synchronization detect asserts send_s_sigdet to indicate that the alert (link synchronization)	Name of signal indicating that the SEND_S signal has been detected	No change needed - SEND_S is a signal
134	Figure 149–26—PMA reference diagram	send_s_sigdet	Name of signal indicating that the SEND_S signal has been detected	No change needed - SEND_S is a signal
138	149.4.2.4.6 Data Switch partial PHY frame Count (Editor's note)	removed for D1.3: SEND_S is both the name of a mode and a	Editor's note describing this action to take place	Delete editor's note
141	149.4.2.6 PHY Link Synchronization	When operating, the Link Synchronization function is the data source for the PMA Transmit function (see 149.4.2.2), and generates a signal, SEND_S, used by the MASTER and SLAVE to discover the link partner and synchronize the start of PMA training.	Describes the usage of the SEND_S signal, but suggests that the Link Synchronization function is only responsible for generating SEND_S, and nothing else. It generates SEND_S, detects it, and goes to quiet states as necessary. A better description is that it "uses" SEND_S.	P141 L7: Change "generates" to "uses"
141	149.4.2.6 PHY Link Synchronization	frequency of the SEND_S signal shall be 703.125 MHz. Link Synchronization employs the	Describes the frequency of the SEND_S signal	No change needed - SEND_S is a signal
141	149.4.2.6 PHY Link Synchronization	Synchronization employs the SEND_S signal to achieve synchronization prior to link training. If	Describes the usage of the SEND_S signal	No change needed - SEND_S is a signal
141	149.4.2.6 PHY Link Synchronization	MASTER and SLAVE PHY SEND_S PN sequence generators by linear-feedback shift registers is	Describes the PN generators used in generating the SEND_S signal	No change needed - this is the name of the figure.
141	149.4.2.6 PHY Link Synchronization	separate periods of SEND_S. For 10GBASE-T1, the bit Sn[0] shall be	Describes the usage of the SEND_S signal.	Change "separate periods of SEND_S" on P141 L41 to "separate periods of the SEND_S signal."
142	Figure 149–31—SEND_S PN sequence generator by linear feedback shift registers Sn	Figure 149-31 SEND_S PN sequence generator by linear feedback shift registers Sn	Describes the PN generators used in generating the SEND_S signal	No change needed - describes figure related to SEND_S signal
142	Figure 149–31—SEND_S PN sequence generator by linear feedback shift registers Sn	MASTER PHY SEND_S PN sequence generator	Describes the PN generators used in generating the SEND_S signal	No change needed - describes figure related to SEND_S signal
142	Figure 149–31—SEND_S PN sequence generator by linear feedback shift registers Sn	SLAVE PHY SEND_S PN sequence generator	Describes the PN generators used in generating the SEND_S signal	No change needed - describes figure related to SEND_S signal
143	149.4.2.6.1 State diagram variables	send_s_sigdet	Name of signal indicating that the SEND_S signal has been detected	No change needed - SEND_S is a signal
143	149.4.2.6.1 State diagram variables	This variable indicates whether the SEND_S pattern was detected.	Describes the detection of the SEND_S signal	Change "pattern" to "signal" to be consistent with earlier text (P 143 L8)

Detail of references (2 of 4)

143	149.4.2.6.1 State diagram variables	TRUE: SEND_S pattern detected.	Describes the detection of the SEND_S signal	Change "pattern" to "signal" to be consistent with earlier text (P 143 L11)
143	149.4.2.6.1 State diagram variables	FALSE: SEND_S pattern not detected.	Describes the detection of the SEND_S signal	Change "pattern" to "signal" to be consistent with earlier text (P 143 L12)
143	149.4.2.6.1 State diagram variables	SEND_S: this value is continuously asserted to enable transmission of	The variable this refers to (sync_tx_mode) is not exported or otherwise used, and is the primary source of the "mode vs. signal" confusion. - See fixes below relating to sync_tx_mode and sync_tx_symb. While the text describes the SEND_S signal, it is not quite correct - first, values of variables are not "continuously asserted", especially when the state diagram can change them, and second, while the PN sequence and the SEND_S sequence end up the same, because this goes to the transmitter at the PHY baud rate, the transmitted sequence is more correctly the SEND_S signal defined in 149.4.2.6.	Deleted with deletion of sync_tx_mode in changes below, and fixed in replacement.
143	149.4.2.6.2 State diagram timers	send_s_timer This timer is used to control	Describes transmission of the SEND_S signal	No change needed - SEND_S is a signal
143	149.4.2.6.2 State diagram timers	control the duration SEND_S is transmitted. The timer shall expire 1.25	Describes transmission of the SEND_S signal	No change needed - SEND_S is a signal
143	149.4.2.6.2 State diagram timers	the end of SEND_S. The timer shall expire	Describes transmission or reception of SEND_S signal	No change needed - SEND_S is a signal
143	149.4.2.6.3 Messages	A signal sent from Link Synchronization block to PMA Transmit indicating that a PAM2 (SEND_S) or zero (SEND_Z) symbol is available. The Link Synchronization block generates sync_tx_symb synchronously with every transmit clock cycle.	Describes the SEND_S signal as PAM2, but isn't correct in its function. sync_tx_symb doesn't just indicate that a symbol is available, it communicates the value of the symbol to the PMA transmit function. It has two values "SEND_S" and "SEND_Z". In fact, it appears that this is really what sync_tx_mode is supposed to be.	No change needed - SEND_S is a signal
144	Figure 149–32—PHY Link Synchronization state diagram	TX_SEND_S	Name of state where SEND_S signal is sent	No change needed - SEND_S is a signal
144	Figure 149–32—PHY Link Synchronization state diagram	start send_s_timer	Name of timer in state diagram	No change needed - SEND_S is a signal
144	Figure 149–32—PHY Link Synchronization state diagram	SEND_S	Name of SEND_S	No change needed - SEND_S is a signal

Detail of references (3 of 4)

144	Figure 149–32—PHY Link Synchronization state diagram	config = MASTER send_s_sigdet = false * force_config = SLAVE	Name of signal indicating that the SEND_S signal has been detected	No change needed - SEND_S is a signal
144	Figure 149–32—PHY Link Synchronization state diagram	send_s_timer_done * force_config = MASTER	Name of timer in state diagram	No change needed - SEND_S is a signal
144	Figure 149–32—PHY Link Synchronization state diagram	send_s_timer_done * force_config = SLAVE	Name of timer in state diagram	No change needed - SEND_S is a signal
144	Figure 149–32—PHY Link Synchronization state diagram	send_s_sidget = true	Name of signal indicating that the SEND_S signal has been detected	No change needed - SEND_S is a signal
144	Figure 149–32—PHY Link Synchronization state diagram	send_s_sigdet = false * force_config = MASTER	Name of signal indicating that the SEND_S signal has been detected	No change needed - SEND_S is a signal
155	149.5.2.5 Transmitter peak differential output	transmit modes including SEND_S, SEND_T, and SEND_N modes.	Text says "transmission modes", but really refers to all symbol sequences, and incorrectly calls these "modes".	P155 L36: Change "This limit applies to all transmit modes including SEND_S, SEND_T, and SEND_N modes." to "This limit applies to all transmitted symbol sequences, including SEND_S, SEND_T, and SEND_N."
		References to tx_symb_mode or sync_tx_symb (case insensitive) and recommended action		
Page	**Subclause - title**	**Text in draft1p2**	**Description of usage**	**Recommendation**
143	149.4.2.6.1 State diagram variables	sync_tx_mode This variable indicates what symbols are sent by the PHY Link Synchronization process.	Variable definition - but unused anywhere	Delete definition and variable. Replace variable in state diagram as below. Move description to description of sync_tx_symb as below.
144	Figure 149–32—PHY Link Synchronization state diagram	sync_tx_mode <= SEND_Z	sets transmission to be SEND_Z	Change all references in Figure 149-32 from "sync_tx_mode" to "sync_tx_symb"
144	Figure 149–32—PHY Link Synchronization state diagram	sync_tx_mode <= SEND_Z	sets transmission to be SEND_Z	Change all references in Figure 149-32 from "sync_tx_mode" to "sync_tx_symb"
144	Figure 149–32—PHY Link Synchronization state diagram	sync_tx_mode <= SEND_S	sets transmission to be SEND_S	Change all references in Figure 149-32 from "sync_tx_mode" to "sync_tx_symb"
144	Figure 149–32—PHY Link Synchronization state diagram	sync_tx_mode <= SEND_Z	sets transmission to be SEND_Z	Change all references in Figure 149-32 from "sync_tx_mode" to "sync_tx_symb"
144	Figure 149–32—PHY Link Synchronization state diagram	sync_tx_mode <= SEND_Z	sets transmission to be SEND_Z	Change all references in Figure 149-32 from "sync_tx_mode" to "sync_tx_symb"
71	Figure 149–2—Functional block diagram	sync_tx_symb	Shows sync_tx_symb going from Link Synchronization to PMA Transmit	No change needed
95	149.3.2.2.21 EEE capability	block via sync_tx_symb. The quiet-refresh cycle is repeated until codewords	Describes usage of sync_tx_symb during ALERT transmission	No change needed
134	Figure 149–26—PMA reference diagram	sync_tx_symb	Shows sync_tx_symb going from Link Synchronization to PMA Transmit	No change needed
135	149.4.2.2 PMA Transmit function	not implemented, the sync_tx_symb output by the PHY Link Synchronization function shall	Shows sync_tx_symb as the source for the transmitter	No change needed

Detail of references (4 of 4)

143	149.4.2.6.1 State diagram variables	DISABLE: The data source is the PHY Link Synchronization function (sync_tx_symb).	(definition of variable sync_link_control) - sync_tx_symb as the source for the transmitter	No change needed
143	149.4.2.6.1 State diagram variables	sync_tx_symb A signal sent from Link Synchronization block to PMA Transmit indicating that a PAM2 (SEND_S) or zero (SEND_Z) symbol is available.	States that sync_tx_symb only indicates that a symbol is available, not that it is the source. Not set or referenced in the state diagram. Needs to be changed so that the state diagram sets its value, and values are defined.	P143 L47-48: Replace "A signal sent from Link Synchronization block to PMA Transmit indicating that a PAM2 (SEND_S) or zero (SEND_Z) symbol is available. " with: (modified text from P143 L21-25) "The value of sync_tx_symb is set by the Link Synchronization state diagram and indicates the symbols sent from the PHY Link Synchronization block to PMA Transmit. Values: SEND_S: transmit the SEND_S signal defined in 149.4.2.6. SEND_Z: : transmit a zero value."
143	149.4.2.6.1 State diagram variables	The Link Synchronization block generates sync_tx_symb synchronously with every transmit clock cycle.	Gives timing for the sync_tx_symb	No change needed