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SAS-2 Speed Negotiation T10/06-295r1

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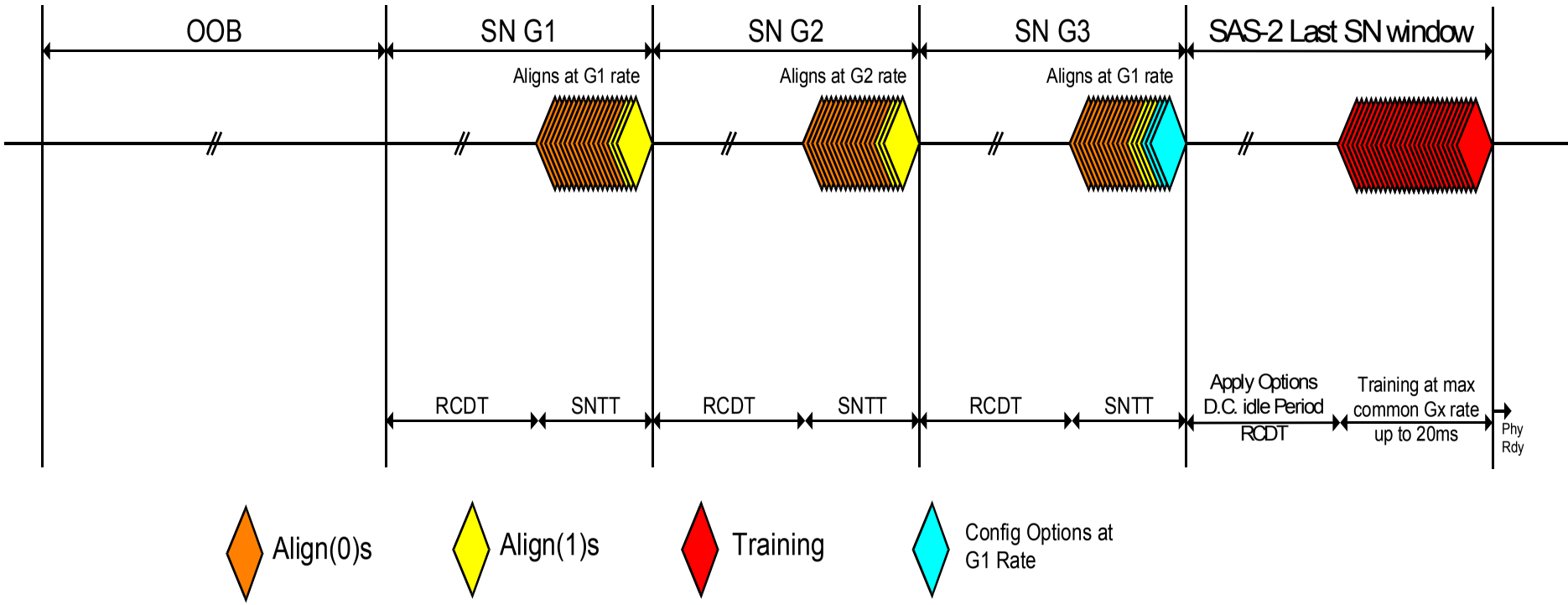
Changes to Speed Negotiation G3 window

- Suggested details proposed to use G1 rate during G3 window.



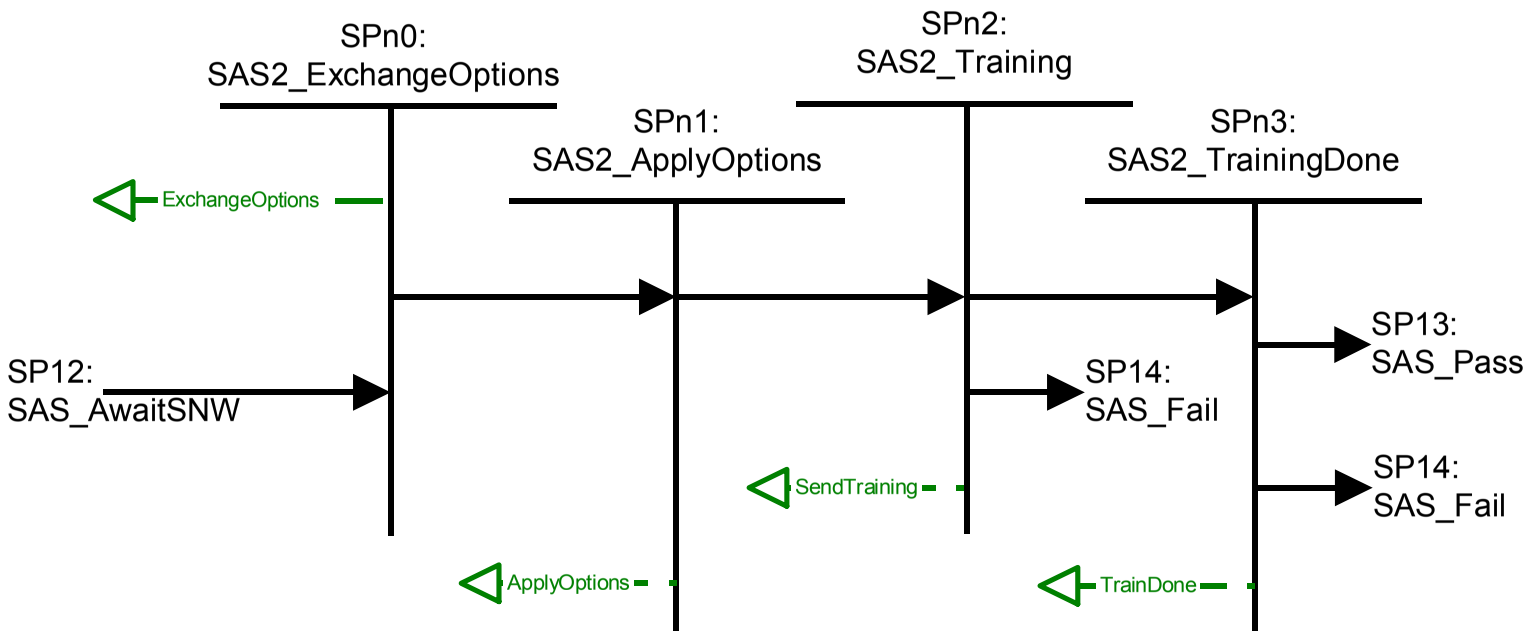
Changes to Speed Negotiation G3 window and the next window

- Sends ALIGNs at G1 rate during G3 window to establish DW sync.
- Sends configuration options that include:
  - SSC support: Down, Symmetric, None
  - Physical rates: rates supported
  - Possibly other options can be defined later.
- In the window next to G3, a squelch period is provided to apply configuration settings.
- Training is done at the highest speed negotiated Gx. It is used to achieve both bit lock and DWORD sync.

SAS-2 SP state machine changes

- Changes to existing SP state machine:
  - SP8:SAS_Start must now send a Set Rate message to the transmitter indicating 1.5G when the speed negotiation window is G3.
  - SP12:SAS_AwaitSNW should transition to new states (next slides) instead of to SP13 if the speed negotiation window is G3.
- Note that the global reset transitions have been omitted on following slides and descriptions

SAS-2 SP state machine changes (continued)



SPn0:SAS2_ExchangeOptions

- During this state, the transmitter shall send the a PHYS frame describing the capabilities of the phy (i.e. rates supported, SSC settings) followed by ALIGN(1)s until the SNTT timer expires.
- The receiver shall monitor the incoming data for such options received from the remote phy.
- Once the SNTT timer has expired, the state machine shall transition to SPn1:SAS2_ApplyOptions
- The ‘final negotiation window’ flag shall be set as well

PHYS Address Frame

Byte\Bit	7	6	5	4	3	2	1	0
0	Reserved				ADDRESS FRAME TYPE (2h)			
1	Reserved							
2	PHYSICAL LINK RATES SUPPORTED							
3	RX SPREAD SPECTRUM CLOCKING SUPPORTED							
4	TX SPREAD SPECTRUM CLOCKING SUPPORTED							
5	CURRENT TX SPREAD SPECTRUM CLOCKING							
6	Reserved							
27								
28	(MSB)							
31	CRC							(LSB)

- As proposed in T10/06-301r0
- Link rates and SSC support are bit encoded.

SPn1:SAS2_ApplyOptions

- The ApplyOptionsT timer shall be started, and the phy shall be configured according to its capabilities and the capabilities of the remote phy.
- Since this configuration will generally affect analog gain settings, timing, clock recovery, etc…, it is not expected that DWS will be maintained and the transmitters should return to DC Idle.
- Once the ApplyOptionsT timer has expired, the devices should transition to SPn2:Training

SPn2:SAS2_Training

- During this state, the transmitter shall send a periodic pattern at the agreed-upon rate, intended to allow analog circuits to train.
- State timer TrainingT shall be started with duration of 20ms.
- Suggest the 05-397r3 proposal pattern of 4 Dwords (160 bits) of a new primitive $TRAIN_P$ (K28.5 D30.3 D30.3 D30.3) followed by 40 Dwords (1600 bits) of scrambled pseudo-random data.
- Once the analog circuitry has sufficiently trained, transition to SPn3:SAS2_Training_Done. This is similar to the ALIGN0/ALIGN1 handshaking.
- If the timer expires before training has completed, transition to SP14:SAS_Fail.

SPn3:SAS2_Training_Done

- During this state the transmitter shall send the training pattern, except that $TRAIN_P$ is replaced with $TRAIN\_DONE_P$ (K28.5 D30.3 D30.3 D10.2)
- If the state machine both sees and sends $TRAIN\_DONE_P$, transition to SP13:SAS_Pass. Since this has been flagged as the final speed negotiation window, it will transition to SP15:SAS_PHY_Ready.
- If the timer TrainingT expires instead, transition to SP14:SAS_Fail

SAS-2 SP state machine changes (continued)

- What happens if we fail?
  - Repeated fails (through SP14:SAS_Fail) should cause the highest available rate to be removed from the ‘supported’ rates list.
  - Possibly also downgrade other capabilities (SSC, etc) for greater reliability.

Concerns

- Even though the SAS-1.1 spec does not call for any detection in G3 window for those device that do not support it, some legacy devices may behave incorrectly when they see G1 traffic in G3 window.
  - May restart the whole sequence seeing an unexpected rate.
  - May actually lock with align(0) and (1) at G1 rate and confuse the SAS-2 device into moving to the new window.

Open Questions

- Would legacy devices have an issue with seeing G1 ALIGNs in the G3 window?
  - By spec, they should be ignoring the received data during SP9:SAS_RateNotSupported
  - No one is concerned so far.
- How do we make sure PHYS frame is robustly received?
  - Force transition into SPn0:SAS2_ExchangeOptions to be after SNLT expires.
  - Or repeat transmission of PHYS frame until SNTT expires
  - Or transmit PHYS frame repeatedly at the beginning of final SNW
- Reasonable values for the new timers: ApplyOptionsT, TrainingT?
  - ApplyOptionsT: RCDT seems enough. TrainingT: 20ms
  - May want a microprocessor to control certain aspects of configuration once PHYS address frame is received.
- Do we need to specify how the negotiated options are selected from the capabilities presented in the PHYS frame and how they are down graded in case of negotiation failure? Concern of orthogonal downgrades.

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