Upstream Burst Delimiter and Sync Pattern Assignment

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Background / 1

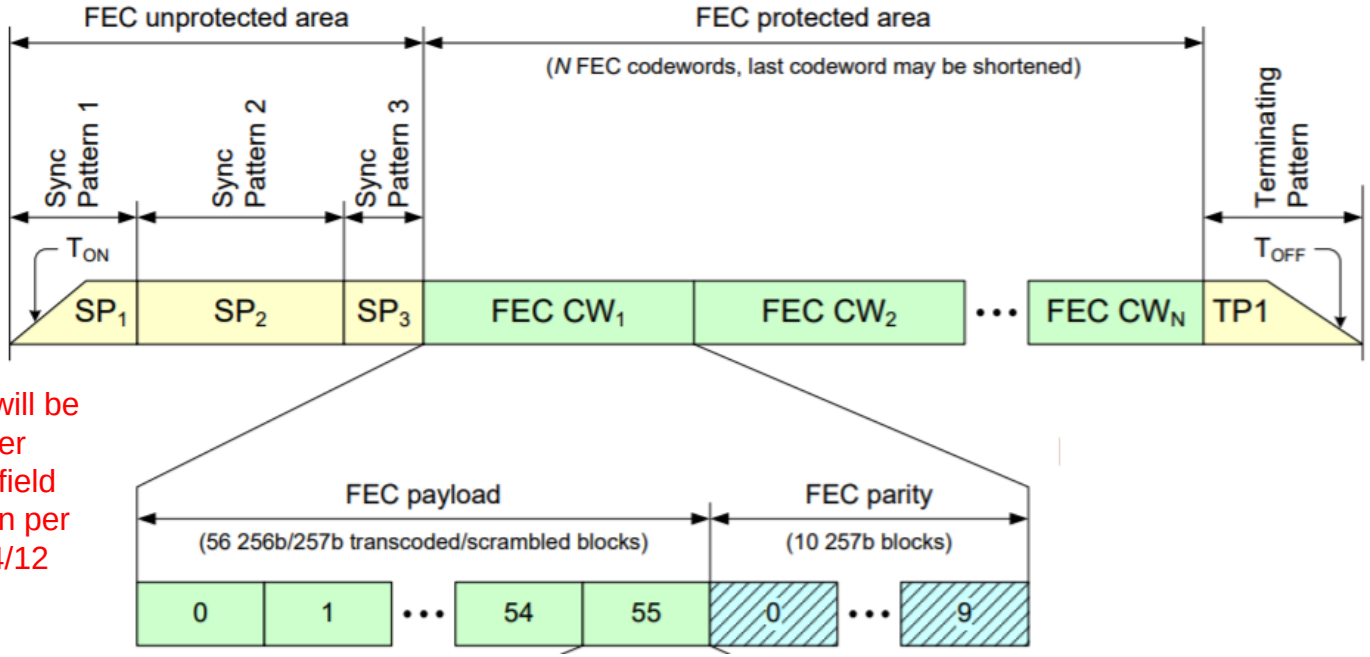
- In January 2018, contributions on upstream burst delimiter selection were revised (kramer_3ca_2_0118.pdf, effenberger_3ca_1_0118.pdf, and hajduczenia_3ca_1_0118.pdf). There was agreement that different OLT Rx implementations may need different Sync Pattern (SP) and Start of Burst Delimiter (SBD) delimiter patterns to optimize burst reception process
- Irrespective of actual SP and SBD values, as long as sufficient Hamming distance is guaranteed, MTT for false burst lock and burst loss can be guaranteed.
- New MPCPDU(s) needed to broadcast SP and SBD pattern values to all ONUs on PON

Background /2

- OLT announces SP and SBD pattern values to ONUs during initial MPCP Discovery process to be used in the upstream direction.
- ONU always uses SP/SBD values announced by OLT during Discovery.
- OLT uses default SP/SBD values unless different values are specified by the vendor. Default values (see next slide for SP1/2/3 definitions):
  - SP1 (AGC): TBD
  - SP2 (CDR): TBD
  - SP3 (SBD): TBD

Burst structure

Image source: kramer_3ca_2_0318.pdf#6



NOTE: Figure will be updated to better represent SP1 field and its definition per discussion on 4/12 call

- Three separate portions of FEC unprotected area: SP1 (for AGC), SP2 (for CDR), and SP3 (SBD = Start Burst Delimiter)
- SP1, SP2, and SP3 value may be different, as elected by OLT, to optimize given function (AGC, CDR, SBD)
- Each block length is multiple of 257 bits (block quanta)
- End Burst Delimiter (EBD) is not variable (defined in spec)

Parameters Needed

- OLT announces values for SP1, SP2, and SP3 = three independent parameters. Each parameter is announced once, before the Discovery GATE, with value lengths in multiples of 257-blocks.
- OLT may announce different SP1/2/3 field length for discovery (longer) and regular (shorter) operation to optimize discovery and regular granting
- SBD needs to support minimum Hamming distance of X (e.g., 110 for 257-bit SBD pattern)
- New MPCPDU needed to carry each value separately
  - Single MPCPDU has 40-octet payload available (see Figure 144–4 in D1.0). Details on mapping SP pattern on next slides
- EBD uses 1 x 257-bit block of all zeros (similar to 10G-EPON)

SYNC_PATTERN MPCPDU / 1

- Used to announce the value of Synchronization Pattern (SP) to all ONUs on PON
  - Opcode 0x0018 (next available)
  - Bits 1 through 256 (they are scrambled and encoded together) of Sync Pattern saved into 32-octets wide data field *Sync Pattern*, right adjusted. Bit 0 of Sync Pattern saved into *SP Info* field (see next slide for details).
  - This arrangement saves on bit-level operations on MPCPDU and separates scrambled and encoded portion of pattern from bit 0 (pass-through)
  - Same encoding used for SP1, SP2, and SP3 fields

Octet	Value (binary)
0	SP<8:1>
...	...
30	SP<248:241>
31	SP<256:249>

SYNC_PATTERN MPCPDU / 2

- *SP Info* carries information on SP pattern in this MPCPDU:
  - Bit 0-1: SP Index (value 1, 2, 3), indicating which SP period is carried in this SYNC_PATTERN message (SP1/2/3)
  - Bit 3-4: SP Count (value 2 or 3), indicating how many SYNC_PATTERN messages are expected in announcement sequence
  - Bit 7: SP Balanced: 1 = balanced, 0 = unbalanced (see slide 8)
  - Bit 15: SP bit 0 (first bit of the SP sequence)
  - Other bits reserved / set to 0 on transmit
- *Discovery Repeat* indicates how many times the given 257-bit SP field is transmitted during Discovery Window transmission. Max 2^{16}-1 = 65535
- *Granting Repeat* indicates how many times the given the given 257-bit SP field is transmitted during regular granting operation. Max 2^{16}-1 = 65535

SYNC_PATTERN MPCPDU

Destination Address	6
Source Address	6
Length/Type = 0x8808	2
Opcode = 0x0018	2
Timestamp	4
SP Info	2
Sync Pattern (SP)	32
Discovery Repeat	2
Granting Repeat	2
Padding	1
FCS	4

SYNC_PATTERN MPCPDU / 3

- Separate **Discovery Repeat** and **Granting Repeat** fields allow for different burst preamble lengths during discovery and regular operation.

- Balanced bit sequence may be more suitable for some OLT Rx implementations. But 257-bit pattern cannot be perfectly balanced. When the **SP Balanced** bit is set to one, rather than repeating SP+SP…SP N times, the ONU shall alternate SP and its inverted value $\overline{SP}$ N times (SP+$\overline{SP}$+SP+$\overline{SP}$…).

OLT Behavior

- OLT announces SP values using SYNC_PATTERN MPCPDU before issuing DISCOVERY GATE MPCPDU
- SYNC_PATTERN MPCPDUs are sent on broadcast PLID.
- Each SP value is announced using a separate SYNC_PATTERN MPCPDU.
- The OLT may announce 2 or 3 SP values (as indicated by SP Count field):
  - **SP Count = 3**: SP1 for AGC, SP2 for CDR, and SP3 for SBD
  - **SP Count = 2**: SP1 for AGC+CDR, SP2 for SBD.
- OLT may announce different SP values (or even different counts of SP values) for different discovery attempts.

ONU Behavior

- Unregistered ONUs always process and store the last-announced SP values (SP values may change from one discovery attempt to another).
- ONUs do not validate the SP values or acknowledge the SYNC_PATTERN MPCPDUs received from the OLT.
- An unregistered ONU shall not respond to a DISCOVERY GATE MPCPDU until a full set the SP values (as indicated by SP Count field) is received from the OLT.
- Once registered, ONU stops listening and acting on SYNC_PATTERN MPCPDUs. The registered ONUs continue to use SP values that they stored at the registration time.