40/100 GbE PCS/PMA Testing

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PCS Testing Background- 10GBASE-R

- 10GBASE-R has the following test patterns that can be generated:

    Square wave (required, only used for tx test)

    > In KR it is used for equalization training also (a high freq and lower freq version).

    Pseudo-random (required, output of scrambler)

    PRBS31 (optional)

- These are used for optical testing and conformance

PCS Testing Background – 10GBASE-R

- Square wave details

  n ones followed by n zeros, 4 <= n <= 11

  KR has 8 <= n <= 11

  No sync bits

- Pseudo-random details

  Output of scrambler, where seed changes every 128 66b blocks

  Seed is A, Invert A, B, Invert B (A and B are programmable)

  Receiver expects 1 block error every 128 blocks (while syncs up to new seed)

  128 chosen to allow off shelf BERT devices to lock up

  Included is the '10' sync bits

- PRBS31 details

  $1 + x^{28} + x^{31}$

  Any seed is fine as long as it is not zero

  No sync bits

Testing for 40/100Ge

- The square wave test is used for OMA measurements today

    If we want to stick with a similar measurement then we need the square wave

    There is no simple way to generate a square wave pattern in the 100/40G PCS that looks like a square wave on the line due to muxing, skew etc.

    We could require the PMA to generate the square wave pattern if needed

    Other option is to base the optical power measurement on an eye diagram or other method

   KR also needs the square wave though

Testing for 40/100Ge

- Other tests are ok with random data

    But….what are the goals of the testing?

    Will we carry any test patterns across an OTN network?

- Goals for pattern testing:

    Optical conformance testing

    General BER performance testing and stress testing

    Fault isolation to a physical lane

    Interoperability with basic test gear (that does not know about our PCS)

    KR needs them for equalization training

    Basic sanity testing of the PCS operation, deskew etc.

Testing for 40/100Ge

- It seems that to meet all of the testing goals, we need test patterns in a couple of places

- Proposal:

    Aggregate scrambler based pseudo random pattern in the PCS

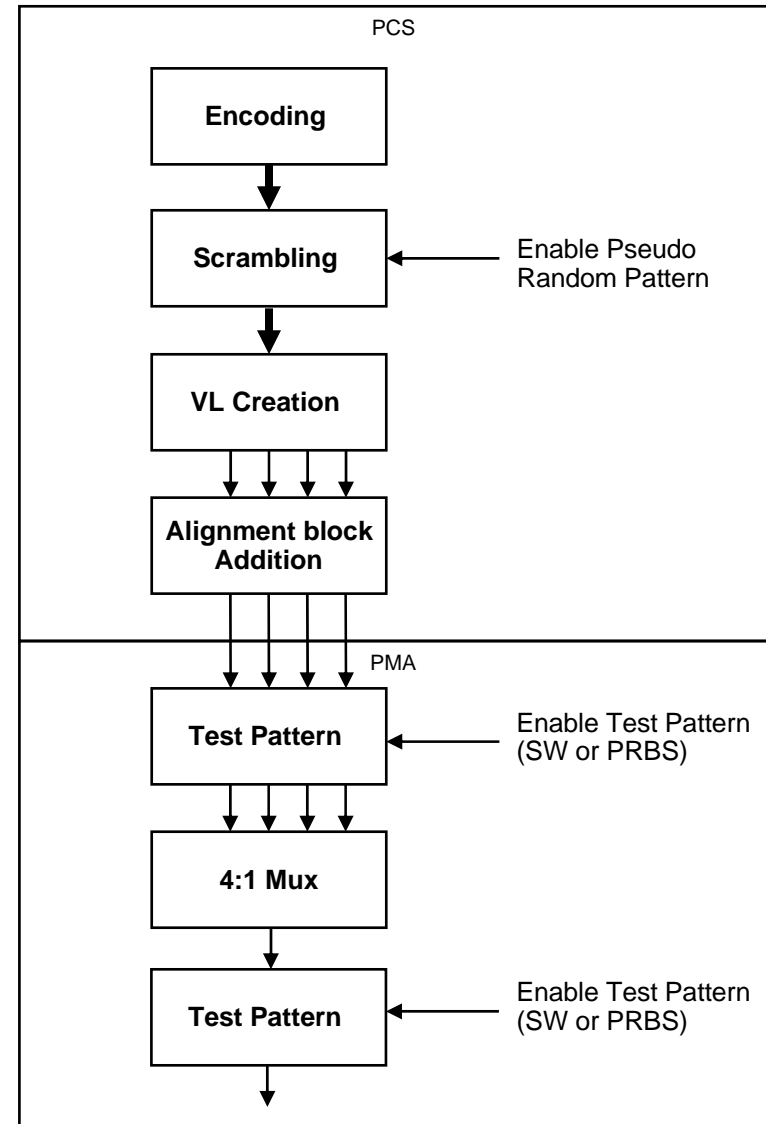   Square wave and one required PRBS at each physical lane (10G, 25G, etc) in the PMA

40Ge (non serial)

- 40G is the easiest
- Support at the 40G PCS aggregate level the following:
    Pseudo-random (required, output of scrambler)
- Support at each 10G lane level the following:
    Square wave (required, only used for tx test)
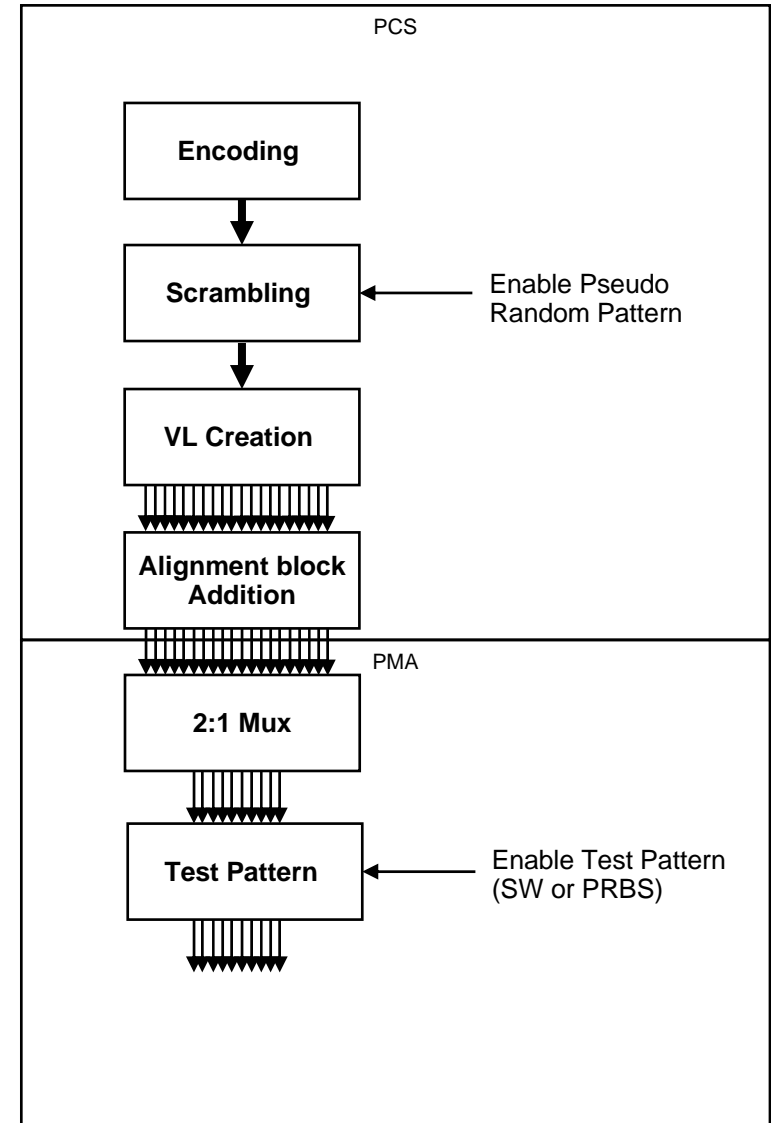   PRBS31 (required)
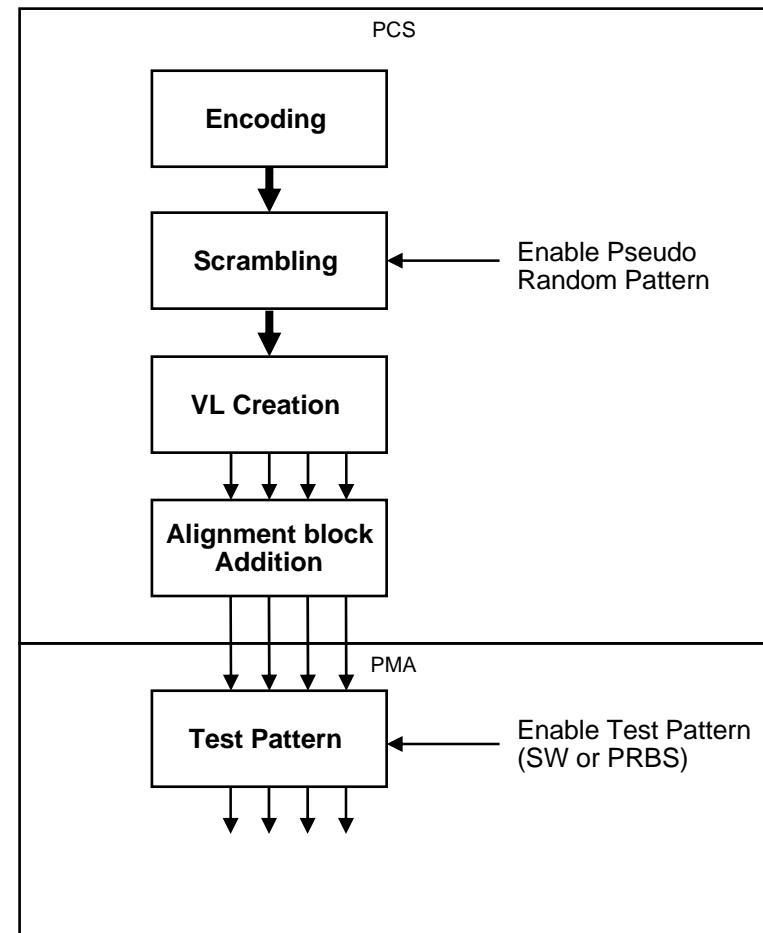
40Ge (serial)

- Support at the 40G PCS aggregate level the following:

  Pseudo-random (required, output of scrambler)

- Support at each 10G lane level the following:

  Square wave (required, only used for tx test)

  PRBS31 (required)

- Support at the 40G aggregate level the following:

  Square wave (required, only used for tx test)

  PRBS31 (required)

PCS

| Encoding |

| Scrambling | ← Enable Pseudo Random Pattern

| VL Creation |

| Alignment block Addition |

PMA

| Test Pattern | ← Enable Test Pattern (SW or PRBS)

| 4:1 Mux |

| Test Pattern | ← Enable Test Pattern (SW or PRBS)

100Ge (multi-mode and Cu)

- Support at the 100G PCS aggregate level the following:

    Pseudo-random (required, output of scrambler)

- Support at each 10G lane level the following:

    Square wave (required, only used for tx test)

    PRBS31 (required)

PCS

Encoding

Scrambling ← Enable Pseudo Random Pattern

VL Creation

Alignment block Addition

PMA

2:1 Mux

Test Pattern ← Enable Test Pattern (SW or PRBS)

100Ge (single mode)

- Support at the 100G PCS aggregate level the following:

  Pseudo-random (required, output of scrambler)

- Support at each 10G lane level the following:

  Square wave (required, only used for tx test)

  PRBS31 (required)

- Support at each 25G lane level the following:

  Square wave (required, only used for tx test)
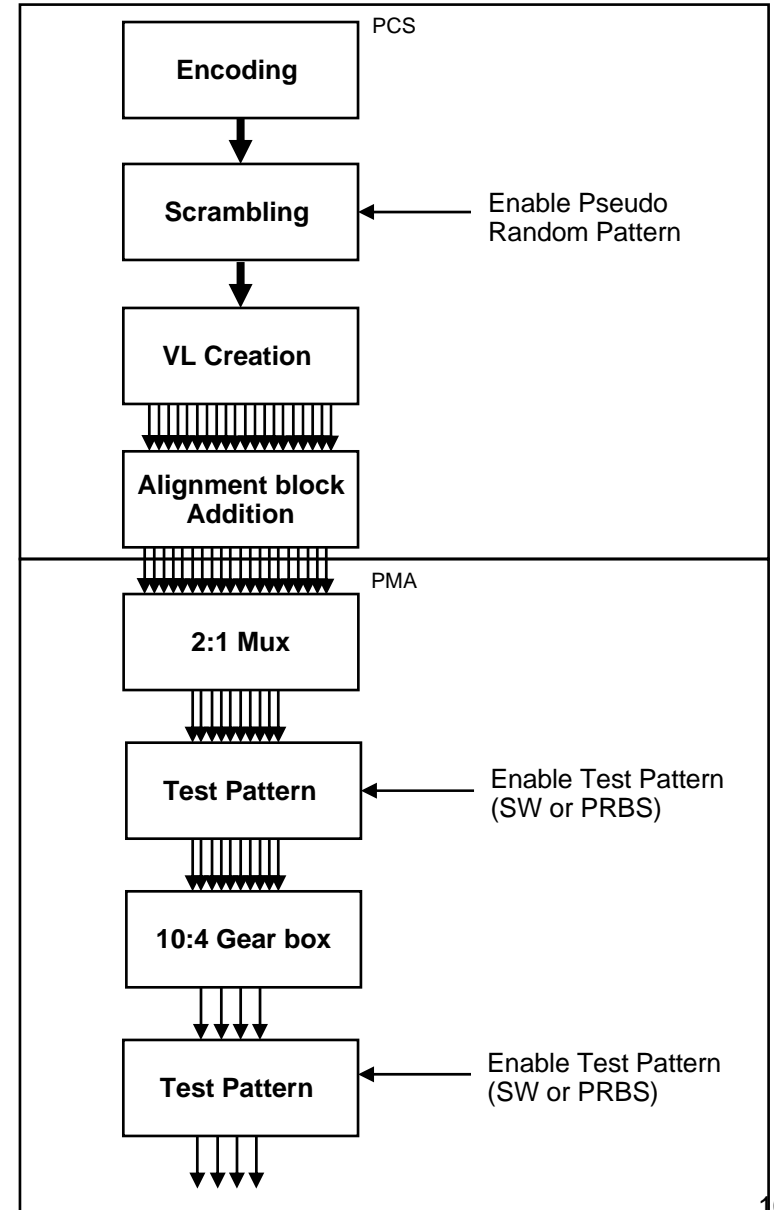
  PRBS31 (required)

100G and 40G PCS Test Proposal

- 100/40Ge have the following test patterns that can be generated:

    Pseudo-random (required, output of scrambler) in the PCS

    Square wave and PRBS31 in the PMA for each physical lane

- Pseudo-random details

    Output of scrambler, where scrambler is randomly seeded and then let to free run

    Input pattern to the scrambler is PCS Idle pattern, with sync field = '10', distributed to VLs and adding lane alignment markers

    Implementation is simple: prevent frame date from entering encoder!

- PRBS31 details

    $1 + x^{28} + x^{31}$

    Random seed, that differs across lanes

    No sync bits

    Other PRBS options (PRBS7, PRBS15, PRBS23)

    These are all commonly found in serdes macros anyhow?

- Square wave details

    n ones followed by n zeros, 3 < n < 12

    No sync bits

100G and 40G PCS Test Proposal - draft

Testing Goal	Aggregate Pseudo Random	Per Lane Square Wave	Per Lane PRBS
Optical conformance testing		✔	✔
General BER performance testing and stress testing			✔
Fault isolation to a physical lane			✔
Interoperability with basic test gear			✔
KR equalization training		✔	
Basic sanity testing of the PCS operation, deskew etc.	✔		

Open Questions

- How much power does the test function take?

    Particularly concerned about this when the test pattern is in the PMD module

- What PRBS pattern should we specify?

    Is PRBS31 sufficient?