Downstream MPRS

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Outline

- **Problems**
- **Proposed solution**
- **Examples**
- **Details**
  - DS Envelope Header details
  - OLT DS high level block diagram
  - OLT INPUT_PROCESS SD
  - OLT TRANSMIT_PROCESS SD
  - MPRS_CTRL Primitives

A slightly different set of problems

- **Traffic patterns are different from US**
  - Traffic for ONUs does not come to the OLT grouped by ONU
    - Frames for specific ONUs/LLIDs are interspersed
  - Ideally the OLT should not require large buffers to artificially group ONU traffic to emulate US envelopes
    - DS envelopes should be able to transport a single frame without excessive overhead.
- **We have a challenging optical budget**
  - We will likely need a better (less efficient) FEC to close the budget
  - It would be nice if we could offset this efficiency loss; there are several areas we could potentially recover capacity
    - 64B/66B line code imposes a 3% overhead
    - IPG (12B) imposes an overhead of 18.75% to < 0.8% (frame length dependent)

Proposed solution

- **Enhance the envelope header solution adopted for US to solve DS problems**
  - Maintain LLID, EPAM, & Length(with modification) fields as in US
  - Each Frame Start marks the beginning of an Envelope
    - New Envelope Header replaces Preamble (no loss of efficiency)
    - Allows flexible traffic distribution to ONUs consistent with frame arrival and higher layer QoS
  - Header IDs end of frame location by channel & byte within last EQ
- **Improve transmission efficiency**
  - Eliminate 64B/66B line code
  - Minimize IPG
- **Retain MII control codes to ID FEC replacement opportunity**
  - NO_ENVELOPE_CODE not needed for DS
  - IDLE code is replaced with well know data pattern
  - Start and Terminate codes replaced with pointers (works well in other systems)

Examples of Envelope Header functionality

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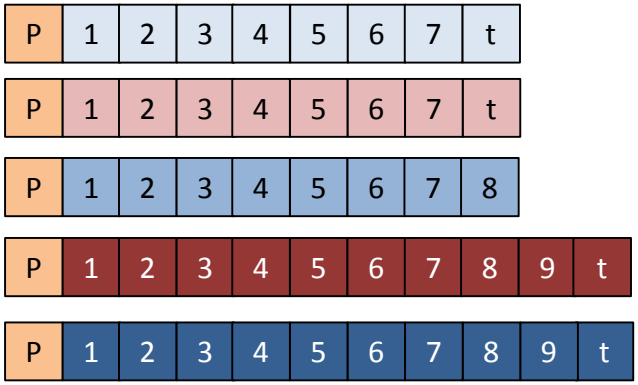
Example Transmission Order



Fm1 - 66B, 8.250 EQ

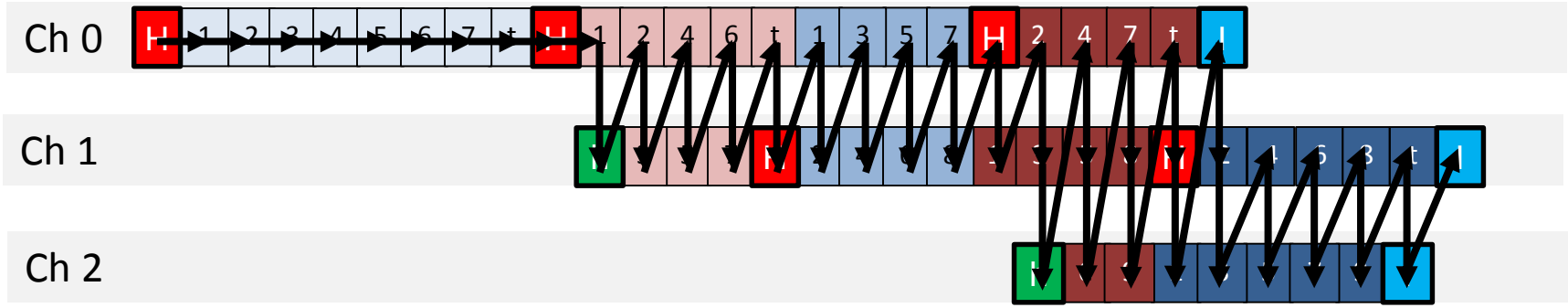
Fm 2 - 71B, 8.875 EQ

Fm 3 - 72B, 9.000 EQ†

Fm 4 - 79B, 9.875 EQ

Fm 5 - 73B, 9.125 EQ

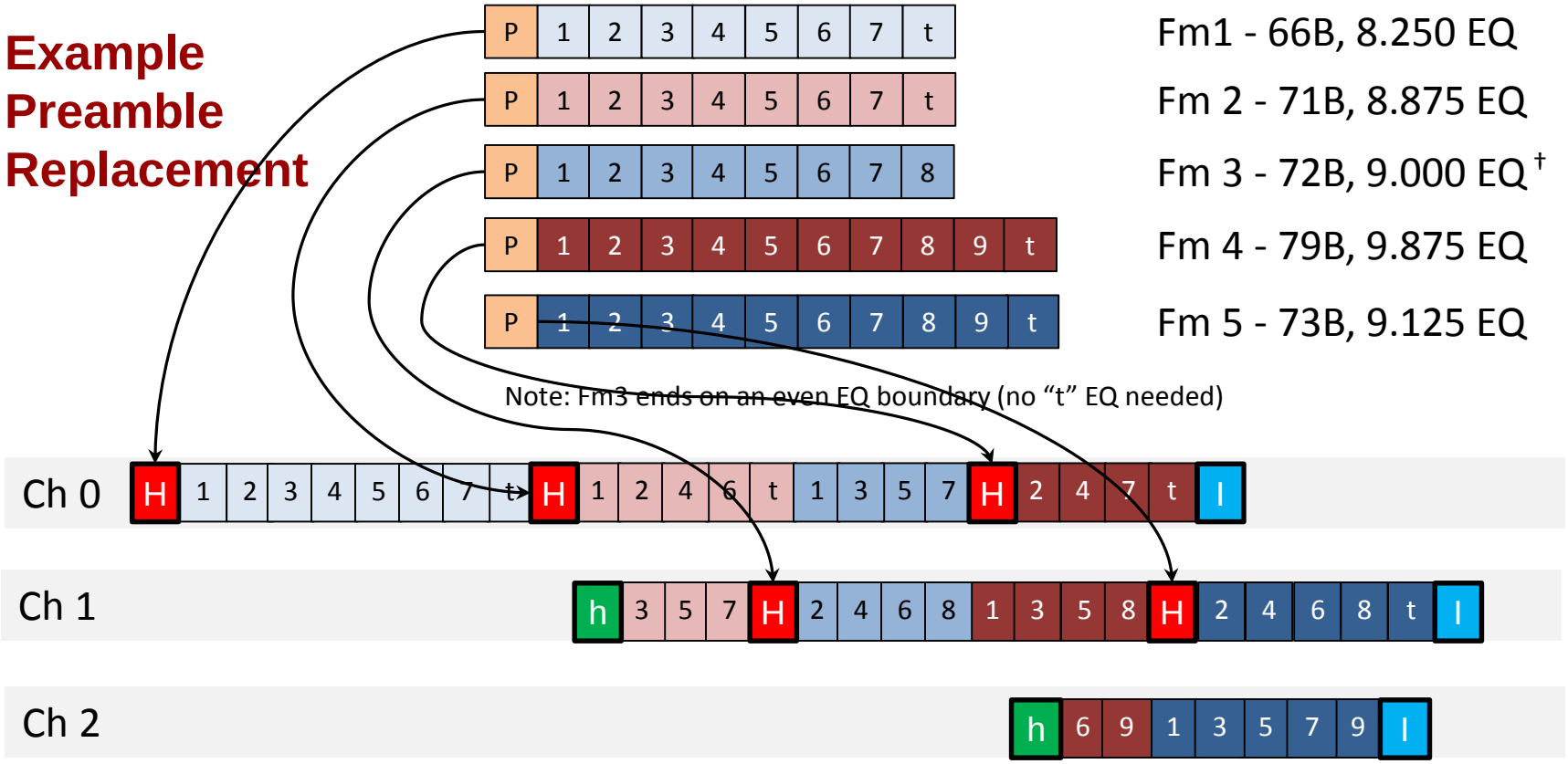
Note: Fm3 ends on an even EQ boundary (no “t” EQ needed)



- P — Frame Preamble
- t — EQ with /T/ control code
- H — Header of a new Frame
- h — Header of a continuing Frame
- I — Header of nothing (Idle)

Transmission order is similar to that in US – ch0 to ch3. An envelope can begin anywhere in a frame but a frame start always marks the beginning of an envelope.

Example Preamble Replacement



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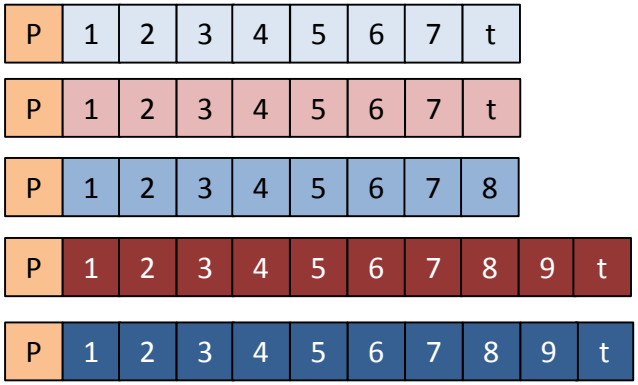
Each Frame Preamble is replaced with an Envelope Header

Example Envelope Length



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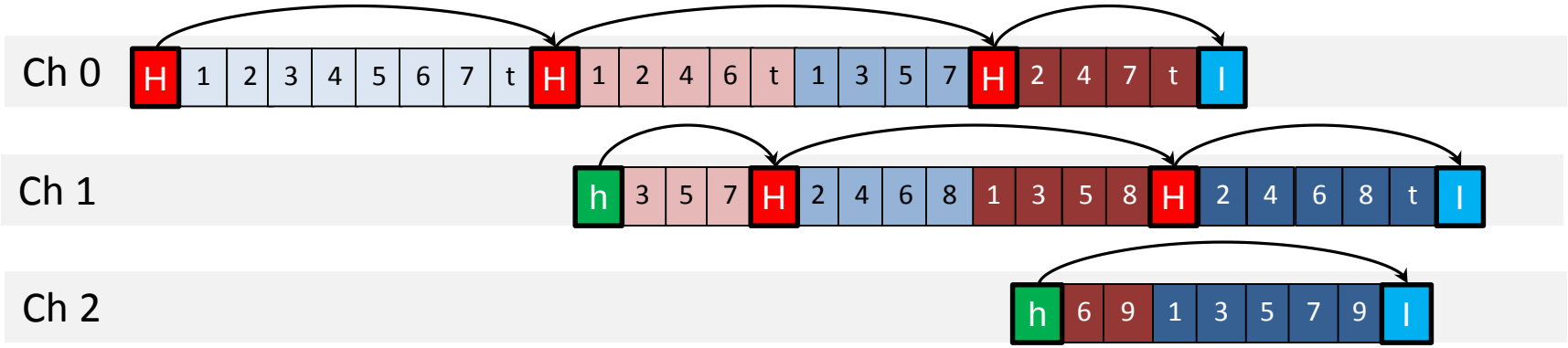

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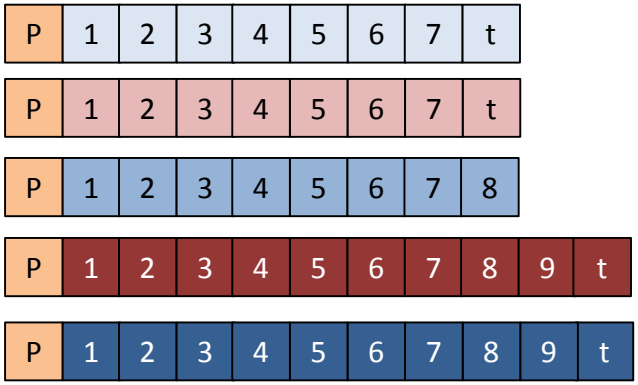
Each Envelope Header has the length of transmission in that lane until the next envelope. This gives the RS enough information to delineate the Envelopes.

Example
TC & REM



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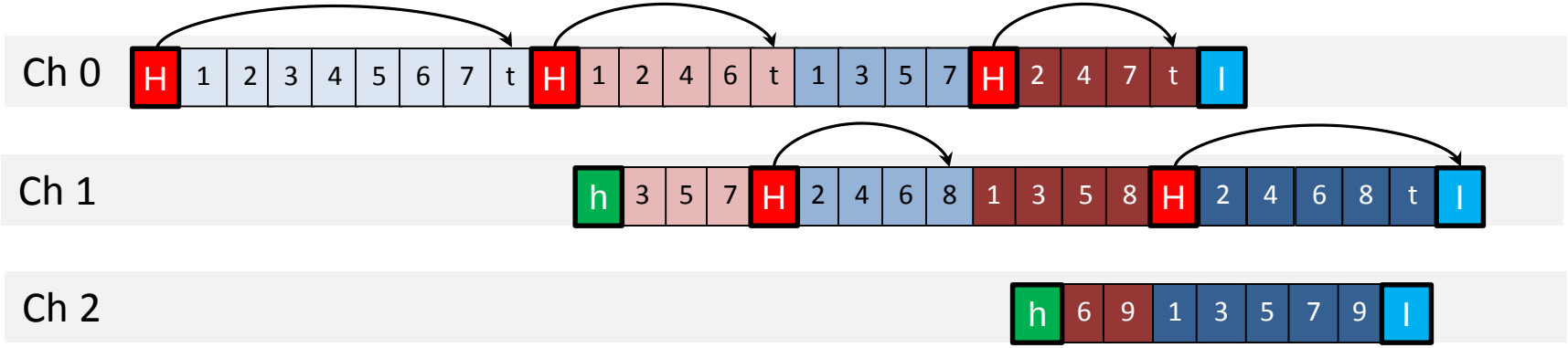

- P — Frame Preamble
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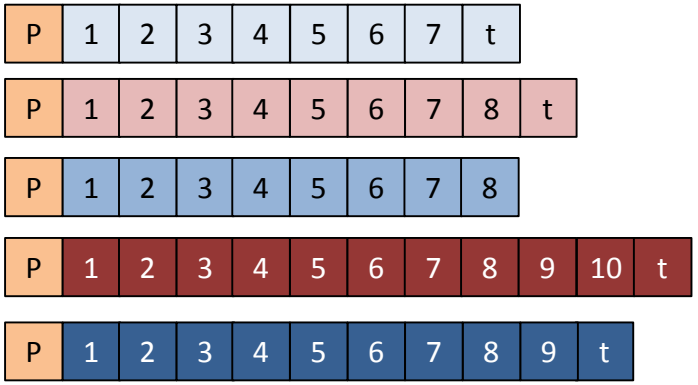
Each Envelope Header points to the end of the frame which it starts. This gives the RS enough information to delineate the EoF

Another Example End of Frame Pointer



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Fm 2 - 79B, 9.875 EQ

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Fm 4 - 94B, 11.750 EQ

Fm 5 - 84B, 10.500EQ

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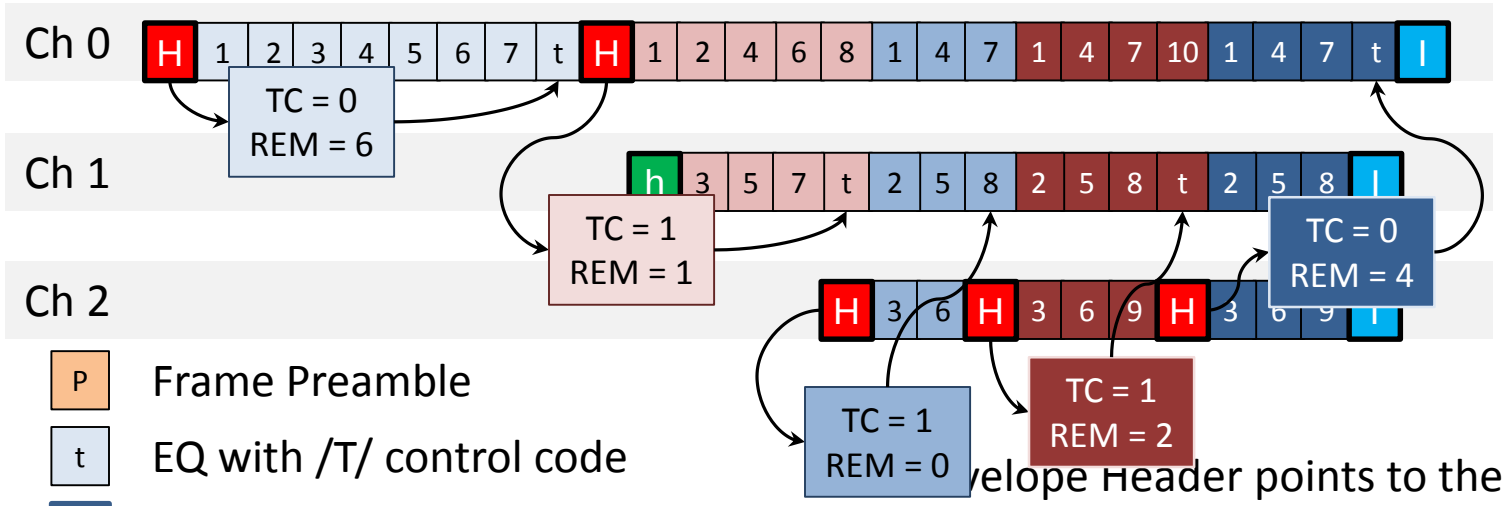

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Details

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DS Envelope Header

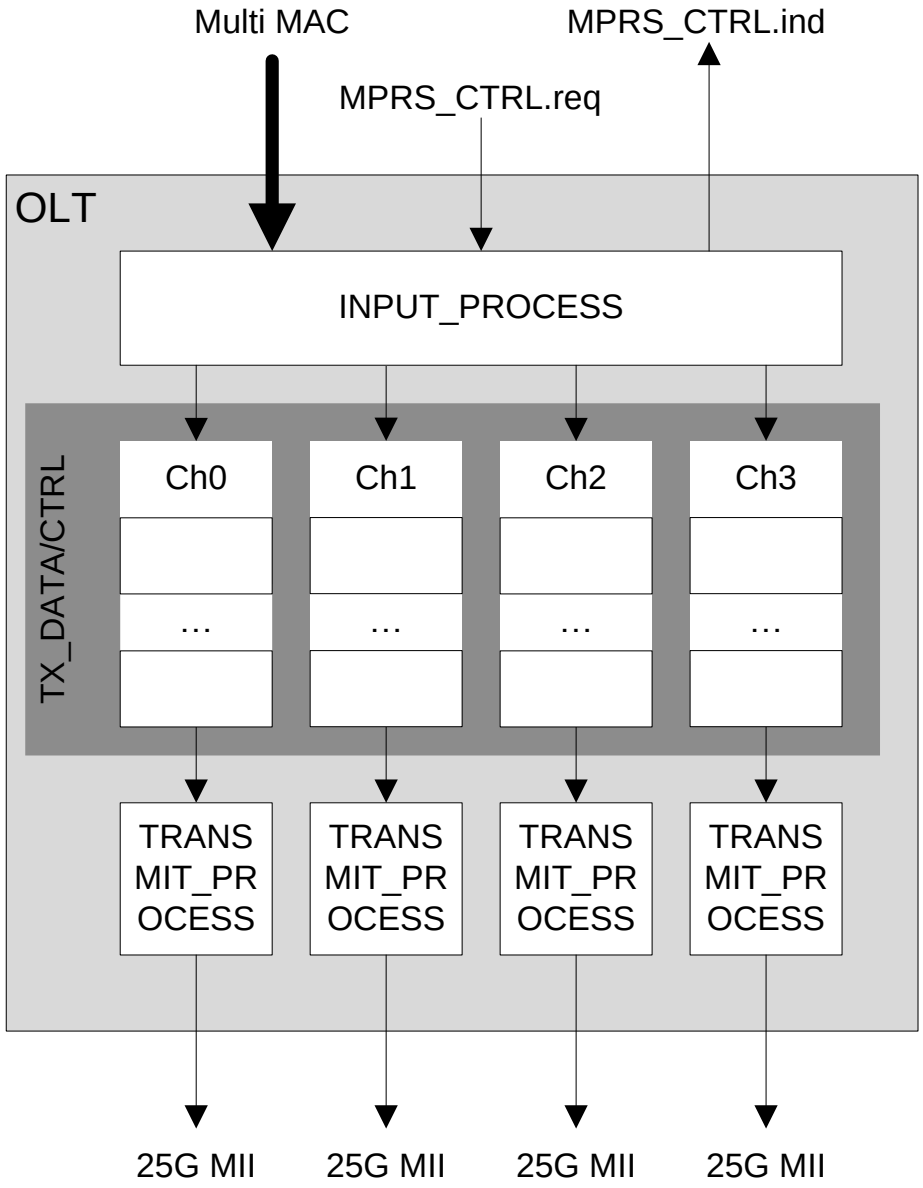
- **LLID, EPAM, as in US**
- **LENGTH – (11b, in EQ >>10KB)**
- **Continuation Code (CF, 1b)**
  - Change of LLID in channel, TC & REM invalid)
- **Security Key (SK, 2b)**
  - Potential security key bits
- **Termination Channel (TC, 2b)**
  - Points to channel with last EQ of frame
- **Remainder (REM, 3b)**
  - Number of IDLE Bytes in last EQ of Frame
- **Header Error Correction (HEC13, 13b)**
  - Error detection & correction

Byte	8								7								6								5							
bit	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1
Header	HEC(13)													CF	p2		LLID(16)																

Byte	4								3								2								1							
bit	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1
Header	p3			EPAM(5)					p6						SK(2)		TC(2)	REM(3)			LENGTH(11)											

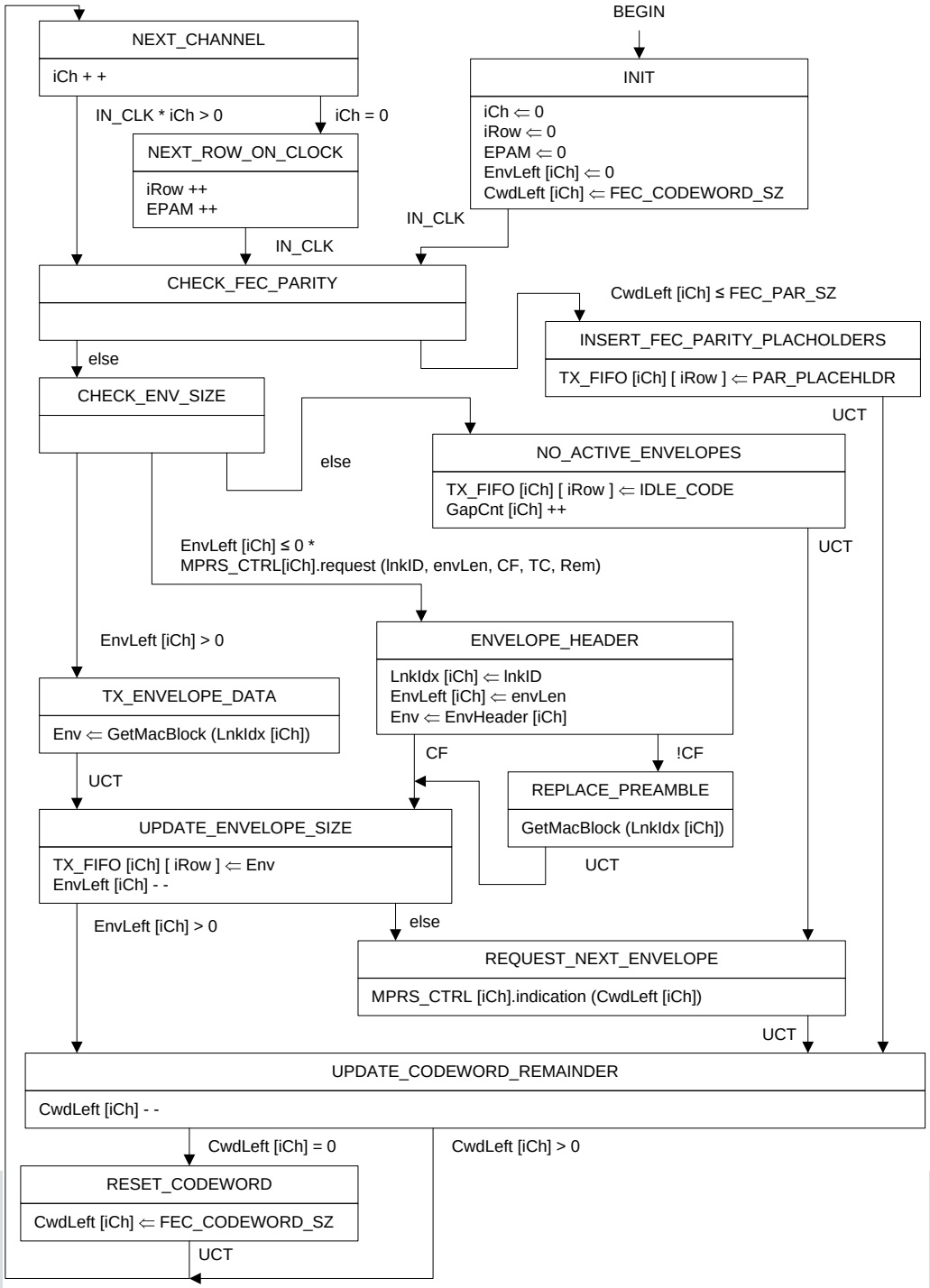
OLT DS high level block diagram

- **INPUT_PROCESS**
  - Transfers data from MAC interfaces to TX_FIFO in increments of one EQ
  - Inserts header to each envelope
  - One per OLT
- **TRANSMIT_PROCESS**
  - Outputs one 36-bit vector (TXD<31:0>&TXC<3:0> to each 25GMII interface on MMI clock edge)
  - One per channel
    - frequency & phase synchronized



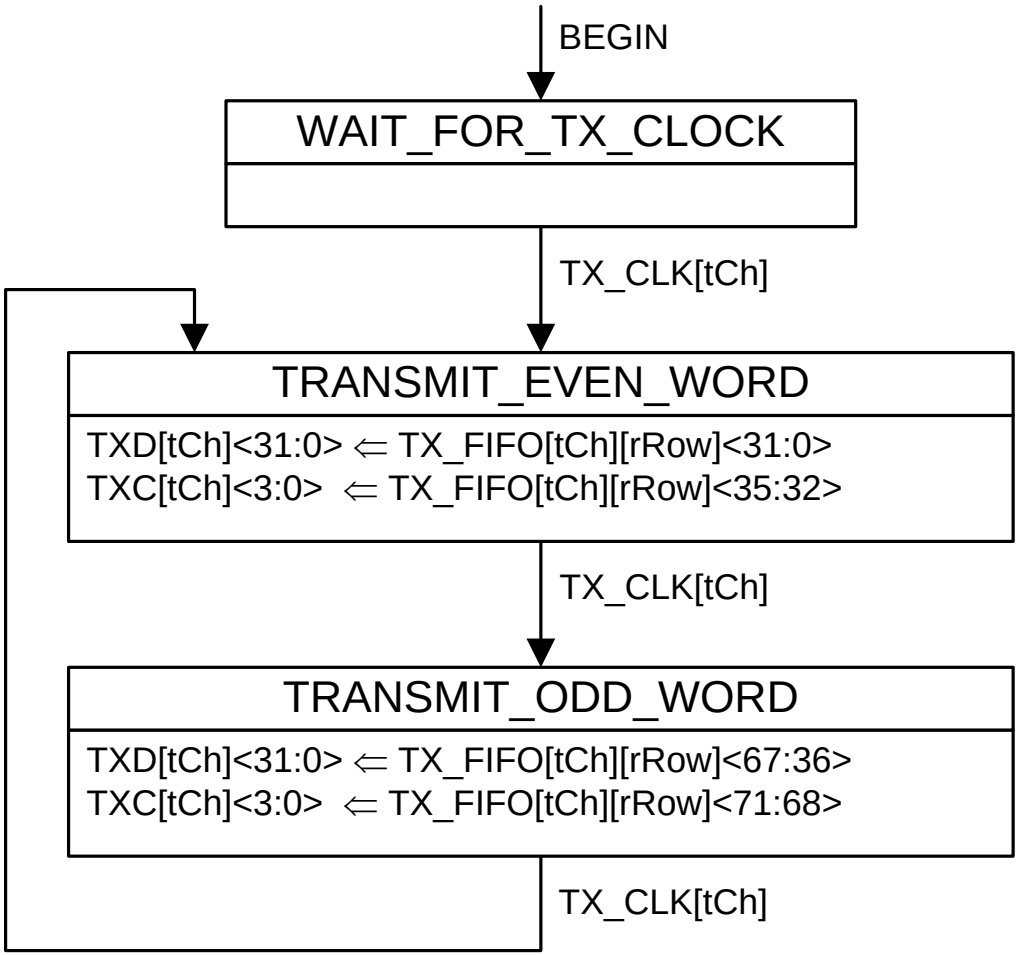
OLT
INPUT_PROCESS SD

- **Similar to US except**
  - Preamble is over written



OLT TRANSMIT_PROCESS SD

- **Same as ONU TX Process**



MPRS_CTRL Primitives

- **MPRS_CTRL [ch].request**
  - Initiates a new envelope on channel “ch” and informs RS of envelope parameters
  - MPRS_CTRL [ch].request (LLID, CF, SK, TC, REM, LENGTH)

- **MPRS_CTRL.indication**
  - Same as for ONU US

Thank you

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SD variables & functions

INPUT_PROCESS

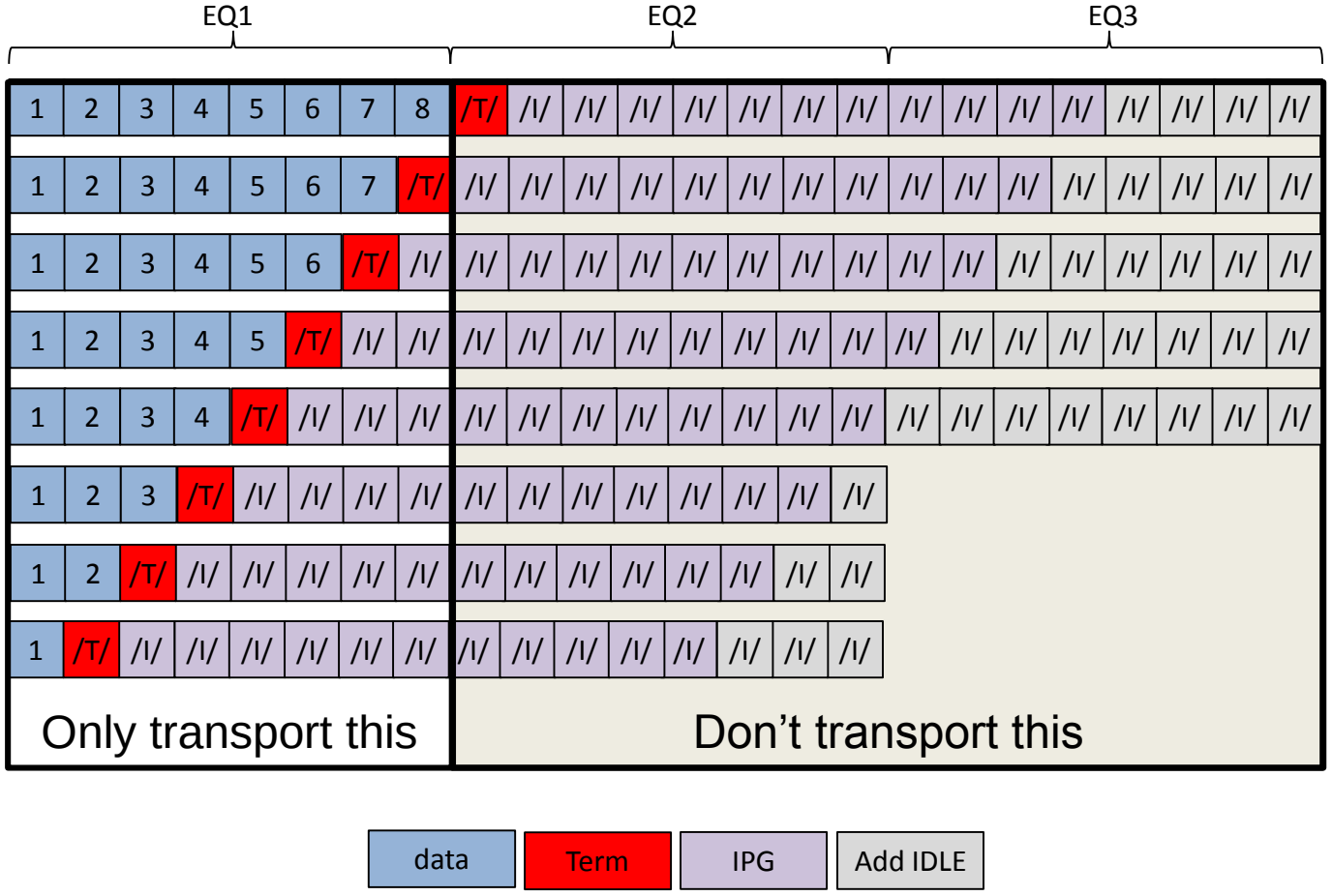
- isStart (env) – function that returns True if the EQ (env) is a Preamble, else False
- iRow – pointer into TX_FIFO row
- iCh – channel (column) pointer into TX_FIFO row
- Others same as for US

TRANSMIT PROCESS

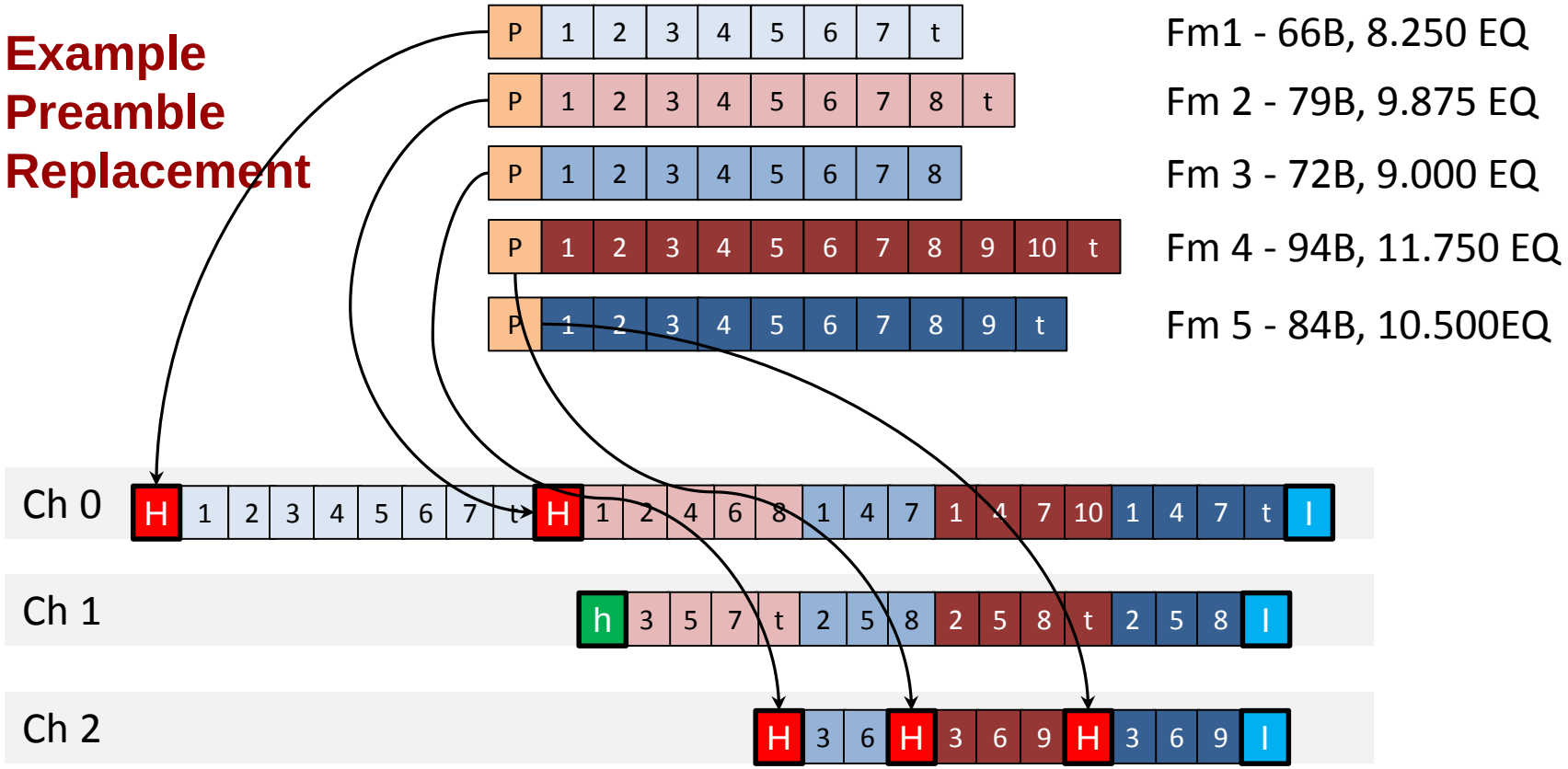
- tRow – pointer into TX_FIFO row
- tCh – channel (column) pointer into TX_FIFO row
- Others same as for US

Minimizing overhead; IPG, /I/, and /T/

- **8 possible termination sequences**



Example Preamble Replacement



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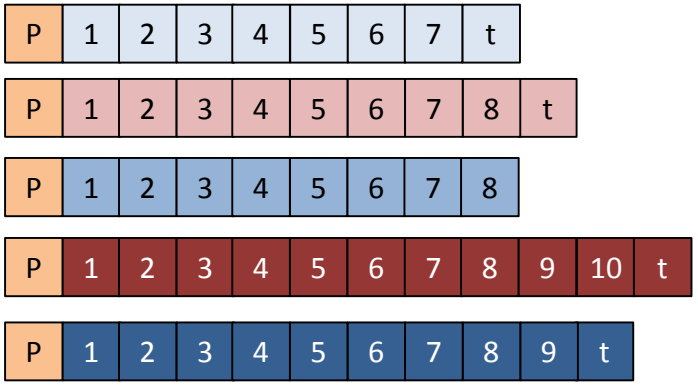
Example Length field



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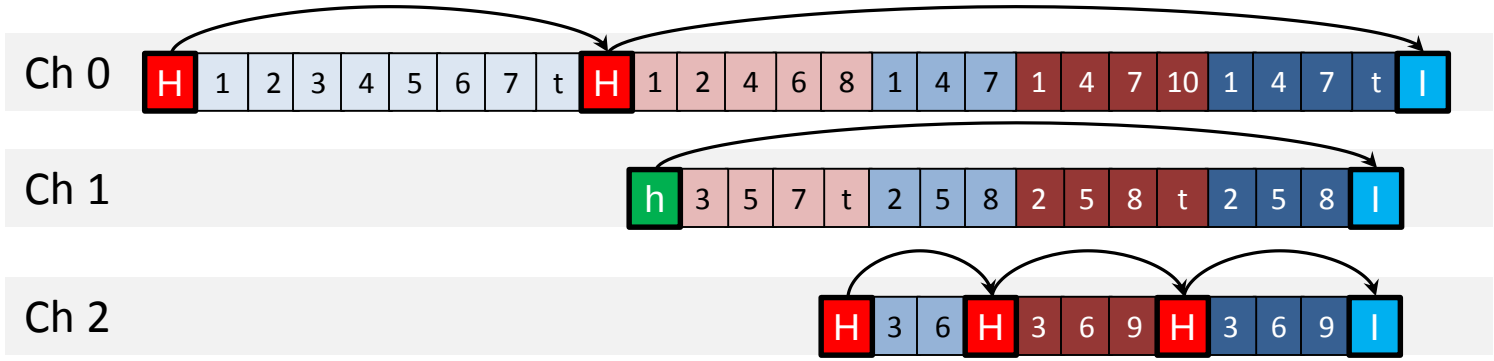

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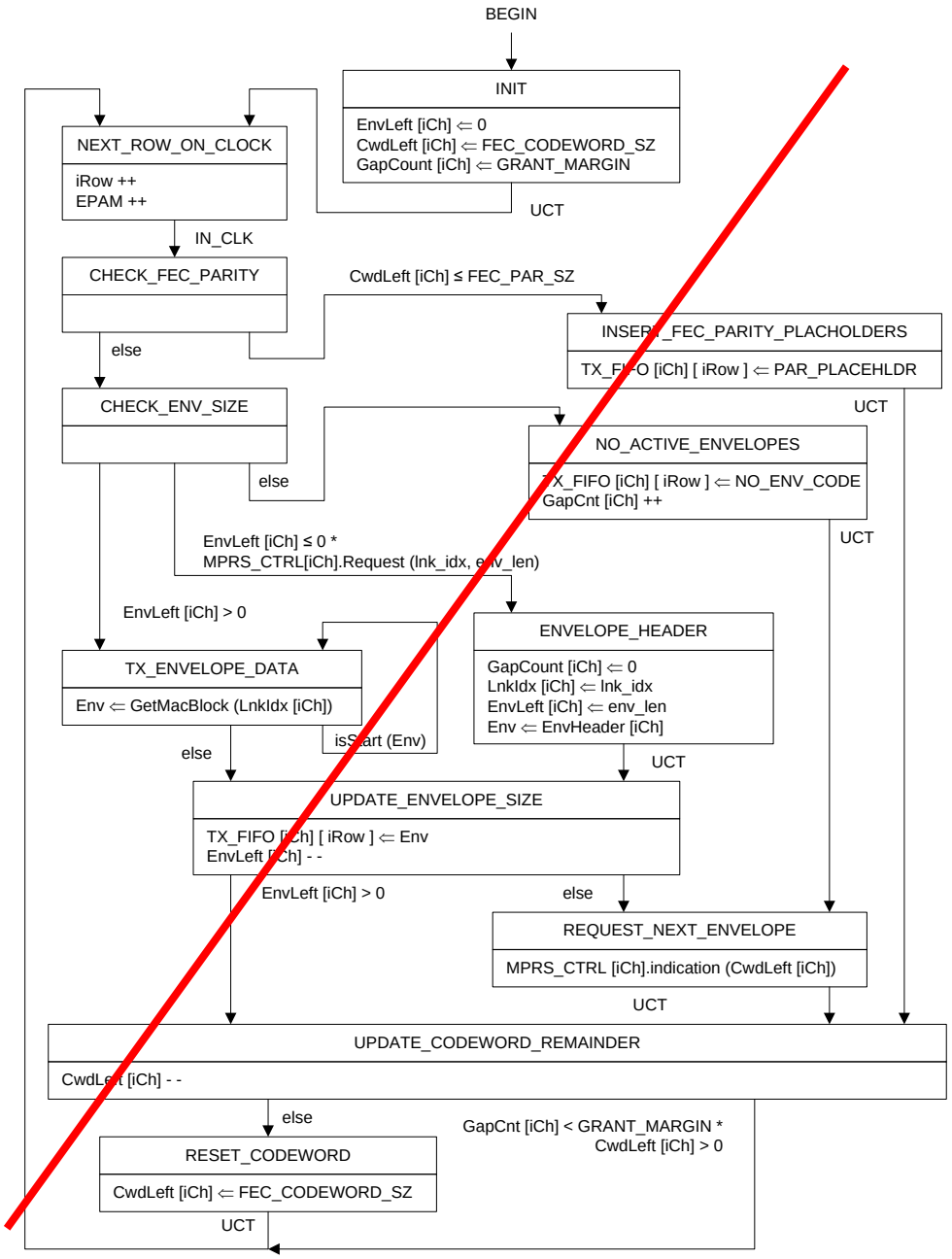

OLT
INPUT_PROCESS SD

- **Similar to US except**
  - Preamble is over written
- **Changes**
  - Removed:
    - GapCount (same as US)
    - isStart loop to TX_ENVELOPE_DATQ state
  - Replaced:
    - NO_ENV_CODE with IDLE_CODE inn NO_ACTIVE_ENVELOPES
    - Lnk_idx with lnkID
    - Env_len with EnvLen
  - Added:
    - Variables CF, RC, & Rem to MPRS_CTRL.request
    - REPLACE_PREAMPLE state
    - NEXT_CHANNEL state