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MPCP Compatibility with 64b/66b Line Coding

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Laser Control with 8b/10b Line Coding (802.3ah)

- MPCP is located in MAC Control Sublayer

- MPCP is not aware whether 8b/10b or 64b/66b encoding is used. MPCP is based on time (time unit = 16 ns).

- Laser on/off is controlled by Data Detector function in PCS (**IEEE802.3-2005, section 65.2.2 Burst-mode operation**).

- In 802.3ah the Data Detector monitors Tx data stream and turns laser off when it sees more then X IDLEs.
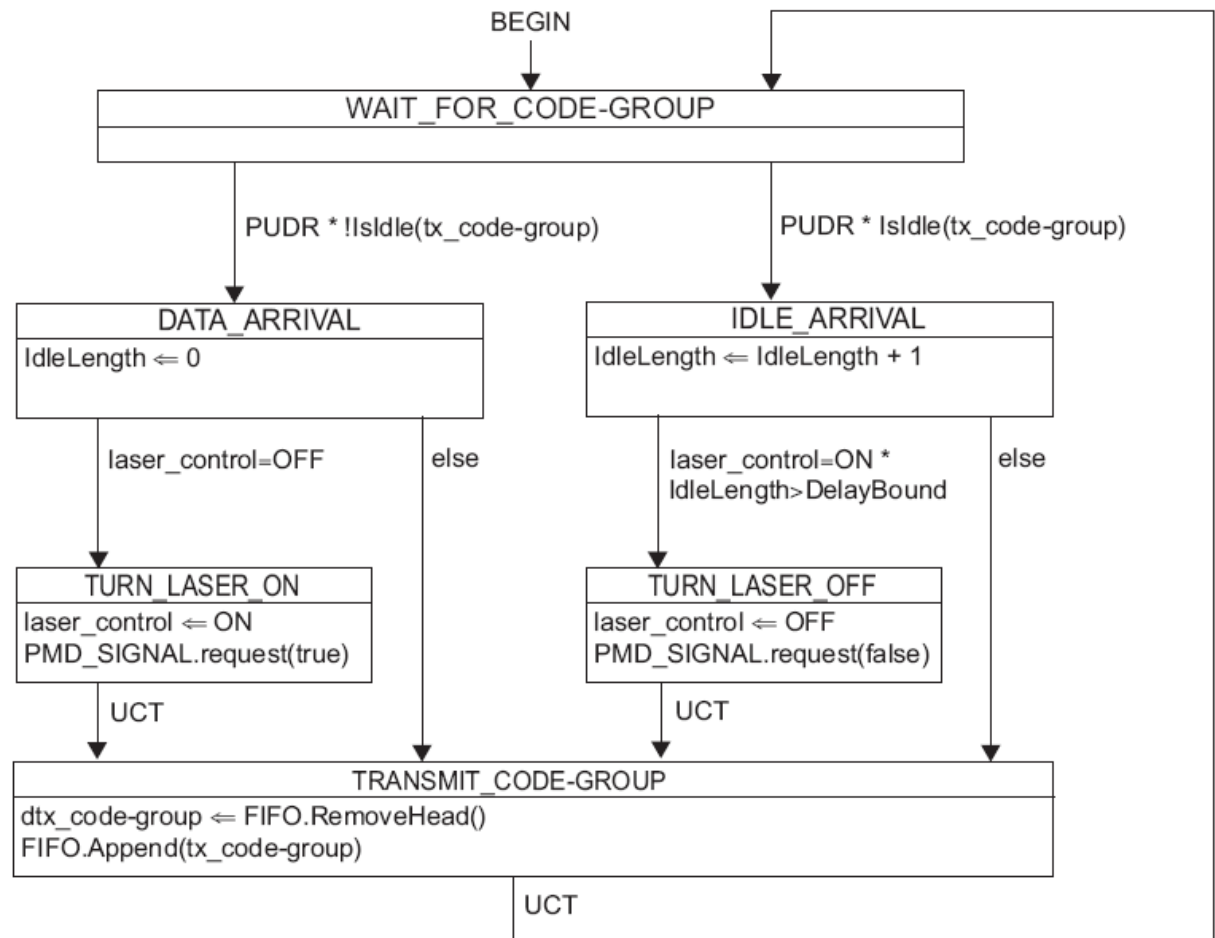
```
                              BEGIN
                                │              ┌─────────────┐
                                ▼              ▼             │
        ┌──────────────────────────────────────────────────┐│
        │            WAIT_FOR_CODE-GROUP                    ││
        ├──────────────────────────────────────────────────┤│
        └──────────────────────────────────────────────────┘│
            │                                    │           │
  PUDR * !IsIdle(tx_code-group)     PUDR * IsIdle(tx_code-group)
            ▼                                    ▼           │
  ┌───────────────────────┐      ┌───────────────────────────┐
  │    DATA_ARRIVAL        │      │      IDLE_ARRIVAL         │
  ├───────────────────────┤      ├───────────────────────────┤
  │ IdleLength ⇐ 0         │      │ IdleLength ⇐ IdleLength + 1│
  └───────────────────────┘      └───────────────────────────┘
     │              │                  │                 │
 laser_control=OFF  else    laser_control=ON *         else
     │              │       IdleLength>DelayBound        │
     ▼              │            ▼                        │
  ┌───────────────┐ │      ┌───────────────────┐          │
  │ TURN_LASER_ON │ │      │  TURN_LASER_OFF   │          │
  ├───────────────┤ │      ├───────────────────┤          │
  │laser_control⇐ON│ │      │laser_control⇐OFF │          │
  │PMD_SIGNAL.request(true)│ │PMD_SIGNAL.request(false)│   │
  └───────────────┘ │      └───────────────────┘          │
     │ UCT          │            │ UCT                     │
     ▼              ▼            ▼                         ▼
  ┌──────────────────────────────────────────────────────────┐
  │              TRANSMIT_CODE-GROUP                          │
  ├──────────────────────────────────────────────────────────┤
  │ dtx_code-group ⇐ FIFO.RemoveHead()                        │
  │ FIFO.Append(tx_code-group)                                │
  └──────────────────────────────────────────────────────────┘
              │ UCT
```

Figure 65–6—ONU data decoder state diagram

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Laser Control with 64b/66b Line Coding

- 66-bit blocks should be transmitted without segmentation

- The 10Gb/s Data Detector instead of looking at 10-bit code-groups can look at 66-bit blocks (see state machine).

- This would force laser_on and laser_off signals to be asserted only on 66-bit block boundaries.
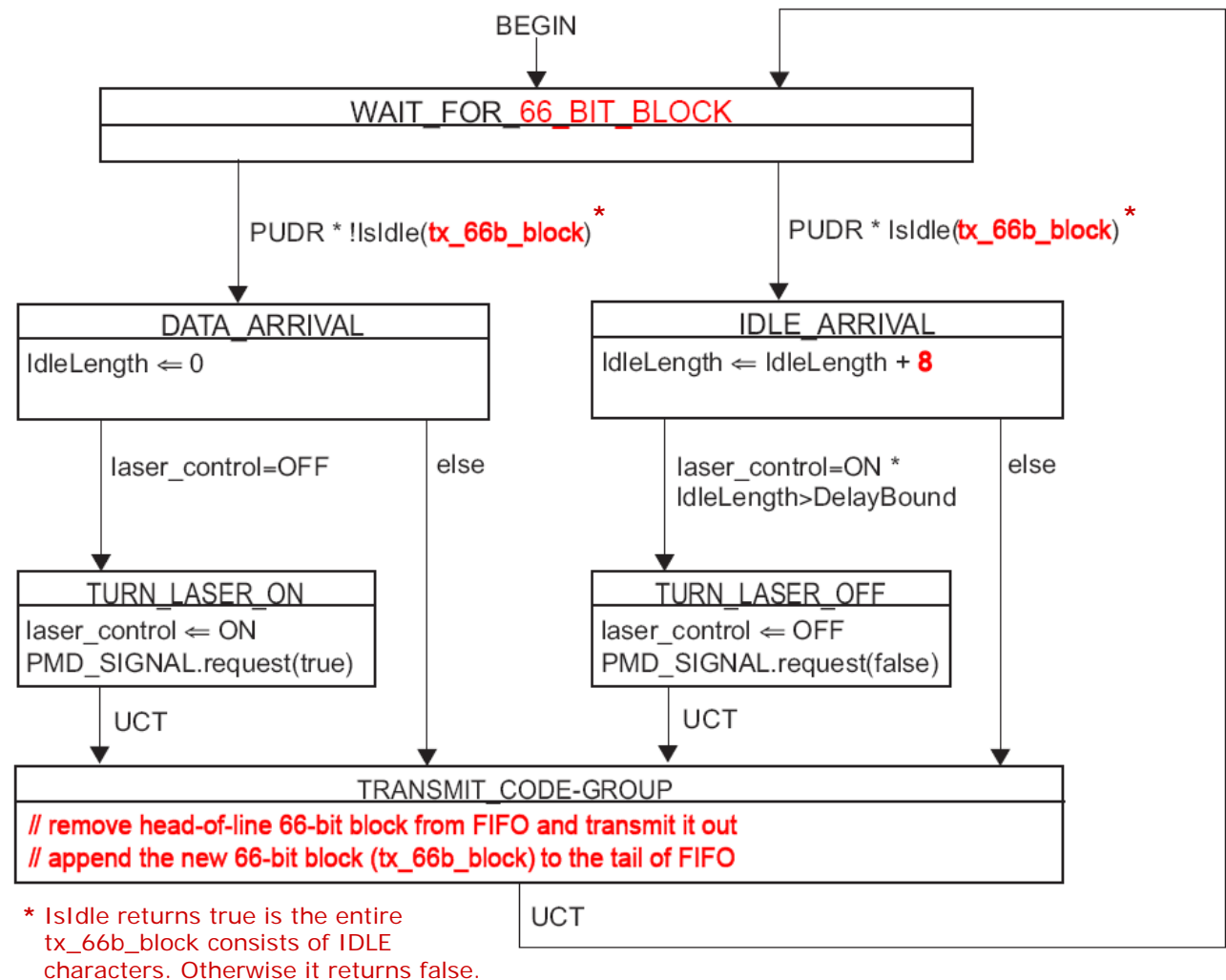
BEGIN

WAIT_FOR_66_BIT_BLOCK

PUDR * !IsIdle(**tx_66b_block**)*

PUDR * IsIdle(**tx_66b_block**)*

DATA_ARRIVAL
IdleLength ⇐ 0

IDLE_ARRIVAL
IdleLength ⇐ IdleLength + **8**

laser_control=OFF

else

laser_control=ON *
IdleLength>DelayBound

else

TURN_LASER_ON
laser_control ⇐ ON
PMD_SIGNAL.request(true)

UCT

TURN_LASER_OFF
laser_control ⇐ OFF
PMD_SIGNAL.request(false)

UCT

TRANSMIT_CODE-GROUP
// remove head-of-line 66-bit block from FIFO and transmit it out
// append the new 66-bit block (tx_66b_block) to the tail of FIFO

UCT

* IsIdle returns true is the entire tx_66b_block consists of IDLE characters. Otherwise it returns false.

Figure 65–6—ONU data decoder state diagram (for 64b/66b)
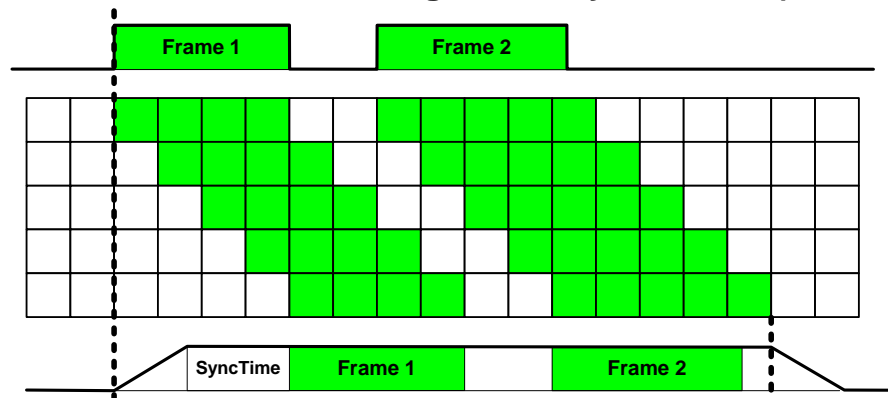
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MPCP compatibility with 64b/66b Encoding

- The laser_on signal is moved **down** to the nearest 66-bit block boundary.

- The laser_off signal is moved **up** to the nearest 66-bit block boundary.

- This may increase the laser_on time by $\leq 7+7=14$ bytes per burst, or 0.7 TQ in the worst case.

- According to IEEE 802.3ah, MPCP clock has tolerance of 8 TQ or 12 TQ
  - guardThresholdONU = 8 TQ
  - guardThresholdOLT = 12 TQ

- Rounding up to 66-bit is within granting accuracy of existing MPCP and does not result in any additional overhead

1 Gb/s EPON: laser_on granularity = 10 bits (8 ns)

| Frame 1 | Frame 2 |

| SyncTime | Frame 1 | Frame 2 |
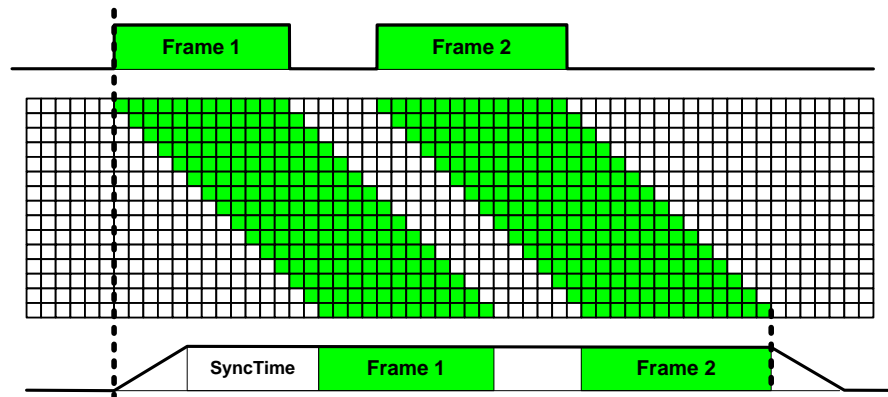
10 Gb/s EPON: laser_on granularity = 66 bits (6.4 ns)

| Frame 1 | Frame 2 |

| SyncTime | Frame 1 | Frame 2 |

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Conclusion

- **Data detector is a function of PCS.**

  – Data detector should operate on Xb/Yb encoder output blocks (10 bits for 8b/10b; 66 bits for 64b/66b).

  – Data detector always turns laser on and off on a block boundary.

- **No changes to MPCP are required to use 64b/66b.**

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