Multiple Profiles for EPoC – Part II

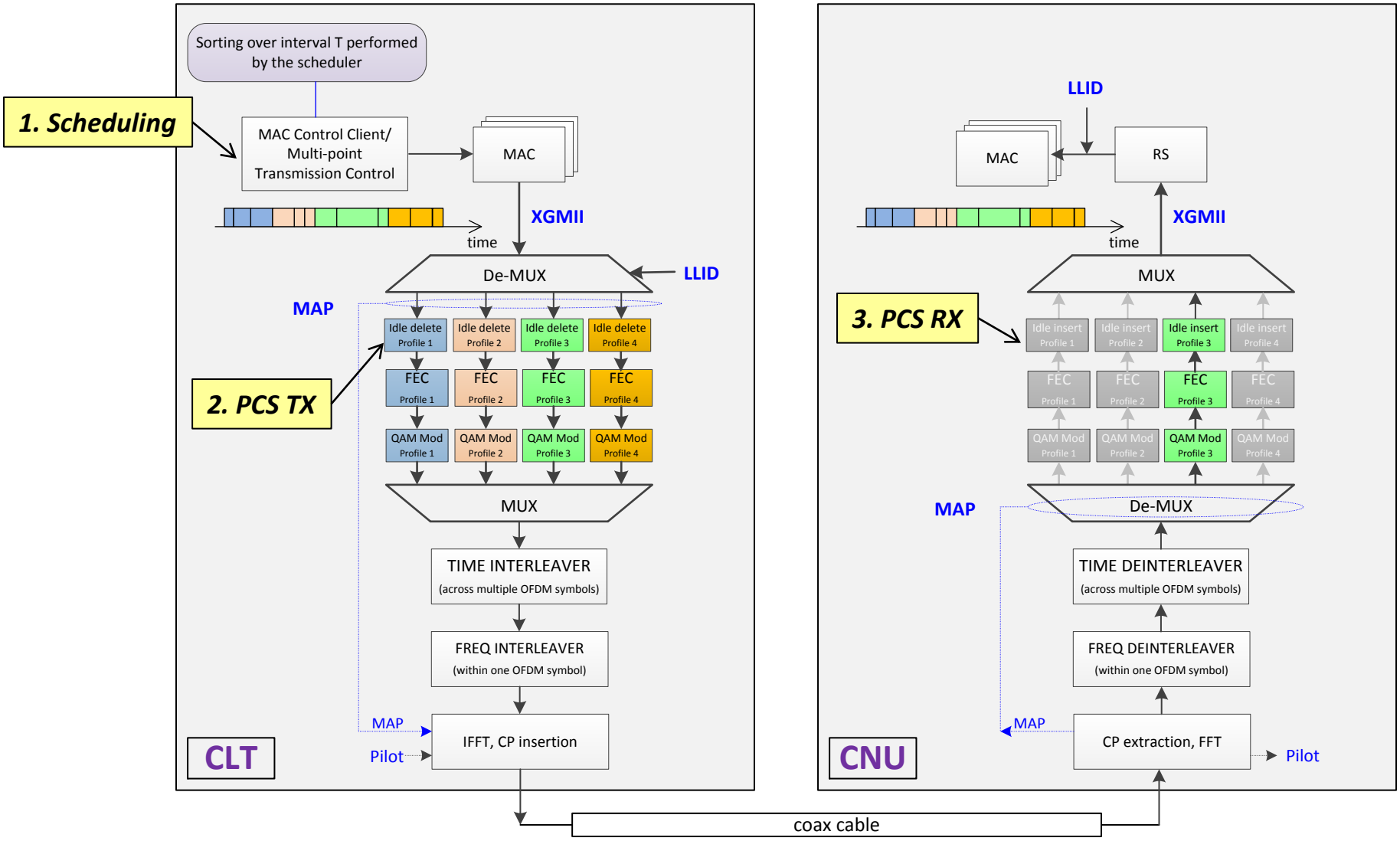
IEEE 802.3bn – Multiple Profile ad-hoc

11 January 2013

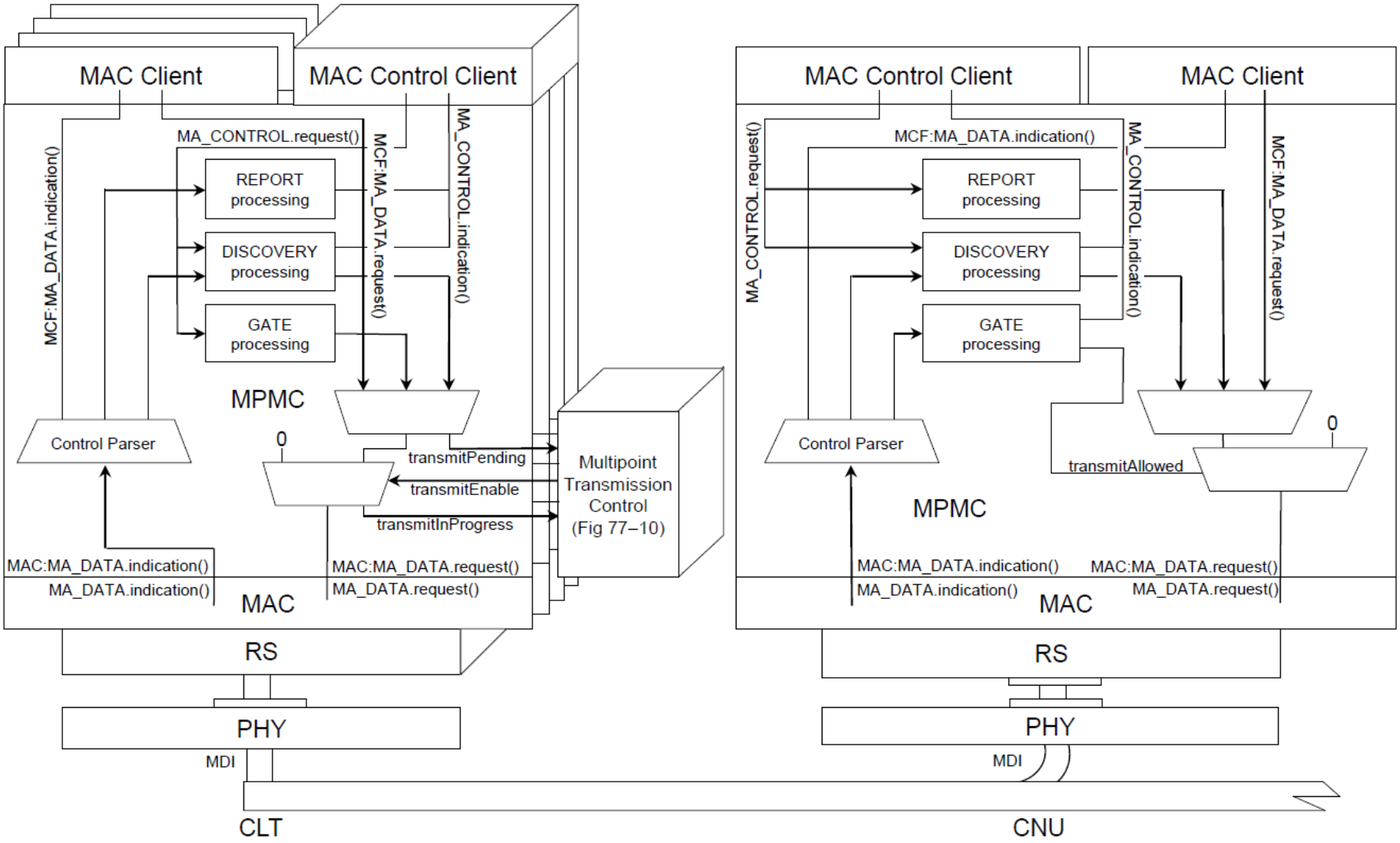
Multiple Profiles - Overview

Note: sorting only applies among LLID flows
Order of packets in one LLID flow does not change

Note: CNU is expected to have one or two profiles, here represented a case with one profile (green)

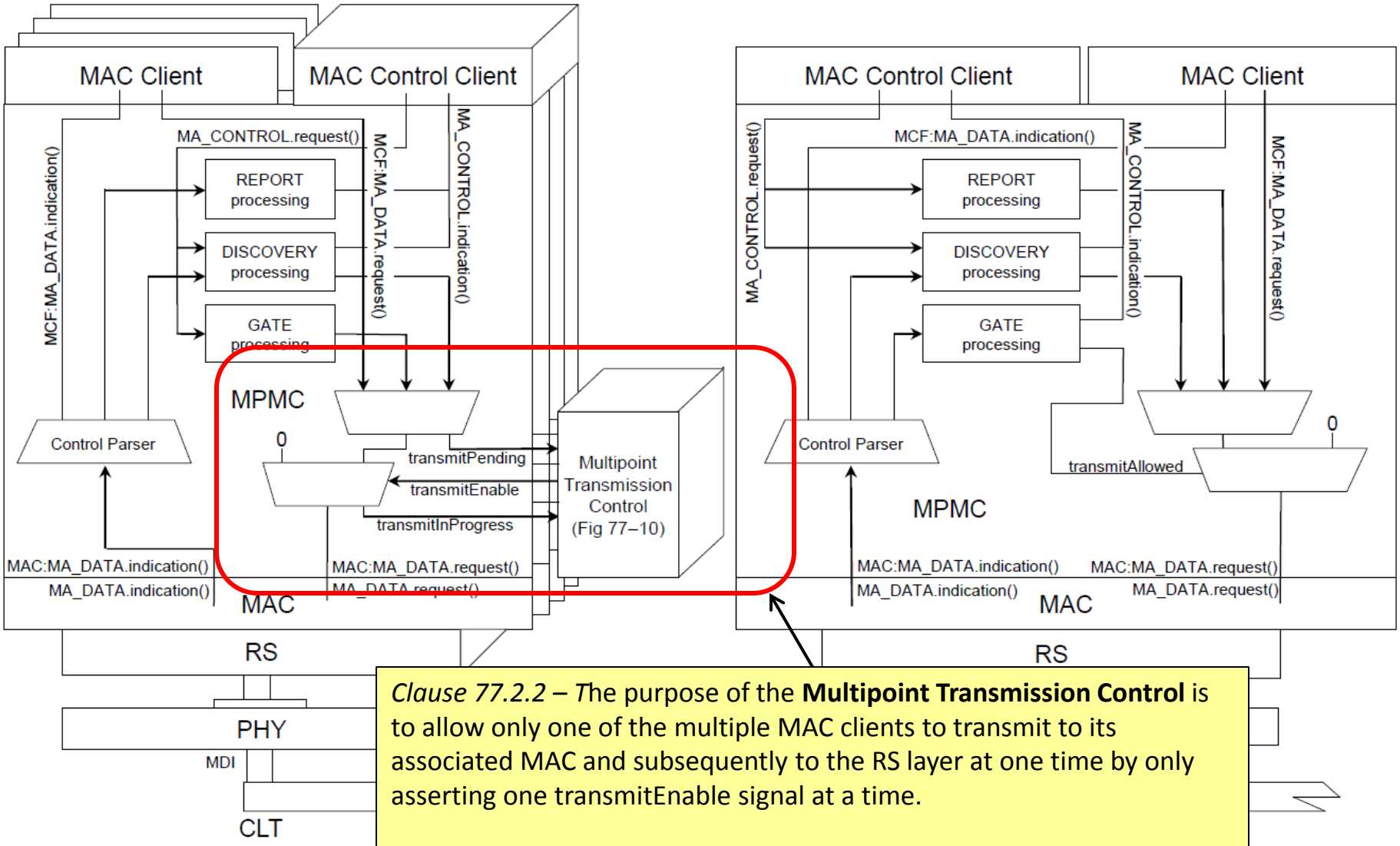


EPON – DS Multipoint MAC Control



Multipoint MAC Control – from "IEEE 802.3 Architecture" – law_01a_1112.pdf

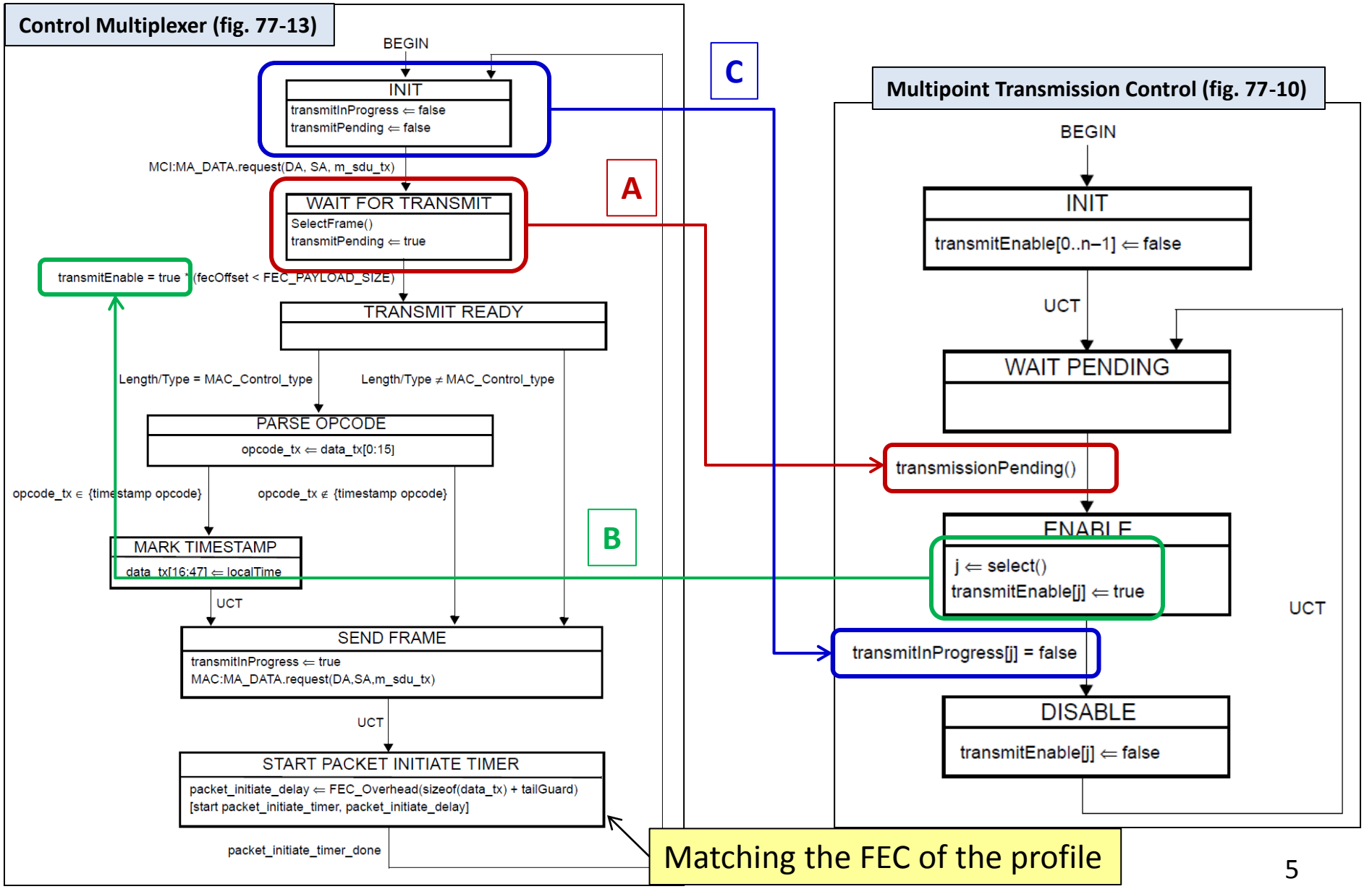
EPON – DS Multipoint MAC Control



*Clause 77.2.2 – T*he purpose of the **Multipoint Transmission Control** is to allow only one of the multiple MAC clients to transmit to its associated MAC and subsequently to the RS layer at one time by only asserting one transmitEnable signal at a time.

The **Control Multiplexer** is responsible for forwarding frames from the MAC Control opcode-specific functions and the MAC Client to the MAC.

1. Scheduling – DS Multipoint MAC Control (77.2.2)



1. Scheduling – DS Multipoint MAC Control

select(): This function selects the next Multipoint MAC Control instance allowed to initiate transmission of a frame. The function returns an index to the *transmitPending* array for which the value is not false. The selection criteria in the presence of multiple active elements in the list is implementation dependent.

transmissionPending(): This function returns true if any of the Multipoint MAC Control instances has a frame waiting to be transmitted.

transmitEnable: This array contains one element per each Multipoint MAC Control instance. Elements of this array are used to control the transmit path in the Multipoint MAC Control instance at the CLT. Setting an element to TRUE indicates that the selected instance is permitted to transmit a frame. Setting it to FALSE inhibits the transmission of frames in the selected instance. Only one element of *transmitEnable* should be set to TRUE at a time.

transmitInProgress: This array contains one element per each Multipoint MAC Control instance. The element *j* of this array set to on indicates that the Multipoint MAC Control instance *j* is in the process of transmitting a frame.

A → control frames of a MAC Instance are prioritized over data by *selectFrame()*

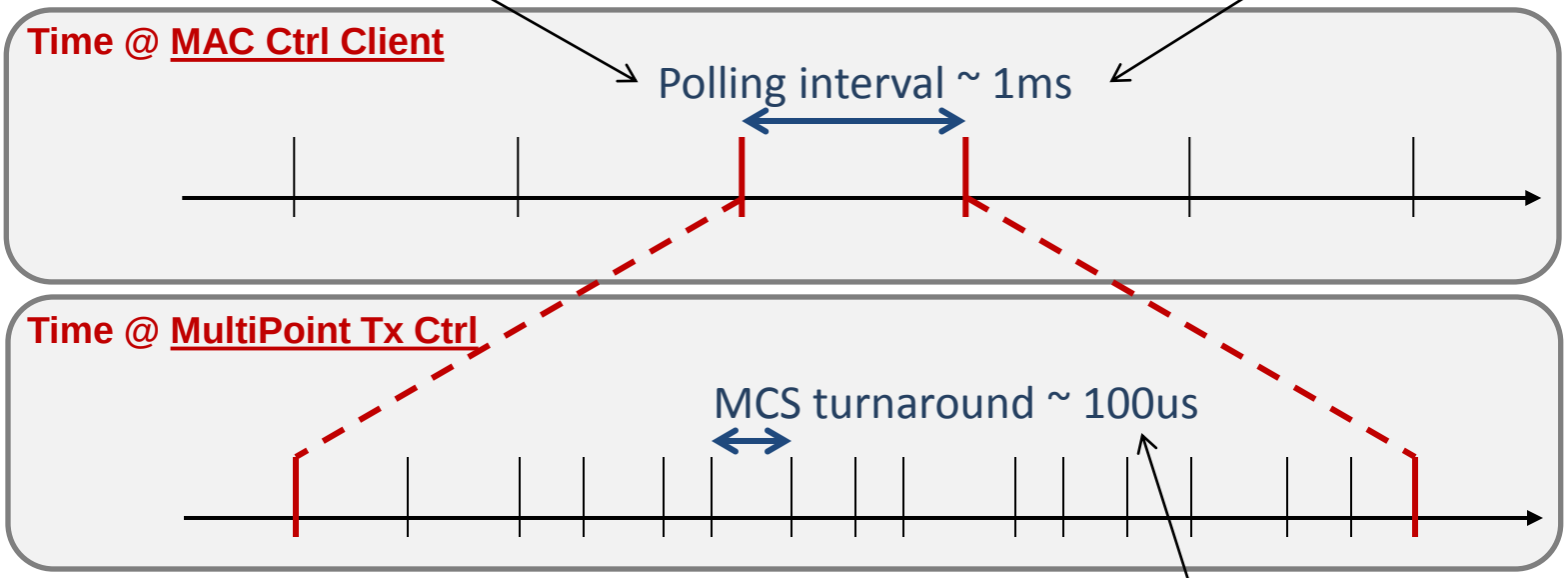
B → the transmission token is given by the scheduler to user j ← select()

C → at the end of the transmission, the token is given back to the MP TX Control

1. Scheduling – GATE message handling

The *MAC Ctrl Client* produces GATE messages in order to poll all CNUs regularly (polling interval).

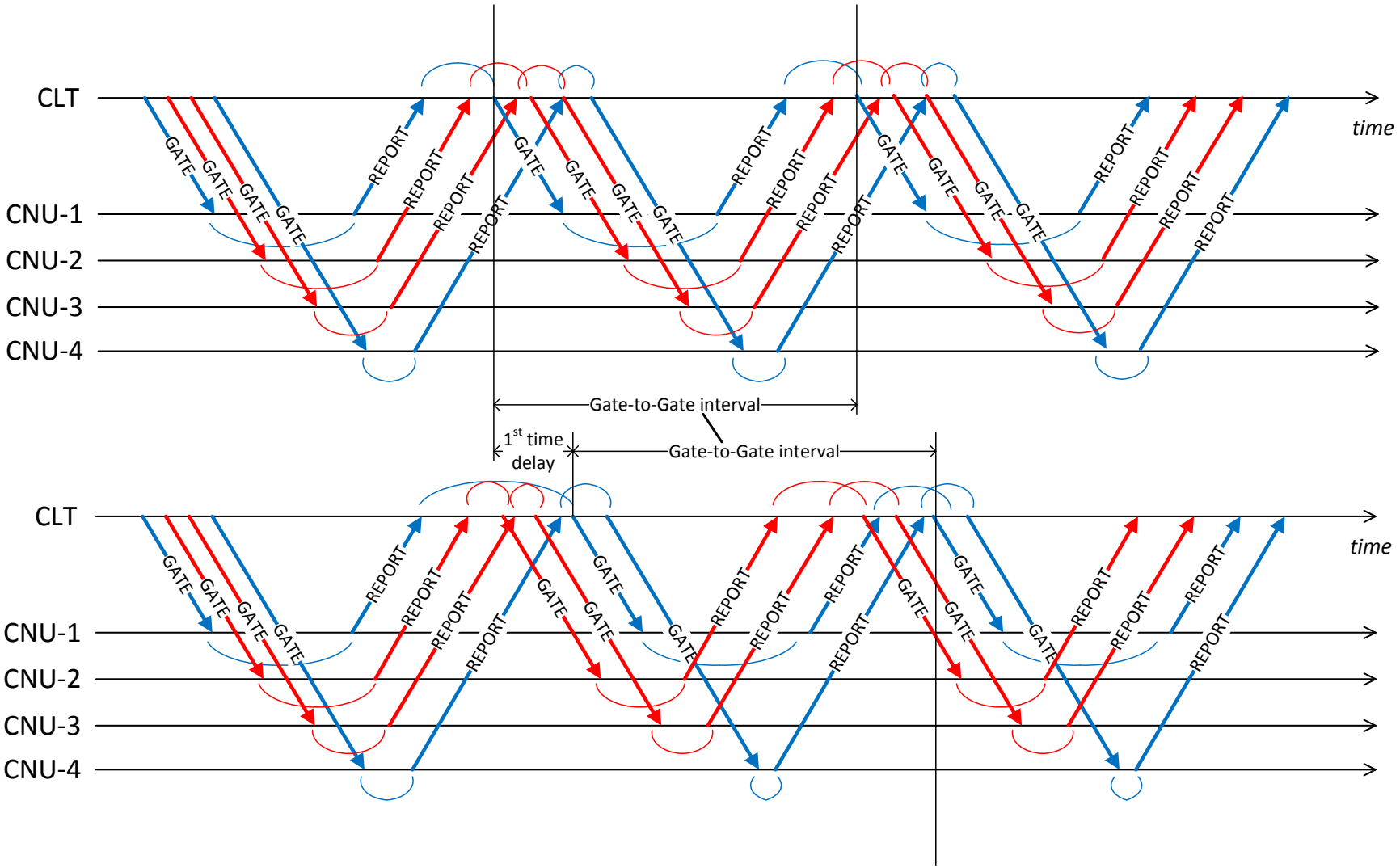
The *polling interval* is typically in the order milliseconds (*tens of OFDM symbols*)



The scheduler within the *Multipoint Tx Ctrl* enables transmissions from MAC Clients according to the MCS they are associated with.

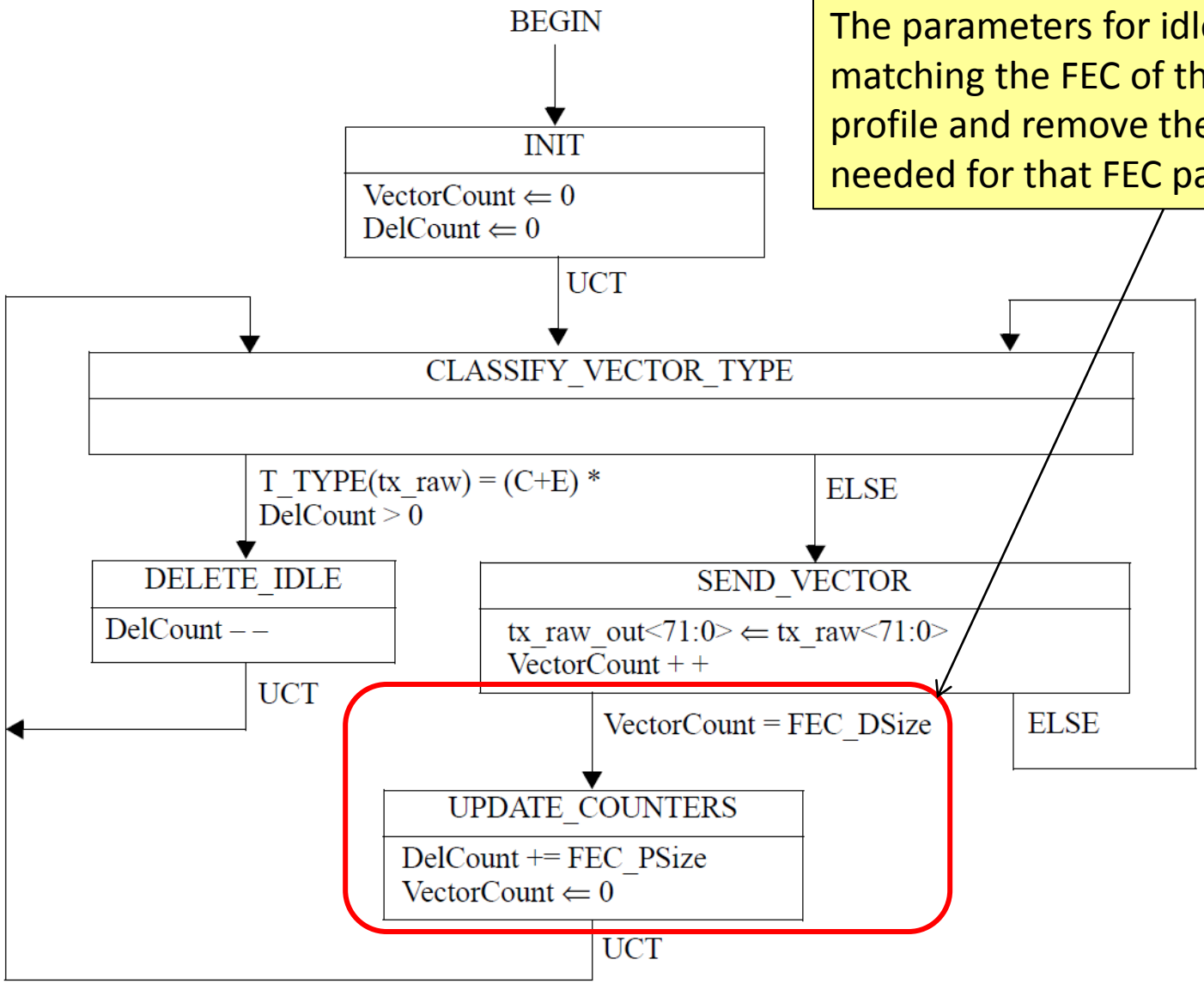
The *turnaround time* is the time the scheduler takes to cycle through all MCSs.
The turnaround time may be variable (most general case), but in any case it will span only *few OFDM symbols*.

1. Scheduling – GATE/REPORT timeline

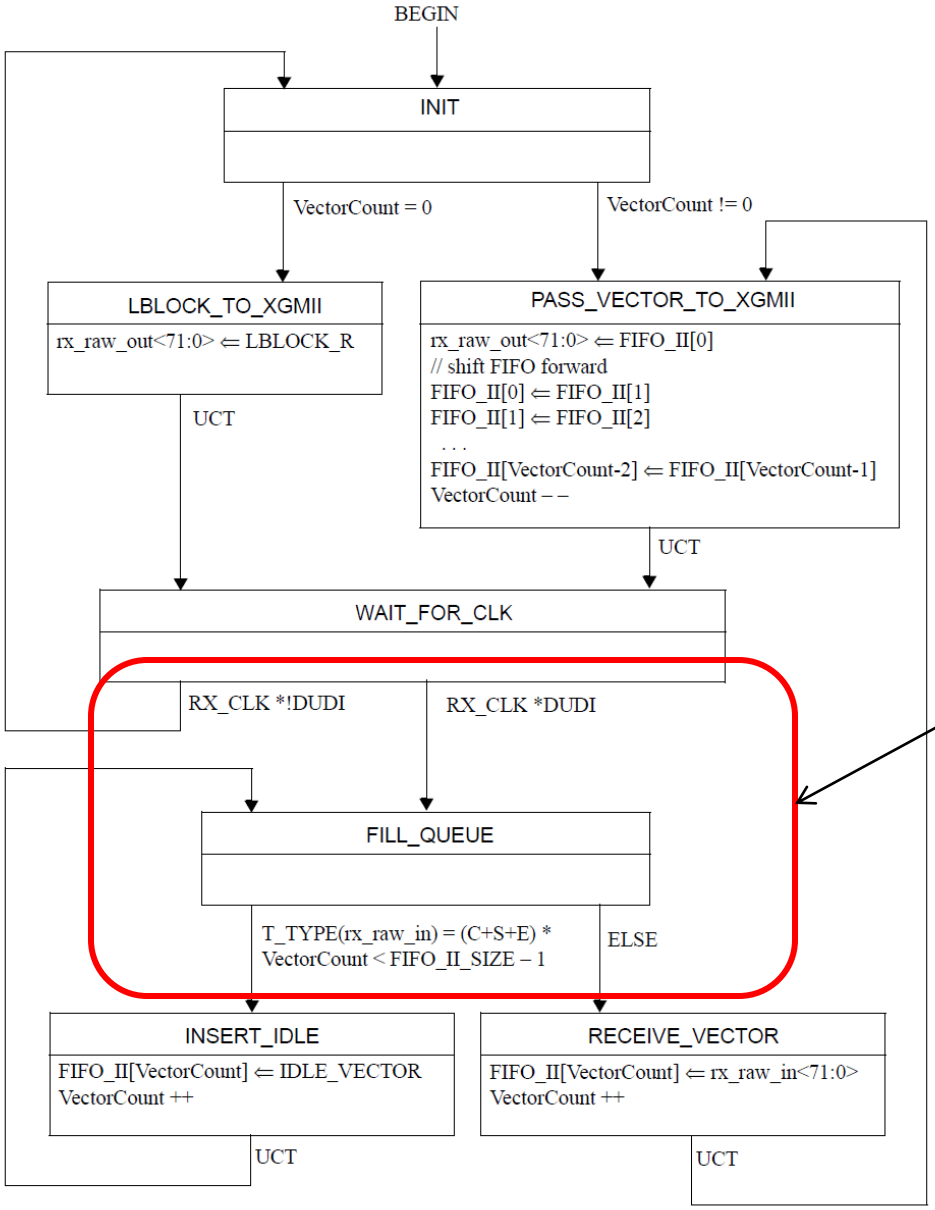


2. DS TX Idle deletion in PCS

Clause 76.3.2.1
The parameters for idle deletion are matching the FEC of the corresponding profile and remove the number of idles needed for that FEC parity



3. DS RX Idle insertion in PCS



Clause 76.3.7
At the CNU receiver, idle insertion is performed at PCS

For each profile, the function of EPON could be in principle reused, input by the corresponding FEC decoder of the CNU

Multiple Profile Architecture – Summary

- The function ***select()*** in the CLT Multipoint Transmission Control selects MAC Client grouping them over certain time interval – data or control packet can be selected, **control remain prioritized**

- Idle Insertion at CLT Control Multiplexer **matches the FEC of the profile** of the selected CNU, for correct parity insertion – de-rating can be applied according to the rate of that profile

- Idle deletion at CLT PCS transmitter **uses parameters of FEC and rate of the related profile**, for correct idle removal

- Idle insertion at the CNU PCS receiver is input by the FEC decoder of the corresponding profile, **inserting idle for FEC parity removal, un-decoded code words and XGMII rate match**

Question and Answers – mail from Ed on Jan 8

- [Q1 – from Ed] "The solution proposed requires new OLT functionality and it is not compatible with existing OLTs. It doesn't matter where you define it outside of the PHY. It doesn't exist so it is not compatible and it requires additional define outside the scope of the project. EPON over Coax should leave EPON alone. "
- **[A1 – QCOM]: There is no change in EPON, the changes are for the EPoC part only, namely in CLT and/or CNU – this is the scope of the project in our understanding.**

- [Q2 – from Ed] In the current solution, the downstream MAC/PHY is a pass through device. There isn't shuffling of packets to group them. The shuffling is not reversed on the output so a packet is jitter. The scheduler has no definition and in fact, it does nothing. The proposed solution requires adding scheduler functionality that doesn't exist. It is not compatible for that reason.
- **[A2 – QCOM]: please refer to slides 5 and 6: the specification clearly mention scheduler functionality in section 77.2.1, which is implementation dependent and accomplish for DS via a proper algorithm that is behind the function *select()*. That function decides which MAC Client to serve in case multiple clients request to transmit.**

Question and Answers

- [Q3 – from Ed] The fiber has a fixed delay and data rate. This solution is not like Ethernet or EPON with QoS/packet ordering is handled at the higher layer. Shuffling and jittering packets in the MAC layer is a mess. The data rate is based on the amount of spectrum available and not the position of the modem in the network.
- **[A3 – QCOM]: There is no jittering between entry and exit point of XGMII, as all decision are done above that layer. The *select()* function select users according to certain rule (implementation dependent, already possible today) and the timestamp happens after that selection (see slide 5) as today. The packet then get processed and transmitted and this process is following the same operations of idle deletion, encoding, modulation, interleaving and IFFT, reversed in CNU receiver.**
- **Tend to disagree that in a coax network the data rate is not affected by the location of the modem in the network and the components that needs to be crossed till there - there is clearly a dependency as shown by the various data presented by MSO.**

Question and Answers

- [Q4 – from Ed] When you shuffle packets, the packets are jittered on the downstream. They do not enter and exit with the same delay. If you timestamp the packets and add a play out buffer at the output, you can remove the jitter. This adds delay but doesn't add the jitter.
- [Q5 – from Ed] It is expected that the MAC/PHY has a fixed delay and performance. This solution varies the delay (by shuffling packets between stations) and data rate based on the other traffic. The priority of my traffic is not used to determine the order to the output.
- **[A4/5 – QCOM]: Please see slide 5, shuffling is between users (not packet belonging to the same flow – they remain in the original order) and applied before timestamp at MPCP – there is therefore no jitter and all packets enters XGMII and exits that after a fixed delay as in the current system. If we were to shuffle packets directly below the XGMII interface, then jitter may occur and would have to be addressed.**
- **The data rate for one profile is constant and it is optimized to what the CNU could receive based on its channel conditions – this help achieving high throughput and decrease the overall delay as for the same amount of data, less time is needed to carry them and resources are free sooner for other users, which also wait less.**

Question and Answers

- [Q6 – from Ed] I don't know how to explain this. The GATE frame comes out based on the scheduler. If it is not going in the MMP block that is currently going out, the MMP block needs to break up the FEC block or delay the GATE until the proper FEC block comes around. It is either very inefficient or it adds a millisecond or more to the schedulers delay to generate a GATE. This goes into the REPORT/GATE loop.
- **[A6 – QCOM]: Please see slides 5 and 8: the GATE packets are input to the Control Multiplexer of the CLT and are prioritized over data packets as in the current spec – this is achieved by the function *SelectFrame()*. The Multipoint Transmission Control only receives a *transmitPending* signal and it does not know whether there is a GATE or data, it simply schedule MAC Clients requesting to transmit based on certain policy (example round robin over a scheduling cycle) – this is the same as today**
- **Only once a user is selected by *select()* and enabled to transmit, the selected frame in its Control Multiplexer will timestamp the packet – this happens for GATE messages as well for data packets.**

Question and Answers

- [Q7 – from Ed] In short, we can't support MMP on smaller pipes
- **[A7 – QCOM]: Yes, we can. It is a matter of what performance metrics mostly matter to the particular operator in the particular plant and spectrum conditions. The idea with MMP is to provide sufficient flexibility for the operator to choose from and it can well be than in certain situation single profile is better and will be configured – as said multiple times, this is and shall be possible in our opinion.**