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Bandwidth Assignment Methods for EPOC

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Outline

- General bandwidth assignment considerations
- OFMDA Downstream and MAC layer requirements
- OFDM Downstream and MAC layer requirements
- OFDMA Upstream and MAC layer requirements
- Conclusions

This is a baseline proposal of bandwidth assignment methods for EPOC

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General Considerations

- Narrow band receiver
  - Lower cost and lower power consumption
  - Suitable for OFDMA
  - Need control message for tuning
- Bandwidth assignment considerations for narrow band receiver
  - Choose adjacent subcarriers/subcarrier groups
  - All subcarriers/group start and stop transmission simultaneously to simplify control message
- Full-band/wideband receiver
  - No tuning is needed, simplify MAC control
  - Works especially well with EPON MAC
  - Suitable for OFDM
  - May consume more power
- Bandwidth assignment considerations for full band/wideband receiver
  - Subcarrier/group does not have to be adjacent
  - Need to consider guard band between OFDM channels and SC QAM channels

General Considerations (continue)

- Upstream maximum bandwidth range option: 5MHz to 200 MHz
  - 195 MHz maximum useable bandwidth
  - 5 MHz to 42 MHz range could be reserved for DOCSIS during the coexist period
- Downstream maximum bandwidth range option: 300 MHz to 1.1 GHz
  - 800 MHz maximum useable bandwidth
  - TF could define a evolutional or stepped approach
    - For example steps with 200 MHz, 400MHz, 600MHz, etc.
    - Corresponding downstream spectra range:
      - 300 MHz to 500 MHz
      - 300 MHz to 700 MHz
      - 300 MHz to 900 MHz
      - 300 MHz to 1.1 GHz
- 85 MHz mid-split and high-band split (high band upstream) are another options

MAC requirements for OFDMA Downstream

- **Scheduling for EPOC OFDMA downstream**
  - **Hybrid TDMA and OFDMA scheduler**
  - **2 dimensional (time and subcarrier)**
  - **Need control messages for tuning or digital tuning**
- **EPON does not have downstream scheduling mechanism**
  - **Need a new downstream message similar to GATE message**
    - **Start Subcarrier (SSC)**
    - **Start Subcarrier Group (SSCR)**
    - **Number of Subcarriers (NSC)**
    - **Number of Subcarrier Group (NSCG)**

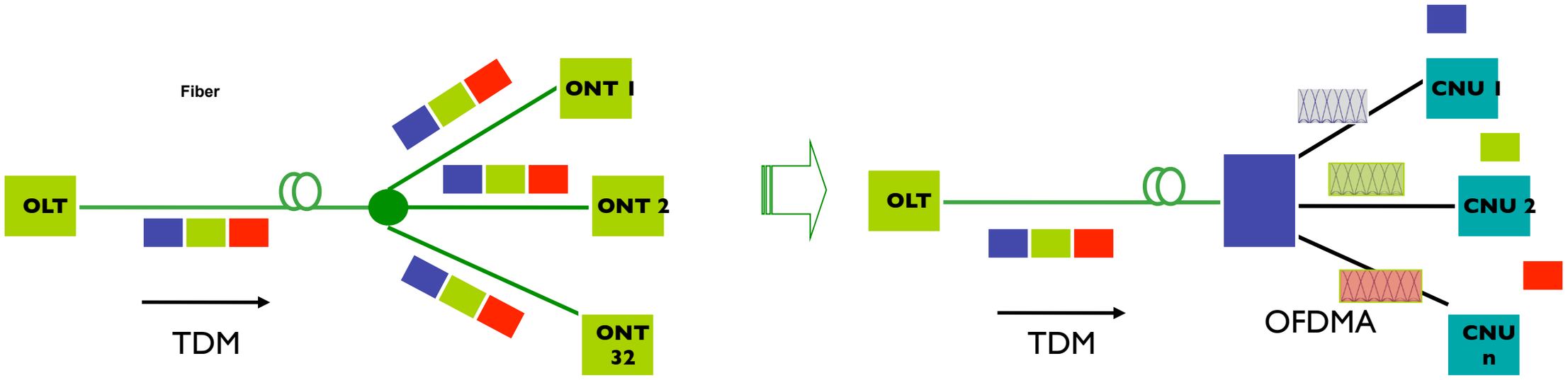
Example:

New MPCP CNU receiver configuration WINDOW message

Byte	
6	DA
6	SA
2	Length/Type =0x8808
2	Opcode = TBD
4	Time stamp
2	SSC/SSCR
2	NSC/NSCG
36	PAD
4	FCS

Problems with OFDMA for Downstream

- A new MPCP RX_Conf_Window message is needed to configure CNU receivers
  - A major change to MPCP; not “minimum augmentation”
  - New hardware may required; current EPON MAC does not support
  - Backward compatibility is a problem
- Change DS P2M shared physical “channel” to P2P physical “channels”
  - How to deal with multicast and broadcast?
    - OFDMA multicast and broadcast channels?
  - Implementation complexity



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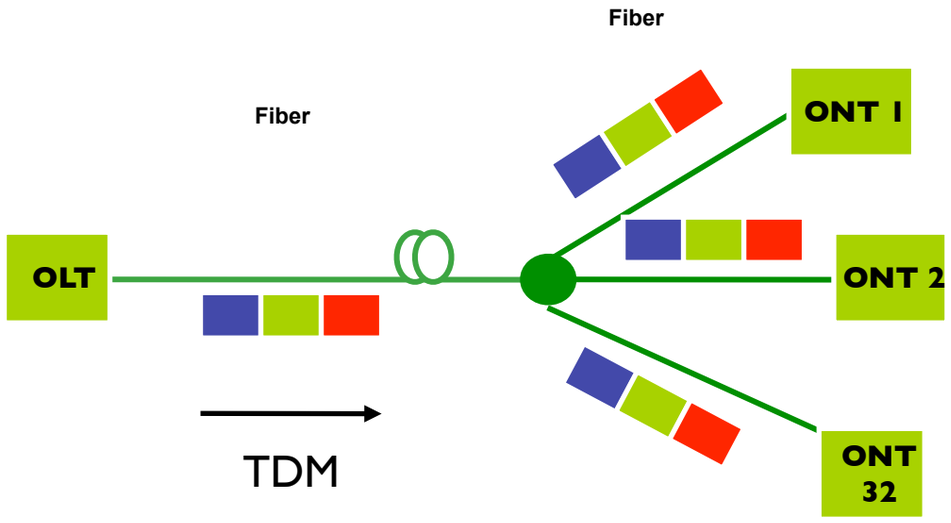
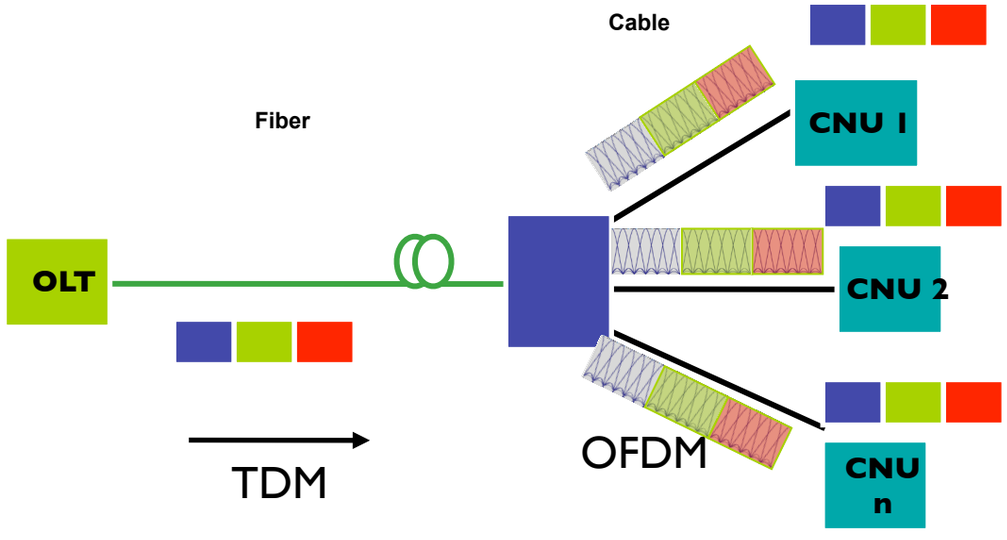
MAC requirements for OFDM Downstream

- No scheduling is needed for EPOC OFDM downstream
  - Keep EPON TDM
  - 1 dimensional scheduling
- Full band capture enables CNU to directly decode EPON MAC frames
  - OFDM RX replaces Optical RX
  - DS subcarrier assignment is controlled by OLT; CNUs do not need to know
  - CNU MAC implementation is the same as that of ONU
  - No new MAC control message is needed
  - An EPOC system behaves the same way as an EPON system
    - Multicast and broadcast





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MAC requirements for OFDMA Upstream

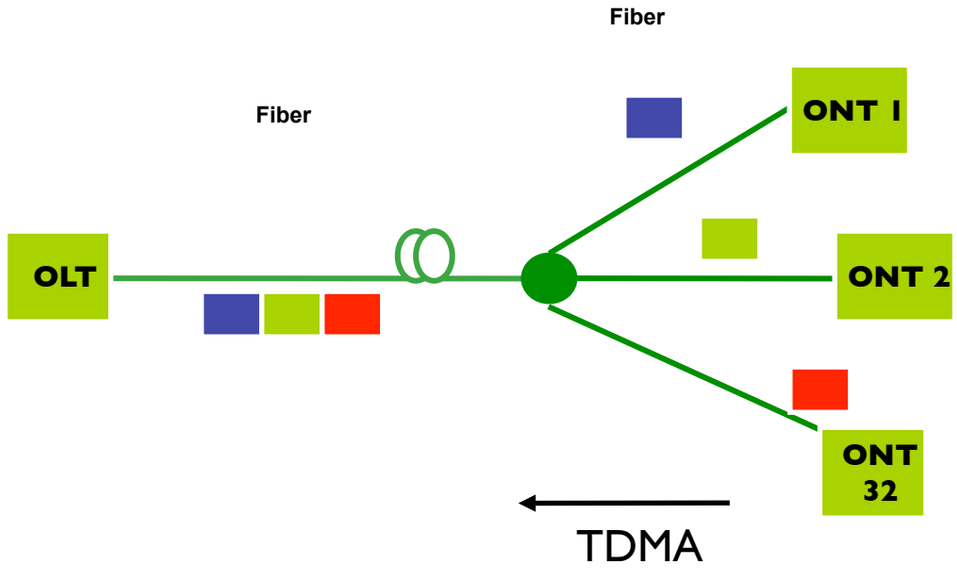
- **Mapping TDMA to OFDMA**
  - **Allow parallel transmission, Reduce latency**
- **Could be done with NO MAC changes**
  - **For example, direct time to time/ frequency mapping**
- **In worst case it may need new control messages for upstream subcarrier assignment**
  - **Could be done with extension to the MPCP GATE message**
  - **Assuming PHY layer negotiations completed**
- **Example of extension of GATE message**
  - **Grant n Start Subcarrier (SSC)**
  - **Grant n Start Subcarrier Groups**
  - **Grant n Number of Subcarriers (NSC)**
  - **Grant n Number of Subcarrier Groups (NSCR)**

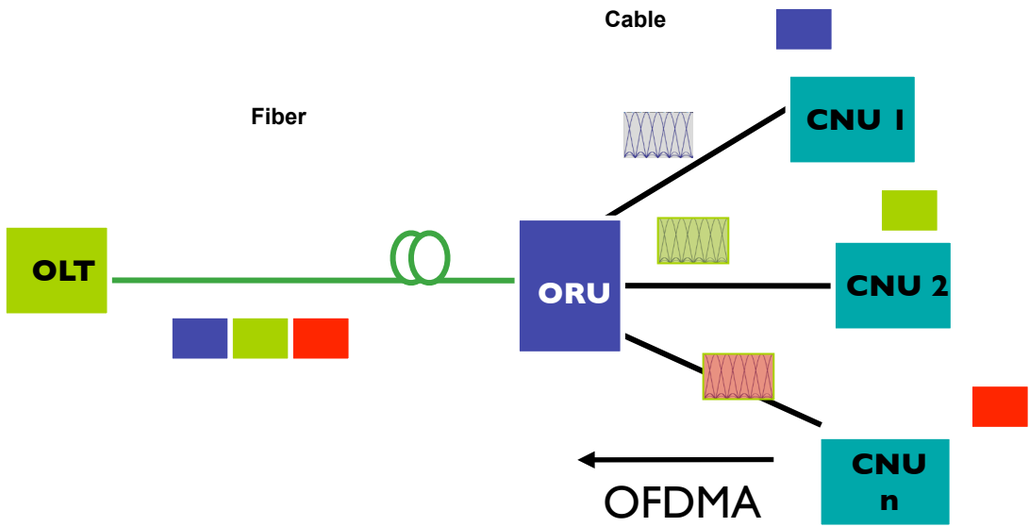
Example of MPCP GATE extension:

Byte	
6	DA
6	SA
2	Length/Type =0x8808
2	Opcode = TBD
4	Time stamp
1	Number of Grant
4	Grant 1 start time
4	Grant 1 Length
2	Grant 1 SSC/SSCR
2	Grant 1 NSC/NSCR
	Grant 2 …
3-39	PAD
4	FCS

Advantages of OFDMA Upstream

- OFDMA can be implemented with no changes to MPCP (recommended approach)
- If OFDMA requires changes to MPCP
  - Changes can be minimum and limited to the extension of GATE message only
  - Might result in hardware changes if MPCP processing is implemented in hardware
- In either case the P2P upstream topology is maintained without any changes





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Conclusions

- OFDMA downstream needs a new MPCP message, similar to GATE message, is considered a major change
- OFDMA downstream for EPON introduces implementation complexities
  - May need hardware change
  - System behavior of EPOC may be different from that of EPON
- OFDM downstream does not need any change to MPCP
  - No hardware change is needed
  - An EPOC system behaves the same as EPON
- OFDMA upstream allows parallel transmission to reduce latency
  - No or minimum hardware changes

We propose OFDM downstream and OFDMA upstream for EPOC as the baseline

Thanks

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