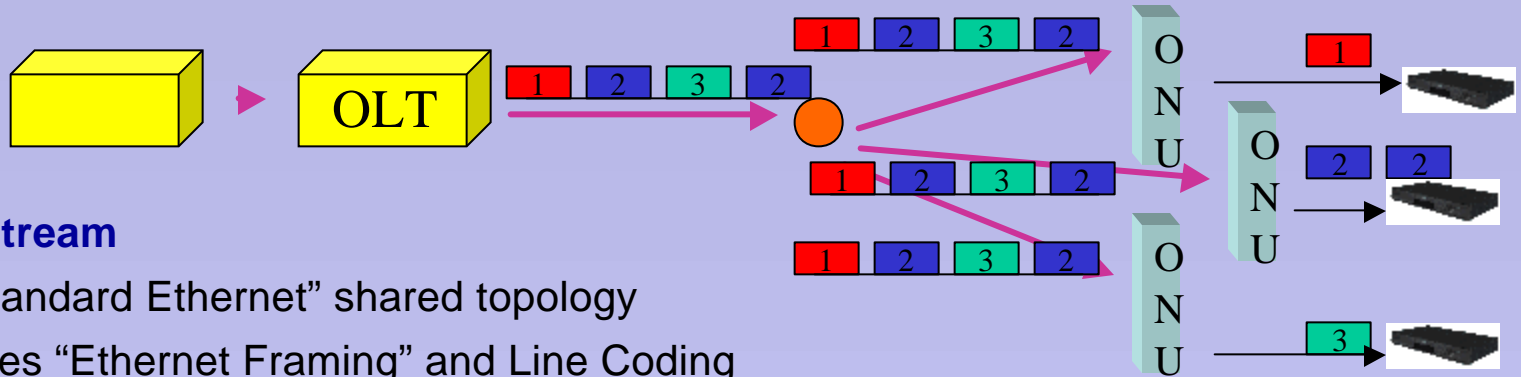


# **MPCP: Multi-Point Control Protocol for EPONs**

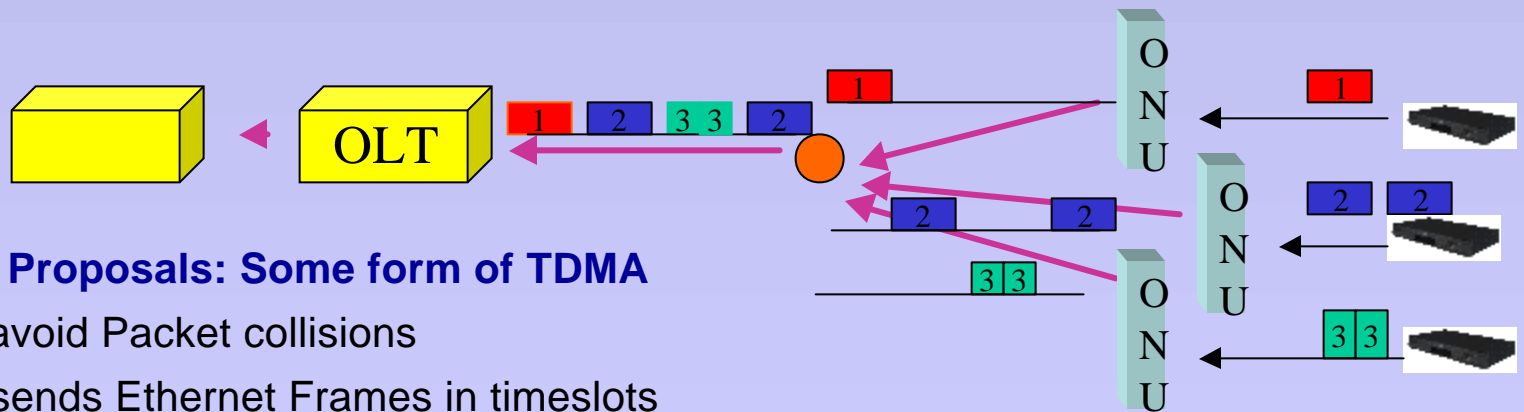
**Bob Gaglianella**

# EPON Basics



- **Downstream**

- “Standard Ethernet” shared topology
- Uses “Ethernet Framing” and Line Coding
- Packets selected by filtering mechanism



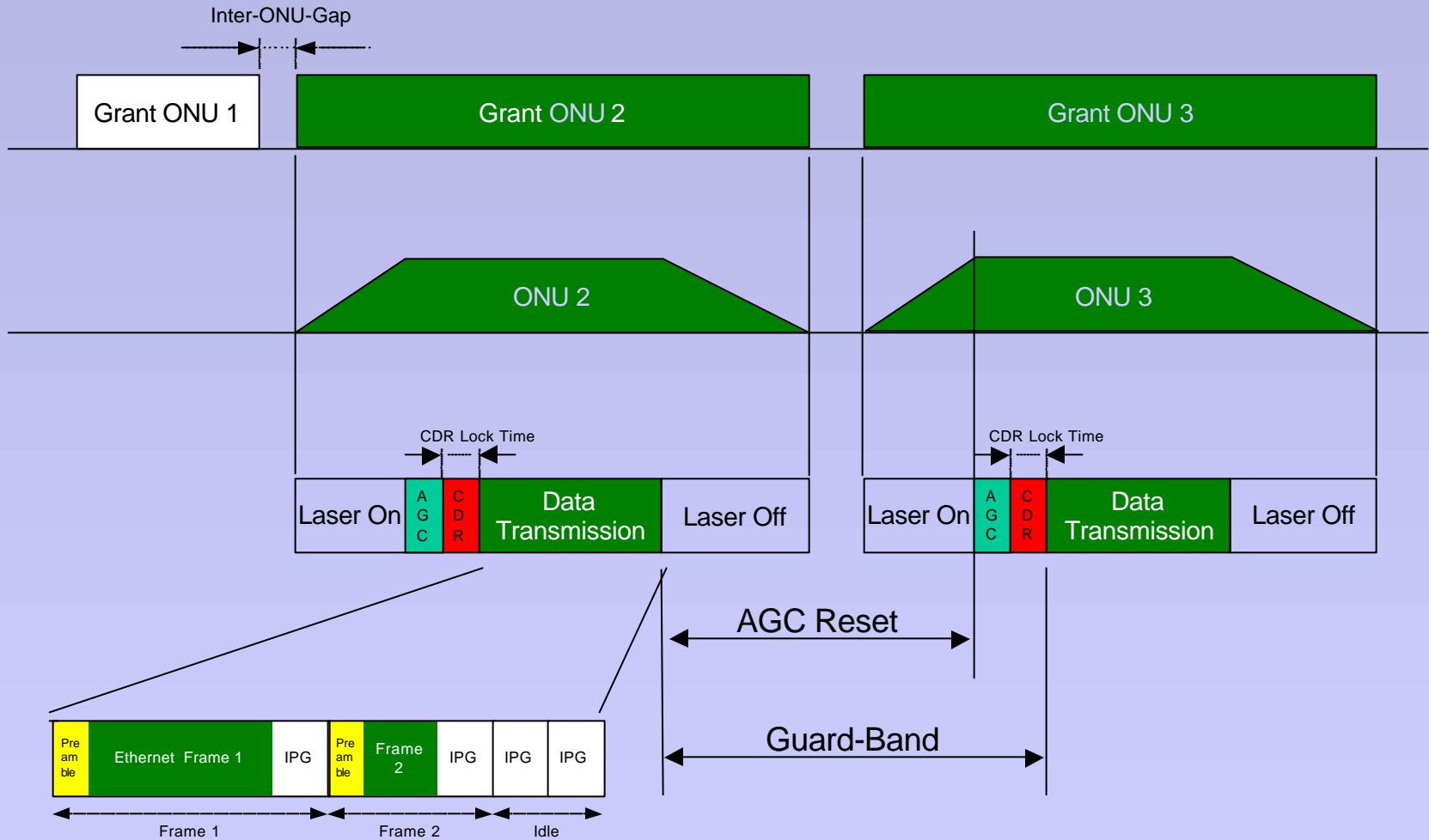
- **Upstream Proposals: Some form of TDMA**

- Must avoid Packet collisions
- ONU sends Ethernet Frames in timeslots
- Allocation of timeslots is Main function of MPCP
- BW allocation easily mapped to timeslots

# Multi-Point Control Protocol (MPCP) Overview

- The (MPCP) specifies mechanism between an OLT and ONUs connected to a Point-to-Multi-Point (P2MP) Pon segment to allow efficient transmission of data **in the UPSTREAM direction**.
- **Functions performed are:**
  - Provide Timing Reference to synchronize ONUs
  - Control Auto Discovery process
  - Bandwidth / Timeslot assignment to ONUs
- **Five new MAC control messages are introduced:**
  - **GATE, REPORT:** assign and request bandwidth
  - **REGISTER\_REQ, REGISTER, and REGISTER\_ACK:** used during the **Auto-Discovery** process

# Burst Mode Data Reception (OLT's View)

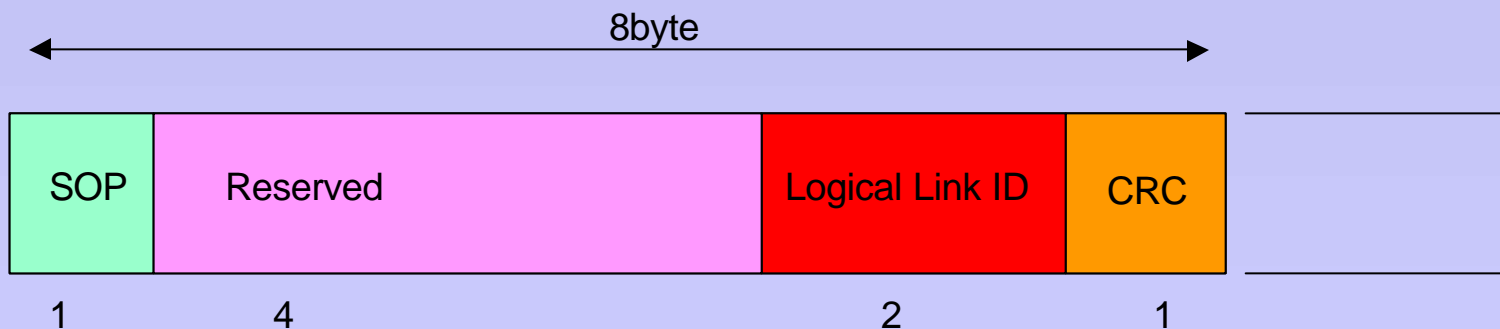


# Message Structure

- **MAC Control is layer responsible for message generation and termination**
- **MAC Control imposes known EtherType, demultiplexing is performed through opcode field**
- **Distinct opcode defined for each message type**
- **Length limitation of 64 bytes imposed by MAC Control**
- **Content limit when using a 64 bytes MAC control packet is:**  
$$64 - 6(\text{DA}) - 6(\text{SA}) - 2(\text{EtherType}) - 2(\text{MAC control opcode}) - 4(\text{FCS}) = 44$$

# Logical Link ID (LLID) Format

- **8 byte Preamble to carry:**
  - 2byte : Logical Link-ID
  - 2-4byte : Reserved
  - 1byte : CRC
- **2 byte Logical Link-ID = 1-bit mode indicator + 15 Bit PHY-Ids**
- **Mode indicator: P2P / Shared Emulation**
- **CRC8 protected**



# MPCP-Timing Model

- **Absolute timing model**
  - A global clock exists in the OLT
  - All MPCP messages are timestamped by local clock
  - Timestamp is added when message is transmitted by MAC Control layer
  - ONUs set their local clock to OLT clock
  - Clocks count in 16 bit-times(16 nsecs) granularity and are 32 bits “long”

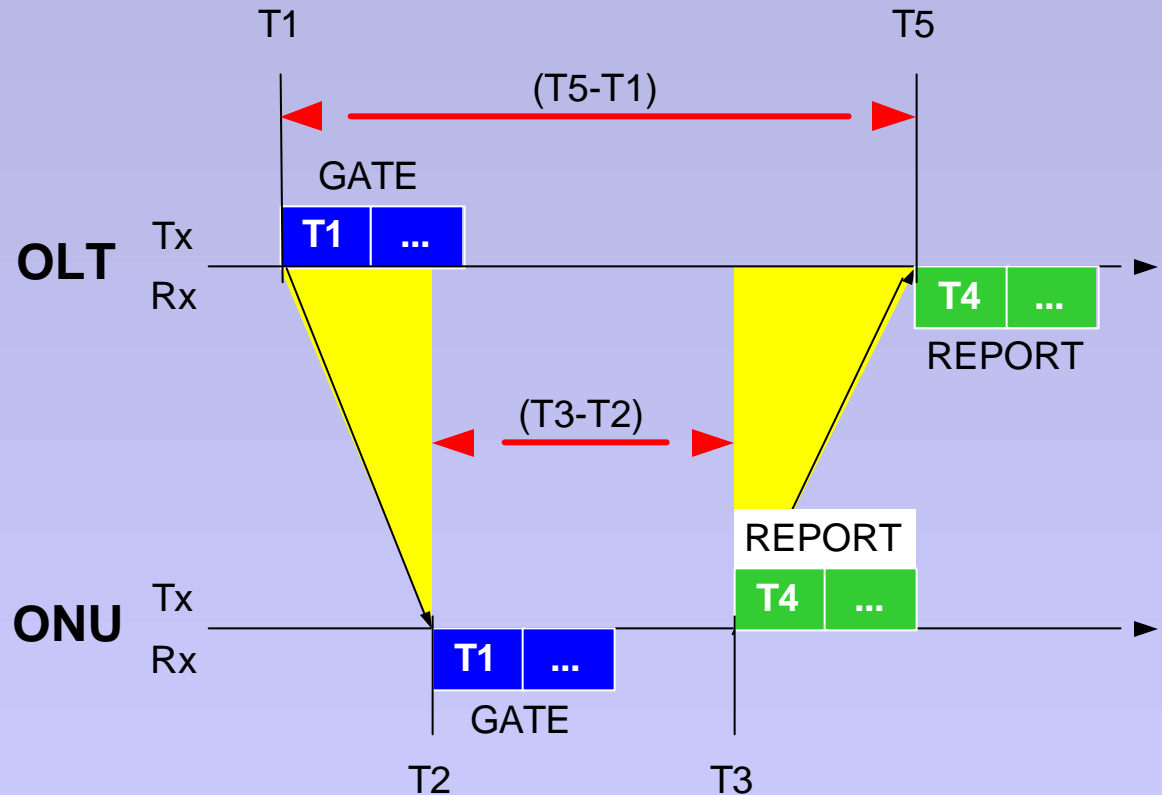
# RTT Compensation

- Delay compensation is performed at OLT
- Grants to ONU reflect arrival time that is compensated for RTT
- Example:
  - If OLT is to receive data from an ONU at time  $T$ , it will send GATE containing Slot Start =  $T - \text{RTT}$
- Minimal and maximal distance defined between the timestamp and start-time, to allow for processing time



# Ranging - RTT Measurement

- OLT sends GATE at absolute T1
- ONU receives GATE at T2, and resets local clock to show T1
- ONU sends REPORT at time T3, showing timestamp T4
- OLT receives REPORT at absolute T5



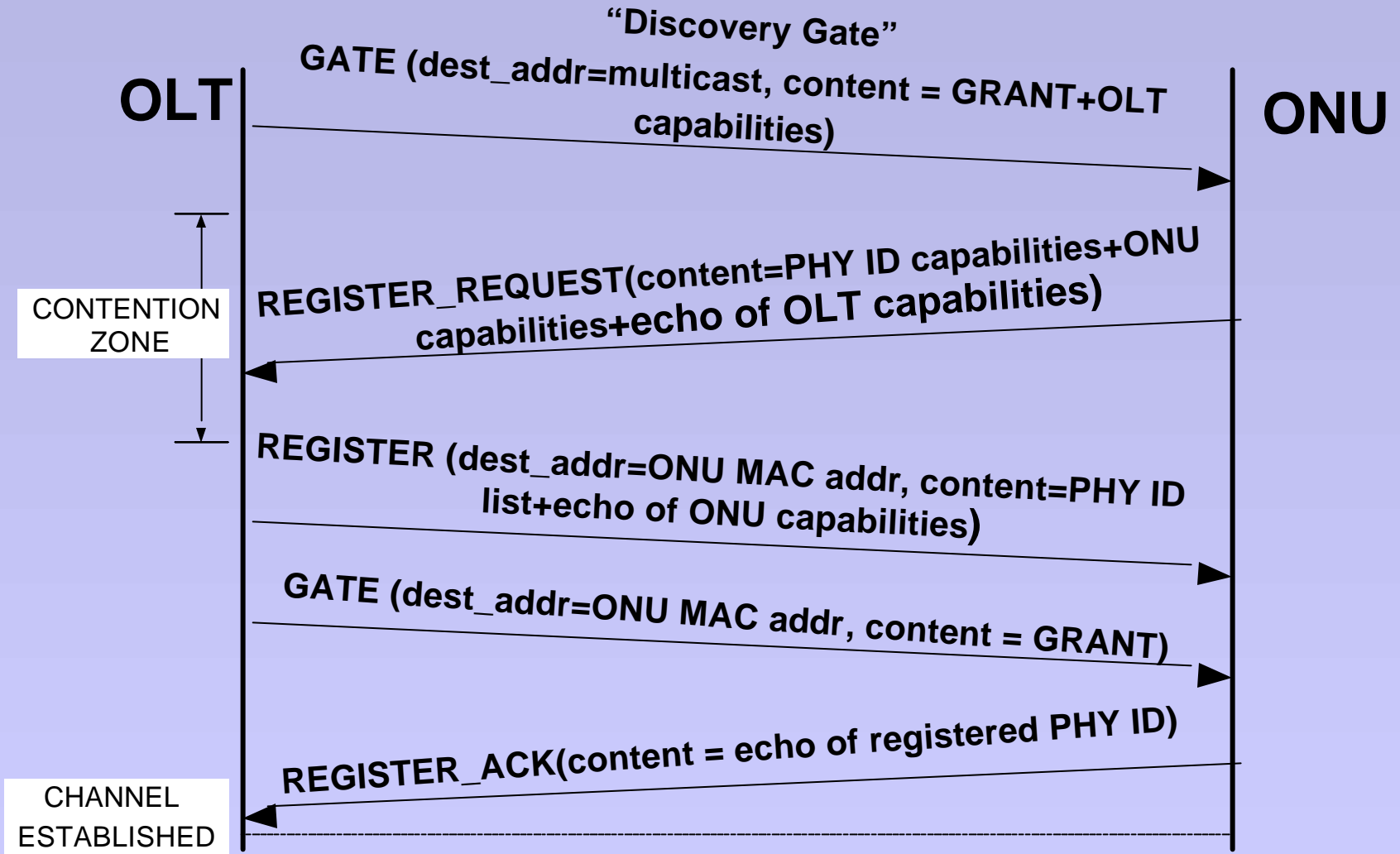
$$RTT = T2 - T1 + T5 - T3 = T5 - T4$$

$$T3 - T2 = T4 - T1$$

# Auto Discovery

- **Harmonizing a new ONU into a PON**
  - Knowing it's there
  - Knowing who it is
  - Negotiating System parameters such as:
    - Determining RTT
    - Laser turn-on/off times
    - CDR lock, AGC settling times
  - Assigning LLID's for ONUs

# Discovery Sequence Summary



# MPCP- Goals

- **Optimize Network Resources:**
  - Ranging is performed to determine ONU distance, and reduce slack
  - Reporting of bandwidth requirements by ONUs allow dynamic allocation of bandwidth
  - Fast scheduling cycles allow support of over-subscription
  - At least 128 ONUs supported in the PON
  - Optical parameters are negotiated to achieve optimal performance

# MPCP Goals Continued

- **Address Service Provider Requirements**

- Long reach (20Km), up to 128 splits
- Fast granting cycle allows low end-to-end delays, and support voice services
  - TDM services are supported with 1ms delay
- Dynamic granting capability allows fast bandwidth assignment
  - TCP services easily supported in conjunction with statistical multiplexing
- PON Native mode has single copy broadcast capability **in Downstream Direction**
  - Video can be broadcast without bandwidth waste