MPCP: Auto Discovery

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Problem Description

- **How to harmonize a new ONU into a PON**
  - Knowing it's there
  - Knowing who it is
  - Assigning ports in P2PE
  - Compensating for RTD
  - Negotiating network parameters

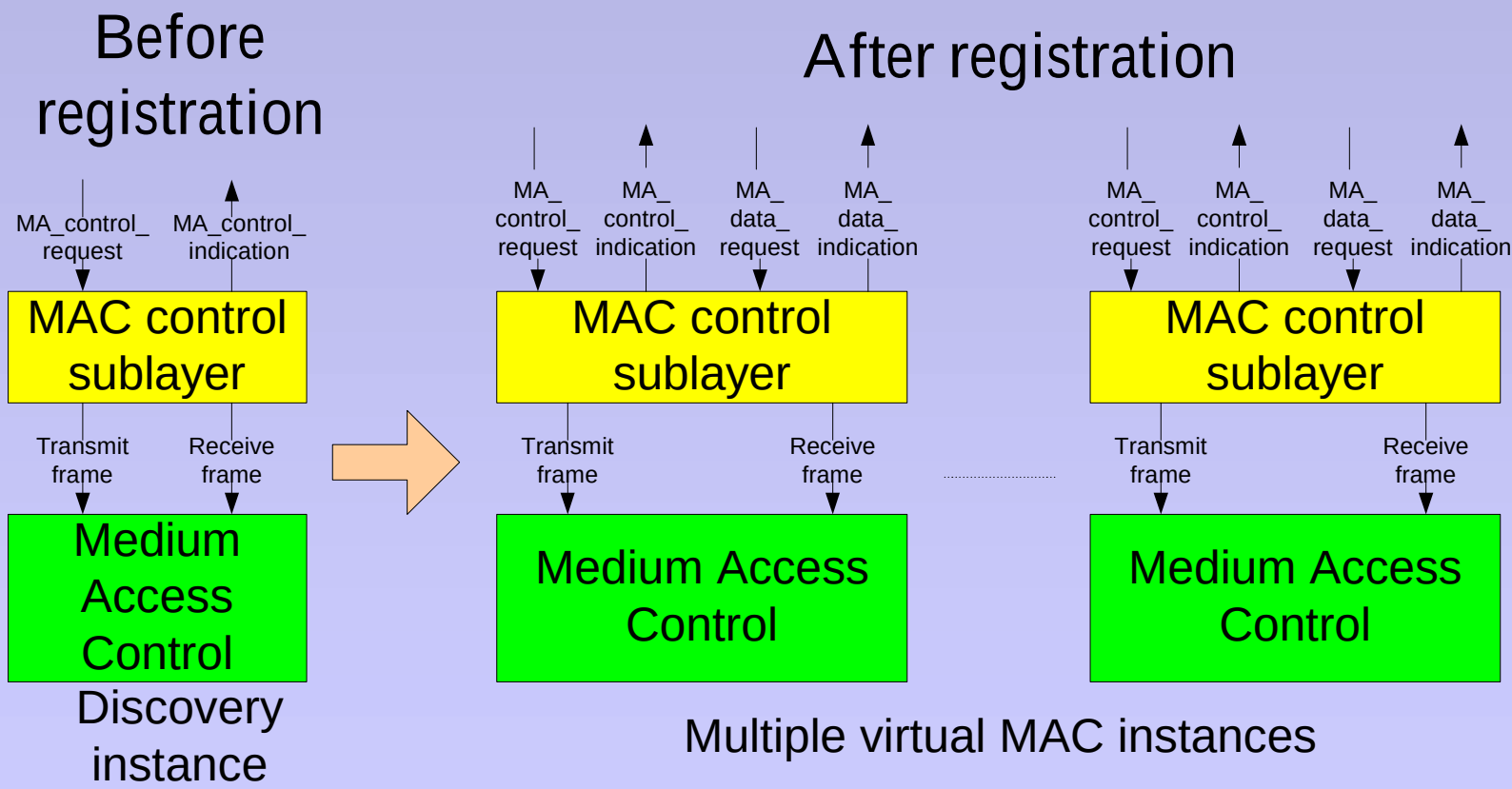
Auto-discovery Background

- **ONU address is unknown**
  - Discovery should be broadcast to all stations
- **ONUs can wake-up independently**
  - Discovery should deal with contention in ONU responses
  - Discovery is performed perpetually
- **RTD to ONU is unknown**
  - OLT should allocate big enough discovery slot

Discovery and MP2PE

- **P2PE is not active before discovery, and PHY IDs are not assigned**
  - A discovery PHY ID (=0?) is pre-assigned following reset
  - A logical link is established between OLT to all undiscovered ONUs
  - Discovery PHY ID is used until channel establishment

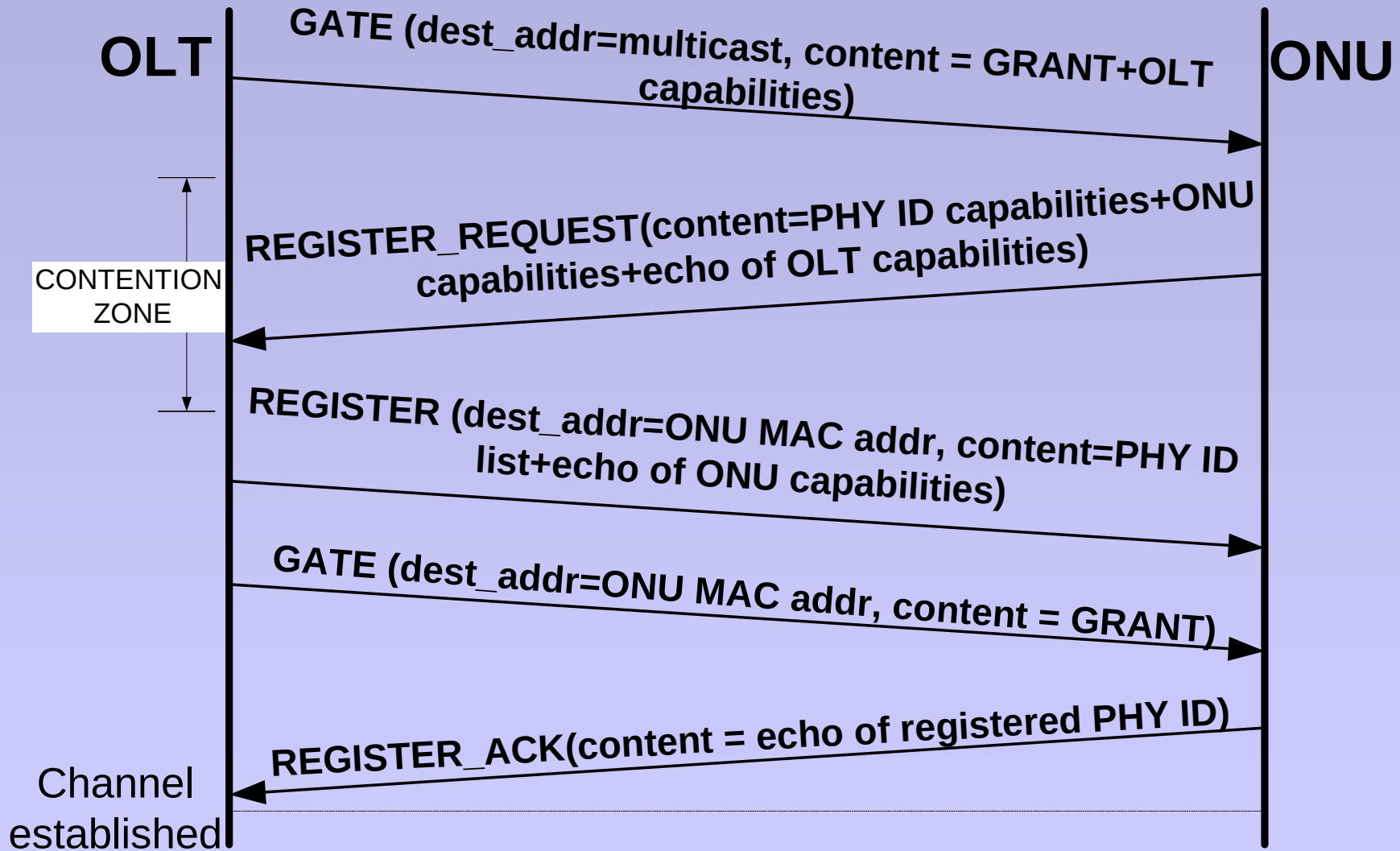
Virtual MAC Instances



Discovery Protocol

- A globally assigned multicast address may be used (for example, Pause): 01-80-C2-00-00-01
- A GATE message creates a transmission opportunity to unregistered devices
- REGISTER_REQUEST, REGISTER and REGISTER_ACK messages complete the protocol
- Contention is solved by ONU time-out on REGISTER message

Sequence Summary



GATE Message

- **OLT transmits a GATE message with the following parameters:**
  - Number of grants: 1
    - Grant type: discovery grant
    - Grant #1 start: First time to expect REGISTER_REQUEST
    - Grant #1 length: Bigger than duration of one register packet transmission
  - OLT optional capabilities
  - OLT vendor extensions
- **OLT should allocate reception window in the size of: <Grant length> + <maximal round trip delay>**

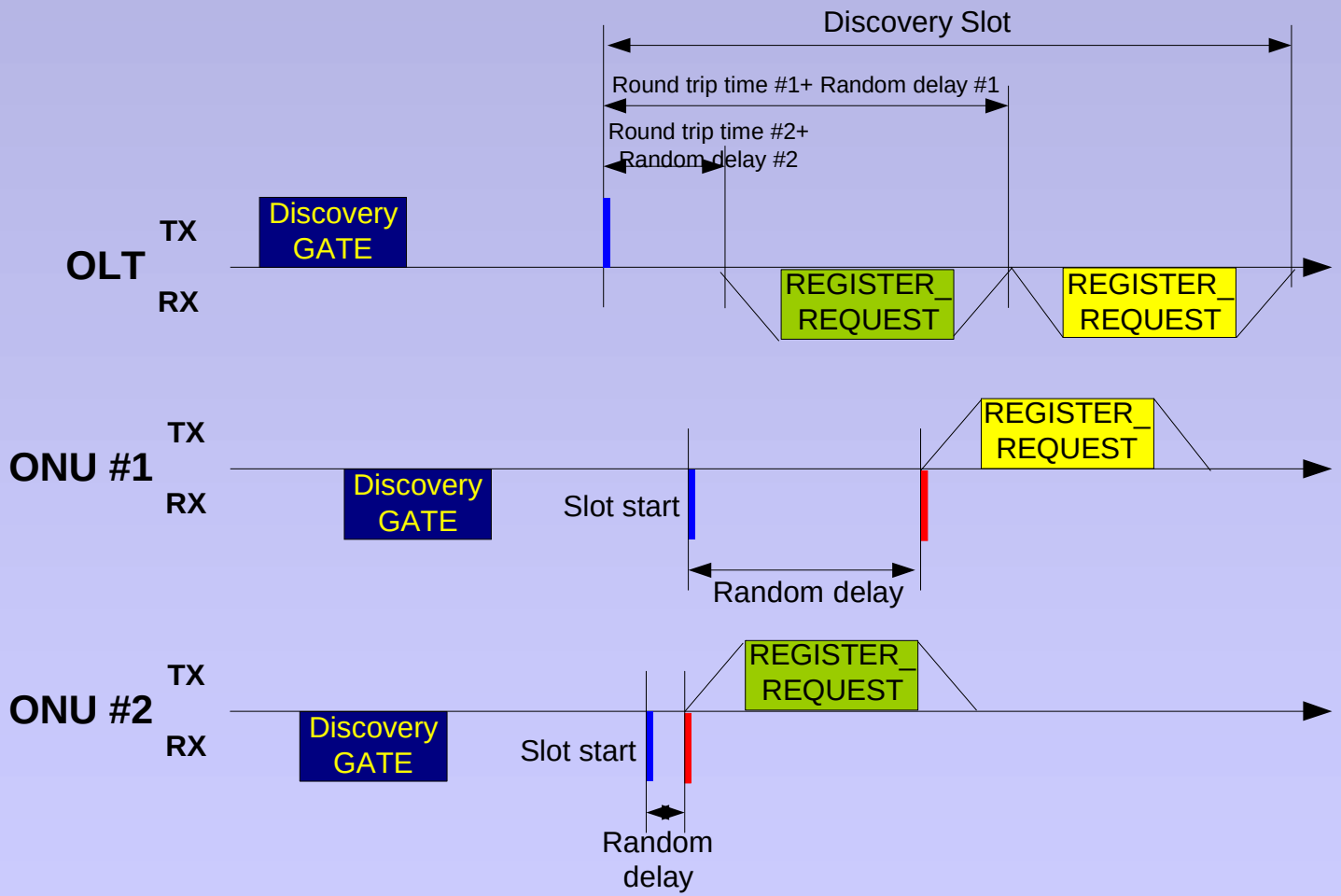
Registration Behavior

- **ONU responds only if received PHY ID matches discovery PHY ID and grant type is discovery**
- **ONU must have a REGISTER_REQUEST packet ready**
- **ONU starts to transmit randomly between <Grant start> and <Grant start> + <Grant length> – <duration of one register packet transmission>**
- **Destination address is OLT multicast address**
- **ONU MAC address is reported in src_addr field**
  - For security reasons, a random MAC ADDR may be used, though it is useless without a complete security solution

REGISTER_REQUEST Message

- **Logical PHY ID registration is static by nature and can be performed only during discovery phase**
- **REGISTER_REQUEST message contains the following parameters:**
  - Number of shared media MACs [0..1]
  - Number of P2PE MACs [0..TBD]
  - ONU optional capabilities
  - ONU vendor extensions
  - Echo of understood OLT capabilities

GATE and REGISTER_REQ



REGISTER Message

- **REGISTER message contains the following parameters:**
  - Destination address: ONU MAC address
  - Number of shared media MACs assigned
  - Shared media PHY ID value (U/M bit is set to M)
  - Number of P2P MACs assigned
  - List of P2P PHY IDs (U/M bit is set to U)
  - Echo of understood ONU capabilities

REGISTER_ACK Message

- **ONU sends REGISTER_ACK message at the first grant opportunity (grant type = regular)**
- **The registered PHY IDs are reported to guarantee creation of virtual MAC instances**
- **Allows ONU to convey non-support for an OLT capability requested in prior message, e.g.:**
  - Not enough resources remaining to support it at present time
  - Request not understood
  - Request out of range

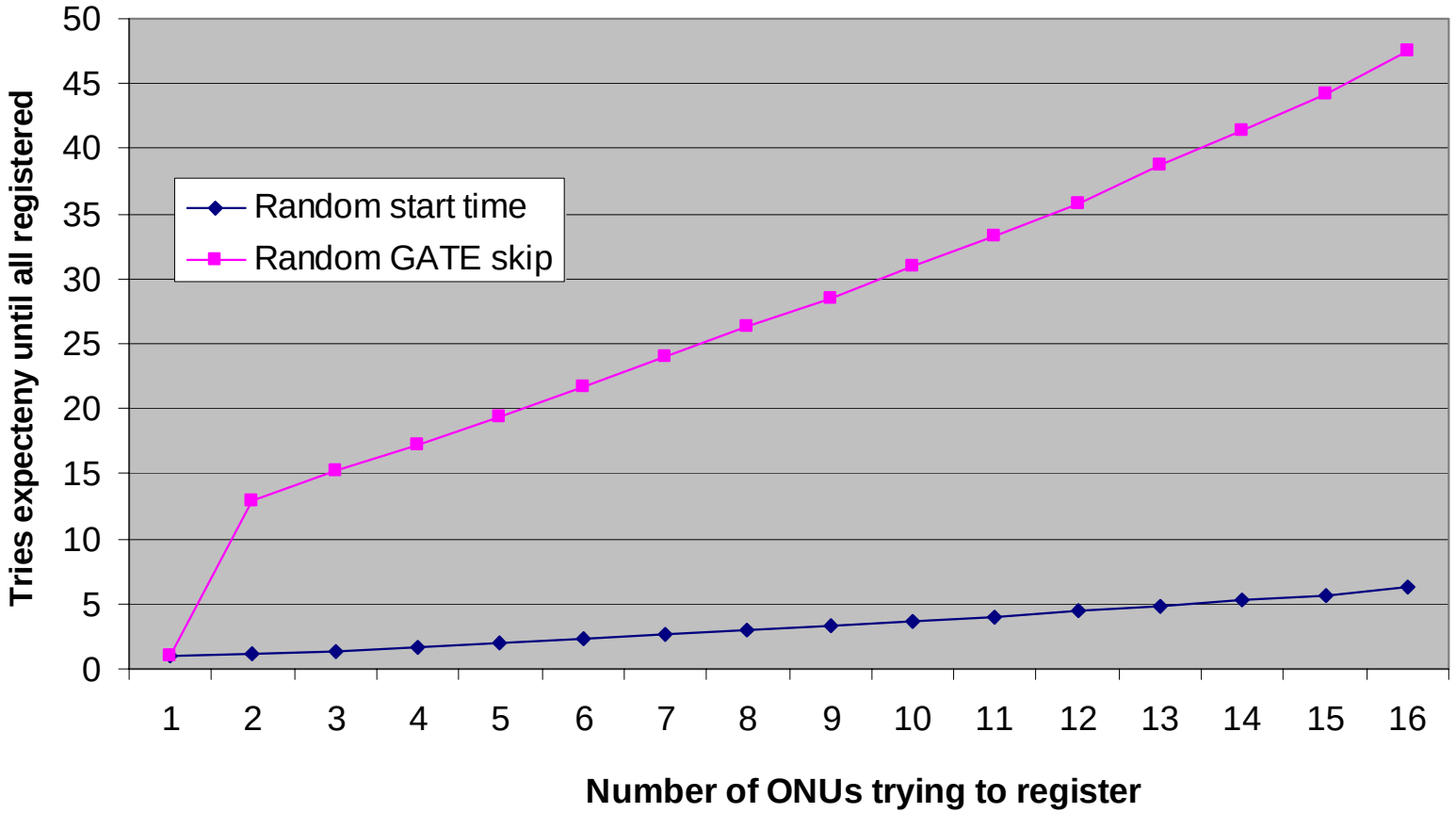
Sequence – Failure Modes

- **OLT assumes ONU is unregistered if:**
  - REGISTER_ACK message wasn't received at the first grant opportunity
  - ONU responds to discovery GATE messages
- **ONU must respond to query GATE if it hasn't received a REGISTER message after sending a REGISTER_REQUEST message**
- **Reset / timeout should be investigated**

Discovery Convergence

- **Some sort of randomization must be applied in ONU responses to discovery**
- **Two options are investigated:**
  - ONU skips (ignores) random number of discovery opportunities after previous ONU response wasn't acknowledged
    - Graph is showing exponentially growing backoff
  - ONU responds to every discovery opportunity using a random delay within the discovery grant
    - Graph is showing a scenario in which up to 8 ONUs can be registered at one attempt: grant length = 16*(packet length+switching time)

Convergence Comparison



Summary

- **Auto-discovery protocol enabling ONU plug-and-play includes:**
  - MP2PE registration
  - RTT measurement
  - Capabilities negotiation
- **Efficient collision-avoidance scheme was suggested**