Power Savings Messaging Comparison

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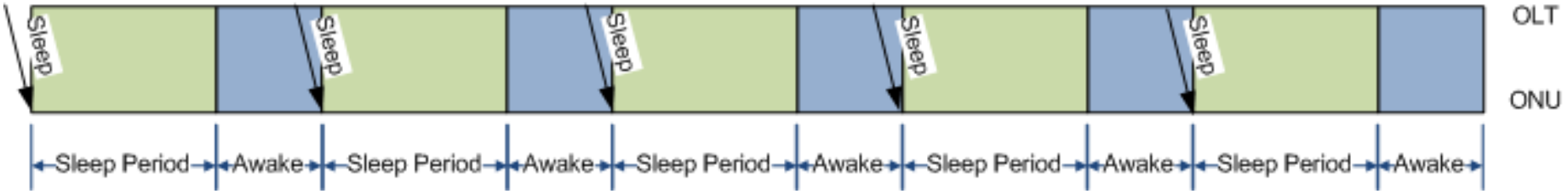
Methods of Messaging Reduction

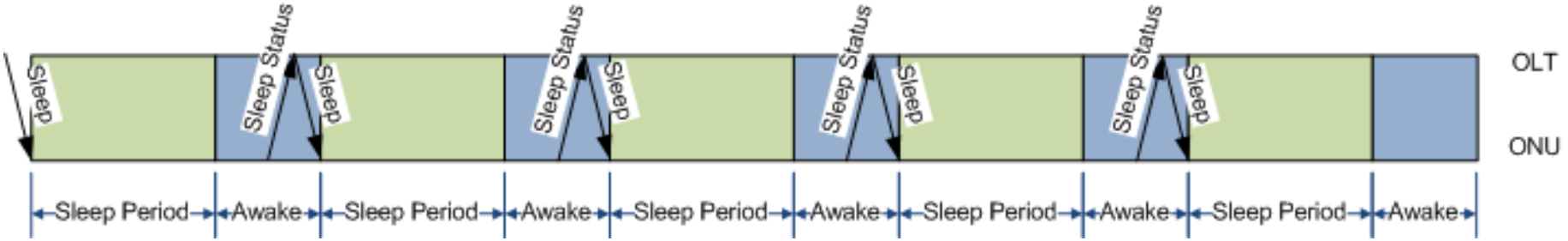
- This presentation compares 4 methods
  - Explicit cycle (OLT –Driven)
  - Explicit cycle (ONU – Driven)
  - Repeated cycle
  - Early wakeup
- The messaging overhead is directly proportional to the sleep cycle period
  - (84 Bytes per sleep message*32 ONUs per PON*8 bits per byte)/200ms = 107Kbps
  - (84 Bytes per sleep message*32 ONUs per PON*8 bits per byte)/20ms = 1.07Mbps
- Longer sleep cycles save more power, but add more delay to traffic.

Explicit cycle (OLT –Driven)



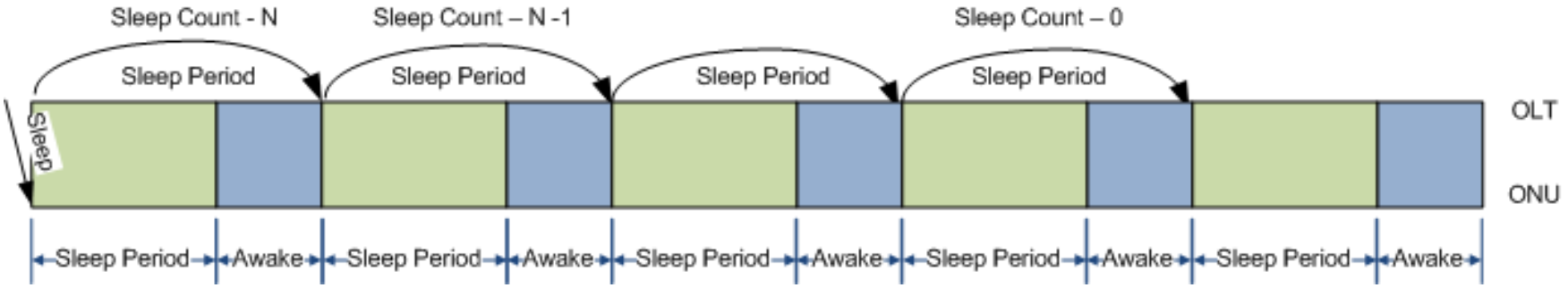
- Pros:
  - Explicit control of each cycle. The ONU always knows what to do.
  - Simple protocol and state machines
- Cons:
  - 1 message per cycle. Moderate overhead if sleep cycle is frequent.
    - Downstream : 50ms sleep cycle = 13.4 Kbps per ONU

Explicit cycle (ONU – Driven)



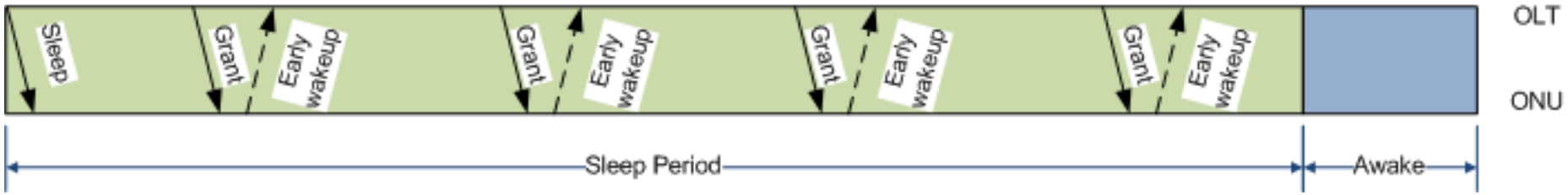
- Pros:
  - Explicit control of each cycle. The ONU always knows what to do.
- Cons:
  - 2 messages per cycle. Overhead in upstream and downstream.
    - Downstream : 50ms sleep cycle = 13.4 Kbps per ONU
    - Upstream : 50ms sleep cycle + Optical OH = **33.9Kbps** for1G ONU ; **221Kbps** for 10G ONU
      - » 50ms sleep cycle = 13.4 Kbps per ONU
      - » 1G optical OH(32 TQ Laser on + 32 TQ Laser off)*16 /50ms = 20.5Kbps
      - » For 10G optical OH could be 10x (160 bits/TQ) = 200.5Kbps

Repeated cycle



- Pros:
  - 1 message per N cycle
- Cons:
  - More complicated protocol and states at OLT.
    - Must send sleep end message if status changes in the middle of a cycle.
  - More state stored at ONU makes this less robust.
    - Timers must stay synchronized.
    - Cycles must terminate if registration status changes.
  - Many sleep cycles will be missed if sleep message is lost.

Early wakeup



- Pros:
  - 1 sleep message per extended sleep cycle + wakeup message if required.
  - Longer sleep period for greater power savings.
  - Reaction time is defined by reduced granting period.
- Cons:
  - Not good for TRx sleep if OLT needs to wakeup ONU

Conclusions

- MPCP messages are sent more frequently than sleep messages. MPCP messages are reduced or disabled while the ONU is in sleep.
  - **Bandwidth is actually gained!**
- Additional complexity should not be added to save an insignificant amount of BW.
- Early wakeup offers a method that allow longer sleep periods while reducing traffic delays.
- Optical overhead is large for upstream sleep messages from 10G ONUs and should be avoided.