MPCP and SDN
- Make 100G EPON Going Further

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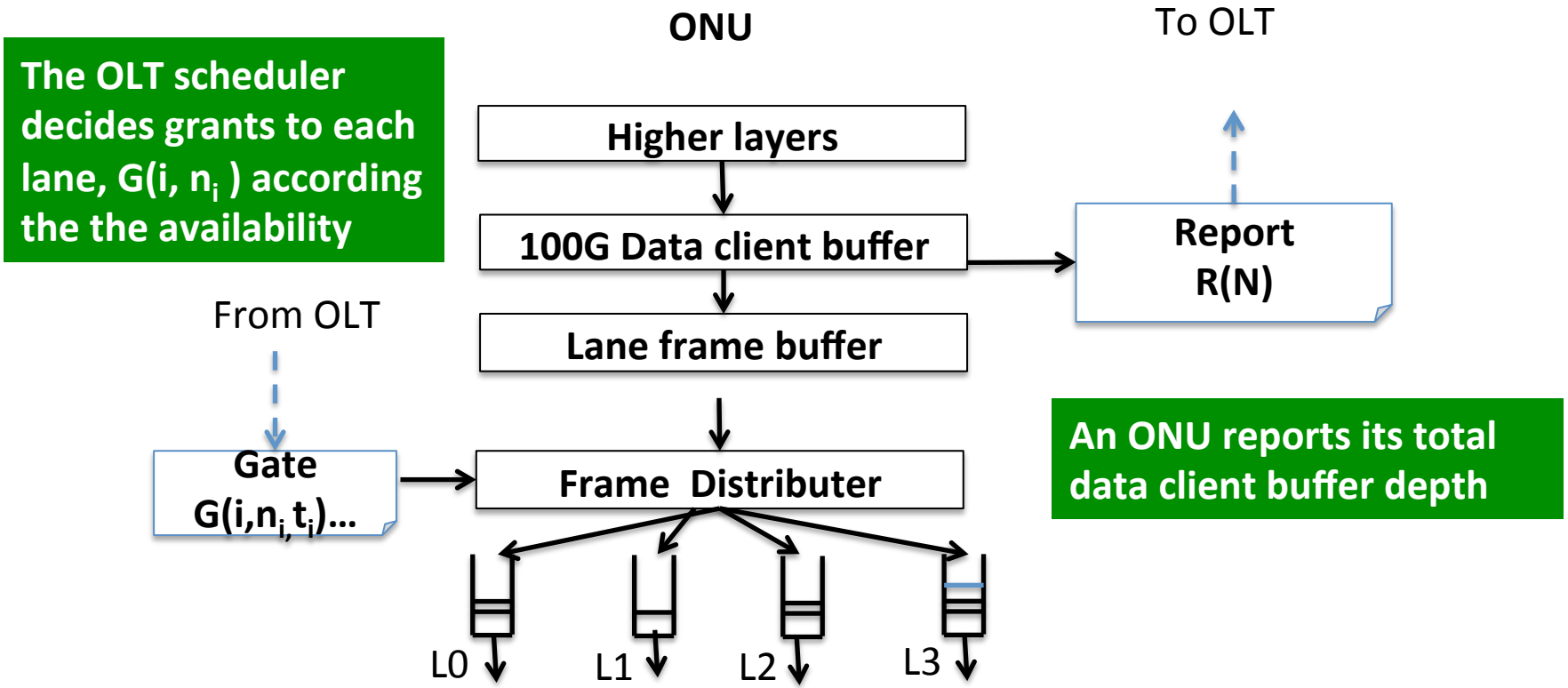
Outline

- **Frame boundary aware MPCP and fragmentation**
- **Frame boundary aware MPCP and dynamic channel bonding**
- **SDN and MPCP**

Background

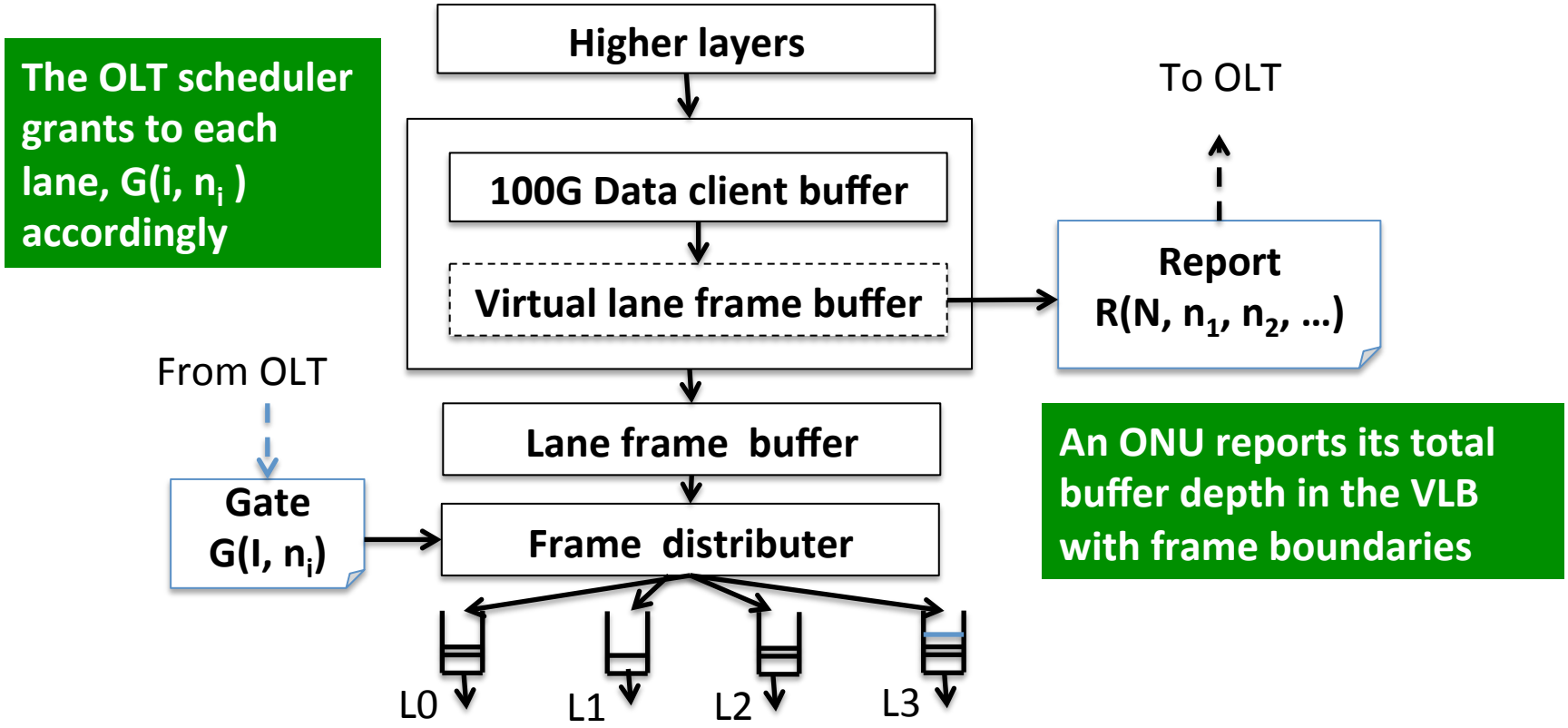
- Variable length Ethernet frames cause fragmentation in the frame based channel bonding model, such as MAC control sub-layer bonding
- Going back to RS layer bonding with FEC word as a container could avoid fragmentation of Ethernet frames, however, this approach is inflexible
- The fragmentation problem in the MAC control sub-layer bonding could be solved by introducing 2D scheduling with frame boundary aware MPCP (dai_3ca_01_0716)
- The flexible frame boundary aware MPCP enables dynamic channel bonding
- The future of SDN for PON may benefit from dynamic channel bonding

Problem with MAC control sub-layer bonding



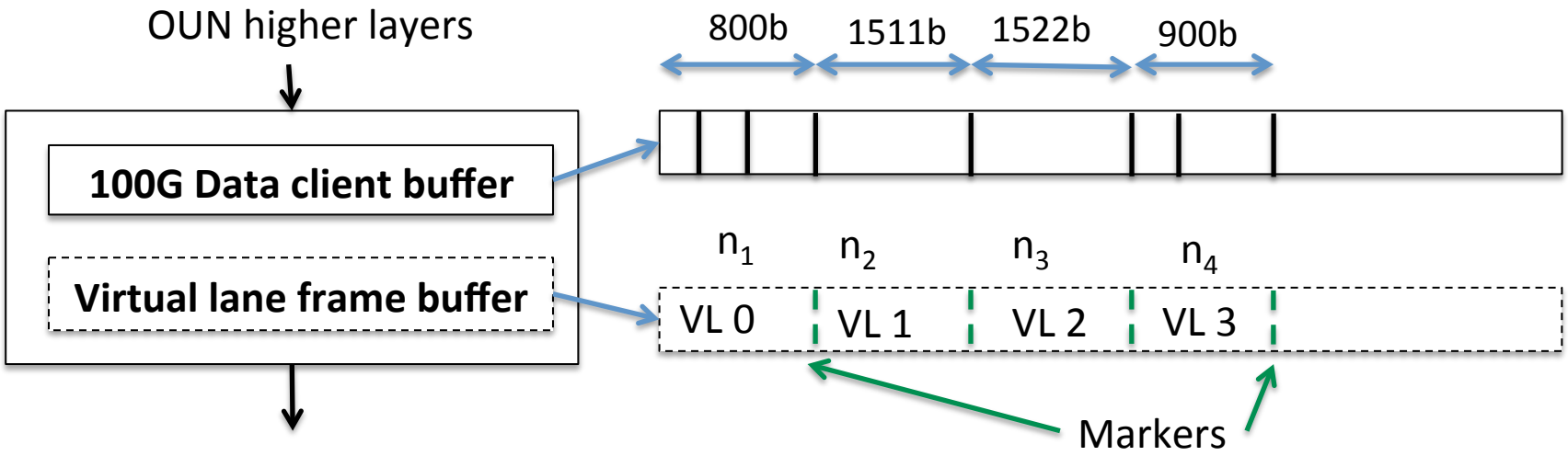
- **The OLT doesn't know the frame structures in report R(N), as a result the grant G(i, n_i) may cause fragmentation**

Solution – frame boundary aware MPCP



- ONU: Search frame boundaries in the Virtual Lane Buffer, report buffer depth in VLB with frame boundaries
- OLT: Grant each available lane according to the frame boundaries
- The result is no fragmentations

Example of frame boundary aware MPCP report

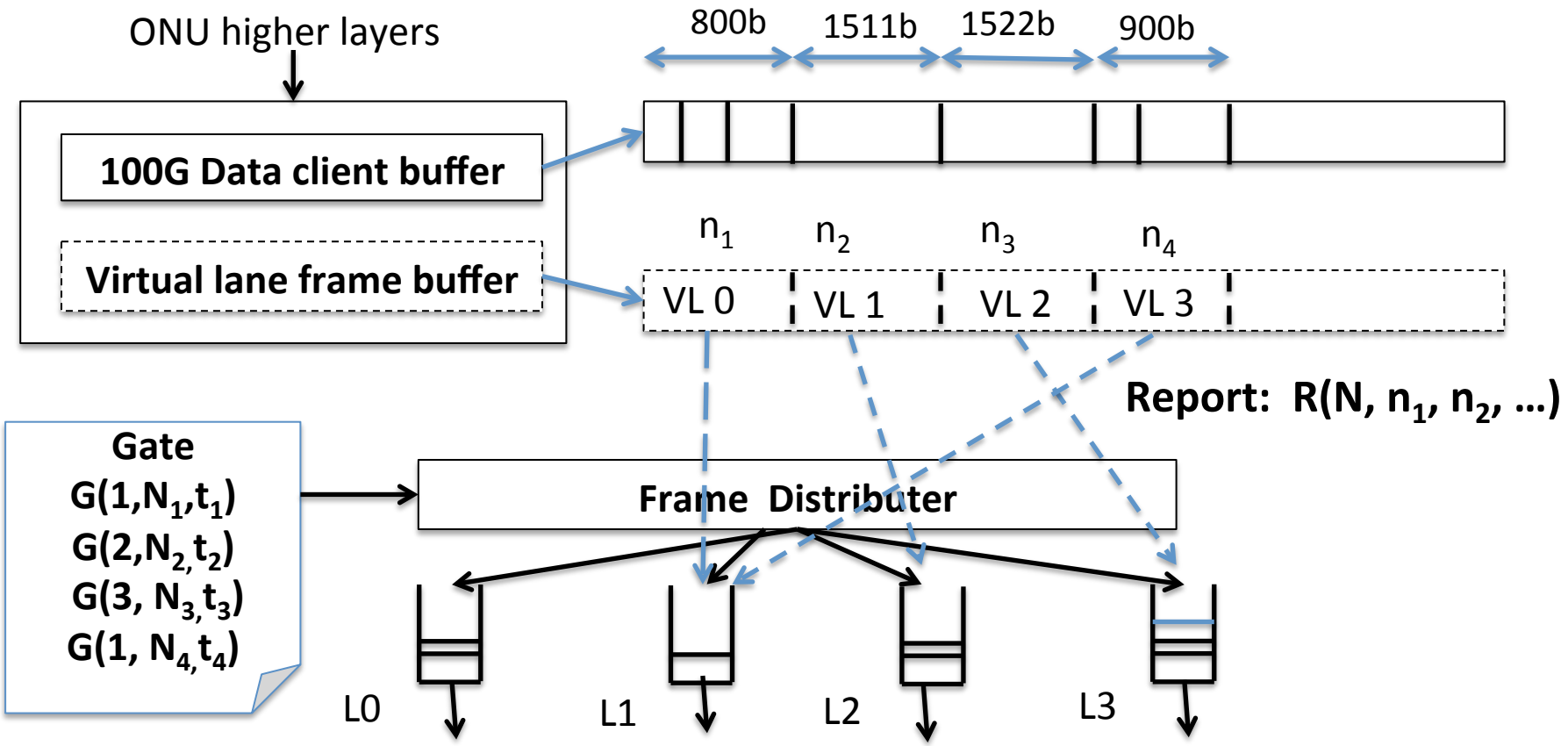


Report: R(N, n_1, n_2, …)

Where n_i ($1 \leq i \leq 4$) are frame boundaries for the close value of 1522 bytes*. In above example, n_1 = 800 bytes, n_2 = 1511 byte, n_3 = 1522 bytes, n_4 = 900 byte. VL represent virtual lane. N is the number of lanes the ONU supports.

* We have assumed the maximum lane frame buffer = maximum Ethernet frame size

Frame boundary aware MPCP Grant



- Fragmentations are avoided with frame boundary aware MPCP report and grant

Dynamic Channel Bonding

- The frame boundary aware MPCP report R(N, n_1, n_2, …) can be used to enable dynamic channel bonding
- An ONU reports it lane/channel configuration with parameter N in R(N, n_1, n_2, …)
- The OLT grants transmision channels according the the parameter N in the report
- Dynamic channel bonding is achieved with frame boundary aware MPCP
- Dynamic channel bonding could be important for the SDN for PON in the future
- Dynamic channel bonding can also be used for power saving, or with tunable optics

SDN for PON – what should hand out(to SDN control) what should not?

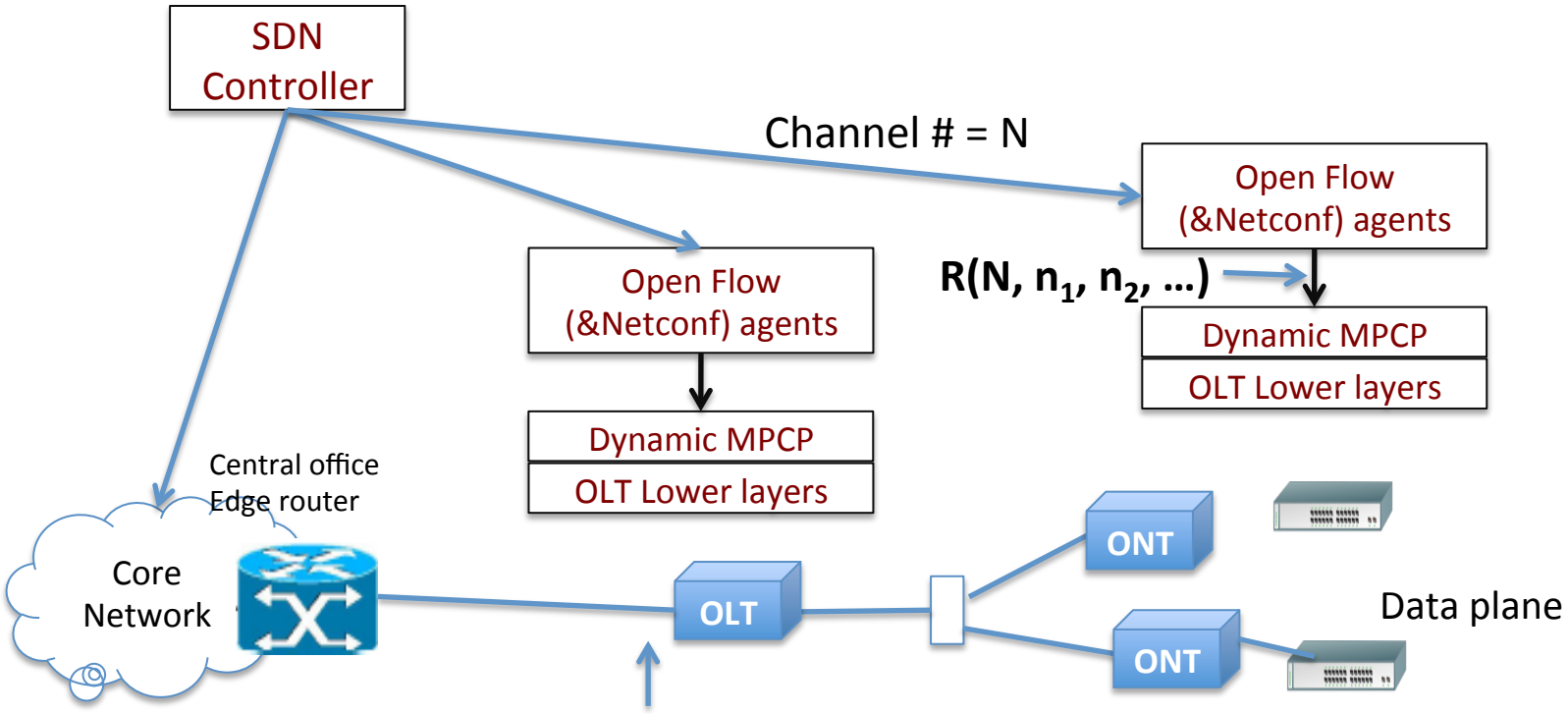
- There are literatures discussing SDN for PON, generally suggesting:
  - Move DBA function to an external SDN controller
  - Expose GEM/XGEM Port-ID, Allo-ID, T-cont etc. to the SDN controller
  - Expose LLID, MPCP, etc., to an external SDN controller

- There are several problems with those approaches
  - GEM/XGEM Port-ID, LLID, T-cont, etc. are local resources, have no global meaning.
  - DBA is a closed protocol between OLT and ONUs.
  - Many of those parameters have strident timing and delay requirements, for example the conventional MPCP.

However, It is feasible to expose channel bonding related MPCP to SDN controllers

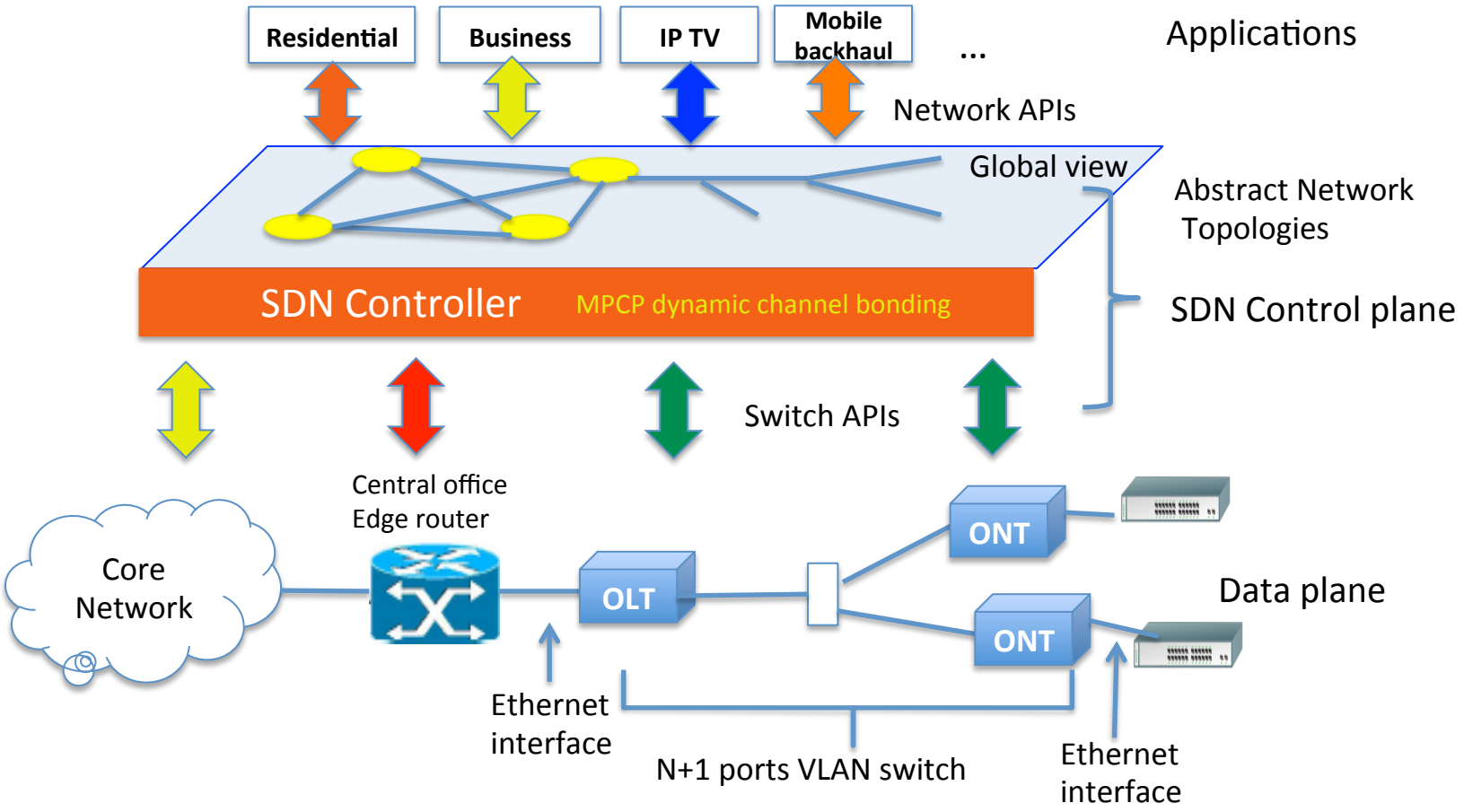
- **Dynamic channel bonding, in the shortest scale, is the time period of service flows, but it could be much longer. The timing requirements for dynamic channel bonding is much relaxed.**

SDN and Dynamic channel bonding



- **A SDN controller sends channel bonding requests according to the end-to-end flow requirements.**
- **Dynamic channel bonding is enabled with frame boundary aware dynamic MPCP**

SDN view of Core and PON Networks



- **A unified SDN based control plane controls both core and PON networks.**
- **The SDN controller can invoke dynamic channels in PON through MPCP**

Conclusions

- The Ethernet fragmentation problem can be solved with RS layer channel bonding or with frame boundary aware MPCP
- The Frame boundary aware MPCP channel bonding model enables dynamic channel bonding
- The flexibility of dynamic channel bonding benefits the integration of SDN with PON in the future

Thanks

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