



Frame Level Sharing for DBA Virtualization in Multi-Tenant PONs

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The O'SHARE project

An open-access SDN-driven architecture enabling multi-operator and multi-service convergence in shared optical access networks





Outline

- What is True PON multi-tenancy?
- Frame Level Sharing (FLS) architecture
 - Related Work- Slice Scheduler (SS)
- Simulation results comparing FLS and SS & conclusion





What is PON Multi-Tenancy?

High level solutions:







What is PON Multi-Tenancy?













True Multi-Tenancy Features

- Give VNOs full control over capacity assignment:
 - Potential for tight control of capacity, latency and jitter
 - Enable level of QoS control necessary for 5G applications
- Reduce CAPEX:
 - VNOs can trust shared network infrastructure not only for best effort residential but also for business and x-haul
- Clear separation between entities:
 - End user establishes tight SLA over PON with VNO
 - VNO establishes SLA with InP over a number of different priority levels
 - VNO can optimise its assignment across multiple users aggregating capacity





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Frame Level Sharing (FLS) Architecture





Virtual-PHY Layers Interaction





Sharing Engine

- DBRu can report ONUs queue length (according to standards) or be generated by the application and sent directly to the vDBA
- The vDBA constitutes an ideal interface between BBU scheduler and OLT DBA for fronthaul (as suggested in "paper Tu3F.3 OFC 2014)
- Also the vBMmap does not need to follow standard Bmap...
- ... only needs to convey the necessary information, e.g., capacity, latency, jitter





Sharing Policy Algorithms

No Capacity Sharing

Capacity Sharing







Related Work- Slice Scheduler (SS)

- Slice Scheduler proposed in **
- Idea to assign entire upstream frames to different VNOs in order to keep physical frame separation.
- However it intuitively is less efficient than sharing within each frame





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Simulation Model

- C++ XGS-PON (~10Gbps symmetric) simulator
- 60 ONUs with maximum physical distance of 40 Km
- Self-similar traffic with long range dependence (LRD)
- VNOs have equal capacity share, equal number of ONUs, and employ GIANT as vDBA
- Three T-CONTs, namely: assured, non-assured and best effort
- Multiple offered load distribution scenarios
- Comparison of literature SS and our proposed FLS scheme



Performance-Assured Bandwidth



VNOs have same load

VNOs load ratio 1:2





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Performance- Non-Assured Bandwidth

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VNOs have same load





VNOs load ratio 1:2



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Performance- Best Effort Bandwidth



VNOs have same load





VNOs, balanced

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VNOs load ratio 1:2







Concluding Remarks

• High capacity 5G service require cost effective backhaul (cell densification)...

...network sharing is a must for low cost of operations

- PON can be cost effective but need for tight control of capacity allocation in multitenancy scenarios
- Proposed a True Multi Tenant-PON with use of virtual DBA
- Showed performance improvement with respect to multiplexing VNOs by frame
- Sharing capacity important for bandwidth efficiency: the only compromise is some lack of traffic isolation for best effort traffic at high load





Thank You

Questions?





VNOs load ratio 1:2

2 VNOs, low loaded

Networks of the Future

2 VNOs, high loaded



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