NTT's activities in SEBA development

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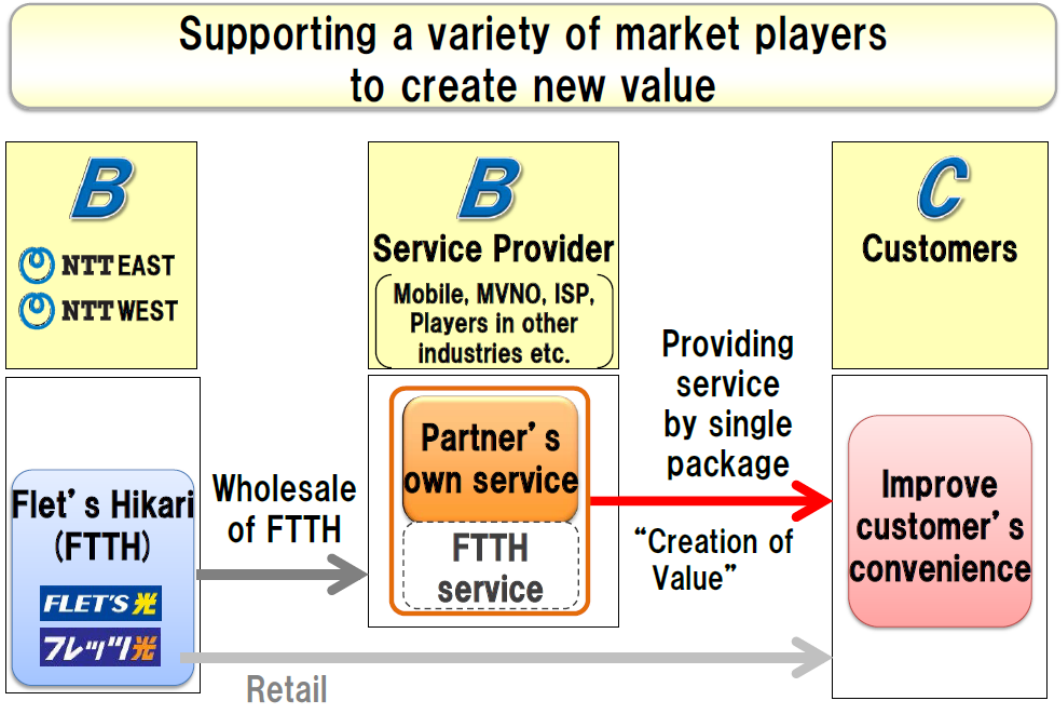
NTT Access Network Service Systems Laboratories

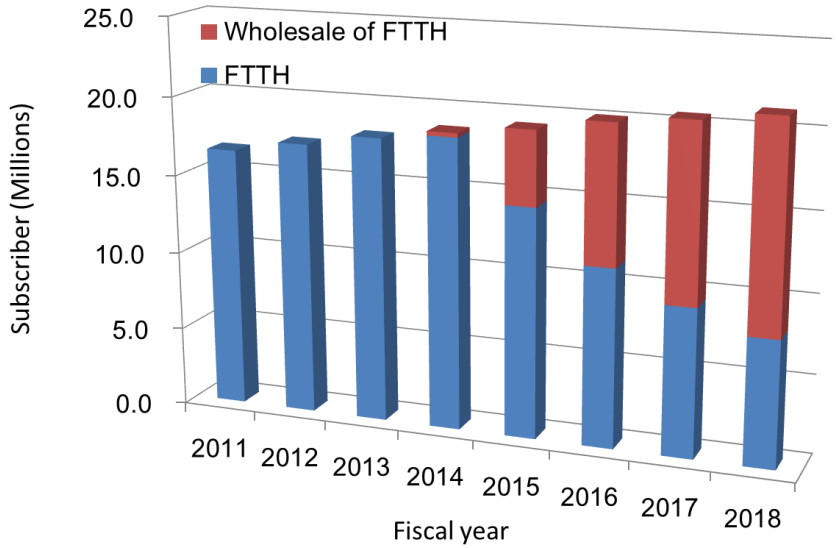
Broadband strategy in NTT

- NTT had updated the broadband business strategy to B2B2C (Business to Business to Consumers) in addition to conventional B2C.
- In 2015, we started wholesaling fiber access according to this strategy.



FTTH subscribers in NTT

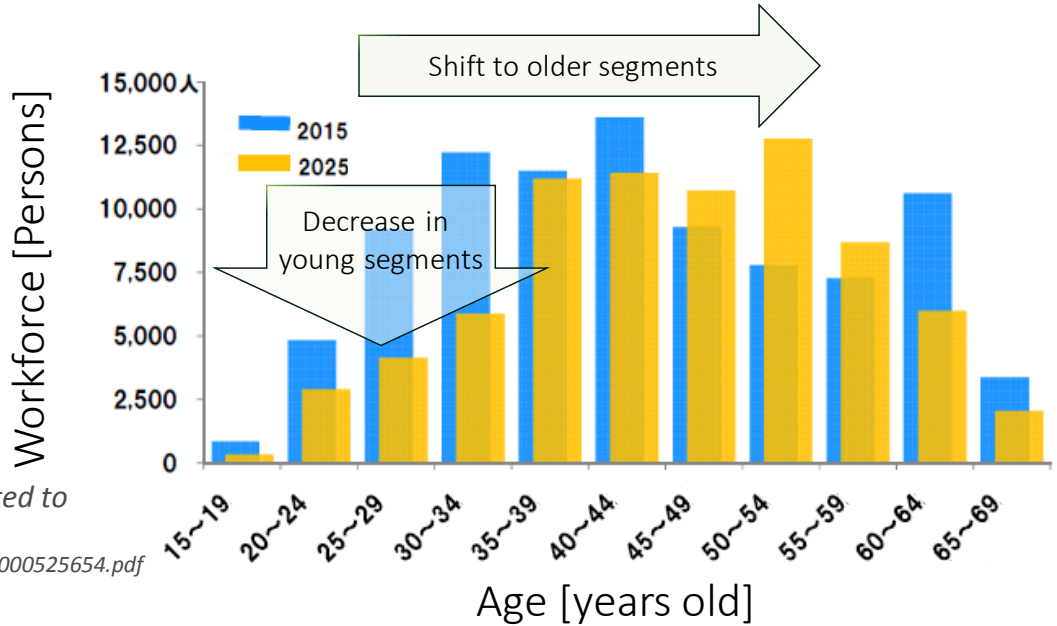
- A number of FTTH subscribers in NTT reached >20M subscribers.
- The numbers of subscriber over FTTH wholesale service are rapidly increasing.
- Business partners are M(V)NOs, ISPs, local CATV operators, video distribution SPs, local gas/electric power providers, retailers, manufacturers, and others.



From NTT Financial report, http://www.ntt.co.jp/ir/library/presentation/financial.html

Workforce issue

- Workforce at telco facilities will drastically decrease by 20% in ten years.
  - As of 2015 (Blue bars)　: 90,000 persons
  - As of 2025 (Yellow bars): 70,000 persons (expected)
- Low-maintenance NW for easy management of huge amount of assets is needed.



From NTT's document submitted to MIC (19th Dec., 2017)
http://www.soumu.go.jp/main_content/000525654.pdf

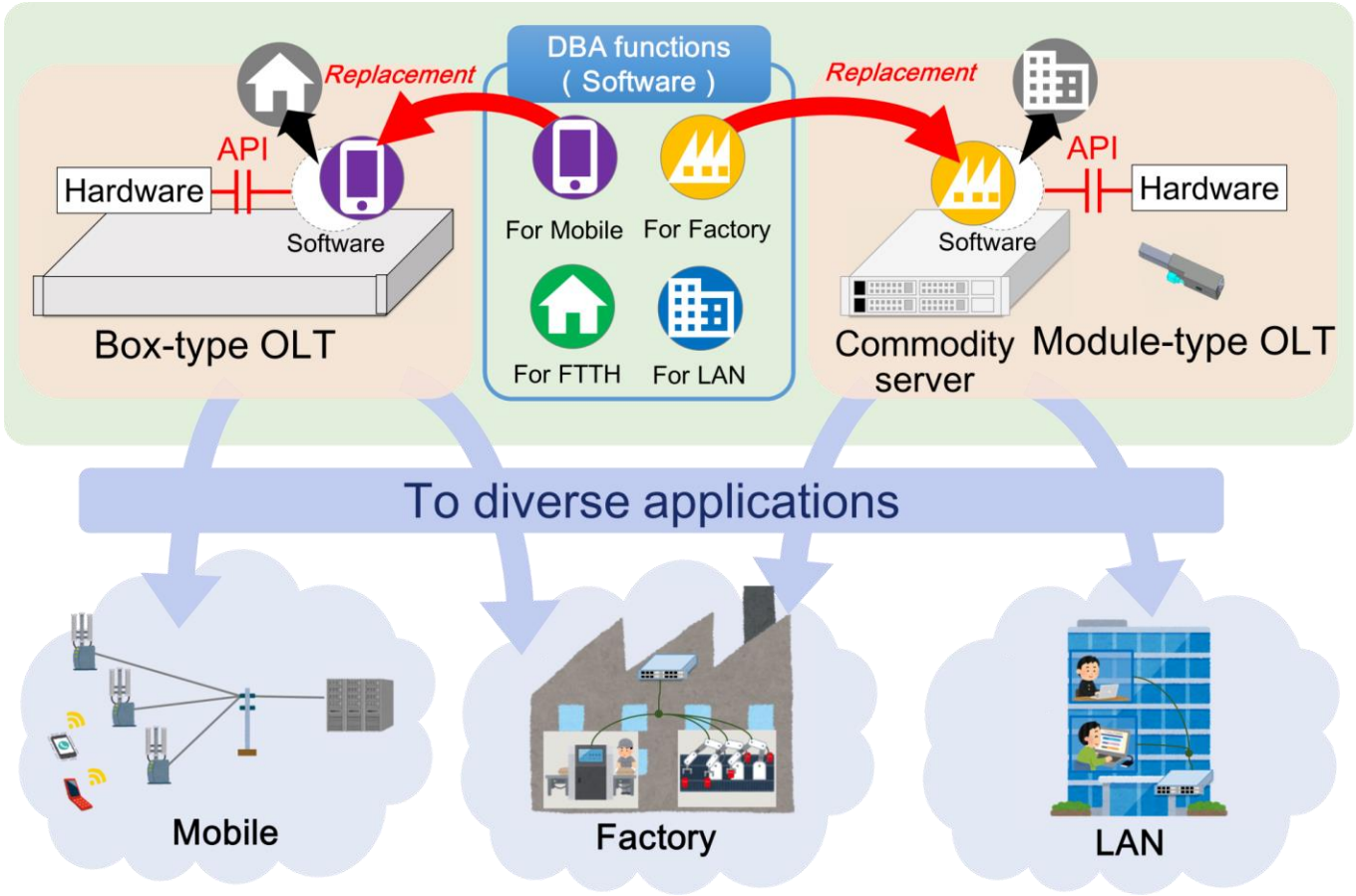
Perspective

- To meet emerging requirements by middle “B” partners, NTT needs flexibility, agility and ecosystem for future access systems.
- Small-start capability in access systems is also necessary, since the massive FTTH deployment had already done with legacy OLTs/ONUs.
- Given the expected drastic decrease of workforce, NTT needs low-maintenance NW for easy to manage huge amount of assets.
- These possible requirements could be achieved by disaggregation as well as SDN/NFV technologies. This is why NTT believes that those technologies are promising candidates for future access systems.

Derived requirements

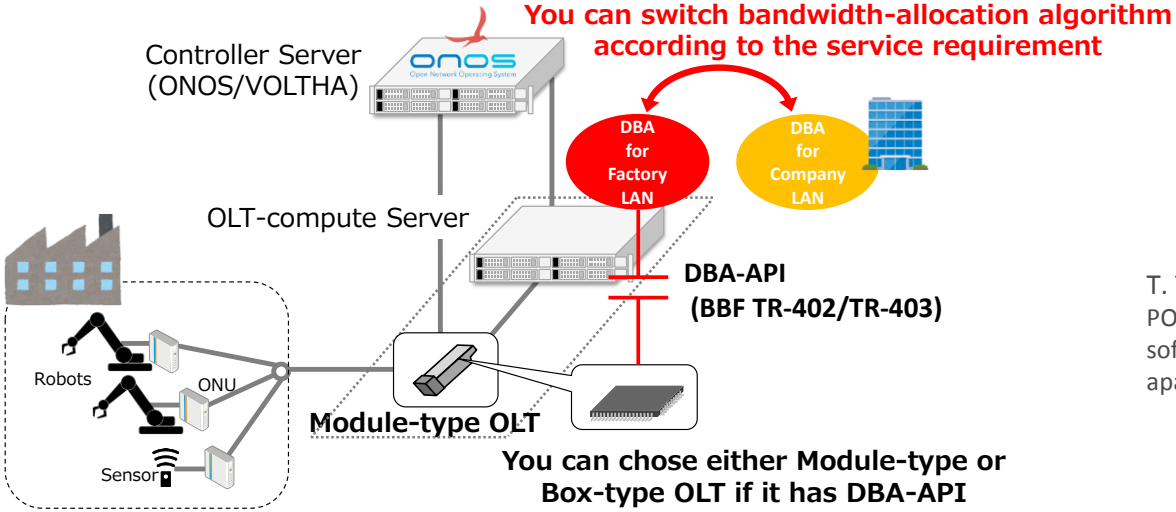
- ***Flexibility***; Flexible for replacement/update of functions
- ***Agility***; Early time-to-market with small-start manner
- ***Ecosystem***; Use of OSS and white box hardware (incl. modular type)
- ***Low-maintenance NW***; Automation, Stable operation, etc…

Our approach



Use case (1) Mini-PON

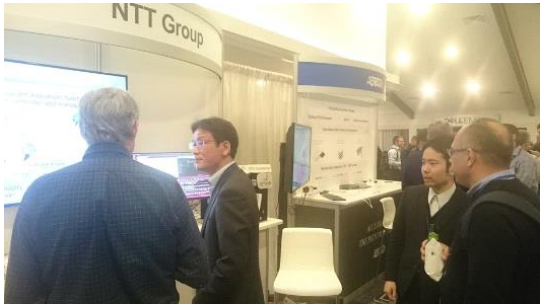
- High-speed optical LAN at tight spaces, such as factory, campus, and building, is flexibly provided by small-start capability of Mini-PON with OSSs and standard.
  - Composed of small modular OLT, compute server, and controller with minimum set of software.
  - Efficient development leveraging deliverables from ONF and BBF.



To be presented at ECOC 2019 (W.1.F.3)

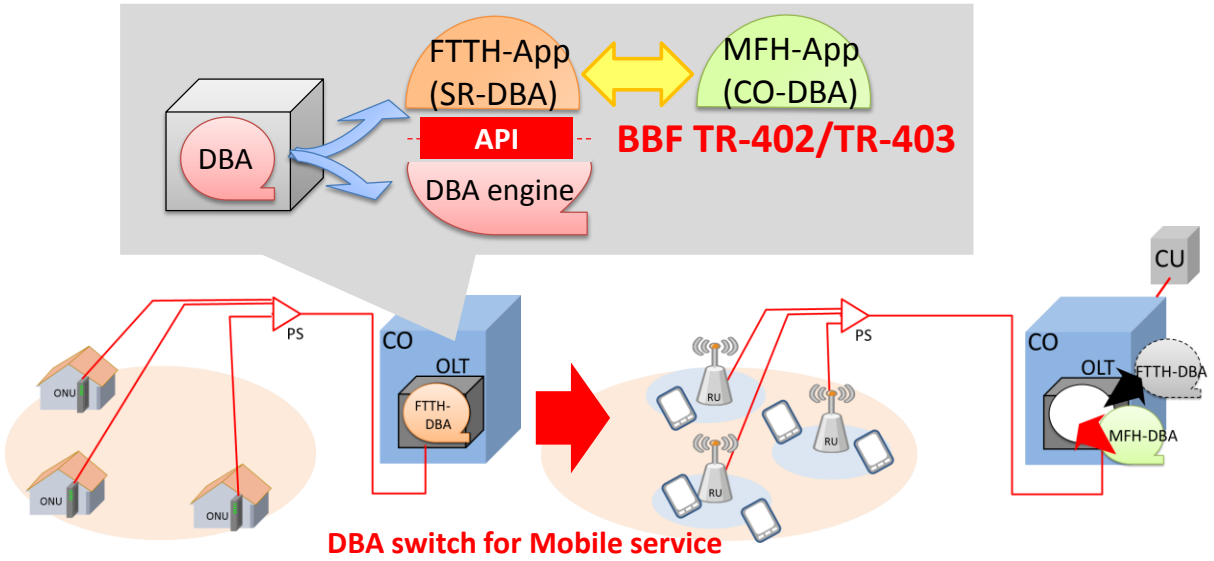
T. Tochino et al, "First demonstration of Mini-PON by using standard-based DBA-API and software components on commodity server apart from modular OLT"

Demo in ONF Connect 2018

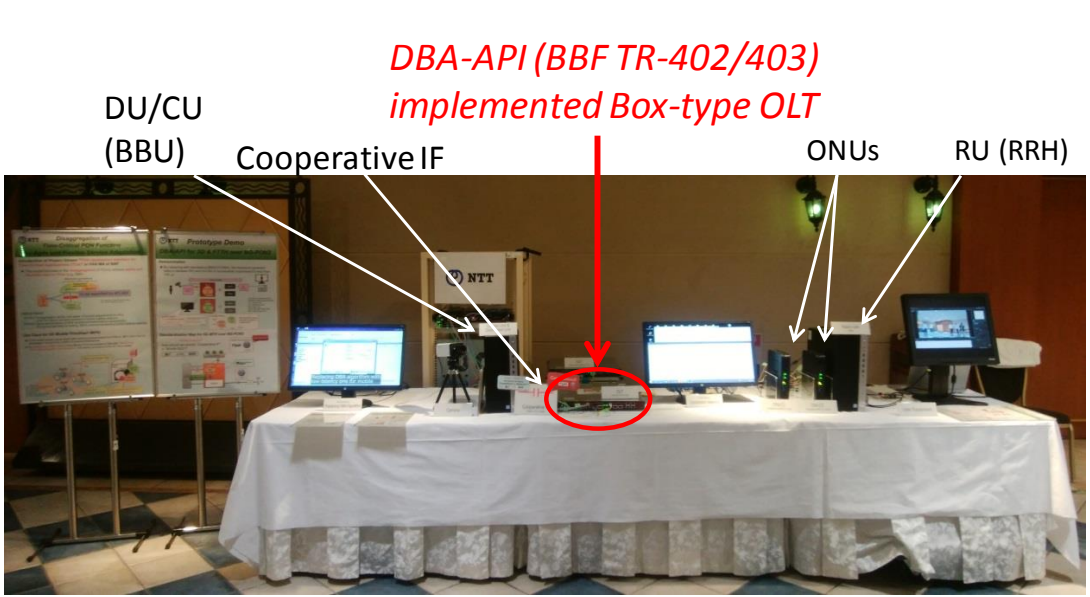


Use case (2) MFH by PON with cooperative DBA

- In future mobile systems, dense small cells could be accommodated by a PON as MFH, which has an advantage in terms of low CAPEX of physical infrastructure.
- By replacing the DBA software from SR-DBA to CO-DBA, TDM-PON-based MFH can be realized. This avoids re-building the OLT from the beginning.



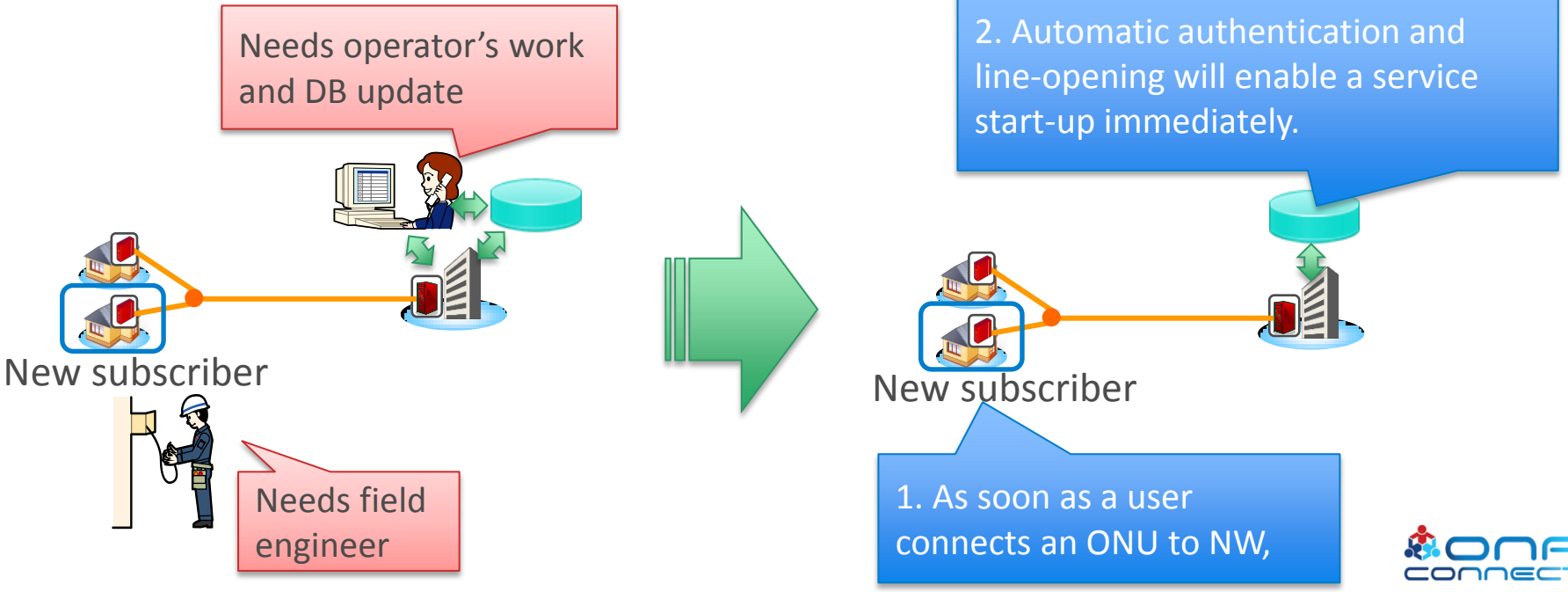
Demo in BBF Osaka meeting June 2018



Demo setup of mobile fronthaul over NG-PON2 system

Use case (3) Zero Touch Provisioning (ZTP)

- Future access system should be easier to manage than ever. Otherwise, we cannot maintain our networks with a limited number of workforce.
- Details on ZTP use case are under developing.



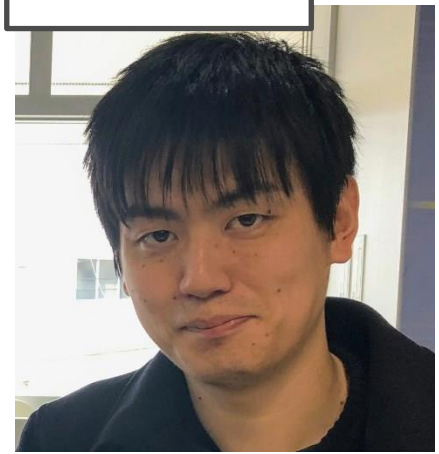
NTT’s activities in SEBA

- SEBA Reference Design (RD)
- Broadband Simulator (BBSim)
- Delegates working at ONF office

Keita

Apr. 2018~Apr. 2019

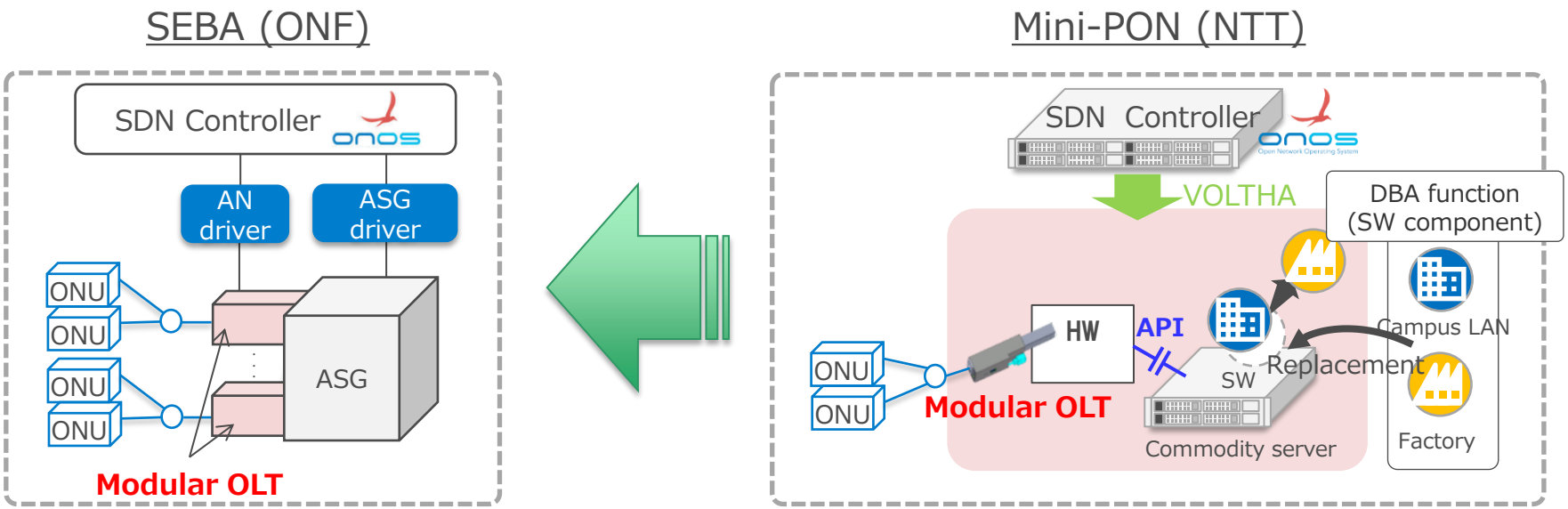
Takahiro



Aug., 2019~

Contributions to SEBA RD

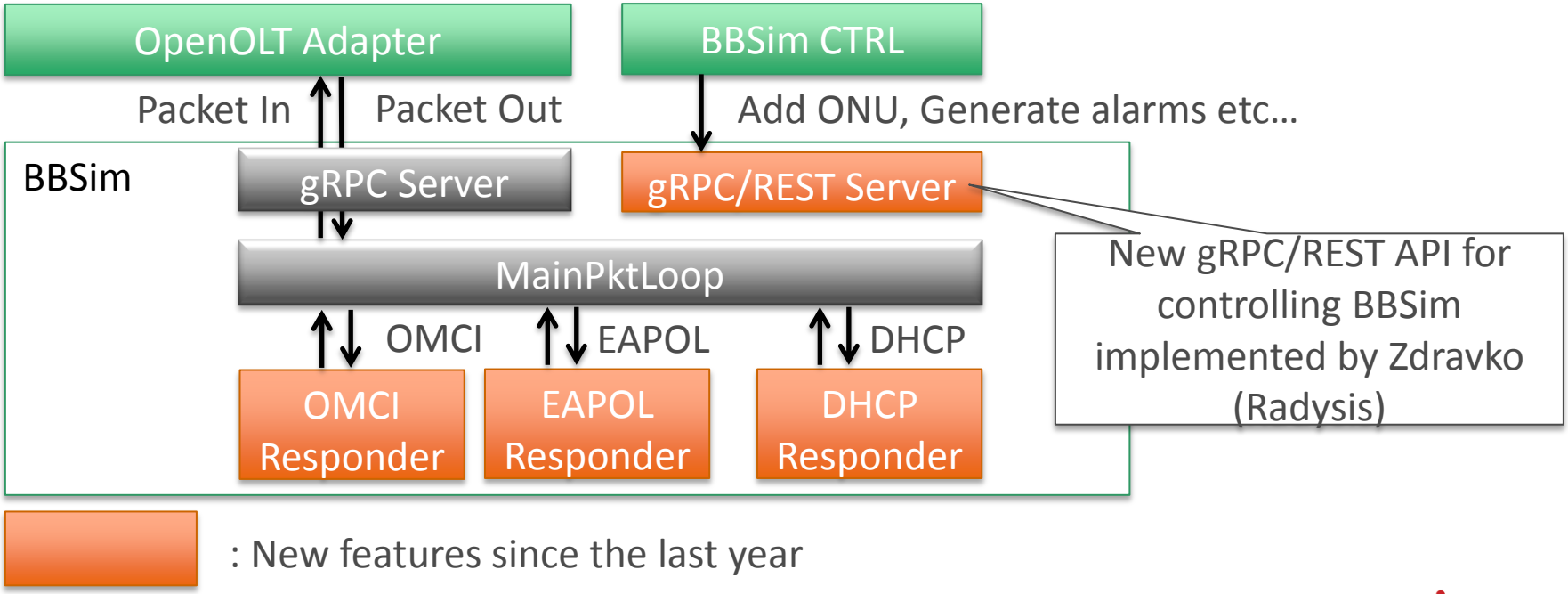
- Our expertise obtained by Mini-PON architecture was incorporated as a pluggable module-type (modular) OLT into the SEBA RD document.



From Reference Design, SEBA, ONF TS-100, Mar., 2019

Contributions to BBSim

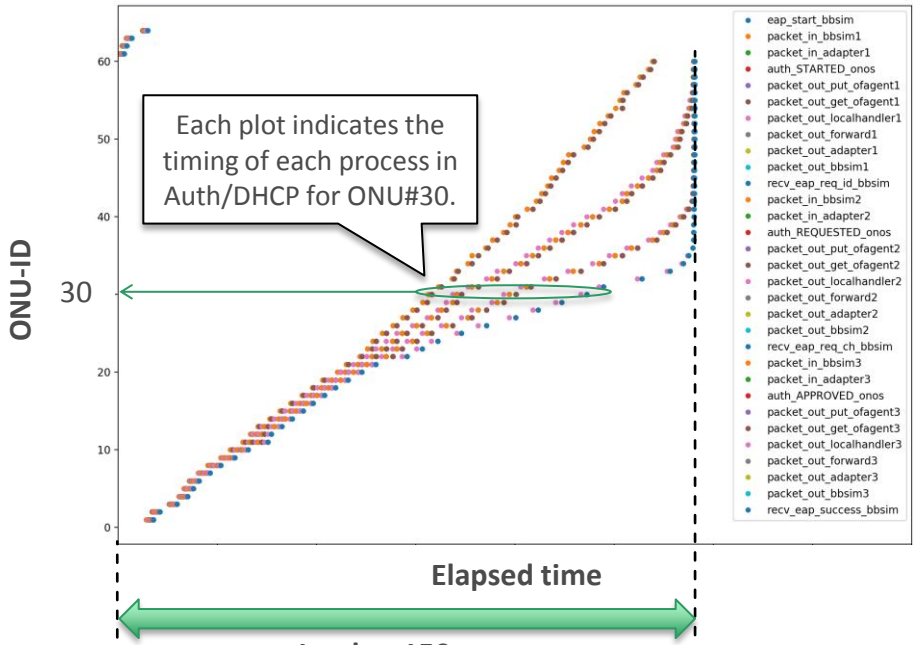
- Keita implemented light-weighted EAPOL/DHCP/OMCI packet emulators (Responder) for improving BBSim scalability.



VOLTHA scalability evaluation by BBSim

- Conducted VOLTHA 1.6 performance test and revealed its scalability issue

→ VOLTHA 2.X will solve this performance issue



BBSim redesign plan

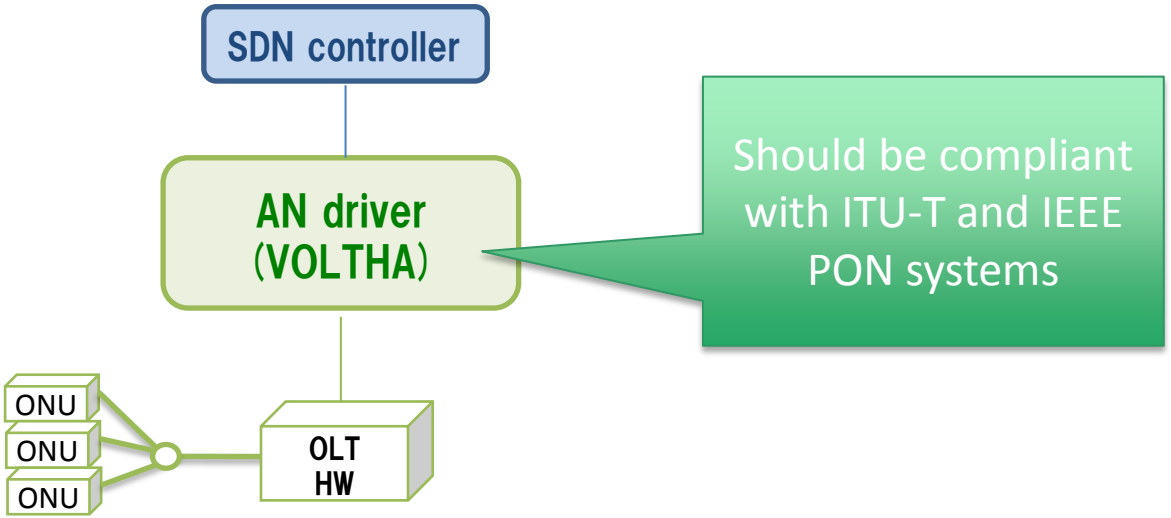
- Matteo (ONF) proposed the redesign of BBSim for improving its readability and further scalability (>1024 ONUs). Some parts of the current BBSim (e.g. Responder, gRPC/REST server) will be reused for implementing the new one.
- NTT is also supportive for the redesign, and will keep contributing.

Our plan in SEBA

- EPON-compliant VOLTHA
- Contributions to NEM
- SEBA as xhaul platform

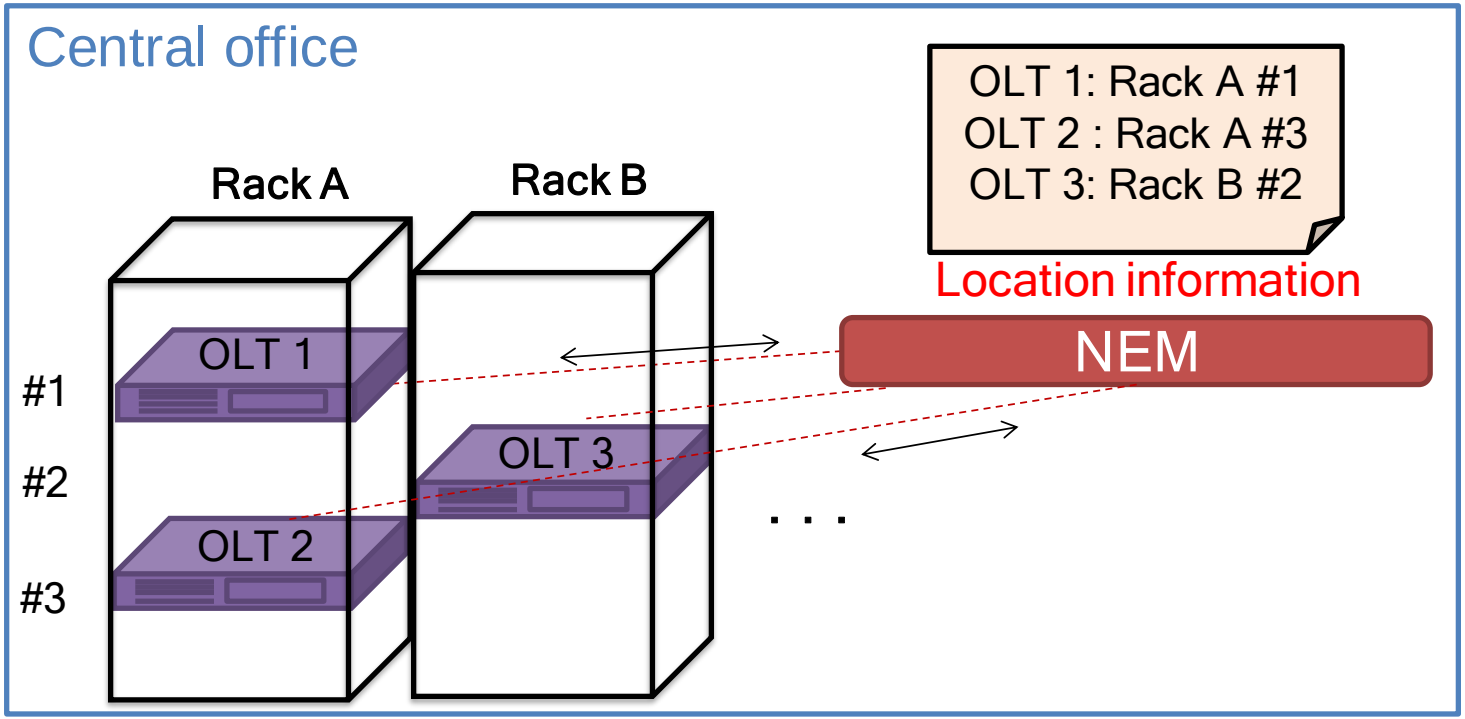
EPON-compliant VOLTHA

- As our current FTTH systems are based on IEEE GE-PON, we need EPON-compliant VOLTHA, which should provide benefit for other EPON users.
- NTT will lead the project with Tibit and Furukawa. Other partners should be welcomed!



NEM function expansion for low-maintenance NW

- Collection of OLT's location information for fault location identification
- Requirements: API for location information and workflow for OLT installation

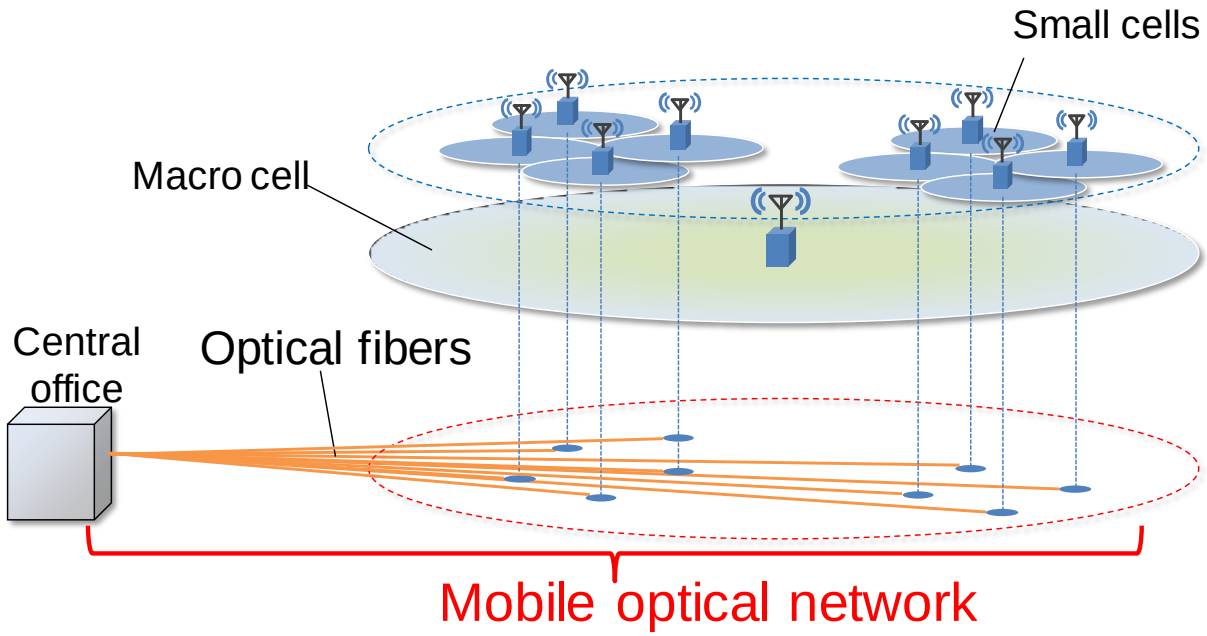


SEBA as xhaul platform

- Current activities in SEBA are mostly dedicated to the FTTH (PON) service.
- To establish further ecosystem in access industries, application field of SEBA should be expanded.
- One of the candidates is a mobile service.

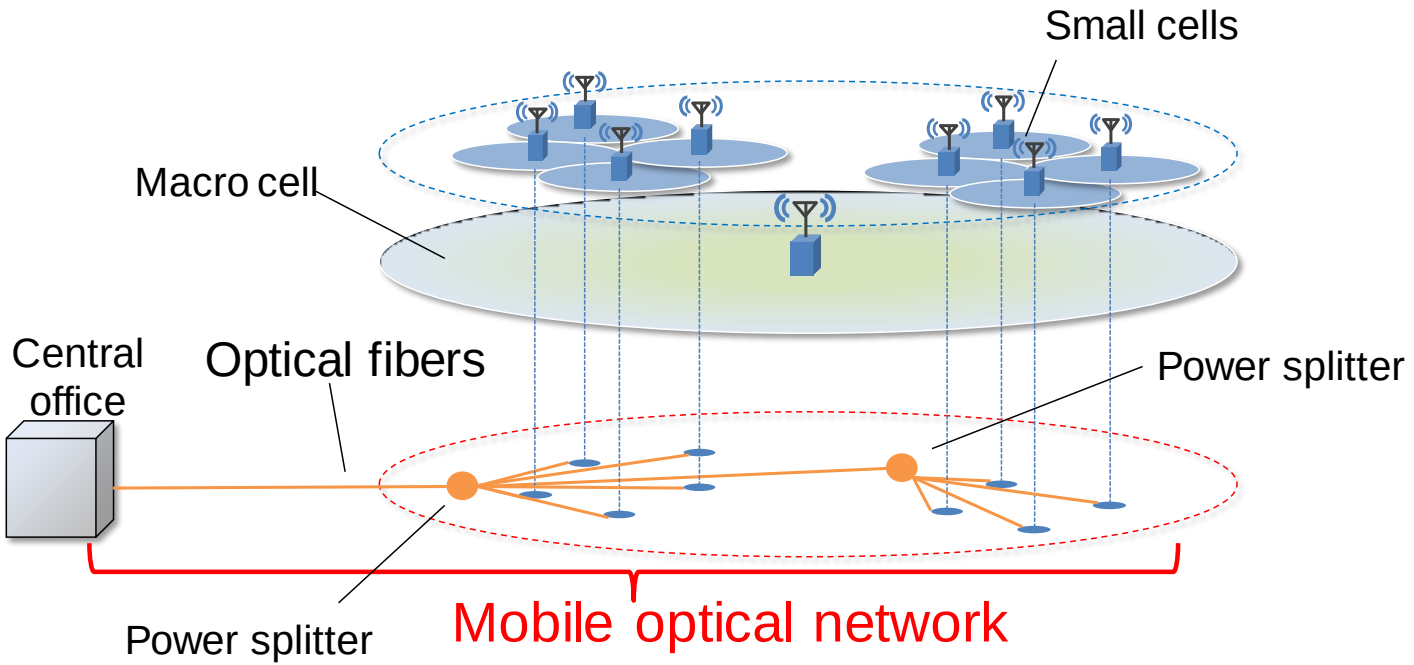
Mobile optical network in 5G and beyond

- Small cells will be deployed densely at area of high population density.
- Too many optical fibers as same numbers as small cells need to be installed.



Efficient fiber usage

- Utilization of PON to mobile optical network reduces number of optical fiber and contributes to construct it cost effectively.

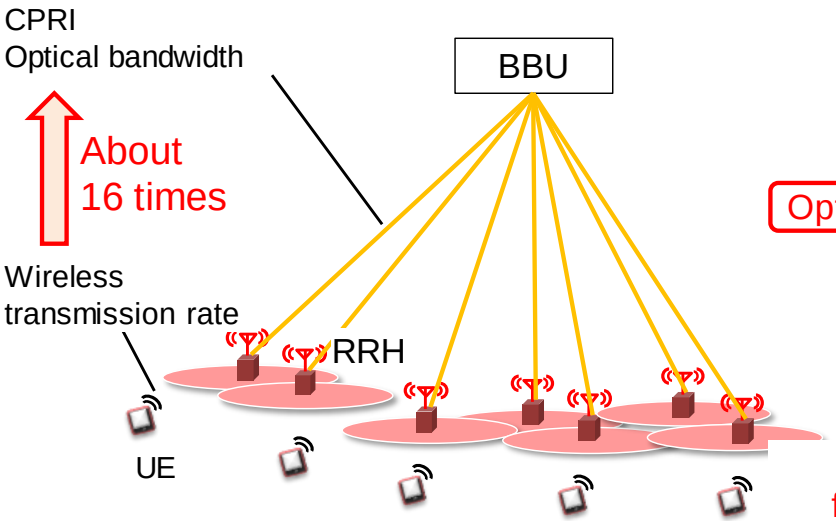


MFH over TDM-PON

- Bandwidth reduction by using new interfaces in MFH to use PON
- Cooperative DBA (CO-DBA) to meet low-latency requirements
- Cooperative Transport IF (CTI) to receive UE scheduling info from mobile system

High capacity requirement by CPRI transmission

- CPRI interface requires large optical bandwidth, which is about 16 times of wireless transmission rate, so in the 5G, required optical bandwidth will increase to 160Gbps and cost of optical transceivers will be very expensive.



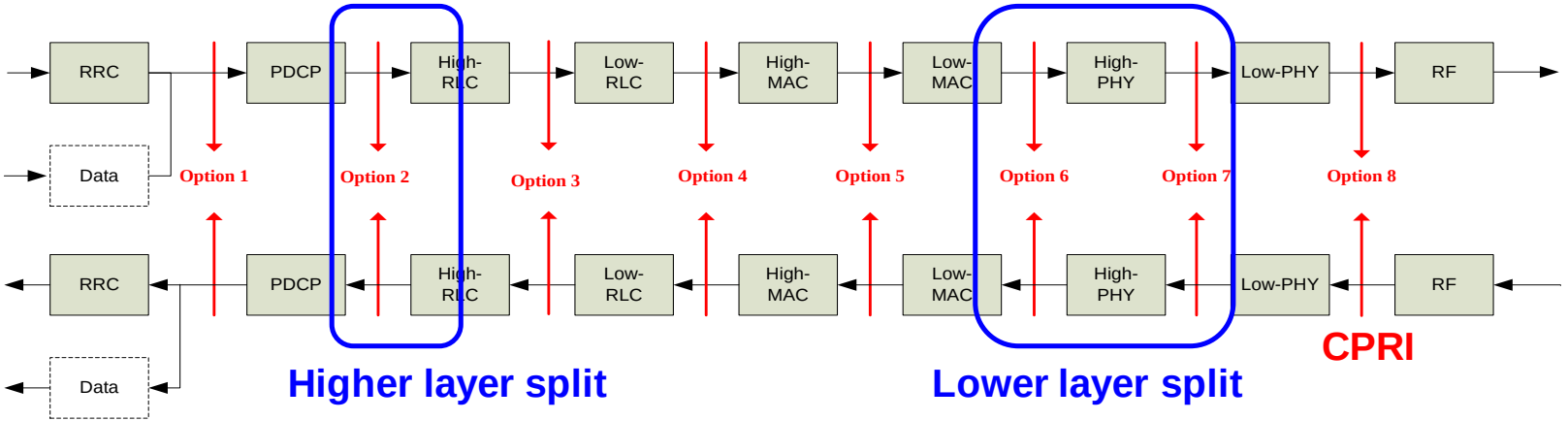
	Wireless transmission rate	Optical bandwidth
~4G	300 Mbps	4.8 Gbps
5G	10 Gbps	**160 Gbps**

Optical transceivers are very expensive

To reduce optical bandwidth,
functional splitting point is reconsidered

Discussion on splitting point for MFH

- Splitting point under discussion in 3GPP (TR 38.801)



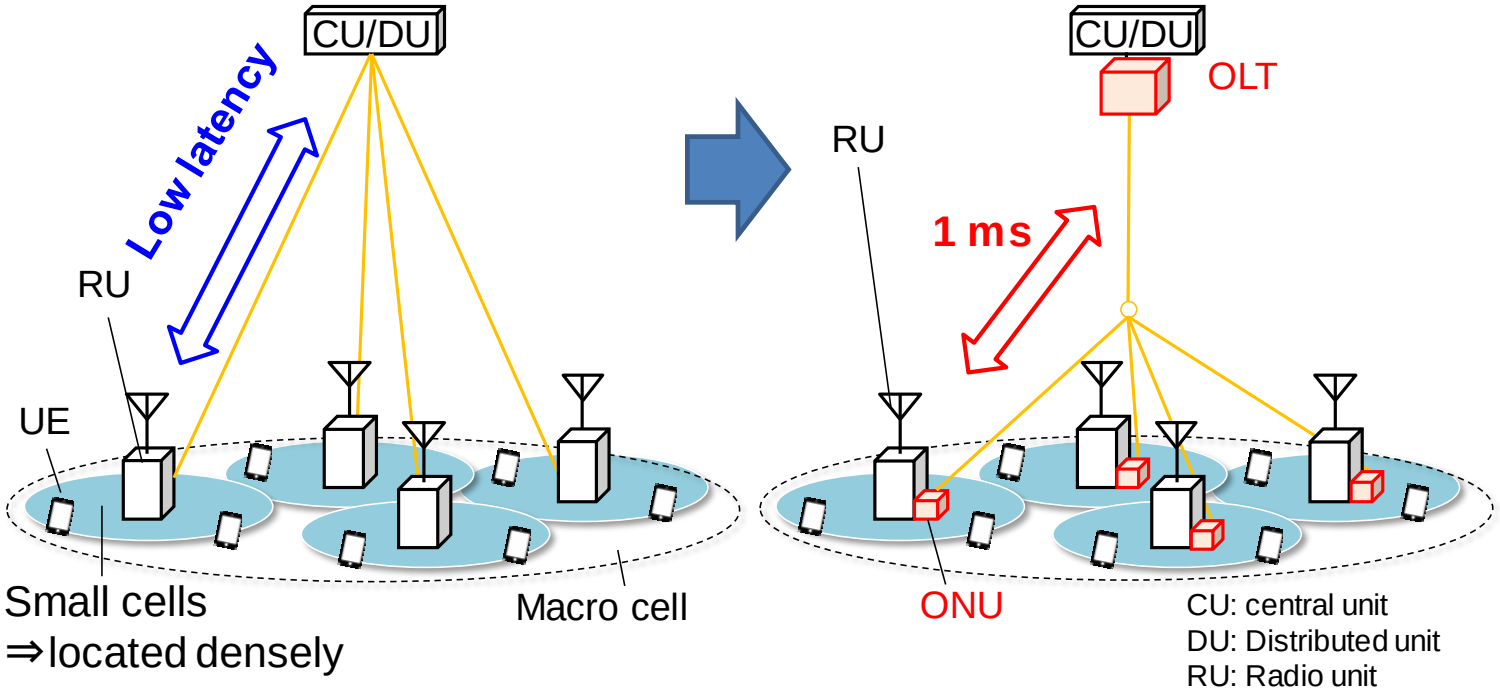
Small — MFH optical bandwidth — Large

High — Latency requirement — Low

- Right-side split points have good wireless performance (CoMP), but low latency is required.
- Left-side split points have good (reduced) optical bandwidth and good (large) latency requirement.
- Ethernet-based transmission will be used.

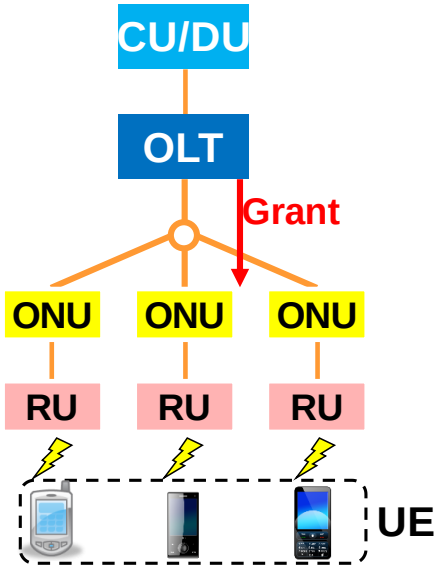
Technical issue of PON for LLS MFH

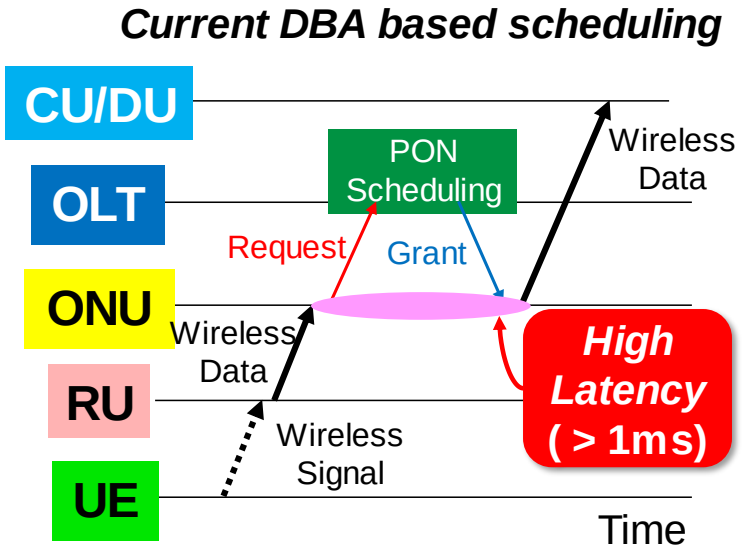
- LLS based MFH requires low latency between DU and RU (< 250 µs).
- General uplink latency between OLT and ONU is about 1 ms due to DBA.



Latency of current DBA for FTTH

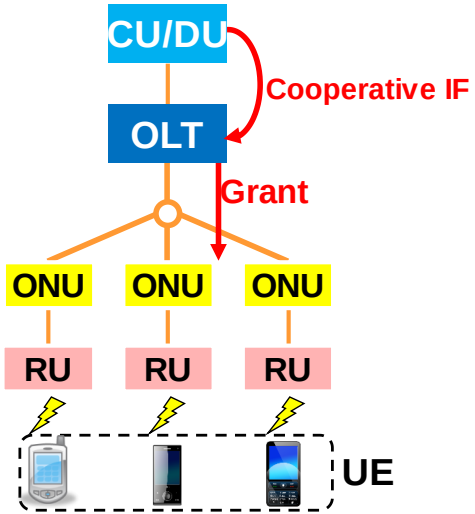
- OLT schedules each ONU uplink transmission according to requests from all ONUs and sends scheduled result (grant) to ONU.
- ONU needs to wait for OLT's reply and it causes large latency around 1ms

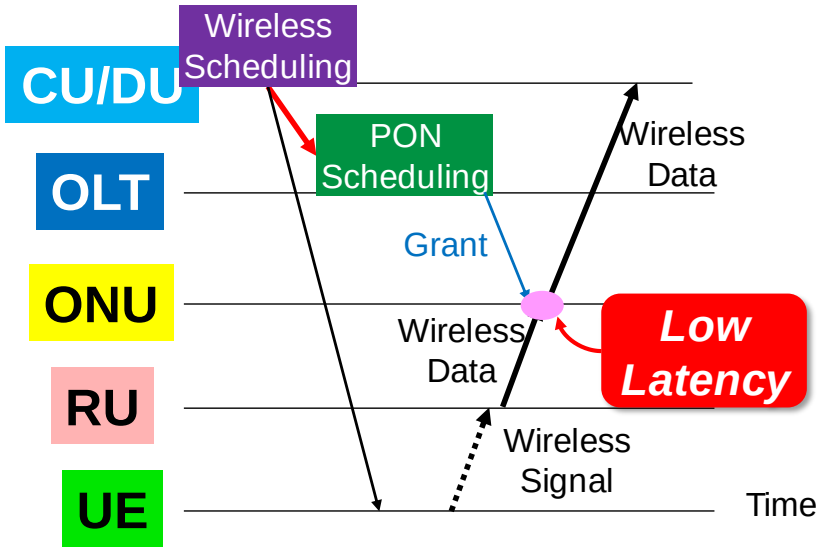




Cooperative DBA for low latency PON

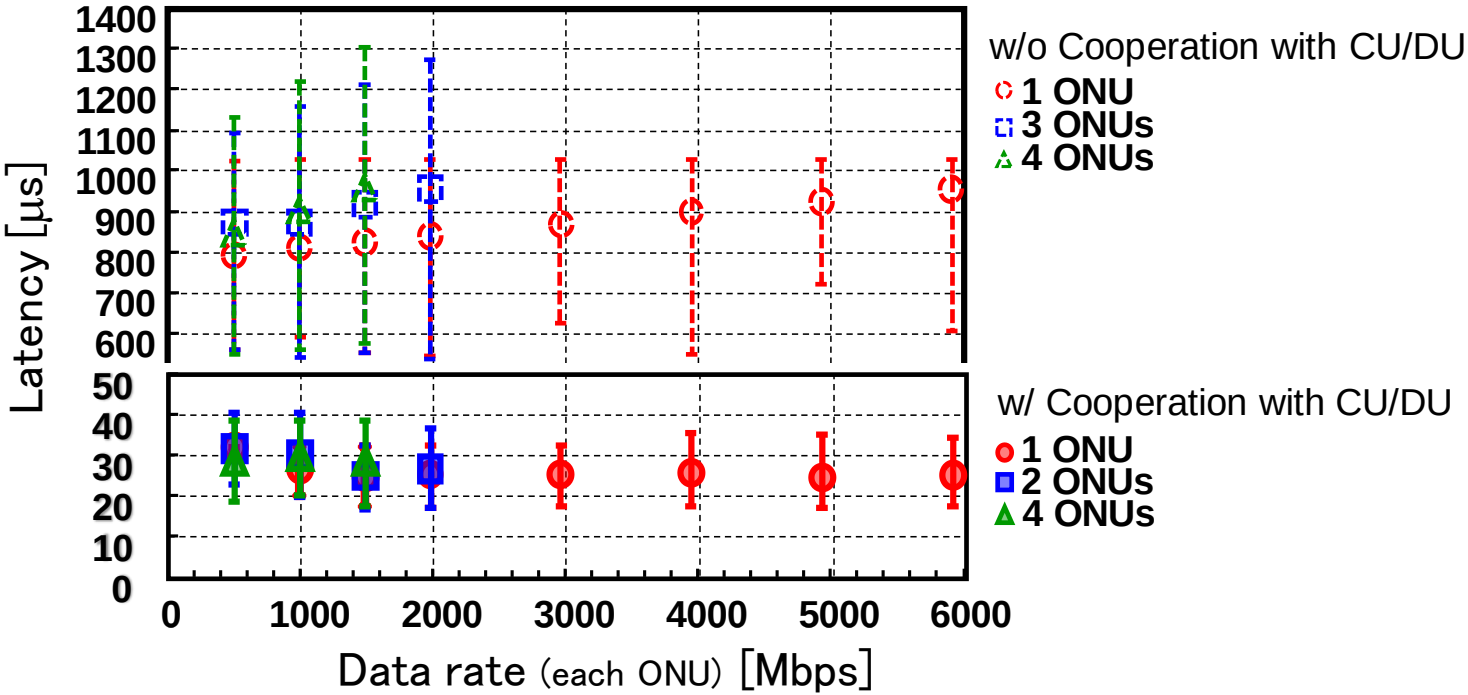
- CU/DU controls uplink transmission of UE and has information time and size of uplink transmissions. If this scheduling information is shared to OLT, OLT can execute DBA calculation before uplink data from RU arrives at ONU.
- This cooperative DBA reduces the latency greatly and cooperative interface between DU and OLT is needed.





Evaluation of Cooperation between CU/DU and OLT

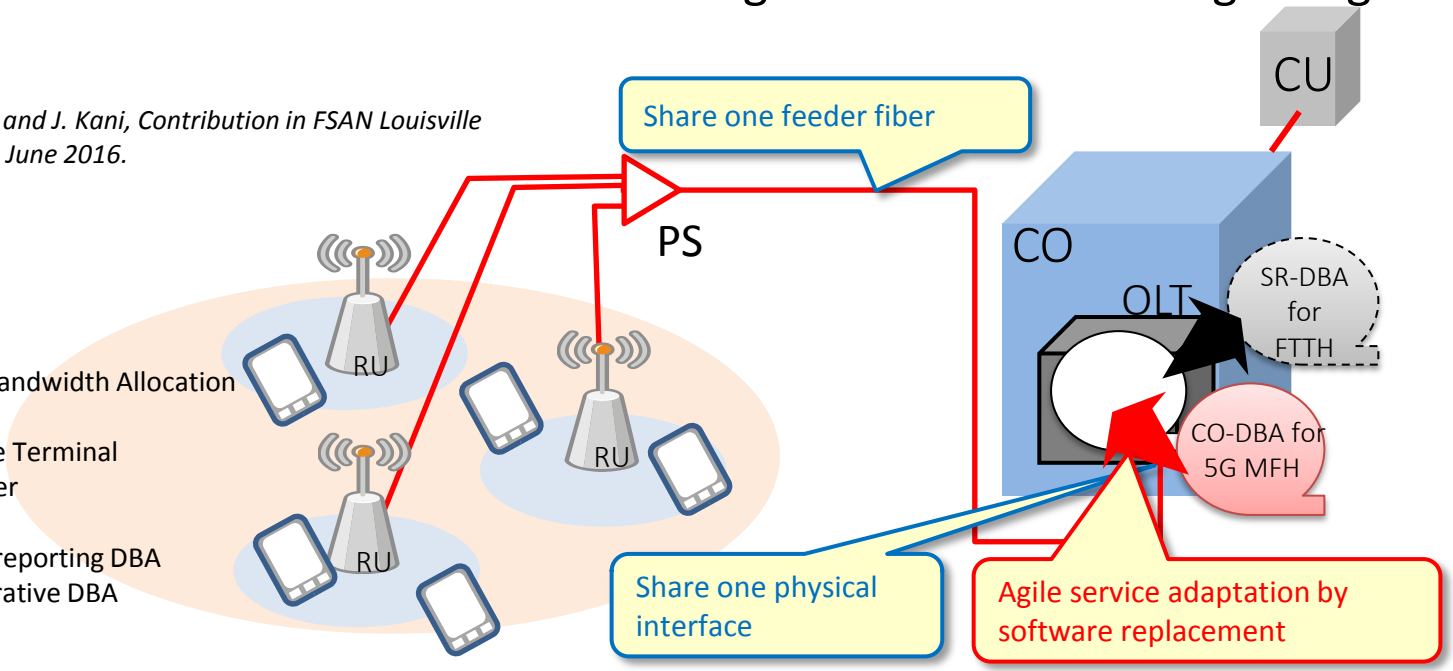
- Latency without Cooperation is around 1 ms.
- Cooperative DBA through Cooperative IF lowers latency to less than 50 µs.



DBA replacement

- In 5G mobile system, dense small cells could be accommodated by a PON as MFH, which has an advantage in terms of low CAPEX of physical infrastructure.
- By replacing the DBA software from SR-DBA to CO-DBA, TDM-PON-based MFH can be realized. This avoids re-building the OLT from the beginning.

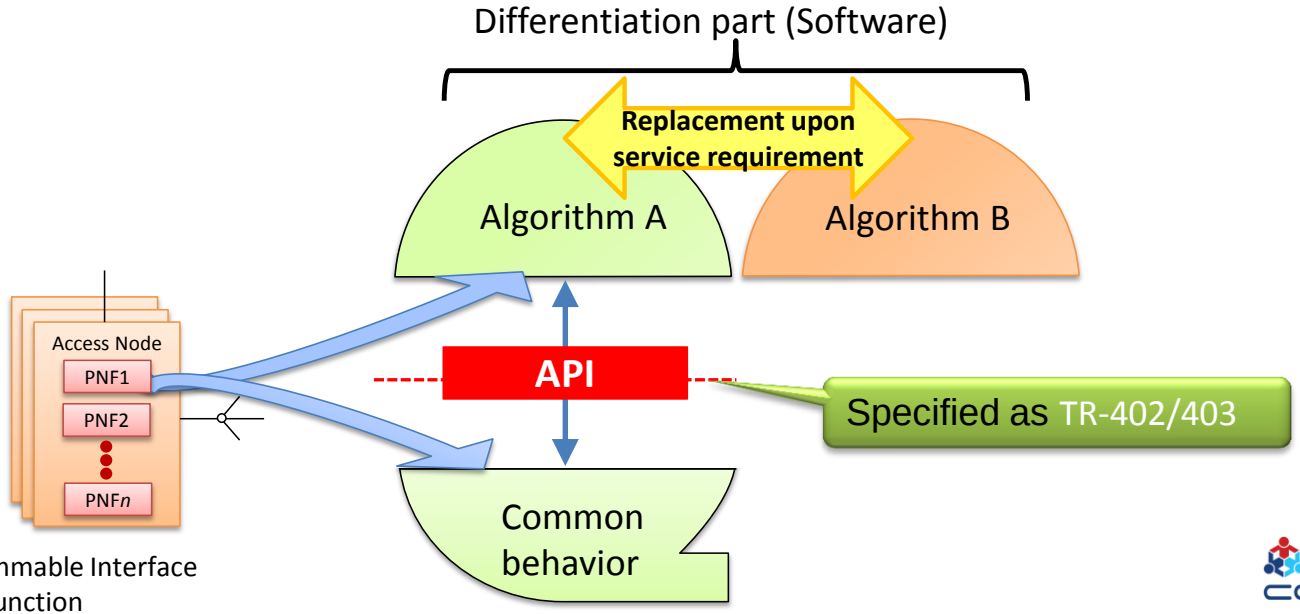
K. Asaka and J. Kani, Contribution in FSAN Louisville meeting, June 2016.



CU: Central Unit
DBA: Dynamic Bandwidth Allocation
LL: Low-latency
OLT: Optical Line Terminal
PS: Power Splitter
RU: Radio Unit
SR-DBA: Status-reporting DBA
CO-DBA: Cooperative DBA

Standardization at BBF

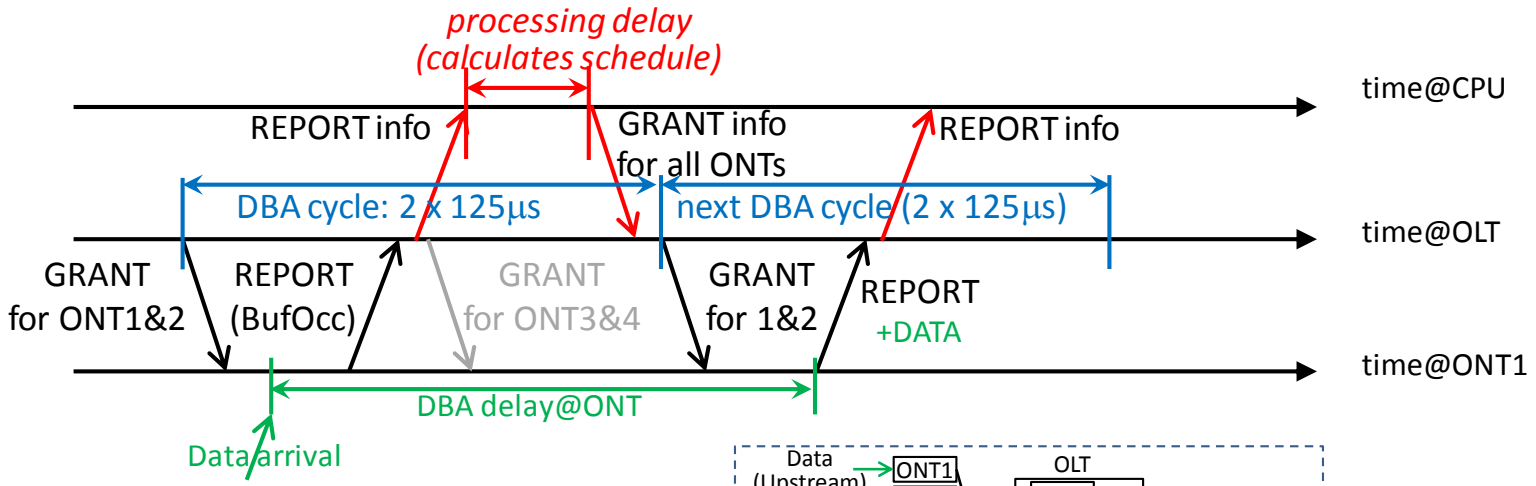
- Project Stream “PON abstraction Interface for Time-Critical Applications (TCA)” specified the related specifications in FAN WA of BBF.
- The project focuses on the disaggregation of TCA to achieve agility and flexibility even in TCAs (e.g. DBA).

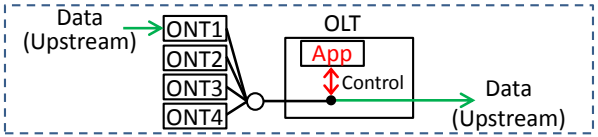


API: Application Programmable Interface
PNF: Physical Network Function

Conventional DBA

- When using DBA as a TCA, processing delay should be much less than DBA cycle (N x 125 us). Otherwise, DBA delay increases by 125-us period.
- Therefore, the interfaces to tell CPU of “Report” , and the one to designate “Grant” from CPU are time-critical.

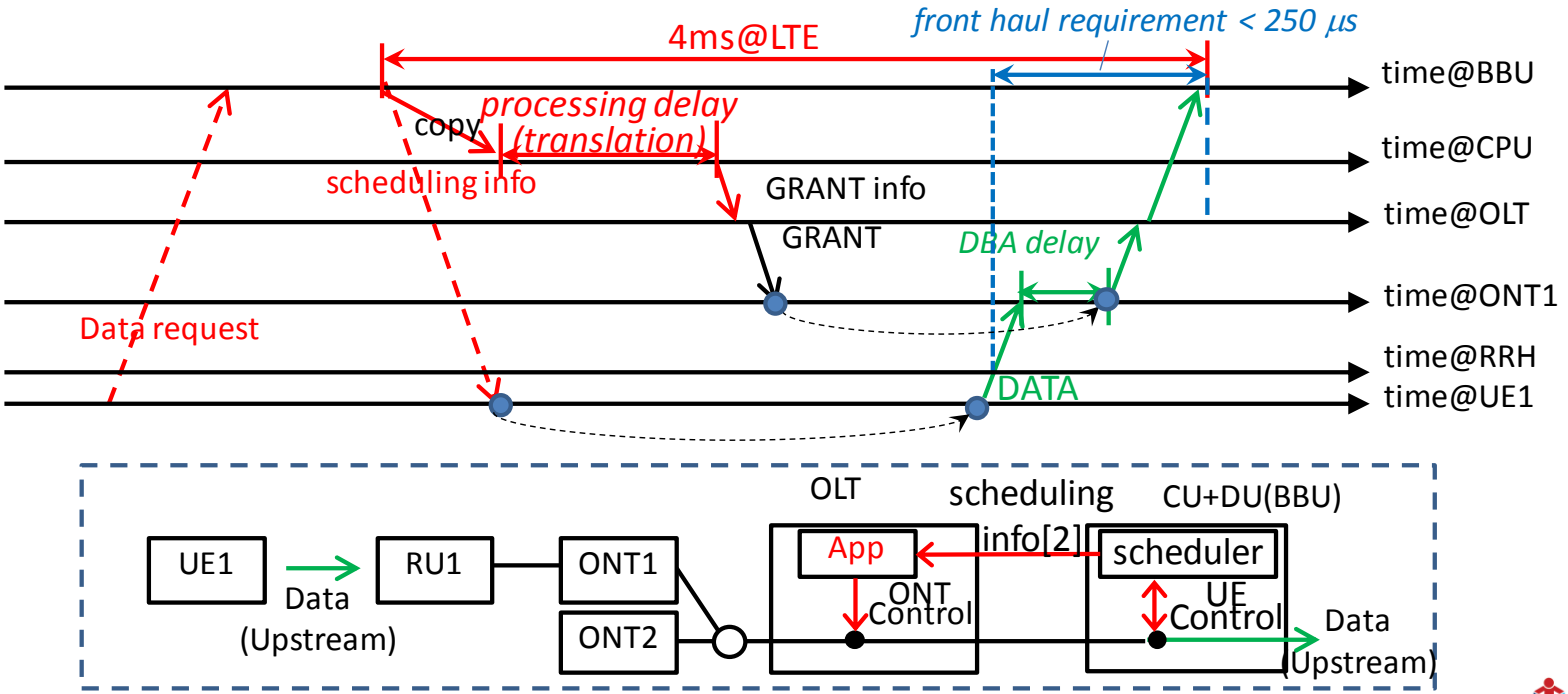




From BBF contribution (bbf2017.427) by H. Ujikawa, K. Asaka, and B. Nagel for Taipei meeting, May 2017.

CO-DBA

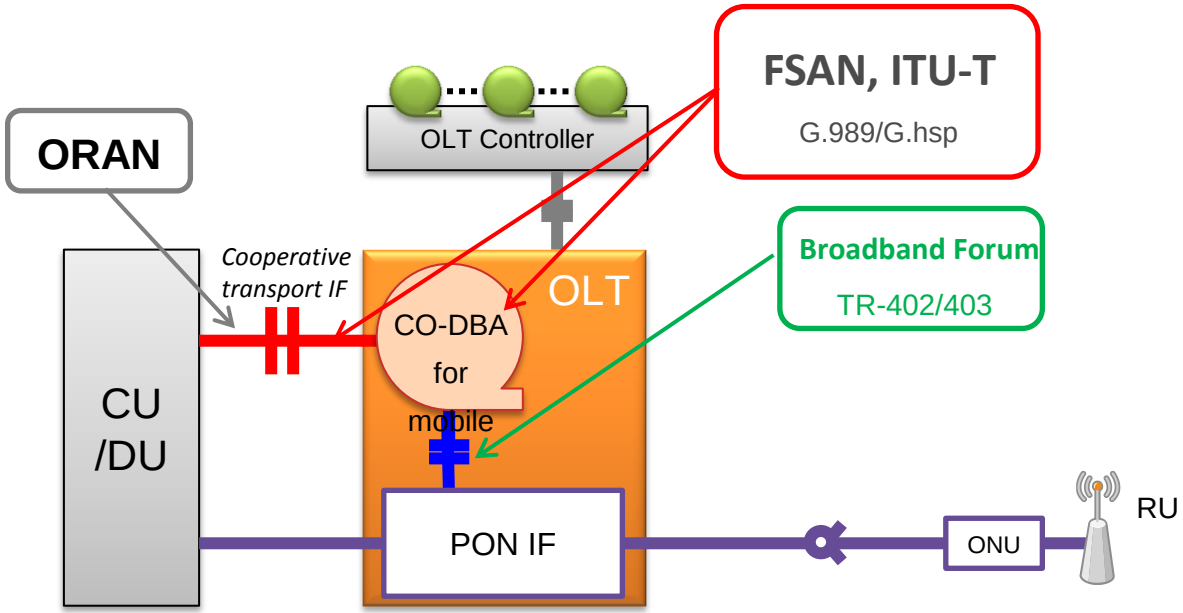
- For MFH, the summation of DBA delay and propagation delay should be shorter than 250 us.



From BBF contribution (bbf2017.427) by H. Ujikawa, K. Asaka, and B. Nagel for Taipei meeting, May 2017.

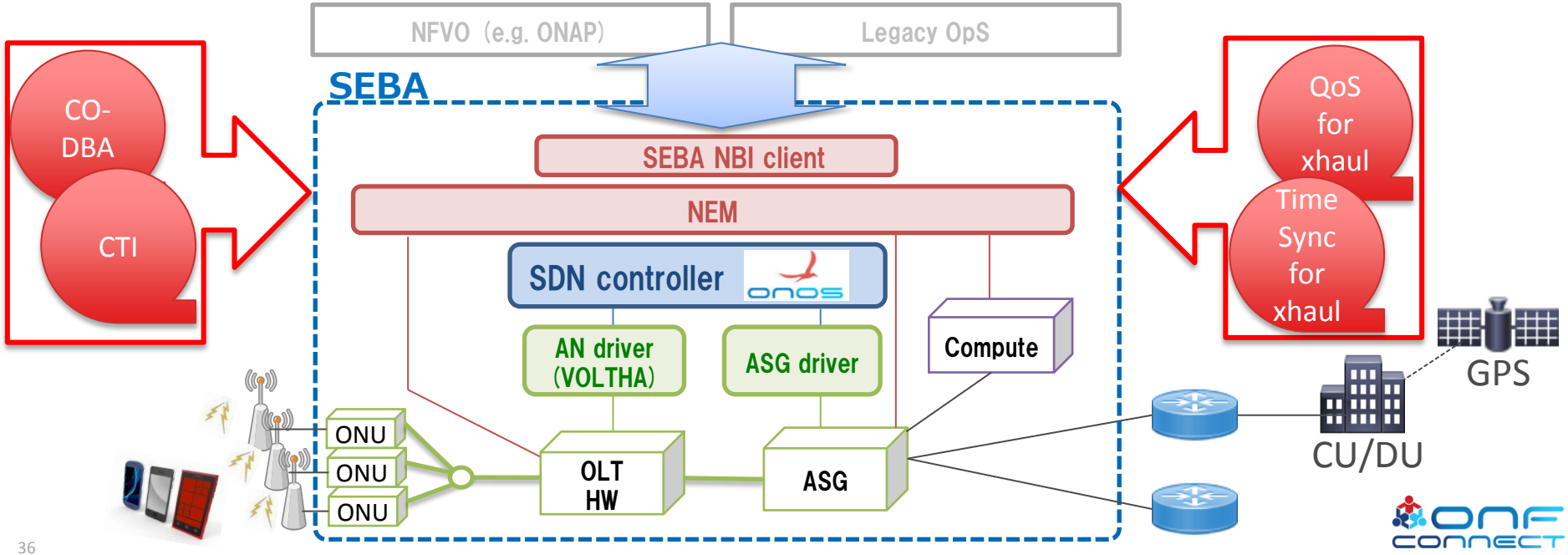
Collaborative standardization activities

- PON: Cooperative DBA is being specified in ITU-T SG15/Q2.
  - API realizing easy replacement of CO DBA and FTTH DBA was specified in BBF
- Mobile: ORAN Alliance(WG4) starts specification of CO IF(CTI project) and target time frame is Dec. 2019.



What are missing parts in SEBA?

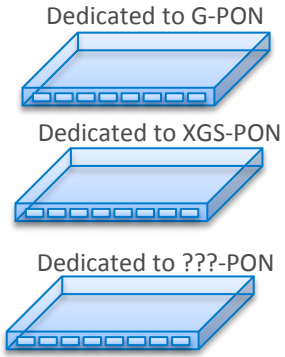
- White box OLT needs to have standard compliant interfaces (O-RAN and BBF)
- QoS and Time sync. control functions are necessary at SDN controller and/or anywhere at HW level.



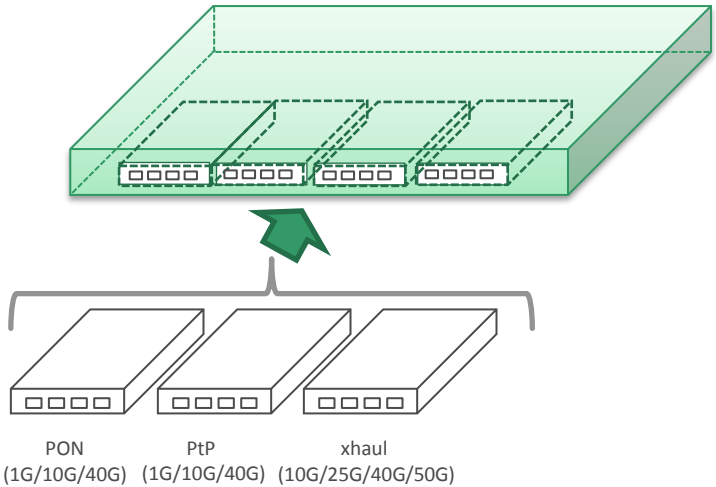
White box optical access node for multiple services

- NTT supports on-going discussion for SEBA enhancement
- SEBA should be applicable not only for FTTH, but also for Enterprise (PtP), Mobile (xhaul, mmWave), and others.
- Dedicated WB-OLT for each service vs WB-OAN for multi services.

Dedicated to WB-OLT for each PON system



WB-OAN for multiple services



Summary

- NTT’s activities in SEBA are reviewed.
  - We keep contributing to SEBA through EPON VOLTHA, BBSim, and NEM developments.
- SEBA should expand its application field to establish ecosystem in access industry.
- As an example, SEBA as xhaul platform is proposed.
  - We welcome partners for further discussions.
- A preliminary concept of WB-OAN for multiple services is introduced.

Thank You

Follow Up Links:

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