

# New Optical Access Network System for Green Society

— Establishment of Open Laboratory  
for the Application of New Structure Optical Fiber —

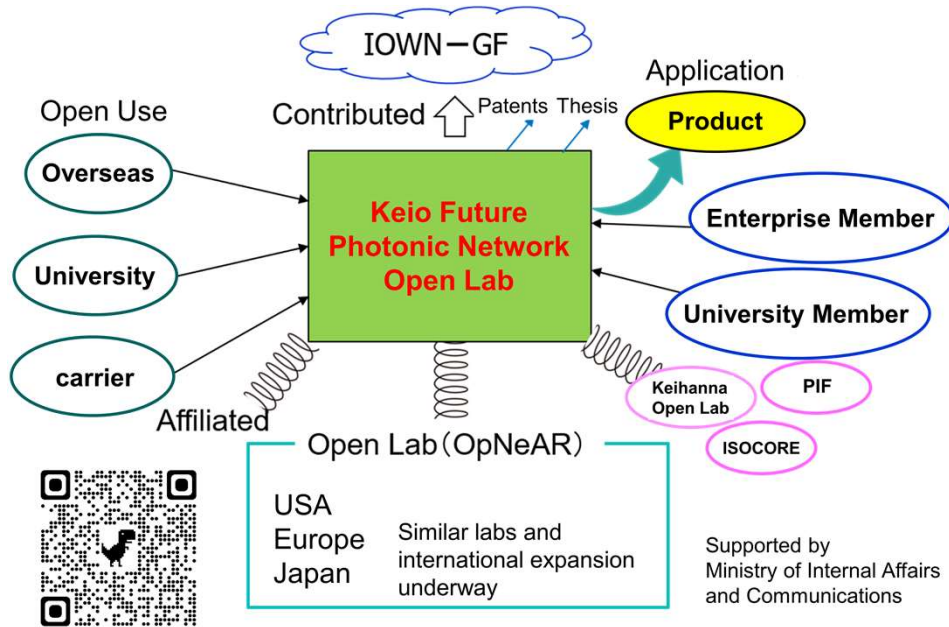
Yamanaka Laboratory and Tsuda Laboratory, Keio University, Japan

## Future Photonic Network Open Laboratory

### Features of Open Lab

- **400 Gbps** (initially 10 Gbps) Optical Access Systems (PON/OLT/ONU) will be introduced.
- For the first time in the world, **Hollow Core Fiber** will be available!
- Local 5G system has been installed.
- We are working with UTD (University of Texas at Dallas) to create a global open lab.

URL <https://pilab.jp/OpenLab/>



If you are interested, please contact [Prof. Yamanaka](#) or [Prof. Tsuda](#).

## Open Lab Facilities and Equipments



Arbitrary Waveform Generator



Oscilloscope



Local 5G Base Station



Optical Surface Tables (2 systems)



Compact Autonomous Guided Vehicles



Ultra-High Quality Display (SAGE-3)



Optical Fiber Cable



Autonomous Car



Remote Control Robot



### Contact us

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This research includes the results of "Research and Development of Advanced Optical Transmission Technologies Contributing to Green Society (JPM100316)" conducted by the Ministry of Internal Affairs and Communications.



# New Optical Access Network System for Green Society

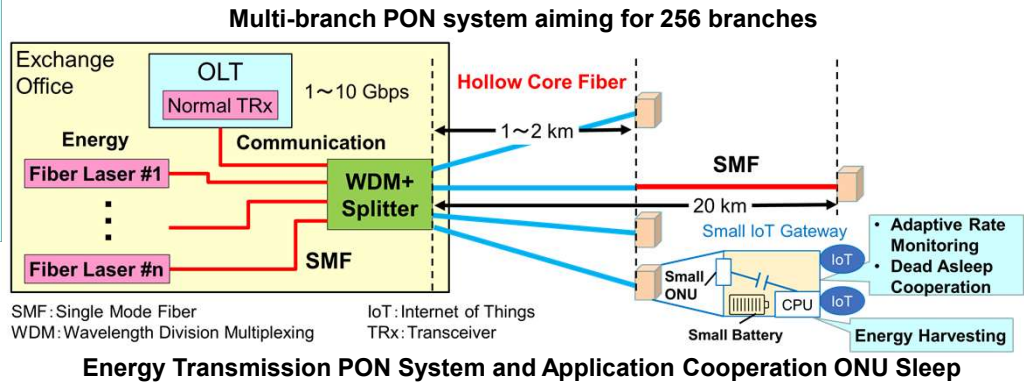
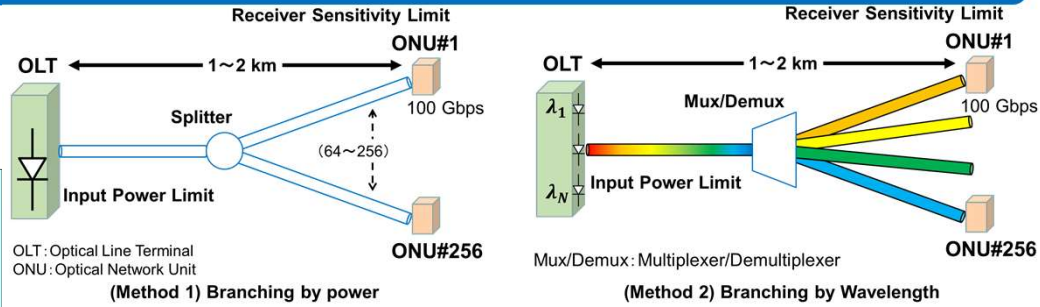
## —Development of Power-Saving, Hyper-Branching, Energy-Transmitting PON—

Yamanaka Laboratory and Tsuda Laboratory, Keio University, Japan

### Research and Development of Highly-branched Access Network Configuration Technology

#### objective

- Realization of hyper-branching PON (target 256 branches)
- Energy transmission PON design
- Establishment of ONU sleep in cooperation with applications, adaptive rate control techniques, and control plane configuration methods.



Energy Transmission PON System and Application Cooperation ONU Sleep

### ONU (Optical Network Unit) Sleep by Cooperating with Applications

We aim to reduce ONU standby power by 50% through ONU sleep in cooperation with our application

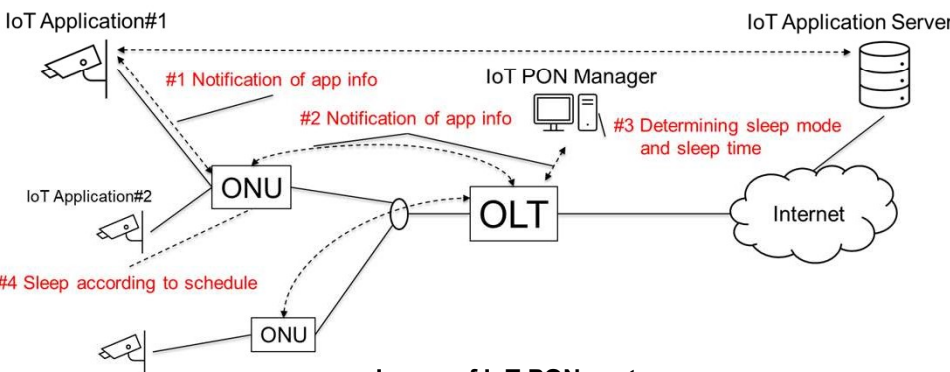


Image of IoT-PON system

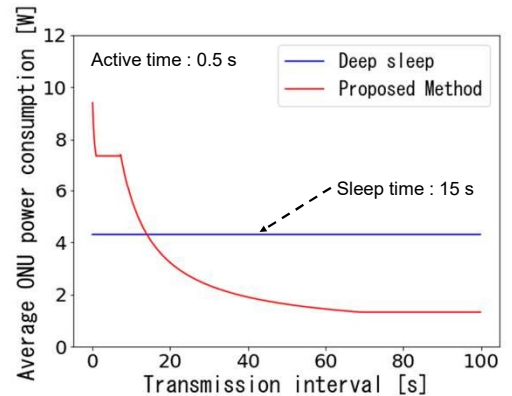
#### Cooperation Method

- #1 IoT application notifies the ONU of the transmission interval.
- #2 Notification is sent from ONU to IoT PON manager via OLT
- #3 PON Manager understands information of apps under ONU, calculates sleep mode and time, and notifies ONU
- #4 ONU sleeps according to the schedule

#### Deep sleep

- Sleep mode that periodically turns off nearly all components except the sleep timer
- Allow significant traffic impact, such as link disconnects
- **Highly power-efficient**, with power savings of **90%** or more during sleep mode
- Data cannot be received during sleep and rise, so if applications do not send data during the period when the ONU can receive it, **data will be lost**
- **Long rise time**(few-second order)

Aim to achieve the goal by enabling the use of deep sleep, which is currently unavailable



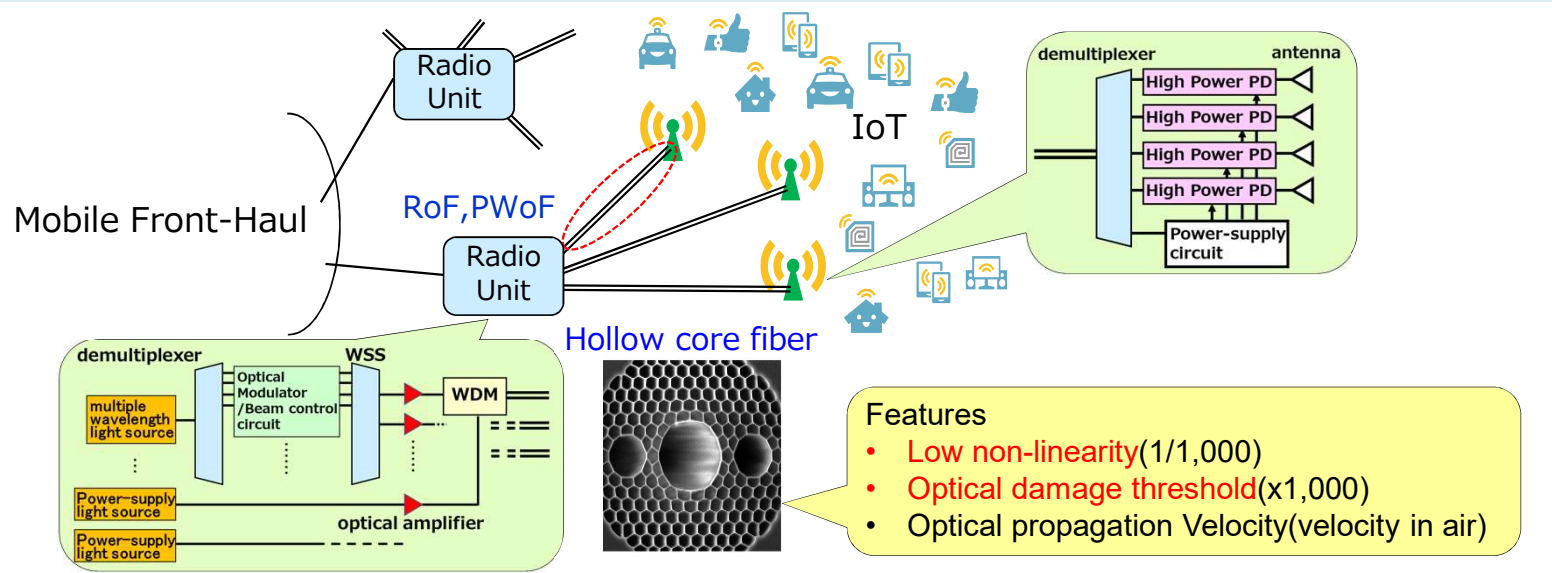
Variation of average ONU power consumption by transmission interval

This research includes the results of "Research and Development of Advanced Optical Transmission Technologies Contributing to Green Society (JPMI00316)" conducted by the Ministry of Internal Affairs and Communications.

## Paradigm Shift in Mobile Front-haul

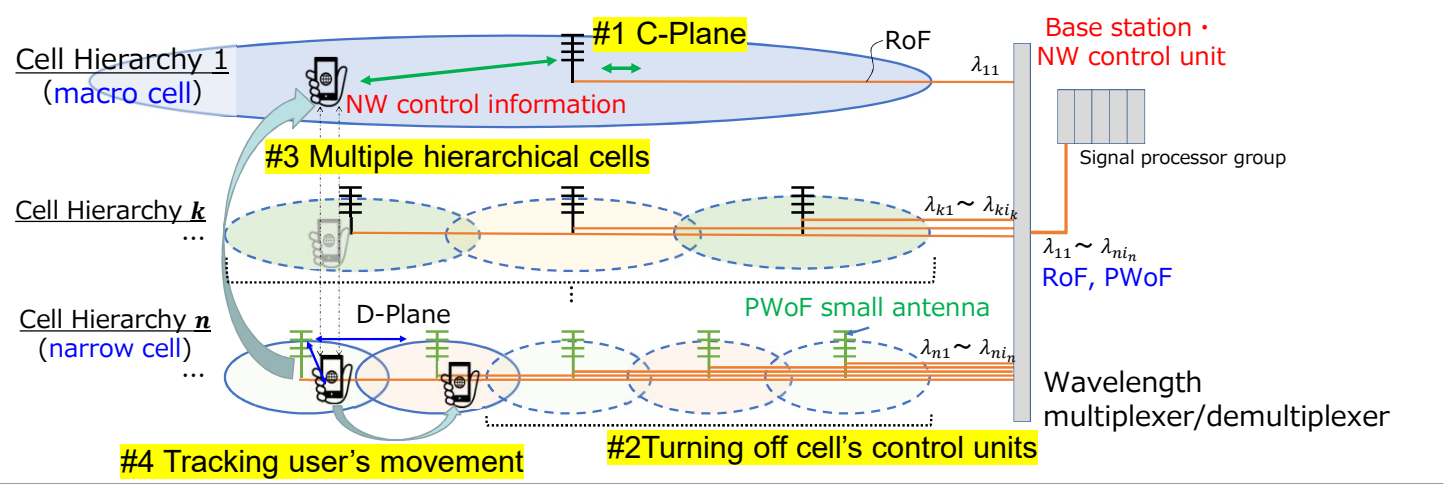
What we are aiming for :  
**Construction of mobile front-haul using optical power feed analog RoF antennas!**

- In Beyond 5G, cells must be further minimized. 100s of meter to 10s of meter and personalized.
- Quite numerous antennas required! Power supply is a critical issue.
  - ✓ Solution#1 : High power analog Radio over Fiber (RoF) and Power over Fiber (PWoF) over Hollow Core Fiber.
  - ✓ Solution#2 : Smart Mobile Front-haul using Hierarchical Cell Structure.



## Smart Mobile Front-haul Using Hierarchical Cell Structure

- #1 Installation of **C-plane** using macro cell
- #2 Turn off cell's control units with 0 users  $\Rightarrow$  **Reduction of power consumption**
- #3 Using multiple hierarchical cells  $\Rightarrow$  **Increasing Capacity/ Reliability for users**
- #4 **Tracking and Optimization** by the switched RoF technology



These research results are obtained from the commissioned research by National Institute of Information and Communications Technology (NICT), JAPAN.

# Dynamic task assignment experiment for container-based in-network heterogeneous distributed MEC environment

Yamanaka Laboratory, Keio University, Japan



## AMec: Access - Metro Edge Computing

- ◆ AMec (Access-metro Edge Computing): Concept of edge computing that utilizes surplus in-network computing resources
  - ◆ There are times when resources on network devices are reclaimed for their original tasks, such as information gathering and routing reconfiguration, and then are not available for AMec tasks
- Computing devices join and leave the resource pool

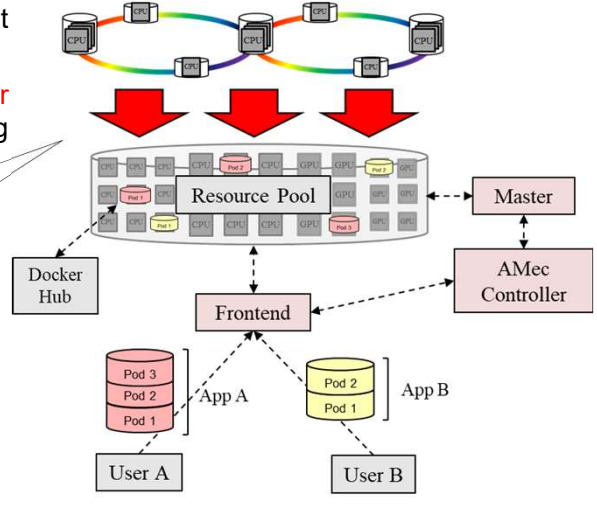
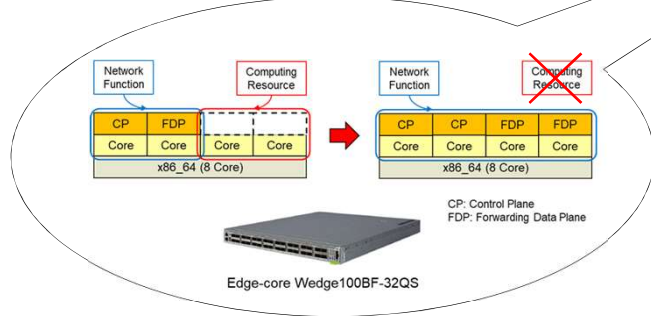


Fig. 1 Image of Overall AMec Architecture

## Experiment Overview

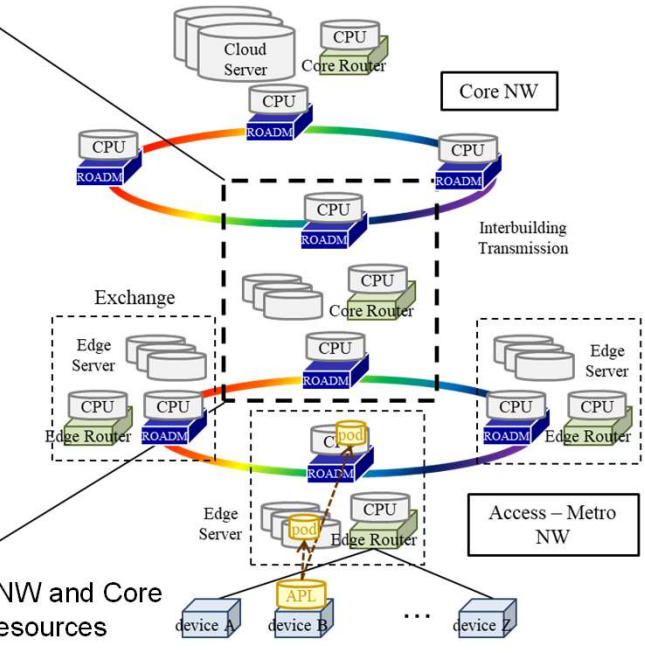
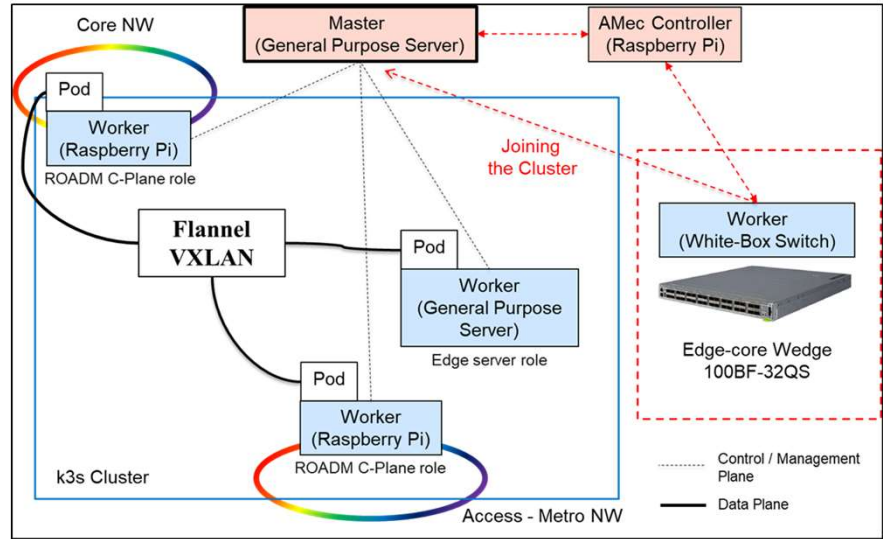


Fig. 2 Experiment overview

Emulating an internal network of a building that connects Access-Metro NW and Core NW, we have made a **Kubernetes cluster** consisting of their computing resources

- ◆ We have built a PoC that shows part of the concept and system of AMec
  - The container-based system allows third-party apps to be executed, and a variety of apps can run on AMec
  - Network devices that detect resource availability automatically join the cluster through the mediation of AMec Controller and are assigned pods

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This research includes the results of 「research and development of innovative optical network technology for new social infrastructure (JPMI00316)」 conducted by the Ministry of Internal Affairs and Communications.