SDN Access Area Network
(Fixed and Mobile services with virtualized PON)

OKI Open up your dreams

■Promising Services

- **Fixed and mobile** : Multi-resource data access with the seamless and adequate user experience.
- **Multi-tenant** : Fundamental infrastructure for various service providers (SPs) including IoT SPs.
- **Local cloud** : Quick response ICT services, cache, and front-end-processor for the core cloud.

■Functionalities for benefits

- **Customized policy**: Desirable policy network for each service or customer.
  (Policies: QoS, AAA, reliability, security, naming, addressing, routing)
- **Low power, low cost**: CAPEX and OPEX reduction by Just In Time investment and resource allocation.
- **Friendly and easy Interface**: Not only for the operating but also service creation or programming of modules.

■Key technologies

- **SDN / NFV** : Deep provisioning, awareness and analysis
- **Multi-resource multi-layer:**
  Coordination of inconsistent points
- **Close up to physical & logical limitation:**
  Adaptive modulation and numerical optimization
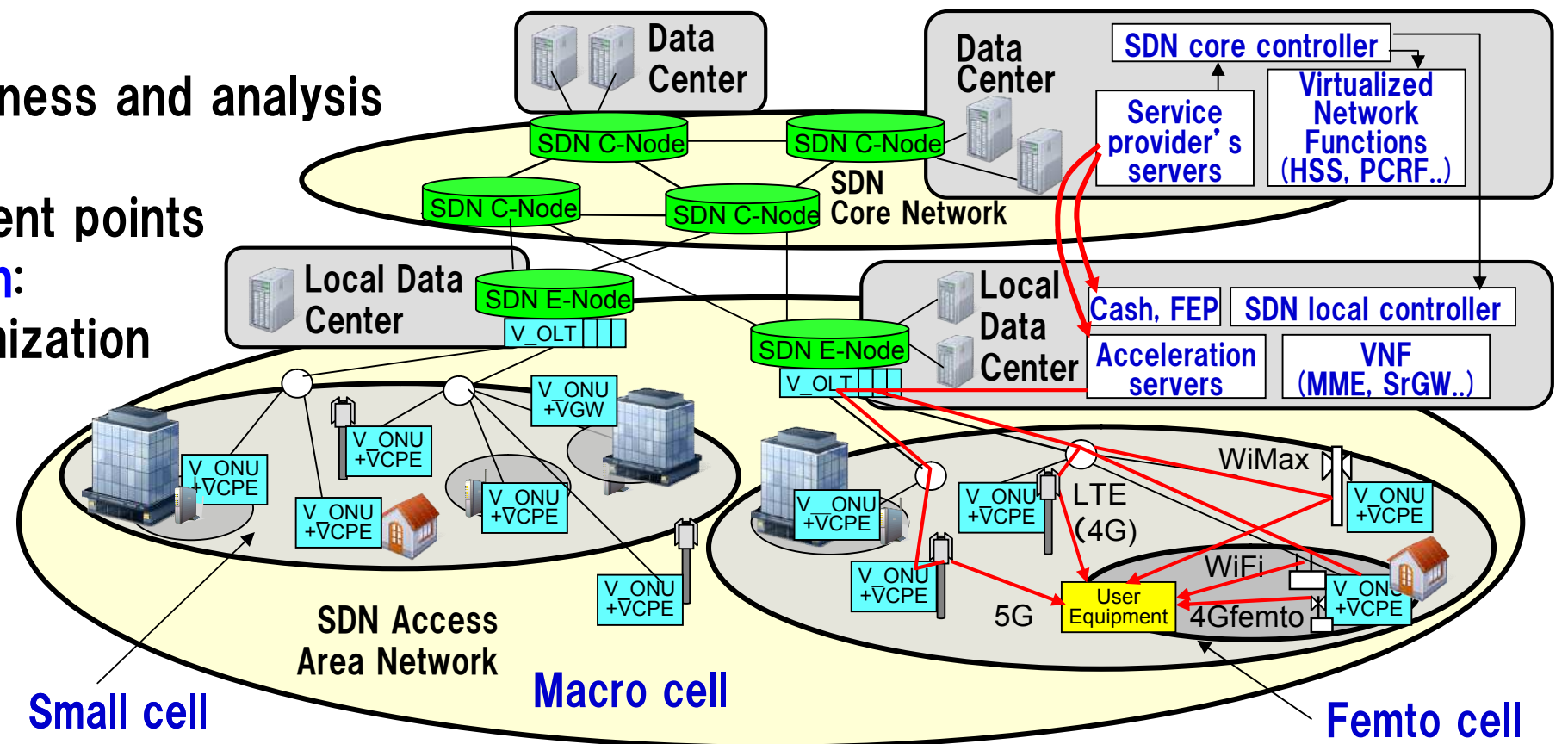
Prototype of Virtualized PON (WDM/TDM-PON)

SPECIFICATIONS (ONU)
- Tunable 4 wavelengths
- 200GHz Spacing (G.989)
- Lunched power 0dBm
- Sensitivity −28dBm @10E-3

OLT

ONU

A part of this work is supported by the MIC of Japan

Data Center
Data Center
SDN core controller
Service provider's servers
Virtualized Network Functions (HSS, PCRF..)
SDN C-Node
SDN Core Network
Local Data Center
SDN E-Node
V_OLT
Local Data Center
Cash, FEP
SDN local controller
Acceleration servers
VNF (MME, SrGW..)
SDN E-Node
V_OLT
V_ONU +VGW
V_ONU +VCPE
WiMax
LTE (4G)
WiFi
5G
User Equipment
4Gfemto
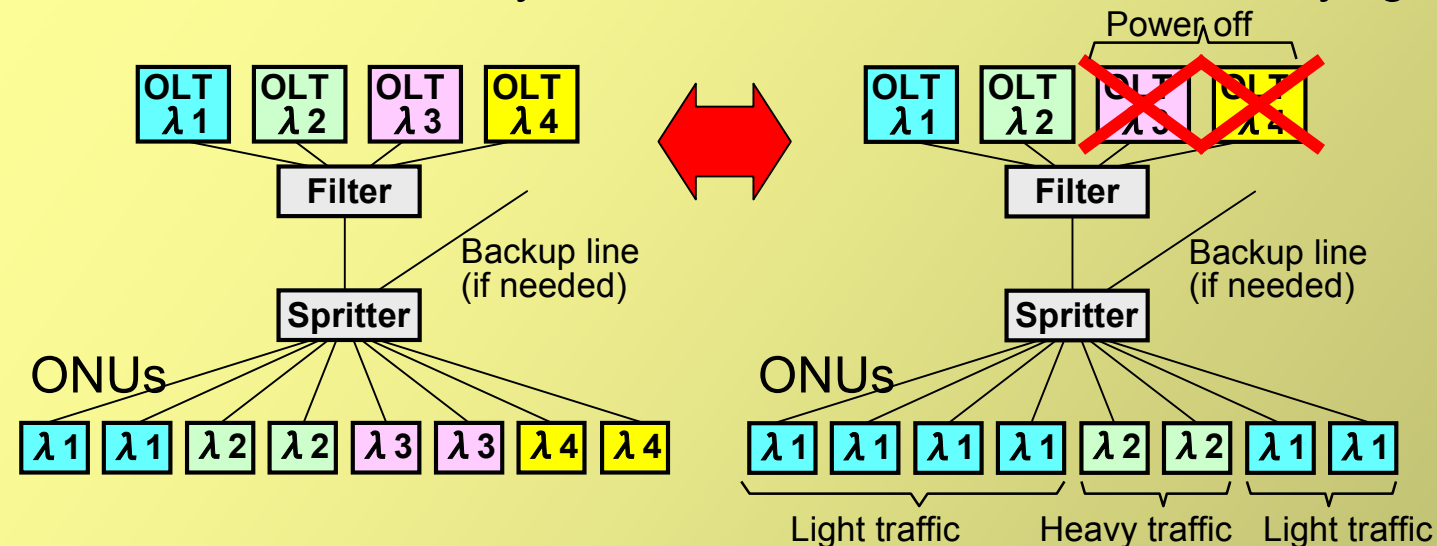SDN Access Area Network
Small cell
Macro cell
Femto cell

SDN E node : SDN Edge node
SDN C node : SDN Core node
VNF: Virtualized Network Function
V_ONU+VCPE: Virtualized PON ONU
+Virtual Customer Premises Equipment
V_OLT : Virtualized PON OLT

HSS: Home Subscriber Server
MME: Mobility Management Entity
PCRF: Policy and Charging Rules Function
PGW: Packet Date Network Gateway
SrGW: Serving Gateway

Virtualized PON: Low power high efficiency access node

(1) System: Basic configuration of Virtualized PON

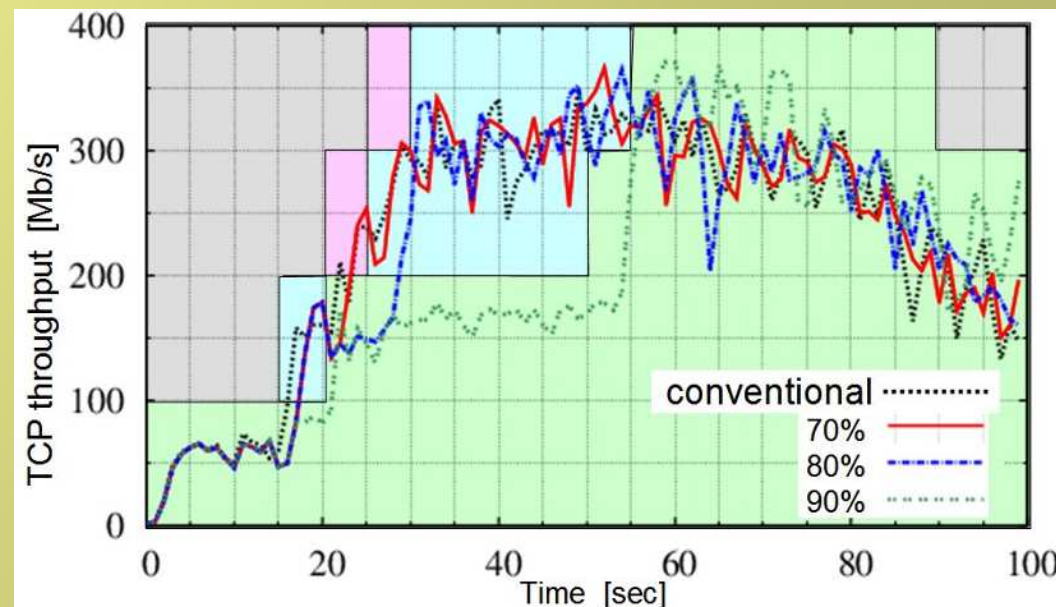Case1 Traffic is heavy   Case2 Traffic is relatively light

Power off

| OLT λ1 | OLT λ2 | OLT λ3 | OLT λ4 |

Filter

Spritter

Backup line (if needed)

ONUs

| λ1 | λ1 | λ2 | λ2 | λ3 | λ3 | λ4 | λ4 |

| OLT λ1 | OLT λ2 | OLT λ3 | OLT λ4 |

Filter

Spritter

Backup line (if needed)

ONUs

| λ1 | λ1 | λ1 | λ1 | λ2 | λ2 | λ1 | λ1 |

Light traffic   Heavy traffic   Light traffic

(2) Issue:
TCP restricts traffic when remaining bandwidth is small.

TCP L3/L2/L1   Remaining bandwidth   TCP L3/L2/L1

(3) Simulation:
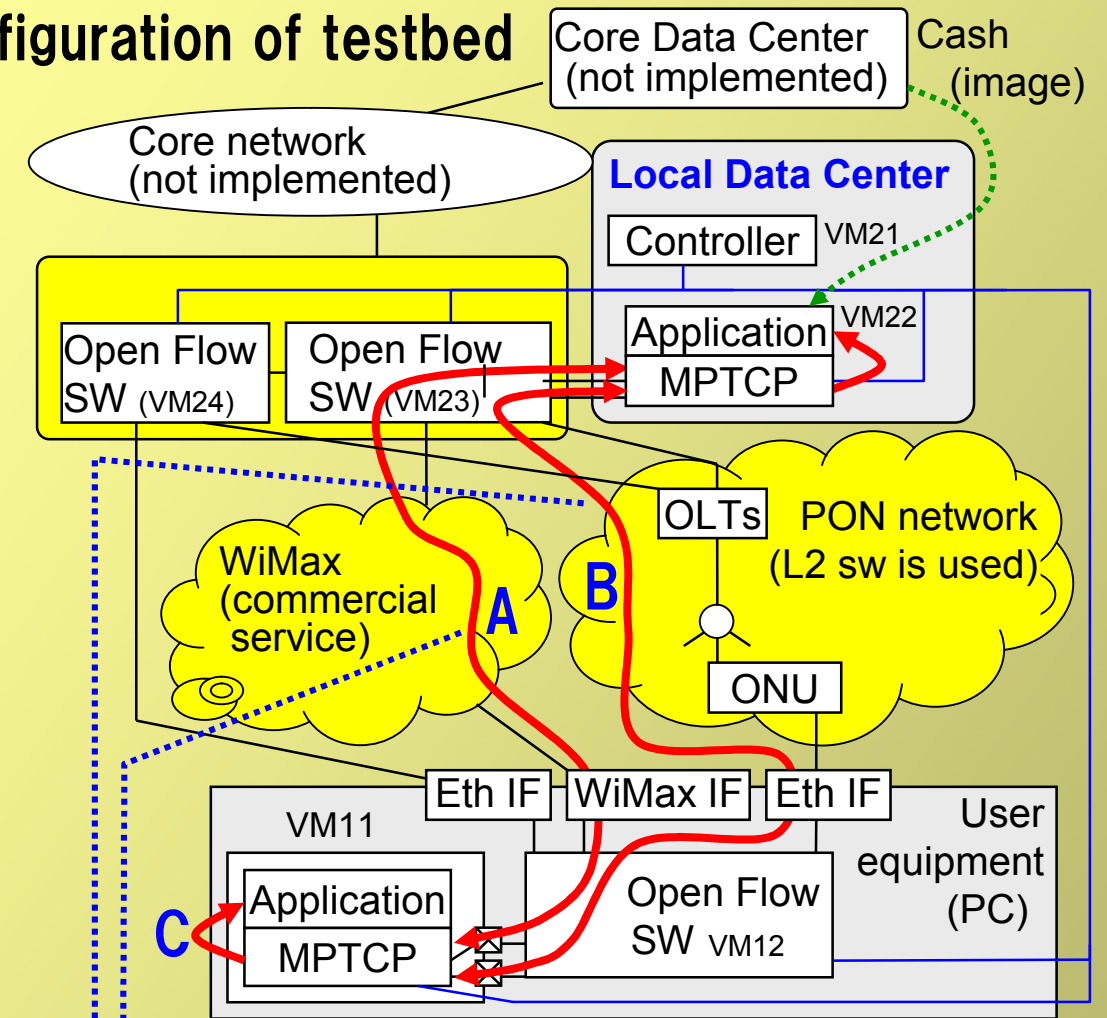

TCP throughput [Mb/s] vs Time [sec]

conventional
70%
80%
90%
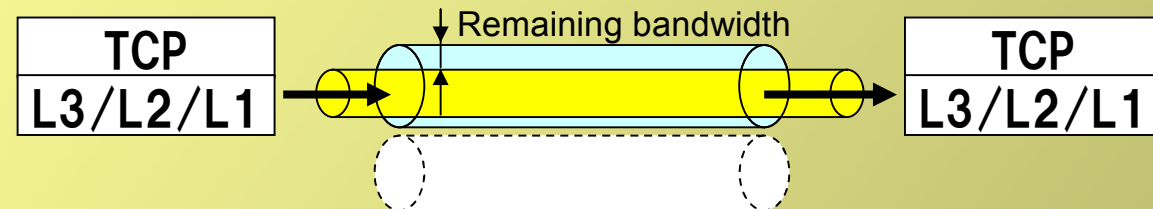
The relation between threshold level and throughput.

Multi-resource simultaneous reliable layer 4 communication （MPTCP）in SDN access testbed

(1) Configuration of testbed

Core Data Center (not implemented)   Cash (image)

Core network (not implemented)

Local Data Center

Controller VM21

Application VM22
MPTCP

Open Flow SW (VM24)   Open Flow SW (VM23)

WiMax (commercial service)   A   B

OLTs   PON network (L2 sw is used)

ONU

Eth IF WiMax IF Eth IF   User equipment (PC)

VM11

C   Application
MPTCP

Open Flow SW VM12

(2) Experiments

- MPTCP communication with external control for transmission ratio of each resource
- Routing by openflow switches （open vSwitch）

A
[Mb/s]
WiMax disconnect
Traffic obtained by WiMax resource for One TCP flow   [sec]

B
Ether wire disconnect
Traffic obained by wired resource for One TCP flow   [sec]

C
Always connecting using multi-resources
Traffic obtained by all resources for One TCP flow   [sec]