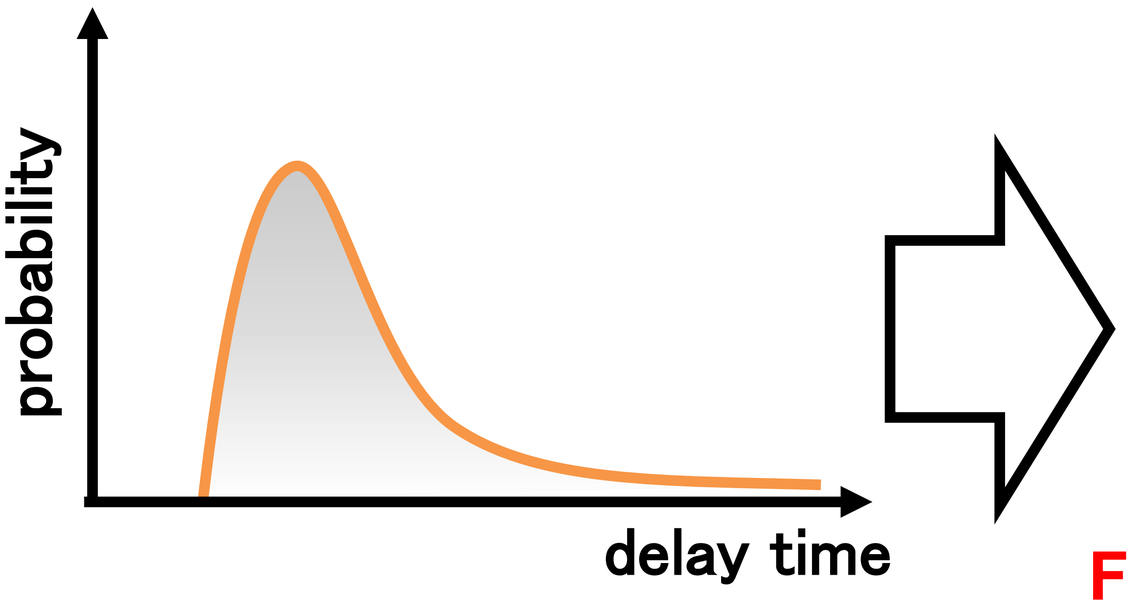
Ultra Low Latency Low Jitter and Massively Parallel Networks towards Beyond 5G Era

- Delay Jitter Reduction Control Technology -

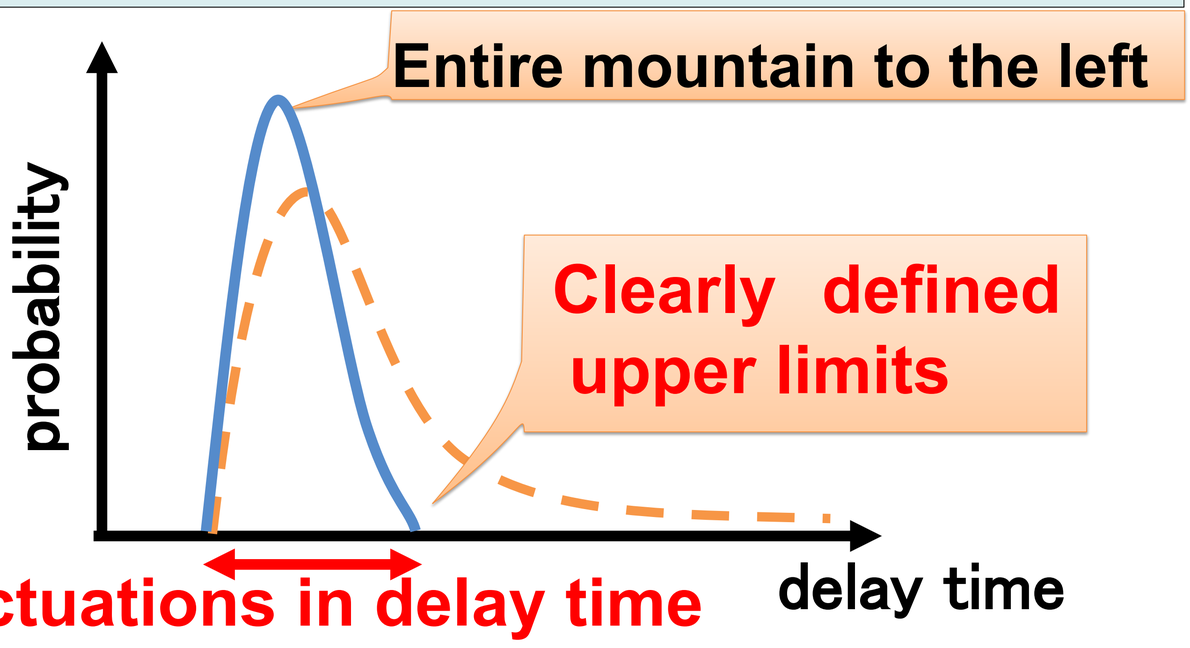
Yamanaka Laboratory, Keio University, Japan

Background：Ultra-Low Latency (ULL)

Applications such as VR, automated driving, etc. require ULL.
To achieve ULL, ″low latency″ and ″low jitter″ must be guaranteed while minimizing not only latency but also delay variation (jitter) between network ends via multiple switches and routers.



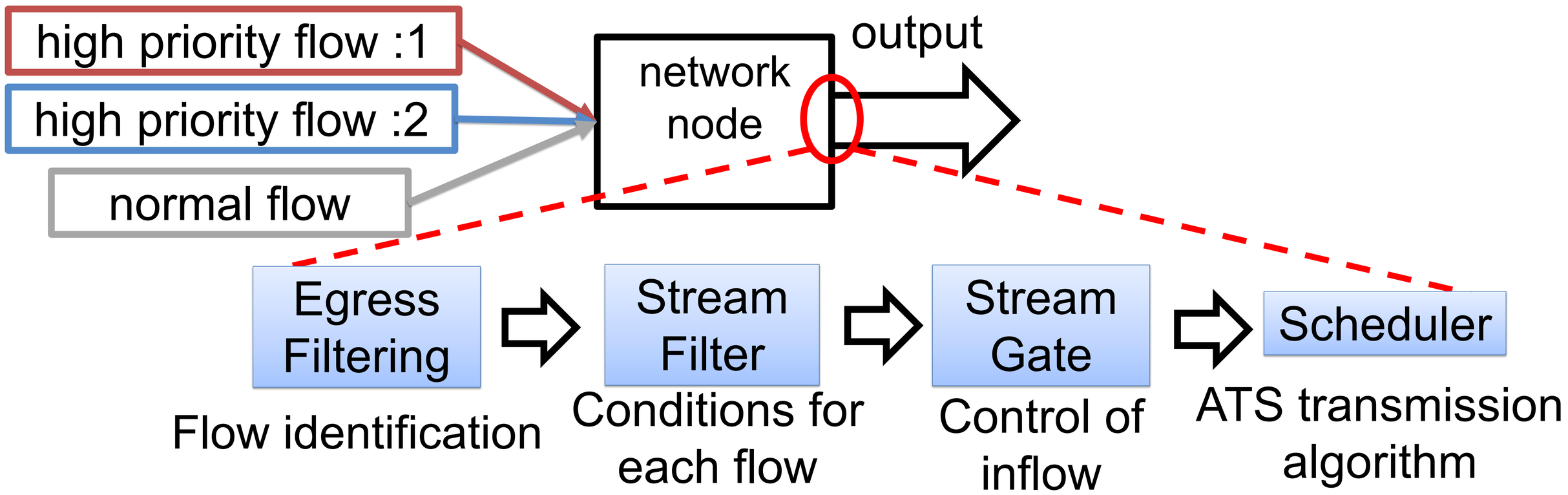
General delay probability distribution



ULL's delay probability distribution target

Existing method ：Asynchronous Traffic Shaper (ATS)

One of the jitter reduction techniques being standardized in IEEE 802.1 Qcr. Priority control is performed by assigning a priority to each flow at each node in the network.



Because priority is given to each flow, it is difficult to guarantee jitter at the packet level because priority control cannot be performed based on the delay status of packets.

contact infomation
Mail : yamanaka@keio.jp
URL : https://www.Yamanaka.ics.keio.ac.jp/

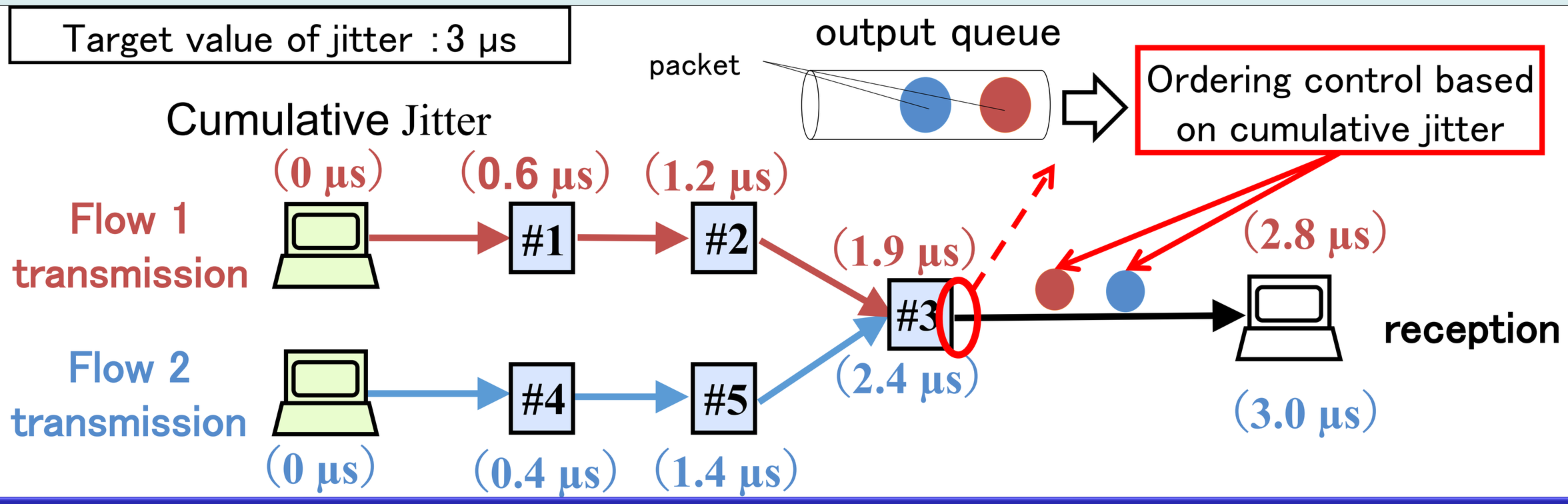
This research is supported by the National Institute of Information and Communications Technology (NICT).

Ultra Low Latency Low Jitter and Massively Parallel Networks towards Beyond 5G Era
- Delay Jitter Reduction Control Technology -

Yamanaka Laboratory, Keio University, Japan

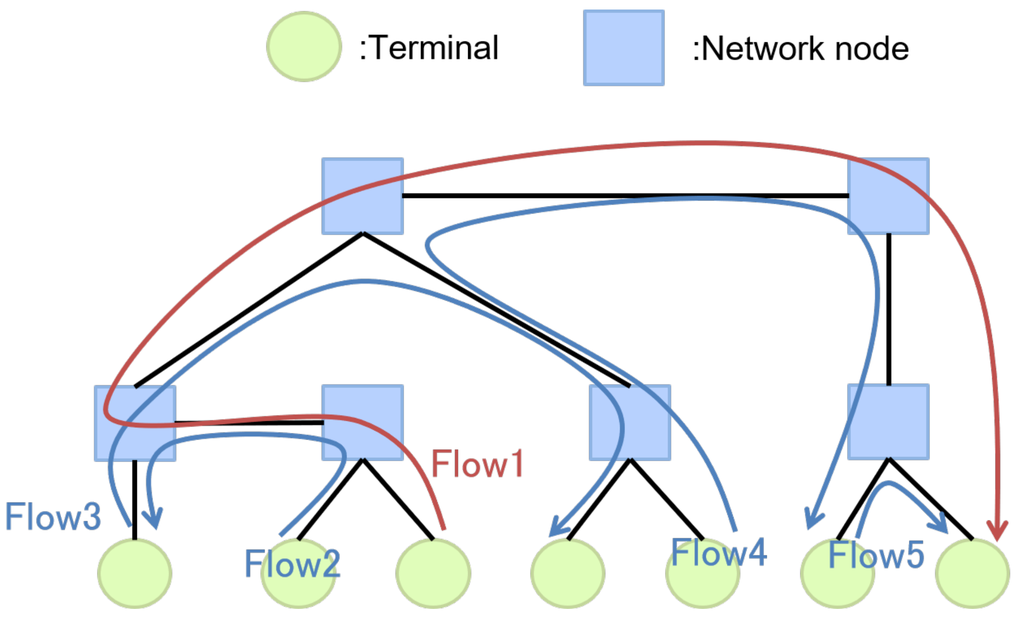
Proposed method: queue read control method to guarantee the jitter in μs order

Priority control is performed by assigning a priority to each packet at each node based on the accumulated jitter at the node it passes through, further reducing jitter while guaranteeing packet-level jitter between ends.
The jitter of each node is calculated from the difference of input/output time to the node, written as cumulative jitter at the end of each packet, and retained.

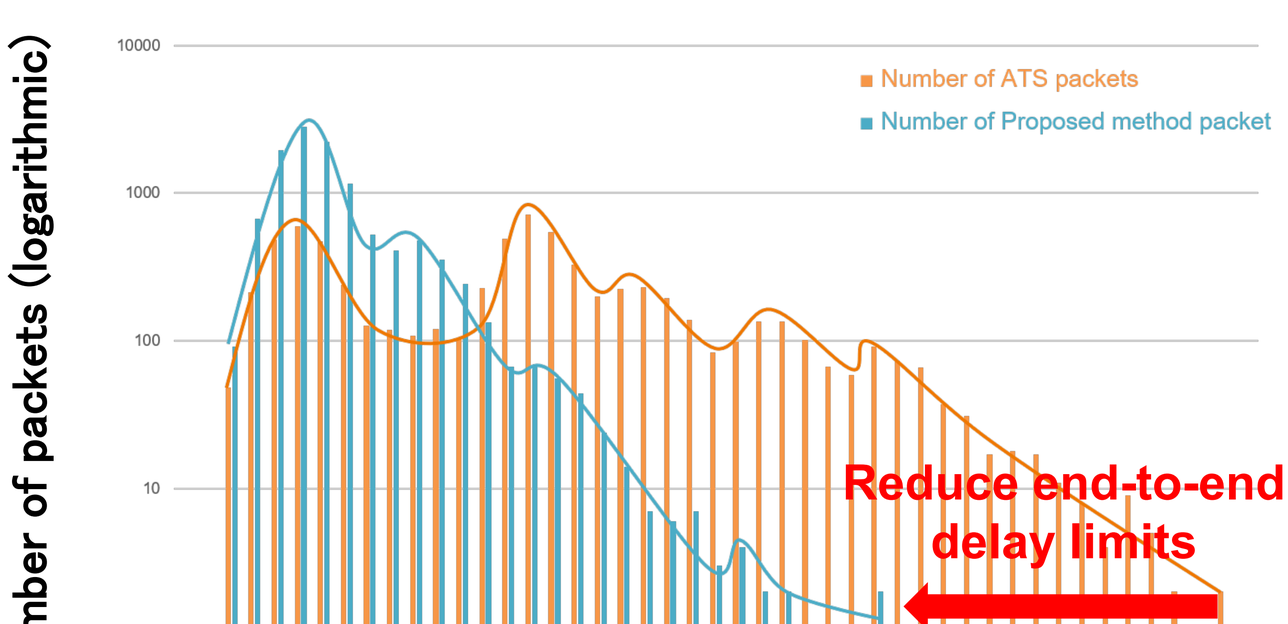


Booth Demo in iPOP2022

Comparison of the distribution of cumulative jitter values per packet at the receiving end between the ATS and the proposed method, focusing on the red flow and with four blue flows flowing as competing flows with the red flow.



Topology and flow in which the experiment was performed



We confirmed that the proposed method can reduce the jitter more by moving the peaks of the cumulative jitter value distribution chart to the left.

This research is supported by the National Institute of Information and Communications Technology (NICT).

Dynamic Task Assignment MEC using Remaining xPU Resources in Heterogeneous Network Devices

Yamanaka Laboratory, Keio University, Japan

HERO-NET

Yamanaka Lab.

Keio University 1858 CALAMVS GLADIO FORTIOR

AMec：Access - Metro Edge Computing

◆ Network equipment in Access-Metro network are becoming more and more white-boxed. It is expected that the extra computing resources in network equipment will be provided to users as a computing resource pool.

◆ Access-Metro edge computing (AMec) proposes to utilize the pool of computing resources provided by the network.
e.g., processing modules (CPU, GPU etc.) of network devices, IoT devices, and unused user devices (Game Gears)

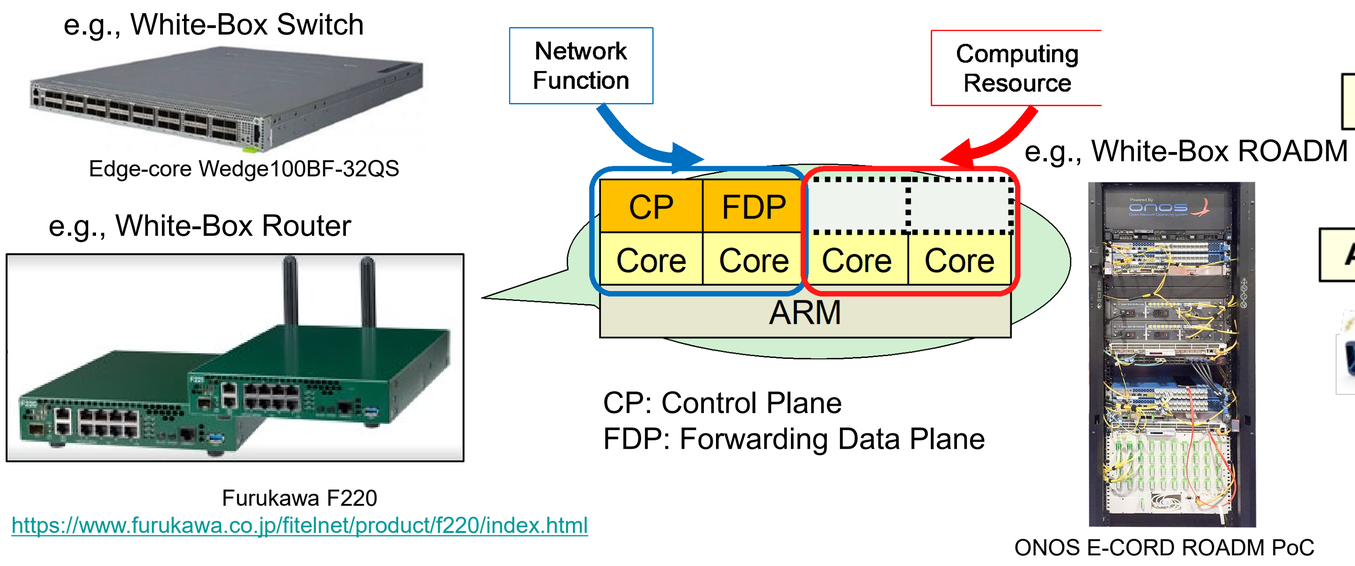


Fig 1. Computing resource in white-box equipment

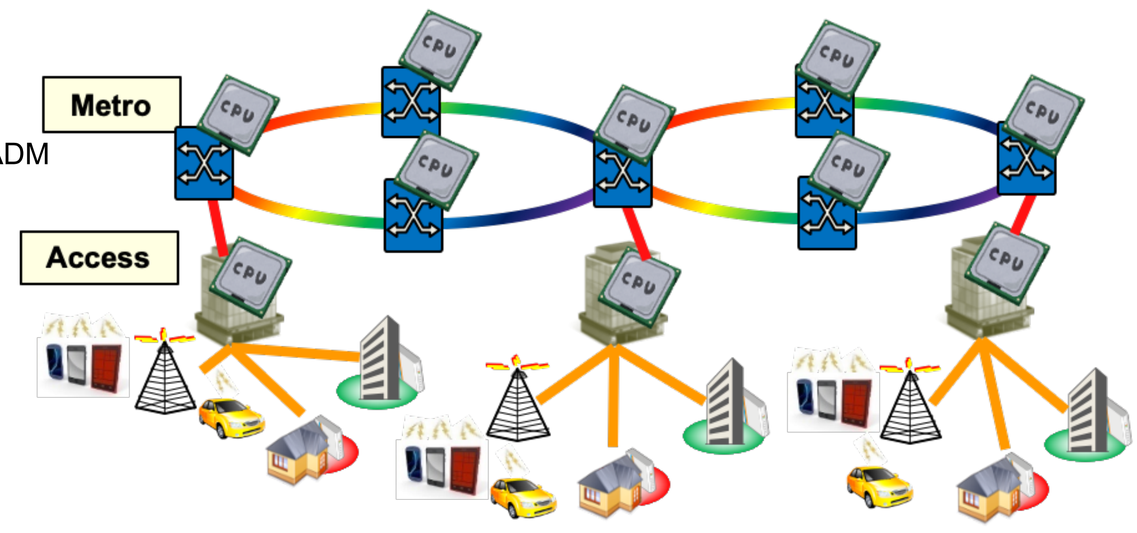


Fig 2. Resource pool in AMec environment

AMec Demonstration with Face Recognition System

AMec Frontend divides the received face recognition job into three tasks
#1 Gray Scale, #2 Face Cropping, and #3 Face Collation
and assign them according to AMec Controller‘s instructions

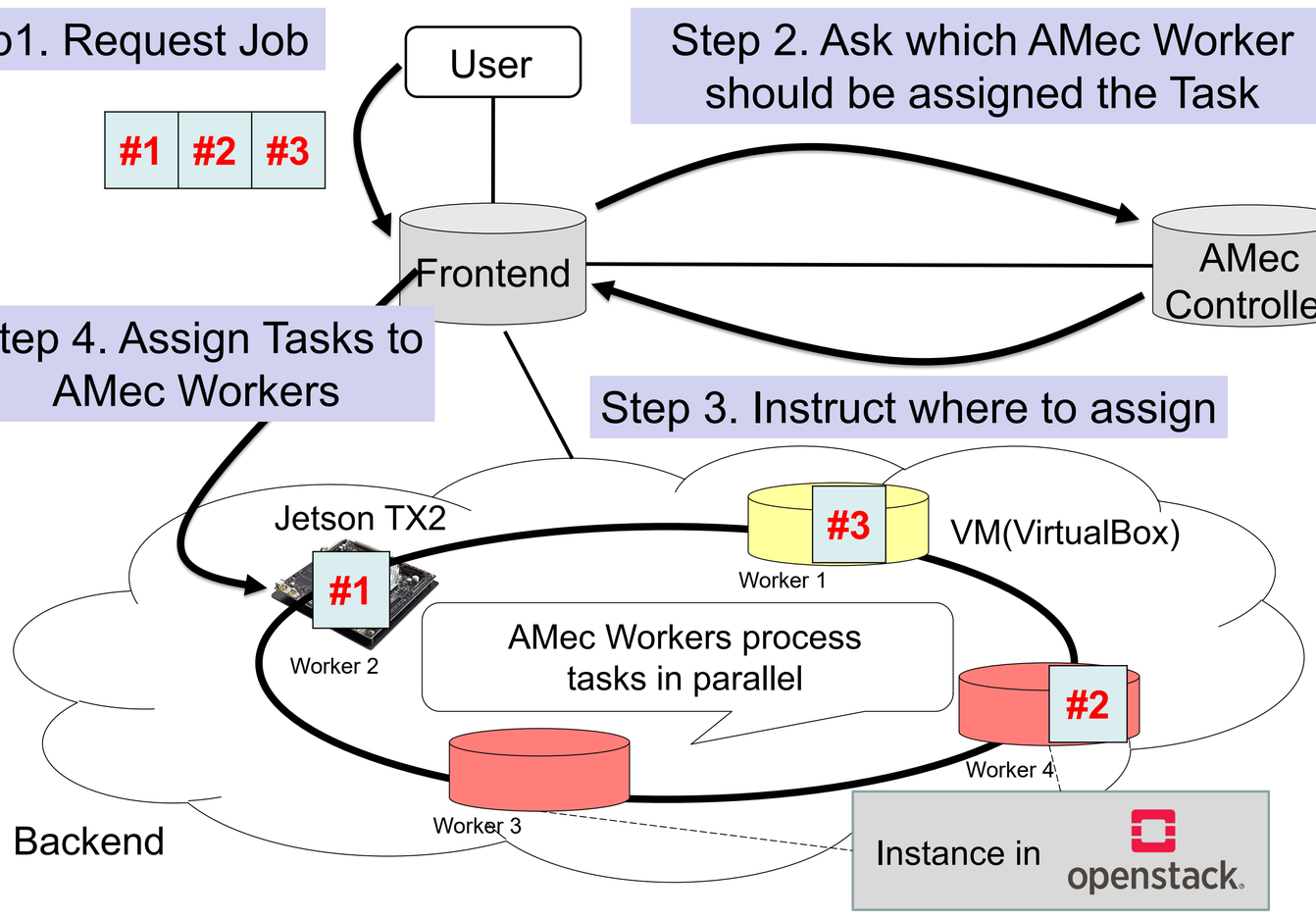


Fig 3. Task assignment procedure

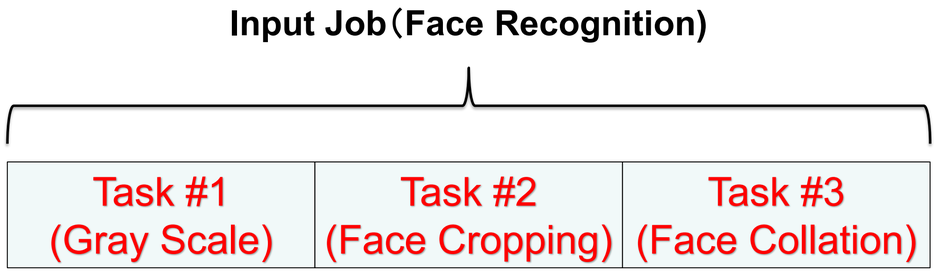


Fig 4. Definition of Job and Tasks

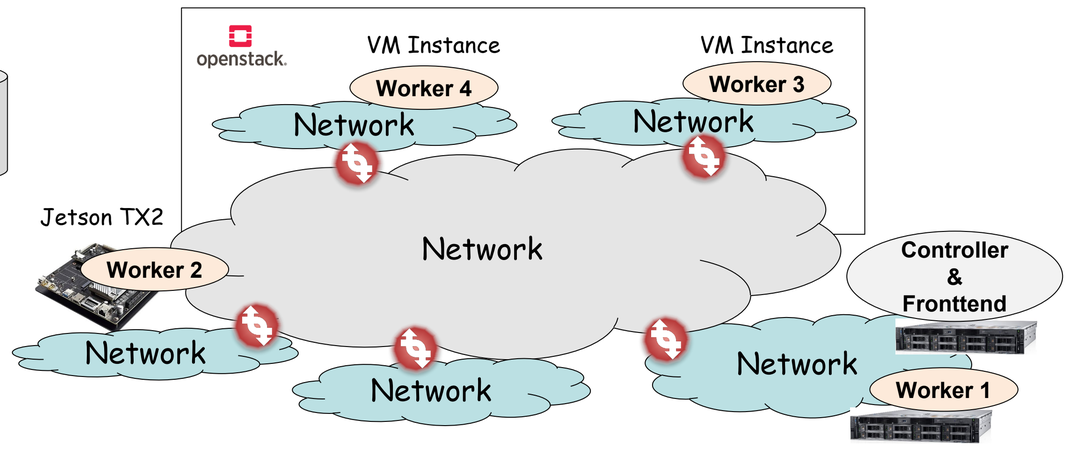


Fig 5. Heterogeneous devices in the demonstration network

AMec controller gather information (CPU/GPU usage, memory usage, etc.) from heterogeneous devices which work as AMec Workers distributed to different networks and decide which one to assign the task.

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.

Ultra Low Latency Low Jitter and Massively Parallel Networks towards Beyond 5G Era
- MAC technology for parallel transmissyon -

Yamanaka Laboratory, Keio University, Japan

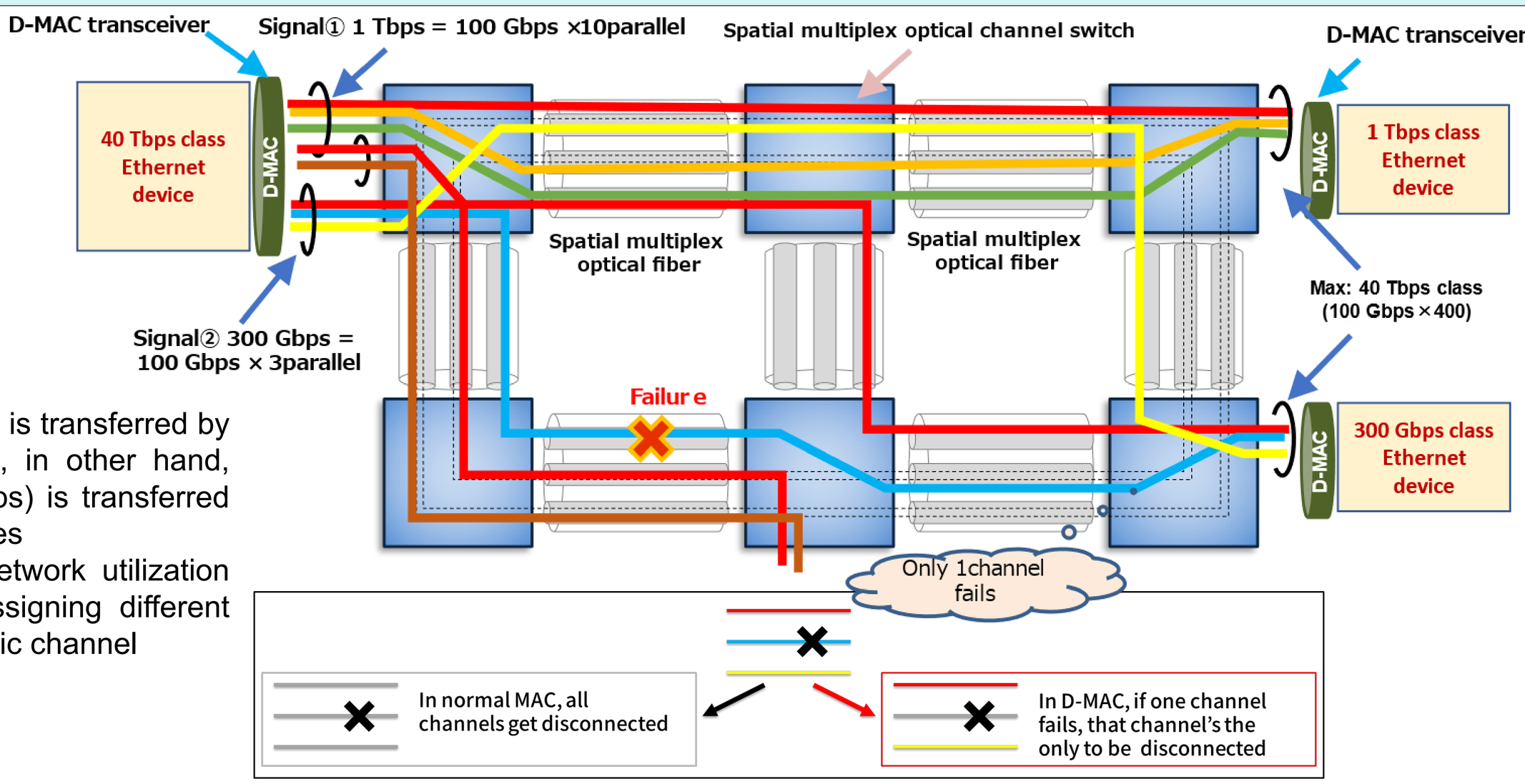
MAPLE
Massively Parallel and Sliced Optical Network

Keio University
1858
CALAMVS GLADIO FORTIOR

Yamanaka Lab.

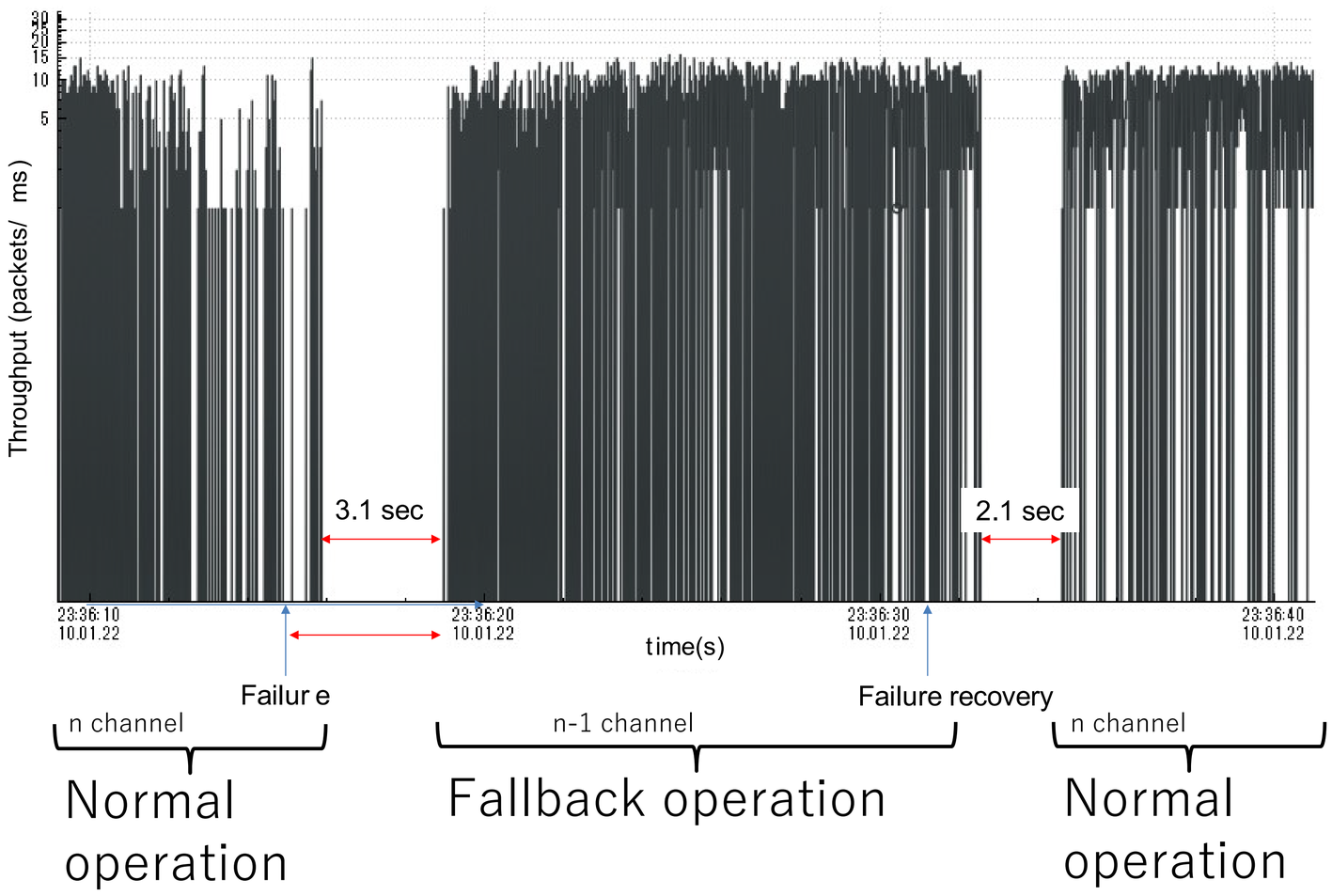
Dynamic-MAC

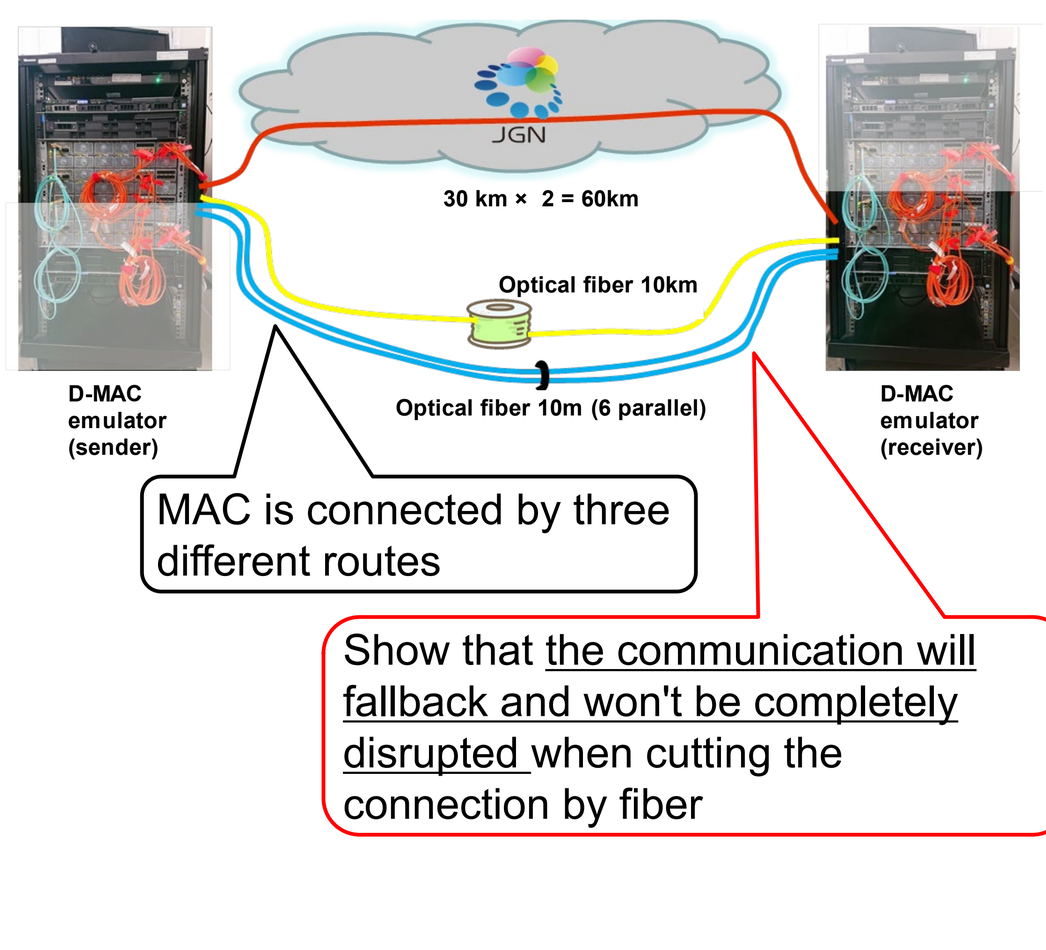
- We have proposed the Dynamic-MAC as one of the methods for accommodating high-capacity services. Dynamic-MAC is a concept which will provide 100 Gbit/s class to 10 Tbit/s class variable capacity MAC with parallel transmission link over spatial division multiplexing (SDM) networks.
- For one of the features of Dynamic-MAC, when partial failures occur, the communication will fallback and not be completely disrupted.



- Signal①(1Tbps) is transferred by the same route, in other hand, signal②(300Gbps) is transferred by different routes
- Improves the network utilization efficiency by assigning different routes to the optic channel

Demonstration for fallback operation





This work is partly supported by the National Institute of Information and Communications Technology (NICT) Japan