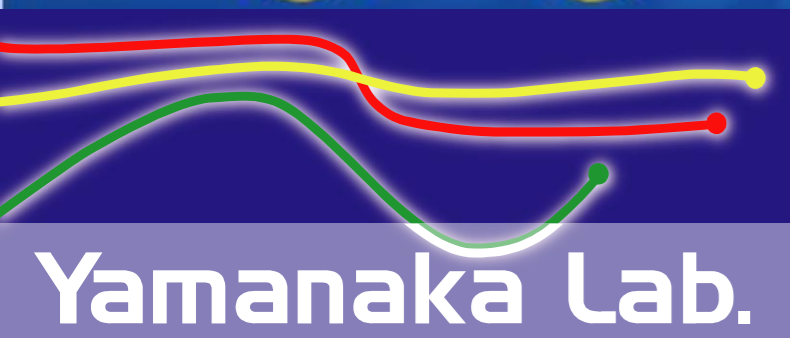


# Optical network with guaranteed communication capacity based on failure prediction

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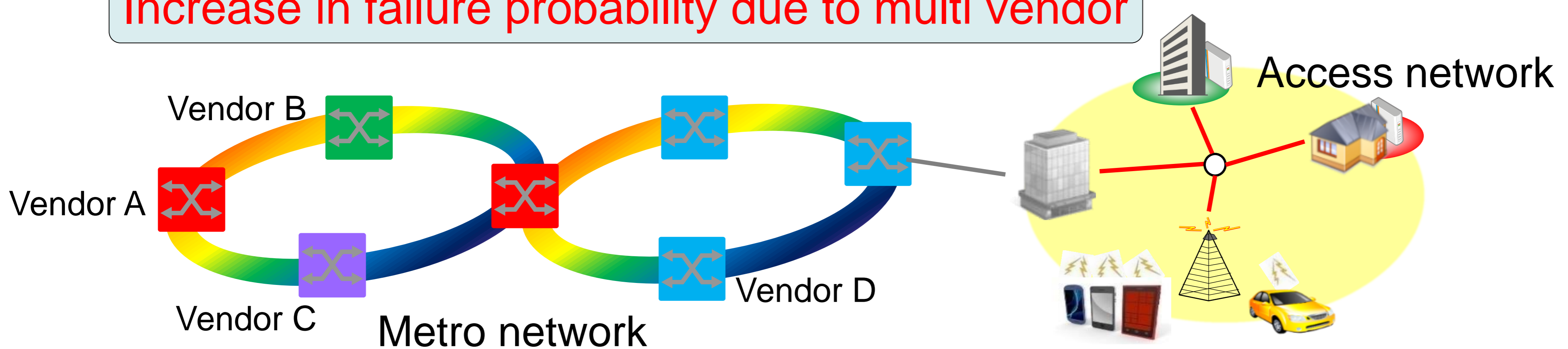


## Research background

- The distribution of high-quality video of 4K and 8K, the spread of IoT, and the progress of 5G mobiles increase communication traffic.
- Multi vendor of optical transmission devices that make up access metro networks progress, **failure probability increases**.

➔ It is necessary to secure a backup path to prevent data loss due to network route failure.

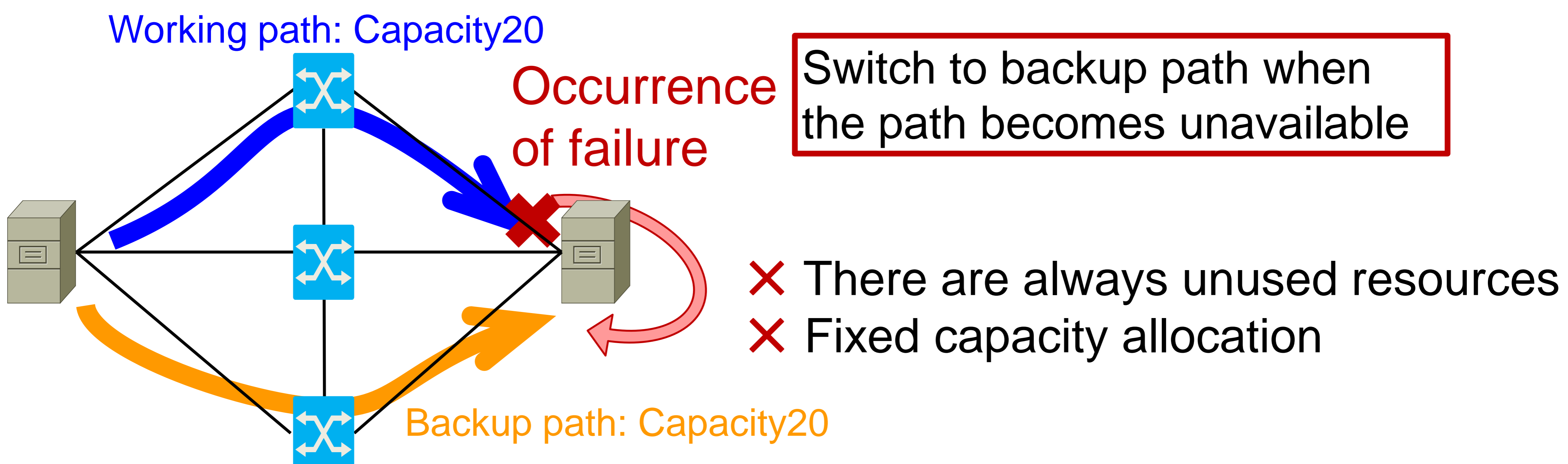
Increase in failure probability due to multi vendor



## High availability routing for increased risk of failure

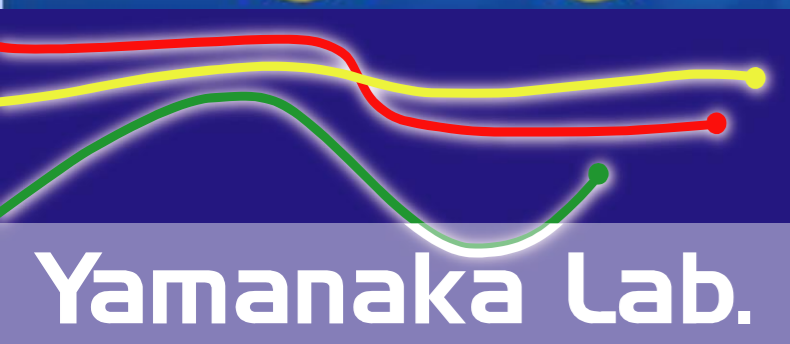
When performing multipath transfer to secure a backup path, except when a failure occurs the backup path becomes an unused resource and resulting in fixed capacity allocation.

### Conventional method





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## ECGR: Expected Capacity Guaranteed Routing [1]

- Satisfy the required traffic capacity based on expected value calculation.
- ECGR does not distinguish between working and backup path.
- The smaller the failure probability, the larger the flow.
- As related technology, multi-path routing technology that flows the same flow in multiple paths is required.

[1] S.Sekigawa, E.Oki, T.Sato, S.Okamoto, N.Yamanaka "Expected capacity guaranteed routing method based on failure probability of links" at IPOP 2018, ICCN2018

### ECGR

Availability probability: 25%

Path1: Capacity8

Path2: Capacity10

Path3: Capacity12

Availability probability: 90%

Availability probability: 75%

Accumulate analysis of equipment log information, failure prediction

Allocated capacity

Required capacity

Availability probability

100%

Allocate required capacity on average

Flexible determination of number of allocated paths and capacity according to failure prediction.

Achieve lean resource allocation with expected value guarantee.

## Multipath forwarding of ECGR

At the exhibition, perform multipath transfer as shown in demo configuration.

In multipath transfer, since the same flow is transferred by multiple paths, there is a possibility **that arrival time may differ depending on the path**. The use of multipath frames with order control information added in the switch network **enables data order to be restored on receiving side**, and special operations on the sending and receiving servers are omitted.

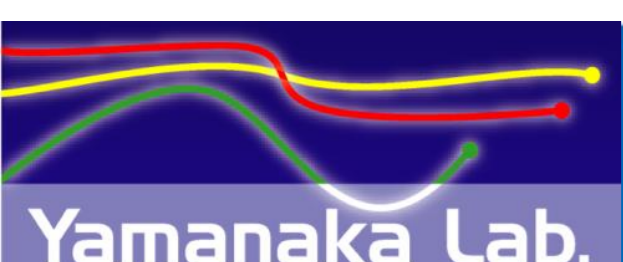
Researcher

Contact information

Department of Information and Computer Science Prof. Naoaki Yamanaka

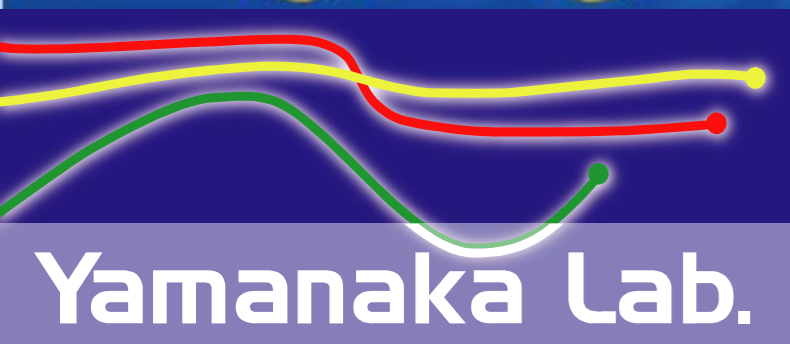
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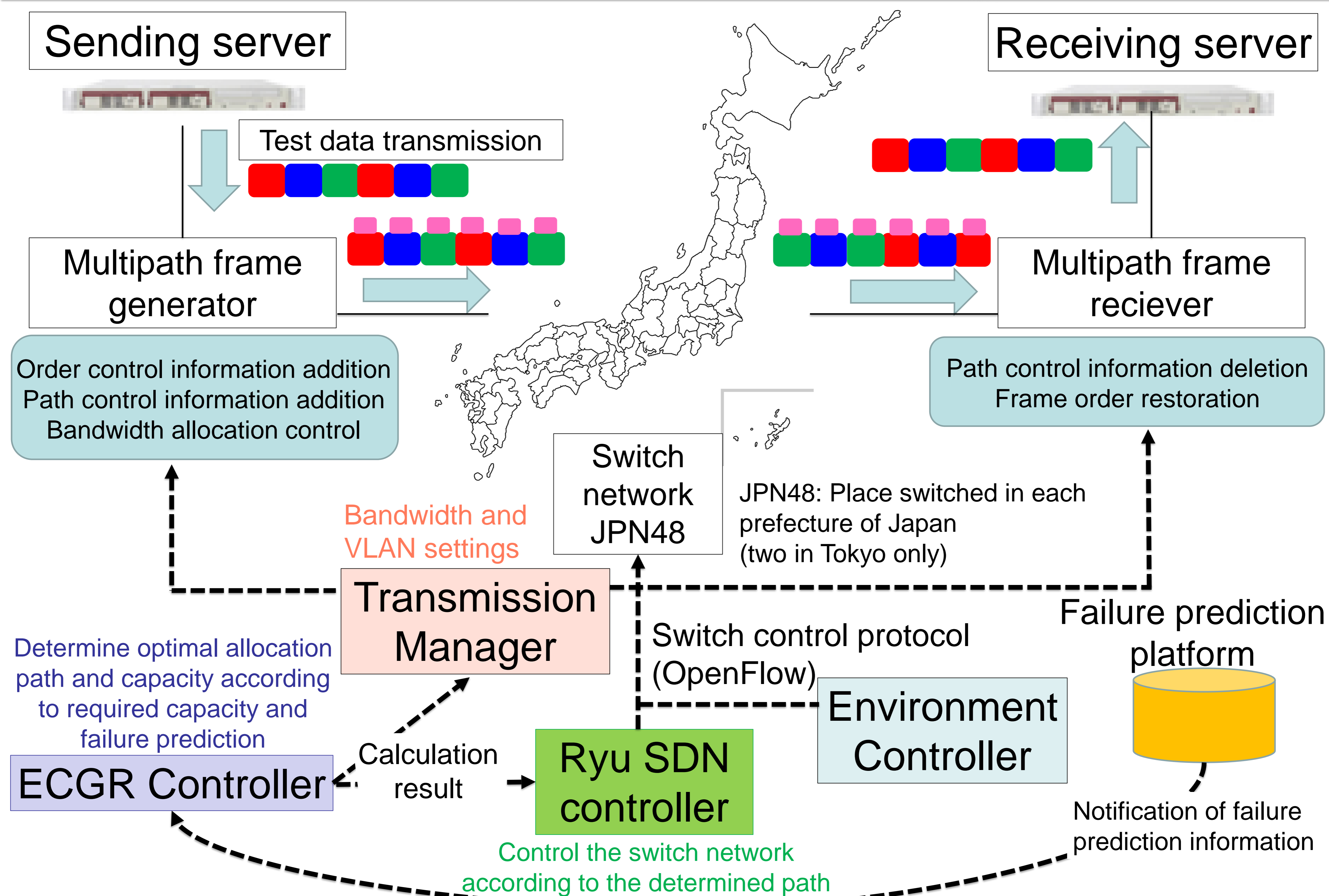
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## ECGR using k-shortest path

The demo uses k-shortest path that can be calculated quickly for path calculation.

- The k-shortest path determines the k-th shortest path as follows.
1. The first path (shortest path) is determined by the Dijkstra method.
  2. In the k-th path ( $k \geq 2$ ), the nodes of the (k-1)-th path are made sequentially as spur nodes. Calculate the shortest path for each spur node with the weight of the path corresponding to the next node in the (k-1)-th path from spur node as  $\infty$ .
  3. After calculating the shortest path at each spur node, the smallest path among them is determined as the k-th path.

## Demo configuration



This technology is the result of research and development commissioned by the Ministry of Internal Affairs and Communications "research and development of innovative optical network technology to support new social infrastructure".

