Study on Highly Available Switching Technique for Active-Standby Process in Network Nodes for Next Generation Cloud Systems

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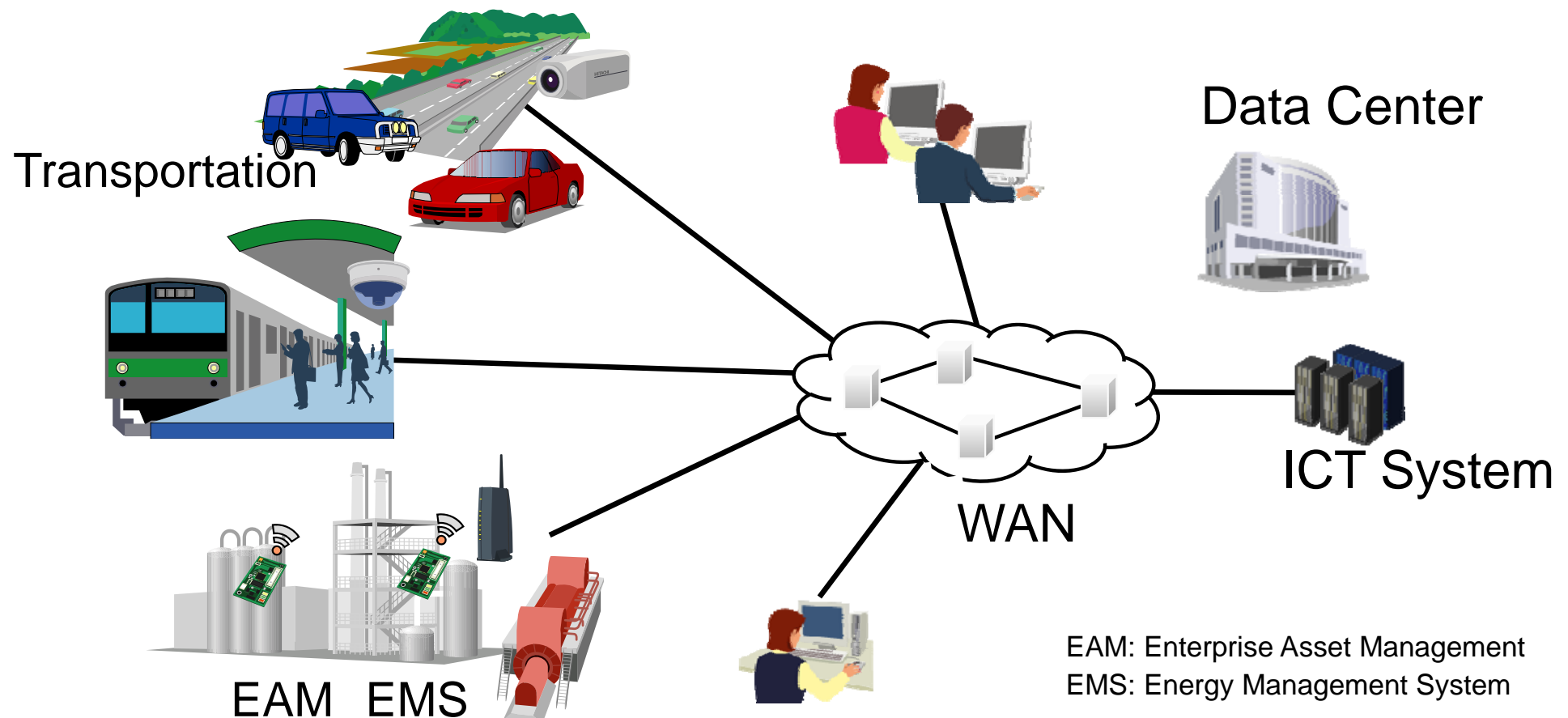
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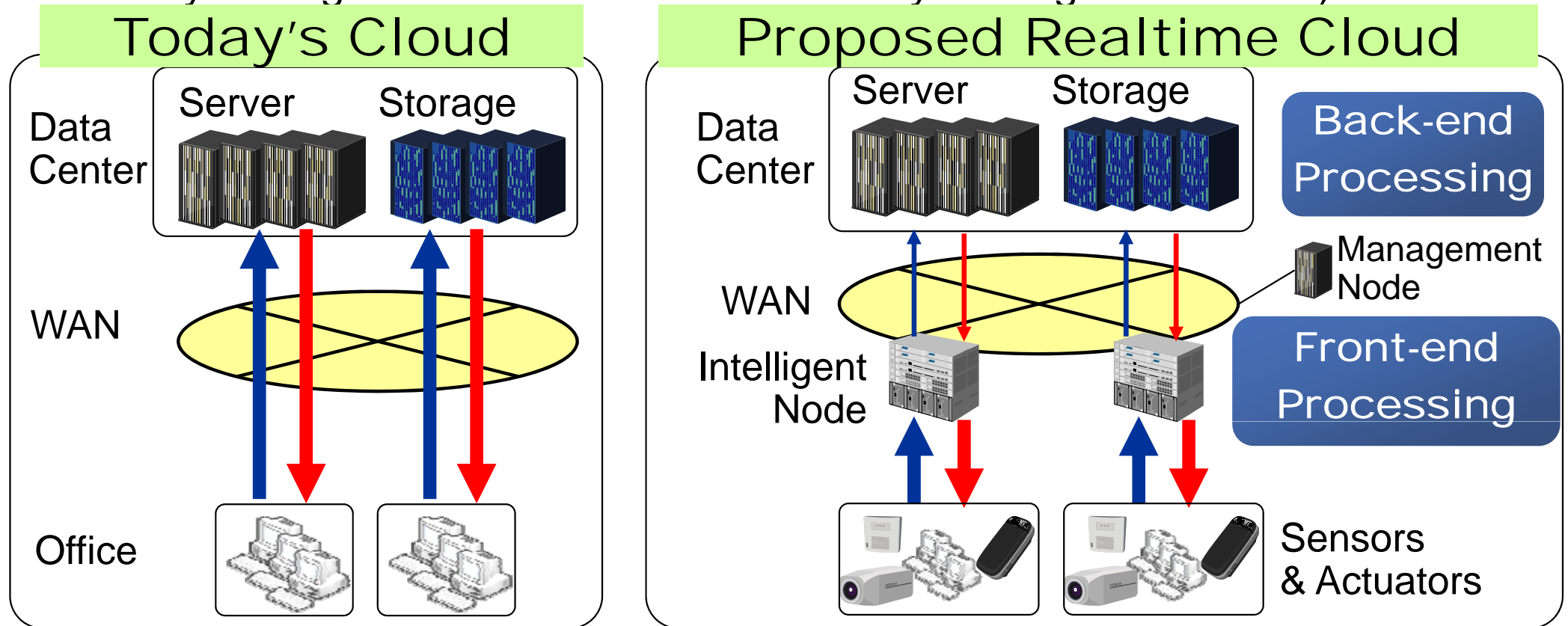
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1 Back Ground & Motivation

■ Connected tightly with the real world via sensors & actuators.
  → Giving intelligent control over the real world
  - Massive amount of sensor data flows into WAN & data centers
  - Many control systems require short-time response: **less than 10 ms** for real-time response
  - Reliable processing and communication: **less than 100 ms** switching when a failure occurs
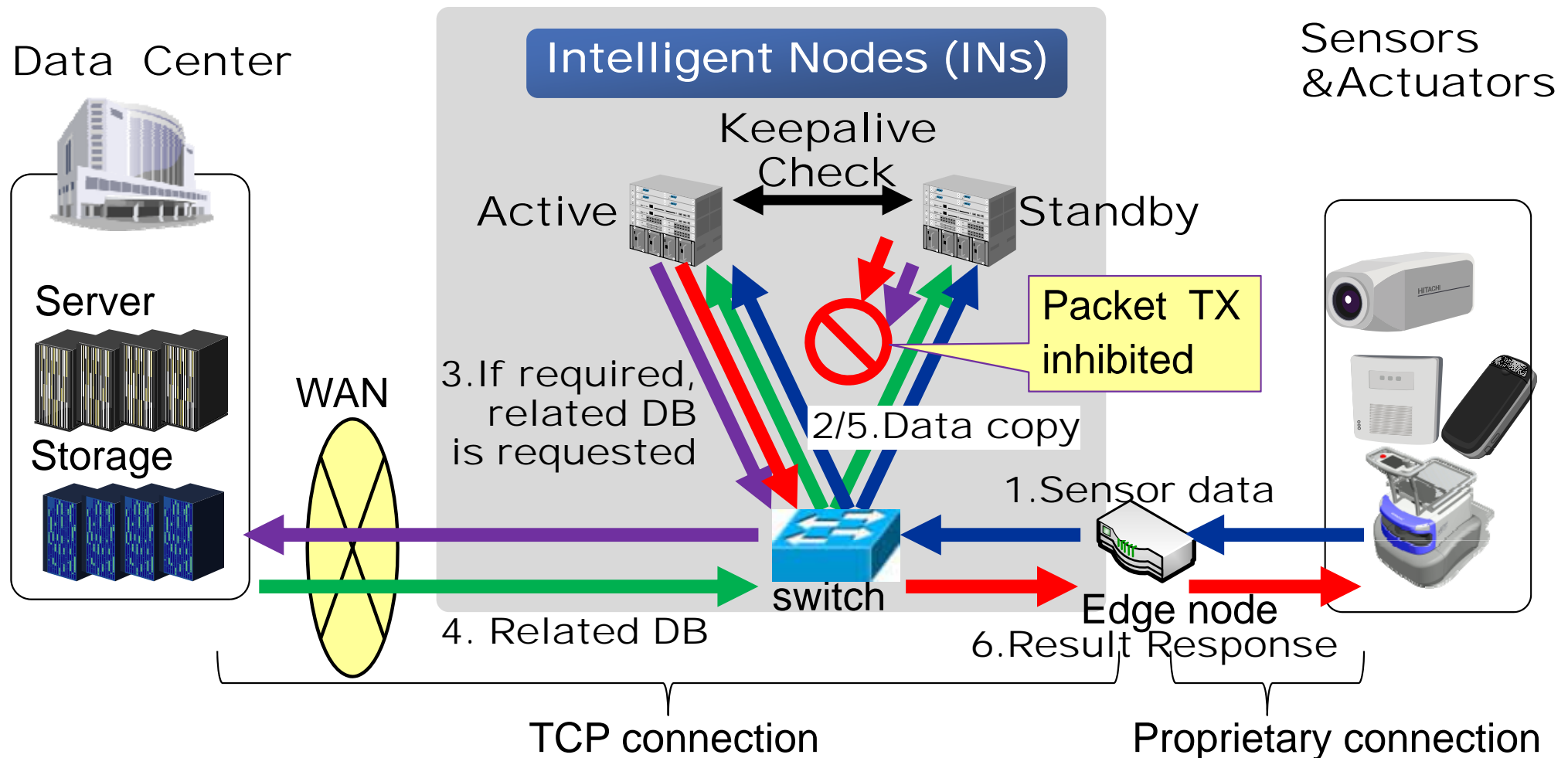
Transportation

Data Center

WAN

ICT System

EAM EMS

EAM: Enterprise Asset Management
EMS: Energy Management System

HITACHI
Inspire the Next

■ Divide processing capabilities of cloud into 2 parts:

- ■ Back-end: High-level analysis by handling stocked data (database management, data mining)

- ■ Front-end: Handling data streams from the real world (reducing data entering WAN, generating fast response to the real world by Intelligent Nodes which controlled by Management Node)
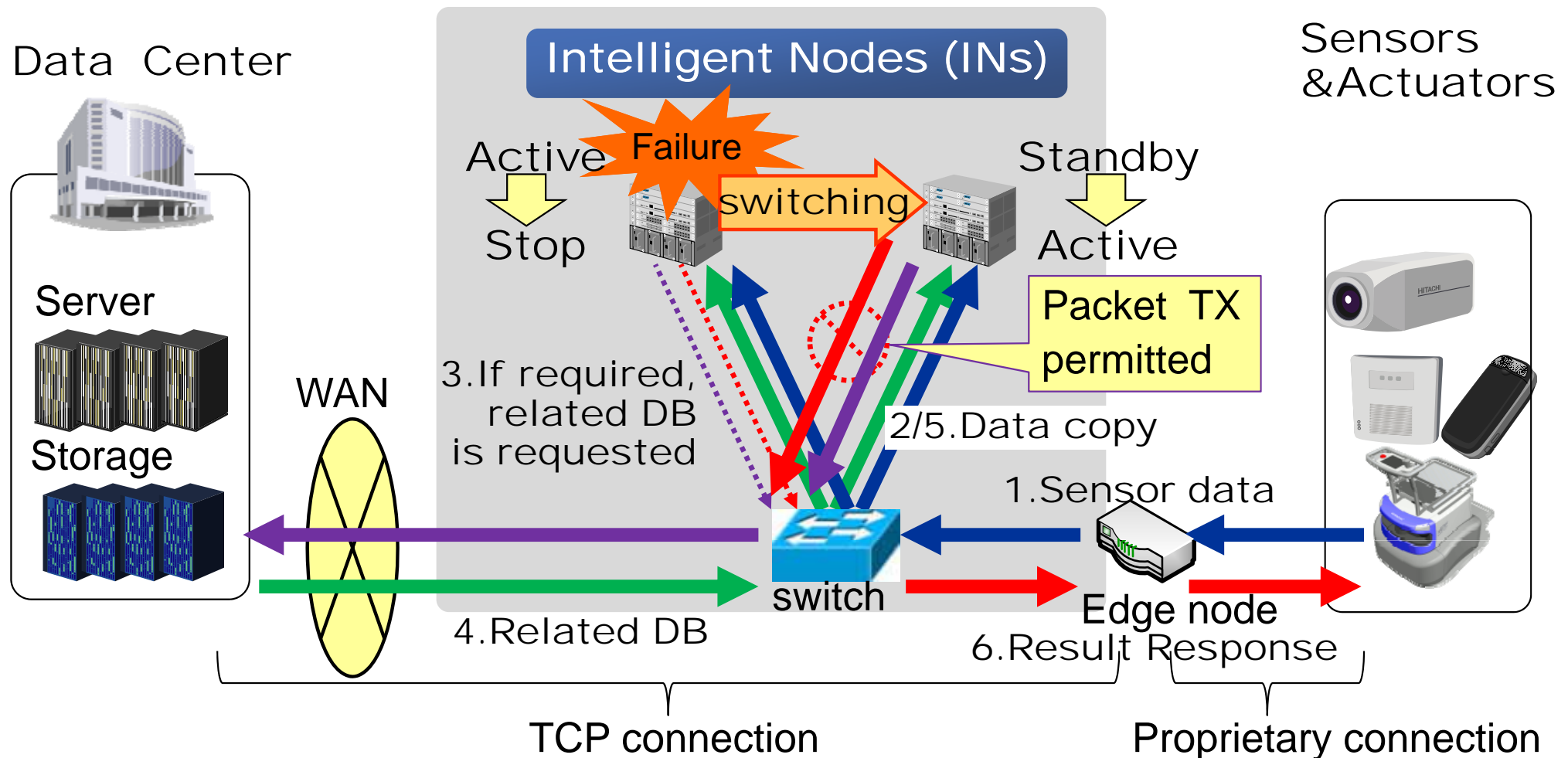
Today's Cloud

Data Center — Server, Storage

WAN

Office

Proposed Realtime Cloud

Data Center — Server, Storage — **Back-end Processing**

Management Node

WAN

Intelligent Node — **Front-end Processing**

Sensors & Actuators

- Some sensor data Processing fetch a related DB from a data center
- Both ACT & STB Intelligent Nodes process same packets
- STB Node stops packet transmission when ACT Node works

Data Center

Intelligent Nodes (INs)

Sensors &Actuators

Keepalive Check

Active **Standby**

Packet TX inhibited

Server

3.If required, related DB is requested

2/5.Data copy

WAN

Storage

1.Sensor data

4. Related DB

switch

Edge node

6.Result Response

TCP connection

Proprietary connection

2-3 Highly Available Switching 2

- When STB Node detects trouble of ACT Node, STB Node is promoted as new ACT Node and starts packet transmission
- Packet loss at the time of switching from ACT Node to STB Node is completely recoverable by TCP among DC, IN, and edge node

Data Center

Intelligent Nodes (INs)

Sensors &Actuators

Active → Failure → switching → Standby

Stop

Active

Packet TX permitted

Server

Storage

WAN

3.If required, related DB is requested

2/5.Data copy

1.Sensor data

switch

Edge node

4.Related DB

6.Result Response

TCP connection

Proprietary connection

3 Prototyping

- Switching Part: Conventional L3 Switch
- Processing Part: NW Application(Proxy) and Highly-Available-Switching Function are implemented on Network Processor
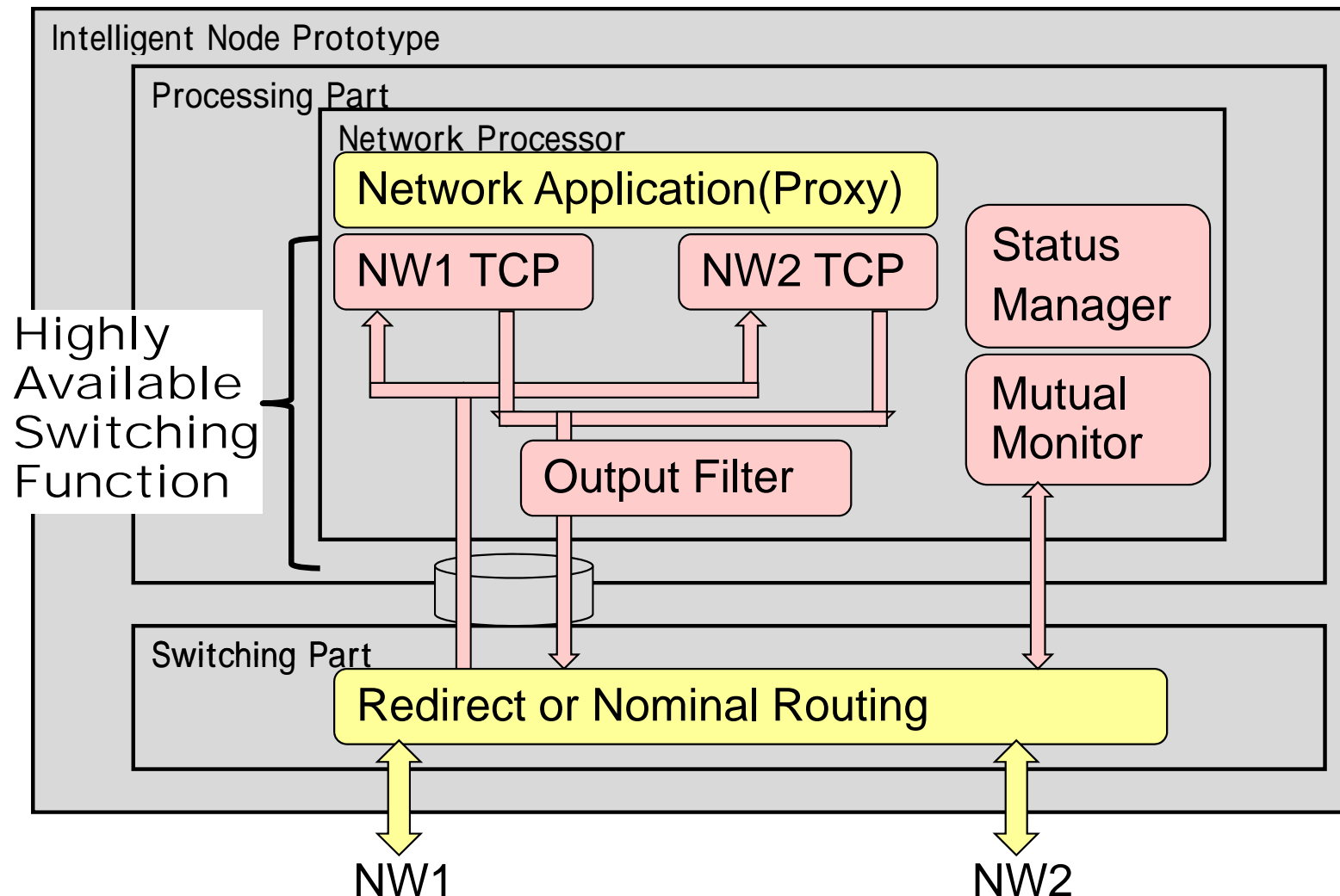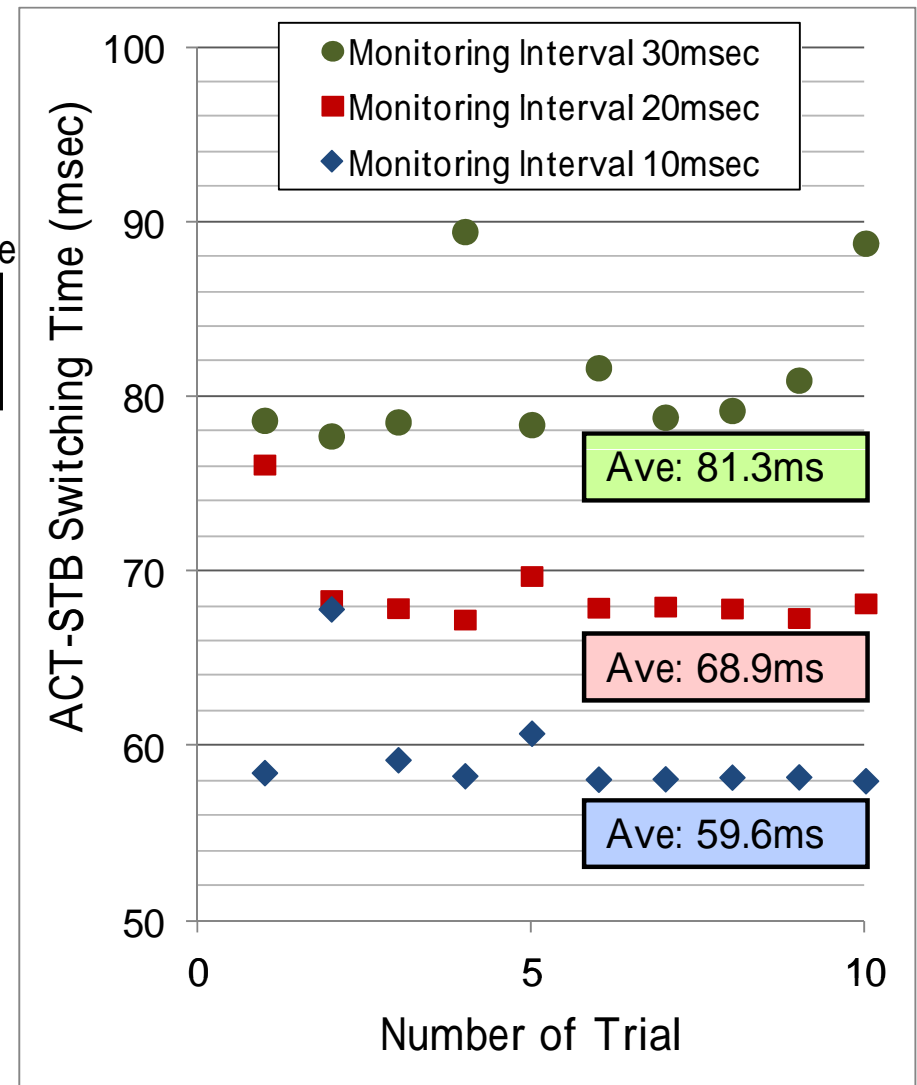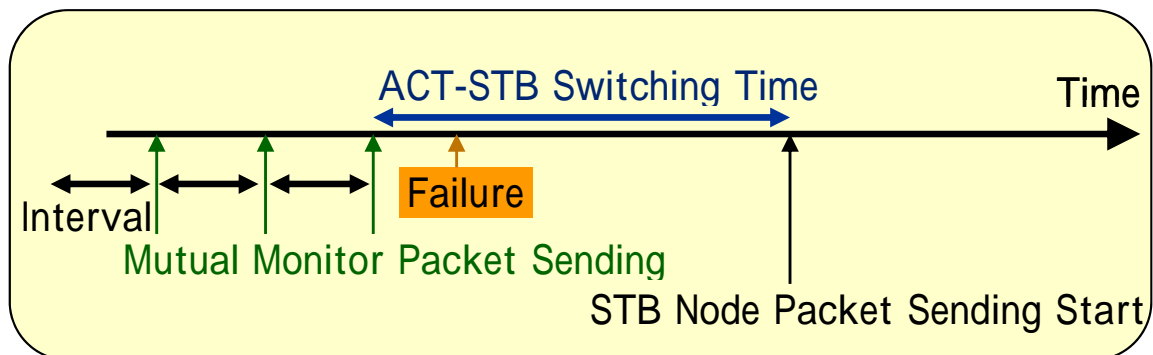
4 Evaluation Result

- Same TCP connections among server, Intelligent Node and client were maintained after ACT-STB switching

- Average ACT-STB switching time was under 100ms

[Evaluation Environment]
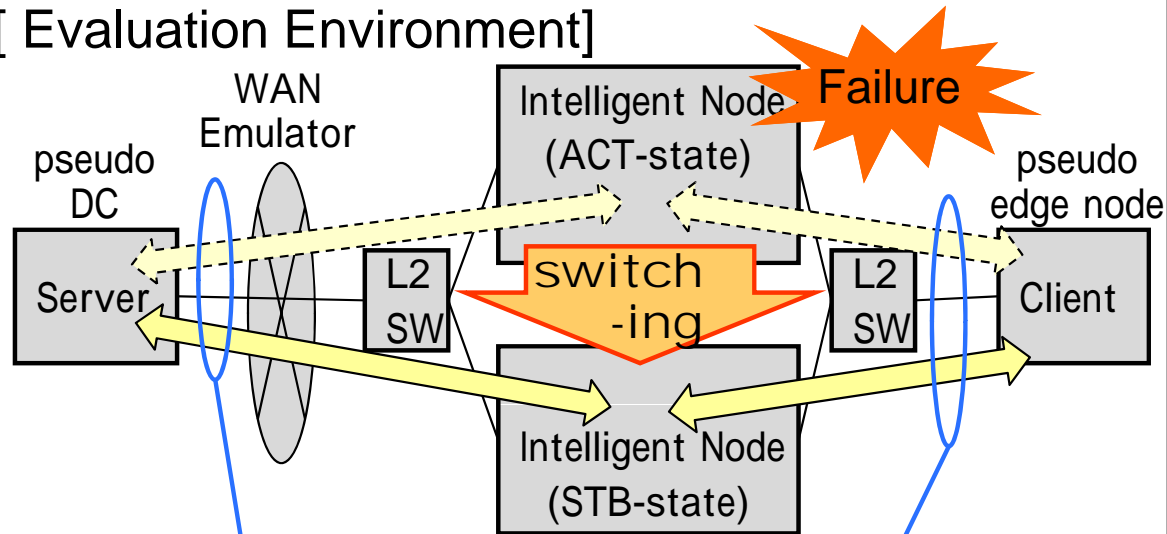
5. Conclusion

- **Real time cloud computing architecture is introduced**
  - Intelligent Nodes realize real-time response from sensors' data on network, i.e., near the real world   (10ms <)
  - Intelligent Node uses highly available switching technology to realize continuous TCP connection between a data center and edge sensor system

- **Evaluation result shows that highly available switching can continue data transmission and its average switching time is 81.3 ms with 30 ms mutual monitoring interval**
  - Desired value (100ms <) is satisfied