Monitoring Green Power and Distributed Edge Computing Infrastructure with Zabbix

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Introduction

Self-introduction

- **Who am I?**
  - ☐ Hiroshi ABE
    - ● Ph.D.(Information Science)

- **Affiliation**
  - ☐ Toyota Motor Corporation
    - ● Group Manager,
      E2E computing group,
      Information and Communication Planning Div,
      Information System Group

- **Research area**
  - ☐ Monitoring mechanisms in large-scale networks
  - ☐ Distributed processing using edge computing
  - ☐ Data processing efficiency

Research targets

TOYOTA

①Cognitive radio

②JIT edge offloading
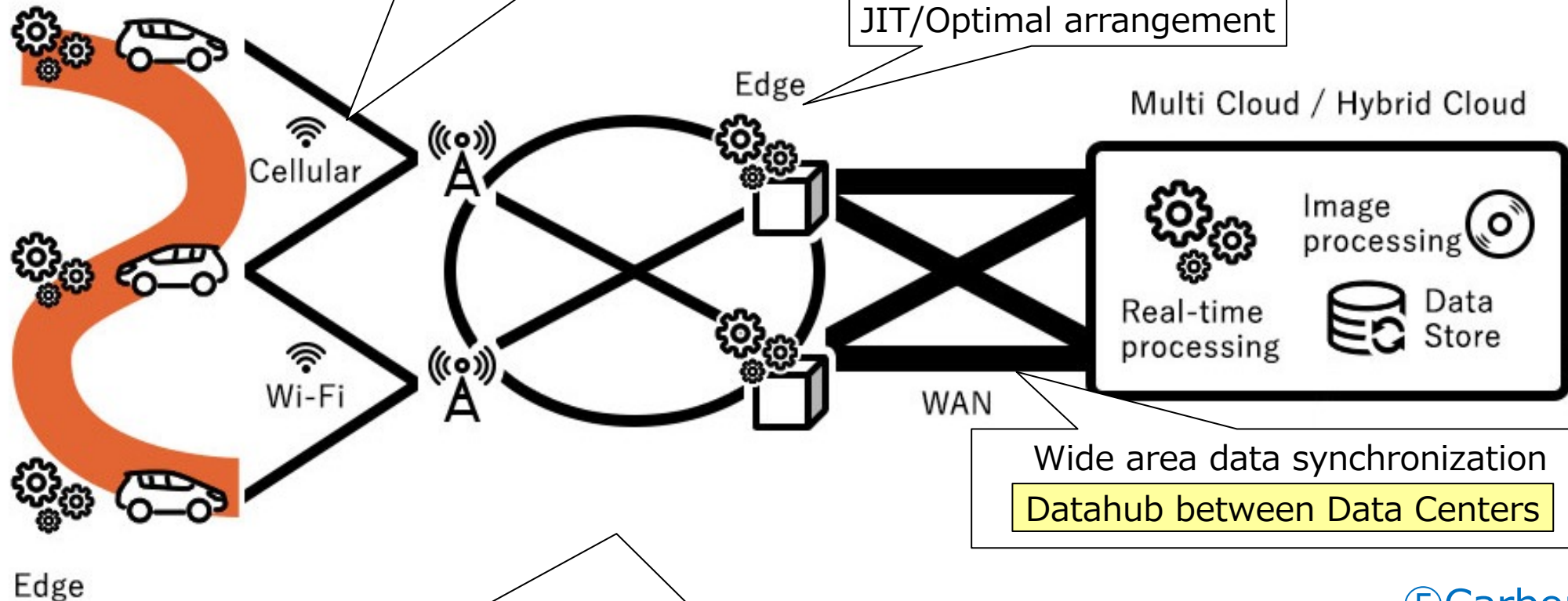
Multimedia communication

Multiple radio

Load balancing

Request routing

JIT/Optimal arrangement

Edge

Multi Cloud / Hybrid Cloud

Cellular

Wi-Fi

Image processing

Real-time processing

Data Store

WAN

Wide area data synchronization

Datahub between Data Centers

Edge

③④E2E monitoring/ security/resilience

⑤Carbon neutral Data center

E2E monitoring, security, MLOps

Distributed monitoring

Security honeypot

Passive E2E measurement

Research targets

①Cognitive radio

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Edge

Wide-area data synchronization

Today's Topic → Datahub between Data Centers

③④E2E monitoring/ security/resilience

E2E monitoring, security, MLOps

Distributed monitoring

Security honeypot
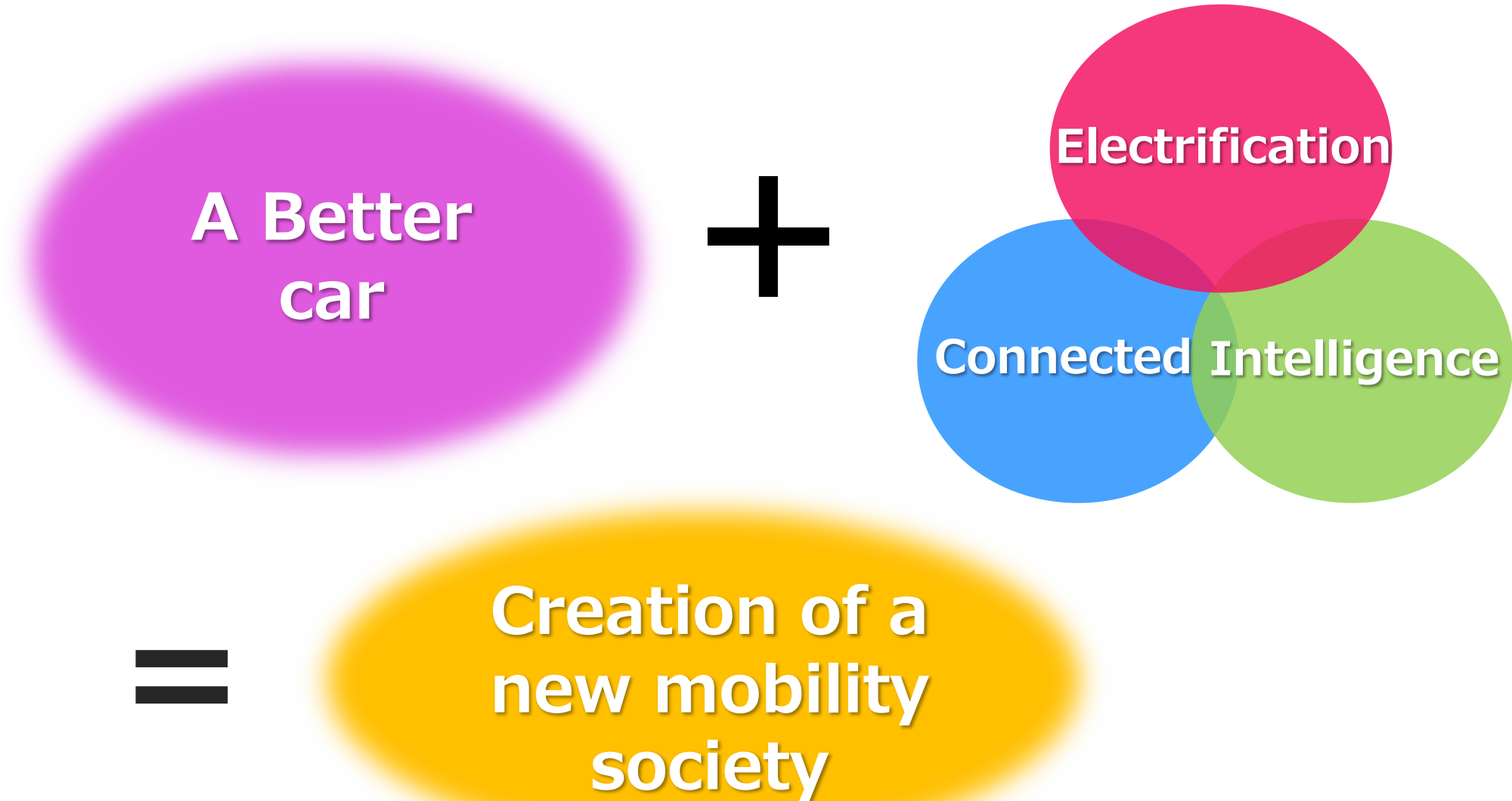
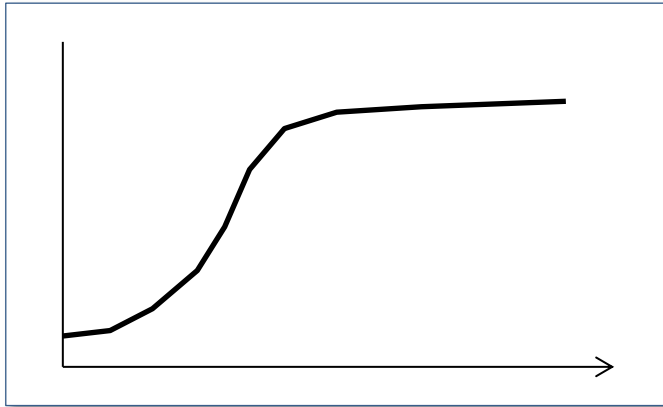Passive E2E measurement

⑤Carbon neutral Data center

Mobility

What customers and society want from automobiles TOYOTA

A Better car

+

Electrification

Connected Intelligence
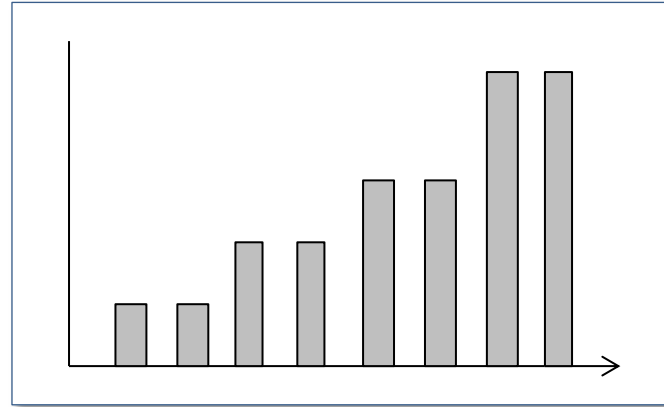
=

Creation of a new mobility society

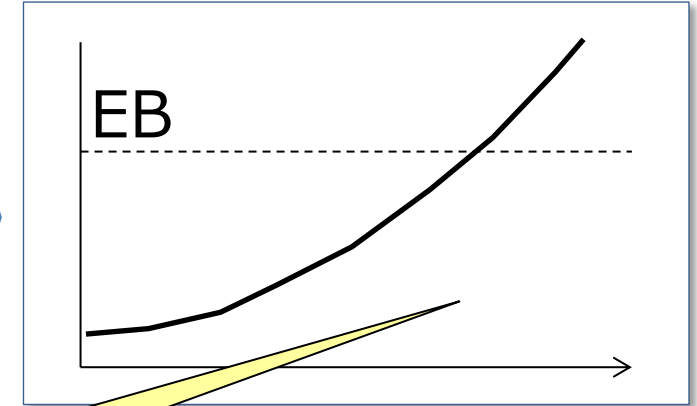# Data collected from cars is increasing

TOYOTA
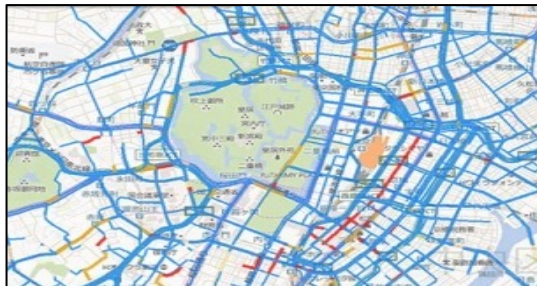

Changes in the total
Number of connected cars
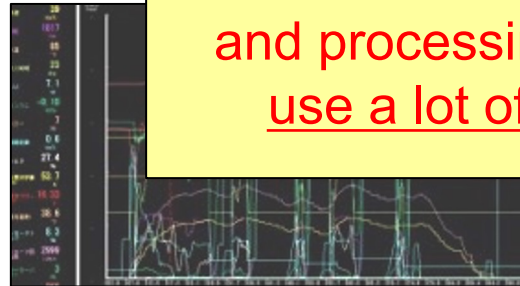
×

Transition of data transfer
amount per unit

Connected car total data
transfer volume

EB

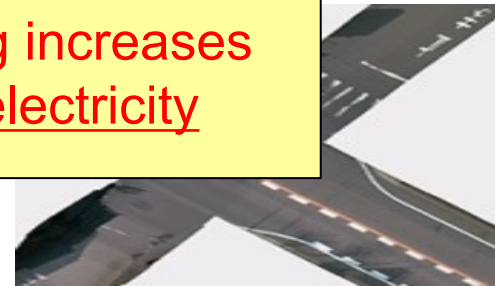**If the amount of transfer
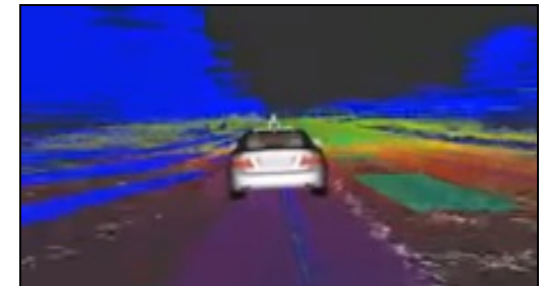and processing increases
use a lot of electricity**

Navi probe data

**Vehicle condition
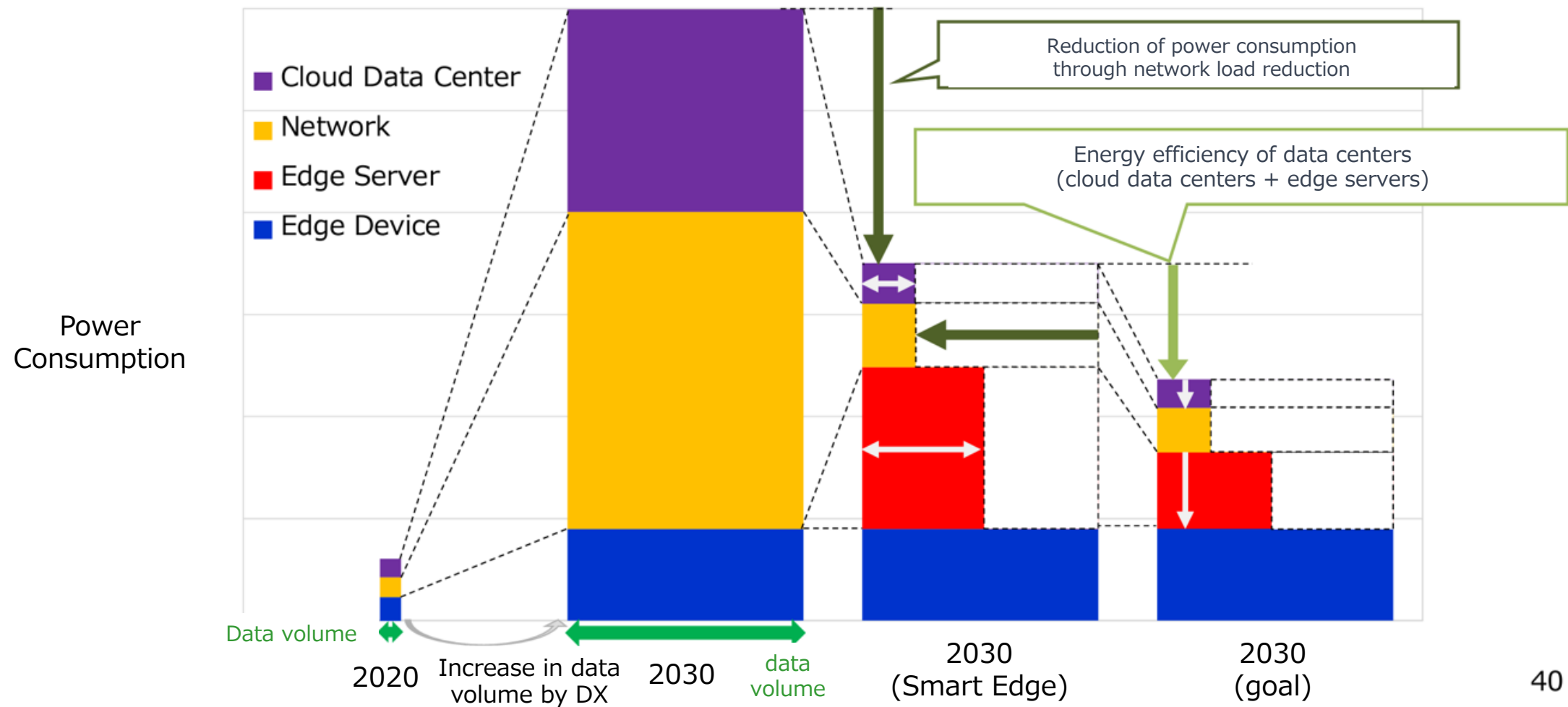data**

**High definition
Map generation**

Sensing data

Green Digital Computing

Japanese Ministry of Economy, Trade and Industry **TOYOTA**

Main challenge: Green Digital Computing(image)

Power Consumption

- Cloud Data Center
- Network
- Edge Server
- Edge Device

Reduction of power consumption through network load reduction

Energy efficiency of data centers (cloud data centers + edge servers)

Data volume

2020   Increase in data volume by DX   2030   data volume   2030 (Smart Edge)   2030 (goal)

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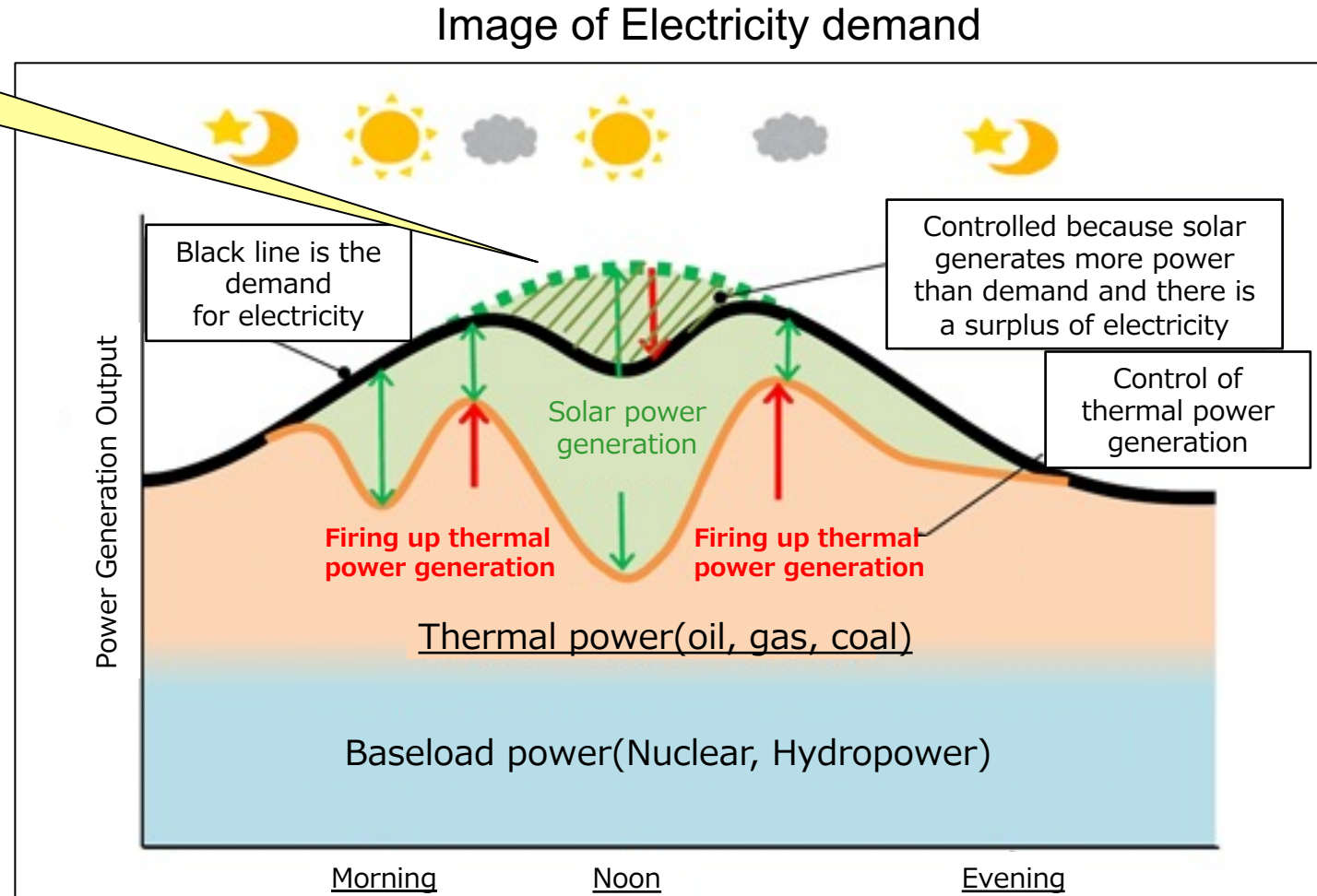https://www.meti.go.jp/policy/mono_info_service/joho/conference/semicon_digital/0002/03.pdf

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Priority Power Supply Rules

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■ Surplus green energy can be <u>discarded</u>

The electricity here can be <u>discarded</u>

Image of Electricity demand

Black line is the demand for electricity

Controlled because solar generates more power than demand and there is a surplus of electricity

Control of thermal power generation

Power Generation Output

Solar power generation

Firing up thermal power generation

Firing up thermal power generation

Thermal power(oil, gas, coal)

Baseload power(Nuclear, Hydropower)

Morning   Noon   Evening

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Local data production/consumption by green power

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- Will the use of the edge and local production and consumption of data accelerate?

- Edge advantages in local production and consumption of data
    - Faster response time
    - No need to transport data to the cloud (less power consumption)

- Viewpoint of green power usage
    - Adjusting processing with the power output of green energy sources
    - Distribute processing across a wide area according to the power output

⬇
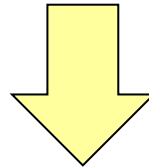
- Necessity of improving edge utilization efficiency
- Necessity for distributed monitoring of systems and power

Wide area data synchronization

Electricity and data transmission

- **It's probably easier to send data than to send electricity**
  - Surplus of renewable energy generated in the spring and autumn in north and south of Japan
  - Enhancing the transmission grid is essential to transport surplus electricity = transfer const is very high
  - Move computational demand instead of electrical power

Transfer cost ... ...
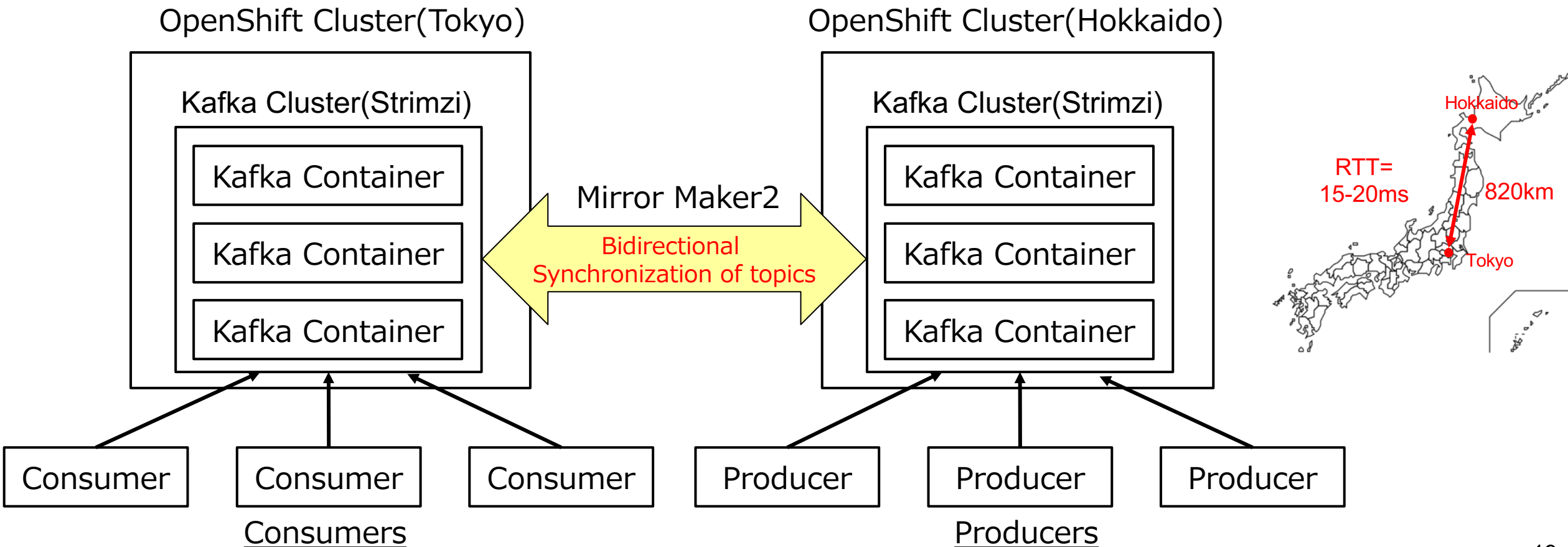= Energy Productivity···

Electricity >> **Digital bits**

x00 : 1

https://www.nic.ad.jp/sc-sapporo/program/c14.pdf

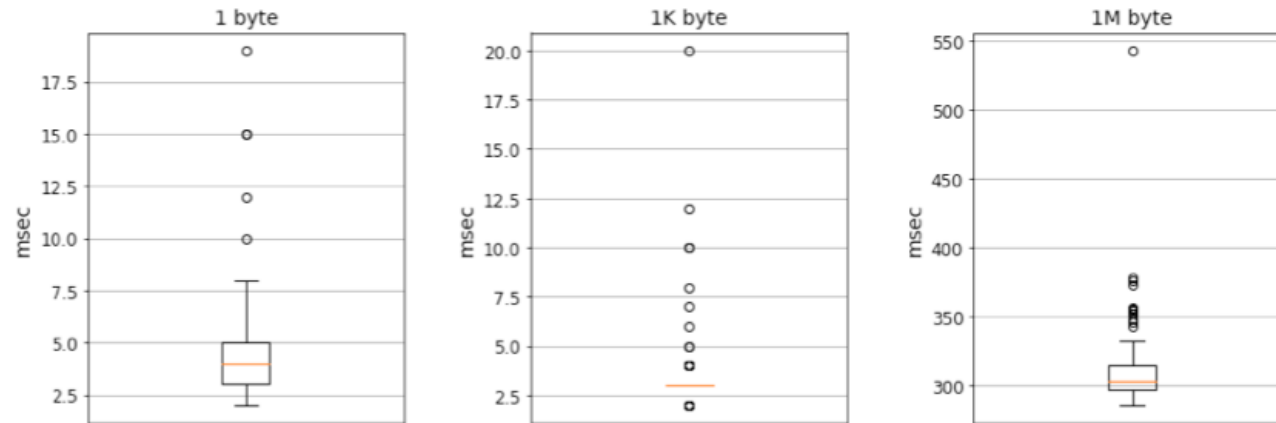# Experiment to synchronize data over a wide area

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- Mirror Maker2 by Apache Kafka
  - Wide-area data synchronization between <u>Tokyo</u> and <u>Hokkaido</u>
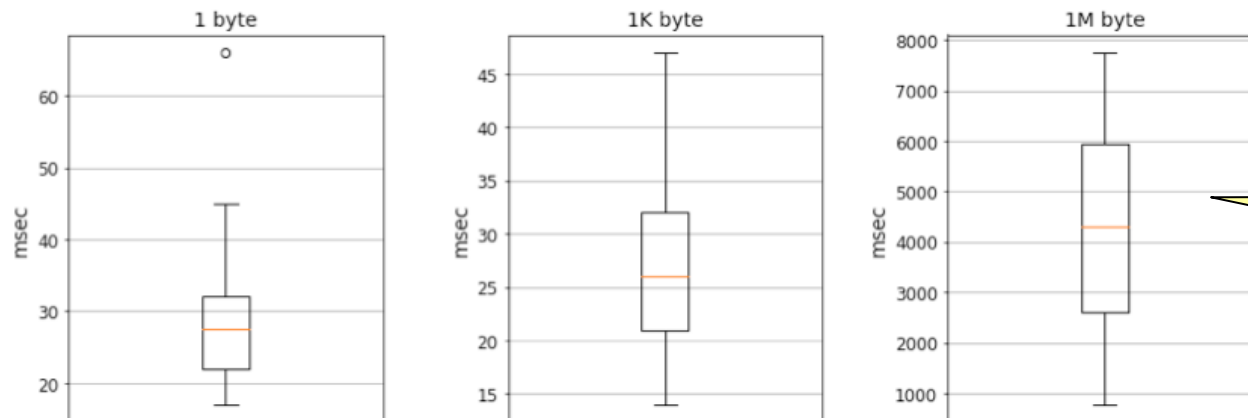
Consume time - Produce time = processing time

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■ Processing within the same Data center

Processing finishes
within 300 ms
even with large data

■ wide-area data synchronization (Hokkaido -> Tokyo)

    □ Add extra data synchronization time

more than the
synchronization time
is being added.
Especially the sync
of 1MB data takes time

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Consideration

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- Synchronization of data seems to be manageable
    - if the size of data is small
- Next is the timing of data production and processing
- If real-time performance is required
    - wide-area synchronization should not be used
- It is acceptable if real-time response is not required
    - such as in asynchronous processing or batch processing
- Can move processing wherever you like
    - It is also possible to send processing to where there is surplus power
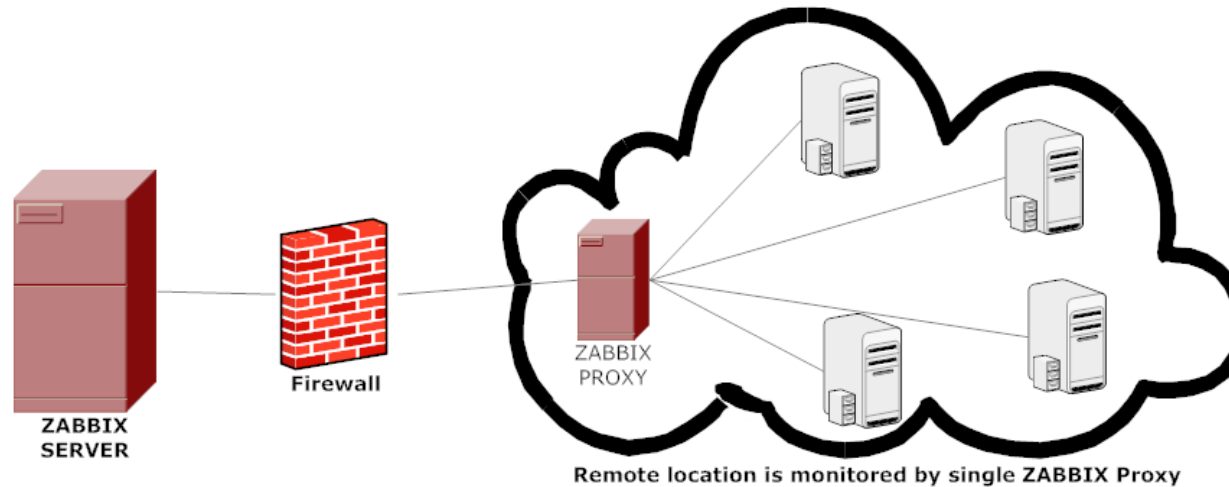
Wide area distributed monitoring

Where to process and to direct the processing?

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- Items that require monitoring over a wide area
  - Monitoring of the entire edge system in Hokkaido, Tokyo
    - processing volume, processing load, response time, etc.
  - Power monitoring
    - consumption, green power generation

- Distributed monitoring over a wide area
  - OSS monitoring system = Zabbix!!
  - Can Zabbix do distributed monitoring?
  - Yes!! Zabbix Proxy!!

Hokkaido

820km

Tokyo
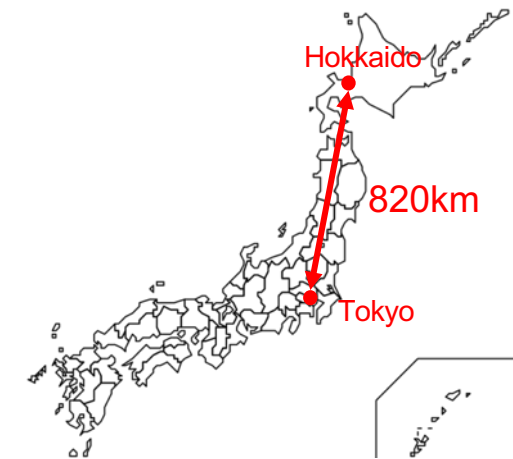
About Zabbix Proxy
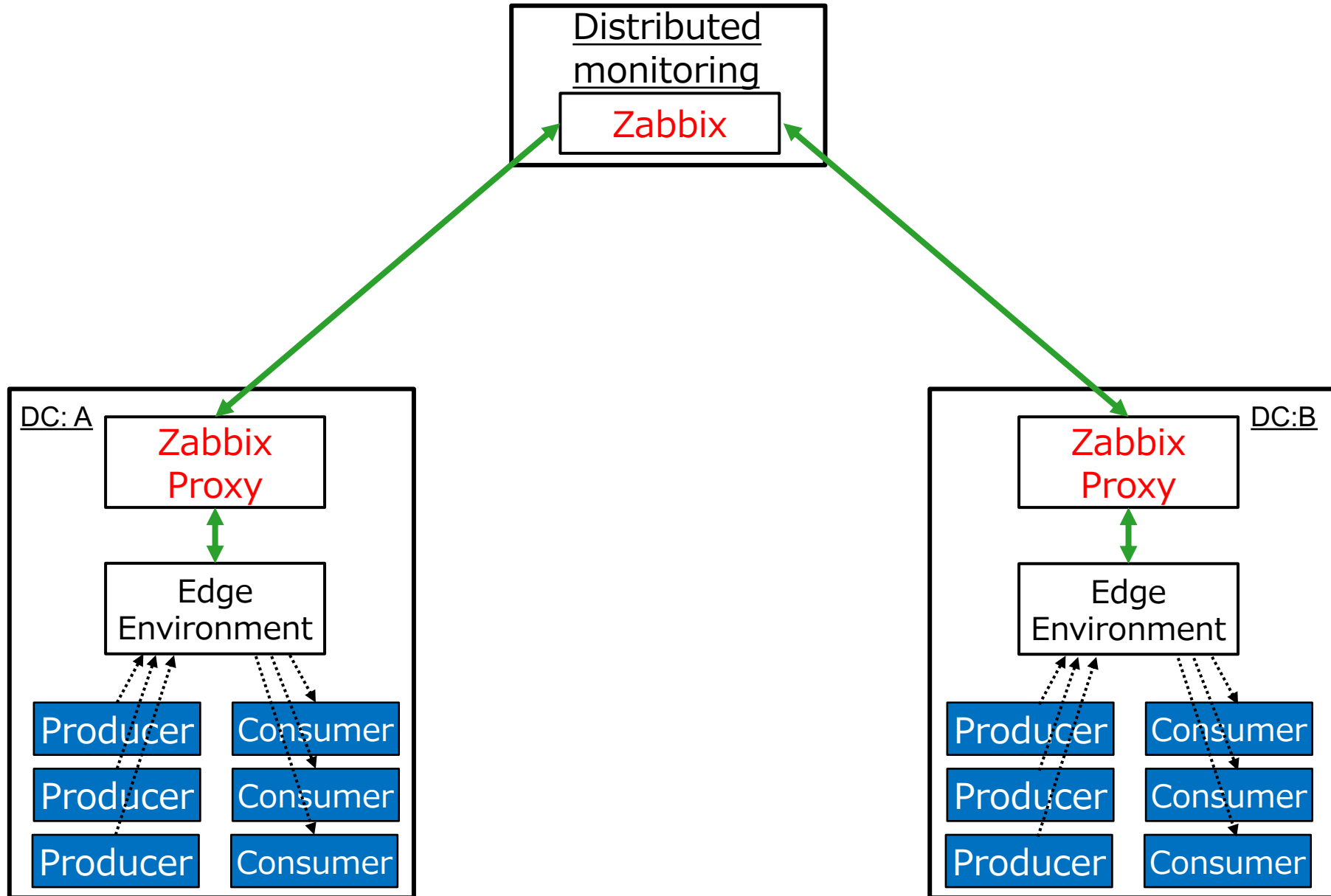
- Zabbix proxy can be used to
  - Monitoring remote locations
  - Monitoring locations having unreliable communications
  - Offload the Zabbix server when monitoring thousand of devices
  - Simplify the maintenance of distributed monitoring

Remote location is monitored by single ZABBIX Proxy

https://www.zabbix.com/documentation/current/en/manual/distributed_monitoring/proxies

Distributed monitoring of Edges using Zabbix TOYOTA

PoC Results

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Distributed monitoring of Edges using Zabbix

PoC Results

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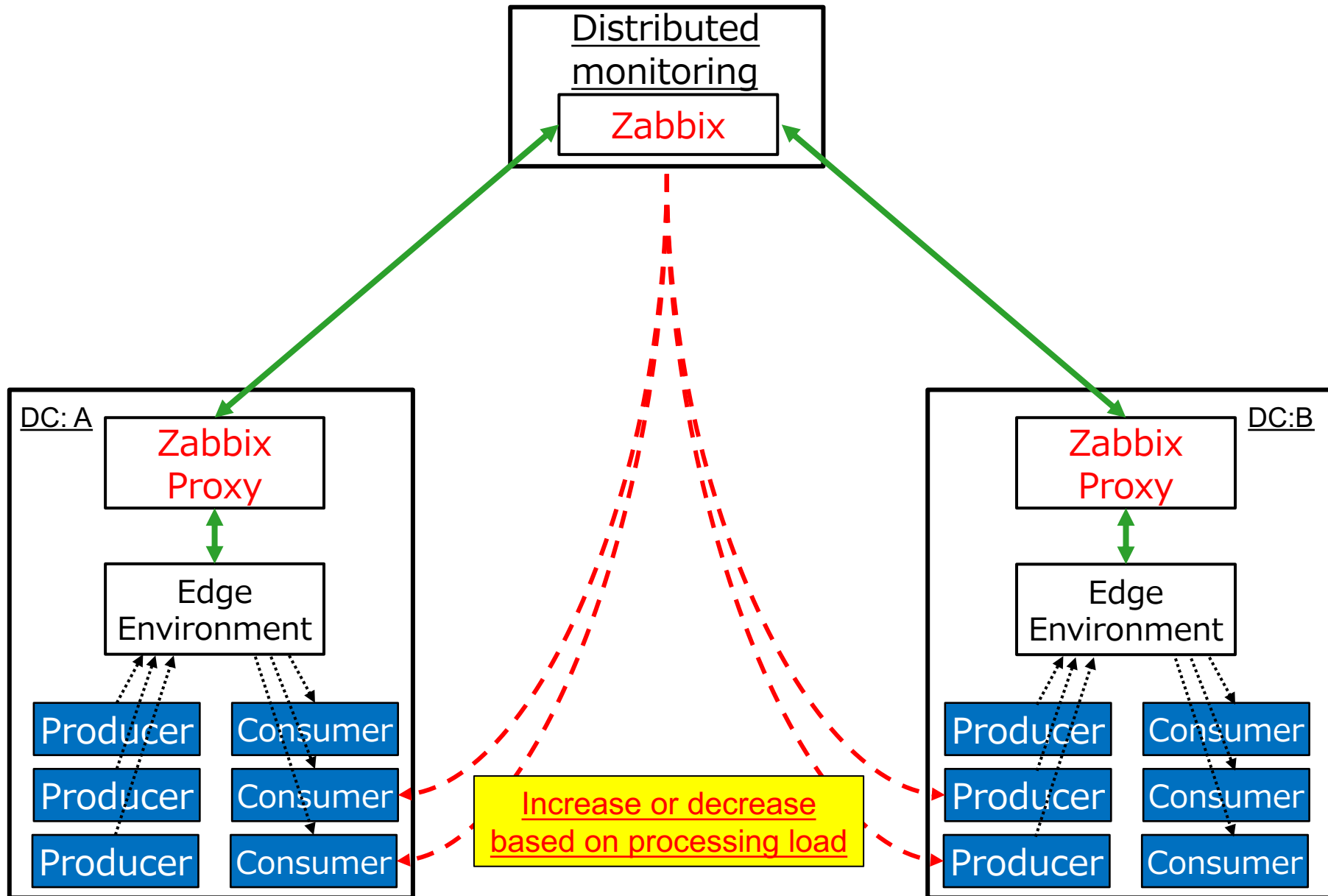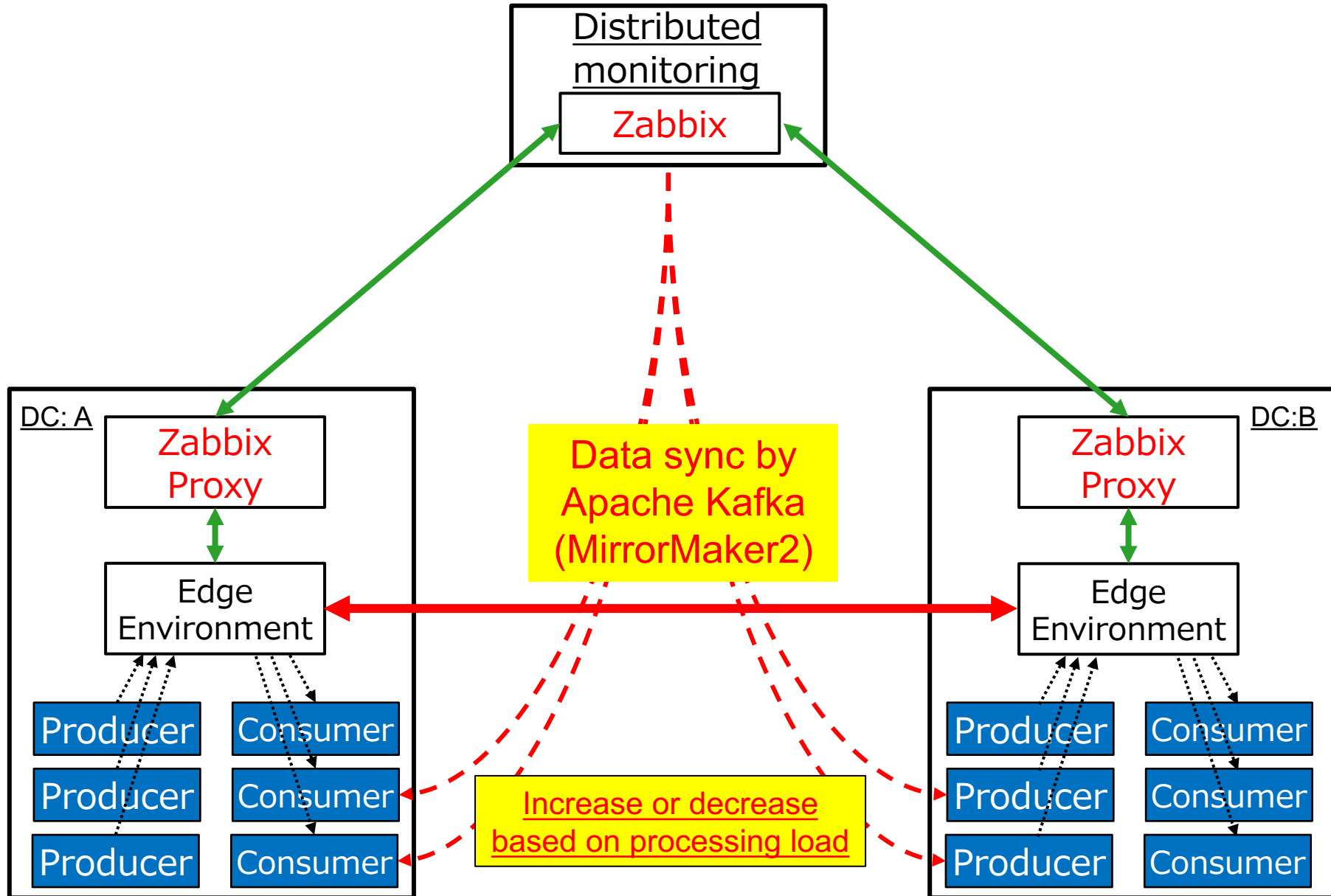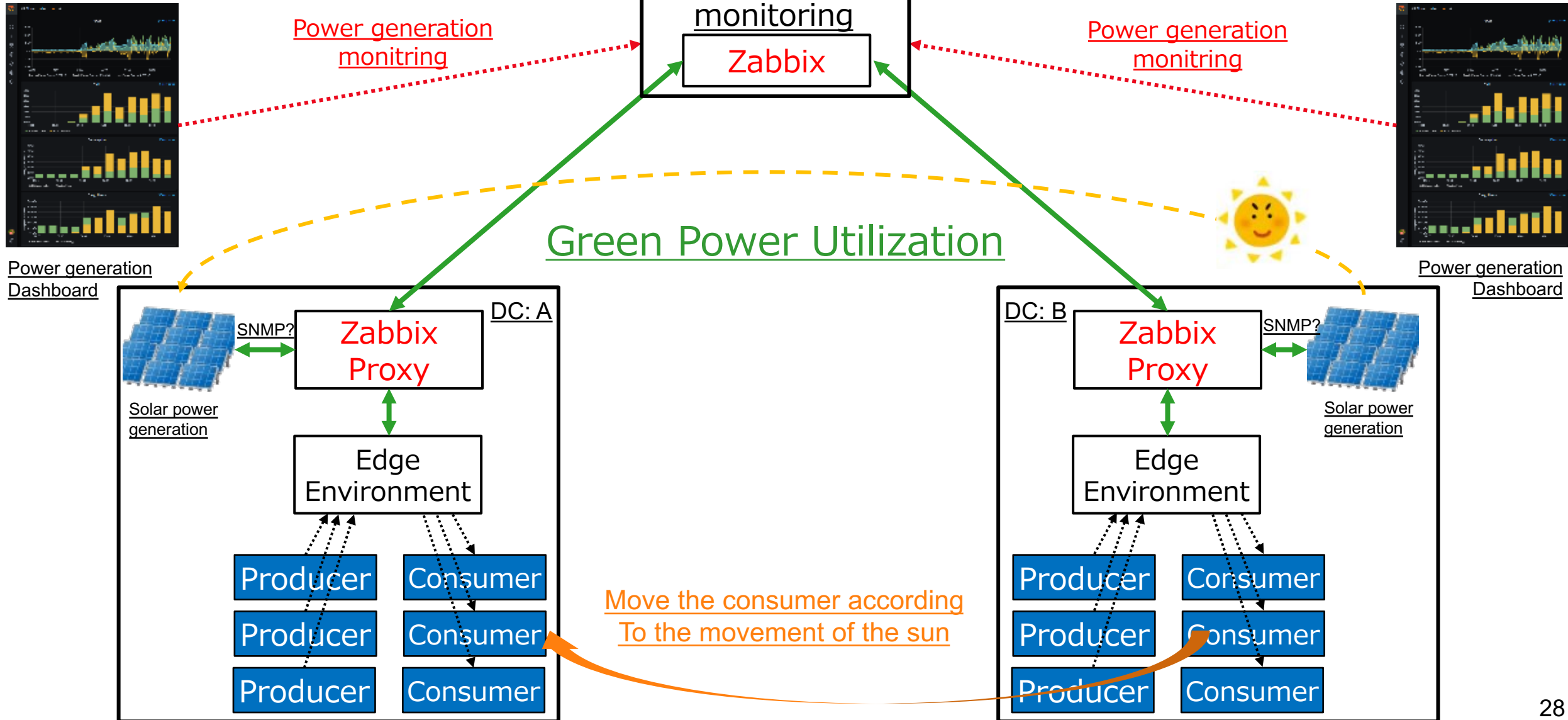
Distributed monitoring of Edges using Zabbix

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Distributed monitoring of Edges using Zabbix **TOYOTA**

Future Work

Power generation monitring

Power generation monitring

Distributed monitoring

Zabbix

Green Power Utilization

Power generation Dashboard

Power generation Dashboard

DC: A

Solar power generation

SNMP?

Zabbix Proxy

Edge Environment

Producer Consumer
Producer Consumer
Producer Consumer

DC: B

Solar power generation

SNMP?

Zabbix Proxy

Edge Environment

Producer Consumer
Producer Consumer
Producer Consumer

Move the consumer according To the movement of the sun

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Distributed monitoring of Edges using Zabbix

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Distributed monitoring

Zabbix

Power generation monitring

Power generation monitring

Green Power Utilization

Power generation Dashboard

Power generation Dashboard

DC: A

SNMP?

Zabbix Proxy

Solar power generation

Data sync by Apache Kafka (MirrorMaker2)

DC: B

SNMP?

Zabbix Proxy

Solar power generation

Edge Environment

Edge Environment

Producer

Consumer

Producer

Consumer

Producer

Consumer

Move the consumer according To the movement of the sun

Producer

Consumer

Producer

Consumer

Producer

Consumer

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Increase/Decrease of Producer/Consumer by Zabbix **TOYOTA**

- **Increase and decrease of processing linked to green energy**
  - The real-time aspect of green energy fluctuations is limited
  - To operate linked with weather forecast data
  - Remote command action from a Zabbix proxy
- **Where to put the wisdom?**
  - Specialize in the Zabbix monitoring
  - Send monitoring triggers to the controller
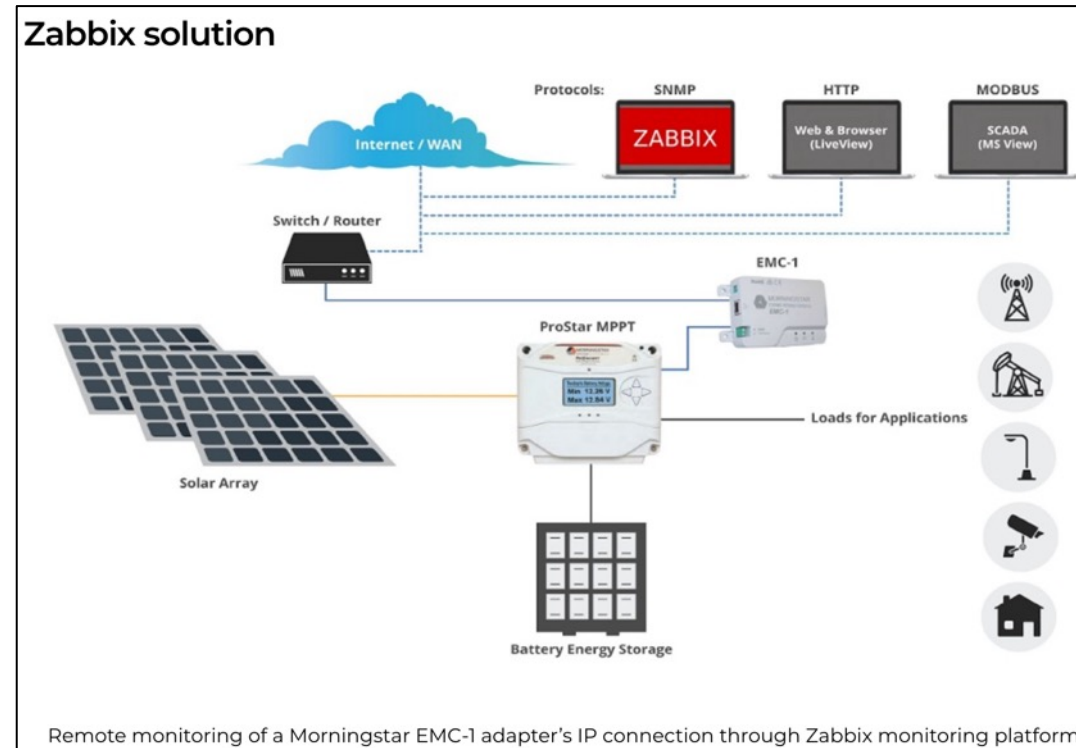 - Increase and decrease of Producer/Consumer processes
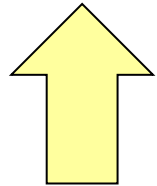
- **Flexibility of system design**

Integration Solar power system with Zabbix

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- **I found the answer!!**
  - "Data Solution for Solar Energy Application" in Zabbix Summit 2020
    - https://blog.zabbix.com/data-solution-for-solar-energy-application/13005/

Remote monitoring of a Morningstar EMC-1 adapter's IP connection through Zabbix monitoring platform

  - All concerned, let's talk later ☺

Challenge to Green Mobility

Wide area data sync and wide area monitoring

- ## Wide are data synchronization
  - Use Kafka to create a pipe of data that makes data available anywhere in the world
  - Users can process data asynchronously using Producer/Consumer
  - Asynchronous data processing is easy to implement
- ## Wide area monitoring
  - Toward the realization of worldwide distributed monitoring
  - Determination of demand for green electricity by monitoring power generation
  - Distributed monitoring design with scalability using Zabbix + Zabbix Proxy

# What would make you happy if you could make it?   **TOYOTA**

- **<u>Follow The Sun</u>**
  - Efficient use of surplus electricity from solar power generation by following the sun
  - Realization of distributed systems through active use of green energy

- **<u>Follow The Moon</u>**
  - Centralization of processing in locations with low nighttime electricity costs, as advocated by Google
  - Reducing costs by using cheap electricity from nuclear and hydroelectric power generation
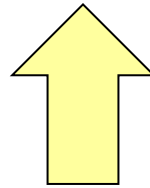
- Environmental issues are one of the major challenges for automotive companies
- Continue to consider what can be done in terms of IT and telecommunications

Summary

- For research on efficient use of edge

- Realization of wide-area data synchronization using Kafka's data synchronization functionality

- Realization of distributed monitoring of edge infrastructure distributed over a wide area using Zabbix

- Combining these two, we are building a wide-area distributed system that actively utilizes green power
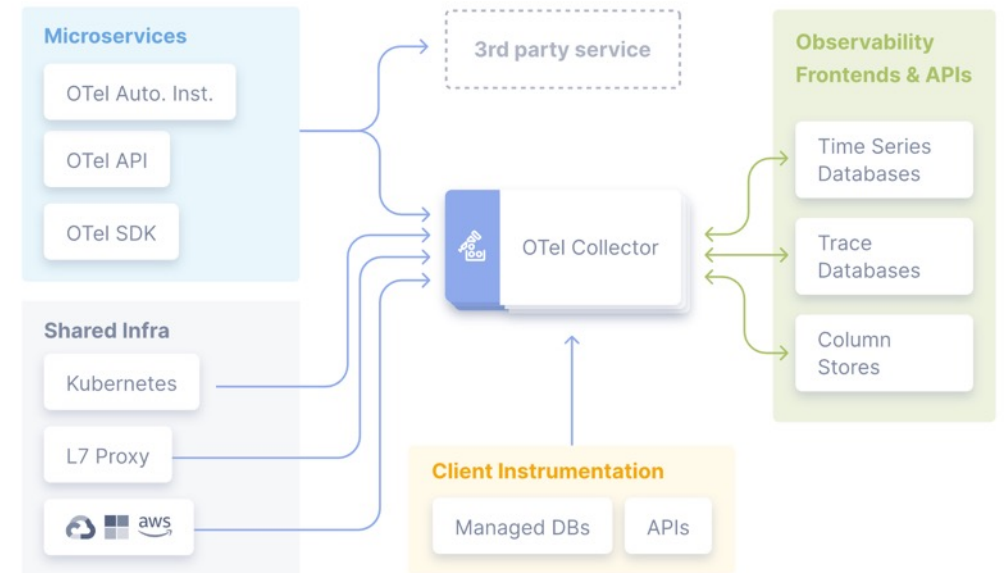
Wish to Zabbix

- **Support for Opentelemetry(Otel)**
  - Otel is becoming an abstraction layer for system integration
    - https://opentelemetry.io/docs/

- **Our new office systems**
  - log, xFlow : Splunk
  - SIEM : Splunk Enterprise Security
  - APM : New Relic
  - SNMP : Zabbix

- **My Best is**
  - Zabbix SNMP data -> Otel -> Splunk Dashboard
    or
  - All Otel Collector data -> Zabbix Dashboard☺

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