TOSHIBA

ロボット革命イニシアティブ協議会
Robot Revolution & Industrial IoT Initiative

IoT Design Approach by Adapting Framework

~Coexistence of Control and Service powered by CPS~

Toshiba Corporation

Digitization CTO & GM, Digital Innovation Technology Center

Hiroshi Yamamoto
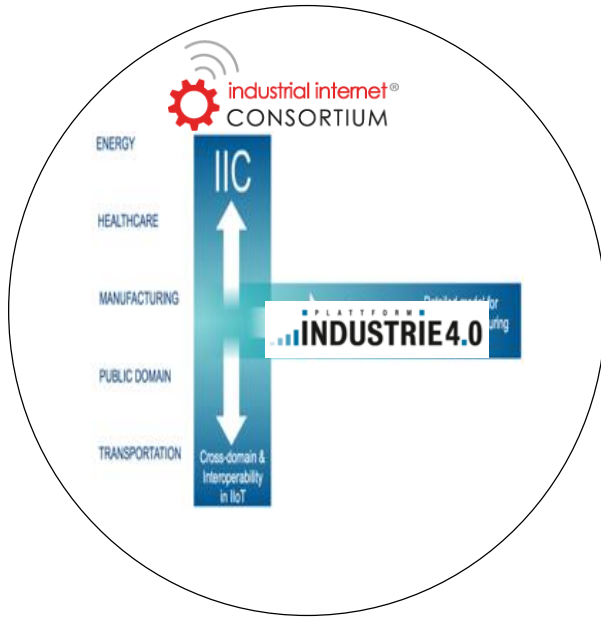
RRI

Security Expert

Masue Shiba

Key Highlights

- Why global IoT collaboration?

- Collaboration Case Study (Japan and Germany)

- CPS framework Introduction

- Business Challenge for manufactures ~ Sell or Subscription ?

Global IoT Collaboration

B2B

Government

B2C

DX ~ Existing Competitors as potential future Partners

- Step1 - Digital Evolution : Digital Service based on our products
- Step2 - Digital Transformation: Digital Service based on every products

Step1

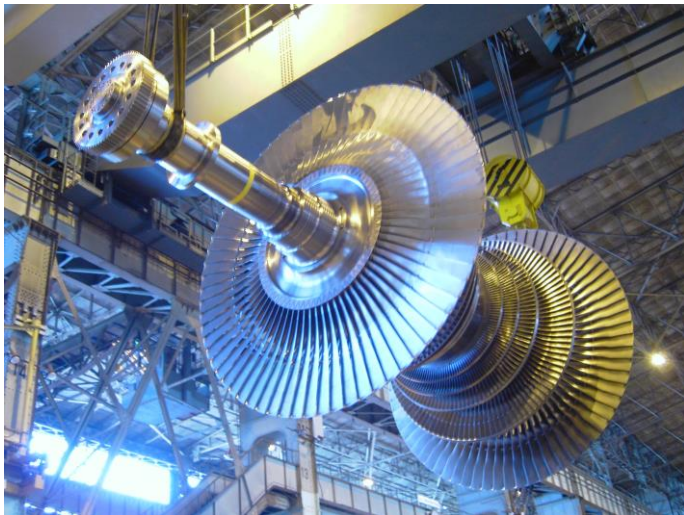Step2

Service

Digital Evolution

Digital Transformation

Things

PRODUCTS

PRODUCTS
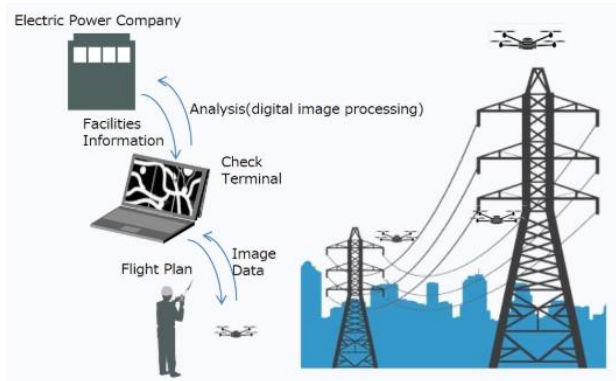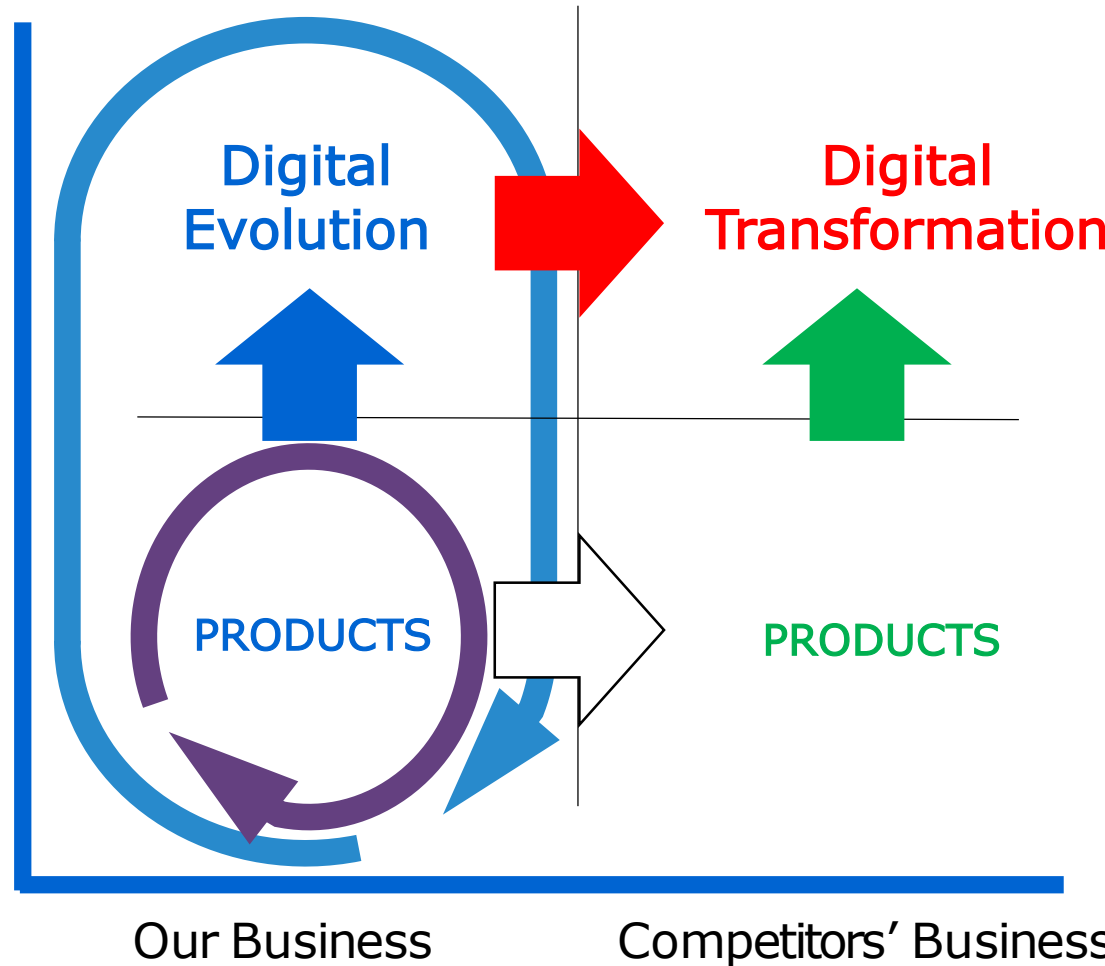
Our Business

Competitors' Business

IoT/M2M is much more complicated than traditional enterprise system (OLTP/Batch systems)

Smart Meter ~ Scalability

x 5
x 10
x 100 ?

M2M Trading System ~ Fast Response

< 0.5 msec

Video Surveillance ~Quick Alert

Figure 2-1: Convergence of IT and OT Trustworthiness
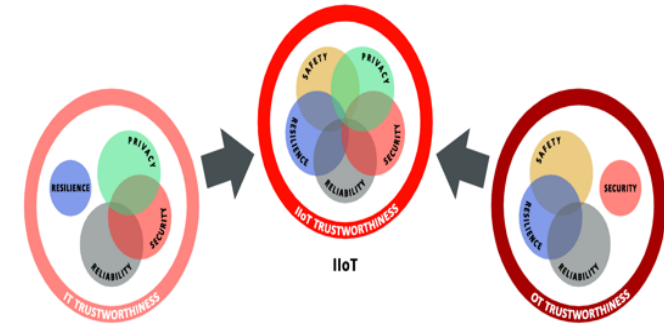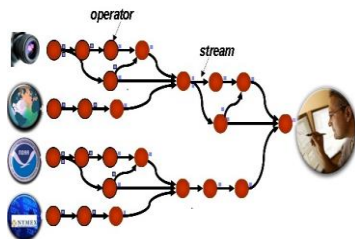
Information Technology (IT)   IIoT   Operational Technology (OT)

(Source: Industrial Internet Security Framework)

- ✓ Security, Privacy and Safety
- ✓ Scalability
- ✓ High Availability
- ✓ Interaction and Short-range Communication
- ✓ Wireless Communication
- ✓ Interoperability
- ✓ Software Complexity
- ✓ Data Volumes and Velocity
- ✓ Data Interpretation
- ✓ Low Latency

Germany and Japan Collaboration Industrial Cyber Security

☐ PLATTFORM INDUSTRIE 4.0 (PI4) Germany and Robot Revolution Initiative (RRI) Japan announced their 3rd common position paper "Facilitating International Cooperation for Secure Industrial Internet of Things / Industrie 4.0" at the conference "HANNOVER MESSE 2019".

☐ The goal of this activity is to foster trustworthiness in increasing digital and interconnected economies.

☐ Trustworthiness is an important qualitative decision-making criterion for the entire secure value chain.

Need to build security and trustworthiness for Cyber Physical System

Cyber

Physical

factory

data

risk

Things

'Six Elements'

| organization | people | component | data | system | procedure |

6
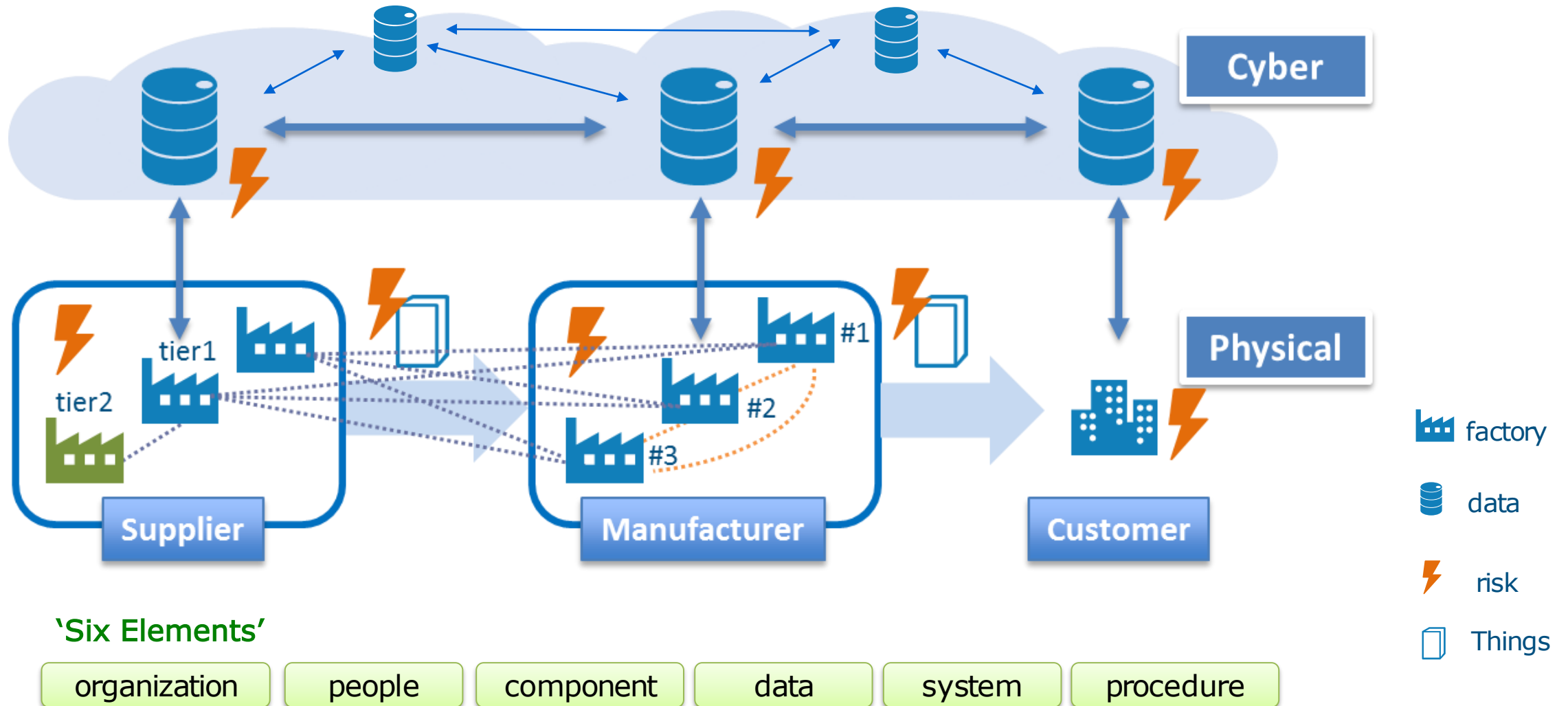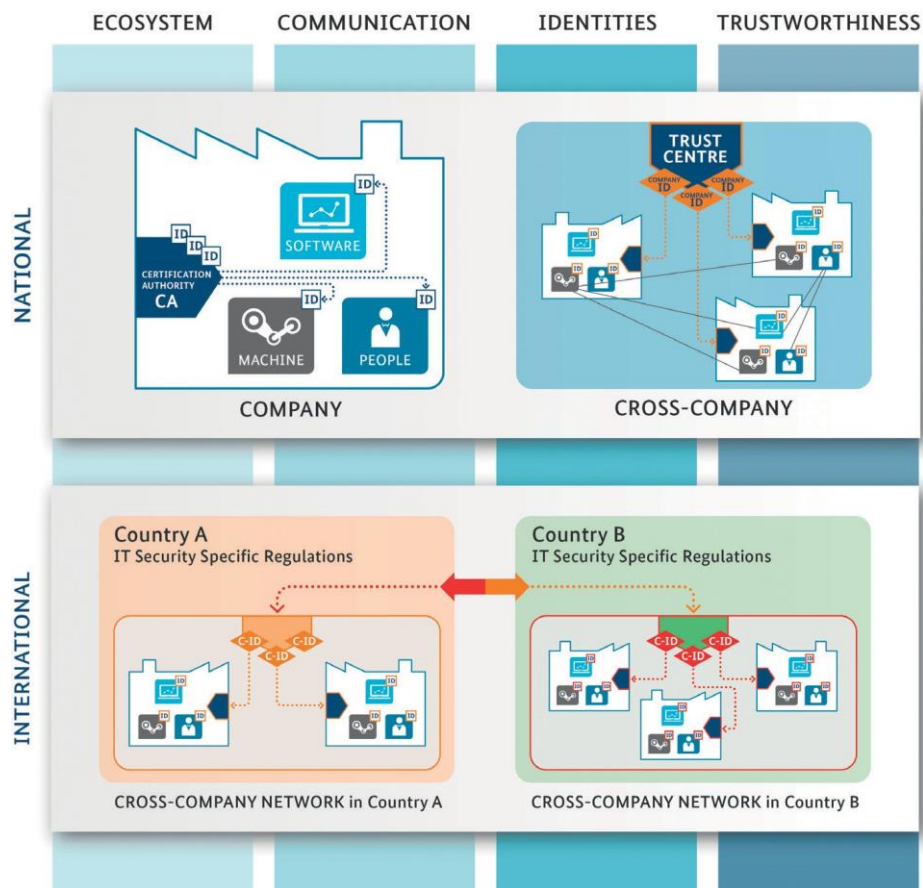
- Use-case scenario: Establishing the infrastructure for secure communication between Germany and Japan

  - A potential supplier based in Japan wants to establish a new business relationship with a customer in Germany.

  - They do not have a business history together, i.e. they have not worked on any joint projects or collaborations in the past.

  - They need support for secure communication and collaboration.

  - At this stage, existing and new international standards are to be applied.

Discussion Key issues to be considered in use case scenario

Germany

G-CAs

Japan

J-CAs

Legal Person ID
President ID

Corporation A

Legal Person ID
President ID

Corporation B

General Manager ID

General Manager ID

Business Unit A-1

Business Unit A-2

Online contract

Business Unit B-1

Business Unit B-2

Security level A-2

Security level B-1
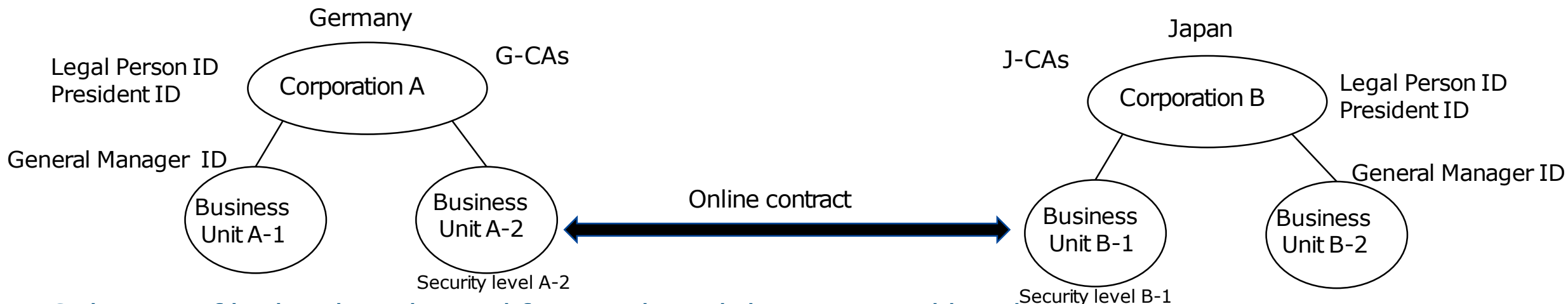
Solutions of both sides, derived from technical, business and legal issues

Item list to be identified	Germany	Japan	Technical Issues
Legal Person ID and its provider	VATIN (USt-IdNr.), DUNS	NTA,TSE	—
Natural person ID/BU ID and its provider	eIDAS	Each Corp.	Appropriate BU ID code is not yet determined.
Digital Certification for natural person	eSignature, eIDAS	Each Corp.	—
Digital Certification for legal entities	SEAL, eIDAS	NTA, TSE	Cross certification is needed.
Standards used for security assurance	ISO/IEC27001, IEC62443		Digital Certificate of security level should be issued.
Security level certification	Trusted 3rd party		Corporate Process certification is not yet established.
Online contract signing	Signed by the representative of a BU		Cross certification is needed.
Online contract security level agreement	Using certification issued by a trusted 3rd Party.		—

Draft plan of interoperable trustworthiness pilot project

| 2018 Oct. | 2019 April | 2019 May | 2019 Sept. | 2019 Oct. | 2020 March | 2020 April | | 2021 March |

Understanding Trustworthiness through contract phase

Understanding Trustworthiness through operation phase

Identification of evaluation items through the pilot

Interoperable trustworthiness pilot development & evaluation

Development → Evaluation

Use case
Tech. Issues
Bus.Leg. Issues

Use case
Tech. Issues
Bus.Leg. Issues

Project Plan
Evaluation Items Overview

Evaluation Items in detail

Trustworthiness for Organization

Trustworthiness for
System, component
People, Procedure,
(data)

Contract format
Trust level definition
Certificate profile
Legal person, natural person, component
Digital signature(message software)

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Next Plan Announcement by CEO on Nov 8th 2018

The next 20 years

A social revolution driven by cyber-physical tech

Demands from a rapidly changing society

Energy, Natural resources, Climate change, Urbanization, Aging, Workforce shortages

The fusion of cyber and physical technologies

Further evolution of cyber tech

AI (deep learning), Digital twin, Quantum computing, Security

Physical technology breakthroughs

Robotics, Autonomous driving, Biotech, Sensing, Wireless, Materials

https://www.toshiba.co.jp/about/ir/en/pr/pdf/tpr2018q2e_2.pdf

FY2018 Technology Strategy Briefing on Nov 22th 2018

Opening the briefing, Nobuaki Kurumatani, Toshiba's CEO, commented "Toshiba has established strengths in physical technology in a wide range of business domains in its 143-year history, and also in high level cyber technologies, exemplified by our world leadership in image recognition. The venture spirit of the two founders has come down to our employees today and shapes our company's culture. We will advance our digital transformation to become a world-leading CPS technology company that contributes to achievement of the SDGs."

Shiro Saito, Toshiba Group's Chief Technology Officer, explained the company's three core R&D policies: to further strengthen component technologies based on abundant assets in business domains; to develop technologies that improve customer value through digitization based on AI & IoT technologies; and to create cutting-edge technologies to solve social issues that will emerge in the future, particularly original technologies and know-how in CPS that will differentiate Toshiba and its capabilities. In his comments, he said: "Toshiba Group will contribute to achieving the SDGs through CPS technologies that create new services and value that combine strengths in the physical world and core components nourished during a long history of manufacturing with further advances in cyber technologies, particularly AI and IoT."

Hiroshi Yamamoto, the Group's Corporate Digitization CTO, introduced Toshiba Group's basic policy on IoT strategy.
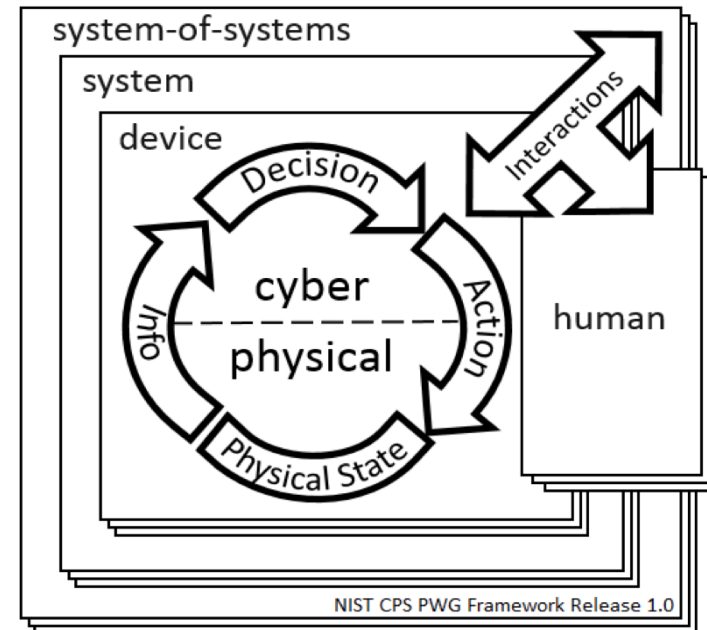
http://www.toshiba.co.jp/about/press/2018_11/pr2201.htm?fromRSS=IR2018112202

Cyber Physical System as DX Enabler

- IoT, IoS and IoP as major elements
- A closed loop back between cyber and physical
- Systems, System-of-Systems and Human Interaction as key characteristics
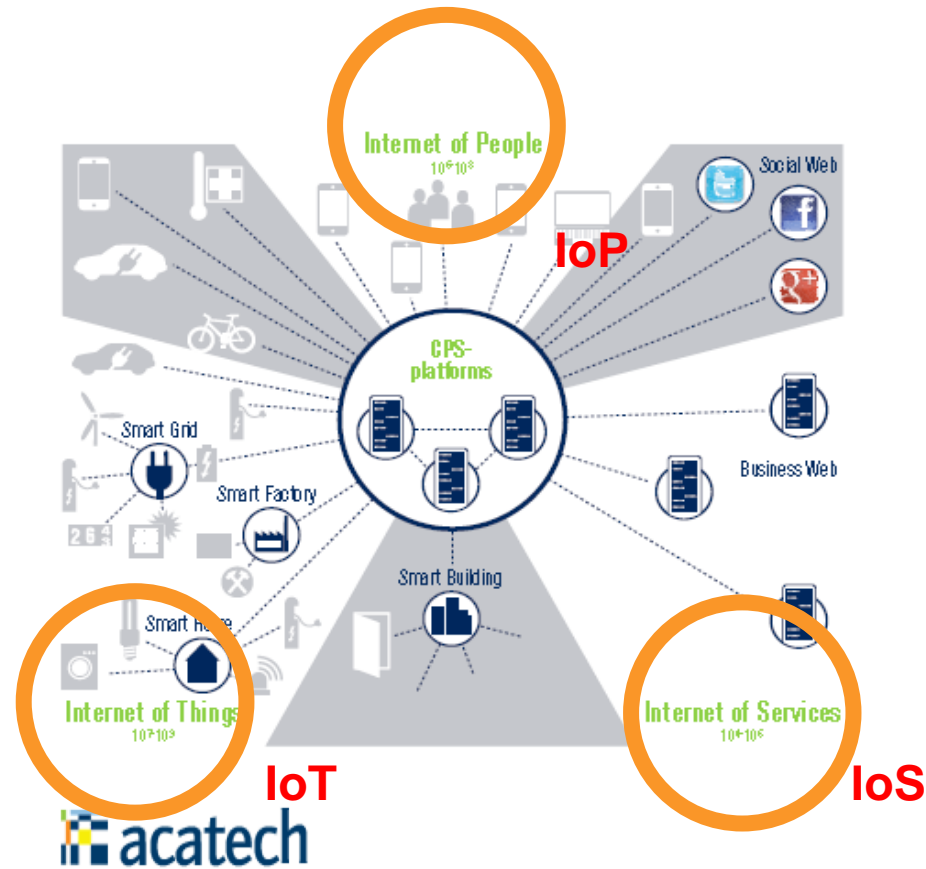
Source："Recommendations for implementing the strategic initiative INDUSTRIE 4."

Source："Cyber-Physical Systems (CPS) Framework Release 1.0"

Objective of CPS ~ Control vs. Service

CPS falls into two broad categories—control and service
United architecture for control and service is required

Closed Innovation

Open innovation

**Cloud computing
High speed networks
GPS**
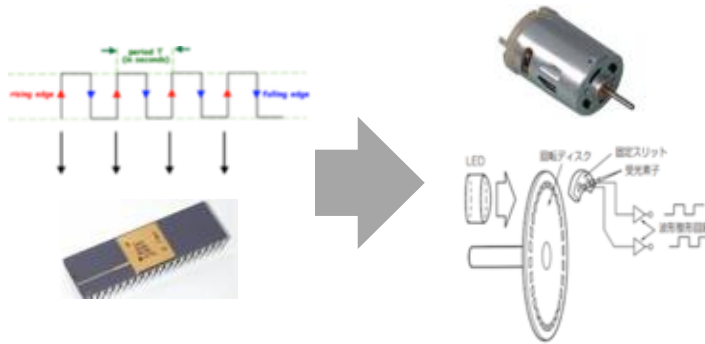
Traditional CPS (System)

Control with time sensitive
(no best efforts)

Interruption, I/O triggers state transition

● Servo motor controls processed CPU
Interruption by encoder pulse
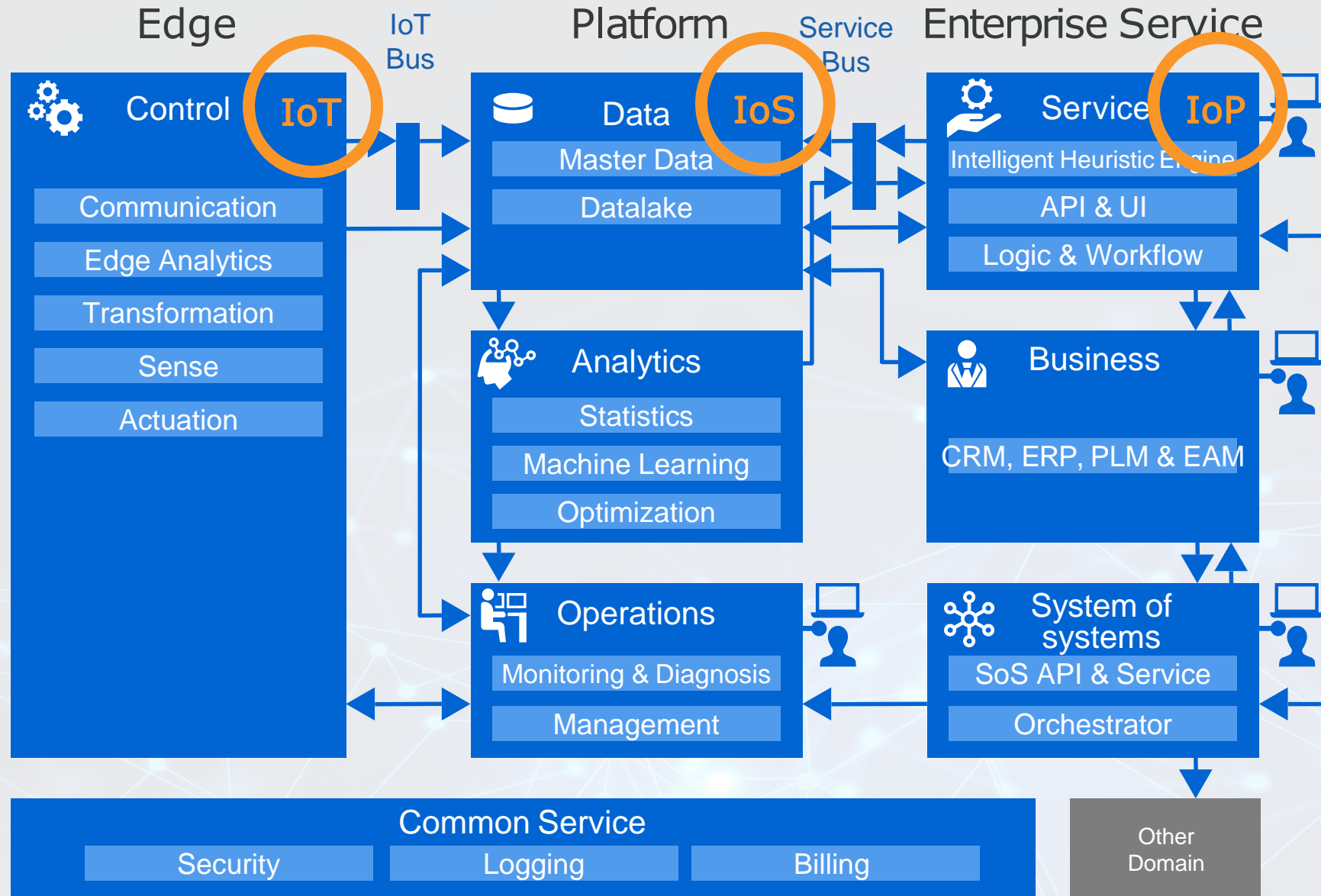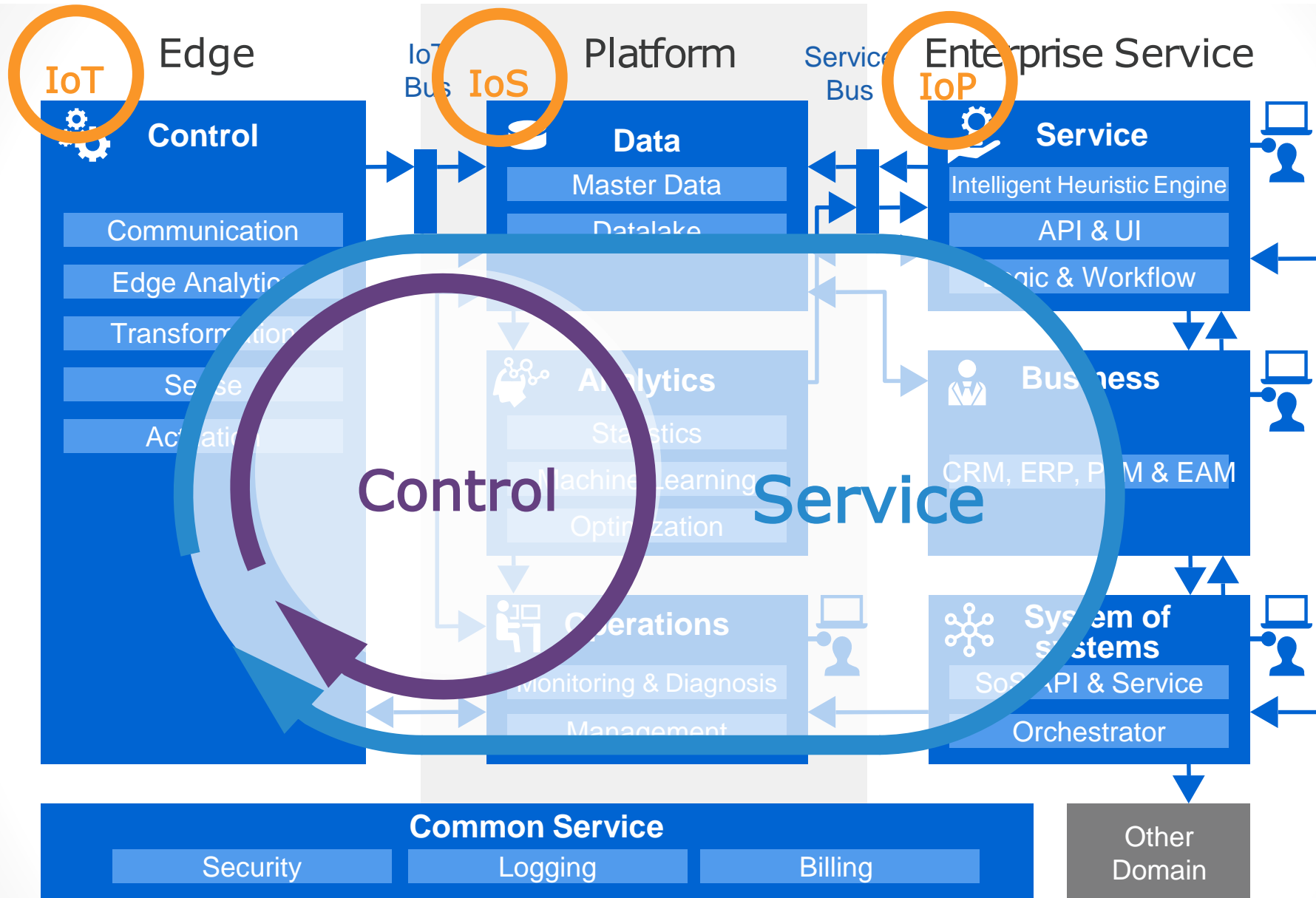
Modern CPS (System-of-Systems)

Service with a feedback loop
Data/API triggers state transition
Data sources: DB, People, things
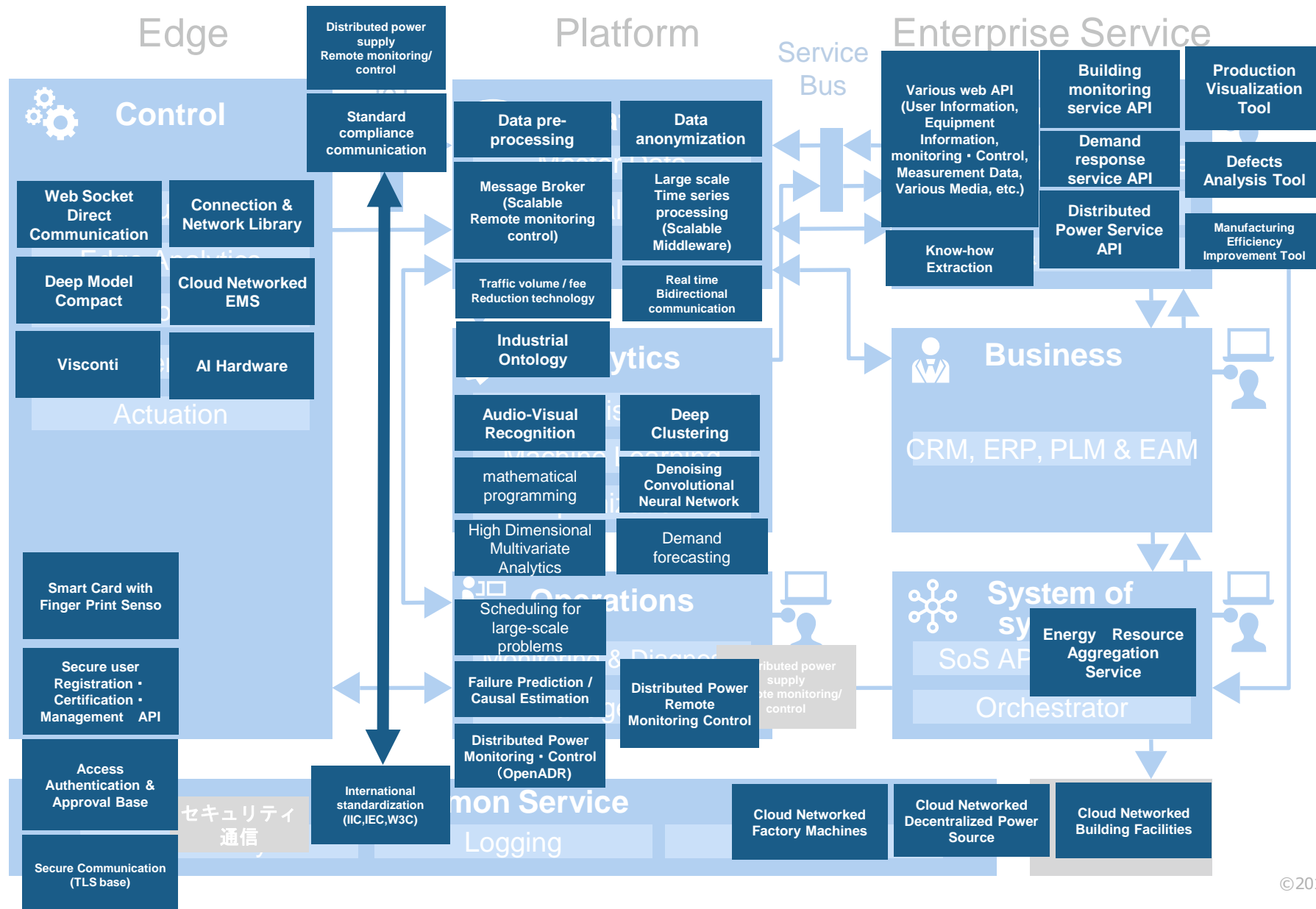- ● Public loop
- ● Enterprise loop

Toshiba IoT Reference Architecture Ver2.0 (3 Tier Architecture)

Toshiba IoT Reference Architecture Ver2.0 (3 Tier Architecture)

Technology Inventory Assessment - Internal

Edge

Control

- Web Socket Direct Communication
- Connection & Network Library
- Deep Model Compact
- Cloud Networked EMS
- Visconti
- AI Hardware

Actuation

- Smart Card with Finger Print Senso
- Secure user Registration・Certification・Management API
- Access Authentication & Approval Base
- Secure Communication (TLS base)

セキュリティ通信

- Distributed power supply Remote monitoring/control
- Standard compliance communication
- International standardization (IIC,IEC,W3C)

Platform

- Data pre-processing
- Data anonymization
- Message Broker (Scalable Remote monitoring control)
- Large scale Time series processing (Scalable Middleware)
- Traffic volume / fee Reduction technology
- Real time Bidirectional communication
- Industrial Ontology
- Audio-Visual Recognition
- Deep Clustering
- mathematical programming
- Denoising Convolutional Neural Network
- High Dimensional Multivariate Analytics
- Demand forecasting

Operations

- Scheduling for large-scale problems
- Failure Prediction / Causal Estimation
- Distributed Power Monitoring・Control (OpenADR)
- Distributed Power Remote Monitoring Control
- Distributed power supply Remote monitoring/control

Common Service

Logging

Service Bus

Enterprise Service

- Various web API (User Information, Equipment Information, monitoring・Control, Measurement Data, Various Media, etc.)
- Building monitoring service API
- Production Visualization Tool
- Demand response service API
- Defects Analysis Tool
- Distributed Power Service API
- Manufacturing Efficiency Improvement Tool
- Know-how Extraction

Business

CRM, ERP, PLM & EAM

System of sy

SoS AP

- Energy Resource Aggregation Service

Orchestrator

- Cloud Networked Factory Machines
- Cloud Networked Decentralized Power Source
- Cloud Networked Building Facilities

- Split *Information* into *Data* and *Analytics*

- Change Application to *Service* to highlight human interaction (IoP)

- Add *System of Systems* for multiple system orchestration

  -Vertical – Same Domain Systems (Virtual One Factory, VPP)
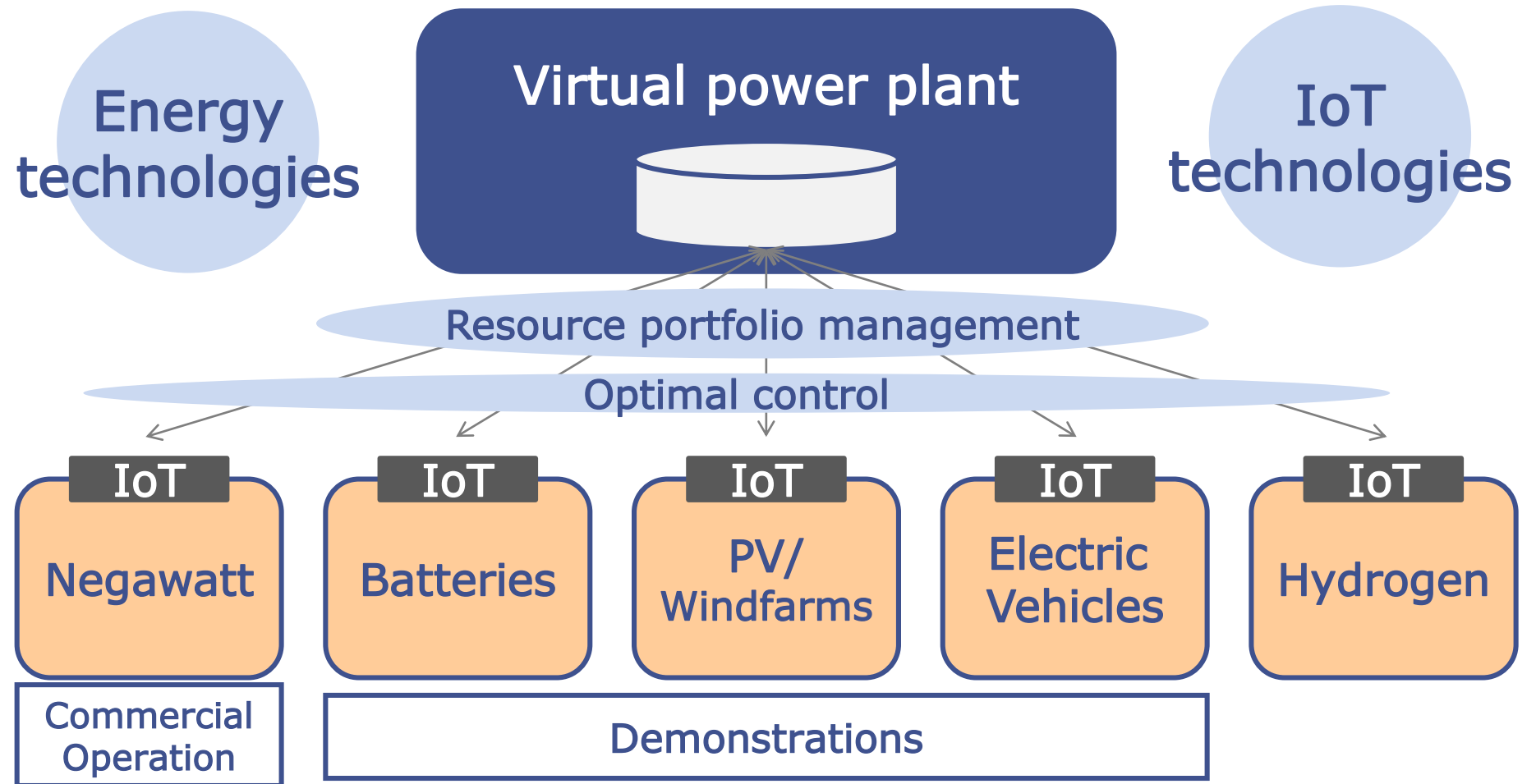 -Horizontal – Different Domain Systems (Connected Industries

  Maier, M.W. 1998. "Architecting Principles for Systems-of-Systems."

Vertical ~ Virtual Power Plant

✓ VPP keeps the electricity system stable when increasing renewable energy sources
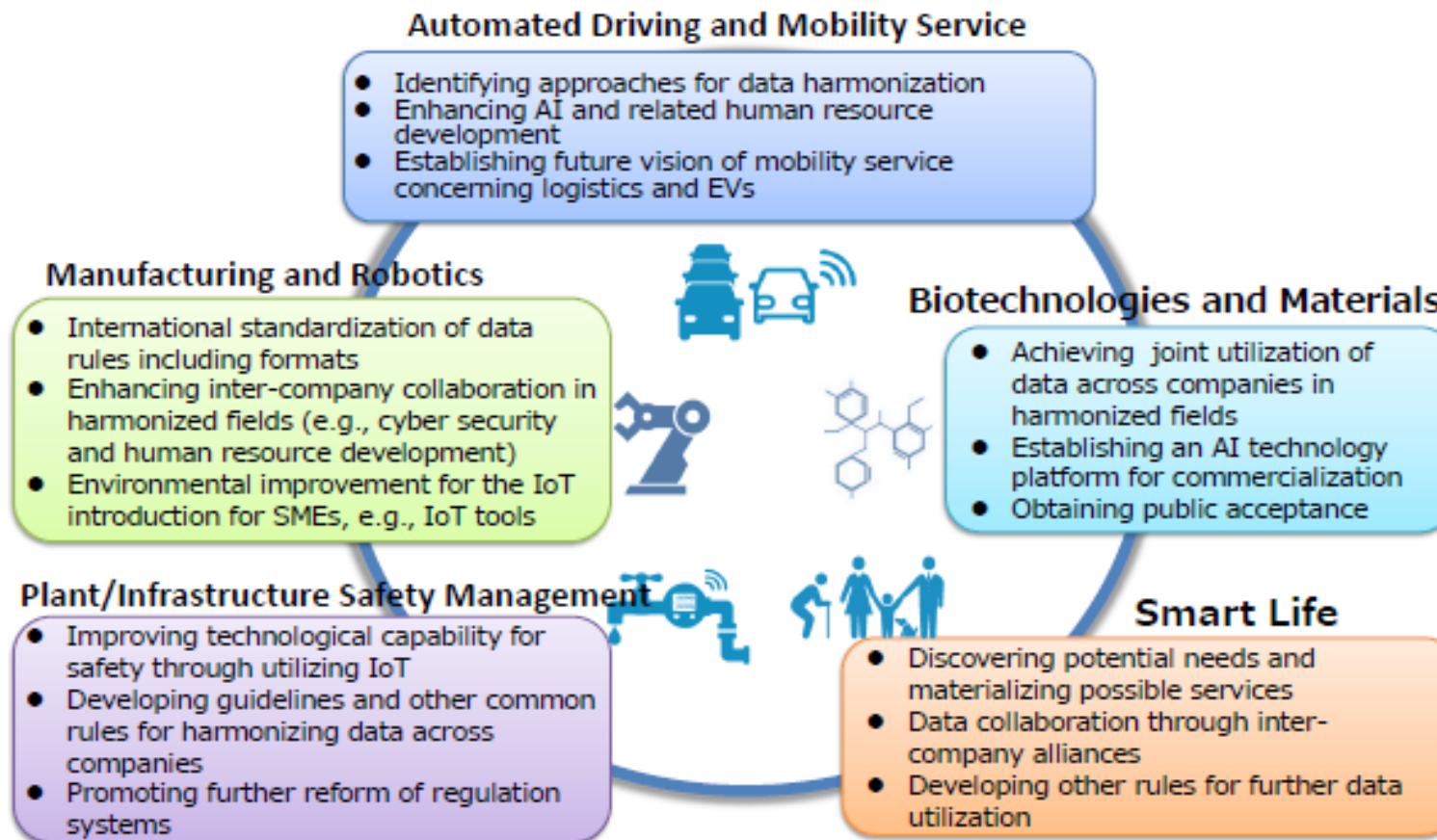
System of systems
SoS API & Service
Orchestrator

Energy technologies

Virtual power plant

IoT technologies

Resource portfolio management

Optimal control

IoT	IoT	IoT	IoT	IoT
Negawatt	Batteries	PV/ Windfarms	Electric Vehicles	Hydrogen

Commercial Operation

Demonstrations

Business Model Challenge for Manufactures

Robot Controller (PLC)

Heuristic Operation

Alert

A/D Converter & Gateway

Edge

Database

Analytics

Workflow

Monitoring
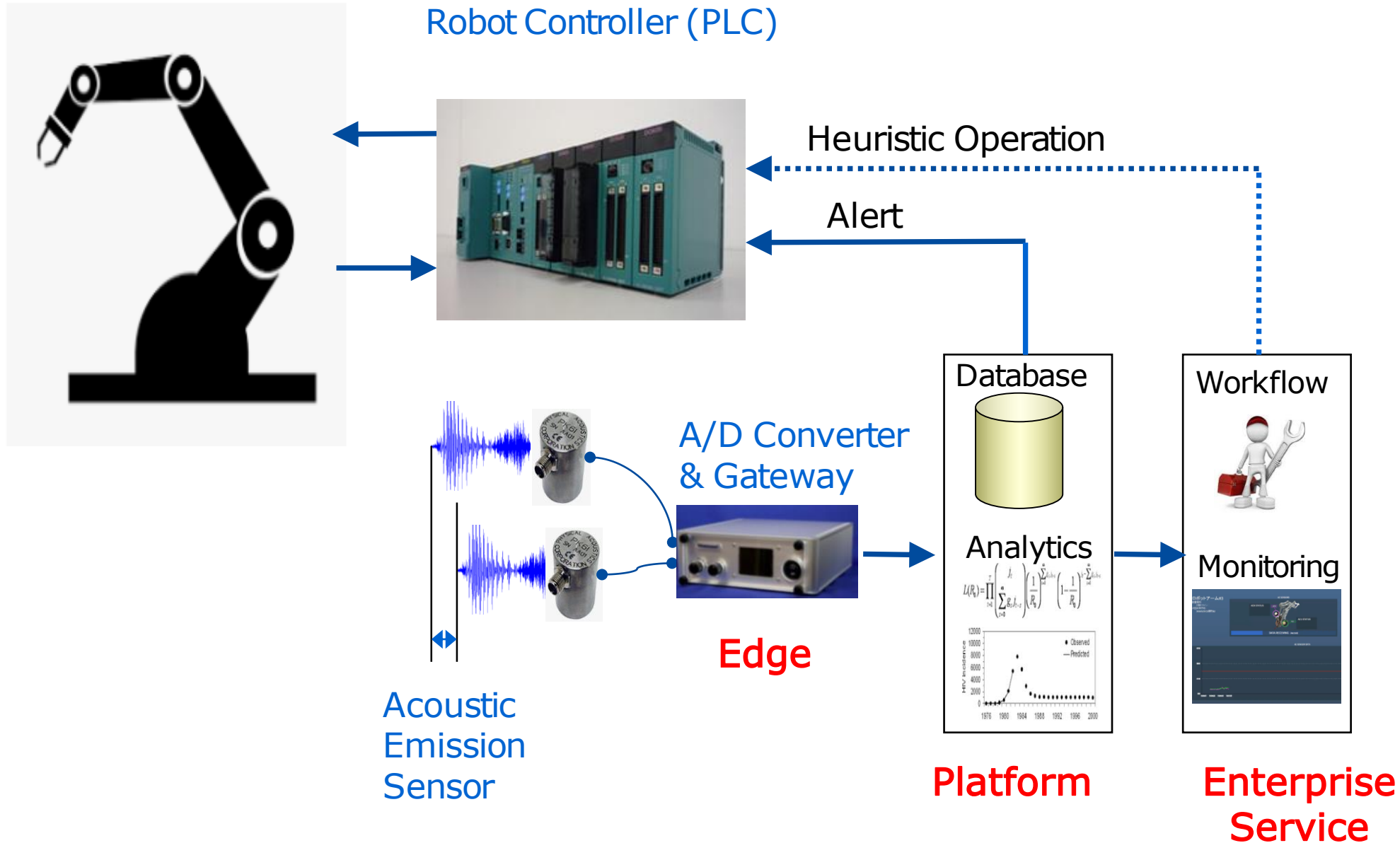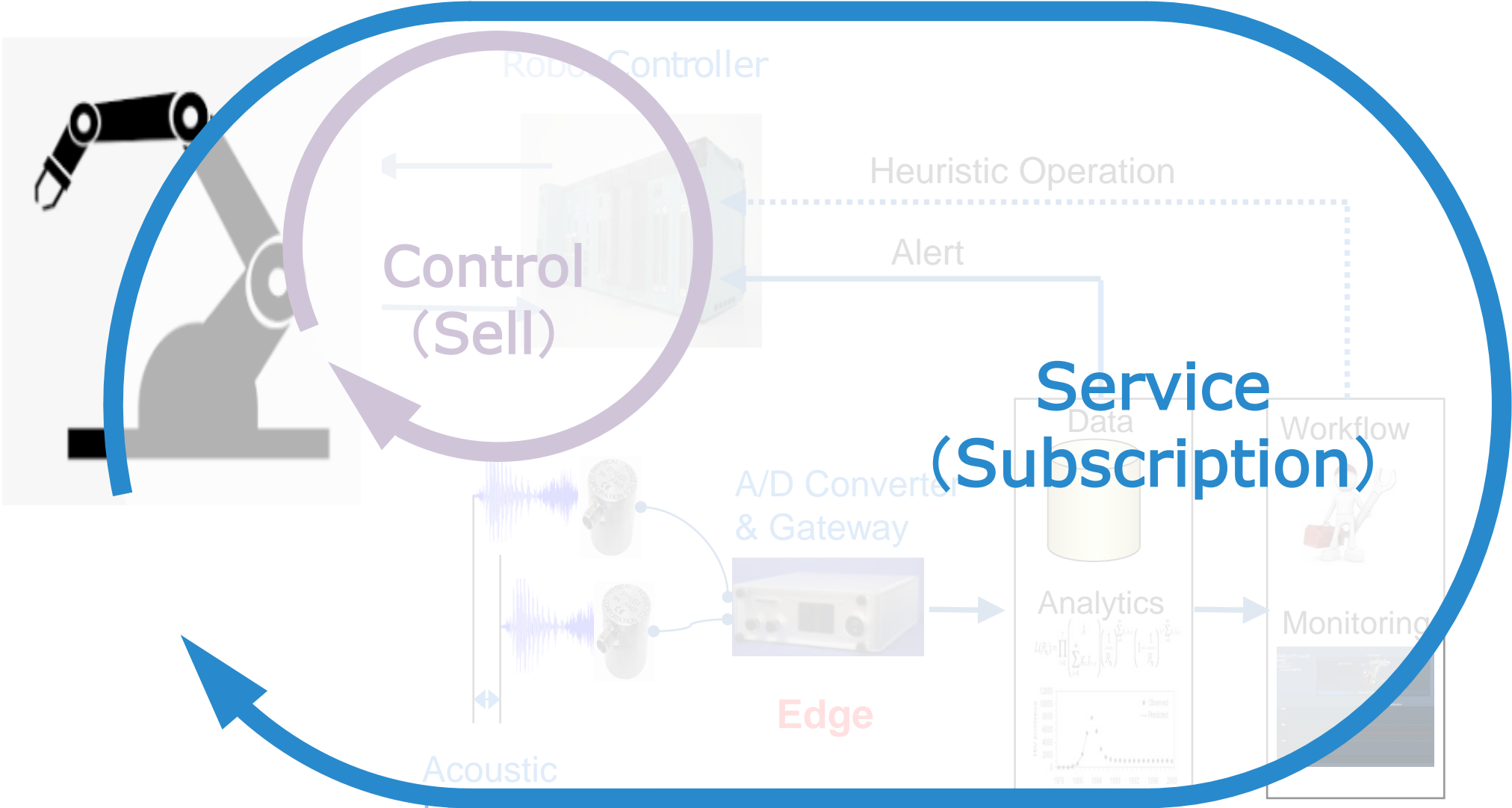
Platform

Enterprise Service

Acoustic Emission Sensor

Sell ? Or Subscription?

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●Forum Industrie 4.0 (meets RRI) @ *Hall 8*
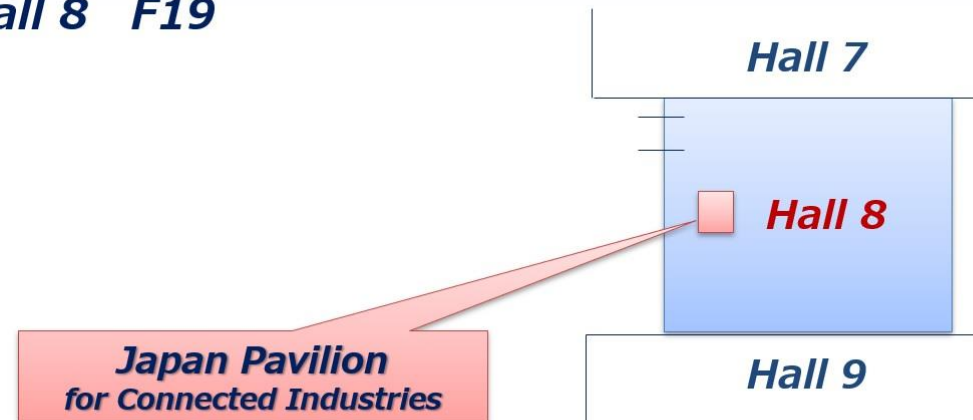
· Monday, 1 April, 12:30-13:00,
       "IoT Design Approach by Adapting Framework", Mr. Hiroshi YAMAMOTO, Toshiba Corp., Corporation Digitaization CTO

· Monday, 1 April, 14:00-14:30,
       "Connected Industries Open Framework for Industrial Value Chain Transformation", Dr. Yasuyuki NISHIOKA, Industrial Value Chain Initiative, President

· Tuesday, 2 April, 16:00-16:30,
       "Navigation Scheme of Smart Manufacturing System Development for Each Maturity Level Enterprise",
          Dr. Youichi NONAKA, Hitachi, Ltd., Senior Chief Researcher

· Wednesday, 3 April, 10:00-10:30,
       "German-Japan Collaboration for Standardization in Smart Manufacturing", Dr. Fumihiko KIMURA, The University of Tokyo, Professor Emeritus

· Wednesday, 3 April, 11:00-11:30
       "Toward Realization of Smart Manufacturing Systems",
          Dr. Shinsuke KONDOH, National Institute of Advanced Industrial Science and Technology, Group leader

●13th German – Japanese Economic Forum @ *Hall 27*

Wednesday, 3 April, 13:45–14:30
· "IIoT Security: The role of trustworthiness in international value chains", Ms. Masue SHIBA, Toshiba Corp.
· "Standardization Activities in Germany-Japan Cooperation for Smart Manufacturing", Dr. Youichi NONAKA, Hitachi. Ltd.

●Japan Pavilion for Connected Industries @ *Hall 8   F19*

Hall 7

Hall 8

Japan Pavilion
for Connected Industries

Hall 9

Thank you