



# Toshiba's Cyber Strategy 2020

## To the Practical Phase

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Toshiba Corporation

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# Key Takeaways

1. What progress has Toshiba made toward one of the world's leading CPS companies in the past two years?
  2. What is Toshiba's digital transformation?
  3. Why did Toshiba make infrastructure services a strategy?
  4. What impact is Toshiba giving to the industry?
- ~Closing~



# Takeaways at a glance

## 1 Looking back on the last 2 years

Establishing corporate foundations for CPS



TIRA



(Industrial Architecture Design Center)

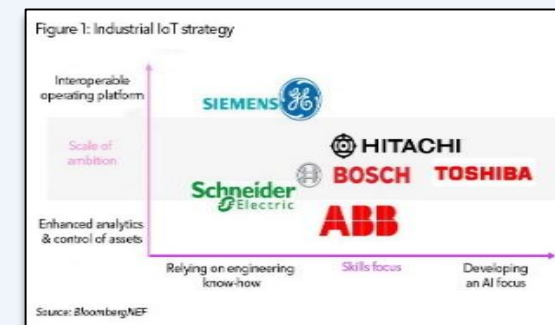
CPS service development



12 IIoT Service

Energy	① Dashboards	Social Infrastructure	⑥ Rolling stock remote monitoring service
	② Performance evaluation/performance monitoring to detect abnormalities		⑦ Remote management and maintenance service for chillers
	③ Detection of signs of failure using operating data		⑧ Building wellness service
	④ Optimal power generation planning service	Manufacturing	⑨ Meister Cloud™ Series for manufacturing industry
	⑤ Data management system based on engineering drawings		⑩ Distributed & coupled simulation platform for in-vehicle control model
		Logistics	⑪ AI image inspection service
			⑫ Logistics IIoT cloud service

CPS Thought Leadership



2019 Bloomberg

5W1H

## 2 Digital transformation

### Toshiba IoT Service Factory

- Service component standardization
- Service environment automated configuration
- Connect, expand, and bundle services

### TOSHIBA SPINEX Marketplace

- Business visualization
- Global delivery

### Infrastructure service development approach

- Business top down
- Technology bottom up

### Focus service area

- IIoT service winning pattern

### Domestic and overseas customer case studies

## 3 Initiatives for infrastructure services

## 4 Toshiba as an influencer



# Infrastructure Services 5W1H



WHEN

**2020-2025**  
(Next Plan Phase2&3)



# 1

## Looking Back on the Past Two Years

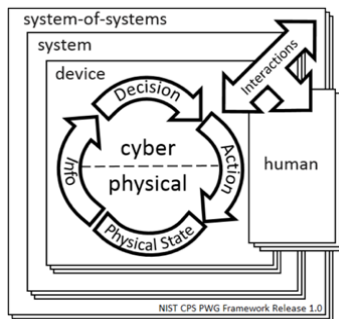


# Toshiba IoT Reference Architecture (TIRA)

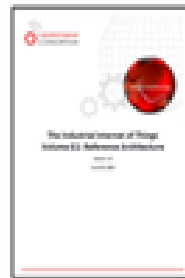
- In 2018, Toshiba formulated and released the Toshiba IoT Reference Architecture (TIRA), based on IoT industry standards: Industry 4.0, IIRA, NIST CPS framework, etc.
- TIRA is connected by an interface that exchanges data with hardware (IoT Bus) and an interface that interconnects with other systems and services (Service Bus), and has three layers: Edge (IoT/Things); "Platform (IoS/Services); and Enterprise Service (IoP/People)"



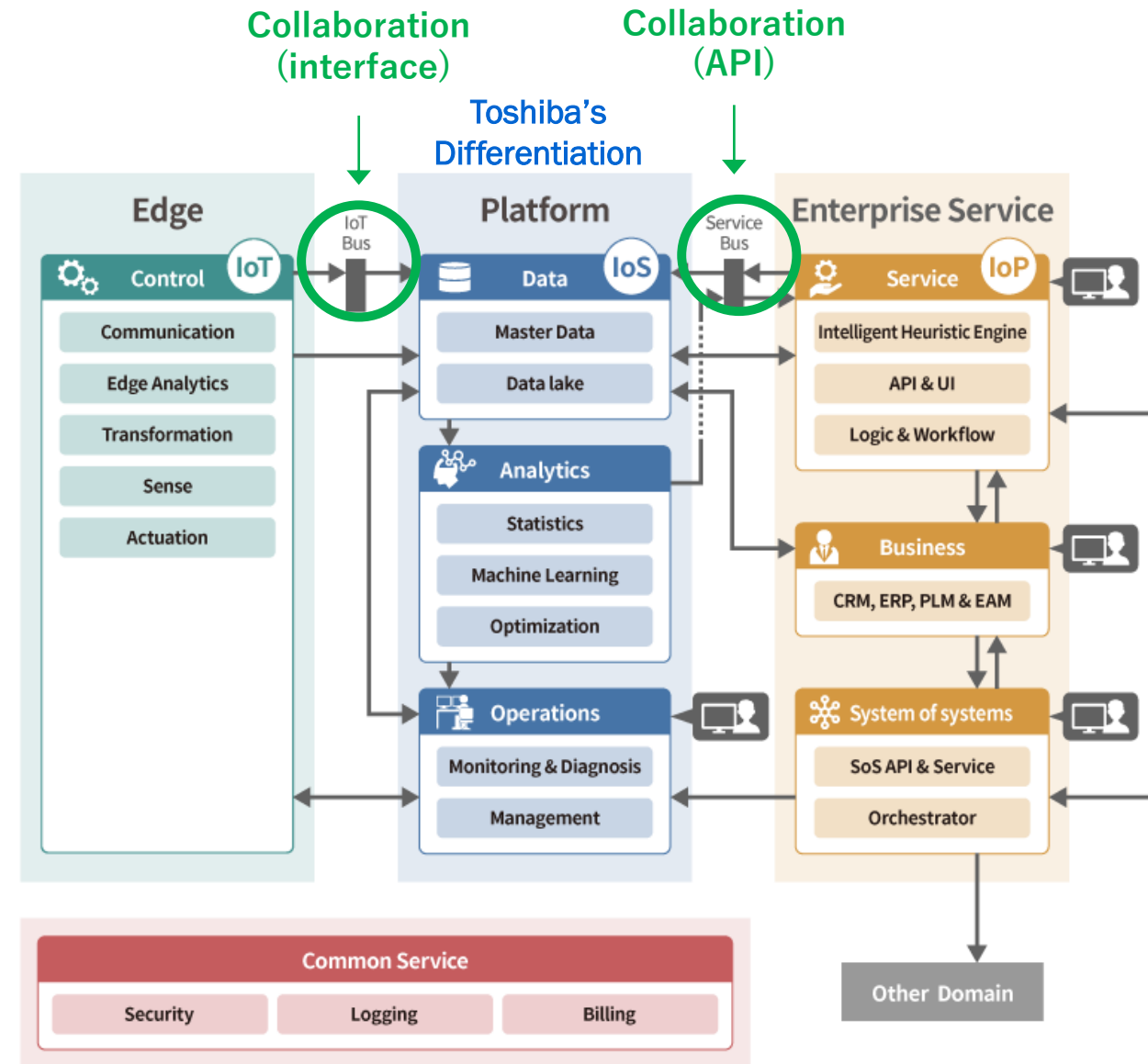
Source: "Recommendations for implementing the strategic initiative INDUSTRIE 4."



CPS Conceptual Model

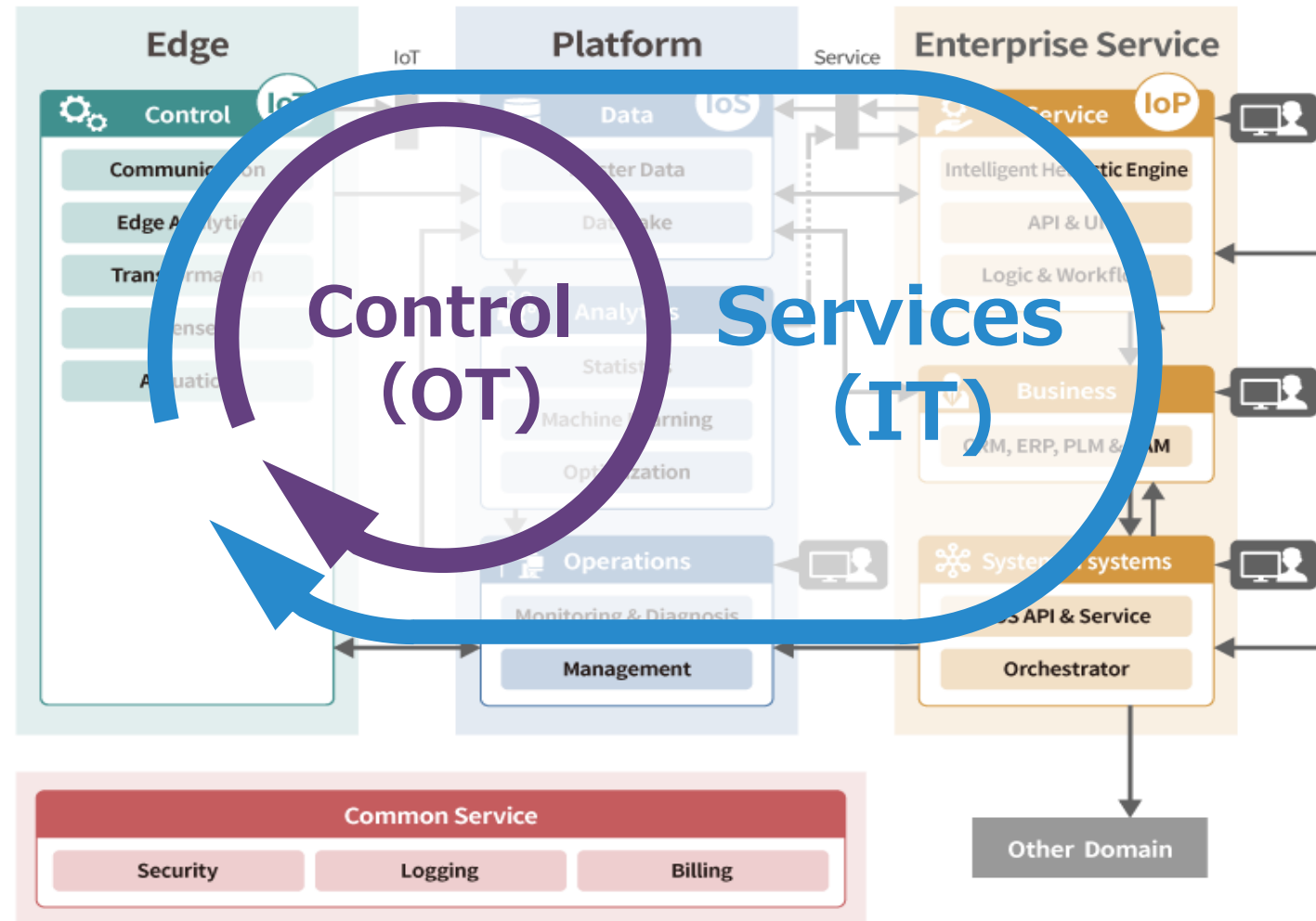


IIRA



# TIRA(Toshiba IoT Reference Architecture) Concept

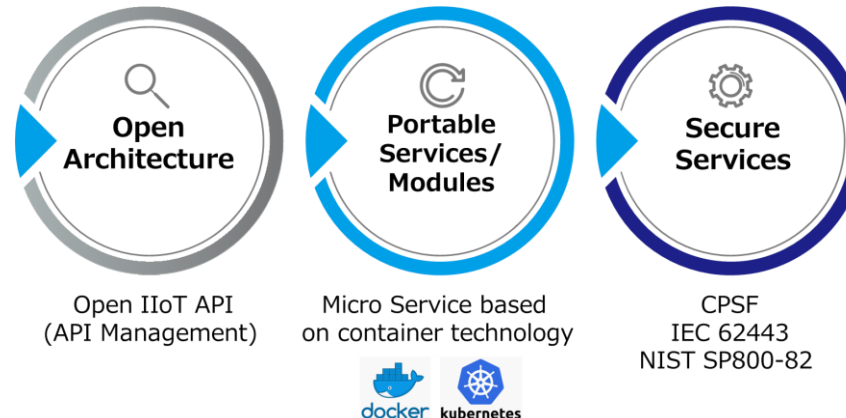
TIRA's features and concepts express the two objectives of CPS (control and services), in one architecture.



# TOSHIBA SPINEX Services

- At the end of FY2019, 12 (types of) TIRA compliant services were released as the TOSHIBA SPINEX Suite
- We defined two TIRA-compliant certification criteria and one design recommendation

Energy	Dashboard	Social infrastructure	Data management systems that utilize plan and diagram linkage
	Performance evaluation and error detection through performance monitoring		Heat source and air conditioning remote management /maintenance services for plants
	Failure prediction based on operation data		Building wellness services
	Optimal power generation planning service	Manufacturing	Meister Cloud IoT services for the manufacturing industry
	Data management systems that utilize plan and diagram linkage		Vehicle design and simulation platform for distributed environment
			Image inspection service with AI
		Logistics	Logistics IoT cloud service





# TIRA Criteria Part 1: API definition

- IIoT services are API defined (preferably open)
- API specifications are based on industry standards such as OpenAPI/WSDL(\*) (new services are OpenAPI)

Guarantee high interoperability by adopting a standard API



**POST** Invalidate a token

**GET** Get information about a user

**POST** Get information about a user

User API >

Role API >

Device API >

Device Timeseries API >

### Authorization request

These APIs are compliant with the authorization endpoint specified by (<https://tools.ietf.org/html/rfc6749>) and [OAuth 2.0 PKCE (RFC7636)]

The access token issued by `response_type=token` expires in two hours. The access token issued by `response_type=code` (seven days).

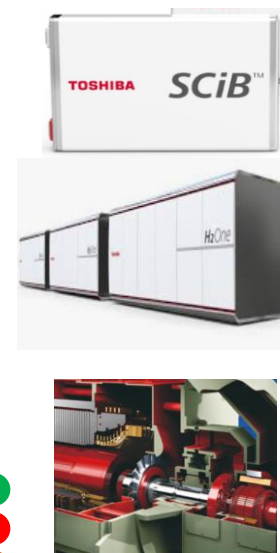
#### QUERY PARAMETERS

<code>response_type</code>	string
<code>required</code>	Enum: "code" "token"
Response types	
• <code>code</code>	- Returns an authorization code
• <code>token</code>	- Returns an access token

## CTO VISION #1:

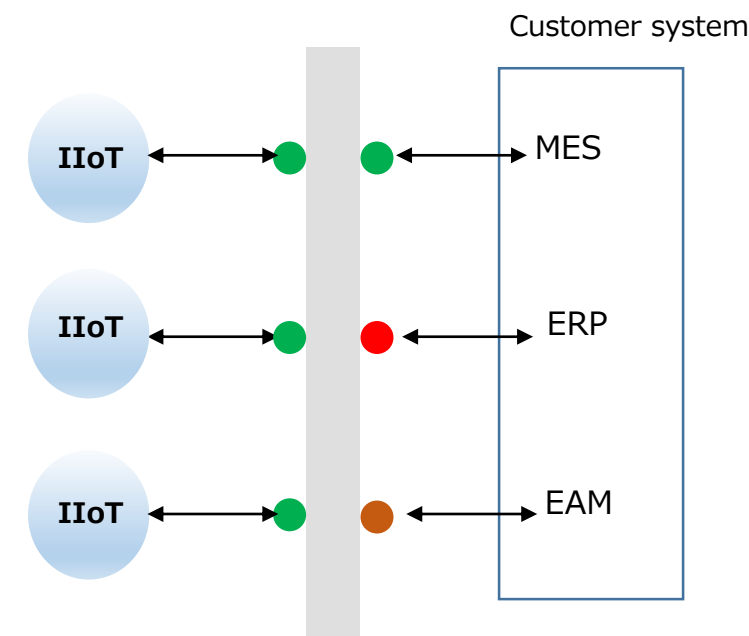
In the future Toshiba will provide infrastructure system functions "As a Service". Toshiba Enterprise Service will be built as a service platform to enable customers to use this service without changing their current customer system.

### Real Infrastructure As a Service



RESTful: ●  
AMQP: ●  
SOAP: ●

### Toshiba Enterprise Service Bus



\* WSDL: Web Services Description Language

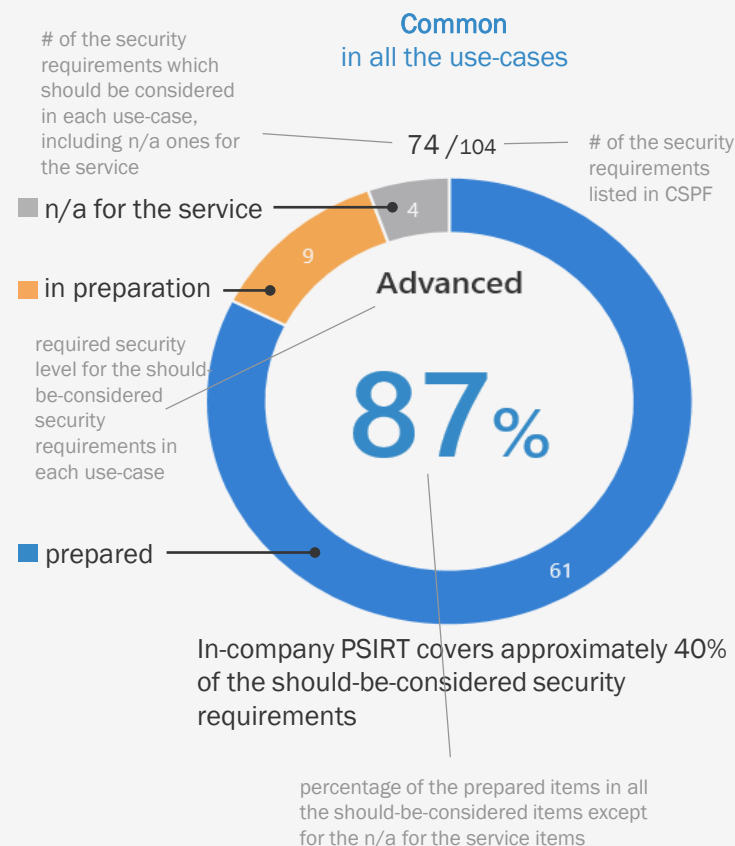
# TIRA Criteria Part 2: Security Assessment

## Conducting security assessment based on IoT security standards

- METI\* Cyber Physical Security Framework
- NIST \* SP800-53
- IEC \* 62443

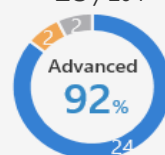
\* Ministry of Economy, Trade and Industry, Japan  
\* National Institute of Standards and Technology, US  
\* International Electrotechnical Commission

### Should-be-considered security requirements for each use-cases and their situation of consideration



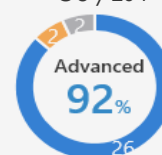
#### Use-case A Management of management data

28 / 104



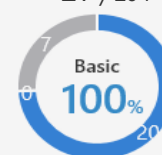
#### Use-case B Remote monitoring

30 / 104



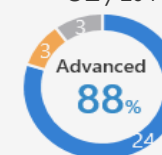
#### Use-case C equipment status check

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#### Use-case D equipment installation

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### Summary of status of the "in preparation( )" items

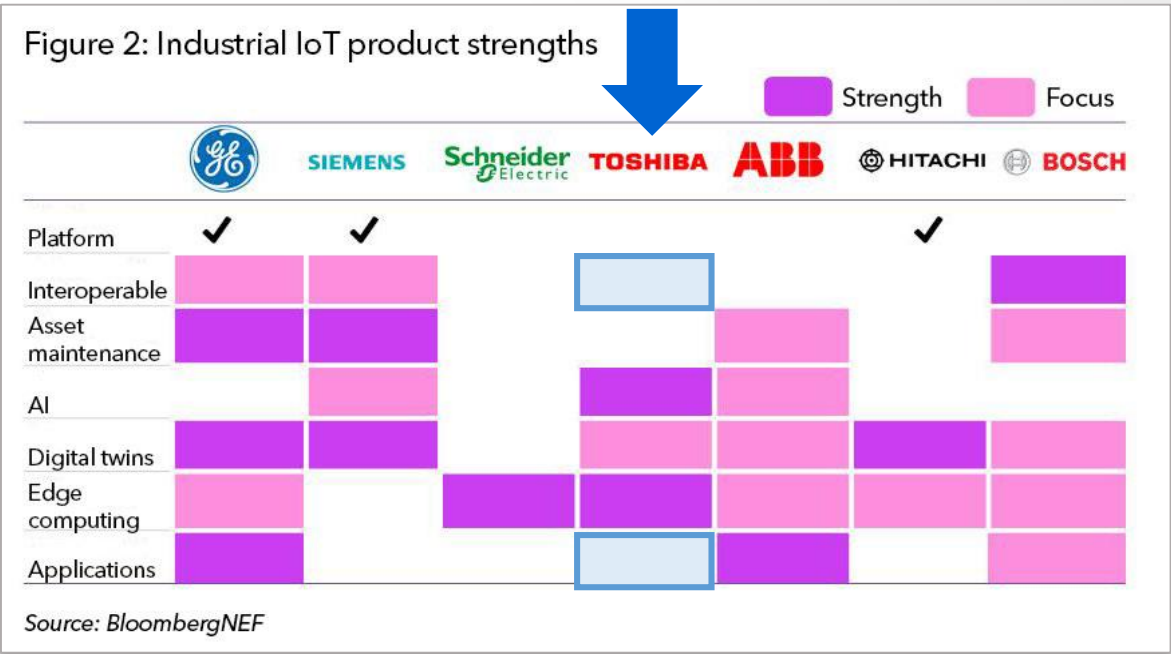
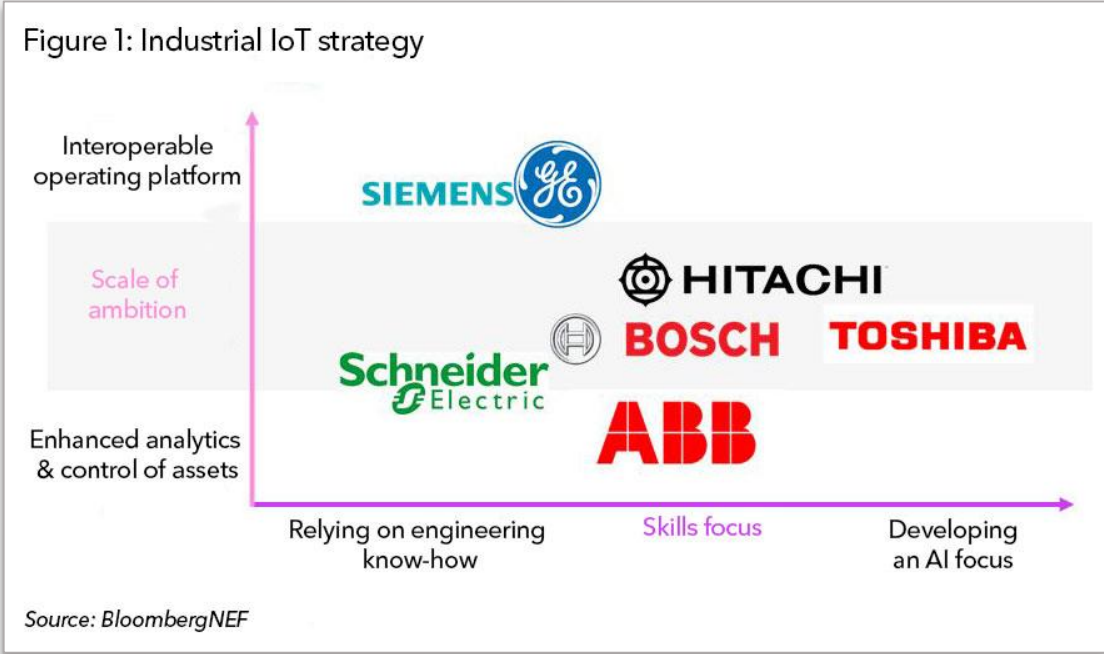
1. Orchestration of PSIRT/SOC
  - Security training
  - Evaluation of response to security incidents (evaluation and improvement of actual treatment in response)
  - Consideration of security incidents in business continuity plan
2. Supporting multi-factor authentication (MFA)
  - as an option menu provided as demanded
3. Data level encryption
  - currently out of scope, since communication-path level encryption is prepared and it achieves SLA of the service
4. Inherently safe design

### Points to be improved

1. Security measures for hardware and firmware of IoT Gateway
  - A target of functional enhancement in the future. currently the risk regarding hardware and firmware of IoT Gateway is shifted onto safety of the physical environment where the gateway is installed.
2. Control of outbound communication

# Bloomberg's Evaluation of the World's Major Industrials' Industrial IoT Strategy

Strong AI and Edge – Reinforcement of mutual connectivity (Open) and application (service)



**Bloomberg NEF**  
says

“Toshiba is looking to leverage its knowledge of chips to build an IoT product based on machine learning, practicing on its own assets and buildings first.”

Source : Bloomberg NEF  
<https://about.bnef.com/blog/ges-digital-division-spin-off-lead-industrials-following-suit-looking-sustained-growth/>

# 2

## Digital Transformation

Realizing evolving infrastructure services

HOW



WHERE

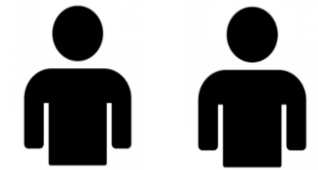


# Toshiba IIoT Common Infrastructure Service~ How to build

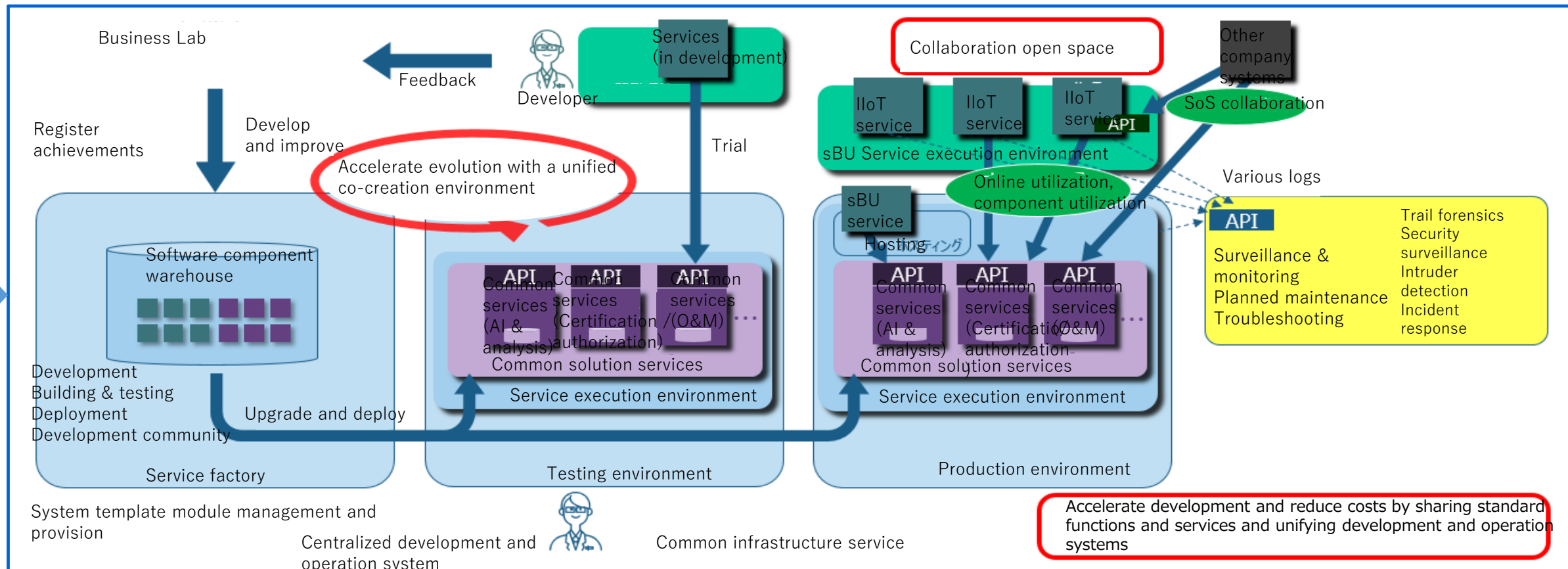
HOW



- Development without SI
- Lifecycle management to realize evolving infrastructure services
- Service evolution based on three policies (bundle, expand, connect)
- Development and operation based on a common service platform



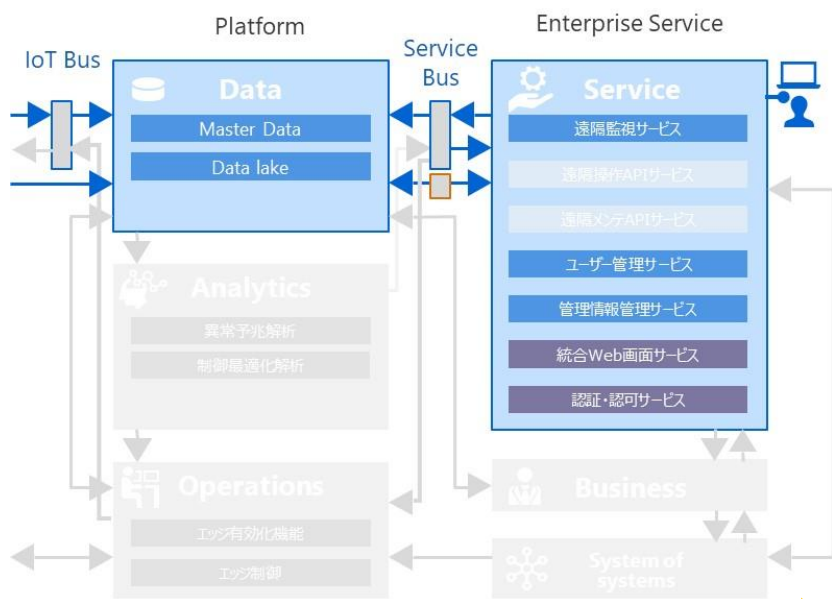
Chief Technical Executives  
(Y & Y)



# Development Without SI ~Automation・Visualization・Standardization

Use DevOps (automation and visualization) to improve productivity of IIoT service development  
For pattern development and standardization, consider the direction of IIoT service evolution and maturity trends

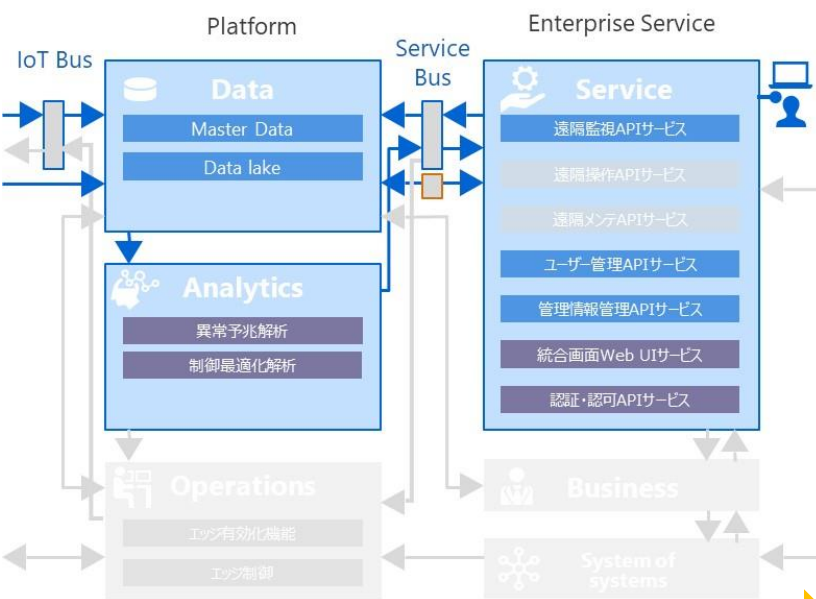
**Pattern A**  
Simple remote monitoring service



1) Visualization

IIoT Maturity Evolution

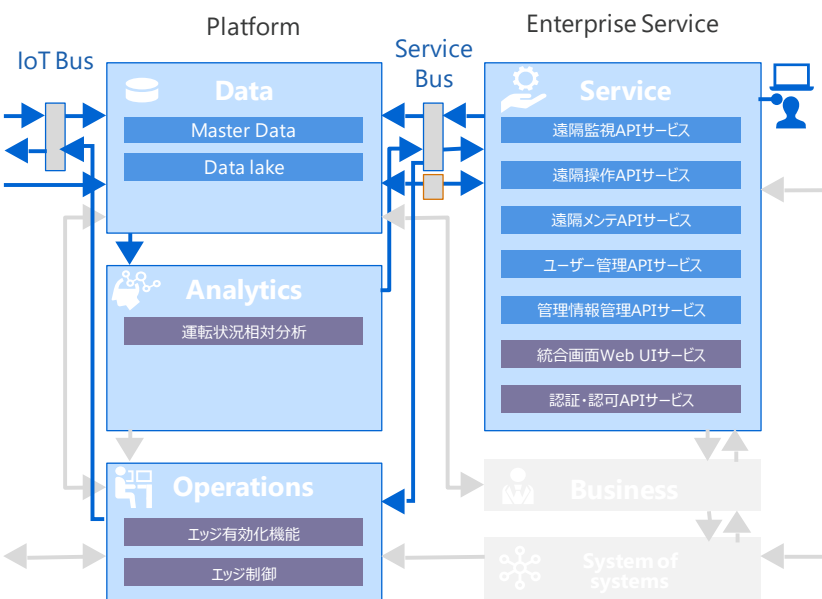
**Pattern B**  
Remote monitoring service with advanced analysis



2) Visualization + analysis (AI)

IIoT Maturity Evolution

**Pattern Y**  
Remote management service (monitoring, maintenance and control)

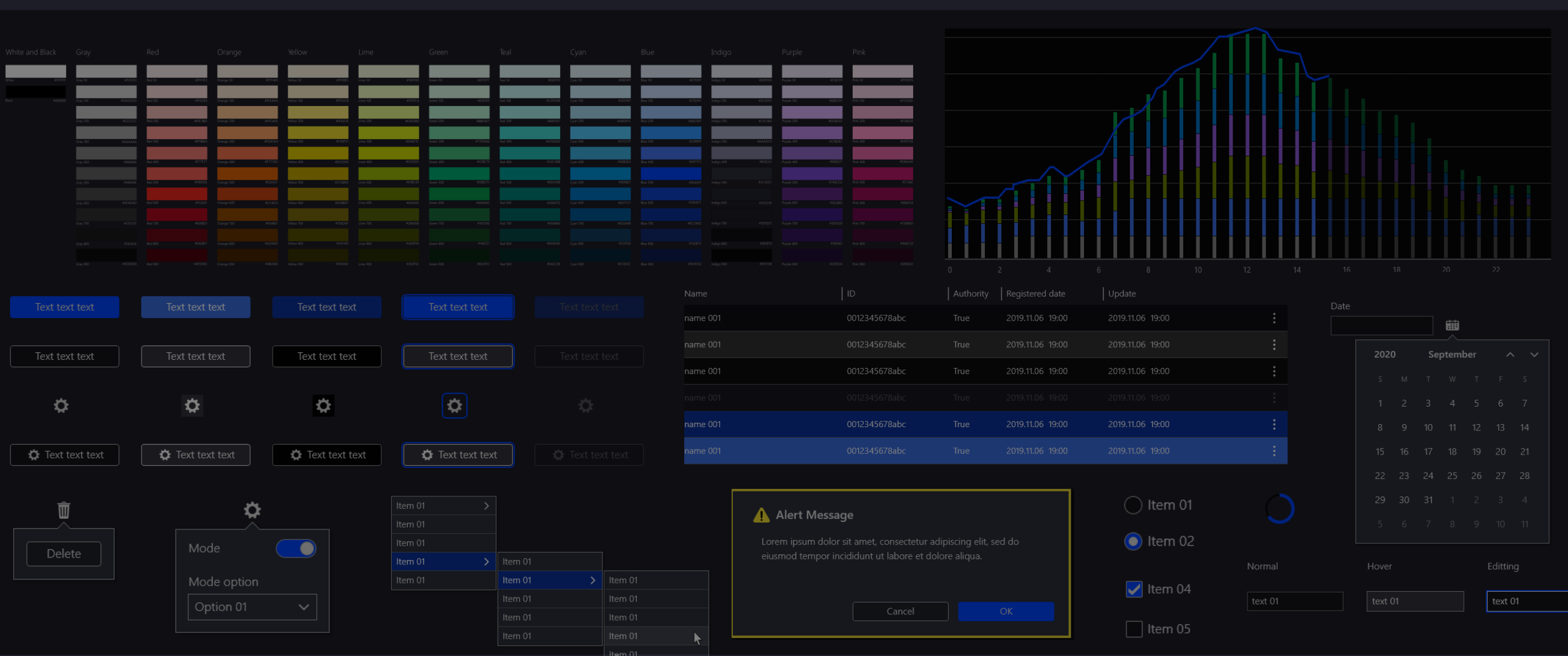


3) Visualization + analysis (AI) + action



# TOSHIBA SPINEX Design System

- Enhance the Toshiba IIoT service brand value by providing a consistent look and feel
- Scheduled global application and rollout of style sheets, etc., to Toshiba Group in 2021



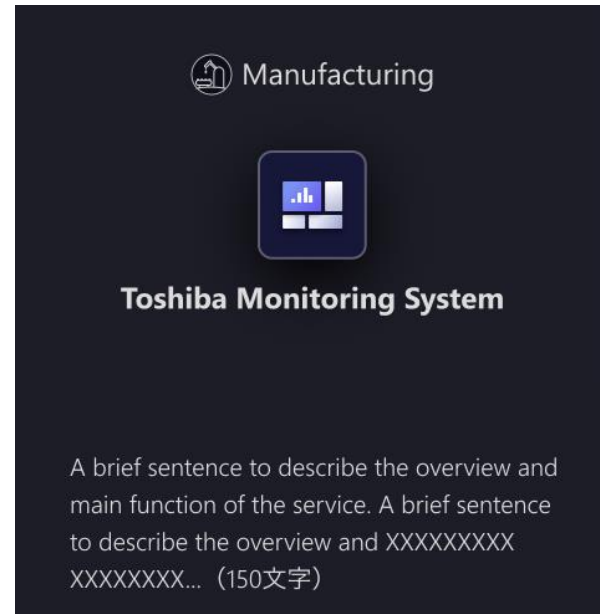
# TOSHIBA SPINEX Marketplace ~ Where to reach out WHERE



- Toshiba IIoT Service Factory Outlet
- Providing a unique UX for each service, currently a showroom (no payment function)
- Called "Marketplace" because we are considering receiving payments on the site in the future

[www.spinex-marketplace.toshiba](http://www.spinex-marketplace.toshiba)

(Scheduled for global release in December 2020)

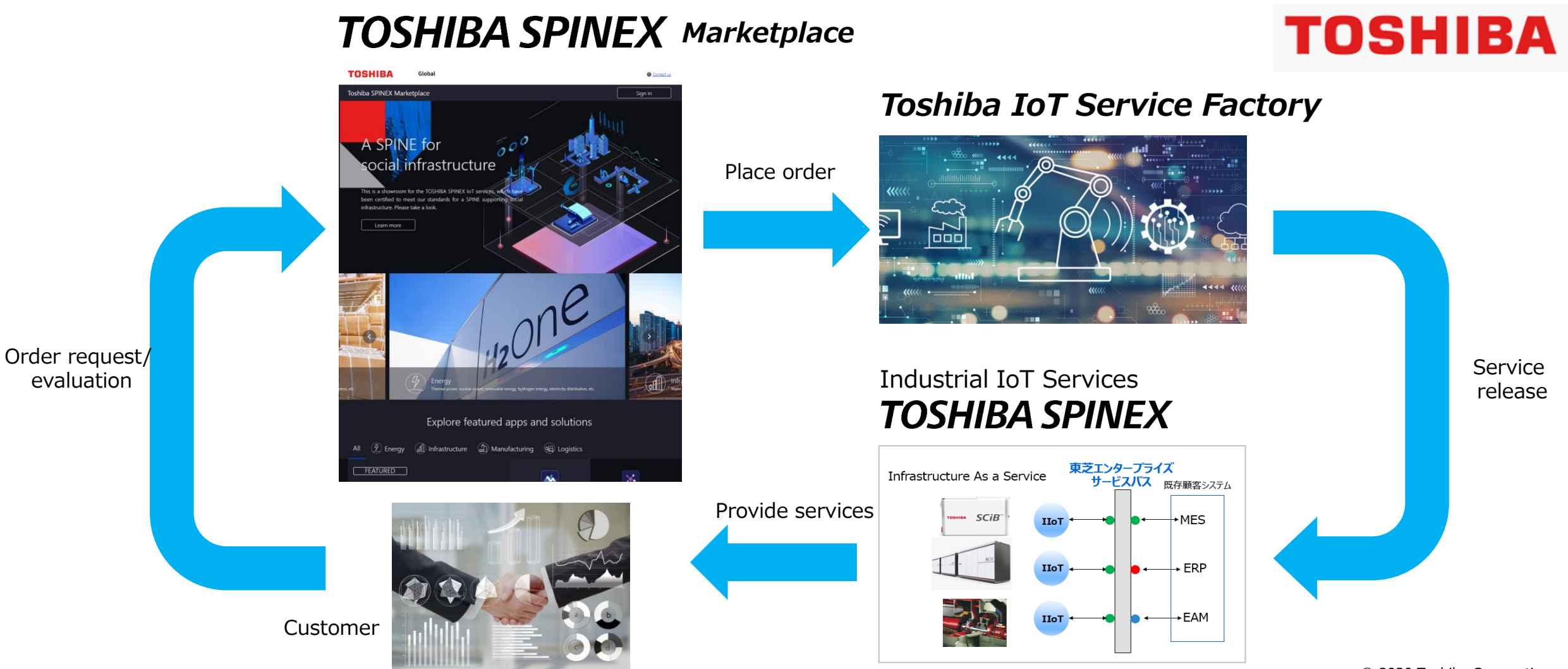


\* Picture is an image and may differ from the actual version.



# CTO VISION #2: Aiming to a leading CPS Company in 2025

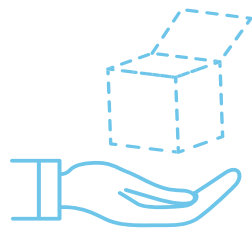
A feedback loop for evolving infrastructure services



# 3

## Initiatives for Infrastructure Services

? WHY



WHAT



WHO

# Basic Policy

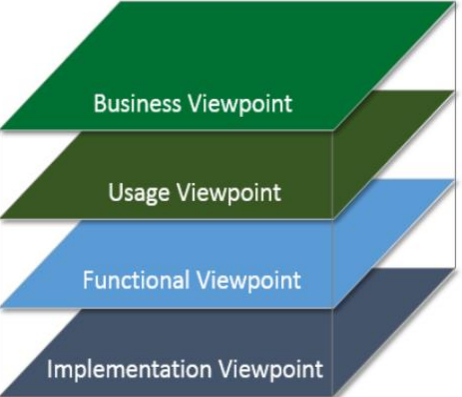
Make "Meet in the Middle" the basic policy for infrastructure service initiatives

Business value

Usage cases

External design

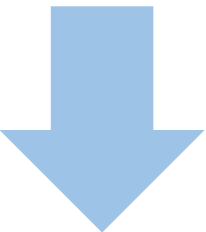
Detailed design



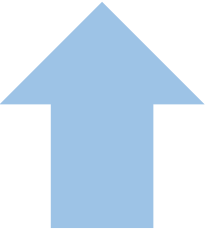
Industrial Internet Reference  
Architecture Viewpoint

(Quoted from IIRA 1.9)

Top down business

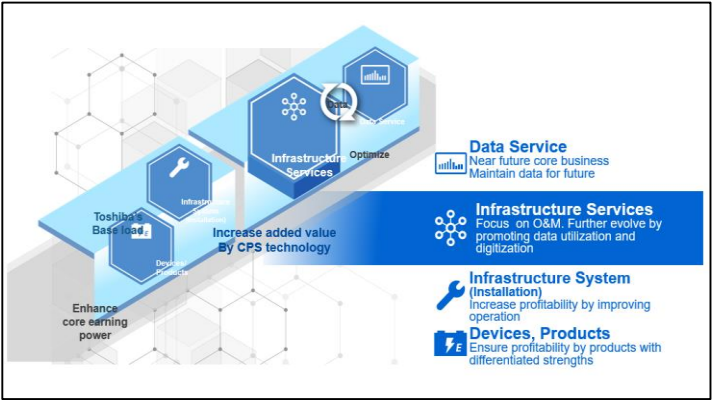


Meet in the middle

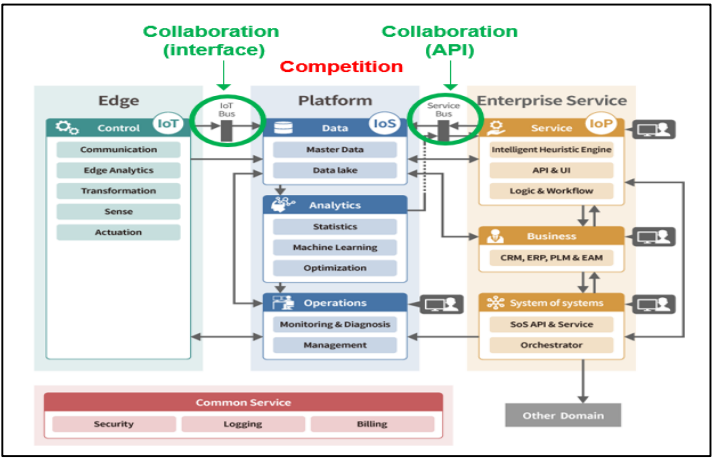


Bottom up technology

Infrastructure business



TOSHIBA SPINEX Solutions





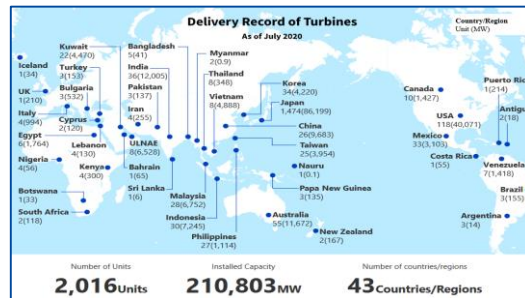
# What are the 3 Reasons Why Toshiba is Focusing On Infrastructure Services?

WHY?

- Social infrastructure is in Toshiba's DNA and management philosophy (Committed to people, committed to the future)
- We have an enormous service opportunity due to past achievements in introducing social infrastructure systems, long operating history, and macro trends
- With the TOSHIBA SPINEX family and collaborative solutions with other companies, we can harvest business and expand solutions

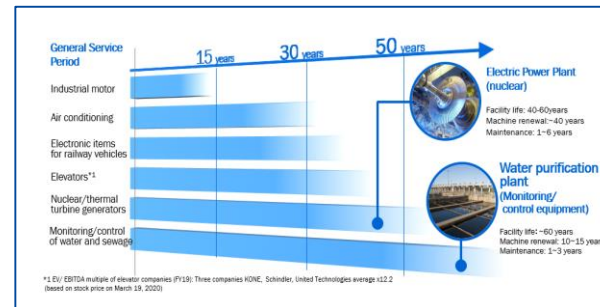
## Opportunities

### Huge asset delivery record



Steam turbine example

### Long life cycle



### CRA

#### Compelling Reason to Act

Factors that must be dealt with  
Eg: decarbonization



## TOSHIBA SPINEX Solutions

### TOSHIBA SPINEX

Energy	Dashboard	Social infrastructure	Data management systems that utilize plan and diagram linkage
	Performance evaluation and error detection through performance monitoring		Heat source and air conditioning remote management /maintenance services for plants
			Building wellness services
	Failure prediction based on operation data	Manufacturing	Meister Cloud IoT services for the manufacturing industry
	Optimal power generation planning service		Vehicle design and simulation platform for distributed environment
	Data management systems that utilize plan and diagram linkage	Logistics	Image inspection service with AI
			Logistics IoT cloud service

### Open/Close architecture





# What are Toshiba's Infrastructure Services? (as of December 2020)



## Nineteen solutions for four business issues resulting from macro trend and serious social risk

CRA



### 4 business requirements

Energy management optimization

O&M Digitization  
(new normal)

Resilient  
disaster prevention  
Security

Infrastructure owner decision  
support (value chain optimization)

Meet in the middle



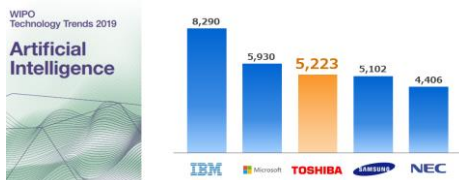
## TOSHIBA SPINEX

19 solution areas

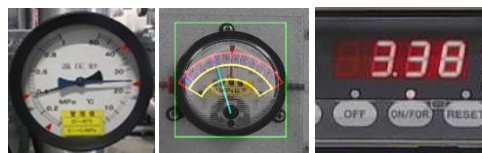
- Factory management
- Building management
- Factory production solutions
- Distributed power management services
- Dashboards
- Linked drawing data management services
- Power generation performance monitoring services
- Power equipment failure detection services
- Logistics solutions
- Freight railway services
- Electricity demand forecasts
- Renewable energy generation forecasts
- Power generation optimization services
- Highway operator services
- Rainwater drainage solutions
- Basin integrated water / environmental information services
- Physical security
- Resilient cities
- Remote radars (UPS)

# Technology Inventory ~ Best of Breed

## AI patents



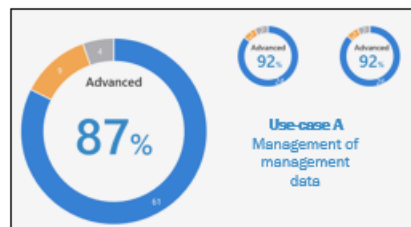
## Meter reading solutions



## Visconti™ 5



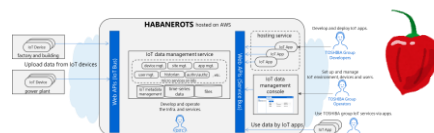
## CPSF Security Assessment



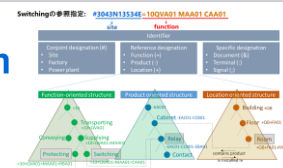
## GridDB™



## HABANEROTS™



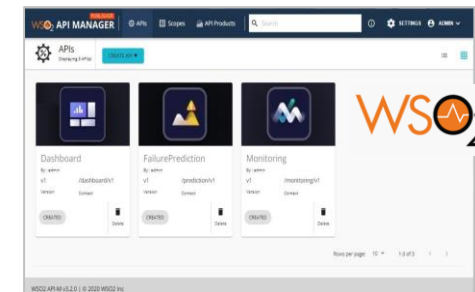
## Information models



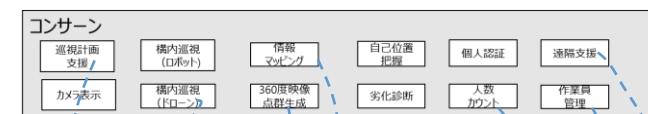
## Building information models



## API Manager



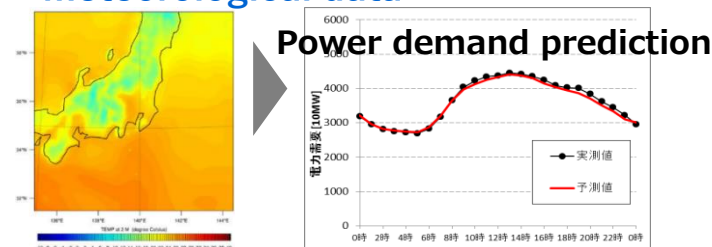
## Concern-Oriented Architecture



## Enduser Driven Service Development



## Forecasting technology using meteorological data



## Quantum Key Distribution



## CYTHEMIS™



# What Kind of Customers Are Using It?

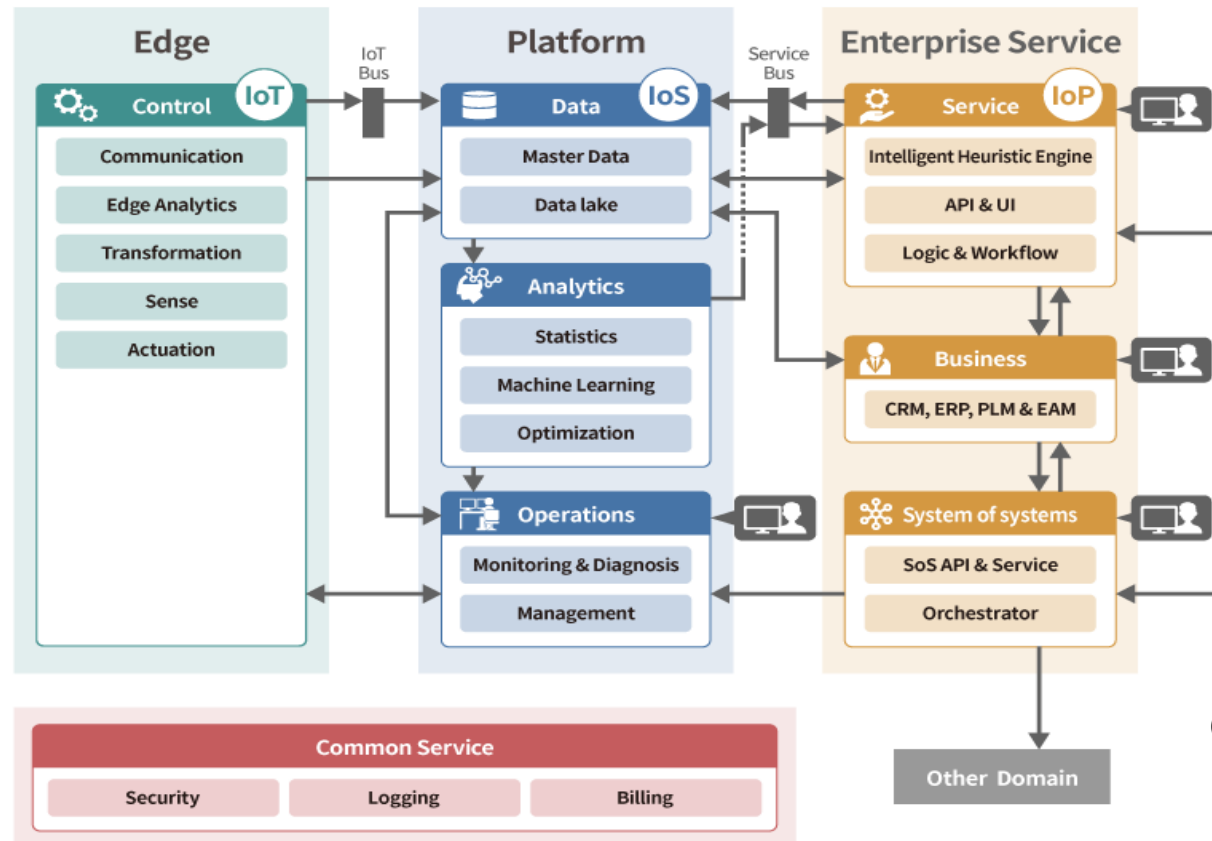


In general, O&M (operation and maintenance) is a highly competitive field dominated by IT and OT vendors,  
In addition to high-quality and secure O&M services, look to differentiate with IoP (people) and  
System of Systems

Customer



① UPS\*1  
Remote monitoring  
(Security)



② IoP (Internet of People)

③ VPP renewable energy solutions  
(System of Systems)

\*1: Uninterruptible power supply



# 1. RemotRADAR Service for Uninterruptible Power Supply (UPS)

## Case Study: A customer in the North American healthcare industry

### Business challenge: CUSTOMER PROBLEM

- The customer was forced to use local monitoring software created by different uninterruptible power supply (UPS) manufacturers for their own UPS. This has become an IT operational challenge. It was also difficult to monitor UPS status from multiple types of software from multiple locations in multiple regions.

### Introduction objective and aims: BUSINESS OBJECTIVE

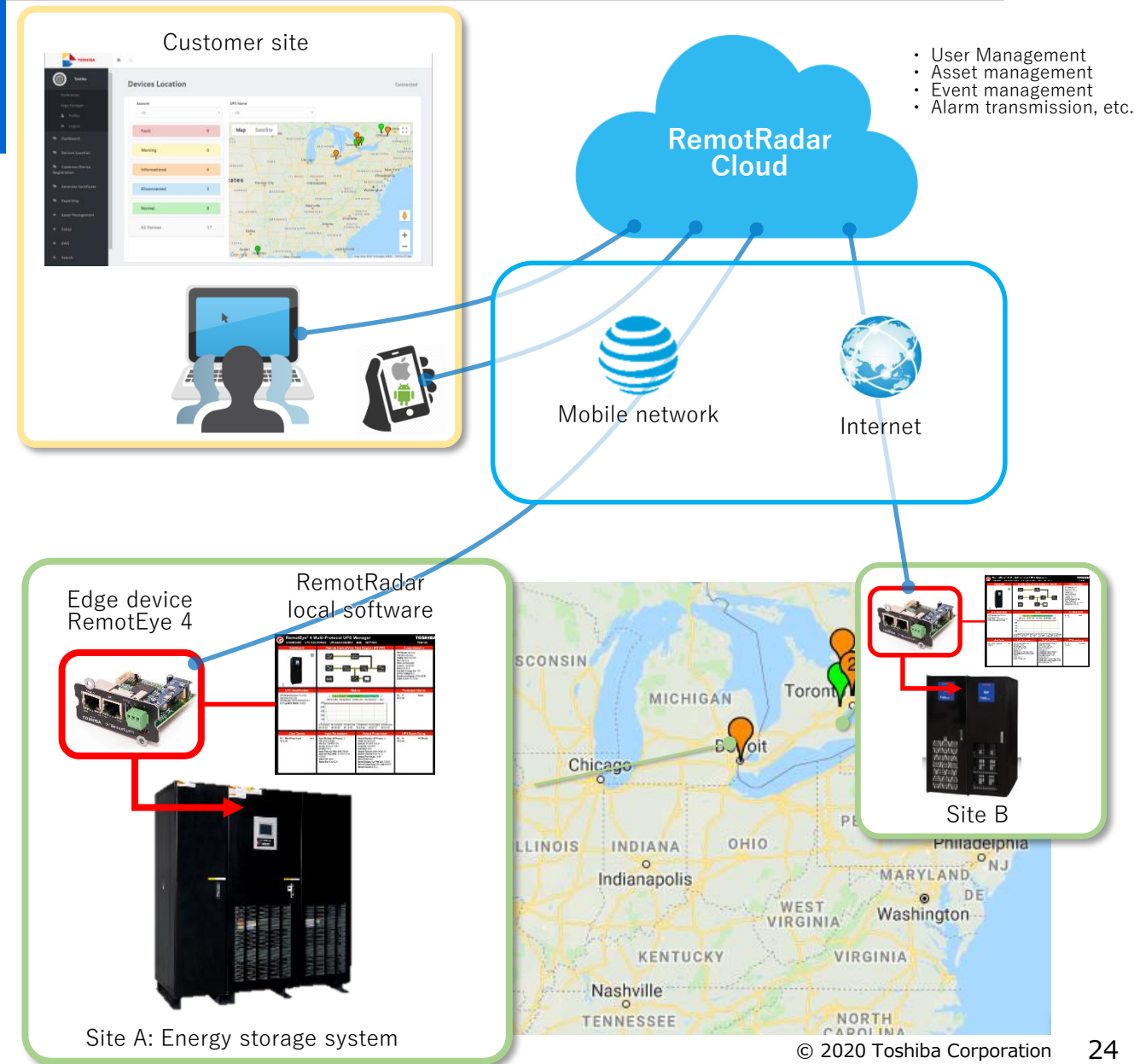
- Realization of a single platform that allows customers to monitor all UPS located in all regions and at all sites, and to receive alarms when UPS status changes to a warning status or malfunction.

### Toshiba Solution: Toshiba Solution

- Toshiba has developed and put into production SaaS (RemotRADAR) that can monitor not only Toshiba UPS but also UPS from other companies.
- The customer is currently monitoring **14 UPS** systems with RemotRADAR.
- In addition, in view of the need for TIRA security certification for RemotRADAR in the North American market, RemotRADAR conforms with the National Institute of Standards and Technology (NIST) security control (SP800).

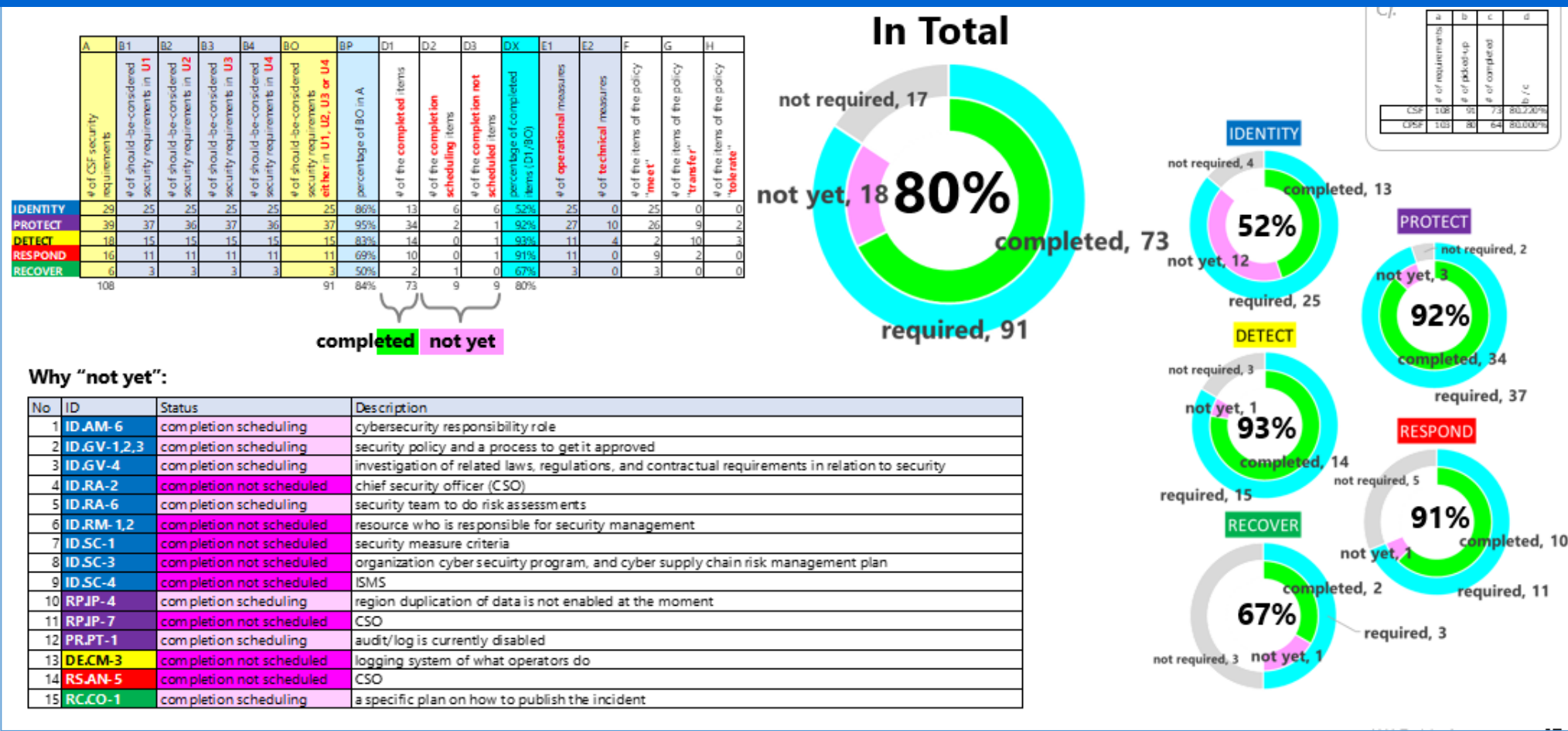
### Effects: Customer Payback

- The low cost of the subscription to the RemotRADAR cloud service, the reduction of UPS system repairs, and lower parts and labor costs, allowed the customer to recover the investment in three years
- By signing a failure prevention contract, customers can extend the life of their UPS system and extend the fixed cost amortization period.
- In the COVID19 environment we realized an unmanned monitoring service.



# RemotRADAR Security Assessment

Security assessment is based on NIST Cyber Security Framework (SP800-53)  
The next challenge is horizontal expansion (service location expansion)  
with the objective of expanding other services in the North American market



## 2. Solutions that Complements People (IoP) / Factory Transformation

### Case study: A semiconductor plant

#### Business challenge: CUSTOMER PROBLEM

- Ensuring stable operation imposed a heavy burden patrolling and inspecting meters at more than 1000 locations throughout the factory.
- Analog meters were checked and managed by people.
- Due to aging of the workforce, there was a shortage of personnel to operate and maintain equipment.

#### Introduction objective and aims: BUSINESS OBJECTIVE

- Monitor the status of aging equipment, labor savings and cost reductions in inspection work, with minimum investment
- Control investment by using robots to patrol and inspect meters, without having to upgrade the meters themselves
- Secure stable operation by monitoring the status of all facilities in real time from the factory equipment monitoring center
- By monitoring trends in measured values, abnormal signs can be detected early, maintenance timing optimized, and equipment utilization rates maximized

#### Toshiba solution: Toshiba Solution

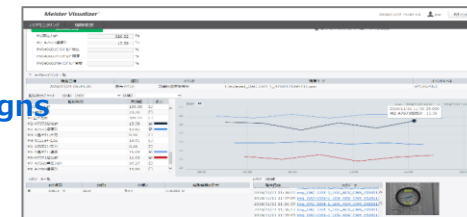
- Toshiba's develop original [analog meter reading technology](#) (combining image recognition + AI + OCR technology, etc.) and applied it at sites in the factory
- Installation on an [automatic guided vehicle \(AGV\)](#) equipped with a PTZ camera achieved unmanned operability and realized Edge AI analysis and processing

#### Effects: Customer Payback

- Achieved patrol inspection labor savings of 75% (an annual labor-saving effect of about 100 million yen (predicted)).
- Covered about 80% of all meters with AGV (problems with steps, obstacles, upper and lower floors, doors, etc.).
- Patrol inspection was implemented using existing AGVs, so almost no new capital investment in equipment was needed.

#### Toshiba Manufacturing IoT *Meister*<sup>TM</sup> series

- Monitor equipment status trend
- Early detection of abnormality signs
- Optimization of maintenance and inspection intervals
- Downtime minimization



Integrated data infrastructure

Numerical data

Imaging data

IoT Gateway

WiFi

Meter reading AI on AGV



(Pressure gauge, thermometer, power meter, etc.)

External machine room

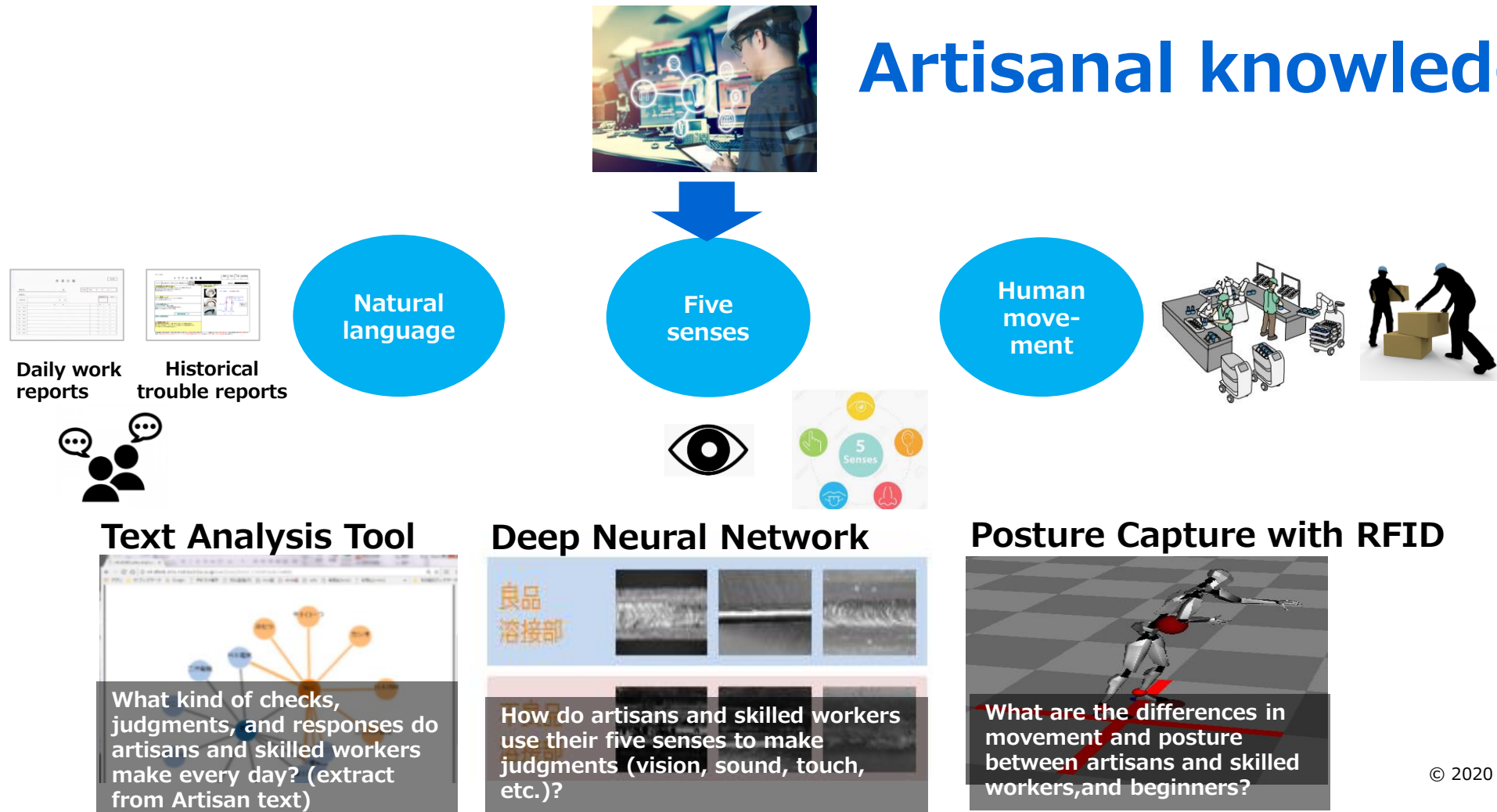
Water recycling chamber

Refrigerator



# IoP (Internet of People)

At manufacturing sites, people demonstrate their various abilities through language, the five senses, artisanal skills, etc.  
The next challenge is to model human abilities and to deliver them as a service (evolution of value-added services)



# 3. VPP Renewable Energy Solutions

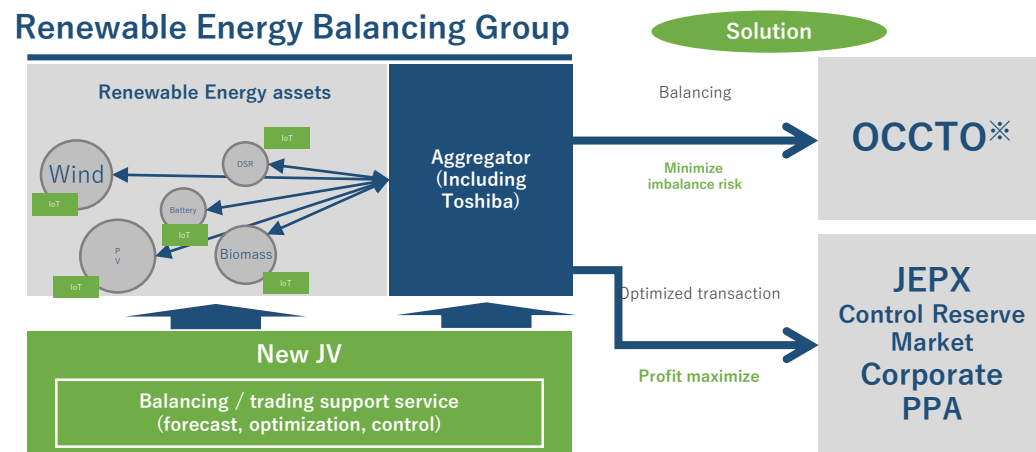
## Case study: Services for a renewable energy company

### Market background

- In Japan, the FIT system\*<sup>1</sup> will be reviewed and transferred to a FIP system\*<sup>2</sup> in April 2022, with the aim of making renewable energy the main power source.
- Renewable energy companies will face two new challenges.
  - ① Market risk under market fluctuations
  - ② Balancing responsibility (obligation to plan values at same-time in the same-amount) ??Output-demand balancing??

### Introduction objective and aims: BUSINESS OBJECTIVE

- Under the FIP system, renewable energy companies submit their power generation plans to OCCTO\*<sup>3</sup>, and penalties are imposed for any discrepancy between the plans and the actual results.
- Support renewable energy companies to maximize their profits by reducing the risk of penalties through accurate power generation forecasting, and optimal market trading.



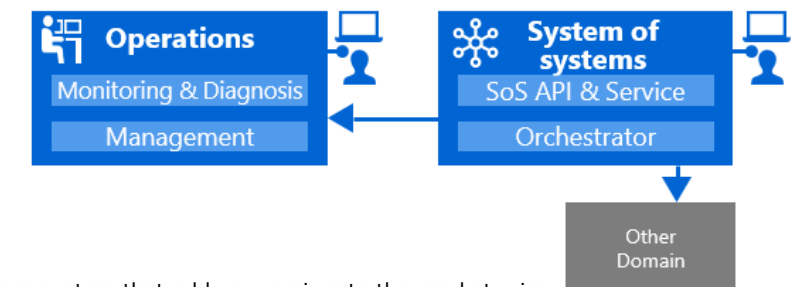
\* Organization for Cross-regional Coordination of Transmission Operators, JAPAN

### Toshiba Solution: Toshiba Solution

- Established a joint venture with Next Kraftwerke, which boasts the largest business scale in the leading European FIP system. (Announced on November 2nd)
- The joint venture will combine Toshiba power system technology with NKW digital operation technology to provide the functions required of renewable energy company businesses with SaaS.
- Providing forecasting and System of Systems functionality
  - ✓ Power generation prediction function (using AI)
  - ✓ Power generation planning function
  - ✓ Market price forecast / transaction support function (trading optimization)
  - ✓ IoT control function for distributed power resources (renewable energy and storage batteries)

### Effects: Customer Payback

- Expect to reduce penalties by applying System of Systems and improve profits by about 10% through optimal trading



\*1 FIT system: Feed-in tariff system

\*2 FIP system: Feed-In-Premium - a purchase system that adds a premium to the market price

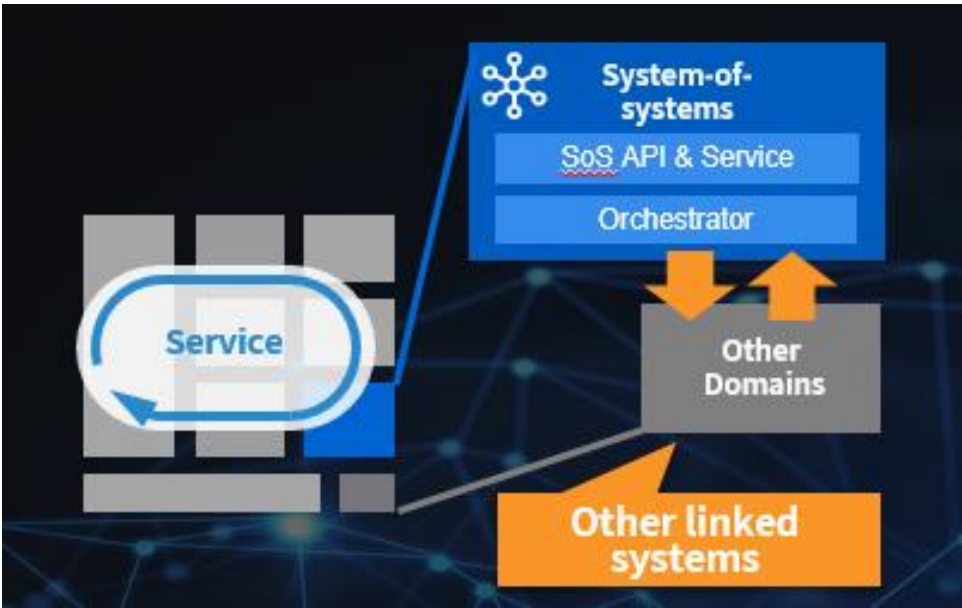
\*3 OCCTO: Organization for Cross-regional Coordination of Transmission Operators, JAPAN  
<https://www.occto.or.jp/en/>

\*4 Renewable energy balancing group: A group that manages a portfolio of multiple power plants in order to achieve planned value same-time same-amounts (typically called an "aggregator")

# System of Systems—From Strategy To Practical Application

Following advocacy of the strategic System of Systems in 2018 and realization of international standardization in 2019, in 2020 System of Systems is deployed to create case studies. The next challenge is horizontal deployment.

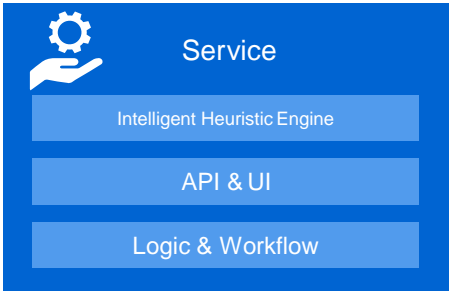
From 2018 Toshiba Technology Strategy Briefing Materials



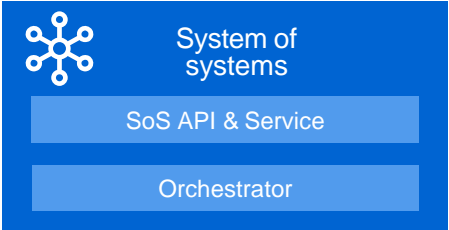
The Japanese government announced Connected Industries in 2017, covering five business domains. All are very closely linked to Toshiba’s business domains. Systems-of-Systems creates value by connecting multiple systems or different businesses. In this area, Toshiba’s long accumulated industry know-how is an important differentiating factor

From 2019 Toshiba Technology Strategy Briefing Materials

By contributing to international standards, establish Toshiba thought leadership (opinion leader) in the market



6.10 THE HUMAN ROLES IN THE CREATION AND OPERATION OF AN IIoT SYSTEM



7.1.4 System of Systems Architecture Pattern

# 4

## **Toshiba as an Influencer**

# Toshiba's Contributions to IIRA 2.0

## Toshiba Contribution Summary: When it comes to SoS, it's TOSHIBA

- **New Sections for IIRA 2.0:**
  - IIRA Stakeholder Definitions
  - **Systems of Systems Conceptual Viewpoint**
  - **System of Systems Implementation Viewpoint**
- **New Architecture Design Patterns:**
  - **Heuristics Computational Intelligence (IoP)**
  - **System of Systems** Horizontal Design Pattern
  - **System of Systems** Vertical Design Pattern
- **New Content and Discussion Material:**
  - Data and Analytics decoupling concept
  - **Virtual Power Plant System of Systems Example**



## INDUSTRIAL INTERNET REFERENCE ARCHITECTURE V 2.0



- Hiroshi Yamamoto, Toshiba
- Daniel Young, Toshiba
- Sam Bhattarai, Toshiba

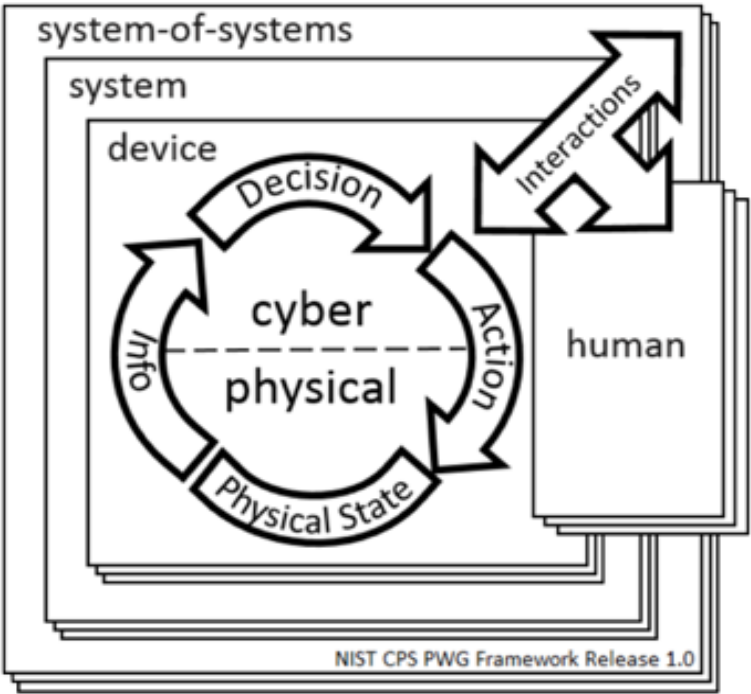
\* Toshiba will be appointed as Co-Chair of the IIC Technology Working Group in 2021



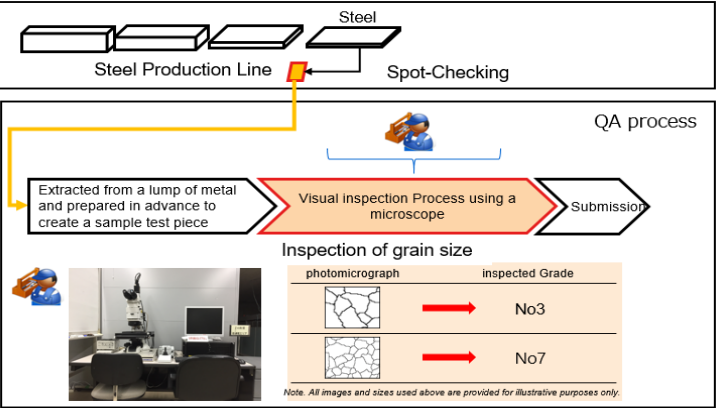
# IoP Heuristic Computation Intelligence (HCI)

Advocating three roles based on actual solutions for people in IIoT systems

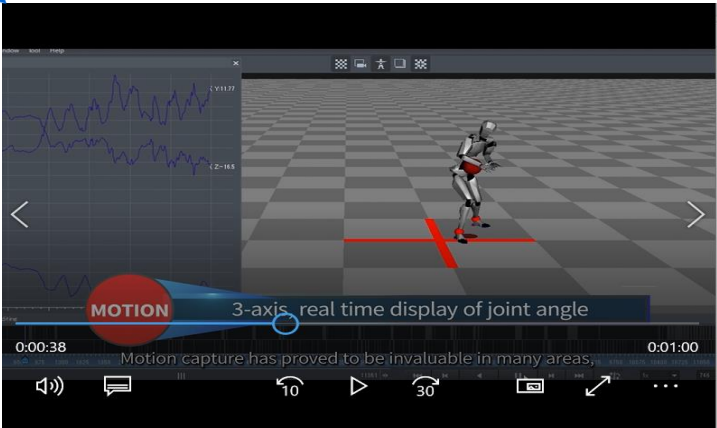
- 1. Person as a system user
- 2. Person as a system function
- 3. Person as monitored by the system



## METALSPECTOR/AI (Toshiba Digital Solutions Corporation)



## Human movement analysis (Toshiba Corporate Manufacturing Engineering Center)





# Closing

- In 2020, Toshiba took off, en route to becoming an infrastructure service company with CPS technology.
- We will develop more than 30 service menus and create more than 30 customer case studies by 2022 (seat belt sign off)
- From 2023, we will become one of the world's leading CPS companies through the four CPS differentiations (level flight)



3000 meters altitude



- 30 service menus
- 30 customer case studies

**Phase 2** 2020~  
Stable Growth as an  
Infrastructure Services Company

10,000 meters cruising altitude



- Clear goals (4 customer challenges)
- Clear methods (19 solutions)
- High employee morale and motivation

**Phase 3** 2023~  
Evolution into a  
CPS technology company

1.8 Trillion yen

M&A  
ファイアンス

ROS 12%  
ROIC 25%

2018, 2019, 2020

2021~2022

2023~2025

The background features a large, solid blue rectangle on the left side. To its right, there are several overlapping geometric shapes: a white triangle pointing right, a red triangle pointing left, and a blue triangle pointing right. These shapes are arranged in a way that creates a sense of depth and movement. The text is positioned on the blue rectangle.

**Committed to People,  
Committed to the Future.**

**TOSHIBA**