SDN Initiatives

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NEC Corporation

Contents

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1. Introduction

NEC Business Domains towards the Realization of the Group Vision

Realization of an affluent and equitable society which makes efficient use of resources and whose members are safe and personally secure

Solutions for society

- Supporting the advancement of social infrastructure and systems throughout the world via ICT
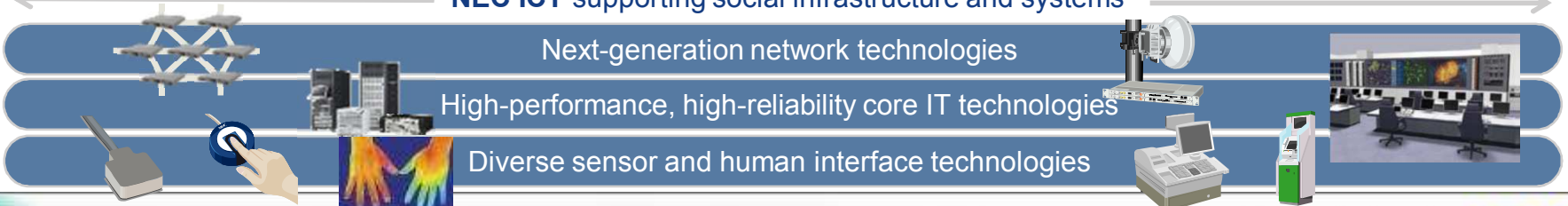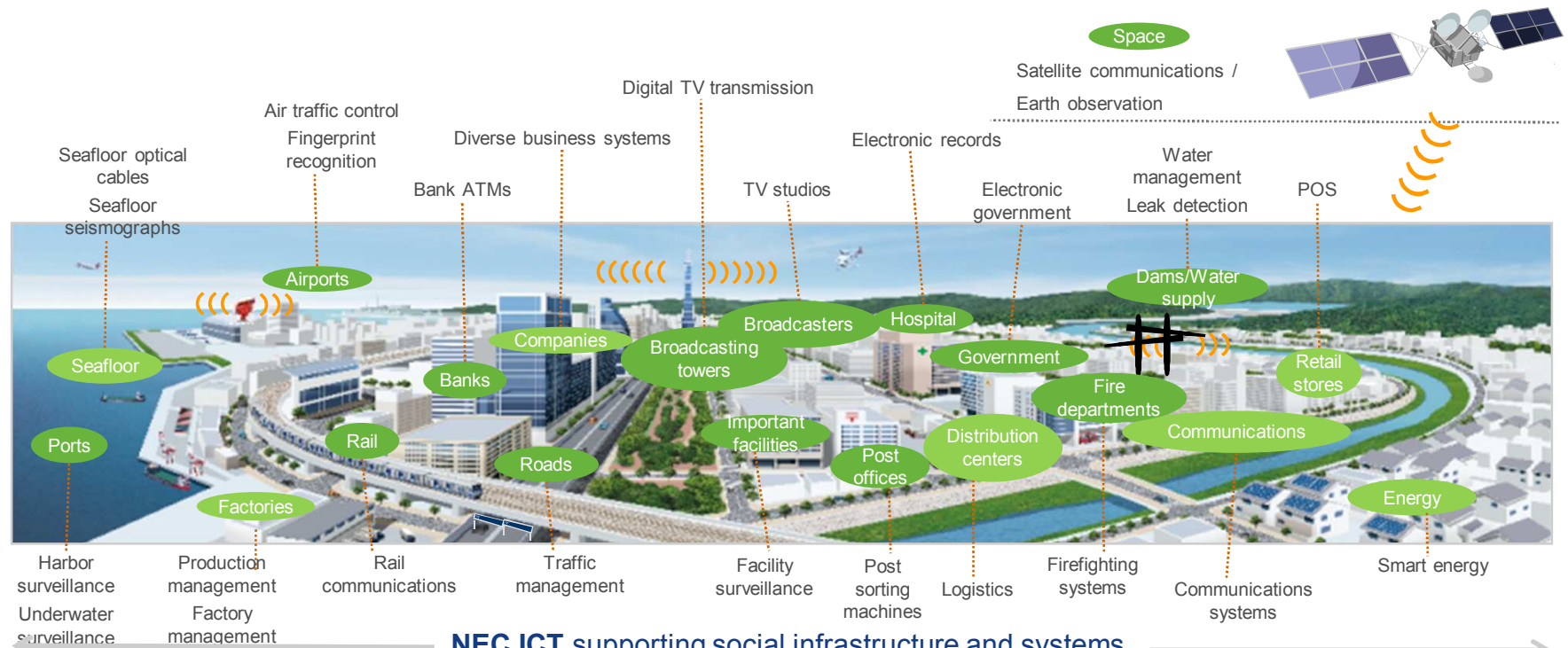- Create new business models with the understanding that social problems provide an opportunity for growth

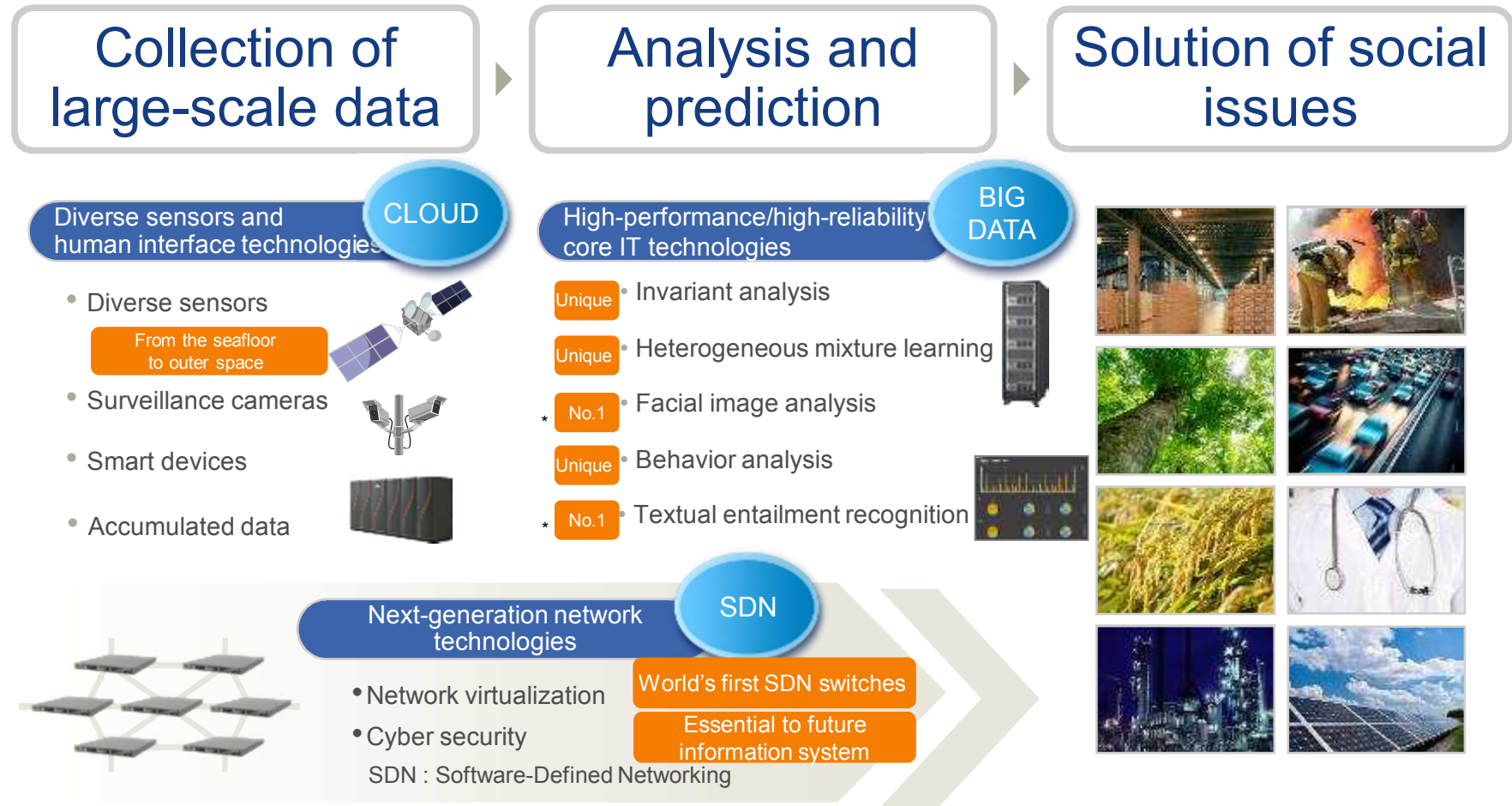# Transformation into Social Value Innovator

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(1) Innovation of Social Infrastructure via ICT(1)

Leveraging our proven results and strong position for global expansion

- From the seafloor to outer space, concentrating management resources in areas in which social infrastructure will be innovated by ICT

Space
Satellite communications / Earth observation

Digital TV transmission

Air traffic control
Fingerprint recognition

Diverse business systems

Electronic records

Water management
Leak detection

Seafloor optical cables
Seafloor seismographs

Bank ATMs

TV studios

Electronic government

POS

Airports

Dams/Water supply

Seafloor

Companies

Broadcasters

Hospital

Broadcasting towers

Government

Banks

Fire departments

Retail stores

Rail

Important facilities

Distribution centers

Communications

Ports

Roads

Post offices

Factories

Energy

Harbor surveillance
Underwater surveillance

Production management
Factory management

Rail communications

Traffic management

Facility surveillance

Post sorting machines

Logistics

Firefighting systems

Communications systems

Smart energy

NEC ICT supporting social infrastructure and systems

Next-generation network technologies

High-performance, high-reliability core IT technologies

Diverse sensor and human interface technologies

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(1) Innovation of Social Infrastructure via ICT(2)

Collection of large-scale data

→

Analysis and prediction

→

Solution of social issues

Diverse sensors and human interface technologies

CLOUD

- Diverse sensors
  - From the seafloor to outer space
- Surveillance cameras
- Smart devices
- Accumulated data

High-performance/high-reliability core IT technologies

BIG DATA

- Unique • Invariant analysis
- Unique • Heterogeneous mixture learning
- * No.1 • Facial image analysis
- Unique • Behavior analysis
- * No.1 • Textual entailment recognition

Next-generation network technologies

SDN

- Network virtualization
- Cyber security

World's first SDN switches

Essential to future information system

SDN : Software-Defined Networking

Leveraging information captured by our unique and highly competitive ICT assets to become a social value innovator

* Rated as No. 1 among organizations participating in an evaluation task organized by the U.S. National Institute of Standards and Technology (NIST)

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SDN Business Promotion Organization(As of April 2013)

▍ **"SDN Strategy" was established in the Business Innovation Unit, a BU organization for NEC's areas of focus**

Corporate Sales and Sales Operations Unit

Sales (Affiliate/Branch)

Partner Business

Sales — **Public** Business Unit

Sales — **Enterprise** Business Unit

Sales — **Telecom Carrier** Business Unit

Sales — **Smart Energy** Business Unit

RHQ (Regional Headquarters) — **Global** Business Unit

SI/Service Operations Unit

SI/Service Business Promotion

Supply Chain Management Unit

SCM/Quality/Procurement

System Platform Business Unit

Business Innovation Unit — **SDN Strategy**

Central Research Laboratories

(As of April 1, 2013)

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2.What is SDN?

* SDN: Software-Defined Networking

Issues with Conventional ICT systems

Current ICT systems enable easy, flexible communications anywhere and low-cost services are available

Meanwhile, it has become more difficult to quickly and easily implement and change advanced social systems and complex ICT systems in some cases

Can ICT systems provide convenience in the same way as car navigation systems?
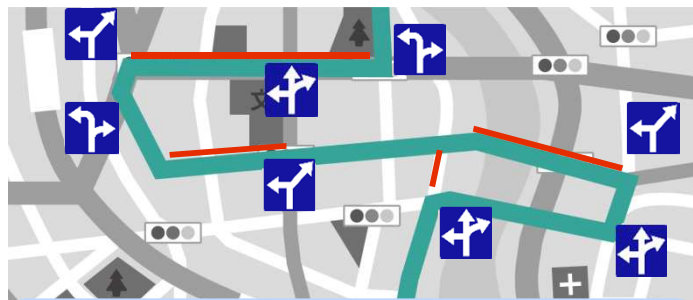
Driving while following the destination display

- Entire route to the destination is not shown
- Traffic jams cannot be predicted
- The route cannot be changed flexibly
- Arrival time is unknown
- Whether or not the road has a high incidence of accidents is not shown

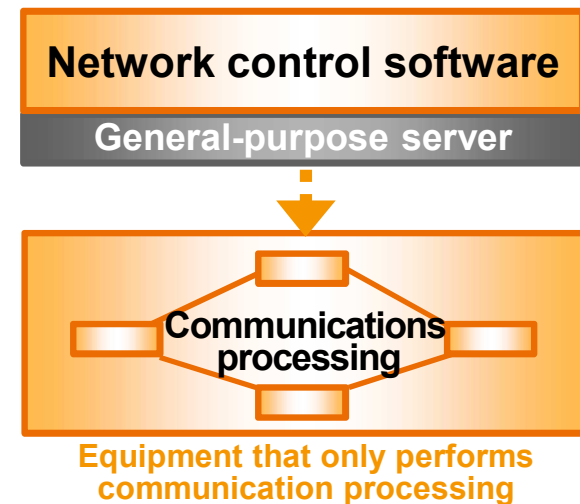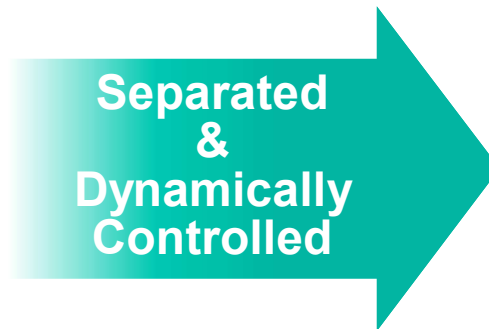**Driving while following car navigation system instructions**

- A route that avoids traffic jams or construction sites is selected in advance. The route can be changed flexibly according to the situation just by inputting the destination

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What is SDN (Software-Defined Networking)?

SDN refers to dynamically controlling networks using software and its architecture

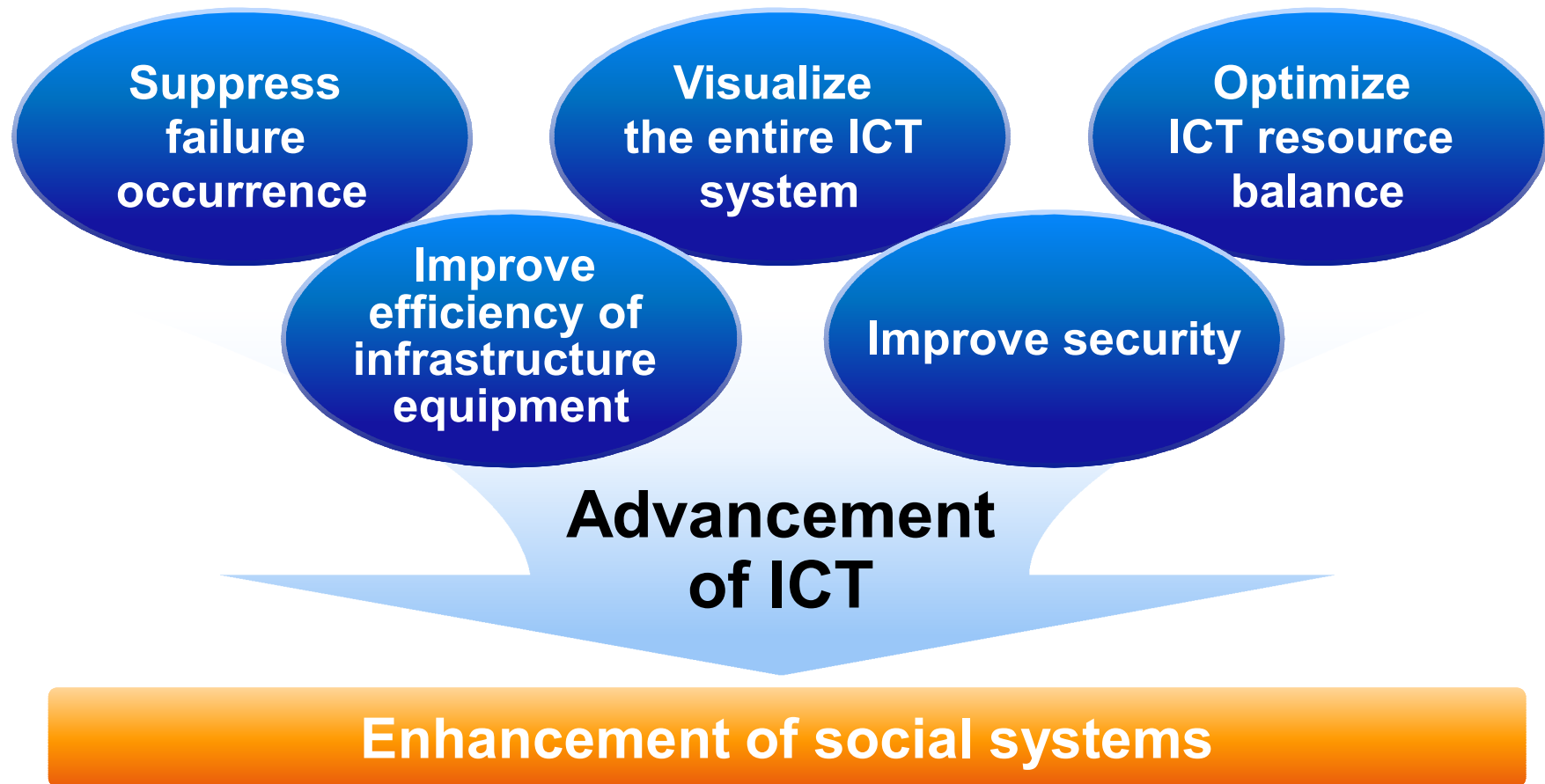| Past/Present	Future
Static network where network control by dedicated network equipment and data transfer processing were performed together	**Network control and communications processing are separated**
	Equipment that only performs communications processing is dynamically controlled by using software on a general-purpose server
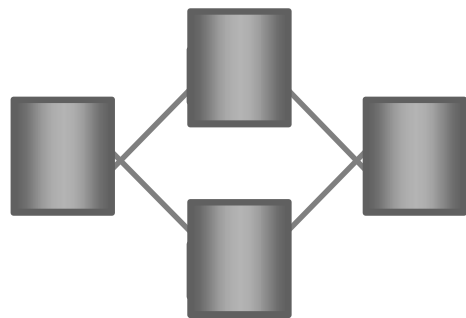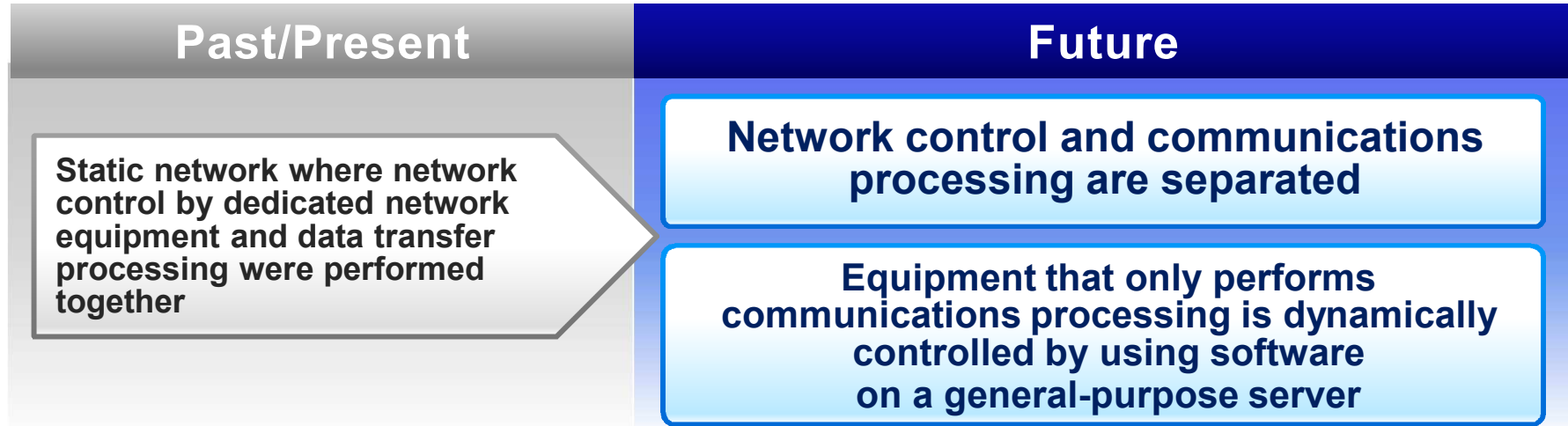
Dedicated equipment with network control function

Separated & Dynamically Controlled

Network control software

General-purpose server

Communications processing

Equipment that only performs communication processing
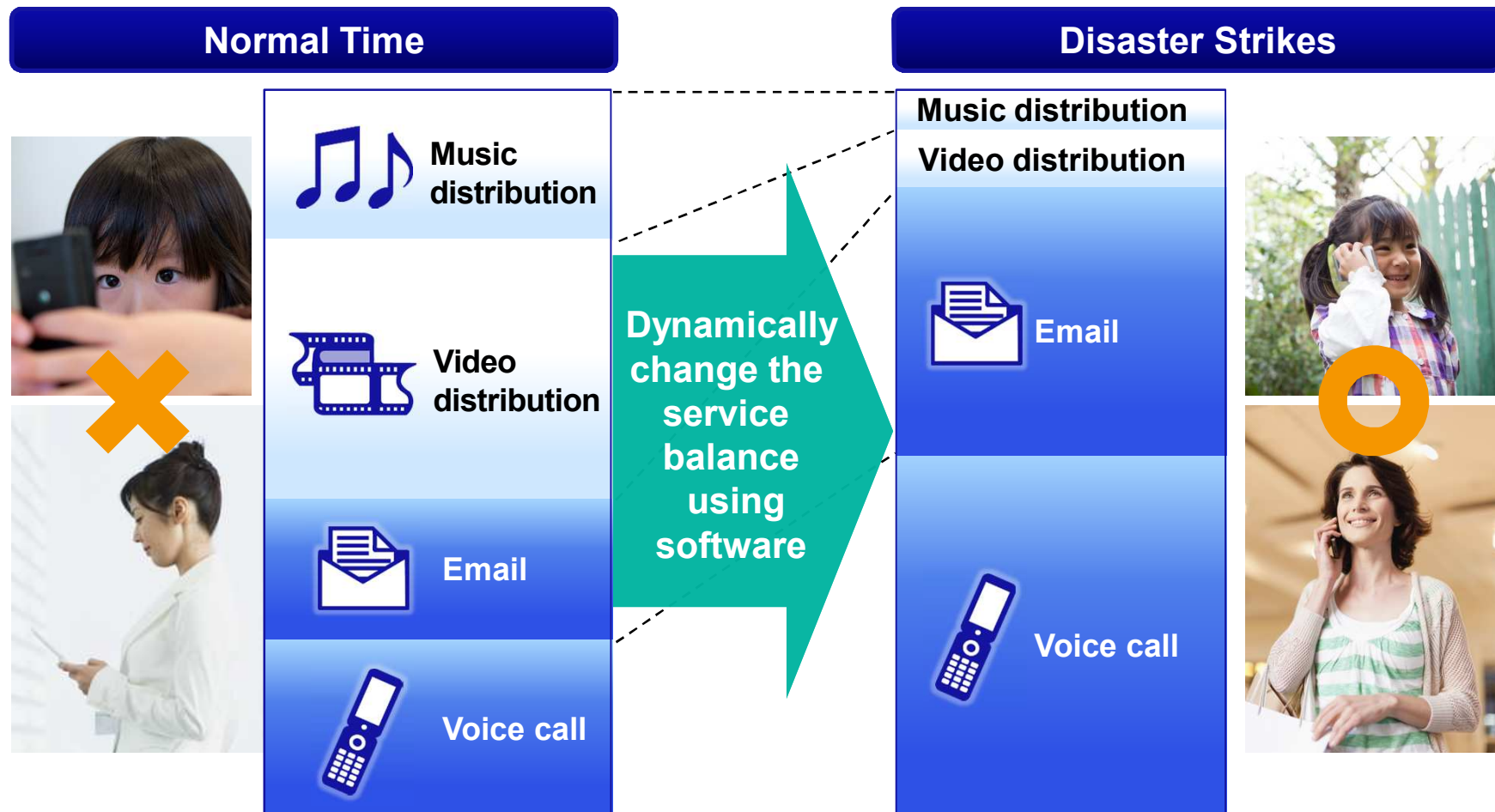
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SDN to Contribute to Enhancement of Social Infrastructure

Advance ICT systems using SDN that controls networks with software dynamically

Suppress failure occurrence

Visualize the entire ICT system

Optimize ICT resource balance

Improve efficiency of infrastructure equipment

Improve security

Advancement of ICT

Enhancement of social systems

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SDN Application Example (1): Realizing social infrastructure capable of handling emergency situations

In the event of disaster, prioritize email messages and voice calls by dynamically changing the ICT service balance when many people make calls and send email messages to confirm safety

Normal Time

Music distribution

Video distribution

Email

Voice call

Dynamically change the service balance using software

Disaster Strikes

Music distribution

Video distribution

Email

Voice call

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SDN Application Example (2): Realizing easy-to-use social infrastructure

Enable smooth utilization even when network access spikes at an online shop clearance sale or campaign by controlling networks optimally.
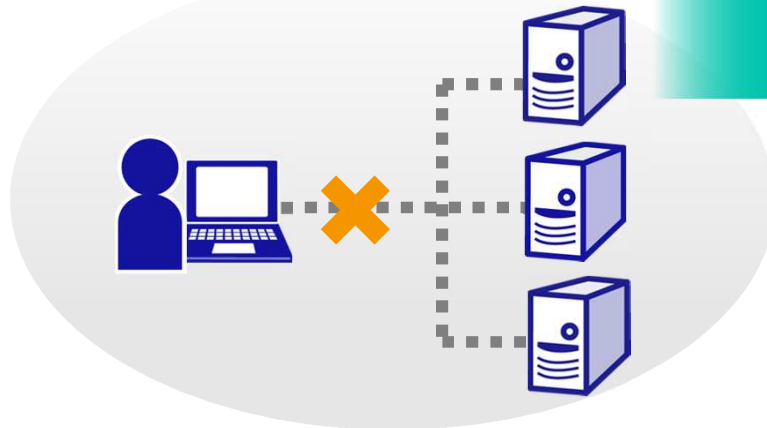
Present
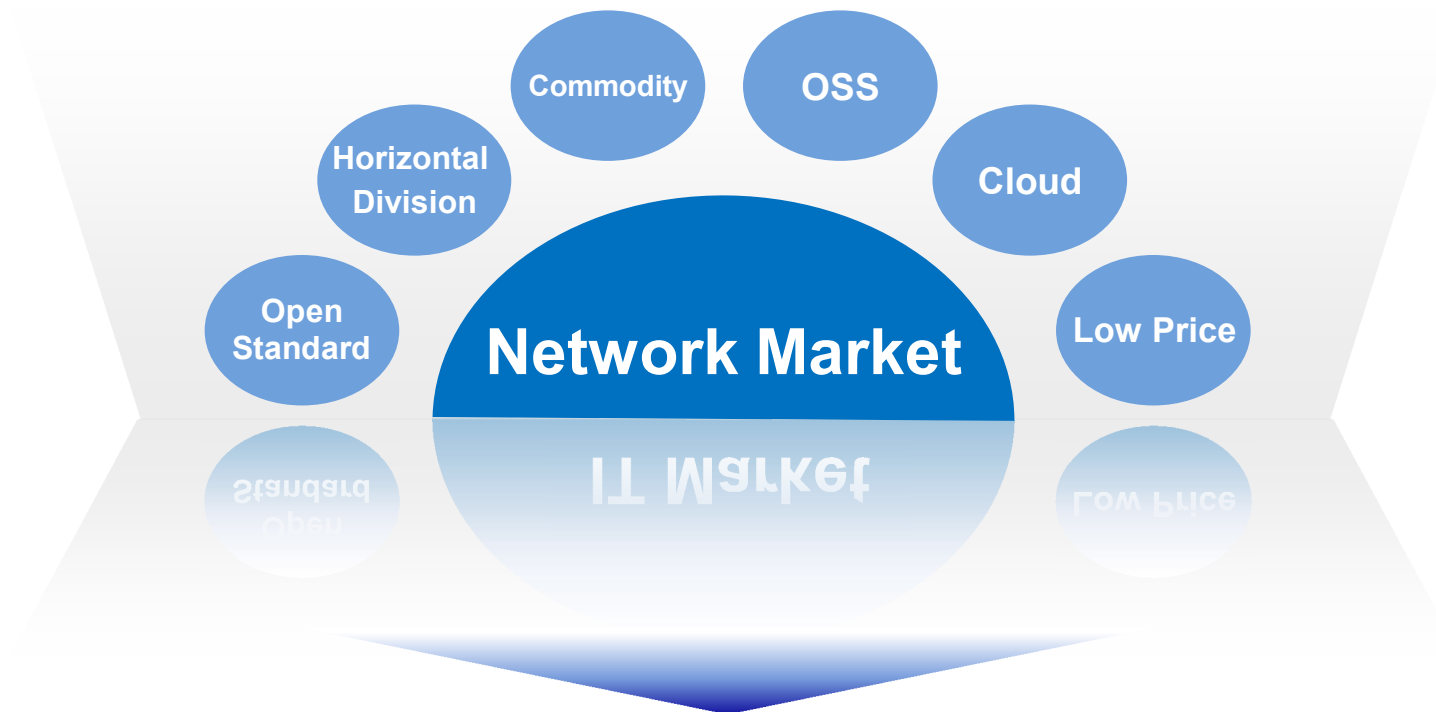
Oh, no! Cannot access! The sale is almost over!

Using SDN

I got it!

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Emergence of an IT/Network Fusion Market via SDN

- **Changes occurred in the IT market are also spreading in the network market rapidly**
- **A new market where IT and networks are merged emerged**
- **Moving to a value creation competition with new solutions**

To a new value creation in the IT/network fusion market

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Potential of SDN Market

Worldwide SDN market scale is expected to grow to 4.7 trillion yen by 2017

unit：trillion yen

CY2012	CY2013	CY2014	CY2015	CY2016	CY2017
0.10	0.13	0.5	1.3	2.2	4.7
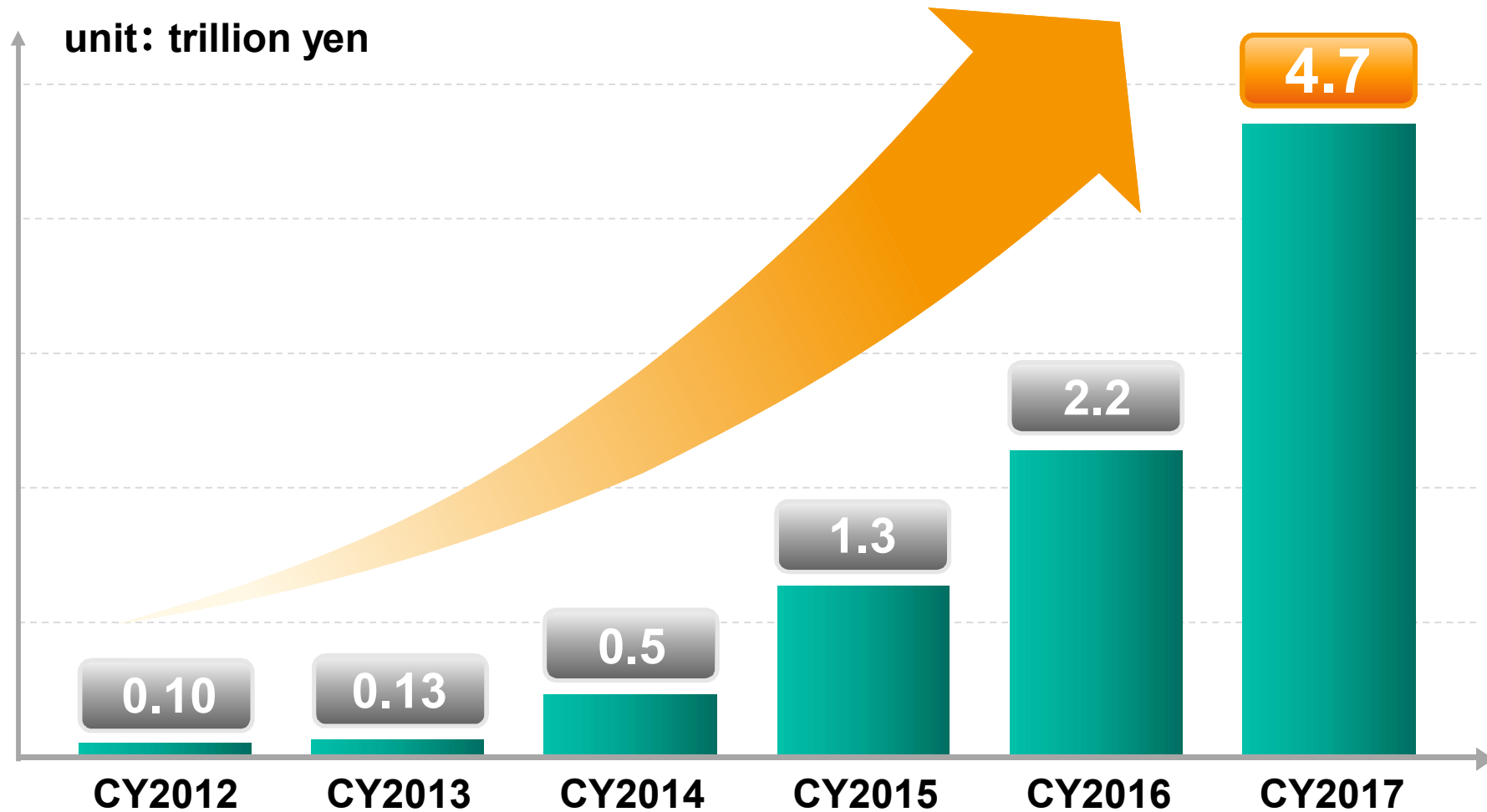
*Calculated by NEC based on various market surveys

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3. NEC's Initiatives for SDN (Past)

NEC's Past Initiatives

NEC leads the research and development of SDN architecture and OpenFlow[*1] protocol

Participated in the Clean Slate Program of Stanford University from the beginning. Also, proactively participates in various standardization organizations and communities such as ONF, contributing to SDN promotion

2008	2009	2010	2011	2012	2013

OpenFlow R&D — ★**World's first OpenFlow products**

OpenFlow Switch Consortium

Open Networking Foundation — ONF OPEN NETWORKING FOUNDATION

Participated in "Clean Slate Program" of Stanford University

Formulated and standardized OpenFlow specifications

SDN R&D

Open Networking Research Center — ONRC

OSS activities for SDN software — **Open Daylight** — OPEN DAYLIGHT

SDN standardization activities by telecom carriers — **NFV ISG** — ETSI

Application development project for SDN — **US Ignite** [*2] — usignite

*1 OpenFlow: Standard of network control protocol *2 National high-speed broadband network project of US federal government

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Reference: Trends in SDN Standardization and NEC's Activities

Proactively conduct activities at major SDN-related organizations

*NEC activities as of July 10, 2013

Organization Name	Establishment/Objective	NEC Activities
Open Networking Foundation (ONF)	• Established by Deutsche Telekom, Facebook, Google, Microsoft, Verizon and Yahoo in March, 2011. 93 companies participate. (As of May, 2013) • Formulates OpenFlow standard specifications	• Participates from the establishment of the former OpenFlow Switch Consortium • Vice chair of the architecture and configuration workgroups
Network Functions Virtualization (NFV)	• Established by world's top 13 telecom carriers as a subordinate organization of ETSI (European Telecommunications Standards Institute). (October 2012) • Promotes the realization of functions, equivalent to the functions realized by expensive network equipment, using general-purpose servers	• NEC participates from the establishment • Vice chair of the reliability workgroup, editor of the management workgroup
OpenDaylight Project	• SDN open source project established by 18 major network-related vendors (April, 2013) • Participating companies donate their own SDN-related codes to the project, promoting SDN framework implementation	• Provides Virtual Tenant Networking (VTN) models and applications enabling users to create/control multi-tenant virtual networks
Open Networking Research Center (ONRC)	• Established by Stanford University, UC Berkeley, and others (April, 2012) • Leads SDN research and development, and develops software to realize SDN	• Participates from the establishment of ONRC • Develops OpenFlow product technologies through joint research

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NEC's Leading SDN Products

Use SDN technologies and successful experience in the enterprise/data center market. Provide SDN products to realize simple operations

Integrated operation management software

WebSAM

- Long-term experience in the enterprise/DC market
- Commitment to "Simple Operation"
- Cloud platform where know-how and expertise accumulated through cloud operations are implemented

IT

Cloud network platform "UNIVERGE PF Series"

UNIVERGE

- Commercial experience in Japan and overseas
- Realize an open cooperation with partners
- World's first OpenFlow products

Network

Announced on May 29, 2013
The first to realize OpenFlow-based SDN on a commercial cloud platform
- Automated operations -

WebSAM vDC Automation
×
UNIVERGE PF6800

Announced on June 10, 2013
Products compatible with the latest OpenFlow 1.3 Specifications released

UNIVERGE PF Series

٭ **Best of Show Award People's Choice Category (Product Category)**

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Case Study (1): Kanazawa University Hospital

▊ **Improves the hospital network management efficiency to support 24/7 medical services**

▊ **Integrates department LANs with different policies and reduces installation costs**

▊ **Provides stable networks and reduces time and costs for the operation management and configuration modifications**

Conventional Network

Core software

Servers

Electronic records

Anesthesia dept.

Radiology dept.

SDN Network

Electronic records (Patient info)

High resolution image transfer

Office work LAN

Network appliance pool

Firewall

Network pool

Server pool

Electronic records

Anesthesia dept.

Radiology dept.

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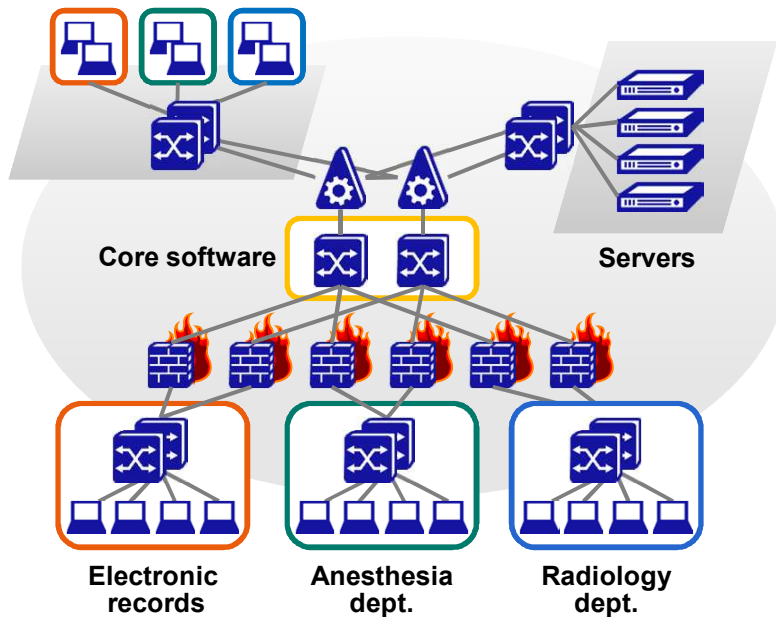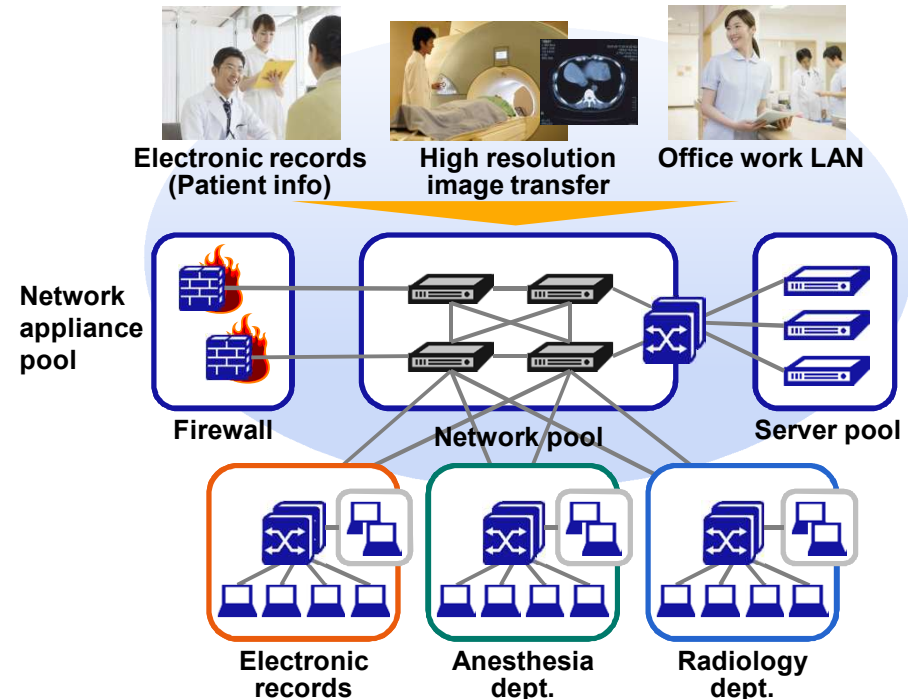
Case Study (2): NEC Software Factory

▌**Implements virtual networks using OpenFlow technologies. Deploys software development environments to multiple data centers.**

- Realizes BCP (Business Continuity Plan) by disaster recovery functions
- Developers can work without knowing the connection destination and load concentration because the loads are distributed to multiple sites

▌**Provides customers with stable software services through the continuous usage of software development environment**

Developers

Data Center A

Virtual network

Data Center B

Virtual network

Virtual network Load distribution /Automated switching

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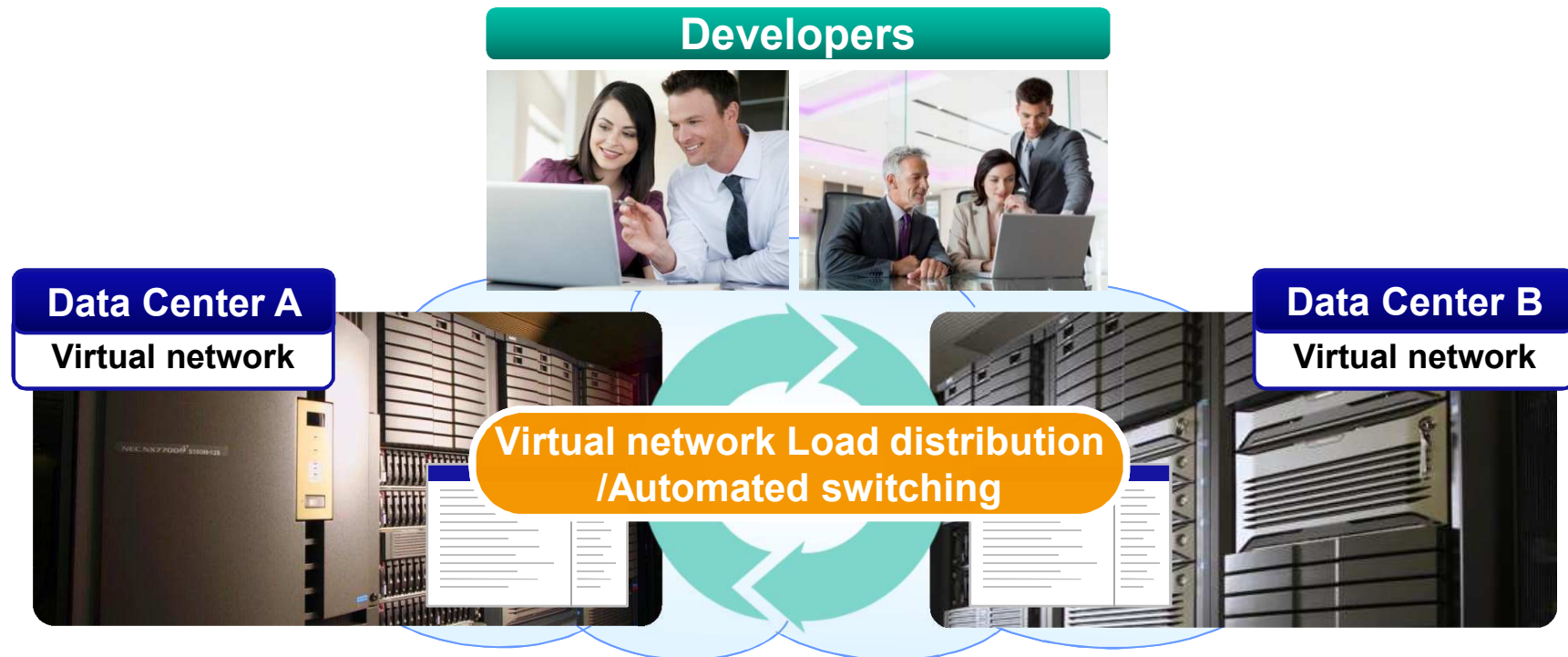
Case Study (3): NEC BIGLOBE Data Center

Proprietary developed cloud controller controls virtual servers and virtual networks collectively

Planning Requirement definitions → Infrastructure design
(Server/network design)
5 days

Server implementation

Network implementation

Connection

Operation

2 weeks ⇒ Shorten to approx. 10 min

Speed

Flexibility

Network services

Firewall
Router
Load balancer

IP address types

Global IP address
Private IF address
Owner specific IP address

Manage personal information securely using cloud services

Connection between cloud services and platform systems

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Past Case Studies/Demonstration Examples

▎**Employment and demonstration at companies/organizations are accelerated globally**

Overseas		
• Stanford University	• GenesisHosting (Chicago)	• Tervela (New York)
• Selerity Corp (New Jersey)	• Telefónica (Spain)	• Portugal Telecom (Portugal)

Japan		
• NTT Communications (Biz Hosting)	• Nippon Express	• Kanazawa University Hospital
• Ministries and agencies	• Universities	• R&D
• Manufacturing companies	• Electronic manufacturers	• System integrators
• Trading companies	• Logistics companies	• Broadcasting stations

Operating as active operation systems at various companies

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4. NEC SDN Solutions
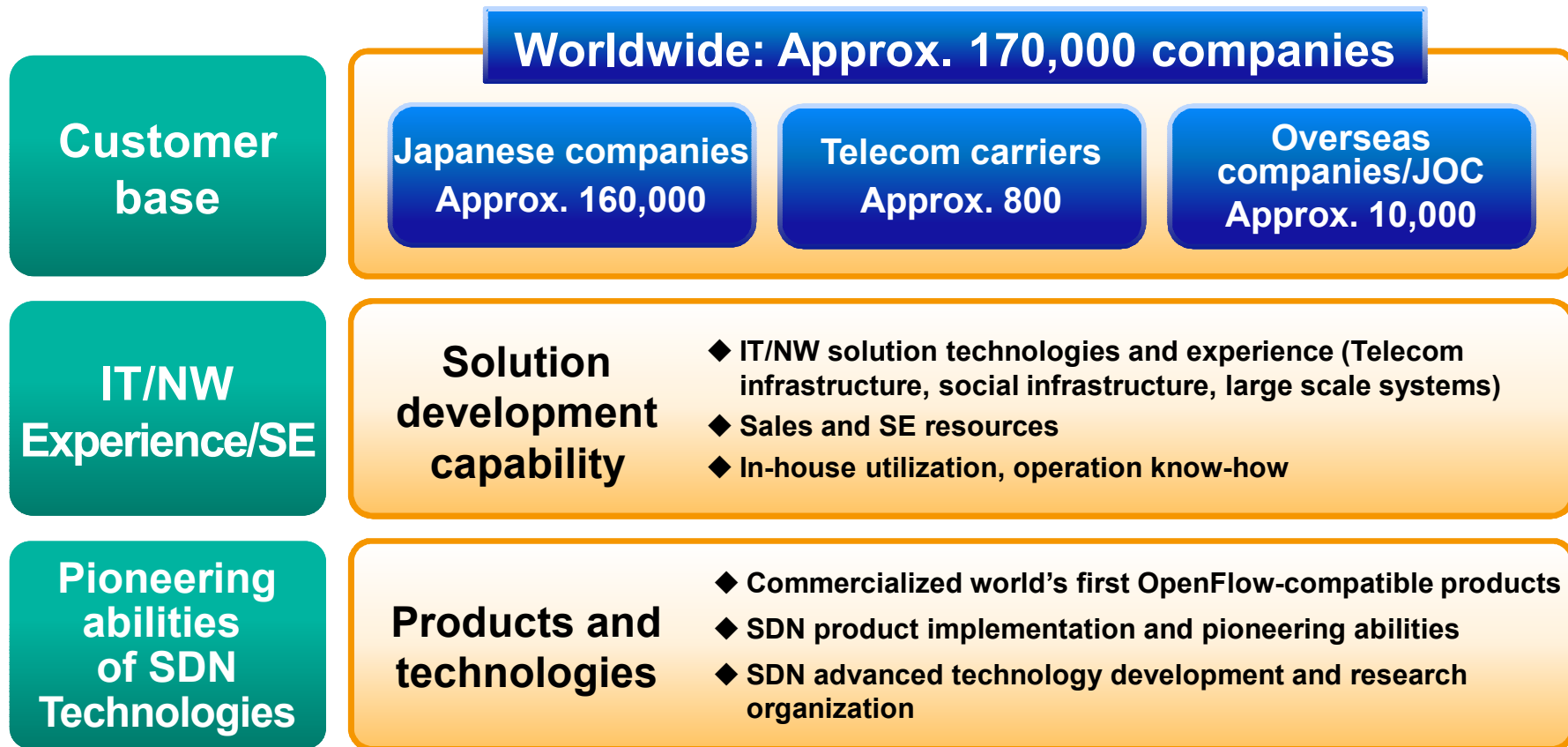
Expanding SDN Business at NEC

Past/Present

Deploy business focusing on technologies and products mainly for data centers

Future

- **Leading to solution business based on product business experience**
- **Expanding the applicable market from data centers to enterprise/telecom carriers**

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NEC's SDN Business Strength

In addition to the technologies and head-start experience of SDN, we deploy SDN solutions underpinned by NEC's customer base, successful experience in IT, networking systems and SE resources

Customer base

Worldwide: Approx. 170,000 companies

Japanese companies Approx. 160,000	Telecom carriers Approx. 800	Overseas companies/JOC Approx. 10,000

IT/NW Experience/SE

Solution development capability

- ◆ IT/NW solution technologies and experience (Telecom infrastructure, social infrastructure, large scale systems)
- ◆ Sales and SE resources
- ◆ In-house utilization, operation know-how

Pioneering abilities of SDN Technologies

Products and technologies

- ◆ Commercialized world's first OpenFlow-compatible products
- ◆ SDN product implementation and pioneering abilities
- ◆ SDN advanced technology development and research organization

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NEC SDN Solutions: Lineup

NEC launches SDN Solutions in October 2013 *1

Market	Category	Solution	Products
NEC Enterprise SDN Solutions	**Network Optimization**	•WAN Connection Optimization for Offices and Data Centers •Office LAN Optimization	**Products**
	Security	•Access Authentication	**WebSAM** WebSAM vDC Automation
	Mobile	–	
NEC Data Center SDN Solutions	**Operation and Management**	•IaaS Operation Automation Solution	**UNIVERGE** UNIVERGE PF Series
	Consolidation	•Data Center Network Integration Solution	
NEC Telecom Carrier SDN Solutions	**Network Management**	•Integrated Operations Management	**Technology**
	Network Infrastructure	•Network Virtualization •Transport	**ProgrammableFlow**

*1：Availability varies by region

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Reference: Situation at NEC and Other Companies' Efforts (Source: NEC)
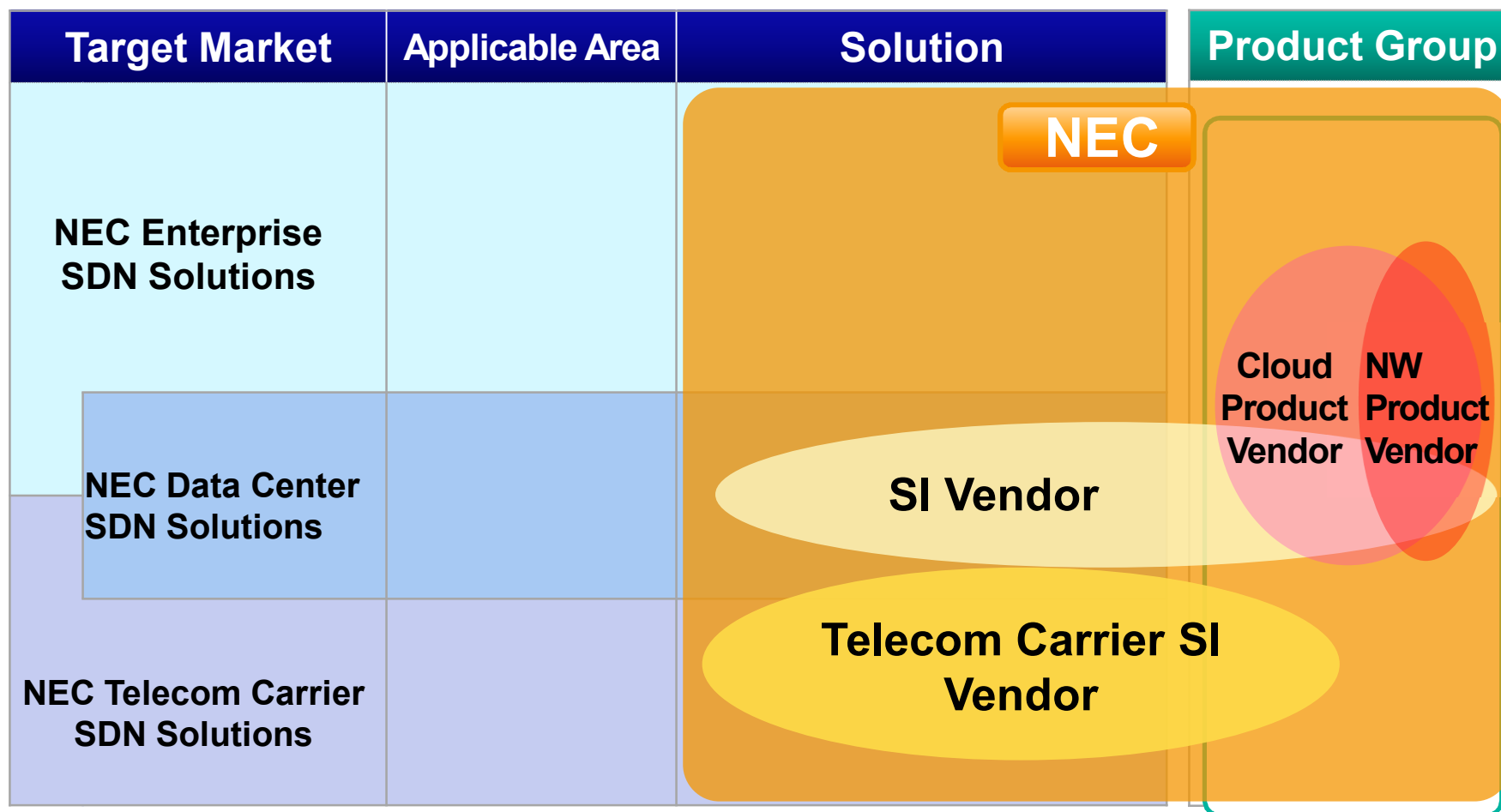
Target Market	Applicable Area	Solution	Product Group
NEC Enterprise SDN Solutions		**NEC**	
NEC Data Center SDN Solutions		SI Vendor	Cloud Product Vendor — NW Product Vendor
NEC Telecom Carrier SDN Solutions		Telecom Carrier SI Vendor	

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WAN Connection Optimization for Offices and Data Centers solution

▌ **Improve business efficiency and speed up new business responses by visualizing and dynamically controlling enterprise networks**

▌ **Improve the usage efficiency of communications lines/devices and reduce ICT investment and operation management costs**

A solution to optimize the usage efficiency and routes of communication lines based on the communications line performance, which connects sites and a data center/between data centers, the communications status monitored information, and the usage time slot management functions, etc.

Data center

Mobile

Logistics site

Headquarters office

Branch

Production site

Route/bandwidth control

Visualization

Flexible changes

Automated operations

Usability improvement

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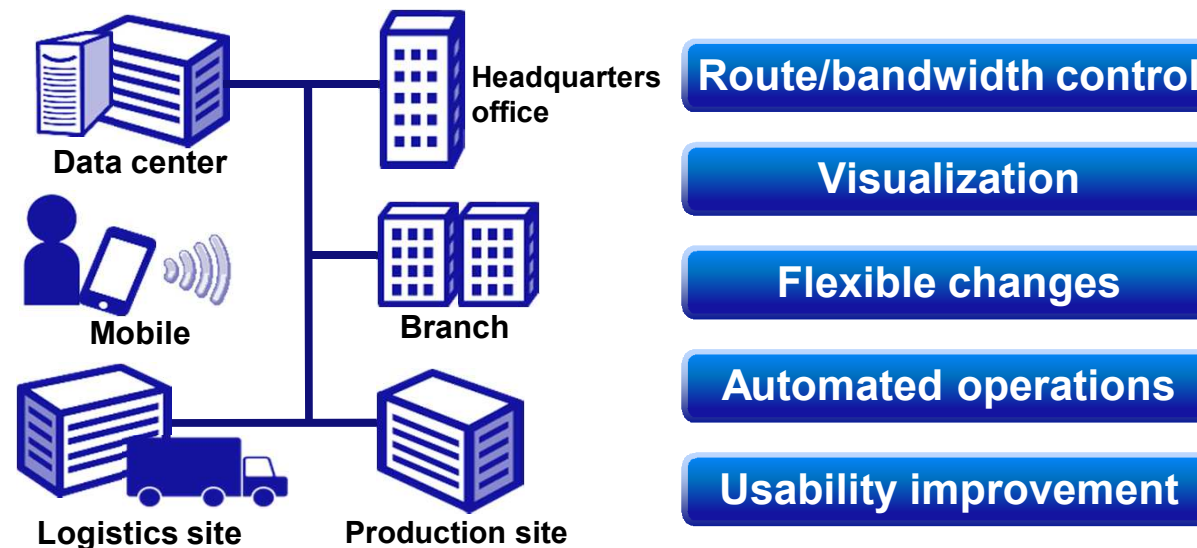
Access authentication solution

Improve business efficiency for information system users and administrators, and realize flexible and prompt responses to the ever-changing business environment while securing information safety and security

● **Solution: "Access authentication"**

The use of centralized authentication information authenticates each user or each terminal and implements virtual networks separated for each group (department/project). Automates rule settings and modifications for appropriate access control

Device

Access control for each device, BYOD foothold

Headquarters/Project

Access control for each project is possible as well as for each department.

Site

Osaka   Tokyo

Normal access even from a different location

Always appropriate access control

Access authentication by linking with human resource information

Business servers

Device server

Department server

Project server

Access range is automatically configured

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Enhancement Policy for SDN Solution Business for Enterprises/Data Centers

Established a new dedicated SDN division fostering and enhancing engineers with IT and networking integrated skills, and developing advanced solutions through conversations, proposals and installations for customers in various industries and businesses

Leading SDN products/
Installation/demonstration
case studies

IT network
System development
Human resources/
know-how

SDN advanced
technologies/research

Respond to IT/network fusion areas
Foster and enhance engineers

Dedicated SDN division for enterprise and data centers

Develop solutions based on ICT

Customers
(Japan/worldwide)

Leading cases

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Values Provided by SDN Solutions for Telecom Carriers

SDN implements flexible networks, realizes simple operations, and provides value-added networks.

Infrastructure	Management & Orchestration	Services
Efficient resource utilization	**Automated settings**	**Prompt service provision**
• Efficient resource utilization through virtualization • Network with high programmability, scalability and reliability • CAPEX reduction	• Automated setting • Central control and management • OPEX reduction	• Service promptness • Easy service deployment • New revenue

Simple & Flexible

Fusion of IT technologies and network technologies

Mission critical computing technologies	High-reliability network technologies	Virtualization technologies

*:CAPEX:Capital Expenditure /投資コスト、OPEX：Operating Expense/運用費用

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NEC Telecom Carrier SDN Solutions

Responds to network needs of telecom carriers and focuses on three solutions

Integrated Operation/ Management Solutions	SDN Service Controller	OSS/BSS	TMS

Automate SDN integrated operations/management. Realize control optimization

Orchestration management

Transport Network

Transport Solutions

Provide efficient network resource utilization by controlling with software

NFV（vEPC, etc）

Network Virtualization Solutions

Implement network functions on servers
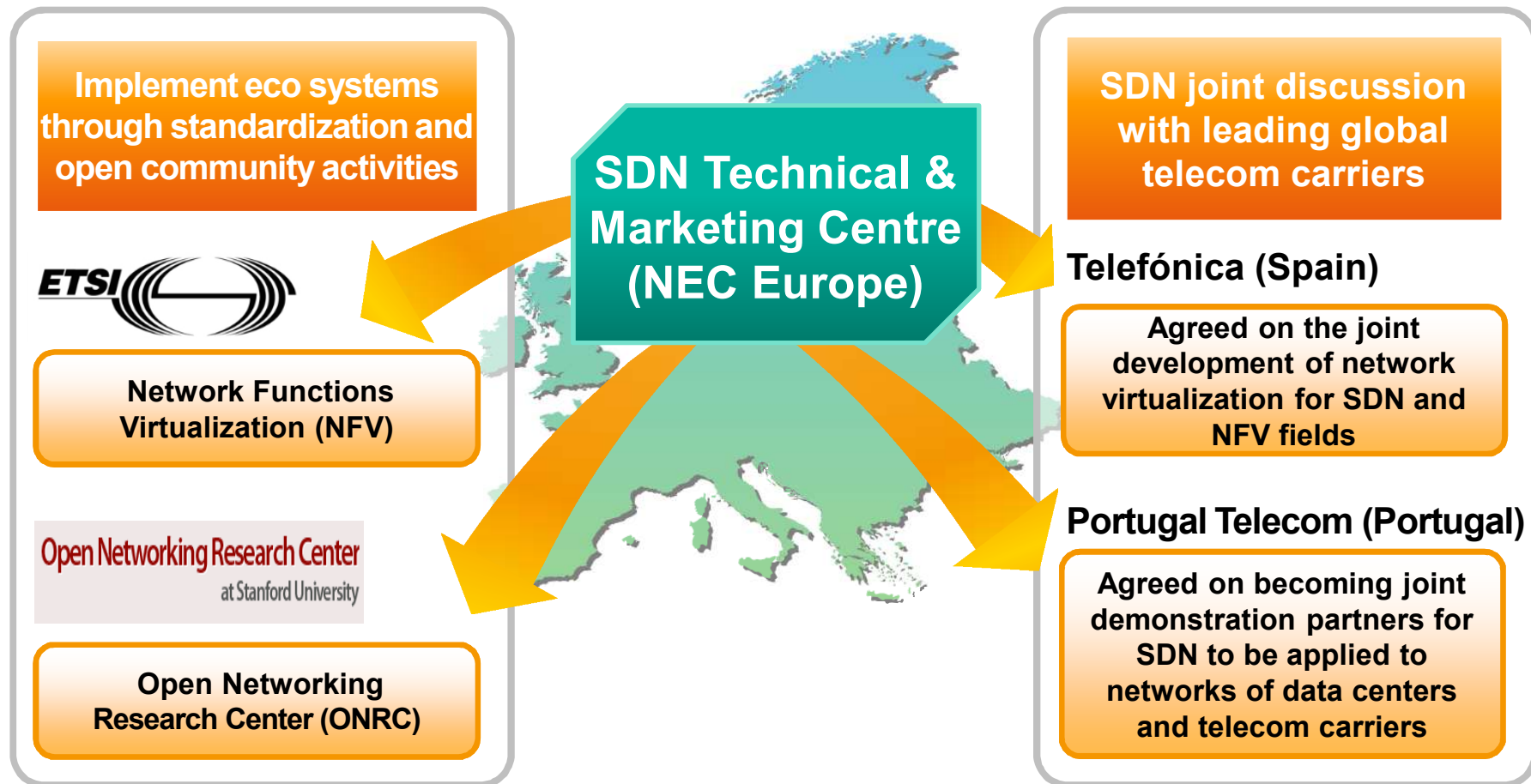
ICT resource integration and virtualization

*:OSS/BSS: Operation Support System / Business Support System (Systems to support business operations of telecom carriers)
*:TMS: Traffic Management System (Communications management system) *:EPC: Evolved Packet Core (Next generation mobile core network to realize ALL-IP network)

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Enhancement Policy Telecom carrier SDN Solutions

Base is located in Europe to support SDN business for telecom carriers

Enhance cooperation with leading global telecom carriers, standardization organizations and R&D institutes

Implement eco systems through standardization and open community activities

ETSI

Network Functions Virtualization (NFV)

Open Networking Research Center
at Stanford University

Open Networking Research Center (ONRC)

SDN Technical & Marketing Centre (NEC Europe)

SDN joint discussion with leading global telecom carriers

Telefónica (Spain)

Agreed on the joint development of network virtualization for SDN and NFV fields

Portugal Telecom (Portugal)

Agreed on becoming joint demonstration partners for SDN to be applied to networks of data centers and telecom carriers

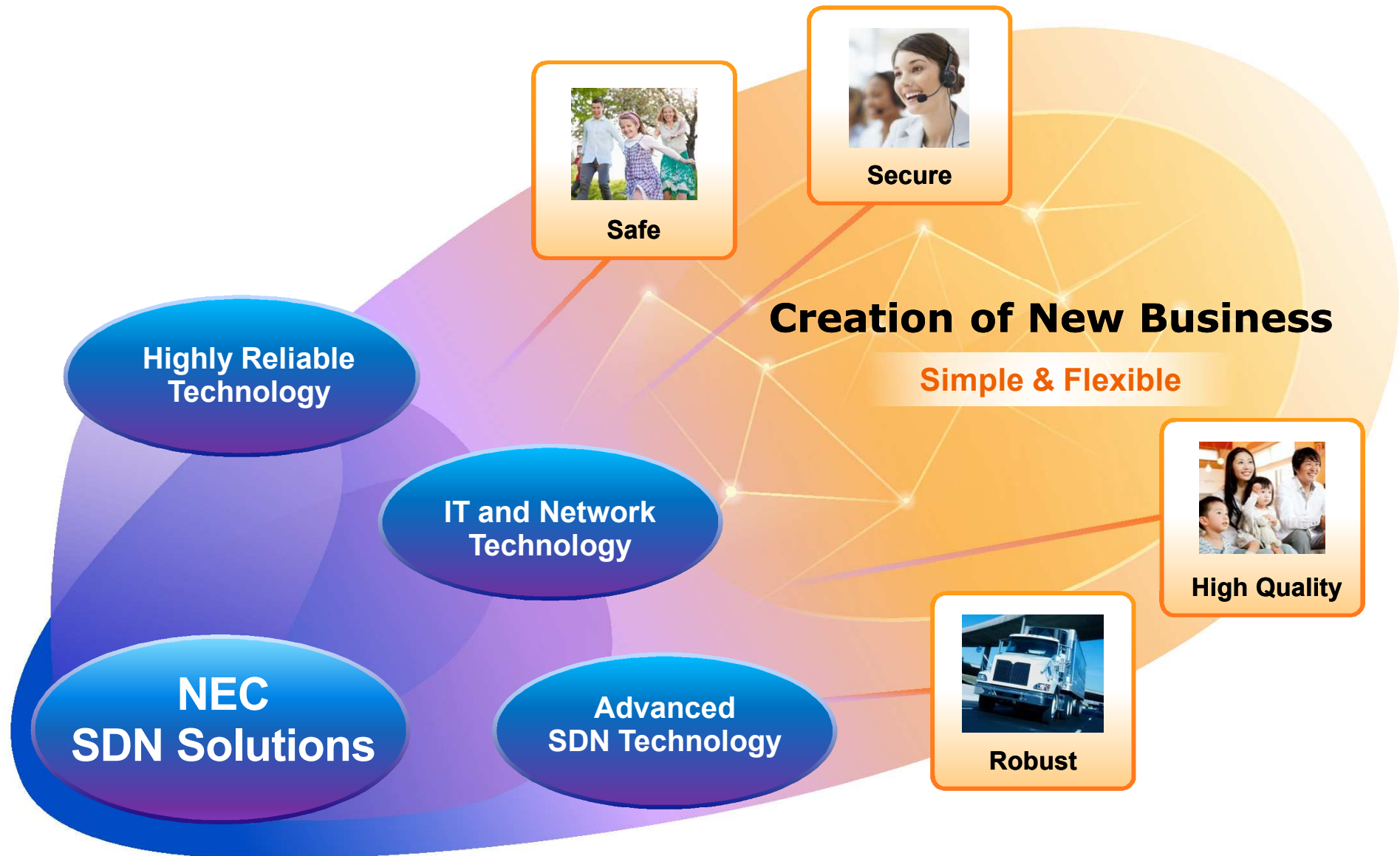Empowered by Innovation **NEC**

5. Conclusion

NEC SDN Solutions

**NEC SDN Solutions are
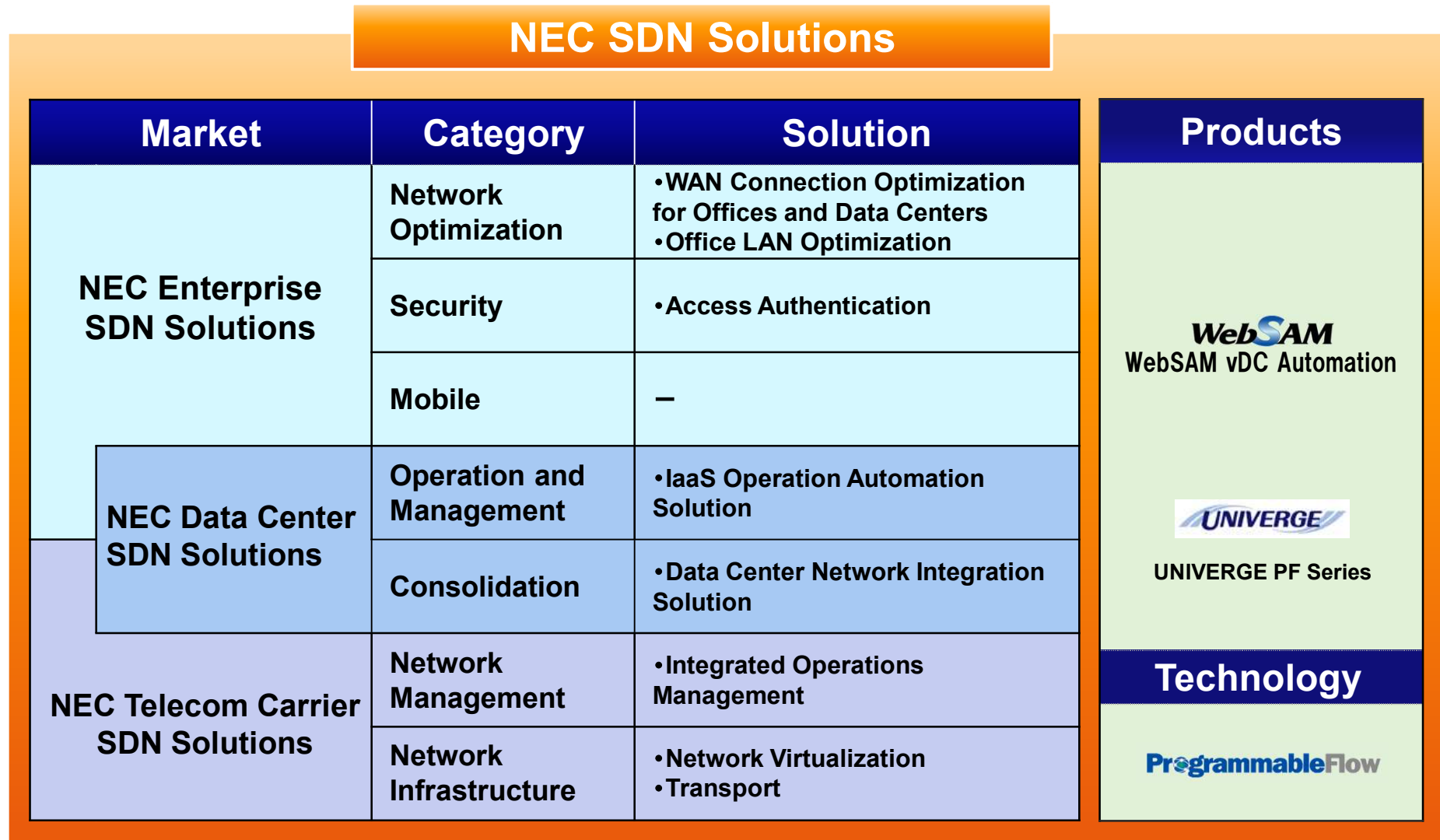IT and Network integrated solutions realized
through NEC's advanced technologies**

**Safe, Secure, High Quality and Robust,
NEC SDN Solutions simply and flexibly
support customers' needs and the creation of new business**

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NEC SDN Solutions

Safe

Secure

Creation of New Business

Simple & Flexible

Highly Reliable Technology

IT and Network Technology

High Quality

NEC SDN Solutions

Advanced SDN Technology

Robust

NEC SDN Solutions' Framework

NEC SDN Solutions			Products
Market	**Category**	**Solution**	**Products**
NEC Enterprise SDN Solutions	Network Optimization	•WAN Connection Optimization for Offices and Data Centers •Office LAN Optimization	**WebSAM** WebSAM vDC Automation
	Security	•Access Authentication	
	Mobile	–	
NEC Data Center SDN Solutions	Operation and Management	•IaaS Operation Automation Solution	**UNIVERGE** UNIVERGE PF Series
	Consolidation	•Data Center Network Integration Solution	
NEC Telecom Carrier SDN Solutions	Network Management	•Integrated Operations Management	**Technology** **ProgrammableFlow**
	Network Infrastructure	•Network Virtualization •Transport	

*1：Availability varies by region

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