SDN Initiatives

July 10, 2013

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SDN Strategy Director
NEC Corporation
1. Introduction

2. What is SDN (Software-Defined Networking)?

3. NEC’s Initiatives for SDN (Past)

4. NEC SDN Solutions

5. Conclusion
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
(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

Next-generation network technologies
High-performance, high-reliability core IT technologies
Diverse sensor and human interface technologies

NEC ICT supporting social infrastructure and systems

• From the seafloor to outer space, concentrating management resources in areas in which social infrastructure will be innovated by ICT
(1) Innovation of Social Infrastructure via ICT (2)

Collection of large-scale data
- Diverse sensors and human interface technologies
  - From the seafloor to outer space
  - Surveillance cameras
  - Smart devices
  - Accumulated data

Analysis and prediction
- High-performance/high-reliability core IT technologies
  - Invariant analysis
  - Heterogeneous mixture learning
  - Facial image analysis
  - Behavior analysis
  - Textual entailment recognition

Solution of social issues

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)
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

SI/Service Operations Unit

Supply Chain Management Unit

Sales

Public Business Unit

Enterprise Business Unit

Telecom Carrier Business Unit

Smart Energy Business Unit

Global Business Unit

RHQ (Regional Headquarters)

SI/Service Business Promotion

SCM/Quality/Procurement

System Platform Business Unit

Business Innovation Unit

Central Research Laboratories

(As of April 1, 2013)
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.
What is SDN (Software-Defined Networking)?

SDN refers to dynamically controlling networks using software and its architecture.

<table>
<thead>
<tr>
<th>Past/Present</th>
<th>Future</th>
</tr>
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<tbody>
<tr>
<td>Static network where network control by dedicated network equipment and data transfer processing were performed together</td>
<td>Network control and communications processing are separated</td>
</tr>
<tr>
<td>Equipment that only performs communications processing is dynamically controlled by using software on a general-purpose server</td>
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</table>

Dedicated equipment with network control function

Separated & Dynamically Controlled

Network control software

General-purpose server

Communications processing

Equipment that only performs communication processing
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
- Improve ICT resource balance
- Improve efficiency of infrastructure equipment
- Improve security

Advancement of ICT

Enhancement of social systems
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.
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!

Using SDN enables smooth utilization even when network access spikes at an online shop clearance sale or campaign by controlling networks optimally.
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.
Potential of SDN Market

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

unit: trillion yen

*Calculated by NEC based on various market surveys
3. NEC’s Initiatives for SDN (Past)
NEC’s Past Initiatives

NEC leads the research and development of SDN architecture and OpenFlow 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.

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<table>
<thead>
<tr>
<th>Year</th>
<th>OpenFlow R&amp;D</th>
<th>OpenFlow Switch Consortium</th>
<th>Open Networking Foundation</th>
<th>Formulated and standardized OpenFlow specifications</th>
<th>SDN R&amp;D</th>
<th>Open Networking Research Center</th>
<th>OSS activities for SDN software</th>
<th>SDN standardization activities by telecom carriers</th>
<th>Application development project for SDN</th>
<th>US Ignite</th>
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<td>2008</td>
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*1 OpenFlow: Standard of network control protocol
*2 National high-speed broadband network project of US federal government
# Reference: Trends in SDN Standardization and NEC’s Activities

Proactively conduct activities at major SDN-related organizations

*NEC activities as of July 10, 2013*

<table>
<thead>
<tr>
<th>Organization Name</th>
<th>Establishment/Objective</th>
<th>NEC Activities</th>
</tr>
</thead>
</table>
| 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 |
NEC’s Leading SDN Products

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

- Integrated operation management software

- Cloud network platform “UNIVERGE PF Series”
  - Commercial experience in Japan and overseas
  - Realize an open cooperation with partners
  - World’s first OpenFlow products

- 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)
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**

**SDN Network**

Electronic records
Anesthesia dept.
Radiology dept.

Network appliance pool

Firewall

Electronic records (Patient info)
High resolution image transfer
Office work LAN

Network pool

Server pool

Electronic records
Anesthesia dept.
Radiology dept.
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
Proprietary developed cloud controller controls virtual servers and virtual networks collectively

**Speed**
- Planning Requirement definitions
- Infrastructure design
- Server implementation
- Network implementation
- Connection
- Operation

**Flexibility**
- 5 days
- 2 weeks ⇒ Shorten to approx. 10 min

**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**
### 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

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**Operating as active operation systems at various companies**
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
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.

Worldwide: Approx. 170,000 companies
- Japanese companies: Approx. 160,000
- Telecom carriers: Approx. 800
- Overseas companies/JOC: Approx. 10,000

Customer base

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
NEC SDN Solutions: Lineup

NEC launches SDN Solutions in October 2013 *1

<table>
<thead>
<tr>
<th>Market</th>
<th>Category</th>
<th>Solution</th>
</tr>
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</table>
| NEC Enterprise SDN Solutions| Network Optimization      | • WAN Connection Optimization for Offices and Data Centers  
                             | • Office LAN Optimization                                               |
|                             | Security                  | • Access Authentication                                                   |
|                             | Mobile                    | —                                                                        |
| NEC Data Center SDN Solutions| Operation and Management  | • IaaS Operation Automation Solution                                     |
|                             | Consolidation             | • Data Center Network Integration Solution                                |
| NEC Telecom Carrier SDN Solutions| Network Management        | • Integrated Operations Management                                        |
|                             | Network Infrastructure    | • Network Virtualization  
                             | • Transport                                                             |

*1: Availability varies by region
## Reference: Situation at NEC and Other Companies’ Efforts (Source: NEC)

<table>
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<th>Target Market</th>
<th>Applicable Area</th>
<th>Solution</th>
<th>Product Group</th>
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### Solution

- **Cloud Product Vendor**
- **NW Product Vendor**

### Product Group

- **SI Vendor**
- **Telecom Carrier SI Vendor**
NEC Enterprise SDN Solutions: Network optimization

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.

![Diagram of network connectivity and optimization features]
NEC Enterprise SDN Solutions : Security
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.

- Access control for each device, BYOD foothold
- Access control for each project is possible as well as for each department.
- Normal access even from a different location
- Access authentication by linking with human resource information
- Access range is automatically configured
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

Develop solutions based on ICT

Respond to IT/network fusion areas Foster and enhance engineers

Customers (Japan/worldwide)
Leading cases

Dedicated SDN division for enterprise and data centers
Values Provided by SDN Solutions for Telecom Carriers

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

**Simple & Flexible**

**Infrastructure**
- Efficient resource utilization
  - Efficient resource utilization through virtualization
  - Network with high programmability, scalability and reliability
  - CAPEX reduction

**Management & Orchestration**
- Automated settings
  - Automated setting
  - Central control and management
  - OPEX reduction

**Services**
- Prompt service provision
  - Service promptness
  - Easy service deployment
  - New revenue

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**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 Solutions**
  - Transport Network
  - NFV (vEPC, etc)

  - Provide efficient network resource utilization by controlling with software
  - Implement network functions on servers

  **ICT resource integration and virtualization**

- **Network Virtualization Solutions**

*: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)
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

SDN Technical & Marketing Centre (NEC Europe)

- Implement eco systems through standardization and open community activities
- Network Functions Virtualization (NFV)
- Open Networking Research Center (ONRC)
- 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
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
NEC SDN Solutions

Highly Reliable Technology

IT and Network Technology

Advanced SDN Technology

NEC SDN Solutions

Secure

Safe

Creation of New Business

Simple & Flexible

High Quality

Robust
# NEC SDN Solutions’ Framework

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### Products

- **WebSAM vDC Automation**
- **UNIVERGE PF Series**

### Technology

- **ProgrammableFlow**

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