The result of use case of P4 and New use case of P4
Agenda

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   2. Market of Japan

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   3. Use case and the Results

3. The new use case of P4
   1. Current network demands
   2. Expectation of new network
   3. The new use case of P4
   4. Conclusion
Introduction
About NTT Group

NTT (as a holding company) and several operational companies.

- NTT: Group management and basic research
- NTT East/West: Regional communications business
- NTT Communication: Long distance and international communications business
- NTT DoCoMo: Mobile communications business

![Diagram of NTT Group structure](image)
NTT EAST/WEST is providing “Regional fixed access service (last mile)”. 

FTTH share in Japan ※1

The total of NTT EAST & WEST FTTH share is almost 70%.

20.53 million subscriptions ※2


※2: The figures include the number of subscriptions for wholesale services providers through the use of the Hikari collaboration. (as of march 31, 2018)
The Result of Use cases of P4
Next Generation Network (NGN)

- Provide FTTH and other services thorough NGN.
- Thousands of “Legacy” routers are in operation.
- Market, technologies and services are rapidly changing.

Rough sketch of NGN

![Diagram of NGN with components: NGN Services, Internet, ISP, IPoE, CPE]
Expectation for P4 Switch

- Cost reduction is important.
- Creating New business is more important.
Meeting the need for new services

P4 data plane

Central Office

Services

Video contents

Video distribution offloading

Function addition

Distribute to Central Office

Receive Video Feed

Enjoy New Services

• Evaluated following two use cases using P4 switches to explore the service benefits and business opportunities.
(1) Live streaming use case (#1)
(2) Data plane feature re-programability use case (#2)
System structure

Int-NW-SW Catalyst 2960
(ToR)

L2SW
(Int-NW-SW
AlaxalA
AX38305-XW)

P4 Switch
(Barefoot
Wedge 100B)

Server
(DELL PowerEdge
R440:ubuntu16.04)

ONOS1.14

Distribution
Management
Application

Legend
- : Data Plane
- : Data Plane (inside SW)
- : Control Plane

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Hardware structure

Legend:
- 1000Base-T (MING)
- 40G
- 1000Base-T

Int-NW-SW Catalyst 2960 (ToR)

L2SW (Int-NW-SW AlaxalA AX38305-XW)

P4 Switch (Barefoot Wedge 100B)

Server (DELL PowerEdge R440:ubuntu16.04)

ONOS1.14
Distribution Management Application

Legend:
- 1000Base-T (MING)
- 40G
- 1000Base-T
The use case #1: Live Streaming

- **Deploy and Test the streaming function on P4 switch.**
  - (left fig) Sending the Video to cloud server before streaming to users.
  - (right fig) Streaming the Video to users using P4 functions.

**Simulating live streaming structures**
What's happening inside the P4 Switch

**STEP1 : Screen packets for RTP**

Packet A
- IPv4
- Others
- UC
- MAC

Packet B
- IPv4
- RTP
- UC
- MAC

**STEP2 : Change IP address from Unicast to Multicast**

- Change MAC address from Server to Terminal

IPv4
- RTP
- UC
- MAC

IPv4
- RTP
- MC
- MAC

**STEP3 : Forward Packets**

IPv4
- RTP
- MC
- MAC

P4chip

Switch

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Results of Use case #1

- (1) Deployed streaming function on P4 Switch.
- (2) Visibly checked the function works well.
- (3) Regarding the latency: there are few difference between them.
  → This is natural result in this system.

<table>
<thead>
<tr>
<th>Distribution from</th>
<th>Mean of latency*</th>
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<tbody>
<tr>
<td>Server</td>
<td>4.54 [msec]</td>
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<tr>
<td>P4 Switch</td>
<td>4.43 [msec]</td>
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</table>

※Mean for 5 time measurements.
The use case #2 : Switching Functions

- Adding streaming function to P4 Switch using software processing.
  - Switching function A to B.
- Check the operation verification of adding new function to P4 switch.
  - Switching functions is a basic feature of P4. But It is important for our company.

Results

✓ Packet loss time within 30 msec.
New Use Cases of P4
Current Network demands a lot.

- Large amount/kinds of things will be connected.
- Market, technologies and services are rapidly changing.
Current Network demands a lot.

- Large amount/kinds of things will be connected.
- Market, technologies and services are rapidly changing.
- Connecting new services to our network flexibly is important.
- P4 is one of the most useful technologies to handle those requirements.
Expectation for new network

- P4 solve such problems and create new services.
- As one use cases of P4, we focus on Local 5G network.
New use case for P4: Local 5G

Why Local 5G

• Low entry barriers
  Any operator can start the broadband wireless internet services.
• Market expansions
  The number of service providers are growing up significantly.
• Various capabilities
  Local 5G capabilities bring new opportunities to user’s business area.

Target business area

• Live streaming service
• Government, campus, hospital network
• Rural area broadband
• Industrial automation
• Autonomous cars
Local 5G network architecture

There are two types of the architecture.

**On-premise**
Whole system in user’s local area

- Internet
- Carrier network
- EPC
  - eNB/gNB Local area #1
  - eNB/gNB Local area #2
  - eNB/gNB Local area #3

**Cloud**
Shared system based on a cloud

- Internet
- Shared EPC
- Carrier network
- IPsec VPN
- EPC
  - eNB/gNB Local area #1
  - eNB/gNB Local area #2
  - eNB/gNB Local area #3
Local 5G network architecture

There are two types of the architecture.

**On-premise**
Whole system in user’s local area

- Cost effectiveness
- Easy network operation

**Cloud**
Shared system based on a cloud

- Internet
  - Carrier network
  - IPsec VPN

Whole system in user’s local area

Shared system based on a cloud
Existing problems in the cloud architecture

Using a public cloud, problems are existing in some use cases.

1. **Low latency service**
   e.g. Live streaming, autonomous cars

   ![Diagram of low latency service](image1)

2. **Data confidentiality service**
   e.g. Industrial automation, government NW

   ![Diagram of data confidentiality service](image2)
New architecture with P4

- This architecture we proposed has two features:
  - Multi-tenant EPC using P4-offloaded S/P GW in network edge
  - Local breakout to a MEC server by P4 packet broker
- Basic implementation is done!

Our proposed architecture

1. Multi-tenant EPC
   EPC is placed in network edge for each user.

2. Local breakout
   User traffic is offload to the local system from GTP tunnel.
Conclusion

■ Evaluate the P4 use cases

(1) Streaming Video:
   Deployed the streaming function on P4 Switch.
   Visibly checked streaming function works well.

(2) Switching functions:
   We were able to switch the functions in 30 msec.

■ New use cases of P4

Local 5G architecture with P4 as a use case

- Evaluation timeline (TBD)

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<th>2020</th>
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<tbody>
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<td>Evaluate P4 Use cases</td>
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<td>➢ Live streaming</td>
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<td>➢ Switching Functions</td>
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<tr>
<td>➢ Local breakout by P4 packet broker</td>
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Thank you