"Operational" flexibility

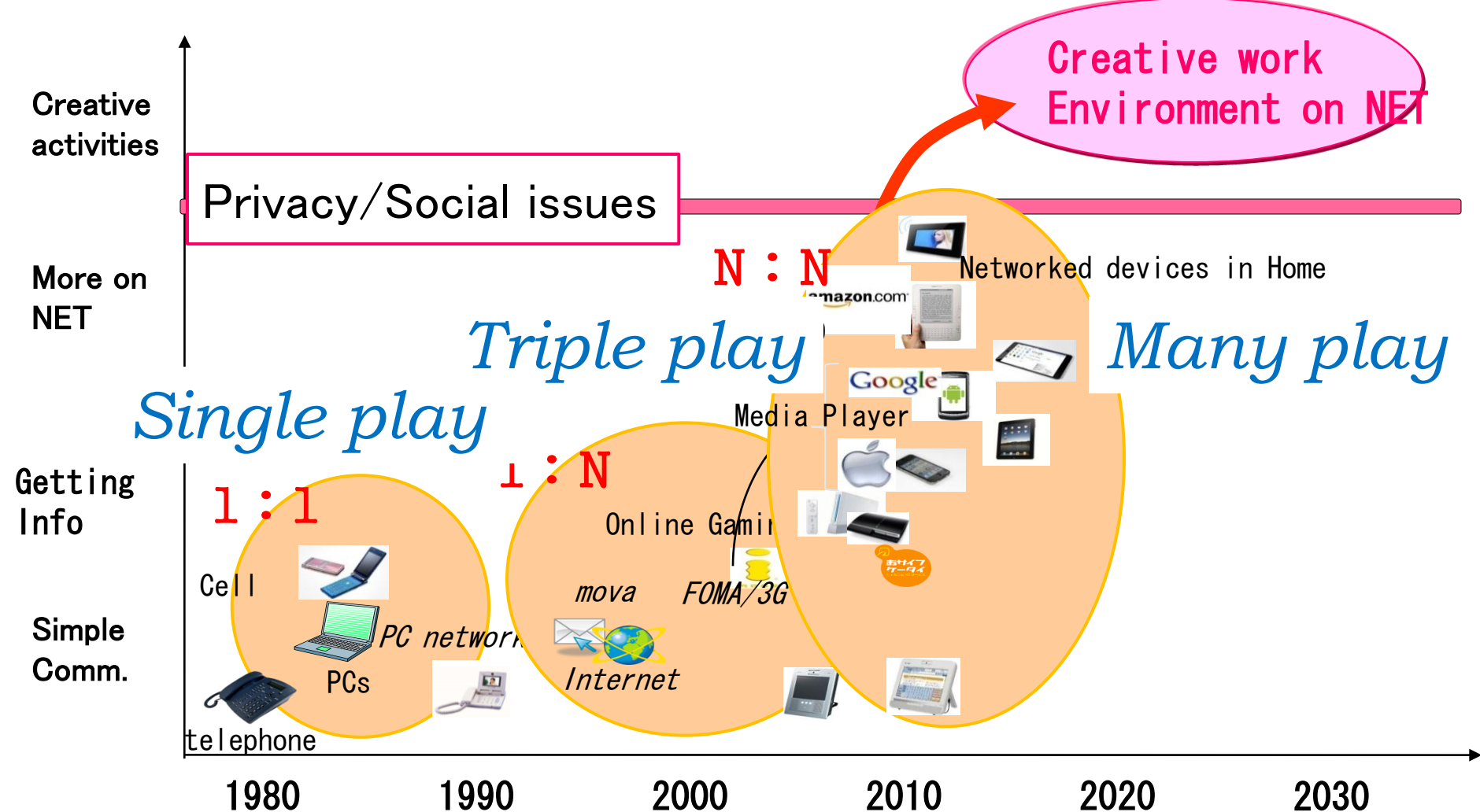## Managing Clouds, Smart Networks and Services

Atsushi Takahara
NTT Network Innovation Labs.
2011/9/23

NTT

Evolution of communication

Creative activities

Privacy/Social issues

Creative work Environment on NET

More on NET

N:N

Networked devices in Home

Triple play

Many play

Single play

Media Player

Getting Info

1:1

1:N

Online Gaming

Cell

mova   FOMA/3G

Simple Comm.

PC network

PCs

Internet

telephone

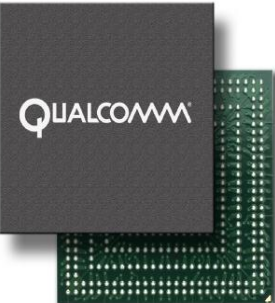1980   1990   2000   2010   2020   2030

Smartphone
Endpoint is so powerful!

7 BILLION CHIPS shipped!

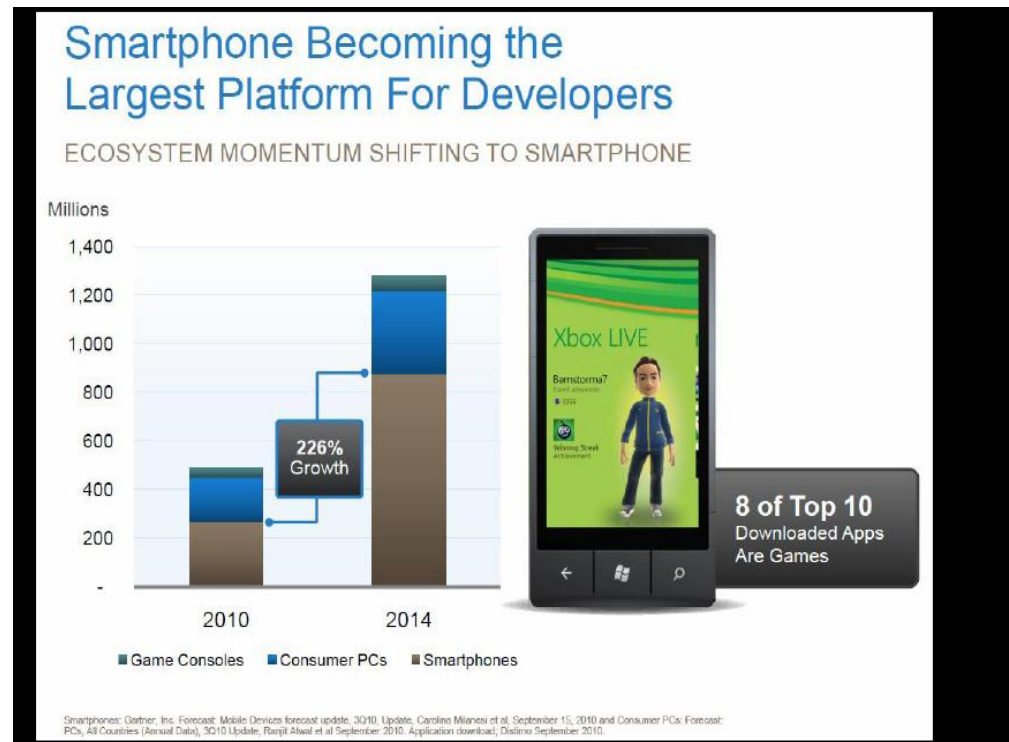**Some Background on Qualcomm's chip division (QCT)**

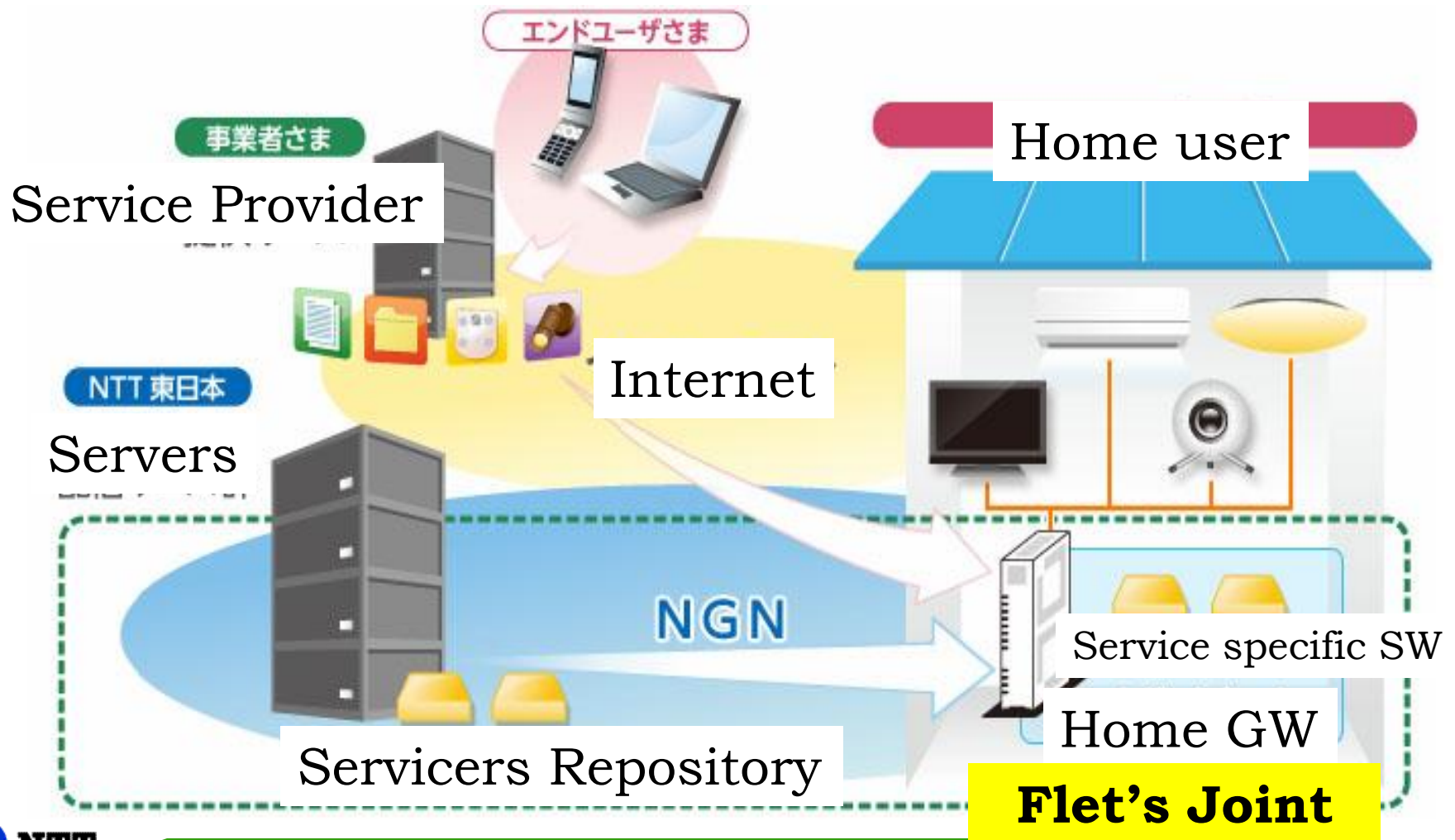OVER **7 BILLION** CHIPS SHIPPED

RECORD 2010 SHIPMENTS

• 400M+ MSMs SHIPPED

• 745+ DEVICE LAUNCHES

• Snapdragon Platform
  • 55 Smartphones with 60+ Carriers
  • 125+ in Design, Including
    10 Companies on Tablets

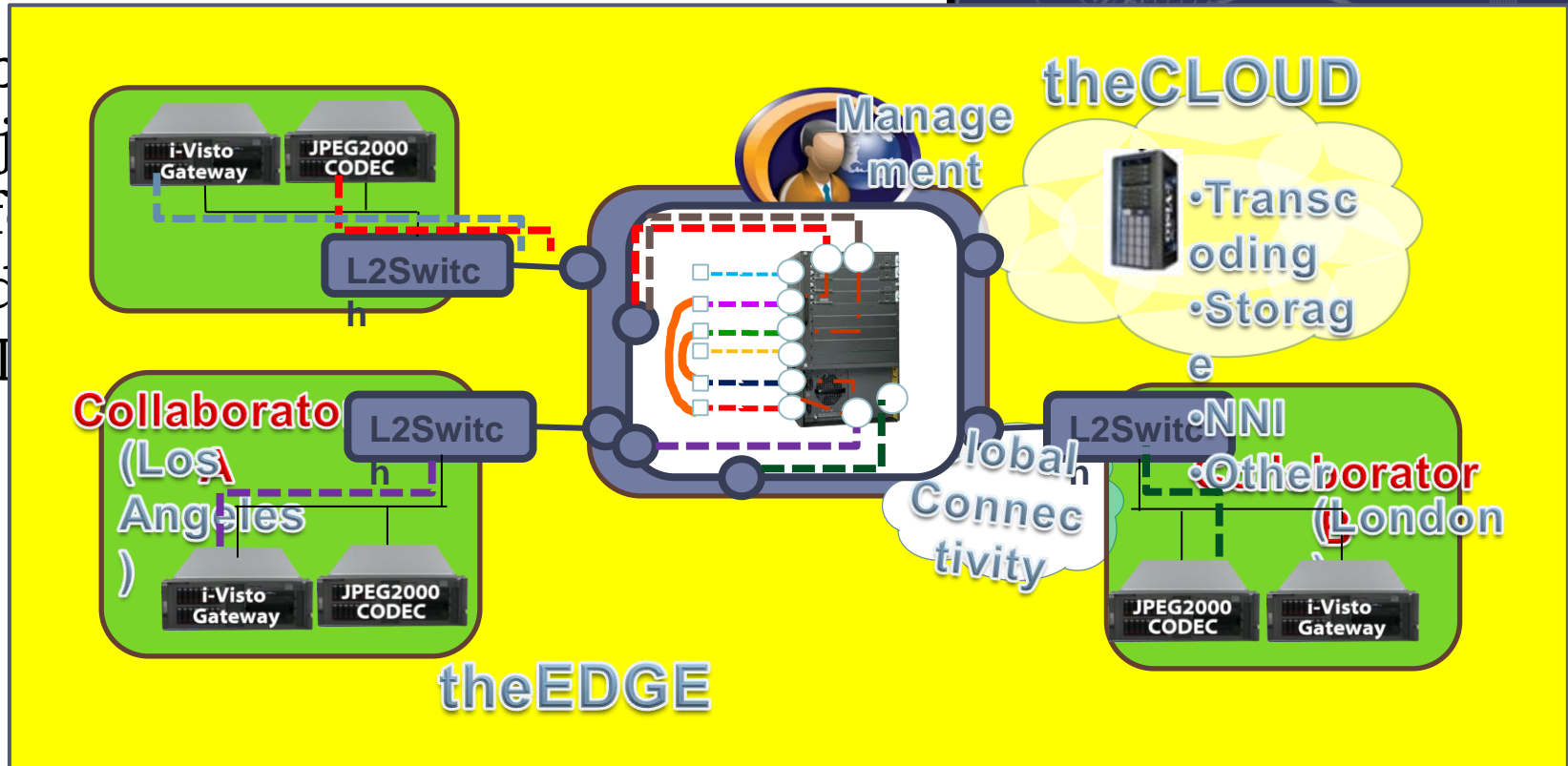*World's largest fabless semiconductor company*

Smartphone Becoming the Largest Platform For Developers

ECOSYSTEM MOMENTUM SHIFTING TO SMARTPHONE

226% Growth

Xbox LIVE

8 of Top 10 Downloaded Apps Are Games

■ Game Consoles ■ Consumer PCs ■ Smartphones

Smartphones: Gartner, Inc. Forecast: Mobile Devices forecast update, 3Q10, Update, Carolina Milanesi et al, September 15, 2010 and Consumer PCs: Forecast: PCs, All Countries (Annual Data), 3Q10 Update, Ranjit Atwal et al September 2010. Application download; Distimo September 2010.

Double/4 year

Newly introduced service based on OSGi technology (Flet's Joint)

Service Provider

Home user

Servers

Internet

Servicers Repository

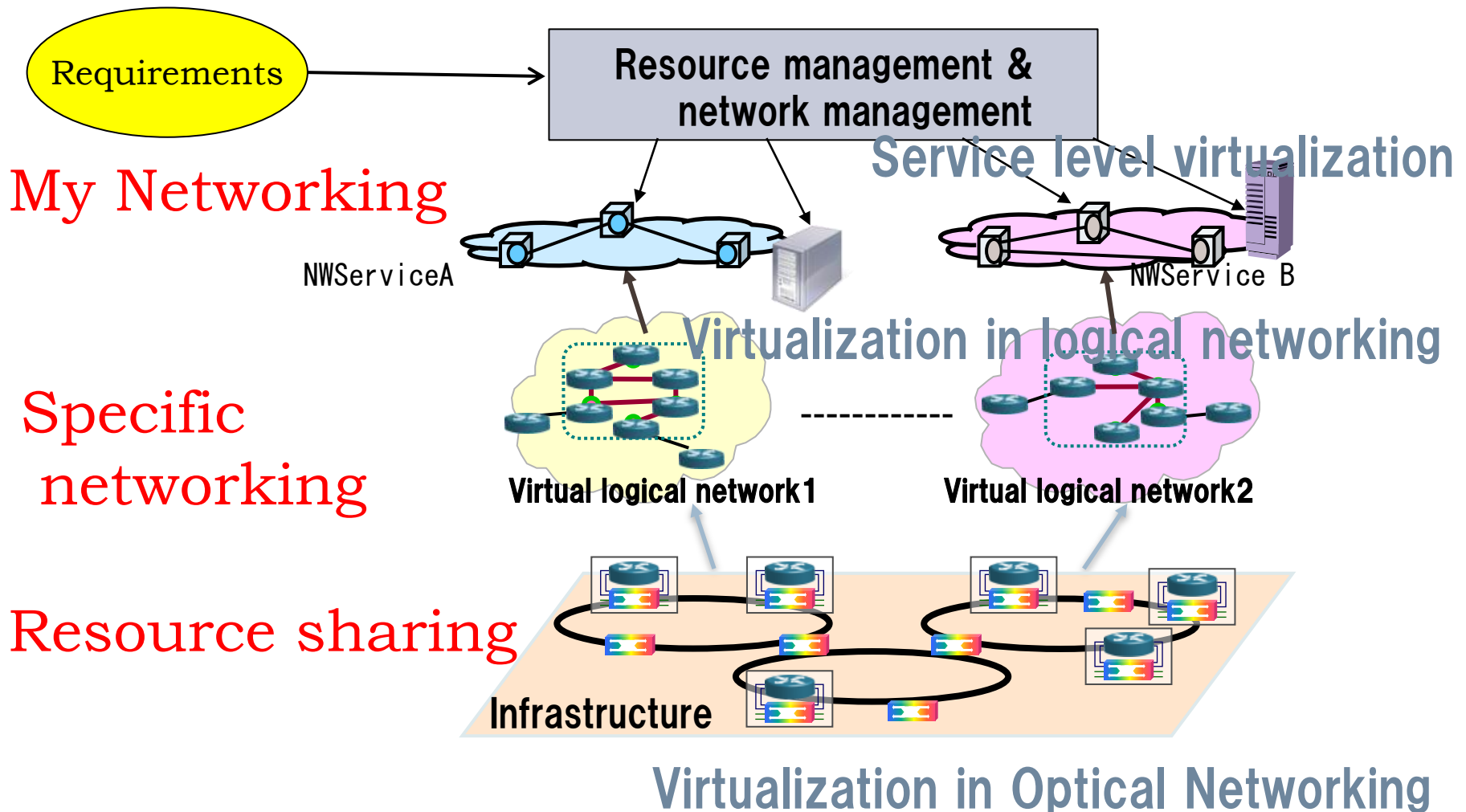Service specific SW

Home GW

Flet's Joint
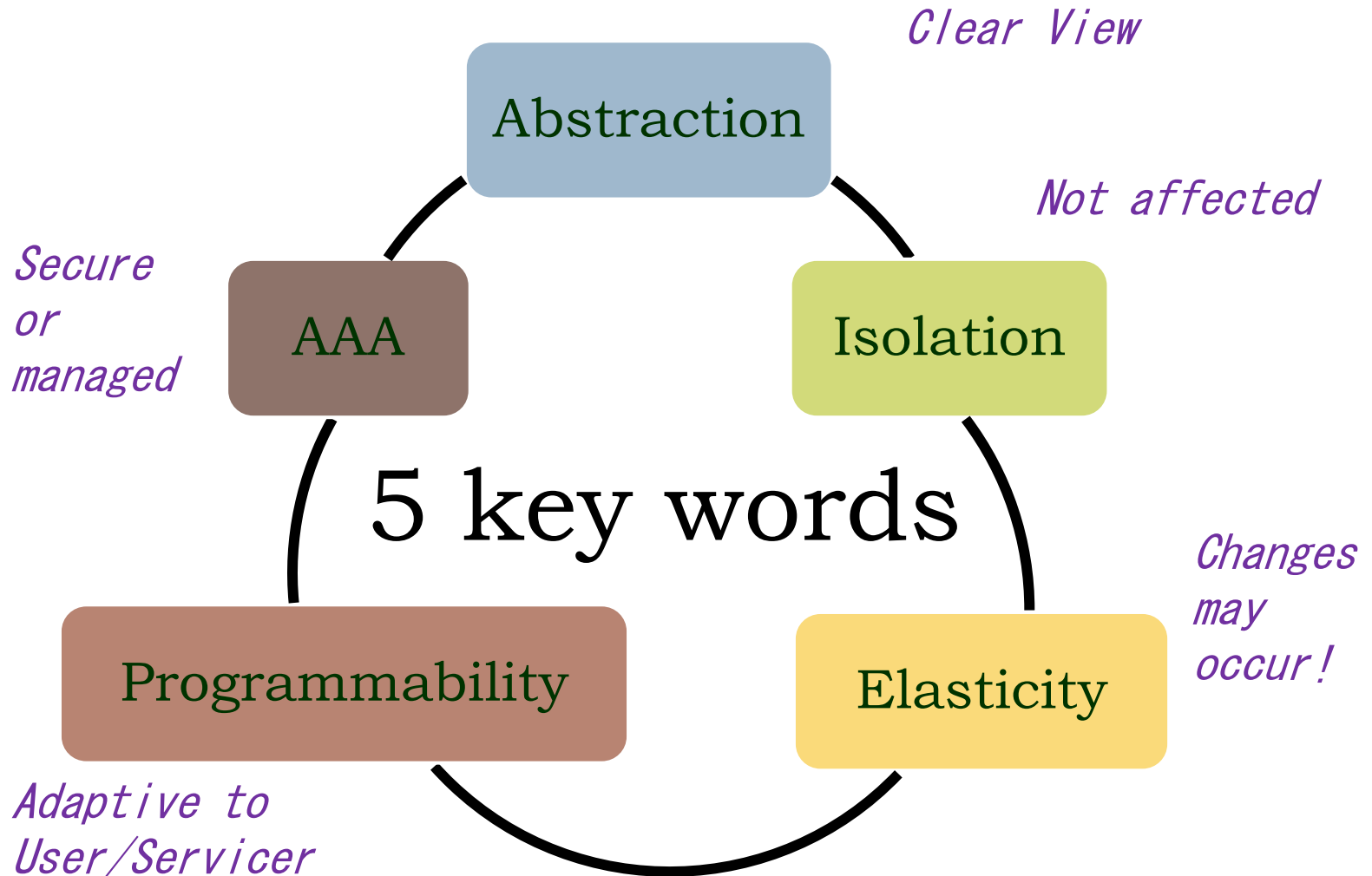
CineCloud

2011 NAB at Las Vegas
By NTT America

What should we do?

▸ Many things should be considered.

▸ Divide and Conquer

▸ How can we divide networks?

▸ "Network Virtualization"

Network Virtualization

Network Virtualization

Clear View

Abstraction

Not affected

Secure
or
managed

AAA

Isolation

5 key words

Changes
may
occur!

Programmability

Elasticity

Adaptive to
User/Servicer

What's the role of Openflow?

▶ A kind of network virtualization

▶ Providing another look of network

  ▶ A flow or a set of flows

  ▶ The simple view

▶ Simplify the interface to application

▶ Limited functions in "actions"

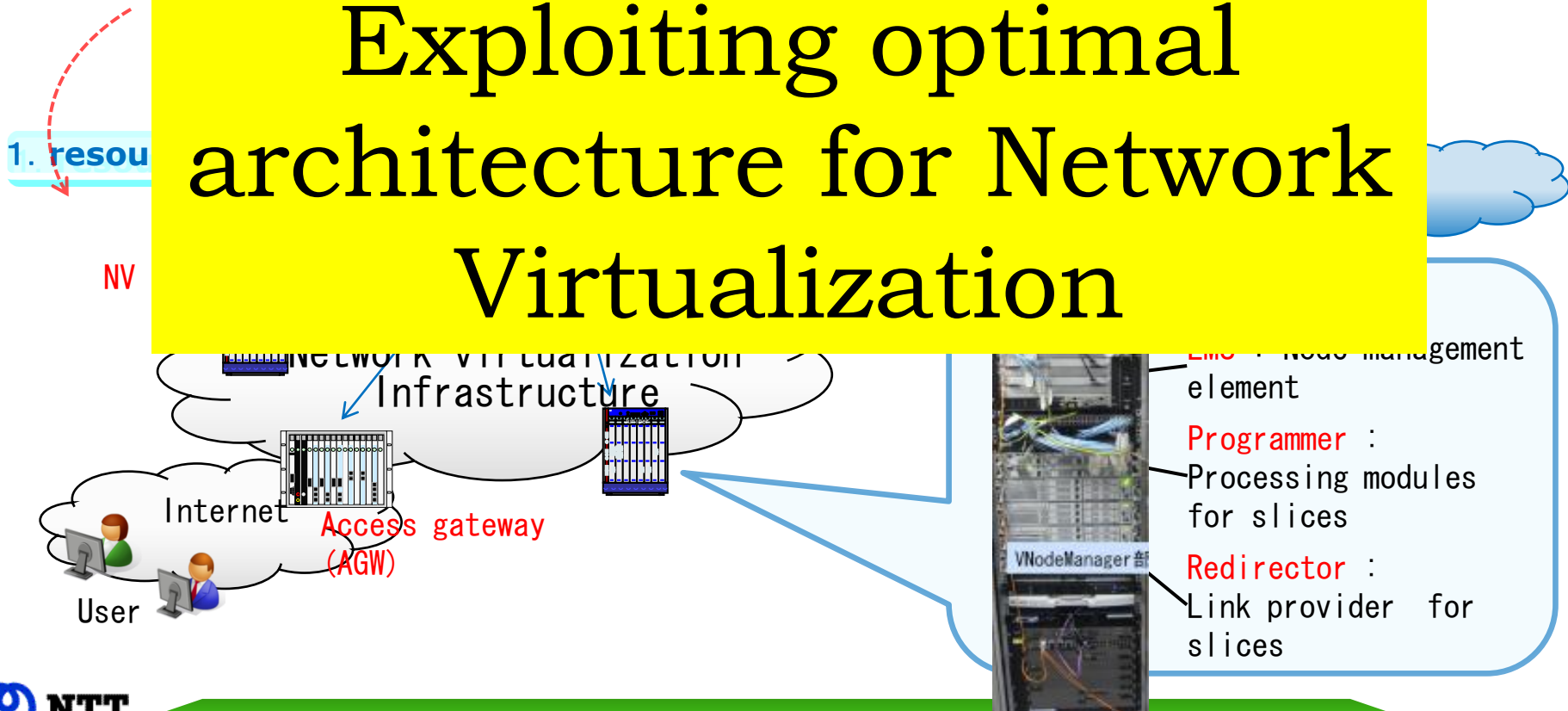▶ Think more on Network Virtualization!

Network Virtualization R&D in Japan

- NICT Project : Network virtualization infrastructure R&D
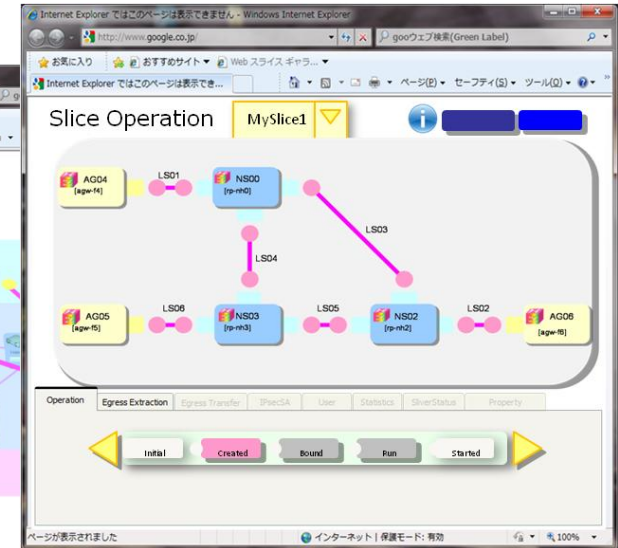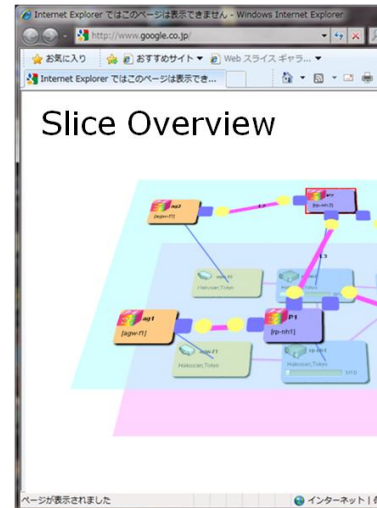 - Prof. Nakao (U. of Tokyo), NTT, NEC, Fujitsu, Hitachi
  - 3Year Project

Usability

1. resou

NV

Exploiting optimal architecture for Network Virtualization

Network Virtualization
Infrastructure

Internet

Access gateway
(AGW)

User

EMS : Node management element

Programmer :
Processing modules for slices

VNodeManager部

Redirector :
Link provider for slices

NTT

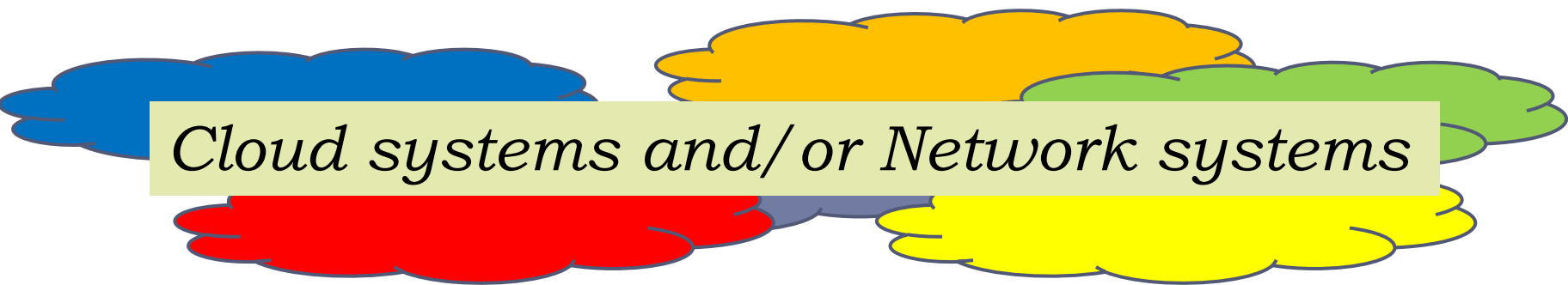# Proto typing of Generalized Network Virtualization

11nodes are installed in JGN-X (Japan National R&E testbed).

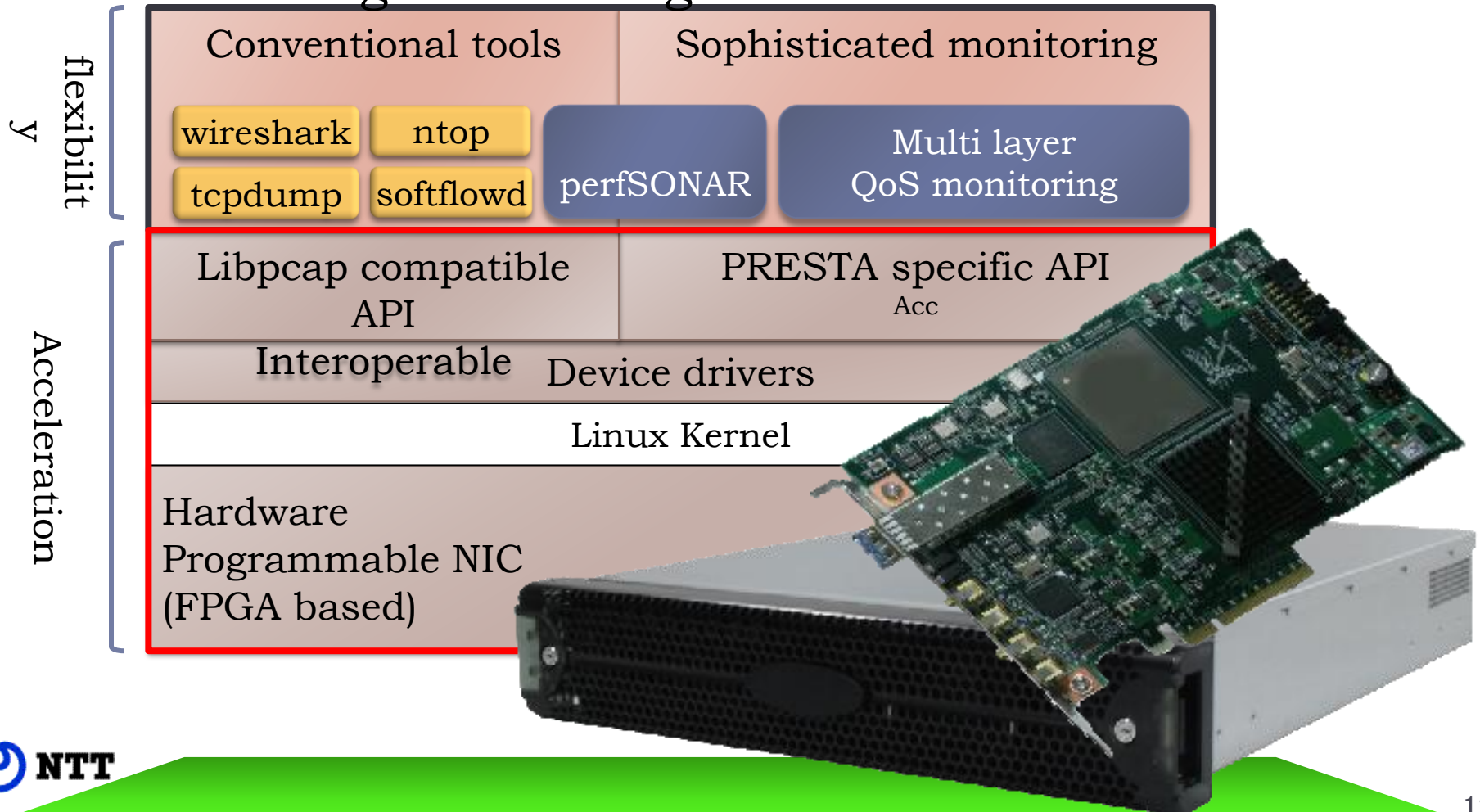# What's happened in Network Virtualization Era?

Many slices

Operation and Management

Cloud systems and/or Network systems

Reconfigurable network monitor

Flexible monitoring is also needed for proper management: Programmable NIC + Linux

flexibility

Acceleration

Conventional tools	Sophisticated monitoring

- wireshark
- ntop
- tcpdump
- softflowd

perfSONAR

Multi layer QoS monitoring

Libpcap compatible API	PRESTA specific API

Acc

Interoperable Device drivers

Linux Kernel

Hardware Programmable NIC (FPGA based)

NTT

Summary

- Many services are introduced and they need their own networking.
- They definitely need their own operation or operational system.
- We should resolve many of operators/operation methods rather than many of "flexible" networking.
- "Operational" flexibility is the key of Network Virtualization era and next generation networking.

Thank you for your kind attention.