Orchestration of Virtualized Base Station in OAI

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ETRI
THE FLEXELL PROJECT
(FLEXible cELL)

<table>
<thead>
<tr>
<th>Project</th>
<th>Development of 5G mobile access platform technology based on virtualization converged with computing</th>
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<td>Period</td>
<td>2016.4.1. ~ 2020.12.31. (57Months)</td>
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<td>Object</td>
<td>Develop the virtualization base station system that can operate in real time by building a virtualization platform that can accommodate communication functions and virtualizing multi-RAT access function of 5G mobile communication</td>
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RACHTECH Research and Development

Juni SmallcCell & Solutions

ETRI Electronics and Telecommunications Research Institute
CONTENTS

• Introduction
• Design & Implementation
• Demo by Video Clips
• Conclusions
INTRODUCTION
VIRTUALIZATION

• Using only Virtualized CPU, Storage, Network by HYPERVISOR

• New Innovative Development Paradigm

• SW, independent of HW
  • Increase Portability of SW
  • Increase System Flexibility

• Apply to
  • Wired Network: Cloud Server, Edge Server, Router
  • Mobile Network: EPC, HSS, MEC Server

• Now eNB(BS) Virtualization
CLOUD, SDN

- **Cloud**
  - Centralization of Common Function
  - Distribution of Each Function
  - Trunking Gain

- **SDN**
  - Separation of Data and Control
  - Programmable Network, Open Network, Flexible Switch
  - Data Plane Acceleration (DPA)
5G System

- 3 Key Improvements
  - High Bandwidth
  - Low Latency
  - Massive Connection

- 5G Services
  - Intelligent, Personalized, Regional
  - Numerous & Variety
5G INFRASTRUCTURE

• MANY Industries by ONE network
• Flexible: Easy to Make, Easy to Change
• Adaptive: Smart & Dynamic Change
• Getting new innovative concepts like Virtualization, Cloud and SDN
DESIGN & IMPLEMENTATION
NFV Reference Model

VNF (Virtual Network Function)
- VNF#1
- VNF#2
- VNF#3
- VNF#4

VNF Manager

NFVI (NFV Infrastructure)
- Virtual Resources
- Hypervisor
- Real HW Resources

MANO (Multi-Access Edge Computing)
- Orchestrator
- MANO Manager

Virtual Infrastructure
- MANO
- Virtual Resources

Hypervisor
- vCPU
- vSTO
- vNET

NFVI
- CPU
- STO
- NET

OAI + ETRI Protocol Stacks

VMware vCenter

Intel Xeon Server

VMware ESXi 6.5

FLEXELL Orchestrator
CLOUD STRUCTURE

Central Unit (CU)

VNF

Fronthaul Transport Link Requirement
- Low Latency
- High Bandwidth

fronthaul

Remote Unit (RU)

PNF

VNF: Virtual Network Function
PNF: Physical Network Function
**FUNCTIONAL SPLIT & SW**

- **CU SW**
  - OAI RRC & S1AP
  - ETRI PDCP, GTP & RRM
  - Mult-RAT of TDD, FDD
  - Hypervisor for VMware ESXi 6.5
  - Ubuntu 16.04 LTS for Guest OS

- **RU(RSCU) SW**
  - RLC, MAC of NXP 9131/9132 Smallcell
  - PHY, RF, ANT of NXP 9131 Smallcell
  - Eliminating above RLC(PDCP, GTP, S1AP, RRC, RRM...)
  - Communication Agent for CU-RU interface
FUNCTIONAL SPLIT & HW

• CU HW
  ✓ M/B : SuperMicro X11SPi-TF
  ✓ CPU : INTEL XEON-SP 6154
  ✓ NIC : INTEL X710DA2 (SFP+, 10G)
  ✓ RAM : DDR4 96GB
  ✓ SSD : 512GB

• RU(RSCU) HW
  ✓ NXP 9131(FDD), NXP9132(TDD)
  ✓ Core : Power Architecture one e500 processor
  ✓ DSP : StarCore SC3850 DSP
  ✓ Acceleration : MAPLE-B2F multi-accelerator platform engine(supports LTE-FDD/TDD)
  ✓ Memory : 1G DDR3 memory
  ✓ RF Interface : ADI RF interfaces
  ✓ Connectivity: Gigabit-Ethernet controllers(support IEEE 1588v2), DMA controller(Power Architecture cores and DSP)
INTERFACES

- SCTP for two VMs (vRRC-vPDCP)
- DPDK KNI for vPDCP-CP and vPDCP-UP/GTP
- Non-Standard Messages between PNF-VNF
FLEXELL NODES
Testing Bed
BUILDING TWO vBS INSTANCES OF TDD, FDD
Demo
Orchestration & Traffic
Conclusions
NEXT WORK
TOWARD FULL NETWORK SLICING

• Virtualization for great FLEXIBILITY
  ▪ Easy to change Standard, Scale, Connectivity
  ▪ Easy to make New Services using One Infrastructure

• RAN Virtualization
  • Final Stage of Network Slicing
  • Performance Degradation due to Virtual CPU and I/O
  • OAI will be a Good solution of SW Modem for Virtualization
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THANKS FOR YOUR ATTENTION

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