NFV ISG PoC Proposal

A.1 NFV ISG PoC Proposal Template

A.1.1 PoC Team Members

- **PoC Project Name: C-RAN virtualization with dedicated hardware accelerator**
- Network Operators/ Service Providers: **China Mobile** (Contact: Jinri Huang, huangjinri@chinamobile.com)
- Manufacturer A: Telecom Equipment Manufacturer: **Alcatel-Lucent** (Contact: Min Zhang Min.Zhang@alcatel-sbell.com.cn)
- Manufacturer B: OS & Hypervisor: Wind River Systems (Contact: Ron Breault, Ron.breault@windriver.com)
- Manufacturer C: Si Provider: **Intel** (Contact: Valerie Young, Valerie.j.young@intel.com)

A.1.2 PoC Project Goals

This PoC will realize C-RAN (cloud RAN) and implement virtualisation based on general-purpose platform which will support not only TD-LTE but also GSM systems. In order to meet the stringent real-time requirement imposed by wireless signal processing, a dedicated hardware accelerator will be used to process partial physical layer functions such as FFT/iFFT, channel codding/decoding. The goals of the PoC include the following:

- PoC Project Goal #1: To demonstrate the feasibility of base station virtualization, especially C-RAN virtualization;
- PoC Project Goal #2: To evaluate the system performance of the soft (i.e. virtualized) base station and compare with traditional implementation based on vendors' proprietary platform in terms of for example, the power consumption, the throughput and so on;
- PoC Project Goal #3: To evaluate and demonstrate the live migration mechanism that we designed to enable seamless LTE L3 VM (virtual machine) live migration;
- PoC Project Goal #4: To demonstrate the advantage of soft base station in easy support of multi-RAT, i.e. GSM and TD-LTE on the same platform;
- PoC Project Goal #5: To find out potential issues and challenges through the PoC development to accelerate the momentum for commercial-level C-RAN virtualization

A.1.3 PoC Demonstration

Venue for the demonstration of the PoC:

- Part of the PoC with selected functions will be demonstrated in Mobile World Congress, 24-28 Feb, 2014, Barcelona, Spain

- The whole PoC can be visited at Alcatel-Lucent Shanghai Lab in Shanghai, China after MWC event

A.1.4 (optional) Publication

- A final PoC report with results and findings will be -submitted to ETSI NFV ISG by 31st, July, 2014
- The report will also be published in China Mobile Research Institute's website: http://labs.chinamobile.com/ by 31st, July, 2014

A.1.5 PoC Project Timeline

• What is the PoC start date?	This project has already been started.
• (First) Demonstration target date	24-28 Feb, 2014
• PoC stages target dates	31st May, 2014
• PoC Report target date	31st July, 2014
• When is the PoC considered completed?	This PoC will be considered complete after the report has been submitted to ETSI NFV ISG.

A.2 NFV PoC Technical Details

A.2.1 PoC Overview

Figure 1 illustrates the network topology of this PoC for C-RAN virtualization.

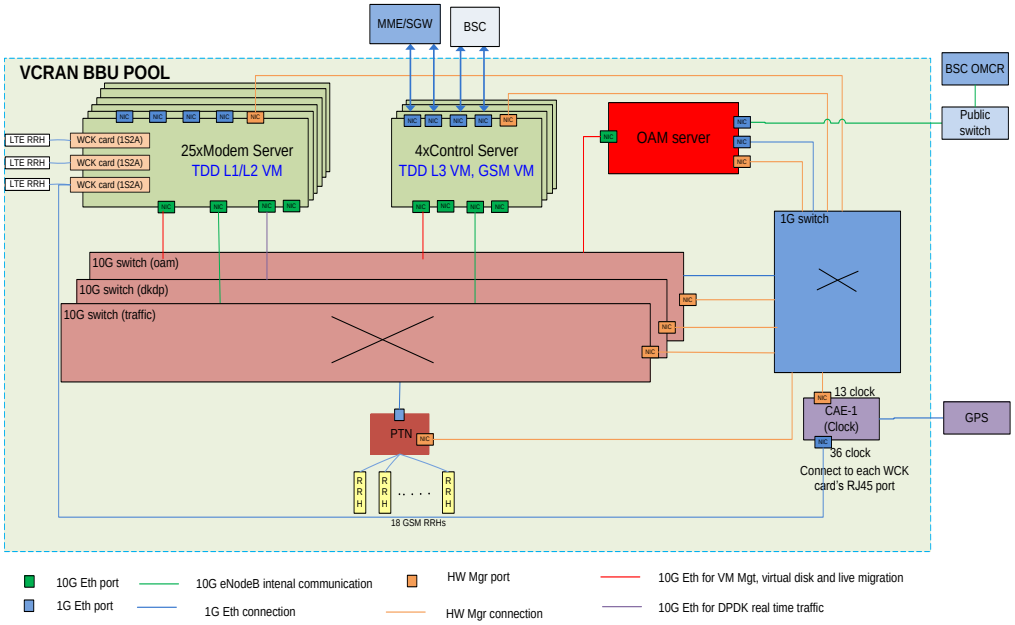

Figure 1: Network topology of the virtualized C-RAN PoC

In the figure depicted above, all the physical servers are interconnected via three 10G Ethernet switchs. They are used for carrying different traffic flows – real time traffic / non-real time traffic /virtualization OAM traffic. Another one 1G switch is equipped for hardware OAM traffic. A standalone OAM server is provided for cloud management including virtualization management and hardware management.

Two kinds of physical servers are used for hosting different applications. In modem server, TD-LTE L1 (PHY) and TD-LTE L2 (MAC/RLC) protocols are running in different virtual machines residing in different physical modem servers. In each modem server, several CPRI PCIe Plug-in cards are equipped for TD-LTE CPRI link termination linked to RRH. Some TD-LTE physical layer functions are offloaded from x86 CPU to the CPRI PCIe Plug-in card. Each CPRI PCIe Plug-in card is assigned to the virtual machine where TD-LTE L1 (PHY) is running, TD-LTE L1 (PHY) virtual machine live migration is disabled at this phase, though future live migration is planned . A central clock generation equipment (CAE) is provided to supply each CPRI PCIe Plug-in card with the reference synchronization clock. CAE itself can take GPS signal as the reference clock or run in free mode. In TD-LTE L2 (MAC/RLC) virtual machine, TD-LTE L2 programs highly depend on the real time character of system, so TD-LTE L2 (MAC/RLC) virtual machine is live migration disabled either.

In control server, there are 2 kinds of virtual machine running in it – GSM virtual machine and TD-LTE L3 (all protocols except PHY/MAC/RLC). Control server has external Ethernet connections to EPC(MME/SGW) and BSC. Those external connections are used by the virtual machines for backhaul connection. All the virtual machines running in control servers are live migration enabled. For GSM virtual machines, there are no dedicated PCI-E cards equipped for link termination linked to RRH. All GSM RRH links terminate at a standalone equipment – PTN which forwards the traffic between RRHs and GSM virtual machines.

A.2.2 PoC Scenarios

- **Scenario 1: multi-RAT demonstration with real services**

In this scenario, both GSM and TD-LTE will operate simustaneously on the same platform. Two commercial TD-LTE UE will demo video calls while two GSM UEs will be used to demonstrate the voice service. From L1 through L3 the base station is virtualized. This demonstrates the basestation virtualized indicating the most restrictive timing requirements.

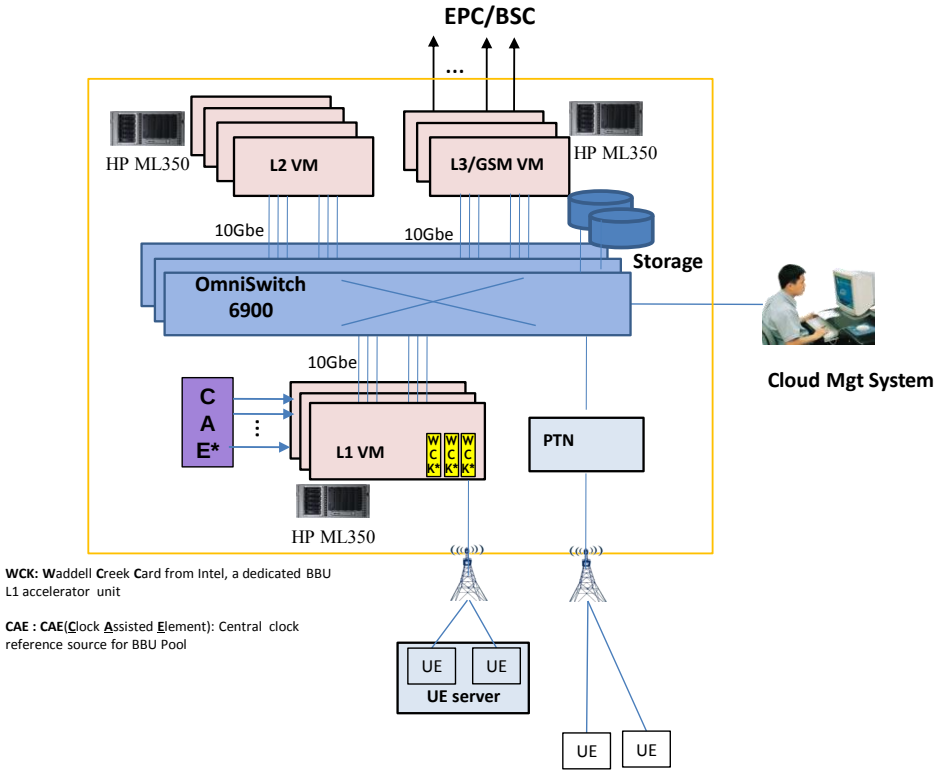

Figure 2: Scenario 1

Two TD-LTE USB UE dongles are pluged into USB interfaces of UE server. The TD-LTE UE dongle is connected to TD-LTE RRH via cable. In this UE server, 2 virtual machines will be created and executed to control TD-LTE UE dongles for TD-LTE UE simulation. These 2 TD-LTE UEs are residing in one same cell and handled by the same CPRI PCIe Plug-in card.

Another 2 GSM UEs are connected to GSM RRH via cable directly. One GSM UE can make voice call directly to the other one in same cell.

- **Scenario 2: LTE L3 live migration without service interruption**

When TD-LTE L3 virtual machine is live migrated with traffic is running, according to the traffic type different impact will be introduced by live migration action:

1. For signalling plane, the traffic loss between TD-LTE L3 virtual machine and MME during live migration period will be recovered by sctp protocol. The traffic loss between TD-LTE L3 virtual machine and other virtual machine during live migration period will be recovered by tipc protocol.

2. For user plane, if the traffic is carried based on transport protocol with the guarantee of transmission reliability like TCP/SCTP from end to end,the traffic loss will be recovered by these transport protocols, otherwise the traffic loss has to be recovered at application level.

A.2.3 Mapping to NFV ISG Work

Describe how this PoC relates to the NFV ISG work:

1) Specify below the most relevant NFV ISG end-to-end concept from the NFV Use Cases, Requirements, and Architectural Framework functional blocks or reference points addressed by the different PoC scenarios:

	Use Case	Requirement	E2E Arch	Comments
Scenario 1	*Use Case 6 Virtualization of mobile base stations*	[Perf. 3]	-	PoC framework provides the functions of monitoring the running VNF; can collect the information of resources such as compute, storage that a VNF is using
Scenario 2	*Use Case 6 Virtualization of mobile base stations*	[OaM.2]	-	PoC provides the functions to instatiate VNF, acllocate and reconfigure the needed resources on demand, and teminate VNF whenever necessary

A.2.4 PoC Success Criteria

This proof-of-concept will be considered successful when either all scenarios have been successfully implemented, and demonstrated, or, key lessons are learned if not all requirements are met.

A.2.5 Expected PoC Contribution

One of the intended goals of the NFV PoC activity is to support the various groups within the NFV ISG. The PoC Team is therefore expected to submit contributions relevant to the NFV ISG work as a result of their PoC Project.

List of contributions towards specific NFV ISG Groups expected to result from the PoC Project:

The contribution may depend on the PoC development progress. Hopefully we can submit the following contribution:

- PoC Project Contribution #1: A proposal on architecture of C-RAN virtualization to NFV Group: INF; it is expected the INF WG would benefit from the hypervisor, hardware and networking results in demonstrating meeting requirements of vCRAN, including portability. If gaps are exposed during this PoC, an effort by the ETSI NFVINF WG could recommend which SDO could solve the gap if appropriate.