6WIND
Virtualized Networking Software

Enabling Cloud RAN Virtualization

4G mobile networks are based on eNodeBs covering a radio area and overlapping to provide a wide coverage to mobile users. eNodeBs are connected to the mobile core network through a backhaul network. An eNodeB is a complete sub-system including radio processing, digital conversion to forward to and receive packets from the backhaul, protocol handling between the eNodeBs and the mobile network, cooling, battery, etc.

Cloud Radio Access Network (Cloud RAN) is a new architecture for mobile access networks. Instead of deploying all access functions in complex eNodeBs, Cloud RAN moves mobile network access functions in central servers running eNodeBs in virtualized architectures. Cloud RAN relies on simple radio front-ends (RRU: Remote Radio Unit) connected through an optical network (fronthaul) to a pool of remote virtualized BBUs (Base Band Units). Optical technology is required for the fronthaul because the RRU only implements the radio function and uses the fronthaul to provide raw information to Layer 1 (baseband) and Layer 2-3 functions located in BBUs.

Cloud RAN is one of the use cases addressed by the ETSI NFV (Network Functions Virtualization) standardization group. The expected benefits of Cloud RAN compared to traditional architectures is to deploy cost-effective low power RRUs and reduce CAPEX and OPEX by centralizing the architecture on generic servers. Using virtualized BBU also provides more flexibility for network resource allocation to dynamically manage traffic peaks and enables the introduction of innovative edge services such as CDN appliances or Web caches that can also run on the same servers.

Cloud RAN virtualization brings very high performance and low latency requirements for communication inside the virtualized servers. The 6WINDGate software solution for Cloud RAN solves networking performance bottlenecks to enable costeffective Cloud RAN architectures.

Since the first shipment of its 6WINDGate packet processing software in 2007, 6WIND has been selected by major network vendors to unlock hidden infrastructure performance for commercial off-theshelf (COTS) and server hardware.

Cloud RAN Virtualization Relies on High Performance and Low Latency Networking Software

In Cloud RAN architectures, multiple independent virtual BBUs can be instantiated on a pool of servers located in a data center. Each virtual BBU can use several Virtual Machines (VMs). For instance, VMs can run different L2 mobile communication standards while another VM performs L3 processing. Other VMs can implement local edge services.

Traffic from and to the fronthaul is processed by L1 accelerators using digital signal processors or ASICs. Communications between L1 and L2-3 virtualized functions rely on high performance and low latency.

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Virtualizing mobile network access functions in centralized servers makes economic sense only if a large number of BBU instances can be instantiated on a single server, thus reducing the price per virtualized BBU but increasing performance challenges.

In ETSI NFV terminology, communications between hardware and VMs are managed by the NFVI (Network Function Virtualization Infrastructure). Virtualized architectures add many software processing layers between the network interface and the VMs. They cause significant networking performance penalties and aren't able to sustain the level of performance required to implement an efficient NFVI for Cloud RAN.

Performance can be improved by using technologies such as SR-IOV (Single Root I/O Virtualization) that bypass the hypervisor but SR-IOV is hardware dependent and limited by the PCI Express bandwidth. Compared to a standard virtualized workloads, it has also to be noted that BBUs rely on real-time OS services and efficient VM migration mechanisms.

Mobile infrastructures also rely on different communication protocols between equipment and these protocols have now to be implemented at the hypervisor level for better efficiency. These protocols include VLAN, Link Aggregation, GRE, IP in IP, GTP, routing, shaping, NAT, firewall, IPsec, and more.

6WINDGate Enables Cloud RAN Virtualization

6WINDGate is high performance Layer 2 – 4 packet processing software optimized for generic multicore platforms. Based on its fast path architecture, 6WINDGate transparently accelerates Linux and virtualized network environments to provide more than 10x network performance improvements compared to standard software architectures. It allows for less than 1/10th computing resources to be used to process a defined amount of bandwidth, saving computing resources to implement more BBU VMs.

6WINDGate is available for market-leading processor platforms including Cavium, Intel and Mellanox. Most of 6WINDGate's software uses generic code and portability over different platforms is ensured by a thin layer called FPN-SDK (Fast Path Networking – SDK) on top of the processor vendor's SDK. For Intel platforms, 6WIND sits on top of DPDK (Data Plane Development Kit).

At the hypervisor level 6WINDGate provides a complete and high performance NFVI solution that meets all the requirements for Cloud RAN virtualization:

- 6WINDGate transparently accelerates the selected software switch to provide extreme bandwidth and low-latency to BBU VMs. As an example, 6WINDGate Open vSwitch (OVS) acceleration processes 20 Gbps per core on an Intel platform without any modification to OVS or its management.
- Compared to hardware technologies that bypass the hypervisor, 6WIND's software switch-based solution isolates VMs from real hardware, thus eliminating driver dependency in VM operating systems and allowing network hardware changes without impact on VMs. It allows for live and scheduled migration of VMs from one platform to the other without any hardware NIC adaptations.
- BBU VMs can communicate with 6WINDGate's NFVI services through standard Virtio guest drivers that are available in all operating systems.
- Beyond pure switching capabilities, 6WINDGate also provides enhanced networking services such as VLAN, encapsulation mechanism, L3 forwarding, virtual routing, firewalling, NAT, IPsec and more to extend service chaining capabilities between BBU VMs.

6WINDGate's fast path is compatible with all open source and commercial Linux distributions including those supporting real-time preemption patches.

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