White Paper

Communications Service Providers

5G in the Radio Access Network

Viettel High Tech Brings 5G to Vietnam

Vietnam's leading telecommunications company achieves a download speed of1.4Gbps through its custom-designed micro cell, based on Intel technologies[1*].

To fulfill the potential of 5G, communications service providers (CoSPs) are building flexible radio access network (RAN) technologies. Viettel High Tech has designed its own RAN, based on Intel® processors and network cards. The Layer 1 baseband processing is enabled by Intel based FlexRAN™ software. A public trial took place in Hanoi, and Viettel High Tech reports that it has achieved download speeds of up to 1.4Gbps connecting a commercial user device to its micro cell[1*].

Challenge

Viettel High Tech needed compute, networking, and hardware acceleration technologies that would meet the stringent performance and timing requirements of the RAN. As Viettel High Tech was developing its own RAN solution, it also needed software that would help cut its development time.

Solution

Viettel High Tech used servers based on Intel® Xeon® D and Intel® Xeon® Gold processors. The Intel® Ethernet Network Adapter XXV710-DA2T provides the required support for time synchronization. The Intel based FlexRAN™ software provided a blueprint for the Layer 1 RAN processing on Intel® architecture, to help Viettel High Tech develop its solution faster. The Intel® FPGA Programmable Acceleration Card (Intel® FPGA PAC) N3000 was used to accelerate forward error correction (FEC) in the Layer 1 processing.

Result

Viettel High Tech completed its first 5G call in January 2020, and launched a public trial in Hanoi in November 2020. Viettel High Tech has measured the download speed connecting to its micro cell at up to 1.4Gbps[1*]. Now Viettel High Tech has joined the O-RAN Alliance and is working on developing and refining O-RAN compliant solutions.

* See backup for workloads and configurations. Results may vary.

Preparing the Radio Access Network for 5G

Viettel Group is Vietnam's biggest telecommunications group, with more than 70 million customers in Vietnam[3]. The company provides network services and also manufactures network equipment.

With massive device connectivity, ultra-low latency, and high bandwidth, 5G will make new services possible. For CoSPs such as Viettel, the challenge is to implement 5G flexibly. The RAN is one of the most performance-sensitive parts of the network, with strict timing requirements that the hardware must be able to meet. For its 5G implementation, Viettel High Tech needed a highly performant hardware platform to support its RAN initiatives.

Viettel High Tech aimed to build a custom RAN solution that could use Enhanced CPRI (eCPRI) to increase fronthaul efficiency. Later on, Viettel High Tech plans to create virtualized RAN solutions (vRAN) that disaggregate the hardware and software in the RAN for greater flexibility. The 5G standards emphasize the need for a virtualized and cloud- native platform, with the ability to scale individual components independently. At the cell site, vRAN technologies enable CoSPs to consolidate baseband processing, scale with greater granularity, and deploy vRAN in sites with less space and/or power available.

Viettel High Tech wanted to design and develop its own 5G RAN platform, so the company also needed solutions that would help cut the development time.

Viettel High Tech's RAN solution

Viettel High Tech's RAN architecture locates the distributed unit (DU) and centralized unit (CU) in a shared server (see Figure 1). The Common Public Radio Interface (CPRI) or Enhanced CPRI (eCPRI) protocol can be used for the fiber connection between the remote radio unit (RRU) and the DU. The RRU and DU use an Option 7.2 split for dividing the baseband functions. Viettel High Tech is using a non-stand-alone core, but has the flexibility to use a stand-alone core in the future. Viettel High Tech is working with four different types of RRU: micro 4T4R, micro 8T8R RRU, macro 8T8R RRU, and macro 64T64R RRU.

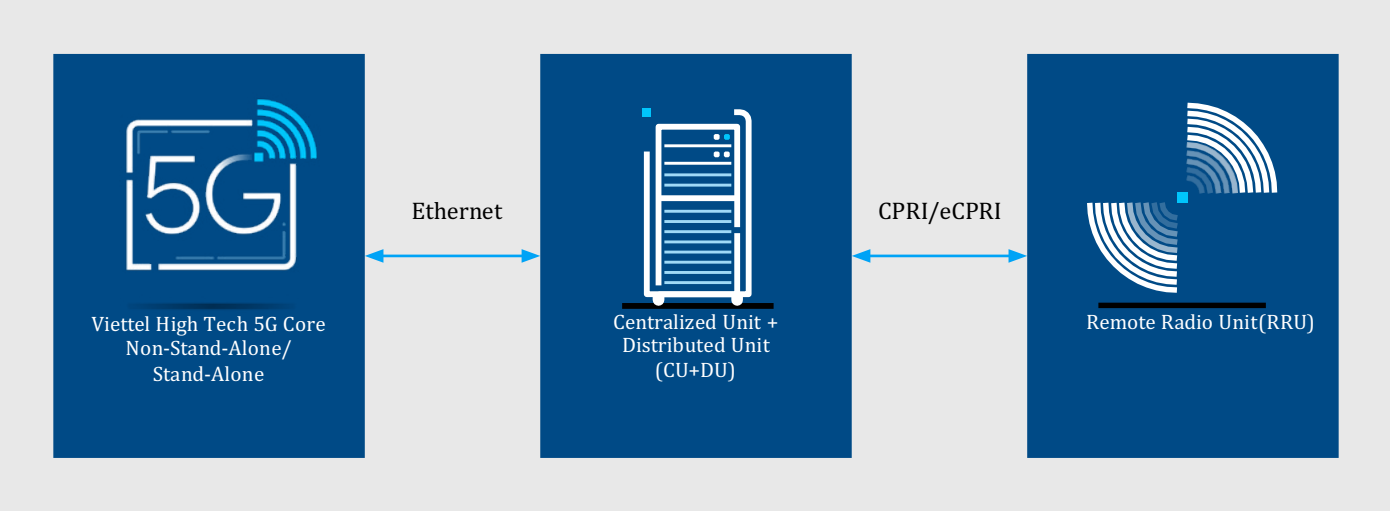

Figure 1. Viettel High Tech's radio access network (RAN) architecture at a glance.

Viettel High Tech based its RAN platform on Intel based FlexRAN™, which provides a blueprint for baseband processing on Intel architecture. Using FlexRAN™, Viettel High Tech was able to speed up the development of its Layer 1 (physical layer) RAN processing. For Layer 2 and Layer 3 processing, Viettel High Tech licensed software from Altran, which is now part of Capgemini Engineering. The Altran software covered about 60 percent of Viettel High Tech's requirements, with the rest developed by Viettel High Tech. Viettel High Tech carried out its own systems integration and testing.

Nguyen Chi Linh, 5G Project Manager, Deputy Director of Wireless Broadband Equipments R&D Center, Viettel High Tech, said: "By integrating Intel® Xeon® Scalable processors, and Intel's intelligent NICs, accelerators, and FlexRAN™ reference software, we have enabled our growing network with the flexibility to scale for future enhancements. Intel has definitely accelerated our 5G project deployment schedule. Utilizing Intel technology allowed our products to achieve the performance and coverage needed to satisfy our customers today and in the future with 5G services and applications."

The company adopted the Intel® Xeon® D processor for its micro cell RAN platform (see Figure 2), and the 2nd generation Intel® Xeon® Gold processor for its macro cell. TheFlexRAN™ software is optimized to take advantage of Intel® Advanced Vector Extensions 512 (Intel® AVX-512) in the Intel® Xeon® processors. Intel® AVX-512 provides new instructions for parallel processing, with ultra-wide 512-bit vectors. The Intel® Xeon® Gold processor is part of the Intel® Xeon® Scalable family, which offers a range of CPUs with different core counts and clock frequencies. This variety will help Viettel High Tech cater for a range of deployment scenarios, from low-capacity rural locations to massive MIMO (multiple input, multiple output) for dense urban areas.

Between the RRU and the DU is a 10/25G Ethernet eCPRI connection. For the server, Viettel High Tech chose the Intel® Ethernet Network Adapter XXV 710-DA2T for time synchronization because it has a programmable clock and enhanced support for the PTP 1588 protocol for network synchronization.

Viettel High Tech used the Intel® FPGA PAC N3000 to accelerate FEC in the Layer 1 processing. FEC is used to correct errors in transmission without requiring retransmission, which is fundamental to 5G. The N3000 is a SmartNIC platform based on an Intel® Field Programmable Gate Array (Intel® FPGA), which enables program logic to be implemented in hardware. The Intel® FPGA PAC N3000 product family includes a variant that is designed to be Network Equipment Building System (NEBS)-friendly, for use in central offices. The Intel® FPGA PAC N3000 enables high throughput, low latency and low power per bit for a custom networking pipeline.

Figure 2. Viettel High Tech's micro cell solution.

Testing performance

In January 2020, Viettel High Tech successfully completedthe first 5G call using its own technology. In March 2021, using a commercial user equipment device connecting to a micro cell, Viettel High Tech achieved a download speed of 1.4Gbps using RRU 8T8R, based on the CPRI protocol[1*]. This speed was achieved at Viettel High Tech's research and development lab at Hoa Lac High Tech Park. In a public trial location, Viettel High Tech has achieved 1 Gbps[1*].

Now that Viettel High Tech has joined the O-RAN Alliance, development is focused on the eCPRI protocol, defined by the Alliance. So far, Viettel High Tech has achieved download speeds of 800Mbps using O-RU 4T4R, based on O-RAN Fronthaul eCPRI[1*]. Work continues to improve the throughput.

Viettel High Tech tested a variety of server suppliers and models. The aim was to identify the one with the optimal price and performance for its full roll-out.

In November 2020, Viettel officially launched a 5G trial in the Hoan Kiem, Ba Dinh, and Hai Ba Trung districts of capital city Hanoi, using Viettel High Tech's RAN platform. In the trial, Viettel offered free 5G data with unlimited capacity so that customers could experience the power of 5G for themselves. Viettel reported that customers could download a 90-minute HD movie in 30 seconds[2].

Throughout 2022, Viettel aims to deploy 1,000 base stations. Of those, 30 percent will be based on Viettel's own solution and others will be RAN solutions from network equipment providers (NEPs).

Technical Components of Solution

- **Intel® Xeon® D processor**. Intel® Xeon® D processors deliver workload optimized performance in space and power constrained environments, from the data center to the intelligent edge. Viettel High Tech is using these processors in its micro cell RAN platform.
- **Intel® Xeon® Scalable processor (Gold SKU)**. Intel® Xeon® Scalable processors support high memory speeds, enhanced memory capacity, and built-in workload acceleration. Viettel High Tech is using these processors in its macro cell RAN platform (see Figure 3), and is planning to adopt the latest 3rd gen Intel® Xeon® Scalable processor family.
- **Intel® Ethernet Network Adapter XXV710-DA2T**. Part of the Intel® Ethernet 700 Series NetworkAdapters family, this network adapter delivers excellent performance for 25GbE connectivity, and intelligent offloads and accelerators to unlock network performance in servers with Intel® Xeon® processors. Kernel and Data Plane Development Kit (DPDK) drivers enable scalable packet processing.
- **Intel® FPGA Programmable Acceleration Card (Intel® FPGA PAC) N3000**. This highly customizable SmartNIC platform has a memory mixture designed for network functions and an integrated network interface card (NIC). It has a small form factor and enables high throughput, low latency, and low power per bit for customer networking pipelines.

Figure 3. Viettel High Tech's macro cell solution, from posterior and anterior angles.

Next steps

Viettel High Tech is planning to deploy the 3rd generation Intel® Xeon® Scalable processor family to improve the capacity and processing power of the DU. The latest generation processor includes improvements in input/output, memory, storage, and networking technologies. The FlexRAN™ software architecture has been optimized for the new processor family and will help Viettel High Tech to realize performance improvements in the processors.

Viettel High Tech's plans will see it continuing to deploy 5G across Vietnam, with a target of 12,000 base stations deployed by 2025.

Viettel High Tech is planning to test the Intel® vRAN Dedicated Accelerator ACC100, as a more workload-targeted replacement for the Intel® FPGA PAC N3000.

Spotlight on Viettel

Viettel is a multinational telecommunications company, headquartered in Vietnam. Worldwide, Viettel operates in 11 countries has more than 70 million subscribers in Vietnam[3], and more than 120 million subscribers globally[4]. The company's 2020 revenue was more than USD 11.48 billion[5], making this group Southeast Asia's most valuable telecommunications brand.

http://viettel.com.vn/en

* See backup for workloads and configurations. Results may vary.

Learn More

- FlexRAN™ at GitHub
- E-guide: Deploying Open and Intelligent RAN
- Intel® Xeon® D processor
- Intel® Xeon® Gold processor
- Intel® Ethernet Network Adapter XXV710-DA2T
- Intel® FPGA Programmable Acceleration Card (PAC) N3000
- Intel® vRAN Dedicated Accelerator ACC100

Find the solution that is right for your organization. Contactyour Intel representative or visit **intel.com/communications**

[1] Configurations: Micro cell server based on Intel® Xeon® D-2183IT processor, 16 cores, 32 threads, 2.2 GHz, 100W, 32GB RAM, 240GB SSD, 1 x Intel® Ethernet Network Adapter XXV710-DA2T. Server: SuperMicro SYS-E403-9D-16C-FN13TP. Software spec: NSA/SA, 128UE/cell, 5G NR release 15, SU-MIMO 4 layer, FlexRAN software for L1, Viettel High Tech's protocol stack for L2 and L3. CentOS 7.7. Frequency band: n78, n41. Macro cell server based on Intel® Xeon® Gold 6242R processor, 64GB RAM, 240GB SSD, 3x Intel® Ethernet Network Adapter XXV710-DA2T. Server: SuperMicro SYS-220U-MTRP. Software spec: NSA/SA, 128UE/cell, 5G NR release 15, SU-MIMO 4 layer, FlexRAN software for L1, Viettel High Tech's protocol stack for L2 and L3. CentOS 7.7. Frequency band: n78, n41. Testing by Viettel High Tech in March 2021.

[2] http://viettel.com.vn/en/post/viettel-becomes-first-5g-carrier-vietnam

[3] https://thanhnien.vn/tai-chinh-kinh-doanh/viettel-duoc-danh-gia-la-mang-vien-thong-co-trai-nghiem-tot-nhat-1306272.html

[4] http://baochinhphu.vn/Utilities/PrintView.aspx?distributionid=442124

[5] https://en.vietnamplus.vn/viettel-posts-115-billion-usd-in-2020-revenue/194728.vnp

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Performance results are based on testing as of dates shown in configurations and may not reflect all publicly available updates. See configuration disclosure for details. No product or component can be absolutely secure.

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