NAKAO LAB

Next Generation Cyber Infrastructure “Beyond5G”

Ultra-compact Software Defined Radio Board in the Local 5G Box

- Accelerating Development of Programmable Base Stations Evolving with Software Expansion -

NICT B5G Fund Project “Research and Development of B5G IoT SoC and IoT solution Building Platform of Continuous Evolution”
Grant #00801

Successfully developed an “ultra-compact” software-defined radio (SDR) board that supports the development of next-generation communication standards

✓ Developed a board that supports M.2 standard interface, ultra-compact size (80mm long, 22mm wide , 5mm thick (board thickness 0.8mm)) and can be programmed with 5G and next-generation communication protocols

✓ Accelerate the resolution of social issues, the exploration of latent needs, and the creation of value through confirmation and verification of usefulness in demonstrations using 5G/B5G communication equipment that utilizes SDR

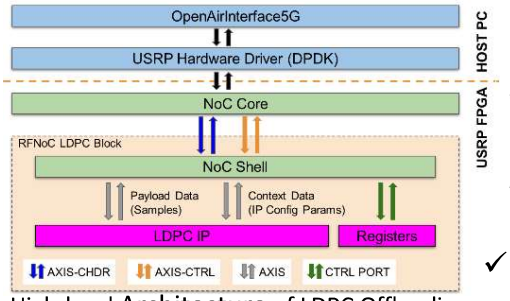
- ultra-compact: Compatible with M.2 standard.
- Height 80 mm, width 22 mm, thickness approx. 5mm
- Flexibly add network functions through software
- Expand frequency bandwidth by daisy chaining multiple boards
- Confirmed to work as a 5G base station

Palm-sized Local 5G Box
10.7 x 10.7 x 5.5 cm

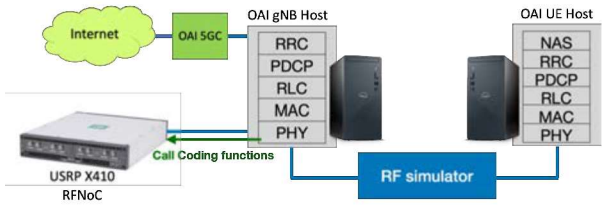
Comparative Analysis of Processing Latency and CPU Efficiency in FPGA-Based FEC Acceleration

✓ Application of RF Network on Chip (RFNoC) technology for FPGA-based acceleration of Low- Density Parity-Check (LDPC) code and Polar code

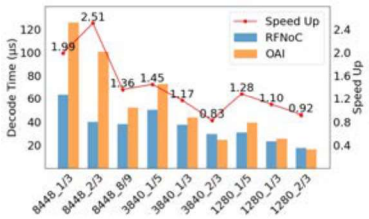
✓ Comparative analysis of CPU and FPGA processing performance in OpenAinInterface (OAI) platform



High-level Architecture of LDPC Offloading



FPGA accelerator is deployed on USRP X410



LDPC Code: Single Block(Decoder)

✓ A pioneering RFNoC-based FPGA offloading approach for LDPC and Polar codes is presented, demonstrating a 5x acceleration with only a 5% increase in CPU consumption.

✓ It can be applied to Application-specific, Network slicing and AI-driven resource allocation.

Ready-to-use, compact, low-power, high-performance Internet Directly Connected Local 5G System “HYPER NOVA”

Industry-Academia Collaboration among UTokyo, NESIC(NEC Networks & System Integration Corporation)

✓ Integrates local 5G base station, 5G core, and MEC Software-based, quick functionality update is possible

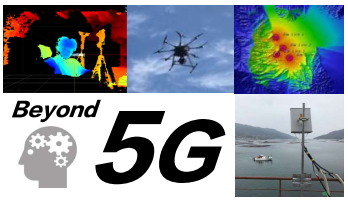
✓ Quickly deployable,Space-saving, low power consumption, High performance

- **Output: 1 W × 4 ports (Total 4W)**
- **Size: (W)135 x (H)189 x (D)357 mm (excluding antenna)**
- **Weight: 6 kg**
- **Power consumption: Approx. 150W**
- **Fast upload over 700Mbps**
- **Supports semi-synchronous system (TDD1/2/3)**
- **Number of UE connections: over 128**

Outdoor case option available

Nakao Research Laboratory

SCHOOL OF ENGINEERING
THE UNIVERSITY OF TOKYO

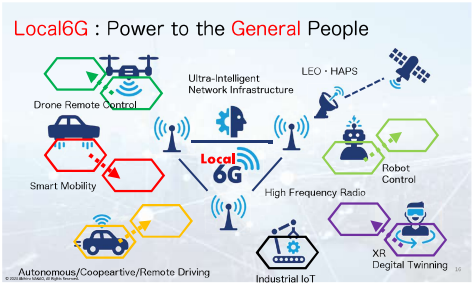


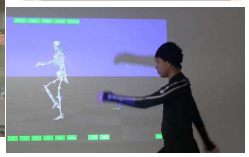
Research areas : Next Generation Cyber Infrastructure

- 5G and Beyond 5G Mobile Networking
- AI/Machine Learning Empowered Networking
- Ultra-Low Latency Communication
- Internet of Things (IoT)
- Network Softwarization
- Network Applications
- Software Defined Networking (SDN)
- Network Functions Virtualization (NFV)
- Multi-Access Edge Computing (MEC)
- Network Security

Research on Next Generation Cyber Infrastructure “Beyond5G”

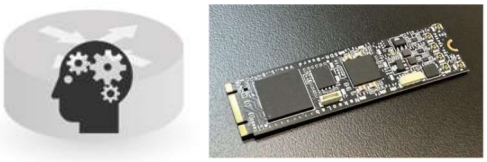
We conduct research and development of information infrastructure technology and applied technology (VR / AR / MR, remote monitoring control, autonomous cooperative control, etc.) of Beyond 5G aiming for realization around 2030 in the future.





Construction of flexible cyber infrastructure by softwarization

We research on “network virtualization technology” that integrates information science and communication engineering and allows many communication functions to coexist independently, “network softwarization” that configures network devices with software such as SDN that realizes centralized control and NFV that builds functions on virtual machines, and “network slicing” that divides programmable resources such as bandwidth, calculation, and storage resources that build communication infrastructure into independent sets called “slices” using virtualization technology, and executes the implemented network functions without interference with each other.



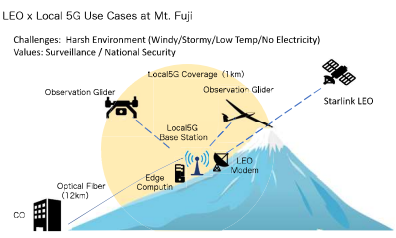
[Ultra-compact Software Defined Radio Board]

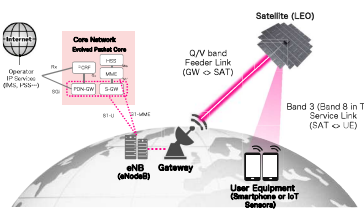
[Ultra Compact Local5G Softwarized System]

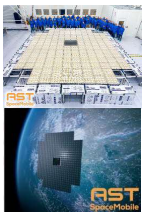
Regional revitalization utilizing the next-geneartion cyber infrastructure

We conduct research on promotion of regional revitalization by collecting and analyzing huge amounts of real-time data by making full use of 5G / local 5G with the characteristics of large capacity, low latency, and massive machine type communications, and by means of IoT / AI / machine learning.

We conclude a social cooperation agreement with the region, accelerate technical exchanges and academic exchanges related to informatics, information communication technology, and use the region as a field for demonstration experiments of information communication technology to accelerate research that contributes to industrial promotion and resolution of regional issues.







[R&D of Super-coverage IoT using Low Earth Orbit Satellites]