



OPEN RAN 5G NR BASE STATION

This Project Group Charter establishes the scope, intellectual property and copyright terms used to develop the materials identified in this Project Group.

Only Participants that execute this Working Group Charter will be bound by its terms and be permitted to participate in this Project Group and shall be considered “Contributors” in the Project Group as defined in the **Telecom Infra Project IPR Policy document**.

TIP Board of Directors Approval Date: 02/6/2019

1. PROJECT GROUP NAME

OpenRAN 5G NR Base Station

2. PURPOSE

Although the 5G standards have been recently ratified, the industry is all excited and already participating in technical trials, spectrum auctions, conferences, marketing initiatives, and operator announcements around 5G launches. TIP needs to prepare for and influence this new technology in its early phase to re-affirm the roadmap towards next generation networks.

The very first component of the 5G system is the 5G New Radio (5G NR), specifications which are now available within 3GPP standards, and it is compatible for trialing against existing 4G infrastructure; enabling a path for 5G acceleration with minimal infrastructure overhaul.

3. GOAL

Collaborate via TIP to define a disaggregated approach with a whitebox platform for 5G NR that is easy to configure and deploy.

Goal is to create a new 5G NR Project Group within the TIP Community with a focus on publicly available hardware. The high level objectives of the group will be to create reference designs for the various radio network components

including but not limited to the baseband, radio, and antenna; initially for small cell architectures with a potential extension to macro in a later phase. The end goal is to have hardware partners build RAN components based on the reference design and have software partners integrate with said components.

4. PROJECT GROUP SCOPE

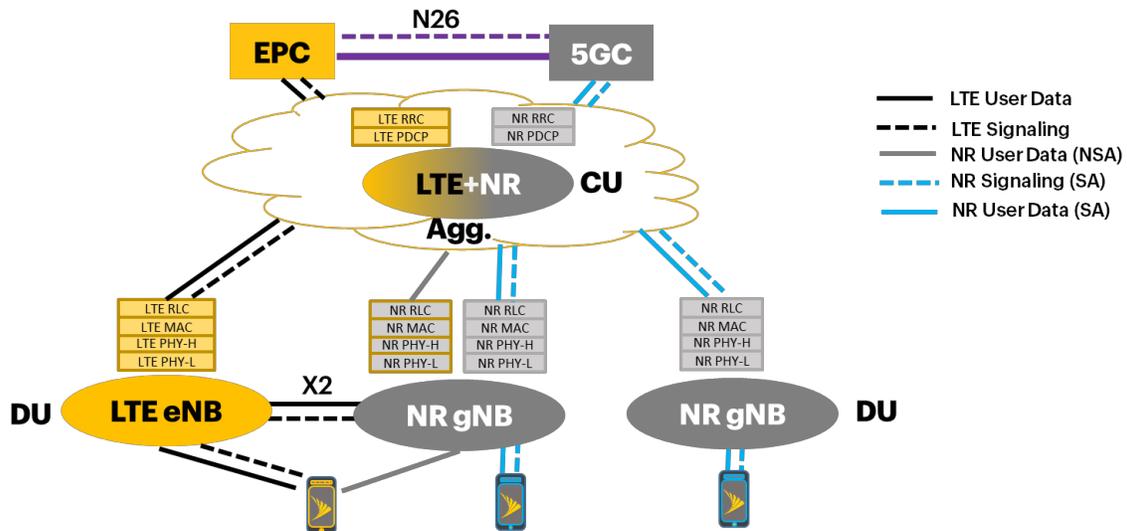
The OpenRAN 5G NR Base Station Project Group seeks to coordinate with other relevant bodies and organizations focused on 5G RAN technologies, systems, and networks; and share the outcome with the community. The Project Group will work with ecosystem partners and external organizations such as 3GPP, O-RAN Alliance etc. via third party collaboration agreements with TIP.

The 5G NR base station platform will have the flexibility to support all classes of 5G use cases defined by 3GPP. The Project Group will consider 5G NR technology to select practical use cases, and develop modeling techniques and a test framework. Specifically, the project group will identify key use-cases and suitable wireless system architectures (both standalone and non-standalone) for the specific applications and deployment scenarios based on operator input.

This Project Group is not focused on developing the 5G NR handset or user equipment. Actual Software is out of scope of this Project Group (other than the firmware and the integration specifications). However, the Project Group will help enable an ecosystem of innovative software providers.

Initial Use Cases:

EN-DC LTE+NR with EPC in sub 6-GHz (with specific focus on 2.6 GHz - Band 41/n41) is the targeted initial 5G architecture option. Operator deployment architectures include all in one small cells (baseband+radio in one enclosure) and distributed/centralized RAN options (separate baseband and radio) for both outdoor and indoor scenarios. The intent is to have a modular approach with the reference design for infrastructure for 5G only or for both LTE and 5G.



Example Deployment Scenario of LTE and 5G

Future Use Cases:

Focus on an all in one mmWave gNodeB design with a path leading to distributed/centralized architectures. Operator deployment architectures include all in one small cells (baseband+radio in one enclosure) and distributed/centralized RAN options (separate baseband and radio) for both outdoor and indoor scenarios. The intent is to have a modular approach with the reference design for infrastructure for 5G only or for both LTE and 5G.

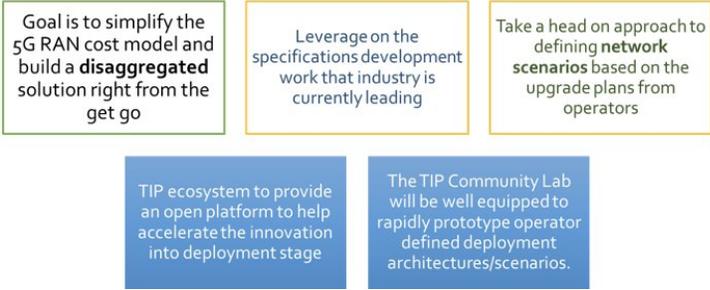
The use cases above are to be detailed out and planned for execution as part of the project group roadmap.

Goal is to focus on supporting Enhanced Mobile Broadband which aligns with our aim towards connecting people and broadening the coverage.

- Start with a combination of whitebox and off the shelf components
- Define a reference hardware framework/software architecture that decomposes 5G NR based RAN into individual blocks and components
- Multiple vendors with a publicly available API-based approach and full interoperability
- Compatible with 4G EPC for connectivity augmentation

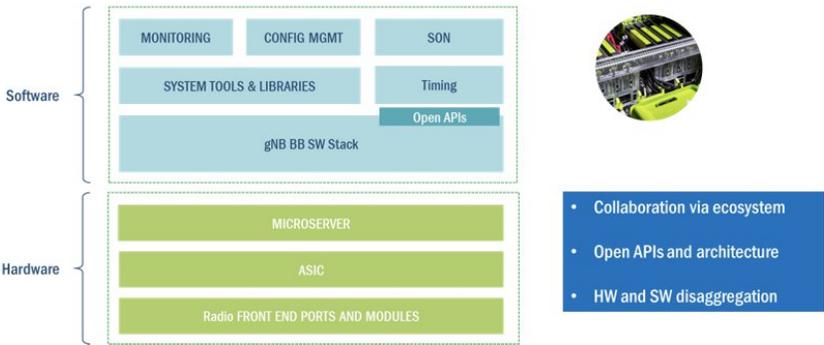
5G NR Open Base station Platform

A flexible RAN Solution for next generation



5G NR Open Architecture

Accelerate flexible network approach for next generation networks



5. PROJECT GROUP DELIVERABLES

General Deliverables: The Project Group will collaborate to assemble a whitebox toolkit including the following items that will be available to TIP members to build efficient and flexible 5G NR base station solutions. In the following, a disaggregated approach refers to a design that allows for various components (HW/SW) to be contributed by multiple vendors and are enabled by agreed upon interfaces and APIs. The following lists the Deliverables to be developed by the Project Group.

1. Specifications:
 - a. Develop a hardware reference design technical specification
 - i. Baseband general purpose processing module
 - ii. RF transceiver and timing sync module

- iii. Digital and analog front end module
 - iv. Management and monitoring system
 - v. Form factor mechanical design
 - vi. PHY layer integration with upper layer
 - b. Develop, reuse or extend interface specifications from 3GPP, O-RAN Alliance et al.
 - c. Firmware files with the hardware reference design for the platform (detailed schematics, PCB design, BoM, drawings of form factor hardware etc.)
- 2. Informational Technical Documents:
 - a. Describe typical use cases for 5G NR based networks in different geographic areas.
 - b. Develop integration procedures with protocol software (binary format) for a whitebox based, cost-efficient 5G NR base station solution
 - c. Author a comprehensive whitepaper document that covers use cases and methodologies for the testing whitebox based 5G wireless networks
 - d. Develop a set of guidelines for operators to integrate low-cost 5G NR whitebox into their existing network and deploy rapidly in all geographies.
- 3. Informational Non-Technical Documents:
 - a. Develop reference cost economic models for mobile/FWA connectivity using 5G networks in different geographic areas.
 - b. Build a framework for modeling of the overall cost economics (CAPEX, OPEX) of a proposed 5G NR network infrastructure.
- 4. Test Materials: Create test methodologies and comprehensive test plan documents for operator-defined use-cases. This includes the ability to meet specific quality of service, stability, availability and reliability targets, etc. This also covers functional and performance test plans for lab tests and field trials.

Timeline:

1. 5G NR based network operations, optimization, and planning for an all in one small cell

- a. Phase 1 [Target for Q2'19]: Define initial use cases
 - i. Identify the requirements for 5G NR small cell platform
 - ii. Define initial set of network operations use cases
 - iii. Define reference architecture
 - iv. Define open APIs at HW/SW level
 - v. Output: Contribute baseline requirements, initial use cases and learnings

b. Phase 2 [Target for Q4'19]: First Prototype(s) i. Select common architecture data model and sharing approach for solution development within the project group ii. Identify, select and assess solutions regarding their applicability to the defined use cases iii. Output: Demonstrate first prototypes and samples iv. Output: Contribute initial practices, algorithms and prototype results

c. Phase 3 [Target for Q2'20]: Validation of Use Cases i. PoC of initial use cases ii. Evaluate capabilities for the addressed scope regarding automated decision making, learning and knowledge management iii. Output: Contribution of PoC results, technical architecture, HW reference design, whitepaper with API definition

d. Phase 4 [Target for Q4'20]: Production Pilots with Shared Implementation

i. Production pilots of selected use cases

2. 5G NR based Macro solutions

To be planned as above at a later phase based on operator requirements.

6. PATENT LICENSING

The patent license for all Contributions, Draft Specifications and Final Specifications within this Project Group shall be:

[Check one box]

RAND License Option, as set forth in Section 5.2.1 of the Telecom Infra Project IPR Policy.

Royalty-free License Option, as set forth in Section 5.2.2 of the Telecom Infra Project IPR Policy.

7. FINAL DELIVERABLE COPYRIGHT LICENSING

Project Group agrees to grant the following copyright license for the Final Specification:

[Check one box]

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8. INITIAL PROJECT CHAMPIONS

Sprint, Vodafone, Facebook, ARM, Airspan, Altiostar, Qualcomm Technologies, Intel, Nokia, Tech Mahindra, TBD

9. CHAIR AND(OR) CO-CHAIR OF PROJECT GROUP

Chair

Durga Satapathy, Sprint

Co-Chair

Vanesa Fernandez , Vodafone