# Report on Open RAN Use Cases

*Open Radio Access Network Advisory Group*

*National Spectrum Consortium*

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# Report on Open RAN Use Cases

## Methodology: The National Spectrum Consortium's Use Case Sub-Group

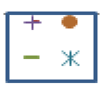
With the goal of accelerating Open RAN adoption, the National Spectrum Consortium and its Open RAN Advisory Council formed the Use Case sub-group. This group was created to identify Open RAN use cases, and provide input to the Prototyping and Experimentation sub-group.

The entire NSC Open RAN Advisory Council was invited to join. Participants included DOD (OUSD), Qualcomm, VMware, AT&T, Parallel Wireless, Intrinsix, Palantir, Celona, DISH, X-COM, Deepsig, Universities (GMU, VT, GTRI), consultants, and others.

The sub-group met between September and December 2022. Members were encouraged to submit use cases, which were discussed in the meetings. The use cases were then included in a survey (developed by ATI), which was distributed to all members of the NSC Open RAN Advisory Council and DOD. The respondents were asked to rate each use case on importance (5 point scale) and priority (3 point scale).

## Results

The use cases that the sub-group identified are shown on the chart below. These are not exclusively Open RAN use cases. The x-axis is the importance, and the y-axis is the priority, both calculated as the mean from all the votes each use case received.



(Note the rectangle's use case titles are shown to the left, due to lack of space on the chart).

## Selected Top Use Cases

Below is a list of the top use cases that the sub-group identified:

**Air Interface RAN Identification and Countering of EMI and/or Jamming**

Federal and private 5G networks are both subject to a range of sources of interference— for instance, industrial equipment emissions from heaters, generators, welders, HVAC, unauthorized repeaters, and many other sources. This can cause network degradation and can often require expensive truck rolls, manual diagnosis, and mitigation processes. All of this can be time-consuming, slow to correct, and can lead to service disruptions for long periods of time. Both federal and commercial networks can be subject to malicious wireless attacks as well. However, federal systems may be especially subject to jamming, EW, and EA-type threats to the air interface.

In the face of such threats, 5G networks offer an enormous advantage: the ability to detect, identify, and spatially isolate or localize these threats or their sources. This allows the network to mitigate these by nulling energy around the emitter, responding to the event electronically or physically, identifying the type of threat to a human or security operator, and generally acting towards much faster resolution of the source of the threat or system degradation.

**Mobility – Small Form-Factor Integrated O-RU/O-DU & U.S.-CHIP capabilities**

The future of the RAN in both commercial and federal spaces will be won based on economies of scale and integrated solutions which deliver intelligent and efficient processing with the best costs of hardware, operations, and best-performing edge KPIs (e.g., spectral efficiency, power consumption, link margin, sum-rate, and end-user-experience). Open RAN-compliant small form-factor, high-volume O-RU, O-DU, and embedded O-RU/O-DU combination platforms should be key to ensuring that software providers in the U.S. ecosystem can co-develop competitive algorithmic offerings and attract scaled adoption of Open RAN and Open RAN equipment.

Likewise, the ability to develop, deliver, and supply this core enabling silicon at scale is also key requirement for the success of future Open RAN solutions. It will also be a key requirement for the ability of U.S. Open-RAN-centric software and algorithm solution vendors to bring their solutions to market.

**Air Interface Security/Facility Threat Monitoring**

Numerous facilities, especially U.S. government and military facilities, have strict access and perimeter control, which is important to the security, privacy, and effectiveness of their operations. Deployed private 5G systems are able to provide awareness of device movement and activity throughout and within these facilities. These systems leverage existing O-RU and network elements to perform wideband spectrum monitoring, long-term analytics, and pattern and change detection in order to detect, track, and alert on the behavior of new devices, and new threats to these facilities. By leveraging sensing as deployed within private 5G infrastructure, integrated into the O-RU and edge devices, federal users can also begin to secure and monitor their spectral operating environment for many facilities and bases across a wide range of threats with RF signatures which currently are undetectable by most wireless intrusion detection systems .

**RAN Power and Cost Reduction at Edge**

Open RAN device cost and power consumption, especially at the edge within the O-RU and O-DU, is important in wireless systems. Technologies which reduce power consumption and cost of O-RU and O-DU components will help both the federal and commercial ecosystem and accelerate Open RAN adoption and deployment. Lower power means lower CapEx and OpEx, both of which are deciding factors in vendor selection and are areas where Open RAN can struggle.

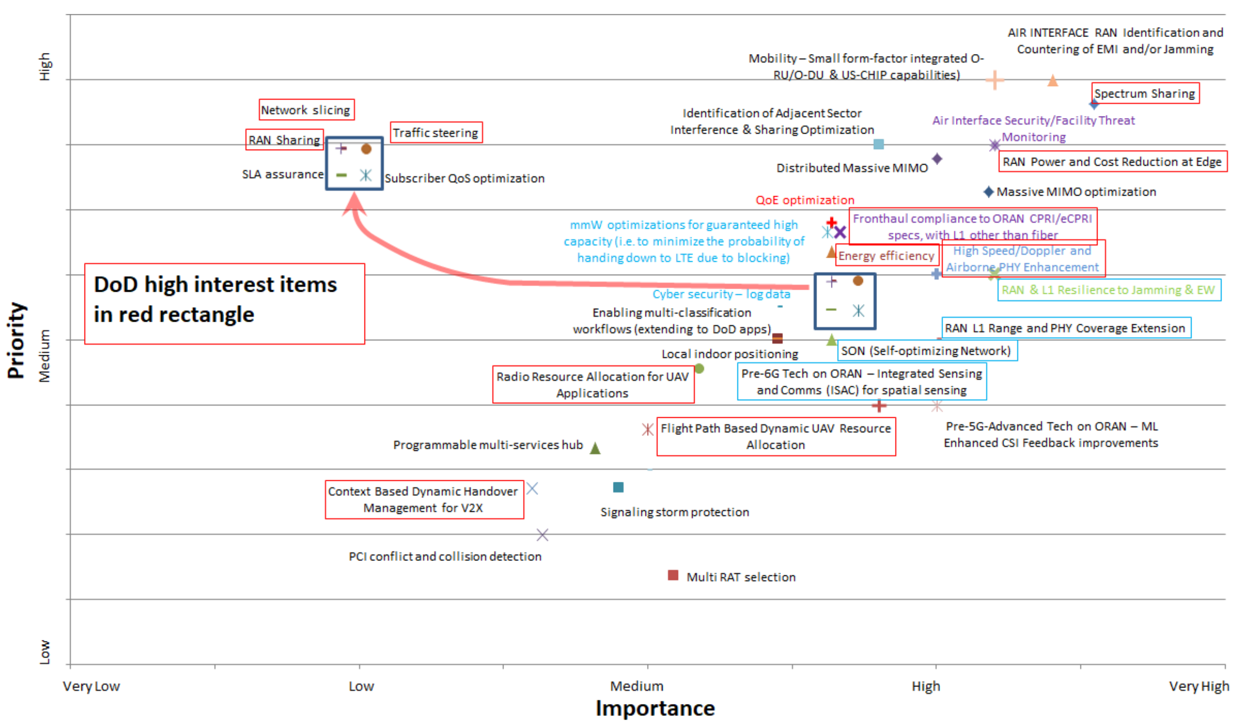
To counter this, a number of new technologies can be employed in the O-RU and the O-DU, specifically within the Upper and Lower PHY, and joint design around the analog RF component and converter hardware selected to operate jointly with it. Through machine learning and neural processing, hardware effects can be compensated. This reduces the requirements on components, leverages cheaper and lower power digital processing platforms with economies of scale, and makes self-tuning and lower cost front-end equipment better suited for deployment.

Ultimately, a range of technologies can be applied in both HW and SW design and co-design to help make Open RAN edge devices such as O-RU and O-DU components cheaper and easier to deploy and operate – especially for mMIMO deployments. The success and competitiveness of Open RAN ride heavily on the KPIs and costs incurred at the edge in this fashion, so this is one of the most important investment areas to determine the competitive nature of Open RAN.

**Identification of Adjacent Sector Interference & Sharing Optimization**

Spectrum sharing and dense re-use of spectrum are becoming increasingly important. CBRS has proven an important first step in allowing the deployment of private 5G services on shared spectrum bands. However, this model  is not particularly aggressive in its attempts to re-use spectrum, assuming only height above-average-terrain propagation models and relying on ESCs for ground truth of high powered primary users which are easy to identify (e.g., radars).

The next generation of spectrum sharing should have much more pervasive awareness of spectrum usage and should optimize unlicensed band sharing. To enable this, radio units (and ultimately UEs) should have more “common sense” in identifying properties of emitters in the spectrum around them (e.g., power levels of adjacent emitters, cells, UEs, etc.) or the presence of other protocols or adjacent sectors in the band. This kind of general air-interface awareness provides the raw material and information which can be used to optimize wireless systems and gNBs for optimal nearby operation, coordination, co-scheduling, power control, spatial/beam tuning, or for band vacating or other actions. This is even more critical for DOD 5G systems which may need to operate in new areas and new regions or to adapt to and interoperate with spectrum-sharing peers.



**List of Use Cases**

1. Massive MIMO optimization
2. Local indoor positioning
3. Programmable multi-services hub
4. PCI conflict and collision detection
5. Subscriber QoS optimization
6. Traffic steering
7. QoE optimization
8. Network slicing
9. SLA assurance
10. Signaling storm protection
11. Energy efficiency
12. Context Based Dynamic Handover Management for V2X
13. Flight Path Based Dynamic UAV Resource Allocation
14. Radio Resource Allocation for UAV Applications
15. RAN Sharing
16. Cyber security – log data
17. Enabling multi-classification workflows (extending to DOD apps)
18. Spectrum Sharing
19. Multi RAT selection
20. SON (Self-optimizing Network)
21. Distributed Massive MIMO
22. Fronthaul compliance to Open RAN CPRI/eCPRI specs, with L1 other than fiber
23. mmW optimizations for guaranteed high capacity (i.e. to minimize the probability of handing down to LTE due to blocking)
24. High Speed/Doppler and Airborne PHY Enhancement
25. RAN L1 Range and PHY Coverage Extension
26. RAN & L1 Resilience to Jamming & EW
27. RAN Power and Cost Reduction at Edge
28. Identification of Adjacent Sector Interference & Sharing Optimization
29. AIR INTERFACE RAN Identification and Countering of EMI and/or Jamming
30. Air Interface Security/Facility Threat Monitoring
31. Pre-5G-Advanced Tech on Open RAN – ML Enhanced CSI Feedback improvements
32. Pre-6G Tech on Open RAN – AI-Native Air Interface for resilience and mil Apps
33. Pre-6G Tech on Open RAN – Integrated Sensing and Comms (ISAC) for spatial sensing
34. Pre-6G Tech on Open RAN – Integration of Digital Twin World Spectral-Spatial Model building
35. Mobility – Small form-factor integrated O-RU/O-DU & US-CHIP capabilities

Most use case descriptions can be found in the linked documents, based on the table below.

| | VMware | ORAN Alliance | Deepsig |
|---|---|---|---|
| Massive MIMO optimization | X | X | |
| Local indoor positioning | X | | |
| Programmable multi-services hub | X | | |
| PCI conflict and collision detection | X | | |
| Subscriber QoS optimization | X | X | |
| Traffic steering | X | X | |
| QoE optimization | X | X | |
| Network slicing | X | | |
| SLA assurance | X | X | |
| Signaling storm protection | X | | |
| Energy efficiency | X | | |
| Context Based Dynamic Handover Management for V2X | | X | |
| Flight Path Based Dynamic UAV Resource Allocation | | X | |
| Radio Resource Allocation for UAV Applications | | X | |
| RAN Sharing | | X | |
| RAN Power and Cost Reduction at Edge | | | X |
| Identification of Adjacent Sector Interference & Sharing Optimization | | | X |
| AIR INTERFACE RAN Identification and Countering of EMI and/or Jamming | | | X |
| Air Interface Security/Facility Threat Monitoring | | | X |
| Mobility – Small form-factor integrated O-RU/O-DU & U.S.-CHIP capabilities | | | X |