USD(R&E)

B5G Network Customization for DoD

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Agenda

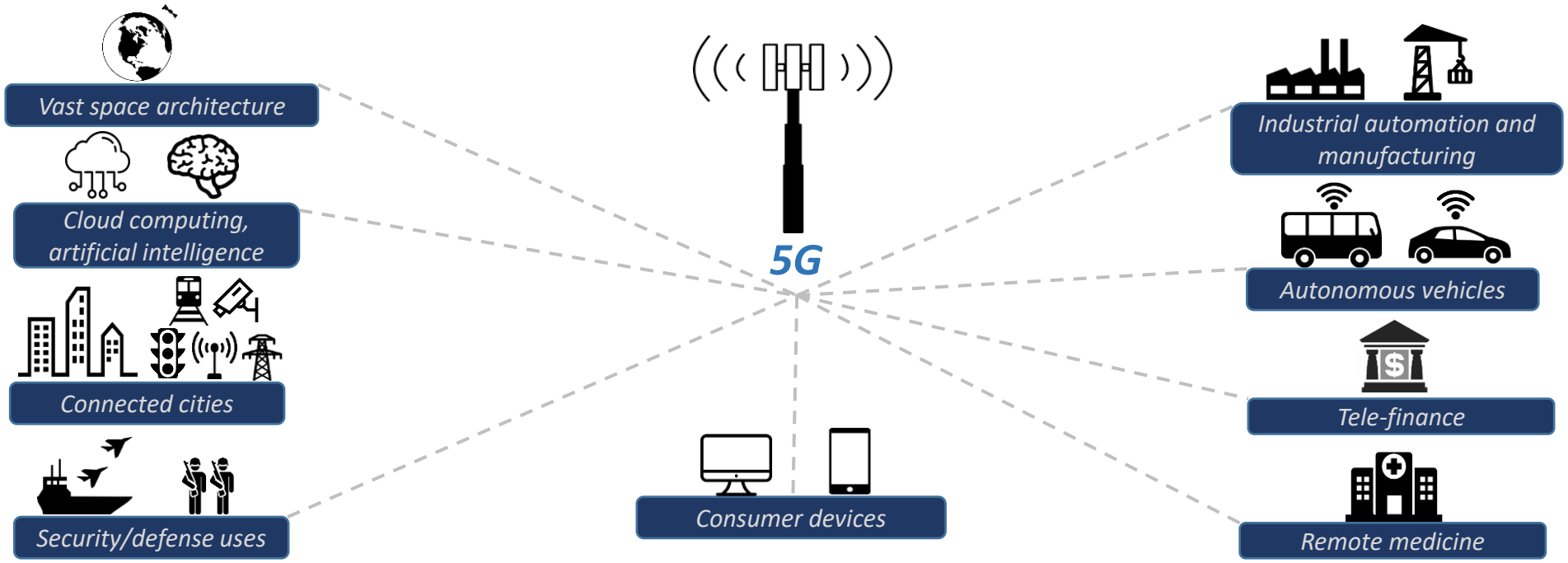
1. Why does Beyond 5G Matter to the Department of Defense
   - R&E 5G-to-xG Initiative

2. Innovate B5G Thrust Overview
   - Key Technology Pillars

3. DoD/Commercial Confluence
   - Use Cases, B5G Elements, Standardization

Why does Beyond 5G Matter to DoD?

B5G will underpin national economies and critical infrastructure operations



- B5G is transformational: Not just new radios/cell phones & network equipment
  - Ubiquitous Connectivity: human-to-human, machine-to-machine, human-to-machine
- Critical for DoD but no such thing as a totally secure system
  - Must operate through adversary impediments

DoD Strategies for 5G to xG

- Partnering with industry *up-front* allows DoD to understand and influence hardware, software, architectures, standards, and interfaces of 5G to B5G
  - → utilize advantages, adapt to CONOPs, mitigate vulnerabilities/operate through
    - Full-scale *collaborative experimentation* is the best way forward
    - Use DoD investment to leverage the > $350B invested by US telecom industry in 5G/B5G
- DoD cannot afford to sit on the sidelines, wait for industry to develop 5G to B5G capabilities, and then try to retrofit/adapt for our use
    - Leads to DoD having far less capability than the private sector.
    - Commercial industry will not adequately mature all that DoD needs - not aligned with their business models.
- Ultimately, the military that masters 5G to B5G will maintain overmatch.

OUSD R&E 5G to xG Initiative Overview

Revitalize the telecom ecosystem as a national security and defense modernization imperative !

❑ Objectives
- Advance U.S. & partner 5G capabilities – lead in 5G technology (*Accelerate* & *Innovate*)
- Heighten 5G security – sustain overmatch in the 5G security fight (*Operate Through*)

- ***Accelerate*** 5G technology with at-scale prototyping & experimentation
  - DoD is anchor tenant for advanced applications – high end of value chain
  - DoD helps commoditize RAN* via open interfaces (use US software excellence)
- ***Operate Through*** all network environments
  - Congested, contented, and compromised nets
  - Make market manipulation irrelevant by working over untrusted networks
- ***Innovate*** at 5G & beyond


Smart Warehouses – Transshipment
Naval Base Coronado


Dynamic Spectrum Sharing – 5G and Radars
Hill AFB


AR/VR for Distributed Ground Combat Training
Fort Hood


Smart Warehouses – Vehicle Maintenance
Marine Corps Logistics Base Albany


Robust Distributed Command & Control
Nellis AFB

❑ Reinforce these thrusts with standards activity, interagency engagement, and international partnerships

IB5G Strategic Roadmap

Commercial Wireless

DoD 5G Strategy

DoD 5G Implementation Plan

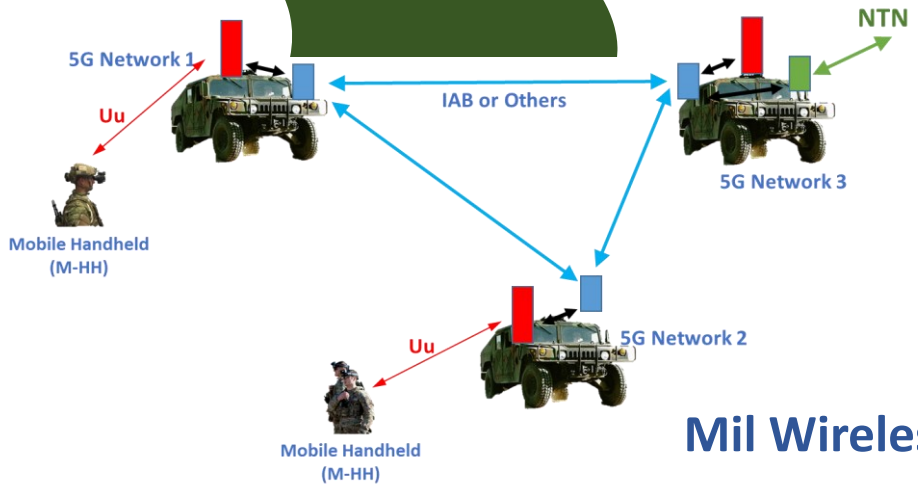
Standards

B5G TECHNOLOGY FRONTIERS

- DISTRIBUTED MOBILE MIMO
- TERRESTRIAL-NON TERRESTRIAL INTEGRATION
- MULTI-BAND, MULT-RAT OPERATION
- DYNAMIC SPECTRUM MANAGEMENT
- AUTONOMY & INTELLIGENCE
- NETWORK SOFTWARIZATION & VIRTUALIZATION

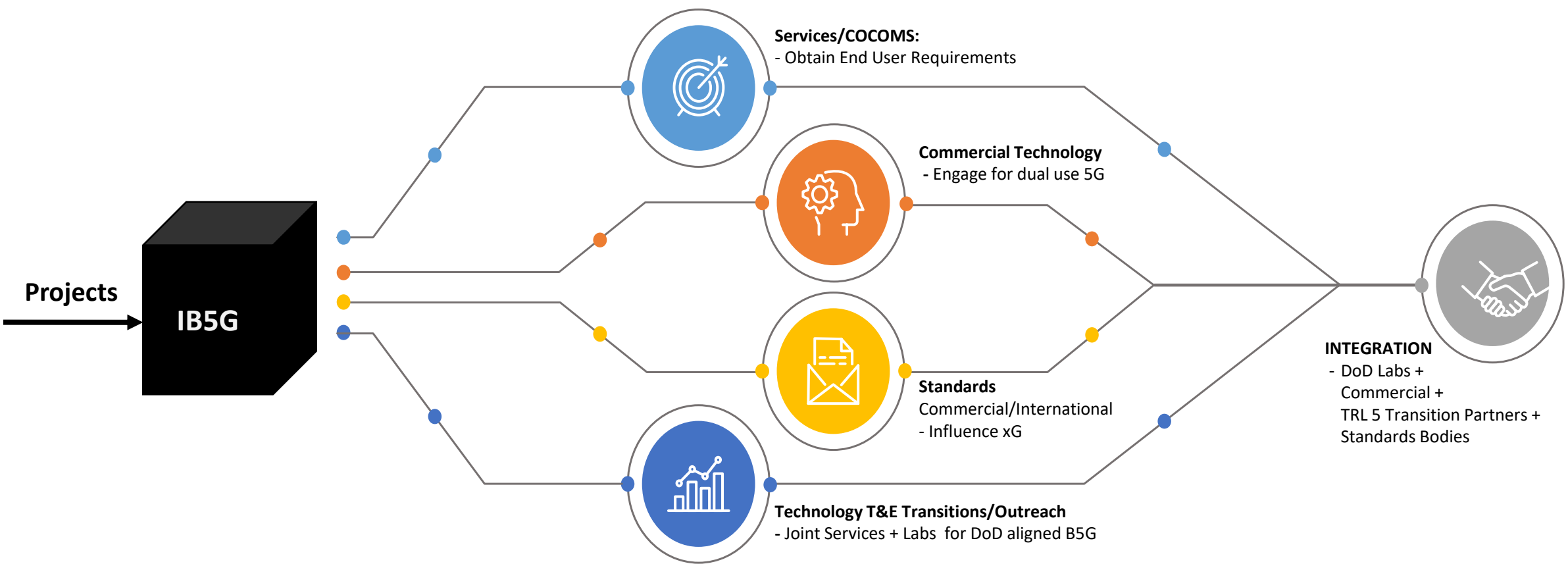
B5G STANDARDS

- Use Case & Requirements → Tech Specs, Gap Analysis (DoD Cross Functional Team)
- 3GPP Study Items (National Spectrum Consortium, ATIS)



Mil Wireless

Innovate B5G Tactical Overview

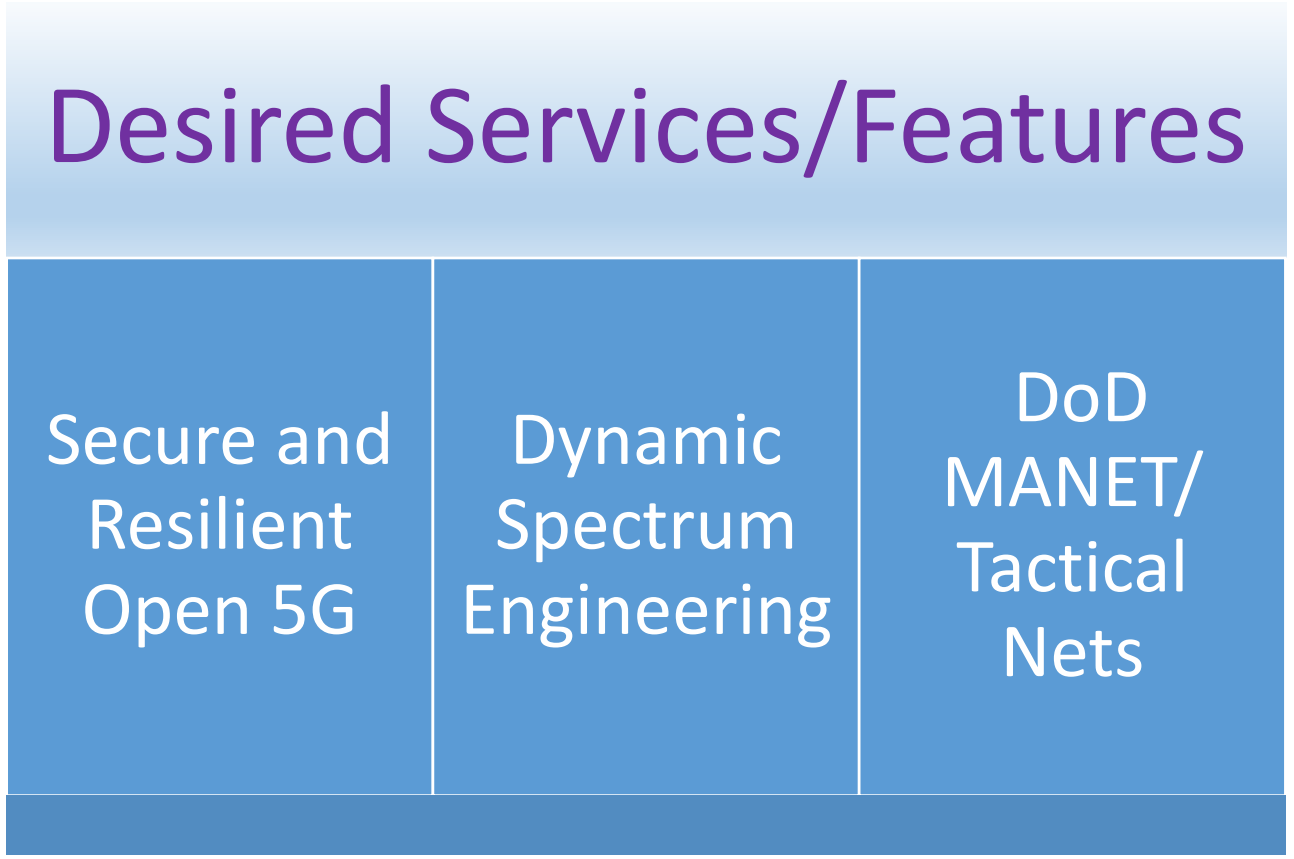


IB5G enhances core 5G components for DoD CONOPS, matures to TRL5 , identifies dual-use feature alignments with industry, influences standards

IB5G Opportunities to Collaborate

- NSF Resilient and Intelligent NextG Systems (RINGS) Awards Announced
  - Joint Public-Private Research Program
    - Apple, Ericsson, Google, IBM, Intel, Microsoft, Nokia, Qualcomm, VMware + NSF, DoD R&E, NIST
  - IB5G contributed $6M to the total $35.5M awarded across 37 projects
- S2MARTS OTA for Dynamic Spectrum Management ($6M Ph I)
  - Submission deadline 29 April
- TREX Request for Solutions (RFS) for the “Innovate Beyond 5G (IB5G) Prototype Project” draft posted 29 April

IB5G Technology Pillars



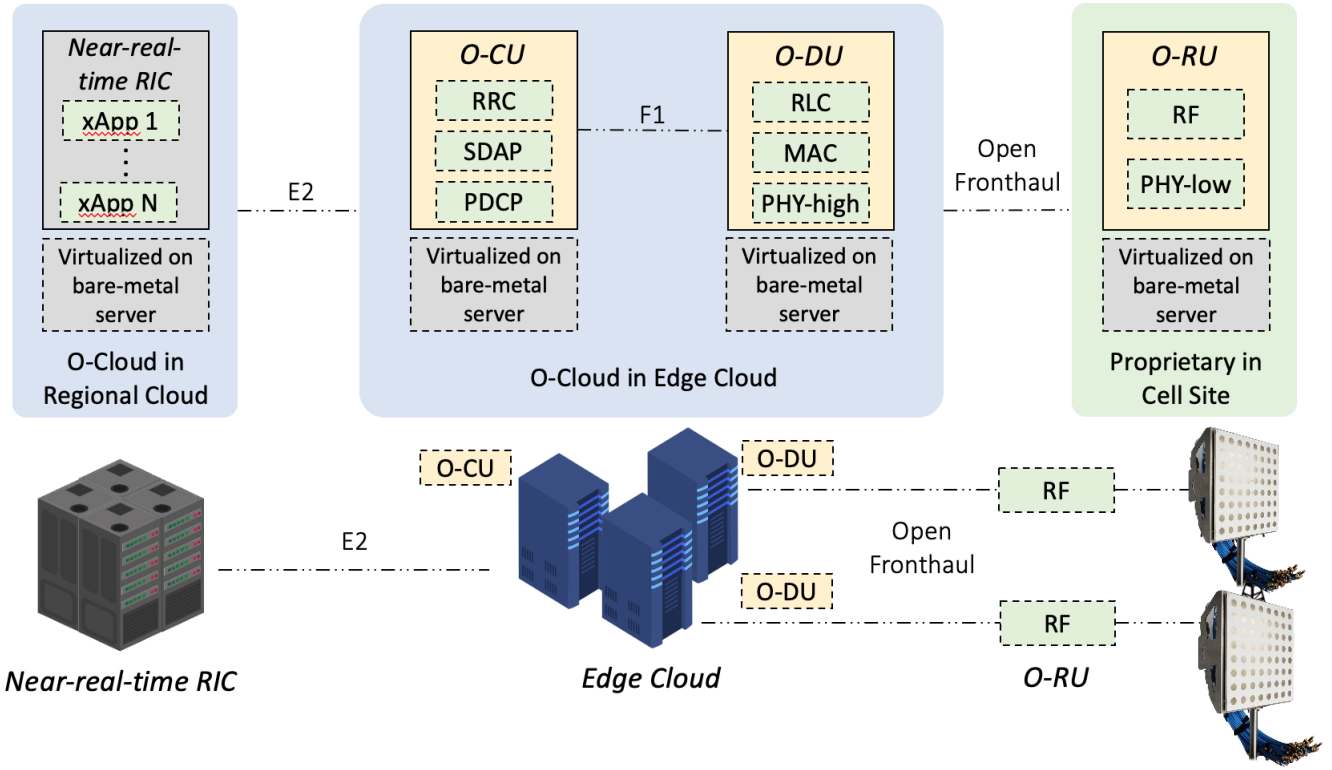
Flexible, Disaggregated and Programmable 5G

Traditional “black-box”

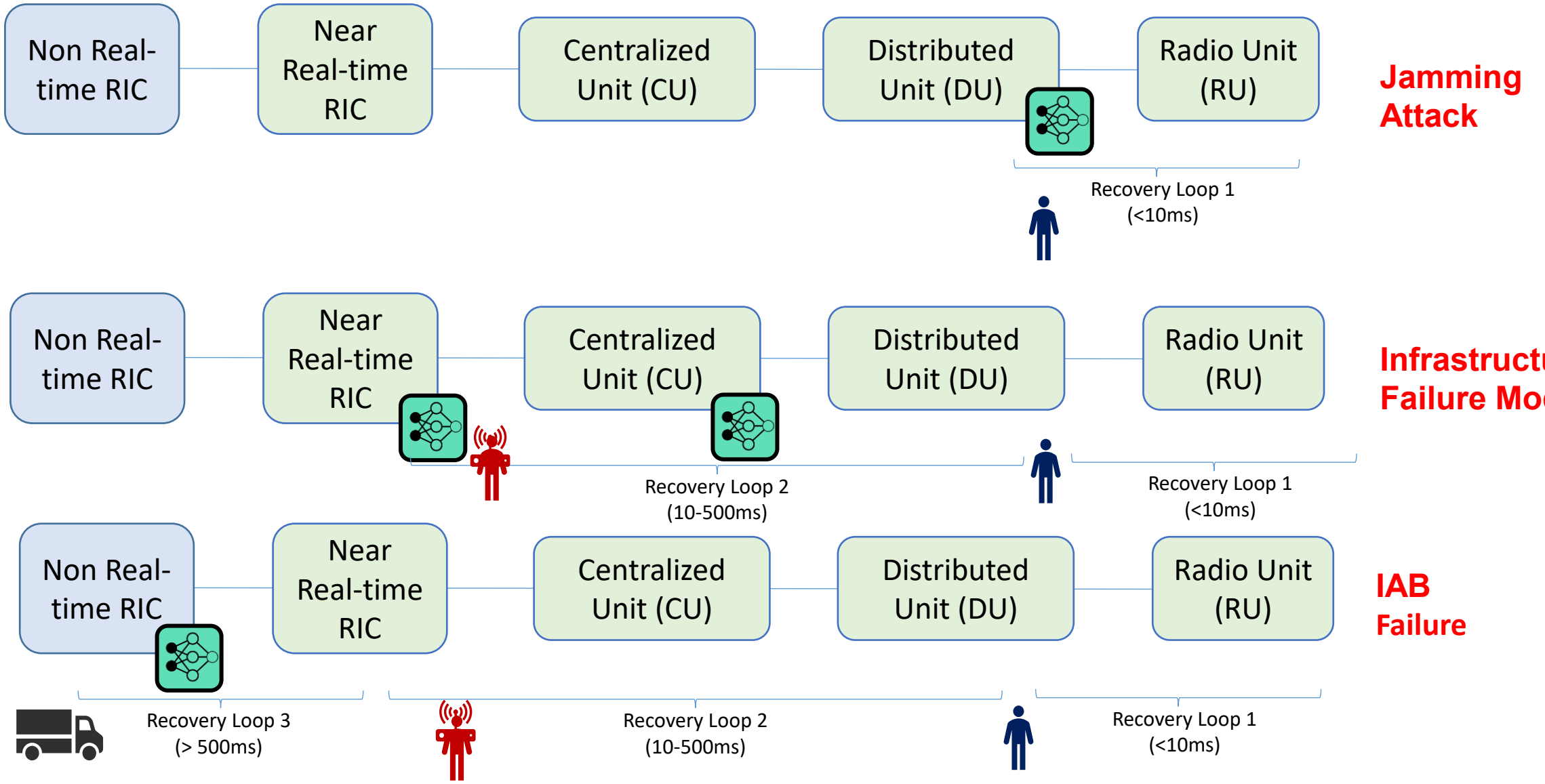
RRC SDAP PDCP

RLC MAC RF PHY

Open, programmable and virtualized

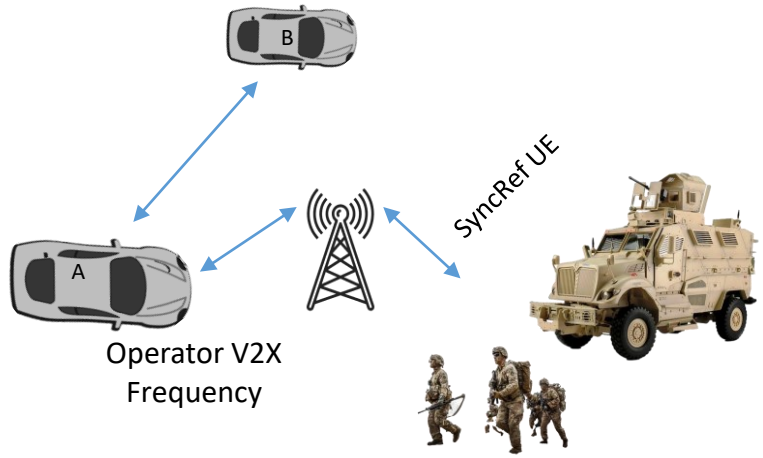


DoD Tactical Edge leveraging 5G + O-RAN



C-V2X/Sidelink Modes: In- & Out-Of-Coverage

In-Coverage (Mode 1)



In-Coverage:

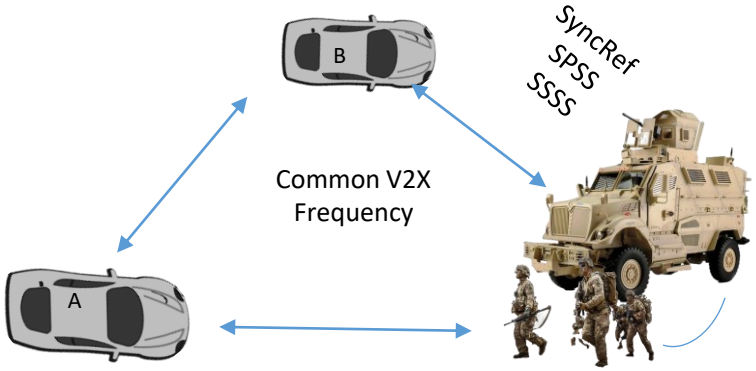
- gNodeB (Cellular Base Station) schedules UEs (User Equipment)

➢ **Low latency/high reliability comms**

➢ **In-Coverage, Out-of-Coverage, Partial-Coverage, Relaying**

➢ Vehicular Connectivity: Remote/Autonomous driving

Out-Of-Coverage (Mode 2)



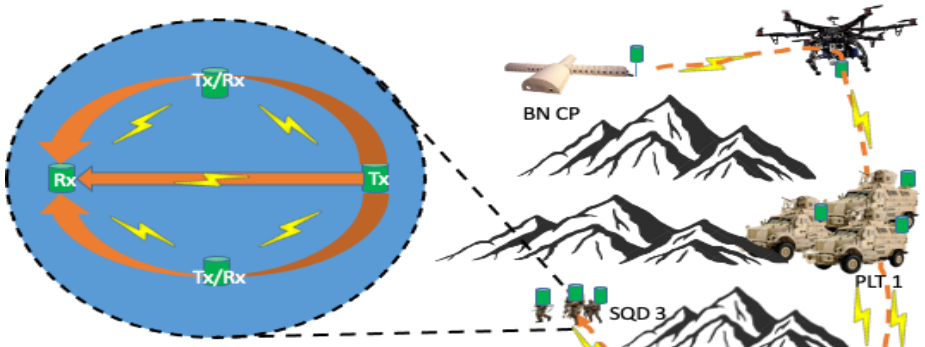
Out-of-Coverage:

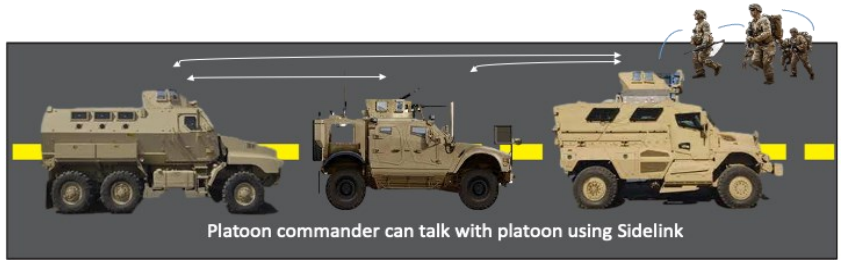
- No gNode B scheduling
- Autonomous Resource Selection

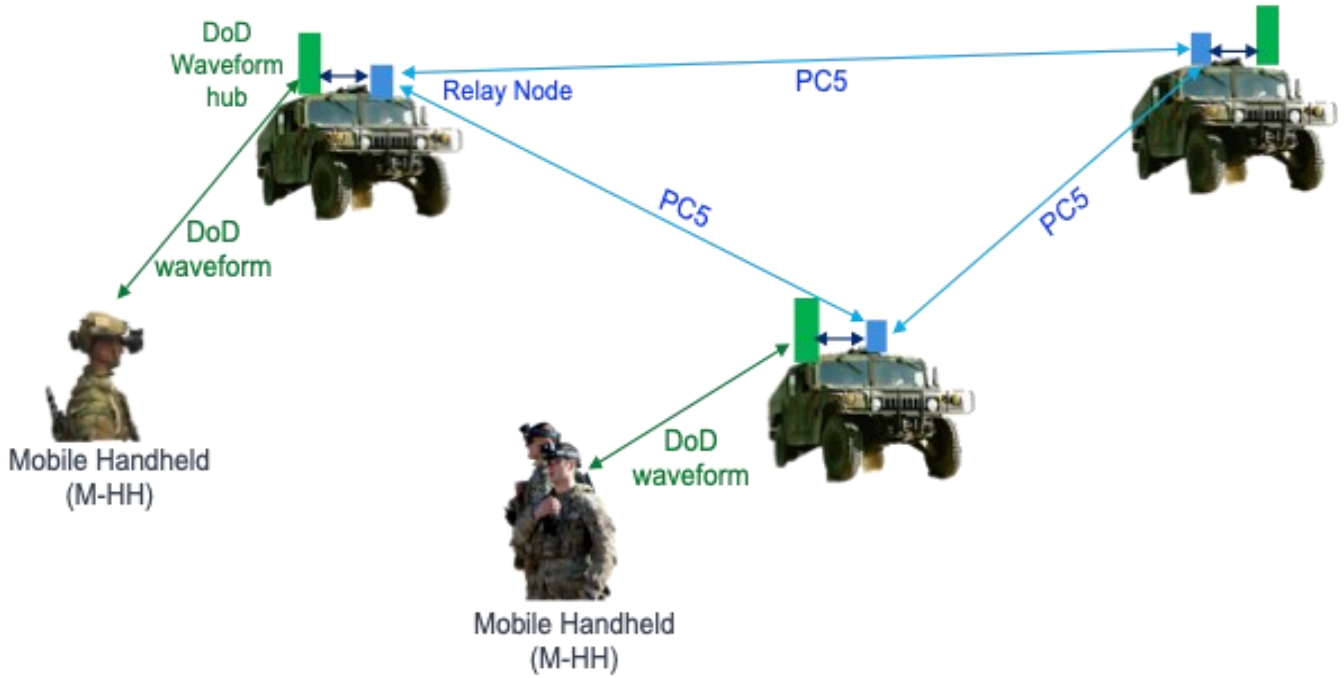
➢ UE-UE, Vehicle-to-Vehicle, V-to-Infrastructure, V-to-Soldier, V-to-Network

➢ Connectivity between: pedestrian, vehicles, drones

Sidelink Use Cases for DoD MANET

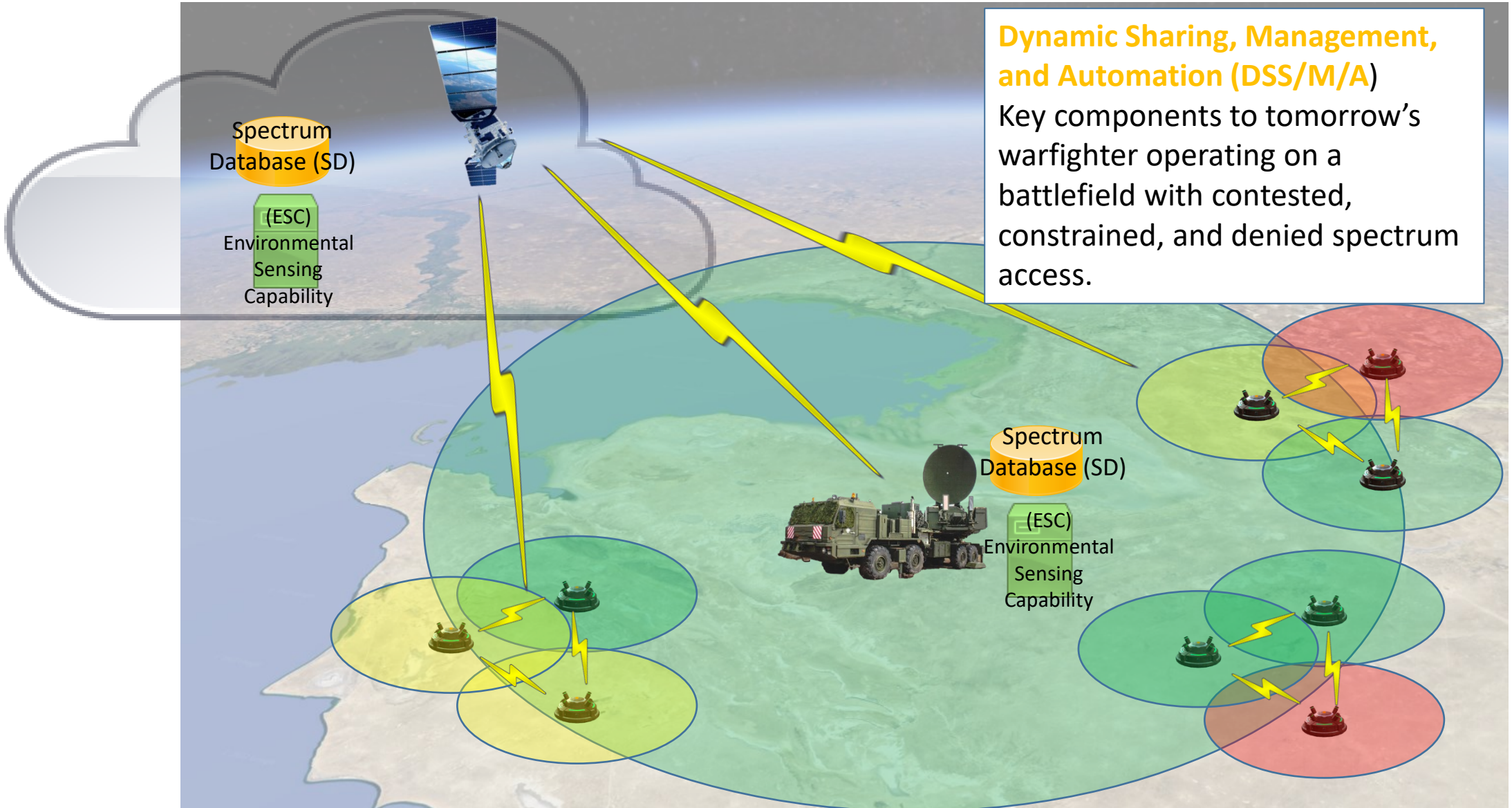






* Significant potential for technology adaptation of Sidelink/C-V2X to support DoD next generation battlefield mobile ad-hoc networks (MANETs).

Dynamic Spectrum Management



Dynamic Sharing, Management, and Automation (DSS/M/A)
Key components to tomorrow's warfighter operating on a battlefield with contested, constrained, and denied spectrum access.

IB5G Standards Contributions – Examples

- Study of Spectrum Sharing with Incompatible Radio Systems

S1-213015

3GPP TSG-SA WG1 Meeting #95-e

Electronic Meeting, 23 Aug –2 Sep 2021

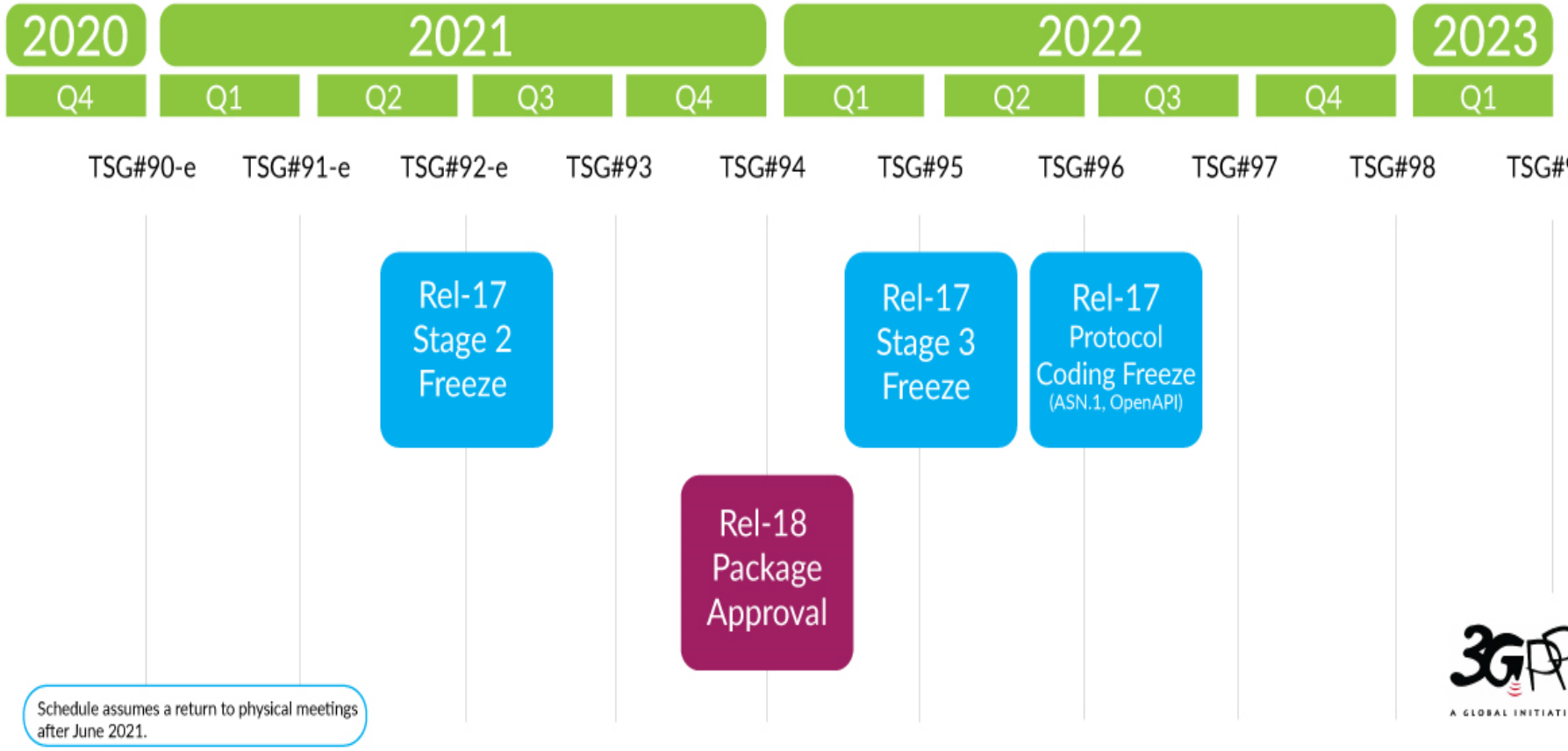
Objective: Identify use cases and define potential requirements in the following areas:

- Explore spectrum sharing use cases where incompatible radio systems:
  - May not have an interface for coordinated use of spectrum,
  - May have a unidirectional interface for sharing information relative to spectrum use.
    - 5G to non-3GPP based systems.
    - Non-3GPP based systems to 5G.
  - May have a bi-directional interface for sharing information relative to spectrum use.
- Explore use cases for different access priority schemes where
  - Non-5G incumbent radio system/users have priority.
  - 5G system/users have priority,
  - Non-5G incumbent radio system/users and 5G system/users have co-equal priority,
- Explore key performance indicators that would facilitate real time spectrum sharing.
- Explore security considerations (including risks, availability etc. to incumbents)

3GPP Rel -18/19 Potential Contributions

- Innovate B5G Thrust Areas aligned with 3GPP Study/Work Items

Sidelink (D-2-D via C-V2X), Integrated Access & Backhaul, Non-Terrestrial Networks, Non 3GPP Network Integration



Rel. 18 completion now mid 2023

- Some existing Approved Work items

https://www.3gpp.org/DynaReport/WI-List.htm

890022: Vehicle Mounted Relays (Rel-18 S1)

850046: Asset Tracking for 5G (Rel-17 S1)

860043: NR Dynamic Spectrum Sharing (Rel-17)

860046: NR_NTN Solutions (Rel-17 R2)

IB5G Standards: Other Elements

- National Spectrum Consortium TG: Sidelink/NTN co-chair

  https://www.nationalspectrumconsortium.org/

- DoD Observer - ATIS Next G Alliance

  https://nextgalliance.org/