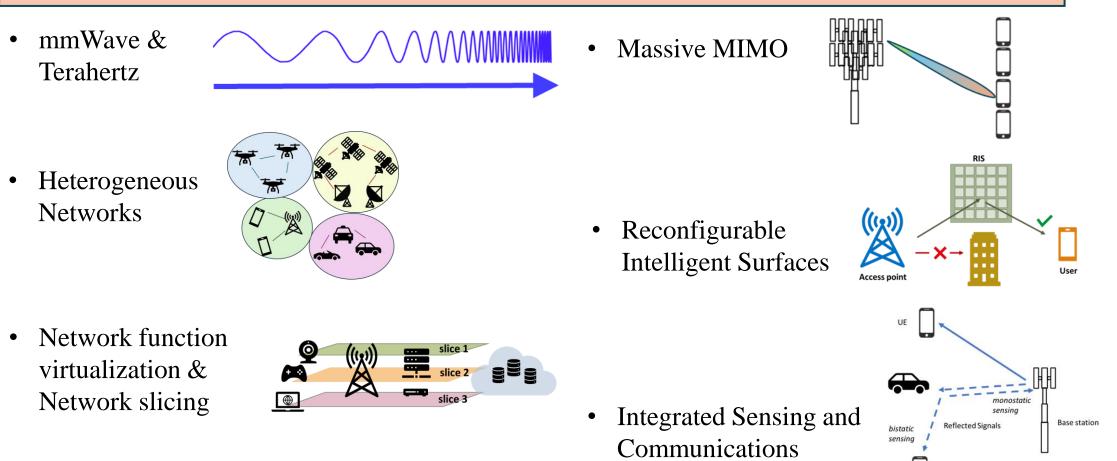




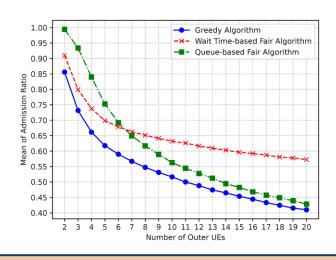
5G and Beyond Communication Networks

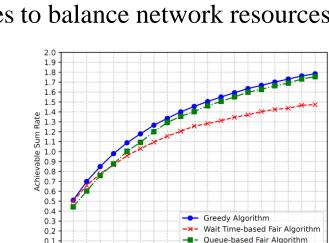




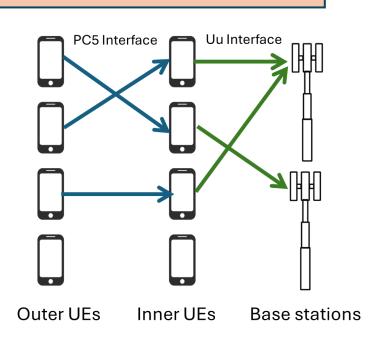
SIDELINK COMMUNICATIONS

- Sidelink connects out-of-coverage UEs to gNodeB via other UEs.
- Greedy algorithm incrementally selects links to optimize the rate.
- Fair algorithm adjusts UE priorities to balance network resources.



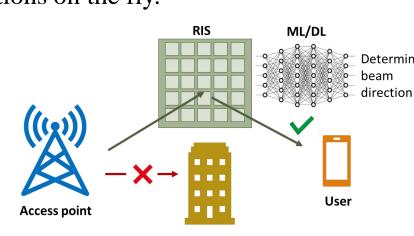


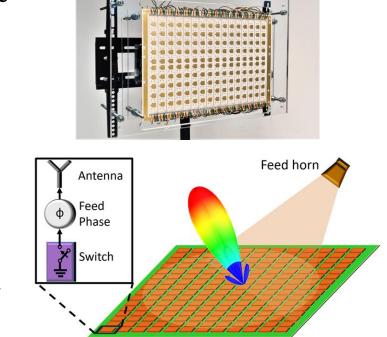
8 9 10 11 12 13 14 15 16 17 18 19 20



RECONFIGURABLE INTELLIGENT SURFACES

• Modify phases/amplitudes of incoming signals and change signal directions on the fly.



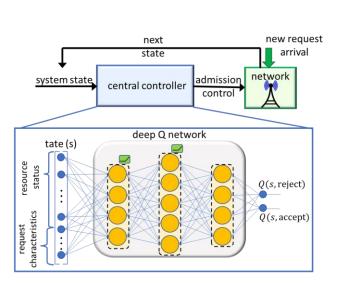


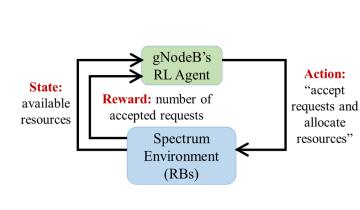
- Large arrays acting as reflective or refractive in an ad hoc way.
- Beamforming with fast convergence high mobility.

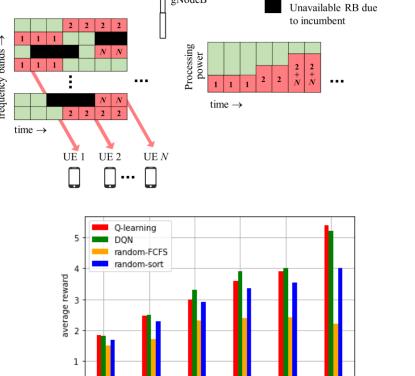
NETWORK SLICING

• Multiplex virtualized and independent logical networks on the same physical network infrastructure.

gNodeB decides which UE requests to accept and which resources to allocate via deep reinforcement learning.

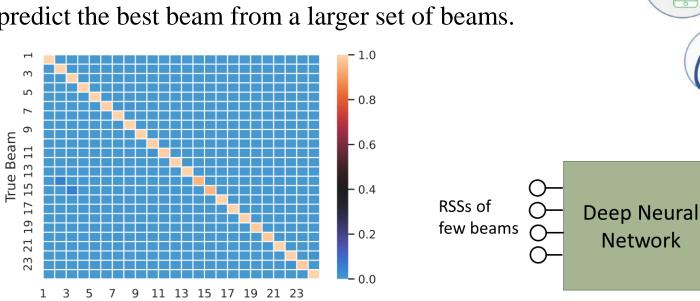






BEAMFORMING AND INITIAL ACCESS

- To connect to 5G network, UEs establish initial access with gNodeBs.
 - gNodeBs transmit pilot signals with narrow beams.
 - UEs compute received signal strengths and find the best beam.
- Deep learning to reduce time for initial access:
 - gNodeB transmits with a small number of narrow beams.
 - UEs predict the best beam from a larger set of beams.



SEMANTIC COMMUNICATIONS

Task-oriented communications: Transfer sufficient information to complete a task at the receiver.

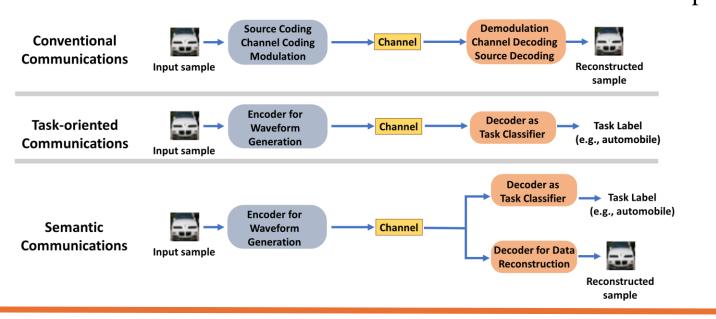
Predicted Beam

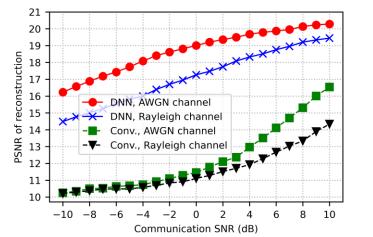
Semantic communications: Multi-task learning for information recovery and task completion.

beam from

a larger

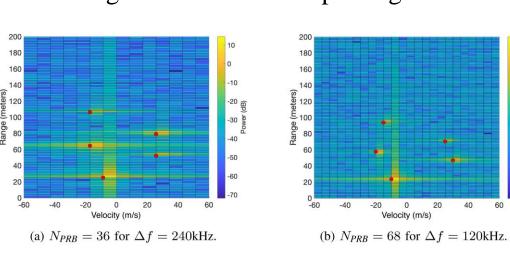
beam set

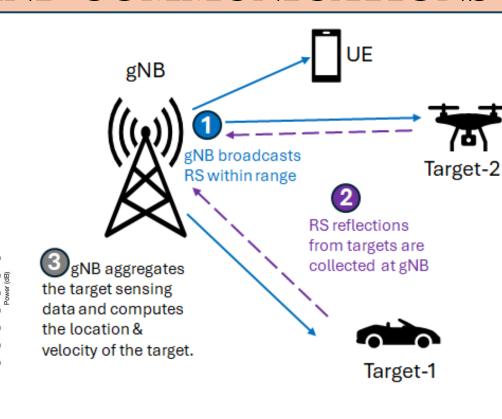




INTEGRATED SENSING AND COMMUNICATIONS

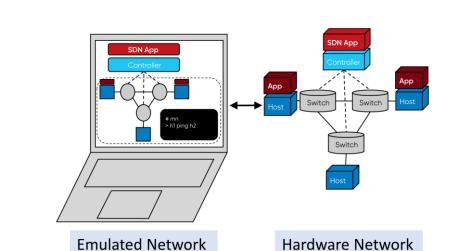
- Repurpose communication signals for sensing.
- Uncover moving targets in NextG networks.
 - Estimate target range and velocity.
 - Distinguish between multiple targets.

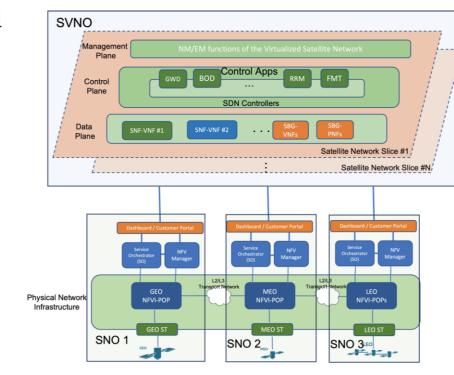




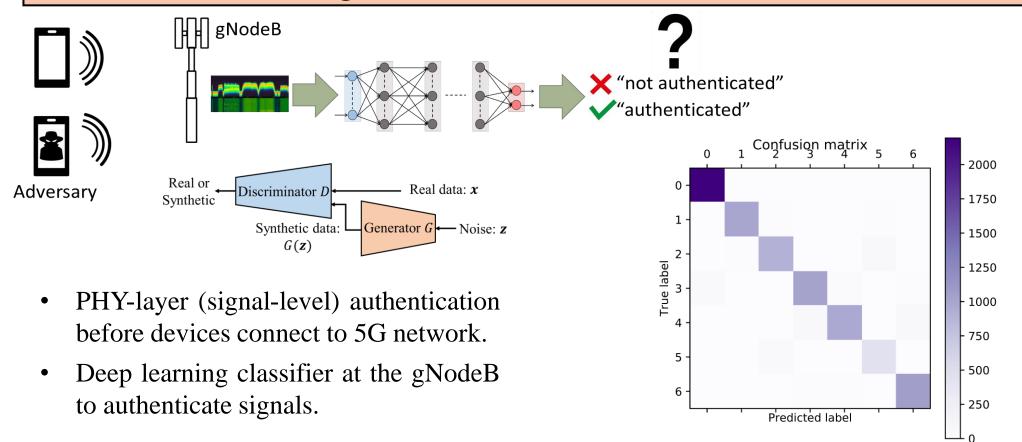
SOFTWARE-DEFINED NETWORKING (SDN)

- Fast and optimal provisioning of aggregated heterogenous (satellite and ground user) resources.
- SDN concepts: network slicing and orchestration.

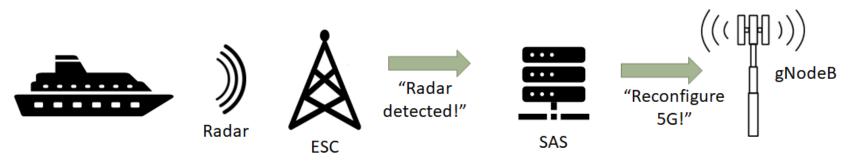




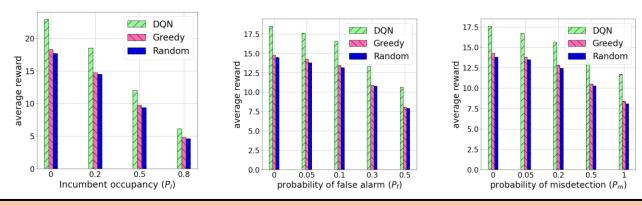
USER EQUIPMENT AUTHENTICATION



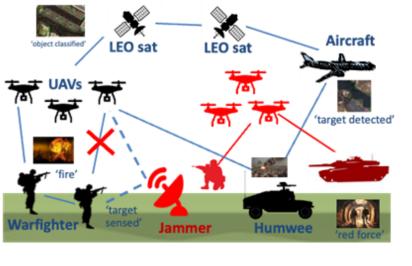
SPECTRUM CO-EXISTENCE/SHARING

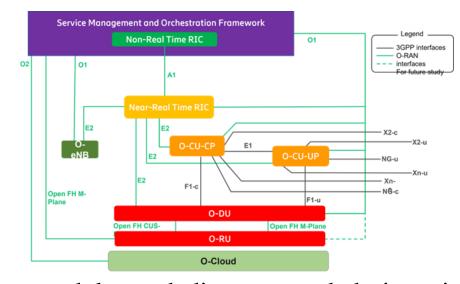


- Environmental Sensing Capability (ESC) needs to detect incumbent radar signals.
 - Deep learning for signal detection and classification using I/Q samples.
- Spectrum Access System (SAS) (re)configures and manages the 5G system.



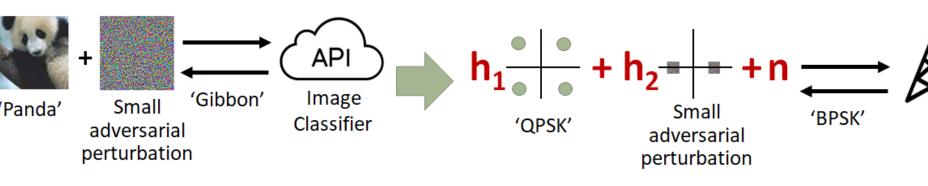
DISTRIBUTED 5G WITH ORAN



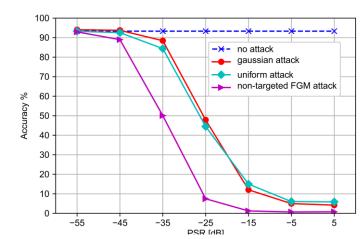


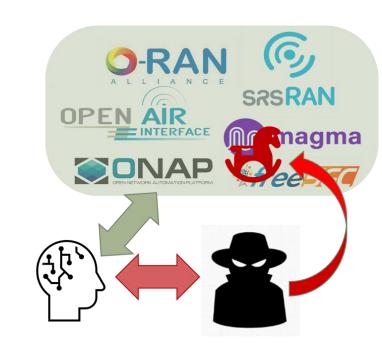
- Open Radio Access Network (O-RAN) allows modular and disaggregated design via open interfaces and intelligent controllers.
- Open architecture and control applications to enable Distributed Group Communications.

ADVERSARIAL MACHINE LEARNING FOR NEXTG



- Adversarial attacks can manipulate inputs to machine learning during training or testing phases.
- Defense against adversarial machine learning.
- Example: Attack on beamforming:





Web: www.nexcepta.com Email: info@nexcepta.com