3GPP SA WG1 Meeting #97e
Electronic Meeting, 14 Feb –24 Feb 2022

S1-220094

Cooperative Communication & Sensing Motivations, Use Cases and Proposal

Agenda Item 4: New Study Proposals

Release-19

Source: Qualcomm

Cooperative Communication & Sensing

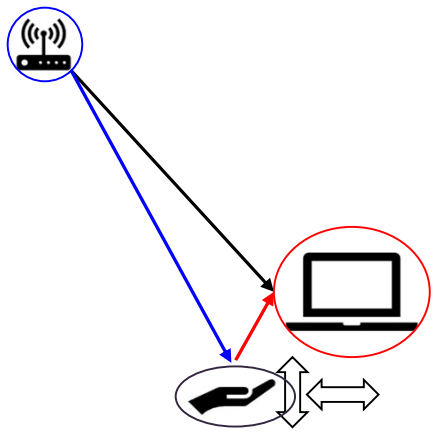
The 5G system can enable and enhance cooperation between Communication and Sensing services:

- Communication-Assisted Sensing
  - Using RF and/or non-RF sensor inputs to improve existing QoE for services; and enable new services for use case such as consumer/gaming, positioning, automotive.
- Sensing-Assisted Communication
  - Leveraging RF and/or non-RF sensor inputs to improve communication related operations, e.g., enhanced radio resource management, beam management, mobility, etc.
- Cooperative communication and sensing could be network-centric, UE-centric or combination of both.

Communication-Assisted Sensing

Example Use Cases (5G RF sensing and/or other sensors)

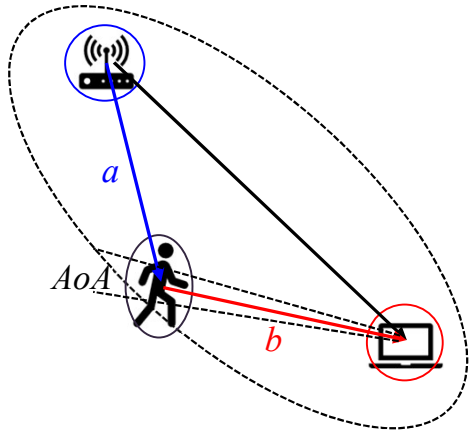
Consumer / Gaming



Gesture/Motion Recognition:

- Human motion recognition
- Keystroke detection
- Sign language recognition
- Health monitoring

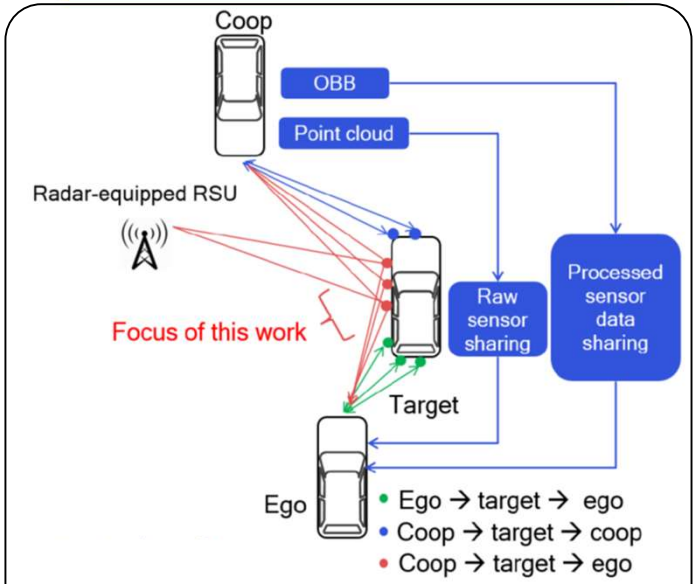
Positioning



Contextual Information Acquisition:

- Location detection/tracking
- Position/speed estimation of surrounding objects

Automotive

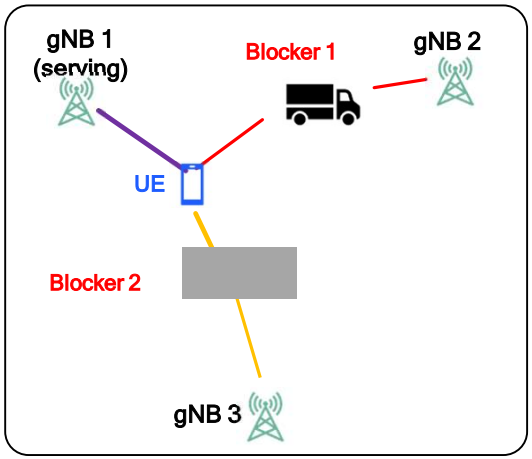


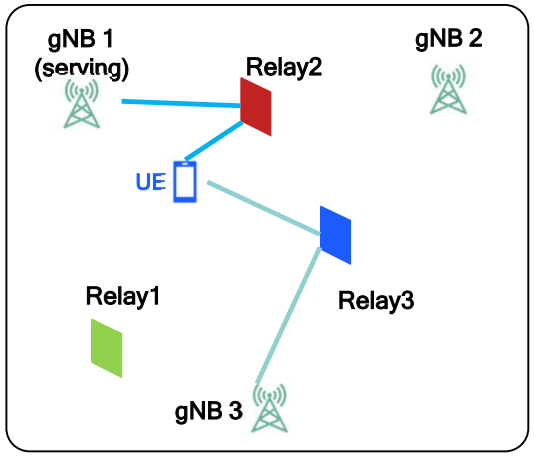
Cooperative sensing can improve object detection, localization, safety, etc.

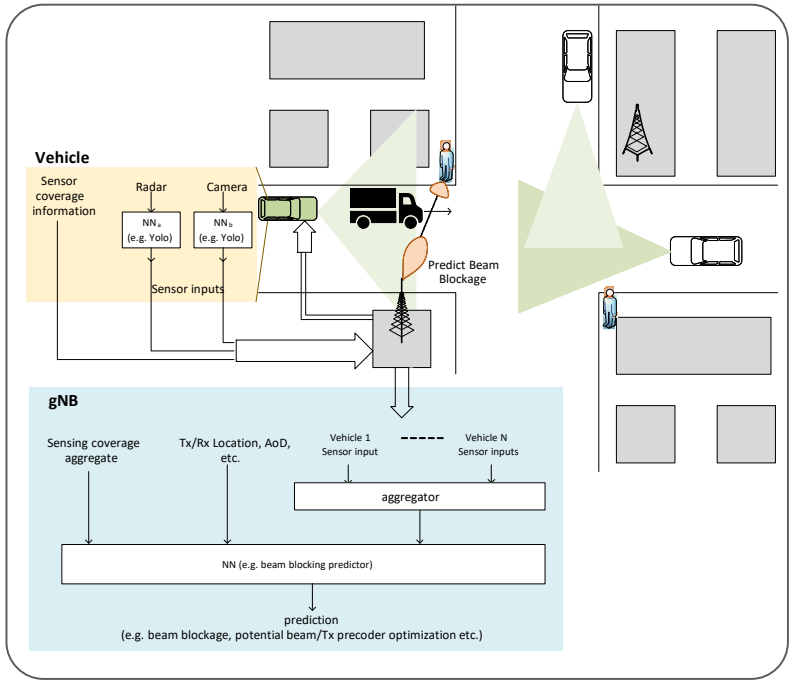
Sensing-Assisted Communication (1/2)

Example Use Cases (5G RF sensing and/or other sensors)

Perceptive 5G - Optimized Radio management and Performance





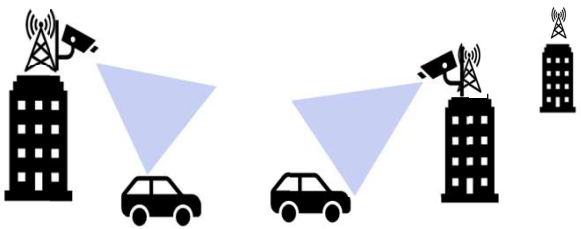


Better perception of wireless environment => Enhanced radio management and performance, e.g. Outage/blockage detection and prevention, beam management, optimized mobility.

Sensing-Assisted Communication (2/2)

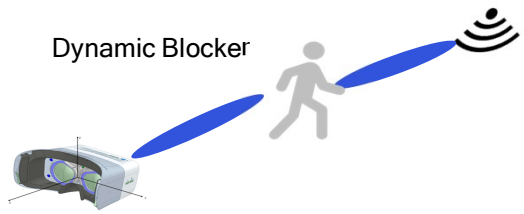
Example Use Cases (other sensors)

Network-Side Sensors



- The network uses data from multiple sensors (e.g., cameras or radars) deployed at gNBs or in other locations overlooking the environment to improve communication.
- Sensing assisted communication enhancements may include beam prediction, blocker prediction, cell selection, rate adaptation, handover, etc.
- Selected information may be shared with UE to optimize UE operations and measurements such as beam measurements..

UE-Side Sensors



Moving HMD with cameras and IMU

- Leverage sensors at the UE or nearby UEs (e.g., HMD with camera, accelerometer, etc) to assist communication and optimize radio link performance.
- Some of the optimizations may include motion compensation, blocker prediction and detection, environment learning, etc.
- Information can be shared with the NW to coordinate and perform joint optimizations.

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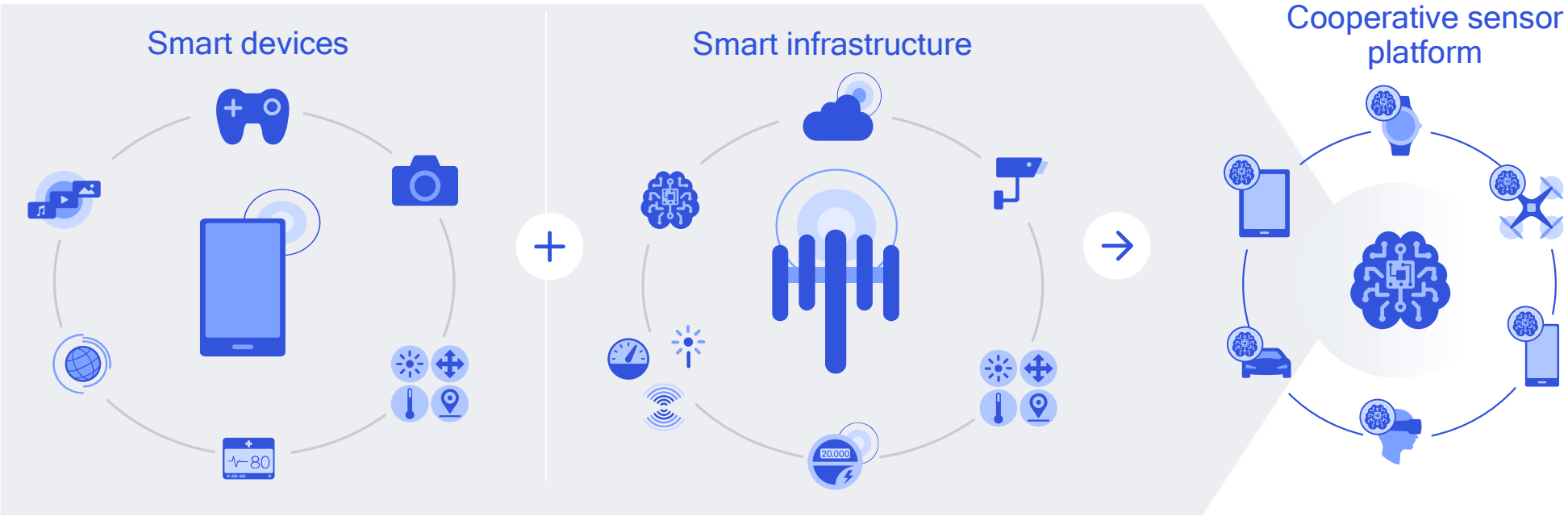
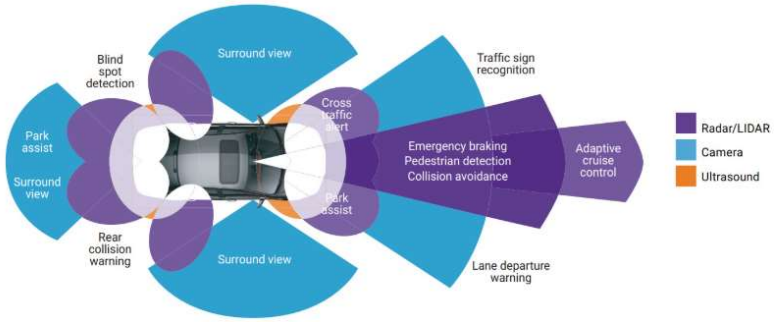
Enhancing 5G sensing services and communication



Convergence of sensors, smart devices and infrastructure enable an intelligent edge and cooperative communication & sensing platform

Why Consider non-5G based Sensors?

- Many use cases and applications have already employed multiple non-5G based sensors. For example, in the automotive use case, multiple sensors inputs are used to enable autonomous driving and ADAS.
- However, these systems needs enhancements to meet the stringent requirements of automation, e.g., autonomous driving, uncrewed vehicles, robots, etc.:
  - higher accuracy, and reliability
  - full “perception” from multiple perspectives



- 5G-based sensing system is expected to provide services to enable enhancements and optimized sensing operations. In addition to providing RF sensing service, the 5G can enable or even provide sensing services using 5G and non-5G sensors.
- In this scenario, examples of the 5GS role include:
  - providing discovery and coordination service to reduce sensor interferences;
  - managing and supporting collaboration sessions between sensors for accuracy/perspective enhancements
  - Offering network-based sensor information collection and sharing as a service

SA1 Rel-19 Proposal

SA1 study on enhanced Sensing and communication – Objectives

Identify use cases and service requirements to enable 5GS support of cooperative communication and sensing, including:

- Discovery and (de)activation of service and peers for cooperative sensing
  - E.g., sharing sensing capability & availability, location & trajectory, sensor configuration
- Authorization, coordination and control of sensing entities, sensing parameters, collection and reporting of sensing related data (offline or real-time)
- Communication requirements, for transferring sensing information between sensing entities and between sensing and communication entities
- Sensing requirements, including sensing specific KPIs, e.g. range, angle, motion/velocity, accuracy, frequency, latency, misdetection, coverage, energy efficiency

The following options should be considered:

- 5G-RF sensing and/or other type of sensors (radar, lidar, ultrasound, cameras, motion sensors, etc.)
- Sensors can be
  - integrated in the UE, gNB and/or separate entities;
  - connected to the UE or gNB, using 5G or other connectivity (fixed/wireless)
- NW and/or UE based/assisted configuration and control (centralized/distributed)

Other aspects to investigate: Privacy, Security, Charging and Regulations