**Device-to-Device for Public Safety (DDPS)**

- **PROBLEM SPACE & STAKEHOLDERS**
  - Partial-on-network ProSe (PC5)
  - eNB
  - UE-to-Network Relay
  - eNB ProSe Function

- **DDPS Support of Key Services**:
  - Mission-Critical Voice
  - 3GPP Proximity Service (ProSe)
  - 1:1 and 1:many group communication

- **Key Stakeholders**:
  - Law enforcement
  - Firefighters
  - Medical personnel
  - Military organizations
  - Volunteer groups

- **Key CONOPS for Public Safety**:
  - Fall back in the event of complete LTE network failure, e.g., natural disasters
  - Support communication among different emergency responder groups.

- **Challenges and Approach**
  - Build complete ProSe stack for Mission Critical Voice based on 3GPP standard and Open Source OAI and demonstrate in a hardware testbed.
  - Design and implement new scheduling algorithms for autonomous resource allocation, which improves on current baseline ProSe specification to minimize collision probability.
  - Design and implement novel multi-antenna-based synchronization techniques to achieve significant improvement in UE autonomous synchronization.

- **Service Continuity Scenarios**

  **Scenario 1**
  1. UE B starts in the on-network mode with direct communication with UE A;
  2. UE B moves out of range of the eNodeB, lost connection to UE A;
  3. UE B discovers nearby node (UE C) which acts as a relay to UE A;
  4. Affected UEs are reconfigured automatically to prevent service interruption when switching modes.

  **Scenario 2**
  1. At the beginning, both cells are down, so UEs A and B communicate via the off-network mode.
  2. Then UEs A and B move out of each other’s range and may lose the call.
  3. They then search for a nearby UE C, which is reconfigured as a UE-to-Network Relay to relay the call between UEs A and B.

- **Vencore Labs (VL)**
  - Research lab for Vencore, 200+ researchers, main locations in New Jersey, 55% PHD., 60+ on-going govt programs, Bell heritage, 74% govt clearance, 460+ patents.

- **Eurecom**
  - DDPS partner, established the OpenAirInterface™ (OAI) Software Alliance (OSA) in 2014 as a non-profit consortium

- **Relevant Experiences**
  - VL is prime of the US Army’s Multi Access Cellular Extension (MACE) program, which has developed a secure ad hoc network based D2D solution for commercial smart phones
  - VL is prime of the NSC Cellular Range Telemetry Network (CeRTN) project, which adapts commercial LTE for airborne mobile telemetry on military test ranges.
  - Eurecom provides 3GPP LTE compliant soft implementation of UE, eNodeB, MME (Mobility Management Entity), HSS (Home Subscriber Server), SGW (Serving Gateway) and PGW (Packet Data Network Gateway) subsystems on standard Linux-based computing equipment

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