Device-to-Device for Public Safety (DDPS)

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Acknowledgements

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- Vencore Labs (Prime) and EURECOM collaborate on DDPS technology
- Vencore Labs
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OpenAirInterface

5G software alliance for democratising wireless innovation

http://www.openairinterface.org/

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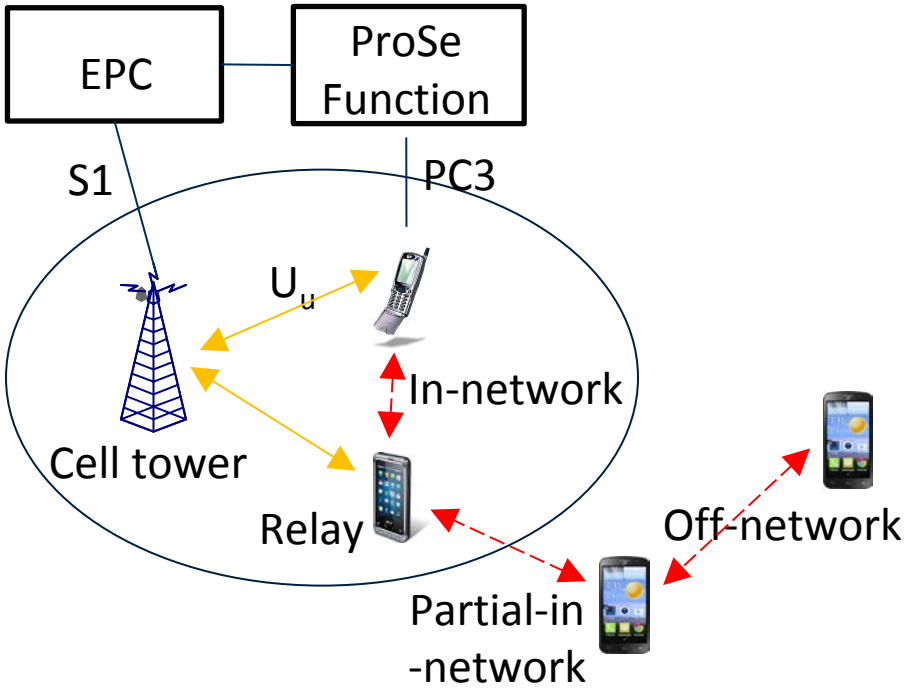
Problem Space & Stakeholders



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
- UE-UE communication within coverage
- UE-UE communication outside coverage
- Mixture of UE communication within and outside coverage

Key Services:

- ✓ Mission-Critical Voice
- ✓ 3GPP Proximity Service (ProSe)
- ✓ 1:1 and 1:many Group Communication
- ✓ Service Continuity

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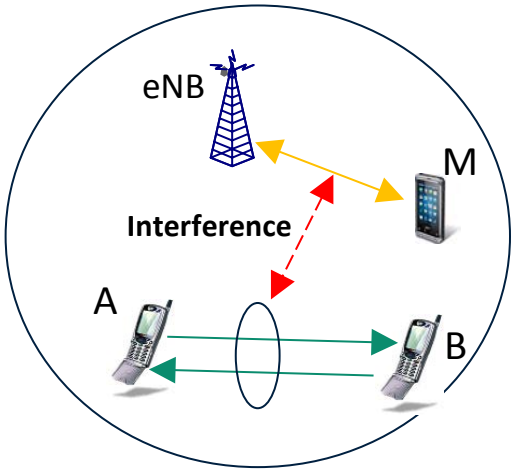
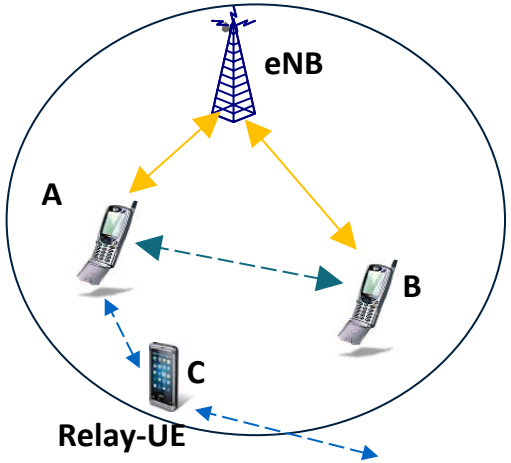
DDPS Objectives

- Build complete ProSe stack by extending current OpenAirInterface™ implementation to include ProSe services based on 3GPP Rel-14 specifications
- Solve open issues related to resource allocation, time synchronization, and service continuity
  - Develop new scheduling algorithms for autonomous resource allocation to minimize collision probability.
  - Develop novel multi-antenna-based synchronization techniques to achieve significant improvement in UE autonomous synchronization
  - Solve complex service continuity challenges for on-, off-, and partial-on-network operations
- Demonstrate ProSe solution on software defined radio platform
- Help create an ecosystem that can be provided to interested vendors for commercialization on a system-on-a-chip platform



Interference



Service Continuity

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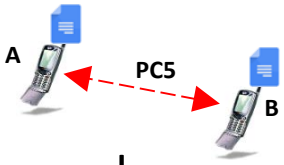
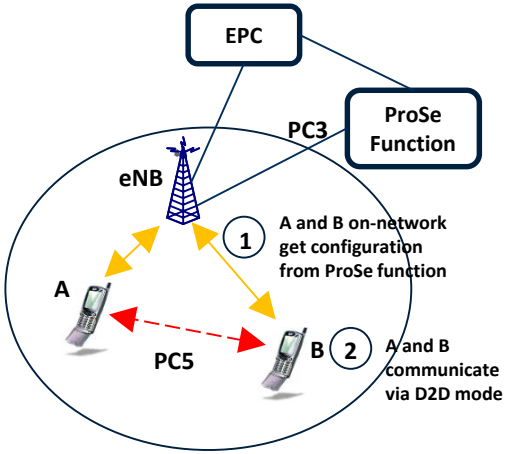
DDPS Scenarios

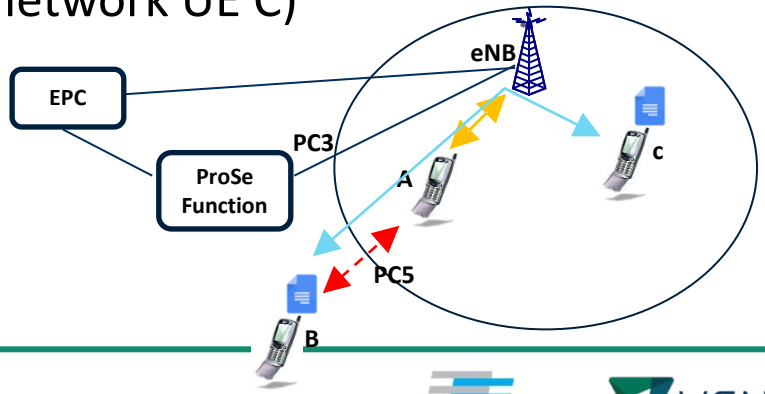
- **Scenario 1: Off-Network D2D**
  - Two UEs are off-network but communicate directly via a sidelink channel



- **Scenario 2: On-Network D2D**
  - Two UEs are located closed to their eNodeB but communicate directly via a sidelink channel



- **Scenario 3: UE-to-Network Relay**
  - UE A is closed to its eNodeB while a second UE B is out-of-coverage but within coverage of UE A. UE A acts as a relay to remote UE B and relay its traffic (e.g., to a FTP server, or another on-network UE C)



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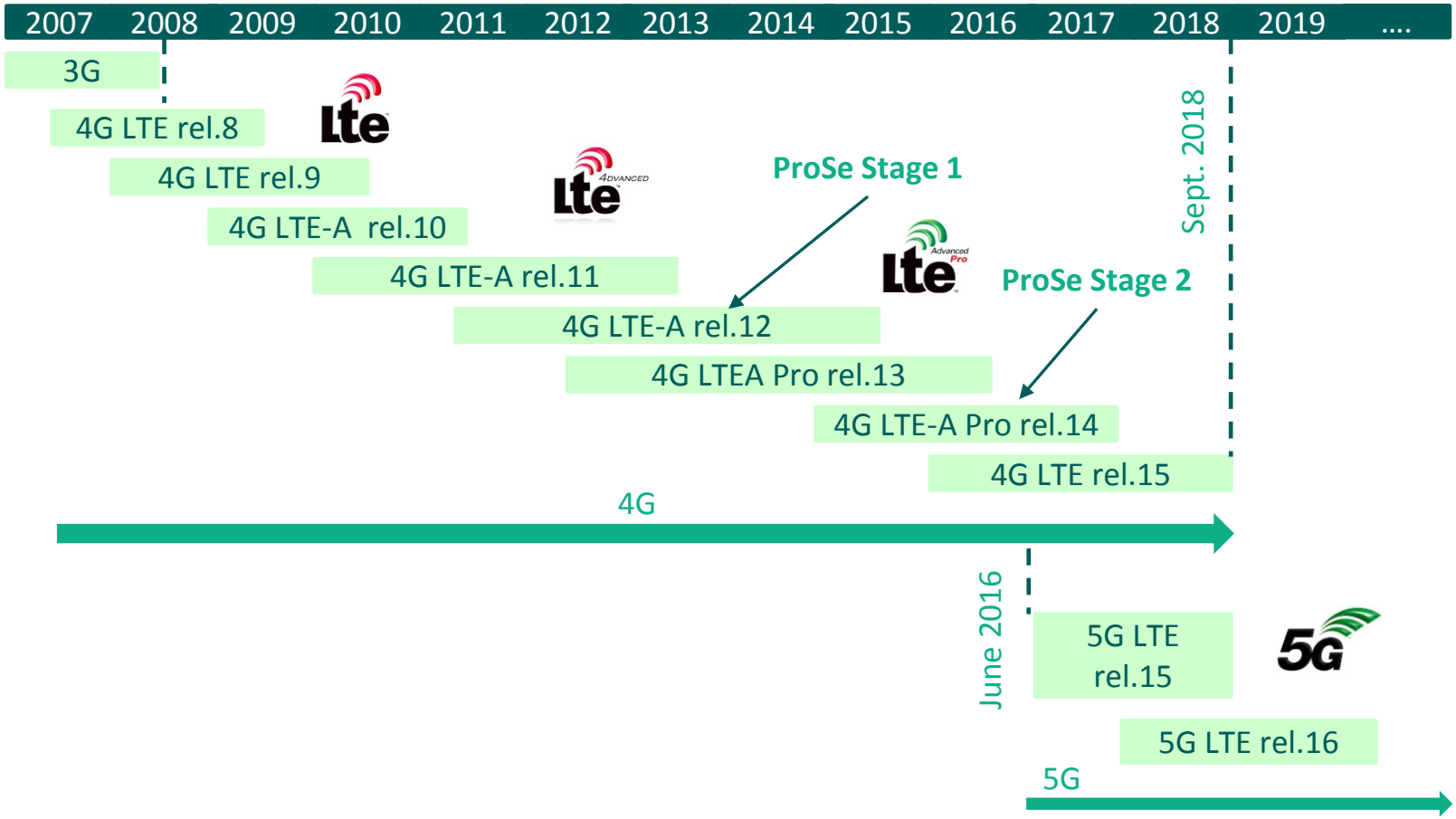
LTE ProSe 3GPP Standardization Timeline



ProSe: Proximity Services

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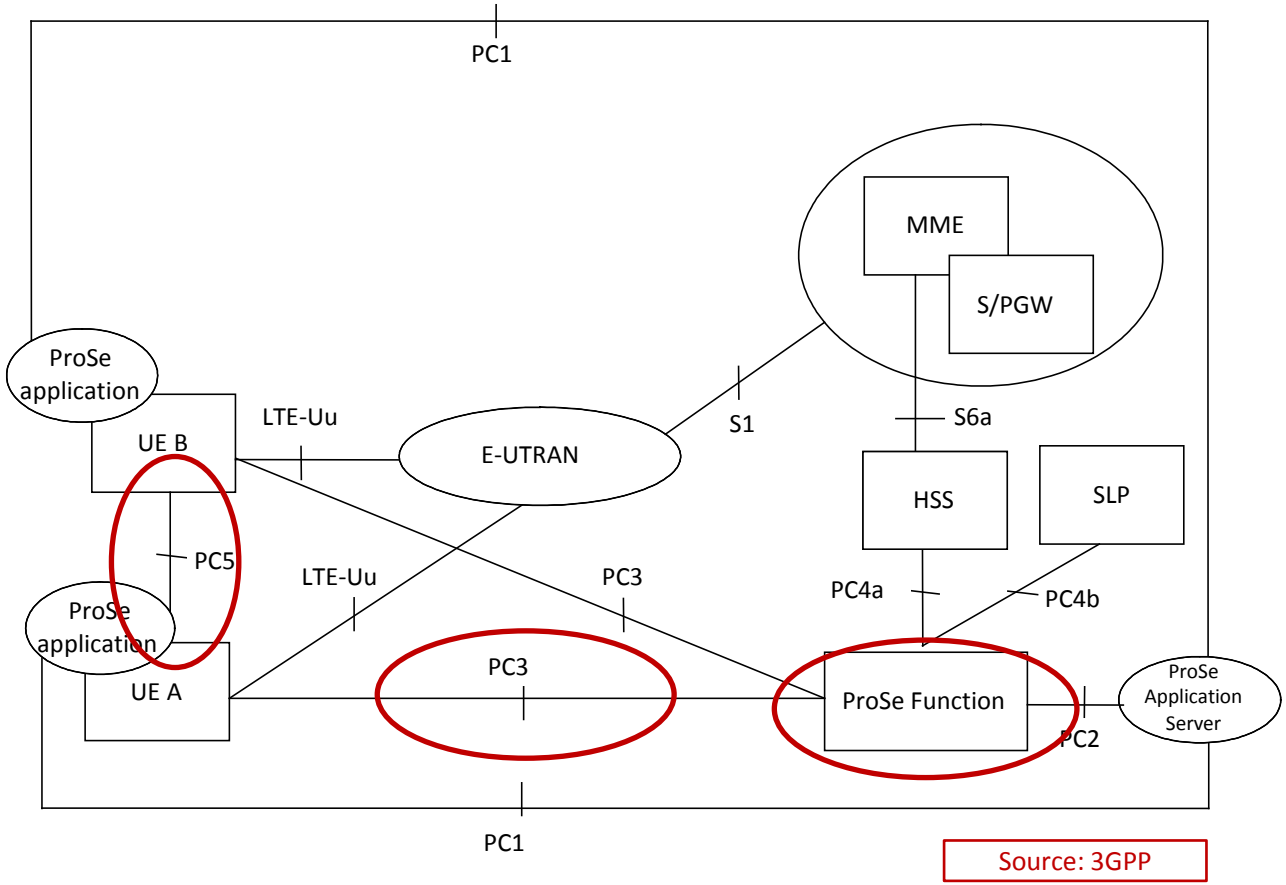
LTE Proximity Services (ProSe)

- LTE ProSe enables establishment of communication paths between two or more ProSe-enabled UEs.

- LTE ProSe enables communication functions
  1. One-to-One – Direct UE-to-UE Communication
  2. One-to-Many - Communication to a ProSe group
- LTE ProSe Functions:
  - Discovery
    - Mode A – 'I am here'
    - Mode B – 'how is there ?'
  - Direct Communication
    - Mode 1 – Coordinated by eNB
    - Mode 2 – Ad-Hoc mode

Restricted to Public Safety (rel.14)

LTE Prose Extended Architecture



Source: 3GPP

New Architecture Elements:

a) ProSe Function – management of D2D communication (authentication, discovery)

b) PC5 interface – UE to UE

c) PC3 interface – Prose Function to UE

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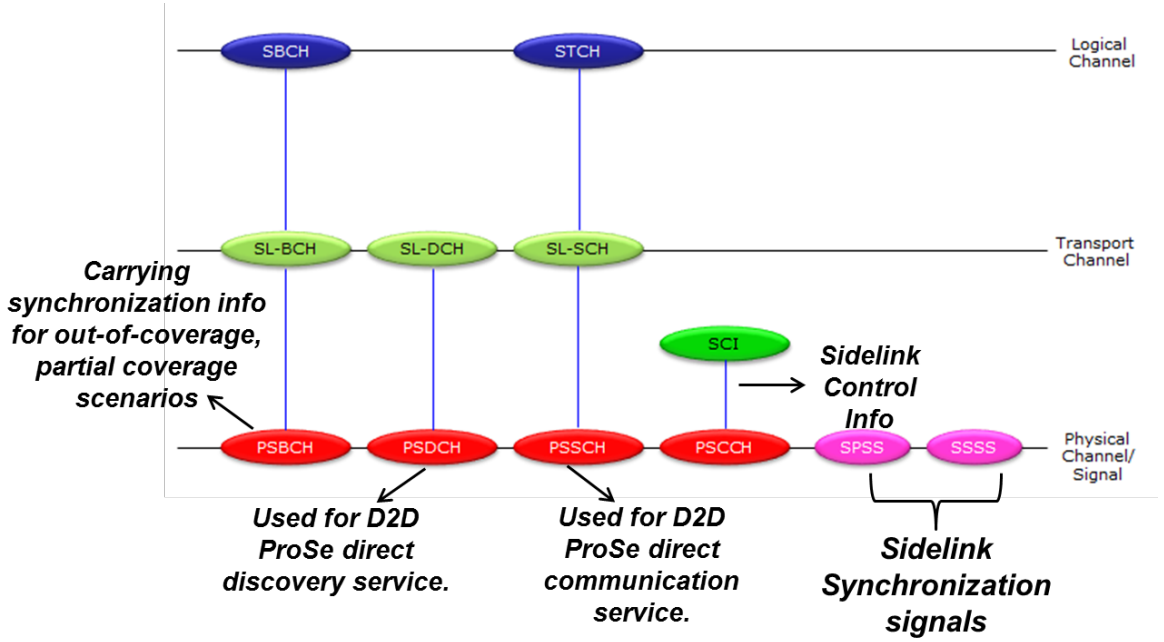
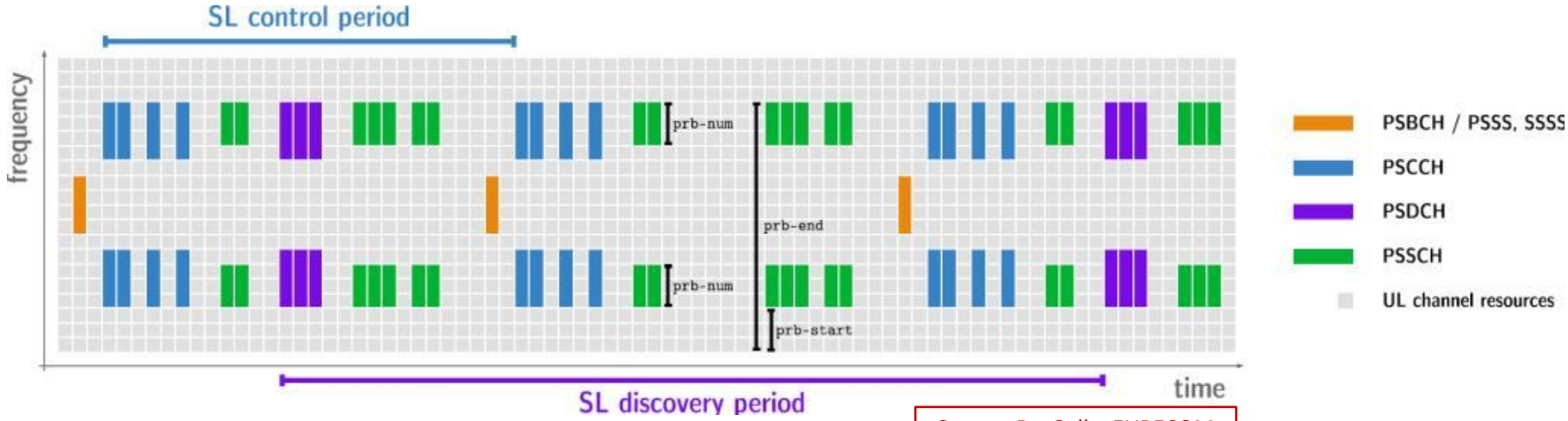
LTE ProSe – New Slidelink (SL) Channels

a) Sidelink Channels



b) Slidelink Pool



Source: Dr. Gallo, EURECOM

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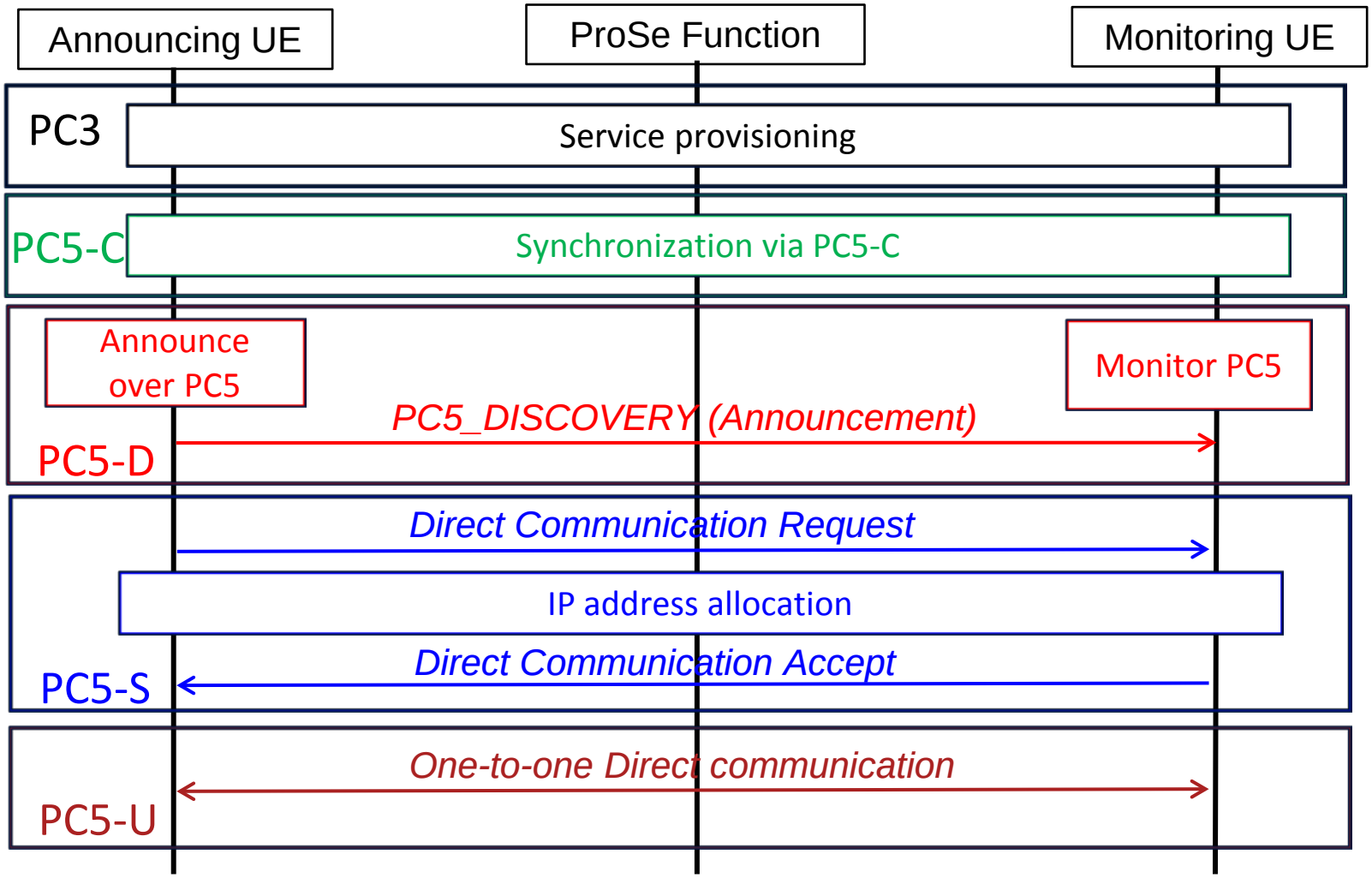
Discovery & One-to-One Communication



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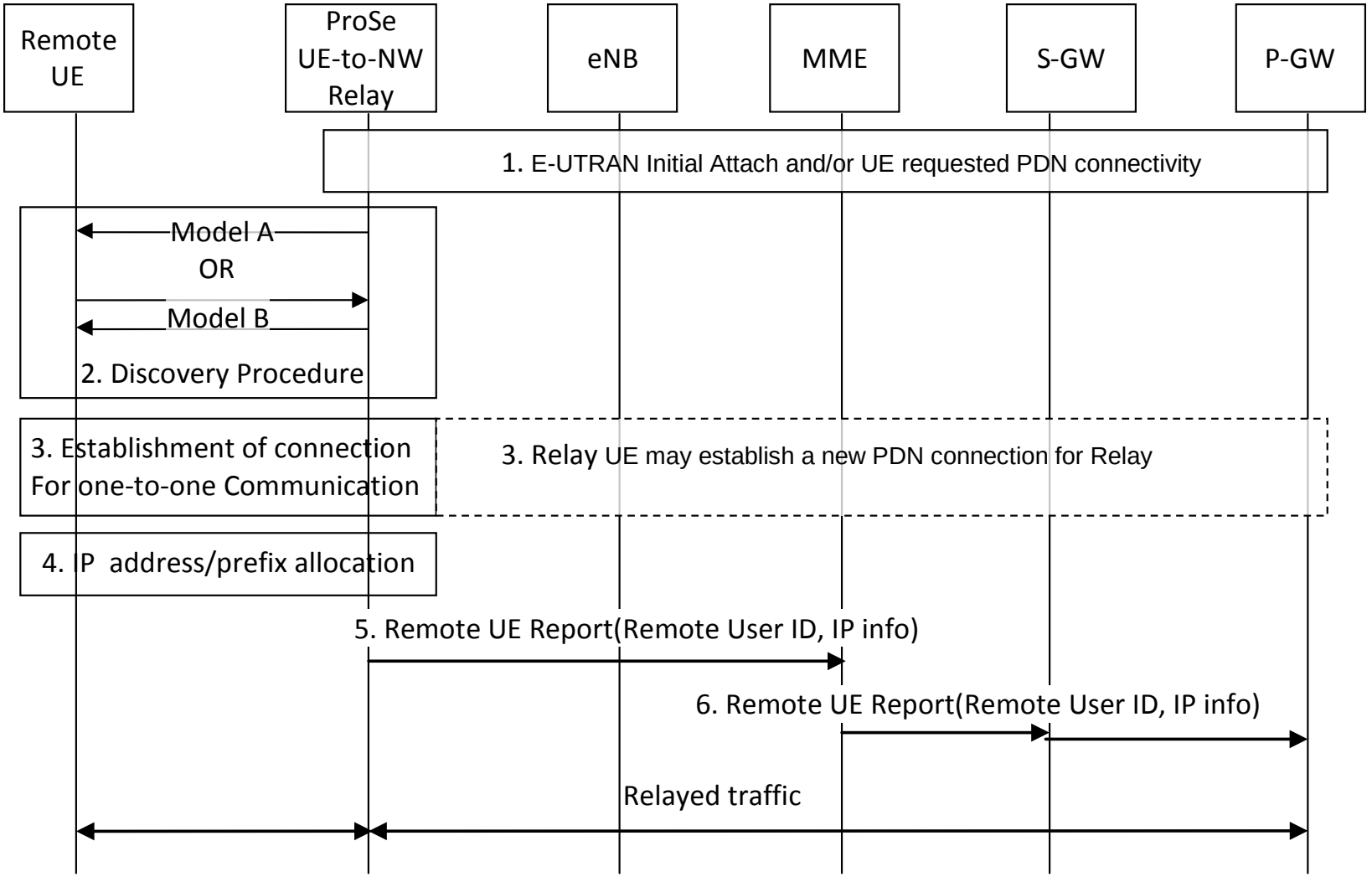
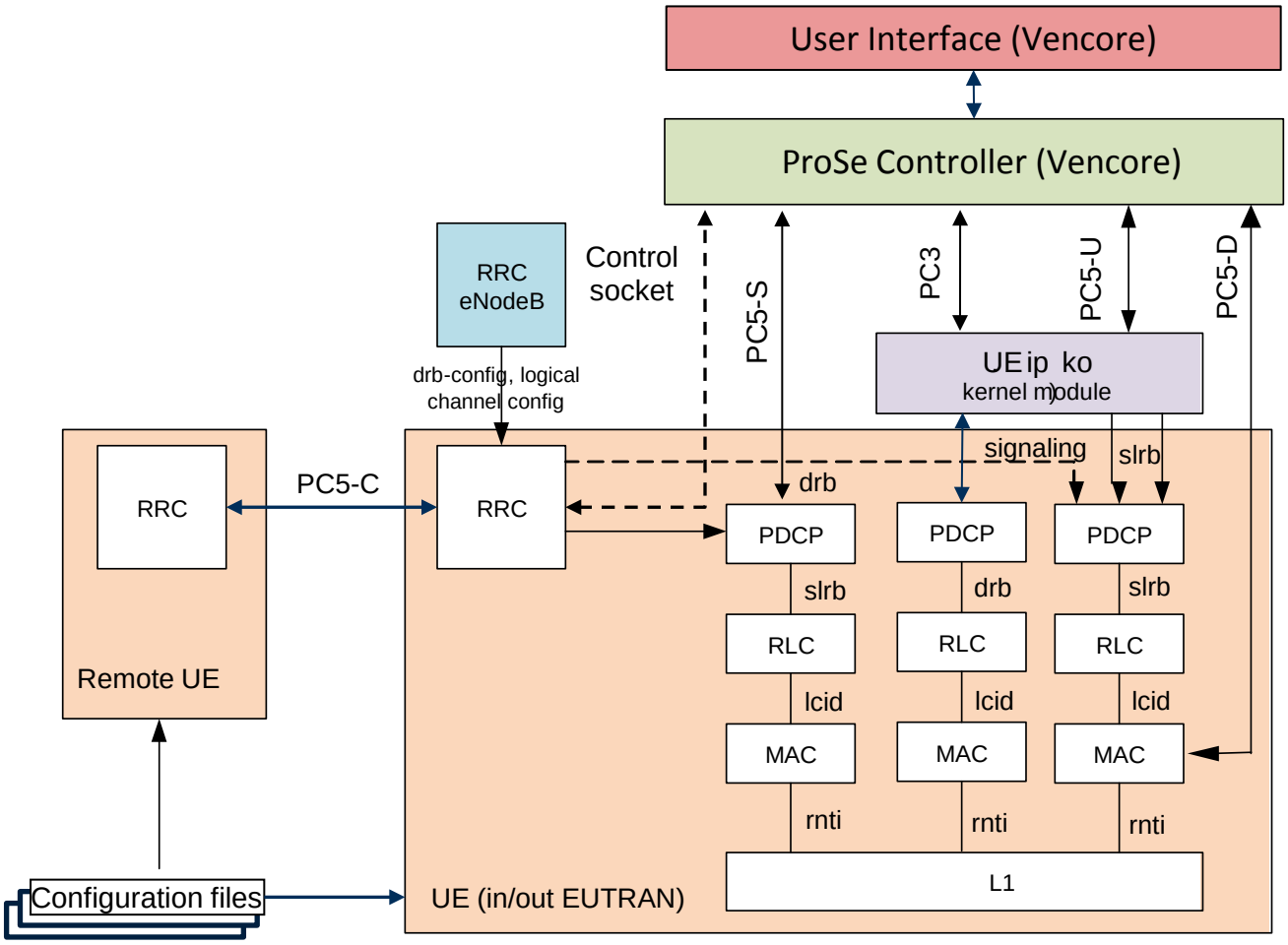
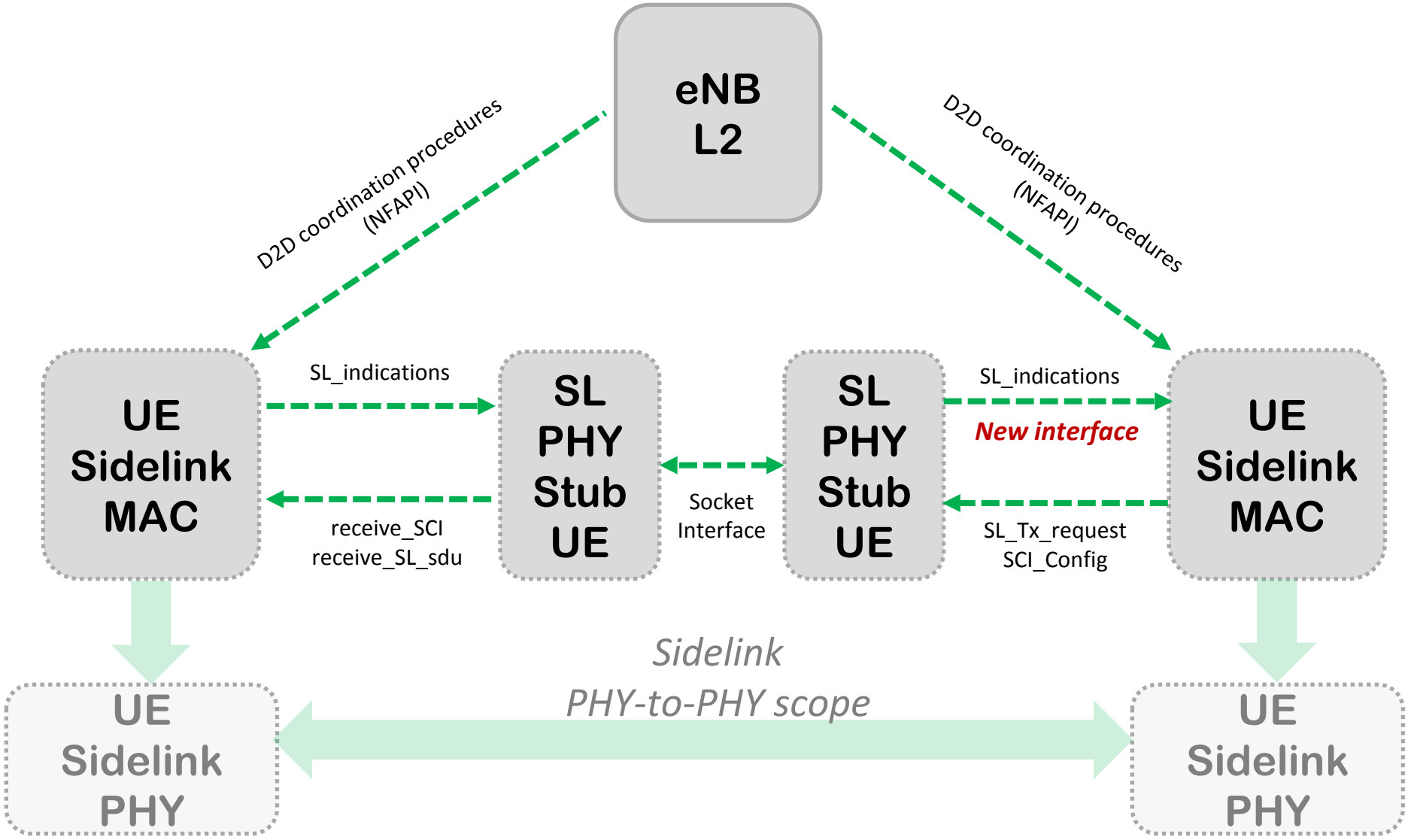
Relay Discovery, Selection & Direct Communication



OAI Architecture for ProSe Interfaces



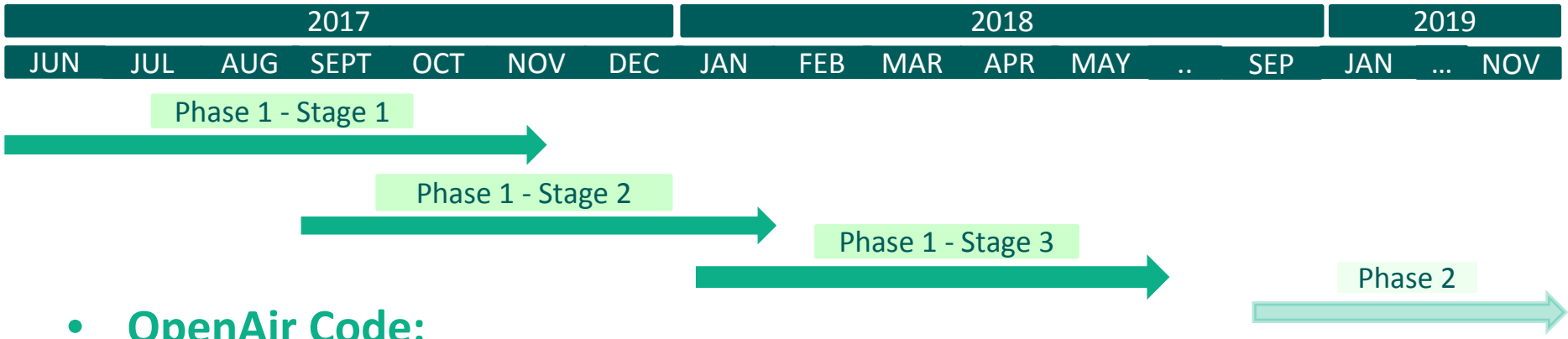
OAI Emulation Extensions for DDPS



D2D for Public Safety on OAI – RoadMap

- **Phase 1 Stage 1 - Emulation**
  - Redesign of emulation mode – new PHY STUB
- **Phase 1 Stage 2 - Implementation**
  - Part A – Implementation of the ProSe Function/RRC/PDCP/RLC/MAC
  - Part B – Implementation of the PHY
- **Phase 1 Stage 3: Performance Evaluation**
  - Emulation-based Proof-of-Concept and Performance Evaluation
- Phase 2 – Real-Time Lab
  - Real-time UE PHY and Field Deployment

Not Yet Approved…



- **OpenAir Code:**
  - https://gitlab.eurecom.fr/matzakos/LTE-D2D

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