

5G Standalone Seamless Roaming for Cross-Border Automotive Use Cases

Rintse van de Vlasakker, Belma Turkovic, Nassima Toumi, Ramon de Souza Schwartz, Peter-Paul Schackmann

Networks Department, TNO, The Netherlands

5G Seamless Roaming

To achieve seamless roaming, the following 3 measures are proposed:

1. HR roaming + N14 handover:

Combination of the following two procedures from 3GPP specification release 16 to allow the user context info to be transferred across PLMNs and be reused by the Visited PLMN:

- **Home-Routed (HR) roaming:** UE's traffic is redirected to the home PLMN network through a tunnel between the UPFs on the N9 interface. Tunnel info is exchanged between the SMFs of both home and visited networks through the N16 interface;

- **N14-based handover,** where the UE context is transferred between two gNBs through the N14 interface connecting home and visited AMFs;

2. Prepare in advance:

PDU session is prepared in advance as much as possible before final UE context release at the home PLMN to further minimize downtime.

3. Seamless roaming in both directions:

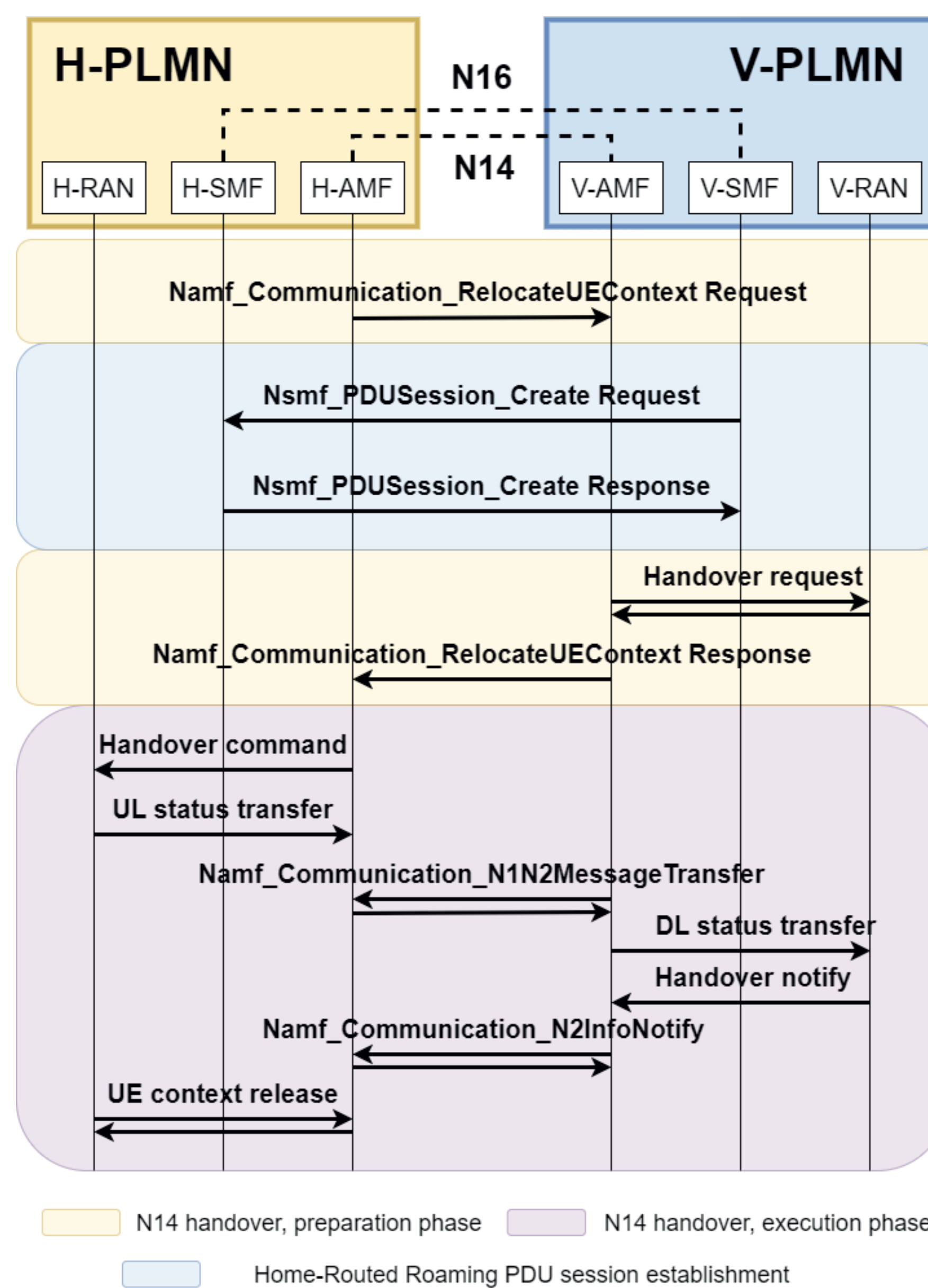
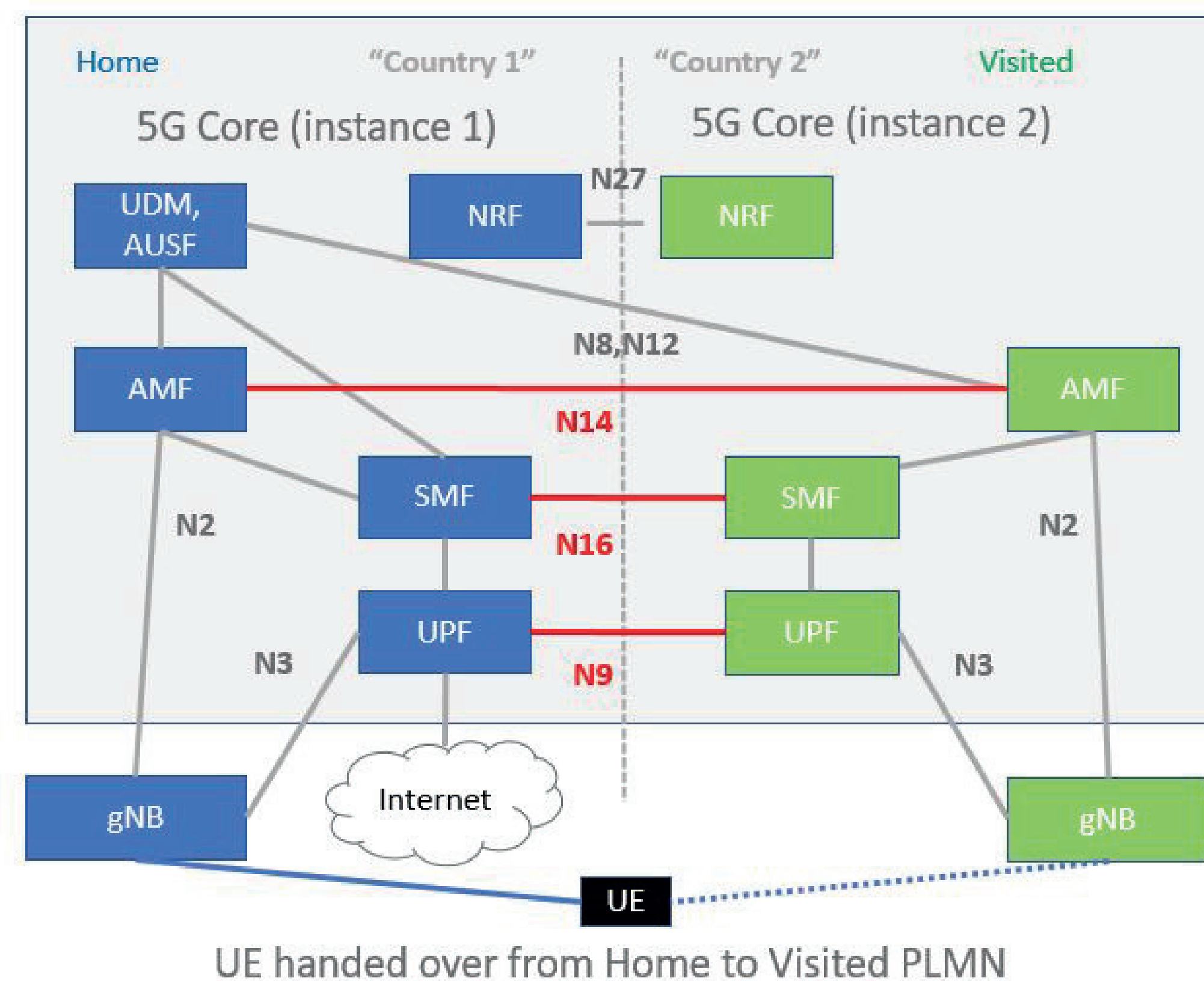
An additional call-flow for handing over the UE from the V-PLMN back to H-PLMN to allow seamless roaming both directions without interrupting the user session.

Problem statement

Typical 5G roaming procedure causes network interruption in the order of tens of seconds which is not sufficient for tele-operated driving use cases that tolerate a maximum interruption time of ~150 milliseconds.

Contribution

The 5G-Blueprint project provides technical solutions for 5G-enabled uninterrupted (i.e., seamless) communications in cross-border teleoperated automotive use cases.



Software/Hardware setup

5G SA Core	Built upon Open5GS
gNBs	Ericsson and Huawei
UE	Quectel 5G modem
UE mobility	Teleoperated vehicle
Evaluation methodology	
Traffic	UDP traffic from the UE (iperf)
Metric	UE data traffic switch time between MNOs
Experiment	Repeated 10 times

Results and conclusions

Our preliminary results show that the downtime can be significantly reduced from 14s (minimum achieved in 5G-MOBIX) to **135ms** (on average).

Preparing the PDU as much as possible before handover reduces downtime and potentially removes SLA requirements between operators regarding special QoS between the networks.

The proposed changes and additions to the standard are now being discussed to be included in the upcoming 3GPP release 19.