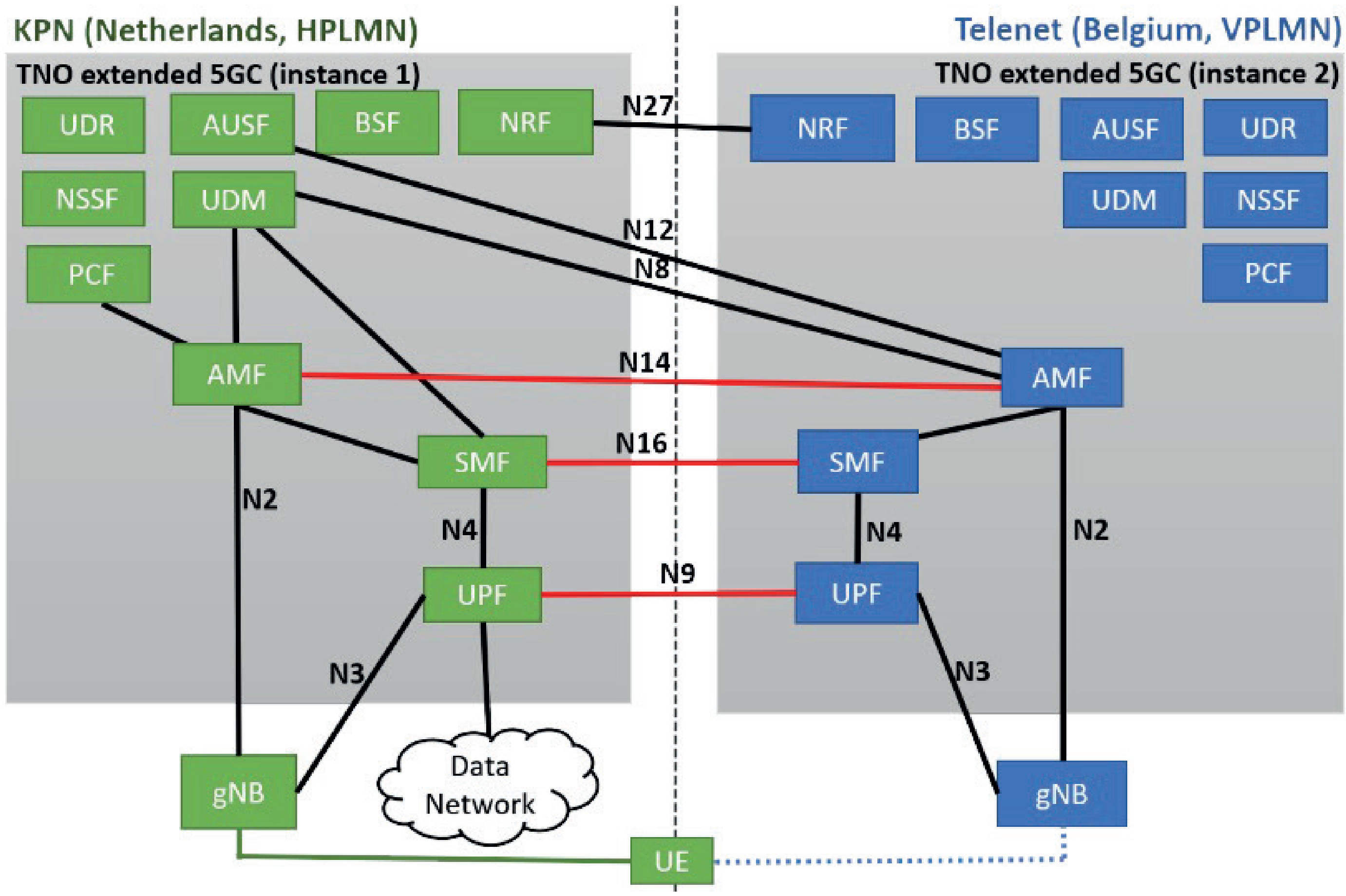
5G BLUEPRINT

5G architecture for enabling seamless cross-border teleoperation

5gblueprint.eu

SEAMLESS 5G STANDALONE ROAMING ARCHITECTURE

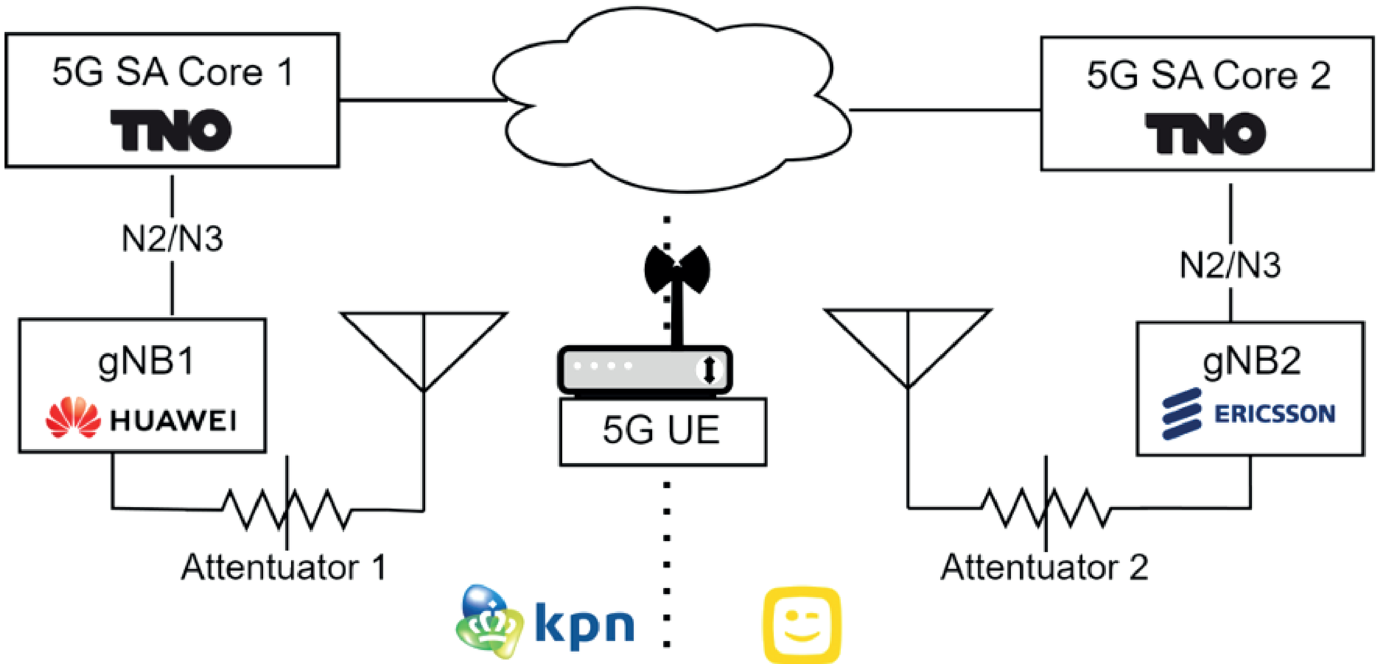
Vehicular teleoperation is a step towards autonomous driving and other advanced Cooperative, Connected and Automated Mobility (CCAM) use cases. It is a promising alternative for road transport and logistics, especially with the current labor shortages affecting multiple industries. However, to enable such mission-critical use cases, 5G connectivity should satisfy stringent latency requirements and remain un-interrupted. This task is more challenging in a cross-border roaming scenario where the vehicle has to be handed over to the network of a different operator in a different country.



5G-Blueprint's seamless roaming solution is **the first practical implementation of seamless 5G SA roaming.** It combines procedures from the 16th Release of the 3GPP specifications (Home-Routed Roaming and N14 Handover) with further novel optimizations to reduce downtime. The red lines in the figure show the interfaces (N9, N14 and N16) that have been developed with the lead of TNO during the project.

LAB SETUP

The proposed solution was first built and validated in a lab setup at TNO, which consists of two machines, each running the TNO extended 5G SA core, two off-the-shelf gNBs - Ericsson (provisioned by Telenet) and Huawei (provisioned by KPN) - and a 5G User Equipment (e.g., Quectel or Sierra Wireless 5G modem, or a smartphone). Two attenuators are used to decrease the signals from the gNBs. This way, we mimic cross-border scenarios (e.g., a car moving away from the coverage area of MNO1 to the corresponding area of MNO2).



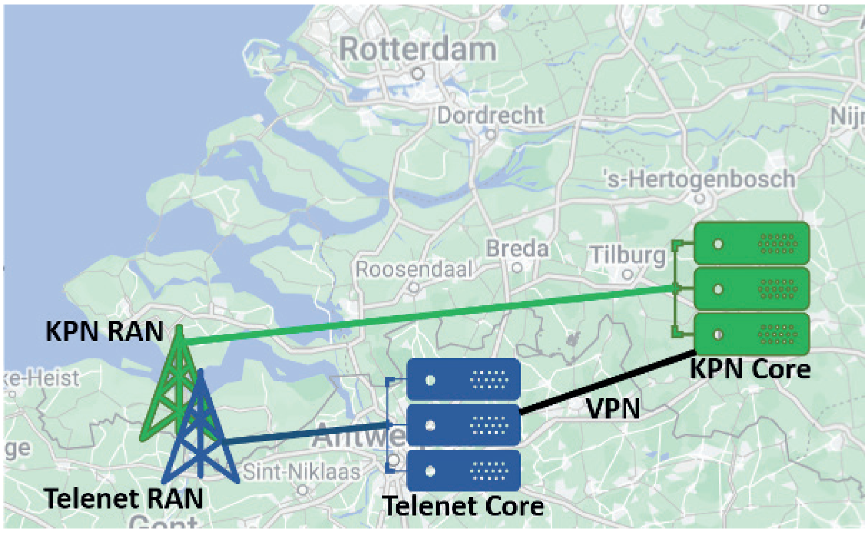
RESULTS

We tested the handover procedure in our lab using the setup described above, with ideal networking circumstances. The results show that the usage of Seamless 5G SA roaming significantly reduces the average downtime: **from 14s** (which was the minimum achieved in 5G-MOBIX Project) **to less than 100ms** (as shown below).

Mean uplink downtime	Mean downlink downtime
92 ms	95 ms

CROSS-BORDER TRIALS

In the cross-border trials, the same 5G SA cores and gNBs from the lab are used. The trial tests consist of a vehicle driving across the border a number of times to collect measurements for Round Trip Time, Signal Strength, downtime and throughput for both uplink and downlink.



Our field results show no significant deviation from the lab results.

With an average downtime of around 110ms, our proposed solution meets the latency requirements of teleoperated driving services.

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