Lessons learned

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DE TS Webinar, 22 June 2022

5GMOBIX

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 825496

Lessons learned

- Technological
- Regulatory
- Reliability and availability

Lessons learned: Technological

Requirement	Description	Satisfied	Impact	Workaround
Seamless Roaming	Instant Roaming between different MNOs means seamless communication for Apps and OS	No. Current networks do not support cross-border CAM services due to long disconnection times	Communications Blackout during seconds (After attaching to roaming network)	Dual Modem and MEC service to UEs for assisted roaming based on signal intensity and GPS positioning
Seamless Dual Modem inter-PLMN switch	The backup network interface is immediately running when one UE is disabled.	No.	The transition between UEs is not instant and Application system is temporally disconnected	Router that forwards traffic through one or other UE where both are enabled.
MEC discovery	UEs know the address of the MEC endpoint.	No. A MEC discovery service is required to be implemented in the application layer.	Vehicles do not know the address of the MEC and cannot connect to it.	MEC Registry deployed in the Cloud compiling available MECs. MEC Orchestrator deployed in each MEC to manage MEC Handover and data synch.

Lessons learned: Technological

Requirement	Description	Satisfied	Impact	Workaround
Intra-MNO or Inter-MNO UE IP visibility	UEs in the same area for the same or different MNO can communicate each other through UDP sockets	Sometimes, depending on the MNO.	Big latencies and lower scalability	APN that provides public IP to UE. Gateway installed on a server and publicly available in Internet.
Session Continuity	Maintain ongoing IP sessions while changing from the home PLMN to the visiting PLMN. SSC Mode 3 fully established.	No.	TCP/UDP sessions are required to be re-negotiated. KPI measuring tools need to support IP changes.	No. Vendors need to work on SSC Mode 3 implementation.
5G SA compatible UE	UE supporting 5G SA	Often. 5G SA and specific bands are on the roadmap of vendors but this support is not always solid or even implemented	Time consumed in testing several options while 5G technology implementation consolidates.	Testing different vendors and firmware versions. Use of smartphones (last resource).

Lessons learned: regulatory

Requirement	Description	Satisfied	Impact	Workaround
Temporal permissions for Experimental net works	Temporal operation of experimental networks in idle bands	No. Tight regulations, complicated and long procedures with public institutions requiring detailed prototype equipment working in a specific band that is agreed after an initial study. The permission ends after some months and it is dependent on arranged or unexpected commercial auctions	It is difficult to invest in an experimental setup with a lot of conditions to ensure availability	Use of commercial networks for outdoor tests.

Lessons learned: Reliability and availability

Requirement	Description	Satisfied	Impact	Workaround
DL BW	Average DownLink Bandwidth at RX > 50Mbps	Sometimes (day, time, position)	Visual Artifacts or Server Disconnection	QoS Bitrate adaptation
UL BW	Average UpLink Bandwidth at TX > 30Mbps	Sometimes (day, time, position)	Visual Artifacts or Server Disconnection	QoS Bitrate adaptation
Packet Loss	Packet loss under 2%	Sometimes (day, time, position)	Connection Failure	QoS Bitrate adaptation
MEC latency	Average latency similar to Wired < 20ms	Sometimes (it is around 30ms)	Big latencies and visual artifacts	Jitter Buffer
Steady handover and ro aming control in commercial networks	The network tries to avoid ping-pong between cells and PLMNs.	Sometimes (areas)	Handover (performance degradation) or roaming (service interruption.).	Dual Modem for roaming. Handover control not in the hands of CCAM developers.

Conclusions

- Not all the requirements of the CCAM use cases are fulfilled with current technology or network deployments (at least NSA), which are not in the hands of CCAM developers.
- CCAM developers need to implement some workarounds to avoid or mitigate the negative impact of these unsatisfied requirements.

Thank you

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