

Busting the myths of cellular V2x communication by testing

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On the way to a future of autonomous driving

Safety



93% of all car accidents are caused by human errors

Efficiency



People spending more than 4 years of life in cars

Comfort

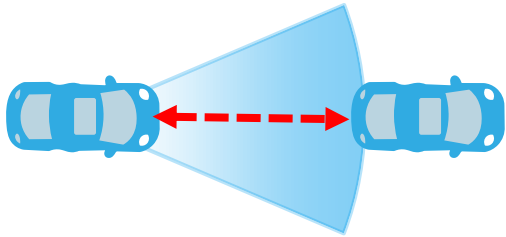


People like to text, surf or just enjoy time in cars



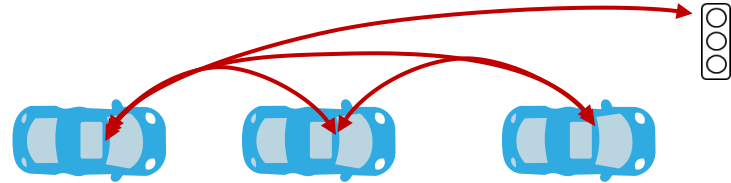
Autonomous and/or cooperative systems

Autonomous Systems e.g. Pre-collision safety system



On-board sensors are used to detect objects (other vehicles, signs, pedestrians) around the vehicle **within the visibility range**

Cooperative Systems e.g. Traffic hazard warning

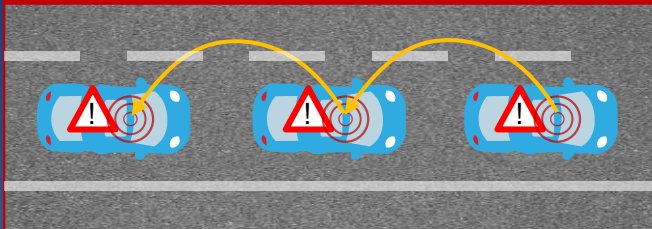


Communication with infrastructure or other vehicles enables detection of objects and 'events' **outside the visibility range**

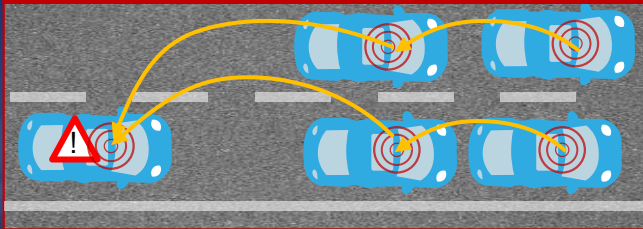
Enhanced safety systems leverage the smart use of both approaches

Typical cooperative safety applications addressed by V2x

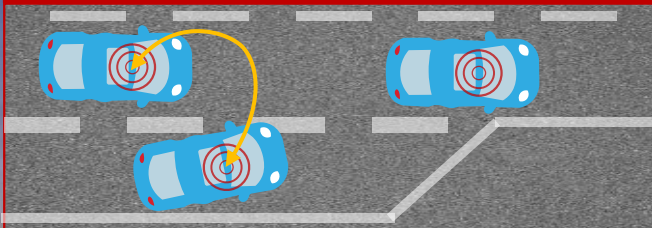
Emergency electronic brake lights



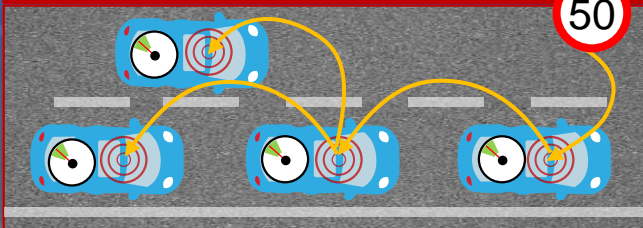
Queue warning



Cooperative maneuver

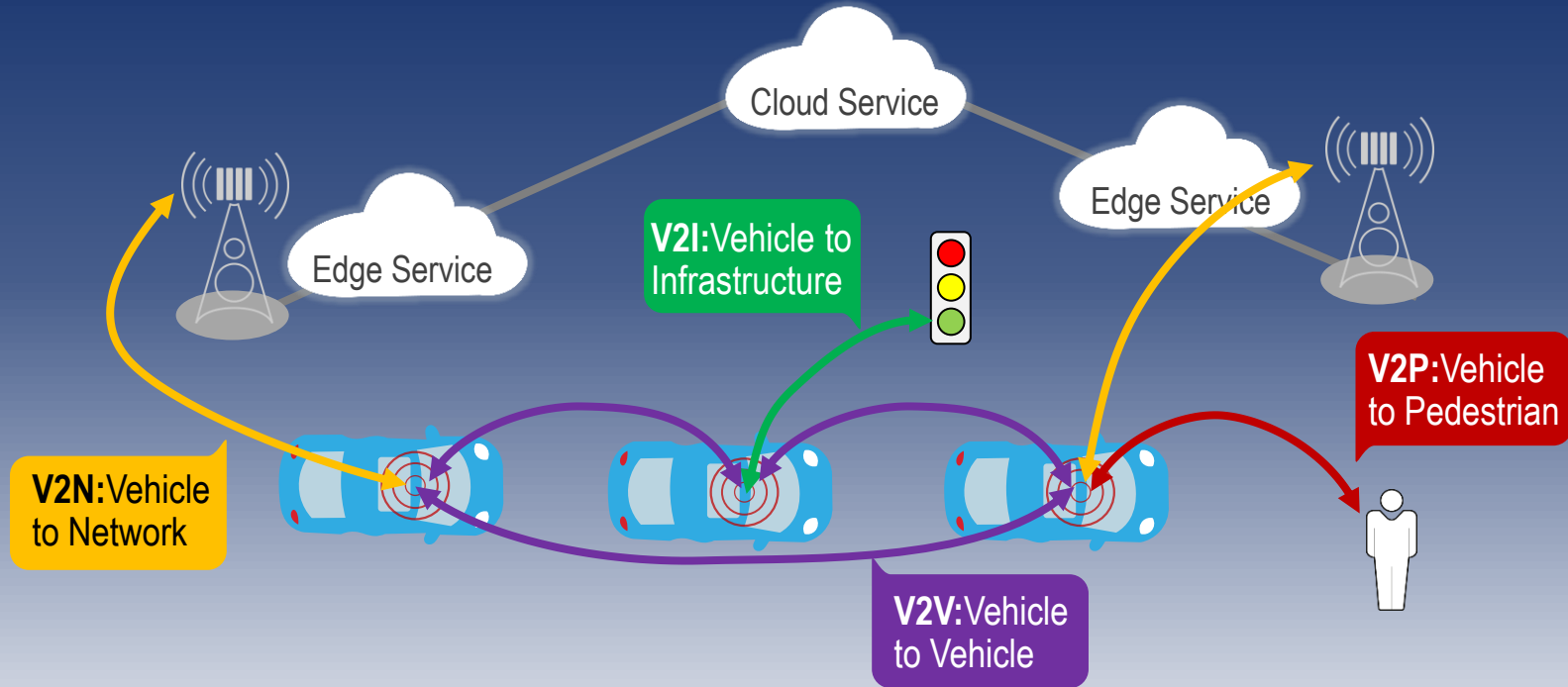


Speed harmonization



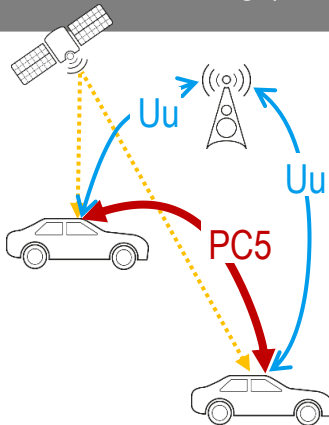
V2X communication architecture: V2V | V2N | V2I | V2P

Direct communication (PC5) or network communication (Uu)

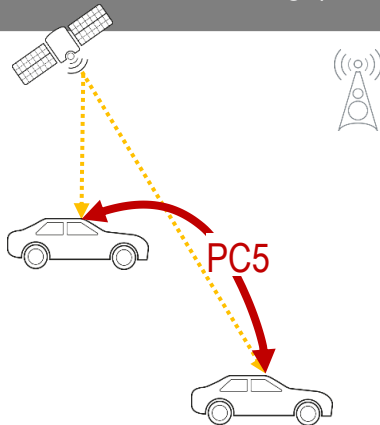


3GPP Rel. 14: Adoption of LTE-D2D PC5 in a dedicated carrier for V2V in-coverage and out-of-coverage scenarios

In-coverage scenario w/
eNodeB scheduling (TM3)



Out-of-coverage scenario w/
distributed scheduling (TM4)



Reused channel structure
of sidelink communication

Time synchronization via
GNSS

New arrangement of
resources into resource
pools (RPs)

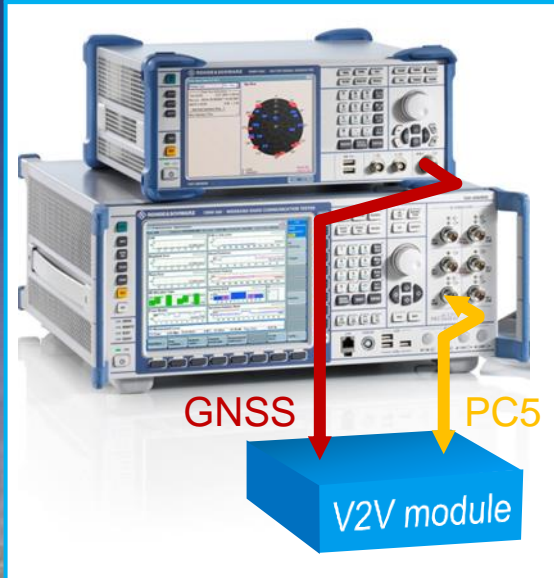
DMRS extension to cope
with relative speed of
up to 500 km/h

Spectrum sensing and
collision avoidance for
distributed scheduling

Introduction the concept of
zones for transmission
resources

Essential to ensure interoperability and required performance: Test and certification of C-V2x communication devices

LTE-V (PC5) Test setup



09.05.2018 | Test & Measurement

Rohde & Schwarz first to provide 3GPP Cellular-V2X device testing through application layer

Supporting end-to-end C-V2X safety related scenarios, the R&S CMW500 wideband radio communication tester enables cellular vehicle-to-everything (C-V2X) device verification in the lab

- LTE-PC5 communication test
 - Transmission Mode 4 (3GPP Rel.14, PSCCH, PSSCH)
 - Out-of-coverage operation with GNSS synchronization
- GCF Protocol Conformance
 - LTE-V2V GCF Work Item 281 (V2V)
 - LTE-V2X GCF Work Item 282 (V2X)

C-V2x signaling solution for 3GPP Rel.14



First C-V2x signaling solution on the market

CMW500 MLAPI based C-V2x Test Cases

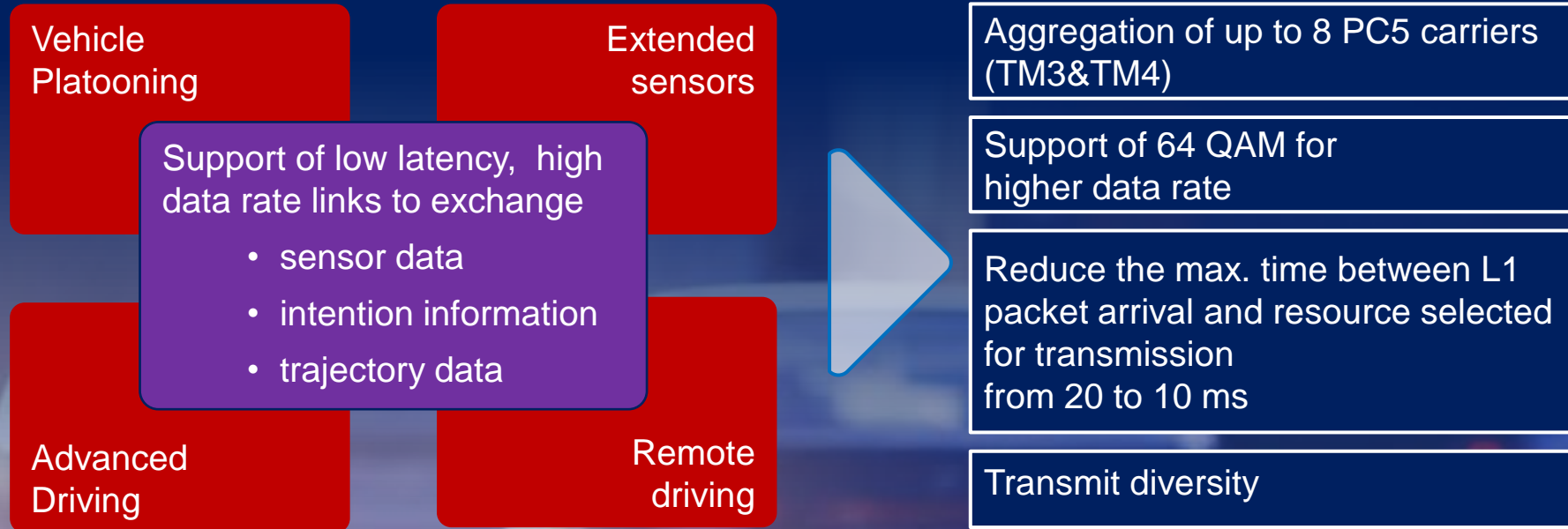
The demo shows vehicle-to-vehicle (V2V) PC5 mode communications between a simulated vehicle (DUT) and the R&S®CMW500.

Transferring ITS messages from one vehicle to the other will be demonstrated. E.g. if one vehicle brakes, it will be seen in the other vehicle.

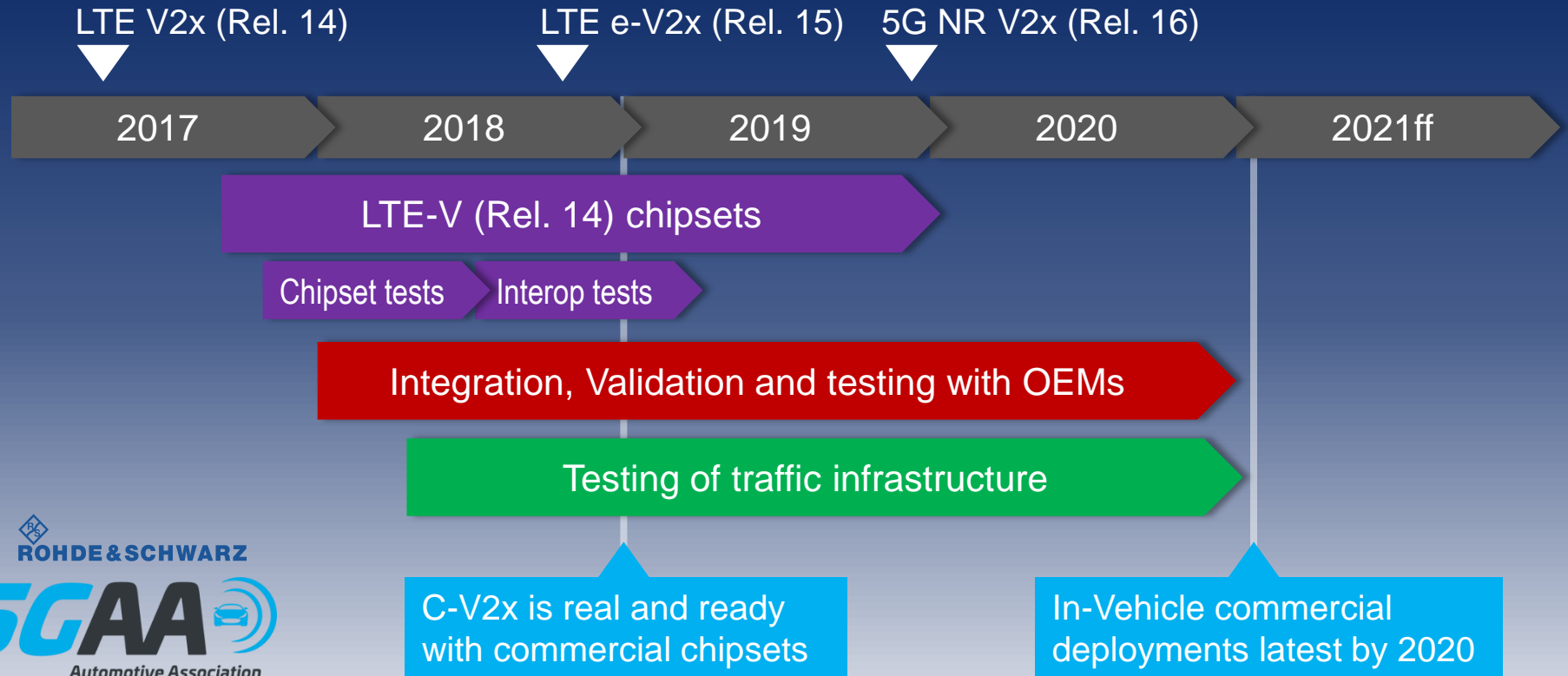
Link: <https://www.youtube.com/watch?v=EMam1ve4mCQ>



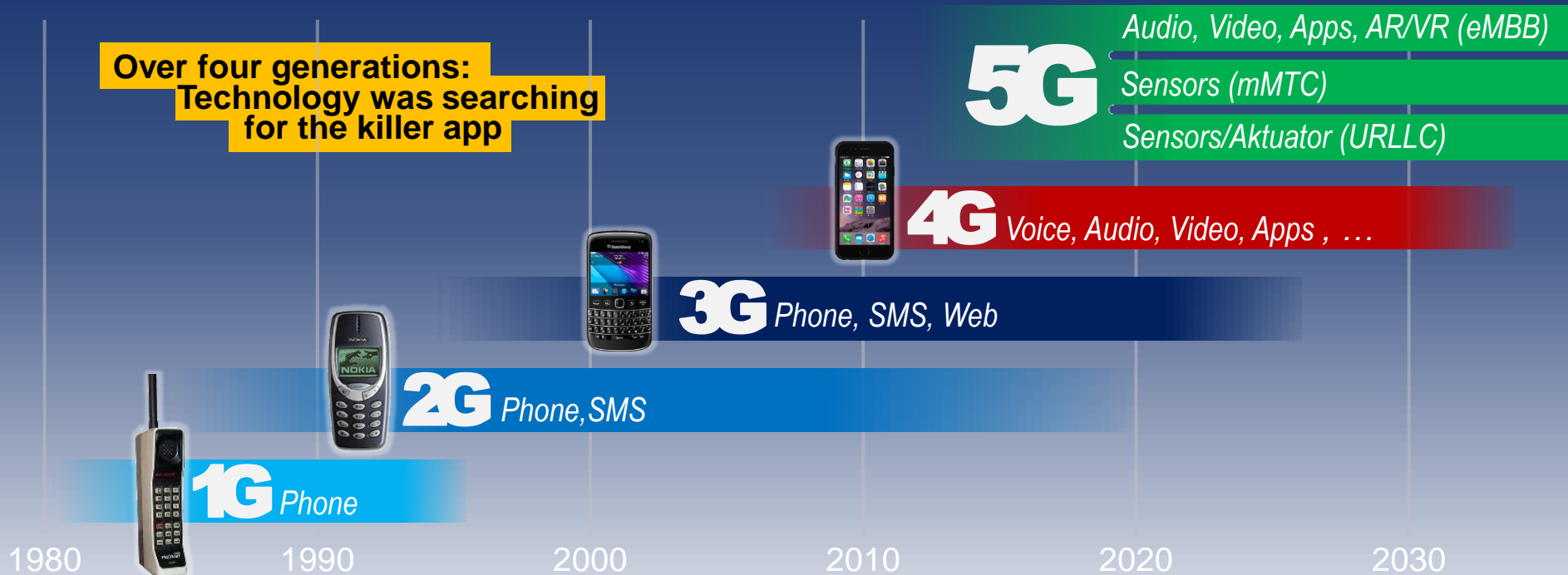
C-V2x enhancement in 3GPP focusing on specific use cases requiring high data rates and lower latency



5GAA timeline for deployment of LTE-V2x (V2V, V2I)

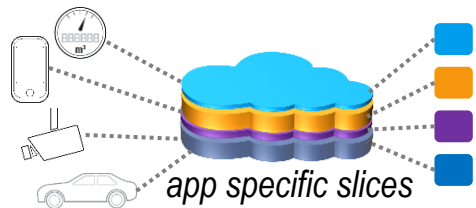


5G started with trying to define a wide range of applications first and define a very flexible 5G NR numerology to support most of them

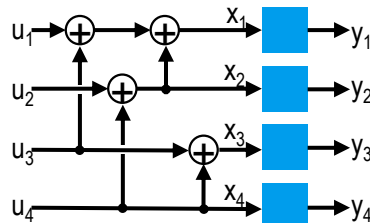


5G NR technology cornerstones to meet reliability and latency requirements of URLLC&V2X applications

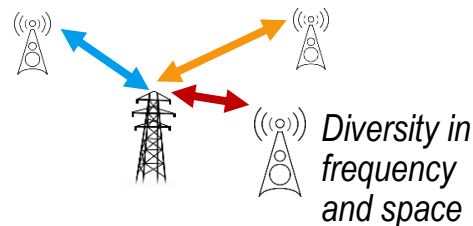
Network Virtualization



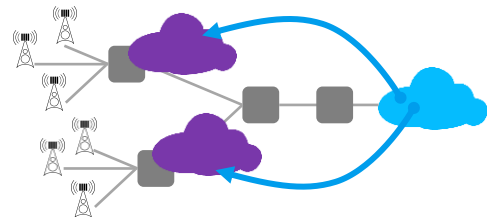
Robust coding



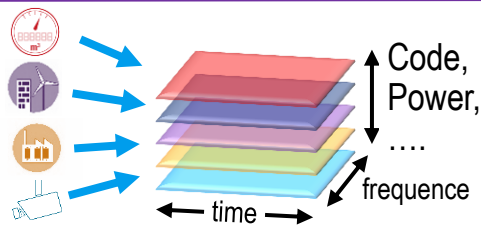
Multipoint connectivity



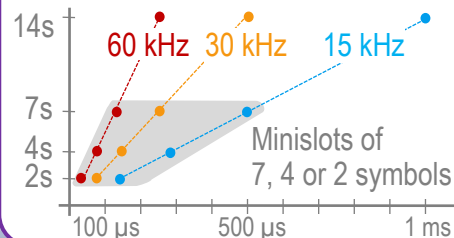
Mobile edge computing



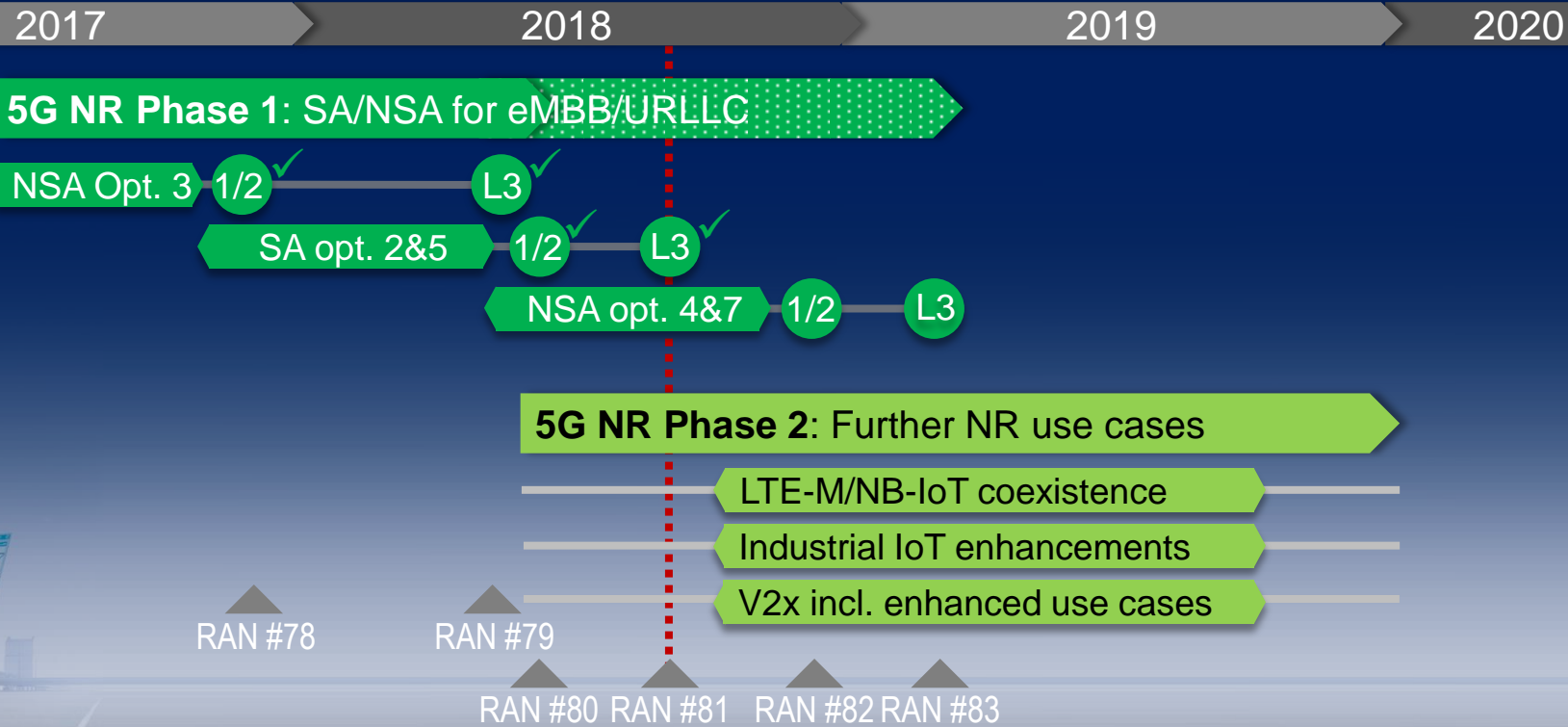
Grant free access



Minislots – short symbols



3GPP RAN 5G NR standardization overview



We help our customers to realize the vision of automated driving with dedicated test solutions for the automotive market



Signal analysis
for high-
frequency
radar signals



Determine the
permissibility of
radome
material.



Testing of
radars with
echo
generation



Reliable,
automated test
solutions for
V2X



Emergency call
- independently
certified test
solution



Testing in-
vehicle
communication
networks



Rohde & Schwarz
Our solutions for all trends
in the automotive industry

Thank you very much!