FUNCTIONS FOR AUTONOMOUS DRIVING AS NETWORK CHALLENGE IN 5G

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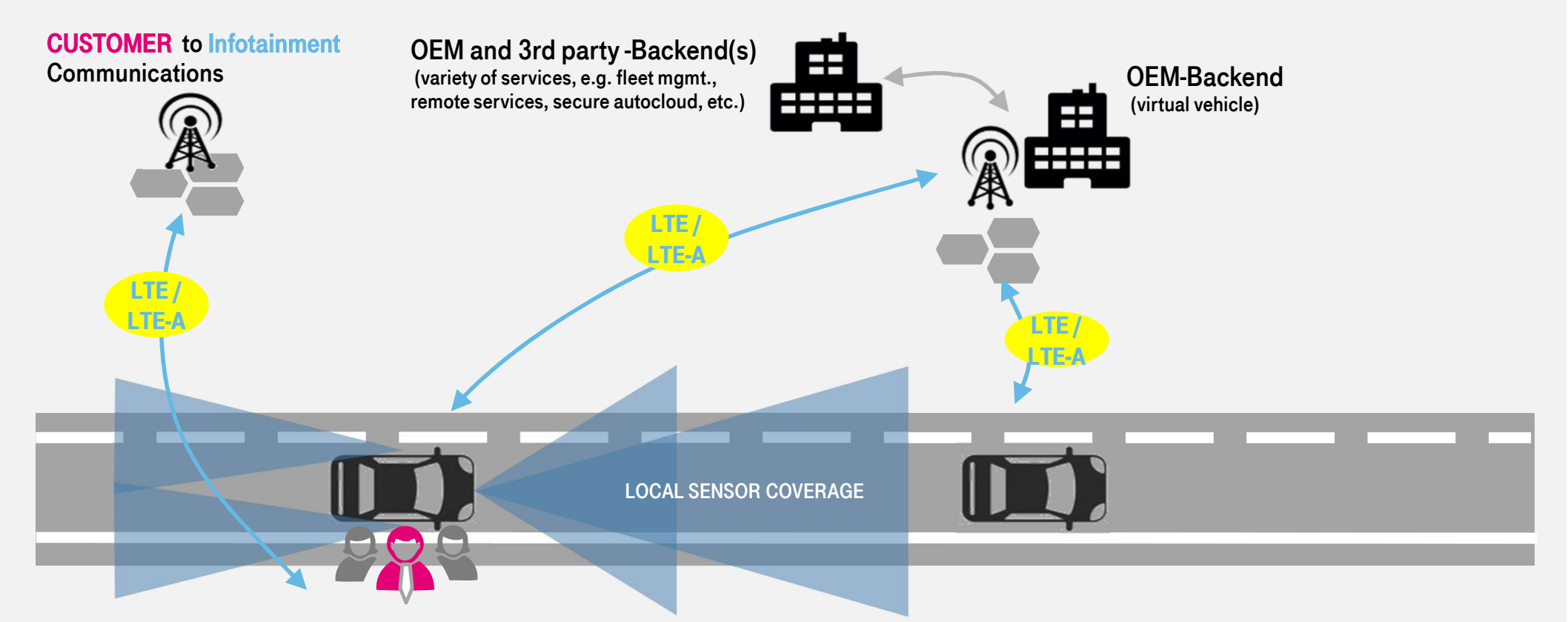
LIFE IS FOR SHARING.

AUTOMOTIVE PICTURE TODAY
CELLULAR CONNECTIVITY AS A MATTER FACT



USE CASES – 4 EXAMPLES AND REQUESTED „5G“ CAPABILITIES

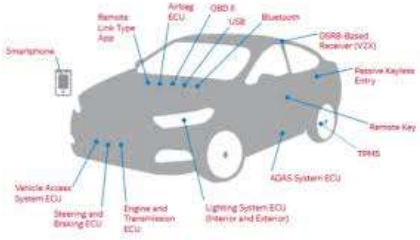
Authorization for Autonomous Driving (Level 3) / Sensor Data upload & dynamic/volatile Map Data download (e.g. hazard warnings)

Coverage:	highly relevant
Availability:	high
Locations:	„everywhere“, 1st on motorways
Data Size:	10KB
Throughput:	<10 KB/sec
Latency:	1-2 sec

(Predictive) QoS
Precise Positioning

Broadcast (**)

SOTA Download / Map (tiles) Download



Coverage:	low relevance
Availability:	low
Locations:	best effort
Data Size:	1 GB
Throughput:	10 MB/sec
„Latency“:	1-2 weeks

(Predictive) QoS

Automated Valet Parking / Remote / Teleoperated Driving

Coverage:	higly relevant
Availability:	ultra-high
Locations:	selected areas
Data Size:	>1 GB
Throughput:	10 MB/sec
Latency:	20 msec (dep. on speed)

Mobile Edge Computing

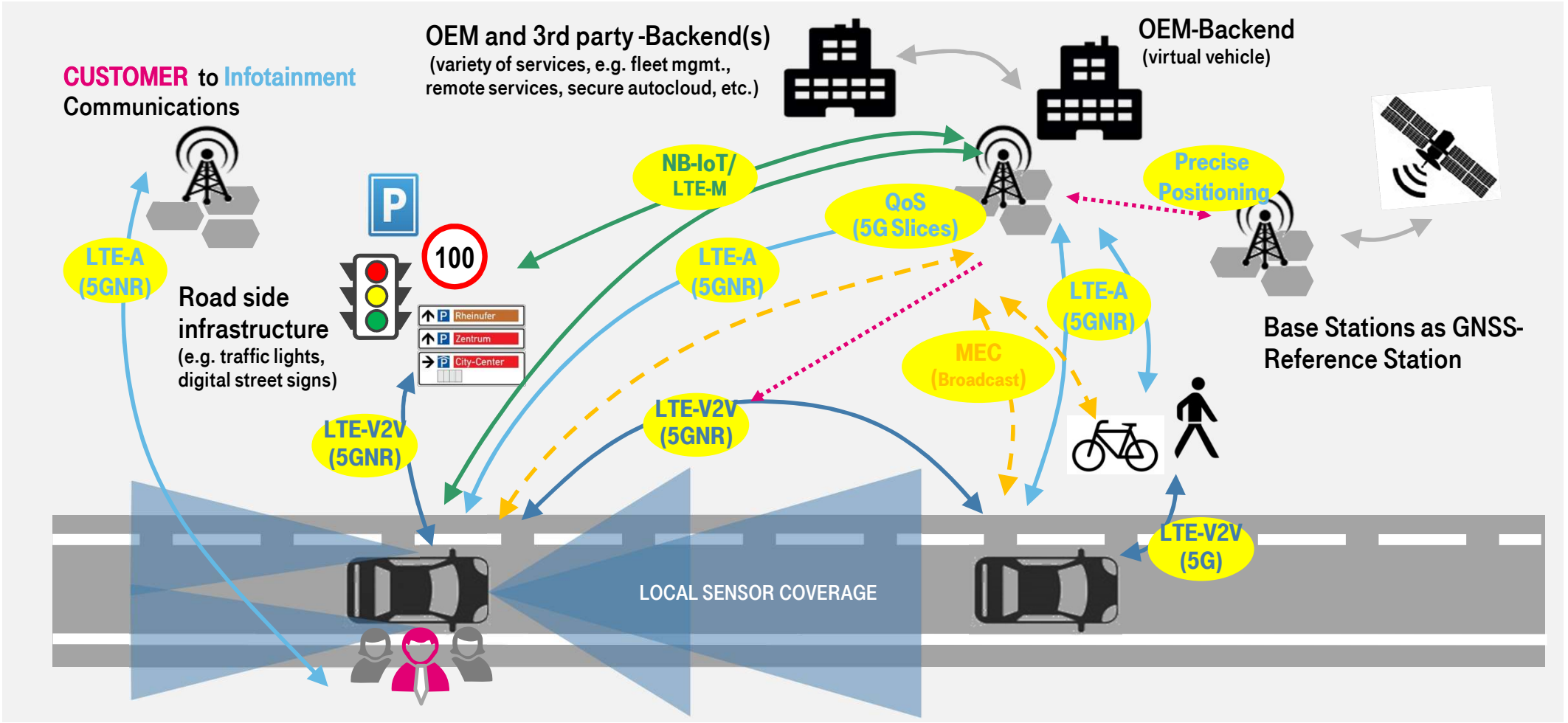
(High Density) Truck Platooning / V2V communication

Coverage:	higly relevant
Availability:	ultra-high
Locations:	„everywhere“, 1st on motorways
Data Size:	>1 GB
Throughput:	10 KB/sec 10MB/sec (*)
Latency:	<10 msec

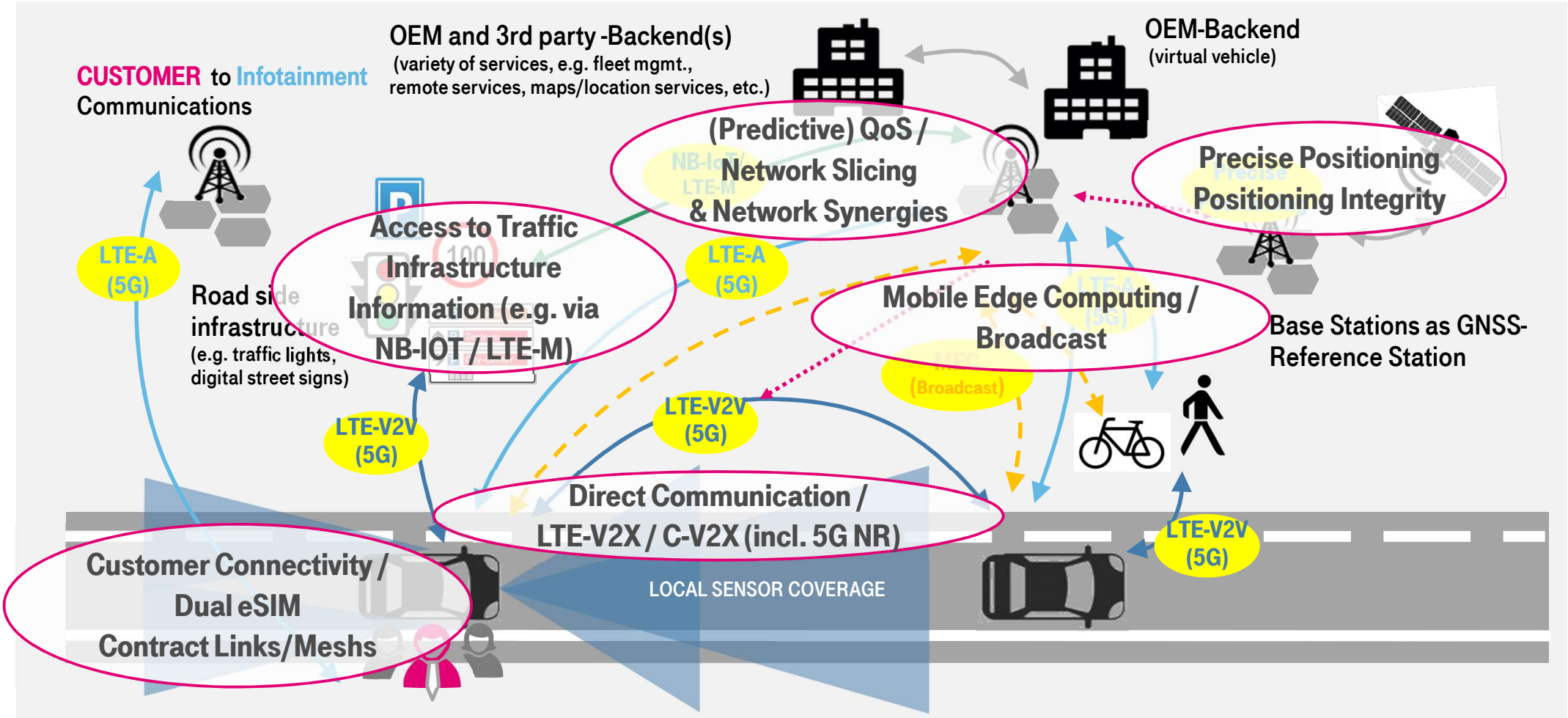
C-V2X
(LTE-V2X / 5GNR (*)-V2X)

(*) 5GNR (New Radio) for use cases such as „see through“ / complex sensor sharing
(**) dependend on #customers / #use case deployments

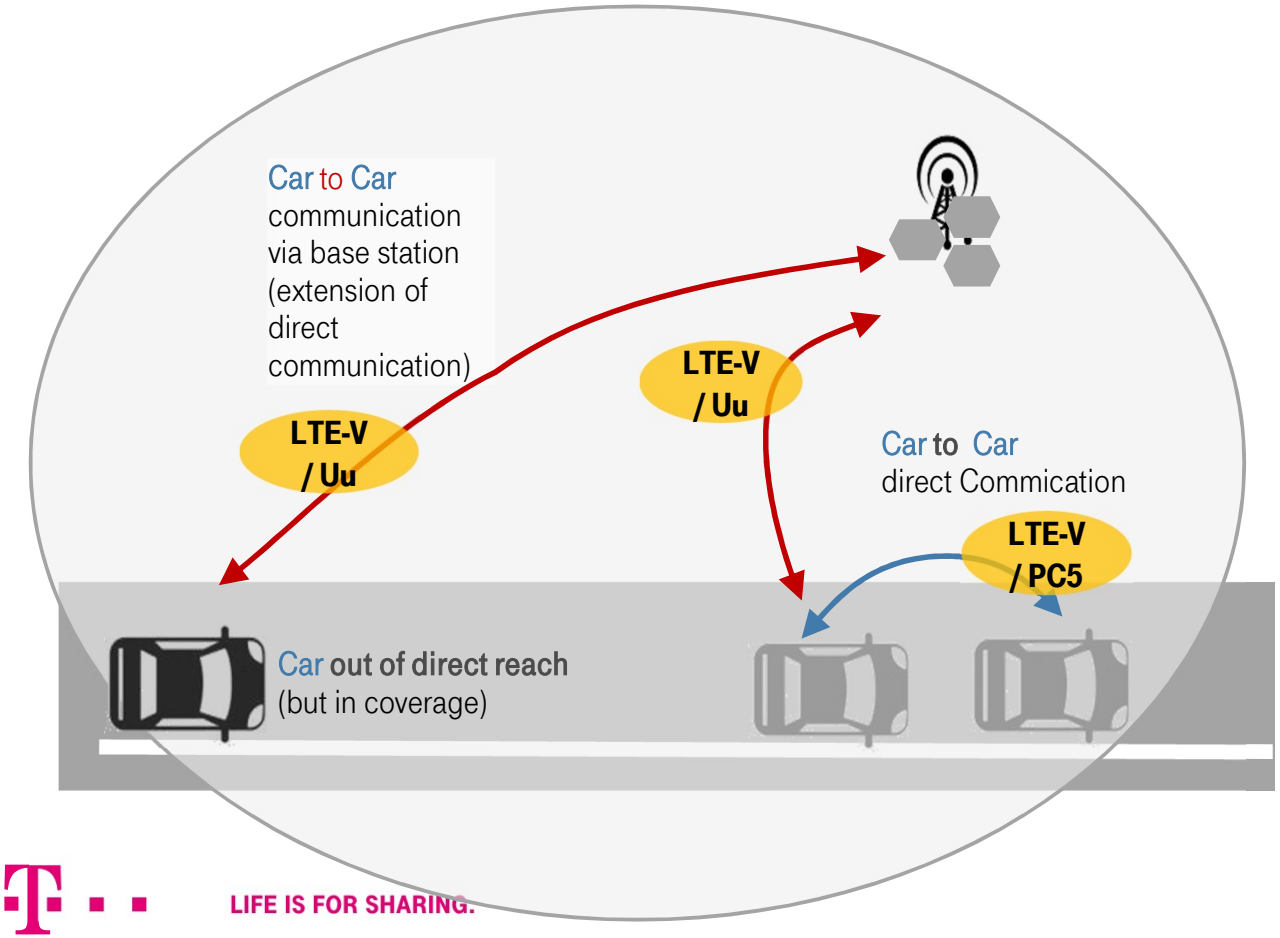
EXTENDED AUTOMOTIVE CELLULAR CONNECTIVITY LANDSCAPE

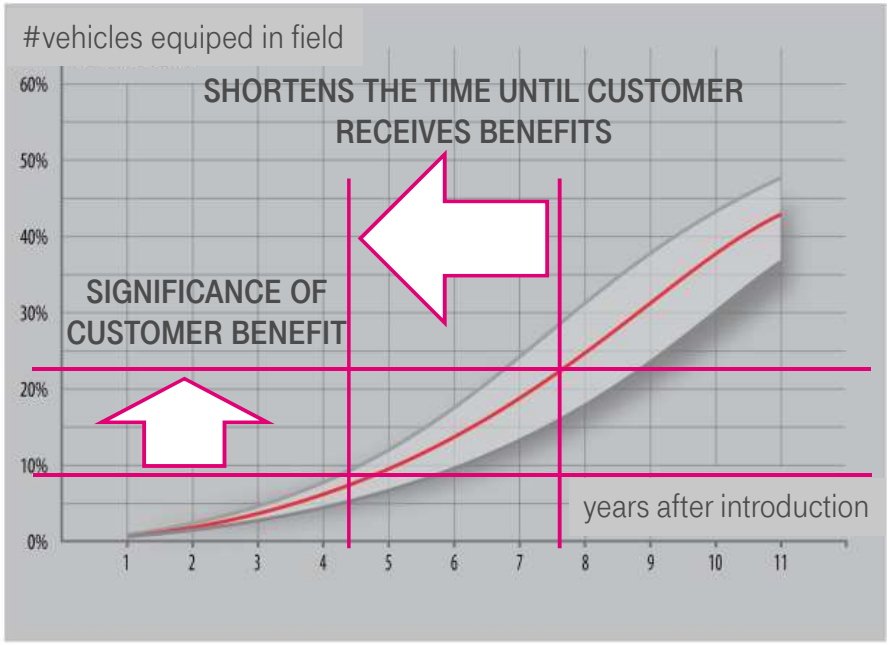


AUTOMOTIVE CELLULAR CONNECTIVITY / TOPICS



DIRECT COMMUNICATION PENETRATION RATE CHALENGE: C-V2X: EXTENSION OF REACH VIA CELLULAR NEWTORKS



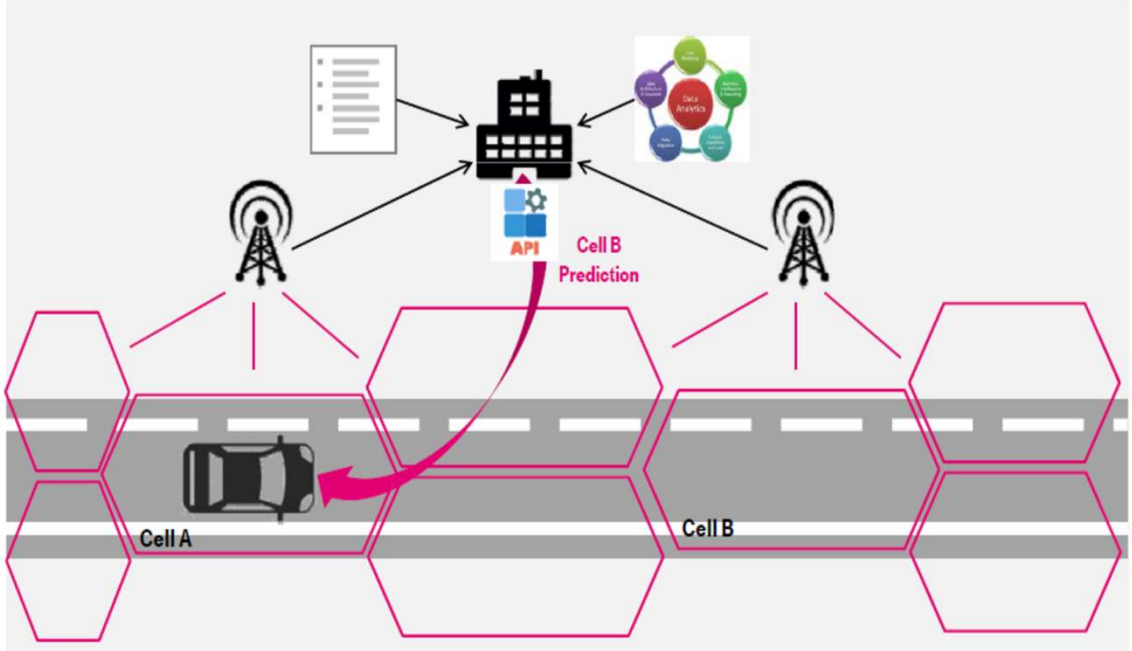


expected deployment of Car-2-X equipment in the field after start of deployment

QUALITY OF SERVICE & NETWORK SLICING: SERVICE RELIABILITY AND RESILIENCE

STEPWISE APPROACH:

1. Static (location based) map with certain network KPIs, e.g. throughput, latency
2. Dynamic map, continuously updated, based on the analysis of network data
   Provisioning the data at an API
   (location based request → KPI response)
3. Dynamic map including (time) prediction model, prediction is based on analytics of e.g. historical data
   Provisioning of the data as an (extended) API:
   API - location based request and time window forecast, KPI response)



NETWORK-RTK / PPP FOR VOLUME SERVICES

- Objective: positioning accuracy: less than 30cm
- General approach: broadcasting of corrections

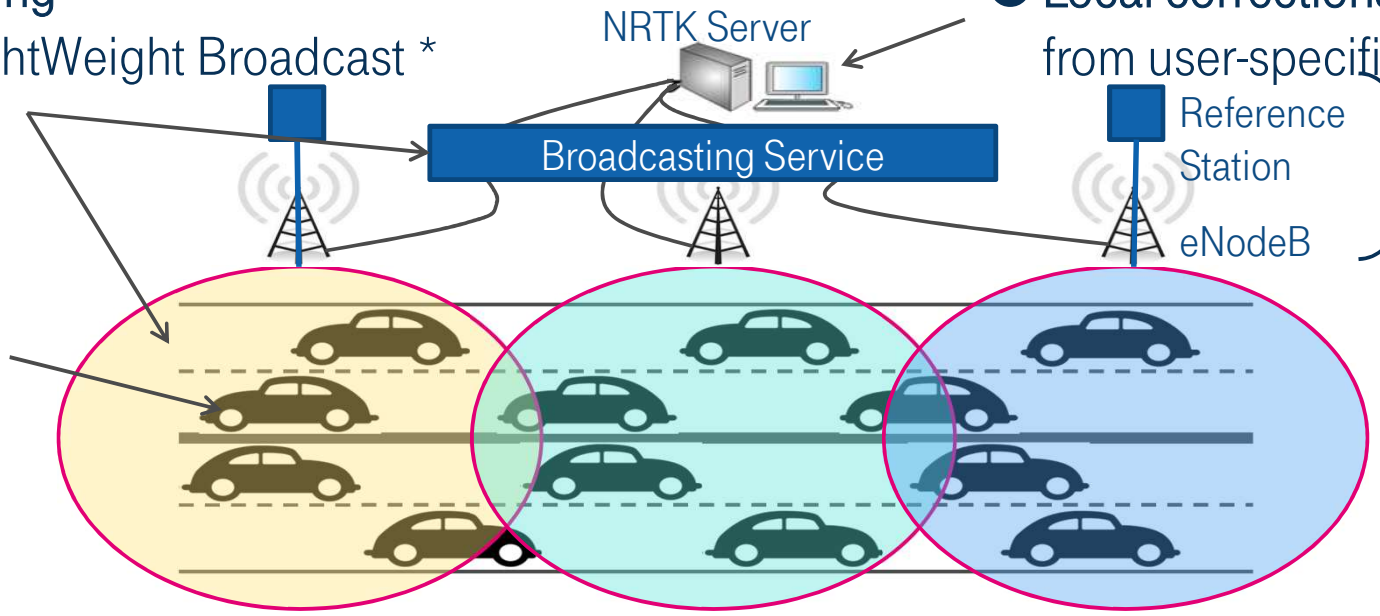
plus

Pilot under evaluation

❸ Local broadcasting
e.g. applying LightWeight Broadcast *
and MEC**

❷ Local corrections
from user-specific to regional

❹ On-board unit
integrating
connectivity
and positioning

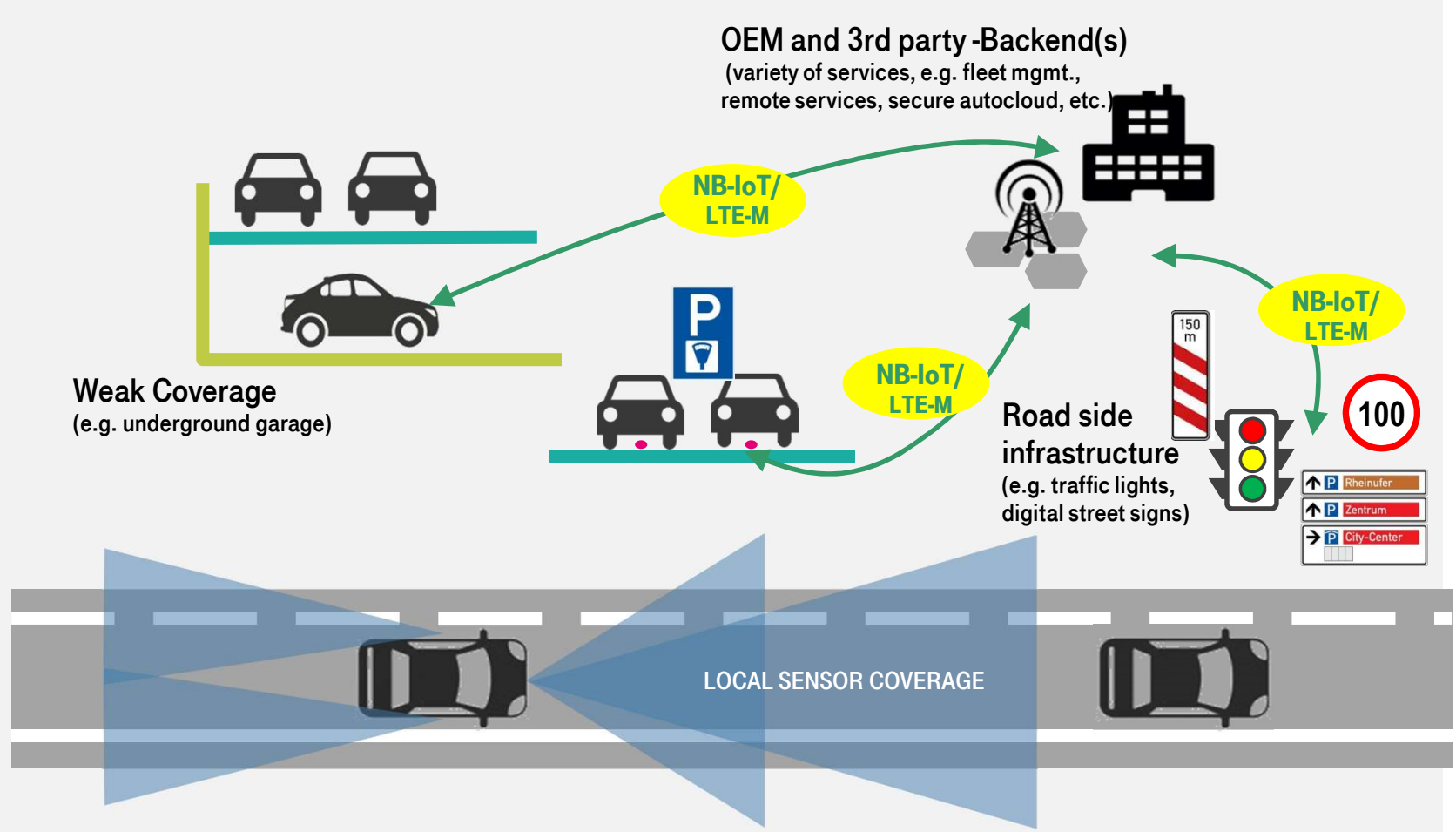


❶ Site-Sharing
Optimization of
NRTK grid

* SIB/System Information Block Broadcast

** MEC: Mobile Edge Computing

NARROW BAND IOT AND LTE MACHINE TYPE COMMUNICATION FOR INFRASTRUCTURE (AND VEHICLES)



FUNDAMENTAL: CONNECTED CAR SECURITY

7

Aftermarket solution uses Advanced secure pairing to avoid Man-In-The-Middle attack

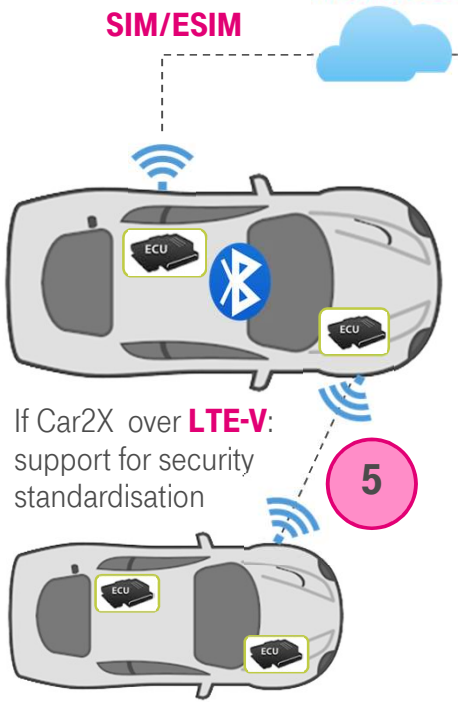
1

IN-CAR SECURITY

- Intrusion detection algorithms to identify attacks / alarms
- Keystore/Crypto-engine (**TCOS**)
  - >130 Mio instances
  - Used in automotive industry, smart-cards, ID-Cards, health care (eGK) etc.

2

CONNECTIVITY SECURITY
FRAUD DETECTION AS A SERVICE ON SIM/ESIM



If Car2X over **LTE-V**: support for security standardisation

5

Service Provider

3

BACKEND SECURITY
(PSA-approved)

- Hardening and CIA (Confidentiality, Integrity, Availability)
- Penetration Tests
- Intrusion protection/detection in cooperation with other providers
- Data Inspection and verification /advanced analytics for provided Data
- Security Monitoring
- Identity& Device Management especially for security updates
- Car Hacking demonstrator

App/Web Security (PSA-approved)

6

4

E2E SECURITY (PSA-approved)

- Transaction security
- 3rd party integration
- Content security

PSA – Privacy Security Assessment (Telekom internal process)
ECU – Electronic Control Unit

Connected mobility for vehicles, people and transport infrastructure

5GAA brings together the automotive and telecommunications industries to accelerate the global deployment of Cellular Vehicle-To-Everything (C-V2X) as a first step towards a fully integrated intelligent transport system with 5G

AUTOMOTIVE INDUSTRY

Vehicle Platform, Hardware and Software Solutions

TELECOMMUNICATIONS

Connectivity and Networking Systems, Devices and Technologies

5GAA unites 110+ members* from around the world working together on all aspects of C-V2X including technology, standards, spectrum, policy, regulations, testing, business models and go-to-market

*as of Jan 2019

Deutsche Telekom AG | T-Systems International
DTAG Technology & Innovation | Digital Division/Connected Mobility

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LIFE IS FOR SHARING.

V2V/V2X/V2I ABBREVIATIONS

5G	5th Generation of cellular
dB	Decibel
dBm	Decibel meter
DSRC	Dedicated Short Range Communication
D-GNSS	Differential GNSS
DL	Downlink
EPC	Evolved Packet Core
eSIM	embedded SIM
FDMA	Frequency division multiple access
GNSS	Global Navigation Satellite System
IEEE 802.11p	
ITS	Intelligent Transport System
ITS-G5	
LTE	Long Term Evolution
Mbps	Mega bit per Second
MHz	Mega Hertz
NR	New Radio
MEC	Mobile Edge Computing
MME	Mobility Management Entity
P-GW	Packet Gateway
PLMN	Public Land Mobile Network
RRM	Radio Resource Management
Rx	Receiver
S-GW	Serving Gateway
S1	S1-interface
Tx	Transmitter
UE	User Equipment
UICC	Universal Integrated Circuit Card
UL	Uplink
V2V	vehicular-2-vehicular
V2I	vehicular-2-infrastructure
V2X	vehicular-2-everything
V2N	vehicular-2-network

Organizations:

3GPP	www.3gpp.org
5GAA	www.5gaa.org
ETSI ITS	www.etsi.org
IEEE	www.ieee.org
NGMN	www.ngmn.org
IEEE	www.gsma.com