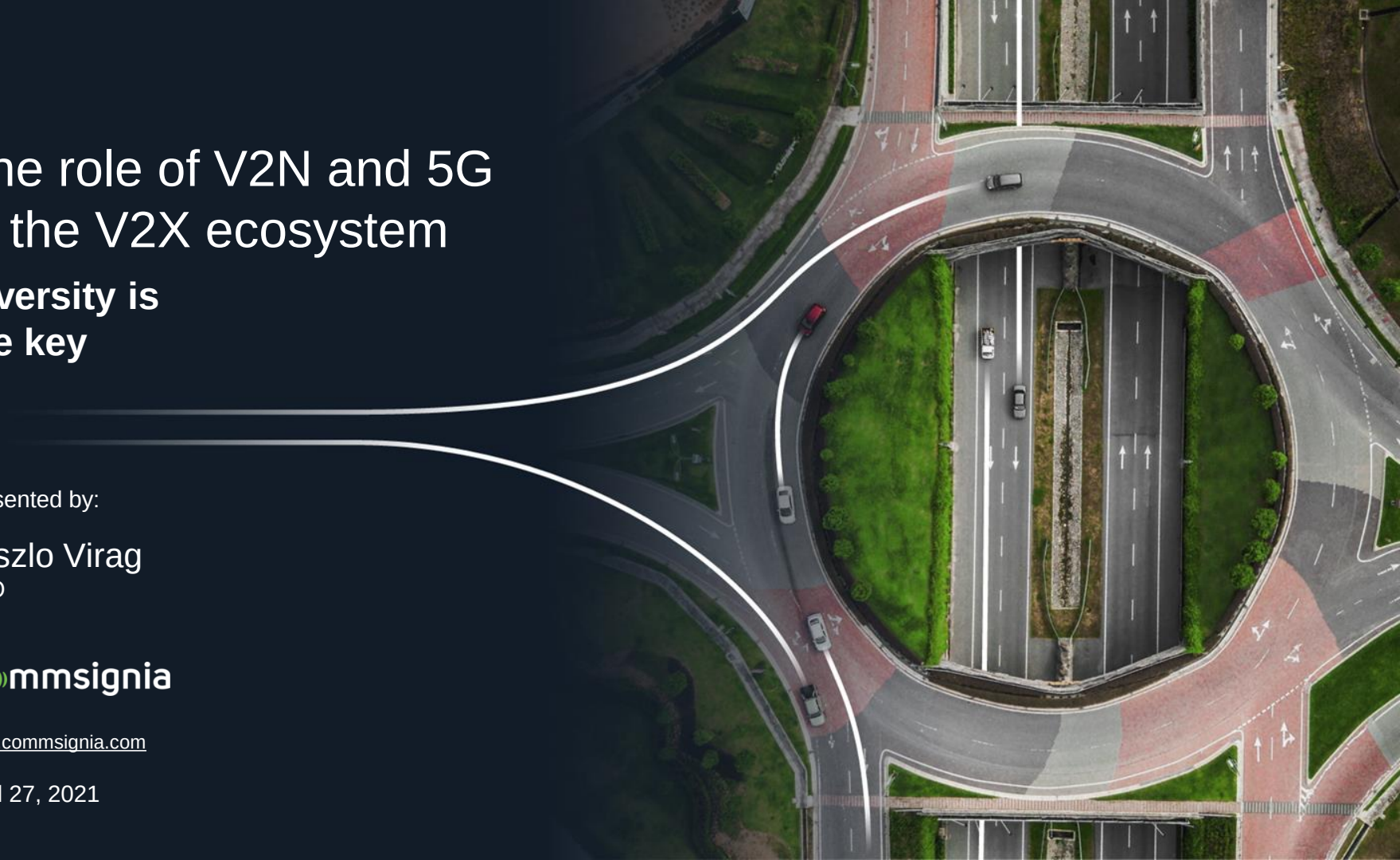
The role of V2N and 5G in the V2X ecosystem

Diversity is the key



Presented by:

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CTO

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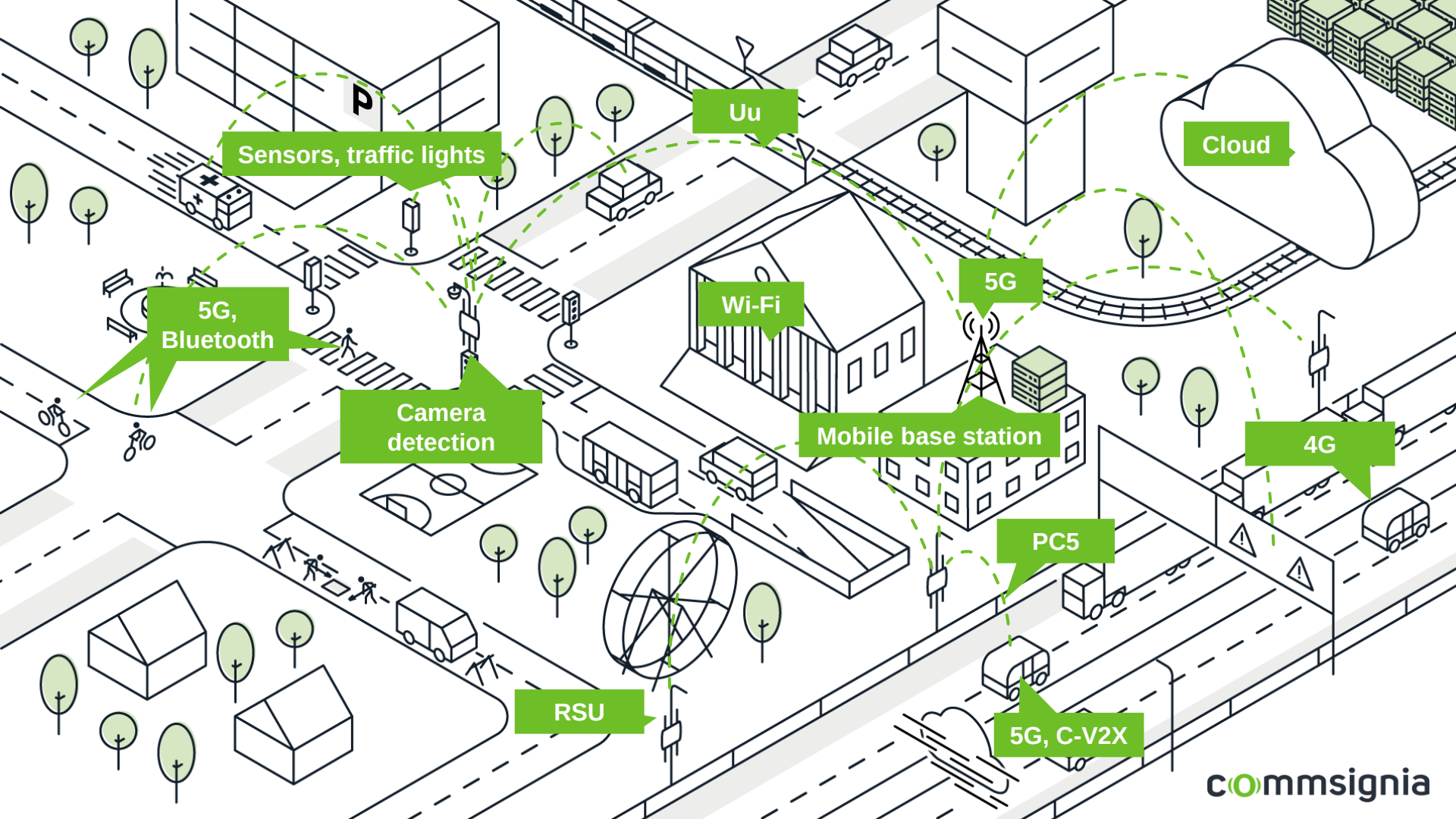
April 27, 2021


Sensors, traffic lights
Uu
Cloud
5G, Bluetooth
Wi-Fi
5G
Camera detection
Mobile base station
4G
PC5
RSU
5G, C-V2X
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INFRASTRUCTURE

- Traffic lights
- Beacons
- Cameras
- Sensors
- Roadside units

RADIO CHANNELS

- 5.9 GHz road safety band
- 4G
- 5G
- Wifi
- Bluetooth
- UWB

DEVICES

- Cars
- Scooters
- E-bikes
- Motorcycles
- Trucks

…

- Phones

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5G phones and tablets everywhere

- Widespread
- Easy to use
- Open platforms
- Notifications

- Limited antenna size
- Users lack knowledge to keep it secure
- A V2X app needed to receive messages
- It’s possible to turn off notifications, connections
- The users control everything

Will the road safety app run when it’s needed?

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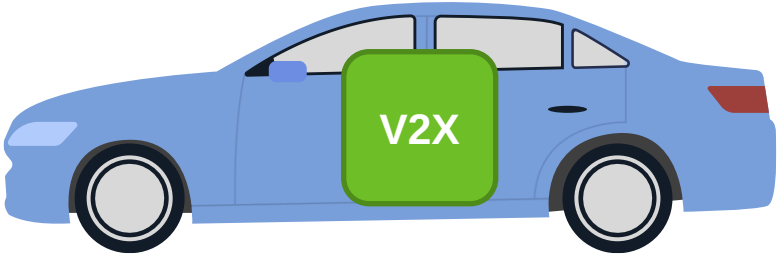
Vehicles as software platforms



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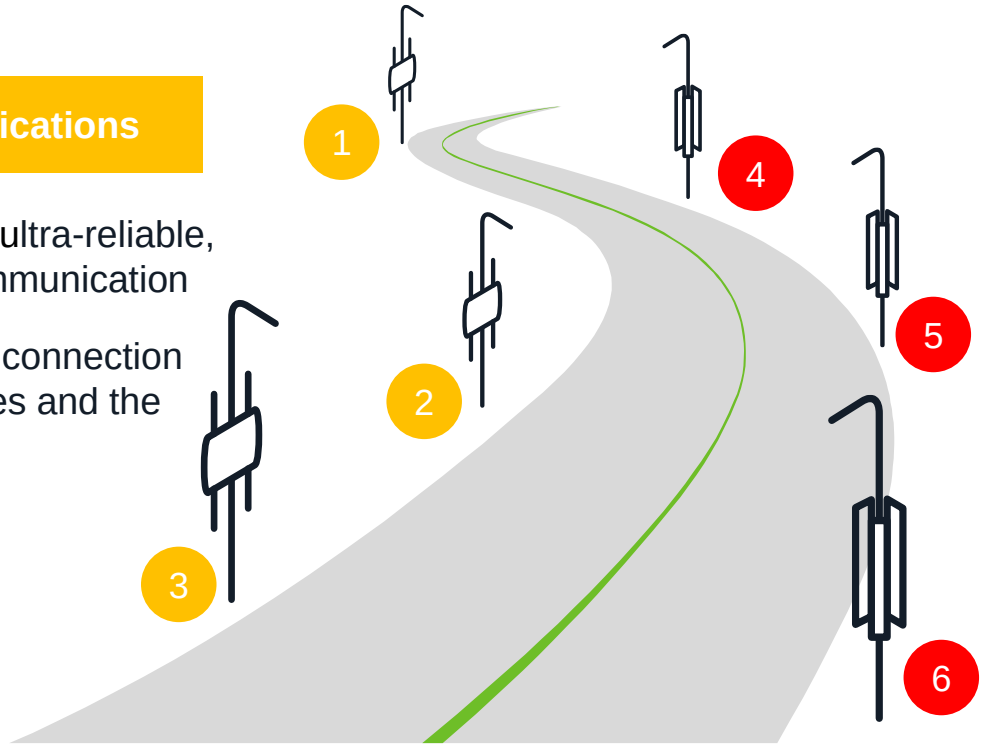
Road networks

Safety applications

1. Short-range, ultra-reliable, low-latency communication

2. Allows direct connection between vehicles and the infrastructure

3. Free to use



General applications

4. Long-range messages

5. Normal, not latency critical communication

6. Paid 4G or 5G network access

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Terminology

range		SHORT-RANGE <1 mile	LONG-RANGE >1 mile
Network protocol	**cellular**	C-V2X (PC5)	4G or 5G (Uu)
	wifi	DSRC (802.11p)	
V2?		V2V, V2I, V2P	V2N
application		SAFETY AND EFFICIENCY	MOSTLY FOR INFOTAINMENT AND EFFICIENCY

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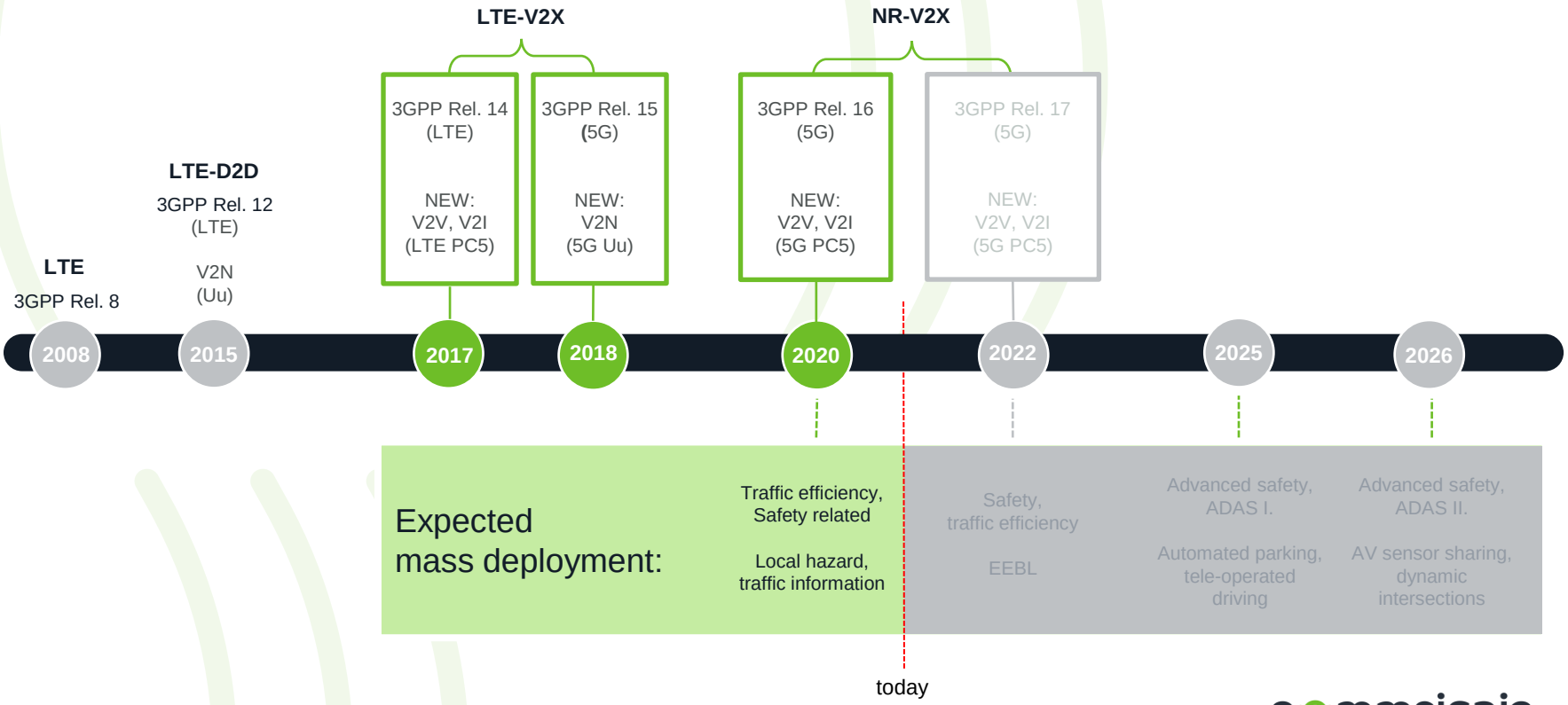
Cellular timeline until now



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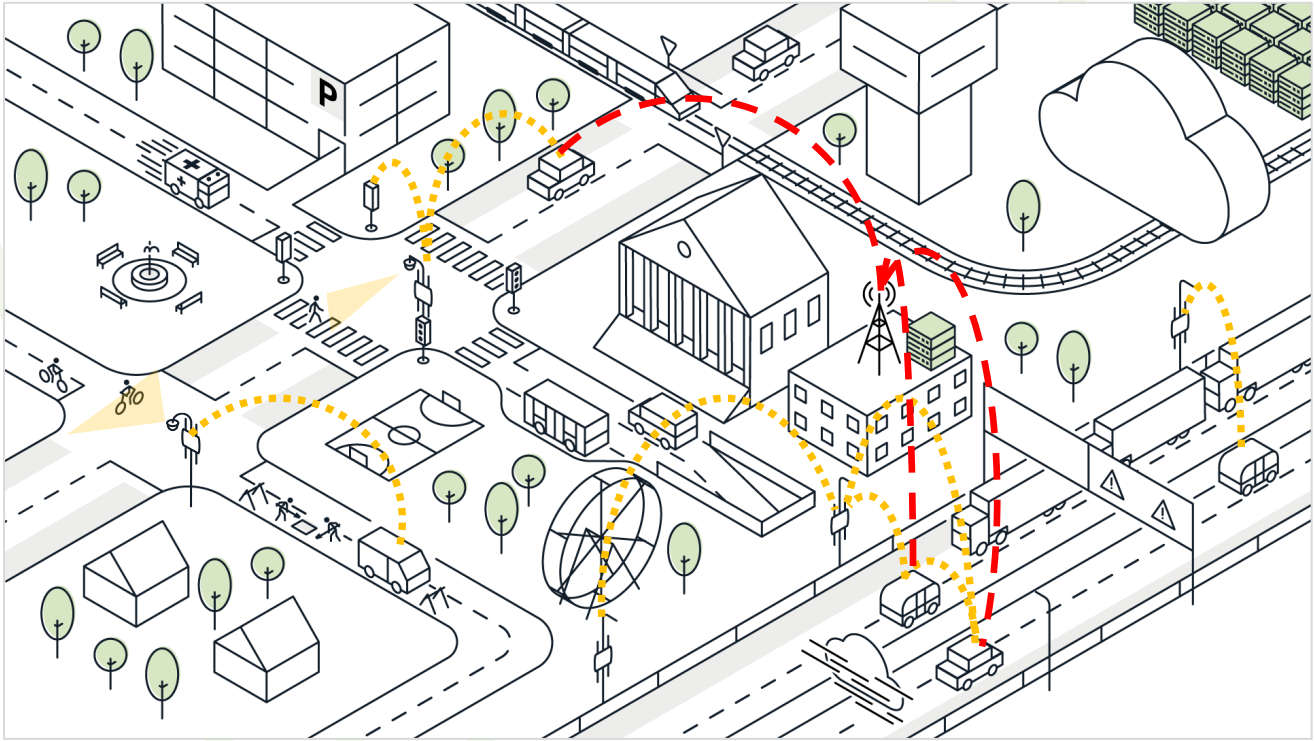
C-V2X messaging now



SHORT-RANGE MESSAGES

- nearby hazard warning
- here & now relevant
- precise locations and sensor data
- PC5 link

LONG-RANGE MESSAGES

- possible hazard on route
- general weather updates
- traffic updates
- Uu link

CAMERA VRU RECOGNITION

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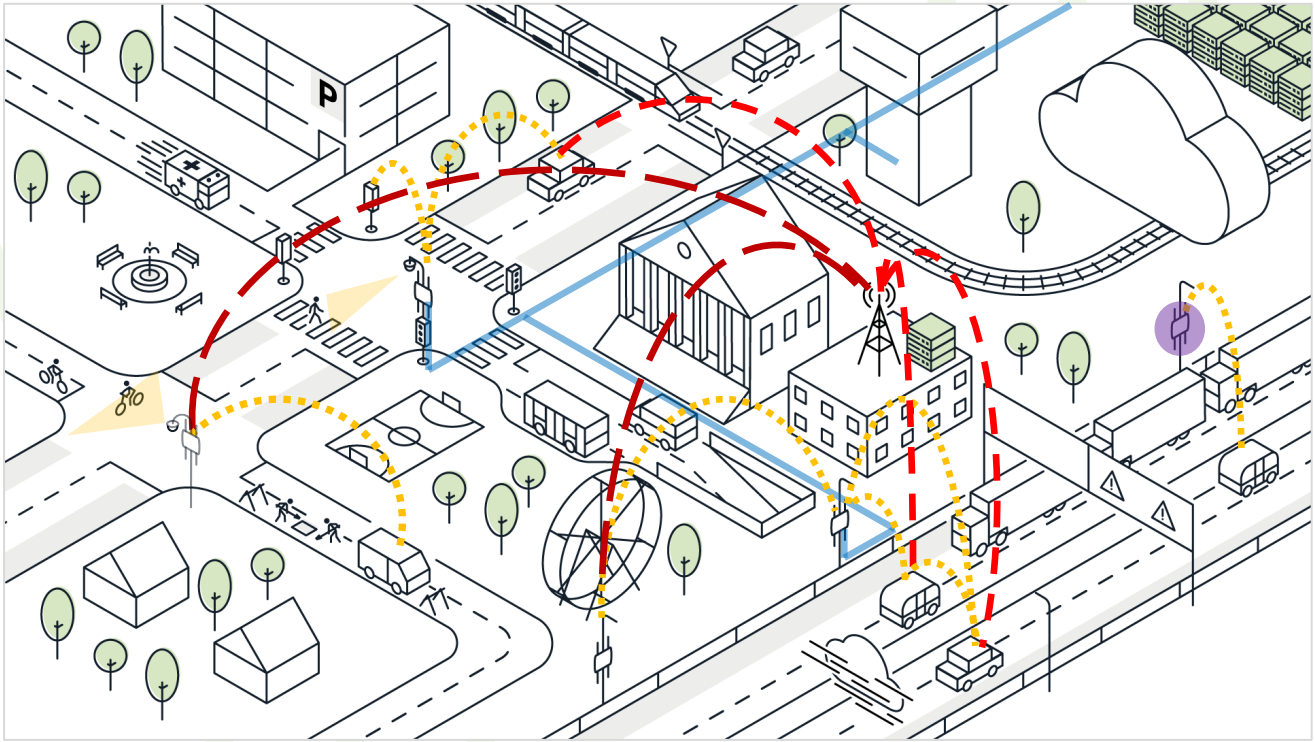
C-V2X messaging + backhaul connections



SHORT-RANGE MESSAGES
C-V2X or DSRC

LONG-RANGE MESSAGES
4G or 5G

WIRED (FIBER) BACKHAUL

WIRELESS (4G/5G) BACKHAUL

AUTONOMOUS OPERATION

CAMERA VRU RECOGNITION

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Cellular timeline until now

LTE
3GPP Rel. 8

LTE-D2D
3GPP Rel. 12
(LTE)

V2N
(Uu)

LTE-V2X

3GPP Rel. 14
(LTE)

NEW:
V2V, V2I
(LTE PC5)

3GPP Rel. 15
(5G)

NEW:
V2N
(5G Uu)

NR-V2X

3GPP Rel. 16
(5G)

NEW:
V2V, V2I
(5G PC5)

3GPP Rel. 17
(5G)

NEW:
V2V, V2I
(5G PC5)

2008 | 2015 | 2017 | 2018 | 2020 | 2022 | 2025 | 2026

today

Expected mass deployment:	2020	2022	2025	2026
	Traffic efficiency, Safety related Local hazard, traffic information	Safety, traffic efficiency EEBL	Advanced safety, ADAS I. Automated parking, tele-operated driving	Advanced safety, ADAS II. AV sensor sharing, dynamic intersections

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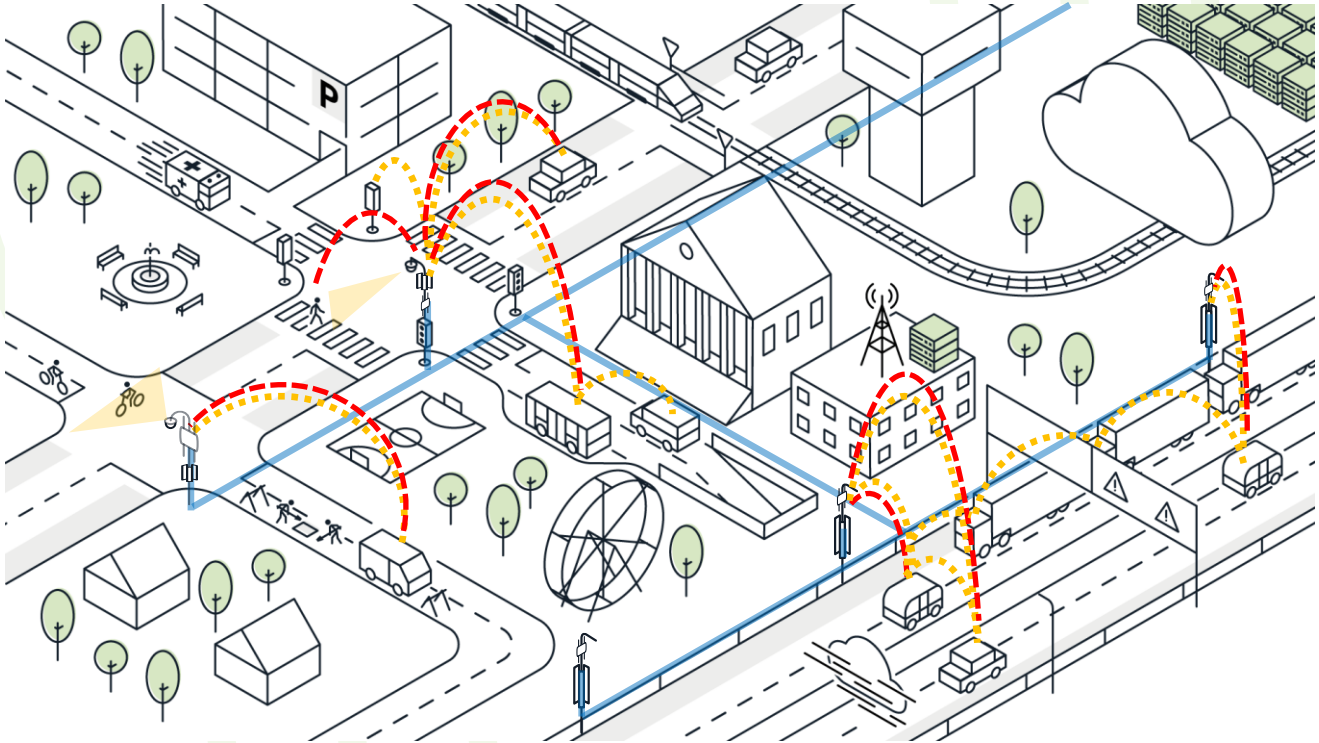
Brave new 5G world



DIRECT MESSAGES
C-V2X or DSRC

NETWORK MESSAGES
4G or 5G

CAMERA VRU RECOGNITION

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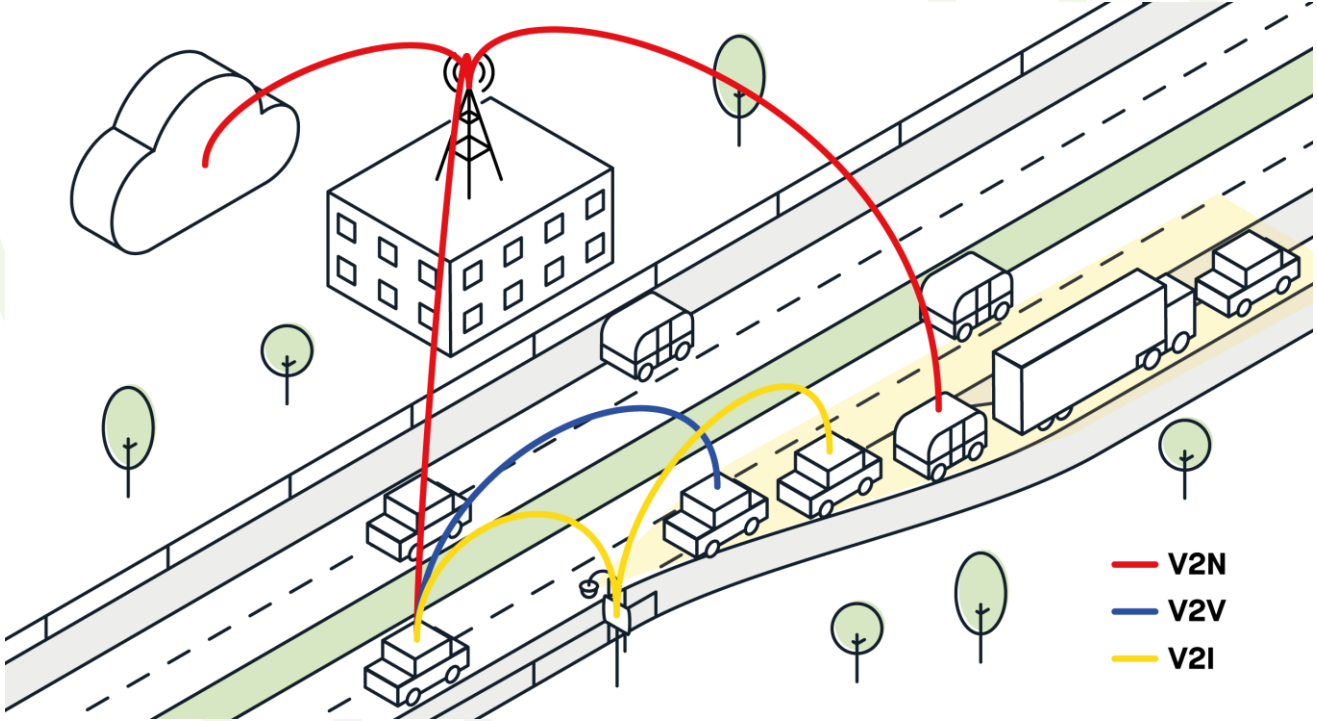
Cloud fusion of 4G/5G and short-range messages



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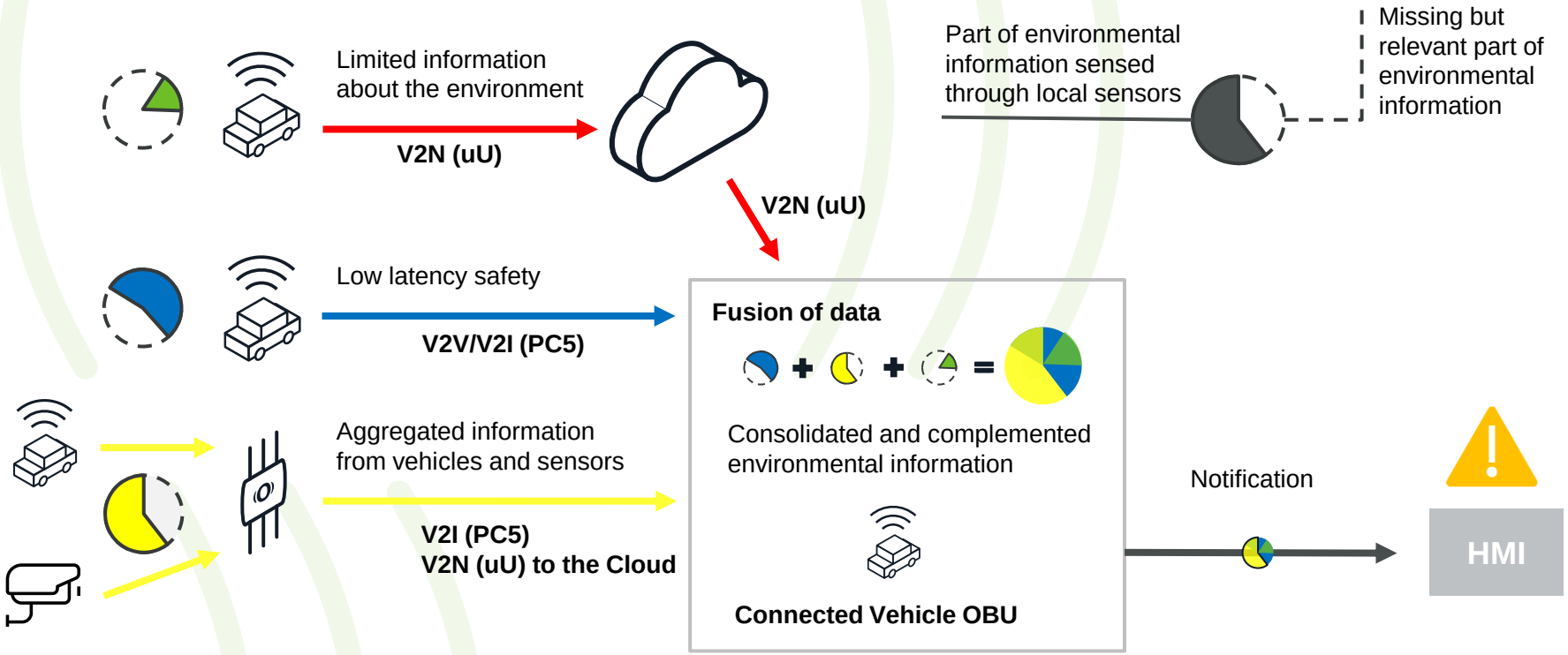
Fusion of V2N, V2I and V2V



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