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It is an exciting era with the cellular generations, but it is also causing headache for the automotive sector

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Overview

- Today’s status
- What comes next in 5G and 6G?
- The V2X ecosystem
- Challenges caused by the cellular generations
- IPv6

Technologies and functions of today

Broadcasting:
AM, FM, DAB, SDARS &
TV, DVB

Cellular: 2G/3G/4G/5G

Wi-Fi: 802.11a/b/g/n/ac/ax

Remote diagnostic

SW updates over-the-air

Spotify

GNSS:
GPS
Galileo
GLONASS
Beiduo

Navigation

Map updates

Connected safety

Wi-Fi hotspot

BT & BLE

UWB

NFC

Youtube

Phone as key

Other:
125kHz
434MHz
5.8GHz

Tire pressure monitoring system

Handsfree call

Weather forecast

In a car we have 30-40 antennas

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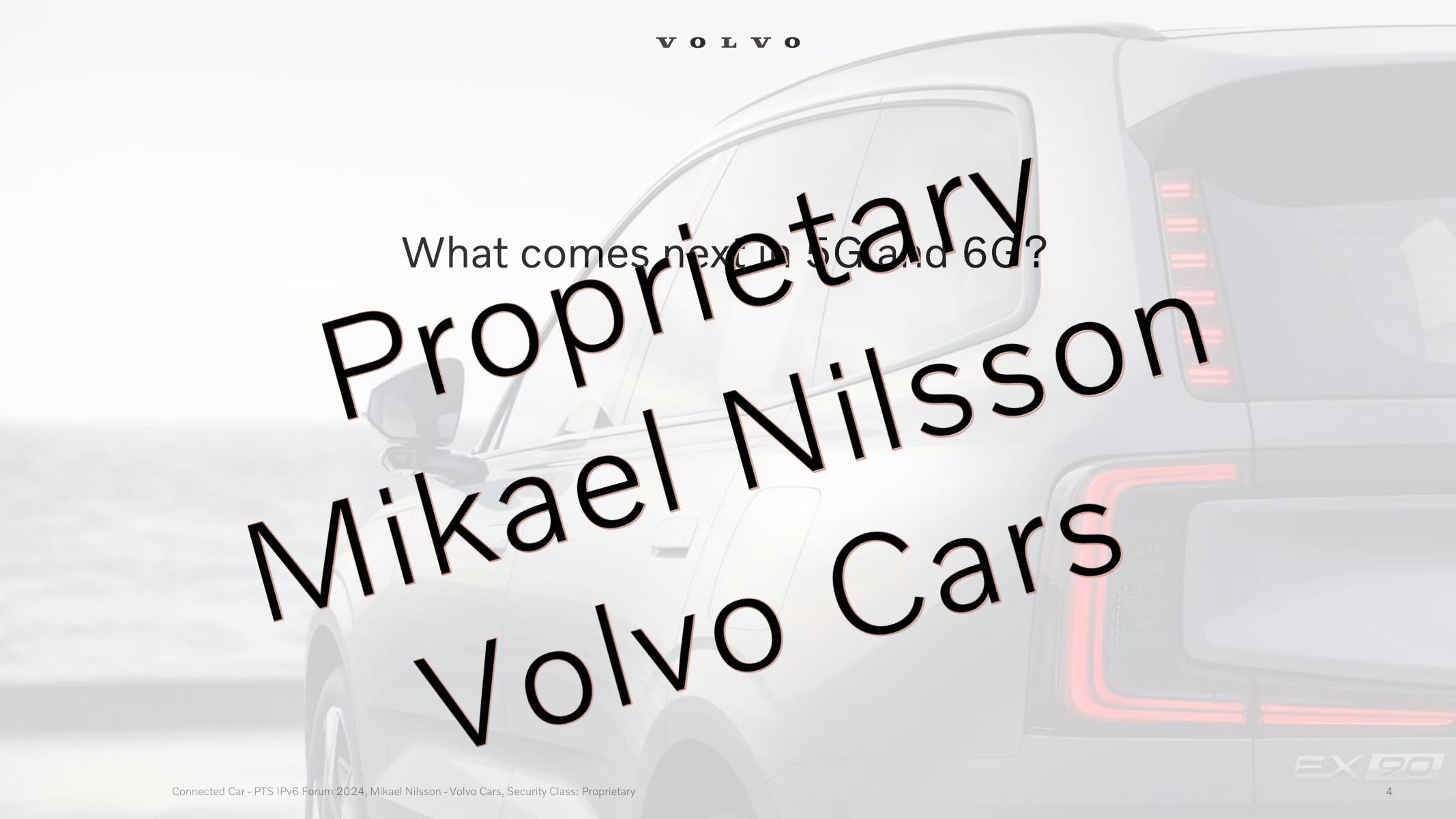
What comes next in 5G and 6G?

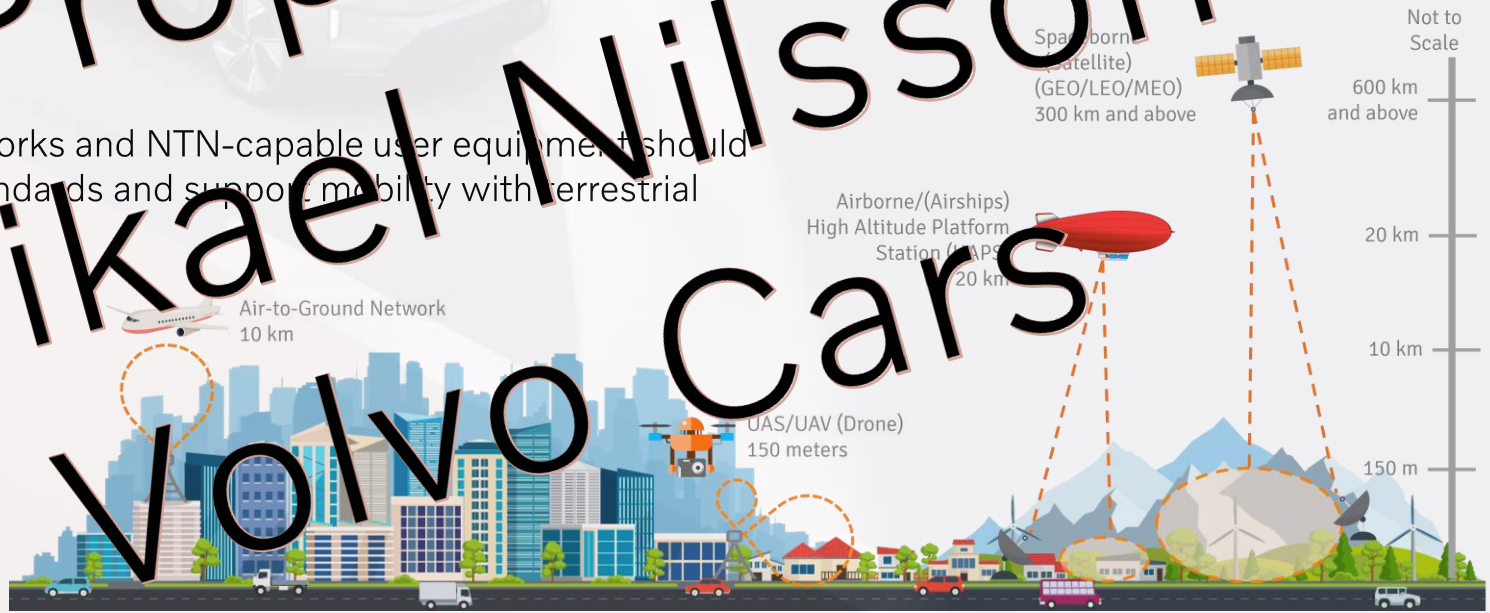


Opportunities:
Non-Terrestrial Network Connectivity

Three Benefits of Non-Terrestrial Networks

- Service Continuity
- Service Ubiquity
- Service Scalability

5GAA: “Non-terrestrial networks and NTN-capable user equipment should be compliant with 3GPP standards and support mobility with terrestrial 4G and 5G networks”.



Ref.: https://www.awardsolutions.com/portal/shareables/why-do-we-need-satellite-based-non-terrestrial-networks-ntn-5g
Ref.: 5GAA Position on the Secure Space-Based Connectivity Programmeand Focus on the European Communication Satellite Constellation

Opportunities :
5G Broadcasting

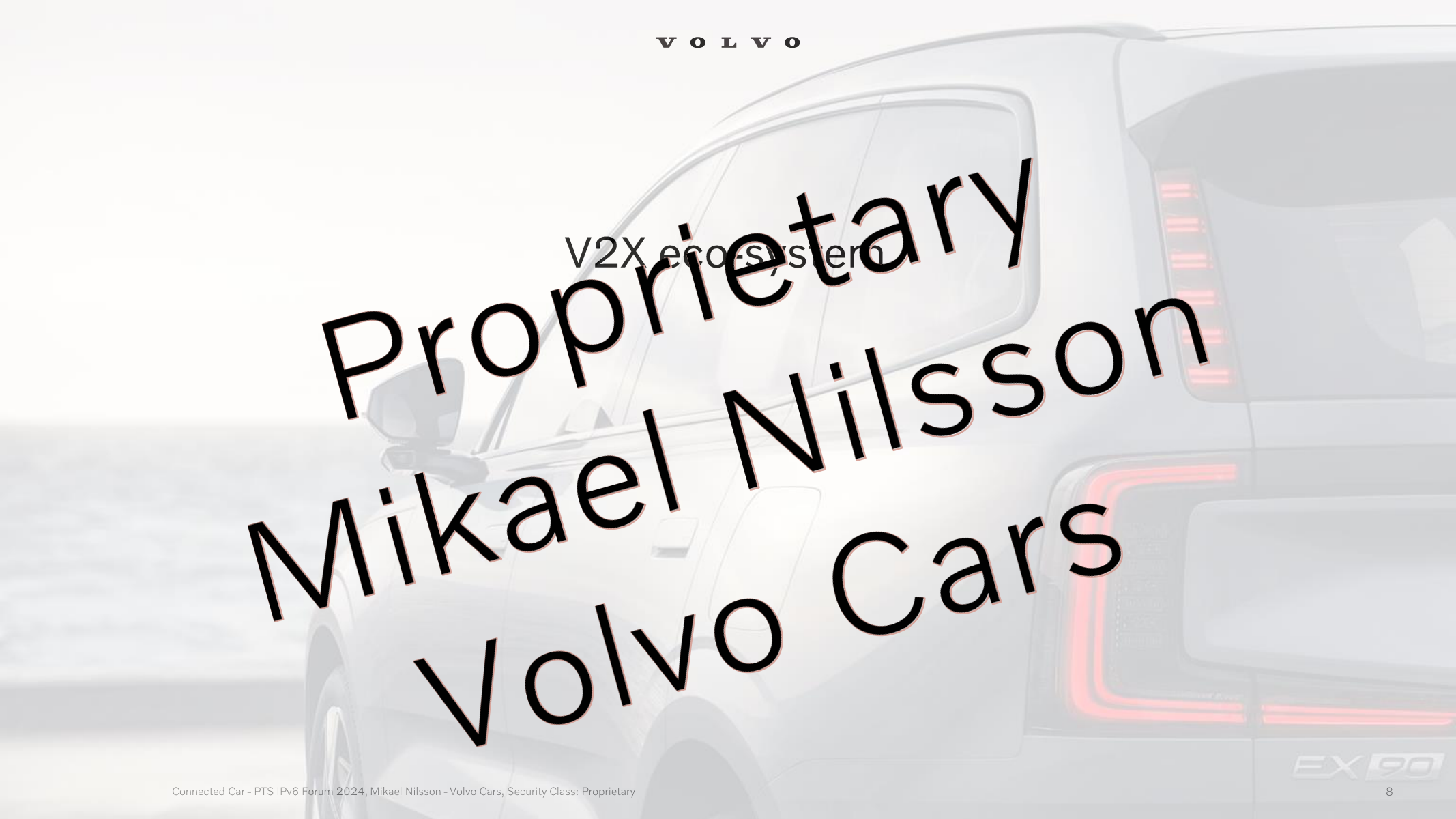
- Frequencies< 1 GHz
- Large-scale cells
- High Power High Tower (HPHT)
- Multicast together with unicast

Ref: Nik Dimitrakopoulos - 5G Broadcast for Automotive - ITU Workshop

Opportunities :
The future of wireless technologies – 6G

In the next decade, the three attributes above will merge and utilize the same wireless technology, as a complement to today's technologies in the different areas.

V2X eco-system



The V2X eco-system

The vehicles have just started to be part of a complex systems-of-systems

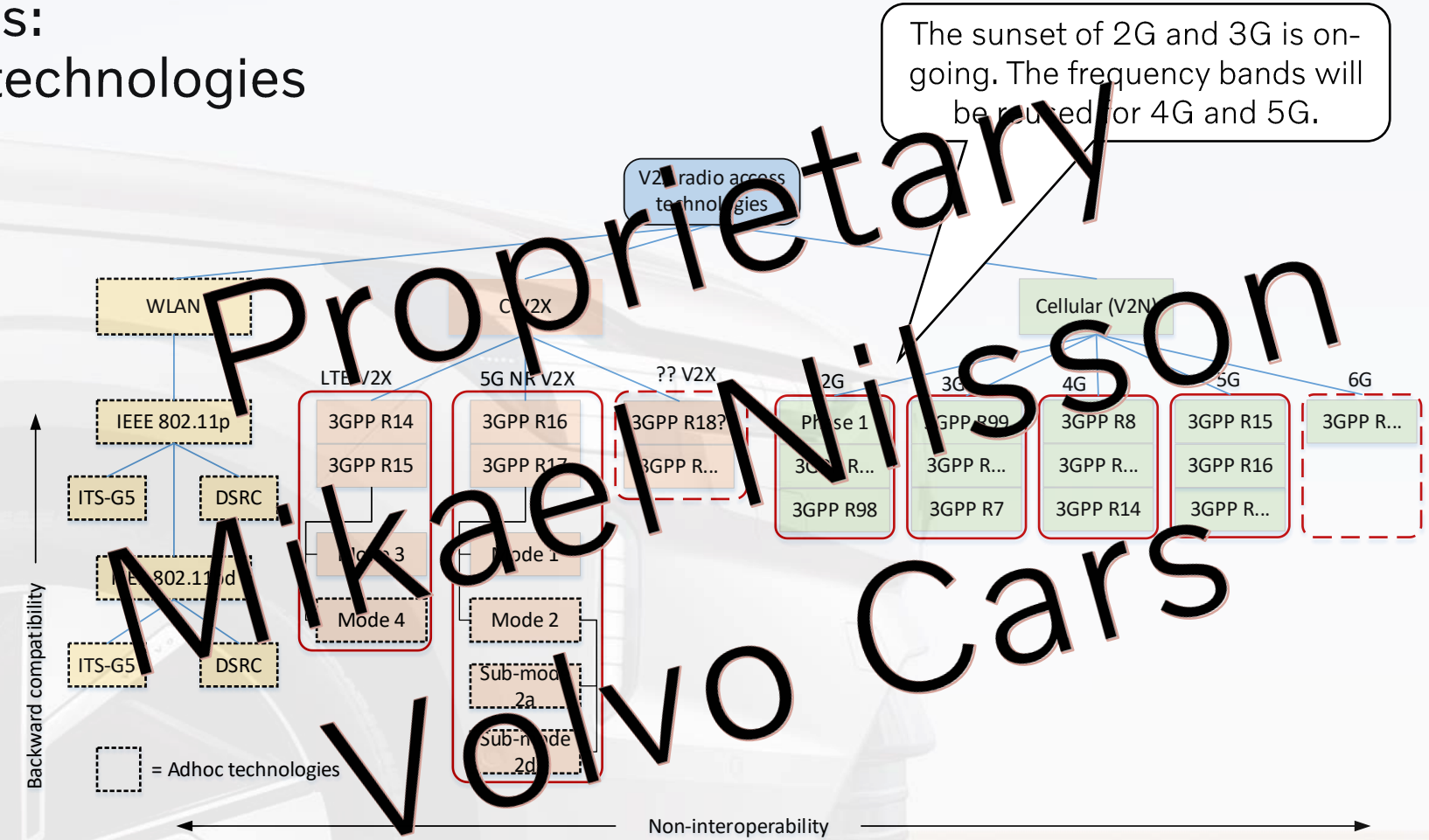
V2X eco-system

Long (cloud) and short (direct) range communication with other:

- Vehicles
- Infrastructure
- Pedestrians
- Bicyclists

https://5gaa.org/c-v2x-explained/

Status:
V2X technologies



Status:
Market situation of V2X long-range

The Connected Safety function can inform the driver whether another vehicle further ahead on the same road has activated its hazard warning flashers or detected slippery driving conditions

data for road safety

Ref: https://www.volvocars.com/uk/support/topics/article/9f6373819205e691c0a8015148785fe1
Ref: https://www.dataforroadsafety.eu/

Status:
Market situation of V2X short-range

China: Deployment of LTE-V2X is on-going.

Ref: 24:th 5GAA workshop

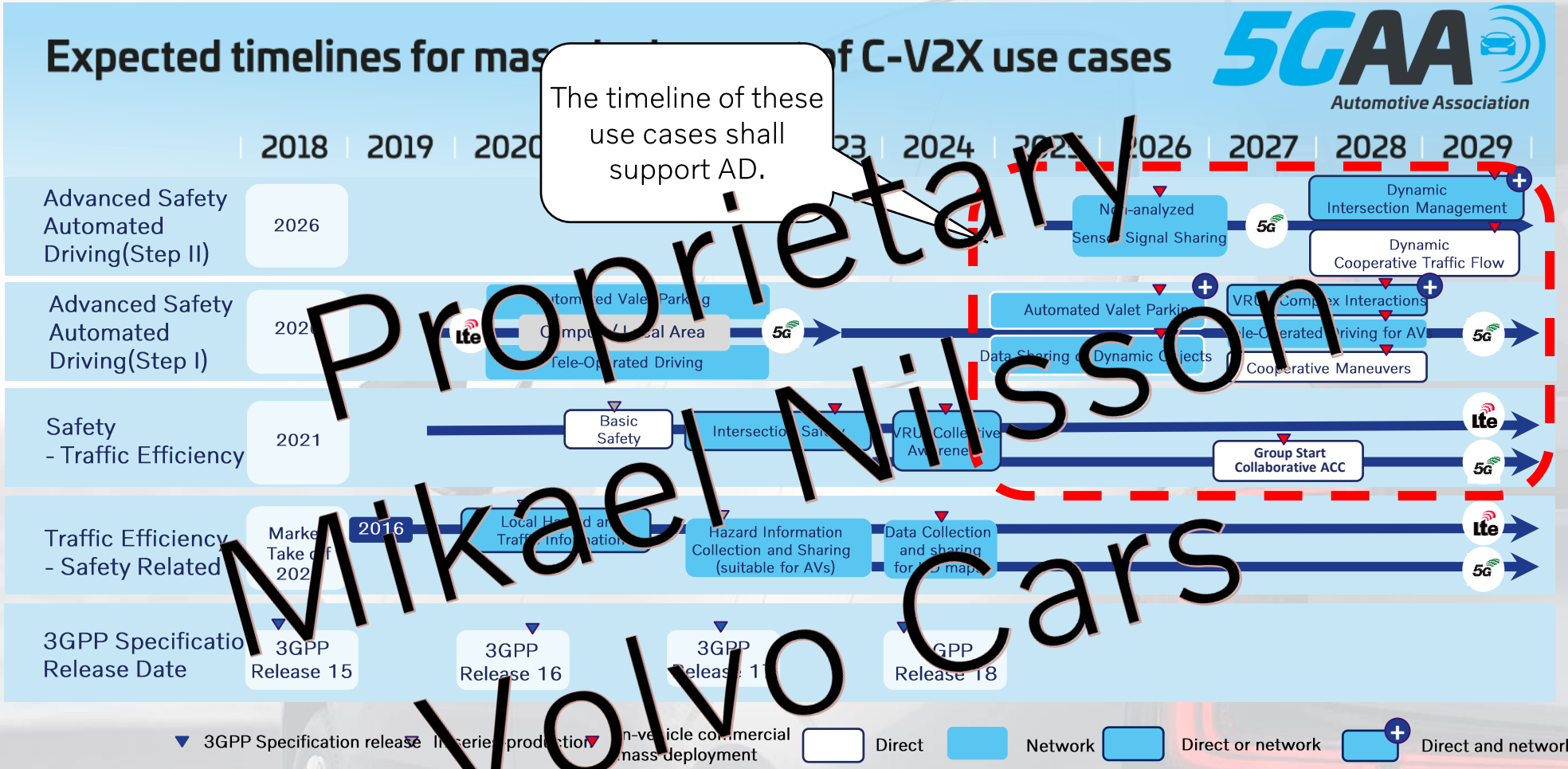
EU: Volkswagen have introduced ITS-G5 in Golf VIII and in the ID-family cars. Die Autobahn have introduced roadworks warning via ITS-G5. Euro-NCAP have introduced V2X, both long- and short-range, in their 2030 roadmap.

Ref: https://www.volkswagen-newsroom.com/en/press-releases/world-premiere-for-the-new-golf-digitalised-connected-and-intelligent-5490Ref: https://cdn.euroncap.com/media/74468/euro-ncap-roadmap-vision-2030.pdf
Ref:https://www.autobahn.de/fileadmin/user_upload/Pressemitteilung_Intelligente_Mobilitaet_fuer_weniger_Verkehrsunfaelle.pdf

US: In 2020-Q4, Federal Communications Commission (FCC) dramatically changed the rule for the 5.9GHz frequency band.

- From Wi-Fi (DSRC) to LTE-V2X (4G).
- 45MHz was allocated to normal Wi-Fi, now only 30MHz left for safety related functions. No spectrum for 5G NR-V2X.

Ref: https://www.fcc.gov/document/fcc-modernizes-59-ghz-band-improve-wi-fi-and-automotive-safety



https://5gaa.org/content/uploads/2020/09/A-Visionary-Roadmap-for-Advanced-Driving-Use-Cases-Connectivity-Technologies-and-Radio-Spectrum-Needs.pdf

Note:
Size of Use Case Boxes driven by design restrictions
in-series-production indicators will be updated as publicly announced

Status
Gartner's Hype Cycle*

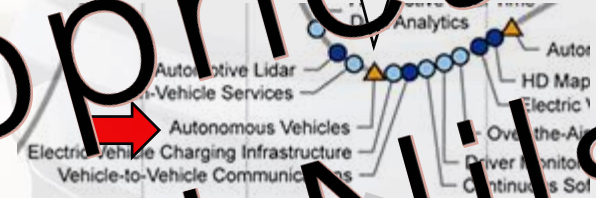
According to Volvo CEO Jim Rowan, fully autonomous cars are still a "long way off," despite the maturity of the technology.

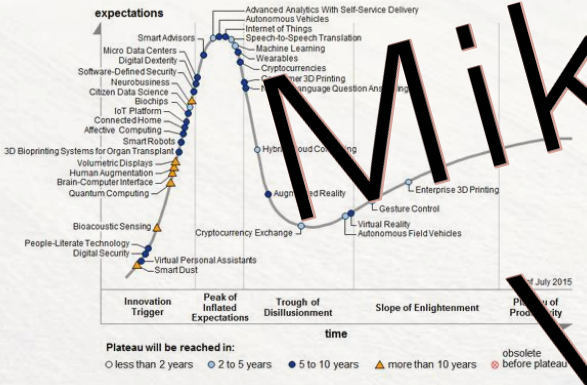
"In December 2021, Mercedes-Benz was the first automotive manufacturer worldwide to secure internationally valid system approval for conditionally automated driving (SAE Level 3)."

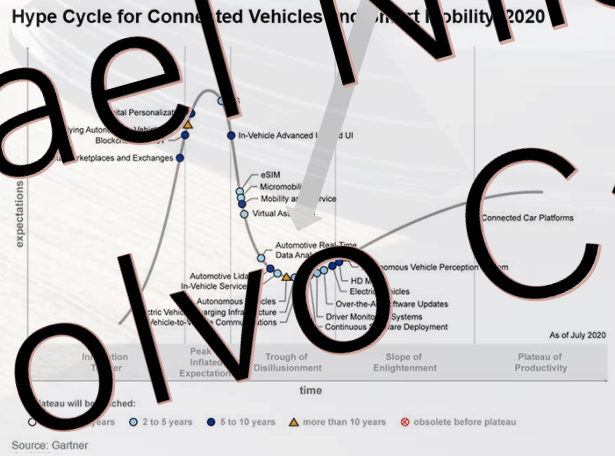
2015: Autonomous vehicles, at the peak of the Hype Cycle, plateau in 5 to 10 years

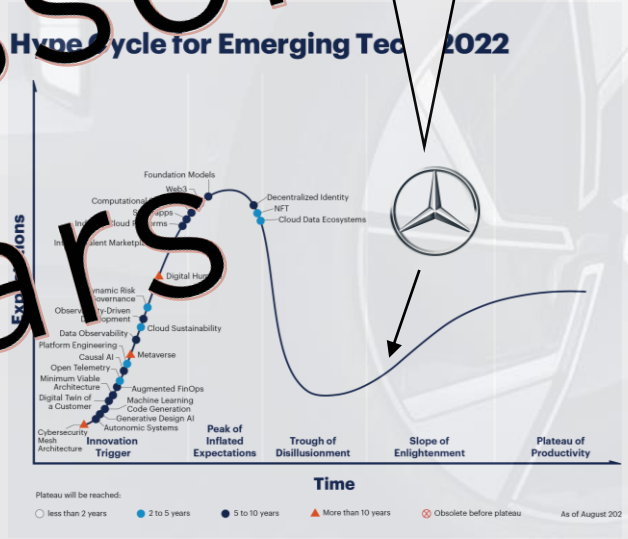
2020: Autonomous veh… the trough of disillusionment, +10 y… to plateau

2022: Autonomous veh… n the Hype Cycle any longer...







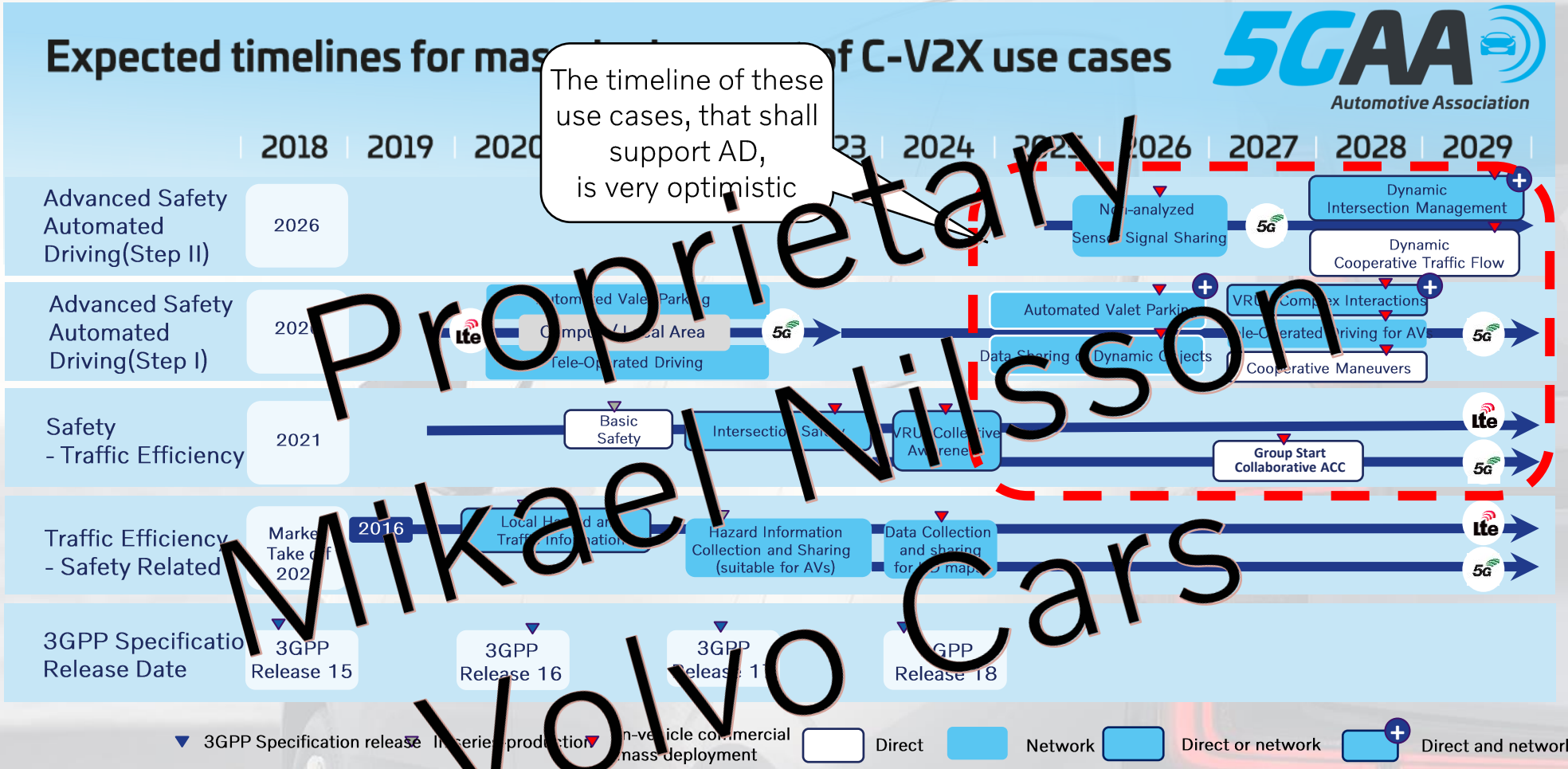


https://www.gartner.com/en/newsroom/press-releases/2015-08-18-gartners-2015-hype-cycle-for-emerging-technologies-identifies-the-computing-innovations-that-organizations-should-monitor

https://www.sae.org/news/2020/09/2020-hype-cycle-for-connected-vehicles-and-smart-mobility

https://www.gartner.com/en/articles/what-s-new-in-the-2022-gartner-hype-cycle-for-emerging-technologies

*https://en.wikipedia.org/wiki/Gartner_hype_cycle
https://group.mercedes-benz.com/innovation/case/autonomous/drive-pilot-2.html
https://group.mercedes-benz.com/innovation/case/autonomous/drive-pilot-2.html
https://www.motor1.com/news/632733/volvo-ceo-autonomous-cars-opinion/



Proprietary
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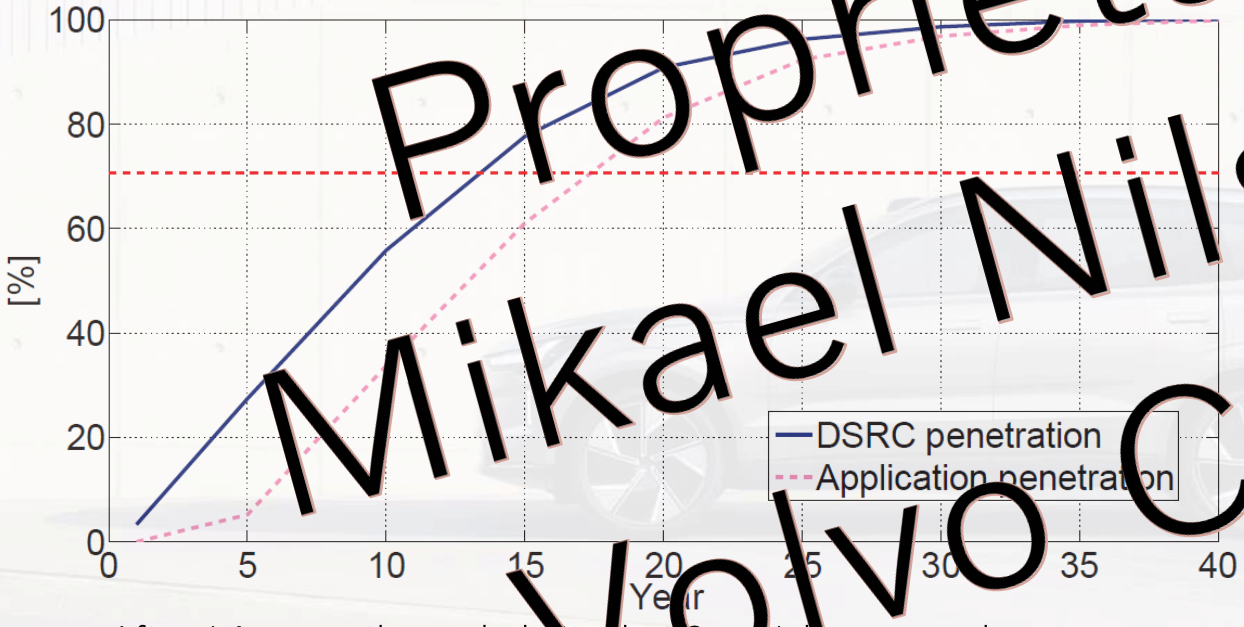
Status:
Today's mismatch in the industry regarding mass deployment of Cooperative Connected Automated Mobility (CCAM) services

NHTSA's previous assumption of V2V fleet penetration based on legislation



After 14 years, the probability that 2 vehicles can exchange information is larger than 50%, if the technology is mandated by law

Gartner: +10 years

5GAA: 5 years

China: Deployment On-going

EU: Only deployment by VW

NHTSA: 14 years

More realistically, we can expect CCAM services close to 2040.

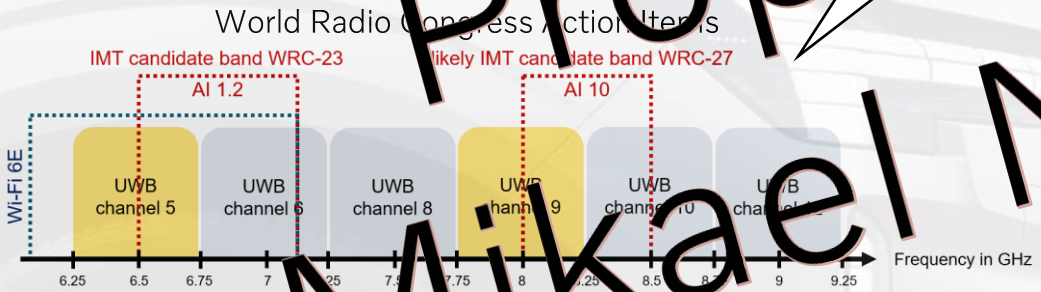
U.S. Department of Transportation, National Highway Trac Safety Administration, "49 CFR Part 571 Notice of proposed rulemaking on V2V communication," 2016.

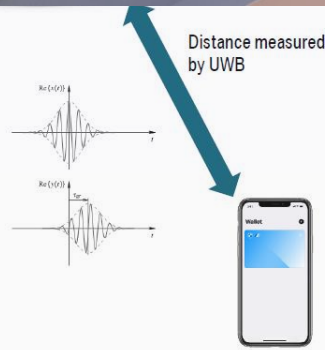
Challenges caused by the cellular generations

Challenges:
Potential 6G threat to UWB (as key systems

Frequency spectrum is a rare natural resource that needs to be shared by many

Ultra bandwidth (UWB) used in phone as key syste ce (time-of-flight) between the vehicle and the sm ph e purpose to withstand relay attacks.





- 7-24GHz is being investigated worldwide for 6G, one main candidate is 8-8.5GHz
- CH9 is the primary global band for UWB
- CH10 is expected to be important as a replacement to CH5, which is subjected to heavy Wi-Fi 6E interference.

⇨ 6G in 8-8.5GHz will massively interfere with UWB and cause enormous customer complaints.

- Ref.: ACEA & CLEPA input to ECC regarding UWB applications in frequency bands under discussion of AI 10
- Ref.: 5GAA BMW Group Potential 6G threat to UWB used in CCC digital key standard
- Ref.: CCC UWB Spectrum Regulatory Position

Challenges:
Development, Sales, and Lifetime of two different products

Challenges:
EU market, eCall - 112

- Vehicle manufacturers are bound by the type approval framework to include eCall and circuit-switched technology shall be used, i.e., 2G/3G
- Member states are subject to a decision with varying degree of implementation of the public safety answering points (PSAP)
- The MNOs do not have any obligations at all to maintain and continue operating 2G/3G networks

How did we end up here, with one optional part in the legislation?

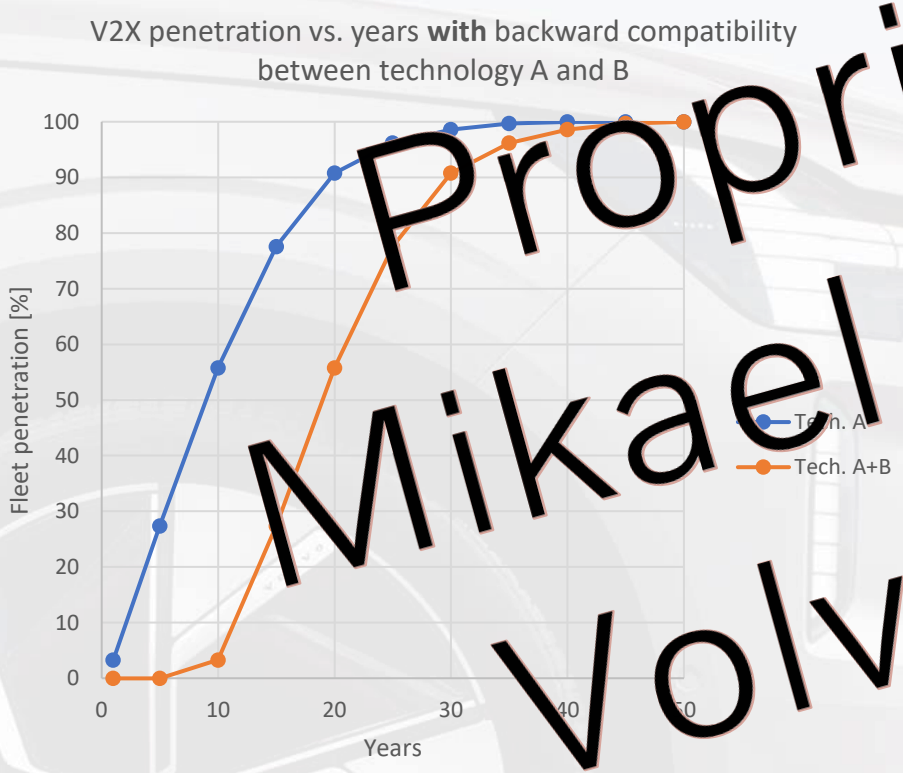
The legal burden for different involved eCall actors

The automotive industry proposal

- Discontinue the current technology-specific eCall legislation, instead use e.g., Advanced Mobile Location
- Since in-vehicle systems are in compliance with existing legislation at the time of registration; the vehicles shouldn't be treated as non-compliant when service is unavailable due to 2G/3G shutdown or any other infrastructure-related updates
- Mandate an eCall service either via binding legislation or voluntary tools such as EuroNCAP

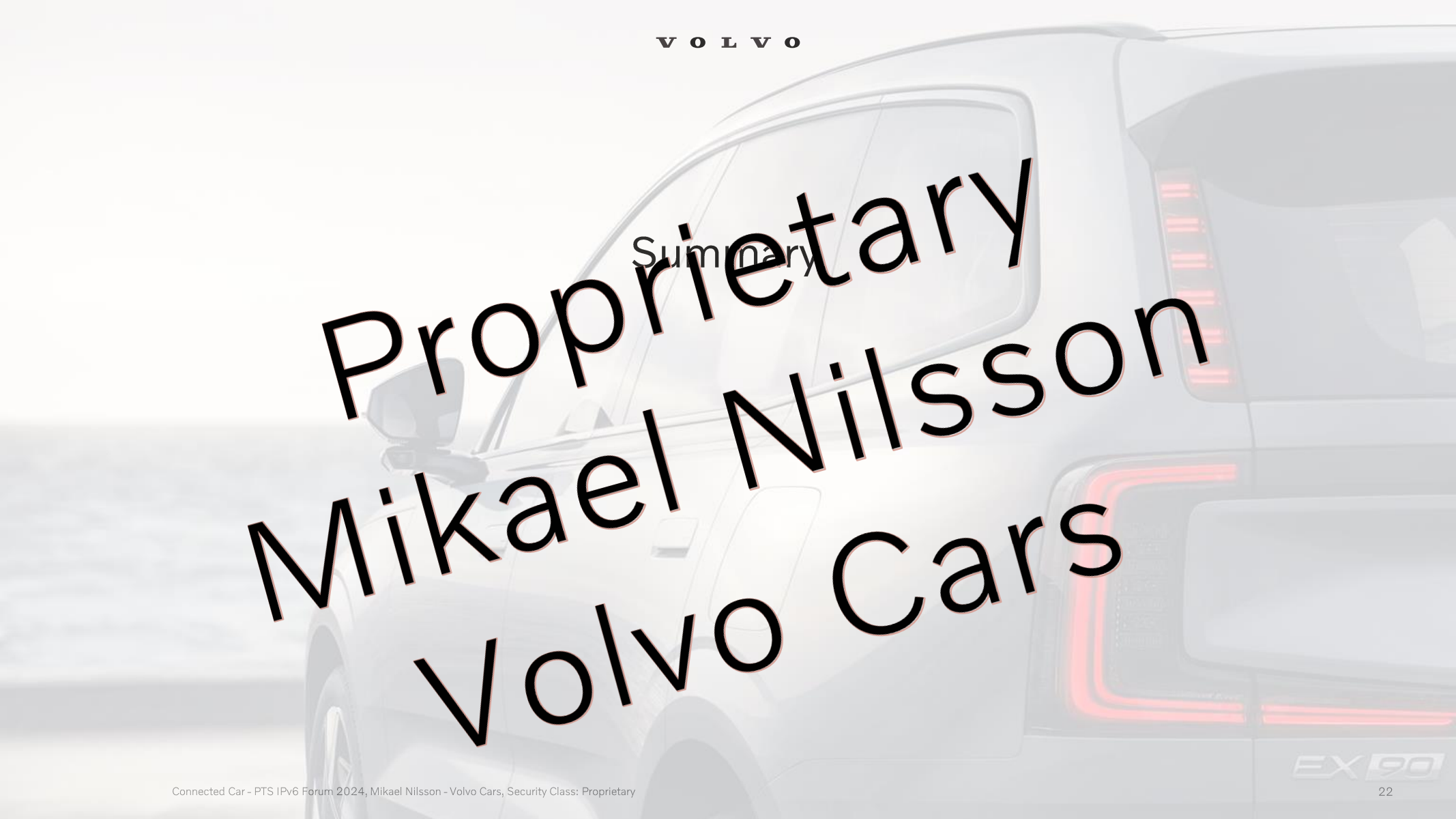
Ref.: ACEA/CLEPA draft position paper on the review of the EU eCall Regulation DRAFT 30 November 2022

Challenges:
V2X short range backward compatibility – why it is s



If we don't have backward compatibility, we will never see CCAM services

Summary



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Exciting era!

https://www.media.volvocars.com/se/sv-se/media/pressreleases/305658/ett-battre-liv-med-helt-elektriska-volvo-ex90

Will we have 6G in vehicles?

First, does the customer need it?

But it is cool!

So, YES, we will have it!!

But, why? 6>5

IPv6

Our vehicle architecture supports IPv6

- We use it to pass the certification on the Chinese market (MIIT NAL)
- Evolution of IPv6 may partly be determined by market requirements
- However, we don’t see any benefits to move from IPv4 to IPv6 for the internal communication

Thank you!

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