Akraino Automotive Area workshop

Introduction to Open Discussion

Ike Alisson
LF Edge Akraino Documentation
Sub-committee TSC Chair

2021 - 07 - 27 Rev PA10

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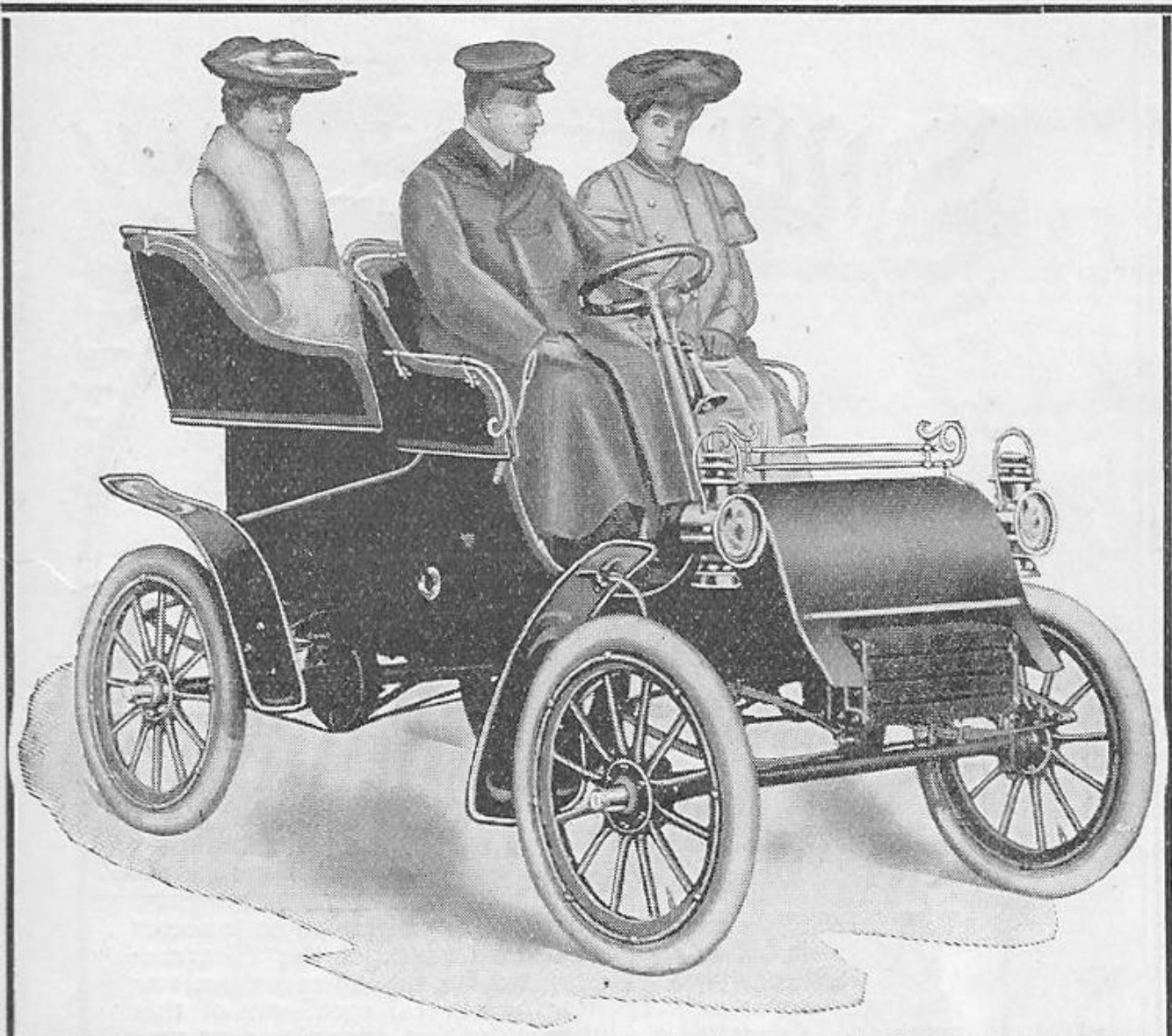


The Advance of *The* Ford

All the *best* things in this world are usually worth even more than the price you pay for them. A *cheap* automobile is dear at any price. but a car like the Ford is a bargain at any reasonable figure.

The advanced and improved construction, the higher grade of materials used in building the machinery and body, and the addition of heavy 3 in. detachable tires to its equipment compel us to make the price of the **1904 Ford**

$900 with Tonneau $800 as a Runabout.

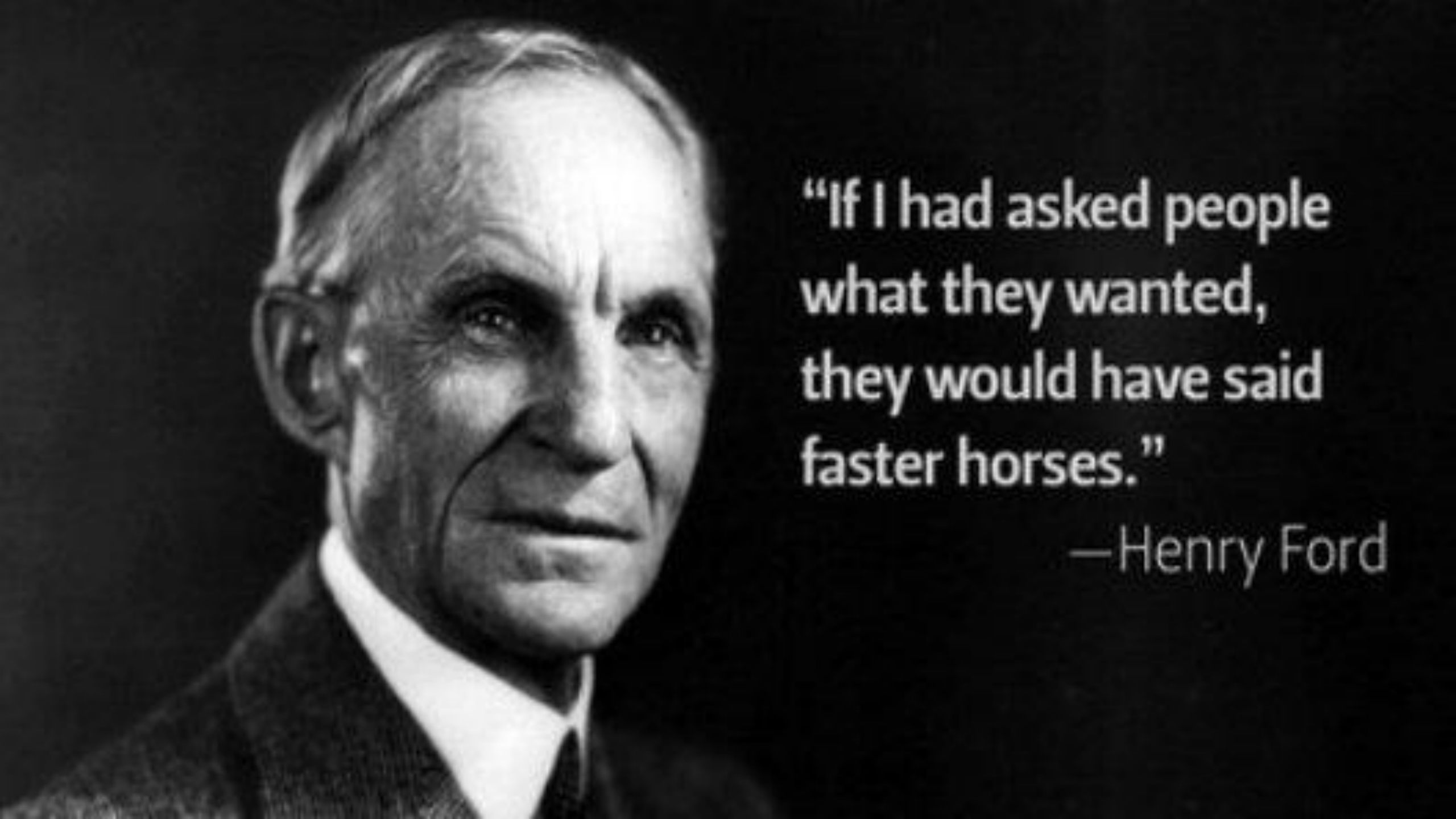
Lamps, Horn and Brass Trimmings Extra.

Mr. Ford made the first automobile in Detroit and the third in the United States. THE FORD MOTOR CAR of today represents the most advanced type of automobile construction.

WE agree to assume all responsibility in any action the Trust may take regarding alleged infringement of the Selden Patent to prevent you from buying the Ford, "The car of satisfaction."

Write for full information and Illustrated Catalogue to

FORD MOTOR CO. Detroit, Mich.


“If I had asked people what they wanted, they would have said faster horses.”
—Henry Ford

Ref. Demonetizing Everything. A post Capitalism World, Peter Diamandis, Sngularity Univ Summit, 2017

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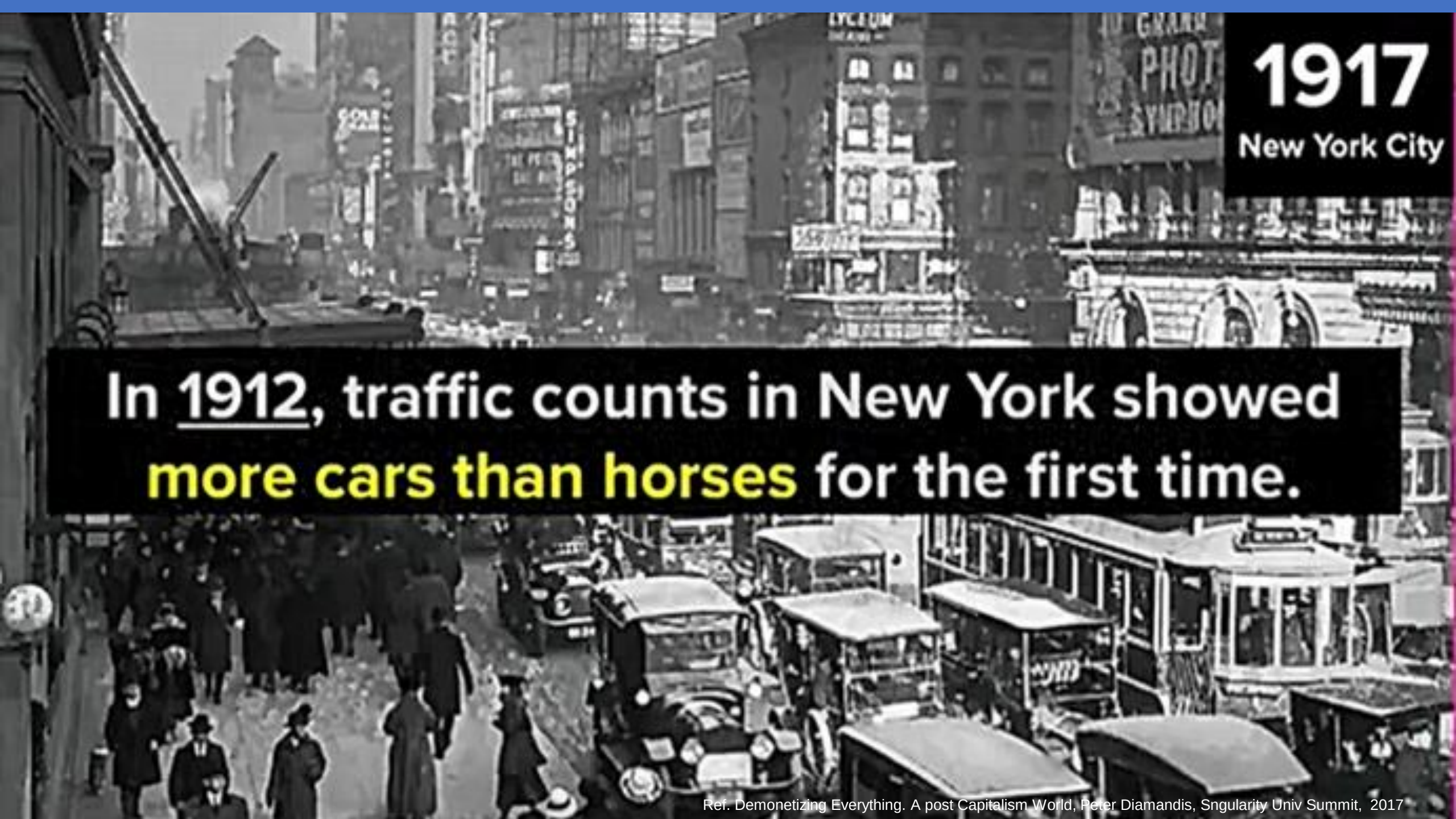
Ford 1921 T-Model



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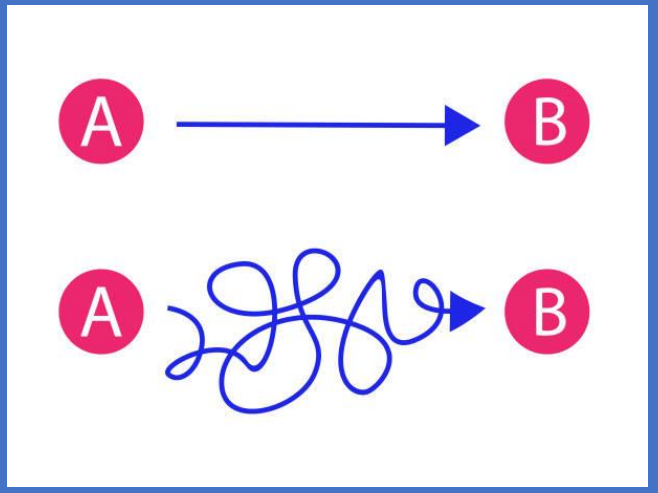
YOUR
DESTINATION
Got Purpose?
START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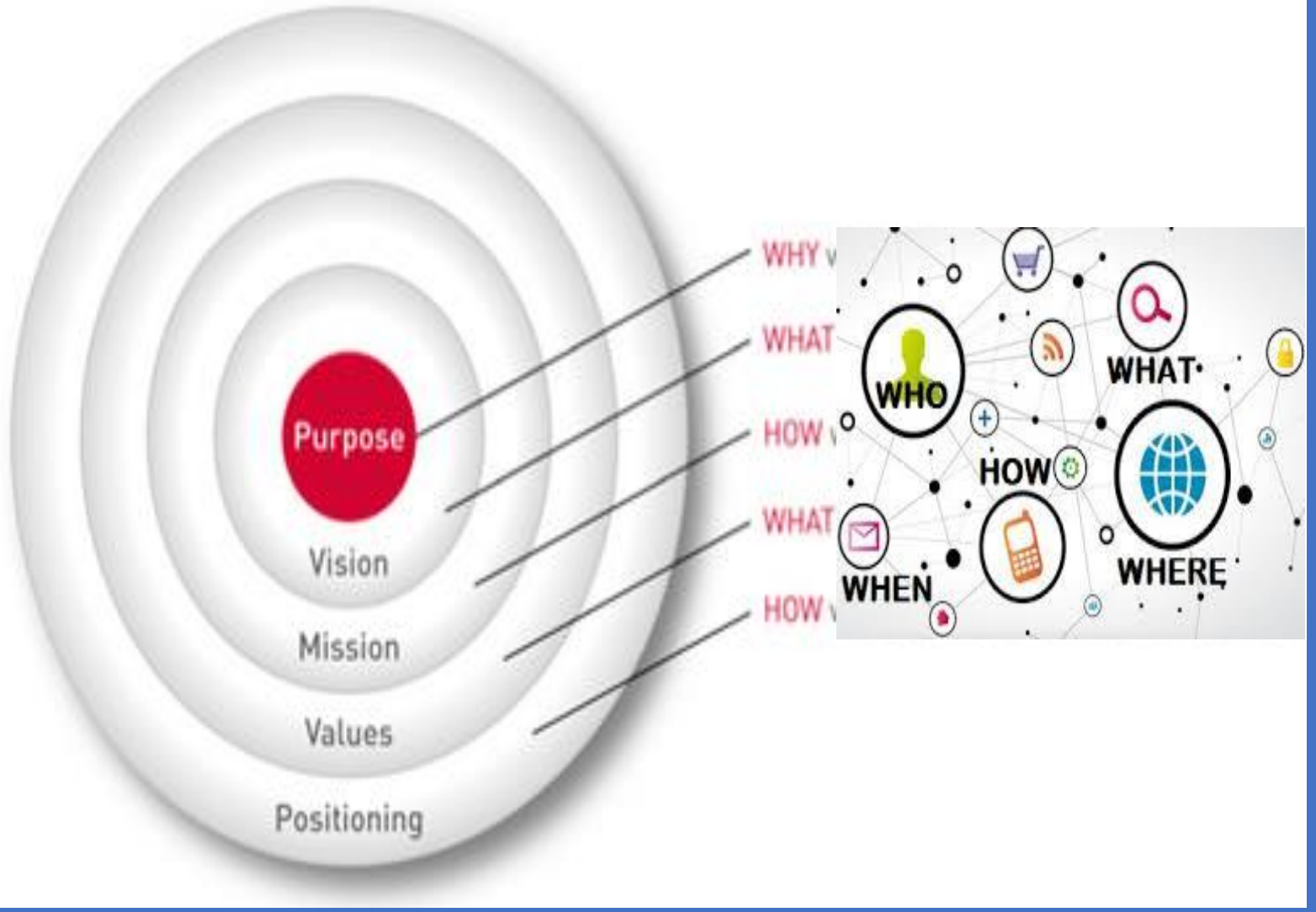
Purpose
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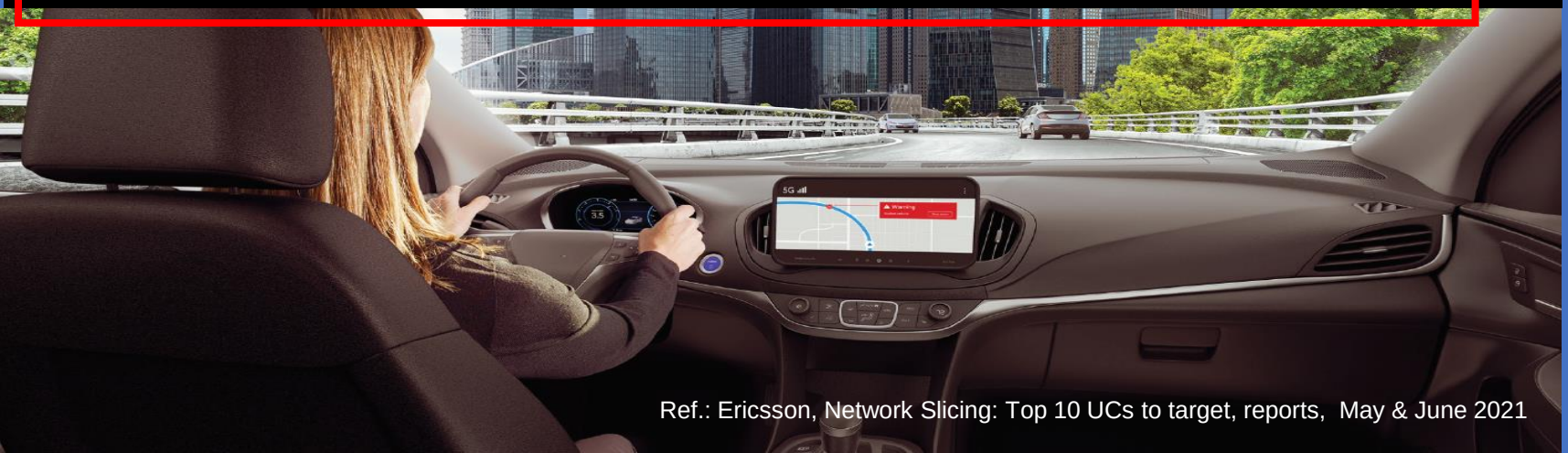
Network slicing: Top 10 use cases to target

An overview of industries and use cases that will drive the majority of the revenue potential

1. Automotive: A USD 23 Billion Market Opportunity

Tele-Operated Driving alone is a USD 300 million Near-term Opportunity



Ref.: Ericsson, Network Slicing: Top 10 UCs to target, reports, May & June 2021

Segment overview
Automotive

Segment scope
Manufacturing, maintenance, and services for connected vehicles

Typical CSP customers
Fleet operators

Key slicing cases:

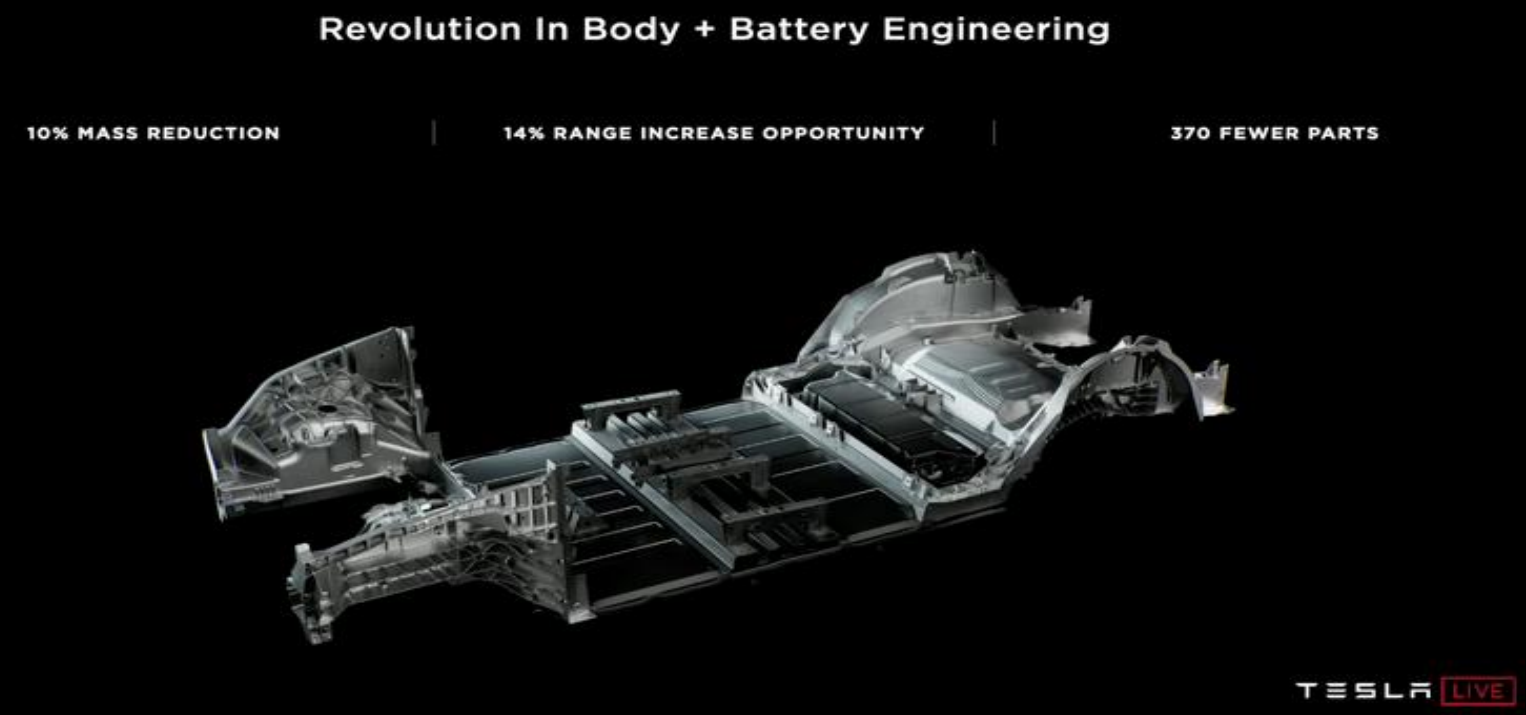
Tele-operated driving  Low Latency	**Platooning**  Low Latency
Automated lane change  Availability	**Real-time-situational awareness**  Availability

Future Tesla Cars Will Use Batteries for Shell Structure (Sept 22, 2020)

To Increase Range & Reduce Cost, Tesla Battery Packs will become Structurally Integral.

Battery Packs in current Tesla's are mounted in the floor of the Cars, but they're not structural parts of the Chassis.

The cells will be adhered to top and bottom "sheets" with a flame-retardant structural adhesive, which Musk says provides incredible rigidity. So much rigidity that if you were to build a convertible based around this sort of chassis, it'd be stiffer than a conventional car.
This New Approach to Chassis design is part of Tesla's goal of reducing cost per kilowatt hour of battery capacity by half.



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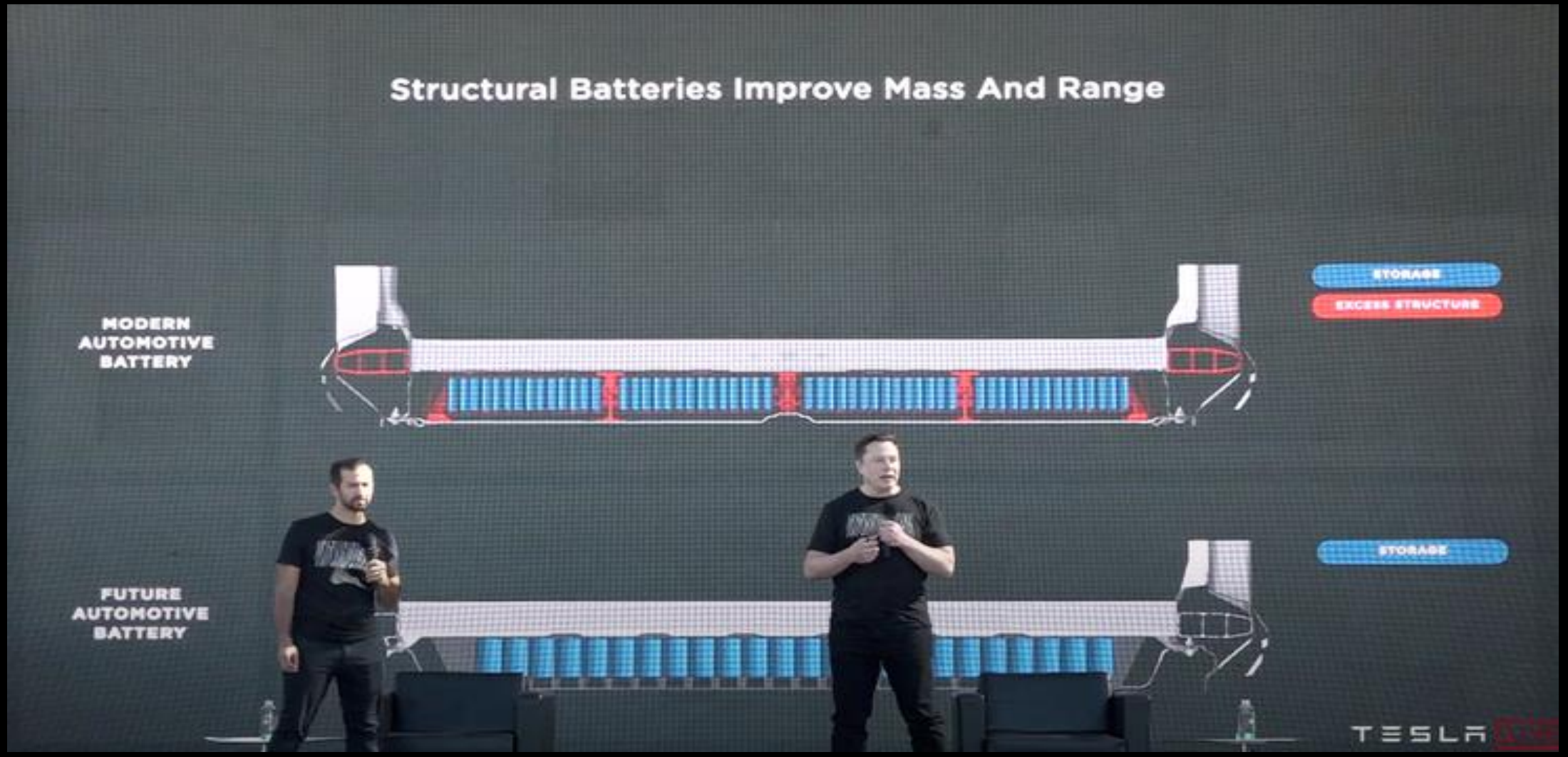
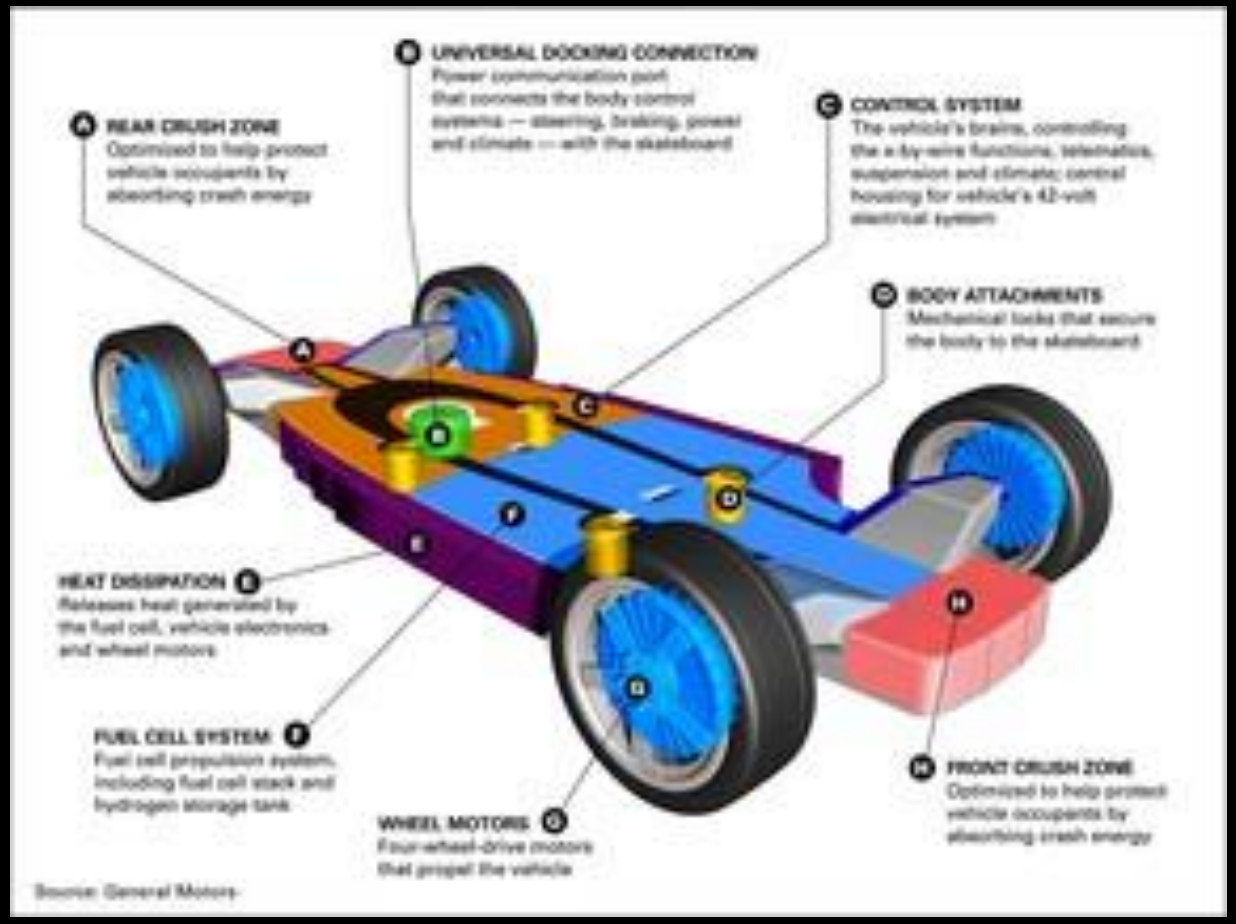


EV Electric Vehicle Skateboard Chassis - GM



EV Electric Vehicle Skateboard Chassis - Canoo

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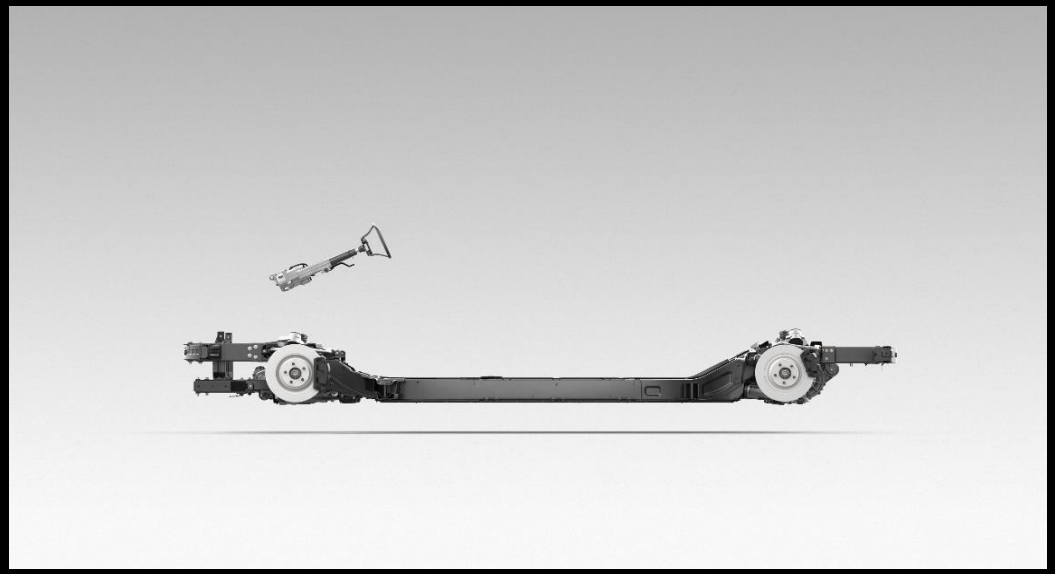

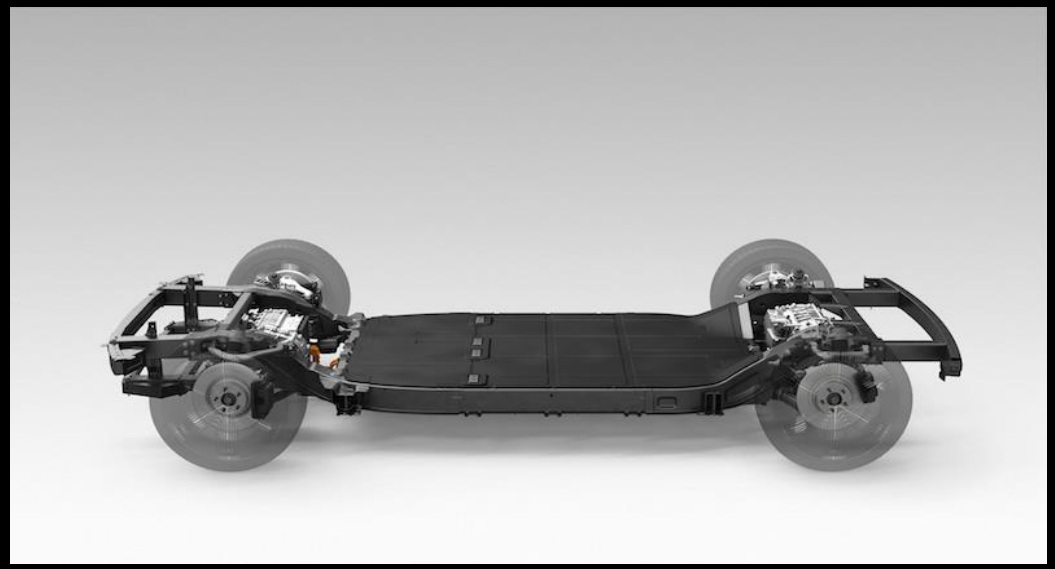

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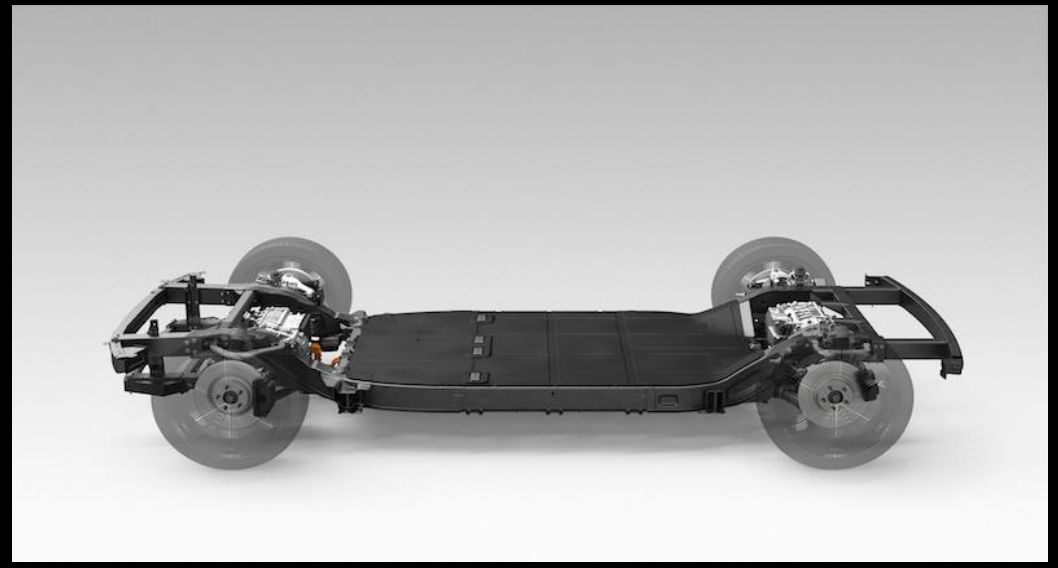


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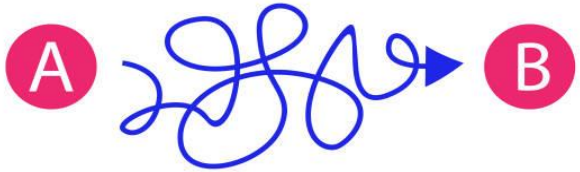
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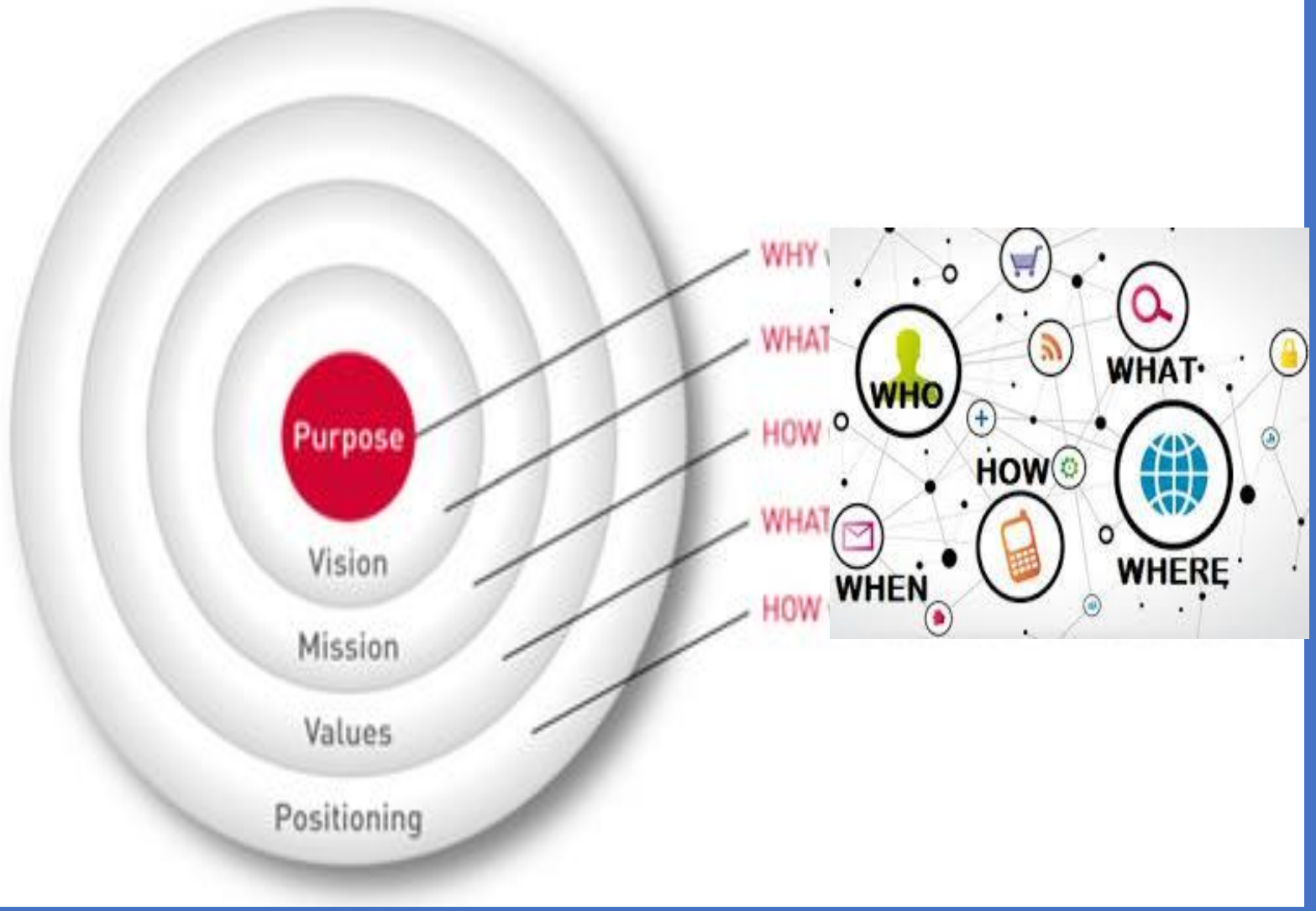
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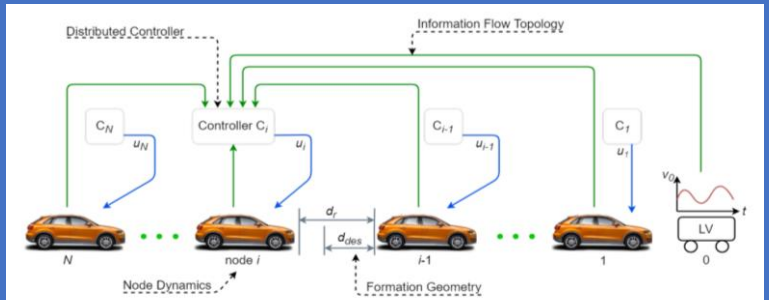


Figure 3. Distributed controllers in platoon framework, adapted from [32].

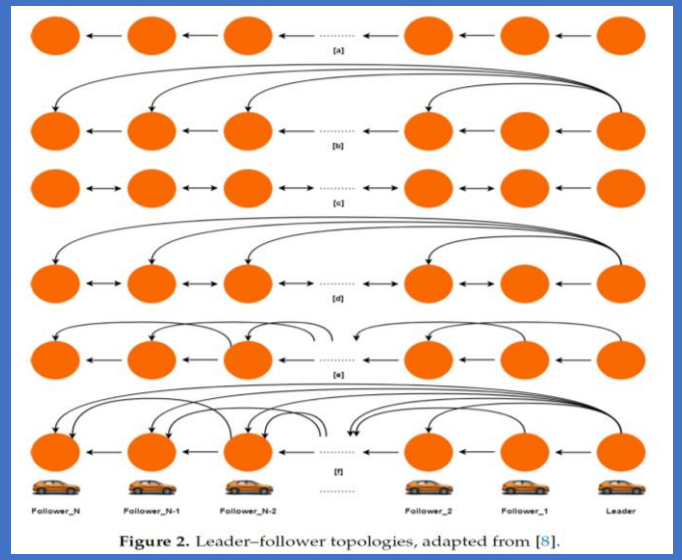


Figure 2. Leader–follower topologies, adapted from [8].

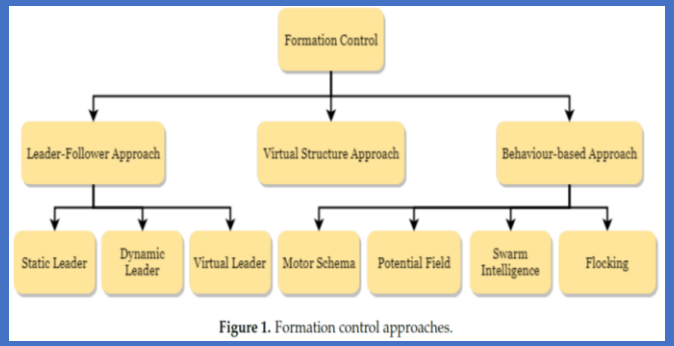


Figure 1. Formation control approaches.

Table 1. Theoretical detail of algorithms and their survey papers.

Algorithms	Algorithm Details	Survey Papers
Particle Swarm Optimization (PSO)	[78,79]	[80,81]
Ant Colony Optimization (ACO)	[82]	[83]
Artificial Bees Colony Optimization (ABCO)	[84,85]	[86]
Artificial Fish Swarm Algorithm (AFSA)	[87,88]	[89]
Bacteria Foraging Optimization (BFO)	[90]	[91]
Glowworm Swarm Optimization (GSO)	[92]	[93]
Firefly Algorithm (FA)	[94]	[95]
Bat Algorithm (BA)	[96]	[97]
Grey Wolf Optimizer (GWO)	[98]	[99]

Table 2. The balance between exploration and exploitation can be handled by these parameters.

Algorithms	Algorithm Parameters
PSO	Inertia Weight, w
ACO	Pheromone evaporation rate (Good at exploring)
ABCO	Distance between food source (Good at exploring)
AFSA	Visual and step
BFO	Run length
GSO	Euclidean Distance
FA	Attractiveness (Good at exploring)
BA	Frequency, loudness and pulse emission rates
GWO	a and A

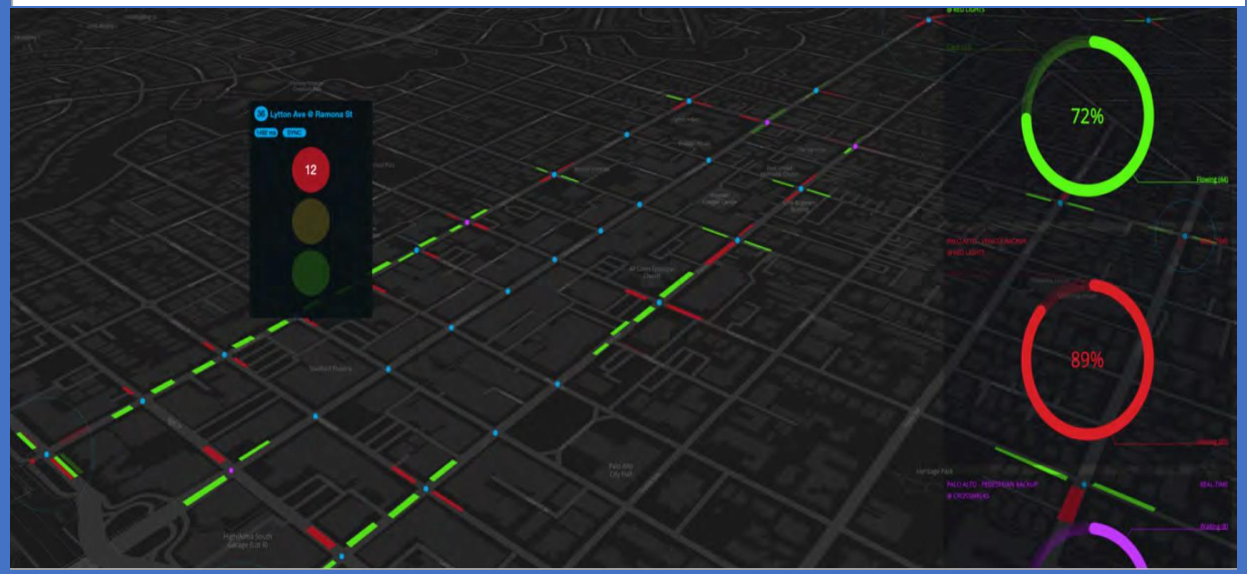
Ref: Formation Control for a Fleet of Autonomous Ground Vehicles: A Survey, 2018: 3, 7, 13

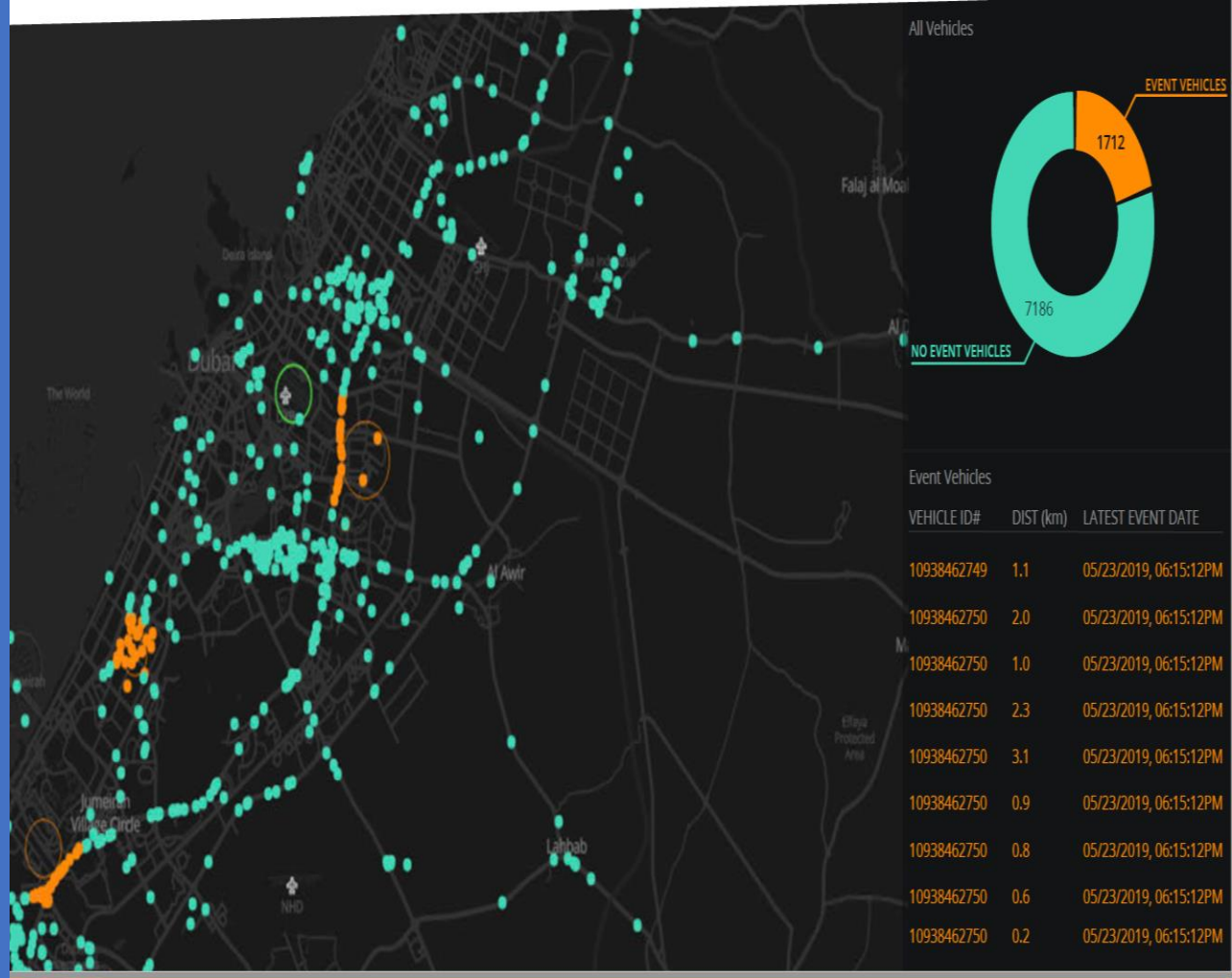
swim

CASE STUDY

Enabling Intelligent Infrastructure

Connected Vehicles





CASE STUDY

swim

Real-Time Monitoring & Alerting

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Network slicing: Top 10 use cases to target

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Ref.: Ericsson, Network Slicing: Top 10 UCs to target, reports, May & June 2021

5GS QoS handling for V2X Communication PQI (PC5 5QI (5G QoS Identifier))

Table 5.4.4-1: Standardized PQI to QoS characteristics mapping

PQI Value	Resource Type	Default Priority Level	Packet Delay Budget	Packet Error Rate	Default Maximum Data Burst Volume	Default Averaging Window	Example Services
21	GBR (NOTE 1)	3	20 ms	10^{-4}	N/A	2000 ms	Platooning between UEs – Higher degree of automation; Platooning between UE and RSU – Higher degree of automation
22		4	50 ms	10^{-2}	N/A	2000 ms	Sensor sharing – higher degree of automation
23		3	100 ms	10^{-4}	N/A	2000 ms	Information sharing for automated driving – between UEs or UE and RSU - higher degree of automation
55	Non-GBR	3	10 ms	10^{-4}	N/A	N/A	Cooperative lane change – higher degree of automation
56		6	20 ms	10^{-1}	N/A	N/A	Platooning informative exchange – low degree of automation; Platooning – information sharing with RSU
57		5	25 ms	10^{-1}	N/A	N/A	Cooperative lane change – lower degree of automation
58		4	100 ms	10^{-2}	N/A	N/A	Sensor information sharing – lower degree of automation
59		6	500 ms	10^{-1}	N/A	N/A	Platooning – reporting to an RSU
90	Delay Critical GBR (NOTE 1)	3	10 ms	10^{-4}	2000 bytes	2000 ms	Cooperative collision avoidance; Sensor sharing – Higher degree of automation; Video sharing – higher degree of automation
91		2	3 ms	10^{-5}	2000 bytes	2000 ms	Emergency trajectory alignment; Sensor sharing – Higher degree of automation

NOTE 1: GBR and Delay Critical GBR PQIs can only be used for unicast PC5 communications.

Figure 5: Network slicing, the packet core view

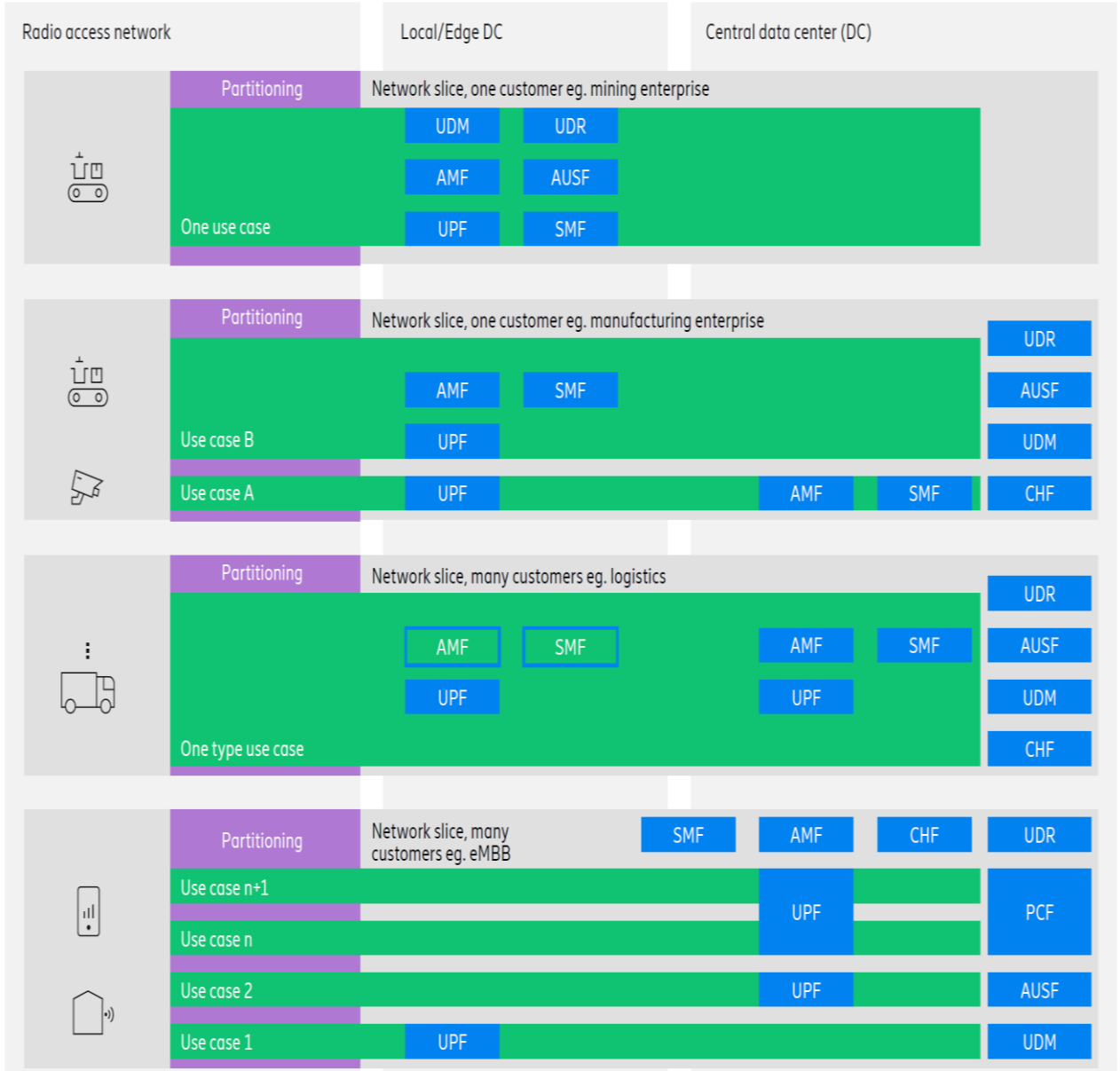
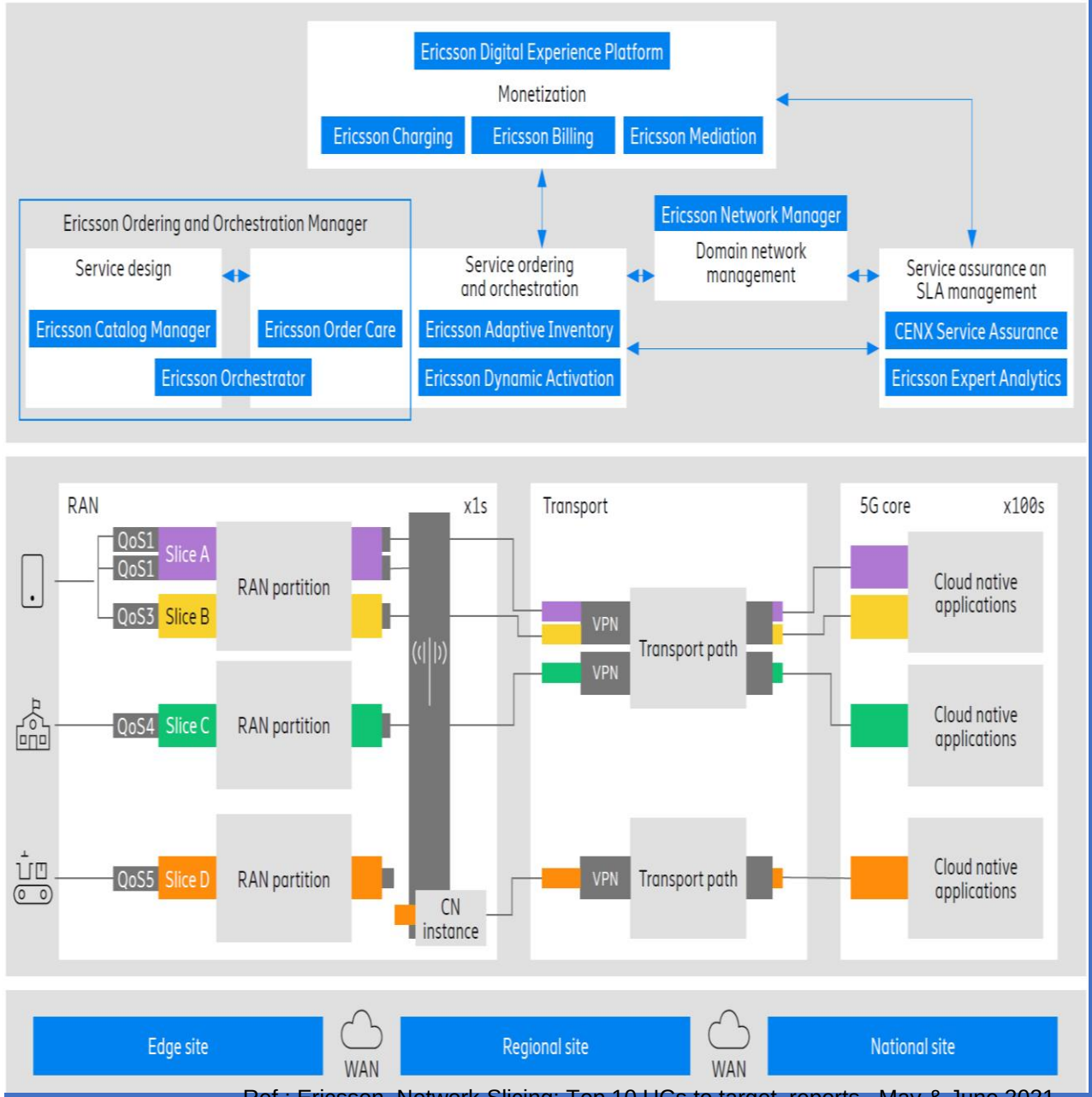


Figure 4: E2E network slicing architecture



Ref.: Ericsson, Network Slicing: Top 10 UCs to target, reports, May & June 2021

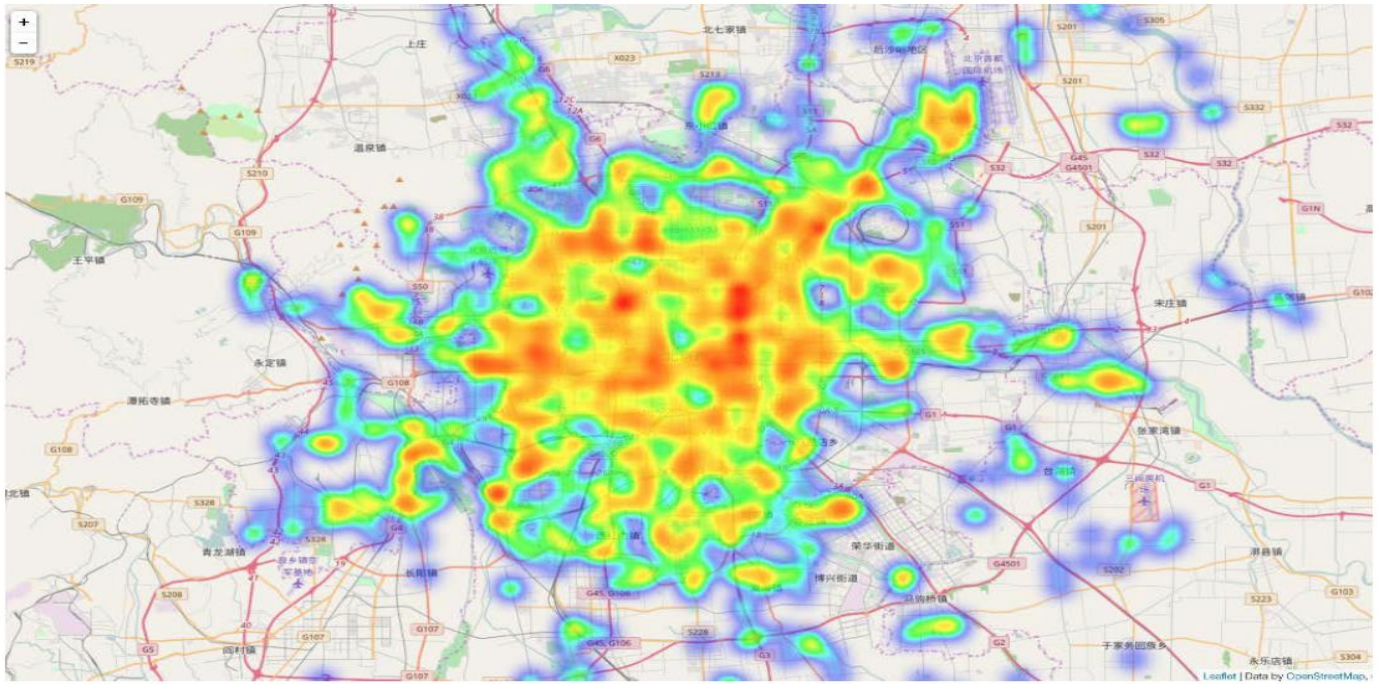
Where is the Electron and How Many of Them?

Beijing – Traffic Heatmap

DATA:LAB MUNICH

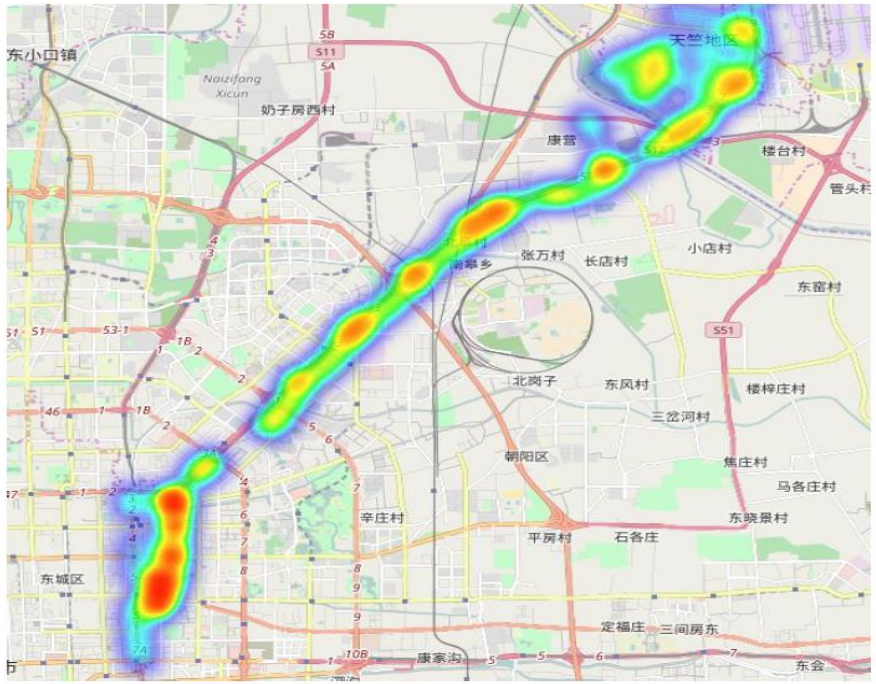
Traffic in the city

- 10.000 cars



Detail: route to the Airport

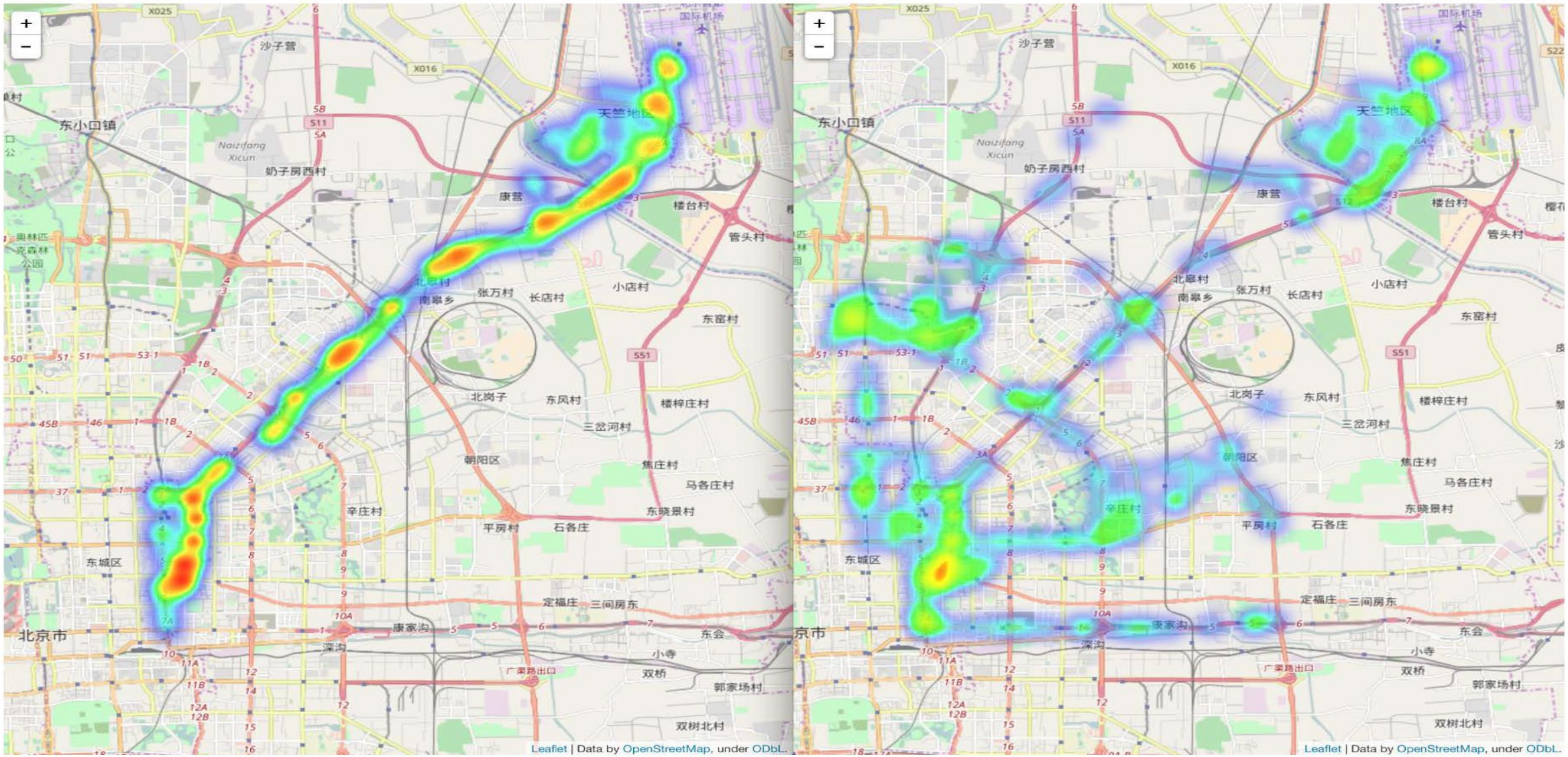
- 418 cars



→ We assigned each of the 418 cars 3 possible routes to reach the airport

→ Size of the problem space: 3^418

Result: unoptimised vs optimised traffic



Enterprises don't understand the tech or ROI – Ford on what to fix with private 5G

James Blackman • May 25, 2021 •

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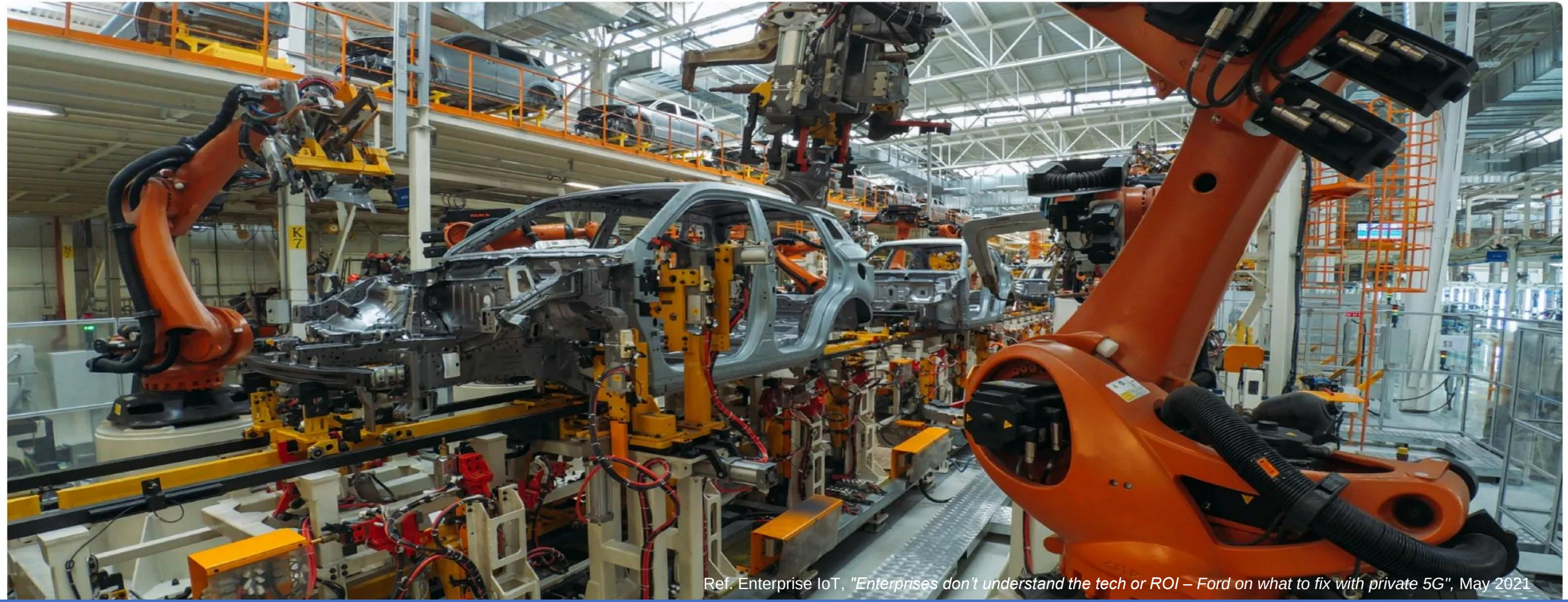
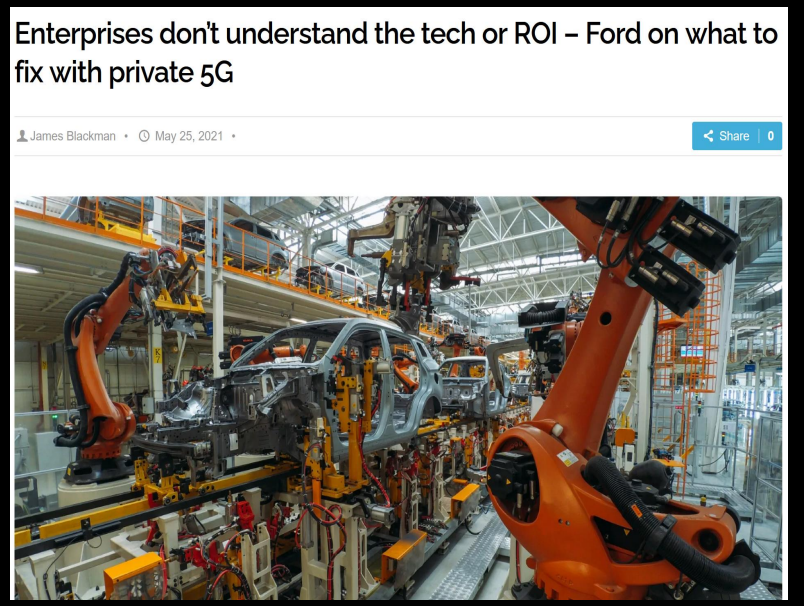


Ref. Enterprise IoT, *"Enterprises don't understand the tech or ROI – Ford on what to fix with private 5G"*, May 2021

Chris White, Electrification Manager for Ford's European business, commented:



"Our understanding was really poor at the start.
We've been in this a year, working with Vodafone, and we have built-up that understanding.

But… that understanding about [industrial 5G] is very poor outside of the Telecoms World."

"Standalone SA), Non-´Standalone (NSA) all the latest 3GPP Releases –
[there is a lack of understanding about] all these things we have talked about, and what they mean for Enterprises."

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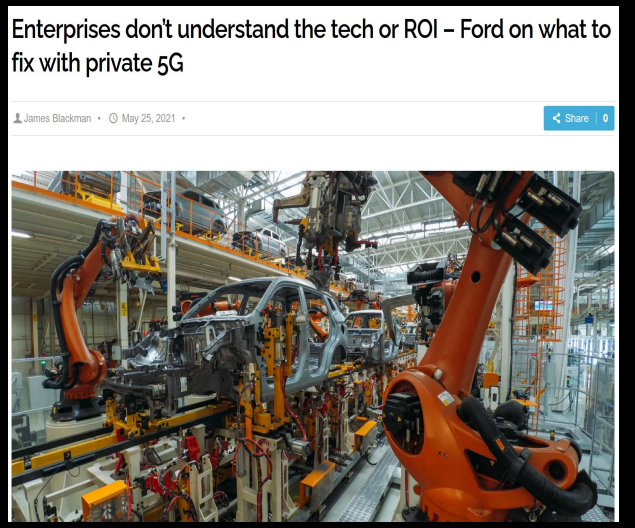

White warned that: **"5G is a "Means-to-an-End";**

the subtext is the **Telecoms Community is inclined to present it as the Solution, instead** – as per the criticism, referenced above, levelled at the sector by enterprises.

"5G is just an Enabler. There is No Business Case (BC) for 5G," he said.

"**There is a BC for all of the things it (5G) enables within the Enterprises** – whether that is

- Industry 4.0, or
- Augmented Reality (AR) and
- Preventive Maintenance via IoT Sensors.

All those things have a BC, but [the Market] has to realise you can't just put 5G Network in and get a return;

You need a Plan for everything to launch off the back of it (5G)."

Ref. Enterprise IoT, *"Enterprises don't understand the tech or ROI – Ford on what to fix with private 5G"*, May 2021

5G System Architecture for V2X Communication
Application Function (AF) -based Service Parameter Provisioning for V2X Communications

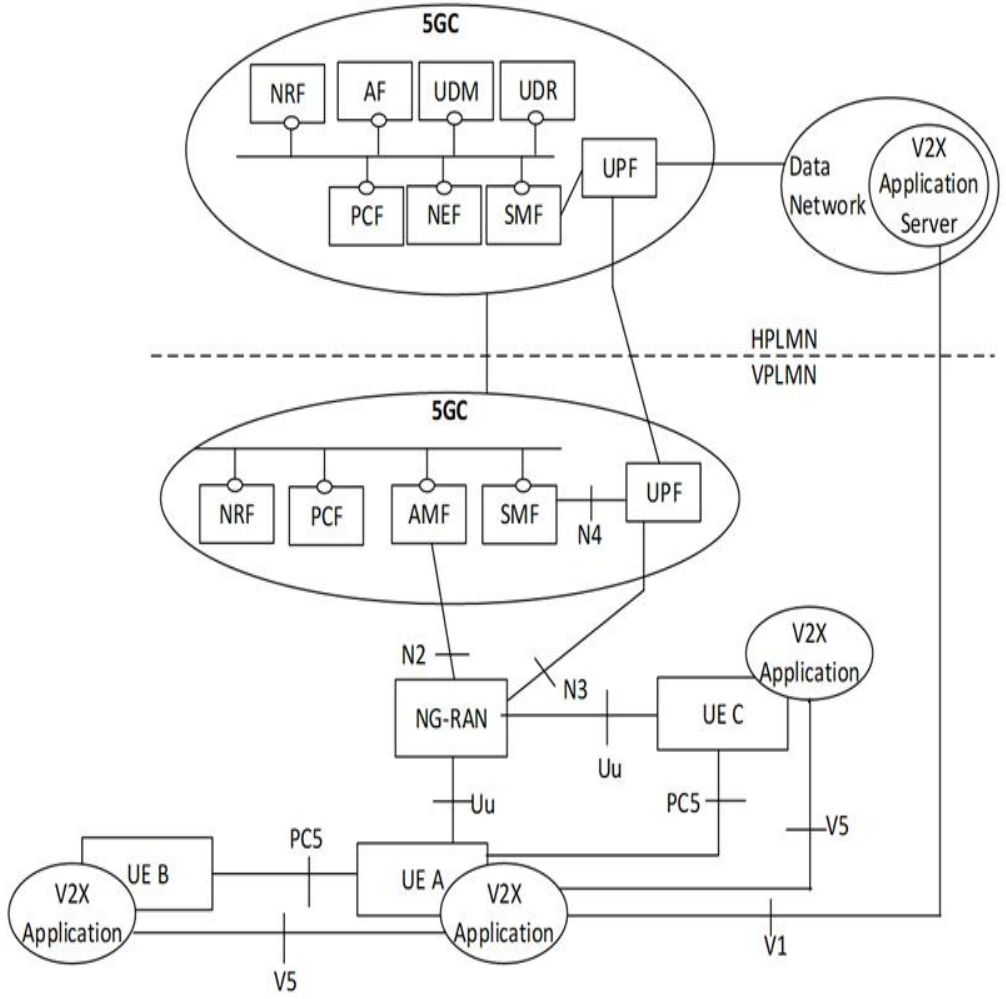

Figure 4.2.1.2-2: Roaming 5G System architecture for V2X communication over PC5 and Uu reference points - Home routed scenario

The 5G System provides NEF Services to enable Communication between NFs in the PLMN & V2X Application Server. The V2X Application Server may provide V2X Service Parameters to the PLMN via NEF. The NEF stores the V2X Service parameters in the UDR.

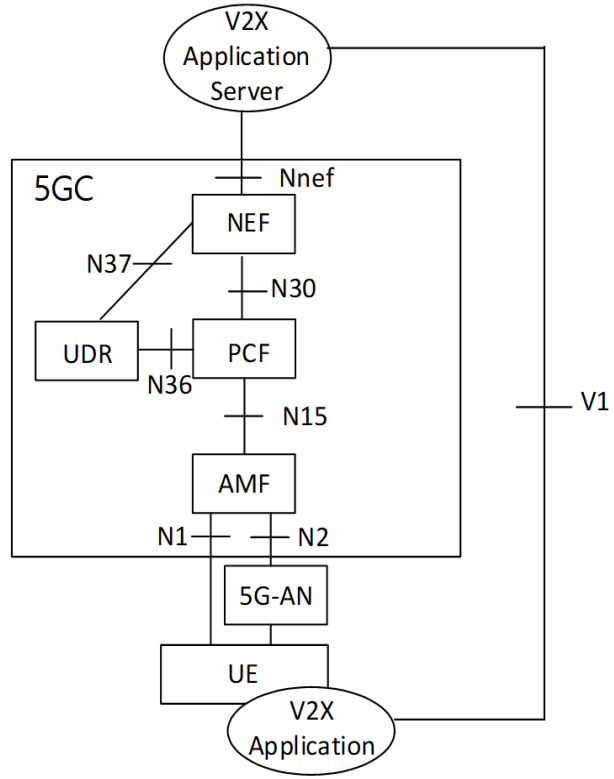

Figure 4.2.2-1: 5G System architecture for AF-based service parameter provisioning for V2X communications

Application Function (AF) influence based Edge Computing for V2X Services

To route V2X Messages or any traffic for V2X purposes to/from V2X Application Server(s) in a local Data Network (DN) close to NG-RAN,

V2X Application Server operated by e.g.:
- Operators,
- OEMs and
- Road Authorities, can use the

Application Function (AF) influence on Traffic Routing feature defined in clause 5.6.7 of 5G System Architecure.

The V2X Application Server that sends the AF request for AF influence based Edge Computing for V2X Services can be the same V2X Application Server to/from which the traffic is routed.

When AF influence on Traffic Routing is applied, a local UPF can be selected to route the traffic to the local V2X Application Server.
Usage of Application Function (AF) influence on Traffic Routing feature and its application for SMF to control UPF data forwarding are defined in clause 5.6.7 and clause 5.8.2 of 5G System Architecture specification.

UE-type RSU, which combines a UE with the V2X Application logic

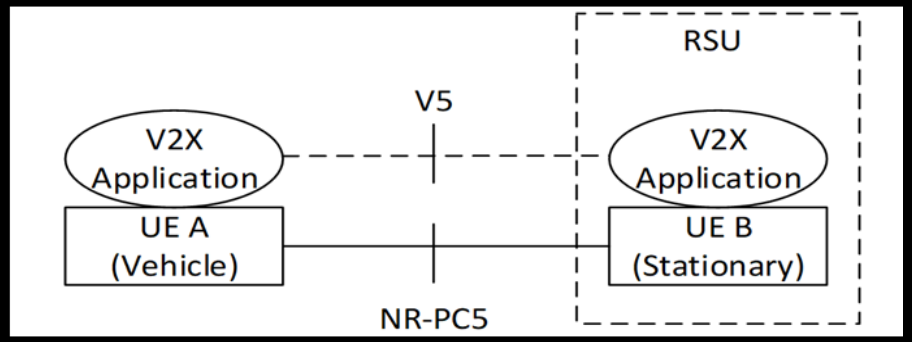

Fig. B-1:RSU includes a UE and the V2X Application Logic

Example of gNB-type RSUs, in which, the RSU comprises a gNB, a collocated UPF, and a V2X Application Server.

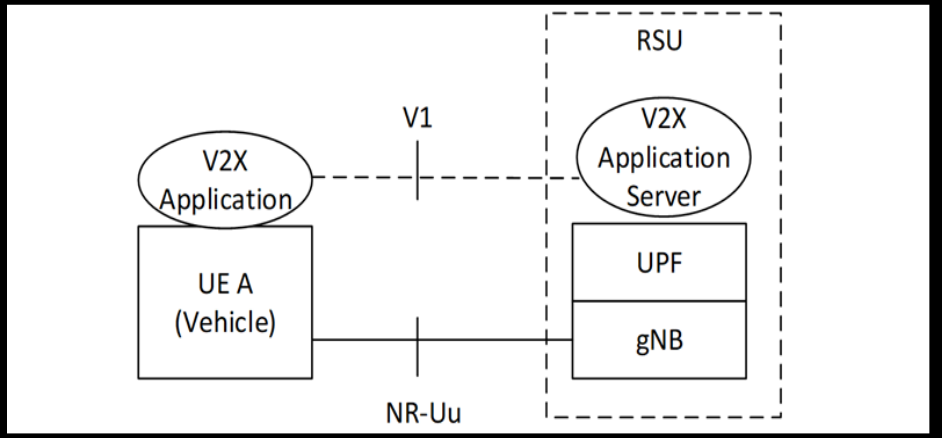

Fig. B-2: RSU includes a gNB, collocated UPF and a V2X Application Server

5GS QoS handling for V2X Communication

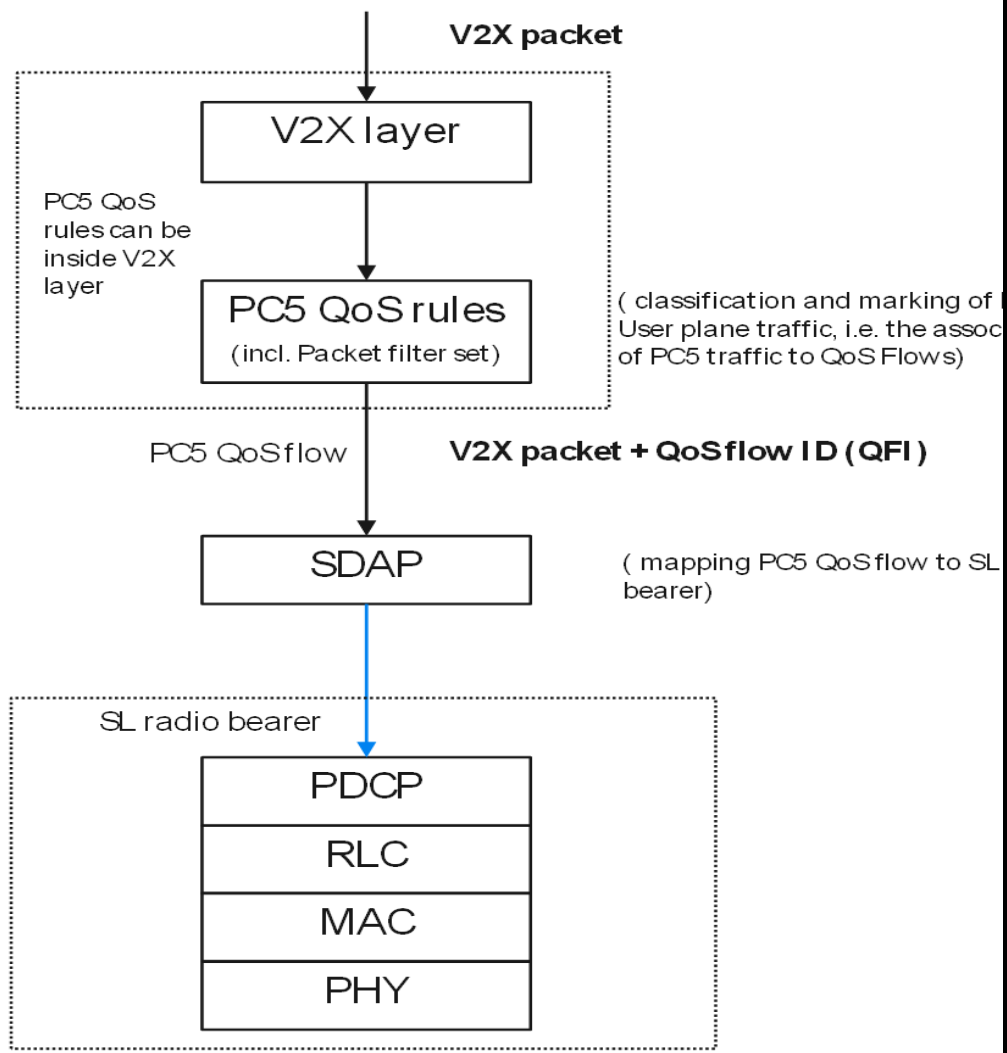

Figure 5.4.1.1.1-1: Per-Flow PC5 QoS Model for NR PC5

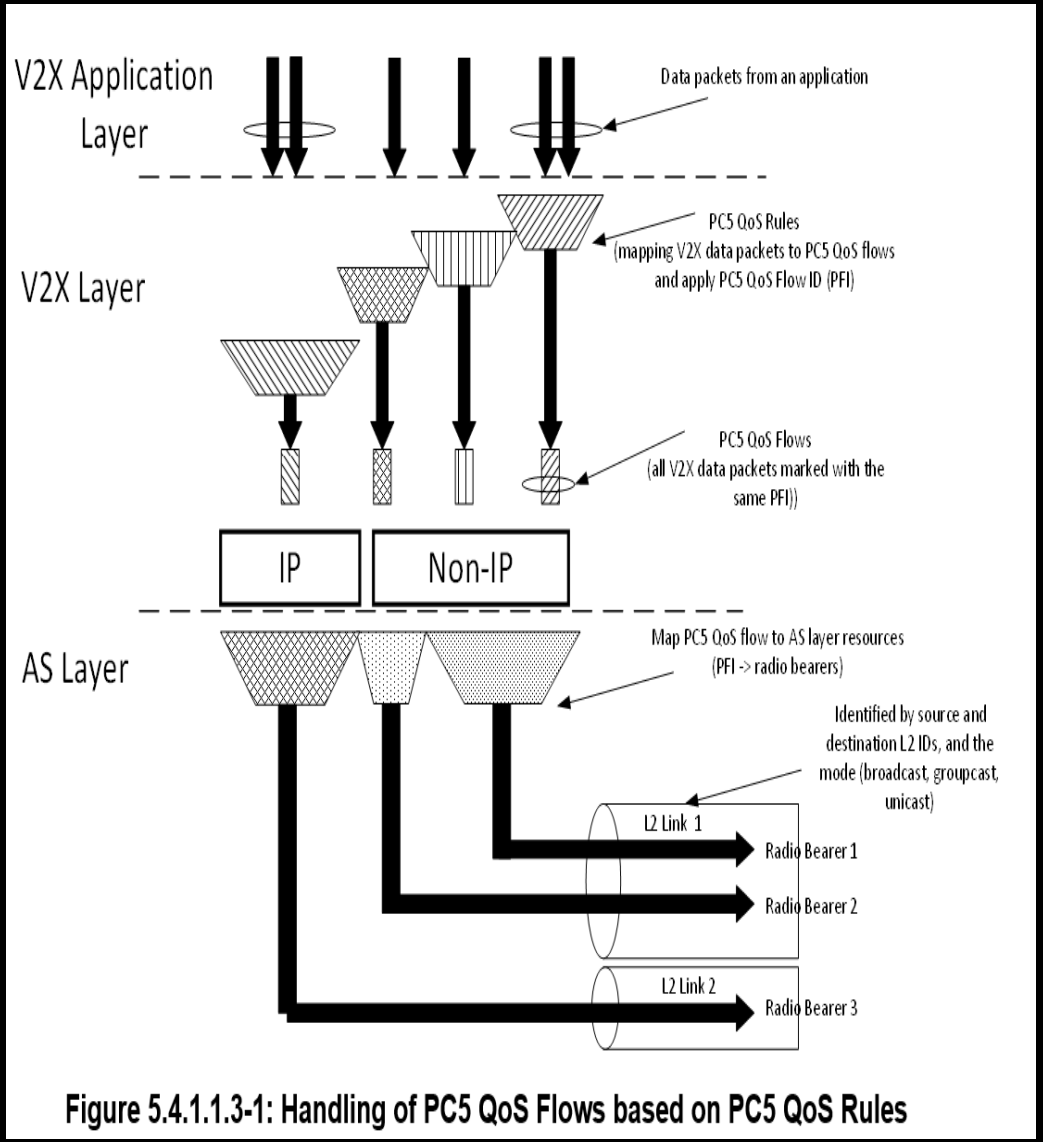

Figure 5.4.1.1.3-1: Handling of PC5 QoS Flows based on PC5 QoS Rules

5GS QoS handling for V2X Communication PQI (PC5 5QI (5G QoS Identifier)

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56		6	20 ms	10^{-1}	N/A	N/A	Platooning informative exchange – low degree of automation; Platooning – information sharing with RSU
57		5	25 ms	10^{-1}	N/A	N/A	Cooperative lane change – lower degree of automation
58		4	100 ms	10^{-2}	N/A	N/A	Sensor information sharing – lower degree of automation
59		6	500 ms	10^{-1}	N/A	N/A	Platooning – reporting to an RSU
90	Delay Critical GBR (NOTE 1)	3	10 ms	10^{-4}	2000 bytes	2000 ms	Cooperative collision avoidance; Sensor sharing – Higher degree of automation; Video sharing – higher degree of automation
91		2	3 ms	10^{-5}	2000 bytes	2000 ms	Emergency trajectory alignment; Sensor sharing – Higher degree of automation

NOTE 1: GBR and Delay Critical GBR PQIs can only be used for unicast PC5 communications.

5GS Selected Capabilities - 1

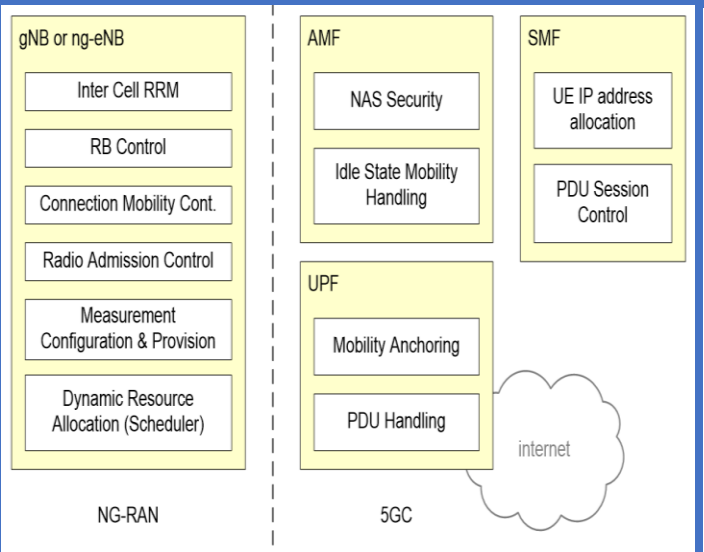


Figure 4.2-1: Functional Split between NG-RAN and 5GC

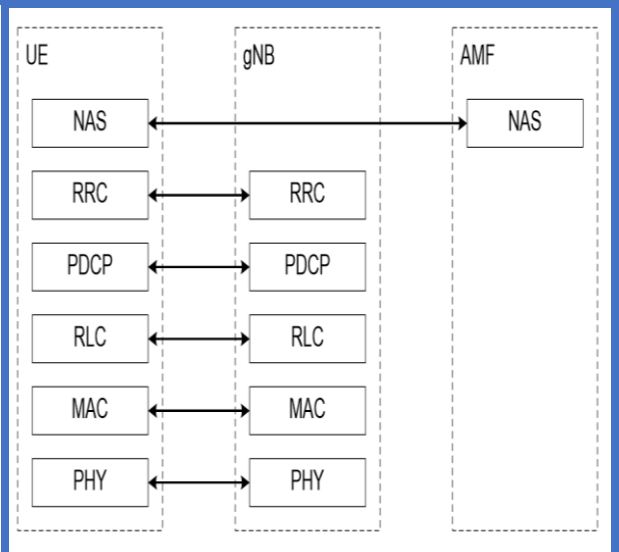


Figure 4.4.2-1: Control Plane Protocol Stack

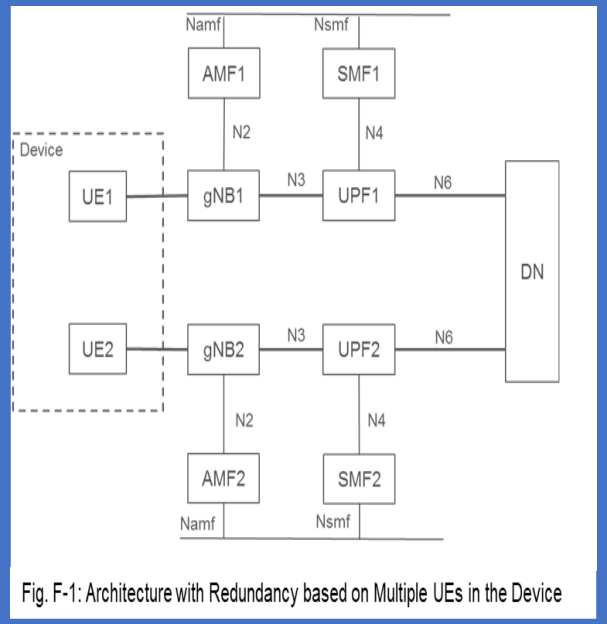


Fig. F-1: Architecture with Redundancy based on Multiple UEs in the Device

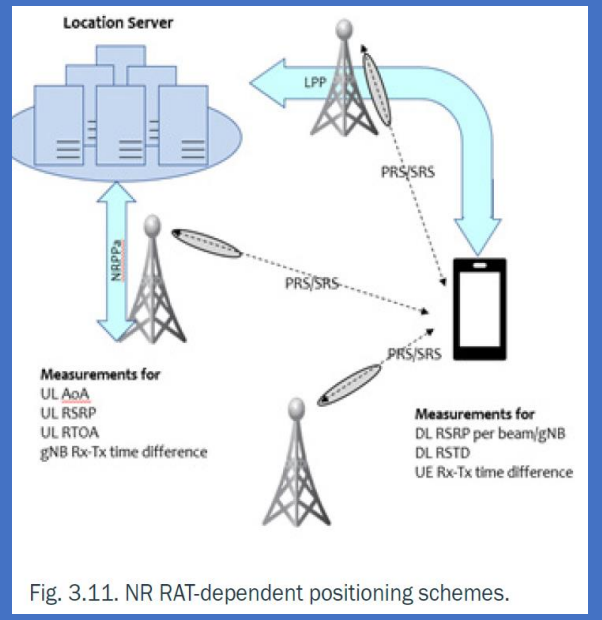


Fig. 3.11. NR RAT-dependent positioning schemes.

Figure 4.2.1-2 illustrates an overview of UE state machine and state transitions in NR as well as the mobility procedures supported between NR/5GC E-UTRA/EPC and E-UTRA/5GC.

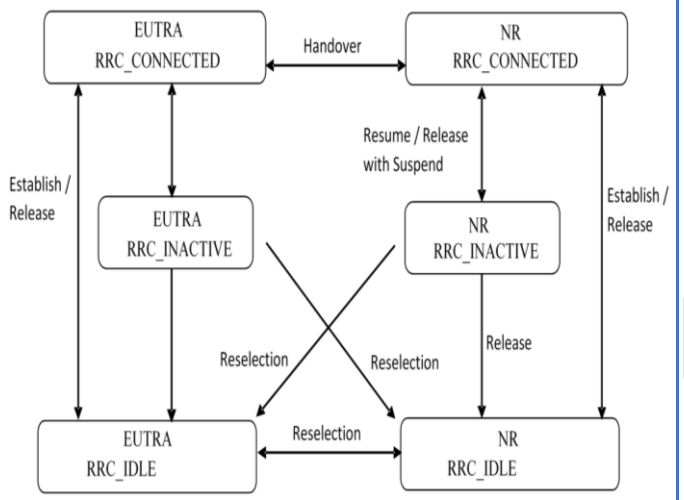


Figure 4.2.1-2: UE state machine and state transitions between NR/5GC, E-UTRA/EPC and E-UTRA/5GC

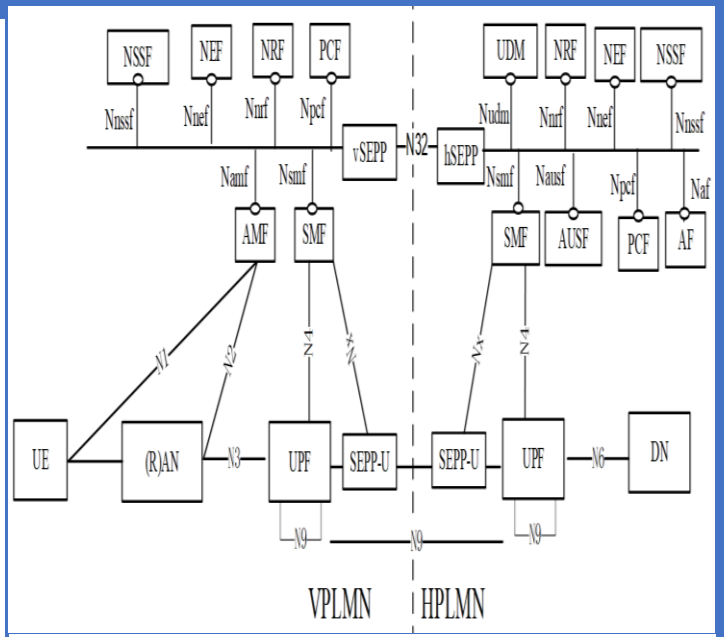


Fig.: UP GW Function SEPP (Secure Edge Protection Proxy) for the inter - PLMN N9 Interface

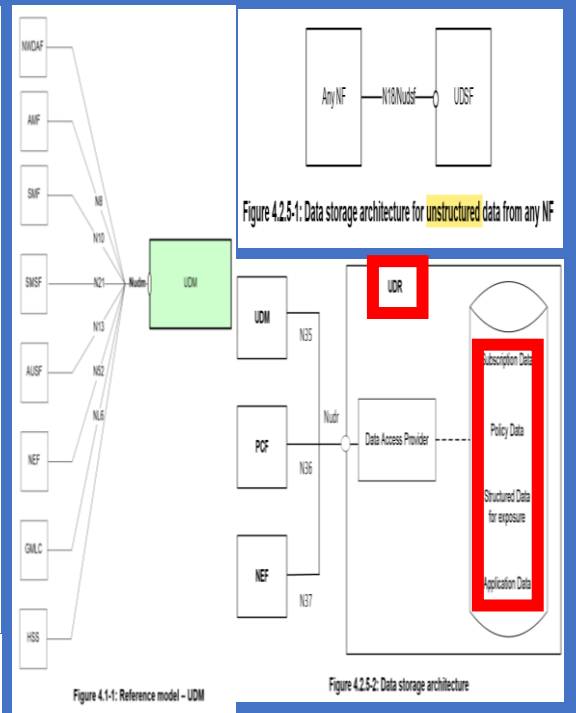


Figure 4.1-1: Reference model – UDM

Figure 4.2.5-1: Data storage architecture for unstructured data from any NF

Figure 4.2.5-2: Data storage architecture

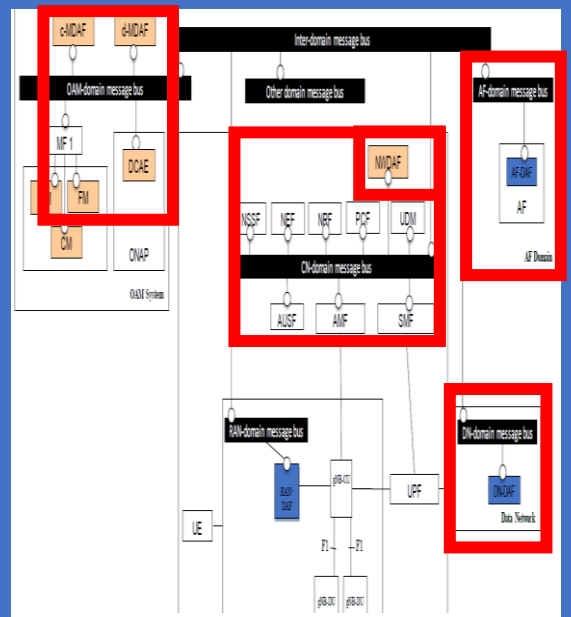
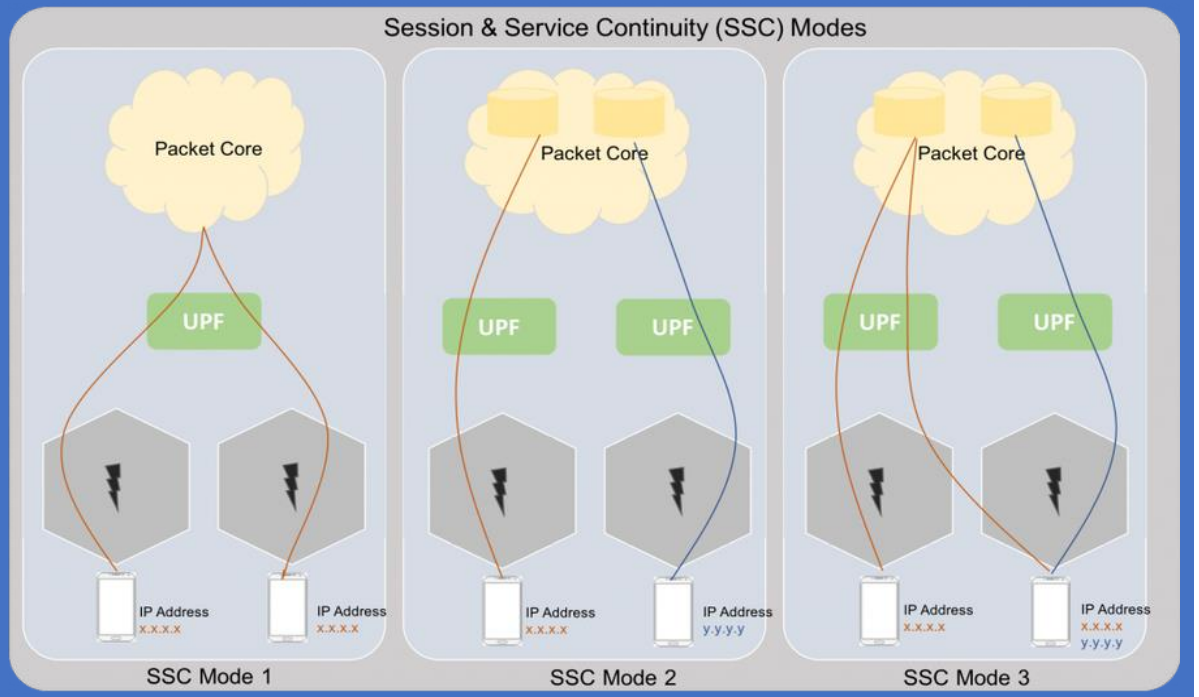
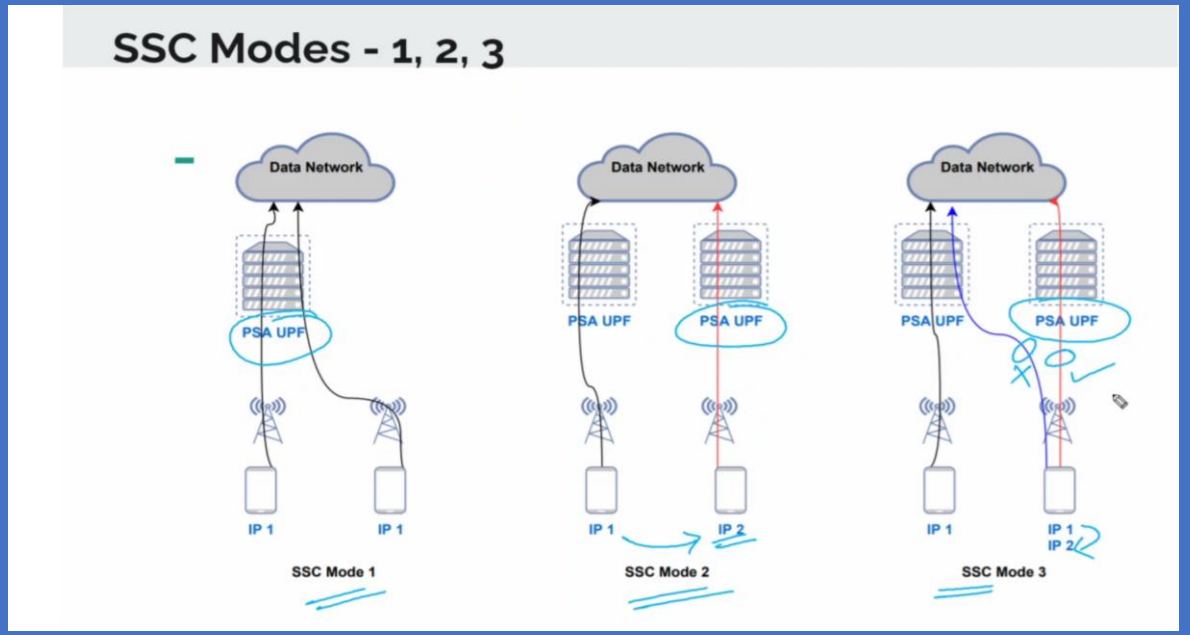


Figure 4-4 5G Mobile Network Architecture Integrated Analytics Architecture

5GS Selected Capabilities - 2





- The multi-homed PDU Session may be used to support make-before-break service continuity to support SSC mode 3. This is illustrated in Figure 5.6.4.3-1.

- The multi-homed PDU Session may also be used to support cases where UE needs to access both a local service (e.g. local server) and a central service (e.g. the internet), illustrated in Figure 5.6.4.3-2.

- The UE shall use the method specified in clause 4.3.5.3 of TS 23.502 [3] to determine if a multi-homed PDU Session is used to support the service continuity case shown in Figure 5.6.4.3-1, or if it is used to support the local access to DN case shown in Figure 5.6.4.3-2.

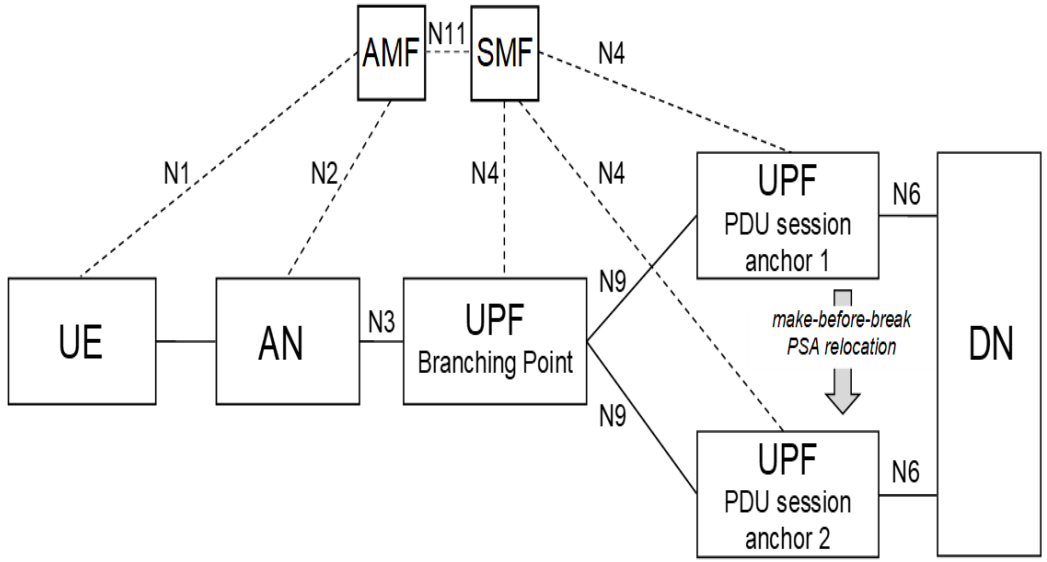


Figure 5.6.4.3-1: Multi-homed PDU Session: service continuity case

NOTE 2: It is possible for a given UPF to support both the Branching Point and the PDU Session Anchor functionalities.

Ref: 3GPP TS Rel. 17 June 2021 Telco Bytes 2021

Questions?