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July 2022 | Volume Yr 22 | Issue 7

Telematics Wire

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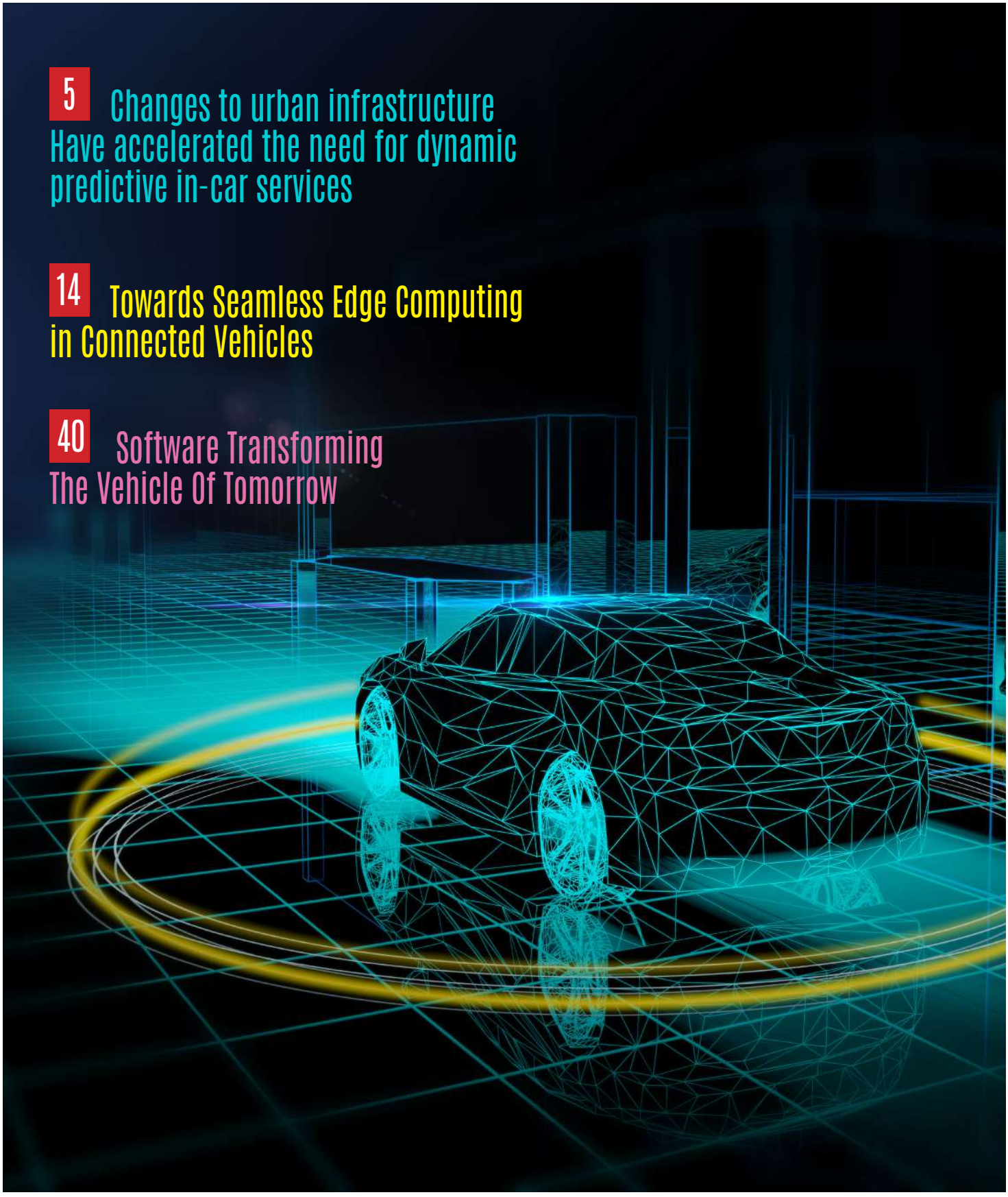

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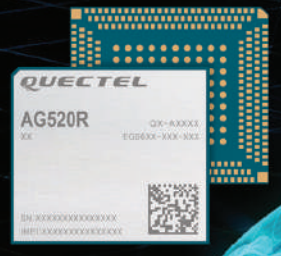

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Printed and Published by
Maneesh Prasad on behalf of Telematics Wire Pvt. Ltd.

Telematics Wire Pvt. Ltd.
D-98, 2nd Floor, Noida Sec-63
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Changes to Urban Infrastructure have Accelerated the Need for Dynamic Predictive In-Car Services

✍ EUGENE TSYRKLEVICH
Parkopedia

Sustainability measures put in place by municipalities to improve the quality of life for inhabitants living in urban areas are putting automakers under increasing pressure to provide dynamic services that will allow them to continue to provide positive on-street parking experiences for drivers.

According to the United Nations Department of Economic and Social Affairs, densely populated urban areas will be home to more than two-thirds of the world's population by 2050. However, the transport sector, which generates more greenhouse gas emissions than any other, is currently causing large amounts of air pollution within cities. By removing vehicles from inner-city areas, emissions, noise and congestion are reduced, while air quality, and also the safety of inhabitants is improved.

Global on-street parking inventory is decreasing

Many EU cities are now adhering to strict emissions restrictions by introducing fee payable congestion and Ultra Low Emission Zones (ULEZ) which dissuade motorists from driving into highly populated areas. On-street parking is also gradually being reduced with the aim to encourage drivers to use alternative forms of transportation for the final leg of their journey.

However, finding on-street parking is already a struggle for many drivers. Each year drivers in European and North American cities spend an average of 55 hours searching for on-street parking spaces. Searching for a suitable parking space now accounts for almost one-third of inner-city traffic in Europe, with approximately 1.3 kilograms of CO_2 emitted for every search - contributing significantly to the carbon footprint of each journey.

In 2020, Paris announced that it will remove 60,000 of its 140,000 on-street parking spaces to allow for more space for cyclists and pedestrians, and allow

for an 'ecological transformation of the city', with the aim to improve daily life for Parisians. Since then, an additional 10,000 spaces and amenities for motorists have been removed, key thoroughfares have been made inaccessible to vehicles, and the previous 70,000 parking spaces have been replaced with 'green' spaces, vegetable plots and playgrounds. Last year, Paris also announced a 50% increase in parking prices and the introduction of parking charges for motorcycles for the first time, with only electric motorbikes remaining exempt, aiming to encourage riders and drivers to switch to more environmentally friendly forms of transport in the city centre.

Amsterdam's Green Infrastructure Vision 2050 plan delineates clear goals for a greener future, with the aim of transforming the concrete city into a place where nature can thrive and coexist with the urban landscape, thus improving both the city's liveability and tackling climate change. The plans to achieve this include the introduction of more urban green spaces, more cycling and walking routes, and more car-free streets. Amsterdam is already one of the most expensive cities in Europe for on-street parking, with an average price of $13.31 for 2-hour parking, and plans to remove more on-street parking spaces in the future.

In London, where on-street parking takes up space equivalent to 10 Hyde Parks (or 14,164,000m^2), the city has also implemented tighter parking regulations in densely populated areas, to encourage public transport and 'active travel'. According to the Centre for London, residents want trees, green spaces, clutter-free pavements and more children's play areas prioritised over on-street parking or EV charging points, however, neither car ownership, nor the proportion of trips made by public transport, walking or cycling, has changed significantly over the last three years, resulting in greater competition, for fewer spaces.

Recent COVID-19 restrictions also saw a reduction in on-street parking as municipalities promoted central businesses to expand their outside facilities. In 2021, Milan removed a tax related to the overall footprint to enable businesses to expand their outdoor facilities, allowing them to continue to trade under new social distancing restrictions, however, this resulted in the loss of around 3,000 parking spaces which were heavily utilised by visitors and residents.

Further challenges to on-street parking for ICE vehicles are plans to repurpose on-street parking spaces for EV vehicle charging only. A step to reducing emissions, but requiring the installation of a large volume of on-street chargers. Amsterdam is currently installing 1,100 new chargers as part of its aim to achieve 'emission-free transport' by 2030, however, critics suggest the scheme has significant financial challenges to provide the volume of chargers without substantial government grants, with on-street charging currently not proving commercially viable.

As well as an overall reduction in the total number of spaces, drivers also now face greater restrictions on those that remain. Maximum stay times are significantly reduced and enforcement has been intensified, encouraging a much higher turn-over per space. Drivers who still wish to park curbside, now risk a much greater chance of receiving a fine if they fall foul of the many changing restrictions now in place.

Associated tariffs are also continuing to rise due to growing demand, with payment zones reduced, in order to efficiently manage these high-demand areas. In some cities, such as New York, dynamic pricing is used, with prices increasing in line with times of peak demand and drivers charged based on the actual perceived value of the space rather than a static arbitrary amount. On-street is traditionally cheaper than off-street parking, however, dynamic pricing allows car park operators to incentivise drivers to use their facilities with prices now significantly lower than those on-street - looking to reduce situations where drivers circle around crowded streets looking for a space, causing additional pollution and congestion.

The more complex on-street parking landscape creates an even bigger need for accurate and granular on-street parking data, which is essential to support drivers by giving them the information required to make well-informed parking decisions as part of their overall journey.

Providing accurate and granular data

As the global leader in digital parking services, Parkopedia's parking database now covers almost 1.5 million on-street locations worldwide, more than three times that of our nearest competitor, with 1 million locations added within the last 4 years alone.

Over the last 4 years our total completeness has also grown consistently to reach just under 99%. Data completeness refers to the comprehensiveness of the data with no gaps or missing information being present. Inaccurate or incomplete data renders the service unusable to the driver potentially causing detrimental user experiences.

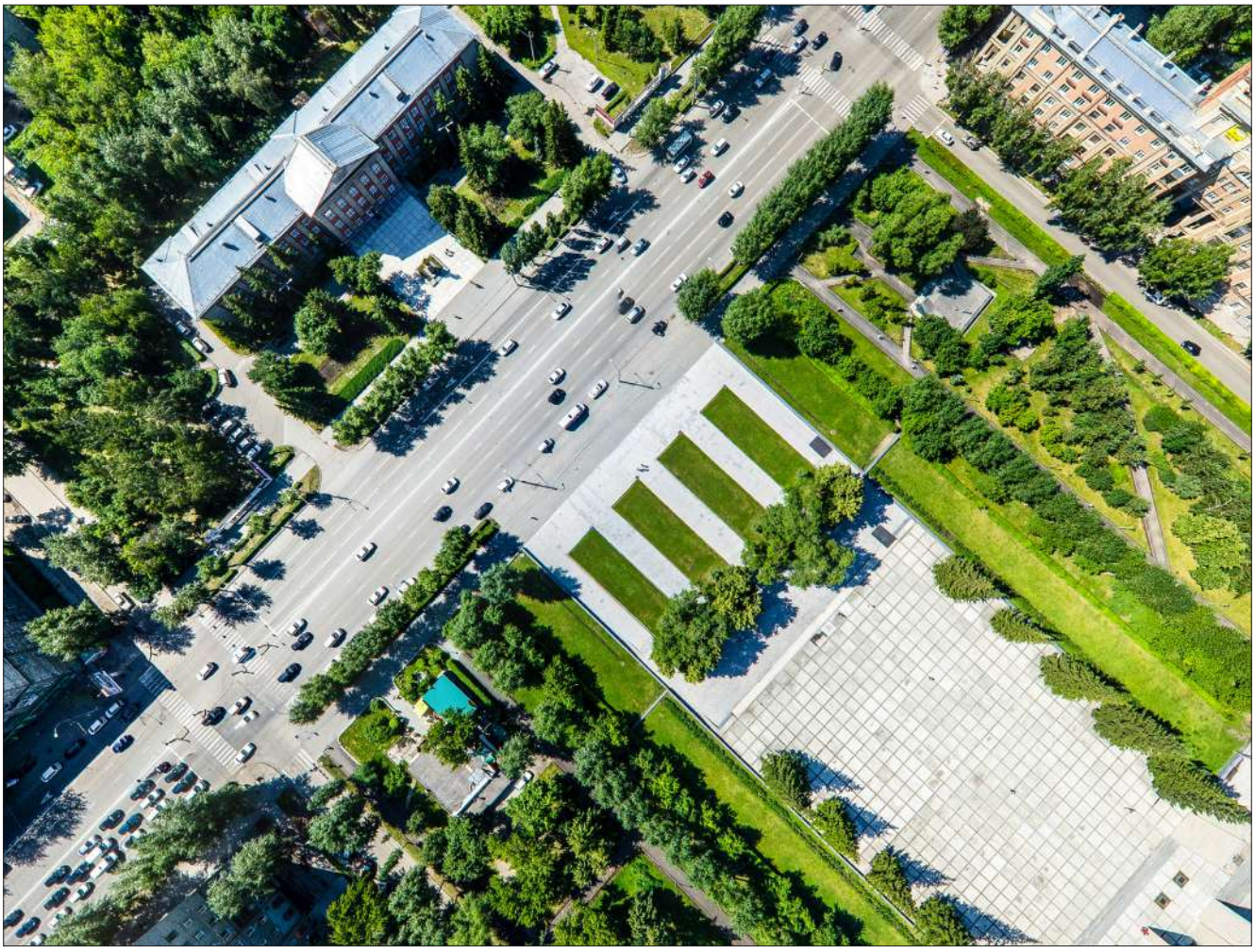
Alongside traffic and weather, parking is the most requested driver information service. Automakers who don't already prioritise their parking services, have the potential to create lasting negative user experiences for drivers. Static parking information is a valuable tool for drivers. Parkopedia, for example, gathers dozens of static parking data attributes for every location, including the precise location of each on-street parking space, as well as useful information such as hours of operation, any restrictions and parking costs. However, when parking is highly competitive, dynamic services which predict occupancy at a specific location, become essential.

By leveraging parking payment transaction data, and vehicle sensor data Parkopedia provides the highest quality predictions available to drivers, with our dynamic data providing space occupancy information, as well as the "probability to find parking" by individual street segments and for off-street parking facilities.

Our predictions also continue to improve as cutting-edge machine learning and computer vision methods and partnerships help to solve difficult parking problems. By carefully managing the data collection process, Parkopedia has grown its dynamic data coverage availability by more than 600% over the last 4 years.

Geofencing for automated on-street parking payments

Highly granular parking data will be crucial for automated parking payments, with transactions requiring deep vehicle integrations across all available data and sensor inputs for the next-generation user experiences expected.



Currently, parking payment operators rely on charging drivers according to their location due to large zonal areas, similar to a postal or ZIP code. The user will manually pin their location and be charged the corresponding amount for that zone and for the duration of their parking session. However, as driver demand increases for automated payments, this current blanket approach across large areas will not be a viable solution in up to 80% of cases at certain locations. When parking payments become automated, all parked vehicles within these large zones will be sent trigger payments, and drivers could even be charged or fined for parking on their own driveway, for example.

Only Parkopedia is currently able to overcome this issue, as it is the only provider with the necessary technology and granularity of data to create much smaller and more accurate 'geofences', enabling automated payment requests or triggers for customers within a specified area only. Our on-street data standard and accuracy allows us to create geofences to as little as a row of 3-4 parking spaces, allowing for GPS to identify it as a paid parking zone, and match the POI location to a payment ID, thus triggering an accurate payment request.

The foundation of what's to come

The removal of on-street parking in urban areas is a growing issue for automakers who want to provide their drivers with positive parking experiences and 'peace of mind' so they can effortlessly complete their journeys. In order to keep up with the dwindling supply of on-street spaces, evolving restrictions and strategic pricing models, automakers require accurate, complete and highly granular parking data that can be updated in real-time for the driver, and support highly automated seamless in-vehicle payments. This combination empowers drivers to make well-informed parking decisions, even when finishing journeys without 'local knowledge' at new destinations, and also delivers upon the next generation in-car convenience services that are expected by drivers from today's vehicles. ❑

AUTHOR

EUGENE TSYRKLEVICH
Founder & CEO
Parkopedia

Eugene launched Parkopedia in 2007 after driving to a conference in San Francisco and struggling to find any useful parking information online. After realising that drivers all over the world must be facing the exact same problem every day, Eugene created Parkopedia with the mission of improving the world by delivering innovative parking solutions.

Over-the-air (OTA) : A Differentiator for Software-Defined-Vehicles

SUJAY NANDI & SANKALP SINHA
IBM Consulting

An introduction to Software-Defined-Vehicles

Concept

The automotive industry has seen a major shift since the last decade. As the vehicles gradually transforms into E/E (electric/electronic), the experience of what is known as "Vehicle 4.0" becomes more and more evident. This is further characterized by the convergence of electrification, connected and autonomous emerging into enhanced experiences, new forms of mobility, strong alignment to environmental concerns, developing eco-system and underpinned by the demand for a digitally transformed enterprise. Developing such vehicle of the present and that of future, requires capabilities and partners to address the challenges of automotive software engineering. A vehicle whose design, manufacturing on one hand and features and functions on the other are primarily enabled through software, or software led hardware is termed as "Software Defined Vehicle".

The Software-Defined-Vehicle has created an opportunity for manufacturers to mitigate risks and differentiate in the customer experiences space with brand loyalty, novel business models, features, and experiences – all primarily enabled by software. Premium vehicles today already have up to millions of lines of software code, may be distributed among 100+ electronic control units (ECUs) supported by several sensors, cameras, radar and LIDAR devices. While the premium vehicles are leading the need for advanced technologies, the commoditization is not far behind and mass-market vehicles are expected to catch-up with the race very soon.

Necessity and Imperatives

The automotive industry, since its inception, has been guided by the machines, and hardware that gradually reached its maximum limit of optimization and enhancement leading to standardized hardware. Subsequently the transformation arena over the past few years has moved to software and software-defined platforms, this is expected to further intensify as differentiation along with price competitiveness continues to be the key focus for the auto providers. The recent automotive innovations that are now part

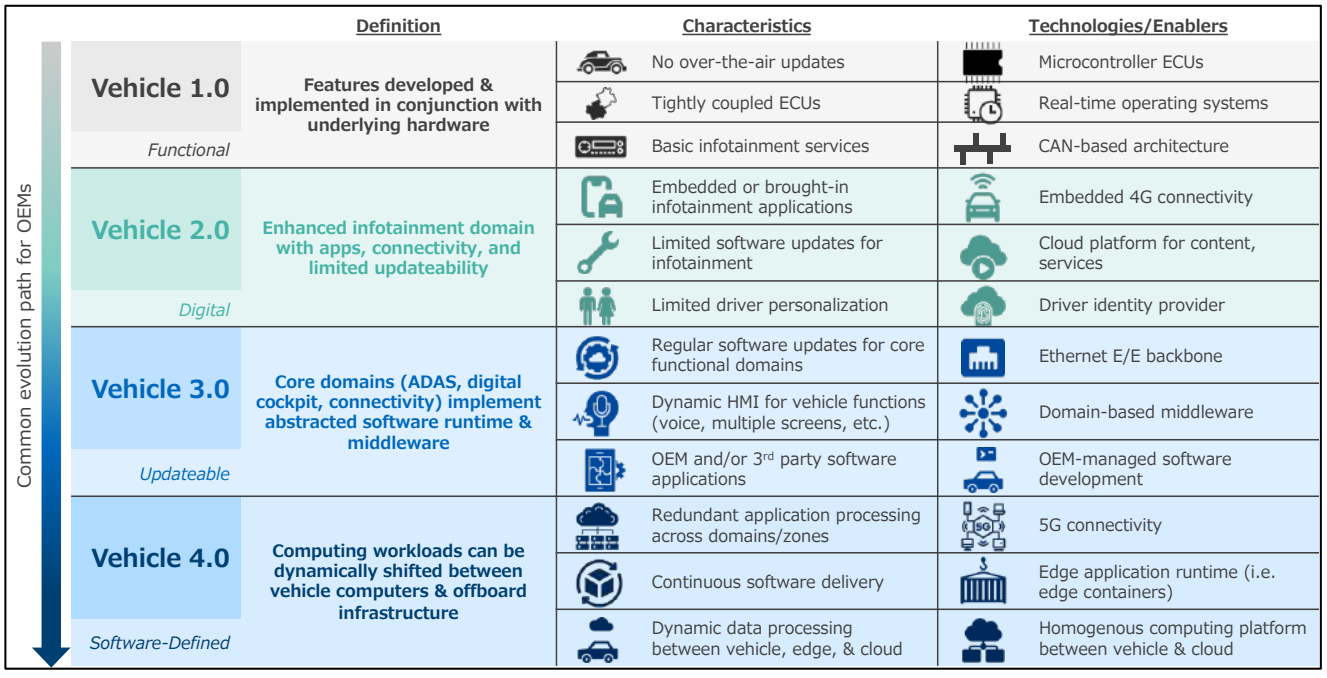


Figure 1: Vehicle X.0 – The evolution from functions to services
(SOURCE: SBD - THE SOFTWARE-DEFINED-VEHICLES)

of even a basic car including infotainment, sensor based detection and driveability relies more on software precision, quality, scalability and integration than on mechanical ingenuity. As the shift from mechanical to electro-mechanical to essentially software-driven becomes even more prominent, the laggards in the software space faces hurdle and risks. The arrival of the new-entrants including digital and technology players has further fuelled the need for traditional OEM to innovate and transform in the space.

Key Trends

Following are some of the technical solution trends observed in the automotive industry:

- Rise of the **'Computing Power'** in vehicles
- The 'Evolution' of the **connected vehicle**
- 'Multi-Dimensional Innovation' in the **electric vehicle** space
- The '**Online Era'** of vehicle retail and aftersales

The key macro trends in the global automotive indicates software as a key disruptor. It is expected that from 2020 to 2030 for software and electric/ electronic market, the CAGR will reach 12%-more than three times the expected growth of general automotive sales. The strongest growth areas include software functions (CAGR of 11%) and integration testing (12%). No wonder, many want to claim the $640bn market for automotive software-based features & services and the annual revenue ambition for major OEMs by 2030 is pinned on software services.

With possibilities, comes challenges..

As described above, the software and electronics is making the vehicles practically processor on wheels controlling underlying mechanicals entirely from powertrain to body control. Like a smartphone app and OS or a laptop which requires software updates for vulnerability, security, improvements, vehicles too need update of the software. The maintenance scenarios thus changes, from the traditional vehicles of yesteryear which was all about fixing mechanical to those maintaining the version of software, updating, upgrading and fixing patches. Unless the updates are thoughtfully handled, overall customer experience, ownership and driveability could be seriously impacted. With frequent updates required by the software, a vehicle owner may land up visiting vehicle workshop almost every month, waiting for the automotive technician to plug an USB stick to port on the vehicle and install updates.

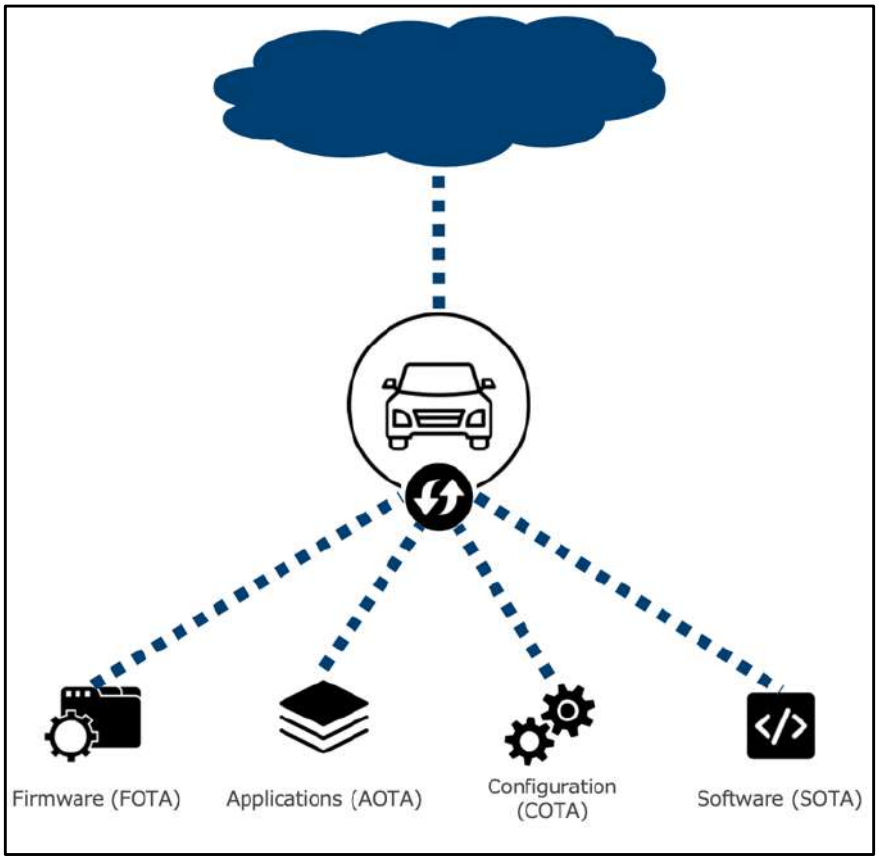


Figure 2: Kinds of OTA
(SOURCE: SBD - THE AUTOMOTIVE OVER -THE-AIR UPDATE ECOSYSTEM)

Thus while software-defined-vehicle opens up plethora of opportunities, it also poses multiple challenges that must be taken into consideration: -

- Current software and hardware architecture is not well suited for software-defined vehicles owing to constraints in computing power, communication and wiring challenges
- Unless well controlled, every new functionality adds to the software complexity. The productivity level on the other hand for both automotive players as well as technology leaders are barely able to match the software complexity. Overall there is an increasingly wide and unsustainable gap between the both
- Features such as adaptive cruise and ADAS that is becoming a key vehicle differentiation needs far more updates than the others
- Delivering new features or essential software upgrade through traditional brick and mortar workshops dents customer experience making differentiation through software challenging
- Software upgrade without any monetization benefit is not a sustainable model for the OEMs
- In-person recalls due to faulty software has a higher chance of occurrence
- Higher labour cost due to frequent visits to workshops for upgrades
- Higher rate of depreciation as the software becomes obsolete
- Compliance and changing safety regulation can impact longer term ownership

Augmenting Software-Defined Vehicles with OTA

What is OTA?

Over-the-air refers to the ability to deliver

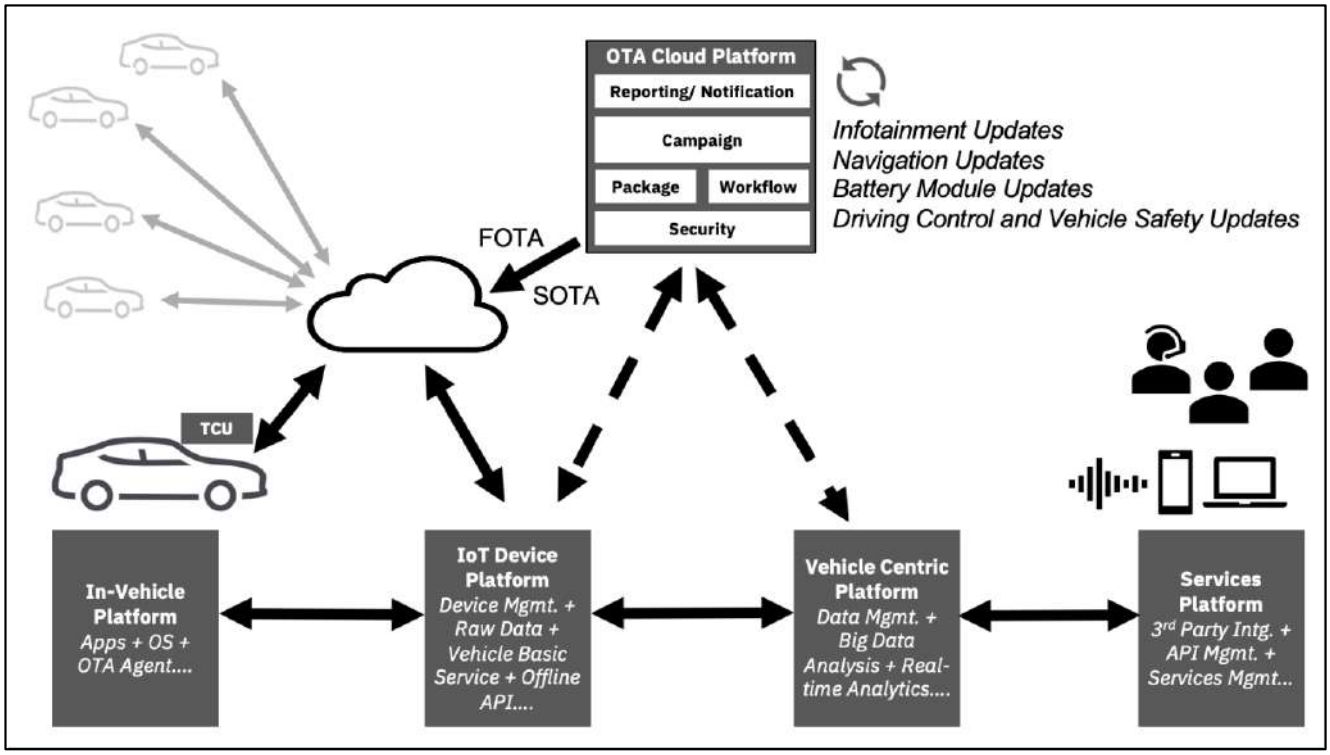


Figure 3: OTA representative architecture

on one hand, and receive on the other, remote updates to the software without the use of physical update medium. This is delivered through the form of network which can range from wi-fi connection/ LAN to 3G/ 4G/ 5G GSM network or even over Bluetooth etc. Smart phone, digital TV platform were one of the first and wide implementors of OTA, in the automotive industry the first commercial and wide use of OTA was brought in by Tesla with the launch of Model S in 2012.

Unpacking OTA

As the network connectivity becomes ubiquitous, OTA becomes the natural choice for vehicle updates but what all constitutes OTA? Essentially it could be categorised into two major types: -

1. **SOTA (Software over-the-air):** - Software updates over the air as the name indicates, includes updating underlying software components within the vehicle. This can range for e.g. from powertrain to battery to in-vehicle infotainment etc.
2. **FOTA (Firmware over-the-air)**: - FOTA incudes the process of updating firmware over the air i.e., the main system software that controls the underlying hardware

Besides the basic categories there could be few more types of OTA including

- **A**pplications over-the-air (AOTA), responsible for updating applications in-vehicle e.g. map applications, music application and so on
- Configuration over-the-air (COTA), specifically designed for updating vehicle configurations to boost performance, range, comfort etc.

Architectural solution for OTA

We discuss here the technical solution for OTA which includes three essential aspects to be considered for: -

In-vehicle setup for OTA – responsible for orchestrating and applying updates to the vehicle software, OS and/ or firmware and responding back to source. This includes OTA Client and Agents at the vehicle level that communicates with the off-vehicle platform usually through the TCU (Telematics Control Unit) that hosts the mobile connectivity or via Bluetooth connection with mobile phone. Updateable ECUs are fundamental requirement for the OTA to function, the degree and extent of it would determine the range of update functionalities that OTA could offer

Off-Vehicle setup for OTA – responsible for orchestrating update campaigns, managing of update files, pushing updates and reporting. This can be a cloud platform or on-premises solution.

Supporting Connected Vehicle Platform – An OTA set-up works in close coordination with the connected vehicle platform typically comprising of IoT Device, Vehicle Centric and Services Platforms

There are numerous possibilities in truly leveraging software through over the air updates (OTA) impacting infotainment improvements, monitoring and tuning of core functional capabilities of the vehicle, such as powertrain, ADAS etc. Vehicle manufacturers have the overall opportunity to improve life-cycle management and develop revenue-generating features they can offer to customers.

What is in for Auto OEM and the Ecosystem with OTA

Having discussed the essentialness of Software-Defined-Vehicles and OTA a key enabler, it is time to discuss how it can benefit the OEMs. We discussed the challenges with Software-Defined-Vehicles in Section B, while it is not possible to address all of them with OTA, noteworthy, most of them

could actually be addressed. Let us first see the potential of OTA in strengthening the OEMs proposition in this area: -

- **Vehicle issue resolution** through planned and unplanned updates. No product is defect free, likewise any automotive vehicle would have its share of bugs. OTA helps automotive OEM to fix such defects non-intrusively without necessitating costly recall
- **Cybersecurity** is a concern for all connected systems including vehicle. There is no full proof system and security threats evolves over time. OTA enables OEM to fix such vulnerability from time to time
- **Revenue opportunity** with faster roll out of features. Additional services features are now realizable at higher frequency and quickly which can be capitalized after sales revenue
- **Subscription economy**, periodic releases and differentiated features is expected to keep the interest for on-going subscription live among customers, thus higher renewal and lower dropouts
- **Regulatory compliance,** the automotive scenario with respect to regulatory governance is changing rapidly across the world, OTA thus can be an effective mechanism make the cars compliant
- **Ecosystem Map Provider,** with ADAS features becoming prevalent now, map becomes an de-facto feature of such vehicles. OTA helps to keep such map updated and relevant in the vehicles
- **Ecosystem Battery Providers,** with OTA there is a lot more opportunity for providers to roll out battery updates to the vehicles through OEM. This is especially applicable for EV vehicles
- **Ecosystem Technology Providers,** while on one hand OTA is a great enabler for Software-Defined-Vehicles realizable, on the other OTA relies on the underlying Software-Defined-Vehicles for its plausibility. Thus the overall Software-Defined-Vehicles strategy is essential and opportunity for technology companies e.g. network providers, middleware vendors, OS manufacturers, automotive engineering consultants, cloud hyperscalers etc.

Current State of OTA -

Most auto OEM currently delivers OTA primarily in the infotainment category, however with all the vehicular advancements, there is a need to extend beyond. Here are the 4 principal categories by functions which are being targeted by OTA currently and future: -

1. **Infotainment and Navigation Updates** – This is usually the first target and most Auto OEM are in some form or the other providing OTA in this category
2. **Battery Energy Management Updates** – This is a differentiating category esp. for the EV makers
3. **Driving Control and Safety Updates** - This category of updates includes all the critical drivability, vehicle safety updates. It includes e.g., the ADAS, adaptive cruise control, electric motor software, Body Control Module, Powertrain Control, intelligent brake, lane assist updates etc. While this is the most pervasive and most complex updates to be catered for and more futuristic, the ones such as ADAS are first targets for OTA
4. **Devices, Camera and Comfort Feature Updates**

Let us now look at the current state of OTA from thee views: -

Auto OEM View

- **Tesla** - OTA updates extend to its entire fleet and are released consistently. Mostly for minor bug fixes, but a few times a year, Tesla owners can look forward to extensive OTA updates. It is one of the first OEMs to deploy updates for powertrain ECUs. Tesla has utilized FOTA to deploy major updates to their ADAS ECUs, including support for Autopilot and Summon features and used OTA updates to improve the Model 3's braking distance by up to 20 feet.
- **Audi** - Currently, Audi does offer over the air updates, but only for its vehicle maps. In January 2019, Audi announced a subscription service "Functions on Demand" on the new e-tron, allowing users to enable new features and services via OTA update via a smartphone app. This service was first shown to also be initiated using the in-vehicle infotainment system. The new e-tron will also support software updates for the infotainment system.
- **BMW** - The automaker offer over-the-air software updates to most of its models, but limited to infotainment systems to enhance features already onboard and to purchase and install "optional equipment features." Updates to the ADAS can be updated OTA in a limited capacity.
- **FCA** - Offers OTA firmware updates for its infotainment systems. The updates keep interfaces like navigation fresh, while offering capabilities to add new features like Alexa and CarPlay. Plans to offer connected services in its vehicles with the goal of putting 26 million "monetized connected cars" on roads by 2026, this strategy includes over-the-air updates, as well as connected features like autonomous driving features.
- **Ford** - In 2020, Ford began equipping its designed vehicles with OTA capabilities. This includes its popular Mustang Mach-E and the new 2022 F-150 Lightning. The primary method for updates on Ford's infotainment and telematics platform is via Wi-Fi. Wind River's public announcement that it is working with Ford to deliver OTA updates indicates that OTA is a key part of Ford's current engineering lifecycle

Trend 4: Established Automakers Ramp Up OTA as Their Main Digital Revenue Channel

Last year saw major changes in the automotive over-the-air (OTA) software market when several car manufacturers began to offer software updates.

As most automakers have updated the hardware on the vehicles to enable software updates, they will now begin to shift to a revenue model that is based on services rather than the sale of the asset.

Gartner analysts predict that by 2023, half of the top 10 automakers will offer unlocks and capability upgrades through software updates that can be purchased after the sale of the vehicle.

Figure 4: Top Five Automotive Technology Trends for 2022 (Source: GARTNER)

and product roadmap.

- **GM** - First introduced OTA tech in 2009 by performing over-the-air updates through OnStar and in-vehicle infotainment. In late 2019, GM introduced Vehicle Intelligence Platform (VIP) enabling GM to send OTA updates to nearly every vehicle control module, not just infotainment. It has announced a new software platform called Ultifi, that will build on top of VIP to provide more frequent and seamless OTA updates.
- **Mercedes Benz** - Currently offers OTA updates every three months or so. pertaining entirely to navigation and infotainment features. Mercedes-Benz customers can view installed updates and release notes on the Mercedes Me portal. Through a partnership with Nvidia, it is now developing an entirely new software architecture and in-vehicle platform. This is expected to roll out in Mercedes-Benz's 2024 models
- **Volvo** - As the co-owner of the aforementioned Polestar, Volvo launched the same over-the-air software update in 2021. Additionally, Volvo has launched its C40 recharge SUV, which also holsters OTA capabilities.
- **Rivian** - Rivian has begun rolling customer ready versions of its R1T pickup, followed by a small number R1S SUVs. Its OTA capabilities are a key feature in keeping its fleet consistently updated. This includes updates to Rivian's driver assistance system Driver+.
- **BYD** - It was one of the earliest to announce full-vehicle OTA on mass-produced vehicle. Last year BYD announced a partnership with Aurora Mobile Limited to collaborate toward digital upgrades of BYDs EVs. It has enabled about fifteen OTA updates across multiple models to improve things like intelligent connectivity, driving assistance system and power.
- **NIO** - NIO offers a variety of over-the-air capabilities to its fleet. In its OS 2.8.0 launch in late 2020, OTA capabilities for all NIO models were enhanced. Similar to Tesla, this includes both FOTA and Infotainment SOTA.

Supplier View

Suppliers in the space includes a mix of traditional automotive, non-traditional and recent players: -

1. **Non-traditional Players** – Aeris, Fujitsu, Google, Sibros, AURORA are few examples of non-traditional OTA players. They offer OTA capability in various forms and formats. Google has OTA update capabilities as evidenced through its OEM smartphone businesses. Through its development activities with Android Automotive and Google Automotive Services, Google can also offer OTA update capabilities for OEMs who leverage the Android Automotive platform for their infotainment platform. Aeris is a non-traditional player in the automotive OTA space, the Aeris Mobility Platform (AMP). While Aeris does not specialize in OTA, it is operationally supporting multiple OEM connected vehicle programs. Sibros is a young automotive platform startup, its product was introduced in 2019, focusing largely on the client software as well as building an easy-to-use, iterative campaign management toolset. Aurora Labs is one of the newer OTA platform providers in the space that focuses on provision of OTA update capabilities, in-vehicle OS and in-vehicle middleware platform. AURORA has mulitple large players investing on for the development of Autonomous Vehicle Platforms.
2. **Traditional Players** – Bosch, AURORA, Aptiv, Airbiquity, HERE, Excelfore, HARMAN, Wind River are some of the traditional automotive players that provides OTA capabilities leveraging its years of expertise in the automotive engineering domain. Bosch is one of the biggest, longest-running tier 1 suppliers to the automotive industry. Bosch has a Connected Mobility Solutions division which focuses on building and delivering cloud-based applications and services for its customers. Bosch IoT Cloud and Bosch Vehicle Management Solution has the "Updates over the air" capability. Excelfore in 2017 formally launched its eSync OTA platform as well as the eSync Alliance, a non-profit whose mandate is to provide a forum for the open standardization of non- differentiating elements of the OTA update solution stack. Harman, a global automotive tier 1, is the industry leader for automotive OTA in terms of production programs supported and production volume.

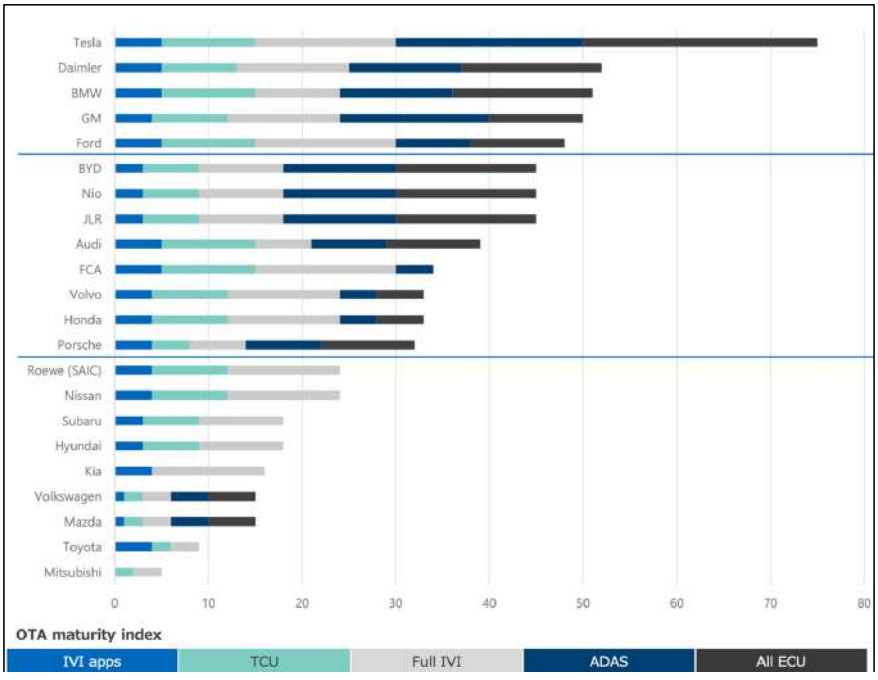


Figure 5: OEM OTA Maturity Index
(SOURCE: SBD - THE AUTOMOTIVE OVER-THE-AIR UPDATE ECOSYSTEM)

Industry Alliance View

While the OEMs and suppliers individually innovates stand up their OTA platform, industry associations are initiating the latest OTA developments. Here are some of the

major ones

- The objective of **eSync Alliance** is to create a collaborative space for automotive companies to develop standard specifications for OTA update protocols, patterns, and components. It was started by Excelfore, other companies such as Molex and Alpine, Hella, Mobica, and ZF have joined the alliance.
- **Uptane** an open source design is for industry standardization activities for OTA that includes major OEM such as Toyota, GM, HERE technologies etc.
- **AUTOSAR** and **AUTOSAR Adaptive platform** is an extremely popular automotive industry alliance impacts the OTA platform providers who need to ensure any OTA client software developed is in accordance with the Update and Configuration Management Requirements Specification.
- **ISO/AWI 24089** standards are incredibly important to how OTA update capabilities are built once published.

Conclusion

As we approach the next inflection point in the automotive world, the principles of systems, software engineering and agile culture is going to dominate development and implementation of systems either in-vehicle or outside vehicle. OTA not only brings in the required agility to the overall feature release process it overall brings in the practicality and realizability of Software-Defined-Vehicles.

Architecturally speaking, service oriented E/E architecture will be future that has to be supported by domain controller based vehicle architecture as opposed to ECU based architecture. From security point of view, a high focus on the in-Vehicle and as well as off-vehicle security. From safety angle most current OTA implementations are rated at either QM (Quality Management) or ASIL B (Automotive Safety Integrity Level). Future OTA requirements on Gateways are likely to change from QM/B to ASIL C/D. Last but not the least, the all-important electrification of vehicles is going to boost further the focus on software defined vehicles and thus OTA.

It has been many decades in the making to transform from solely mechanics based vehicle to platform which relies on 4 core yet disruptive principles – autonomous, connectivity, electrification and smart mobility (ACES). The need to make OTA as fundamental in the overall connected strategy is felt across the industry. To match TESLA's extent of OTA, the automakers would have to add significant amount of flexibility in their vehicle architecture and adopt a win-win strategy that would be beneficial for customers, ecosystem and OEM itself. ❑

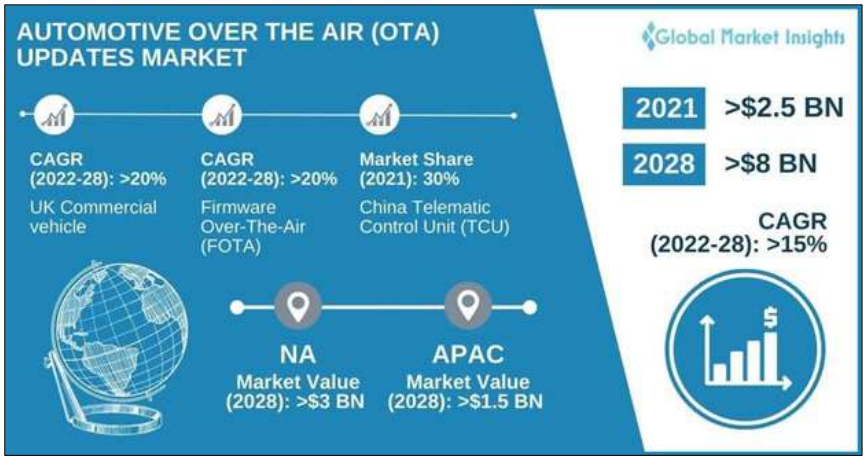


Figure 6: Automotive OTA Updates Market, Size Report 2028 (Source: GLOBAL MARKET INSIGHTS)

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Towards Seamless Edge Computing in Connected Vehicles

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ABSTRACT

Around the world, the share of vehicles with in-built connectivity is projected to increase from about 48% in 2020 to about 96% in 2030 with connected vehicle systems playing an important role in advanced features and functions in new vehicle launches. Recent advances on the Internet of Things (IoT), the Internet of Vehicles (IoV), and 5G networks have enabled the offering of value-added services in real-time that were hitherto difficult to accomplish. 5G networks supplemented with Multiaccess Edge Computing (MEC), Network slicing, and Task offloading enable connected vehicles to offer resource-intensive services and computing capability. Demand for good quality of service faces the dual challenges of the congestion of wireless networks and insufficient computing resources of edge servers in IoT, with the additional challenge of hi-speed vehicle movement in IoV. A potential solution incorporates the virtualization of an IoT/IoV platform with minimum functions to support specific IoT/IoV services and host the instance in an edge node. This architecture ensures that the network traffic for the end-user near the edge node need not traverse back to the cloud while the instance at the MEC node and the network slice located at the edge node provides the service. This assures low latency besides providing efficient management of IoT/IoV services at the edge node. Containerization is a lightweight virtualization solution for this network architecture because containers enable application and service orchestration and play a vital role to deal with Platform-as-a-Service (PaaS) clouds. Additionally, containers with their relatively smaller size and increased flexibility offer benefit over traditional virtual machines in the cloud. In the edge-cloud-enabled IoV architecture with virtualization using containers, vehicles requiring increased computation and large resources will be directed to communicate with the nearest edge node or a roadside unit (RSU), and the concepts of network slicing (NS), task offloading, and load balancing is applied for optimal resource utilization. Several simulations and experiments using sliced IoT/IoV functions in the MEC showed double the transmission time of the conventional cloud-based IoT/IoV platform with almost half the resource utilization.

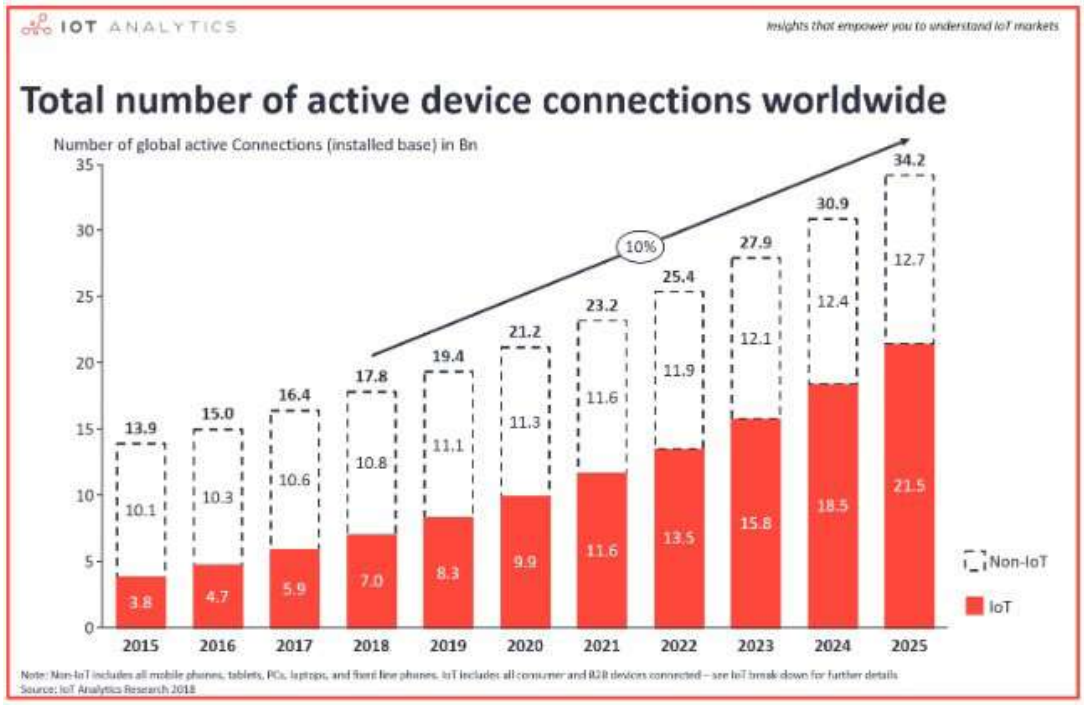

Figure 1: Growth of IoT and Non-IoT Devices in the past decade [1]

Introduction

The total number of active device connections worldwide has been growing y-o-y with IOT devices showing 2.6X growth from 2015 to 2020 and 2.1X growth estimated between 2020 and 2025, as can be seen in Figure 1 [1]. The connected vehicles are expected to account for about 96% of the total vehicle sales worldwide in 2030 from about 48% share

in 2020.

The billions of IoT devices need to be designed and developed and their associated data need to be tested using specific test cases associated with their industries or applications. This is a mammoth task requiring high bandwidth and low latency to support real-time IoT services. The current solution of distributed IoT architecture based on a centralized platform in the cloud will increasingly find it difficult to provide real-time services based on massive data processing and will impede the scaling up of the central IoT platform. Recent research has investigated offering solutions based on new technologies such as multiaccess edge computing (MEC) and Artificial Intelligence/Machine Learning (AI/ML) algorithms for more efficient data management and improved real-time service [2], [3], [4], [5]. The advent of 5G networks and the new network slicing (NS) technology allow catering to multiple IoT service requirements using the existing network infrastructure. The new techniques of Network Function Virtualization (NFV) and Software-Defined Networking (SDN) associated with 5G networks allow the implementation of flexible and scalable network slices on top of a physical network infrastructure. The integration of SDN and NFV enables increased throughput and the optimal use of network resources, which was hitherto impossible even with SDN or NFV applied individually. To realize the benefits of improved throughput and latency through the integration of SDN and NFV with network slicing on physical network infrastructure, the application server must be located at the edge node instead of a far-away location from the central cloud to have reduced round-trip time (RTT) for the messages from IoT devices to the server and back. In addition to having an architecture virtualizing the IoT common service functions and deploying them to an edge node, IoT resources and the associated services must also be delivered at the edge nodes. In scenarios where IoT services are running in the cloud-based IoT platform, despite IoT common service functions supported at the edge nodes, the message/data traffic from IoT sensors still needs to traverse back and forth to the IoT platform, thus increasing the latency and reducing the overall performance efficiency. Hence, it is important for IoT platforms running in the cloud to create and manage multiple virtual IoT services catering only to the necessary common service functions. Also, an important requirement for the edge nodes is that they should handle network slicing capabilities and serve the virtualized IoT service functions in addition to the resources representing IoT data and services.

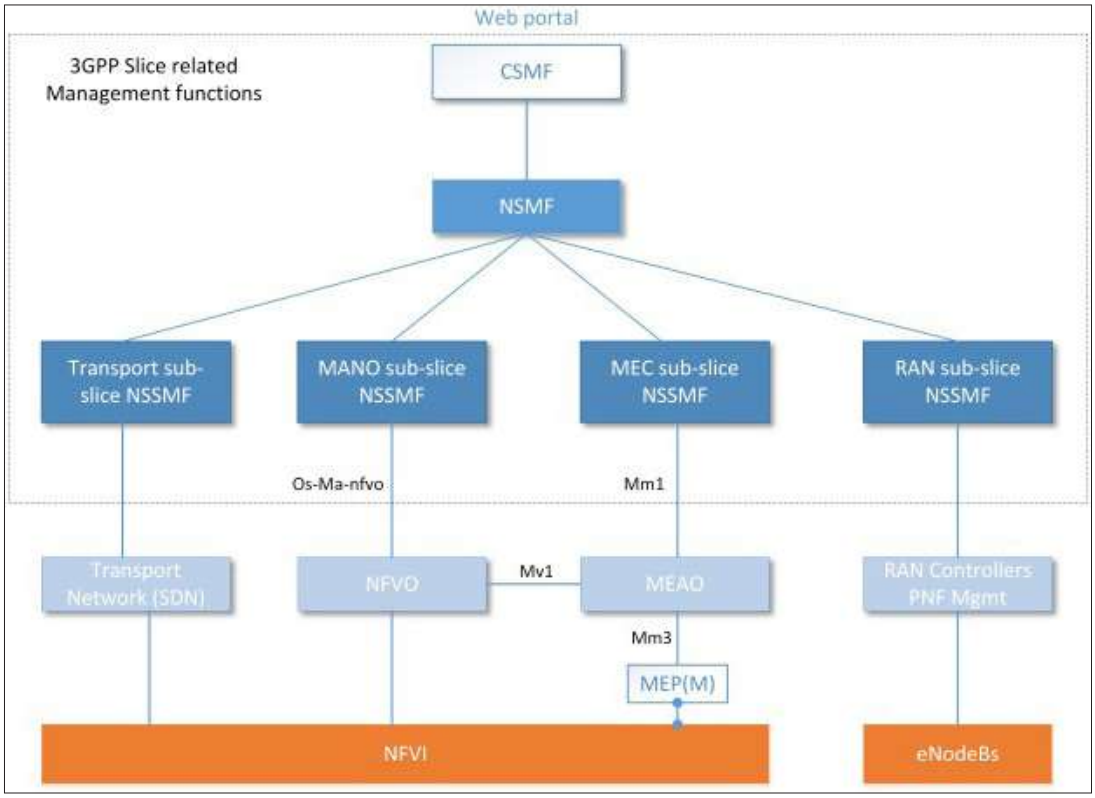

Figure 2: NS and MEC architecture in a 5G environment, as proposed in 3GPP [6]

To completely leverage the advantage of 5G networks, SDN, and NFV, the architecture must be designed to avoid network traffic traversing up and down from an IoT sensor or device to the application in the cloud. The cloud-based IoT platform must be designed to provide a common set of service functions such as registration and data management while edge computing at the edge nodes must cater to local data acquisition from the sensors, data processing, and decision-making. In specific IoT or IoV use cases requiring low latency (< 1 ms) and mission-critical services such as in industrial applications or connected vehicles, even if the networks are deployed closer to the end-users using SDN/NFV, it may not be possible to reduce the round-trip time (RTT) for the messages from an end IoT device or application to the central cloud platform.

In recent research, a novel IoT architecture was proposed with two distinct features; 1) the virtualization of an IoT platform with minimum functions to support specific IoT services and 2) hosting of the IoT instance in an edge node close to the end-user. In this architecture, low latency and high IoT service management at the edge node are assured because the message/data traffic for the end-user need not traverse back and forth to the cloud and the IoT instance provides its service at the edge node which is co-located with the MEC node with network slicing. Studies showed that the data transmission time in the new IoT architecture is halved

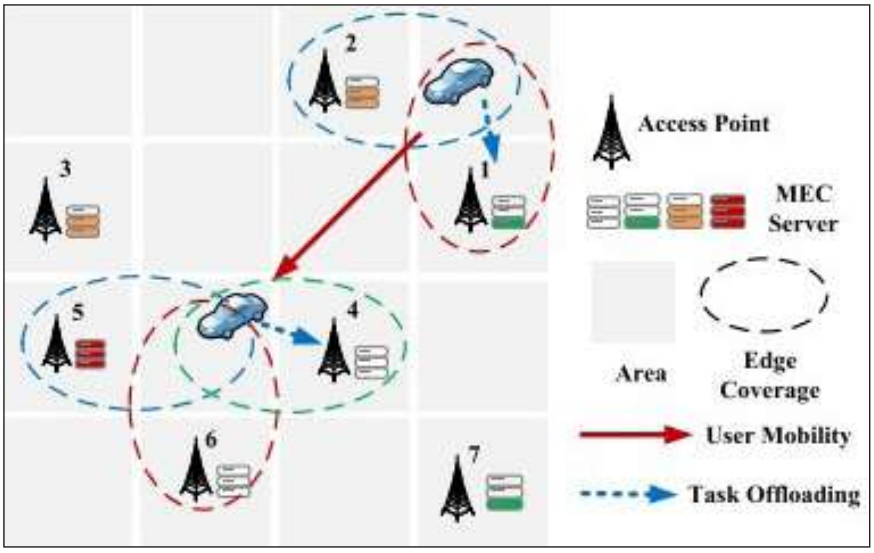

Figure 3: Dynamic Task Offloading in Vehicular Edge Computing [7]

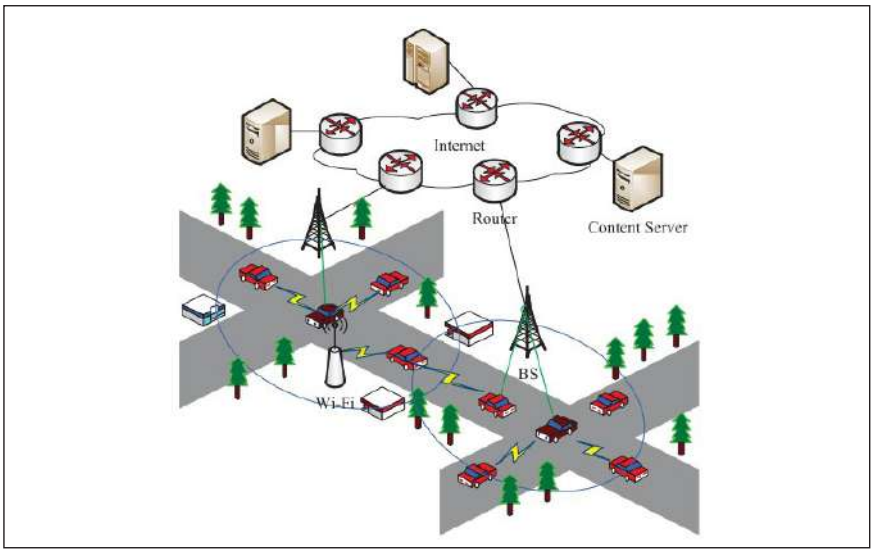

Figure 4: A schematic representation of data offloading system integrating cellular network and vehicular ad hoc networks [8]

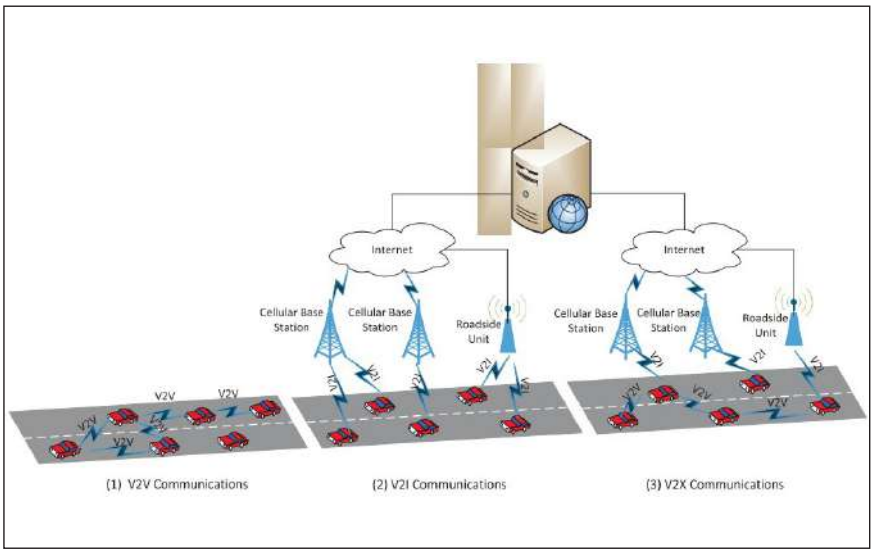

Figure 5: Different Data Offloading Techniques in V2X Communications [8]

compared to the conventional cloud-based IoT platform.

Recent developments in Connected Vehicles include the successful adaptation of 5G networks and SDN/NFV to provide Ultra-Reliable Low Latency Communications (URLLC). This is supplemented by Multiaccess Edge Computing (MEC) which enables vehicles to obtain network resources and computing capability in addition to meeting the ever-increasing vehicular service requirements.

In IoV architecture, the MEC servers are typically co-located with Roadside Units (RSUs) to provide computing and storage capabilities at the edge of the vehicular networks. The communications between the vehicles and the RSUs are enabled by small cell networks. An access point (AP) is provided at the local 5G base station (BS) where the edge servers are typically co-located. The vehicles or end-users can access the services through the AP at the BS through the edge server located nearby, which improves the latency for the IoT devices compared to the communication with a remote IoV cloud platform.

Network Slicing in Connected Vehicles

The increased computing power available within modern vehicles helps carry out numerous in-vehicle applications. However, specific requirements such as autonomous driving capabilities and new applications such as dynamic traffic guidance, human-vehicle dynamic interaction, and road/weather-based augmented reality (AR) demand powerful computing capability, massive data storage/transfer/processing, and low latency for faster decision-making. Recent research has provided a new IoT architecture comprising two core concepts:

network slicing and task offloading. Network slicing divides a physical network into a dedicated and logically divided network instance for providing service to the end-users. The NS and MEC architecture in a 5G environment, as proposed in 3GPP standards, is shown in Figure 2 [6]. Through the Network Slicing (NS) technology that comprises Software Defined Networking (SDN) and Network Function Virtualization (NFV), physical network infrastructure can be shared to provide flexible and dynamic virtual networks that can be tailored to

provide specific services or applications. The Network Slicing (NS) adopts network function virtualization (NFV) and enables the division of IoT/IoV services by functionality to offer flexibility and granular details for the execution of functions at the edge nodes. Each network slice is assured of the availability of network resources such as virtualized server resources and virtualized network resources. Network Slicing is visualized as a disparate and self-contained network in the context of connected vehicles as outlined in the 3GPP standards, to provide specific network capabilities akin to a regular, physical network. Each network slice is isolated from other slices to ensure that errors or failures that may occur in a specific network slice do not impact the communication of other network slices. From the vehicle-to-everything (V2X) perspective, NS helps to come out with specific use cases such as cooperative maneuvering, autonomous capabilities, remote driving, and enhanced safety. Some of these test cases have conflicting and diverse requirements related to high-end computing, latency, dynamic data storage and processing, throughput, and reliability. Using NS, one or more network slices can be designed and bundled to support multiple conflicting V2X requirements and concurrently provide Quality of Service (QoS).

Task Offloading in Connected Vehicles

A schematic of dynamic task offloading in vehicular edge computing is shown in Figure 3 [7] which contains multiple network access points around the moving vehicles. As the vehicle moves from the top right corner to the new position in the direction indicated by the arrow, the task units (TUs) are initially offloaded to the edge server numbered 1, close to the initial position of the car. To maintain the Quality of Service (QoS) during the movement of the vehicle, the unfinished TUs need to be offloaded to a new edge server (either 4 or 5 or 6) close to the new position of the car. A similar concept of data offloading integrated with cellular networks and vehicular ad hoc networks is shown in Figure 4 [8].

Recent studies propose the concept of IoT/IoV task offloading along with Network Slicing to provide similar quality of services at the edge nodes by creating IoT/IoV

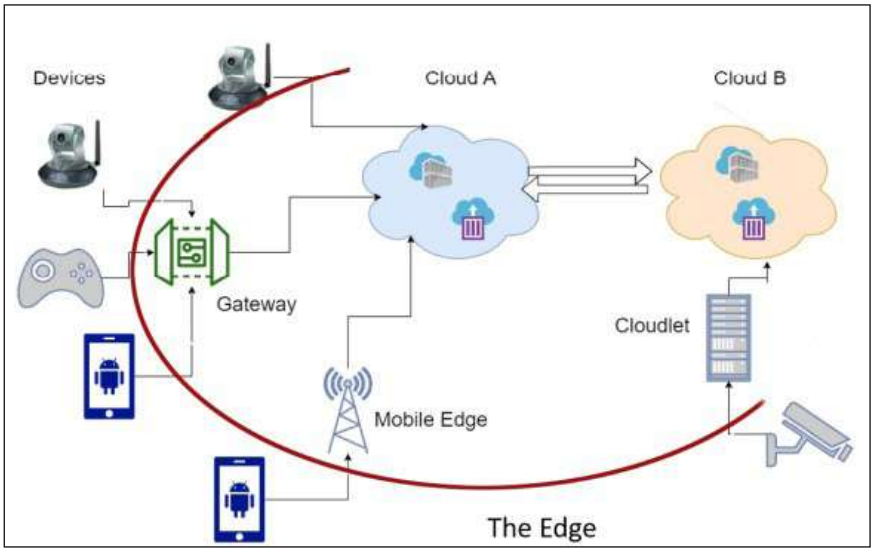

Figure 6: A representative Cloud Infrastructure [3]

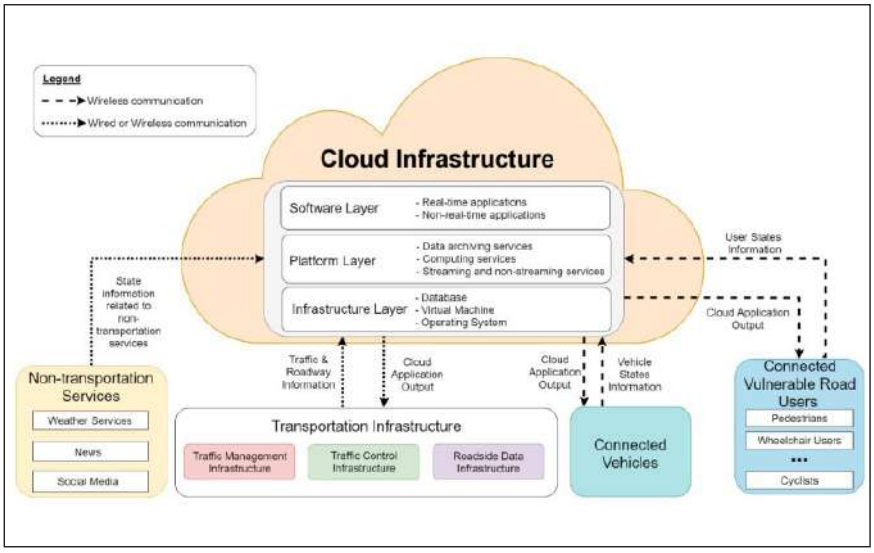

Figure 7: Cloud-based Architecture for Connected Vehicles [9]

resources that are typically operated in the central cloud platform. As shown in Figure 5 [8], multiple technologies have evolved in V2X communications on task offloading and load reduction in wireless communication networks. The task offloading is segregated into three categories: 1) through V2V communications, 2) through V2I communications or 3) through V2X communications (a hybrid of multiple methods). Through the deployment of both IoT/IoV service slice and 5G network slice at the same edge node close to the end-users, IoT/IoV functions and services can be provided seamlessly and efficiently with significantly reduced latency time (up to half the earlier value) for data or message transmission. For carrying out increasingly complex and powerful computations requiring large data storage resources in modern vehicular communication networks, edge computing nodes hosted at wireless 5G new generation nodes (gNBs) or roadside units (RSUs) are utilized with network slicing and resource-optimal load balancing concepts duly applied. This concept uses the NFV framework to manage the data, balances the loads between various slices per node, and supports multiple edge computing nodes, resulting in savings of up to 48% in resources.

Edge Computing

In a cyber-physical system (CPS), the edge is likely to be the system to which IoT devices are connected. An infrastructure able to support different kinds of edge applications (given the above definition

of the Edge), might be quite complex. A representative complex cloud infrastructure is shown in Figure 6 [3] with heterogeneous varieties of IoT devices, multiple clouds, gateways, mobile base stations, and cloudlets. To realize the benefits of Edge Computing and leverage the ultra-low latency and ultra-high reliability of 5G networks with little impact on security and data privacy, it is imperative to move the physical infrastructure elements closer to where the data needs to be processed. The value chain in edge computing is being transformed into a value network through enhanced connectivity and 5G network availability aided by new applications and services such as Artificial Intelligence (AI), IoT, and IoV, and the demand to provide service and data/messages in real-time with low latency and ultra-high reliability.

A cloud-based architecture for connected vehicles is shown in Figure 7 [9] that combines both wired and wireless communications and presents the integrated cloud services connecting non-transportation units (NTUs), traffic management and control, roadside infrastructure, connected vehicles, and vulnerable road users (VRUs). As the number of connected vehicles increases dramatically in the next decade with an increasing amount of data such as Telematics, Infotainment, Location-based services, etc., it puts enormous strain on the underlying mobile networks, justifying the combination of 5G networks and Multiaccess Edge Computing (MEC). Embedded edge computing in the vehicles is the need of the hour as it provides a framework for an increasing number of connected vehicles and associated large data transfer and processing in the existing networks. For a cost-effective solution, the commercial cloud and the associated hardware and software provide a viable option. The cloud architecture shown in Figure 7 comprises an infrastructure layer, a platform layer, and a software layer [9]. The bottom infrastructure layer provides infrastructure-as-a-service (IaaS) to the cloud users and application developers in the form of server instances (virtual machines) through hardware components besides database resources and operating systems. The middle platform layer provides a worry-free underlying infrastructure and forms the basis for platform-as-a-service (PaaS) by enabling developers to build applications using multiple cloud services including streaming, and non-streaming, computing, and database management. The top software layer provides the software-as-a-service (SaaS) to the developers who can upload the data from NTUs or transportation infrastructure or connected vehicles or VRUs (Figure 7), deploy their applications in the cloud, and monitor/analyze the output from the applications running in the cloud.

Depending upon the needs of connected vehicle applications and the requirements, the cloud-based architecture shown in Figure 7 can operate in real-time or non-real-time. The cloud services must meet the Quality of Service (QoS) agreements through compliance with the computing and latency requirements. Besides, for efficient real-time cloud services of connected vehicles, the components of the architecture must meet the requirements related to real-time cloud computing, real-time data transmission, and data archiving. A reference edge computing platform consisting of a device layer, edge cloud layer, network layer, back-end layer, and application layer is shown in Figure 8 [10].

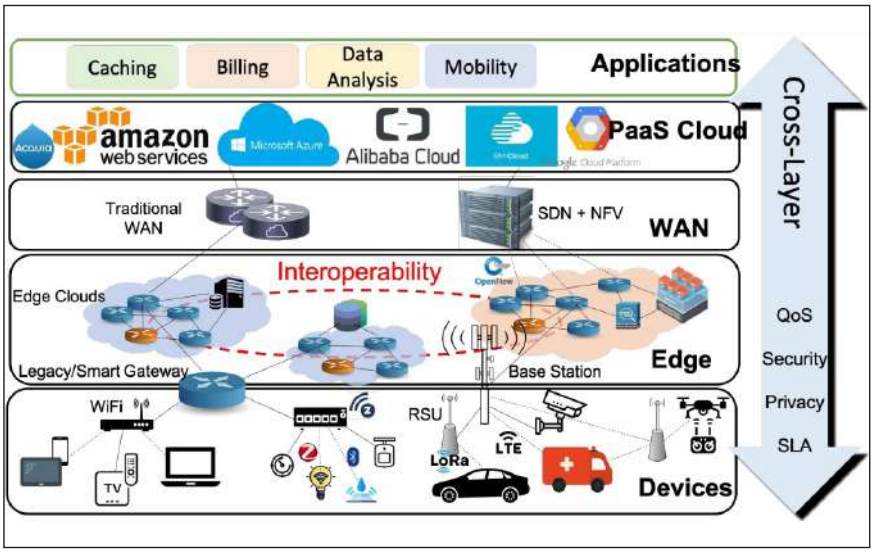

Figure8: Reference architecture of edge computing platforms [10]

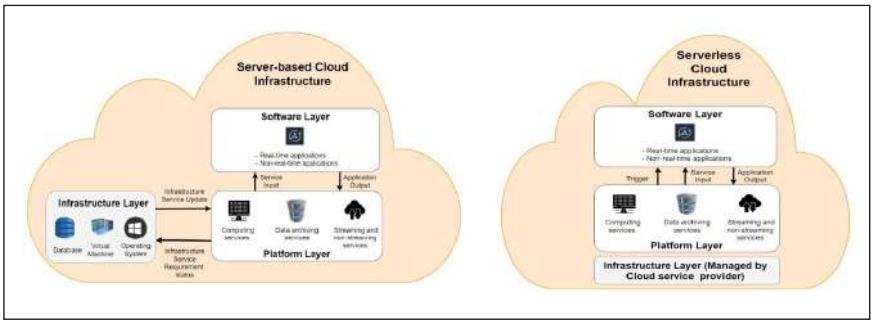

Figure 9: Cloud Infrastructure: (a) Server-based and (b) Serverless [9]

Real-time Cloud Computing

Real-time cloud computing in a cloud-based connected vehicles application involves multiple activities such as data acquisition from IoT devices, data uploading from the database, data processing, and message/data downloading while meeting the latency requirements. A server-based architecture mandates application developers to establish a cloud server instance to carry out their computing needs. This in turn demands significant expertise, cost, and time for hardware setup and virtual environment configuration. Additionally, this arrangement is not conducive to the dynamic scaling of computing resources to meet the varying demands. To meet these challenges, a new "serverless cloud computing architecture"

has emerged that not only provides relief to the application developers from the burden of setting up or configuring the hardware and virtual environment and gives them the opportunity to exclusively focus on application development but also scales up dynamically to allocate resources for application development with no additional requests or intervention from the developers. As serverless architecture is not burdened with the cumbersome, expensive, and time-consuming establishment and maintenance of server instances, it quickly evolved into a cost-effective alternative to server-based computing.

The details of and important differences between server-based and serverless cloud computing are provided next. The cloud infrastructure shown in Figure 9 can be segregated into two types: server-based as shown in Figure 9 (a) or serverless as shown in Figure 9 (b).

Server-based Cloud Computing

For a real-time or a non-real-time cloud computing application, developers need to establish a cloud server instance, in the commercial cloud, to begin with, as shown in Figure 9 (a) [9]. For a given application, the server instance calls for the configuration of dedicated or virtualized hardware (e.g., CPU, storage, memory), operating systems (OS), and software coding platforms (e.g., language environment, compilers, libraries). The Application Programming Interface (API) helps the applications interact with other cloud services, to carry out different functionalities. Though it is possible for the developers to customize the computing capabilities to meet specific demands, they are required to be experts in configuring and maintaining server instances and spend a sizeable amount of time and effort on this. Further, the potential wastage of computing capacity is high in the case of server-based cloud computing if specific applications need fewer resources because it is not scalable.

Serverless Cloud Computing

In the case of serverless cloud computing, as shown in Figure 9 (b) [9], the application developers a) are not required to establish server instances, b) can focus solely on application development, and c) are relieved of the burden of creating, configuring, maintaining, and operating the server instances. This architecture supports multiple programming languages such as Python, .NET, Java, and Node.JS. The applications in serverless cloud computing are typically configured to get activated automatically based on specific triggers such as input data availability, database update service, or actions of other cloud services and are active till the task is completed. Upon task completion, the commercial cloud automatically releases the computing resources, to enable dynamic scaling depending on varying loads. This results in a more efficient and cost-effective cloud architecture with additional savings on time and effort.

Function as a Service (FaaS), also known as serverless computing, allows developers to upload and execute code in the cloud easily without managing servers and by making hardware an abstraction layer in cloud computing [11], [12], [13]. (FaaS) computing enables developers to deploy several short functions with clearly defined tasks and outputs and not worry about deploying and managing software stacks on the cloud. The key characteristics of FaaS include resource elasticity, zero ops, and pay-as-you-use. Serverless cloud computing frees the developers from the responsibility of server maintenance and provides event-driven distributed applications that can use a set of existing cloud services directly from their application such as cloud databases (Firebase or DynamoDB), messaging systems (Google Cloud Pub/Sub), and notification services (Amazon SNS). Serverless computing also enables the execution of custom application code in the background using special cloud functions such as AWS Lambda, Google Cloud Function (GCF), or Microsoft Azure Functions. Compared with IaaS (Infrastructure-as-a-Service), serverless computing offers a higher level of abstraction and hence promises to deliver higher developer productivity and lower operating costs. Functions form the basis of serverless computing focusing on the execution of a specific operation. They are essentially small software programs that usually run independently of any operating system or other execution environment and can be deployed on the cloud infrastructure triggered by an external event such as a) change in a cloud database (uploading or downloading of files), or b) a new message or an action scheduled at a pre-determined time, or c) direct request from the application triggered through API. There could be several short functions running in parallel independent of each other and managed by the cloud provider. Examples of events that trigger the functions can also include an interface request that the cloud provider is managing for the customer for which the function could be written by the developer to handle that certain event.

In serverless computing, functions are hosted in an underlying cloud infrastructure that provides monitoring and logging as well as automatic provisioning of resources such as storage, memory, CPU, and scaling to adjust to varying functional loads. Developers solely focus on providing executable code as mandated by the serverless computing framework and have the flexibility to work with multiple programming languages such as Node.js, Java, and Python that can interface with AWS Lambda and Google Cloud Function, respectively [11], [12]. However, developers are completely at the mercy of the execution environment, underlying operating system, and runtime libraries but have the freedom to upload executable code in the required format and use custom libraries along with the associated package managers. The fundamental difference between functions and Virtual Machines (VMs) in IaaS cloud architecture is that the users using VMs have full control over the operating system (OS) including root access and can customize the execution environment to suit their requirements while developers using functions are not burdened with the cumbersome tasks of configuring, maintaining, and managing server resources. Functions essentially serve individual tasks and are typically short-lived till execution, unlike the long-running, permanent, and stateful services. Hence, functions are more suitable for high throughput computations consisting of fine granular tasks, with serverless computing offering cost-effective solutions compared to VMs [11], [12], [13].

Recently, novel architectural concepts have been proposed that virtualize IoT/

IoV common service functions to provide services at the edge nodes close to the end-users. Further, studies indicate the benefit of edge computing through the offering of virtualized IoT services at the same edge node with a 5G network slice to achieve higher throughput and lower latency and reduce RTT by half compared to the earlier concept.

Serverless Computing -- Scalability

In a real-world dynamic situation of connected vehicles with peak and lean periods of traffic and changing road and weather conditions, the associated cyber-physical system (CPS) must also scale automatically. Even though serverless cloud computing is known to be automatically scalable, limitations are introduced by the underlying commercial cloud service providers (e.g., AWS, Azure, Google Cloud) who set upper limits on memory usage, limiting the support for a large-scale CPS in real-time. To overcome this, a concept is proposed wherein the functions handling traffic and connected vehicles operate in parallel to improve the throughput so a large amount of data could be handled without compromising on the latency requirements [11], [12].

IoT Function Modulization using microservice and virtualization

One of the first steps toward offering IoT/IoV services through network slicing is the modulization of the IoT/IoV platform. As per current practice, a centralized cloud service deploys almost all the IoT service functions such as device management, registration, and discovery. This poses a challenge for users expecting different types of IoT services, computational resources, and modularized IoT functions at the edge. This can be addressed by dividing the IoT platform into multiple small components to modularize it and offer microservices, which can be deployed, scaled, and tested and improves the efficiency and agility of services and functions. The modulized IoT functions thus provide a flexible and agile development environment by independently deploying software and reducing dependency on the centralized cloud.

Container Technologies

Recent developments have resulted in a container-based architecture where packaged software in containers enables easier deployment to heterogeneous systems as a virtual OS and file system executing on top of the native system [11], [12]. Container technologies enable the code to be portable so it can run properly and independently irrespective of the hardware architecture or operative system structure on which it is running. Containers thus allow developers to test the code on separate development machines and upon successful run can deploy it in the IoT platform to run with other functions. Containers provide multiple advantages including fast start-up time, low overhead, and good isolation because developers are required to build, compile, test, and deploy only once in the virtualized platform. The virtualization layer takes the responsibility of translating the actions inside the container for the underlying system, without burdening the developers. Further, the containers provide an isolated sandbox environment for the programs residing in them. Hence, the developers find it easier to work with containers that can be constrained relatively easily than programs running on the native platform. Also, because a container is essentially an isolated sandbox, any spurious software or malware that may have affected the container may not impact the rest of the applications. In an application or a software stack, we can have an overseeing container orchestration framework that controls multiple containers (sandboxes) running in parallel without one container affecting the other and can easily deploy and manage large container-based software stacks. Though a sandbox running software in containers involves virtualization and isolation, the drawback is it reduces the performance due to additional software overhead, which may not be a hindrance on high-performance computing (HPC) machines but may impact IoT devices with edge computing. Still, containers with virtualization of multiple platforms and services, are a preferred choice among software developers with Docker and WebAssembly (Wasm) finding increasing acceptance by a large SW community to implement microservices. Though Docker is currently the dominant container technology, its shortcomings include large and complicated systems and limitations while running on hardware-constrained IoT devices. WebAssembly containers, though relatively new, appear to be a promising solution for running small

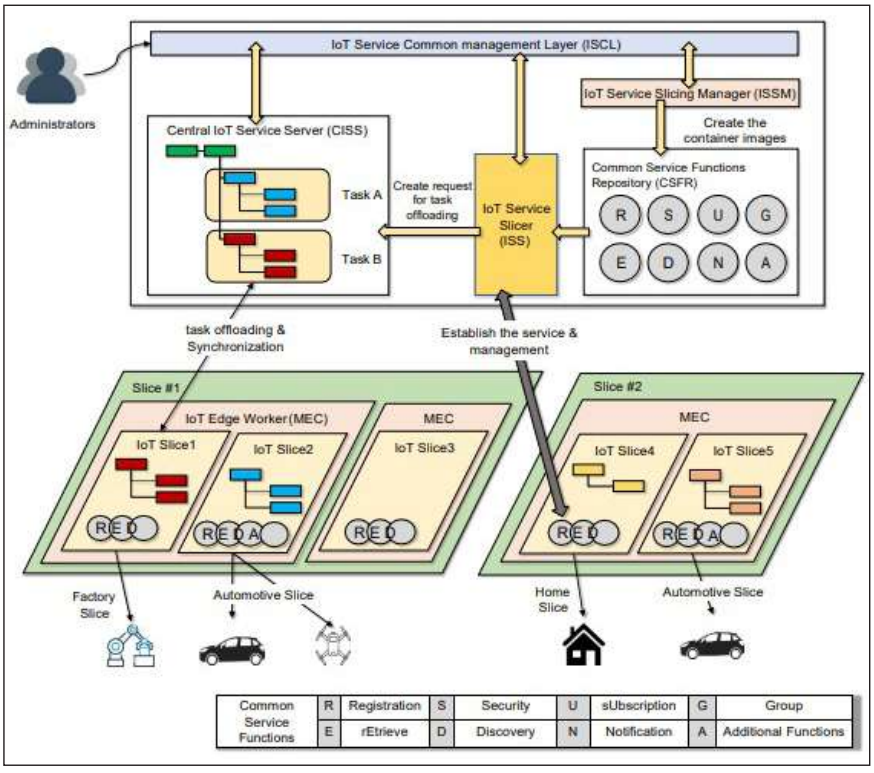

Figure 10: Reference architecture for IoT network slicing and task offloading [14]

lightweight containers and are better suited for hardware-constrained IoT devices in edge computing with simpler runtime. Additionally, many SW developers across the world using 5G networks acknowledge Kubernetes as an open-source container orchestration system for efficient management of operational resources and scalability as per varying load demands [11], [12], [13].

Multiaccess Edge Computing combined with Network Slicing & Task Offloading

As the number of IoT devices has been significantly increasing y-o-y, the European Telecommunications Standards Institute Multiaccess Edge Computing (ETSI MEC) industry specification group (ISG) has been working on standards development, use cases, architecture, and application programming interfaces (APIs) to overcome the latency challenge and assure ultra-high reliability during real-time services in connected vehicles, smart cities, smart factories, etc. ISG is also working on creating an open environment to provide a vendor-neutral MEC framework and defining the MEC APIs for IoT systems.

Figure 10 shows a reference architecture for IoT network slicing and task offloading [14]. As explained earlier, using the concept of network or service slicing, the common service functions of the IoT platform can be modularized into small microservices and deployed at the edge nodes. Here, only the necessary IoT microservices are selected as required to create a virtual IoT platform instance and deploy it towards the edge nodes. This improves the efficiency as each IoT service slice is optimized for a specific use case and provides scalability in providing multiple IoT services as required. The IoT platform in Figure 10 [14] depicts a Resource-Oriented Architecture (ROA) wherein task offloading is carried out through the transfer of necessary IoT resources from the cloud to the edge nodes for executing the requested service.

As shown in Figure 10 [14], there are multiple service requests (Home, Automotive, Drone, Factory, etc.) that may need low latency. The IoT platform checks as to which IoT common service functions

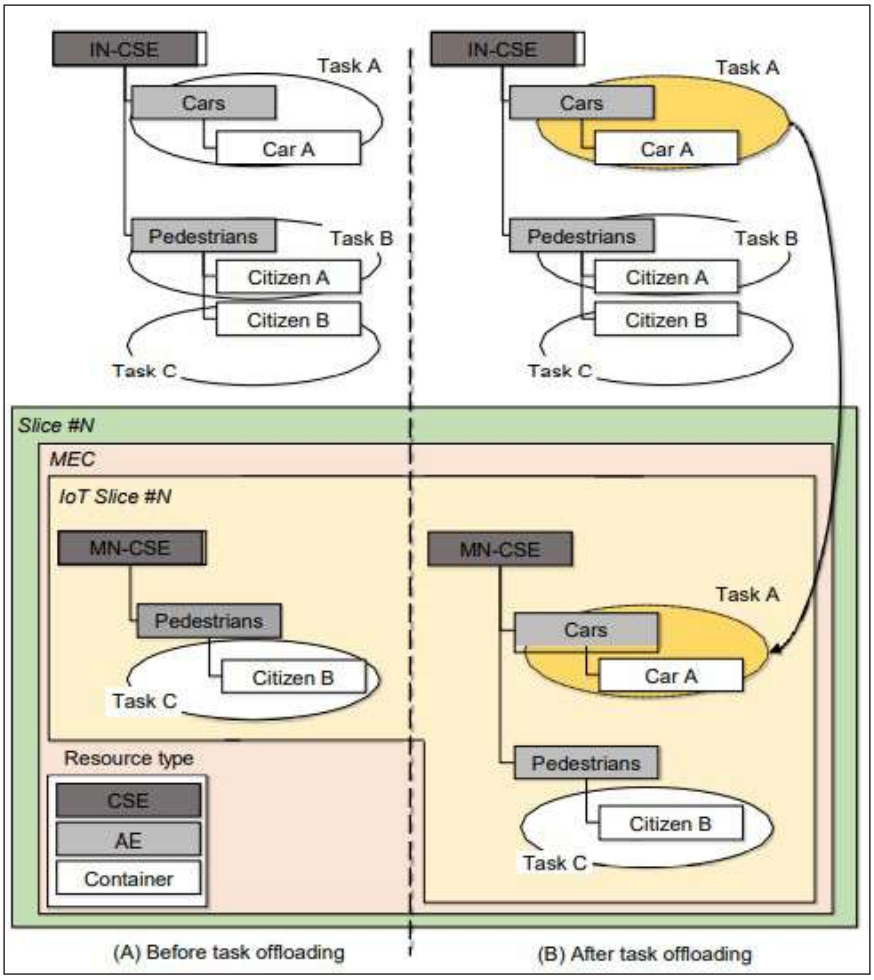

Figure 11: IoT Task Offloading Comparison [14]

are required to satisfy the requests from different IoT devices and accordingly assigns an IoT slice that contains the required micro common IoT service functions. The IoT platform then checks the availability of MEC nodes around the specific IoT device and selects one MEC node to host the instantiated IoT slice. Next, the IoT platform offloads the resources to the MEC node to execute the service requested by the IoT device, thus, fulfilling both IoT network slicing and task offloading.

For the effective realization of MEC and offering of services at the edge nodes, it is imperative to carry out network slicing and task offloading as well as data transfer & processing and containerization of IoT functions at the edge nodes. A task is identified as a set of resources representing physical infrastructure, sensors, RSUs, etc. with associated data. Upon identification of a suitable edge node to serve a sliced IoT platform, task offloading must be carried out to place the relevant resources required to support the service at the edge node. Figure 11 [14] shows a use case of connected vehicles operating in a smart city wherein messages about pedestrians crossing a crosswalk are passed onto the cars reaching the intersection by comparing two scenarios, before and after task offloading. In Figure 11 (a), task A (car A) and task B (pedestrian citizen A) are assumed to be running on the central IoT cloud platform while task C (pedestrian citizen B) is assumed to be running the edge node. Pedestrian citizen B will experience edge-based IoT services. To meet specific latency requirements, it is imperative for the central IoT cloud to offload the tasks from the cloud to the edge gateway, with resource reorientation containing CSE (Common Service Entity), AE (Application Entity), and Container changed to the structure as shown in Figure 11 (b). Now, car A can have faster IoT services than in the earlier case due to reduced latency. Similar use cases for connected vehicles involving microservices at the edge nodes need to

be prepared, as per the guidelines given for MEC by ETSI.

IoT Service Slicing based on Microservices

It is generally believed that if the edge nodes have enough CPU and memory resources then the deployment of an IoT service platform that supports all common service functions at the edge nodes is relatively easy. The challenge is in providing granular IoT services at the edge nodes with limited CPU and memory resources using slicing and task offloading based on microservices. The advantages of a microservices-based IoT platform include a) less complexity to reboot the system especially the microservices at the edge nodes in case of unexpected errors, b) no subscription or notification functionalities in hardware for seemingly simple tasks at the edge nodes such as temperature or voltage measurement, and c) no stringent latency requirements for some IoT services such as smart homes [14]. Though different IoT services have different latency and computation requirements they can be operated on the same edge nodes. To ensure the highest Quality of Experience (QoE) to the end-users the IoT service must be designed to dynamically handle the varying resource requirements (latency and computation) at the edge nodes against assigning similar resources for seemingly simple tasks, leading to inefficiencies.

IoT Service with inherent Trust and Security using Blockchain

In the IoT platform offering microservices, in line with the Blockchain framework that uses a decentralized public ledger, the data is stored at the edge nodes on the network in a block structure logically connected to each other based on the hash value. To prevent and protect against security breaches, data forgery, data alterations, and cyberattacks that may compromise data and privacy, the entire network is populated with these data blocks which are copied and shared along with the blockchain system [14]. A MEC framework with network slicing and task offloading may experience multiple security challenges due to a) heterogeneous data transfer across different IoT stakeholders and organizations, b) unauthorized access to private data, and c) data replication or unauthorized publishing of data. The heterogeneous data transfer is handled through transparent and secure collaboration with other servers or applications. The issues of data privacy and duplication or unauthorized publication arise due to the separation of ownership and control of data and the outsourcing of complete or partial responsibility when data gets transferred between edge nodes or the data center in the cloud. Any compromised data poses challenges due to highly changing dynamic situations at the IoT nodes and the openness associated with edge computing, posing serious compromises to data integrity, or allowing hackers to access/modify the data. These issues can be resolved using the blockchain technology that connects MEC instances together with the IoT platform to increase the trust among IoT service slices.

Certain IoT platforms with network slicing and Blockchain support a resource to control access rights which in turn allows storing the authentication key value generated internally to be used for device authentication. Before an IoT platform responds to a service request, it checks the authentication key value for a match with the stored values. However, the IoT platform still needs to verify the reliability of data exchanged among the edge nodes and ensure it is not tampered with or compromised on privacy or published without proper authorization. In this regard, an IoT device that utilizes the services from the edge nodes or data on the IoT device or cloud interface needs to carry out a synchronization mechanism and data blockchain using blockchain. .

As shown in Figure 12, the edge computing architecture can offer more secure and trustworthy services by incorporating blockchain into the edge nodes where data are processed locally. As the IoT devices, edge nodes, service instances, and the cloud are connected within the same blockchain network, trustworthy data transfer and information exchange are assured by a consensus mechanism used in blockchain technology. The MEC-enabled blockchain for IoT slicing and task offloading shown in Figure 12 supports information and data storage and distribution to the connected blockchain entities.

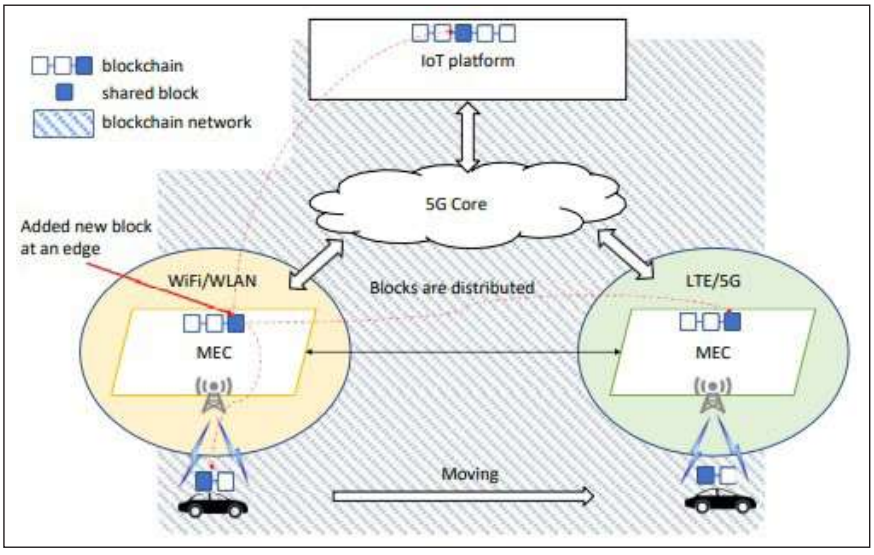

Figure 12: MEC enabled blockchain for IoT slicing and task offloading [14]

Conclusion

With a multifold increase in the number of IoT devices in billions supported by advances in IoT technology, numerous value-added services are being offered as new possibilities. New technologies such as MEC along with network slicing and task offloading enhance the possibilities for IoT to offer further advanced services in real-time. As the launch of 5G networks has opened new avenues of use cases and business opportunities by offering low latency and ultra-high reliability among other advantages, the conventional IoT service platforms in the cloud may still fall short of providing real-time services efficiently with billions of IoT devices. Comparisons and advantages between

server-cloud and serverless cloud computing have been provided followed by a detailed explanation of Container technologies and the concept of IoT service slicing based on microservices. Recent studies have extended the reference architecture of MEC to include containerization toward serverless edge computing successfully combining network slicing and task offloading in the form of improved latency. This has been further enhanced through blockchain at the edge nodes, IoT devices, and service instances using which ensures trustworthy data transfer and information exchange.

Future Work

One of the aspects of future work would be the optimization of Quality of Service (QoS) in terms of latency, security, and range of services at the IoT edges while taking into consideration the network availability, network slicing, and task offloading. Future research should also evaluate the relative performance of the serverless and server-based cloud architecture for Connected Vehicle applications in terms of cost, reliability, RTT, and security in a real-world scenario in different parts of the world, as per 3GPP and ETSI recommended use cases. Another potential opportunity for future research includes a comparison of different commercial cloud service providers such as Microsoft Azure, GCP, and AWS while applying different use cases on connected vehicle applications in real-world traffic and driving conditions. The use case evaluation on connected vehicles should also include exclusive tests on cybersecurity in connected vehicle applications with serverless computing at the edge nodes such as identity protection, data privacy, authentication, data integrity, unauthorized data publishing, etc. Future work may also include variability of network connections through drones or unmanned aerial vehicles in remote areas to study the impact on QoS of connected vehicles especially augmenting Advanced Driver Assistance Systems (ADAS) such as collision avoidance, and frontal collision warning, lane departure warning, etc. The dynamic management of containers by using AI technologies and comparison of virtualization of microservices at the edge nodes based on effective containerization is also another potential area of future research. ❑

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The Future of Vehicle Security in India, Why It's Important to Stay Ahead of the Curve

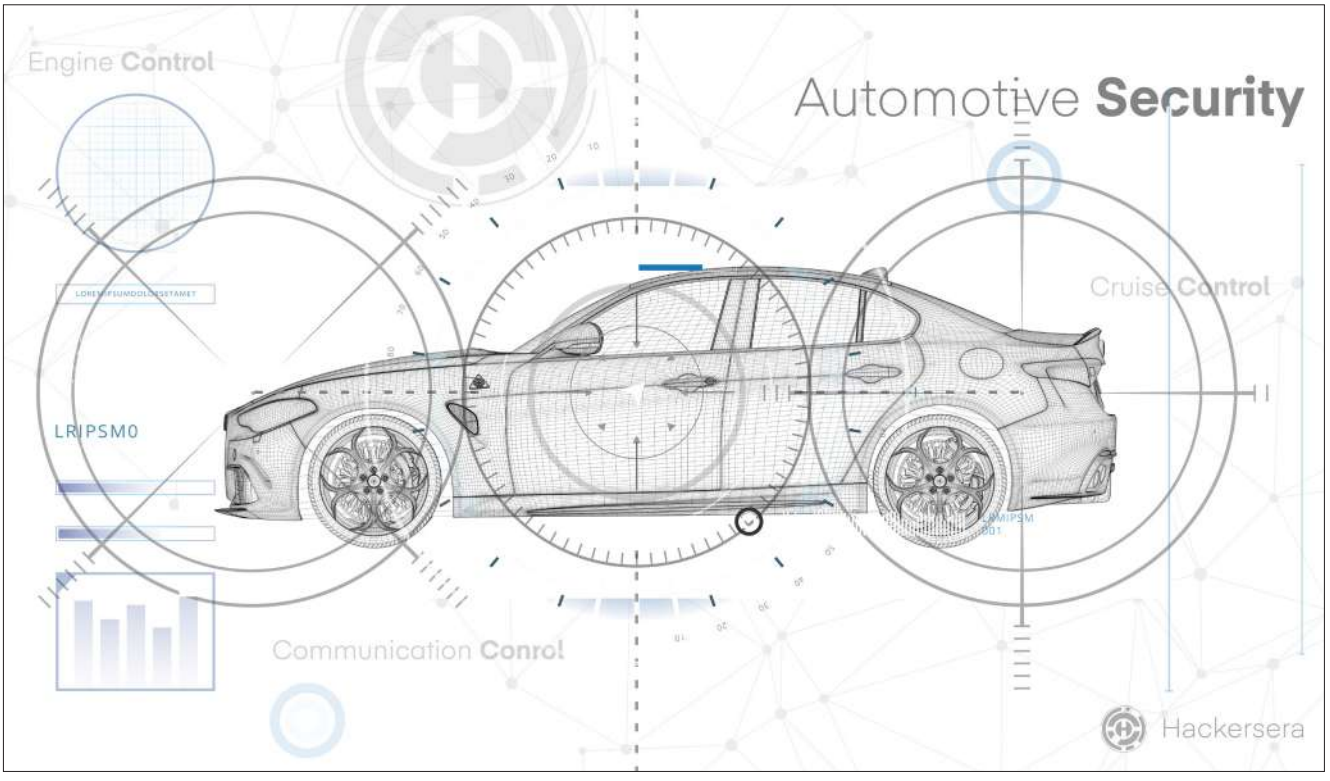
VIKASH CHAUDHARY
HackersEra India Pvt Ltd

India, with a fast-growing population of 1.3 billion and an economy that is expected to grow at 7.4% for the next four years, is experiencing one of the largest economic expansions in history. With all this growth comes a rapid change in lifestyle and way of life, which also includes a leap forward in automobile ownership. For example, India has seen a 50% increase in car sales over the past five years and the number of motorcycles has increased by 200 million in just six years' time. The country's automotive industry is worth $140 billion and there are over 20 different automotive companies operating in India today.

Introduction: The Current State of Vehicle Security in India

The current state of vehicle security in India is not good. There have been several high-profile cases of car theft and hijacking in recent years, and the situation does not seem to be improving. This is a cause for concern for many reasons, not least of which is the fact that cars are becoming increasingly sophisticated and expensive. If criminals can easily steal or hijack vehicles, it stands to reason that they will also be able to target other valuable assets such as jewellery, art or even homes.

This is why it is so important to stay ahead of the curve when it comes to vehicle security. There are a number of ways to do this, but one of the most important is to choose a good car alarm system. A good alarm system will deter thieves and make it more difficult for them to steal your vehicle.



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It is also worth considering other security measures such as immobilisers and GPS tracking devices.

By taking steps to improve the security of your vehicle, you can help to protect yourself and your belongings from crime. In a country like India where car theft and hijacking are becoming more common, it is vital to do whatever you can to stay safe.

Threats Posed by Cyber Criminals to the Automotive Industry

The automotive industry is under constant threat from cyber criminals. These criminals are constantly looking for new ways to exploit vulnerabilities in vehicles and steal sensitive data. In India, the future of vehicle security is likely to be even more at risk due to the rapid growth of the automotive market and the increasing reliance on connected and automated vehicles.

There are a number of ways that cyber criminals can target vehicles. One common method is through the use of malware. This can be installed on a vehicle's infotainment system or other connected devices and used to gain access to the vehicle's controls or to steal sensitive data such as personal information or financial details.

Another way that cyber criminals can target vehicles is through hacking into the vehicle's systems remotely. This could allow them to take control of the vehicle or disable critical systems such as the brakes or engine. This type of attack could have devastating consequences if it was carried out on a large scale, such as during a mass transit incident.

The best way to protect against these threats is to stay ahead of the curve by keeping up with the latest security updates and developments. Automotive manufacturers and suppliers need to work together to ensure that vehicles are equipped with the latest security features and that they are constantly

India's Stance on Car Hacking & What Can Be Done To Prevent It

The Indian government has been working hard to stay ahead of the curve when it comes to vehicle security. In the wake of the recent spate of car thefts and attacks, the government has beefed up security measures and instituted new regulations to help keep drivers and their vehicles safe. Here are some of the things you can expect to see in the future:

- More stringent vehicle safety standards: The government is looking to make it mandatory for all new vehicles to meet certain safety standards, such as anti-theft devices and GPS tracking.
- Improved public transportation: To reduce the reliance on private vehicles, the government is investing in better public transportation options, such as metros and buses.
- Greater awareness campaigns: To educate drivers about the importance of vehicle security, the government will be launching awareness campaigns that will offer tips on how to protect your car from thieves.

Why are Security Assessments Necessary for Vehicle Manufacturers?

In recent years, the automotive industry has been plagued by a number of high-profile security breaches. In 2015, Jeep was the victim of a particularly damaging attack that saw hackers gain control of the vehicle's systems and disable its brakes.

This incident served as a wake-up call for the industry and highlighted the importance of security assessments for vehicle manufacturers. By conducting regular security assessments, manufacturers can identify potential vulnerabilities in their systems and take steps to mitigate them.

Security assessments are not just a good idea for vehicle manufacturers - they are essential. With the ever-evolving threat landscape, it is essential for manufacturers to stay ahead of the curve and ensure that their vehicles are secure.

Security Standards for the Automotive Industry in India

The automotive industry in India is one of the fastest growing industries in the world. With the increasing demand for vehicles, the need for improved security standards is also on the rise. Here are some of the security standards that the industry is currently working on:

1. ISO/TS 16949 – This standard was introduced in 2009 and specifies the requirements for quality management systems in the automotive industry. It helps to ensure that products and services meet the customer's expectations.
2. ISO 26262 – This standard deals with functional safety in road vehicles. It was introduced in 2011 and covers all aspects of design, production, service and disposal of vehicles.
3. IEC 61508 – This standard deals with electronic safety systems in vehicles. It was introduced in 2010 and covers all aspects of design, production, service and disposal of vehicles.
4. SAE J3061 – This standard deals with cybersecurity for connected and automated vehicles. It was introduced in 2016 and covers all aspects of design, production, service and disposal of vehicles.

The automotive industry is constantly evolving and so are the security standards. It is important for companies to stay up-to-date with the latest standards to ensure that their

How to Conduct a Security Assessment for Vehicles?

As the number of vehicles on Indian roads continues to grow, so does the need for effective security measures. Vehicle security is a complex issue, and one that requires a multi-faceted approach. In order to stay ahead of the curve, it is important to understand the various risks and vulnerabilities associated with vehicles, and to put in place suitable mitigation strategies.

One of the first steps in ensuring vehicle security is to conduct a security assessment. This assessment should aim to identify potential risks and vulnerabilities, and to recommend suitable mitigation measures. There are a number of factors to consider when conducting a security assessment for vehicles, which we have outlined below:

- **The type of vehicle:** Different types of vehicles will have different security risks and vulnerabilities. For example, luxury cars are more likely to be targeted by thieves than lower-priced models.
- **The environment:** The environment in which the vehicle will be used will also impact its security risks. For example, vehicles used in rural areas are at greater risk of being involved in hit-and-run accidents than those used in urban areas.
- **The purpose of use:** The way in which the vehicle will be used will also affect its security risks. For example, vehicles

Conclusion: How Will We Address These Challenges In The Future?

The future of vehicle security is a hot topic in India. With the rise in popularity of electric vehicles, the need for better security measures is more important than ever. There are many challenges that need to be addressed when it comes to vehicle security, but there are also many potential solutions.

One potential solution is the use of blockchain technology. Blockchain can be used to create a decentralized database that stores all of the data related to a vehicle. This would allow for better tracking of vehicles and could potentially help to prevent theft and other crimes.

Another solution is the use of biometrics. This could include fingerprint scanners and iris scanners. This would allow for only authorized individuals to access a vehicle.

These are just some of the potential solutions that could be used to improve vehicle security in India. It is important to stay ahead of the curve when it comes to vehicle security, as this is an ever-evolving field. ❑

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Vikash Chaudhary is a Pillar of the Indian Hackers community and is responsible for a whole new generation of rising ethical hackers, a lot of whom successfully contribute to platforms like HackerOne & Bugcrowd. He's looking to expand his mentorship for the new generation to come in this field i.e. Cyber Security, which he thinks could be a great resource to help grow the security talent pool worldwide.

SHARED MOBILITY

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Abstract

The exponential growth in population in major cities across the globe has put a tremendous amount of strain on the existing infrastructure. The pace of development cannot keep up with the unprecedented urbanization. Most major cities face traffic stalls daily. The increasing number of vehicles also require a lot of fuel which is simply not sustainable. It is the need of the hour to make the transport system more efficient rather than bulky. Shared mobility is a step in that direction. In this paper, we analyze different types of shared mobility, the challenges, and how we can adapt to them.

Introduction

The popularity of shared mobility has accelerated in the past decade, but it's been around for quite a long time. The first carsharing company started in Zurich, Switzerland in 1948, and the first bike-sharing establishment was started in 1965 in Amsterdam, Netherlands. Shared mobility becomes an effective means to commute sustainably. The development of infrastructure, science, and technology so far was made in a manner to make human lives better but now development needs to take a different arc of sustainability. Shared mobility allows us to effectively use the current infrastructure. Metropolitan cities with a lot of traffic problems can benefit heavily.

The most known forms of shared mobility are carsharing and bike-sharing, but it also includes public transport, ridesharing, micro-transit, and many more. Shared mobility opens a range of different mobility options to explore. Popular TNC Companies like Uber and Lyft have tried to commercialize certain modes of shared mobility like ride-splitting which allows the users to travel more economically. Since the objective of shared mobility is Sustainability, it paves the path for popularizing new modes of transport like e-vehicles, micro transits, and even Sky trains. To ensure shared mobility also reduces the commute time, faster public transport systems will come up. As the popularity of shared mobility increases, it will slowly become the norm. Cities like Vancouver and Helsinki have pioneered and established the success of shared mobility. Helsinki has managed to reduce its carbon dioxide emissions by 34 percent, reduce congestions by 37 percent and increase rail/metro ridership between 15 percent to 23 percent.[3]

Different modes of Shared Mobility

Any form of the communal transport system can be considered a type of shared mobility. These include buses, trains, metro, trams, etc. But these forms of transport require a lot of investment and they cannot provide last-mile connectivity to everyone. Even those who are actively using the public transport system must rely on vehicles like cars and bikes for getting access to the system. This leads to there being a need for large parking spaces near metro stations, and bus stands. The limited size of the parking space force commuters to use privately owned vehicles for end-to-end connectivity. Given that there are more than 1.4 billion cars in the world, Shared mobility is focusing on utilizing these privately owned vehicles to provide enhanced and comfortable connectivity.

The different types of shared mobility considered in this paper are:

- **Carsharing:** Renters can borrow a vehicle for a short amount of time
- **Roundtrip carsharing:** Renter picks up and returns the vehicle to the same point.
- **Point-to-point Carsharing:** Renter picks up the car at one point and drops it at his/her destination
- **Peer-to-peer carsharing:** Owner can enroll their vehicle in carsharing programs.
- **Niche carsharing services:** Closed network car sharing for apartments, colleges, etc.
- **Ride sourcing:** Certain companies connect commuters with private vehicle owners for renting the vehicle.
- **Ride-Sharing:** It involves adding extra riders to pre-existing trips who might be travelling along the same way
- **Carpooling:** A formal or informal arrangement between commuters to share vehicles to save on fuel.
- **Vanpooling:** A larger form of carpooling often used by employees of a company or by schools.
- **Real-time or dynamic ridesharing:** Online applications which add extra commuters who are travelling along the same path to an ongoing ride.

Existing Challenges

Shared mobility has a lot of promising benefits but also has its fair share of challenges. Shared mobility will require people to rethink the way they view travel. The best mode of travel is determined by three parameters: cost, convenience, and commute time. Shared mobility currently faces the issue of addressing these three parameters effectively. Walking is an essential part of shared mobility. Most developing cities are not pedestrian-friendly. They lack the infrastructure to provide pedestrian safety. Safety and security are major concerns when it comes to shared mobility. The common security concerns are pickpocket crimes, thievery, rash driving, or an uncanny encounter with a person brewing ill intentions. In-vehicle sharing, oftentimes the vehicle is not in the right condition and that may lead to unfortunate accidents.

Shared mobility is a relatively new terminology that has been gaining importance recently. Due to the newness, people are still not accustomed to the idea. Countries need to update the transport policies to accommodate new modes of transport. Owning a vehicle for individual transport needs has been the norm for quite some time. Apart from cities with excellent public transport connectivity, most cities don't practice shared mobility. In certain countries, it's seen as a status symbol to own a car. Also having an independent mode of

transport allows a degree of freedom that is not possible in shared mobility. Oftentimes people prefer to use a single mode of transport to reach a destination. Shared mobility requires people's willingness to adapt to the multi-mode of transport.

Although there are multiple modes of shared mobility, there is usually a lack of connectivity. A lot of cities have only two or three metro lines that don't provide connectivity to all parts of the city. At times, even if there are a lot of buses available, the routes are not optimized to provide coverage throughout the city. When it comes to bike-sharing or car sharing, an ample number of pickup points are not present.

Solutions

Recent development in the automobile industry has provided solutions to many of the issues related to safety and security. Smartphone used as keys to access the vehicle provides easy yet secure access. Physical exchange of keys is not required, and the owner can keep track of the vehicle using GPS. Local and cloud-based analysis of the driving pattern can detect rash driving and the vehicle may be turned off remotely if needed. The use of a camera or other gadgets like a smartwatch or health band to monitor the passengers is being researched. This can increase the safety of women co-passengers.

Combining different methods of shared mobility can provide continuous and last-mile connectivity. Bikes can provide short-distance or last-mile connectivity while cars, buses, and metros can be used interchangeably for larger distances. Today, most shared mobility companies focus on providing end-to-end connectivity. With the limited number of vehicles owned by such a company, wait time becomes huge and people avoid this form of transport. Instead, shared mobility companies need to combine their vehicle fleets with the public transport system as well as other forms of carsharing and ridesharing and provide the shortest travel time possible. This will reduce wait time and increase the reliability of the shared mobility system.

At Elektrobit, we focus on enriching the future of mobility. EB Zentur offers products that enrich and upgrade the security of the connected vehicles with the employment of hardware security modules (HSMs). They help to build a secure platform that is protected from unauthorized access to key material and software manipulation.

Elektrobit also has unique solutions to enable database decisions and remote software updates for connected cars. We are also working on products to increase passenger safety and rash driving detection. Its line of products related to automated driving makes car-sharing simpler and non-dependent on the skill of the driver.

Advantages

Shared mobility has the following advantages:

- It ensures that the existing infrastructure is effectively utilized
- It can reduce the consumption of depleting natural resources. Air and noise pollution levels will drastically come down
- It will also help reduce the traffic density and thus decrease the commute time required to reach a destination. Traffic bottlenecks will be mitigated as the traffic will be now manageable by the traffic systems
- Shared mobility will allow people to have a social journey
- Implementing shared mobility will create new job opportunities
- It also encourages people to become more active by encouraging them to use walking as means of first mile/ last mile connectivity for short distances
- It will also aid in fulfilling the UN's 17 Sustainable development goals.[4]
- Shared mobility can provide cheaper travel costs and as the confidence in shared mobility grows people will be more likely to adapt to the new method of transport.

Conclusion

Shared mobility is a revolutionary idea that can transform the way we travel. There are already enough vehicles on the road, and it is time that they are utilized to their full potential. Due to the reduced cost of convenient travel of shared mobility, the idea has taken a root. In big cities and some way of formal or informal vehicle sharing has been on the rise in the past few years. As the confidence of commuters grows in the new method of transportation, its efficiency will increase. The commute time will go down.

The pandemic has pushed back the progress of the past few years. It has forced commuters to avoid any form of social interaction, but it provides some opportunities as well. To avoid the crowded public transport systems, commuters may look towards ride-sharing.

While shared mobility has a lot of benefits, the challenges are numerous as well. But the challenges are mostly behavioral in nature and can be overcome with time. ❑

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Appendix

TNC – Transportation Network Companies

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Location Services - Overview of Technology Landscape

TIRTHANKAR GUHA
Ericsson

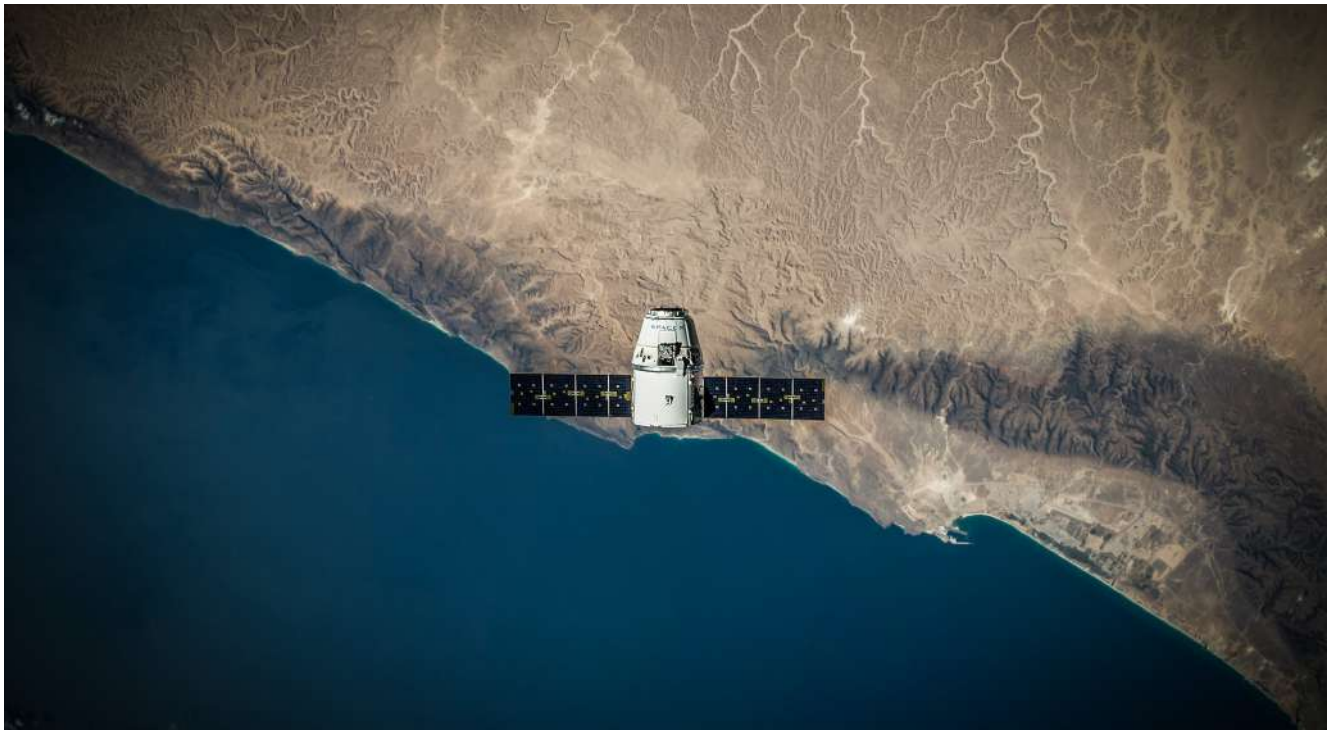
The importance of assessing the exact location of vehicle is becoming profound due to the plethora of location based services being offered that serves both industry and consumer use cases. As per analysts, the worldwide location based services market across industry verticals is expected to be more than 200B USD by 2029 growing at a CAGR of more than 15% with Automotive segment having a major share. The capability to map the exact location of a vehicle opens a window of opportunity for the Automotive OEMs to provide better customer experience, optimize their OPEX and open additional revenue streams. A few examples of location based use cases are navigation services, concierge services, location based promotions, anti-theft, secure fleet management and many others. The primary input to these use cases is the raw location information of the vehicle made available through multiple technology enablers. The focus of this article would be to have a quick overview of these technology enablers

While there are many location technology enablers, this article is going to focus on satellite based and network based methodologies. The expected location accuracy would be use case specific. It is important to understand that the location accuracy can be improved by combining the above mentioned location technologies

Satellite Based

There are many constellations of satellites that broadcast data for positioning, navigation, and timing, which is used for location measurements. These constellations of satellites are called GNSS or Global Navigation Satellite systems.

Today there are four main GNSS constellations with global coverage, i.e., GPS from the United States, GLONASS from Russia, GALILEO from European Union and BEIDOU from China. In addition to that there are 2 regional GNSS constellations, namely QZSS from Japan and NAVIC from India. These satellite constellations are managed by the respective countries and each of them provides different levels of location accuracy (in the range of a few meters). A GNSS not only comprises of the satellite constellation orbiting the earth, but also has 2 other key components, namely control stations



and positioning equipment. A network of control stations on earth's surface are responsible for monitoring the satellite as well as provides a location accuracy baseline. The positioning equipment that receives the time and orbital data from the satellite are responsible to provide the actual location of itself. One important thing to note is that the satellite data are prone to error caused by multiple reasons, for which there is a high reliance on corrections services like SBAS or Satellite Based Augmentation Systems. These correction systems are very important in getting high accuracy location information using GNSS

Network Based

In addition to satellites, intelligence from cellular and non-cellular networks (like Wi-Fi, LORA, etc.) can also provide high location accuracy of a device. Although there are legacy positioning methodologies used in the era of 2G/3G networks, this segment will talk about the positioning methodologies in LTE and how these are enhanced in 5G networks. The positioning methodologies in LTE networks are as follows:

- ***Assisted GNSS*** – The low bandwidth of a satellite signal causes long delays in downloading satellite data and in some cases the collection needs to start from scratch in case the satellite signal is poor or is lost. Assisted GNSS is a solution to this specific problem where the satellite data is fetched by a Assisted GNSS enabled device from the Assisted GNSS server (which stores the cache database of the satellite data) using the high bandwidth cellular and non-cellular network. The Assisted GNSS server infrastructure is deployed and managed by the network operator. The location accuracy ranges between 10 to 50 meters

- ***Enhanced Cell ID (ECID)*** – This technique amplifies the location accuracy of cell-ID based positioning by considering two additional attributes, namely RTT (round trip time of the signal between the device and the base station) and AOA (Angle of Arrival of the signal between the device and the base station). Cell ID based positioning estimates the location of the device in reference to the base station to which it is latched on to. However, location accuracy is poor especially when cell radius becomes larger for example in rural areas. RTT helps to estimate the distance of the device from the base station, whereas AOA helps to estimate the direction of the device from the base station. So RTT and AOA improves the location accuracy in ECID. However, the location accuracy using ECID is poor as compared to Assisted GNSS, where ECID provides a location accuracy of around 150 meters

- ***Observed Time Difference of Arrival (OTDOA)*** – The technique is based on the device calculating the time difference between the downlink signals received from 2 or more base stations. With the knowledge of the base station location and the measured time difference, the device location can be easily estimated. The location accuracy ranges between 50 to 200 meters

With the advent of 5G networks, we can see significant enhancements to the location accuracy provided by the LTE networks. Following are some of the technology elements in 5G network which promises to provide a location accuracy of up to a few meters:

- ***Beamforming*** – This is a signal processing technique that allows directional transmission and reception of signals. While in LTE the base station can estimate the sector of a cell where the device is located, beamforming provides greater location accuracy as it slices the base station transmissions into multiple spatial components which are few degrees apart. Also, with beamforming antennas having a 2D structure, the positioning methodology gains the dimension of vertical axis as well

- ***Higher Frequency*** – This would increase the beamforming resolution which would translate in greater 2D location accuracy

- ***Higher Network Density*** – Considering the limited coverage of millimeter wave frequencies which are used in 5G networks, the 5G network planning would be significantly denser as compared to LTE. With such dense network infrastructure where the device will have a direct line of sight with the radio infrastructure, the location accuracy would significantly improve

The positioning methodologies described above helps to estimate the precise location of the device. However, translating the location information into a tangible use case would require the role of the application layer which consumes the location information of the device. This is where comes the role of location based services (LBS) which essentially is a software based service. On a broad level the LBS can be categorized into the following segments relevant from Automotive standpoint – Navigation Services, Tracking Services (traffic information, vehicle tracking), Infotainment Services (city guide, tourist information) and other Value Added Applications like location based advertising. With a promising growth in the connected vehicles segment, there will be sharp demand in these services which will further fuel the need of greater location accuracy. This business rationale of greater location accuracy would justify the technology investment in coming up with more accurate positioning technologies. ❑

AUTHOR

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Tirthankar is the Go to Market Manager at Ericsson for the IoT Connectivity portfolio based in Montreal, Canada. He is responsible for driving the global Go to Market strategy for some of the key offerings within Ericsson's IoT Connectivity portfolio towards Ericsson's CSP Partners and Enterprise Customers across different industry verticals. Tirthankar has more than 18 years of experience in the telecom industry spanning across different market areas across the globe.

Mahindra Scorpio-N

Mahindra had launched Scorpio N on June 27.
Official bookings for Scorpio N will start from July 30.
The introductory prices of the manual variants of the new-generation Scorpio is Rs11.99 lakhs.

SPECIFICATIONS

Safety Features:

- Overspeed Warning - 1 beep over 80kmph, Continuous beeps over 120kmph
- Emergency Brake Light Flashing
- 6 Airbags (Driver, Front Passenger, 2 Curtain, Driver Side, Front Passenger Side)
- Middle Rear Head Rest
- Tyre Pressure Monitoring System (TPMS)
- Child Seat Anchor Points
- Seat Belt Warning

Engine & Transmission:

- Fuel Type – Diesel
- Max Power - 172 bhp @ 3500 rpm
- Max Torque - 370 Nm @ 1500 rpm
- Drivetrain – RWD
- Transmission - Manual - 6 Gears, Manual Override, Sport Mode
- Emission Standard – BS6
- Turbocharged
- Idle Start/Stop

Braking & Traction:

- Anti-Lock Braking System (ABS)
- Electronic Brake-force Distribution (EBD)
- Brake Assist (BA)
- Electronic Stability Program (ESP)
- Hill Hold Control
- Traction Control System (TC/TCS)
- Hill Descent Control

Locks & Security Features:

- Engine immobilizer
- Central Locking - Keyless
- Speed Sensing Door Lock
- Child Safety Lock

Entertainment, Information & Communication Features:

- Smart Connectivity - Android Auto (Wireless), Apple Car Play (Wireless)
- Touch-screen Display
- Integrated (in-dash) Music System
- 6+ Speakers
- Steering mounted controls
- GPS Navigation System
- Bluetooth Compatibility (Phone & Audio Streaming)
- USB Compatibility
- Aux Compatibility
- AM/FM Radio
- Voice Command

Telematics Features:

- Find My Car
- Check Vehicle Status Via App
- Geo-Fence
- Emergency Call
- Over The Air (OTA) Updates
- Remote AC On/Off Via app
- Remote Car Lock/Unlock Via app
- Remote Car Light Flashing & Honking Via app
- Alexa Compatibility

Instrumentation:

- Instantaneous Consumption
- Digital Instrument Cluster
- Electronic 2 Trips Meter
- Average Fuel Consumption
- Average Speed
- Distance to Empty
- Digital Clock
- Low Fuel Level Warning
- Door Ajar Warning
- Adjustable Cluster Brightness
- Gear Indicator

Maruti Suzuki Brezza

Maruti Suzuki has launched the new generation Brezza in India. Prices of the new 2022 Maruti Suzuki Brezza start at Rs 7.99 Lakh and go up to Rs 13.96 Lakh ex-showroom.

SPECIFICATIONS

Safety Features:

- Overspeed Warning - 1 beep over 80kmph, Continuous beeps over 120kmph
- 6 Airbags (Driver, Front Passenger, 2 Curtain, Driver Side, Front Passenger Side)
- Child Seat Anchor Points
- Seat Belt Warning

Engine & Transmission:

- Fuel Type – Petrol
- Max Power - 102 bhp @ 6000 rpm
- Max Torque – 136.8 Nm @ 4400 rpm
- Drivetrain – FWD
- Automatic (TC) - 6 Gears, Paddle Shift
- Emission Standard – BS6
- Regenerative Braking, Idle Start/Stop

Braking & Traction:

- Anti-Lock Braking System (ABS)
- Electronic Brake-force Distribution (EBD)
- Brake Assist (BA)
- Electronic Stability Program (ESP)
- Hill Hold Control

Locks & Security Features:

- Engine immobilizer
- Central Locking - Keyless
- Speed Sensing Door Lock
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Telematics Features:

- Find My Car
- Check Vehicle Status Via App
- Geo-Fence
- Over The Air (OTA) Updates
- Remote AC On/Off Via app
- Remote Car Lock/Unlock Via app
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Entertainment, Information & Communication Features:

- Smart Connectivity - Android Auto, Apple Car Play
- Touch-screen Display
- Integrated (in-dash) Music System
- 6+ Speakers
- Steering mounted controls
- GPS Navigation System
- Bluetooth Compatibility (Phone & Audio Streaming)
- USB Compatibility
- Aux Compatibility
- AM/FM Radio
- Wireless Charger
- iPod Compatibility
- Voice Command

Instrumentation:

- Instantaneous Consumption
- Analogue Instrument Cluster
- 2 Trips Meter
- Average Fuel Consumption
- Average Speed
- Analogue Clock
- Low Fuel Level Warning
- Door Ajar Warning
- Gear Indicator
- Heads Up Display (HUD)
- Analogue Tachometer

5G, An intersection of Telecom, Cloud, and IT world

SANJAY KUMAR
Learnizo Global

Introduction

5G is the buzzword today and almost everybody is talking about it. Many MNO's have launched or are in the process of launching their 5G networks but let us understand, what makes 5G so interesting and how it is different from the previous generation of Telecom Networks.

A lot of new telecoms, IT/ITES, and Startup companies are entering this space and this 5G space is buzzing with a lot of excitement.

In this article, we will try to understand what makes 5G so exciting, what new capabilities it brings to end-users, and what business opportunities it is going to bring to the companies.

Telecom, Networking, Cloud and IT worlds

Telecom was typically referred to as Wireless and Wireline Networks for providing connectivity to the end-users, Networking was more about IP Networks created using many Switches and Routers, Cloud was a public or private infrastructure and IT was referred to as some Software application hosted on On-Prem Data centers or public or private cloud Infrastructure.

Telecom Networks were mostly very closed networks in the early days and most of the Telecom hardware was purpose-built for Telecom Software which was again very specific to Telecom Applications. Communication between various Telecom Equipment was happening using telecom Specific protocols and was not very scalable. So, the telecom industry was dominated by a handful of companies.

However, Cloud Infrastructure was mostly built using some commodity hardware and the IT application running on them were also standardized and had a huge open ecosystem.

Even IP World was using mostly open protocols and have a lot of benefits like interworking and Quality of Services.

Challenges with Telecom Networks

Because of these closed architectures, Protocols, and purpose-built hardware, Telecom networks were not scalable and replaceable and because of not so open ecosystem, It was not easy for new companies to enter into this business as well there was a very limited scope of innovation.

Mobile Networks Operators have very few choices, and it was not easy for them to change the existing vendors as they need to replace whole hardware and software.

All these types of equipment were given to MNO's as black boxes and mostly they

were not able to play either with hardware or software.

Because of these limitations, MNO's technical capabilities were limited and instead of managing these networks on their own, they started outsourcing these Managed services from OEM (Original Equipment Manufacturers) or vendors.

Era of OTT (Over-The-Top) dominance

Major revenue sources for MNO's were voice, SMS and Data Services, and when OTT like WhatsApp, Skype, and Telegram arrived, first they started eating SMS revenues of operators and then moved to voice revenues.

Most OTT applications were taking free rides on Telecom Networks and making money out of it whereas Telecom Operators were struggling to make ends meet.

At the same time, Operators were stuck with some OEM and didn't have a lot of options while deploying these networks. Even these standard telecom networks were just good enough for providing some basic services like Voice and SMS were not capable of providing more advanced services which are required in the current scenarios.

What do mobile network operators want?

Operators wished to have some open networks where there are very less dependencies on fewer vendor companies.

These networks should be disaggregated, and software and hardware should not be purpose-built.

Operators wanted to have a larger ecosystem, Open protocols, Scalable networks, Networks that were more Software and Service centric and Networks where resources can be logically isolated, and networks can be used as multiple logical layers on a single physical infrastructure.

What's new in 5G?

5G is not just another wireless technology but much more than that.

5G enables the network's deployment on Public/private cloud infrastructure and Telecom Network Functions are created as VNF's (Virtual Networks Functions) or CNF's (Cloud Native Networks Functions). However, this is not a completely new thing, some of these efforts were initiated in later updates (read 3GPP releases) in 4G networks as well.

All these Network Functions can be broken down into multiple microservices and can be hosted in containerized environments. This makes Cloud Native Architecture a front runner in 5G Deployments.

Finer granularity in these Network Function and Cloud Native Architecture will fuel the usage of DevOps in Telecom which was completely missing in previous telecom generations.

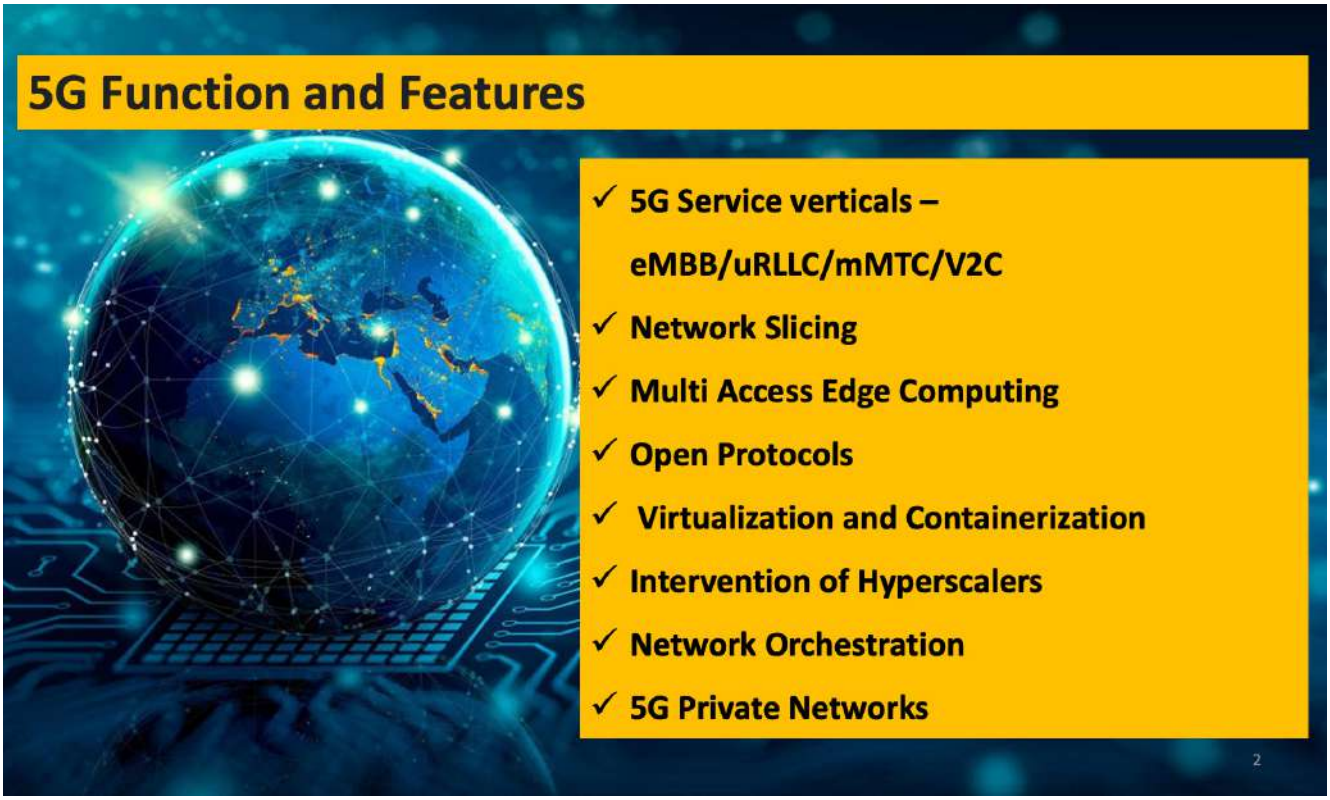
Let us try to understand what new functions and features enable the 5G for next-level growth and how it is going to benefit the users and businesses-

5G Service Vertical

From day one, 5G was not planned as a ubiquitous Network that is one size fits all.

Instead, 5G is designed for multiple service verticals like eMBB (Enhanced Mobile Broadband) which can provide data rates up to 20 Gbps in the downlink, mMTC (massive machine type communication) which can accommodate millions of devices, uRLLC (Ultra reliable and Low Latency Communication) which can promise very low latencies (<1ms) and very high reliability (up to 99.9% or more) and V2X which may be specifically designed for Vehicular communication.

The performance requirement of these



different service verticals can be very extreme and may be difficult to meet in a single network hence network resources should be isolated logically and should form multiple logical layers in over a single physical network and these logical layers are called Network Slices.

Network Slicing

Network Slicing is one of the most recognized features of 5G Networks where physical resources can be isolated and formed into some logical layer which are meeting certain performance requirements and these Network Slices can be allocated to a variety of users.

Some of these slices can be standard and available for retail users and provide some required performance for service verticals like eMBB, uRLLC, and mMTC whereas some other slices can be further customized and can be provided as NaaS (Network as a service) to enterprise customers, industry verticals and Public Safety and mission-critical services

Multi-Access Edge Computing (MEC)

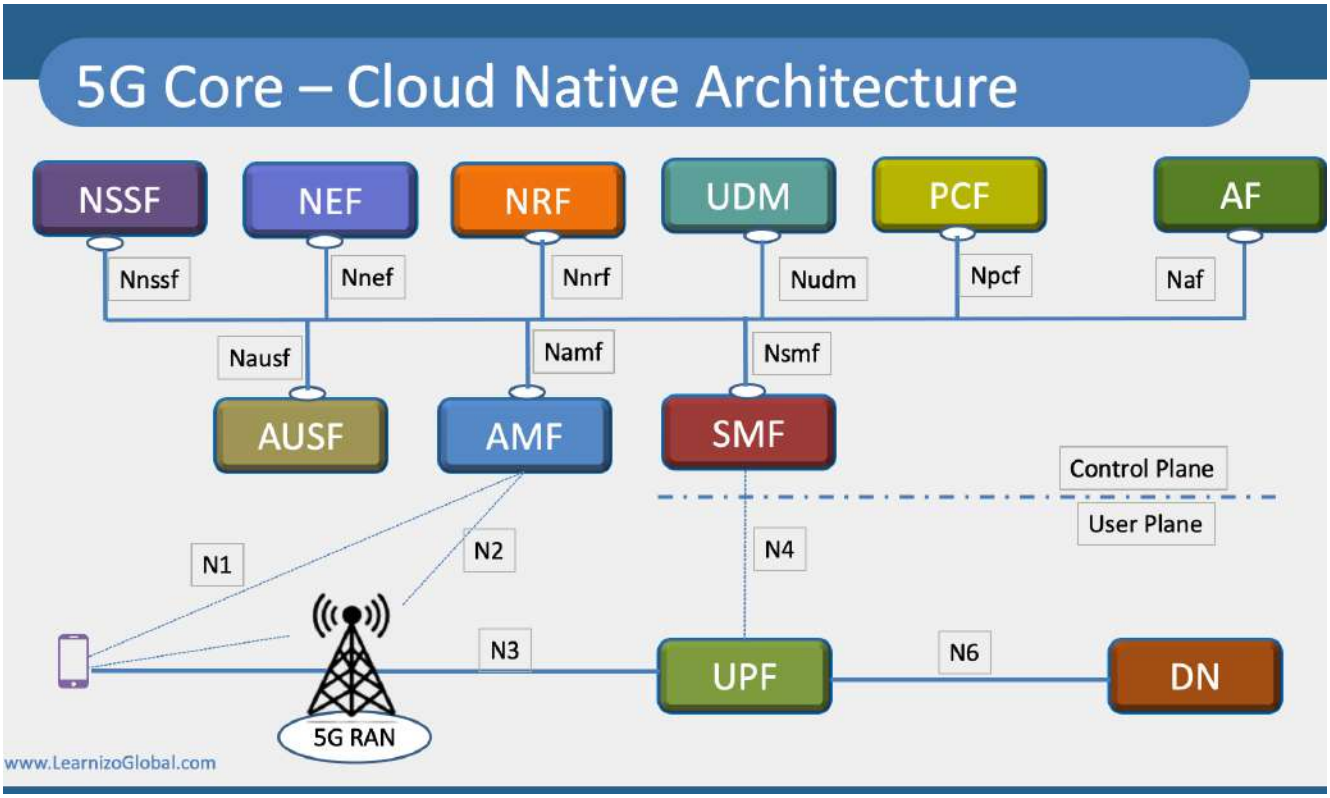
As many of the 5G use cases will require very low latencies and a lot of local processing, we may need to bring some of these applications closer to the end-user and mostly at the base station. There is not something new to the IT world as a lot of content caching and Content Delivery Networks (CDN's) were defined but little new for Telecom as it was rarely used in previous generations.

Open protocols

As mentioned earlier, most of the communication within telecom networks were happening on Telecom Specific protocols, and most of these Telecom-specific protocols are being scrapped and migrated to industry-standard protocol like HTTP2 and HTTPS and all telecom-specific information is written into JSON Schema in HTTP Body. All these network functions communicate with each other using RESTful API-based communication and this is a first in Wireless Networks. This makes 5G networks more open and enables them to communicate with IT infrastructure and other applications.

Virtualization and Containerization

Most of the 5G Network deployments are



happening in virtualized and containerized environments and that makes 5G networks more scalable, highly available, and cost-effective. Because all these network functions are designed using microservices, DevOps enables them to have continuous integration and continuous deployment (CI/CD) and improves software delivery cycles.

Intervention of Hyperscalers

As Cloud infrastructure comes into existence in Telecom Networks, Hyperscalers are active in this space and introducing a lot of new features, Functions, and services to empower Wireless Networks like 4G, and 5G. In fact, some of the MNO's like Dish Wireless in the USA have deployed their complete 5G Network on AWS Infrastructure

Network Orchestration

As we need a lot of dynamism in Telecom Network management, it is practically not possible to manage these networks manually and that's where the larger intervention of Automation and Orchestration kicks in. Today all these future networks are powered by the latest Network orchestration techniques which are fueled by Machine Learning and Artificial Intelligence.

5G private Networks

With a lot of these new requirements from new use cases of 5G networks, achieving diverse performance requirements may not be possible in the public networks. So there is a lot of stress upon deploying many of these use cases in private networks referred to as Private 5G or NPN (Non-Public Networks). These private networks can be completely isolated from public 5G Networks and can be integrated with Public Networks. Even Networks Slices can be used as a private network in some scenarios.

Challenges

As technology is evolving quickly it brings a lot of challenges as well. Today MNO's are struggling to make these big investments in the networks and are cautious about return on investments.

There is a huge skills gap in the industry and companies are struggling to hire skilled resources which have brought unique challenges to the industry.

Summary

In this article, we have looked at the big picture of 5G without getting into too many technical details. 5G looks very promising right now and is still in its very early stages. 5G promises a lot of new features and use cases but it is a bit early to say how many of them will be successful.

Initial deployments of 5G networks are going to have a lot of dependencies on existing 4G networks and a threat from early discussion of 6G Networks.

So far, it's looking like a pretty exciting place, and expect a lot of action over the next few years. ❑

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Software Transforming The Vehicle Of Tomorrow

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Connectivity, autonomous driving, shared mobility and electrification are megatrends transforming the automotive industry disruptively. Tomorrow every vehicle will be connected, and it will be a part of Internet of Things (IoT) that communicates with smart devices and systems outside the vehicle in home, office, other vehicles and infrastructure offering user with personalized, remote, connected and on-demand services. With autonomous driving today's driver will be tomorrow's passenger thereby handing over the safe driving independently to the vehicle and user can focus on comfort and entertainment services that the vehicle offers. There is a shift in the individual mobility behavior with the introduction of new mobility services like car sharing, microtransit etc. that offers cost-effective environment-friendly mobility, increases accessibility and convenience. Emission free mobility has become a legislative requirement already forcing the industry to explore alternative drivetrains. How do we drive these trends in the automotive industry? The answer is software-defined vehicle. A story is the best example to illustrate how software can create an outstanding user experience. Rosie and family are travelling to Barcelona for their vacation and book the robo taxi. Taxi arrives at her home with a personalized welcome note on the windscreen and as soon as she enters using the key in her mobile, the entire car interior space is adapted to her preference. Rosie then subscribes the on-demand feature 'eTravel Companion' that offers them a guided tour and various proactive, contextualized, and personalized location-based services during their travel. Her husband continues watching the Netflix series that he paused last night at home in the wide screen car entertainment unit while the window changes its transparency, audio sounds amplified, and his seat adjusted to relax thereby providing the theater effects in car. Kids play games in the in-car metaverse systems. Cabin sensing system detects tiredness in Rosie and asks if car should navigate to her favorite coffee chain. Rosie and family stop over for coffee. During this time car has reserved its charging spot to refill its battery. They continue their journey and suddenly the health monitoring system in the car warns Rosie's father regarding his abnormal pulse rate. In-car digital health assistant connects her online to the doctor and the doctor prescribes a medicine. Rosie orders the medicines in the in-car displays. Car drops Rosie and family at their destination safely. Rosie's father's medicine is ready at their hotel doorstep which was delivered via a last mile delivery robot. How that story that offers user safety, convenience, and entertainment is realized? Again, the answer is software.

Car is considered as mobile living space offering an extended home/office to the user. Hence a seamless connectivity and holistic user experience are key for future of mobility. Mobility will soon be considered

as a service delivering more on-demand, digitalized and personalized service to the user. User can subscribe for features on-demand and pay per use. User will give consent to collect data in exchange for the convenience. User centric design is influenced by software and software will significantly alter automotive market value chains leading to architecture changes, new operating models, new collaboration models and new business models. The software-defined vehicle increases the lifecycle and value cycle of the vehicle. It reduces the manufacturer's cost to build and maintain vehicle and provides user a higher resale value. It also opens new revenue streams for data-driven services, features on-demand, shared and fleet services etc. According to The Brainy insights the global automotive software market was USD 24.61 billion in 2021 and is expected to reach ~USD 105.13 billion by 2030. Munich based Berylls Group calculates that that the value of vehicle software per vehicle will triple in the current decade from around EUR 800 to almost EUR 2,400. OEMs, tier-1 and tier-2 suppliers will have new responsibilities, new partnership and collaboration models to cope up with development speed, increasing complexity and sharing cost. OEMs are also increasing their in-house software capability, and few have their own software companies like CARIAD, an automotive software company for Volkswagen group, MBition for Mercedes-Benz cars. New entrants like Tesla take a software centric car development approach unlike traditional automotive OEMs that are hardware centric thereby often leading innovation. As future of mobility is beyond the perimeter of the car with seamless connectivity and holistic user experience, the IT giants like Google, Amazon, Microsoft and Telecommunication giants like T-Mobile, Vodafone, Huawei are contributing to the mobility ecosystem with their products and services. Eclipse foundation has set up an open technology platform for the software-defined vehicle to accelerate innovation of automotive -grade in-car software stacks using open source and open specifications. Arm has set-up Scalable Open Architecture for Embedded Edge (SOAFEE) project, that facilitates collaboration between automakers, semiconductor suppliers, open source and independent software vendors, and cloud technology leaders to create a cloud-native architecture enhanced for mixed-criticality automotive applications. Hardware has become a commodity and innovation & functionality are driven by Software as a result reinventing the new business models of Software as a Product (SaaP) and Software as a Service (SaaS) in automotive. Automotive companies are mastering the journey towards user-centricity via software-centricity and updating their operating model to include agile resulting in continuously value delivery.

The vehicle architecture is evolving from distributed Electronic Control Units (ECU) to scalable vehicle centralized compute platform to cope up with the increasing complexity, functionality, and cost. Traditionally in a car we have ~100 ECUs with each having limited compute power and functionalities isolated in ECUs with tightly integrated software and hardware. Tomorrow with domain centralization, car will have only few high performing computers and zone controllers catering to functions defined by software thereby setting the course for software-defined vehicles. The lines of code in the car today are already 100 million and will grow to ~300 million by 2030. Software-defined vehicle is built on a service-oriented architecture that consists of microservices and containers to decouple the software functions from the hardware. With the decoupling of software and hardware, it can accommodate different development speeds and enable faster innovation cycle. Software-defined vehicle is powered with Artificial Intelligence (AI) and Cloud solutions enabling connectivity, scalability, upgradability, automation, prediction, and supervision. As most of us are aware AI is key element for autonomous mobility; however, it is not limited to autonomous driving. AI also plays a role in improving user experience like the AI-powered digital companion that can serve the user with an intuitive empathetic communication using natural language, cabin sensing AI systems for personalizing vehicle interiors and driver monitoring. Cloud solution enables seamless connected services, data-driven services, predictive vehicle maintenance and more. Over-the-air (OTA) updates in the field enables continuous software deployment for new features, bug fixes, security updates and guarantees shorter time to market. Few automotive players are also standardizing automotive operating system to ensure interoperability and seamless integration like MB.OS (Mercedes Benz Operating System) and VW.OS (Volkswagen Operating System). Overall, the automotive software complexity has increased significantly and to cope up software is architected with modular and reusable modules and delivered with continuous integration and testing. Continental has paved the way in developing the state-of-the-art software-defined-vehicle with its Continental Automotive Edge Framework (CAEdge) – a modular hardware and software scalable compute framework connected to the cloud. CAEdge framework also includes DevOps workbench that provides the toolchain for software development and maintenance. Continental believes in the power of collaboration and has partnered with AWS for cloud computing. Continental is a part of Eclipse foundation initiative and SOAFEE to co-create and co-develop software-defined vehicles. Software is key for the future of mobility and Continental is well prepared for driving the trend.

To summarize software has enabled the automotive industry to be innovative, agile and efficient thereby transforming the vehicle of tomorrow. ❑

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Rosemary Joshy is the Head of Global SW Strategy, Innovation and Business Improvement for Continental Business Area User Experience. In this role, she spearheads the software strategy, innovation and business improvements across all locations, product portfolio and customers. During her career she has worked with major automotive Tier 1s through the entire spectra of software spanning from Software engineer to Head of Software Development Center.

OTSL announced state-of-art millimeter-wave radar simulator product for autonomous driving

OTSL Inc. announced a new 3D real-time millimeter-wave radar simulator for autonomous driving, AMMWR2 (Advanced Millimeter Wave Radar Simulator 2). Since introducing AMMWR to market in 2017 for autonomous driving that enables dynamic real-time simulation, OTSL has continued to invest aggressively in its development. With the announcement of AMMWR2, OTSL has manifested the leaps in functionality and performance achieved in this development. This product is planned to be marketed worldwide by the end of this year to automotive manufacturers, system supply manufacturers developing, designing and producing vehicle sensors, and semiconductor manufacturers developing sensor devices.

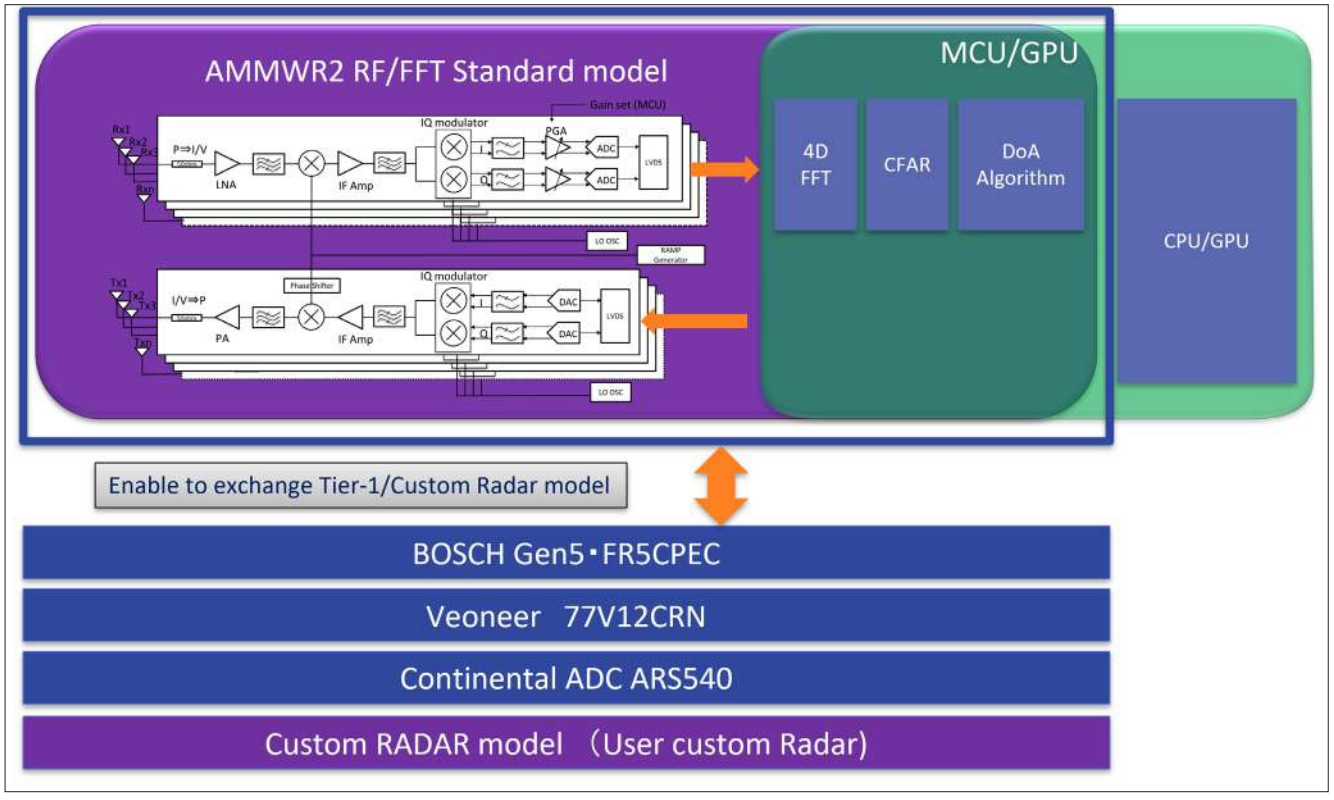
AMMWR2 uses the ray-tracing method using in the optics simulation field and unique reflection / diffraction models, applying a dedicated three-dimensional computer-generated map from Unreal Engine 4 (EPIC Games, Inc.) implementation of reflection and diffraction models of roads, roadside trees, streetlights, traffic signals, signs, and others to achieve real-time simulation of dynamic objects. Developing original measurement methods and creating reflection models from data obtained by the measurement enables accurate simulation of how radio wave from radar is reflected, considering even the shapes and materials of vehicles, pedestrians, traffic signals, signs, and other objects. By strengthened partnership with COSIDE (R), a SystemC AMS design and simulation tool from COSEDA Technologies GmbH for semiconductors supporting design from the circuit design to the system design level, an environment can be created in which simulation can be performed entirely in software without the need for any hardware, such as sensors or electronic control units (ECUs), or even the vehicle itself.

AMMWR2 features the following major update. These performance and function enhancements will further facilitate shorter development and testing lead times for manufacturers working on autonomous driving technologies.

Accelerated the simulation engine through internal code optimization and super parallel processing techniques. This has improved the performance of simulations with ray tracing by a factor of 10 or more.

By strengthening partnership with COSEDA Technologies GmbH which develops SystemC AMS design and simulation tool COSIDE (R), various radar can be used as custom models in addition to unique radar models based on automotive radar that Tier-1 provides with OEM, including Bosch's FR5CPEC and Continental's ARS540.

AMMWR2 now supports integration with the open-source CARLA Simulator, which is used widely for autonomous driving algorithm development and testing. ❑



AMMWR2 System RF Block (a part) and post signal processings.

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VOL 009
RS. 1.01

iTriangle

A DEVICE FOR ALL NEEDS
A ONE STOP SHOP

BASIC TELEMATICS

- Driving Behaviour
- Speed & Geo Fencing
- Supports Panic Button, Immobilizer, Fuel Sensor Integration
- Device based Configurable Alerts Module & Track & Trace

COMPLIANCE TELEMATICS

- All Telematics Features
- AIS 140 Certified
- Hassle Free Common Layer Activation
- Hassle Free E-Sim activation
- Empanelled in all AIS 140 active States
- Additional Advanced Features over and above AIS 140 Mandate
- Supports Panic Button, Fuel Sensor, Immobilizer, Integration

ADVANCED TELEMATICS

- Video Telematics
- Diagnostics
- Data Points for Prognostics of Vehicle/ Vehicle ECUs
- Vehicle ECU FOTA/COTA
- Live Diagnostics of Vehicle ECUs with J2534 standard CAN and Device based
- Configurable Alerts module

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- Subscription Renewals
- Vaahan Registration
- Common Layer Registration as per AIS 140 Mandate
- Sales Enquiries and Assistance

SO MUCH, FOR SO LESS

EV TELEMATICS

- Track & Trace
- All Telematics Features
- Support for CAN
- Battery Charge Status, SOC, Vehicle functional parameters on CAN etc
- Support for High voltage EV vehicle(9-90V)
- CAN and Device based Configurable Alerts module

INSURANCE TELEMATICS

- Accident Reconstruction using Video Telematics
- Driver Behaviour Analysis: Risk profiling of customers
- Data Points for Prognostics of Vehicle Consumables.
- Data points for Efficient Claims management

FILL OUT - CUT OFF - MAIL

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Renesas launched cellular-to-cloud IoT development platforms powered by RA and RX MCU families

Renesas Electronics Corporation announced two new cloud development kits, CK-RA6M5 and CK-RX65N, providing a complete connectivity solution for the RA and RX Families of 32-bit microcontrollers (MCUs). The cloud kits are the first to be equipped with Renesas' RYZ014A Cat-M1 module, a certified LTE cellular module that offers the ability to establish wireless connection between MCUs and cloud services quickly and securely without a gateway.

Armed with these cloud kits, users can rapidly develop IoT cloud products and solutions without having to design their own complex circuitry and software stacks. The kits include the RYZ014A Cat-M1 Pmod™ module, multiple sensors, a high-performance MCU, hardware-based security, and a reliable software stack.

The cloud kits are ready to connect to global cloud service providers such as AWS Cloud and IoT services. Both kits are designed to run on AWS (Amazon Web Services) FreeRTOS for CK-RA6M5 using FSP (Flexible Software Package) and CK-RX65N using RDP (RX Driver Package). Once connected to AWS IoT Core, the kits have access to many Cloud and IoT services from AWS for data analytics and IoT device management.

The cloud kits are the first to support the Renesas' RA6M5 and RX65N MCU groups under a unified development platform, ensuring a consistent user experience. The CK-RA6M5 and CK-RX65N both have identical hardware and software features and a common dashboard user interface to access real-time cloud data.

In addition to the Cat-M1 RYZ014A wireless module, the kits also provide an option to use Ethernet to securely connect to cloud when the Cat-M1 network is not available. Renesas plans to offer more wireless connectivity options in the future. These kits will also be offered as part of Renesas' Quick-Connect IoT Platform, which combines standard hardware and software building blocks to enable rapid prototyping of IoT systems.

Key Features of the Renesas CK-RA6M5 and CK-RX65N Kits

Two network connectivity options: RYZ014A LTE Cat-M1 Pmod and Ethernet

Highly secure Arm® Cortex®-M33 core-based RA6M5 MCUs with TrustZone® and Secure Crypto Engine, and RX65N MCUs with TSIP (Trusted Secure IP)

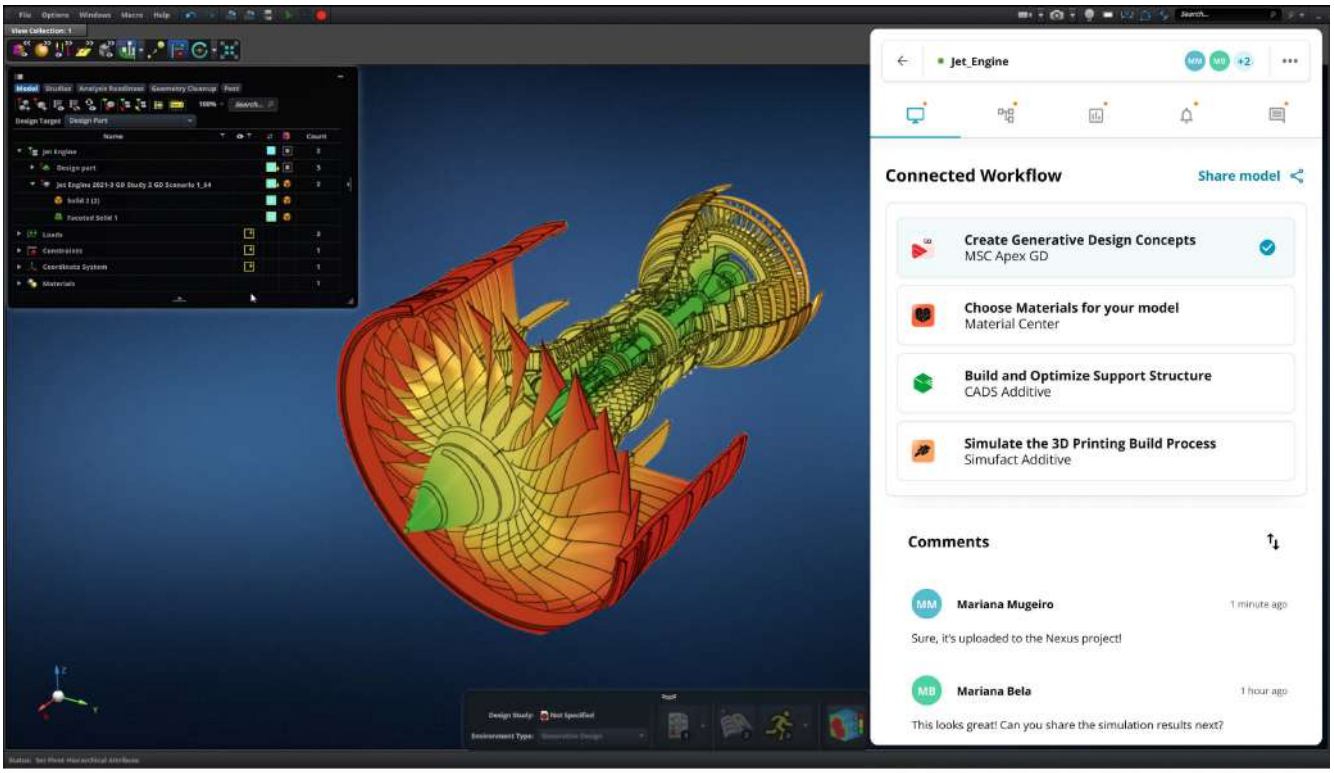
AWS qualified devices with a comprehensive software suite and a custom designed dashboard to visualize sensor data. ❑

Hexagon announces Nexus, a platform to connect siloed engineering and unlock smart manufacturing innovation

Hexagon's Manufacturing Intelligence division has announced an open platform for smart manufacturing, Nexus, which will revolutionize how technology professionals collaborate and innovate. Nexus will enable real time data sharing between different design, simulation and production applications. It will connect different applications to form workflows, and combine technologies to develop unique solutions to engineering and manufacturing problems, from concept to delivery. It will empower cross-functional teams to leverage fragmented digital data by improving visibility and connectivity, and help them gain unprecedented insight, bring their ideas to life faster, and produce higher quality results.

Nexus is the foundation for Hexagon's new solution offerings in the smart manufacturing space going forward. Today, it is capable of leveraging Hexagon data sources from across the vast portfolio; connecting hundreds of Hexagon design and engineering, production and metrology software tools and unlocking new insights from metrology devices and connected machines. Additionally, first-in-class cloud-native visualisations and data management solutions such as HxGN Metrology Reporting and MaterialCenter have been built as cloud-native connected applications, and will be connected through Nexus.

Hexagon is also developing purpose-built solutions through the platform that combine multiple technologies to help users to improve productivity and digitally optimise complex processes and workflows. One example is a "ready-to-go" workflow for 3D printing an optimised reverse-engineered part that could be used, for example, to streamline the repair of grounded aircraft components. This workflow connects data from a 3D laser scan to Hexagon products such as RECreate, MSC Apex Generative Design, MaterialCenter and Simufact Additive, as well as connecting to a third-party market-leading application called CADS Additive to significantly improve productivity and enable rapid collaboration to address production issues. ❑



A cross-functional team collaborates to address design and manufacturing issues together in real time

Source: Hexagon

New Product Launches and Partnerships to Improve Device Capabilities with 5G Chipsets

PRATIK KIRVE
Allied Market Research

The development of new 5G chipsets is ongoing to power the next-generation of devices including smartphones. The revolution in the smartphone industry will be driven with the help of 5G chipsets. So, technology firms are focusing their efforts and conducting extensive R&D activities on the development of chipsets with best-in-class capabilities. These chipsets are developed for improving the capabilities of smartphones in terms of speed, efficiency, and power. These chipsets will power the devices and improve the overall user experience. As the era of internet of things (IoT) arrive, the demand for 5G chipsets is increasing and manufacturers are taking efforts in developing chips that will power such devices. New products are launched to support next generation of smartphones and improve communication network capabilities. In addition, partnership is another strategy adopted by manufacturers to enhance capabilities of their devices and appeal users to opt for their products. The demand for 5G chipsets will increase considerably in the coming years. According to the report published by Allied Market Research, the global 5G chipset market is estimated to reach $92.05 billion by 2030. Following are some of the activities taking place across the world.

Market players are adopting various strategies such as new product launches to raise their stakes in the competitive marketplace and widen the portfolio of solutions. MediaTek launched the Dimensity 1050 system-on-chip [SoC] solution, which is a mmWave 5G chipset that will supply the power to the upcoming 5G smartphones. The chipset is developed with an aim to ensure seamless power efficiency, improve gaming experience, provide smooth connectivity, and enhance display. In addition, the dual connectivity of mmWave and sub-6GHz will provide the next generation smartphones with the required capacity and speed.

CH Chen, the Deputy General Manager of Wireless Communications Business Unit at MediaTek, highlighted that the new chipset will offer features that will help smartphones gain competitive edge in the market. With superior power efficiency, uninterrupted connectivity, and end-to-end 5G experience, smartphones will have reliable and superfast connectivity and advanced technologies in cameras. MediaTek's HyperEngine 5.0 gaming technology incorporated in the Dimensity 1050 will expand the game time and overall performance for smartphones. Also, the LPDDR5 memory and high-end UFS 3.1 storage will speed up the data streaming, apps, and social feeds. The launch of such innovative chipsets will bring a new dimension for smartphones.

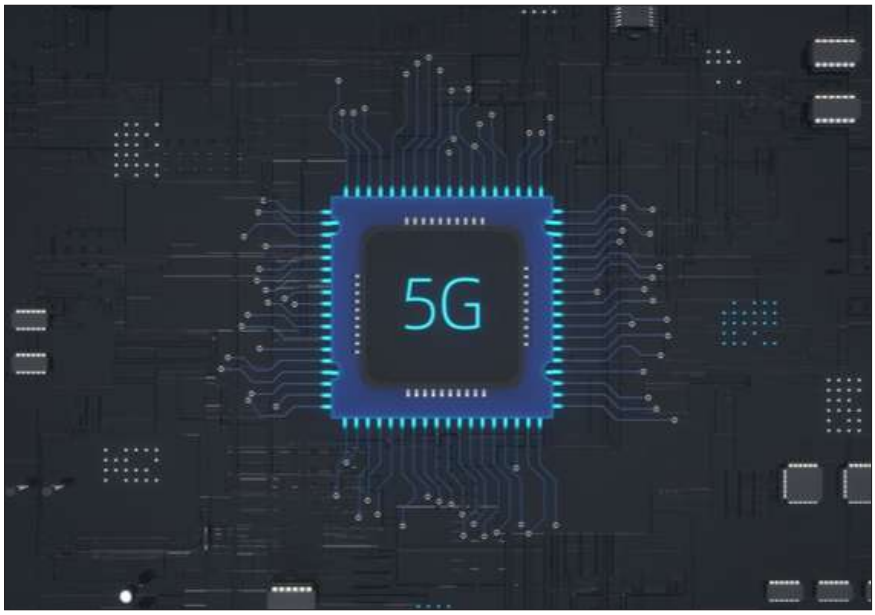
The trend of launch of new solutions continues with another tech giant launching

their solutions to accelerate the new generation of devices. Samsung introduced new chipsets for 5G solutions and devices. These new line products include baseband units, Compact Macro, and Massive MIMO units. These chipsets have the third-generation mmWave Radio Frequency Integrated Circuit (RFIC) chip, the Digital Front End (DFE)-RFIC integrated chip, and the second-generation 5G modem System-on-Chip (SoC).

Commenting on the new chipsets, Junehee Lee, the Executive Vice President and Head of R&D, Networks Business at Samsung Electronics, highlighted that the chipsets are the fundamental parts of the 5G solutions. They are developed through the extensive R&D activities and aimed at taking the company to the forefront of 5G technology development. The RFIC chip will improve power consumption and support 28 GHz and 39 GHz spectrums to result in lightweight and compact-sized 5G radio devices. The DFE-RFIC Integrated Chip will two-fold the frequency of bandwidth, surge output power, and lower down the size. The 2nd Generation 5G Modem SoC chip will support mmWave and below-6 GHz spectrums. In addition, it will surge the power efficiency of 5G Massive MIMO and Compact Macro radio. The devices will improve power and speed of Samsung's next generation of smartphones.

Along with the strategy of launching new chipsets, market players adopted the strategy of partnership to take advantage of each other's capabilities to strengthen products. Ligado Networks partnered with Sony Semiconductor Israel for development of 5G chipsets for Ligado's mobile satellite network. This step is taken to power internet of things (IoT) devices and deploy connectivity services in the North American region. The 5G satellite IoT network will provide support for millions of mobile devices and enable machine-to-machine communication. New IoT solutions will be deployed in various sectors such as agriculture, energy, transportation, utilities, and others.

Sachin Chhibber, the Chief Technology Officer at Ligado, highlighted that the partnership is aimed at advancing new capabilities and providing solutions for the 5G mobile satellite connectivity market in the North American region, especially in the U.S. The newly-developed chipsets will offer support to the 5G mobile private network solutions through reliability and coverage. This will help companies in modernizing their operations and improve the communication with customers. Sony highlighted that it will take comprehensive design efforts and develop standards for its chipsets to assist in development of 5G IoT technology and provide compatibility with Ligado's L-band MSS spectrum. The partnership strategy to utilize 5G chipsets to improve overall capabilities of network will assist the market growth in the coming years. ❑



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Pratik Kirve is writer, blogger, and sport enthusiast. He holds a bachelor degree in Electronics and Telecommunication Engineering, and is currently working as a Team Lead - Content Writing at Allied Market Research. He has an avid interest in writing across different verticals. When he is not following the updates and trends, he spends his time reading, writing poetry, and playing football.

How Lidar Enables a Smart Approach to Traffic Management

SALLY FRYKMAN
Velodyne Lidar

Traffic management is an important tool in creating safer and more sustainable communities around the world. Advanced traffic analysis tools need to leverage modern, smart technology in order to create intelligent infrastructure, which will in turn increase efficiency and sustainability, and save lives.

Across the globe traffic deaths are on the rise. In America alone, the National Highway Traffic Safety Administration projects that an estimated 31,720 people died in motor vehicle traffic crashes from January through September 2021. This was an increase of approximately 12 percent from the 28,325 fatalities projected in the first nine months of 2020. The projection is the highest number of fatalities during the first nine months of any year since 2006 and the highest percentage increase during the first nine months in the Fatality Analysis Reporting System's history.

Lidar is a technology that can enhance traffic management systems by creating an accurate real-time 3D representation of roadways for multimodal analysis to design and implement solutions that address infrastructure challenges.

The Power of Lidar

According to the INRIX 2020 Global Traffic Scorecard, in the United States, congestion, often due to inefficiency, cost US$305 billion in 2020. The use of lidar in Intelligent Transportation Systems (ITS) can improve the efficiency of vehicles and reduce traffic through smart infrastructure. This helps to reduce pollution and improve the overall sustainability of the transportation ecosystem.

Understanding which technologies and datasets solve which problems is imperative for any governmental organization looking to begin the community's infrastructure modernization process. Technologies like lidar and artificial intelligence are being used together for the first time in ITS applications to create intelligent infrastructure systems that inform decision-making and strategy.

Lidar is becoming a key technology in intelligent infrastructure solutions. Unlike older technologies, such as camera, radar and inductive loops, lidar creates a real-time 3D map of roads and intersections, delivering precise traffic monitoring and analytics to detect collisions before they happen.

Lidar reliably collects data in a wide range of lighting or weather conditions, supporting 24/7, 365-days-a-year operation. Additionally, as privacy concerns grow in civic applications, there is a need for non-biased technology. Lidar sensors do not identify biometric data, such as facial features and skin color. This helps preserve community trust and meet privacy law compliance.

A multichannel lidar sensor scans its environment with millions of photons per second, with rotational lidar sensors providing a precise 360-degree view of the surrounding environment. Lidar can detect and classify both moving and static objects. Furthermore, as its own light source, lidar can see in all lighting conditions, including nighttime.

Unlike 2D cameras, lidar sees in 3D, a huge advantage when accuracy and precision are paramount. The laser-based technology produces real-time, high-resolution 3D maps, or point clouds, of the surroundings. Lidar delivers a level of distance accuracy that is superior to cameras, even ones with stereo vision. Whereas cameras make assumptions about an object's distance, lidar produces and provides exact measurements. Compared to camera systems, lidar's ability to see by way of precise mathematical measurements decreases the chance of feeding false information to the infrastructure solutions.

Camera performance is also greatly impacted by environmental conditions, such as bright sunlight and glare, and darkness. Cameras are also more susceptible to unpredictable blind spots and generating

false positives or negatives. These are issues that do not impact lidar sensors.

Lidar in Intelligent Infrastructure

Municipalities and governments are increasingly recognizing big future potential benefits that can be gained with ITS. Modernization of infrastructure can be advanced by solutions that apply deep learning to transform raw lidar data into actionable road usage and safety information. From movement counts of turning vehicles to analyzing near misses between vehicles, pedestrians and cyclists, a lidar-based monitoring system reliably detects and tracks all road users.

An example of a lidar-based application is Velodyne's Intelligent Infrastructure Solution, a full-stack hardware plus software system. It combines Velodyne's lidar sensors and AI software from Bluecity to provide a modern approach to monitor traffic networks. The system is a turnkey solution for traffic operations, transport planning and safety improvements.

Intelligent Infrastructure Solution can predict, diagnose and address road challenges and provide cities with better data for smoothing out traffic problems. Lidar, AI and real-time multimodal analytics provide actionable data, empowering city officials to determine infrastructure needs and initiatives, including roadway planning and optimization, traffic flow, citizen safety, parking management and environmental improvement. The solution provides the ability to improve traffic flow patterns through an intersection, which can reduce congestion and maximize traffic efficiency, in turn decreasing pollution.

Intelligent Infrastructure Solution is helping communities in three continents understand the root causes for traffic safety and operation issues. They can use the data collected to diagnose and then solve the problems uncovered. The solution provides advanced tools to help transportation and city officials plan for and invest in a safer, more sustainable and equitable traffic network, and advance Vision Zero initiatives.

Vision Zero is a global movement to end traffic-related fatalities and serious injuries by taking a systemic approach to road safety. The premise of this strategy is that road deaths and injuries are unacceptable and preventable. First implemented in Sweden in the 1990s, Vision Zero has proved successful across Europe – and now it is gaining momentum in North America, South America and India.

For example, Intelligent Infrastructure Solution is deployed in the city of Austin, Texas USA to help achieve its Vision Zero goal of eliminating traffic deaths and serious injuries on Austin streets. The installation

began with a pilot at an intersection that has been identified as needing improvement due to accident history, fatality risks, speeding prevalence and congestion. Austin is testing the solution at this intersection to demonstrate data accuracy and scalability to maximize taxpayers' dollars.

Intelligent Infrastructure Solution provides a data-driven approach to roadway safety, through Surrogate Safety Analysis of all road users. It enables governments to take a proactive approach on safety by offering real-time Surrogate Safety Analysis of not only vehicles, but also vulnerable road users.

Let's look at some of the ways a lidar-based intelligent infrastructure solution can be used.

Safety Analytics. Intelligent infrastructure solutions, using a single lidar sensor, provide near-miss analytics that can be used to predict, diagnose and address road safety challenges before the next collision happens. Today's camera-based solutions require several cameras per intersection or identified public area, which typically take longer processing times to get the final analysis. Traffic studies aren't complete if they operate only at certain hours or under certain conditions.

Traffic Efficiency and Sustainability. These solutions deliver reliable real-time traffic data to optimize traffic light timing based on congestion and throughput in all types of weather and lighting conditions. Lidar-based solutions cover various road users, including vulnerable pedestrians and cyclists, whereas current technologies generally provide data for vehicles only. By making traffic more efficient, the cities can reduce pollution, improve public transportation and advance other sustainability initiatives.

Crowd Analytics. An intelligent infrastructure solution can enable businesses and cities to improve revenue and infrastructure by providing foot traffic data analytics to learn about traffic patterns, congregation areas, congestion points and more. Knowing how people move and where they stop along the way is useful to designers, architects and city planners.

Emergency Services. These solutions can

detect collisions and near-miss incidents in real time to provide data to emergency response services for faster dispatch in both urban and rural environments.

Wildlife Protection. An intelligent infrastructure solution can detect wildlife crossings and help prevent collisions that often result in substantial personal, environmental and economic losses, including human injuries, fatalities, loss of wildlife and vehicle damage.

Vehicle to Everything (V2X) Communication. V2X is an umbrella term for a vehicle's wireless communication system, where information from sensors and other data sources is shared via high-bandwidth communication. Intelligent infrastructure solutions can use extracted trajectory road user data around intersections to predict potential collisions. This information can be used to warn connected vehicles via V2X communications. Vehicle manufacturers can leverage the solution's analytics in combination with their on-board safety systems to reduce accident probability.

Planning for V2X Communications

In many countries, local governments view V2X technology as offering great promise to help reduce road fatalities. Much of the early V2X focus has been on communication between vehicles to exchange information that can help determine the risk of crashes so drivers can take early evasive actions, as needed. To fully realize the safety benefits of V2X, this communication needs to extend beyond vehicles to include infrastructure and pedestrians using the same roadways. In doing so, V2X can provide the critical data needed to improve traffic and protect vulnerable road users.

The future of transportation includes infrastructure interacting with vehicles through wireless technologies. For example, ITS applications can use lidar to extract trajectory road user data around intersections to predict potential collisions. This data can be used to warn connected vehicles through V2X communications. Vehicle manufacturers can leverage ITS analytics in combination with their on-board safety systems to reduce collision probability.

The world is headed to a collaborative environment between infrastructure and road users. Velodyne's Intelligent Infrastructure Solution supports V2X communication that provides connected vehicles and autonomous vehicles with reliable multimodal traffic data. The solution converts that data into insights which vehicles can use in daily activities. Smart infrastructure integrated with connected and autonomous vehicles have the potential to deliver major improvements in roadway efficiency and safety.

Conclusion

Traffic counts are essential to optimize traffic management. Automated traffic counting is widespread on motorways today. Numerous contact loops, camera systems and radar sensors are permanently installed in order to analyze the traffic separately for heavy-duty and passenger traffic in real time.

However, often only data on the number of road users is available, depending on the type of sensor used. In addition, there are current system restrictions resulting from the use of cameras, which do not perform well in poor lighting and climate conditions, and radar, which completely misses information on vulnerable road users such as cyclists or pedestrians. Additionally, these systems can only detect collisions after they happen.

Using lidar sensors, powerful multimodal traffic analysis solutions can be created that go far beyond basic traffic counts. Lidar can provide reliable traffic data with enhanced metrics, such as real-time incident detection, warning messages, real-time accident prediction, hotspot identification and more. Lidar is an essential component to building smart, modern traffic management that can create a world where traffic accidents are rare, driving is a positive experience and carbon emissions are reduced.❑

AUTHOR

SALLY FRYKMAN
Chief Marketing Officer
Velodyne Lidar

Sally Frykman is Chief Marketing Officer at Velodyne Lidar. As CMO, Sally oversees the strategic development and execution of global marketing and communications programs, including public and media relations, marketing campaigns and events, public policy and advocacy, education efforts and more. Sally is deeply committed to advancing Velodyne's mission of creating smart technology for a world in motion to advance mobility and safety for all.

Indicative: BIS formulated performance standards IS 17855:2022 for Electric Vehicle Batteries

Electric vehicles are vehicles that operate on electric motor and rechargeable batteries. Over the past decade, Electric vehicles have grown in terms of visibility and availability in the market. For safety of consumer, reliability and safety, Energy storage systems become critical part of any EV. Most of the EVs use Lithium- ion batteries because of its High power to weight ratio.

Lithium-ion-based battery systems are an efficient alternative energy storage system for electrically propelled vehicles. The requirements for lithium-ion based battery systems for use as a power source for the propulsion of electric road vehicles are significantly different from those batteries used for consumer electronics or stationary usage. Bureau of Indian Standard, National Standard Body of India, recently published a standard IS 17855: 2022 (Electrically Propelled Road Vehicles — Test Specification for Lithium-ion Traction Battery Packs and Systems — Performance Testing), which is harmonized with ISO 12405-4: 2018.

ISO 12405 specifies test procedures for lithium-ion battery packs and systems which are connected to the electric propulsion system of electrically propelled vehicles. The objective of ISO 12405 is to specify standard test procedures for the basic characteristics of performance, reliability and electrical functionality of lithium-ion battery packs and systems and to assist the user in comparing the test results achieved for different battery packs or systems.

This standard provides specific test procedures for lithium-ion battery packs and systems specially developed for propulsion of road vehicles. It specifies such tests and related requirements to ensure that a battery pack or system is able to meet the specific needs of the automobile industry. It enables vehicle manufactures to choose test procedures to evaluate the characteristics of a battery pack or system for their specific requirements. It is formulated considering real life scenarios for an electric vehicle such as vehicle is in parking (battery is not used for extended period of time), battery system is being shipped (stored), operating battery at low and high temperature etc., accordingly various tests are incorporated in this standard. Tests specified in this standard are as follows.

General tests

a) Preconditioning cycles
b) Standard cycle

Performance Tests

a) Energy and capacity at RT
b) Energy and capacity at different temperatures and discharge rates
c) Power and internal resistance
d) No load SOC loss
e) SOC loss at storage
f) Cranking power at low temperature
g) Cranking power at high temperature
h) Energy efficiency
i) Energy efficiency at fast charging
j) Cycle life

This standard also consist informative annexures about Battery packs, example of test condition etc.

Safety and performance are two critical aspect of Electronic devices. This standard incorporates the test procedure for basic characteristic of performance, reliability and electrical functionality for the battery packs and system for either high power or high energy application. Unless otherwise stated, the test applies to both applications. ❑

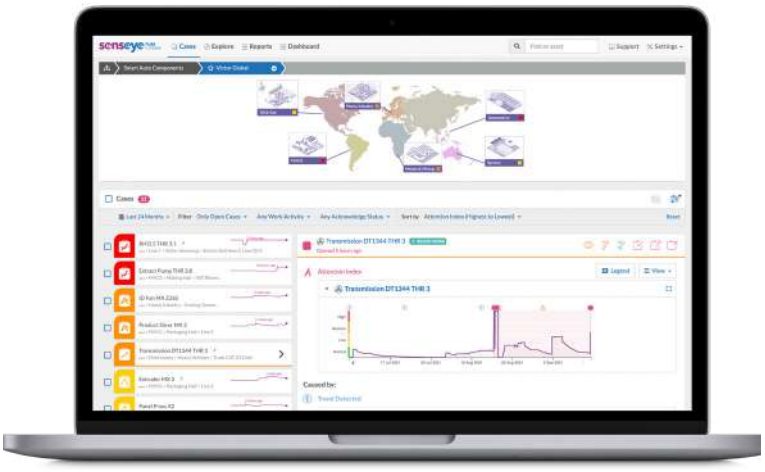
Siemens in Automotive

Siemens acquired Senseye

Recently, Siemens Digital Industries acquired Senseye, the UK headquartered provider of predictive maintenance software. Founded in 2014, Senseye has since then raised approximately $20 million across various funding rounds. In addition to the UK, Senseye has offices in Germany, Japan, France and USA. Senseye will join Siemens Digital Industries as part of the Customer Services Business Unit.

Senseye and Siemens have had a strategic partnership since 2018. The partnership has enabled Senseye's predictive maintenance software to be available to firms through the Mindsphere IoT platform. The acquisition signifies a natural next step to the four-year partnership, and with Senseye's software as part of its Digital Enterprise portfolio, Siemens aims to offer industrial firms solutions to better understand the condition of assets and therefore improve overall equipment effectiveness (OEE).

This acquisition will enable firms to access the best of both worlds - Senseye's AI-based predictive maintenance software with Siemens' technology ecosystem and industry expertise to optimize maintenance and improve asset as well as manufacturing performance.



Cases-MacbookPro **Source:** Siemens

Siemens invested in WiTricity

Siemens has invested US$25 million and acquired a minority stake in US-based WiTricity, a wireless charging technology company. Siemens and WiTricity will work together to adoption of open, interoperable standards in wireless charging for global electric vehicle infrastructure.

In addition, both parties will collaborate to advance the technical development of wireless charging systems. Siemens will also become a technology license partner, benefitting from WiTricity's deep know-how and decade-long collaboration with global automotive OEMs to develop proven, field-tested, interoperable wireless charging solutions.

The ultimate goal of the collaboration is to accelerate the maturing of wireless charging technologies together with OEMs and infrastructure partners to simultaneously ensure their cost-effective availability worldwide.

Recently, the United Arab Emirates' Ministry of Energy and Infrastructure selected Siemens technology for a nationwide network of ultra-fast EV chargers which will help reduce carbon emissions, boost adoption of EVs by addressing so-called range anxiety, and lay the groundwork for a more connected and sustainable transportation system.

Siemens will provide the charging infrastructure equipment, control and monitoring software, as well as training and commissioning support for the new network. The command-and-control system allows full monitoring and control of all units and provides the foundation for the next phase of the project, which is to build an app for drivers to access and book chargers ❑

Setup for wireless charging of electric vehicles **Source:** Siemens

Sony Electronics has launched its brand new XAV-AX4000 and XAV-AX6000.

Sony Electronics has launched its brand new XAV-AX4000 and XAV-AX6000.

Both AV receivers will come with new features, including the one that lets you make a fully wireless smartphone conversion. That feature will make it easier for the drivers to use voice control to control the audio and navigate the roads without needing to take their phones out.

The devices will also integrate Apple CarPlay and Android Auto. First, Apple CarPlay will be able to access music, make phone calls, get proper directions, and send and receive messages without any hassle.

The new AV receivers from Sony Electronics have a sleek overall design. Both of them come with a 6.95 inches display.

While the XAV-AX6000 equips a bezel-less flush panel, the XAV-AX4000 has an anti-glare one. They also offer a stylish look and seamless user experience.

On that note, the XAV-AX6000 has an HDMI port. That will enable to hook up external video and audio sources. And as both have support for LDAC, you will get an exceptional overall sound from the wireless audio sources.

The devices are also compatible with FLAC audio files. One can get a redefined car music-listening experience.

Using the receivers will not be a hassle either. Both have simple button controls, and the buttons are reasonably large in size. You can quickly tune the source, sound, and volume settings through those.

XAV AX 6000

Furthermore, the Sony Electronics XAV-AX6000 and XAV-AX4000 come with a USB Type C connection interface.

For that reason, plugging the devices into the power source will be hassle-free. Also, the connectivity will ensure maximum smartphone connectivity as it can carry up to 5 V and 3 Amps.

Then, the Android Auto, which comes with the latest update, will enhance the safety and convenience to the max. It will enable the drivers to stay informed and entertained without needing to take their eyes off the road.

Alongside that, the devices are compatible with iDatalink Maestro. It makes the devices capable of working like a customized display for the car.

And thanks to that, there is no need to worry about losing the factory-equipped features and functions of the vehicle. It also offers a seamless interface for factory infotainment. ❑

XAV AX 4000

Volkswagen-led research team to recycle batteries multiple times for the first time

Partners from the industrial and scientific communities want to jointly prove that the most valuable components of traction batteries can be recovered and reused several times in succession through recycling. The HVBatCycle research consortium has the goal of keeping cathode metals, electrolyte and graphite permanently in a closed material cycle (closed loop). Under the leadership of the Volkswagen Group, TANIOBIS GmbH, J. Schmalz GmbH and Viscom AG are working together with researchers from RWTH Aachen University, TU Braunschweig and the Fraunhofer Institute for Surface Engineering and Thin Films (IST) for three years to research and develop the necessary processes. The project is funded by the Federal Ministry for Economic Affairs and Climate Action.

HEADLINES

- LG accelerates its electric vehicle charger solutions business
- NovaCHARGE goes international with its electric vehicle hardware and cloud networking solutions
- Volkswagen's first fully-electric limousine: The ID. AERO is under starter's orders
- Delta launches SLIM 100 EV charger for space critical applications
- Otonomo's connected OEM data enables electric car subscription company to accelerate growth and create new revenue streams
- One of America's largest electric bus fleets reveals operating costs of EV buses using wireless chargers from Momentum Dynamics is half of a diesel-fueled bus
- Volvo Trucks showcases new zero-emissions truck
- Saietta accelerates transition to a provider of fully integrated e-drive systems
- Atlis Motor Vehicles signs MOU to provide batteries to UK-based INDe EV Limited for new commercial electric vans
- Biden announces standards to make electric vehicle charging stations accessible
- Landis+Gyr's EV charging business picks up speed with software contract in New Zealand
- Renesas introduces complex device driver software to ease development of battery management systems for electric vehicles
- EdgeEnergy™ releases 100 kW single-phase DC fast charging solution

Orange EV unveils the e-TRIEVER™, the 3rd generation of its electric yard trucks

Orange EV announced the new e-TRIEVER™ brand for its Model Year 2022 all-electric terminal trucks. The e-TRIEVER builds upon the T-Series' exceptional foundation while continuing Orange EV's commitment to innovation and delivering trucks that meet the demanding needs of heavy-duty, goods movement operations.

Orange EV commercially deployed its first all-electric yard truck in 2015. Five million miles, 1.5 million hours, and 400 trucks later, Orange EV is recognized as the leading manufacturer of Class 8 electric truck solutions.

The e-TRIEVER features DTS™ (Digital Truck Systems) designed to integrate with autonomous control systems along with advanced digital cab architecture, improved sensing, remote diagnostic capabilities, and an optional IntelliBoom™ package that captures 5th wheel load weight, boom lift cycles, and kingpin presence and retention data.

Scania introduces electric trucks for regional long-haul

Scania introduced solutions built upon the next level of battery-electric trucks (BEV). The new generation, available with R or S sleeper cabs, is part of a complete solution that will open the door to the electrified transport landscape wide for a vast number of customers and applications. With 624 kWh of batteries installed, Scania provides the means for a major shift regarding electric trucks and their operability in regional long-haul operations.

Scania's new BEV truck generation is based on classic Scania cornerstones such as modularity, sustainability and a total operating economy with the potential to match or even exceed what can be expected from conventional trucks. And the latest electric Scania trucks are accompanied by all the support with operational factors and services that make them complete solutions, with charging, finance, insurance and maintenance all in place.

Otonomo and Xouba make roads safer using connected vehicle data

Otonomo Technologies Ltd. announced a strategic collaboration with Xouba to unlock data insights that will guide road network improvements and enhance safety on roads in Spain. As part of the agreement, Xouba will gain access to Otonomo's floating car data to help identify high-risk, accident-prone locations, determine areas that need road work and to study the effectiveness of implemented road safety measures.

The first project to be developed using the data provided by Otonomo's platform will focus on safety within high-risk areas such as school district crosswalks. In the past, monitoring of car speeds required "traffic-camming," otherwise known as radars or cameras within the crosswalk areas. Now, with Otonomo, near-real time and historical data on driving patterns can be harnessed and analyzed in these priority areas.

Aramex selects Rand McNally's Connected Vehicle Platform

Rand McNally announced that its connected vehicle platform, Rand Platform, has been chosen by Aramex to help optimize the organization's fleet performance. The global logistics and delivery company is rolling out the solution to 11 locations in the Middle East and North Africa region, with plans to expand the program in coming months.

Focused on saving fuel and improving vehicle and driver performance, Aramex chose the Rand McNally Fleet platform due to the solution's "API-first" architecture that makes integrations easy and flexible. The platform is device-agnostic and seamlessly supports multiple asset types – just what Aramex needed with its varied vehicle fleet that includes vans, motorcycles, trucks, and warehouse vehicles, among others.

The deal with Aramex includes Rand McNally supplied hardware, a driver app and manager app, and a customized web portal from which managers can track vehicles and driver metrics. The hardware is a mixture of OBDII plug-in devices as well as hard-wired equipment for two-wheeled and older vehicles that don't have OBDII ports.

Wejo launches Wejo Labs to provide data scientists with self-serve access to connected vehicle data

Wejo Group Limited announced the launch of Wejo Labs. Wejo Labs is a cloud-based platform that allows researchers and data scientists from universities, research organizations and civil and traffic engineering consultancies to run traffic and mobility studies at scale with accurate Connected Vehicle Data (CVD) from tens of millions of connected vehicles across the US and Europe.

Traffic and mobility studies can be run with Wejo Labs through the configuration of CVD on vehicle events. Queries on this data can lead to a better understanding of how road conditions affect driving behaviors, validate weather conditions with hyper-local data points, analyze parking trends and identify roads in which hazardous driving occurs most often to support safety improvements. Additionally, users can also leverage the CVD when analyzing vehicle movements for views into routes and journeys, enhanced origin-destination studies, congestion management, event planning and high traffic destinations.

HEADLINES

- **Raythink completes Series A+ financing to accelerate mass production of in-vehicle AR displays**
- **WirelessCar expands connected vehicle services with new Android Automotive OS-based applications featured in Polestar cars**

Senmiao Technology launches ride-hailing platform in Guiyang

Senmiao Technology Limited announced the launch of its proprietary online ride-hailing platform for drivers in Guiyang, the capital of Guizhou Province.

A total of over 2300 rides have been completed in Guiyang on Senmiao's online ride-hailing platform since it was launched on June 14, 2022. With the addition of Guiyang, Senmiao's platform is now available in 20 cities across China, including six cities in Sichuan Province and 14 major cities in other provinces in China.

With a population of approximately 6.1 million, Guiyang is one of the fastest-growing provincial capital cities in China. Guiyang is recognized as one of the key central cities in Southwest China by the State Council and has become the political, economic, cultural, scientific and educational center of Guizhou Province, following the establishment of the Guiyang Free Trade Zone in 2013. Guiyang is also an important transportation and communication hub, driving industry, business and tourism in the southwest region of China.

New type of vehicle developed by Einride gets NHTSA approval to operate on US public road

Aerial photo of an Einride Autonomous Electric Transport (AET) vehicle

Source: Business Wire

Freight technology company Einride announced that it has received approval from the National Highway Traffic Safety Administration (NHTSA) to operate its Autonomous Electric Transport (AET) vehicles on U.S. public roads. With this approval, Einride will conduct a public road pilot to support operational flows for customer GE Appliances, a Haier company, showcasing the Einride Pod's purpose-built functionality for future commercialization. The autonomous and electric Einride Pod's design does not leave room for a driver on board and is instead remotely monitored by a Remote Pod Operator, marking this pilot as an industry first for this new type of vehicle.

The Einride Pod will operate on public roads with mixed traffic while executing real life workflows. This will include the movement of goods and coordinating with teams at various warehouses for loading and unloading. A Remote Pod Operator will be remotely monitoring the vehicle at all times – a first of its kind role that Einride sees critical in safely scaling autonomous vehicles by keeping humans in the loop and creating jobs to fulfill a future way of shipping.

OTTO Motors software release gives unparalleled visibility into fleet performance of autonomous mobile robots

OTTO Motors released software giving customers better visibility and depth of their fleet's performance in a continued commitment to support the world's largest AMR deployments.

Capabilities for independent troubleshooting and fleet analysis

- Customers can now playback snapshots, which are detailed logs of Fleet Manager, robot actions, and statuses presented in video form. They show what the robot was "seeing" and "thinking" at the time of an issue. Because snapshot playback can be done inside Fleet Manager without calling customer support, customers now can run immediate diagnosis of issues on their own.
- Customers are shown a historical timeline of exceptions and can create snapshots to send to customer support or for internal playback. Now, customers can review the history of exceptions, spot trends, correlate them to events in their facility and diagnose root causes.

Fleet Analytics for process improvements

The new Fleet Analytics tool provides access and insight into the deployed fleet. Operators can find jobs, places, robots, or tasks that are slow or failure prone so they know where to target process improvements to increase material handling flow and return on their AMR investment.

Fleet Dashboard for insights and status tracking

The new Fleet Dashboard, designed for a big-screen TV, provides an at-a-glance status of the fleet from across the floor, providing another way for end-users to stay on top of their operations.

HEADLINES

- EV Connect acquired by Schneider Electric to accelerate EV Revolution
- Hyundai Motor Group and Michelin join hands to develop next-gen tires for premium EVs to foster clean mobility
- Toyota to collaborate with Redwood Materials on a sustainable, closed-loop electrified vehicle battery ecosystem
- Shape and SSAB announce partnership on fossil-free steel for automotive applications
- Sternum joins NXP marketplace as its first real-time IoT security and observability solution
- Dirac and Dolby collaborate to demonstrate high quality immersive automotive audio experience
- Samsara and General Motors work to optimize cloud-based fleet management
- Monbat and Advanced Battery Concepts sign memorandum targeting full-scale commercialization of bipolar lead batteries
- SoftBank Robotics America announces global strategic partnership with Autonomous Solutions, Inc.
- Supply chain specialist proudly attains Earned Recognition with TruTac
- Stellantis and Toyota expand partnership with new large-size commercial van including an electric version
- Kolte-Patil Developers and Tata Power partner to ease EV adoption, drive sustainability
- Avanci announces patent license agreement with Ford
- Ford Trucks select CYMOTIVE Technologies to undertake its cybersecurity compliance certification for vehicle-type approval under UNR 155 AND 156 regulations
- BlackBerry-powered PATEO digital cockpit selected for 10+ new vehicle models across five OEMs
- Vayyar selects proteanTecs to advance vehicle safety with predictive analytics
- Hyzon Motors to collaborate with Schlumberger in decarbonizing oil & gas field operations with high-power fuel cells
- AI chipmaker Hailo collaborates with Renesas to enable automotive customers to seamlessly scale from ADAS to automated driving
- FEV and ProLogium sign MOU for the development of solid-state battery systems
- Volkswagen and Siemens invest in Electrify America's ambitious growth plans
- Wejo and Ford to leverage connected vehicle data across Europe to enable end-to-end insurance offerings
- DMI and SoundHound partner to bring conversational intelligence and connected vehicle solutions to the automotive industry
- Renesas and Cyberon partner to deliver integrated voice user interface solutions for Renesas RA MCUs supporting over 40 global languages
- Renesas partners with Tata to accelerate progress in advanced electronics for India and emerging markets
- Motive and Navistar partner to equip fleet operators with robust vehicle telematics data and insights

RoboSense reached strategic partnership with WeRide to promote large-scale commercial application of autonomous driving technologies

RoboSense announced strategic partnership with WeRide. This partnership will assist WeRide in accelerating its on-board application of automotive-grade smart solid-state LiDAR and speed up the large-scale series production and commercial application of autonomous driving technologies.

Constant technological innovation, aim at commercial application, and focus on large-scale production are the basis of this partnership. Currently, RoboSense has connected with a number of upstream and downstream partners in the industry to integrate advantageous resources and establish a complete supply chain. Deployment of a number of smart production lines of RoboSense in Guangzhou, Shenzhen and other cities are basically completed, with an expected annual production capacity of one million units, which guarantees a continuous and stable supply of advanced and reliable products for WeRide and other partners.

Based on this strategic cooperation, the two parties will continue to deepen industrial integration through technological innovation to provide consumers with a safer, more comfortable, convenient and normalized autonomous driving travel experience.

Waymo Via and Uber Freight partner to accelerate the future of logistics

Uber Freight and Waymo Via announced a long-term strategic partnership to connect their technologies and deploy autonomous trucks at scale on the Uber Freight network. This partnership brings together the power of Waymo's autonomous driving technology with the scale of Uber Freight's network and leading marketplace technology, unlocking a roadmap for the thoughtful and safe implementation of autonomous trucks on America's roads.

This agreement is an important milestone that includes a deep product integration and long-term collaboration roadmap that involves building the tools and infrastructure specific to the successful deployment of autonomous trucks for Uber Freight's shipper and carrier customers. Carriers that purchase trucks equipped with the Waymo Driver in the future will be able to opt-in to Uber Freight's marketplace through user-friendly applications that enable them to seamlessly deploy their autonomous assets on the Uber Freight network.

Ride share and Ride-hailing boost global purpose-built vehicle demand

The need to address various requirements in ride share and ride-hailing expedites purpose-built vehicle (PBV) market growth, finds Frost & Sullivan's recent analysis. This sector involves original equipment manufacturers (OEMs) designing, fabricating, and selling highly customized vehicles that adapt to customers' application needs. With three innovative business models—build-and-own, build-and-sell, and configure-and-buy—the PBV market improves automotive business models' vertical integration and brings customers and manufacturers closer by eliminating gaps.

Customers' increasing preference for PBVs presents growth prospects for market participants in different areas, including:

- Disrupting the cargo delivery vehicle market: Logistics companies can commission PBVs to achieve maximum cargo space and reduce the fleet number and operational costs incurred by each fleet.
- Facilitating the advent of autonomous shuttles and robotaxis: Companies developing purpose-built shuttle services can consider optimizing the vehicle design to convert the same vehicle to autonomous shuttles and robotaxis in the future.
- Creating opportunities for start-ups: Automotive start-ups can leverage the PBV market to offer fresh concepts and create technologically updated vehicles for ride share and ride-hailing services.

On-road hydrogen vehicles to exceed 1 million globally by 2027, Juniper Research study finds

A new study from Juniper Research has found the number of hydrogen vehicles in service globally will exceed 1 million in 2027, from just over 60,000 in 2022 – a substantial growth of over 1,500%.

Juniper Research defines hydrogen vehicles as vehicles that use hydrogen propulsion systems as their onboard fuel. The chemical energy of hydrogen and oxygen reacts with the fuel cell and converts the energy to electricity.

The research identified hydrogen vehicles as an increasingly viable alternative to BEVs (Battery Electric Vehicles). The potential for enhanced range and rapid refuelling compares favourably with BEVs; reducing customer anxieties around BEV ownership. These positives have led to significant investment by car manufacturers, including Hyundai, Toyota and BMW, and this will translate into an increasingly popular and available product over the next 5 years.

HEADLINES

- **The TMS market value in Europe and North America to exceed € 3 billion by 2026**
- **Guidehouse Insights anticipates market for solar-integrated transportation technologies will grow to more than $12 billion by 2031**
- **Electric vehicle charging stations market to grow USD 12490 million by 2028 with a CAGR of 31.5% | Valuates Reports**

Berg Insight ranks the leading vehicle telematics hardware suppliers

Berg Insight released new findings about the vehicle telematics hardware market. Close to 42.0 million aftermarket telematics devices were shipped globally during 2021, a market valued at approximately € 2.2 billion. The performance of the market was affected by the COVID-19 pandemic and the supply chain crisis, but the setbacks are expected to be temporary. Until 2026, annual shipments of aftermarket hardware are forecasted to grow at a compound annual growth rate (CAGR) of 12 percent to reach 72.8 million at the end of the forecast period. Berg Insight estimates at the same time that global shipments of OEM telematics hardware for passenger cars, light trucks and commercial vehicles reached close to 53.0 million units in 2021 corresponding to a market value of € 7.8 billion. A combination of commercial and regulatory drivers now encourages a broader set of carmakers to expand availability of connected car services across geographies and market segments. There are also numerous OEM telematics offerings from commercial vehicle manufacturers. The attach rate of embedded telematics units among passenger cars, light trucks and commercial vehicles is forecasted to increase from about 64 percent in 2021 to 85 percent in 2026.

mentor_insight. **Source:** eDriving

eDriving launches non-telematics version of Mentor driver app

eDrivingSM, a Solera company announced the availability of Mentor Insight – the non-telematics version of its driver safety app, MentorSM.

The newest addition to the Mentor family of driver safety apps, Mentor Insight offers many of the same tools to help improve driver behavior, including risk assessment, predictive driver scoring, eLearning, manager coaching, and gamification, but without telematics-based monitoring of driver behavior behind the wheel. This makes Mentor Insight ideal for those companies not yet ready to navigate the privacy concerns that often accompany a full-scale implementation of telematics-based safety applications, as well as companies that may have a telematics solution in place but would like to leverage Mentor's additional feature. One such feature is an integrated Personal SOS function with Emergency Response Services powered by Bosch and Sfara. Available in more than 50 countries, the Personal SOS alert can be triggered by drivers to request assistance if they feel unwell or concerned about their safety at any time, in any place.

HEADLINES

- **SYSTECH is to exhibit fully integrated container and fleet tracking solutions in Mexico**
- **Geotab launches integrated telematics collaboration with Renault to provide turnkey connectivity for fleet managers**
- **Strategy Analytics ranks HERE No. 1 for location data and services**

Find anywhere fast: Jaguar Land Rover, what3words and HERE deliver world-first navigation solution

Jaguar Land Rover is offering customers accurate and precise navigation even in the most remote locations, by becoming the first automotive manufacturer to integrate what3words global location technology into vehicles already on the road through a software-over-the-air (SOTA) update.

Jaguar Land Rover has completed more than 1.3 million vehicle-level updates and more than three million engine control unit updates as part of its always-on, always-connected capability, delivering modern luxury to customers.

Once updated, the system allows customers to input what3words addresses directly into the navigation bar on the Pivi Pro Infotainment system. The integration has been delivered by HERE Technologies, Jaguar Land Rover's navigation partner for the past 25 years. HERE's end-to-end, connected driving services include turn-by-turn guidance, real-time traffic and on and off-street parking that enable a personalized experience, intuitively guiding drivers through their entire journey. Integrated what3words is available in all new and existing Jaguar and Land Rover vehicles fitted with its advanced Pivi Pro infotainment system.

Otonomo debuts key new fleet functionality in Smart Mobility Data Platform

Otonomo Technologies Ltd. introduced fleet Maintenance and Mileage dashboards in the Otonomo Smart Mobility Data Platform. These are the first of several new dashboards to be introduced and provide customers with a breadth of insights that offer fleet managers a snapshot view of all relevant connected vehicle data to easily and efficiently manage fleets of all sizes. Users can set up push notifications for maintenance issues such as low battery charge for electric vehicles, low fuel levels, and for immediate issues, such as when warning lights are triggered.

In the Mileage dashboard, fleet managers can track service milestones and overall mileage, as well as distances traveled by vehicle or by fleet to track trends and spot usage anomalies. The insights presented in the Mileage dashboard are applicable for a number of industry use cases, such as supporting last mile delivery drivers, mileage reimbursement for employees, customer billing, dispatching vehicles for service jobs, and fleet rotation.

The Maintenance dashboard provides near-real-time updates on key vehicle metrics such as electric vehicle charge levels, fuel, and oil levels, brake wear, tire pressure, engine temperature, and more to ensure the highest levels of safety for drivers and vehicles. Fleet managers can receive proactive alerts when routine maintenance is due or when a high-risk event is detected in a vehicle, such as a temperature spike or a flat tire.

Haryana approves 15% discount on electric vehicles

Haryana Cabinet which met under the chairmanship of Chief Minister Manohar Lal Khattar approved the Haryana Electric Vehicle (EV) Policy-2022. Under the policy, a discount of 15 percent will be given to buyers of EVs.

A discount of 15 percent or of Rs Six lakh would be given on an electric car priced between Rs 15 lakh and Rs 40 lakh. Similarly, a 15 percent price discount or a discount of Rs Three lakh will be given on the purchase of a hybrid electric car costing between Rs 15 lakh and Rs 40 lakh.

This apart, 15 percent price discount or a discount of Rs 10 lakh will be given on the purchase of an electric car that costs between Rs 40 lakh and Rs 70 lakh. The CM said that 100 percent rebate in motor vehicle tax would be given on the purchase of electric two-wheeler and three-wheeler.

He said electric vehicle manufacturers will also be given exemption under the Electric Vehicle Policy. An exemption of 50 percent on state GST for 10 years will be given to the manufacturers. There will be 100 percent exemption in stamp duty. Also, 100 percent exemption will be given on electricity duty for 20 years. He said the startup policy has also been approved in the Cabinet meeting which will encourage startups and new employment opportunities will also be created.

HEADLINES

- Three-wheeler EV sales race past those of ICE models in April-May
- Second-life use: Audi e-tron battery modules power electric rickshaws in India
- Tata Motors signs an agreement with BluSmart Electric Mobility for 10,000 XPRES T EVs
- Jio-bp, MG Motor and Castrol sign partnership to boost electric mobility

Omaxe partners with Jio-bp to set up EV charging and swapping infrastructure

Omaxe announced its partnership with Jio-bp, a fuel, and mobility joint venture between Reliance Industries Limited (RIL) and bp, to establish a battery charging ecosystem for electrical vehicles. Jio-bp will set up EV charging and swapping infrastructure at various Omaxe properties across Delhi, Noida, Greater Noida, Faridabad, Ghaziabad, New Chandigarh, Ludhiana, Patiala, Amritsar, Jaipur, Sonipat, and Bahadurgarh in a phased manner.

Appreciating the need for EV charging infrastructure at commercial establishments, Jio-bp is working with developers and real estate players in the country. Jio-bp will install 24*7 EV charging infrastructure for two and four-wheelers at Omaxe properties.

Last year, Jio-bp constructed and launched two of India's largest EV charging hubs. Leveraging the best of RIL & bp's strengths in electrification, Jio-bp is creating a charging ecosystem that will benefit all the stakeholders in the EV value chain. The JV's EV services operate under the brand Jio-bp pulse, and with the Jio-bp pulse mobile app, customers can easily find charging stations nearby and seamlessly charge their electric vehicles.

MG Motor India launches MGverse: A future-ready Metaverse platform

MG Motor announced its vision of MGverse, a Metaverse platform. It will provide an immersive experience to its customers and stakeholders through multiple arenas.

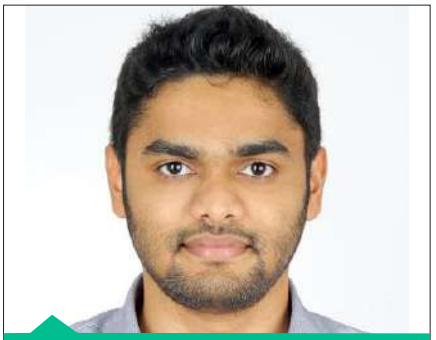
MGverse will act as a universe that combines multiple virtual spaces into a single platform. With this, the brand aims to bring MG fans, customers, partners, and employees together to work, play, en gage, collaborate, co-create, socialise and shop. It will enable users to transcend beyond the restrictions of screens and the boundaries of distance into a future where everyone can be present together to create new possibilities and experience new things.

The platform will be accessible on mobile as well as other web browsers to engage GenZ and GenAlpha. MG intends to make similar experiences available for VR headsets, allowing a more captivating and realistic experience at home and in dealerships. The platform will be executed in phases, with the first phase being implemented during the coming festive season.

MG_Verse. **Source:** MG Motor

IN CONVERSATION WITH INDUSTRY LEADERS

SCOTT MORELL
Vice President of Engineering
Danlaw Inc



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Sales Director
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Co-Founder
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Zen Microsystems

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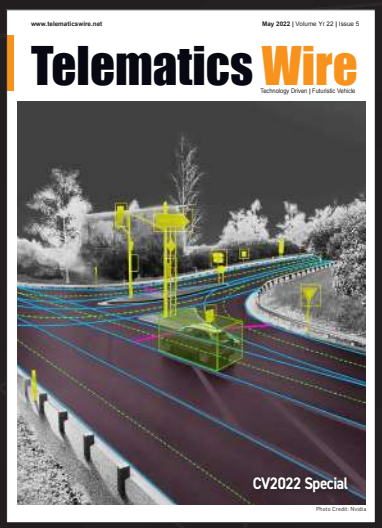

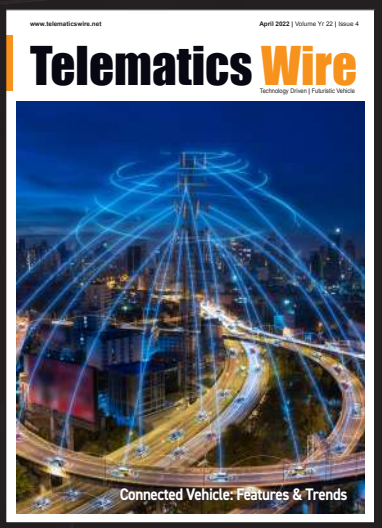

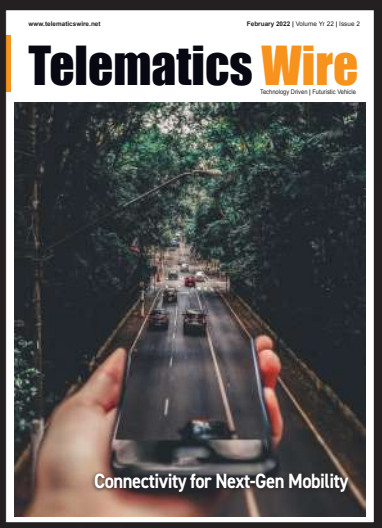

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