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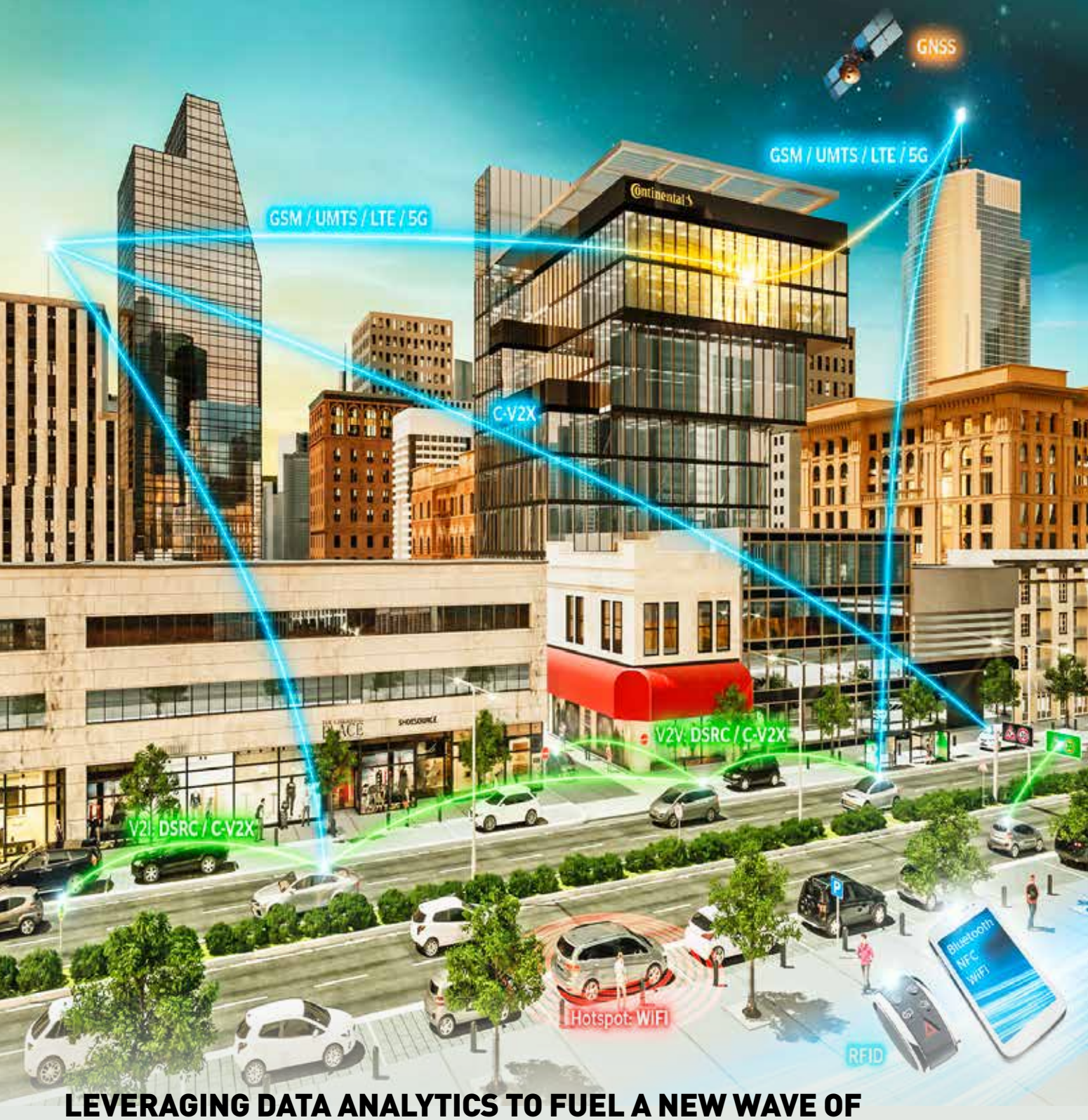

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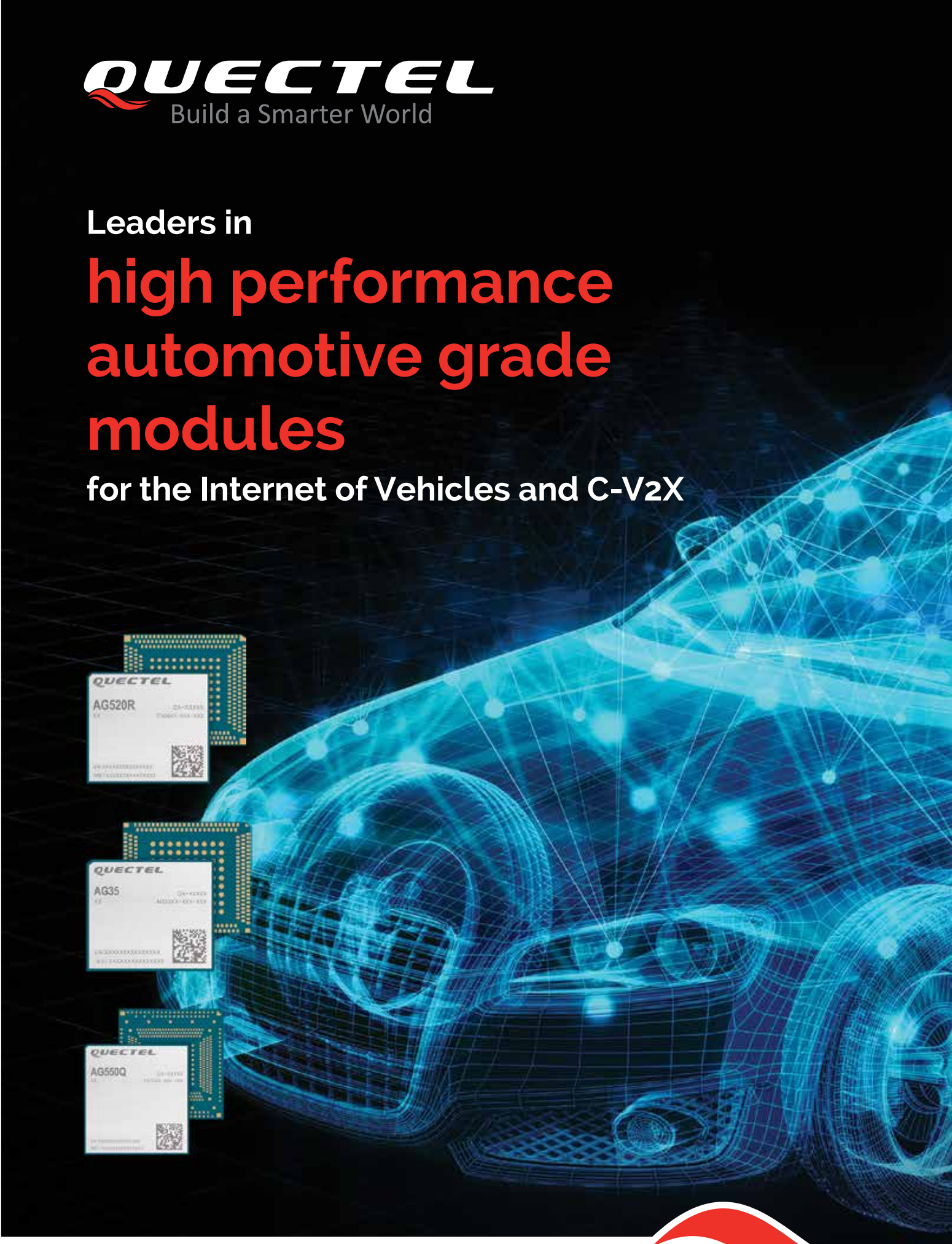

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Data Driven Monetization is the Future of Smart Vehicle

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With the speedy digitisation of the universe, the automotive industry is poised for a gigantic change in the coming decade, if not in the next few years. The automobile industry is on the verge of a technological revolution where vehicles are no longer just mechanical engines. The confluence of automotive industry and smart technologies has made the journey of drivers more easier and safer. At the same time, vehicles have become more feature rich and advanced in meeting societal needs. IoV (Internet of vehicles) may still be far fetched but undeniably vehicles are becoming biggest data creators, and may be next only to humans. They are now mobile data centres, pushing a new wave of storage technology requirements. Significant quantities of data are generated and consumed as cars become more linked and autonomous.

This data, true to its name, is a Big Data which is already giving valuable insights to the automotive industry to improve further in a number of ways by increasing the safety of vehicles, reducing the repair cost and increasing the productivity with predictive analysis and so on.

Smart vehicles contain plenty of data. Most of this vehicles data is of a technical identity and is available temporarily, with very less usefulness locally. The utility of the data within the car which is not stored for a long time is only going to increase in coming years . But certain data even now, is frequently analysed to provide better services, the connected vehicle can provide awareness into driver behaviour, vehicle health and enhance customer confidence in reliability of the vehicle as predictive maintenance replaces traditional approaches to vehicle maintenance.

Automobile data analytics will allow the vehicles to navigate, collaborate and communicate with each other without any human intervention making use of the huge amount of data which is being generated by the sensors in the vehicle.

It is just about an autonomous vehicle; data science, artificial intelligence and machine learning technologies which can help in keeping the automobile companies more competitive by improving R&D, design manufacturing and marketing processes.

Machine learning, data science and eventually artificial intelligence can improve efficiency in the production of smart vehicles which will enable the companies to cut down their production costs, better customer service and development of futuristic innovative products.

With the help of vehicle data analytics the OEMs, Service Centres, Drivers, customers as well as regulators stand to gain. Some of the Big Data mobile apps like (Tableau, Google Chart, Roambi, Qlik etc.,) collect real-time data about the traffic, transportation, accidents and other problems that may occur on the road. Thanks to these applications, crowdsourcing helps in massive collaboration amongst the users. These apps also help the users in reaching their destinations faster and more safely. The car features like parking assistance, booking of parking space or active driver assistance and many others will soon become common features in the vehicles.

As connected and self-driving cars become more common, the use of vehicle data opens up new revenue streams for OEMs and partners. In all spheres, data is being considered as a new gold and the same is going to be true in automotive sector as vehicle data can be used to make money. Big data is an essential by product for autonomous vehicles to see, hear, and respond to their surroundings. It also acts as a resource for a number of use cases outside of the automotive industry, such as retail, banking, and entertainment.

Newer predictions and patterns in the monetization of collected data are on the horizon. In-car microphones, cameras, and sensors generate vast quantities of data in connected cars. These IoT devices not only provide useful information about the driver's actions and interests, but they also track passengers and bystanders, vehicle journey locations and time as well. This enables the collection of a large amount of essential and non-essential data along the way but all that have a potential for innovative new streams of products and services through analytics.

The ability to deliver high-quality goods and services faster than rivals would be the differentiator of success for businesses. But as of now the road ahead does not seem to be devoid of breakers. Would consumers, however, be able to share personal information in return for advanced data-driven solutions? The level of willingness varies dramatically between use cases. Customers are more willing to share information if they understand the benefits and are assured that their information is secure. Data access legislation and the ability to provide advanced protection for personal data are important. It is not possible to simply sell gathered data to third parties.

There are challenges in developing data monetisation business models. Customers, in one way or the other, are a barrier to personal data monetisation, as is the businesses' ability to earn their loyalty. OEMs and their collaborators have to forge a common understanding with the customers and regulators on legal, social, and technological issues related to vehicle data monetisation. Need is to establish norms and solutions that enable them to live more comfortably in the shared data space and focus on developing business models wherein each stakeholder perceives a fair share from the gains.

ON 5G NETWORKS AND MOBILE EDGE COMPUTING IN CONNECTED VEHICLES

DR. ARUNKUMAR M. SAMPATH
MAHINDRA ELECTRIC MOBILITY LIMITED

Over the last few years, connected vehicles have evolved, with automakers installing telematics control units (TCUs) in partnership with telematics service providers (TSPs) and multiple announcements made on connected car cloud and industrial cloud platform developments. Additionally, major changes came about in hardware (4G TCU) and operating system (OS), with almost all automakers launching infotainment systems with advanced in-vehicle experiences. Connected vehicle ecosystem and increased sales of Electric Vehicles (EV) have spearheaded embedded telematics to reach more than 85% penetration in US and EU markets though some automakers are increasingly reliant on Google Automotive Services (GAS) while others continue to encourage home-grown OS to keep tabs on technology know-how. As migration to 5G networks is still ongoing, automakers continue to install 4G TCUs to enable connected vehicles.

Connected Cars and 5G

The number of connected vehicles is growing rapidly capturing almost 35% of the total number of vehicles on the road and with revenue from connected vehicles of about $18 billion. A typical Vehicle to Everything (V2X) architecture is depicted in Figure 1 (Ref [1]) wherein communication of vehicles and roadside sensors with a roadside unit (RSU) is intended to increase the safety, efficiency, and convenience of the transportation system, by the exchange of critical safety and operational data. The key element is LTE/5G networks which enables communication with V2I, V2V, and V2P through Edge Cloud. This architecture also provides value added services such as car finder, parking location and entertainment services.

The V2X architecture in Figure 1 depicts "connected digital ecosystem" providing several smart services opportunities for drivers, passengers, automakers, and mobile network/telematics service providers such as: (i) Advanced/Automated Driver Assistance Systems/Services (ADAS) as driver assistant, parking assistant, self-parking, and semi-automated/automated driving, (ii) Telematics as traffic alerts and road weather condition alerts, (iii) Infotainment services as music/video streaming, (iv) Enhanced visit experience to tourists with Augmented Reality (AR) and Virtual Reality (VR), and (v) Remote diagnostics/maintenance through software/firmware over-the-air (SOTA/FOTA) updates.

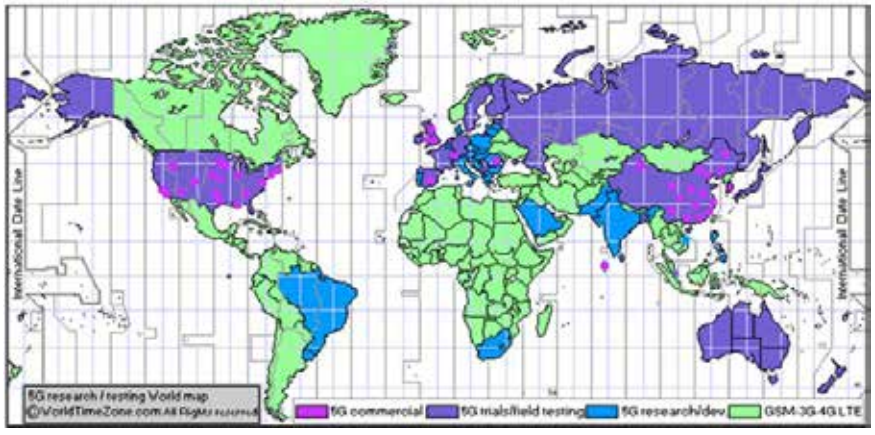

Fig 2. 5G commercial network world coverage map, as of Dec 2019 (Ref [2])

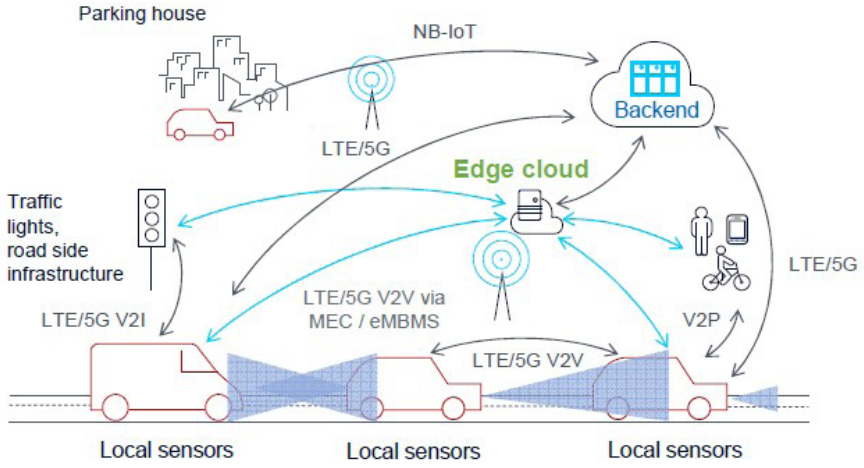

Fig 1. Vehicle to Everything (V2X) Architecture (Ref [1])

The 5G spectrum operates in 3-300 GHz, has bandwidth (BW) of 0.25-1 GHz,

data rate of up to 20 Gbps, spectral efficiency of 30 bps/Hz, mobility of up to 500 km/h, U-plane latency of 0.5 ms, C-plane latency of 10 ms, and with applications comprising voice, data, video call, digital video broadcasting (DVB), video chat, VR/AR/3600 videos, UHD videos, V2X, IoT, smart city, and wearable devices. With 5G networks, it is possible to deliver an extensive variety of services comprising enhanced mobile broadband (eMBB), ultra-reliable and low-latency communications (uRLLC), and massive machine type communications (mMTC). The 5G commercial network coverage across the world as of December 2019 is shown in Figure 2 (Ref [2]), with about 65% of the world population to be covered by 2025.

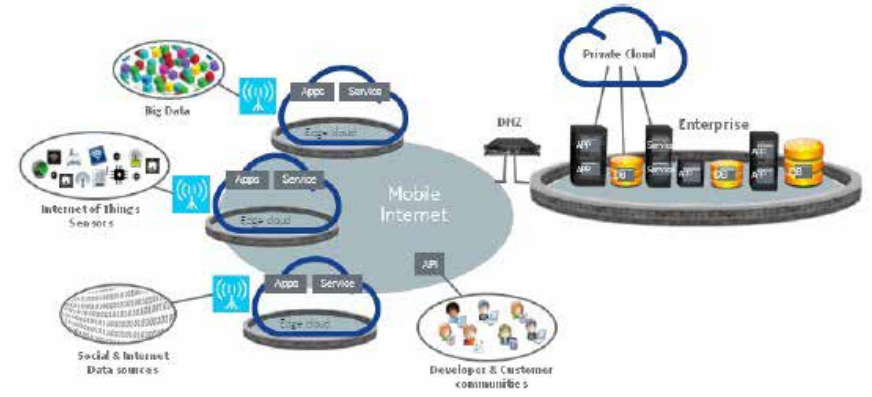

Fig 4. Improved QoE with MEC in close proximity to end users (Ref [3])

Mobile Edge Computing

Mobile Edge Computing (MEC) is a new technology being standardized in the Industry Specification Group (ISG) under European Telecommunications Standards Institute (ETSI). MEC provides cloud-computing capabilities at the edge of the mobile network, within the Radio Access Network (RAN) near mobile subscribers. MEC offers distinct advantages such as reduced latency, highly efficient network operation and service delivery, and improved user experience. MEC is a natural development in the evolution of mobile base stations and the convergence of IT and telecommunications networking as it represents a key technology and architectural concept to enable the evolution to 5G and satisfy the demanding requirements of 5G in terms of expected throughout, latency, scalability and automation. The market drivers of MEC, as shown in Figure 3, include business transformation, technology integration, and industry collaboration.

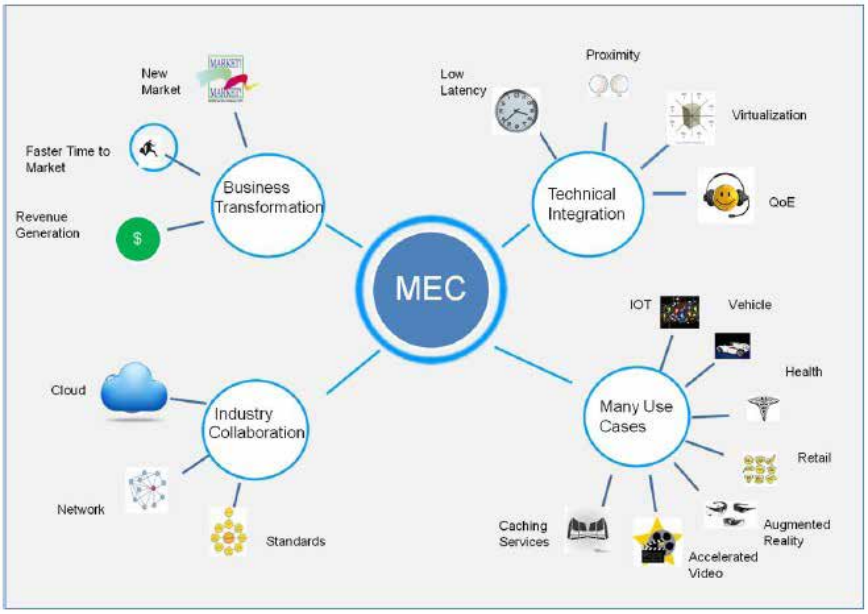

Fig 3. Mobile Edge Computing Market Drivers (Ref [3])

Mobile Edge Computing provides improved Quality of Experience (QoE) in close proximity to end users and opens up services to regular and enterprise customers as well as to adjacent industries that can now deliver their mission-critical applications over the mobile network (Fig 4). MEC enables a new value chain and develops favourable market conditions which will create sustainable business for all players in the value chain. MEC opens up fresh business opportunities and a myriad of new use cases across multiple sectors to facilitate global market growth. MEC helps to create a standardized, open environment that not only allows the efficient and seamless integration of applications across multi-vendor MEC platforms but also ensures that most of the customers of a mobile operator can be served.

Engineering community will continue to face the dual challenges of handling increased volume of data from ever increasing number of connected vehicles while trying to maintain or reduce the latency to ensure faster response time and critical/quick decision making, especially for semi-automated and automated vehicles.

MEC-based Vehicle-to-Cloud solutions enable edge cloud capabilities for different levels of autonomous driving, including Highly Autonomous Driving (HAD) and Fully Autonomous Driving (FAD), corresponding to SAE Levels 4 and 5 of automation, respectively. MEC can be used to extend the connected car cloud into the highly distributed mobile base station environment and enable data and applications to be housed close to the vehicles. This can reduce the round-trip time of data and enable a layer of abstraction from both the core network and applications provided over the internet. MEC provides real-time driving services by utilizing High Definition real-time Maps, real-time traffic monitoring and alerts, and richer passengers experience. MEC applications can run on MEC servers which are deployed at

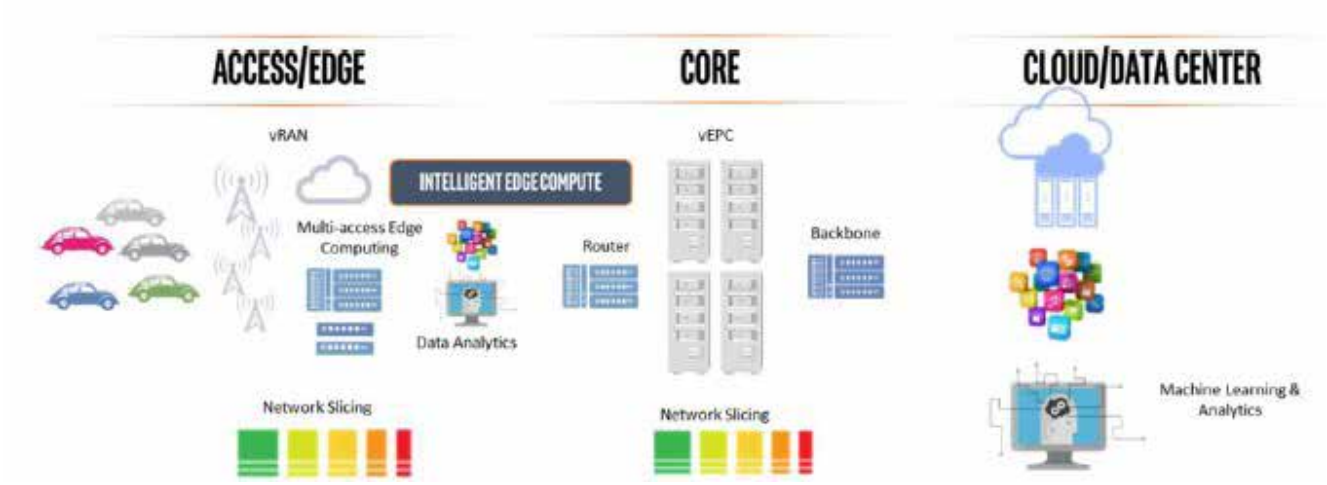

Fig 5. MEC Support to Services for Connected and Autonomous Vehicles (Ref [1])

the LTE base station site to provide the roadside functionality, to support vehicles on roads to drive cooperatively, to be aware of road hazards, and to provide better user experience and trust to drivers and passengers. The MEC applications can receive local messages directly from the applications in the vehicles and the roadside sensors, analyse them and then propagate (with extremely low latency) hazard warnings and other latency-sensitive messages to other cars in the area. This enables a nearby car to receive data in a matter of milliseconds, allowing the driver to immediately react.

Figure 5 depicts the MEC Support to Services for Connected and Autonomous Vehicles by offering Network slicing and Data Analytics at the edge (Ref [1]). As shown in Figure 5, the following features enable MEC:

- Network Slicing to tailor the capacity and capabilities of the network for each different service
- Service-specific profiles for dynamic assignment of service-specific HW-acceleration to optimize the compute and storage based on simultaneous services requirements
- Hierarchical deployment of the MEC environment using a hierarchy of gateways/RSUs with MEC servers arranged to reduce the latency and distribute the processing.

Summary and Way Forward

5G networks with significantly low latency and high network reliability play a critical role in connected vehicle communication networks. Mobile Edge Computing can be considered as a key technology supporting multiple services for Connected and Autonomous Drive vehicles. MEC enables innovative service scenarios that can ensure enhanced personal experience and optimized network operation, as well as opening up new business opportunities. MEC attracts a new value-chain and energized eco-system, where all players can benefit from closer collaboration. MEC supports different deployment options, as MEC servers can be located at different places within the Radio Access Network depending on technical and business requirements. MEC applications leverage proximity to users and vehicles along with network and context information to offer quick decision making with reduced latency. Efforts are continuing towards standardization of MEC technology, as open standards are the way to open the market and to ensure interoperability. A proper synergy between standards (ETSI, 3GPP) and 5GAA is considered particularly important for the development of interoperable technology solutions and for the acceleration of their commercial availability and global market penetration.

As a way forward, the MEC ISG is developing the foundation to enable an open radio access network (RAN) which can host third party innovative applications and content at the edge of the network. A MEC Proof-of-Concept (PoC) program has been established to demonstrate the viability of MEC implementations. Feedback is taken from the results and lessons learned by the MEC PoCs to improve the ISG MEC specification activities. The ISG is open to members and non-members of ETSI to participate and contribute towards this innovative technology, and to take part in the PoC activities

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The Design, Calibration and Application of Traffic Speedmap for Ride Scheduling

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SWAT Mobility

In recent years, we witnessed a gradual paradigm shift in personalized transport services from private vehicle ownership to mobility as a service application (MaaS). A MaaS provider operates a fleet of vehicles that ferry users from their pick-up locations to their drop-off locations at a time of their choosing. To achieve efficient vehicle utilization and overall economies of scale, a MaaS service typically employs a routing and scheduling algorithm to pool a number of users who are headed in similar directions at mutually compatible timings.

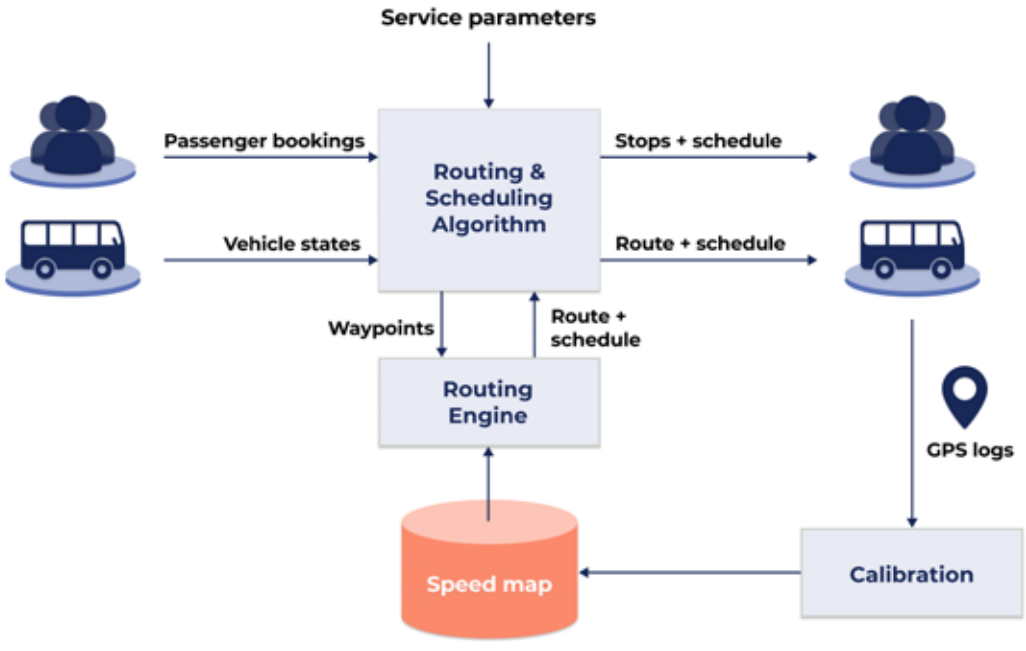
As illustrated in Figure 1, at the heart of a routing and scheduling algorithm is an optimization formulation, where millions of solution candidates, each comprising a permutation of routes and passengers, are evaluated and scored to derive the most optimal outcome while simultaneously satisfying a slew of constraints imposed by passenger bookings, vehicle states, as well as service parameters.

To support the evaluation of each solution candidate, the algorithm calls a routing engine to compute the shortest journey time for a route that passes through a set of waypoints. The routing engine takes into consideration the speed of the vehicle vis-à-vis the expected traffic condition of a road, the accessibility of the road given the vehicle's size, turn restrictions and time penalties associated with navigational maneuvers. To ensure the accuracy of this evaluation, the routing engine taps a database of speed statistics, henceforth referred to as the speedmap.

This article describes an approach for designing, organizing, and calibrating the speedmaps deployed in our real services. Since 2016, we have successfully routed, scheduled and completed millions of rides with this speedmap approach, in numerous Asia Pacific cities such as Singapore, Tokyo, Sydney, Hanoi, Bangkok and Manila. The version of technology presented here has been appropriately modified or vaguely described in parts to safeguard our competitive interest, and to better serve the intended scope and objective of this educational piece.

A speedmap is a database comprising the statistics that summarily quantify the traffic speed distribution of a set of roads plied by the vehicles

The key to accurate ride scheduling is a time-dependent speedmap model that differentiates between weekdays and weekends, and among consecutive time blocks of a day



Index	Way ID	Day of Week	Time Block	Mean Speed	Stddev Speed
0	W0001	Weekday	Peak	20	10
1	W0001	Weekday	Off Peak	40	5
2	W0001	Weekend	Peak	25	10
3	W0001	Weekend	Off Peak	45	8
4	...		...	...	
5	...		...	...	

of a service. The statistics can be the mean, median, standard deviation and various percentiles of the traffic speed distributions.

In the simplest form, a speedmap consists of a singular, time-invariant average traffic speed for each road class. The same speed value is applicable to every way belonging to the same road class, day and night, weekday and weekend. It goes without saying that this is hardly realistic for modelling the traffic situations of most cities.

As traffic speeds vary throughout a day and differ from day to day, an alternative, more useful model for speed statistics is one that differentiates between weekdays and weekends, and among consecutive time blocks of a day. Figure 2 illustrates one such database table for storing traffic speed statistics. We refer to this design as a time-dependent speedmap.

To populate the time-dependent speedmap, raw GPS logs of vehicles are processed in a multi-step speedmap calibration pipeline. As illustrated in Figure 3, speedmap calibration comprises a Map Matching step, a Machine Learning step, and finally, a Map Construction step.

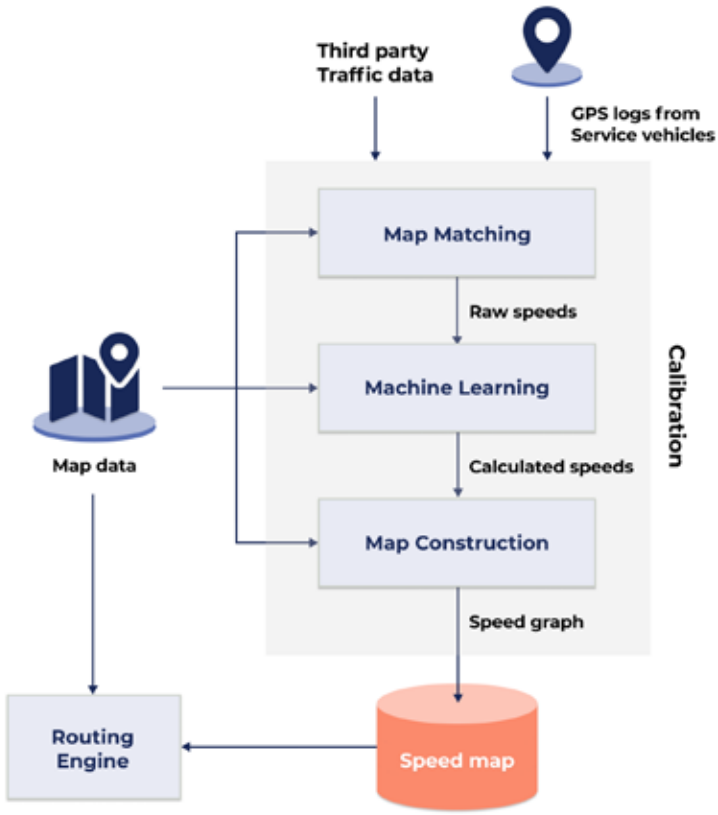
The Map Matching step converts GPS logs of vehicles into raw speed data by matching noisy time-stamped vehicle positions to the road geometries of a trusted map source, such as OpenStreetMap (OSM). As OSM divides a road into connected segments called 'ways' and assigns a way ID to each segment, map-matched positions along the same way can be grouped to derive a raw speed for the way segment. The output from the Map Matching stage is a collection of raw speeds, each characterized by a way ID, a timestamp and a speed value.

At this point, a chicken-and-egg conundrum inevitably arises: a speedmap is required to start a service in a new area, but there isn't in-house historical data available for calibration prior to the service. This is known as the 'cold start' issue. To address this, GPS data can be purchased from third party sources or gathered by putting a few GPS-logging vehicles on the road. For the services we operate, we adopt such a two-pronged approach in building up our initial repository of raw speed data for a new area. Over time, service operations would amass a significant volume of historical speed samples for each way, thereby enabling progressively more accurate statistical quantification in the next step of speedmap calibration.

The Machine Learning step encompasses three major processes: statistical aggregation, model training and prediction. In statistical aggregation, the raw speed samples are grouped by their way ID, weekday/weekend split and time block - collectively known as the grouping labels. Statistics like mean and standard deviation are then aggregated for each group. In model training, a machine learning model is trained to establish a relationship between the underlying map features of the ways, the grouping labels and the aggregated statistics. Based on our research, map features deemed useful for training include, but not limited to, the position, bearing, road class, number of lanes, width and maximum speed of the ways. Groups with insufficient number of speed samples or statistics classified as outliers would be excluded from the training. Finally, in the prediction process, the trained model is used to predict the statistics for all ways using their underlying map features and grouping labels as inputs to the trained model.

Map Construction is the final step of speedmap calibration pipeline, where the map data and the predicted speeds are analysed to generate additional speed-up information that allows the routing engine to accelerate its search for the fastest route through a set of waypoints. Two renown speed-up algorithms are Contraction Hierarchies and Multilevel Dijkstra. Contraction Hierarchies exploits the hierarchical nature of road networks to create direct links between important road nodes; Multilevel Dijkstra creates layers of varying road network sparsity that can be switched around during a search. Regardless of the speed-up algorithm used, the Map Construction step equips the routing engine with the essential data to carry out its path-finding tasks effectively.

To ensure timeliness in capturing the shifts in traffic pattern brought about by social-economic developments, speedmaps should be periodically calibrated using speed data captured in a recent time window



Given a series of ordered waypoints, the routing engine searches for a string of connected ways that pass through the waypoints in the shortest time. The length of each way can be obtained from the map data, while the means and standard deviations of their speeds can be extracted from the calibrated speedmap. The overall mean and standard deviation journey time of the concatenated route can therefore be computed using established statistical theorems. With this information, the route can be scored and compared with another route candidate that serves another permutation of waypoints.

For lateness-sensitive services, such as employee transport that ferries employees from their homes to their workplaces, scheduling a route with mean journey time alone makes the service susceptible to variable traffic conditions, thus elevating the risk of lateness for work. With the aforementioned speedmap design, it is possible to alleviate the risk of lateness by estimating journey time pessimistically with the standard deviation data in the route scheduling process.

To ensure timeliness in capturing the shifts in traffic pattern brought about by long-term social-economic developments like population growth, urban planning, a shift in regulatory landscape and emergence of new transportation networks, speedmaps should be calibrated on a periodic cadence using speed data captured in a recent time window, spanning several months preceding the date of calibration.

As with most things modelled with historical data, a speedmap, notwithstanding its time-dependent intricacies, isn't an infallible crystal ball. Cities typically bustle with ad hoc events - traffic accidents, a sudden rainstorm, a traffic light malfunction, a big truck hogging an entire highway, festive parades or the end of a pop concert – that can occur at various locations during service hours, creating and propagating congestion through chain reactions in dynamic, unpredictable and far-reaching ways. Such ad hoc events can, in reality, subvert a meticulously laid plan and result in service lateness.

While complete elimination of lateness is unattainable, occurrences of lateness can be strategically mitigated by factoring ad hoc incidents into the route planning process. Additional strategies can be put in place to complement the aforementioned pessimistic journey time approach. For example, extra service time buffers can be allocated to each stop to absorb the lateness incurred in preceding journeys, and drivers can be empowered to seek out alternative routes to help them circumvent visible congestion. ❑

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HOW CONNECTED MOBILITY IS DRIVING THE FUTURE OF CARS

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Over the last decade, vehicles have evolved beyond being transportation modes. While some cars on the road today are capable of connecting with the environment around them, this number is growing at a rapid pace. According to few market reports, about 25 percent of the cars on the road across the world will be connected by 2025.

The vehicles of tomorrow will be constantly connected to the internet, and be autonomous, presenting a complex challenge to automakers today. Autonomous driving requires seamless and secure integration, both internally and externally - the vehicle needs to be able to communicate with the surrounding infrastructure and within itself, with minimal or zero inputs from the driver or the occupants. For that to happen, we need to set the stage today.

The vehicles of tomorrow will be an integral part of the internet, just as the mobile phone is today. In terms of function, this needs to be explored in three parts:

- How the vehicle interacts with the driver and the environment
- How the vehicle understands the needs of the driver and offers solutions
- How the systems are integrated within the vehicle for optimal functioning.

In other words, the functions fall under - Connect, Inform and Integrate.

Connectivity: The Vehicle, The Driver & The Environment

Connectivity is not merely about comfort and infotainment. It is also about safety and smart mobility. Connectivity is making our vehicles akin to personal devices. Some features of automotive connectivity integrate the smartphone into the vehicle.

One example is CoSmA with Ultra-Wideband technology, which has already proven its success in 5G and Vehicle-to-Everything (V2X).

CoSmA makes the smartphone a digital vehicle key, effectively replacing conventional key fobs. It allows the user to access, unlock and start the car using his or her smartphone. The onboard architecture of the CoSmA solution also features a central electronic computer unit with a state-of-the-art secure element as certified secure storage for any digital vehicle key application. The vehicle owner can generate and manage multiple digital keys and share them with friends or family.

As soon as the position of the authorized smartphone is precisely determined, the system allows the vehicle to be unlocked and the engine to be started without having to interact with the smartphone. As soon as authentication is provided by the backend key management system in the Continental.cloud, access to the vehicle is granted.

Smart Mobility

Access to navigation systems and a wealth of data has enabled a much smarter system of mobility. Smart Mobility includes the collection of data and using the information to provide valuable insights and recommendations to the driver and the vehicle. The kind of data collected and analyzed is also critical for safety. B2B logistics is a good example of the benefits of smart mobility. Fleet Management solutions that focus on driver & vehicle safety, maintenance, emissions, and other diagnostics have been deployed across the world.

As the infrastructure gets better, there are further possibilities in this domain, ensuring greater efficiency and safety. To enable this, we need a vast amount of software that helps the various components work seamlessly.

Software is the oxygen of the automotive industry today. A vehicle in 2021 has over a hundred million lines

of code, which will only increase as the vehicle architecture gets more complex. A vehicle collects information from sensors to provide data regarding traffic, road conditions, and other disruptions. It collects data from the environment and shares information back with the infrastructure.

As the quantum of such communication exchange increases, the number of components also increases. The amount of data produced also multiplies exponentially. Naturally, this requires high computing power to ensure optimal and seamless performance.

High Performance Computers (HPCs) are critical to meet the technical demands of the vehicle. HPCs can single-handedly do the work of multiple independent control systems, which otherwise required several processing units and added complexities, thus paving the way for the future of vehicle connectivity.

The HPC acts as the 'electronic brain' in a vehicle - enhancing connectivity and the benefits achieved in safety, information, and seamless mobility. The vehicle becomes much like a smartphone - wherein the user can easily install and update apps and other services. It also allows the user to update the software, installs new software, or driving functions Over-The-Air (OTA) without having to visit a workshop.

HPCs also have the added benefits for OEMs, making product recalls that occur due to software errors redundant. Additionally, HPCs also help in providing a holistic user experience, wherein infotainment solutions can be integrated into the computer.

Connectivity: User Experience

User Experience - a term previously used in consumer electronics, mobile apps, and websites - has now become a commonplace term in automotive as well. UX, as it is commonly referred to, is a critical factor in the customer's decision-making process.

In the automotive sector, however, UX is not limited to the luxury aspects of the car. The entry of the internet into the vehicle has made it imperative to have a high-quality, digital, interactive user

experience.

With connectivity entering the vehicle, the traditional interior of the car is undergoing a sea of change. Conventional displays and control systems are replaced with digital systems that handle more complex tasks. These are Human-Machine Interfaces that are interconnected and can facilitate better dialogue and information exchanges between the driver and the vehicle, making the driving experience less stressful and more enjoyable.

A simple example of this is the Natural 3D Lightfield Display, which allows all passengers in the vehicle to enjoy a 3D experience without requiring special glasses or head tracker cameras. This is a part of a range of HMI solutions that aim at making the overall driving experience better.

The display covers the entire cockpit, which can be changed according to the driving mode. If the driver is using the manual driving mode, the screen will showcase only relevant information such as speed or navigation data. However, if the driver is in the automated driving mode, the screen changes to infotainment mode, which can be operated via touch, and the content is aligned to the user's preferences.

Connectivity & Safety

Many of the features mentioned above have critical safety functions as well. Even as customers in India demand more luxury and connectivity features, there is also a conscious ask about safety features. As we move closer towards automation and autonomous mobility, we also need to look closer at how connectivity can enable safety.

The goal is Vision Zero - a future with zero fatalities, zero injuries, zero crashes. This is possible only with a holistic approach encompassing active and passive safety systems. This approach requires us to consider how we can collect and analyze safety-related data, and how this can be communicated to the driver and the vehicle's systems to prevent accidents and enhance safety.

E-horizon is a great example of how we can achieve this, in conjunction with other technologies. eHorizon is an intelligent digital map that allows vehicles to see objects that are beyond the driver's sight. Data is collected through vehicle sensors and stored in the in-vehicle database. E-horizon uses the cloud to process all data from multiple databases that are collected from a large group of vehicles.

Processing of this data is carried out with the support of Artificial Intelligence in combination with other technologies, increasing prediction reliability. eHorizon

(V2X) communication. Vehicles can communicate with each other and the infrastructure. And much of this will be required to take place in real-time, regardless of the presence of internet connectivity, to ensure a safer driving experience. However, connectivity can pose a challenge in remote areas. In such cases, Cellular-V2X allows an exchange of time-sensitive and safety-critical information, for example - about warnings of potentially hazardous situations, even in areas without mobile network coverage.

HPCs form the cornerstone of this future, moving away from distributed to server-based E/E architecture. This gives the vehicles the ability to process multiple terabytes of data and share information almost instantaneously.

can be coupled with many technologies. For instance, in The Road Condition Observer, which also uses Electronic Stability Control (ESC) and camera systems, to classify the road conditions as dry, wet, very wet (risk of aquaplaning), snow-covered or icy. Here, eHorizon processes the data collected from the entire vehicle fleet with the aid of Artificial Intelligence and other technologies, which again increases the reliability of these predictions.

Connectivity & The Future

The features mentioned above require a change in vehicle architecture. Various components, functions, and services need to be integrated into the vehicle, also keeping in mind an optimal price point.

With the arrival of 5G technology, we can see a boost in Vehicle to Everything

AUTHOR

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Connectivity's Potential

Connectivity is an integral part of future mobility. It has opened doors for smart, convenient, and autonomous mobility, and is enabling a safer mode of transportation with a richer user experience. Thanks to connected technologies, vehicles are becoming computers on wheels, making the driving experience more enjoyable and safer. However, technology can truly be effective when it is made accessible to all, and this is one of the key challenges faced by the automotive industry: How do we make technology accessible to all? ❑

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How Data management is key to monetize the same?

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At an insidious level, there are far reaching changes taking place in the ways vehicles and their components will be built in the future. A software-defined vehicle concept is quickly becoming a reality. Cars and trucks generate enormous amounts of vehicle and driver behavioural data daily. This data is valuable to carmakers and suppliers, as well as to content and service providers including dealers, fleet operators, insurance companies, retailers, and gas stations. However, before this valuable data can be analyzed or even monetized, it needs to be harvested from the vehicle. This is going to require massive changes in the way vehicle design is conceptualised. Vehicle manufacturers and OEMs are building a secure and reliable vehicle-to-cloud data exchange platform not only to collect the vehicle data but to facilitate software updates and deliver content. Most importantly, all the players in the value chain need to take cognizance of the fact that the data generated can provide a valuable income stream.

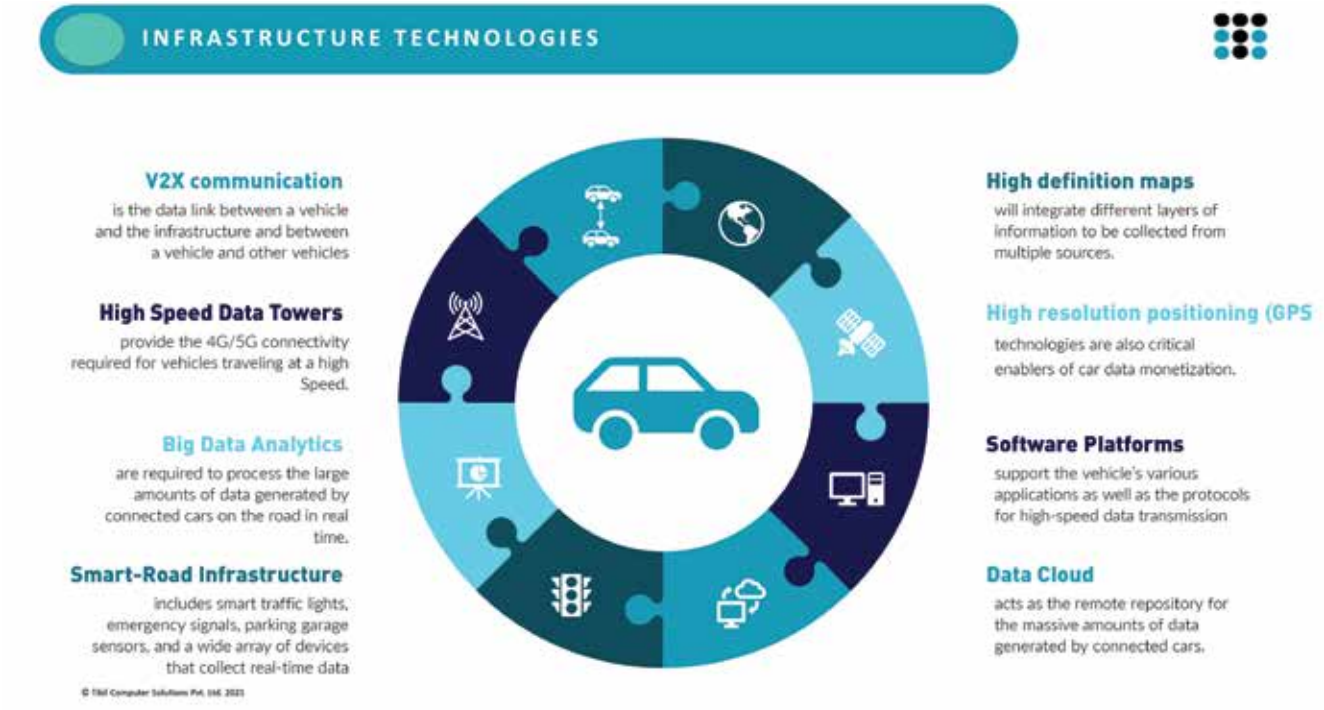
Ultimately, high-tech companies, start-ups, alternative mobility operators, data management services, insurers, roadside assistance providers, and infrastructure operators will all be players in the car data monetization landscape. However, it is the most traditional of automotive players, who may find staking a claim most challenging. OEMs and suppliers are accustomed to seven-year product cycles, full control over a stable value chain, consolidated monetization models, and few interactions with end customers. They are also used to delivering products and services with limited digital capabilities. Car data monetization will challenge

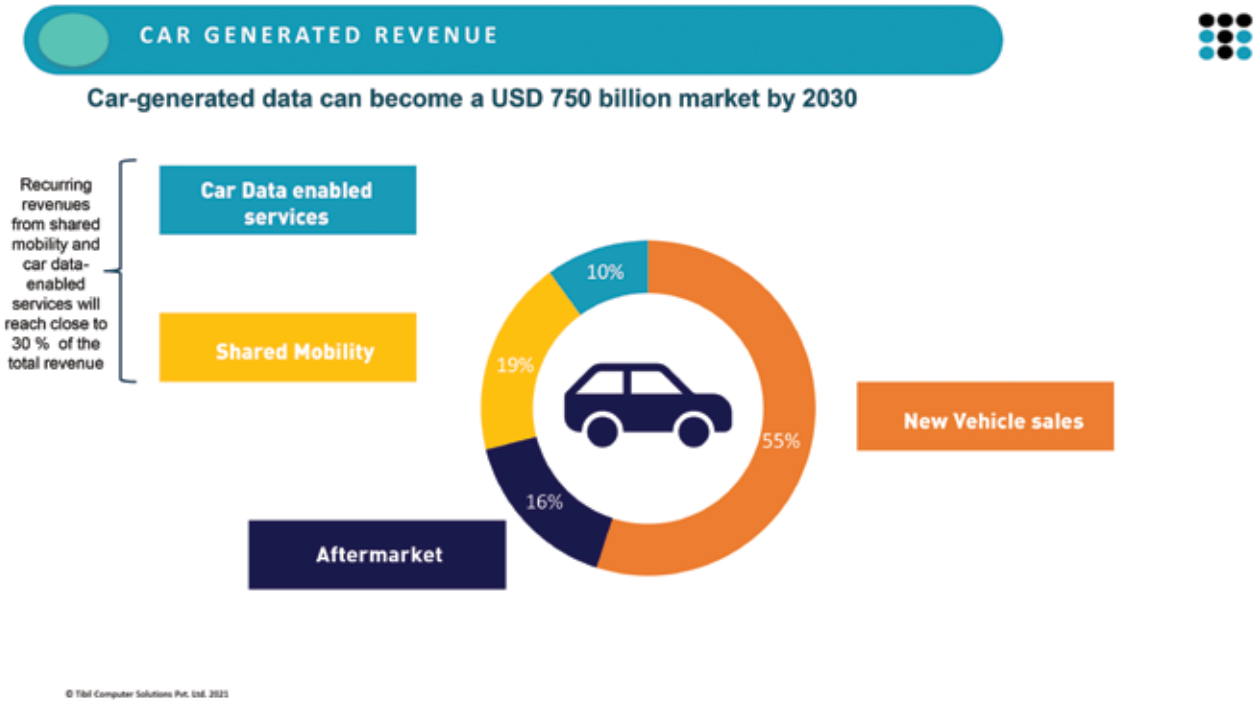
all of these current realities and compel them to undergo a sea change in their entire thinking process. Besides hugely enhanced IT and data analytical services, it will also require a shift from being pure product company to service providers who interact with the end consumers and integrate changes in their products based on feedback.

For traditional players like automobile OEMs or tier-1 suppliers, building and operating service businesses is a new and significant challenge, requiring the development of specific capabilities either internally by developing digital talent or externally by partnering with or existing players in the field. From a skill set point of view in order to monetize any car data some basic data management capabilities are required:

- Collection, cleansing and formatting of data from a multitude of relevant sources - the car, OEM Web site, social media and the dealer management system
- Data analysis that applies "big data/ advanced analytics" techniques to extract valuable insights from this wide and complex data landscape
- Generating insights, which will ultimately result in deploying features, products, services, and recommendations to customers and/ or to business partners to complement the offering and refine them to ensure that the highest levels of customer satisfaction are achieved.

However, this shift in an extremely traditional industry is not easy.





Pushing beyond the basics, making services, R&D, factories, and channels digital ready, especially for traditional automotive organizations – is resulting in a fundamental paradigm shift in the automotive sector. Industry executives concur that organizational complexity and a lack of specific digital skills fundamentally can still delay OEMs' ability to innovate at the rate of nimbler high-tech players and start-ups.

Besides changes within the organisation, technology, market, and regulatory trends will also make strategic collaboration increasingly necessary. Openness and agility in creating partnerships in R&D and sales channels development will be required to succeed. We are witnessing therefore an enormous mind set change in the automotive industry, in what used to be an extremely traditional, closed ecosystem.

However, path breaking as these changes may seem, there has already been some progress made in the field. A multitude of use cases already exist in today's market. Connected car services such as remote diagnostics, remote vehicle control, eCall, Bcall and Real-time traffic monitoring have already seen increasing adoption of trends among the consumers. And going forward, with the advent of 5G technology in the automotive ecosystem, a further increase in adoption rates of other potential use cases as well as, V2X, UBI and in-car commerce can be expected to accelerate.

According to an Intel study smart vehicles will produce 4TB of data for every 1.5 hours on the road. With that volume of data, the next challenge for automakers will be how much information is openly available to third parties while also securing the system from misuse. One emerging strategy takes some of the heavy-lifting off the telematics control unit (TCU) by processing only real-time needs locally and passing subsets of data to the cloud. More complex AI and analytics can unburden the TCU by making use of ultra-low latency Network Edge Compute technologies.

There are a number of ways to monetize vehicle data. The two main categories are of course cost savings and new revenue generation. OTA software updates and early recall management can save automakers millions of dollars. Real-time data feeds will also help their R&D efforts tremendously. Interestingly, although cars have been equipped with some tools of data mining, two wheelers remain largely untapped. Two-wheeler users will definitely benefit from their riding behaviour analysis and custom UBI offers. Thus, while modern cars come with factory-installed TCUs, this is not the case for motorcycles, scooters, ATVs and other powersports vehicles. Only recently, the leading powersports OEMs have started equipping their flagship models with TCUs.

The ability to monetize car data hinges on the technological development and customer acceptance of in-car technology and the interconnections of the various data sources and data management tools. For instance:

Vehicle technical sensors monitor the vehicle's performance status, track malfunctions, and enable remote/ predictive maintenance capabilities. Moreover, collecting data on running cars allows OEMs and suppliers to observe how their products withstand usage and establish a clear cause-effect relationship for breakdowns. However, setting the type and frequency of data gathering and integrating the findings with R&D processes represents a challenge that OEMs and suppliers are still tackling.

Environment sensors detect data related to whatever is around the car. For instance, the road, weather, nearby vehicles and other hazards as well as inside the car – the driver, passengers, and the cargo.

For instance, a set of sensors could be fitted to monitor the driver's physical condition vide his vital signs (e.g., heart rate, blood pressure) or even his sobriety. Monetization opportunities here will largely depend on the degree to which customers are willing to share bio-

> **WITH THE INCREASING PROLIFERATION OF NEW FEATURES AND SERVICES, CAR DATA WILL BECOME A KEY THEME ON THE AUTOMOTIVE INDUSTRY AGENDA AND – IF ITS POTENTIAL IS FULLY REALIZED – HIGHLY MONETIZABLE**

information about themselves and their passengers.

HMI and customer ID. The HMI is the set of technologies by which end customers access and activate the vehicle's features and receive the outputs of the vehicle's computing system in response.

Buttons, touch screens, voice commands, and visual or gesture recognition sensors are among the technologies that must be reimagined to create an optimal user experience Connectivity concerns the link between the vehicle, its onboard sensors and devices, and the Internet. The gateways of connectivity include Wi-Fi, Bluetooth, USB, RFID, and radio.

However, it is perhaps the high-speed 4G/5G modem gateway that comes with the biggest challenges. As vehicles travel, geographical gaps in high-speed data connectivity become an issue that must be resolved, along with the significant cost of continuousdata connectivity.

Onboard data storage is the local hardware repository for data generated by the vehicle.

Necessary developments in this area include determining which data is stored onboard and who has access to it (e.g., insurers) as well as ensuring that this data is protected.

Beyond the processors, sensors, and gateways with which the vehicle itself is equipped lies a network of external technologies that are linked to the road itself or related to the operation of the in-car technologies. The development of these infrastructure technologies are fundamental to car data monetization.

High-speed data towers. An adequate coverage is the key to maintaining continuous and reliable performance.

The deployment speed and cost of the towers are central issues. For this reason, an array of alternative connectivity technologies (e.g., satellite based) are being explored for low-density areas.

V2X communication. The successful transmission of traffic, safety, and social data may depend, in large measure, on the development of standard formats and frequencies that facilitate this communication. The standardization of communication protocols represents an ongoing challenge for industry players, even more so considering the safety-critical communications for autonomous vehicles.

Smart-road infrastructure. One of the biggest challenges as costs to fit the road system are likely to be significant and hence multiple questions about financing the investment by cash-strapped governments and municipalities have yet to be fully answered.

Big data analytics. While Industry players are already developing internal competences in advanced analytics that will enable them to leverage this strategic asset, a lot of heavy lifting will still need to be done by tech companies and tech start-ups to bridge the gap.

Data cloud. The required capacity and redundancy, security levels, and access rights are often the critical elements to be determined.

High-definition maps. Highly accurate 3D map used in autonomous driving, containing details not normally present on traditional maps. Such maps can be precise at a centimetre level. HD maps are captured using an array of sensors, such as LiDARs, radars, digital cameras and GPS.

Software platforms Questions regarding the reliability of OTA software updates and which of them consumers will pay for are fundamental to successful car data monetization.

Location/navigation. Which map's "technical archetype" to adopt, how maps are updated, and how vehicle location (i.e., GPS) information is stored, shared, and transmitted are among the critical decisions going forward for industry players.

With the increasing proliferation of new features and services, car data will become a key theme on the automotive industry agenda and – if its potential is fully realized – highly monetizable. It is estimated that by 2030 a total revenue of 750 billion by 2030 can be generated by data enabled services.

What this means is that this will lead to an unprecedented explosion in car-generated digital data, with significant implications not just for the traditional automotive industry businesses but also for new players. Companies representing high-tech, insurance, telecommunications, and other sectors that at once seemed, at most, "automotive adjacent" will play critical roles in enabling car data-related services and monetize the same. ❑

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Big Data Needs Big Security

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How the "Connected Car" introduces a broad spectrum of security, safety, privacy, and legal vulnerabilities

The first 3 Telematics Wire issues of 2021 covered AV, ADAS and CV. This issue focuses on huge data generated by these systems and many of the significant positive benefits to the industry and society through the analysis and application of this "Big Data". As such the authors of this article will not venture into those areas. Rather, we present some cautionary thoughts on the need for robust and holistic security postures to protect this data and the exponential growth in threat surface it introduces for a multitude of stakeholders. For the context of this article, the authors use Connected Car (CC) to refer to all the CV, AV, ADAS, Telematics, Infotainment, cellular, Wi-Fi and other plethora of "connected features" of the modern vehicle.

A high-level overview of the impact to a typical transportation management system (TMS) is shown in figure 1. In the black box is a typical TMS without CC and within the red circles, the points of interaction where CC introduces a large, exponential expansion of the threat surface to the TMS and vice versa.

"The introduction of Connected Car and Big Data offer great benefit to the industry, safety, mobility, the environment, quality of life, and the economy; the flip side of the coin however, is an equally great expansion of risk and vulnerability"

Space will not permit the discussion of potential solutions for protection against these threats; therefore, we will present an overview with a few examples and close with a suggested reading list and resources for specialized assistance. We offer examples impacting System Security, Safety, Privacy, and Liability

System security. System security involves the efforts taken to prevent the discovery and exploitation of vulnerabilities to escalate privileges and expand access to the larger system and its external connection to other systems. With vehicles connecting to intersections and TMS connecting to Big Data entities to share the vehicle data, as depicted in Figure 1 below, the potential for newly opened threat vectors becomes apparent.

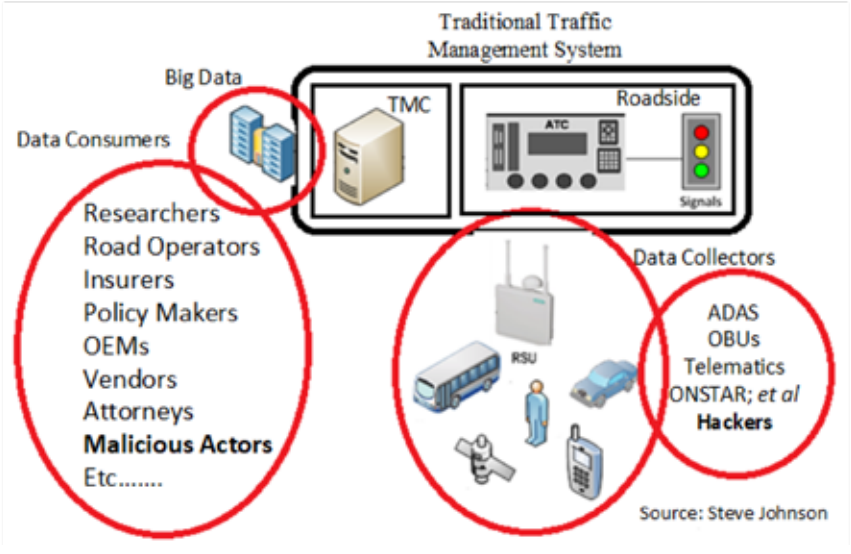

Figure 1

Vehicle System Security: Vehicles systems used to be simple, consisting of body structure, propulsion, driver control, signaling, and comfort/cosmetic.

The hacker of those days put sugar in your gas tank. But the modern vehicle can have more than 100 CPUs and millions of lines of code. See figure 2 for a comparison with other control systems. By now, everyone has heard of the Charlie Miller team's hack on a private vehicle on 3 occasions. The first couple were line of sight in a parking lot. But the lessons learned there along with some online research allowed them to conduct the next exploit from 10+ miles away via satellite comms, to among other things, shut down the engine. My co-author will present the safety impact of that in the following section

Traffic Management System Security: Traffic signal security was for many years ruled by the "security by obscurity" principle. No one knows what's in there and doesn't care. So, we added a simple lock with an industry standard key (author once opened a traffic cabinet in Trinidad with his key) and stuck our collective heads in the sand. Many still exist in this state but agencies have gotten the message and are scurrying to provide a better mouse trap. Even with the best of locks, today's environment is rife with opportunities for intrusion. One can simply idle nearby and hack in wirelessly or use a connected car to gain access.

The City of Tampa, FL, a forward thinking, innovation-embracing agency, provided a standard traffic signal cabinet configuration for vulnerability testing. A white-hat hacker with no previous knowledge of traffic control systems was quickly able to penetrate the system, determine its use and take full control of the intersection (lab setting), including changing the light cycles and shutting the signal down. Tampa quickly moved to become one of the most protected signal

	Lines of Code (Millions)									
	10	20	30	40	50	60	70	80	90	100
Space Shuttle	0.4									
F-22 Raptor Fighter Jet	1.7									
Hubble Space Telescope	2.0									
Facebook						62				
Average Modern Car										100

Figure 2

systems in the U.S. as a result. A research project sponsored by the Transportation Research Board in 2019 discovered a vulnerability in one vendor's software that allowed for green/green conflict override, which is a good segue to my colleague's section on safety impacts.

Safety Impacts: As auto OEMs evolve connected vehicle services to enhance the traveler experience and improve safety, manufacturers face the challenge of prioritizing digital security in vehicle design to safeguard those safety advantages. A recent survey partnered by Synopsys and SAE International shows that 84 percent of professionals responsible for assessing the security of automotive components report concerns that "cybersecurity practices are not keeping pace with evolving technologies".[1]

Basic security design principles can be relatively simple to implement, yet costly to overlook in terms of lives lost and monetary damages. Consider the recall for 1.4 million vehicles Fiat Chrysler Automotive issued in 2015 after cybersecurity researchers Charlie Miller and Chris Valasek demonstrated how to hack a Jeep Cherokee remotely to disable the brakes, transmission, and steering while driving in reverse. Again in 2016 they showed how connecting to the vehicle OBD-II port granted access to safety subsystems, allowing incredibly dangerous maneuvers to be carried out, such as enabling a parking brake and controlling the steering at high speeds, disabling the brakes at low speeds, even causing the vehicle to accelerate and slam on brakes.[3]

In 2018 BMW issued a silent over-the-air update to patch 14 vulnerabilities affecting vehicles dating back to 2012 allowing hackers to remotely gain control of CAN buses and execute arbitrary, unauthorized diagnostic requests while gaining local and remote control of the infotainment system.[4] The same security research firm exposed flaws that granted remote access to Tesla, an OEM heavily investing on advancing autonomous vehicles.[5]

Although autonomous vehicles (AV) are expected to significantly reduce crashes, there are legitimate concerns surrounding the over-the-air updates required to maintain the hardware system and features. If hackers can access a vehicle's safety-critical system today, consider the impact if an attacker gains access to a driverless vehicle operating in a dense metropolitan area or worse, a coordinated attack on an AV Rail fleet with multiple passengers. Consider the 20,000 users of the Protrack GPS app who were hacked in 2019, showing how through the app an attacker could remotely shut down vehicle engine.[7]

Safety continues to be a significant concern in the auto manufacturing design process. Since wired connections can be challenging to implement and impact fuel economy, in-vehicle wireless subsystems continue to increase. This includes sensors for managing pressure and temperature, chemical and gas, position and proximity, and many other sensors rely on Bluetooth or RFID for non-critical features.[3]

A study funded by the National Security Foundation and Army Research proved that in under a week a vehicle tire pressure monitoring system (TPMS) could be reverse engineered. At 40 meters, a 125kHz activation signal could trigger the sensor to transmit data. Transmissions were sniffed and decoded to create a forged message broadcast to the vehicle. The attack was able to trigger a low-pressure warning light and the central warning light on a vehicle traveling at both 55 km/h and 110 km/h.[2]

Intentional security means considering the impact of plain-text, unauthenticated messages, factoring in its broadcast range, and making intentional design choices to circumvent such risk. In this scenario, encrypting messages, randomizing the identifier and a checksum on input data would serve to close that open door. It may seem inconsequential, but an alert showing tires are critically low can cause a driver to pull over and there are many reports showing the efforts highway robbers go through to get people to pull over.

This is not just a safety risk. Consider the time and expense of unsuspecting owners who take the vehicle in for service or the cost of OEMs servicing vehicles under warranty. In addition, consider the loss of trust in the auto manufacturer and innovative technology.

Policy reform is needed that considers and defines software as a safety-critical component within a vehicle to be regulated, in addition to the existing material and mechanical regulations that exist over the design and production of automobiles, to ensure public safety.

In 2017 the SELF DRIVE Act introduced the first cyber security regulation in the U.S. but only required "a cyber plan" that explains how the auto OEM identifies, assesses, and mitigates potential vulnerabilities from cyber-attacks or unauthorized intrusions to protect a vehicle from receiving and responding to malicious control commands or fake messages6. The AV START Act in 2018 and the SPY CAR Act of 2019 are new bills, but the drafts have not succeeded yet.8,9

The National Highway Traffic Safety Administration (NHTSA) maintains a database that consumers can access to remain informed on vehicle safety ratings, defects, recalls and more: https://www.safercar.gov

Privacy Impacts: In the U.S., recent court cases have ruled that geolocation over time = PII (personally identifying information). Privacy advocates around the globe have differing concepts on what constitutes privacy, and the trade-off in relinquishing some amount in exchange for safety and efficiency. The author's direct experience in one connected vehicle project was that a few visitors from Asia were shocked and surprised by the effort put into preserving privacy while Canadian guests felt we had not gone far enough. But even the most stoic about it did recognize that the emerging technologies driving Big Data inherently include the risk of privacy loss.

The U.S. Department of

Transportation (USDOT), in deploying 3 pilot CV programs made privacy a key concern, requiring a series of deliverables supporting its preservation. Additionally, an Institutional Review Board was required for ethical oversight of the enrollment and treatment of private citizen participants; further, both the USDOT and the SAE made vehicle anonymization a key requirement in the technical standards for connected vehicles (SAE J-2275, J-2945 and IEEE 1609.x).

Despite these best practices, additional protections had to be considered after a paper was presented during the 2020 TRB annual meeting that demonstrated how previously anonymized vehicles could be re-identified using data visualization tools. This, coupled with concurrent use of metadata and the always evolving hacker community, means that privacy will remain a concern for the foreseeable future. That doesn't even begin to consider the amount of data motorists are willing to hand over via insurance company data loggers in exchange for a policy discount.

Legal Impacts: The Autonomous Vehicle Summit (San Diego, 2020) presented a mock trial involving the malicious hack of a fleet of autonomous semi-trucks that resulted in concurrent loss of control of all active fleet vehicles on the road upon reaching a zero day event. Author Johnson was called as an expert witness for the plaintiff and 2 others were called by the co-defendants. The plaintiffs argued that the OEM for the vehicles and control system were liable because they chose over the air (OTA) broadcast as the media for firmware upgrades and that the fleet owner was also liable because they did not properly protect the system which re-broadcast those updates to the trucks, nor did they have a way to override the remote lockout control system. The defendants both argued that the hacker (an unidentified co-defendant assumed to be a nation/state) had conducted such a sophisticated attack that no reasonable prevention was available or practical.

In the author's view (perhaps biased), the pre-scripted arguments leaned heavily in favor of the defendants. However, despite that, 2 of the 4 empaneled juries levied at least some portion of liability (10% and 15%) upon the OEM and fleet owner. This is a good indication that liability issues will continue to evolve as rapidly as the technology itself and both legislators and Courts will be hard pressed to keep up.

"2 of the 4 empaneled juries levied at least some portion of liability (10% and 15%) upon the OEM and fleet owner"

As the authors have presented only a small sample of the admittedly large potential for vulnerability, and no deep dive on potential solutions due to space limitations, we do offer the below list of sources referenced and some starting points for further reading.

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Suggested Reading

- ENISA GOOD PRACTICES FOR SECURITY OF SMART CARS, November 2019 www.enisa.europa.eu
- Securing the Modern Vehicle: A Study of Automotive Industry Cybersecurity Practices, SAE and Synopsis, 2018 www.ponemon.org
- Beyond Car Hacking: The Cyber Threat Landscape for Automotive Companies www.insights.com
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Range Controversy: A Vehicle Data Monetization Opportunity

MOHAN SATYARANJAN
TAQANAL ENERGY

The TATA Nexon EV "Range" controversy has been a topic of hot debates in recent times. ARAI certified the "range" of the vehicle as 312 Kms. However, a customer sued TATA Motors because he did not get the claimed range. Several other customers joined the chorus. The Delhi government delisted it from its subsidy scheme, and court provided interim relief.

Accuracy of prediction of "range" is not such a big deal in ICE (Internal Combustion Engines; such as Petrol/Diesel engines) vehicles due to ubiquitous presence of gas stations. However, a vehicle with better fuel economy is more desirable. In case of EVs, customer expectation about "Predicted Range" accuracy is higher. "Higher Range " requires bigger batteries, increasing the cost of the vehicle. Batteries constitute more than 50% of the cost of an EV. Having paid more, just for a bigger range, customer expectations around accuracy of "range claim" are higher.

The controversy around TATA Nexon EV's range arose due to customer perception of the OEM's claim of range Is it so difficult to accurately estimate the remaining range?

Good solutions are available, but they require instrumentation & computing. All these solutions, work on the basic principle of measuring the amount of fuel left in the tank (or charge in the battery in case of an EV), and estimating the distance the vehicle can go on that fuel.

Fairly accurate measurements of fuel in the tank, average fuel consumption, and current fuel consumption have been available in mid-range ICE vehicles for a while. Also, as gas stations are ubiquitous, there is less anxiety about "how much will my vehicle go in reserve".

However, he problem of estimating range in EVs is fairly complex:

1. Estimating the "Remaining Useful Charge" in the Battery is often done using estimating the "State of Charge (SoC)". Estimating SoC accurately is a known challenge.
2. Range estimate at any moment depends on current load, ambient temp., route (elevation, road/conditions), wind-direction/speed,...), time of the day, driving mode & style...

Estimating Useful Range/ Soc Accurately

Modern BMS's (the Battery Management System inside batteries that controls, charging/discharging of the battery, monitors all key parameters, and performs operations to keep the battery in an optimum state of safety, and operation) maintain an estimate of SoC. The algorithms that estimate SoC have been growing in sophistication, and estimation accuracy. For higher accuracy, the algorithms need detailed historical data.

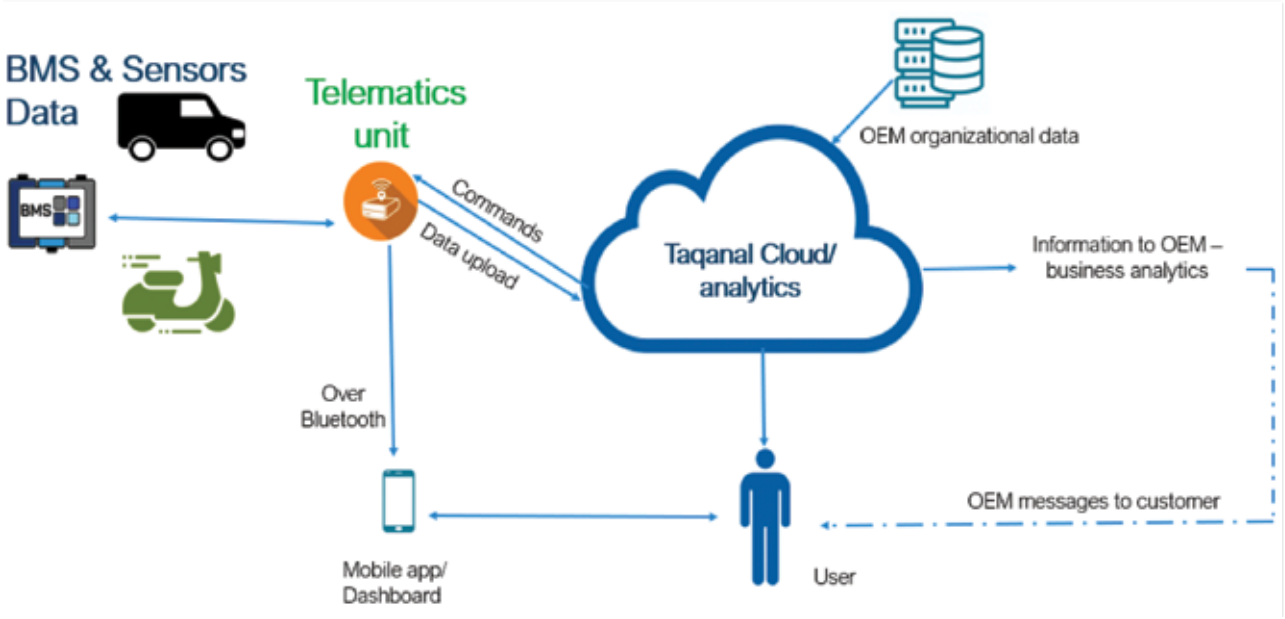
However, due to memory & compute limitations on the BMS, it is not possible to keep large amount of historical data, and process them. This limitation is overcome, by sending all the data collected in the BMS to a "Cloud" (a remotely accessible infrastructure where large amount of data can be stored, and vast computations can be done economically. In the Cloud, incoming data from the BMS, and past data is continuously analyzed. Typically, a very large number of batteries send their data individually to the cloud, and similar algorithms work on data coming from each, and every battery. The Machine-Learning based models in the cloud continuously fine-tune their algorithms for determining the SoC for each battery. With knowledge of history of each battery, and that of a large number of other batteries, the SoC accuracy for each battery improves significantly. Like all Machine Learning applications, the SoC estimation accuracy improves with the amount of historical data from a large number of connected batteries.

As these computations are done in the cloud, where memory, and CPU resources are not a constraint, the SoC estimation accuracy is significantly higher, and keeps improving with time. Typically, the current estimate is sent to the battery at regular intervals, ensuring an accurate estimate of the remaining charge in the battery is available at all times.

Battery is the most expensive part in any EV. To keep costs low, many a times, they are not instrumented well enough. Worse, a lot of times, there is no way to find out the goings on inside a battery; there is no way to communicate with the battery. Poor instrumentation, lack of visibility, inability to get sufficient data, and process it not only inhibits accurate SoC, it also results in compromised safety, reliability, and long-term TCO (Total Cost of Ownership).

In the past, the engine was given a divine status: auto-owners were preached to offer the most expensive "synthetic motor oil" to the presiding deity in the vehicle with religious punctuality. In an EV, the battery rightfully deserves the status equal to or better than an engine in an ICE vehicle.

Typically, cloud-connected vehicles do much more than just SoC/Remaining Range estimation. All the measured data is continuously analysed to predict any failures, and preventive maintenance is advised to eliminate breakdowns. Some of the data & analytics are used by the OEM, some by the service stations, some by the parts/sub-system makers, some by law-enforcement,



some by neighbouring vehicles, some by insurance companies… The following sketch depicts the general use case:

Remaining Range estimation at any moment

"Remaining Range" depends on a lot of factors that change dynamically: Load, Road conditions, wind-speed, wind-direction, ambient temperature, elevation, time-of-the day, driving-speed, and driving style.

Larger the number of passengers or payload, larger will be the energy consumption. Bad roads cause more friction, and more energy is consumed traveling on those. If the wind is favorable, and blowing in the direction of the vehicle, less energy will be consumed. Batteries have different behaviors at different temperatures. Climbing to a hill station can consume significantly more energy (while coming down can generate energy in an EV, and charge the batteries). Time of the day makes a difference too: Headlights consume energy during dark conditions & temperature varies during the day. Driving in economy modes can return significantly higher mileage than driving in Sports mode. Energy for all loads (AC, heating, lighting, wipers, infotainment, ADAS…) comes from the battery, and affects the range.

All the parameters affecting energy consumptions need to be measured at frequent intervals. A vehicle going at 60KMPH covers a distance of 16.67 Kms every second. Some of the parameters above (such as road conditions, elevation) can change during that interval. Ideally, the sampling rate should increase with increasing speed.

Cost-effective sensors are available to measure most of the parameters. Instrumentation in vehicles has already been increasing to introduce ADAS. Algorithms are available to use all the measurements, and refine the estimate of current & projected energy consumption. Combining it with an accurate estimate of SoC at the moment, it is easy to provide an accurate estimate of range.

Summary

Range" is dynamic. It changes with current load, ambient temp., route (elevation, road/conditions), wind-direction/ speed...), time of the day, driving mode & style...Technology exists to predict range accurately, at every moment in an EV. It changes, if conditions change. The fuel consumption/range estimation in an ICE engine vehicle is far more error prone, as they consume fuel while idling too. EVs (unless using AC/Lights) don't use any energy while stopped. People don't complain about poor range prediction in ICE vehicles due to ubiquity of gas stations. Absence of fast charging stations makes "Accurate Range Prediction" a necessity in EVs.

With a well instrumented, cloud-connected battery, instrumentation in the vehicle, and a combination of cloud-computing, and on-boarding computing it is possible to estimate "Remaining Range" with a very high degree of accuracy. As OEMs introduce ADAS related features, sensors needed to measure parameters needed for these computations are likely to become standard. Algorithms already exist. EV OEMs should consider making their customers happy with the "Accurate Remaining Range" feature. ❑

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How can the Telematics Industry Spur the Electric Vehicular Revolution?

TUSHAR BHAGAT
DIRECTOR, UFFIZIO INDIA

Why choose EVs?

Lower Carbon Footprints:

- As opposed to internal combustion engines (ICE), electric drive vehicles employ electric motors for propulsion. Hence, making electronically powered cars extremely pertinent to all discussions of global sustainability.
- In the wake of climate change and the ongoing energy crisis, EVs reduce human reliability on fossil fuels and non-renewable sources of energy. When compared to gas-powered cars, EVs emit zero localized emissions—meaning no more charry smog discharge from car exhaust pipes!

Affordability and Feasibility:

- EVs are easy on your wallets too! A study conducted by the Transport Research Institute of the University of Michigan conclusively reports EV operating costs to be half as much as gas-powered cars.
- Besides, the rapid and widespread development of charging infrastructure and replaceable batteries has eliminated EV transportation anxiety.
- Supercharging stations facilitate charging up to 200 miles in less than 15 mins--so you never get stuck! (https://www.tesla.com/supercharger)

Efficiency

- EVs convert 77% of electric energy while an ICE converts only 12-13%. Hence, EVs are four times more energy-efficient than gas cars. (https://www.fueleconomy.gov/feg/evtech.shtml#:~:text=EVs%20have%20several%20advantages%20over,to%20power%20at%20the%20wheels.)
- EVs are quieter, drive smoother, and have a stronger acceleration than ICEs. EVs have greater torque and can accelerate from 0 to 60 mph in less than a second.
- Unlike ICEs, electric cars deploy regenerative braking that recovers energy—that would otherwise get lost. EVs retract Kinetic energy produced by the forward motions of the car and utilize it for braking.
- Also, regenerative braking takes a lesser toll on brake shoes and wheel tires. Hence, consequently lowering your vehicular maintenance costs.

How can the Telematics industry help?

Unquestionably, the EV era poses a new set of challenges, and resolving them is quintessential. The telematics industry needs to do the spadework and rapidly adapt to this foreseeable change. Developers of satellite monitoring platforms need solutions that incorporate the EV characteristics and metrics. Real-time data and analytics insights will be valued like never before, and the world is counting on the telematics industry to make this happen!

Energy Metrics and the State of Charge

With EVs, fleet owners will no longer have to worry about fuel theft. Hence, making fuel monitoring and fuel sensors obsolete. However, EV's battery life and the state of charge raise a cause of concern. Every EV user needs to know how long can their EV be on the road before they need recharging. Real-time data can supplement users' understanding of charge levels and help them resolve charging issues proactively.

Battery Life

Besides, it is crucial to understand charging processes and monitor potential mistakes. EV batteries can cost a fortune, so owners would want to reduce their maintenance and replacement costs. To lengthen battery life, one must prevent over-charging or battery drainage. For instance, it is tempting to overuse the fast charging mode or use counterfeit charging accessories. Such actions may seem cost-effective but can adversely affect an EV's battery life. Hence, there is an excessive demand for solutions that maximize battery utility and improve its functionality.

The Telematics Industry should brace itself for swiftly changing modes of transportation. The future of transportation belongs to Electric Vehicles, and that future is here! ❑

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THE BIG OPPORTUNITY – VEHICLE DATA MONETIZATION

VISHAL SANGHAVI
ARANCA

In India, indirect data monetization is gaining considerable popularity, creating many opportunities over the last few years. However, the market for direct monetization is in its nascent stage, with limited use cases and few partnerships

New Business Adjacencies for Car Manufacturers

Conventionally, OEMs generate the majority of their revenue through sales of vehicles and aftermarket services. However, new revenue streams are emerging as car manufacturers invest in new business models such as mobility-as-a-service and vehicle-as-a-platform.

On average, conventional businesses account for over 90% of revenue generated by manufacturers. However, by 2035, this share is expected to shrink to about 70% as new business models gain traction. Mobility-as-a-service has witnessed rapid growth in the past five years through services such as ride sharing, ride hailing, and subscription.

Vehicle-as-a-platform is a relatively new concept with less than one 1% share in total automotive revenue. However, this segment is expected to grow to 7% by 2035 (1.3x growth year-on-year), making it the fastest growing business model. This business segment is categorized by two revenue streams: data monetization and platform-as-a-service.

Europe and the US are currently leading the data monetization landscape. On the other hand, in markets such as India, the opportunity is still in the early stages, with major focus on infrastructure development for connected technology.

Data Generation: Tapping New Revenue Streams

Data is a direct byproduct of connected technology, and given technological advancement, several companies in India are eager to tap the potential opportunity.

Five key entities are working toward development of the market.

- Government: The Indian government and several agencies are recognizing the value of data and implementing various programs that allow private companies to utilize data to create business value. AIS 140 mandate, bulk data sharing policy, IRDAI's provision for usage-based insurance (UBI), and proposal for ease of access to satellite remote sensing data are some of the recent initiatives undertaken by the government.
- OEMs: In 2019, less than 5% of new cars had connected features, and now that number has increased to over 15%. Both car and two-wheeler manufacturers are recognizing the opportunity and launched over 25 new models with several connected capabilities. Hyundai, Suzuki, Tata, and Hero are a few prominent manufacturers that have introduced connected technologies in their vehicles.
- Telecom companies: Communication is crucial to facilitate data collection; hence, telecom companies such as Vodafone Idea, Airtel, and Jio have developed solutions for automotive IoT. Vodafone is leading the market with major partnerships with Hyundai, Suzuki, and Mahindra, to name a few. Airtel recently announced a partnership with Morris Garages.
- Data aggregation: Companies such as Rollr, Here Technologies, C.E. Info Systems Pvt Ltd (MapmyIndia), and Deduce Technologies are providing platforms that enable collection, storage, and analysis of data.
- Hardware providers: From infotainment system manufacturers to telematics hardware suppliers, companies are developing products with 4G and 5G capability for data communication.

The data analyzed is being used by several customer segments such as OEM, insurance, banking and finance, e-commerce, media, and advertisement.

Data Utilization Models

There are two broad applications of data:

- Indirect monetization: Data analysis is important to improve the overall efficiency of business performance, which results in indirect realization of revenue generated.

For instance, to enhance supply chain efficiency through predictive maintenance, several OEMs have developed inhouse algorithms that predict potential component failure through data analysis. This data is relayed across the supply chain to ensure parts availability, optimize inventory,

schedule repair services, and even facilitate payment or insurance.

Use cases include fleet telematics, insurance, financial services, diagnostics, supply chain solutions, connected driving, autonomous solutions, urban mobility, dealerships, among others.

- Direct monetization: Another key application, which is relatively new in the market, is the direct sale of data collected. In these cases, data is directly sold to end-use customer segments.

New-age companies such as Otonomo and Wejo are gaining popularity by developing robust use cases that deliver value for enterprises through analysis of data collected by OEMs.

For instance, location-based data from vehicles is used by companies such as MapmyIndia to develop insights on traffic, and several players use these solutions to plan their logistics and warehousing. Such data is also utilized by government agencies to plan infrastructure projects.

Use cases include driver/rider profiles, media & advertisements, maps & navigations, smart cities, geo-spatial analysis, traffic solutions, among others.

While companies have developed a substantially robust process for indirect monetization, the direct monetization model is still in the early stages. Globally, Western Europe, followed by the US, has made inroads in terms of developing and testing several use cases.

In India, indirect data monetization is gaining considerable popularity, creating many opportunities over the last few years. For instance, IRDAI allowed UBI under its Regulatory Sandbox, enabling companies such a TATA AIG to launch AutoSafe (UBI). This has also prompted several firms to offer cloud-based data management, storage, and transfer solutions.

However, for the market for direct monetization is in nascent stage, with limited use cases and few partnerships.

Key Use Cases Currently Monetized in India

Asset monitoring: At present, asset monitoring is largely undertaken by commercial vehicle fleet owners and banks. Fleet owners' avail of short- and mid-term loans from banks for purchasing/leasing vehicles for logistics and distribution purposes. A key challenge for the banks is to evaluate the potential return on their investments and the risks associated.

Real-time and historic data of vehicle location and odometer readings, among others, helps banks run an algorithm that defines the potential returns and tracks non-performing assets (which are seized in case the company defaults on loan payments).

Insurance: Insurance claim fraud is increasing in India. For vehicles alone, 90% of frauds are due to padding claims (adding vehicle damages, injuries, and fictitious passengers to claims). Therefore, data-driven collision analysis can help companies accurately determine the potential cost of repair and reimbursement.

Such connected features reduce the claim cycle time and increase the overall process efficiency, which in turn adds value to businesses and consumers.

Traffic: Companies such as MapmyIndia purchase real-time location and velocity/speed data from data-generating companies including OEMs and fleet owners. The data points are analyzed to track traffic flow and develop specific use cases.

Traffic information is made available via traffic APIs, using which customers can develop tailored solutions for their businesses. For instance, users can relay traffic details for a specific route along with alternate routes to logistic fleets in order to improve their fuel efficiency and delivery time.

Potential Market Size and Conclusion

For OEMs, the key opportunity is in indirect monetization that adds value to consumers or end users through solutions, this directly results in a stronger brand and increased revenue. Revenue generated through direct monetization is relatively low and mainly aimed to recover infrastructure costs.

For data aggregator companies there are two key opportunities, data analytics, and software as a service. Data analytics is done through software which are predominantly designed with machine learning, Big Data, and artificial intelligence. These software are also offered to companies for their data processing and provide additional sources of revenue.

The Indian market for vehicle data monetization is expected to grow exponentially to reach over USD 500 million by 2025. Revenue is a product of average revenue generated per vehicle per month and number of vehicles. Manufacturers can develop robust monetization models to generate revenues of up to USD 5 per vehicle each month.

However, there are three key aspects to consider:

- It is important to design a robust infrastructure to develop suitable solutions. In addition, strategic deployment of technology such as narrowband and massive IoT is critical for a sustainable revenue stream.
- It is crucial to identify partners for realizing the full potential of revenues offered by data monetization.
- It is vital to identify opportunities for data synergies to discover new business cases. ❑

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Connected Vehicles and Mobile Edge Computing – A Marriage of Convenience

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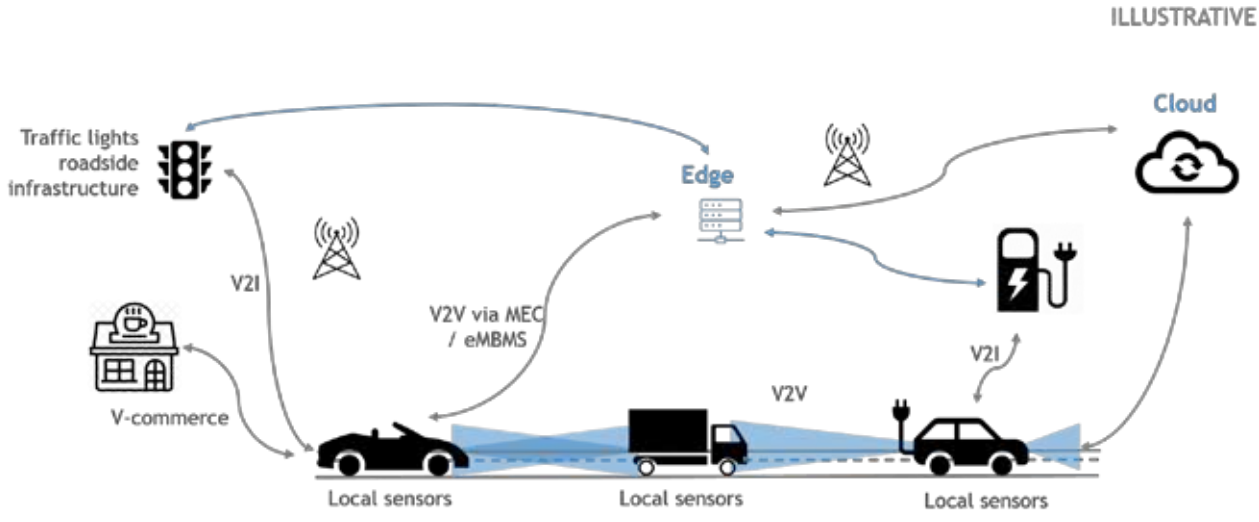
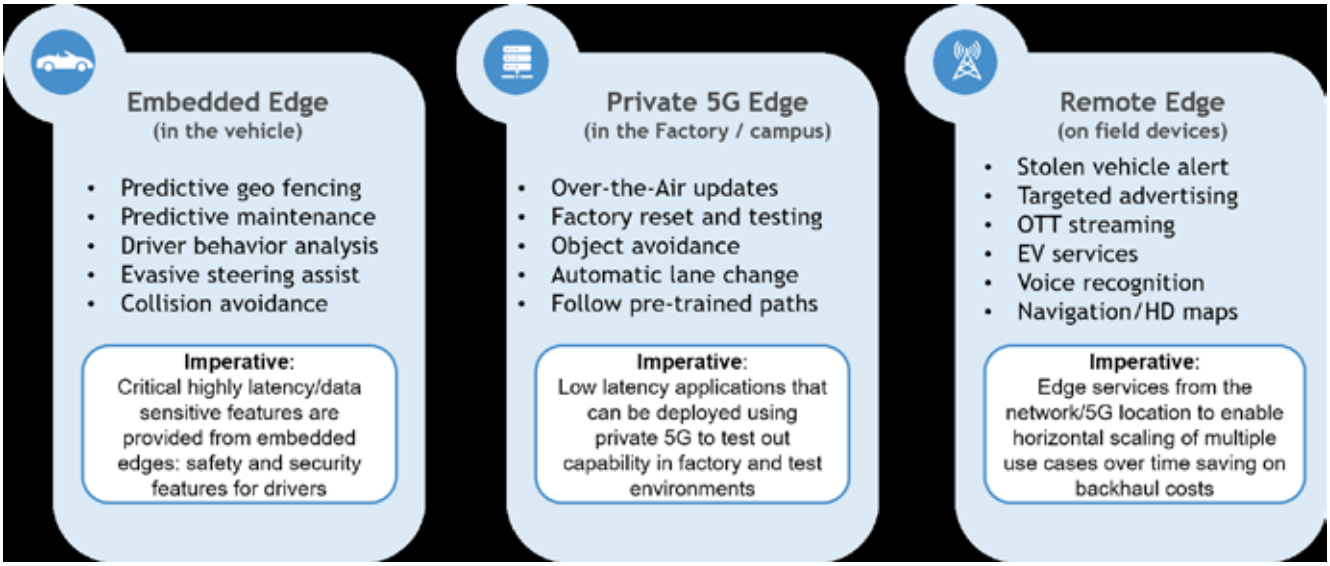
With the emergence of cloud computing, there has been a change in perception about the way that information management resources are deployed and how information is distributed and consumed. The idea behind cloud computing is to separate data from the potential limitations associated with physical hardware. By hosting applications and data storage in the cloud the physical proximity of the data that needs to be processed and accessed becomes remote. This places extra demands on the networks that connect the hyperscale cloud data centres to their end users. With 5G and its evolutions, users will expect the connected society to be available with no limitations, and users will make use of bandwidth-demanding services like augmented reality and virtual office applications, also when on the move.

Amongst other things, 5G is forever expected to change the way we drive! The automotive industry is on a path where vehicles are continuously becoming more aware of their environment due to the addition of various types of integrated sensors. At the same time, the amount of automation in vehicles increases, which – with some intermediate steps – will eventually culminate in fully-automated driving without human intervention.

Due to connectivity and driven by new 5G technologies, the value chain is transforming into a value network. Along this path, the number of interactions increases, both in-between vehicles, between vehicles and other road users, and with an increasingly intelligent road infrastructure. Therefore, the significance and reliance on capable communication systems for vehicle-to-anything (V2X)



5G Cellular with the help of edge computing with enable will enable multiple new automotive (V2X) applications ranging from collision avoidance and safety systems (V2V), traffic signal timing/priority (V2I), real-time traffic/routing and cloud services (V2N), and safety alerts to pedestrians/bicyclists (V2P).



5G is going to be the major change for business models, enabling new services and improving the existing ones.

communication is becoming a key asset that will enhance the performance of automated driving and increase further road traffic safety with combination of sensor-based technologies.

This challenge is brought into sharp focus when we consider the processing needs of new applications and services, including Artificial Intelligence, the 'Internet of Things' and the need to process and access data in near real-time. Cloud computing brings the convenience of virtualisation to some extent, but it is not an ideal approach for real-time data collection, processing, and analysis. High speed of the vehicles, dynamic surroundings often cluttered with static and mobile scatterers, and low antenna heights create challenges for V2X communications that are unique compared to other communication systems.

A solution to this is ironically, to move elements of the physical infrastructure closer to where the data needs to be processed. This idea is referred to as 'Edge Computing'. In the context of mobile communications, and as 5G networks with their processing power come onstream, edge computing becomes a necessity. Edge computing works by using the physical characteristics of the existing mobile network. For the sake of convenience let us define the edge of the network as the point of the network closest to the connected devices that are generating the data. At the edge of a mobile communications network or indeed any communications network, there are opportunities to locate servers and even data storage closer to the users – we can think of a user as a human or a machine in this context. This approach reduces round-trip latency.

In a network designed for edge computing and 5G is very much the case in point, there are three approaches, which we can refer to as:

- Cellular unassisted V2V: Embedded Edge
- Cellular V2X: RAN, Private 5G
- Cellular-assisted V2V: Remote edge

5G lends itself well to the idea of mobile edge computing, which is also referred to as multi-access edge computing or MEC. Benefits with MEC include:

Minimal latency: Relying on the cloud is not ideal for some automotive applications, as cloud-based services are relatively slow. As automotive applications are coming to rely increasingly on AI enabled applications, this disqualifies the cloud for use in many automotive applications, such as ADAS and autonomous vehicle applications. Servers and processing power located in more compact data centre enclosures closer to where their processes will be accessed and used, solves this latency issue associated with the cloud. It could also create a new market for computing services that cloud architecture is not able to address. In the case of a connected vehicle, having this processing power closer to the connected vehicles improves processing speed, which means that real-time analytics and control becomes feasible.

Maintenance: The sort of micro-data centres envisaged to support MEC are designed for accessibility and ease of maintenance, with just enough servers for hosting real-time critical functions. This combination of accessibility and the modular nature of what will be needed in these environments not only facilitates maintenance but also ensures redundancy, as when one site is being managed, other proximate sites can temporarily take on the load.

Climate: There is appeal to the idea of distributing computing power, in smaller physically distributed facilities, as opposed to huge, centralised data centres. Quite part from the electricity required to power both the processing and the cooling in large data centres, there are considerations about redundancy of connectivity.

For connected vehicle applications, while MEC brings advantages, there are also challenges to be considered. An obvious one is the physical scope to deploy MEC. While mobile base stations are regarded as the preferred location to deploy the edge servers, not all base station enclosures have the room to do so. There are also security concerns, with people being able to tamper with or even remove servers from remote locations. Another consideration is the feasibility

Advantage	Explanation
Data collection / Protection	Data is collected closer to the point of generation. Rather than sending data to cloud-based servers, the data is processed securely closer to the vehicle and usually in real-time.
Scalability	Logically the set-up of a distributed computing architecture both enhances network resilience and decreases mobile network load.
Reduced Cost	By reducing data transmission frequency and the volume of data being sent back to a central cloud location, network usage cost goes down
Decrease in Latency	MEC decreases latency, as data generated by the vehicle is not transferred across the mobile network to a remote data centre or onto the cloud for further processing.

of providing 3-Phase power supplies to power the extra equipment to some remote locations.

These challenges need to be weighed against an objective assessment of the longer-term sustainability of the public cloud model. With increasing demands for connected vehicle applications, operating in near real-time, with increasing volumes of data being generated, then the public cloud model needs to change. If location matters and in the case of automotive applications this is the case, this means that approach to enterprise computing needs to change. The hyperscale, centralized cloud data centre model needs to give way to smaller, localised processing points, more cost-effective operating models, and a distributed location architecture.

For connected vehicles, the marriage of 5G and MEC reduces the strain on mobile networks as an increasing number of vehicles become connected and generate an increasing amount of data (Telematics, Diagnostics, Infotainment, Location based services, V-Commerce etc). This distributed approach to data processing at the edge of the mobile network ensures that more connected vehicles and the data they are exchanging can be supported – so more vehicles can be accommodated on the existing networks as well as more data being processed. Combining 5G and MEC, instead of each individual connected vehicle regularly sending information to the network, data can be cached and transferred to the main framework as required.

A Hybrid Future

As the assertion has been made that for connected vehicle applications, reliance on public cloud in its present form is not sustainable, then MEC does present a viable alternative approach, despite the challenges indicated above.

The implication of moving more processing to the network edge takes us from the realms of information technology towards operational technology (OT). The reason for this is that with more emphasis and focus coming onto the edge infrastructure, the people who will be managing the infrastructure will be those who, up until now, have been responsible for maintenance and software support. Thus, to support this new mobile edge paradigm we see a shift towards more focus on operational technology for the mobile network operators.

Another emerging concept is the idea of the 'Edge Cloud', a kind of hybrid approach which is effectively a collection of multiple physical edge deployment, collected in a single 'virtual' platform. With this approach mobile network operators will have an opportunity to offer public-cloud type services, including SaaS and virtual server hosting.

What could these changes mean for automotive OEMs? The clear message is that for connected vehicle applications, requiring real-time or close to real-time processing need the support of a new architecture approach from the mobile network operators. Reliance on cloud-based applications for certain types of telematics use cases, ADAS or autonomous vehicle services is not realistic. Anything that can introduce lower latency data processing is a bonus, but 5G can do this on its own. The beauty of a combination of 5G with MEC is the new use cases it could open up for automotive OEMs, with an array of V2X services and revenue earning opportunities. A distributed edge architecture brings both the speed and volume of data to be processed and acted upon into reach. The use of AI for deterministic applications, such as which network connection is best to use, when and where to perform an OTA update, how to connect a vehicle with the infrastructure around it are all requirements that a combination of 5G with MEC can help fulfil. ❑

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Sensor & Functions
Concepts
Reference Systems
Driver Monitoring

Measurement Solutions

Measurement Engineering
Measurement Hardware
Measurement Software

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Data Types

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- 2D Side, Fish eye,
- Driver Cam
- Lidar
- RADAR

Annotation Types

- Bounding Box
- Semantic Segmentation
- 3D & 2D Point Cloud
- Bounding Box
- 3D & 2D Point Cloud Semantic
- Eye Labeling

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- Free space Annotation
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WHERE INNOVATION DRIVES DEVELOPMENT.

DATA SCIENCE APPLICATIONS FOR AUTOMOTIVE DATA

DR. ASHWIN SABAPATHY
DANLAW INC

Vehicles have increasingly been transforming into complex digital systems, generating tremendous volumes of high frequency data. With greater uses of sensors, connectivity, GPS and driver aids such as ADAS systems and the gradual shift towards autonomous vehicles, the generation of data from each vehicle is expected to grow exponentially.

The volume of data from vehicles can range from a few kiloBytes an hour of driving when a vehicle is tracked at a few minutes apart to tens of megaBytes an hour when high frequency vehicle sensor data is transmitted. This presents two challenges - one, transmitting such large volumes of data and, two, analysing the data to find patterns in such large data volumes. The first problem can be addressed through some level of edge computing using pre-trained models deployed on onboard devices capable of processing this data. This economises data transmission by sending only data which requires some further attention or which serve as inputs to other models in further steps of analysis. Analysing and modelling the data transmitted provides tremendous value in addressing problems related to vehicle health, safety, efficiency and utilization at the individual vehicle or fleet level as well as in providing alternatives to regulation and enforcement at the regional and city levels. Examples of the value provided by leveraging analytics for such data is presented in this article, some of which are from the experience we have gained in this area. It is through such insights from data that efficiency gains can be realized that cascade down the value chain of the automotive sector.

Establishing parameter thresholds for specific vehicle models while controlling for different ambient conditions and driving states has been an area of interest in which data mining can play a key role

Vehicle health

One compelling use case for data analysis includes vehicle health status determination using ECU sensor data. A vehicle's ECUs report multiple parameters that could indicate potential vehicle issues. The operating ranges of these parameters could serve as potential thresholds to detect anomalies, but these are not indicative of poor vehicle health as a certain number of anomalous values could be expected in the normal operation of the vehicle and the parameter values could subsequently recover to within normal operational range. Indeed, diagnostic trouble codes reported by vehicles are based on such operational ranges and frequency of occurrence.

Establishing parameter thresholds for specific vehicle models while controlling for different ambient conditions and driving states has been an area of interest in which data mining can play a key role. Here, data from a fleet of vehicles reporting parameters at periodic intervals, after being cleaned and filtered to remove invalid values and treated for missing values and outliers, can be used to define vehicle sub-system operating regimes and outlier thresholds for specific vehicle models in different ambient conditions. Operating regimes could be defined for individual parameters or for a group of parameters for multiple ambient conditions (such as ambient temperature, pressure, relative humidity, and altitude) as well as for different driving states (idling, acceleration, braking, cruising, etc.). The operating regimes for different ambient conditions would ensure that behaviours and extraneous factors are controlled for and only the variations due to vehicle health are factored. The thresholds for these operating regimes themselves could be parameterised using different multivariate statistical techniques that are distance based (such as Euclidean distance, Mahalanobis distance, etc.) or correlation based or even histogram (distribution) based.

Since data is pooled from multiple vehicles, the thresholds for each operating regime can be mined or "learned" from historic data for a given vehicle model and continuously refreshed as new data becomes available. Of course, care needs to be taken to ensure that the baselines of each operating regime are estimated after filtering out vehicle data from vehicles displaying abnormal performance. This could be achieved through several unsupervised learning methods. The health of a vehicle could then be determined by comparing that vehicle's parameters within an operating regime to baseline values. The vehicle's overall health score could be arrived at by combining scores for each operating regime.

This framework can be quite challenging and implementing this requires a combination of

non-trivial data management tasks at the edge and interactions with a backend system that is continuously mining data from a pool of vehicles and refreshing baselines. The health scoring of vehicles could be designed to either occur at the edge by deploying algorithms on onboard systems or on backend systems that expose the scores for a vehicle through APIs for display on dashboards. This depends on the use cases for which the system needs to be designed - for example, if the need is to provide real-time information on the vehicle's health on the vehicle's dashboard, it would be appropriate to deploy the scoring algorithm on the edge and have the vehicle communicate to the backend only to fetch refreshed baseline values at periodic intervals. The scores may also be transmitted to the backend for fleet dashboard displays. On the other hand, if the need is to monitor vehicle health only at the fleet level, the vehicle parameters could have some level of pre-processing to minimize data transmission and have aggregations and transformation done onboard the vehicle. This aggregated data could be used on the backend for scoring and monitoring.

Driver behaviour and Risk scoring

An analysis of accidents in the United States shows that excessive speeding was a factor in more than 28% of all accidents (National Highway Transport and Safety Administration, 2014). Hard Braking is another indication of being distracted while driving and a risk factor.

We have analysed over 85 million miles of driving data in the United States and Canada and modelled the link between speeding, hard braking and rapid acceleration behaviour with real accident records of these vehicles. This has been the basis for a driver scoring algorithm that makes use of a multi-layered data set comprising behaviour data overlaid with weather, time-of-day, magnitude and frequency of events, vehicle class, etc. A model of these driver scores and accidents shows that for a 10-point increase in the Braking score, the risk of an accident reduces by 23.6%. Similarly, a 10-point increase in Acceleration scores reduces risk by 3.3%. A 10-point increase in the overall Driver Score corresponds to a 11.4% decrease in risk. When Exposure Risk is also considered in the overall score (used as an Insurance Score), a 10-point increase in the overall score corresponds to a 48.6% decrease in the risk of a preventable accident. These models show that telematics data can provide an excellent measure of behavioural and exposure risk and can be used by insurers to price products and by individual drivers and fleets to improve driving behaviour to mitigate risk. Monitoring driver behaviour for fleets and providing feedback can significantly minimize accident risk and improve fleet efficiency while usage based insurance programmes that use driver scores to incentivize good driving behaviour can contribute to overall safety improvements in the transportation sector.

Analysing historical driving patterns is another powerful way of assessing risk. Machine learning models of individual driving to predict behaviours based on past patterns of driving can be used to pre-empt risky driving behaviour through incentives or appropriate notifications delivered to the vehicle's dashboard.

More recently vision based Advanced Driver Assistance Systems are becoming available as retrofits to alert drivers on traffic speed limits using image recognition and on collision warning or stopping distance estimation using more advanced models. These also offer lane departure warnings as well as distracted driving and drowsy driving detection using pre-trained AI models. Such in-vehicle systems are estimated to decrease the fatalities by up to 16 per cent based on reported crash data from 1999 to 2008 (Source: CASR Report Series, CASR094. Center for Automotive Safety Research. The University of Adelaide, Australia). Video snippets of violations are sent to a cloud repository where these can be reviewed as and when required.

Fuel economy

Fuel economy is another area that data analysis can provide useful insights on. In India, ARAI typically tests new vehicle models on a chassis dynamometer that simulates driving in India using the modified Indian Driving Cycle (IDC) for emissions as well as fuel performance. These tests provide a fuel economy performance value for each vehicle model but this can vary significantly from actual performance in real-world conditions due to various factors such as terrain, weather conditions, driving behaviour as well as differences in driving patterns. The large volumes of data available from multiple vehicles at a granular level – every second or even at the end of a trip – can be used to estimate fuel economy performance using population based models at the trip level and can offer tremendous value in benchmarking fuel economy for each vehicle make-model.

For example, using fuel consumption data from over 210 million miles, we have been able to develop such fuel economy benchmarks for over 2500 year-model-make-engine types for multiple geographic regions and seasons. These benchmarks allow us to rate trips against these benchmarks for a particular average trip speed in a region and season and can highlight whether the trip's fuel efficiency was poor due to poor driving behaviour or due to a possible vehicle health issue. Having such population based benchmarks can help regulators

The large volumes of data available from multiple vehicles at a granular level can be used to estimate fuel economy performance using population based models at the trip level and can offer tremendous value in benchmarking fuel economy for each vehicle make-model

assess the actual fuel performance of vehicles meets prescribed standards and to set standards accordingly. Vehicle manufacturers can also benefit from such data and benchmarks in compliance with policy and regulations.

Modeling fuel consumption with respect to driving behaviour can also establish a quantitative link between additional fuel consumed as a result of individual driving behaviours like braking and speeding. This can quantify costs related to poor driving behaviour from a fuel perspective. For example, for a particular medium commercial vehicle model, we have been able to relate a single hard braking event to an increase of 0.16 litres of fuel and speeding for 1 minute above 120 kmph to an increase of 0.05 litres.

Accelerometer data applications

Onboard vehicle devices are typically equipped with accelerometers that have the ability to detect accidents when a certain g-force threshold is crossed. This is a form of edge computing requiring the edge deployment of a classification model to distinguish between real impact events and false positives that are triggered when a vehicle has gone over a large pothole at high speed. Classification models are developed using high frequency data (a minimum of 100Hz) and use various inputs in addition to the accelerometer. Such accident detection algorithms are useful to provide real-time notifications for emergency response in the event of an incident. The data obtained from accelerometers and other sensors like gyroscopes along with other contextual information is also very useful in accident reconstruction as well as for injury classification to provide a better understanding of the event, which can serve as useful input for vehicle insurers.

> **"INTEGRATING ADVANCED DATA ANALYTICS AND MODELLING CAN ADD TREMENDOUS VALUE TO A VARIETY OF STAKEHOLDERS ACROSS THE VALUE CHAIN AND CAN PRODUCE INNOVATIVE BUSINESS MODELS TO MONETIZE SUCH DATA"**

Accelerometer data can also be used to model and classify road surfaces that a vehicle has driven on. This has applications to determine additional stresses on tyres as well as vibrations that could impact certain vehicle systems. Classifying roads in terms of their quality can also help local governments identify stretches that need maintenance and can provide transparency in the way funds are allocated to different areas under their purview.

Electric vehicles

The shift to EVs has been rapid over the past few years and this shift is expected to accelerate even further over the next few years. In addition to EV health monitoring and driving behaviour monitoring described above, vehicle parameters (voltage, current, temperature from multiple sub-systems) can be used along with ambient conditions and driving styles to model and compute more accurate and reliable estimates of driving range at different States of Charge (SOC) than currently available algorithms. Similarly, the relationships between multiple battery parameters can be used to model the State of Health (SOH) of batteries to indicate whether the battery needs to be replaced. At the system level too, optimizing charging networks and utilities (especially integration with renewable sources) and other infrastructure integration can be better informed through data analysis of driving patterns, resource availability and operations. The integration of EVs with smart grids is another emerging use case that is likely to generate more interest in the future with tremendous applications for the use of vehicle batteries to supply power to the grid during peak demand, to detect network deficiencies, maximize renewable energy uptake for vehicle charging, etc.

Conclusion

This article has outlined several applications and use cases of analyzing and modelling vehicle data. These range from vehicle development efforts of OEMs, improving safety, fuel economy and operational efficiencies of commercial fleets as well as passenger vehicles. Integration of contextual data such as weather and traffic conditions along with behavioural inputs that might be derived from the vehicle data itself or from additional sensors / feeds provide an opportunity for a richer analysis with deeper insights. The EV industry, including EV charging, is in early stages of development. Integrating advanced data analytics and modelling can add tremendous value to a variety of stakeholders across the value chain and can produce innovative business models to monetize such data. The future of the automotive sector within the overall mobility space offers great potential for the future and the first movers harnessing the power of data analytics are likely to benefit greatly in the application and monetization of automotive data. ❑

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Ashwin has over 20 years of research and consulting experience and currently heads the Data Science practice at Danlaw Inc. He is responsible for building innovative solutions involving advanced statistical techniques applied to automotive and telematics data and has been leading the development of an analytics platform for the automotive sector integrating multiple services for vehicle health, risk scoring and other sensor based models.

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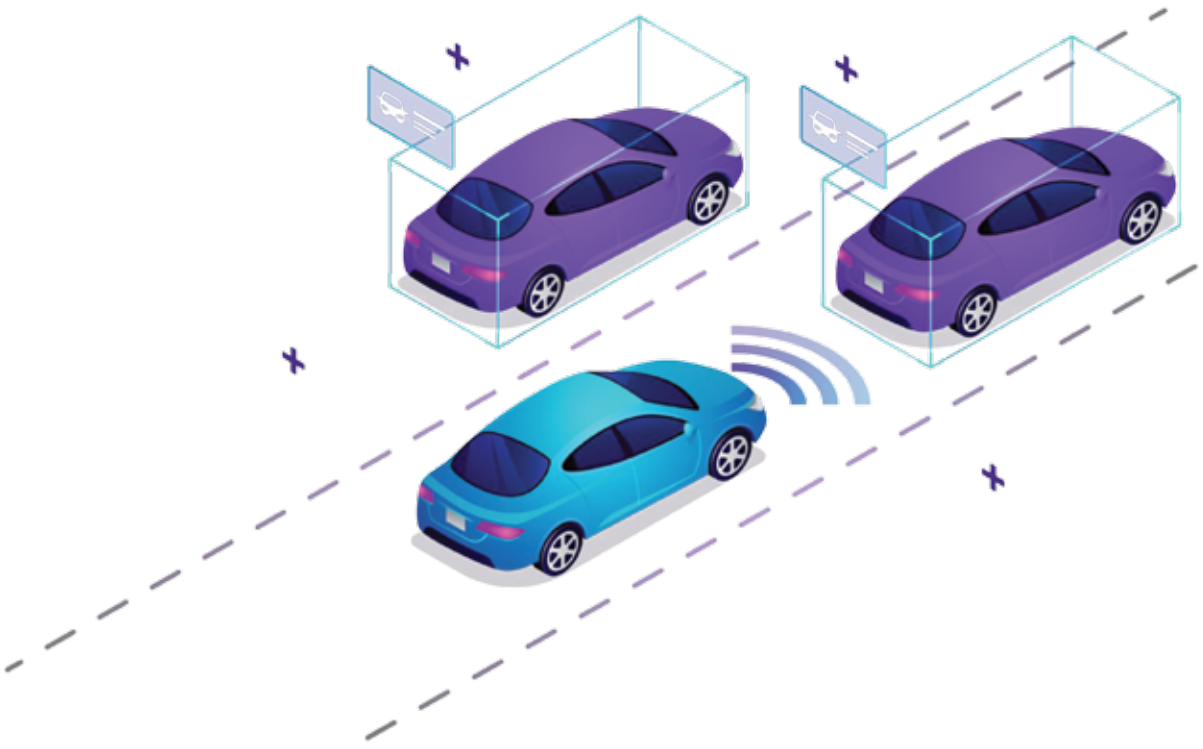

When Smart Data and Analytics meets the Road

NAGESH KP
SLK SOFTWARE

Cars are becoming a necessity more than luxury with the current pandemic that is challenging Status Quo. The automotive industry has seen a steady growth over the decades, but the evolution of the industry to provide superior digital user experience is yet to keep pace with this growth.

The past decade has seen the utilization of various digital technologies into the process of making, driving or monitoring a motor vehicle. Various digital technologies like AI/ML, Big Data, Industrial IoT, Spatial Analytics are fast converging into the automobile industry.

Smart data is helping the automotive industry advance further in several ways- by enhancing overall vehicle experience including uptime predictions, reduce cost of repairs, advanced driver assistance systems, self-driving vehicles.

Smart Data collected from automotive is becoming the glue or the new fuel for growth. Converting this as an asset and building new business models atop this is becoming the new norm.

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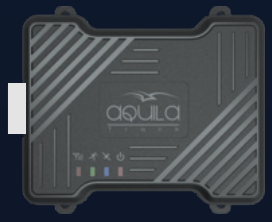

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Below are the Smart Data Use Cases used in the automotive Value Chain

Core Processes	Applied Innovation, Automation & New Business Models
Sensor Stream processing	JIT Spare Parts management
Cross - Stream Complex Event Processing	Predective Supply Chain
Process driven R&D	Real-time quality assurance
Preventive Warning	Preventive recalls
Real-time Monitoring	Risk Analysis
Supply Chain Planning	Usage Data
Predictive Maintainence	Ride Sharing
Customer 720	B2B Sales
Customer centric use caes – Churn, customization	Virtual Car Appraisals

Automotive Industry & Smart Data

Below are few areas where the automotive industry is using smart data analytics to go to the next level:

Connected Cars

In today's connected world, cars are becoming the identity of the owners. Few Car Makers are enabling this as an unique identity as we drive-in to a bank to identify ourselves.

Superior Driving Experience

Smart data analytics have transformed driver experiences, providing predictive and preventive real-time data insights both from inside and outside the environment to improve driver safety, vehicle services thereby improving the overall driving experience.

Deep Personalized Experience

Automotive retailers collect massive amounts of customer data both from within and outside the organization including federal agencies to get to know their customers and car better. They create real-time & massive historical insights to provide personalized experience for car buying, selling, ancillary opportunities like maintenance, insurance.

Product Quality & Recall management

Sensors in automotive are growing by the day. They collect information like speed, emissions, fuel consumption, usage data for resources, and security. All these data can be used to find patterns and resolve quality issues or prevent them from happening altogether. Analytics is used to increase superior customer experience and quality management at an efficient & effective level. Using this for preventive maintenance will enable reduce smart recalls.

Smart City Planning & Safety

Smart City problems like effective traffic management, distribution of resources, carbon emission and environmental issues can be tackled with combining insights from automotive data and other sources such as satellite, mobile, GPS data, etc.

Virtual Car Appraisals

Sensors collect information like speed, usage data, pictures, patterns to evolve a persona of the driver. These smart data in combination with data from federal agencies can give insights into car usage, accidents, damages, by identifying patterns from amongst the large data collected. This can be further used to provide the right appraisal for an used car.

Supply Chain Management

Pandemic has taught us new lessons in supply chain management as parts are manufactured and assembled globally. The global supply chain delays have delayed go-to-market for many automobile models, electric vehicles due

to lack of circuitry, sensors, boards and other essential foundational elements needed to make an automobile. Smart data comes to the rescue in this area to plan and organize this better based on the open supply routes and options

Can we build a Smart factory with minimal dependency on all resources including people to build the same? With Industry 5.0 this is now becoming a fast trend in this pandemic world. Automotive manufacturers are rethinking competitive advantage by applying new age digital technologies to build agility, applied innovative, predictive automation and intelligence across all areas of the manufacturing life cycle

Conclusion

So, with the rapid increase in the advancements from the ever growing digital world. Smart Data has been the foundational aspect of all these advancements since the amount of data collected for all these developments increases massively and needs parallel processing to handle this large data generated every moment. We can now say that Smart Data has finally reignited the digital passion and superior customer, driving experience in the automobile industry. ❑

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Connected Cars – Testing V2X Systems

RAVI PATIL
SPIRENT COMMUNICATIONS

V2X communication technology is an important enabler for advanced driver assistance systems (ADAS), a system developed to facilitate autonomous driving and smart cities with intelligent transportation systems (ITS). Asia Pacific continues to lead the global connected car market, for cars to communicate with each other local govt plays an important role to mandate and implement V2X technology.

As assisted driving technology and connected cars are becoming a reality, there will be significant growth in the importance of V2X communication in vehicles. New vehicles are becoming more connected – with each other, internet and with surrounding infrastructure. New systems are being developed and integrated at a rapid pace, as automotive brands compete to claim an edge by harnessing the potential to improve the driver and passenger experience – in terms of safety, information, convenience and entertainment. The arrival of new systems and protocols requires new testing approaches and will increase demands upon automotive research and development in terms of network expertise.

To ensure absolute reliability from automotive systems, testing is crucial to meet the challenging requirements of conformance, performance, safety and reliability. In order to achieve truly flexible and robust V2X testing and dynamic behaviour of V2X entities, in a virtual and field environment that accurately re-creates the key conditions, T&M companies are playing a vital role in accelerating adoption of V2X technology, delivering rigorous and cost-effective tests, while empowering automotive companies to shape the future of transportation.

Testing V2X systems

Testing V2X communications is becoming a critical part of vehicle development and presents a unique combination of challenges. As with any automotive system, it is essential to test and ensure, that every connected vehicle is safe, performs accurately and responds to real-world situations and challenges in a way the user would expect. Testing to evaluate the systems should include metrics for precision, robustness, repeatability, safety and much more.

Testing for conformance and interoperability:

Connected vehicles need to interact with roadside infrastructure – and just as importantly, each other. That means, all manufacturers will need to conform to a common set of agreed standards. As with all new automotive technology, consumers' trust will be essential to adoption – and any failures, particularly those affecting safety, will reflect directly upon the brand involved. But in many respects, interoperability is a new challenge for the automotive sector. OEMs and their supply chains have an excellent track record in setting, meeting and policing their own standards – but direct interoperability, based upon shared protocols, will be something many automotive

test engineers are facing for the first time. Manufacturers in the sector therefore, need to define test cases that will enable them to confirm any new V2X systems conform fully to the relevant protocols for each territory.

Testing for functionality and performance:

Conformance with agreed protocols is only a first step. For V2X, this means it needs to send, receive and interpret signals correctly, interact well with infrastructure and other vehicles and make sense of all this information to react appropriately in every scenario. A framework for tests would include:

Evaluating response to real-world challenges; such as, radio channel impairments, obstacles to reception, and both deliberate and accidental cyber-attacks.

- Including other on-board units (OBUs) and roadside units (RSUs) to scale up the complexity of the environment and see how systems cope with a changing variety of V2X signals at once.
- Finding failure points by pushing the system beyond its limits, to evaluate its tolerances and discover how it behaves.
- Capturing how the device under test (DUT) behaves, with clear reporting to enable performance comparisons and confirm whether it responded as expected
- Testing at component and system level - including both software-in-the-loop (SiL) and hardware-in-the-loop (HiL).
- Testing V2X security:

Alongside any tests for standards conformance or system performance and functionality, it is essential that the V2X test regime confirms security in the face of a growing number of increasingly realistic threats: V2X communications give hackers a direct route into a vehicle's systems – the technology and knowhow to abuse that opportunity. To mitigate the risk, V2X systems need to be robust, reliable, and capable of recognizing when they are under attack – and these capabilities need to be tested. It is essential that V2X test equipment includes the flexibility to recreate current and future threats as they emerge. A configurable, GUI-based emulator gives the required control.

"IN-VEHICLE NETWORKS AND VEHICLE CONNECTIVITY ARE BECOMING INCREASINGLY COMPLEX, MAKING PERFORMANCE AND RELIABILITY MORE IMPORTANT THAN EVER. SPIRENT OFFERS AUTOMATED TEST SOLUTIONS FOR CONNECTED AND AUTONOMOUS VEHICLES, AUTOMOTIVE ETHERNET, AND 5G CONNECTIVITY"

Testing V2X

Distributed Short Range Communication (DSRC) defined in IEEE802.11p has been around for years as the main radio technology for V2X, supporting Vehicle-to-Vehicle (V2V) as well as Infrastructure-to-Vehicle (I2V) communication. Recently, we've seen growing support for usage of cellular radio technology for the same purpose.

Now with Cellular V2X (C-V2X) specifications published by 3GPP the need for testing C-V2X to ensure interoperability and validate performance is becoming urgent. C-V2X defines Proximity Services (ProSe) and the PC5 interface for device-to-device communication, to support Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) applications.

Testing V2X in lab and field – best of both

Although live, drive testing in the field remains a key part of developing any automotive system, laboratory-based tests also have a critical role to play. The two approaches have complementary strengths. Both laboratory and field testing have important roles to play in the future of V2X development and the industry should make the best possible use of both in order to drive innovation in a safe, robust and cost-effective way. However, as the technologies involved become more sophisticated and numerous, the gap between the two approaches is growing. It is becoming increasingly difficult to reflect all the internal and external influences upon the connected car in a laboratory environment and harness the respective strengths of both. There is a pressing need for smart integration of lab test equipment, with a higher standard of simulation, to give a more precise, accurate and controllable lab-based version of live test conditions.

The way forward

Increasing integration of V2X, ADAS and automated systems present automotive companies with a number of challenges, most notably, interoperability and cyber security. To find a reliable, robust and cost-effective way to ensure that the vehicle and all its components deliver the best & safest experience for the driver – remains the same as it has always been. Solutions for testing the next generation of connected vehicles should be built upon proven methods, technologies and techniques that deliver robust results, while enabling rapid innovation. ❑

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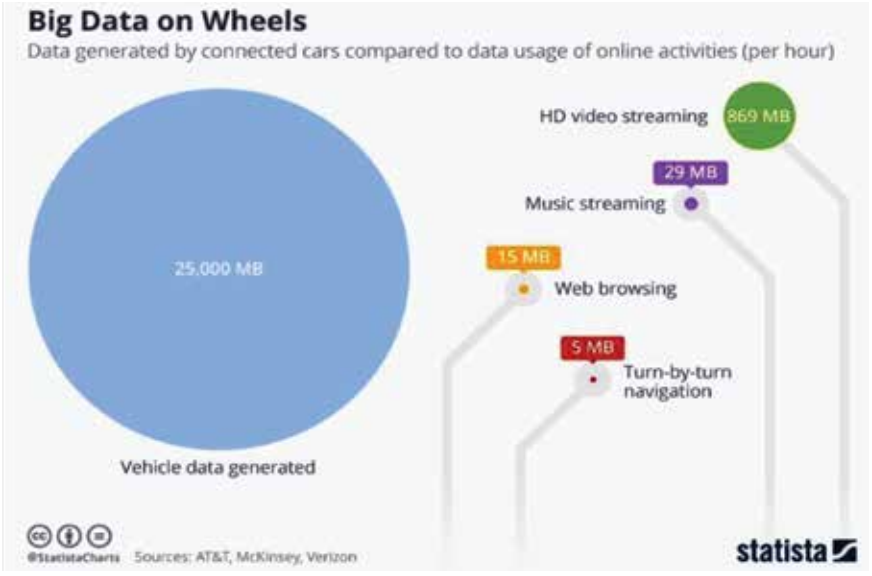
The Data-Wide-Web of Automotive World

ANIL GUPTA
MAGNOS TECHNOLOGIES LLP

Like any other sector, any other industry, Data has taken centre-stage in automotive world too. Automotive Industry has gone through various stages of evolution and revolution. Till about mid 90s or so, most of the innovations were on mechanical front – the engineering, design, production etc. then slowly electrical engineering and electrical systems started capturing their own bit of innovation. Around 2000 or so, the Electronics world started playing its role, and started stealing most of the innovation budget in Automotive new innovations. And now, in last few years, it is the data, data enabled services, analytics that is playing major role in almost every area related to Automotive – Sales, Marketing, Production, Customer Experience, Connecting with End Customer, Resale, Aftermarket and so on.



Following picture depicts, a related size of data in the context of other data related applications

Remember – the above picture is referring to just connected car services. In the context of Autonomous vehicle or some high end connected car services the volume may go upto dealing with 4000 GB per day, per car data. And it is not just sheer volume, there is a huge complexity in the variety of this data too. Sensors data, GPS data, Camera inputs, Images, Radar data, Sonar data, Lidar data and what not. That's the sort of volume and variety we are talking about.

Application Areas – Most of the touch points in the whole lifecycle of vehicle – from concept to retirement, have applicability and different set of use-cases for data enabled services. These areas can broadly be classified in following categories :

- Product Development, Design and Manufacturing – in a number of ways such as preventing design errors, tracking changes in design, quality of the work, managing entire production and manufacturing process – improving quality as well as reducing cost.
- Supply Chain -- minimize risk & maximize growth by optimizing the entire supply chain system. Identification of right vendors and partners, implement the state of the art just in time approach and so on.
- After-Sales, Warranty & Dealer Management -- After sales support, Ontime, on-demand services, prognostic services, fuel management, fleet management, performance data analytics etc.
- Marketing, Sales & Other Applications -- Planning for overall marketing spending, targeting, strategizing for best marketing outcomes, understanding competitor marketing strategy and counter those. Understanding customer buying patterns and so on.
- Connected Vehicles & Intelligent Transportation -- A whole host of connected vehicle services, some of which are detailed more in Usecases section
- Quality Analytics - Understand quality related flaws & resolve that at a very early stage of product manufacturing
- Vehicle Financing

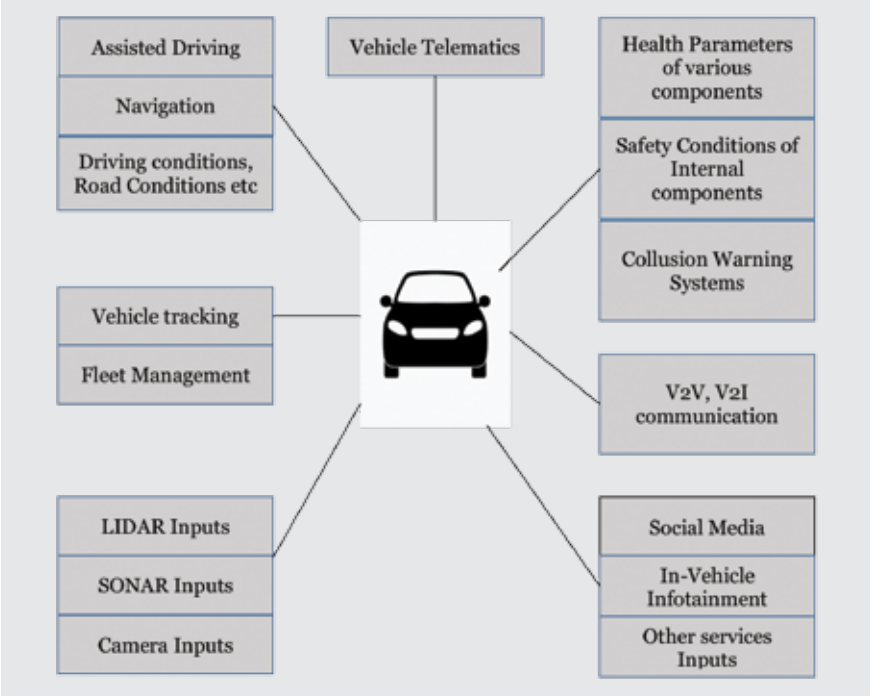
Use Cases - there are hundreds of usecases, Data production and consumption is done under-the-hood, by those tens of ECUs connected to different data collection and controlling devices, such as sensors, camera, GPS devices, Lidars and so on. Data production and consumptions is also done above the hood for a whole host of

connected car and Infotainment services. Much of the data produced is hosted and consumed locally without much interaction with the cloud. However, indeed there is partial data that is stored in the cloud, and exchanged between vehicle and OEM or other service providers. Some examples of different usecases are

- Automotive Insights for Design and Production
- Product Design & Planning
- Predictive Maintenance & Real-Time Diagnostics
- Parts Inventory & Pricing Optimization
- Supply Chain Management
- Dealer Management & Customer Support Services
- UBI (Usage-Based Insurance)
- Autonomous & Semi-Autonomous Driving
- Intelligent Transportation
- Fleet Management
- Driver Safety & Vehicle Cyber Security
- In-Vehicle Experience, Navigation & Infotainment
- Ride Sourcing, Sharing & Rentals
- Marketing & Sales
- Customer Retention
- Third Party Monetization
- Supply Chain improvement

Data Sources – When we talk of automobiles, there are a number of sources internally to auto machinery as well as outside, who are creating, manipulating and using the data. There are thousands of parts in auto machinery. A lot of these parts are generating a lot of data bundles.

Autos are running on the road, where they have opportunity to talk to other elements on the road such as adjacent vehicles, road side infrastructures, the signal, and so on. People are using and sitting in automobiles, so automobiles have opportunity to get data from these people, and finally their creators, manufacturers --- OEMs, Tier –I, II providers, Service providers and so on. Each of these objects practically work as Data source for automotive.



Data Collection Techniques

The data collected from automobiles can be simple sensor based techniques to record and monitor performance, maintenance and behavior of critical automobile systems, or more sophisticated GPS and satellite based techniques such as tracking vehicle position and recording external conditions.

Data collection techniques for automobiles gained maturity over the years by using current technology offerings like mobile devices, wearables, Big Data, Business Intelligence, Cloud and Social Media. The major focus of these collection techniques was to improve customer experience and achieve better vehicle health.

Standardization and regulatory initiatives – As this whole thing is taking a massive shape and now likely to become the mainstream for automotive lifecycle, the need for standardization and regulation automatically arise. Trust issues, interworking issues, ownership issues, retention v/s destruction issues and so on. Cyber security, especially security along with safety and privacy are likely to be the key areas of topic, in fact they already are. Several frameworks across geography have emerged. A number of industry forums have been created to discuss and iron-out these issues and workings.

Challenges - Dealing with data, Giga, Terra, Peta bytes of data is never without challenges, be it in any domain. With automotive, the complexity and the amount of these challenges only increase rather than reducing.

Industry stalwarts are still struggling with several burning issues. Questions such as "Whose Data is it anyway?", "What is the right size, frequency, type…etc of the data to be collected?", "Are we morally right to collect, store, use it internally, and eventually sell the data?", "Who pays for the maintenance, collection and services of the data enabled services?", How to monetize the data, and so on… Several such questions needs to be answered. And this is an ongoing process. ❑

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CO-FOUNDER
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Anil Gupta, Co-founder of Magnos Technologies LLP. He has about 25 years of experience in Connected Cars, Connected Devices, Embedded software, Automotive Infotainment, Telematics, GIS, Energy, and Telecom domain. Anil is MS in Computers and Software Engineering from Illinois Institute of Chicago. Currently pursuing his interest in technology, finance and investments -- publishes several articles around these topics.

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Big Data and Data Analytics are Extending Arm of OEMs

RICHA TYAGI
TELEMATICS WIRE

Introduction

Terms like Big Data and Data Analytics are commonplace in the automotive industry. Now it is getting applied in every stage of automotive conceptualization, designing, and production. According to the McKinsey & Company report, by 2030, global revenues from automotive data-related services will grow to around $750B. Automotive giants like Tesla, BMW, Ford, Toyota are built on data.

Nowadays the automotive companies find difficulties with integrating a large amount of data and analyzing it within a tight time frame. That's why they decide to outsource the whole part of their data analysis, to be able to control a large volume of data. Data analytics companies across the world are racing to develop innovative business solutions and widen the scope of usage of data analytics in areas as diverse as payment transactions to operational efficacy by offering expanded services to their customers. At the core of these developments are the insights gained through the analysis of the data being generated in the business operations.

We've looked into some big data and data analytics companies in the automotive industry across Europe, Asia, North America, and Australia. These are the companies that focus primarily on big data and/or data analytics in the automotive industry and large IT outsourcing companies that can support your project with versatile expertise:

Zene

An Indian company Zene, headquartered in Gurgaon, Haryana, founded in 2014, is a plug-and-play device that connects the car to the cloud and enables it to capture great insights from the car's data. This device not only can manage the car remotely but also know whether it is performing at its optimal level.

OBD II - Car Diagnosis Device
Source: Zene

Hansa Cequity

Hansa Cequity is an Indian company, situated in Bengaluru. It is a marketing company that provides customer strategy, data services, analytics, campaign management, digital and Customer relationship Centre services for key clients across different verticals. Hansa Cequity was established by R K SWAMY HANSA Group along with S. Swaminathan and Ajay Kelkar.

V2X Network

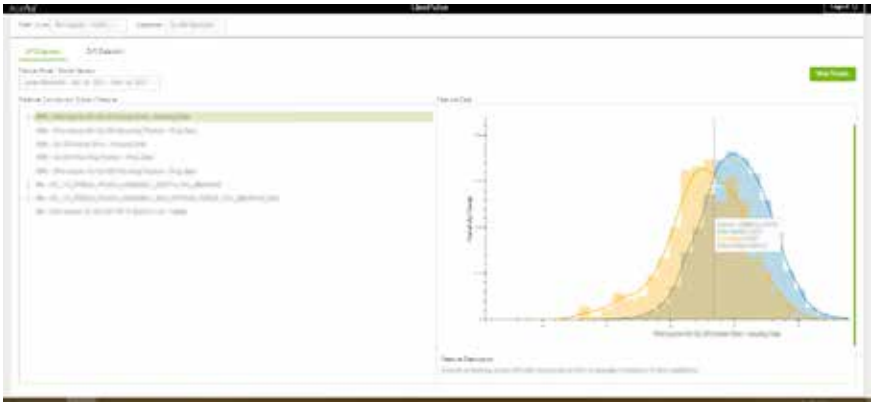
Headquartered in London, V2X Network seems to be a rather nascent player in handling payment transactions. Their platform V2X Network is an autonomous transaction platform for the mobility ecosystem. V2X uses distributed ledger technologies, to enable peer-2-peer data and payment transactions between vehicles and connected service providers. Founded in 2018, V2X Network enables the vehicles to transact on their own by using digital vehicle identity.

Motorq

Motorq, US-based a connected car data ecosystem, with office in Chennai (India) was founded in 2016 that enables enterprises such as fleets, insurance companies, and governments access to connected vehicle data and analytics at scale so that enterprises can rapidly improve operations and expand services.

In November 2020, Motorq and General Motors have announced that they have integrated GM's OnStar Pre-Delivery data service with Motorq's cloud-based

EvalExpert Source: AlgoDriven



Linepulse 2.0 Source: PRWeb
LinePulse Smart Line Analytics helps engineers identify the most significant signals for investigation during root cause analysis, reducing the time commitment from weeks to hours.

platform to allow fleet operators to identify and track the location of Chevrolet, Buick, GMC, and Cadillac vehicles throughout their logistics lifecycles.

Motorq has closed a $7 million Series A round of funding in December 2020. The round was led by Story Ventures with participation from existing investors FM Capital, Monta Vista Capital, and Avanta Ventures, the investment arm of CSAA, a AAA Insurer.

AlgoDriven

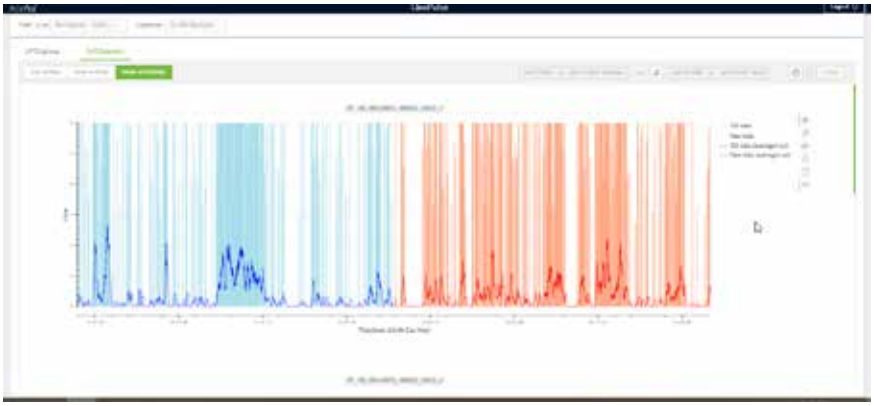
The UAE-based startup, AlgoDriven founded in 2017, is an automotive data platform. EvalExpert mobile app, a vehicle appraisal solution developed by AlgoDriven that uses proprietary algorithms for vehicle appraisal, price guidance, and wholesale management. EvalExpert features a web dashboard and integrates with the existing business solutions for easy usability. Car dealers use EvalExpert to appraise their cars.

Acerta

Acerta, a startup in Canada, delivers machine learning technology to the manufacturing and automotive industries.

Acerta Analytics and GAA extended their partnership in January 2021, providing in-country resources to support and deploy Acerta's advanced AI and machine learning solutions to automotive customers across Europe, North America, and Asia.

In February 2021, Acerta Analytics announced the release of its industrial machine learning platform, LinePulse 2.0. With the help of this platform, users can benefit from an expanded range of data analysis and visualization options, including Intelligent Component Selection for AI-driven recommendations during assembly, Smart Line Analytics for enhanced data visibility, and Automatic Retraining for continuous model improvement.



LinePulse 2.0 Source: PRWeb
LinePulse uses an innovative auto-retraining framework to compensate for variability in manufacturing data due to changes in instrumentation, seasonality, and even personnel. Whenever the platform det Data Drift detection in the LinePulse UI.

DRVR

By using connected car data and data analytics companies are enabled to take better control of their fleets. DRVR from Bangkok, founded in 2014, is focused on Data analytics centered on vehicles. DRVR has developed dashboards for Data Analytics that are compatible with many different off-the-shelf Telematics solutions. The main focus of the company in 2020 has been on its new suite of driving behavior services.

In 2017, DRVR partnered with Tata Communications as a global IoT connectivity partner. DRVR claims they will be making Asia's vehicle fleets the smartest and most cost-efficient in the world.

In 2020, DRVR announced that it has raised an undisclosed amount of funding from Smart Axiata's Digital Innovation Fund. With the funding, the company wants to expand its services into Cambodia and hire across the board.

N-IX

Headquartered in Lviv, L'vivs'ka Oblast', Ukraine, N-IX helps businesses ensure predictive vehicle maintenance and make data-driven decisions on the road. The company was founded in 2002 and has got a broad range of expertise in artificial intelligence, machine learning, data science, and big data analytics in the automotive sector.

In 2020, N-iX has reached a Partner Level status in the Google Cloud Partner Advantage Program. With the partnership, N-IX will leverage Google Cloud and its advanced capabilities to help its clients drive maximum value from their cloud investment by expanding their market reach, improving the performance of their products, increasing time to market, and more. N-IX has achieved Amazon Web Services Advanced Consulting Partner status in the AWS Partner Network (APN) in February 2021.

Future Processing

Future Processing was founded in 2000. Its headquarters is situated in Poland. Future Processing is a software development company that provides data

analytics services to many companies in the automotive industry and helps them augment their teams with automotive software developers to meet their business goals. The key clients of the companies are Valeo, Volkswagen Group Polska, and Tanneco.

Data Reply

Data Reply, London based company, founded in 2015, offers a wide range of data processing and analytics services. They specialize in big data, data science, artificial intelligence, cloud computing, digital communication, IoT, mobile and social networking. It provides its services to many automotive companies such as Audi, Fiat, and CNH Industrial.

Phocas

The automotive data analytics company Phocas, headquartered in the UK, delivers data analytics solutions to manufacturers, distributors, and retailers around the world. Phocas provides powerful data tools and dashboards that will enable automotive businesses to quickly determine sales and inventory priorities. In January 2021, Phocas Software announced a US$34 million capital raise to accelerate its growth in America and the United Kingdom, expand into new industries and develop its core products.

Softweb Solutions

The US-based Softweb Solutions, with office in Ahmedabad (India), has experience in data analytics in the automotive industry from 2000, as well as helps businesses gain valuable insights from data in retail, oil & gas, telecom, and healthcare industries.

In 2018, the company was acquired by Avnet, a global technology solutions provider. Softweb Solutions accelerates Avnet's IoT efforts as well as its data services and AI capabilities.

ISoftStone

The Chinese company iSoftStone started in 2001, provides technology services in Data Analytics, Mobility, Enterprise Application Integration, Cloud, and Quality Assurance. Additionally, the company offers iSoftStone RapidStart solution accelerators: RapidStart Data Analytics, a reporting, and analytics solution, and RapidStart SharePoint Migration that supports small to large scale SharePoint content migration.

Xomnia

Xomnia from the Netherlands started in 2013, helps organizations generate value from data by developing, integrating, and maintaining their big data platforms and predictive solutions. The company also assists businesses to gain insights with the help of data analytics in the automotive industry. The key clients of Xomnia are ProRail, Geelen Projects, Schadegarant etc.

Pythian

Pythian Services Inc., known as Pythian is a Canadian multinational corporation. It has its office in Telangana, India. Founded in 1997, the company provides cloud and data analytics services to companies in the automotive industry. It helps businesses by technologies such as advanced analytics, big data, cloud, databases, and infrastructure management. In November 2020, Pythian has earned the Data Management Partner Specialization in the Google Cloud Partner Advantage Program.

Drust

Established in 2014, DRUST is a French company. It is a car data analytics cloud-based platform. DRUST powers driver-oriented services alongside car service brands, to provide the drivers with insights about their car and their driving. DRUST was acquired by Continental in 2019.

Sight Machine

Sight Machine is a California-based company, set up in 2012. It provides an analytics platform that addresses critical challenges in quality and productivity throughout the businesses.

In February 2021, Essex Furukawa partnered with Sight Machine Inc. as the manufacturing productivity platform for its plants in China, the US, and Germany. The agreement extends the digital transformation initiative begun at Essex Furukawa's magnet wire plant in Torreón, Mexico, where Sight Machine has helped Essex Furukawa increase EV production. Essex Furukawa will use Sight Machine to improve manufacturing quality, speed, and uptime in its plants supplying automakers in four of the world's six largest auto-making countries.

Zendrive

The US venture Zendrive, founded in 2013, powers mobile sensor data to provide actionable insights that improve safety for passengers and drivers globally. It has one of its office in Bengaluru. In December 2020, Zendrive released a visual data report that analyzes driving behavior in the wake of the Covid-19 pandemic. Additionally, with a sample dataset of verified collision incidents from 2018 through 2020, the report reveals that distracted driving now contributes to more than 57% of all collisions on the road.

PitStop

A Canadian platform, PitStop, founded in 2015, aggregates data and uses machine learning to perform predictive maintenance for vehicles. In October 2020, Pitstop announced a Series A round of funding led by Sensata Technologies with participation from existing investors Ripple Ventures and Hike Ventures. With the funds, Pitstop will expand market reach, enhance product features and build additional prediction algorithms for the automotive industry. The amount of funding was not disclosed.

CARFIT

CARFIT, headquartered in California, was established in 2016. It is a self-diagnostic & predictive maintenance platform in the connected car space that provides the dealers/service companies with customized lead generation and car-owners with individualized predictive maintenance info on their car.

wejo ADEPT

Started in 2013, the UK-based Wejo gathers & analyzes car data from connected cars to help car manufacturers improve their products through data-driven decisions. In March 2021, Wejo collaborated with HELLA, an automotive part supplier. The collaboration aims to develop new data-based business models and further enhance the performance of HELLA's sensor portfolio. HELLA also acquired a minority stake in Wejo. Wejo organizes data from about 15 million connected vehicles for its clients such as General Motors Co, Hyundai Motor Co, and Daimler.

Otonomo

The Otonomo Automotive Data Services Platform is an Israeli company that was started in 2015. It helps to fuel an ecosystem of OEMs, fleets, and more than 100 service providers. Otonomo's neutral platform securely ingests more than 2.6 billion data points per day from over 20 million global connected vehicles, then reshapes and enriches it, to accelerate time to market for new services that delight drivers. Use cases include emergency services, mapping, EV management, subscription-based fueling, parking, predictive maintenance, usage-based insurance, media measurement, in-vehicle services, and dozens of smart city services.

In November 2020, Otonomo had partnered with xyzt.ai. Otonomo provides xyzt.ai and its diverse collection of over 100 commercial partners with access to multi-layered connected vehicle data from 12 OEMs, including traffic, hazard, ultrasonic sensor, weather, parking, and other vehicle-based data.

Vinli

Vinli is an automotive technology company, established in Texas, the US in 2014. Vinli builds data intelligence solutions and services for the connected world. It offers its own connected car platform called Tenjin, which businesses can use to quickly create their own connected car services and applications. In 2018, ALD Automotive signed a strategic partnership with Vinli. Through the partnership, Vinli provides services to enrich ALD's service offering and develop new value-added solutions to improve both TCO and driver experience.

Xevo

Xevo, a part of Lear Corporation, is a Seattle-based company, started in 2000. It provides connected-car software. It is a development partner to some of the world's largest automakers such as Chevrolet, GMC, Buick, Hyundai, etc.

In 2017, Xevo launched Journeyware, a suite of products that includes a data management software designed to personalize the consumer driving experience. Journeyware's components are already deployed in more than 25 million vehicles worldwide.

Smartcar

Smartcar is a US-based company that was established in 2015. It develops car API for mobility applications. The company is collecting data from connected cars and making that data available to developers who want to enable their apps to locate, unlock, and read the odometers from cars across more than a dozen car brands.

Smartcar has formed a partnership with True Mileage in January 2021. Under the partnership, both companies will launch usage-based insurance (UBI) solution for auto insurers. The solution combines Smartcar's API with True Mileage's UBI analytics. In August 2020, Smartcar and Pitstop have announced a partnership to offer the hardware-free prescriptive fleet maintenance solution to enterprises in the United States and Canada.

Oxylabs

Lithuania-based Oxylabs, established in 2008, is a technology company that provides tools and resources for web data collection. In 2020, the company partnered with undergraduate students from Stanford University, the University of Virginia, and Virginia Tech to support TrackCorona, a COVID-19 tracking website that went from a blip on the radar screen to a prominent global resource with 1.4 million visits from 193 countries, averaging 40,000 users per day.

Bright Data (Formerly Luminati Networks)

Bright Data is an Israeli startup that was founded in 2014. It is a data collection enablement platform. In March 2021, Luminati Networks announced that it is to become Bright Data as it takes the next step in its journey to deliver valuable online data to organizations and further support the data collection industry.

Teradata

US company Teradata, founded in 1979, offers analytic data platforms, applications, and services for data warehousing and analytic technologies. In India it has its office in Bengaluru, Pune, Hyderabad, Gurugram and Navi Mumbai. In February 2021, Teradata joined the Open Manufacturing Platform, a global alliance initiated by the BMW Group and Microsoft to drive industrial IoT developments and build future Industry 4.0 solutions in the manufacturing and automotive sector. As a member of the OMP, Teradata will help manufacturers accelerate innovation and achieve production efficiencies across the entire value chain by unlocking the potential of their data.

Conclusion:

Nowadays vehicles are more complex and sophisticated, they generate a huge amount of data. Automotive players must invest in data management to protect and improve their relationship with customers. Managing data is a three steps process: real-time data acquisition, data unification, and data insights. These three steps are the keep to responding to the challenges and promise of new technologies.

The companies working in the automotive data sector are growing around the world. Choosing the right vendor that suits business needs can become a real challenge. In order to make an informed decision, it is always better to choose from big data and or data analytics companies which are focussed in automotive segment. ❑

Parkopedia announces production version of indoor mapping services

Parkopedia has launched the production version of its indoor mapping technology for in-vehicle navigation use. Indoor maps are based on high-definition 3D models of indoor parking facilities, where GPS signal is typically restricted.

Parkopedia's indoor mapping technology can be used to deliver the following key use cases:

1. In-vehicle indoor navigation – no GPS dead zones
2. Precise indoor positioning – locate your vehicle
3. Automated Valet Parking – self-parking cars require indoor maps

SAIC to use Telenav's VIVID Nav solution for markets outside China

SAIC has selected Telenav's VIVID® Nav solution for its overseas markets in Europe, Southeast Asia and Australia-New Zealand. VIVID Nav delivers a seamless cloud-connected and onboard navigation experience, optimized to provide end users with the most up-to-date map and online content, while minimizing the amount of mobile data used to reduce SAIC's costs.

Geotab Marketplace to have Lytx's Surfsight video telematics

Geotab together with Lytx® announced the availability of an integrated camera solution from Surfsight™ on the Geotab Marketplace. The Surfsight AI-12 camera solution is specifically designed to assist improve fleet safety through its continuous recording and advanced machine vision and AI technology.

'Care by Volvo' using cloud-hosted FICO Platform

Volvo Cars has used the cloud-hosted FICO® Platform to digitize and accelerate the customer onboarding process for its vehicle subscription service, Care by Volvo.

Care by Volvo is a vehicle subscription service designed to let customers enjoy the benefits of a new Volvo, without the challenges of owning one. For a fixed monthly fee, Volvo provides subscribers with a brand-new Volvo and covers all regular service, maintenance costs and breakdown cover. The service was introduced to reflect the shift in consumer preference toward car usage and away from absolute ownership.

Volvo adopted various components of the FICO Platform — FICO® Decision Modeler, FICO® Application Studio, FICO® Data Orchestrator Data Acquisition Module — in a cloud-hosted version for maximum efficiency.

AGM Systems launches Velodyne lidar-based UAV mapping solution

AGM Systems will utilize Velodyne's Ultra Puck lidar sensor in their new AGM-MS3 Unmanned Aerial Vehicle (UAV) mapping solution. This solution is their second generation of UAV lidar scanning technologies for mapping in Russia.

Combined use of AGM-PS inertial navigation systems, highly detailed Velodyne Lidar output and proprietary software makes it possible to obtain centimeter-level accuracy when scanning from heights of up to 200 meters. A key factor for UAVs is navigation and safe landing, which is why AGM Systems chose Velodyne's precise, compact Ultra Puck lidar sensor.

Bridgestone launches Firestone Direct

Bridgestone Americas announced the launch of Firestone Direct mobile vehicle service for car owners and fleet operators. Firestone Direct brings Bridgestone's automotive services directly to vehicle owners' homes or workplaces to offer maximum convenience with safe, contact-free service.

This service uses specially equipped vans operated by certified technicians to perform a wide range of maintenance services, including fluid and filter changes, tire repair and replacement, battery check and replacement, and more.

Through 2021, Firestone Direct will continue to grow into additional markets across the southeastern U.S., with plans to expand nationwide by 2023.

HELLA Ventures invests in data-driven business, picks minority stake in Wejo

HELLA has entered a partnership with connected vehicle data provider Wejo. The relationship aims to potentially develop new data-driven business models. As part of the collaboration, HELLA acquired a minority stake in Wejo.

The first joint pilot projects between HELLA and Wejo are currently being defined and will begin shortly. A strategic investment in Wejo also forms part of the collaboration between the two companies. The investment has been made by the Silicon Valley-based venture capital arm HELLA Ventures. The contracting parties have agreed not to disclose the exact amount of the investment.

Garmin's automotive infotainment systems to have Alexa Custom Assistant

Garmin® International, Inc. expanded its strategic relationship with Amazon with the integration of Alexa Custom Assistant into Garmin's in-vehicle infotainment systems. Alexa Custom Assistant is a comprehensive solution that allows automakers to access Alexa's advanced AI to create their own intelligent assistants tailored to their brand personality and customer needs.

Garmin's Automotive voice development team has been working closely with Amazon to adopt Alexa Custom Assistant and is now showcasing its integration for adoption in production vehicles. The Alexa Custom Assistant technology will be available on Garmin's latest infotainment solutions, which are built on Qualcomm's latest-generation chipsets.

Western Digital reiterates the importance of data backup this World Backup Day

Western Digital Corp. announced the launch of #BackUpAndStaySafe to commemorate World Backup Day on March 31st. The digital-led campaign is aimed at building awareness around the benefits and the importance of backing up digital content. In the age of digitization and rapid technological evolution, the company wants to help empower consumers and reiterate the value of data safe-keeping and emphasize the importance of making data backups a regular habit.

The brand has released three real-life situation videos around data loss, that highlight how accidentally deleting files or a virus attack on a PC can spell disaster for the valuable data saved in it, and without backup, these files can be compromised for good.

As a part of this campaign, Western Digital also unveiled micro-site populated with informative posts, interesting facts about data backup, quirky creatives, myth busters, and interactive quizzes to make the experience more engaging for the visitors.

HAAS Alert builds out connected vehicle business unit

HAAS Alert announced it has hired Jeff Niermann as Vice President of Connected Vehicle Sales to lead its business development activities with automotive manufacturers, suppliers, and emerging autonomous and electric mobility companies. In his new role, Jeff will work to bring HAAS Alert's V2X digital alerting platform Safety Cloud® to connected vehicles, building on the nearly 1 billion driver alerts it has processed to date through its existing navigation partners.

Founded in 2015, HAAS Alert first prioritized growing the volume of roadway assets activated on Safety Cloud that lead to hazardous situations for other drivers. Almost 300 public safety departments, state & municipal DOTs, towing operators, and construction companies are connected to Safety Cloud, generating 1.4 million minutes of roadway hazard time during February 2021 alone.

Anritsu's MT8000A and MediaTek M80 5G modem achieve over 7Gbps downlink throughput with FR1+FR2 dual connectivity

Anritsu Corporation announced that its Radio Communication Test Station MT8000A successfully achieved a downlink (DL) throughput over 7 Gbps using FR1+FR2 Dual Connectivity (DC) technology and 256QAM modulation in 5G Standalone (SA) mode in conjunction with MediaTek's latest M80 5G modem. This achievement demonstrates Anritsu's commitment to contribute to the development and wider rollout of new 5G services, which, through its collaboration with MediaTek, verifies leading-edge 5G technology features.

Together MediaTek and Anritsu have been focusing on development and testing of both FR1 and FR2 technologies and functions. Increasing data throughput based on FR1+FR2 DC and 256QAM has been one of the latest successes in this ongoing partnership.

FR1+FR2 DC combines FR1 and FR2 technologies to improve data throughput per user by grouping cell base stations with different frequency ranges to transmit data; the 256QAM modulation technology uses advanced RF and signal-processing technologies to support faster communications by sending 8 bits of data in a single symbol.

INDUSTRY NEWS UPDATES

- Motion Intelligence announces availability of driver safety solution on Geotab's Marketplace
- Embark and the Arizona Department of Transportation collaborate to promote safe navigation of work zones by autonomous trucks
- Velodyne demonstrates LiDAR technology for improving pedestrian safety
- Lux Research predicts autonomous vehicle market to be a $50 billion opportunity by 2040
- WaveSense secures $15 million to accelerate next generation ADAS and autonomous features with world's most precise and reliable positioning system
- Vietnam launches first autonomous vehicle
- Self-driving truck company Plus upsizes recent fundraising to $420 million
- Mercedes-AMG defines the future of Driving Performance
- Renesas introduces complete power and functional safety solution for R-Car V3H ADAS camera systems
- Pony announces brand name of autonomous truck business "PonyTron"
- Optimus Ride partners with Polaris on fully autonomous GEM vehicles
- WaveSense secures $15 million to accelerate next generation ADAS and autonomous features with world's most precise and reliable positioning system
- Engineering an Ethicist in Autonomous (Vehicle) Beings
- FORESEE automotive eMMCs from Longsys enhance driver assistance system safety
- Volkswagen Commercial Vehicles moves ahead with Autonomous Driving R&D for Mobility as a Service

Sony (SNE), NTT Docomo conduct autonomous vehicle trial in Japan

Sony Corporation SNE, along with NTT Docomo Inc., announced the successful trial of a remotely-operated Sony Sociable Cart (SC-1) entertainment vehicle. This vehicle carried passengers for more than 2,500 kilometers, via a 5G network.

Video of the vehicle's perimeter was captured with Sony image sensors and sent in real-time to a Sony office in Tokyo where the vehicle was driven remotely while the operator watched a monitor, taking advantage of 5G's low latency, large capacity and extra-high-speed connectivity. The test was conducted on a 5G network, provided by Docomo Pacific. The SC-1's image sensors are attached to the vehicle's front, rear, and sides for high-resolution video visible by the remote operator. Sony provides reliability by using its '3R' technologies (Reality, Real-time, and Remote) for a better mobility experience in various fields.

CalPro launches new calibration tool ADAS IdentiScan

CalPro ADAS Solutions has announced the launch of its new ADAS IdentiScan product. The ADAS IdentiScan solution delivers detailed information and guidance to collision shops so they can efficiently and effectively manage the estimation and repair process by identifying the advanced driver-assistance systems (ADAS) and required calibrations.

Benefits that current ADAS IdentiScan customers are already experiencing include:

- The tool improves a shop's ability to capture calibration requirements
- The most thorough and accurate ADAS feature data available in the market
- An easy and intuitive vehicle inspection and survey wizard which can be completed in under a minute
- Works effectively across all vehicle manufacturers, while not putting any customer information at risk

InnovizAPP, an Automotive Perception Platform released

Innoviz Technologies, Ltd. has released its Automotive Perception Platform – InnovizAPP for the automotive industry. InnovizAPP is a perception platform, which includes automotive-grade hardware and software that enable autonomous vehicles to identify and classify objects.

InnovizAPP is based on Innoviz's advanced Perception Software, which leverages the rich data derived from Innoviz's LiDAR sensors, coupled with proprietary AI algorithms, to analyze the point cloud and estimate an object's speed with high precision. The software can accurately detect and classify objects in any 3D driving scene up to 250 meters away, including cars, trucks, motorcycles, pedestrians, and more. It also executes perception algorithms in real time, detecting and classifying pixels as collision relevant or non-collision relevant.

IDA Ireland

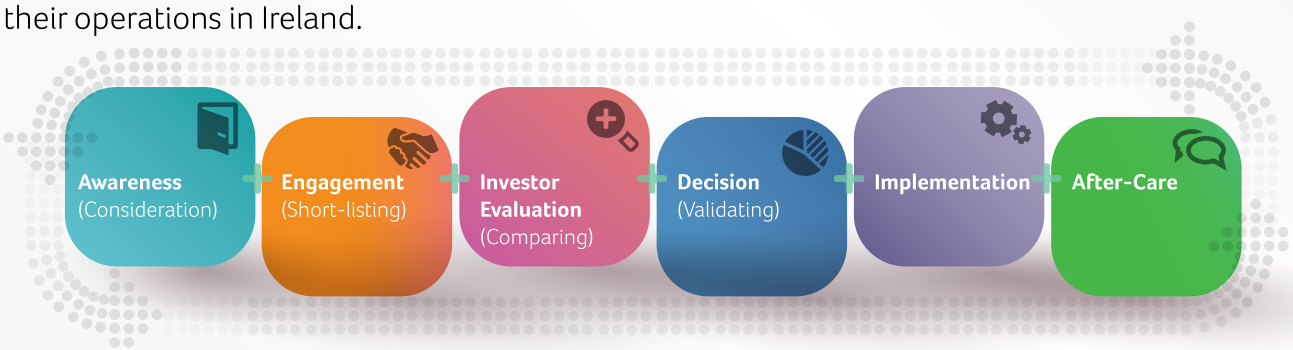
Why Ireland for Connected and Autonomous Vehicles

Ireland has become a global technology hub of choice when it comes to next generation of business and technology for connected mobility.

Transport is changing and Ireland is in the driving seat. Global companies that innovate are most likely to succeed, particularly in the fast-changing automotive and mobility space.

IDA Ireland, your partner on your investment journey

Ireland's inward investment promotion agency, IDA Ireland, is a non-commercial, semi-state body promoting Foreign Direct Investment into Ireland through a wide range of services and supports. We partner with potential and existing investors to help them establish or expand their operations in Ireland.



- Hosted Site Visits
- Introductions to:
  - Peer Companies
  - Industry Associations
  - Professional Services
- Employment Permits & Visas
- Property Solutions
- Collaborative Research Opportunities
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INDUSTRY NEWS UPDATES

- 1.3M Electric Vehicles were sold in China in 2020 – Projected for 51% increase by 2021
- The Rise of the Electric Vehicle during the Covid-19 Pandemic
- EV Connect pilots first V2G charging project in the Midwest
- India: New scheme to incentivise EV manufacturing soon
- India: Goa introduces Olectra electric buses in its fleet
- Planned comparison with catenary trucks
- Geely Auto forms new electric car company Zeekr
- India Electric Vehicle (EV) Market Report 2021
- Sindh govt launched their electric bus project
- 2024 GMC HUMMER EV SUV debuts during March Madness
- 44 Irizar e-buses headed to Bulgaria
- India: Hyderabad-based startup developed the electric scooter EPluto 7G
- Vitesco Technologies drives the development of e-mobility towards a mass market
- Dongfeng Motor partners with Aulton for battery swapping business
- India: Flipkart partners with Mahindra Logistics to accelerate use of EVs
- Chevrolet Silverado electric pickup and GMC HUMMER EV SUV to be built at GM's Factory ZERO plant
- India: Karnataka has 'big focus' on electric vehicle adoption
- All-new KONA N with Eight-speed N DCT and 2.0 Turbo engine provides uncompromising performance to Hyundai customers
- Ampere Electric announces 'Ampowering Change'
- Meghalaya announces EV policy
- Lion Electric announces the construction of its battery manufacturing plant and innovation center in Quebec

Kia reveals new design philosophy and full images of EV6

Kia has unveiled the EV6 with images of the car's exterior and interior. The company calls the EV6 its first "dedicated battery electric vehicle," meaning its the first car in Kia's lineup to be electric-only (unlike, say, the Kia Niro, which also comes as hybrid). The company saved the details on the EV6's specifications for the March launch. The EV6 is based on Hyundai Motor Group's new Electric-Global Modular Platform or E-GMP, which is the company's foundation for electric vehicles going forward.

Xiaomi to invest $10bn in electric vehicle

Xiaomi announced that it is getting into the electric car business. It said that it will invest an estimated $10 billion over the next 10 years, starting with an initial investment of $1.5 billion. Xiaomi will set up a wholly-owned subsidiary to run its electric vehicle business, with the company's chief executive Lei Jun heading up the new venture.

The company has given no indication about whether it will produce budget models or target the top end of the market.

Jaguar I-Pace, the all-electric performance SUV, launched in India from ₹105.9 Lakh

Jaguar Land Rover India launched the all-electric Jaguar I-PACE in India with a starting price of 105.9 Lakh. The Jaguar I-PACE is powered by a 90 kWh battery that delivers 294 kW power and 696 Nm torque, allowing the I-PACE to accelerate from 0-100 km/h in just 4.8 s.

Since its launch, the Jaguar I-PACE has won over 80 global awards, including the prestigious World Car of the Year, World Car Design of the Year, and World Green Car in 2019, making it a true electric vehicle icon within a short span of time.

Momenta and Toyota to collaborate on automated HD mapping

Momenta has announced partnership with Toyota to provide automated HD mapping and updates through vision-based technologies.

Momenta's vision-based HD mapping uses low-cost consumer-grade sensor sets, which consist of camera, GPS, and IMU to automatically generate HD maps with 10cm level relative accuracy by using technologies such as deep-learning based perception, SLAM (simultaneous localization and mapping), etc. Momenta's HD map not only includes rich geometry features, such as traffic signs, poles, lane borders, traffic lights, road markings but also generates road level & lane level topology and semantic features. By processing big data through automated mapping pipeline, the HD map can be updated with high frequency, thus provides a "live", reliable map for different autonomous driving modules such as localization, planning and control.

Argus collaborates with Microsoft to bring cyber security cloud solution to vehicle manufacturers with Microsoft Azure IoT

Argus Cyber Security has collaborated with Microsoft Azure IoT and joined the Microsoft partner network to provide vehicle manufacturers the ability to monitor, detect, and mitigate attacks in the cloud.

Argus cyber security solution, integrated with Azure IoT for automotive applications, includes Argus Fleet Protection, an Automotive Security Operation Center (ASOC) solution, in-vehicle insights from Argus Connected ECU Protection, and update capabilities with Argus Software Updates Over-the-Air (OTA).

Argus Connected ECU Protection, deployed on connected ECUs such as telematics, infotainment centers, and ADAS units, detects operating system anomalies and suspicious activity in the vehicle according to customer-defined threat models. By integrating end-to-end automotive cyber security with Microsoft Azure IoT, vehicle manufacturers can leverage data across a wide range of sources to build a more accurate, all-encompassing cyber intelligence picture.

Goodyear and TNO to demonstrate an Intelligent Brake System

The Goodyear Tire & Rubber Company and Dutch research organization TNO are collaborating on a demonstration vehicle that will test the implications of connected tires talking to the vehicle's control system, most specifically the anti-lock brake system (ABS).

By connecting Goodyear's intelligent tires with a vehicle's ABS system, braking performance can be optimized for the situation and tire state while helping with the steerability of the vehicle. Previous studies by Goodyear indicate that integration of these two components can reduce the stopping distance loss by about 30%. Both companies are focused on maximizing potential safety and sustainability implications and expect to share results in early 2022.

INDUSTRY NEWS UPDATES

- Hyundai and Shell sign new agreement to expand collaborations on clean energy solutions
- Volkswagen Group and bp to join forces to expand ultra-fast electric vehicle charging across Europe
- Momenta and Toyota to collaborate on automated HD mapping
- Hyundai Motor and Singtel MOU
- Leading UK bus operator extends partnership with MiX Telematics
- ECARX and Volvo Cars to setup JV for infotainment platform
- Unity and HERE collaborate on real-time 3D in-vehicle experiences
- Volvo partners with Aurora to the deployment of autonomous trucks
- ABB and Amazon Web Services to build EV fleet management platform
- Argus collaborates with Microsoft to bring cyber security cloud solution to vehicle manufacturers with Microsoft Azure IoT
- Panasonic, McAfee agree to join to tackle vehicle cybersecurity
- GlobalLogic to be acquired by Hitachi
- Human Horizons works with JOYNEXT, Quectel and Qualcomm to feature intelligent in-vehicle experiences in new HiPhi X sports utility vehicles
- SiriusXM expands into Mexico with NissanConnect® Services
- Spirent acquires octoScope to expand WiFi test capabilities
- HARMAN acquires 5G Edge and V2X leader Safari
- Daimler Truck AG and the Volvo Group complete creation of fuel-cell joint venture: cellcentric
- LG Elec leads series A funding for U.S. connected car solution startup CerebrumX
- Goodyear and TNO to demonstrate an Intelligent Brake System
- Cruise acquires Voyage in another autonomous vehicle merger
- TDW Distribution selects Microlise as technology partner for the long haul
- Purdy Mobility and Toyota launch mobility solution: Subscribe + Drive Powered by Toyota

Nitin Gadkari announces vehicle scrappage policy in Lok Sabha

The Union Minister, Nitin Gadkari, has announced the vehicle scrappage policy in the Lok Sabha. The Minister said scrapping older vehicles and recycling them will be a win-win policy for everyone. The scheme will provide incentives to owners of old vehicles to scrap unfit vehicles via registered scrapping centers. Some of the incentives outlined by the Road Transport Ministry include:

- Scrap value given by scrapping centre is approximately 4-6 percent of the ex-showroom price of new vehicles.
- The state governments may be advised to offer a road-tax rebate of upto 25 percent for personal vehicles.
- Manufacturers will be advised to provide a discount of 5 percent on buying new vehicles against a scrapping certificate.
- In addition, the Ministry is also considering waiving registration fees of new vehicles against the scrapping certificate.

The Ministry of Road Transport and Highways will promote fixing Registered Vehicle Scrapping Facility (RVSF) across India and can encourage private participation for opening such centres. Similarly, the Ministry will promote setting up of Automated Fitness Centres on a PPP model by the state government, private sector automobile companies, and the like.

Appointment for fitness centres may be booked online and tests reports shall also be generated in an electric mode. The tentative timeline for application of the proposed Scrappage Policy is –

- Rules for Fitness Tests and Scrapping Centres: October 1, 2021
- Scrapping Government and PSU vehicles above 15 years: April 1, 2022
- Mandatory fitness testing for heavy commercial vehicles: April 1, 2023
- Mandatory fitness testing (phased manner for other categories): June 1, 2024

Triton Electric in talks with Karnataka govt to set up plant in India

Triton Electric, the US-headquartered company that plans to introduce electric cars in India, held an extensive discussion with the Karnataka government. Led by Himanshu Patel, CEO and Founder of Triton Electric, held a virtual meeting with Chief Minister B S Yediyurappa.

The company plans to introduce an N4 sedan in India with a price starting at ₹35 lakh. Recently the company registered the Indian subsidiary by the name of Triton Electric Vehicles India in New Delhi.

Ashok Leyland to bring electric vehicles from UK subsidiary

Ashok Leyland through its UK subsidiary Switch Mobility, announced its expansion plans into India and its plan to create two subsidiary companies.

The first, Switch Mobility Automotive and the second is OHM Global Mobility Private.

India won't extend 2022 deadline for tighter fuel efficiency rules for carmakers

India will not extend an April 2022 deadline to tighten fuel efficiency standards, in a potential setback for carmakers which are lobbying for more time, government and industry sources told Reuters.

Prime Minister Narendra Modi has set aggressive carbon reduction targets under the Paris Accord and not extending the deadline to tighten the corporate average fuel efficiency (CAFE) requirements could be part of this agenda.

Volkswagen Tiguan Allspace unveiled in Indian market

Volkswagen has revealed the 2021 Tiguan Allspace for the Indian market. The SUV is imported as a completely built unit (CBU). It is one of the four cars that are part of the brand's SUVW strategy.

Powered by a 2.0-litre, turbo-petrol engine, the 7-seater SUV featured with panoramic sunroof, digital instrument cluster, touchscreen infotainment head-unit with Apple CarPlay and Android Auto and automatic tailgate to name a few.

Driverless pod taxis to connect Greater Noida with Jewar International Airport

According to the Yamuna Expressway Industrial Development Authority (YEIDA), the DMRC will be responsible for developing the pod taxi service that will connect Greater Noida and Jewar International Airport, regarding which a detailed project report (DPR) will also be presented soon. Reportedly, the estimated cost of the said project is estimated to be around INR 50-60 crore per km, which will bring the total cost of the project to an estimated INR 1250-1500 crore.

Referring to this, MLA Dhirendra Singh said that though there is metro connectivity to Greater Noida, Jewar International airport is around 25 km away from Greater Noida city; thus, this option has been considered. He added that to bridge the said distance gap, pod taxis will be useful. The upcoming Jewar Airport will be easily accessible via road from Rajasthan, Haryana, Delhi and a large part of Uttar Pradesh.

How Vishal Bajpai's distant vision of protecting connected vehicles from cyber attacks turned into a successful venture?

The world of IT security has always fascinated Vishal Bajpai who is currently serving as Co-founder and CEO, SecureThings. Like any other software engineer, he had dreamed of starting his own product company since his college days. Vishal comes with 21+ years of industry experience and is an expert in the Automotive Cybersecurity domain. Prior to venturing SecureThings, he was leading the Automotive Cybersecurity team in Symantec, USA. His mission is to create awareness and safeguard society from cyber threats, especially in the automotive ecosystem. He has co-authored the bestseller 'Cracking The Rich Code Vol 3' with Jim Britt, who is one of the World's Top 20 Success Coaches & Kevin Harrington, who is one of the original Sharks on the Shark Tank series.

In 1997, Vishal was doing a summer internship at IIT Kanpur where he used to work till late at night in the research labs and also spent a lot of time discussing innovative ideas and concepts with his friends. It was during this time that he openly expressed his desire to start his own venture in Silicon Valley one day.

Vishal has worked with Symantec, both in India & the USA for more than 15 years. It was Symantec USA, where he got the opportunity to work in the domain of automotive connectivity and cybersecurity. Year 2014, was a milestone year in the automotive industry, when a couple of researchers demonstrated how a car can be hacked which he found a very crucial area as a remote attack on a vehicle was and has been a huge concern. Vishal recalls it as the big turning point in his life and he eventually put a lot of thoughts into it. He considers himself lucky to get a chance to work on automotive cybersecurity within Symantec where he spent the next three years researching how the team can build machine learning models using vehicle network communication to detect cyber-attacks. He even got an opportunity to work very closely with the University of Michigan Transportation Department and top OEMs. That experience was an eye-opener for him as he could clearly see the severity of that threat. Along with this, he was very aware of the solutions being provided by the existing players at that time. His three years of research and domain knowledge motivated him to launch a startup in this domain.

Vishal Bajpai, Co-founder and CEO, SecureThings

"The thoughts and ideas that I had were very different. While the existing solution providers were looking for a specific problem, my belief was to provide a complete safeguarding solution for the vehicles. When we looked at the vehicle, many other unknown areas were not being touched. So the notion and conviction of providing a complete and secure solution that can build trust among manufacturers, suppliers as well as vehicle owners to enjoy this automotive transformation triggered the idea to start SecureThings, in late 2017," says Vishal Bajpai.

When Vishal started his journey towards entrepreneurship, the western market had already accepted the problem of emerging cyber threats in automotive. Eventually, he decided to set up his main R&D center in India. Vishal believes that India's location is going to be very strategic, both in-terms of growing automotive market as well as the talent pool. In 2017-18, in India, nobody was envisioning the need for cybersecurity solutions for automotive as it was something five years down the line. It was quite challenging for the team at SecureThings but they started educating, showcasing, and talking about cyber threats within the vehicle, through different industry-specific events participation. Vishal is a regular speaker in different events, talking on his passion - automotive cybersecurity, creating awareness about the cyber threats that the current vehicle may have.

In 2019, Vishal set up an automotive cybersecurity research lab in his office and subsequently started looking at the threats within the vehicles running on the road. Startups face many challenges especially during the initial stage but with this strategy SecureThings started receiving good response from the market especially from the manufacturers and suppliers who used to resonate well while accepting that cybersecurity issues are a big threat for the future of smart mobility. As a result of the continued efforts by manufacturers and different bodies, the Government of India amended the Motor Bill in 2019. The bill stated that the manufacturer is liable for any threat

to the vehicle, be it electronics, software, or any other thing that can cause damage or harm to the driver, passenger, or surroundings. This brought a lot of change since late 2019 as everyone started taking cybersecurity seriously while working on developing various standards, driven by the regulations.

Cybersecurity has now become one of the top priorities of manufacturers and suppliers. With connectivity coming in, cybersecurity cannot be ignored especially in India, which is the third-largest country in the world where cyberattacks happen. Being more cybersecurity-ready has become a priority pursuit for the entire automotive ecosystem across the globe from the manufacturers to their suppliers. Vishal turned his distant dream into reality not by wishing upon a star, but by converting it into a concrete vision. Now, he is ready to challenge global competitors in the automotive cybersecurity domain.

Building a startup is both challenging and exciting and being a first-time entrepreneur, Vishal Bajpai also had to face many financial challenges, especially during the early stage. As a founder, he made significant investments to start this venture and put it back into speed. In mid-2019, Vishal met the investor who believed in the team's conviction and had shown commitment to support in building industry-leading solutions. Eventually, SecureThings raised funds to foster business growth and scale the operations.

Till 2019, the startup was flying high, and then came the pandemic. COVID-19 has had and continues to have a dramatic impact on businesses around the world and it was no different for Vishal. However, he feels extremely proud of his team members, associates, partners and most important family who have been his pillars of strength helping him get through the tough times. But as a strategic entrepreneur, he decided to convert the Covid crisis into an opportunity and as result his team came out with unique industry-first as well as innovative solutions for the automotive industry.

During this pandemic, initially it was difficult for the team to work from home and collaborate considering the nature of the work, but the team rose to the occasion and became very productive with increased communication and by taking some smart initiatives. He further adds that his team is consistently enthusiastic and passionate about its work- that's what keeps him motivated!

Talking about his journey so far, Vishal says, *"So far, my journey has been fascinating, nothing less than a dream come true! I still remember those nights when I used to sit and brainstorm ideas, creating mind maps on how to build a successful venture. I still feel the same energy and now I'm even blessed with a great team of people who are as passionate as I am about what we're here to do."*

SecureThings's rise has been nothing short of meteoric but the road to success is never easy. The brand that started building cybersecurity solutions with only one engineer in early 2018 is now being recognized as one of the automotive cybersecurity leaders by the top analysts in India. Vishal Bajpai is creating a name in Automotive Cybersecurity, with his command in this domain and innovation. He is also helping in policy making, leading a task force within Automotive Component Manufacturers Association (ACMA) to come up with cybersecurity policy recommendations.

Vishal started the research lab in 2019 intending to identify all the relevant automotive-related cyber risks. So far, SecureThings's research shows that even today more than millions of vehicles running on the India roads are vulnerable. This research helped the team to know some unique attack areas and the solutions for the same differentiates the brand from its competitors. Today, SecureThings is the only automotive cybersecurity provider globally that offers six layers of protection to the vehicle ecosystem. Vishal brings his domain expertise and understanding of the system to define the company's product strategy.

The team was able to find 'n' number of problems that the automotive industry is facing with the advent of emerging technologies. It has thus become crucial for the automotive industry to make vehicle cybersecurity an organizational priority. Today, vehicles are more software-driven than mechanical, generating a lot of critical data that is vulnerable to tampering and spoofing. To keep up with the process of digital transformation in the automotive industry, the data must be secured from outside attacks and this is what has been the focus of SecureThings since its inception.

Vishal's bold strategy to gain automotive cybersecurity market share in the country like India at the time when not a lot of vehicle manufacturers & suppliers were talking, resulted in a masterstroke. In a very short span of time, SecureThings has made a mark in the automotive industry and is presently working with various top vehicle manufacturers, components suppliers working towards protecting their vehicles and solving their real-time problems. At present, the brand is working with all segments- commercial vehicles, passenger vehicles, two-wheelers, electric bikes, and more. As we are stepping into the era of connected mobility, all the market players are witnessing newer business opportunities and at the same time face unique sets of challenges that need to be addressed on an urgent basis. Vishal finds it exciting to solve these challenges, adding value to their customers and creating awareness about the growing need for end-to-end solutions for vehicle security to ensure the protection of software, devices, and data.

Shedding more light about his future plans, Vishal says *"We are now growing in the USA and in the next couple of years, we are planning to expand into other key automotive markets like Europe & Japan. India, which is becoming a major and a critical market will always be strategic to us. We will be building more partnerships, relationships with the academia and growing SecureThings brand while solving the problems of global customers with our implacable solution."*

At SecureThings, the team believes that innovation is in their DNA and they are putting a lot of effort into establishing research in newer areas like V2X (Vehicle to Infrastructure), electric vehicle charging stations, etc. They are all set to make more investment on the research side to come up with more unique and innovative products for their customers.

Vishal concludes with a message for the startup enthusiasts and budding entrepreneurs, *"Entrepreneurship is fascinating, think about customer problems and come up with innovative ideas that can bring a difference. You need to take a bold step; you will face a lot of challenges, but you should go with your conviction. Be strong and just look around, you will find ways and the support. Remember, if your conviction is strong, you will always succeed!"* ❑

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