Mar - Apr 2018

SMART AUTOMOTIVE

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Contents

Mar - Apr 2018

Expert Speak

Thought Leaders

SMART AUTOMOTIVE

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Editorial

Maneesh Prasad
Editor & CEO

Waymo will soon be providing shared mobility services in Arizona. With a business model where they have partnered with players from automotive manufacturing, repair & maintenance service provider, insurance company and others, they have kept themselves focused on improving the self-drive capability of the vehicle based on millions of miles of test drive. Self-driving vehicle in shared mobility will bring down the cost of the mobility, besides providing convenient and safe mobility.

Once Waymo tests its ground in shared mobility through self-driving autonomous vehicles, it is expected to provide similar services in other geographies, including India. When, they will launch such service in India? Certainly not soon. But, whenever there are here they may look for similar partners for Pan-India repair and maintenance(like Carnation Auto etc), insurance service(similar to those covering our travel through railways or air) and an automotive partner to provide the vehicles. The world of Ola and others will change with competition going to a new level with Waymo. A similar situation which the home-grown company like MapmyIndia is having in geospatial mapping space with Google Maps.

Continuous update in policies and regulatory framework to accommodate and encourage research and test of new technologies is essential today. Policy makers will have to move from allowing only things which are done somewhere by somebody, to a new generation of policy making based on thought leadership. There are several players including startups working in autonomous vehicles, but we do not have a framework to encourage these initiatives through regular policy update or coordinating body. I hope government will not be forced to take a soft approach(knowingly ignore violations of existing archaic policy) to autonomous vehicle 10-12 years down the road, just as they have done in the field of geospatial mapping. It will only stifle our own capacity building and keep us in basic consumer mode. No wonder where Ordnance Survey(National mapping agency of Great Britain) has been mandated (E CAVE Project, Jan'18) to update its map data for connected and autonomous vehicles, here in India people question- Why shouldn't Survey of India be dismantled?

Before we could witness shared mobility service transition into self-driving shared mobility, there are surely few things which connected vehicle can help us with:

Safe Driving: Over the last couple of years we have seen the increasing presence of Ola/Uber on roads, which has been a great service to us all. Once you board a taxi, as it hits the broadway/highway, at times I have seen it starts over-speeding(now becoming frequent). Many a times beating Google Maps estimated time hands-down, reaching the destination much earlier. As the taxi-aggregator has the track of vehicle, a system(software) based check on vehicle speed can ensure that if there is an over-speeding, there is a voice/visual alert/prompt to the driver(an online feedback) to check over-speeding.

Detour Prevention: Once the best route has been worked out based on various weightage, any deviation should be prevented by backend system monitoring the vehicle movement. Alternately an option for the passenger to alert a detour can also be provided. This may not only lead to lesser over-billing, but larger benefit could be in the form of safe commute, specifically for passengers who are new to a city.

Early this month on 9th February Department of Telecommunications, Govt of India, through its directive asked telecom service providers to start issuing 13-digit numbers for machine-to-machine (M2M) services, which will be made available to users from 1st July 2018 onwards. The existing 10 digit M2M SIM will be ported to 13 digit SIM between October to December 2018. I hope such directives brings us closer to achieving the milestone of creating a US$ 15 billion IoT industry(TRAI recommendation, Sept'17) in India by 2020.

Enabling Connected Mobility in India

Aravind Doss
Associate Vice President, Telematics
Harman International

Aravind Doss is the Associate Vice President of Telematics Business Unit at Harman (a Samsung Company). He heads the effort to develop Next Generation Telematics solutions. His focus is to create cutting edge Telematics to enable new use cases like 5G/V2X/ADAS/ Autonomous driving, and optimizing the cost/value to allow for adoption of Telematics across multiple market segments.

Today, cellular and wireless media are enabling a connected world where information exchange has become easier. The biggest example is the Internet of Things, which enables smart connectivity, starting from home to smart cities - where we are trying to create a connected world. This is enabling a better way of life, optimum utilisation of resources and improved productivity. Similarly, automobile industry is also adapting to connected technology where vehicles are connected in an ecosystem and are sharing information on traffic as well as Roadside Unit (RSU), such as traffic lights, public transport system, road work warnings, and variable message signs.

India's Smart Cities Mission has promoted sustainable and inclusive cities that can provide low carbon transportation and core infrastructure. Niti Ayog has created an action plan to provide convergence of Amrut, Smart Cities mission and low carbon transport. As part of this three year action plan charted out by Niti Ayog, automobile sector can contribute towards the Smart Cities Mission by offering affordable, safer and low carbon transportation.

Since the launch of Smart Cities Mission, the need for Smart Mobility is fast catching up in India.

Smart Mobility will bring in safety of users, efficiency in the cars, protecting the environment. We can achieve this through the Vehicle to Everything (V2X) technology where the auto industry is working to build the right ecosystem.

India has been a rapid adapter of technology which has improved the quality of life over last few decades. For instance, Google Maps has redefined the way India travels and has made navigation through busy roads easier. Similarly, India recorded its one-billionth mobile phone customer which at one point of time was considered luxury. India being a cost sensitive market, every technology that is developed must appeal to masses which defines the scale and success of the product offering. Infrastructural support such as 5G communications technology and Advanced Telematics Control Unit (TCU) which can support this technology become imperative for the successful adoption of connected mobility.

HARMAN and Samsung are jointly developing modular solutions for advanced telematics which will be capable of providing one Gigabit/second bandwidth. 5G connectivity can prove to be the major enabler in terms of the infrastructure to develop the ecosystem for connected mobility.

5G: Enabler for Connected Mobility

5G Connectivity is envisioned to cater to three broad categories of services:

1. Enhanced Mobile Broadband (eMBB): Enhanced Mobile Broadband will lay foundation for immersive In Car experiences and augmented reality. In automobile there will be a surge in bandwidth requirement and need for sustained high capacity with multiple sensors exchanging data.
2. Ultra Reliable Low Latency Communication (URLLC): V2X and automated driving which are mission critical will require an ultra-reliable extremely low latency communication.

3. Massive Machine Type Communication (mMTC): Smart cities, home and cars will have multiple sensors, which will keep generating massive amount of data that needs to be communicated via gateway to cloud.

With growing population, increased use of technology, internet penetration and ever evolving auto technology, driving experience is undergoing a major transformation.

The matter to be considered is whether Connected Mobility has solutions for the future growth in India by solving the key issues such as traffic congestion management and accident prevention.

Traffic Congestion Management:

As per a recent Revised Master Plan 2031 by the Bangalore Development Authority and reported by The Times of India, 10 million Bengalureans lose 60 crore hours, INR 3,700 crore a year to road congestion.

Automotive connectivity will be offered through 5G, C-V2X enabled by enhanced mobile bandwidth (eMBB) and ultra-reliable low latency (URLLC). These provide mechanisms for vehicles to receive real time information from Smart City Command Center, Emergency recovery teams about specific scenarios, city/ roadway projects, lane closures, traffic, and other conditions that may necessitate adjustments to route, take a detour, or use an alternate public transport. Few specific scenarios as below:

Emergency Trajectory Alignment: Emergency Trajectory Alignment targets the transport in city limits and on Highways. Estimated Time of Arrival can be utilized for intelligent navigation system with the situational information of the vicinity and managing the traffic queues, resulting due to an accident. Vehicles near the mishap location will be able to share geographic information with other vehicles and infrastructure, to provide enhanced situational awareness and re-calculate trajectory/path. When a vehicle ahead is blocked, this may cause traffic congestion. The roadside infrastructure detects queue status on the road due to an accident or traffic jam. In addition, the roadside infrastructure also collects location of all vehicles and passes the congestion and queue information to every vehicle.

Traffic Light Optimized Speed Advisory: Driver of the vehicle is advised to slow down or speed up when approaching a traffic light to avoid halts and traffic build up at intersections. This results in vehicles being provided with optimal speed profile to time traffic lights and reduce queues at intersections.

Signal Violation Warning & Advance Signage assistance: This use case enables a connected vehicle alert to the driver if the vehicle approaching traffic signal is on a trajectory that would be violation of the traffic signal. It also helps to inform driver in real time and well before line of sight about dynamic signs due to road maintenance, road closings and reduced speed limits. All these would lead to efficient vehicle performance and mileage, which are key ingredients to directly benefit the user with the reduced fuel bills.

Road Accident Prevention:

A report by the Ministry of Road Transport & Highways published by The Indian Express says that India witnessed 17 deaths and 55 road accidents every hour in 2016, one of the highest in the world.

Forward Collision Warning: Intended to provide warning to the driver of the trailing vehicle that it is on a trajectory to collide with a leading vehicle, which has stopped or moving at a slow speed. Every year due to fog and smog several vehicles collide serially due to low visibility.

Emergency Brake Warning: Intended to improve awareness and reaction time, provide drivers with timely alerts of nearby emergency breaking events to handle unexpected situations. Several accidents happen on undivided roads where sudden braking of the leading vehicle, which is not visible leads to severe pile up.

Abnormal Vehicle Warning: There are numerous situations and scenarios whereby a vehicle maybe operating outside of normal or expected parameters. This use case is intended to provide vehicles with means to notify surrounding vehicles that they are operating outside of normal parameters of speed, traffic signal and road signage compliance.

Some common examples in India are of trucks loaded beyond their actual capacity or an oversized vehicle.

Control Lost Warning: There are numerous scenarios that can lead to loss of control. Wet, snow covered and icy road conditions can lead to a loss of braking and steering control. A vehicle can also be out of control if the driver has lost consciousness or fallen asleep. If a vehicle has lost control, alerting nearby vehicles may avoid possible collisions. This is common in winter conditions in North India and in hilly areas.

Pravin Samuel
Sr. Manager, Operations, Telematics
Harman International

Pravin Samuel is responsible for Telematics Technical Sales Engineering at Harman with major focus on enabling Connectivity solutions for Automotive OEMs in Asia. With additional responsibilities in the Product management for Telematics, he has more than 13+ years of experience. He is an inventor and holds 2 patents in the aftermarket Test equipment domain.

'Do not pass' Warning: This use case warns drivers of the risk of collision when attempting a manoeuvre for overtaking. Non-compliance to lane discipline and overtaking from left, leads to lot of accidents. An advance 'Do not pass' warning can prevent these accidents. A tell-tale symbol on the dashboard might give an indication of 'Do not pass' warning and when it is safe to overtake.

Emergency Vehicle Warning: This use case alerts drivers of approaching emergency vehicles. Emergency vehicles may be approaching at high speed from directions that are difficult to see, such as from behind or from lateral directions at intersections. There are instances where a clear drive way is not provided to the emergency vehicles. An advance indication to driver of emergency vehicle approaching and passive monitoring of vehicles by traffic authorities can help avoid accidents and also ensure

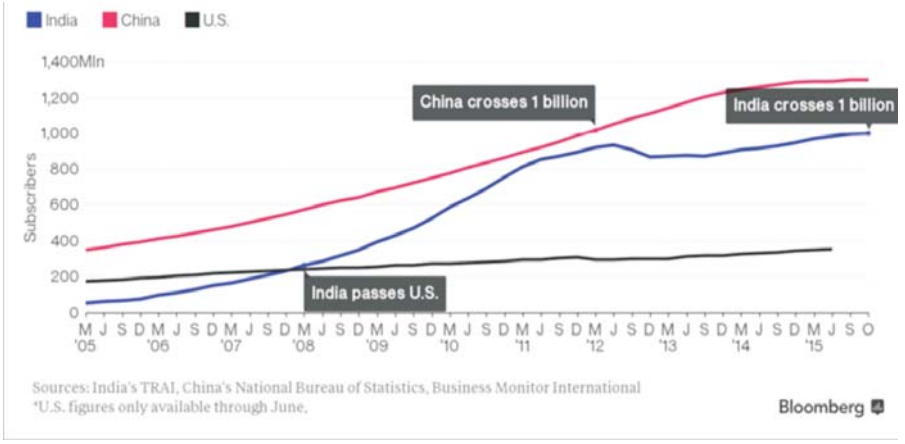
Pratapaditya Singh
Principal Engineer - Telematics division
Harman International

Pratapaditya Singh is responsible for 5G Telematics platform definition and leading the 5G platform quality assurance. Pratap previously worked at Intel and has delivered 2 lifestyle products.

He holds a Master's degree in Computer applications from RV College Bangalore.

India Signs Up Billionth Mobile-Phone Customer

Becomes second country to hit the milestone after China



adherence to strict rules of giving way to emergency vehicles.

Vulnerable Road User: Vulnerable pedestrian might be a pedestrian or an individual using a bike, eBike, skateboard that is travelling along the road. Driver of the vehicle needs to be informed about a vulnerable road user and be warned of any risk of collision. Vehicle location, safe stopping distance and lane change, to avoid collision, primarily depends on positional accuracy and low latency communication that can help driver take decisions to slow down, stop or change lane and ensure pedestrian safety. As we touch upon the few use cases that benefits the user with decrease in recurring vehicle maintenance and operating expenses, it also brings in the safety aspects for the whole mobility as such. Hence, with the appropriate customization of the use cases to suit the Indian mobility eco-system, we should get to the connectivity space for automobiles swiftly.▪▪■

EV market in India expected to grow in double digits

According to a recent ASSOCHAM - Ernst and Young joint study, titled "Electric mobility in India: Leveraging Collaboration and Nascency," the sector has potential to witness significant growth in coming years. EV market is expected to grow in double digits annually in India till 2020. The important points brought up by the study are:

- Telematics market in India is still nascent, however, it is poised to grow at a much faster rate till next couple of years as growing consumer demand for electric vehicles (EVs) is leading rising investments in the sector.
- The absence of an EV supply chain in the country demands an urgent investment in research and development (R&D) and local manufacturing capabilities.
- EV industry at present in India is at a nascent stage in India, comprising less than one percent of total vehicle sales and is dominated by two-wheelers (95 percent).
- The boost in sales is expected to be driven by stricter emission norms, reducing battery prices, increasing consumer awareness and government push.
- Going forward, EVs will be a stepping-stone in designing an intelligent transport infrastructure in India. The roadmap to electric mobility vision is based on growing collaborative economy and proliferation and success of electric and shared mobility business models.
- There is an urgent need for creating charging infrastructure at a rapid pace as it is the determining factor for the growth of EVs.
- The share of public charging is expected to grow, however, home charging would still continue to be the dominant source with a share of nearly 70 percent in 2030.
- EV adoption will be highly dependent on the pace of fall in battery costs as EVs are significantly more expensive than traditionally propelled vehicles due to the high cost of Li-ion batteries. The battery cost is expected to decline to US$100/kWh by 2023.
- In order to achieve its electrified mobility target, reclaiming materials from old Li-Ion batteries in a certified and sustainable manner should be a huge priority of the Government of India.
- With the growing use of telematics across multiple services such as EV to grids interaction, fleet/ asset management, navigation and location-based systems, insurance, V2V, V2X systems, remote alarm and incidence monitoring, safety and security; telematics is poised to grow at a compounded annual growth rate (CAGR) of 31.2 percent till 2020.
- Embedding telematics into EVs can facilitate locating nearest charging station, reserve spot at charging station, enable smart charging, vehicle to grid charging, time of charging (users can charge at off-peak hours when rates are lowest) and notify people when charging stops or is unplugged.
- The global telematics market is poised to grow exponentially, with 104 million new cars expected to have some form of connectivity by 2025.
- The global market size of telematics will be around US$47.6 billion (bn) in 2020 from US$20.02 bn in 2015 and 88 percent penetration of global integrated telematics for new cars is expected to be achieved by 2022▪▪■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A New Relationship Between Cars & People is Emerging

Shalini Kapoor
Director & CTO – Watson IoT India
IBM Distinguished Engineer

Shalini Kapoor drives architecture of new IoT solutions for ecosystem partners including IBM's Global System Integrators and development of IoT Solutions for clients in India. She holds 11 patents and has co-authored 4 IEEE papers. She is member of CII's IoT core working group where she works with industry leaders on designing India's IoT policies and ecosystem fabric.

Q How is IoT changing the automotive industry? What role is IBM Watson IoT playing in it?

A A car today is more an electronics engineering creation than just mechanical engineering one. It has millions of lines of code and almost all parts are connected which enables us to detect, monitor, manage and predict behaviour over a period of time. IoT is game changing for the automotive industry and can be considered as one of the biggest change which this industry is undergoing. While new software is being written, new rules are being written on what the automotive OEM and its clients and partners want to know about the insides of the car which is all about data. Auto companies are turning increasingly to cognitive computing to unlock the insights within a car, according to 500 auto executives who participated in IBM's recent cognitive computing study. A new relationship between cars and people is emerging.

IBM provides full lifecycle IoT solutions for the automotive industry, from smart product development to smart manufacturing, to new service models, enhancing the customer experiences. Our spectrum of solutions ensure that intelligent and sustainable vehicles would be built in the future as we provide vehicle connectivity, deliver personal and immersive customer experiences and disruption in manufacturing and supply chain.

Our IoT for Automotive solution is an industry solution for connected vehicles that collects, analyses, stores and takes action on vehicle sensor data. IoT for Automotive is a vehicle-to-cloud offering that enables awareness of the environment beyond the car and helps use information to establish a relationship with the driver, not just the vehicle. Our solution enables connected vehicles that can detect driver behaviour patterns from drifting, braking and accelerations that indicate potential danger. As car's accidents are many times dependant on moods of the driver, we totally understand that capturing the emotions is key to predict an accident.

As an example of this, Panasonic Automotive and IBM Watson pushed the boundaries of vehicle infotainment systems for tech-savvy and time-crunched travellers with a superior, more relevant, in-vehicle experience.

I would like to mention, another offering which we are creating for Auto companies - Digital Twin. This is emerging as key in helping industries bring together systems to gain a view of software, hardware and sensors. IBM and Schaeffler are partnering to develop offerings to address specific cross-domain scenarios which will provide full system level traceability. These offerings will enable engineering, manufacturing, sales and operations professionals to have a full understanding of Schaeffler's product lines.

Q Will IBM Watson assist in automotive cybersecurity?

A Specifically for vehicle, we in IBM are focussing on security at all stages: Design, Build and Drive. Most of the consumers are obviously more concerned about threats to in-service vehicles and data privacy which are aspects of the Drive phase. We help automakers build and design vehicles in a way that they can engineer technology to prevent exploits, detect suspicious behaviour and respond safely to alarms.

Q At CES 2018 we saw companies introducing AI based features in cars like Personal Assistants, what are your views on this?

A Automakers are converging to provide a much more personalised user experience for all the consumers. At CES, IBM collaborated with Harman and Local Motors on separate projects to integrate AI into show vehicles. Car's personal digital assistant can be put to many uses, especially when you can ask the car to stop at a resting place because the baby in the back seat is crying!

We will lead with solutions based on Watson technology, specifically, natural language recognition and apply them to vehicles. As a user of cars, I would definitely want to talk to the car while driving and not bother about my mobile or the dashboard screen.

Q Watson IoT has been working very closely with the Indian startups, would you like to comment on their present status and future prospects?

A The startups have come a long way as several OBD devices are being manufactured in India. As I work with Nasscom IoT CoE, I have evaluated several startups who provide visual analytics and camera mounted analytics on the road, all of which are highly essential as we move towards self-driving vehicles. The pace at which startups are innovating and adopting IoT for Automotive platform is phenomenal. I see the trend going only stronger and our partnerships with the partner ecosystem would be the key to success in this new world of IoT.

Q Considering the present IoT in India, how & when do you see it transforming the connected vehicle ecosystem in India?

A It is already present in pockets and

the writing is on the wall- connected vehicles will increasingly be more visible on the roads. It is beneficial to fleet operators, auto companies, dealers and consumers as data from cars can change modus operandi of each one of these stakeholders. There is already proliferation of OBD devices in the Indian market and several of them available for buying on popular ecommerce sites. Insurance companies in India are re-selling auto insurance policies bundled with these OBD devices for better data capture and driver behaviour analysis. At IBM we work with several of these OBD device players to integrate our IoT for Automotive offering and jointly present the solution to our clients.

Q Do you think IoT solutions can transform India's auto insurance industry with Usage Based Insurance?

A Insurance industry is definitely up for a transformation with Pay How you Drive (PHYD) model gaining acceptance in the industry. Telematics based PHYD insurance is being propelled by technology advances, which continue to improve cost, convenience and effectiveness using telematic devices. Data has traditionally been one of insurances industry's greatest and most valuable asset. Auto insurance is fast becoming a big data industry, with telematics base PHYD potentially changing the business of insurance as we know it.

While in PAYD (Pay As You Drive) drivers pay premiums based on the kilometers driven, PHYD is more mature, bills customers according to their individual driving behavior.

There are definitely benefits for customers as PHYD improves safety while reducing insurance policy cost, demonstrates safe driving behavior after an accident and ensures value added services like young driver monitoring, stolen vehicle recovery and vehicle diagnostics.

Insurers on the other hand are benefited as this solution corrects risk misclassification, enhances pricing accuracy, retains profitable accounts, fights fraudulent claims, reduces claim cost, enables lower premiums and most importantly creates a brand differentiation in a highly competitive market.

Last year in September IBM and Reliance Unlimit announced a partnership under which they are building IoT Solutions for User based Insurance for automobiles. ▪▪■

With permission from Arizona DoT, Waymo now closer to launch its robotaxis

Waymo has reached a step closer to launch its self-driving taxis. The company has got permission from the Arizona Department of Transportation to operate as a Transportation Network Company. With this permission, the company can now pick up and drop off riders in Arizona on its fleet of self-driving cars. The rides can be booked through a smartphone app or website, as in case of Uber, Grab, Lyft, Ola etc.

The company has earlier this year entered into a partnership with Trov and AutoNation. Trov is an on-demand insurance technology company that will power trip insurance customized for passengers of Waymo's soon-to-be-launched service. AutoNation will offer vehicle repair and maintenance through its franchised stores across United States.

Waymo will be using Chrysler Pacifica hybrid vehicle for self-driving taxis. It is also known that Waymo had recently ordered 'thousands' of self-driving Pacifica minivans from FCA.

Waymo will launch its commercial service in Phoenix this year. It has been testing its autonomous cars in Phoenix.

Waymo has been offering the residents free rides in its driverless cars.

Whenever Waymo launches its Robotaxis– which seems very soon– it will be a milestone in shared mobility. Other companies like Uber, Lyft, GM may follow Waymo to launch their Robotaxi services, as these companies have also been working on self-driving vehicle/robotoxis for quite some time. ▪▪■

Assembling a Connected-Car Using MicroServices

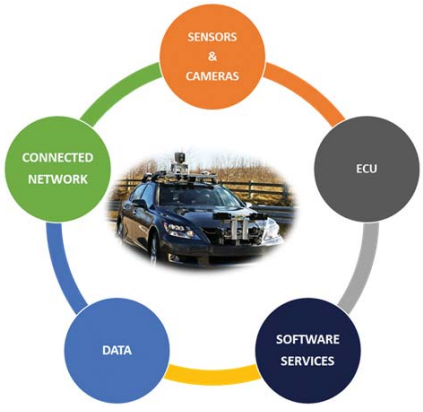
Ragu Sivaraman
Founder
MacMetry

Ragu Sivaraman was earlier instrumental in launching MacTrac, a two wheeler tracking product that augments a rider, a Dealer and/or Fleet provider to manage and monitor motorcycles in real time using tracking device, mobile app and a cloud hosted reporting solution.

If a Connected Vehicle could talk, it will say "AV, you complete me!!" Welcome the Connected Autonomous Vehicle world (CAV) where the Connected Vehicle is all about supplying useful information to a driver or to the Autonomous vehicle to help make safer or more informed decisions. CAV has high demands on the exchange of data and files between the connected car on the road, and a variety of scalable and agile services in the backend. This results in a software services life cycle where in which the deprecation and deployment of new services must happen on a frequent basis. To solve these upcoming challenges, a scalable and flexible architecture is required. Choosing Microservices as an architectural paradigm will enable us to achieve scalable and agile CAV backend that provides with increased operational efficiency and code quality.

CAV-Architecture Building Blocks

When it comes to connecting drivers and technology, the auto industry has a longer and richer track record than any other



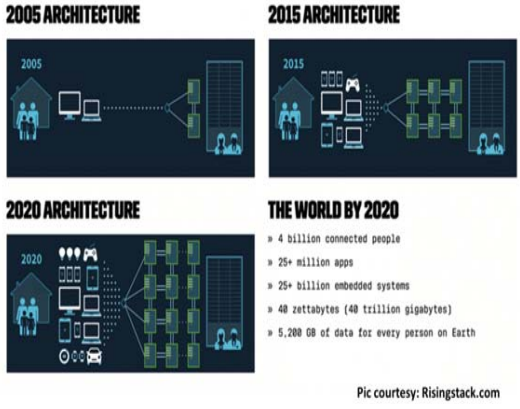
sector. Although turning "connected car" into a significant revenue generator has remained sketchy, its role in the AV (Autonomous Vehicle) world is pivotal and will make the car safer, faster, and more efficient. Furthermore, virtually all autonomous vehicles will require connectivity to ensure that their software services and data sets are current. While the CAV has been the most prominent example of IoT these days, the cars as such are increasingly becoming software driven and the real cloud based IoT developments in the auto industry are happening behind the scenes.

OEMs or the solution provider must address the complexity of behind the scenes software development requirements with IoT centric use cases in mind. Some of the key points include:

- **Scalability:** Some software components are more often used and/or more resource intensive than others, resulting efficient ways to replicate specific components necessary
- **Loosely Coupled:** Components in major software solutions can quickly become outdated. So it is important to find a way of exchanging a component easily without affecting other components
- **Reuse:** Many projects use similar software features to work within the cloud. So a set of standard services used among multiple projects must be identified
- **Continuous Integration and deployment:** Features that are added to a service must be visible at once, so that compatibility with other services can be tested automatically
- **Code quality:** The same code is used in different projects. So the demands on software code quality and genericity have increased

What are MicroServices?

Over the past decade, most applications were deployed using monolithic architecture design principles. This means in an application all modules, libraries, and inter-dependencies that exist in a single code base is deployed and,

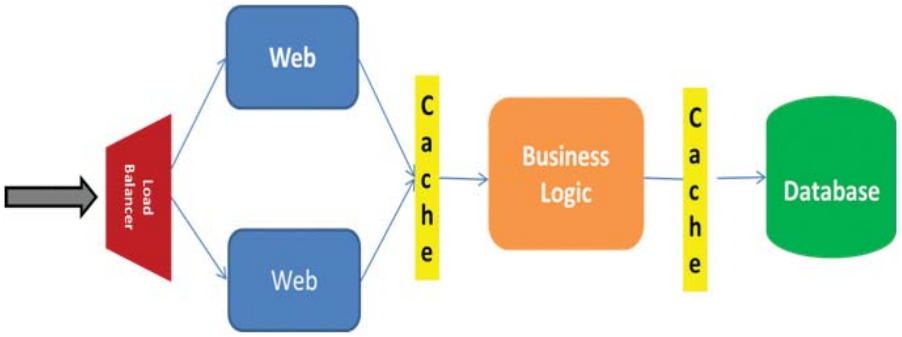


Pic courtesy: Risingstack.com

importantly, scaled as a single unit. This architecture concept created a significant impediment in the emerging IoT world. For ex: If a small piece of the application needs a change, the whole application has to be compiled, tested and deployed again. This means that all parts of the application have to undergo the software development process even though most of the modules don't experience any changes. This comes at big costs taking manpower, time and IT resources and in most cases lead to delays. In addition, a monolith makes it difficult to ensure:

- Scalability
- Be Highly Available
- Agile
- Continuous Service Delivery

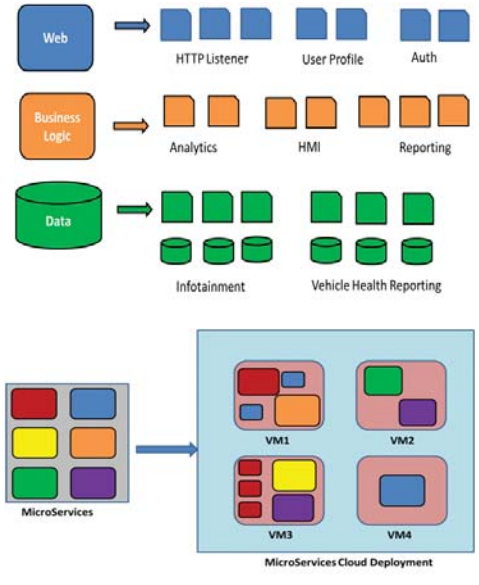
To meet these challenges the application architecture must change from a big blob of monolith to an architecture design where complex applications are composed



of small, independent processes and services, each organized around individual capabilities and communicate with each other via language-agnostic Application Programming Interfaces – APIs. This software architecture design pattern is commonly called Microservices, where these services are primarily small and focus on completing singular tasks.

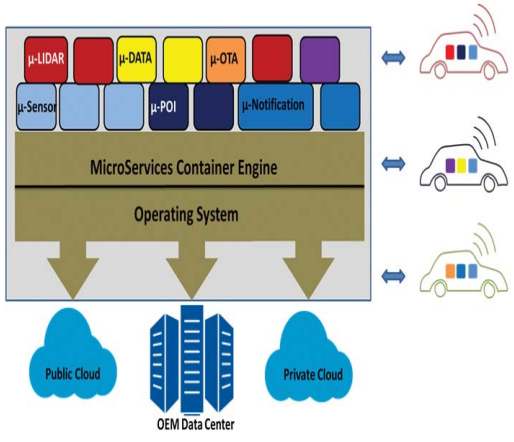
In microservices architecture, one single MicroService can be updated and deployed in a stronger hardware without affecting other services. Also each MicroService can be developed and deployed in a different language – Java, C, C++, Scala, Python, etc. Granular governance and decentralized data management where each MicroService label and handle data separately is also possible.

Microservices architecture supports automated, integration with Continuous Integration (CI) and Continuous Delivery (CD) pipelines allowing developers to safely and frequently evolve the application and scale-out to be nearly instantaneous, allowing an application to adapt to changing loads. Their loose coupling also means that each MicroService can scale independently and can move entire assemblies of Microservices from one deployment environment to another, thereby achieving infrastructure portability.



MicroServices in the IoT Automotive World

In an IoT Automotive world the "Things" are most of the times the small machines with their own processor, operating system and sensors and contain some (hard-wired) logic. They can be communicated using some lightweight APIs. They are completely autonomous, run in their own process space and deliver a small service



which means a "Thing" is the ultimate incarnation of a MicroServices living inside the car.

Automotive IoT generates certain types of workloads that promote the adoption of MicroServices in a container instead of virtual machines for a lightweight, loosely-coupled deployment. Containers encapsulate discrete components of application logic provisioned only with the minimal resources needed to do their job. Unlike virtual machines (VM), containers have no need for embedded operating systems (OS) and calls are made for OS resources via an application programming interface (API). So when viewed through the lens of IoT requirements both Containers and Microservices have a high degree of relevance to be applied for the future IoT systems design.

When an automobile manufacturer rolls out one or more connected car models, each car may have several user apps (Navigation, etc.), as well as several sensors that upload telemetry data to the manufacturer's cloud. Also the manufacturer may want to update the software on a frequent basis. In this type of situation we can use containers and microservices and reap the benefits of instantiating one container (container in auto scaling group) per car. Furthermore, the OEM backend can even have one MicroService per individual sensor since the container technology can rise to this challenge, of scaling to hundreds of thousands of cars. If there is one MicroService per sensor, then an intelligent integration infrastructure that manages the telemetry messages and compress them, to optimize message traffic is required, since the communications link between the automobiles and the cloud is limited and is relatively expensive.

Achieving MicroServices

While Microservices are a product of software architecture and programming practices, the potential mistake in developing Microservices is ignoring the impact that Microservices can have on Operations. Microservices architectures typically produce smaller, but more numerous artifacts that Operations is responsible for regularly deploying and managing.

These deployments are called microdeployments. In order to accelerate the development and bridge the gap between microservices and microdeployments every OEM must nurture a DevOps culture within the organization. DevOps is not a role. DevOps is a term that describes the mindset and the organizational structures that are required to deeply integrate Development and Operations for developing MicroServices based Applications. At present, many Auto makers including Ford, Mercedes-Benz, and VW are actively adapting Microservices/Container architecture principles in developing IoT enabled apps for their vehicles. So with a bright future on the horizon, let's welcome the software assembly to the Vehicle Production Assembly Line!! ▪▪■

The Role of Simulation in Development of Reliable and Safe Autonomous Vehicle

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Ashok Khondge serves as automotive CAE application specialist for Asia region and part of ANSYS Customer Excellence team. Over past 15 years he has held product, applications and leadership roles providing CAE solutions to Automotive industry.

Leading automakers across the world are giving high priority to development of autonomous vehicles. It is a formidable technological challenge. Studies show that billions of miles of road testing will be necessary to ensure safety and reliability of autonomous vehicles, yet time-to-market is short with competition heating up. This seemingly difficult task can only be accomplished using simulation with precision, speed and within available resources.

Background and Challenges

Connected and smart vehicles, Ride sharing, Electrification and Autonomous vehicles are disrupting transportation industry today. The global competition to develop such technologies is heating up. New business models will evolve taking advantage of such technology innovations. The first company to have the upper hand will win and sustain. The autonomous vehicle revolution will have a major impact on the vehicle manufacturing and will change the society forever. But creating autonomous vehicle is a formidable technological challenge. The autonomous vehicle can be described as a super computer crunching tens of terabytes of data during a few hours of driving. Developing autonomous vehicle technology requires ambitious new development in various technologies such as sensing, machine learning and artificial intelligence.

The reliable development of machine learning based vision and perception models that imitate human driver under all possible driving condition is a major problem. An autonomous vehicle's computer needs a 360-degree surround view. It must recognize other vehicles, road signs, pedestrians, markings, trees, buildings, traffic lights, and several other things under all possible driving scenarios and weather conditions such as in the darkness of night or while fogging, in rain and in snow etc. This is a difficult problem to solve using rule based computer algorithms. Autonomous vehicle engineers are using machine learning based neural network methods that can be trained using data rather than programmed. Autonomous vehicle engineers train such computer models by feeding them with enough test data to sufficiently react to multiple scenarios. However, the problem is, it is not easy or safe to replicate many scenarios in the real-world environments. A report by RAND [1] indicate that autonomous vehicles would have to be driven hundreds of millions of miles or sometimes billions of miles to demonstrate acceptable reliability. Under very aggressive testing assumptions, it would take tens of years or may be hundreds of years to drive these many miles. This is an impossible proposition to develop reliable and safe autonomous vehicles.

Fast-tracking Reliable and Safe Autonomy

To fast track the development of autonomous vehicles, auto OEMs may start rolling out autonomous vehicles suitable for constrained environment. OEMs may collaborate with likes of Uber and Ola, operating within certain city limit with constrained border lowering the technological barrier. However, this may still take several years to develop autonomous vehicles given that machine learning based neural network algorithms need a lot of data to make them reliable, and safe. The other option is to build machine learning models that will be able to train with little data. However, such technology development is in early phase of research. Finally, it is the simulation, if build properly can help autonomous vehicle engineers to gather enough training data and test their algorithms in quick time. Simulation has been used in automotive industry for several decades with proven record of accelerating technology development. With simulation, thousands of virtual tests can be performed on virtual prototypes using computers, enabling acceleration in technology development within a fraction of budget and time required for physical testing. Simulation provides three broad benefits namely – Faster time-to-market, Reduced cost, and Enhanced product quality.

Autonomous vehicle system is essentially a control loop, comprising of four important elements – physical world, sensors, controllers and actuators (Figure 1). An autonomous drive control software is embedded on controller with ability to train itself while performing virtual tests such as Model in loop (MiL), Software in Loop (SiL), and Hardware in Loop (HiL). To replicate this autonomous driving system

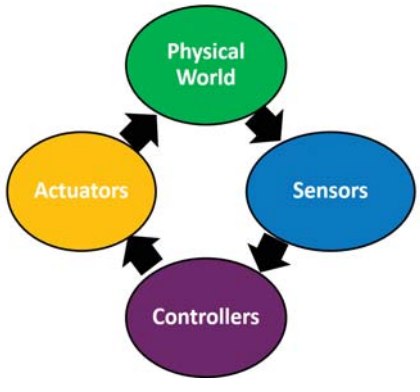

Figure-1 Essential elements of autonomous system control

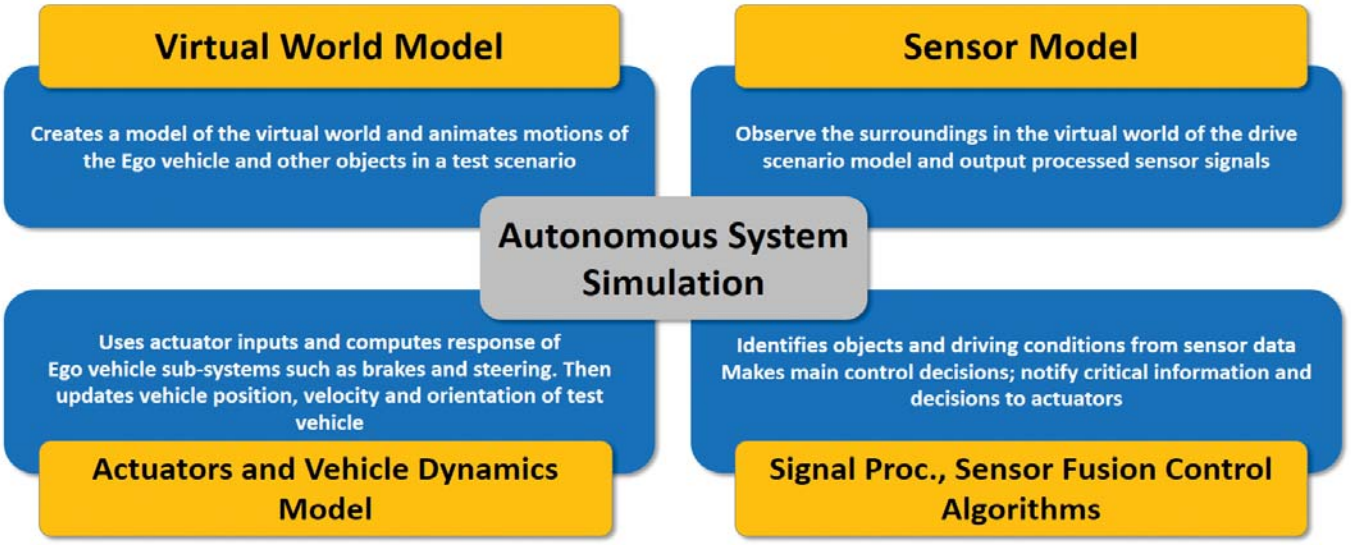

Figure-2 Autonomous driving system simulation loop

loop virtually – for instance, a scenario where a car approaches an intersection, looks for crossing traffic, waits for crossing traffic to clear, finds a safe moment and crosses the intersection – requires a model based system simulation (Figure 2).

The important building blocks of model based system simulation loop are:

- Building virtual world with variety of driving scenarios including traffic, weather, road, and environment etc.
- Modelling multiple sensors such as RADAR, LiDAR, Ultrasonic Sensors, Camera etc.
- Modelling sensor data processing and fusion, enabling detection of objects and recognition of driving condition based on simulated and processed sensor data. Developing control algorithm and human machine interface (HMI) with ability to take important driving decisions and display the information.
- Modelling vehicle actuation, and vehicle movement.

The model based system simulation loop consists for following steps and it repeats until the driving scenario is completed.

The Virtual World

The vehicle with autonomous system is referred as Ego vehicle. It moves in this virtual world. The first step in building system model is to construct the virtual world using libraries of roads, buildings, pedestrians, and other vehicles (Figure 3). Also, such world can be a replica of real city and can be constructed by using 3D map data of city.

Figure-3 Virtual world model representing Ego Vehicle and its surroundings (image courtesy ANSYS, Inc., www.ansys.com)

Sensor Modelling & Performance

Typical sensor suite mounted on Ego Vehicle includes RADARs, LiDAR, Ultrasonic Sensors, and Cameras. This suite of sensors observes the virtual world surrounding the Ego Vehicle and generate simulated sensor signals. For simulating cameras, building photorealistic virtual environment is very important. It enables acquisition of good quality simulated signals. LiDAR is another important sensor that constantly generates simulated 3D map of vehicle surroundings and provide high resolution wide field of view. Simulation of LiDAR involves 3D ray tracing, and processing point cloud obtained from the reflected rays. High fidelity 3D electromagnetics simulations are used to predict performance of RADARs and V2X antennas e.g. an automotive RADAR antenna pattern when it is installed on car facia (Figure 4). The high-fidelity 3D modelling is an order of magnitude, slow when compared with real time simulation. To alleviate this problem surrogate modelling techniques (a.k.a. Reduced Order Models or ROMS) are used to create a real time still accurate sensor models that can be integrated in the virtual world.

Sensor Data Processing/ Fusion and Control Software Development

Figure-4 Automotive RADAR antenna pattern when it is installed on car facia (image courtesy ANSYS, Inc., www.ansys.com)

The simulated signals received from various sensors are passed to signal processing, sensor data fusion and control algorithms. These algorithms make decision about braking, accelerating or changing direction of Ego Vehicle. These control algorithms based on machine learning methods can be utilized for training as well as conducting virtual testing.

Developing and testing signal processing functions, sensor fusion algorithms, object recognition functions, control algorithms, and human machine interface (HMI) software, with model-based software development techniques makes the software robust, less error-prone, and safe. Automotive manufacturers and suppliers increasingly follow the ISO 26262 standard for engineering active and passive safety systems in vehicles. Since autonomous vehicle systems are inherently safety critical, the ISO 26262 standard is essential in their development.

Modelling Actuation and Vehicle Dynamics

After processing sensors data, controller passes simulated commands to actuators such as brakes and steering, and virtual powertrain which control the Ego Vehicle's movement. Vehicle dynamics is used to model the movement of Ego Vehicle, other vehicles, pedestrian, and any other moving object in the virtual world. The vehicle dynamics accounts for friction between road and tyre – e.g. slippery road due to snow or dry road etc., precisely estimates the movement of vehicle, and updating its new position in the virtual world.

Model based system simulations are highly valuable for developing training data set. Simulation allows engineers to construct statistically hazardous scenarios that are important for an autonomous vehicle computer or controller to be able to recognize. Such scenario may not come during hundreds of hours of training on real roads. Additionally, using simulation, engineers can conduct system failure mode and effect analysis – e.g. effect of failure of one of the sensor or failure to pass the signal from controller to actuator etc.

Summary

Developing reliable and safe autonomous vehicles require significantly more test cases, evaluation of more number of operating scenarios, and vast number of functional requirements as compared to control system on today's vehicles. Simulation as a tool needed to accomplish this prohibitively expensive, time-consuming tasks. The speed, cost economy, accuracy, and automation of simulation makes it an indispensable tool for repetition of a pre-defined set of regression tests. Autonomous vehicle engineers can virtually evaluate thousands of test cases, scenarios and design parameters, in a fraction of cost and time needed for physical testing.

References

[1]*Kalra N. and Paddock S., "Driving to Safety: How Many Miles of Driving Would It Take to Demonstrate Autonomous Vehicle Reliability?" Rand Corporation, RR-1478-RC (2016) http://www.rand.org/pubs/research_reports/RR1478.html* ▪▪■

"Charter of Trust" on Cybersecurity

Siemens, Munich Security Conference (MSC), Airbus, Allianz, Daimler Group, IBM, SGS, Deutsche Telekom and NXP have signed the Charter of Trust on February 16, 2018 for binding rules and standards to build trust in cybersecurity and further advance digitalization.

The initiative was welcomed by Canadian foreign minister and G7 representative Chrystia Freeland as well as witnessed by Elbieta Biekowska, the EU Commissioner for Internal Market, Industry, Entrepreneurship and Small and Medium-sized Enterprises.

The Charter delineates action areas in cybersecurity where governments and businesses must both become active some of those are:

- Responsibility for cybersecurity to be assumed at the highest levels of government and business. Introduction of a dedicated ministry in governments and a chief information security officer at companies.
- Companies to establish mandatory, independent third-party certification for critical infrastructure and solutions – above all, where dangerous situations can arise, such as with autonomous vehicles or the robots of tomorrow, which will interact directly with humans during production processes.
- In the future, security and data protection functions are to be preconfigured as a part of technologies, and cybersecurity regulations are to be incorporated into free trade agreements.
- Greater efforts to foster an understanding of cybersecurity through training and continuing education as well as international initiatives.

As the world gets more interconnected with the rise of IoT, cybersecurity, the protection of technological and societal assets has become a global challenge, which calls for strengthening collaboration among the industry, governments, and society. ▪▪■

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Perspectives on the Future of Smart Automotive in India

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Automotive sector is evolving very rapidly. From being purely mechanical devices, they are now coming with software and connectivity components. Vehicles now have multiple systems controlling different functions in them. Growth in functionality is predominantly driven by safety, connectivity and consumer needs.

This comes at a time when India is set to experience a digital revolution that will see business, government and the society fundamentally transforming the way each operate. The importance of emerging technologies (such as AI, IoT, Big Data, Cloud apps) has been widely acknowledged. The current budget presented by government depicts plans to invest in the above areas. Further, allied industry usage of emerging technologies - for example, in infrastructure, where efforts are underway to implement 'pay-as-you-go' systems at toll plazas - will provide further impetus to accelerate the growth of smart vehicles to fully realize efficiencies from these initiatives.

What is the innovation?

Automotive players are looking to capitalize on IoT, Big Data, and AI systems to differentiate themselves from their competition. By integrating digital human-machine interfaces (HMIs), IoT sensors, software applications for connectivity and autonomous features (such as object recognition and self-driving capabilities), they are creating vehicles of the future. The increased focus on R&D by global automotive and technology leaders in smart cars is expected to disrupt the current business model. India, having a large automotive market, cannot go untouched. Innovation leaders are finding merit in initiatives such as self-driving vehicle projects and software offerings such as smart mobility and connectivity platforms for cars to cater to the growing need from the automotive sector. Some examples include:

- A large automotive player working with technology & ecommerce giant on an IoT platform to grant vehicle owners access to their connected-home devices from their cars through an application
- Applications to use voice commands to remotely lock their vehicle, check fuel levels as well as the other way round, i.e., access home systems connected to the IoT network from the vehicle

What is driving the shift?

Smart manufacturing and IoT in automotive production has been in play for some time now. These enable OEMs to more effectively track critical machine data through the use of sensors and respond to deviations quickly. This in turn has a direct impact on the quality and safety standards of the final car components. It also results in major cost savings through reduced scrap, rejection rates and after-market issues. The 'smart' advantages are now moving outside manufacturing plants and being embedded onto the products i.e. the vehicles. The time is ripe as consumers have already been exposed to these through other industries. Some of the key drivers for the focus to be shifting towards the smart automotive could be:

- The growing use of sensors and software embedded in products
- The ability to reliably and inexpensively connect and network with customers, and suppliers via the Internet of Things
- The availability of cloud-based data storage
- Sophisticated analytical systems capable of processing large volumes of data and deliver insights in near real-time and finally,
- Rising customer expectations towards smart, connected and autonomous vehicles

The smart automotive ecosystem is also expected to be characterized by technology-led growth in related areas and industries such as:

- Internal Usage for manufacturers: Customer relationship analytics, R&D spend optimization, and Warranty servicing
- Ancillary Usage: Usage based insurance packages, Mobility services, Fleet optimization, Electric car servicing, Mobile commerce payments
- Enterprise to Enterprise: Remote diagnostics & predictive maintenance, Device management
- Enterprise to customer: Safety and security, Auto telematics, In-car infotainment, customization, ADAS (Advanced Driver Assistance Systems)

Smart opportunities in the vehicle

Mobile navigation apps connected to the car's smart system are already in use. Other than helping in navigation, they also help by highlighting places of interest (such as restaurants and fuel stations) on the route. They are likely to become further entrenched through a series of mainstream offerings from automotive OEMs. The smart automotive can also

provide users the experience of intelligent functions as self-parking, auto-braking, cruise control alongside automatic accident-prevention features, machine-operated power-steering, and electric parking brakes, as well as electronic throttles and engine control.

As the ecosystem scales up, Indian OEMs, platform and software providers and other players might further need to forge or strengthen partnerships with global chipset manufacturers and best-in-class technology providers to achieve comparable levels of performance in their self-driving vehicles.

With further technological maturity, the connected car is expected to shape market trends and automotive manufacturers' relationships. Smart features such as engine maintenance signals, safety sensors and smartphone integration are already transitioning towards mainstays in upmarket vehicles. Industry leadership is expected, in certain cases to favor newer players capitalizing on the above, as conventional OEMs may be compelled to accelerate their drive for innovation.

Moving towards a fully autonomous vehicle

Autonomous systems in vehicles may range from partial to complete autonomy. In the former case, for example, the vehicle may take over longitudinal and lateral control in controlled situations such as highways, with the driver monitoring traffic and retaining control with a lead time. In the latter case, the vehicle may be entrusted to control all tasks.

In-roads into partial and full automation of vehicles in India will be dependent on the development of enabling infrastructure to support the same. The deployment of low latency V2X (Vehicle to Everything) communication systems – e.g., V2I (Vehicle to Infrastructure), V2P (Vehicle to Pedestrian), V2V (Vehicle to Vehicle) and V2G (Vehicle to Grid), is expected to facilitate the above and bring about demonstrable value through the added safety and energy savings from them.

In the initial phases, autonomous vehicles could find use in controlled ecosystems such as industrial parks and institutional premises and campuses, (for example as shuttles, which could act as viable testing grounds to ascertain the longer term safety, maintenance and legal implications of operating them). The focus on ensuring reliable connectivity and processing large volumes of data is expected to provide a boost to telecom operators. Some of them have already got into partnerships with hardware, platform and software developers and OEMs for the same.

Also, some of the leading mobile app-based transportation service providers have begun to collaborate with large, technologically advanced OEMs in co-developing driverless cars with the goal of deploying a fleet of autonomous vehicles.

Fully autonomous vehicles might require a longer span of time to reach the mainstream consumer. This span would be marked by an exciting period of transformation for automotive manufacturers who must navigate the challenges of designing, manufacturing, and upgrading traditional models while making strides in new-age technologies and improved customer experience.

Our viewpoint

We believe that with the wide-scale developments in V2X communication and networking of the smart vehicle, the utility of vehicles may be accentuated beyond mere transportation into a hub where people can communicate, work, surf the internet and access multi-media services during the journey. The value chain for automotive players could extend beyond the showrooms and into software based interactions with individual vehicle owners for a sustained brand experience and customer relationships.

Further, we picture a future for the automotive industry where autonomous, shared and connected features will increase the rate of innovation characterized by shortened model introduction cycles (from the current 5-8 years to an annual basis). The above trend can be expected to be driven by incremental integration of the latest hardware and software features, which could be pushed to vehicle owners in the form of regular upgrades. It would also likely imply a re-distribution in R&D investment for automakers – with greater focus on smart features and software applications and quicker returns. Manufacturing operations may be faced with the need for flexible production techniques to accommodate the pace of upgrades.

Autonomous vehicle adoption will be further supported by (and reciprocally supported the simultaneous electrification of vehicles. For example, autonomous vehicles targeted towards safe transport in urban settings may act as a case for electric cars which are suitable for similar scenarios. Conversely, the availability of automatic charging points would prove conducive to seamlessly operating autonomous vehicles.

Finally, changing consumer preferences among the younger generations might weigh in in favor of 'shared mobility' versus 'ownership'. Combined with the focus on safety and efficiency in smart vehicles, this could imply much more intensive use of vehicles at lower maintenance and repair costs. The smart automotive revolution is already underway as has been seen in the Auto Expo 2018 where OEMs have unveiled examples of electric and autonomous vehicles, smart features such as touch-screens, face and gesture recognition, auto-balancing two-wheelers, augmented reality displays, and intelligent learning of routes and more.

In conclusion

Automakers making investments in emerging market countries such as India may require a conservative approach – closely managing costs and factory capacity to navigate the next few years. The cost of enabling technology such as sensors (proximity, GPS, vision, audio, etc.), software, storage and connectivity is expected to drop over the coming years along with the mushrooming of start-ups and specialized connected, smart and autonomous vehicle technology providers. As the technology is further democratized and commercialized, strategic partnerships and joint business relationships with local players might benefit automakers looking to gain competitive advantage in the evolving market.

While the basic tenets of the smart automotive remains the same, the traffic rules and conditions of each country force unique customizations to the solution. For India, it is important that the underlying AI and Machine Learning systems for smart vehicles be trained in a way that captures the added complexity of roads in India, traffic signs and markings which may be worn out, pedestrian movement on roads, unstructured traffic conditions, high proportion of two-wheelers, abrupt lane changes, etc. as opposed deploying systems trained on more structured environments of developed markets.

Connected Cars: Innovation Driven by Data

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Product Manager Data-Management
CMORE Automotive GmbH

Simon Papel holds a Master of Science in Business Informatics and has worked for over 12 years for the Deutsche Telekom AG. During that time, he worked on the enterprise critical database for mobile networks storing all information of customers, contracts, products and intelligent network.

Basic Challenges, High-Level-View

The first steps towards connected cars have been already taken since 2013 with the Connected Car Traffic & Diagnostics Cloud. It uses anonymized traffic movement data and messages and hooks up to traffic participants, road side units, logistic enterprises, OEMS, and others. It is also used for telematic messages for the maintenance of cars and exchanges data with repair shops.

Aside to the connection to clouds, connected cars use a heterogeneous communication network between themselves and the surrounding infrastructure with either WLAN-11p (IEEE 1609 802.11p), cellular network communication (LTE-V, LTE/5G) or digital broadcast (DAB+/DMB). The communication network itself must overcome the challenges of connection management, encryption & authentication to offer online services for traffic, parking & toll payment, vehicle sharing, personalized functions on demand, and secure over-the-air-updates.

The communication network has also to share information that is out of sight of the vehicle, like warnings for traffic jams ahead, hazardous locations, road works, lane changes or blocked intersections. Very detailed maps according to the car's position could be sent on top, when road lines and guard rails are missing in addition to the information that is surrounding the vehicle or the information that is out of sight.

Next to the communication challenges there are legal and strategic challenges:

- Legal permissions and responsibilities
- Safety aspect
- Heterogeneous technical systems of different ages
- Cooperation of road side unit manufacturers
- Calculation of signal prediction (latency, quality)

What could be the use cases driven by the innovations of connected cars? Obviously the highly automated and connected driving functions in the context of urban traffic flows and smart traffic control. That also includes co-operative, highly automated and autonomous driving in public transport and commercial vehicles in mixed traffic situations. For these autonomous vehicles to become a reality, they need data. Big data in fact. The vehicles are furnished with sensors measuring everything from position, speed, direction and braking; to traffic signals, pedestrian proximity and hazards. The groundwork has already been laid for autonomous vehicles with ADAS functions like collision warning, lane keeping, brake assist, and speed control. In general, all information in these cases is processed locally and kept privately within the vehicle. In contrast, with connected cars, all information can be shared between cars and between cars and any kind of a centralized intelligence instance. By exploiting this shared data, the connected vehicles will be able to make even better decisions and carry out even more appropriate responses to traffic situations than in the purely isolated case.

Cooperative Driving Functions in Urban Environments

The examples mentioned earlier indicate the potential for innovations that could come with data management for connected cars, but the potential for cooperative driving functions in urban environments are even higher, especially when thinking of a multi-cloud-environment for vehicles, road side units, mobile networks, and a centralized traffic managing system.

Vehicular Cloud

The vehicular cloud would be based on temporary vehicular ad hoc networks and clouds to enable the swarm intelligence. Operation of the vehicular cloud be achieved with IEEE 802.11p, 4G D2D and 5G D2D. The major advantage would be that no infrastructure is needed, which makes it especially suitable for emergency cases because of the robustness. From a financial point of view such a solution must be low cost and OEM independent to gain full potential.

Road Side Unit Cloud

The road side unit cloud could be based in first step on vehicular ad hoc networks and later migrates to a 5G network. But are the road operators and public authorities ready to operate such a cloud or will there be new market players? The advantages of the road side unit cloud would be, that it taps into the local intelligence for safety critical hotspots and has low latency due to high-grade proximity. Yet who will invest that tremendously when there is a lack of existing business models or operator schemes?

Mobile Edge Cloud

The mobile edge computing is the pivotal building block for 4G+/5G networks which is operated by the telecommunication industry; which are the firms with 4G (notably LTE-V) and 5G (notably 5G V2X) and WiFi and backbone access technology. The mobile edge cloud can be built on top

of existing cellular infrastructures that is then usable for a variety of (also non-traffic) applications and their data. The mobile operator will probably use specific solutions and might even prevent cloud roaming. Having in mind that Europe alone has about 200 carriers for mobile networks shrinking in numbers every day, what will be the chances for new market players? And what about partially suboptimal location of existing cellular nodes for roadside applications? These are all problems that might occur with the mobile edge cloud.

Centralized Traffic Management Cloud

All data converges in worldwide or nationwide centralized traffic management clouds created by tech companies, car manufacturers, and service providers having superior storage, processing and communication capacities with the greatest possible economies of scale. Even with latest technologies there are still problems like high latency, security and privacy protection to solve. The centralized traffic management cloud would be a highly attractive target for IT attacks because of the valuable data.

First Steps Toward Connected Cars and Automated Driving

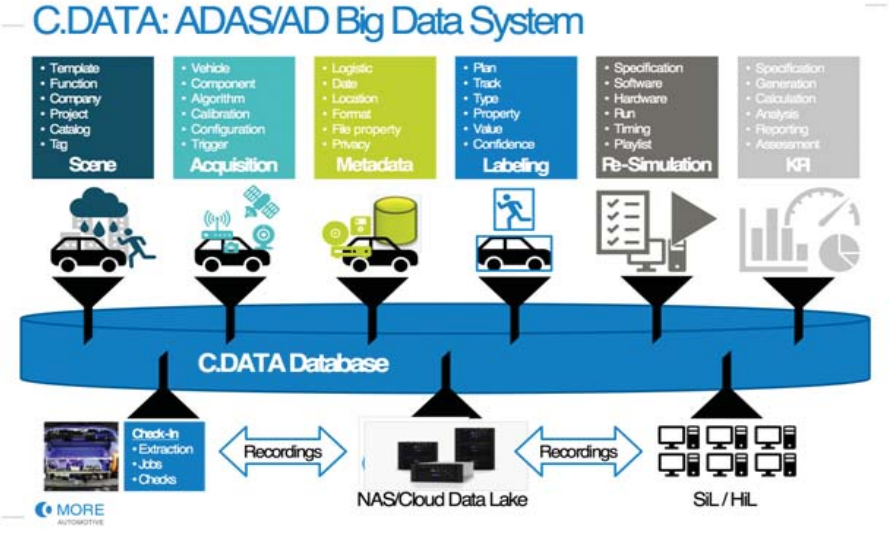
Connected cars in the context of automated driving need a validation process during development. The development of level 3 to 5 automation systems will become a major technical challenge, especially considering the expected data rates of a level 5 automation system: 17,500 gigabytes per hour. Even a level 3 automation system produces between 1,400 and 2,700 gigabytes per hour. And this is just the raw data that often needs selection, conversion, annotation for the ground truth, and transmission to software, for example for re-simulation and KPI visualization. That is why data management is so important. For the data management we need to be sure about the entities considered from an ADAS data point-of-view:

- scenes in every-day traffic,
- data acquisition,
- metadata describing the massive data chunks and the data logistics,
- annotating and labeling data for the ground truth,
- putting modern sensors in re-processing or re-simulation – including virtual – environments,
- and create KPI reports out of that.

All these entities are in focus of CMORE Automotive GmbH (CMORE/EC.MOBILITY) and its business unit C.IDS (Integrated Data Solutions). CMORE/EC.MOBILITY is specialized on validating ADAS/AD sensors and meets the current and future data management requirements with the C.IDS development of C.DATA.

Data Management During Development

C.DATA is an automated big data system which highly efficiently and effectively manages ADAS/AD mass data along the validation and development process for complex sensors and sensor configurations. The primary goal of



C.DATA is to keep manual intervention to a minimum while offering the flexibility and freedom required in a constantly changing data environment. One of the special features of C.DATA is that it is tailored to the ADAS/AD requirements and its continuous validation for level 3 or higher ADAS/AD functions. Everything from scene management, vehicle construction, data logistics, annotation data, re-simulation to KPI management and KPI reporting is combined in one platform.

In addition to C.DATA, CMORE/EC.MOBILITY developed the PODBOX (Persistent Onboard Diagnostic BOX). PODBOX as a multifunctional platform offers custom measurement technology solutions for use in the vehicle or in the laboratory and additionally for prototyping algorithms and functions. It is a multifunctional measurement and diagnostic platform for intelligent data analysis. It enables remote access to ECU diagnostics including data logging (CAN, video, GPS, online tagging, etc.), automated tests and reports, system monitoring, and documentation of test drives. It integrates over-the-air functionality (WiFi, 3G/GSM) and provides real-time data in multiple views.

Conclusion

Think of all the possibilities and rewards when harnessing the data of connected cars and the disruptive potential for innovations regarding future mobility. Travelling overall will become a much different experience: safer and more flexible with the seamless integration of

personalized data. Safer for all participants of every-day-traffic – even when not in sight – including new mobility concepts for commercial and public transport.

The data management to enable all that should not be seen as hinderance or burden, but as a chance to uplift modern – and much more mobile – society. ▪▪▪

EXPERT SPEAK

Vehicles are Becoming Smart Devices & Connectivity/Autonomy the Norm

Warren Harris
CEO & Managing Director
Tata Technologies

Warren Harris has been with Tata Technologies and its predecessor companies for more than 25 years. His roles have evolved from engineer to a number of technical management positions worldwide. He is an authority on global manufacturing. He has also contributed his insights to the book, "Globality – Competing With Everyone From Everywhere For Everything."

Q What is at the core of Tata Technologies? How has it evolved over the years?

A Engineering, Research and Development (ER&D), as we call it internally has been our biggest line of business, and is at the core of what we do. Over the years, we've evolved from being a strategic staffing business into an organization that can take on complex work packages (system / sub-systems), and full-vehicle programs, and deliver them successfully within technical parameters and defined budgets. Quite a few established and emerging OEMs are leveraging this capability of ours. Our automotive manufacturing DNA, and the excellent pool of talented engineers spread across the globe is what lends us that strategic advantage. While already excelling in their respective domains, our engineers are now embracing new challenges which the ACES (autonomous, connected, electric and sharing) trend in automotive is presenting. We currently have several strategic initiatives underway, which will determine the future course of the company in this direction.

Q India seems to be moving closer to a world of electric and autonomous vehicles. How TTL will orient its E&D services to address changing strategies in manufacturing, which may emerge, for these future vehicles?

A During the opening of our new European Innovation and Development Center in June last year, Dr. Ralf Speth, CEO of Jaguar & Land Rover highlighted that the rate of change that the automotive industry will see in the next 5 years is going to be faster than what it has seen in the last 50. You are correct in pointing out that this is true even in India's case. The Indian government's push to electrify all vehicles by 2030 is going to be a major factor in this direction. Any OEM that does not embrace it is staring at extinction.

Tata Technologies too is gearing up as an engineering service provider to address the needs of our customers in these spaces. On the electric front, we are experts in the field of lightweighting, or 'rightweighting' as we call it. We have internally developed a methodology based on which we have successfully designed and engineered electric vehicles for OEMs. We also have an electric vehicle platform about which we are in discussions with a few emerging OEMs. Our teams have also done some great work on electrification, and battery-swapping techniques. On the autonomous and connectivity side, we have several internal projects going on, the benefits of which, we are taking to our customers. We are also currently formulating our digital strategy roadmap, where our ER&D line of business forms a critical piece.

Q How the company is developing its capabilities to tap the electric mobility wave in India?

A Capabilities-wise, we are already able to tap into the electric mobility wave. Currently we are in discussions with several established and emerging OEMs about their electrification needs. As mentioned earlier our electric vehicle platform, coupled with our lightweighting and prior experience with developing electric vehicles is a game-changer. Throw-in our frugal engineering, and strong VAVE, tear-down benchmarking capabilities; we have it in us to be able to roll-out a complete electric vehicle by ourselves in a country like India. We are practically a one-stop shop for our electric vehicle customers.

Q How do you see Indian automotive telematics market in terms of investments, growth opportunities, R & D capabilities, resources, and challenges, among others?

A The potential is huge! With Tata Technologies having a strong presence in the U.S. and Western Europe, we are in a vantage position to be able to see the pace at which different technologies are converging into automotive. The influence that telematics is having on connectivity and related features is immense. So far, I would say India has been a 'fast-follower' of the trends in automotive industry and still has a lot to catch-up on. If anything, this only means a tremendous opportunity either by adapting technologies already been embraced in the west, like telematics for car insurance, or by investing to solve local issues, like parents tracking the school bus in which their kids are traveling.

Q TTL at present has only one centre in India for advanced engineering design, dedicated to the automotive and aerospace sectors. As both of these are growing sectors in India, do you plan to open more centres in near future?

A While our main engineering and design centers are in Pune, we serve our clients across India and have satellite

sites in the east, north and south of the country as well. Through these centers, we are not just satisfying the needs of automotive and aerospace customers, but also industrial and heavy machinery customers. We recently collaborated with Tata Hitachi to launch its new backhoe loader Shinrai at Excon 2017. For this, besides the engineering capabilities of our India-based engineers, we also brought in specialist heavy machinery engineering capabilities from our delivery centers in Romania. This was a unique case of reverse outsourcing, where we brought in specialist skills independent of the location. That's what makes us unique. On the question on expansion – we are looking to make a stronger presence in other cities in India. A couple of proposals are under evaluation, and it would be announced at an appropriate time.

Q Crash-test centre in Pune, established by TTL & Tata Motors is known to be the only installation of its kind in the country. Are there any other major initiatives in the offing at TTL towards technology adaptation and innovation in increasing road safety with crash analysis, especially in context of adequate technology infrastructure need for handling issues related to cyber security?

A As the industry moves towards ACES the need for cyber security is only going to increase. Recognizing this, as I mentioned earlier, we are creating our own digital strategy roadmap which will address this area.

Q With Government's push for startups and innovations, are there any initiatives being taken by TTL in the autonomous vehicles segment?

A Most definitely! Our teams are currently engaged with quite a few companies that offer autonomous platforms. Tata Technologies is uniquely positioned to excel in this space, because of its capabilities spread across both the spaces; software, through its enterprise IT, electronics, and PLM practices and mechanical through its ER&D capabilities. We believe we are a company of system integrators, and as applications evolve, we will have a greater role to play in integrating them into a vehicle by working on its underlying platform.

Q How Indian workforce can serve as a major asset to support the company's global operations, especially in area of research and development?

A The Indian workforce is already a major asset to the organization. Firstly, it's a near-shore center to support operations in China, and other countries far east, where we are enjoying tremendous success. Besides, it is also proving to be of significant benefit to some of our other customers in Europe and North America. In December last year, we announced our strategic partnership agreement with Zodiac Seats UK, a part of Zodiac Aerospace, under which we have opened a new Offshore Dedicated Engineering Centre (ODEC) in Pune. Over the years, we have seen a shift in the industry, whereby now our customers are depending on our India centers for increasingly strategic and value-added work rather than the repetitive ENVA (essential non-value added). Going forward, I believe this trend is only going to increase.

Q As an industry stalwart, what is your perspective about the future of connected vehicles and autonomous vehicles in India?

A There's absolutely no doubt in my mind that as these technologies start to get proven, they will become the norm in India. As I said earlier, this space is evolving very rapidly, and unlike the times when airbags took over 40 years to become the norm since it was first invented, new technology will very quickly become the norm.

The penetration of international brands in the Indian market is changing the dynamics completely. These next generation technologies are going to be a way for these brands to differentiate themselves in an otherwise crowded marketplace. Additionally, with changing demographics, an average well-educated Indian is spending a considerable amount of time in developed and fast developing markets, where technologies like these are already in use to various levels of maturity. This will bring about a shift in their mentality. This coupled with more disposable income will make connectivity and autonomy soon from being a luxury to being a basic need of these consumers. Smart phone penetration, and the whole IoT wave is another aspect which would have a huge bearing on this whole journey. Over the next few years, mobile apps, and features like remote-start, ability to monitor tire pressure, check fuel and engine oil levels etc. are going to become a basic expectation just as it is becoming in the developed markets today. GPS tracking today has already become a common feature, especially in ride-hailing. Similarly, connectivity and lower levels of automation too would soon catchup.

But all of this cannot happen without proper government intervention. This will be required in the form of infrastructure development for electrification, and proper regulations around autonomous vehicles. Currently in the U.S., certain state governments are already working around regulating this space, because with the onset of autonomy, drivers will no longer have to be assessed and licensed, rather it will be the car itself. And all of it won't happen at the same time, it'll have to be in a phased manner. So, till the time all vehicles are fully autonomous, with zero human dependence there's going to be a strong need for regulation and governance to minimize fatalities. There are also discussions around the need to come out with industry standards around which these developments are to be done. This is mainly because every company today has its own definition of autonomous, and calls its features by different names, which can be a little confusing for the consumers. Such interventions would be necessary to enable this change.

> ***"Over the next few years, mobile apps, and features like remote-start, ability to monitor tire pressure, check fuel and engine oil levels etc. are going to become a basic expectation"***

Bosch Telematics eCall Plug (TEP)

Source: Bosch

Bosch launched Telematics eCall Plug (TEP), a retrofit plug-in sensor device in the early 2018. The device delivers event data such as driving behavior and crash detection for telematics, fleet management and insurance applications. The smart sensor device easily plugs into a standard 12V car cigarette lighter socket. The TEP utilizes its built-in sensors and microcontroller to track driving behavior parameters such as acceleration, braking and cornering forces, then transmits this data to the driver's smartphone via Bluetooth. There is no connection to the car's IT infrastructure.

Data from the TEP enables innovative usage-based business models, e.g. for insurance purposes, however, it is also setup to be adopted by fleet operators and automobile clubs. The device's eCall function registers car crash severity and can help to save lives by enabling faster emergency response times. ▪▪■

The Norwegian Road Status Information, a technology for winter road prognosis

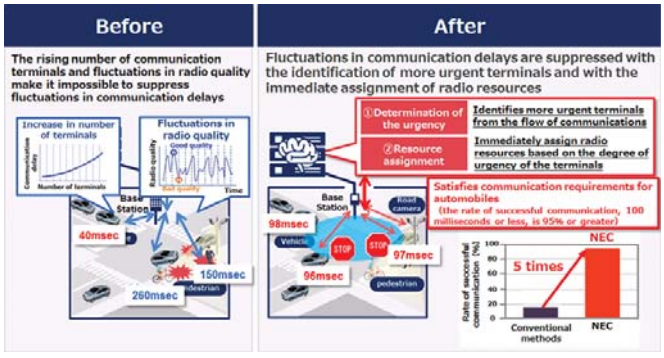
The Norwegian road authority Norska Statens Vegvesen has demonstrated Road Status Information (RSI) software. The software has been developed by Klimator and NIRA Dynamics.

RSI software through its advanced algorithms combines the data from connected vehicles with information from roadside weather stations and weather forecasts. That makes connected vehicles rolling weather stations which transmit various signals including current road friction which is the key to determine local road grip. The vehicles are connected via NIRA-developed OBD-dongles that register current position, ambient temperature, wiper activity and road friction. The data is continuously made available on the RSI-server.

RSI manages to determine the road grip conditions in real time with high precision and creates accurate 12h forecasts. This enables an increased safety on wintery roads, a significant environmental benefit and cost savings through the more efficient use of winter service resources (road salt consumption, driven miles in salt trucks, etc.). ▪▪■

NEC adaptive network control

NEC has developed an adaptive network control technology for controlling networks that prioritizes certain urgent communication terminals based on their communications flow, then immediately assigns bandwidth and communication time (radio resources) to these terminals, rather than their less urgent counterparts. This helps to ensure that data transmission is complete within the 100-millisecond target time.



Source: NEC

Adaptive network control has been tested in a simulated traffic environment where 100 automobiles and 100 pedestrians were using a variety of communication terminals, such as smartphones, while connected to an LTE radio base station. This testing verified that an automobile's communication delay could be shortened to 100 milliseconds or less and the rate of successful communication could reach 95%. This represents an improvement of more than five times over the conventional Proportional Fairness method of communications. ▪▪■

Jarvis, cloud-based static binary code scanning solution

BlackBerry Jarvis was unveiled in January 2018. It is cloud-based static binary code scanning solution that identifies vulnerabilities in software used in automobiles. It scans and delivers actionable insights, what would otherwise involve manually scanning.

Jarvis is offered on a pay-as-you-go usage basis and is customized for the unique needs of each OEM and their entire software supply chain. Once initiated, automakers will have online access to Jarvis and can scan any number of binary files at every stage of software development. This includes the capability to evaluate new software under consideration as well as the ability to assess existing software already in production.

In addition to cost and time savings, BlackBerry Jarvis helps ensure that production software adheres to industry standards such as MISRA and CERT and enables OEMs to define custom rules to meet organization-specific objectives. ▪▪■

Open platform for camera-based driver assistance systems

HELLA Aglaia is rolling out an open platform for camera-based driver assistance systems. The software system developed is thus not bound to a specific hardware and can be flexibly used for the platforms of various manufacturers. Customers can combine different software components freely with other components by HELLA or third-party providers while integrating newly available functions via software updates.

Source: Hella

This provides customers with the possibility of updating hardware components and series-proven software functions, such as lighting control, lane/traffic sign/pedestrian and object recognition, according to individual preferences and needs. The market launch of the new software system is anticipated for 2019.

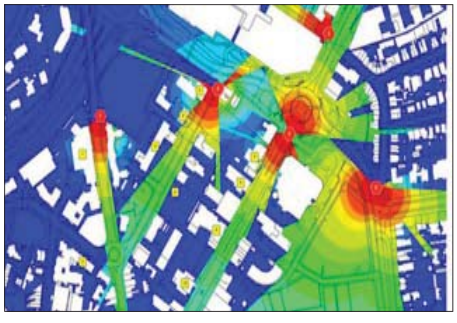
Ford files for a patent on an autonomous police car

Autonomous cars can serve in carrying out activities of maintaining law and order. In this line, Ford has filed for a patent which describes an autonomous police vehicle that would be able to detect infractions performed by another vehicle, either on its own or in conjunction with surveillance cameras and/or road-side sensors.

The police car will also have AI and Machine Learning capacity that would also help the car to decide if there is any breach of law by the car. The patent would further empower police to manually take over control of the vehicle or use its wireless connection to various databases to gain more information on those breaking the law.

However, there is still a long way to go to make such an autonomous police car a reality, but the step will bring autonomous vehicle technology to various areas like law enforcement.

Ordnance Survey to update geospatial infrastructure for Connected and Autonomous Vehicles



OS already has experience of being at the heart of national infrastructure projects, such as this planning trial in Bournemouth which looked at the effects of the built environment on proposed 5G frequencies.

Ordnance Survey (OS) has been mandated by Business Secretary Greg Clark to help shape a national geospatial infrastructure capable of supporting a nationwide network of Connected and Autonomous Vehicles (CAVs). Ordnance Survey is Great Britain's mapping service for government, business and citizens. The four-year E-CAVE project lies at the heart of the Government's Industrial Strategy.

The organization says that E-CAVE will enable real-time vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) data sharing, using open standards and architecture that will "transcend" proprietary interests. It claims that it has both the digital and geospatial expertise required to understand the challenges and capabilities of CAVs, and that precise location is not only a fundamental part of its work but also vital for the efficient collaboration between vehicles, which includes the exchange of map messages. With an aim to ensure public safety, this project is expected to accelerate the pace of development and deployment of driverless technology in the UK.

QUICK UPDATE

- Bosch, Vodafone and Huawei demonstrate driver assistance systems also benefit from C-V2X
- Mercedes-Benz introduces an experimental Connected Vehicle API
- Continental, Ericsson, Nissan, NTT DOCOMO, OKI and Qualcomm Technologies plan to carry out their first Cellular Vehicle-to-Everything (C-V2X) trials in Japan

Acquisitions and Announcements

- BMW Group acquires Parkmobile
- Autonomous Intelligent Driving GmbH licenses the Mapillary Vistas Dataset to develop technology for self-driving cars across the whole Volkswagen Group
- Vodafone (Germany) and HERE partner on services for autonomous vehicles and smart cities

Autonomous Vehicle

- Aquantia announces collabotarion with NVIDIA, introduces a suite of products targeted at autonomous vehicle platforms
- Continental and NVIDIA partner to create AI self-driving vehicle systems
- Sumitomo and NEC collaborating in IoT and AI based mobility business

Safety & Security

- Autoliv spin-off Veoneer to focus on ADAS and autonomous driving
- Panasonic and Trend Micro to jointly develop automotive cyber security solution

Shared Mobility

- Daimler and Bosch plan to test self-driving taxis in next few months

Eye-Net, an accident prevention system

Foresight Autonomous Holdings has completed a demo version of its new Eye-Net accident prevention system.

Eye-Net is a V2X (vehicle to everything) cellular-based accident prevention solution, designed to provide real-time pre-collision alerts to pedestrians and vehicles, by using smartphones and relying on existing cellular networks.

The Eye-Net system is designed to provide a complementary layer of protection beyond traditional advanced driver assistance systems and extend protection to road users who are not in direct line of sight and not covered by other alerting systems.

Redundant braking for automated driving

Last month at an event, Bosch showcased redundant braking for automated driving. Redundant functions ensure that all safety-critical functions continue in case of any failure in the system. For SAE levels 4 and 5, the redundancy becomes even more critical as the time span increases without the driver in the loop.

Source: Bosch

Bosch's solution for a fail-degraded brake system (steering system and E/E architecture) is the combination of its electromechanical brake booster iBooster and ESC (Electronic Stability Control), also known as ESP (electronic stability program), systems. Both are independently capable of performing braking functions for the vehicle in the rare case of a single failure.

A conventional brake system today comprises two actuators: a vacuum brake booster and ESC unit. The technological breakthrough of redundant braking was achieved by modifying one system element; the vacuum brake booster is replaced by an intelligent electro-mechanical booster, the iBooster.

The each actuator is now capable to decelerate the vehicle independent of the driver applying the brake pedal. Even if a failure occurs in the brake system, either actuator (iBooster or ESC) is able to avoid wheel lock-up by modulating the brake pressure, which maintains the ability to steer during deceleration.

Australia allows the 5.9 GHz band to be used for ITS

Source: ACMA

Australian Communications and Media Authority has introduced new regulations that will allow Australian road traffic authorities to roll out intelligent transport systems (ITS) that enable vehicle-to-vehicle, vehicle-to-person or vehicle-to-infrastructure communications. Following industry consultation, the Australian Communications and Media Authority introduced the Radiocommunications (Intelligent Transport Systems) Class Licence 2017, which will support the use of complying wireless technologies and devices. The regulations allow the 5.9 GHz band to be used for ITS in Australia and are consistent with the ITS arrangements in major vehicle markets such as the United States and the European Union.

Harmonising Australia's ITS arrangements with wider global developments means Australian motorists are more likely to enjoy the benefits of connected vehicles as they become available. According to FCC, Dedicated Short Range Communications (DSRC) Service in the Intelligent Transportation Systems (ITS) Radio Service in the 5.850-5.925 GHz band (5.9 GHz band) involves vehicle-to-vehicle and vehicle-to-infrastructure communications, helping to protect the safety of the traveling public. It can save lives by warning drivers of an impending dangerous condition or event in time to take corrective or evasive actions.

'HumanDrive' safety guidance in the autonomous car project

HORIBA MIRA announced its plans to develop safety guidance in the autonomous car project, 'HumanDrive'. The HumanDrive project, led by Nissan's European Technical Centre as part of Renault-Nissan Alliance research activities, will culminate in the most complex journey yet attempted across the UK without human driver input.

The focus of the HumanDrive project is to develop a vehicle that will emulate a natural human driving style, providing an enhanced experience for the occupants. To achieve this, the project will draw upon the expertise of a variety of organisations, including Aimsun Ltd, Atkins, Cranfield University, Highways England, Hitachi, HORIBA MIRA, SBD Automotive, Transport Systems Catapult and the University of Leeds.

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VOLTY

DENSO develops standard vision sensor

DENSO has developed a standard vision sensor that detects pedestrians at night, cyclists, road signs, driving lanes and other road users. The sensor was featured in the 2018 Toyota Alphard and Vellfire, which were released in January this year.

The vision sensor works in conjunction with a millimeter-wave radar sensor and allows automobiles to automatically activate emergency braking when obstacles are identified, helping reduce accidents and improve overall vehicle safety.

udelv launches autonomous last-mile delivery vehicle

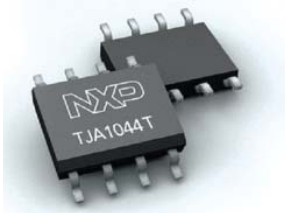
udelv, a California based company has launched its autonomous, last-mile delivery vehicle. The vehicle was also tested on the public roads where it traveled through a 2.5-mile loop with traffic lights, lane changes, unsignalized left turns and two delivery stops to deliver items to two nearby customers. In compliance with existing California regulations, the vehicle was supervised by a safety driver and in test mode.

The distinctive orange udelv customized vehicle
Source: udelv

The vehicle is built on a fully electric powertrain and features 18 secure cargo compartments with automatic doors using a cloud-based proprietary technology that is shared between the vehicle, customers, and merchants. In its current configuration, the vehicle can drive for up to 60 miles per cycle and can load up to 700 pounds of cargo.

NXP's new CAN Transceiver family that secures CAN communications without cryptography

NXP Semiconductors announced a CAN transceiver family that offers a seamless, efficient solution for secure CAN communications without requiring software or cryptography. With secure CAN transceivers, however, automakers can secure messages from the ECUs already used in the design, offering a simpler, faster rollout of security than it would take to transition the existing ECUs to secure ones.



A pure transceiver based solution for the CAN network developed by NXP offers security without bandwidth overhead, delays and processor load. This approach complements crypto-based security solutions with an additional layer in a Defense-in-Depth (DiD) concept, or as a standalone option. Another feature is the flooding prevention and rate limit control. Security solutions present in the market today protect CAN communication with message authentication code (MAC) based on cryptography and complex key management, but they require increased busload, message latency, or computing power consumption. In addition to this, upgrading devices to support secure CAN messages is also not available, when the processors do not have sufficient computing power. However, with secure CAN transceivers, users can secure messages from devices already installed in systems by means of exchanging the transceiver, which makes it a reliable solution for increasingly complex cars.

High resolution automotive radar ICON

Source: Magna

Magna unveiled (Jan 2018) its high-resolution automotive radar ICON which incorporates advanced technology used by the U.S. military to provide precise detection, extensive range and high resiliency. The technology helps close the gap between level 3 and level 5 to reach full reliable autonomous driving.

With a range of more than 300 meters, Magna's ICON RADAR continuously scans the environment in four dimensions (distance, height, depth and speed), which is 50 times faster than the time it takes a human to blink an eye. With its compact size, ICON RADAR also allows greater flexibility in exterior design and can be easily integrated into an automaker's autonomous system or as part of Magna's MAX4 autonomous vehicle platform. It will thus enable faster decision making process in complex surroundings thereby ensuring safe mobility.

Ola working to develop safety systems capable of preventing accidents

The system being developed by the company would be able to prevent accidents by alerting the driver to take the corrective action in case it detects any possibility of an accident, like if the driver is drowsy or the car is likely to hit a pedestrian. The system would also be able to alert a central command, passenger's family in case of an accident.

The company plans to employ automotive telematics and use sensors like camera and radar to collect data. These devices would collect data that would be sent to a central command where it would be combined with other data like passenger's booking history, time, location etc to be able to predict and prevent accidents. Earlier this month there were reports that the company is hiring technology professionals with autonomous or self-driving car coding skills. As of now the company is testing these systems on a fleet of Ola cabs, however, the business model and how the expenses of employing these services will be met has not been made clear till now. The report says the company aims to keep the expenses to the minimum and is in talks with some automakers on how these data can be collected and utilized. It needs to be seen when and how these features are added in Ola Cabs.

KPIT launches ARAI certified AIS 140 compliant vehicle telematics device

KPIT has launched ARAI (Automotive Research Association of India)-certified AIS- (Automotive Industry Standard)-140 compliant vehicle telematics and emergency button solution. According to KPIT, it is designed keeping in view the Indian operating conditions and aligned to future AIS140 roadmap such as Vehicle Health Monitoring, CCTV Camera, Passenger Information System etc. Salient Features of this AIS-140 Compliant Vehicle Tracking system are:

- Easy to install
- Real-time vehicle updates
- Easy-to-integrate peripherals like voice box, LED Boards, etc.
- Battery backup up to 8-hour

MapmyIndia Smart Mobility Platform

MapmyIndia has unveiled Smart Mobility Platform designed to address the emerging challenges of the Automotive Industry for both personal and commercial customers. MSMP can be easily connected to the vehicle using multiple interfaces like SDL (smart device link). It becomes a central control point for the interaction between the vehicle and the user. The newly created MapmyIndia Map App will offer users a single window access to features like navigation, tracking, streaming media services, driver feedback etc. on the device of their choice viz. vehicle AV, smartphone etc.

Motherson Group launches telematics product 'Rollr'

Samvardhana Motherson Group has launched telematics product 'Rollr', which provides information on real-time tracking, location analytics and engine health. Rollr provides connected vehicle solutions from devices to applications, thereby providing users access to vehicle telematics comprising real-time tracking and location analytics, engine health. It can also provide security alerts and driving behavior, along with providing regular reports summarising pre-set parameters. While Rollr Mini is perfect for families use as a track and trace solution, Rollr Fleet caters to fleet owners with more than ten vehicles and enterprise Rollr is aimed at large businesses with over 200 vehicles.

Tata Motors testing driverless buses

Tata Motors is testing driverless buses at its Pune campus. The company has developed a full-fledged bus which is being tested on a fixed route, without any human intervention, from the last two months. The bus uses the sensors placed at simulated bus stops to slow down or adjust its speed allowing the passengers to board and alight. At present the buses being tested at a lower speed of 10Kmph but as the platform stabilizes, they would be tested at higher speeds and more realistic road conditions.

Quick Takeaway

- ŠKODA AUTO India launches a new version of its 'MyŠKODA' mobile app
- Ashok Leyland to work with Phinergy on electric vehicles
- Zoomcar set to raise $50 million from Mahindra & Mahindra and Ford
- Nissan Motor plans to launch a low budget electric car in India
- Trak N Tell launches "Intelli Fleet"
- Scania and Haylion Technologies join forces

Electric Vehicles & Connectivity Driving the Indian Passenger Vehicles Towards Intelligent Mobility

Kaushik Madhavan
Director, Mobility Practice (Automotive & Transportation)
Frost & Sullivan Menasa

Kaushik Madhavan's expertise lies in competitive intelligence and benchmarking, new market entry and diversification strategies, new business model analysis and evaluation and end consumer analysis of automotive technologies.

The Auto Expo 2018 in New Delhi was characterized by the absence of a few of the biggest brands including the likes of Volkswagen Group, Nissan, Bajaj and Royal Enfield. However, the OEMs who did make it this year made sure that their Electric Vehicle (EVs) offerings and long term roadmap was out there to be seen by everyone. The most eagerly awaited entry was Kia Motors and they certainly did not disappoint. Kia showcased its entire line-up of vehicles introducing the Indian customer to its range of compact hatches, luxurious sedans and SUVs. Kia will launch its first offering in India in 2019.

The 2018 edition of the Auto Expo saw the highest number of EV showcases by OEMs across vehicle segments, including two and three-wheelers apart from passenger and commercial vehicles. The message is very clear – that all mainstream OEMs are ready with their EV models, should the Indian market demand a diverse range of electric mobility offerings.

Passenger Vehicles – EVs on Existing Platforms the Flavor of the Expo

"We will wait for the EV charging infrastructure to develop before we bring our EVs into the Indian market" said the CEO of a leading Japanese manufacturer with a strong presence in India. Although we have seen mixed responses from OEMs when asked about their EV plans for India, all key OEMs took this opportunity to display their EV models in front of the masses.

Mahindra and Tata Motors displayed a wide range of electric mobility offerings aimed not only at the private customer, but also fleet operators in the last-mile connectivity business. Although a few OEMs such as Honda showcased EV concepts, the emphasis during this edition was definitely on models that were closer to their production avatars. The excitement and buzz around EVs was evident as more customers were seen enquiring about key performance indicators such as range, battery capacity, charging time and price.

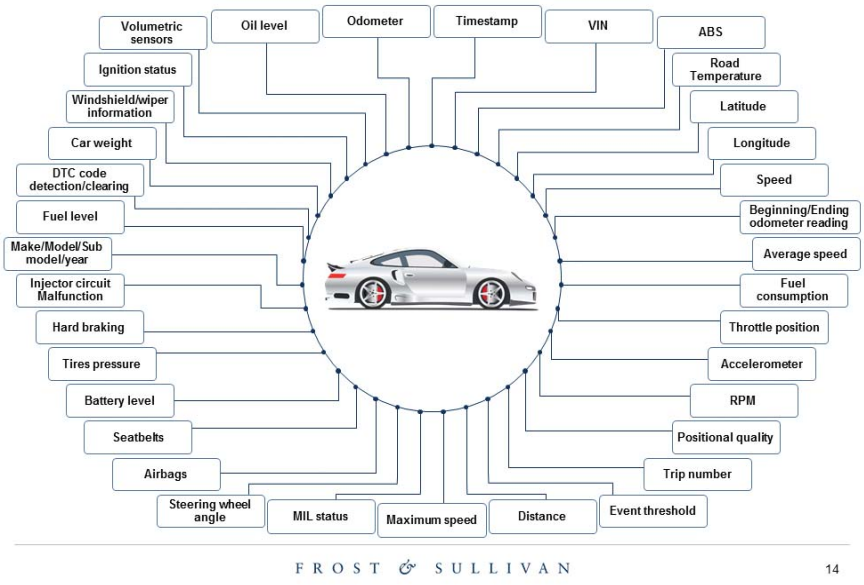
The manufacturers also made sure that imagery was attractive as well. All EVs sported green / blue colored livery attracting customers. The 2018 edition of the Auto Expo has marked the beginning of electric mobility as a mainstream offering. Buyers are more aware now of the various options available.

Two & Three-wheelers – Last-mile Connectivity driving Electric Propulsion Adoption

The focus on improving last-mile connectivity in India has been on top of the to-do list for successive governments over the past 15 years. In this direction, the Government has encouraged the development of last-mile connectivity solutions in collaboration with private operators to make public transport more attractive, efficient and viable.

The 2018 edition saw not only established mainstream OEMs such as Mahindra, Greaves and Piaggio but also smaller bespoke manufacturers focusing solely on electric 3-wheeler (3W) offerings such as Lohia and Vikram including Chinese OEMs such as Shigan. Lohia also had a solar powered 3 wheeler rickshaw on display. With the Government emphasizing the need to move toward renewable energy

Snapshot of Frequently Used Vehicle Parameters for Data Capture



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sources, these products are likely to build long-term viability for mobility operators.

Of particular interest was the prototype on display at the Greaves pavilion. Greaves has gone all the way in developing not only the vehicle, but have also invested in the development of electric motor, battery management system and peripherals including battery and tires for the electric 3W model. It is time for the electric 3W industry to see participation from mainstream OEMs such as Mahindra and Greaves as this is only going to increase competition on product quality and reliability apart from strengthening service and aftermarket support for long term growth.

Connected Vehicles – transitioning towards autonomous driving capabilities

Passenger Vehicle and two-wheeler OEMs, focusing on introducing EV models are also investing significantly on connected services including the likes of data management and cloud enabled services. Most companies are experimenting with different data delivery models ranging from raw data to offering services such as targeted advertising with over 40% offering raw & embedded data through APIs. With consumer use-cases increasing by the day, OEMs are investing in data analytics to enable themselves and customers to create "value-added" services such as location based suggestions, concierge services, etc. If all the connected vehicles with the ability to capture certain data types were monetized at the current value per car per year rates, the overall opportunity sums up to ~$2.0 billion.

Among two-wheelers, TVS was the key mainstream OEM with its Creon on display. Powered by three Lithium-ion batteries, the Creon can be charged to 80% in just 60 minutes. The model also offers a range of 80 km on full charge with a 0-60 kmph acceleration of just over 5 seconds. Twenty Two Motors also showcased its AI enabled, cloud connected electric 2W capable of a range of 160 km which can be charged to 70% within an hour. With significant investment in data analytics, Twenty Two Motors promises to offer customers a whole new experience in owning an electric 2W.

Concept EVs – Global Design Language Showcase to Attract Indian Buyers

Concept vehicles are always crowd-pullers in auto shows and this edition was no exception. With a wide variety of concept vehicles on display by all OEMs, the focus was largely on personalized mobility options with electric propulsion. Cloud connectivity, telematics, electric powertrain and personalization options were the key attractors among all concept vehicles on display.

As the country moves toward new forms of mobility solutions including aggregation and subscription based usage, concept vehicles are much closer to their production siblings. Frost & Sullivan estimates EVs to account for about 30-35 percent of the new vehicles market by 2030 translating to about 2.0 – 2.5 million new passenger vehicles annually. In this direction, as we see more OEMs using auto shows as a platform to showcase their design language, technology roadmap and customer-centricity, the importance of electric mobility is higher than ever before. With non-automotive stakeholders such as insurance companies, energy suppliers and software companies jumping into the fray, the EV Ecosystem is fast turning into an eclectic mix of players who will play a key role in the long run.▪▪■

Korean self driving vehicles at Pyeongchang Winter Olympics

At Pyeongchang Winter Olympics, Hyundai Motors, South Korea's largest automaker showcased its autonomous sedans. KT Corp, country's largest telephone company also showcased its self-driving bus named 5G Bus at the event according to a report by The Associated Press.

Hyundai is the local sponsor for the transport category of the games this year. It is also known that in comparison to other automakers is a late entrant to this race for developing self-driving cars, therefore, this exercise will also help the company to shed that image.

Hyundai also has tested its fleet of self-driven fuel cell electric cars in Korea as we had reported. The cars successfully completed a journey of 190 kilometers from Seoul to Pyeongchang. This is the first time level 4 autonomous driving was achieved with fuel cell electric cars.

In their journey to Pyeongchang, the cars had performed many functions like entering the highway, moving in response to the natural flow of traffic, lane changes and overtaking maneuvers,

and navigation through toll gates using Hi-pass, South-Korea's wireless expressway payment system. Hyundai also has got into a strategic partnership with technology company Aurora with the aim to bring self-driving vehicles to market by 2021.

KT, the Korean telecom giant, along with Intel and Samsung Electronics, has built 5G networks as a trial service in the Olympic towns. Being the telecom sponsor of the Winter Olympics but not the automotive sponsor, the company did not present its two "5G connected" buses to the media as driving unmanned, but these buses were operating in the seaside town of Gangneung, where Olympic ice hockey and skating matches are underway. The company plans to begin 5G services across South Korea in 2019. Showcasing these vehicles at the Olympics not only show the country's progress in the field of advanced vehicle technology but also helps to allay fears and popularise these technologies among the attendees and the audience world over.▪▪■

Technology Leaders for AIS-140 Implementation

In one of its latest standards published, the AIS - 140, ARAI deals with Intelligent Transport Systems (ITS). This standard applies to both individual components within the vehicle as well as the overall ecosystem of public transport. The standards have been provisioned for device level approval; including specifications of the new devices to be installed. Device level approval is needed to enable retro-fitment of ITS systems on in-use vehicles. This will ensure ITS Backend Control Centre infrastructure, already present with the STUs, can be more fully utilized and make the investment in the Backend Control Centre infrastructure more viable.

What does AIS 140 entail?

AIS-140 is being implemented across the country for all public transport vehicles, starting 1st April,2018.

Broadly AIS 140 defines the Safety and Security feature requirement for all public transport vehicles. It defines that all such vehicles must be fitted with GPS tracking devices specifically for Vehicle Location Tracking and with the function of a mandatory Emergency Button also known as panic button or SOS button.

There are many specifications (~30 specs) for the GPS tracking device, under the AIS -140 of which we have listed a few important ones here :

1. Location tracking through Indian Regional Navigation Satellite System (IRNSS/NavIC)
2. Communicate to designated backend government servers with PVT data
3. Dual IP addresses for PVT data and Emergency response
4. Alert ID on pressing emergency button
5. 4 hour internal battery back-up
6. Unique ID or IMEI number
7. Register vehicle to device
8. E-SIM
9. Operate between 8VDC to 32VDC
10. Assisted GPS
11. 3 axis accelerometer and gyroscope
12. Multi-slot GPRS

Who and how does AIS -140 impact?

As per the Ministry of Road Transport and Highways (MoRTH), all passenger transport vehicles including taxis and buses are to be mandatorily equipped with GPS devices starting 1st April, 2018.

Make In India GPS Device manufacturers such as Volty IoT Solutions Pvt Ltd, have invested into vehicle safety and security solutions along with their technology partners Ublox. They have already developed the AIS 140 complaint device hardware, under their flagship brand TranSync. They can be the right kind of partners for such a fleet transformation project for state transport undertakings.

Out of the various standards defined in the AIS 140 only the Vehicle Tracking aspect (VLT) and the Emergency Button or Panic button or SOS Button have been chosen by the government for enforcement. Given the government's push on road safety and its clear intent on implementation of these standards despite some push back from some quarters, it is best that the following organization start planning the incorporation of this standard into their fleet:

1. State Transport Undertakings – Inter-city & Intra city
2. Private Bus Operators – Inter & Intra city
3. Car and Bus Taxi fleet owners or operators (incl. corporate fleets)
4. Schools, Colleges and institutional (incl. corporate) bus operators
5. Rental taxis operators
6. Taxi hailing service providers
7. Self-driven car rental operators

Daniel Ammann
Executive Director
ublox

Why is the U-Blox technology superior?

U-blox is a global leader in wireless communications and positioning semiconductors and modules for the industrial, automotive and consumer markets. With over a decade of experience working with the automotive industry, U-blox has positioned itself as a leading provider of GNSS technology for the growing automotive market.

U-Blox and Volty IoT Solutions are technology partners for bringing the best in class AIS-140 complaint devices and solutions for the Indian market

The key aspect of the U-Blox technology from an AIS-140 perspective is that, together with Volty, they has invested in developing a roadmap with specific features in their modules to address the

NEO-M8Q
Automotive grade GNSS module with operational range –40 °C to +105 °C

NEO-M8L
Automotive grade GNSS and Dead Reckoning module with accurate navigation under all signal conditions, operational up to +85 °C

MAX-M8Q
The smallest automotive grade GNSS module with operational range –40 °C to +105 °C
•Pin-to-pin compatible with the professional grade MAX modules

AIS-140 specifications. Some of the salient features from this roadmap are as follows:

1. Highest accuracy amongst IRNSS (NavIC) compatible modules (<1 mt accuracy using L1& L5)
2. High sensitivity of -167 dBM which powers greater accuracy
3. Smallest available IRNSS module which is 17.0 X 22.4 mm small
4. First in the market with 12 band, dual frequency
5. High availability with precision up to centimetre level
6. Dead Reckoning option for positioning in challenging situations
7. High security with anti-jamming and spoofing

U-Blox has 12 years of experience in the automotive industry and is the No.1 preferred partners of GPS device OEMs globally. In India, U-Blox has a strategic partnership with Volty IoT Solutions for AIS-140 device and other devices as well.

Who can you reach out to for being AIS - 140 compliant?

There are not even a handful of OEMs who have invested in developing the AIS140 complaint GPS tracker with panic button. These OEMs have queued up at ARAI & ICAT to get their devices AIS 140 certified. TranSync (www.transync.in), a GPS Tracker brand of Volty IoT Solutions Pvt Ltd is a leader in the Indian GPS device OEM market, with hundreds of thousands of its devices functioning live on the Indian roads. TranSync, not only provides AIS-140 complaint devices, but also GPS trackers for all other tracking needs such as:

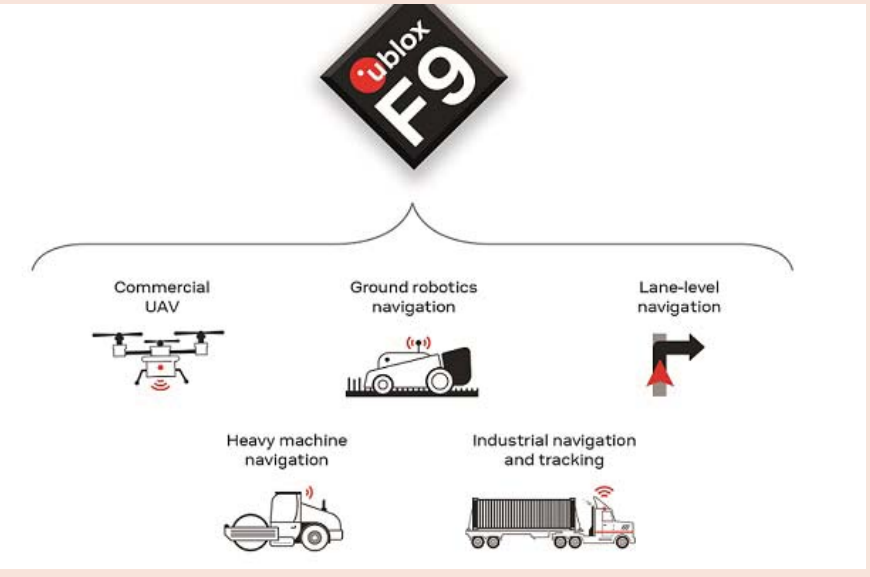
1. Fleet Management Solutions:
   a. Logistics Management
   b. Mining Fleet Management
   c. Oil and Natural Gas Fleet Management
   d. Insurance Management – with advanced analytics of driver behaviour
   e. Solid Waste Management
2. Two Wheeler Tracking– for sales force management
3. Warehouse Management
4. Three wheelers – for hailing apps
5. Asset Management – for Person of Interest (PoI), Cargo and Logistics management

There are also a plethora of software service providers who will integrate these AIS 140 complaint devices onto their Vehicle Tracking Platforms and provide various packages for end clients.

The VLT service with command centre integration solution is a long term investment for all the mandated service providers. As an end client, it is advisable to be ahead of the game and find the right kind of partner for your ITS journey. The ideal partner is the one who can survive through investment and innovation in this constantly evolving space.

ublox announces F9 technology platform for industrial and automotive applications

ublox has announced F9 technology platform. The platform combines multi-band Global Navigation Satellite System (GNSS) technology with dead reckoning, high precision algorithms, and compatibility with a variety of GNSS correction data services to achieve precision down to the centimeter level.



It uses GNSS signals in multiple frequency bands (L1/L2/L5) to correct positioning errors caused by the ionosphere and deliver fast time to first fix (Fast TTFF). Its ability to receive signals from all GNSS constellations (GPS, GLONASS, Galileo, Beidou) further improves performance by increasing the number of satellites that are visible at any given time. Stand-alone ublox F9 solutions robustly achieve meter-level accuracy.

To achieve centimeter-level accuracy, ublox F9 offers optional on-chip Real Time Kinematic (RTK) technology. In addition to offering an open interface to legacy GNSS correction service providers, it supports the main GNSS correction services, taking RTK high precision positioning to mass markets for the first time.

Optimized for low power consumption, the ublox F9 platform has built-in jamming and spoofing detection systems that protect against intentional and unintentional interference. Dead reckoning technology based on inertial sensors extends high precision performance to otherwise challenging urban environments.

The platform will find application in automotive technology that includes lane-level navigation for head-up displays and vehicular infotainment systems as well as for vehicle-to-everything (V2X) communication, a prerequisite for highly automated and fully autonomous vehicles. In the industrial realm, the platform will enable mass adoption of commercial unmanned vehicle applications including drones and ground vehicles such as heavy trucks or robotic lawnmowers.

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The Opportunity for Engineers as Domain Experts in Closing the Data Scientist Gap

Wensi Jin
Automotive Industry Manager
MathWorks

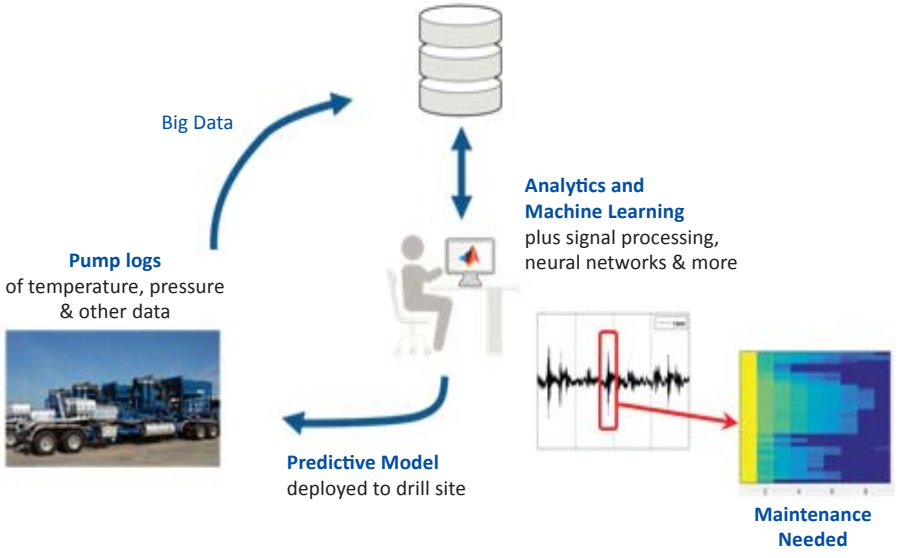
Wensi Jin is responsible for strategic planning and technology rollout. His focus is to foster industry adoption of Model-Based Design and MathWorks tools. Prior to joining MathWorks, he worked on real-time simulation and hardware in-the-loop test systems. He also worked on automatic transmissions control systems at General Motors Powertrain. Wensi holds a degree in Electrical Engineering from University of Texas at Austin.

Getting data from test vehicles into the hands of end users is a common barrier for engineers who need data to formulate requirements for new products, troubleshoot field problems, and come up with new technologies. Connectivity technologies such as CAN and high-speed mobile communication removed this barrier in many situations. With more and more streaming data from vehicles, we are faced with a data science challenge. We need to ensure that the speed of data analysis is keeping pace with data intake and, equally important, provide the capability to zoom into and extract insight from stored data throughout the engineering community.

To address this new challenge, one often looks for those who have computer science skills, knowledge of statistics, and domain expertise relevant to their specific engineering problems. Such instinct is not wrong, but these types of candidates are rare. You may find success by focusing on domain expertise. Domain expertise is often overlooked, yet it is essential for making judgement calls during the development of an analytic model. It enables one to distinguish between correlation and causation, and between signal and noise. Domain knowledge is hard to teach. It requires on-the-job experience, mentorship, and time to develop. This type of expertise is often found in engineering and research departments that have built cultures around understanding the products they design and build. These teams are intimately familiar with the systems they work on. They use statistical methods and technical computing tools as part of their design processes, making the jump to the machine learning algorithms and big data tools of the data analytics world manageable. Instead of searching for elusive data scientists, companies can stay competitive by enabling their engineers to do data science with a flexible tool environment like MATLAB that enables engineers to become data scientists.

Engineers with domain knowledge need flexible and scalable environments to do data science. They need traditional analysis techniques such as statistics and optimization, data-specific techniques such as signal processing and image processing, as well as new capabilities such as machine learning algorithms. In particular, machine learning with big data leads to a host of different technologies that support the iterative process of building a data analytics algorithm. It's this beginning stage of the iterative process of building the algorithm that can set a business up for success. This iterative process involves trying several strategies like finding other sources of data and different machine learning approaches and feature transformations. Given the potentially unlimited number of combinations to try, it is crucial to iterate quickly. Domain experts are well suited to iterate quickly, as they can use their knowledge and intuition to avoid approaches that are unlikely to give strong results. The faster an engineer with domain knowledge can apply their knowledge with the tools that enable quick iterations, the faster the business can gain a competitive advantage.

According to Gartner, engineers with the domain expertise "can bridge the gap between mainstream self-service analytics by business users and the advanced analytics techniques of data scientists. They are now able to perform



Baker Hughes predictive maintenance workflow

sophisticated analysis that would previously have required more expertise, enabling them to deliver advanced analytics without having the skills that characterize data scientists."

Let's look at a real-world example. Engineers at Baker Hughes used machine learning techniques to predict when pumps on their gas and oil extraction trucks would fail.

They collected nearly a terabyte of data from these trucks, then used signal processing techniques to identify relevant frequency content. Domain knowledge was crucial here, as they needed to be aware of other systems on the truck that might show up in sensor readings, but that weren't helpful at predicting pump failures. They applied machine learning techniques that can distinguish a healthy pump from an unhealthy one. The resulting system is projected to reduce overall costs by $10 million. Throughout the process, their knowledge of the systems on the pumping trucks enabled them to dig into the data and iterate quickly.

Baker Hughes predictive maintenance workflow: Leveraging tools for processing big data and applying machine learning, engineers such as those at Baker Hughes are well-positioned to tackle problems that improve business outcomes. With their domain knowledge of these complex systems, engineers take these tools far beyond traditional uses for web and marketing applications.

How to start? Engineers with domain knowledge should look for tools that get them up and running quickly. They need to ensure that the selected tools can simultaneously lower the bar for machine learning for the domain experts and provide flexibility and extensibility for others. Finally, engineers need to integrate their data analytics work with their companies' systems, products, and services. This typically means deploying the analytic up to the servers maintained by IT, and down into embedded devices such as an ECU. I have personally worked with many teams using MATLAB to build engineering analytics applications and automatically convert their analytics model to run in embedded devices, which reduces development time by several months, and eliminate bugs caused from rewriting the analytics programs.

Technologies that enable domain experts to apply machine learning and other data analytics techniques to their work are here to stay. They provide exciting opportunities for engineering teams to innovate—in both their design workflows and the products they create. Given the shortage of data scientists, engineers as domain experts have an opportunity to play a crucial role in filling this gap. Their knowledge of the business and the products it produces positions them well to find innovative ways to apply data analytics technologies. ▪▪■

Intel invests in Moovit, a transit data and mobility analytics company

Moovit has closed a $50 million Series D round led by Intel Capital. The other investors are Sequoia, BMW iVentures, NGP, Ashton Kutcher's Sound Ventures, BRM, Gemini, Vaizra, Vintage, and Hanaco.

It is known that Moovit is a transit data and mobility analytics company and transit app. The Israeli startup combines information from public transit operators and authorities with live information from its user community and offers transit riders a real-time picture, including the best route for the journey.

Moovit plans to use the funds to expand its global sales team, enhancing its consumer products to support user growth and investing in its Mobility as a Service (MaaS) platform. The company expects to surpass 1 billion users by 2021 and to expand the number of cities.

The investment in the company by Intel is important as along with Mobileye Moovit's technology and data can be instrumental in Intel's plans related to autonomous vehicles. Amnon Shashua SVP of Intel and CEO / CTO of Mobileye will join Moovit's Board of Directors as an observer.

"With significant investments in automated driving, mobility management platforms and smart infrastructure, Intel is at the forefront of a fundamental transformation of urban mobility."

"We're working with some of the most innovative transit companies, municipalities and transit authorities to build critical foundational technologies for this transformation."

"Moovit is one of the world's leaders in public transit data and analytics, the combination of Mobileye's and Moovit's technology and data will be instrumental in making cities ready for autonomous vehicles." said Professor Amnon Shashua, SVP of Intel and CEO / CTO of Mobileye in Feb 2018. ▪▪■

Smart city frameworks of the near future

Opeyemi Thomas
Founder and CEO
Roadi

Opeyemi Thomas is the Founder and CEO of Roadi, a software development company focused on applications for smart cities. He is member of U.S. National Institute of Standards and Technology (NIST), responsible for setting standards in methodologies of smart cities development.

Increasing internet connectivity, disruptive business models, and demand for autonomous devices, that automate decision making have become drivers of smart city developments. Environmental health and policy making represent convergent points that will shape the near-term development of smart cities. It is common to look at the potential implications that a single technology can have on our communities, however it is the convergence of technologies at the right time in consumer adoption that have the greatest impact. For example, the internet, smartphones and broadband connectivity met at the convergence point of consumers demanding mobile services. This convergence point redefined how we communicate and interact more than any individual technology did by itself.

I first came to think about this when discovering the SixSense technology in 2009, a gesture based wearable computer system developed by Pranav Mistry, now SVP at Samsung. Moreover, for three years I have built and run a mobile startup, called Roadi, focused on helping drivers navigate for parking in a smart city. My teams work, experience and conversation has convinced me of the need to better conceptualize the frameworks that will shape smart cities, and why.

Frameworks

Infrastructure framework can be represented well by systems such as low emission zones. Having successful low emission initiatives is made possible by having the right infrastructure that can detect data such as air quality or traffic congestion patterns. Another good example of a smart infrastructure is having a network that supports an electric vehicle infrastructure. This is critical as autonomous, decision making, devices will likely be electrical powered.

Ultimately a smart city lays a foundation to deliver a sustainable city. An encyclopedic definition of a sustainable city states, "A sustainable city is one that is designed to have as little impact on the environment as possible"

Applications framework relates to the variety of IoT and machine learning devices that will carry out the services that will be available in a smart city. I will provide some statistics of the Iot market as it represents much of the applications market. The other elements are software which will interface with the consumer and the server clients. The application framework is what the consumer and citizen will experience and interact with in the form of products and in some cases services.

Internet of things relates to machine to machine communication, where the user no longer needs to make a series of decisions in selecting from a variety of choices, in their day to day activity. Also, decision making applications provide a mechanism for making and enforce policy decisions.

IoT stats

- According to a post by PR newswire, anticipated growth in the US is projected to grow at a CAGR over 14% during and can be attributed to growing number of connected devices, rising internet penetration, an technology advancements

- 'Hardware' accounts for largest share in the country's IoT market, followed by 'Software' and 'Services' segments. Moreover, consumer electronics and transportation sectors dominated the US IoT market in 2016, and the segments are anticipated to continue dominating the country's IoT market in the coming years as well

Source: http:www.Intel.com

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> ***Smart city frameworks of the near future: Increasing internet connectivity, disruptive business models, and demand for autonomous devices, that automate decision making have become drivers of smart city developments.***

Convergent points

Public health (allow products to make decisions for us): Public health also accounts for the health of the physical infrastructure. The public health centered smart city initiatives utilize an infrastructure framework.

Since many of the decisions and associated tasks humans make day to day can be automated or remotely managed, much of the associated waste can also be reduced. Think for example the progression of technology used to make the first maps, then software applications created maps, now we want our devices to not only present us with the best, waste reducing, route but to also make the route decision and carry out all the associated tasks. At each level we were reducing the distance between a person deciding and acting, and subsequently reduce the waste associated with human inefficiency.

Low emission zones (LEZ) present a use case where Iot connects the infrastructure and application frameworks. The sensors in street lights, for example, can sense a vehicle entering a LEZ and send a signal to reduce the vehicles speed or take other action to manage the vehicle's impact on air quality. Remote sensing devices have shown to be able to enforce LEZ emission zones through trials in cities such as London.

Other ways that cities are adopting health focused frameworks is with electrical vehicle (EV) infrastructure. States in U.S. now are providing incentives for businesses that support the development of EV networks. and other smart transit solutions such transit hubs, where EV ports are installs, [1]Maryland EV highlights transit hub case studies.

The convergent point of public health will produce opportunities that relate the key factors of a sustainable city, as described by [2]Salem Press Encyclopedia as: air quality, clean water, energy use, biodiversity, food and agriculture, waste.

India is leader in the development of smart cities. with a large population and the migration into cities, citizens are in more demand of scare resources. Also, the size of the population in cities poses environmental challenges. In India you can find more interest in the infrastructure development and whole Iot systems, in contrast to interest in standalone applications. [3]Findings of students from Amrita School of Engineering in a paper showed that urbanization and population growth has led to higher demand for resources like water which are of scarce." (VIJAI,2016)

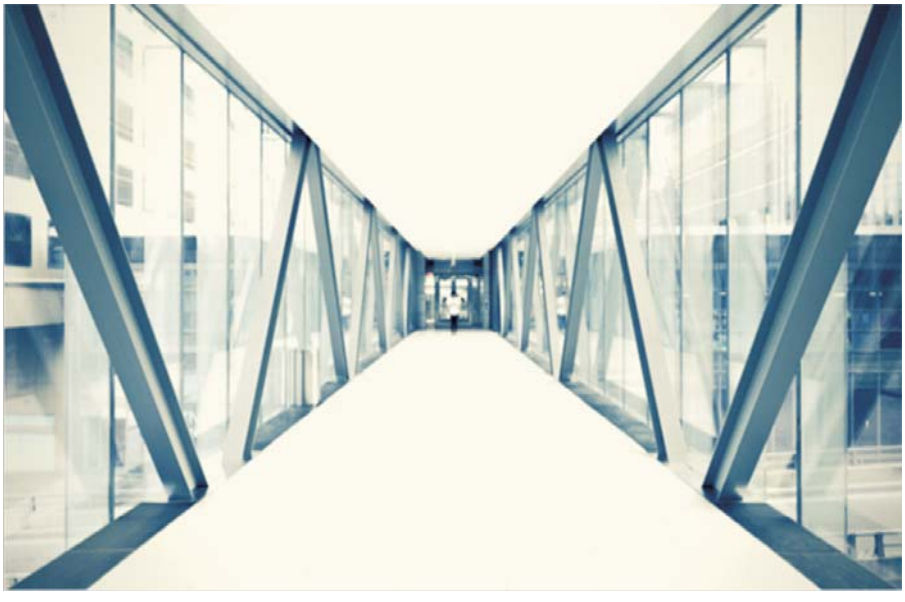
Example

The health of some cities are linked to the level of waste produced by freight movements, therefore better decision making through automation is being explored by business owners and public officials.

[4]Findings by the U.S. dept of transportation found that impact on public heath could be made by, "improving reliability of freight by installing signals that prioritize truck movement along freight corridors. Providing truckers with real-time information on parking availability and truck routes. Demonstrating the potential for automated and connected freight vehicles to make freight movements safer and more efficient."

Public policy convergence comes from the need to help us make better decisions. The goal of which is to reduce future negative environmental impact, improved mobility of people and the economy. Applications are produced for consumers because of policy changes. On the other hand, disruptive technologies can influence policy making. The recent case of ridesharing apps and their effect on infrastructure and policy decisions.

LEZ at the application level will bring opportunities and inventions from new vendors who provide the products and services to the citizens and public agencies. Alternatively, consumer demand for a product will greatly influence the policy making of officials. The increasing



Source: https://www.Canva.com

numbers of autonomous devices built for optimization, on the micro and macro scale, will press policy makers with the question, What to optimize for.

The International Society for Photogrammetry and Remote Sensing (ISPRS) states, "The holy grail of smart cities is an integrated, sustainable approach to improve the efficiency of the city's operations and the quality of life of citizens." – (ISPRS, 2017). Disruptive technologies will cause policy makers to make decisions about policies surrounding technologies used in public spaces either physical or digital. At Roadi, we have also helped design software that can detect freight vehicles entering low emission zones.

Applications that will have the most impact will come from artificial intelligence; electric vehicles; autonomous vehicles; mobile applications; drones; wearable and smart devices. Each one and their integration will pose a challenge for policy makers. They provide many opportunities for optimization and better decision making, but the continued advancement poses a challenge for policy makers to ensure the citizens best interests are accounted for while still enjoying the benefits of the advancements in technology. Consumer engagement, and consumer adoption are a critical factor in the policy decision. This breeds incentive for business owners to deliver compelling consumer goods. The authors of a research paper focused on consumer response to smart grids, found that, "they (consumers) displayed an interest in playing a much more informed and active role in energy decision-making," regarding smart grids the research concludes that, "More policy attention is needed on demand-side measures, introducing institutional and regulatory changes, and modifying relationships between consumers, the government and utilities."

Companies like Roadi which provide wayfinding technology for real time parking availability focus on the user experience of finding parking nearby their current location. Giving more attention to the user experience in public policy framework is more important than is a public health convergence or infrastructure framework. This is so because policy makers will be limited in implementing new smart city focused initiative if consumers do not adopt the associated technologies helps to increase the adoption of smart city application.

[5]The report from one smart city workshop observed "Team members agreed that the goal of applying smart cities technology is to significantly improve the quality of life for residents."

Bringing the concepts together

Intelligent Transport Systems (ITS) – (PR) an example of an infrastructure level framework that touches both public health and public policy and creates opportunities on the application level for vendors and consumers.

> ***"Applications that will have the most impact will come from artificial intelligence; electric vehicles; autonomous vehicles; mobile applications; drones; wearable and smart devices. Each one and their integration will pose a challenge for policy makers"***

Smart cities answer the question of what to optimize for, by optimizing for the environmental and economic health of the citizens. Public policy convergences want to improve transportation, economic mobility, and safety. A city optimizing for public health will apply technology more aggressively and seek system level tools that will support an infrastructure which can reduce the causes of poor public health. Intelligent transport systems being such an example.

An application level framework will likely be focused on the convergence of public policy needs. Here policy makers will implement department specific technology rather than whole infrastructure specific systems.

Regardless of which framework is adopted in the long run most cities will arrive at the same destination of having a deeply integrated and autonomous city.

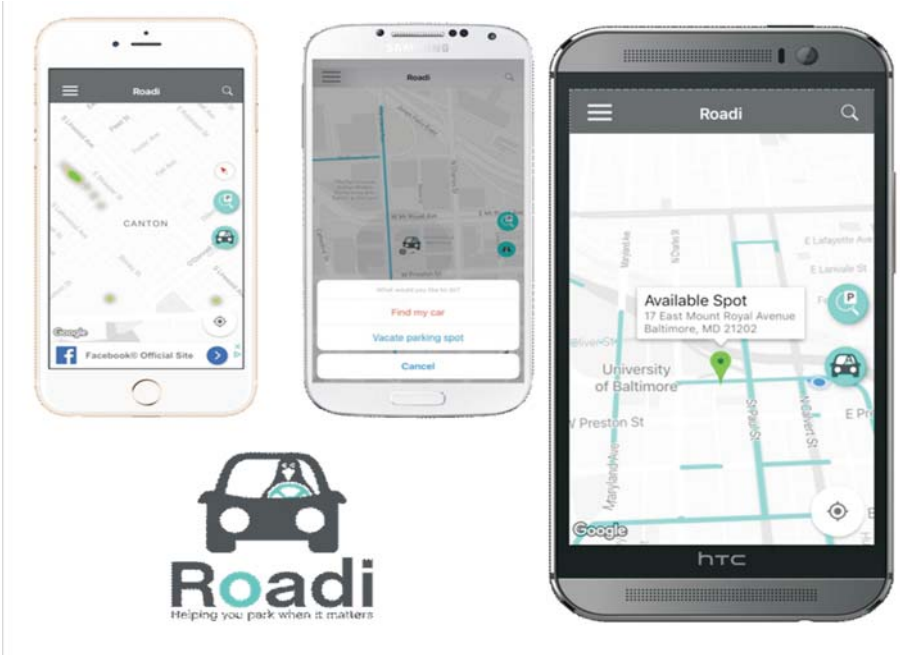


Figure: Roadi smart parking wayfinder display
Source: Opeyemi Thomas

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Startup Corner

Intellicar Telematics

Intellicar Telematics, an IoT & Big data company was set up in 2015 by Karan Makhija, Kaushik Raju, Shunmuga Krishnan and Sidharth Middela, with a vision to provide in depth analytics to help clients increase efficiencies and reduce downtime.

- Karan Makhija, Co-founder - focused on operations, business and product development
- Kaushik Raju, Co-founder - looks after the business strategy
- Shunmuga Krishnan, CTO & Sidharth Middela, VP Engineering - manages technology and product development

Kaushik Raju (L) & Karan Makhija (R)

The Team at Intellicar Telematics

The Genesis: The founding team decided to start a company that could position itself as one of the leaders in IoT and Data Analytics.

Moving forward: The Intellicar Telematics founders were keen to come up with solution that solves real world problems faced today. They believed in knowing how to tailor make a solution for different clients rather than assuming one size fits all as every company has different priorities. They decided to work with B2B first to ensure they address larger use cases and scale the product. This also made unique economic sense to go that way before they moved to B2C. In a short span, they have been able to prove as a valuable partner to leading companies in various sectors, from Self-drive, Taxi aggregators, Truck Logistics, construction equipment, Insurance and Mining, among others.

The journey so far and challenges faced: Talking about their journey so far, the team says that it has been tough but fun; they have had some ups and downs on the way but each step teaching us valuable lessons. Market responses has been quite overwhelming, and they are in the process of consolidating various opportunities. One of the biggest challenges they faced was moving the mar-ket from a simple track and trace solution to utilizing the power of data to enable businesses make more informed day to day decisions and develop long term strategies more effectively. Moreover, the team has successfully managed to sustain without any outside funds.

Business model: Treating all its clients as partners, the team at Intellicar Telematics believes in understanding their business and subsequently figuring out how to solve problems they are facing today and problems they may face going forward. The company's unique proposition is complete connectivity with clients' assets and predictive maintenance. Through proprietary algorithms, exact useful life estimation of parts like when a part is required to be serviced or changed can be predicted which can reduce consequential damages. Moreover, it can provide insights on how particular drivers are affecting the health and safety of a vehicle like vehicle health scores.

This allows its clients to efficiently use their vehicles while avoiding unforeseen breakdowns during travel, monitor fuel pilferage, plan better routes. Speaking about the data-driven business, Karan says, "There is a lot of noise in the market especially in the simple track and trace solutions. We are often compared to this, we believe in providing progressive and holistic solutions to businesses using the power of data."

Future plans

The company's future plans majorly include:

- To increase geographical reach and work with major OEMs around the world.
- To continuously evolve and add more products that solve real world problems.
- To be a world leader in the connected ecosystem space.

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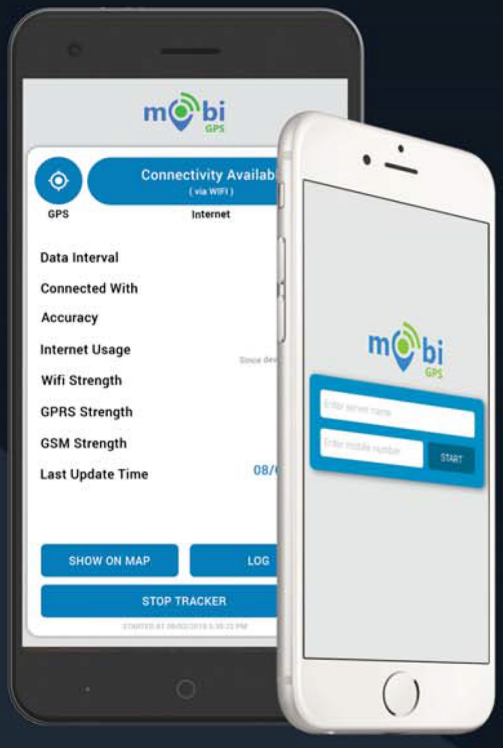

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