Vehicle connectivity is expanding at a rapid rate. In fact, according to Gartner, by 2020, there will be a quarter billion connected vehicles on the road, enabling new in-vehicle services and automated driving capabilities. Currently, automotive connectivity focusses on driver comfort, safety, enduring car automation and provides boundless business opportunities at various stages of connected car implementation. Implementation of this may surface various challenges, which need several catalyzing agents to enhance the connected car proliferation.

The three basic connected spaces – In-vehicle connectivity, V2X connectivity and cloud connectivity – are being driven by several factors during connected car implementation phases. While some of these factors would create new challenges, others would enable novel technological solutions to ensure the smooth movement of the connected world from one phase to the other. Advancements in technological areas related to safety systems, display, and telematics combined with the developments in V2X and telecom would result in newer solutions for safety and driver comfort. Technological progression can transform the existing limitations into opportunities and would require strong catalysts to bridge the gaps and produce effective integrated solutions for connected cars solutions.

Driver experience and comfort have primarily driven the need for status/warning data from various automotive subsystems, but the increased emphasis on vehicle safety has pushed the demand for better connectivity, enhanced data security, advanced safety technologies and integrated solutions.

Most of the vehicle safety and other connective business solutions are achieved by close integration of automotive subsystems (such as ADAS, V2X and Telematics) and there is a slow shift in the kind of integration from interdependent to cooperative subsystems of connected car. This trend is pushing the automotive world from standalone entities to cooperative and well synchronized entities, which requires meticulously architected embedded infrastructure & technological catalyzing solutions.

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To understand this further, let us analyze the connected car activities and the challenges cropping up at each phase, along with the possible catalyzing solutions.

The basic need of connectivity lies in efficiently analyzing and representing the data derived from various automotive subsystems. The lack of adequate primary level data & data consolidation methods which limited the possibilities of connected solutions have been addressed in the ‘Sensing Driving Phase’ by providing consolidated data from sensors and ECUs which might increase the overall cost of embedded infrastructure.

The solution lies in optimizing the cost of the embedded infrastructure (sensors, connecting elements) and proper integration of vehicle electronics, which is one of the key catalyzing agent. Some surveys indicate that the cost of in-vehicle electronics may increase by around 10% every two years, in order to meet the projected requirements of connected car. The ability to integrate vehicle electronics at the system and module level may help achieve cost optimization and may provide clarity on the progressive cost per feature. This needs be addressed by considering product/feature quality.
levels, which may grow from each phase of connected car.

Network service performance with 4G is a big catalyst and can help to add more relevant data to Telematics. Advanced Over-The-Air data transfer methods along with stringent data security measures would be indispensable for the future of connected cars.

Making consolidated vehicle data available at backend would enhance data analytics, providing business opportunities for OEMs, fleet/asset management and other services, thereby increasing the demand for improved connected infrastructure and better connectivity among the subsystems providing raw data for data analytics. Some surveys believe that a well-architected backend solution with highly reliable connectivity can supplement some functions of automotive embedded subsystems.

Ensuring the availability of relevant data from various sensors, ADAS, V2X and others for processing various safety applications would increase the demand for ECUs with higher processing capabilities and matured communication methodologies resolve the challenges of connected car applications, thereby paving the way for the ‘Cooperative Driving Phase’.

Though a cost center, it would also serve as an opportunity for the optimization and integration of best-in-class vehicle electronics. It would also pave the way for the deployment of platform independent software architecture with flexibility, modularity and scalability. A strong software architecture, with AUTOSAR would address these problems.

Sensor data collected from various sources may need to go through advanced fusion techniques for the accurate compilation of safety data. This data is critical for system level integration and address challenges posed by features such as adaptive cruise control, lane keep assist etc. These features will be more significant in the connected car context, when addressed with highly accurate position & localization data.

While the ADAS roadmap has been predicted up to the year 2019-20, the ‘Cooperative Connected Car systems’ roadmap plans are roughly being detailed around the year 2019-21. 5G will also be introduced in the market during this period. With most of the work related to connected car targeted around the same time, few of the challenges may be addressed but the industry may face several other challenges related to the technical stability of connected features/services, high cost of technology & products and most importantly the synchronization of these entities. Quality gaps at the systems level integration, insufficient value engineering activities, reliability & robustness of the vehicle data and accuracy of predictive & fusion solutions may be some of the core reasons for these challenges.

During this phase, overall cost of the connected solutions, specifically that embedded infrastructure in the vehicle may touch new heights. It is important that these challenges are effectively addressed, since this phase is vital and may witness complex scenarios, which can slow down the progress of connected car solutions.

In short, embedded capability enhancements along with cost optimization, system level Integration, position accuracy and data fusion techniques are the key catalysts to move the connected car journey to next level. These enhancements would create a perfect ecosystem for the various vehicle subsystems to interact and share their perspectives with each other. The phase (Synchronized and Cooperative Driving phase) where all the automotive subsystems would cooperate and synchronize with each other would create more meaningful scenarios for connected cars.

The consolidated data from the various cooperative systems would be subjected to superior predictive algorithms and trajectories, thereby addressing connected car features such as intersection assistance, VRU, cooperative adaptive cruise control etc. The implementation of these features
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In the next few years we will start getting data on the usage of autonomous taxi which has started running in limited and controlled manners in cities like Singapore. Automotive majors would start rolling out autonomous cars in next 3-4 years, conforming to SAE level 4, which would mark the beginning of a new era in automotive.

Is it an opportunity for India?
Yes, it is if we look at some of the benefits we have been reading and talking which will come with autonomous vehicle:
1. Reduce accidents
2. Increase mobility & reduce cost of mobility.
3. Logistics and transport to see the lowering of cost in long run
4. Decreased insurance cost or it may lead to insurance in new avatar
5. Free urban space
6. Modular mobility may encourage more people to opt for public transport

However, the bigger question is if we are prepared to go for autonomous vehicle? In terms of status of our roads & highways; ‘eco-system on roads’ in urban areas, which springs up with the city waking up; turf negotiation on clogged crossings or U-turns etc., we are different. Technically, I feel its a distant story, but government can seed the process where technical institutions and research centres can be encouraged to work on autonomous vehicle. Govt. funding should be provided to test such vehicle in our environment and results/outcome be discussed and shared as common learning.

Although it may not be easy to suggest a city or state which will be suitable for test run of autonomous vehicles, which has so far had test run in North America or Europe or other high income economies, but we can have urban pockets or localities which can be used for testing. Remote and sparsely populated regions may also be considered for pilot projects.

Are there any impediments for autonomous vehicle in India?
There are many hurdles which needs to be cleared before the vehicles run on road on their own. Sensors - LiDAR and optical has to be permitted for use on vehicle which is also fitted with positioning system. Because going by the recent draft Geospatial information and Regulatory Bill(issued by Ministry of Home Affairs), such act may be prohibited. Even if they are allowed, the data collected would need clearance from Ministry of Defense. As any data which has geographical location along with photographic image or LiDAR profile will be considered a geospatial data, requiring it to be cleared by the ‘data vetting committee’ in MoD before it can be used. The regulatory agencies may come up with specific guidelines for autonomous vehicles, which can be permitted for government agencies and research centres.

Vehicles need to be aware of the environment through comprehensive and updated 3D maps. But in our context, companies like Here(earlier Nokia) and other have been struggling with their request to create 3D maps, but we are yet to come with specific instruction whether we are going to allow creation of such 3D maps for public use. Industry players like Google, MapmyIndia and others are waiting for further clarity before they invest in 3D maps.

Why do we need policy for autonomous vehicles?
Although it has been often argued by the industry that new technology segment should not have regulatory framework kicking-in from the beginning, but here its not about regulating it, but more about removing impediments, which may prevent uncalled for hassle during test run of an autonomous vehicle.

Can driver assistance and active safety system be a stepping stone?
The recent bill, Motor Vehicle(Amendment) Bill 2016, which has been approved by the cabinet and introduced in the Lok Sabha, addresses many issues including those which concerns road safety. From ‘passive safety’ point, it will add ‘sting’ in the form of steeper fines, to deter voluntary violators.

But the big question is- Can increased fine help reduce the accidents and loss of lives?
No. Passive safety has its limitation. One needs to look into active safety measure which are already giving results in high income countries.

Semi-autonomous vehicles or those with assisted driving technologies can help reduce the vehicle accidents by substantial percentage. This would mean saving of precious lives and also capital cost saving for the nation. Savings of lives, which mostly are in the productive age. Road accidents accounts for the highest loss of lives amongst the people aged 15–29 years (Source: World Health Organization, Global Health Estimates, 2014); more than loss of lives due to HIV/AIDS, Diarrhoea, heart disease etc. in this age group. Middle and low income countries have just 54% of entire vehicular population, but account for 90% of road accident death. (Global Status Report on Road Safety 2015). If we look at our own figure, accidents kills 400 people everyday leading to 3% of GDP loss, compared to 1.5% in other middle income countries.

High income countries have been able to reduce on an average of 54% accidents between 2000-2013, making a serious case for effort needed in ‘active safety’ space. Its time we move beyond mandatory seat-belts or optional airbags to active safety features.

Till the time we are able to bring down the loss of lives on roads, someone will be morally held accountable for it.

Maneesh Prasad
Navigating through The Telematics Ecosystem Quagmire

It has been exactly a year since my last interview on the Connected Vehicles in “Smart Automotive” in Sept’2015 where I had spoken about the challenges towards the mass adoption of the connected vehicles solutions and also my personal view on the subject that it is just a matter of time that the connected vehicles will become a mainstream in India. I had mentioned that though there are many aftermarket solution providers, it will take strategic call from the OEMs to make telematics an integral offering in the vehicles (especially commercial vehicles) where it would not only benefit the customer for bringing in more efficiency but will also help the OEMs in a big way through the insights (Data Analytics) that can be available to better the service offerings & product designs and also that we (Mahindra) are shortly going to introduce our own Connected Vehicles solution in the market.

I would restrict my views in this article mainly from the lens of an OEM/consolidated player. In the last one year we have seen a couple of market launches from the OEMs in India (Honda & Mahindra) and some works are in pipeline from other OEMs.

Honda introduced their Connected Vehicles solution for their passenger cars in Dec-2015 and created a lot of initial buzz by pitting it as an exclusive offering. Honda offered an OBD based dongle and a mobile-app based solution at a discounted price for the initial few customers with a trial for one-month post which the customer was expected to pay one-year subscription charges. It offered introductory features with location tracking and to some level integration with service related features, more in the realm of convenience based features.

On Aug 26th 2016, Mahindra & Mahindra launched its homegrown Connected Vehicles Platform “DIGISENSE” becoming the first OEM to leverage one integrated technology platform for connected vehicles across a wide range of mobility products, tractors and businesses which is multi-application and multi-product enabled. DiGISENSE will initially be available in the Jeeto and Imperio in the small commercial vehicles space; the Arjun Novo in the tractor space; the Mahindra Blazo in the heavy commercial vehicles space; and the Earthmaster in the construction equipment space and will eventually be available across the entire line-up of Mahindra’s vehicles.

Exclusive v/s Inclusive
Unlike many connected vehicles solutions in the industry that are positioned as an exclusive offering in the passenger cars space or closed telematics systems, Mahindra has taken the strategy to make it a more inclusive solution. By inclusive I mean keeping in view the bottom of the pyramid where such a solution will make the maximum impact and including it in the breadth of its mobility portfolio (CVs, Off-road vehicles & Tractors). M&M has chosen to provide value to businesses first by addressing the direct customer needs impacting their businesses and bringing in the relevant features to address the need gap. The inclusivity also stems from the fact that M&M is holding the entire responsibility of the solution through a factory fitted telematics hardware (instead of a dongle or aftermarket hardware) and orchestrating the entire ecosystem by including various partners (Bosch, TechMahindra, Vodafone, etc. to name a few) and providing tailor made solutions to suit the various customer segments/needs (Fleet Owner, Driver, Dealer, Service Technician, etc.).

This brings to the fore an important point – as to what to consider as the ecosystem in this domain. In my view, a comprehensive telematics solution is impacted by the following key considerations which I term as the ABCs of the connected vehicles ecosystem:
A. Affiliate Ecosystem
B. Business Ecosystem
C. Customer Ecosystem

A. Affiliate Ecosystem
The telematics solution shave moved away from just being a black and white transactional offering to a more colorful interplay of the entire spectrum of technology affiliates/stakeholders. It is no more in the capability of a single solution provider to be able to build it in entirety. It has become imperative that it needs an orchestration of the complete ecosystem for a successful solution.

One of the most critical player in the affiliate ecosystem is the Telecom service provider, who not only has the responsibility to provide highly reliable connectivity under all conditions
& geographies, but also provide a comprehensive M2M platform (to monitor the SIM and data usage & other functions) that empowers the solution provider to offer most optimal solution to the end customer. Compared to earlier days, this is now fast changing in India with Vodafone leading the pack with a home grown M2M platform and others catching up through partnerships with established global players. The other key players in the ecosystem are the Technology enablers who have a variety of choices available on hand to provide the end-user applications (web/mobile, etc.). There are umpteen choices available today in terms of the application technologies and at times it is difficult to make a decision as to which one to pick. The rate of obsolescence is so high that by the time a solution is stabilized, the technology/version would have got upgraded and the applications break down in backward compatibility. To add to the complexity, this is also marred with the challenges of compatibility issues between various technologies (Java, .NET, ASP, etc.) at different interfaces. The need of the hour is to choose an approach where the feature functions implementation and technologies are loosely coupled so that they are not only able to withstand the changes but also be able to provide seamless upgrades to the customers without major impact on the existing applications/business logic and avoid extra costs.

The Cloud forms another important piece of the puzzle and thankfully there are several cloud and IoT platforms at disposal that offer a very good performance and scalability. One just has to make sure that the data servers reside in the country of origin in order to avoid any regulatory/compliances issues. The availability of 3rd party affiliates is growing by the day – with many more entities and startups coming up with very innovative ideas and value added services. The challenge is to provide an open platform where these services can be easily plugged-in and convert them into sustainable value propositions & business models.

The suppliers of the telematics hardware solution have now matured are able to provide very robust hardware systems that the OEMs can rely upon and in certain cases also provide grounds-up development from scratch to meet the OEM’s requirements within acceptable time-to-market.

The issues of maintaining interoperability (IOP) and compatibilities with various mobile devices is always a challenge with the growing number of mobile device manufacturers and variety of models around. However, with the usage of the standardized hardware configurations, this is slowly moving away from the limelight.

B. Business Ecosystem

When a telematics solution comes as an offering from an OEM stable, then it is not enough to sit tight on the feature offerings without integrating with the business processes. For example, in case of a breakdown alert arising from the system, the customer value proposition is not fulfilled until the entire service chain is not able to respond within a few hours with the right fix for the breakdown at the location. The entire chain had to be activated to be able to provide a timely response & resolution.

The key lies in creating a compelling value proposition for the customers to use the features on a sustainable basis. The Connected Vehicle platforms can provide exponential value through integration of the entire business ecosystem namely the Service management systems, Dealer management, Spares management and the Call centres, Customer databases, Sales databases, etc. that can pipe into one single CRM window for the OEM.

The OEMs can bring in tremendous value by seamlessly integrating all the business processes/systems, not only to the end customers but to the various entities within the organizations by being able to provide lots of insights about their vehicles and customers. Starting from Product Planning, Marketing teams to R&D teams and Service and Spares teams, everyone can benefit from the insights that the Telematics systems can provide. Very often the OEM teams get bogged down by the costs and investments required for scaling this up and understandably so since the Indian market & customers are very cost sensitive. However, the real potential of
a comprehensive telematics platform can be harnessed only through a seamless business ecosystem and this needs to be backed by a value oriented thinking rather than cost oriented thinking.

C. Customer Ecosystem

The third and most critical aspect is the Customer Ecosystem. Though the core elements of a telematics solutions remain the same across, but the application and the context in which customers utilize these vastly differ. There are a variety of applications where the telematics solutions can be applied, be it fleet management of inter-city load carriers, intra-city distribution, security vans, e-commerce vendors, food-supplies, logistics, school-buses, public/private transportation, personal convenience, etc. Each context has a unique requirement in terms of business needs and performance parameters. The customers in these business look for the specific enablement of their needs and this is the reason why you see so many scattered solutions and players in the aftermarket. For a consolidated player to be able to meet this need, it is imperative that they have to provide a platform that is highly adaptable& flexible and which gives full control to the customer in terms of defining and monitoring their specific business needs.

The success of the telematics business lies in being able to positively impact the bottom-line sensitivity of the customers and their impacting touchpoints. The customer should feel the empowered and be able to control the way their business gets enabled through a solution which can be fully configurable.

At M&M we have considered most of the above elements while solutioning the DiGiSENSE platform. The initial features available are just beginning of the journey that have been carefully selected keeping the various customer needs in mind.

DiGiSense: Mahindra & Mahindra's technology platform

Mahindra & Mahindra’s DiGiSense connects M&M vehicles, tractors, trucks and construction equipment to the cloud. The integrated technology solution will empower Mahindra customers to digitally build knowledge 24X7 about the performance and location of their mobility products and tractors.

With DiGiSense, drivers can contact emergency breakdown services or pull up a route planner at the touch of a button and fleet owners and dealers can track the location of their vehicles in real time. The remote diagnostics and reports allow service teams to monitor the vehicle’s health and productivity parameters on a real time basis. The solution will initially be available in the Jeeto and Imperio in the small commercial vehicles space; the Arjun Novo in the tractor space; the Mahindra Blazo in the heavy commercial vehicles space; and the Earthmaster in the construction equipment space.

Imagine yourself a couple of years in the future...you are driving yourself home, only you are not really driving, but you are steering a car that is automatic, and is mostly driving itself. The gear shift is automatic, the speed is set to a pre-determined level, and all you really need to do is steer gently.

As you get close to your apartment complex, the car sends out an automatic alert to the security staff to allow you to enter, while your smart phone alerted by your GPS location automatically gets the air-conditioning switched on. At this point in time, it may seem a bit like a scene from Star Wars, but in actual fact, the technology is in place, and the expectations from automobiles, is far more driven by electronics than mechanics. This is turn obviously has a huge impact on the eco system that drives the industry. A clear parallel is the IT industry, where Microsoft and other such major PC manufacturers are scrambling to find a place in a market that is evolving at a supersonic pace. Physical storage space is no longer of any consequence, as storage has shifted to the cloud, and both business and shopping are now done by smart phones. Like the Dinosaur, those that do not evolve, perish.

Automobile companies are slowly awakening to the fact that the manner in which cars are being made is changing rapidly from the mechanical to the digital. Where they are in for a rude awakening is the fact that the way cars are being bought is also changing rapidly. Car showrooms as they exist today, would largely become distribution points where people pick up vehicles that have been researched, bought and paid for vide the internet.

It would make a lot of sense for car distribution companies to move their heads out of the sand, recognise this fact, and begin developing superior websites and internet platforms and payment gateways, rather than fancy showrooms.

To respond effectively to a changing market, and stay ahead, traditional auto makers and sellers will need many digital capabilities. These will include digital sales and marketing, multi-channel customer engagement, and the ability to package and deliver digital products and services. In the operations sphere, they’ll need data and content management skills, along with the ability to manage digital infrastructure, protect customer identities, secure information systems, and manage service-oriented technology, while overseeing a digital operating model and numerous outside partnerships. To hold their own in the Internet of Things, auto makers will need to manage sensors and connected devices, create mobile-to-mobile services, and analyse reams of data generated by autonomous vehicles.
Ecosystem of Telematics

The most important change will be cultural. The automotive industry culture has always been supply-driven — companies push products into markets and try to persuade people to buy them. The focus is on shaping buying behaviour to fall in line with what the companies produce. On the other hand, Digital companies cultures, respond to customer demand - their major spend is on advanced technology and analytics to meet rising expectations. Marketing spend is extremely low.

The other major change stems from the fact that currently auto companies have analog cultures. They have a slower decision making process and multiple layers of hierarchical management. They are ruled by systems and processes, which in large measure have not changed since the inception of the industry. To graduate to being more progressive, auto companies would have to adopt a more digital culture, with flat hierarchies that speed up decision making. The focus would have to shift to result over process, and workers would be empowered to innovate, knock down barriers, and achieve goals. The ideal worker would have vision, curiosity, flexibility, and motivation. Collaboration would become critical, with mixed teams from various functional specialities working together on projects. This reflects the dynamic tech industry, where change is rapid and unpredictable, innovation essential to survival, and quick action critical to victory.

Obviously the key to staying ahead of the pack would be to meet customer demand in a way that is both unique and technologically advanced. Once the technology has been perfected, the OEM would need to build the capabilities to create this type of vehicle at global scale, even if it means selling under other brands (as long as you control the arrangement), try a variety of digital ventures that can unlock data value: and most importantly, move from a transaction-based business model, selling cars, to a service-led setup in which lifetime customer acquisition becomes the primary goal.

For volume auto makers, it would also be necessary to find a viable economic equation: a way to offer the right digital features to the right customers in a way that integrates you into this new world with affordable prices. They might look to share the R&D burden with other companies through smart cooperatives. Other ways might include launching their own digital ventures, to unlock data value. OEMs will have to find ways to remove bureaucratic blocks so they can unleash creativity and practice frugality at the same time. The ultimate goal will have to be to shape and support mobility ecosystems and design cars for the shared-vehicle drivers of today and the driverless passengers of tomorrow.

In the future, consumers will want the flexibility to choose the best solution for a specific purpose, on demand and via their smartphones. Therefore the importance of private-car ownership will be declining. This is already obvious in the USA where the share of young people (16 to 24 years) who hold a driver’s license has dropped from 76 percent in 2000 to 71 percent in 2013, while there has been over 30 percent annual growth in car-sharing users in North America and Germany over the last five years.

At the same time, the objective is not necessarily to be the company with the most cutting-edge connected car. Those that are first to bring this technology to the market will need to balance their own R&D with cooperation- and platform-based innovation to avoid the “winner’s curse” of ultimately losing out to competitors that improve upon the technology. Apple has rarely been the first to innovate, but has a record of success in scaling up technology that others have originated. Being best rather than first is even more important when the product is an automobile which carries people and puts their lives at stake.

In a way the connected car is the leading edge of disruptive technology as it is changing not only the automobile, but the nature of the automotive industry as whole. As connectivity paves the way for autonomous driving, digital content and services have become the industry’s primary source of growth. More fundamentally, OEMs oriented to their traditional role as product manufacturers must embrace a new identity as service providers. Those that can make this shift — while providing the security assurances consumers demand — will flourish in the digital era.

With this paradigm shift to mobility as a service, along with new entrants, traditional car manufacturers will be ultimately forced to compete on multiple fronts. Mobility providers (Uber, for example), tech giants (such as Apple, Google), and specialty OEMs (Tesla, for instance) increase the complexity of an already competitive landscape. Traditional automotive players that are under continuous pressure to reduce costs, improve fuel efficiency, reduce emissions, and become more capital-efficient will feel the squeeze, likely leading to shifting market positions in the evolving automotive and mobility industries.; potentially leading to consolidation or new forms of partnerships among incumbent players.

Therefore it’s not surprising that the recent conflict between VW and one of its suppliers which led to a production stop at VW might been more than just poor management. It could also be seen as a sign of how relationships between traditional suppliers and OEMs might change and how disruptive new supply chain management processes can be. In fact in the future it is extremely likely that suppliers from the telecom and IT industries will ultimately change the way business is done in the automotive industry.

Markus Pfefferer
Managing Director - Asia Pacific
Ducker Worldwide
Ducker Worldwide, is a consulting and research firm. It is headquartered in Troy, Michigan, with offices around the world including Bangalore, Berlin, London, Paris and Shanghai. Founded by William H. Ducker in 1961 Ducker celebrates over 55 years in business.
Automotive Telematics Ecosystem: An open system approach

With cars becoming more affordable and limited road infrastructure, the urban transportation landscape is becoming more congested. Pollution and associated social issues are taking a center stage. In this changing environment, it is becoming important that the data collected by the connected system is not only used to improve operational efficiencies, provide on time deliveries and safety services, but evolve new services and business models.

It is also becoming clear that a single operator or service provider will not be able to understand the needs of the complete ecosystem, let alone build all the required applications.

Today, most of the telematics players have a closed system. This puts the onus of understanding and developing the applications on the telematics service provider (TSP) and/or customers. This is not a viable option as many TSPs and customers may not understand all the requirements of a business.

The open framework approach will enable a host of third party application developers to develop diverse application which may not necessarily fall in the domain of the end customer or telematics service provider. For example, anonymous data from a particular section of a national highway can be analyzed to suggest the best location to open a restaurant on the highway. Depending on the nature of traffic (commercial, passenger), the nature and type of restaurant can be different.

Similarly, select private data (only the arrival/departure info and mileage) from a logistics provider can be shared with dealer service agency. The service agency can monitor the arrivals of vehicles at hub locations and the mileage clocked by a vehicle. This will reduce service costs and vehicle downtime for the logistics company. The same private data (trip information + goods manifest) can be used to optimize the transportation cost.

The need of the hour is an open system which allows various stakeholders to interact and utilize the data in a meaningful way, while maintaining security and privacy; and at the same time providing flexibility to each of the stakeholder to innovate and differentiate services.

**Open Platform approach**

Figure 1 depicts a framework for an open architecture. The proposed architecture comprises a 3 Tier system of components. The interfaces at each layer are defined and standardized.

1. **Tier 1: Data Collection Agent (DCA).**

   The interface to the communication gateway can be an open standard. However, the data can be encrypted and secured for privacy. This will allow multiple on-board-units (OBU) suppliers to talk to a particular server in a seamless fashion.

   The data collection agents may source data from:

   → **OBU:** For instance, a small fleet operator who has installed aftermarket OBU can directly talk to the communication gateway and an OEM can have its own private server to talk to the OBU.

   → **Secondary data collection agent:** An OEM can have its own private data collection agent to talk to the OEM installed OBUs. The data collected
from the OBUs can be filtered (any vehicle specific private data) by the secondary data collection agent. The filtered data can be forwarded to the main telematics server. This hierarchical approach allows for easy data segregation and protection.

2. **Tier 2: Data Storage and Management Layer.**
Data coming from various sources is archived in a uniform format in a central database. The archived data is segregated into:

- **Private data**: Private data can be accessed by specific customers who have access rights. The data should be further secured to address certain sensitive applications (like data from cash handling vehicles).
- **Anonymous Data**: Data from various OBUs should be appropriately mapped to generate anonymous data. The anonymous data can be used for various third party application developers to serve niche markets.

**Commercial models**: The open frameworks allow for easy adaption of various commercial models. The data can be shared by customers based on various commercial models. In a simplistic model, a customer has the option of not sharing his data (private data) and pay for all the services; or alternatively, he/she can share the data anonymously and get a discount.

There are few open telematics frameworks available, but most of them operate at Tier-1/Tier-2 interface layer. For example, a number of telematics platforms can operate with multiple different types of OBUs. However, the real benefit will come when the Tier-2/Tier-3 layer is made open.

The key challenges in implementing an open system is primarily the apprehension of customers about data security and commercial interests (who should make more money? application providers or data aggregator).

With the development of ever present data connectivity (4G and beyond), and penetration of connectivity components in a vehicle, it is becoming increasingly important to design open systems without compromising security and privacy. An open system will allow multiple players to interact seamlessly widening and improving the ecosystem.

Connected vehicles will become a reality very soon (with launch of V2X and smart city projects). The connectivity will drive a host of applications and services and will change the way the entire mobility ecosystem works. There will be entry of new players and some of the existing players will have to change their business and business models.

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**Delphi to begin testing robot taxis in Singapore**

Delphi will begin testing autonomous autos in Singapore this year that may lead to robot taxis by the end of the decade. The project has been introduced in partnership with the Singapore Land Transit Authority, where the company begin testing vehicles in order to make them commercially viable in near future. The test rides will include six autonomous autos, starting with the modified Audi Q5. Delphi’s vice president of engineering Glen DeVos said in a statement ‘that a cab ride in a dense urban area can cost $3 to 4 a mile.’

The company is trying its best to eliminate drivers from its vehicles and will develop software that lets commuters call them. Initially, the cars will travel at slow speeds along predetermined loops of about 3.5 miles (5.6 kilometres), with a human driver ready to take the wheel if needed.
Automotive Telematics Ecosystem

Bhuvan Anandakrishnan
Director of Electronics Department
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Telematics has grown in the last several years resulting in touching almost every industry that we know of. A technology of this magnitude goes through rapid evolution and thereby resulting in rapid changes to its ecosystem. Putting together such an ecosystem for the automotive industry that is evolving at a similar pace can be seen as solving puzzle with no defined output.

On-Board Electronics

With electronics making its presence in every part of the automobile industry, the amount of data available from a vehicle is enormous. Handling such huge dataset requires some robust electronics; a box that could talk all languages with other controls on the vehicle and have good storage space is essential. CAN, Ethernet, Bluetooth and Wi-Fi could all be supported, yet it is important to keep the hardware modular enough to suit the different applications or market segments the vehicle would serve, by keeping the cost under control. For example, supporting satellite communication on passenger vehicle is baseless; but supporting Bluetooth to talk to On-board infotainment system to collect passenger’s music taste to provide a jukebox radio solution is creating new market! Hence creating a product line of devices with varying hardware capabilities provides end applications (vehicles) select the Telematics solution based on the market they intend to serve.

Getting the data back

Collecting and storing the data, is the main part of the puzzle. Transferring the huge data collection from the machines to data centres can be done through cellular, satellite network for the automotive world. Offloading the data at Wi-Fi hotspots could also be a solution for fleet applications like Taxi services. Data transfer cost, overall load on the network and the gateway needs to be considered while designing the system. Data mulling using vehicle to vehicle communication could be an effective solution in terms of cost and load on the system. Another idea could be creating an off-board tool that can download the data from the vehicles locally over wired or wireless (Wi-Fi or Bluetooth) mode, which can later be uploaded to back office. Key to this would be a proper design of the localized tool; customer should see the benefit in using the tool and also in uploading the data to OEM’s data centres. For example, uploading the vehicle data to customer should be through a cloud back-up service, in order for them to access across their multiple mobile devices at the cost of one subscription.

System can’t be successful. It is important to decide what type of data is necessary for what application. Subscription based model could help in achieving this. Subscriptions can be defined based on the type of application the vehicle could be put to, yet it should be scalable to define new subscription as the system evolves to cater different market segments. It should be noted that, design of on-board systems should take care of the subscription strategy, including scalability to make the final integration smooth.

Archiving the data for long term usage is the next piece of the big puzzle. It involves selection of proper cloud service with storage solutions and accessibility to develop different front solution and / or integration to custom ERP solution.

Putting it to use...

Once the puzzle of getting the data and storing it is solved, next tough job is presenting the data and features to the customers, based on the application. Customers do not look for all the technical details, but only the key points that could help them in their business or usability. For example, a Taxi service operator will look where are his/her equipment, their health and a way to disable them on the fly. He doesn’t need the Latitude, Longitude values but only needs to visualize the equipment on map. For an independent owner of the vehicle, front end solution could be a web service providing all the information about his / her vehicle, like maintenance history, service recommendations, and upgrade option for next car. Mobile application based solution would be best suited for passenger automobiles, especially for requesting support during emergency. Integration to service replacements, parts sales and other aftermarket products/ solutions would improve the business for OEM and also improve the user experience for customers.

Front end solution are not limited to customers only. OEMs can create a data visualization service for their marketing team to easily decipher the vehicle’s usability; create marketing strategy and better sales pitch for the next car or upgrade for the user. Combining it with analytics, engineering team could

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At the vehicle level, clear differentiation between the data network and control network could protect the vehicle."

Often, we are greedy to collect all the data, but without proper strategy and design on how to use the data both for OEM & Customers’ benefit, Telematics
Improving safety outcomes and enhancing customer experiences through reliable Automotive Telematics

The Indian auto industry is one of the largest and most competitive industry in the world. A $74 billion industry in 2015, the Indian automotive sector accounted for 7.1 per cent of the country’s Gross Domestic Product (GDP). By 2026, it is expected to achieve a turnover of $300 billion-clocking a CAGR of ~15 percent (Society of Indian Automotive Manufacturers). Driven by the consumer’s digital lifestyle and enabled by the interconnectedness of everything; the Indian automotive sector is also getting disrupted rapidly. Automotive telematics, in simple terms, is the integrated use of telecommunications and informatics applied in the vehicles, providing required information while the vehicle is on the move. With the advent of Internet of Things (IoT) enabled “connected car”, the vehicle turns into a hub for an entire ecosystem of connected services that offers consumers a wealth of benefits. And this in turn has led to a creative disruption between consumers and automakers, consumers and vehicles and among the traditional and non-traditional participants in automotive ecosystem.

As a result, the in-vehicle telematics has now matured from being a luxurious option in the past to a bare minimum customer expectation today. The scope of telematics has surpassed safety and security requirements as the automakers are now focusing on meeting the consumer expectations by enabling telematics around hands-free calling, geo-fencing, turn-by-turn navigation, mileage reporting, accident recording, fuel economy, usage based insurance, vehicle firmware upgrades, vehicle diagnosis for predictive maintenance and infotainment etc. We are also seeing a lot of traction by the government in the area of intelligent transport systems in India with initiatives taken towards digitization of vehicular information to improve driver and passenger safety. All these developments are driving the telematics market upwards in India which is predicted to scale $113.7 million by 2018 (6Wresearch).

The state-of-the-art telematics tracking systems are helping manage

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availability, access, and use of vehicles for the large fleet operators in verticals such as logistics, distribution, mining, construction, and transportation. This is also benefiting the emerging vehicle rental model market players such as the Uber, Ola and others with the data analysis which can dramatically help increase business efficiency as the system uses telematics to capture data from moving vehicles and enable remote operational control such as activating and accessing vehicles using Radio-frequency identification (RFID) or a smartphone to track and record journey data for ensuring passenger and goods safety and also proper billing. Telematics also enables anti-theft features, tracking the location of the vehicle and an automated interface with law enforcement agencies reduces the response time which eventually leads to reduction in vehicular theft numbers.

As connected vehicle management solutions become more prevalent, both the automakers and large fleet owners are finding ways to enhance their services to customers and generate new revenue streams outside the original scope of their businesses. For example, certain solutions designed for delivery route optimization have proven themselves as outstanding compliance engines for both the government and corporates. Cargo tracking solutions have become customer service engines. Driver monitoring solutions have improved driver retention and training programs. Geo-location of commercial vehicles, teenage vehicle geo fencing and public safety has improved emergency response times.

However, the above benefits can only be realized once an advanced and secure technology infrastructure to support Automotive Telematics is in place. That is, ubiquitous connectivity with wide area coverage and faster streaming capabilities such the one provided by LTE/5G is essential. It also needs systems which can seamlessly manage a constant flow of data extracted from multiple sensors in the vehicle, send this data for processing through a Cloud platform, and then to the back-office for real-time analysis and relay of meaningful information to the end user. Aeris, being a pioneer in machine to machine technology has a flexible Telematics Services Platform with a modular architecture which allows for rapid and cost effective scaling. The distributed processing architecture delivers speed and responsiveness for delivering the best customer experience. Aeris can work with any cloud-based solution provider and ensure a fully integrated and scalable service delivery platform that includes,

- **Complete account creation and management services**
- **Readily integrates and connects with vehicle**
- **Smartphone application delivery**
- **Easily integrates with OEM CRM, marketing, portals, and communications systems**
- **Comprehensive customer care tools**

In conclusion, we see both Indian consumers as well as the automotive giants leveraging the advanced technology and adopting automotive telematics solutions at a faster pace for reaping social benefits towards road safety and also improvements in economic efficiency. The scale and success will be largely defined by the technology in this field. Hence, it is imperative for the automakers to partner with experienced IoT solution providers and invest carefully in the right fit automotive telematics platform.

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**Automotive Evolving an**

**F**rom the dawn of human civilisation, mankind’s predominant pursuit has been for connectivity. While the dream for physical connectivity dominated for thousands of years, the electromagnetism (EM) based connect is a much more recent pursuit. Today we have extensively connected systems, generically called the Internet. In the last decade or so, with the second wave of internet, we have ubiquitous mobile devices now, greatly harnessing on the potential of EM or wireless communication. This perennial quest for connectivity has brought us to a juncture where we are ready to step up to integrate and connect our vehicles to the Internet. We have “smart cars”, that communicate and collaborate with other smart objects on the Internet. Vehicular Telematics is about this and much more.

Telematics is in fact a watershed for the developments that have taken place in various disciplines and fields over the last few decades. Cloud Computing and Server Virtualization, Machine Learning and Artificial Intelligence, Big Data Analysis, Navigation Satellite Technology form critical subsystems in the telematics ecosystem. With the paradigms of Connected Cars, the Advanced Driver Assistance Systems (ADAS), and Self Driving vehicles, we are seeing emerging metasystems or “system of systems” in the field of telematics.

In the larger space of Internet of Things, Automotive or Vehicular Telematics leads the race. This is because the features that Telematics brings to the table, Safety, Security and Productivity, have found their applications best in this domain. The general public concerns like driver safety and road accidents have strongly fuelled the adoption of telematics solutions by automakers. And thus a sharp contrast between the adoption in automotive vis-a-vis other sectors.

Telematics in general is marked by the presence of several key stakeholders. This is not surprising owing to the fact that Telematics has emerged as a highly intersectoral technology. Some of the
Telematics in India: Organic Ecosystem

natural stakeholders in this space, specifically pertaining to automotive, are:

1. Telecom Sector
2. Navigation Satellite Systems
3. Automakers
4. OEMs and ODMs
   → Automotive Component Suppliers
   → Independent Telematics Unit Suppliers
5. Auto-repair Service Provider
6. Firmware Companies
7. Cloud Service/IT Infrastructure Providers
8. Web Mapping/GIS Service providers
9. Automotive Software Providers
10. Big Data Players
11. Content and Infotainment Providers
12. Insurance
13. Governments

While the many critical subsystems of the telematics space bring great advantage to it, the challenge remains in evolving cohesion between these players. This is easier said than done. In this article, we will explore ways in which this synergy be achieved in the Indian context.

The adoption and integration of telematics solutions have attained certain maturity in the West. We see a number of B2B & B2C applications in this domain and a general adoption and acceptance by all the players involved including the end customer. For instance, Usage Based Insurance has become mainstream in the West. In India, however, the concept of telematics is still at a nascent stage. It is mostly confined to Track-and-Trace and the applications are sold B2B. There is no significant traction yet on the B2C front. For the Indian customer, telematics solutions rank much lower in the wish list of what they wish to see in their automobiles. However, recent surveys show a positive sentiment among the Indian customers in the adoption of telematics solutions. In a 2014 consumer survey conducted by Deloitte, over 48% were willing to pay for telematics solutions in their vehicle [1].

The key stakeholders have both the advantage and responsibility to play a critical part in evolving an organic ecosystem for telematics in India. The central and state governments in India should promote and regulate the sector. Currently, the Center for Development of Telematics functions as a wing in the Telecom Technology Center in the Government of India. Both empowerment and independence is needed for this body on the lines of TRAI (Telecom Regulatory Authority of India). The scope of its functions should expand to promotion, regulation, and development of the telematics sector. Though the telematics sector is enabled by telecom, it has to find its progress independently.

GSM Network plays the most critical role in connecting the Telematics Units with Cloud. Even with a mobile subscriber base of 240 million, the GSM network is often patchy in India. The coverage gap exceeds 50% in most North East and Central Indian States. And even where there is mobile network, poor signal and packet drops are a commonplace. This prevents governments to seamlessly adopt telematics solutions as general policies. And businesses with operations in these areas too find difficulty in adopting telematics solutions. This also discourages the automakers to adopt pre-assembly telematics integrations in the Indian releases. It is unlikely that an automaker would risk to lose the rural market in pursuit of a value addition for the urban market. Needless to say, strong mobile coverage is a great enabler for successful telematics solutions in India. With Digital India and Broadband Highways programs, we can expect significant improvement in the telecom infrastructure in the coming years. The Universal Service Obligation Fund (USOF) currently sources telecom infrastructure in parts of the country where private players do not find operations profitable. Active contributions are needed by both private and public players to bridge the coverage gaps.

The poor or no mobile networks affects most telematics solutions but not all. A logistics company can replay the route taken by its automobiles at the end of the day even if there were a poor or no GSM network. All it needs to do is to capture the real time locations and store it onboard and transmit it only when it finds a signal. The firmware players in India now have these well tested solutions. But most telematics solutions would need real time processing of this data. An infotainment solution to access reviews on nearby hotels on your way back home from office requires V2I (Vehicle-to-Infrastructure) solutions delivered almost immediately. In addition to contributing to the expansion of mobile coverage, the Indian telecom companies have another role to play. The nascent and mostly urban telematics industry needs cost effective M2M (Machine-to-Machine) Data Solutions. With the largest cab aggregators in India adopting telematics solutions, this makes business sense to all stakeholders.

India is no exception to another universal problem in telematics - the lack of standardisation in protocols. This greatly hinders interoperability. For all the stakeholders to work in synergy towards a common objective, this is a prerequisite. The NGTP or the Next Generation Telematics Protocol, claimed to be a technology neutral approach, needs to still find its ground among the huge base of stakeholders involved.
ECU Convergence: How it will change the shape of the automotive telematics and infotainment ecosystem

Traditionally, the automotive industry has introduced an Electronic Control Unit (ECU) for each major new function. This means that separate functions such as the head-up display, infotainment system, instrument cluster or driver assistance require a distinct processor each. As a consequence, most modern cars will contain at least 30 to 50 ECUs, leading to increased complexity and inefficiencies.

The automotive telematics and infotainment ecosystem is beginning to change, with vehicle manufacturers searching for cost reductions and enhanced performance. At the same time, chipset developments are improving the feasibility of running multiple functions from the same ECU.

Speed of cross-carline adoption depends on level of fragmentation within infotainment line-up:
What to consolidate and why?
There are various stages of ECU consolidation anticipated, with the most immediate impact expected to be felt within the instrument cluster, heads-up display and infotainment systems. Currently, these functions are generally designed by different teams within a vehicle manufacturer and sourced to different suppliers. However, keeping these functions separate while maintaining a seamless user experience is becoming increasingly difficult to manage. Instead, various vehicle manufacturers are now converging those teams into one, and sourcing a single advanced ECU that can support multiple functions.
The reasons for considering the consolidation of multiple ECUs into one are varied for different car manufacturers, with cost, consistency and complexity being the primary ones. With the growing number of displays, it is becoming increasingly hard to create a holistic user experience with disparate ECUs sourced from multiple suppliers. In addition to the consistency difficulties posed by multiple ECUs, minimising latency issues becomes particularly important when multiple displays show safety-critical information (e.g. for ADAS).

“first cars leveraging a converged ECU architecture that supports multiple displays are expected to arrive on the market by 2020
With OEMs planning to support a larger range of content across multiple displays, closer coordination will be required. Monitoring drivers and managing distractions can pose additional safety difficulties if the content on the multiple displays is not centrally managed.

How is the ecosystem adapting?
Suppliers have been quick to adapt, with Visteon, Bosch and Harman recently demonstrating the benefits of running multiple displays from the same ECU.

In doing so, OEMs are being promised a more holistic and consistent user experience, and a reduction in the total cost of ownership by $100-$200 from the removal of redundant hardware and simplification of the vehicle architecture. Although OEMs currently benefit commercially from multi-supplier sourcing, the consolidation of ECUs across multiple functions will likely reduce the operational complexity of dealing with several suppliers.

Despite all of the potential benefits, challenges remain. Changing the culture internally and re-organising teams from multiple vertical strands to one horizontal strand within OEMs is difficult logistically (and politically).

Furthermore, according to SBD’s Headunit Tracker, some OEMs have as many as 25 variants of headunits across all of their models. Consequently, the legacy of existing headunits and the architecture in which the consolidated functions will sit is also a difficult task to manage.

There are also various technical challenges associated with running both safety-critical and non-safety critical functions from the same ECU, requiring heavy virtualisation at both a hardware and software level.

Gradually, more and more OEMs will overcome the challenges and make the transition to ECU consolidation. In turn, this will drastically change the tier-1 supplier landscape.

Which suppliers are well positioned to deliver in this changing ecosystem?
The transition to ECU consolidation will make it harder for suppliers with only partial solutions to compete effectively, allowing larger players like Bosch and Denso that develop both instrument clusters and infotainment platforms to scoop up more business. Others will need to partner up or make strategic acquisitions to remain competitive in the longer term (which partially explains why the largest supplier of instrument clusters, Visteon, purchased Johnson Control’s infotainment business).

Convergence of ECUs, coupled with a simplification of headunit line-ups will lead to a greater number of ‘winner-takes-all’ contracts for Tier-1s, compared to before when suppliers could hope to at least get a part of the business for at least some of the OEM’s platforms.

The first cars leveraging a converged ECU architecture that supports multiple displays are expected to arrive on the market by 2020, giving suppliers a limited time to adapt to this new reality. Grand ambitions of moving from a decentralised 50-ECU strategy to a single centralised ‘super brain’ may still be far off, but that journey is already starting today.
Connected Vehicles and the Internet of Things that Really Matter

The Internet of Things (IoT) has come to automotive. Having started with infotainment it has evolved to fusing sensor, positioning, cellular and short-range communications within exciting new V2X architectures that will enhance the driving experience and safety and accelerate the development of autonomous vehicles.

At a basic level V2X, vehicles can communicate critical information between vehicles, infrastructure to avoid accidents at intersections or send location information for increasingly mandatory emergency call (eCall) services.

However, the excitement is around V2X's potential to usher in a new era of cognitive automobiles that are not only aware of their own status, but are also aware of the status of other vehicles, the environment, weather and road conditions, traffic and myriad other parameters that might affect driver safety and travel efficiency.

This automotive cognition, where sensing, communication and decisions take place at a machine-to-machine level, takes automotive transportation way beyond entertainment and classic IoT, into the realm of the "Internet of Things That Really Matter," as one slip up along the path from a single critical sensing or positioning element, to remote analysis, to final response, could spell disaster for the driver, and potentially for the OEM.

The corollary of this is move to V2X is also true, in that by taking appropriate measures with regard to reliable, low-latency communications and incorporating proven design techniques and reliable components or modules, automotive cognition can pave the way to the Holy Grail of safe, reliable, truly autonomous vehicles. Along the way, it will enhance driver safety through more tightly integrated advanced driving assistance systems (ADAS) for collision avoidance while also enhancing the bottom line of commercial tasks such as fleet management.

Infotainment is just a starting point

From a purely technological point of view, the addition of Internet connectivity to automotive for infotainment purposes

![Connected-Car Shipments Forecast](Global)

- **Global Cars Shipped**
- **Shipped With Connectivity**

Five-Year (2015-2020)

CAGR 45%

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Source: Scotiabank, BI Intelligence Estimates

*Figure 1. By 2020, 75% of the estimated 92 million cars shipped globally will be built with Internet connection hardware, constituting a CAGR of 45%.*

is a natural and evolutionary reaction to the movement of mobile devices from the home to the car. Automotive manufacturers recognize that consumers would like to more tightly integrate their home, mobile and automotive entertainment experience.

According to recent figures from Scotiabank/BI Intelligence, by 2020, 75% of the estimated 92 million cars that will be shipped will have Internet connectivity hardware, constituting a CAGR of 45% (Figure 1).

Applications range from streaming music and video, searching the Web, and receiving alerts of traffic and weather conditions. It puts the average selling price of a connected vehicle into the luxury range of $55,000, though prices will fall precipitously.

For its part, Gartner predicts that by 2020, more than 250 million vehicles will be connected globally – with consumer spend on in-vehicle connectivity doubling. Interestingly, BI estimates that of the 220 million total connected cars on the road globally in 2020, only 88 million of these will have their services activated by their owners. That said, BI expects embedded connections to gain favor as not only do they circumvent use of the consumer’s data plans, but they also allow manufacturers to get information on a car’s performance and send over-the-air updates to reduce the need for recalls, a critical feature for systems that are becoming exponentially more complex as the applications of IoT for vehicles – private, public or corporate fleets – increase.

In 2014, Gartner released a study in which it calculated the total number of installed IoT devices will reach 25 billion by 2020 (Figure 2) Of those, the automotive sector showed the highest growth rate of 96% in 2015.

The applications for IoT in automotive, and transportation as a whole are many. ThingWorx, which specializes in providing easy-to-use and secure IoT device cloud connectivity, deployment, commissioning and management, points to a number of features IoT enables. These include emergency services, remote vehicle diagnostics, vehicle tracking and recovery, safe driver and no-texting services and teen driver management. It also points out that insurance carriers can use vehicle telematics data to analyze driving patterns, encourage safe driving practices and reward customers with lower premiums for good driving behavior.

The gathering and transmission of on-board diagnostic (OBD-II) data, combined with sensors, precise positioning and driver monitoring is also critical for fleet managers, who can now track truck and driver status to make sure the truck receives maintenance before breaking down. They can also check that the driver is alert and maintaining good driving habits.

While this monitoring may have a “big brother” feel to it, for fleet managers in a very competitive environment, it can make the difference between staying in business, or not. Fuel savings, automatic tolls to save time, along with fewer breakdowns can add up quickly to reduced overall business costs.

This monitoring also sets the stage for autonomous transportation systems,
which are on the horizon thanks to the work of Google, Audi, Apple, BMW, BlackBerry, Ford and many others. These companies are actively engaged with each other to the point that it becomes almost difficult to separate car manufacturers from what were once “consumer” software developers. This ownership of the driving experience will be an interesting tug-of-war to watch.

BI Intelligence also points to IoT’s use in powering driving-assistance services such as self-parking. But this is just the tip of a very large and exciting iceberg called V2X, the current stage of automotive development (Figure 3.)

A report issued in August of 2015 by a team from Deloitte Consulting LLP, led by Simon Ninan, showed the various stages of car connectivity, from early efforts with GM’s DAIR system and OnStar, through Ford’s SYNC, Kia’s UVO and GM’s MyLink, all the way up to stage 3: V2X. Next up is stage 4: Tesla Autopilot and self-driving cars.

Technologies for V2X and autonomous vehicles

Many of the technologies required for V2X are already either in place or are emerging rapidly from the labs, though automotive design cycles mean that they won’t be on the road for few years yet. Automotive design cycles of three to four years from concept to mass production are not to be confused with consumer electronics devices, with cycles of 18 months or less. The slower design cycles for automotive can be attributed to the danger and severe liability associated with malfunctioning equipment. Recent incidences of hacking only contribute to the level of caution required. That said, compliance with standards such as ISO 26262 help ensure functional safety of automotive equipment, but compliance comes at the cost of time and money. The same goes for wireless connectivity across global regulatory requirements.

Still, the applications for V2X technologies continue to swell as developers find new ways to combine sensor data with precise positioning (POS), cellular connectivity (CEL) and short-range wireless (SHO). The result is a back up of ideas and concepts to be implemented as they’re all connected within and around the vehicle (Figure 4.)

Along the lines of autonomous vehicles, heads-up displays providing lane-keeping assist or lane departure warning are an interesting example (Figure 5.) These require accurate positioning, down to 1 meter or less, as well as awareness of intent, not just of the driver, but also the intent of other vehicles. Along with accurate POS, this also requires low-latency communications of steering velocity and relative position and speed of nearby vehicles. Only when all that information is analyzed, can the onboard system indicate a go/no-go for a lane change.

The next step is hands free highway driving assistance, fully automated highway piloting, and then autonomous vehicles.

To achieve the accurate POS, there are many global navigation satellite systems (GNSSs) to turn to, though only two are considered to be truly global in capability: the United States’ NAVSTAR Global Positioning System (the original “GPS”) and Russia’s Global Navigation Satellite System (GLONASS). The others include Europe’s Galileo, China’s BeiDou Navigation Satellite System (BDS), Japan’s Quasi-Zenith and India’s IRNSS (Figure 6.)

Even if those GNSSs were fully available to the public with no constraints, accurate

...
positioning requires the use of multiple GNSS systems, multipath suppression, Kalman filtering, multi-frequency handling and 3D dead reckoning techniques. Datasheets generally give figures for stationary accuracy, but true POS accuracy should only be judged based on real-world dynamic performance and how well it integrates information from accelerometers, gyroscopes and ABS sensors for speed.

A good implementation will be able to enter a tunnel and have a good idea of where the vehicle is until it re-emerges using 3D dead reckoning combined with offline map matching. Fortunately, POS systems generally receive and don’t transmit, so the designer doesn’t have to worry about US FCC, European CE or other wireless emissions regulations, but a POS receiver’s relative immunity to other interferers is a critical factor to consider. With Europe and Russia now making eCall service mandatory to under 1 m, and the US not far behind, choosing the right POS receiver or module is now high on the list of priorities all car manufacturers.

With the availability of modules, the biggest issue an OEM may now face is placement of the antenna. The sharkfin design is one popular approach. With sharkfins, the antenna is placed atop the vehicle and coax cable is run down to the main telematics control unit (TCU).

From there it can be distributed using Ethernet, wireless, or CAN bus interfaces to the head unit and rear-seat displays. In some cases, even the entire electronics is moved to the car roof in order to save expensive RF cables. This requires electronic components with extended temperature range. (Figure 7.)

While coax has traditionally been used, by integrating all the transceiver electronics in the sharkfin or in the side mirrors (for antenna diversity), lower cost digital cables can be used, though the TCU must still withstand temperatures of -40 to 105 degreesC.

These other transceivers include Wi-Fi and Bluetooth low energy, as well as cellular. While these interfaces are good for data exchange, the low latencies required for V2V, V2I and V2X communications has put the emphasis on incorporating 802.11p radios too. 802.11p is an amendment to the 802.11 (Wi-Fi) standard that allows for data exchange between high-speed vehicles and between the vehicles and the roadside infrastructure in the licensed ITS band of 5.9 GHz (5.85-5.925 GHz). It is a completely different physical layer so requires its own radio. While this means more cost in terms of physical hardware as well as software and regulatory compliance, a large chunk of that cost can be taken away using modules.

The modular approach is also interesting from the point of view of cellular operators as US-based operators require full compliance checking before a device can be allowed on their network. The reasoning has to do with making sure the device first does no harm. This is not legally the case in Europe.

Conclusion

With V2X and the Internet of Things That Really Matter, automobiles and fleet management are already the “next big technological battleground,” with plenty of opportunities for both hardware, software and services innovation. How and when we move toward fully autonomous vehicles will be determined by how these first critical steps are managed and implemented. Minimizing risk and error flows against rapid innovation, but with such high stakes, mistakes at the expense of life and lost confidence make choosing the right technology – and partners – a critical move.

References:
http://www.thingworx.com/Markets/Automotive

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<td>GPS</td>
<td>US; Global</td>
<td>5 M</td>
<td>31</td>
</tr>
<tr>
<td>GLONASS</td>
<td>Russia; Global</td>
<td>5 to 10 m</td>
<td>24</td>
</tr>
<tr>
<td>Galileo</td>
<td>European Union; European Space Agency</td>
<td>1 m (public); 1 cm (encrypted)</td>
<td>30</td>
</tr>
<tr>
<td>BDS (Beidou-2)</td>
<td>China</td>
<td>10 m (Free); 0. 1 m (military)</td>
<td>35</td>
</tr>
<tr>
<td>Quasi-Zenith</td>
<td>Japan</td>
<td>0.01 to 1 m</td>
<td>4</td>
</tr>
<tr>
<td>IRNSS</td>
<td>India</td>
<td>10 to 20 m</td>
<td>7</td>
</tr>
</tbody>
</table>

While there are many positioning systems, only two can be considered to be globally accessible, and fewer still have the inherent accuracy needed for safe lane changes. Data source: Wikipedia

Figure 6. While there are many positioning systems, only two can be considered to be globally accessible, and fewer still have the inherent accuracy needed for safe lane changes. Data source: Wikipedia

**Figure 7.** Antennas for both radio and positioning information require coax cable to be run to the main telematics control unit (TCU), but a move to lower-cost digital cabling is afoot, with all the radios integrated in the fin (or mirrors).
OEM connected car solutions: questions of creation and monetization

Today the connected car is becoming a commodity. Through surveys of drivers, and competitive intelligence, auto manufacturers have realized that their market rivals have already achieved some success in this field, and consumers now require connected car solutions. And the main question for the industry now is not whether the service is needed, but how to provide it and how to monetize it. These questions need to be considered at the implementation stage.

Creation
For the car-maker the implementation of connected car services always means modifying the vehicle’s architecture and on-board vehicle electronics. It is important to make connected solutions match regulatory requirements in the jurisdiction where the manufacturer operates. These requirements relate to safety. Specifically, the regulatory authorities require that in case of accident the car automatically notifies the relevant services about the accident and its location, and the rescue services are able to contact the driver through the car’s internal systems and to attend the place of the accident they are unable to contact with the victim. The exact requirements are different in each country. But car-makers are required to equip cars with Telematics Control Units, which increases the cost of the car.

Judging from our surveys, consumers expect three great stories from manufacturers in the field of connected-car telematics. The first is the ability to control the vehicle remotely: the owner wants to know where the car is, and to be notified if anything happens. The second concerns remote climate control. This is true in countries with a harsh climate, where it is very hot or very cold. The driver wants to control the climate in the car via engine start-up, or simply to control the cooling / heating system. The third story is about convenience. The consumer wants to be confident in his car and its condition, all the time. If the tyres deflate, he wants to receive a notification about it; if there is an error in the on-board systems, he wants to know so that he can decide what to do.

Connected-car solutions can also offer an improved quality of user experience, when the car has a video screen, by making it possible to connect the vehicle’s multimedia system to a wide range of...
cloud services.
This is what the market demands today. To change the car’s on-board electronics, you need to determine what exactly is to be connected up. The car-maker has to think about data transmission, especially for manufacturers operating in several international markets. It is important to comply with local legislation. Most countries have specific requirements for the storage of personal data, requiring such data to be stored within the country and not transferred overseas. That is why, if manufacturers equip their cars with connected car solutions, they need to understand who will ensure the transfer of data from the car to the cloud and how this will be done.

Accordingly, the question of server infrastructure arises. All of connected cars generate a huge amount of data that must be stored and analyzed. According to our experience, each car generates an average of about 30-50 megabytes per month. If we multiply that by the number of cars and the number of months they will be in service, there will be a huge volume—many terabytes—of data to be stored, backed up, and distributed regionally in accordance with the regulatory requirements. And this presents a certain technological challenge.

No less important is the question of customer experience. What exactly should people be given, on the basis of the connected car platform, in order to make them happy? On the basis of our company’s experience, we believe the best way to provide services to consumers is by way of their smartphones. Smartphones have very high penetration in all countries of the world, and are equipped with operating systems that allow apps to be downloaded. This is the most convenient and effective means of delivering services to consumers. Taking this fact into account, it is necessary to comply with the requirements and recommendations of smartphone vendors in terms of performance, appearance, and platform integration. For example, all platforms now have social network integration, depending on the region—a fact that must be considered. Local adaptation must be very deep. And it is necessary to bear these facts in mind during the system’s design and launch stages. Apps will be different, and therefore it is necessary to consider all these factors when scheduling deployment.

We also believe that it is better not to try using the telematics platform to cover all services and markets at once. We recommend manufacturers to think of the implementation of connected services not as the addition of another option in the car, like new seats or a new multimedia system, but as an IT project, and to follow the methodologies that are accepted in the IT industry for implementing software.

At present, the most effective methodologies are globally recognized to be flexible ones, such as Agile and Scrum, which dictate that services need to be implemented iteratively. Any connected car solution can be updated remotely. With connected car technology the car-maker can deliver updates via the cloud, as is customary with modern software manufacturers such as Apple, Google, and Microsoft. In the process they can roll out new services, modify existing ones, improve the user experience, and correct any errors. Accordingly, it is better to run this kind of service by proceeding from a smaller function set to a larger one, constantly analyzing the functionality provided, tracking use...
By combining flexible software elaboration with this approach, car manufacturers can implement the core technology very quickly, over a period of six or seven months, test it using standard methodologies that the manufacturer accepts prior to marketing, and then add more and more updates. It is not necessary to try to do everything at once. You can start with a few functions, and then gradually and constantly add new ones. This also has a positive effect on consumer satisfaction with the car and the brand. Receiving all these new features, months after buying the car, extends the driver’s pleasure of ownership, which also increases the chance he will return to the brand for his next purchase.

Of course it is important to pay attention to the engineering and technological characteristics of the software and of the infrastructure that will support the connected car service. Our experience indicates that it does not make sense to invest in a specialized data center. It is better to use the cloud, particularly given that there are now a lot of vendors who provide cloud infrastructure, so as to minimize the cost of the product launch. If the manufacturer sees the potential to generate revenue for himself, he can always transfer the service to his own data centre. But we recommend to begin by minimizing costs on startup by using a cloud system. Doing everything independently and from scratch will definitely make the cost of launching the technology higher than it needs to be. And everybody who launches a project is concerned about how to recoup the costs of deploying and supporting the technology, and how to make money.

**How to monetize independent connected-car solutions**

The first option is to make the services paid. Car-makers can distinguish between different expenses for the launch of their products. Everybody has cars that they sell with a few modifications. There is always a choice: either provide connected car functionality for the entire range, or offer it only for premium class. It is important to find a balance.

In this case, users pay for the service themselves. But, according to our statistics, this option works less well. No more than 30% of users are willing to pay any significant extra money for this kind of service. At the same time, more than 80% of respondents say they want connected services in the car for free. They have paid for the car, and they think that’s enough.

The second option is a freemium model. Car-makers can see what happens in a sector like IT: how free services work, especially those with a large audience (search, mail), and how they are monetized.

One answer is that these services are monetized through data or through the sale of data to third-party companies that sell services or products to the auto manufacturer’s audience. Thus, the car-maker can create a marketplace where a variety of additional services are sold to motorists. This requires that the telematics services and applications are free. According to our statistics, more than 90% of consumers who receive such functionality for free activate services and really use them at least twice a day. This means that the application will attract high traffic, and any marketplaces that there may be will be effective because of their large audience, comparable to the total audience for the car manufacturer.

Besides marketplaces, selling data about drivers can be useful to all companies interested in this audience. First of all, there is insurance. The smart insurance business is growing worldwide. This is linked to the fact that insurance companies find it very profitable to reduce risk by selecting policies and offering discounts based on driving style.

A safe driver who is willing and able to provide data about his driving makes an attractive client for an insurance company, allowing them to reduce the cost of insuring against accidents. Insurance companies will pay to gain access to clients of this kind. Thus, the car-maker can get the business of generating leads for insurance companies, and creating a marketplace for insurance services. Selling data is relevant also for car dealers and providers of map services.

If the manufacturer sells a large volume of cars, the last version of monetization is the most appropriate. For manufacturers operating in the premium and luxury sector, with a small audience, the easiest way is to include the cost of these services in their margins, and make them available free of charge. But for manufacturers in the mass sector, selling very high volumes, it is better to monetize connected car functionality through the sale of additional services, and through selling data to third parties. This must of course be done with the driver’s consent: and, in turn, drivers will receive discounts and special offers.
In Vehicle Connected Customer Experience that matters!

Passenger cars in today's time would see an explosion of innovative features on “in-vehicle connectivity” and that would provide the OEM with the much-needed competitive differentiation. When all other features (like, styling, LED headlamps, improved NVH, Power versus fuel economy), which historically used to serve as customer “delighters” are rapidly regressing towards “basic needs” or must haves”, (reinforcing Kano’s Model), enhancing customer value through in-vehicle connectivity provides a welcome area for every OEM’s to work on. Every OEM, worth its salt is doing something or the other to explore this area so that customer feels connected, safe and comfortable while driving his/her vehicles. Thanks to the “wonder” device, the smart phone, that has become the sixth sense for us. In this increased digitized world the in-vehicle connectivity platform can use the smart phone to control the navigation, entertainment and communication of the vehicle. Smart phones today represent the gateway to in-vehicle data traffic that car makers have been dreaming of building into their human machine interface. It will be a matter of time, when in-vehicle connectivity technologies would be used by OEM’s to enhance customer’s value by self - diagnosing a problem, automatically sending an repair alert, or call an emergency number, allow in-vehicle payment and even monitor driver’s behavior which can serve as a reference for insurance premiums. However, the challenge that needs to be overcome would be how these in-vehicle connectivity system would compete or differentiate with the features already available in the smart phones. According to the JD Power’s 2015 Driver Interactive Vehicle Experience, connectivity solution like in-vehicle concierge services, heads up displays and built in apps are among the top 5 function that respondent report they never use in the first 90 days of car ownership - a time frame described as a “make or break stage”. This implies, if the customers have not used it for first 90 days, it is very likely that they are not going to use it in future. Customer would invariably ask, “What is in it for me”? “Could it give me anything that I can’t already do with my smartphone and my current system”. Yes, customers might argue, that they would never get into a road accident so serious, that they cannot locate their smart phone and call emergency assistance. However, if this situation does happen, then customer would certainly get enormously benefited, if the in-vehicle system automatically fetches some help. So what else can provide value from in-vehicle connectivity? I think, except the outlier’s event like the accident, mentioned above, the value would come, if the vehicle provides a perception to the owner that the car will never fail him/ her. The customer would love to get this assurance from this in-vehicle platform that he/she will be never stranded or never surprised if he/she drives the “connected” car. No one wants to wake up with a car that fails to start, no one would like to drive a car that leaves him/ her stranded on the highway with a flat tire or a dead battery or a damaged fuel injector pump. Imagine a car, that provides an assurance that OEM’s support is always behind its customer, then this car would give a strong positive feeling to the customer of being “connected” to someone who cares for him/her- one who is always ready to listed to his/her problems and offer solutions . It is one thing to offer the customer what music he/she would love to listen. However the “connected” feeling means a whole new paradigm from an engineering standpoint? This means to provide a service to the customer to have an “on demand” diagnostics. Through a touch of a button, a back end advisor or agent can carry out a complete scan of the vehicle to alert the owner on the ‘health’ of the vehicle and recommend proactive maintenance actions. The other would be the proactive alerts. The onboard diagnostics or back end agents can scan the vehicle’s process variables, e.g. RPM, Power, Engine Condition, Battery Condition etc. and send a proactive alert to the vehicle owner on whether the battery needs immediate attention or the fuel pump needs immediate attention to prevent a ‘walk-home’ event. The dealer can also look into those alerts to identify and/or organize the parts and service necessary to give a ‘best experience’ to the customer when he/she proactively pulls the vehicle to the service center. This is similar to the technology being adopted in Boeing 787. The connected feature of the airplane can send in-flight messages to ground crews alerting them of parts needing inspection before the plane arrives for service, reducing unexpected repairs. To summarize, the in-vehicle connected customer values may not come from giving a host of apps in the HMI of the vehicle through which the customer can identify the direction map or locate the next McDonald shop in the highway or get the music that soothes his/her mood. Many OEM are heavily inventing in offering these kind of value to its customers. However, it might be argued that same feature is already already there is the smart phone. But the “connected” value may be an order of magnitude higher, if the same customer use the same smart phone to trigger a diagnostic scan, that provides a reassurance that he/she is ready to use a embark a journey with a car that would reach the destination without making him/her stranded or surprised during the journey.
Predicting Starting System Anomaly

### Introduction

In the past, Systems were primarily operating in the diagnostics only paradigm in which the focus was the detection and identification of the root causes of failure. Now with advances in sensor technology, communication technology, IT and Analytics it is possible to predict when the critical assets will fail before the fault occurs. This interesting application area is called Prognostics Health Management (PHM), which will facilitate health monitoring and tracking of system/component degradation severity to prevent a Subsystem component from degrading to the point beyond its operational performance envelope. PHM consists of following layers as per ISO 13374, upcoming Condition Monitoring and Diagnostics standard.

This article shows how Anomaly Detection is realized using algorithm for real time streaming sensor data from Vehicle Starting System using a Telematics IOT hardware.

The function of a vehicle’s starting system is to rotate the engine's crankshaft fast enough so that combustion can take place, and the engine can begin to run under its own power. This system, is commonly referred to as the “cranking system”. Providing the cranking power needed for reliable engine starts requires all starting system components to be in good working order. Testing the starting system can confirm that it is functioning properly, or provide valuable diagnostic information to isolate a problem in the system. The STARTING SYSTEM TEST measures starter current draw and cranking voltage. If the engine cranking speed is good, and the starter current draw amperage and cranking voltage readings are within specifications, you can generally conclude that the starting system is functioning properly. But, if the starter does not crank, cranks too slowly, or the amps and/or volts reading are not within, further testing will be required. If starter current draw is too high, voltage is below 10 volts, or the engine cranks slowly a problem is indicated.

The starter Motor Current and Voltage behaviour analysis enable to predict the

### Advisory Generation (AG)

System functions provide actionable information to operational and maintenance personnel or external systems

### Prognostics Assessment (PA)

System functions provide future state of health. performance life remaining, of remaining useful life (usage) indicators.

### Health Assessment (HA)

System functions provide information to determine the current state of health of equipment.

### State Detection (SD)

System functions evaluate equipment state conditions against normal operating profiles and generate normal or abnormal condition indicators

### Data Manipulation (DM)

System functions process and transform the sensor data and health state information collected by the DA.

### Data Acquisition (DA)

System functions Collect sensor data and health state information from equipment internal monitors, vehicle data bus Or data transfer system

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| Source: SAE Paper 2016-01-0075, Published 04/05/2016 |

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The following are the inputs for Algorithm to build the prediction model:

- Scalar
- Categories
- DateTime
- GPS

For the current problem scalar values from the IVT sensor (Current and Voltage) are used.

### Data Collection

Any IOT Hardware developed for Automotive Telematics can be used to acquire the data of a starter motor system from the IVT Sensor and stream into the cloud server. The setup is shown as below:

Starter Motor Current and Battery voltage are fed into the ADC channels of IOT
Telematics hardware, which is processed and sent via GPRS Module to Cloud Server. Data from vehicle fitted with good starter motor and vehicles fitted with near to failure starter motor shall be collected for this experiment.

**Data Set Description**
For this problem the dataset is having Date-Time, Voltage and Current as columns in the header row. There are 4033 record rows. The data set comprises of Normal current, voltage behaviour data as well as abnormal data acquired from vehicles.

**Below is the sample Starter Motor CSV**

<table>
<thead>
<tr>
<th>Time</th>
<th>Voltage</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>1466985600</td>
<td>12.4</td>
<td>8.5</td>
</tr>
<tr>
<td>1466985600</td>
<td>12.4</td>
<td>8.5</td>
</tr>
<tr>
<td>1466986200</td>
<td>12.4</td>
<td>8.5</td>
</tr>
<tr>
<td>1466986800</td>
<td>12.4</td>
<td>8.5</td>
</tr>
</tbody>
</table>

**Experiment**
The Experiment can be done in offline or online.

1. Stream the Good Working Starter Motor data that has normal operating values to the Sequence Learning Algorithm that runs in the Cloud. This can be done by a custom python script.
2. Algorithm builds Models for Voltage and Current Metrics, learns the spatial and temporal patterns of streamed data for a certain period of time until it able to predict the next patterns. Prediction is continuous and steps of prediction is set in the python script.
3. If it sees, pattern not predicted or not expected, Algorithm computes Anomaly Score for each pattern it receives in comparison with the predicted patterns. If an unexpected pattern is detected, it will update it learning table and adapts it as a new normal next time.
4. Based on Anomaly score/Probability score, Anomaly ticket email notification is sent to the stake holders.
5. Dashboard will show the real time monitoring of Current and Voltage behavior, anomalies detected in Graphical or Table form. Monitoring can be done on PC and mobile app. The result below shows only the PC Dashboard.

**Results**
The above data is the Current Sensor data of starter motor for a passenger vehicle. Each cranking cycle has 288 data points. In the above graph the,

- **Green Indicates**: Normal Condition
- **Yellow indicate**: medium Anomaly detected
- **Red indicates**: High Anomaly detected
- **Grey Portion in the lower region indicates** that learning time.

The starter Motor system was continuously monitored and analysed through the web application for anomalies. There were no significance alerts seen or application had not issued any alert tickets from 25th of June (Start of the Data Monitoring and Analysis). However, on 7th of July the web application sent a high anomaly alert indicating a potential problem in the starting system. This was followed by another high alert on 9th where the cranking of the vehicle was becoming worse indicating the Starter System would fail completely. And on 10th of July there was another high Anomaly alert, after which the starter system had died.

Pro-active Anomaly Alerts were classified based on the Anomaly scores. One can see a correlation of High Anomaly score to the system failure / degradation with minimal false positives, leading to starter Motor system failure.

**The experiment was able to predict the failure of the Starting System 3 days ahead.**

**Limitations And Further Improvements**
For the above Experiment:

1. Analysis was done with limited data set but there is scope for continuous data analysis from a real application data set.
2. Only 2 parameters are used for analysis, but can be extended to multi-dimensional values.
3. Diagnostics and RUL Prediction was not in scope but will be added in future as some work is under way.
4. Alerts require expert to analyze, classify and validate it for the likely failure predicted.
Telematics – How Smart Public Transport Systems in-the-making can benefit from it

A fleet owner in the busy central district of the National Capital Territory of Delhi—with 100-odd trucks on different consignments at any given time—picks his smartphone and within seconds get information on where every single vehicle is and how fast it has sped, as he juggles between taking new orders and reviewing his account books. Through the GPS and sensors installed in the trucks, heaven gets to know how long their travel across various locations have taken. Now imagine another scenario- somewhere on expressway, a truck collides with the divider, leading to breakdown of vehicle and serious injury to incumbents. Instantaneously the on-board communication device in vehicle reports the incident to nearest traffic police personnel for emergency assistance.

This is telematics in action, which integrates wireless telecommunication networks and informatics to create a connected vehicle. Since its introduction a decade-and-half ago, the technology has also integrated functions such as route navigation and geofencing—which allows the fleet administrator to set up triggers to receive alerts each time the vehicle crosses the defined boundaries. Telematics, now, is moving to new industry and market segments. According to the “Global Automotive Telematics Market - Analysis and Forecast (2016-2022)” report by Research and Markets, the global market for telematics is estimated to reach $55.97 billion by 2022 at a CAGR of 21% between 2016 and 2022, with the APAC region expected to grow at 22.1%.

Let us look specifically at the case of India. As the technology becomes more accessible, telematics will soon see increased take-up in a territory that is so important for India’s socio-economic lifeline—the public transportation systems. With India aspiring to transform its cities into world-class smart metropolises, ensuring safe, reliable and sustainable mass transit systems for the citizens will be crucial. Europe—which boasts of some of the best designed transportation systems — has the world’s highest number of residents who commute to work by bus or train, thanks to its integrated and well-connected transit systems. In contrast, India has accounted for a rapid rise in registration of cars over the last few years. It touched

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an all-time high of 1.96 crore registrations in 2015, propelled by high uptake of passenger vehicles. This naturally calls for a significant revamping of how our public transport facilities operate and how accessible they are.

Increasing high speed internet connectivity and access to next generation technologies such as cloud based storage and analytics, M2M (machine-to-machine) and IoT (Internet of Things) will play a significant role in driving telematics. STUs (state transport undertakings) can make their fleet more efficient, safe and green by benefiting in two major areas, as outlined below.


telemati cs is becoming a bigger, more integrated and more intelligent system by-the-day, and slowly absorbing everything that is connected

I. Passenger safety
Bus occupancy rates in Indian city buses are, in average, low. This is largely due to factors such as erratic bus schedules, long waiting time and lack of security and safety measures. The solution to this lies in the integration of technology with the public transport system. With sophisticated on-board GPS, GSM, cameras, surveillance systems and functionalities such as panic buttons on-board the vehicle, buses can streamimages real-time to command centers of STUs, which can then respond to emergencies appropriately. In case of accidents, on receiving the alerts and images sent by the bus, the command center can establish communication with the nearest bus depot as well as identify the closest required emergency response vehicle such as the ambulance, fire brigade or police van. If need be, the command center operator can also inform the nearest traffic police to create clear passage for the deployed emergency vehicle to reach the emergency spot in the shortest time possible.

Telematics can also help in reducing the number of road accidents caused due to driver negligence. For example, transporters can analyze data of how a vehicle is being driven, by generating an anituvic scorecard on parameters such as over-speeding, harsh acceleration, harsh braking etc. by the driver. This intelligence can be used for taking corrective measures like training programs for drivers to prevent accidents because of over-speeding.

II. Pro-active vehicle diagnostics
The Urban Bus Specification-II norms specified by the Government of India makes it mandatory for all the states to procure Integrated Intelligent Transportation Systems (ITS) enabled buses with advanced safety features, in addition to being free from vibrations, and harshness. Another important set of specifications are in the area of vehicle health monitoring and diagnostics for over 90 key parameters of engine, transmission and electrical system. To comply with this, State Transport Undertakings(STUs) should look at a comprehensive application that connects its command center to the bus on the road. This could be achieved by creating:

→ Vehicle monitoring dashboard which allows detection of emergencies along with resolution work flow process, and custom alerts based on defined events like geo-fencing, speeding, accidents, delays and other events.

→ Intuitive scorecards for driver behavior and vehicle health monitoring

→ MIS (management information systems ) reports that provide detailed information on vehicle usage, mileage, preventive maintenance schedule etc.

The above, put together, result in actions towards lowered bus wear and tear, reduced bus break-downs and enhanced passenger experience.

Imperatives for successful implementation
Since remote monitoring forms the backbone of telematics, the wireless networks and infrastructure which support it should be robust and enable continued connectivity between the vehicle and the operator.

→ The product design methodology should be such that it ensures GPS signal optimal continuity and strength. Further, it is also essential to identify the ideal location for mounting the GPS on multiple models of buses, and engage with providers offering the best GPRS connectivity in their respective locations.

→ Safeguard the in-vehicle communication systems by installing switches that alert the driver or the command center in case of device tampering.

→ With so much data being exchanged between devices, it is crucial to protect the system from cyber-attack or digital theft. It is critical that every bit of data stored is properly encoded and is transferred over secured protocol when shared.

→ A lot of data is generated from the manual entry of ticketing systems; therefore, it is important to digitize the entire system as much as possible.

V2V (vehicle-to-vehicle) and V2X (vehicle to everything) connectivity will define the extent to which we can make use of the data that comes out of each bus. They can improve traffic management by enabling vehicles to communicate with roadside infrastructure, say for example the traffic lights and signs. V2X, which refers to an intelligent transport system wherein all vehicles and infrastructure systems are connected with each other, will help in providing accurate updates on the traffic situation across the entire route and road network—resulting in optimized traffic flows, reduced congestion and accidents.

Clearly, telematics is becoming a bigger, more integrated and more intelligent system by-the-day, and slowly absorbing everything that is connected. The ability to foresee this and keeping connectivity technologies open to new modules will allow building new intelligence. This, supported with the right infrastructure, technology partnerships and financing by the government, is expected to drive applications of telematics from basic tracking and route guidance to sophisticated analytics. Such enhanced applications of telematics platforms will lead to multi-fold increase in the use and effectiveness of our public transportation systems.
Big Engineering Data: Value-adding Capital of the Future

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For automotive engineers, data and analyses have always been important criterion for vehicle design in order to develop products of high quality standards and durability. However, competitive pressure on automobile manufacturers is visibly increasing competitors introduce new features that are typically included in the design stage at the supplier level. In an automotive market characterized by this pressure, anyone wanting to stay and set themselves apart needs to convince end customers through higher quality and individuality in order to not be a victim of global convergence in vehicle functionality. Doing so requires a much deeper understanding of customer demands, environmental impacts, and operating conditions. Conducting this level of analysis requires collecting data in large volumes, and enabling engineers to make the right strategy and design decisions based on this.

What does Big Data mean in an engineering context?
In the past, the volumes of data analyzed by engineers to optimize a broad range of vehicle components like engines, transmissions and chassis were manageable. Engineers were able to process and analyze the data on desktop machines without notable effort. Over time however, data volumes have risen to the range of tera- and even petabytes. The reasons for this are complex. Firstly, the number and diversity of sensors employed in vehicles keeps increasing as driver assistance systems become prevalent and the moves towards the long-term vision of automated driving (Figure 1). Additionally, vehicles are increasingly turning into communications nodes that can exchange information with their environment and other cars, ultimately making them part of the Internet of Things. Bain & Company estimate that by 2020, about 20 million cars will be networked with each other.

So, what challenge does this big data currently present for design engineers? One of the difficulties is that data volumes are so high that they cannot any longer be deposited in one piece of main memory of a single computer or on its hard disk for processing, making it necessary to partition data before evaluation. Data also need to be analyzed at the same rate of collection as important product decisions depend on the results of data analyses, and computations which take several weeks will introduce expensive delays in subsequent stages of the vehicle design process.

Another challenge is the rapid growth of data volumes in automotive applications. Today, vehicle networks generate several gigabytes of data per minute. As a result, the data servers of automotive companies are filling up with increasing speeds with data that have been recorded during fleet tests and then deposited on off-board servers for subsequent analysis and analytics.

One last point is the diversification in big engineering data. In-vehicle sensor systems provide various types of information like battery currents, vehicle speed, GPS data, the positions and relative speeds of external objects, etc. The question this raises is how can all these data types be holistically applied and related to each other in order to successfully optimize the design and implementation of the vehicle’s features.

Figure 1: The vast amount of vehicle sensors and Big Engineering Data (© MathWorks)
functional design, its operation strategy expressed in control algorithms, and also its performance to environmental and operational conditions?

Below, we will present three examples of how MATLAB helps to efficiently employ big engineering data in the context of automotive product design. The first two examples refer to a real fleet test example designed by MathWorks and the third application case presents an approach for the verification of safety-critical vehicle functions as performed by SCANIA.

Building a big engineering data test system

MathWorks Consulting Services has been engaged in projects for developing MATLAB-based data analysis and analytics systems with numerous customers and integrating them into existing tool environments. To demonstrate the value of big engineering data, the team has developed an automotive data analytics demonstration that shows how MATLAB can be employed for vehicle fleet tests. The fleet consisted of 25 test vehicles that were deployed over various geographic regions to account for the impact of different infrastructure and operating conditions as well as individual driving habits. The vehicle sensor data was read during trips and sent to and pooled at the Amazon EC2 Cloud data server, while the vehicle was driving, using a cellular connection (Figure 2). The system uses a Hadoop Framework which stores the data on a distributed file system as well as for processing it on compute clusters. The goal was to perform the complete analysis of the data collected inside the cloud by taking advantage of high processing power to get results quickly.

MATLAB offers a number of ways to parallelize computations. One of them is using MapReduce in MATLAB together with the Hadoop Distributed File System (HDFS). MapReduce enables the partitioning of large data volumes into smaller data packages where analytical problem can be applied in an intermediate step, after which the partial results are aggregated in a next step to give the final result. For the MathWorks fleet testing system, the partial computations are then parallelized on several machines in the cloud using MATLAB Distributed Computing Server. MathWorks offers a scalable parallelization solution (Figure 3), which helps to initially parallelize the computation on a local multi-core PC in order to accelerate the analysis of part of the data, developing initial ideas and prototypes for the algorithms used to analyze the overall data. Once this concept and these algorithms are proven, the next step is to apply both to the full data set and to perform MapReduce computations in the cloud using MATLAB Distributed Computing Server. This means modifying the traditional approach for data analytics, which historically meant feeding the data stored on a server to the analysis tool. Using MATLAB Distributed Computing Server the computations done on the data are transferred to the Computing Cloud. While doing so, the data analytics can also be integrated into a web-based business application, allowing engineers to control data access and analysis intuitively using a web portal without the installation of an additional Data Analytics and gaining Insight

The goal of data analytics is to provide intelligence that helps to identify potential areas for optimization and innovation. For the fleet testing system built by MathWorks, two application
cases were explored:

- Optimization potential for specific fuel consumption
- Analysis of infrastructural impacts on product planning

Optimizing fuel consumption of automotive powertrains requires not only combustion engine optimization, but also requires design interplay with the transmission in a way that makes gear changes happen just at the most optimal fuel efficient operating points. The evaluation parameter used here is the Brake Specific Fuel Consumption (BSFC), which relates the mechanical power generated to the fuel consumed. Customers often explore this optimization problem using Model-Based Design approaches. MATLAB provides a data-driven aspect, which considers the fuel consumption based on vehicle data recorded during real-world driving scenarios. For 27 vehicles fleet testing system, the BSFC data was derived from various real-world driving scenarios like daily commuting to work of the drivers involved. For analysis the mechanical torque was plotted against function of rotational speed (Figure 4). The mechanical power output is constant along each of the hyperbolas plotted. In addition to the mechanical evaluation parameters recorded, data from other sensors like GPS, together with digital maps, was applied to ensure that the vehicle keeps operating at maximum fuel efficiency through forward-planning. This will key to give drivers the opportunity to choose between different automated driving modes (e.g. Eco, Sport).

The second use case of the MathWorks testing system was looking into the question of how fuel consumption is affected by different infrastructural impacts. This helps vehicle engineers to draw conclusions on useful optimizations for built-in functions, and can also provide quantifiable basis for future infrastructure modifications that reduce fuel consumption and emission. For this, MATLAB was connected to business intelligence software that linked the recorded GPS data together with fuel consumption based on geographical information. A web-based application then made the final results available (Figure 5). The data provided various insights for e.g., it demonstrated at which junctions unnecessary fuel consumption was caused by excessive waiting times. The data recorded and analyzed using MATLAB showed that a waiting time of about 90 seconds at one of the most traffic clogged junctions causes a fuel consumption of 0.0034 gallons. If the junction were replaced by a roundabout, a total of about 120 gallons of fuel per day could be saved, resulting in an emission reduction by about 2,500 tons CO2 per year. From the perspective of an OEM, consumption data can be applied to adapt the operating strategy of vehicles to the infrastructural conditions or to integrate features like start-stop or coasting into the drivetrain control algorithms to optimize fuel efficiency.

Big engineering data analysis of ADAS functions

Driver assistance functions generate significantly more data than other systems in the vehicle. For e.g., cameras and other sensors are used to create a high-resolution environmental model that describes the objects in the near periphery of the vehicle in order to prevent possible collisions, which can generate large data volumes. At a recent MathWorks Automotive Conference, SCANIA presented the team’s design approach, where Model-Based Design in Simulink was connected with MATLAB for data analysis. To implement an Automated Emergency Braking system...
(AEB) for trucks, SCANIA designed a sensor fusion algorithm that has been verified and continually optimized to production maturity using recorded data from their test truck fleet. This has been done through testing the algorithms for sensor data fusion and situation analysis using recorded data from real-world driving. The recorded data is analyzed to confirm that the algorithms have correctly identified objects and traffic situations. In places where the algorithms have incorrectly assessed the sensor data (e.g. by not detecting an object present), the flaw in the algorithm is corrected by the developer and the improved algorithm is reapplied to the recorded sensor data for verification. SCANIA states that their fleet tests have generated about 80 terabytes of data (from nearly one million miles driven on real roads), which is available for safeguarding the algorithms.

**Literature & Resources:***
- Bain & Company - Big Data revolutioniert die Automobilindustrie
- Dmitrij Martynenko, MathWorks – Big
- Arvind Hosagrahara, MathWorks - Engineering Data Analytics with MATLAB (MathWorks Automotive Conference 2015)
- Improving Engine and Vehicle Design Using Big Engineering Data Analytics and MATLAB
Collaboration is a Key Strategy for Automotive Telematics Ecosystem

Vehicle telecommunication industry started seeing its first footprint in the 1990s, primarily with the introduction of portable navigation devices and hands-free calling into vehicles by various players such as Garmin, Teletrac, and Teletrac Navman. The market rapidly expanded with increased penetration of cars with various electronics such as communication, entertainment, and infotainment systems. By 2000, cars began to experience a more integrated telematics system with cellular and GPS functionality, leading to better customer experience. As the market matures, many technology partners from various domains and lots of collaborative efforts.

No single player can hold dominant position in the Automotive Telematics and but it would be need contribution from various tech player who would enable it to be reality such as:

> Cellular and positioning module suppliers for wireless connectivity of the data between vehicle on move and data centers
> Hardware suppliers for the devices and equipments that send and receive wireless signals
> Software suppliers for infrastructure and/or specialized applications
> Telematics service providers (TSPs) for offering GNSS, entertainment service, remote diagnosis and etc. for car makers
> Wireless carriers for the bandwidth are vital link.
> Content providers for generating the information sent to the vehicles
> Automakers for ensuring that everything comes bundle together as one cohesive system to end user

Car makers have a unique opportunity to build a new way to interact with their customer base and could find telematics as a new tool to expand its brand equity. This might need car maker to enhance without knowing complexities of individual system brings in to make it work seamlessly.

Car makers have a unique opportunity to build a new way to interact with their customer base and could find telematics as a new tool to expand its brand equity. This might need them to collaborate to partner with technology experts to provide various services. These experts would help them to keep abreast with technology, which is changing, at a rapid pace.

Being interconnected is essence between consumers and automakers; consumers and vehicle. Consumers, mobility and the ecosystem are causing traditional industry borders to be redrawn or even disappear. Requirement of cars are going beyond movement of people to offer sophisticated features, comforts and data for further improvement making cars increasingly intelligent. Concept of mobility is getting redefined again and again catalyzed by electronics and telecommunications enterprises.

Key driving factors for global commercial telematics markets are penetration of smart phones, ever reducing connectivity cost, availability of high speed internet bandwidth through LTE, governmental mandate in terms of safety compliance etc. By 2020, it is expected that quarter billion connected vehicles would be on road enabling new in-vehicle services and automated driving capabilities featuring comforts and convenience. According to Gartner, Inc. The Indian telematics market is expected to reach $113.7 million by 2018, growing at a CAGR of 22.8% from 2013-2018 according to a recent report from 6Wresearch, India. The only way to maintain this dramatic growth for automotive telematics market is technology agreements and collaborations.

Like any other market in India “Vehicle Telematics” is also expected to follow same trajectory to grow exponentially in coming years.
Usage Based Insurance – New Dawn in Indian Insurance Sector

There has been a lot of talk and chatter on print and social media on ‘Telematics’ and Usage Based Insurance (UBI) coming together in a big way in India. While the enthusiasm is good and the model has been in place for over 5 years in countries like the US, UK and more recently in Italy and South Africa – telematics in the Indian context as well as consumer behaviour differs. For any insurer, OEM or a product company to come up with such an offering, the concept will need to be Indianised. Let’s start with some basics – UBI essentially means calculating insurance premium on the go. In other words, premium is calculated based on the number of kilometres the vehicle is driven and factors such as how it is driven and when or where it is driven. All this data is received by the insurance carrier through a plug-and-play device which fits easily into the OBD2 port of a car (all cars manufactured in India after 2013 have an OBD2 port) and transmits information through GPS. UBI gives a better understanding of the risk for the insurance carriers as they can then tailor an insurance package based on the driving behaviour, driving distance, time of the day when the vehicle was driven etc., in addition to assistance during emergencies.

Next, to talk about the current and future possibilities, we must look at the UBI and Telematics business model for insurers. Fundamentally, if you look at the proposition for a Telematics product or service, it would be the following –

1. **Customer Value > (Cost of the device + Price of the Service offered)**
2. where, **Customer Value = Convenience or Savings or Safety or Emergency Assistance etc.**

If you look at the formula above, while the cost of the device can go down only so much, the lever to manoeuvre would be the service. This means the entire ecosystem of Value Added Services (VAS, which means bundling of services useful to the customer with the device) provides opportunities for a lower marginal cost with a higher perceived/ actual customer value.

The UBI space has a bunch of services or utility offerings that installing a device in a car can enable and connect the driver and car to this ecosystem. I believe that most of the future offerings and action would be pertaining to these services offered. Each of these services will target a specific customer value like the ones discussed above and will consist of a bundle of services, which belong to the self-contained ecosystem. Let’s look at some of these possibilities:

1. **Infotainment Services through the Telematics device** – radio, video, news, emails, calls, social networking sites
2. **Navigation / Location based Services** – points of interest, parking, fuel prices, weather, traffic / journey times, specific offers based on location
3. **Fleet Management Services** – managing a fleet of commercial vehicles, including safety of drivers, goods and overall safety
4. **Safety based Services** – remote monitoring, tracking of stolen vehicles, emergency services provided through Connected Car services
5. **Convenience, Savings and Profit / Benefit based Services** – toll fees, green/eco driving, saving fuel through habit optimisation, car sharing, driver behaviour tracking for insurance premium savings with models like Pay As You Drive (PVD), Pay How You Drive (PHYD) and the more advanced Control Your Driving (CYD)

Two generic business models (we can slice and dice them as we want) emerge out of the myriad possibilities of services play above and most of the possibilities in the future will be based on one of these models:

1. **Enable once for free, bundle subscription based services**
2. **Charge for enabling incremental subscription based services based on the Freemium model**

The two largest geographical markets in the world where Telematics has been relatively successful and have the largest amount of Telematics data are the United States and Italy. The US market is now mature in Telematics offerings with Insurers such as Progressive Insurance pioneering its Snapshot device model in early 2011 and today, along with other Insurers like All State, State Farm etc. accounting for 4% penetration in the US. Italy is an interesting case study, because, though they started a bit late, with the right combination of price, value proposition and a forward looking regulator, the country has caught up fast, and today, around 16% of all insured cars running in Italy carry a Telematics based device or app.

Other markets like the UK are catching up fast with Insurers like Aviva advertising heavily through TV commercials, print media advertisement etc. and focusing the entire offering on ‘young’ drivers. Meanwhile, Insurers like Discovery in South Africa have come up with an international best practice model called Discovery – Vitality drive, where cashback incentive for gasoline bought from partner gas stations replaces the premium discount concept.

**Sourabh Chatterjee**  
Head - IT  
Web Sales and Digital Marketing  
Bajaj Allianz
The Indian market is still at a nascent stage when it comes to insurers coming out with an offer for Telematics on a large scale, though there have been some on and off experiments by some insurance carriers. From a manufacturer’s standpoint, OEMs such as Honda have come up with a Telematics device offering called Honda Connect (working with UNO Minda), which is getting offered to all new Honda Cars, though the jury is still not out on how much interest it is generating amongst car buyers.

The luxury segment (cars beyond Rs 20 lakh) already has some of these devices (in some shape or form), although they may or may not be connected to the right ecosystem to provide value to the vehicle owner. The Indian market is also unique in the sense that in India, today, we insure the vehicle and not the driver. However, the complete value proposition of a Telematics based offering needs to include not just vehicle diagnostics, but also behavioural aspects of the driver as well as their driving patterns.

Finally, my belief is that the Telematics and UBI market in India is at a very interesting junction and will take a sharp turn with many Insurers, Insuretechs and OEMs entering it in a big way. Only time will tell who will do well in this space and who will not. But I can forecast that whoever gets the ‘Connected Ecosystem’ right and makes the Customer Value proposition strong, will definitely have an edge over the others.

World’s first driverless shuttle service

The eastern French city of Lyon has become the world’s first city to introduce driverless shuttles for public transport. The driverless minibuses manufactured by the French firm Navya after a yearlong experiment to use the vehicle as a mode of daily transport by local residents.

The two vehicles launched by the company are fitted with high-tech equipment including laser sensors, stereo vision and GPS, can ferry around 15 passengers at a top speed of 20 kilometres an hour. The vehicles have been tested without passengers in other French cities and in Switzerland, and a trial is under way in Dubai, using a bus developed with the help of a French company.

Costing 200,000 euros (USD 225,000) a piece, the prototype of this electric vehicle was tested in the year 2013. In Lyon, the 4-metre-long buses attracted curious onlookers who took ‘selfies’ beside the vehicles, which allow passengers to stand at the front and enjoy the journey from a “driver’s eye view”.

Solving

Addresses in India are an enigma – it is highly non-standard, unstructured and non-hierarchical. Add to that there are streets with no names or unstructured addresses, and slum-like areas that change frequently, as well as most of its 600,000 villages are not street addressable.

The way address in written in India also adds to the challenge. Figure 1 shows the variety – everything from a person’s name, building’s name, points of interest and even a workflow containing direction to the approximate location of the house is considered an acceptable way of writing an address.

The ambiguity around addresses has large impact on the timelines and cost of delivery of a package in India. The package delivery route has three broad components, the “first mile” where the package is picked up from the sellers warehouse, the “line haul” where it is moved between cities (usually by air or truck), and the “last mile” where the bike riding delivery personnel (called “Field Executives” or FEs) deliver the package to one’s house.

The ambiguity around addresses forces the FEs to stop at various locations on route, either to ask local people for location or directions to a particular apartment complex. In case of a new address or landmark that the address refers to, FEs sometimes have to call the recipient to get directions, or in the worst case, postpone delivering until the recipient calls back to clarify address and provide directions.

Key reasons for delivery delay or misroute:

There are many reasons packages get delayed or misrouted in India. Typical issues are:

→ Wrong Pin Codes are written in 20-30% of addresses. This ratio is typically higher in smaller towns or areas that are growing rapidly. For example, most people in Gurgaon, Haryana use 122001 as their Pin code

→ Multiple localities with the same name in a city. For example there are three “Rathtala’s” in Kolkata. Combine that with wrong Pin code and figuring out the correct locality becomes
India’s Address Enigma

Person’s Name
c/o S Bhattacharya, 111Goshala Road, Mahadevpura, Bangalore 560048
Building’s Name
146-B Purva Appt, Old Airport Road, Bangalore 560035
Street Name
20K, Ohakuria Station Road, Dhakuria PS: Jadavpur, Kolkata 700031
Points of Interest
(P01) International Pvt. Ltd., Near Payal Cinema Complex, Gurgaon 122001
Address or Work
Near Kaman Chowmuni, East Side, Fourth Gali, near medical shop

Figure 1. Variation on how addresses are written in India

Benefit of solving this problem:
Comparatively, logistics cost in India is far higher than western countries; not being able to resolve address in the “last mile” adds significantly to that cost. Typically in the western countries, the last mile cost of logistics is 7-8% of the total delivery cost, while in India it is in the ~25% range. If we can resolve the addresses to a reasonable resolution, say, to 500 meters, a significant time and cost would be saved in the delivery, bringing down the overall cost of the logistics by 8-15%. Advising our field executives on the most efficient routes for delivery is a prime example of where we need to build an efficient way to determine address.

How are we solving this problem:
An in-house second generation machine-learning address resolving system, AddFix™, enables us to correctly identify a locality with over 98% accuracy, significantly speeding up package deliveries. Currently, this technology provides us with better disambiguation of addresses than ANY off-the-shelf mapping technology available for India. Technically, Delhivery’s AddFix™ is a geocoder service which is currently working at a locality level. It cleanses input addresses and returns details such as locality, sub-locality and pin-codes, with latitude and longitudes. If the pin-code generated by the algorithm does not match the pin-code written by the customer, it returns a list of the correct pin-codes for that particular locality.

There are multiple data sources that contribute to AddFix: Third Party sources such Open Street Map (SOM) and Google cover 20-40 % for an Indian city. This is augmented by historical address from our past deliveries, now nearing 100 million addresses.

The solution targets to cover 95% of the localities in a city. By Diwali (October 2016) it will cover the top 150 Indian cities where over 90% of eCommerce shipments in India take place.

Our longer term goal includes building a “real”, searchable map of India comprising of POI data, weather and traffic, so as to provide “realistic” directions to people in a format familiar to them.
might be complex as it requires high bandwidth and less latency to ensure accuracy and synchronization of the resultant data to ensure the highest degree of safety. Thus, efficient predictive algorithms, advanced fusion techniques and implementation of 5G would be the catalyzing agents for this phase.

To summarize, major software catalyzing agents include advanced methodologies for OTA data transfer, accurate data fusion and predictive algorithms. As there is a possibility of shuffling functionalities during systems level integration at different phases, a platform independent modular architecture is highly recommended to provide flexibility and improve efficiency.

Subsequently software functional and deployment efficiency would become the key for the success for the implementation of connected cars. The basic embedded infrastructure (ECUs with enhanced software architecture, sensors, communication systems etc.) will serve as a foundation for cooperative connected systems and all the innovative connected features would emerge from the analytical integration and feature consolidation of software systems. Tata Elxsi, having experience in all these technologies is well placed to develop and implement these catalyzing solutions.

The two major challenges that industry may face during these phases include ‘Embedded infrastructure costs’ and ‘Connectivity & deployment costs’. ADAS and V2X are the major contributors for the former, while V2X infrastructure and incorporation of 5G being the major contributors for the latter. There is a strong need for the various stakeholders to work out a resolution to mitigate these costs, with innovative technical service organizations having a considerable role in achieving this.

Clear regulatory compliance requirements at each phase of this journey can help various automotive stakeholders to ensure step by step progress to facilitate various connected car services. It also helps saving on monitory side by having right plan of execution.

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**Ford promises to mass produce fully autonomous cars by 2021**

Ford plans to launch fully autonomous cars by the year 2021. It is doing so by doubling the investment in its research centre in the city, and make sizable investments in technology companies in the autonomy industry.

The planned vehicle will hold a Level 4 Society of Automotive Engineers (SEA) autonomous vehicle rating. According to the SAE’s rating scheme, the vehicle will have full control over execution of steering and acceleration, monitoring of its driving environment and fall back performance of dynamic driving tasks.

**Government in China bans testing of self-driving cars**

The automotive industry in China is not so keen for allowing self-drive testing on highways. The industry is planning to tie up with police to introduce new rules & regulations to curb down the autonomous car testing. A draft has been launched by the government, which is of the preliminary regulations. This step has been taken by the Chinese government after this year’s Tesla fatal crash.

Measures are now being taken in order to legalize autonomous vehicles that will appear on China’s highways in three to five years, and then in Chinese cities by 2025.

**Global automotive telematics market to reach $55.97 billion by 2022**

The global automotive telematics market is estimated to reach $55.97 billion by 2022 at a CAGR of 21% between 2016 and 2022, according to Research & Markets. Growing awareness about driver safety, decreasing cost of connectivity, increasing market penetration rate of smartphones, and stringent automotive safety regulations are some of the reasons fueling the market growth. However, certain constraints such as increasing hacking/privacy concerns, lack of cellular coverage, and low awareness about telematics can hamper its overall growth.

**‘My Mercedes-My Service’ program by Mercedes-Benz**

Mercedes Benz has introduced My Mercedes My Service programme for its customers, which comprises initiatives like Digital Service Drive, Premier Express Service and innovative Service Products. The Digital Service Drive is an initiative offering transparency, convenience and time saving measures to customers of the brand. The key objective of launching this platform is to enhance the ownership experience of the customer resulting in brand loyalty. This initiative also aims to strengthen overall operational efficiency and reduce turnaround time for the customer.
Mobileye to end deal with Tesla for future self-driving cars

Amnon Shashua, CTO of Mobileye has declared plans to end the company’s relationship with Tesla Motor. Most of the semi-autonomous models of Tesla have implemented Mobileye’s EyeQ system-on-a-chip. Mobileye said that its work with Tesla will not extend past the EyeQ3, the current technologies that are found in Tesla Model S and Model X electric vehicles.

This announcement did not come as a surprise for the industry as merely a few months ago in May, a Tesla Model S was crashed when the driver switched the car to autopilot mode. On the other hand, Mobileye has steadily dominated its small corner in the automotive industry. The technology—vision chips and software introduced by the company interprets data from a camera to anticipate possible collisions with cars, people, animals, and other objects.

Royace Eye signs pact with ITI to make vehicle security devices in India

Royace Eye Industries has collaborated with a public sector undertaking (PSU) Indian Telephone Industries Limited (ITI Limited). This has been done to locally manufacture security devices for the Indian market such as Vehicle Security Solutions, GPS Tracking Devices and Sports Camera. The partnership would set ground, that would support both firms to manufacture products under Make in India Project and will cater to the market of Smart surveillance and security devices and IoT based products in commercial and public sectors.

The government has approved Rs 4,156.79 crore to upgrade infrastructure of ITI for its revival. The funds are to be released in two phases, consisting of Rs 1,892.79 crore as grants-in-aid for payment of statutory liabilities and Rs 2,264 crore as capex.

WhatsApp co-founder invests in Trak N Tell to introduce connected cars in India

In a new round of funding from a group of investors, led by WhatsApp cofounder Brian Acton, Trak N Tell- a Gurgaon-based car tracking telematics solutions startup has received an undisclosed sum of funding. This move is a strategic step into the evolution of connected cars in India. The companies have invested in about $3.5 million (Rs 23.3 crore) in the nine-year-old venture. This is the first investment for Brian Acton in India.

With this step, Trak N Tell has plans to expand its services in different cities across the country. The company provides vehicle tracking for predictive engine failure & preventative maintenance notification, fuel monitoring system and more.

Novus Drive becomes India’s first driverless shuttle

Velodyne LiDAR has provided its HDL-32E real-time 3D LiDAR sensor to Hi-Tech Robotic Systemz, a company, which has developed the 14-seat Novus Drive autonomous vehicle. The Novus Drive achieves full autonomy through its on-board 32-channel Velodyne LiDAR sensor, stereo vision cameras, GPS inertial navigation system, and machine-driven algorithms for path planning and obstacle detection/avoidance. The vehicle is the first of its kind manufactured in India.

Royace Eye signs pact with ITI to make vehicle security devices in India

Telit has entered into a definitive partnership with Tech Mahindra on developing complete solutions for the Internet of Things (IoT). The relationship is centered on combining and integrating Telit’s portfolio of IoT products and services with Tech Mahindra’s system integration expertise and strengths in developing end-to-end enterprise solutions. Both companies are also jointly pursuing new business opportunities across many markets and industries, such as IoT horizontal and Industrial IoT around the world. Additionally, Telit has reached an agreement to outsource related engineering development and testing activities to Tech Mahindra.
Parker – NVIDIA’s processor for autonomous vehicles

NVIDIA has released the architecture and underlying technology of its new processor- Parker, which is suited for automotive applications like self-driving cars and digital cockpits. Parker will support features important to the automotive market such as deep learning, hardware-level virtualization for tighter design integration, a hardware-based safety engine for reliable fault detection and error processing, and feature-rich IO ports for automotive integration.

Built around NVIDIA’s Pascal GPU architecture and Denver CPU architecture, Parker delivers up to 1.5 teraflops of performance for deep learning-based self-driving AI cockpit systems. Parker delivers 50 to 100 percent higher multi-core CPU performance than other mobile processors. This is due to its CPU architecture consisting of two next-generation 64-bit Denver CPU cores (Denver 2.0) paired with four 64-bit ARM Cortex A57 CPUs. A new 256-core Pascal GPU in Parker delivers the performance needed to run advanced deep learning inference algorithms for self-driving capabilities. Parker is architected to support both decode and encode of video streams up to 4K resolution at 60 frames per second.

Fiat Chrysler joins the bug bounty program

Fiat Chrysler is offering $150 to $1,500 to people who spot software bugs and report them so they can be fixed. The size of the reward depends on how critical the bug is and how many vehicles it affects. Fiat Chrysler has turned to Bugcrowd to tap into the collective creativity of our 30,000+ security researchers, as well as those who aren’t yet members of the Bugcrowd community.

The step has been introduced about a year after two ethical hackers were able to control a Jeep Cherokee remotely with a laptop through loopholes in the vehicle’s radio. The hack touched off recall of 1.4 million vehicles made by FCA including Cherokees in order to patch software holes.

MyHyundai App for Vehicle Management

Hyundai’s new app called MyHyundai with Blue Link integrates services currently available in the previously separate Blue Link and Car Care mobile apps. The app makes it even easier for customers to access Blue Link remote start, schedule service, get vehicle diagnostics and view how-to videos similar to how they can use the MyHyundai.com owner website. The inclusion of Blue Link remote and Assurance Car Care features into the MyHyundai makes vehicle management and ownership seamless.

China forms committee to protect cyber security

China is forming a committee to ensure the safe running of intelligent, connected and electric cars on roads. The committee is headed by Li Jun, a member of the Chinese Academy of Engineering and technical chief of FAW Group Corporation. In order to further intensify this subject, various automakers have partnered with Internet companies to ensure that their vehicles are free from cyber intrusion.
Argus cyber protection for connected cars

Argus Cyber Security suites of products and services delivering end-to-end security for connected cars. Includes following features:

→ **Connectivity Protection**: It defends the infotainment or telematics units by preventing malware installation, detecting operating system (OS) anomalies, isolating suspicious applications, and stopping attacks from spreading to the in-vehicle network. In addition, this suite secures the two-way communication channel with the outside world.

→ **In-Vehicle Network Protection**: It provides in-vehicle network-wide security by detecting attacks, suspicious activity, and changes in standard in-vehicle network behaviour.

→ **ECU Protection**: The ECU protection reinforces select ECUs such as brakes, ADAS, or any other units deemed critical, from attacks originating inside and outside the ECU.

Enabling fleet management with DIRECTOR by Teletrac Navman

Teletrac Navman’s DIRECTOR platform tracks assets and collects data to meet a range of business needs and to drive productivity for customers. Offering fuel use tracking, messaging and routing, along with driver behaviour analysis tools and concise reporting features, DIRECTOR helps businesses reduce operating costs. Its signature safety module, called Safety Analytics, scores driver performance based on company priorities and replays unsafe driving events to aid driver training. The dashboards accumulate information to show trends that would otherwise go unseen, giving companies the insight they need to succeed.

Cloud based information services by HERE

HERE has added three new cloud based information services to its portfolio that provide drivers pre-departure traffic information, personalized fuel and parking recommendations based on their preferences and habits. HERE Departure Alert and HERE Personal Recommendations join the suite of HERE Automotive Services that seamlessly deliver advanced content to drivers via connected embedded navigation systems.

→ **HERE Departure Alert** proactively displays traffic conditions on the most common routes a driver takes. The service learns travel patterns – based on destinations, routes, time and location – and combines the information with HERE Real-Time Traffic to aid decision-making at the start of a trip.

→ **HERE Personal Fuel Recommendations** learns the fuel preferences of the driver and provides timely recommendations.

→ **HERE Personal Parking Recommendations** provides off-street parking facility recommendations when the vehicle is within 1 km of the destination, or around the driver’s location when a destination is not entered.

AAA tests reveal automatic emergency braking systems vary significantly

Automatic emergency braking systems — the safety technology that will soon be standard equipment on 99 percent of vehicles — vary widely in design and performance. All the systems tested by AAA are designed to apply the brakes when a driver fails to engage, however, those that are designed to prevent crashes reduced vehicle speeds by nearly twice that of those designed to lessen crash severity. While any reduction in speed offers a significant safety benefit to drivers, AAA warns that automatic braking systems are not all designed to prevent collisions and urges consumers to fully understand system limitations before getting behind the wheel.

In partnership with the Automobile Club of Southern California’s Automotive Research Center, AAA evaluated five 2016 model-year vehicles equipped with automatic emergency braking systems for performance within system limitations and in real-world driving scenarios.
'Autonomous Drive = Self Drive' is the new buzz word all over media in recent times. Uber partners with Volvo to accelerate their self-drive project, Google Car claims 1.5 million miles of self-driving and Apple's 'iCar' project is on stealth mode, yet it has an estimated R&D budget of $10 billion. However, the key question is: will it ever be possible to have a car that drives itself? Read on.

Nature has instilled human beings with ‘awareness’ via sensory perception. Our gift, coupled with our ability to learn continuously from our environment, defines our adaptability and survival. These self-driving cars, in the making, are being equipped with 'sensor data fusion' and 'V2X' technologies to enable full autonomy. Sensor data fusion equips the self-drive car with a sensory mechanism and 'V2X' technology enables continuous communication between the self-driving car and the road infrastructure, seamlessly connected via telecom network. A typical prototype of a self-drive car or truck is equipped with: sensors, LIDAR (laser image detection and ranging), radar (radio detection and ranging), cameras, GNSS (Global Navigation Satellite System, that includes GPS, GLONASS among others) and High Definition Maps. Self-drive car is a symphony on-wheels orchestrated by complex algorithms coupled with software code. Around 200 million lines of code is required to build a top class luxury car today, the self-drive car will augment this even further. Asynchronous data from the sensors is analysed using algorithms and response is executed using actuators. Real-time HD maps are visualised on-the-go using Lidar, Radar and cameras. Access to GNSS via the navigation system module provides location co-ordinates while in motion. V2X platform enables data flow from the road infrastructure such as traffic signals, intersections, tolls and parking areas. Direct Short Range Communications (DSRC) allows self-drive cars to talk to each other. DSRC in combination with all other technologies described above prevent collisions and accidents. The key to success of self-drive cars, may not, fully lie with engineers. We have to also consider, deeply, social factors. In some scenarios, self-drive will empower various sections of our society with greater mobility, for e.g. people with special needs and the elderly of our society. Smart Cities of the future, will prefer self-drive vehicles to those driven by us. This is because, Smart City communication infrastructure will rely on data flow among all ‘intelligent devices’ and ‘self-drive vehicles’. Steering wheel drive will be seen as an anomaly by the Smart City system. Owning and driving such cars will be seen as a super luxury sport just as it is to own and ride a stallion today. Its ironical that the invention of the petrol engine automobile in 1886, eliminated the horse from the carriage and the self-drive car will eliminate the ‘driver’ from the carriage, perhaps in 2023. Welcome self-drive!

Mobileye and Delphi tie up for SAE level 4/5 automated driving solution for 2019

Automatic emergency braking systems — the safety technology that will soon be standard equipment on 99 percent of vehicles — vary widely in design and performance. All the systems tested by AAA are designed to apply the brakes when a driver fails to engage, however, those that are designed to prevent crashes reduced vehicle speeds by nearly twice that of those designed to lessen crash severity. While any reduction in speed offers a significant safety benefit to drivers, AAA warns that automatic braking systems are not all designed to prevent collisions and urges consumers to fully understand system limitations before getting behind the wheel.

In partnership with the Automobile Club of Southern California’s Automotive Research Center, AAA evaluated five 2016 model-year vehicles equipped with automatic emergency braking systems for performance within system limitations and in real-world driving scenarios.
### Technical Specification

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor</td>
<td>MTX 6258</td>
</tr>
<tr>
<td>Memory</td>
<td>100000 Tracking Records on Solid State Flash, 130K Erase and Program Cycle, 10 year data retention.</td>
</tr>
<tr>
<td>GSM Module</td>
<td>Quad Band GSM 850/900/1800/1900MHz; DC3 GPRS class 10</td>
</tr>
<tr>
<td>GPS Module</td>
<td>GPS6S acquisition / 21 tracking channels, Ultra high tracking/navigation sensitivity -165dBm, In-built patch antenna, 5 Meters Accuracy.</td>
</tr>
<tr>
<td>Antennas</td>
<td>Internal Antenna</td>
</tr>
<tr>
<td>Communication Interlase</td>
<td>TCP/IP on GPRS.</td>
</tr>
<tr>
<td>Record Storage/Buffer</td>
<td>10000 Tracking Records.</td>
</tr>
<tr>
<td>Ports</td>
<td>1-USB Device type, 2 Analogue (Fuel) and 2 Digital IO, 1 Ignition Input</td>
</tr>
<tr>
<td>Configuration</td>
<td>Recording delay, transmission delay.</td>
</tr>
<tr>
<td>Communication Scheme</td>
<td>TCP socket with Open Session.</td>
</tr>
<tr>
<td>Speed Sensor</td>
<td>GPS (default)</td>
</tr>
<tr>
<td>SIM Interface</td>
<td>Supports SIM card: 1.8V &amp; 3V Micro SIM</td>
</tr>
<tr>
<td>SMS</td>
<td>Supports Text</td>
</tr>
<tr>
<td>GPRS Packet Data</td>
<td>Class 10; Class 8 (Optional), Coding Scheme CS1 to CS4</td>
</tr>
<tr>
<td>LED Indicator</td>
<td>Processing, GMS, USB, USB Detection</td>
</tr>
<tr>
<td>Connectors</td>
<td>6 Pin power mate connector</td>
</tr>
<tr>
<td>Power Supply</td>
<td>Wide DC input voltage range (9V - 32V)</td>
</tr>
<tr>
<td>Current Consumption</td>
<td>300mA during tracking and 150mA during standby</td>
</tr>
<tr>
<td>Internal Battery</td>
<td>700mAh, 5 to 6 hr backup</td>
</tr>
<tr>
<td>Enclosure</td>
<td>ABS plastic casing with IP65 rating (IP 67 casing optional, at extra cost)</td>
</tr>
<tr>
<td>Temperature</td>
<td>Operating: -30°C to -60°C</td>
</tr>
<tr>
<td>Storage</td>
<td>-10°C to +55°C (Without Battery)</td>
</tr>
<tr>
<td>Dimension (mm x mm x mm)</td>
<td>80 x 65 x 30</td>
</tr>
<tr>
<td>Weight</td>
<td>120g</td>
</tr>
<tr>
<td>FOTA</td>
<td>Firmware upgrade over the air available</td>
</tr>
<tr>
<td>Other Interfaces</td>
<td>Tamper Alert Switch</td>
</tr>
<tr>
<td>Geo Fencing</td>
<td>Polygonal Geo Fencing available</td>
</tr>
</tbody>
</table>

### Our Quality Your Price...

### Our Other Products

#### Vehicle Tracking & Monitoring System

- **S101**: Optional with WiFi Available

#### Person Tracking

#### Remote Vehicle Diagnostics

- With ID card holder

#### CERTIFICATIONS:

- ARAI
- CE
- IPC

#### iTriangle Advantage
- Standalone, Plug and Play, Compact Tracking Device
- Advanced Power Management with Internal Battery
- Comprehensive Fleet Management Capabilities
- Driving Behavior Management
- Remote Monitoring, Control and Diagnostics of Equipment
- Data collection and Voice Communication
- Analog and Digital Sensor Support

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**Note:** We pursue a policy of continuous research, product development. Specifications & Features are subjected to change without notice.

**Design Development Manufacturing & Software Services**

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or, write to us at: customercare@itriangle.in

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International Updates

- Spireon SkyLink enables car dealers to tap connected car market
- nuTonomy launches first driverless taxi on the streets of Singapore
- Lexus to offer Scout GPS Link by Telenav
- Omnitracs launches FleetScience Digital Hub for transportation and logistics industry
- Advanced auto safety and convenience technology draw growing interest from tech-savvy consumers
- BQR rIXtress optimizes schematic testing in ADAS for Mobileye
- Hella Gutmann solution—full-round vision tool
- Autonomous car sensor startup Quanergy raises $90 million
- Truck platooning to boost global commercial vehicle ADAS market
- Zubie unveils its new range of fleet management & in-vehicle Wi-Fi solutions
- Innovation and technology are driving the future of personal mobility
- Octo Telematics joins initiative for tax relief on telematics for younger drivers
- GM-owned Cruise Automation tests autonomous Chevy Bolt in Arizona
- Toyota invests $22 million at University of Michigan for autonomous driving
- Global commercial telematics market to value USD 55.14 billion by 2021
- IoT platform revenues to grow €3 billion worldwide by 2021
- Israel-based autonomous vehicle startup Innoviz secures $9M in funding
- Allstate launches stand-alone telematics unit, Arity
- Connected car startup Automile raises $6.2 million
- Rohde & Schwarz unveils its new signal analyzer R&S FSWB85
- Automakers publish first cybersecurity best practice guide
- Ford expands its Android Auto services to all 2017 vehicles
- Self-driving bus by Mercedes-Benz completes its first 12-mile trip
- Vehicle automation to increase traffic congestion: HERE & SBD
- Germany: Black box to be made mandatory in autonomous cars
- Drivers asking to link insurance premiums with driving behaviour
- Toyota joins The Linux Foundation as a gold member
- Car Connectivity Consortium launches MirrorLink technology center in China
- Autonomous cars driving the market for new insurance services in UBI
- Tesla not keen to disable autopilot feature in its cars
- Continental forays into Asian market with new ADAS business unit
- Baidu and Nvidia team up to work on artificial intelligence for self-driving car
- LG’s connected car solutions to be powered with Skyworks
- Spireon SkyLink enables car dealers to tap connected car market
- Mercedes & Microsoft working together to launch connected office in cars
- Verizon expands its telematics base, acquires Fleetmatics
- Omnitracs launches asset management solution for vehicle tracking
- ABAX expands its footprint with a new office in China
- Automotive fuel delivery system market to grow with automobile demands
- Azuga plans to expand its operations in 10 countries
- TATA Elxsi picks SOASTA for connected car Initiative
- Telenav taxi on the streets of Singapore
devices
- Microchip & Amazon Web Services release security solution for IoT devices
- Carzonen.<.com sets to invest Rs 400 crore, eyes 5k-crore revenue by 2021
- Volkswagen sets up IT services arm in Pune, invests 3 million euros
- Motherson Sumi to raise Rs 3500 crore, receives investment from Sumitomo
- Rollr launches unified IoT telematics platform for connected driving
- Skoda Auto set to invest Rs 100 crore in India
- Bosch to manufacture two-wheeler ABS in India from 2017
- General Motors is re-evaluating its $1 billion investment plan in India
- Porsche looking to expand its presence in Indian auto market
- Cab aggregator Wiwigo raises 4 crore in new round of funding
- JBM Solaris to introduce electric buses in India, invests Rs 300 crore
- Visteon completes acquisition of AllGo Embedded Systems
- Meru Cabs raises $25 million in new round of funding from Brand Capital
- Sun Telematics raises Pre Series A funding from angel investors
- Logistics IoT startup Locanix raises INR 2 crore in new round of funding
- Bosch invests in revamping its research facility in Bengaluru
- Andhra Pradesh: Traffic violation & offences may become available in public domain
- Sugar mills in Maharashtra benefits from usage of telematics
- Lane departure warning system market to grow at a CAGR of 28.67%
- Connected car ecosystem market to be driven by ADAS & autonomous driving
- Microchip adds dual-mode Bluetooth audio products to its portfolio

India Updates

→ Mahindra would like to pioneer a driverless tractor
→ Scorpion Express, LogiNext partner to optimize operations using telematics
→ Telematics helps farmers connect with IoT devices
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Service
Improve customer service

On Time
Keep deliveries on time

Notification
Instant notification of your delivery fleet's activity

Find Location
Track accurate location of your valuable goods

Safe and Secure
Improve safety of your valuable goods

Vehicle Flexibility
Deliver your goods in any transporter's vehicle
**Upcoming Conferences**

- **Connected Vehicles 2017, January, Chennai**
  Connected Services ➤ Cyber Security ➤ Infotainment ➤ Autonomous Vehicles ➤ ADAS ➤ UBI

- **Vehicle Telematics 2017, April, New Delhi**
  Vehicle Tracking ➤ Fuel Monitoring ➤ Safety & Security ➤ Driver Behaviour ➤ Vehicle Health Monitoring

- **Smart Automotive 2017, August, Pune**
  Automotive Telematics ➤ Connected Vehicles ➤ ADAS ➤ Self-Driving Vehicles ➤ Vehicle Telematics

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