VIEW POINT

AUTOMOTIVE AFTERMARKET: TRANSFORMING THROUGH CONNECTIVITY

Connected Cars as a megatrend in the automotive industry is leading to the creation of exciting products, superior customer experience and opening up entirely newer business models. This strategy has brought the aftermarket domain at the doorsteps of a fundamental transformation, which has the potential of dramatic cost reductions and increased revenue opportunities in this most profitable area for the industry. The success, however, will depend on how the OEMs address the critical process areas and risks.

Infosys Knowledge Institute

Automotive aftermarket: Transforming through connectivity

Today's vehicles are highly sophisticated machines with hundreds of Electronic Control Units (ECUs) providing critical functionalities. In addition to being well networked internally, modern vehicles have also extended their connectivity to the external world, allowing for services like navigation, infotainment, telematics, diagnostics and software updates from the original equipment manufacturer (OEM) to be delivered over-the-air (OTA). Infosys has developed a viewpoint on connectivity-based features from hundreds of client conversations and research, and it can be found here.

In this paper, we elaborate on a fundamental shift in the aftermarket domain, specifically in the core processes of diagnostics and repair, and share our views on the critical aspects that OEMs need to address to fully realize the potential of this strategic initiative.


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23%
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Connectivity as a catalyst

Connectivity-based apps, functionality and services have proliferated in today's cars. This is in addition to a complex networked system of ECUs for core automotive functionalities. The requirement to manage aftermarket processes remotely is becoming a critical component of customer service strategy to meet the objectives of cost reduction, revenue enhancements, workshop productivity and customer satisfaction.

The traditional method for diagnostics and repair requires the vehicle to be present in the workshop, in a controlled environment and under the supervision of a skilled technician to meet a specific customer demand, whether fixing an issue or providing new functionality. A diagnostic routine is executed to identify the fix and if a repair is needed, plan for a repair activity. The repair is generally performed at a subsequent visit and could include ordering of parts or software, special tools, and assignment of correctly-skilled technicians.

This traditional diagnostics and repair process is inefficient, time-consuming, expensive, and inconvenient for all parties. Customers who must bring their car into the shop multiple times are not pleased, and shops must bear the cost of repeated visits.

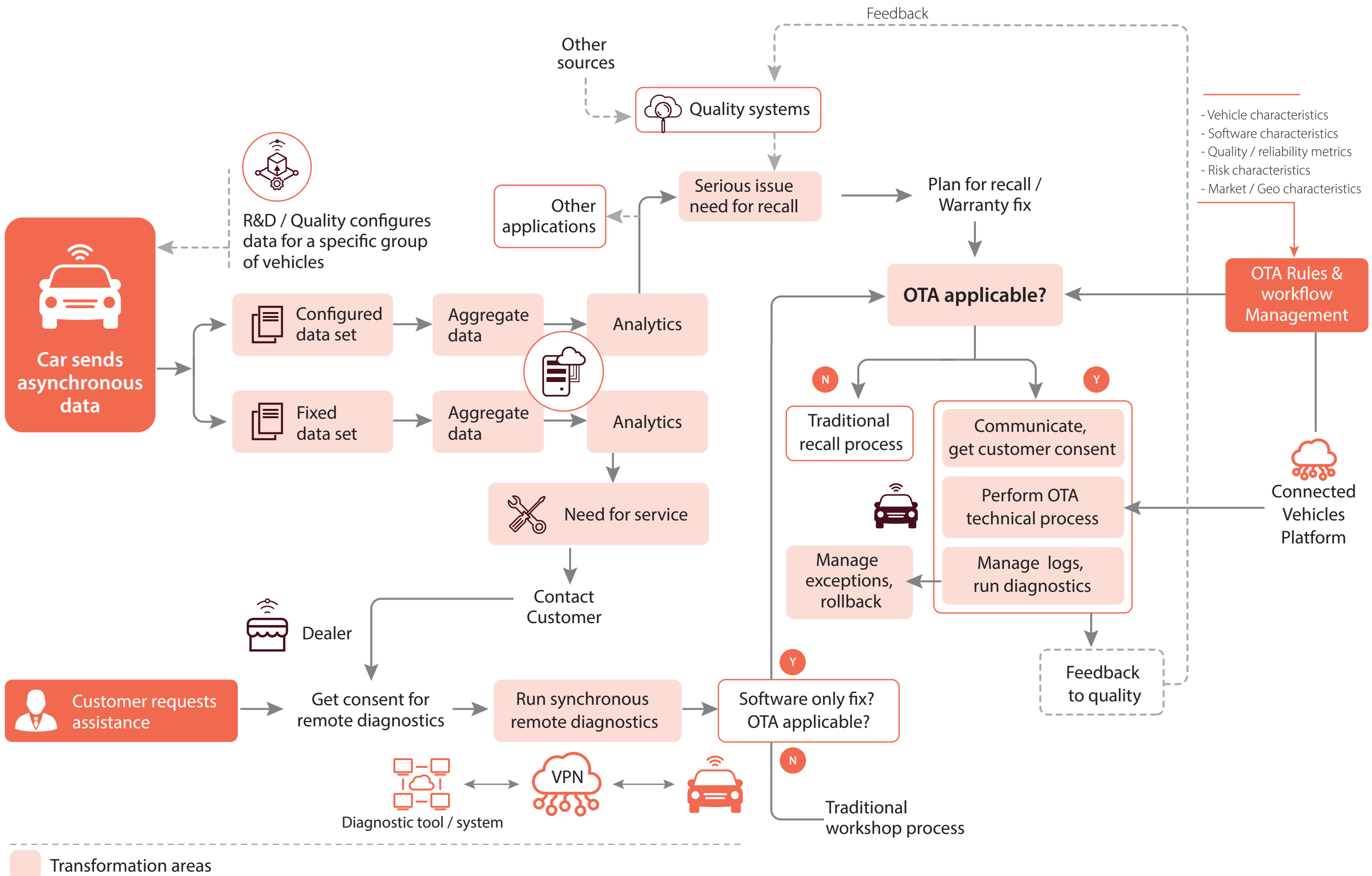
In the case of large software-only warranty issues and recalls, OEMs may have to bear hundreds of millions in costs in order to get the affected vehicles into workshops so needed software fixes can be applied. Vehicle software content is increasing exponentially every year, and software-only recalls are continuously increasing in proportion to overall warranty and recall campaigns. This makes the traditional repair model for software-only recalls unsuitable for costs, risks and customer satisfaction.

The ability of vehicles to connect to the internet blows up this outdated model. In vehicles with connectivity, workshops can remotely connect and diagnose problems, then begin preparing for repairs if they are needed. Software-only fixes can be done remotely over-the-air (OTA), dramatically reducing costs and repair time, and providing customers with a better experience.

While many OEMs are discussing this new connected opportunity, the infotainment domain has captured most of the attention. However, to fully exploit the potential of connectivity-enabled aftermarket processes, OEMs will require comprehensive process re-engineering. This transformed process should include a quality and risk management framework along with decision support mechanisms, particularly with respect to OTA updates given the high risks involved.

Diagnostics and repair

Diagnostics and repair are two core, intertwined aftermarket processes that will be transformed by connectivity and the resulting implications on processes and governance.



Remote diagnostics is an exciting area ripe for transformation wherein the need for the physical presence of a car in the workshop is eliminated, and instead the diagnostic information is sent to the workshop using connectivity. This brings up an entirely new aftermarket model.

There could be multiple ways in which a connected vehicle can send diagnostic information remotely to a technician in a workshop.

A simple option is a fixed-set asynchronous method where the vehicle sends a predefined set of data to the technician over the telematics network at specific events and intervals. This data set is largely static for a given vehicle and is configured in the car based on the diagnostic expertise gained over the years. This, when accessed by the technician, provides adequate information for assessing the condition of the car and to plan subsequent activities of the vehicle repair.

A more flexible option is a specific data set sent asynchronously based on a set of configurations by a third party for specific purposes. For example, the R&D team for a new model vehicle might check for potential warranty issues by configuring select data set for a select group of targeted vehicles under specific driving conditions.

While not as comprehensive as the synchronous method, the above two asynchronous methods deliver adequate information to address most of the general service needs as well as the analytical purposes.

The more advanced technique is where the workshop technician establishes a remote VPN connection with the vehicle thereby simulating a diagnostic session as performed in a workshop. This is applicable for directly addressing a single customer case on a need basis, and allows complete diagnostic capabilities as would be available with the physical presence of the car, and can even theoretically be extended for software downloads to the car.

Multiple technical solutions for such capability in the vehicles are being considered by OEMs that include the features, security, diagnostic protocols and tools. However, before this new diagnostic practice can gain widespread adoption, it has to be made an integrated process of workshop planning and execution. While it is just the first step to receive and interpret the diagnostic data, the subsequent process handoffs should be seamless, including planning for parts and/or software, estimation, checking against a knowledge base for similar issues and resolutions, appointments, and the actual repair and software updates.

On the commercial side, dealers might not be comfortable removing the in-house diagnostic step and reducing their revenue. Also, customers may not be comfortable sending vehicle data to a third party.

Remote Software Updates

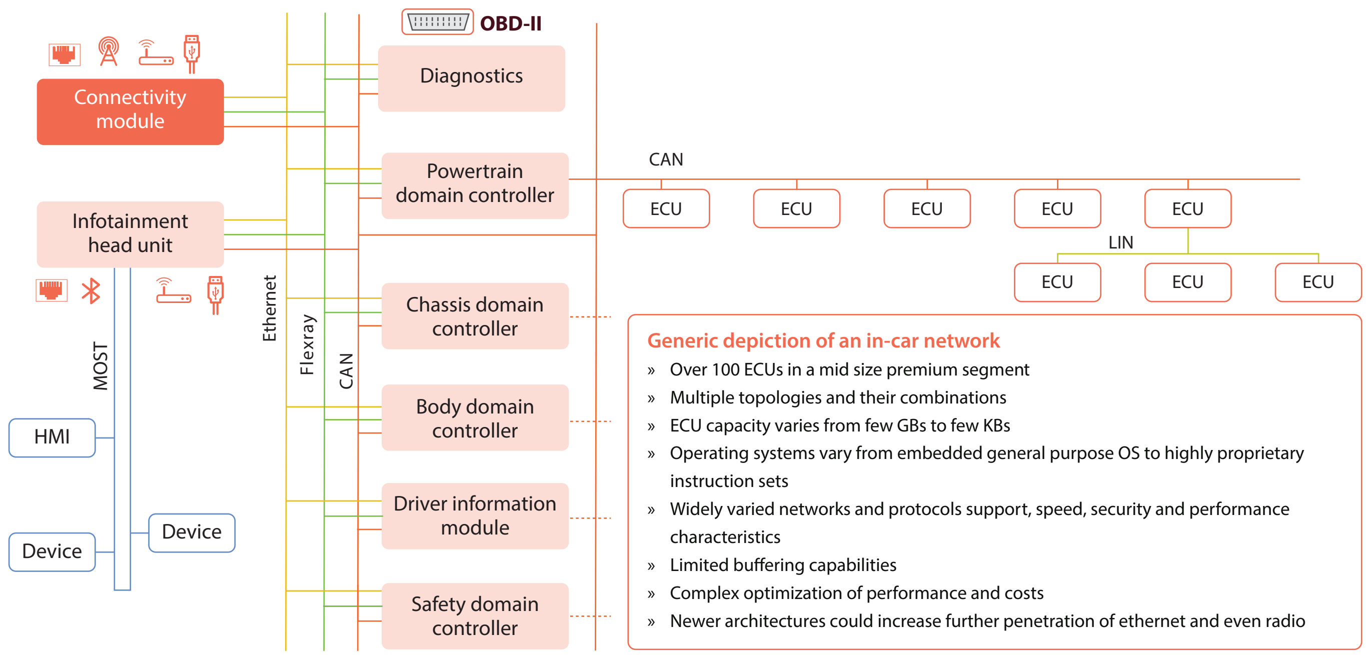
The more complex issue, however, is making OTA software updates. In a workshop environment where updates are applied manually, technicians can resolve any issues while the vehicle is stationary in a controlled environment. But if the vehicle is out on the road and an OTA update to a safety system component causes it to malfunction, a major safety concern can arise as a result of that software update.

Some of the fundamental aspects that need to be considered for an OTA software update are as below.

1. ECU architecture and configuration management

A typical premium segment vehicle architecture has over 100 ECUs, networked on multiple protocols, and with software size varying from a few kilobytes to several gigabytes. While connectivity does provide a high-speed connection to the external world, IP-based networks are generally limited to gateway and infotainment ECUs. The underlying network is a highly optimized Controller Area Network (CAN) bus, which has serious limitations on bus capacity, security and speeds. It further worsens where Local Interconnect Networks (LINs) are involved, though they are generally used on non-critical applications. Moreover, many diagnostics tools today have their own installers and flash block by block to the ECUs, with not so much buffering capabilities in the vehicle architecture itself. The OTA suitability for firmware updates will be different in such cases and, hence, the vehicle platform shall form the fundamental criteria for provisioning of OTA.

Further, as a process issue, a strong vehicle version management is critical for this capability. Cars are getting highly customized, leading to many different combinations of the same vehicle for a given market and customer initiated customizations and subsequent accessories additions. In these conditions, it is critical for the OEMs to hold a valid full software configuration of a given car that includes all the right versions for all the ECUs. While theoretically there could exist multiple working versions for the same car, there is no significant value seen in maintaining such versions over the complexity it introduces. Such configuration management discipline, process and systems are critical for OTA.



2. Reliability

The reliability of OTA software updates is a critical criterion for enabling such updates to a vehicle. The first task is the comprehensive validation of the software download process and assigning a reliability metric to it. Given the complex set of ECUs, signals, networks and the hundreds of software components, it is extremely difficult to list all the possible test conditions and scenarios for a logical test as is common with software testing. Instead, the automotive industry will typically opt for a statistical analysis of reliability. Under such a model, defining an acceptable success rate is complex and highly multi-dimensional, particularly when the number of cycles of validation has to be balanced with a desired reliability index and not go indefinitely. For instance, if an update is tested 100,000 times in a controlled environment and receives a score of 99.91, that might be good enough to update a music app, but what about brake software? Such analyses and metrics and, therefore, the decisions will widely vary with respect to the type of software, criticality of the situation, risk assessment, cost considerations, and also regional or market context.

3. Decision support

This leads to another important question: Who makes these decisions? Decision-makers must be equipped not only with reliability data, test data, and previous failure history, but the ability to weigh difficult choices. For example, if a certain vehicle needs its brake software updated, is the better choice to send that update OTA and deal with potential issues, or let drivers stay on the road with those vehicles until they visit a shop? It should also be noted that any initiative that has a context to risk and safety, would be of immense importance to market safety regulators and insurance companies. It is imperative for the OEMs to consider this aspect and include them as stakeholders in this process design. While OTA can substantially reduce costs and risks and enhance overall safety, this has to be articulated well with such stakeholders for their buy-in.

A comprehensive aftermarket process is needed that includes the multidimensional aspects of vehicle architectures, OTA reliability, quality, software risk assessment, and decision-enabling rules and metrics. The individuals making these decisions cannot take a position without adequate information to back up their decision-making. Without that framework in place, cost savings and improved customer experience from remote diagnostics and OTA updates will not be realized.

Overcoming barriers to adoption

The automotive industry lacks a holistic approach to this problem, and it is a major obstacle that keeps OTA updates from being fully implemented. OEMs have added technological features to vehicles without an integrated approach with the aftermarket processes which must leverage these features. In retrospect, this was the wrong approach, as it created a disconnect between the parties involved.

Transformation roadmaps should include quick successes to bridge this divide. Redesigning aftermarket processes with all stakeholders involved – and parties not operating in isolation – will enable these exciting new technologies to be fully leveraged. These roadmaps will require an understanding of the processes that need to change for quick wins to be realized. To achieve the ideal future state, this roadmap creation process also needs to be iterative and update longer-term milestone as technology continues to evolve.

The value of remote diagnostics and OTA updates must be clearly articulated to all parties for the rate of adoption to increase. Aftermarket providers need to understand how increased efficiency will improve their processes and generate more revenue, not less. OEMs need to be shown how OTA updates can remedy large-scale recalls in a matter of weeks, not months, and save them millions (if not billions) of dollars.

The automotive aftermarket remains a highly attractive domain, and connected capabilities like OTA Software updates offer challenges but significant opportunities. Companies willing to envision the new possibilities and transform their business and operating models will be in the driver's seat to realize the benefits.

Authors

Jeff Kavanaugh

Head – Infosys Knowledge Institute

Jeff_Kavanaugh@infosys.com

Srivathsan S

Senior Principal – Business Consulting

Srivathsan_S05@infosys.com

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For more information, contact askus@infosys.com

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