Cloud Based Vehicle Analytics: The Potential

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INTRODUCTION

In the wake of the recent incident involving the forging of emissions tests by VW, a host of new questions has arisen involving effective, reliable and cost effective methods to perform vehicle emissions testing. The solution of these problems may involve the cloud.

Themany benefits of cloud solutions are fairly well understood and accepted. For example, IDC's recent NA Global Technology and Industry Research Org IT Survey found that 71 percent of respondents are using, planning or researching cloud solutions, and 64 percent believe it is important to have subscription access to software. These findings reflect two advantages of the cloud — speed to insight and ease of data sharing and collaboration [1] While the potential benefits of preforming vehicle analytics on the cloud are great, there are issues of concern as discussed in this short white paper.

CURRENT STATE OF AFFAIRS

The technology is in its infancy as compared to that of the Internet.

Many people are concerned about making vehicle data available in the cloud, and for a good reason. If not done properly, it could make things worse. But it does not have to be that way. To begin with, in terms of security, privacy, freedom and safety, even the state of the art of the technology lags that of other Internet-based industries. Major advances has been made and continue to be made by researchers, developers and entrepreneurs to address motorists concerns. However, the current state of affairs should be understandable because, in engineering and technology, when new systems or applications are designed, not all design considerations are addressed at the same time or with the same level of importance. The first consideration that is typically addressed is at the functional level i.e. ensuring that the system performs its most basic functions. Often, how well or bad the system performs its basic functions is not addressed in a first phase and this is typically done in the second phase: performance. For many systems, addressing functionality and performance is enough. In the case of vehicle telematics and cloud-based vehicle analytics it is clear that just functionality and performance is not enough; there is a compelling case to address other issues as well and chief among them being security, safety and privacy. In fact, the way things are happening in telematics and cloud-based vehicle analytics is not new as it is somewhat natural. The development of the Internet followed the same steps and concerns over the years. About 20 years ago, most people had the same security, safety and privacy concerns about the Internet as they have about cloudbased vehicle analytics today.

But how is data available at the cloud going to solve some of today's most pressing issues involving emissions and engine performance testing, maintenance and repair? The key to the answer lies in On Board Diagnostics (OBD). OBD is highly standardized and has evolved over the years perhaps in directions not intended. The initial OBD standard, called OBD I, was issued in 1985 and the current version (OBD II) was issued in 1996, with OBD III on the horizon. Although in the planning stage for many years, OBD III has not been fully defined and there are currently several alternative technologies under consideration. We propose performing cloud-based vehicle analytics using techniques and methods derived from OBD II and OBD III.

OBD III and cloud-based vehicle analytics offers many possibilities but also dangers.
Cloud-based vehicle analytics is a new endeavor that opens up a sludge of possibilities for providing superior functions and services in the transportation sector particularly for emissions testing. In fact, cloud-based vehicle analytics is a compelling technology to implementing OBD III. CARB has issued a request for proposals (RFP) to implement OBD III involving: i) transponders ii) local access networks, and iii) satellites. Just the consideration of these technologies are making the general public concerned about issues involving freedom, over regulation, safety, confidentiality, security and other motorist rights. Chief among the concerns is that OBD III plans to broadcast a real-time analysis of a vehicle to government agencies, enabling all sorts of nasty possibilities [2].

Many people who are finding out what is possible with technologies involving OBD III or have read about some recent vehicle hacking stories have concerns, and understandably so because the technology is still in its infancy, at least compared to other Internet business use cases. The concerns are warranted, after all nobody wants a police officer issuing you a ticket after happily parking on a shopping center lot because you drove over the speed limit on your way to shopping and this information was collected in real time by road scanners and was wirelessly sent to law enforcement in real time. There is plenty of reason to be concerned. Another example is the possibility of designing a "kill switch" where the steering and braking system of your car can be remotely and wirelessly disabled while simultaneously locking all vehicle doors. Imagine this happening to you while driving 70 mph on a highway. In another example, a Jeep Cherokee was hacked remotely and wirelessly thanks to functionality offered by the OBD II protocol. Nobody foresaw all the possibilities and ramifications of OBD II functionality. Now that we have a clear picture of these possibilities, it is time to rethink OBD III as a long term solution and with a futuristic vision.

Forging, manipulating and otherwise circumventing emission and performance tests.
The much publicized and recent VW emission scandal has demonstrated that it is possible to use dubious schemes involving the forging, manipulating and otherwise circumventing emissions and performance tests. Thus we need practices, technology and regulation to avoid the aforementioned schemes from happening. Likewise, we need regulation and reasonable industry standards protecting motorists involving driver freedom, security, privacy, confidentiality and law enforcement involving data collected in real-time from our vehicles and shared with third parties - including government agencies. Much of the available material on the web and elsewhere gives the impression that having vehicle data on the cloud or vehicle hacking is common, and this opens the door for accidents and security breaches affecting motorists. While some of this is true, it is not a serious problem today although it has the potential of being one if issues are not properly addressed. Thus it is important to scrutinize and reassess current practices with an eye of improving them or creating new practices.

A PROPOSED SOLUTION: CLOUD-BASED ANALYTICS
Cloud-based vehicle analytics may solve many, if not all, of the issues and concerns regarding emissions, performance, repairs, maintenance, driving behavior, accident reconstruction and others. This requires the cooperation of all stakeholders including EPA, CARB, ASA, NHTSA, SEMA, OEMs and motorists. The proposed solution involves real-time collection of all in-vehicle data and uploading it to the cloud in such a manner that all of what can be done at a dealer shop through OBD II, can be also done with the vehicle data available at the cloud. The power, benefits and advantages of this solution must not be underestimated. Of course this solution will only work if concerns regarding privacy, security, confidentiality, safety and individual rights are properly addressed.

Uploading all of the massive in-vehicle data to the cloud for many vehicles on a daily basis is not without challenges. The primary of which isthe huge size of the data, estimated to be about 15 Gbyte per vehicle per day. Another challenge is the real-time logging of all of the in-vehicle data in a time synchronized manner. Yet another challenge is to automatically upload all of this data in a reliable fashion to the cloud. A further challenge is protecting the identity and confidentiality of the driver, vehicle (e.g, the VIN), data and the manufacturer. Most of these challenges have been overcome by a recent project. A proof on concept of this technology has been successfully completed at the Connected Car Laboratory (CCL) of Kettering University in Flint, Michigan. The proof of concept was recently demonstrated to a small group of automotive experts and involved classifying and compressing in-vehicle data, securing it using encryption schemes and using a reliable upload protocol to the cloud (patent pending). Although initial results are highly encouraging, further research and development still needs to be completed involving the verification and validation of the proposed approach.

Ensuring low emission levels, good engine performance, improving diagnostics, repair and maintenance, improving driving behavior, thwarting vehicle thefts, are some of benefits of the approach. But all of this must be be done while ensuring customers' and manufacturers' concerns about privacy, security, confidentiality, law enforcement, freedom and safety. However, there are dangers. If customer concerns are not properly addressed then cloudbased vehicle analytics could make the current situation even worse, a total nightmare for OEMS, drivers and the public in general.

SUMMARY AND CONCLUSIONS

Having in-vehicle data on the cloud is happening today and is paving the way to perform powerful data analytics on this data. Cloud-based vehicle analytics appears to be an advantageous technology to implement OBD III. More research is needed to ensure that cloud-based vehicle analytics is functionaly equivalent to analytics currently done through OBD II and to validate the entire approach so that concerns of multiple stakeholders are properly addressed. Cloud-based vehicle analytics offers the potential to re-engineer OBD III with what matters the most: improving emissions, fuel economy, maintenance and repairs all while addressing stakeholders concerns. The timing is right for in depth scrutiny and reassessment of the functions of the upcoming concept of OBD III in light of cloud-based vehicle analytics.

Acronyms

ASA	Automotive Service Association
CARB	California Air Resources Board
CCL	Connected Car Laboratory (at Kettering University)
EPA	Environmental Protection Agency
IDC	International Data Corporation
NHTSA	National Highway Traffic Safety Administration
OBD	On Board Diagnostics
OEM	Original Equipment Manufacturer
VIN	Vehicle Identification Number

References

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