BSQUARE

Eliminating Blind Spots in Commercial Trucking with IoT

Technology is becoming a critical business tool for truck manufacturers, fleet operators, and service centers. With stringent emissions regulations and upcoming deadlines for Electronic Logging Devices, now is the perfect time to evaluate and implement an Internet of Things (IoT) strategy. On-board diagnostics and telematics systems are a first step, but only provide a singular view and limited scalability. A more comprehensive view of truck health delivers reliability, improved uptime, and faster repairs; but this requires examining a larger and richer set of engine data together with additional data sources.

This paper describes what data sources and analysis are instrumental in helping achieve a 360-degree view of the truck health – whether of an individual truck or an entire fleet. Through illustrative business use cases, the paper highlights the benefits this type of IoT strategy can provide manufacturers, fleet operators, and service centers.

Achieving a 360-Degree View

Today's semi-trucks are highly complex revenue-generating machines outfitted with hundreds of sensors producing rich streams of information. Taken independently each piece of data provides a singular view of a particular piece of equipment. Coupled and analyzed together that same data can enable a holistic view of the entire vehicle, providing greater insight into operations of individual vehicles and the entire fleet. Although many manufacturers and fleet operators are using on-board diagnostics and telematics systems to improve their visibility into truck health, most are using just a small fraction of the total data available to drive positive business outcomes.

While manufacturers and operators understand that technology is important to remaining competitive, many are still hesitant to fully embrace it, or only focus on narrowly defined uses. The impending December 2017 federal deadline for implementing electronic logging devices (ELDs) presents an opportunity to reexamine technology strategies and move beyond the current, limited view.

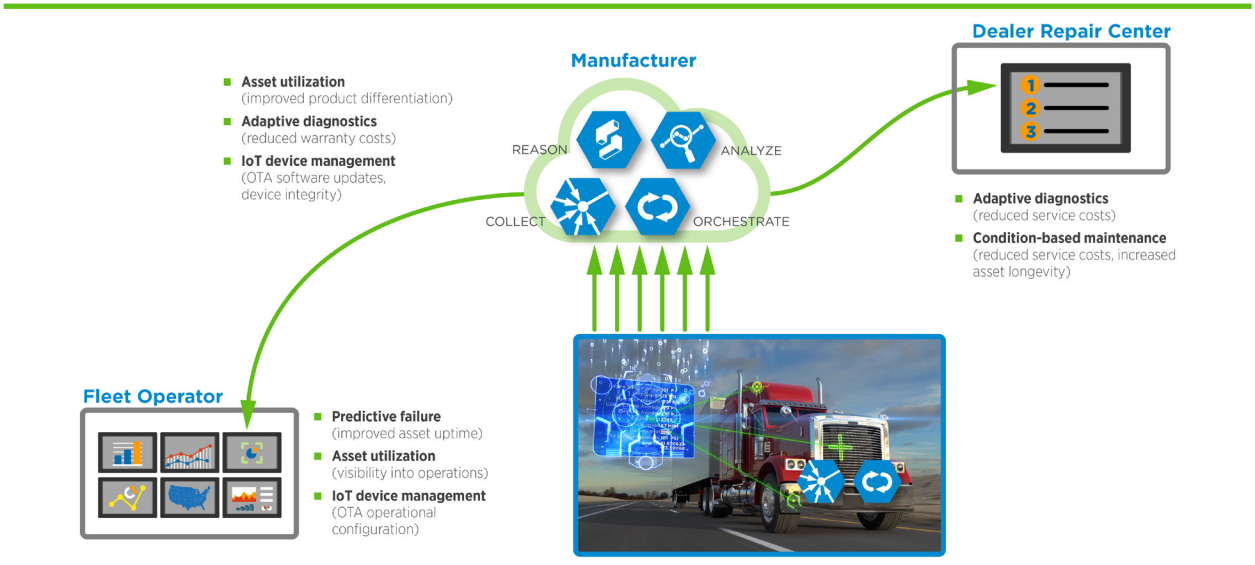

Figure 1
Complete IoT system in a transportation use case

Telematics and on-board diagnostic systems provide a wealth of information about truck engine health, but they only provide a singular view. To achieve a complete view, engine data needs to be combined with other real-time and historical data sources that can include things such as other truck subsystems, maintenance records, and environmental conditions to provide context. For example, a heat-related failure may have been avoidable if excessively hot weather was considered in addition to the truck's mechanical condition.

While it is common for diagnostics to focus on the engine of a truck, that singular view can sometimes result in inaccurate or misleading conclusions. This is due to the fact that many subsystems are interconnected and can contribute to single failure mode. In other cases, it requires information from more than one system to confirm the root cause to a fault.

Consider a situation where coolant temperature is rising. Since it can take some time before a fault is triggered, other systems on the truck can signal a potential problem more quickly. In this example, the origin could be a faulty water pump or a broken drive belt. Adding data from the HVAC system to the engine data provides more insight. If the HVAC system signals that the AC compressor is not turning then the drive belt is the likely cause.

Conversely, if a fault code is triggered indicating that the water pump is not turning, but the HVAC system reports no faults, the combined information increases the probability of a water pump failure. This is just one of many scenarios where information from one system improves the overall understanding of truck health.

Further, the combined data can be analyzed over time to determine what factors are contributing to failures. The resulting intelligence can be used to predict failures before they occur and improve maintenance and repair processes.

To illustrate, Kenworth wanted to improve the uptime and reliability of their trucks to become more competitive and win more fleet business. As a first step, they implemented a telematics system, but expanded their focus to incorporate their warranty service system so they could improve repair and reimbursement efficiency and reduce warranty costs.

By adding information about their different engine configurations and historical warranty, maintenance, and repair data to the mix, and then applying adaptive diagnostics, Kenworth was able to pinpoint the root cause of failures faster and predict future failures more accurately. Repair processes and warranty reimbursement improved as service centers received advance notice of what repairs trucks needed along with detailed repair plans. As a result, Kenworth has achieved shorter mean-time-to-repair (MTTR), greater uptime, and better reliability.

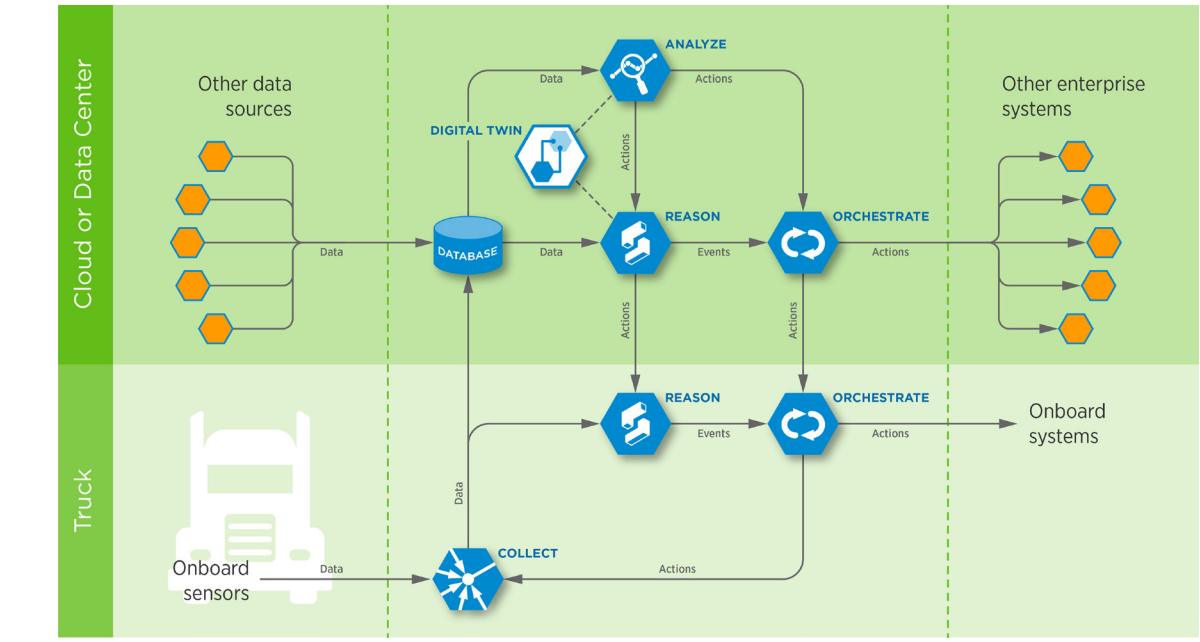

Figure 2
Elements of an IoT system

For manufacturers, establishing and maintaining a reputation for reliability and longevity is crucial for driving sales to fleet operators. Trucks with fewer failures and less unplanned downtime contribute directly to fleet operators' bottom line as they are more likely to keep running and generating revenue. Reliable trucks also help operators avoid towing, emergency service, and driver expenses from failures that occur on the road. Reputable brands help fleet operators help attract and retain drivers.

For instance, Peterbilt, was able to materially reduce MTTR and dramatically improve its "first time fix" ratio. This was accomplished by combining operating data from existing remote diagnostics and telematics systems on tens of thousands of trucks with historical repair data and workflow automation software. Adaptive diagnostics was used to analyze this vast pool of data and dynamically generate and continuously update diagnostic and repair steps based on repair history, factory configuration information, and engine diagnostics. By more quickly diagnosing the problem and using highly accurate repair plans developed from the diagnostic information, Peterbilt's service centers have significantly improved their efficiency and can more quickly train technicians.

Using the same approach, service centers also can improve their bay turnover and revenue stream by being able to more quickly and accurately repair trucks the first time using repair plans that let them know ahead of time what repairs will be needed.

Where IoT Can Help Now

Implementing a comprehensive IoT strategy that utilizes all of the truck's extensive engine data in conjunction with additional data sources generates not only a complete view of truck health, but also measurable business benefits. Specifically, three core IoT use cases can rapidly provide truck manufacturers, fleet operators, and service centers with a better ability to predict failures, apply adaptive diagnostics, and perform true condition-based maintenance.

Predictive Failure

This provides advance warning of engine failures to avoid expensive emergency repair costs and unplanned downtime. It also allows potential issues to be addressed before they occur, avoiding potentially catastrophic failures. By examining the flood of real-time engine data along with external data sources such as engine operating parameters, factory as-built configurations, maintenance and repair data across all connected engines in service, predictive reasoning can more accurately forecast potential failures. It also reduces the instances of false positives and false negatives. With advance warning of a pending failure, fleet operators can schedule service at a time and location with the least negative impact on operations. However, even with predictive failure capabilities, failures may still occur and result in unplanned downtime. In these cases, it is critical to identify the root cause of the problem and get the truck back on the road as soon as possible using adaptive diagnostics.

Adaptive Diagnostics

Adaptive Diagnostics accelerate troubleshooting and repairs by analyzing data with context and providing detailed, accurate repair procedures. Diagnostic Trouble Codes (DTC) are detected as they happen, and since failures often trigger multiple DTCs, sophisticated diagnostics analyze all active fault codes in conjunction with current operating parameters to determine the likely root cause and severity of the fault. Based on this information, repair plans with step-by-step procedures can be created, helping technicians fix it right the first time – and also helping new technicians become more productive in a shorter period of time.

While predictive failure and adaptive diagnostics are clearly beneficial to help predict failures and get them repaired more quickly, maintenance also plays a significant role in helping prevent failures and extending truck engine life.

Condition-based Maintenance

This helps reduce service costs and improve truck engine longevity by servicing trucks only when they really need it based on actual wear and tear and environmental conditions or other external factors. Typically, trucks are serviced at periodic intervals based on mileage or elapsed time. However, this approach often results in servicing more often or less often than necessary. Both can mean excessive expenditures from performing service before it is needed or waiting too long and having a failure and expensive repair occur during a too-long service interval.

By adopting IoT to enable these use cases, fleet operators can keep trucks on the road longer and, when service is necessary, get them running and generating revenue faster while reducing service costs. Service centers experience more rapid bay turnover, allowing them to service more trucks for increased revenues, in addition to being able to more accurately track parts use. Centers also enjoy faster warranty reimbursement as manufacturers receive more immediate notification of completed repairs. At the same time, manufacturers reduce warranty expenses, gain insight into ways to improve future product designs, and help build confidence in their brands.

Getting the Greatest Visibility with IoT

Getting the benefits described in the above use cases is not as simple as just pulling together multiple data sources and running some analytics. As large numbers of trucks come online, the sheer volume of data can overwhelm existing systems that typically rely on dashboards and human operators for interpretation and action. Often in those cases, the amount of data being analyzed is pruned to help manage the deluge, severely limiting the accuracy of analytics. Add other data sources to the mix, each of which may use widely different formats, protocols, and communications technologies, and it may seem impossible to effectively use it all.

IoT can expand visibility from a complete view of the truck to areas of your organization that interact with the truck by providing context and applying sophisticated analytics to the truck's engine data. Gaining a 360-degree view of the truck through IoT can be obtained by taking a staged approach to your IoT implementation as your requirements and needs progress.

- **STAGE 1 – DEVICE CONNECTIVITY AND SIMPLE DATA FORWARDING:** Connected engines generally provide this foundational first stage of data collection and forwarding, without which the subsequent stages are not possible.
- **STAGE 2 – REAL-TIME MONITORING:** Monitoring and visualizing the data coming in from connected engines – often provided by telematics systems – begins to provide improved awareness of engine conditions. Dashboards and alerts allow human operators to take actions to correct error conditions flagged by onboard sensors or diagnostic systems.
- **STAGE 3 – DATA ANALYTICS:** Here, applying complex event processing and adaptive analytics to truck data that is paired with multiple sources of historical and real-time complementary data greatly increases awareness and understanding of truck health.
- **STAGE 4 – AUTOMATION:** Adaptive analytics provide a wealth of insight and awareness. Automation allows the system to become progressively more intelligent by using dynamic rules to orchestrate complex actions across multiple areas of the organization, including service ticketing and inventory systems. This stage provides the full benefit of use cases like condition-based maintenance and asset utilization.
- **STAGE 5 – ENHANCING ON-BOARD INTELLIGENCE:** By adding intelligence and processing capabilities directly onto engines, analytics and actions can be performed at the network edge or even when equipment is offline. Bringing the logic to the data provides much greater accuracy, conserves data storage and network bandwidth, and enables use cases beyond the ones discussed in this paper.

The Time to Adopt IoT is Now

Technology is no longer an optional business tool. It is mandatory, not only to comply with regulations such as emissions and ELD requirements, but to allow truck manufacturers, fleet operators, and service centers to flourish and compete effectively. Developing a holistic IoT strategy to support your technology initiatives can provide a much wider aperture into truck health and associated business processes than implementing individual purpose-built systems that are limited in application and value. Take your business to the next level by using IoT as the foundation of your technology strategy and begin reaping business value that will grow as you proceed through the stages of adoption.

About Bsquare

For over two decades, Bsquare has helped its customers extract business value from a broad array of assets by making them intelligent, connecting them, and using data collected from them to improve business outcomes. Bsquare software solutions have been deployed by a wide variety of enterprises to create business-focused Internet of Things (IoT) systems that can more effectively monitor assets, analyze data, predict events, automate processes and, in general, optimize business outcomes. Bsquare couples innovative software with advanced professional services that can help organizations of all types make IoT a business reality.