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Beyond Telematics: **IoT**

Manufacturers of commercial trucking and heavy construction equipment have wisely invested in telematics capabilities designed to improve the efficiency of their products. The next step is Internet of Things (IoT): comprehensive, multifaceted technology that takes efficiency, uptime, predictive reasoning, and cost savings to the next level.

Many manufacturers of heavy duty commercial vehicles, and even construction equipment, have embraced telematics as a value-add for their products. Telematics capabilities allow them to offer more sophisticated products that can reduce operating costs for their customers. However, while these capabilities are important, they represent only the first step on a path toward true Internet of Things (IoT)-enabled products and the broader array of benefits that can result. It is critical, both for manufacturers and fleet operators, to avoid falling into the trap of thinking that telematics (or M2M) is the same as IoT.

IoT goes substantially beyond basic telematics in order to deliver more comprehensive use cases that result in measurable improvement in targeted business metrics. Whereas telematics systems are often characterized by data collection, normalization, and visual display so that human operators can detect anomalous conditions, IoT applies machine learning, rule processing, and data analytics in order to automate the entire process, improve scaling capabilities, enhance accuracy by several orders of magnitude, and predict anomalous events before the occur. The result is not just a system that reports on the health of fleets of equipment, but rather a holistic system that continually improves asset uptime—driving toward the holy grail of zero unplanned downtime—while optimizing asset efficiency, reducing service and warranty costs, and providing feedback into the product design process.

Telematics is an important starting point

Every IoT initiative begins with smart connected devices and it is here that telematics plays a foundational role. Typical telematics systems provide basic networking, including SIM cards for cellular connectivity (often over multiple wireless carrier networks), extract error codes from engine management systems, and transmit that data, along with other data such as GPS coordinates, to cloud databases. Once there, web portals are frequently built to enable visual inspection of that data. A typical scenario might be trucks positioned on a map and color coded to indicate health. While such as system has value and these initiatives should be pursued, they do not constitute IoT systems and the range of business benefits that can be realized is constrained.

What is "telematics"?

Dealing precisely with complex technology is made more difficult by the fact that the terminology used to describe that technology is often used inconsistently. For the purposes of this paper, "telematics" includes machine-to-machine (M2M) technology used to connect mobile capital assets with cloud-based (public or private) databases and applications. In that context, telematics and M2M are essentially identical. Internet of Things (IoT), as described herein, includes a host of additional technologies used to drive specific business uses cases such as predictive failure and data-driven diagnostics.

Managing data volume

With most telematics initiatives, manufacturers and fleet operators encounter a number of problems. First, the sheer volume of data they have to deal with quickly becomes overwhelming. True, most of this data is informational or reflects minor diagnostic codes, but the noise generated by this river of data makes it more difficult to detect truly anomalous conditions. For this reason, data reporting frequency and data granularity are often reduced in order to make it more manageable for human operators (and, not incidentally, make sure network and storage costs don't balloon out of control). But this directly and adversely impacts the ability of these systems to perform the basic function they were designed for—detect operational problems. In other words, they often cripple the system they built because it is overwhelming.

Modern engines at the core of heavy duty trucking and construction equipment are capable of generating tens and even hundreds of data points, sometimes with a frequency as high as twenty times per second. All of this data has value and can be used to increase the accuracy of predictions and improve the efficiency of the equipment. Artificially reducing the quantity of data extracted from operating assets reduces the ability of these systems to detect, let alone monitor for failures. But, unfortunately, operators often find themselves correcting for the wrong problem—rather than reduce the volume of data so that humans can cope with it, they should be removing humans from the equation.

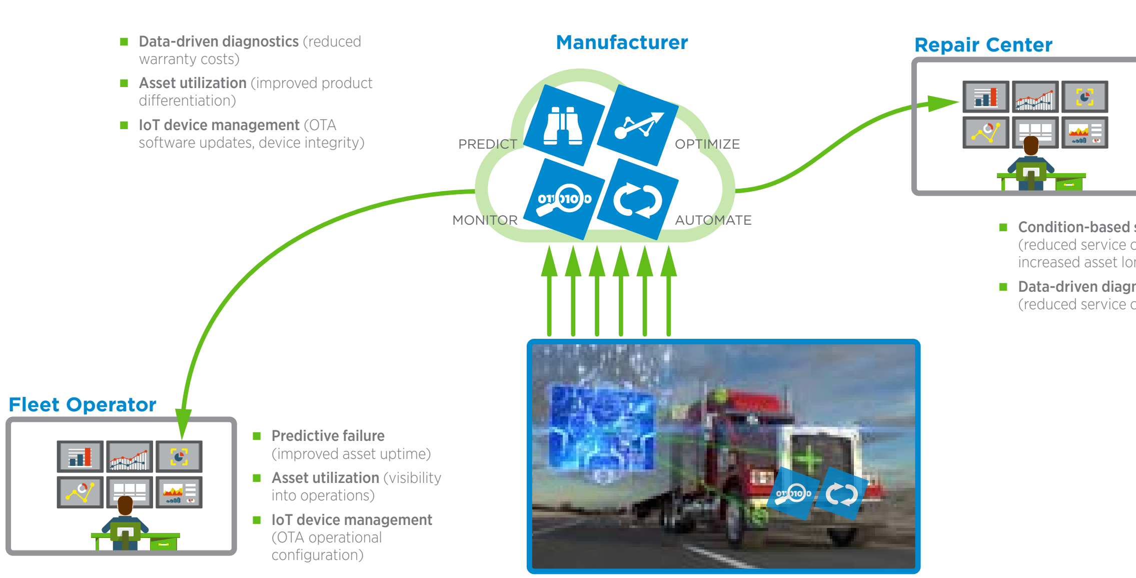

Figure 1
Complete IoT system in a transportation use case

Detecting complex events

To make matters worse, most of these systems perform a very simple classification of error codes ranging in severity from minor (e.g., washer fluid is low) to major (e.g., engine is overheating). What they are looking for are diagnostic codes indicating the need for servicing of the vehicle either immediately or after dropping the current load.

However, because of the relatively simplistic classification methods and lack of robust data analytics, many manufacturers still endure large numbers of false positives (the truck was sent in for servicing but resulted in no problem found) and false negatives (the truck should have been sent in for servicing but was not). This results in still-too-high servicing costs and still-too-low asset uptime. The reason is that actual service-inducing events are often much more complex than a single diagnostic code can convey.

Experience has shown that being able to look at historical data, along with surrounding and contextual data, in addition to data coming off the truck,

IoT use cases

Predictive failure – Given historical and contextual (surrounding) data, analytics can be harnessed to identify leading indicators to failures and search for those indicators among rivers of incoming real-time operational data. Experience has shown that even limited historical data or data lacking meaningful granularity, can predict failures with sufficient accuracy to substantially reduce downtime. As more data is collected these systems become progressively more intelligent and more accurate. With sufficient warning, fleet operators can schedule services at a time and location that does not adversely impact operations.

Data-driven diagnostics – Even with advanced predictive failure capabilities, service-impacting incidences may still occur. In these cases, data-driven diagnostics can be utilized to determine the optimal repair plan, thereby reducing mean-time-to-repair (MTTR), service costs, and warranty expense.

IoT device management – IoT-enabled fleets, while delivering important business benefits, also entail complex technology added to already sophisticated capital assets. This technology includes on-board software applications, drivers, and operating systems that require periodic over-the-air update. Although IoT device management is a necessary requirement for IoT system in general, this capability can be used to dynamically alter asset behavior. For instance, vehicles configuration for "rookie drivers" might call for lower overall power ceilings. Currently, this requires a service stop to adjust configuration settings; with IoT device management this can be done over the air.

Condition-based servicing – In far too many industrial settings, equipment servicing is performed according periodic schedules, e.g., changing the oil every three thousand miles. While this might have been the optimal approach with unintelligent or disconnected assets, the result is a very high probability that equipment is either under-serviced or over-serviced. With IoT, assets can be serviced with greater precision, improving longevity and further reducing service costs.

Asset utilization – The actual operation of devices in the field can provide insight to product designers and fleet operators alike. This insight can be used by designers and engineers to improve the quality and reliability of their products. It can also be used by operators to improve overall fleet efficiency.

Asset optimization – Of critical importance in the operation of any capital intensive asset is the efficiency with which it operates. In trucking, measures of efficiency include not only the obvious, such as fuel economy, but also the not-so-obvious, such as the frequency with which service is required. With IoT, digital models of optimally performing devices can be constructed. These models can then be compared to actual performance by devices in the field and prescriptive actions can be automatically taken to bring under-performing assets into compliance.

often results in event profiles that are more of the form "if a, b, and c occur within 30 minutes of each other and d does not occur, then trigger a major event" than the more simplistic "if a then b" common to basic remote diagnostic systems. But these types of complex events are virtually impossible for humans to detect by looking at dashboards, portals, or monitors, no matter how sophisticated they are. The only way to detect these types of conditions is for software—not humans—to look for them.

Moving from Telematics to IoT

Fortunately, for manufacturers that have already implemented telematics systems, the movement to IoT is a fairly logical progression from what they have already done and can be accomplished with minimal disruption to existing systems.

Step 1 – Extract greater value from existing data streams. Without altering their existing systems in any way, manufacturers can deliver inbound data to a cloud-based IoT system in addition to the systems currently consuming that data. This relatively simple integration allows existing data to be then used to drive predictive reasoning, data-driven diagnostic, and device optimization applications.

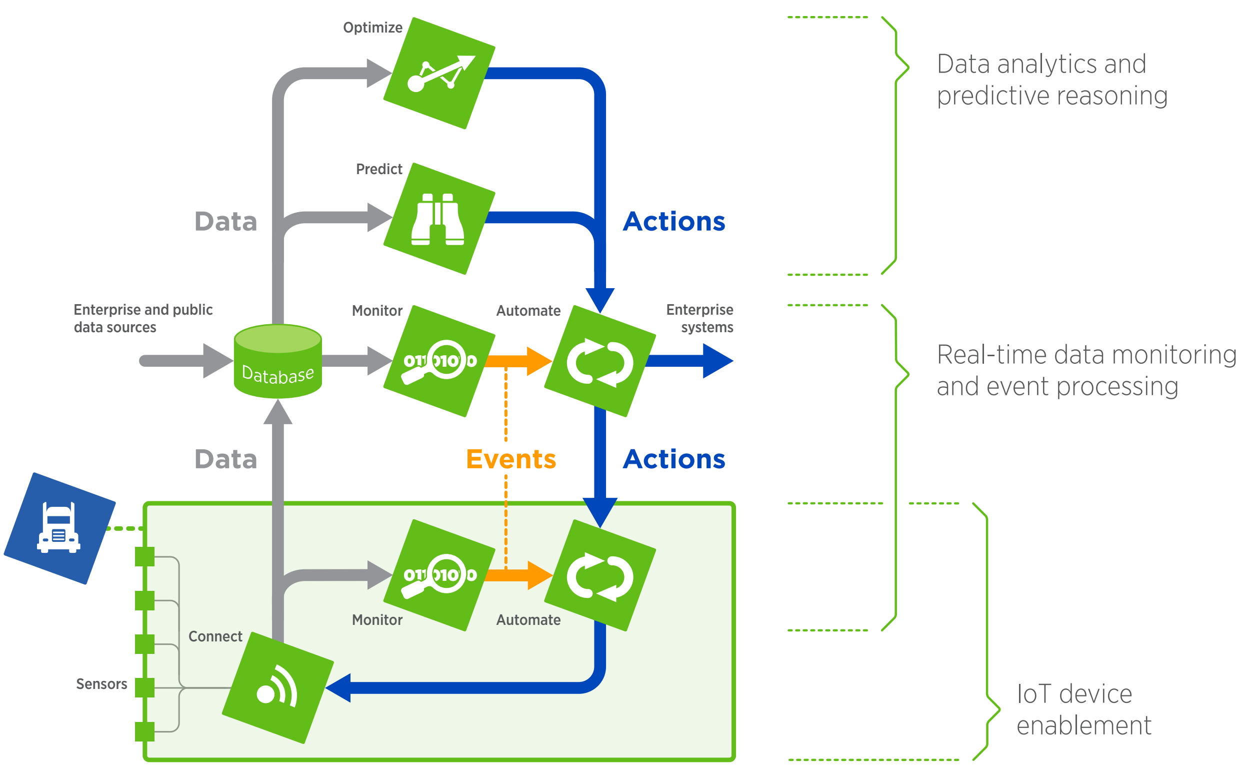

Figure 2
Elements of an IoT system

Step 2 – Add intelligence to on-board telematics gateways. Most existing telematics gateways are designed to extract data from onboard sensors and deliver that data over cellular connections. As described above, that data is almost always constrained in order to minimize network cost and reduce operator complexity (i.e., avoid information overload). But IoT technology is capable of performing onboard monitoring, rule processing, and event handling. This step can further improve asset uptime and optimize performance but does require new software to be added to existing telematics gateways. This step also enables, possibly for the first time, over-the-air software and configuration updates.

Step 3 – Greater control over asset configuration. Virtually all telematics systems are unidirectional; data is collected from the truck and delivered to cloud databases. But IoT includes the capability for cloud applications to orchestrate real-time changes in the operating parameters of in-motion vehicles.

In summary, M2M in general, and telematics in particular, ushered in the era of "connected fleets." While this resulted in a number of positive outcomes, it really represented only the first tentative step toward "connected *intelligent* fleets" as enabled through IoT. IoT allows for a growing range of business benefits centered around increasing asset uptime and reducing overall service and warranty costs. In effect, telematics is not IoT but it is the first step toward IoT.

Bsquare: the business of IoT

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.

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