Analytics at the Edge: Real-Time Results in the Industrial IoT

The Quicker Path from Analysis to Action
EXECUTIVE SUMMARY

Deriving value from the Industrial Internet of Things (IIoT) has traditionally relied on collecting data generated by connected devices and then aggregating it in a centralized, cloud-based system for batch analysis. Not only does this cloud-based architecture for analytics cost a lot, due to the infrastructure required to support it, but it’s not agile, and the tools and techniques can’t scale easily to handle the increasing data volume and velocity. In addition, since these traditional techniques are based on after-the-fact analysis, what’s missing are opportunities based on real-time insights that would allow proactive action while these insights are still fresh and relevant. With advancements in artificial intelligence and the push to move greater compute power to the edge, the ability to execute analytics on devices at the edge of an IoT system makes it possible to automate decisions and initiate action in real time, without having to cycle data through to the cloud and then send decisions back to the device. This paper explores the trend toward edge analytics, contrasts it with traditional cloud-based approaches, and looks at the benefits this new model can yield in monetizing the IoT.

TABLE OF CONTENTS

Executive Summary ................................................................. 2
Rethinking the Big Data Analytics Model ........................................ 3
Intelligence Where It’s Needed ..................................................... 3
Axon Predict Analytics for VxWorks: A Seamless Edge Analytics Solution ........ 4
Conclusion: Eliminate the Middleman ........................................... 5
References ............................................................................. 6
RETHINKING THE BIG DATA ANALYTICS MODEL

The rise of Big Data, coupled with the advancement of predictive analytics, is arguably the biggest driver in business transformation over the past two decades. Enterprises have sought to harness the vast reserves of data generated by their various activities and leverage it to improve operational efficiency, maintain a competitive advantage, and open up new business opportunities. The consulting firm Deloitte has observed a trend of enterprises evolving from being simply “data-driven” to being “insight-driven” organizations. And, according to a study by IDC FutureScape, 75% of large manufacturers are expected to update operations with IoT and analytics by 2019 to mitigate risk and speed time-to-market.

Moreover, this traditional “business intelligence”—the strategies and technologies used for data analysis of business information—is being augmented if not supplanted by predictive analytics. Where business intelligence looks at the rearview mirror to understand what has already happened, predictive analytics peers through the windshield to better anticipate what lies ahead, enabling enterprises to make decisions and take actions to gain an advantage. The bridge between data and action has been the data scientist, the individual tasked with making sense of the data in order to make business decisions.

Critical infrastructure IoT and software-defined networks added exponentially to the accumulation of Big Data for analysis. Yet the Big Data model has remained largely the same: collecting data from edge devices and storing it in a “data lake,” possibly for subsequent analysis by data scientists who use predictive analytics to glean insights and determine an optimal course of action.

While this model is useful or even essential in macro-level operational analysis and decisions, it has some drawbacks relative to the everyday performance of individual devices, particularly in typical control systems. Think of the time it takes simply to collect the data, organize it, analyze it, develop recommendations, and initiate action—a period of latency during which conditions could change materially.

What’s more, the sheer volume of data generated by edge devices can make it difficult to collect and store all the information in a single, centralized cloud environment. And this isn’t getting any easier or cheaper to do. According to Cisco, global data on the IoT/cloud is expected to grow from 3.9 ZB per year in 2015 to 14.1 ZB per year by 2020. In addition, the transmission and storage of massive data sets related to business operations raises considerable security concerns, putting precious intellectual property at risk.

INTELLIGENCE WHERE IT’S NEEDED

One possible solution to these business challenges is to push intelligence closer to the edge—to the gateway and even to the device level—in order to react to data insights in real time, decreasing the response latency caused by the transmission of data to the centralized cloud. And while the amount of data is growing massively, we can also be smarter about what data we actually analyze by tagging it with proper metadata. IDC reported that in 2013, only 22% of the data in the digital universe would have been an actual candidate for analysis; by 2020 this will grow to 37%, mostly because of the growth of data from embedded systems. If we look at the Cisco global data report again, that would give us 5.2 ZB of IoT/cloud data in 2020 to analyze, which is still much better than having to analyze all 14.1 ZB. Edge computing is a natural next step from cloud computing.
Today, with the advancement of computing capabilities and applied mathematics, analytics have evolved from a tool data scientists use to make sense of collected data to autonomous, data-driven applications. The marriage of Moore’s law and analytics has made it possible for high-value solutions to perform advanced analytics more effectively, quickly, and inexpensively than ever before. The old model of fishing in the data lake is now being augmented by a form of “self-service” analytics, in which autonomous solutions at the edge recognize patterns and initiate the appropriate optimization or corrective actions themselves, without the intervention of data scientists.

With edge analytics, there is virtually zero latency between analysis and response. Edge analytics also decreases infrastructure requirements and the associated costs by reducing the volume of data transmitted, stored, and analyzed by the centralized cloud system. By taking advantage of increasing compute power and distributed analytics packages moved to the edge, system developers no longer need to build additional cloud solutions, reducing infrastructure costs.

Edge analytics also dramatically increases the opportunities for developing IoT solutions to run in “disconnected,” cellular, or intermittently connected environments. Such a solution would be easier to secure from cyberthreats because it would limit exposure of a key point of vulnerability, namely the “pipe” from the network to the control system.

One of the most commonly cited IoT use cases is predictive maintenance, in which edge devices tell operators when equipment is showing signs of wear and predict when repair work can be scheduled. Imagine if a device controlling a piece of equipment could automatically take corrective action when the machine reached a certain threshold—relieving pressure, reducing temperatures, slowing operation, or taking any of a number of steps, up to and including alerting operators in specified instances. Consider devices that are expensive, difficult to maintain, and generally disconnected from the cloud, such as drills on oil rigs, wind turbines, cranes, or conveyors. For these complex, disconnected devices, edge analytics proves its worth exponentially. By avoiding latency and initiating a real-time response, edge analytics can further reduce the risk of costly damage and downtime in an industrial or critical infrastructure environment.

After all, financials are a key driver for using data analytics. Deloitte’s “2016 Global Manufacturing Competitiveness Index,” created in combination with the U.S. Council on Competitiveness, found that in the United States, executives consistently stressed predictive analytics; smart, connected products that support IoT; and advanced materials as their highest-priority technologies, vital to their companies’ future competitiveness.

Table 1. Global CEO survey: Ranking of future importance of advanced manufacturing technologies by executives

<table>
<thead>
<tr>
<th>Advanced Manufacturing Technologies</th>
<th>U.S.</th>
<th>China</th>
<th>Europe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predictive Analytics</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Smart, connected products (IoT)</td>
<td>2</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Advanced materials</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Smart factories (IoT)</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Digital design, simulation, and integration</td>
<td>5</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>High-performance computing</td>
<td>6</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Advanced robotics</td>
<td>7</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Additive manufacturing (3-D printing)</td>
<td>8</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>Open source design/Direct customer input</td>
<td>9</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Augmented reality (to improve quality, training, expert knowledge)</td>
<td>10</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Augmented reality (to increase customer service and experience)</td>
<td>11</td>
<td>9</td>
<td>11</td>
</tr>
</tbody>
</table>

Source: Deloitte Touche Tohmatsu Limited and U.S. Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index

AXON PREDICT ANALYTICS FOR VXWORKS: A SEAMLESS EDGE ANALYTICS SOLUTION

Wind River® has a long history of IoT innovation, with an extensive portfolio of integrated technologies for IoT solution development, deployment, and ongoing management. The core of our capabilities is VxWorks®, the industry-leading real-time operating system powering billions of embedded and IoT-connected devices. More than 3.17 billion IoT-connected devices are expected by 2020 for business vertical-specific applications, such as manufacturing field devices, process sensors for electrical generating plants, and real-time location devices for healthcare, according to Gartner’s latest projections. Meanwhile, GE anticipates that the industrial Internet market segment will show growth to $225 billion during this same time frame. Given this massive surge in expected data, Wind River has teamed up with Greenwave Systems, developers of the AXON Platform® for IoT, to integrate VxWorks with the AXON Predict™ Platform, the fully contained edge analytics engine.
AXON Predict Analytics for VxWorks enables VxWorks developers, original equipment manufacturers, and their enterprise customers to realize the cost savings and performance benefits of real-time edge analytics in a single, seamless solution, while reducing cybersecurity risk and operational latency. A key feature of the integrated solution is a visual analytics user interface. This visual interface enables industrial IT and business users to monitor and interpret analytics activity on edge devices, without the need for a data scientist’s analysis. Visual edge analytics capabilities make it easy to develop advanced analytics scripts quickly, through a rich, interactive interface that includes predefined pattern, computational, and learning templates. These enable the system to recognize baseline, normal behavior of end devices as well as patterns that indicate anomalies and degraded behavior. An action framework allows the analytics engine to execute customizable programmatic actions when specific patterns or conditions of interest arise. Figure 3 shows an example use case for a wind farm.

Figure 3. AXON Predict Analytics for VxWorks

With AXON Predict Analytics, you can look at both macro and micro trends with real-time data from multiple sensors. For instance, you can select to have AXON Predict Analytics forecast the future state of a sensor based on a historical trend. In Figure 5, the yellow highlight identifies a single macro, polynomial trend. In Figure 6, individual trends are calculated for a selected time dimension; highlights identify micro, polynomial trends.

Figure 5. AXON Predict multi-sensor view macro trend analysis

Figure 6. AXON Predict multi-sensor view micro trend analysis

CONCLUSION: ELIMINATE THE MIDDLEMAN

The conventional Big Data analytics model relies on human intervention to draw insights from data, analyze options, make decisions, and initiate action. This Big Data model introduces huge latency between data collection, decision making, and implementation of corrective actions, which could lead to unnecessary downtime and lost revenue. Edge analytics represents a new paradigm, one in which analytics-powered, autonomous systems can diagnose issues, recognize optimizations, and take the appropriate action in real time, whether that means alerting operators as necessary or simply initiating an automated response. Today’s advanced analytics solution eliminates the gap between insight and action, enabling IoT critical infrastructure systems to operate with greater precision, remain competitive, deliver economic benefits, and, in some cases, identify new business opportunities. And the data is supporting the trend toward moving to the edge. According to IDC, by 2019 at least 40% of IoT-created data will be stored, processed, analyzed, and acted upon close to, or at the edge of, the network. As the volume of IoT data escalates beyond the capacity of cloud-based analytics and data scientists, edge analytics will be the solution to monetize the IoT. And that day is coming faster than we can imagine.
REFERENCES


