Smart industry

E-HANDBOOK

Edge computing for manufacturing

Trucking, material handling, discrete manufacturing: Many producers drive edge compute use.

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How AI, edge computing, IoT and the cloud are reshaping vehicle-fleet management

Leveraging a distributed-computing environment that optimizes data exchange as well as data storage saves bandwidth for a swift data experience.

By Sumit Chauhan, co-founder and chief operating officer of Cerebrum X

As companies look to modernize their vehicles, the benefits of connected vehicles could make them the new standard, with particular benefits related to fleet management. In fact, 86% of connected-fleet operators reported a solid return on their investment in connected-fleet technology within one year through reduced operational costs.

Furthermore, connected fleets with advanced telematics technology offer additional benefits in terms of managing and maintaining vehicles. Another study illustrated a 13% reduction in fuel costs, along with improvements to preventive maintenance. It also showed a 40% reduction in harsh braking, indicating modifications to driving habits that could both contribute to parts longevity and improve driver safety.

LARGE AMOUNTS OF DATA ARE DIFFICULT TO PROCESS

Vehicle fleets, insurance providers, maintenance and aftermarket companies are all looking to harness more of this intelligent telematics data. However, the amount of data generated keeps growing. As a result, these businesses have more data than ever at their disposal to help make informed business decisions. But, this vast amount of data brings in new challenges in capturing, digesting and analyzing the entirety of the information in a cost-effective manner.

To truly be effective and useful, data must be tracked, managed, cleansed, secured and enriched throughout its journey to generate the right insights. As a result, companies with automotive fleets are turning to new processing capabilities to manage and make sense of this data.

EMBEDDED-SYSTEMS TECHNOLOGY HAS BEEN THE NORM

Traditional telematics systems have relied upon embedded systems, which are devices designed to access, collect, analyze (in-vehicle), and control data in electronic equipment to solve a set of problems. These embedded systems have been widely used, especially in household appliances, and the technology is growing in the use of analyzing vehicle data.

The existing solution in the market is to use the low latency of 5G. Using AI and GPU acceleration on AWS Wavelength or Azure Edge Zone, vehicle OEMs can offload vehicle processors to the cloud, when feasible. This approach enables traffic between 5G devices and content or application servers hosted in wavelength zones to bypass the internet, resulting in reduced variability and content loss.

To ensure optimum accuracy and richness of datasets and to maximize usability, sensors embedded within the vehicles are used to collect the data and transmit it wirelessly between vehicles and a central cloud authority, all in near real-time. Depending on the use cases that are increasingly becoming real-time oriented—think roadside

assistance, ADAS and active-driver score and vehicle-score reporting—the need for lower latency and high throughput have become more important for fleets, insurers and other companies leveraging the data. However, while 5G solves this to a large extent, the cost incurred for the volume of this data being transmitted to the cloud remains cost prohibitive. This makes it imperative to identify advanced, embedded compute capability inside the car for edge processing to happen as efficiently as possible.

THE RISE OF VEHICLE-TO-CLOUD COMMUNICATION

To increase the bandwidth efficiency and mitigate latency issues, it's better to conduct the critical data processing at the edge—within the vehicle—and only share event-related information to the cloud. In-vehicle edge computing has become critical to ensure that connected vehicles can function at scale, due to the applications and data being closer to the source, providing a quicker turnaround and drastically improving system performance.

Technological advancements have made it possible for automotive embedded systems to communicate with sensors, within the vehicle as well as the cloud server, in an effective and efficient manner. Leveraging a distributed-computing environment that optimizes data exchange as well as data storage, automotive IoT improves response times and saves bandwidth for a swift data experience. Integrating this architecture with a cloud-based platform further helps to create a robust, end-to-end communications system for cost-effective business decisions and efficient operations. Collectively, the edge/cloud and embedded-intelligence duo connect the edge devices (sensors embedded within the vehicle) to the IT infrastructure to make way for a new range of user-centric applications based on real-world environments.

This has a wide range of applications across verticals, where resulting insights can be consumed and monetized by the OEMs. The most obvious use case is for aftermarket and vehicle maintenance, where effective algorithms can analyze the health of the vehicle in near real-time to suggest remedies for impending vehicle failures across vehicle assets like engine, oil, battery, tires and so on. Fleets leveraging this data can have maintenance teams ready to perform service on vehicles in a far more efficient manner, since much of the diagnostic work has been performed in real time.

Additionally, insurance and extended warranties can benefit by providing active driver-behavior analysis so that training modules specific to individual driver needs can be created, based on actual driving history and analysis. For fleets, the active monitoring of both the vehicle and driver scores can enable reduced TCO (total cost of ownership) for fleet operators to reduce losses owing to pilferage, theft and negligence while, again, providing active training to the drivers.

POWERING THE FUTURE OF FLEET MANAGEMENT

AI-powered analytics leveraging IoT, edge computing and the cloud are rapidly changing how fleet management is performed, making it more efficient and effective than ever. The ability of AI to analyze large amounts of information from telematics devices provides managers with valuable information to improve fleet efficiency, reduce costs and optimize productivity. From real-time analytics to driver-safety management, AI is already changing the way fleets are managed.

The more datasets AI collects with OEM processing via the cloud, the better predictions it can make. This means safer, more intuitive automated vehicles in the future with more accurate routes and better real-time vehicle diagnostics. ◻

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Case Study: Expanding edge capabilities for end users

A systems integrator is building on a foundation of edge-computing platforms to deliver smart solutions.

By Tim Shope, vice president of operations and technology at Avid Solutions

Processing and manufacturing end users are increasingly expecting product suppliers and systems integrators (SIs) to go beyond simply meeting basic automation needs.

Certainly, equipment must start, stop, interlock and perform as needed for production. But these systems must also provide rich information and diagnostics, so users can operate and maintain equipment at peak efficiency. This accelerating sophistication is compelled, in part, by end-user requirements to do more with less, with these demands met by implementing a range of improved hardware, software, and networking technologies.

For industrial operational technology (OT) systems, the term 'edge' has developed to describe the field locales at facilities, manufacturing sites, and remote locations where digital devices interface with sensors and actuators for monitoring and control. Modern automation and computing solutions must survive the rigors of the OT edge, while permitting seamless connectivity to on-site and cloud-based systems via information technology (IT) infrastructure. The case studies below describe how Avid Solutions converged OT and IT for their clients.

DOING MORE AT THE EDGE

End users are accustomed to the easy availability of information via consumer applications and the internet, and they are looking for the same level of data accessibility for industrial systems, an experience commonly referred to as the Industrial Internet of Things (IIoT). They want to remotely monitor and control their systems, and they need to analyze IIoT data for optimizing operations and responding rapidly to issues.

Proven elements such as programmable logic controllers (PLCs) and embedded human-machine interfaces (HMIs) will continue to play a role, although they are not ideal with regards to cybersecurity and data handling. PC-based systems offer the right performance when properly implemented, but many manufacturers don't have access to the multi-discipline OT and IT teams, or to the data center and networking-infrastructure resources, to support this type of solution. Concurrently, industry suppliers and SIs have been searching for the best way to support their clients and create modern yet practical edge-capable solutions.

Following are two application examples where the Avid Solutions team developed solutions meeting these needs.

SUPPORTING SCALABLE PHARMA

Many industries are shifting to standardized modular designs, enabling re-use of design effort while providing more prefab and test options. Adding modules also is an effective way to quickly scale-up production, while minimizing required onsite installation and startup labor.

From an automation standpoint, modularity concepts can be thwarted as designers search for the best balance between deploying computing resources on each module or centralizing computing for many modules. Going too far in either direction can introduce cost and performance problems.

For one such project, the Avid Solutions team was formulating the most efficient way to architect the computing infrastructure for remotely deployable production skids. Standard automation platforms could be mounted on-skid, but lacked the desired capabilities. On the other hand, a centralized server environment would be very expensive to procure, install, and maintain—and complicated by the need to support skid quantities ranging from one to dozens.

The Avid Solutions team designed a ztC Edge redundant pair installed on-board each skid as the cost-effective and high-performance answer. Each skid benefited from complete self-sufficiency from an automation, visualization, data handling, and computing standpoint—while skids could still be arranged as peers in any number necessary, and then supervised as a whole to achieve production goals.

Figure 1: Remote terminal locations are challenging sites for implementing digital technologies, so systems like the Stratus ztC Edge are the best solution for providing maintainable IT capabilities designed to perform in the OT environment.

REMOTE TERMINAL SOLUTION

Industries as varied as fertilizers, oil & gas, food & beverage, and more often rely on liquid or dry bulk material handling for transfers of raw materials, finished products, or both. Terminals are where trucks, railcars, or barges are loaded and unloaded, and a company may operate dozens or hundreds of these facilities at remote sites around the country (Figure 1).

Remote terminal locations are typically lightly staffed and have very little electrical/instrumentation/controls support. Centralized computing does not make sense for these remote sites, but each does need to communicate information back and forth with the enterprise, and ideally establish automation system consistency between sites.

In this case, the Avid Solutions team determined a ztC Edge redundant pair installed at each terminal site hit the sweet spot of capability. This was the right solution logistically and economically, especially considering several virtualized servers could be run on one compact platform to perform all computing roles. Remote technical personnel can now access the local systems over the internet, and local staff are easily engaged to change out hardware parts in the unlikely event of a failure.

Using this type of solution, operations of all sizes can realize the advantages of modern converged OT/IT designs. Each site functions as well or better than a traditionally automated operation, while gaining the remote support and data access functions required to improve operations.

AN EDGE-COMPUTING PLATFORM

Figure 2: Modern automation and information systems of all types require edge-capable computing to merge IT communication capabilities with OT environments. This example shows a redundant pair of Stratus ztC Edge devices installed in separated locations.

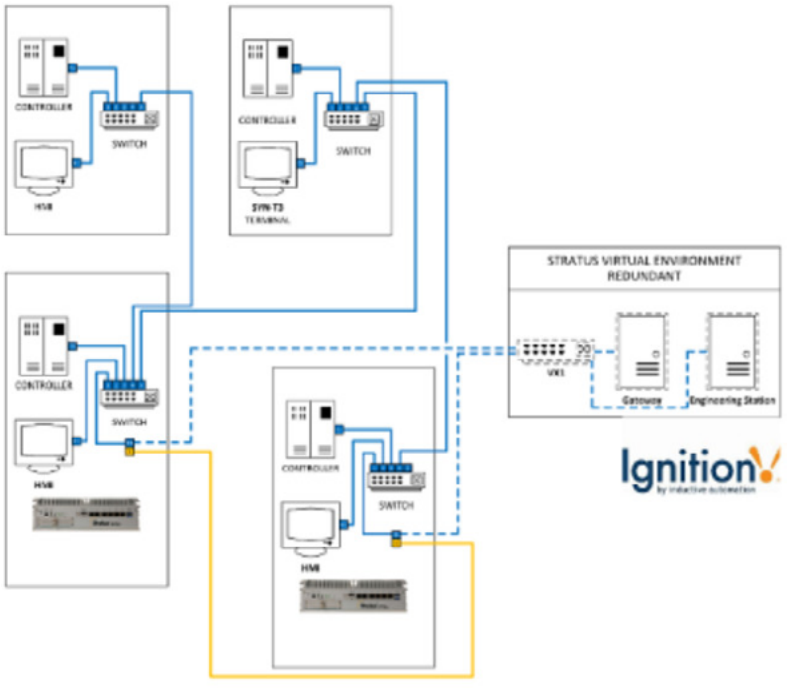

Figure 2: Modern automation and information systems of all types require edge-capable computing to merge IT communication capabilities with OT environments. This example shows a redundant pair of Stratus ztC Edge devices installed in separated locations.

The preceding examples of OT/IT convergence show the increasingly common need for architectures integrating OT-sourced data with IT-based systems. Some architectures allow for edge computing redundant pairs to be separated geographically for better resilience (Figure 2), while other systems such as production skids can install the redundant pair right on the equipment (Figure 3).

Due to the increasing volume of edge-generated data and the need for low-latency processing, edge-capable computing has become vital. Stratus Technologies realized the business-critical edge computing and IIoT challenges facing many industries and designed their ztC Edge platform (Figure 4) to address these issues by providing:

Industrial-grade robust and compact form-factor installs almost anywhere, even in a small control panel on-board machinery or equipment skids.

Native virtualization via a built-in hypervisor, enabling developers to employ multiple independent operating systems and applications of their choice.

Efficient hardware designs to minimize power consumption and heat generation.

Deployed in pairs (which can be physically located some distance apart for best effect), the ztC Edge system is redundant and only a single spare CPU needs to be stocked.

Self-protecting and self-monitoring phone-home support services drastically reduce unplanned downtime.

End-user local personnel of nearly any skill level can easily replace problem hardware with simple plugged connections.

After hardware replacement, software automatically restores, replicates, and synchronizes between CPUs.

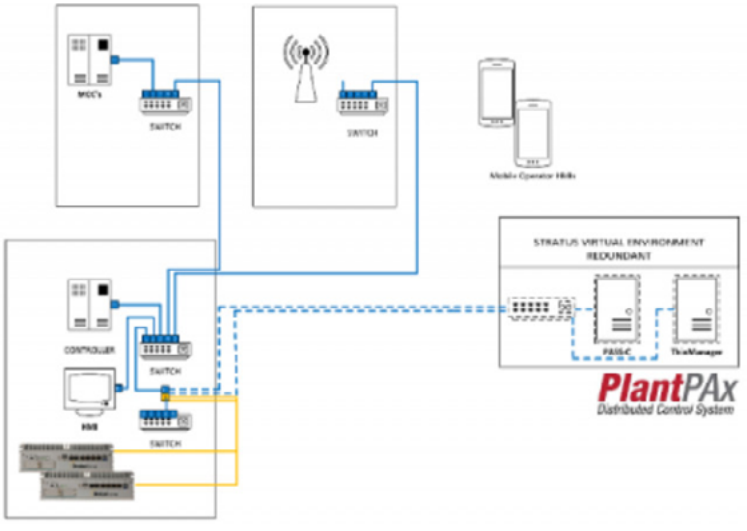

Figure 3: Skid-based designs can use a Stratus ztC Edge device pair installed right on the equipment.

Figure 4: The Stratus Technologies ztC Edge platform enables exceptionally robust computing to be installed right at the operational edge to support OT/IT convergence.

This type of platform can be configured to run core HMI applications, support remote/mobile visualization, act as a gateway between multiple intelligent devices, function as a store-and-forward data historian, perform data analysis and pre-processing, and more. The ztC Edge thus combines all the computing characteristics needed for SIs to build a supportable high-performance IIoT edge automation solution.

CONCLUSION

Industry is transforming and looking to incorporate contemporary IT technologies to reach the next threshold of productivity. To do so, today's end users of all sizes are preferring a more open and interoperable approach, implemented by leveraging commercial off-the-shelf technologies.

End users still need to support their systems over the entire lifecycle, but favor options which can be serviced and maintained by the average technician, with remote support from in-house subject-matter experts or external SIs as needed.

Integrating complete automation and IIoT systems demands a wide breadth of knowledge. SIs like Avid Solutions must be familiar with countless brands of PLCs and HMI products, smart instrumentation, and specialized industrial communication protocols—as well as IT-based hardware, software, cybersecurity, cloud computing, and networking technologies. By building upon computing options like the Stratus ztC Edge platform, designers can create distributed architectures to provide optimal performance. ◻

Figures and graphics courtesy of Stratus Technologies and Avid Solutions

GET AN EDGE ON YOUR NETWORK

COMPUTERS & CONTROLLERS

- Concurrent analytics and real-time control
- Data gateway between OT and IT
- Local processing, low latency
- Data aggregation for Cloud memory optimization
- Linux operating system

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Does the industrial edge look different in Europe?

Manufacturers need compute power closer to where data is generated to turn connected devices into smart systems.

With the recent news that Lumen Technologies is expanding its edge-computing services into Europe, we got to thinking about edge adoption domestically vs. across the pond. Here, we connect with Steve Grabow, Lumen Technologies senior vice president of edge computing, to get his perspective at this moment of growth. Take a look…

Smart Industry: What are the most drastic differences with edge adoption in the industrial space domestically vs. Europe, Asia and other markets?

Steve: Data sovereignty and privacy considerations are key drivers for adoption of edge computing in Europe and many other countries globally. GDPR and other data-privacy laws can prohibit code or data from existing outside specific geographic boundaries. This can constrain data and analytics teams from adopting centralized/cloud-based environments. By localizing analytics in edge environments, data remains close to its originating location, increasing the likelihood of compliance and decreasing the level of risk to businesses.

Smart Industry: Why is this the case?

Steve: Vast amounts of data is produced by IoT, sensors, cameras and other technology at the customer premises. Edge computing offers efficiency and performance opportunities that make it an attractive alternative or complementary venue.

For example, retailers are looking to video analytics, tied to point-of-sale systems that manage inventory shrinkage. Imagine a self-checkout where a customer does not need to scan an item before placing it in the bagging area. Video analytics are required to identify the input action. This action then triggers a review of items that have been scanned within the point-of-sale system. These systems must work together in real time to gather, analyze, and act on the data to ensure the experience was as expected.

Speed is critical to optimize the customer experience and reduce loss. If the system takes too long to interpret the action, the result will be a poor customer experience or continued inventory shrinkage. Now imagine this at scale across multiple lanes and hundreds of shoppers per day. The application must work through an immense amount of data in milliseconds, which can only be supported by edge computing to achieve the desired outcomes.

Smart Industry: What about differences with edge-computing adoption among manufacturing verticals domestically and globally?

Steve: The motivation for edge-computing adoption among manufacturers is consistent globally. Manufacturers need compute power closer to where data is generated to turn connected devices into smart systems. And they need ultra-low latency to ensure real-time systems control.

Quality assurance is the lifeline of a manufacturing facility. Failure to identify product that is out of specification quickly results in loss of time and raw material. It introduces rework. It also can lead to equipment failure and can compromise worker safety. A factory line that goes down, even for a short period of time, can cost a company millions of dollars.

Fine-tuning the automation and reducing the variation in output results in optimal productivity. The systems that collaborate to analyze and tune automation need to be perfectly synced. Moving the compute farther from the point of production increases risk to the system. It is

for this reason that most smart-manufacturing applications reside on the premises. However, IT-infrastructure management is not necessarily a core competency to manufacturers. Edge computing can help solve these challenges by providing a managed cloud solution, on the premises or in an edge datacenter, to provide the proximity and resiliency needed in a familiar cloud model.

Smart Industry: What do you see changing with edge computing in the industrial space in the coming years?

Steve: Lumen is investing in edge computing. We see this as an immense growth area and expect adoption of edge computing to grow in the industrial space, as well as numerous other industries, over the next few years. ◻

How the scarcity of truckers hurts manufacturing (and how to fix the problem)

Ensuring that an autonomous truck operates safely and effectively requires the power of a data center at the "rugged edge."

By David Raun, CEO of One Stop Systems, Inc. (OSS)

According to the American Trucking Associations (ATA), at current trends the driver shortage could surpass 160,000 by 2030. ATA estimates that, in the next decade, the industry will have to recruit nearly a million new drivers into the industry to replace drivers exiting the field due to retirements, driver burn-out, compensation and poor benefits. These are the challenges facing transportation executives in securing a robust driver pool.

However, the challenge of driver shortages does not end with the trucking industry. Rather, the scarcity of drivers directly affects the larger manufacturing sector.

HOW SO?

Consider that disruptions in supply chains due to transportation bottlenecks create negative feedback loops relative to production forecasting, logistics, shipping, transportation costs and business in general.

Also read: The 3 biggest takeaways from the supply chain crisis.

Against this backdrop, manufacturing and transportation leaders are searching for solutions, which can streamline operations and control cost structures. One such solution is autonomous trucking delivered through artificial intelligence technology.

AUTONOMOUS TRUCKING IN ACTION

People are familiar with autonomous cars, yet most individuals are stunned to learn that autonomous trucks are already on the road with hundreds of thousands of miles logged on delivery routes.

There are many advantages to autonomous trucking for the manufacturing sector, with the prime benefit being a substantive reduction in travel times, doubling utilization and load capacity.

A typical coast-to-coast journey for a long-haul delivery trucker is four days. Autonomous trucks can reduce this time by half due to an 11-hour restriction on driving times for traditional truckers in a 24-hour period; autonomous trucks can be on the road for 22 hours and only require time for fueling.

For manufacturers, this time-savings means significantly reduced time-to-market, and greater transparency in their planning and logistics scheduling.

And as delivery times are reduced, companies are reducing their expenses. The bottom line: 2X the productivity equals 2X the profits!

FACTORS DRIVING AUTONOMOUS ADOPTION

Several dynamics are in play regarding the increased utilization of autonomous trucking. Leading the list is the sheer market forces of demand. The economics are so strong that trucking companies and manufacturers are interested in Autonomous Driving Levels 4 and 5. Here's a breakdown:

Level 0 Momentary Driver Assistance
Level 1 Driver Assistance
Level 2 Additional Assistance
Level 3 Conditional Automation
Level 4 High Automation
Level 5 Full Automation

Another compelling reason for adoption is the ongoing rise of e-commerce, which is forecast to grow rapidly, and could increase from $3.3 trillion in 2022 to $5.4 trillion in 2026, according to Morgan Stanley.

Accelerating e-commerce will directly translate to increased manufacturing, and more trucks on the road to facilitate supply delivery.

And business leaders know this, which is why major companies are heavily investing in this technology—Amazon, UPS, Fed Ex, Walmart, Peterbilt, Freightliner, Daimler and Bridgestone.

Additional benefits to those who are committing to autonomous trucking include improved fuel efficiency and the elimination of safety issues associated with driver fatigue.

TECHNOLOGY & INNOVATION

Ensuring that an autonomous truck operates safely and effectively is a challenging proposition, and requires the power of a data center at the "rugged edge." This edge computing must function at the highest levels of performance in harsh environments. In the case of a truck, the hardware must survive extreme conditions of vibration, heat and moisture, while processing and storing an enormous volume of data that must be offloaded quickly to the cloud for additional analysis.

Edge-computing hardware has unique power requirements, and must possess the most advanced modular, highest-density, fast-compute and memory capabilities. Trucks were never designed to support a 2,000-watt supercomputer on board, so the challenges are complex.

An autonomous truck is an innovation marvel with sensors, cameras, lidar, and radar as well as compute and storage hardware with enough performance capabilities to replace a human driver. In addition, AI systems provide computation and analysis, and autonomous-software solutions deliver efficiency and reliability.

AUTONOMOUS EVOLUTION

Autonomous trucking operates at various levels of complexity, relative to the routes it operates. This is a critically important point for manufacturers, as the most common utilization is a vehicle that operates on only highways from one transfer hub to another. This is called hub-to-hub. A second, more complex application involves a dock-to-dock trip, requiring turn capability and city-street navigation. As technology and data-analysis evolve, this full capability will improve and prove extremely valuable to manufacturers from a cost perspective.

In the not-too-distant future, autonomous cars will be the norm; however, autonomous trucks are already here and changing the manufacturing and transportation industries. It is likely you have shared the road with one of these vehicles.

Three trends that will shift the edge-computing industry

By Jason Andersen, Stratus Technologies vice president of business line management

Edge computing is a technology that has been on the market for several years but has recently seen rapid adoption as businesses are finding unique new use cases. Since the platform operates outside the data center, sometimes on the plant floor close to where the data is collected and used for real-time decision-making, industry experts are forecasting that the technology will continue to see massive expansion.

In fact, new data from Stratus Technologies and Espalier (formerly Boston Analytics) highlights key use cases and verticals projected to drive edge-computing adoption, with the industry projected to grow by almost $10 billion through 2026. Industries like supply chain, oil and gas, digital manufacturing, and life sciences will drive edge computing's growth as they adopt the technology to reduce latency, ensure uptime and expand operations outside the plant floor.

However, as more organizations invest in edge-computing platforms, it's important that they understand where the technology is today and what the future of it looks like, so executives and employees can make informed decisions with their data. As demand for edge-computing platforms grows significantly, businesses should look to understand key industry trends when they are selecting the right platform for their business. Three trends that the edge-computing industry is currently experiencing include the need for more capacity, an increase in data storage and an IT trickle-down effect. Let's explore…

THE NEED FOR MORE CAPACITY

Recently, edge-computing users have been looking for platforms that offer more capacity while reducing their infrastructure without disrupting operations, and several factors are playing a role in driving this need. First is the pent-up demand stemming from the COVID-19 pandemic. The manufacturing industry was one of the biggest victims of supply chain delays caused by the pandemic, and there has been an increased demand for goods across the board. Businesses with complex supply chains in the manufacturing industry experienced the most challenges, as their production is vulnerable to disruption due to shortages and inputs from other businesses.

As companies adjust following more than two years of disruptions, they are starting to deliver more goods and looking to digitally transform through platforms (like edge computing) to enhance operations and remain competitive. As a result, data volume has increased as more data is being collected and stored by smart devices, and edge-computing users need more capacity to make the most informed decisions to drive business results.

Next, data frequency, the notion that data is being collected from devices and programmable logic controllers (PLCs) in shorter intervals, is pushing processing, networking and memory requirements. Also, the combination of new workloads to satisfy new requirements around analytics and digital twins is driving the need for more memory and virtualization. With IT standardization, along with the

addition of IT tools for security, backup and remote monitoring is driving the need for more memory, processing, virtualization and containerization, as these tools may not have been required before. Pent-up demand following the pandemic is creating increased data volume, coupled with greater data frequency, workload diversity and IT standardization. This is the perfect storm for creating a need for more data capacity. And with the need for more data capacity, edge-computing users are also looking for better ways to store their data.

THE DEMAND FOR MORE DATA STORAGE

Along with the need for more data capacity comes an increased demand for more data storage. As edge computing has scaled, so too has the amount of data, providing businesses with the opportunity to get more value from their data than ever before. Tools such as artificial intelligence (AI) and machine learning (ML) enable users to create more actionable data so they can make better decisions to improve operations. With an influx in the amount of data being collected, edge-computing users need to find new ways to manage and store that data.

By storing data locally, applications can continue to operate in the case of unplanned downtime. Increasing data-storage capabilities will also enable organizations greater visibility into assessing macro trends and data analytics, enabling them to act smarter and faster. As a result, businesses can leverage real-time data to create actionable results.

THE IT TRICKLE-DOWN EFFECT

Edge-computing users have also been experiencing an IT trickle-down effect, meaning that enterprise demand has trickled down from the top, and users need capabilities in smaller sites. The value of the data and the ability to share that data offsite enables organizations to make more agile or real-time decisions, a trend that will continue into the foreseeable future. However, in the past, the computing and data resources were segregated with minimal or no contact with other sites. Additionally, the compute workloads onsite were basic and limited in scope. The new requirements are creating new demand for secure connectivity and data sharing.

This new factor is leading to the IT trickle-down effect, and with it comes several ramifications at the edge, most notably an increased focus on cybersecurity. When there is the risk of a single device compromising an entire organization, businesses need to be armed with the right resources to ensure continuous operations. More importantly, several new considerations come to light, including the responsibility for buying and operating this new infrastructure, and questions about the technology's lifecycle and maintenance policies. As the lines between IT and OT teams blur, an edge-computing platform can help businesses focus their efforts on sustainability, manageability, and serviceability, rather than commodity IT computing.

As businesses continue to digitally transform, edge-computing platforms will be critical for ensuring uptime and providing key insights and visibility into daily processes at the location where products are being made, and customers are being served. With increased capacity and data storage, businesses across industries such as digital manufacturing, oil and gas, and life sciences are thriving by investing in edge-computing platforms that enable maximized operational efficiency and "always on" availability. ◻