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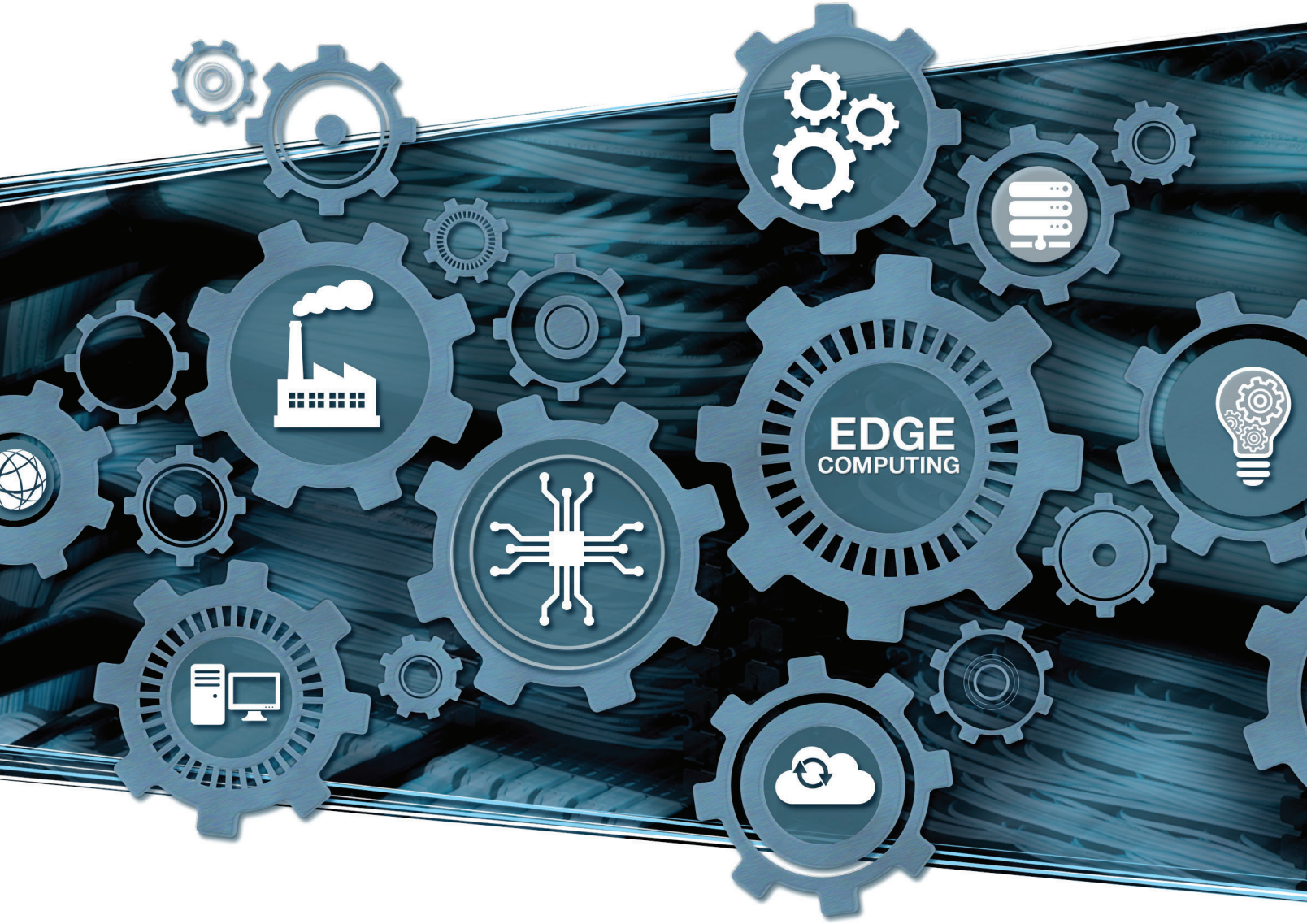

LEVERAGING INFRASTRUCTURE TO OPTIMIZE THE EDGE

Moving Compute Functions to the Edge Makes Infrastructure More Critical

By Brian L. Kelly and Mark Dehmlow

The number of connected devices is growing. That rate of growth varies widely depending on the organization doing the projecting. The Telecommunications Industry Association (TIA) touts on its website a number of 29 billion globally by 2022. In a recently published paper from the TIA's Edge Data Center Working Group, *TIA Position Paper: Edge Data Centers*, that group suggests that machine-generated network traffic could dwarf current internet growth with a forecast of one million new internet of things (IoT) devices sold every hour by 2021.

"The next wave of technology innovation is already here with new applications transforming the way we live, work, and travel," TIA says in its paper. "The huge adoption of these new services drives exponential growth in the total demand for data. We must provide more data capacity and higher computing speeds if we hope to keep up. The sheer scale and scope of the gap we face demands that we rethink the way we have traditionally organized the design and deployment of networks and data centers. As many hands make light work, deploying many smaller distributed data centers seems the most viable solution."

These smaller distributed data centers, which complement the cloud, are what the data center industry today recognizes as the edge.

Edge compute pushes computing functions closer to the end use, proximate to where data is generated, analyzed, and stored. This evolution of the network realizes numerous benefits, chief among them are reduced latency between the end use and the compute resource (cloud or servers), improved application performance, and optimized transmission costs.

Applications for the edge are far-reaching. The fastest growth is happening in applications that are most sensitive to network latency, require enhanced security or are bound by regulatory requirements. Industries such as manufacturing, healthcare, and finance are among those that are adopting edge networks today.

Regardless of the application or the reason for the transition to the edge, there are ways to leverage infrastructure that impact the deployment, monitoring, management, and operation of an edge data center (EDC). These infrastructure choices can help those responsible for the data center to address common challenges related to security, environmental conditions, and reliability, thereby ensuring uptime for the network and those systems that are dependent on the network.

EDGE COMPUTE EXPLAINED

At its core, edge compute is a shift from a centralized compute model to a hybrid distributed compute model. What does that mean? For the past 20 years or so, the compute model has been almost strictly centralized. On-premise data centers, cloud compute, and hybrid cloud models are all centralized compute models, meaning all the data is processed and stored in a central location (e.g., data center, cloud data center). Edge compute supplements that model with additional compute resources at the edge or in closer proximity to the end use (Figure 1).

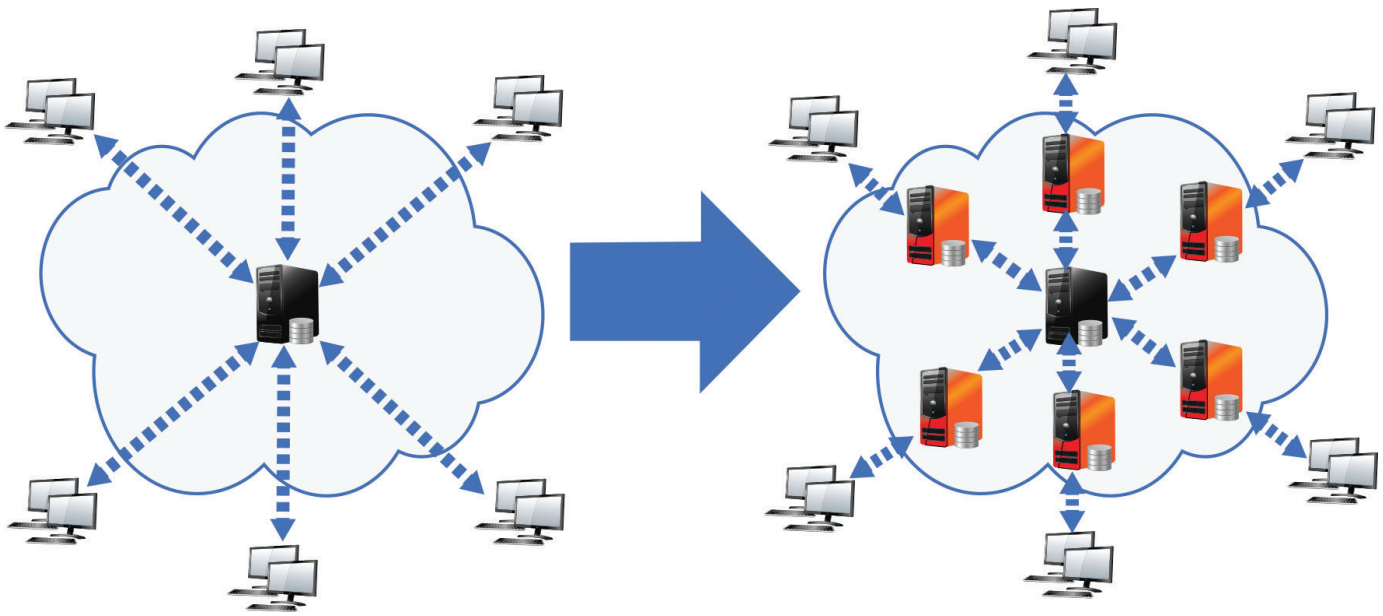

FIGURE 1: Edge compute is a shift from a centralized compute model to a distributed compute model.

CDN: THE ORIGINAL EDGE COMPUTE APPLICATION

A content delivery network (CDN) is used every time someone watches an online video, downloads something from the internet, and accesses content via social media. With a CDN, content is uploaded to an origin server, which then distributes that content to all the points of presence (PoP) in the CDN. Once distributed, end users pull the content from the closest CDN PoP, rather than the origin server (Figure 2).

Consider this example: An end user near Chicago wants to download content housed on a server in London with no CDN. The downloading of that content will suffer from high latency, potentially 220 ms. This will appear as buffering, lagging or pixilation. If a CDN is present, with a PoP in or near Chicago, the content downloads quickly and consistently with the latency potentially at 10 ms. The end user experience is much better, and the content provider benefits from reduced costs due to reduced bandwidth. It is a win-win solution for all parties.

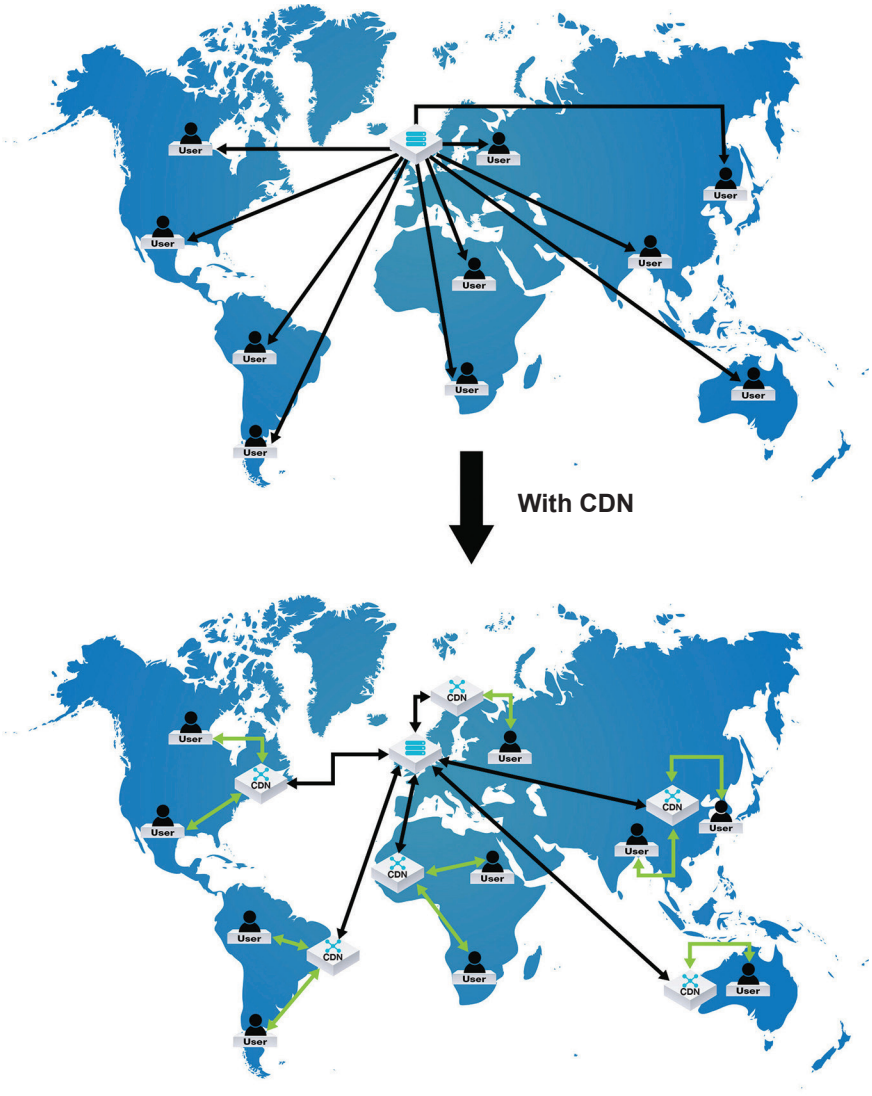

FIGURE 2: A content delivery network (CDN) puts content closer to the user and is one of the first uses of edge computing.

OPTIMIZING EDGE DEPLOYMENTS WITH INFRASTRUCTURE

Locating compute functions at the edge comes with a unique set of challenges for IT and ICT managers:

- Remote and geographically distributed sites
- Lack of dedicated on-site IT and ICT personnel
- Non-traditional IT spaces with limited security and environmental controls

Edge deployments are no different than other data centers where operators expect consistent uptime. Additionally, if IT or ICT personnel are required to travel to the site to address network issues, the price tag associated with that travel and the extended downtime to allow for travel can quickly get out of hand. This makes it imperative to have systems in place that help to ensure reliable, long-term, and hands-off operation.

The infrastructure selected for an edge deployment can help address these challenges. Specifically, infrastructure serves as building blocks that address consistency, reliability, security, and remote management.

- **Consistency:** Edge is not a single instance but a multitude of instances across a broad geographic landscape. Consistent preconfigured designs enable efficient deployments across a multi-site distributed architecture, as well as ongoing maintenance of that network.

Specifically, infrastructure serves as building blocks that address consistency, reliability, security, and remote management.

- **Reliability:** High quality, standards-based solutions are a critical first step to ensuring site reliability where on-site IT and ICT personnel may not be present. When reliable infrastructure design reduces future network issues, that can be considered a valuable foundational first step.

- **Security:** Edge environments are not traditional IT spaces. Controlling physical access ensures that authorized personnel can access the systems, while the curious passerby and nefarious characters are deterred.

- **Remote Management:** Intelligent infrastructure solutions deliver crucial oversight for remote installations. Remotely monitor, manage, and control physical and environmental conditions, thereby limiting the need for on-site visits.

The specific infrastructure solutions that form these building blocks include:

Preconfigured Solutions

When organizations have multiple sites, whether they are across town or on the other side of the globe, it is beneficial to have consistent layout, architecture, and footprint at each of those deployments. The benefits include simplified ordering, speed and consistency of deployment, and ease of remote management. That consistency is achieved by preconfiguring the enclosure prior to arrival on site. This could use enclosures that are purchased preconfigured from a vendor or configured at a central site before being deployed around the globe.

Preconfigured enclosure or cabinet offerings can range from a simple package that includes a few standard components to one that is specified by the end user and built according to that spec, so it is ready to drop into a remote site, plug in, and go. When setting up multiple sites, this step can save considerable time and money in labor costs. Although the organization will pay more up front for the convenience of having the enclosure preconfigured, time and labor usually are reduced during installation. If a technician or installer is required to travel to the site to oversee or complete the installation, travel and perhaps other expenses need to be considered as well.

Because edge sites typically do not have dedicated on-site IT and ICT personnel, remote management is a crucial capability, and consistency in deployments favorably impacts that ability. When every site is exactly the same, remote troubleshooting becomes easier. A technician can talk local personnel, who may not be trained in IT/ICT, through a series of steps to rectify a problem. Also, system-wide upgrades can be made, even by untrained personnel, with a single clear set of instructions based on the common architecture and layout used in all instances.

Intelligent Solutions

Intelligent solutions play a fundamental role in edge installations. They support remote monitoring and management, along with security, environmental controls, and power delivery. Intelligence can take many forms, including systems that monitor connections within the enclosure, temperature monitoring and control, security access, and power distribution. Smart power distribution units (PDUs) support many of these functions, as well as sensors, intelligent patch panels and patch cords, and even intelligent door handles.

One of the fundamental needs of a data center is security in order to prevent unauthorized access to both data and equipment. In traditional data centers, security is managed by door locks and control systems that limit access. With an EDC that is contained in an enclosure on the factory floor, within a trailer near a mining site or in the manager's office in a retail store, that same level of security is not always possible. A variety of systems are available that control access, whether from enclosure

Remote monitoring and management are also enabled via intelligent solutions at the edge. This function is considered by some to be the most critical because of the lack of dedicated IT and ICT personnel at most edge locations.

handles that can be opened remotely by an authorized user with a keycard or code on-site, as well as sensors that send an alert to indicate unauthorized access.

Remote monitoring and management are also enabled via intelligent solutions at the edge. This function is considered by some to be the most critical because of the lack of dedicated IT and ICT personnel at most edge locations. When the nearest technician is several hours away, downtime and travel become costly. This risk pushes some organizations away from an edge decision. When temperature, moisture or security sensors can advise of real-time risks and intelligent solutions allow an operator on the other side of the globe to make adjustments in real time, those risks become manageable. Similarly, intelligent connectivity simplifies remote management; it can advise of a bad connection so adjustments can be made.

Consider this example: A national sporting goods retailer sets up kiosks in various parts of its stores during different times of the year. As summer season begins, kiosks are moved into the boating and fishing area of the stores. Historically, this required a handful of technicians to travel to each location to change the connectivity to enable the point of sale system to switch to that new location. With an edge solution in a back room or office, complete with intelligent connectivity, a technician can talk an on-site store employee through the changes needed—by activating lights at ports that need to be disconnected or connected. Within a day or two, every location has been changed, resulting in zero travel expenses and less labor cost.

Enclosures

The edge environment dictates the enclosure needed for the deployment. It is imperative to understand the installation space because one size does not fit all when it comes to enclosures. Standard data center cabinets will work in some highly protected indoor spaces, while enclosures that are rated for harsh environments may be mandated for industrial applications. A mining site or refinery may seem like an application that requires rugged enclosures, but those sites may use standard cabinets inside a rugged container that has environmental controls installed. Also, one healthcare clinic may require a small enclosure that will fit under a desk in a back closet, while another has a dedicated space that allows a more traditional cabinet or rack.

When deciding about the type of enclosure, common characteristics to keep in mind include basics (e.g., size and load rating), more specialized factors such as NEMA or UL ratings, and the presence of or ability to add environmental controls and security features.

Selecting the right size of enclosure is especially important. Much like Goldilocks, organizations need to find the one that is just right. A structure that is too large can eat up valuable real estate and would most likely require a larger investment than necessary. Moreover, too small may mean the enclosure will not house all of the needed equipment today or in the near future. Beyond space for network equipment, the enclosure will need enough space for PDUs and network connectivity. Right-sized for the environment means an enclosure that fits in the available footprint and houses all of the needed equipment.

Harsh environments will require specialized enclosures that protect again dust, debris, moisture, vibration, and extreme temperatures.

Cabling and Connectivity

Standards-based cabling and connectivity help provide assurance that systems will function as designed. Whether using optical fiber and/or copper, both the cabling and

connectivity are critical for delivering reliability and uptime. This is another area where the environment can impact choice. If systems are being installed in a harsh environment or one where electromagnetic interference is present, then rugged jackets or shielding may be needed on the cabling and connectivity components.

USE CASES AND COMMON ENVIRONMENTS

Each data center application and environment has unique characteristics that demand solutions that address those characteristics, and edge deployments are no exception. The infrastructure for a highly protected indoor environment is vastly different than what is needed in a harsh space. Following are common use cases where edge is deployed, along with general information on what has been defined as the four environments for edge:

Use Cases

Edge Colocation

The colocation market has been growing for decades. For the most part, growth has been driven by colocation facilities located in or near larger Tier 1 cities (e.g., New York, San Francisco, Chicago). Applications that were running in these facilities were not particularly latency sensitive, and thus the distance of the colocation facility from a company's office was of little concern. The edge computing trend is changing that view. Some applications are becoming more sensitive to latency; thus, the closer a facility is located to the end user, the better the performance of that application. Edge colocation is taking advantage of the trend to move colocation facilities into more Tier 2 and Tier 3 cities. While not compromising latency sensitivity in the process, this is allowing companies with operations in more rural locations to gain the benefits of colocation.

Health Care

Patient-generated health data (PGHD) is an excellent healthcare use case. In a perfect world, data generated by IoT technologies, such as wearables, blood glucose monitors, home scales, telehealth tools, mHealth apps, and other sensor-related devices, could be collected and analyzed to pattern one's health, allowing for detailed preventative healthcare and event detection. Patient data could be analyzed at a macro level to detect patterns in a multitude of different areas (Figure 3).

FIGURE 3: Areas, such as surgical spaces, need to find ways to incorporate advanced IoT and PGHD sensor technologies while ensuring patient privacy and security in data collection.

In 1996, the Health Insurance Portability and Accountability Act (HIPAA) was passed in the United States. It addresses concerns about sensitivity of healthcare information and the lack of security in place for that data. HIPAA restricts how healthcare information can be transferred and analyzed. The challenge is in transferring PGHD securely within the boundaries that HIPAA necessitates. Published reports show that an estimated 40 percent of IoT sensors will be PGHD devices, so this is going to become an industry-wide challenge very quickly.[1]

It is imperative to understand the installation space because one size does not fit all when it comes to enclosures.

Industrial/Manufacturing

The industrial automation space has been collecting and analyzing data for decades. This data has historically been processed in centralized data centers, which in some cases can be in a location quite some distance from the factory floor. Many newer industrial automation applications require real-time or near real-time interaction with compute resources. Due to this requirement, many factories are moving the compute resources closer to the factory floor or on the factory floor. This opens up a whole other realm of issues when data center servers and networking equipment are exposed to the harsh environments of the factory floor. Contamination from water, dust, and corrosives become potential hazards. Harsh environment enclosures, equipment, and physical infrastructure are required to properly address these issues (Figure 4).

Retail

The brick and mortar retail space has been under assault from online retailers for quite some time. To counteract this assault, brick and mortar retailers are always searching

FIGURE 4: Many industrial automation applications require real-time or near real-time interaction with compute resources.

for advantages they can leverage to provide a competitive edge. A lot of the innovations driving this competitive edge require a significant amount of additional compute power at the retail location.

- Augmented reality (AR) mirrors can show shoppers how they look in different clothing without physically trying them on (Figure 5).
  - Amazon has patented a mirror that dresses viewers in virtual clothes.
  - Magic Mirror is an independent freestanding console with a digital screen that allows people to try on different outfits using simple hand gestures.
- Coca-Cola Freestyle machines have servers attached to them that collect and process customer preferences on site; it then sends information to the cloud.
- Amazon Go stores that are brick and mortar enable customers to grab items off the shelves and simply leave by using technologies, such as computer vision, sensor fusion and deep learning.[2]

FIGURE 5: Augmented reality mirrors make it possible for shoppers to virtually "try on" clothing, thereby potentially improving revenue for retailers. This technology demands more compute power at the location.

Agriculture

Smart farms are becoming the standard in today's ultra-competitive agricultural landscape. Any advantage that can be obtained by technology is directly attributable to higher yields, thereby resulting in higher profits. Many companies are competing in this space to provide farmers with the best and most comprehensive data about their fields. This is allowing farmers to make informed decisions about planting, irrigation, and harvesting based on multiple data sources, which include direct sensor data from the fields and even satellite data (Figure 6).

FIGURE 6: Many companies are competing in the agriculture space, where farmers are using comprehensive data about their fields to make informed decisions about planning, irrigation, and harvesting.

Edge Environments

Four types of physical infrastructure environments are prevalent in edge compute deployments. These environments have characteristics that set them apart from others and help define the solutions that are most advantageous for each.

Highly Protected Indoor

The highly protected indoor environment is very familiar to those who have worked in traditional IT spaces. It is basically the data center space that many organizations have on-site and commonly referred to as an on-premise data center. However, this may be located in an area not typically used. This environment has most or all the amenities of a traditional data center space, including power, cooling, connectivity, physical security, and a highly protected setting that is expected in a traditional data center. What it may lack is the trained data center staff to handle every need, so remote management is key to a successful deployment.

An excellent example of this environment is edge colocation. Several colocation companies have adopted the edge as their business strategy. These colocation data centers are in non-traditional second and third tier cities, closer to the end user/use. The solution and vertical industry example include:

- Remote data center or similar deployment, including highly controlled environment and room/data hall level security
- Example: Edge colocation DC

General Indoor

The general indoor environment may also be somewhat familiar. These are typically located in indoor spaces that require environmental controls; however, they may have space limitations and have enhanced needs around security and remote management. Examples of this environment would be a telecom room, server room, or closet. The solution and vertical industry examples include:

- Indoor deployment with controlled environment but with limited cooling and basic security
- Example: Retail stores, healthcare facilities

Harsh Indoor

A harsh indoor environment is typically found in manufacturing and more industrial-type settings. A growing number of applications on the manufacturing floor require lower latency to perform at an optimum level. To meet this requirement, equipment is placed in closer proximity to the end use. In this environment, the enclosure and connectivity may need to be rated for a harsher environment to protect equipment and data center performance. The solution and vertical industry examples include:

- Limited protection from the outdoor environment and limited security; potential for dry or liquid hazards (e.g., dust, water)
- Example: Manufacturing floor, warehouse

Outdoor

When compute equipment is required to be placed in an outdoor environment, it must be either placed in an enclosure that is able to provide a "data center" like space (e.g., container, trailer) and/or be hardened to the point that it can withstand the extremes that the outside environment can bring (Figure 7). When dealing with the outdoor environment, several factors must be considered in the selection of the equipment and enclosure including:

- Temperature control (heating, cooling, solar loading)
- Sealing (against liquids, particulates, corrosives, flora and fauna)
- Physical security (access control,anti-vandalism)
- Electromagnetic shielding
- Vibration and shock isolation
- Example: Agriculture, mining

PUTTING EDGE TO WORK

Edge compute is changing the way that network and compute resources are deployed. Many new and unfamiliar decisions will have to be made to have a successful edge compute deployment. Physical infrastructure is foundational to edge deployments and can enable consistency and reliability across a geographically distributed edge footprint.

FIGURE 7: Outdoor spaces, such as refineries, require a container of some type to house data center equipment.

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REFERENCES:

1. Jordan, Nick." 7 Staggering Stats on Healthcare IoT Innovation," *Data Driven Investor*, 16 August 2020.
2. Tillman, Maggie. "What is Amazon Go, where is it, and how does it work?" *Pocket-lint*, 25 February 2020.