DATA CENTER
Frontier Special Report

Edge Computing: A New Architecture for a Hyperconnected World

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The Big Picture

Digital infrastructure becomes more important every day. That's particularly true in light of the COVID-19 pandemic, which has reinforced the importance of reliable low-latency connectivity for a distributed world. With hundreds of millions of people around the globe now working from home, we are seeing unprecedented demand for VPNs (virtual private networks), cloud platforms and video collaboration tools like Zoom, Microsoft Teams and Google Hangout.

The newly distributed workforce has accelerated the case for edge computing, which extends data processing and storage closer to the growing universe of devices and sensors at the edge of the network. Many of these devices are found in non-traditional environments, such as manufacturing floors, warehouses and distribution centers, or even outdoors.

"The boundaries of infrastructure are shifting," says Gartner analyst Tom Bittman. "We believe your infrastructure will be everywhere—in the cloud, in the data center, and extend all the way to the edge."

By moving infrastructure closer to users, edge architecture allows the compute and content delivery process to happen within 10 milliseconds or less—ultra-low latency that will transform existing applications and lay the groundwork for new ones.

The trends driving the edge computing model are the increased use of consumer mobile devices, especially consumption of video and virtual reality content and the growth of sensors as part of the Internet of Things (IoT).

Edge infrastructure is also a response to emerging technologies—think autonomous vehicles and distributed artificial intelligence (AI) applications—that require low latency and close proximity to users. These technologies will shape the future of Internet infrastructure, and enterprises and service providers alike are positioning their organizations to take advantage of this shift.

For edge computing to be deployed everywhere at scale, it will need to be compact, cheaper and take the network to new places. The key components of edge computing include mobile devices, wireless networks, telecom towers, small cells and distributed antenna systems (DAS) as well as data centers and cloud platforms. It's a universe that transcends traditional business models built on specialization.

Edge Computing and Why It Matters

Edge computing will have a transformational impact on global society and business, enabling new technologies and services across instant wireless connectivity. Some technologists believe edge computing will unleash a new world of powerful mobile devices unencumbered by limitations on compute power and data.

Consultant and futurist Chetan Sharma projects the edge economy will reach $4.1 trillion by 2030. The State of the Edge 2020 report from the Linux Foundation projects that edge investment will accelerate after 2024, with the deployed global power footprint of edge IT and data center facilities forecast to reach 102,000 megawatts by 2028, with annual capital expenditures of $146 billion.

For IT professionals who have spent their careers working in the controlled environments of enterprise data centers, the transition to managing equipment in the field may come as a bit of a shock. Sensitive electronics in manufacturing plants, aboard ships and atop telephone poles are subject to abuse from the elements that few have experienced. Remote devices are also more prone to dropped connections, electromagnetic interference and cyberattacks, and servicing them can be an expensive and even risky proposition.

> End users and investors will focus on near-term cost/benefit analyses rather than long-term potential.

Many organizations are currently learning this the hard way. Cisco reported back in 2017 that nearly three-quarters of IoT projects were failing at the time, with nearly half of respondents to the survey citing lack of expertise as the culprit. In a similar vein, in 2019 Microsoft found that this complexity and lack of technical skills frustrates 38% of IoT decision-makers and 47% say they don't have enough skilled workers to build and maintain networks of connected devices.

The technology world is somewhat divided about the short-term prospects for edge computing. The split is not about whether edge computing will be useful, but whether—and when—it will be profitable. That's why the economics of edge computing will come into sharp relief in 2020. End users and investors will focus on near-term cost/benefit analyses rather than long-term potential.

The many forms of edge computing

Anthem data center

Photo credits (clockwise): Vapor IO, Chatsworth Products, Ford Motor Co., and SRP

How Data Center Frontier Sees the Edge

At Data Center Frontier, we continue to see a large opportunity for edge data centers, a view that is reinforced by our discussions with many veteran data center executives.

We believe edge computing will play out over many years, boosted by the gradual adoption of technologies with long deployment horizons. This timeline will be the backstory behind many of the headlines in edge computing this year. Even before the outbreak of the COVID-19 pandemic, it was clear that there would be successes and disappointments in 2020, and both the "edge boom" and "edge hype" scenarios will factor into an active merger and acquisition landscape.

This revolution won't be cheap. Many executives predict the buildout of edge computing will pressure the economics of digital infrastructure, leading to the creation of affordable deployments using repeatable form factors. Perhaps most importantly, most edge data facilities will be unmanned, remotely managed and highly automated.

> Not every edge project will succeed. With a fluid ecosystem and product segmentation, many promising ventures may struggle to locate a profitable niche.

There are signs of maturity and emerging leadership in the edge computing sector, most notably in the success of Vapor IO, which in January unveiled a Series C equity funding of $90 million, allowing the company to build out infrastructure in 36 cities by the end of 2021. Vapor IO has also made an alliance with Digital Realty, the world's largest wholesale data center operator. The companies have unveiled an "edge-to-core" offering for joint customers in three markets—Chicago, Dallas and Atlanta—with more to come. This offering could serve as a model for how colocation providers and edge specialists partner on integration.

Not every edge project will succeed. With a fluid ecosystem and product segmentation, many promising ventures may struggle to locate a profitable niche. With most investors wary of speculative projects, expect to see consolidation as stronger incumbents and well-funded platform builders seek to "bolt on" promising edge players that run short of funding. Other initiatives may not survive.

Many venture capital and private equity investors are urging belt-tightening for their portfolio companies. Given the capital-intensive nature of the data center business, this could create a more challenging environment for startups requiring additional funding to reach profitability.

Meanwhile, all the major cloud players have huge ambitions in edge computing, and are extending their footprints and product sets to capture early adopters. These platforms have enormous amounts of capital and the ability to deploy capacity quickly through existing relationships with data center providers and telecom companies.

Noteworthy Developments thus far in 2020

- ✓ **JANUARY -** The acquisition of Packet by Equinix also reinforces the case for M&A, in which data centers firms will acquire edge platforms to gain critical mass around promising technologies (in this case, bare metal cloud).
- ✓ **MARCH -** Modular data center specialist Baselayer Technologies was acquired by the IE Corporation, which says the deal will accelerate its expansion into edge computing.
- ✓ **MAY -** Early mover DartPoints was acquired by private equity firm Astra Capital, which says it will pursue a growth strategy by both buying and building edge data centers.
- ✓ **JUNE -** Ericsson began informing partners that its Edge Gravity initiative "will shut down over time" after it failed to meet the company's expectations.

Layers and Location of Edge Computing

As edge computing takes shape, we are approaching the brink of a new phase for global Internet infrastructure. Edge computing is evolving in tiers, with opportunities in regional data hubs, cities, telecom towers and on devices. Think of it in terms of "edge, edgier and edgiest."

Key trends include the densification of large cities, and enhancing connectivity and coverage in second-tier markets. Says one C-suite executive: "What we're actually doing is building data centers at aggregation points. We look at locations based on population density, access to cell towers and cable head-ends."

Here's a look at the layers of infrastructure and their chief characteristics:

Micro Data Centers in Major Cities
Supporting 5G networks and other edge technologies will require denser wireless infrastructure. Early movers in edge computing are looking to deploy small clusters of modular data centers in primary data center markets like Chicago, Atlanta and Dallas, and connect to colocation facilities in the major telco hubs (carrier hotels) in these markets.

Data Centers in Regional Markets
A growing number of data center providers have targeted "second-tier" cities that have active business communities but are outside the "Big Six" primary data center markets (Northern Virginia, Silicon Valley, Greater New York/New Jersey, Dallas, Chicago and Phoenix).

Micro Data Centers at Telecom Towers
Many edge computing models see tower sites as key points to connect end-user devices to the core network. Some edge strategies include the deployment of data storage and compute capacity at tower sites, which will require enclosures that reside at the base of the tower.

On-Site IT Enclosures and Appliances
The edge network will need to extend to office campuses, factories, warehouses, hospitals and logistic centers to support data collection from IoT devices and sensors. Some analysts refer to this as the "fog" layer. These installations will likely feature IT cabinets or server appliances, and this is a key area of focus for cloud computing providers.

Street Furniture and Lighting
You may not think of street lights as edge computing infrastructure. But "smart street lights" are a key enabler of Smart Cities strategies, and can include built-in wireless connectivity (Bluetooth and Wi-Fi), high-definition digital cameras, and sensors to monitor weather and air quality. Most smart street lights come with a control network that can connect a city-wide array of sensors and analytics packages. 5G will also boost demand for low-power antennas, known as small cells and DAS, which can be mounted on utility poles, buildings and street furniture.

End-User Devices
This includes everything from smartphones to smart speakers ("Alexa, tell me a joke") to drones and autonomous cars. Some of these devices will have the on-board horsepower to run AI and other compute-intensive applications, while others will operate as terminals that send data to the core or cloud.

A key concept is to use edge infrastructure to drive a fundamental shift in Internet architecture, moving network interconnection points – the key intersections that allow data to move between networks – from the core of the Internet to its outer perimeter.

Interconnection has historically been focused in the largest carrier hotel buildings in major business markets. This can create longer routes for data traffic, creating latency and performance issues that will grow as workloads move further from central hubs. A distributed network of edge interconnection centers would transform the performance of the Internet, creating local connections that will dramatically reduce latency.

In practice, this means data will be processed at the edge and won't have to travel all the way to the core of the network. Since network capacity is expensive, a distributed network will need to prioritize the type and value of data.

As more data is generated by edge devices and applications, distributed edge computing capacity will also perform "data thinning" – running an initial round of analysis before sending business-critical datasets across the network.

Business Use Cases

For edge computing to succeed, these concepts must translate into business value that can justify the considerable expense of creating a massively distributed network. Who are the users driving demand for edge computing? And what are the use cases that will deliver on this new architecture?

Large enterprise users affirm their readiness to invest in edge strategies, establishing a market beyond the telcos and content players.

"Edge computing gives us that real-time agility and responsiveness at the edge," says Gartner's Bittman. "Digital business is completely disruptive to your infrastructure. We're blurring the lines between physical and digital. It creates new interactions between businesses and people and things."

The earliest use cases will be those that help networks operate more cost-effectively.

Here are prominent examples of use cases for edge computing:

Artificial Intelligence
AI can make services and devices smarter and is high on the "must-have" list for most companies, especially in the tech sector. A group of hardware startups are developing energy-efficient chips for mobile AI that will bring beefier processing power to smartphones and other edge devices. Some data will be offloaded to aggregation points or directly to the cloud. As AI becomes more powerful and distributed, new edge use cases will emerge. "In the next few years, we'll have a massive switch to the edge," says Steve Jurvetson of Future Ventures, a veteran venture capitalist and chip engineer who was an early investor in Tesla and SpaceX. "AI is potentially going to dominate all other forms of programming, and AI needs the edge. It's difficult to build an intelligent system without an edge presence."

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Content Delivery
The oldest edge use case is more compelling than ever, as traditional CDN use cases get super-sized to handle 4K streaming video at scale. It's not just Netflix anymore, as the emergence of Disney+, HBO Max and Peacock shifts more video onto fiber networks.

Video Gaming
Perhaps the fastest-growing consumer use case for low-latency connectivity is video gaming and eSports, where "lag" is the enemy. The launch of Google Stadia and other streaming gaming platforms will place significant demand on the latency of existing network infrastructure.

TV and Film Production
The original "Netflix problem" was getting video to consumers. As more streaming services become content producers, they are keen to revamp the on-location film production, in which couriers are used to deliver "dailies" to studios. Netflix, for one, sees edge computing as a way to accelerate this process. It's not an accident that the first Amazon Web Services (AWS) Local Zone is in Los Angeles.

5G Infrastructure
As previously discussed, mobile networks are making huge investments in new infrastructure for fifth-generation networks. Analysts expect this to gather momentum in 2021 and 2022.

4G Infrastructure
Existing mobile networks continue to be tested by demand for new services and existing applications. "The care, feeding and monitoring of fiber networks on a backhaul scenario is not sexy, but the economics are significant," says Chris Crosby, CEO of Compass Datacenters. "You have too many 'Things' that require a lot of capacity."

Factory Automation
As the factory floor is automated and instrumented, it is producing large volumes of data with potential business value. Having compute power on-site or nearby enables factory operators to run analytics to perform data thinning. Many industrial cities and towns currently have minimal data center infrastructure.

Telemedicine
One of the primary pandemic-driven growth sectors is telemedicine, which quickly shifted from an option to a necessity for doctors and patients. Telemedicine services will require more local infrastructure over time as they integrate high-resolution medical imaging like CAT scans.

Virtual Reality (VR) and Augmented Reality (AR)
In some ways, the pandemic has been a missed opportunity for VR due to the limited availability of the most popular headsets. Some edge advocates believe edge capacity can reduce latency in a way that can make AR and VR more accessible to a mass audience, including solving motion sickness issues. "Things like this that are just on the verge of working can now cross over," says Adrian Cockcroft, the VP of Cloud Architecture at AWS. "If you can make that (latency) loop tight enough, your brain starts accepting it as reality."

Autonomous Vehicles
Self-driving cars will be among the most sophisticated edge devices, with massive on-board processing power and wireless connectivity to download and upload data for analytics, forensics and algorithm refinement. Autonomous cars could generate up to 5 TB of data an hour, according to estimates from the Automotive Edge Computing Consortium (AECC). "Autonomous cars are one of the poster children for edge computing," says AECC board member Vish Nandlall.

Business practices also create some challenges. The vision for a new architecture doesn't always align with historic business practices in key tenant segments.

As an example, edge peering at tower sites would be a meaningful shift in how these locations have managed data traffic. The major tenants at towers have been mobile network operators (MNOs), whose antennas provide wireless service for cell phone users. From the tower, each MNO moves data from its base station back to its wireline network, a process known as backhaul. In the mobile world, data often flows from the traffic to the core before it finds its way to its destination—a practice known as "tromboning."

Who Are the Significant Players?

There is a large and growing universe of stakeholders in edge computing, running the gamut from small startups to the world's largest tech companies.

Each of these segments sees computing through a slightly different lens. Some will compete ferociously, others will partner to build an ecosystem. Understanding the motives of leading players is key to navigating the business issues that will guide the economics of a particular use case.

Here's a look at some of the sectors that will be players in the edge ecosystem and sampling of some of the companies to watch.

Edge-Focused Startups

There is a large and growing cluster of startups targeting different facets of edge computing, many of whom are focused on software and chip-level solutions. There is a smaller group of new companies specializing in data center infrastructure for edge computing. Here's a look at some of the notable startups:

- **Vapor IO** has raised more than $100 million to create a distributed network of edge colocation sites, housed in micro modular data centers that can be deployed at key points on the network. Vapor IO combines a focus on software-driven management with expertise in networking and data center hardware – including its distinctive round Vapor Module rack enclosure.
- **Edge Micro** was founded by veterans of Schneider Electric and CBRE, and envisions a future in which thousands of small modular data centers provide multitenant colocation, bridging the infrastructure gap between data networks and mobile devices.

- **Compass EdgePoint,** the edge computing unit of Compass Datacenters, led by former Google Fiber executive, Sharif Fotouh, focuses on modular deployments to help improve bandwidth economics and support the Industrial IoT applications.
- **DartPoints** began planning a distributed network of micro data centers in 2012, making it one of the early players in the edge data center sector. It was recently acquired by Astra Capital, which says it intends to both build and buy edge capacity.
- EdgeGap is an edge provider that helps gaming studios deploy multiplayer server instances closer to end users, improving game performance by providing gamers with fewer hops and routers, and faster reaction times.
- **Mutable** embraces an "Airbnb for Servers" business model, leasing unused compute capacity from data center operators (often telcos or enterprises) and renting this capacity to developers to run low-latency apps.
- **Immersion Edge** is one of the first startups to focus on immersion enclosures for edge workloads, but this is an area that could see additional entries.

Cloud Computing Platforms

"All the cloud providers see themselves as extensions of edge computing," says James Staten, Principal Analyst at Forrester Research. "They're trying to become the edge gateways."

The early leader is **AWS,** which is extending its services closer to users with AWS Outposts—racks filled with turn-key AWS cloud infrastructure. One example is Amazon's Local Zones, which will provide low-latency access to AWS services in major metros. Local Zones will be deployed at colocation facilities, with AWS leasing space and managing fleets of its Outposts. On the 5G front, Amazon has partnered with Verizon on AWS Wavelength, a software product that embeds AWS compute and storage services in the telecom network, enabling developers to use 5G connections to create low-latency apps, which will run on Outposts racks within Verizon's network.

Microsoft Azure has also announced Edge Zones to support several edge scenarios, including a carrier version it has tested with AT&T. It also offers Azure Stack Hub, an on-premise version of Microsoft's infrastructure (similar to Outposts). Microsoft also has built an early position in cloud-connected devices and sensors with its Azure IoT platform of managed and platform services.

Google Cloud Platform has distinguished itself on supporting machine learning in its cloud, and builds on that with its Edge TPU, offering purpose-built ASIC chips to run AI workloads at the edge.

Telecoms and Mobile Network Operators

Deutsche Bank projects that the three primary mobile network operators (MNOs)—**Verizon. AT&T** and **T-Mobile**—will invest $35 billion on capital spending on network improvements in 2021, and $37 billion in 2022 as they gear up their 5G offerings. This will make them major customers for other players in the edge computing ecosystem, notably tower operators and edge infrastructure providers.

As previously noted, Verizon is working closely with AWS, while AT&T is partnering closely with Google Cloud Platform on its 5G infrastructure.

Fiber-focused telco providers also see an angle on edge computing. **CenturyLink** is working with AWS to provide customers with Outpost racks at a nearby central office, and extend it to the customer premises.

A player to watch in the telco edge space is **MobileEdgeX,** which was backed by Deutsche Telekom but partners with other telcos to provide an "edge cloud" platform housed in the central offices of its telecom partners.

Tower REITs

The three large public tower real estate investment trusts (REITs)—**American Tower, Crown Castle** and **SBA Communications**—have all made investments in data center companies. SBA and American Tower have each bought an interconnection-focused data center in a major metro. American Tower made its first acquisition in the data center sector in April 2019, buying Colo ATL, which provides carrier-neutral colocation and interconnection services from 55 Marietta Street, one of the carrier hotels in Atlanta. SBA bought New Continuum Data Centers in the Suburban Chicago market, which it has rebranded as SBA Edge. Crown Castle is a leading investor in edge data center specialist Vapor IO, but has said it is unlikely to build or buy its own edge data centers.

The tower REITs are more narrowly focused on monetizing edge capacity at their thousands of tower sites, but these deals also represent a wager that the earliest edge growth may involve creating denser networks in cities.

Suppliers of power and cooling infrastructure also see an opportunity in edge computing, which will be driven by modular and micro-modular enclosures.

Regional Data Center Networks

There are a growing number of data center providers targeting second-tier markets and touting edge capabilities. Most notably, **EdgeConneX** operates a network of 25 data center sites that help solve the "Netflix problem" of network congestion from streaming video, with leading cable companies among its anchor customers. **DataBank** is also sharply focused on the edge computing market, with facilities in nine cities. TierPoint, Flexential and vXchange are also among the second-tier players that could play a role in the edge ecosystem.

Content Delivery Networks

CDNs were early pioneers in edge computing, building distributed networks to cache content to improve the delivery performance of video, games and bandwidth-sensitive apps (like e-commerce). Akamai was the first CDN and is advancing its expertise in distributed security and DDoS defense as key edge services.

Other CDN players to watch are StackPath, Cloudflare and Fastly, which each offer services that allow developers to run code at the edge of the network to improve app performance.

Equipment Providers

Suppliers of power and cooling infrastructure also see an opportunity in edge computing, which will be driven by modular and micro-modular enclosures. Leading players in this part of the edge landscape include Chatsworth Products, Schneider Electric, Vertiv, Rittal, ScaleMatrix (Elliptical Mobile) and IE Corp. (Baselayer) At least one enclosure maker has spun out edge network operators. Mobile Life Solutions created EdgePresence, which has 15 locations at cell towers. These companies will play a critical role in the supply chain for edge infrastructure.

Deployments, Designs and Form Factors

All these ambitions must be secured and powered by enclosures suitable to the environment and business case. Edge computing will rely upon modular enclosures in a range of form factors to support the scope of envisioned implementations and use cases.

Early players have developed modules sized by power capacity, ranging from 48 kW to about 300 kW of power capacity. Most companies are using a repeatable "building block" approach that can be used to deploy standardized infrastructure in multiple sites, as well as multiple modules at single sites that require expansion.

Network infrastructure will lead the first wave of edge infrastructure, with compute to follow. This will guide the evolution of edge design to support more power capacity over time.

Many edge facilities will be unstaffed remote sites, and enclosure designs will need to incorporate the security and reliability features to support unstaffed operation, including cameras and sophisticated access control. Monitoring and alert systems will be important components of remote management systems, both for physical security and the ability to respond to weather damage.

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As we noted earlier, for edge computing to be deployed everywhere at scale, it will need to be compact, cheaper and take the network to new places. This is an area where existing designs and technology will be adapted to meet specific customer needs, and the emerging economics of the edge computing business.

Three Considerations When Deploying Edge Computing

Deploying edge computing infrastructure can be challenging for end users, who must adapt their models and processes for a smaller, denser environment to process more services and user data (often with a specific use case in mind).

There are three common challenges reported by end users working with edge designs: Defining the use case, inexperience with edge deployments and data management concerns.

Software-defined solutions allow you to integrate with core data center systems and support powerful data locality policies, which are critical requirements for industries like pharma, health care, and other regulated organizations.

1 Defining the Use Case

This is actually a major stopping point for edge projects. There may be a great idea or concept but defining the use case reaches a barrier. This usually happens when there's misalignment between IT, operations technology (OT) requirements and management. In these situations, it's important to take a step back and look at the long-term strategy of your own organization. Are you growing? Will you be supporting remote users? Are you trying to deliver new types of connected services? If you see that edge is a fit, take the next steps to write up a solid business plan and technology strategy to support it. You don't have to be an edge expert to clearly define your own use-case. Furthermore, there are providers who can help you on this journey. However, it's important to align infrastructure and business to ensure that your strategy can succeed. From there, it's key to work with the right people who can bring that vision to life. Which brings us to the next point.

2 Lack of Expertise

Even if an organization is able to define a use case, they might get stuck when it comes to working with partners who can help them implement the vision. Edge deployments come with different considerations around space, density, power, management, connectivity and redundancy than a traditional data center. Identifying experienced partners is essential, and there are a growing number of organizations, partners and data center providers that can help with edge solutions.

3 Concerns Around Data Management

End users will need to take extra time to define data requirements and management policies. Is the data transient or will it be stored at the edge? What type of data is being processed? What is the connectivity control method around the data? All of this will need to be defined and integrated into an effective edge solution. Compliance and regulation can be built into an edge architecture, but this requires extra precautions to ensure data security and control. Although there isn't a defined standard on edge computing yet, it's important to consider the location of the edge, storage systems at the edge, how the data will be processed, and who will have access to it. Software-defined solutions allow you to integrate with core data center systems and support powerful data locality policies, which are critical requirements for industries like pharma, health care, and other regulated organizations.

How Chatsworth Products Fits In

Edge computing will require infrastructure that is flexible and versatile, and can adapt to the range of use cases and budgets likely to come into play in edge deployments.

This section showcases the company's expertise and capabilities, insights on how its offerings can help edge-focused businesses succeed in their goals, and some examples/use cases of how Chatsworth Products (CPI) delivers value for its edge clients.

Managing IoT Devices at the Edge—Does Your IT Team Have What it Takes?

When it comes to edge computing, CPI's focus is on micro data centers and on-site IT enclosures for wireless densification, network expansion and protection of equipment ranging from information and communications technology equipment, automation controls and 5G sensors.

Photo credit: Chatsworth Products

A free-standing enclosure with integrated cooling unit holds and protects power electronics for a private radio network of a railroad operator.

Equipment located in even seemingly benign locations like sports arenas and retail warehouses can come in for a beating over time due to the long-term effects of sunlight and dust. When deployed in shop floor settings, the effects of heat, humidity, vibration and more can cause electronics to fail much faster than they would in the air-conditioned, low-humidity environment of a data center.

When located outdoors, devices such as smart meters, device controllers, equipment monitors and network routers absorb orders of magnitude more punishment. Rain, snow, hail, high winds, lightning and dust are just a few of their nemeses. And did we mention insects?

It isn't just the elements that are a factor. Many constantly connected devices demand robust network connections, something that can be a hit-or-miss proposition in environments like warehouses and heavy manufacturing. Wi-Fi and cellular data signals are prone to interference and may be blocked by buildings or nearby equipment. The stainless steel and carbon steel enclosures that are sometimes used to provide environmental protection have the unintended side effect of also blocking Wi-Fi signals from getting through.

Consumer and even industrial-grade off-the-shelf equipment often is not up to the task of withstanding the rigors of harsh environments. Specialty hardened equipment may be available, but choices are often limited and the cost of ruggedized hardware can be five to 10 times that of devices built for the mass market.

Keeping it Cool

A significant but often underappreciated factor in deploying IoT equipment is cooling. Devices deployed in sealed enclosures that protect them from the elements can also restrict air flow and generate enormous amounts of heat. Specialty vents can help, but large equipment may require dedicated active cooling.

This presents a special set of challenges. Most data centers have the luxury of multiple cooling units that can be cycled on and off as needed. In the field there is one point of failure. Short-cycling, or shutting down the system prematurely and starting it up again a little while later, may damage air conditioning components and cause the compressor to burn out. In either case, it's the IT maintenance team that must fix the problem.

Photo credit: Chatsworth Products

Vital equipment in distribution centers for pharmaceutical provider, AmerisourceBergen, is protected against dust, dirt and debris thanks to CPI enclosures and kitted accessories that store, cool and power the company's IT equipment, providing an efficient IT protection system.


Photo credit: Chatsworth Products

If deployed in harsh environments, network equipment should be protected with NEMA Type and IP protection ratings. Stainless steel enclosures add another layer of protection against corrosion.

Finally, remote management and troubleshooting also present new complexities. Few IT professionals relish the idea of hanging onto a telephone pole to apply a software patch to a security camera, so the firmware updates needed to ensure security must be automatic and verifiable across a network of devices. Remote monitoring must be robust enough to determine the status of every piece of equipment as well as to anticipate failures. Replacing a dead device in the data center is a walk in the park compared to replacing one 30 feet up the wall of a warehouse.

With these conditions in mind, CPI has developed a comprehensive strategy with five aspects to consider with each edge deployment, with the intent to assist customers in defining the application, creating a plan and kitting each solution. Edge enclosures mix existing standard products with new designs and need to scale easily.

1. **Plan for environmental conditions**
   Harsh weather conditions require equipment to have higher levels of protection. In nontraditional spaces, the enclosure provides the primary protection for equipment.
2. **Protect against security vulnerabilities**
   Remote, edge locations have minimal or zero personnel, so it is important to invest in a comprehensive physical security solution that can be easily integrated or kitted with your edge enclosure and provide notification of unauthorized entry.
3. **Mitigate risk with adaptable equipment and cabling**
   Each piece of edge equipment will likely have different airflow requirements, and depending on either copper or fiber-optic cable, it can require different styles of cable management. Cable penetrations should utilize approved fittings to maintain the enclosure's protection ratings.
4. **Extend the life of equipment with thermal control and management**
   The sealed design of edge enclosures does not allow for ventilation, so a filter fan or cooling unit is an important requirement to exhaust or reject heat from the enclosures in order to maintain the equipment manufacturer's recommended temperature operating range.
5. **Manage assets with remote monitoring and switching capability**
   Remote monitoring of power and environmental conditions within the enclosure can mean the difference between operations and downtime. Power distribution units (PDUs) with robust capabilities distribute power to equipment, provide remote outlet control so it's possible to reboot equipment and monitor power usage.

To review CPI's five-pillars strategy for edge deployments, download the e-book.


Photo credit: Chatsworth Products

A tall, heavy-duty bollard conceals and protects most vendors' outdoor Wi-Fi and small cell equipment.