EDGE COMPUTING: THE FOURTH WAVE RISES

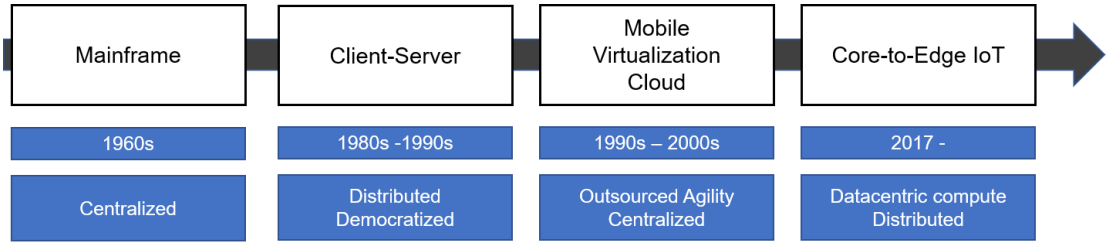
DELL EMC HAS A COMPELLING EDGE SOLUTIONS PORTFOLIO

INTRODUCTION

The IT and compute industry has undergone three tectonic shifts in compute models since the 1960s. Centralized compute with mainframes gave way to client server and distributed compute in the 1980s. The 1990s saw the rise of mobility. Smart phones, the internet, and eventually cloud computing emerged enabled by virtualization. This rise of the cloud saw a return to a more centralized compute model where compute resources are provisioned to users and workloads.

Edge computing has ushered in the fourth wave of computing. This distributed compute model executes data analysis and processing close to the data source. According to Gartner, 20 billion devices will make up the Internet of Things (IoT) by 2020. Approximately 6 billion of those devices will be dedicated to driving efficiencies in business, healthcare, science, and government. [1] This explosive growth in the number of devices has led to an even greater explosion in the creation of data. In this same time that the industry sees 20 billion connected devices, we see between 35 zettabytes (ZB) and 45 ZB of data generated by 2020. That number should rise to over 150 ZB by 2025.

FIGURE 1 - THE FOUR WAVES OF COMPUTE



Source: Moor Insights & Strategy

MI&S believes organizations that deploy cloud models will embrace distributed compute as the need for real-time analysis becomes an essential key to success. While edge farms (IoT devices connected to server and networking for real-time processing) will be cloud connected, the performance requirements of this real-time analysis will dictate the

1. https://www.gartner.com/newsroom/id/3598917

local collection, storage, and transformation of raw data into actionable intelligence and micro decisions.

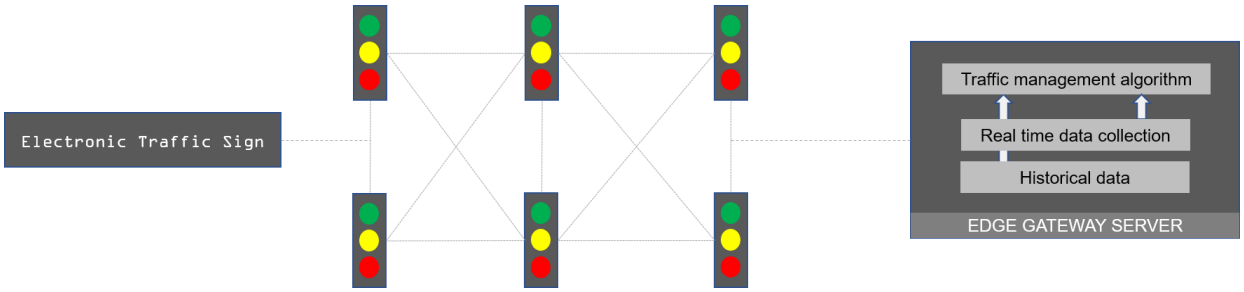
MI&S believes the edge computing market will eventually overtake traditional IT and cloud in terms of shipments and revenue.

Edge Computing Use Cases

Edge computing exists today. Sensors on oil rigs measure flow rate and barrels of crude filled. Medical devices in hospitals collect patient health information, while other devices deliver much needed medicine. In some cities, grids of traffic lights are programmed to manage traffic during peak times, while mounted cameras capture license plate numbers of cars passing through intersections.

Marrying analytics to edge computing results in far greater benefits realized and efficiencies achieved. For example, ***retail outlets*** can tailor "end cap" advertisements for customers based on intelligence gathered from mobile phones via beacons. ***Hospitals*** can increase operational efficiency and speed patient recovery through smart room technology. ***Smart cities*** can compare real-time traffic data with historical traffic conditions using algorithms fed through mounted cameras. This type of smart city grid can also intelligently route traffic based on volume of cars, accidents, and road closures. ***Smart factories*** can detect failures before they occur and prevent downtime of assembly lines using data collected from machine sensors. Finally, ***surveillance cameras*** can capture hundreds of faces in railway stations and airports and analyze these images in real-time for security purposes.

Figure 2 - Edge computing: managing traffic based on real-time intelligence



Source: Moor Insights & Strategy

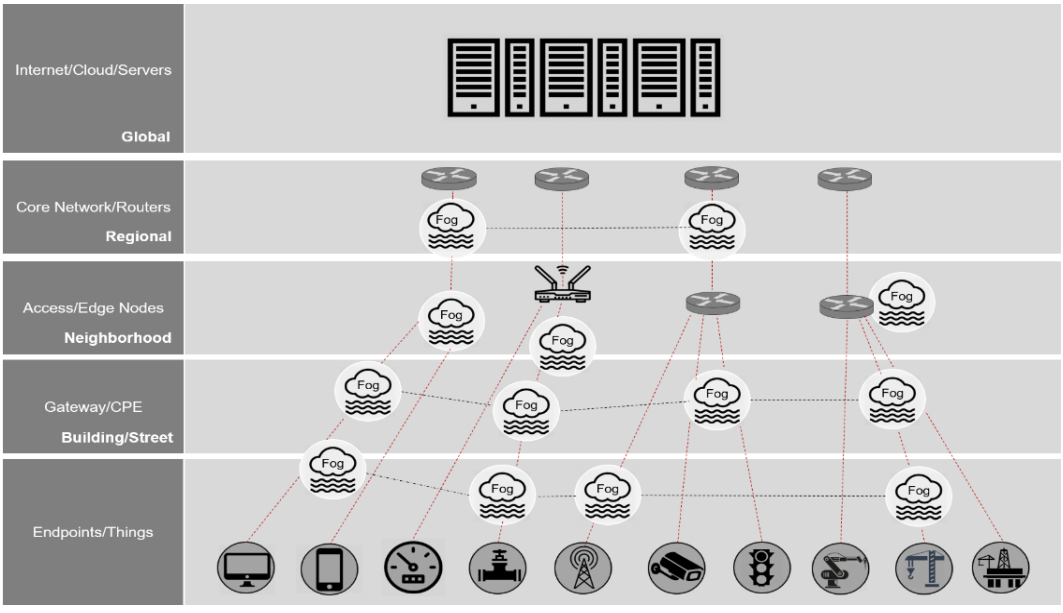
In Figure 2, multiple traffic lights are interconnected and their data is shared with an edge gateway server. The raw data is collected, refined, and compared to historical data to deliver real-time coordination of traffic lights for a city grid. This data intelligence alerts drivers to bottlenecks or accidents or redirects drivers around congestion. This intelligence also feeds map tools such as Waze to reroute drivers based on their destinations.

EDGE COMPUTING VERSUS FOG COMPUTING

Edge computing shares similarities with fog computing. However, the latency requirements associated with edge computing require localized compute while fog computing occurs along the "cloud-to-thing" continuum. Put simply, edge computing is about deploying computing closer to the point of data creation and action to more quickly produce actionable intelligence.

For example, analysis must happen in real-time like in the case of a bank of surveillance cameras scanning a crowd for known threats. Sending video captures to a cloud datacenter for analysis could allow for that known threat to escape authorities. Conversely, an edge farm that could collect, process, analyze, and alert in real-time enables authorities to act while that known threat is still in view.

FIGURE 3: FOG COMPUTING



Source: Moor Insights & Strategy

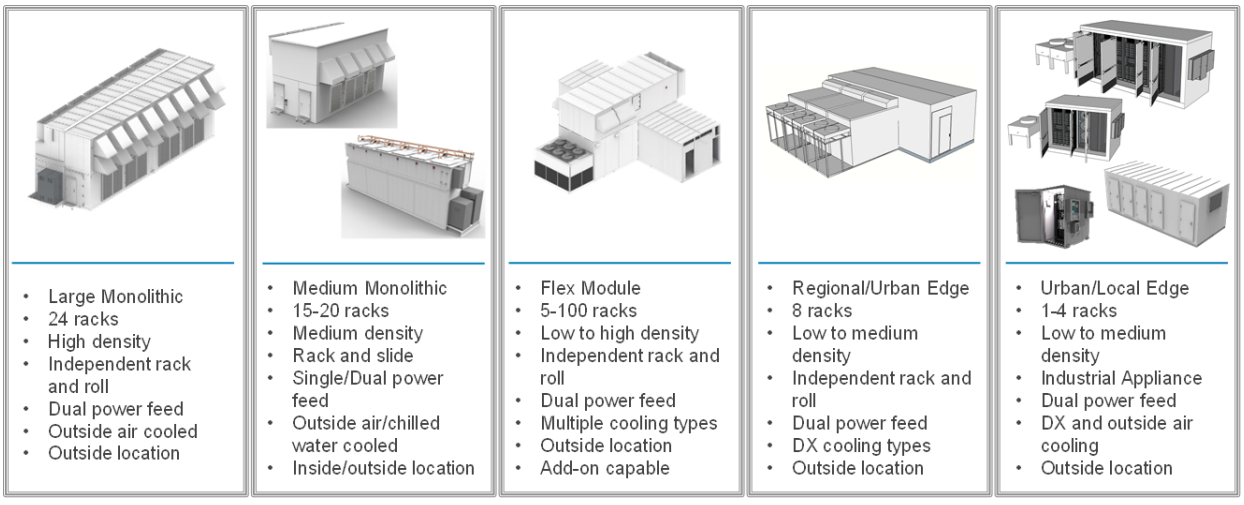
THE NEEDS OF THE EDGE

One of the key requirements for a performant edge deployment is **security**. The sheer number of devices added to an organization's network can create what seems like a security nightmare for an IT administrator. Each connected device must be physically hardened to withstand any number of attempts to exploit. Additionally, the use of Smart Network Interface Cards (NICs) will deliver added protection to ensure isolation and performance.

Edge deployments must also be **resilient**. Deployment environments can be Remote Office/Branch Offices (ROBO), hospital closets, military installations, factories, or even oil rigs and oil fields. When seeking an edge solutions provider, organizations should look for providers with deep experience (and a corresponding portfolio) in designing and deploying these environments and consider ruggedized specifications such as a Network Equipment Building System (NEBS) (Level 3) and European Telecommunications Standards Institute (ETSI).

Carriers and service providers have many distributed locations to leverage for IoT and Big Data projects. Traditional datacenter architectures are often not optimized for edge-oriented initiatives. Dell EMC's Extreme Scale Infrastructure division offers a wide variety of modular datacenter designs capable of deploying one to 500 or more racks with or without pre-integrated servers in locations where datacenters are not available or economical using traditional brick and mortar facilities.

FIGURE 4: TYPES OF MODULAR DATACENTERS



Source: Dell EMC

Most importantly, edge deployments must enable **right-sized performance**. Workloads such as real-time analytics will require performant compute, storage, memory, and network technologies to be effective.

Organizations will undoubtedly find specific business needs based on their environments and other factors. MI&S recommends carefully documenting these needs to help guide discussions with solutions providers.

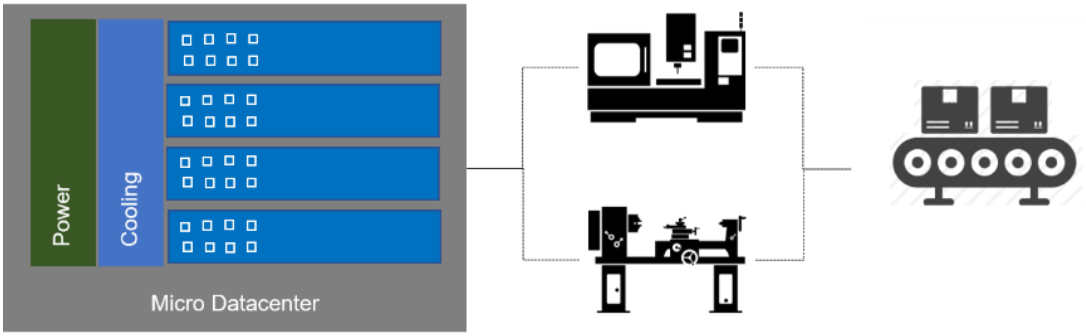
Technology companies that build servers for datacenters do not necessarily have the expertise to design and build compute solutions for the edge. MI&S has found Dell EMC to be one of the market leaders both in terms of completeness and integration of the portfolio.

THE FOUNDATIONAL ELEMENTS OF THE FOURTH WAVE

As mentioned previously, edge environments can exist in a number of environments and conditions. **Near-edge** environments mirror traditional datacenter environments, such as server rooms that sit in hospitals. Traditional servers, such as a Dell EMC PowerEdge class server, will be deployed. The deployment will also include the appropriate accelerator such as Graphic Processor Units (GPU) or Field Programmable Gate Arrays (FPGA) for machine learning and real-time inferencing. Smart NICs will assist in agile software-defined network requirements.

Extended edge environments have different requirements than those that sit in an environmentally-controlled closet. Factory floors and other areas where temperatures can hit extremes, or dust and other particles can fill the air, are not uncommon environments for the edge. In these environments, self-contained compute environments known as micro datacenters are deployed. These products ensure air is filtered and cooling is provided to more ruggedized, bespoke servers. Dell EMC has a series of servers that meet the needs of an extended edge environment. For example, the Dell EMC R440xr is designed to withstand more extreme environments while providing the necessary compute resources. Much like near-edge environments, Smart NICs and compute accelerators provide real-time analysis.

FIGURE 5 - MICRO DATACENTERS DELIVER SERVER ENVIRONMENTS THAT CAN WITHSTAND EXTREME ENVIRONMENTS



Source: Moor Insights & Strategy

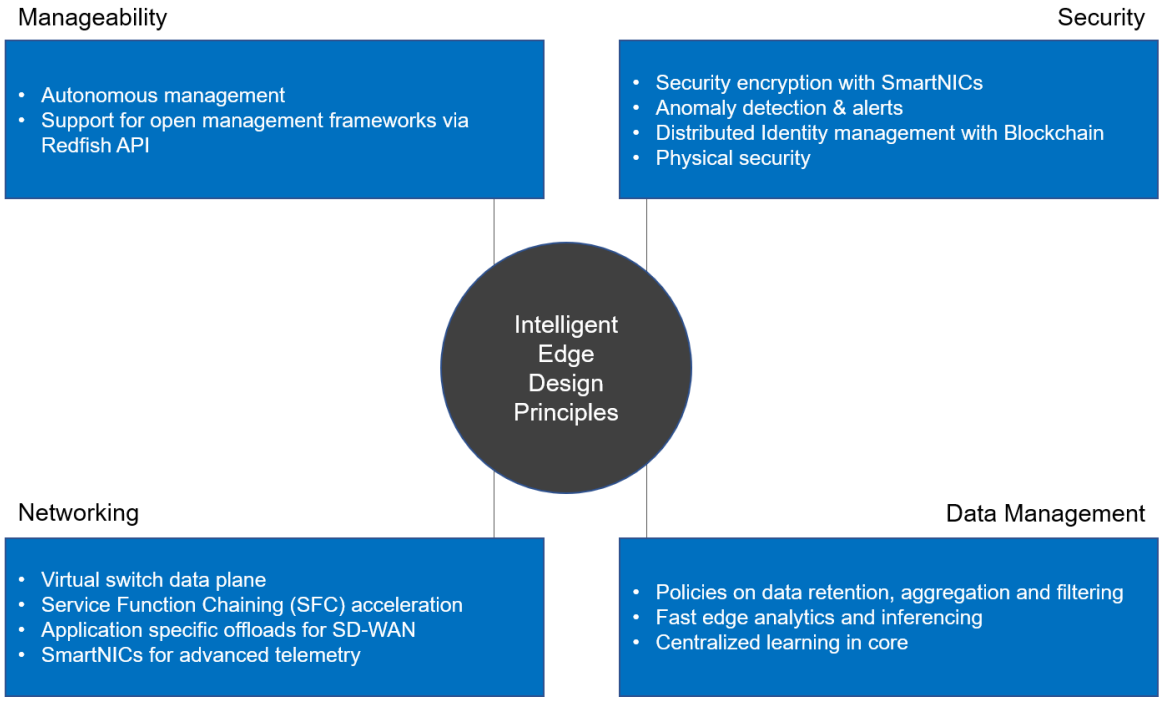
Far-edge environments or **extreme-edge** environments are those environments where ruggedized equipment is the norm and networking is achieved via cloud radio access networks (C-RAN) and a multi-access edge compute server (MEC). Because of these extreme operating conditions, organizations must look to specialized compute environments to fulfill their needs. Tight integration of all hardware and software elements is key to a successful deployment. Additionally, autonomy coupled with advanced telemetry is an absolute must. Dell EMC servers such as the R440xr, R640tel, and R740tel support the needs of these far-edge environments and adhere to NEBS and Telcom standards.

A solutions provider that can deliver across all deployment models can be difficult to find. Dell Technologies seems to be well positioned to meet the needs of the market from servers to storage to networking to software.

ESSENTIAL ELEMENTS OF THE INTELLIGENT EDGE

Intelligent edge computing describes the entire edge computing environment in terms of performance, security, and manageability. An edge environment that is lacking in any of these areas can quickly shift from being an IT asset to a liability. To achieve success in deploying an intelligent edge environment, IT organizations should consider the principles indicated below in Figure 6.

FIGURE 6: INTELLIGENT EDGE DESIGN PRINCIPLES



Source: Moor Insights & Strategy

- **Distributed security** is essential. Security must span from devices and sensors to servers and gateways and include hardware, software, and networking. IT organizations should look to providers who have made security the underlying foundation of their edge computing solution.

- **Distributed and remote management** coupled with distributed security, is a critical element of the intelligent edge. IT organizations evaluating solutions providers should look for both depth and breadth in terms of manageability. Intelligent automation is necessary for delivering autonomy. Open standards such as Redfish that ensure cross-platform compatibility must be embraced.

- **Network Services Acceleration** delivers the required bandwidth and aids in the security and manageability of intelligent edge environments. It enables acceleration of network services and efficient deployment of software-defined network services (SDN). This technology also frees up the server CPU cores and memory for running critical applications, data analytics, and machine learning at the edge. The network data-plane acceleration provides opportunities to build a

highly secure network data plane that can perform traffic analytics and application isolation to deliver higher levels of security.

- **Distributed core to edge data management and analytics** refers to how raw data can be turned into actionable intelligence. IT organizations should look for edge platforms that are designed to deliver best-in-class performance while delivering on security and manageability. Frameworks that enable real-time analytics, filter streaming data, and encrypt data sent over network or stored on the edge are critical.

THE INTELLIGENT EDGE MARKET

There is a lot of hype surrounding the IoT and edge computing market. MI&S has evaluated the market and believes there are few vendors who can comprehensively deliver an intelligent edge computing solution in a real and meaningful way. Organizations should consider the list of vendors carefully. Of these, we believe Dell EMC is well positioned for the below reasons.

- ***Portfolio*** – MI&S believes Dell EMC has all of the critical components and a level of integration that only a few vendors can claim. From custom built hardware to reference architectures, Dell EMC can support the needs of the most demanding edge use cases with offerings like their PowerEdge R6415, XR2, OEM R740, R640, gateways 5100, and embedded PC's 5000 and 3000.

- ***Experience*** – Dell EMC has designed and deployed edge solutions for major corporations which we believe should convey a sense of confidence to consumers.

- ***Vision*** – Dell EMC has demonstrated both a vision and commitment to the edge space going so far as to dedicate a business unit to delivering best-in-class edge computing solutions beyond just building products.

CALL TO ACTION

The "edge" has evolved from millions of connected devices generating ZB of raw data to billions of devices controlling our world from streets to factories to hospitals. We believe organizations of all sizes can benefit from deploying intelligent edge solutions that can take raw data and transform it into actionable intelligence. These solutions can yield

cost savings, increased reliability, reduction in threats, and greater levels of compliance around data integrity and sovereignty.

MI&S recommend holistic planning, deployment, and management of your intelligent edge compute environment. Ensure your security strategy is multi-dimensional and thorough. Consider your bandwidth needs and networking solutions that can deliver increased performance while enhancing your security and management strategy. Avoid sacrificing performance when evaluating your operational and management needs. Consider future needs when capacity planning. We also believe the amount of raw data generated will increase significantly in the coming years so deploying platforms that can learn, inference, and analyze the needs of today may require additional investments in the near future.

Because of the complexity involved in planning, deploying, and maintaining an intelligent edge solution, we recommend seeking out solutions providers with products, experience, and ecosystem partnerships that can deliver value in each phase of deployment.

Moor Insights & Strategy believes that Dell EMC is uniquely qualified in the edge computing marketplace and the depth and breadth of their portfolio is unmatched. The company can deliver and service the entire value chain from hardware to networking to partner software and has tightly integrated “up the stack”. The provider’s portfolio coupled with their deep experience and vision makes them a vendor worth considering for your next intelligent edge project.

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