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Gaining an intelligent edge

Edge computing and intelligence could propel tech and telecom growth

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RISING FROM DECADES of instrumentation, automation, and connectivity, the intelligent edge is maturing into a revolutionary set of capabilities that are already transforming some of the largest technology and communications companies on the planet. Although market estimates vary considerably,[1] Deloitte predicts that in 2021, the global market for the intelligent edge will expand to US$12 billion, continuing a compound annual growth rate (CAGR) of around 35%.[2] Expansion in 2021 will be driven primarily by telecoms deploying the intelligent edge for 5G networks, and by hyperscale cloud providers optimizing their infrastructure and service offerings. These highly capitalized leaders are establishing the use cases and best practices that may make it easier for companies across multiple industries to attain the capabilities of the intelligent edge. By 2023, 70% of enterprises may likely run some amount of data processing at the edge.[3] As one leading graphics processing unit (GPU) manufacturer has stated, "We're about to enter a phase where we're going to create an internet that is thousands of times bigger than the internet that we enjoy today."[4]

Though challenges and headwinds exist, we believe that the intelligent edge is poised to transform the computing landscape, propelling the world's largest technology companies toward the next generation of connectivity and operational efficiency. By bringing powerful computing capabilities closer to where data originates and needs to be consumed, the intelligent edge unlocks the potential for faster, less expensive, and more secure operations in everything from autonomous vehicles to virtual reality to the Internet of Things (IoT)—helping to accelerate the Fourth Industrial Revolution.[5]

What is the intelligent edge?

The intelligent edge is the combination of advanced connectivity, compact processing power, and artificial intelligence (AI) located near devices that use and generate data.[6] It represents an evolution and convergence of trends in industrial monitoring, automated manufacturing, utility management, and telecommunications, amplified by cloud computing, data analytics, and AI. The intelligent edge puts these latter capabilities physically near where data needs rapid analysis and response, enabling that data to be acted on directly or filtered to push only the most important bits to the core. In particular, the intelligent edge's ability to bring cloud capabilities to remote operations could greatly amplify their performance.

The monumental rise of AI and the evolution of computation to support it are critical enablers, driving tectonic shifts in the semiconductor industry.[7] Graphics processing units (GPUs) have been moving into data centers to support AI workloads and dedicated AI chips are reaching out to the edges, including devices, to operate on incoming data immediately.[8] Advanced connectivity ties them all together, while virtualization enables services to seamlessly run

across a web of diverse and dynamic components, from the cloud to the edge. Indeed, effective planning and implementation of an intelligent edge strategy may require coordination and orchestration of multiple ecosystem providers.

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This rise of the intelligent edge will likely drive the evolution of service architectures to become more location-driven, decentralized, and distributed. The intelligent edge does not replace the cloud or data centers but, rather, is an element within a holistic cloud-to-edge architecture.[9] Some components of a service will run in a centralized cloud, others at the data center, and more yet at the edges on sensor arrays, autonomous vehicles, and potentially billions of machine endpoints. The ways that computation operates on different parts of the data journey, where it operates, and the differing requirements those operations place on connectivity and speed may reshape how services are architected by distributing components based on their needs.

There are challenges to overcome, however. Standards and best practices have yet to cohere, and issues with interoperability and security will likely become more visible. The intelligent edge today combines solutions from telecoms, hyperscalers, and technology providers, and effective implementation requires coordination and integration across multiple sectors. Who owns which pieces? Who makes the most of their capabilities? Who will deliver the best end-to-end solutions for the rest of the market? The answers to these questions could shape the landscape for years.

Why is the intelligent edge important?

For businesses with data-driven use cases, the intelligent edge can offer the following key capabilities:[10]

- More efficient use of bandwidth and greater network visibility, which can lower costs
- Resilience against poor, unreliable, and lost connectivity due to lower dependency on wide area networks (WANs)
- More control over data triage, normalization, residency, and privacy through the ability to keep more data local rather than needing to transmit it across the network to the core
- Support for low-latency use cases and fast response times
- Greater automation and autonomy

With these capabilities, the intelligent edge can add greater visibility across operations, support faster data analysis and real-time response, and enable better automation and more dynamic systems. If certain microservices require very low latency and high security, such as facial recognition for facility access, they can execute at the edge rather than in the cloud. This can enable much tighter decision loops, reducing the costs and security risks of network transit: The edge can send the most important bits to the core and the core can manage the edge.

The intelligent edge can support large-scale transformational solutions that could radically evolve manufacturing, logistics, robotics, mobility, and consumer electronics.[11] For instance, an

intelligent edge system can shift supply chains from somewhat fragile, linear systems to more programmable, responsive, and adaptive digital networks, which are able to reshape themselves to address changing demands and disruptions.[12] As another example, utilities and similar organizations could use the intelligent edge to connect AI-enabled drones to address mounting risks posed by aging infrastructure,[13] which could make identifying and addressing those risks much faster. One Norwegian oil rig has already deployed a remote autonomous robotic dog that can patrol the rig and visually inspect for issues such as gas leaks.[14] These devices can be deployed 24/7 to map and monitor assets, flag problems, and alert the rig's networks and crews of potential risks.

The advantages of using the intelligent edge for such operations can be significant. Consider how an automated drone could inspect a pipeline for defects. With cloud, the drone might fill its local storage with video of a pipeline inspection, and then return to its base station. It would then upload the video to a remote data center, potentially sending gigabytes of information over the network and requiring significant time to do so. The cloud would apply machine learning (ML) to evaluate the data for defects and, upon spotting them, return that information back to the pipeline site to provoke a response: treat the defect and possibly reroute flows.

With edge intelligence, the same AI/ML inference algorithms that the cloud uses to evaluate the video can be run at the edge directly on the drone. Instead of scanning and analyzing the entire video, the drone could operate on a small, near real-time buffer of the video feed to classify defects. When it identifies a defect, the drone can immediately notify nearby crews to treat the problem. Only frames with defects are archived in the cloud to feed models and training sets, which can then update other drones in the field for better spotting. This minimizes the data load for analysis and transit, greatly reduces the time between inspection and action, and uses the network only for critical information that will add to the toolchain and drive greater insights and learning.

Who needs the intelligent edge?

The intelligent edge can benefit any business that manages infrastructure, networks, clouds, data centers, and connected endpoints such as sensors, actuators, and devices. It can support consumer use cases that require very low latency, such as cloud gaming and augmented and virtual reality. It can enable enterprise uses that require aggregating, securing, and analyzing a great deal of data across operations and customers. And it can improve industrial processes for managing quality, materials, and energy use, such as monitoring factory floors, assembly lines, and logistics.

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Not all businesses will be able to implement intelligent edge solutions broadly right away. Many may need to invest in the right infrastructure and partnerships first before seeing a return on investment from narrow use cases. But laying these foundations can give organizations much greater opportunities in the future.

What's driving demand?

In the year ahead, we anticipate that early growth will be led not only by large telecoms but by hyperscale service providers, content delivery network (CDN) providers, and technology companies as they consume and sell intelligent edge solutions. Technology companies, while marketing intelligent edge components, appliances, and software layers to early adopters, may also seek to reinforce their own manufacturing and supply chains with intelligent edge capabilities. Similarly, telecoms, hyperscalers, and CDNs are not only making more capabilities available to their customers, but also expanding their own intelligent edge infrastructures to advance strategic initiatives. In the medium term, the use of intelligent edge beyond these early adopters will likely grow among manufacturing, logistics, and supply chain.

Most spending on edge computing and intelligence today comes from US telecoms and communication service providers (CSPs).[15] With more devices moving on and off networks, and with more diverse bandwidth needs emerging, these network providers are facing mounting management challenges. They are using intelligent edge technologies to transform and reinforce their own infrastructure, such as by expanding central offices to become next-generation data centers and edge hubs, enabling high-density and dynamic connectivity for 5G and multi-access edge computing (MEC),[16] and virtualizing more of their networks with solutions such as open RAN. These steps support their core business of delivering greater quality of service to subscribers and selling networks to enterprise customers.

Hyperscale cloud and service providers are also moving quickly to add intelligent edge capabilities to their data-driven businesses. Demand is growing from use-case—driven solutions such as autonomous vehicles and mobile robotics that require low-latency, high-redundancy capabilities, as well as from manufacturing and supply chains seeking greater transparency and resilience in a post–COVID-19 world. Further demand may come from the intelligent edge's ability to address emerging regulations for data sovereignty and compliance. With an intelligent edge, data can be secured and held locally, keeping it within the region it was collected instead of sending it to foreign clouds.[17] This could potentially draw more investment from social media platforms looking to the intelligent edge to help them comply with regulatory regimes, such as the General Data Protection Regulation (GDPR), that may require personal information to be processed locally and anonymously.[18]

Finally, rising demand from industries like manufacturing and mobility (such as automakers and ride-hailing services) could lead to the development of more packaged and managed offerings. This could make it easier for more businesses to attain intelligent edge capabilities. As the COVID-19 crisis accelerates migration to the cloud, businesses undergoing their first wave of cloud transformation could design cloud-to-edge solutions that best meets the needs of their use cases.[19]

Who plays in the intelligent edge ecosystem?

No single provider seems able to build an effective intelligent edge solution by itself. Telecoms, hyperscalers, CDNs, and tech companies all play a role in enabling the intelligent edge, with each providing a part of the solution. Coordinating these various components is not easy: With each company pursuing its own strategic goals, cooperation is often not far from competition. Understanding the role of these players, what they offer, and how they fit in the competitive landscape can better arm organizations looking to attain intelligent edge capabilities.

TELECOMS AND THE EXPANDING INTERNET

For many intelligent edge deployments, telecoms are key partners,[20] with the largest telecoms increasingly selling their own edge computing and IoT solutions as well as on-premise private enterprise networks. As providers within the edge ecosystem, telecoms can offer their enterprise customers and partners end-to-end connectivity for wired and wireless networks, from fiber, cable, 4G/LTE, and Wi-Fi to advanced solutions with 5G and Wi-Fi 6. They also lease portions of their network that enable direct access to backhaul and offer real estate to host edge appliances and data centers in central offices. Cell tower companies can also lease space for edge appliances at their towers, which typically connect directly to fiber.[21]

One key challenge for telecoms is that they no longer have a near-monopoly on connectivity and communication, despite the billions of dollars they spend each year to modernize their networks. Many CSPs deliver network services on top of IP networks, and more hyperscalers and CDNs are building their own network infrastructure. However, telecoms' ability to provide the combination of backhaul, 5G, Wi-Fi 6, and the intelligent edge could unleash stronger capabilities for managed connectivity, giving them a competitive advantage in delivering next-generation networks with greater quality of service.

HYPERSCALERS ENCIRCLING THE GLOBE

Some of the world's most valuable companies—the so-called hyperscalers—offer end-to-end technology solutions, from cloud services to enterprise productivity and consumer lifestyle experiences. These businesses are highly data-driven, both for optimizing and extending their internal operations, and to deliver better services and drive continued engagement by understanding their customers and users. They are implementing the intelligent edge to advance both efforts by extending their hyperscale capabilities closer to the things they measure, and the enterprises they serve.

Hyperscalers' biggest challenge will likely be to maintain control over data while partnering with connectivity providers. Hyperscale networks could indirectly encroach on CSPs, especially if they were to offer connectivity as a part of their platforms. Nevertheless, building high-quality networks is difficult and costly, especially at scale, which makes partnerships with connectivity providers a more feasible route.[22]

As hyperscalers pursue intelligent edge deployments, they will likely establish new proofs of concept and use cases that will further drive adoption across the market. For example, some hyperscalers are positioning voice AI as a key interface modality across all their consumer services.[23] Being able to run natural language processing on the device—a smartphone, smart speaker, or car—without having to go back to the cloud can reduce latency, guard against connectivity failures and security breaches, and deliver greater quality of service while retaining data within regulatory jurisdictions.

For businesses deploying intelligent edge capabilities, hyperscalers offer public clouds and the IT services and management solutions that run on top of them, as well as AI capabilities. Some hyperscalers already control their own CDNs as well. Their development and marketing of these intelligent edge solutions aim to support their expanding business offerings across cloud, payments, health care, transportation, and media and entertainment.

CDNs ASPIRING TO BECOME THE OTHER HYPERSCALERS

Arguably, CDNs constitute a proto-edge in that they were developed to shift content closer to the consumer to accelerate the early Web.[24] Some CDN providers are now actively pursuing and marketing intelligent edge solutions, putting them in both cooperation and competition with telecoms and hyperscalers.[25]

CDNs have strong relationships with many businesses, and they boast some of the industry's highest-quality, redundancy, security, and delivery capabilities. The intelligent edge may reinforce their delivery networks and enable greater quality of service at a time when more companies need strong delivery services. However, because some hyperscalers and telecoms already control their own CDNs, the sectors currently driving the intelligent edge may not need external CDN providers. Additionally, CDN companies may not have strong relationships with the industries likely to adopt edge next, such as manufacturing and automotive.

TECH PROVIDERS OFFERING HARDWARE AND MANAGED SERVICES

Underneath the cloud-to-edge value chain reside innumerable hardware components and software layers that support it. Tech providers have a vast growth opportunity in selling their products and services into data centers, networks, on-premise facilities, and endpoints from factory floors and smart buildings to computers and vehicles.

Data center equipment and Wi-Fi connectivity will likely be in especially high demand. One forecast expects the edge data center market to approach US$16 billion by 2025.[26] Tech providers can help telecoms transform their central offices into modern data centers, help manufacturing facilities build stronger on-premise capabilities, and provide intelligent edge appliances and micro data centers to enterprise customers. They can also offer the middleware and management layers that tie these hybrid clouds together into seamless fabrics. In this sense, the edge is another location for the hybrid cloud.

Also, not all intelligent edge solutions require 5G, and more solutions may develop hybrid networks that include Wi-Fi, LTE, and 5G, depending on the use case. This means that some tech businesses may see more opportunities as Wi-Fi providers. The latest generation of Wi-Fi, Wi-Fi 6, offers bandwidth slicing, better power management, and support for an increased number of devices,[27] all of which can enable much more robust and dynamic local networks. Private local networks could also help some businesses reduce their dependence on cloud providers and telecoms.

All this being said, tech providers' position in the intelligent edge marketplace may be challenged by some of their largest customers—the hyperscalers and telecoms—building more of their own components, as well as the ongoing trend to dematerialize hardware into software wherever possible. However, as the market matures, tech providers may also serve more second-tier adopters less able to build their own solutions. This shift may be the next milestone for the realization of Industry 4.0, in which next-generation cloud-to-edge architectures become more standardized and commoditized.

DON'T FORGET SEMICONDUCTORS

Running AI on lightweight edge devices can require more specialized compute solutions such as custom field programmable gate arrays (FPGAs) and application-specific integrated circuits (ASICS), as well as GPUs designed specifically to accelerate AI algorithms on devices, in edge appliances, and in micro data centers. Demand for edge AI chips has grown substantially, and the market will likely expand considerably in the next few years.[28] To meet this demand, more semiconductor companies are accelerating production of edge AI chips.[29] Some are pursuing monumental M&A deals to shore up their position in the next wave of machine intelligence and computation.[30] Hyperscalers are also designing more of their own specialized chips to support their largest operations. And foundries and chip design firms are responding to meet the demand driven by data centers, AI, and the ever-expanding digitization of industrial systems.

What are the potential headwinds?

As it matures, the intelligent edge market faces some challenges. The COVID-19 crisis has disrupted demand, challenged supply chains, dragged down earnings, raised costs for many businesses, and injected uncertainty into outlooks. Additionally, the ongoing trade war continues to drive supply uncertainty, adding complexity, cost, and time to navigating supplier networks. In this environment, demand is difficult to auger and supply may be unreliable. Such conditions may engender a more conservative approach to capex on emerging technologies. Businesses may feel they can reinforce their existing cloud capabilities with less risk than implementing an intelligent edge, especially during a crisis that is demanding more remote and connected services.[31] Building the fundamentals of cloud migration may occupy many businesses in the near term, leaving edge development to the largest companies.

Additionally, while edge opportunities are becoming clearer, many companies may still regard them as a forward-looking strategic investment rather than an obvious way to drive their current business. Implementation can be challenging and costly, often requiring orchestration between multiple providers. Standards are still forming, best practices are not yet clear, and security across an abundance of diverse edge endpoints cannot yet be guaranteed.[32] In times of greater economic restraint, investments in the future may be easiest for the largest and most durable businesses—and even they may need to orchestrate services across providers.

The year 2021 may thus see the intelligent edge colonized primarily by already-dominant tech sector and telecom leaders, further reinforcing their competitive advantage in the coming wave of transformation. The efforts of these early adopters over the next year can help the intelligent edge prove its value. In the next two years, the market will likely sort out best practices, establish standards and interoperability, and potentially lift early leaders while making it easier for smaller businesses to adopt intelligent edge capabilities.

THE BOTTOM LINE

Each party in the intelligent edge ecosystem—telecoms, hyperscalers, CDNs, tech providers, and semiconductor makers—has a stake in the success of the intelligent edge and the next generation of cloud-to-edge architectures and services. The landscape is young and dynamic, but it also has decades of momentum behind it due to ongoing computing and network trends toward instrumentation, monitoring, and automation of facilities. With digitization, connectivity, and data analysis now maturing rapidly, the intelligent edge is beginning to transform some of the largest physical systems on the planet.

Like previous large-scale infrastructure upgrades, innumerable unexpected innovations will likely emerge as intelligent edge adoption expands. Executives should wade in and develop pilots with a clear path to results and strategic value. They should move beyond buzzwords and terminology to focus on use cases, metrics, and outcomes. Most importantly, they should understand that “edge” and “intelligence” are just components of a more holistic solution for faster data handling, greater autonomy and transparency across operations, and a more flexible and adaptive enterprise.

Endnotes

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