MARKET PERSPECTIVE

The Technology Impacts of Edge Computing in Europe

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EXECUTIVE SNAPSHOT

FIGURE 1

Executive Snapshot: Edge Computing impacts on different technology areas in Europe

This IDC Market Perspective offers a broad view of how edge computing is triggering innovation and otherwise impacting a range of technology areas. It focuses on recent developments in Europe. Areas examined in the document include enterprise networking and infrastructure, workload balancing, the Internet of Things (IoT), telecommunications, manufacturing, cloud, analytics, artificial intelligence (AI), data management, and security.

Key Takeaways

- Edge computing is impacting many technology domains, including infrastructure, networking, IoT, security, and cloud.
- Domains like data management, workload balancing, and AI are assessing edge computing. Edge's impact on these domains may be significant in the coming years.
- Telecom players are seeing both the internal and external implications of edge computing on their business strategies.
- The European scenario is slightly lagging developments in the U.S. (with the exception of manufacturing). European telecom operators are keeping the pace with their peers in other regions.

Recommended Actions

- Prepare for the rise of edge computing. Edge use cases demand a combination of facets that could be new to some vendors.
- Focus on providing end users with solutions that meet specific use-case challenges. Leverage consulting and professional services to understand the most promising use cases and business models.
- Build a solid ecosystem with a wide variety of players. A win-win business case for each partner is a key to success. The channel will be critical, especially for vertical-/use case-specific solutions.
- Capitalize on experience gained outside Europe. Leverage partnerships with local players to deliver solutions across the highly fragmented European scenario.

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NEW MARKET DEVELOPMENTS AND DYNAMICS

In just a few years, edge computing has grown from a tech industry buzzword into a trend that demands to be watched. In recognition of the increasing impact of edge computing, IDC recently established a research launchpad to analyze the phenomenon from different standpoints.

Like other emerging technologies and innovation accelerators, edge computing has a relevance to, and an influence on, a range of technology domains. This document discusses how edge computing is impacting and triggering innovation in different technology areas, with a focus on developments in Europe.

Edge's Impact on Enterprise Networking

The impact of edge computing on enterprise networking strategies has already been substantial. The 2019 IDC Enterprise Communications Survey of more than 1,000 European enterprise network heads found that more than 60% of European companies are leveraging edge computing solutions, either extensively or in a limited way. The potential benefits of edge computing are driving enterprises to reexamine how they plan, manage, orchestrate, and analyze their networks. The exponentially growing number of connected endpoints requires networks to have the capacity to connect via various protocols and connectivity types. Everything must work together, securely. Networking vendors are seeking to establish converged end-to-end solutions from the datacenter to endpoints, eliminating silos.

Edge computing directly increases the importance of networks — especially delocalized networks. Beyond mere optimization, edge requires true innovation in how networks are analyzed, managed, and orchestrated. This can no longer be delegated to hardware: Software functionalities must be implemented. Digital native software-defined networks are now looking to cloud as the simplest and most optimal way to centrally manage all parts of the network, at a lower cost (OPEX versus CAPEX).

U.S. enterprises are leading the way in edge computing initiatives, with European peers lagging by about two years. The development of some network types has been piecemeal. The adoption of private Long-Term Evolution (LTE) networks, for example, has slowed due to country differences in spectrum availability. Some countries that rely heavily on manufacturing (e.g., Germany) support private LTE, but other countries do not. The U.S. is an active proponent of private LTE. In 2015, the Federal Communication Commission established the Citizens Broadband Radio Service (CBRS) for shared wireless broadband use. The U.S.-based CBRS Alliance, whose members include telecom operators (e.g., AT&T, Verizon, and Sprint) and networking vendors (e.g., Cisco, Ericsson, Nokia, Ruckus, Qualcomm, and others), has begun offering private spectrum to enterprises.

Different industries have shown different propensities and maturities in adapting networks to edge computing. In Europe, the retail industry is slightly more advanced than other industries. Requirements for network security, performance, and management have restrained the financial industry's adoption of edge computing.

Enterprise networking vendors are partnering with manufacturers and operational technology (OT) companies to deliver Industry 4.0 solutions. They are working with Internet of Things (IoT) providers to offer gateways that enable low latency use cases and analytics at the edge.

Edge's Impact on Enterprise Infrastructure — Servers and Storage

Servers and storage are being impacted by the transformation in networking hardware and the growing importance of software-defined solutions. To broaden the infrastructure discussion, vendors are aligning cloud-to-core-to-edge propositions. The cloud-to-core segment is currently more advanced, but vendors are seeking reliable hardware and data management solutions that expand to edge locations.

Not all vendors are at the same maturity stage. Some have specialized solutions for edge; others have solutions that have been developed for other purposes but that can be deployed in edge. For infrastructure vendors, defining "edge computing" is a top priority. Does it, for example, include remote office and branch office (ROBO) deployments?

Edge computing is tied to the innovation of hyperconverged infrastructure, which has emerged in recent years. Edge solutions initially targeted ROBOs due to their cheaper, easier-to-deploy, and plug-and-play nature. Edge devices are now being ruggedized and deployed in small form factor. They sometimes feature OT communication protocols. Initially devoted to secondary workloads, these solutions are increasingly targeting mission-critical workloads.

Edge is currently a marginal part of IoT infrastructure spending, but IDC estimates it will grow rapidly, reaching upward of 25% of total IoT infrastructure spending in 2022. In Western Europe and Central and Eastern Europe, big manufacturing companies, especially in the automotive field, are increasingly adopting edge computing infrastructure.

Edge's Impact on Workload Balancing Strategies

Edge computing offers new possibilities in terms of workload balancing. Infrastructure for core and edge locations is blurring borders and accelerating evolution. Hyperconverged infrastructure enables workloads to be performed in the most appropriate locations (according to the use-case requirements and the overall economics of the business case). Workloads performed on captured data in real time or near real time benefit the most from edge computing. In the case of artificial intelligence (AI), finding patterns implies that the inference must be performed at the edge (reducing the usefulness of cloud for applicable models). Model training (which requires substantial computing and storage efforts, even in offline mode) is best performed in a datacenter or cloud. IDC's AI-cognitive survey showed that this "mixed" approach, with inferencing at the edge and training at the core, has been adopted by 35% of Western European companies that use AI. This trend is expected to broaden.

Europe is also lagging the U.S. in enterprise infrastructure. The trend in Europe is mainly driven by isolated big deployments in a handful of key industries (e.g., oil and gas, manufacturing, and retail). But smaller deployments, mainly tied to IoT, are starting to gain traction. Vendors are establishing partnerships with a range of technology players. Workload balancing strategies will become more important as edge deployments proliferate.

Edge's Impact on IoT Deployments

Edge computing has quickly become an important element of IoT. Its benefits include:

- **Reduced Costs:** Network bandwidth and cloud data storage costs are reduced when large amounts of sensor data can be processed at the edge — closer to the "things" — before being sent to the cloud. Edge computing enables the analysis and filtering of data closer to the sensors. Only relevant data is sent to the cloud.
- **Reduced Latency:** Many IoT use cases, from those in industrial environments to autonomous vehicles, require millisecond response times to ensure the safety of critical and precision operations. They cannot wait for a return trip to an IoT cloud platform.
- **Increased Privacy and Security:** Edge computing offers the possibility of shielding critical processes and infrastructure from direct network connections. This helps ensure that sensitive information remains within the organization.

The use of edge computing in IoT is linked to optimization and innovation. In some use cases, the benefits in terms of bandwidth and data transfer and storage offer new efficiencies (e.g., in remote locations, like an oil rig or a ship in the ocean, where satellite connections could be bottlenecked). In terms of innovation, edge computing is enabling IoT use cases that would not work with only "core" technologies (especially when ultra-low latency comes into the equation). Edge computing enables

use cases that leverage real-time video analytics and AI at the edge (e.g., in scenarios like public safety and security, autonomous vehicles, and production asset management).

The 2018 IDC Global IoT Decision Maker Survey found that European organizations are almost evenly split between those that process data at the edge, close to the point of creation (37%), and those that process data on premises in an enterprise-grade datacenter (35%). Organizations in Denmark, Sweden, Spain, and Italy have shown the highest propensity for edge computing. IDC expects that, by 2020, half the initial analysis of IoT data will occur at the edge (IDC 2019 European FutureScape).

The growing importance of edge computing in IoT will drive spending on edge infrastructure. IT spending on edge infrastructure in Europe is forecast to rise to 26% of total IoT infrastructure spending (compute, storage, and network elements) in 2022. Growth will be driven by deployments of converged IT/OT systems that reduce the time to value of data collected from connected devices.

Edge's Impact on Telco Strategies

Telecom operators are evaluating the impact of edge computing from two perspectives:

- **Internal Perspective:** The optimization of transport networks is the first direct consequence of distributing computing capabilities at a geographical level. There is no need to move gigabytes of traffic. Resources may be optimized in different areas. Analytics services at the network edge may be improved. Edge computing also enables specific security-rules applications at different edges. 5G will natively support edge. Network slicing from the core to the radio access network will use edge resources to deliver the required service-level agreements. Edge will play a significant role in telecom infrastructure transformation toward distributed clouds.
- **External Impacts:** Telecom service operators are leveraging edge computing to provide services to clients. Traditional business models are being transformed by offers of bandwidth on demand, self-service solutions, and content delivery networks. Edge enables the provision of ultra-low latency services (e.g., mobile gaming, live video, and AR/VR for consumers and enterprises). Providers are also complementing cloud services with virtual desktop infrastructure and storage services.

Edge computing is optimizing telcos' business models and portfolios, and the rise of 5G will drive further innovation. The interaction between 5G, cloud, and edge is opening opportunities in services. Private LTE and 5G are beginning to see some interest in European countries, especially in manufacturing and transport powers like Germany, France, and Italy.

IDC does not see major differences or gaps between Europe and other geographies (except China). Major European telecom services providers are experimenting and offering services at the same pace as major players in North America and elsewhere.

Edge's Impact on Cloud

The question sometimes arises: "Will edge replace cloud?" The technologies are not necessarily in competition. In IDC's view, they are complementary and interact in a smart and intelligent way. Edge may help boost cloud adoption within industries and use cases in which cloud has lagged. It is up to businesses to analyze their use cases and unique needs to determine the right balance of processing performed in the cloud and at the edge. IDC forecasts that, in 2020, more than 50% of European organizations' cloud deployments will include edge computing and that 20% of endpoint devices and systems will execute AI algorithms. AI is an example of how edge and cloud can complement each other. AI models can be executed on edge devices. Inference and model training need large data sets and storage and computational capabilities, making cloud the most appropriate place to run these processes. It should be noted that transferring large data sets to a central cloud can be challenging and can impact data management and connectivity.

The main cloud players are enriching their portfolios with edge-to-cloud services that include direct cloud links. This enables the performance of processes on distributed computing platforms. Partnerships may help aid the transition of edge-generated data to the cloud.

Due to data security and privacy concerns, Europe has been slower to embrace cloud computing. However, now that cloud and cloud security are better understood, IDC sees accelerating adoption of cloud in Europe. As edge computing use cases emerge, especially in the manufacturing industry, cloud will play an important role. Edge devices are typically far from the main datacenter. Cloud provides a decentralized set of access points closer to the device and will become the essential building block in any edge-cloud-datacenter architecture. The drive to implement edge computing solutions, especially in the manufacturing sector, will accelerate cloud adoption in Europe.

Edge's Impact on Big Data Analytics and Artificial Intelligence

The technical benefits of edge analytics include:

- Reduced network (bandwidth) and central storage requirements, which improves the efficiency of centralized analytics (i.e., only relevant data to analyze)
- Reduced latency (a requirement in select use cases)
- Locally administered security
- Computational scalability

As edge computing matures as a technology, it will act as a distributed computation engine for the analysis of data that did not originate locally.

Edge analytics is often seen as an enabler of applications that were previously infeasible because of technical limitations. Edge is especially linked to novel IoT applications. Edge analytics may be applied to address the limitations of existing applications. It may be used, for example, to enable an increase in the responsiveness or resilience of a mobile data network.

Edge is becoming increasingly attractive as an implementation infrastructure for AI/machine learning. It can be deployed in the execution of inference engines derived from machine learning (even if the engines were trained on large volumes of data in the cloud). The 2018 IDC Europe AI/Cognitive Survey indicated that 52% of European organizations that are considering or evaluating the use of AI solutions are planning to deploy edge inferencing. More than one-quarter (26%) plan to roll out edge-edge solutions (in which training and inferencing are executed at the edge).

For the last few years, Europe has trailed the U.S. and some other nations in cloud adoption (for reasons including compliance with data protection regulations). But this is beginning to change. IDC assesses that, in edge computing deployment, including edge analytics, Europe has advanced and continues to do so.

Edge's Impact on Data Management

The effective use of data created at edge locations requires endpoint data to be collected, stored, managed, and analyzed at the edge in real time. Because of the nature of edge environments, storage, compute, and data management and analytics infrastructure need to be efficient and of a small form factor.

The edge is evolving rapidly. It is connecting devices, sensors, and endpoints (including cameras and lighting) that generate huge volumes of data that need to be extracted and analyzed. The vast amount of data generated by IoT-related devices can create challenges for enterprises that lack clear infrastructure strategies across different edge-location types. From a data management perspective, some edges can serve as hubs for smaller edges.

Managing data across different edges, in an edge-to-core-to-cloud fashion, requires a strategy for storage and data growth and for replication, encryption, and security. These requirements are driving demand for enterprise-grade edge infrastructure that enables the performance of immediate real-time analytics and the easy extraction and secure transfer of data to a datacenter core or cloud. Software-defined storage, small form factor storage, and hyperconverged appliances and server-based storage (with integrated data services and an ability to migrate some parts of data to cloud or core) are emerging as initial options for data management at the edge.

Edge data management in Europe is still very much an emerging use case. The heightened privacy and data protection priorities of European authorities suggest that data management at the edge will continue to be viewed from a security and compliance perspective. IDC expects European organizations to develop a unified platform strategy for data protection and management. This will encompass fragmented data across the spectrum (cloud to edge) and will simplify the management and minimize the risks of the edge.

Edge's Impact on Security

Organizations should not regard security only as a matter of protecting possible points of attack and guarding the expanding (in the age of IoT and edge) attack surface. Instead, they should value security as an enabler of digital transformation.

IDC has observed IoT edge network gateways deployed as security frontlines. As organizations seek ways to aggregate and analyze data, edge IoT gateways are emerging to provide a level of compute capabilities for "network of things" environments. This is boosting interest in controls for visibility and compliance at the edge (in conjunction with other security products to support analytics platforms in datacenters and cloud hosted services).

The unique location of the IoT edge network gateway, which often bridges the enterprise intranet to the internet or to public cloud and connecting endpoints, makes it a prime target for potential attacks. As IoT edge network gateways integrate more software, this may create additional openings for hackers to exploit. Because endpoints are often not equipped to handle security functions, IoT edge network gateways are embedding security features like digital certificates to authenticate and identify endpoint devices as they come online. The goal is to enable gateways to encrypt/decrypt network traffic. This will make the IoT edge network gateway the first line of defense against bottom-up attacks.

The EU's General Data Protection Regulation (GDPR), which went into effect in 2018, has strongly impacted the IoT market in terms of data collection and data residency. The legislation requires both EU and non-EU vendors to comply with rules governing the collection and usage of data of EU persons. Security technologies and services are playing a key role in helping organizations meet their compliance requirements. GDPR compliance should not be considered in isolation. Other new rules, including the EU's Network and Information Security directive and the ePrivacy Regulation, compel businesses to handle data overlaps and to resolve differences between these laws and GDPR.

Edge's Impact on Manufacturing

Edge computing works across three, previously separate, domains: IT, OT, and communications technology. The manufacturing vertical, which is very OT-oriented, presents many opportunities for edge computing. Manufacturing is impacted by edge computing in two main areas:

- **Smart Manufacturing:** Companies have been struggling to access the huge amounts of OT data in machines and robots. (Such data is usually accessible only by a limited number of people, usually technicians.) Edge devices enable the translation of OT language into IT systems. This enables the possibility of remotely monitoring, controlling, and managing machines in real time.
- **Visibility and Real-Time Key Performance Indicators**: On top of managing and controlling machines, edge enables a top-down approach to processing and the reconciliation of domains

that were previously disconnected. Companies can ensure latency and security features locally, taking relevant information and pushing it to the cloud. Cloud's potential in manufacturing AI and analytics can be exploited by filtering and transforming data **at the edge** and by performing inferencing and deep analysis connected to processes **in the cloud.**

Process optimization is a direct benefit of introducing edge in the manufacturing environment. Just as connected machines enable new services, OEMs can develop new products that connect from the edge to the cloud. The enabled feedback-loop data can then be leveraged to improve these products and their hosts. Such data can also lead to new services and can be shared across companies and possibly be monetized.

The manufacturing sector in Europe is in a prime position to move forward with edge technologies. Europe was the cradle of Industry 4.0 initiatives and is home to many key suppliers of production ecosystems. European manufacturers will increasingly look for their major enterprise applications to be the means through which they automate and accelerate execution, leveraging machine-embedded and edge intelligence.

Several implementations are already taking place. In the automotive industry, major European companies (e.g., Volkswagen Group and BMW) are moving toward the concept of edge-to-cloud smart manufacturing data analysis in a bid to reap the highest possible value from data and gain next-generation process improvements. In the aerospace industry, inherent process complexity and work intensity is driving companies (e.g., Airbus) to invest in making handheld tools more intelligent and connected. The goal is to improve quality and reliability and enhance the visibility of processes and worker performance.

Some companies have joined forces. Key suppliers (including European firms like HARTING IT, KUKA, Phoenix Controls, Schneider Electric, Software AG, and TTTech) have recently joined forces and coalesced into the Edge Computing Consortium Europe with a view to providing a comprehensive edge-computing-industry cooperation platform.

ADVICE FOR THE TECHNOLOGY SUPPLIER

Edge computing has different impacts on different technology domains. End users need to consider potential complexity when exploring the benefits of the edge computing ecosystem. IDC recommends that technology suppliers consider the following:

- **Prepare for the rise of edge computing.** Different workloads have different requirements for bandwidth, latency, range, and power consumption. Technology vendors are offering new and novel hardware to serve as an intermediate tier between connected device sensors and core infrastructure. Vendors must provide solutions that meet specific data processing needs — at the edge or in the cloud (or a combination of them).
- **Focus on solutions.** Whatever the technology domain, success in the edge computing field requires vendors to be more than technology providers: They need to be solutions providers. This means combining technology with use cases and offering clients solutions to the challenges their businesses are facing from new and emerging technologies.
- **Include a win-win business case for each player.** With so many technology domains involved, building a single end-to-end solution for a target use case is usually impossible. Vendors should look to partnerships to combine expertise and functionalities and build a use case-oriented solution. A business case that rewards each stakeholder is critical to success.
- **Work with professional services and consulting.** Many uncertainties exist around edge computing monetization and successful use cases. Consulting professional services will be crucial to identify the most promising use cases and business models. Many will require the creation and management of digital ecosystems that include players from multiple verticals.

- **Leverage channels to translate technology into vertical/use case propositions.** For traditional IT vendors seeking to gain traction in specific verticals, building a vertical edge solution may not be timely or efficient. Vendors should look to partnerships with vertical-specific vendors that can take a horizontal offering and combine it with expertise and functionality. Benefits are to be gained through building an appropriate channel strategy with partners that understand the challenges of verticals like manufacturing, utilities, and public administration.
- **Leverage the edge computing narrative to find opportunities.** Players in the edge computing ecosystem should be open to building relationships that enable them to exploit undeveloped or unexplored parts of the market. Vendors should leverage edge projects to develop client trust and methods to assess end-user maturity.
- **Follow the leaders.** Vendors should focus on the European industries most amenable to edge computing (e.g., manufacturing, retail, oil and gas, and the public sector). They should transfer experience gained deploying use cases from one region to another. They should seek to leverage the expertise of local industry-specific partners to cope with the different requirements of enterprises in different regions.

LEARN MORE

Related Research

- *IoT at the Edge in Europe: A Vendor Landscape* (IDC #EUR144674219, June 2019)
- *IoT and Edge: An Infrastructure Impact Analysis Across Industries and Use Cases* (IDC #EMEA44932618, March 2019)
- *The Edge - Perspectives on Market Definitions and Sizing* (IDC #US44602118, January 2019)
- *Which European Industries Are Leveraging Edge Computing the Most?* (IDC #EUR244996019, April 2019)
- *Edge Computing: The Opportunity Behind Distributing Capabilities* (IDC #EMEA44363618, October 2018)
- *Edge Computing Opportunities for Telecom Operators: Myth or Reality?* (IDC #EMEA44675519, April 2019)
- *Orange Business Services Business Summit: 5G and Co-Innovation* (IDC #IcEUR145025919 April 2019)
- *MWC19: 5G on the Cusp of Commercialization* (IDC #EMEA44902819, March 2019)
- *Market Analysis Perspective: EMEA Enterprise Network Life-Cycle Services, 2019* (IDC #EMEA44835119, February 2019)
- *Best Practices for Planning an Edge Computing Infrastructure* (IDC #US43615818, March 2018)
- *Edge Computing: The Next Stage of Datacenter Evolution* (IDC #US43727418, April 2018)
- *Edge Computing is Reshaping IoT: Time for European Enterprises to Take Notice* (IDC #EMEA43589818, March 2018)
- *What are the Most Popular AI Deployment Models for European Companies?* (IDC #EMEA44893919, March 2019)
- *IDC FutureScape: Western Europe IT Industry Implications 2019* (IDC #EMEA44481618, December 2018)

Synopsis

This IDC Market Perspective provides an overview of the impacts of and relationships between edge computing and other key technology domains, with a focus on the European scenario.

"Edge computing has implications in many traditional and innovative technology domains. The success and proliferation of edge computing use cases are directly linked to how vendors combine their capabilities and technologies to deliver the best solution for each use case." — European Edge Computing Launchpad Lead Gabriele Roberti, IDC EMEA

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