EDGE COMPUTING—ENABLING THE SMART EDGE WITH THE R

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Edge compu g, utilities and many ot care and smart cities,

But what is

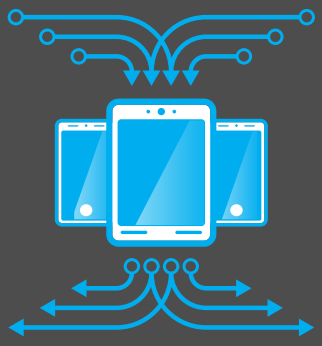
This eBook delves into the numerous ways that edge computing can benefit manufacturing and utilities organizations, as well as:

- Describes the important role of edge computing in a modern manufacturing or utilities organization
- Highlights key supporting edge technologies, including analytics, Internet of Things (IoT) and 5G
- Explains the role of mobile devices for enabling smarter, more streamlined processes

The importance of edge computing in a modern manufacturing or utilities organization.

Think of all the internet-enabled sensors, cameras, laptops and IoT devices you come across daily in your work and personal life. They are each part of the edge computing landscape. By 2023, there will be 29.3 billion of these networked devices in use. And every one of them provides data that could be used to innovate operations.

Within manufacturing and utilities, data from edge devices can be used to improve asset management, deliver predictive maintenance, offer new insights to manage supply and peak-demand forecasting, improve worker safety on the factory floor and in the field, and more.



29.3 billion

By 2023, there will be 29.3 billion networked devices in use.[1]

Work happens at the edge

There's more to edge computing than connected devices. Edge computing puts data, processing and computing power at the edge of the network, where work happens.

More specifically, edge computing is part of a two-level architecture based on a central cloud. The "edge" extends a cloud environment by physically locating computing resources close to the user or the source of the data.

THE BENEFITS FOR USERS ARE SIGNIFICANT

At a time when agility is more important than ever, this ability to store, process and manage data where it's collected can mean significant opportunity for organizations seeking to drive productivity, increase operational efficiency and control costs.

Indeed, edge computing is just about mainstream for organizations that want to implement IoT and digital transformational initiatives. Infrastructure and operational leaders should be looking at edge computing as a foundation for their cloud computing and application strategies.[2]

1. Cisco Annual Internet Report (2018–2023).
2. 2021 Strategic Roadmap for Edge Computing, Gartner.

Cloud computing vs. edge computing

Cloud computing has delivered significant improvements within the manufacturing and utilities industry to date. Centralizing resources at data centers owned by cloud providers has enabled organizations to reduce management costs and avoid capital expenditures needed for internal data centers. Centralization delivers many additional benefits, from user experience gains to greater business agility and improved organizational efficiency.

Today, more than 92% of organizations have a multi-cloud strategy and, within 12 months, 55% of enterprise workloads are expected to be in a public cloud.[1]

EDGE COMPUTING AND 5G GIVE BUSINESS APPS A BOOST

175,000,000,000,000,000,000,000

175 ZB $(ZB=10^{21})$

Data generated by devices connected to the internet will reach an astounding 175 zettabytes by 2025.[2]

Meanwhile, a massive amount of data flows every day from the billions of devices connected to the internet, and it's growing rapidly. In fact, data generated by devices connected to the internet will reach an astounding 175 zettabytes by 2025. That's a tenfold increase from 2016 levels.

But today's centralized cloud and data center infrastructure can't move or process those huge volumes of data fast enough, and the cloud can only handle so much data before it hits network limitations of bandwidth, latency and reliability.

THAT FLOOD OF DATA DEMANDS A DIFFERENT WAY TO HANDLE COMPUTING.

ENTER EDGE COMPUTING

1. Flexera 2021 State of the Cloud Report.
2. State of the Edge Report 2018, The Linux Foundation.

Edge computing

Edge computing (also called industrial edge computing when applied to the manufacturing and utilities industries) serves as an intermediary between the devices at the edge—which are usually small, operate on low power and don't have a lot of processing power—and the centralized cloud or data center. In an edge network, the cloud architecture is extended to edge nodes and networks, placing computing close to the source.

Note: As we look at both technologies, it's important to note that edge computing is a part of a distributed approach to networking, rather than a competing technology to cloud.

In an edge computing environment, processing and analysis are performed where the data is generated, rather than transmitting raw data to a central data center. The results of data processed at the edge are rapid—and real-time business insights, equipment maintenance predictions, supply shortages and other details are sent back to the main data center for review and other human interactions.

This fast delivery of actionable information is critical for industrial organizations that need immediate updates related to outages and service or machine disruptions, and to provide real-time updates to teams and customers who are seeking fast action while also enabling smarter, more streamlined processes.

Fog computing vs. edge computing

The term "fog computing" is sometimes used synonymously with edge computing. Although they are related, they are not the same thing.

Fog computing provides a geographically distributed infrastructure with organized communication among nodes dispersed in a network, connecting to a centralized cloud and to the edge through a gateway.

Fog includes edge processing and the network connections that transfer the data to a centralized cloud.

FIVE ADVANTAGES OF PROCESSING DATA AT THE EDGE

The Internet of Things and enabling technologies—Analytics, AI and 5G.

The convergence of IoT, advanced analytics, artificial intelligence (AI) and machine learning (ML) is leading to a wave of new applications and innovations in industrial edge computing. These advancements include robotics, augmented reality/virtual reality (AR/VR) and automation capabilities that are already driving the evolution toward smart grids and factories.

The promise of 5G means even greater connectivity and bandwidth, playing a key role in increasing the speed at which data travels between two locations. This will help with situations like augmented reality, where the real-time nature of the data processing is critical.

How do these technologies work together?

While each edge deployment will vary based on the unique use case and its requirements, what each deployment has in common is the need for several technologies to work together. This includes cloud, AI and ML, advanced analytics applications, the gateway, connectivity, and devices and other data sources.

Each of these technologies themselves is network-dependent: Any digital transformation initiative within a manufacturing or utilities environment also requires a network transformation. Businesses will need to adopt centralized network management, the use of network analytics tools, network virtualization and automated networking provisioning to support their edge use cases.[1]

1. Andrew Froehlich, What are the steps I should take for network transformation?, TechTarget (2019).

HOW ARE THESE TECHNOLOGIES USED AT THE EDGE?

- CLOUD
- AI/ML AND ADVANCED ANALYTICS APPLICATIONS
- CONNECTIVITY
- MULTI-ACCESS EDGE COMPUTING (MEC)
- THE GATEWAY
- DEVICES AND DATA SOURCES

Why 5G is a critical enabler for edge computing

5G is a critically important enabler for edge computing, as it allows edge devices to communicate and share data faster and more reliably.

Edge-native applications can be built to take advantage of edge computing's low latency and bandwidth scalability, which will help drive demand for 5G networks and subsequently the growth of edge computing.

Wi-Fi 6 supports data transmission speed and efficiency

Wi-Fi 6 is the newest upgrade of the 802.11 standard for wireless network transmissions, and with it comes the promise of faster transmission speeds to reshape how internet-enabled devices manage data.[1]

The role of mobile technology at the edge

Mobile technology at the edge comprises the wide range of wearables, handhelds, tablets and laptops that collect, analyze and report data in real time, making it possible for humans to interact with edge data.

Mobile devices at the edge are used to access and capture data, bringing advanced technologies such as IoT, AI, AR and 5G to the decision-making process through applications and a faster network. They bring real-time data and visibility to the tools, components and processes throughout manufacturing and utility workflows. Consider these use cases:

- Alerts and notifications sent directly to machine operators' mobile devices can warn of potential problems or enhance decision-making close to where action must be taken.
- Thermal imaging software can be used on a mobile device as a diagnostic tool to help pinpoint equipment or site hotspots that might require repair.
- Preventive maintenance of equipment can be assisted by schematics for documentation or safety data accessed on the device at the machine site.
- Edge apps that integrate mobile devices with wearable gloves and/or barcode scanners can improve assembly, material handling, quality control, inbound and outbound transport, and warehouse processes such as picking.
- High-performing, rugged tablets can serve as controllers for inspection drones that monitor assets and feed data back to the device for further processing.

Ultimately, mobile technology supports an ever-growing set of use cases for manufacturing and utilities organizations alike.

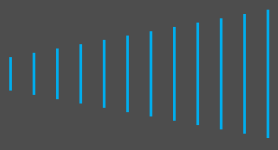
1. Ry Crist, Wi-Fi 6: Better, faster routers are here—here's what you need to know, CNET (Nov 30, 2019).

Edge computing in manufacturing.

Faced with the need to increase shop-floor efficiency, control costs, and streamline and optimize the supply chain, manufacturing leaders are looking to digitization to deliver significant improvements and strengthen their competitive positioning.

Edge computing is one of the technologies reshaping the manufacturing landscape, not only by capturing, processing and analyzing data from IoT devices and sensors, but also through robotic systems, drones and AR/VR applications.

2019
$360 million



2028
$3.55 billion

Combined, the global edge market for manufacturing services is predicted to increase from $360 million U.S. dollars to $3.55 billion U.S. dollars between 2019 and 2028.[1]

Manufacturing use cases for edge computing

An essential part of an overall modernization strategy, edge computing can be integrated in a variety of ways to automate the factory floor, streamline processes and deliver intelligent, actionable insights for better decision-making.

Monitoring product quality throughout industrial manufacturing process

Analytics can be used to monitor the production line, giving organizations more control throughout the product life cycle. AI and ML applications can predict and alert production teams of anomalies on their mobile devices, pinpoint where production inefficiencies occur and improve quality control. By knowing where problems are, organizations can greatly improve production quality, throughput and cost savings.

Asset tracking

Continual small disruptions can cause big production delays and drive up operational costs in a manufacturing plant. RFID- or GPS-based tracking devices attached to high-value assets and resources can help ensure they're transferred safely in the plant. Additionally, tracking devices can help gauge distances and estimated arrival times to improve scheduling and planning when equipment is on the move between facilities.

1. Manufacturing infrastructure edge computing capital expenditure (CAPEX) distribution worldwide in 2019 and 2025, by segment; State of the Edge 2019.

Equipment maintenance

Maintenance and repair are constant factors in operational efficiency for manufacturing companies. Condition-based monitoring uses data to manage the health of equipment and assets so factories can create a maintenance schedule only when service is needed. Complex equipment and plant inspections that use automated checklists and audits accessed via mobile devices can be shared with the back office to inform detailed reporting.

Predictive maintenance is more proactive, advanced technology using machine data and analytics to predict the likelihood of parts failure so repair teams can service equipment faster.

With advance notice of repair needs, equipment maintenance can also be conducted at off-peak hours to optimize daily operations and minimize disruption.

AR/VR in the manufacturing plant

AR/VR technologies have several potential applications in the manufacturing plant. AR/VR headsets can be used for equipment inspections, remote maintenance and repair, equipment and process training, and even for guiding workers through hazardous environments.

Manufacturing as a service

Leveraging economies of scale to share services within and across facilities and the agility to respond to changing demands from customers are becoming more important than ever. Edge computing infrastructure supported by a low-latency network, such as 5G or a virtual private LTE, enables manufacturers to stand up new manufacturing sites rapidly and scale production up or down based on demand.[1]

Plant security enforcement

Remote video can be deployed to monitor equipment and plants in real time, and location-tracking sensors can help track equipment location at all times.

Precision monitoring and control

AI and ML can analyze key edge data to provide quality assurance and real-time visibility from raw materials receiving to finished goods shipping. Here, too, edge nodes keep data processing local, filtering it to send only relevant or essential data to the cloud—increasing speed and operational efficiency and facilitating agility on the factory floor.[2]

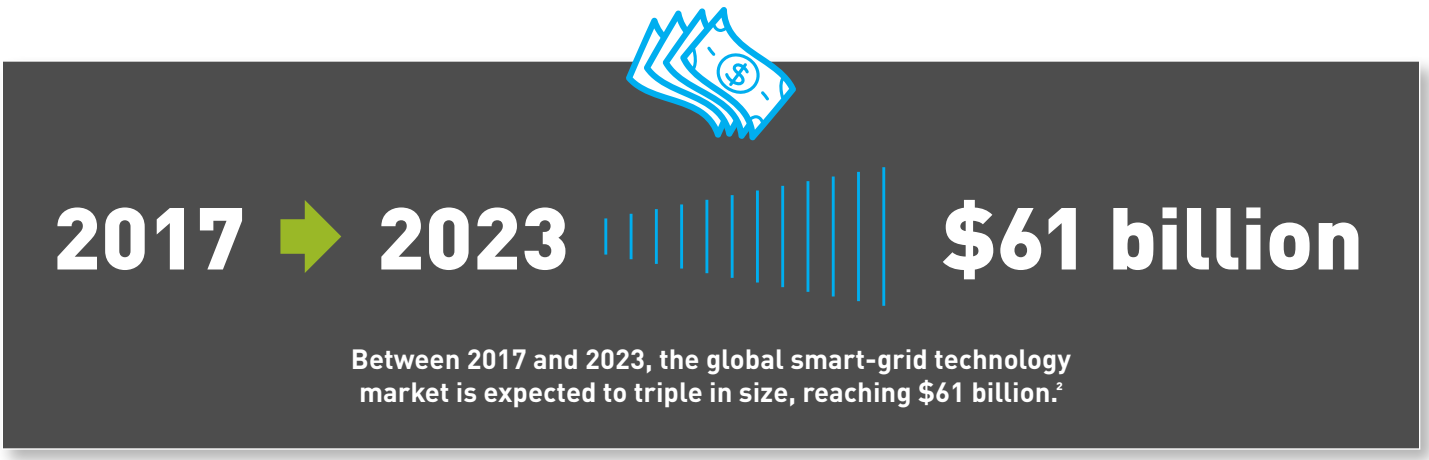
Digital twins in manufacturing replicate the physical manufacturing environment into a virtual representation to enable machines and systems previously in silos to exchange data. With full visibility into operations, manufacturers can optimize processes by collecting, aggregating and analyzing the data that represents physical events from the virtual twin. Other ways digital twins are used include asset maintenance, in which technicians use virtual engineering models via AR to perform maintenance and repair, and virtual simulation technology to simulate, validate and improve product designs.

1. Five edge computing use cases for the manufacturing industry, STL Partners.
2. Ibid.
3. EIA forecasts slower growth in natural gas-fired generation while renewable energy rises, EIA.
4. Global smart grid market size by region 2017-2023, Statista; March 2019.

Edge computing for utilities.

Digital transformation initiatives that include edge computing have a valuable role to play in the energy industry. Today, utility organizations are seeking to manage risk that comes from market volatility, improve the supply chain efficiency, better manage high-value assets, improve worker safety and address regulatory compliance.

Renewable energy growth, predicted to deliver 35% of US energy by 2024,[1] is also driving transformation. And smart-grid technology implementations are increasing rapidly. Between 2017 and 2023, the global smart-grid technology market is expected to triple in size, reaching $61 billion USD.[2] The utility grid is poised to become a dynamic, predictive, data-driven network.



Use cases for energy and utility companies

As part of an overall modernization strategy, edge computing enables utilities to act in real time, helping to drive a wide range of improvements across use cases.

Automated distribution of water and electricity

Applications of smart grid technology give utilities a more efficient way to measure and manage the automated distribution of water, electricity and natural gas, while advanced data analytics can help ensure grid stability. Smart meters embedded across the infrastructure also can monitor usage and identify opportunities to use energy more efficiently, all in real time.

Predictive maintenance

With IoT devices, which integrate sensors, machinery, charging units, transformers and other equipment, maintenance teams gain the data and insights needed to conduct preventative service and repairs on assets in far-flung locations. For example, edge computing enables autonomous drilling equipment to react to unexpected conditions miles offshore, even when disconnected from the central network.[3]

1. EIA forecasts slower growth in natural gas-fired generation while renewable energy rises, EIA.
2. Global smart grid market size by region 2017-2023, Statista, March 2019.
3. Adopting IoT for Manufacturing Sector: Its Impact and Applications, IIoT World.

Once issues are identified, maintenance technicians can proactively request the parts they need from inventory and AR/VR apps can guide technicians through repairs.

Asset monitoring

Remote inspections using drones and similar monitoring devices controlled by mobile devices make it easier to inspect and manage resources and extend the life of assets.

Supply and demand forecasting and managing peak demand

Edge data can play a crucial role in evaluating energy patterns and providing information to help supply and demand forecasting and managing spikes in demand. Insights can be gathered to help utilities strategize, anticipate changes and optimize to meet customer expectations.[1]

Emergency response activation

Real-time tracking of assets can pinpoint gas leaks or downed power lines, and IoT data can be used to improve emergency maintenance and repair response times. With advanced analytics, utilities can determine when and where larger issues make it necessary to engage work teams from other regions for a coordinated response, such as during floods, fires or large storms.

Security and safety

IoT sensors can be deployed at critical infrastructure sites to gather important data on the health of off-shore drilling sites, electrical grids and more, and they can be combined with cameras and other tools to support near-real-time monitoring. Having immediate access to equipment sensor data, such as temperature, humidity, pressure, sound, vibration and moisture, can provide key insights to help manage and maintain the health and safety of expensive equipment operating in remote and harsh conditions.

Smart meters

Smart meters can be deployed at building sites to monitor energy or water use for billing purposes, or in residences where customers can gain visibility into their own uses. This can be especially important in times of resource constraints due to excess heat, drought or other conditions.

Inspections, surveys and assessments

Equipment such as drones controlled by mobile devices can be used to conduct visual inspections of pipelines, facilities, powerlines, bridges or buildings. Critical data is captured locally, and advanced analytics can be used to identify potential defects or items in need of repair.

Digital twins for utilities

Digital twins create an accurate digital representation of a physical asset—whether equipment, IoT processes or an entire system—and can enable different machines and systems to share data for analyses, increasing visibility into operations. For example, power utilities can use digital twins to simulate an electrical network, dynamically modeling its components to understand how it would handle failures or upset conditions.

1. Adopting IoT for Manufacturing Sector: Its Impact and Applications, IIoT World.

Bring intelligence and efficiency to manufacturing and utility operations with TOUGHBOOK at the edge.

Our solutions combine Panasonic TOUGHBOOK® rugged laptops, tablets and handheld devices with industry-leading software and services to help you:

- **Increase operational efficiency** with access to real-time data that helps you improve asset tracking, optimize performance and reduce downtime.
- **Ensure operations are working** smoothly with mobile inspections, surveys and assessments.
- **Improve supply chain efficiency** with reliable connectivity that extends across your distributed operations.
- **Keep workers protected** and productive with powerful, rugged mobile devices designed to work safely in hazardous conditions.

Combined with a 5G module, our TOUGHBOOK product line offers rugged laptops, 2-in-1s, handhelds and tablets purpose-built for working in harsh environments at the edge, with modular device options for even more flexibility.

Even better, our TOUGHBOOK devices are easy to use, deploy quickly and put data directly into the hands of frontline workers, so they can stay connected and operate safely and productively. They all share powerful processors to handle sophisticated software for edge applications. They also feature:

- Rugged engineering
- Reliable connectivity
- Long-life batteries
- Third-party, military-standard certifications
- Industry-leading low failure rates
- ANSI certifications to meet safety regulations

TOUGHBOOK solutions can also be supported by some of the best service offerings in the business. We offer hardware and software solutions, including development and integration services for Windows® and Android™ environments, installation and mounting, deployment, kitting, engineering services, device monitoring via TOUGHBOOK Smart Essentials, and more.

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