



The Five Essential IoT Requirements and How to Achieve Them

From edge computing to data ingestion and insight sharing, here's how to maximize the benefits of Internet of Things deployments.

The way to IoT: five essential requirements

Smart devices fueled by the hyper-connected Internet of Things (IoT) are becoming ever more prevalent and pervasive in our personal lives. Sensors are everywhere, and the trend will only continue. Today, sensor-equipped industrial equipment is powered by artificial intelligence (AI). Medical devices can self-diagnose and send alerts to patients and doctors to remotely manage healthcare. Automobiles with in-car connectivity can download new features on the fly. Very soon, refrigerators will plan your dinner – and ovens will know how to cook it.

Every industry is seeking ways to use sensor- or device-enabled insights to improve our lives and the health of machines. As the number of devices explodes, so do the opportunities to use IoT to reshape industries and societies.

As the number of connected devices swells beyond an **expected 30 billion by 2020**, linking them through IoT will help enterprises across industries improve operations. Based on our observations, enterprises that **adopt IoT** have decreased supply chain costs by more than 20%, increased productivity by 10% to 20% and reduced design-to-market times by 20% to 50%.

IoT also expands capabilities. Logistics providers can track the exact locations and conditions of goods in transit. Manufacturers can monitor vibration levels of factory floor equipment to address issues before they arise. Drillers can remotely monitor oil well pressure to maximize production and prevent costly failures.

Yet many organizations experience their IoT initiatives as a difficult journey into the unknown. **A survey by Cisco** reveals that only 26% of companies consider their IoT initiatives a success, with a majority saying they were more complicated or took longer than expected. In an **IoT Institute survey**, almost half of all respondents were challenged to complete production-scale IoT projects on time. Sixty percent of top IT executives **polled by Cognizant's Center for the Future of Work** said IoT will add tremendous complexity to their IT infrastructure in areas such as networking, integration and data analysis.

As they seek to reap the benefits of IoT, enterprises face many challenges (see Figure 1), including:

- Selecting, implementing, customizing and supporting new technologies across the IoT continuum, from sensors and cloud platforms, to analytics and AI.
- Understanding and implementing unfamiliar data formats and proprietary communication protocols.
- Integrating the IoT infrastructure with existing systems without overloading corporate networks, **compromising security**, exceeding budget or falling behind competitive efforts.

Navigating these challenges requires careful planning, domain knowledge and rigorous implementation. Based on our work with clients, we have identified **five essential requirements** for processes and practices that should be part of every IoT implementation:

- 1 Edge computing/analytics.** Data needs to be gathered by sensors and analyzed in real-time. This allows for rapid response to sudden change, such as an autonomous car reacting to a dog darting into its pathway, identifying a surgical device malfunction or spotting a grocery freezer compressor failure.
- 2 Data ingestion and stream processing.** Processes need to be in place for gathering data from multiple devices and sensors and transforming it for use by cloud-based analytic platforms.
- 3 Device management.** Businesses need to ensure their IoT devices are provisioned securely, communicate efficiently and can be updated with accelerated and agile approaches.
- 4 Cold path and advanced analytics.** Deep dives into IoT data should result in cost savings, as well as insights to create new products and new revenue models.
- 5 Enterprise integration with business systems.** IoT insights need to be delivered to enterprise systems and receive reference metadata in order to interpret device data.

Challenges in IoT implementations



32%
IoT
security



31%
Cross-department
cooperation



30%
Integration of
disparate data



29%
Availability of
skilled talent

Source: Forbes Insights, 2017.

Figure 1: Percent of respondents citing each challenge.

Edge Computing & Analytics

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WHAT IS IT?

Edge computing refers to the computation and analysis of data on distributed devices positioned at the edge of a network rather than on centralized systems.

This function involves both local sensors that gather data, and edge gateways that process it. The advantage of an edge computing architecture is that data can be analyzed close to where it is captured, resulting in faster response to changing conditions. Additionally, edge gateways can transform proprietary or legacy protocols into IoT protocols for transmission to existing corporate networks or the cloud.

Gateways and sensors are able to operate in the low-bandwidth conditions at the network edge. In addition to performing edge analytics, the gateways can also pre-process and filter data to reduce transmission, processing and storage

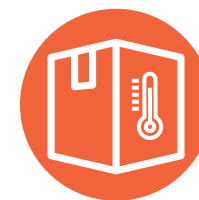
costs, as well as send commands to IoT devices and perform software upgrades.

PLANNING AND STRATEGY TIPS

- Fully assess lifetime device costs, being sure to include operational overhead expenses, such as monitoring, upgrades and power requirement. Adjust planning to ensure such costs do not outweigh lifetime value.
- Create policies to secure devices with appropriate firewalls and hardened operating systems. Use digital signatures to protect the code and algorithms. Encrypt data at rest and in transit.
- Aggregate data before transmission to maximize bandwidth. Send changed data only, using the proper encoding format and packet size. Use separate frequencies depending on how critical the data is.
- Implement retry and circuit breaker patterns to detect and prevent failures when sharing

data with external systems. This practice is also useful when edge gateways have only intermittent connectivity with on-premise or cloud platforms.

- Assess which analyses are most time-critical for your business and perform them at the edge to allow immediate action.



An edge-processing system can respond in a few milliseconds, compared with a cloud system, which could take **more than 100 milliseconds.**

Data Ingestion & Stream Processing

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WHAT IS IT?

Data ingestion refers to device telemetry data being imported and converted into a format usable by cloud-based IoT services.

Stream processing normalizes the data into a common data model. Notification services and message buses inform business applications and users to conditions that require action, such as an alarm triggered by a food freezer that can't maintain the desired temperature range.

PLANNING AND STRATEGY TIPS

- Assess the expected data message size, criticality and required response time to ensure the cloud components can process the data required to meet business KPIs and IoT goals.
 - Send telemetry data about business conditions on a dedicated, higher-bandwidth channel rather than through a channel used for less critical log files. Doing so will reduce bandwidth requirements and related costs while ensuring business objectives are met.
 - Cache frequently-needed data so it doesn't have to be fetched repeatedly from a remote
- Evaluate regulatory requirements to ensure ingested data is stored in compliance with government or industry regulations.
 - Configure the gateway and platform hardware with ample computing and storage capacity to perform protocol conversion.
 - Provide load balancing, horizontal auto-scaling and failover data processing to ensure consistent, high-performance data ingestion.

source. This will maximize performance and minimize network costs.



Six out of 10 IT executives say collecting, storing, integrating and analyzing real-time data from endpoint devices is a key barrier to a successful IoT implementation.

Source: Cognizant, 2017.

Device Management

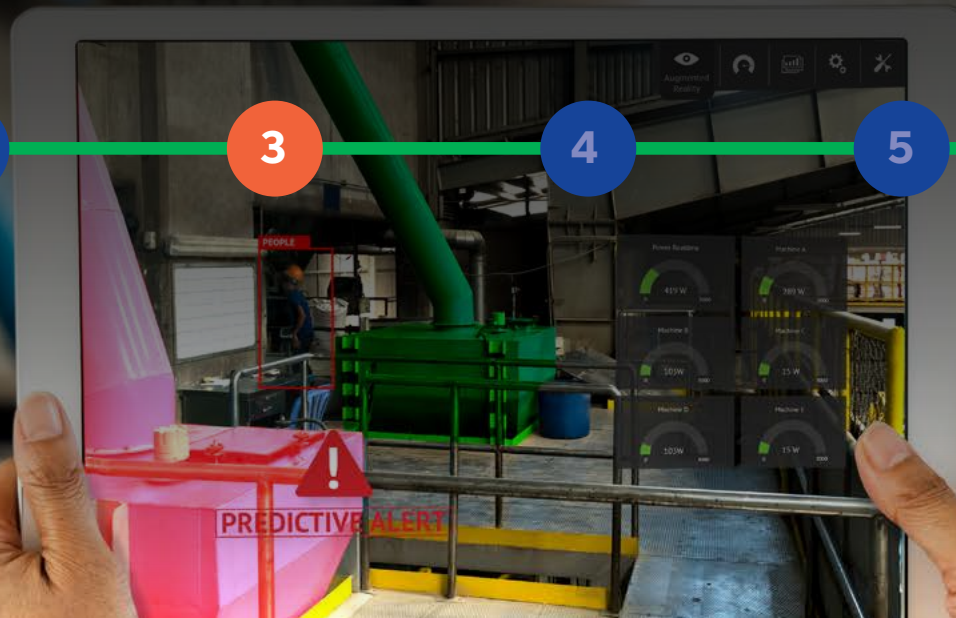
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WHAT IS IT?

Device management covers the hardware, software and processes that ensure devices are properly registered, managed, secured and upgraded, and that the staff and systems are notified if a device fails.

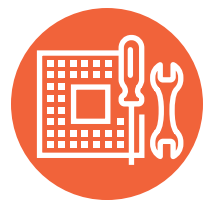
Required functions include device configuration, security, command dispatching, operational control, remote monitoring and troubleshooting. The organization will need to account for these functions, even if the cloud provider doesn't offer the required device management components. Comprehensive device management enables connected devices to easily and securely communicate with other devices and cloud platforms, while helping the enterprise reliably scale to billions of connected devices and trillions of messages.

PLANNING AND STRATEGY TIPS

- To help ensure performance and reliability, consider monitoring device "heartbeats" with services such as the native message broker in AWS IoT Core, which creates a separate channel that confirms connectivity with the cloud platform.
- Create dedicated channels and processes for various types of device data to make the best use of available bandwidth and increase scalability. For example, businesses can create separate approaches for large files and time-series telemetry data, which include any set of values organized by time, such as sensor data.
- For increased reliability, configure a dedicated, persistent, bi-directional channel that sends device commands even if other communication channels fail. To more quickly add new devices to the network, enable auto-registration through validation with a trusted system, such as a network management platform.

- Create an abstraction layer that allows for greater automation of processes to reduce management costs.
- Use a content delivery network to speed the delivery of device software updates.

Device management should reliably scale to **billions of connected devices** and trillions of messages.



Cold Path Processing & Advanced Analytics

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WHAT IS IT?

With **cold path processing**, large amounts of data are analyzed by advanced algorithms after the data is stored on the cloud platform.

Such analysis can uncover trends or corrective actions needed to improve the business or customer experience. Unlike streaming analytics (hot path) that apply relatively simple rules to data in real time for short-term actions (i.e., detecting fraud, security breaches or critical component

failures), cold path processing involves more sophisticated big data analytics, such as machine learning and AI, being applied to provide deeper data insights.

PLANNING AND STRATEGY TIPS

- To drive the most insights from data, consider using a complex event processing framework that combines data from multiple sources, such as enterprise applications and IoT devices, to dynamically define and process analytical rules by inferring meaning from complex situations.

- Aggregate data before rather than during analysis to improve processing speed.
- Use a data lake, which stores data in its native format, to consolidate enterprise data for easier access.
- Categorize telemetry data by each variable, such as message size and the receiving application's needs, to speed access.
- Consider creating data services to make it easier for users to access data on demand.



Large-scale processing can include loads greater than **100,000 events per second** or that have a total aggregate event payload size of over **100MB per second**.

Enterprise Integration

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WHAT IS IT?

Integration with business applications and enterprise systems enables the sharing of raw and processed data, as well as analysis-driven insights.

With deep enterprise integration, the IoT architecture can deliver benefits such as improved efficiencies, reduced costs, increased sales, heightened customer satisfaction and the ability to create and lead new markets. To share data and insights, businesses need mechanisms such as application programming interface (API) gateways, service buses and custom connectors.

PLANNING AND STRATEGY TIPS

- Evaluate communication needs to choose the best approaches, such as simple message broker, request/response and data-level integration, based on data volumes, performance requirements and the integration needs of downstream systems.
- Provide self-service APIs to develop an ecosystem that enables integrators and developers to consume data and business insights.
- Use **RESTful APIs** to provide on-demand sharing of data in various formats and among disparate systems.
- Design APIs that make it easier for mobile applications to consume and access operational data from IoT devices anywhere and at any time.
- Create high data-ingestion queues on the cloud IoT platform to swiftly pass large volumes of data from IoT devices to downstream applications.



Seeing the results: improved efficiencies, reduced costs, heightened customer satisfaction and the ability to create and lead new markets.

Roadmap for success

Every IoT implementation will be distinct in its own way, depending on each business's requirements, expected outcomes, levels of IoT and data skills, and technology infrastructure maturity. In all cases, however, five requirements are essential to ensuring a successful IoT implementation, with minimal cost and delay.

Each enterprise must conduct a rigorous needs assessment and carefully plan its roadmap to deliver a flexible, secure and scalable IoT solution. To help guide the implementation, organizations should also consider using pre-built solutions, reference architectures and blueprints from experienced technology service providers.

Learn more about how companies are beginning their journey to IoT success by visiting www.cognizant.com/iot.

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Learn More

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