Microsoft

Azure IoT Edge + Windows 10 IoT: Supporting AI at the edge

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Introduction

If you're in IT, in a company of any size, you probably already have a basic knowledge of the modern Internet of Things (IoT)—the convergence of the cloud, artificial intelligence (AI), and edge computing (using intelligent edge devices). You may also have an appreciation for what it can do, how it can enable new business value, and maybe even some ideas for IoT projects of your own. That said, with so many moving pieces, IoT can be complex. You may know what you want to do, but still be unsure about exactly how to go about it.

For example, you'll need to consider how to put your AI workload where it makes the most sense. Early (or first-generation) IoT solutions were primarily based on "dumb" sensors, which collected raw data to send to the cloud for processing. Entry card readers/electronic door locks in a large office building are a good example. However, this isn't always the best architecture and, in some cases, might not even be possible. Take a video surveillance scenario, where full high-definition video from many remote cameras is too bandwidth-intensive to transmit. Or a cruise ship, where connectivity is limited (and expensive) when not in port. Latency can also be an issue, such as with multimillion-dollar manufacturing equipment where the time between an initial increase in vibration and catastrophic failure is measured in milliseconds.

Clearly, analytics and AI drive significant value in IoT solutions, even when the cloud isn't always the best location for such processing. For example, to minimize response times on the manufacturing line, you may want to perform anomaly detection on the device itself. Similarly, to minimize bandwidth costs or address intermittent connectivity, you may want to clean, aggregate, process, and store data locally before sending insights to the cloud. Both are examples of IoT solutions that employ intelligent edge devices, or "AI at the edge," as a means of analyzing data locally on the IoT device instead of doing everything in the cloud. You may also need to process and/or analyze the data collected by your IoT solution at the edge to address security, privacy, or data sovereignty issues.

There are other considerations, as well. For example, how can you ensure rapid time-to-market? Do your developers have the skills needed to build such solutions? If not, are they readily available in the market? Can you reuse existing IT infrastructure, or will you need to develop that from scratch as well? Can you find smart devices with the features you need, or will you need to piece those together yourself? What about ongoing operations, from deployment of new devices to day-to-day management—including necessities like patching and system health monitoring? Finally, what about other essentials like security and support? How can you protect your devices from tampering, and safeguard the data they collect both in-transit and at-rest? How long will the technologies you rely on be supported, including timely security patches, and will you have a single source of support when things aren't working like they should?

All of these are areas where the Microsoft IoT platform can help. In the rest of this paper, we'll look at how two key components of that platform—Azure IoT Edge and Windows 10 IoT—work together to help you address all of the above considerations.

Azure IoT Edge + Windows 10 IoT: A powerful combination

To understand why Azure IoT Edge and Windows 10 IoT are such a powerful combination, it's worth taking a brief look at what each does, and then how they work together.

Windows 10 IoT

Windows 10 IoT is optimized for edge computing. It brings enterprise-class development tools, intelligent security, and leading-edge AI to your IoT edge devices, along with all the "usual" benefits of Windows, including exceptional manageability, regular updates, enterprise-grade support, extensive hardware options, standards-based connectivity, and a worldwide partner ecosystem.

Windows 10 IoT has three editions:

- **Windows 10 IoT Enterprise**, a binary equivalent of Windows 10 Enterprise, is designed for fixed-purpose IoT devices. It uses the same familiar development and management tools as client PCs and laptops. Devices can be locked to a specific set of apps and peripherals, such as preventing the use of USB flash drives. System messages can be suppressed and the boot sequence can be customized. You can even have a "read-only" system that returns to its original state after each power cycle. And with its integrated cloud connectivity, you can provision and manage Windows 10 IoT Enterprise devices by using Azure IoT Hub.
- **Windows 10 IoT Core** is a version of Windows 10 that's optimized for single-purpose IoT devices. It builds on our decades of experience with Windows Embedded to deliver the security, supportability, and manageability you expect from Windows 10, but with a much smaller footprint (<2GB). Microsoft works with leading system-on-a-chip (SoC) vendors—including Broadcom, Intel, NXP, and Qualcomm—to verify support for Windows 10 IoT Core on their SoCs, which are used by hundreds of different device OEMs and ODMs. Recently, Microsoft launched Windows 10 IoT Core Services, a cloud subscription service that provides a device update mechanism, ongoing support and additional security—and helps Microsoft partners create new business models that drive recurring long-term value for themselves and their customers.
- **Windows Server IoT 2019,** a binary equivalent to Windows Server 2019, lets customers create IoT solutions to handle large workloads that require more computing power, storage, and connectivity—such as applying image recognition to multiple video streams. These solutions can aggregate data from many IoT devices, and store that data in huge local databases. Modern container technologies managed by Azure IoT Edge can be used to provide advanced security, high availability, and manageability—enabling you to innovate more quickly and safely.

Azure IoT Edge

Azure IoT Edge, a managed service from Microsoft, makes it easy to extend AI, analytics, and custom business logic to edge devices. It's ideal for scenarios where latency, bandwidth, or data privacy requirements are important considerations. You can easily develop and deploy powerful IoT solutions at scale, with strong security, whether those IoT devices are connected to the cloud or offline. Azure IoT Edge is available in the free and standard tier of Azure IoT Hub, a service that supports bidirectional communications between IoT devices and the backend services those devices rely upon.

How they work together

In technical terms, you can use IoT Edge to containerize cloud workloads and run them locally on any number of devices. This is achieved using *IoT Edge modules*, containers that run the code deployed to IoT Edge devices for local execution, and the *IoT Edge runtime*, which runs on each edge device

and manages the modules deployed to those devices. The IoT Edge runtime can run on Windows IoT or Linux.

IoT Edge modules

IoT Edge modules, implemented as Docker-compatible containers, can be configured to communicate with each other, such as might be required for an on-device data processing pipeline. You can package certain Azure services into modules for deployment, or you can develop your own custom modules. For example, you can run Azure services like Azure Functions, Azure Stream Analytics, and the Custom Vision Service on edge devices, as a means of deploying complex event processing, image recognition, and other high-value AI functions to the location where they provide the most value—all without writing your own code in-house. Of course, if you want to write and deploy your own code, you can do that too.

IoT Edge runtime

The IoT Edge runtime is what enables IoT Edge modules to run on Windows 10 IoT. It resides on the edge device, performing management and communication functions such as installing and updating workloads, maintaining IoT Edge security standards on the device, ensuring that IoT Edge modules remain running, and reporting module health to the cloud for remote monitoring. The IoT Edge runtime also manages communication between downstream devices and an IoT Edge device, between modules on an IoT Edge device, and between an IoT Edge device and the cloud.

With the IoT Edge runtime, you'll have the flexibility to architect your IoT solution in the way that works best for you, including the ability to deploy IoT Edge modules to gateways that aggregate and process data from multiple other on-premises devices. Downstream devices can also be IoT Edge devices, regardless of whether they're connected to a gateway or directly to the cloud. The IoT Edge runtime runs on a broad range of devices, abstracting away device specifics in a way that gives you the flexibility to use anything from an inexpensive, small-footprint device for light processing workloads to an industrialized server for running resource-intensive edge workloads.

Benefits of using Azure IoT Edge and Windows 10 IoT together

Azure IoT Edge and Windows 10 IoT are designed to work together, making it easier to securely implement AI at the edge, with minimal effort and complexity—even when connectivity might be an issue. We've handled a lot of the low-level plumbing so you can stay focused on your business needs, reuse existing business logic, and bring in a partner or two to help if you want. And after your IoT solution is deployed, you'll rest easy knowing you have a single source of support, and a 10-year support lifecycle for the software powering your IoT devices.

Putting your IoT workload where it makes the most sense

With Azure IoT Edge and Windows 10 IoT, you can deploy AI and analytics to the edge, as a means of supporting complex event processing, image recognition, and other high-value AI functions—including code you write yourself or prebuilt Azure services. In turn, this ability to push AI to the edge can help you respond to events that are local to the edge device in near-real time, with the lowest possible latency between data acquisition and desired insights.

The combination of IoT Edge and Windows 10 IoT is also ideal for operating IoT devices offline or with intermittent connectivity, helping ensure reliable operation regardless of the situation. Processing data locally can also help you reduce communications costs, sending only what's needed to the cloud for further analysis. Of course, this also provides a means of addressing potential privacy and/or data sovereignty requirements.

IoT Edge and Windows 10 IoT also give you the tools you need to help secure intelligent edge devices against potential threats, which can range from physical tampering to IP hacking. Some of these capabilities are provided by the IoT Edge service and the IoT Edge runtime, such as built-in mechanisms for authentication, authorization, attestation, and more. Others are native to Windows 10 IoT, including features such as Secure Boot, BitLocker, Device Guard, TPM support, and Device Health Attestation*. That said, they're designed to work together. And you can rely on the worldwide Windows Update service to ensure your devices remain current with any security patches.

Simplifying IoT for faster time-to-market

With IoT Edge and Windows 10 IoT, you can accelerate time-to-market by leveraging your existing developer skills and IT infrastructure. You'll simplify development by using the same programming model you use for other Azure services, including the flexibility to run the same code in the cloud and on edge devices running Windows 10 IoT.

You can develop IoT Edge modules using C#, .NET Core, .NET, and C++, with support for Python and Node.js coming soon, which means you'll be able to leverage existing business logic written in those languages. And if you want, you can also run Azure services like Azure Functions, Azure Stream Analytics, Custom Vision Service, and inference models trained using Azure Machine Learning on your edge devices, so you can avoid writing nearly as much code in-house. Either way, you'll have access to a number of IoT solution accelerators from Microsoft to jumpstart your efforts.

You'll also simplify IT operations. After your IoT solution is deployed, you can manage it using the same tools that you use to manage your Windows-based servers and desktops. And last but not least, you can take advantage of the extensive Microsoft partner ecosystem to accelerate time-to-market by bringing in outside resources—ranging from consultants, software developers, and system integrators to Microsoft hardware partners.

Enterprise-grade support

When it comes to ongoing support, you'll be in good hands. Microsoft has decades of experience supporting embedded devices for businesses of all sizes, from startups to Fortune 100 companies. You won't need support contracts from different vendors for cloud and devices—in fact, you'll have the same enterprise-grade support from Microsoft that you already depend on for your servers and PCs. And when it comes to devices, you won't be hamstrung by short support lifecycles like with some device platforms; Microsoft has committed to supporting Windows 10 IoT Long Term Servicing Channel (LTSC) releases for 10 years*, with security updates and bug fixes delivered in the same way you already receive updates for your servers and PCs—through our robust, worldwide Windows Update network or Windows Server Update Services[1] (WSUS).

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* Some features may require additional service subscriptions

[1] WSUS only supported on Windows 10 IoT Enterprise

Conclusion

With Azure IoT Edge and Windows 10 IoT, you can put your AI workloads where they make the most sense, even when faced with challenges like offline operation or intermittent connectivity. We've built a lot of the plumbing for you, enabling you to remain focused on what your IoT solutions need to do instead of how to do it. And you'll rest well knowing your solutions are robust, well-secured, and supported—from the edge to the cloud, and at every point in between.

Get started with Azure IoT Edge and Windows 10 IoT

Learn more

- Azure IoT Edge - https://azure.microsoft.com/en-us/services/iot-edge/
- Windows 10 IoT - https://www.microsoft.com/en-us/windowsforbusiness/windows-iot

Start developing

- Azure IoT Edge - https://docs.microsoft.com/en-us/azure/iot-edge/
- Windows 10 IoT - https://docs.microsoft.com/en-us/windows/iot-core/