THE MIGRATION JOURNEY FROM AZURE EVENT HUBS TO AZURE IOT HUB

**A more advanced approach
to the Internet of Things**

December, 2016

EXECUTIVE SUMMARY

How can organisations become more daring at adopting IoT technologies?

Having a comprehensive IoT system capable of supporting device communication on a large scale gives enterprises access to previously unexplored insights, which can turn out essential to strategic decision making. Due to its potential to enhance remote connectivity for line-of-business assets and to ensure a better communication between them, IoT has become one the strongest influencers in building a smarter enterprise.

Committed to helping enterprises on their journey to make the most out of the IoT technologies, we monitor their expectations and look for ways to better meet them. Deciding to explore new IoT platforms such as Microsoft's Azure IoT Hub comes to support this promise.

This whitepaper aims to go through the migration journey of our IoT solution from Microsoft Azure Event Hubs to the new Azure IoT Hub. We outline the reason behind the migration and describe the path, the changes experienced at the technical level, and the benefits of such a transition.

INTRODUCTION

The digital age has challenged all industries to share a part of their strategic focus with the new tech wave.

The emergence of innovations such as the Internet of Things (IoT), cloud, big data, augmented reality and social engagement has prompted enterprises to transform their business models and start acting more in line with the market's need of being better connected and engaged.

The use of smart devices and machine-to-machine (M2M) communication has many facets, starting from wearables and personalised medicine in Life Sciences and remote servicing in Manufacturing to connected cars in Automotive and adaptive network control in Transportation.

Enterprises deal with a massive amount of valuable assets, most of them critical for both their business and their clients, which makes data privacy extremely important in this ecosystem and one of the main concerns.[1] And with rapidly evolving digital channels, it is only natural to look for solutions that are able to cover both system efficiency and data security. A prerequisite to that is to have assets securely connected with their backend. Lacking this strong connection, most of them could not work for more than a few hours without having a direct impact on the business and eventually on the customer experience. Imagine what would happen if a hospital couldn't perform blood tests for 3 days.

From all emerging technologies that are believed to already have a big impact on businesses, organisations place IoT on top of the list.

CompTIA, 2016

BUSINESSES BELIEVE EMERGING TECHNOLOGIES ARE ALREADY STARTING TO HAVE AN IMPACT

■ Already starting to have an impact

■ Impact expected over the next 2–4 years
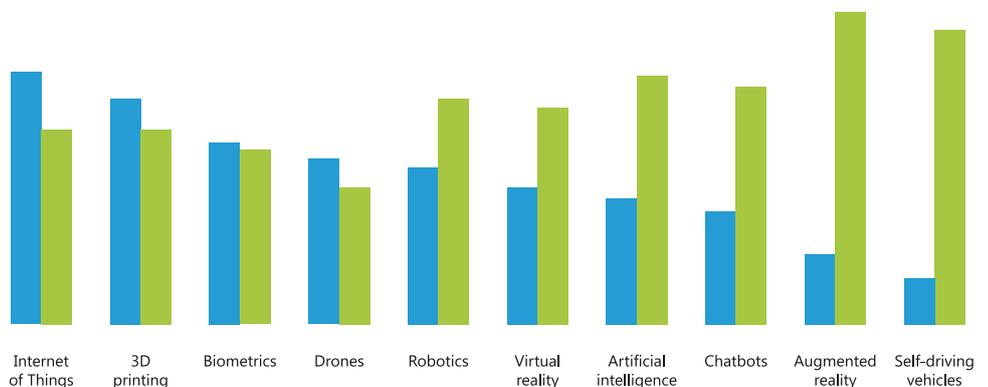
Source: CompTIA, 2016

With IoT technology enterprises can create a better connected network of devices while contributing to better informed industries.

From all emerging technologies that are believed to already have a big impact on businesses, organisations place IoT on top of the list.[2]

Recognising the value IoT technology could bring to the business ecosystem will play a big role in building a strong competitive advantage for companies determined to adopt and execute IoT related programs.

iQuest has been working for the past years on a Microsoft Azure based IoT solution that could communicate with 100.000 connected devices and ready to manage over 1 million of them. Having Microsoft as our strategic partner gave us the opportunity to start building an IoT solution using the Microsoft Azure Event Hubs since its launch.

While Azure Event Hubs is a service capable of connecting huge amounts of data and bring them together ready to be transformed into real-time insights, the market dynamics asked for a more advanced solution that could ensure a more complex device communication. We decided to migrate the current architecture to Azure IoT Hub, the new Azure service that brings stronger communication capabilities within a large-scale IoT device network.

THE CHALLENGE

The Anatomy of Azure Event Hubs

When we think of a connected industry, we think of enterprises wired with IoT capabilities powerful enough to build and sustain a smart, large-scale network of devices. Bearing this purpose in mind, our efforts go into building IoT solutions that can serve as a solid foundation for any industry's advancement. Migrating our solution from Azure Event Hubs to Azure IoT Hub comes to support this focus.

Azure Event Hubs is a scalable telemetry ingestion platform that acts as a "front door" for an event pipeline, capable of processing millions of events and stream them into multiple applications. Designed around messaging systems, it captures all the information produced by various applications that later serves as valuable input for analytics or real-time monitoring[3].

We used the Azure Event Hubs platform to build an IoT solution ready to communicate with a set of devices through the delivery of various messages and commands.

BUSINESS LOGIC

ACTIVE-ACTIVE REDUNDANCY CHANNEL

ALERTS
(Event Hub)

COMMANDS
(Azure Table)
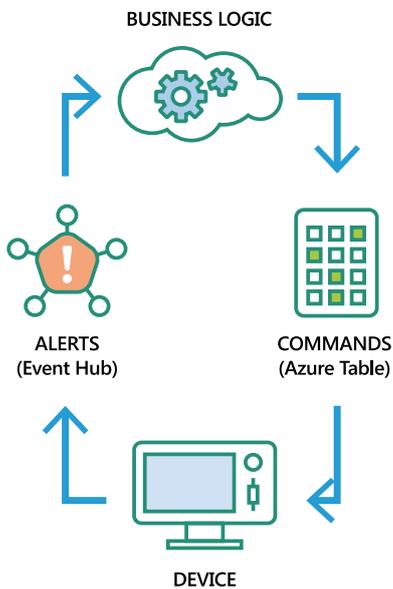
DEVICE

Any command or message that intended to arrive on a particular device was added to Azure Tables. An Azure Table was created for every device receiving the command which contained three different partitions, each carrying messages with different priorities. Alerts and events produced by devices were sent to the platform through Event Hubs.

The payload that had to be transferred from devices to the backend or vice versa used Azure Storage which acted as a cache for the payload. Around these systems multiple web application and processing units have been developed. In a full load, more than 2.000 CPU cores were working at full capacity inside Worker Roles and Web Apps, communicating through Azure Service Bus.

Being highly sophisticated, the solution turned out complex. Here's why.

Devices are registered and authorised by the platform using a web endpoint that creates a Shared Access Signature (secure token) for Azure Table and Event Hubs. Even if these keys are secured, managing the configuration can be challenging. For example, if one of the Shared Access Signatures is compromised, you cannot invalidate only that one. The group policy of that key is required which means that 5.000 devices will demand their key validation again. These flows can take up to 10 minutes and during this time devices can neither receive nor send data, even if the data is cached until the devices are up and running again.

So, in order to be compliant with the availability and the failover requirements, a custom architecture was put in place with all the communication channels, inside and outside the platform, being in an active-active or active-passive mode. This type of architecture can be quite expensive, the most costly one being the Active-Active one, where the same content is sent through two different channels. The content then requires a correlation on the consumer side to ensure that each message is processed only once. When facing a throughput of 100.000 RPS (Requests per Second) this can become challenging.

Although Event Hubs is deployed in around 28 Azure Regions around the world, each with its particular laws and regulations, offering data privacy to all customers regardless of their location or status, the solution still carries a layer of complexity as it demands constant attention.

A custom solution built on the Azure Event Hubs containing multiple services that work together can be flexible, but it is still not an out-of-the-box solution. This implies that non-functional requirements, such as availability or consistency, are difficult to maintain when you orchestrate multiple services. And there are plenty of Azure Services linked to the end-to-end solution which create noise for the support and operation team, especially when tracking the source of an issue.

THE SOLUTION

Why Migrate to Azure IoT Hub

The migration to Azure IoT Hub came out of the need for a more comprehensive platform in terms of scalability, device management, security and communication. Azure IoT Hub is a fully managed service that enables reliable and secure bidirectional communication between millions of IoT devices and a solution backend.[4] Similar to Azure Event Hubs, IoT Hub is an event processing service, but with a more exhaustive suite of IoT-specific features.

There were a couple of things with regard to the Azure IoT Hub potential that helped us make the decision towards the migration.

- Per-device authentication: increasing the platform's security

- Bidirectional communication, device-to-cloud and cloud-to device messaging: enhancing data availability

- Out-of-the-box device identity management: extending monitoring capabilities, speeding up the support process, and optimising their related costs

The Migration Process

Changes at the Architectural Level
Our expectations regarding the migration process revolved around the big amount of custom logic that would've been necessary to implement. To find that the real impact on the overall solution was fairly small and isolated. The biggest changes left a footprint in 3 main areas:

- At the communication layer of the device

- In the backend component that sends messages to devices

- In the configuration flow

BUSINESS LOGIC

AZURE IoT HUB

MANAGE DEVICE REGISTRATION AND COMMUNICATION

DEVICE

1. The communication layer of the devices was completely replaced with the one offered by IoT Hub. As the client libraries were already available in C++, they only had to be switched between them.

2. A similar case was identified in the backend. The component in charge of pushing messages to Azure Tables was replaced with the IoT Hub library accountable for pushing messages to devices.

However, during the migration, the message structure hasn't been changed. The same message content was inserted directly into IoT Hub's messages payload

3. Because both the registration and the configuration flow of the current solution were complex and involved a lot of custom logic, the decision was to keep the registration flow from the initial solution. So, once a device is successfully registered, the platform generates an access token for it.

Other minor adjustments

Both IoT Hub and Event Hubs use the same concept of Consumer Groups to ingest events from devices. Which means that each consuming application has a separate view of the event stream and is able to read the stream independently at its own pace and with its own offsets.[5] There were no major changes made at this level, except updating the component that converts transport events to business logic events.

Overall, the changes were isolated and rather simple. After implementation they were tested without any difficulties since the business flows haven't been modified and the IoT Hub libraries were put to use.

THE BENEFITS

Migrating the platform from Event Hubs to IoT Hub brought a collection of benefits which are reflected mainly into the reliability and the security of the communication process between the existing assets.

Having IoT Hub as an out-of-the-box solution on the communication layer enables companies to focus more on the insights drawn from the devices' data and less on the infrastructure side. This is a sign of advancement in the maturity of our IoT solutions.
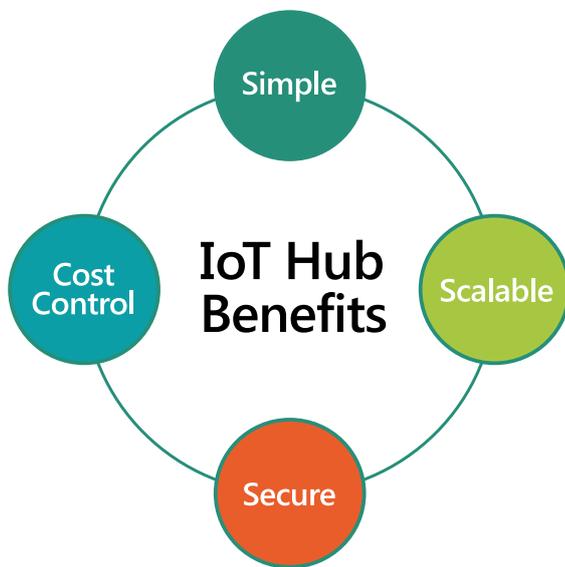
The main benefits of this migration can be found in:

Increased Availability and SLAs
An out-of-the-box solution, such as Azure IoT Hub that connects devices around the globe to their backend has an important quality advantage over a custom solution that includes multiple services.

Decreased Overall Complexity
IoT Hub is a service that has been created particularly for IoT assets connectivity which significantly simplifies the communication with multiple devices. It also makes the availability, failover and redundancy of the platform easier to manage.

Scalability

In comparison to Event Hubs, which can manage a limited number of connected devices, IoT Hub is able to support millions of simultaneous connections, without any impact on the non-functional requirements. Having a single dedicated service, rather than 3 or 4 custom-made ones, makes it easier to manage and scale when an opportunity comes up.

Reduced Operations and Maintenance Costs

Having a dedicated service for telemetry data ingress and egress drastically minimises the effort made by the operations and maintenance team. It also has a positive effect on the platform's issue tracking process, cancelling the unnecessary noise and helping the team to spot and solve a problem faster and painless.

Easy Connectivity

IoT Hub is a well-integrated solution that offers out-of-the-box connectivity with other Azure services through an open-source library on the devices side. If on the Event Hubs platform adding new features was challenging with a potential impact on the communication layer, in the IoT Hub, this is made possible with the Azure IoT Protocol Gateway[6], the framework built to help companies advance their cloud service capabilities with extra functionalities.

Improved Quality

Relying on bidirectional communication implies having valuable data available for real-time actions to be taken and therefore leads to better decision making.

CONCLUSION

The Internet of Things has already begun to change the way companies manage their assets and interact with their customers.

Some industries are expecting significant growth. Digitisation, driven by the Internet of Things and the industrial internet, will accelerate growth in the medium to long term.[7] As an example, forecasters predict up to 20 billion Internet of Things devices within a few years, generating 5 trillion gigabytes of data every year and creating more than $300 billion in opportunities for tech vendors, telcos and device makers by 2020.[8]

Yes, digitalisation does not come easy on most industries, but we believe that IoT is an essential contributor to their potential to thrive in the digital ecosystem. Using IoT technologies, organisations can bring intelligence to their resources and increase their operational efficiency, optimise costs and strengthen their service and product quality.[9]

Leveraging this potential asks for IoT solutions that are able to support a complex device network. We see Azure IoT Hub as a comprehensive platform with the capacity to connect millions of devices to their backend in a secure and reliable way. And the migration from Azure Event Hubs to IoT Hub meant first of all a progressive shift in our purpose to help companies focus more on their core business and on more mature areas, such as machine learning or real-time maintenance, and less on the infrastructure part.

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As a Solution Architect at iQuest, Radu Vunvulea is strongly focused on building and implementing LoB applications using Microsoft technologies. Having worked on large-scale implementation projects for Pharma, Automotive, Logistics, and Transportation companies, Radu became a subject-matter expert in delivering and integrating Microsoft technology based services and products. Radu has a solid experience in both cloud and on-premises deployment, covering multiple platforms from mobile and web to backend implementations.

Since 2012, Radu has been recognised every year as Most Valuable Professional (MVP) by Microsoft, acknowledging his technical expertise, dedication and proficiency in using his knowledge of Microsoft products and service to find solutions to real-world problems.

ABOUT IQUEST

iQuest is an independent, global IT services and solutions provider with more than 18 years of experience in delivering first-class software solutions to leading companies in Life Sciences, Telecom, Transportation, Financial Services, and Energy. iQuest provides a full range of software development services, integration services, and software products, all of which rely on the latest commerce, cloud, big data, and analytics platforms.

Headquartered in Frankfurt am Main, iQuest benefits from a growing international presence, currently employing around 700 people, distributed across delivery centers in Romania, as well as local and affiliate offices across EMEA and the US.

With over 10 years' experience in building connected solutions, iQuest has been chosen by leading biotech, energy and industrial companies to help them capitalise on the benefits of the Internet of Things.

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