

# ZEBRA TECHNOLOGIES: DRIVING CHIP-TO-CLOUD STANDARDS-BASED IoT CLOUD SERVICE

ZEBRA'S ZATAR COMBINES UNIQUE AVATAR CONCEPTS WITH STANDARDIZED ARM MBED TO ACCELERATE INTERNET OF THINGS SOLUTIONS

## EXECUTIVE SUMMARY

For most organizations around the world, comprehending the Internet of Things (IoT) is a daunting task. Some have already jumped headlong into deploying IoT systems and are using newly collected data from a wide range of devices to adjust and optimize their operations. Most, however, are stuck on first. They realize they have systems that need to be optimized and they can gain great value from analyzing their data, but the thought of designing a system has frozen their decision-making process. What they really want is to buy something that works.

Moor Insights & Strategy (MI&S) believes successful companies will focus on platforms and tools that will help them get to market quickly and securely by using standards-based solutions from chip to cloud. Zebra Technologies—with its global presence, long history with enterprise customers and partners, broad hardware offerings, Zatar IoT cloud service, and commitment to open standards—is a company that MI&S believes is set to be a leader in the IoT space. Zebra's partnership with ARM on its mbed IoT platform connects them to one of the IoT industry's strongest standards-based ecosystems. Using Zatar and the mbed platform can help organizations achieve their goals faster, scalably, and securely, while leveraging the mbed ecosystem to reduce design risk.

## FROM CHIP TO CLOUD: MAKING IoT DESIGNS EASY

There is no shortage of hardware and software vendors stating **they** are the solution to solve IoT problems. So what is holding up the deployment of IoT systems? Many hardware developers can answer the question of what problem they are trying to solve at least initially. However, the sheer number of IoT solutions makes finding the **right** solution an overwhelming task.

Moor Insights & Strategy believes that in order to successfully develop an IoT solution, identifying the problem is step one. Step two, and equally important, is choosing the right development toolset and platform. When choosing a development toolset, engineers should ask themselves:

- Am I able to develop and deploy a solution to my problem quickly and easily?
- Will the tools I choose help me develop a solution that integrates with and supports industry-leading products both today and tomorrow?
- Can I rapidly configure the system to support my changing needs and goals without costly redesign?

### *GET TO MARKET FAST & EASY*

The list of IoT “problems” that any organization can identify to solve is seemingly endless. Successful new designs are all about identifying problems that, when solved, provide real business value in a timely manner.

New designs and technologies are complicated. Add to this complexity the sheer number of potential IoT problems to attack, and one quickly realizes that the IoT requires design teams to be more flexible and efficient—and this needs to influence their choice of technologies. To support IoT embedded design teams, technology providers must deliver a standard, comprehensive embedded design platform that spans from sensors to the cloud. Software design tools must be tightly integrated and support standard off-the-shelf hardware, while remaining intuitive enough to be used by nearly all levels of engineers.

Moor Insights & Strategy believes that new embedded IoT design tools must enable even small teams of developers to experiment and solve problems quickly and efficiently. With productivity as the measurement of a successful design team, a standard set of software tools that can support a wide variety of hardware platforms—and connect to an equally wide range of cloud-based systems—will provide an extremely productive environment to develop IoT solutions.

Flexible and modular integrated platforms that provide a single software development environment, a large library of controls, and tight integration with communication and application specific I/O will give design teams the ability to easily move from first prototype to final deployment while using the same code throughout.

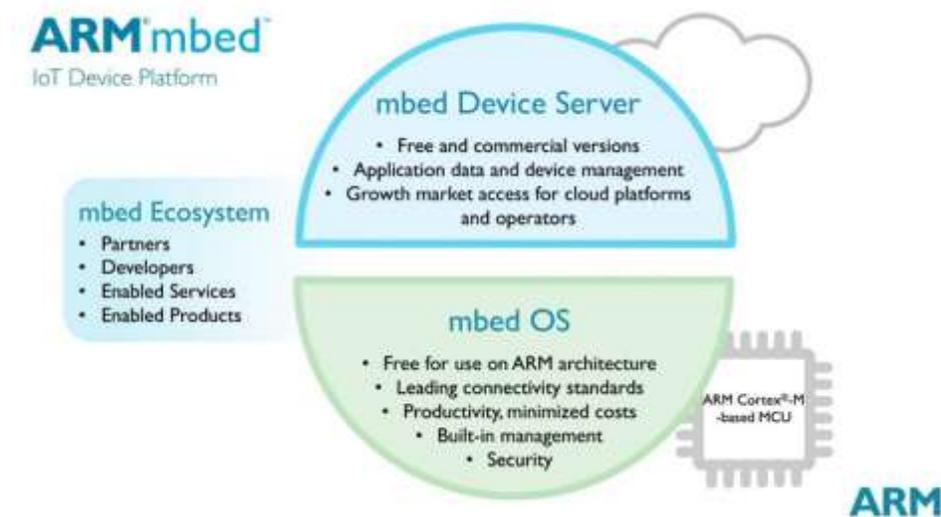
## DESIGNED TO LAST

Many organizations get it wrong when it comes to thinking about standards and innovation. They think standards are a “necessary evil” with their significance limited to cost reductions and quality improvement. MI&S believes **standards are a critical tool of innovation**, and developing and using IoT standards is not a choice but rather a requirement to enable IoT designs today that will live into the future. Standards not only reduce cost, but they also actually drive innovation by allowing the development of an ecosystem of dynamically interoperable components. This combination of standards and ecosystem provides significant advantages to both vendors and users by:

- **Fostering innovation** by bringing collaborative companies together to work toward a common goal
- **Increasing attractiveness** for new users and applications by providing a “ready-made” customer base
- **Driving adoption** by connecting a wide variety of suppliers and companies in complementary businesses
- **Guaranteeing interoperability** between disparate vendors and solutions
- **Creating competition** to develop best-in-class solutions
- **Embedding security** at each point in the total solution

## ARM MBED SIMPLICITY, SECURITY, & STANDARDIZATION

FIGURE 1: ARM MBED IOT DEVICE PLATFORM



Source: ARM

Moor Insights & Strategy believes one of the key issues slowing the transition to connected IoT devices is the availability of scalable and secure interoperable components that can be used to build solution-focused ecosystems. Standards and standard toolsets are a key requirement for this to occur. ARM, a leader in embedded microcontroller architecture, is leading the charge in transition from embedded designs to connected mbed (or IoT) designs and as such has strong motivation to lead in IoT standardization around their architecture.

In 2014, ARM introduced the mbed IoT Device Platform, specifically designed from the ground up as an IoT platform, and consisting of a client-side embedded operating system (mbed OS) and a middleware platform, the mbed Device Server (mbed DS) bolstered by an ecosystem of silicon, hardware, and software providers.

Critical to the deployment of new IoT solutions is the ability to assemble “puzzle pieces” of an IoT system quickly, securely, and with the confidence all the pieces will work. The mbed ecosystem is one of the great strengths of committing to the mbed platform, providing key, interoperable, and tested solutions for each facet of a final IoT deployment.

## *ARM MBED OS*

Traditional embedded OSs were designed before the IoT and before everything was expected to be connected to a broad network. As such, most OSs do not comprehend the requirements of emerging IoT devices. ARM mbed was designed from the ground up specifically for IoT, so it is focused specifically on what mbed calls their core principles of “security, connectivity, manageability, efficiency, and productivity”.

At its core, mbed brings a standardized approach to embedded IoT system design. Using mbed, designers can develop standard, secure IoT applications that can be prototyped in a very short timeframe (some claim hours). Pick a board, write some software using the mbed hardware and software development kits, download the software to any compatible board, and you are off and running.

mbed OS is an open source, embedded OS that is specifically designed for controlling IoT devices. Working together with the mbed Device Connector, the mbed Device

Server, and the mbed Client<sup>1</sup>, the OS forms the client-side portion of the mbed IoT Device Platform.

The OS runs on ARM Cortex-M microcontrollers and supports all the “typical” OS functions including communications, drivers for I/O devices, and sensors. For the IoT, the OS is designed to be tiny, low cost, and low power.

One of the critical tenets of mbed designs is the need to run standardized protocols all the way to the edge of the network, *i.e.* “IP to the edge”. As such, mbed OS supports:

- Ethernet
- WiFi
- IPv6 and 6LoWPAN
- Thread
- Bluetooth Low Energy (BLE)

MI&S believes these standards will be the primary protocols for IoT connectivity for the foreseeable future, and other protocols will be limited to fringe applications over time.

### *ARM MBED DEVICE SERVER*

The ARM mbed Device Server is a middleware component that connects IoT devices to web applications. By using a standards-based approach, Moor Insights & Strategy believes mbed DS can enable:

- **Improved efficiency:** Both in communications and handling of events, a standardized platform can provide optimized solutions. Devices can be registered with the server, allowing all lookup, resolution, and discovery to be quickly and easily handled. In addition, the need to communicate between web applications and devices is removed, saving bandwidth. Data events are easily handled with standardized mechanisms for pushing data from devices to web applications. Events are aggregated and retrieved using CoAP (a new, much more efficient transport than HTTP) and then again aggregated into standard HTTP for use with web applications.

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<sup>1</sup> The mbed Device Connector and mbed Client are tools to assist in the rapid development and prototyping of IoT designs.

- **Quicker integration to existing software applications and cloud services:** ARM has attracted many of the best, most influential software and cloud applications to its ecosystem, providing seamless integration with its middleware.
- **Quicker web application development:** ARM's solution allows software vendors to do what they do best: develop software. Developers need no special knowledge of IoT devices and can use their favorite development processes and tools.
- **Rapid connectivity to a large selection of IoT hardware devices:** Again, through ARM's strong ecosystem, silicon and device providers are plentiful and should meet the needs of many IoT solution developers.

### *ARM MBED SECURITY*

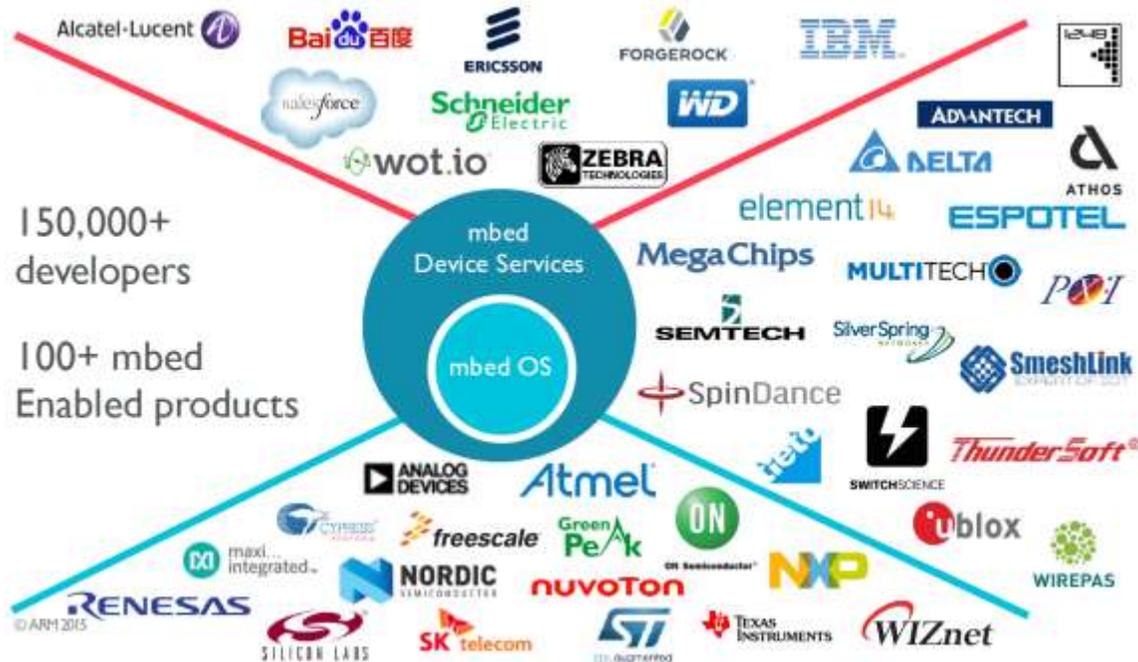
Security is often the first issue cited when discussing the IoT. Current network designs did not comprehend the sheer number and variety of device types that will be connected in the future. Securing critical data at all points in the system is not only essential, but it can often be critical to meet regulatory requirements.

Because the mbed platform is an “end-to-end” solution, security is built in at all layers from device to cloud. In addition, ARM has a deep understanding of its own device architecture, making it easier to create and enforce security policies on the entire IoT platform. At each step, from the device to communications between the device and cloud, as well as to managing the lifecycle of the device from deployment to retirement (including software upgrades, *etc.*), security is built in.

The basis of mbed OS's device security architecture is the mbed OS uVisor, which takes advantage of mbed's knowledge of ARM's architecture and its features. Developers can create and enforce isolated security domains within the microcontroller, protecting the boot process and debug sessions, ensuring firmware updates are installed securely, and protecting against malicious or faulty code. In addition, mbed OS implements both Transport Layer Security (mbed TLS) and Datagram TLS (DTLS) protocol, the standard protocols for securing communications on the internet.

*MBED ECOSYSTEM*

FIGURE 2: SAMPLING OF ARM MBED ECOSYSTEM

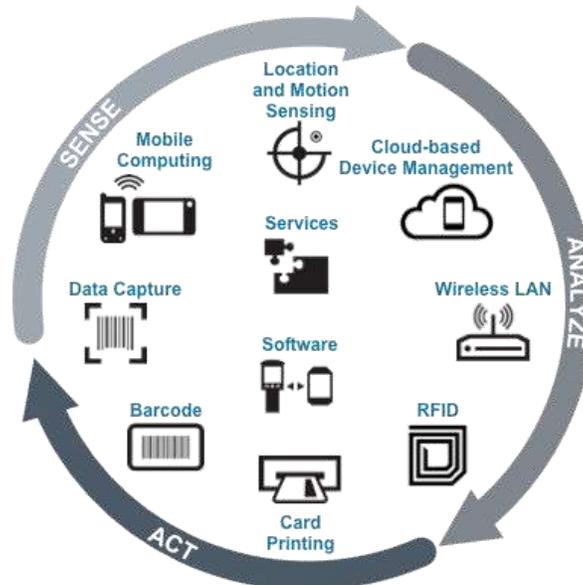


Source: ARM

One of the great advantages of being a leader in the embedded space is ARM’s ability to drive ecosystem development, and this extends to the mbed IoT Platform. The ecosystem has continued to grow since the initial rollout of the platform, and key vendors continue to be added. Not surprisingly, the initial, strongest group of vendors includes silicon partners, but software and cloud partners continue to grow, with IBM being the latest to announce support for the platform. MI&S believes that the mbed ecosystem is one of the platforms’ great strengths and a distinct advantage when it comes to designing and deploying IoT systems quickly and with confidence.

## ZEBRA TECHNOLOGIES: CONNECTING THE PHYSICAL WORLD TO THE DIGITAL WORLD

FIGURE 3: ZEBRA TECHNOLOGIES OVERVIEW



Source: Zebra Technologies

Zebra Technologies has been connecting the physical to the digital world for over 40 years. Delivering an extensive portfolio of asset-tracking, location, and printing technologies, including barcode, passive and active RFID, RTLS and sensors, Zebra has been “in” IoT since before it was called IoT.

In 2014, Zebra added the Motorola Solutions enterprise business to its portfolio. With Zebra’s leadership position in specialty printing, location, and RFID in combination with Motorola’s position in mobile enterprise solutions, data capture, and huge global presence, Zebra was poised to attack the new IoT business. Adding the final piece, Zebra’s IoT service Zatar, makes Zebra a truly end-to-end provider of IoT solutions.

Key to Zebra’s solutions is providing enterprises with real-time visibility of their assets, to see events and make decisions, helping businesses understand how they work and how they could work better. Zebra does this through a combination of:

- **Commitment to Standards:** Key to success in the IoT space is developing solutions that allow integration and communication with other “best of breed” solutions, from device to cloud. Moor Insights & Strategy believes the best way to

support IoT initiatives is to work with and support standards that can help the diverse IoT “universe” reduce the number of communication and design protocols currently deployed in the industrial world. Zebra is committed to simplifying IoT designs through its support (and use) of standards such as mbed, CoAP, and the Lightweight Machine-To-Machine (LwM2M) protocol from the Open Mobility Alliance.

- **Global Presence:** Zebra has access to 20,000 channel partners, a global footprint, and 4,500 patents around the world. Zebra and its partners have vast experience working with companies that are the leading implementers of new IoT solutions. Extending their own offerings to software, Zebra has a distinct advantage to providing IoT implementations.
- **End-to-End Vertical Portfolio:** Zebra has a long history of developing hardware endpoints. Their expertise in asset tracking and management is the basis for a wide variety of IoT applications in retail, healthcare, transportation and logistics, and field mobility. Zebra can provide a variety of solutions from IoT endpoint to platform and everything in between.

## ZATAR: THE STANDARDS-BASED CHIP-TO-CLOUD IOT SERVICE

FIGURE 4: ZATAR OVERVIEW



Source: Zebra Technologies

Zatar is all about simple connectivity, control, and collaboration. Using Zatar, developers can quickly and easily connect a diverse group of IoT endpoints or devices with a wide variety of enterprise applications that can monitor and control these devices to help optimize systems and maximize efficiency. Zatar’s IoT cloud service philosophy is:

- **Make data accessible to everyone:** Using a simple web interface that can be accessed from any device, users can see every connected device on their own profile page. The Zatar application's API is based on industry-standard HTTP(s) REST with JSON payloads, so solution-specific applications are simple to construct. Applications are authorized to access user data through use of the OAuth 2.0 security protocol.
- **Make data available anywhere:** Using a software-as-a-service device portal enables access to devices and endpoints from any location and any platform across the world.
- **Make prototyping fast and easy:** Zatar's focus on using the mbed standardized interfaces and protocols makes it quick and easy to add new devices and connect them to applications—even if you are not a seasoned system designer.

Moor Insights & Strategy believes that the key differentiators for Zatar are the Zatar Avatar concept, Device Portal, its commitment to the standard mbed platform, and the Zatar ecosystem partnerships.

### *ZATAR'S AVATAR CONCEPT*

Zatar's easy to use API is focused on making development as simple as possible. The use of Avatars allows developers to quickly and easily identify endpoints and integrate their features and functions into the overall system, as well as for users to quickly and easily both monitor the system and analyze the data. Key features of the Zatar API are:

- **Avatars:** Zatar abstracts devices and their data into "Avatars", which are digital representations of physical devices. Applications can access devices and their data by simply doing an HTTP "GET" on the device Avatars. All devices are accessed in the same manner, making it simple to create rich applications using heterogeneous device data without any specific device domain knowledge.
- **Avatar Definitions:** Avatars are created by developers through "Avatar Definitions", which are simple JSON structures that describe the device's unique characteristics in terms of well-known abstractions such as sensors, settings, commands, and metadata. A developer can create an Avatar Definition for anything, and then link that definition to the device by using a "Device Code Token" and mapping the device attributes to each unique device parameter.
- **Worlds:** Avatars "live" in Worlds. Multiple users can be invited to be members of Worlds, and as such they can collaborate using devices and information available to each world to which they have access.

- **Sharing:** By adding devices to Worlds and inviting groups to those Worlds, users can create dynamic areas with controlled permissions that allow ad-hoc and agile collaboration. The device owner always maintains control over his or her devices and can group and re-group collaboration areas at will.

By making use of Avatars, Avatar Definitions, Worlds, and advanced Sharing concepts, the Zatar Application's API creates a rich environment for collaboration and enables the creation of a diverse set of solution-specific vertical applications without the need for device-specific domain knowledge. This system will greatly accelerate the development of IoT applications.

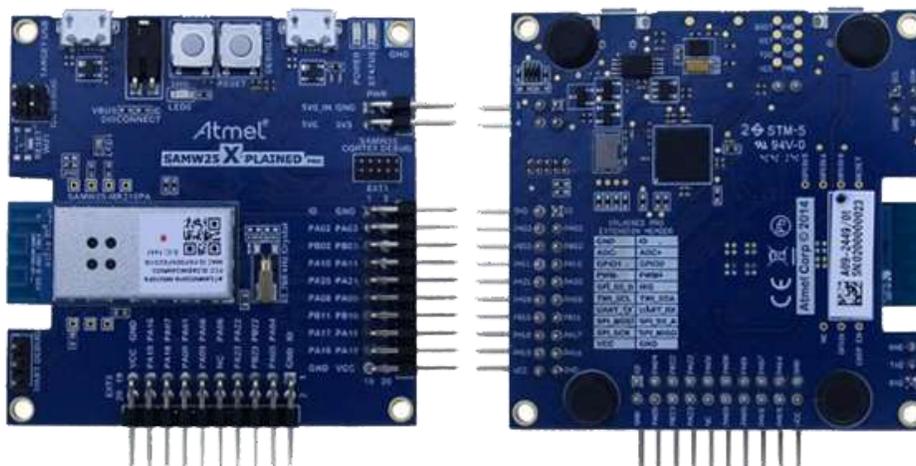
## ZATAR MBED SUPPORT

As previously noted, Zatar is strongly committed to the ARM mbed design platform. Use of this platform allows Zatar customers the ability to deploy IoT solutions quickly, easily, and securely with the confidence their solutions will work "out of the box".

By using the mbed OS and mbed DS components, a developer can rapidly create a connected IoT device. By leveraging Zatar's seamless integration of the mbed system, device details can be abstracted away and vertical applications can be taken to a new level of performance and flexibility.

## ZATAR ECOSYSTEM

FIGURE 5: ZATAR IOT STARTER KIT



Source: Zebra Technologies

Zatar supports a wide range of IoT devices, having committed to the ARM mbed IoT Solution. Initial ecosystem partnerships include Atmel, Freescale, Renesas, and Silicon Labs. Zatar's first support tool, the IoT Starter Kit, is powered by Atmel's Xplained board. It enables simple, standards-based cloud connectivity for creating next generation, internet-aware, enterprise products integrated with the Zatar IoT cloud service.

## CALL TO ACTION

The challenge in developing IoT systems is not in identifying **what** problem to solve but in choosing **how** to solve your IoT problems. Many uses for IoT systems have yet to be identified.

Hundreds of vendors, from innovative small startups to well-established multi-nationals, have designed, developed, and are selling IoT tool sets and platforms. Some are comprehensive, covering device-to-cloud, and some solve only pieces of the final puzzle. How do companies choose the platform and tools that are right for them?

Organizations that are trying to solve IoT problems need to look for solutions that are:

- Standards-based
- Support chip-to-cloud solutions and ecosystems
- Easy to use
- Quick to deploy
- Flexible
- Secure from end-to-end

The IoT market is nascent, and these solutions need to not only solve “today’s problems” but also need to be flexible enough to adapt to problems that we have not yet even discovered.

MI&S recommends companies that want to engage with tools and platform solutions:

- Target the investigation of solutions that they believe will become **industry standards**
- Look for a **growing ecosystem** with **innovative partners** that will provide all the necessary best-of-breed solutions
- Identify tools that provide **flexibility** and **speed** allowing quick development of prototype systems and easy deployment of commercial solutions
- Think about end-to-end **security** from the beginning

Zebra Technologies is a vendor that Moor Insights & Strategy believes companies should strongly consider for IoT solutions. Zebra has a strong global presence and is delivering solutions today to solve IoT problems. The company has a successful history of providing hardware solutions, and its recent addition of Zatar, its IoT cloud service, has provided Zebra with the ability to deliver end-to-end solutions to customers that can solve current problems with the flexibility to solve future problems. Zebra's partnership with ARM on its mbed IoT platform is indicative of its commitment to industry standards-based solutions. Zebra is connected to one of the IoT industry's strongest ecosystems, providing real value today to companies looking to leverage smart data gathering and analytics with the right tools to optimize their businesses both today and tomorrow.

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