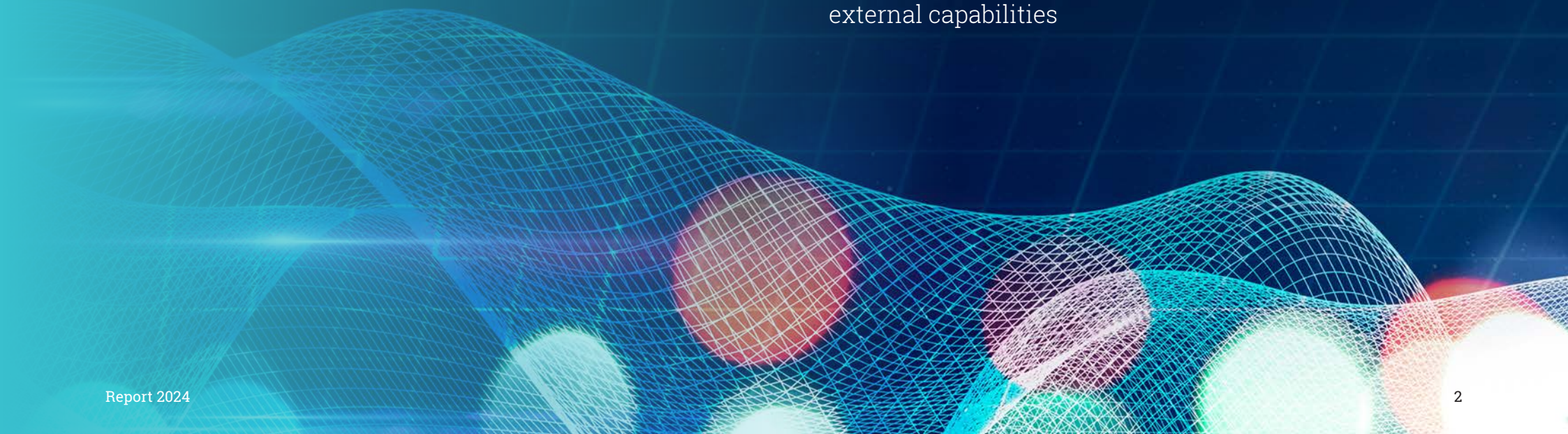
Memfault

Build, Buy, or Blend: Optimizing IoT Project Performance in the Hyperscale Era

Introduction

Massive IoT is here, and organizations face huge pressures when deploying hundreds of thousands or even millions of IoT devices. The scale magnifies the complexities and creates a significant management burden. In response, organizations are assessing how they will manage development, operations, upgrades, maintenance, and service interruptions or failures at hyperscale.

Fast responses coupled with automated solutions are crucial. Organizations need to have tools and systems in place to enable rapid reactions and, ideally, proactive identification and resolution of issues before they affect services. IoT organizations are therefore focusing on how they introduce IoT offerings and considering if they should build these themselves, buy them from specialists, or create an integrated blend of internal and external capabilities



The ability to respond rapidly to changing needs, issues, and service interruptions is essential. Observability – which enables developers to pinpoint issues, understand root causes, and monitor the performance of IoT services—has become a critical factor in optimizing IoT development and operations.

Growth is here to stay so these pressures and challenges are set to continue, with greater efficiency a priority. Research firm Transforma Insights has recently predicted that global IoT connections will reach 40 billion in 2033, running at about 10% CAGR each year between now and then. It's not only the number of projects that is increasing; the scale of the projects is growing too, amplifying the operational challenges IoT organizations face. A recent survey of IoT users found that more than a quarter (26%) of respondents said they already had deployments that involve over 10,000 connected devices, and a majority (50%) had deployments of more than 500 connected devices[1].*

Digital twins, autonomous robots, assisted driving, enhanced automation and the application of AI will drive introduction of new projects and make existing IoT-enabled deployments more appealing. The business case has been strengthened by these capabilities and IoT organization's are becoming increasingly familiar with what can be achieved.

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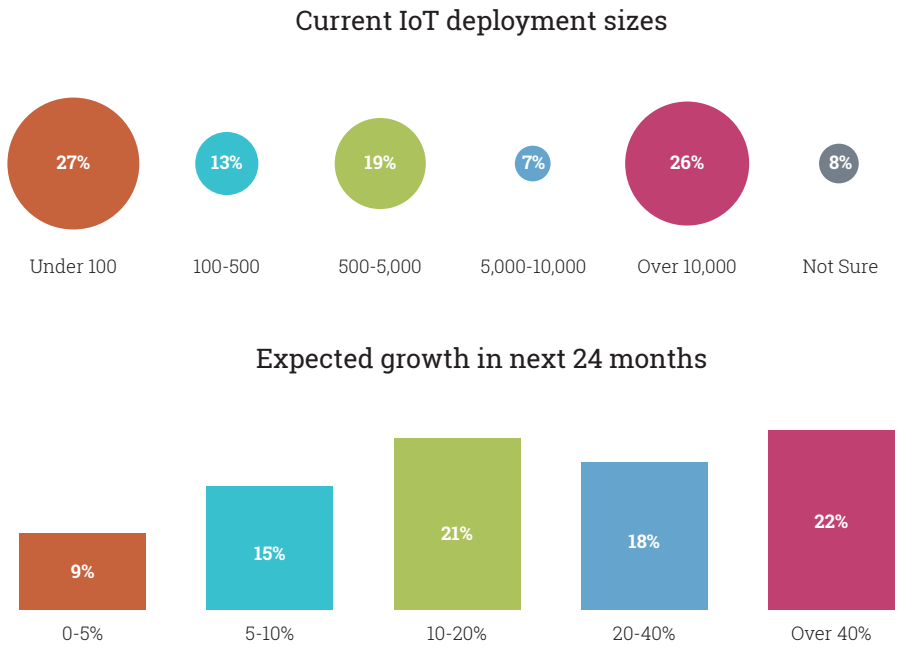
Figure 1: Survey of IoT users: size of IoT deployments expected to grow rapidly*



[1] https://www.iot-now.com/2024/03/01/143049-iot-moves-to-large-deployments/
Source: Beecham Research, 2024*
Source: Transforma Insights**

Monitor devices in real-time to keep IoT projects on track

IoT software, composed of platforms, infrastructure and applications, is proliferating with strong growth predicted over the coming decade. Infrastructure-as-a-service in support of IoT and applications to manage IoT both appear set for continued compound annual growth rates (CAGR) of more than 20%.(2) Moreover, AI integration is set to drive enterprise IoT software spending as the integration of IoT with other emerging technologies, such as AI and machine learning, offers advanced features like predictive analytics, real-time monitoring and AI-driven insights[2].

Such tools and capabilities can't be adopted quickly enough given high rates of IoT project failure. It's well understood that an unacceptable number of IoT projects fail to achieve their potential[3].

As many as 58% of projects fail, with just 18% considered a success.

This evidence suggests that strategic challenges are limiting IoT performance. There are several reasons for this, one being that IoT relies on a specific set of technologies that are often outside the scope of the business. In many cases, organizations are turning their existing products into IoT devices or entering a new market. Another reason is that IoT is a complex technological landscape with highly specific demands. There are also shortages of certain skills and some organization's find it hard to recruit the personnel they need to develop solutions properly and bring them to market. Add to that typical technology challenges around increasing and managing scale and there's a perfect storm of issues for each large-scale IoT project to overcome.

*The automotive industry is undergoing major technological upheaval as cars transform into software-defined vehicles that often contain more than 100 million lines of code.****

[2] https://iot-analytics.com/wp/wp-content/uploads/2024/07/INSIGHTS-RELEASE-IoT-market-update-Enterprise-IoT-market-size-reached-USD-269-billion-in-2023.pdf
[3] https://www.iot-now.com/2022/08/05/122841-why-iot-projects-fail/
State of IoT Software Development, VDC Research, April 2024***

From product to service

Consider a scenario where a chainsaw manufacturer is transforming its business model to one where customers rent a saw as-a-service on an hourly basis. The business model has changed drastically from a business that sells a product to one that offers a service but the core competence of developing and manufacturing chainsaws remains the same. What's new and challenging is adoption of the new model which utilizes unfamiliar technology and requires new management and operational approaches.

In this scenario, it's essential for the chainsaw manufacturer to:

- Maximize product uptime
- Optimize consumables such as battery life, fuel, and the cutting chain's efficiency and sharpness
- Secure the product so it cannot be stolen
- Accurately charge for usage

Those are all large and complex new activities for a manufacturer that has previously focused on selling its products through retailers, with only a limited service operation.

Software development now accounts for almost 60% of project development costs and the average IoT project contains 548,000 lines of code[4].

It's clear that software is both a significant consumer of resources and a large source of risk. In fact, fixing software defects has become a substantial cost and cause of delay for IoT projects. Fixing software defects reported by customers requires anything from 75 additional person hours to up to three person months for the most complex projects.

Ensuring the quality of an IoT product's software code can be challenging for product makers who have previously focused solely on hardware.

[4] 2024 State of IoT Software Development, VDC Research, April 2024 https://memfault.com/iot-software-development-report/

In-house tools vs third-party solutions

Efficient incident resolution relies heavily on collection of device performance and health data from deployed products with companies relying heavily on in-house developed methods. However, these appear to be less effective than using third party solutions.

Users of third-party solutions are 1.7 times as likely to finish ahead of schedule than those using in-house tools. In addition, the cost of using in-house tools was greater.*

The median cost of project development was higher for those using in-house tools to collect device performance and health data at $875,000, compared to those using third-party tools which had costs of $500,000. In other words, engineers using third-party tools to collect device performance and health data saved 57% in overall project development costs versus those using in-house solutions. For those using in-house tools, 27.1% of the development costs went to embedded software development, compared to 22.3% for those using third-party tools.

Initially, the temptation to develop these new capabilities in-house might be strong because of perceived greater long-term control, potential savings on operational costs and mistrust of the supplier ecosystem. However, the downsides of going at it alone often far outweigh the benefits of partnering with function-specific experts. Companies often miss out by attempting to build everything themselves, with skills and experience to optimize IoT devices in short supply.

They often waste time and money developing supporting infrastructure in-house when they could focus their resources on developing the product rather than building extensive custom tools to support it. The reality is that companies building IoT device reliability solutions that are purpose-built for embedded systems can support development and provide tools faster and more cost effectively, simplifying your project thanks to their greater experience. In fact, many use cases depend on time-to-market for success.

*VDC Research

Time constraints add pressure

In the case of the chainsaw manufacturer, arriving late could mean competitors have already taken the market they were aiming for. It's therefore worth considering from the start what additional skills you need, the likely scale of your IoT activities, and how you plan to manage them. This is very much dependent on the product or service type, the business model being adopted, and the current skills and resource base of your company. It's clear that the vast range of IoT propositions cannot be looked at as a single set of challenges and different products and services have different challenges to address.

For those with well-established firmware development teams, for example, it won't be necessary to buy-in that expertise. However, for others that lack power consumption, signal propagation, connectivity or security knowledge, collaborating with an expert service provider gets you over those hurdles – and quickly. Similarly, a product-focused company might have unequalled innovation to bring to market by developing new hardware but it may not have the scale to support millions of devices in deployment. Make no mistake, we are now talking about vast scale in IoT.

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*VDC Research

Prepare for optimized hyperscale development and operations

Where once a pilot or experimental IoT project might have involved a few hundred devices which could easily be manually fixed by an engineer, the mature era of IoT relies on automation and remote maintenance. It is also subject to heightened user expectations for maximized uptime, seamless upgrades, and uninterrupted performance. Often this can be critical to the operations of customer businesses with consequences for lack of performance, like poor reviews or excessive returns.

Innovators aren't operating alone

Partnering with experts who understand not only the technologies that underpin IoT but also the operational imperatives for IoT success can take companies from being sector-specific specialists to having comprehensive IoT offerings that take them into new markets and new modes of hyperscale operation.

A full 57% of unsuccessful projects relied more heavily on in-house resources while for successful IoT projects, this was 36%.*

In contrast, 49% of successful projects relied more heavily on a mix of in-house and external resources, while only 17% of unsuccessful projects did this.

This finding suggests that a focus on in-house resources only is less likely to achieve the results sought – a combination of in-house and carefully chosen external resources is more likely to yield success. This is borne out by the VDC Research which revealed that engineers using third-party tools to collect device performance and health data saved 57% in overall project development costs versus those using in-house solutions.

Finding the right balance is essential for ensuring cost effectiveness. Generally, external resources may be best utilized for more technical challenges and infrastructure support, while internal resources maintain a focus on business challenges and product design. Some overlap is clearly required to create an integrated project approach but ensuring granular visibility into device and software health and performance is a critical enabler of IoT success both in the development and the mass scale operational phases of IoT projects.

A blend of built and bought solutions can deliver benefits but this depends on the organization that is deploying the IoT service. If you have a large team of IoT-specialized developers in your business and have the technical staff to manage many thousands of devices, there may be less reason to buy your own systems. However, it will still take time for these to be developed, which your use case may be unable to spare. In addition, your resources may be better directed adding features and developing your future business than re-inventing capabilities that already exist.

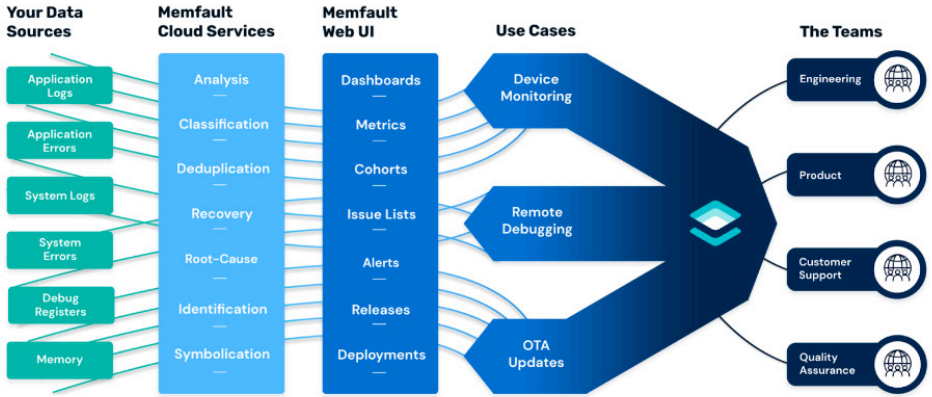
*Beecham Research

How does Memfault help?

Memfault is a device observability platform that allows developers and engineers to understand how their devices are performing in the field, quickly identify when something goes wrong, and easily assess the impact of that issue across the device fleet.

Total Cost of Ownership

Data housing and computing are only small parts of the cost. Consider how Memfault works. All highlighted portions must be manually re-created and maintained by your engineers



Memfault automatically collects crash data, health metrics and logs so that, in the event of a crash, for example, all the data is available immediately, facilitating rapid resolution.

The collected data will, for example, reveal that the crash has affected 25% of the fleet and identify the line of code that has caused the issue. However, Memfault is not only a retrospective tool for identifying the source of problems. It also provides highly granular information on the health of your device fleet. This includes a complete set of out-of-the-box metrics for monitoring battery health, the reliability of the device connection and more plus the ability to add any custom metrics with minimal extra effort.

Users are able to drill down to a specific device at a specific time to ensure that they are highly reliable in the field. This is essential for sensitive or critical IoT applications and enables pre-emptive action to be taken so firmware can be upgraded before issues occur. Memfault collects data directly from the device, at a system level, regardless of whether the device is connected at the time or not. It is also designed to work even when bandwidth is extremely constrained, chunking data into very small packets to keep things efficient.

This means customers can access valuable data without sacrificing performance and that data will have no gaps, regardless of connectivity state, providing a far richer understanding of real usage and the potential source of issues. Memfault brings together information on product usage with detailed insights on device reliability to deliver the complete picture of product quality and performance, all consolidated in one system and integrated in one software developer kit. Memfault can become a single source of truth for device data and save precious space on constrained IoT devices.

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Conclusion

IoT deployments have matured into large-scale, long-term projects consisting of thousands of devices, with more being added daily. Alongside the increasing number of connected devices, organizations are continuously introducing innovative new features and capabilities, often through over-the-air (OTA) firmware upgrades.

All these complexities open the door for errors, bad code, and security vulnerabilities. The ability to quickly identify and fix issues is crucial for IoT businesses. Relying on a homemade, in-house system that doesn't integrate smoothly with adjacent or external systems can leave deployments open to threats or unable to quickly adapt and react to issues.

Investing in a purpose-built, widely utilized, and continuously evolving platform for device observability and OTA updates gives organizations a single system to address multiple device performance issues. Moreover, it enables the addition and support of new functionalities during the life of the deployment, which is vital for maintaining a competitive edge in today's market.