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How hard is the IoT? Quantifying and easing the decision load faced by developers

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In 2017, fresh from its acquisition by SoftBank, Arm made a prediction—that there would be one trillion IoT devices by 2035. While the likelihood of the global IoT reaching that figure has declined since then, there is a "Project: One Trillion": the literally trillions of possible configurations for an IoT device.

Four trillion, to be exact. And to be clear, a minimum of four trillion configurations. Omdia research has shown that given the number of parameters and options per parameter, any given IoT device could have at least that many different configurations, without even beginning to consider the many different silicon vendors, software packages, connectivity service providers, and other competitors offering solutions.

4 Trillion

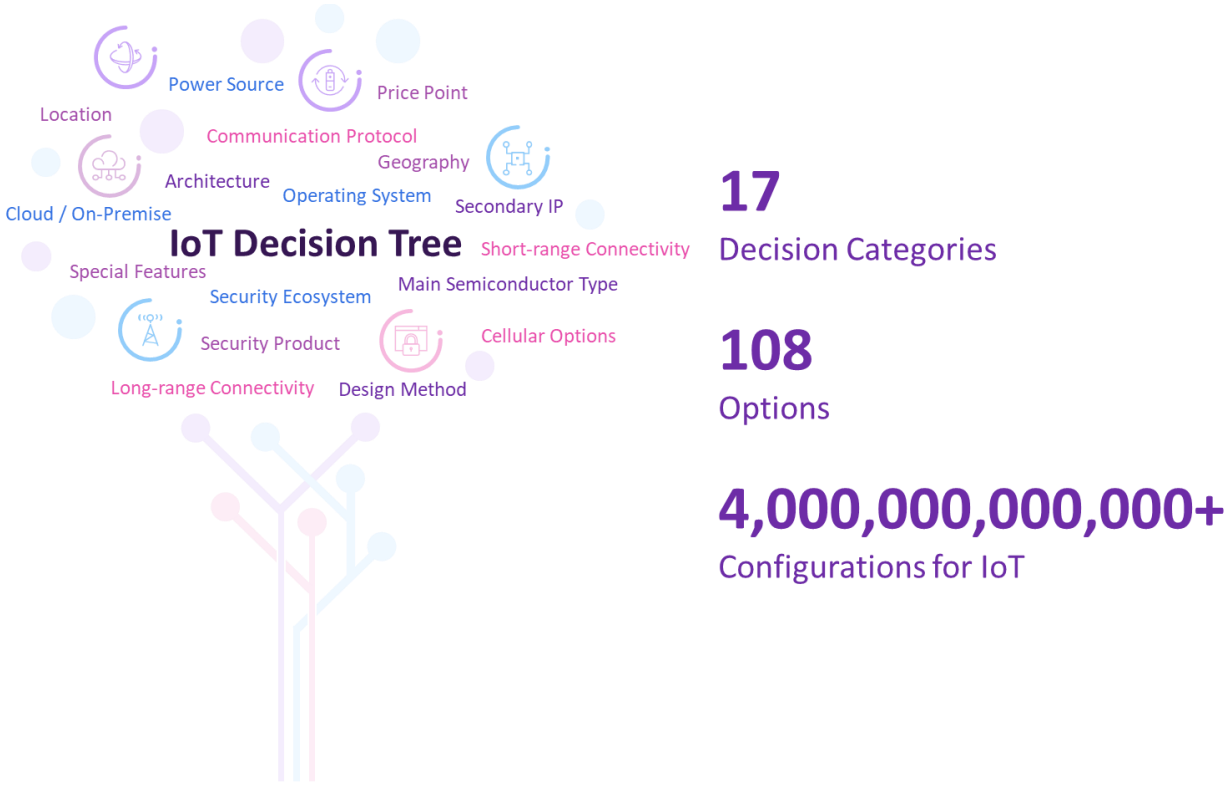
Configurations for IoT.

"Only the IoT developer faces this ever-expanding array of options—and some choices have ramifications not immediately visible."

This is a complexity unique to the IoT—most other segments are more defined, or in some way limited, which greatly reduces the decision load on bringing a device to market. A new server, for example, doesn't have to worry about cellular profiles, real-time operating systems, or local wireless connectivity. Mobile phones have a very limited selection of operating systems in what's basically a closed ecosystem. The automotive industry is carefully regimented and regulated specifically to narrow many of these options. Only the IoT developer faces this ever-expanding array of options—and some choices have ramifications not immediately visible. Will a future security package be compatible with running on bare metal? Will a reduced capacity cellular connectivity like LTE Cat-M1 be able to

handle flashing firmware and updating an edge AI model in five years? Will your hardware outlast the only cellular connectivity your modem allows?

Figure 1. Over 4 trillion configurations in the IoT decision tree



Source: Omdia

Omdia identified 17 different decision categories which represent the minimum decision set for launching a cloud or edge connected product. These include categories related to the silicon (operating system, architecture, bit size, application specific vs general purpose, presence of secondary IP such as GPUs or ISPs), communications and connectivity (communication protocol, short or long range connectivity, SIM options), security options, geographical and other deployment options (fixed or mobile, single region or country, global), and many other elements such as power supply, data storage, degree of ruggedization, etc.

Just in the area of connectivity alone, there are over 200,000,000 permutations, including different combinations of local connectivity, cellular connectivity (of different network standards), Wi-Fi standards, and so on. The number of IoT startups or new endeavours focussing specifically on connectivity is fairly small; the number of new endeavours in the IoT requiring connectivity is by definition 100%. These decisions are vital, complex, and confusing.

The sheer breadth of choices and size and scope of decisions is already a source of anxiety among IoT developers, as fear of making the wrong choice adds to the cost of the decision load born by those tasked with bringing a new IoT device to market. In a survey conducted by Omdia in early 2023, 25% of those surveyed cited “choosing the wrong technology” as one of their top concerns, while a further 33% listed “lack of internal expertise”.

Third-party Case Study: Golioth and Method Recycling

Method Recycling designs products that help organisations reduce waste. Their high-end, colour-coded modular bins are found in offices around the world. Method developed an IoT product called 'Method InSight', which leveraged real-time data from office recycling and waste bins, allowing businesses greater capability to manage their waste removals and cleaning schedule. The granular data allows organisations to implement waste reduction initiatives and provide data for sustainability certifications.

This product, of course, requires robust connectivity, and Method began by using a single cellular solution. However, during the supply chain crunch affecting the semiconductor market in 2021 and 2022, the cellular model they used was in short supply. IoT platform specialist Golioth was able to offer Method a module solution incorporating a management platform which allowed Method to bridge across all of their hardware, managing their new and legacy devices through a single secure platform.

It's illustrative here to look at all the things that Method no longer had to include on their checklist once they formed a partnership with Golioth. Connectivity, firmware updates, over-the-air updates, cloud management, platform management, module, geography, cloud configuration; by Omdia's calculation, using Golioth took approximately 500,000,000 possible configurations off the table in one swipe, already significantly reducing the potential decision load for Method.

> *"…by Omdia's calculation, using Golioth took approximately 500,000,000 possible configurations off the table in one swipe, already significantly reducing the potential decision load for Method."*

This illustrates how removing the weight of the decision load can allow a company to focus on its key activities, without needing to allocate time and focus on what are fundamentally background activities. Method had better use of its resources than to spend hours figuring out how to make four different devices running three different modules connect to the same platform across two different cloud data providers—moreover, there was the risk of a potentially catastrophic, business-limiting mistake. Businesses have been known to develop and deploy devices that can't be updated because they lack memory, or to find their business model requires always-on connectivity that ends up costing a fortune in cellular data, or that their solution is limited by region and cannot be deployed in a new territory where the business could be competitive.

Furthermore, there is the knowledge that the desired decision set—those differentiating or proposition-based decisions a business wants to make, perhaps has even entered the industry to make—are supported. For example, Method wanted to use a flexible real-time operating system (RTOS) like Zephyr, which Golioth could support, instead of requiring a fixed or proprietary system. A company could know that they wanted to offer a certain grade of security in the future, or be ready to move to 5G RedCap when it becomes available in their region, and using a vendor that can guarantee those choices at inception, rather than forcing the company to cobble together a mostly working solution, or to compromise on their vision, is invaluable.

Conclusion

The potential to scale is the greatest asset a company has, and the fear of losing that potential due to a decision casually made early in the business plan is justified—perhaps in some ways the figure of one in four afraid of choosing the wrong technology simply represents a failure of imagination in the other three. Third-party support remains the most versatile tool in the vendor's toolbox and is perhaps the only way a new entrant to the market can hope to navigate the trillions of choices and seemingly almost as many pitfalls.

"Third-party support remains the most versatile tool in the vendor's toolbox."

Author(s)

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Appendix

The full IoT decision tree used by Omdia for calculation (17 categories, 108 options)

Architecture
x86
Arm
RISC-V
Proprietary
Tensilica
Other

Design Method
Design method
Partner
Buy GP
Customise

Main Semiconductor Type
ASIC/ASSP
MPU
MCU (32+)
MCU(16-)
FPGA

Secondary IP
GPU
NPU
ISP
DSP

Operating System
Contiki
FreeRTOS
Mbed
QNX
Zephyr
RIOT
Oniro
Mongoose
Bare metal
Android
Linux
Azure
Windows
FreeBSD
Other BSD

Price Point
Budget
Basic
Mid-tier
High-end

Communication Protocol
AMQP
CanBUS
CoAP
DDS
HTTP
QUIC
MQTT
OPC-UA
Proprietary
REST
TCP/IP
WebSockets
XMPP
zenoh

Short-range Connectivity
BLE
Thread
Zigbee
Z-Wave
Wi-Fi
ANT
DECT
Bluetooth CLassic
Ethernet

Long-range Connectivity
NB-IoT
CAT-M
LoRaWAN
MIoTY
Wi-SUN
RedCap
LTE
5G
Private 5G
NTN
DECT NR+

Cellular Options
Sim
eSim
iSim

Security Ecosystem
Build yourself
Buy
Partner

Security Product
Physical tampering resistance
PUF
Secure Element
PSA
HSM
TPM

Geography
Global
Region-tied
Country-tied
Flexible region
Flexible country
Multi-region
Multi-country

Location
Stationary
Mobile
Semi-mobile

Special Features
Temperature hardened
Ruggedized
Radiation hardened
Water exposure
Safety
Military grade

Cloud / On-premises
On prem
Cloud
Hybrid

Power Source
Mains
Rechargeable battery
Coin cell
Button battery
Energy harvesting

This piece of research was commissioned by Golioth Inc.

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