ECLIPSE[®] FOUNDATION

December 2021

IoT & Edge Developer Survey Report

EGE | NATIVE

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Thank you for sharing the survey with your communities!







The 2021 survey was conducted with the following objectives:

- 1. To gain insights into the IoT & edge computing industry landscape
- 2. To understand the challenges IoT & edge computing developers are facing
- 3. To help identify the opportunities for enterprise IoT & edge computing stakeholders in the IoT & edge computing open source ecosystem

Read this report to learn more about the key findings and industry trends for IoT & edge computing stakeholders.

The 2021 developer survey provides essential insights about the loT & edge computing industry landscape



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Sponsored by <u>Eclipse IoT</u>, <u>Eclipse Edge Native</u>, and <u>Eclipse Sparkplug</u> Working Groups the 2021 IoT & Edge Developer survey was conducted from Aug 28th to Oct 12th, 2021.

662 developers, committers, architects and decision makers were surveyed, with participation from across the globe and within a broad range of industries. **49%** of survey participants are both open source committers and users, a**10% Increase** over 2020. **55%** of survey participants work on a mix of IoT & edge computing projects. 662 global developers, committers, architects and decision makers were surveyed



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Executive Summary

- **C and C++** are the most widely used programming languages for **constrained devices**. **Developers prefer Python over Java** for edge servers, IoT & edge gateways, and cloud platform development.
- **MQTT has emerged as the clear leading protocol for IIoT communication**. At 44%, MQTT shows solid growth in adoption over the past year, while other protocols like REST, HTTP/HTTPS and TCP/IP show a significant decline in IIoT usage compared to 2020.
- While ARM continues to dominate hardware architectures for constrained devices, gateways and edge servers, **the RISC-V architecture, including its CORE-V implementation by OpenHW Group**, is showing strong market share gains.
- The IoT middleware market is dominated by **AWS IoT** (37%), **Microsoft Azure IoT** (27%), and **Google Cloud IoT Platform** (22%).
- Amazon AWS with 44% usage (+3% in 2021), Microsoft Azure with 29% (-1% in 2021), and Google Cloud Platform with 20% (-7% in 2021) continue to dominate the public IoT and cloud platforms.



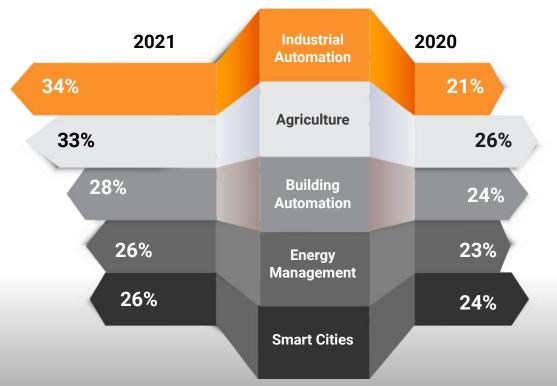


- Industrial automation has emerged as the leading industry for IIoT and edge computing technology (34%), followed by agriculture (33%) and building automation (28%).
- Security (46%), connectivity (38%) and deployment (31%) are the top three concerns for IoT & edge developers in 2021, with all three concerns growing from 2020.
- Artificial intelligence (21%) was the most frequently selected edge computing workload.
- **Container images (30%)** was the most frequently selected edge computing deployment artifact.
- **Communication security** (43%), **data encryption** (27%), **and analytics/anomaly detection** (22%) are the most commonly used security-related technologies for constrained devices, IoT/edge gateways and edge servers.





Primary Industry Verticals







Industrial Automation and Agriculture Segments are Growing

Industrial automation is now the top industry for IIoT and edge computing technology adoption (at 34%, compared to 21% in 2020). Agriculture also shows significant growth (up from 26% in 2020 to 33% in 2021). Advancements in smart farming fuel the rise in adoption of IoT & edge computing-based technologies to increase yields, reduce costs, and eliminate waste, among other driving factors.

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Building automation follows at 28%, while energy management, connected/smart cities are tied both come in at 26%, a 5% increase over 2020.



The education industry shows a significant decline in interest (from 21% in 2020 to 17% in 2021). This vertical may have been negatively impacted by shifting priorities due to COVID-19.

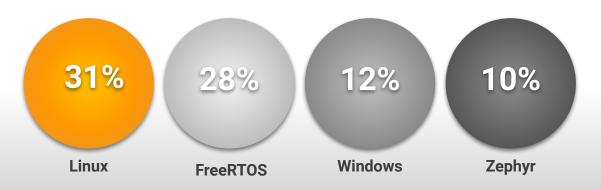




For Constrained Devices: It's a Linux and FreeRTOS World:

Top Operating System for Constrained Devices and Gateways

- Linux (31%), FreeRTOS (28%) and Windows (12%) are the top OS choices for constrained devices and edge nodes.
- Zephyr continues its steady growth (from 8% in 2020 to 10% in 2021).



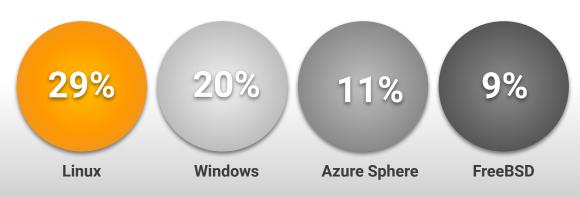


Key Finding 2.1

Linux and Windows Dominate the Edge and Cloud Landscape

Top Operating System for Edge Servers and the Cloud

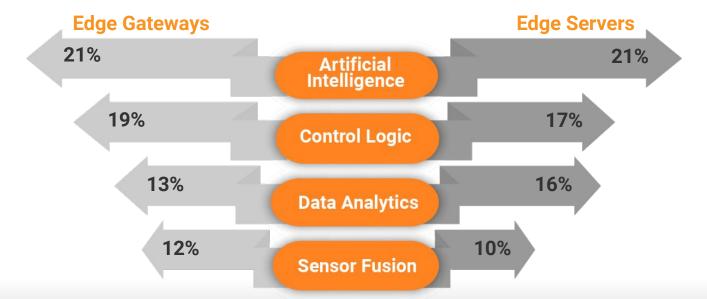
- Linux (29%), Windows (20%) and Azure Sphere (11%) are the top OS choices for edge servers and the cloud.
- **FreeBSD** is at **9%** for 2021.







Top Edge Computing Workloads



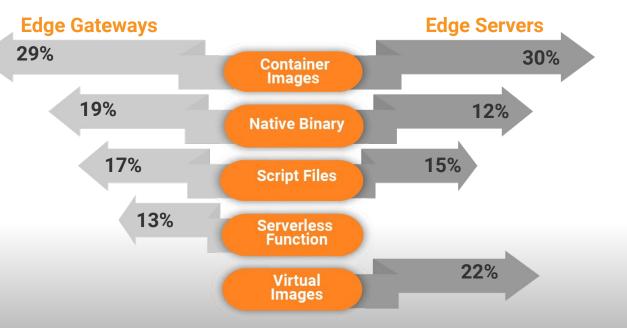
Artificial intelligence (21%) is the most common workload for both edge gateways and edge servers. **Control logic**, **data analytics** (involving 1GB+ of local storage) and **sensor fusion** (data aggregation and filtering) round out the top 4 edge computing workloads.





Top Edge Computing Artifacts Deployed for IoT Solutions

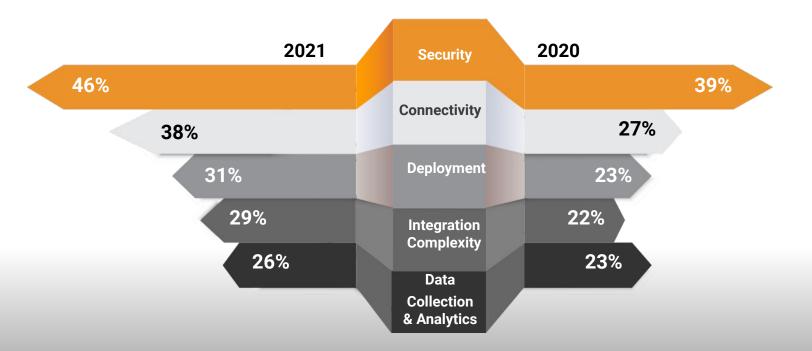
Container Images are the most commonly used edge computing artifacts for both edge gateways and edge servers.







IoT & Edge Computing Developer Concerns







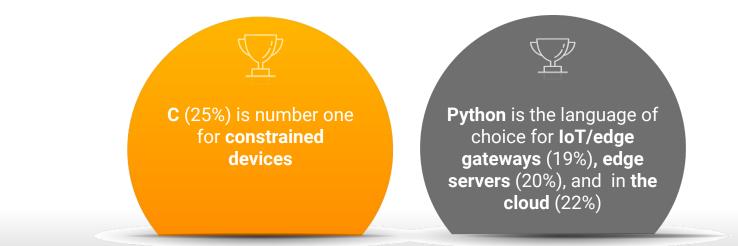
Top Edge Computing Artifacts Deployed for IoT Solutions

- Security 46% (39% in 2020), connectivity 38% (27% in 2020) and deployment 31% (23% in 2020) continue to be the top three developer concerns in 2021.
- A significant increase in both security & connectivity concerns underscores the challenges developers face in determining the right technologies for the job.
- An increase in deployment-related concerns (at 31%, up from 23% in 2020) indicates that more solutions are moving past the PoC phase and developers are starting to focus on optimizing production systems for better user experience.
- Concerns around **integration complexity** are also on the rise (up from 22% in 2020 to 27%). As the number of deployments increase, the need for additional integrations with complementary technologies and systems becomes apparent.





Programming Languages: All The Usual Suspects



C, C++, Python, Java and JavaScript dominate the IoT & edge space, as they do in the rest of the IT market.





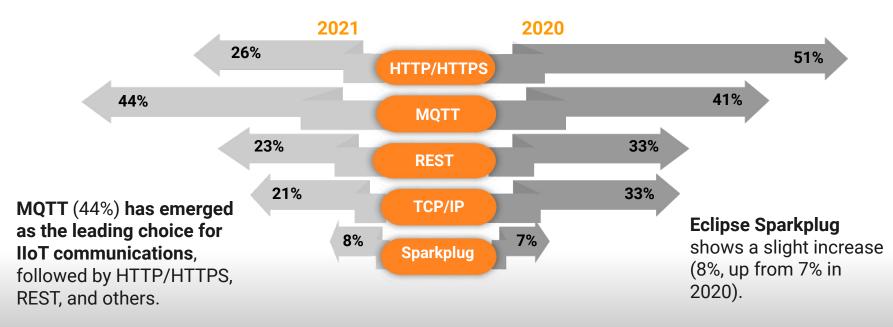
Programming Languages: Top 4 by Tier

Constrained Device	IoT/Edge Gateway	Edge Server	Cloud
1. C - 25%	1. Python- 20%	1. Python - 19%	1. Python 22%
2. C++ - 18%	2. C++ - 16%	2. Java - 15%	2. Java - 18%
3. Java - 12%	3. C - 15%	3. C++ - 14%	3. Javascript - 16%
4. Python - 11%	4. Java - 14%	4.C - 7%	4.C++ - 9%





Preferred IoT Communication Protocols

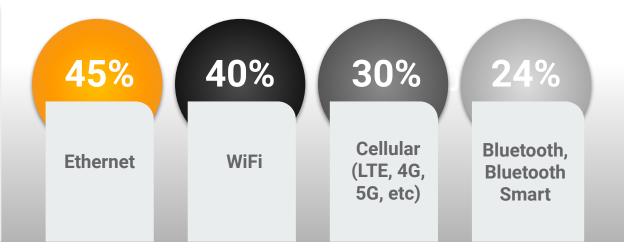






Most Used Connectivity Technologies

Top Connectivity Technologies Being Used are **Ethernet 45%** (39% in 2020), **WiFi 40%** (44% in 2020) **cellular (LTE, 4G, 5G, etc) 30%** (37% in 2020) and **Bluetooth/Bluetooth Smart 24%** (37% in 2021).

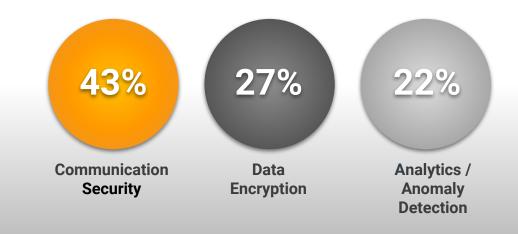






Communication security (e.g. TLS, DTLS) (43%), data encryption (27%), and analytics/anomaly detection (22%) are the most often used security-related technologies for constrained devices, IoT/edge gateways and edge servers.

Most Favored Security-Related Technologies

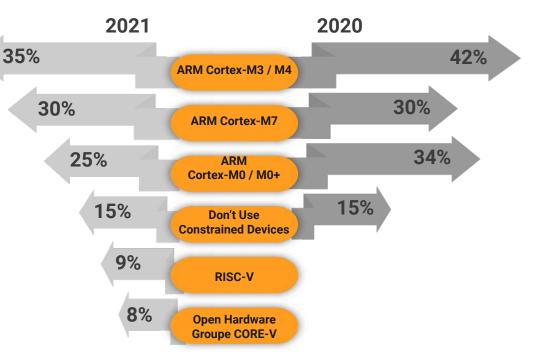






Hardware Architecture Usage for IoT Constrained Devices

- While ARM dominates, ARM
 Cortex-M3 / M4 usage has dropped from 42% in 2020 to 35% in 2021.
- **ARM Cortex-M7** usage remains at **30%**, with no change compared to 2020.
- ARM Cortex-M0 / M0+ usage has dropped from 34% to 25% since 2020.
- **RISC-V** at 9% and **OpenHW Group CORE-V** at 8% are gaining traction.

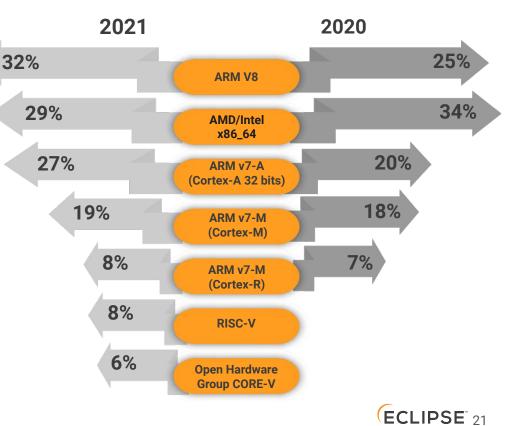




Key Finding 11

Hardware Architecture Usage for IoT/Edge Gateways and Edge Servers

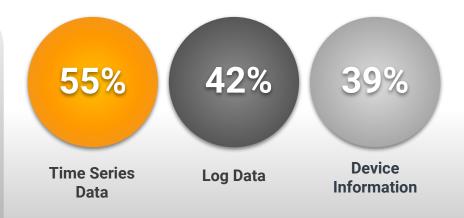
- **ARM Cortex V8** usage shows an increase (32% compared to 25% in 2020).
- AMD/Intel x86_64 usage shows 5% decrease in 2021 compared to 2020
- **ARM v7-A** usage is at 27%, compared to 20% in 2020.
- While ARM continues to dominate, **RISC-V** at 8%, **and OpenHW Group** at 6% are gaining traction.





Types of IoT Data Stored in Database/Data Store

Time series data (55%), log data (42%), and device information (39%) are the most common types of IoT data being stored in databases and data stores.

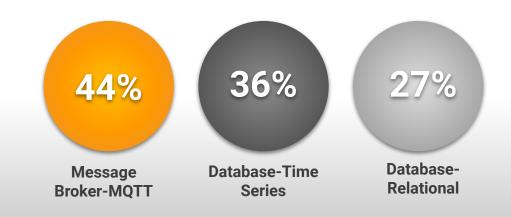






Most Common Technologies Used In Messaging Infrastructure

Message broker-MQTT (44%), database-time series (36%), and database-relational (27%) are preferred messaging infrastructure technologies.



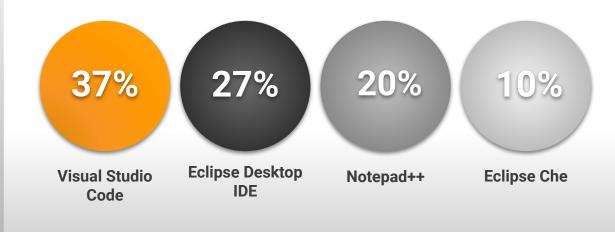




Developers use a variety of IDEs and text editors, with **Visual Studio Code** (37%), **Eclipse Desktop IDE** (27%) and **Notepad++** (20%) being most common.

Eclipse Cloud Development tools are also starting to see significant adoption in IoT and edge development with **Eclipse Che** coming in at a solid 10%.

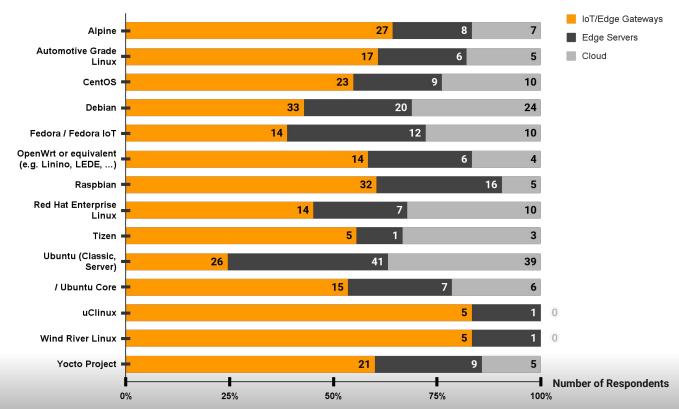
Preferred Development Tools





Key Finding 15

Linux Distributions Employed in Cloud, Edge Servers and IoT/Edge Gateways

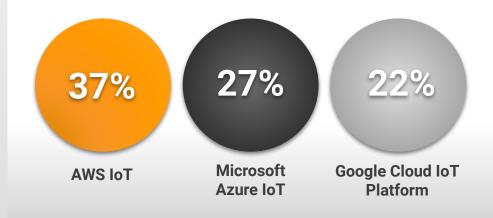






- IoT middleware is dominated by AWS IoT (37%, +2% in 2021), Microsoft Azure IoT (27%, -3% in 2021), and Google Cloud IoT Platform (22%, -8% in 2021).
- The market is also seeing a rise of other middleware options: (IBM Watson IoT platform (15%), Bosch IoT suite (10%), Cumulocity (9%).
- The diversity in responses indicates that this technology segment is still young and competitive.

IoT Middleware: The Race Is Still Young

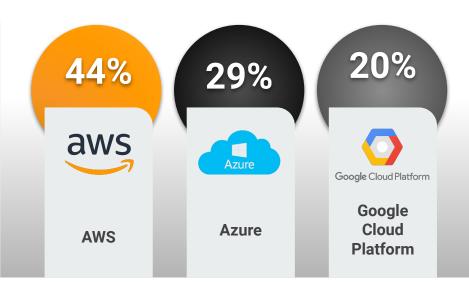






Public Cloud and IoT: The Big Three Continue to Rule

Amazon AWS with 44% (41% in 2020), Microsoft Azure with 29% (30% in 2020), and Google Cloud Platform with 20% (27% in 2020) continue their dominance of public IoT and cloud platforms.

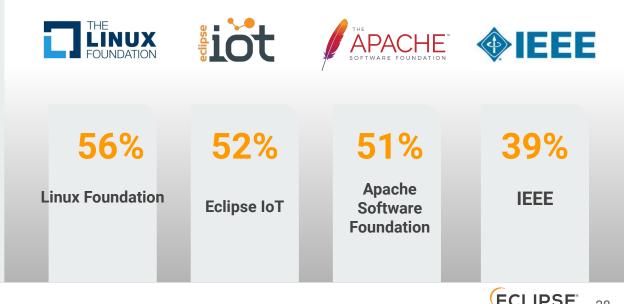






The Linux Foundation 56% (+7% from 2020), Eclipse IoT/Eclipse Foundation 52% (+3% from 2020), Apache Software Foundation 51% (-2% from 2020), and IEEE 39% are considered by developers to be the most relevant organizations for IoT strategies.

Most Relevant Organizations for IoT Strategies





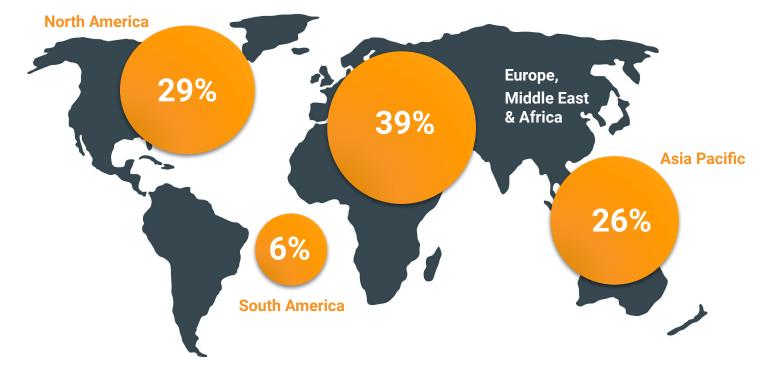
Demographics







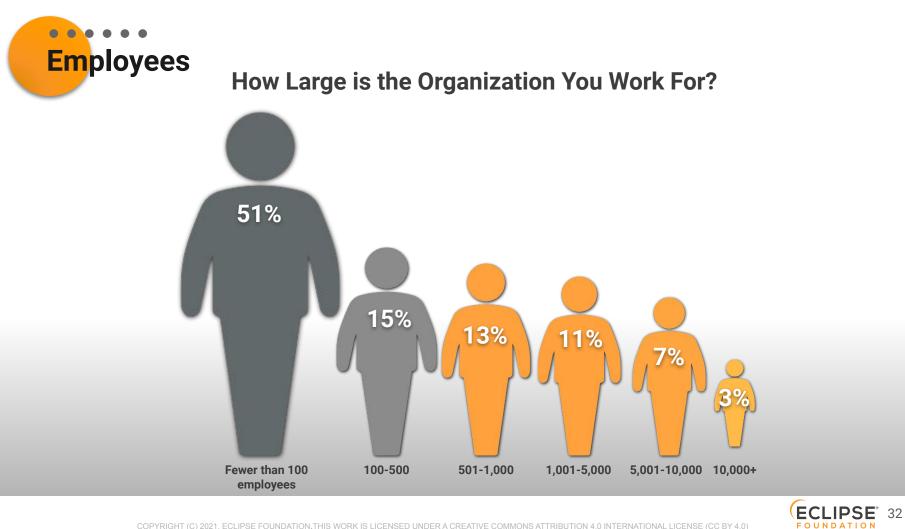
In Which Region Are You Located?



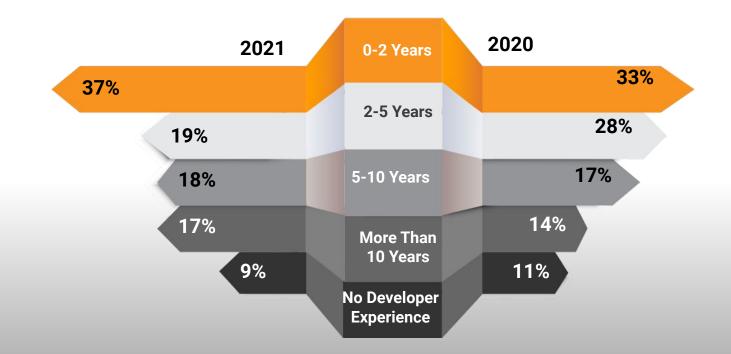








Experience How Much Experience Do You Have Developing IoT/Edge Solutions?

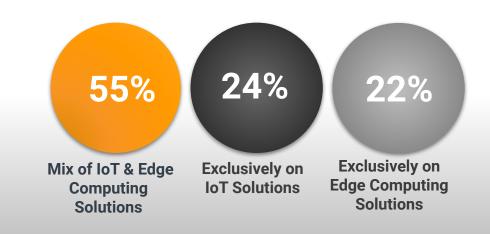






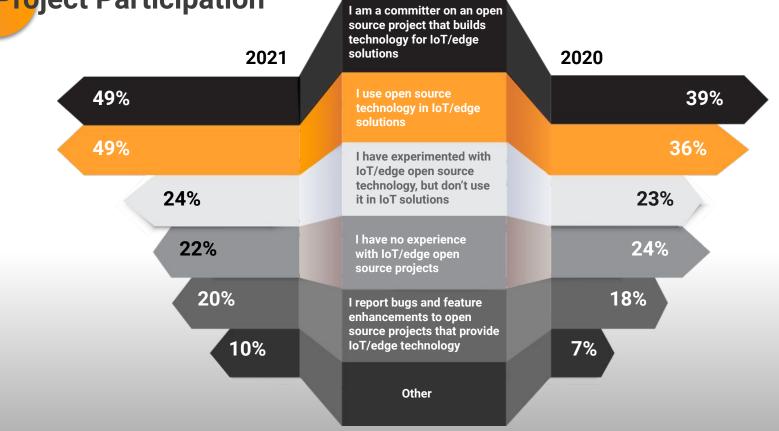
What Types of Solutions Are You Predominantly Working On?

- 55% of survey participants work exclusively on a mix of loT & edge computing solutions
- 24% work exclusively on IoT solutions
- 22% work exclusively on edge computing solutions





Project Participation





Thank You!

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