# IoT Developer Survey Results

April 2018

# Survey Introduction

- The **Eclipse IoT Working Group**, **AGILE IoT**, **IEEE**, and the **Open Mobile Alliance** co-sponsored an online survey to better understand how developers are building IoT solutions.

- The survey was open from January 24 until March 5, 2018. A total of **502 individuals participated** in the survey. Each partner promoted the survey to their communities through social media and web sites.

# Key findings

# What People Are Building
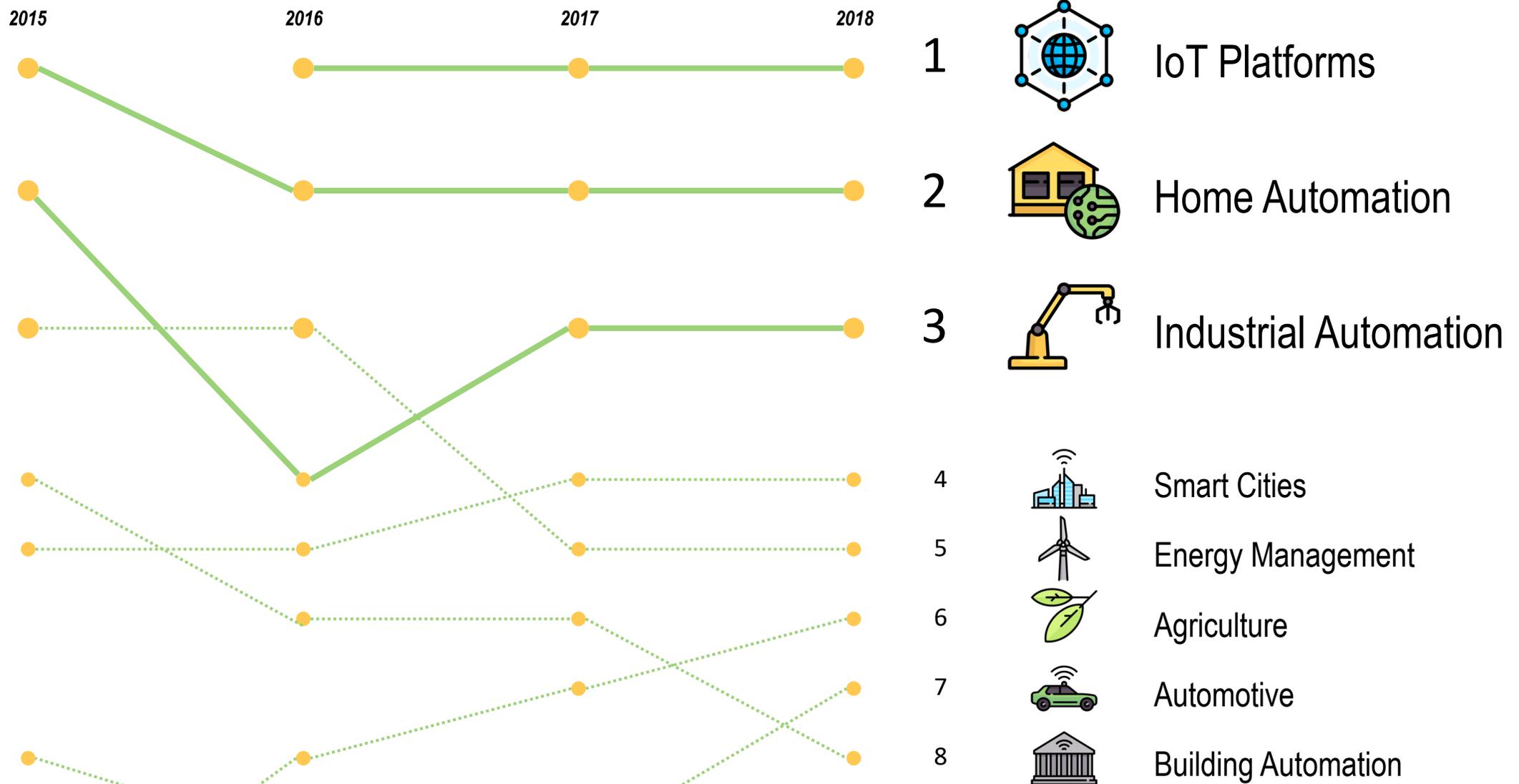
# KEY IoT CONCERNS



**Security**

**Data Collection & Analytics**

**Connectivity**
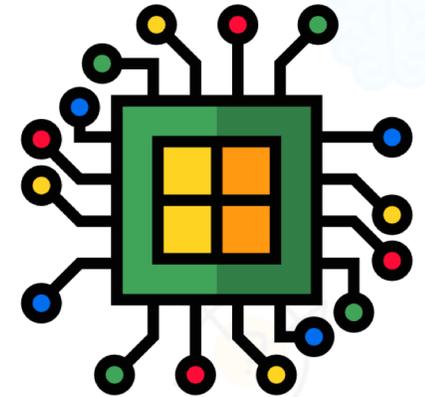
**Hardware Integration**

# KEY IoT SECURITY TECHNOLOGIES

**Communication security (e.g TLS, DTLS)**
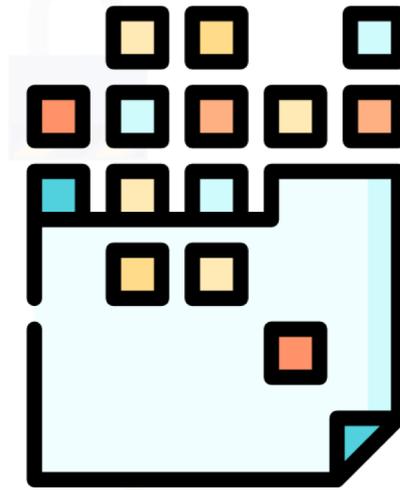
**Data Encryption**

# MOST COLLECTED TYPE OF DATA
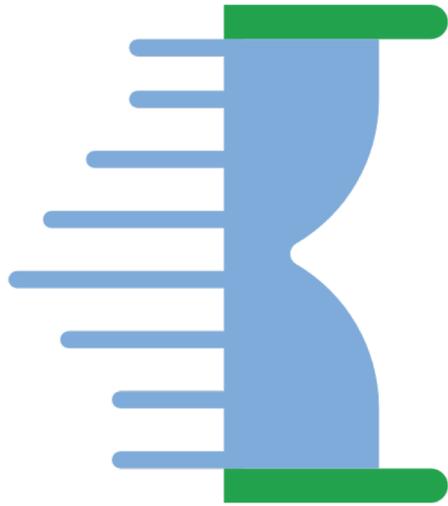
**Time Series Data**
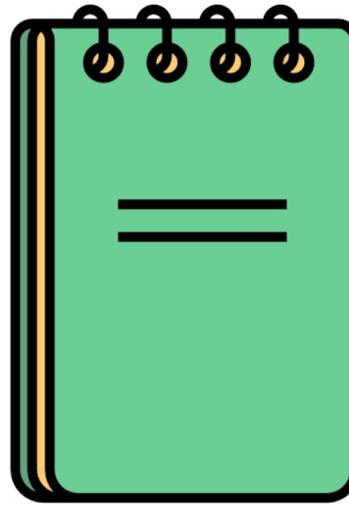
**Device Information**

**Log Data**

# 93% OF DATABASES USED IN IoT ARE OPEN SOURCE
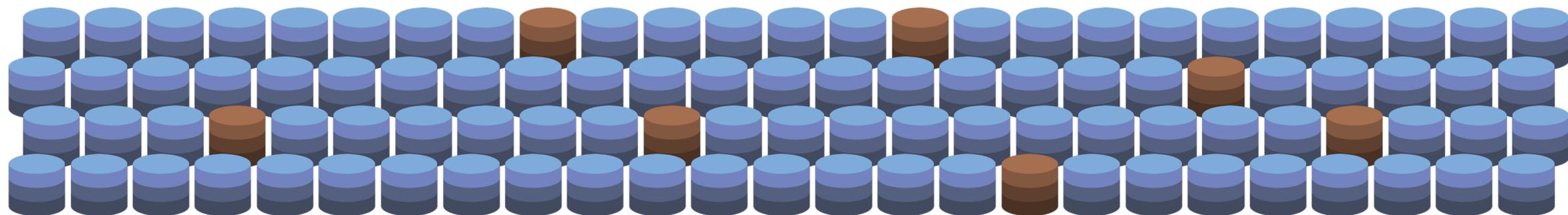
# Top IoT Programming Languages

**Devices**

C · CPP · PY · JAVA

**Gateways**

JAVA · PY · C · CPP

**Cloud**

JAVA · JS · PY · PHP
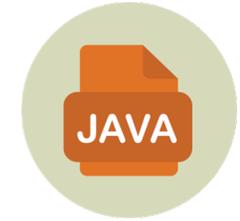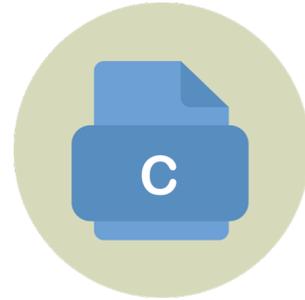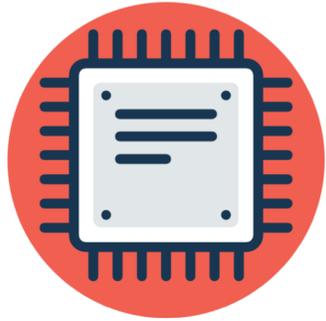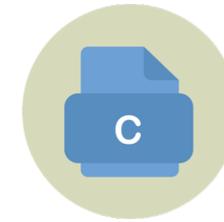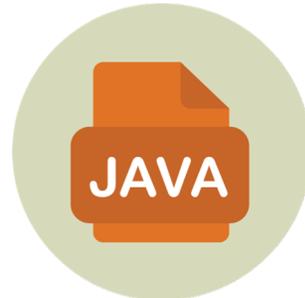
# TOP IoT OPERATING SYSTEMS & DISTROS

71%

Raspbian

ubuntu

debian
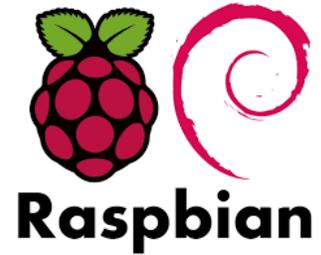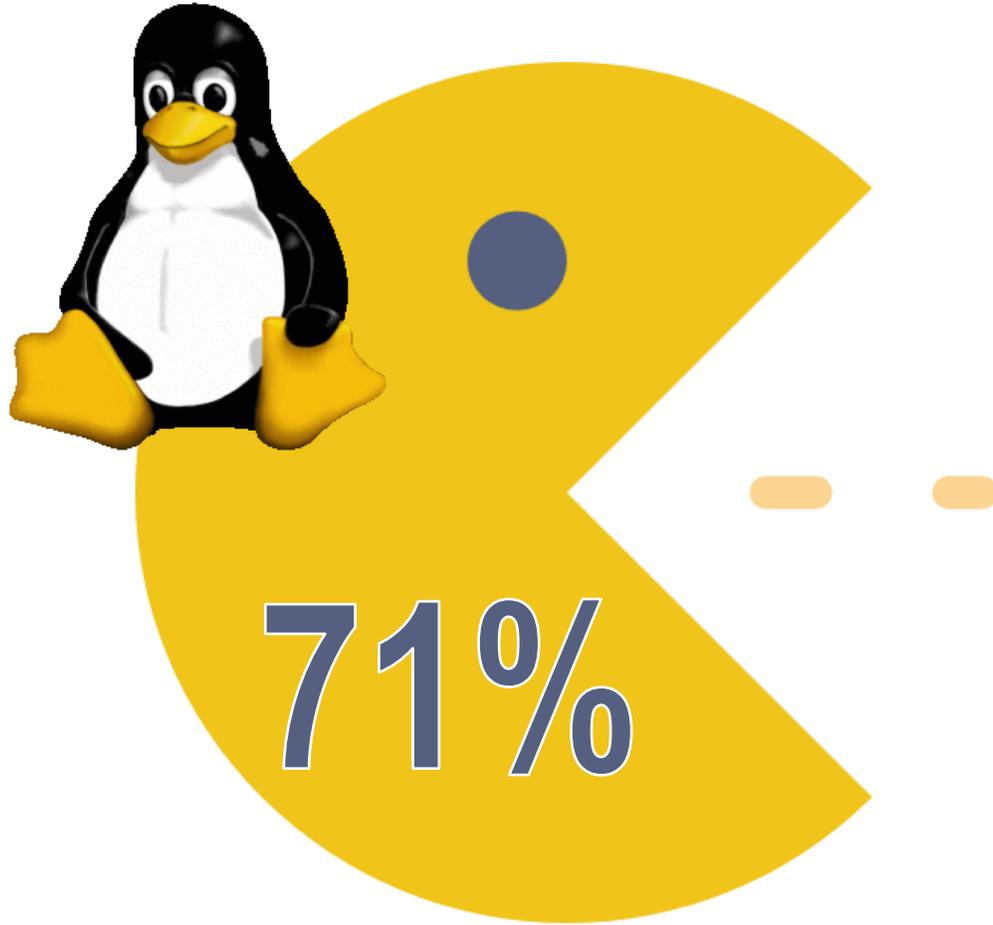
# CLOUD PLATFORMS OF CHOICE FOR IoT
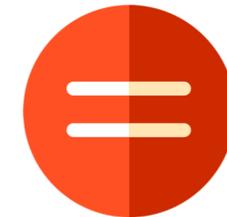
# CONSOLIDATION IN MESSAGING PROTOCOLS
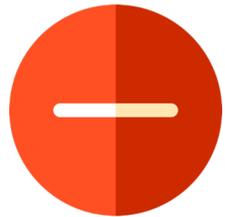
IoT Experience

# IoT Experience

*What is your primary experience with building IoT solutions?*



Legend:
- I develop IoT solutions for my company
- I am learning about IoT technology in my spare time
- I am researching IoT solutions for my company
- No experience
- I develop IoT solutions in my spare time only
- Other (please specify)
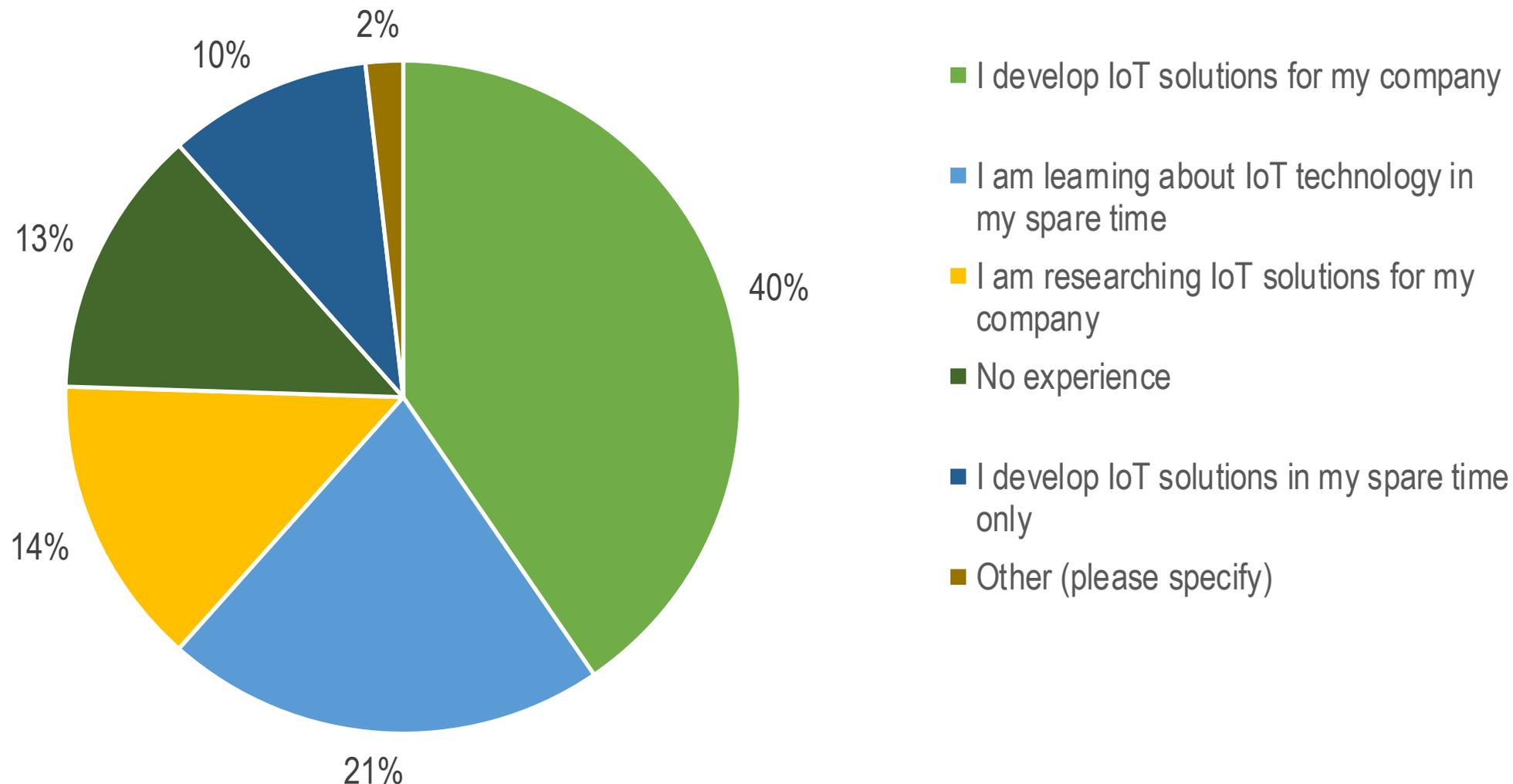
# COMPANY PLANS FOR IoT

*What is your company's plan for IoT solutions?*



Pie chart:
- 44% — My company develops and deploys IoT solutions today (green)
- 17% — Don't know (light blue)
- 14% — My company has no plans to develop IoT solutions (yellow)
- 13% — My company plans to develop and deploy IoT solutions in the next 6 months (dark green)
- 12% — My company plans to develop and deploy IoT solutions in the next 7-18 months (dark blue)
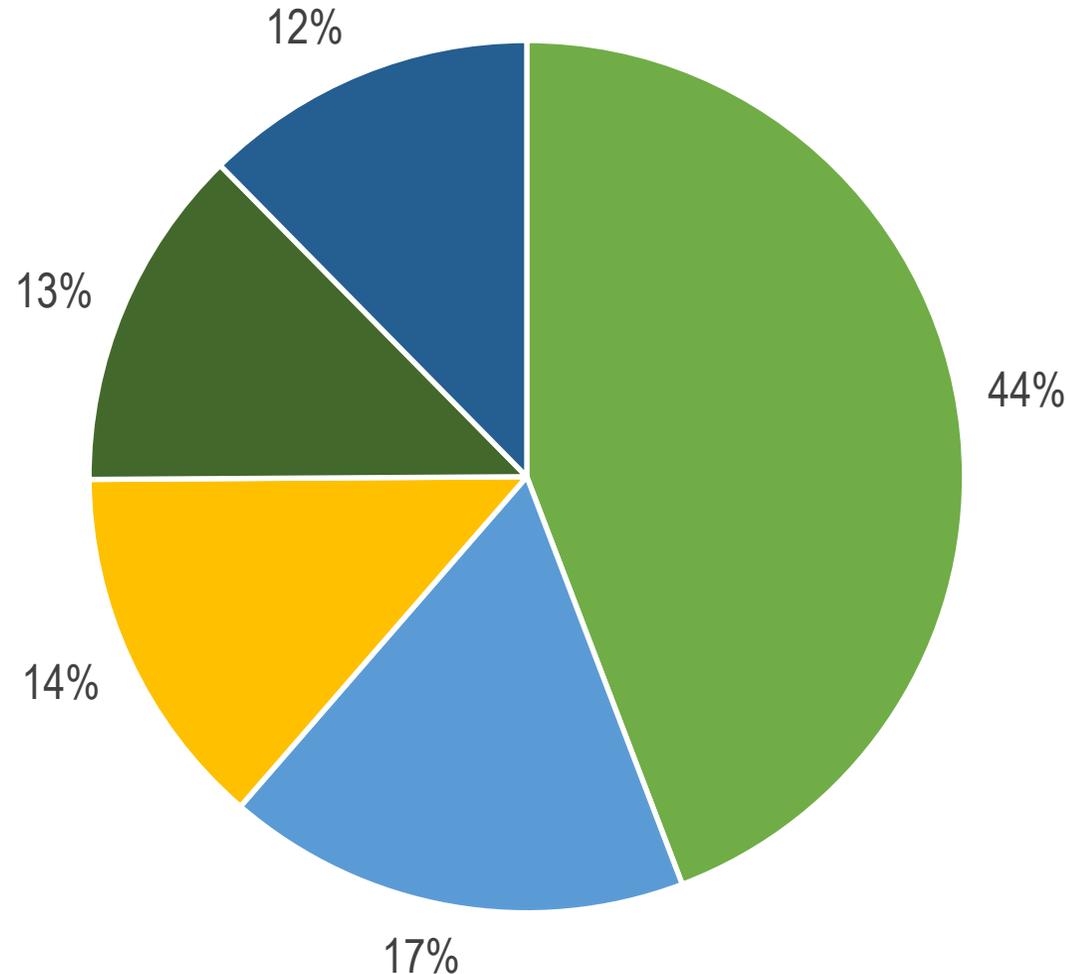
Legend:
- ■ My company develops and deploys IoT solutions today
- ■ Don't know
- ■ My company has no plans to develop IoT solutions
- ■ My company plans to develop and deploy IoT solutions in the next 6 months
- ■ My company plans to develop and deploy IoT solutions in the next 7-18 months

# KEY INDUSTRIES

*What industry or industries best describe(s) the type of IoT solutions you have built or will build?*

| Industry | Percentage |
|---|---|
| IOT PLATFORM / MIDDLEWARE | 39.8% |
| HOME AUTOMATION | 35.8% |
| INDUSTRIAL AUTOMATION | 31.4% |
| CONNECTED / SMART CITIES | 28.4% |
| ENERGY MANAGEMENT | 27.2% |
| AUTOMOTIVE | 23.8% |
| AGRICULTURE | 23.8% |
| BUILDING AUTOMATION | 21.7% |
| TRANSPORTATION | 19.6% |
| HEALTHCARE | 14.7% |
| ENVIRONMENT | 14.3% |
| UTILITIES | 13.5% |
| EDUCATION | 13.5% |
| WEARABLES | 13.1% |
| SECURITY / PUBLIC SAFETY | 11.4% |
| RETAIL | 10.5% |
| PUBLIC UTILITIES | 10.5% |
| SECURITY / DEFENSE | 8.4% |
| FITNESS | 7.4% |
| VENDING | 6.3% |
| BANKING / FINANCIAL / FINTECH | 5.9% |
| COLLABORATIVE & SHARING ECONOMY | 5.1% |
| OTHER | 4.4% |

# Key Industries / Trends 2016-2018



Chart legend:
- 2016 (green)
- 2017 (blue)
- 2018 (yellow)

Categories with 2018 values:
- IoT Platform / Middleware: 39.8%
- Home Automation: 35.8%
- Industrial Automation: 31.4%
- Connected / Smart Cities: 28.4%
- Energy Management: 27.2%
- Agriculture: 23.8%
- Automotive: 23.8%
- Building Automation: 21.7%
- Transportation: 19.6%
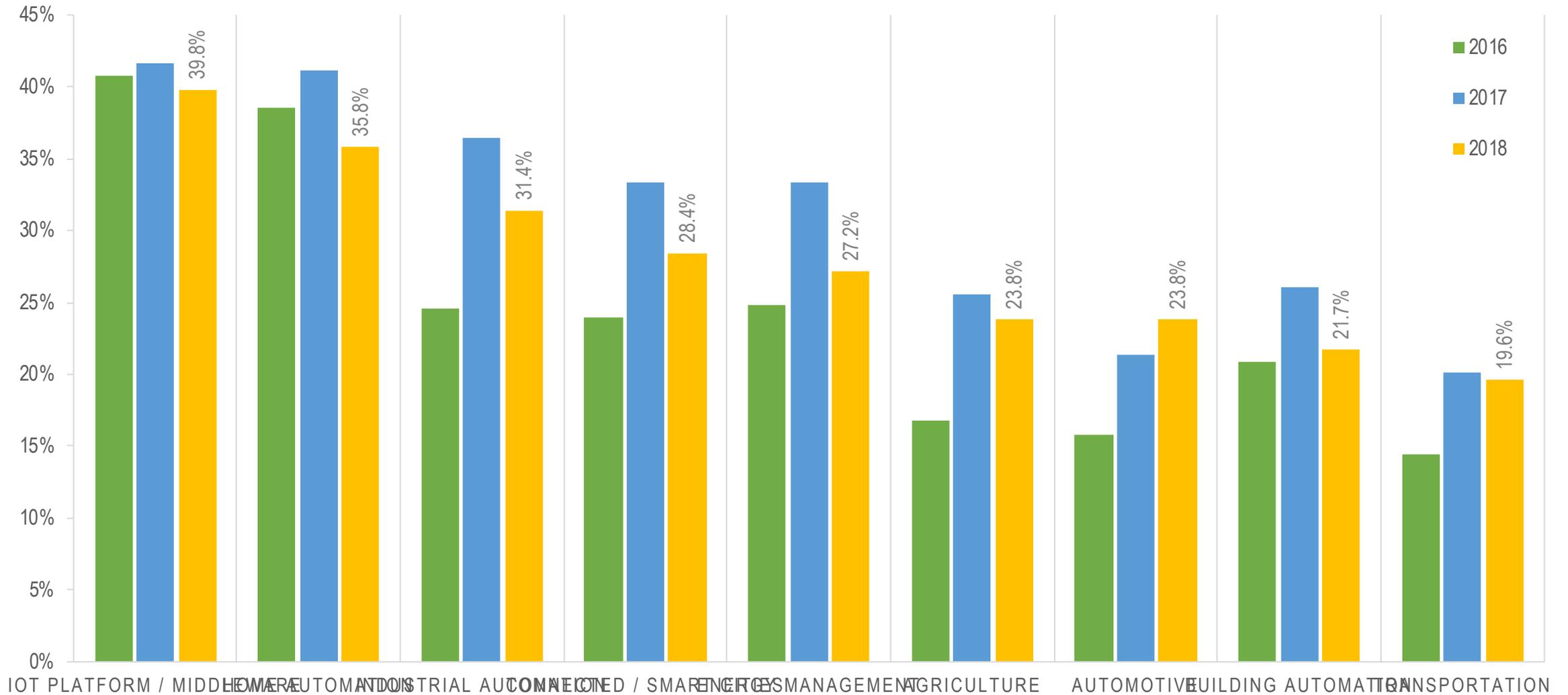
# TOP IoT CONCERNS

*What are your top 2 concerns for developing IoT solutions?*



| Concern | Percentage |
|---|---|
| SECURITY | 39.0% |
| DATA COLLECTION & ANALYTICS | 18.5% |
| INTEGRATION WITH HARDWARE | 15.5% |
| CONNECTIVITY | 15.5% |
| INTEROPERABILITY | 15.1% |
| ROI | 14.1% |
| SCALABILITY | 11.6% |
| PRIVACY | 11.2% |
| STANDARDS | 10.8% |
| PERFORMANCE | 10.8% |
| MAINTENANCE | 10.2% |
| COST | 8.2% |
| COMPLEXITY | 7.6% |
| DON'T KNOW | 5.4% |
| CERTIFICATION/CONFORMANCE | 3.6% |
| OTHER | 3.0% |
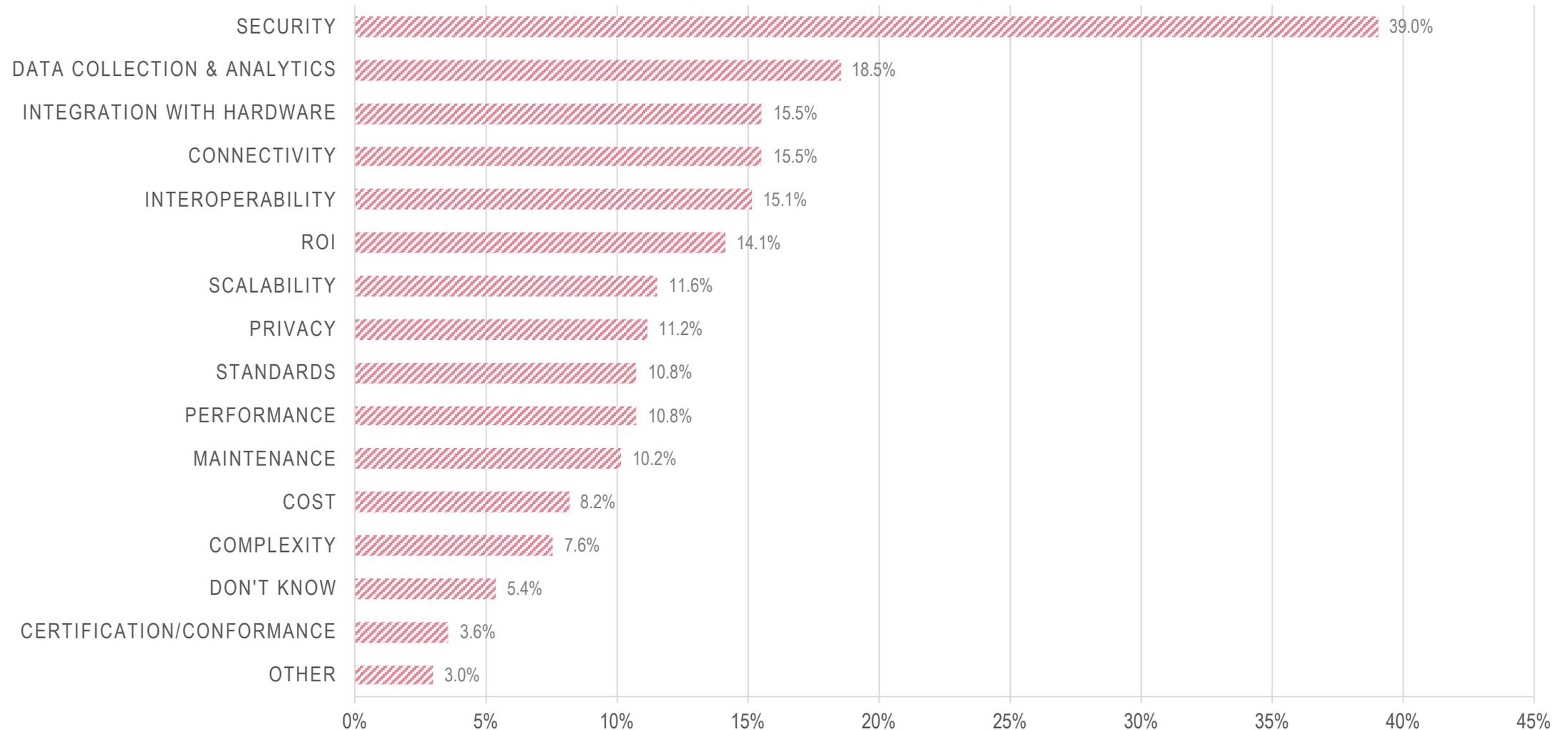
# TOP IoT CONCERNS / TRENDS 2016-2018



Grouped bar chart showing top IoT concerns for years 2016 (green), 2017 (blue), and 2018 (yellow). Y-axis ranges from 0% to 50%.

- SECURITY: 2018 = 39.0%
- DATA COLLECTION & ANALYTICS: 2018 = 18.5%
- CONNECTIVITY: 2018 = 15.5%
- INTEGRATION WITH HARDWARE: 2018 = 15.5%
- INTEROPERABILITY: 2018 = 15.1%
- ROI: 2018 = 14.1%
- SCALABILITY: 2018 = 11.6%
- PRIVACY: 2018 = 11.2%
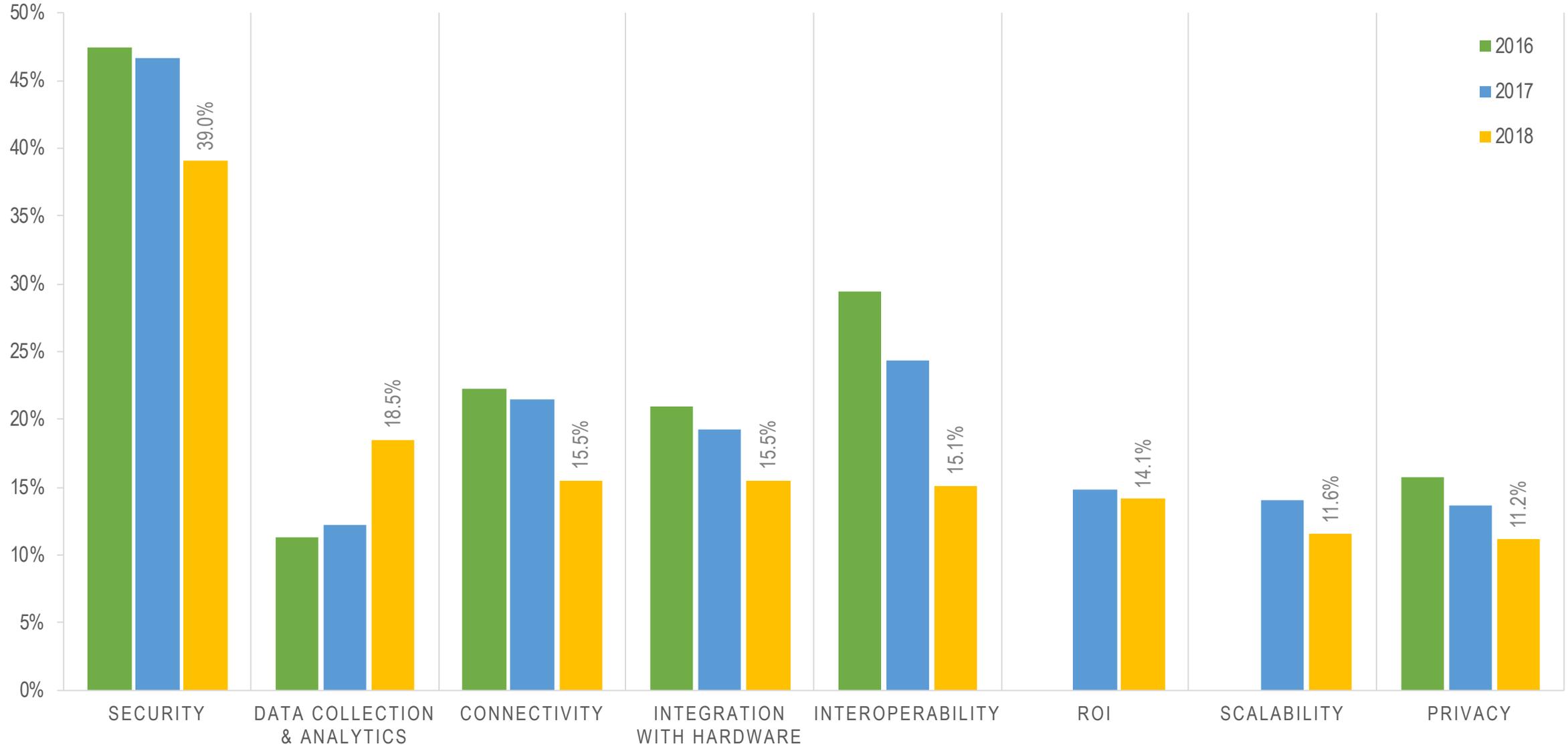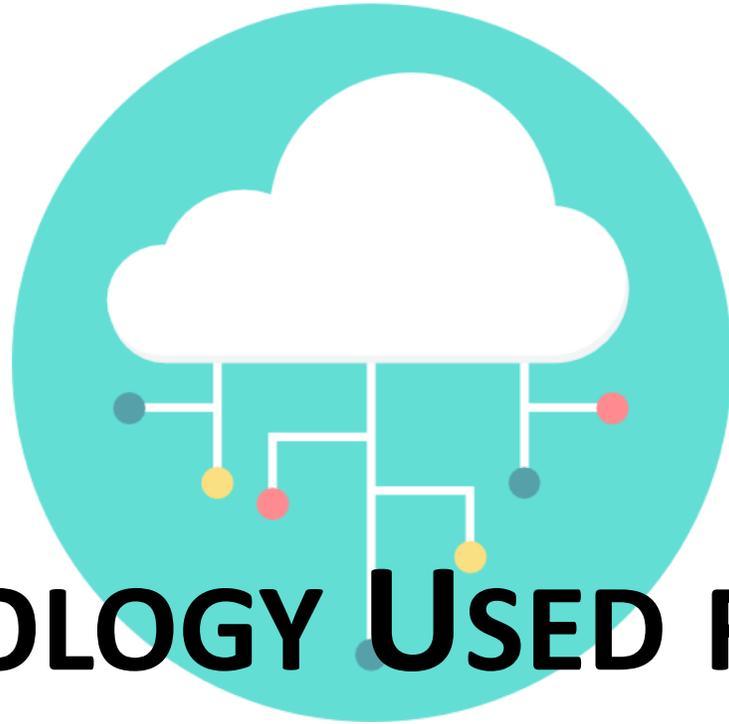
Technology Used for IoT

# OVERALL SUMMARY OF PROGRAMMING LANGUAGES

*Which of the following programming languages, if any, do you use to build IoT solutions?*
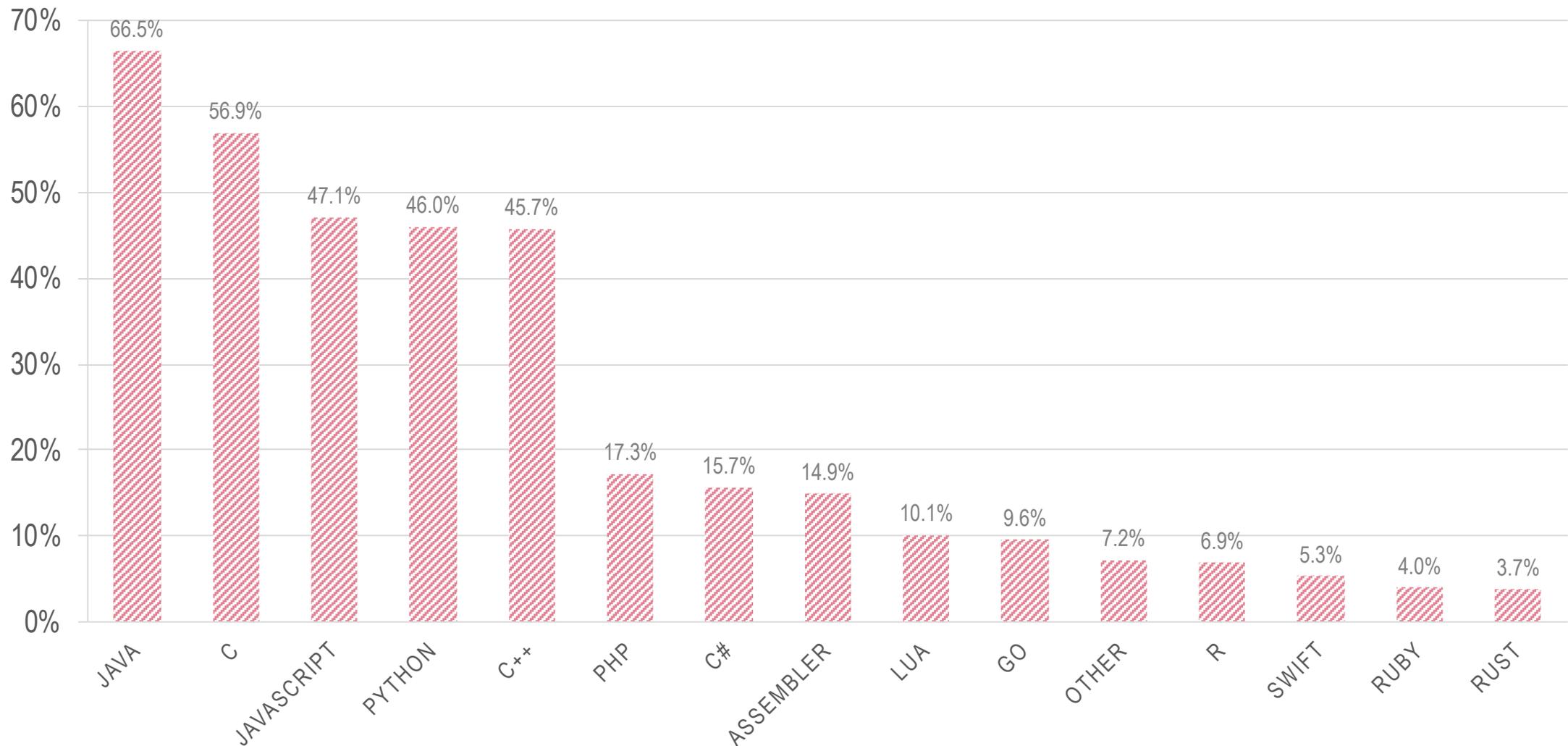
# PROGRAMMING LANGUAGES – CONSTRAINED DEVICES

*Which of the following programming languages, if any, do you use to build IoT solutions? (Constrained Devices)*



Bar chart showing percentages by language:
- C: 53.7%
- C++: 35.4%
- PYTHON: 20.2%
- JAVA: 17.6%
- ASSEMBLER: 12.8%
- JAVASCRIPT: 11.2%
- LUA: 6.1%
- C#: 4.0%
- PHP: 4.0%
- OTHER: 2.9%
- RUST: 2.4%
- GO: 1.9%
- R: 1.3%
- SWIFT: 1.1%
- RUBY: 0.5%
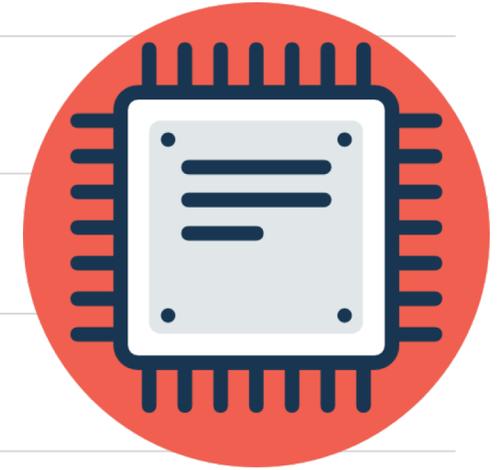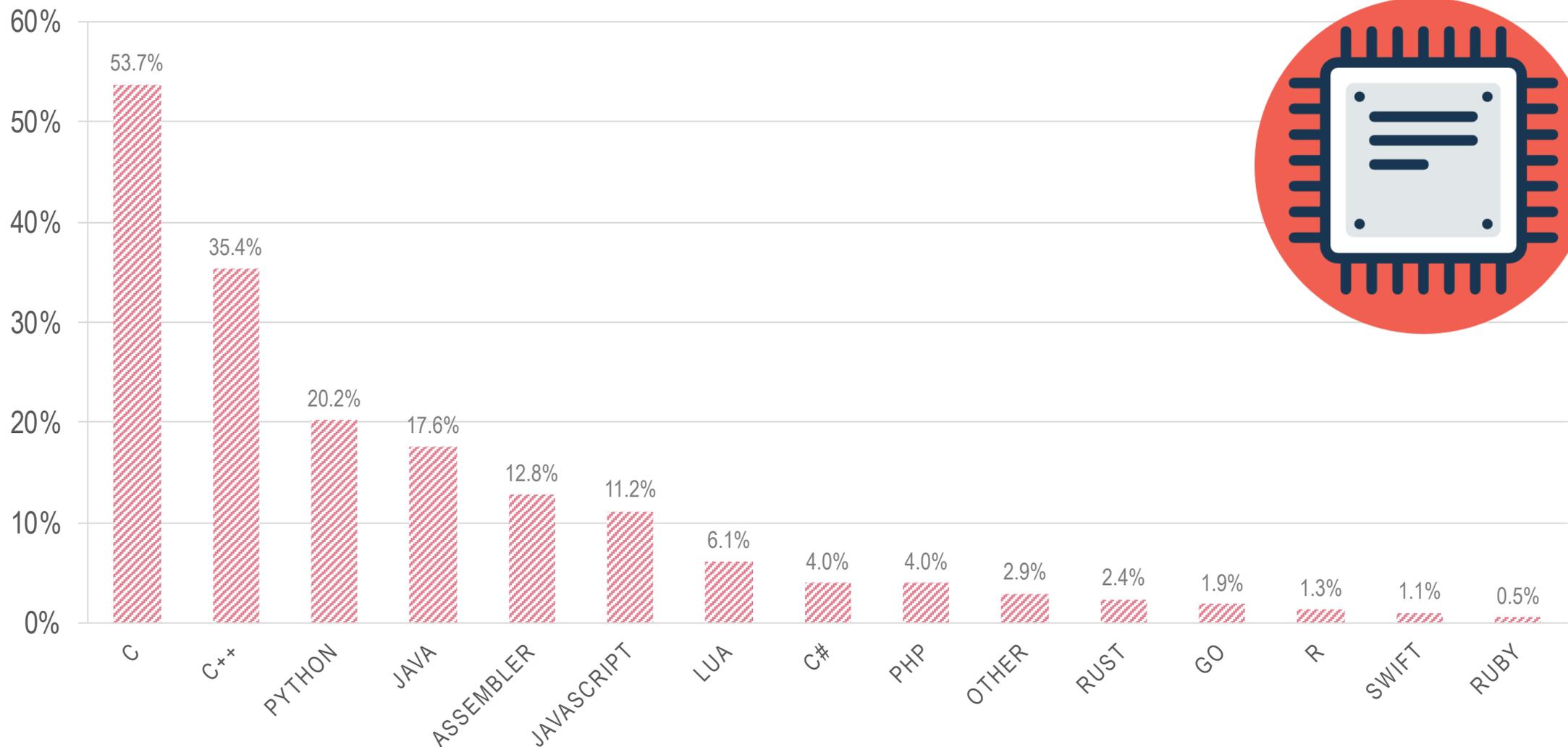
# PROGRAMMING LANGUAGES – IoT GATEWAYS

*Which of the following programming languages, if any, do you use to build IoT solutions? (Gateways)*



Bar chart showing percentages by programming language:

- JAVA: 42.8%
- PYTHON: 30.3%
- C: 21.0%
- C++: 20.5%
- JAVASCRIPT: 18.9%
- C#: 8.8%
- GO: 5.3%
- PHP: 5.3%
- OTHER: 3.7%
- LUA: 3.5%
- ASSEMBLER: 2.7%
- SWIFT: 2.7%
- RUST: 2.4%
- R: 2.1%
- RUBY: 1.3%
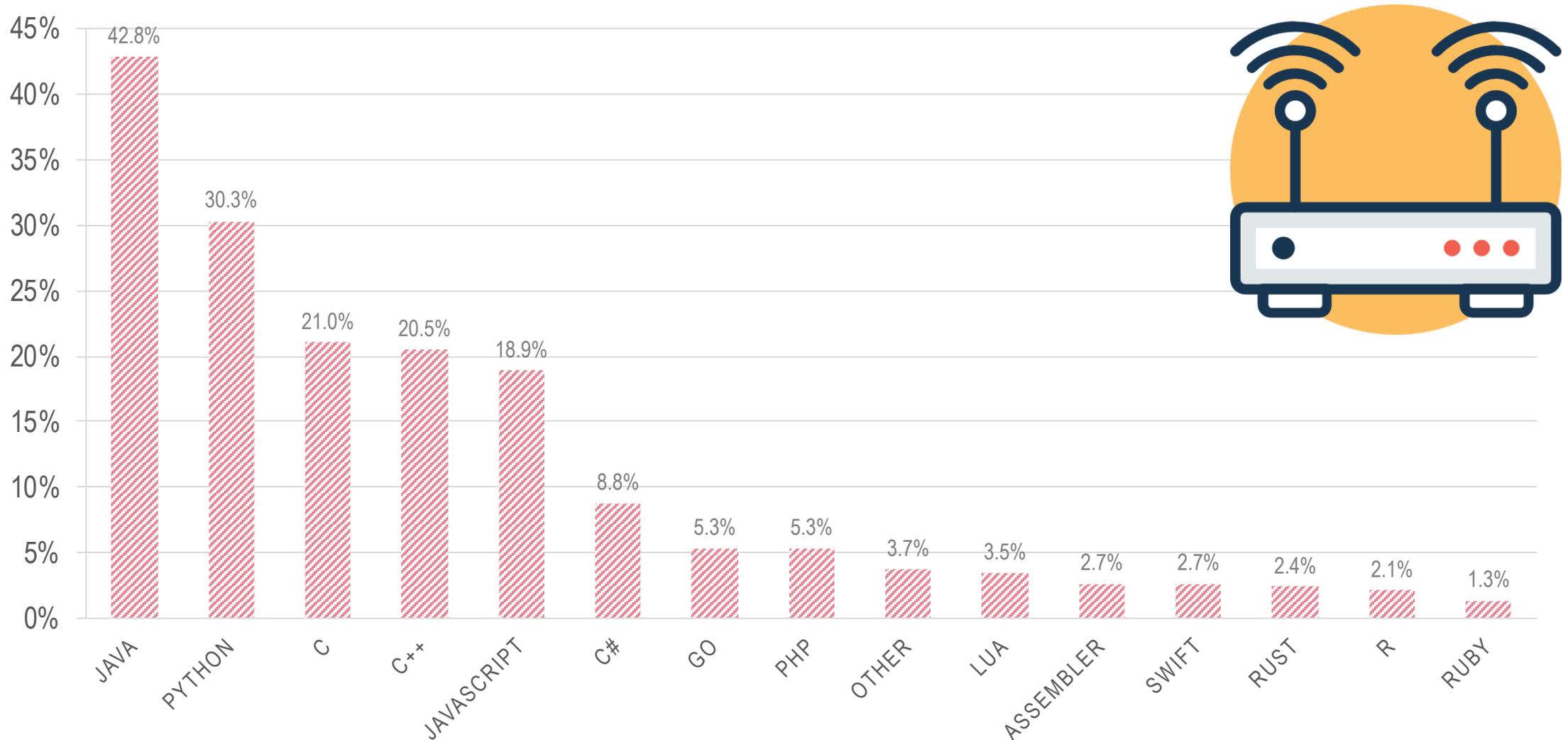
# PROGRAMMING LANGUAGES – IoT CLOUD

*Which of the following programming languages, if any, do you use to build IoT solutions? (Cloud Platform)*



A bar chart showing:

- JAVA: 53.2%
- JAVASCRIPT: 37.5%
- PYTHON: 29.3%
- PHP: 12.5%
- C#: 9.3%
- C++: 7.5%
- GO: 5.9%
- R: 5.1%
- OTHER: 4.8%
- C: 4.0%
- RUBY: 2.9%
- SWIFT: 2.9%
- LUA: 2.4%
- ASSEMBLER: 1.9%
- RUST: 1.3%
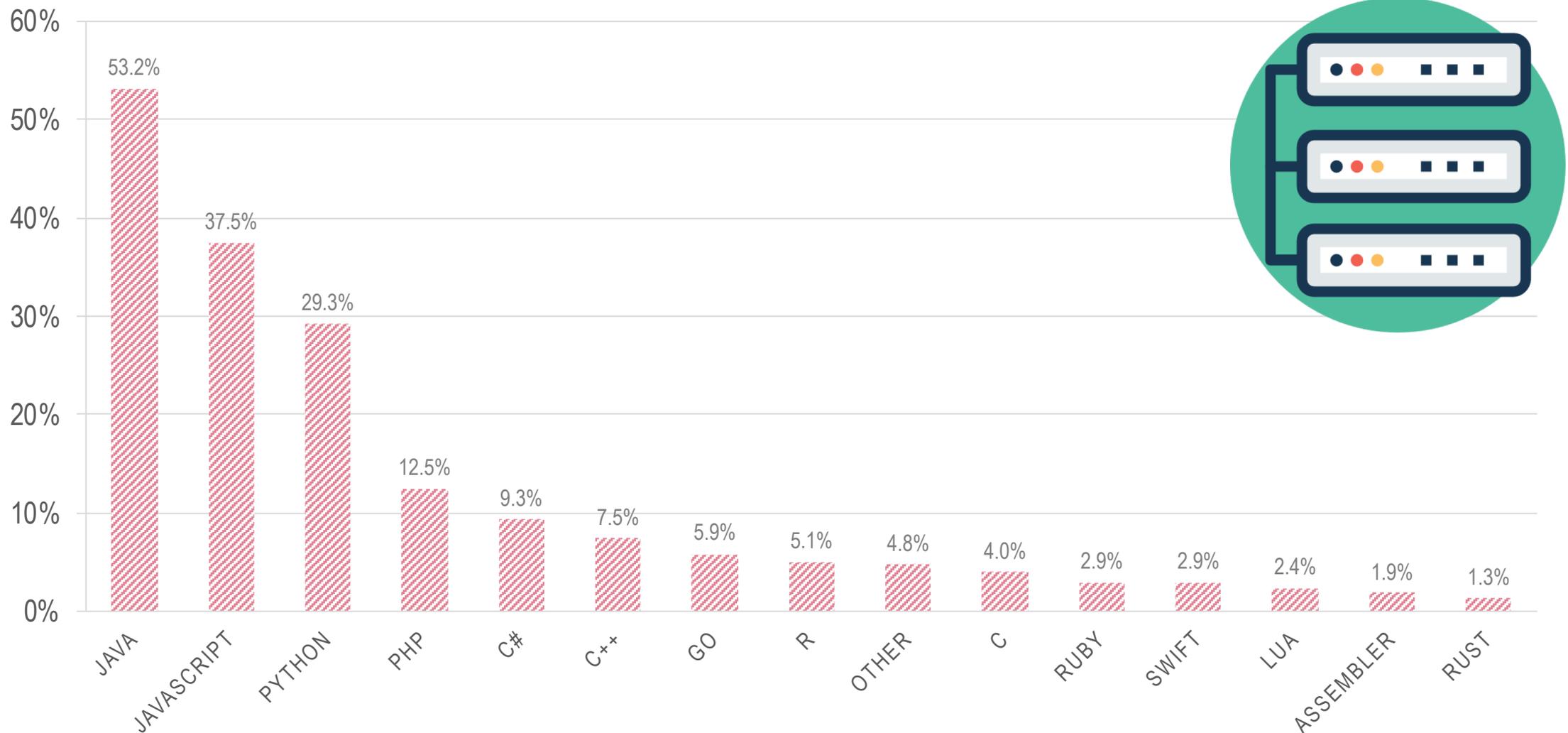
# IoT Operating Systems

*Which operating system(s) do you use for your IoT devices?*
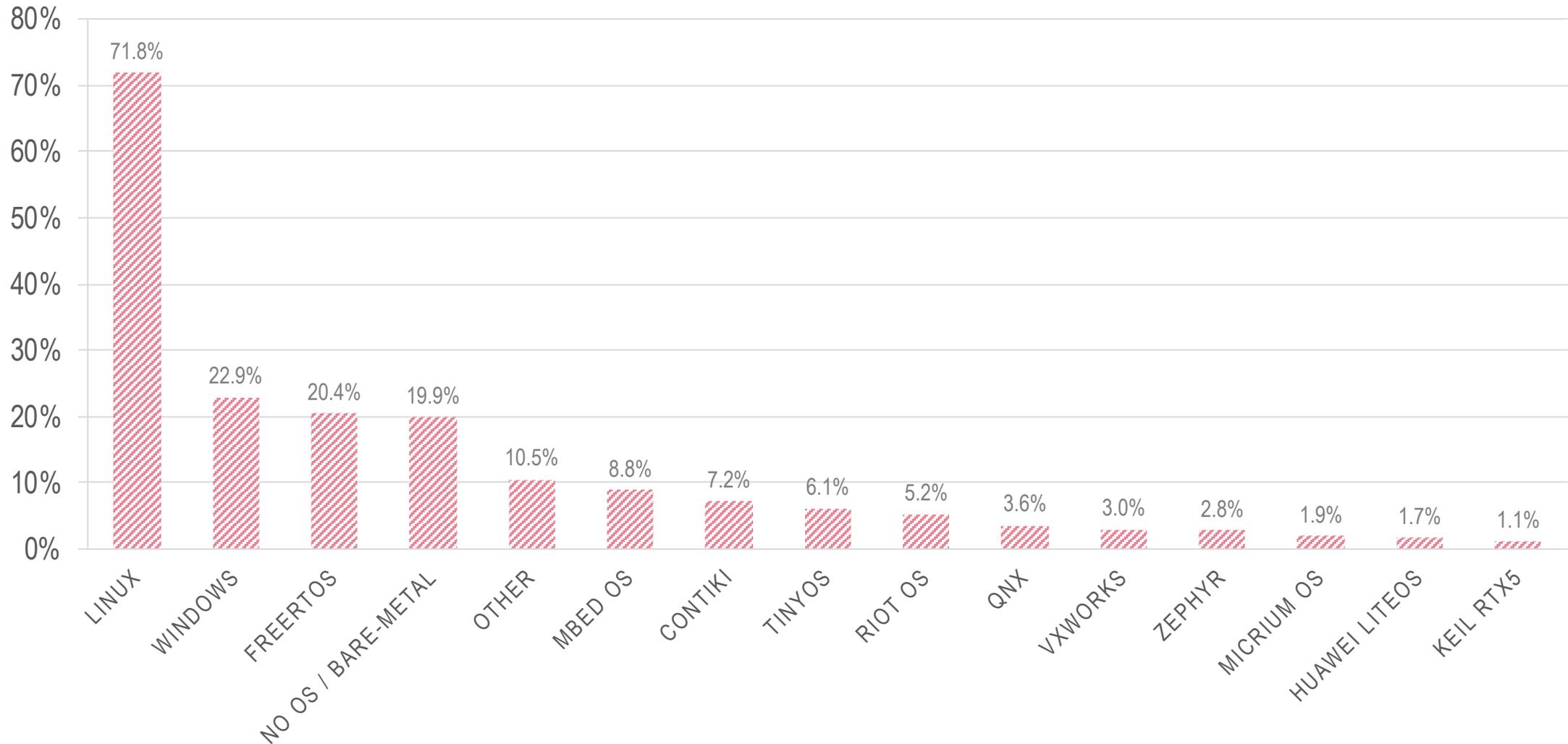
# ALTERNATIVES TO USING LINUX FOR IoT
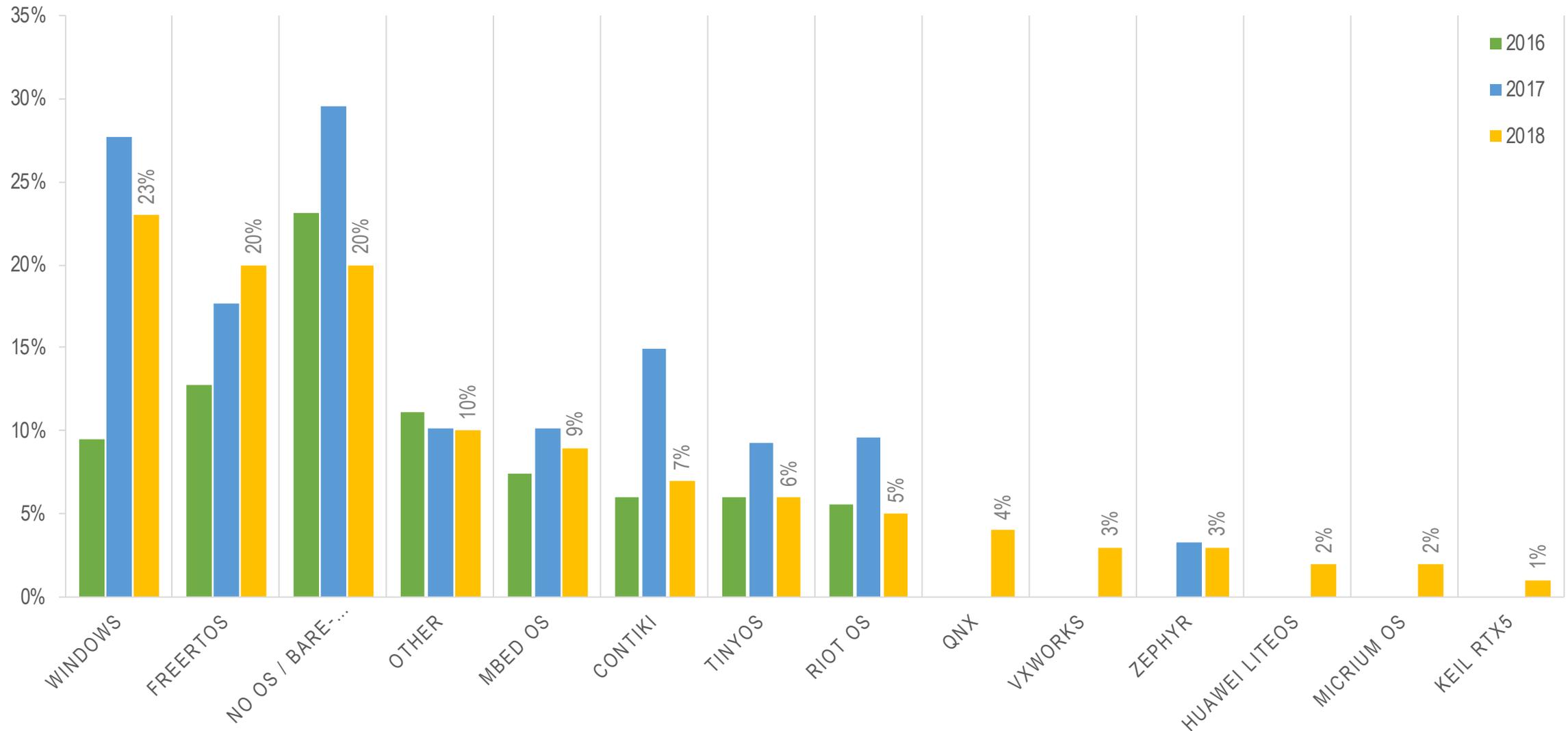
# IoT Operating Systems – Constrained Devices

*Which operating system(s) do you use for your IoT devices? (Constrained Devices)*



Bar chart showing:
- LINUX: 38.7%
- NO OS / BARE-METAL: 19.6%
- FREERTOS: 19.3%
- WINDOWS: 14.1%
- OTHER: 8.0%
- MBED OS: 7.7%
- CONTIKI: 6.1%
- TINYOS: 5.5%
- RIOT OS: 4.7%
- QNX: 3.0%
- VXWORKS: 2.2%
- ZEPHYR: 1.4%
- HUAWEI LITEOS: 1.1%
- MICRIUM OS: 1.1%
- KEIL RTX5: 0.8%
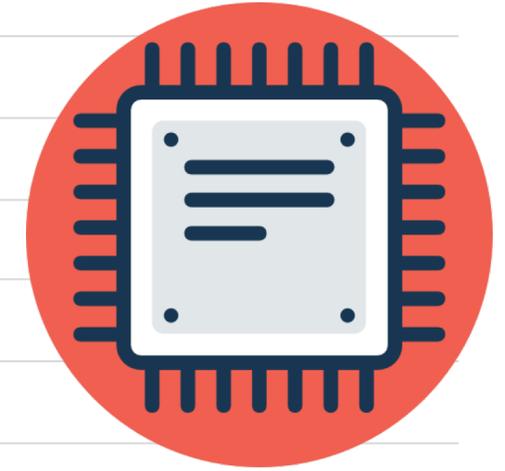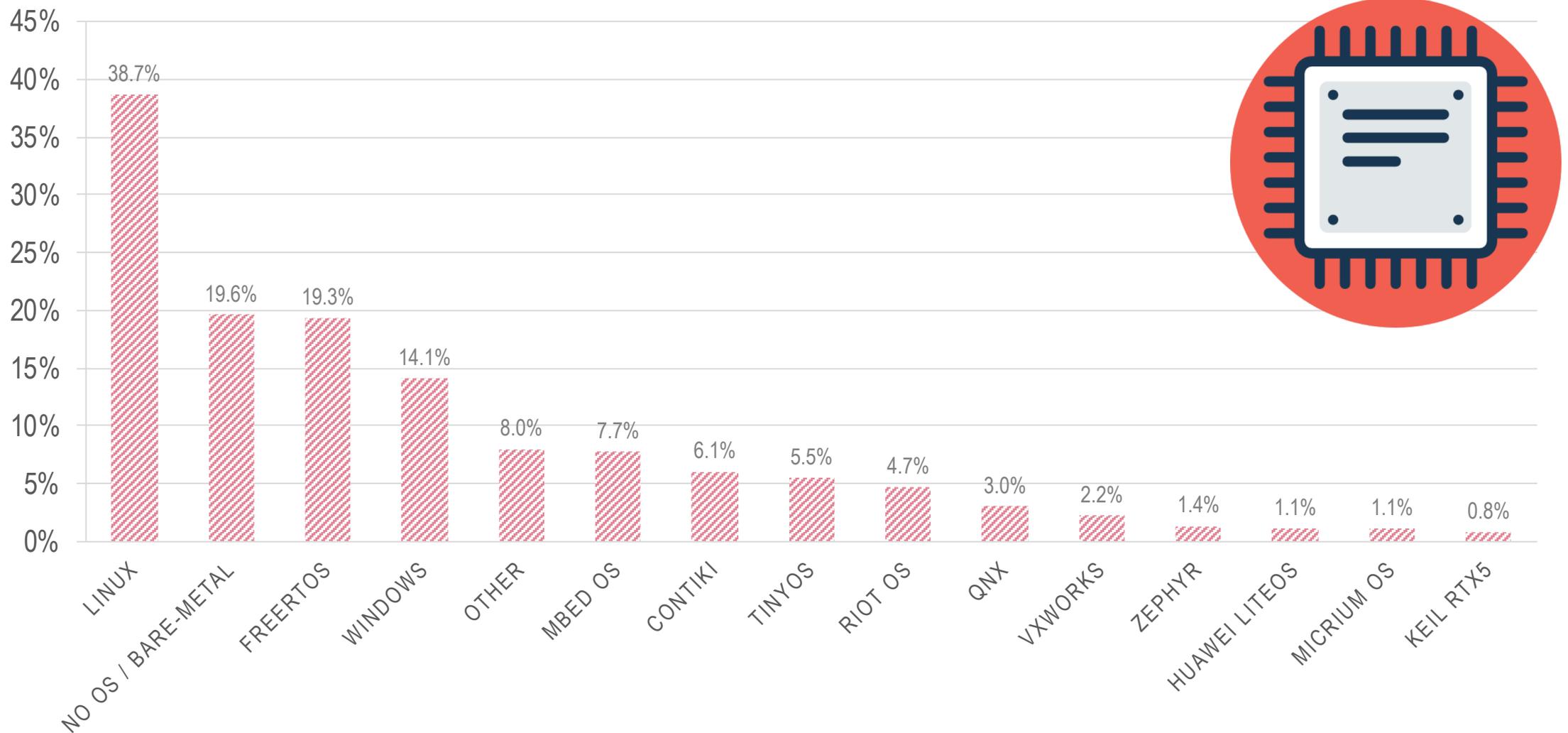
# IoT Operating Systems – IoT Gateway

*Which operating system(s) do you use for your IoT devices? (Edge / Gateway)*



| OS | % |
|---|---|
| LINUX | 64.1% |
| WINDOWS | 14.9% |
| OTHER | 6.1% |
| FREERTOS | 5.0% |
| TINYOS | 2.2% |
| MBED OS | 2.2% |
| CONTIKI | 2.2% |
| QNX | 1.9% |
| ZEPHYR | 1.7% |
| RIOT OS | 1.7% |
| VXWORKS | 1.4% |
| MICRIUM OS | 1.1% |
| NO OS / BARE-METAL | 0.8% |
| KEIL RTX5 | 0.8% |
| HUAWEI LITEOS | 0.6% |
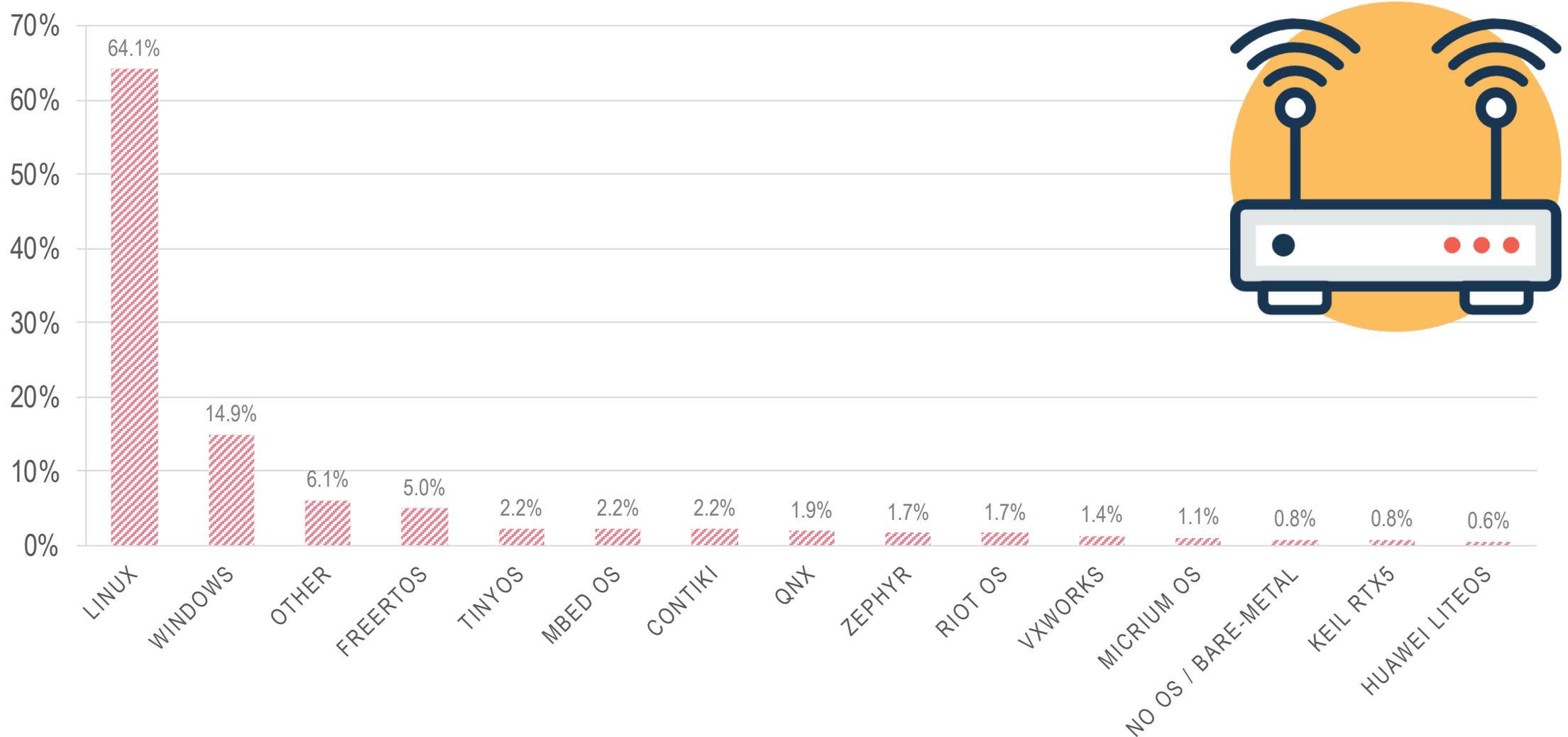
# IoT Operating Systems / Linux Distros for IoT

*If you are using Linux, what distribution do you typically use for your IoT solution?*

| Distribution | Percentage |
|---|---|
| Raspbian | 43.3% |
| Ubuntu / Ubuntu Core | 40.2% |
| Debian | 30.9% |
| Android | 19.6% |
| CentOS | 15.6% |
| Yocto Project | 14.2% |
| Other | 8.2% |
| Android Things | 7.9% |
| OpenWRT or equivalent | 7.9% |
| Don't use Linux | 7.7% |
| uClinux | 2.0% |
| Tizen | 1.7% |
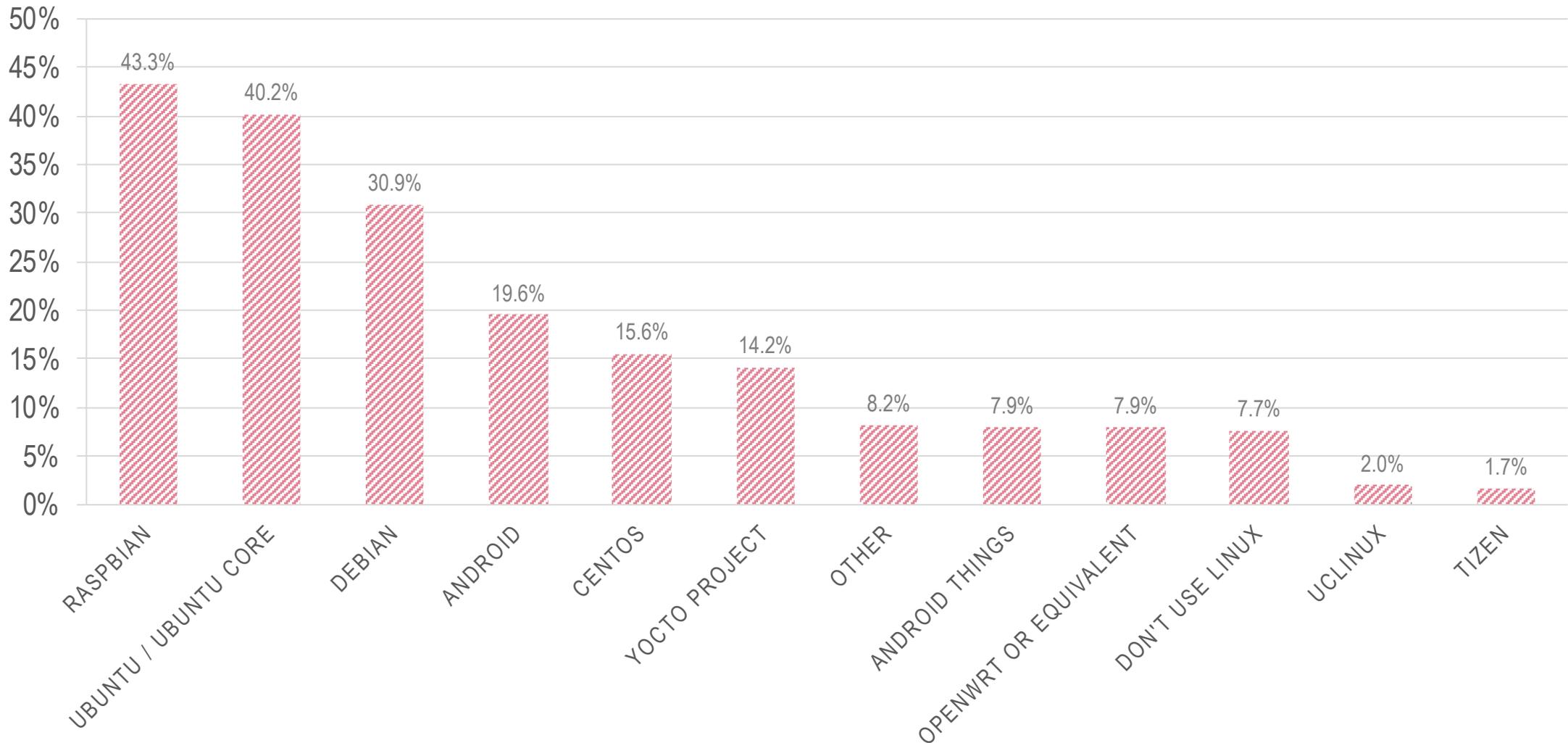
# IoT HARDWARE ARCHITECTURES

*What hardware architectures are you using for your IoT constrained device(s)?*



Chart data:
- DON'T KNOW: 28.0%
- ARM CORTEX-M3 / ARM CORTEX-M4: 26.1%
- OTHER 32-BIT MCU: 23.5%
- ARM CORTEX-M0 / ARM CORTEX-M0+: 20.7%
- ARM CORTEX-M7: 19.6%
- 16-BIT MCU: 19.1%
- 8-BIT MCU: 17.9%
- DON'T USE CONSTRAINED DEVICES: 7.8%
- OTHER: 5.3%
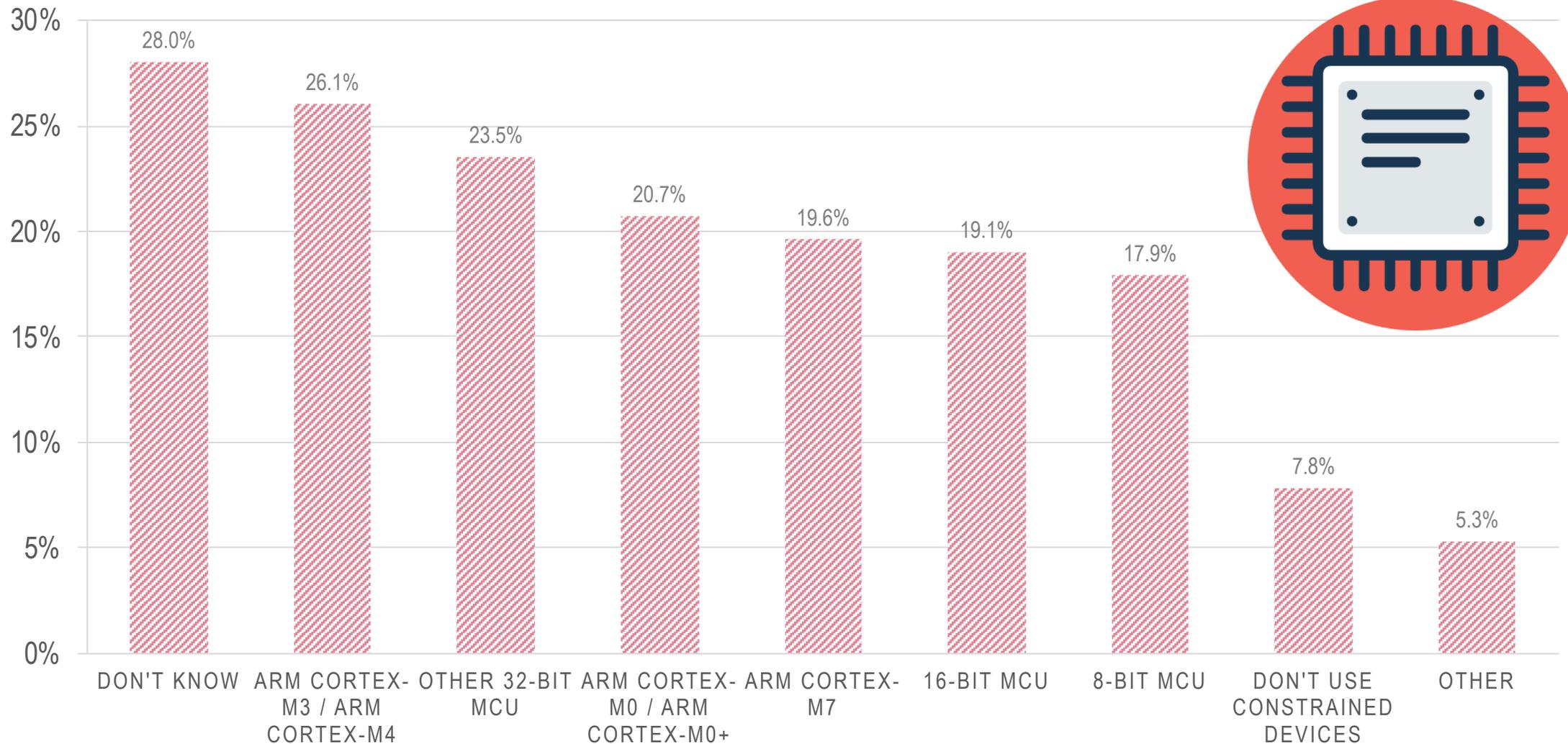
# IoT Hardware Architectures

*What hardware architectures are you using for your IoT gateway(s)?*



Chart showing percentages:
- INTEL X86_64: 31.8%
- ARM V8 (CORTEX-A 64 BITS): 24.5%
- (bar): 22.6%
- (bar): 22.0%
- INTEL X86: 15.9%
- (bar): 15.0%
- ARM V6: 10.3%
- (bar): 7.8%
- DON'T USE GATEWAYS: 7.2%
- (bar): 3.9%
- OTHER (PLEASE SPECIFY): 2.8%
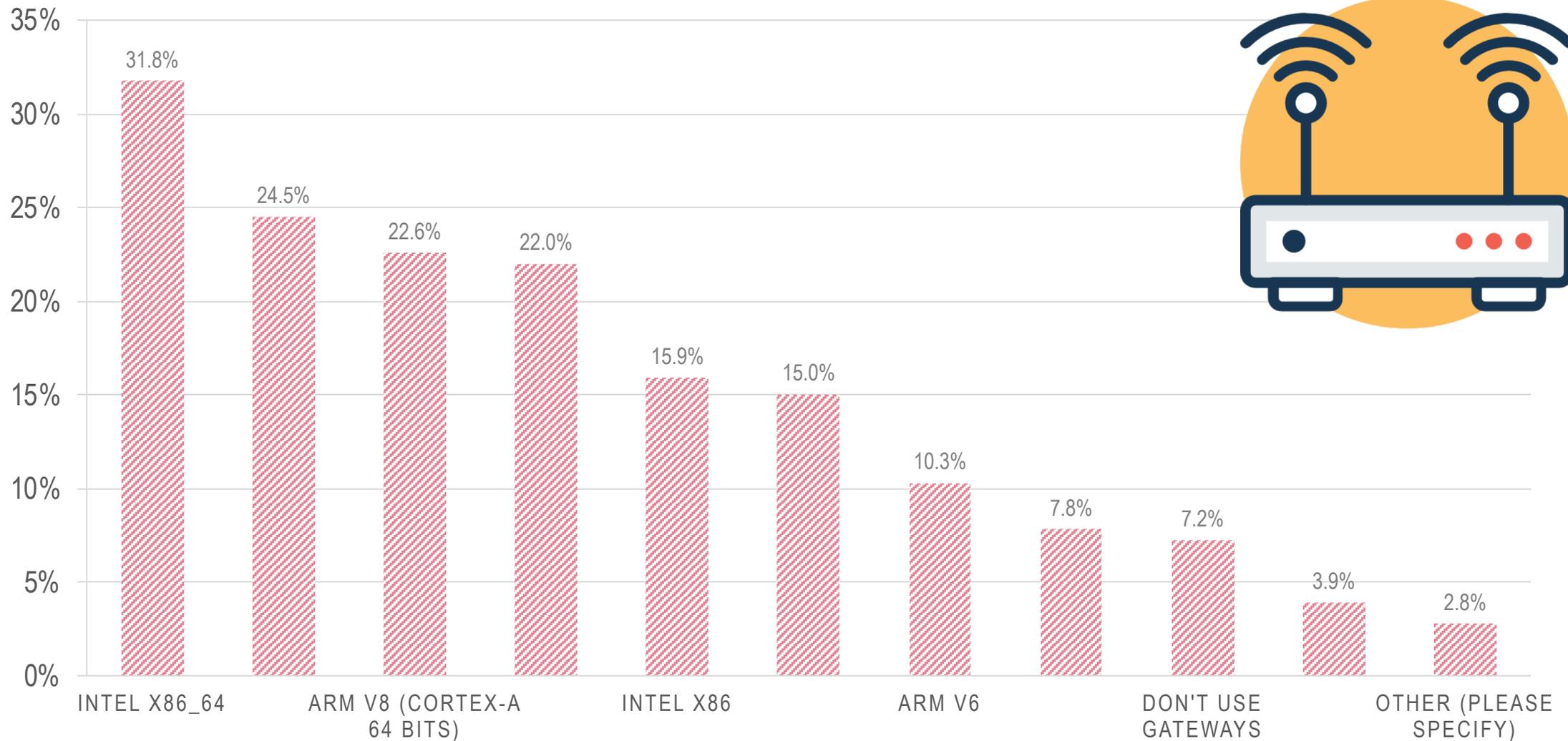
# IoT Security Technologies

*Which of the following security-related technologies do you use in your IoT solution?*



Legend: ■ 2017  ■ 2018

| Category | 2018 |
|---|---|
| COMMUNI... | 57.27% |
| DATA ENC... | 45.10% |
| JSON WEB... | 35.31% |
| PUBLIC... | 28.78% |
| OVER-... | 27.30% |
| OAUTH &... | 27.30% |
| SECURE... | 11.87% |
| BLOCKCH... | 10.98% |
| HARDWA... | 10.68% |
| NO SEC... | 10.39% |
| TRUSTED... | 10.39% |
| DON'T KNOW | 10.09% |
| OTHER | 1.48% |
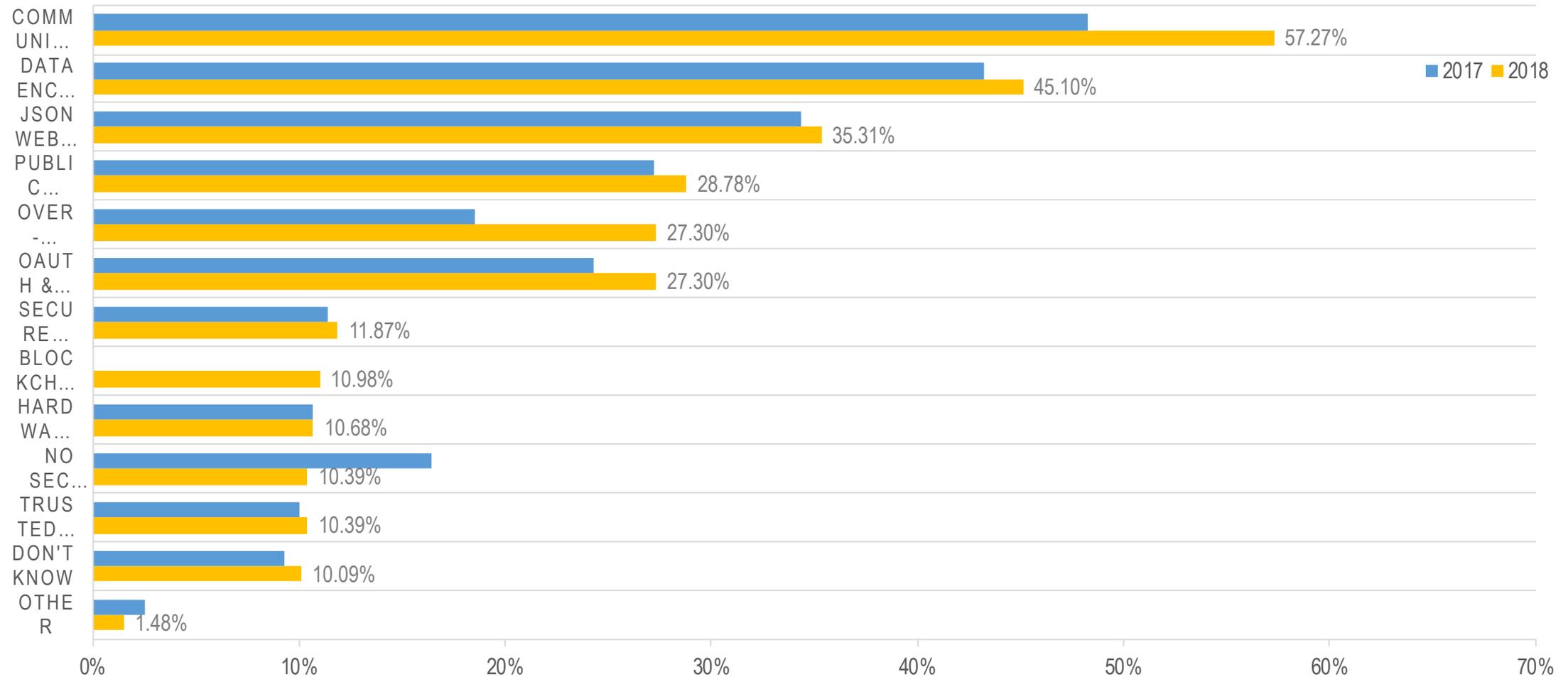
# IoT Data

*What type of IoT data are you storing in a database or data store?*

| Data Type | Percentage |
|-----------|-----------|
| TIME SERIES DATA | 61.9% |
| DEVICE INFORMATION | 60.4% |
| LOG DATA | 54.1% |
| CONTEXTUAL DATA | 42.0% |
| OPERATIONAL DATA | 37.8% |
| ENTERPRISE DATA | 18.0% |
| IMAGES / VIDEO | 17.7% |
| AUDIO | 7.2% |
| DON'T KNOW | 6.9% |
| NONE | 4.8% |
| OTHER | 0.9% |
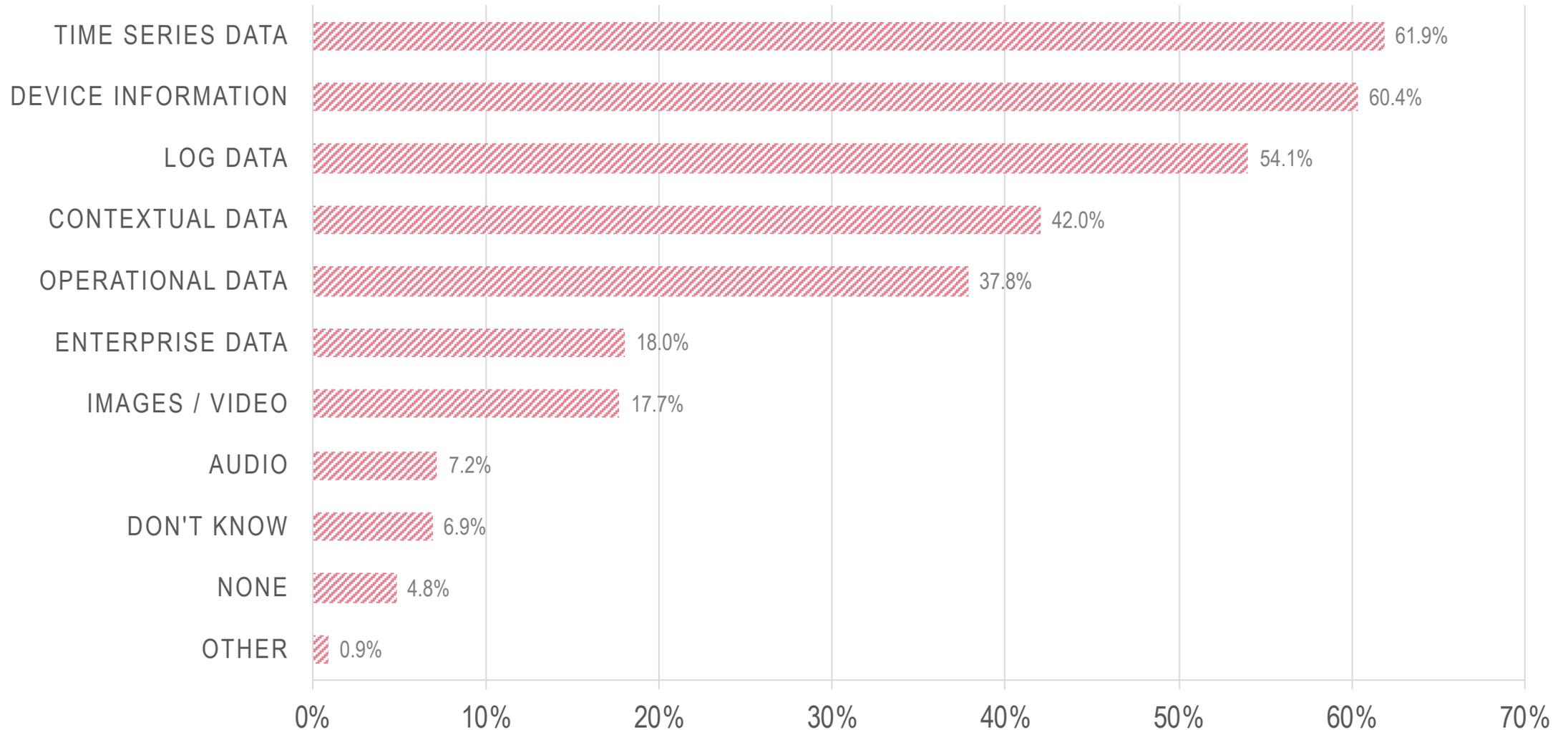
# IoT Databases

*Which of the following database technologies do you use in your IoT solution?*
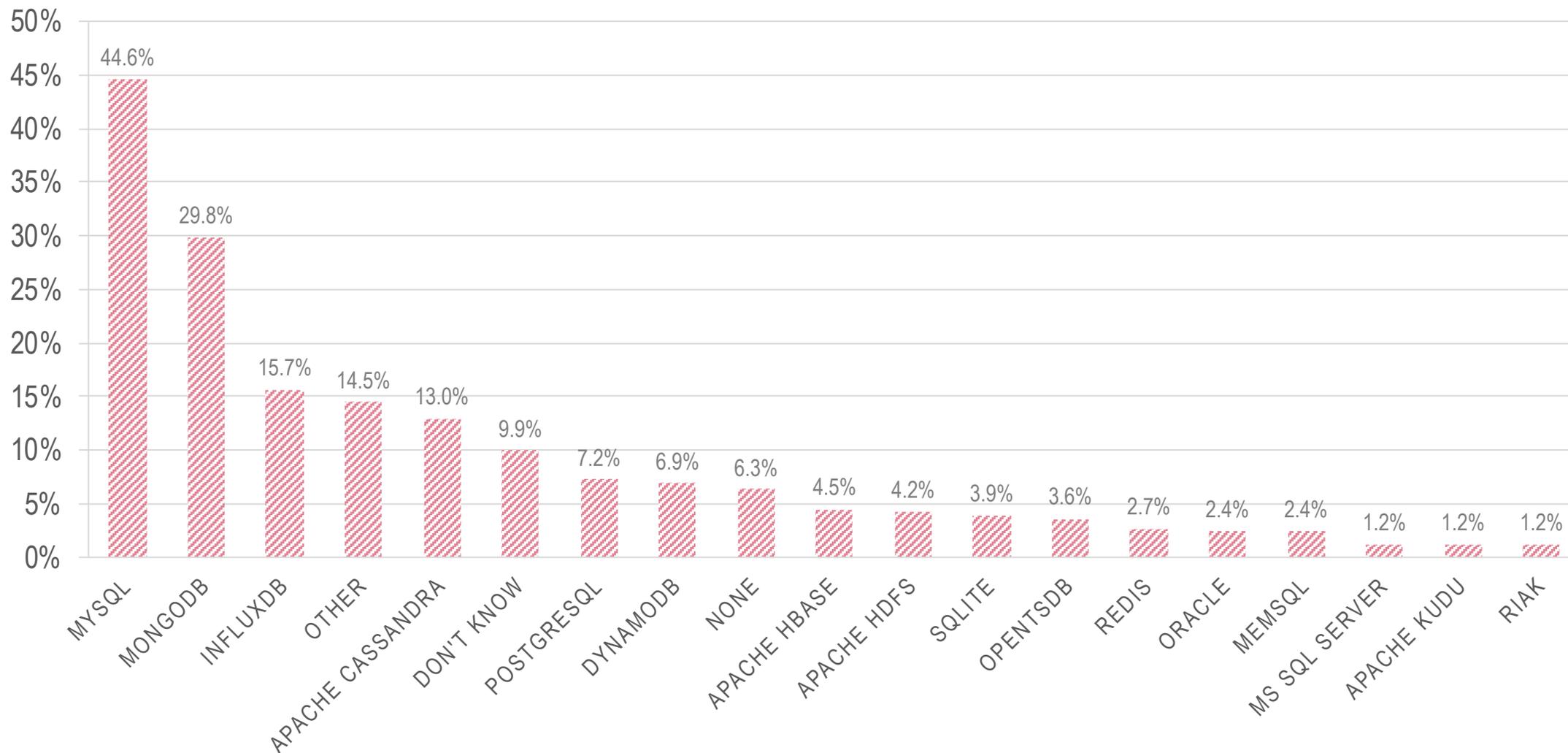
# Cloud Services for IoT

*Do you use, or plan to use, any of the following cloud service offerings for implementing your IoT solution?*



Bar chart values:
- AMAZON AWS: 51.8%
- MICROSOFT AZURE: 31.2%
- PRIVATE / ON-PREM CLOUD: 19.4%
- GOOGLE CLOUD PLATFORM: 18.8%
- KUBERNETES: 17.3%
- IBM BLUEMIX: 14.2%
- OPENSTACK (ON-PREM): 10.3%
- DON'T KNOW: 10.0%
- RED HAT OPENSHIFT: 9.1%
- NONE: 9.1%
- CLOUD FOUNDRY (ON-PREM): 8.8%
- OTHER: 6.1%
- GE PREDIX: 2.1%
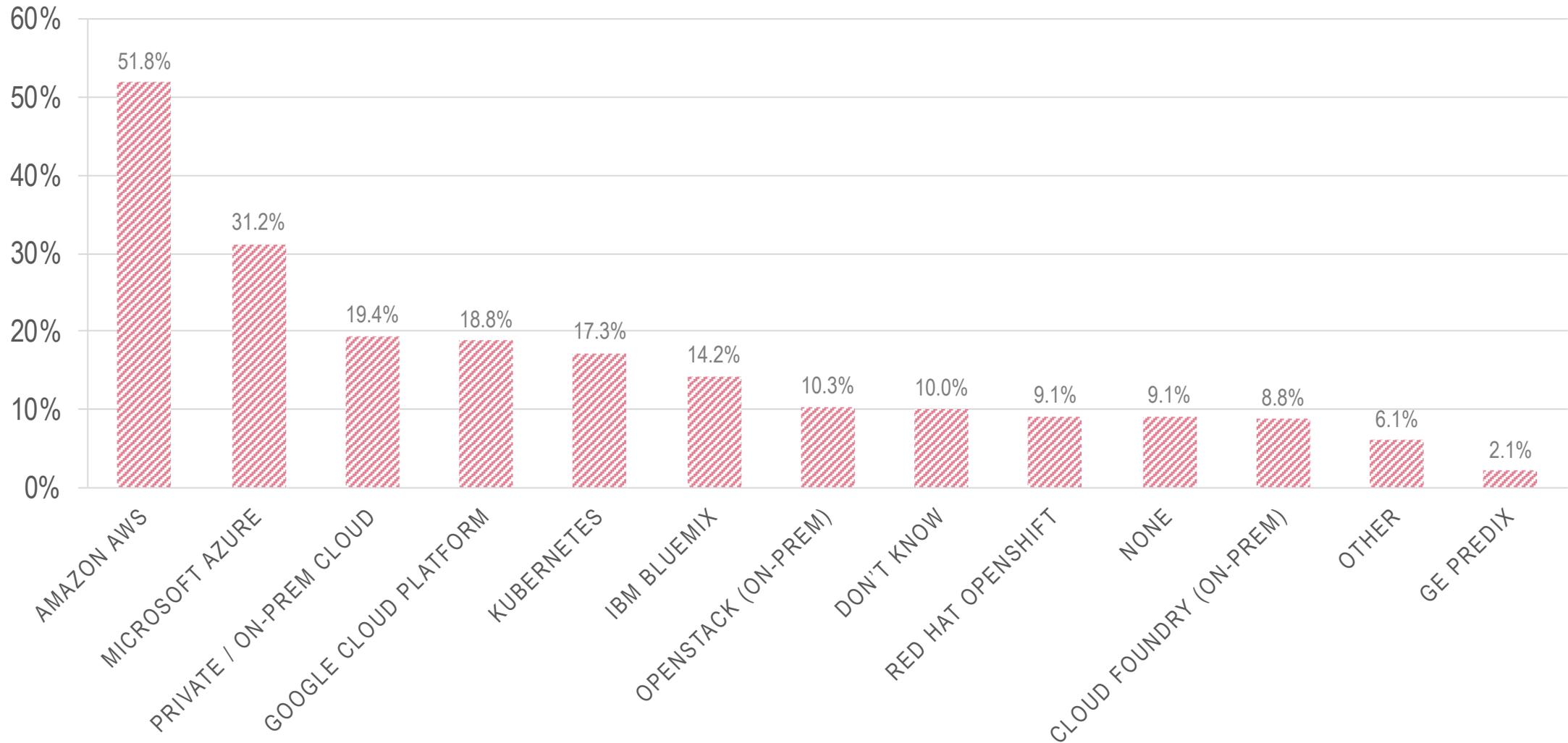
# TRENDS OF CLOUD SERVICES FOR IoT 2016-2018



Legend:
- 2016 (green)
- 2017 (blue)
- 2018 (yellow)

Categories and 2018 values:
- AMAZON WEB SERVICES: 51.82%
- MICROSOFT AZURE: 31.21%
- PRIVATE/ ON-PREM CLOUD: 19.39%
- GOOGLE CLOUD PLATFORM: 18.79%
- KUBERNETES: 17.27%
- IBM BLUEMIX: 14.24%
- OPENSTACK (ON-PREM): 10.30%
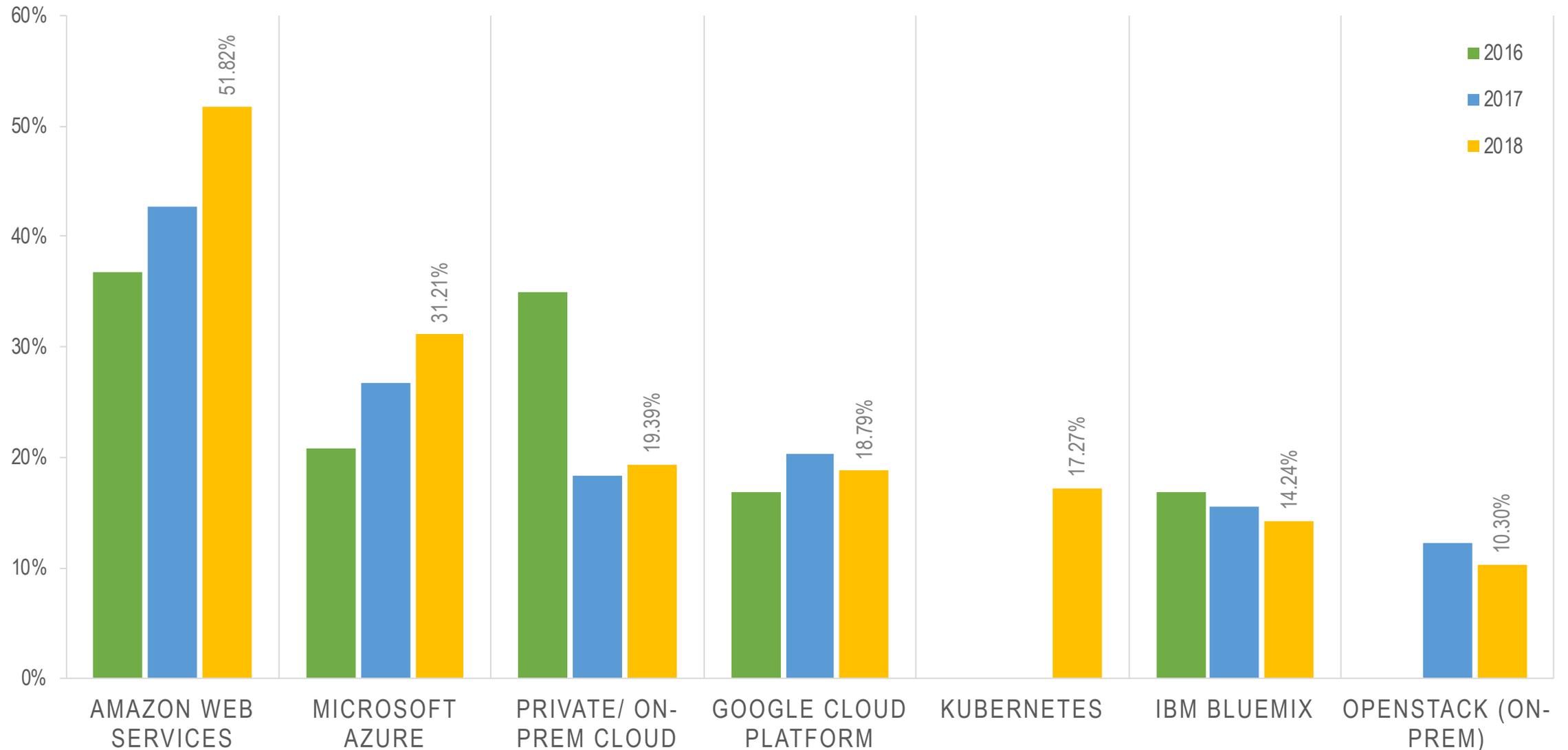
# CONNECTIVITY PROTOCOLS

*What connectivity protocol(s) do you use for your IoT solution?*

| Protocol | Percentage |
|---|---|
| TCP/IP | 62.9% |
| WI-FI | 55.3% |
| ETHERNET | 47.7% |
| BLUETOOTH / BLUETOOTH SMART | 38.3% |
| CELLULAR | 35.6% |
| UDP/IP | 32.2% |
| ZIGBEE | 21.6% |
| LPWA | 21.3% |
| SERIAL RS-232/RS-485 | 17.9% |
| 6LOWPAN | 13.4% |
| Z-WAVE | 9.1% |
| UPNP | 6.1% |
| DON'T KNOW | 5.8% |
| OTHER | 3.7% |
| THREAD | 2.7% |
| SATELLITE | 2.7% |
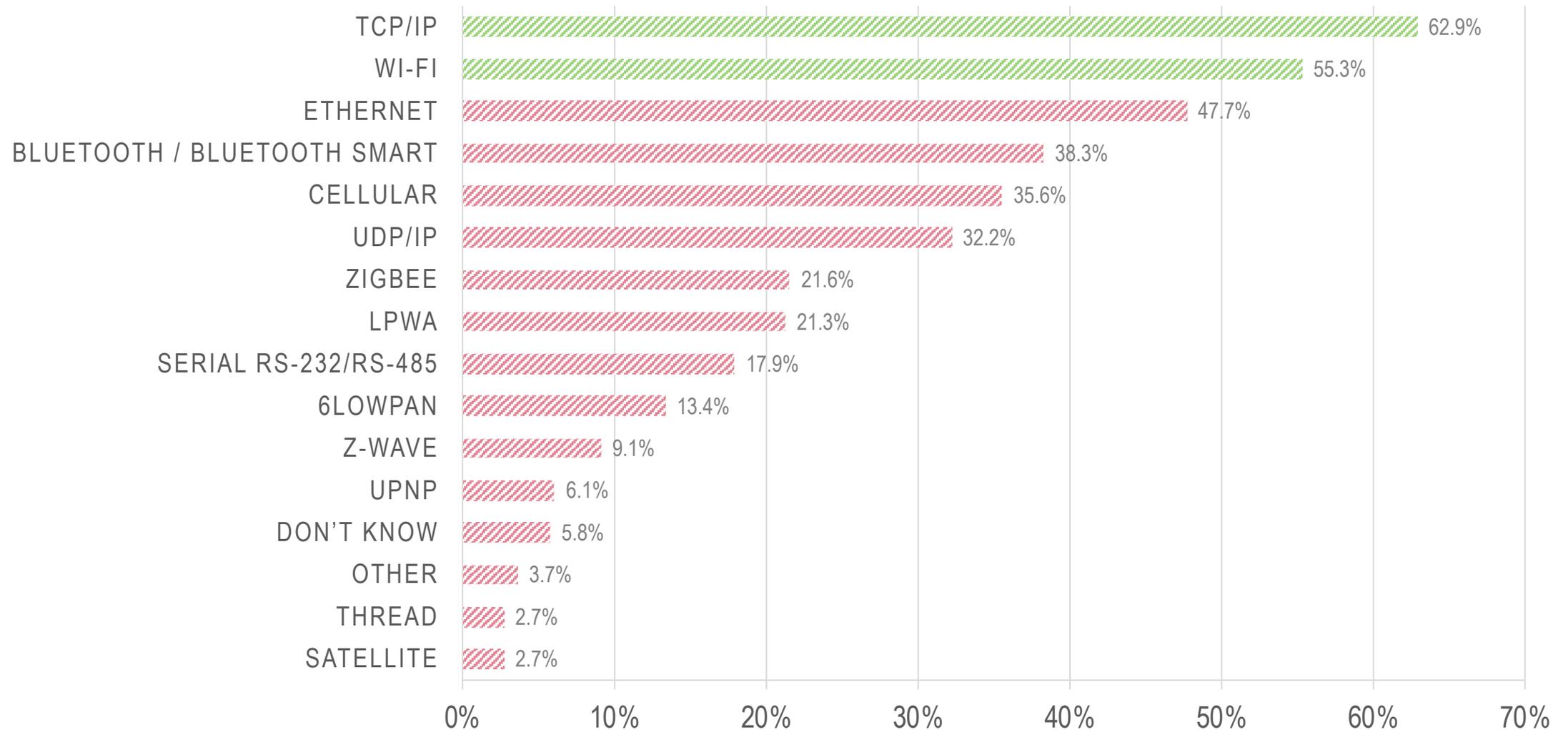
# MESSAGING STANDARDS

*What messaging protocol(s) do you use for your IoT solution?*
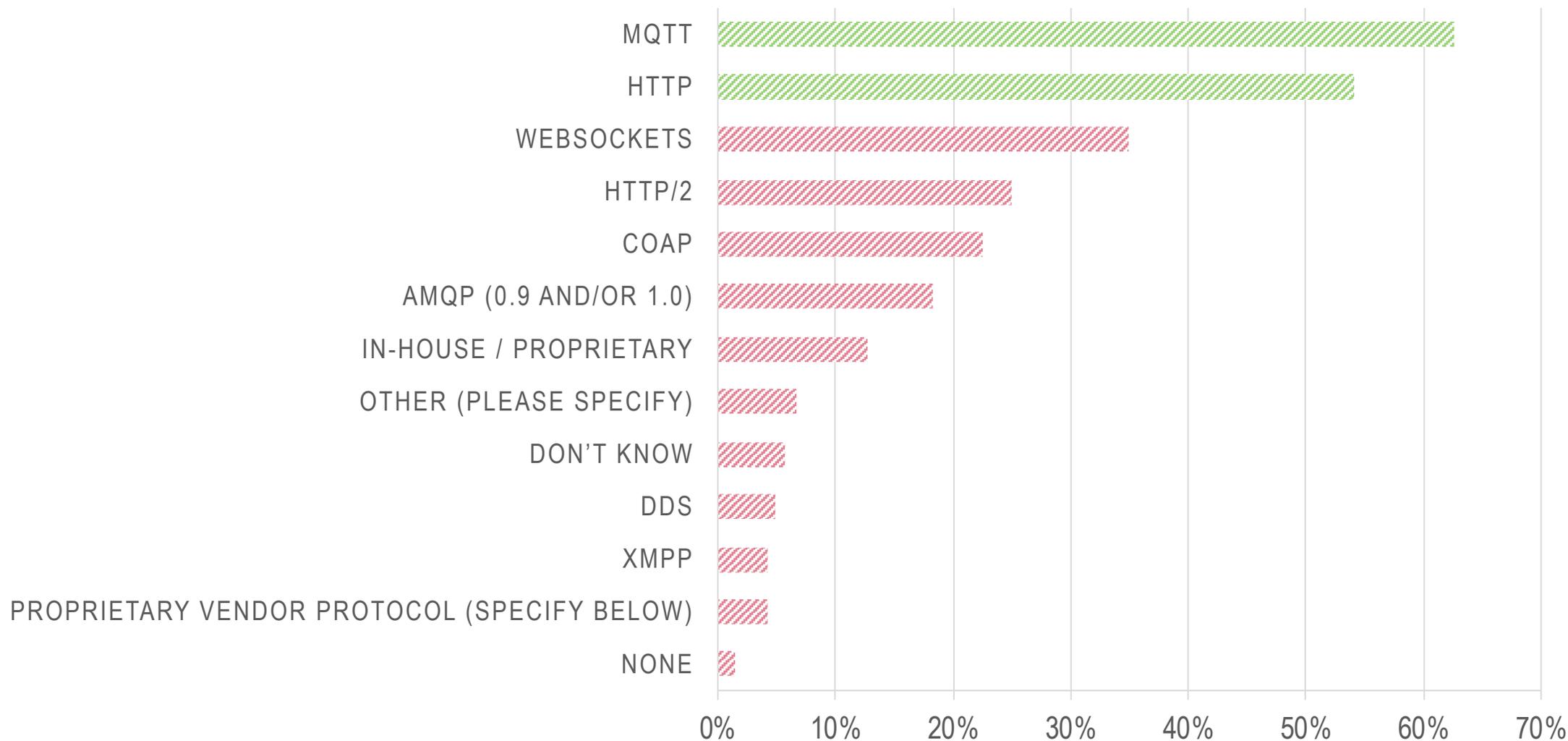
# MESSAGING STANDARDS - TRENDS



Legend: 2016, 2017, 2018

- MQTT: 62.61% (2018)
- HTTP: 54.10% (2018)
- WEBSOCKETS: 34.95% (2018)
- HTTP/2: 24.92% (2018)
- COAP: 22.49% (2018)
- AMQP: 18.24% (2018)
- IN-HOUSE: 12.77% (2018)
- OTHER: 6.69% (2018)
- DON'T KNOW: 5.78% (2018)
- DDS: 4.86% (2018)
- PROPRIETARY ...: 4.26% (2018)
- XMPP: 4.26% (2018)
- NONE: 1.52% (2018)
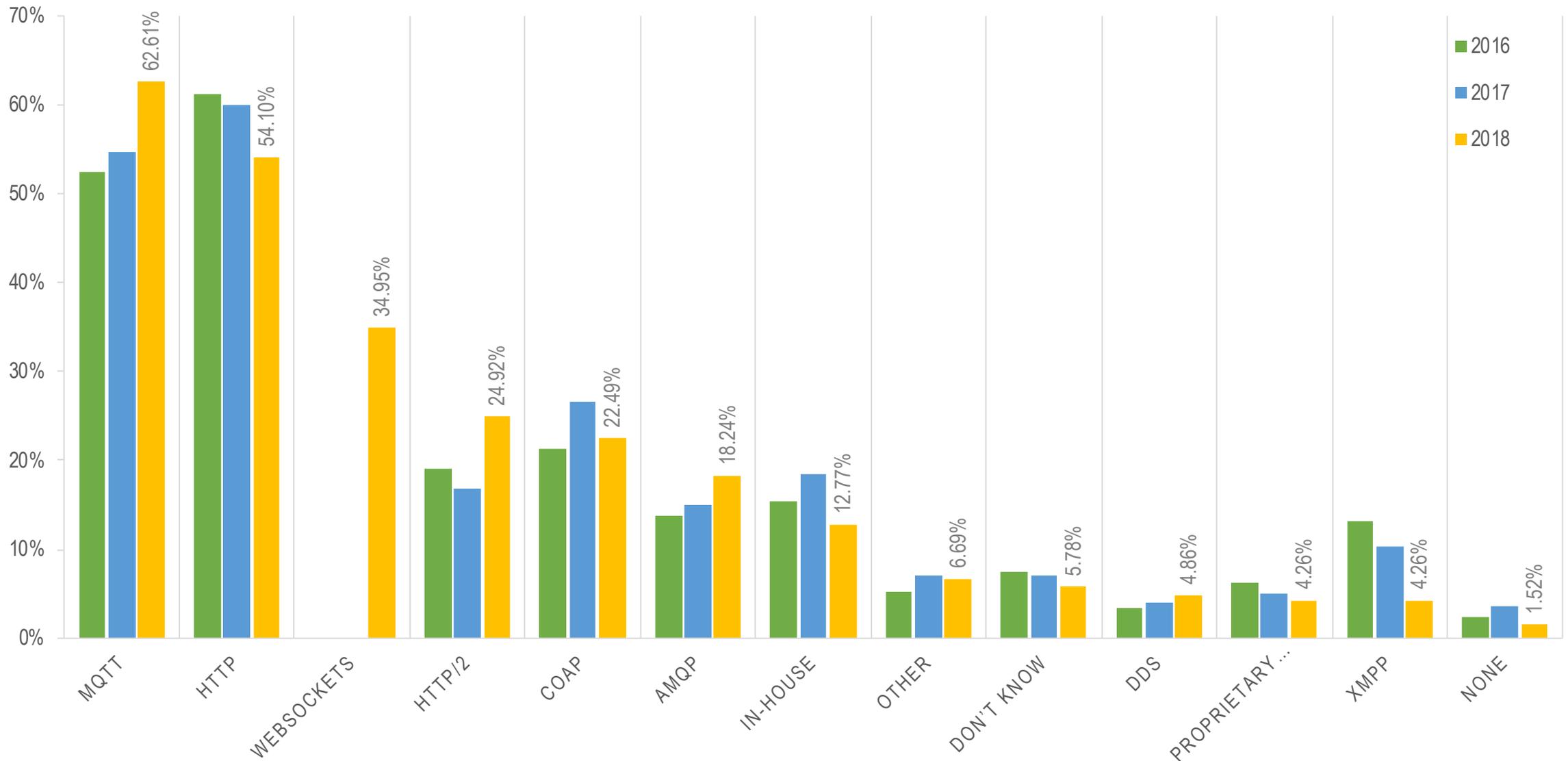
# TEXT EDITORS / IDES

*Which text editor(s) or IDE(s) do you use when building IoT solutions?*
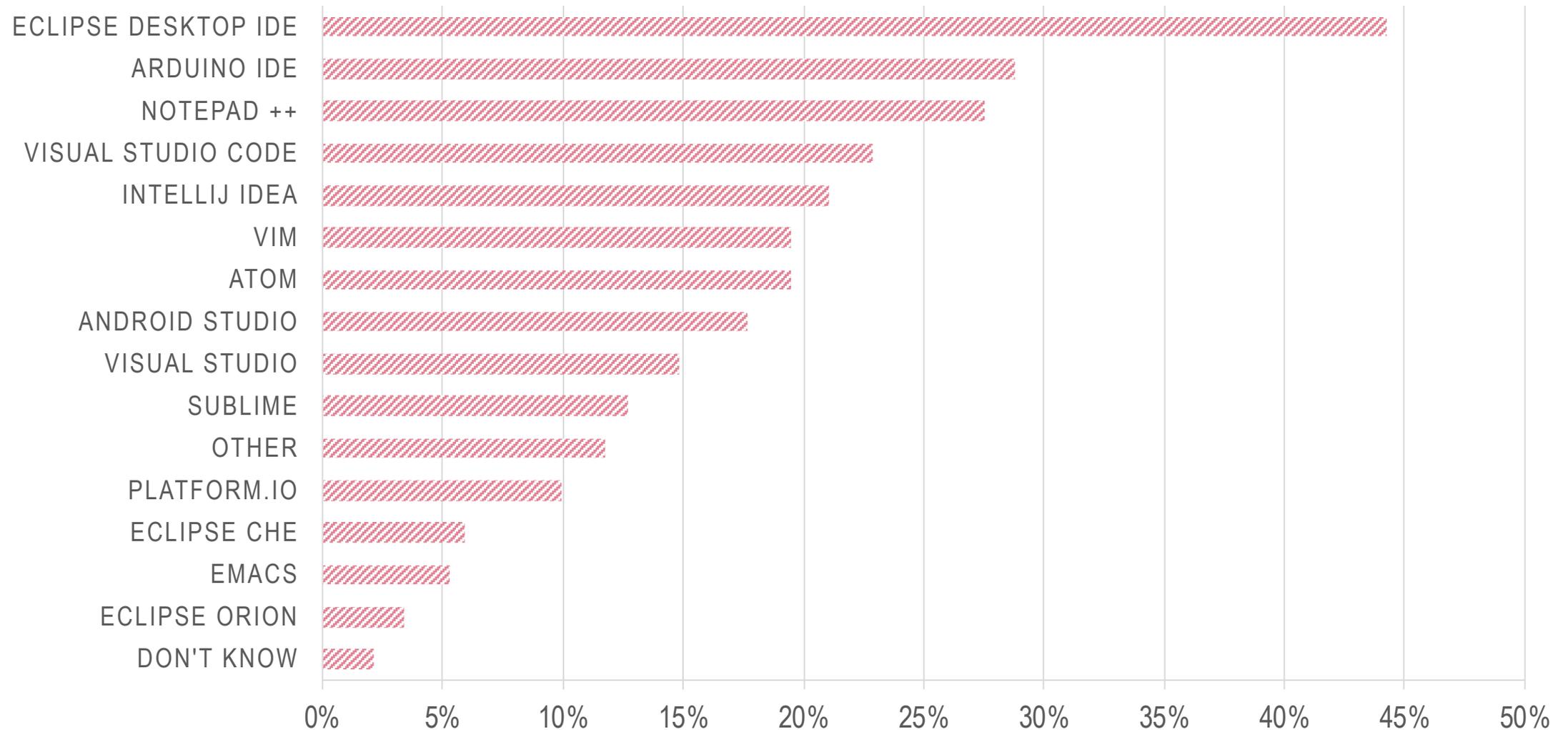
# Text Editors / IDEs – Trends



Legend: 2017 (blue), 2018 (yellow)

| Editor/IDE | 2017 | 2018 |
|---|---|---|
| Eclipse Desktop IDE | 47% | 44% |
| Arduino IDE | 29% | 29% |
| Notepad ++ | | 28% |
| Visual Studio Code | 21% | 23% |
| IntelliJ IDEA | 14% | 21% |
| Atom | 17% | 20% |
| Vim | 26% | 20% |
| Android Studio | 22% | 18% |
| Visual Studio | | 15% |
| Sublime | 11% | 13% |
| Other | 17% | 12% |
| Platform.io | | 10% |
| Eclipse Che | 4% | 6% |
| Emacs | 9% | 5% |
| Eclipse Orion | 4% | 3% |
| Don't Know | 7% | 2% |
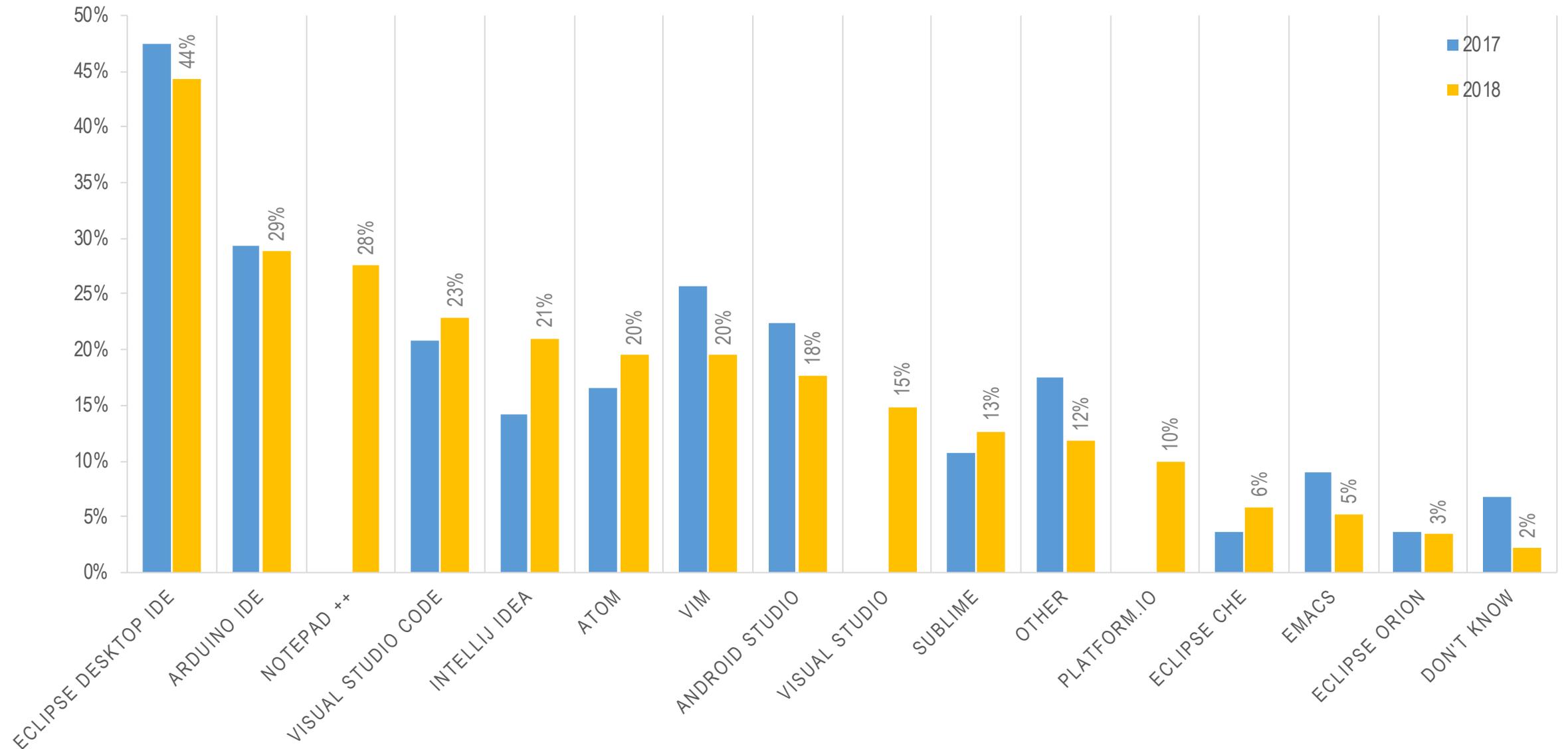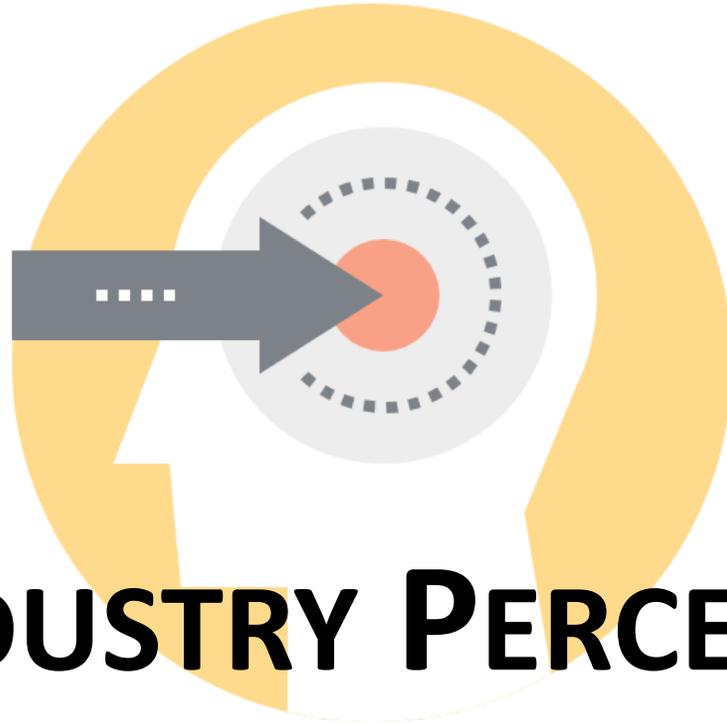
IoT Industry Perceptions

# OPEN SOURCE POLICY

*Which of the following statement(s) best describes your IoT open source project participation?*
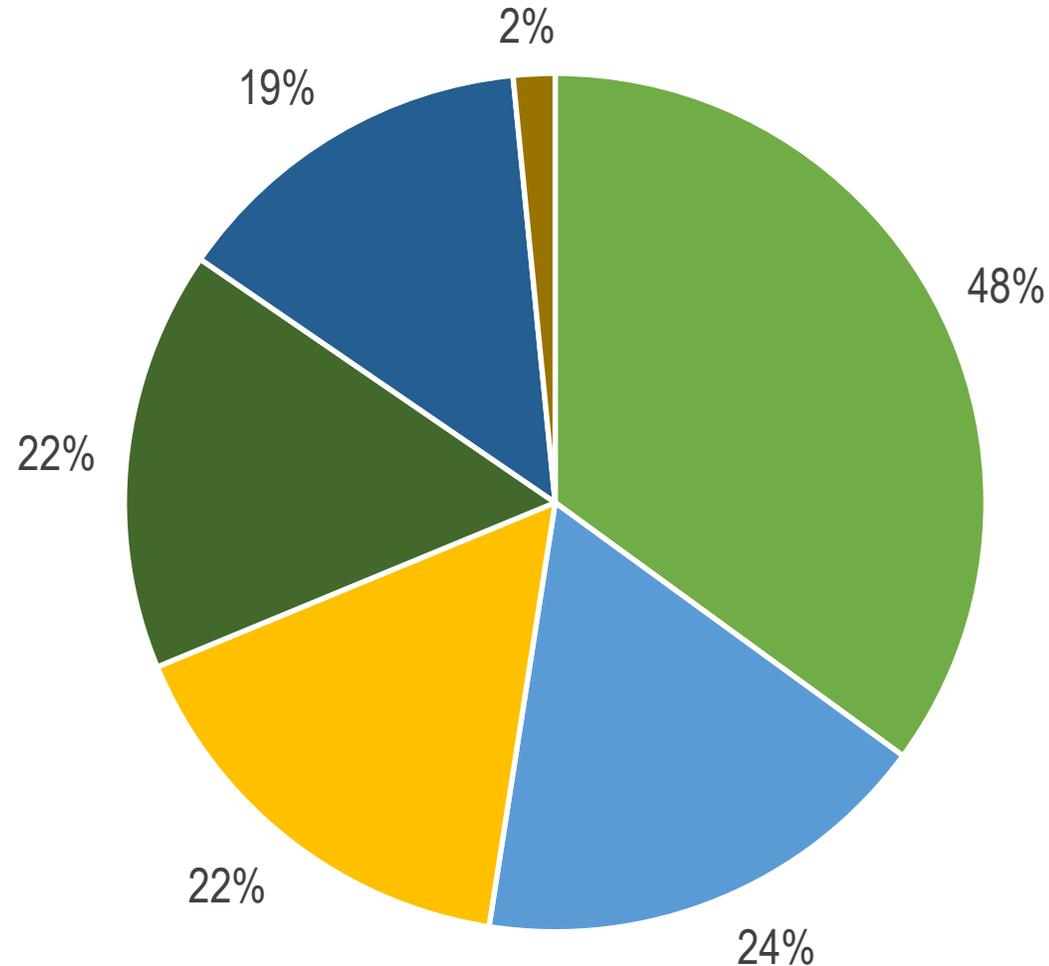


Legend:
- **My organization uses open source technology in our IoT solutions** — 48%
- **I am a committer on an open source project that builds technology for IoT solutions** — 24%
- **I have no experience with IoT open source projects** — 22%
- **I have experimented with IoT open source technology, but don't use it in IoT solutions** — 22%
- **I report bugs and feature enhancements to open source projects that provide IoT technology** — 19%
- **Other** — 2%

# IoT Consortiums

*How would you rank your organization's perceived importance of the following IoT Consortiums to your IoT strategy? ( 1 = Important, 5 = Never heard of them)*

| | Important | Neutral | Not Important | Don't Know | Never heard of them | Average rating |
|---|---|---|---|---|---|---|
| **Eclipse IoT** | **56.89%** | **21.20%** | **6.36%** | **11.31%** | **4.24%** | **1.85** |
| **Apache Foundation** | **44.24%** | **29.14%** | **8.63%** | **16.91%** | **1.08%** | **2.01** |
| **W3C** | **38.72%** | **31.58%** | **11.65%** | **15.79%** | **2.26%** | **2.11** |
| **IEEE** | **37.59%** | **28.95%** | **13.53%** | **18.05%** | **1.88%** | **2.18** |
| IETF | 29.02% | 26.67% | 10.59% | 23.53% | 10.20% | 2.59 |
| LoRa Alliance | 30.80% | 23.95% | 13.31% | 17.49% | 14.45% | 2.61 |
| Industrial Internet Consortium (IIC) | 19.23% | 26.54% | 14.23% | 24.23% | 15.77% | 2.91 |
| Open Mobile Alliance (OMA) | 24.03% | 22.09% | 11.63% | 21.32% | 20.93% | 2.93 |
| OASIS | 13.15% | 27.09% | 17.13% | 25.10% | 17.53% | 3.07 |
| Open Connectivity Foundation (OCF) | 18.22% | 22.48% | 13.18% | 23.64% | 22.48% | 3.1 |
| oneM2M | 15.18% | 24.51% | 15.18% | 21.01% | 24.12% | 3.14 |
| Thread Group | 10.81% | 20.08% | 15.83% | 24.71% | 28.57% | 3.4 |
| OpenFog | 11.37% | 20.00% | 10.59% | 25.49% | 32.55% | 3.48 |

# TOP IOT CORPORATE LEADERS

# WHO RESPONDED?

# Job Title

*What is your job title?*



Legend:
- Developer — 30%
- Architect — 16%
- Development Manager — 12%
- Researcher — 10%
- Independent Consultant — 8%
- Other — 7%
- Executive — 6%
- Product Manager — 5%
- Student — 4%
- Role in sales and/or business development — 1%
- Not currently employed — 1%
- Testing — 1%
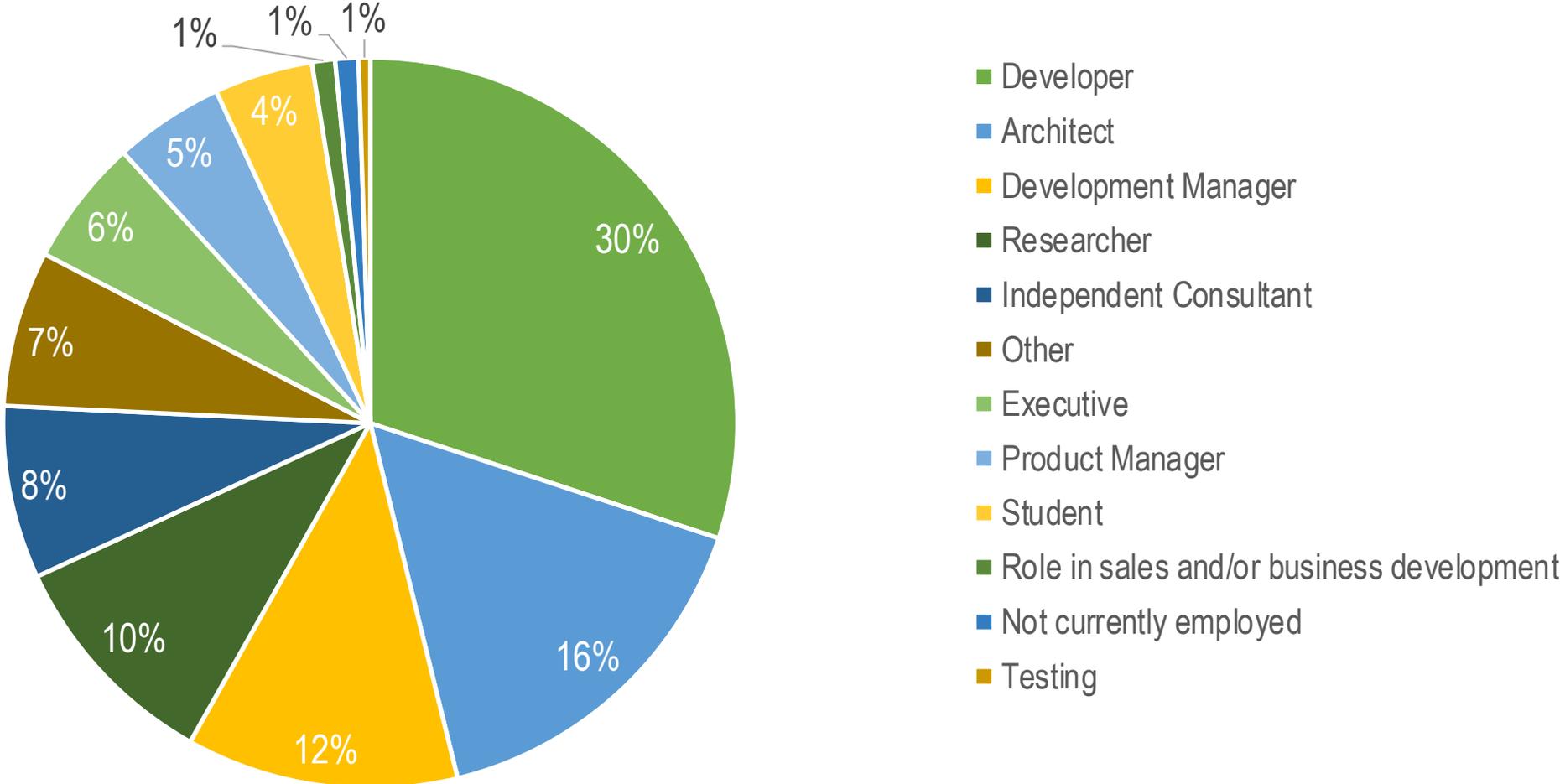
# Technology Focus

What is your personal current technology focus within your organization?
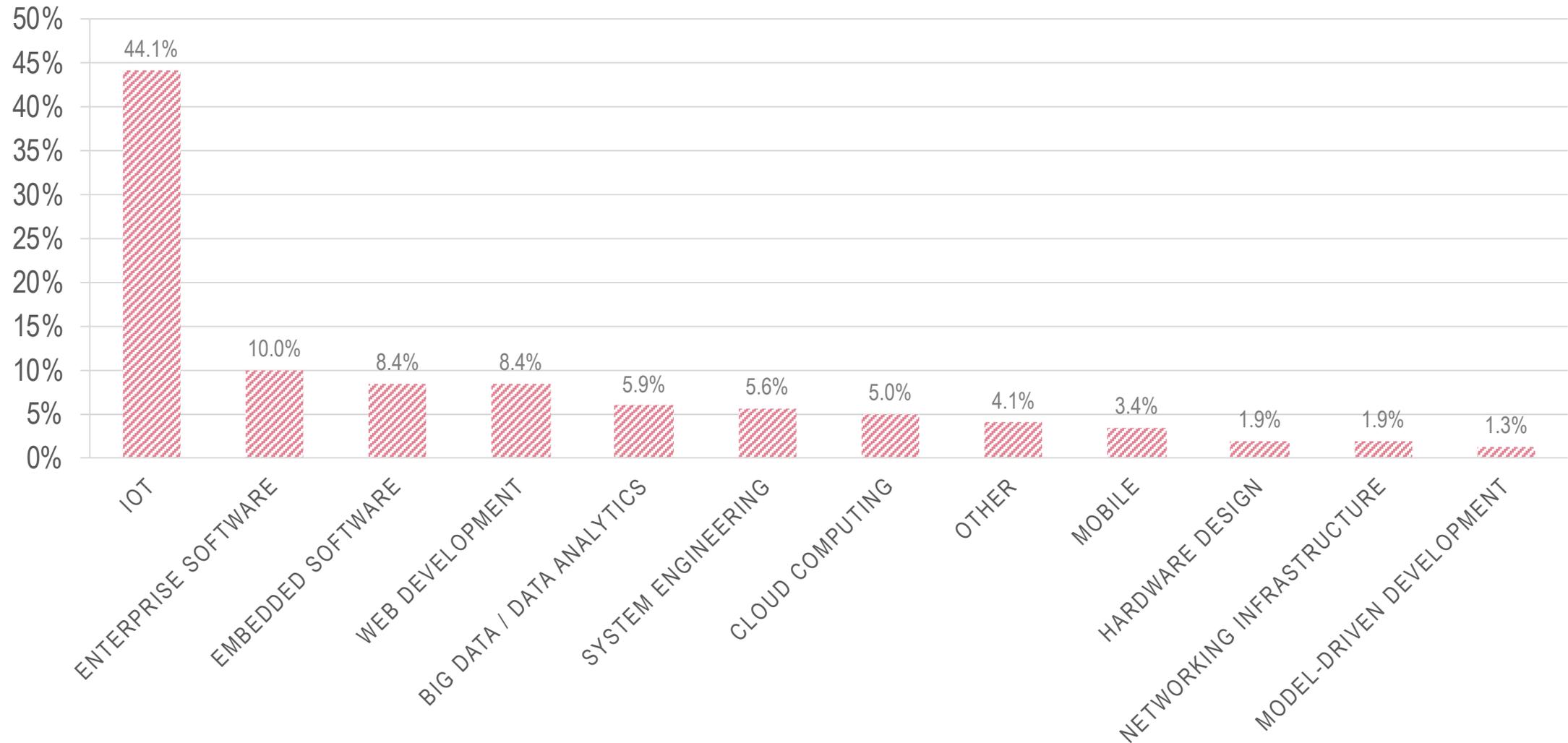
# ORGANIZATION SIZE

*How large is the organization you work for (# employees)?*

# REGION

*Where do you live?*



North America — 17%

South America — 7%

Europe — 52%

Africa + Middle East — 5%

Asia + Pacific — 19.0%
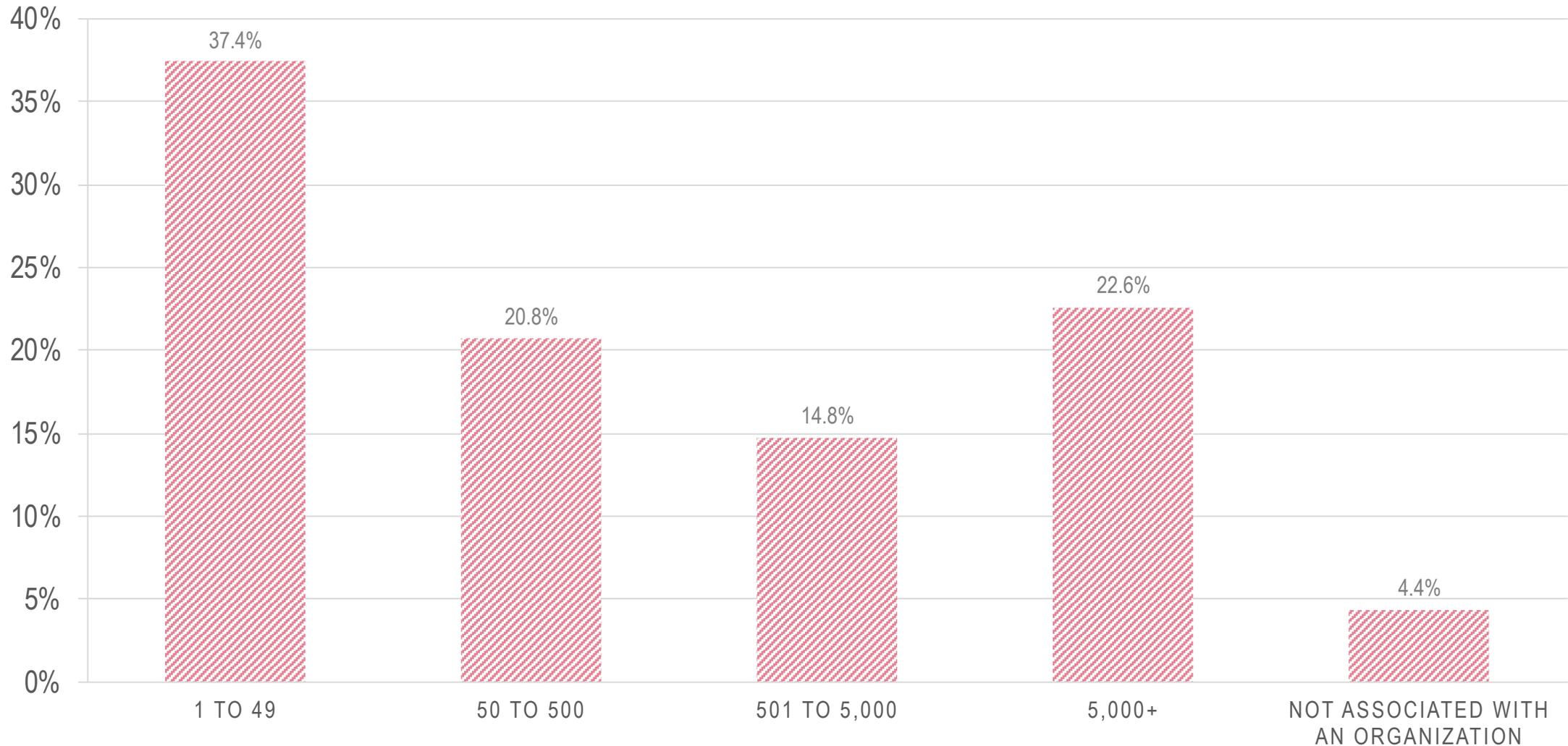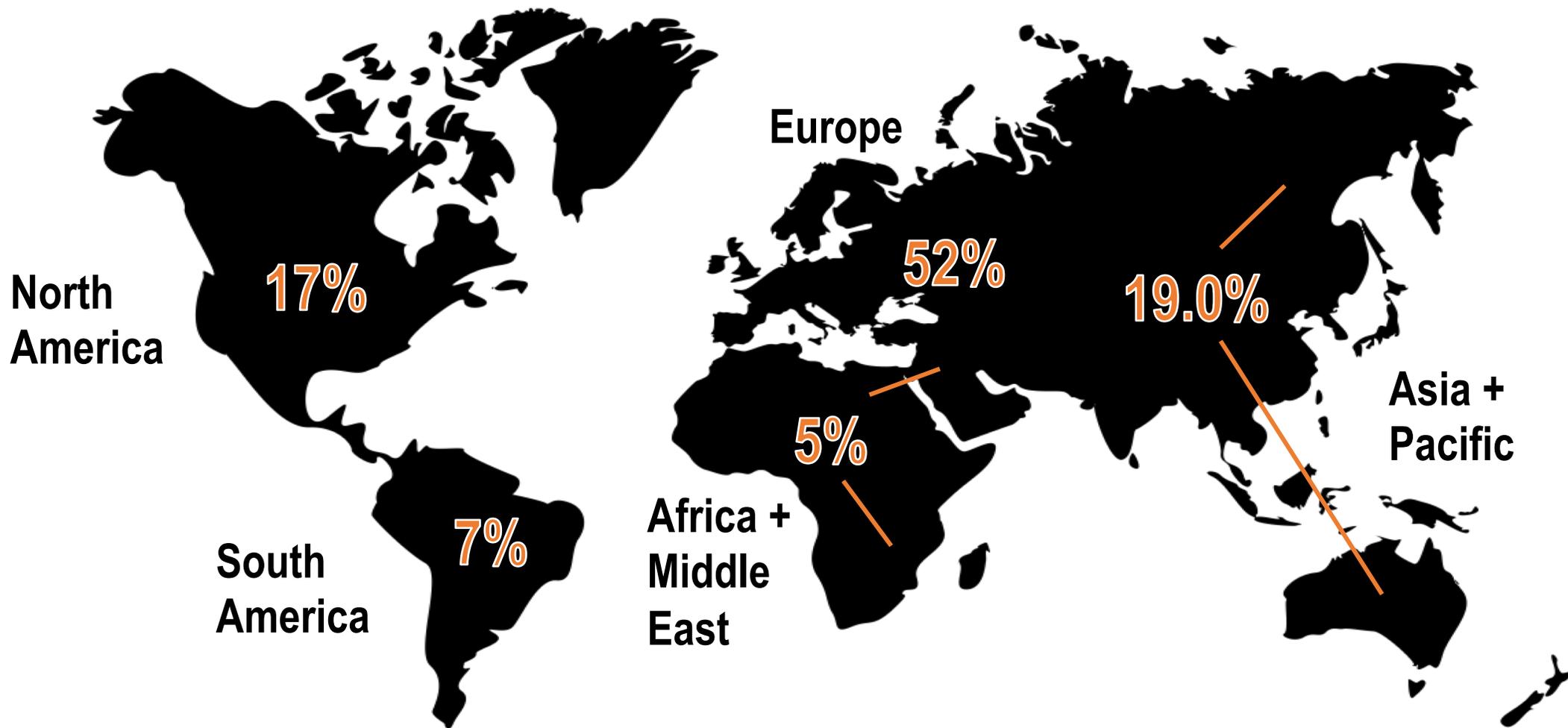
# Contact Information

iot.eclipse.org

@EclipseIoT

iot.ieee.org

@IEEEIoT

agile-iot.eu

@agile_iot

omaspecworks.org

@omaspecworks