



**SAKARYA ÜNİVERSİTESİ**  
**Bilgisayar ve Bilişim Bilimleri Fakültesi**  
**Bilgisayar Mühendisliği Bölümü**

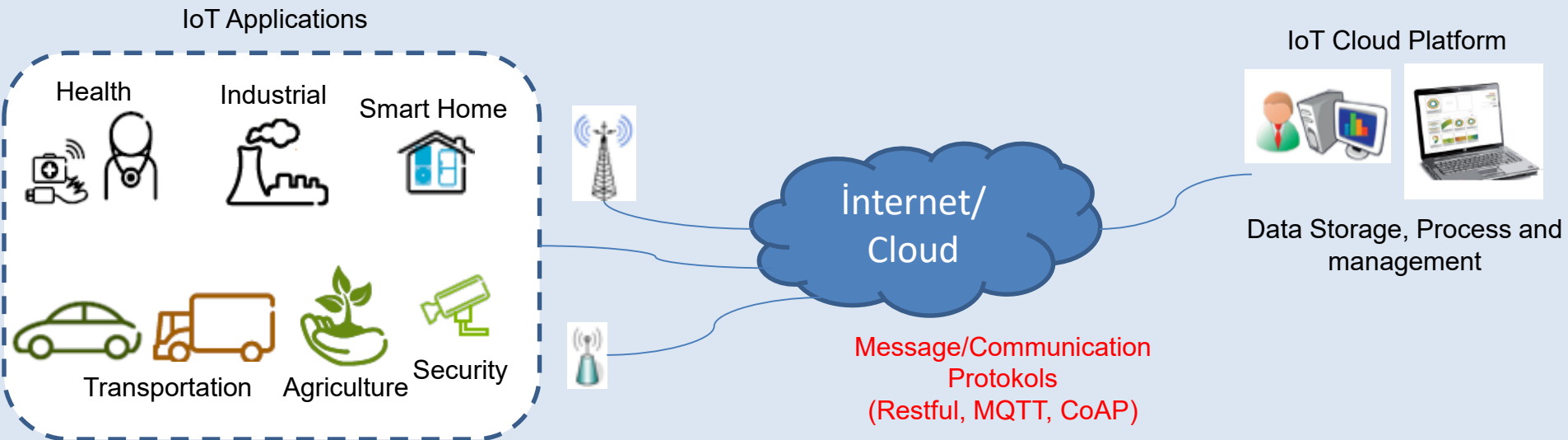
**BSM 451**

**Internet of Things (IoT) and Applications**

**THE INTERNET OF THINGS  
TECHNOLOGIES USED IN APPLICATIONS**

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# Technologies Used in IoT Applications



## IoT Technologies

- RFID
- NFC
- Bluetooth Low Energy
- GSM
- GPS

# IoT Protocol Architecture

## Internet of Things – Technology architecture



# IoT Network and Components

## ❑ Network components of IoT

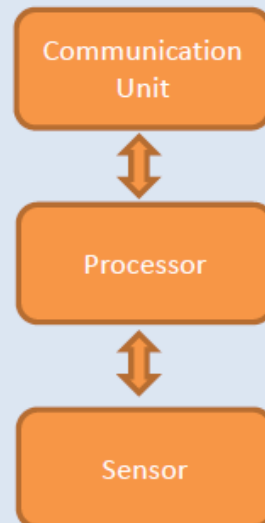


❑ OT: Transferring right info to the right person in the right time.

## ❑ IoT Smart Things

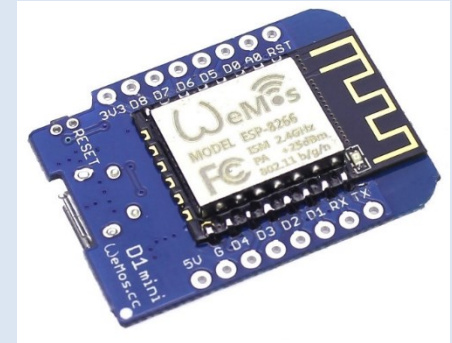
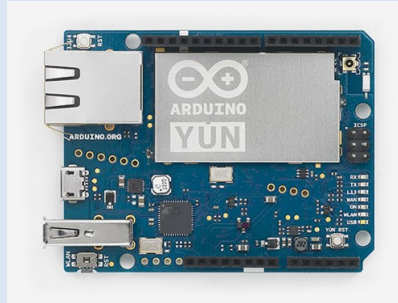
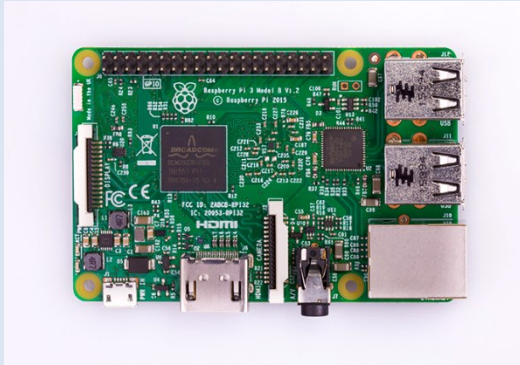


❑ Physical devices that can process data, make smart decisions, communicate with each other and internet



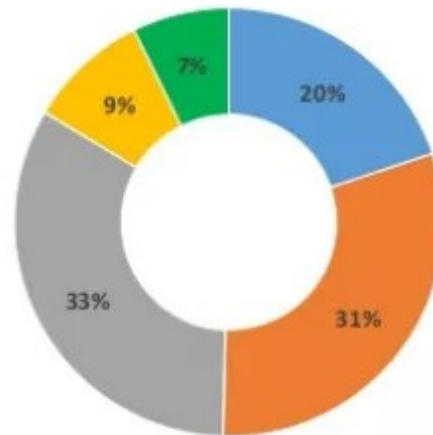
# IoT Hardware Examples

## IoT open source Hardwares



## USAGE OF OPEN HARDWARE

*Have you ever used any open hardware platforms like Raspberry Pi, Arduino, BeagleBone, etc.?*

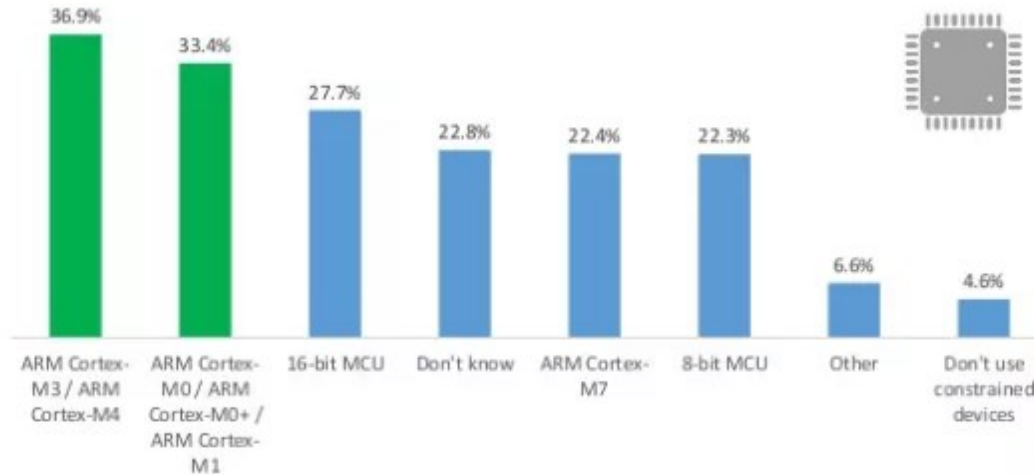


- Yes, my company deploys IoT solution using an open hardware platform
- Yes, my company prototypes IoT solutions using an open hardware platform
- Yes, I have experimented with open hardware in my spare time
- No, but I intend to experiment with open hardware in the next 6 months
- Never used open hardware

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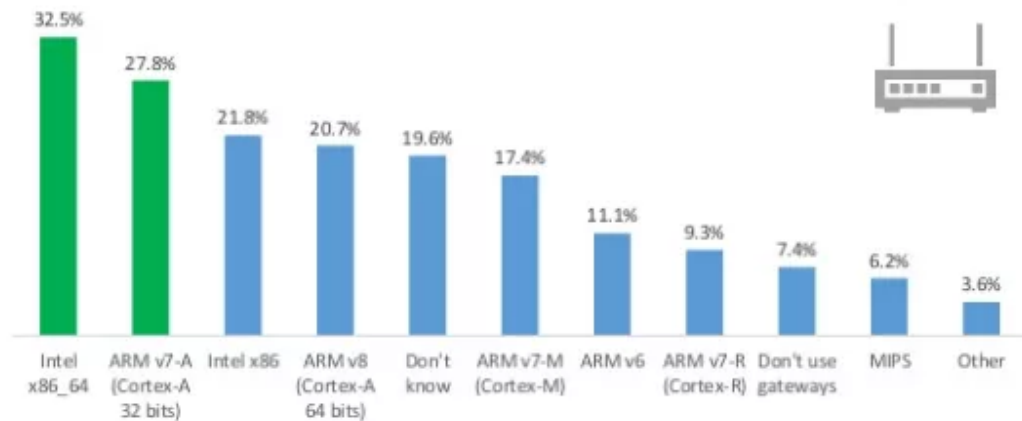
# IoT Hardware Architecture

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



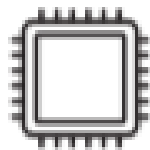
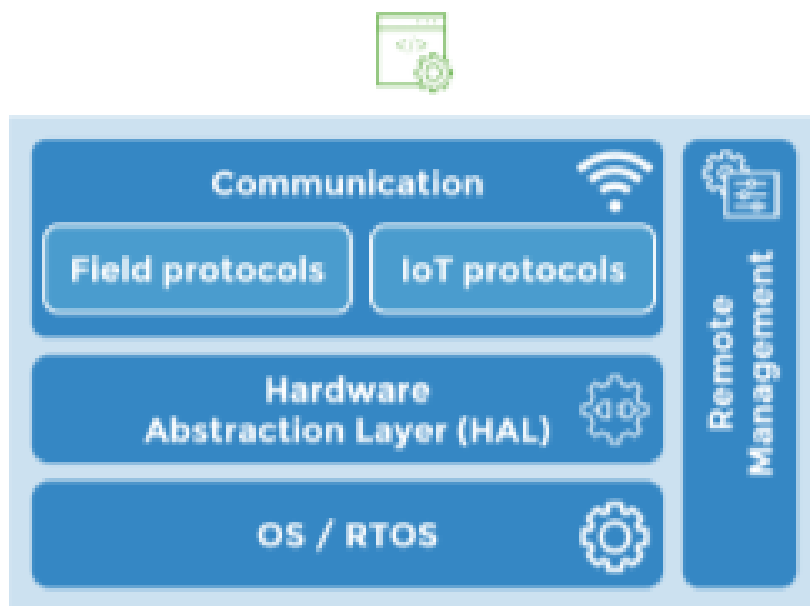
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*What hardware architectures are you using for your IoT gateway(s)?*

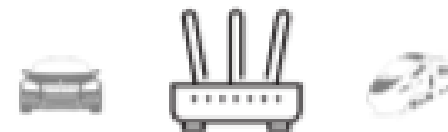
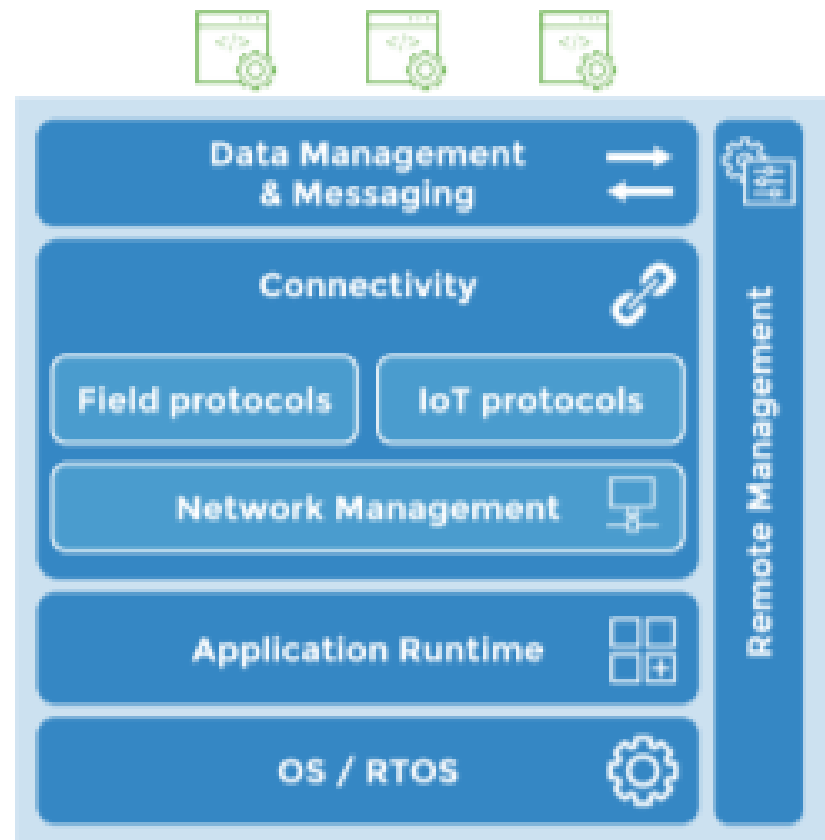


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# IoT Embedded Software Models



**CONSTRAINED DEVICES**

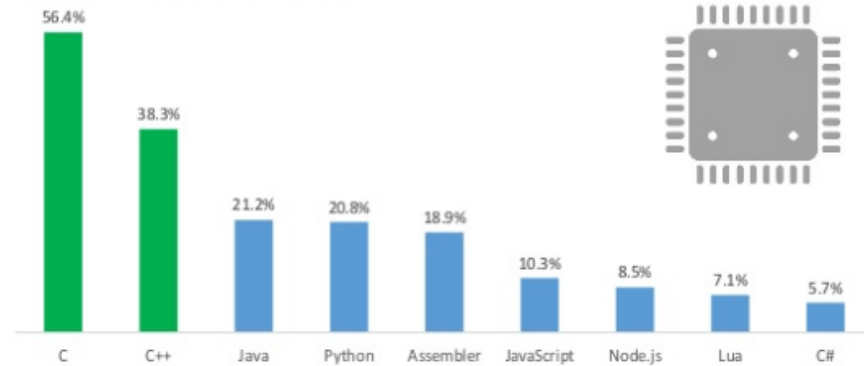


**GATEWAYS AND SMART DEVICES**

# IoT Programming Languages

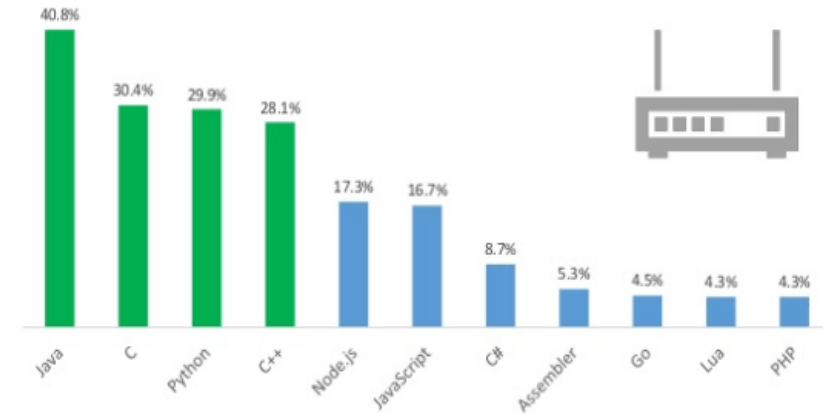
## PROGRAMMING LANGUAGES – CONSTRAINED DEVICES

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



## PROGRAMMING LANGUAGES – IOT GATEWAYS

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



## OVERALL SUMMARY OF LANGUAGE USAGE

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

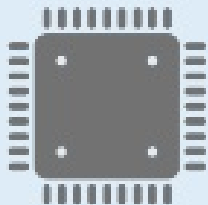




# IoT Programming Languages

## TOP IoT PROGRAMMING LANGUAGES

CONSTRAINED  
DEVICES

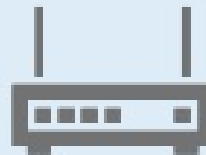


C

C++ python™



GATEWAYS



C/C++ python™

IoT  
CLOUD



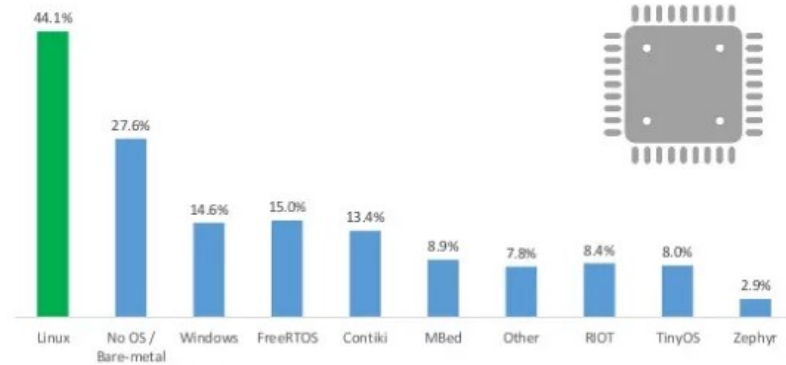
JS node®

python™

# Operating Systems Used in IoT Hardware

## IoT OPERATING SYSTEMS – CONSTRAINED DEVICES

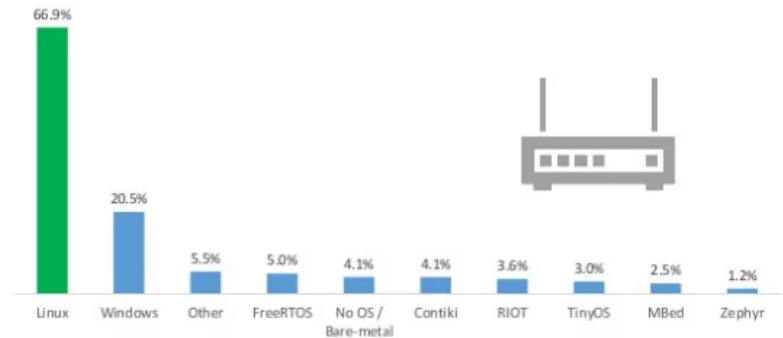
Which operating system(s) do you use for your IoT devices? (Devices)



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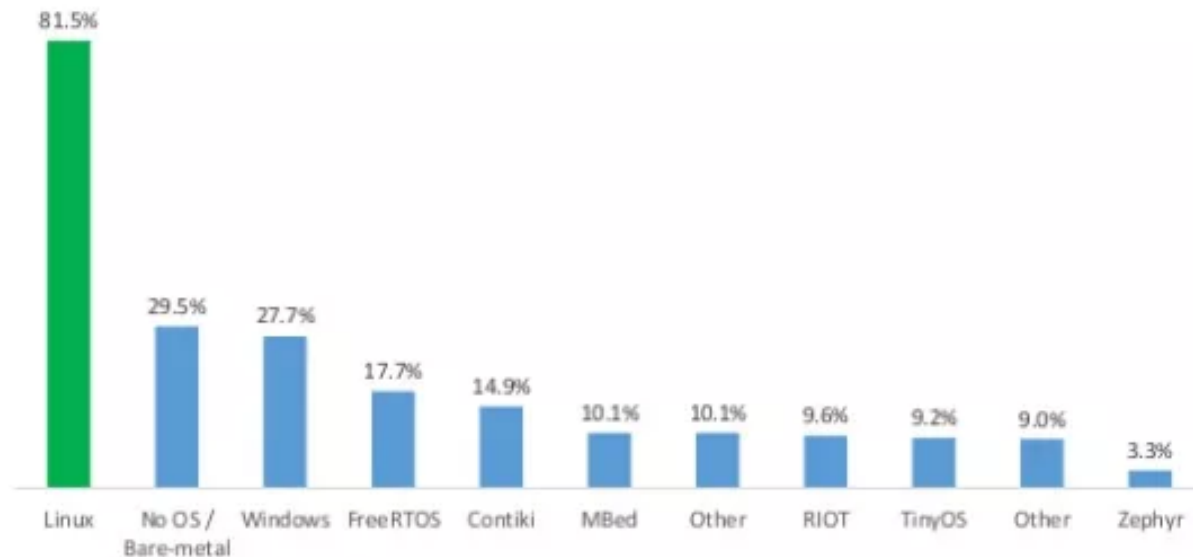
## IoT OPERATING SYSTEMS – IoT GATEWAY

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



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## Which operating system(s) do you use for your IoT devices? (Summary)

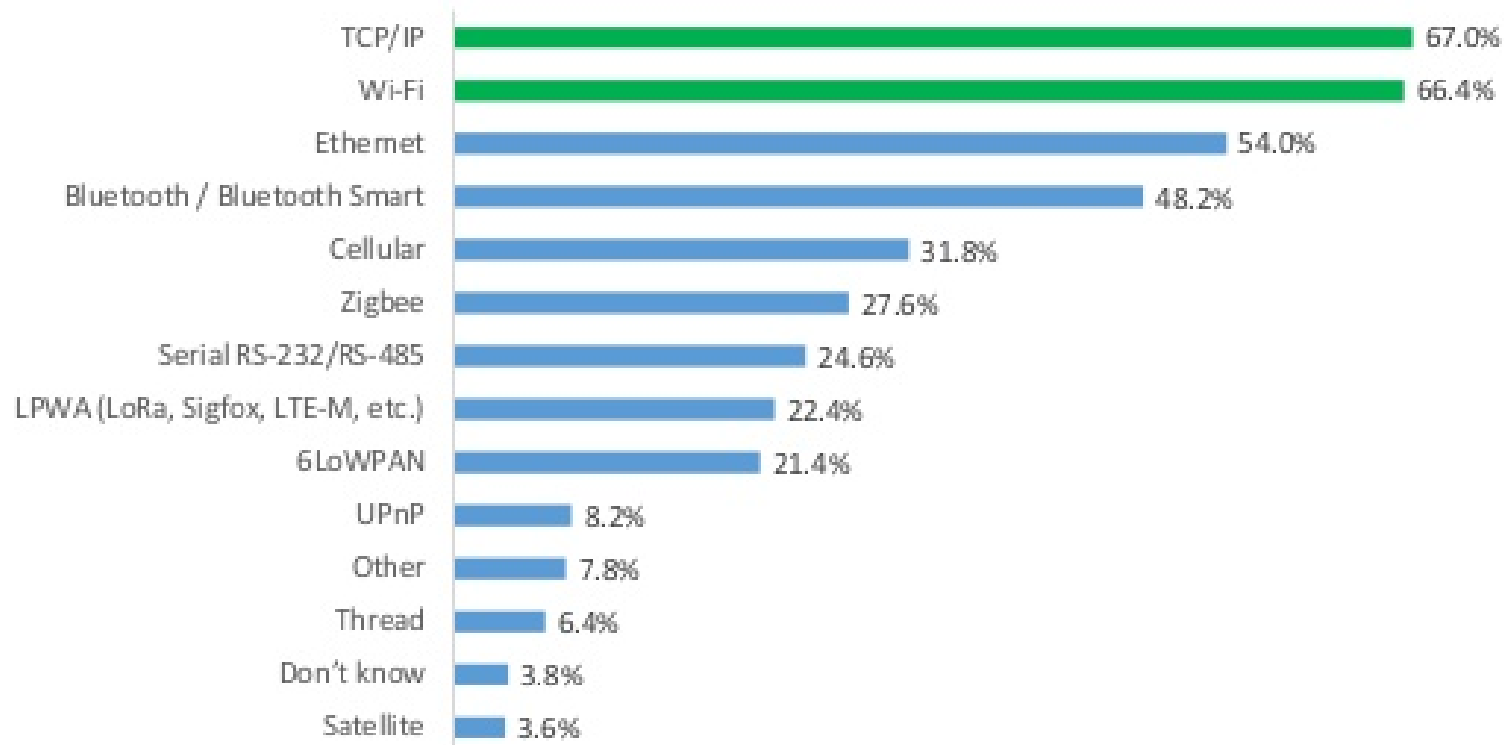


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# IoT Connection Protocols

## CONNECTIVITY PROTOCOLS

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



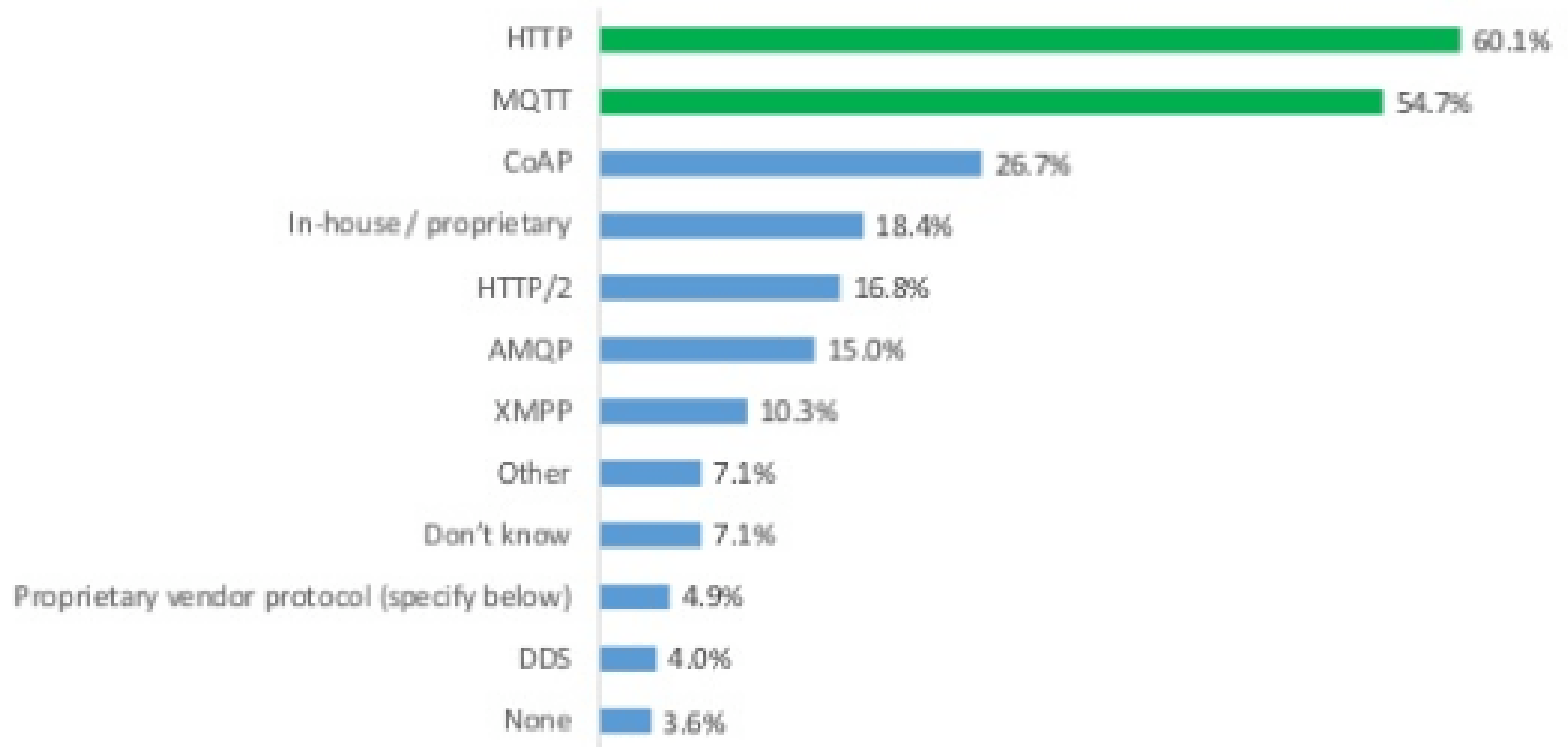
# IoT Messaging / Communication Protocols Overview

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- ❑ Web Services is a communication method that provides communication between two remote devices by sending and receiving XML with HTTP protocol.
- ❑ Web Services are discussed in the application / communication protocols on IoT.
- ❑ In the selection of Application / Communication Protocol, it should be considered that IoT devices with limited equipment can use their resources such as cpu, memory, battery effectively. For this reason, IoT applications need communication with lightweight protocols.

# IoT Messaging Protocols

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



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# IoT Cloud Platforms

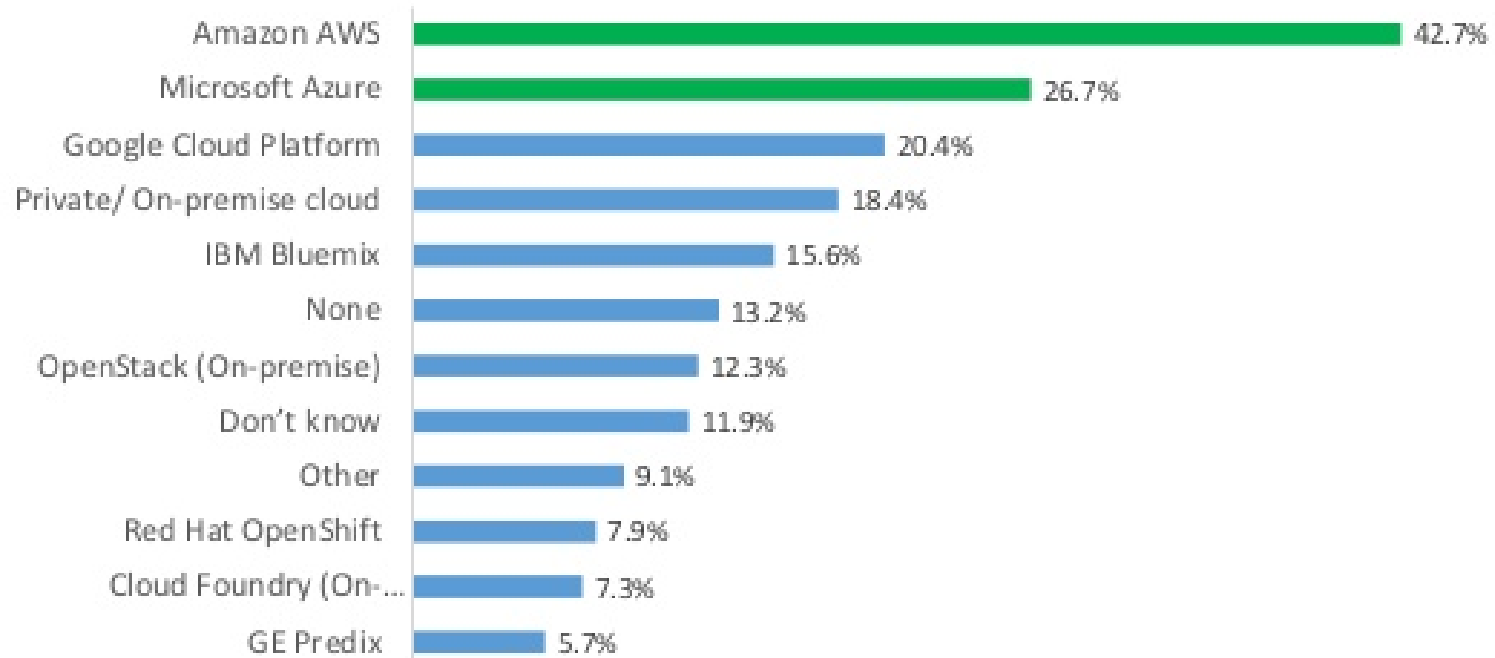
❑ Due to the nature of IoT applications, there is a need for environments where the data produced / obtained by the objects will be stored and visualized / analyzed on the internet.

- adafruit,
- ThingSpeak,
- Firebase,
- TeMBoo,
- IBM Watson IoT,
- Microsoft Azure IoT,
- Amazon Web Services (AWS) IoT,
- ThingWorx IoT Platform,
- Carriots,

# The Cloud Services for IoT Applications

## CLOUD SERVICES FOR IoT

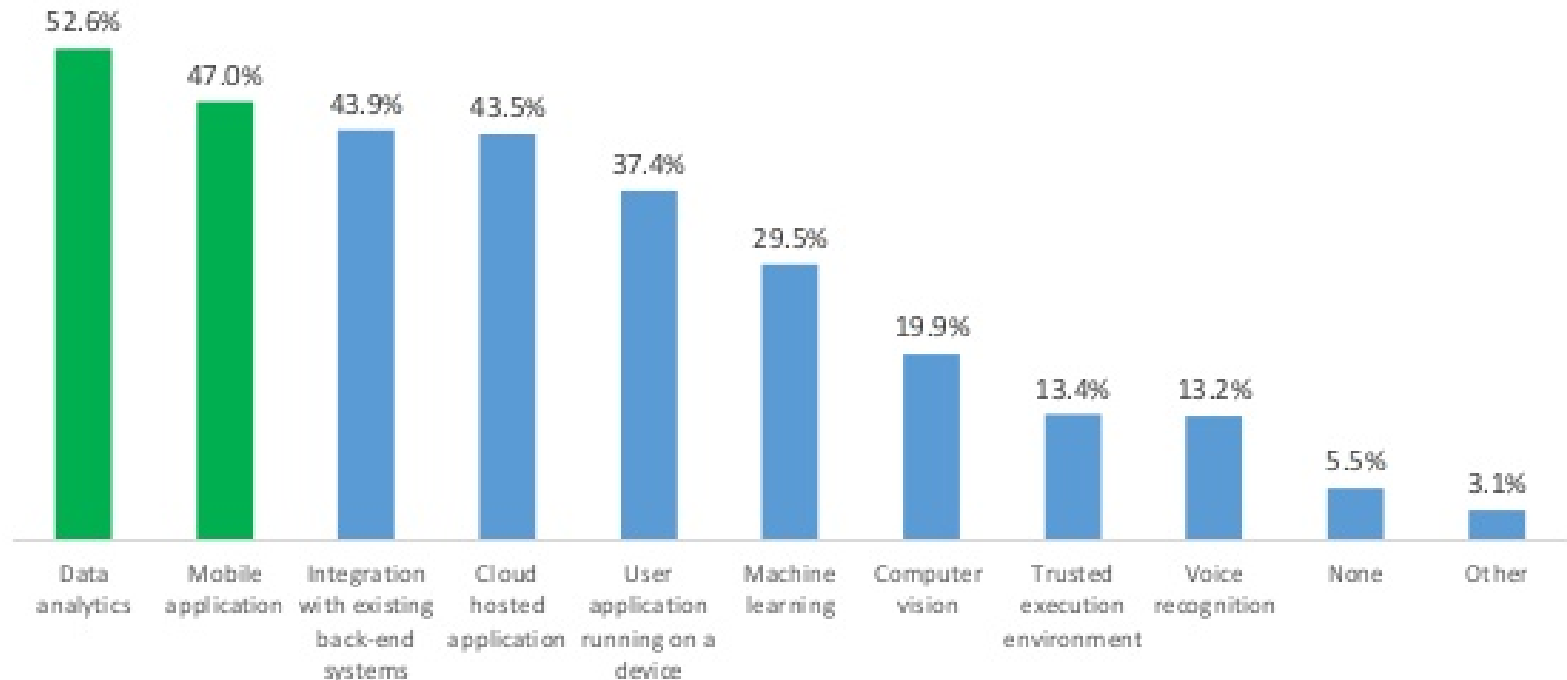
*Do you use, or plan to use, any of the following cloud service offerings for implementing your IoT solution?*



# Software Features in IoT Applications

## SOFTWARE FEATURES IN IoT SOLUTIONS

*What software features are included in your IoT solution?*



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# Resources

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- **Lecture Notes -Presentations**
- [Eclipse Foundation IOT Developer Survey 2017](#)