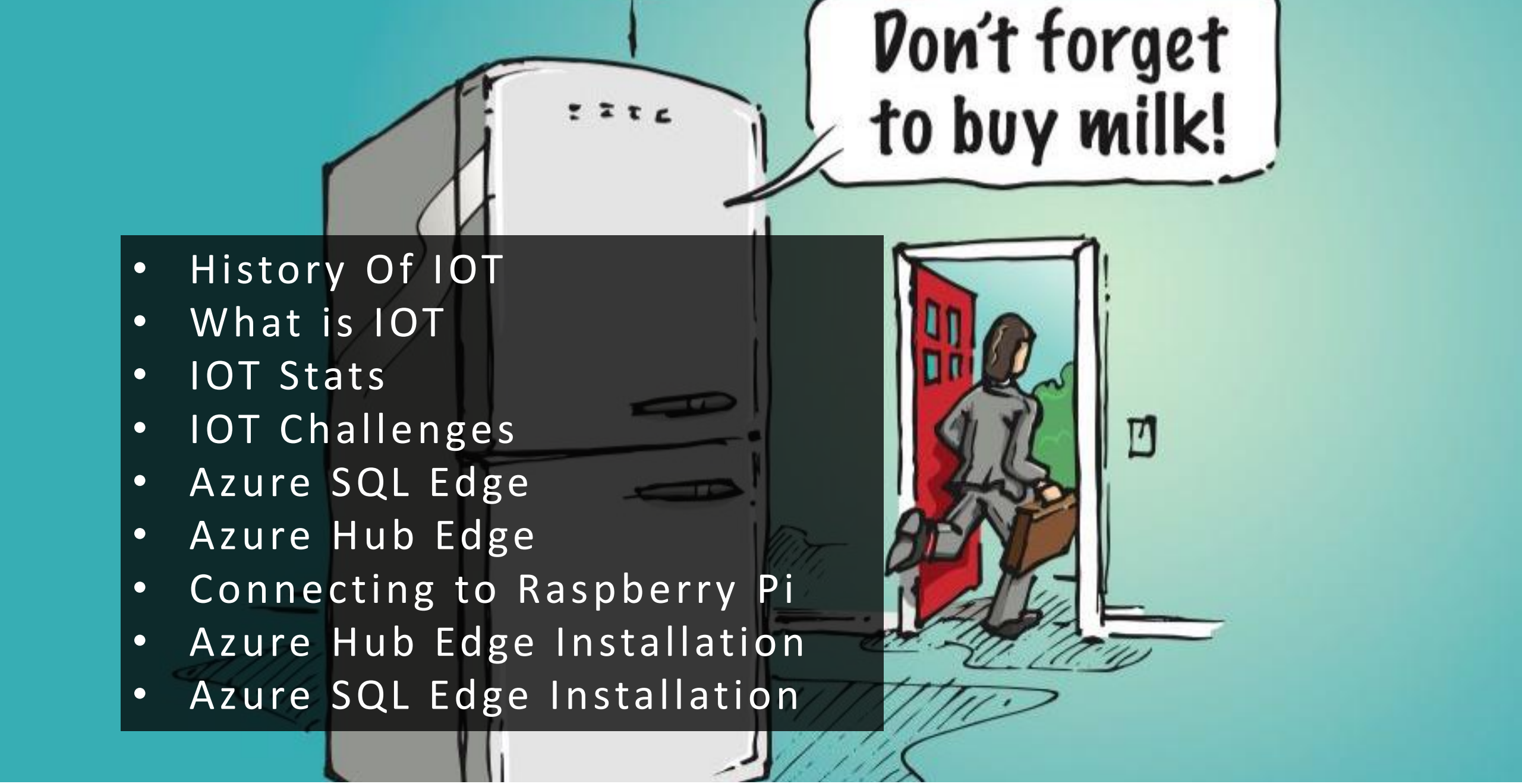


- History Of IOT
- What is IOT
- IOT Stats
- IOT Challenges
- Azure SQL Edge
- Azure Hub Edge
- Connecting to Raspberry Pi
- Azure Hub Edge Installation
- Azure SQL Edge Installation

Starting with Azure SQL Edge on Raspberry Pi

Hasan Savran

BI MANAGER

About Me

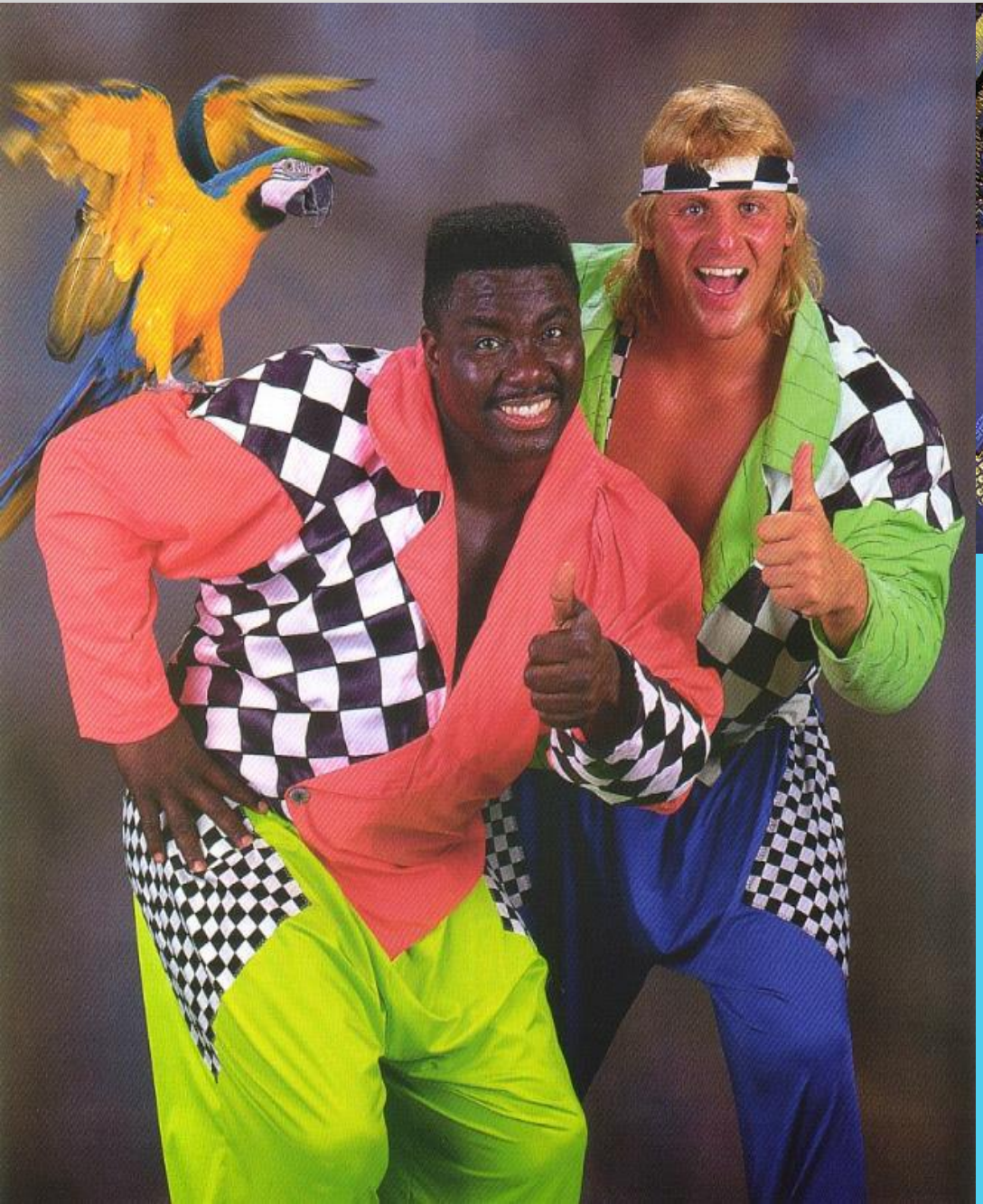
- MS Data Platform MVP
- From Cleveland, USA
- BI Manager at Progressive Insurance
- 15 years Web Development
- 7 years Business Intelligence

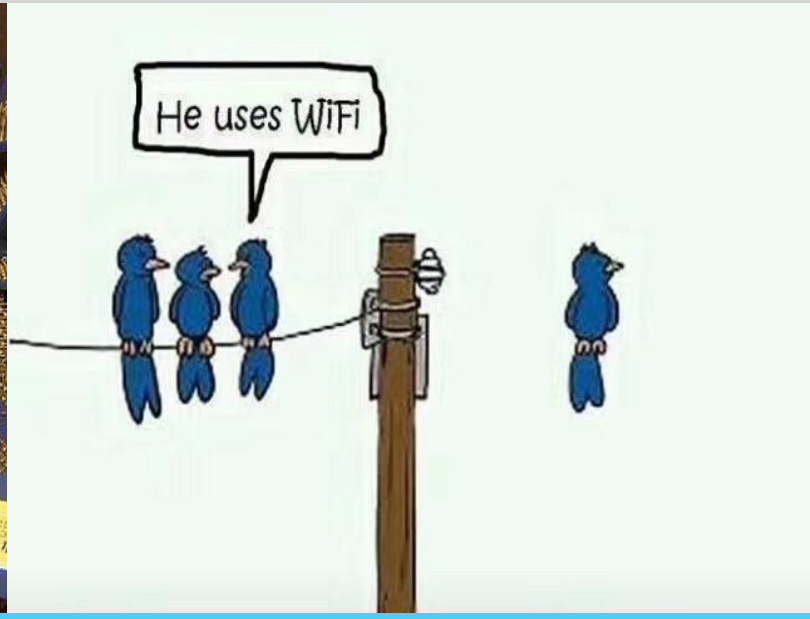
https://h-savran.blogspot.com/

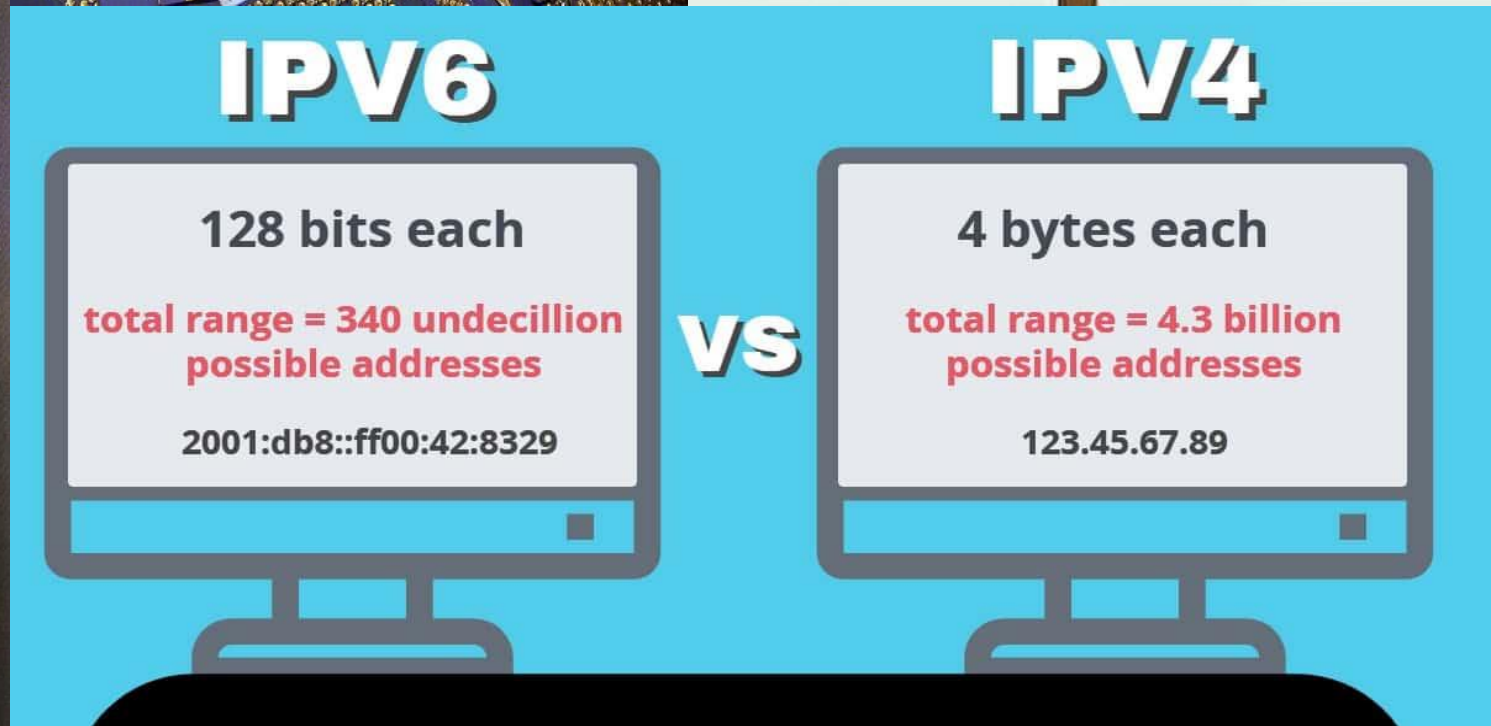
hasansavran

SavranWeb

IOT HISTORY




He uses WiFi


IPV6
128 bits each
total range = 340 undecillion possible addresses
2001:db8::ff00:42:8329
VS
IPV4
4 bytes each
total range = 4.3 billion possible addresses
123.45.67.89

FIRST IOT DEVICE

CSE 3002

1982

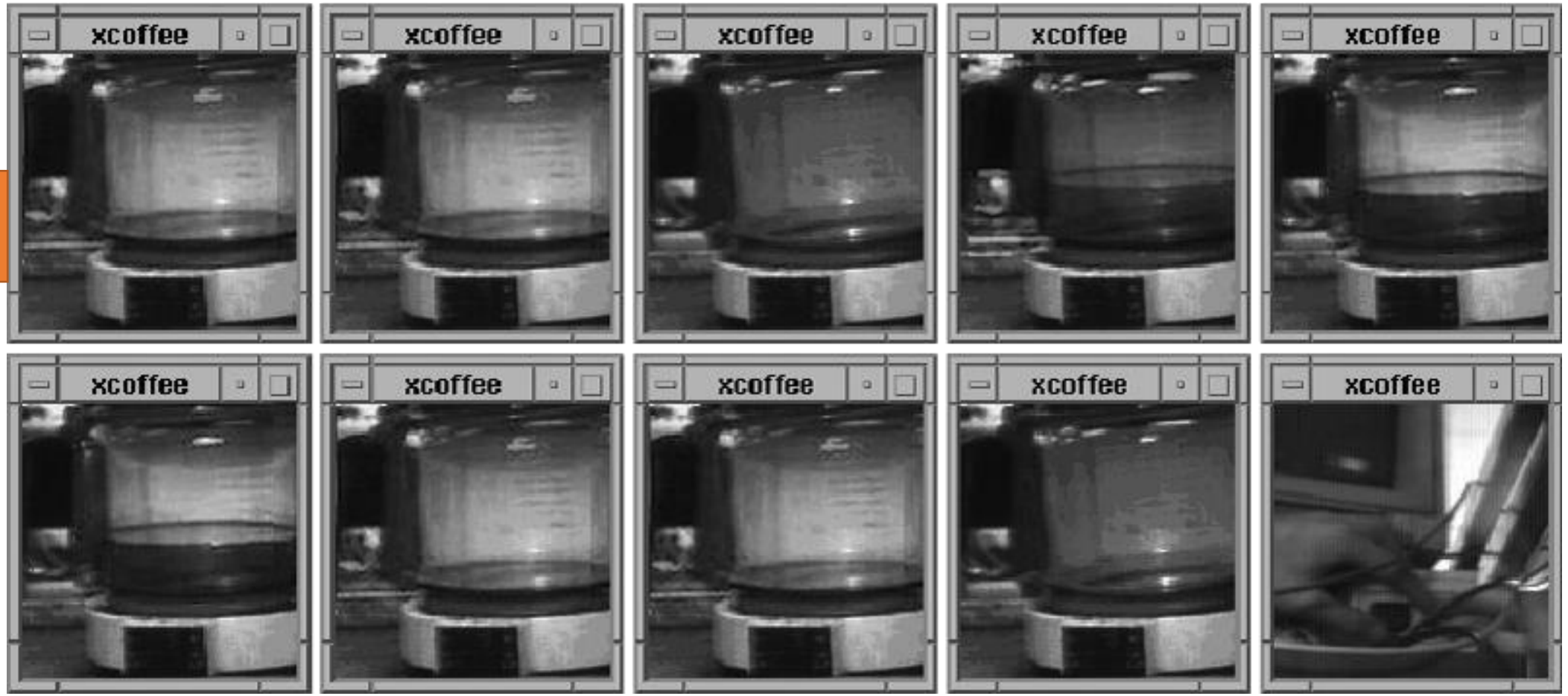
- Coke Machine 1982

FIRST TCP/IP CONNECTED DEVICE

1990

FIRST WEBCAMERA

1991

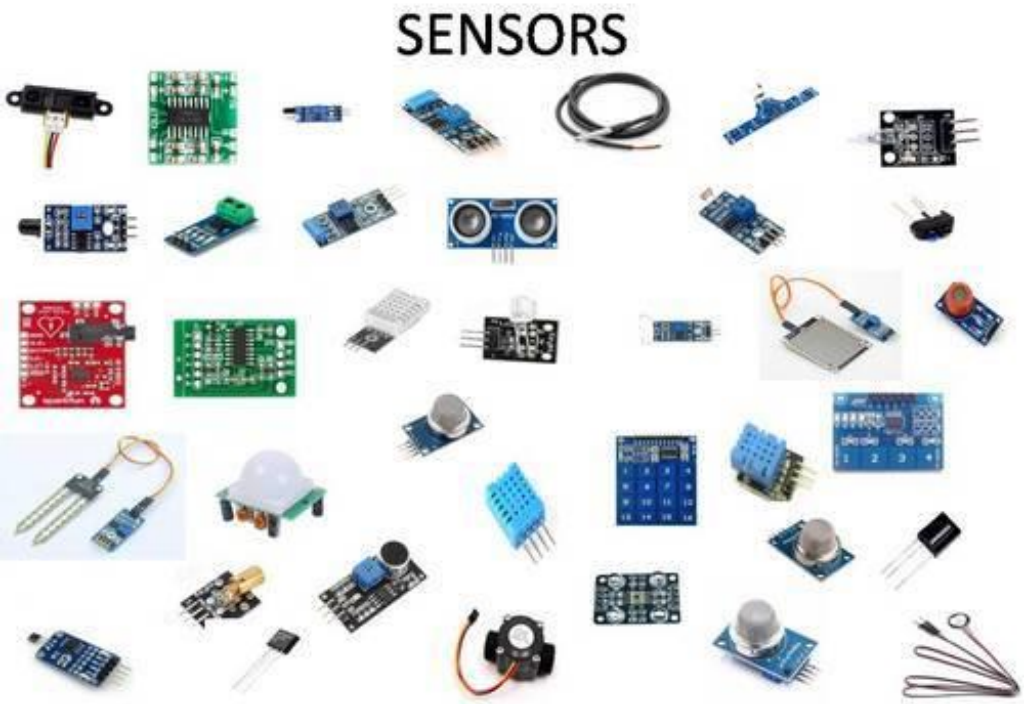


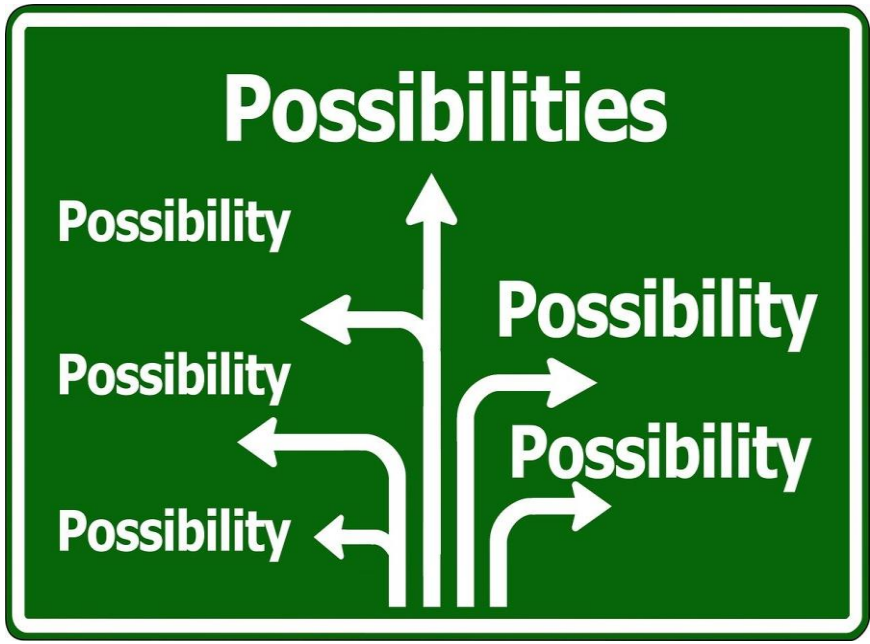
INTERNET CONNECTED REFRIGERATOR

2000

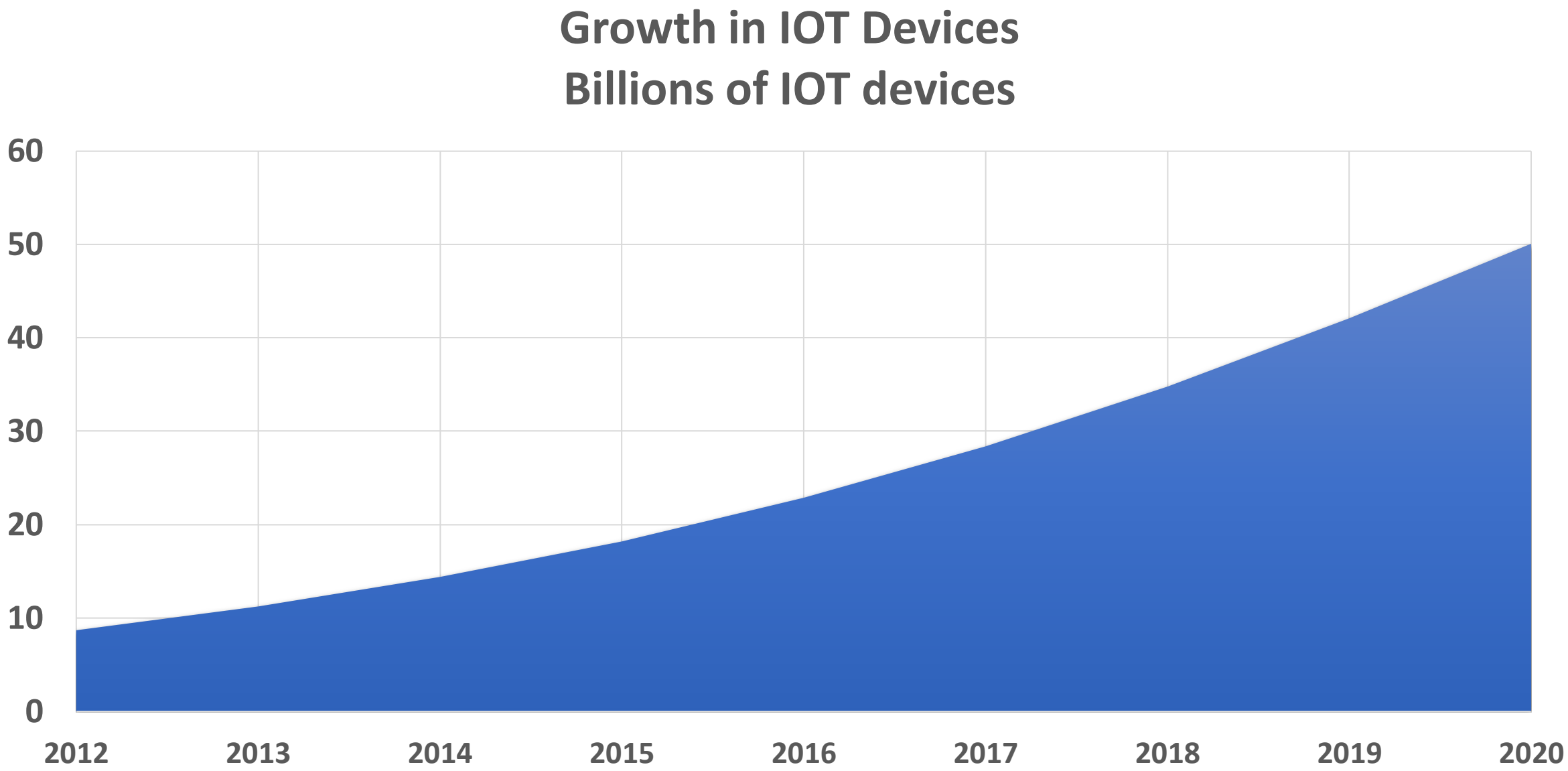
LG's DIOS R-S73CT
Original Price Tag: $20,000
Launched at CES 2000

WHAT IS IOT?


SENSORS

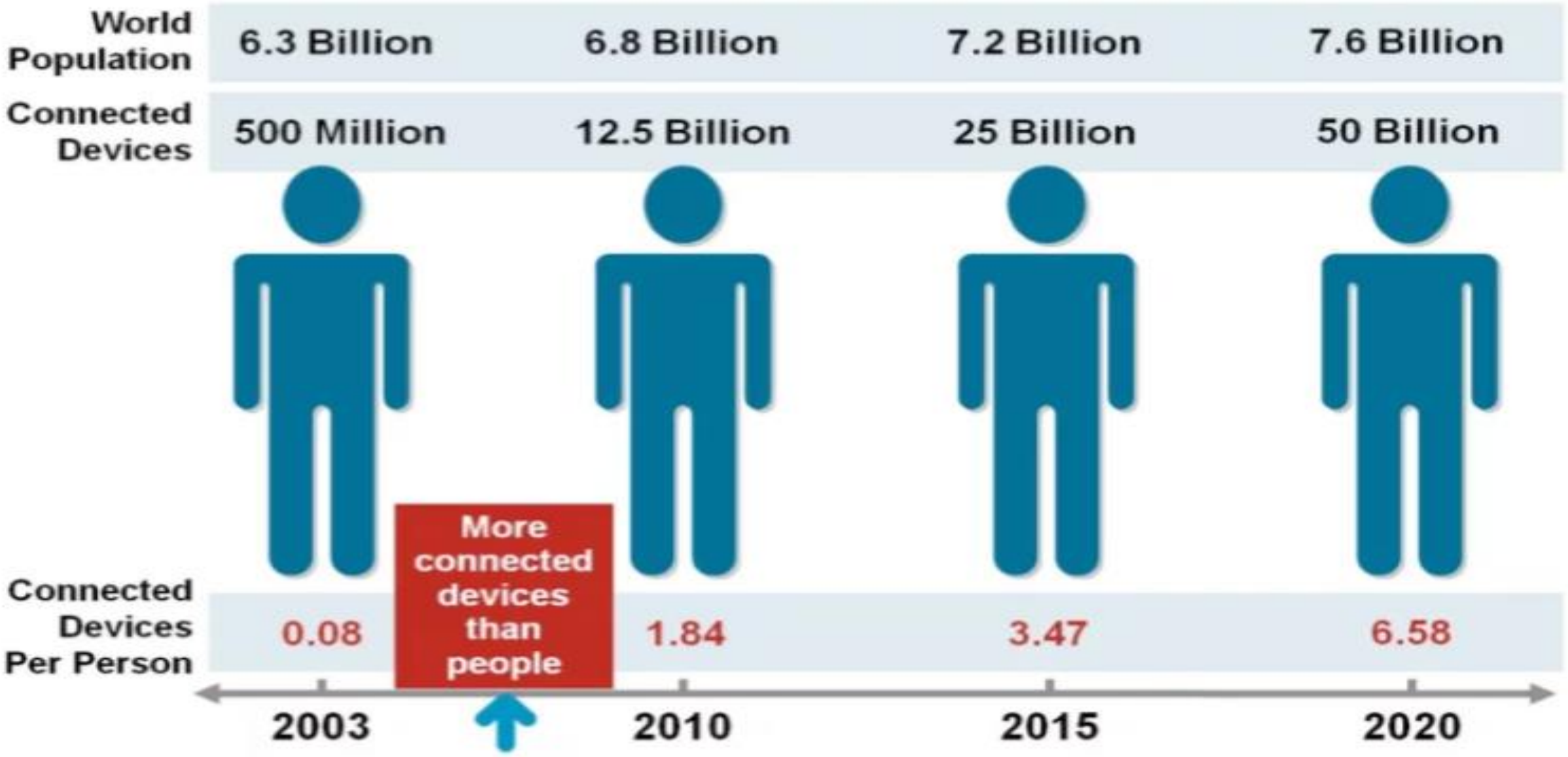

Possibilities
Possibility
Possibility
Possibility
Possibility
Possibility

IOT TREND



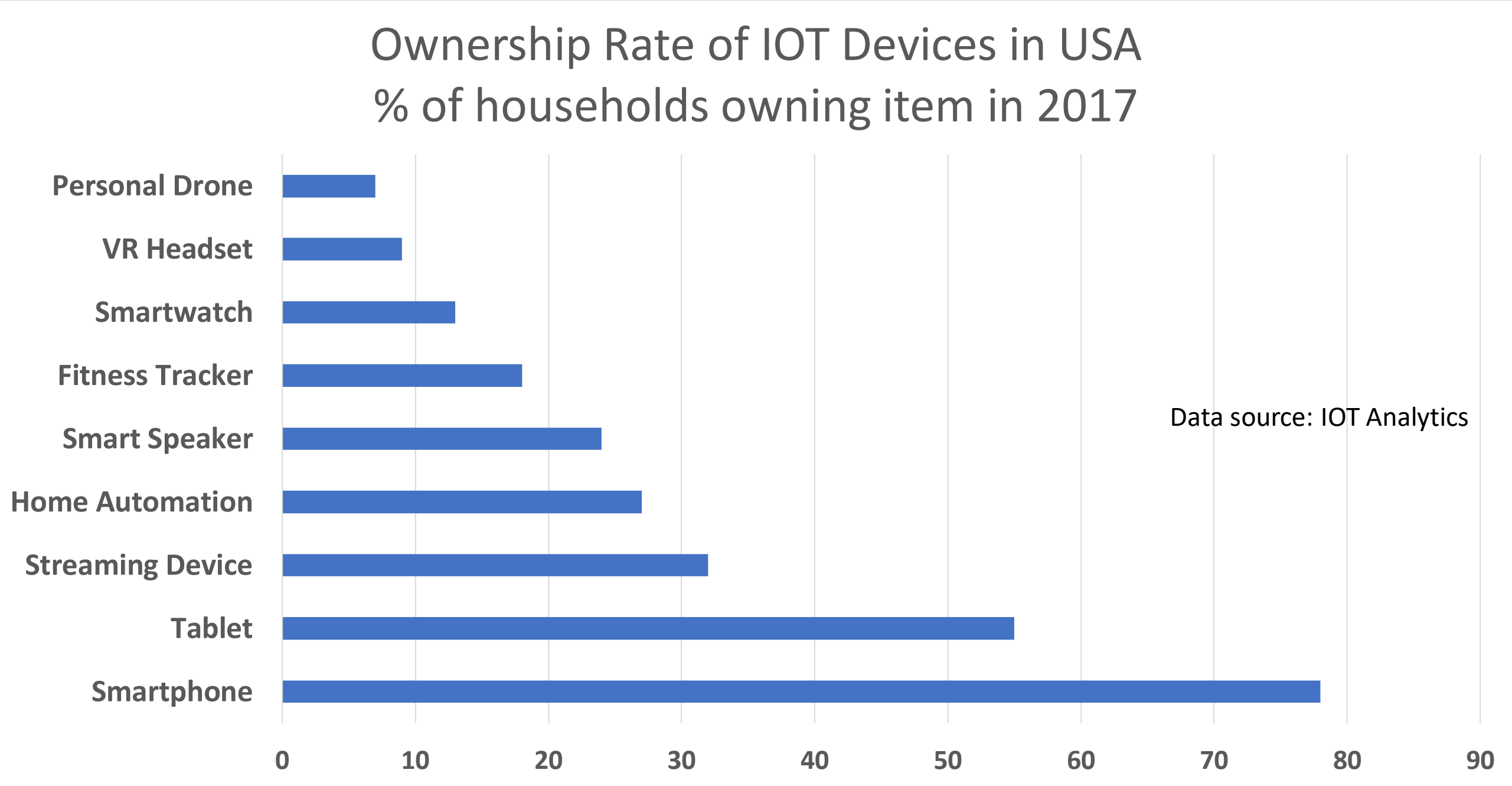
Data source: NCTA

IOT TREND



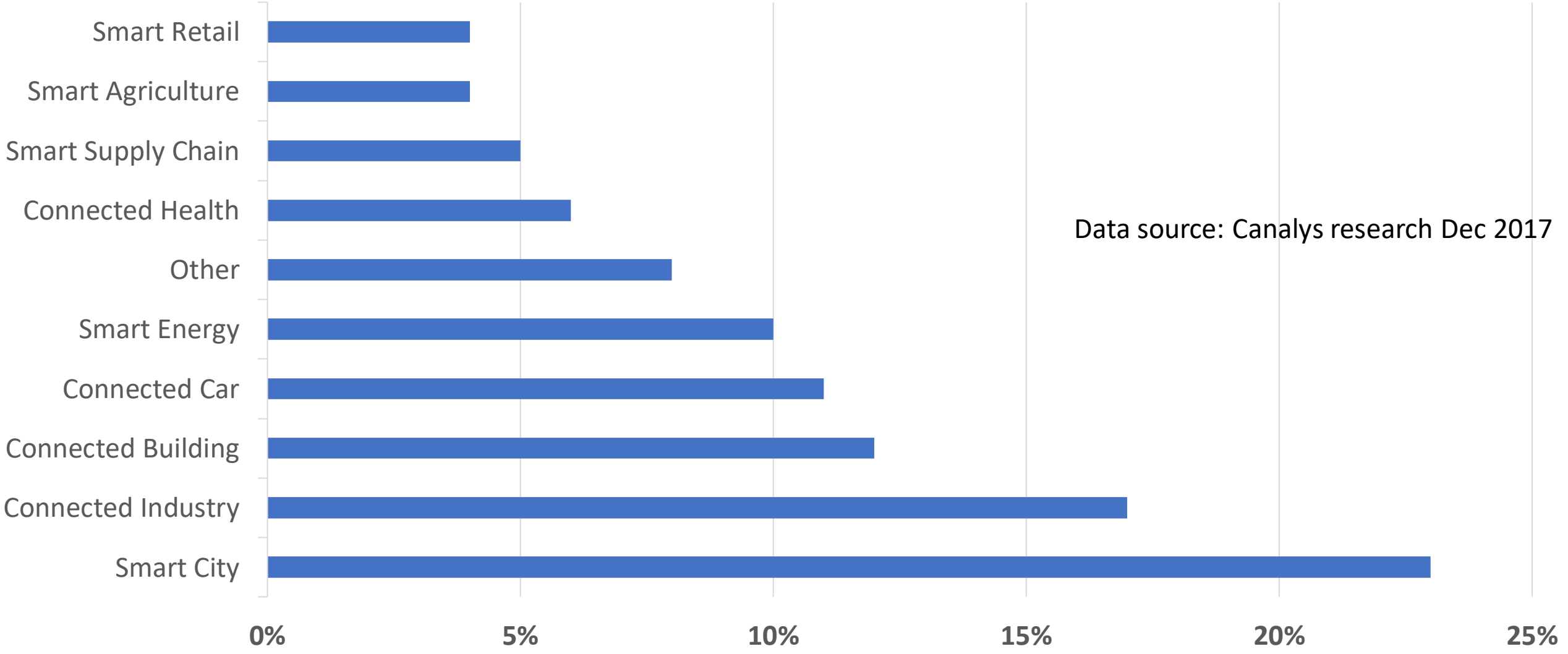
Source: Cisco IBSG, April 2011

IOT Trend


Ownership Rate of IOT Devices in USA
% of households owning item in 2017
Personal Drone
VR Headset
Smartwatch
Fitness Tracker
Smart Speaker
Home Automation
Streaming Device
Tablet
Smartphone
Data source: IOT Analytics
0
10
20
30
40
50
60
70
80
90

IOT TREND

Large-Scale Uses of IOT
Global share of IOT by category



IOT CONNECTIONS

High Power
High Range
High Bandwidth

Low Power
Low Range
High Bandwidth

Low Power
Low Range
High Bandwidth

LPWAN
Low-Power Wide-Area Network

Low Power
High Range
Low Bandwidth

IOT SECURITY ISSUES

Hardcoded
Default Passwords

Not strong to support
advanced security features

AZURE IOT HUB

- Managed Service hosted in Cloud
- Central Hub
- Reliable and Secure
- Scalable

AZURE IOT HUB SCALING

Basic tier

EDITION TYPE	PRICE PER IOT HUB UNIT (PER MONTH)	TOTAL NUMBER OF MESSAGES/DAY PER IOT HUB UNIT	MESSAGE METER SIZE
B1	$10	400,000	4 KB
B2	$50	6,000,000	4 KB
B3	$500	300,000,000	4 KB

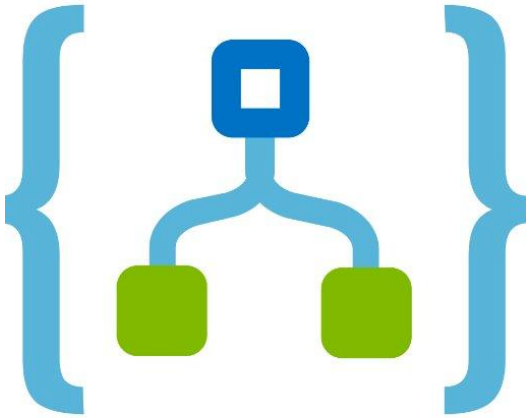
Standard tier

EDITION TYPE	PRICE PER IOT HUB UNIT (PER MONTH)	TOTAL NUMBER OF MESSAGES/DAY PER IOT HUB UNIT	MESSAGE METER SIZE
Free	Free	8,000	0.5 KB
S1	$25	400,000	4 KB
S2	$250	6,000,000	4 KB
S3	$2,500	300,000,000	4 KB

AZURE PRODUCTS TO USE WITH IOT HUB

Event Grid

For Critical Events



Logic Apps

Automate Business Processes

Machine Learning

Add AI models

Stream Analytics

Real-Time Analytics

AZURE IOT HUB EDGE

- Less Network calls
- Responsive to Local changes
- Reliable in offline periods
- Containers

AZURE SQL EDGE

SQL Server 2019 on Linux
Ubuntu 18.04
Database Engine Only

64-bit processor (x64 or ARM64)
1 CPU & 1 GB RAM
Startup Mem Footprint is 450 MB

AZURE SQL EDGE

SQL Streaming
Date-Bucket T-SQL function
ONNX runtime

$10.001/device/month
$100/device/year (Reserved for 1 year)
$60/device/year (Reserved for 3 years)

AZURE SQL EDGE

AZURE IOT EDGE RUNTIME

- Turns a device into IOT Edge Device
- Install & Update Workloads
- Maintain Security Standards
- Manage IOT Edge Modules
- Report module health
- Manage communication

IOT EDGE RUNTIME MODULES

IoT Edge Agent

Instantiating Modules
Reporting the Status

200 - OK
400 - THE DEPLOYMENT CONFIGURATION IS MALFORMED OR INVALID.
417 - THE DEVICE DOESN'T HAVE A DEPLOYMENT CONFIGURATION SET.
412 - THE SCHEMA VERSION IN THE DEPLOYMENT CONFIGURATION IS INVALID.
406 - THE IOT EDGE DEVICE IS OFFLINE OR NOT SENDING STATUS REPORTS.
500 - AN ERROR OCCURRED IN THE IOT EDGE RUNTIME.

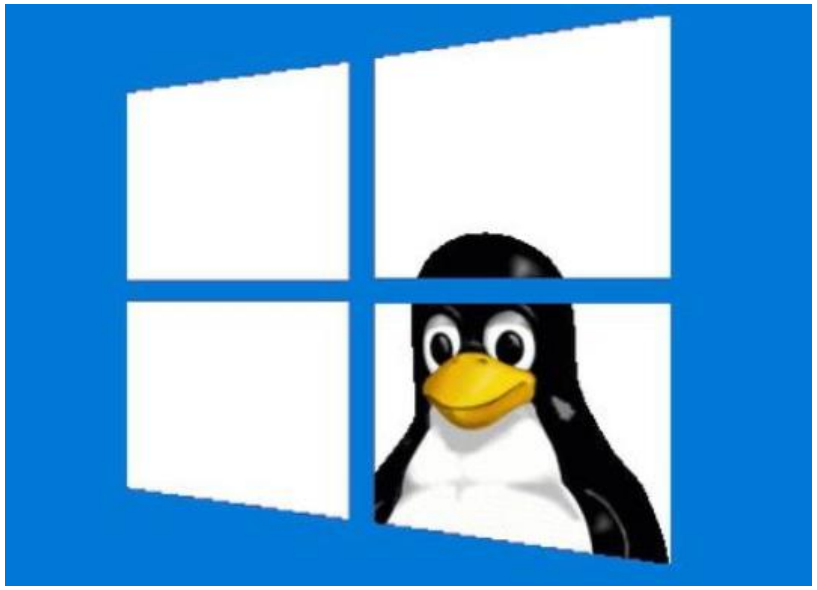
IoT Edge Hub

Acts as a local proxy for IoT Hub
Reporting the Status
Communicates Cloud

RASPBERRY PI

- CPU – Broadcom BCM2711, Quad core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz
- RAM – 1GB, 2GB or 4GB LPDDR4-2400 SDRAM (depending on model)
- WiFI – 2.4 GHz and 5.0 GHz IEEE 802.11ac wireless, Bluetooth 5.0, BLE
- Ethernet – Gigabit
- USB – 2 USB 3.0 ports; 2 USB 2.0 ports
- GPIO header – Raspberry Pi standard 40 pin
- HDMI – 2 × micro-HDMI ports (up to 4kp60 supported)
- Display port – 2-lane MIPI DSI
- Camera port – 2-lane MIPI CSI
- Audio – 4-pole stereo audio and composite video port
- Storage – Micro-SD card slot for loading operating system and data storage
- OS – Debian Linux 10 based

CONNECTING TO LINUX FROM WINDOWS



Use PowerShell to install OpenSSH

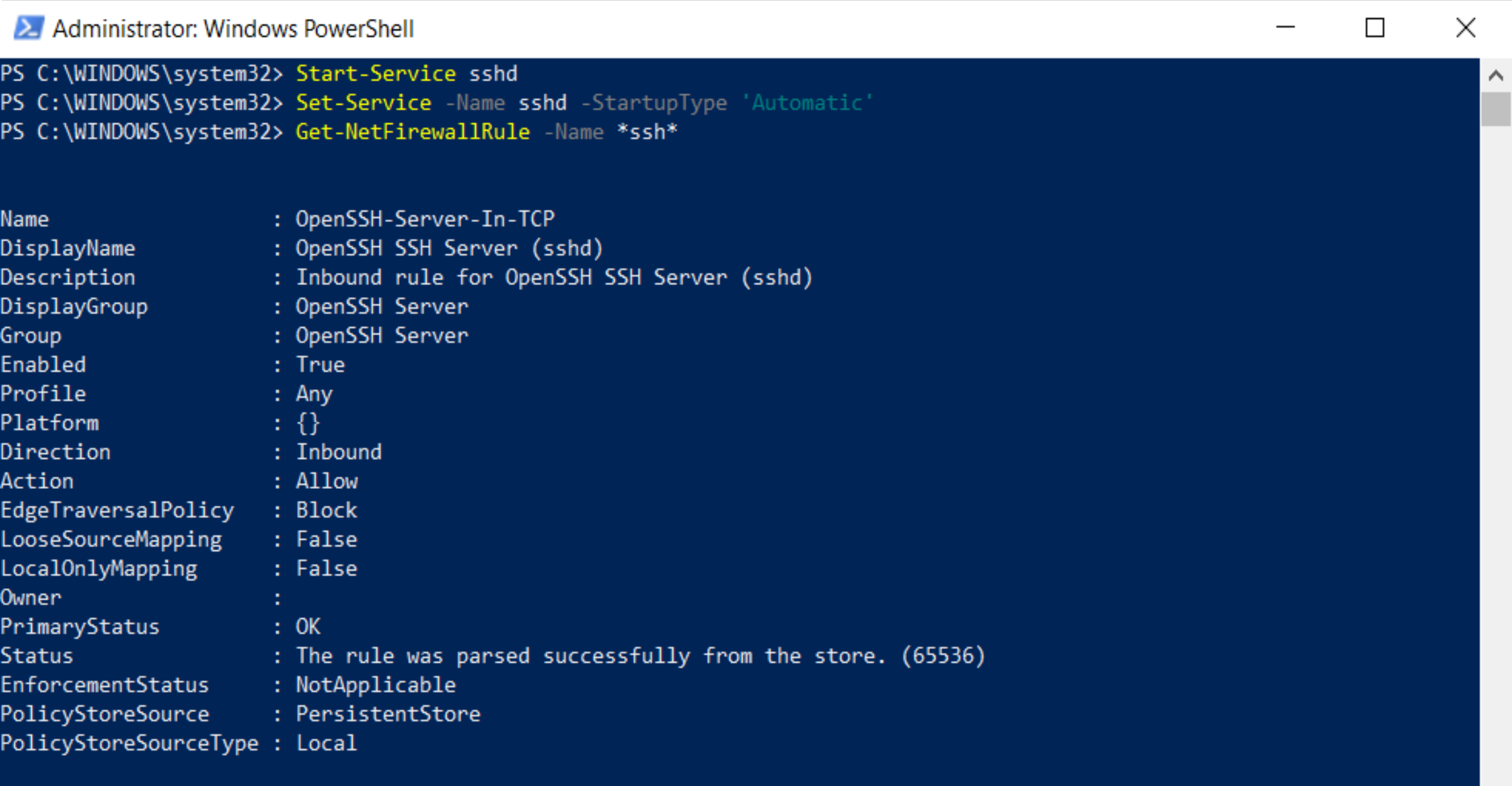
OpenSSH is the premier connectivity tool for remote login with the SSH protocol

INSTALL OPENSSH WITH POWERSHELL

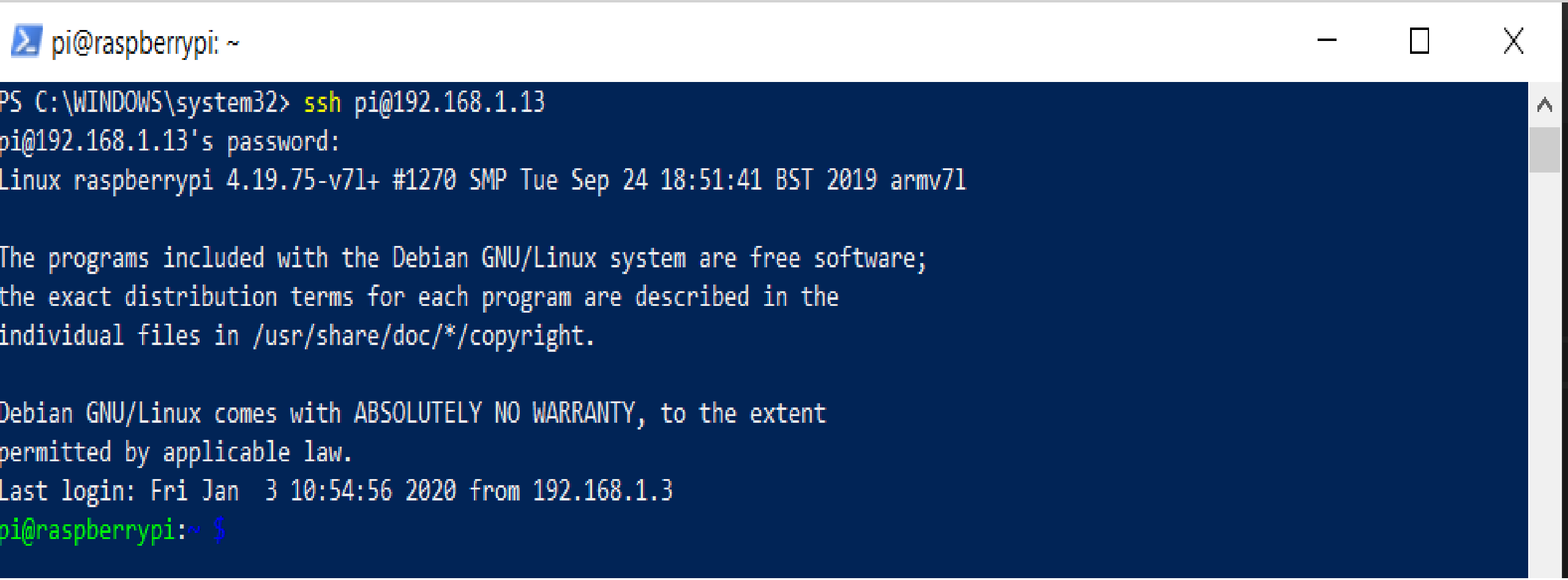
Administrator: Windows PowerShell

```
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

Try the new cross-platform PowerShell https://aka.ms/pscore6

PS C:\WINDOWS\system32> Add-WindowsCapability -Online -Name OpenSSH.Client~~~~0.0.1.0


Path          :
Online        : True
RestartNeeded : False



PS C:\WINDOWS\system32> Add-WindowsCapability -Online -Name OpenSSH.Server~~~~0.0.1.0


Path          :
Online        : True
RestartNeeded : False



PS C:\WINDOWS\system32>
```

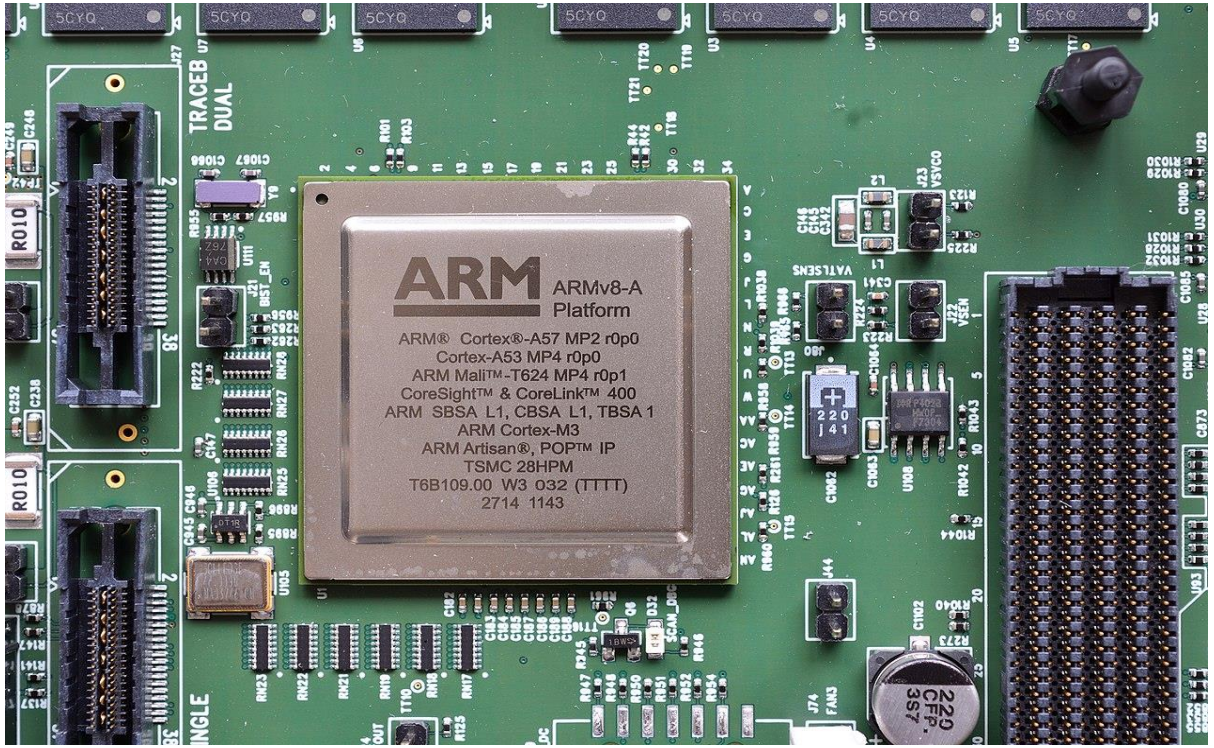
ENABLE OPEN SSH WITH POWERSHELL

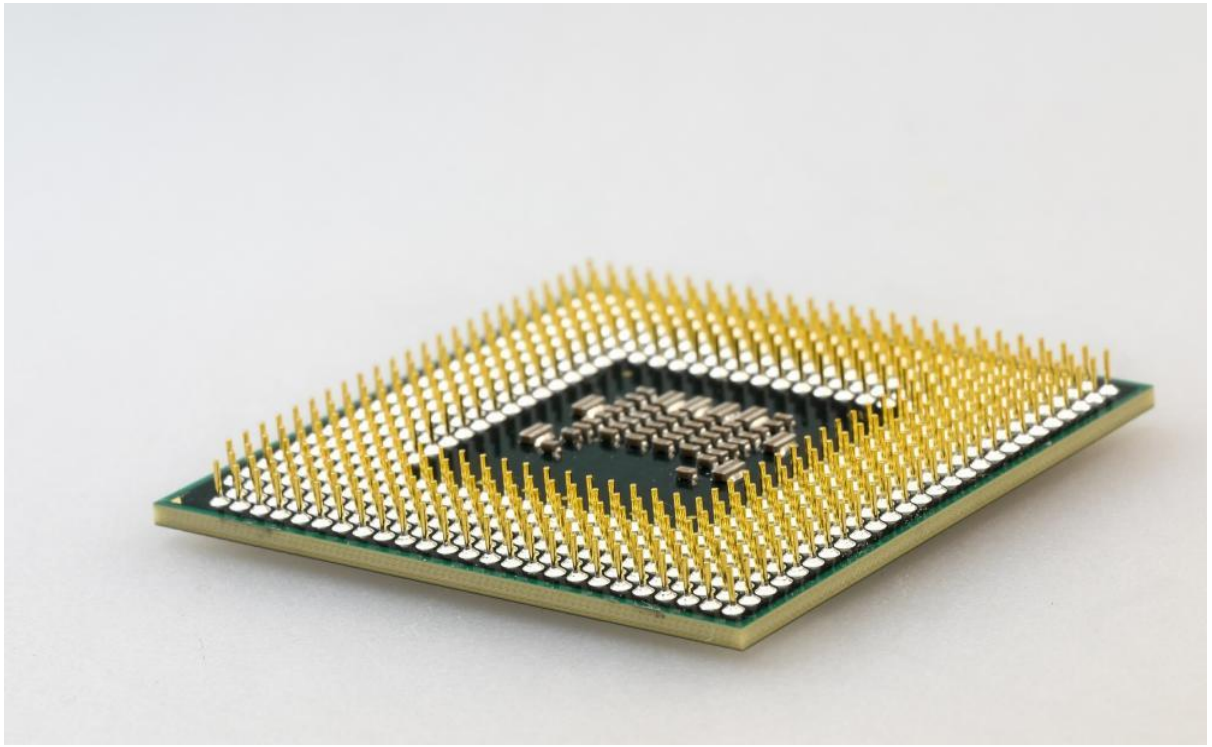


CONNECT TO RASPBERRY PI



CPU ARCHITECTURE

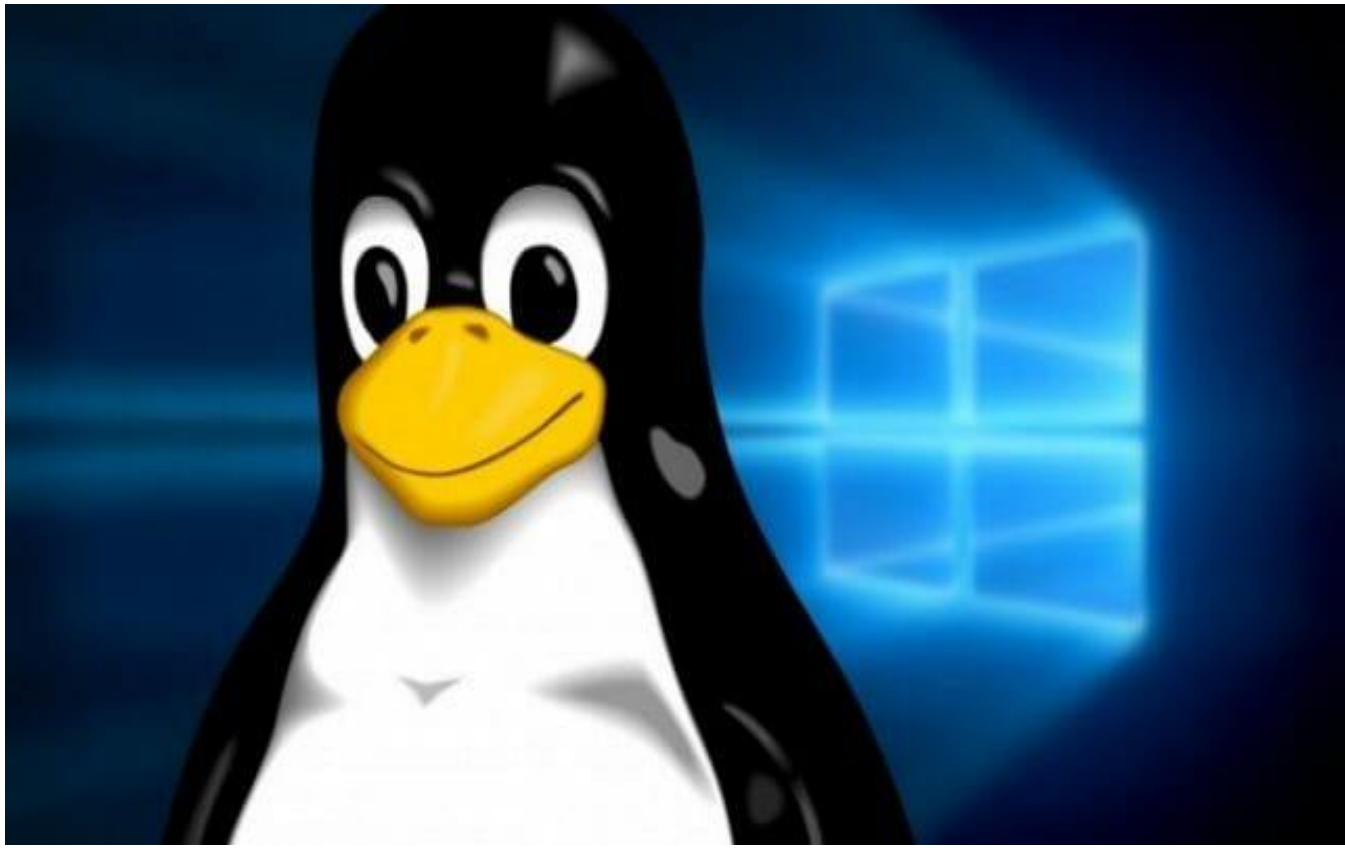




ARM32v7
ARM64

AMD64

AZURE IOT EDGE SUPPORTED SYSTEMS



IoT Edge modules are implemented as containers

Supported Operating Systems are grouped into tiers

TIER 1 SUPPORT

Operating System	AMD64	ARM32v7	ARM64
Raspberry Pi OS Stretch		✓	
Ubuntu Server 16.04	✓		Public preview
Ubuntu Server 18.04	✓		Public preview
Windows 10 IoT Enterprise, build 17763	✓		
Windows 10 IoT Core, build 17763	✓		
Windows Server 2019, build 17763	✓		
Windows Server IoT 2019, build 17763	✓		

TIER 2 SUPPORT

Operating System	AMD64	ARM32v7	ARM64
CentOS 7.5	✓	✓	✓
Debian 8	✓	✓	✓
Debian 9	✓	✓	✓
Debian 10 [1]	✓	✓	✓
Mentor Embedded Linux Flex OS	✓	✓	✓
Mentor Embedded Linux Omni OS	✓		✓
RHEL 7.5	✓	✓	✓
Ubuntu 16.04	✓	✓	✓
Ubuntu 18.04	✓	✓	✓
Wind River 8	✓		
Yocto	✓	✓	✓
Raspberry Pi OS Buster [1]		✓	✓
Ubuntu 20.04 [2]	✓	✓	✓

INSTALLING RUNTIME FOR TIER 1

UBUNTU SERVER 16.04

```
curl https://packages.microsoft.com/config/ubuntu/16.04/prod.list > ./microsoft-prod.list
```

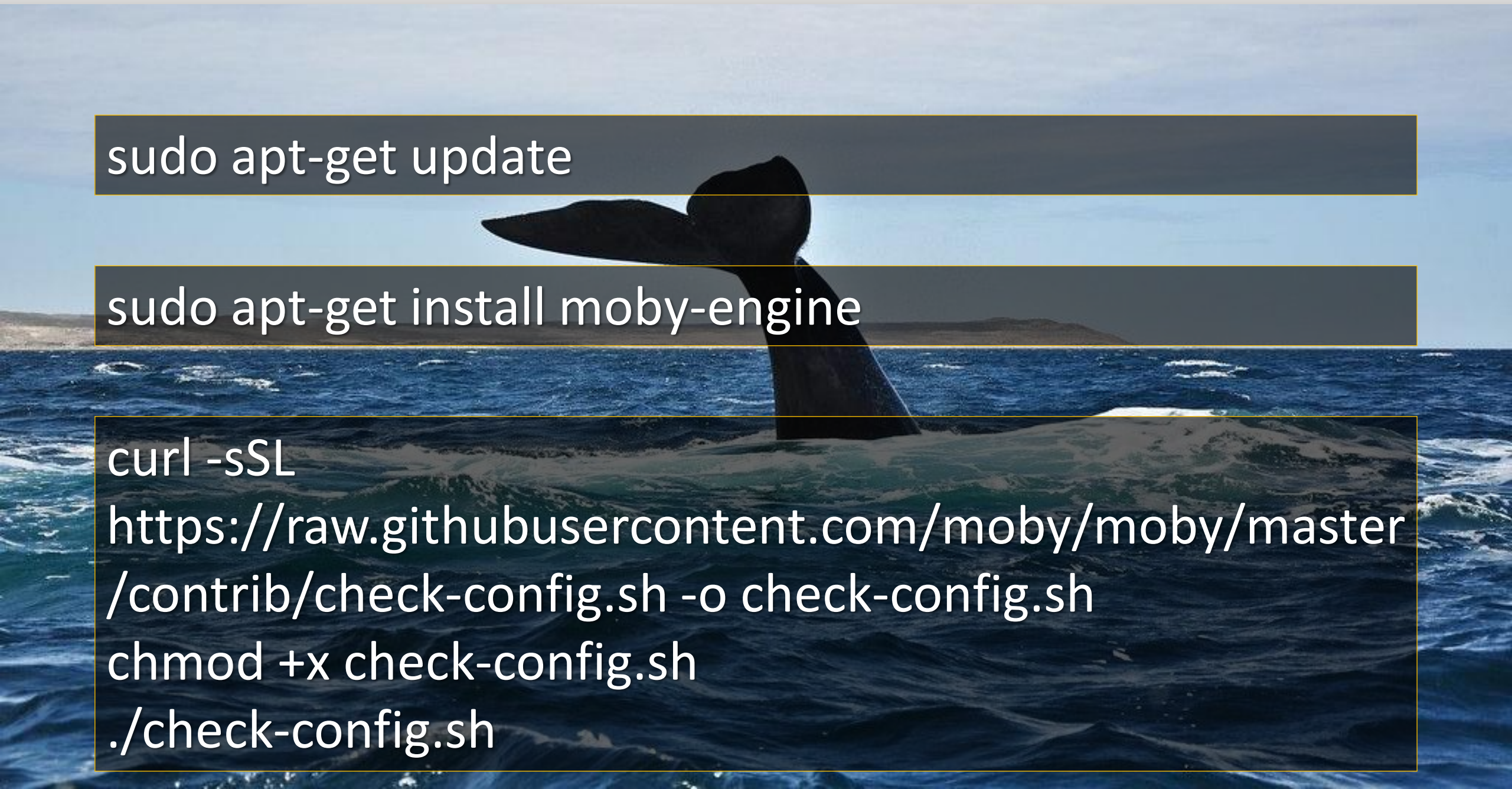
```
sudo cp ./microsoft-prod.list /etc/apt/sources.list.d/
```

INSTALLING PGP FOR TIER 1 & 2

```
curl https://packages.microsoft.com/keys/microsoft.asc
| gpg --dearmor > microsoft.gpg
```

```
sudo cp ./microsoft.gpg /etc/apt/trusted.gpg.d/
```

INSTALLING CONTAINER ENGINE FOR TIER 1 & 2



```
sudo apt-get update
```

```
sudo apt-get install moby-engine
```

```
curl -sSL
https://raw.githubusercontent.com/moby/moby/master
/contrib/check-config.sh -o check-config.sh
chmod +x check-config.sh
./check-config.sh
```

IOT EDGE SECURITY DAEMON FOR TIER 1

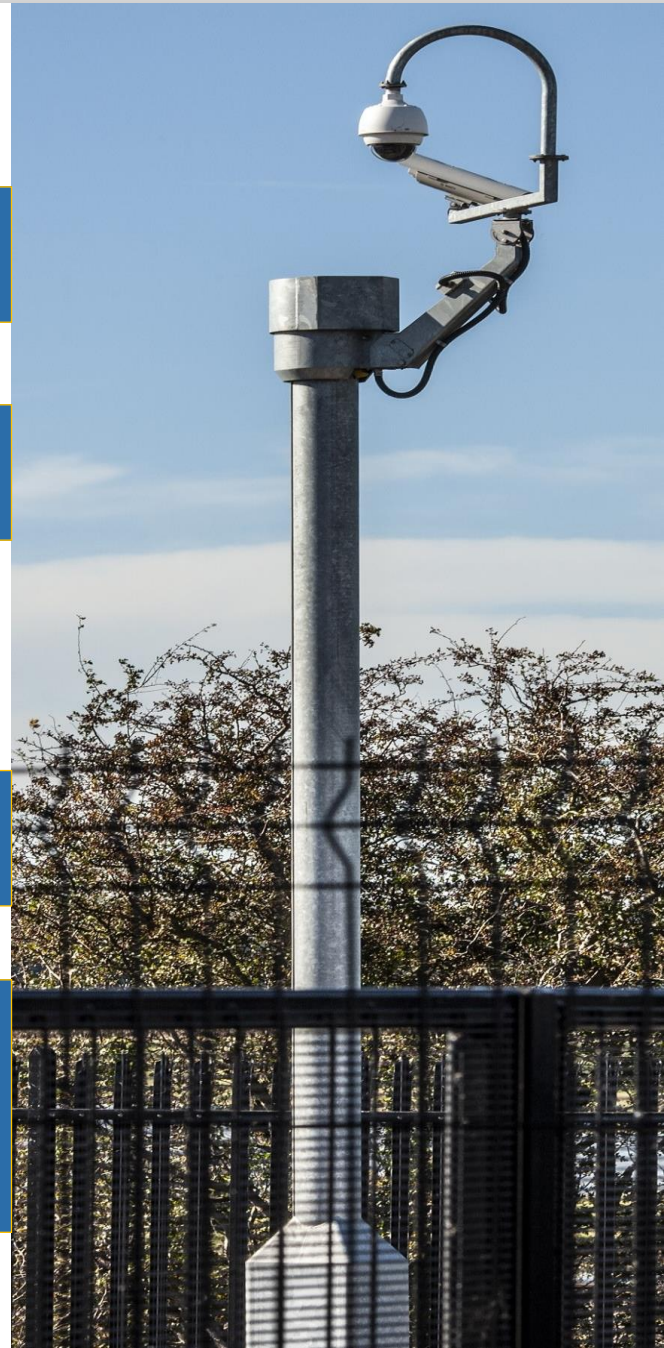
```
sudo apt-get update
```

```
sudo apt-get install iotedge
```

Looking for a specific of IOT Edge?

```
apt list –a iotedge
```

```
sudo apt-get install iotedge=1.0.8* libiothsm-std=1.0.8*
```



MANUAL INSTALLATION FOR TIER 2

ubuntu.pkgs.org/18.04/ubuntu-updates-main-arm64/libssl1.0.0_1.0.2n-1ubuntu5.5_arm64.deb.html

pkgs.org About Contributors Linux Unix Support Us Example: mplayer

Alternatives

Package	Version	Arch	Repository
libssl1.0.0_1.0.2n-1ubuntu5.5_amd64.deb	1.0.2n	amd64	Ubuntu Updates Main Official
libssl1.0.0_1.0.2n-1ubuntu5.5_armhf.deb	1.0.2n	armhf	Ubuntu Updates Main Official
libssl1.0.0_1.0.2n-1ubuntu5.5_i386.deb	1.0.2n	i386	Ubuntu Updates Main Official
libssl1.0.0_1.0.2n-1ubuntu5_amd64.deb	1.0.2n	amd64	Ubuntu Main Official
libssl1.0.0_1.0.2n-1ubuntu5_arm64.deb	1.0.2n	arm64	Ubuntu Main Official
libssl1.0.0_1.0.2n-1ubuntu5_armhf.deb	1.0.2n	armhf	Ubuntu Main Official
libssl1.0.0_1.0.2n-1ubuntu5_i386.deb	1.0.2n	i386	Ubuntu Main Official
libssl1.0.0	All	All	All

Requires

Name	Value
debconf	>= 0.5
debconf-2.0	-
libc6	>= 2.17

Required By

Search Packages

Download

Type	URL
Mirror	ports.ubuntu.com
Binary Package	http://ports.ubuntu.com/pool/main/o/openssl1.0/libssl1.0.0_1.0.2n-1ubuntu5.5_arm64.deb
Source Package	openssl1.0

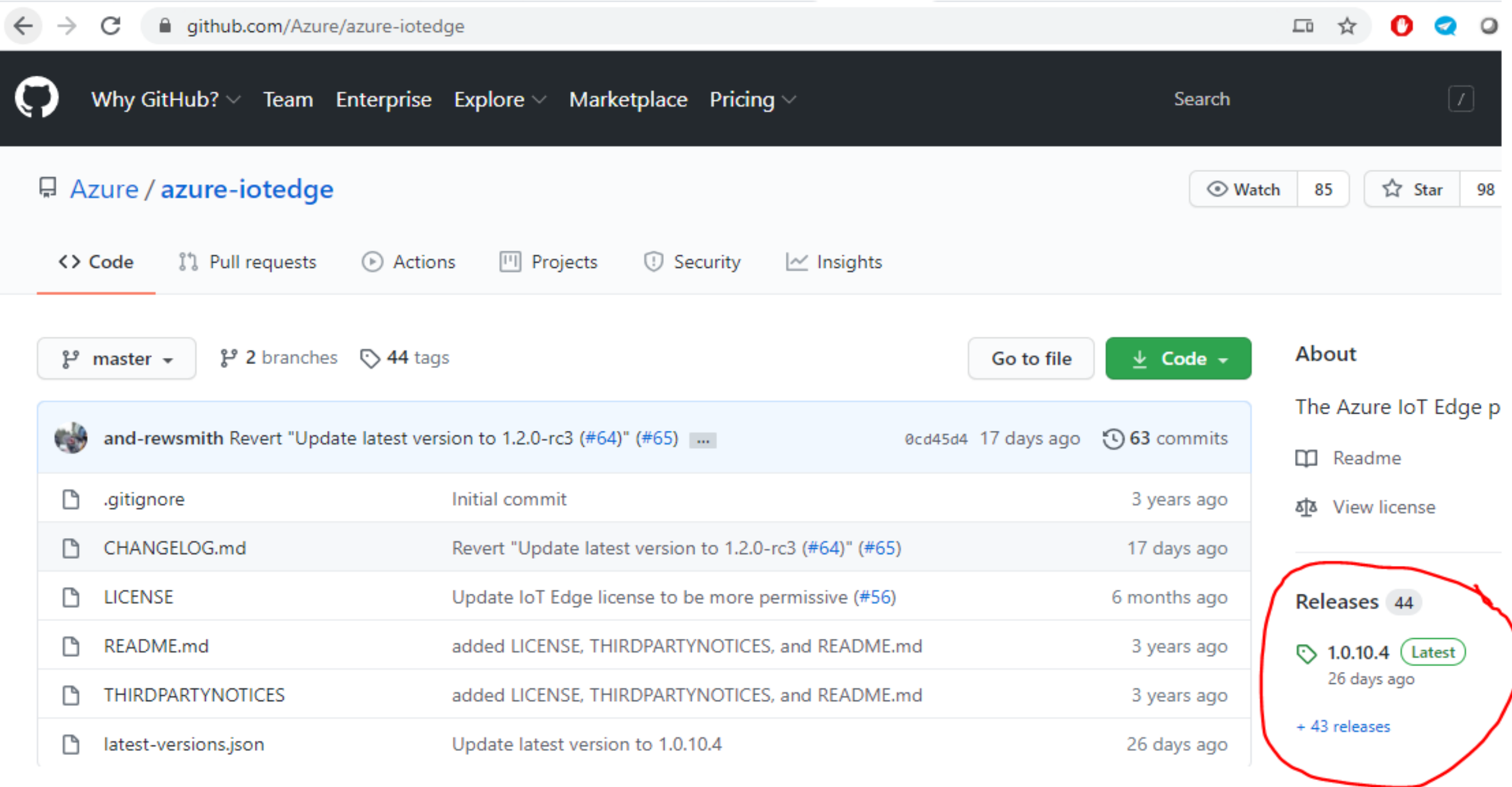
INSTALLING LIBSSL1.0.0

```
ubuntu@ubuntu:~$ curl http://ports.ubuntu.com/pool/main/o/openssl1.0/libssl1.0.0_1.0.2n-1ubuntu5_arm64.deb > test.deb
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100  705k  100  705k    0     0   618k      0  0:00:01  0:00:01 --:--:--  618k


ubuntu@ubuntu:~$ sudo dpkg -i ./test.deb
Selecting previously unselected package libssl1.0.0:arm64.
(Reading database ... 177089 files and directories currently installed.)
Preparing to unpack ./test.deb ...
Unpacking libssl1.0.0:arm64 (1.0.2n-1ubuntu5) ...
Setting up libssl1.0.0:arm64 (1.0.2n-1ubuntu5) ...
Processing triggers for libc-bin (2.31-0ubuntu9.1) ...
```

INSTALLING LIBSSL1.0.0

```
ubuntu@ubuntu:~$ sudo apt-get install libssl1.0.0
Reading package lists... Done
Building dependency tree
Reading state information... Done
libssl1.0.0 is already the newest version (1.0.2n-1ubuntu5).
0 upgraded, 0 newly installed, 0 to remove and 51 not upgraded.
2 not fully installed or removed.
After this operation, 0 B of additional disk space will be used.
Do you want to continue? [Y/n] Y
Setting up libiothsm-std (1.0.10.4-1) ...
```

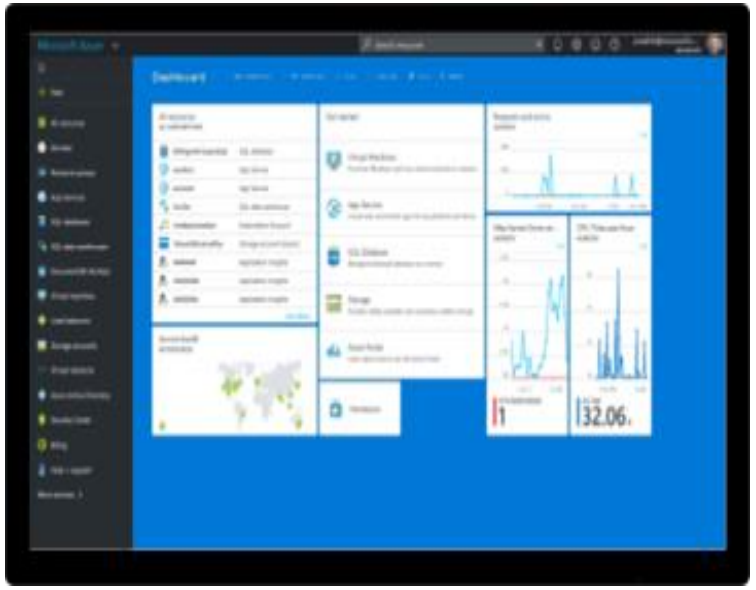
MANUAL INSTALLATION FOR TIER 2



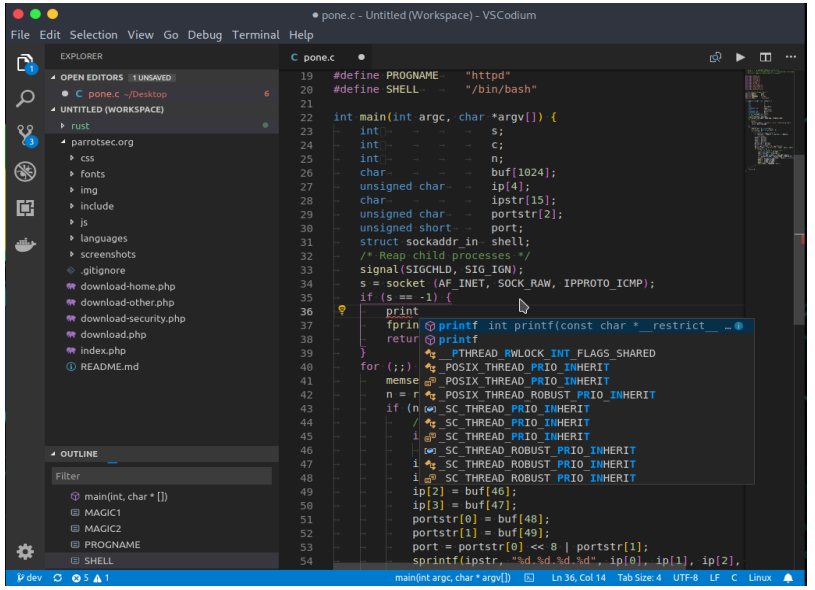
INSTALLING IOTEDGE

```
Setting up iotedge (1.0.10.4-1) ...
================================================================================

                              Azure IoT Edge

  IMPORTANT: Please update the configuration file located at:

    /etc/iotedge/config.yaml

  with your device's provisioning information. You will need to restart the
  'iotedge' service for these changes to take effect.

  To restart the 'iotedge' service, use:

    'systemctl restart iotedge'

    - OR -

    /etc/init.d/iotedge restart

  These commands may need to be run with sudo depending on your environment.

================================================================================
Created symlink /etc/systemd/system/sockets.target.wants/iotedge.mgmt.socket → /lib/systemd/system/iotedge.mgmt.socket.
Created symlink /etc/systemd/system/multi-user.target.wants/iotedge.service → /lib/systemd/system/iotedge.service.
Created symlink /etc/systemd/system/sockets.target.wants/iotedge.socket → /lib/systemd/system/iotedge.socket.
Processing triggers for systemd (245.4-4ubuntu3.3) ...
```

REGISTERING YOUR DEVICE

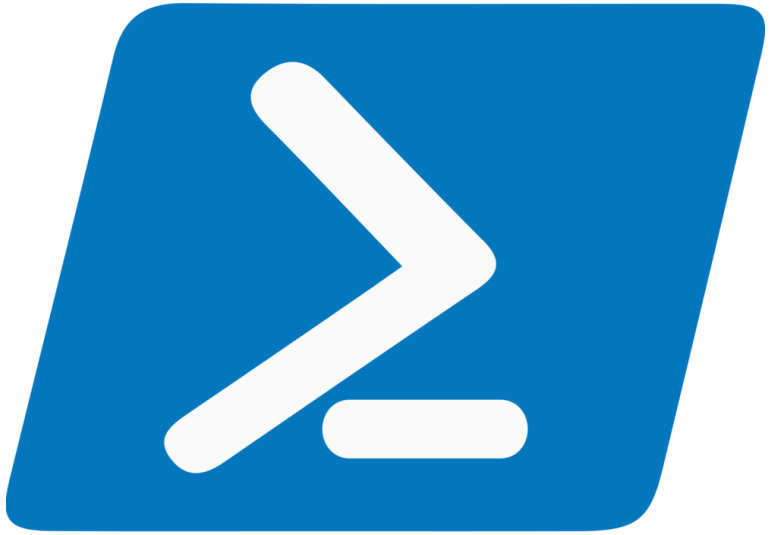


Azure Portal



VS Code

Azure IOT Tools Extension



Azure CLI

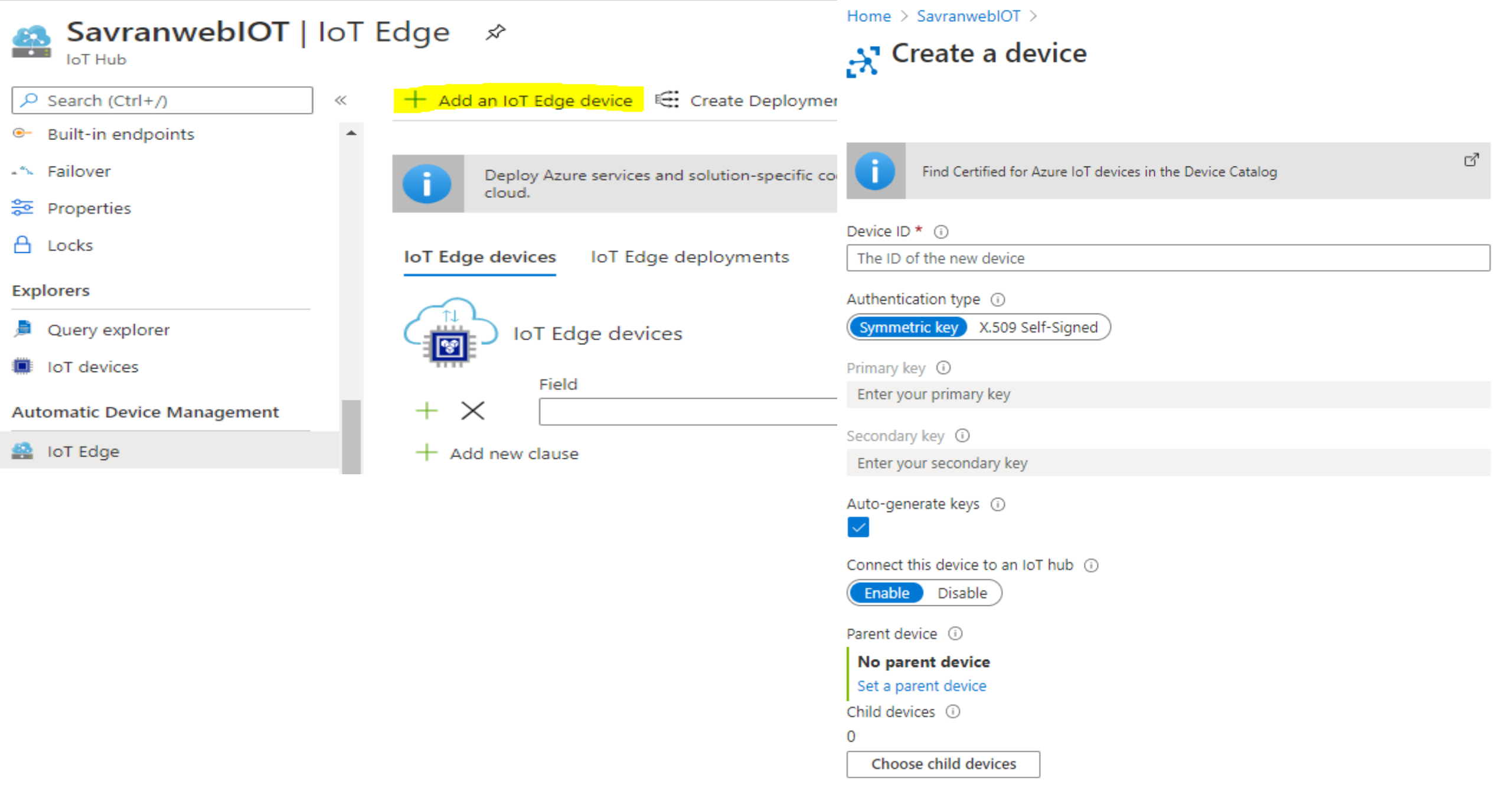
2.0.70 or newer version
IOT Extension for Azure CLI

AUTHENTICATING IOT EDGE DEVICES

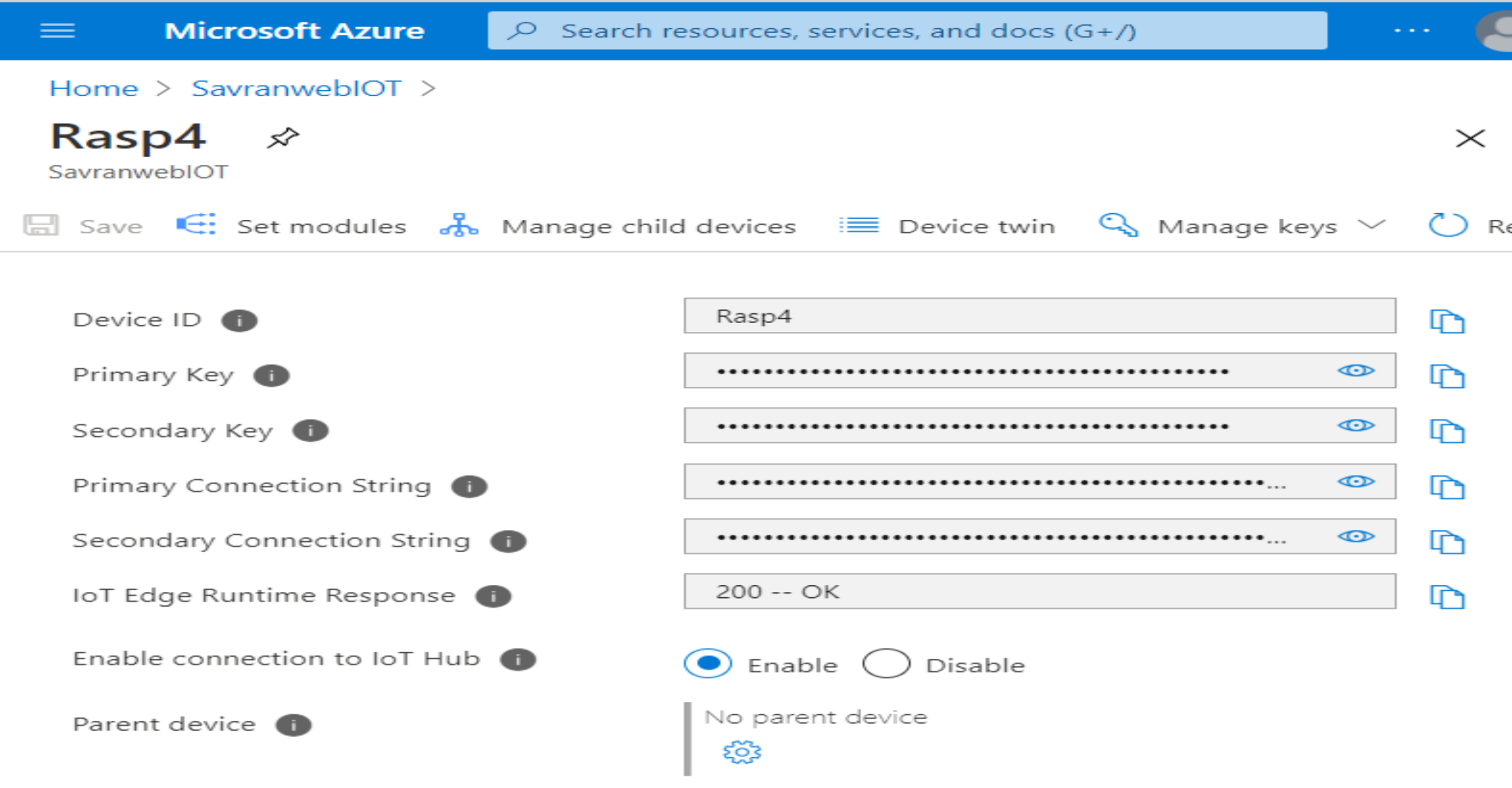
Symmetric Key Authentication

X.509 Certificate Authentication

REGISTERING YOUR DEVICE



REGISTERING YOUR DEVICE



PROVISION IOT EDGE DEVICE

sudo nano /etc/iotedge/config.yaml

```
##############################################################################

# Manual provisioning configuration
provisioning:
  source: "manual"
  device_connection_string: "<ADD DEVICE CONNECTION STRING HERE>"
```

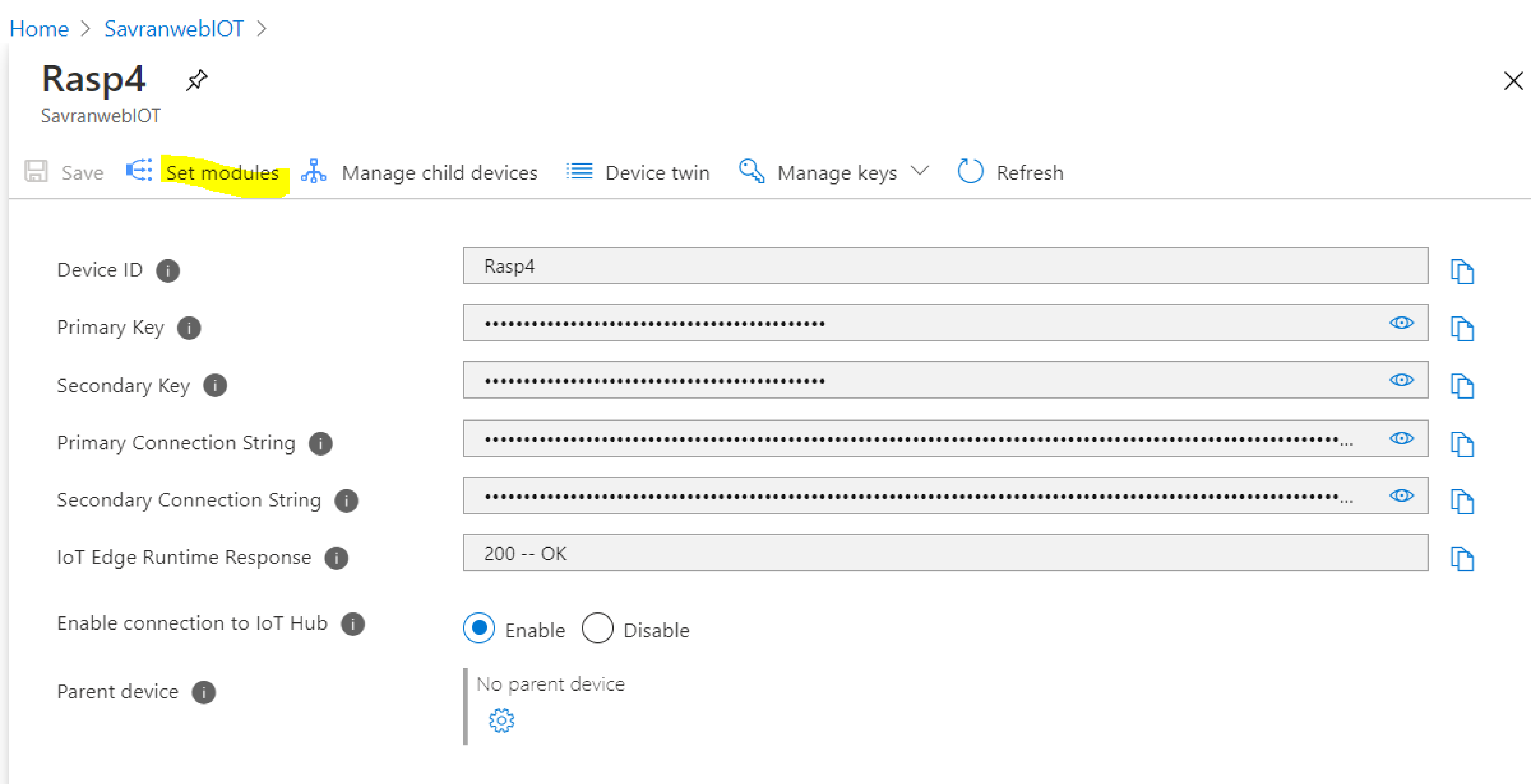
sudo systemctl restart iotedge

systemctl status iotedge

START IOTEDGE

```
ubuntu@ubuntu:~$ sudo systemctl restart iotedge
ubuntu@ubuntu:~$ sudo iotedge check
Configuration checks
--------------------
√ config.yaml is well-formed - OK
√ config.yaml has well-formed connection string - OK
√ container engine is installed and functional - OK
√ config.yaml has correct hostname - OK
√ config.yaml has correct URIs for daemon mgmt endpoint - OK
√ latest security daemon - OK
√ host time is close to real time - OK
√ container time is close to host time - OK

Connectivity checks
-------------------
√ host can connect to and perform TLS handshake with IoT Hub AMQP port - OK
√ host can connect to and perform TLS handshake with IoT Hub HTTPS / WebSockets port - OK
√ host can connect to and perform TLS handshake with IoT Hub MQTT port - OK
√ container on the default network can connect to IoT Hub AMQP port - OK
√ container on the default network can connect to IoT Hub HTTPS / WebSockets port - OK
√ container on the default network can connect to IoT Hub MQTT port - OK
√ container on the IoT Edge module network can connect to IoT Hub AMQP port - OK
√ container on the IoT Edge module network can connect to IoT Hub HTTPS / WebSockets port - OK
√ container on the IoT Edge module network can connect to IoT Hub MQTT port - OK

18 check(s) succeeded.
```

INSTALLING AZURE SQL



INSTALLING AZURE SQL

Set modules on device: Rasp4

SavranwebIOT

Modules | Routes | Review + create

Container Registry Credentials

You can specify credentials to container registries hosting module images. Listed credentials are used to retrieve
error code 500 if it can't find a container registry setting for a module.

NAME	ADDRESS	USER NAME
Name	Address	User name

IoT Edge Modules

An IoT Edge module is a Docker container you can deploy to IoT Edge devices. It communicates with other modu
can import Azure Service IoT Edge modules or specify the settings for an IoT Edge module. Setting modules on e
based on the IoT Hub tier and units. For example, for S1 tier, modules can be set 10 times per second if no other

+ Add | Runtime Settings

- + IoT Edge Module
- + Marketplace Module
- + Azure Stream Analytics Module

DESIRED STATUS

running

help improve our products and services. Read our privacy statement to learn

INSTALLING AZURE SQL

Home > SavranwebIOT > Rasp4 >

Set modules on device: Rasp4

SavranwebIOT

Modules | Routes | Review + create

Container Registry Credentials

You can specify credentials to container registries hosting module ima
error code 500 if it can't find a container registry setting for a module

NAME | ADDRESS

Name | Address

IoT Edge Modules

An IoT Edge module is a Docker container you can deploy to IoT Edge
can import Azure Service IoT Edge modules or specify the settings for
based on the IoT Hub tier and units. For example, for S1 tier, modules

Add | Runtime Settings

NAME	DESIRED STATU
AzureSQLEdge	running

Send usage data to Microsoft to help improve our products and s

IoT Edge Module Marketplace

Marketplace

sql

Azure SQL Edge Developer
Microsoft
Azure SQL Edge Developer

Azure SQL Edge
Microsoft
Azure SQL Edge

SQL Server Module
Microsoft
IoT Edge module that simulates a temperature sensor

DxOdyssey for IoT
DH2i Company
DxOdyssey for IoT

Free
Microsoft IoT Edge Module Publishing
Free version of SQLite Module

INSTALLING AZURE SQL

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IoT Edge Module Details

AzureSQLEdge

Module Identity Twin | Direct method | Refresh

Primary key ⓘ **********

Secondary key ⓘ **********

Connection string (primary key) ⓘ **********

Connection string (secondary key) ⓘ **********

IoT Edge Module Settings | Container Create Options | **Environment Variables**

Setting Name	Desired Value	Reported Value
ACCEPT_EULA	Y	Y
MSSQL_SA_PASSWORD	[redacted]	[redacted]
MSSQL_LCID	1033	1033
MSSQL_COLLATION	SQL_Latin1_General_CP1_CI_AS	SQL_Latin1_General_CP1_CI_AS

INSTALLING AZURE SQL

```
ubuntu@ubuntu:~$ iotedge list
NAME            STATUS           DESCRIPTION      CONFIG
AzureSQLEdge    running          Up 19 seconds    mcr.microsoft.com/azure-sql-edge/developer:latest
edgeAgent       running          Up 25 minutes    mcr.microsoft.com/azureiotedge-agent:1.0
edgeHub         running          Up 25 minutes    mcr.microsoft.com/azureiotedge-hub:1.0
```

Hasan Savran

BI MANAGER

Thank you!

https://h-savran.blogspot.com/

hasansavran

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