

# Internet of Things

## Programming

### WEEK 9 IoT and Cloud

Anas Dawod

[adawod@swin.edu.au](mailto:adawod@swin.edu.au)

Swinburne University of Technology

May 2023

Mainframe

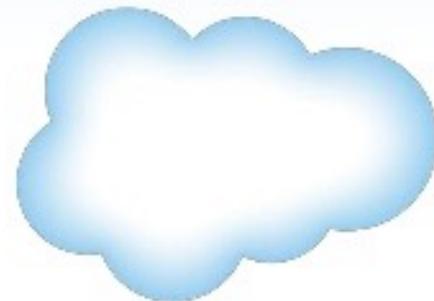


1960s

Client/Server



1980s



## Enterprise Cloud Computing

No Hardware/Software  
Subscription Model  
Automatic Upgrades  
Constant Innovation

Today



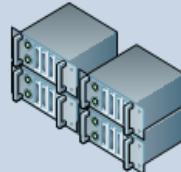
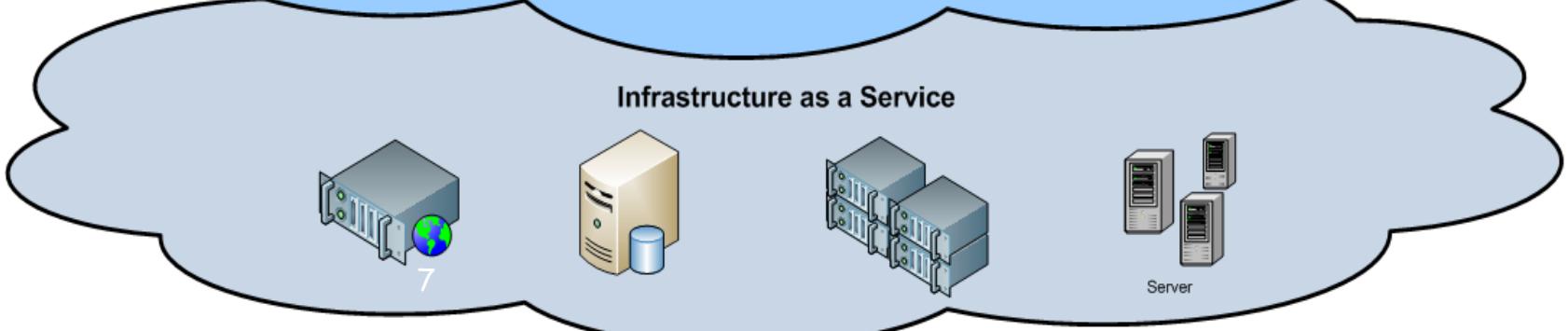
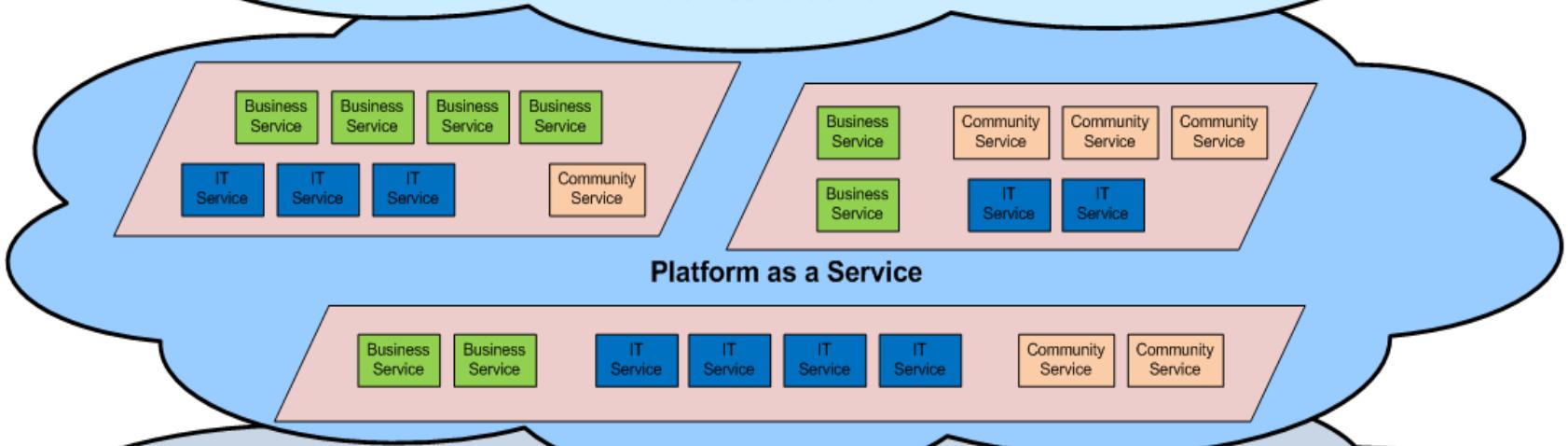
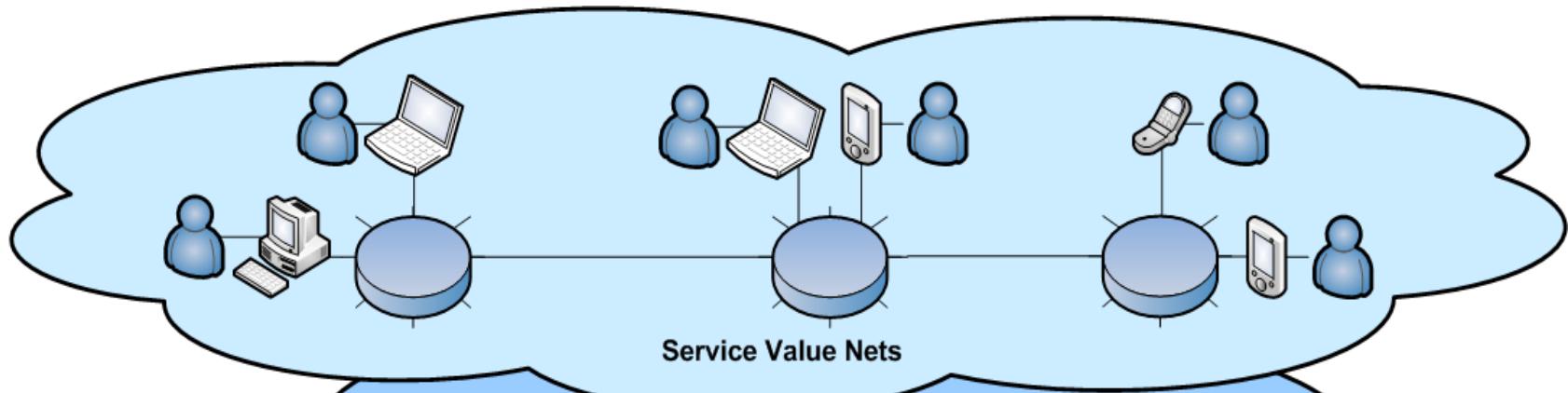
# CLOUD COMPUTING

- “Cloud computing is an emerging computing technology that uses the internet and central remote servers to maintain data and applications”
- The underlying concept of cloud computing dates back to 1960, when John McCarthy opined that "computation may someday be organized as a public utility";
- Cloud Computing is a general term used to describe a new class of network based computing that takes place over the Internet
- It is a collection/group of integrated and networked hardware, software and Internet infrastructure (called a platform).
- Using the Internet for communication and transport provides hardware, software and networking services to clients
- These platforms hide the complexity and details of the underlying infrastructure from users and applications by providing very simple graphical interface or API
- Pay for use and as needed

# CLOUD COMPUTING

- Remotely hosted
- Ubiquitous
- Shared pool of configurable computing resources
- On-demand network access
- Provisioned by the Service Provider
- Pay-as-you-go
- no-need-to-know

Cloud computing is an umbrella term used to refer to Internet based development and services



Server

# Infrastructure as a Service

- The delivery of services such as hardware, storage, networking, data centre space, and various utility software elements on request.
- Both public and private versions of IaaS exist
  - In the public IaaS, the user needs a simple sign-up mechanism to acquire resources. When users no longer need the resources, they simply de-provision them.
  - In a private IaaS, the IT organisation or an integrator creates an infrastructure designed to provide resources on demand to internal users and sometimes partners. IaaS is the fundamental element used by other cloud models. Some customers bring their own tools and software to create applications
- It can be a highly practical solution for companies that want access to resources in an on-demand manner.
- IaaS can also be used effectively to augment data centre services, either to increase capacity when needed, to replace ageing hardware with cloud-based services, or to provide ongoing access to sophisticated services, such as advanced analytics.

Examples:

Nectar, Amazon EC2, Azure, Google Compute Engine.

<https://nectar.org.au/research-cloud/>

# Platform as a Service

- A mechanism for combining IaaS with an abstracted set of middleware services, software development, and deployment tools that allow the organization to have a consistent way to create and deploy applications on a cloud or on-premises environment.
- A PaaS offers a consistent set of programming and middleware services that ensure developers have a well-tested and well-integrated way to create applications in a cloud environment.
- A PaaS requires an infrastructure service
- When you have a software developed by you, but you want to deploy and run on a publicly available platform then you use PaaS

Examples: Google App Engine, Heroku, AWS Lambda

# Software as a Service

- A business application created and hosted by a provider in a multi-tenant (shared) model.
- The SaaS application sits on top of both a PaaS and foundational IaaS.

Examples: Google Apps, Microsoft Office 365s, Dropbox, Spotify

# Core Cloud Capabilities



## Elasticity

you can use just the resources you want when you need them  
When the user no longer needs that resource and stops paying, the resource is released back into the pool of resources



## Billing and metering of service usage

A cloud service has to provide a way to measure and meter a service consequently a cloud environment includes a built-in service that tracks how many resources a customer uses.  
Customers are charged for units of resources consumed



## Workload and service management

The cloud is a federated (distributed) environment that pools resources so they can work together.

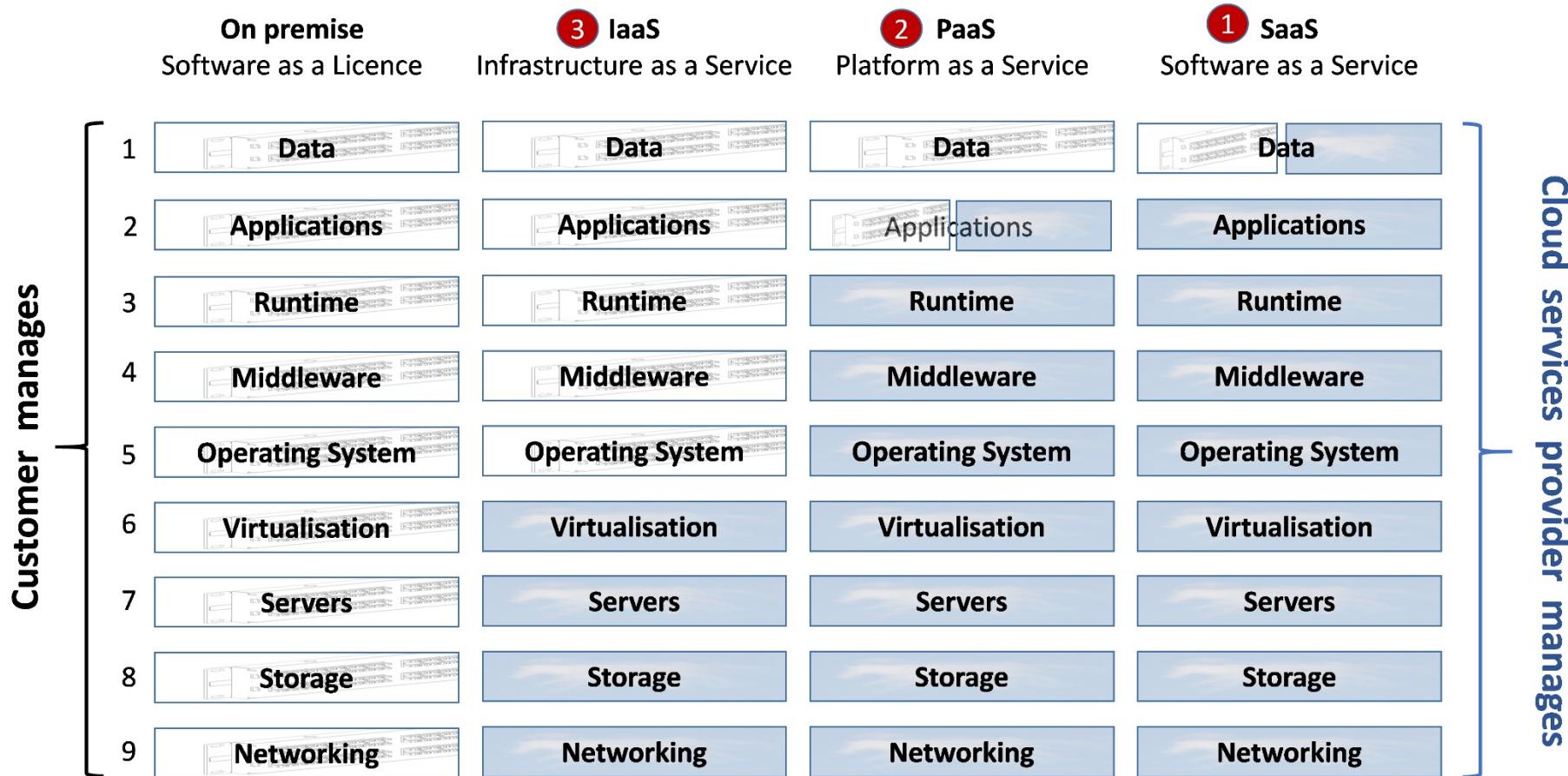
Many management services are mandatory for ensuring that cloud computing is a well-managed platform. Security and governance are key services to ensure that your applications and data are protected

# Dynamic Scaling

- *Dynamic scaling* occurs when resources can be automatically expanded or contracted based on the requirements of the workload or task. If users need more resources than expected, they can get them immediately.
- A provider or creator of IaaS typically optimises the environment so the hardware, the operating system, and automation can support a huge number of workloads.

# Service levels Agreements

- Many consumers acquire capacity based on an on-demand model with no contract. In other situations, the consumer signs a contract for a specific amount of storage and/or compute.
- A typical IaaS contract has some level of service guarantee. At the low end, a provider may state that the company will do its best to provide good service.
- The level of service you require depends on the workloads you're running



# OPPORTUNITIES

- It enables services to be used without any understanding of their infrastructure.
- Cloud computing works using economies of scale:
  - It potentially lowers the outlay expense for start up companies, as they would no longer need to buy their own software or servers.
  - Cost would be by on-demand pricing.
  - Vendors and Service providers claim costs by establishing an ongoing revenue stream.
- Data and services are stored remotely but accessible from “anywhere”.

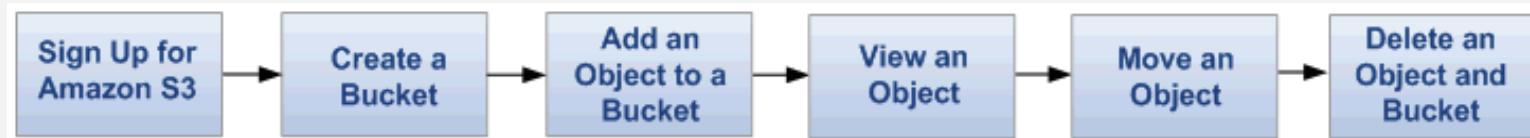
# Challenges

- ▶ Use of cloud computing means dependence on others and that could possibly limit flexibility and innovation:
  - ▶ The others are likely become the bigger Internet companies like Google and IBM, who may monopolise the market.
- ▶ Security could prove to be a big issue:
  - ▶ It is still unclear how safe out-sourced data is and when using these services ownership of data is not always clear.
- ▶ There are also issues relating to policy and access:
  - ▶ If your data is stored abroad whose policy do you adhere to?
  - ▶ What happens if the remote server goes down?
  - ▶ How will you then access files?
  - ▶ There have been cases of users being locked out of accounts and losing access to data.

# CLOUD STORAGE

- Allows data stored remotely to be temporarily cached on desktop computers, mobile phones or other Internet-linked devices.

## Amazon S3 Storage



<https://aws.amazon.com/s3/>

The screenshot displays the AWS S3 console interface. On the left, there's a sidebar with buttons for 'Create bucket' (highlighted with a red arrow), 'Delete bucket', and 'Empty bucket'. Below this is a 'Bucket name' input field with 'admin-created' typed in. In the center, a 'Create bucket' dialog is open, showing four steps: 1. Name and region, 2. Configure options, 3. Set permissions, 4. Review. The 'Name and region' section is filled out with 'admin-created' in the 'Bucket name' field and 'US West (Oregon)' in the 'Region' dropdown. At the bottom of this dialog are 'Create' and 'Cancel' buttons, with 'Create' also highlighted by a red arrow. To the right of the central dialog, there's a 'More' button with a dropdown arrow. Further right, another window titled 'Upload' is open, showing four steps: 1. Select files, 2. Set permissions, 3. Set properties, 4. Review. A large 'Add files' button is visible in this window. Red arrows also point to the 'Upload' button in the top bar and the 'Add files' button in the 'Upload' window.



Netflix delivers billions of hours of content from Amazon S3 to customers around the world. Amazon S3 also serves as the data lake for their big data analytics solution.

FINRA uses Amazon S3 to ingest and store data for over 75 billion market events daily and AWS Lambda functions to format and validate the data against more than 200 rules.



Airbnb houses backup data and static files on Amazon S3, including over 10 petabytes of user pictures. As a born-in-the-cloud solution, they continually innovate new ways to analyze data stored on Amazon S3.

GE uses Amazon S3 to store and protect a petabyte of critical medical imaging data for its GE Health Cloud service, which connects hundreds of thousands of imaging machines and other medical devices.

# Amazon Elastic Compute

Amazon EC2 is a web service that provides secure, resizable compute capacity in the cloud

Fairly cheap

Linux, Windows

Management Console/AP

ELASTIC WEB-SCALE COMPUTING

COMPLETELY CONTROLLED

RELIABLE

EASY TO START

Amazon announced a limited public beta test of EC2 on August 25, 2006

# Instance Types



General Purpose: A1, T3, T2, M5, M5a, M4, T3a



Compute Optimized:  
C5, C5n, C4

optimized for  
compute-intensive  
workloads



Memory Optimized:  
R5, R5a, R4, X1e, X1,  
High Memory, z1d

deliver additional  
memory per vCPU  
and the largest size  
provides 768 GiB of  
memory.



Accelerated  
Computing: P3, P2,  
G3, F1

general purpose  
GPU instances



Storage Optimized:  
H1, I3, D2

instance storage  
optimized for low  
latency, very high  
random I/O  
performance, high  
sequential read



Amazon  
**EC2**

Model	vCPU*	Mem (GiB)	Storage (GB)	Dedicated EBS Bandwidth (Mbps)	Network Performance (Gbps)
m5.large	2	8	EBS-only	Up to 3,500	Up to 10
m5.xlarge	4	16	EBS-only	Up to 3,500	Up to 10
m5.2xlarge	8	32	EBS-only	Up to 3,500	Up to 10
m5.4xlarge	16	64	EBS-only	3,500	Up to 10
m5.12xlarge	48	192	EBS-only	7,000	10
m5.24xlarge	96	384	EBS-only	14,000	25

https://aws.amazon.com/emr/pricing/

Region: US East (Ohio) ▾

	Amazon EC2 Price	Amazon EMR Price
<b>General Purpose - Current Generation</b>		
m5.xlarge	\$0.192 per Hour	\$0.048 per Hour
m5.2xlarge	\$0.384 per Hour	\$0.096 per Hour
m5.4xlarge	\$0.768 per Hour	\$0.192 per Hour
m5.12xlarge	\$2.304 per Hour	\$0.27 per Hour
m5.24xlarge	\$4.608 per Hour	\$0.27 per Hour
m5a.xlarge	\$0.172 per Hour	\$0.043 per Hour
m5a.2xlarge	\$0.344 per Hour	\$0.086 per Hour
m5a.4xlarge	\$0.688 per Hour	\$0.172 per Hour
m5a.12xlarge	\$2.064 per Hour	\$0.27 per Hour
m5a.24xlarge	\$4.128 per Hour	\$0.27 per Hour
m5d.xlarge	\$0.226 per Hour	\$0.057 per Hour
m5d.2xlarge	\$0.452 per Hour	\$0.113 per Hour
m5d.4xlarge	\$0.904 per Hour	\$0.226 per Hour

An AMI is a template that contains the software configuration (operating system, application server, and applications) required to launch your instance. You can select an AMI provided by AWS, our user community, or the AWS Marketplace; or you can select one of your own AMIs.

Quick Start

My AMIs

AWS Marketplace

Community AMIs

Free tier only (i)

1 to 22 of 22 AMIs < >

 <b>Amazon Linux AMI 2016.03.0 (HVM), SSD Volume Type - ami-1b0f7d7b</b>	<span>Select</span>
 <b>Red Hat Enterprise Linux 7.2 (HVM), SSD Volume Type - ami-d1315fb1</b>	<span>Select</span>
 <b>SUSE Linux Enterprise Server 12 SP 1 (HVM), SSD Volume Type - ami-6d701b0d</b>	<span>Select</span>
 <b>Ubuntu Server 14.04 LTS (HVM), SSD Volume Type - ami-06116566</b>	<span>Select</span>

The screenshot shows a list of available Amazon Machine Images (AMIs) for selection. A green arrow points to the 'Select' button for the first item, 'Amazon Linux AMI 2016.03.0 (HVM), SSD Volume Type - ami-1b0f7d7b'. The interface includes a sidebar for 'Quick Start' with links for 'My AMIs', 'AWS Marketplace', and 'Community AMIs', and a checkbox for 'Free tier only'. The main area displays 22 AMIs, with the first one being highlighted. Each entry includes the AMI name, provider logo, volume type, AMI ID, and a 'Select' button. The 'Amazon Linux' entry is also labeled as 'Free tier eligible'.

console.aws.amazon.com

aws Services Resource Groups Actions

EC2 Dashboard Events Tags Reports Limits INSTANCES Instances Spot Requests Reserved Instances Scheduled Instances Dedicated Hosts IMAGES AMIs Bundle Tasks ELASTIC BLOCK STORE Volumes Snapshots NETWORK & SECURITY Security Groups Elastic IPs Placement Groups Key Pairs Network Interfaces LOAD BALANCING

Launch Instance Connect Actions

Filter by tags and attributes or search by keyword

1 to 12 of 12

Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status
couchbase-ServerRally	i-01d4a488a574ee4...	m4.xlarge	us-east-1b	running	2/2 checks ...	None
couchbase-Server	i-0384cf0da86021c1f	m4.xlarge	us-east-1d	running	2/2 checks ...	None
couchbase-SyncGateway	i-08a5674bb9e387dc6	m4.xlarge	us-east-1c	running	2/2 checks ...	None
couchbase-SyncGateway	i-093ed70beedbb84cb	m4.xlarge	us-east-1b	running	2/2 checks ...	None
couchbase-Server	i-09547ec179d327d22	m4.xlarge	us-east-1e	running	2/2 checks ...	None
couchbase-Server	i-0ff27a0f8477a84dd	m4.xlarge	us-east-1a	running	2/2 checks ...	None

Select an instance above

Feedback English (US)

© 2008 - 2017, Amazon Web Services, Inc. or its affiliates. All rights reserved. Privacy Policy Terms of Use

AWS Educate

https://aws.amazon.com/education/awseducate/

Contact Sales Support ▾ English ▾ My Account ▾ Create an AWS Account

Products Solutions Pricing Documentation Learn Partner Network AWS Marketplace Explore More Q

aws<sup>®</sup> educate

# Teach Tomorrow's Cloud Workforce Today

With the increasing demand for cloud employees, AWS Educate provides an academic gateway for the next generation of IT and cloud professionals. AWS Educate is Amazon's global initiative to provide students and educators with the resources needed to accelerate cloud-related learning.

Join AWS Educate

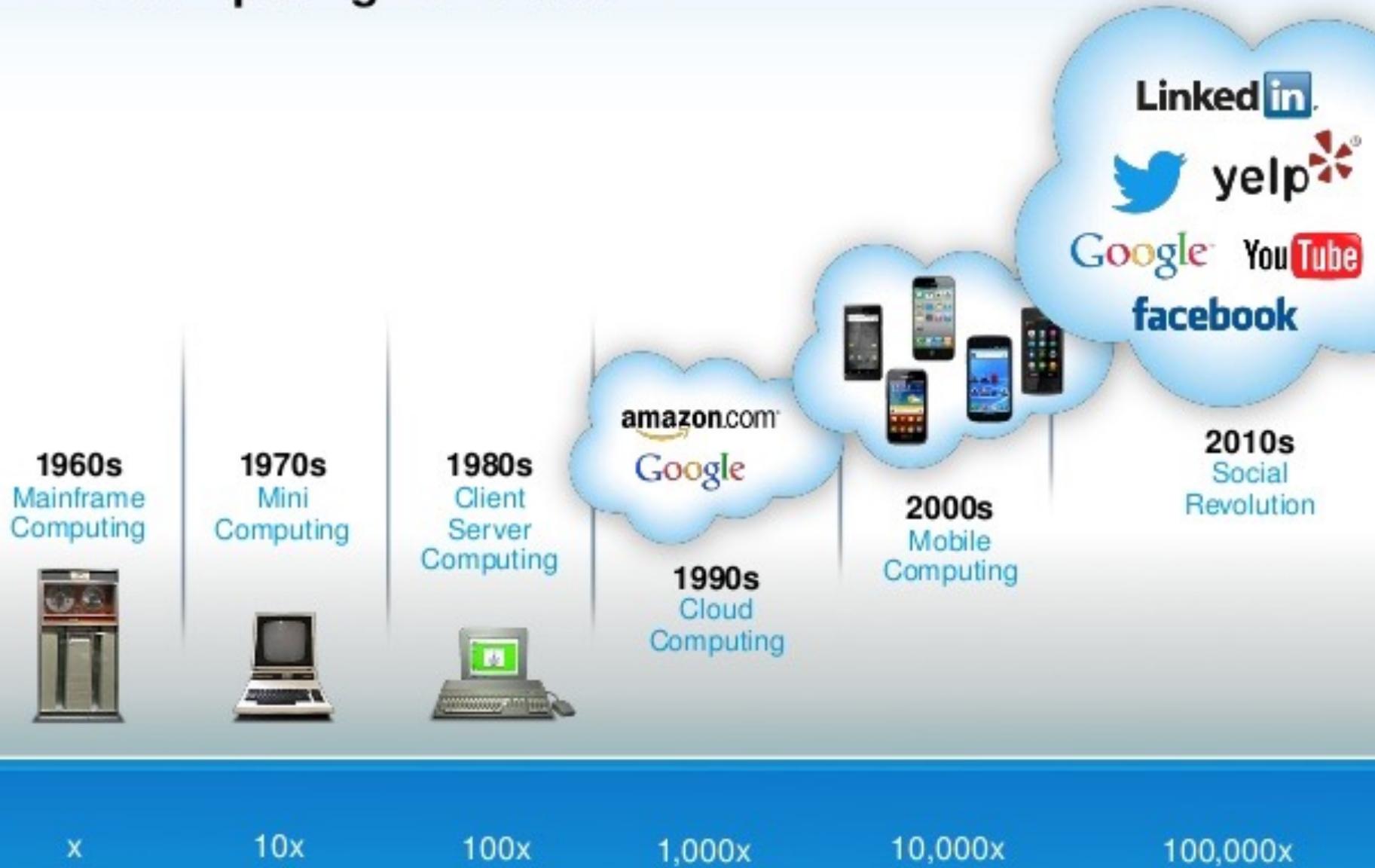
Login to AWS Educate



Internet of  
Things and Cloud  
Computing



# The Computing Revolution



# Arduino

Flash Memory: 32 KB of which 0.5 KB used by bootloader

SRAM: 2 KB

EEPROM: 1 KB

Clock Speed: 16 MHz

Year: 2010



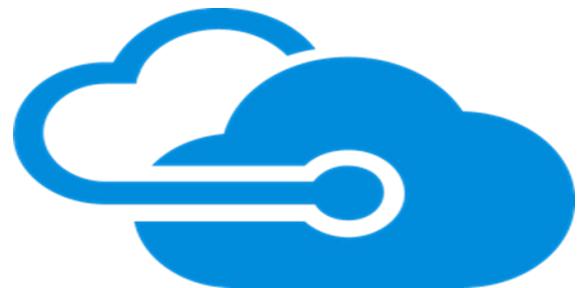
# Intel 80486

clock rate: 16-100 Mhz

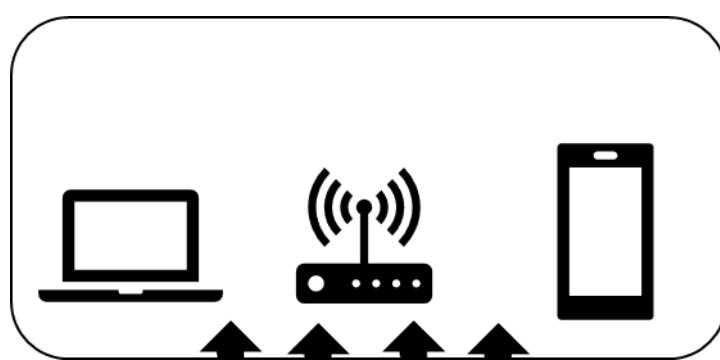
Memory: usually 8 to 16MB

Year: 1989





Cloud



Edge



Sensors

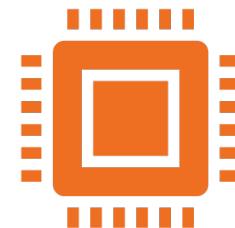
# Convergence Approaches



## Cloud-centric IoT

Bring IoT functionalities in Cloud

Move processing and computing of the IoT data to the cloud



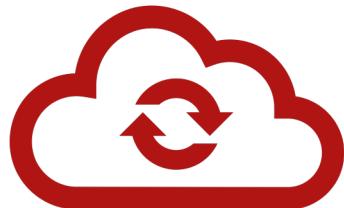
## IoT-centric Cloud

Bring Cloud functionalities to IoT

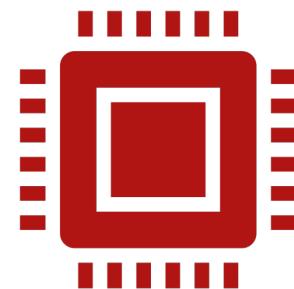
Processing and storage of data close to the users (e.g., edge)

Supporting end-user security

# Google Cloud IoT Core



Google Cloud IoT is a complete set of tools to connect, process, store, and analyse data both at the edge and in the cloud.



The platform consists of scalable, fully-managed cloud services; an integrated software stack for edge/on-premises computing with machine learning capabilities for all your IoT needs.

# Google Cloud IoT-ready hardware

- Google and its partners offer devices and prototyping kits that simplify integration and make it easy to connect to the Google Cloud Platform.



**AE-CLOUD2 Cellular IoT Kit**

AE-CLOUD2 uses the Renesas Synergy S5D9 Cortex-M4 microcontroller. The kit can connect using cellular, Wi-Fi, or Ethernet and includes sensors for lighting, microphone, environmental, accelerometer, gyroscope, and GPS. The kit can be used for cellular applications globally as it has passed global RF tests and certifications.



**Microchip security development kit with ATECC608A**

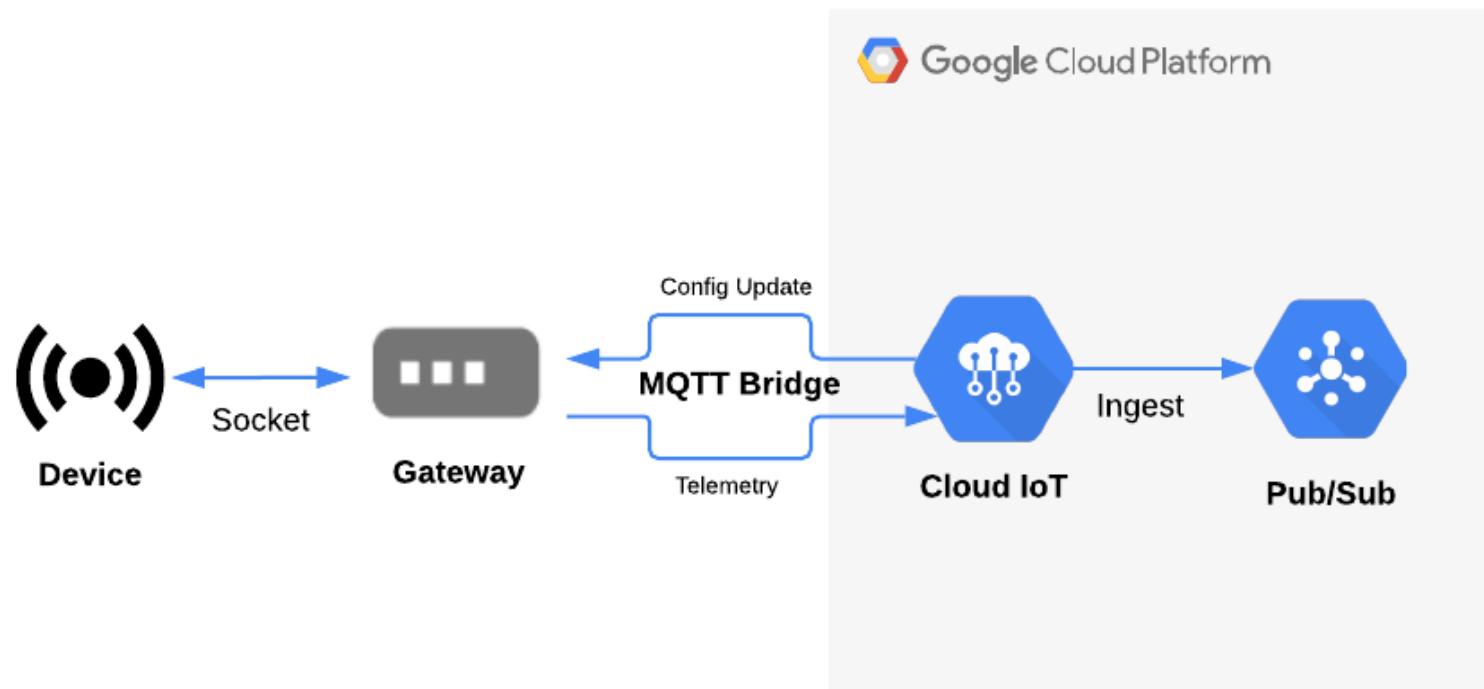
Connect Microchip WINC1500 Wi-Fi b/g/n, the ATSAMD21 Cortex-M0, and the ATECC608A secure element to start prototyping industrial-grade designs with security in mind on a light-embedded system.



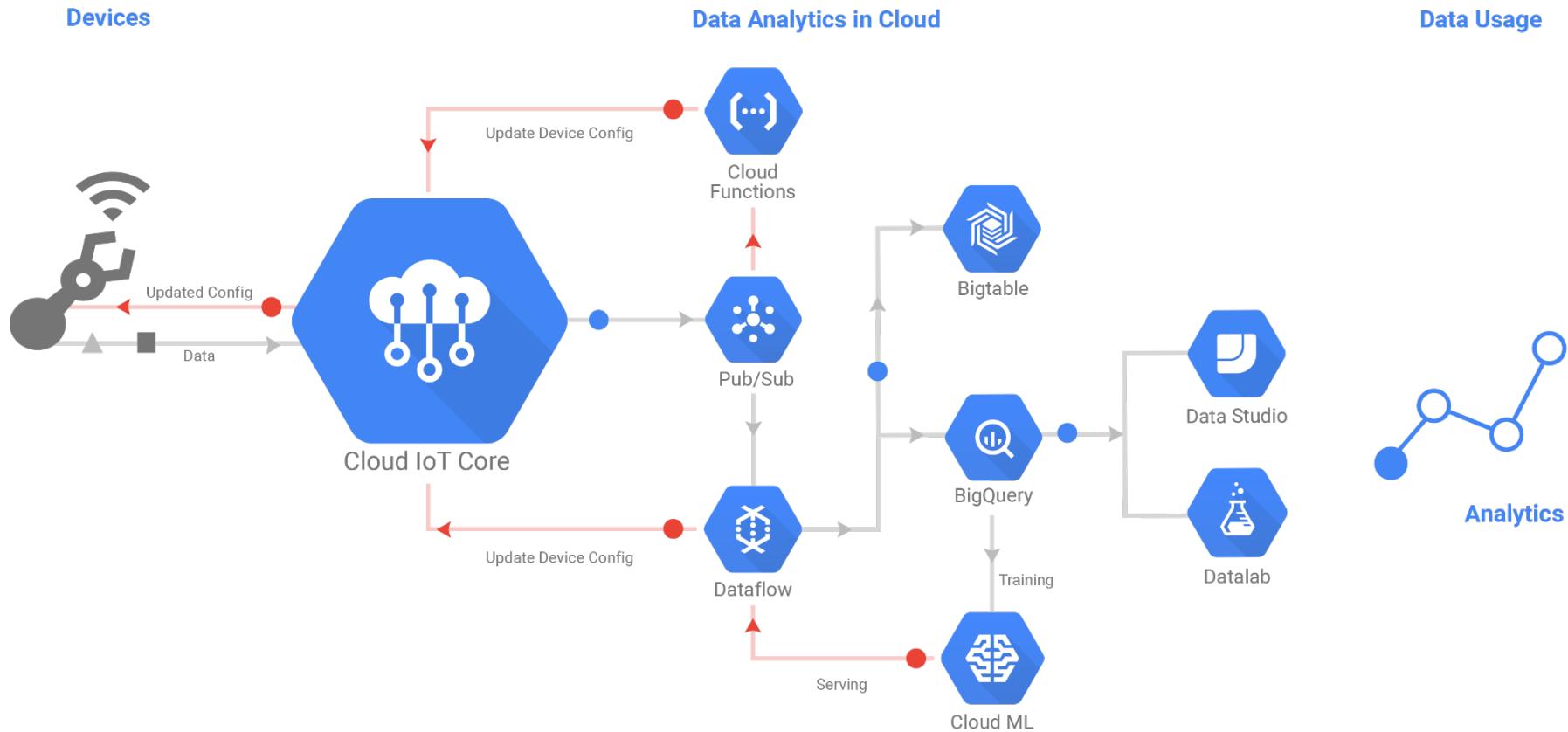
**ThingaOS - T4G-Q4020**

Tantiv4's T4G-Q4020 GCP Integration Development Kit is based on the Qualcomm IoT QCA4020 chipset. Using Tantiv4's ThingaOS solution, connect Qualcomm's QCA4020-based M20 board with M4 Application processor and seven on-board sensors to Cloud Pub/Sub and other services.

# Using Cloud IoT Core gateways



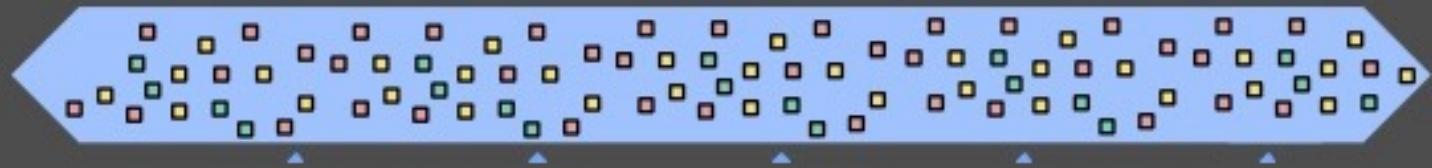
# Google Cloud ARCHITECTURE





Dataflow: organize torrents of IoT data  
into actionable windows

Input



Output



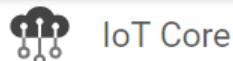
# Device Registration

- In order for a device to connect, it must first be registered with Cloud IoT Core.
- Registration consists of adding a device to a collection (the registry) and defining some essential properties.
- You can register a device with Cloud Platform Console, gcloud commands, or the REST-style API



Google Cloud Platform

My Project



## IoT Core

## Device registries

A device registry allows you to group devices and set properties that they all share, such as connection protocol, data storage location, and Cloud Pub/Sub topics. To start connecting devices to Cloud IoT, first create a device registry to place them in. [Learn more](#)

[Create a device registry](#)

Create registry - My Project - Google Cloud Platform +

https://console.cloud.google.com/iot/registries/new?project=liquid-8340

Google Cloud Platform My Project

IoT Core Create a registry

Define how devices in this registry will send data to Cloud IoT Core. After you create your registry, you can start adding devices to it. [Learn more](#)

**Registry ID**  
Enter a permanent ID that starts with a lowercase letter. Must end in a letter or number.  
You can also include the following characters: + . % - \_ ~

**Region**  
Determines where data is stored for devices in this registry. Choice is permanent.

Select a region

**Protocol**  
Select the protocols your devices will use to connect to Cloud IoT Core. [Learn more](#)

MQTT  
 HTTP

**Cloud Pub/Sub topics**  
Cloud IoT Core routes device messages to Cloud Pub/Sub for aggregation. You can route messages to different topics and subfolders in Cloud Pub/Sub based on the type of data in the messages. [Learn more](#)

**Default telemetry topic**  
Device telemetry events will be published to this topic by default. Add more topics if you want these events to be published to separate topics.

Select a Cloud Pub/Sub topic

▼ Add more telemetry topics

**Device state topic (Optional)**  
State events published by MQTT devices are stored in the registry by default. You can also select a Cloud Pub/Sub topic where these messages will be published on a best-effort

Create registry - My Project - Go + New tab

https://console.cloud.google.com/iot/registries/new?project=liquid-champion-112201

Google Cloud Platform My Project

IoT Core Create a registry

Cloud IoT Core routes device messages to Cloud Pub/Sub for aggregation. You can route messages to different topics and subfolders in Cloud Pub/Sub based on the type of data in the messages. [Learn more](#)

**Default telemetry topic**  
Device telemetry events will be published to this topic by default. Add more topics if you want these events to be published to separate topics.

None

**⚠️** Cloud IoT cannot read data from the registry a telemetry topic.

**Add more telemetry topics**

**Device state topic (Optional)**  
State events published by MQTT devices select a Cloud Pub/Sub topic where they basis. [Learn more](#)

None

**Stackdriver Logging**  
Set the default logging for all devices in this registry. You can apply a different setting or debug at the device level. [Learn more](#)

None [?](#)  
 Error [?](#)  
 Info [?](#)  
 Debug [?](#)

**Create** **Cancel**

### Create a topic

Add a topic to Pub/Sub so that you can use it in your device registry.

Name [?](#)  
projects/liquid-champion-112201/topics/ IoTProgramming

**CANCEL** **CREATE**

IoT Core – My Project – Google C X +

https://console.cloud.google.com/iot/locations/us-central1/regis... ☆ G D E F 1

Google Cloud Platform My Project

☰ IoT Core Registry details EDIT REGISTRY DELETE REGISTRY

Registry ID: Test ▾

Region	us-central1
Protocol	MQTT HTTP
Stackdriver Logging	None <a href="#">View logs</a>

Cloud Pub/Sub topics

A registry can have 1 or more topics for publishing device telemetry and state events.

[Add or edit topics](#)

Topic name	Topic type	Subfolders
projects/liquid-champion-112201/topics/IoTProgramming	Default telemetry	—
—	Device state	—

▼ CA CERTIFICATES

IoT Core – My Project – Google C X

← → ⌛ ⌂ 🔍 https://console.cloud.google.com/iot/locations/us-central1/regi... ☆ 📄 📤 🎁 🖥 🗃 🚶 🚪 🚧 🚫 🚭 🚮 🚯 🚳 🚴 🚺 🚵 🚷 🚸 🚹 🚻 🚻 🚻 🚻

☰ Google Cloud Platform ⚡ My Project 🔍 ⏺ ? 🔔 🔍

**IoT Core**

Devices [+ CREATE A DEVICE](#) [DELETE](#)

**Registry ID: Test**  
us-central1

Devices are things that connect to the internet directly or through a gateway. [Learn more](#)

Enter exact device ID

<input type="checkbox"/> Device ID	Communication	Last seen	Stackdriver Logging
No devices to display in this registry			

[Cloud IoT Core documentation](#)

Create a device - My Project - Go X

https://console.cloud.google.com/iot/locations/us-central1/registries...

Google Cloud Platform My Project

IoT Core Create a device

Create a device in registry Test.

Device ID

Device communication  Allow  Block

Authentication (Optional)  Enter manually  Upload

Public key format  RS256  ES256  RS256\_X509  ES256\_X509

Public key value  
-----BEGIN PUBLIC KEY-----  
(Public key value must be in PEM format)  
-----END PUBLIC KEY-----

Public key expiration date (Optional)  
 Expires on:

Device details - My Project - Google Cloud Platform

https://console.cloud.google.com/iot/locations/us-central1/registries...

Google Cloud Platform My Project

IoT Core

Device ID: test1

Numeric ID: 2699756698873821 Registry: Test Stackdriver Logging: Registry default [View logs](#)

Device communication: Allowed

Details Configuration & state history

Latest activity

Heartbeat (MQTT only)	-
Telemetry event received	-
Device state event received	-
Config sent	-
Config ACK (MQTT only)	-
Error	-

Device metadata

None

Authentication

[Add public key](#) [Delete](#)

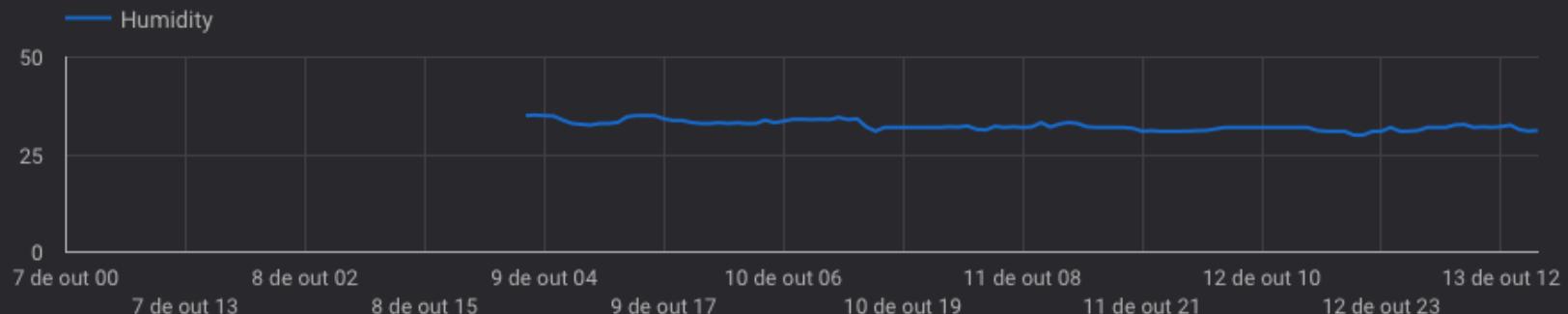
No authentication keys have been added for this device.

The device won't be able to connect to Google Cloud Platform without a valid key.

# Weather Station Report

Humidity  
32,43

Temperature  
32,21



Device ID	Timestamp ▾	Temperature	Humidity
1. esp32_02455C	13 de out de 2017 16	33	31,21
2. esp32_02455C	13 de out de 2017 15	33,05	31,05

- Google Cloud's IoT platform provides features, including:
  - Provides huge storage
  - Cuts cost for server maintenance
  - Efficient and scalable
  - Analyse big data
- **Pros**
  - Fastest input/output
  - Lesser access time
  - Provides integration with other Google services
- **Cons**
  - Most of the components are Google technologies
  - Limited programming language choices



Founded 2009, Venture backed – SFE

Product Released in 2011

Disruptive, Successful & Growing Rapidly



*"ThingWorx is re-defining the concept of connected platforms"*



2013 Winner:  
Best Platform for Enabling Third Party  
Developers

# ThingWorx partners & ecosystem

ThingWorx  
A PTC Business

Edge Communication  
& Embedded Devices



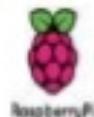
Hewlett Packard  
Enterprise



vmware®



QUALCOMM



Communication  
Service Providers

PORTUGAL  
TELECOM



etisalat The Etisalat logo, featuring a green play button icon next to the brand name.

docomo

elisa

ROGERS™

telenor  
connexion

vodafone

System Integrators  
& VARs



Tech  
**Mahindra**  
accenture

MCKESSON



Cognizant

Infosys



Business Systems  
& Analytics



IBM  
COGNOS



splunk®

Solution  
Providers



servicemax

ONFARM  
DATA INSIGHTS



NSW  
NIPPON SYSTEMWARE CO.,LTD.

- Thingworx is an IoT platform designed by PTC for development of enterprise app development. It offers basic features, such as:
  - Easy connectivity with electronic devices, like sensors and RFIDs
  - You can work remotely once you are done with the setup
  - Pre-built widgets for the dashboard
  - Remove Complexity of the project
  - Integrated machine learning
- **Pros**
  - Easy web page designs for customers
  - Easy to manage devices
  - Simple connectivity solutions
- **Cons**
  - Difficult to use with custom programs in C#
  - Hard to manage complex systems.
  - The limitation to install edge program on a custom platform.

# Microsoft Azure IoT services

Devices	Device Connectivity	Storage	Analytics	Presentation & Action
	 Event Hubs	 SQL Database	 Machine Learning	 App Service
	 IoT Hubs	 Table/Blob Storage	 Stream Analytics	 Power BI
	 Service Bus	 DocumentDB	 HDInsight	 Notification Hubs
	 External Data Sources	 External Data Sources	 Data Factory	 Mobile Services
			 BizTalk Services	



Bi-directional communication  
with billions of IoT devices

Device-to-cloud telemetry data, cloud-to-  
device command, track message delivery



Work with familiar  
platforms and protocols

SDKs for multi-platforms  
HTTP, AMQP, and MQTT



IoT Gateway SDK

Got legacy or non-IP-enabled devices?  
Build your own gateway for those devices

Home - Microsoft Azure x +

https://portal.azure.com/#home

Microsoft Azure Search resources, services, and docs

Create a resource Home Dashboard All services FAVORITES All resources Resource groups App Services Function Apps SQL databases Azure Cosmos DB Virtual machines Load balancers Storage accounts Virtual networks Azure Active Directory Monitor Advisor Security Center Cost Management + Bill...

Azure services See all (100+) Create a resource

Virtual machines App Services Storage accounts SQL databases Azure Database for PostgreSQL servers Azure Cosmos DB Kubernetes services

Function App

Microsoft Learn Learn Azure with free online training from Microsoft

Azure Monitor Monitor your apps and infrastructure

Security Center Secure your apps and infrastructure

Cost Management Analyze and optimize your cloud spend for free

Recent resources See all your recent resources See all your resources

Useful links

Technical Documentation ↗

Azure Services ↗

Recent Azure Updates ↗

Azure Blog ↗

Home - Microsoft Azure x +

https://portal.azure.com/#home

Microsoft Azure Search resources, services, and docs

ayavari@swin.edu.au SWINBURNE UNIVERSITY User icon

Create a resource Home Dashboard All services Favorites All resources Resource groups App Services Function Apps SQL databases Azure Cosmos DB Virtual machines Load balancers Storage accounts Virtual networks Azure Active Directory Monitor Advisor Security Center Cost Management + Bill...

All services IoT

Everything Windows 10 IoT Core Services Keywords: iot ★

General IoT Central Applications ★

Compute IoT Hub ★

Networking Azure IoT Hub Security PREVIEW ★

Storage Digital Twins PREVIEW ★

Web

Mobile

Containers

Databases

Analytics

AI + machine learning

Internet of things

Integration

Identity

Security

DevOps

Migrate

Management + governance

IoT Hub - Microsoft Azure

https://portal.azure.com/#blade/HubsExtension/BrowseResourceBlade/resourceType/Microsoft.Devices%2FiotHubs

Microsoft Azure

Search resources, services, and docs

ayavari@swin.edu.au SWINBURNE UNIVERSITY

Create a resource

Home

Dashboard

All services

FAVORITES

All resources

Resource groups

App Services

Function Apps

SQL databases

Azure Cosmos DB

Virtual machines

Load balancers

Storage accounts

Virtual networks

Azure Active Directory

Monitor

Advisor

Security Center

Cost Management + Bill...

Home > IoT Hub

IoT Hub  
Swinburne University

Add Edit columns Refresh Assign tags

No subscriptions in Swinburne University directory.

Filter by name... All resource groups All tags No grouping

0 items

NAME ↑↓	TYPE ↑↓	RESOURCE GROUP ↑↓	LOCATION ↑↓	SUBSCRIPTION ↑↓
No results.				

No IoT hub to display

Create an IoT hub to help you connect, monitor, and manage billions of your IoT assets.

Learn more about IoT Hub Quickstart: send telemetry from device

Create IoT hub



Search (Ctrl+ /)

Delete

Resource group (change)  
tutorials-iot-hub-rg

Status  
Activating

Location  
West US

Subscription (change)  
Pay-As-You-Go

Subscription ID  
1f09d235-d756-45bc-97b3-ffdca8ed7e5a

Hostname  
--

Pricing and scale tier  
F1 - Free

Number of IoT Hub units  
1

EXPLORERS

Query explorer

IoT devices

AUTOMATIC DEVICE MANAGEMENT

IoT Edge (preview)

MESSAGING

File upload

Endpoints

Need a way to provision millions of devices?

IoT Hub Device Provisioning Service enables zero-touch, just-in-time provisioning to the right IoT hub without requiring human intervention.

Add Device

+ Add

Learn more about creating devices

\* Device ID  
MyTestDevice

Authentication Type  
Symmetric Key X.509 Self-Signed X.509 CA Signed

\* Primary Key  
Enter your primary key here

\* Secondary Key  
Enter your secondary key here

Auto Generate Keys

Connect device to IoT Hub

Save

- Azure IoT Suite provides:

- Easy Device Registry.
- Rich Integration with SAP, Salesforce, Oracle, WebSphere, etc
- Dashboards and visualisation
- Real-time streaming

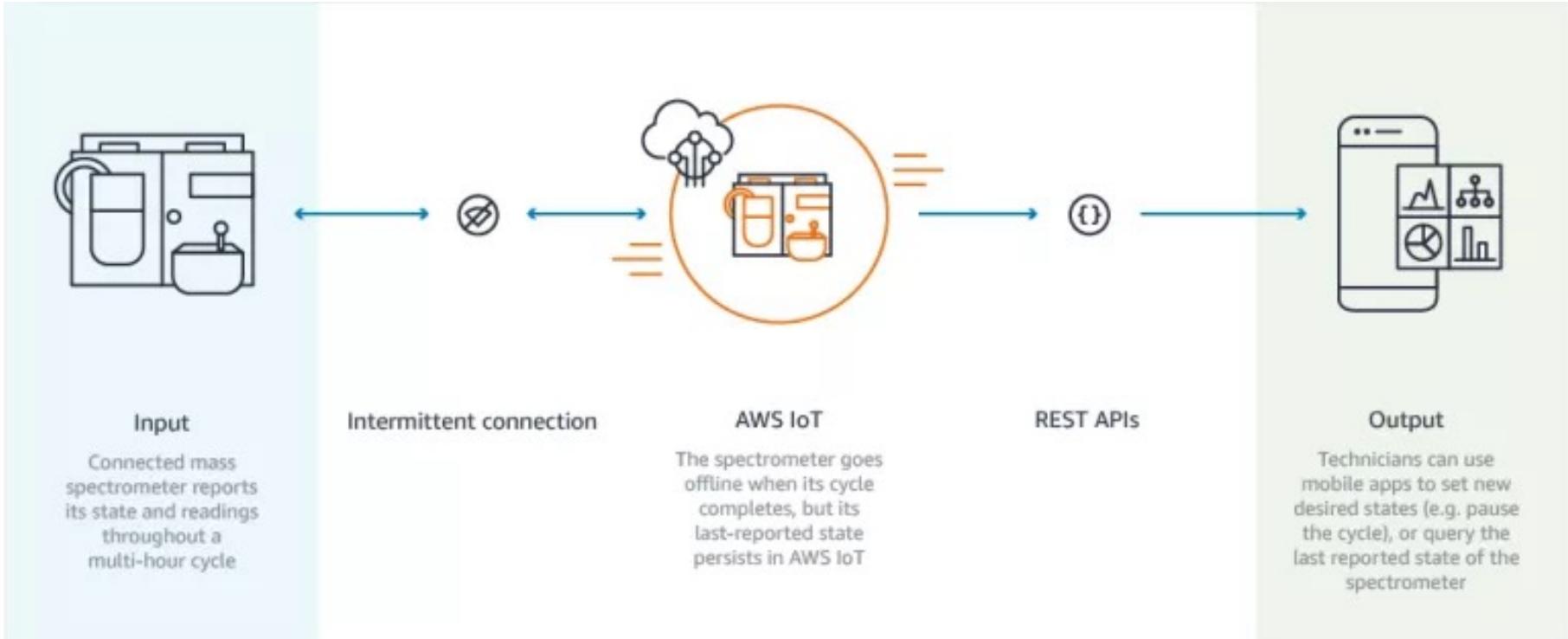
- **Pros**

- Offers third-party services
- Secure and scalable
- High availability

- **Cons**

- Requires management
- Expensive
- No support for bugs

# AWS IoT Platform





Monitor

Onboard

Manage

Greengrass

Secure

Defend

Act

Test

Software

Settings

Learn

## Welcome to the AWS IoT Console

To get started, you can jump into the recommended starting points below, or explore other learning resources as needed.



### See how AWS IoT works

Explore an interactive tutorial through the components of AWS IoT.

[Start the tutorial](#)

It takes 5 minutes



### Connect to AWS IoT

Connect a device, a mobile or web app to AWS IoT in a few easy steps!

[View connection options](#)



### Explore documentation

The AWS IoT documentation is a great resource for more details.

[Go to documentation](#)





Monitor

Onboard

## Manage

Things

Types

Thing Groups

Billing Groups

Jobs

Greengrass

Secure

Defend

Act

Test

Software

Settings

Learn



## You don't have any things yet

A thing is the representation of a device in the cloud.

[Learn more](#)

[Register a thing](#)

# Creating AWS IoT things

An IoT thing is a representation and record of your physical device in the cloud. Any physical device needs a thing record in order to work with AWS IoT. [Learn more.](#)

## Register a single AWS IoT thing

Create a thing in your registry

[Create a single thing](#)

## Bulk register many AWS IoT things

Create things in your registry for a large number of devices already using AWS IoT, or register devices so they are ready to connect to AWS IoT.

[Create many things](#)

[Cancel](#)

[Create a single thing](#)

## Add your device to the thing registry

This step creates an entry in the thing registry and a thing shadow for your device.

Name

### Apply a type to this thing

Using a thing type simplifies device management by providing consistent registry data for things that share a type. Types provide things with a common set of attributes, which describe the identity and capabilities of your device, and a description.

Thing Type

### Add this thing to a group

Adding your thing to a group allows you to manage devices remotely using jobs.

Thing Group

### Set searchable thing attributes (optional)

Enter a value for one or more of these attributes so that you can search for your things in the registry.

Attribute key

Value

Show thing shadow ▾

- ▶ Main features of the AWS IoT platform are:
  - ▶ Device management
  - ▶ Secure gateway for devices
  - ▶ Authentication and encryption
- ▶ Pros
  - ▶ Good integration with IaaS
  - ▶ Price dropped over the last six years
  - ▶ Open and flexible
- ▶ Cons
  - ▶ A big learning curve for AWS
  - ▶ Three outages in the last 2 years



# ThingsBoard

- Open-source IoT platform (Community edition)
- Create rich IoT Dashboards for data visualization and remote device control in real-time



# Other platforms

- ▶ **Cisco IoT Cloud Connect**
- ▶ **Salesforce IoT Cloud**
- ▶ **Kaa IoT Platform**
- ▶ **Oracle IoT Platform**
- ▶ **Thingspeak IoT Platform**
- ▶ **GE Predix IoT Platform**
- ▶ **Cumulocity IoT**

---

# Questions?