

# IoT Applications

Presented by  
Dr. Amany AbdElSamea

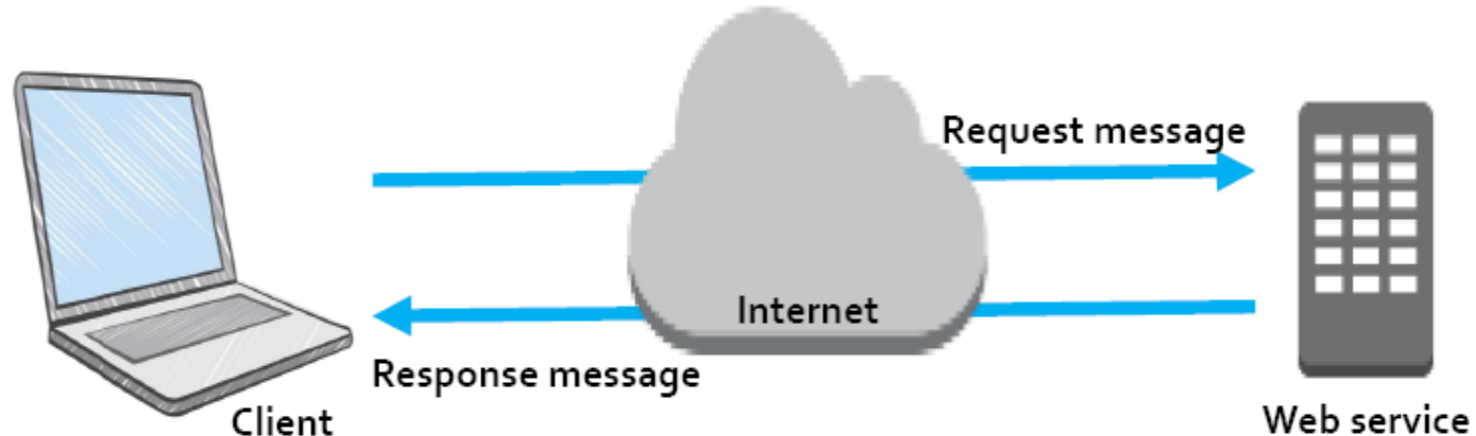


# Outline

- Web Services
- Amazon Web Services
- IoT Applications

# Web Services

A **web service** is any piece of software that makes itself available over the internet and uses a **standardized format** (XML or JSON) for the request and the response of an **API interaction**.



# Amazon Web Services

- **Amazon Web Services (AWS)** is a collection of **remote computing services (web services)** that together make up a **cloud computing platform**, offered over the Internet by Amazon.com.
- Website: <http://aws.amazon.com>
- AWS is located in **9 geographical 'Regions'**. Each Region is **wholly contained within a single country** and all of its data and services **stay** within the designated Region.
- Each Region has **multiple 'Availability Zones'**, which are **distinct data centers** providing AWS services.



# Amazon Web Services for IoT



# Amazon EC2

- An IaaS provided by Amazon
- EC2 delivers scalable, pay-as-you-go compute capacity in the cloud.
- Web service that provides computing capacity in the form of virtual machine
- EC2 can be used for several purposes for IoT systems

# Amazon S3

- Online cloud based data storage infrastructure for storing and retrieving large amount of data.
- Offers reliable, scalable, fast, fully redundant and affordable storage infrastructure
- Serve as raw datastore for IoT systems for storing raw data such as sensor data, log data, image, audio, video, etc.

# Amazon Autoscaling

- Allows automatically scaling EC2 capacity up (**vertical scaling** entails installing more powerful systems or upgrading to more powerful components) Or down (**horizontal scaling** adds to resources by expanding the number of servers or other processing units) according to user condition.
- Users can increase number of EC2 instances.
- Autoscaling can be used for auto scaling IoT applications and IoT platforms deployed as Amazon EC2.



# Amazon RDS

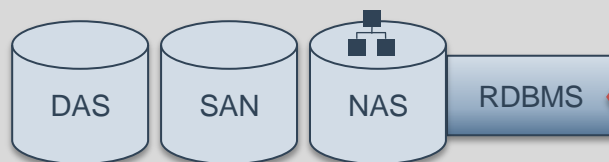
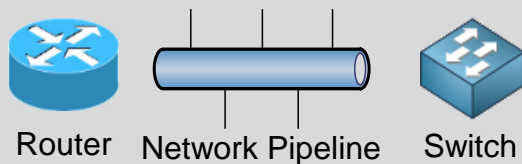
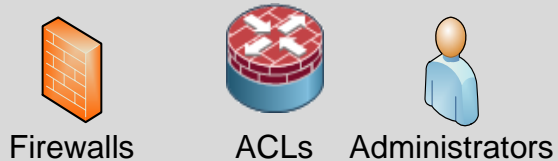
- Web service that allows to create instances of MySQL, Oracle or MS SQL Server in cloud
- Developers can easily setup, operate and scale a relational database in cloud
- Serve as a scalable datastore for IoT systems
- With RDS, IoT system developers can store any amount of data in scalable relational databases

# Amazon DynamoDB

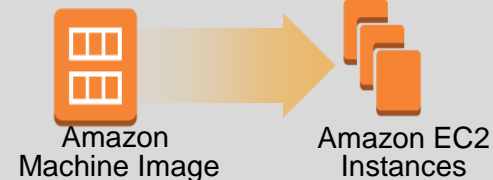
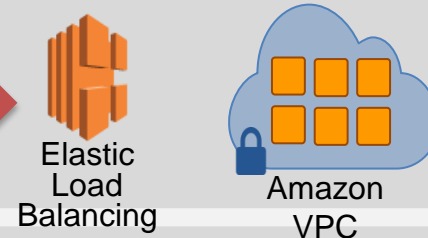
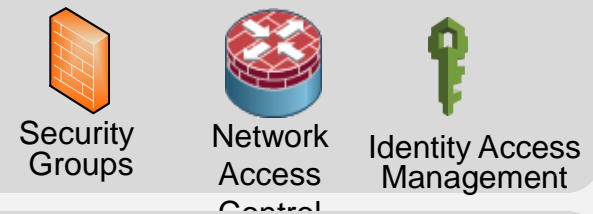
- Fully-managed, scalable, high performance No-SQL database service
- Serve as scalable datastore for IoT systems
- With DynamoDB, IoT system developers can store any amount of data and serve any level of requests for the data.

# On-Premises and AWS Comparison

## On-Premises Infrastructure



## Amazon Web Services



Security

Networking

Servers

Storage and Database

# AWS by Category: Core Services

## Compute



Amazon EC2



AWS Lambda



Auto Scaling



AWS Elastic Beanstalk



Amazon Elastic Container Registry



Amazon Elastic Container Service



Amazon Lightsail



AWS Batch

## Networking



Amazon VPC



Amazon Route 53



AWS Direct Connect



Elastic Load Balancing

## Storage



Amazon S3



Amazon EBS



Amazon CloudFront



Amazon Glacier



Amazon Elastic File System



AWS Snowball



Storage Gateway



AWS Snowmobile

## Database



Amazon RDS



Amazon DynamoDB



Amazon Redshift



AWS Database Migration Service



Amazon ElastiCache

# AWS by Category: Foundational Services

## Analytics



Amazon  
EMR



AWS Data  
Pipeline



Amazon  
Elasticsearch



Amazon  
Kinesis



Amazon  
Machine Learning



Amazon  
QuickSight



Amazon  
Redshift



Amazon  
Athena

## Enterprise Apps



Amazon  
WorkSpaces



Amazon  
WorkMail



Amazon  
WorkDocs

## Mobile Services



AWS  
MobileHub



Amazon  
SNS



Amazon  
Cognito



AWS  
Device Farm



Amazon Mobile  
Analytics



AWS  
Mobile SDKs



Amazon  
Pinpoint

## Internet of Things

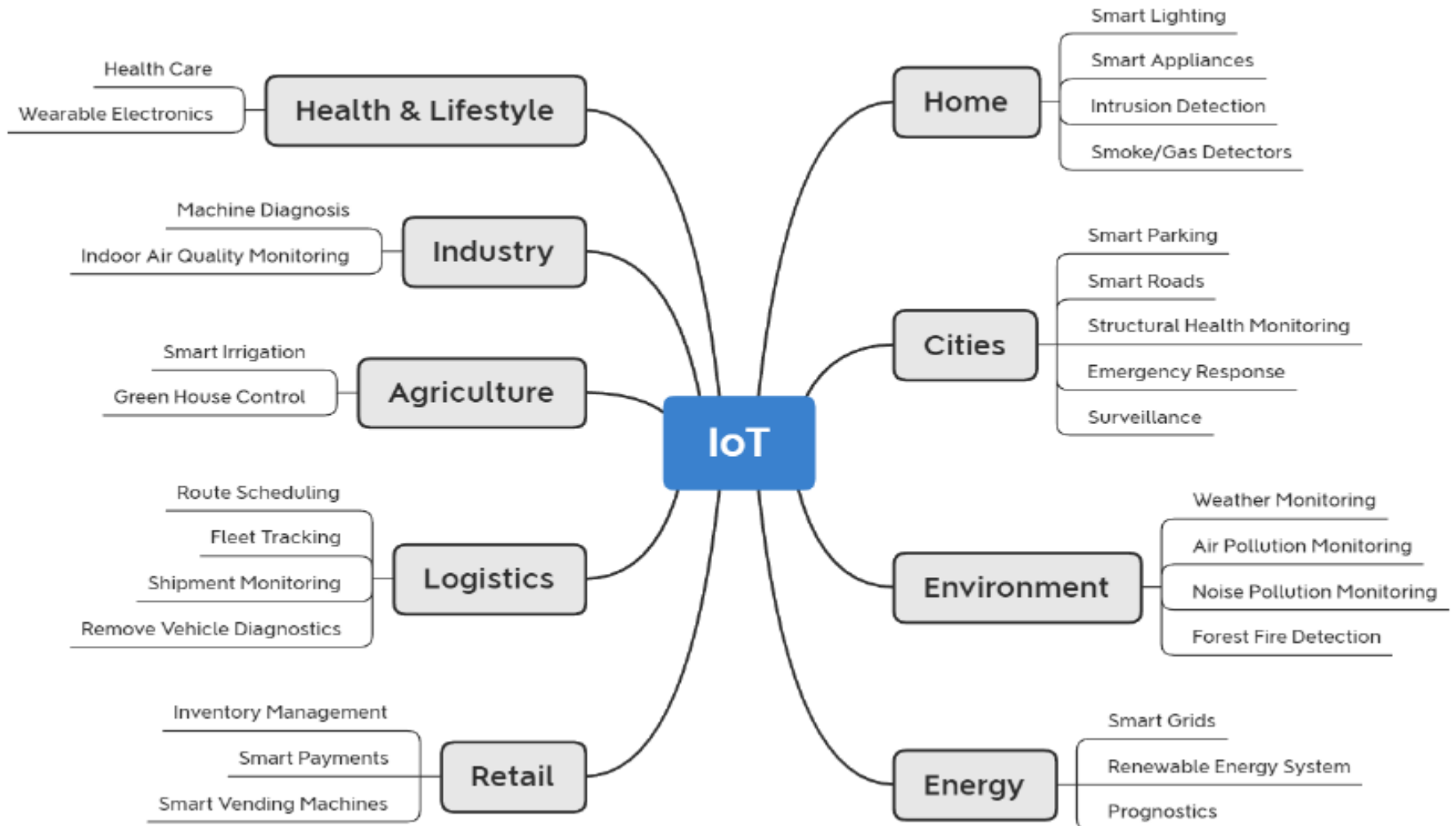


AWS IoT



AWS Greengrass

# Applications of IoT



# Home Automation

- Smart Lighting
  - Control lighting by remotely (mobile or web applications)
- Smart Appliances
  - Provide status information to the users remotely
- Intrusion Detection
  - Use security cameras and sensors (PIR sensors and door sensors)
  - Detect intrusions and raise alerts
  - The alerts form: an SMS or an email sent to the user
- Smoke/Gas Detectors
  - Use optical detection, ionization, or air sampling techniques to detect the smoke
  - Gas detectors can detect harmful gases
    - Carbon monoxide (CO)
    - Liquid petroleum gas (LPG)
  - Raise alerts to the user or local fire safety department

# Cities

- Smart Parking
  - Detect the number of empty parking slots
  - Send the information over the internet and accessed by smartphones
- Smart Roads
  - Provide information on driving conditions, traffic congestions, accidents
  - Alert for poor driving conditions
- Structural Health Monitoring
  - Monitor the vibration levels in the structures (bridges and buildings)
  - Advance warning for imminent failure of the structure
- Surveillance
  - Use the large number of distributed and internet connected video surveillance cameras
  - Aggregate the video in cloud-based scalable storage solutions
- Emergency Response
  - Used for critical infrastructure monitoring
  - Detect adverse events



# Environment

- Weather Monitoring
  - Collect data from several sensors (temperature, humidity, pressure, etc.)
  - Send the data to cloud-based applications and storage back-ends
- Air Pollution Monitoring
  - Monitor emission of harmful gases ( $CO_2$ ,  $CO$ ,  $NO$ ,  $NO_2$ , etc.)
  - Factories and automobiles use gaseous and meteorological sensors
  - Integration with a single-chip microcontroller, several air pollution sensors, GPRS-modem, and a GPS module
- Noise Pollution Monitoring
  - Use a number of noise monitoring stations
  - Generate noise maps from data collected
- Forest Fire Detection
  - Use a number of monitoring nodes deployed at different locations in a forests
    - Use temperature, humidity, light levels, etc.
  - Provide early warning of potential forest fire
  - Estimates the scale and intensity
- River Floods Detection
  - Monitoring the water level (using ultrasonic sensors) and flow rate (using the flow velocity sensors)
  - Raise alerts when rapid increase in water level and flow rate is detected

# Energy

- Smart Grids
  - Collect data regarding electricity generation, consumption, storage (conversion of energy into other forms), distribution, equipment health data
  - Control the consumption of electricity
  - Remotely switch off supply
- Renewable Energy Systems
  - Measure the electrical variables
  - Measure how much the power is fed into the grid
- Prognostics
  - Predict performance of machines or energy systems
    - By collect and analyze the data from sensors

# Agriculture

- Smart Irrigation
  - Use sensors to determine the amount of moisture in the soil
  - Release the flow of water
    - Using predefined moisture levels
  - Water Scheduling
- Green House Control
  - Automatically control the climatological conditions inside a green house
    - Using several sensors to monitor
    - Using actuation devices to control
      - Valves for releasing water and switches for controlling fans
  - Maintenance of agricultural production

# Industry

- Machine Diagnosis
  - Sensors in machine monitor the operating conditions
    - For example: temperature & vibration levels
  - Collecting and analyzing massive scale machine sensor data
    - For reliability analysis and fault prediction in machines
- Indoor Air Quality Monitoring
  - Use various gas sensors
    - To monitor the harmful and toxic gases ( $CO$ ,  $NO$ ,  $NO_2$ , etc.)
  - Measure the environmental parameters to determine the indoor air quality
    - Temperature, humidity, gaseous pollutants, aerosol

# Health and Lifestyle

- Health & Fitness Monitoring
  - Collect the health-care data
    - Using some sensors: body temperature, heart rate, movement (with accelerometers), etc.
  - Various forms : belts and wrist-bands
- Wearable electronic
  - Assists the daily activities
    - Smart watch
    - Smart shoes
    - Smart wristbands

# Questions