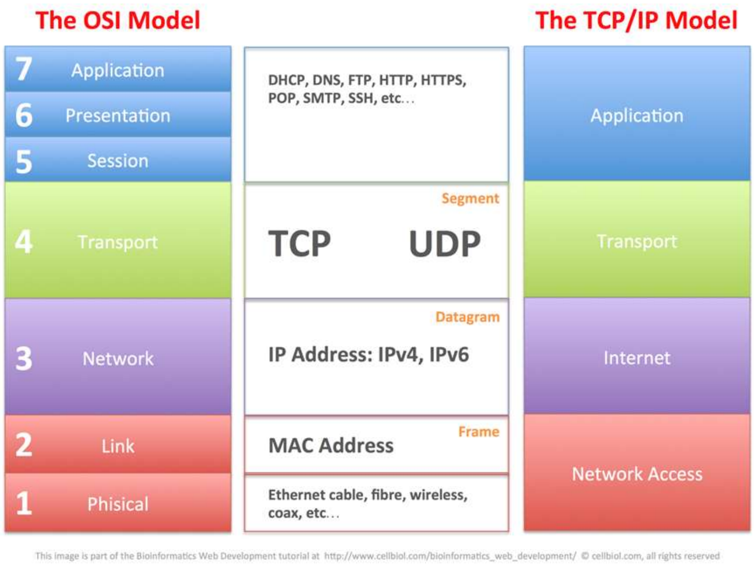
Internet Architecture

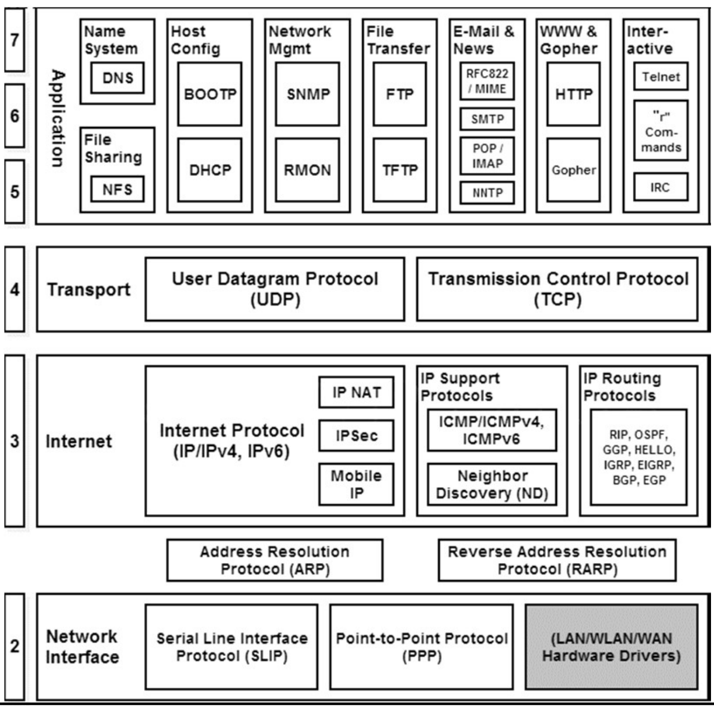
Aj.Drusawin Vongpramate
Information Technology
Science, BRU

Network Model

Layer	Application/Example		Central Device/ Protocols			DOD4 Model
Application (7) Serves as the window for users and application processes to access the network services.	**End User layer** Program that opens what was sent or creates what is to be sent Resource sharing • Remote file access • Remote printer access • Directory services • Network management		**User Applications** SMTP		GATEWAY Can be used on all layers	Process
Presentation (6) Formats the data to be presented to the Application layer. It can be viewed as the "Translator" for the network.	**Syntax layer** encrypt & decrypt (if needed) Character code translation • Data conversion • Data compression • Data encryption • **Character Set Translation**		JPEG/ASCII EBDIC/TIFF/GIF PICT			
Session (5) Allows session establishment between processes running on different stations.	**Synch & send to ports** (logical ports) Session establishment, maintenance and termination • Session support - perform security, name recognition, logging, etc.		**Logical Ports** RPC/SQL/NFS NetBIOS names			
Transport (4) Ensures that messages are delivered error-free, in sequence, and with no losses or duplications.	**TCP** Host to Host, Flow Control Message segmentation • Message acknowledgement • Message traffic control • Session multiplexing	PACKET FILTERING	TCP/SPX/UDP			Host to Host
Network (3) Controls the operations of the subnet, deciding which physical path the data takes.	**Packets** ("letter", contains IP address) Routing • Subnet traffic control • Frame fragmentation • Logical-physical address mapping • Subnet usage accounting		**Routers** IP/IPX/ICMP			Internet
Data Link (2) Provides error-free transfer of data frames from one node to another over the Physical layer.	**Frames** ("envelopes", contains MAC address) [NIC card — Switch — NIC card] (end to end) Establishes & terminates the logical link between nodes • Frame traffic control • Frame sequencing • Frame acknowledgment • Frame delimiting • Frame error checking • Media access control		**Switch** **Bridge** **WAP** PPP/SLIP	Land Based Layers		Network
Physical (1) Concerned with the transmission and reception of the unstructured raw bit stream over the physical medium.	**Physical structure** Cables, hubs, etc. Data Encoding • Physical medium attachment • Transmission technique - Baseband or Broadband • Physical medium transmission Bits & Volts		**Hub**			

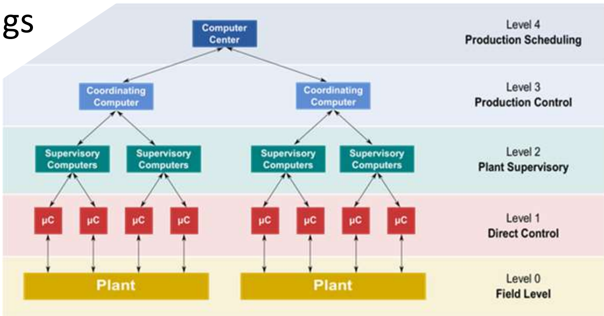
Internet (TCP/IP) Model





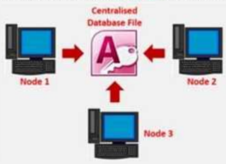
Applications

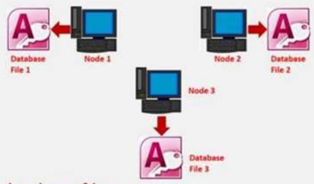
- Distributed Computing
  - Grid Computing
  - Cloud Computing
- Virtualization
- Internet of Things
- Etc.



Centralised vs. Distributed Databases

Centralised Databases	Distributed Databases
A **single** database located at **1 site** on a network	Consists of **2 or more files** located at different sites on a network





Centralised Databases

Advantages:
Since there is only 1 database file, it is easier to:
- Get a complete view of Data
- Manage, update an backup Data

Disadvantages:
- Bottle necking from multiple users accessing the same file – slowing down productivity

Distributed Databases

Advantages:
Having multiple database files means:
- Users wont interfere with each other when accessing / manipulating Data
- Speed since files are retrieved from nearest location
- If one site fails, the system can still run

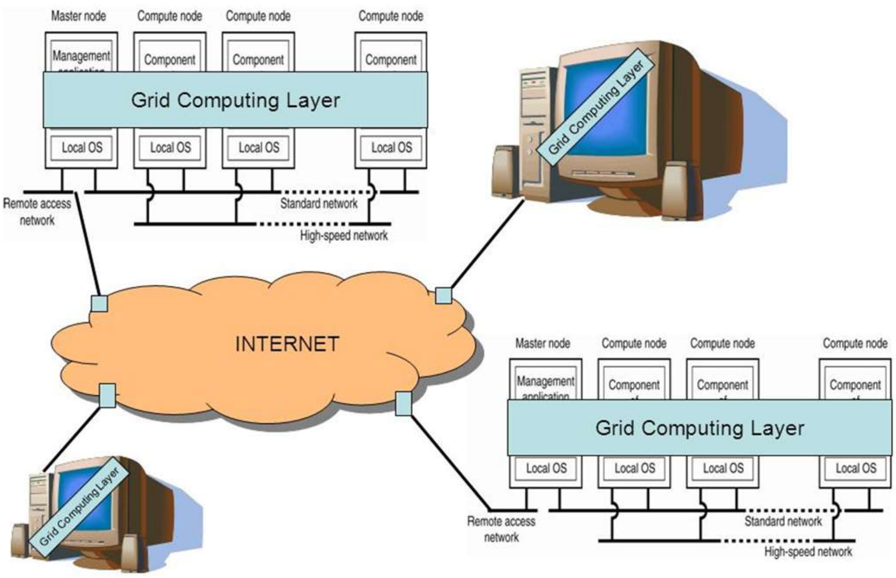
Disadvantages:
- Time for Synchronisation of the multiple databases
- Data Replication for each different database file

Ref : https://www.youtube.com/watch?v=QjvjeQquon8

Grid Computing

A computer network in which each computer's resources are **shared with every other computer** in the system. Processing power, memory and data storage are all community resources that authorized users can tap into and leverage for specific tasks. A grid computing system can be as simple as a **collection of similar computers** running on the same operating system or as complex as inter-networked systems comprised of every computer platform you can think of.

Grid Computing System

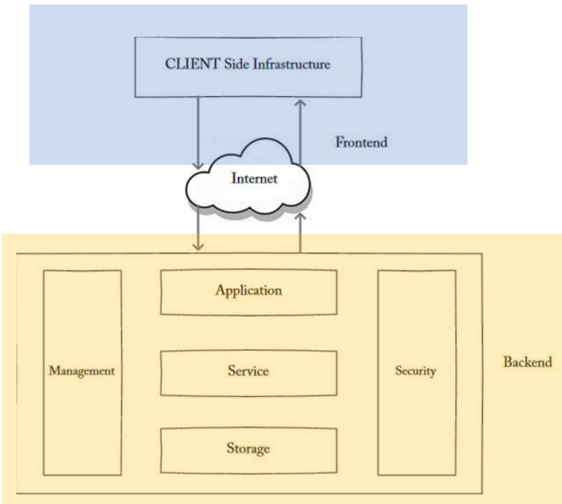


Cloud Computing

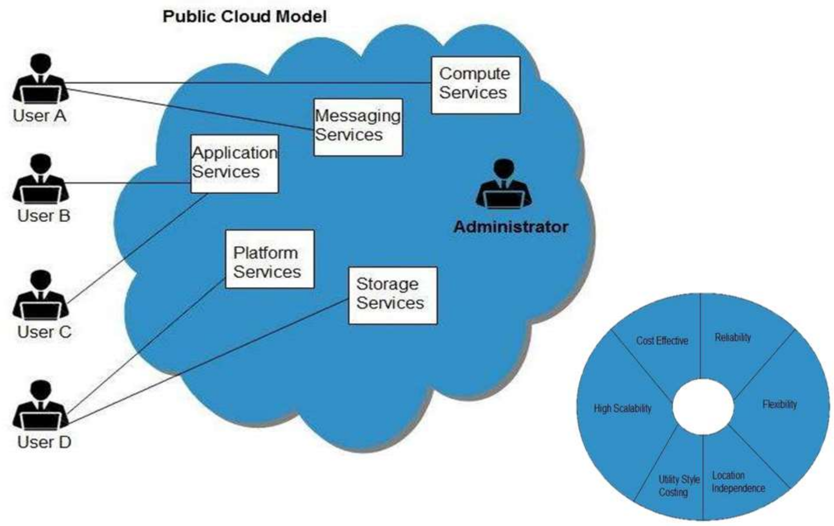
Cloud computing has been trending in today's technology-driven world for years now, and with good reason. Cloud computing offers many advantages with flexibility, storage, sharing and easy accessibility, cloud computing is being used by companies of all sizes. Even at home, we use cloud technologies for various daily activities. From Google Docs to OneDrive to Skype and Spotify, these services are provided to us through virtual networks.

Ref : https://www.w3schools.in/cloud-computing/cloud-computing/

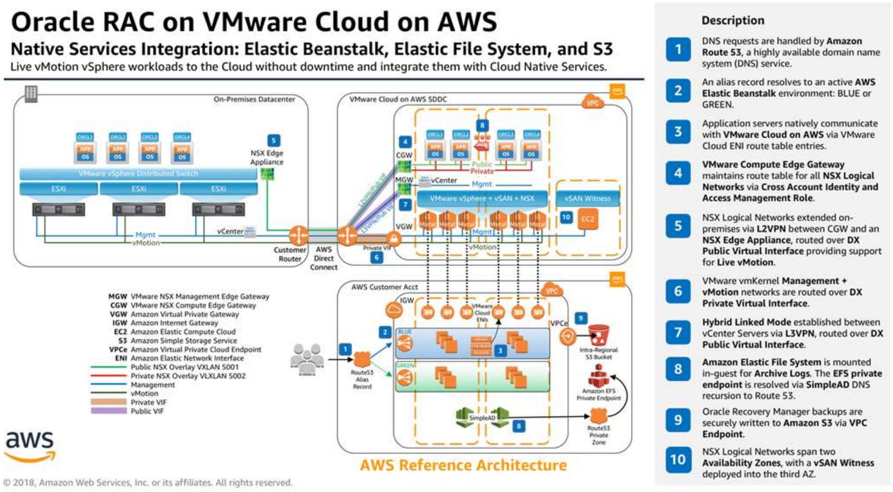
Cloud Computing



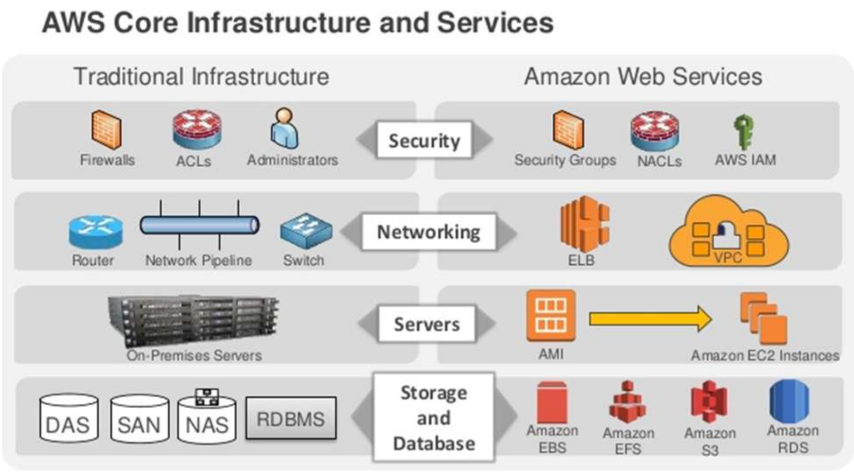
Cloud Computing



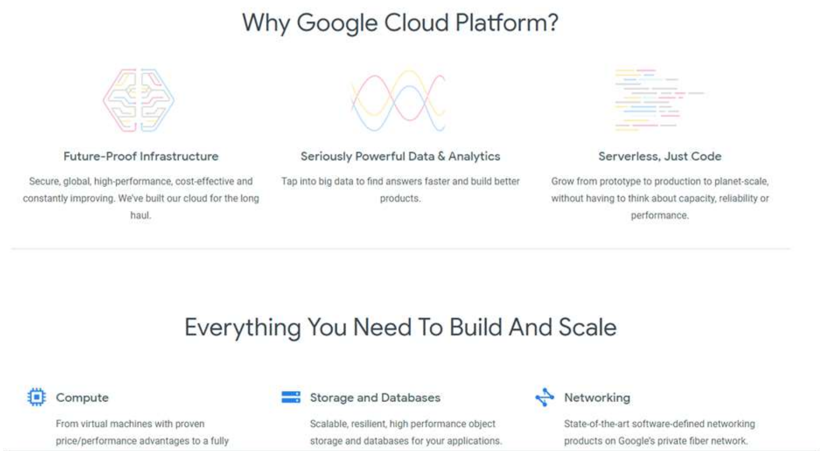
Cloud Computing



Cloud Computing



Example : https://cloud.google.com



Internet of things (IoT)

The extension of Internet connectivity into physical devices and everyday objects. Embedded with electronics, Internet connectivity, and other forms of hardware (such as sensors), these devices can communicate and interact with others over the Internet, and they can be remotely monitored and controlled

Ref :
https://en.wikipedia.org/wiki/Internet_of_things

Internet of things (IoT)

The definition of the Internet of things has evolved due to the convergence of multiple technologies, **real-time analytics**, **machine learning**, **commodity sensors**, and **embedded systems**. Traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), and others all contribute to enabling the Internet of things.

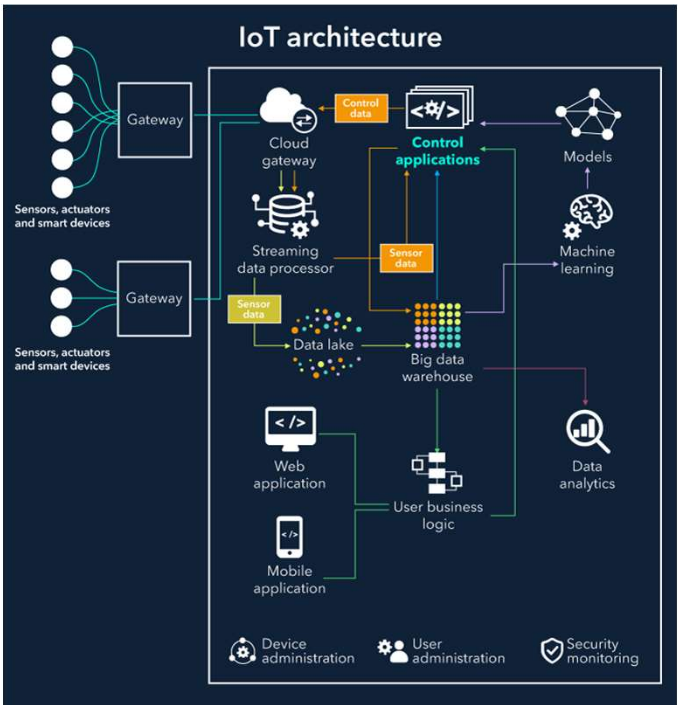
Internet of things (IoT)

In the consumer market, IoT technology is most synonymous with products pertaining to the concept of the "**smart home**", covering devices and appliances (such as lighting fixtures, thermostats, home security systems and cameras, and other home appliances) that support one or more common ecosystems, and can be controlled via devices associated with that ecosystem, such as smartphones and smart speakers.

Basic elements of IoT architecture

Our approach to IoT architecture is reflected in the IoT architecture diagram which shows the building blocks of an IoT system and how they are connected to collect, store and process data.

Ref : https://www.scnsoft.com/blog/iot-architecture-in-a-nutshell-and-how-it-works



IoT architecture

Things. A “thing” is an object equipped with **sensors** that gather data which will be transferred over a network and **actuators** that allow things to act (for example, to switch on or off the light, to open or close a door, to increase or decrease engine rotation speed and more). This concept includes fridges, street lamps, buildings, vehicles, production machinery, rehabilitation equipment and everything else imaginable. Sensors are not in all cases physically attached to the things: sensors may need to monitor, for example, what happens in the closest environment to a thing.

IoT architecture

Gateways. Data goes from things to the cloud and vice versa through the gateways. A gateway provides **connectivity** between things and the cloud part of the IoT solution, enables data preprocessing and filtering before moving it to the cloud (to reduce the volume of data for detailed processing and storing) and transmits control commands going from the cloud to things. Things then execute commands using their actuators.

IoT architecture

Cloud gateway facilitates data **compression** and **secure** data transmission between field gateways and cloud IoT servers. It also ensures compatibility with various protocols and communicates with field gateways using different protocols depending on what protocol is supported by gateways.

Streaming data processor **ensures** effective transition of input data to a data lake and control applications. No data can be occasionally lost or corrupted.

IoT architecture

Data lake. A data lake is used for **storing** the data generated by connected devices in its natural format. Big data comes in "batches" or in “streams”. When the data is needed for meaningful insights it’s extracted from a data lake and loaded to a big data warehouse.

IoT architecture

Big data warehouse. Filtered and preprocessed data needed for meaningful insights is extracted from a data lake to a big data warehouse. A big data warehouse contains only cleaned, structured and matched data (compared to a data lake which contains all sorts of data generated by sensors). Also, data warehouse stores context information about things and sensors (for example, where sensors are installed) and the commands control applications send to things.

IoT architecture

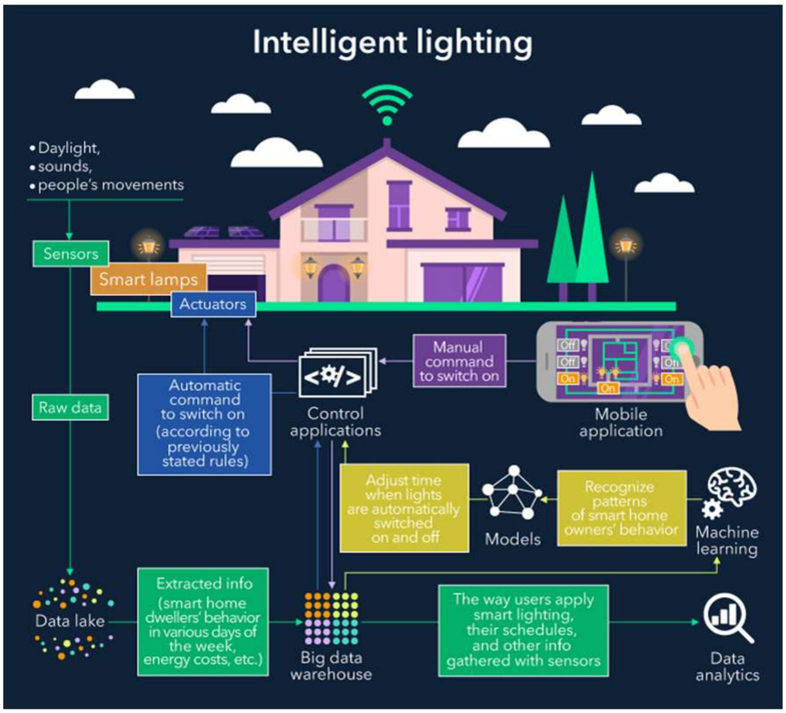
Data analytics. Data analysts can use data from the big data warehouse to find trends and gain actionable insights. When analyzed (and in many cases – visualized in schemes, diagrams, infographics) big data show, for example, the performance of devices, help identify inefficiencies and work out the ways to improve an IoT system (make it more reliable, more customer-oriented). Also, the correlations and patterns found manually can further contribute to creating algorithms for control applications.

IoT architecture

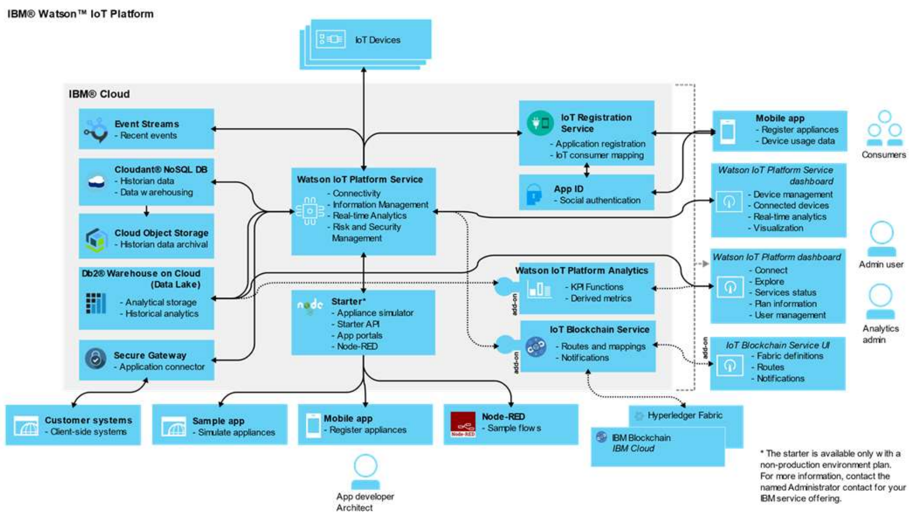
Machine learning and the models ML generates. With machine learning, there is an opportunity to **create** more **precise** and more **efficient models** for control applications. Models are regularly updated (for example, once in a week or once in a month) based on the historical data accumulated in a big data warehouse. When the applicability and efficiency of new models are tested and approved by data analysts, new models are used by control applications.

Example – Intelligent lighting

Let’s see how our IoT architecture elements work together by the example of smart yard lighting as a part of a smart home – a bright illustration of how an IoT solution simultaneously contributes to user convenience and energy efficiency. There are various ways a smart lighting system can function, and we’ll cover basic options.



Other IoT Platform



Q & A