

①

34033

Set 3 Answers

Q-1-A

1. Which one of the following is **not** an HTTP Method- UNDO
2. The **chown** command changes the user and/or group that owns a file
3. LED stands for **Light Emitting Diode**
4. Raspberry Pi GPIO has **40** number of pins.
5. **Virtual Private Networks** is Tools for achieving security

Q-1-B

1. **HTTP** works on request - response architecture.
2. The role of the **publisher** is to connect to the message broker and publish content.
3. **UART** is an asynchronous serial communication protocol
4. **GND** are the pins you use to ground your devices
5. ARM is **Advanced RISC Machine**

Q-1-C Explain in brief.

1. What is PWM- Its pulse width modulation.
2. Thingier.io is a platform that allows connecting things to the Internet.
3. The main difference between CoAP and HTTPU is that CoAP replaces the text headers used in HTTPU with more compact binary headers, and furthermore, it reduces the number of options available in the header.
4. Define the term - Protocol:- Its set of rules for communication over medium.
5. List stages of 5-stage pipeline organisation:- Fetch – Decode - Execute- Buffer data- write back.

Q. 2 Attempt the following (Any THREE)

(15)

a) Explain How this small Soc boots without BIOS.

Ans

The firmware is closed-source proprietary code programmed into the SoC (System on a Chip) processor, which cannot be modified.

Upon power-up the firmware will initiate a bootloader on the SD card

After this point everything else comes from the SD card.

1. First stage bootloader - This is used to mount the FAT32 boot partition on the SD card so that the second stage bootloader can be accessed. It is programmed into the SoC itself during manufacture of the RPi and cannot be reprogrammed by a user.
2. Second stage bootloader (bootcode.bin) - This is used to retrieve the GPU firmware from the SD card, program the firmware, then start the GPU.

3. GPU firmware (start.elf) - Once loaded, this allows the GPU to start up the CPU. An additional file, fixup.dat, is used to configure the SDRAM partition between the GPU and the CPU. At this point, the CPU is release from reset and execution is transferred over.

4. User code - This can be one of any number of binaries. By default, it is the Linux kernel (usually named kernel.img), but it can also be another bootloader (e.g. U-Boot), or a bare-bones application.

b) Explain FPGA.

Ans- Processors and FPGAs (field-programmable gate arrays) are the hardworking cores of most embedded systems. Integrating the high-level management functionality of processors and the stringent, real-time operations, extreme data processing, or interface functions of an FPGA (Field Programmable Gate Array) into a single device forms an even more powerful embedded computing platform.

SoC FPGA devices integrate both processor and FPGA architectures into a single device. Consequently, they provide higher integration, lower power, smaller board size, and higher bandwidth communication between the processor and FPGA. They also include a rich set of peripherals, on-chip memory, an FPGA-style logic array, and high speed transceivers.

A field-programmable gate array (FPGA) is an integrated circuit designed to be configured by a customer or a designer after manufacturing – hence "field-programmable".

FPGAs contain an array of programmable logic blocks, and a hierarchy of reconfigurable interconnects that allow the blocks to be "wired together", like many logic gates that can be inter-wired in different configurations. Logic blocks can be configured to perform complex combinational functions, or merely simple logic gates like AND and XOR.

In most FPGAs, logic blocks also include memory elements, which may be simple flip-flops or more complete blocks of memory. An FPGA can be used to solve any problem which is computable. This is trivially proven by the fact FPGA can be used to implement a soft microprocessor, such as the Xilinx MicroBlaze or Altera Nios II. Their advantage lies in that they are sometimes significantly faster for some applications because of their parallel nature and optimality in terms of the number of gates used for a certain process.

c) Write the steps to install Raspbian operating system on raspberry pi model B.

ans-

Installing raspberry pi

Before you start, you (obviously) should have a microSD card and a computer with an SD card reader. Besides that, download the Raspbian image file directly from raspberrypi.com (don't forget to unzip the image file!). Done? Good, let's get started.

Image : <https://www.raspberrypi.org/downloads/raspbian/>

select : RASPBIAN JESSIE WITH PIXEL

1. Insert your microSD card into your card reader and find out its drive letter in Windows Explorer (for example G:).
2. Download Win32DiskImager, unzip the downloaded file and run the utility file.
3. Select the Raspbian image file you downloaded.
4. Select the drive of your SD card in the 'Device' dropdown. Make sure you chose the

3

correct one. Otherwise, you risk damaging the data on your hard drive.

5. Select 'Write' and wait for the process to finish. That's it!

6. Now you can plug the SD card into your Raspberry Pi's slot.

d) Write a short note on ARM 8

ans- The ARMv8 architecture introduces 64-bit support to the ARM architecture with a focus on power-efficient implementation while maintaining compatibility with existing 32-bit software.

By adopting a clean approach ARMv8-A processors extend the performance range available while maintaining the low power consumption characteristics of the ARM processors that will power tomorrow's most innovative and efficient devices.

ARM has 3 different product tiers supporting the ARMv8-A architecture:

1. High Performance,
2. High Efficiency, and
3. Ultra-High Efficiency.

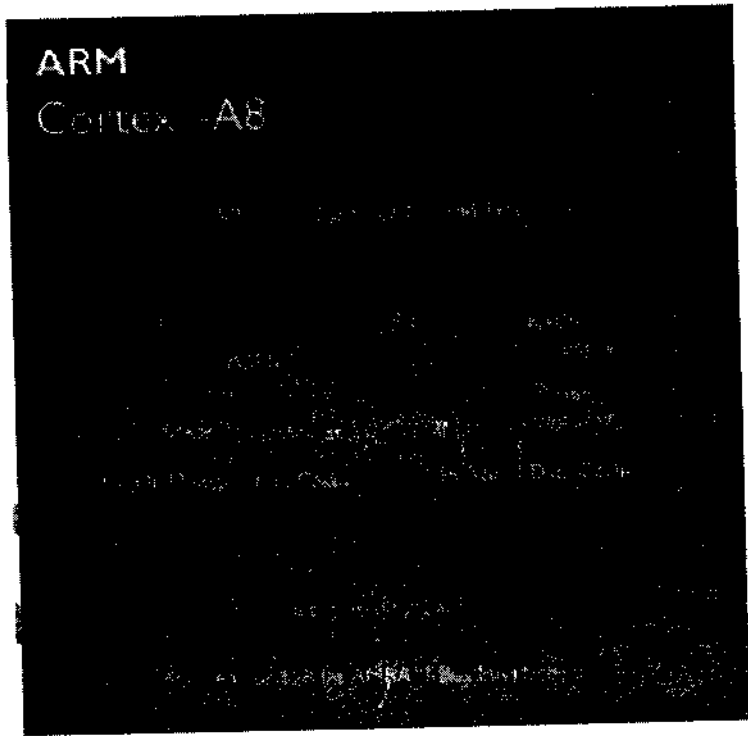
Increased availability of larger registers for general purpose and media instructions, a greater addressing range and cryptography instructions enable new categories of applications for superphone and tablet computing, while bringing the ARM benefits of efficient design and low power consumption to applications where 64-bit computing is already established, such as servers and network infrastructure, promising to revolutionize the data center.

The ARMv8 architecture maintains compatibility with the comprehensive software ecosystem for 32-bit components. This enables a wealth of software optimized for existing ARM processors to benefit from the enhanced performance of processors based on the ARMv8 architecture while the addition of 32-bit cryptographic instructions further enables optimization for emerging requirements.

Developing the software to make best use of the new 64-bit capabilities requires the availability of excellent tools, test platforms and key open source components.

While developing the architecture and the processors based on ARMv8-A, ARM has also ensured that the essential tools for development are available to software developers today, enabling the ARM software ecosystem to continue to innovate around the Architecture for the Digital World.

5



e) Explain the basic hardware components of Raspberry Pi.

Ans- Sd card , Adapter, keyboard, mouse, monitor, ethernet cable.

f) State the difference between an Soc and CPU

Ans- The number one advantage of an SoC is its size: An SoC is only a little bit larger than a CPU, and yet it contains a lot more functionality. If you use a CPU, it's very hard to make a computer that's smaller than 10cm (4 inches) squared, purely because of the number of individual chips that you need to squeeze in. Using SoCs, we can put complete computers in smartphones and tablets, and still have plenty of space for batteries.

Due to its very high level of integration and much shorter wiring, an SoC also uses considerably less power — again, this is a big bonus when it comes to mobile computing. Cutting down on the number of physical chips means that it's much cheaper to build a computer using an SoC, too.

The only real disadvantage of an SoC is a complete lack of flexibility. With your PC, you can put in a new CPU, GPU, or RAM at any time — you cannot do the same for your smartphone. In the future you might be able to buy SoCs that you can slot in, but because everything is integrated this will be wasteful and expensive if you only want to add more RAM.

Q. 3 Attempt the following (Any THREE)

(15)

a) Explain following terms: 1.Booth multiplier 2.control unit

Ans-

Booth Multiplier Factor

It has factor has 32 bits inputs and the input return from the register file. the multiplier output is barely 32 Least significant bits of the merchandise. the entity representation of the multiplier factor .the multiplication starts whenever the beginning 4 input goes active .fin of the output goes high when finishing.

5

control unit

The control unit is sometimes a pure combinational circuit design. Here, the control unit is implemented by easy state machine. The processor timing is additionally included within the control unit. Signals from the control unit are connected to each component within the processor to supervise its operation. It directs the flow of data between the CPU and the other devices. John von Neumann included the control unit as part of the von Neumann architecture.

b) Write a short note on free open source Raspbian OS

Ans- Raspbian is a free operating system based on Debian optimized for the Raspberry Pi hardware.

An operating system is the set of basic programs and utilities that make your Raspberry Pi run. However, Raspbian provides more than a pure OS: it comes with over 35,000 packages, pre-compiled software bundled in a nice format for easy installation on your Raspberry Pi. The initial build of over 35,000 Raspbian packages, optimized for best performance on the Raspberry Pi, was completed in June of 2012. However, Raspbian is still under active development with an emphasis on improving the stability and performance of as many Debian

packages as possible.

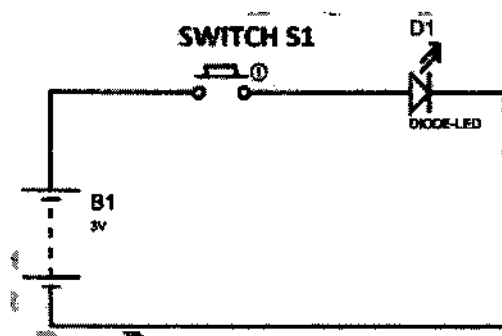
Raspbian is not affiliated with the Raspberry Pi Foundation. Raspbian was created by a small, dedicated team of developers that are fans of the Raspberry Pi hardware, the educational goals of the Raspberry Pi Foundation and, of course, the Debian Project.

Raspbian was created by Mike Thompson and Peter Green as an independent project.

The operating system is still under active development. Raspbian is highly optimized for the Raspberry Pi line's low-performance ARM CPUs. Raspbian uses PIXEL, Pi Improved Xwindows Environment, Lightweight as its main desktop environment as of the latest update. It is composed of a modified LXDE desktop environment and the Openbox stacking window manager with a new theme and few other changes.

c) Define and explain with an example Pulse Width Modulation

Ans-



In above figure, if the switch is closed continuously over a period of time, the LED will be 'ON' during this time continuously. If the switch is closed for half second and opened for next half second, then LED will be ON only in the first half second. Now the proportion for which the LED is ON over the total time is called the Duty Cycle, and can be calculated as follows:



Duty Cycle = Turn ON time / (Turn ON time + Turn OFF time)

Duty Cycle = $(0.5 / (0.5 + 0.5)) = 50\%$

So the average output voltage will be 50% of the battery voltage.

This is the case for one second and we can see the LED being OFF for half second and LED being ON the other half second. If Frequency of ON and OFF times increased from '1 per second' to '50 per second'. The human eye cannot capture this frequency. For a normal eye the LED will be seen, as glowing with half of the brightness. So with further reduction of ON time the LED appears much lighter.

d) Explain cross compiler

ans- A cross compiler is a compiler that runs on one platform/architecture but generates binaries for another platform/architecture. With devices like the Raspberry Pi, where you really don't have much CPU or memory to work with, if you're doing any heavy compiling (like when working on the kernel) a cross compiler is the only way to go.

For example, I build all my Raspberry Pi kernels on my nice Sandy Bridge Xeon E3 home server where they compile in only a fraction of the time they would on the Pi.

While there are a lot of different methods for building cross-compilers, by far the quickest and easiest is to use crosstool-ng. This is a set of scripts that bring up a menuconfig-like interface to choose your compiler settings, then goes off and downloads what it needs, patches it, configures it, builds it and installs it all for you.

e) Features of node.js?

Ans- Features of Node.js

Asynchronous and Event Driven – All APIs of Node.js library are asynchronous, that is, non-blocking. It essentially means a Node.js based server never waits for an API to return data. The server moves to the next API after calling it and a notification mechanism of Events of Node.js helps the server to get a response from the previous API call.

Very Fast – Being built on Google Chrome's V8 JavaScript Engine, Node.js library is very fast in code execution.

Single Threaded but Highly Scalable – Node.js uses a single threaded model with event looping. Event mechanism helps the server to respond in a non-blocking way and makes the server highly scalable as opposed to traditional servers which create limited threads to handle requests. Node.js uses a single threaded program and the same program can provide service to a much larger number of requests than traditional servers like Apache HTTP Server.

No Buffering – Node.js applications never buffer any data. These applications simply output the data in chunks.

License – Node.js is released under the MIT license (Massachusetts Institute of Technology)

f) Define GPIO programming.

Ans- A General Purpose Input/output (GPIO) is an interface available on most modern microcontrollers (MCU) to provide an ease of access to the devices internal properties.

7

Generally there are multiple GPIO pins on a single MCU for the use of multiple interaction so simultaneous application. The pins can be programmed as input, where data from some external source is being fed into the system to be manipulated at a desired time and location.

Output can also be performed on GPIOs, where formatted data can be transmitted efficiently to outside devices, this provides a simple mechanism to program and retransmit data depending on user desires through a single port interface.

The pins are usually arranged into groups of 8 pins where signals can be sent or received to and from other devices. In many applications, the GPIOs can be configured as interrupt lines for a CPU to signal immediate processing of input lines. In many newer designs, they also have the ability to control and use Direct Memory Access (DMA) to transfer blocks of data in a more efficient manner. Essentially all ports can be tailored to fit specific design goals and provide reusability within applications

Q. 4 Attempt the following (Any THREE)

(15)

a) Explain XMPP protocol used in IoT communication with block diagram.

Ans-

XMPP was originally designed for use in instant messaging applications (or chat). It is an open protocol, standardized by Internet Engineering Task Force (IETF), as are HTTP and CoAP.

Even though it was first designed for chat applications, it lends itself very well to other applications, such as the ones for IoT, due to its flexibility and richness of communication patterns.

The XMPP architecture builds on the tremendous success and global scalability of the Simple Mail Transfer Protocol (SMTP)

The difference is that XMPP is designed for real-time instantaneous messaging applications, where smaller messages are sent with as little latency as possible and without any persistence XMPP uses a federated network of XMPP servers as message brokers to allow clients behind separate firewalls to communicate with each other

Each server controls its own domain and authenticates users on that domain.

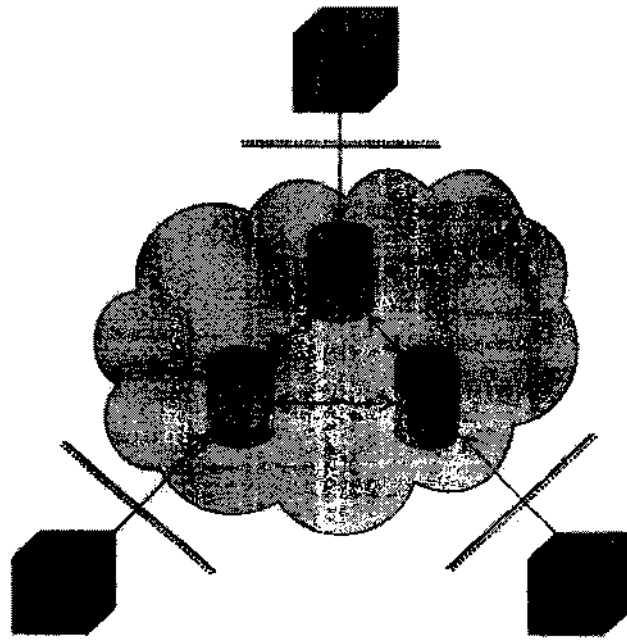
Clients can communicate with clients on other domains through the use of federation where the servers create connections between themselves in a secure manner to interchange messages between their domains.

It is this federation that allows you to have a globally scalable architecture. All of this happens at the server level, so there is nothing that clients need to worry about. They only need to ensure

that they maintain the connection with their respective servers, and through the servers, each of them will have the possibility to send messages to any other client in the federated network.

It is this architecture of federation that makes XMPP scalable and allows you to make billions of devices communicate with each other in the same federated network.

The following illustration shows how clients (C1, C2, and C3) behind firewalls connect to different servers (S1, S2, and S3) in a federated network to exchange messages:



b) IoT Service as a Platform 1. Clayster platform 2. thinger.io

Ans-

Clayster platform

We will start the download of the Clayster platform by downloading its version meant for Console Applications outlines the process to create a simple console application. When we create a service for a service platform, the executable EXE file already exists.

Therefore, we have to create a library project instead and make sure that the target framework corresponds to the version of the Clayster distribution (dot net 3.5)

Such a project will generate a dynamic link library (DLL) file. During startup, the Clayster executable file will load any DLL file it finds marked as a Clayster Module in its installation folder or any of its subfolders.

thinger.io

Thinger.io is a platform that allows connecting things to the Internet. And what's new? Hardware agnostic: Connect anything! from basic Arduinos with very limited resources, to more complex embedded systems running linux like Raspberry Pi

It is Open Source, so you can take the code and build your own cloud if you want. It provides thing API discovery right out of the box, so you can code your things and interact easily from the web.

9

e) what are different attacks possible in IOT? Explain 1 Guessing the credentials 2. Getting access to stored credentials

Ans-

1 Guessing the credentials

One way to get access to a system is to impersonate a client in the system by trying to guess the client's credentials. To make this type of attack less effective, make sure each client and each device has a long and unique, perhaps randomly generated, set of credentials.

2. Getting access to stored credentials

One common way to illicitly enter a system is when user credentials are found somewhere else and reused.

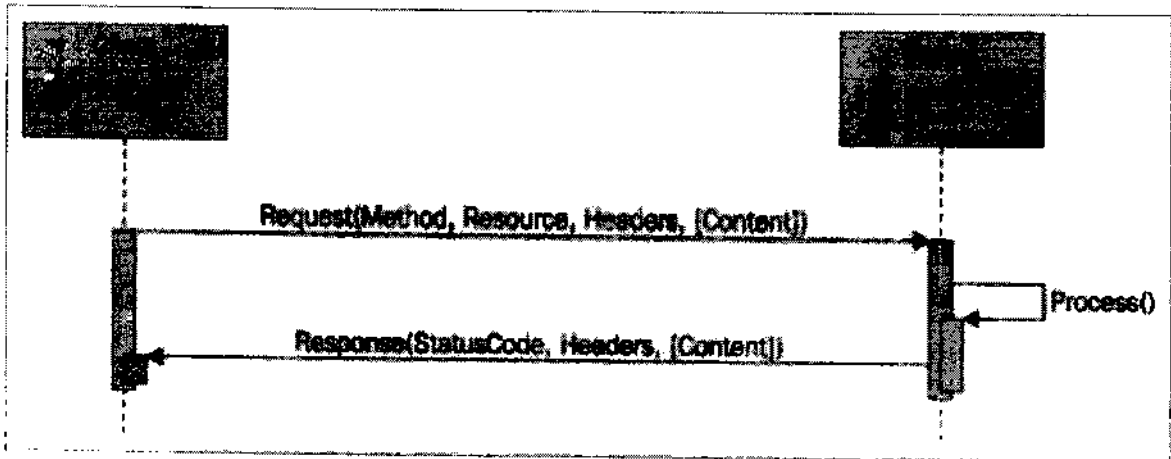
Often, people reuse credentials in different systems. There are various ways to avoid this risk from happening. One is to make sure that credentials are not reused in different devices or across different services and applications.

d) Explain HTTP protocol working IOT.

Ans- It is safe to assume that most people that use a computer today have had an experience of Hypertext Transfer Protocol (HTTP), perhaps without even knowing it. When they "surf the Web", what they do is they navigate between pages using a browser that communicates with the server using HTTP.

HTTP has become much more than navigation between pages on the Internet. Today, it is also used in machine to machine (M2M) communication, automation, and Internet of Things, among other things.

So much is done on the Internet today, using the HTTP protocol, because it is easily accessible and easy to relate to. For this reason, we are starting our study of Internet of Things by studying HTTP. This will allow you to get a good grasp of its strengths and weaknesses, even though it is perhaps one of the more technically complex protocols.



e) Explain Node-RED as software tool in IoT.

Ans- Node-RED



Node-RED is a software tool developed by IBM for wiring together hardware devices, APIs and online services as part of the Internet of Things.

Node-RED provides a browser-based flow editor, which can be used to create JavaScript functions.

Elements of applications can be saved or shared for re-use. The runtime is built on Node.js.

The flows created in Node-RED are stored using JSON. Node-RED is built on Node.js, taking full advantage of its event-driven, non-blocking model.

This makes it ideal to run at the edge of the network on low-cost hardware such as the Raspberry Pi as well as in the cloud.

By default, the Node-RED editor is not secured - anyone who can access the IP address and port it is running on can access the editor and deploy changes. This is only suitable if you are running on a trusted network.

f) What is IOT and what are its features?

Ans-

1. Intelligence

IoT comes with the combination of algorithms and computation, software & hardware that makes it smart. Ambient intelligence in IoT enhances its capabilities which facilitate the things to respond in an intelligent way to a particular situation and supports them in carrying out specific tasks. In spite of all the popularity of smart technologies, intelligence in IoT is only concerned as means of interaction between devices, while user and device interaction is achieved by standard input methods and graphical user interface.

2. Connectivity

Connectivity empowers Internet of Things by bringing together everyday objects. Connectivity of these objects is pivotal because simple object level interactions contribute towards collective intelligence in IoT network. It enables network accessibility and compatibility in the things. With this connectivity, new market opportunities for Internet of things can be created by the networking of smart things and applications.

3. Dynamic Nature

The primary activity of Internet of Things is to collect data from its environment, this is achieved with the dynamic changes that take place around the devices. The state of these devices change dynamically, example sleeping and waking up, connected and/or disconnected as well as the context of devices including temperature, location and speed. In addition to the state of the device, the number of devices also changes dynamically with a person, place and time.

4. Enormous scale

The number of devices that need to be managed and that communicate with each other will be much larger than the devices connected to the current Internet. The management of data generated from these devices and their interpretation for application purposes becomes more critical. Gartner (2015) confirms the enormous scale of IoT in the estimated report where it stated that 5.5 million new things will get connected every day and 6.4 billion connected things will be in use worldwide in 2016, which is up by 30 percent from 2015. The report also forecasts that the number of connected devices will reach 20.8 billion by 2020.

5. Sensing

IoT wouldn't be possible without sensors which will detect or measure any changes in the environment to generate data that can report on their status or even interact with the environment. Sensing technologies provide the means to create capabilities that reflect a true awareness of the physical world and the people in it. The sensing information is simply the analogue input from the physical world, but it can provide the rich understanding of our complex world.

6. Heterogeneity

Heterogeneity in Internet of Things as one of the key characteristics. Devices in IoT are based on different hardware platforms and networks and can interact with other devices or service platforms through different networks. IoT architecture should support direct network connectivity between heterogeneous networks. The key design requirements for heterogeneous things and their environments in IoT are scalabilities, modularity, extensibility and interoperability.

7. Security

IoT devices are naturally vulnerable to security threats. As we gain efficiencies, novel experiences, and other benefits from the IoT, it would be a mistake to forget about security concerns associated with it. There is a high level of transparency and privacy issues with IoT. It is important to secure the endpoints, the networks, and the data that is transferred across all of it means creating a security paradigm.

There are a wide variety of technologies that are associated with Internet of Things that facilitate in its successful functioning. IoT technologies possess the above-mentioned characteristics which create value and support human activities; they further enhance the capabilities of the IoT network by mutual cooperation and becoming the part of the total system.

Q. 5 Attempt the following (Any THREE)

(15)

a) Discuss the characteristics of SPI. How one can connect Camera module using SPI.

Ans_ Serial Peripheral Interface (SPI) is an interface bus commonly used to send data between microcontrollers and small peripherals such as shift registers, sensors, and SD cards. It uses separate clock and data lines, along with a select line to choose the device you wish to talk to.

A common serial port, the kind with TX and RX lines, is called 'asynchronous' (not synchronous) because there is no control over when data is sent or any guarantee that both sides are running at precisely the same rate. Since computers normally rely on everything being synchronized to a single 'clock' (the main crystal attached to a computer that drives everything), this can be a problem when two systems with slightly different clocks try to communicate with each other.

To work around this problem, asynchronous serial connections add extra start and stop bits to each byte help the receiver sync up to data as it arrives. Both sides must also agree on the transmission speed (such as 9600 bits per second) in advance. Slight differences in the transmission rate aren't a problem because the receiver re-syncs at the start of each byte.

SPI works in a slightly different manner. It's a 'synchronous' data bus, which means that it uses separate lines for data and a 'clock' that keeps both sides in perfect sync.

The clock is an oscillating signal that tells the receiver exactly when to sample the bits on the data line. This could be the rising (low to high) or falling (high to low) edge of the clock signal; the datasheet

b) Explain different security tools in IOT.



Ans-

Breaking ciphers

Ciphers can be broken using known vulnerabilities in code where attackers exploit program implementations rather than the underlying algorithm of the cipher.

To safeguard against such attacks, it's important to realize that an attacker does not spend more effort into an attack than what is expected to be gained by the attack.

By storing massive amounts of sensitive data centrally or controlling massive amounts of devices from one point, you increase the value of the target, increasing the interest of attacking.

Sniffing network communication

If communication is not encrypted, everybody with access to the communication stream can read the messages using simple sniffing applications, such as Wireshark.

Remember to always use encryption if sensitive data is communicated. If data is private, encryption should still be used, even if the data might not be sensitive at first glance.

Port scanning and web crawling

Port scanning is a method where you systematically test a range of ports across a range of IP addresses to see which ports are open and serviced by applications.

This method can be combined with different tests to see the applications that might be behind these ports.

If HTTP servers are found, standard page names and web-crawling techniques can be used to try to figure out which web resources lie behind each HTTP server.

c) Explain general architecture of an SoC with block diagram.

Ans- A system on a chip or system on chip (SoC or SOC) is an integrated circuit (also known as an "IC" or "chip") that integrates all components of a computer or other electronic systems.

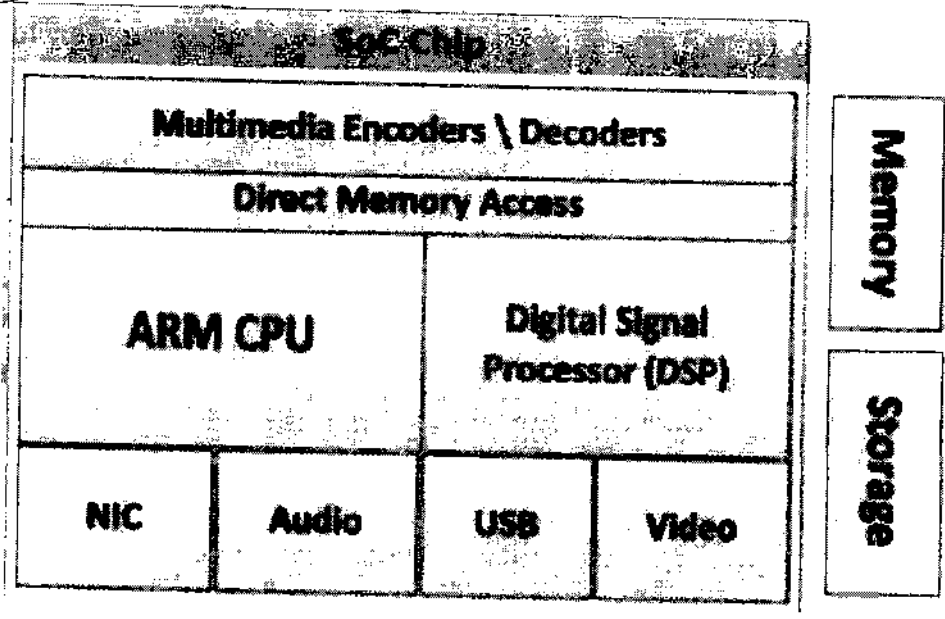
It may contain digital, analog, mixed-signal, and often radio-frequency functions—all on a single substrate.

SoCs are very common in the mobile computing market because of their low power- consumption.

typical application is in the area of embedded systems. The contrast with a microcontroller, SoC integrates microcontroller (or microprocessor) with advanced peripherals like graphics processing unit (GPU), Wi-Fi module, or coprocessor. In general, we can distinguish three types of SoC

1. SoC built around a microcontroller
2. SoC built around a microprocessor (this type can be found in mobile phones)
3. specialized SoC designed for specific applications that do not fit into the above two categories.

13



d) Explain the following linux commands: ls, pwd, cat, tar, unzip

LS

The ls command lists the content of the current directory (or one that is specified). It can be used with the -l flag to display additional information (permissions, owner, group, size, date and timestamp of last edit) about each file and directory in a list format. The -a flag allows you to view files beginning with . (i.e. dotfiles).

PWD

The pwd command displays the name of the present working directory: on a Raspberry Pi, entering pwd will output something like /home/pi.

CAT

You can use cat to list the contents of file(s), e.g. cat thisFile will display the contents of thisFile. Can be used to list the contents of multiple files, i.e. cat *.txt will list the contents of all .txt files in the current directory.

UNZIP

The unzip command extracts the files from a compressed zip file.

TAR

Use tar to store or extract files from a tape archive file. It can also reduce the space required by compressing the file similar to a zip file.

e) Explain the working of protocol in MQTT in IOT.

Ans-One of the major problems we encountered when we looked at the HTTP, UPnP, and CoAP protocols is how to cross firewall boundaries

Firewalls not only block incoming connection attempts, but they also hide a home or office network behind a single IP address.

5

Unless the firewall blocks outgoing connections, which it does only if explicitly configured to do so, we can cross firewall boundaries if all the endpoints in a conversation act as clients to a common message broker that lies outside of the firewall and is therefore accessible to everybody.

The message broker acts as a server, but all it does is relay messages between clients. One protocol that uses message brokers is the Message Queue Telemetry Transport (MQTT) protocol.

