DHRUV GARG 16 BCE 1190

INTERNET OF THINGS – DIGITAL ASSIGNMENT 3

AIM: Comparison of architectures of different applications of Internet Of Things (IOT).

LAYER NUMBER	INTERNET OF THINGS (IOT)	WEB OF THINGS (WOT)	INTERNET OF VEHICLES (IOV)	INTERNET OF EVERYTHING (IOE)
LAYER 7	Not applicable	Not applicable	**SECURITY LAYER:** It communicates directly with the rest of the layers. Implements security functions like data authentication, integrity, non-repudiation, confidentiality and access control. The layer is designed to mitigate various security attacks in IoV. **Protocols used:** HSM, S-IC, IEEE 1609.2.	Not applicable
LAYER 6	Not applicable	Not applicable	**BUSINESS LAYER:** Processes large amounts of information using cloud computing infrastructures locally and remotely. Performs storing, processing and analysing the data received from the other layers, and making decisions based on data statistical analysis and identifying strategies that help in applying business models.	Not applicable
LAYER 5	Not applicable	Not applicable	**CONTROL AND MANAGEMENT LAYER:** It is the global coordinator that is responsible for managing the different network service providers that are within the IoV environment. It manages the data exchange among the various services. **Protocols used:** CALM-SL, WAVE 1609.6.	Not applicable
LAYER 4	**APPLICATION LAYER:** Defines how the applications interface with the lower layer protocols. Application layer protocols enable process-to-process connections using ports.	**APPLICATION LAYER (divided into 4 sub-layers):** **ACCESS:** Responsible for turning any Thing into a Web Thing that can be interacted with using HTTP requests. A Web Thing is a REST API that	**COMMUNICATION LAYER:** This layer selects the best network to send the information based on several selection parameters such as congestion and Quality of Service (QoS) level	**INTERNET / CLOUD LAYER:** This is the internet where data usually ends up. Data send to and from this layer are usually stored in huge data centers.

	Protocols used: HTTP, COAP, MQTT, XMPP, DDS, AMQP and WebSocket.	allows to interact with the real world. **FIND:** This layer ensures that your Thing can not only be easily used by other HTTP clients but can also be findable and automatically usable by other WoT applications. It reuses web semantic standards to describe things and their services, which enables searching for things through search engines. **SHARE:** Specifies how the data generated by Things can be shared in an efficient and secure manner over the web. First, TLS protocol makes transactions on the Web secure. Then, techniques such as delegated web authentication mechanisms can be integrated. We can also use social networks to share Things and their resources. **COMPOSE:** To build large-scale, meaningful applications for the Web of Things. In other words, we need to understand the integration of data and services from heterogeneous Things into an immense ecosystem of web tools such as analytics software.	over the different available networks, information relevance, privacy and security among others. **Protocols used:** 6LoWPAN, IPv4, IPv6, RPL, ROLL.	
LAYER 3	**TRANSPORT LAYER:** It provides end-to-end message transfer capability independent of the underlying network. This layer provides functions such as error control, segmentation, flow control and congestion control. **Protocols used:** TCP (connections using	**TRANSPORT LAYER:** It provides end-to-end message transfer capability independent of the underlying network. This layer provides functions such as error control, segmentation, flow control and congestion control. **Protocols used**: TCP (connections using	**DATA FILTERING AND PRE-PROCESSING LAYER:** In IoV, devices have the potential to generate huge amounts of data although but much of it may not be relevant. This layer analyses the collected information and performs some filtering on the data to avoid the dissemination of	**SESSION / COMMUNICATION LAYER:** This layer manages how applications connect to the Internet. Protocols involved are HTTP-the most widely used protocol to send and receive files and web pages, and HTTPS – the more secure version of HTTP.

	handshakes) and UDP (connections without acknowledgements).	handshakes) and UDP (connections without acknowledgements).	irrelevant information and reduce the network traffic. **Protocols used:** XMPP, CoAP, HTTP REST, MQTT, LLAP.	**Protocols used:** HTTP, HTTPS
LAYER 2	**NETWORK / INTERNET LAYER:** Responsible for sending of IP datagrams from the source network to the destination network. It performs host addressing and packet routing. Host identification is done using hierarchical IP addressing schemes. **Protocols used:** IPv4 (32-bit address), IPv6 (128-bit address) and 6LOWPAN (brings IP to low power devices having low processing capability).	**NETWORK / INTERNET LAYER:** Responsible for sending of IP datagrams from the source network to the destination network. It performs host addressing and packet routing. Host identification is done using hierarchical IP addressing schemes. **Protocols used:** IPv4 (32-bit address), IPv6 (128-bit address) and 6LOWPAN (brings IP to low power devices having low processing capability).	**DATA ACQUISITION LAYER:** This layer gathers data relevant to safety, traffic information, infotainment, from a given area of interest from all the sources (vehicle's internal sensors, global positioning system, inter-vehicle communication, body sensors, WSN, and different devices such as cellular phones, sensors and actuators, traffic lights and road signals) located on streets and highways. **Protocols used:** BLE, RFID, NFC, WiFi-HaLow, WiMAX, LoRaWAN and 2G/3G/LTE.	**ROUTER / SMART HUB LAYER:** This is the router and/or smart hub, a device that multiple smart devices in the home connect to the internet by creating a hotspot that they can hook onto.
LAYER 1	**DATA LINK LAYER:** It determines how the data is physically sent over the network's physical layer or medium. Hosts on the same link exchange data packets over the link layer using link layer protocols. The link layer determines how the packets are coded and signalled by the hardware device. **Protocols used:** 802.3 (Ethernet), 802.11 (WiFi), 802.11ah (WiFi HaLow), 802.15.4 (Zigbee or LRW-PAN), 2G/3G/LTE (Cellular), Bluetooth and Bluetooth Low Energy (BLE).	**DATA LINK LAYER:** It determines how the data is physically sent over the network's physical layer or medium. Hosts on the same link exchange data packets over the link layer using link layer protocols. The link layer determines how the packets are coded and signalled by the hardware device. **Protocols used**: 802.3 (Ethernet), 802.11 (WiFi), 802.11ah (WiFi HaLow), 802.15.4 (Zigbee or LRW-PAN), 2G/3G/LTE (Cellular), Bluetooth and Bluetooth Low Energy (BLE).	**USER INTERACTION LAYER:** This layer provides a direct interaction with the driver through a management interface to coordinate all driver notifications and selects the best display element based on the current situation or event to help reduce driver's distractions. **Tools used:** Auditive, Visual and Haptic.	**DATA LINK LAYER:** This layer provides a way for smart physical devices to be sent to the network and to the Internet. **Protocols used:** 802.3 (Ethernet), 802.11 (WiFi), 2G/3G/LTE (Cellular), and Bluetooth.