



INTRODUCTION TO COMMUNICATION TECHNOLOGIES & PROTOCOLS OF IOT:



3G/4G TECHNOLOGIES

- **3G**
- 3G STANDS FOR THIRD GENERATION TECHNOLOGY, AND WAS INTRODUCED IN 2001. IT HAS A MAXIMUM DOWNLOAD RATE OF 21 MEGABYTES PER SECOND (MBPS) AND A MAXIMUM UPLOAD RATE OF 5 MBPS. 3G IS SUITABLE FOR BASIC TASKS LIKE WEB BROWSING, EMAIL, AND TEXT MESSAGING.
- **4G**
- 4G STANDS FOR FOURTH GENERATION TECHNOLOGY, AND WAS INTRODUCED IN 2009. IT HAS A MAXIMUM DOWNLOAD RATE OF 1 GIGABIT PER SECOND (GBPS) AND A MAXIMUM UPLOAD RATE OF 500 MBPS. 4G IS CAPABLE OF FASTER DATA SPEEDS, ALLOWING FOR SMOOTHER VIDEO STREAMING, CONFERENCING, AND DATA-INTENSIVE APPLICATIONS.



HTTP

- **HTTP STANDS FOR HYPERTEXT TRANSFER PROTOCOL.** IT IS THE MAIN WAY WEB BROWSERS AND SERVERS COMMUNICATE TO SHARE INFORMATION ON THE INTERNET. TIM BERNER INVENTS IT. HYPERTEXT IS THE TYPE OF TEXT THAT IS SPECIALLY CODED WITH THE HELP OF SOME STANDARD CODING LANGUAGE CALLED **HYPER TEXT MARKUP LANGUAGE (HTML).** **HTTP/2** IS THE NEW VERSION OF HTTP. **HTTP/3** IS THE LATEST VERSION OF HTTP, WHICH IS PUBLISHED IN 2022.
- WHEN YOU VISIT A WEBSITE, HTTP HELPS YOUR BROWSER REQUEST AND RECEIVE THE DATA NEEDED TO DISPLAY THE WEB PAGES YOU SEE. IT IS A FUNDAMENTAL PART OF HOW THE INTERNET WORKS, MAKING IT POSSIBLE FOR US TO BROWSE AND INTERACT WITH WEBSITES. IN THIS ARTICLE, WE ARE GOING TO DISCUSS THE FULL FORM OF HTTP ALONG WITH ITS WORKING, ADVANTAGES, AND DISADVANTAGES.



KEY POINTS

BASIC STRUCTURE: HTTP FORMS THE FOUNDATION OF THE WEB, ENABLING DATA COMMUNICATION AND FILE SHARING.

WEB BROWSING: MOST WEBSITES USE HTTP, SO WHEN YOU CLICK ON A LINK OR DOWNLOAD A FILE, HTTP IS AT WORK.

CLIENT-SERVER MODEL: HTTP WORKS ON A REQUEST-RESPONSE SYSTEM. YOUR BROWSER (CLIENT) ASKS FOR INFORMATION, AND THE WEBSITE'S SERVER RESPONDS WITH THE DATA.

APPLICATION LAYER PROTOCOL: HTTP OPERATES WITHIN THE INTERNET PROTOCOL SUITE, MANAGING HOW DATA IS TRANSMITTED AND RECEIVED.



WHAT IS HYPERTEXT?

- THE PROTOCOL USED TO TRANSFER HYPERTEXT BETWEEN TWO COMPUTERS IS KNOWN AS HYPERTEXT TRANSFER PROTOCOL. HTTP PROVIDES A STANDARD BETWEEN A WEB BROWSER AND A WEB SERVER TO ESTABLISH COMMUNICATION. IT IS A SET OF RULES FOR TRANSFERRING DATA FROM ONE COMPUTER TO ANOTHER.
- DATA SUCH AS TEXT, IMAGES, AND OTHER MULTIMEDIA FILES ARE SHARED ON THE WORLD WIDE WEB. WHENEVER A WEB USER OPENS THEIR WEB BROWSER, THE USER INDIRECTLY USES HTTP. IT IS AN APPLICATION PROTOCOL THAT IS USED FOR DISTRIBUTED, COLLABORATIVE, HYPERMEDIA INFORMATION SYSTEMS



WORKING OF HTTP [HYPERTEXT TRANSFER PROTOCOL]

- FIRST OF ALL, WHENEVER WE WANT TO OPEN ANY WEBSITE WE FIRST OPEN A WEB BROWSER AFTER THAT WE WILL TYPE THE URL OF THAT WEBSITE (E.G., WWW.FACEBOOK.COM). THIS URL IS NOW SENT TO THE [DOMAIN NAME SERVER \(DNS\)](#).
- THEN DNS FIRST CHECKS RECORDS FOR THIS URL IN THEIR DATABASE, AND THEN DNS WILL RETURN THE IP ADDRESS TO THE WEB BROWSER CORRESPONDING TO THIS URL. NOW THE BROWSER IS ABLE TO SEND REQUESTS TO THE ACTUAL SERVER.
- AFTER THE SERVER SENDS DATA TO THE CLIENT, THE CONNECTION WILL BE CLOSED. IF WE WANT SOMETHING ELSE FROM THE SERVER WE SHOULD HAVE TO RE-ESTABLISH THE CONNECTION BETWEEN THE CLIENT AND THE SERVER.



HTTP Connection



Client

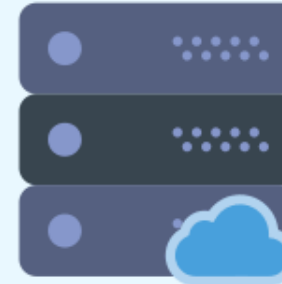
Request



Response



TCP Connection



Server



WHAT IS AN HTTP REQUEST?

- HTTP REQUEST IS SIMPLY TERMED AS THE INFORMATION OR DATA THAT IS NEEDED BY INTERNET BROWSERS FOR LOADING A WEBSITE. THIS IS SIMPLY KNOWN AS HTTP REQUEST.
- THERE IS SOME COMMON INFORMATION THAT IS GENERALLY PRESENT IN ALL HTTP REQUESTS. THESE ARE MENTIONED BELOW.
- HTTP VERSION
- URL
- HTTP METHOD
- HTTP REQUEST HEADERS
- HTTP BODY



HTTP REQUEST HEADERS

- HTTP REQUEST HEADERS GENERALLY STORE INFORMATION IN THE FORM OF KEY-VALUE AND MUST BE PRESENT IN EACH HTTP REQUEST. THE USE OF THIS REQUEST HEADER IS TO PROVIDE CORE INFORMATION ABOUT THE CLIENT'S INFORMATION, ETC.

HTTP REQUEST BODY

- HTTP REQUEST BODY SIMPLY CONTAINS THE INFORMATION THAT HAS TO BE TRANSFERRED. HTTP REQUEST HAS THE INFORMATION OR DATA TO BE SENT TO THESE BROWSERS.

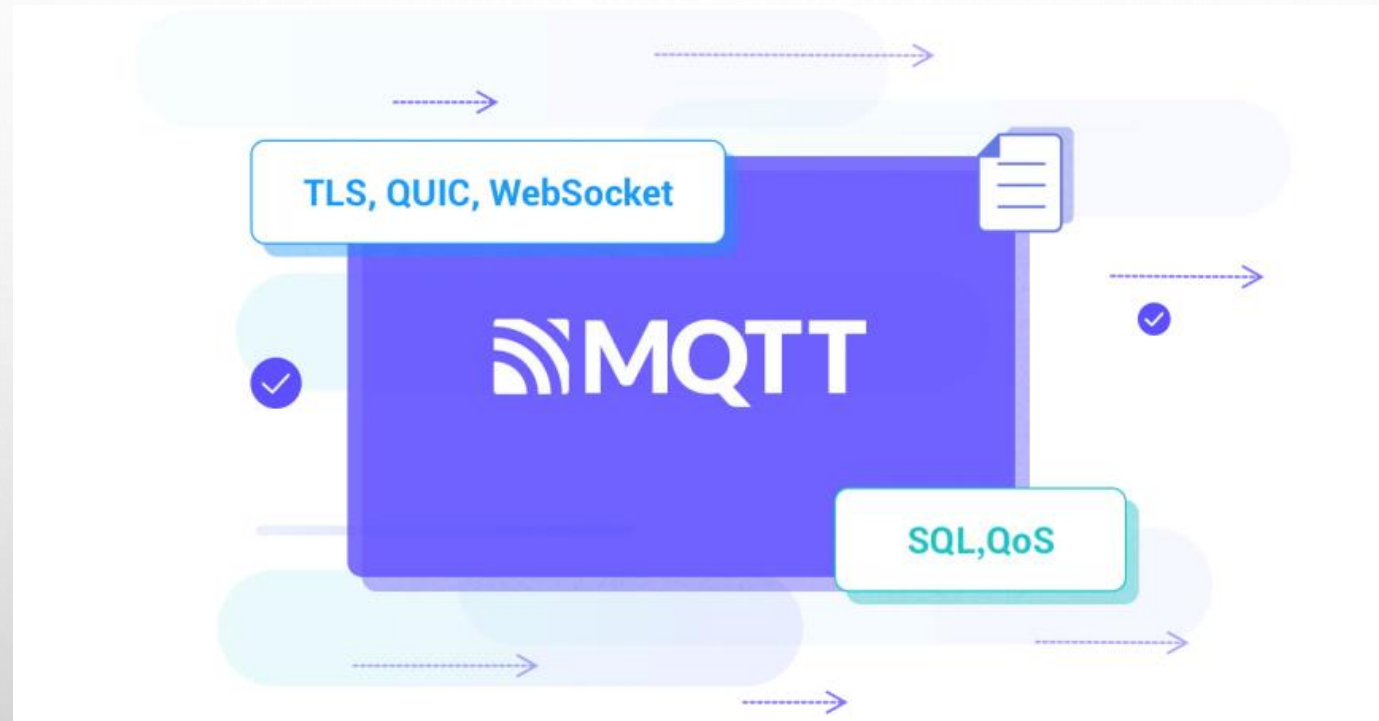
HTTP METHOD

- HTTP METHODS ARE SIMPLY HTTP VERB. IN SPITE OF BEING PRESENT SO MANY HTTP METHODS, THE MOST COMMON HTTP METHODS ARE [HTTP GET AND HTTP POST](#). THESE TWO ARE GENERALLY USED IN HTTP CASES. IN HTTP GET, THE INFORMATION IS RECEIVED IN THE FORM OF A WEBSITE.



MQTT

- **MQTT (MESSAGE QUEUING TELEMETRY TRANSPORT)** IS AN OASIS STANDARD MESSAGING PROTOCOL FOR THE INTERNET OF THINGS (IOT).
- IT IS DESIGNED WITH AN EXTREMELY LIGHTWEIGHT PUBLISH/SUBSCRIBE MESSAGING MODEL, MAKING IT IDEAL FOR CONNECTING IOT DEVICES WITH A SMALL CODE FOOTPRINT AND MINIMAL NETWORK BANDWIDTH AND EXCHANGING DATA IN REAL-TIME BETWEEN CONNECTED DEVICES AND CLOUD SERVICES.
- MQTT CAN NOT ONLY BE USED AS A GATEWAY TO ACCESS COMMUNICATION ON THE DEVICE SIDE, BUT ALSO AS A DEVICE-CLOUD COMMUNICATION PROTOCOL. MOST GATEWAY PROTOCOLS SUCH AS ZIGBEE AND LORA CAN BE CONVERTED INTO MQTT PROTOCOL TO CONNECT TO THE CLOUD.





- **LIGHTWEIGHT AND RELIABLE:** MQTT MESSAGES ARE COMPACT, ENABLING STABLE TRANSMISSION ON SEVERELY CONSTRAINED HARDWARE DEVICES AND NETWORKS WITH LOW BANDWIDTH AND HIGH LATENCY.
- **PUBLISH/SUBSCRIBE MODEL:** BASED ON THE PUBLISH/SUBSCRIBE MODEL, ITS ADVANTAGE LIES IN DECOUPLING PUBLISHERS AND SUBSCRIBERS - THEY DON'T NEED TO ESTABLISH A DIRECT CONNECTION OR BE ONLINE SIMULTANEOUSLY.
- **DESIGNED FOR IOT:** PROVIDES COMPREHENSIVE IOT APPLICATION FEATURES SUCH AS KEEP ALIVE MECHANISM, [WILL MESSAGE](#), [QOS](#), [TOPIC](#), AND SECURITY MANAGEMENT.
- **MORE COMPLETE ECOSYSTEM:** IT COVERS CLIENT AND SDK PLATFORMS IN ALL LANGUAGES, AND HAS MATURE BROKER SERVER SOFTWARE, SUPPORTING A VAST NUMBER OF TOPICS, MILLIONS OF DEVICE CONNECTIONS, AND RICH ENTERPRISE INTEGRATION CAPABILITIES.



- MQTT IS A MESSAGING PROTOCOL THAT USES A PUBLISH-SUBSCRIBE MODEL, WHICH IS DIFFERENT FROM THE TRADITIONAL CLIENT-SERVER MODEL. IT SEPARATES THE MESSAGE SENDER (PUBLISHER) FROM THE RECEIVER (SUBSCRIBER), MAKING IT AN EFFICIENT WAY TO SEND AND RECEIVE MESSAGES IN A DISTRIBUTED NETWORK. MULTIPLE PUBLISHERS CAN SEND MESSAGES TO A SUBSCRIBER, AND MULTIPLE SUBSCRIBERS CAN RECEIVE MESSAGES FROM A PUBLISHER SIMULTANEOUSLY.
- MQTT TODAY IS WIDELY USED IN THE IOT, INDUSTRIAL IOT (IIOT), INTERNET OF VEHICLES (IOV), AND [CONNECTED CARS](#), AS WELL AS IN A WIDE VARIETY OF INDUSTRIES SUCH AS AUTOMOTIVE, MANUFACTURING, TELECOMMUNICATIONS, TRANSPORTATION & LOGISTICS, AND OIL & GAS, ETC.
- MQTT IS THE STANDARD COMMUNICATION PROTOCOL OF THE IOT PLATFORM OF TOP CLOUD PROVIDERS SUCH AS [AWS IOT CORE](#), [AZURE IOT HUB](#), AND ALIBABA CLOUD IOT PLATFORM. IT IS ALSO THE PREFERRED PROTOCOL FOR GATEWAYS AND CLOUD IN VARIOUS INDUSTRIES.



COAP

- COAP IS AN HTTP-LIKE PROTOCOL IN THE IOT WORLD, USED ON RESOURCE-CONSTRAINED IOT DEVICES. ITS DETAILED SPECIFICATION IS DEFINED IN RFC 7252.
- IOT DEVICES HAVE LIMITED RESOURCES LIKE CPU, RAM, FLASH, AND NETWORK BANDWIDTH. DIRECT DATA EXCHANGE USING TCP AND HTTP IS UNREALISTIC. COAP PROTOCOL EMERGED TO SOLVE THIS PROBLEM AND ENABLE THESE DEVICES TO CONNECT TO THE NETWORK SMOOTHLY.
- COAP INCORPORATES HTTP DESIGN IDEAS AND DEVELOPS PRACTICAL FUNCTIONS SPECIFIC TO RESOURCE-LIMITED DEVICES.
- BASED ON THE MESSAGE MODEL.
- ITS TRANSPORT LAYER IS BASED ON UDP PROTOCOL AND SUPPORTS RESTRICTED DEVICES.
- USES REQUEST/RESPONSE MODEL SIMILAR TO HTTP AND BINARY FORMAT WHICH IS MORE COMPACT THAN THE TEXT FORMAT OF HTTP.



COAP

- SUPPORTS TWO-WAY COMMUNICATION.
- LIGHTWEIGHT AND LOW POWER CONSUMPTION.
- SUPPORTS RELIABLE TRANSMISSION, DATA RE-TRANSMISSION, AND BLOCK TRANSMISSION TO ENSURE RELIABLE ARRIVAL OF DATA.
- SUPPORTS IP MULTICAST.
- SUPPORTS OBSERVATION MODE.
- SUPPORTS ASYNCHRONOUS COMMUNICATION.
- COMPARED WITH MQTT, COAP IS LIGHTER WITH LOWER OVERHEAD, AND IT IS MORE SUITABLE FOR CERTAIN DEVICE AND NETWORK ENVIRONMENTS.