

Terminology » PHY Vs MAC In IoT Networking: Key Diffe...

PHY vs MAC in IoT Networking: Key Differences Explained

[IoT](#) [Phy Layer](#) [Mac Layer](#) [Networking](#) [Communication](#)

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In the context of IoT (Internet of Things) networking, the PHY (Physical) layer and MAC (Media Access Control) layer are two fundamental layers of the OSI (Open Systems Interconnection) model that play crucial roles in enabling  communication between devices. They represent different layers of the networking stack and serve distinct functions. The PHY layer occupies the lowest layer-1 of OSI stack and handles the physical aspects of communication. The MAC layer occupies the lowest layer-2 and manages access to the communication medium and ensures efficient and secure data transmission in IoT networks. [Communications & Media Studies](#)

Let us understand functions of phy and mac layer before we explore difference between physical and mac layer.

What is PHY Layer

PHY is the short form of Physical Layer. It is the layer-1 in OSI stack. It interfaces physical medium with MAC and upper layers. Physical medium can be copper wire, fiber optic cable, twisted pair or even wireless channel.

Function: The PHY layer is the lowest layer in the OSI model and is responsible for the physical transmission of raw bits over the communication medium. Following are the key responsibilities of PHY layer :



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- Converts data into a form suitable for transmission over the physical medium.
- Incorporates modulation and demodulation functionalities which transforms bits into symbols and vice versa.
- Specifies the data transfer rate and the encoding scheme used for transmitting data over the physical medium.
- Provides error correction capability by using convolutional encoder or turbo encoder at transmit end and suitable decoder at the receive end.
- Describes the physical connectors, pinouts, and electrical properties required for data transmission.

Data	Application	Layer-7
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Packets	Network	Layer-3
Frames	MAC	Layer-2
Bits	Physical	Layer-1
EM Waves	RF	

OSI Layers

There are different physical layers as per different wireless and wired standards. The variation in physical layer depends on medium requirement and system performance requirement (i.e. BER, SNR, spectral efficiency or Bandwidth efficiency, power efficiency). Different PHY layers will have different FEC configurations and modulation formats.

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What is MAC Layer

MAC is the short form of Medium Access Control Layer. It is the layer-2 in OSI stack. It interfaces PHY layer and Upper layers (i.e. network and above).

Function: The MAC layer operates at a higher level than the PHY layer and is responsible for managing access to the shared communication medium.

Following are the key responsibilities of MAC layer : Communications & Media Studies

- **Addressing:** Assigns unique MAC addresses to devices on the network for identification. MAC Header is added at the beginning of IP packet for this purpose.
- **Channel access:** Controls how devices on the network gain access to the communication channel, especially in shared or wireless environments. CSMA/CD and CSMA/CA are examples of media access control protocols used in Ethernet networks.
- **Frame formatting:** Divides data into frames, adds addressing information, control bits, and error-checking, creating a structured format for transmission. CRC is added at the end of frame for error detection and retransmission (using ARQ protocol).
- **Flow control:** Manages the flow of data to ensure efficient communication between devices. This is achieved by segmentation (at transmit end) and re-assembly (at receive end).

Difference between PHY and MAC layer

Following table mentions difference between PHY and MAC layer.

Parameters	PHY Layer	MAC Layer
Layer position in OSI stack	Lowest layer (i.e. Layer-1)	Higher layer (i.e. Layer-2)

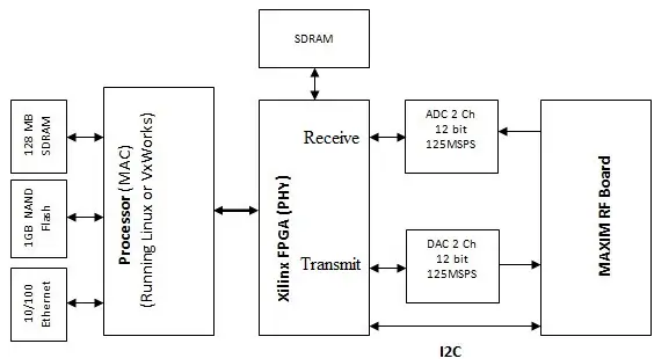


Data form

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Layer interaction	It interfaces with medium wired/wireless (RF) through ADC/DAC at one end and MAC layer at the other end.	It interfaces with PHY layer at one end and network layer at the other end.
Addressing	Does not involve device addressing	Assigns unique MAC addresses for device identification
Implementation perspective	PHY code which requires low latency and high complexity runs on FPGA	MAC code runs on processor
Other name	Baseband or modem	Data link layer or Medium Access Control layer

Case study : Physical and mac layer implementation



The figure depicts hardware block diagram for PHY/MAC implementation for wireless physical layer. In this example, PHY layer modules have been ported on FPGA where as MAC layer blocks have been ported on Intel Processor. PHY layer interacts with wireless medium using radio frequency with the help of Maxim RF board. Both PHY and RF are interfaced using DAC/ADC.

Conclusion

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Application Layer

MAC Layer

PHY Layer

RF Layer

* Applications as per end user requirements

* FCS for error detection

* Modulation, preamble add/remove

* Radio Frequency, Tx Power etc.

SigFox Protocol Layers

SigFox Protocol Stack Layers

Explore the SigFox protocol stack architecture, including RF, PHY, MAC, and Application layers, and their roles in efficient IoT communication within the SigFox network.

Sigfox Protocol lot

IEEE 802.11ah: WLAN Technology Basics

Explore the fundamentals of IEEE 802.11ah WLAN technology, designed for IoT applications in the sub-1GHz frequency range, including PHY/MAC layers and key features.

IEEE 802.11ah Wlan lot

**RF**

Network layer

Multicast support

Architecture model

Synchronous communication

Overhead

Application

Less overhead and it is simple.

More overhead compare to CoAP and it is complex.

Designed for resource constrained networking devices such as

Designed for internet devices where there is no issue of any resources.

Coap

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Interview

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MetMo - High End Fidget Toys

MetMo

Client

Server

Request

Retransmission

Response

Request processing

Without Separate Response

Client

Server

Request

ACK

Response

ACK

Request processing

With Separate Response

Explore the CoAP protocol designed for IoT, covering its architecture, layers, message format, and how it enables efficient communication in resource constrained environments.

About

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Coap

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Protocol

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Vendors of M2M IoT Products

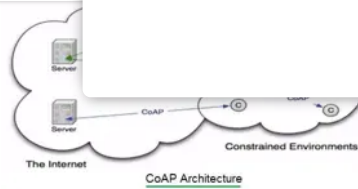
Explore vendors and resources for Machine-to-Machine (M2M) and Internet of Things (IoT) products, enabling seamless machine communication via the internet.

M2m lot Vendors

https://www.rfwireless-world.com/terminology/phy-vs-mac-in-iot-networking

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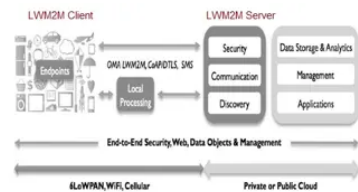


Coap lot Protocol

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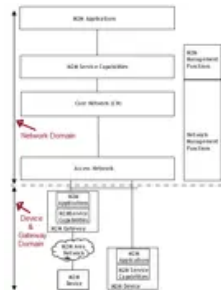
LWM2M: Advantages and Disadvantages Explained



Explore the benefits and drawbacks of LWM2M (Lightweight Machine to Machine [Communication](#)). Understand its advantages and disadvantages for constrained IoT devices.

Lwm2m lot Protocol

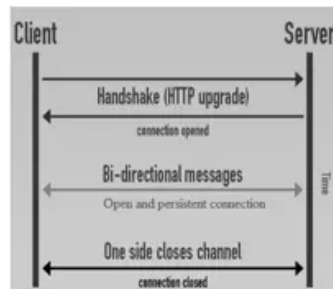
M2M Communication: Advantages and Disadvantages



Explore the benefits and drawbacks of Machine-to-Machine (M2M) communication, including its architecture, advantages, and disadvantages in various network topologies.

M2m Communication lot

WebSockets: Advantages and Disadvantages Explained



Explore the pros and cons of using WebSockets compared to HTTP, particularly in the context of real-time communication and IoT applications. [Communications & Media Studies](#)

Websocket Http Protocol