Graphic Era Deemed to be University
DEHRADUN

Centre for Distance and Online Education

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Subject Code: OMC 403D **Subject Name:** Internet of Things

Programme Name: MCA - ODL **Semester:** 04

Signature of the Student

Ques (1) IOT (Internet of Things) is applied across various domains, transforming how systems operate by enabling real time data exchange.

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Connected Roadways Real time traffic monitoring, smart traffic lights, accident alerts, and connected vehicles improve safety and reduce congestion.

Connected Factories (Industrial IOT) Predictive maintenance, automated inventory management, real time monitoring of machinery and energy consumption enhance operational efficiency.

Smart Homes Devices like smart thermostats, lighting systems and voice assistants improve convenience and energy efficiency.

Healthcare (IOMT): Wearables, remote patient monitoring and smart medical devices enhance diagnosis and treatment.

Smart Agriculture: IOT based irrigation systems, crop monitoring sensors, and weather prediction tools optimizing yield and resource usage.

Smart Cities: Waste management, water supply, air quality monitoring and public transportation benefit from IOT integration.

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Ques (02) In an IOT ecosystem:

- **Sensors** collect data from the environment (eg temperature, humidity, motion etc)

- **Actuators** receive the commands and perform actions (eg opening a valve, turning on a fan).

- **Smart Objects** are physical devices, embedded with sensors actuators and connectivity to perform the intelligent tasks.
  (eg a smart thermostat that senses room temperature and adjusts it automatically)

- **Internet/Connectivity** is the medium or the network which bind all the devices together to form the complete ecosystem.

These all components work together to sense, process and act on data, enabling automation and remote control in the real time.

Ques (3)

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Here is the detailed comparision of LoRaWAN, NB-IOT and 802.11ah

	LoRaWAN	NB-IOT	802.11ah
Frequency	Sub-GHz (868/915 MHz)	Licensed LTE bands	Sub-GHz (900 MHz)
Range	Long (up to 15 kms)	Medium to Long	Medium 1 KM
Data Rate	Low (~50 Kbps)	Moderate (~250 Kbps)	Higher (~ 347 Mbps)
Power Efficiency	High	High	Medium
Use cases	Rural Agriculture Remote sensors Border areas	Smart Meters Parking Healthcare	Industrial Automation & Video sensors

Ques ④ 6LOWPAN (IPv6 over Low Power Wireless Personal Area Networks) allow IPv6 packets to be sent over IEEE 802.15.4 networks.

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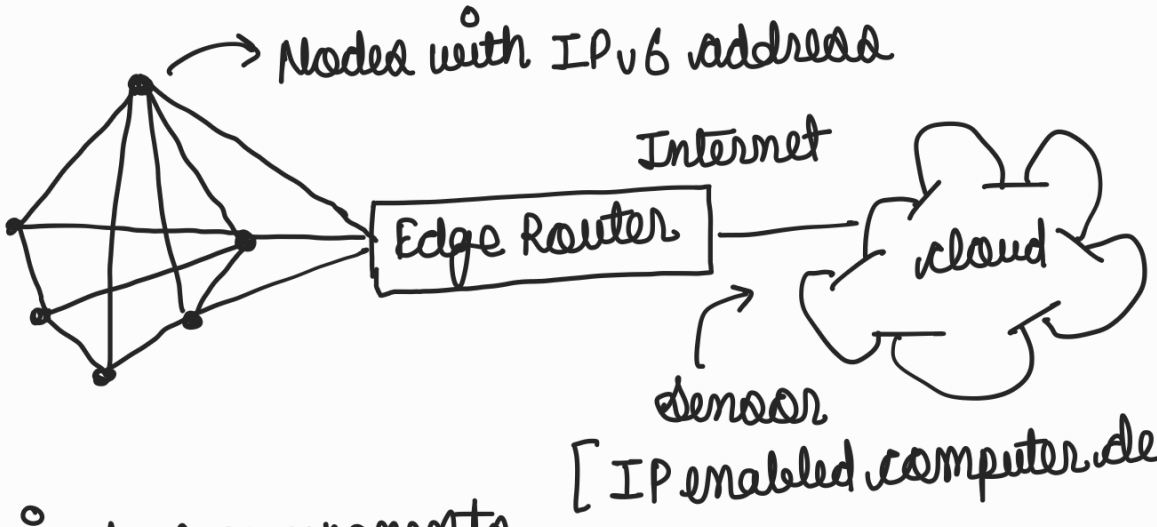

Architecture components

① 6LOWPAN Nodes - contains sensors and actuators with IPv6 stacks
② 6LOWPAN Router - handles the routing within the network
③ Border Router - connects to 6LOWPAN to the internet.

Working

① Header Compression reduces IPv6 header size from 40 bytes to a few bytes for efficient transmission
② Fragmentation splits larger IPv6 packets into smaller frames suitable for IEEE 802.15.4
③ Adaptation layer provide the interface between IPv6 and MAC layer, handles the addressing, compression & fragmentation.

This makes IPv6 practical for use in low power, lossy networks like IOT sensor networks.

Ques ⑤

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IOT transport Methods

① MQTT light weight publisher subscriber protocol.

② CoAP UDP based RESTful protocol for the constrained devices.

③ HTTP/HTTPS standard web protocol but heavy for the constrained devices.

IOT Data Brokers

Act as the middleware for message exchange (eg MQTT broker receives data from sensors and forwards to subscribers)

SCADA systems

Supervisory Control and Data Acquisition systems used in the industrial automation and monitoring and control. They use proprietary protocols (eg Modbus, DNP3).

SCADA	Web based IOT protocols
centralized architecture	decentralized architecture
proprietary protocols	Open standards (HTTP, MQTT etc)
Limited scalability	Highly scalable.