Batch: A2	**Roll No.: 16010322014**
Experiment / assignment / tutorial No. 09	
Grade: AA / AB / BB / BC / CC / CD /DD	

TITLE: To Explore Azure portal services for real time analytics

AIM: I. Provision the remote monitoring preconfigured solution

II. Create IoT hubs for Device to cloud communication

OUTCOME: Explore advances and recent trends in embedded systems .

About Microsoft Azure:

Microsoft Azure is a cloud computing platform providing a vast array of services, including computing, storage, networking, AI, and analytics, allowing businesses and individuals to build, deploy, and manage applications and services globally without owning hardware. It operates from a global network of data centers and offers Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) models. Azure supports open-source technologies, integrates with existing systems like Active Directory, and emphasizes enterprise-grade security and scalability for workloads of all sizes.

Key Features and Services:

Cloud Computing Services: Azure offers a wide range of services, such as virtual machines (online computers), databases, AI-driven applications, and analytics tools.

Scalability and Flexibility: Users can rent computing power and scale their resources up or down as needed, leading to cost efficiency and greater agility.

Global Infrastructure: Azure has one of the most extensive cloud footprints, with data centers in over 60 regions worldwide, ensuring global availability and performance.

Enterprise-Grade Capabilities: The platform is built to meet the high availability and reliability requirements of mission-critical workloads for businesses.

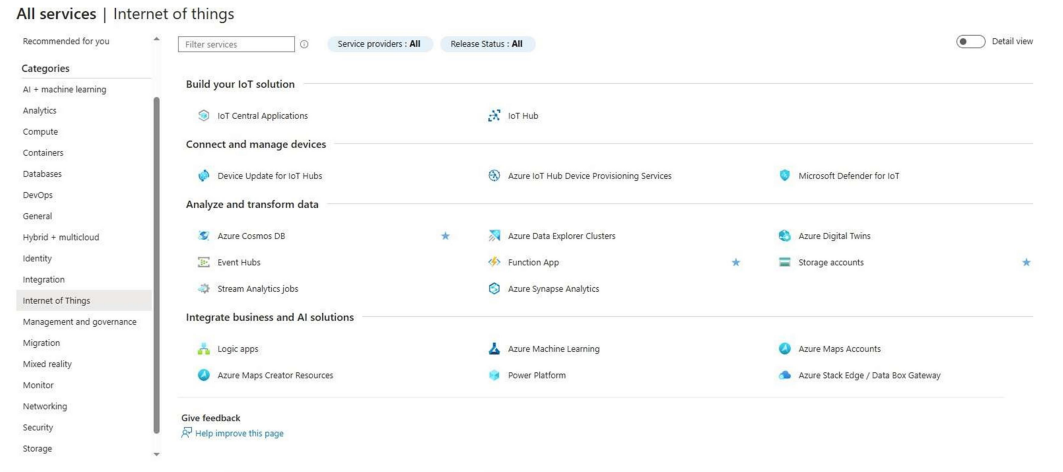
Security: Azure incorporates built-in security features and is monitored by security experts who use AI and advanced analytics to protect against cyberthreats.

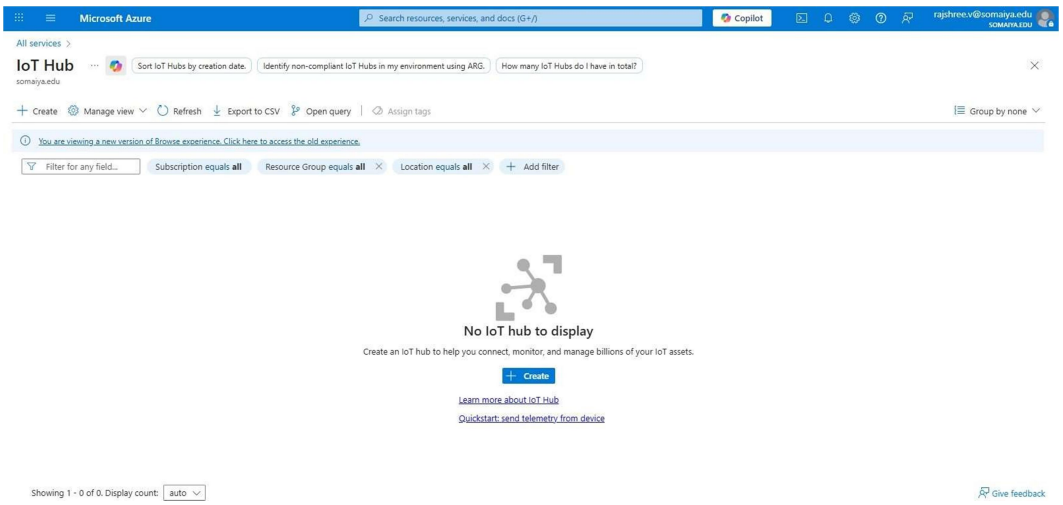
Hybrid and Multicloud Support: Azure allows users to build and manage applications across cloud, hybrid, and edge environments, using their preferred tools and frameworks.

AI and Innovation: It provides industry-leading AI developer services and supports open-source innovation, empowering developers to create advanced solutions.

Task1: **Provision the remote monitoring preconfigured solution**

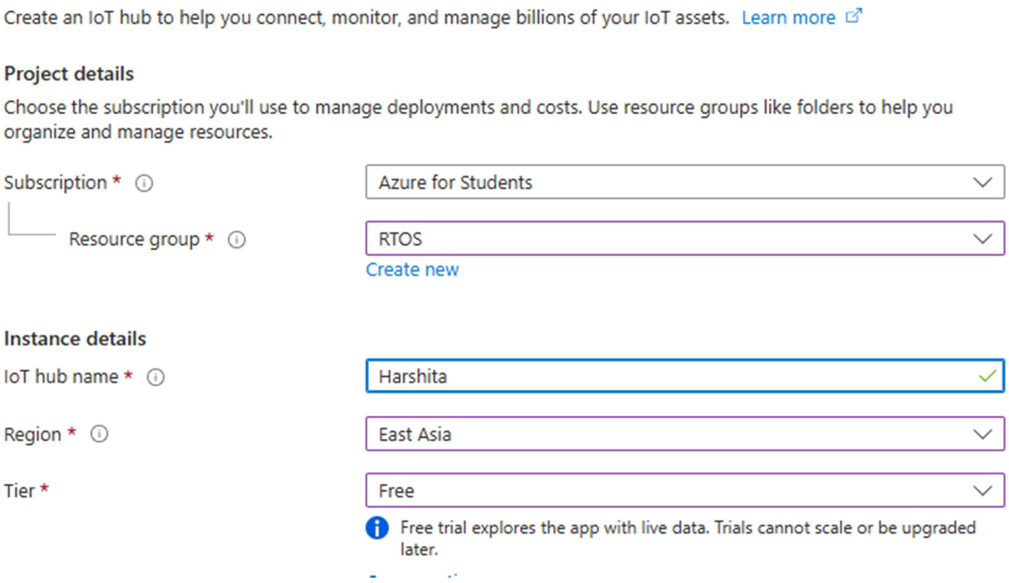
(students are expected to paste the screenshots as per the help document provided)

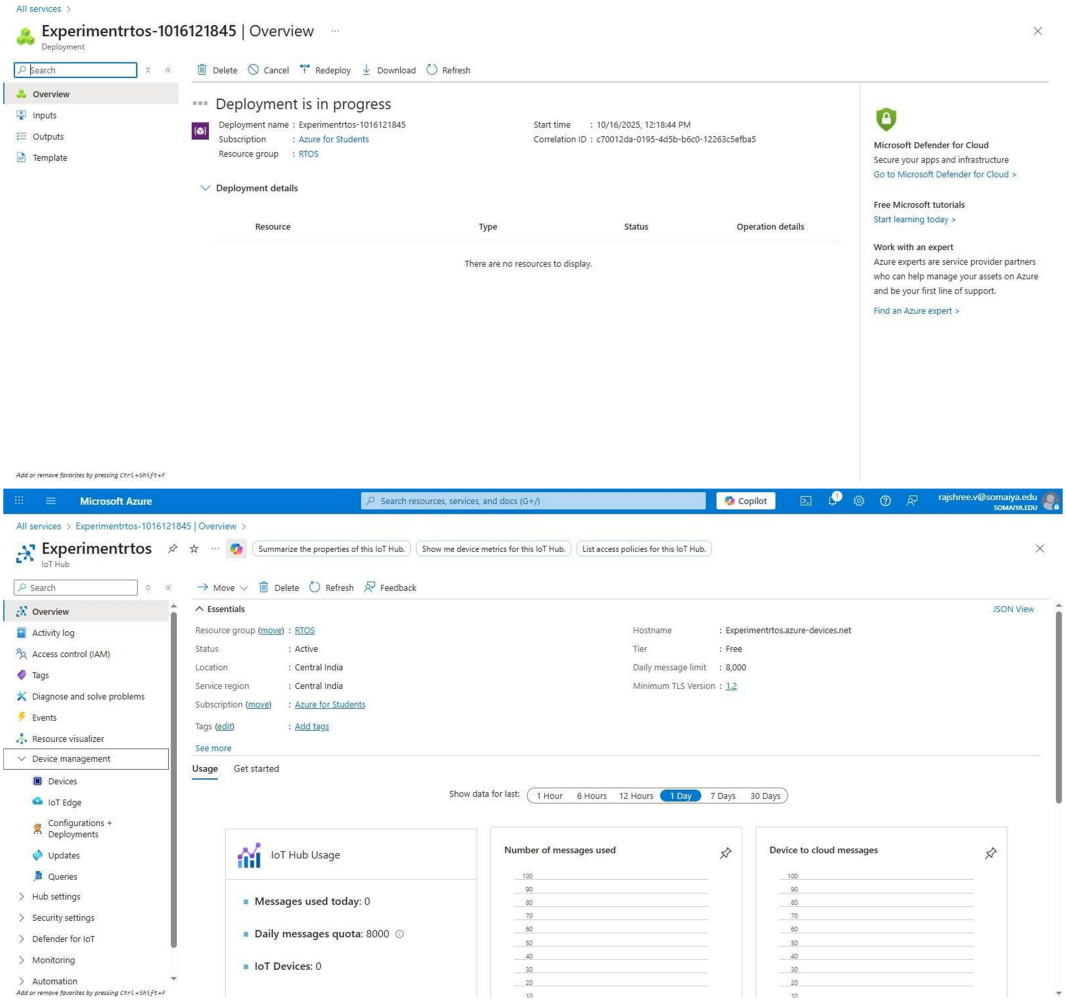




Task2: Create IoT hubs for Device to cloud communication

(students are expected to paste the screenshots as per the help document provided)




All services >
Experimentrtos-1016121845 | Overview
Deployment
Search
Delete
Cancel
Redeploy
Download
Refresh
Overview
Inputs
Outputs
Template
Deployment is in progress
Deployment name : Experimentrtos-1016121845
Subscription : Azure for Students
Resource group : RTOS
Start time : 10/16/2025, 12:18:44 PM
Correlation ID : c70012da-0195-4d5b-b6c0-12263c5efba5
Deployment details
Resource
Type
Status
Operation details
There are no resources to display.
Microsoft Defender for Cloud
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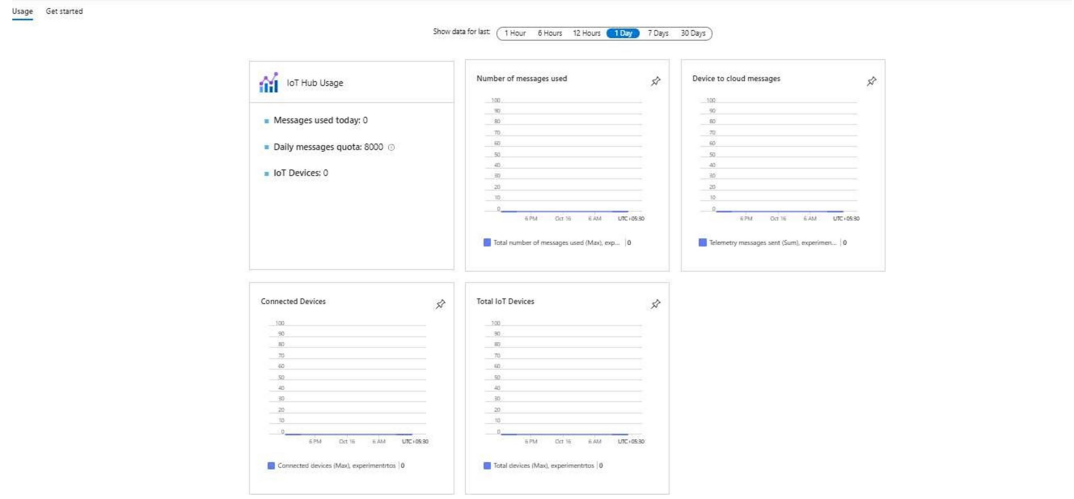
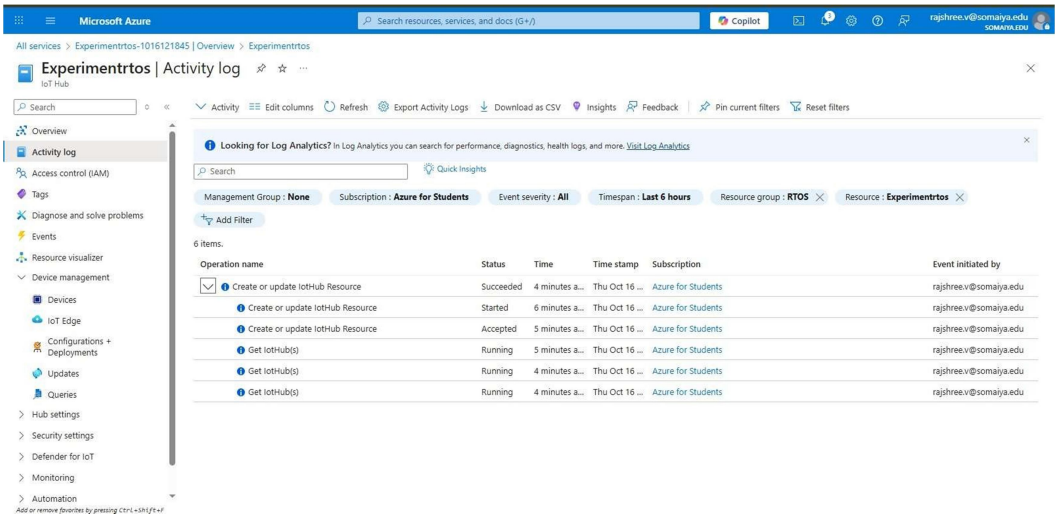
rajshree.v@somaiya.edu
All services > Experimentrtos-1016121845 | Overview >
Experimentrtos
IoT Hub
Summarize the properties of this IoT Hub.
Show me device metrics for this IoT Hub.
List access policies for this IoT Hub.
Move
Delete
Refresh
Feedback
Overview
Activity log
Access control (IAM)
Tags
Diagnose and solve problems
Events
Resource visualizer
Device management
Devices
IoT Edge
Configurations + Deployments
Updates
Queries
Hub settings
Security settings
Defender for IoT
Monitoring
Automation
Essentials
JSON View
Resource group (move) : RTOS
Status : Active
Location : Central India
Service region : Central India
Subscription (move) : Azure for Students
Tags (edit) : Add tags
Hostname : Experimentrtos.azure-devices.net
Tier : Free
Daily message limit : 8,000
Minimum TLS Version : 1.2
See more
Usage
Get started
Show data for last:
1 Hour
6 Hours
12 Hours
1 Day
7 Days
30 Days
IoT Hub Usage
Messages used today: 0
Daily messages quota: 8000
IoT Devices: 0
Number of messages used
Device to cloud messages





Post lab Questions:

1. **What is IoT hub?**

Azure IoT Hub is a **cloud-based managed service** provided by Microsoft as part of the Azure platform, designed to enable secure and reliable communication between IoT (Internet of Things) devices and cloud-based applications.

It acts as a central message hub for bi-directional communication between IoT applications and the devices it manages. Azure IoT Hub supports device-to-cloud (D2C), cloud-to-device (C2D), and device-to-device messaging.

Key Features:

- Bi-directional communication (commands, telemetry, and control)
- Device identity and authentication
- Device management (including firmware updates)
- Scalable to millions of devices

- Integration with Azure services like Stream Analytics, Logic Apps, and Machine Learning

2. **What are the services provided by IoT hub?**

Azure IoT Hub offers a wide range of services and capabilities:

Service	Description
Device-to-Cloud Messaging	Securely sends telemetry (sensor data, logs, etc.) from devices to the cloud.
Cloud-to-Device Messaging	Sends commands or notifications from the cloud to the device (e.g., reboot device, update firmware).
Device Identity Registry	Maintains identities and credentials of each registered device.
Message Routing	Routes incoming messages to different services (e.g., Azure Storage, Event Hub, Stream Analytics).
Device Twin	A JSON document that stores metadata, configurations, and conditions of the device. Useful for device management.
Direct Methods	Allows cloud applications to directly invoke functions on a device.
Device Streams	Enables bi-directional streaming communication for remote diagnostics.
Security	Uses per-device security credentials and access control.
Integration	Connects with other Azure services like Logic Apps, Power BI, Azure ML, etc.

3. **Discuss in detail Azure IoT Suite SDKs. (Device-facing and Service-facing)**

Azure provides SDKs (Software Development Kits) to simplify integration between devices, cloud apps, and IoT Hub.

A. Device-facing SDKs

These SDKs are used **on the device side** to connect IoT devices to Azure IoT Hub. They handle sending telemetry data, receiving commands, updating twin properties, etc.

- **Languages supported**: C, C#, Python, Java, Node.js
- **Key Features**:
    - Send telemetry data to IoT Hub
    - Receive commands from IoT Hub
    - Support for device twins and direct methods
    - Secure connection using authentication (e.g., SAS tokens, X.509 certificates)

Common Device SDKs:

- Microsoft.Azure.Devices.Client (for C#, .NET)
- azure-iot-device (for Python)
- azure-iot-sdk-c (for embedded systems using C)

B. Service-facing SDKs

These SDKs are used **on the cloud/service side** to interact with the devices via IoT Hub. They are used in backend applications or web apps to manage devices, send messages, and retrieve device data.

- **Languages supported**: C#, Node.js, Java, Python
- **Key Features**:
    - Manage device identities (register, remove)
    - Send cloud-to-device messages
    - Invoke direct methods on devices
    - Query device twins
    - Update desired properties of device twins

Common Service SDKs:

- Microsoft.Azure.Devices (for C#, .NET)

- azure-iot-hub (for Node.js)
- azure-iot-hub-service-client (for Python)

4. **Discuss the used cases for IoT hubs**

IoT Hub can be applied in many real-world scenarios across industries:

A. Smart Manufacturing (Industrial IoT)

- Monitor and control factory machines in real-time
- Predictive maintenance using telemetry data
- Remote diagnostics and software updates

B. Smart Cities

- Monitor traffic patterns using IoT sensors
- Manage street lighting remotely
- Real-time air and water quality monitoring

C. Energy Management

- Remote monitoring of smart meters
- Load forecasting and demand management
- Solar and wind power generation analytics

D. Healthcare

- Remote patient monitoring (e.g., heart rate sensors)
- Medical equipment diagnostics and control
- Alerting systems for abnormal readings

E. Smart Agriculture

- Soil moisture and temperature monitoring
- Livestock tracking
- Automated irrigation systems

F. Logistics and Fleet Management

- Track vehicle location and condition

- Monitor cold chain storage temperatures
- Optimize delivery routes in real-time

G. Retail

- Connected vending machines and refrigerators
- Inventory management via smart shelves
- Personalized customer experience based on in-store behavior

Conclusion:

Microsoft Azure IoT Hub is a secure, scalable cloud service that enables real-time remote monitoring and management of connected devices. It facilitates seamless bi-directional communication between IoT devices and cloud applications, allowing businesses to collect telemetry data, send commands, and perform diagnostics remotely. With built-in device authentication, device twins for state management, and integration with advanced analytics and AI services, Azure IoT Hub empowers organizations to optimize operations, enhance predictive maintenance, and gain actionable insights from their IoT deployments

Signature of faculty in-charge with date