

Exploring AWS IoT: Device-to-Cloud Integration

Learn to connect embedded devices to AWS and manage IoT data streams. A course for developers and engineers building real-world IoT solutions.

DevOps Instructor: Sabina Rose • 5 sections • 55 lessons • 18.75h total

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About this course

Connecting physical devices to the cloud involves complex steps like secure communication, data routing, and device management. Many IoT projects fail due to integration challenges and lack of scalable architecture. In this course, you'll learn how to program embedded devices using AWS IoT SDK, set up data pipelines with services like Lambda and DynamoDB, and implement security best practices. The content includes video lessons, hands-on labs, and case studies to help you build production-ready IoT systems.

Course curriculum

Foundations of AWS IoT and Embedded Systems

- **Introduction to IoT and Its 2026 Landscape (18m)**
Get a clear overview of IoT concepts, current trends, and how devices connect to the cloud.
- **Mapping AWS IoT Architecture: Devices, Gateways, and Cloud (25m)**
Understand the key components of AWS IoT architecture and how they interact.
- **Exploring AWS IoT Core and Related Services (22m)**
Dive into AWS IoT Core, Device Shadow, Fleet Hub, and other essential services.
- **Selecting Embedded Platforms for IoT Projects (15m)**
Compare popular platforms like ESP32, Raspberry Pi, and STM32 for your IoT needs.
- **Comparing IoT Communication Protocols: MQTT, HTTPS, LoRaWAN (20m)**
Learn the strengths and use cases of common protocols for device-cloud communication.
- **Setting Up Your AWS Account and IoT Console (12m)**
Step-by-step guide to creating a free-tier AWS account and navigating the IoT console.
- **Hands-on: Navigating AWS IoT Core Features (18m)**
Practical session to familiarize yourself with the AWS IoT console interface and basic operations.

Connecting Your First Device to AWS IoT Core

- **Registering a Device as an AWS IoT Thing (15m)**
Learn how to create and manage Things in AWS IoT Core for device representation.
- **Generating and Managing X.509 Certificates (20m)**
Set up secure authentication using X.509 certificates for your devices.
- **Using Fleet Provisioning for Device Registration (18m)**
Implement scalable device registration with AWS IoT fleet provisioning templates.
- **Defining and Attaching IoT Policies (16m)**
Create policies to control device access to AWS IoT resources.
- **Integrating IAM Roles for IoT Access (14m)**
Connect IAM roles to IoT policies for fine-grained access control.
- **Configuring MQTT Topics and Message Brokers (22m)**
Set up MQTT topics and broker settings for efficient message routing.
- **Simulating a TLS-Secured Device Connection (25m)**
Use tools like MQTT Explorer to establish a secure connection to AWS IoT Core.
- **Publishing Sensor Telemetry Data (18m)**
Learn to publish device data to MQTT topics for cloud ingestion.
- **Subscribing to MQTT Topics for Real-Time Updates (16m)**
Subscribe to topics to receive commands and updates from the cloud.
- **Introduction to AWS IoT Device Shadow (20m)**
Understand the Device Shadow service for managing device state.
- **Managing Desired and Reported Shadow States (22m)**
Handle desired and reported states for remote device configuration.

- **Hands-on Lab: Complete Device-to-Cloud Setup (32m)**
Practice end-to-end device connection, from registration to data publishing.

Programming Embedded Devices for Cloud Communication

- **Preparing Your Embedded Development Environment (18m)**
Set up PlatformIO, Arduino IDE, or AWS IoT Device SDK for development.
- **Installing and Configuring AWS IoT Device SDK (20m)**
Integrate the SDK on ESP32 or Raspberry Pi for cloud connectivity.
- **Writing Firmware to Connect to AWS IoT Core (25m)**
Build code that establishes a connection to AWS IoT using MQTT.
- **Programming MQTT Client for Sensor Data (22m)**
Develop firmware to publish sensor readings over MQTT.
- **Implementing Device Shadow Interactions (20m)**
Code to handle Device Shadow updates and sync device state.
- **Building Error Handling and Reconnection Logic (18m)**
Make your device robust with error handling and automatic reconnection.
- **Implementing Over-the-Air Updates with AWS IoT Jobs (25m)**
Use AWS IoT Jobs to deploy firmware updates remotely.
- **Hands-on Lab: Streaming Environmental Data to AWS IoT (32m)**
Complete project: connect a temperature/humidity sensor and stream data to the cloud.
- **Testing and Debugging Embedded Device Code (15m)**
Techniques to test and debug your embedded applications effectively.

Data Ingestion, Storage, and Processing in AWS

- **Introduction to AWS IoT Rules Engine (15m)**
Learn how to route messages from devices to other AWS services.
- **Creating Rules for Message Routing (20m)**
Step-by-step guide to defining rules in the IoT Rules Engine.
- **Integrating Lambda Functions for Data Processing (22m)**
Use Lambda to process device data before storage.
- **Storing Data in DynamoDB for Quick Access (18m)**
Set up DynamoDB tables to store and query IoT telemetry.
- **Using Amazon Timestream for Time-Series Data (20m)**
Implement Timestream for efficient time-series data management.
- **Archiving Telemetry Data to S3 (16m)**
Store historical data in S3 for long-term retention and analysis.
- **Setting Up Amazon Kinesis Data Streams (22m)**
Configure Kinesis for real-time data streaming from devices.
- **Processing Real-Time Data with Kinesis (25m)**
Build applications that process data in real-time using Kinesis.
- **Visualizing Device Data with AWS IoT SiteWise (20m)**
Create dashboards in SiteWise to monitor device metrics.

- **Creating Dashboards in Amazon QuickSight (18m)**
Use QuickSight for advanced data visualization and reporting.
- **Designing Event-Driven Architectures with EventBridge (22m)**
Integrate EventBridge to trigger actions based on IoT events.
- **Orchestrating Workflows with Step Functions (20m)**
Use Step Functions to coordinate complex IoT workflows.
- **Hands-on Lab: Building a Data Pipeline from Device to Dashboard (35m)**
End-to-end project: connect device data to storage, processing, and visualization.
- **Monitoring and Logging Data Flows (15m)**
Implement monitoring with CloudWatch and logging for data pipelines.

Security, Scaling, and Production-Ready IoT Architectures

- **Deep Dive into X.509 Certificate Authentication (20m)**
Advanced techniques for using X.509 certificates in IoT security.
- **Setting Up Just-in-Time Provisioning (18m)**
Implement JITP for automatic device registration at scale.
- **Building Custom Authorizers for IoT (22m)**
Create custom authorizers to authenticate devices with external services.
- **Applying Fine-Grained IoT Policies (16m)**
Define policies with specific permissions for device access.
- **Using Policy Variables and Resource Tags (18m)**
Leverage variables and tags for dynamic policy management.
- **Implementing Network Isolation with VPC Endpoints (20m)**
Secure IoT traffic by using VPC endpoints for private connectivity.
- **Establishing Private Connectivity for IoT Devices (22m)**
Set up private links and endpoints for enhanced security.
- **Scaling with AWS IoT Device Management (25m)**
Manage large device fleets with AWS IoT Device Management features.
- **Using Fleet Indexing for Device Queries (18m)**
Index and query device data for fleet-wide insights.
- **Protecting Fleets with AWS IoT Defender (20m)**
Monitor and defend your IoT fleet against security threats.
- **Edge Computing with AWS IoT Greengrass Overview (22m)**
Introduction to running AWS services on edge devices with Greengrass.
- **Hands-on Lab: Production Security and Scaling Setup (35m)**
Apply security best practices and scaling techniques to a real IoT deployment.
- **Designing Resilient IoT Architectures (18m)**
Plan and build IoT systems that are reliable and scalable for production use.

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