SMART HOME – IOT HUB

Team 5

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What is Azure IoT Hub?

A cloud service from Microsoft

Communication between devices and the cloud remotely

Scalable for small to large IoT solutions

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Key Features

Bi-Directional Communication

Device Management

Security

Scalability

Real-World Applications of IoT Hub

To monitor inventory levels in real-time

To notify staff when stock is low

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track customer movement

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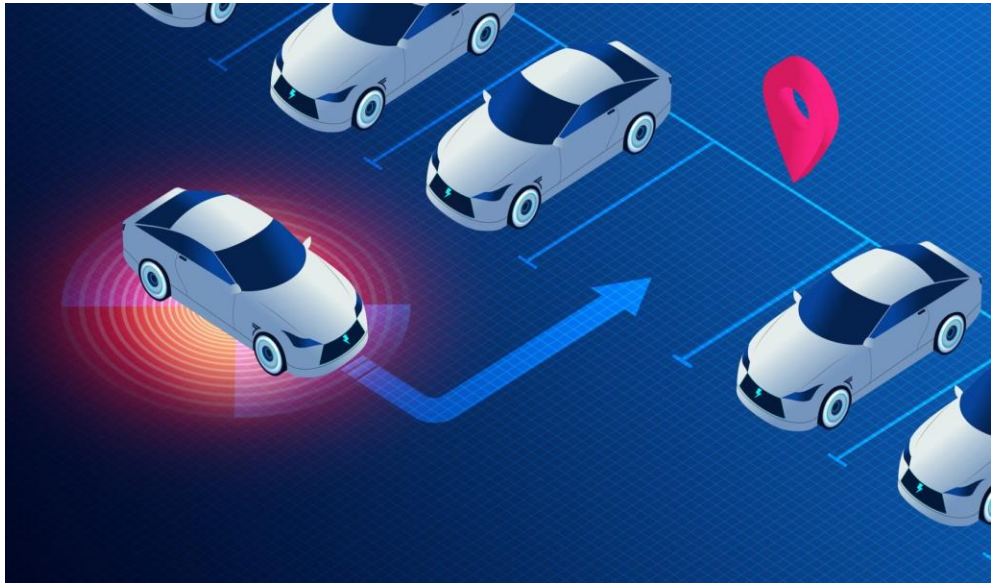
Use case – Smart City



Smart street lighting:
-Sensor detect movements

Smart parking systems:
-Help drivers find available parking spot

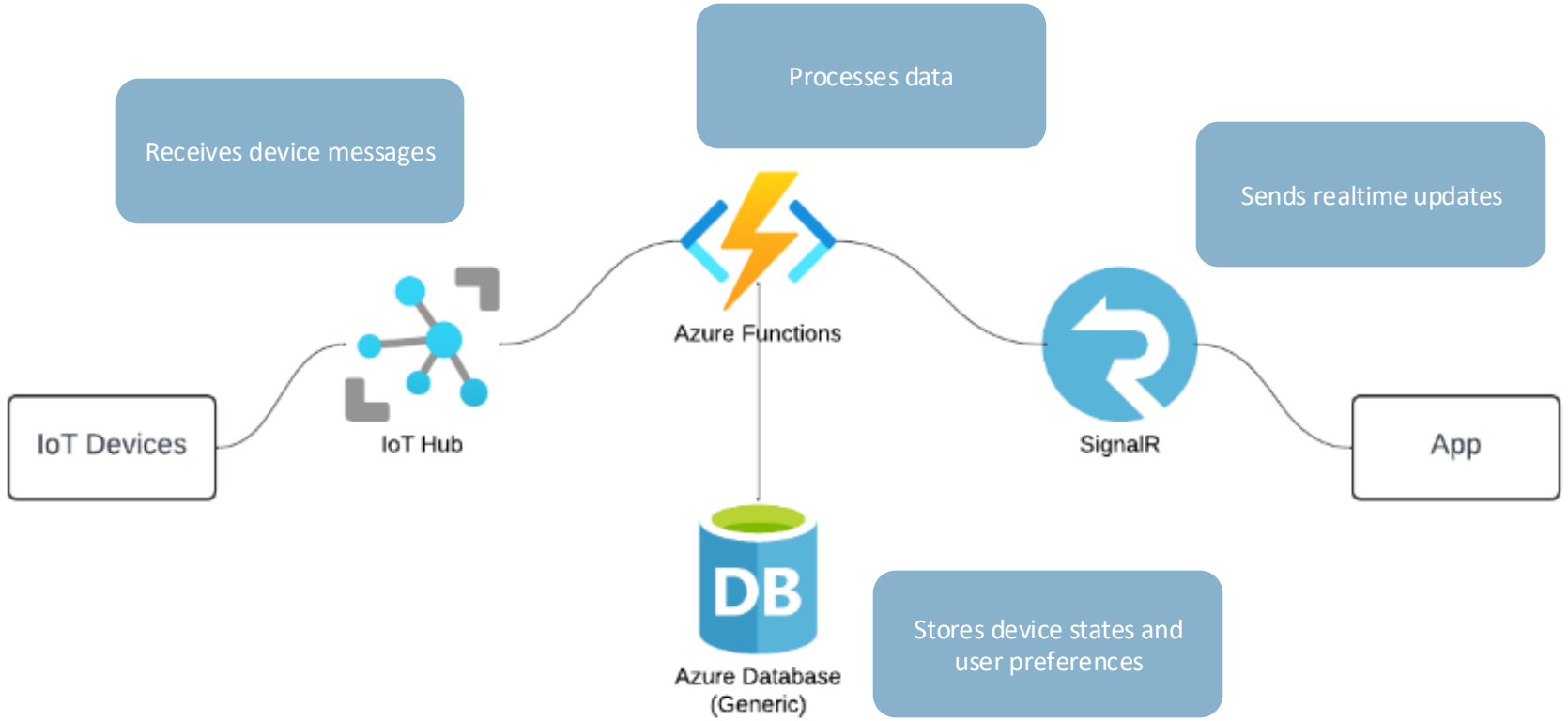
Security Considerations for IoT Devices

Device Authentication

Data Encryption

Real-Time Monitoring

Integrating IoT Hub into the Architecture



Questions?

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SignalR
Kheirallah Elie
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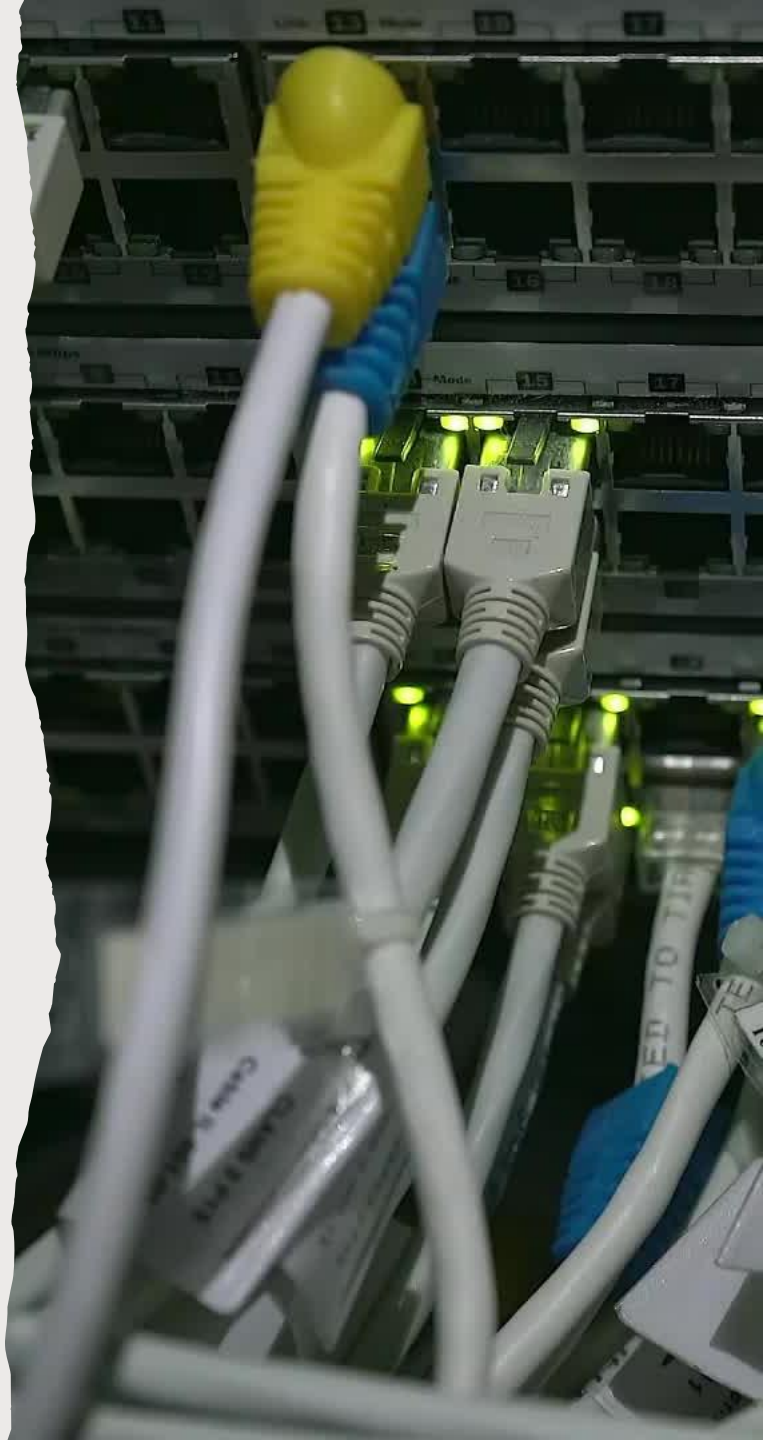
SignalR Overview: What is SignalR?

- ASP.NET Core library to facilitate real-time web functions
  - Instant server-side code pushes content to connected clients
- Persistent connections between client and server
  - Real-time communication
  - Instantaneous updates
  - No more frequent and slow server polling



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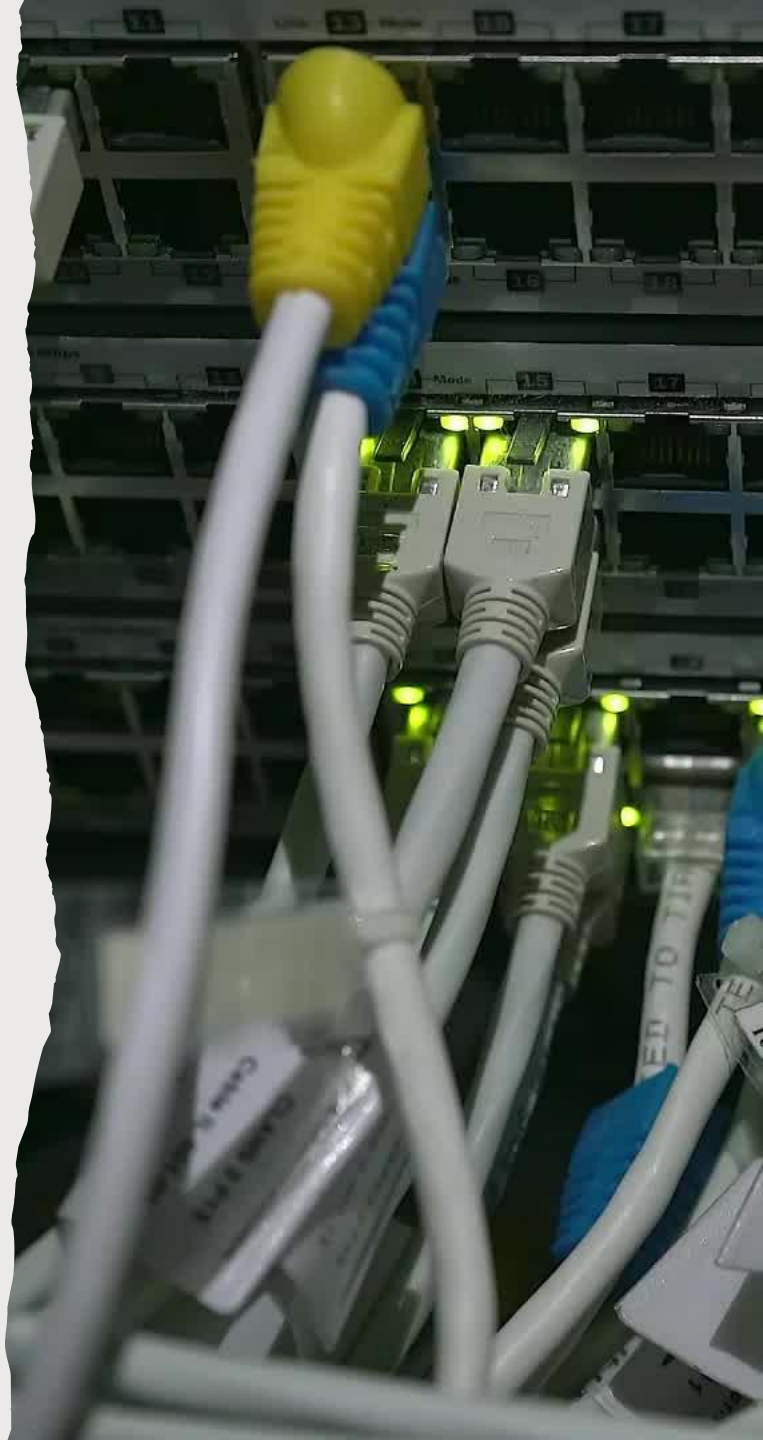
SignalR Use cases: Where can it be useful?

- Chat applications
- Live notifications
- Real-time dashboards and collaboration tools (Figma, PPT Online, etc..)
- Multiplayer games



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SignalR:
Key features and Benefits?

Automatic connection management

Real-time communication without constant polling

Support for Multiple Transports

WebSockets (perfomant)

Server-Sent Events (for less interactive scenarios)

Long Polling (fallback option)

Broacasting and Group Messaging

Cross-platform Compatibility (any platform that supports web technologies like Angular, JavaScript, .NET, etc..)

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SignalR
Role in Real-Time Web Applications

Notifications

Live notifications -> IoT device state change

Live Updates

Real-time change on a web page without refreshing

Chat Functionality

Enables real-time, bi-directional communications for chat and messaging

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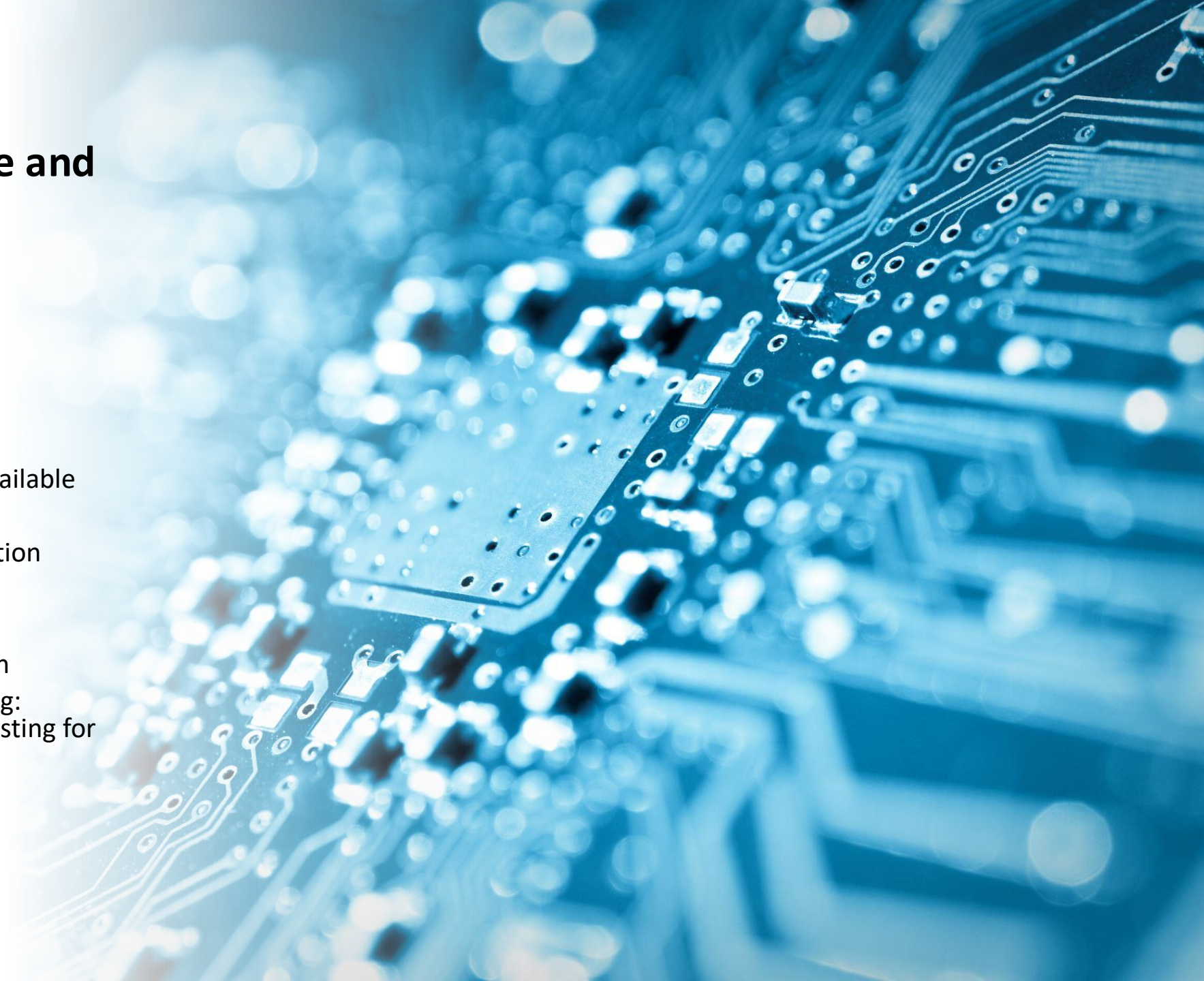
SignalR's Integration with Azure and other technologies



- In Azure:
  - Can host SignalR
    - Benefits:
      - Reliable and available
      - Autoscaling
      - Global distribution
  - Azure SignalR Service
    - Benefits:
      - Easy integration
      - Offloads hosting: Handles the hosting for you

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SignalR's How it integrates in Azure

- Azure IoT Hub
  - Arduino pushes real-time data to Azure IoT Hub
- Azure Functions
  - Process incoming data and push updates to client via SignalR
- Angular Web App (client-side receiver connected via SignalR)
  - Displays the updates in real-time
- Database
  - Settings and information stored here and updated

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SignalR's Performance and scalability

Azure IoT Hub

Arduino pushes real-time data to Azure IoT Hub

Azure Functions

Process incoming data and push updates to client via SignalR

Angular Web App (client-side receiver connected via SignalR)

Displays the updates in real-time

Database

Settings and information stored here and updated

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Case Studies and Real-World Applications (examples)

MICROSOFT TEAMS

STOCK MARKET DASHBOARDS

COLLABORATIVE TOOLS

ONLINE GAMING

ETC..

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SignalR's Role in the Context of This Project

Real-Time updates for IoT Data

Streams the state of the IoT devices in real-time

Users receives instant feedback when performing an actions like turning lights on/off from the web page

User notifications

Notifies users of the current state of their IoT devices

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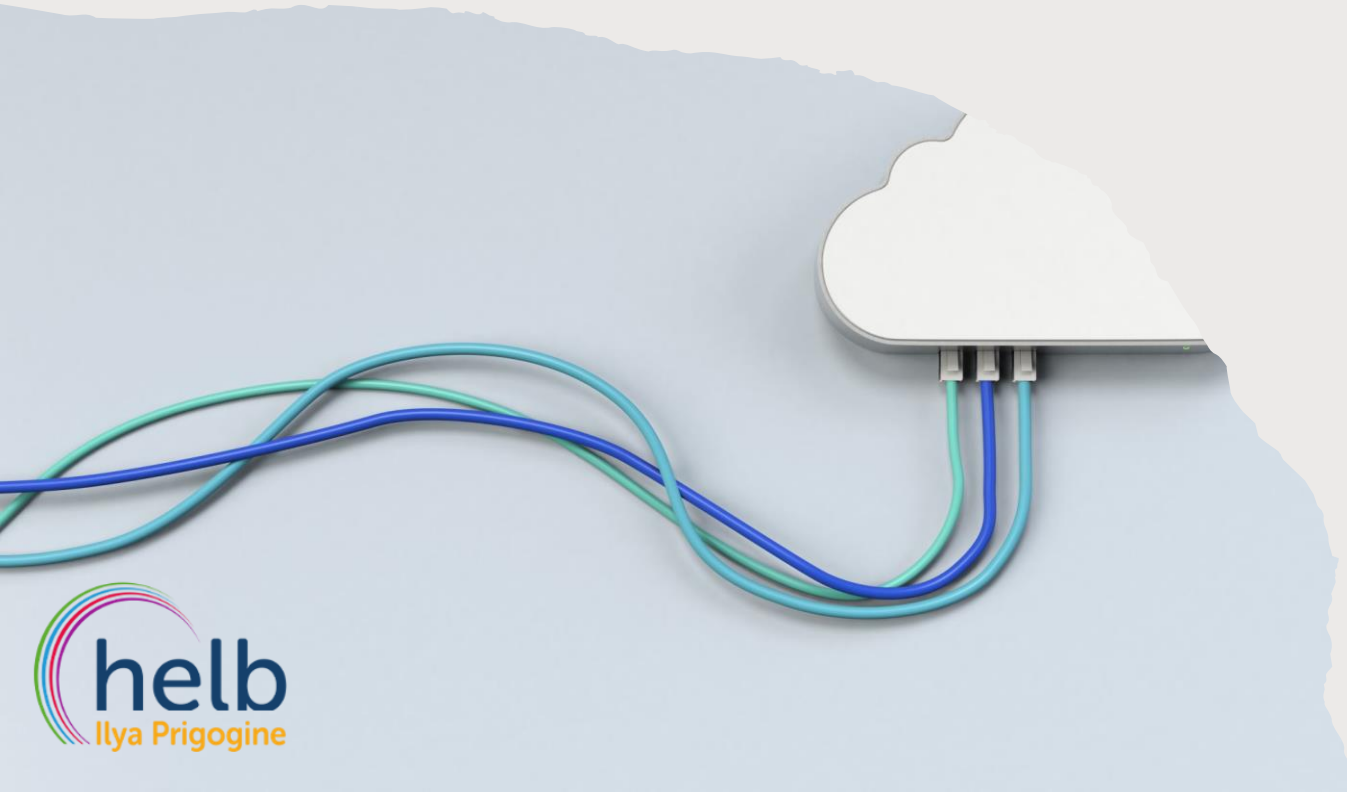
Finally, how is SignalR integrated into this application?



1- The Arduino captures data from the IoT devices and sends it to the cloud

2- Azure functions will process the data and send relevant updates to connected clients through **SignalR**

3- SignalR pushes the real-time data updates and control messages (like turning the light on or off) to the Angular front-end

4- The client on the front-end Angular Web App interact with the app and send messages via SignalR to receive feedback in return

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Azure Functions

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Léo Calvo Castaño

Overview

Act as the core for specific event-driven tasks in the architecture.

Seamless interaction with other Azure services ensures smooth data flows between components.

Reduce complexity by abstracting infrastructure management.

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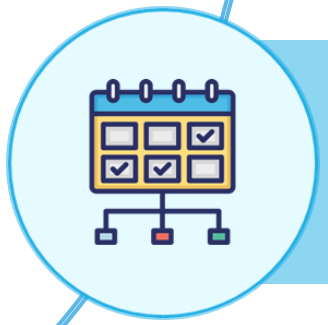
Key Features

Serverless

No Maintenance



Event-triggered code

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Benefits

- Pay for execution time
  - Cost efficiency
  - Auto-scaling to meet demand
- No infrastructure management
  - Chose language
  - Focus on code

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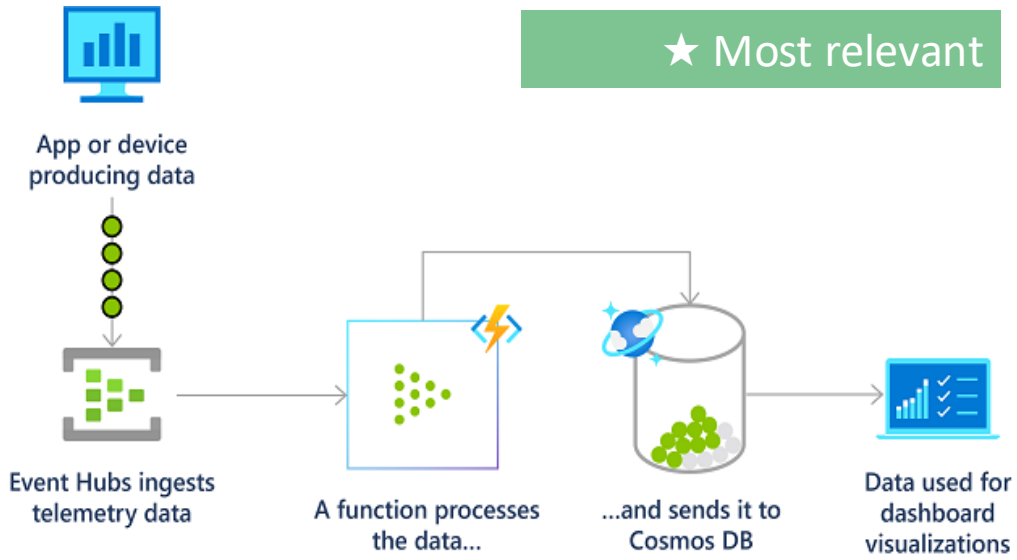
Common Use Cases

- Reminders and notifications
- Scheduled tasks and messages
- File processing
- ★ Data streams processing
- Running background backup tasks
- Computing backend calculations
- Lightweight Web APIs, proofs of concept, MVPs



Picture: Ggailey. (2024, 26 septembre). *Azure functions scenarios*. Microsoft Learn. https://learn.microsoft.com/en-us/azure/azure-functions/functions-scenarios?pivots=programming-language-csharp

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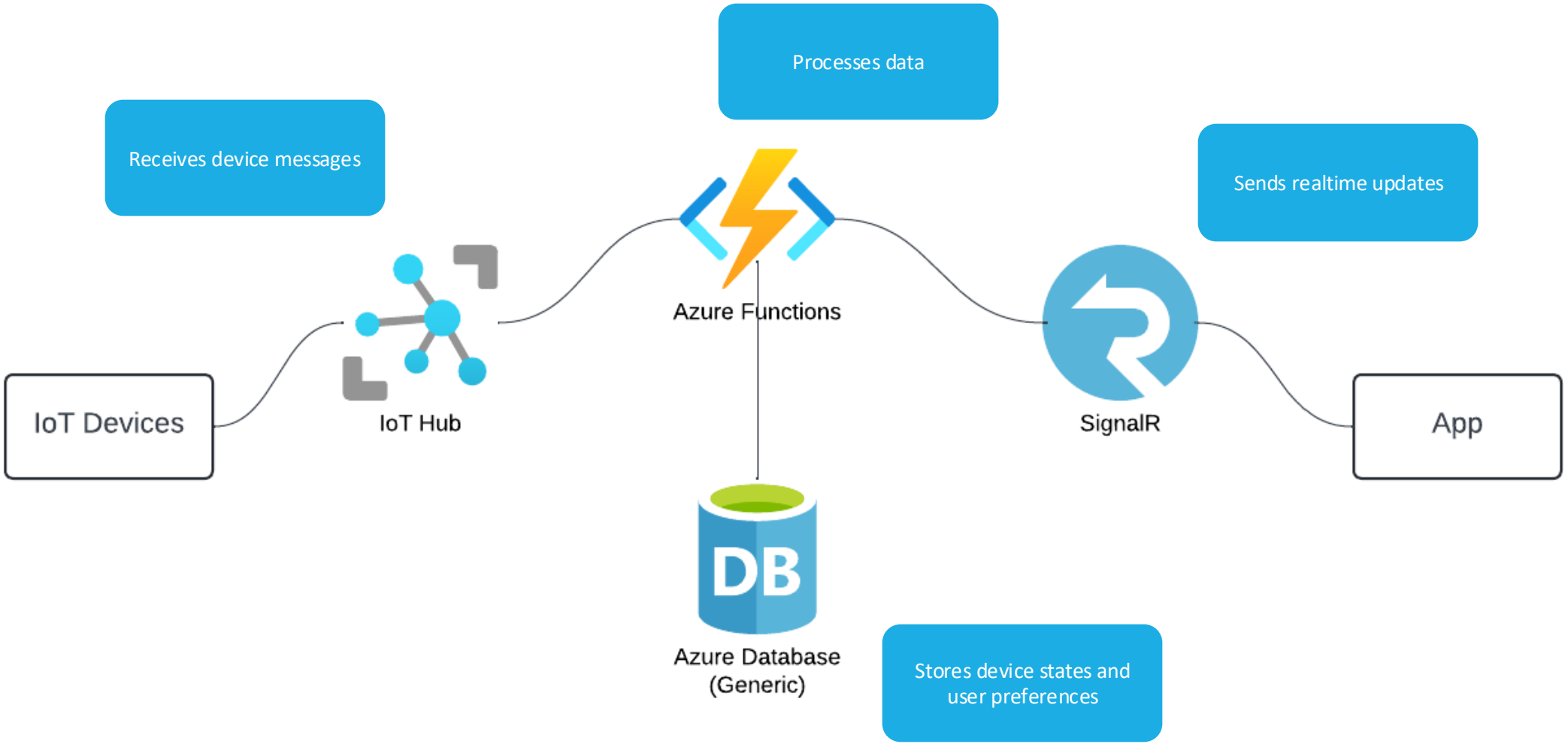
Integration



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Introduction to Azure Web App

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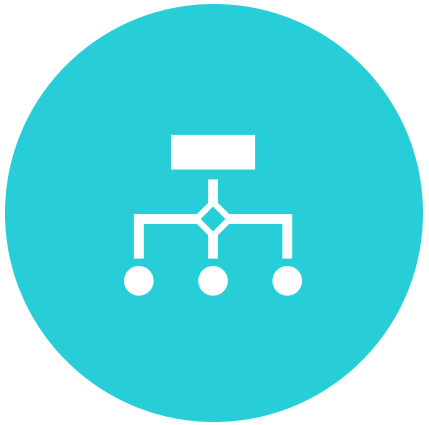
Jamal Assou – Team 5

12/10/2024

What is Azure Web App?

PLATFORM SERVICE (PAAS) FOR DEPLOYING AND MANAGING WEB APPLICATIONS.



MANAGES THE INFRASTRUCTURE

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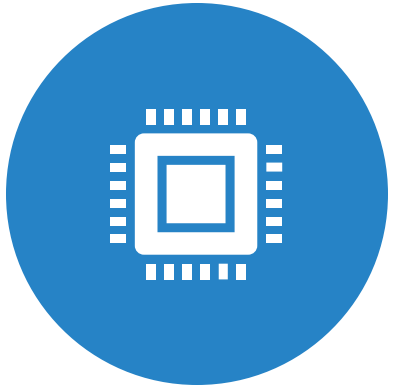
Key benefits



SIMPLIFIED HOSTING: RAPID DEPLOYMENT WITHOUT COMPLEX SERVER CONFIGURATION.

MULTI-LANGUAGE SUPPORT: COMPATIBLE WITH .NET, NODE.JS, JAVA, PHP, PYTHON, ETC.

SCALABILITY: AUTOMATIC SCALABILITY TO HANDLE VARIABLE TRAFFIC.

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Key features

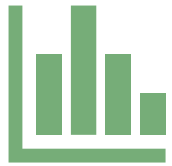
Continuous management .

Continuous integration and continuous deployment (CI/CD).

Support for GitHub, Azure DevOps.

Security :

SSL certificate management, integration with Azure AD.



Monitoring **:**

Tools like Azure Monitor and Application Insights for performance diagnostics.

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Use cases

Corporate websites.

REST APIs.

E-commerce applications.

SaaS applications.

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Overview of NoSQL Databases

Definition: Non-relational databases, also known as 'Not Only SQL.'

Characteristics: Schema flexibility, horizontal scaling, and distributed storage.

Types of NoSQL Databases: Document, Key-Value, Column-Family, Graph databases.

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What is MongoDB?

OPEN-SOURCE, DOCUMENT-ORIENTED DATABASE.

STORES DATA IN JSON-LIKE FORMAT CALLED BSON.

DEVELOPED TO MANAGE HIGH-VOLUME DATA STORAGE.

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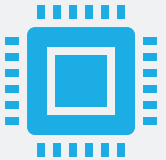
MongoDB Features and Benefits

Schema Flexibility: Allows for evolving data structures.

Horizontal Scalability: Sharding support enables large-scale distribution.

High Performance: Optimized for read and write performance.



Data Redundancy: Supports replica sets for high availability.

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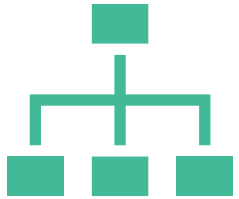
Data Structure in MongoDB

Document Model: Data is stored in BSON documents.

Collections: Groups of documents, similar to tables in relational databases.



Hierarchical Data Structure: Supports embedded documents and arrays.

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MongoDB in Real-World Applications

Big Data: Efficiently manages massive datasets.

Real-Time Analytics: Ideal for dynamic data processing.

Content Management: Flexible schema is suitable for multimedia and content-heavy apps.

Cloud Applications: Suits modern, distributed cloud architectures.

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Performance, Scalability, and Security

Performance: Fast read/write speeds due to document-based storage.

Scalability: Horizontal scaling with sharding.

Security: Role-Based Access Control (RBAC), encryption, and access control mechanisms.

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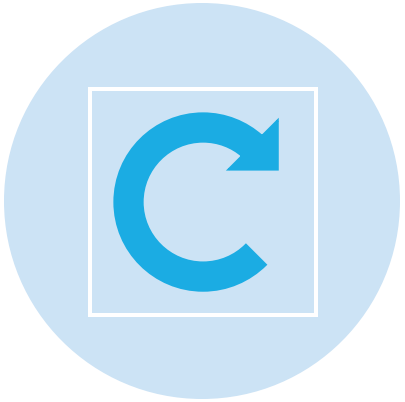
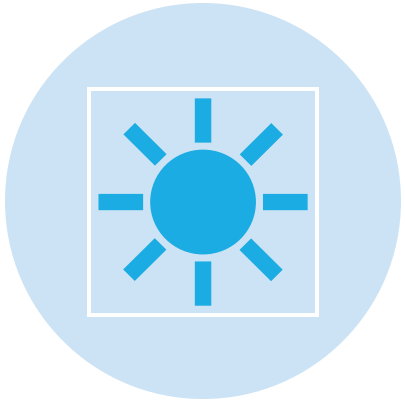
Role of MongoDB in the Smart Home Project



STORES DATA ABOUT LIGHTING CONFIGURATIONS



MAINTAINS THE STATUS OF EACH LIGHT (ON/OFF, BRIGHTNESS LEVEL, ETC.) IN REAL-TIME.

PROVIDES A SCALABLE, FLEXIBLE STORAGE SOLUTION SUITABLE FOR UNSTRUCTURED AND STRUCTURED DATA.

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Integration of MongoDB with Other Architecture Components

- Backend Access: The backend server interacts with MongoDB to store and retrieve lighting states and settings.
- Data Flow: MongoDB serves as a central repository, allowing the web app to query and display real-time lighting status.
- IoT Device Updates: Receives and logs data from IoT sensors, which track the current state of the lighting.

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QUESTIONS?