



GadgEon

Engineering Smartness

ULTRA LOW-COST HOME SECURITY GATEWAY

April, 2020

Version 1.0

▶ Ultra Low-cost Home Security Gateway



Worldwide leader in universal control and sensing technologies wanted to develop a home security gateway/hub with associated cloud and mobile application for securing homes against fire, flood and freeze. The solution was expected to be low-cost hubs. The customer will be offering this product as a combination of IoT Gateway + few sensors.

Solution Description

- Gadgeon architected the complete system including the gateway, iOS /Android mobile application, backend cloud application and browser UI application.
- Simple and reliable gateway/hub for securing homes against fire, flood and freeze
- Easy to use mobile app for managing the hubs, receiving the notifications and control the actuators like thermostat and valves
- Robust backend cloud application for managing users, hubs, sensors/actuators and handling real time notification via text messages, emails and push notifications
- The complete system was developed to handle millions of gateways while keeping the overall cost of the individual gateways at minimum

Outcome and Benefits Delivered

- Delivered a low-cost system under few tens of dollars
- System is highly scalable: Supported millions of gateways/hubs and users
- Supports multiple wireless technologies for sensor and actuators at 433MHz and Z-wave
- Homeowners would receive notifications if there was a water (flood), temperature (freeze), or fire (smoke detector) event and can take timely action to prevent occurrence of a catastrophic event
- Provided convenience, ease of use, and user friendly UI to the end home users

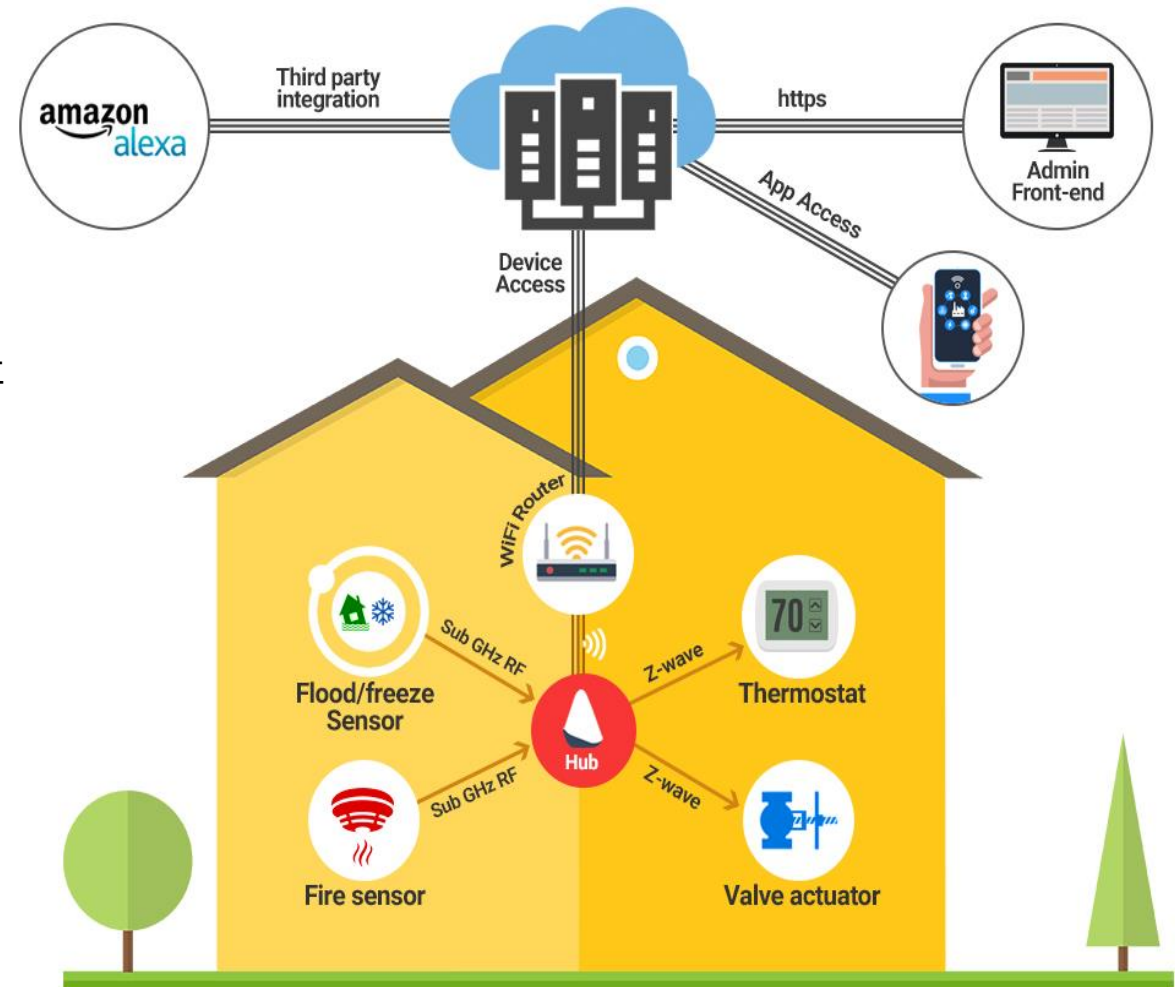


The Business Context and Challenges of the Customer

- The customer is a universal leader who offers sensors and products in a range of sub-gig frequencies for the professional market, Home Automation and DIY market. The companies/users that purchase the sensors and products from the customer were looking for hubs that can work with these sensors. They needed a “sub-gig frequencies sensors + Z-Wave enabled” hub for applications where the users want to have installed Z-Wave products like thermostats and lighting controls.
- In addition, there are opportunities in HVAC, DIY, Home Automation, Insurance, and the remediation market for an easy to install hub + sensor kit that allows the homeowner to monitor flood/freeze and fire events via a simple to use app.
- Hence the customer wanted to develop a gateway which can easily connect with the sensors and wanted to keep the hardware cost and the running cost at minimum. The customer will be offering this product as a combination of IoT Gateway + few sensors. Moreover, selling an IoT Home gateway to customers who are looking for a low-cost hub to use with existing products allows the customer to push more sensors/products into the marketplace. .

The Solution / System Description

- Gadgeon architected the complete system including the gateway, iOS /Android mobile application, backend cloud application and browser UI application.
- The complete solution included:
 - Simple and reliable gateway/hub for securing homes against fire, flood and freeze
 - Easy to use mobile app for managing the hubs, receiving the notifications and control the actuators like thermostat and valves
 - Robust backend cloud application for managing users, hubs, sensors/actuators and handling real time notification via text messages, emails and push notification
 - Administrator web application was developed to manage the users, hubs, and the complete system
- The complete system was developed to handle millions of gateways while keeping the overall cost of the individual gateways at minimum
- Followed server less Microservices architecture for future enhancements and to reduce overall cost



The Solution / System Description

- We developed a simple and reliable IoT home gateway along with backend cloud application and mobile applications. This involved hardware design, development of firmware for the hub, development of iOS & Android mobile apps, Web UI and backend cloud server application.
- The details of the solution are given below:-

Hardware design with low cost optimization, prototyping, board bring up

- Cadence Allegro was used for the design of hardware
- Feasibility analysis for meeting sub 20\$ BoM cost. Compared multiple MCU and MPU based system designs to arrive at the lowest cost option.
- Identifying pin compatible alternatives for memory with different capacities (SPI flash and DDR) for future proofing the software.

The Solution / System Description

Hub Firmware

- Gadgeon designed an ultra low cost gateway based on MT7688 chipset capable of running OpenWRT Linux. This gateway supports ethernet and Wi-Fi interfaces for communication with home router. It supports 433MHz radio and Z-wave for sensor communication.
- 433MHz based sensor nodes detect events like fire, flood and freeze and communicate that to the gateway/hub. The gateway/hub informs the event to the cloud which notifies the users through the companion mobile application.
- Various technologies and services used includes the following
 - U boot customization for the specific RAM and flash memory on the custom board.
 - IOTVity framework, 433MHz support for sensor integration
 - ZIP Gateway for Z-Wave Integration
 - Board manufacturing test software with testing for all interfaces, firmware upgrade support
 - MQTT for cloud communication with AWS IoT cloud service
 - Development of protocol stack for handling communication with the PIC MCU
 - Integration of SQLite DB
 - Security – Support for mutual authentication with cloud

The Solution / System Description

Cloud application:

- Cloud server hosted in Amazon. The hub will intimate the events to cloud via MQTT (AWS IoT) protocol. The cloud will intimate the event details to the users via Text, eMail or push notification. AWS SNS, AWS SES and FCM services are used for notification. REST APIs (AWS API Gateway) is used to communicate cloud and mobile apps.
- Microservice architecture using AWS Lambda, is used as a server less compute service that runs code in response to events and automatically manages the compute resources required. Amazon DynamoDB, AWS S3 and ElastiCache are used for Data and cache management. The application followed the security practises to ensure a highly secure system using various services like IAM, Certificate Manager etc.
- Angular based web application hosted on AWS S3 is used as Administrator UI. It has the functionalities of user and hub management, firmware upgrade etc. The entire cloud server application is architected properly to optimize the cost without compromising the security and scalability.
- Various technologies and services used includes the following
 - Cloud server hosted in Amazon.
 - AWS IoT for communication with Hub over MQTT and HTTP.
 - AWS API Gateway for communication with the mobile App.
 - AWS Lambda is used as a server less compute service that runs code in response to events and automatically manages the compute resources required.
 - Amazon SNS messaging service is used to send notifications to Apple iOS, Android and other mobile devices, send emails and text messages.
 - Amazon DynamoDB. NoSQL database is used for storage



The Solution / System Description

Mobile Application: iOS & Android

- Mobile app alerts users of the events using APNS and FCM push notifications. Whenever the users receive alert notifications, they can control valves and thermostats remotely, by sending commands using this app.
- The app also helps the user to set up the hub and sensors/actuators by guiding through each step of the installation process.
- It communicates directly with hub over Wi-Fi for initial configuration. REST API calls are used in this process
- Various technologies and services used includes the following:
 - MVC architecture
 - Real-time notifications using APNS and FCM
 - REST API for direct configuration of the Hub
 - Followed the recommended design patterns from Apple and Google.

THANK YOU



For More Details, Let's Connect



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