

# A Review of Connectivity Challenges in IoT-Smart Home

S.Sujin Issac Samuel

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## 1 Introduction

A home that provides intelligent living environment for daily convenient life is a smart home. In smart homes all the household digital devices are connected to the internet to Nowadays, Internet of Things (IoT) means advanced connectivity of anything such as devices, The connected devices in the smart home form a home network that deals with various devices, digital appliances and handles different kind of network devices. used within a home network and these connections should enable smooth communication among the devices without interference with other wireless networks. various range network protocol and platform. growth projections are high, the related smart home network Whether it's the end equipment, the connectivity piece, the Connectivity is the backbone of IoT that is established by communication standards variety of wireless network protocols are being used in smart home applications, like IEEE 802.11(Wi-Fi), Bluetooth LE (Low Energy), cellular, ZigBee (a low-power As the home network builds with products from different vendors and connected with different protocols, certain challenges have to be faced in connectivity within the smart home. in a home connects to the control system or internet in its own Depend on connectivity, cloud based IoT concepts are advantageous when consider energy dissipation

## 2 Connectivity Standards

Smart home systems can be challenging with evolving wireless connectivity standards that are relevant for smart different wireless standards that can be applied in home

### 2.1 Wifi

802.11ah is the recently-developed IEEE WiFi standard that operates in 2.4 and 5 GHz and reduce the complexity of implementation. The established WiFi standard 802.11 is only effective at the nearest access point and couldn't provide service to the users with large homes. Wi-Fi enables communication between electronic devices such as smartphones, tablets etc.

### 2.2 Zig Bee

ZigBee is a low power wireless mesh technology that mainly operates in 2.4 GHz ISM band. It uses radios based on IEEE 802.15.4 standard for Personal Area Network with a focus on monitoring, control and sensor applications. The Alliance is pushing the standard for home based based devices, from temperature and lighting systems to security monitors and smoke detectors.

### 2.3 Z-Wave

This home automation technology uses little power and is designed for remote control applications in residential and light business settings. It may be found in a wide variety of consumer goods all around the world. These include automatic window coverings, home cinema, pool and spa control, and metre readings.

## 2.4 Bluetooth LE

Bluetooth LE (IEEE 802.15.1) is a standard designed to provide a safe and affordable means of establishing connections with and exchanging data across enabled devices. The 2.4 to 2.485 GHz frequency radio bands are used by Bluetooth LE. It allows for long-term operation with coin cell batteries and considerably lowers the power consumption of Bluetooth devices. Bluetooth provides a direct connection architecture that enables customers to operate home appliances from their mobile devices.

# 3 Connectivity Challenges In Smart Home Network

## 3.1 Interoperability

As customers need gadgets that are simple to use, connect, and connect to one another, interoperability is a major challenge. Devices and systems in a smart home network include from various suppliers with various network interfaces, but nevertheless need to work together to complete duties in unison. System, application, and service interoperability is the capacity to function consistently and predictably together. It refers to a system's capacity to utilise information that has been shared between two or more other systems [8]. The WiFi Alliance's impressive interoperability effort is mainly to thank for the widespread adoption of WiFi. In contrast to its initial version, which was unable to achieve interoperability, ZigBee 3.0 will enable a larger range of devices to operate together effortlessly.

## 3.2 Self Management

Intelligent gadgets can keep an eye on their own operational health and warn consumers of any possible problems before they shut down. Many sensor network applications are run without the aid of infrastructure or the capacity for upkeep and repair. The sensor nodes must be self-managed, which is intended to be entirely independent of human intervention, in order to operate, interact with other devices, adapt to failures, and evolve with the environment. Z-Wave is easy to instal and deploy, and network administration is made simple by automated address assignment. With the help of the random back-off algorithm, two-way acknowledgement, and collision-avoidance, it has outstanding anti-interference properties. ZigBee offers dependable data transport thanks to its strong, self-formed mesh networking.

## 3.3 Maintainability

This crucial characteristic for a network determines how dependable and long-lasting the smart home network is. Everywhere undergoes change, even the home environment with its worn-out batteries, malfunctioning nodes, and new tasks. Therefore, the subsystems in the smart home network must keep track of their own power and condition in order to adjust operating settings or select alternative services, such offering lesser quality with constrained energy resources. The smart home network must be created with the intention of being simple to maintain so that the numerous gadgets and communication components may be fixed quickly and affordably.

## 3.4 Signaling

Reliability of bidirectional signalling is essential in an IoT network of linked devices for data collection and routing between devices, and here is where IoT data streams come into play. Any device connected to a smart home network may talk to a server to gather data, or the server may converse directly with the devices, or both. As opposed to Zigbee and zwave, which have no signal loss due to their low bandwidth and are thus ideal for devices that just require data connections to turn on or off, Wi-Fi suffers from signal loss. Since Z-wave operates on the low frequency radio band 908.4 MHz (US), Wi-Fi networks are unaffected by Z-wave devices. The protocol thread makes use of 2.4 GHz radio transmission, which might interfere with WiFi signals. Because Thread is a completely dispersed mesh network without a single point of failure and lacks a hub, we benefit from increased dependability and range in our house.

### 3.5 Bandwidth

Another issue for IoT connection is bandwidth usage. Managing bandwidth on the home network becomes essential as well. Modern houses frequently need more bandwidth due to the vast quantity of data being generated by the growing number of personal and home gadgets. The application that uses the most bandwidth lately is the video stream in particular. It causes a significant server issue and necessitates a large-scale server to manage all of this data. Consequently, data may be smoothly transferred between devices and servers via a lightweight network. Bluetooth LE provides more data bandwidth than Zigbee and Z-Wave, although Wi-Fi is a high bandwidth network that consumes a lot of power.

### 3.6 Power Consumption

The linked IoT smart home devices may choose the most effective time to function, resulting in greater power consumption efficiency. Numerous IoT gadgets connected to one another in a smart home exchange signals and data constantly, consuming a lot of CPU and electricity. Low power consumption and minimum battery depletion are required for effective IoT networks to communicate. Standard Wi-Fi uses a lot of power. Although Bluetooth Low Energy uses less power, it has restrictions on the number of devices it can connect to and the signal range. ZigBee-based networks typically use 25% less power than Wi-Fi networks, while Z-wave uses less power than WiFi but has a slower data transfer rate than Wi-Fi.

## 4 Infrastructure

Wi-Fi is a key component of the current connectivity systems in a smart home and is mostly powered by computers and mobile devices. Wi-Fi has historically had a high data rate and used more power. The IEEE 802.11ah standard, which offers a greater range at a lower data rate and power consumption, has recently been under pressure for use in Internet of Things applications. ZigBee also gives linked devices another choice. ZigBee is used in a wide range of goods, including smart metres, thermostats, lightbulbs, and charging stations for electric vehicles. Regarding mesh networking and network authentication, Thread is a crucial wireless technology. Choosing networking and routing protocols that offer scalable, adaptable, and administration solutions is the main design factor for connectivity. In a physical network, evaluating the networking and routing characteristics is difficult. Therefore, the needed data may be obtained using a software simulator. In order to use web-based services Constrained Application Protocol (CoAP) is employed to offer a trustworthy and adaptable method to remotely received sensor and network data. When bandwidth cannot be transmitted to user devices, it is of little use to a household or company. A home network's duties include monitoring connected devices and distributing bandwidth. As new generations of home networking technology are released, they get faster, more dependable, and more energy-efficient. The system comprises of several smart nodes connected by a home area network that includes a few sensors. Depending on the software and hardware being utilised, sensors for light, solar energy, temperature, and humidity are linked. Using any of the wireless protocols, the sensor nodes are connected to a gateway or Home Control Unit (HCU). In essence, the gateway device serves as a bridge for data transmission between wireless sensor networks to the Internet. The internal database may be accessed to show node and sensor data to users via a web-based system or a mobile application.

## 5 Conclusion

The networks for smart homes are now encouraging people to live well. IoT will soon enable internet connectivity for even the most basic home appliances. The market standards that form the foundation of the home network and innovation are outlined in this article. On the basis of its connectivity, the difficulties in the smart home network are also solved. ZigBee modules are utilised for low power requirements, whereas Wi-Fi is the standard for applications requiring higher bandwidth.