

Apple HomeKit Application and Cost Breakdown

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A principle part of the American dream is to own a home. The definition of an American home is constantly changing, and smart home technology gives more functionality and control over a person's space. With devices updating constantly and with newer devices coming out every day, having an organized, well-connected smart home can define a person's home. Apple's HomeKit ecosystem gives users a single application interface to operate smart home technology for an entire, organized home opposed to other similar ecosystems without necessary functions run by other companies like Google or Amazon. Starting or remodeling a smart home can be easy enough for a homeowner to complete on their own but there are many obstacles in completing a smart home. Preparing this application and cost deliverable will make it easier for an American homeowner to update their own home with Apple's HomeKit. Running into unforeseen costs or time delays due to bridges or hubs necessary connection or problems with installation can postpone a schedule or dismantle a project. This paper provides pricing, connection requirements, installation notes, and additional notes to help homeowners plan and develop an Apple Homekit based smart home and avoid common smart home problems, saving time and money.

Key Words: Apple, Smart Home Technology, HomeKit, Remodel

Introduction

Implementing smart home technology for the average homeowner requires basic knowledge that should be simple enough for any homeowner to understand such as screwing in lightbulbs, plugging devices into outlets, and connecting devices to home Wi-Fi networks. Most homeowners will not find issues with installation of smart home technology but will with operating these devices and, unknowingly, under-utilize their devices. Smart home technology implementation has been made simple for a "do-it-yourself" mentality. This being said, hidden costs and problems can delay or ruin a smart home project which not only contributes to fewer smart homes being built but also, less output and development of better smart home technology from manufacturers (Weinreich, 2017, p.33). Reducing these hidden problems could be the first step of further implementing smart home technology.

A smart home is defined as "[a home] wired with technology features that monitor the well-being of their residents to improve overall quality of life, increased independence and prevent emergencies," (Demiris & Hensel, 2009). This technology, commonly called singularly as a smart home device, is becoming popular globally and very accessible for the common American (Apple, 2020). The popularity of smart home technology came about through the increase in quality of life and necessity through live saving capabilities (Frank, 2018). Smart home technology has become an inexpensive way to improve the common American's life which gives way to their want in society and increase in popularity (Weinreich, 2017).

The purpose of this paper is to:

- Provide a cost break down of Apple's HomeKit devices in the United States

- Show common mistakes and unknown costs associated with certain items
- Describe different functions and connectivity of available devices

Smart Homes

Apple products include the iPhone, AppleTV, HomePod, iPad, and more. Apple's HomeKit products include 43 different types of non-Apple branded devices like lights, cameras, and entry door locks in the United States. There are other products that work with Apple's HomeKit but only available in different countries that have yet to come to the United States (Apple, 2020). Problems include having interface in different languages, having different power specifications, or any other array of issues.

An American homeowner wanting smart home technology should first start by dedicating their home to one operating system such as Apple's iOS products. Other systems are comparable such as Amazon's Alexa and Google's Assistant but Apple's functionality through automation and remote access put it ahead of its competitors (Looper, 2020). Amazon's ecosystem lacks a phone which is detrimental because a phone can serve many uses including as a remote or as a central hub. Google and Apple's phones have abilities like these built in which reduce spending on extra devices like Amazon's Echo (Google, 2020). Google's ecosystem is very comparable to Apple's, but Google lacks the amount of branded devices Apple has (Looper 2020). These three systems are very similar but with Apple's popularity in the United States and advantages, HomeKit remains at the focus of this analysis (O'Dea, 2020).

The second step should be creating a well-connected Wi-Fi network that can be reached throughout an entire home. Devices like lights and security cameras can be set up around the home or out of reach of a home Wi-Fi network which would limit device usage or make devices inoperable. In short, having a strong Wi-Fi network and an iPhone can be all a person needs to start their smart home.

Making a smart home affordable will make the common homeowner's control of their surroundings more enhanced. Having complete control of one's home is further developed with a smart home which is a power an American homeowner should utilize. Using a cost breakdown of smart home devices to explore one's options can be a useful tool for smart home implementation.

Apple HomeKit

The Home app is the center of Apple's smart home and provides one place to view and control a smart home. Setting up all smart devices through Apple's home app is an important step of automating an Apple smart home (Looper, 2020). By setting up smart devices through Apple's home app, the device is now a part of Apple's network allowing many functions that would not be able to function through different third-party apps or that specific devices own company app. These functions include using voice activation to control devices through Siri, automation, and remote access even outside of the home. Automation allows a person to set up scheduled timers for their devices and use location services to operate devices like turning on lights upon arrival home. Being also able to operate devices away from the home, like checking security cameras, is an integral part of the smart home and possible through Apple HomeKit (Apple, 2020). These or some services are not guaranteed through other apps whereas Apple's HomeKit is exceptional.



Figure 1: Apple HomeKit Product Sticker

Apple reviews all devices to be included through their Home app which is a part of the HomeKit family. All products that work through the Home app have a HomeKit sticker on the product when sold or are seen under Apple's accessories on their website. There are many devices including HomeKit products that are operable under a separate application that is not the Home app. For best use, having only HomeKit products under the Home app makes usage easier and functionality seamless.

Products

There are 43 listed products that are accessible under Apple HomeKit (Apple, 2020). These items in the United States include cameras, lights, light switches, entry door locks, outlets, remotes, sensors, and thermostats. After buying a product that is supported by HomeKit, the device will be installed into any smart home all managed together under one app.

Most smart home technology is not supported under Apple or Apple's HomeKit. Ways around this problem include using switches and outlets to your advantage. By putting an unsupported accessory, like a garage door or water heater, on a smart outlet or switch, you can have full control of turning them on and off without having that specific smart device (Apple, 2020). Kitchen appliances have yet to become popular as smart home technology, but some are operable under switches and outlets. Ovens, dishwashers, coffee makers, rice cookers, and others require human involvement by loading in items which limit their ability to become smart devices. Some ovens can be pre-heated via smart technology, but this has not been popularized through HomeKit.

Connection

Connection is a huge problem with smart homes (Barrett, 2020). Having a strong Wi-Fi network that reaches an entire home and any outdoor areas will prevent many problems with connection. Buying a Wi-Fi extender or repeater can help this problem which are found online. Many devices need bridges and hubs as well that act as middlemen between the devices and Wi-Fi networks. Without bridges and hubs, these specified devices will have no ability to work. Most all smart devices either use Wi-Fi or Bluetooth so a homeowner's web of devices being in signal from one another and having connectivity is necessary.

Bridges

Bridges can be one of the biggest unforeseen costs of creating a smart home. Bridges are one way for companies to keep multiple devices through one central unit that usually connects, or bridges, devices to the home internet (Rouse, 2020). This bridge is usually connected to the internet via ethernet cable but allows multiple devices to connect through Bluetooth in range of the bridge. Philips Hue, a lighting company, requires a bridge that is \$60 for even a single device but can hold up to 50 devices

(Philips Hue, 2020). The attached spread sheet can help guide a potential buyer through buying HomeKit compatible products.

Hub

A hub is another necessary item for some smart devices. A hub is a centrally located Apple device that runs a smart home. This requires an iPad, Apple TV, or HomePod to stay in the home to run the devices (Apple, 2020). Without a hub that is permanently home, some devices will not run or be able to work from remote locations. Items are noted in Appendix A.

Considerations for Smart Home Applications

The attached Excel spreadsheet (Appendix A) is a guide to buying and setting up a smart home from Apple's HomeKit. The spreadsheet is organized by name, item, price, company, if the device needs a bridge, if the device needs an ethernet connection, if the device needs a Wi-Fi connection, if the device is wired or needs an outlet, and installation notes. This spreadsheet allows a person to see the current pricing, other devices by the same company that would work well together, requirements the device has in which it must operate, and any notes for installation to complete a smart home project.

An example smart home would contain many different items all in Apple's HomeKit family including multiple Philip's Hue lights with the Philips Hue bridge, Logitech's security cameras, Yale's door lock, Eve's energy strip to track electric energy usage items like a television, Eve's light switch, and ecobee3's smart thermostat. With these products, the homeowner would be able to control the home from anywhere being able to turn on and off devices, check security cameras, and unlock the front door. A person with multiple homes or on vacation could operate their home or homes remotely for utility and ease of mind. For someone bedbound or handicap, controlling the home through HomeKit allows people to operate their home through their iPhone instead of getting up which could be difficult or impossible (Frank, 2018). Apple's HomeKit works well with many different devices working side by side to make a well-rounded smart home chosen by the home user. There are many categories per each item to keep in mind when making a smart home like company, installation, bridges needed, and price.

Company

When choosing a smart device, it is best to stay with the same company for each genre of device. For example, when choosing lighting, choosing all Philips Hue lights will make connection easier, replacement quicker, and coordination faster (Philips Hue, 2020). Choosing different brands will make the devices harder to match and not as seamless to the end goal of operability. Need for bridges also makes installation more confusing and costly when choosing multiple brands because each brand has their own independent bridge if required. Limiting a home to few device companies makes smart homes easier to operate and better coordinated.

Installation

Most items have simple install that either require batteries, being plugged into an outlet, or being screwed in, like a light bulb, to an existing light fixture. Most thermostats, light switches, and plugs require being wired to a home electrical panel replacing existing devices and using existing wiring

(Apple, 2020). This basic wiring is easy enough for the average homeowner using the existing wiring but can be done by most handymen or electricians if the homeowner is not capable.

Bridges

Bridges are required for some devices as previously expressed. Devices are noted on the spreadsheet if they are included, required and not included, or not applicable for the device. Bridges are an expensive item to forget so the items without a bridge included but require one are marked in red or noted.

Price Estimate

The price column is the hard price for each individual product that is sold online at the time this paper was written. The price estimate is the estimated price including tax at 7.75% and a shipping cost of \$5 (Apple, 2020). Having a correctly estimated price gives homeowners a realistic cost so they can better see how the product fits into their budget. Seeing also that other products, like bridges, are needed but not included helps see these unforeseen costs. Batteries are also needed for many of the products, which is listed in the notes section, but not in the price column because many of the products come with rechargeable batteries. Other unforeseen costs would include site specific unknowns like having outlets not work or products that need an extension cord to outlets. These unforeseen costs are also not included in the price column.

More information for these products can be seen on Apple's website under HomeKit accessories and online on their manufacturers site (Apple, 2020).

Lessons Learned

Starting a smart home is simple but common smart home technology for the average homeowner has yet to include all areas of the home and products. Apple HomeKit does a great job of getting some major products under their HomeKit which will be highly sought after as further generations better with technology buy homes (Muhammad, 2017). Google and Amazon are comparable, but the popularity of Apple's iPhone puts itself over Google's phones and Amazon's lack of a phone to use in remote locations and for automation (O'Dea, 2020).

Apple has a magnitude of products that work with HomeKit, but many are unsupported in the United States. Many European and Asian companies have their own technology which is better supported for their specifications and lifestyle. As time goes on, Apple should hopefully continue to add products and this system will only become better for consumers.

Price for these devices can range depending on the home and user's needs. A smart home including lights, locks, switches, cameras, and thermostats can cost less than \$1,500 in total and installed in less than an 8-hour workday. Considering options before installation or buying the products speeds up the time of the project drastically.

Multi-home function is a great way to have rental properties or assist people such as elderly family members (Humphreys, 2018). Many of the smart devices track information such as utility usage to further analyze a houses consumption and activity. This directly correlates to utility bills and allows

for users to make changes to system usage. Also, giving access to a home either temporarily or permanently allows multiple people to view a home and make changes to the system.

Conclusion

Properly planning and creating a functioning home allows people to be comfortable and live their lives with ease (Humphreys, 2018). Apple's HomeKit allows the average American to control their home as best they can, and this worksheet (Appendix A) allows a person to reach that point as soon as possible without wasting money. Taking full control of a home through smart home technology gives people more options to change and dictate what happens in their surrounding spaces. Getting rid of hidden problems and costs further implements smart home technology and leads to the development of new and better devices (Muhammad, 2017). Knowledge of Apple smart home technology, from associated brand names to functionality and usage, can shorten project times and save money. Apple's HomeKit is one of the top ecosystems to start a smart home off and Apple provide a nicely packaged interface for users (Looper, 2020). These results can help Americans apply Apple HomeKit to their homes and further expand technology throughout that can dramatically improve their lives (Humphreys, 2018).

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Appendix

Appendix A: Excel Cost Breakdown

	Name	Item	Price	Estimated Price	Company	Bridge needed?	Bridge?	Does it need an Ethernet connection?	Does it need Wifi?	Outlet?	Hard Wired?	Install	Other Notes
1	Wemo Bridge	Bridges	\$ 30.00	\$ 37.33	Wemo			X		X		Connect ethernet. Plug into outlet.	Bridges connect to home internet via ethernet.
2	Philips HUE HomeKit Upgrade Bridge (for Current HUE Bridge Users)	Bridges	\$ 60.00	\$ 69.65	Phillips			X		X		Connect ethernet. Plug into outlet.	Bridges connect to home internet via ethernet.
3	Arlo Ultra 4K Wire-Free Security Camera System (2 Cameras)	Camera	\$ 600.00	\$ 651.50	Arlo	Comes with bridge	X	X				Screw wall mount into wall.	2 Cameras. Battery powered.
4	Arlo Baby 1080p HD Monitoring Camera by NETGEAR	Camera	\$ 150.00	\$ 166.63	Arlo/Netgear	N/A			X	X		Plug into outlet.	Baby monitor.
5	Logitech Circle 2 Indoor/Outdoor Weatherproof Wired	Camera	\$ 150.00	\$ 166.63	Logitech	N/A			X	X		Plug into outlet.	Indoor/Outdoor. Can buy \$40 window mount.
6	Philips Hue White and Color Ambience 4-Pack Starter Kit	Lights	\$ 200.00	\$ 220.50	Phillips	Comes with bridge	X	X				Screw in bulb. Bridge connectivity and bridge to device connection.	Color and white variant blubs.
7	Philips Hue White Starter Kit 9.5W A19 E26	Lights	\$ 100.00	\$ 112.75	Phillips	Comes with bridge	X	X				Screw in bulb. Bridge connectivity and bridge to device connection.	White Variance only bulbs.
8	Nanoleaf Canvas Smarter Light Kit	Lights	\$ 200.00	\$ 220.50	Nanoleaf	N/A			X	X		Plug into outlet. Comand strips included.	
9	Philips Hue Outdoor Lightstrip (2 m)	Lights	\$ 90.00	\$ 101.98	Phillips	NEED NOT INCLUDED	X		X	X		Plug into outlet.	Color and white variant. Bridge sold separately (item
10	Eve Movie Night	Lights	\$ 100.00	\$ 112.75	Eve	Comes with bridge			X	X		Plug into outlet. Bridge connectivity and bridge to device connection.	
11	Philips Hue Play White and Color Ambience Light Bar (2-pack)	Lights	\$ 130.00	\$ 145.08	Phillips	NEED NOT INCLUDED	X		X	X		Plug into outlet.	Color and white variant. Bridge sold separately (item #2).
12	Wemo Smart Light Switch (3-Light Swi Way)		\$ 50.00	\$ 58.88	Wemo	N/A			X	X		Plug into outlet.	Made to replace existing light switch.
13	Philips Hue Lightstrip Plus	Lights	\$ 80.00	\$ 91.20	Phillips	NEED NOT INCLUDED	X		X	X		Plug into outlet.	Color and white variant. Bridge sold separately (item
14	LIFX Mini White (2700K Warm) A19 E26 Wi-Fi Smart LED Light Bulb	Lights	\$ 20.00	\$ 26.55	LIFX	N/A. Needs Wifi			X	X		Screw in bulb.	
15	LIFX Mini Color and White A19 E26 Wi-Fi Smart LED Light Bulb	Lights	\$ 45.00	\$ 53.49	LIFX	N/A. Needs Wifi			X	X		Screw in bulb.	
16	LIFX Mini Day & Dusk (White to Amber Spectrum) A19 E26 Wi-Fi Smart LED	Lights	\$ 30.00	\$ 37.33	LIFX	N/A. Needs Wifi			X	X		Screw in bulb.	
17	LIFX + Infrared Multicolor A19 E26 Dimmable Wi-Fi Smart LED Light Bulb	Lights	\$ 80.00	\$ 91.20	LIFX	N/A. Needs Wifi			X	X		Screw in bulb.	
18	Philips Hue Lightstrip Plus Extension Set (3 ft./1 m)	Lights	\$ 25.00	\$ 31.94	Phillips	NEED NOT INCLUDED	X		X	X		Plug into outlet.	Bridge sold separately (item #2).
19	LIFX Multicolor A19 E26 Dimmable Wi-Fi Smart LED Light Bulb	Lights	\$ 60.00	\$ 69.65	LIFX	N/A. Needs Wifi			X			Screw in bulb.	
20	August Smart Lock Pro + Connect	Locks	\$ 230.00	\$ 252.83	August	Comes with bridge	X		X			Bridge connectivity.	Battery powered.
21	Yale Assure Lock SL with iM1	Locks	\$ 200.00	\$ 220.50	Yale	N/A							Battery powered.
22	Wemo Mini Smart Plug	Outlets	\$ 30.00	\$ 37.33	Wemo	N/A			X	X			Wifi needed.
23	iDevices Socket	Outlets	\$ 40.00	\$ 48.10	iDevice	N/A			X			Screw in.	
24	iHome - control ISP6 SmartPlug	Outlets	\$ 40.00	\$ 48.10	iHome	N/A			X	X		Plug into outlet.	Wifi needed.
25	iHome - control ISP8 SmartPlug with Remote Control	Outlets	\$ 50.00	\$ 58.88	iHome	N/A			X	X		Plug into outlet.	Comes with remote.
26	Eve Energy Strip - Connected Triple Outlet	Outlets	\$ 100.00	\$ 112.75	Eve	N/A			X	X		Plug into outlet.	Wifi needed in order for device to work.
27	Eve Energy	Outlets	\$ 50.00	\$ 58.88	Eve	N/A				X		Plug into outlet.	Bluetooth conection.
28	Nanoleaf Remote	Remote	\$ 50.00	\$ 58.88	Nanoleaf	N/A. Needs Wifi and Bluetooth			X			Battery powered.	Remote used for other smart devices. Paired well with item #8.
29	Eve Button - Connected Home Remote	Remote	\$ 50.00	\$ 58.88	Eve	Requires Apple TV w/ OS11 or iPad as hub	X					Hub connectivity. Battery powered.	Needs Apple TV or Homepod as a home hub.
30	Philips Hue Outdoor Motion Sensor	Sensor	\$ 50.00	\$ 58.88	Phillips	NEED NOT INCLUDED	X		X			Battery powered.	Bridge sold separately.
31	FIBARO Flood Sensor (HomeKit Enabled)	Sensor	\$ 50.00	\$ 58.88	Fibaro	N/A						Battery powered.	Bluetooth connection.
32	iHome control iSS50 5-in-1 Smart Monitor	Sensor	\$ 50.00	\$ 58.88	iHome	N/A			X	X		Plug into outlet.	Wifi needed in order for device to work.
33	Eve Aqua Smart Water Controller	Sensor	\$ 100.00	\$ 112.75	Eve	N/A						Battery powered. Screwed into hose.	Bluetooth connection.
34	Eve Degree Connected Weather Station	Sensor	\$ 80.00	\$ 91.20	Eve	N/A							Bluetooth connection.
35	Eve Room Indoor Air Quality Monitor	Sensor	\$ 100.00	\$ 112.75	Eve	N/A							Charge batteries every 6 weeks. Bluetooth connection.
36	Eve Door & Window Wireless Contact Sensor	Sensor	\$ 40.00	\$ 48.10	Eve	N/A						Battery powered. Comand strips included.	Bluetooth connection.
37	Eve Motion Wireless Motion Sensor	Sensor	\$ 50.00	\$ 58.88	Eve	N/A						Battery powered.	Bluetooth connection.
38	Eve Light Switch	Switch	\$ 50.00	\$ 58.88	Eve	N/A					X	Install into existing light switch.	Bluetooth connection.
39	Lutron Caséta Wireless Smart Lighting Dimmer Switch Starter Kit	Switch	\$ 100.00	\$ 112.75	Lutron	Comes with bridge	X		X		X	Bridge connectivity.	Whole package for lighting on dimmers and timer.
40	Lutron Caséta Wireless In-Wall Light Dimmer with Remote	Switch	\$ 65.00	\$ 75.04	Lutron	NEED NOT INCLUDED	X				X		Bridge sold separately.
41	FIBARO Button Multicontroller	Switch	\$ 50.00	\$ 58.88	Fibaro	N/A						Battery powered.	Bluetooth connection.
42	iDevices Thermostat	Thermos	\$ 100.00	\$ 112.75	iDevice	N/A			X		X		Bluetooth connection.
43	ecobee3 lite Smart Thermostat	Thermos	\$ 170.00	\$ 188.18	ecobee3	N/A			X		X		