Connected Home Use-Case Audit

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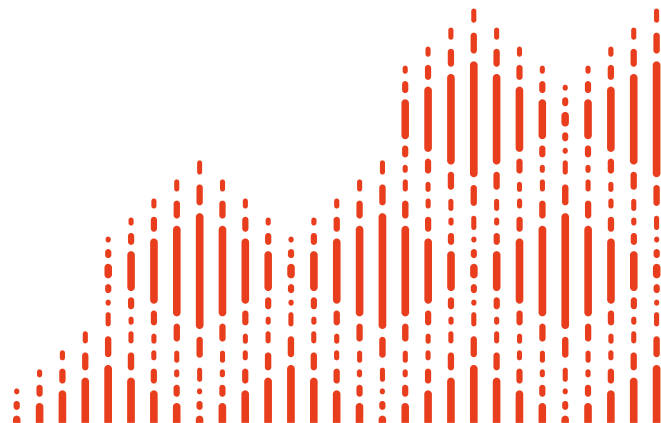
Connected Home Use-Case Audit
A CABA White Paper

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The Continental Automated Buildings Association (CABA) is an international not-for-profit industry association, founded in 1988, and dedicated to the advancement of intelligent home and intelligent building technologies. The organization is supported by an international membership of over 385 organizations involved in the design, manufacture, installation and retailing of products relating to "Internet of Things, M2M, home automation and intelligent buildings". Public organizations, including utilities and government are also members. CABA's mandate includes providing its members with networking and market research opportunities. CABA also encourages the development of industry standards and protocols, and leads cross-industry initiatives. CABA's collaborative research scope evolved and expanded into the CABA Research Program, which is directed by the CABA Board of Directors. The CABA Research Program's scope includes White Papers and multi-client market research in both the Intelligent Buildings and Connected Home sectors. www.caba.org

ABOUT CABA'S CONNECTED HOME COUNCIL (CHC)
Established in 2004, the CABA Connected Home Council initiates and reviews projects that relate to connected home and multiple dwelling unit technologies and applications. Connected homes intelligently access wide area network services such as television and radio programming, data and voice communications, life safety and energy management/control information and distribute them throughout the home for convenient use by consumers. The Council also examines industry opportunities that can accelerate the adoption of new technologies, consumer electronics and broadband services within the burgeoning connected home market. www.caba.org/chc

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TABLE OF CONTENTS

1. THE OPPORTUNITY: SMART & CONNECTED HOMES

Internet of Everything (IoE)

- ✓ $14.4 trillion (net profit) over the next decade
- ✓ Growth driven largely by connectivity

Internet of Things (IoT)

- ✓ 26 billion: The number of global connected devices by 2020

A connected world

- ✓ $732 billion: Global market opportunity for connected homes, work and cities by 2020
- ✓ $111 billion: Value associated just with connected homes
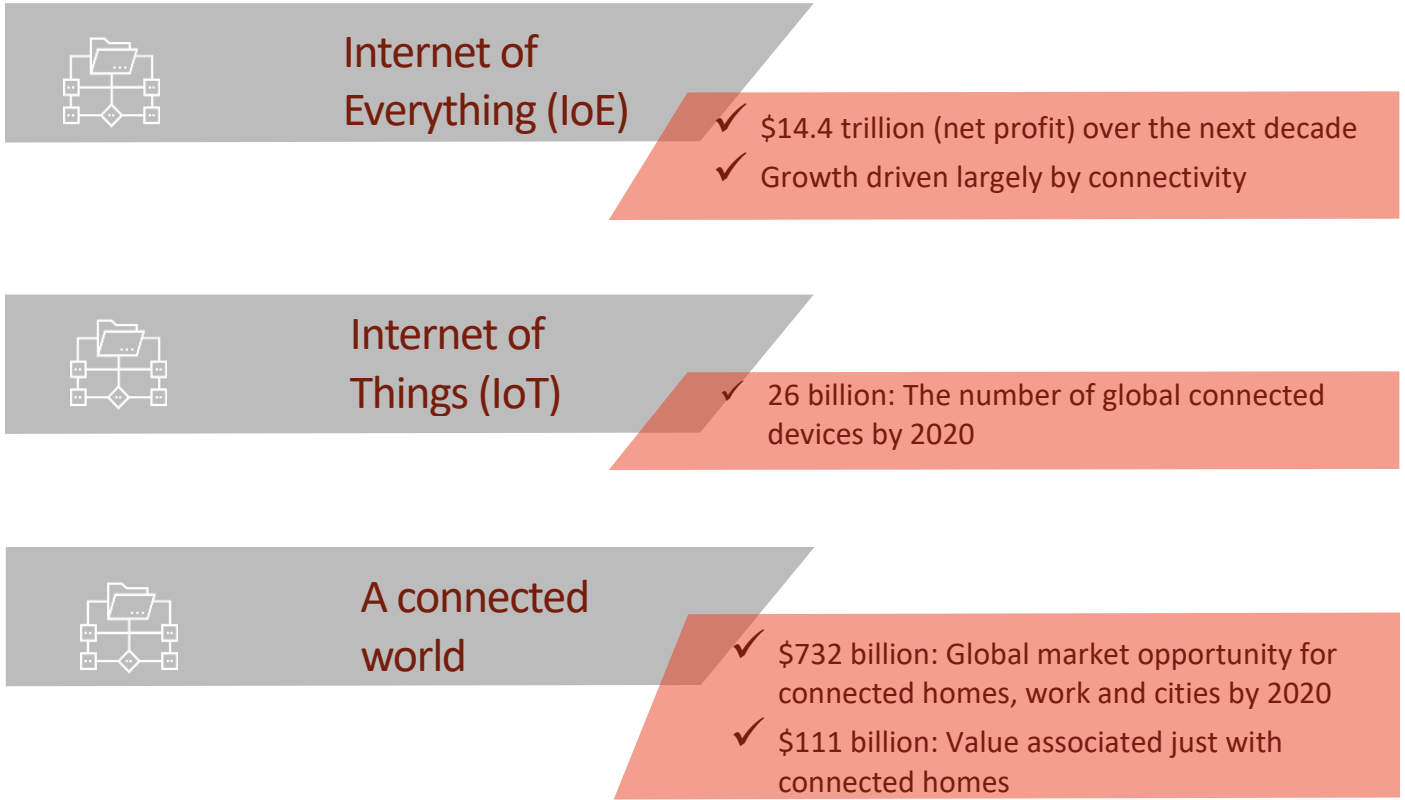
Figure 1   Smart Home Revenue CAGR ('15-'21), by Segment

Worldwide   **U.S.**

65%   45%   25%   5%   15%   35%   55%

Segment	Worldwide	U.S.
Total Home Automation	35.5%	22.2%
Total Security	43.1%	35.4%
Total Home Entertainment	39.0%	28.0%
Total Ambient Asstd. Living	60.5%	46.5%
Total Energy Management	34.7%	22.8%

Total Smart Home system/ device revenue in the U.S. is expected to grow from a $14.6 billion market in 2017, to a $32 billion market in 2021, a 28%
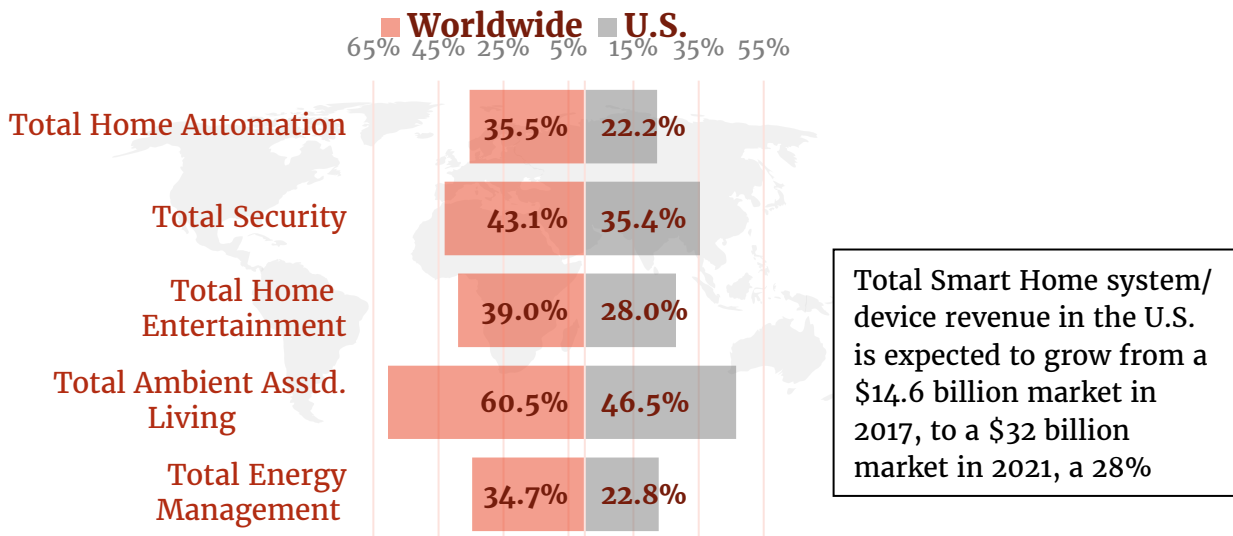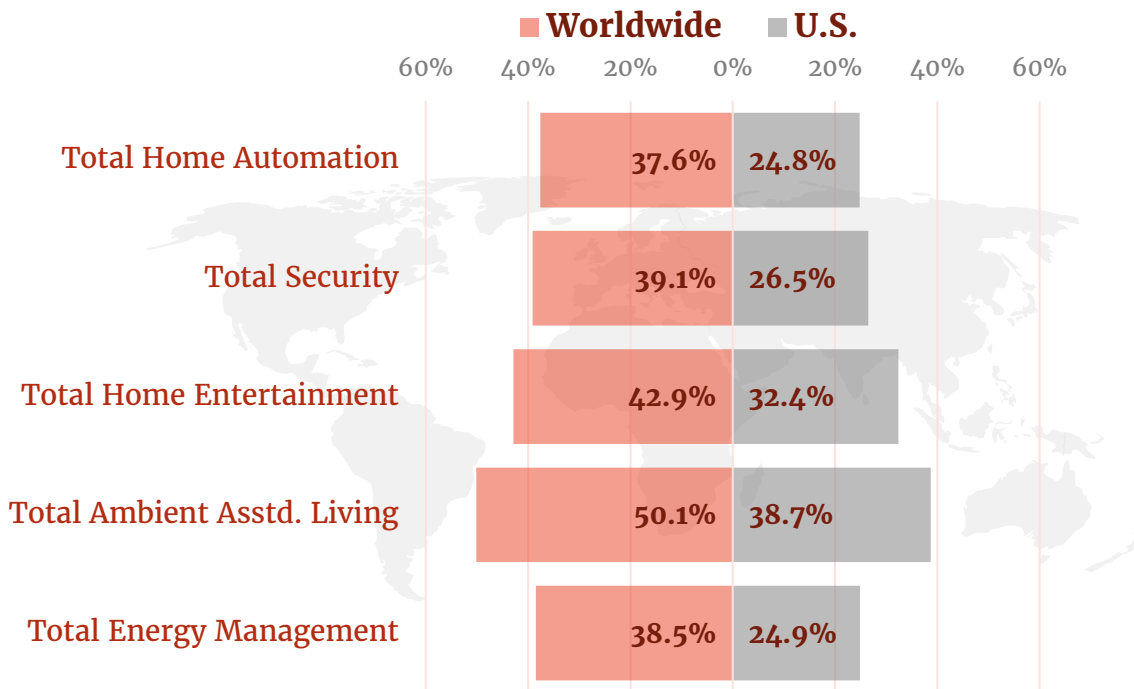
Source: Statista Digital Market Outlook 2016

There are many statistics documenting the growth in sales associated with smart devices and the connected home. On the supply side, manufacturers and service providers in some categories are well along the development of third generation devices (e.g., Nest, August Smart Lock). On the demand side, a confluence of solutions has improved the user experience (e.g., apps, sensors, actuators, software platforms, control consoles, gateways, and hubs).

Forecasts on *market penetration* are equally as bullish:

Figure 2 Smart Home Segment Penetration Rate CAGR ('15-'21)

	Worldwide	U.S.
Total Home Automation	37.6%	24.8%
Total Security	39.1%	26.5%
Total Home Entertainment	42.9%	32.4%
Total Ambient Asstd. Living	50.1%	38.7%
Total Energy Management	38.5%	24.9%

Source: Statista Digital Market Outlook 2016

With ample evidence that the world is rapidly embracing connected technology, what are the applications driving this impressive growth, and how does the U.S. market compare to the rest of the world? According to Statista, home automation and security represent the two largest segments (by revenue volume) within what they refer to as the global smart home market. As a percent of revenue, the U.S. market averages 58 percent of the global market; one U.S. segment, security (67%), over indexes the global market, while energy management lags in the U.S. (46% of global segment revenues).

Figure 3 Smart Home Segment Opportunity Map
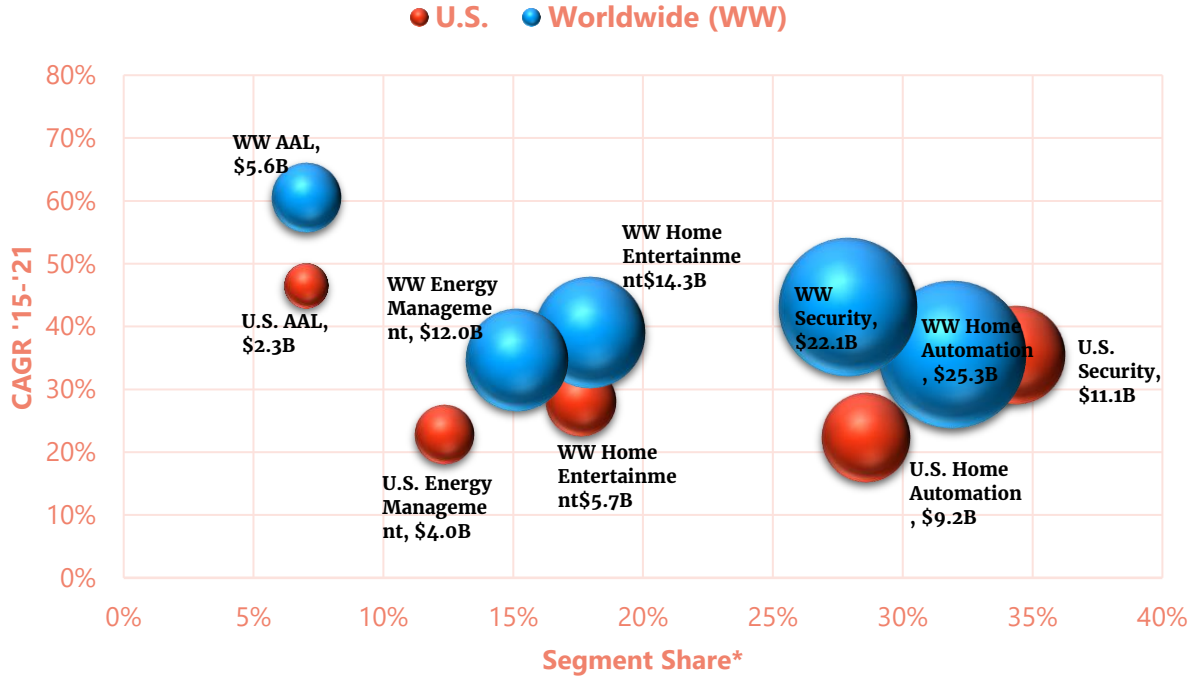
the globe by only 7% (36% CAGR vs. 43%)

* Segment Share and revenue numbers based on 2021 projections
Source: Statista Digital Market Outlook 2016

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Of particular interest is the varying difference in forecast growth for *standalone* technology vs. *integrated* technology:
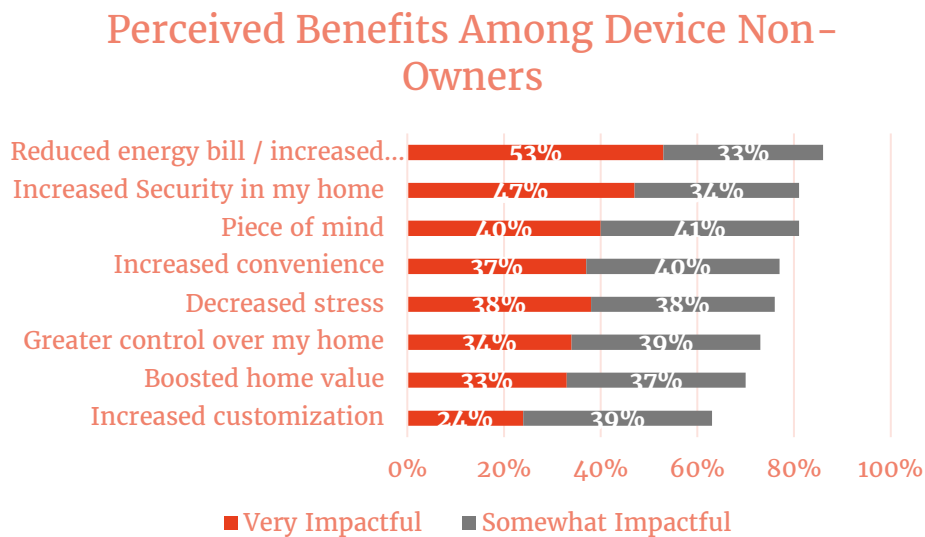
- Integrated home automation technology in the U.S. is expected to grow at nearly the same compound annual growth rate (CAGR) as its standalone sister technology (2%), while integrated security technology CAGR is only 8 percent more than standalone

- On the other end of the spectrum, much of the growth in ambient assisted living (AAL) (27%) and home entertainment (42%) in the U.S. is expected to come from integrated technology, much more than standalone devices

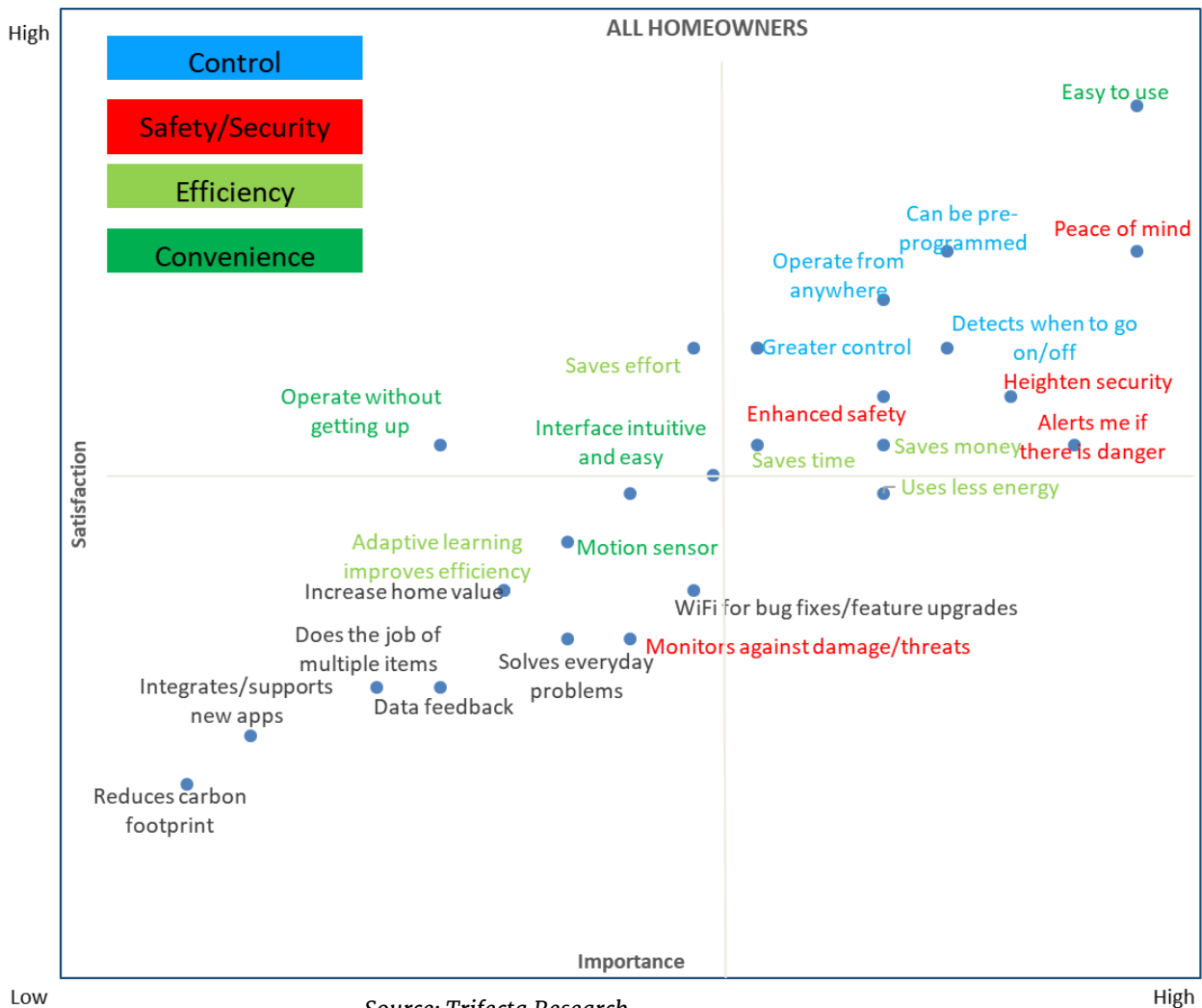## 2. CONNECTED HOME DRIVERS: PURCHASE VS. SATISFACTION

Studies among U.S. consumers are remarkably consistent in identifying the top motivators of purchase. In a 2017 study of 1,000 respondents (non-owners of smart/connected devices), PwC identified four top drivers: 1) Savings; 2) Safety; 3) Convenience; and 4) Control. (See Figure 4, below.)

Figure 4 Perceived Benefits Among Device Non-Owners

Perceived Benefits Among Device Non-Owners

Benefit	Very Impactful	Somewhat Impactful
Reduced energy bill / increased…	53%	33%
Increased Security in my home	47%	37%
Piece of mind	40%	41%
Increased convenience	37%	40%
Decreased stress	38%	38%
Greater control over my home	34%	39%
Boosted home value	33%	37%
Increased customization	24%	39%

■ Very Impactful   ■ Somewhat Impactful

Source: Statista Digital Market Outlook 2016

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Figure 5 Device Satisfaction vs. Importance

Source: Trifecta Research

In a 2016 survey of 2008 U.S. homeowners and smart/connected device owners, Trifecta Research identified four very similar key **drivers of purchase** ("Importance" in Figure 5): 1) Control; 2) Safety; 3) Efficiency; and 4) Convenience.

However, when measuring the degree to which those drivers of purchase are also **drivers of satisfaction post installation** ("Satisfaction" in Figure 5), a very interesting picture emerges. Manufacturers have successfully bridged expectation and experience on two key motivators: *ease of use* and *peace of mind.* And, in general, motivators of control have delivered on their promises. Nevertheless, there is room for improvement in meeting consumers' expectations in several important security motivators and efficiency motivators.

## 3. THE CHALLENGE: VALUE PROPOSITION

Neither complexity nor lack of understanding poses a significant barrier to ownership of smart and connected devices. Regardless of generation, most homeowners appear comfortable with the technology and with its installation. Data security and privacy concerns do reflect real concerns among some current device owners and this appears to be growing (37 percent of Trifecta Research's 2016 survey respondents expressed such concerns, up 5 percent year-to-year). The primary barriers to device ownership, however, continue to relate more to *value* than to resistance to technology. And, it is not just price (purchase, installation, and maintenance); among today's devices, there is a ***lack of compelling need*** and, as a result, an inequitable value proposition.
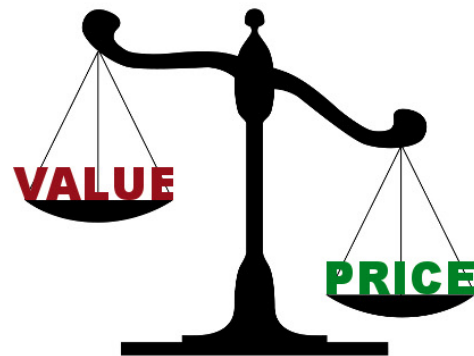
More than four in 10 survey respondents mention expense as a barrier to purchase:

- Purchase price
- Installation
- Maintenance
- Not worth the money

Figure 6 Barriers to Purchase

Barriers to Purchae
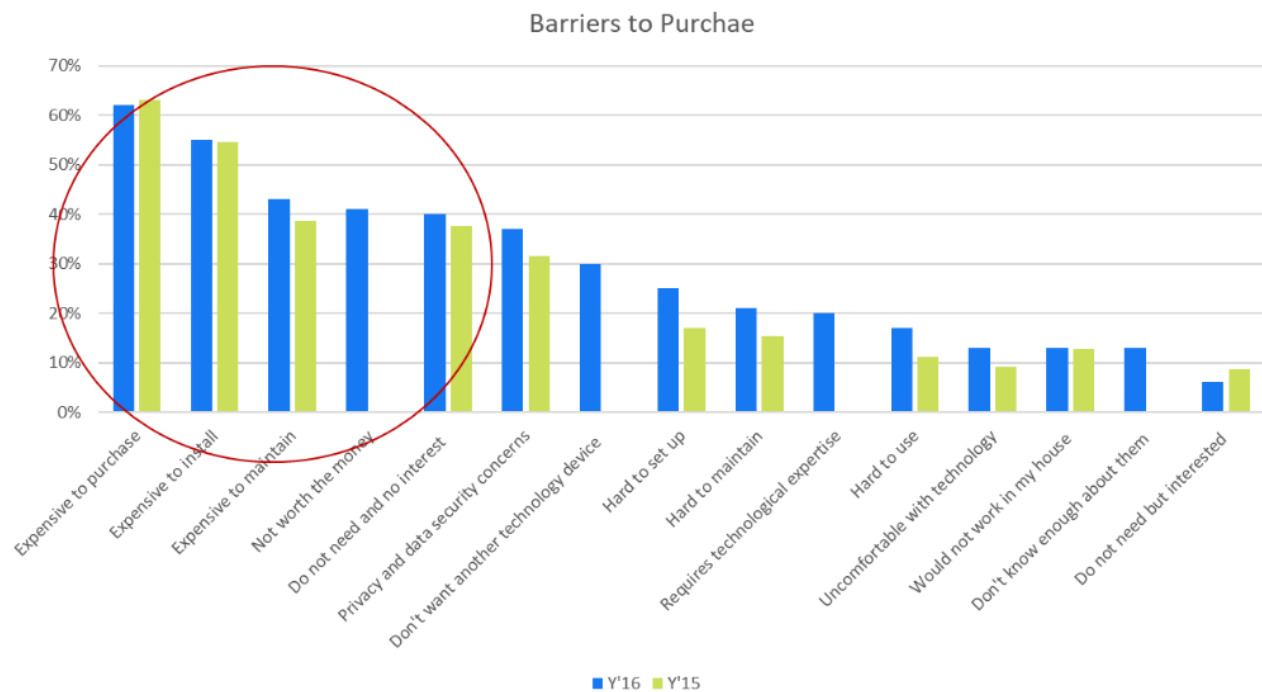
Source: Trifecta Research

4.   USE CASES AS VEHICLES FOR PRESSURE TESTING THE CURRENT ENVIRONMENT

CABA has undertaken an investigation to see how these dynamics are playing out among connected home devices and their ownership in the market today via an exploration of connected home use cases. In preparation for identifying and profiling three use cases of interest for this White Paper, Trifecta Research used multiple parameters of evaluation, including:

- Macro Trends
- Size of Opportunity
- Cost/Value for Money/ROI
- Degree of Regulatory Activity
- Degree of Category Activity
- Indication of Staying Power
- Representative Products & Services
- Household Penetration Rates

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Using those to drive our research strategy, a list of 10 potential use cases, was developed and put to a vote by members of Working Group of this White Paper. The following list are those initial 10, and the three finalists selected for profiling (marked by an *):

- Aging-in-Place
- Pet Monitoring
- Child Monitoring
- Repositioning the Home as the Place of Serenity from a Hostile Outside World via Connected Technologies*
- "Lifehacking" to Maximize Simple Pleasures in the Home
- Minimizing the Effect of the Home on the Environment
- Repositioning the Home as the Center for Entertainment
- Shifting healthcare from a pull model to a push model*
- Interoperable Centralization of Home Functions Across Applications*
- Empowering Mobility or Accessibility Challenged Home Residents

Each of the three scenarios are profiled, below.

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5. USE CASE #1: REPOSITIONING THE HOME AS THE PLACE OF SERENITY FROM A HOSTILE OUTSIDE WORLD VIA CONNECTED TECHNOLOGIES

5.2 Definition

With the perception of an increasingly chaotic and sometimes hostile world, connected technologies provide ***real security*** and ***enhanced peace of mind*** for homeowners who are feeling under siege.

5.3 Context

A quick look at the numbers reveals a very strong reason to believe:

- The U.S. market for smart home security devices/systems is already several years ahead of other developed regions and is expected to be $4.5 billion in 2017, 67 percent of the global market, with a 35 percent CAGR through 2021 (Statista).
- With 12.5 million households, Security smart home household penetration in the U.S. is 13 percent (Statista 2017), forecast to grow to 30 percent by 2021.
- The U.S. market has the highest transformation rate from standalone Security devices to integrated systems (Statista).
- U.S. home security alarm systems, the more established of connected home solutions, have nearly double the adoption rates (18%) of newer connected home solutions such as home monitoring (11%), home automation or energy management (9%), and health and wellness management (11%)[1].

That said, there are two critical macro drivers that must be considered when discussing this scenario:

1. Awareness and interest among U.S. consumers is high, driven in large part because there is already a large installed base of security devices and systems in many American homes:

    - 63 percent indicate they would be interested in network-connected cameras as part of a smart home-enabled security service
    - 62 percent are interested in using their smart phone to arm, monitor, and receive alerts about a security system[2]

2. Smart and connected technologies present an intuitive bridge to consumers, providing piece of mind by relieving stress, and relieving stress by providing piece of mind.

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Both of these drivers explain why American consumers have taken to security devices quickly as IoT emerges as a growing phenomenon. In addition – and not to be underappreciated – per Figure 5, manufacturers have done an impressive job of delivering on their promises, satisfying the most important among consumers' needs for safety and security: piece of mind; heightened security; alerting when danger is present; and enhanced safety.

Moreover, there are drivers unrelated to smart and connected that have and continue to conspire to create a consumer mindset well suited for security-based connected technologies, including:

- Rising crime (perceived or actual)
- Rise of e-commerce (packages routinely left on porch and, increasingly, stolen)
- More mobile lifestyles and need to monitor remotely
- Emergence of the smartphone as the "command center" of our lives
- Increased frequency of data breaches and hacking
- Digitization of Neighborhood Watch (e.g., Next Door app)
- And, increasingly, traditional demographic milestones and life events are prompting interest in connected security devices:
  - o Moving into new house (Millennials)
  - o Having a new baby (Millennials)
  - o Even a burglary in the neighborhood (Baby Boomers)

All of these influencers are coinciding, forcing the current residential security model in the U.S. to undergo major change[3]:

 "The traditional, one-way security systems are giving way to innovative solutions that meld remote monitoring and control as well as automation capabilities with notifications of security breaches and events homeowners want to be alerted about. These innovations are creating new options for consumers and driving changes in the way monitoring services and first responders react to emergencies."

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5.4   Pulling It All Together

This use case consists of two components: 1) a use profile; and 2) a "Day in the life of...."

5.4.1   User Profile

Sources: Trifecta Research,
Statistics....

5.4.2 Day in the Life of....

Before she gets out of bed, Liz disables her home's alarm system from her smartphone phone so that her son doesn't accidentally trigger the security alarm when he heads out for a morning run.

Liz's dog, Fido, can head out to the yard without setting off any alarms, too. Programmed into her smartphone alarm snooze feature, the pet door is automatically unlocked so Fido can take himself outside for a morning sniff. No concerns about security here, though, because Fido wears an RFID-enabled collar that works in conjunction with the SureFlap pet door to ensure that Fido is the only dog who can come and go from Elizabeth's home.

Liz's daughter, Sara, leaves for high school early in the morning. Despite the perception of rising crime in the cable news cycle, Liz is not worried for Sara's safety. Dangling off Sara's backpack is Bluetooth-enabled *Tile*, which alerts Liz to her daughter's location if she doesn't come home when expected.

While Liz is at work, her *Ring* video doorbell alerts her via a smartphone app with a video image of a visitor at her door: UPS has left a package on the porch. No problem! Liz doesn't worry that someone might steal her package from the front steps – The Ring camera is motion-activated, so if anyone approaches the front door, Liz is notified immediately and can communicate in real-time with anyone standing near the door.

Fido needs some exercise while Liz is at work, so Liz relies on a dog-walking service. In the past, she was always uneasy handing over the keys to her house, as service companies are notorious for high employee attrition. But with her August smart lock, Liz can grant temporary access to the dogwalker and can revoke it at any time. Not only does she enjoy peace of mind knowing that she'll never need her locks changed – She also receives an alert from her smart lock letting her know that Fido's been picked up for a long hike, so there's no need to worry whether the dog walker came or not.

As Liz sips an afternoon coffee during a meeting, she receives a notification from her home's smart lock that her daughter has returned safely from school. And if it turns out to be a long day at work, Liz can easily turn on the exterior lights at her house while she finishes up at the office so that it's well-lit upon her arrival home.

When Liz and her family go away on vacation, they can monitor their home security remotely via a smartphone or tablet, enabling or disabling alarms, lights, locks or any other connected feature as needed. Is the neighbor coming over to water the plants while Liz relaxes on the beach in Mexico? No

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problem: Liz can quickly and easily enable and disable her home's alarm system and grant temporary access to her neighbor, all via her smartphone. Liz's phone will even alert her if there is an unexpected water leak while she's away.

After settling into bed after a long day, sometimes Liz can't shake the feeling that she's left the door unlocked, or has forgotten to turn off lights. No problem: All can be checked on – and switched on or off -- from the comfort of bed.

Liz has peace of mind and is the master of her home, wherever she is.

6.   USE CASE #2: SHIFTING HEALTHCARE FROM A PULL MODEL TO A PUSH MODEL

6.2   Definition
Connected technologies are enabling a holistic democratization of healthcare whereby the home is repositioned as the doctor's office and patients are given the tools to self-monitor and take a more active role in the maintenance and management of their own health.

6.3   Context
Analysts are very bullish on the market for digital medical services. This eHealth market is considerably diffuse, consisting primarily of:

- Apps and wearables
- Smart devices
- Telemedical services

Projected to grow 14.3 percent to $36.2 billion by 2020 globally, telemedicine may promise the greatest impact and has garnered the most attention. The market is growing domestically as well. Among U.S. employers, 70 percent had planned to offer telemedicine services as an employee benefit, and 90 percent of healthcare executives indicated their organizations are in some stage of development of telemedicine program development[4].

Lawmakers are responding[5]:

- In 2015, 42 states proposed a total of more than 200 pieces of telemedicine legislation;
- 29 states and D.C. had laws on the books mandating that health plans cover telemedicine services.

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Independent analysis of statistics from the American Medical Association and Wellness Council of America suggests that as much as 75 percent of all physician, urgent care and emergency room visits "could be handled safely and effectively over the phone or video[6]." And, a majority of primary care physicians (57%) and their American patients (66%) are open to holding appointments via video. Indeed, 20 percent of American consumers are willing to *switch* primary care providers in order to have access to this service[7].

A major contributor to the cost of traditional healthcare in the U.S. is the result of delays in treatment, often driven by consumers. In fact, 67 percent of Americans say they have delayed seeking treatment for a health problem. Much of the value of eHealth services is the promise that the convenience and preventative benefits of technology will alleviate the primary causes of such delays, including:

- It costs too much (23%)
- It takes too long to get in to see a doctor or nurse (23%)
- Consumers thought the problem would go away on its own (36%)
- Consumers are too busy (13%)

Of particular interest to CABA members are the following three market segments:

- Fitness Apps/wearables
- Ambient Assisted Living devices
- Personal technology for the treatment of chronic diseases

6.3.1 Fitness Apps & Wearables
Below are some topline stats about the U.S. "eHealth" market[8]:

- So-called "eHealth" is currently a $3.1 billion industry in the United States, and is expected to grow to $5 billion by 2020 (Statista).
- The largest among the U.S. eHealth market segments, personal fitness includes both apps and wearables.
- With a 2016 market value of $1.2 billion, and a projected CAGR of 15 percent through 2021, fitness wearables own the largest revenue share (>60%).

In addition to measuring and analyzing one's physical activity and body functions, technology is increasingly providing ways to measure the *impact* of health and other "meta health" benefits:

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- Sleep trackers that graph the quality of sleep over the course of the night
- Wearable devices that track breathing to help decrease stress and anxiety
- Wearable baby monitors that allow parents to know their child is healthy and safe
- Apps designed to help users track fertility cycles

The integration of wearable devices into the smart home has only been hinted at with the Home app on the Apple Watch. The wearable market to date has been mostly focused on fitness, based on the analysis of consumer reviews below.

Figure 7 Product Attributes for Wearables (n=83,812)
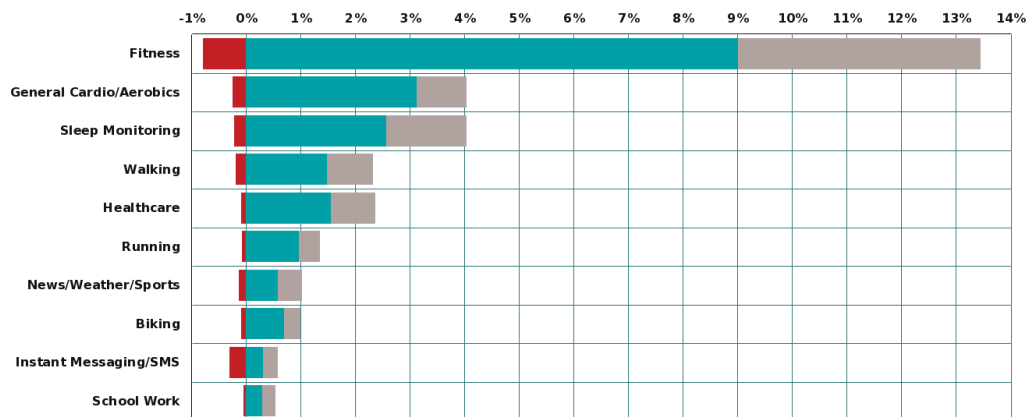
For period 4/1/17 thru 4/17/18. Sources included: Reviews   © Argus Insights

This analysis of over 83,000 wearable consumer reviews indicates that while fitness is the key consideration for consumers, sleep monitoring, communication (SMS, IM) and even school work show up in the most mentioned usage scenarios. Smart home and eldercare are applications barely mentioned at this stage.

More of integrations of personal emergency response devices are beginning to be observed in smart home environments. While a smaller market than wearables, the PERS market tends to focus on the elderly or children, which are perfect targets for the integration of growing intelligence in the home.

Figure 8 Product Attributes for Personal Emergency Response (n=2,777)
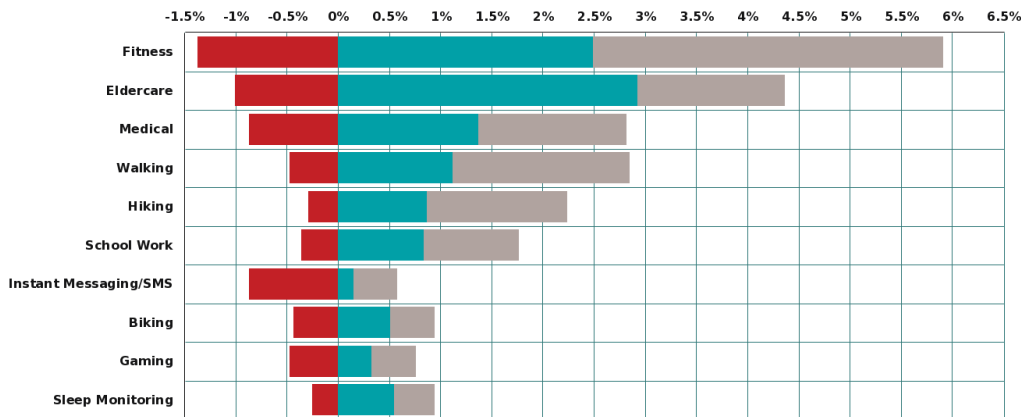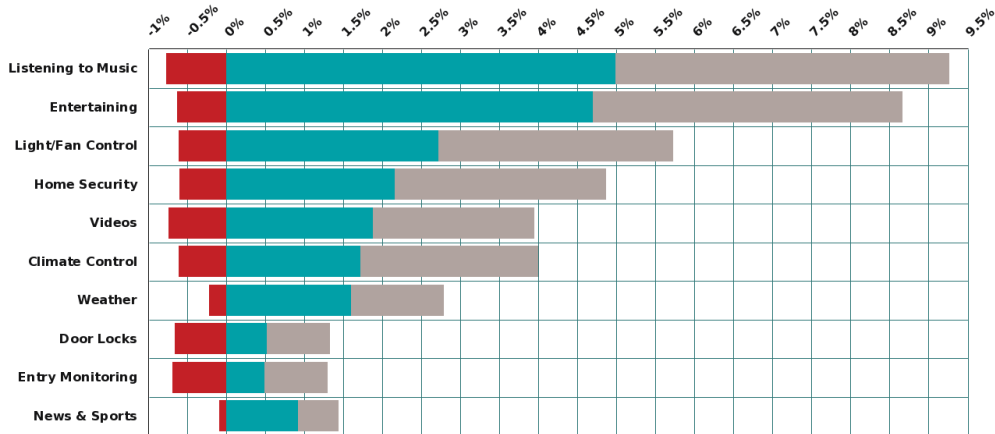

For period 3/1/15 thru 4/17/18. Sources included: Reviews   © Argus Insights

You can see that supporting aging-in-place is a key application area of PERS, but one that has not yet found its way to be a key factor in how consumers leverage their smart home today. This can be obsered in this analysis of the most mentioned usage scenarios by consumers in device reviews over the last year.

Figure 9 Product Attributes for Smart Home Devices (n=310,432)

For period 3/26/17 thru 4/17/18. Sources included: Reviews   © Argus Insights

While the data is dominated by the voice assistants being used for entertainment, consumers share many other uses for their smart home, before considering uses tied to wearable devices, including PERS. Entry monitoring and smart door locks are the most logical connection points for

PERS and other wearables, especially when working to serve occupants of all ages within a home.

6.3.2 Ambient Assisted Living

As Baby Boomers retire, more and more are intending to stay in their homes for as long as possible, "aging-in-place", rather than choosing to move to senior communities, assisted living facilities, or nursing homes. A 2014 study showed that 87 percent of Americans age 65 and older intend to stay in their homes and communities as long as possible[9].

The concern with aging-in-place is that health needs change as people age, and a home that had been safe for a younger adult can be dangerous for an older one. The children of older Americans are very concerned about their parents who increasingly have chronic health conditions which may impair them physically or mentally. Fortunately, these adult children of senior citizens are technologically savvy, and the eHealth market is expanding, offering devices made to help older people age safely, and younger people have confidence in their parents' safety.

Topline statistics[10]:

- The AAL market had revenues of US$366 million in the U.S. in 2016 and is the fastest growing segment within the U.S. eHealth market, with a forecasted CAGR of 44 percent through 2021
- The average revenue per user (ARPU) in the AAL market was US$256 in 2016 and will reach US$319 in 2021
- There are promising opportunities for robots and connected home integration with wearables

Numerous devices exist to support seniors in their ambient assisted living needs, including:

- Digitally connected appliances to support people with special needs
- Emergency call buttons
- Pressure mats
- Fall sensors
- Smart scales
- Emergency services with connection to a broader smart home

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With 10,000 Baby Boomers turning 65 every day, the opportunity for integrating products and services for networked systems of emergency alarms, accident detection, and activity monitoring is significant when designed to support independent living for elderly people.
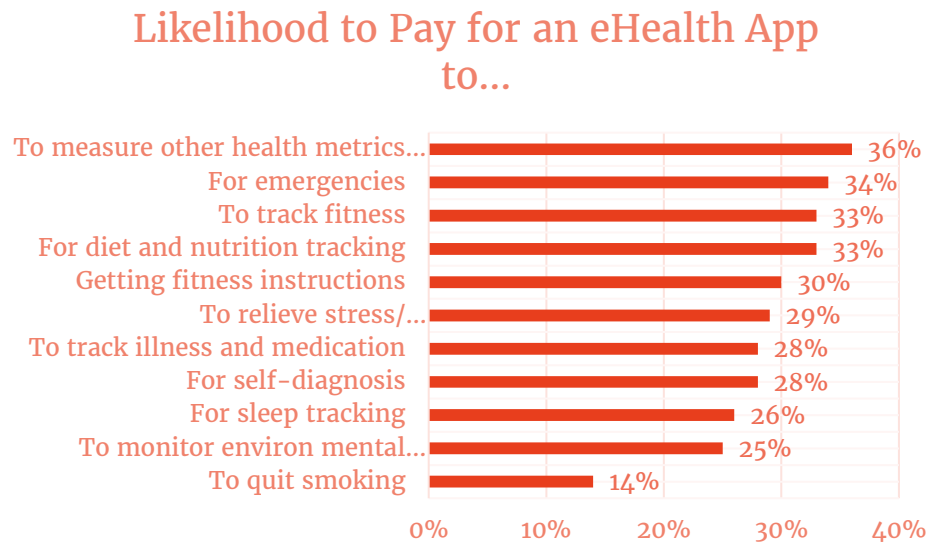
6.3.2 Smart Treatment Devices

The market for eHealth products and services (including apps, telemedicine, and smart devices) for the treatment of chronic illness (primarily diabetes, hypertension, and heart failure), is a $1.264 billion market. Of this, 75 percent is for the treatment of heart failure, and 58 percent of smart devices, that are equipped with dedicated interfaces or SIM cards that transmit measurement data across a wireless connection (e.g., via mobile networks, Wi-Fi, Bluetooth, M2M technologies, NFC, BLE)[11]. Examples of such devices include the following:

- Connected glucose meters
- Connected insulin injection devices
- Connected blood pressure monitors
- Connected weighing scales and Tele-ECG-cards (often combined with a telemedical monitoring service for heart patients)

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6.4 Obstacles

eHealth does not appear to suffer from the upside-down value proposition that many other smart/connected devices do. In fact, according to Statista, consumers are 'very likely' or 'somewhat likely' to pay for most apps and eHealth devices:
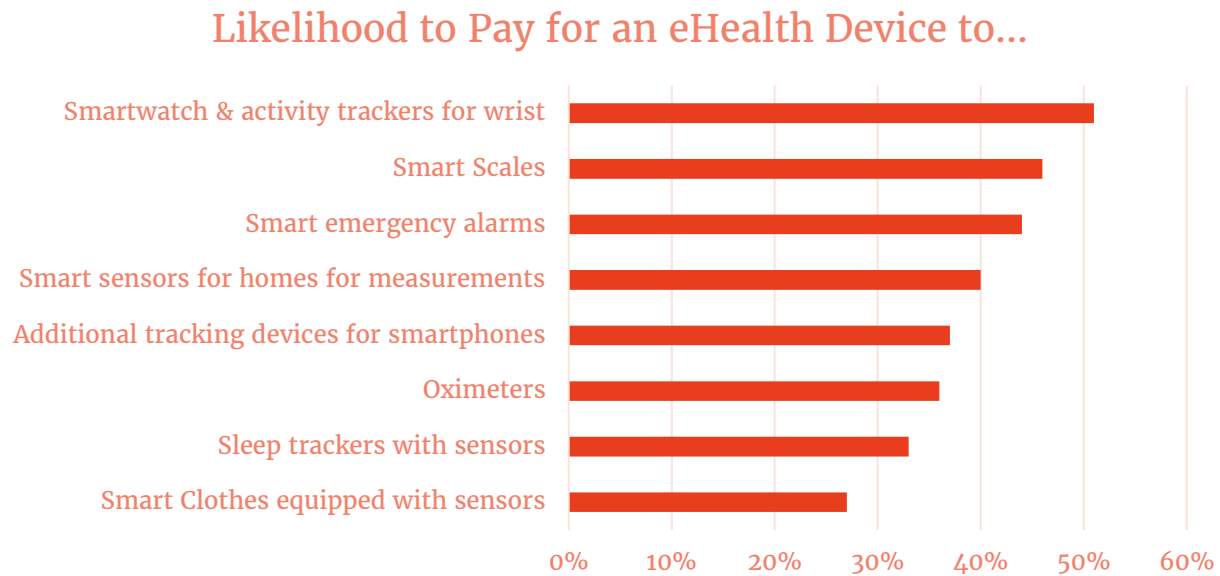
Figure 10 Value Proposition for Apps

Likelihood to Pay for an eHealth App to...

Category	Percentage
To measure other health metrics...	36%
For emergencies	34%
To track fitness	33%
For diet and nutrition tracking	33%
Getting fitness instructions	30%
To relieve stress/...	29%
To track illness and medication	28%
For self-diagnosis	28%
For sleep tracking	26%
To monitor environ mental...	25%
To quit smoking	14%

"How likely is it that you would pay for any of these apps? Answer: very likely or rather likely"; n=1,043
Source: *Statista Survey Digital Health & Hospitals 2017*

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Figure 11 Value Proposition for Devices

Likelihood to Pay for an eHealth Device to...

"How likely is it that you would pay for any of these devices? Answer: very likely or rather likely"; n=1,043
Source: *Statista Survey Digital Health & Hospitals 2017*

Rather, the current obstacles appear to be awareness and understanding. Fifty-nine percent of Americans have never heard of eHealth, and an additional 32 percent have heard of eHealth but do not know what it is. Despite those abysmal awareness numbers, two in three Americans are "very interested" or "rather interested" in the topic. For manufacturers, the opportunities exist, but success will require a significant investment in advertising and promotion (A&P).

6.5   Pulling It All Together

This use case consists of two components: 1) a use profile; and 2) a "day in the life of…."

6.5.1   User Profile

Source: Trifecta Research

6.5.2   Day in the Life of…

It's 4 am and William wakes up to an alert on his phone. The *Mimo Smart Baby Monitor* his 8-month old daughter Rose is wearing has sensed that she is awake and has a low fever. He shuts off the alert so his wife Hannah doesn't wake up. Her alarm is set for 6:30 am, but her S+ by *ResMed Personal Sleep Solution* will wake her up at the lightest point in her sleep cycle in the half-hour prior.

Rose is awake, crying, and tugging at her right ear. William immediately recognizes this as an ear infection. Whereas in the past, he would have had to either take her to the emergency room for something that is clearly not an emergency or he would settle in for another five hours of her daughter being

in pain until he could call the pediatrician to try to get an appointment for that day. Instead, he takes out his phone and calls his doctor's 24 hour helpline. The doctor asks to do a video call so she can see Rose's symptoms. After a 10 minute consult, the doctor has sent a prescription to William's pharmacy.

William leaves his apartment and walks three blocks to the 24 hour pharmacy to pick up the prescription. While there, he picks up a birthday card for his mother. He hadn't talked to his mother in a couple days and is reminded to call her later. He used to worry about her living alone. She's diabetic and sometimes forgets to take her medication. The two of them talked about his worries, and she got a *Continuous Glucose Monitor* that syncs to her phone. It tells her when she needs to take insulin, and is programmed to text her doctor as well as William if she has a diabetic emergency. He feels a lot better about her health, and they both know that, if the situation changes, there are other devices that they can use to detect if she falls, has a heart problem, or many other issues that people have as they age.

When William gets home, he gives his daughter her first doses of antibiotics and analgesics, and puts a *TimerCap* on both bottles so his wife and he both know when her last doses were and don't accidentally miss one or double up. As he holds Rose hoping she'll feel better and be able to go back to sleep, he taps his *Fitbit*. Already he has 2,000 steps, and he hasn't even had breakfast yet.

To William, the health of his family is the most important thing in his life, and he is glad that there is so much technology available to him to help make sure his loved ones are healthy and happy.

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7.   USE CASE #3: INTEROPERABLE CENTRALIZATION OF HOME FUNCTIONS ACROSS APPLICATIONS

7.2   Definition

With an increasing clutter of smart home devices in households competing for consumers' attention, and the connectivity between device and transaction/fulfillment/delivery increasingly linked to the owner of the ecosystem, the value of a central hub that can help end-users control all other connected devices is growing, and the race to own it is intensifying.

7.3   Context

What began with smart lighting has grown to the massive global home automation and security control market discussed previously and includes: 270,000 devices; more than 6,000 brands; multiple wireless protocols and the need for bridge hardware; evolving connectivity technologies beyond USB and Bluetooth; voice activated apps such as Alexa and Google's Assistant; competitive delivery platforms (Amazon Prime and Google Express); and on and on.

Indeed, as consumers bring more independent connected products into their homes, they are beginning to consider (in greater numbers) how to link them all together and provide a centralized hub to make their connected products function more easily and synchronously. This need is magnified by the growing expectation that the smartphone is the "command center" of all these products.

As what were previously unrelated categories – and even sectors, in some cases – developing and working independently of one another, are now becoming increasingly interconnected, and hubs are expected to keep up: monitoring specific family members in the home using presence sensors; knowing/learning their preferences in experience and usage; and tracking/monitoring their remote location using location services on their smartphones.

In fact, it's increasingly hard to see which is the tail and which is the dog, as manufacturers respond to consumer needs in their product development, and in turn new functionality and the improving cost-effectiveness of smart home hubs attract price-sensitive, new buyers into the market.

One of the significant challenges (and opportunities) facing the smart home market is the proliferation of capabilities coupled with an exponential growth in the apps and devices used to control them. Not only does almost every device manufacturer have their own app for consumers to control their device, but there are also a multitude of other apps, from service providers

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and firms seeking to craft the 'One App To Rule Them All.' The growing number of voice assistants, such as Amazon Alexa, Google Home or Apple Homepod, are adding to the confusion of how consumers interface and control their smart home ecosystems of growing complexity. Nowhere is the negative impact of this lack of centralization than in the consumer perception gap between the smart home devices and the apps that control them.

One can see a gap of almost 50 percent in the Net Promoter Score metric between how consumer view Apps and Devices. The gap narrowed after December 2017 but not for any good reason, as perceptions of both devices and apps continued to erode in the hearts and minds of consumers.

Figure 12   The App Gap
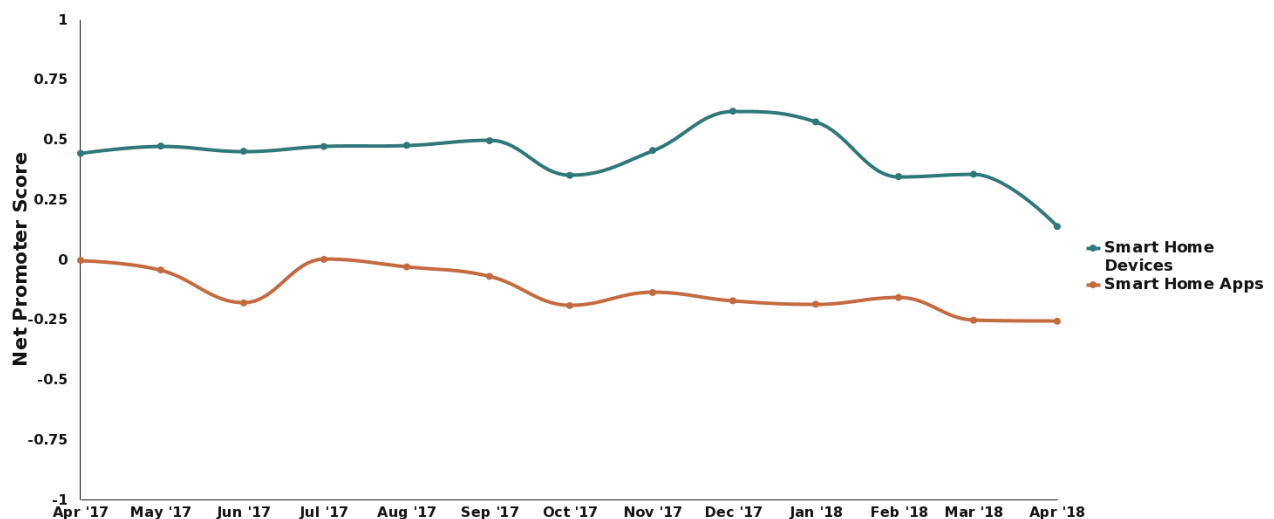
For period 3/26/17 thru 4/17/18, Sources included: Reviews   © Argus Insights

The so called "App Gap" is due to the lack of coherence in the smart home user experience. To date, both device-centric apps and those designed to act as "universal remotes" for your home have focused on device control, not the more holistic integrated intelligence. Some allow end-users to chain together macros of sensing and actuation (turn on lights and raise blinds when they get home) but lack the ability to offer true agency. Vivint Smart Home is the closest with their Sky intelligence offering that enables consumers to have a chatbot style interface with their home, asking for repeated steps that should become automatic for the homeowner and more.

7.3.1 A Look at the Numbers

These are still early days, with manufacturers still trying to wrangle interoperability issues, while understanding the breadth and depth of consumer needs:

- The global smart home hub market is expected to see a CAGR between 4-5% in terms of both unit shipment and revenue between 2016–2022
- In 2016, North America was the largest segment of the global smart home hub market, accounting for market share of 44.9 percent and 46.1 percent in terms of unit shipment and value, respectively[12].
- The smart home hub market in North America (2017): Shipments 1.3 million units, $122 million
- Voice assistant penetration rose from 5 percent of U.S. broadband households in 4Q 2015 to 12 percent in 4Q 2016[13]

Fifteen percent market penetration often represents a critical mass at which technology adoption can really accelerate. Adoption of smart speakers has surpassed 11 percent of U.S. households that are Wi-Fi enabled, and as a bellwether, owners of smart speakers are 3.3 times more likely to own a smart hub and 6.6 times more likely to own a smart light system[14].

6.4 Obstacles

One significant obstacle to centralized hubs is security. Maintaining security over unauthorized access represents not only a technical challenge, but a disproportionate threat. As connected homes increasingly provide online access to everything from door locks to security cameras, many consumers are rightfully concerned about the vulnerability of these products to hacking. In September 2016, hackers managed to take control of over one million home video security cameras. Although this was due to, and exposed as, a security breach limited to a single vendor, the event received worldwide attention and publicity. In a recurring tracker of consumer awareness, attitudes and ownership rates of smart can connected devices among U.S. homeowners, Trifecta Research has seen upticks in aggregate concern following similarly well publicized security breaches, which exacerbates marketers' efforts to convince potential hub purchasers of the security of their systems.

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Additionally, until and unless the market overcomes the challenges with interoperability, manufacturers will continue to contend with the "cascade effect" within the connected home ecosystem, whereby most consumers (54%) fear that if one devices fails it will cause other connected devices in the home to fail[15].

6.5   Pulling It All Together

This use case consists of two components: 1) a use profile; and 2) a "day in the life of...."

6.5.1 Theoretical User Profile
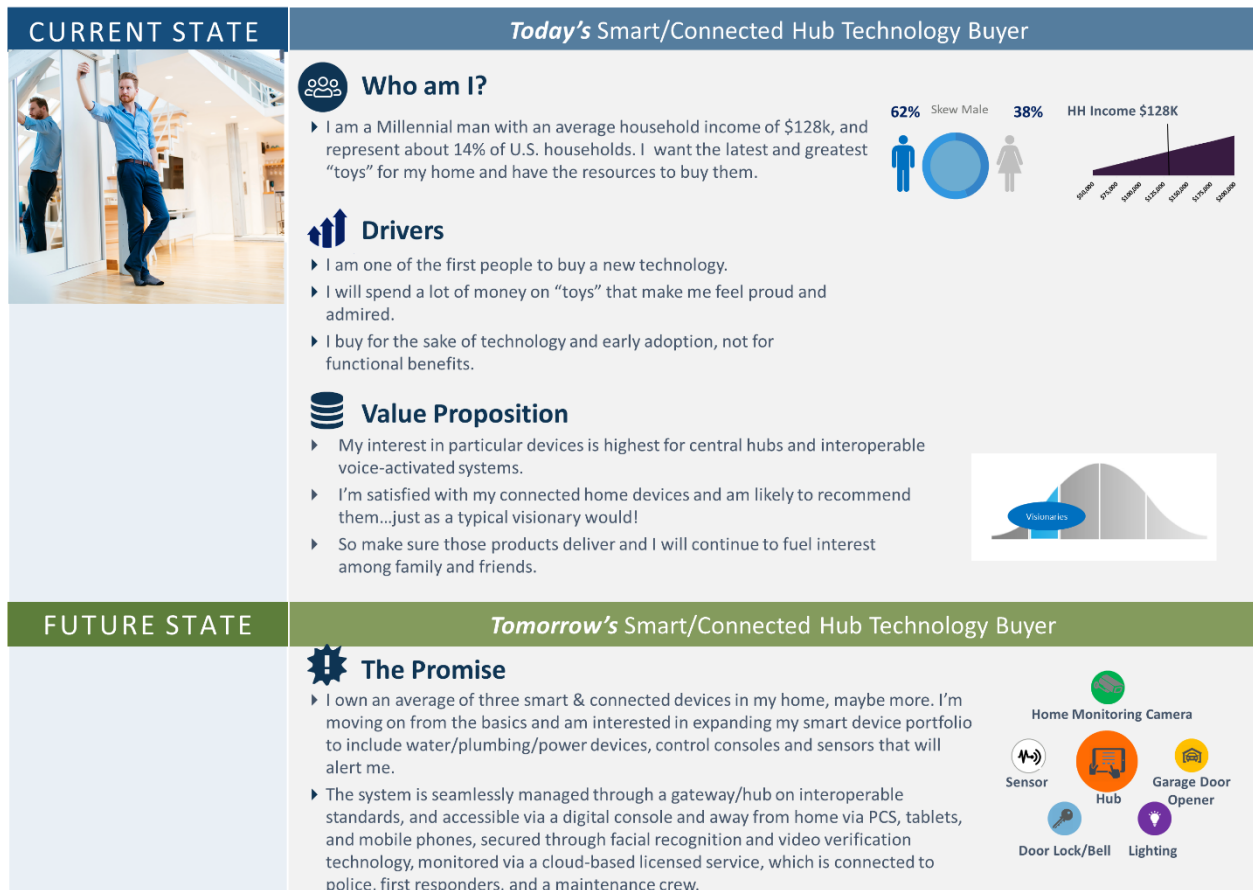
Source: Trifecta Research

6.5.2 Day in the Life of....

Before John, Sarah and their kids even wake up for the day, their hub is hard at work. Overnight, it has monitored the outdoor temperature and adjusted the thermostat appropriately before anyone's up and out of bed. The smart hub even knows to raise the shades in the bedrooms at a designated hour to ensure that everyone wakes up with the sun for school and work. Since it's a chilly morning, while John is listening to the latest news on his *Amazon Alexa* while he gets dressed and brushes his teeth, he remote-starts his car using a voice command so that it will be nice and defrosted when he takes the kids to school and heads off to work.

The *Samsung SmartThings Hub* that John and Sarah installed at home monitors their house while they're at work and even sends notifications should something seem amiss… like the time one of the kids accidentally left a tap running and caused a leak!

The family heads home from work. They have configured their hub to automatically turn on the downstairs lights whenever they unlock their front door. So with their hands full of dinner groceries, they can easily make their way to the kitchen without fumbling for a switch.

Tired of constantly adjusting the lighting in their living room, Sarah configured *Elgato Eve Motion's* motion sensor to turn on the living room's overhead lights to 50 percent brightness if the sensor detects activity when neither she nor John are home—but only between the hours of 10 p.m. and 6 a.m. It does this by activating a Lutron Caséta dimmer.

After a long day, John heads upstairs to bed. Halfway through Chapter 13 of the latest thriller he's reading, he realizes that the kids may have left some of the downstairs lights on… which leads him to wonder if he has also set the alarm for the night. Without lifting a finger, John uses voice commands through his *Google Home* speaker to confirm that all downstairs lights are off, all outside lights are on, and that the home security system is armed for the night.

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