



# CONNECTED CONSUMER ROADMAP

Driven by the Internet of Things

## EXECUTIVE SUMMARY



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# EXECUTIVE SUMMARY

## ES.1 EXECUTIVE SUMMARY

This executive summary presents top level trends and conclusions from the CABA Landmark Study “The Connected Consumer Roadmap - Driven by the Internet of Things” report which was created by IHS, a leading analyst research firm, for the Continental Automated Buildings Association (CABA). CABA is a leader in initiating and developing cross-industry collaborative research, under the CABA Research Program. The research presented in this executive summary - and the full report in whole, was driven from a consumer survey of 1,036 residents within Canada and the United States, conducted in January 2015, and based on a range of interviews with suppliers, service providers and other ecosystem players within the connected home market. For the purposes of this research, the term “North America” refers only to Canada and the United States.

### SPONSORS

IHS and CABA would like to acknowledge the CABA member sponsors listed below, and the respondents who helped make this research possible. We would also like to take this opportunity to thank the CABA member sponsors and CABA, as well as all those organizations that contributed their valuable time and information. In particular, we appreciate the trust and transparency shown by respondents willing to share confidential information. Without the help of all these organizations it would not have been possible to produce such an in-depth and detailed study.

Ruby sponsors (American Family Insurance, UPnP Forum) were provided the opportunity to present a case study in this report.

The Emerald sponsors were Arizona Public Service Company, Hydro One Networks Inc., IEEE, Intel Corporation, Intermatic Inc., Microsoft Corporation, MOEN Inc., Pella Corporation, Philips, Qualcomm Incorporated, Schneider Electric, Southern California Edison Company, Support.com and TELUS.

The Diamond sponsors were Alarm.com, Arrayent Inc., Hydro-Québec, Panasonic, and SecurTek Monitoring Solutions.

The final presentation was delivered by webinar in May 2015.

### ROLE OF THE STEERING COMMITTEE

The Steering Committee represents a cross-section of solution providers in the Connected Consumer marketplace. Representatives from each company joined IHS and CABA on regular collaboration calls to ensure the research scope met the project objectives. The Steering Committee plays a vital role in outlining the research product in terms of defining the



required content as well in collaboration on the research approach including the development of the interview scripts and survey guides.

#### ABOUT CABA

The Continental Automated Buildings Association (CABA) is an international not-for-profit industry association, founded in 1988, dedicated to the advancement of connected home and building technologies. The organization is supported by an international membership of over 400 organizations involved in the design, manufacture, installation and retailing of products relating to home automation and building automation. 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.

Please visit <http://www.caba.org> for more information.

#### ABOUT IHS

IHS Inc. (NYSE: IHS) is the leading source of information, insight and analytics in critical areas that shape today's business landscape. Businesses and governments in more than 150 countries around the globe rely on the comprehensive content, expert independent analysis and flexible delivery methods of IHS to make high-impact decisions and develop strategies with speed and confidence. IHS has been in business since 1959 and became a publicly traded company on the New York Stock Exchange in 2005. Headquartered in Englewood, Colorado, USA, IHS is committed to sustainable, profitable growth and employs about 8,800 people in 32 countries around the world.

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## ES.2 INTERNET OF THINGS OVERVIEW

The world is becoming increasingly digital, driven by the potential for near ubiquitous connectivity, continually decreasing costs of processing and sensor solutions, and the ability to use the Internet to facilitate communication between electronic devices. As such, we are in the early stages of the Internet of Things (IoT) – a technological evolution that is based on how connected devices can be used to enhance communication, automate complex industrial processes, strengthen customer relationships, and provide a wealth of information that can be processed into useful actions aimed to make our lives easier.

The term "Internet of Things" was first used in 1999 by Kevin Ashton as part of a theoretical concept for increasing the potential of automating systems by assigning computer data representing the location and status of objects in the physical world. His initial approach involved a much greater reliance on RFID tags for physical objects, to allow them to be inventoried and tracked with little to no human interaction for a more robust system for automating replenishment and inventory control systems. The concept has been expanded and now encompasses concepts such as condition monitoring, automated control, location-based services, and even augmented reality.

## ES.3 INTERNET OF THINGS DEFINITION

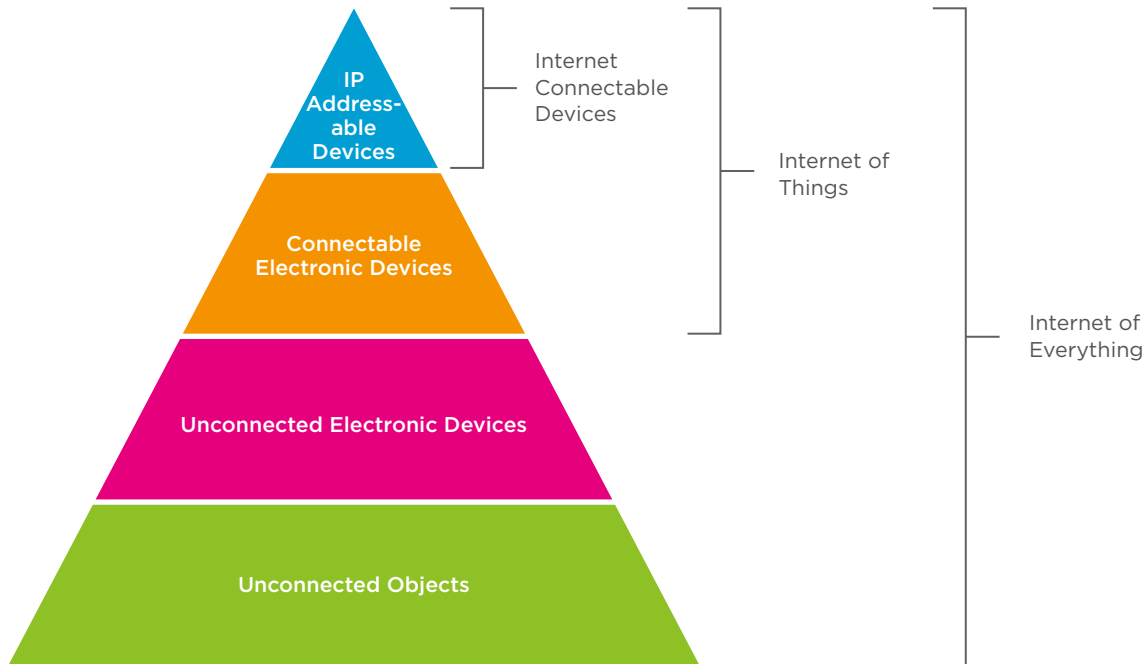
It is important to note that the IoT is not a specific device or technology – it is a conceptual framework, driven by the idea of embedding connectivity and intelligence in a wide range of devices. IHS defines an IoT device as a device which has some form of embedded connectivity that allows the device to be directly connected to the Internet (that is, it is IP

addressable), or allows the device to connect (tether) to an IP addressable device. This connection can be wired or wireless. These devices can include a range of sensors as well as some type of user interface (UI), but neither sensors nor a user interface is required under this definition.

The ability to collect vast amounts of data in near real-time from this broad range of intelligent connected devices is the foundation of the IoT. This data can then be accessed directly, or via the cloud, and unique value propositions can be created through the application of complex analytics and big data techniques. In this way, the IoT can, and will, be used to provide unique value propositions and create complex information systems which are greater than the sum of the individual components.

To help illustrate this definition, IHS has devised the IoT hierarchy shown in Figure ES.1.

Figure ES.1 Internet of Things Hierarchy



Source: IHS © 2015 IHS

IHS has included both unconnected objects as well as unconnected electronics devices in this hierarchy. The reason for this is to show the distinction between the extent of the “Internet of Things” as well as the “Internet of Everything,” which is even broader in scope. In many ways, the Internet of Everything (IoE) is closer to Kevin Ashton’s original definition of the IoT, with technologies such as RFID being used to tag even unconnected, non-electronic objects to allow them to be identified, and potentially interact with, IoT devices.

Based on this definition, IHS includes machine-to-machine (M2M) communication as a sub-set of the IoT overall. IHS defines machine-to-machine (M2M) as communication between machines, devices, and equipment with little or no direct human interaction. The transmission of data and information between these machines and devices can occur over a wired, wireless, or hybrid network. In the context of the IoT, IHS includes many other types of interactions as well: machine-to-people, people-to-machine, machine-to-objects, people-to-objects, etc.

The current interest in the IoT from a device and connectivity standpoint is in the potential for devices and objects to move from one category to the next. Many see this as the immediate growth opportunity for IoT: the diverse array of devices and objects that will incorporate connectivity to allow them to either directly connect to the Internet, or to tether to a device that can.

It is important to note that categories shown in Figure ES.1 and described in the following sections represent Total

Available Market (TAM) segments and define potential IoT market opportunity rather than the current connectivity status.

### IP-ADDRESSABLE DEVICES

IHS defines an IP-addressable device as any device that can connect to the Internet directly and has a unique IP address. Internet-connected devices can range from an IP-addressable sensor module and telemetry devices (such as M2M modules) to powerful computing devices with a full operating system (OS) and a rich User Interface (UI), usually via a smartphone or laptop.

### CONNECTABLE ELECTRONIC DEVICES

Devices in the “Connectable Electronic Devices” category have the ability to directly connect to another device, and to transmit some level of information. However functionality can vary widely, and is often restricted based on a specific existing use-case. One example is a wireless speaker that can be used for playing an audio stream from another device. What is interesting about devices that fall into this category is they already have some level of connectivity built in, and could potentially play a larger role in the broader IoT ecosystem in the coming years. For example, the wireless speaker in the previous example could potentially be incorporated into a smart home network and broadcast alerts from other devices within the home.

### UNCONNECTED ELECTRONIC DEVICES

These devices do not currently have the ability to communicate or transmit data to other devices. Since they are electronic devices, the potential exists to begin incorporating connectivity into them, either at the time they are manufactured, or through retrofitting via an add-on module. As the price of wireless integrated circuits (ICs) has fallen, many manufacturers have begun to look at adding connectivity as a way to offer product differentiation, as well as offer new services. Recent examples in this category are personal printers and television sets in the consumer sector, and streetlights and parking meters in the industrial category.

### UNCONNECTED OBJECTS

This category encompasses all of the other physical objects in the world, from desk chairs to pet collars. Depending on the IoT/IoE use-case, methods to allow these objects to be recognized as part of the IoT/IoE could range from basic RFID tagging to adding complex M2M modules with environmental sensors.

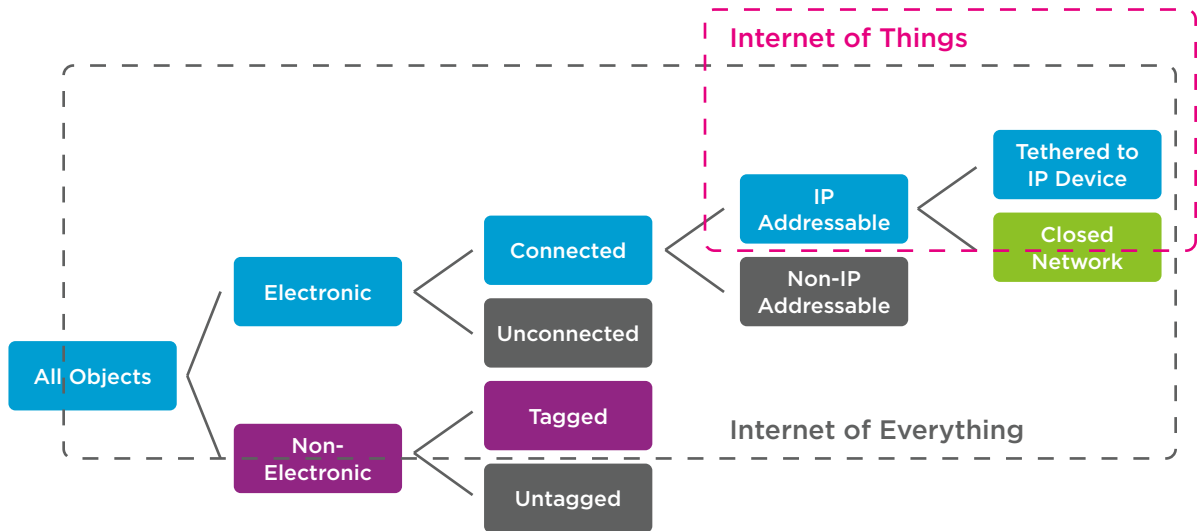
This is a potentially vast segment of the market, which IHS does not forecast at present because it is challenging to size accurately, and the forecast itself would not convey a meaningful view of the market potential at any point in time. However, when considering the possibilities for IoT and the Internet of Everything (IoE) over the long term, there is good reason for optimism that eventually it will be a world of trillions and not billions of connection points. The use-cases are limited only by the imagination.

This hierarchy of connected devices is illustrated in Figure ES.2

### APPROACH TO CATEGORIZING THE INTERNET OF THINGS

The IoT ecosystem can be categorized into seven main industry sub-segments. These are outlined in Figure ES.3. This report focuses on the connected consumer roadmap and the part that IoT has to play in it. Although IHS has defined a specific segment as ‘consumer’, in reality consumers will own devices that interact with the IoT ecosystem from a range of these sub-segments, including automotive, communications, IT and consumer medical. Therefore it is important that the reader understands the market drivers in each part of this ecosystem; and how the ecosystem interacts with the connected consumer.

Figure ES.2 Connected Devices Hierarchy



**Unconnected Objects:** Desk, chair, soda can, fire hydrant, animal collar, shipping pallet, buildings, etc.

**Unconnected Electronic Devices:** Calculator, streetlight, vending machine, coffee maker, blood pressure monitor, etc.

**Connected / Tethered Electronic Devices:** Audio headset, printer, computer monitor, DVD player, licensed mobile radio unit, etc.

**IP-addressable Devices:** TabletPC, smartphone, infotainment head unit, smart meter, EV charging station, home health hub, etc.

Source: IHS © 2015 IHS

Figure ES.3 IHS Approach to Categorizing IoT Market Segments



**Automotive**

- Infotainment
- Under-the-hood



**Communications**

- Consumer CPE
- Enterprise CPE
- Last-mile Access
- Backbone
- Mobile Handsets / Infrastructure



**Information Technology**

- Desktop
- Server
- Portable Computing (Netbook, Notebook & Tablet)



**Medical**

- Consumer Medical
- Imaging
- Other Medical



### Industrial

- Commercial Building Automation
- Commercial Transportation
- EFT-POS & Smartcards
- Industrial Automation
- Commercial Lighting
- Power & Energy
- Security
- Test & Measurement
- Other Industrial & Commercial



### Consumer

- Home Appliance
- Home Automation
- Home Consumer Electronics
- PC Peripherals & Office Equipment
- Portable CE
- Smart Toys
- Sports & Fitness
- Other Consumer



### Military & Aerospace

- Commercial aerospace
- Military Equipment

Source: IHS © 2015 IHS

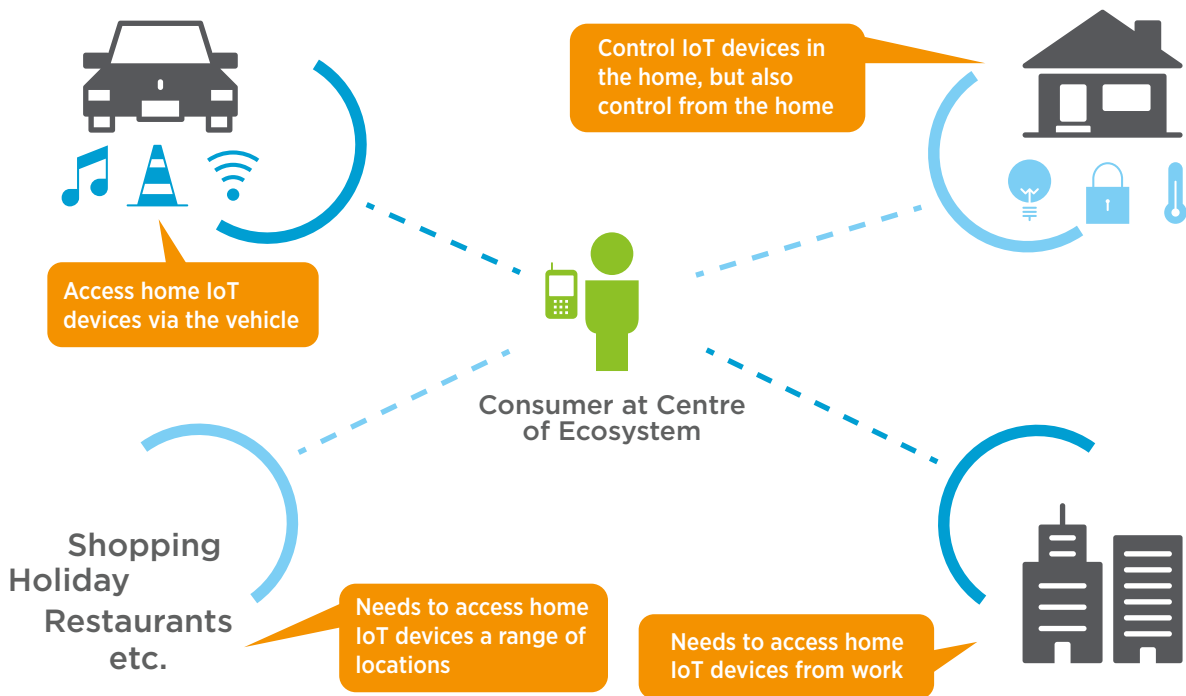
## ES.4 THE PLACE OF THE CONNECTED CONSUMER WITHIN THE IOT ECOSYSTEM

The previous section outlined the wider IoT ecosystem and started to touch upon where the consumer sat within it. Figure ES.4 illustrates the concept a little further.

For the consumer, the main interactions with the IoT ecosystem will be via home control devices and personal area network devices. These are the device types that are explored further in this report and include thermostats, smart plugs, HVAC, connected appliances, security systems, person monitoring devices, health devices, wearables and entertainment devices. However, a key benefit of having these devices IoT-enabled is the fact that they are controllable from a variety of locations, such as when in a vehicle, at work, shopping, on vacation, etc.

So although the consumer IoT ecosystem, in terms of sensor devices and other devices that are actually controlled, is centred in the home, an ecosystem needs to be in place that allows the user to interface with the home from any location.

Figure ES.4 Consumers Location in IoT Ecosystem

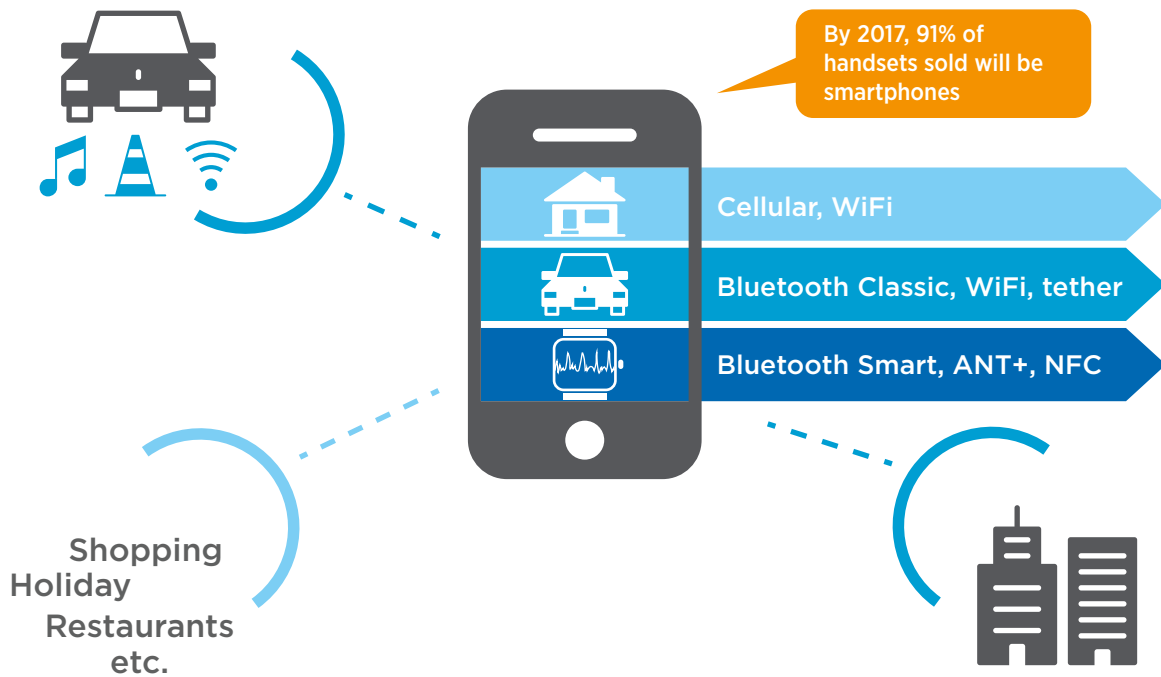


Source: IHS © 2015 IHS

As supported by the consumer research from this study, the cellular handset is the device most used when interfacing with home systems via the cloud from remote locations such as the vehicle, the workplace, etc. As well as it being the device most easily accessible for the user, it is of all user end-devices the one that is the most “connected”, as illustrated in Figure ES.5. Typically a smartphone can interface with WAN networks via a range of cellular technologies such as HSPA, EDGE and GPRS. It can also interface with local area networks and fixed networks via 802.11, and it can be linked to mesh networks and personal area networks (PAN), via technologies such as Bluetooth and Bluetooth Smart.

This ultimately means that it is the most suitable device to provide a consumer with access to the cloud in the widest range of locations; it will become the centre of the consumer IoT ecosystem.

Figure ES.5 Remote Connectivity



Source: IHS © 2015 IHS

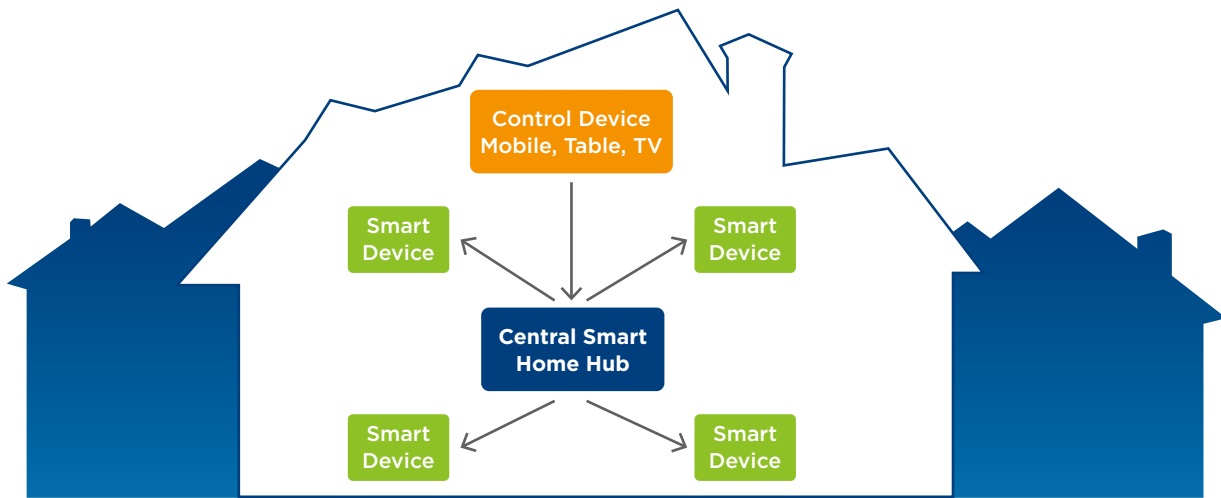
For access within the home, two visions of the consumer IoT ecosystem are emerging. One is built around a central hub; in the other, “plug-in” user devices are controlled directly from various consumer electronic devices.

In a central hub solution (as illustrated in Figure ES.6), the various devices associated with the smart home are controlled by a central device, and this then can extend outwards to access a variety of secondary smart home features. Such a hub can also be managed itself by a more accessible, personal device such as smartphone or tablet.

A solution such as this would be ideal for a Multi-service Operator (MSO), as in most households they own or lease the fundamental networking equipment. The main threat to them is that a rival company, such as a security specialist or utility firm, offers a rival service-based solution to its existing subscribers. However, such services present challenges for these rivals as they are less likely to have the breadth of technology relationships or solutions to deal fully with the smart home. Partnerships between such companies and MSOs would address this point to some extent.

This, in the long-term, makes partnerships between other specialists and platform providers more likely. It is also possible for suppliers of standalone hubs, such as SmartThings, to enter the market; but without either the financial backing or service-based model to sustain subscriber growth and R&D costs, it will be very difficult to challenge established providers.

Figure ES.6 IoT in The Home – Hub Solution

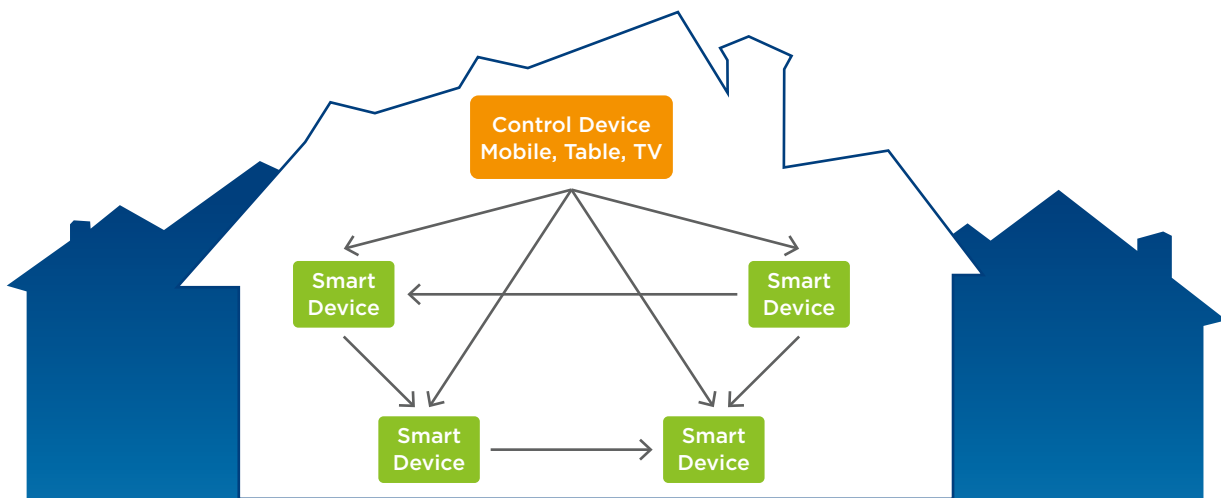


Source: IHS © 2015 IHS

In the direct control view of the consumer IoT ecosystem, illustrated in Figure ES.7, each device has its own embedded protocols and capabilities, and can directly interact with other node devices.

Samsung and Apple are the two examples of companies offering solutions following this topology. For example, in the Samsung view of the market, your Samsung washing machine could automate your Samsung refrigerator, and vice versa. Meanwhile, in the Apple view of the Smart Home, you could be using your iPhone, iPad or Apple TV to control your lighting directly, via embedded HomeKit protocols.

Figure ES.7 IoT in The Home – In Home Device Ecosystem



Source: IHS © 2015 IHS

One significant factor, that governs both the development of the wider market and ecosystem but also governs which of these topologies wins out, relates to issues around connectivity in the home. The consumer survey responses from this report emphasized how important interoperability is, and also demonstrated that consumers expect to some extent to be able to purchase connected devices from a range of suppliers and for these to work together and be controlled together.



However, the consumer IoT market is currently extremely fragmented in terms of the connectivity technologies used by the node devices within networks. The following section examines how connectivity will play a part in developing the connected consumer ecosystem.

**ES.5 CONNECTIVITY IN THE CONSUMER IOT ECOSYSTEM**

Many connectivity technologies are used in the consumer IoT ecosystem, particularly at the local and personal area network level. For many of the sensor devices used in the connected consumer ecosystem, low power consumption is paramount. These sensors also tend to have only relatively low data throughput requirements. Therefore, technologies such as 802.11 can be overkill both in terms of throughput and power consumption. This has led to a wide range of standards and proprietary technologies being used; they are outlined in Figure ES.8.

Figure ES.8 IoT in The Home – The Connectivity Decision



Source: IHS © 2015 IHS

Compared with the range of solutions used within the home, the range of solutions used for remote access to home automation devices is less complex, as outlined in Figure ES.9. For most remote applications, the user is looking to make a connection to the cloud, from either a smartphone, PC, tablet or in-vehicle system. For that, any connectivity solution that will connect the control device to the cloud will suffice.

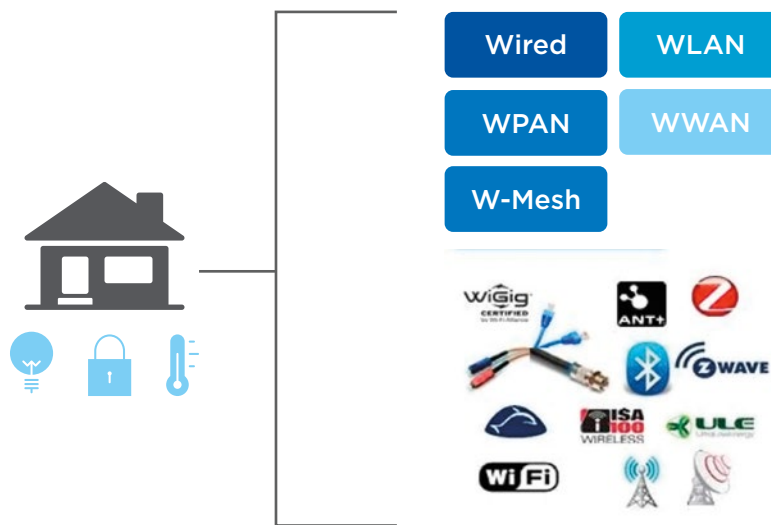
Figure ES.9 Remote Access – Connectivity Solutions & Choices



Source: IHS © 2015 IHS

However, the range of connectivity solutions used within the home is vast and complex (as displayed in Figure ES.10) and will depend on which technology the node or system manufacturer has decide to use. Not only does this result in devices not being able to communicate directly with each other, and solutions from different suppliers not being interoperable, but also means that standalone gateways that connect to the residential gateways are required in most implementations.

Figure ES.10 IoT in The Home – Connectivity Solutions and Choices



Source: IHS © 2015 IHS

The connectivity technologies adopted by smart home automation devices will vary by system type and device type. Overall, Wi-Fi is projected to be the most widely shipped connectivity technology in the smart home market because of its inclusion in most standalone smart home gateways and its adoption in other smart devices such as smart thermostats, control panels, and some smart plugs. Additionally, its inclusion in smart appliances and smart air conditioners further supports its general adoption in the smart home as these devices become more prevalent.

ZigBee is projected to be the second most commonly shipped technology at a global level. ZigBee is used across most device types as it is becoming an increasingly common node-level communications technology. ZigBee adoption is projected to be strongest in the Americas and EMEA, with APAC a weaker market. It is important to note that ZigBee adoption is also heavily influenced by the anticipated IHD and energy gateway deployments expected to be mandated in the UK market. Should this legislative landscape change, this would result in lower total ZigBee shipments.

Use of Z-Wave is largely concentrated in the Americas, with EMEA and APAC not showing the same level of adoption, although the large size of the American smart home market gives it a strong global standing. In the Americas, Z-Wave has proved itself as a strong technology for the smart home, with good range and penetration (being a sub-GHz technology) and a wide range of interoperable solutions from multiple vendors. This has helped it to gain traction from service providers such as ADT.

Proprietary sub-GHz wireless has been a relatively widely adopted technology in the fragmented smart home environment because of its prevalence in security devices. Interestingly, smart home systems will often use a combination of proprietary sub-GHz technologies for devices such as motion sensors, and then either ZigBee, Z-Wave or another alternative for other nodes, such as thermostats. As a result of the large unit shipments of window/door contacts and motion sensors, proprietary sub-GHz technology is projected to remain amongst the top wireless technologies after Wi-Fi, ZigBee and Z-Wave.

Insteon is a dual-band technology, using both RF and powerline. Most introductory smart home Insteon kits come with an Insteon hub; this is expected to drive shipments of gateways for Insteon.

Insteon is projected to predominantly find growth with connected lighting systems and, to some extent, smart plugs and smart thermostats. Insteon is the preferred connected lighting technology option, specifically in the Americas, where it is largely concentrated. It is important to note, however, that Insteon technology is proprietary to SmartLabs, Inc., a privately held corporation.

Other wired technologies include a combination of Ethernet, which is used in some standalone gateways to connect to the home network, and specialist wired lighting solutions such as DALI and other wired technologies. Its use is projected to increase because of the growth of the gateway and connected lighting categories; however, its use in other applications remains relatively low.

The “other wireless” category includes several technologies, such as EchoNET (which is becoming increasingly prominent in certain Asian markets, such as Japan) and the newly announced Thread technology (which is being promoted by Nest along with other prominent vendors like Samsung and Silicon Labs) which uses 802.15.4 as the base PHY layer with 6LOWPAN and IPV6 stacks.

Lutron’s ClearConnect RF technology used for connected lighting systems and window shades is available in 2.4 GHz and sub-GHz versions, counted in either the proprietary 2.4 GHz or proprietary sub-GHz categories depending on the frequency used.

EnOcean is projected to drive large unit shipments for connected lighting systems in EMEA. Also in EMEA, some security devices like door/window contacts and motion sensors are expected to use EnOcean to create wider smart home networks.

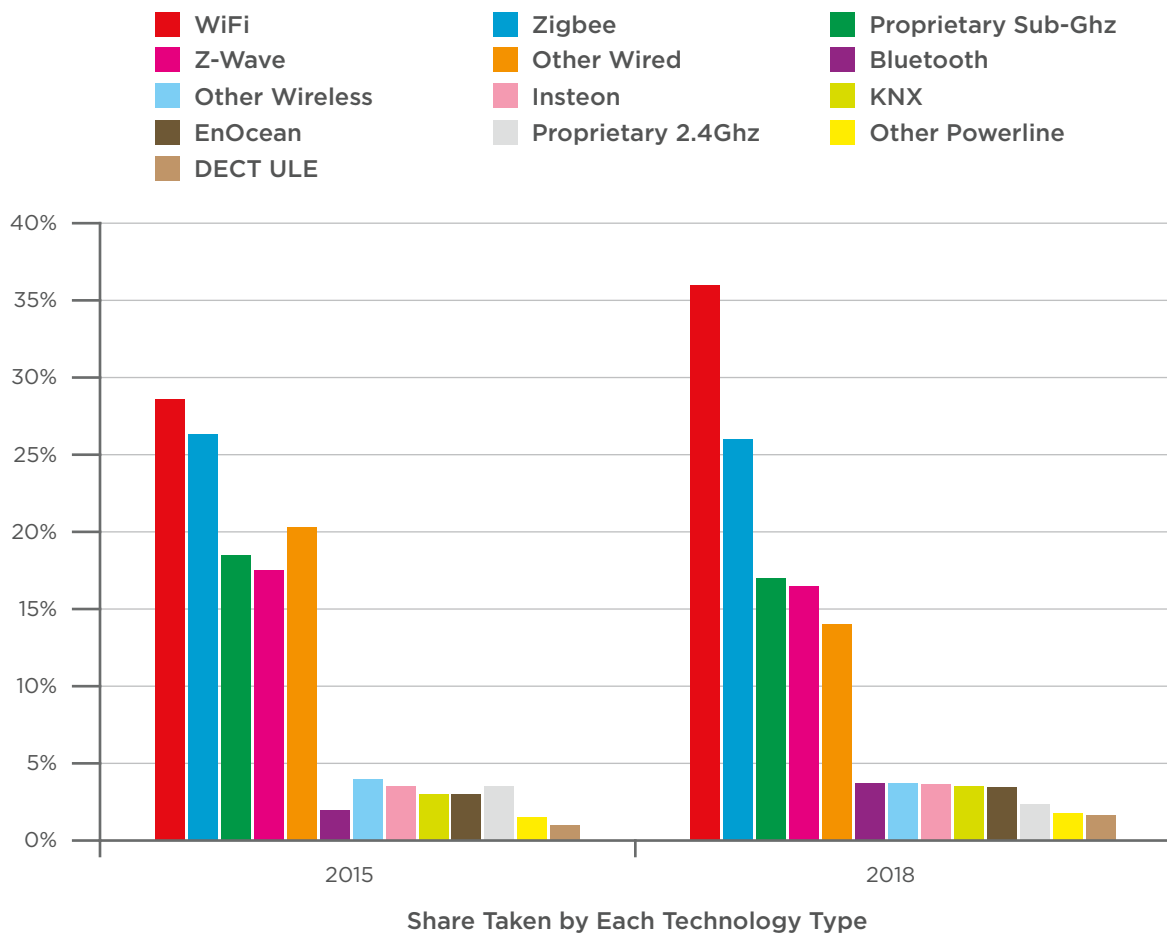
Bluetooth technology currently has a very small share of the global market. However, this is projected to change as Bluetooth Smart and innovative implementations of the technology, such as Bluetooth Smart mesh solutions, make the technology better suited to use within the smart home. Consequently, its adoption is projected to grow over the forecast period as device manufacturers overcome concerns over the range of the technology, and look for a solution that enables the option of direct smartphone control without requiring a separate gateway (although a gateway will still be required for the added cloud-based functionality and for when the user is away from home).

DECT is a popular wireless technology used in phone handsets across the world. DECT ULE, a newer low-power variant,

is aimed at the smart home market. However, its success depends on its adoption into VOIP gateways (potentially through an over-the-air upgrade) and its support from node-level device OEMs. As DECT ULE is still a new technology with low vendor support, its use is projected to grow more slowly than that of the main technologies used today (such as ZigBee, Z-Wave and others).

Figure ES.11 displays the development of the smart home market in terms of devices shipped by connectivity solution in 2015 and 2018.

Figure ES.11 Connectivity Solution Shares in Home Automation



Source: IHS © 2015 IHS

### ES.6 INTRODUCTION TO THE SMART HOME MARKET

This section starts with a short overview of the smart home market, examining:

- » The size of the total market by service type.
- » The size of the total market by region.
- » The main company types supplying the market.
- » The respective sizes of the main components of the market.

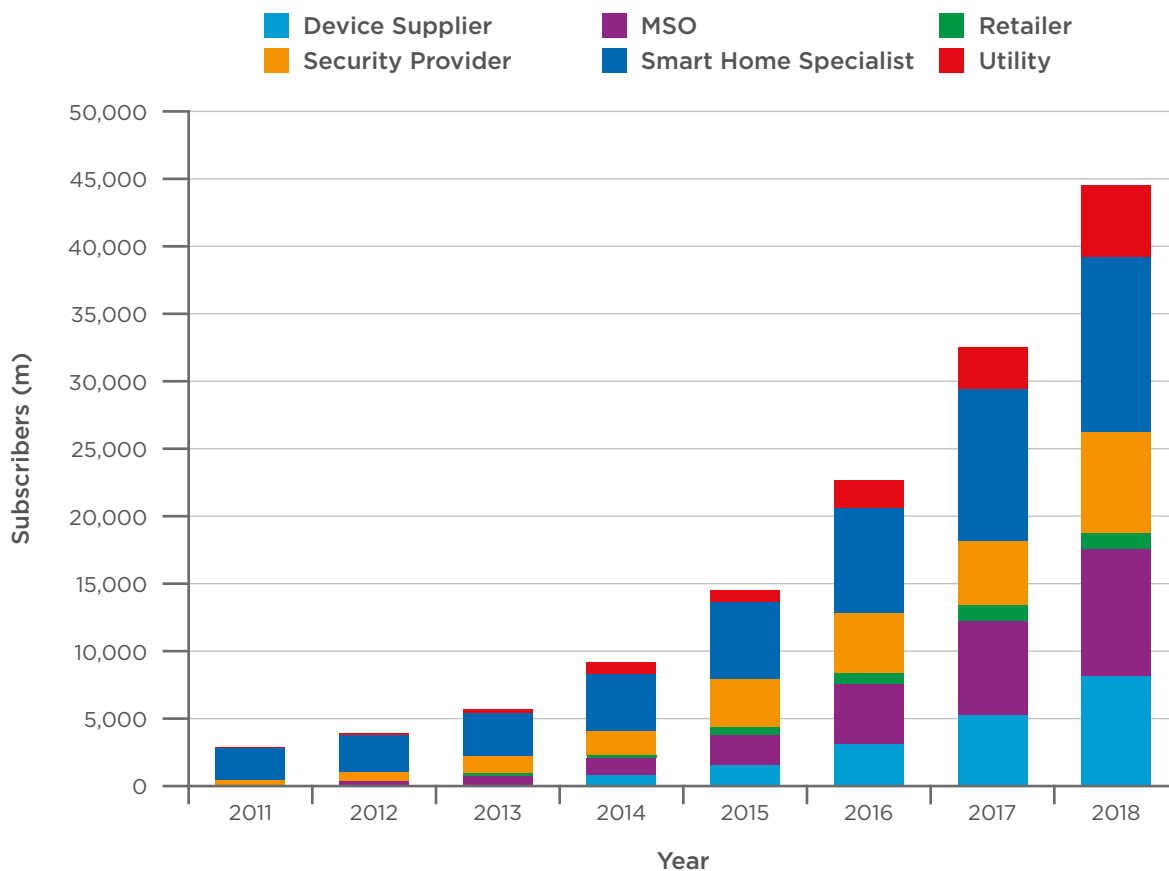
As displayed in Figure ES.12, IHS projects that at the end of 2018 there will be 44 million smart home service households globally (up from just over nine million at the end of 2014), worth almost US\$5 billion a year in service revenues.

The types of companies offering cloud-based home management systems vary widely. One major group consists of existing service providers that have other core business lines; examples are security or telecommunications providers and utility companies. These companies have entered the home-management market to reduce customer churn or to increase new subscriber rates and average revenue per user (ARPU).

Other types of companies also are entering the fray, including device suppliers and retailers. Smart home specialists are forecast to play a major role in the deployment of smart home services globally. This category of companies includes both home automation providers that are moving their existing customers to cloud-based services by providing an external communications gateway and an associated back-end service; there is also a new breed of connected home specialists, such as Nest, SmartThings, and others. Many of this new breed have emerged as acquisition targets for established companies looking to enter the smart home market.

The smart home service provider landscape is projected to vary widely by country. In North America, security providers, such as ADT, Alarm.com and Vivint, have been at the forefront of the market, providing combined smart home and professionally monitored security systems. Telecommunications companies, such as Comcast and AT&T, also play a major role.

Figure ES.12 Smart Home Services - By Provider



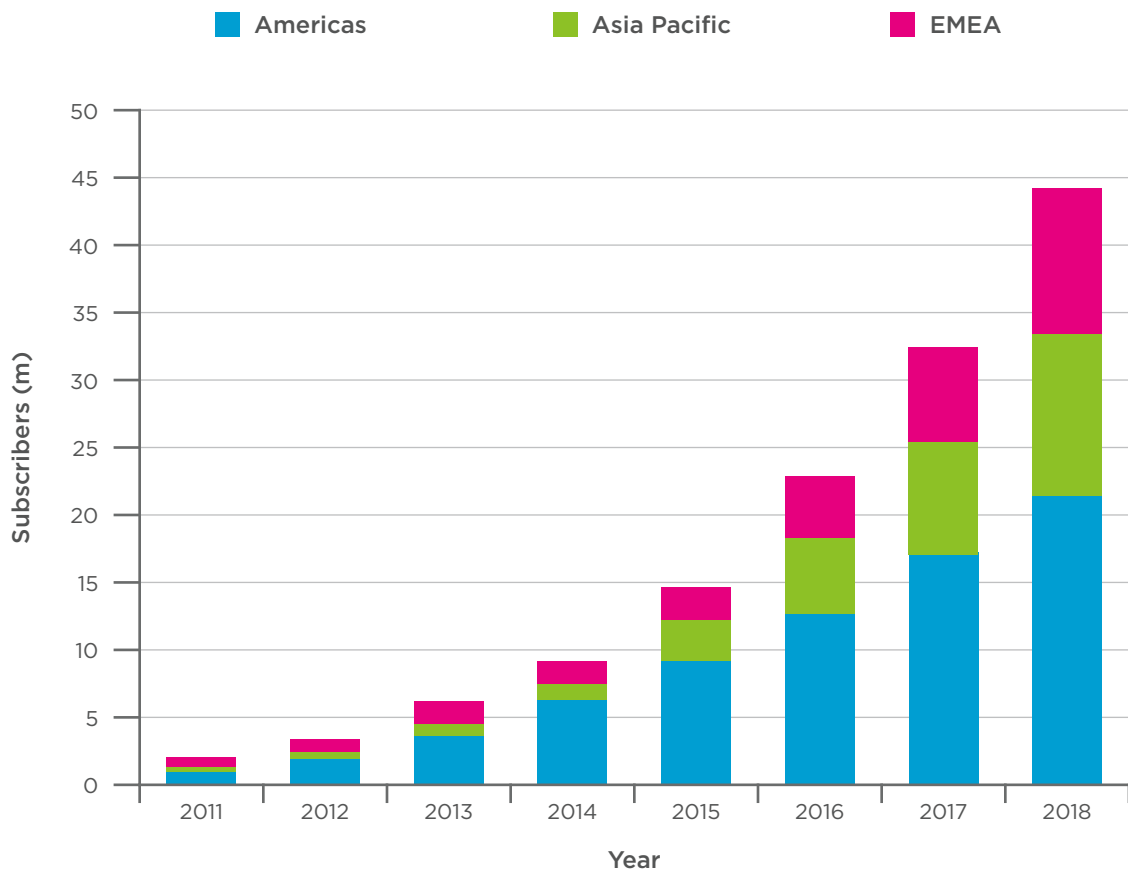
Source: IHS © 2015 IHS

Figure ES.13 shows the number of smart home service households by region. In the European, Middle Eastern and African (EMEA) region, utility companies are expected to dominate, providing one-third of the installed base of smart home systems at the end of 2018. Utility companies already offering or developing smart home devices or services in Europe include British Gas, Essent, Eneco, Nuon, RWE, EnBW and Eon. European multi-service operators (MSO) have generally been slower to enter the smart home service market than those in North America, although there have been exceptions such as Bouygues Telecom and Swisscom. Others, such as SFR and Orange, have also now entered the market, with more expected to follow.

In the Asia-Pacific region, some multi-service operators have been offering basic smart home services for a number of years, although volumes have remained relatively low. As more enter the market, with wider value propositions and attractive tiered pricing, the role of MSOs is set to grow.

The vendor ecosystem that is supplying this market is complex, as shown below in Table ES.1:

Figure ES.13 Smart Home Services - Bv Region



Source: IHS © 2015 IHS

Table ES.1 IoT in The Home – Supplier Ecosystems

Industry	Definition	Value Proposition	Opportunities	Challenges
<b>Existing Service Providers</b>	Companies with a core business line (security, telecommunications, etc.) that start to offer smart home services	<ul style="list-style-type: none"> <li>• Low cost (compared with many home automation providers)</li> <li>• Existing subscriber base to target</li> <li>• Strong background in services</li> </ul>	<ul style="list-style-type: none"> <li>• Consumer education</li> <li>• Increasing revenue per existing user</li> <li>• Beyond the subscriber base</li> </ul>	<ul style="list-style-type: none"> <li>• Subscriber saturation</li> <li>• Longevity of subscription model</li> <li>• Consumer demand for additional devices</li> </ul>
<b>Dedicated Service Providers</b>	Exclusively offering smarthome services	<ul style="list-style-type: none"> <li>• In-depth market knowledge</li> <li>• Lower cost than Existing SPs</li> <li>• DIY/ professional Install flexibility</li> </ul>	<ul style="list-style-type: none"> <li>• Consumer education from other channels</li> <li>• Partnerships between dedicated device suppliers, e.g. Nest, with existing SPs</li> </ul>	<ul style="list-style-type: none"> <li>• Subscriber saturation</li> <li>• Longevity of subscription model</li> <li>• Consumer demand for additional devices</li> </ul>
<b>Specialist Home Automation</b>	Exclusively offering connected home devices/systems	<ul style="list-style-type: none"> <li>• Customization of connected system</li> <li>• End-to-end involvement in implementation of system</li> <li>• Full after care service</li> </ul>	<ul style="list-style-type: none"> <li>• Increased education of consumers = higher net worth individuals</li> <li>• Separate ranges targeting lower-end of high net worth</li> </ul>	<ul style="list-style-type: none"> <li>• Growing availability of mass market systems removing some customers</li> <li>• Interoperability of systems</li> </ul>
<b>Device Suppliers</b>	Companies selling connected home devices at retail	<ul style="list-style-type: none"> <li>• Economies of scale</li> <li>• Ease-of-use /ease-of integration</li> <li>• Experience from other product lines</li> </ul>	<ul style="list-style-type: none"> <li>• Strategic device partnerships</li> <li>• Retail market opportunities</li> <li>• Service provision</li> <li>• Residential load management•</li> </ul>	<ul style="list-style-type: none"> <li>• Potential margin pressure</li> <li>• Device interoperability</li> <li>• Application-based market development</li> </ul>
<b>Contractor and Installation Companies</b>	Companies that exclusively install third party hardware	<ul style="list-style-type: none"> <li>• Expert knowledge of electrical &amp; in-home systems</li> <li>• Consumer trust in professional installation company</li> </ul>	<ul style="list-style-type: none"> <li>• Partnerships with connected home providers</li> <li>• Ongoing services</li> <li>• Opportunity to consolidate regional networks</li> </ul>	<ul style="list-style-type: none"> <li>• Rise of mass market DIY connected home systems</li> <li>• Education of contractor / installer companies</li> </ul>
<b>Utility Providers</b>	Utility companies providing home energy solutions	<ul style="list-style-type: none"> <li>• Unlimited access to energy database</li> <li>• Well-placed to feed electricity into the home</li> <li>• Load control activities</li> </ul>	<ul style="list-style-type: none"> <li>• Consumer demand for connected devices</li> <li>• Mass market DIY systems</li> <li>• Ongoing services</li> </ul>	<ul style="list-style-type: none"> <li>• End-to-end solutions</li> <li>• Major service provider entrance to market</li> </ul>
<b>Retailers</b>	Retailers offering connected home devices/services	<ul style="list-style-type: none"> <li>• Knowledge of local area and target demographics/areas</li> <li>• Existing customer base</li> <li>• Local link for multinationals</li> </ul>	<ul style="list-style-type: none"> <li>• Cloud-to-cloud connectivity</li> <li>• Extended partnership opportunities</li> <li>• Branding opportunities</li> </ul>	<ul style="list-style-type: none"> <li>• Security as primary value proposition</li> <li>• Demand response aggregators developing residential systems</li> </ul>

Industry	Definition	Value Proposition	Opportunities	Challenges
<b>Software and Platform Providers</b>	Solutions catering to the service/software element of the home	<ul style="list-style-type: none"> <li>• End-to-end package</li> <li>• Knowledge of software/platform design</li> <li>• Customization of package•</li> </ul>	<ul style="list-style-type: none"> <li>• Application agnostic solutions-Functionality expansion</li> <li>• Movement into adjacent sectors</li> <li>• Expanded partnership opportunities</li> </ul>	<ul style="list-style-type: none"> <li>• Backwards Integration from SPs</li> <li>• Low barriers to entry</li> </ul>

Source: IHS © 2015 IHS

## SAFETY AND SECURITY DEVICES

The residential security market is moving away from hybrid panels and burglar-alarm solutions to smart security or the smart home (although panels are likely to remain as back-up). Security is driving home solutions for many MSOs in the United States, with smart energy devices a secondary step; whereas in Asia, it is essential to work with construction companies. Interactive touchscreens are being replaced increasingly by consumer tablets and smartphones.

There are three deployment types of home security:

**Point Security** - Hardware that does not link to other devices for automation; instead each device has its own internal intelligence and applications.

**Connected Security** - Traditional alarm systems, in which each device is connected to a central panel (wired or wireless), with limited automation.

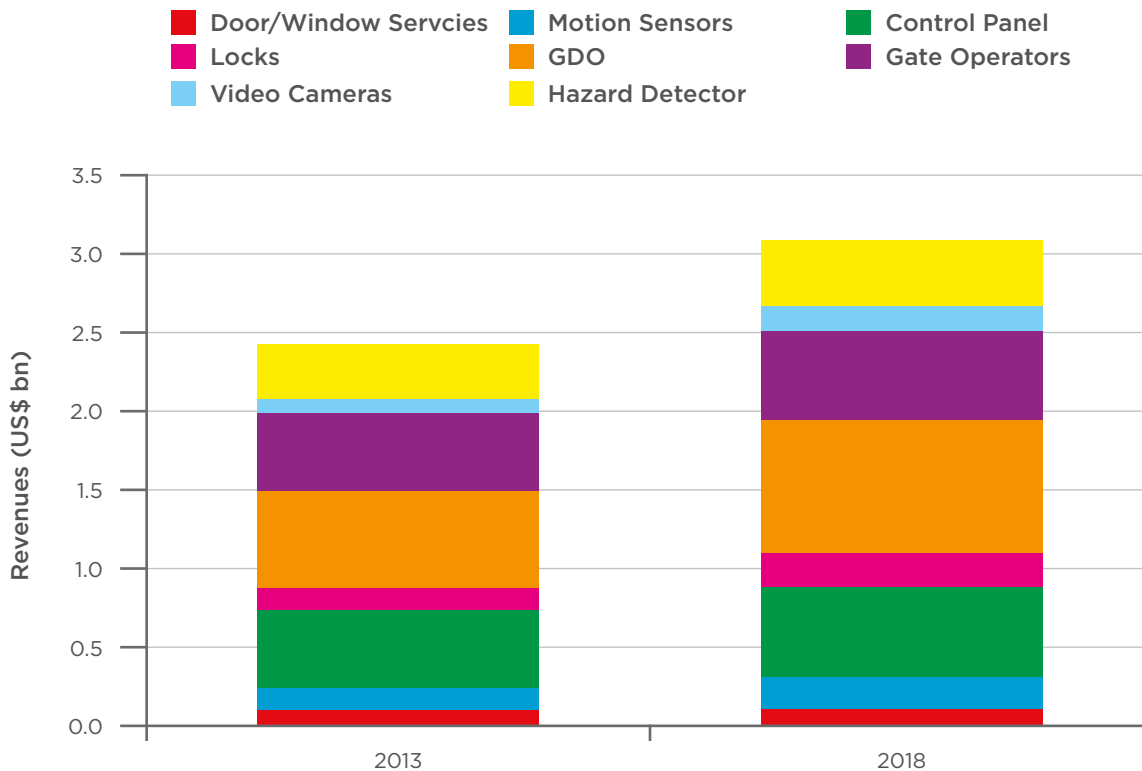
**Smart Security** - When devices are linked to each other through one central point; and when one application can manage all devices.

Informing end-users remains the key for device adoption and the expansion of the market. End-user education will need to focus on how to use the technology, why the technology is needed, and the cost savings. A lack of consumer understanding is one of the primary barriers to adoption across EMEA and Asia.

Although many of the features currently offered by service providers remain more for tech savvy users, they will be the gateway to increasing a customer base, since burglar alarm monitoring in North America has stalled at 20% penetration for the past decade. Figure ES.14 displays the traditional security market in terms of revenues in 2013 and 2018.



Figure ES.14 Traditional Security Revenues (US\$ bn)



Source: IHS © 2015 IHS

**ENERGY MANAGEMENT DEVICES**

Energy management uses devices such as smart plugs, thermostats, and other home appliances that can monitor and optimize energy usage. Energy management is the second most important smart home application, after security, in North America. There, it is often seen as an upsell solution for existing subscribers.

Direct-to-consumer energy solutions, such as thermostats or management devices, tend to be sold to a one-off pricing model. There is potential, though, for business-to-business (B2B) partnerships, in which residential load is controlled by service providers in partnership with utility companies.

There are several main ways in which energy management can be addressed in the smart home.

**Manual monitoring and adjustment** – Through devices such as smart plugs, consumers can measure how much energy is being use by devices, and optimize energy consumption in the home. These devices can be controlled externally by consumer devices, but the core technology is relatively simple.

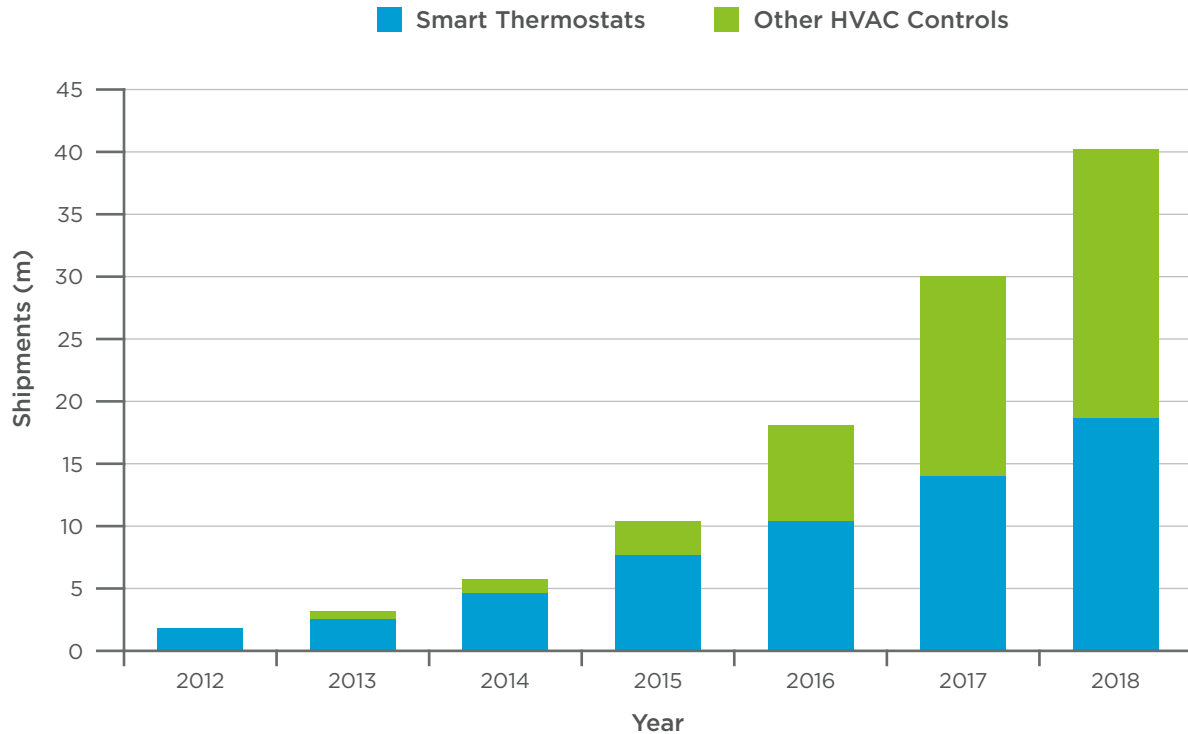
**Intelligent learning** – Devices adjust intelligently to individual behavior, to learn habits and reduce energy consumption. These devices are typically thermostats from companies like Nest, marketed as reducing energy with little inconvenience.

**Residential load control** - If advanced metering infrastructure (AMI) is in place, a utility company can send signals to request that devices change their operation during peak times, or when the electricity supply is constrained. Consumers are incentivized, by rebates or by subsidized devices.

In the North American market, energy management is often considered a secondary value proposition, behind home monitoring or safety and security applications.

As energy management becomes an increasingly common add-on, utility companies will need to develop a clear value proposition which cannot be easily replicated by other providers to the connected home. Figure ES.15 displays the smart home energy management device market in terms of units shipped.

Figure ES.15 Smart Home – Energy Device Shipments by Type



Source: IHS © 2015 IHS

### HOME HEALTH DEVICES AND SERVICES

In 2014, the global market for home health technologies and supporting services was worth nearly US\$6 billion (not including home attendant care or nursing home services). With an expected Compound Annual Growth Rate (CAGR) of 17% from 2014 through 2018, this market is forecast to be worth US\$12 billion in 2018. Devices comprise 72% of the revenue today, but will fall to 50% as telehealth services experience significant growth. The Americas region represented more than 50% of global revenue in 2014, and is projected to be the fastest-growing region through 2018.

The underlying factors supporting this forecast growth are fundamental changes in healthcare provision, which are necessitated by a growing prevalence of chronic disease, and an aging population increasing the demand for care.

The movement to a more integrated continuum of care that extends beyond the hospital presents an opportunity to improve the quality of care while lowering total healthcare expenditure. This continuum of care is to provide patient-centered care; i.e., the right amount of care at the right time and place. Home health technologies may prove to be a facilitator.

There are still barriers to the development of this market, however. The most important is the need for both service providers and the recipients of care to change their behaviour.

In terms of the competitive environment, there is a low level of concentration in the home health technology market as identified by IHS. Omron and Philips are the market leaders. Convergence of services is expected to depress service revenues in the long term.

**RESIDENTIAL LIGHTING DEVICES**

The world market for smart lighting and connected lighting controls has grown steadily for a number of years. Growth slowed during the global economic crisis but is now poised to accelerate as consumer and business confidence returns to the construction industry. New technologies such as wireless solutions (which typically reduce the installation costs in refurbishment and upgrade projects) are also influencing growth in this market.

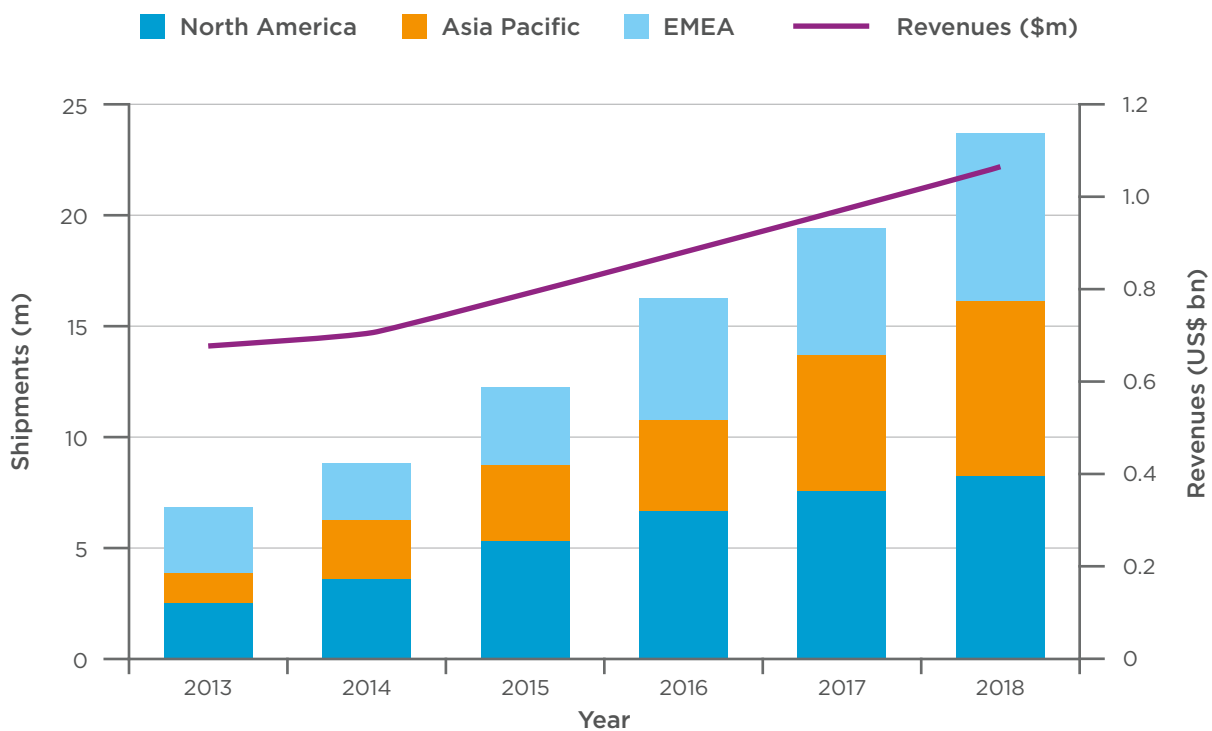
Lighting solutions have three core target markets:

**In residential applications**, smart lighting and connected lighting controls enable consumers to add intelligence and control to the lighting in their homes.

**In commercial applications**, smart lighting and connected lighting control solutions offer facility managers, building owners and other related stakeholders effective ways to reduce energy consumption; while solutions offer real-estate owners ways to increase either rents or occupancy rates.

**For street-lighting applications**, smart solutions enable municipalities and other infrastructure owners to reduce energy consumption, or to add functionality (such as the ability to flash) to traditional street-light luminaires.

Figure ES.16 Smart Lighting Residential Device Shipments



Source: IHS © 2015 IHS

There is a steady move in the lighting control industry towards more open products. This is achieved through vendors using common communication protocols such as DALI, Insteon, Wi-Fi, Bluetooth, ZigBee and Z-Wave. Figure ES.16 displays the smart residential lighting market in terms of device shipments and revenues.

## ES.7 SEGMENTING THE MARKET BY USER GROUP

Because this project placed a heavy emphasis on understanding consumer behavior and the differing attitudes of different groups within the mass market, the report presents most survey results with analysis by consumer segments.

The segmentation is of two types. The first three segments are based on respondents' desires regarding connected products. Their responses to Questions 2.1 and 2.2 from the consumer survey conducted for this years and were used to calculate the categorization. These three segments are mutually exclusive.

- » **Adopters** (268 respondents) – These respondents have demonstrated ownership of at least one 'connected home' device, through their answers to Q2.1.
- » **Potential adopters** (346 respondents) – These respondents do not own any 'connected home' devices, but demonstrated some interest in these devices in Q2.2. IHS defined this category as those respondents who selected an interest level of at least "Very valuable" in at least four out of the 24 application categories defined in Q2.2.
- » **Little potential** (422 respondents) – These respondents are the remainder. They may have a little interest in the 'connected home' in some cases; but the majority have little to no interest at all. They do not own any connected home devices and did not express an interest in more than three of the applications defined in Q2.2.

The second type of segmentation focused on the respondents' attitudes and abilities in four areas that are important for the connected home: technology, media, energy, and practical skills (DIY). For each category, each respondent obtained a score based on the answers to a number of questions designed to probe their interest and capability in each area. A segment was created for the uppermost group (UG) and lowest group (LG) for each score. The top and bottom quartile of the scores of the entire respondent population was determined. (In the event, respondents with the same score were above and below these quartile boundaries).The UG was defined by comparing a respondent's score to the upper quartile result of scores and including the respondent if their score was equal to or higher than this value. The LG was defined similarly, taking the lower quartile result of scores and taking the respondents who scored equal to or less than this value. Note that this method results in groups that are larger than 25% of the total sample and therefore cannot be considered a quartile of the respondent population. In summary, the UG represents those who embrace the subject and the LG represents those that are generally unfamiliar with it. Although the UG and LG for each score are mutually exclusive it is possible for the respondent to be segmented into different groups for the different areas scored. For example, a respondent could be in the technology uppermost group (TECH UG), the media uppermost group (MEDIA UG), the practical skills lowest group (DIY LG), and be outside the uppermost or lowest group, that is remain un-segmented, in energy management (EM).

**Technology score (TECH)** –This was designed to assess the adoption of technology by the respondent, and the confidence and enthusiasm relating to it. The first five options are taken from Q1.9 and were allocated 1 or 2 points, for responses of 'Agree' or 'Strongly Agree' respectively. The remaining four options are taken from Q1.12 and were given a score of 1 if the statement applied to them. This resulted in the maximum score of 18. The uppermost group was made up of those who scored 7 or higher (302 respondents) and the lowest group of those who scored 3 or lower (369 respondents)

- » I love to try out new technology and be the first to have new devices (e.g. iPhone, mp3 player, etc.).
- » I am comfortable setting up a home network.
- » I use technology to improve convenience in my home (e.g. automated devices, single remote control for multiple devices).
- » I want my lights, doors, security system and thermostat, etc. all to be controllable from one device.
- » I use Bluetooth to connect devices in my car or at home.
- » I have a Wi-Fi network in my home.
- » I own a smart phone.
- » I own a tablet (e.g., iPad).
- » I own a PC or Mac.

**Media score (MEDIA)** –This was designed to assess the adoption of media applications by the respondent. The first three options are taken from Q1.9 and were allocated 1 or 2 points, for those that answered ‘Agree’ or ‘Strongly Agree’ respectively. The remaining two options were taken from Q1.10 and Q1.12 and were given a score of 1 if the statement applied to them. This resulted in the maximum score of 8. The uppermost group was made up of those who scored 4 or higher (270 Respondents) and the lowest group of those who scored 1 or zero (435 respondents):

- » I watch a lot of video on demand.
- » I change my telecom provider to get better deals on my Internet, phone and TV services.
- » I regularly use social media apps and websites.
- » Which of these do you currently own? - A smart TV (a smart TV can connect to the internet e.g. via Wi-Fi or Ethernet).
- » I own a PC or Mac.

**Energy management score (EM)** –This was designed to assess the respondents awareness of their energy usage and their attitudes towards energy saving. The first three options are taken from Q1.9 and were allocated one or two points, for those that answered ‘Agree’ or ‘Strongly Agree’ respectively. The remaining two options were taken from Q1.10 and Q1.12 and were given a score of one if the statement applied to them. This resulted in the maximum score of eight. The uppermost group was made up of those who scored four or higher (270 Respondents) and the lowest group of those who scored one or zero (435 respondents):

- » I prefer devices that are energy-efficient and reduce costs.
- » I check my energy usage regularly.
- » I change my energy provider to get better deals.
- » Which of these do you currently own? - A Photovoltaic (PV) system (solar panels).
- » I own a PC or Mac.
- » I own an energy consumption monitor.

**Practical skills score (DIY)** – This was designed to assess the practical skills of the respondent, encompassing a range of ability levels. The score was built up using the last seven options from Q3.6, which asked respondents about how comfortable they were performing certain tasks. The options available (and associated score) were: Would ask somebody else to do (0), Not very confident (1), confident (2) and very confident (3). This resulted in the maximum score of 21. The uppermost group was made up of those who scored 15 or higher (269 respondents) and the lowest group of those who scored 5 or lower (281 respondents). The tasks examined were as follows:

- » Install a new light switch.
- » Install an external door lock.
- » Install a security camera.
- » Attach an open/closed sensor to a window or door.
- » Fit motorized window dressings.
- » Install a new thermostat.
- » Change a light bulb.

## ES.8 KEY INDUSTRY THEMES

The connected consumer roadmap has been defined along the lines of action the industry needs to take in relation to 10 key themes. These themes were defined by the project steering group.

Sections 2.1-2.10 of the full report explore these 10 key themes. For each, a hypothesis is presented. The evidence to support this hypothesis, either from the ecosystem interviews or from the end-user survey, is then presented. This is then

followed by a conclusion that comments on the extent to which the evidence proves or disproves the hypothesis. The analysis in terms of the hypothesis for each theme and the conclusions are summarized here.

## PRIVACY

The hypothesis explored was “Consumer concerns over privacy will slow down the development of the connected consumer roadmap”.

The key take-aways from the research on privacy are:

- » Ecosystem suppliers are very aware of privacy issues, and believe that they will become increasingly central to the development of the connected consumer roadmap as the market accelerates and as larger brand names enter the market.
- » After cost, survey respondents viewed loss of privacy as the greatest barrier to purchasing smart home products.
- » There were significant differences in attitude as to which types of information respondents would be willing to share. Data on energy consumption and climate control appeared to be least contentious. Information about the location of individuals in the home and media consumption habits were the most different.
- » There was a marked difference in how comfortable respondents were in sharing information with their service provider, compared with sharing with service providers’ partners. Respondents were much more willing to share with their service provider.
- » Some form of added value also resulted in many more respondents being comfortable sharing their data. This on average roughly doubled the share of respondents willing to share. The value-add that was most appealing was a monetary incentive, followed by alerts of device or service faults.
- » These results were backed up to some extent by responses to the questions on demand response (DR), where respondents were more willing to relinquish control of devices to providers in return for some monetary gain/saving.

The above all contribute to some extent in **upholding the hypothesis that consumer concerns about privacy will slow down the development of the connected consumer roadmap**. However, the results do give some indication as to the direction in which the industry needs to move to limit this and also on which areas privacy is going to be a greater barrier.

## SECURITY

The data from the ecosystem interviews and those from the consumer research painted two quite different pictures. For the ecosystem players, security was an extremely important element of the connected consumer roadmap. For the consumers, other issues were considered much more important.

The end-user research suggested that the hypothesis “**Concerns about the security of connected home devices are slowing down the market development**” is largely not true. It would seem that for most applications security is low down in the list of reasons why a consumer would not purchase or subscribe to a connected home service.

The one area of exception is in applications where security devices, such as door locks, can actually be controlled. Here, security is a bigger issue. However, for applications concerning energy, hazard detection, personal monitoring, comfort/convenience, and even security monitoring, the security of the system does not seem a barrier to adoption.

However, the ecosystem interviews should act as a warning to some extent. It would seem security is largely low on the consumer’s list of concerns. But this may be partly down to the fact it has not been raised as an issue to date. No high-profile security concerns have been raised or publicized in relation to smart home products. The concern and focus from the industry however, would suggest that many believe that in order to keep security as a low concern, a high level of vigilance in product and service design is required. And should a number of high-profile security problems occur, then confidence would quickly evaporate and the hypothesis would become more real.

## INTEROPERABILITY AND INTER-APPLICATION FUNCTIONALITY

The hypothesis to be explored is therefore **“A lack of interoperability and inter-application functionality will significantly limit the development of the connected consumer roadmap”**.

The evidence from the consumer survey suggests that in many cases consumers are purchasing multiple connected consumer products. This suggests that interoperability is important. There was also strong evidence from non-adopters that having a simple network was essential, and that complexity was a potential barrier to adoption. To add to this, being able to control all applications from one common application was highly desirable and so would add weight to the hypothesis.

The results did, however, point to some evidence that not all applications needed to be interoperable. There were natural groups of security-related devices and of energy-related devices, where there appeared to be a greater requirement for interoperability within the group, rather than across the whole range on in-scope smart home devices. Suppliers of smart home products thus need to prioritize their interoperability efforts around specific groups.

There were some results that countered the hypothesis. Certainly only a relatively small proportion of respondents extended their initial system set-up, and of those that did, there seemed to be little concern about interoperability. However, overall, the evidence from the research largely supports the hypothesis.

## USER INTERFACE (UI) AND REMOTE ACCESS

Two of the hypotheses were explored together. These were **“Fragmentation of UIs across device types helps, but within device types hinders, the development of the connected consumer roadmap”**.

“The need for remote access will result in different device types and different UIs depending on location and application.”

The key take-aways from the research for these hypotheses were:

- » Proliferation of different apps to control different parts of the home automation ecosystem will be detrimental to the market development.
- » The smartphone should be the primary device around which suppliers build their UI.
- » However, the UI should not be limited to just the smartphone. It is important that other devices can be used in certain locations; and for certain applications, other Internet-enabled devices offer a preferable interface for many users.
- » The UI for security, person monitoring and hazard detection applications needs to be developed considering the fact that, on many occasions, these applications will be accessed when not in the home; i.e., they require remote access. The smartphone is by far the most preferred device type when this is the case.
- » The UI for energy management and convenience applications are more likely to be used in the home, than in remote locations. The device types used in this situation are likely to be more varied and include in-home displays (IHDs), PCs, tablets and in some cases the device itself.
- » A complex UI is not a major factor in slowing down the adoption of the connected consumer roadmap. In general, the vast majority of respondents are not put off by the UI.
- » There is little appetite for alternative UIs, such as voice control.

The above all contribute to some extent in upholding the hypothesis that **“Fragmentation of UI across device types helps, but within device types hinders, the development of the connected consumer roadmap”**. It is definitely the case that multiple UIs are needed to enable interface via different device types. However, for an individual device, having one UI for all applications is preferable. However, the ecosystem interviews suggest this is unlikely to be achieved for some time.

The above also uphold the hypothesis **“The need for remote access will result in different devices types and different UIs depending on location and application”**. However, the results also support the fact that the smartphone will be central for remote access, even more so than for applications accessed in the home.

## INSTALLATION CHALLENGES AND SERVICING

The hypotheses are **“Professional installation will continue to be important, despite a growing self-install market”** and **“Providing good customer service is key to growing the market through building a better consumer experience”**.

IHS expects both the self-install and professional-install markets to develop alongside each other for the next few years. The target markets for each approach are sufficiently different that both may continue to coexist for the foreseeable future. The professional install market is more suited to more affluent consumers and those without the time or skill to install a system themselves. However, the self-install market will be split between those who have simply opted for a DIY solution in order to save money, and those who are true enthusiasts, who have a desire to understand the system and make the most of the connected home. This results in a fragmented market for self-install solutions.

Providing a good support service will be important for both self-install and professional-install. Those consumers who opt for a professional will expect a high level of service. However, those opting for self-install may find themselves often in need of support. As consumer awareness and knowledge of these systems is still relatively low, it is important to be able to educate existing customers after purchase, so that they will be able to troubleshoot their own systems more effectively.

As the industry grows into the mass consumer market, there will be an increased need for consumer support. There is also expected to be a growing need for professional install, at least for the initial set-up of the system.

## ROUTES TO MARKET, CHANNELS AND SUPPLIERS

**“Some routes to market are currently more dominant than others. However, this could change in future”**.

With more companies providing services and devices, the industry presented conflicting views on which companies the customer will prefer in future. All the industry participants agreed that awareness was one of the main factors driving the route to market to certain directions. As providers seek to find traction in the mass market, awareness and education will be powerful tools. This is an area where multi-service operators (MSOs) have an advantage, through a powerful brand and existing customer relationships. An installer network and a high-tech brand image will be key factors in reaching the mass market. However, as awareness of these systems increases, the industry expects that systems offered by retailers as self-install services will become more popular.

It is important for providers to be the first supplier of a connected system to the customer, as this will greatly increase the likelihood of the consumer purchasing additional products from them. This is important for all provider types, but customer retention will be most difficult in the retail market, as there often no ongoing fee for products and therefore no contract tying the consumer to the provider. However, it is expected that consumers who purchase a system through a retailer are more likely to buy additional products over time.

Connected home solutions are seen as a positive aspect when homes are for sale. Although the added value of these systems will vary dramatically, there is general agreement that they undoubtedly make a dwelling more attractive to buyers and can increase the marketability of a home significantly. There is expected to be a market in new buildings in future, with more providers approaching builders to incorporate comprehensive solutions into new homes. It is possible that, in the future, new homes will be expected to have a home automation system built in, just as high-speed Internet is expected to be built into new developments today.

## DEVICE MOBILITY

The hypothesis **“Consumers, especially those renting, prefer systems which are easy to move”** and **“Home automation systems make a home more attractive for a buyer”** were tested during the research.

**Advantages and disadvantages:** Traditionally, smart home systems were complex networks that often required hard wiring into the home. This model is changing, making use of more advanced low-power wireless technology to deliver a system that can operate for years without the battery needing to be changed. This has allowed simpler installation and associated de-installation of these systems. These systems also limit the amount of work that needs to be done on the home itself, reducing installation time and associated costs. This is a benefit to the consumer and also allows the provider to reach a larger market.



**Mobile solution overview:** Mobile solutions are usually easier and simpler to install and to uninstall. This makes them more attractive to consumers from segments which are less familiar with technology. This topic is discussed further in the Section 2.5.

Mobile solutions are more attractive to the rental market since they often require very little alteration to the property. People may also choose to take their system with them when they move out, which is likely to be after a shorter period than those who own their home.

**Built-in solution overview:** The customer may renew their purchase when moving home, offering the supplier an opportunity to gather feedback and build upon the customer relationship. This is a key proposition for high-end system providers that rely on high amounts of revenue from a relatively small customer base.

A built-in system encourages a deeper relationship with the provider through engineers installing and providing support for the system.

Built-in solutions are likely to add value to a home, as it is a more complex task to install them. These systems are rarely seen as a negative attribute of a home and are often seen as a very positive addition. In the coming years, as more houses become smart, it may be expected that new homes have some kind of smart functionality built-in. This may become a key differentiator in the new-build market similar to the eco-home segment we see emerging today.

Although the hypothesis “**Consumers, especially those renting, prefer systems which are easy to move**” was generally true, it should be noted that those with less familiarity with the technology were more likely to opt for a more mobile solution. The hypothesis “**Home automation systems make a home more attractive for a buyer**” was shown to be partly true in that it was unlikely that a home automation system would be a negative attribute of a house, but the strength of the positive nature of systems depends greatly on the consumer’s knowledge, experience, and desire for such a system.

## CONSUMER MOTIVATION

A number of key factors inhibit consumer procurement of connected home devices:

- » Awareness was hypothesized by the industry as a key barrier to uptake. Although this is a significant barrier for the adoption of connected home systems, the consumer seems to have become more aware of these systems since 2013. It seems that the work of some companies to market smart home systems, through campaigns based in stores, the Internet or TV advertising, has had an impact on awareness. There is still work to be done on this factor, which will continue to be a significant barrier for the market in the immediate future.
- » Education was thought to be a large barrier by the industry. This was backed up by the responses in the consumer survey where nearly a quarter of respondents were unsure of where to start with a home automation solution. Furthermore, education could effectively reduce the concerns over data privacy and home security which were both common reasons for lack of adoption.
- » Cost has had mixed opinions, with some of the industry believing that home automation is priced correctly. The hypothesis was that home automation systems have been priced for enthusiasts and high-end systems; in order to bring home automation to the mass market, the cost does need to be reduced. This is particularly the case for the initial investment, as the cost of setting up the initial devices is disproportionate to that for subsequent devices. This hypothesis was tested in the consumer survey, which discovered that cost was the largest hurdle for many consumers, across the ecosystem. However, cost had the largest impact on those with some interest in connected home applications, who had not yet purchased any. This highlighted the importance of reducing the initial cost of smart home systems, and focusing on generating revenues through subsequent purchases or a recurring fee.

## SCENARIOS AND AUTOMATION

The hypothesis was that “Scenario creation and adaptive learning systems are the first steps on the road to realizing the potential of the Internet of Things”.

The applications and functions of smart home systems that are needed change as the consumer's situation changes. They can generally be separated into two segments of 'home' and 'away': energy management and convenience are more important while at home; and security and home monitoring are more important while away. It is also of note that the 'away' preferences change slightly when the consumer is on holiday, focusing more on video surveillance rather than a sensor-based security reading.

The connected car is an important location for receiving notifications, but is secondary to receiving information at work. There was perceived benefit in opening and closing the garage door; and checking the home was secure on the journey to work in the morning.

The consumer still needs to be educated on the benefits of scenario generation and how to set this kind of automation up. This will be one of the greatest barriers to unlocking the potential of the Internet of Things within the connected home. Many consumers still do not create automation between different device sets, and feel more comfortable keeping the automation to single device segments.

The intelligence in these systems needs to be placed at the right level. Consumers do not want to feel that they are not in control of their homes. They expect the system to act as they imagine it should, and feel uncomfortable giving full control of in-home systems to a system able to make decisions by itself. The best use of this kind of intelligence is to offer the user ideas for automation programs. This way the user is in control of their system and knows what automation is expected and enabled.

## ES.9 PLOTTING AND NAVIGATING THE ROADMAP

The main objective of this report is to aid plotting the connected consumer roadmap. IHS has taken the view that the roadmap is defined by the respondent groups that have been pulled out in this report and outlined in the previous section. How to move along this roadmap is the key to realizing its full potential.

For example, the start of the roadmap is the "little potential" group of users. Understanding their behaviors and preferences is the first step. Using this understanding to move them along the roadmap to become 'potential adopters' is the challenge.

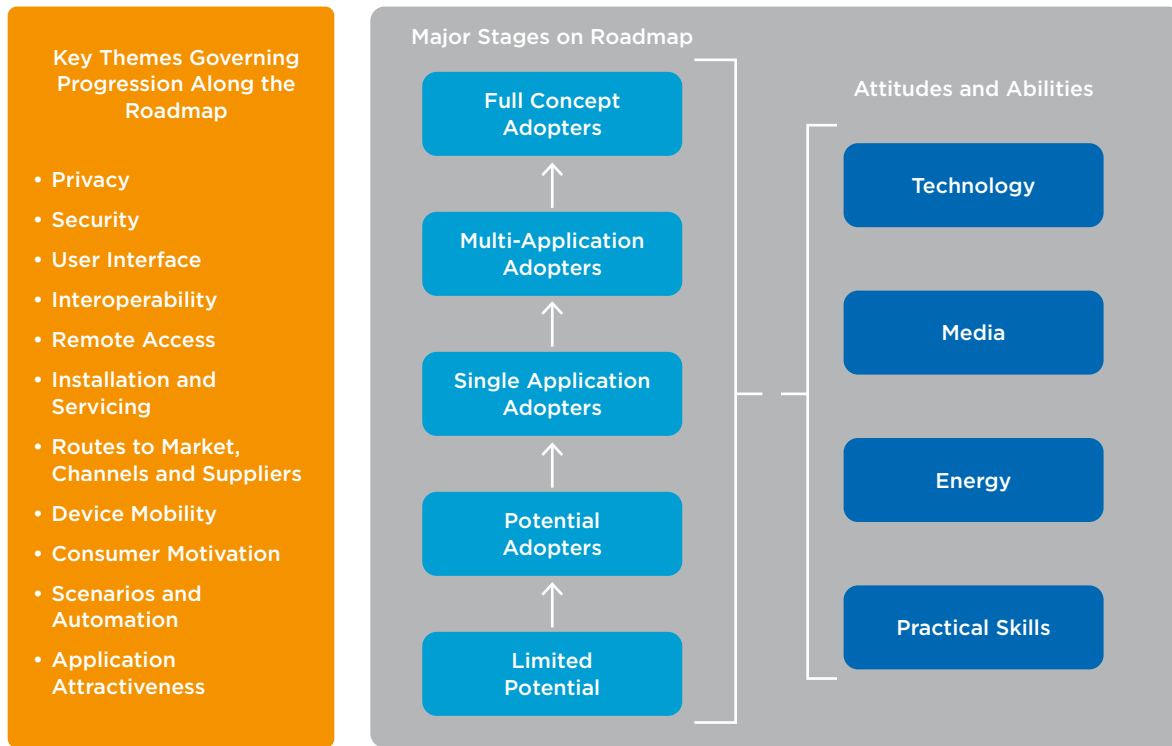
Similarly, understanding the behaviors and preferences of the "potential adopters" group is the next step. Using this understanding to move them along the roadmap to the "adopters" group is the challenge.

Finally, understanding the behaviors and preferences of the "adopters" group is next. For this group, expanding the breadth of connected consumer services is the challenge.

For each major customer segment, the other respondent segments around technology, media, energy management and practical skills play a part too. Moving consumers along the roadmap will have some subtleties depending on which group they belong to.

This section explores these concepts, taking each stage of the connected consumer roadmap and discussing behaviors and preferences of the group members and the requirements needed from the industry to move these consumers along the roadmap. The figure below expresses this map graphically. Each major stage in the map is now explored, examining the trends of the key themes associated with that location on the map and the nuances that differing attitudes and abilities bring to progression.

Figure ES.17 Connected Consumer Roadmap

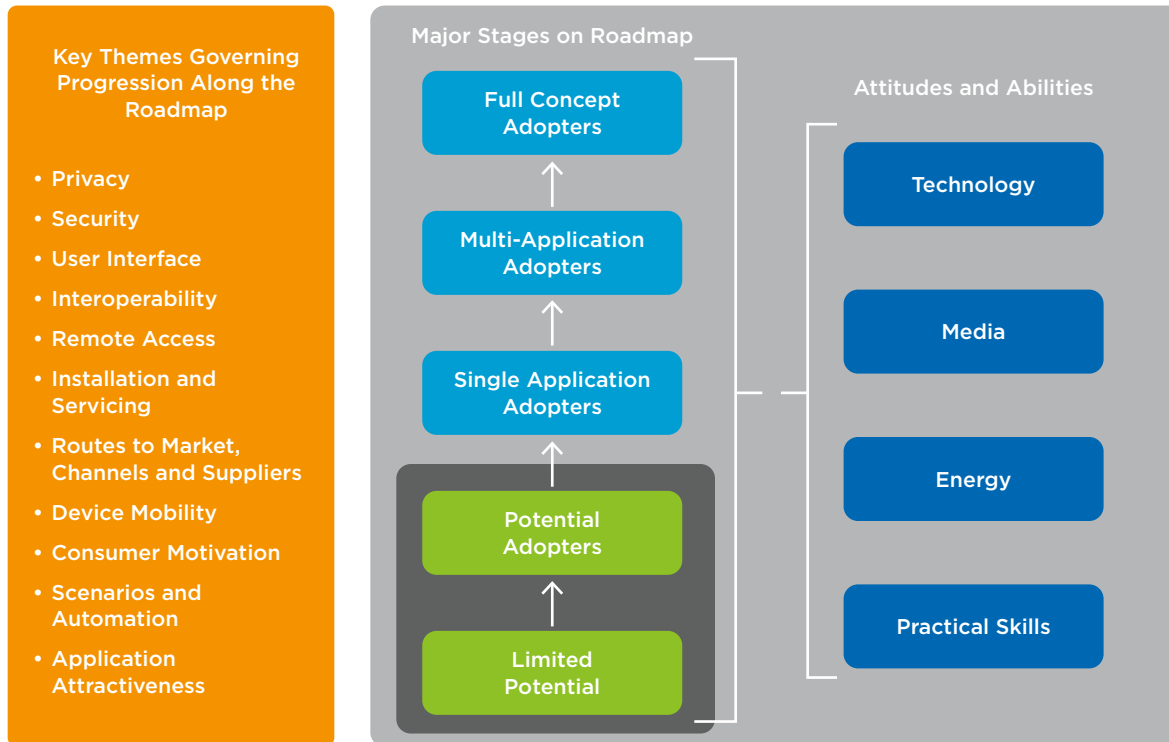


Source: IHS © 2015 IHS

## LITTLE POTENTIAL

These respondents had very little interest in the connected home in most cases; with some respondents exhibiting no interest at all. They do not own any connected home devices and did not express an interest in more than three of the applications defined in Q2.2. This section attempts to understand the behaviors of this group and aid the reader in obtaining insight as to how to move the 'little potential' group up the connected consumer roadmap to become potential adopters.

Figure ES.18 Connected Consumer Roadmap – Part 2



Source: IHS © 2015 IHS

Some of the key attributes of this group relating to the key themes are:

- » **Motivating the Consumer** is one of the largest challenges in engaging with this segment, as it has little interest in connected home applications. By far the largest hurdle is general awareness; 25% of this segment was made aware of connected home devices by the survey. This segment was less likely to have heard about the connected home by word of mouth, but had a strong response from TV. The Internet was a less common source of awareness than for the other segments because of the lack of interest. Only once consumers are aware of connected home solutions, can they be educated on the path they should take and the applications that are available. It is likely that once this segment is made aware, its members will begin to see more value in the connected home and may move into the next segment on the road to full adoption.
- » In general **Privacy** was a key barrier to adoption of consumer IoT applications, second only to cost. However it was not at the top of the list of barriers for respondents that fell into this group. It has been assumed that this is not because this group didn't care about privacy; but just that there were many other issues that had greater importance for this group.
- » Overall, **security** was less of a barrier to adoption of consumer IoT applications than other parameters examined. Although it was treated very seriously by ecosystem suppliers, consumers seemed much less

concerned with **security**, apart from in a small number of very sensitive applications. The trend in relation to security for the 'little potential' group was very similar to that of privacy; that is, it was not a major listed barrier, largely because other more fundamental barriers existed.

- » As with the previous two themes, **interoperability and inter-application functionality** were just too far along the roadmap to be an issue for this group. By definition, this group did not own any of the device types in question, and so getting multiple devices working together in an efficient way was not their immediate concern. When asked about the value of accessing multiple functions on one applications, this group was largely neutral and, overall, the least enthusiastic about this proposition. Again, it is assumed this relates to their concerns being linked to more fundamental barriers. If those could be overcome, the author is sure that the importance of interoperability and inter-application functionality would then increase for this group. Part of the analysis of this theme explored why respondents saw little value in any applications. The 'little potential' group by definition was largely the respondents answering this question; as it was only asked to those who had no interest in any application. "Keeping things simple" was the most important reason, so this does suggest that, even for these users, once other more fundamental barriers are crossed, should interoperability make things more complex, it would be another barrier to adoption.
- » The 'little potential' group was the one with the lowest level of ownership of the core devices that could be used as the **user interface** for applications in the connected consumer roadmap. For example, smart TV, smartphone and tablet ownership for this group was 16%, 44% and 37% respectively, compared with a sample average of 31%, 64% and 50%. Therefore, this needs to be kept in mind as the user interface (UI) is explored for this segment of the roadmap. However, PC ownership, at 88%, was near the sample average of 89%. So the group varied little from the sample average for this potential UI. The results for the analysis on UI in Section 2.4 concluded that the smartphone should be the primary UI in a multi-application ecosystem. However, the majority of this group doesn't own a smartphone, so this will be a fundamental barrier in moving them along the connected consumer roadmap. IHS projects that smartphone ownership will continue to increase, so the proportion of those that do not own such as device is projected to decrease, ultimately reducing the barrier; however, that does not mean suppliers to the connected home should ignore this element of the market if they expect to move "little interest" consumers along the roadmap to "potential adopters". Suppliers should also bear in mind the importance of keeping things simple for this group. The appetite for alternative UIs such as voice control was substantially less for this section of the market. Only 21% of this group saw any value, compared to nearly half of the wider sample. Some could argue that voice control did make things simpler. However, experience of voice control for most consumers to date has typically been one of more complex interfaces with technology. Suppliers to this market looking to move this group along the roadmap thus need to ensure that voice control is not the primary interface unless it is simple and very reliable. Interestingly, when members of this user group were asked why they did not wish to perform certain functions associated with the connected home, a much lower than average proportion indicated that a complex user interface was the issue. The UI appeared to be more of a barrier for respondents further along the roadmap. Instead, this group leaned much more towards more fundamental issues, such as practical benefit and financial benefit as the reasons, rather than the UI. This was true for the wider sample, but was a stronger trend for this group.
- » Question 3.11 examined the preferred locations for accessing different applications for all users. The respondents were given a range of choices, either at home or a range of **remote access** locations. Finally the users were permitted to select none of these locations. The preference for accessing services from remote locations was less appealing for the 'little potential' group than for the 'adopters' or 'potential adopters' groups. The fact that there was the option for the respondent to choose none of the devices goes some way to explaining this. However, taking this out of the equation, the trend was still for the 'little potential' group to see more value across the board in accessing applications from the home. So a key take-away from this is that to move the 'little potential' consumers into the 'potential adopters' segment of the map, the industry should at first focus on the benefits of in-home automation control. Remote access would be a potentially harder sell in general. The applications where this group did see the most benefit in relation to remote access were security-related, such

- as intruder alerts, door locking/unlocking, CCTV, and third-party wellbeing. This mirrored the wider sample.
- » **Installation and Servicing** – The ‘little potential’ segment is thought to be a good target for professional installation, as its lack of awareness hampers the ability to build a satisfactory consumer experience through a self-install solution. However, this was the segment most likely to opt for a DIY installation. This is largely due to this option being perceived as a lower cost alternative. Customer support will be very important for this segment; as it is likely to require help in all stages of the consumer process, from purchasing to installation and then to ongoing use.
  - » The **route to market** for the members of the ‘little potential’ segment is likely to be influenced heavily by word of mouth, as they are unlikely to have the knowledge of the ecosystem to select a route which works best for them. However, they would be best suited to a route that offers comprehensive support. This will be needed as the consumer will need to be educated on the capabilities and limitations of the solution. They are most likely to purchase a connected home solution through a provider with which they already have a relationship. This makes security and cable and satellite providers well placed to offer solutions to this segment.
  - » Because of a lack of education, members of the ‘little potential’ segment were the least confident on the subject of **scenarios and automation**. They are likely to expect the installer to set up all the automation they need and would not spend much time setting up additional scenarios. Indeed, around one-third of this segment said that they would prefer not to have scenarios. This shows how little investment this segment is willing to make in the connected home, as they do not understand the potential benefits of automation.

### CONCLUSIONS AND RECOMMENDATIONS FOR MOVING ‘LITTLE POTENTIAL’ CONSUMERS ALONG THE ROADMAP

In order to move the ‘little potential’ group into the ‘potential adopter’ group, the starting point needs to be awareness. A large proportion of this group were simply not aware of what technology was offered in relation to the connected consumer roadmap. Once awareness is raised, selling the basic concept will be the next challenge. Many in this segment were just not convinced of the basic selling points of consumer IoT. A large proportion believed that connected home devices were more hassle than they were worth, both in terms of cost, installation and usability.

The industry therefore needs to make it a priority that the consumer is educated on the benefits; and that both ease of installation and of use are prioritized. Devices also need to be designed assuming that many of this group do not have access to smartphones, smart TVs or tablets. Consequently, when at home, interfacing with applications via dedicated control panels is important; and for remote access, ensuring a compelling PC interface is also important. Leveraging existing consumer relationships (with utilities, media/communications providers and consumer electronics companies) is also important in accessing this market segment.

Simplicity and clear value propositions are the key to unlocking this group.

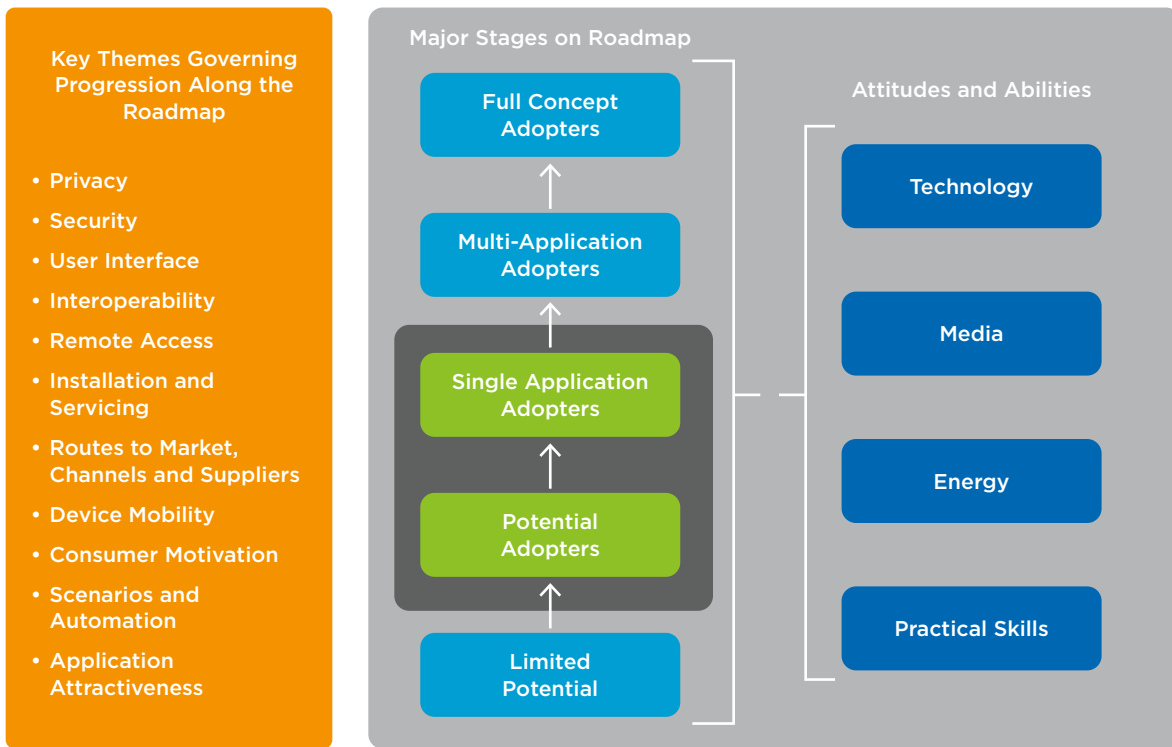
Some in the industry may believe that this segment should not be targeted initially, as there is lower hanging fruit in terms of market segments. However, 422 of the 1,036 respondents fell into this group, so by not addressing the needs of this group, much of the market is potentially ignored. This segment is expected to be under represented in this survey, due to this segment having a decreased interest in the connected home and therefore being less likely to complete the survey. Although focusing on expanding the use of applications in the adopter group and introducing the potential adopter group to their first products and services should be a priority, ensuring the ‘little potential’ group at least progressed out of a segment that is defined by a total lack of enthusiasm for connected home applications also needs to be given attention.

### POTENTIAL ADOPTERS

To recap, this group of respondents did not own any connected home devices, but demonstrated a level of interest in these devices in Q2.2. IHS included in the group the respondents who selected an interest level of at least “very valuable” in at least four out of the 24 application categories defined in Q2.2. This represents the group of consumers most likely to become new ‘adopters’. This section attempts to understand the behaviors of this group and aid the reader in obtaining insight as to how to move the ‘potential adopters’ up the connected consumer roadmap to become ‘adopters’.

- » Respondents in this group were a little more concerned about **privacy** compared with the little potential group. For the 'little potential' group privacy ranked fourth in the list of barriers to purchasing smart home products, with more fundamental issues presenting largest barriers. For the 'potential adopters', it ranked as second only to cost. The author assumes that this group has been "won over" in terms of the core value of the connected home and their concerns are now more about the subtleties of implementation.
- » The story is similar in relation to **security**. Respondents in this group were more concerned than the 'little potential' group about security on an application-by-application basis, but less concerned than the 'adopters', who expressed views that indicated they had the highest level of concern about security. However, the difference was not particularly large and security was not perceived as a particularly large barrier or issue. As with the wider sample, their concerns were more pronounced around security-related products and services, such as the ability to lock/unlock doors remotely, control garage doors, receive alerts in relation to intruders and remotely view a CCTV feed. For energy and comfort/convenience applications, security was perceived as a concern for less than 90% of this group. As a general barrier to smart home adoption, there was little difference between the 'adopter', 'potential adopter' and 'little potential' groups was limited.

Figure ES.19 Connected Consumer Roadmap – Part 3



Source: IHS © 2015 IHS

- » **Interoperability and Inter-application Functionality:** By definition, this group did not own any of the device types in question, and so getting multiple devices working together in an efficient way was not of immediate concern. When asked about the value of accessing multiple functions on one application, this group was, however, considerably more positive than the 'little potential' group. For the 'little potential group', only 39% saw any value; for the 'potential adopter' group, it was 69%. Thus is a clear indication that, as consumers move along the roadmap, they become more aware of the way that connected home applications and appliances work together. Suppliers should keep this in mind as they target products at this group, ensuring that the

virtues of interoperability across applications of their particular products are clear.

- » The ownership of devices that are potential **user interfaces (UIs)** for this group were around the sample average. For example, smart TV, smartphone, tablet and PC ownership for this group was 24%, 64%, 46% and 88% respectively, compared to a sample average of 31%, 64%, 50% and 89%. The attitude to voice control for this group was somewhat different to that of the 'little potential' group, although the "average" response was still below "moderately valuable". This group saw complex UI as a relatively unimportant issue in their adoption of the connected home. For most applications in question, the percentage of respondents from this group that believed a complex UI would be a barrier was largely less than 5%, and for all but three applications was less than 10%. This percentage was lower than for the 'adopter' group. This suggests that in general, a complex UI is not a perceived issue prior to purchase, although once consumers become 'adopters' the realities of using some UIs mean that it becomes a greater barrier to further adoption.
- » The results from Question 4.14-4.17 were examined specifically for this 'potential adopters' group. The value that this group placed in being able to access applications from **remote locations** (in Questions 4.14-4.17) when not at home, was actually higher than for the 'adopter' group on average. Perhaps the suggested promise of remote access was actually of more importance than the reality. As with the wider sample, the greatest value was seen in relation to security application. This was followed by health related applications, then energy, and finally by entertainment and convenience. Question 3.11 examined which device types were preferred by application and location. Overall, as with the wider sample, this 'potential adopter' group typically saw the smartphone as the preferred device.
- » **Installation Challenges and Servicing** will vary considerable within this segment. It consists of a broad range of consumers whose needs and capabilities vary greatly. This segment commonly opt for professional install: the respondents in the group were aware of their own lack of understanding and appreciated the support that could be given through a provider with an installer network. There were also many who would prefer self-installation, usually to save money. Potential adopters tended to have better DIY and technical skills than those in the 'little potential' segment.
- » **Routes to Market, Channels and Suppliers** will be heavily influenced by the consumers' existing experiences. They are likely to use companies with which they are familiar or with which they have an existing relationship. Such companies will mainly consist of security service providers, mass-media companies and retailers. Those more likely to opt for security and service providers will be those with a lower understanding and confidence with connected technology, but who have the income available to subscribe to these services. Retail companies will be more popular among those looking to save money. Although being knowledgeable and tech-savvy is currently seen as a prerequisite for installing a retailer-provided solution, the industry is taking steps to reduce this assumption to give the wider market confidence to buy solutions from retail outlets.
- » **Device Mobility** may be important for potential adopters, as a potential consumer may purchase only a few devices to begin with, to experiment and learn more about the connected home before making a larger investment. Devices that are pre-installed into an existing home may be a good way of introducing more consumers to connected home devices.
- » **Consumer Motivation** will be driven by increasing education into the capabilities of the connected home. As awareness and desire have been established with this segment, all that remains is to reduce the barriers to entry. The most significant of these is unfamiliarity with the kinds of technology and solutions available. It is noted that when educating the consumer, it is important to approach the subject from an approachable lifestyle standpoint, rather than bombarding them with technical terms that risk alienating the consumer from the solution. Television remains a powerful tool for educating the potential adopter, with the Internet becoming an increasingly effective resource, as the interest of this group in connected home solutions encourages them to look a little further into the industry.
- » Engagement with **scenarios and automation** is noticeably higher than with the 'little potential' segment. Although perceived confidence is not much higher than with the 'little potential' segment, the number of respondents willing to 'have a go' was higher, with only one-third not attempting any kind of scenario



creation. They were also willing to spend more time on scenario creation. It is important for this segment, whose confidence is still relatively low, to offer assistance and suggestions on automation programs and schedules. Regarding an intelligent learning system, because of the limited understanding of technology, a fully autonomous learning system could present an unpredictable consumer experience. This type of intelligence may be better utilized by offering advice and suggestions to the consumer to improve the connected home experience; however, it is important that the consumer is always aware of the changes to the automation system, so they can do a sanity check on the proposed changes, and to increase their engagement with the system.

### CONCLUSIONS AND RECOMMENDATIONS FOR MOVING 'POTENTIAL ADOPTER' CONSUMERS ALONG THE ROADMAP

To some extent, education also plays a key role for this group. It is, in general, more educated on the concepts of the connected home. However, there are pockets where this is less so. Many in this group are already sold on the concepts offered by the connected home. The essential challenge is motivating them to make that first step; and educating them in how to do it.

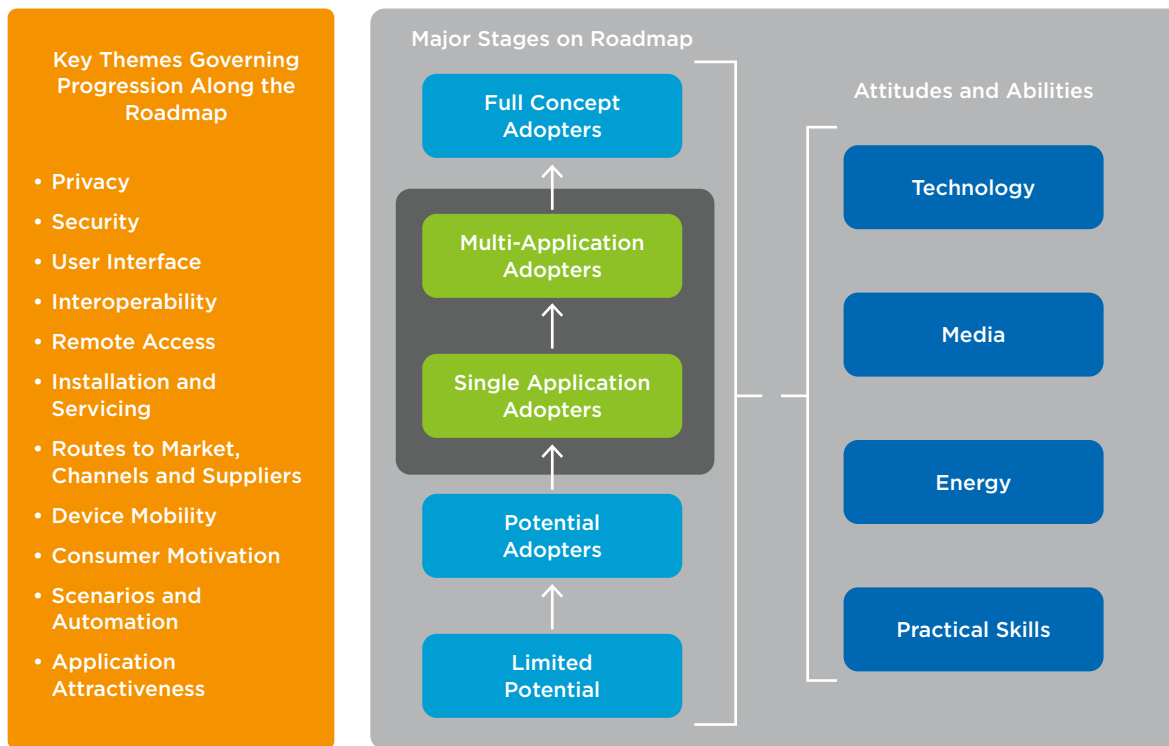
The routes to do this are again through channels where users have existing relationships, through existing security solution providers, their existing energy suppliers, via consumer electronics brands that they are already familiar with, and media/communication companies they already use. There is no one-size-fits-all route at present as respondents indicated a whole range of suppliers they would go to for different applications. IHS believes that there will be some consolidation in this respect. However, for the foreseeable future fragmentation of the supplier base will remain.

As this 'potential adopter' group is more aware of the concepts, it also tends to be more astute in terms of issues such as privacy, usability and interoperability. Application fragmentation will be a significant barrier for this group. Having a range of devices to access applications is essential; but for each device, fragmentation of applications is a negative.

### SINGLE APPLICATION ADOPTERS

To recap, in the sample, these respondents demonstrated ownership of at least one connected home device, through their answers to Q2.1. In the map, IHS has made the distinction between those that owned just one product (excluding control devices) and those that owned multiple devices or those that have expanded their network. The challenge for the industry in relation to this group is persuading them to move from their single devices or single application ownership to having a more complex connected home.

Figure ES.20 Connected Consumer Roadmap – Part 4



Source: IHS © 2015 IHS

- » Respondents in this group were the most concerned about **privacy**. For the 'little potential' group it ranked second in the list of barriers to purchasing smart home products, as it did with this group. However, for this group it was much closer to cost in relative importance. As with the 'potential adopter' group, the author assumes that this group has been "won over" in terms of the core value of the connected home and its concerns are now more about the subtleties of their existing systems and potential expansions. Therefore, suppliers to this market, looking to move single device adopters along the roadmap to become multiple device adopters, need to keep privacy at the forefront of their message, ensuring that as they try to move the consumer along a path to a more complex connected home, privacy is handled carefully and, wherever possible, traded off for added value propositions such as reductions in costs/bills or improved services. This group in particular has a heightened concern about data being shared with parties other than the main service provider; and so again, this should be at the forefront of supplier minds as they develop products targeted at this group. The sensitivity to which the suppliers approach privacy also needs to be tailored toward the type of data they are looking to collect. Information on energy consumption, heating/cooling appliance usage, in-house climate and diagnostic data is perceived as less sensitive by this group. Information on the location of home occupants and media consumption is more sensitive.
- » The story is similar in relation to **security**. Respondents in this group were more concerned than the 'potential adopter' and 'little potential' groups in terms of their concerns around security on an application-by-application basis. However, the difference was not particularly large and security was not perceived as a particularly large barrier or issue. As with the wider sample, their concerns were more pronounced about security-related products and services, such as the ability to lock/unlock doors remotely, control garage doors, receive alerts in relation to intruders, and remotely view a CCTV feed. For energy and comfort/convenience applications, security was perceived as a concern for less than 90% of this group. As an overall barrier to smart home

- adoption, the difference between 'adopters', 'potential adopters' and 'little potential' respondents was limited.
- » **Interoperability and inter-application functionality:** The data in this section can be used to understand what is required to move consumers along the roadmap to a position where a complex ecosystem of connected devices is used in their homes. The results show that, on average, already the adopter group owns 3.4 devices. However, for many this includes a dedicated display and TV/entertainment control. Take these devices out and the number is nearer 2.8. However, still this means that many adopters are already at that next step along the roadmap in terms of owning multiple connected devices.
  - » That being said, it is probably more interesting to understand the split across defined major applications areas. If each of the applications tested in Question 2.1 are allocated into just six wider groups of controller/display, appliances, energy, security, health, and lighting, and then the controller and display devices removed from the analysis, some more telling results are obtained. The results show the proportion of adopters just using one major category of device is 44%. Of those, the most common is the wider "security" area. This was followed by energy, health, appliance, and lighting. Of the 56% that were already using a combination of major application categories, more than half had a security and energy combination (some with additional applications too). Therefore, as far as the inter-application functionality that would move those adopters using just one major category to the place in the map of true multi-application adopters, the combination with the most impact would be security and energy. Of those using more than one major category, the wider security category was in 83% of the combinations. This further suggests that any cross-platform offering needs to have security-related applications at the centre in order to move this group to the next stage on the roadmap.
  - » The 'adopter' group, far more than any other, placed a value on having multiple functions controllable from the same app; 81% placed value in this, compared to 69% for the potential adopters. There was little difference within the adopter group to this proposition, between those using just one major category of applications and those using more.
  - » Perhaps slightly surprisingly, when asked in Questions 4.14-4.17 about the more important attributes of a connected home, remote access was ranked lower for this group than the potential adopter group. As mentioned earlier this perhaps suggests that the perceived advantages of remote access are greater than the reality. As with the wider sample and other sub-groups, the security application area was the area where respondents saw the greatest value from remote access. And the smartphone was the preferred access method; this applied even on locations such as vehicles, where the vehicle itself could provide the UI.
  - » The ownership of devices that are potential **UIs** for this group were well above the sample average. For example, smart TV, smartphone, tablet and PC ownership for this group was 58%, 83%, 69% and 92% respectively, compared to a sample average of 31%, 64%, 50% and 89%. So when approaching this group, providers can assume that a range of UI can be used to access applications, The attitude to voice control for this group was somewhat different to the 'little potential' group, although the "average" response was still below "moderately valuable". This group saw complex UI as of relatively low importance in their adoption of the connected home. For most applications in question, the share of respondents from this group that believed a complex UI would be a barrier was largely less than 5%, and for all but three applications was less than 10%. Although still low, this was higher than with the 'potential adopter' group. This suggests that in general, complex UI is not a perceived issue prior to purchase, although once consumers become adopters the realities of using some UI mean that it becomes a greater barrier to further adoption. Therefore, a complex UI is a potential barrier to moving some in this group from single application user to the next stage in the roadmap.
  - » When asked about the value of having all connected home functions controllable and accessible via one application (Question 3.12), this group was the keenest. On average across the sample, 70% saw this as valuable. With actual users, i.e., the adopter group, 81% saw the value.
  - » It is important to maintain installation and support services past the purchase stage. In order to move initial adopters to adopting more devices, they must have a high degree of satisfaction with their experience. This includes satisfaction with the devices themselves, the effectiveness of the automation solution that has been implemented, and the experience the consumer has had in working with the provider. Although adopters

- had the highest levels of confidence in setting up self-install solutions, they were the most likely to opt for a professionally installed system; partly because they had a high household income.
- » Adopters tend to retain their initial routes to market, channels and suppliers. Additionally, 20% of those who bought additional products bought them from their initial provider without even considering other suppliers. This highlights the importance of building a relationship with the consumer that encourages them to purchase additional products.
  - » Device mobility is not a concern for many adopters as they intend to remain in their current home for the foreseeable future. Many early adopters also have traditional high-end systems that are not mobile. In this case, it is likely that, should the consumer move homes, they would re-purchase the system in the new home. This opens an opportunity to gain a new customer as the system is pre-installed in the old home; 95% of adopters would place value in a smart home system incorporated into a new home. This shows that there is potential to increase the value or attractiveness of a property by using connected home solutions.
  - » Consumer motivation is still important with those who have started to buy connected products. For these consumers, awareness and education are less of a barrier, although many consumers may still be unaware of the capabilities of the devices they own. It is likely that consumers who own multiple connected devices are more likely to build upon their system with additional devices. This is the key to accessing the potential of the Internet of Things. However, the most significant barrier for the consumers in this segment is cost. There was a group of respondents, owning high-end solutions and with large household incomes, for whom cost was not a major concern. However, for the mass market, cost is still a major barrier to the purchase of additional devices, being selected as a significant barrier by 78% of the total sample.
  - » Those in the 'adopter' segment were the most familiar with scenarios and automation. However, 21% of them would still not attempt to set up scenarios on a home automation system. One industry expert stated that only 27% of their users set up automation between two device segments. This shows that even those who have adopted connected home technology are not realizing the potential of their systems. Solution providers need to offer their customers more help in this regard by assisting them in setting up automation, or suggesting scenarios that they may find helpful. This is where a learning system can have a large impact, by suggesting adjustments and additional scenarios to the user's schedule. Around 90% of adopters indicated they would be willing to spend time setting up scenarios, with more than one-third of respondents happy to spend a few hours or more setting up their system with the necessary automation scenarios.

## CONCLUSIONS AND RECOMMENDATIONS FOR MOVING 'SINGLE-APPLICATION ADOPTERS' ALONG THE ROADMAP

The key point to take away from this section is that 44% of respondents that had in-scope devices/applications already in use, used applications in just one of the major categories (security, energy, lighting, health, and appliances). This group represents an important group of consumers, who have already been convinced of the benefit of the connected home; but they have made only a limited investment. Many seem keen to expand their connected home, although few have actually done so.

For most, the central application is security and so expanding applications from this central pillar would make most sense. It also needs to be noted that this group is the one that is most highly aware of and concerned about issues of privacy, security and user interface. It is thus central to marketing and design strategy to ensure these issues are addressed.

Finally, when expanding the connected home ecosystem, although many consumers go back to their original suppliers, more also look beyond their original suppliers. Enabling a true connected consumer experience will therefore be always constrained, if this process is hindered by the lack of interoperability that currently exists between so many solutions.

## ES.10 TOP TEN TAKEAWAYS AND RECOMMENDATIONS

The below outlines the top ten take aways and recommendations from this research:

- » IoT (the Internet of Things) is one of three technologies that IHS recently projected would have the most

impact on the world of technology over the next five years. Consumer applications are central to many of the IoT markets and ecosystems that will develop. Around 96 billion connected IoT devices are forecast to be in use by 2025. The technology to enable this is already in place. However, the biggest challenge to realizing the full potential will be the development of business models. A compelling business case with a solid return on investment (ROI) is required for equipment manufacturers, end-users and service providers that are considering investment in IoT solutions and applications. Although some business models are well defined and easily quantified, for many, considerable work still needs to be done.

- » Interoperability is essential. At present, many devices types, topologies and connectivity solutions are on the market. This is limiting the potential of the connected consumer roadmap as consumers want to interface with consumer IoT applications from multiple suppliers using one device. The industry needs to work together to develop standard platforms and protocols for consumer IoT or smart home applications.
- » The full concept of the connected consumer will only be realized when currently disparate systems can fully work together with little user set-up required. At present most consumers that own IoT devices are using them in relatively closed, application-specific ecosystems. The industry is leaving a lot on the table if solutions are not adapted so that a more connected automation ecosystem can be offered. That being said, consumers are not in a position to understand fully how advanced features such as scenarios can aid them. Therefore, suppliers to the market need to develop this for the consumer to some extent.
- » For most consumers that have purchased consumer IoT products, most have bought from specialists. That being said, IHS believes this will change. Historically, the market has been dominated by higher-end systems, an area where specialists have some advantages. However, the market is forecast to change; as this occurs, the use of specialists is forecast to decline.
- » The center of the connected consumer ecosystem is the smartphone. Other devices types will play a role as the control device, but the smartphone will ultimately win out. This gives MSOs, such as AT&T and Verizon, and smartphone suppliers, such as Apple and Samsung, an advantage; as they already have a relationship with the consumer via this central device. This advantage is perhaps greater when consumers are looking for broad solutions that include several applications, such as a combination of lighting, security and energy management. Although the market will not solely develop around these types of companies, other companies looking to develop a business in the consumer IoT market would have an advantage if they developed partnerships with leading MSOs and smartphone suppliers.
- » For consumers looking to set up very application-specific solutions, then suppliers associated with that solution type are forecast to succeed. For example, utilities are forecast to dominate consumers looking for smart energy management devices and security suppliers for those looking specifically for smart security solutions.
- » Privacy is a significant concern for consumers in relation to consumer IoT/smart home applications. After cost, this is the largest barrier. Suppliers and other players in the connected consumer ecosystem need to keep privacy at the center of product development as they look to offer devices and services to this market. How consumer data is used, and by whom, must be transparent to consumers; and the benefits to them must be made obvious.
- » Cost is still a significant barrier to adoption. That being said, many consumers have expanded their initial network of connected IoT devices since installation. So once an initial purchase was made, consumers were largely very positive about their investment and were keen to expand. Setting a low-cost point-of-entry with a product strategy that then allows consumers to expand their networks, devices and services is recommended.
- » Difficulties of installation are a significant barrier to adoption. The most highly successful electronics-based services markets that have developed in recent decades have been largely plug-and-play – for example the mobile phone itself, broadband Internet, and Wi-Fi. There are some applications around the smart home where professional installation is a must. However, suppliers of products and services need to ensure that wherever possible, self-install solutions are offered, with professional installation as a premium back-up for those that require it.
- » Remote access is essential for most applications, particularly those for security, hazard detection and energy

management. Again the smart phone is central, and remote access solutions should be built using the smart phone as the primary interface device. The most common remote access locations are the consumer's workplace and car. However, even in these locations, where other devices such as a PC or vehicle infotainment solutions are available to the user as the point of access, the smart phone is still the solution preferred by most.

## **ES.11 CASE STUDY ON THE DISCOVERY & SERVICE LAYER FOR IOT PROVIDED BY THE UPnP FORUM**

### **THE FIRST CHAPTER: THE CONNECTED HOME**

In late 1999, the founding members of what would become the UPnP Forum started to put together their original framework and specification to connect the growing number of connected devices in the home.

At the time, the primary use case was broadband sharing. Multi-PC households were just beginning to take hold, fuelled by lower priced computers and newer networking technologies such as Wi-Fi. Over the next few years, tens of millions of consumers would begin sharing high-speed Internet. In a few more years, the same consumers would be gaming online, listening to streaming music services and watching Netflix and YouTube on their TVs.

The success of the UPnP Forum's early work exceeded all expectations. Over the next decade, UPnP technology helped fuel an explosion in home networking and connected entertainment as over a thousand companies would eventually become members and over 2 billion UPnP enabled products would make their way into consumer's homes.

### **THE INTERNET OF THINGS OPPORTUNITY**

As the rise of consumer connectivity envisioned by UPnP Forum became a widely adopted reality, a whole new set of driving forces began to reshape the technology landscape over the next few years. The arrival of mobile computing, cloud and big data, alongside massive advances in embedded computing and sensor networks combined to create the foundation of the next wave in technology evolution in the Internet of Things.

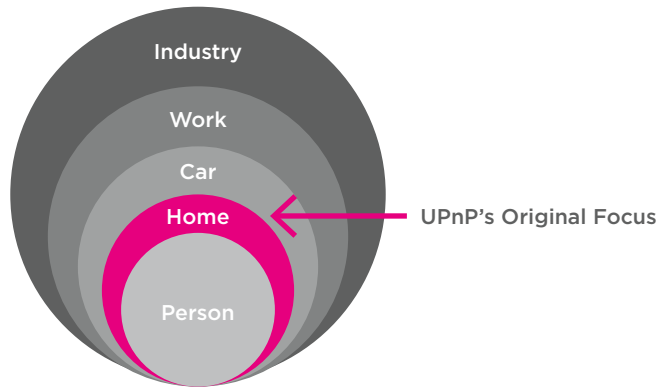
The expectations for the Internet of Things are impressive. According to Cisco, the Internet of "Everything" is a \$19 trillion opportunity, while companies like GE see markets like healthcare garnering an extra \$63 billion in incremental value over the next 15 years.

While the arrival of the Internet of Things has created significant excitement across the technology, investor and media communities, it has also sparked conversation about the necessity for industry and technology interoperability. The promise of the Internet of Things is only possible when proper device and service discovery frameworks are in place, the foundation of which provides a way to bridge device, network, company and industry divides.

### **A NEW UPnP FOR THE INTERNET OF THINGS ERA**

This need for enabling software frameworks to power the Internet of Things has created a new opportunity for UPnP Forum to expand beyond its original focus.

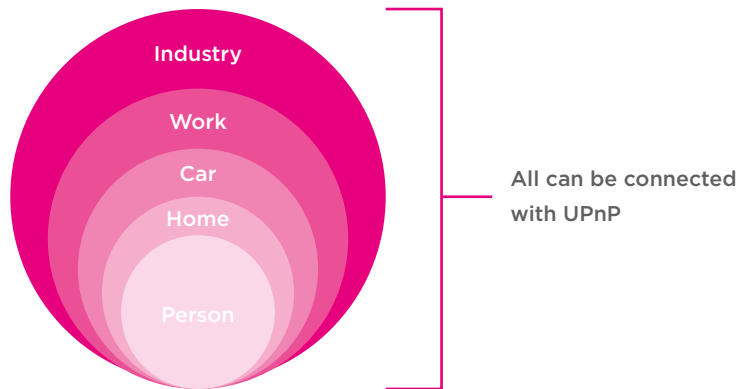
Figure ES.21 UPnP Forum's Original Focus



The above graphic illustrates the focus of the original UPnP standard. The connected home, which has seen significant adoption and change over the years as consumers have embraced connected entertainment devices, was at the center of UPnP Forum's first wave of success. While UPnP technology was ahead of others with discovery frameworks for devices such as automatic blinds, HVAC and lighting (first certification seven years ago, other segments of the Internet of Things such as industrial technology and M2M matured largely independent of UPnP and remain largely siloed in the past.

However, industry and technology silos are unsustainable if the Internet of Things is to reach its massive potential. By definition, the Internet of Things requires a dissolving of artificial barriers between markets, where every "thing" with an embedded sensor and computing intelligence becomes part of a much larger world where things are connected, have access to services, and share data with one another.

Figure ES.22 Addressable Markets for UPnP in IoT Era



This is where an established framework like UPnP can help. By increasing its scope beyond the connected home (as seen above), UPnP can provide the necessary discovery and service layer for the Internet of Things and enable device, network and service interoperability. The above illustration shows what segments of the Internet of Things that could benefit from UPnP.

**UPNP+: A MODERN UPNP FOR THE INTERNET OF THINGS ERA**

With the Internet of Things on the horizon, UPnP Forum realized over the past few years it had a significant opportunity to meet a growing need in the market for a mature and future-proofed connectivity framework. It began to prepare the specification for the future, and the first step in this process was identifying the requirements of a modern and adaptable standard.

Below are requirements of a modern connectivity framework for the Internet of Things:

- » **Must Be Built For a Modern Internet And Be Backwards Compatible:** Any modern connectivity framework needs to integrate the latest Internet technologies, including IPV6, while also being backwards compatible with IPV4.
- » **Must Be Cloud Compatible:** Devices in the Internet of Things require seamless connectivity to the cloud, including Web services, software and content.
- » **Must Be Interoperable Across PAN, LAN and WAN:** Needs to work across a variety of networks and protocols, with both IP and non-IP networks, including low-power devices on networks such as Z-Wave, ZigBee and Bluetooth.
- » **Must Be Secure:** The Internet of Things opens up potential new vulnerabilities. Any standard must have robust security built into the core specification.
- » **Must Be Scalable:** With forecasts for the Internet of Things reaching tens of billions of devices, foundational platforms must be scalable.

With these requirements in mind, UPnP Forum built the next generation of UPnP with UPnP+. UPnP+ is a modern standard built for the future that also leverages the core competencies of a standard with over a decade and a half of market acceptance. UPnP technology is already installed on over 2 billion devices the market, already has established device control protocols for automation of devices such as HVAC, security and lighting, and a robust security framework that is now a required part of UPnP+® Certified products.

On top of this solid foundation, UPnP+ adds the following key components:

**Bridging and Sensor Management.** UPnP+ is written to support a variety of sensors and actuators across a variety of radio technologies such as Wi-Fi, Z-Wave, ZigBee, Bluetooth and more. The UPnP+ architecture allows for low-power bridging of IP and non-IP devices.

Additionally, the UPnP core standard has already laid a foundation for the IoT hub – a necessary component in bridging the different IoT networks - in with its UPnP Internet Device Gateway (IGD) standard, a software framework that today is installed on tens of millions of routers already in the market.

**Cloud And Anywhere Access Built Into Standard.** UPnP+ makes cloud connectivity a core part of its architecture by mapping UPnP devices to the cloud using the mature and well-recognized XMPP framework. XMPP also UPnP+ to virtually any Web technology and enables devices anywhere to communicate with any other device using this same proven protocol that enables private and secure communication in today's Internet chat rooms.

**Robust And Scalable Data Model Built for the Internet of Things.** The UPnP data model has been updated for the Internet of Things to account for sensor access, management and data. The UPnP+ data model enables a new IoT device to be defined within minutes without the need for a new specification, allowing those building products and services with UPnP to scale at the speed of the Internet.

**Security:** UPnP+ certification requires implementation of the DeviceProtection:1 security service, a new service developed in 2011 to update the original UPnP security standard from 2003 to address new threats and an evolving consumer device landscape. Easier to set up and modernized to recognize the prevalence of technologies like Wi-Fi, the new DeviceProtection:1 service is a role-based security model that is expected to be baseline protection to billions of new IoT devices.

#### UPNP+ AND THE INTERNET OF THINGS INDUSTRY

While UPnP Forum has worked hard to create a modern specification to help the Internet of Things to reach its full potential in UPnP+, they recognize they are not the only group working to develop a standard in this exciting and highly dynamic market.



In addition to working closely with all of the physical layer technology standard bodies overseeing such standards as ZigBee and Wi-Fi, the UPnP Forum is actively open to alliance agreement opportunities with others developing connectivity frameworks. The UPnP Forum's decade and a half of experience developing a robust standard for device discovery and control in the connected home is unparalleled, and they look forward to working with others to help the Internet of Things deliver on its promise.

At the same time, UPnP Forum believes they offer what is the best foundation for the Internet of Things today. A quick comparison of UPnP to others in Figure ES.23 below shows the advantages of UPnP and UPnP+ relative to emerging frameworks.

UPnP's wide adoption in over 2 billion devices is due in large part to UPnP Forum's embrace of both commercial and open source environments. Today UPnP development tools and code bases are available across every major operating system including Windows, iOS, MacOS, Linux, and Android, is available in a variety of open source projects, and runs in a variety of programming languages such as C, C++, Java, Javascript and Python.

Figure ES.23 IoT Software Framework Comparison Matrix

	UPnP	AllSeen	OIC	HomeKit	Works with Nest
Open-Source	Yes	Yes	Yes	No	No
# of Devices in Field	Over 2 billion	Less than 5 million	New - less than 1 million	None as of March 2015	Less than 10 million
Physical Layer Agnostic	Yes	Yes	Yes	Maybe	Maybe
Years of Development	14	4	1	1	1
Member Companies	1,000+	-150	-70	?	?
App Multiplatform?	Yes	Yes	Yes	Control points only iOS	Works with iOS, Android
Specialized silicon required?	No	No	No	Yes	Yes

Source: IHS © 2015 IHS

## SUMMARY

Today's Internet of Things landscape is one that holds great promise. As this new set of disruptive technologies based on advances in embedded computing, sensors, cloud and big data begins to take hold, most experts believe we will see huge changes across nearly every industry.

Massive shifts in business and operational models in medical, manufacturing, consumer goods and other industries are just the beginning, as companies completely reinvent the way they create and offer products and services to consumers.

However, the promise of IoT and the resulting creation of new economic value is entirely dependent on the ability of these new technologies to reach across industry, company and consumer divides through a robust set of agreed upon software and technology standards. Today's lack of a widely agreed upon interoperability and discovery framework threatens to slow adoption of the Internet of Things and, even worse, means that it fails to deliver on its promise.

With UPnP and UPnP+, the industry has a proven, established discovery and control framework built for the Internet of Things. By building upon the foundation laid through the adoption of UPnP technology by over one thousand companies,

2 billion products and nearly 15 years of experience, UPnP+ has incorporated modern capabilities such as access to cloud and Web services, sensor bridging for any device regardless of power profile or network, a flexible and easily expandable data model and a robust security layer to create a future-proofed standard built to enable the Internet of Things to reach its full potential.

#### ABOUT UPNP

UPnP Forum, established in 1999, is an impartial global industry standards body that has paved the way for seamless connectivity between more than a billion devices. Its 1000+ companies and organizations work together to enable device-to-device interoperability and facilitate easier, better home networking. UPnP promotes adoption of uniform technical device interconnectivity standards and certifies devices conforming to these, paving the way for seamless connectivity between more than a billion home devices running above the IP layer.

The Forum has widened its scope to encompass the Cloud, including integration for content and services, as well as bridging to non-UPnP networks (ZigBee, Z-Wave, Bluetooth, ANT+...). This enables a broad range of applications including health & fitness, energy management and home automation.



# CONNECTED

## CONSUMER ROADMAP

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Driven by the Internet of Things

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