

# **FUTURE OF VOICE CONTROL FOR CONSUMER INTERACTIONS WITH INTERNET OF THINGS SYSTEMS: IN THE CONTEXT OF INTEGRATION WITH OTHER SERVICES OFFERED BY TRADITIONAL SERVICE PROVIDERS**

Mark Bugajski

ARRIS, USA

## **ABSTRACT**

The Internet of Things (IoT) is emerging as an ecosystem of connected sensors, and wearables that communicate with cloud-based intelligence to generate value-add actions at consumer premises over mainly mobile devices. However, the feedback from initial deployments indicates that there are significant barriers to the average consumer in the areas of installing the equipment, connecting it to the controllers, and setting up and managing new services.

Products and services for IoT in the home (Home IoT) target consumers' premises devices and the connected objects surrounding us. This paper outlines the unique opportunities and challenges that Home IoT and Health IoT will present to existing service providers. The author will review the general readiness for IoT of the existing networking technologies in our connected homes and analyse the longevity of the current connections to the cloud where the service intelligence will reside.

## **INTRODUCTION**

As the population in developed countries ages and installations of flat screens continue en-mass, consumers' affection for large TV screens grows. As a result, increased opportunities will emerge for future IoT services to use large screens as user interface portals. Devices like set-tops and gateways that are currently being provided or certified by established service providers would have a role in delivering these services. Gateways and set-top boxes have historically been regarded as safer than PCs, tablets, Over-the-Top (OTT) mobile devices, and webcams when it comes to data security and privacy. Enabling personalized interaction with these devices will be key to addressing varied levels of consumers' cognitive and physical abilities. The set-top boxes with their remotes (pilots) are already well accepted as a means of interacting with service providers' systems. The rapidly growing voice recognition and the resultant service control using natural language will play a significant role in making self-creation of new services and interaction with them simple and manageable by an average consumer.

## WE ARE FORTUNATE TO LIVE IN INTERESTING, FAST-CHANGING TIMES

The impact on our lives made by ubiquitous, standards-based connectivity across man, machines, and surrounding us via “clouds of intelligence” can be seen everywhere. Nowadays, we “wear” computers exceeding the ones that took us to the moon, and these mobile devices can interact with an unlimited volume of “smarts” in massive data centres. A simple law spelled-out by late Gordon Moore, one of the founders of Intel, continues to make impact on size, cost, and power consumption of processors, memory, wireless radios, and physical sensors. It is extremely easy to augment a simple, every day-use device or relative complex systems that we interact with a “communicator” and put its functionality under the supervision and control of the cloud-based intelligence. Internet standards applied to the physical and software design of such an add-on almost magically changes simple things around us into citizens of “Internet of Things” eco systems.

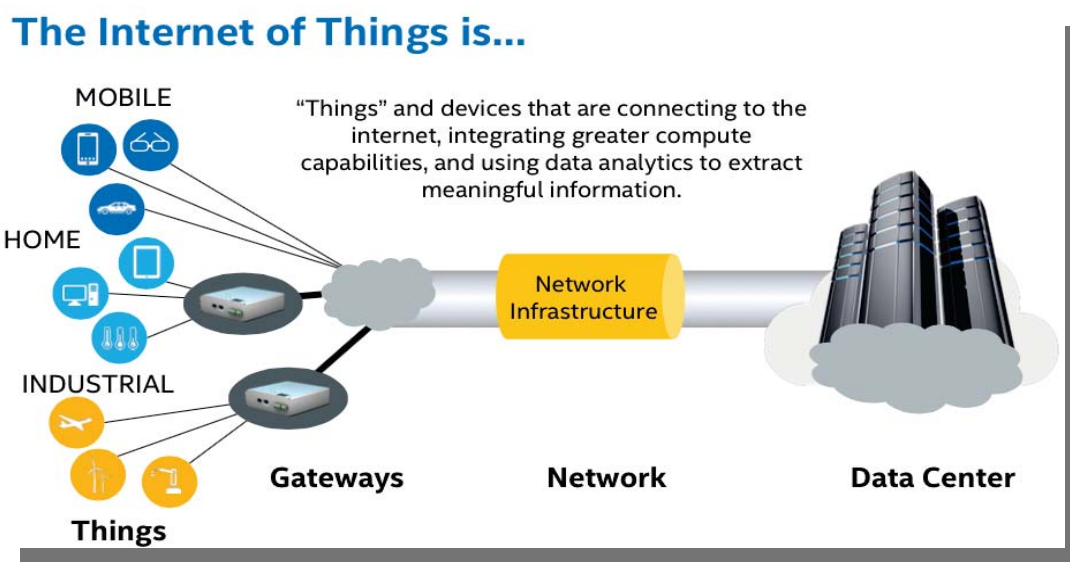


Figure 1 – The Internet of Things is ...

Early deployments of Industrial IoT systems are proceeding quite nicely as a continuation of automation of manufacturing and business processes with extensions to improve efficiencies in connected cities and communities. On the other hand, Home IoT, after the initial phase of enthusiasm of early adopters and lofty predictions by analysts, has run into several roadblocks. OTT IoT service providers, with roots in consumer electronics, started selling vertically integrated solutions consisting of a hub, a mobile app, and a set of theoretically interoperable sensors, bulbs, thermostats, webcams, locks, and actuators that were made by traditional makers of either proprietary or unconnected “things”. Use cases so far concentrate on simple automation, temperature control, and scheduling of lights. Also, webcam to the mobile phone streaming (via a cloud) became available as a service. The search for recurring revenue is increasingly more difficult as an average person tends to believe that they can install and manage the “things” themselves and next finds out that a value proposition of such a “Do it yourself” (DIY) service is not very attractive. What is not helping the perception of early DIY IoT is poor reliability of the connections inside the house, outages of the devices, webcams, hubs, and even problems with the OTT clouds.

The 2015 Consumer Entertainment Index (CEI) survey conducted by ARRIS, identified personal data security, high costs, and the complexity of the IoT systems as significant obstacles to scaling of these new services. It turns out that consumers generally do not

trust OTT IoT service providers, and instead feel much more comfortable with the traditional TV or broadband service provider.

### Whom out of the following would you trust most to supply this sort of remote management or automated home service to you?

	Total	US and Canada	
		US	Canada
Internet service provider	29%	18%	19%
Home security company	19%	21%	23%
TV service provider	14%	25%	20%
Utilities company	10%	13%	8%
Insurance provider	9%	6%	7%
Electronics manufacturer (e.g. the manufacturer of your TV or games console)	6%	4%	3%
Home improvement store/DIY retailer	3%	3%	5%
Healthcare provider	1%	1%	1%
Would not trust any of the above to supply a connected home service	9%	8%	14%
<b>Base</b>	<b>10820</b>	<b>405</b>	<b>392</b>

43%

Figure 2 – Whom do you trust?

Consumers also do not like the “stand-alone” aspects of the home automation services, especially when provided by an unknown, Internet based company.

### Which of the following would make you more likely to choose a specific remote management or automated home service supplier over another?

	Total	US and Canada	
		US	Canada
Receive an all-in-one combined bill with other household services (if supplier also provides other services to your household)	35%	43%	36%
Just pay for the equipment and time that the service is used rather than a fixed monthly bill	32%	32%	24%
Already buy other services from the supplier (e.g. Internet, utilities, etc.)	29%	37%	34%
More deals/vouchers/coupons become available the more you use the service	17%	19%	13%
Service use is linked to advertisements that you see on television, so advertisements are more likely to be relevant to you and your household	6%	6%	3%
Other (please specify)	0%	0%	2%
None of the above	16%	13%	20%
<b>Base</b>	<b>10820</b>	<b>405</b>	<b>392</b>

52%

Figure 3 – Which would you choose: OTT or service provider?

Lack of trust into the current OTT IoT service providers also manifests itself in the answers to the questions related to the personal data exposing and sharing on the Internet.

Would you be willing to share personal data and allow your use of devices to be monitored in exchange for special offers? This would be a function that could be switched off whenever you wanted.

	US and Canada		
	Total	US	Canada
Yes	11%	20%	9%
Yes – but as long as I could opt out at any time	38%	37%	34%
No – I wouldn't feel comfortable with sharing my information in this way	41%	34%	43%
Not sure	10%	9%	15%
Base	10820	405	392

79%

Figure 4 – Would you be willing to share your personal data?

One can draw several conclusions from this and other surveys that also emphasize issues with the perceived high cost of the connected devices and for the service fees being asked:

- Incumbent service providers (telecom, cable, ISP) can make IoT services more interesting than a mere “home automation” by integrating it with other multimedia services. For example, add home network management, on-TV screen notifications, and webcam viewing to the bundle
- They can reduce the monthly “sticker-shock” by bundling the services and create new services paid for by the third party partners (insurance, utilities, advertisers, and health and wellness companies)
- Reduce overall system cost by adding IoT interfaces to their gateways and set-top boxes and using their resources to enable the services
- Add extra security and personal data protection by harnessing their existing content security mechanisms
- Reduce the self-installation and management challenges by using their own field technicians to install and maintain the in-home systems
- Significantly simplify the user experience when interacting with the system by using set-top boxes to show on the TV screen the status of the devices and allow creating of If-This-Then-That sequences using the well-familiar remote/pilot devices

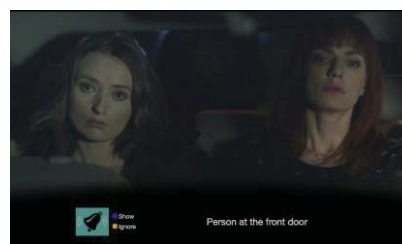


Figure 5 – Example of on-screen notification from the connected doorbell. Blue button on the remote connects webcam to TV screen

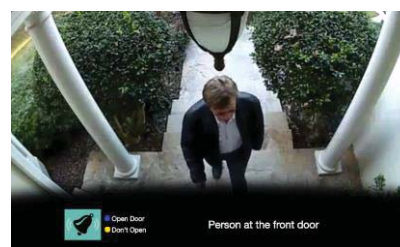


Figure 6 – Example of webcam feed to TV screen via a set-top box with an on-screen notification. Blue button on the remote allows the activation of the connected door lock



- Use voice recognition enabled remote and ASR/NLU engines to control services as well as creating them

As incumbent service providers embrace IoT instead of treating as yet-another OTT connection between things at home and the cloud, new categories of services will emerge. The service provider will become a gate-keeper and a broker for the consumer of multiple offerings from companies loosely connected to the home now and wanting to compete for the home owner’s monies. For example, insurance companies may offer free security and water leakage, and/or fire monitoring devices in return for discounts in the insurance rates. Utilities and local energy generators (solar or wind) may compete to sell electricity and schedule/manage its consumption to optimize its use (schedule electric car charging, washing and drying, cooling and heating, etc.).

We have conducted a joint study with a large service provider to estimate contributions of these new services to the bottom line. The majority of the future IoT services revenue is anticipated to come from the external partners who will use the operators’ connections and partner on bundling. The results are illustrated on the Figure 7 below.

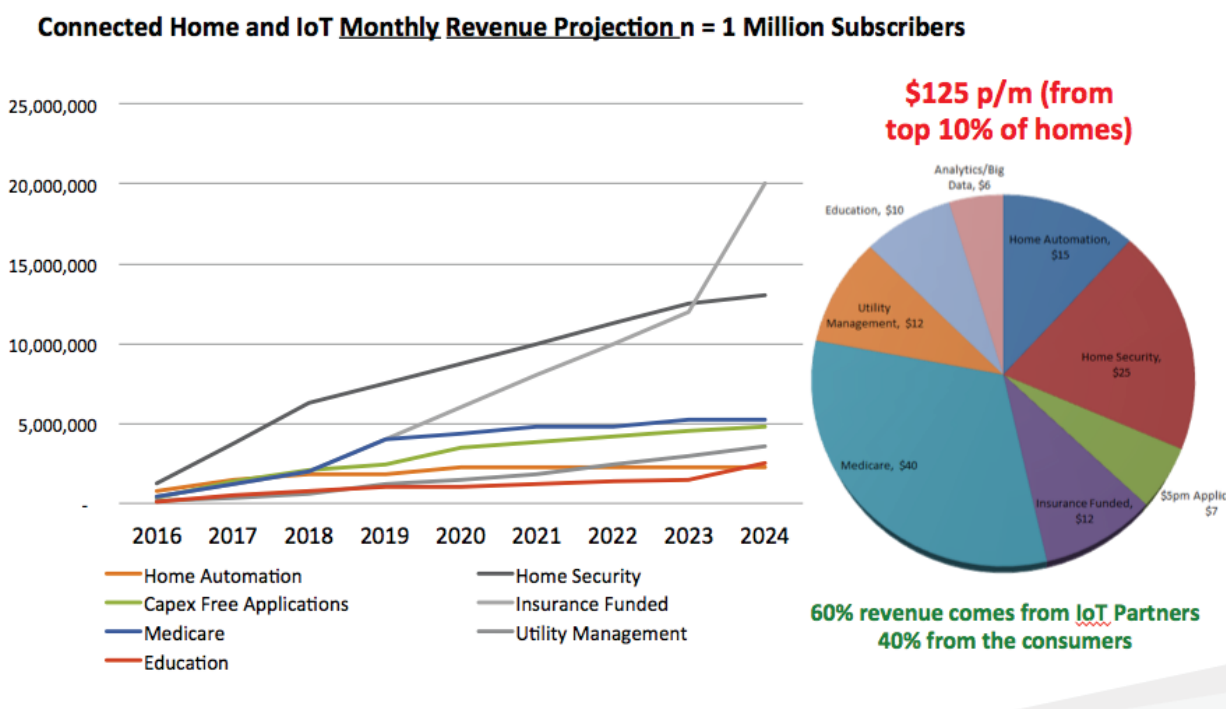


Figure 7 – Connected Home and IoT Monthly Revenue Projection per Million Subscribers

### WE ARE NOT GETTING ANY YOUNGER

The segment of IoT on the pie chart that seems to be gaining investors’ interest and public attention lately has to do with addressing lifestyle and health trends of the aging baby boomers generation. It is directly related to aging-in-place and care-giving/taking. America, Europe, Japan, and China will see significant changes in their “Age Pyramid”. For example, the elderly population of the US will more than double between now and year 2050.

As an example of the effect this has on the general population, current estimates in the USA are that 30% of households today have someone in the family who is either care-

giving or care receiving. The average cost of a day of care in a USA hospital is higher than \$3,000. This new segment often called Internet of Healthy Things (IoHT) aims at automating the monitoring of people, instead of physically being with them and at moving the post-treated patient home with several devices to monitor their vital signs, monitor and ensure their compliance with medication, taking prescription from the doctor including pills and even intravenous dosages of drugs.

There is a strong interest in the USA-based SCTE forum to standardize connections, APIs, security mechanism across multiple operators to form a unified, easy-to-connect to, super secure network for end-to-end IoHT services.

When it comes to service providers opportunities to reduce the cost of the IoT systems to the subscriber and to themselves, there are two devices that they provide or approve for delivery of the existing services (both broadband and TV) that are perfect candidates for playing key roles in the world of IoT.

The broadband gateway can be augmented by the IoT radio (Z-bee and/or Z-wave and Bluetooth). In addition to providing Wi-Fi coverage of the household, the gateway can communicate with new IoT/HT devices. Its CPU can run an IoT Interconnect Framework software that translates various protocols inside the home to a common set of northbound IP interfaces to IoT Systems Cloud as illustrated in Figure 8 below. Connection to the Cloud is always under the service provider's control (vs. OTT). Connection to the gateway is more reliable than to any consumer electronic device (rarely Wi-Fi). The gateway connection is monitored and managed 24 hours a day, all year long. And, the headed gateway/set-top box is least likely to be unplugged from the wall by the consumer.

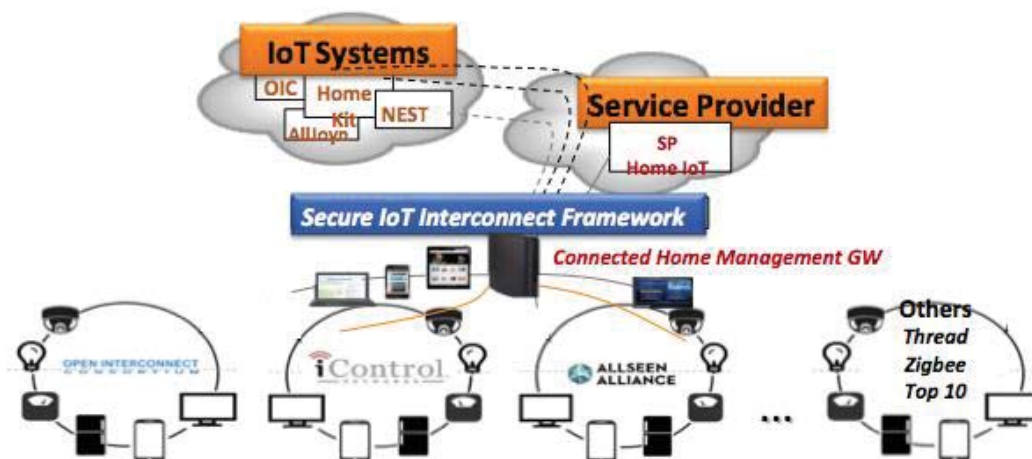


Figure 8 – Secure IoT Interconnect Framework

A modern set-top box as a portal to the IoT services can play an equally important role. The large screen fed by the set-top box provides sufficient real estate to visualize all home devices. Set-top boxes are always connected to the cloud and monitored as diligently as the gateway. Set-top boxes variety is limited and more manageable than consumer electronic devices; this gives set-tops an advantage over mobile devices as IoT portals. Additionally, there is no need to support applications (apps) on many device generations and hundreds of hardware models.

And finally, there is no need to support generations and many releases of operating systems and apps. Today's early adopters of IoT carry and own close to 20 mobile apps that are individually responsible for managing one or two devices and/or functions. These apps' actions do not interact with other apps or each other. Their screen designs are dissimilar, as are the navigation methods. All of that creates an IoT application roulette (Figure 9) that confuses and alienates average consumers. It's even worse for those who have limited vision or hearing, and/or limited hand/eye coordination; each of which makes it difficult to use smart phones and tablets. For that segment of the population, the remote/pilot is still easiest to use and the big screen a dependable source of comfort and information.

When all these diverse apps get integrated into one, cloud-based web app that is rendered by the set-top box on a largest screen in the household, the user experience will improve dramatically. A simple, unified method of navigating inside the app using a remote/pilot device can be devised to make the interaction fun and rewarding.

We are seeing the proliferation of voice control and navigation in cars, computers, connected TVs, OTT set-top boxes, and of course mobile devices. Almost every car manufacturer has one. Some even use celebrity voices to speak to us. Apple's Siri has pioneered the

mobile devices and most recently Amazon's Alexa (the only interface to the Echo device) began to control compatible IoT devices. One can ask why using TV screen and voice-enabled pilot for interaction with IoT and IoT services is better than using apps on mobile devices? The answers are straightforward. The sheer amount of connected devices that need to be visualized and controlled will easily overwhelm any mobile screen and "browsing" for these devices across multiple screens and apps will be much more challenging to the average user than seeing all of them on one large screen. It is very important for the operator committed to embracing these new emerging services to integrate as many services that they already provide (audio, video, and broadband) into a portfolio of services. For example, a light-touch home security service can feature streaming music or active-home-sounds from the STB to Sonos connected speakers. A triggered motion sensor can cause the house to "come-to-life" with sounds and light when we are away.

Voice control is already becoming the preferred way of performing searches on mobile devices. Amazon's Alexa "skills" are experiencing rapid growth as illustrated on Figure 10



Figure 9 – An IoT Application Roulette

## Alexa Voice Service – OEM / Developer Integrations (10+ integrations...)



## Alexa 'Skills' Kit Developers = ~950 Skills (5/16) vs. 14 Skills (9/15)



Figure 10 – Amazon's Alexa "skills" growth

Incumbent service providers have only begun introducing voice-enabled remotes/pilots since the legacy set-top boxes tend to have long shelf life. However, the pace of updates and replacement of set-top boxes is picking up and the addition of a microphone to the remote and a two-way connection to the set-top box (RF4CE or BT LE) appears to be in the planning books of many operators now.

### WE CAN MAKE IOT SERVICES EASIER TO USE

Our experiments and prototyping of an IoT web app that uses voice-based interaction with the user have been shown to address the majority of user experience related issues of an average consumer. Using natural language, the consumer can on-board, name and identify capabilities of a newly connected device. Next she/he can devise and setup multiple-step, simple conditional sequences (IfTTT) where triggering sensors will cause a series of reactions ranging from simple notifications on the TV screen, to more thorough reactions like turning on the lights and alerting friends and family. Other IfTTT mini-services allow users to define action words (by speaking them to the system) that will become triggers for subsequent events. For example: speaking "open the front door" will cause the IP-connected lock to unlock itself.

In our method of visualization of mini IoT services, we use animated icons resembling the actual devices and actions placed in a sequence with service logic linking the icons into a string of events.

Figure 12 shows a set of IfTTT mini services, invoked by a simple voice command "Show Internet of Things Services".



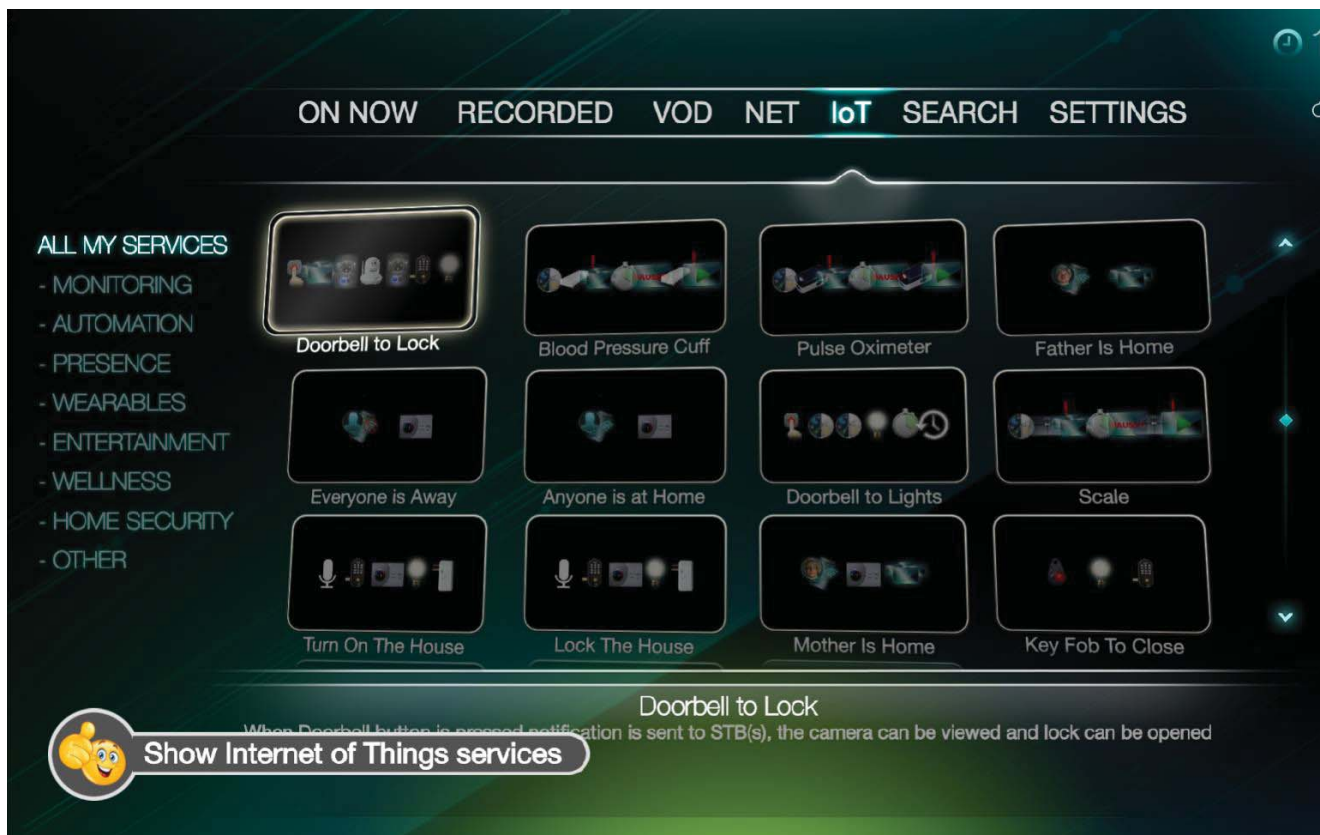


Figure 11 – View on IfTTT mini services

Figure 12 below illustrates expanded view of one of such services in which the triggered motion detector at a specific time of the day causes appearance of notifications (that the motion has been detected) on the TV screen and causes the light to turn on, and causes one outlet to switch on and another light to turn on.

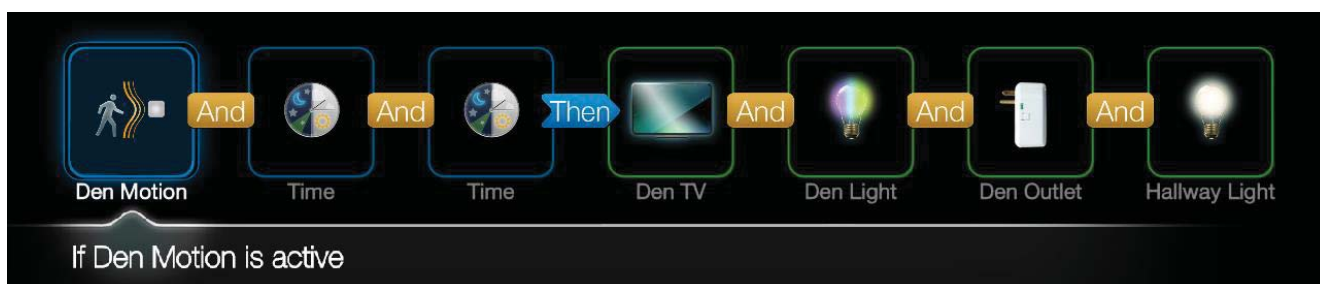


Figure 12 – Example of an IfTTT mini service

This entire sequence of service events can be created using voice control as illustrated on the next set of figures.

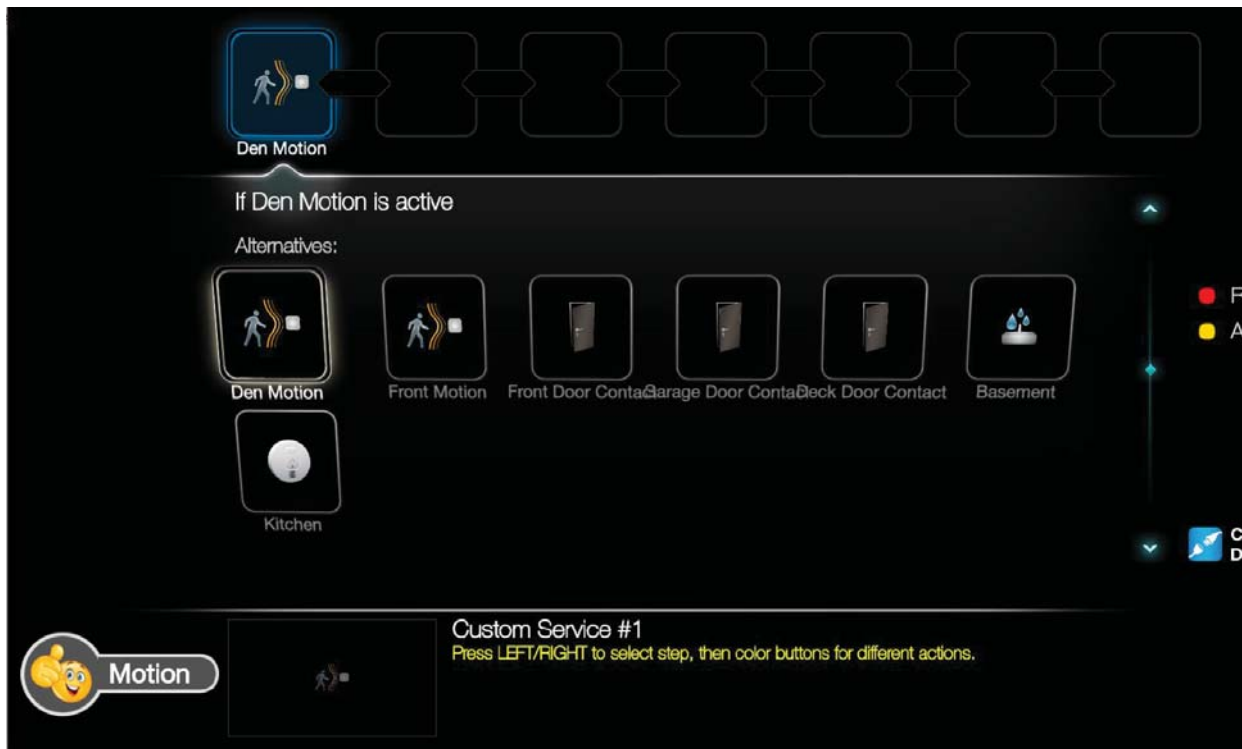


Figure 13 – Voice-based selection of the motion detector



Figure 14 – Voice-based selection of a next step service logic

We could continue creating the entire service, yet will stop here.

This example illustrates how straightforward the creation of IfTTT sequences can be when under voice control. In our opinion, such a user interface is going to significantly accelerate

the adoption of IoT services by allowing average consumers to take ownership of them and create their own use cases. Long term, these mini services can be shared across user communities whilst hosted by the service providers capable of supporting them.

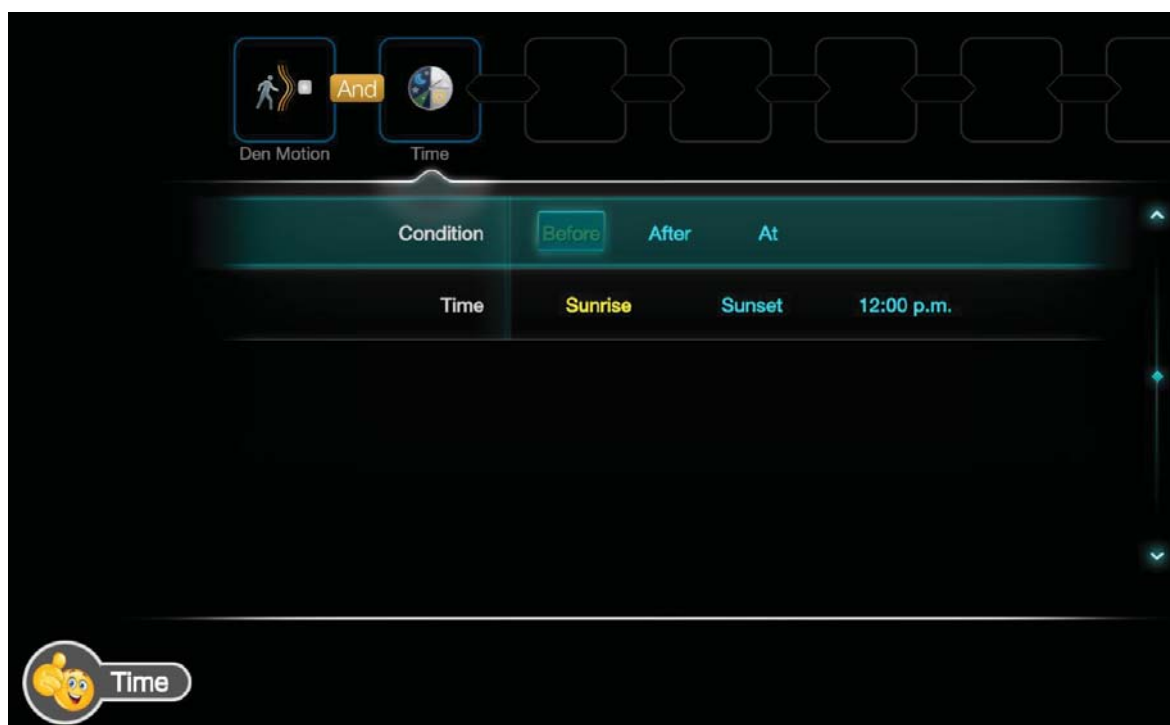


Figure 15 – Voice-based selection of the next step - time conditions

## CONCLUSIONS

An era of Internet of Things started with a lot of hype and expectations. Many industry pundits are still predicting a rapid growth in deployment of millions of connected devices and huge growth in revenue for service providers. However, the early indications are that significant barriers have appeared on a path to IoT growth and scaling to the masses.

Equipment cost, technical difficulties in provisioning and managing the services, lack of trust of early OTT service providers, and resistance of the early adopter to pay subscription fees all contribute to a slow start. We believe that the incumbent service providers are in an excellent position to join the IoT industry, especially when partnering (with health, insurance, and utility companies) to create new, attractive, and true value-added services. Incumbent service providers can easily integrate IoT with their other services, reduce the additional CAPEX, and bundle it with other offerings. They can use existing field technicians to install and maintain IoT equipment. Integration of IoT management with a user interface provided by the set-top box will solve the App Roulette challenge and make interaction with new services simple and intuitive for an average consumer. Voice control-based creation of the mini IoT services (IfTT sequences) will significantly help the consumer fully harness the IoT potential in the future.