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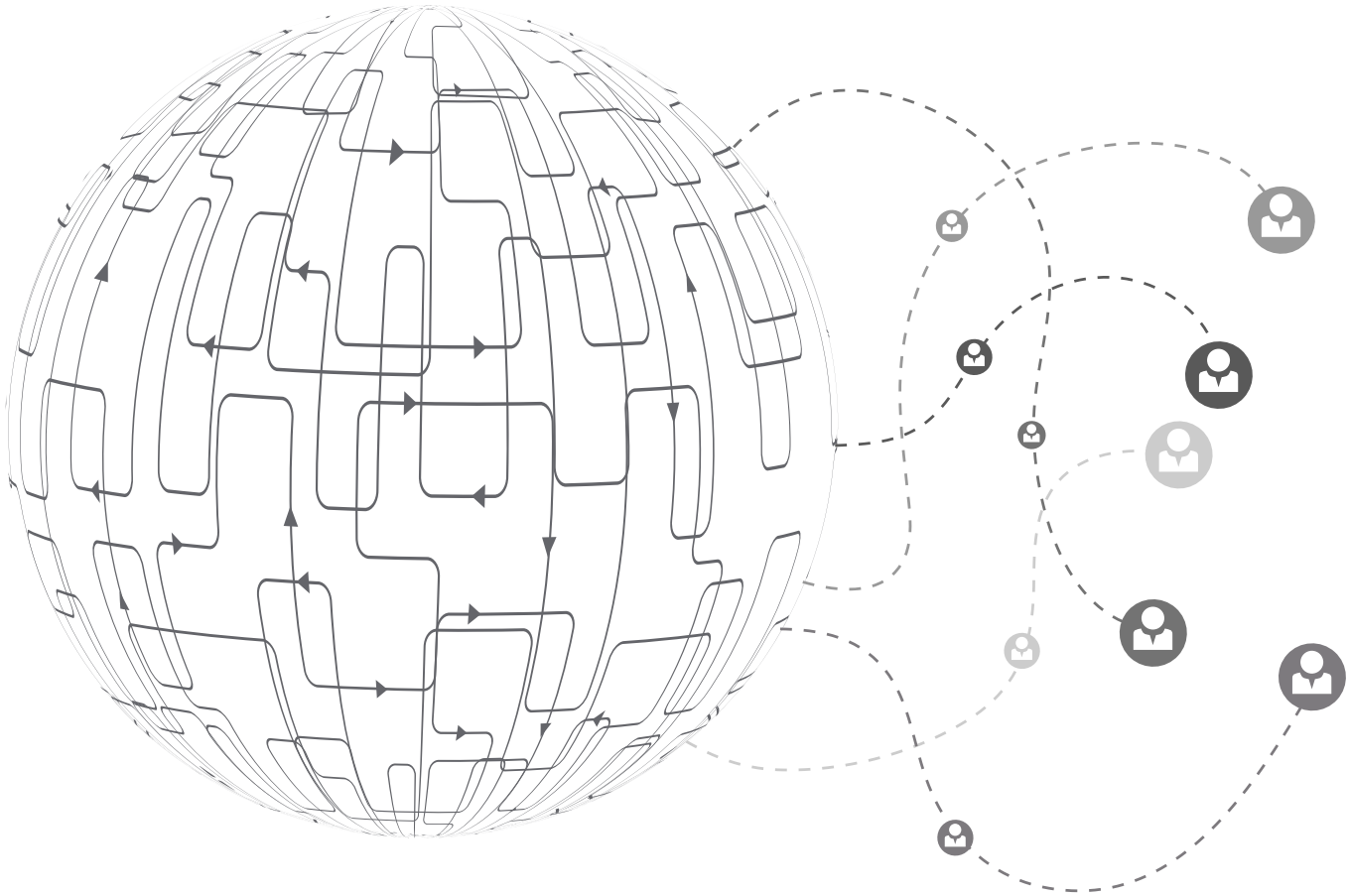
USING CONSUMER MEASUREMENT TO BRING THE INTERNET OF THINGS INTO THE MAINSTREAM

By JP Abello, Director, Global Engineering R&D, Nielsen



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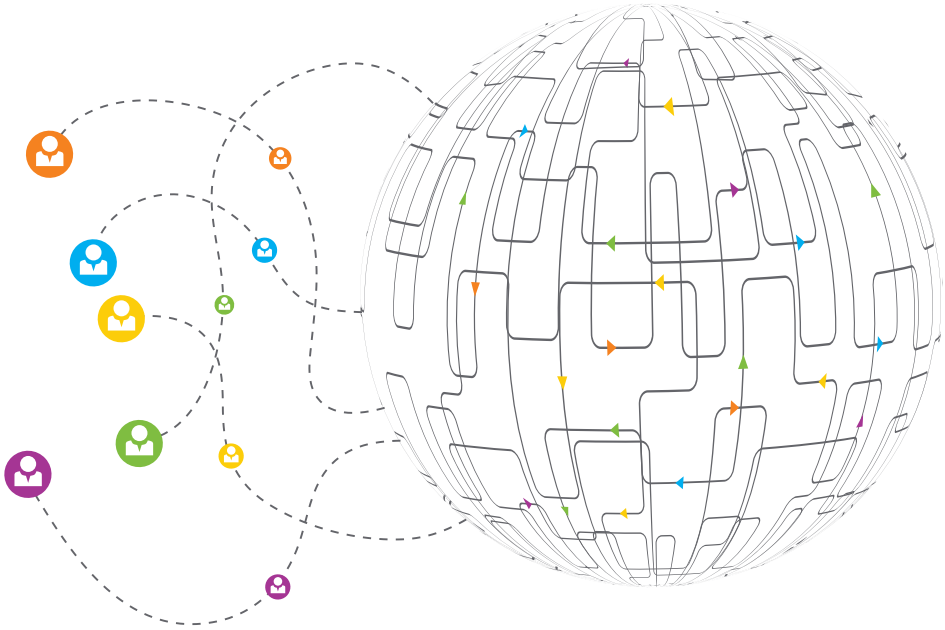
USING CONSUMER MEASUREMENT TO BRING THE INTERNET OF THINGS INTO THE MAINSTREAM

BY JP ABELLO *Director, Global Engineering R&D, Nielsen*



OVERVIEW

The Internet of Things (IoT) promises to connect billions of new devices of every kind to the Internet over the next few years. From door locks, light bulbs, coffee machines and refrigerators to parking meters, traffic signals, health monitors, medical implants, water meters, asset tags and shipping containers, the vision is that many of today's physical products will become "smart" devices that communicate with each other. There is hardly a company nowadays that is not thinking about how IoT will affect its future – and how to best prepare for it.

As valuable as IoT has been already for industrial applications (primarily through efficiency improvements and reduced maintenance costs in the energy sector, manufacturing and supply-chain management), it holds the most promise in domains where it is still very much in a nascent stage: connected homes, for instance, or connected cars, or healthcare. The consumer side of IoT has the potential to profoundly—and very visibly—transform our everyday lives.

Consumer awareness of the IoT space has been bolstered recently by new consumer brands like Nest thermostats, Dropcam cameras, SmartThings hubs and a host of other products, as well as high profile acquisitions from major players like Google and Samsung. Our homes are about not only to realize the vision brought forth by the Jetsons in the 60's, but go one step further with devices that are so smart that they are capable of exchanging information with one another and performing their tasks without human interaction.

The path forward, however, has many obstacles: technological, financial, and regulatory. The situation is further complicated by security and privacy fears and the lack of a common technical standard. Early adopters, technology geeks and trend setters have already embraced the category, even crowdfunding the development of many of its early products. However, as with the web and mobile, and before that television and radio, the development of the consumer IoT market will depend on better understanding the needs and interests of all its users. Most of the real opportunities and dominant business models still have to be uncovered, and market research based on consumer measurement can help companies see past the hype and unlock IoT's full potential.

WHAT DOES THE INTERNET OF THINGS MEAN?

Virtually every news story about the Internet of Things has a different definition of what IoT means, and that definition tends to be very much dependent on the industry or vertical affected. Part of the challenge is that IoT's ultimate goal is to connect every device on the planet – some even call it the "Internet of Everything."

Although the term was coined only a little more than 15 years ago, the concept already existed long before that in the industrial space using Machine-to-Machine (M2M) communication technologies. The past two decades of technical progress have allowed the concept to spread to many more verticals, affecting many product segments that were never previously connected to the Internet.

The result of this explosion in scope is that most consumers today are confused about what IoT means for them and their personal and professional lives. In an oft-cited survey of 2,000 U.S. consumers in 2014[i], the Acquity Group (a subsidiary of Accenture) found that 87% of respondents still had no idea what the Internet of Things was.

One of the more recent definitions, proposed by the McKinsey Global Institute in June 2015, states that the Internet of Things "enables physical assets to become elements of an information system, creating the ability to capture, compute, communicate, and collaborate in novel ways."

Another definition, used by Goldman Sachs and the Internet of Things Consortium, refers to IoT as the "third wave" of the Internet. The first wave connected a billion people via desktop browsers, and the second wave added another billion people on mobile. IoT has already connected twice as many things to the Internet as there are people alive, with forecasts by Cisco, Juniper Research, Gartner, IDC and others of up to 50 billion devices by the end of the decade.

In this paper, we view the Internet of Things as the system of interconnected devices made possible by the combination of several recent breakthroughs: major reductions in size and cost of computing components and sensors, and the emergence of a new class of Internet-based protocols specifically designed for the low-power low-bandwidth IP networks needed to interconnect all these devices. This excludes PCs, smartphones and tablets, which are all based on previous-generation designs that depend on human interaction.

Probably the most important characteristic of these new IoT technologies is that they allow devices to communicate directly with each other, collectively sharing data from their environment. This enables IoT devices to be both autonomous (i.e., independent of human input) and coordinated (i.e., acting together).

For example, self-driving cars in direct communication with each other and their immediate surroundings can access sensor data from the other cars and the roads and structures around them, making personal transportation safer, faster and more efficient than could ever be possible under direct human control. And in the home, the intelligent automation of a multitude of everyday tasks will bring significant benefits to consumers. A McKinsey[ii] study predicts that within 10 years, IoT devices will allow every household to cut 100 hours a year in domestic chores (cleaning, washing, food preparation, gardening, pet care, etc.).

The economic impact of interconnecting billions of IoT devices via the Internet could be unprecedented. Some forecasts by GE and others reach as high as half of the world's global economic output by 2025.

IOT EXPECTATIONS REMAIN INFLATED

The lack of understanding of what IoT is, and the hype that surrounds it, have pushed expectations beyond what may be achievable in the next few years. Even though growth in 2015 has been promising across most IoT sectors, the early forecasts just mentioned are already starting to look unrealistic.

For the second year in a row, the Gartner Hype Cycle for Emerging Technologies continues to put IoT at the "peak of inflated expectations," with its "plateau of productivity" still five to 10 years away. And the "connected home," arguably one of the most promising consumer IoT categories (home automation, connected thermostats, lights, etc.) just appeared in the "innovation trigger" phase – the realm of very early adopters.

As a result, IoT growth forecasts are starting to be scaled back. For example, in June 2015, Ericsson halved the estimate they made back in 2010 (50 billion IoT devices by 2020), bringing it more in line with the most recent numbers from Gartner, IDC and ABI Research (around 25 billion units). Economic impact forecasts are starting to come down as well, with a recent study by IDC now seeing an IoT economic value of $1.7 trillion by 2020, about an order of magnitude lower than previous estimates.

These downward revisions in key market indicators are indicative of large obstacles still standing in the way of this transformation.

TECHNICAL OBSTACLES TO ADOPTION

The first issue is the extremely limited interoperability between IoT products of different brands, a consequence of the fragmentation of the current IoT technical landscape. This means that there is no single technology platform adopted across the IoT industry, which is preventing a large and healthy ecosystem from emerging. This is very different from the early days of the web where any HTML-compliant browser could be used to navigate any website from the very start.

The roots of that situation go back to the old M2M space, which was built on many proprietary non IP-based technologies, and many IoT technical standards groups have been launched in the past few years to try to address the problem. Unfortunately, there has not been sufficient coordination between these groups: Over 50 different IoT technical standards are currently under development, with each group independently working on requirements, specifications and guidelines for their specific markets instead of a single common IoT foundation.

In the consumer IoT space alone, several open standards and proprietary initiatives are already in competition. Two of the most recent ones are the AllSeen Alliance (led by Qualcomm, LG and Microsoft) and the Open Connectivity Foundation (led by Intel and Samsung). Both are building open-source software frameworks for the connected home, using peer-to-peer communication protocols to avoid the latencies and security issues of the open Internet. Unfortunately only a handful of products supporting them have been released in the market to date.

Bluetooth, ZigBee and Z-Wave are the incumbents of the connected home, with large consumer footprints but aging technologies that are not Internet-based. They are all working on upgrading their specifications to support the IP protocol, but they will face inertia in switching their installed base to the latest versions.

Alongside these dedicated efforts, practically all of the software standards bodies worldwide have launched their own IoT initiatives, including the W3C, OASIS, IETF, ISO, IEC, ETSI, ISA, CTA, OMG, OMA, IPSO, and many others. At the same time, proprietary IoT initiatives by Apple (with HomeKit) and Google (with Nest's Thread Group and the Android Brillo OS and Weave framework) have benefited from substantial financial backing and growing awareness.

This technical chaos has not been favorable to the development of a common IoT ecosystem, although some of these groups are starting to merge or cooperate more with one another: The oneM2M consortium entered into an agreement with the AllSeen Alliance last year, the ZigBee Alliance has teamed up with the Thread Group, and the Open Interconnect Consortium recently acquired the assets of the UPnP Forum before changing its name to the Open Connectivity Foundation (OCF). Unfortunately, much more consolidation is still needed to arrive at a single IoT standard comparable in influence to what the W3C did for the Web with HTTP and HTML.

In addition to this fragmentation, some of the technologies required to make IoT ubiquitous are still in the research and development stage. For instance, it will be extremely impractical to change batteries in billions of IoT devices, and the industry is currently exploring efficient energy-harvesting technologies (such as solar, thermal and vibration) as potential options. The EnOcean Alliance has made some strides delivering energy-harvesting solutions in the industry space and recently entered the consumer space. For example, the Leviton self-powered wireless light switch uses the kinetic energy released from pressing the button to power a tiny radio frequency transmitter.

There is also a need for much more efficient use of network resources, particularly in remote locations where only sporadic Internet connectivity at very low bandwidths can be achieved. To support these low-power wide-area networks (LPWAN), a host of highly optimized Internet-based protocols (including 6LowPAN, CoAP, MQTT, AMQP, XMPP, and EXI) are being developed for devices that need to run on extremely little power and minimal Internet connectivity.

SECURITY AND PRIVACY OBSTACLES TO ADOPTION

On top of those technical obstacles, privacy and security have become major concerns holding back mainstream consumers. In an Accenture study conducted in late 2015[iii], nearly 50% of respondents cited those worries as top-of-mind, two-thirds were aware of recent data breaches and 20% of early adopters had returned their IoT devices as a result.

Those concerns are already shared by web and mobile users who are taking their data privacy and security increasingly seriously. But in the case of IoT applications, consumers today are still very much in the dark on what information is being collected about them and for what purpose. They don't know if their data may be used in ways that may affect their employment, access to credit, insurance rates, or even expose them to physical risks. For example, a smart door lock could be hacked to let intruders in, or a connected car could be taken over to cause an accident.

In a study conducted by Harris Interactive in October 2015[iv], young people in the U.S. (those currently in elementary and middle school) were found to be very receptive to the concept of a self-driving car. Nearly half (44%) of them said that once they are old enough to drive, they would prefer a self-driving car to one they would control themselves, versus 28% for their high school counterparts. But even those young technology enthusiasts are concerned about safety (61% deem a self-driving car to be "somewhat dangerous" or "very dangerous") and the potential for data breaches.

The U.S. response to these concerns has been to focus on better encryption and authentication mechanisms. That in itself can be controversial, as the recent feud between Apple and the FBI on iOS security has shown.

In other parts of the world, many governments have been enacting comprehensive new legislation to protect the privacy of data even as it crosses borders. For example, the European Parliament recently passed the 'right to be forgotten,' a resolution that allows individuals to have their digital personal data erased, provided that there are no grounds (legal, contractual, political, etc.) to refuse that request. This can protect children, for example, who may have shared too much online without understanding the implications. Consumer-facing companies will be required to comply and appoint a "data protection officer" to avoid penalties – a step that is likely to create additional friction and enforcement challenges.

IBM and others recently proposed to address security concerns by using Blockchain instead of traditional centralized security architectures. Blockchain provides a distributed ledger of verifiable transactions (i.e., digital events) that is updated through consensus only (similar to how Wikipedia works), and makes third-party data tampering extremely unlikely. Estonia is already using Blockchain to underpin its banking system, and the country's contract management and health management systems are now transitioning to it as well. NASDAQ is also experimenting with Blockchain to authenticate voting records from remote shareholders.

Unfortunately, as hackers and cyber criminals become more sophisticated, breaches are likely to continue to increase, and IoT devices will provide new targets and entry points for security attacks. To respond to this threat, IoT devices deployed in the field will need to accept frequent software updates to correct vulnerabilities as they are uncovered, as PCs and mobile devices do today. And since software and regulatory standards are also expected to continue to evolve rapidly for at least a few more years, it will be necessary to push frequent software updates just to keep the ecosystem from falling into obsolescence. The infrastructure needed to manage that level of complexity has not been deployed yet on that kind of scale.

UNCLEAR VALUE PROPOSITION

Perhaps the biggest barrier for mainstream consumer adoption remains the high cost of IoT products and services. In a survey by Accenture[v] of 28,000 online users across 28 countries in October and November 2015, nearly two thirds of users worldwide (62% almost universally across age groups and countries) said IoT devices and services were too expensive.

Many connected home devices today cost 50 times more than their equivalent "dumb" version. For example, a connected door lock can cost up to $250 while a regular deadbolt costs only $5 in the U.S. Connected light switches by Lutron, Leviton and Insteon can cost $50 to $100, while a regular switch costs about $1. Even connected thermostats like Nest and Ecobee cost five times more than regular digital thermostats. And most of those devices need a smart hub to connect to one another, easily adding $150 to the bill.

Early adopters have historically been willing to pay a premium for new technologies, and with IoT they have even crowdfunded many new products on Kickstarter and Indiegogo – for example, the SmartThings IoT hub (later acquired by Samsung), the Pebble smartwatch, or the LIFX connected light bulb. However, so many new IoT consumer product categories are appearing at the same time that even early adopters are starting to get confused.

Another reason for consumers to pause is the prospect of premature obsolescence and discontinued support for many of these new IoT devices. Connected home appliances in particular (such as refrigerators, washers and dryers) have much longer replacement cycles than traditional computer products (like smartphones), and that may be too much of a financial risk to take with these big-ticket purchases for both early adopters and mainstream consumers alike.

In addition to these concerns, setting up and interconnecting IoT devices of different brands (often incompatible with one another) remains too complex for the average consumer. Retailers are well aware of this issue, and some are already taking steps to educate the general public. Amazon, Best Buy, Home Depot and Lowe's have all launched comprehensive online guides to help prospective customers make their first connected home purchase. Even for these top-tier distribution channels, however, the risk of market failure for new and unproven brands is still very high. For example, the Wink Hub (a simple smart home hub) was heavily promoted by Home Depot, but hardware performance issues and software bugs led its parent company to file for bankruptcy last year.

Considering these multiple obstacles, Gartner's prediction that each U.S. household will contain 500 IoT devices by the year 2022 is starting to look quite optimistic. It will likely take a much crisper and compelling value proposition, coupled with concrete solutions to mainstream consumers' concerns, before these consumers will start truly embracing IoT consumer products.

RELIABLE LONGITUDINAL STUDIES ARE NEEDED

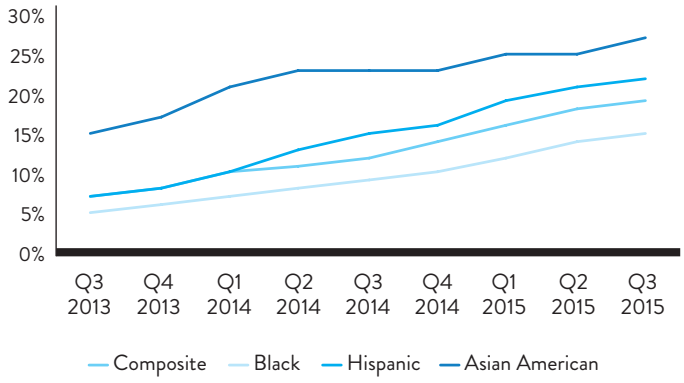
The development of most consumer markets over the past 100 years, including radio, television, the Internet and mobile, has benefited tremendously from consistent and systematic market research, and the same needs to happen with the IoT consumer market.

Today's independent studies on the Internet of Things offer inconsistent numbers from one report to the next. Forecasts for the number of IoT devices can reach anywhere from 5 billion to 1 trillion within five years, and financial forecasts anywhere between $500 billion to $20 trillion. Part of the issue is that every consulting and market research company is defining IoT differently. Some are including the industrial Internet market in their estimates; others are focusing on the consumer market. Some are including smartphones, and others are counting every single sensor as an IoT device (such as in cars, which can have 50 to 100 sensors).

Another challenge is that very few studies have established a track record yet. They are not able to track how fast the industry is growing, the adoption rate by sector or the profile of its users. The Internet of Things needs more systematic consumer research to be performed on a longitudinal basis, with the same definitions and metrics being carried forward. This is essential for measuring the actual progress being made against the many technological and human obstacles holding back the IoT ecosystem.

Nielsen has taken a step in that direction already by monitoring consumer adoption of smart TVs quarter by quarter, using a consistent definition since 2013. As of Q3 2015, 19% of the U.S. population was using a smart TV, compared with 12% a year earlier and 7% the year before that[vi]. Those insights can be sliced by income (13% adoption rate for households whose income is below $50,000 a year, versus 26% for households above that threshold), by race (27% adoption rate among Asian-American households) and other attributes. The ability to trend this type of data over time is of great strategic and tactical value to the whole industry.

SMART TV ADOPTION RATE IN THE US-2013 TO 2015



Source: Nielsen Total Audience Report

Another example is in the insurance industry, where measurement already delivers substantial value. Some auto insurers are now offering policy discounts (5% to 30%) to customers who agree to have a monitoring device track their driving habits (speed, mileage, braking, night driving, etc.). According to the Nielsen Insurance Track Survey[vii], 32% of U.S. drivers were given that option in 2015 (versus 23% in 2013), and nearly two-thirds accepted (versus slightly more than half in 2013). With 90% of all cars expected to have some level of tracking capability by 2020, keeping a close eye on adoption rates over time will help redefine the auto insurance market.

These kinds of longitudinal studies can help assess the full potential of the consumer IoT industry and drive development efforts towards the most promising areas by sector and market. Insights gained from these studies can also be leveraged to help align the various technical standard bodies around common goals based on actual consumer needs. From product and market definition to consumer adoption, infrastructure development to greater standardization, robust longitudinal studies will be essential to the growth of the entire IoT ecosystem.

THE BENEFITS OF MEASURING DETAILED IOT CONSUMER USAGE

A common characteristic of the vast majority of IoT devices is that they come loaded with sensors that generate copious amounts of data. And considering that by some estimates, more than 99% of tomorrow's IoT devices are not connected to the Internet yet, the data generated is about to become so pervasive that it will lead to the creation of enormous value across the industry.

In a fully interconnected IoT ecosystem, the most actionable forms of data will likely be those that can be leveraged for usage analysis and optimization. This goes well beyond the telemetry data of today's legacy M2M systems and early IoT devices, which were only designed for diagnostics and real-time control, and cannot be shared between manufacturers and third-party data aggregators.

To enable the analysis of consumer behaviors, it will be necessary to extend the current IoT software platforms and standards with the ability to collect normal as-designed usage events (such as "using coffee machine" or "brewing extra dark coffee"). This will make consumer measurement available in a consistent manner across a multitude of IoT device types and brands, and will promote significant new benefits for all stakeholders.

New types of consumer segmentation

The availability of IoT consumer usage data will enable the creation of entirely new consumer segments: heavy coffee drinkers who sleep a few hours a night, for instance, or people who commute several hours a day, or people who exercise frequently and cook frozen dishes. This type of consumer segmentation will allow marketers to go one step beyond traditional media and retail segmentation because it will be based on a more granular understanding of real-life every day consumer habits.

Better product designs

IoT device manufacturers and service providers will be able to use richer data insights to prioritize the design of key features in their products with the characteristics and needs of specific consumer segments in mind. For example, for consumers who tend to cook at home frequently, a range hood in the kitchen that works with the smoke detector to automatically run its exhaust fan might be a welcome product feature. Or for regular coffee drinkers, a desirable functionality for the connected coffee machine might be to sync up with the alarm clock in the morning and the garage door in the evening.

Smart context-based advertising

Detailed IoT data could be especially attractive to advertisers looking to find the best time and location to reach their consumers. For example, knowing when a consumer is doing laundry might suggest a good time to play an ad on TV or offer a rebate for a brand of detergent. A November 2014 study commissioned by the Internet of Things Consortium[viii] found a "surprising high tolerance for ads and marketing if it reduces Smart Home costs." Smart context-based advertising linked to detailed IoT consumer data is very likely to improve ad effectiveness across all advertising platforms.

Product subsidies

The IoT consumer space today still requires customers to bear the full price for all IoT services, which is highly unusual in the Internet age. Cost is a major impediment to adoption, and IoT services would likely be much more pervasive and accessible to consumers if the hardware itself were free or offered at much lower costs. By opting to share their data with service providers and advertisers, consumers might be able to get a substantial number of these products and services for free in return for the value created from the data. This model is already being tested in the insurance space: Two home insurance companies, Liberty Mutual and American Family Insurance, are offering Nest Protect smoke detectors free of charge (a $99 value) plus a 5% policy rebate in some markets to customers who agree to share data from those devices.

IOT MEASUREMENT METHODOLOGIES

To be able to deliver on these new benefits, consumer measurement solutions will have to be broadly deployed in the IoT marketplace. Measurement techniques will have to scale across a multitude of consumer devices and through rapid technological change. That will mean taking a census approach to consumer measurement, similar to what is already being done on the web and mobile today, but across a much more fragmented IoT ecosystem that was not designed to enable this kind of data collection in the first place.

Embedded measurement

A simple approach to implement usage measurement on a census basis would be to embed some specialized software directly into the IoT devices themselves. However, to produce data suitable for aggregation and analysis, this would have to be done in a highly consistent manner across a multitude of device types and manufacturer brands, while keeping up with constant software revisions. The magnitude of this task makes it nearly impossible to achieve through separate relationships with each manufacturer.

A more manageable and scalable approach would be to integrate consumer measurement into a common code base used by as many manufacturers as possible. The vehicle for this could be an open-software project like OpenWRT (used in many home routers and IoT gateways); or a popular operating system like Windows or Android; or one of the open-standard frameworks currently being developed for the IoT consumer space. Most IoT manufacturers do not have the resources to develop complex software frameworks from scratch, and will typically be better off adopting an open-source project actively maintained by the industry. And if consumer measurement were already integrated into these frameworks, manufacturers would inherit it by default with minimal maintenance and support overhead.

Currently, the best candidates for these types of IoT open-source framework integrations are probably AllJoyn by the AllSeen Alliance and Iotivity by the OCF. They are both in active development and aiming for broad adoption across all kinds of IoT consumer devices in the very near future.

While ZigBee, Z-Wave and Bluetooth already have a large installed base, they are legacy technologies not based on the Internet. Efforts are underway to upgrade them to the IP protocol, but updating the software stacks in most of these devices is not going to be easy or even feasible, putting those efforts at best on par with the newer IoT frameworks.

Data collection at the edge

Even with embedded measurement, collecting data from these IoT frameworks may not always be possible: Many are primarily intended to enable direct peer-to-peer communication between devices, with most of the data never making it out to the cloud. In fact, the vast majority of IoT consumer networks will be edge networks, or what Cisco calls "fog networks," where data traffic remains localized.

This is especially the case with the smart home, which will continue to have Internet routers and IoT gateways, both to provide a critical layer of privacy and security, and to shortcut the latencies and load constraints of the core broadband network. Today, the vast majority of data traffic in a typical residence already travels directly between devices, over Bluetooth, Z-Wave, ZigBee and Wi-Fi, and never leaves the house. And when devices move outside the house, like smartphones and connected cars, they can find ways to "tunnel" back into the local network through the gateway so that they continue to be virtually part of that IoT edge network.

As a result, a large amount of the IoT data collection and aggregation necessary for measurement will have to be performed at the edge, most likely in the IoT gateway or another device dedicated to providing that function on the local network, before that data can get sent up to a trusted third party in the cloud for further fusion and analysis.

This local aggregation function could be offered as part of the IoT standards currently under development, so that it may be adopted more systematically across the broader ecosystem. Or it could be made available as an extension or downloadable module to existing open-source projects, like OpenWRT, which are increasingly being used in off-the-shelf consumer routers and IoT gateways. In either case, that edge measurement and aggregation component will have to also include a user opt-in mechanism to securely authorize IoT data collection and uploading to trusted third parties.

Panel-based demographics

Whether collected by each individual IoT device, by an IoT gateway at the edge, or by a central network facility, the census-based measurement data is likely to come up short on user demographics, life stage details and other rich descriptive attributes typically needed for market research. This is similar to the situation in the television space, where set-top boxes are capable of capturing granular tuning information from millions of households at a time but cannot tell exactly who is watching.

Carefully selected consumer panels can provide the answer in these situations. Nielsen has developed a census methodology to provide precise "source of truth" demographics for activities as diverse as television watching, Internet usage and grocery shopping. This approach combines census data collection in the field (from devices with anonymized users) with data from carefully selected and maintained user panels, and uses advanced machine learning algorithms to produce insights that neither dataset alone could deliver. This "census + panel" methodology is well suited to the needs of the IoT consumer space.

The importance of data taxonomy

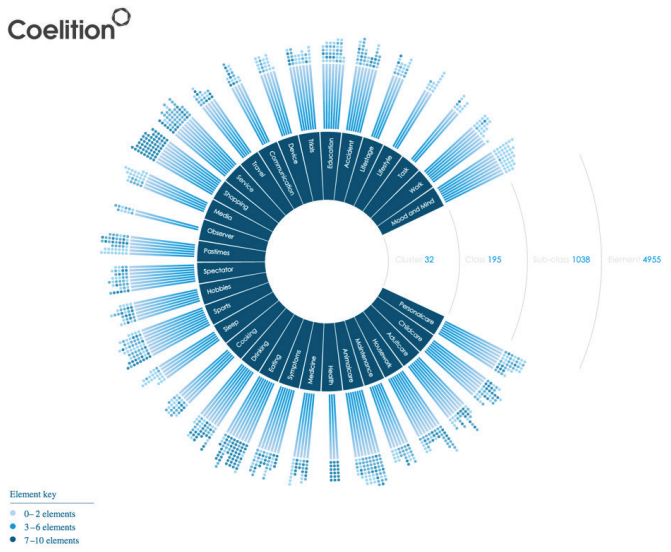
To combine consumer usage data across all possible IoT devices, it is essential for the data to carry the same meaning across all sources. This means that all measurement data should follow a common taxonomy that covers all the specific consumer actions and events worth measuring.

For example, when consumers use their connected refrigerator, events such as "freezer door opened" or "water dispenser running" could provide insights on the type of needs the consumer is looking to satisfy. "Sleeping" might seem a simple enough concept to standardize, but the top fitness wristbands on the market today are tracking sleep very differently. If "freezer door opened" or "sleeping" means two different things for two separate brand manufacturers, measurement companies will need to assemble a meta-library of 'event translation' tables that will be extremely difficult to maintain.

Hence the importance of a common IoT taxonomy – ideally, a common data standard itself referenced by all the different IoT standards groups. One such initiative that has been underway for a couple of years already is the Classification of Everyday Living[ix] (COEL), under development by the OASIS open standards community.

COEL currently has about 5000 elements encoding everyday living events, but it is still far from comprehensive enough to be used for consumer measurement purposes. Much finer-granularity events (such as "unlocking car" instead of just "driving car") and attributes (such as total event duration and frequency) also would be needed. The COEL chart below illustrates its current state of development – and how much is still missing.

This is a crucial step for measurement: Once a common data classification standard like this one gets adopted across the board, data aggregation will become much simpler and make it possible to deliver the actionable intelligence needed to accelerate growth in the IoT ecosystem.



On the value side, measurement will help bring down the price of IoT products and increase consumer adoption rates. The advertising industry may be able to bring the most value to the table, by using the data generated by the devices to subsidize a large portion of consumer costs and reach new segments of the population more effectively than ever before.

For this to happen however, measurement has to overcome enormous challenges: handling the unprecedented volumes of data about to be generated, making sense of the way it is organized and aggregated, and finding solutions to today's excessively fragmented ecosystem. This data will also be extremely sensitive, because it sits right in the middle of our everyday lives and will be open to abuse without proper safeguards.

The IoT industry needs to make independent measurement a top priority and step up to these challenges to deliver on its ambitious promises, and usher in a new era of innovation and growth in the consumer economy. n

CONCLUSION

As the Internet of Things expands into the consumer space, comprehensive consumer measurement solutions delivered by independent third parties will be key to the growth of the ecosystem beyond its current fragmented state and to bringing IoT into the mainstream.

On the product side, measurement will help increase focus on developing the products and services that will have the most impact on consumers. It is also likely to foster better alignment between the various competing IoT standards and ultimately facilitate the emergence of a common IoT software foundation.

[i]Accenture, *The Internet of Things: The Future of Consumer Adoption,* Accenture Interactive: Point of View Series, June 2015, http://bit.ly/1QeiDo6.
[ii]McKinsey Global Institute, *The Internet of Things, Mapping the Value Beyond the Hype,* June 2015, http://bit.ly/1Rys4av.
[iii]Accenture, *Igniting Growth in Consumer Technology,* January 2016, http://bit.ly/1KK7GLY.
[iv]Nielsen, *The Youth Perspective on Self-Driving Cars,* March 2016, http://bit.ly/1ZoNaZu.
[v]Accenture, *Igniting Growth.*
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