

Smart Entertainment in the Smart Home

Reducing Friction in Content and Service, Discovery and Consumption, Across Devices at Home

A Technical Paper prepared for SCTE/ISBE by

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Introduction

The connected home has evolved in many exciting ways. Expedited growth of more affordable and compact computing power, and expanded connectivity have enabled rapid growth of “smart” devices capable of offering new services and creating new ecosystems within the home. Many entertainment devices take advantage of this connectivity to create a cooperative ecosystem of apps and features covering different forms of content delivery as well as smart home services, resulting in a series of new compatibility requirements. **Defying popular belief, new does not always replace the old and quite often can be an addition.** Most homes contain a wide array of traditional devices that are not connected and are now mixed in with the newer connected devices with enhanced capabilities such as voice control. Based on a QuickSet Data Insight study, more than half of the television (TV) installed base in the United States are five years or older. This varying level of “smart” and interactivity causes discontinuity and confusion for consumers in accessing and controlling each device to enjoy their content.¹ This obvious gap in a common approach to interactivity has created an area of opportunity for device manufacturers and service providers. Consumers need a simple and unified approach to interacting with their devices at home, new and old, connected or not, offering a reliable experience with all.

The delivery of entertainment content has been particularly affected by continued improvements in Internet connectivity speeds and processing power in devices. Innovative startups and well-known names in entertainment alike are looking for a winning edge to lead consumers to their content and their services. Content providers are offering a dizzying array of almost unlimited content, available through multiple channels, and some exclusives to a single channel. The starting point in content discovery for consumers now includes necessary decisions such as which app and on which device, and finally, the main question-- what to watch!

Today consumers are expected to decipher where and how to access a specific service or content, **which app on which device through which control interface, a constant context switching from one content source to another, adding friction to daily TV watching activities.** Friction in the user experience will cause fatigue, and users will then quickly stop using a device or service and revert back to the previous methods they understand; after all, watching TV is supposed to be fun. A consumer will naturally be attracted to devices that offer a consistent and reliable experience in finding content and services. This has created an opportunity for service providers and consumer electronics manufacturers to provide an elegant solution to this daily problem.

Successful solutions, with wide adoption, have taken the realities of the home ecosystem into consideration, providing a reliable experience across the installed base of old and new devices in consumer’s home. As an example, while in the first generation Apple TV attempted to address the user experience and TV compatibility with a single protocol such as High-Definition Multimedia Interface Consumer Electronics Control (HDMI-CEC), the second generation now includes multi-protocol support including limited infrared, for TV control; an improvement, but still not the ideal experience for a mainstream product.

Trend-setting set-top boxes from Dish Network and Comcast have employed techniques to automate the set up experience and make their **content reachable with a single touch**, while smart TVs have offered a **unified discovery and control experience across different content sources** and services to manage the daily activities. Some well-known brands also offer universal content search solutions that focus on the experience on a single device, searching across a catalog of content offered by installed apps and

channels, while others strive to unify the experience across devices and services through a combination of content recognition techniques and pre-defined indexed catalogs.

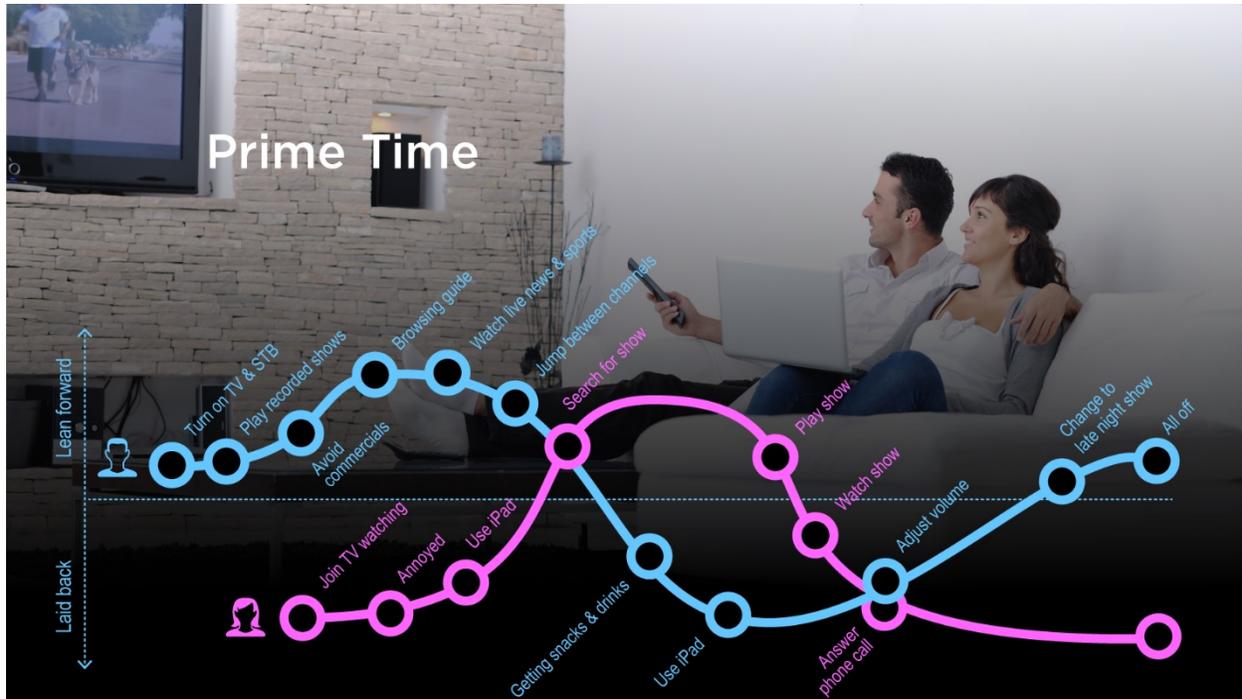


Figure 1 - A Day In A Life

Leading consumer electronics companies are already benefiting from providing a unified interface to interact with different devices and services, taking hold of the **starting point in the users' daily content consumption experience**. This unique position has enabled new business models and revenue opportunities. Solutions such as dynamic media recognition offered by Gracenote and Shazam, or device-centric whole-home discovery and control capabilities have enabled consumers to automatically discover and interact with all points of access to content and applications in the home through a single point of control (a voice assistant; a touchscreen device, or a remote control). These capabilities are offered through set-top boxes, TVs, game consoles, smart home gateways or any connected device offering a service.

Media recognition systems rely on a database of content to dynamically identify matching signatures against live or recorded content. A successful solution, as a device-centric approach, will complement this approach through device specific knowledge, and provide a unified discovery and control interface for devices in the home, through different communication mediums, including High-Definition Multimedia Interface (HDMI), Internet Protocol (IP), and different wireless protocols such as 802.15.4, Bluetooth, and widely used Infrared.

At its core, the ideal solution would enable anyone to **enter a room, seamlessly discover all nearby devices and services offered** by these devices, and interact with these services through an intelligent, simple and natural interface. It should operate independently of any framework tied to specific devices, access protocols or proprietary software ecosystems.

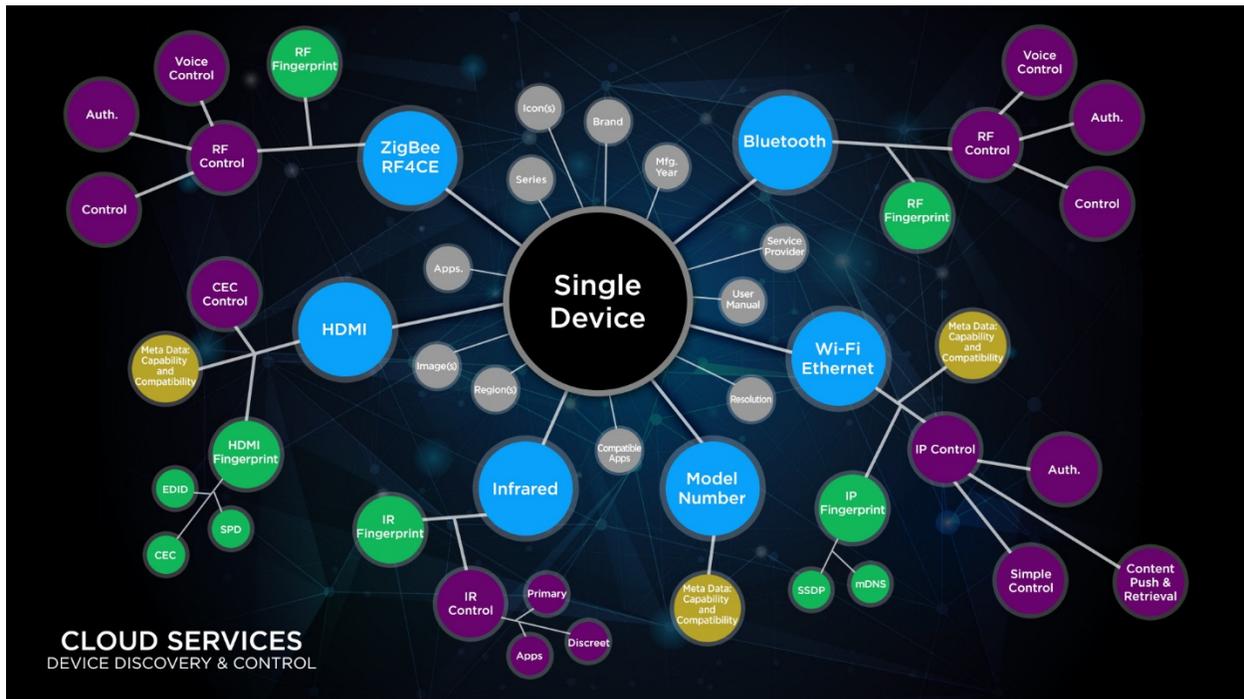


Figure 2 - Device Model in Knowledge Graph

A complete model of a device is the most basic, yet necessary, building block of a **knowledge graph representing devices and services in a home that can add context to all user actions**. Viable platforms rely on algorithms that utilize a knowledge graph of devices with varying control capabilities, communication interfaces and protocols, each identifiable with unique fingerprints.

At the most fundamental level, a capable solution automatically discovers nearby devices through different communication mediums, generates unique fingerprints and matches them to the knowledge graph, to serve up a full range of capabilities. Beyond control, this knowledge graph also adds the much-needed context to all user commands and actions, making dynamic capability discovery of nearby devices possible.

This highly versatile approach to supporting a unified customer experience lends itself to a wide range of brand strategies. Companies such as Comcast, Dish Networks, AT&T, Microsoft and LG Electronics have widely divergent approaches to offering services, but they are all trying to reduce friction in consumption of their services and enhance the customer experience.

In the discussion that follows, we begin by exploring market conditions driving the need for a holistic, automated approach to connected-home device management, followed by a look at how service providers and original equipment manufacturers (OEMs) are meeting that need. In later sections we'll review the enhanced capabilities required to power content discovery across devices, and better smart home services.

Market Overview: More Content, More Apps, More Devices

The ability to provide a consistent experience across devices, hence the need for a universal connected-home control solution, has gained increased importance with cable and satellite operators, over-the-top (OTT) providers, and consumer electronics (CE) OEMs competing for consumption of content and newer services in Internet of Things (IoT) markets. As the increasing volume of gadgets in the home promise a better home, the resulting friction in the user experience imposes an even greater inconvenience to consumers.

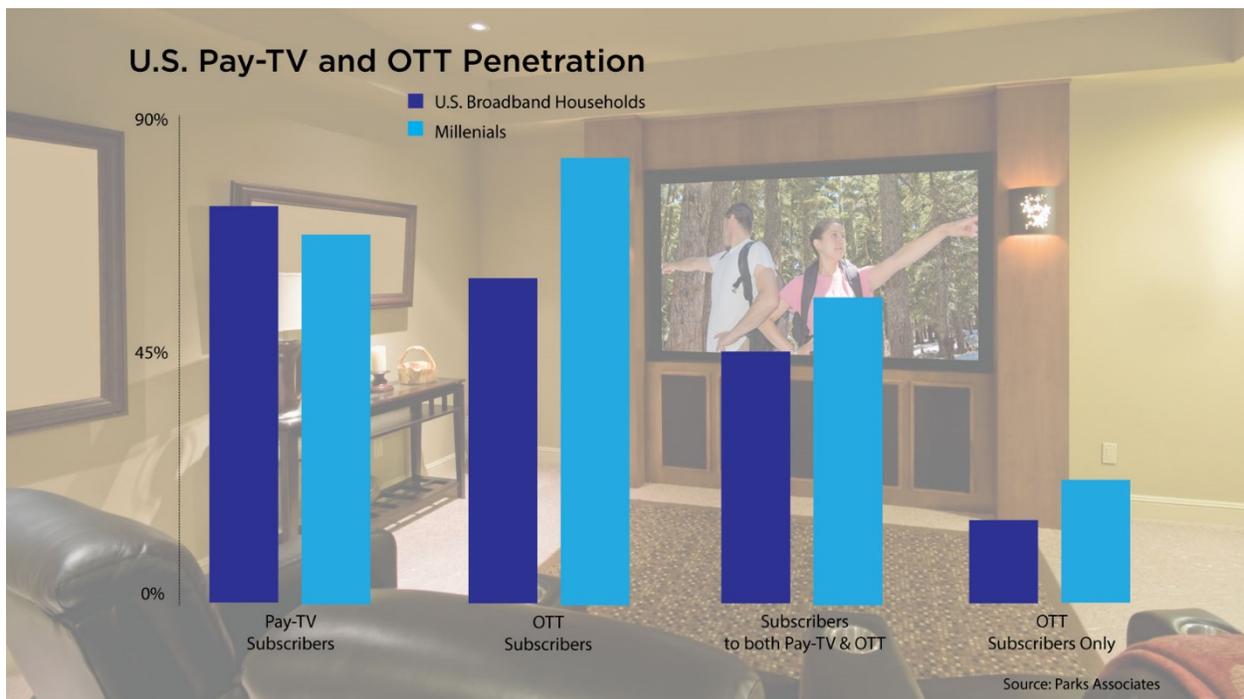


Figure 3 - U.S. Pay-TV and OTT Penetration

This presents both a challenge and an opportunity to provide an elegant and seamless experience in how users discover and access their content and services, thus improving customer satisfaction, lowering attrition.

The increasingly urgent need to simplify device control and navigation is affecting not only traditional cable/satellite providers but also makers of smart TVs and streaming services. According to Parks Associates, **63 percent of U.S. broadband households subscribe to at least one OTT video service and 31 percent subscribe to two or more**ⁱⁱ underlining the increasing friction due to context and input switching between devices and services.

In another report, Parks found that 52 percent of households subscribing to at least one OTT service also subscribe to a traditional pay TV service.ⁱⁱⁱ Sixty-one percent of households headed by people from the millennial generation are in this category, suggesting the multiple subscription phenomenon is here to stay.

Consumers use various combinations of devices to get the content they want, including cable/satellite-supplied set-top boxes, smart TVs, media streamers, game consoles, and personal devices such as smartphones and tablets. Measuring actual network usage in 2016, network traffic tracker Sandvine found that the average North American household had at least **seven active IP devices in use daily, with 65 percent of the usage dedicated to video streaming.**^{iv} By 2019, the average number of connected media-enabled devices per North American household will climb to ten, according to IHS projections.^v

These trends are replicated worldwide. U.K. analyst Ovum in a recent report predicted online video subscriptions, which topped 100 million worldwide at the end of 2015, will increase to 177 million by 2019.^{vi} In another report, Digital TV Research projected that by 2020 online subscription revenues will reach \$21.6 billion, three times the 2014 total, with penetration exceeding 33 percent in ten countries.^{vii}

All these statistics point to the fact that streaming service subscribers, including those who subscribe to cable/satellite services, will be **consuming content through multiple channels and on multiple devices, expanding the ecosystem of devices connected to their TV sets** and adding to the complexity that comes with having to switch TV inputs, applications, and remotes from one service to another. The ability to simplify accessing a provider's services by eliminating this difficulty will only grow more significant to their overall value proposition over time.

In another survey involving 1,812 participants in the UK, France and Germany, researcher Trendbox found that, with an average of 3.3 remote control devices per household, consumers are hungry for a solution that overcomes their usage hassles.^{viii} **80 percent said they want a control device that's easy to set up and use** for accessing all their content on their TV sets. In an acknowledgement of the confusion people experience navigating across TVs, set-top boxes, game consoles and other content sources, **34 percent said they have difficulty getting the content they want onto their viewing screens.** Also important to note 41 percent stressed the importance of eliminating the button clutter common to most remote controls, which highlights the importance of a simple and automated solution.

Satisfying these demands not only adds to the appeal of a given provider's services, it also saves money by reducing customer support calls. 10 percent of the respondents in the Trendbox survey said **they contact customer support to get help when they have trouble navigating among content sources.** This is an especially big headache for cable/satellite providers, who are often held accountable for consumers' OTT as well as legacy pay TV usage issues. Such calls, owing to the complexities of the issues, can potentially consume more time than other types of calls.

The multi-device usage issues surrounding TV services and applications are becoming equally problematic in the smart home realm as consumers engage with multiple applications from different sources. Gartner predicts the number of installed IoT-related devices in homes and businesses worldwide, not counting smartphones, tablets or PCs, will grow to 26 billion by 2020.ⁱⁱⁱ Gartner says that by then IoT component and connectivity costs will be so low that just about everything – light fixtures, windows, doors, appliances, toys and sporting equipment – will be equipped for IoT connectivity to support control, monitoring and sensing.

As noted by Parks Associates, the adoption rate is especially high among millennials. As IDC noted in a recent report, by 2018 millennials, who are the leading adopters of IoT technology, will comprise 16 percent of the world's population, which means IoT adoption will be far more commonplace than it has been so far.^{iv} Consequently, there's a growing opportunity for IoT service providers who can aggregate whatever specific applications consumers choose into a unified experience under the control of a single device.

Case Studies: Power & Versatility in Deployments

Every device manufacturer and service provider has different needs when it comes to their brand experience. TV manufacturers have different goals from streaming service providers, which have different objectives from cable/satellite providers.

Smart TV brands tend to be content-agnostic, and **newcomers as service providers**. Although in recent years, more and more TV brands have begun to serve content from sources they promote, many consider their platform as a common interface for all content. TV manufacturers are in a very competitive marketplace, striving to add value and gain recognition among many competitors. An excellent method to reaching these goals is by providing an easy and satisfying out-of-box experience that can quickly and easily discover and connect to content sources - a consistent and reliable starting point to the daily journey of content discovery and control across different sources.

Streaming service providers and more popular cable and satellite service providers are looking to make their service as easy as possible for subscribers to find and consume. This is necessary in both initial set up as well as daily use where consumers increasingly can be **jumping between content sources**. Getting back to the service provider's content easily is paramount, and the best solution is a single touch or a single "Watch TV" voice command.

1. Simple Content Access on Set-Top Box: Comcast Xfinity

Incumbent service providers are faced with an onslaught of competition from OTT, TV, and other streaming services that are vying for content viewing from the consumer. Traditional grid-based menus and scrolling through long lists of content are now a thing of the past for a competitive service provider. Since content is coming at consumers from multiple devices and from multiple service providers, cable operators like Comcast have taken steps to further refine their experience at finding and switching to content.

Comcast, one of the largest providers in the world and a leading innovator in the segment, has recognized and made considerable advances in further refining their subscriber experience in accessing and enjoying live content and video on demand. Building upon their unique infrastructure capabilities, the recent migration to the cloud based X1 platform delivering Xfinity services has enabled a much more agile approach to delivering better services. This approach has shown great promise for Comcast in maintaining subscribers and providing improved video on demand (VOD) content consumption.

Switching inputs, changing remote controls, and keeping it all straight was a threat to continuity for subscribers and was not a pleasant experience in finding entertainment content. Comcast was able to address the complexities of providing new and improved personalized services in shorter refresh cycles, and adapting to a more complex home environment with increasing friction from context switching between content sources. This **reduced initial install costs** through a combination of self-install kits and shorter professional install times, enabled by a better out-of-the-box experience.



Figure 4 - Xfinity X1 and Voice Remote Provide an Easy Viewing Experience

The solution's ability to discover, recognize, and automate control of multiple devices brought the X1 platform one step closer to a truly automated experience in connecting consumers to their desired content. "What excites us about this feature is that it brings our customers closer to the experiences they love," notes Jonathan Palmatier, vice president of product development and consumer devices at Comcast. "Instead of fumbling with remote codes and instructions, they can just unbox a new remote and start discovering great content right away."



Figure 5 - Xfinity X1 Cloud Services for Device Discovery and Control

Through a scalable cloud-to-cloud integration model, the Xfinity X1 platform has been able to roll-out cloud-enabled features across their nationwide footprint quickly and efficiently. The X1 platform is now capable of automatically discovering televisions and audio devices connected to a set-top box, and retrieving a complete set of control capabilities for these devices. **This dynamic and real-time configuration capability is available throughout the lifecycle of the product**, and automatically reconfigures to address any changes in the consumer entertainment system, such as a purchase of new equipment, or rewiring of the audio/visual (AV) system.

As an example, a simplistic implementation for volume control based on a single protocol such as HDMI-CEC would limit the compatibility of such a rollout to less than 8% of households in North America, where Comcast provides compatibility with over 98% of the install base in the same market.

2. Unified Content Interface on Smart TV

For TV brands, simple internet connectivity is no longer enough to generate consumer excitement. A TV, as the single screen shared by all entertainment devices and applications, is in desperate need of harmony and unification between the available content sources, and services in the home.

In growing from a device manufacturer towards also a reliable service provider, today's TV platforms must gain consumer trust to compete with incumbent sources of content and services. **TVs are in control of the starting point in our daily content consumption journey.** The first step is turning on the display, which makes it one of the more natural places to offer a unifying interface across devices and services. Smart TV content dashboards and applications can fall short in providing continuity in the experience if they simply focus on native content, and overlook dominant sources of content in the home today like cable and satellite set-top boxes and streaming boxes.



Figure 6 - Automatic Discovery and Setup of Connected Devices

In the OEM domain, TV manufacturer Samsung caused a stir in early 2016 with the introduction of its 9500 series Smart TVs, marking an industry-leading shift to a novel approach in consumers' experience across content sources and devices. They turned the display into **an intelligent hub for what consumers truly care about: content and services**. Leveraging a new solution and an external HDMI hub concept, Samsung launched a television platform and remote that discovers and automatically controls entertainment devices connected to it. The automatic set up allows consumers to immediately switch seamlessly between linear and on-demand programming delivered via cable/satellite operators, and streaming content delivered directly via IP.

The manufacturer has won wide praise from reviewers for this innovative approach, putting consumers' needs for multi-brand, multi-control connectivity ahead of single brand compatibility. Personalized content and history is presented in a single interface, regardless of the sources, surfacing all services contained within devices attached to the TV. Users can **access a channel, content or service in a single touch**, and the system then handles all the prerequisite steps and configurations necessary to serve up the desired content on that source.



Figure 7 - No Inputs: Unified Content Dashboard with One Touch Tune

In a video review, Geoffrey Fowler, personal technology columnist for the Wall Street Journal, offered these comments: “[The TV] actually fixed the three-decades old pile-of-remotes problem....I can go from my cable box to my Xbox to Netflix in a snap....I can go to my favorite network without needing to switch inputs or touch that gosh-awful TV programming guide....[The platform is] even smart enough to

pull channel data in over the Internet and make recommendations on the screen....A truly universal TV remote has an immediate impact on my life.”^{ix}



Figure 8 - A Unified Dashboard for Devices and Content with Global Content History

Through an expanded set of discovery and control medium capabilities, the device interface software has further refined the vision of a unified and personalized interface across all devices. The solution is now capable of reaching further into devices, discovering expanded content metadata such as current playing media, installed applications, and services contained within a range of devices. This helps address the issue of app confusion in this day and age where the same app may be offered through different smart devices. **This capability, used in conjunction with traditional media recognition and watermarking techniques, can help build a much more scalable, efficient, and personalized recommendation engine** based on universal history across multiple content sources.

3. Competing for “Input 1” by Streaming Services

Streaming content providers, also known as Over the Top providers (OTT), struggle as the secondary source for content consumption. As such, these providers are particularly vulnerable to context switching issues and resulting friction that prevents subscribers from easily getting to their content.

OTT premium service provider Sling TV deployed the [AirTV player](#) to integrate OTT packages and over-the-air (OTA) broadcast TV options into a complete premium TV viewing experience. Sling TV launched the AirTV at CES 2017 to rave reviews.



Figure 9 - One Touch, and You're Back to Sling

The AirTV Player, is a 4K Android TV streaming device that leverages an advanced device discovery and control solution, uses a Bluetooth Low-Energy (BLE) advanced voice remote to access content through a simpler user interface. The AirTV player set up is completely automated, enabling the consumer to simply plug it into their TV and audio devices to begin the process.

In order to address the exaggerated context switching friction, this implementation includes a feature called **One Touch View**. This allows consumers to immediately **go to the desired content source with a single touch**. In this multi-protocol implementation, the platform uses the fingerprint for the discovered devices to identify the characteristics based on the evolving knowledge graph of devices, and select the optimal combination of commands, across protocols, to take the user back to the desired content.

A single protocol implementation with only coverage according to specifications such as HDMI-CEC will limit an essential feature such as One Touch View to less than 28 percent of households in North America, underlining the necessity for a multi-protocol approach for achieving mainstream viability and 3X compatibility for such features.

4. Voice Assistants and the Rise of AI in Home Control

Artificial Intelligence is enabling many new use cases, predominantly through voice assistants available on smart speakers or voice remotes; home gateways and mobile applications in home control. AI implementations are limited by two important factors: (1) **compatibility with mainstream services and devices** that consumers care about, referred to as “skills,” and (2) **a basic understanding of context** which includes nearby “things” and their current state.

[LG Electronics](#)' transformation of smartphones into whole-home personal assistants illustrates the vision of a handheld device manufacturer in offering a more complete experience for the consumer.



Figure 10 - LG QRemote as a Personal Home Assistant

In recent years, smart speaker category has shown great promise and major improvements in quick cycles; however, popular implementations remain purely focused on cloud service integration. Such an approach falls short in providing features needed for everyday life, and overlooks daily activities such as content consumption on common AV systems. **A true knowledge graph of devices and capabilities can apply context to user commands, and enable compatibility** with popular everyday devices. The need to understand the context of where content is located and how it can be accessed and controlled, available services on nearby devices and their current state, all provide essential signals necessary in properly deciphering the intent and executing the desired actions. Processing a simple command such as “open Netflix” requires knowledge of nearby devices, and available apps on each, and executing this command requires compatibility to execute this command.

A true home butler would need to provide a consistent experience in discovering and interacting with nearby devices at home, regardless of communication protocol and varying implementations of similar capabilities. This multi-protocol requirement, as well as context knowledge, represents an underlying vision of a connected home. In this vision, infrared and RF compatibility is as essential as IP capabilities, to provide both the necessary coverage as well as the expanded capabilities.



Figure 11 - Discovering Nearby Devices, Apps, and Real-time Status

The ultimate solution adds the necessary intelligence to voice assistant implementations as it is capable of not only discovering nearby devices, but also their applications and status. **Device status discovery addresses the limited contextual understanding of voice assistant systems.** Imagine a simple command such as “pause” or “what’s playing?” instead of an unnatural and verbose version where the user needs to convey context in every command. Simple context inferred from the previous command is relatively limiting in real-life scenarios, content playback can be initiated from different control points, or through different playback devices. Media watermarking and recognition techniques may be employed, but can be limiting in reliability, cost and efficiency. A hybrid implementation which includes a dynamic and device-centric discovery platform would enable a scalable and reliable solution.



Figure 12 - Proactive Notifications based on Nearby Device Status Change

Alternative implementations in the market can achieve this in a closed ecosystem of their own brand or tightly integrated partners, but fail when they meet the realities of a consumer's home where multiple brands and providers need to work in a single environment. So if a voice assistant of the smart home is to be the future, it also needs to address these realities.

Discovery and Interaction with Nearby Devices

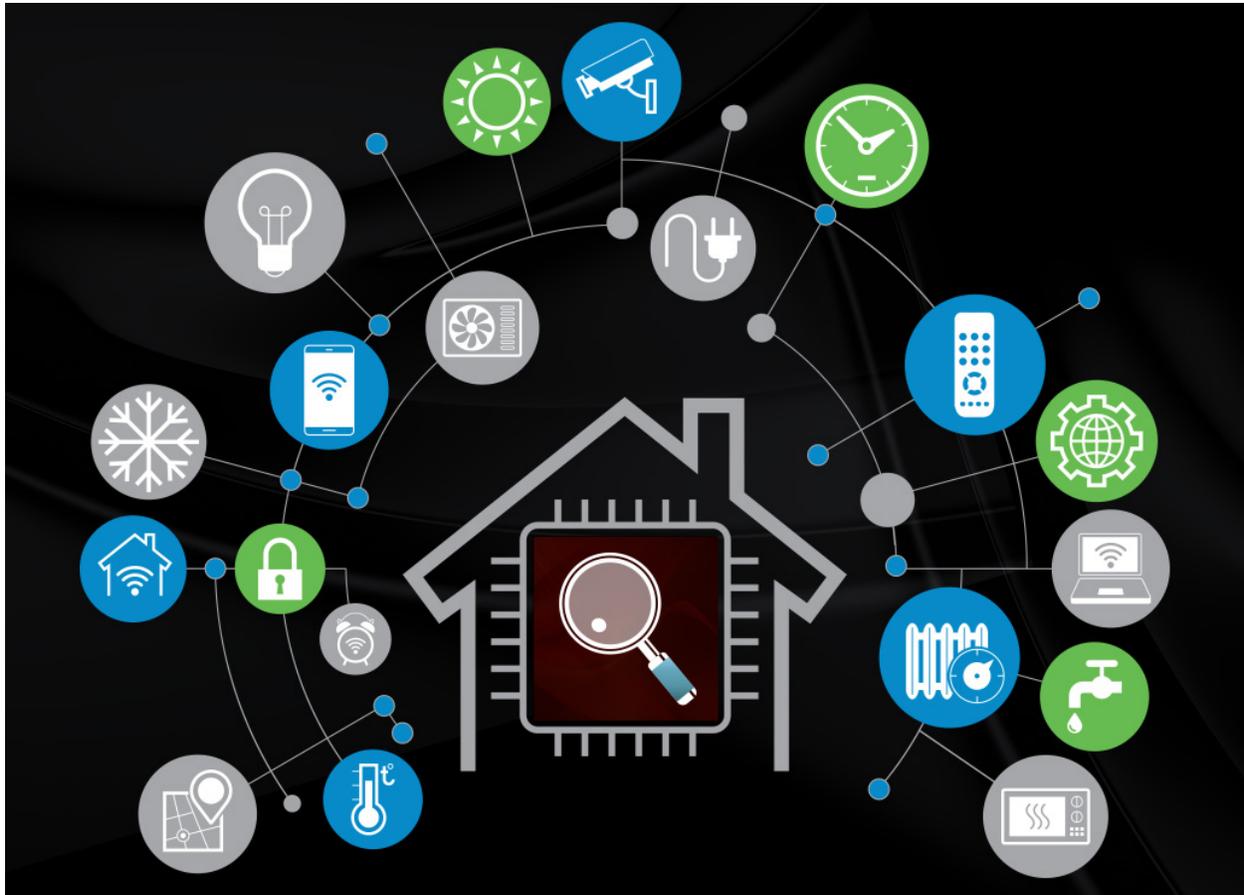


Figure 13 - Discovery and Interaction with Nearby Devices

As a starting point, a viable platform should consider varying business and technical needs, hardware and application architectures, and global ecosystem differences. Its mission is to surface the services offered by all devices in home, no matter what wired or wireless communications interfaces they use, and intuitively present them to the consumer, at the right time and place.

The user doesn't have to give any thought to where the content and applications are coming from. They're just there, **hiding the technology behind the experience.**

To accomplish this mission, operators must invest widely to continually update their platform with a wide range of tools and functionalities including software developmental kits (SDK) for simple integration with popular platforms such as Android and Linux, and Web application programming interfaces (APIs) that enable cloud to cloud integrations, as well as resource constrained edge nodes.

5. Device Discovery and Control: Under the Hood

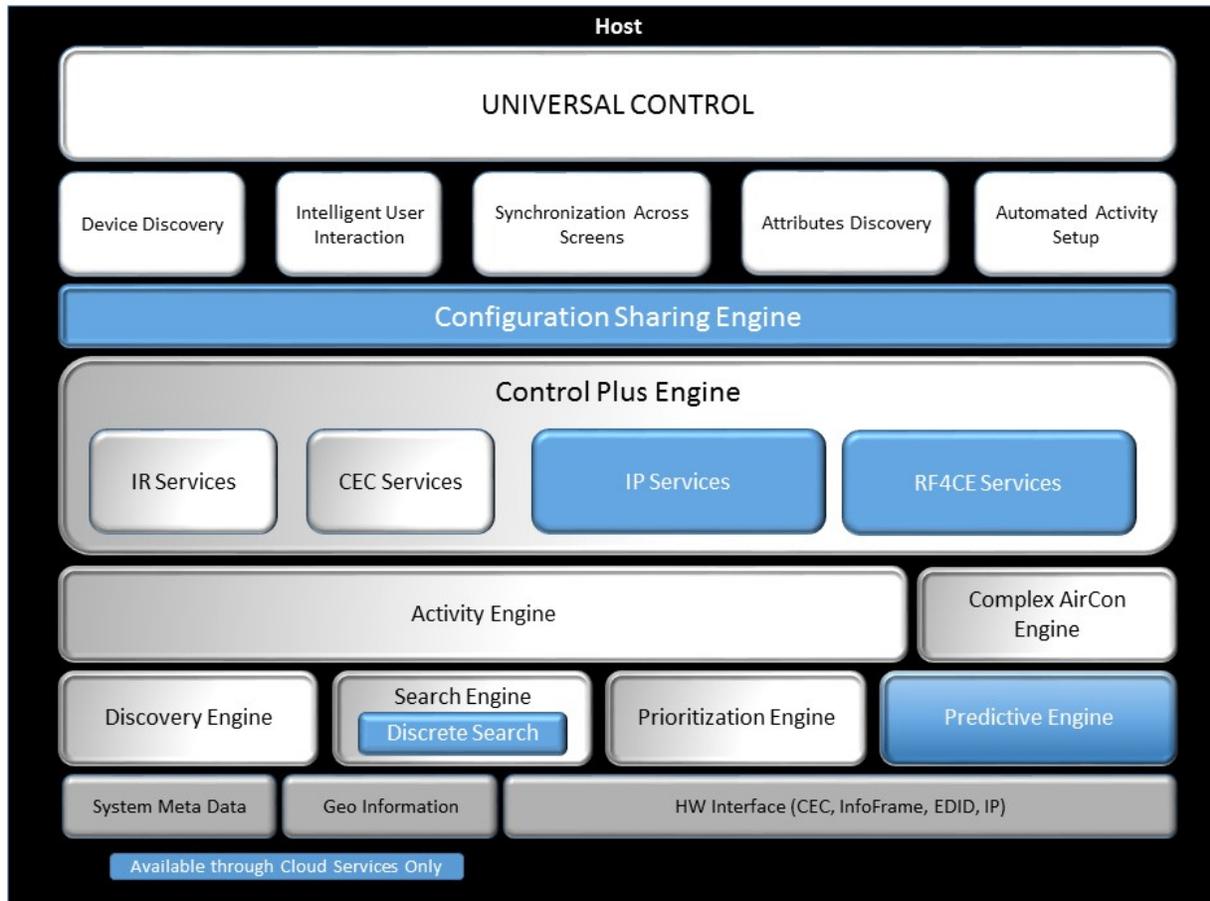


Figure 14 - Device Discovery and Control: Under the Hood

Today, the full range of capabilities embodied in the most advanced solutions comprise the industry’s most comprehensive approach to realizing the vision of a unified and consistent user experience across devices in the home. **A Discovery Engine can be built on top of a range of protocols, and millions of device commands and attributes available in the device knowledge graph**, that can be continually updated as new or updated devices come on the market. The Discovery Engine can discover and apply data native to hundreds of thousands of products used throughout the world with no restrictions as to messaging and link protocols used by any given device.

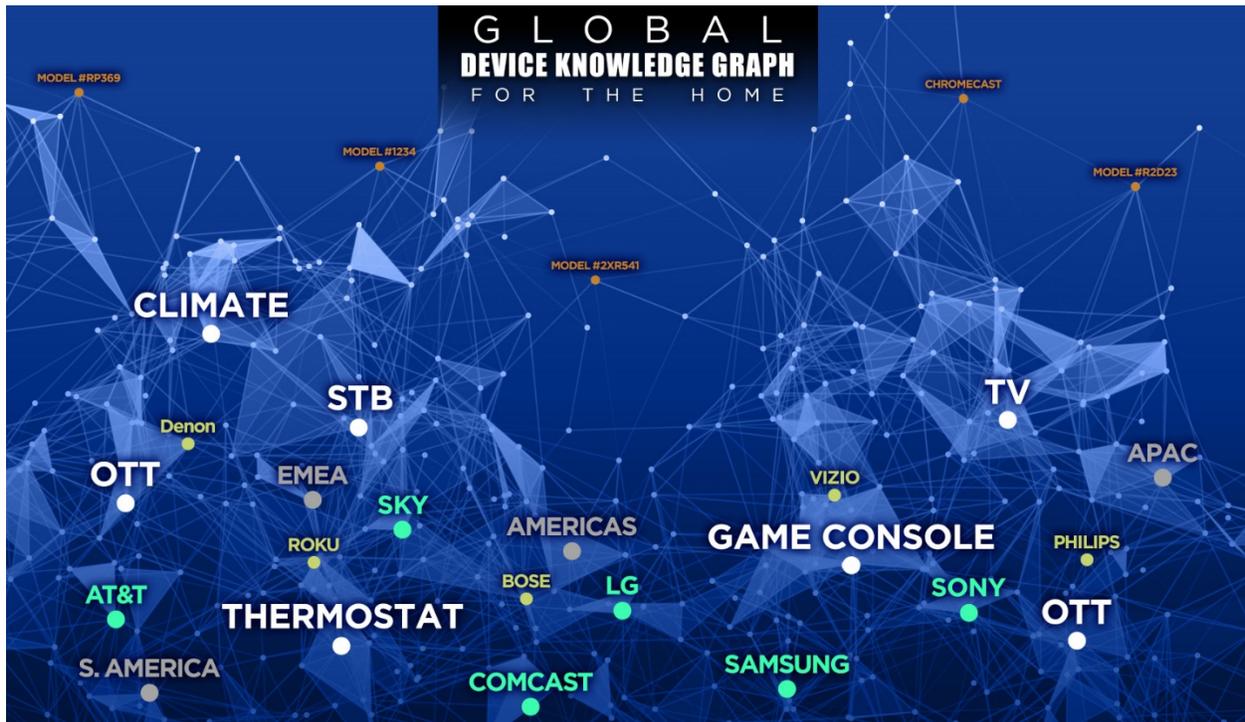


Figure 15 - Global Device Knowledge Graph for the Home

A **multi-protocol method and a unique fingerprinting approach** for identifying devices based on non-structured and non-standard datasets is capable of fingerprinting devices across all communication mediums and physical interfaces in an environment, including a range of characteristics exposed on an IP network, HDMI network and other wireless mediums. This makes it possible to detect the broadest possible range of data, from model and serial numbers to age and region, native video and audio formats, in addition to control capabilities and characteristics.

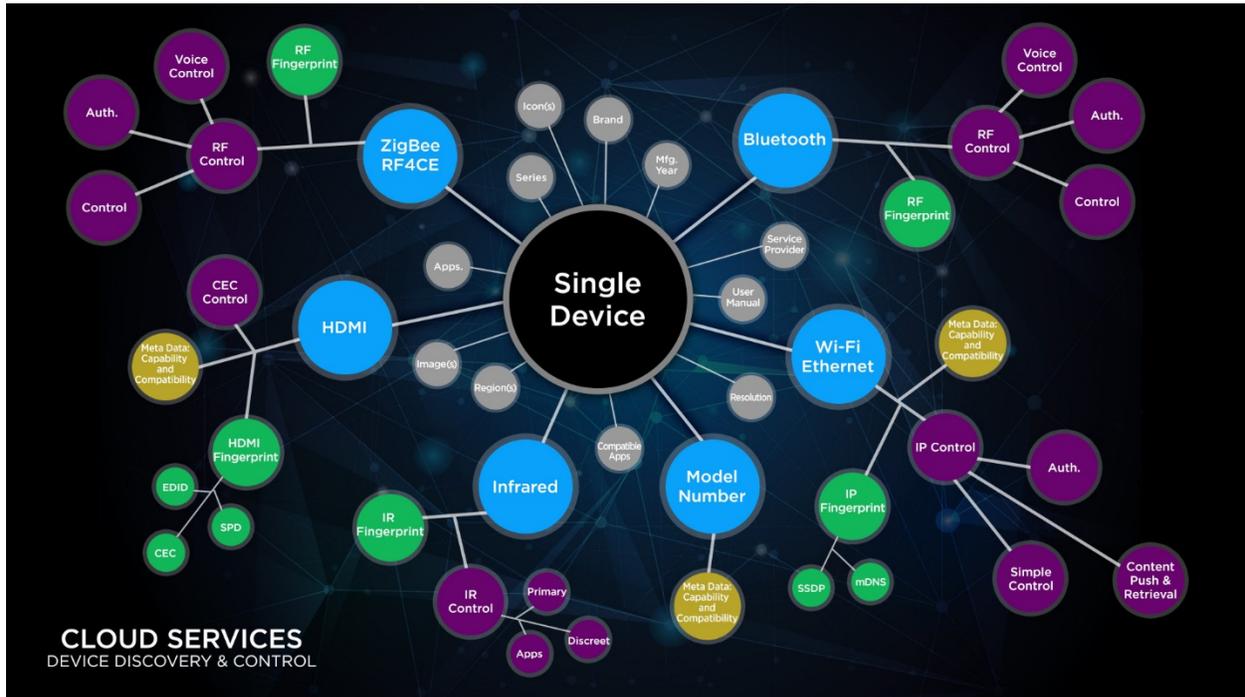


Figure 16 - Multi-Protocol Device Model with Fingerprint

When it comes to control information, multiple protocols must be written and deployed for interacting with multiple devices. This coding must identify the optimal control method(s) for actuating a desired response, which can be on one or multiple control mediums and protocols, including most common wired and wireless protocols in connected home devices.

These capabilities make it possible for providers to fully exploit multi-protocol chipsets and other advances that have been embedded with state-of-the-art smart home gateways, nodes and remote controls.

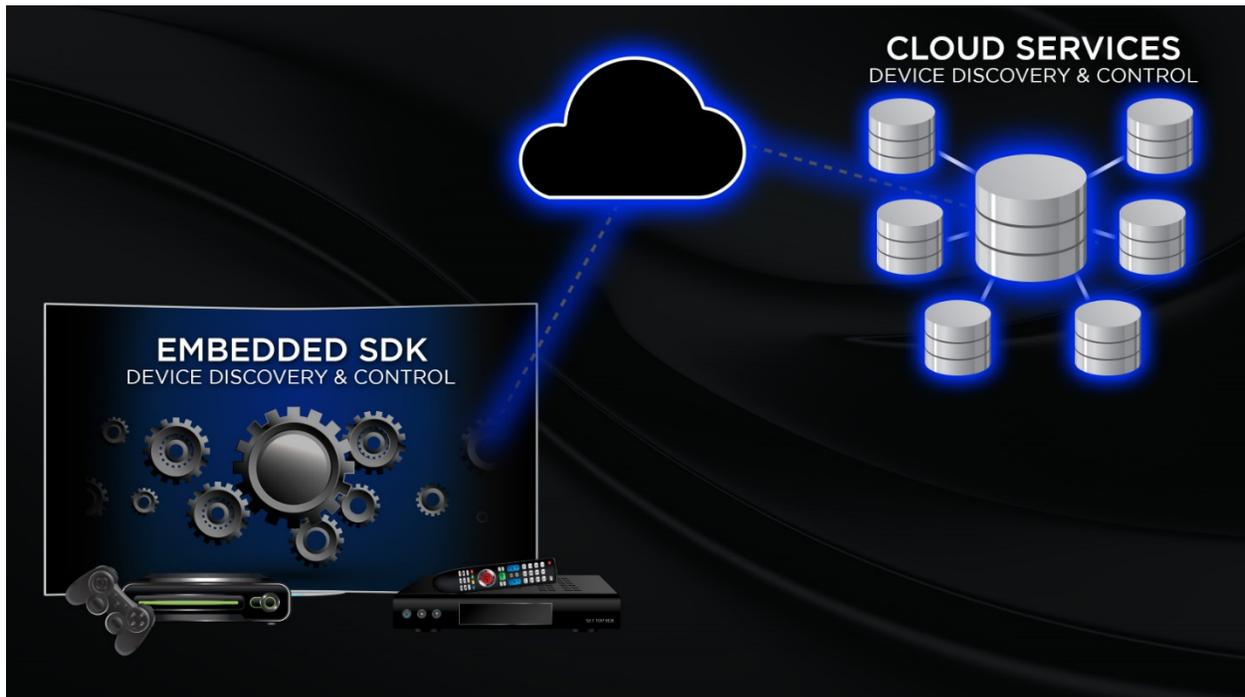


Figure 17 - Hybrid Architecture: SDK backed by Cloud Services

Today operators are taking advantage of the flexibility, power and intelligence added with cloud-based platforms. The cloud's vast processing power, scalability and updateability to enhance recognition capabilities and new services through state-of-the-art machine learning techniques are generally being appreciated.

A viable cloud-based solution can power the simplest nodes including resource constrained devices in need of better discovery and interaction with nearby devices. Equally important, it can be easily integrated over server-to-server links with any connected host platform through simple Web APIs, making it possible to extend features and benefits to managed networks and ecosystems.

Providers have the flexibility to deliver all these benefits through cloud-based solutions, or in hybrid modes that enable close coordination with offline locally hosted snapshots of the knowledge graph in a compressed and efficient format. Cloud connectivity enables near real-time access to an expanding knowledge graph of devices, and continuous updates on a much more flexible schedule.

In fact, a hybrid model with cloud-first configuration has become a common approach among deployments, including the intelligence to dynamically switch between cloud based APIs and offline fallback to provide the best user experience in a flexible integration model.

In a multi-service and multi-device age, cable/satellite operators and CE OEMs can enable second-screen applications, and cross device configuration synchronization to allow control through different interfaces. Coming from the opposite direction, mobile providers can expand the capabilities beyond the initial AV centric applications to **include capabilities for the smart home.**

6. New Experiences in Homes Powered by Device Knowledge Graphs

In tandem with the expanded modes of device discovery, an expanded range of metadata and processes to support new and better experiences targeted at the connected home are necessary. These capabilities power a range of new possibilities for service providers to offer new and personalized services that can be used for monetization through advanced advertising, e-commerce and marketing applications.

6.1. Device Discovery and Contextual Awareness in the Smart Home

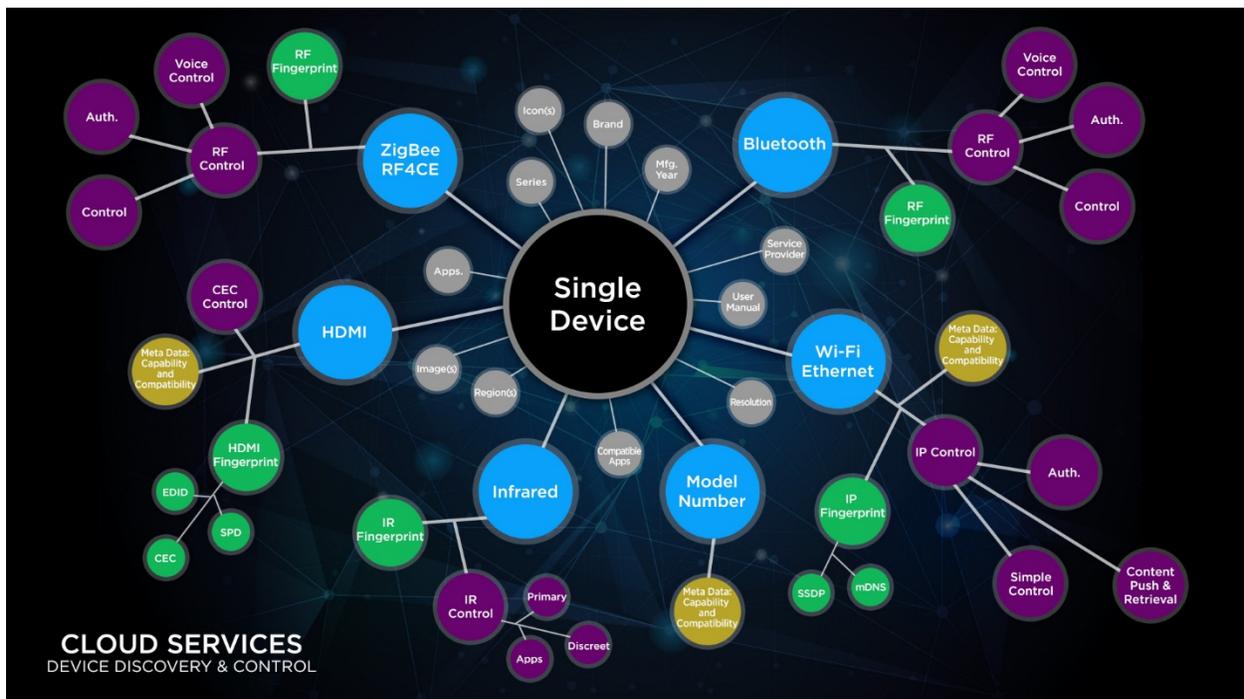


Figure 18 - Expanding Device Model for New Experiences

The **aggregation of additional metadata and device characteristics** are compiled through a combination of advanced data analytics and machine learning processes, combined with a rigorous validation and curation process to assure quality and reliability. The expanding range of metadata can be used by providers to further automate device discovery in the home and to help **improve user experience, or open the door to new business opportunities.**

Available devices, services and content within the home provide the necessary **contextual awareness for better and more personalized services.** In a simple approach, available devices and services are used as signals to trigger a specific persona, such as a household with a specific brand of game console, or subscription to a specific streaming service, or a household in need of a TV system upgrade due to the age of their display. In the world of content, implementations targeting some of these use cases utilize the traditional media recognition techniques which may be limiting and expensive to scale.

These capabilities, when applied to the smart speaker category, can materially improve the experience through better contextual awareness for voice assistants competing to be the primary interface to the

smart home, and a seamless integration with the most common and widely used devices in the household, including new and old entertainment systems and air conditioner units.

6.2. Content Consumption Across Devices and Services

First and foremost, unified discovery and control capabilities satisfy the need among consumers for a way to surface content and applications for easy consumption, regardless of how and where the content is served from.

Upon the completion of initial device discovery on local networks, a solution can apply whatever scripts and protocols are needed to scan and index the content and apps hosted by nearby devices, including any content or apps that might be currently in use. Examples of available insights include which channel is being watched on a cable/satellite service, which application an OTT user is watching or what tune is playing on Spotify. This data is applied in real time to enable aggregation and prioritization of content and applications for display in the provider's **user centric global history and content dashboard**.

There is no set template providers must adhere to in executing this capability. Instead, through the use of the advanced engines, providers have the maximum flexibility to apply metadata and tools to execute all the capabilities in accord with their strategies and user interface (UI) designs.

Critically, providers have the flexibility to provide an intelligent dashboard that adapts to what the end user cares about, dependent on the time of day, and based on their consumption across devices. This global usage history can be used to localize and personalize what appears in the user's UI by referencing the usage profiles captured while adhering to the most stringent privacy and security guidelines.

6.3. Advancing Personalization & Monetization

When the user data is aggregated across devices and services using a unified discovery and control solution, that data can be used to generate **personalized and contextual content recommendations**. A provider can utilize in-house developed or commercially-available recommendation engines to consume data insights to generate content suggestions based on user habits -- not only while consuming the provider's content, but also while interacting with other services.

A platform's support for personalized experiences sets in motion monetization opportunities as well, starting with advertising. Using the metadata aggregated, providers can improve the experience of their ads to be **tuned to specific user or household interests and needs, derived from both user activity as well as the installed base of devices in the home**. Nearby devices in a home can be a strong signal indicating preferences and needs. Such ads might be based on the content a user is drawn to, such as local concert ads for users who frequent a music app; or based on discovered devices such as ads promoting games developed for a specific user's game console.

With assistance from the Predictive Engine, the platform can help OEMs filter their messaging by alerting them to instances where households are using TVs that are at the end of their life spans and would be a strong candidate for upgrades. Similarly, the information identifying types of TV sets in use by any given household can be used by OEMs to avoid running ads promoting new TV models to people who already have them.

For service providers, the opportunities revolve around identification of user behavior that signals potential interest in a service they don't already have. For example, if cable/satellite offers 4K ultra-high-

definition (UHD) service, they will want to alert new buyers of 4K TV sets that the service is available. Or, knowing a user is primarily accessing Netflix for movies, the cable/satellite operator may want to promote its VOD service as a better option.

Conclusion

A simple and enjoyable experience in interacting with devices and content at home has become a key differentiator for service providers and manufacturers at a moment when gadget saturation has become a major drag on consumer satisfaction. **Technology can work behind the scenes to automate discovery of nearby devices and services**, and put content under the fingertips of the user.

Purist approaches have tried to redefine the household devices and protocols, but failed. We believe a flexible approach is capable of scaling across brands and ecosystems to improve daily life for the end users.

These platforms can enable a unified **one-touch** control experience over multiple household platforms, capable of automatic discovery and control over any device regardless of communication protocol. The platform must:

- Aggregate and present content and applications offered across devices in the home to power a unified and personalized dashboard;
- Extend universal control mechanisms to mobile devices and voice assistants;
- Facilitate device and application integration with third-party cloud-based services;
- Support personalization and monetization of the whole-home experience with advances in voice technology, data analytics, and other AI powered services.

It is important to acknowledge the opportunity to improve daily usage experiences for all users through a unified and consistent AI-powered interface, going across device and application boundaries. As a trusted assistant at home in charge of a user's daily journey in finding and consuming new content and services, AI-powered interfaces are now dangerously close to the needs of such an application, only lacking the proper contextual awareness and knowledge of nearby devices and content.

Abbreviations

API	application programming interfaces
AV	audio/visual
BLE	Bluetooth Low-Energy
CE	consumer electronics
HDMI	High-Definition Multimedia Interface
HDMI-CEC	High-Definition Multimedia Interface Consumer Electronics Control
IoT	Internet of Things
IP	Internet Protocol
OEM	Original Equipment Manufacturer
OTT	over-the-top
SDK	software developmental kits
TV	television
UHD	ultra-high-definition
UI	user interface
VOD	video on demand

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