

Anatomy of Smart TVs

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Abstract— While televisions became omnipresent a long time back, technologies that revolve around it have gone through an immense makeover by changing the way we perceive a TV's quality, quantity and features via which content can be viewed, generated and distributed. Unlike Cell phones and mobile devices where the shelf life is quite short (less than two years), owing to its highly volatile ecosystem, the Television has managed to stick around its shelf for longer periods (typically 7-8 years). From the era of CRT screens to plasma/LCD/LED screens, the Television has changed not just in its physical appearance but has managed to instill a sense of intelligence within itself too. From a traditional Analog broadcasting to set-top boxes for a digital entertainment experience, it has evolved to a level of 'smartness' that has changed the way people access digital content and entertainment. With the advent of the Internet information explosion, TVs have evolved to become truly connected devices and have begun utilizing user-TV interactions for semantic analysis. The now popular 'smart TV' can not only give you an enhanced home networking entertainment experience but also act as a window to world of online services and information. This article will take you through some of the most popular smart TV services and technologies along with exploring the challenges faced within the TV ecosystem and finally introducing the Android TV.

Keywords— Smart TV; DLNA; Android; HDR; UHD

Smart TVs have a higher focus on online interactive media, Internet TV, over-the-top content, as well as on-demand streaming media, and home networking access, with much less focus on the traditional broadcasting media that traditional television sets and set-top boxes offer. These devices allow viewers to search and view videos, movies, photos and other content on the Web, on a local cable TV channel, on a satellite TV channel, or on a local storage drive. While content providers have been busy digitizing data, Smart TVs have evolved to a point of convergence of broadband and broadcasting technologies management, on-board entertainment, and much more. Users are also demanding the latest surround sound technologies such as Dolby Digital and DTS to accompany their superior visual experience.

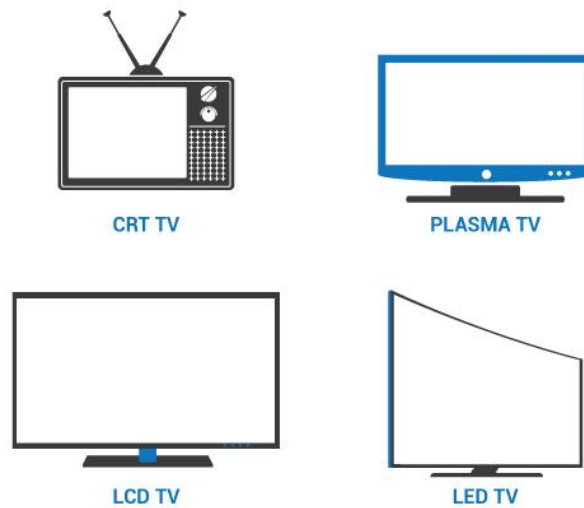


Figure 1: TVs have come a long way from CRTs to OLEDs

Smart TV Features

With increased intelligence, a smart TV can now browse and play content from the internet or from PC and phone. It can also share content with multiple TVs, play different kinds of media formats, make use of additional services from content providers, and much more. It is not only personalizing the user's experience but has also resulted in reduced dependency on the broadcaster for content. While set-top boxes covered the initial requirements for digitization of content, efforts have been made to add that intelligence to the TV itself. With web applications like Netflix and YouTube becoming ubiquitous, smart TV vendors have begun taking the advantage of the plethora of apps and ideas in order to increase its feature base. Catch-up services, video-on-demand (VOD), electronic program guides (EPG), and interactive advertising are taking center stage. Gaming and multimedia features are taking new leaps within the smart TV ecosystem. Penetration of social networking into the market has also garnered immense interest in application development to provide personalization to the user. Thus, content is being sourced from alternate networks apart from operators which means that content distributors can be more agile.

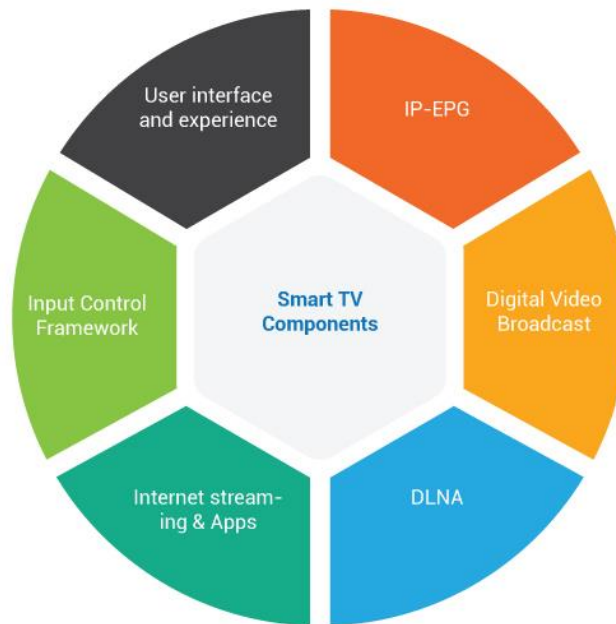


Figure 2: Elements of a Smart TV

Smart TV Components and Design Considerations

1. Internet services and Apps

The smartness of the TV lies in its ability to connect to and utilize internet services. Internet connectivity remains the core feature which opens up a whole new world of possibilities for users. Many new TVs come preloaded with popular apps to deliver on-demand streaming video, music, and news. Users can now catch up with their favorite TV shows, rent and watch online movies, stream videos on demand, connect with family and friends via Skype or social networking sites such as Facebook and Twitter, play games, and even browse the internet. Some of the most popular VOD applications are YouTube, Netflix, BBC-I player, Live TV, etc. Through the power of internet streaming content, which was traditionally meant only for PCs and handheld devices, can now be seen on a larger screen.

2. UI Design

Phone and tablets have dominated the application development space and for long have dictated the terms and conditions for UI design and development. However, with TVs coming into the fray, application and features that drive the user experience and design must consider the increased screen size of the display. Social media interaction needs to be blended seamlessly into the TV interface. For this reason, application development for TVs has to move towards designing icons, buttons and various UI parameters that suit a larger display. The UI

must be designed keeping in mind that the user is going to be at least 10 feet away from the screen. Also, the user brings in specific expectations while watching TV as compare to a phone or tablet. Rich contrast ratios facilitate the need for visually appealing graphics and skins. A visually engaging design must often be accompanied with simplicity for a true enjoyable user interaction.

3. Electronic Program Guides (EPG) and Interactive Program Guide (IPG)

These provide users of television, radio, and other media applications with continuously updated menus displaying broadcast programming or scheduling information for current and upcoming programming. By tuning into an EPG channel, a menu is displayed that lists current and upcoming television programs on all available channels. IPG on the other hand is a form of enhanced TV that offers an advanced onscreen display to locate content. Just as people use search engines and portals to locate content on the web, viewers need powerful IPGs to help them with what they want in regard to television. As the TV gets integrated into the internet, we are now moving into an era of IP-EPG where the program guide is generated by mashing up EPG data over IP.

4. DVB Content Playback

Device manufacturers are responding to the digitization of content by integrating set-top box features within the TV itself. This helps the TV work with an additional capability of supporting EPG and AV content decoding/rendering. Therefore, smart TVs need to have an inbuilt ability to play media content that is obtained via DVB. The most common format used in DVB is MPEG-TS which is less reliable and is used for transmission and storage of program system info, audio and video data. While this area has been the traditional focus point for providing core video services, a lot of it is nowadays being influenced by the operating system capabilities. For example, Android's multimedia framework (e.g. Stagefright) may be used to demux and decode MPEG-TS streams, something that was traditionally done using custom hardware/software as part of the vendor platform capabilities. Hybrid broadcast broadband TV (or "HbbTV") is a global initiative aimed at harmonizing the broadcast and broadband delivery of entertainment services to consumers through connected TVs, set-top boxes and multiscreen devices.

5. Extended Media Format Support

All smart TVs come with an inbuilt support for playback of stored content. This means the TV must have an extended codec support in order to play different container formats and codecs. Most device manufacturers have proprietary software that includes demuxer/decoder software and custom media frameworks to provide support for multiple audio-video formats. Standard operating systems like Android are now changing this landscape by providing support for most

of the basic formats as part of their software platform itself.

6. Home Entertainment Network: DLNA/Miracast

The home networking feature signifies the power of a connected TV. With wired (Ethernet) or wireless (Wi-Fi) connectivity, it utilizes the power of content sharing through plug and play devices within a network. By a simple tap of a button or motion, one can push content to a television or control media play-back on the TV through a smart phone application using Miracast. Using DLNA, one could discover devices providing similar services within the network and subscribe to them. Content discovery and rendering of content on the display can be controlled through different device classes. Once content is discovered, playback happens in a streaming fashion with a client and server.

7. Input Control Framework

For long, the main interface between the user and the TV has been via the IR remote and it continues to do so. With enhanced internet features, it is imperative to provide a mechanism via which data/text can be fed into the TV in a much easier way. Smartphone apps are now being used to replace the remote unit by simulating a remote like user inter-face on the app window. While majority of the smart TVs still stick to IR based remote controls, several smart TV manufacturers have moved to voice commands and gesture recognition for input and control.

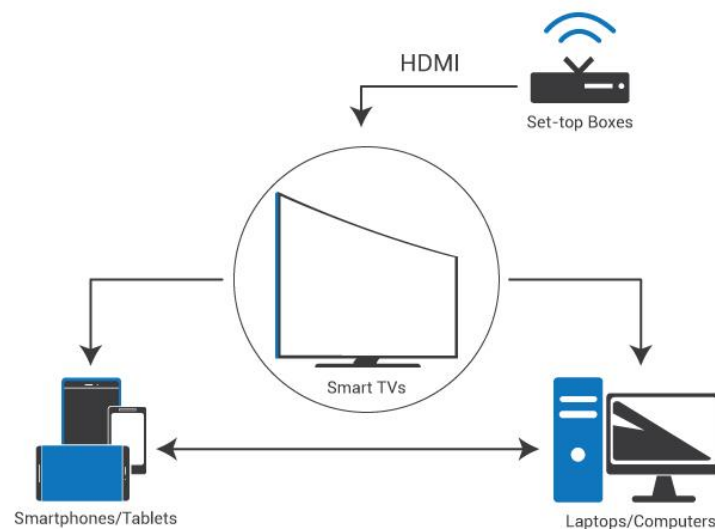


Figure 3: Home entertainment networking components

Android Based Smart TVs

While traditional smart TVs were dependent on device manufacturers to dictate the various apps and features, Android TVs gave control and power to the users and the developer community. By providing specific extensions as part of the L project, Google, and Android in particular, seemed to hint at a greater presence in the smart TV market. Initially known as Google TV, Android TV's creative vision specially revolved around providing casual consumption, cinematic experience, and simplicity to the viewer. With this, television manufacturers were open to integrate TV into the Android ecosystems.

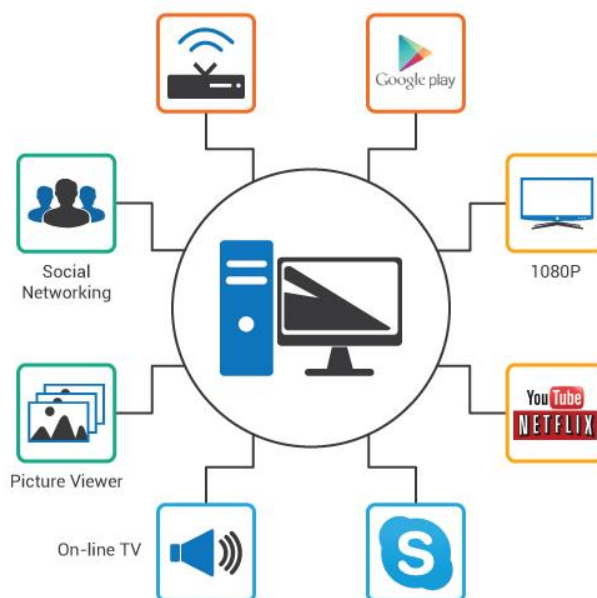


Figure 4: The Android TV

The shelf life of televisions is usually greater than five to seven years, which is a long period considering that platforms like Android evolve continuously. This exposes a major challenge of upgrades with respect to android TVs. This thought has driven Google to think of many other devices which may be seen as competitors to the Android smart TV. Foremost among them is Android TV player (Nexus player) and Chromecast. The Android TV player is set to replace the Google TV project by providing simple box on the lines of the Apple TV device that is feature rich and can render any display device with an HDMI interface as a smart TV.

Conclusion

It is clear that the smart TV ecosystem is filled with innovative solutions. Televisions have evolved from being a mere 'idiot box' to being a 'window to the world' with its various connectivity and broadcast features. The Smart TV is evolving not just in terms of internet applications but also in physical design and intelligence. But at the same time, it is facing a stiff competition from new age devices that seem to be gaining popularity. However, televisions are

still driven by dogmatic standards and need to rapidly adapt to the ever changing technology ecosystem. With 3D features and Ultra HD gaining popularity, onus is also on content providers to generate content to suit these use cases. Most of all, how users are going to respond will decide the future of smart televisions.



Figure 5: The smart TV ecosystem

About The Author

Dorairaj Vembu has over 20 years of experience in product management, product development, program management in Connected Car, Automotive Electronics, Internet of Things, Multimedia, Connectivity and Consumer Electronics space. He has authored and co-authored articles that cover improvement of urban governance by leveraging the smart city concept. Dorairaj has a Bachelor's degree in Computer Science from NIT Trichy and an MBA from IIM Bangalore.

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