Exploring the Potential of TV 3.0: Applications and Impact on Content Delivery and Audience Engagement

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ABSTRACT

This paper explores potential applications for TV 3.0, a groundbreaking evolution in Brazilian digital television that introduces advanced functionalities such as app-based experience, viewer-centered design, enhanced interactivity, and integration with smart technologies. Leveraging these new capabilities, TV 3.0 can revolutionize content delivery and audience engagement in several key areas by enabling personalized content experiences with recommendations and adaptive streaming to enhance viewer satisfaction and retention. We present three use cases that explore some of the new features and their potential impacts on content transmission and consumption and the development of interactive applications.

KEYWORDS

TV 3.0, Use Cases, ATSC 3.0

1 INTRODUCTION

Advancements in Digital TV have introduced a variety of interactive features that surpass traditional passive viewing. Viewers can access on-demand content, participate in live polls, interact with advertisements, and receive real-time updates and notifications. These capabilities create a more engaging and immersive experience, catering to the diverse preferences of the modern audience.

The evolution of TV generations in Brazil reflects the continuous improvement of technology for transmitting and receiving television signals. Analog TV, which dominated until the early 2000s, marked the first major phase, characterized by transmitting analog signals with limited image and sound quality. The introduction of digital TV, with the implementation of the Brazilian Digital Terrestrial Television System (SBTVD) in 2007, represented a significant leap forward, bringing improvements such as high definition (HD), surround sound, and the possibility of multiprogramming.

With the imminent arrival of TV 3.0 [6, 8], Brazilian broadcasters and companies in the sector are preparing for a new technological revolution. TV 3.0 promises a better integration of Broadcast and Broadband, offering a more interactive and personalized experience. Based on the ATSC (Advanced Television System Committee) 3.0 [3] standard, the new TV 3.0 incorporates the ROUTE/DASH specification for the transport layer, in order to enhance the efficiency and flexibility of content delivery in broadcasting. Together, ROUTE and DASH empower broadcasters to deliver highly personalized and contextually relevant content [2].

This new generation will also allow transmission in ultrahigh definition (4K and 8K) and immersive audio by including support for new codecs such as the Versatile Video Coding (VVC) ISO/IEC 23090-3, MPEG-I part 3, the Low Complexity Enhancement Video Coding (LCEVC) MPEG-5 part 2, and MPEG-H audio (ISO/IEC 23008-3).

Furthermore, significant architectural updates are being developed in the application coding layer to support the numerous new features of TV 3.0. One of the key innovations is the application-based experience, where each TV channel is an independent application that encompasses all the content provided by the broadcaster [9]. This approach enhances flexibility and facilitates a more interactive user experience, allowing viewers to seamlessly navigate between live broadcasts, on-demand content, and interactive elements within a unified integrated platform.

Other substantial architectural evolution landmarks are the insertion of viewers' profiles [5], support for multi-user interaction [1], a new multi-devices support [7], multi-interaction capabilities, and support for multi-sensory effects [10]. The viewer's profile transforms the viewing experience into a more personalized and dynamic activity, allowing viewers' preferences to be considered in the content offered by the broadcasters. With multi-user interaction, viewers can interact with each other and with the content displayed,

In: VII Workshop Futuro da TV Digital Interativa (WTVDI 2024). Anais Estendidos do XXX Simpósio Brasileiro de Sistemas Multimídia e Web (WTVDI'2024). Juiz de Fora/MG, Brazil. Porto Alegre: Brazilian Computer Society, 2024.

ISSN 2596-1683

creating a more personalized and cooperative experience. Multi-device support enables seamless integration across various devices, allowing viewers to interact and watch on second-screen devices without interruption and independently. The multi-interaction capability further enhances engagement by enabling the simultaneous use of different interfaces, such as voice commands, remote controls, and gestures, to interact with content in real time. In addition, the introduction of multisensorial effects, such as synchronized lighting, vibrations, and scent, offers an immersive experience that goes beyond sight and sound, creating a more engaging and interactive environment that enhances the overall impact of the content.

Improvements in accessibility are also being implemented through the adoption of new encoding and transmission standards for captions and sign language. Additionally, TV 3.0 incorporates specialized APIs designed for the management and presentation of these resources.

Extensibility is also addressed in TV 3.0 through an API listing feature, which enables the system to identify which APIs and their respective versions are present in the receiver. This capability allows applications to dynamically adapt to the available resources, ensuring compatibility and optimal performance in various scenarios. By providing detailed information about the APIs and their versions, developers can tailor their applications to take advantage of the full potential of the device's capabilities, offering a more seamless and efficient user experience. This approach enhances the system's flexibility, allowing it to evolve and support new features over time without compromising functionality.

In this paper, we aim to explore the exciting new functionalities of TV 3.0, showcasing its application in three different scenarios and highlighting the transformative potential of this new standard for the future of broadcasting. Section 2 is devoted to the three use cases, while Section 3 points out some conclusions.

2 USE CASES

This paper focuses on three use cases that explore some of the main innovative characteristics of the new upcoming Brazilian DTV standard. We start with a *Segmented Programming* use case, which enables broadcasters to customize their content to specific viewers or contexts. Next, we address the *Personalized Channel* capability, allowing users to follow personalized experiences over the delivered content. Lastly, we explore some of the *Extensibility* features, which will provide for the adaptation and evolution of the system itself.

2.1 Segmented Programming

Television content significantly influences society due to its broad reach. TV 3.0, will facilitate content segmentation, allowing broadcasters to use transmission band, location, user profile preferences, and various analytics. This means that viewers in different neighborhoods of the same city would receive the same broadcast service with regional variations. For example, local news, advertisements, and emergency alerts can be customized based on the viewer's location, ensuring relevance and immediacy. Figure 1 presents a scenario with a location-based advertisement delivering two different content in the same broadcast service.

This capability allows broadcasters to deliver more relevant and personalized content, increasing viewer engagement and satisfaction. By leveraging advanced segmentation techniques, broadcasters and advertisers can target audiences more effectively, optimizing content delivery and maximizing the impact of their messages. This geographical targeting ensures that content is finely tuned to meet the specific needs and interests of diverse local audiences within a metropolitan area.

Additionally, that approach enables seamless integration of Over-the-Air (OTA) and Over-the-Top (OTT) content delivery. By combining these methods, broadcasters can offer traditional broadcast content alongside internet-based services, as streaming platforms and social media already do. This integration allows interactive features and on-demand options, such as personalized advertisements and supplementary content available through web platforms, enhancing the viewer experience.

A critical component for segmented programming is the geolocation API, which can be used to determine appropriate content for each viewer. The application verifies user permissions for accessing location data using the user API. Once confirmed, the broadcast transmission can be customized according to the receiver's location. As instance, it can be used to decide whether the advertisement should be general or locally targeted.

Segmented programming also offers unparalleled opportunities for advertisers by enabling highly targeted and contextually relevant advertising. This precision in ad delivery can significantly enhance the effectiveness of advertising campaigns and provide a better return on investment.Advertisers can deliver ads specific to the viewer's location using the geolocation data. For example, a local restaurant can target advertisements to viewers within a certain radius, promoting special offers or events. Similarly, regional businesses can tailor their advertising to reach potential customers in their immediate vicinity, increasing the likelihood of attracting local patrons.

The viewer's context, such as the type of content being watched or the time of day, could also be used to deliver more relevant advertisements. For instance, a sports apparel company could target ads during live sports events, or a coffee shop could advertise breakfast specials during morning news broadcasts. This contextual relevance ensures that advertisements resonate more with the audience, leading to higher engagement and conversion rates.

Moreover, by accessing data points like age, gender, and viewing habits, advertisers can create more personalized ad experiences. For example, a children's toy company could target families with young children during appropriate programming blocks. Similarly, luxury brands can target high-income demographics with tailored advertisements during prime-time shows that attract their target audience.

Based on DASH-IF technology [4], content segmentation can occur using the Media Presentation Description (MPD) table. The MPD provides a detailed description of the media streams, including attributes such as `XLink`, `BaseURL`, `Period`, `AdaptationSet`, and `Representation`. This allows the delivery of multiple streams that can be dynamically adjusted based on geographical location, user preferences, and viewing habits. These elements enable precise timing and placement of advertisements, which can be changed in real-time based on inventory availability, viewer behavior, and

Figure 1: Illustration of location-based programming segmentation. Region 1 and Region 2 represent two different locations such as cities, neighborhoods, streets, etc...

market trends. For example, a retail brand can promote flash sales or limited-time offers that are updated dynamically during the broadcast.

Implementing segmented programming with Real-time Object Delivery over Unidirectional Transport (ROUTE) and MPEG-DASH can involve additional services, different routes, and unique signalizations.

Additional services are crucial for segmented programming. Geolocation services allow broadcasters to identify viewer locations in real time, enabling targeted content delivery. User profile management systems maintain detailed viewer profiles, including preferences, habits, and demographics, facilitating personalized content. Advanced Content Management Systems (CMS) dynamically serve different content variations based on real-time data from ROUTE. Analytics and reporting tools process viewer data, generating insights to optimize content delivery and advertising campaigns.

In that context, different routing strategies can be used. Multiple broadcast streams attend to different regions or user profiles. Then dynamic recommendation algorithms can offer appropriate content streams based on real-time location and preferences for the viewers.

Furthermore, unique signalizations within the broadcast signal further support segmented programming. Metadata tags embedded in the signal provide detailed information about the content, enabling precise targeting. Signal markers trigger content switches or advertisement insertions at predefined points, ensuring relevant content delivery at the right moments.

2.1.1 Viewer Privacy and Data Security. One significant concern with segmented programming is the privacy and security of viewer data. As broadcasters will be able to collect and use personal data such as geolocation, viewing habits, and demographic information, it is essential to establish transparent data-handling practices. Implementing clear consent mechanisms and providing viewers with control over their data can help build trust. Moreover, broadcasters must adhere to regulations like the General Law on the Protection of Personal Data (LGPD) to ensure the ethical use of data. Regular audits and updates to security protocols can help mitigate risks and protect viewer information.

These are some important points for a segmented programming application, which could result in a richer and more engaging viewer experience and offer broadcasters new opportunities for monetization through targeted advertising and personalized content delivery. It is also worth highlighting that viewers can not be forced to accept their data use and manipulation, and those who choose not to do so must still receive the full viewing experience, although without personalized content. This entire aspect is currently being established within the TV 3.0 project through the development of a comprehensive privacy framework.

2.2 Personalized Channel

In addition to the scenarios previously explored, we can also prospect a customized experience where the viewers' preferences are considered for content delivery and organization. This allows the creation of a Personalized (or Virtual) Channel where all its content matches the user's interests and the broadcaster's content availability.

In this use case, there is an integration and abstraction of the means of distribution. The linear (OTA) and digital (OTT) environments work synergistically, enabling the creation of a personalized

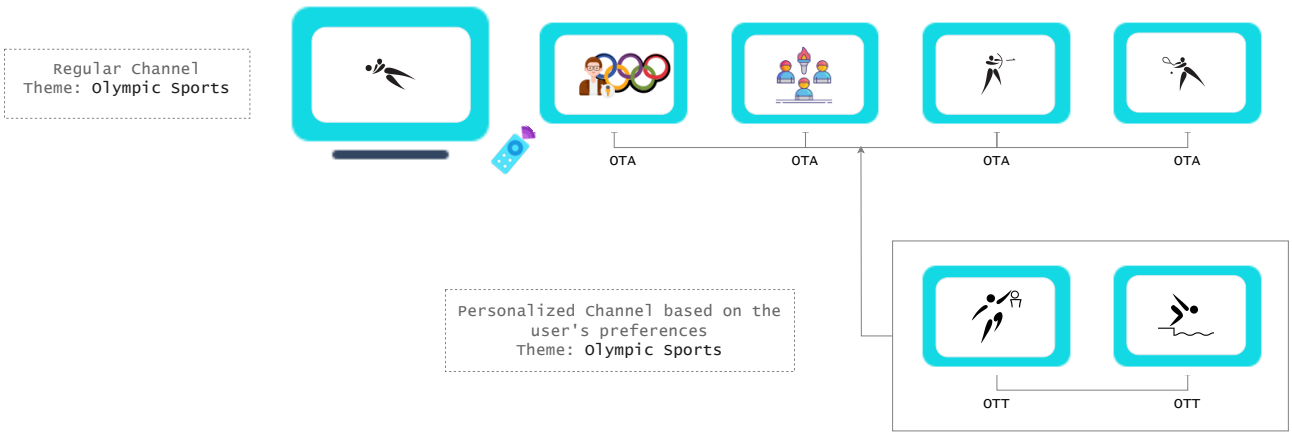

Figure 2: Overview of the personalized channel that suggests content based on the user's preferences.

grid, as illustrated in Figure 3. The channel is composed of content available in both environments and specifically tailored to the user's profile preferences.

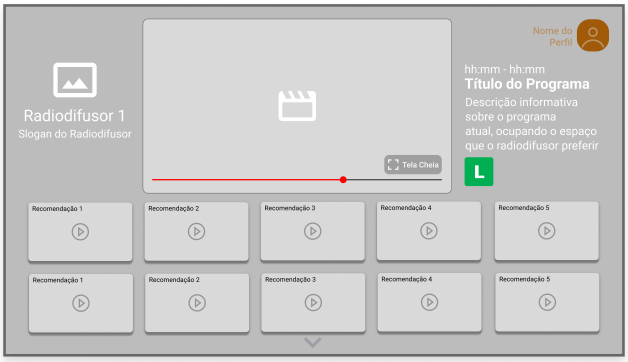

Figure 3: Overview of the personalized channel that suggests content based on the user's preferences.

For example, upon constructing its profile, users can signal their interest in sports, specifically basketball, and swimming. A sports-themed personalized channel will consist of live sports content regularly delivered by the broadcaster (OTA or OTT) and on-demand sports content (Video on Demand, OTT).

During events like the Olympic Games, where live and simultaneous sports competitions occur, OTA distribution delivers common content defined by the broadcaster and provides temporal signaling. These temporal stamps allow an application on the user's TV (OTT) to replace content. As shown in Figure 2, between OTA segments, the broadcaster suggests on-demand content based on the user's preferences (basketball and swimming), creating a personalized channel. This ensures that each user follows a customized journey through the content offered by the broadcaster.

2.3 Extensibility

A key objective of the TV 3.0 project is to develop a system that can evolve and adapt to future use cases. To achieve this, the extensibility functionality proposes a mechanism for applications to determine the capabilities and attributes of a receiver, extending beyond the hardware checks supported in previous versions. Attributes such as operating system name and version, CPU performance, memory, supported codecs, etc. In addition to this information on receiver capabilities, versioning information for all APIs present can also be consulted. This is accomplished through an API call that provides information such as name, version number and release date of a specific API. This enables developers to design applications that adjust their behavior based on the availability of certain software features on the receiver. By maintaining a list of APIs that can be easily expanded over time, this approach allows for a wide range of potential behaviors and functionalities in applications.

Through extensibility, it is possible to introduce new functionalities that are not supported by a given API version. For instance, a broadcaster might want to retrieve data from the audience measurement API regarding the number of viewers who watched a program over a specific period. However, the current version of the audience measurement API only provides data on the duration for which a receiver was tuned to a particular channel. In another scenario, a broadcaster may wish, in addition to counting, to automatically identify who is watching at a given time. This capability would enable the system to automatically switch to the appropriate viewer profile or, in cases where multiple viewers are present, allow the application to recommend content or personalize advertisements based on all the identified profiles.

In these scenarios, two versions of a camera API could be implemented: one capable of simply detecting the number of viewers present, and another with the ability to uniquely identify each viewer by matching them to an internal database of profile images. With viewer consent, an application can employ the basic camera API to collect audience data, such as the number of individuals watching. Furthermore, the application can query the receiver to determine if the more advanced version of the API is supported. If

available, this advanced API allows the system to dynamically adjust the active profile based on the identified viewer or to personalize content and advertisements according to the specific preferences of the viewers.

Both scenarios corroborate the importance of extensibility in ensuring the continued expansion and versatility of TV 3.0 applications.

3 CONCLUSIONS

This paper has explored the transformative potential of TV 3.0 within the broadcasting landscape. The progression from traditional analog TV to digital and now to advanced capabilities marks a significant leap in the methods and quality of content transmission and consumption.

Through various case studies and examples, we have illustrated how the TV 3.0 could empower broadcasters to customize their programming for specific regions within a city, thus addressing local interests and needs with greater precision. This degree of localization not only enhances viewer engagement and satisfaction but also unlocks new opportunities for targeted advertising and region-specific content creation. The ability to deliver customized programming ensures that content is more relevant and compelling for diverse audience segments.

The convergence of Over-the-Air (OTA) and Over-the-Top (OTT) content delivery within the TV 3.0 framework further enriches the viewing experience. This integration blends the reliability and reach of traditional broadcasting with the flexibility and interactivity of Internet-based services. Consequently, viewers can experience a more dynamic and engaging interaction with television content, enjoying features such as on-demand viewing, live polls, and interactive advertisements. Broadcasters, on the other hand, can leverage detailed analytics to refine content delivery strategies, optimize viewer engagement, and enhance service quality.

The adoption of these advanced functionalities will make television more interactive, personalized, and relevant to the diverse preferences of modern audiences. By harnessing TV's full potential, broadcasters can create more immersive and contextually relevant media experiences, paving the way for innovative content delivery methods and setting new standards in the broadcasting industry. This evolution not only enhances viewer satisfaction but also opens new avenues for broadcasters to explore targeted advertising, interactive features, and improved content personalization, ultimately leading to a richer and more engaging television experience.

ACKNOWLEDGMENTS

The authors would like to acknowledge the Brazilian Communications Ministery, Forum SBTVD and RNP for financial support for this work.

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