Multimedia App-based emergency alerts on Brazilian Digital TV3.0

Derzu Omaia

Richelieu Ramos de Andrade Costa

Tiago Maritan Ugulino de Araújo

Guido Lemos de Souza Filho

CITE THIS ARTICLE

Derzu Omaia, Richelieu Ramos de Andrade Costa,Tiago Maritan Ugulino de Araújo, Guido Lemos de Souza Filho; 2025. Multi-media App-based emergency alerts on Brazilian Digital TV3.0. SET INTERNATIONAL JOURNAL OF BROADCAST ENGINEERING. ISSN Print: 2446-9246 ISSN Online: 2446-9432, doi: 10.18580/setijbe.2025.7 web link: https://dx.doi.org/10.18580/setijbe.2025.7

SET INTERNATIONAL JOURNAL OF BROADCAST ENGINEERING – SET IJBE V.11, 2025, Article 7 | 5 p
 | ISSN (Print): 2446-9246 | ISSN (Online): 2446-9432

Multimedia App-based emergency alerts on Brazilian Digital TV3.0

Derzu Omaia, UFPB, Richelieu Ramos de Andrade Costa, UFPB, Tiago Maritan Ugulino de Araújo, UFPB, Guido Lemos de Souza Filho, UFPB.

Abstract — TV 3.0 is currently in the final stages of specification. The Brazilian Digital TV System Forum (SBTVD) initiated this project in 2020 through a call for technology proposals, which received 36 responses from 21 organizations worldwide. Since then, SBTVD has been coordinating the development of this project, which involves researchers from industry and academia. The emergency alerts in TV 3.0 were based on the ATSC 3.0 alert transmission system, Advanced Emergency Information (AEA), which was improved and adapted to the needs of TV 3.0. This work focuses on the innovations proposed for the emergency alert system and presents possible scenarios and solutions that can be explored within these systems. Among the proposed innovations are the requirement for TVs to monitor alerts even when in the context of other applications, in addition to broadcast TV, as well as the requirement to display multimedia alerts containing images, videos, audio, and text, if available. Another innovation is the possibility of displaying alerts accessible in sign language and audio description. If the alert cannot be monitored via OTA, such as when the tuned channel is not enabled to transmit alerts, the alerts can be monitored through a remote URL, via the Internet (OTT). Broadcaster Applications and Companion Applications can monitor emergency alerts. To do so, they must register as listeners of alert events through calls to the Ginga Webservice server API, allowing for greater flexibility and mobility in the display of alerts. It is hoped that this new system will enable the mitigation of disasters of any kind more efficiently, and that the population will be better informed with sufficient time to protect themselves and move to safe locations.

Index Terms — **TV 3.0, Emergency Alerts, Accessibility.**

I. INTRODUCTION

Television (TV) in Brazil plays a crucial role in society, serving not only as a source of entertainment but also as a vital means of information, education, and social interaction. Given its importance, any proposal to change the way Brazilians watch TV is carefully analyzed. The TV 3.0 project, managed by the Brazilian Digital Terrestrial Television System Forum (SBTVD), is currently under development, with the participation of researchers from academia and industry.

The project began in 2020 with a public call for technology proposals, receiving 36 responses from 21 global organizations. The SBTVD Forum has coordinated the development, which is now in the final specification phase. One of the important aspects to be addressed is support for emergency alerts, which are designed to provide critical information to the population during crises, such as natural disasters or public safety incidents.

The TV 3.0 emergency alert system is based on the Advanced Emergency Information (AEA) format of the ATSC 3.0 standard, which has been adapted to Brazil's needs. In previous work by Costa et al. [5], the system architecture and extension of the Common Core Web Service (CCWS) server API were proposed to support accessible alerts with gloss and audio description. The current TV 3.0 alert system is already being implemented and is based on these proposals, allowing, for example, alerts to be monitored and received even in conditions of no internet or cell phone signal, as long as the TV signal is present.

This work is based on innovations proposed for the emergency alert system, which expand the possibilities of the ATSC 3.0 standard. In this sense, solutions were analyzed and proposed for scenarios that require greater flexibility and mobility in the display of alerts. Among the innovations, we highlight the ability of the TV to monitor alerts even when other applications are in use, the display of multimedia alerts with images and videos, and the possibility of monitoring via the internet (OTT) when transmission is not possible through the tuned channel. The proposal is that the new system will contribute to more efficient disaster mitigation, providing the population with more complete and accessible information so that they can protect themselves adequately in emergencies.

II. THEORETICAL BACKGROUND

This section presents some standards for exchanging emergency alert messages.

A. Common Alert Protocol

The Common Alert Protocol (CAP) [6] is an international standard normalized by the ITU and widely used as a protocol for exchanging emergency alert messages across various types of networks. It defines how alert messages should be structured and transmitted to ensure interoperability between different alert systems. CAP allows an alert message to be disseminated simultaneously by many different alert systems, thereby increasing distribution effectiveness [6].

It is distributed in Extensible Markup Language (XML) format and is used in several systems, including Google's Public Alerting System [10] and also by the National Center for Risk and Disaster Management (CENAD) [9].

B. AEA - ATSC 3.0

In the ATSC 3.0 standard, emergency alerts follow the Advanced Emergency Information (AEA) format [3]. In this format, the emergency alert is configured through anXML file in which the characteristics of the alert are defined as XML elements (tags) and attributes. This file is compressed in gzip format [11] and transmitted within the Low Level Signaling (LLS) table, which is transmitted in the payload of IP packets in ATSC 3.0 [3].

https://set.org.br/ijbe/ doi:10.18580/setijbe.2025.7 Web Link: https://dx.doi.org/10.18580/setijbe.2025.7

 | ISSN (Print): 2446-9246 | ISSN (Online): 2446-9432

AEA is compatible with the CAP protocol, making it possible to convert CAP to AEA format. This way, broadcasters can receive an alert in CAP format and transmit it in AEA format [6].

There are five possible priority levels for alerts. They can be: minimal, low, moderate, high, or maximum, which have different interactions with the user, ranging from offering them useful information in a subtle way to critical information that requires greater attention [3].

C. Emergency Alerts on Brazilian TV 3.0

Internationally, Emergency Alert Systems (EAS) have been extensively researched, especially in countries such as Japan and the United States, which traditionally use TV and radio as their main vehicles for transmitting warnings. The transition of these mechanisms to the digital environment offers more adaptability in how data is displayed, as well as allowing notifications to be adjusted according to the individual's geolocation and profile [7].

In TV 3.0, following a CfP (Call for Proposals), it was decided that the emergency alert format to be used would be ATSC 3.0's AEA. Experiments were conducted to investigate the functionality of the system in emergencies, such as natural disasters, floods, dam ruptures, among others. To reach the widest possible audience, these alerts can be transmitted with accessibility, being made available in text, graphic (images and videos), audio description, and sign language formats.

III. ARCHITECTURE OF TV 3.0 EMERGENCY WARNING SYSTEM

The architecture of the TV 3.0 emergency alert system is shown in Figure 1. According to Figure 1, the country's emergency alert management authorities are responsible for monitoring emergency alert situations. When a situation is detected, alerts must be made available so that the broadcaster can access them.

In Brazil, monitoring authorities make alerts available in the Common Alerting Protocol (CAP) format [6]; TV 3.0 uses the ATSC 3.0 format, i.e., AEA [3]. Therefore, it is necessary to convert between these formats. Both formats are represented in XML format, and most of their fields are convertible. The TV 3.0 emergency alert operational guide will provide a conversion table.

The broadcaster must actively and periodically monitor the management authorities. This monitoring can be carried out through a URL provided by the authorities. When the alert received is from the broadcaster's coverage area and is of extreme or severe severity, the alert must be transmitted. To do so, it must be converted to AEA, accessibility must be inserted, and the stream must be configured and multiplexed in order to be broadcast to the entire coverage area.

The receiver, in turn, must verify that the alert received is for its geographic region by comparing the alert region with its current location, which can be obtained through the Webservice geolocation API. If the alert is relevant to its region, it must be processed and displayed. The flexibility of the system allows the alert to be sent to various applications, including local applications, such as broadcaster apps, and

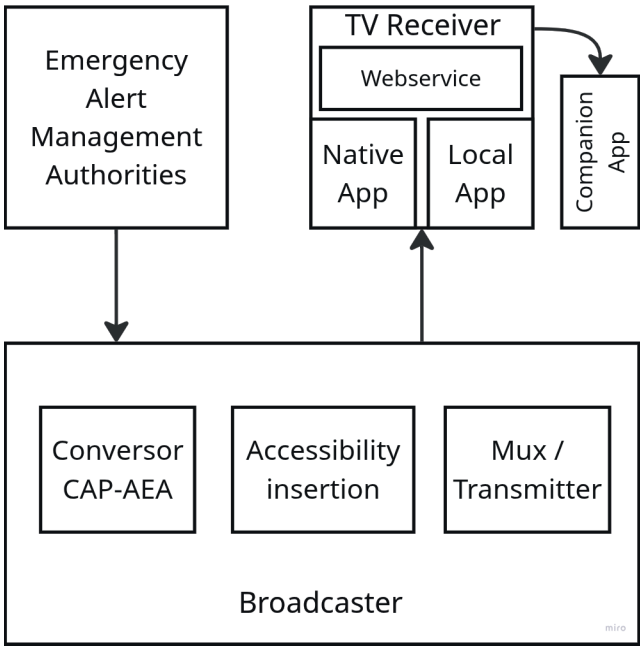

Fig 1. Alert Emergency Warning System Architecture.

Companion Apps, as long as they register to listen to alerts through the Webservice event API. It is important to note that the receiver also monitors alerts even when the TV is in standby mode, using a wake-up field to turn on the TV and display the alert when necessary.

IV. INNOVATIONS OF TV 3.0 EMERGENCY WARNING SYSTEM

The TV 3.0 standard introduces several innovations in emergency alerts, which differ from the ATSC 3.0 standard and were added during the standard development process [1].

One of the main innovations is the requirement to display media such as images, audio, and video, if referenced in the alert message, something not required in ATSC 3.0, which limits the requirement to textual media. To reference these media, it is necessary to configure tags with the <Media> or <LiveMedia> elements in the AEAT XML. Although these tags were defined in ATSC 3.0 [3], they were not exploited in the American digital TV system. This innovation in the Brazilian TV 3.0 emergency alert system proposal allows alerts to be delivered with more information and a richer display of graphic details.

In TV 3.0, the possibility of the <Media> tag referencing applications such as a broadcaster app or local standalone apps was added. More specifically, the app's deeplink must be included in the @url attribute of the <Media> tag [1]. This makes it possible for an emergency alert to reference an external application that has more information about the alert. A use case for this feature is presented in section IV.

Another innovative feature is the flexibility in the form of display. Alerts can be displayed natively by the receiver or by an application from the broadcaster itself (local app). Additionally, they can also be displayed in Companion Apps available on mobile devices. Figure 1 shows the layout of these three applications in the system architecture [1][2].

https://set.org.br/ijbe/ doi:10.18580/setijbe.2025.7 Web Link: https://dx.doi.org/10.18580/setijbe.2025.7

Accessibility is also a key feature, with the option to display alerts in sign language and audio description. For this to happen, the alert must be configured to include these accessible media. To add audio description, the <Media> tag can be used, adding the ROUTE (Real-time Object delivery over Unidirectional Transport) link of the audio media to the @url attribute [3].

To add sign language, the text messages of the alert must be translated into gloss, a textual representation of sign language. In Brazil, the gloss text must be configured with the language "bzs" (Brazilian Sign Language). Table 1 shows an example of the alert text tag

<AEAText> for Portuguese (pt) and Brazilian Sign Language (bzs). It is recommended that accessibility be added by the broadcaster.

Table 1 - Example of AEAT <AEAText> tags for text media in Portuguese (pt) and Brazilian Sign Language (bzs)

```
<AEAText xml:lang="pt">Elevação dos níveis de água dos rios</AEAText>
<AEAText xml:lang="bzs">ELEVAÇÃO NÍVEL ÁGUA RIO</AEAText>
```

A fundamental advance in the Brazilian TV 3.0 emergency alert system proposal is the requirement to monitor alerts even when the TV is not in the TV 3.0 context, or when it is in a DTV service that has not indicated that it is an emergency alert transmitter.

Each DTV service can indicate whether it will be an Over the Air (OTA) and/or Over the Top (OTT) emergency alert transmitter. This feature must be configured in the service's Broadcaster Application Manifest (BAM) [2]. This way, the receiver can monitor alerts even if there is no tuner available, using OTT monitoring. However, if a tuner is available, OTA monitoring should be prioritized, tuning to the highest-power physical channel among those that have indicated that they will transmit emergency alerts [1]. This ability to monitor via OTT or OTA ensures that alerts reach the viewer even if the tuned channel is not broadcasting the alert. In addition, TV 3.0 maintains ATSC's ability to monitor alerts even in standby mode, through wake-up fields.

V. SCENARIOS AND SOLUTIONS THAT CAN BE EXPLORED

The flexibility of the TV 3.0 alert system allows for a wide range of practical applications to increase public safety and well-being. Below are some usage scenarios that explore the innovations already described in this document.

A. Ubiquitous Alerting in Multiple Contexts

In a scenario where the TV viewer is using a streaming app or other interactive feature, a traditional broadcast alert would be missed. The TV 3.0 solution ensures that the alert functionality is ubiquitous. Thanks to continuous monitoring via OTA or OTT, the system overlays the alert on the application in use. Third-party applications can register as "listeners" of alert events through the Ginga Webservice API to integrate this functionality.

B. Inclusive Communication and Mobility

In previous work by Costa et al. [5], emergency alert requirements were presented within the scope of the TV 3.0 project, and accessible forms of presentation based on sign language and audio description were verified. To ensure that the information is understood by everyone and accessible anywhere in the home, the system offers two main solutions: 1) Multimedia and Accessible Alerts: Instead of just text, the system delivers alerts with images, videos (such as risk maps), audio description, and sign language, making the information more impactful and inclusive. A graphic style guide guides the presentation to ensure clarity; 2) Mobility with Companion Apps: The TV acts as a hub that relays the alert to mobile devices connected to the local network, such as cell phones and tablets. This ensures that the user receives critical information even if they are away from the TV.

C. Geolocation and Emergency Alerts in Health Services

The use of TV 3.0 in public services, particularly in the health sector, offers significant potential for improving communication and efficiency in crisis management. It is possible to develop interactive applications integrated with public services, exploiting the functionalities of TV 3.0 with a focus on geolocation and emergency alerts. The issuance of specific emergency alerts for epidemic scenarios enables public health campaigns to be carried out targeting a specific geographical region of viewers.

Health emergency alert situations, such as infectious disease epidemics, are already provided for in the Brazilian Classification and Coding of Disasters (COBRADE) [8] and can be indicated in the TV 3.0 emergency alert configuration.

Emergency alerts can reference external applications, such as the Meu SUS Digital TV app, for health alert situations. To do this, the alert must be configured so that one of its media is a deep link to the Meu SUS Digital TV app [1].

An HTML and JavaScript application was developed to simulate the transmission and reception of health alerts on TV. In the use case analyzed, the bacterial infection alert was transmitted using the COBRADE code 1.5.1.2.0 to represent leptospirosis. Fig. 2 shows a screenshot of this application, in which the alert message is displayed.

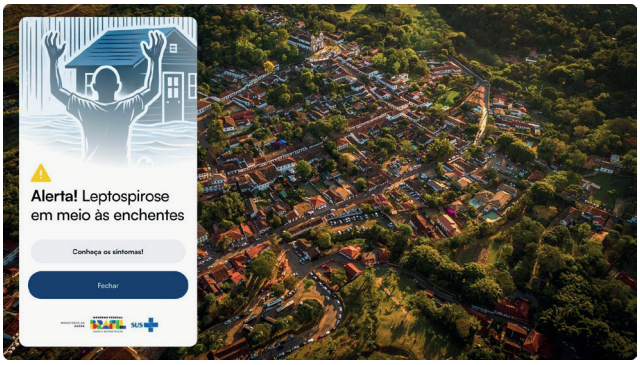

Fig. 2. Health alert providing health information and services.

https://set.org.br/ijbe/ doi:10.18580/setijbe.2025.7 Web Link: https://dx.doi.org/10.18580/setijbe.2025.7

 | ISSN (Print): 2446-9246 | ISSN (Online): 2446-9432

From the alert screen, users can open the Meu SUS na TV app if they want to locate a health facility or even schedule an appointment.

Meu SUS na TV offers health services through appointment scheduling and call centers. Using the TV 3.0 geolocation API, this application is able to display the health centers closest to the receiver, as shown in Fig. 3, aiming to optimize care management and avoid overloading certain health units.

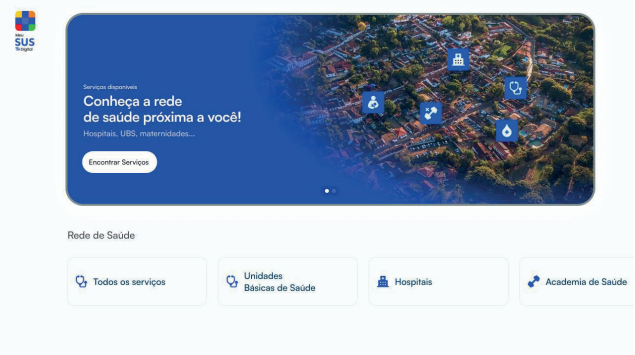

Fig. 3. Meu SUS Digital TV application

VI. CONCLUSION

This paper presented the innovations and solutions proposed for the TV 3.0 emergency alert system, based on the architecture and requirements established in previous research.

The results demonstrate the potential of an alert system that operates ubiquitously, monitoring alerts via broadcaster signal (OTA) and internet (OTT), and allowing the display of multimedia content that is accessible in different television usage contexts. The ability of third-party applications and companion applications to register as alert "listeners" through the Ginga Webservice API promotes greater flexibility and mobility in the dissemination of information, ensuring that viewers receive critical messages on multiple devices.

Ultimately, the application of these innovations to the TV 3.0 emergency alert system represents a significant advance for the safety and well-being of the population, ensuring that digital transmission technology acts as an effective tool in the prevention and mitigation of disasters of any kind.

ACKNOWLEDGEMENTS

The authors would like to thank the entire R&D team of the TV 3.0 Project for their discussions and joint research efforts. They would also like to thank RNP and MCom for their funding and for facilitating face-to-face technical meetings, as well as the SBTVD Forum and its members for their initiative, support, and constant contributions.

REFERENCES

[1] ABNT NBR 25607 - TV 3.0 – Emergency warning system. 2025 Preliminar version.

[2] ABNT NBR 25608 - TV 3.0 – Application Coding. 2025 Preliminar version.

[3] - Advanced Television Systems Committee. "ATSC standard: Signaling, delivery, synchronization, and error protection." Doc. A/331 2021 (2021).

[4] ALMEIDA, R. S.; LIMA, T. A.; FERNANDES, J. L. Aplicações da geolocalização em políticas públicas: eficiência e direcionamento estratégico. Revista Brasileira de Gestão Pública, v. 12, n. 2, p. 45–60, 2020.

[5] - COSTA, Richelieu R. A.; OMAIA, Derzu; ARAÚJO, Tiago M. U.; PEREIRA, Jóison O.; CRUZ, Miguel P. S.; BARBOSA, Matheus M. ; TOSCANO, Rafael; L. S. FILHO, Guido. Suporte a Alertas de Emergência na TV 3.0 Brasileira. In: WORKSHOP FUTURO DA TV DIGITAL INTERATIVA - SIMPÓSIO BRASILEIRO DE SISTEMAS MULTIMÍDIA E WEB (WEBMEDIA), 30. , 2024, Juiz de Fora/MG. Anais [...]. Porto Alegre: Sociedade Brasileira de Computação, 2024 . p. 303-308. ISSN 2596-1683. DOI: https://doi.org/10.5753/webmedia_estendido.2024.244412.

[6] TELECOMMUNICATION STANDARDIZATION SECTOR OF ITU. 2014. Common alerting protocol (CAP 1.2). Technical Report. https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-X.1303bis-201403-I!!PDF-E&type=items

[7] BONARETTI, D., & FISCHER-PREßLER, D. (2023). From Digital Public Warning Systems to Emergency Warning Ecosystems. Capítulo em Disaster Management and Information Technology, na série Public Administration and Information Technology, vol. 40, pp. 381–391. Springer, Cham. Disponível com DOI 10.1007/978-3-031-20939-0_17.

[8] COBRADE. Classificação Brasileira de Desastres 2016. Disponível em: https://educacao.cemaden.gov.br/midiateca/classificacao-e-codificacao-brasileira-de-desastres-cobrade/ Acesso em: 01/08/2025.

[9] Cemaden - Governo Digital. Inovações e Comunicações (MCTIC) Ministério da Ciência, Tecnologia. 2024. https://www.gov.br/cemaden/pt-br/acesso-a-informacao/institucional-1/apresentacao. Online; Accessed on July 15, 2025.

[10] Google. 2024. CAP - Google. https://support.google.com/publicalerts/. Online; Accessed on August 02, 2025.

[11] Peter Deutsch. 1996. Rfc1952: Gzip file format specification version 4.3.

https://set.org.br/ijbe/ doi:10.18580/setijbe.2025.7 Web Link: https://dx.doi.org/10.18580/setijbe.2025.7

 | ISSN (Print): 2446-9246 | ISSN (Online): 2446-9432

Derzu Omaia holds a PhD in Computer Science from the Federal University of Pernambuco (UFPE). He also holds a Master's degree in Computer Science from the Federal University of Paraíba (UFPB). He has been a professor at the UFPB Computer Science Center since 2012 and a researcher at the Center for Research and Extension in Digital Video Applications (LAVID) at the same university since 2006. He is a researcher at VLibras (vlibras.gov.br) - an open platform for automatic translation into LIBRAS for the Web, Digital TV, Cinema, and mobile devices, installed on more than 120,000 websites, including those of the Federal Government, Federal Chamber of Deputies, and Federal Senate. He was also one of the authors of the TV 3.0 technical standards projects: ABNT NBR 25606, 25607, and 25608 (Sign Language, Emergency Alerts, and Application Encoding). He worked on the development of the Ginga middleware and multiplexer for TV 2.0, adopted as the standard in the Brazilian Digital Television System and several other Latin American countries. He works in the field of Computer Science, with an emphasis on Digital TV, Accessibility, Machine Learning, Virtual Reality, and Augmented Reality.

Richelieu Ramos de Andrade Costa, Project Advisor at the Information Technology Center of the Federal University of Paraíba. Computer Engineer at the Federal University of Paraíba (UFPB) since 2019, Master in Computer Science from the Graduate Program in Computer Science (PPGI-UFPB), researcher at the Center for Research and Extension in Digital Video Applications (LAVID). He was one of the authors of the TV 3.0 technical standards projects: ABNT NBR 25606, 25607, and 25608 (Sign Language, Emergency Alerts, and Application Encoding). He works in research and development in the field of Computer Science, with an emphasis on Digital TV and Accessibility

Tiago Maritan Ugulino de Araújo holds a bachelor's and master's degree in Computer Science from the Federal University of Paraíba (UFPB) and a PhD in Computer Engineering from the Federal University of Rio Grande do Norte (UFRN). He is currently a professor and director of the UFPB Computer Science Center and a researcher at the UFPB Center for Research and Extension in Digital Video Applications (LAViD). Since 2019, he has been a Productivity Fellow in Technological Development and Innovative Extension (DT) - Level C of the CNPQ. He coordinates the VLibras Suite project (vlibras.gov.br), an artificial intelligence-based platform that automatically translates content into Libras on the Web, Digital TV, Cinema, and mobile devices. Currently, the platform is installed on more than 120,000 websites, including those of the Federal Government, Federal Chamber, and Federal Senate. With VLibras, he received the 2016 National Web Accessibility Award (Todos@Web 2016), offered by CGI.br and NIC.br, the 2018 Latam Smart City Award, and the 2024 Zero Project Award, offered by the EssL Foundation. He has experience in the areas of Artificial Intelligence, Deep Learning, Accessibility in Computer Systems, and Distributed Multimedia Systems, working mainly on the following topics: deep learning automatic translation into Libras, automatic generation of audio description, and Digital TV., automatic translation into Libras, automatic generation of audio description, and Digital TV.

Guido Lemos de Souza Filho, Secretary of Science and Technology for the Municipality of João Pessoa; Full Professor in the Department of Computer Systems at the Information Technology Center of the Federal University of Paraíba (DSC-CI-UFPB) and PhD in Computer Science from the Pontifical Catholic University of Rio de Janeiro (PUC-RIO). Founder of LAVID (Center for Research and Extension in Digital Video Applications), where he conducts research on the following topics: digital television, digital cinema, distributed multimedia applications, video distribution networks, distributed artistic performances, accessibility, information security, fake news, telehealth, and blockchain applications. He worked on the development of the Ginga middleware, published as ITU-T and ITU-R recommendations, and adopted as a standard in the Brazilian Digital Television System and several other Latin American countries, whose implementation is software currently installed in about 150 million TV sets. Other notable results of his research include the development of a system for storing, transmitting, and displaying 4K 3D videos called Fogo Player, the development of a platform to support distributed dance, theater, and music performances called Arthron, the development of video servers for live and on-demand transmission, called DLive and DVod, which were used in RNP's Digital Video Network and USP-SP's IPTV service; the accessibility software VLibras (used on the websites www.brasil.gov.br, senado.leg.br, and câmara.leg.br), executed 14.6 billion times per year; the development of technologies for the registration, validation, and preservation of blockchain-based Digital Diplomas that will be used in 103 Brazilian public universities; finally, the development of the V4H healthcare video system that uses digital signature, blockchain registration, and preservation technologies to add security to the use of videos generated during medical appointments. He is one of the mentors of the 6BIOS project (6bios.com), which uses satellite image processing and blockchain contracts in a scalable solution for payments for environmental services. He was the coordinator of REUNI at UFPB and participated in its creation and implementation, resulting in an increase from 20,000 to 45,000 in the number of undergraduate and graduate students. He also serves as a member of the Deliberative Council of the Brazilian Digital Television System Forum.

Received in 2025-07-26 | Approved in 2025-08-04

https://set.org.br/ijbe/ doi:10.18580/setijbe.2025.7 Web Link: https://dx.doi.org/10.18580/setijbe.2025.7