

Spectrum Availability for the Deployment of TV 3.0

Thiago Aguiar Soares, Paulo E. R Cardoso, Ugo Silva Dias

Abstract—In this paper, we study the current and future spectrum availability of the VHF and UHF bands in Brazil for the deployment Next-Generation Digital Terrestrial Television Systems, which are being studied under the “TV 3.0 Project” initiative, coordinated by The Brazilian Digital Terrestrial Television System Forum (SBTVD Forum). Coverage simulations of all expected operating stations in Brazil were computed in different scenarios to estimate the spectrum availability over the Brazilian territory. Results indicate that hybrid approaches should be implemented to smoothly introduce new digital television systems.

Index Terms—Digital Terrestrial Television (DTT), Next-Generation Digital Terrestrial Television Systems, Regulation, Spectrum Policies, TV 3.0.

I. INTRODUCTION

Digital Terrestrial Television (DTT) Systems continue their technological evolution. The second generation of digital terrestrial television broadcasting transmission systems is meant as systems offering higher bit rate capacity per Hz and better power efficiency and there is no general requirement for backward compatibility with first-generation systems. So, transitioning from first to second-generation DTT systems will require spectrum availability.

In Brazil, studies for Next-Generation Digital TV Systems have already been initiated. In July 2020, The Brazilian Digital Terrestrial Television System Forum (SBTVD Forum) released a Call for Proposals (CfP) seeking input from interested organizations for Brazil’s next-generation Digital Television system components and sub-components. The initiative is called the “TV 3.0 Project”.

Nonetheless, the availability of spectrum resources for DTT Services is declining worldwide, especially in the UHF Band. This paper analyzes the current and future spectrum usage of television services in Brazil to develop realistic transition approaches for the deployment of TV 3.0.

II. METHODOLOGY

To evaluate spectrum usage of TV Services in Brazil, simulations were made to estimate the coverage of all operating channels. Firstly, a database analysis was conducted to estimate the number of operating TV stations in Brazil. Figure 1 shows the distribution of the estimated operative DTT Channels in Brazil.

T. A. Soares is with the Ministry of Communications (MCom) and University of Brasilia (UnB) (thiago.soares@mcom.gov.br).

Paulo E. R Cardoso is with the National Telecommunications Agency (Anatel) (perc@anatel.gov.br).

U. S. Dias is with the Department of Electrical Engineering, University of Brasilia (UnB) (udias@umb.br).

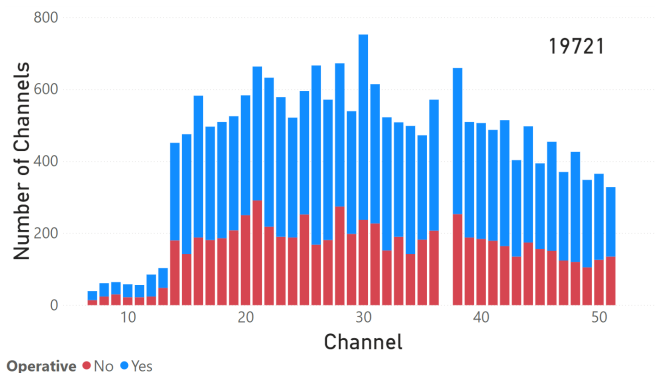


Fig. 1: Distribution of Operative Digital TV Channels in Brazil.

As few of the total DTT stations are currently licensed, the availability of technical data is scarce. So, some approximations were implemented to estimate the antenna patterns and the effective radiated power of all operational stations. Figure 2 illustrates the predicted coverage of DTT channel 20 as an example.

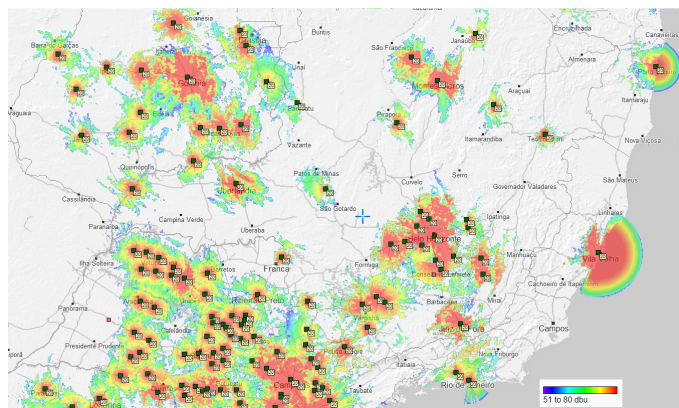


Fig. 2: Example of predicted coverage for DTT Channel 20.

III. ANALYSIS AND RESULTS

The numerical results of the simulations are summarized in Table I, which contains the number of municipalities covered by at least one TV channel (digital, analog, or any of them):

A straightforward finding that can be extracted from data analysis is that digital television has huge penetration in Brazil. As shown in Table I nearly 96% of the Brazilian municipalities can receive at least one DTT channel. On the other hand, analog TV is still covering about 75% of

TABLE I: Number of municipalities covered per frequency band.

Frequency Band	Municipalities with at least one digital channel	Municipalities with at least one analog channel	Municipalities with at least one channel
All Bands	5312 (96.27%)	4210 (75.57%)	5418 (97.32%)
Channels 2 - 6	0 (0.00%)	2691 (48.31%)	2691 (48.31%)
Channels 7 - 13	946 (20.36%)	3800 (67.99%)	4042 (72.73%)
Channels 14 - 36	5179 (94.47%)	2510 (44.45%)	5232 (95.01%)
Channels 38 - 51	4417 (81.69%)	1508 (26.61%)	4565 (83.70%)

the municipalities, which shows the importance of well-defined policies for switching-off television.

Geographically, the Brazilian States from the North, Midwest, and Northwest regions are the ones with a fewer average of received DTT channels. Figure 3 shows the average of received DTT channels per Brazilian State.



Fig. 3: Map view - Categorized average of received DTT channels per Brazilian State: red (less than 5), orange (from 5 to 10), yellow (from 10 to 15), blue (from 15 to 20), and green (more than 20 channels).

Television analog switch-off is expected to be completed in Brazil by the end of 2023. However, there is a huge amount of planned DTT channels that are currently not operative. After developing a database analysis, it was concluded that besides 9,230 analog channels will soon cease operations with the analog switch-off in Brazil, about 4 thousand new DTT channels are expected to start transmission in the short-term. Hence, DTT channel distribution in Brazil after the analog switch-off is expected

to contain about 16,492 operative channels as illustrated in Figure 4.

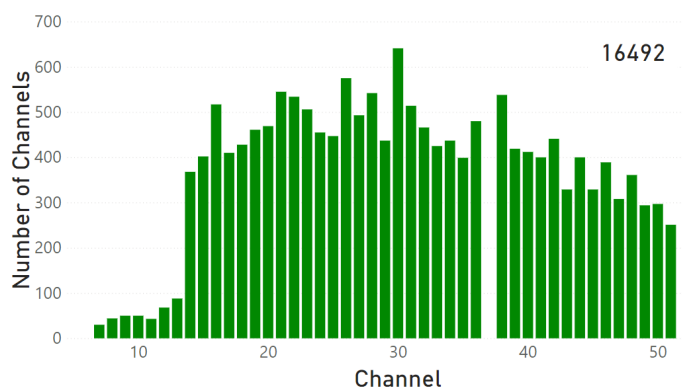


Fig. 4: Expected distribution of Digital TV Channels in Brazil after the analog switch-off.

As could be found in the coverage analysis, spectrum occupancy of DTT services is not uniformly distributed. So, hybrid approaches should be implemented to introduce new digital television systems. Based in the obtained results, some proposals are listed below:

- **Reserve High-VHF Band (Channels 7 to 13) for the transition to TV 3.0.** The CfP for TV 3.0 in Brazil includes the requirement that the over-the-air Physical Layer should consider the deployment in the High-VHF band. Hence, updating the regulation to reserve the band would bring the benefit of having a specific spectrum portion to deploy next-generation DTT networks.
- **Re-plan current DTT channels in some areas to free continuous spectrum portions.** Current DTT channels were planned in a simulcast scenario where analog TV channels had to be protected to guarantee a smooth transition. So, the planning process was not optimized. Channeling optimization would promote spectrum efficiency and release parts of the UHF spectrum for the deployment of next-generation DTT networks.
- **Update regulation to allow multi-programming.** The current Brazilian regulation just allows public broadcasters to transmit more than one program in a single 6 MHz channel. However, it will not be possible to allocate a second 6 MHz channel for all broadcasters for the transition to next-generation DTT Systems, mainly in Brazilian state capitals regions and high dense metropolitan areas. So, multi-programming will be necessary to allow optimize spectrum usage and facilitate the transition
- **Promote installation of shared infrastructure.** Broadcasters have taken advantage of their current analog TV infrastructure to install DTT transmission sites on their own, doing the transition channel by channel. Recent public policies have been established to install complete shared DTT transmission sites in small municipalities to facilitate the transition

from analog to digital television, but more incisive policies are required for the deployment of shared next-generation DTT transmission sites.

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Thiago Aguiar Soares graduated in electrical engineering from the University of Brasília (UnB), Brazil, and post-graduated in telecommunications regulation from the National Institute of Telecommunications (INATEL). He worked for 12 years with the National Agency of Telecommunications (Anatel), coordinating projects on digital television, digital radio, spectrum policies, broadcasting technical regulation, IT systems implementation, among others. Since 2020, he works as Head of Innovation & Regulation of Broadcasting Services in the Brazilian Ministry of Communications. He is Vice-Chairman of the Study Group 6 (Broadcasting) of the Radiocommunication Sector of the International Telecommunications Union (ITU-R). His area of interest is digital broadcasting and spectrum policies.



Paulo E. R. Cardoso holds a PhD from DECOM-FEEC-Unicamp (2018) in Digital TV Regulation; Master's degree in Electrical Engineering (Electronics) from DEMIC-FEEC-Unicamp (2005); and degree in Electrical Engineering from FEEC-Unicamp (2002). He is currently Regulation Expert of the National Telecommunications Agency - Anatel, where he works as Coordinator of Systems and Models of Broadcasting Management, in the Spectrum, Orbit and Broadcasting Management, being responsible for studying, improving and elaborating the Technical Regulation of Broadcasting, including its technical and operational requirements acts; for accompanying the development of new broadcasting technologies and prospecting the future of broadcasting, including the definitions of its needs; in addition to accompanying the development of the broadcasting modules of the Mosaic System. He is the leader of the Reporting Group of GRR6: Broadcasting, of the Brazilian Communication Commission - CBC2: Radiocommunications, coordinating the group's international activities, including the coordination of broadcasting service stations in border areas; working mainly in Study Group 6 - SG6 of the International Telecommunication Union - ITU. He participated as an observer of the Federal Government in the Digital Sound Broadcasting tests, both in the tests of the American standard - HD Radio, in 2008 and 2012, as in the tests of the European standard - DRM, in 2010. He worked as a Telecommunications Researcher at Fundação Centro de Pesquisa and Telecommunications Development - CPqD.



Ugo Silva Dias was born in Belém, Brazil, in 1981. He received the B.S. degree from the Federal University of Pará, Brazil, and the M.Sc. and Ph.D. degrees from the State University of Campinas, Brazil, in 2006 and 2010, respectively, all in electrical engineering. From 2004 to 2010, he was a member of the Wireless Technology Laboratory (WissTek), where he was involved in researching advanced mobile systems, field measurements, and generalized fading channels. He also worked at several companies at the ICT industry. Since 2010, he has been a Professor with the University of Brasília, Brazil. He is a faculty member at the Latitude Laboratory, Department of Electrical Engineering. His research interest include fading channels, field measurements, cell networks, and wireless technologies in general. He is also the IT Director of Brazilian Telecommunications Society, and the Advisor of Brazilian Internet Steering Committee.

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