

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.

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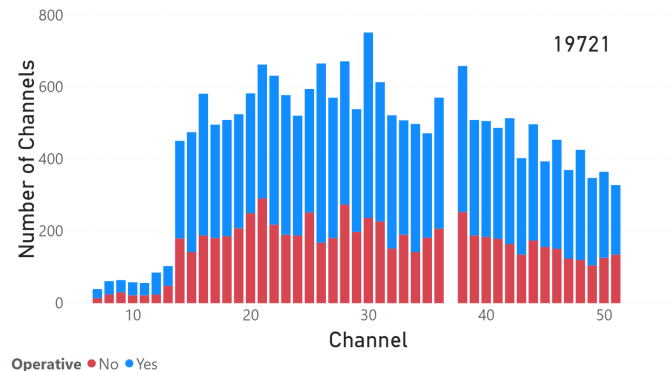


Fig. 1: Distribution of Operative Digital TV Channels in Brazil.

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.

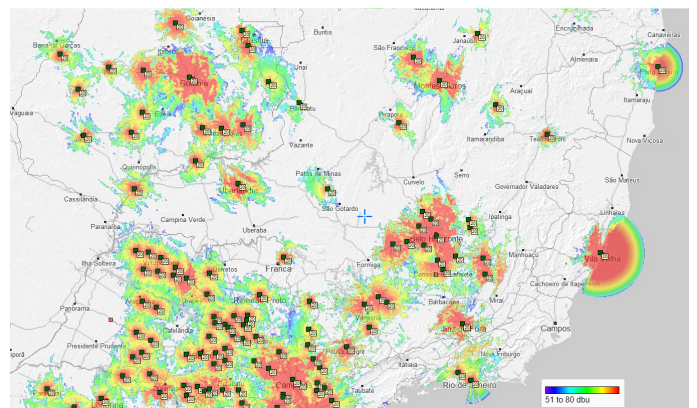


Fig. 2: Example of predicted coverage for DTT Channel 20.

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.

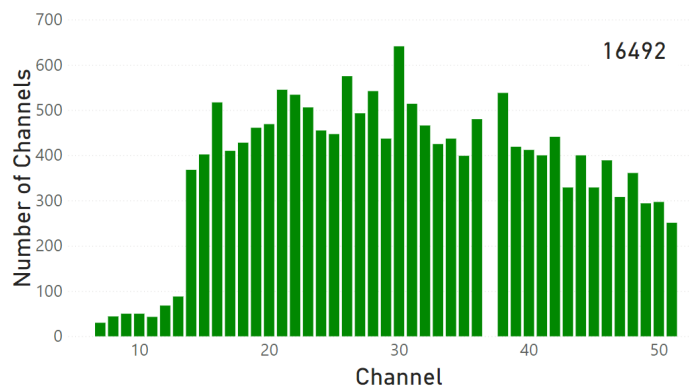


Fig. 4: Expected distribution of Digital TV Channels in Brazil after the analog switch-off.

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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