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METHODOLOGICAL GUIDE FOR THE IMPLEMENTATION OF DIGITAL TELEVISION IN BOLIVIA

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Abstract. The migration to Digital Terrestrial Television or Open Digital Television, with the ISDB-Tb standard, is a transition that involves several changes and heavy investments in the transmission and development of content by television companies and also means a change for users, since they must also adapt their televisions to have access to the new signal with more audio and video quality. It is necessary to study the regulations, to point out the essential requirements for the different phases of implementation, in joint work with companies and specialized professionals, with international recognized good practices in project management. In Bolivia, Telecommunications Law 164 was amended on August 31, 2017 to provide a conglomerate of resolutions and decrees that promote the digital migration of the different analogue television channels and subsequently a series of provisions were established for operating licensing for 15 more years for each current operator, for free. The channels companies have a new digital blackout period for the 3 main cities until November 2021 and others with less coverage until November 2025. The guide resulting from this work has already been applied and its contribution to all other channels is expected.

Keywords: Digital Terrestrial Television, ISDB-Tb, PMBOK and best practices.

GUÍA METODOLÓGICA PARA LA IMPLEMENTACIÓN DE TELEVISIÓN DIGITAL EN BOLIVIA

Resumen. La migración a la Televisión Digital Terrestre o Televisión Digital Abierta, con el estándar ISDB-Tb, es una transición que supone cambios severos y grandes inversiones en la transmisión y elaboración de contenidos por parte de las empresas televisivas y también significa un cambio para la audiencia, ya que también deben adecuar sus televisores para tener acceso a la nueva señal con más calidad de audio y video. Por ello, se hace necesaria una guía metodológica para estudiar la normativa, apuntar los

requisitos esenciales para las distintas fases de implementación, en trabajar mancomunadamente con empresas y profesionales especializados, con buenas prácticas en dirección de proyectos reconocidas a nivel internacional. En Bolivia, la ley de Telecomunicaciones 164 se modificó el 31 de agosto de 2017 para disponer un conglomerado de resoluciones y decretos que promueven la migración digital de los distintos canales de televisión analógicos y posteriormente se estableció una serie de disposiciones para la habilitación de licencias de funcionamiento por 15 años más de forma gratuita para los actuales operadores. Los canales tienen un nuevo plazo de apagón digital para las 3 ciudades principales hasta noviembre de 2021 y otros de menor cobertura hasta noviembre de 2025. La guía resultante de este trabajo, se ha aplicado ya y se espera sea aporte para todos los demás 600 canales que aún no han migrado.

Palabras clave: Televisión Digital Abierta, ISDB-Tb, PMBOK y buenas prácticas.

Introduction

How to address a new important situation in the organization? Where to start? What data and information is available? How much should be invested? These are questions that many managers of television channels are considering in the face of the technological leap towards the new digital television in high definition. These questions are supported (Campero, 2016, p. 62):

> The use of telecommunications and ICT in Bolivia has important scientific, social and cultural implications. As in the rest of the world, telecommunications are one of the fundamental pillars of social and economic development, since they are the tool of information flow and the mechanism used to acquire and apply knowledge.

This article tries to reflect good practices in the development of technological projects. Faced with the imminent change from standard television to the new digital television, it remains only to face it in the best possible way, the opposite would be to disappear from the field. Therefore, it is proposed to develop a methodological guide to enable a successful implementation in a real television network using what has already been advanced in terms of projects by the PMI and its PMBOK guide.

Is it possible to carry out the implementation of digital television based on the best practices of project management and gathering experiences from the region?

The scope of this project is circumscribed by the decrees of the executive body and official resolutions of the Authority for Regulation and Control of Telecommunications and Transportation ATT, of the Bolivian government, concerning the adoption of digital television throughout the territory, which are 10 documents.

Description of the problem

Bolivian Television

Bolivian television enters the air on August 30, 1969 with the state-owned channel 7 from the host city of La Paz government with black and white broadcasts, managed during the government of Gen. René Barrientos, but inaugurated in the short presidency of Luis Adolfo Siles Salinas, in a troubled scenario, television was an instrument of social distraction. Later on, the first network of the Government, advances with the Col. Hugo Banzer, a de facto military president according to Erick Butrón's research. "In 1977, the regime installed the Microwave Trunk Network in La Paz, Oruro, Cochabamba and Santa Cruz." (Butrón, 2018, p. 31). Under the same presidential mandate, state universities are

intervened, but the same Law mandates the creation of the Educational Television System of the Bolivian University and thus establishes the first university channel, in the south of the country, with channel 8 of the Juan Misael Saracho Autonomous University of the city of Tarija in a polychrome signal under the NTSC standard.

The article *Public Television in Latin America: its transition to the digital age* is published in the Mexican Journal of Political and Social Sciences (Toussaint, 2017).

> Where television was managed by governments, - authoritarian regimes- the diversity associated with democracy did not occur. Nor was there -as in Europe- the possibility that an institutional small screen was autonomous and managed separately from power. The countries of Central America and Mexico opted for the commercial scheme and, consequently, the public television service was relegated to the background. In South America, stories differ. In the 1950s and 1960s, military dictatorships and authoritarian governments proliferated and under their aegis, television began. This happened in Brazil, in Venezuela, in Bolivia, in Argentina, in Chile. (p. 226).

A few years later, Butrón (2018, p. 33) writes: "Without consultations, without reflections, without a relevant analysis, only with the dictator's order is it decided that channel 7 begins its color broadcasts under the NTSC standard at the end of 1980." In a 1984 complicated scenario, during the presidency of Dr. Hernán Siles Suazo, according to the investigations of the author Butrón (2018) in his book *Digital Television in Bolivia Challenges for the newcomer*, private channels make the radio spectrum overflow and the first regulations will arrive in 1986.

In 2000, Bolivia had 121 channels in the 9 department capitals and 63 in its provinces. In 2012, the number of channels reaches 577 and in the last publication of the ATT they appear in total 627. On August 30, 2019, Bolivian television turned 50 years old and is the youngest in South America.

State of technology in the country and globally

To describe the state of technology in Bolivia, the data of the 2018 Report of the Global Innovation Index are presented, (Cornell University, 2018) Bolivia occupies the general position No. 117 of 126 countries.

The annualized report provides important data on Information and Communication Technologies indicators, which will be compared with countries in the region and globally with the leaders:

Table 1
Bolivia and region indicators

	Case		South America Region					
POSITION 2018	117		80		64		47	
Country	**BOLIVIA**		ARGENTINA		BRAZIL		CHILE	
GII Indicator	Value	Position	Value	Position	Value	Position	Value	Position
ICTs	46.2	88.0	65.5	47.0	66.4	46.0	68.5	40.0
ICT Access	44.2	95.0	68.7	58.0	62.5	69.0	67.9	60.0
ICT use	33.8	88.0	59.6	47.0	56.9	52.0	53.9	59.0
Online government service	49.3	85.0	71.0	43.0	73.2	37.0	77.5	28.0

Electronic participation	57.6	70.0	62.7	59.0	72.9	37.0	74.6	32.0

Note: Source: The Global Innovation Index 2018

Table 2
Bolivia indicators and leaders

	Case		Global Leaders					
POSITION 2018	117		1		2		3	
Country	**BOLIVIA**		SWITZERLAND		HOLLAND		SWEDEN	
GII Indicator	Value	Position	Value	Position	Value	Position	Value	Position
ICTs	46.2	88.0	73.8	30.0	89.2	3.0	83.4	15.0
ICT Access	44.2	95.0	88.5	7.0	86.5	10.0	85.5	13.0
ICT use	33.8	88.0	88.8	2.0	82.8	9.0	84.0	6.0
Online government service	49.3	85.0	60.1	64.0	92.8	9.0	87.7	15.0
Electronic participation	57.6	70.0	57.6	70.0	94.9	5.0	76.3	27.0

Note: Source: The Global Innovation Index 2018

The contrast of the indices of Bolivia with respect to the countries of the region and more substantial differences with the global leaders is evident, however, digital television is an impulse towards the advancement of the use of new technologies.

Adoption of digital television in Bolivia

Bolivia's path to digital television was formalized in November 2007 with the First Bolivian day "Towards Digital Terrestrial TV", organized by the former SITEL or Superintendency of Telecommunications -today ATT- the Telecommunications and Transportation Regulation and Control Authority. On July 20, 2010, in the government of Evo Morales Ayma, Bolivia signed a memorandum of understanding with Japan, a country that is obliged to donate a test transmission equipment and provide technical assistance, signed by the Secretary of State for Internal Affairs and Communications from Japan, Masamitsu Naito.

As a result of the technical tests carried out in 2010 by the inter-institutional commission made up of the Vice Ministry of Telecommunications, the Telecommunications and Transportation Regularization Authority, Bolivia TV, the Greater University de San Andrés and the Bolivian Catholic University, the implementation of the ISDB-T standard was decided.

The single article of Supreme Decree 0819 of March 2011 states: "The ISDB-T (Integrated Services Digital Broadcasting Terrestrial) standard is adopted, with H.264, MPEG-4 coding with the technological improvements that were available at the time of its implementation, as a system for transmission and reception of Digital Terrestrial Television in the Plurinational State of Bolivia."

The ISDB-T standard was imposed in the South American region, the ATSC[1], North American and Chinese DTMB[2] standards have no presence and the European, DVB-T[3] only in Colombia, Suriname and French Guiana.

ISDB-Tb implementation in the region

[1]Advanced Television Systems Committee
[2] Digital Terrestrial Multimedia Broadcast
[3] Digital Video Broadcasting Terrestrial

The publication of the National Television Council of Chile by the Uruguayan Gustavo Gómez of the Latin American Observatory for Regulation, Media and Convergence gives an account of the experiences of Latin American countries, in Transition to Digital TV and diversity in Latin America. (Gómez, 2018) describes in a very complete way the experience in these countries:

Argentina

Transition Objectives

The deployment of digital television in Argentina is a unique experience, while full of contradictions. In 1998, it was the first country in the region to choose a standard, the US ATSC standard. However, it was never applied. With the economic and political crisis of 2001, DTT-related projects remained in the background until Cristina Fernández's government -in August 2009- decided to adopt the Japanese-Brazilian standard (ISDB-T). From that moment on, a strong campaign was developed regarding digital television, which included the installation of antennas in many cities in the country, the free delivery of Set Top Boxes to adapt analog TVs to digital reception, the creation of a fund for content production and a program to finance the purchase of televisions with digital tuner. As indicated, almost simultaneously with the adoption of the standard, a new regulation for the audiovisual sector was approved (Law 26522/09) that does not comprehensively address the problem of convergence and the transition to the digital environment.

The set of Government policies aimed at promoting digital television found a limit on the high penetration of cable television (approx. 80% of households). The offer of cable systems (60 or more channels, which include sports, movies and series) are, for now, more attractive than digital television, even if it is free, than the offer 16 channels nationwide and 1 or 2 local channels depending on the province (except in the City of Buenos Aires, where the grid is wider since it has 11 local signs). To this, we can add the weakness of the national government in the communication of the plan. The official start of digital television in Argentina took place on September 1, with the publication of decree 1148/09 in the Official Gazette. The Article 1 explained social (inclusion, diversity, industry promotion, etc.) and technological objectives (such as less use of the spectrum, better image and sound quality) to be achieved with the development of DTT. The Article 2 diagrammed institutional structure for the deployment of DTT that fell to the Advisory Council of the Argentine System of Digital Terrestrial Television chaired by the Minister of Federal Planning. Although it also has representatives from eight other ministries and the Headquarters of the Cabinet of Ministers, being under the leadership of the Ministry of Planning, the policy for DTT has been guided by a more industrial than cultural bias. The participation of the industrial sector, broadcasters, workers' associations, the scientific community and consumer associations were reserved for a Consulting Forum that operates under the Council's orbit.

On March 15, 2010, the Government, through decree 364/10, declared the National Terrestrial Digital Television Platform of public interest and designated the Argentine Company of Soluciones Satelitales SA (ARSAT) as responsible for guaranteeing transportation services of signals and their corresponding links for the development, implementation and operation of the infrastructure. A few months later, on July 19, 2010, decree 1010/10 was passed, a key step for the transmission of signals, since it empowered State Radio and Television (RTA) to carry out experimental transmissions of digital TV with signals own or third parties -in the latter case- provided they were assigned free of charge. The first Argentine digital station was state-owned Channel 7.

This decree also enabled private signals to be uploaded to the digital platform on an experimental basis. Although this allowed to expand the offer of digital signals, open channels were created without making the corresponding contest that marks the Law of Audiovisual Communication Services. To this fact, it should be added that the signals that were added to the state platform are mostly of businessmen close to the previous government.

At the end of 2010, the Federal Audiovisual Communication Services Authority (AFSCA) authorized private channels 13, 11, 9 and 2 of the City of Buenos Aires to use UHF channels 33, 34, 35 and 36 respectively for experimental DTT test transmissions.

Technical standards

The decision about the standard for digital television in Argentina involved a complex process with multiple comings and goings, which included decisions made by governments from 1998 onwards, each of which changed the direction of the previous one. The deliberations ended in 2009, with the adoption of the Japanese-Brazilian standard STVDTB. Although the particular thing is that this path did not contemplate democratic debates, but strong business lobbies and defenses of corporate interests. This began with the decision of former President Carlos Menem to adopt the ATSC standard in 1998, when Argentina became the fifth country after the United States, Canada, Taiwan and South Korea, to choose that pattern.

In 2006 the Ministry of Communications created the Commission for Studies and Analysis of Digital Television Systems, made up of representatives of communication companies, private television and related associations, and the Government. In its final report, the proposals of each model were detailed, except for the ISBD-T, which was only mentioned in the introduction as a more existing standard in the market. Despite this, the changes in political dynamics (including the confrontation with the Clarín Group), together with the offers that the representatives of the Japanese norm and the government of that country made, resulted in the decision to adopt STVD-TB, the Brazilian variant of the ISDB-T standard.

Deadlines and stages of the digital transition

The digital ignition was carried out by the State-owned Channel 7, on April 21, 2010. Since then, stations and antennas have been added throughout the country. The distribution of digital television has been left mainly to the state-owned company ARSAT, although private broadcasters are authorized to install their own transmitters. At the moment, the state system distributes 41 signals (16 nationwide), although not all are available at the same time. For example, 25 signals are received in the City of Buenos Aires. The DTT has 86 antennas installed in different provinces of the country with a range of 40 KM, which implies a potential coverage of 85% of the population by land and 100% satellite coverage. The system reaches all provinces, although in several of them with a single antenna in the capital. It highlights the deployment in the province of Buenos Aires (34 antennas), Santa Cruz (8 antennas), Córdoba and Santa Fe (5 antennas), and Mendoza (4 antennas).

Uruguay

The regulatory framework for the transition to open digital TV is developed from Decree 73/012 of March 2012, which identifies the UHF band for the deployment of DTT channels from 20 to 41 (512-638), next 10 TV channels for subscribers (42 to 51 or 638-698 MHz) and 52 to 69 for IV Generation mobile services (698-806 MHz). Also, in that Decree the cleanliness of the 700 MHz Band (Digital Dividend) is determined and the

Communications Services Regulatory Unit -URSEC- is entrusted with the preparation and approval of schedules for the deployment of said services in said band.

In the same year, by decrees 153 and 437 of 2012, the Executive Branch plans DTT services for the entire country distinguishing in the Metropolitan Area of Montevideo (AMM) and the interior of the country, channeling them, dividing the spectrum and the channels to be assigned for commercial, public services (within them, 2 channels were directly awarded for National Television of Uruguay (TNU) and one for the Ministry of Education and Culture (MEC), for use in timeshare- as well as for community TV.

The bases for the new DTT licensing models are generated, foreseeing the entry of new operators, both for Montevideo and for the interior; the specifications and conditions for the procedure for assigning new licenses are determined, both for incoming and existing ones; the deadlines for the procedures and also the date of the analog blackout are established (decree 153, art. 18) that was initially determined for November 21, 2015.

It is noteworthy that the new regulations, endorsed later with the approval of the Audiovisual Communication Services Law, significantly changed the conditions under which licenses or authorizations were previously granted, since it enshrines a competitive procedure for new entrants and, in turn, it sets deadlines for licenses (so far all radio and TV authorizations were precarious and revocable, without deadline) with subsequent procedures for possible renewal. It also enshrines a new service that until now did not exist that is the network operator, in this case the telecommunications company ANTEL and the public television station (TNU) that can carry signals from television dealers, considerably reducing the costs of digital broadcasting.

Technical standards

Uruguay was one of the pioneer countries in Latin America in the election of the DTT standard through the Executive Power resolution No. 315/007 of August 2007, where the European standard DBV-T (and the DBV is chosen) -H for mobile terminals).

However, at the end of 2010 the Executive Branch changes the standard to the Japanese-Brazilian ISDB-Tb standard. President Mujica said the change was due to geopolitical motivations, to align Uruguay with the standard adopted by neighboring countries, especially Brazil. Critics objected that this change was not convenient: the European standard had already been selected and it was said that it would have technical advantages over the ISDB-T and that the funds provided by Europe, as a result of that decision, had already been delivered and were being executed.

Deadlines and stages of the digital transition

Digital television began with the authorization of the experimental digital transmissions of the public broadcaster (National Television of Uruguay - TNU) in August 2012, both in Montevideo and in the City of Colonia, in the southwest of the country with equipment donated by Japan.

The operators of digital TV services (incumbent or incoming) had a maximum term for "digital ignition", set on April 30, 2016 for those installed in the capital and until April 30, 2017 for those located in the rest from the country. The successful bidders of the new authorizations granted by Uruguay should have issued a year after the permission had been delivered, but despite two postponements granted by the Ministry of reference, they never initiated their transmissions and returned their concessions.

The analog blackout was initially determined for November 21, 2015, taking into account the possible advances in digital migration throughout the national territory and to accompany the other countries of the region with the possibility of its revision according to the evaluation of these parameters.

Both countries were visited and the experiences of companies and professionals directly involved in the implementation of television channels were collected, collecting in different interviews good practices, successes and delays in deciding and executing.

The PMBOK guide and project management

There are various management frameworks for IT projects. Dutch analyst Van Haren describes 22 international frameworks in his widely used Frameworks for IT Management book, in the Project Management category, where the focus is on the project, not specifically for IT, highlights MSP, PRINCE2, PMBOK and IPMA Competence Baseline. PMBOK emerges as the best option by owning an entire institution recognized worldwide with many years of experience.

PMBOK appears as the corollary of good practices on which the digital television implementation guide is supported. As rescued from the Spanish Business School website (EAE Business School, 2017), PMBOK stands for Project Management Body of Knowledge, and the realization of its guide is the responsibility of the Project Management Institute (PMI).

It is considered as the manual of good practices, allusions and referrals to the PMBOK project guide are as universal as necessary in the field of project management and management, PMBOK is the convergence of two fundamental elements: macroprocesses, which group all the processes and activities involved in standardized projects, and areas of knowledge, that is, those key aspects whose consideration must intervene in each of the established macroprocesses.

The PMBOK guide establishes a criterion of good practices related to the management, administration and project management through the implementation of techniques and tools that allow the identification of a set of 49 processes, distributed in turn in 5 general macro processes.

The macroprocesses of the PMBOK guide

The PMBOK guide identifies 5 macroprocesses that include the 49 standard processes involved in any project:

1. Start: consisting of 2 minor processes, whose purpose is to define a new project or a new phase of its execution, and obtain the necessary authorization to carry it out.
2. Planning: This macroprocess includes 24 processes aimed at the realization and establishment of objectives, and the design of the most appropriate strategies to achieve its achievement.
3. Execution: includes 10 processes involved in the correct performance, according to the strategy adopted, of the activities defined in the project to achieve the established goals.
4. Control and monitoring: twelve processes are part of this macroprocess, all of them related to the supervision and evaluation of project performance.

5. Closing: last macroprocess, formed by two minor processes, which closes the project in its entirety or some phase of it, referring to the degree of acceptance and satisfaction with the result obtained.

Description of the proposed solution

The project is organized in four phases.

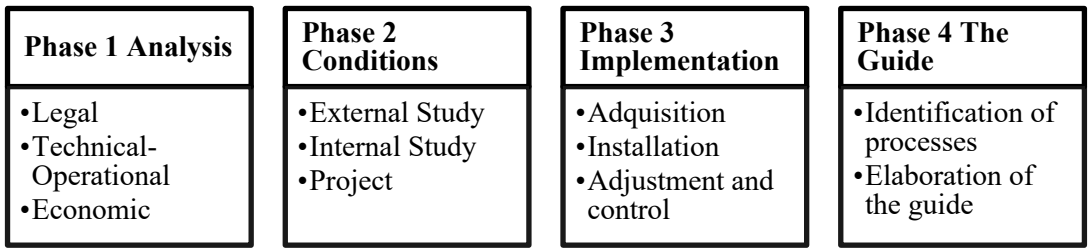

Figure 2. Proposed solution

Phase 1: of analysis

Legal analysis

Taking into account all the regulations indicated in previous chapters, there are legal, technical and economic requirements.

The requirements obtained refer to an existing channel, with the expiration date of its current license as of November 2019, extendable for 15 years without a free tender.

That will begin its digital broadcast in November 2020, one year before the date of analog blackout in the City of La Paz.

On the other hand, the channel is part of the Television Broadcasting Services Operator modality and must implement the entire technological structure to transmit and host, in the future, signal providers.

The television channel must have up to date all its formal registration and trade obligations, taxes, tax solvency and registration before the ATT, with that support, the regulations were analyzed and there are 11[4] **legal** requirements of commercial television:

a) Note or memorial specifying the territorial scope of the proposed license.
b) Name, address, telephone number (s), email and, if applicable, fax, postal box of the bidder.
c) Documents certifying the nature of the applicant.
d) In the case of natural persons, identity card.
e) Photocopy of the Identity Document of the Legal Representative or the designated Holder.
f) Certificate of Fiscal Solvency granted by the State Comptroller General, if applicable.
g) Special Power that proves the legal representative's personality that specifies the powers of nomination and to carry out procedures before the ATT.
h) Photocopy of the Tax Identification Number (TIN).

[4] The Digital Platform called OTTO SYSTEM GRANTING IN TELECOMMUNICATIONS - OTTO, in compliance with the provisions of operative paragraph eight of the Regulatory Administrative Resolution ATT-DJ-RAR-TL LP 919/2018 of December 10, 2018, for the digital management of the granting process is where a television channel must enter the information of the official requirements.

i) Payroll and photocopies or identity documents of all board members or board of directors or partners of legal persons.
j) Affidavit of natural or legal persons, all board members or board of directors that are not included within the prohibitions of General Telecommunications Law No. 164.
k) Certificate of judicial criminal record of the owner or legal representative issued by the competent authority.

Technical analysis – operational

Within the proposed solution, this subchapter is responsible for observing all technical requirements.

However, it should be noted that in order to ensure the high definition quality line it is also important to look towards the television channel's own infrastructure both in the studio and on the transmission site. On the other hand, the production and/or programming line must also carry out its work cycle in the format for digital television.

As a summary, the following instructions and their operational parameters are available.

Table 4.

Technical-operational requirements

Transmission Equipment	**of Description**	**Parameters**
Transmission System	Main and backup transmitter, wiring, Multiplexer, One-Seg, EPG electronic programming guide, EWBS early warning system and GINGA Interactivity.	Cover service area in 3 years. Type A 22 Km, 13 dBK at Field strength, protected contour 60 dBμV/m and interfering contour 41 dBμV/m.
Monitoring System	Monitoring of your signal and that of the suppliers.	Transfer rate, resolution, SEE, MER and others.
Radiant System	Arrangement of antennas.	Tower height 75 m.
Repeater System Link	Gap Filler in SFN.	Type B 13 Km and Type C 9 Km.
System Electrical	Fiber optic or microwave.	Change Encoder - Decoder HD.
System Backup	Generator or Second connection.	Redundancy.
Ground Systems	2 independents	According to Bolivian Standard NB-148009 IBNORCA
Model of planning	1 Full HD Digital Channel p. 1 Full HD Digital Channel and + 1 HD Digital Channel. 1 HD Digital Channel + 1 HD Digital Channel. 1 HD Digital Channel + 2 SD Digital Channels.	1920x1080p, 15 Mbps 1920x1080e, 10 Mbps 1280x720p, 6 Mbps 720x480p, 3 Mbps

4 SD Digital Channels.

In the resolution of the ATT-DJ-RAR-TL LP 584/2017, the Technical Instruction for the operation and operation of Digital Terrestrial Television broadcasting stations with ISDB-Tb technology is established.

The ATT, on the OTTO portal, requests the project itself and specifies the start date of operations on digital television, 13 being all technical requirements, supported by a report endorsed by an engineer of the field belonging to the Society of Engineers from Bolivia, with authorized signature:

a) Geographic coordinates of the stations and descriptive locations of said stations. DATA
b) Elevation of transmission sites (m.a.s.l.). DATA
c) Frequencies to be renewed. DATA
d) Description of emissions according to nomenclature of the Radiocommunication Sector of the International Telecommunications Union - ITU-R DATA
e) Nominal power and Calculation of Effective Radiated Power. DATA
f) Type of tower, total height of the infrastructure and location height of the antennas in the infrastructure. DATA
g) Types of transmitting antennas and their irradiation diagrams. DATA
h) Type of electromagnetic polarization of the radio link, if applicable. DATA
i) Protection system (lightning rod - ground - beacon). DATA
j) Coverage area, attaching corresponding technical study. DATA
k) Study of interference in adjacent channel and co-channel. DATA
l) Technical Study on exposure limits to radiofrequency electromagnetic fields. Data for the television broadcasting service with analogue technology
m) Implementation schedule of the digital television network which will establish the start date of its digital broadcasts, which shall not exceed the date of the analogical blackout corresponding to its service area and group, in accordance with the provisions of the Digital Terrestrial Television Implementation Plan approved by Supreme Decree No. 3152 of April 19, 2017. DATA

Economic Analysis

This is the most delicate aspect in the political arena, since all television companies met and together with the Association of Broadcasters of Bolivia requested an extension of the analog blackout because they lacked the resources to implement digital television and therefore renew their licenses. The presidency extended the term in response to this request and watching over the population that for the most part does not have televisions or receivers to watch digital television.

The digital transition demands an investment in a new technological infrastructure, since all similar equipment is not useful for operating in the digital age. Each of the technical-operational requirements means the disbursement of money, and precisely in this analysis the participation of local and foreign companies was necessary to quote the transmission, coding, services and irradiating system phase. At the same time, the quotes had to be technically validated in terms of the operation requirements of each of the equipment and a specific service area. For this project, 3 main quotes were

obtained, where the technical, operational and service aspects of the company were reviewed.

The ATT requires that the requesting channel, in the first instance, must collect its Financial Obligations Form with the Income Unit dependent on the Financial Administrative Directorate, a document that will reflect whether or not the Operator has outstanding obligations, that is, when submitting physically each of the requirements described above, this Financial Obligations Form WITHOUT DEBTS[5] must be submitted.

Phase 2: Specification of Conditions

External studies

The channel internally provides companies specialized in the field, a list of minimum but complete requirements for the realization of quotes and simulations. Contact is made with leading Bolivian and foreign companies on the issue of digital transition.

Table 5.

Specification of conditions for companies

	ATT 584 DIGITALIZATION				
	TASKS and ACTIVITIES	STARTING DATE	EXPIRING DATE	% COMPLETED	NOTES
1	Separate adjacent stations	Date	Date	0%	2 Km with front and rear channels
2	Quality of service	Date	Date	0%	C. Protected 60 dBu V/m, Interfering C 41 dBu V/m
3	Coverage	Date	Date	0%	A: 22Km/75m, B: 13 Km/37m, C: 9Km/37m and D: 6Km/20m
4	Repeater stations GAP FILLER	Date	Date	0%	Submit registration to ATT
5	Early warning EWBS	Date	Date	0%	24 months from the granting of the qualifying title
6	Mobile signal ONE SEG	Date	Date	0%	Submit implementation schedule
7	Middleware GINGA	Date	Date	0%	24 months from the granting of the qualifying title
8	EPG Programming Guide	Date	Date	0%	At the time of airing

[5] Administrative Resolution of the ATT 919/2018 pag. 4/14

9	Backup power Syst.	Date	Date	0%	To avoid interruption of the service
10	Grounding Environment Syst.	Date	Date	0%	Independent
11	Grounding Antennas Syst.	Date	Date	50%	Independent update. Paint Tower
12	Main transmitter	Date	Date	0%	2.5 KW
13	Auxiliary transmitter	Date	Date	0%	1.3 KW
14	Monitoring Equipment	Date	Date	0%	Transf Rate, Resolution, BER, MER, etc.

The details of the transmission plant and the frequency of the channel enabled in the spectrum were also provided to perform the simulations to comply with the service area:

Table 6.

Parameters for business simulations

Information	**Broadcasting Plant**	**Studies**
Address	Av. Panoramica Nº 2 - Alpacoma Zone, Satellite City - El Alto City - Murillo Province – Department of La Paz.	Calle Guerrilleros Lanza, Passage 1445 Nº 1215 - Miraflores Zone City of La Paz - Murillo Province - Department of La Paz.
Coordinates	Latitude: S. 16 ° - 31 '- 38.20" Longitude: W. 68 ° - 8' - 44.10"	Latitude: S. 16 ° - 29 '- 47" Longitude: W. 68 ° - 7'- 22.10"
Elevation	4.066 m.a.s.l	3.615 m.a.s.l.
Operating frequency	548 to 554 MHz	21,225 GHz

The purpose of the data provided is to achieve the ideal coverage for the cities of La Paz, El Alto, Achocalla, Viacha, Palca, Mecapaca and Laja.

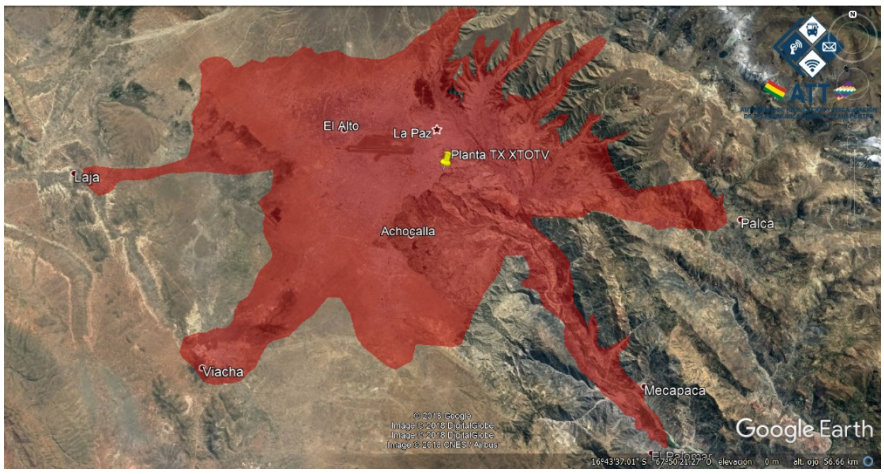

Figure 3. Service area for *La Paz*

Note: Source: Ministry of Public Works, Ministerial Resolution 227, Determination of service areas.

Internal studies

The channel required the production, press, programming and technical departments to study the adequacy of their processes and digital television equipment. The result is indicated in table 7, in which are the general components of a television studio.

Table 7

Channel study improvements

Equipment of Studies	Description
Set equipments	Cameras, lenses, cables, monitors
Master Control	Matrix 20x20,
Central Control	Recorder, PC VTR, Mixer, Console, mixer, converters, Character generators
Emission Control	Automator
Illumination System	Lights led
NLE Press Systems	4 HD equipments
NLE Production Systems	5 HD equipments
Electrical System	AC
Network System	Switcher and connection Cat 6
File System	NAS

In addition, adequacy tests were carried out every six months to refine both the processes and the use of new technological tools.

Project

With the complete picture, as regards all aspects of the standard, it was necessary to formalize a document with a project format, with clear objectives, goals, budget and schedule. It was submitted to the General Management and the National Directorate, the initial dispositions were approved and followed.

Content Project

1. General information
2. Background and description of the project
3. Scope of the project
4. High-level requirements
5. Objectives
6. Regulatory Framework

ANNEX SUMMARY D.S. N° 3152

DIGITAL TERRESTRIAL TELEVISION IMPLEMENTATION PLAN

8. Theoretical - technological framework
9. Methodology
10. Project proposal
11. Specifications for External Study
12. Time Scale Implementation
13. Conclusions and recommendations
14. Approval and authority to continue

The document would allow to take the case as a model for the start of a program of activities for the channel to digitalize its operations in the constitutional framework in the future determined by the terms of the ATT of other 4 channels in other cities of the country, that is to say Cochabamba, Oruro, Potosí and Sucre (capital of Bolivia).

Budget

The first budget in an approximate calculation of access to budgets in the region, that is to say in Ecuador and in the state channel Bolivia TV and another network that gave public information.

The initial calculation was close to $ 200,000 - US dollars, based on a transmitter of only 1.4 KW, since the simulations ensure the coverage of the service area. However, after the offers of the companies, the number of transmitters reached around $180,000 - US dollars, an amount that ignores the entire implementation of studies, civil works, infrastructure and various systems.

Phase 3: Implementation

The implementation phase requires obtaining a coherent study between the legal, technical and economic, but also that it was necessary to validate the experience of the company that would provide support throughout the process from the authorization of the ATT. In this way, meetings were held with different companies with the idea of minimizing risks and costs on the one hand and on the other to ensure emission quality.

In this pre-acquisition phase, the knowledge acquired in technical, strategic direction, the endorsement of experts in regulation, implementation, foreign trade, importation and attendance at events, seminars and companies specialized in ISDB-Tb was very valuable. In this sense, the decision was made to take the services of a foreign company with the experience of implementing more than 100 digital television channels in Uruguay and Argentina, which in the telecommunications market is known as an integrating company, that is, which offers individualized solutions to its customers with the support of a group of manufacturers and international support.

Acquisition

The simulation obtained from the specialist company in the figure is the one that validates the purchase of the transmission equipment. It covers the service area requested for La Paz.

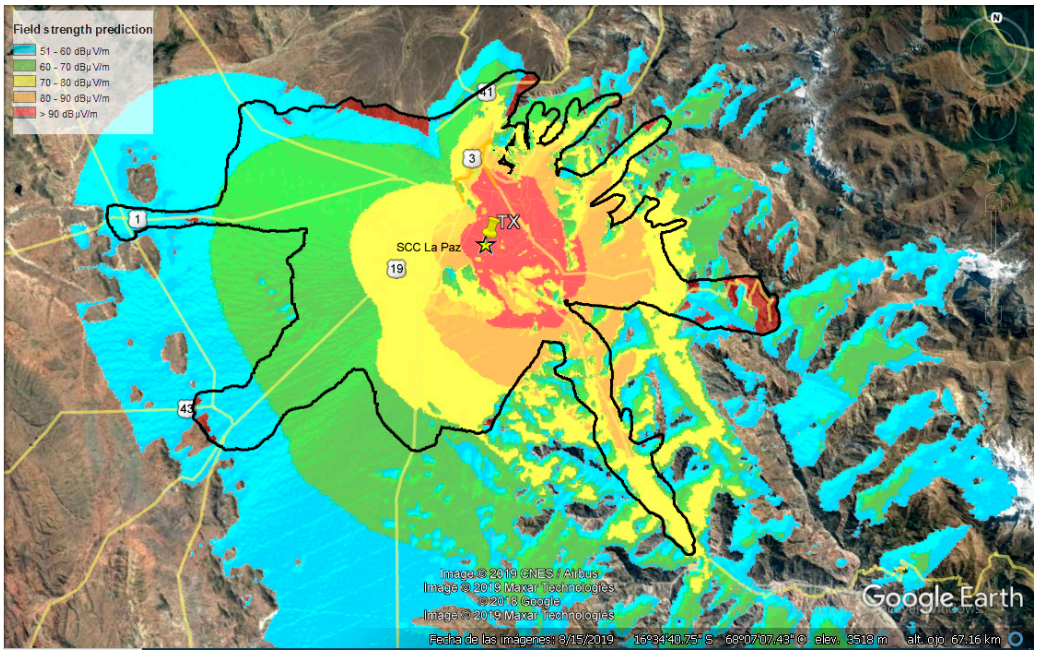

Figure 4. Simulation of the service area for La Paz

Note: Source: RFS company simulation for XTOTV

According to the studies carried out and with the simulation covering the La Paz service area, the list of items for transmission is as follows:

- Air-cooled 1.4 Kw transmitter
- Mask filter
- H.264 encoder

- Multiplexer
- EPG server
- Slot antenna
- GPS antenna
- Connection cable
- Switcher

In the list of items for the improvement of the transmission plant, it is required to acquire signal maintenance and distribution services:

- Independent earthing
- Redundant electrical system
- Signal monitoring system
- Transmission tower maintenance
- Study link and transmitter

Installation

Due to the new deadlines in the analogue blackout in Bolivia, the initially planned for 2019 moves to 2020, where the company selected by the channel will execute the installation and will do the initial tests of operation, measurement studies and training of technical personnel.

The installation will take place in November 2020, for this there are preconditions such as approval, process by which the ATT certifies that the equipment to be purchased possess all the technical characteristics established in the resolutions referring to the equipment. Other details are the purchase of the equipment, the transfer of equipment from bordering or transoceanic countries, the importation into the country, the concretion of the services of technicians that fix the antennas in a place, previously studied, of the tower.

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	MONTH 1	MONTH 2	MONTH 3	MONTH 4	MONTH 5	MONTH 6	MONTH 7
Notification by the ATT to begin the trasition							
Beginning transtition							
Start date of Emissions in Digital Format and completion of respective adjustements							

Figure 5. Installation schedule

Adjustments and Control

Adjustments and control have been permanent in the development of the phases of the proposed solution, in meetings held with both high level and middle level stakeholders.

Budget, risk and quality control adjustments were made in the case of equipment operating parameters and in simulations with different antenna brands and with different transmitter powers.

The implementation guide

In the case of a digital television implementation project in Bolivia, the 5 processes are based (Start, Planning, Execution, Control and Closing). In each of them, the processes that were experienced in the phases already completed are consolidated and the tasks in the closing phase are studied.

The proposed guide coincides with all the tasks and the flow described above and they are:

Start Process:

- The objectives of the project are defined.
- The main stakeholders are identified.
- The sponsor assigns the project manager.
- The start of the project is formally authorized.

Tasks:

- Select a project administrator.
- Know the culture of the organization.
- Know the existing processes and procedures and the historical information of other projects of the organization.
- Divide the project into phases.
- Understand the business case, that is, identify in broad strokes what needs to be done.
- Identify initial requirements, assumptions, risks and restrictions in addition to existing agreements.
- Determine if it is feasible to carry out the project.
- Determine general objectives that are measurable.

Planning Process:

- The scope of the project is defined.
- The objectives are refined.
- The plan for project management is developed.

Tasks:

- Identify how to plan each area of knowledge.
- Determine the requirements in detail.
- Develop the statement of the scope of the project.
- Evaluate the purchases that have to be made and generate your documents.
- Make a list of activities.
- Create a network diagram of the activities.
- Estimate the resources required.
- Estimate time and costs.
- Develop the schedule.
- Develop the budget.
- Determine quality standards, processes and metrics.
- Create a process improvement plan.

- Define roles and responsibilities.
- Define communication channels and stakeholder participation.
- Identify risks, make a qualitative, quantitative analysis and plan the response to them.
- Iterate if necessary.
- Finish purchasing documents.
- Define change management.
- Finalize how to execute and control everything defined in the plans.
- Realistically determine the plan and define a baseline.
- Obtain formal approval of the project plan.
- Hold the project start meeting.

Execution Process

- All resources are coordinated to implement the project management plan.

Tasks:

- Perform the work according to the plan.
- Make deliverables.
- Collect work performance data.
- Request changes.
- Implement only approved change requests.
- Continuous improvement.
- Follow the quality processes.
- Determine which processes are effective.
- Perform quality audits.
- Acquire the work team.
- Manage the team.
- Evaluate the team and individual performance.
- Perform team activities.
- Register in logbooks.
- Manage conflict resolution.
- Release project resources.
- Send and receive information, request feedback.
- Work performance reports.
- Manage stakeholder participation and expectations.
- Hold meetings.

Monitoring Process:

The scope of the project is monitored and corrective actions are applied.

Tasks:

- Measure performance against the baseline.
- Analyze and evaluate performance.
- Determine if it is necessary to implement corrective actions or change requests.
- Perform integrated change control.
- Approve or reject change requests.
- Communicate to the interested parties the results of the changes.
- Monitor stakeholder participation.
- Manage the configuration.
- Develop forecasts.

- Obtain acceptance of the deliverables by the client.
- Perform quality control.
- Control the risks.
- Manage reservations.
- Control acquisitions.

Closing Process:

Project deliverables are formally accepted.

Tasks:

- Confirm that the work has been done according to the requirements.
- Complete the purchases.
- Obtain formal product approval.
- Finalize financial requirements.
- Request feedback from the client.
- Complete performance reports.
- Store reports and project information.
- Generate the lessons learned and update the knowledge base.

Validation Results

The methodological guide for the implementation of digital television in Bolivia that meets all legal and technical requirements under the good practices of PMBOK. Each of the activities are part of the overall objective for the design of the implementation guide included in the schedule.

Communication, integration and risks were a valuable contribution to the project that came from the application of the PMBOK processes. Documents were generated for each phase recorded in the guide.

The good practices of the companies that supported the project allow a justified selection of the new technologies to be adopted, which will have an impact on the use of the technology and on the costs.

The schedule that meets all the deadlines established in the regulations. The time factor in the regulations is crucial, reports are presented in digital and physical format to the Telecommunications Regulatory Authority. Due to the extension of the analog blackout, the Implementation phase has not yet been completed.

The clearest proof of the success of the methodological guide is that the requirements were accepted by the Bolivian Government's Telecommunications Regulation and Control Authority in its OTTO portal and weeks later physically in a folded folder with all the original documentation.

The budget presented meets all technical requirements, with quotes from three national and foreign companies.

Conclusions

Based on each case studied of experiences in the real implementation of digital television, in Argentina and Uruguay, the visits made to telecommunications fairs in Bolivia, the United States and Argentina, the training and courses carried out in Digital Television, the external engineering work simulation of irradiating systems to define the equipment necessary to comply with the Bolivian standard, interviews with businessmen, engineers, regulators, consultants and other media, allow the methodological guide to select the best practices of the project management published by the PMI. Therefore, the optimization of economic resources for the television channel is achieved.

The guide does not have a commercial purpose, but rather regulatory/legal compliance for the permanence of the media. Although it can be used as the basis for the construction of a knowledge platform to provide consulting and training services, new job management schemes for technology projects. This constitutes a task in the process of closing the PMBOK, the knowledge base.

Finally, to date there are 21 digital channels in HD, but the total number of channels in Bolivia is 637, which means that, until November 2025, 96.7% of Bolivian channels can use the guide to implement their channels in digital mode in response to the questions raised at the beginning of this article.

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