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## TEMA:

**"**DESIGN OF A COMMUNITY RADIO IN MODULATED FREQUENCY FOR THE PARISH THE PAINFUL OF THE PRIORATE CITY OF IBARRA PROVINCE OF IMBABURA"

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# DESIGN OF A COMMUNITY RADIO IN MODULATED FREQUENCY FOR THE PARISH THE PAINFUL OF THE PRIORATE PROVINCE OF IMBABURA CITY OF IBARRA

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***Resumen*—** In this work the design of a community radio in the parish of La Dolorosa del Priorato is carried out through the analysis of standard ITU-R P.1546-5. It presents a survey made to the residents of the parish with the purpose of knowing the level of acceptance that the population will have before this means of communication.
After that, the design of the Community Radio based on Recommendation ITU-R P.1546-5 is developed; estimates are made in the Radio Mobile simulation software. Consequently, the processes or legal guidelines that must be followed to obtain the adjudication of the frequency were defined; Processes that comprise forms for each area such as: management area, economic and technical area, which have a score or rating value.

Additionally establish all the equipment of low and high frequency, necessary for the operation of Community Radio and of the radio programming that will be transmitted, taking into consideration the cost, versatility and quality of the equipment.
Finally, to determine the financial viability of the project, an economic study was carried out, which, through tools or economic variables such as the TIR (Inter Return Cup), VAN (Net Present Value) and cost-benefit ratio, establish and support sustainability Project in a given period or number of year.

## I. INTRODUCTION

The urban parish "La Dolorosa del Priorato" was created through Ministerial Agreement No. 0528 and published in the Official Gazette on October 6, 1999 with No. 292. It is located northeast of the city of Ibarra, Province of Imbabura. It is settled around the lagoon of Yahuarcocha, surrounded by a natural geographic feature of elevations such as Yuracruz, El Churo, El Pinllar, El Mirador and Pucará.
The parish has 13 neighborhoods which are: Yahuarcocha, Olivo Alto, Santa Marianita de Olivo, Mirador de la Aduana, La Delicia, Santa Rosa, Sacred Heart, Floresta, San José, Puruhanta, Panecillo, Flor de Valle and Cuatro Corners.
La Dolorosa del Priorato parish is one of the five urban parishes of the Ibarra Canton. The total area of the parish is 9.5 km², it is located at an altitude of 2,225 meters above sea level (msnm). This parish is limited to the North by the parish of El Sagrario, to the South by the parish of San Francisco, to the East by the parish of El Sagrario and to the West by the Parish of Alpachaca.

The Parroquia la Dolorosa del Priorato does not have a means of community radio communication where the inhabitants of the same can express themselves and keep informed of what happens around the environment where they live, that is why the need arises to implement this means of communication.
Fundamentos Teóricos De Sistemas de radiodifusión

*A. Broadcasting*
Broadcasting refers to the service of broadcasting radio and television signals through electromagnetic waves intended to be heard by the general public. Broadcasting covers much of the media, an advantage is that it can be heard in most cases with simple receivers.

*Radioelectric spectrum of sound broadcasting*

The sound broadcasting services occupy certain frequency bands of the radioelectric spectrum. In Table 1 it is possible to visualize the different services and the frequency range assigned to each one.

Table 1. Frequency ranges assigned to sound broadcasting services

| Band | Frequency range |
|---|---|
| **Modulated frequency (FM)** | 88 – 108 MHz |
| **Modulated amplitude (AM)** | 525 – 1705 KHz |
| **Short Wave Tropical (OC)** | 3000 – 5100 KHz (several ranges) |
| **International Short Wave (OC)** | 5100 – 2600 KHz (several ranges) |

Furthermore, within the radioelectric spectrum of sound broadcasting, several ranges of auxiliary frequencies are attributed to the fixed service, said frequencies are necessary for the operation and operation of the broadcasting stations and systems; these frequencies correspond to the radio links between study - transmitter Table 2 shows the frequency ranges.

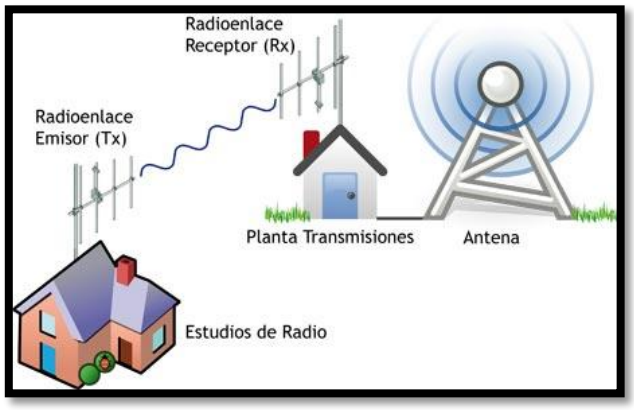
Table 2. Frequency range assigned to the fixed service.

| Service | Band (MHz) |
|---|---|
| **Fixed Service** | 222.0-235.0 |
| | 246.0-248.0 |
| | 417.5-430 |
| | 937-940 |
| | 941-951 |
| | 956-960 |
| | 1670-1690 |

*B. Structure of a broadcasting system*

A broadcasting system is based on three fundamental stages by which the information travels to be transmitted to the air in FM. These stages are: Study, radio link and transmitting plant as shown in Figure 1.

Figure 1. Broadcasting system




*Etudy*

Place where radio programming will be performed, the equipment and systems that make up the study will be configured according to the needs of the dealer. No defined norms are established regarding the amount of equipment that may be used in the studies, being subject to the needs of each station. It is recommended that the signal at the output of the audio equipment as a whole be of such quality that it avoids the effects of modulation on the transmitting equipment.

*Radio link*

A radio link basically consists of transmitter, receiver and antennas, which must be coupled with the authorized technical parameters that guarantee communication without causing interference.

*Transmitting plant*

Where the FM transmitter is located. This transmitting equipment must be designed in such a way that it conforms to the technical parameters and the authorized characteristics and must have basic measuring instruments.

*C. Propagation model for sound broadcasting*

The propagation models allow to predict the loss of power of the electromagnetic signal that propagates in an environment and that is received at some point. These models are a set of expressions: mathematics, algorithms and diagrams that represent radio characteristics of a given environment. Propagation models are generally classified as empirical or statistical, theoretical or deterministic or a combination of the two that would be semi-empirical.

Empirical models base their predictions on real measurements, the theoretical models use the fundamental principles of an RF wave propagation and the semi-empirical ones take into account measurements made but these are then adjusted to a certain theoretically established model, these models are deduced by taking account terrain characteristics, antenna heights.

There are several propagation models used for internationally recognized broadcasting, that is why the Telecommunications Regulation and Control Agency (ARCOTEL) does not assign the application of a specific propagation model within the regulations for the granting of frequency, leaving dealer's choice the application of the propagation model

*Model UIT-R P.1546-5*

Recommendation ITU-R P.1546-5: Point-to-area prediction method for terrestrial services in the frequency range 30 to 3000 MHz, of the P series, Radio wave propagation. This method is based on the interpolation / extrapolation of the field strength curves deduced empirically as a function of: the distance, the height of the antenna, the frequency and the percentage of time. This last aspect refers to the percentage of time where the transmitted signal is available for processing by the receiver. This calculation also includes corrections due to obstacles close to the transmitter and the receiver.

The calculation procedure also includes corrections of the results obtained from the interpolation / extrapolation in order to reflect the detachment of the terrain and the obstacles that obstruct the terminal

*Methodology of calculation for the Field Intensity E*

The following describes the steps for calculating power at a point according to the recommendation for 50% of the reception sites and 50% of the time according to the parameters stipulated in the recommendation.

- We determine the type of path we need to analyze
- The percentage of time, and the frequency ranges to which you wish to work are determined
- Determine the terminals in our case we use the geographical coordinates CGS in the WGS84 system.
- Determine the maximum field strength which should not be exceeded by the field strength E.
- Calculation of height h1 when there is information available from the ground.
- Calculation of the field strength E, through the interpolation and extrapolation of two curves.

*D. Transmission lines*

To feed the antenna can be used: waveguide or coaxial cable, which ensure an adequate coupling between the transmitter and the antenna, with the aim of reducing power losses (ARCOTEL, Technical Standard for the service of Sound Broadcasting in Frequency Modulated Analog, 2015). Preferably, the use of coaxial cable is recommended as it works for frequencies above HF (3 to 30 MHz); It also has high electromagnetic immunity against noise, little attenuation of the signal and can have a considerable bandwidth. It must be taken into consideration that in high power equipment the power lines do not cause losses greater than 10% of the authorized power in order not to overload the transmitting equipment. The shielding of the power lines must be properly adjusted to the support structure in order to protect it and not cause secondary radiations.

## II. LOCATION OF RADIO STUDY AND TRANSMITTER ANTENNA

*A. Location of radio study*

The radio station will be installed in the premises of the national police, located in the Priorato park, bordering the streets Puruhanta and Cunrro, with the geographic coordinates: latitude 0 ° 23'07.75 "North, longitude 78 ° 06'22.08" West, altitude 2240 meters above sea level, as shown in Figure 2, this site is chosen because it has the security provided by the community police, which will allow the population to easily access this means to publicize their needs and community problems. with the grounding of the national police radio, which allows reducing costs when implementing this means of community communication.

Figure 2. Location of the studio-Barrio el Cunrro-Parroquia La Dolorosa del Priorato


*B. Location of transmitter antenna*

Considering that the community radio project is of a social nature and will not generate economic income since its remuneration is social, it is best to share existing physical infrastructure.

In order to share an existing physical telecommunications infrastructure, use is made of the Regulation on Access and Shared Use of Physical Infrastructure necessary to Promote Healthy and Fair Competition in the Provision of Telecommunications Service, Added Value and Audio and Video Systems and Similar, which states in its article 1 that every network operator with an enabling title to present a telecommunications service has the right to access and shared use of physical infrastructure, in turn article 5 states that access and shared use will be made by agreement subscribed between an operator and the owner of a physical infrastructure, whose agreement as dictated by article 6 must be governed by principles of equity, equality, transparency, non-discrimination, efficiency, continuity of service, retribution for shared use, availability of infrastructure physical and quality of service.

The transmitting antenna will be located in the base radio of CNT, located in the family gardens of azaya, with the geographic coordinates: latitude 0 ° 22'44.8 "North, longitude 78 ° 07'51.1" West, altitude 2343 masl, this station will be located 3 km from the radio studio previously selected and also has the necessary infrastructure such as: communication tower, height, energization, security and grounding requirements necessary for signal transmission. In Figure 3 you can see the base radio CNT graphically.

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Figure 3. Base radio station of CNT - Huertos Familiares

## III. PREDICTION OF COVERAGE AREA

*A. Recommendation ITU-R P. 1546-5*

The strategic locations of the recipients according to the population are taken into account, with the purpose of determining the coverage at distances of 3 to 5 km in downtown addresses and remote points, covering the entire perimeter of the parish of La Dolorosa del Priorato. Figure 4 shows the locations of the different transmitter-receiver paths obtained through Google Earth software.

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Figure 4. Location of the transmitter and receiver


*B. Calculation of Effective Height (h1)*

The effective height (h1) is the height of the antenna above the average level of the terrain for distances between 3 and 5 km in the direction of the receiving points. In Table 3 you can see the effective heights for 3, 3.5, 4, 4.5, 5 Km.

Table 3.Effective height for 3, 3.5, 4, 4.5, 5 Km

| Distance (km) | Effective height h1 (m) |
|---|---|
| **3** | 161.6 |
| **3.5** | 146.6 |
| **4** | 142.4 |
| **4.5** | 157.8 |
| **5** | 146.2 |

*C. Calculation of Field Intensity E*

For the calculation of the field strength at a certain distance, the value of the effective height h1 must be previously calculated, after this calculation the lower nominal effective height (hinf), upper nominal effective height (hsup), field strength is obtained. for hinfdenominada (Einf), field strength for hsup called (Esup) of the tabulated tables as specified by the ITU-R P.1546-5 standard. In Table 4 you can see the Field Intensities for 3, 3.5, 4, 4.5, 5 Km.

Table 4. Field Intensity for 3, 3.5, 4, 4.5, 5 Km

| Distance (km) | Field Intensity ITU-R, P.1546-5 dB $(\mu V/m)$ |
|---|---|
| **3** | 89.04 |
| **3.5** | 88.49 |
| **4** | 84.56 |
| **4.5** | 85.19 |
| **5** | 81.75 |

*D. Calculation of the Maximum Field Intensity (Emax)*

The prediction model ITU-R P.1546-5 determines that for earth paths the field strength E (for 3, 3.5, 4, 4.5 and 5 km), must not exceed the value of the maximum field strength (Emax) . In Table 5 the Maximum Field Intensities for 3, 3.5, 4, 4.5, 5 Km can be observed.

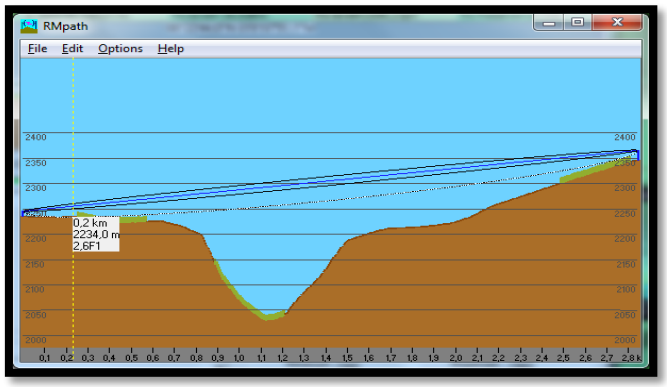
Table 5. Máximum Field Intensity (Emax) 3, 3.5, 4, 4.5, 5 Km

| Distance (km) | Máximum Field Intensity dB $(\mu V/m)$ |
|---|---|
| **3** | 97.35 |
| **3.5** | 95.71 |
| **4** | 94.85 |
| **4.5** | 93.83 |
| **5** | 92.92 |

*E. Survey profile Study - Transmitter*

To visualize the topographic profile between the transmitter and the receiver, the Radio Mobile software is used, with this topographic profile the freedom of the first Fresnel zone can be observed, since it allows to visualize the most representative obstacle located at 0.2 km and at a height of 2234 meters as shown in Figure 5.

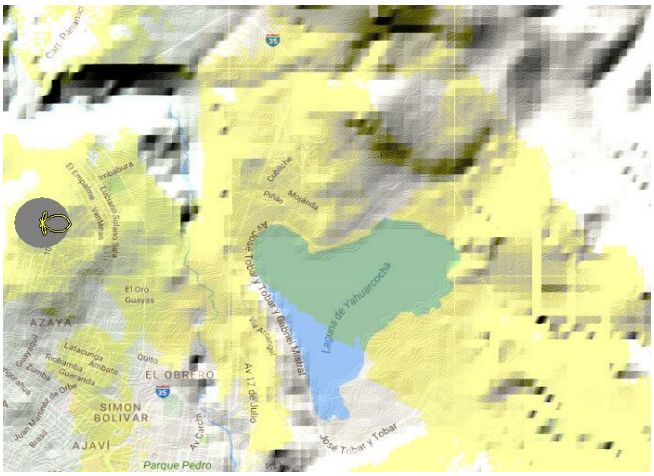
Figure 5. Elevation profile for stud-transmitter link




*F. Transmitter coverage with Radio Mobile*

Through Radio Mobile you can see the coverage of the radio in yellow, through which you can determine that there is total coverage in the parish, on the other hand the area in white is an area that is not populated, however you can affirm that it will have coverage due to reflection effects of the signal. Figure 6 shows the coverage irradiated to the parish graphically

Figure 6. Transmitter coverage - Parroquia la Dolorosa del Priorato




## IV. EQUIPMENT CONNECTION DIAGRAM

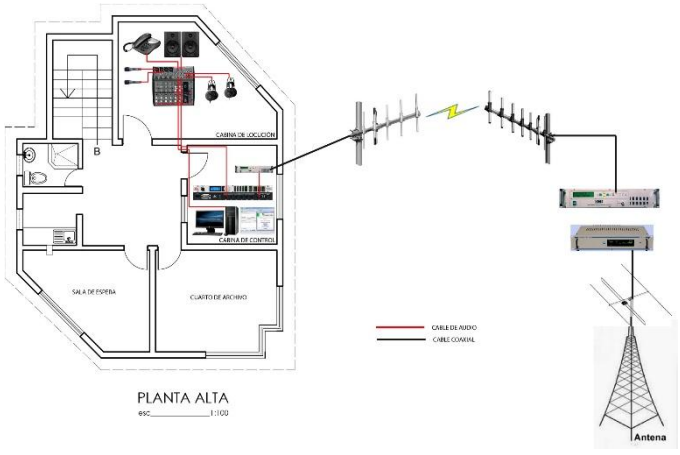
Figure 7 shows the connection of the different high and low frequency devices needed to transmit the programming to the listeners in the parish of the Priory Dolorosa, these devices are distributed in three blocks: audio block, control block and block of radio link and transmission.

- Audio block. - This is where the audio signal that is going to be transmitted is generated.

- Control block. - It is where music, sound effects are inserted and also the quality of the signal that airs through the audio processor is improved.

- Radio link and transmission block.- The signal that is generated in the audio block is sent to the radio link block and in turn to the transmitter, which will be responsible for sending the signal to the FM transmitting antenna that is responsible for radiate the signal to the parish

Figure 7. Equipment connection diagram




## CONCLUSIONS

The design of community radio in Frequency Modulation and its future implementation is fundamental and necessary in the parish of La Dolorosa del Priorato, due to the lack of information that the inhabitants have about what happens in their parish through a medium massive and the duty that the parochial board has to strengthen the spaces of expression and communication.

Through the survey conducted on a sample of 368 inhabitants of the parish, it was determined that 100% of the people surveyed agree with the future implementation of this means of communication such as community radio, which is equivalent to an acceptance of 100 %.

The technical forms necessary for the concession of the frequency and subsequently its transmission, which are: form RTV1 General data of the concessionaire, RTV2 Technical data of the Radio Study, RTV4 Technical data of the transmitter, RTV4 Technical data of the radio link, stipulated by the Agency of Regulation and Control of Telecommunications.

Considering the regulation on Access and Shared Use of Physical Infrastructure necessary to promote healthy and fair competition in the provision of telecommunications service, added value and audio and video systems and similar and taking into account that the community radio project is of A non-profit social character, the transmitter will be located in the base radio CNT, since it also has the necessary infrastructure for the transmission of the radio signal.

In order to determine the field strength, interpolation and extrapolation were applied from tabulated field strengths obtained from two curves. These tabulations were provided by the recommendation ITU-R P.1546-5, results that allowed to verify that as the distance increases the field strength decreases.

The equipment necessary for the operation of the Community Radio in both low and high frequency were analyzed and selected based on the technical requirements calculated, in addition the quality, versatility and costs considering the versatility were considered.

It was proposed topics to be transmitted in radio programming As: youth expression, public opinion, music; topics that will exploit the human talent of the parish, will also give the opportunity to people to express themselves through a community radio communication means building new social relationships.

The economic viability of the project was determined through the economic variables with a projection to 5 years: IRR equal to 16% variable that determines the profitability of the project since its value is greater than 12% value of the discount rate; variable VAN that equals the present value of the cash flows for 5 years the result is 582.16 and determines that the investment will produce profit; and finally the variable C / F

equal to 1.01 which establishes that the income exceeds the costs

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