Automatic novel system for sending emergency alert and alarm for multi events through Radio broadcasting transmission system in Perú

Alejandro José Llanos García, Ronald Gilbert Chávez Rojas, Armando Zaga Ttito, Zoser Sudith Quenaya Hinojosa, Marco Aurelio Jara Quispe, Daniel Diaz Ataucuri
UNI (National University of Engineering)
INICTEL-UNI (National institute of research and training of telecommunications)
Lima-Perú
allanos, rchavez, azaga, zquenaya, mjara, ddiaz @inictel-uni.edu.pe

***Abstract*—This paper describes an integrated system of emergency alert and alarm [1], which uses robust radio diffusion technologies recommended by ITU [2] [3] (DTT-Digital Terrestrial Television and Radio FM). For the insertion of the emergency information in the radio frequency, generators were developed for radio FM and television using RDS (Radio Data System) and information tables respectively. A receiver module developed by INICTEL-UNI (National institute of research and training of telecommunications) decodes the emergency signal and activates sound sirens to alert target audience. This emergency signal is based on the CAP protocol [4] (Common Alerting Protocol) and PLANAGERD [5] (Plan Nacional de Gestión del Riego de Desastres), which allows defining multiple emergency events for dissemination. Finally the management of the system is carried out through a web interface, which is responsible for the emergency activation of multiple events and control and monitoring of the receiver module parameters.**

Keywords—alert; alarm; emergency; broadcasting; RDS; ISDB-T; transmission; EWS.

I. INTRODUCTION

The implementation of an emergency alert and alarm system in Peru is an arduous but crucial task. Due to the great diversity of geographic and climatic conditions like the ring of fire, the Andes mountains, the majority of the microclimates in the world, the Pacific anticyclone, la corriente del Niño, etc. This scenario generates various hazards such as earthquakes, volcanic activity, intense rains, mass movements, low temperatures, etc. These effects have dramatic consequences such as loss of human lives, increase of victims and material damages. For the reasons given, In 2015 INICTEL-UNI developed a receiver module called EWBS (Emergency warning broadcasting system), which allows to pick up an activation signal of a bit (1 bit) and the area code through the digital television as way of diffusion. With the collaboration of TV-PERU Successful tests were carried out to validate the operation of the EWBS system in the district of Punta-Callao like Tsunami simulation. The limitation in this technology is sending the alert and alarm in just one type of message.

This paper proposes an integrated system that sends multiple events of emergency toward a receiver module of radio frequency, using radio FM and digital terrestrial television. The emergency messages of this system are based on the protocol CAP[4] and PLANAGERD [5], this allows sending different kind of emergency messages. A Web Interface controls all the system and can be used for the corresponding emergency entity, which will generate and send the emergency signal by the radiodiffusion. Also this system controls and monitoring the receiver module parameters like the operation frequency, digital power, temperature, humidity, battery level, etc. This project will be implemented in the city of Arequipa to disseminate warning messages in case of overflow of the Chili River.

II. OVERVIEW OF THE SYSTEM

Throughout the emergency alert and alarm system, there are different kinds of development like the following items:

1. New proposal of standard to send emergency messages through the radiodiffusion
2. Develop an encoder of Transport Stream, which insert emergency information in the transmitter of the DTT.
3. Develop a RDS data encoder, which inserts the emergency information in the ODA (Open Data Applications) 9A and 11A groups of the radio FM.
4. Develop a receiver module, which can decode radio and television emergency signal.
5. Development of a web interface which can activate a siren sound and control and monitoring the receiver module parameters.

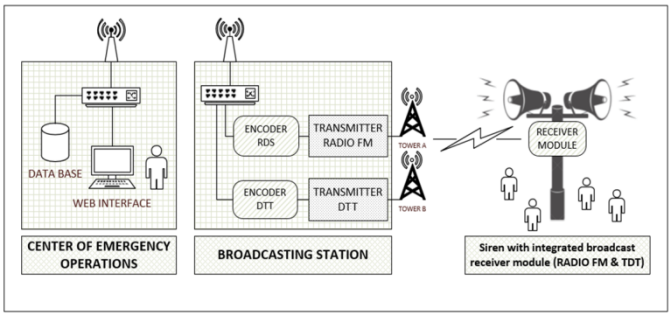

Figure 1. Illustration of the general stage of the emergency system

The Figure1 shows an overview of all the emergency system, which starts from emergency operation center where an operator can interact with the system through a web interface

In the radiodiffusion station the encoders of radio FM and digital terrestrial television are installed to their respectively transmitter. These encoders insert the emergency information into the radiodiffusion.

III. Emergency Information

The emergency signal is based on an adaptation of the PLANAGERD [5] in the CAP protocol [4], which proposes a new emergency protocol called **CAP-PER**.

The CAP-PER protocol allows us to include different types of emergency information [6] according to the natural disasters, as shown in Figure 2.

```
<alerta>
        <identificador>Indeci</identificador>
        <fechaHora>2016-10-19T15:23:53-07:00</fechaHora>
        <estado>Actual</estado>
        <tipo_mensaje>Alerta</tipo_mensaje>
        <ambito>Publico</ambito>
        <referencia>MensajeDeAlerta</referencia>
        <informacion>
                <idioma>Espanol</idioma>
                <categoria>GeodinamicaInterna</categoria>
                <evento>Inundacion</evento>
                <tipo_respuesta>Evacuar</tipo_respuesta>
                <urgencia>Inmediato</urgencia>
                <severidad>Severo</severidad>
                <certeza>Confirmado</certeza>
                <efectivo>2016-10-19T15:23:54-07:00</efectivo>
                <inicio>2016-10-19T15:23:54-07:00</inicio>
                <fin>2016-10-19T15:24:24-07:00</fin>
                <color_alerta>Rojo</color_alerta>
                <parametros>InundacionPuenteGrau</parametros>
                <area>04-01-03</area>
        </informacion>
</alerta>
```

Figure 2. CAP-PER protocol generated by the web interface

IV. Emergency Messages Through Radio Frequency

A. Generator of Emergency information on DTT.

This process is carried out by a script written in Python, which generates a new 188 Byte ISDB-T table [7]. This table has a new descriptor that extracts all emergency information from the CAP-PER protocol. Finally a file is generated with the following name (AET Alert Emergency Table). This file is multiplexed with the OpenCaster software and is ready to be entered into the MPEG-2 stream.

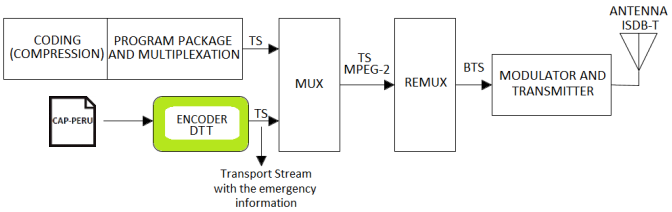

Figure 3. Location of the DTT encoder in the broadcasting station [5], it should be noted that the CAP-PER protocol reaches the DTT encoder via an IP network.

The DTT encoder of Figure 3 is implemented with a Mini-PC on a Linux operating system and an ASI/SD-SDI Dektec interface, which allows the transmission of the emergency information through BNC coaxial cable towards the multiplexer of the broadcasting station.

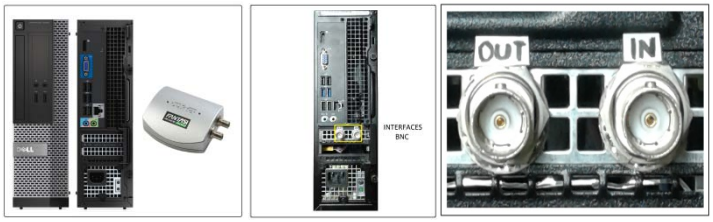

Figure 4. The equipment used for encoder development is shown on the left, the central image shows the back of the MiniPC integrated with the BNC (OUT / IN) interfaces.

The figure 5 shows a general diagram of the operation of the emergency encoder.

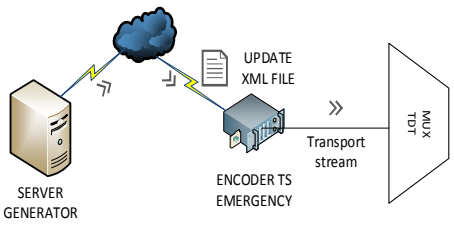

Figure 5: General diagram of the ENCODER for Emergency Alert

The server sends an updated XML file which will be received by the encoder and will generate a Transport Stream packet multiplexed with the emergency alert information.

Figure 6 shows the flow diagram of the encoder

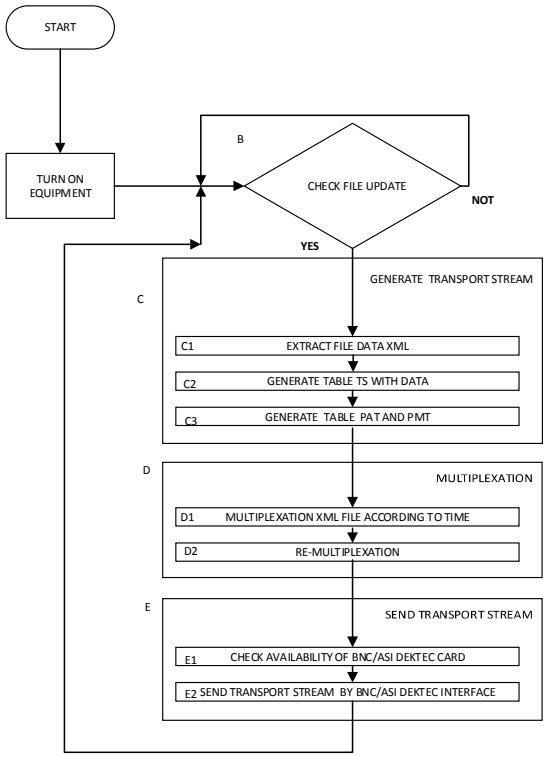

Figure 6: Flow diagram of the encoder for emergency alert.

Firstly we turn on the encoder, later it initiates a verification of a new xml file received, waiting for this event in permanently way. Once the new xml file is received due an external update, new sequences of processes are generated:

- **Generation of Transport Stream:** The encoder obtains data of the XML file, to generate a table of Transport Stream package called AET (Alert Emergency Table); once the Transport Stream Package has been generated, it must be multiplexed together with the PMT and PAT tables so the encoder can send a recognized signal by a Multiplexer.
- **Multiplexing:** The selected bitrate for the AET table is 3008bps, two AET tables are sent per second, as the majority of the SI/PSI tables for MPEG-2 system.
- **Sending Transport Stream:** A BNC/ASI interface is required as a Dektec DTU-245 card that was used for this work.

Once the transmission is finished, the general program will continue checking if a new update of the xml file has arrived.

B. Generator of Emergency information on Radio FM.

In the case of radio broadcasting, a RDS encoder device was developed based on a reduced-plate computer, this encoder receive the protocol CAP-PER by the IP network, extracts all its parameters and assigns a binary code to each parameter CAP-PER to be inserted in groups 9A [8] and 11A as shown in figure 7.

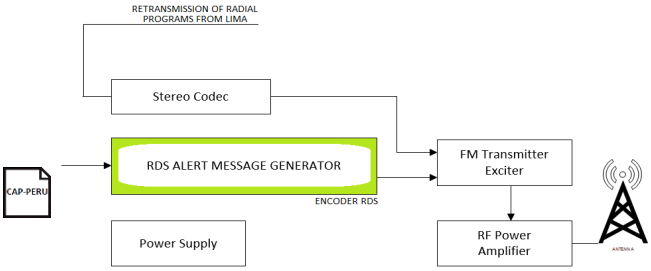

Figure 7. General diagram of system operation FM transmitter.

V. Receiver Module Of Emergency Messages

For the reception of the emergency messages an electronic receiver module has been developed that receives the carrier signal of Digital Terrestrial Television and / or FM radio. In Figure 8 we observe a general scheme of the components of the receiver module as composed of 4 processes that are: The power card, The EWBS, RDS for Radio FM and The Ethernet control card (Raspberry PI) which is connected a modem RF with connection by USB for the reception of signal of Digital Terrestrial Television.

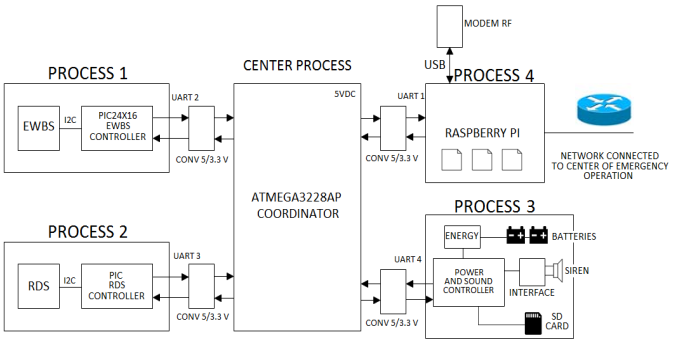

Figure 8. Receiver module for digital television, FM radio and EWBS signals, which contains 4 processes that maintain communication due to central control.

The receiver module can be remotely managed using the SNMP protocol, for this the Agent is located in the microcomputer (Raspberry Pi) and the Manager in a server located in the center of emergency operations. To make possible the management of the module, a MIB module has been developed based on the SMIv2 standard [9], as well as the extension of the agent using the AgentX standard [10]. Figure 9 shows a general scheme of remote management.

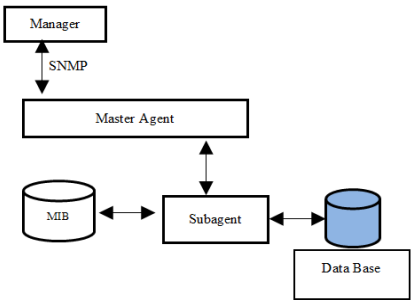

Figure 9. Diagram of the monitoring process of the receiving module.

The power stage of the figure 10 is constituted by a 300w audio amplifier, which is controlled by the central control composed by an Audio generator DFR0299 [11] as shown in the figure 6, which generates the early warning messages, when the power stage receives the emergency signal from the broadcasting technologies FM radio and digital television

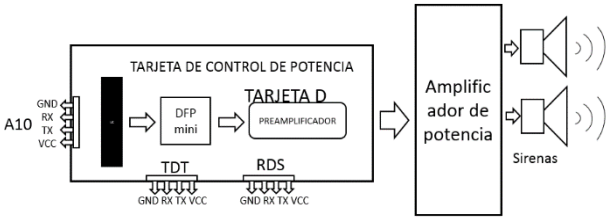

Figure 10. Power control board.

VI. Web Monitoring Interface

This emergency system is managed by a web interface, developed in Java that fulfills 3 main functions: the activation of the sound siren for muti events through the broadcasting, the monitoring and control of the operating parameters of the receiver module through an IP network. As shown in Figure 11

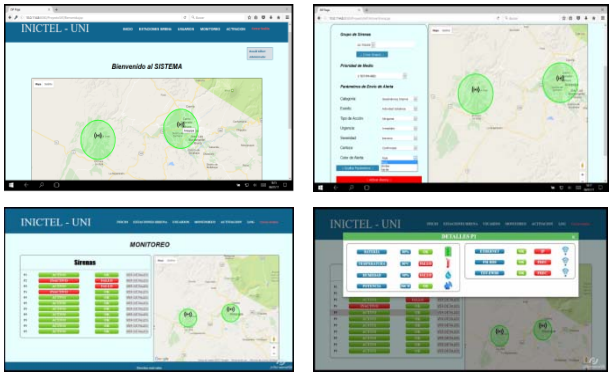

Figure 11. Activation, control and monitoring of the emergency system web interface.

Conclusions

It was proposed a standard for sending emergency messages in via broadcasting via FM Radio and Digital Terrestrial Television ISDB-T, based on the CAP protocol and PLANAGERD, Sending both the same information, creating two redundant broadcast channels and generating greater reliability for sending alerts and emergency alarms. A Encoder for Digital Terrestrial Television and an RDS Radio Encoder have been developed, which insert emergency information into Digital Terrestrial Television and FM Radio transmitters; these encoders have been tested obtaining satisfactory results being able to be implemented in any Operator of broadcasting. For the reception of emergency information a receiver has been developed and validated, which decodes FM radio and Digital Terrestrial Television signals. These receivers will be implemented on posts so that they can alert the population in a timely manner, allow mitigating human and material losses. A Web Platform was developed to activate the alert and manage all the system. This platform will be administered by authorized personnel; in addition the communication that will send this platform will count with security of type AAA, which allows the system to minimize the intrusion of unwanted alerts.

Acknowledgment

The authors would like to thank the National Program of Innovation for Competitiveness and Productivity(Innóvate Perú), for the funds allocated to the project (152-PNICP-PIAP-2015). The authors also acknowledge the National Institute of Civil Defense(INDECI), Catholic University San Pablo-Arequipa(UCSP) and the National Univerisity of Engineer trough the National Institute for Research and Training in Telecommunications (INICTEL-UNI) for the support provided.

References

[1] Satoshi Takahashi, A Novel Method of Determining EWS Wake-up Trigger for ISDB-T Digital Television Receivers, 2014.

[2] ITU. 2007. Compendium of ITU's work on Emergency Telecommunications. International Telecommunication Union.

[3] Recommendation ITU-R BT.1774-2(10/2015) Use of satellite and terrestrial broadcast infrastructures for public warning, disaster mitigation and relief BT Series Broadcasting service (television)

[4] OASIS : Common Alerting Protocol Version 1.2; OASIS Standard 01 July 2010

[5] SINAGERD, PCM,SGRD,CENEPRED,INDECI. PLAN NACIONAL DE GESTIÓN DEL RIESGO DE DESASTRES PLANAGERD 2014-2021. LIMA : s.n., 2014

[6] Karl H. Wolf, "A Location Aware DVB-based Early Warning System for Civil Protection", 2013

[7] Book of Didital Terrestrial Television "Transmision de Television Digital Terrestre en la Norma ISDB-Tb", by Nestor Oscar Pisciotta, Carlos Guillermo Liendo, Roberto Carlos Lauro.

[8] Claudiu Barca, Implementation of RDS Platform Solutions for an Emergency System, 2013.

[9] Internet Standard, Structure of Management Information Version 2 (SMIv2), https://tools.ietf.org/html/rfc2578, April 1999.

[10]Agent Extensibility (AgentX) Protocol, https://www.ietf.org/rfc/rfc2741.txt , January 2000.

[11] Audio generator DFR0299 https://www.dfrobot.com/wiki/index.php/DFPlayer_Mini_SKU:DFR0299