IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
Vol. 04, Issue 04 (April. 2014), ||V4|| PP 17-22

Spectrum Monitoring and management

Nabil Ali Sharaf Murshed[1,] Abdelrasoul jabar Alzubaidi[2]
[1,2]Department of Electronic Engineering (Communication), [1]Sudan Academy of Sciences,
[2] Sudan University of Science and Technology

Abstract: - Spectrum Monitoring is, besides Spectrum Planning and Licensing, one of the key elements in spectrum management process. Monitoring is not only solving interference problems but also tasked with for instance:

- **Checking license parameters, e.g. field strength and band width (remote inspection)**
- **Comparing predicted and measured values**
- **Identifying illegal use**
- **Supporting preparation for WRC**
- **Quick overview of the spectrum**
- **Reframing**

Detecting White Spaces, etc
Frequency Planning and Licensing provide the theoretical (calculated) occupancy. Monitoring provides the real (automatically or manual measured) occupancy.The smaller the difference between theoretical and real occupancy, the better the quality of the overall spectrum management process.

Keywords: *Radio spectrum, monitoring station, management, mobile communication, GSM, Digital radio receiver, simulation and design, licensing*

1. INTRODUCTION

Signal being transmitted, receiver and travel at least significant portion of their path in free space this clearly an essential characteristic in certain application such as mobile phone, satellite communication, broadcasting and radio navigation.
In other application such as fixed links and fixed wireless (FWA), it provides a key advantage the avoidance of upfront cost of laying transmission lines.
The main disadvantage however is that transmission over free space means that stray signals from one radio communication system can easily interfere with the proper reception of another. Interference is unavoidable and ever present.
The impact of excessive interference ranges from simple inconvenience to individual users to, on occasions, the undermining of the viability of networks suffering interference. At the very extreme, it can have safety of life implications, for example where radio systems used by the emergency services suffer interference. Furthermore radio signals do not respect national borders. Thus, if not properly managed, signals emanating from one country can unduly interference with system in other countries.
This propensity to interfere, locally and regionally, is the key factor rendering the radio spectrum a resource. National regulatory authorities (NRAs) throughout the world have therefore regarded it as one of their central duties to ensure both an acceptable interference environment as well as maximizing the (technically) efficient use of the available spectrum.

This has resulted in implication of international regulation and technical considerations on market

mechanisms in spectrum management , a significantly regulated environment in radio communications, with the vast majority of NRAs in the world retaining close control on deciding both the type of permitted services and which organizations should be licensed to operate in a given trencher of spectrum.

So, we need radio monitoring system that can manage radio efficiently and measure radio quality accurately through spectrum analysis for protecting wireless equipment and maintaining quality level of radio, communication service. Also, since conventional radio monitoring system can't measure frequency efficient use investigation and spectrum analysis that is equivalent to occupied bandwidth measurement, broadband frequency measurement, high-speed spectrum measurement, unwanted electromagnetic signal in radio quality measurement, radio monitoring system need to be developed for executing efficient radio monitoring work with reservation measurement function and automatic result storage function that can be done accurate radio measurement of local operators.

I. RADIO MONITORING SYSTEM

We constitute Database and remote control system for save and analysis of measurement data. We use a normal receiver, DSP for spectrum processing with high velocity, control PC to solve the problem of Previous Radio Monitoring System and express efficient radio monitoring system for new communication environment.

General receiver and DSP (Digital Signal Processor) with spectrum analysis equipment based on software defined radio technology design and execute measured algorithm, and analog and digital signal of on-air, that is, mobile base station permitted between 20MHz and 3GHz, FM radio broadcasting station, CDMA, DMB is channel power, frequency deviation and declination,

occupied bandwidth and using this through spectrum analysis can function accurate and efficient analysis ever. Thus, only future program upgrade without hardware exchange can execute multiple measurement function, also future cost reduction and conventional receiver is designed for processing broadband/ narrowband signal.

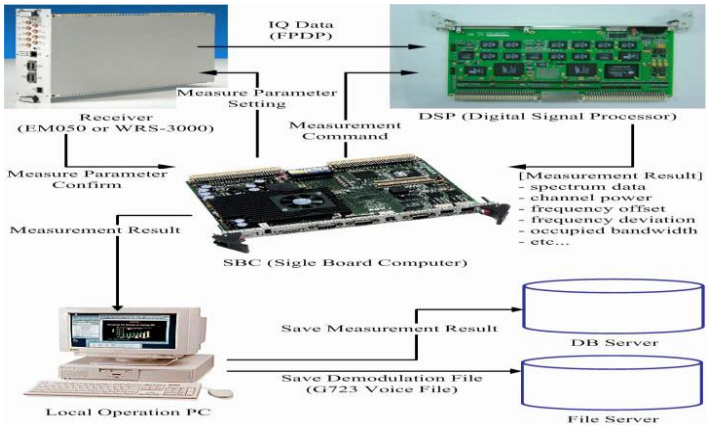

Fig.1 radio monitoring system block diagram

II. RADIO QUALITY MEASUREMENT

Frequency deviation, shift and occupied bandwidth channel power, AM broadcasting about launching radio in wireless station is expressed for measuring modulation type.

Over ten times measured result for assuring correctness and reliability is stored in database.

Spectrum data is stored file format. Demodulated voice file also is stored as G723 format in file server.

Fig3 shows radio quality measurement of real-time analysis screen of deviation distribution graph, time distribution (spectrum intensity, deviation, shift, occupied bandwidth) graph, and spectrogram for monitoring easily

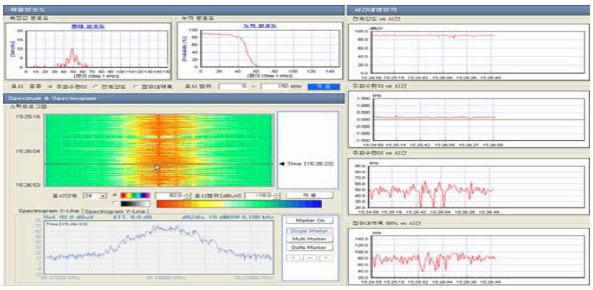

Fig.2 radio quality measurement real-time analysis

Radio quality measurement has direct measurement mode, channel measurement mode, maximum received azimuth measurement mode. Direct measurement mode measuring one frequency generates result about frequency deviation, shift, occupied bandwidth, signal level, in-depth modulation of AM and stores spectrum data, voice file. Channel measurement mode measures received frequency that is over threshold level sequentially, and measured result is identical direct measurement mode. Maximum received azimuth measurement mode turn around direct antenna with three hundred and sixty degree, and measured signal level about frequency, so direct antenna utilize radio quality measurement using measured result of optimal azimuth.

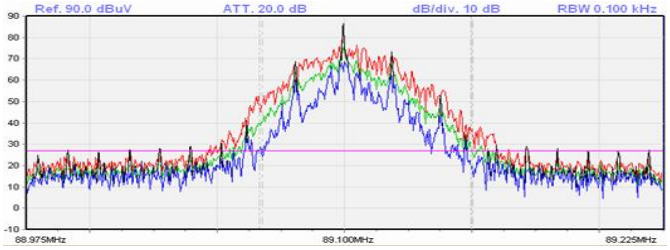

Fig.3 radio quality measurement spectrum

Fig.4 shows measured 89.1MHz medium electric wave using 250 KHz channel bandwidth, and Fig5 shows radio quality measurement result of frequency, modulation, occupied bandwidth, and occupied bandwidth , deviation, shift, signal level, measured time, electrical intensity. Measured result stores in database, spectrum data file stores in control computer, and voice file stores in file server.

III. UNWANTED ELECTROMAGNETIC SIGNAL

4-1Measurement

Unwanted electromagnetic measurement has spurious measurement mode and harmonic measurement mode. Spurious measurement mode measures spurious generation about spurious signal power and mask invasion of analog broadcasting frequency occasionally.

At this time, mask supports FM, CDMA, TRS, PCS, DMB, and DTV considering function of extension.

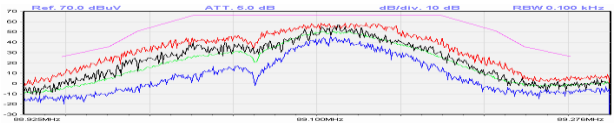

Fig.4 spurious measurement spectrum

armonics measurement mode measures base band and fourth harmonics simultaneously, and measurement result stores automatically, so we can analyze measurement result for distinguishing harmonic generation.

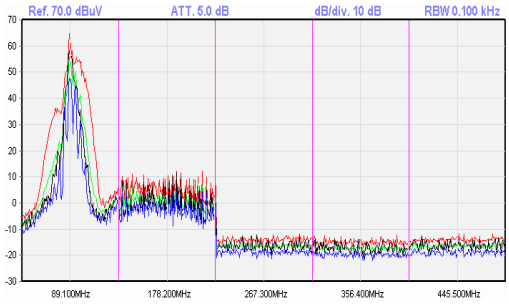

Fig.5 harmonics measurement spectrum

Fig.4 is spurious measurement screen applying maximum, minimum, average spectrum graph and FM mask of 89.1MHz radio frequency, and Fig.5 is harmonic measurement screen of same frequency.

4-2High-Speed Spectrum Measurement

After high-speed spectrum measurement stores maximum 1000 thousand spectrum data that measured within 10 second of sweep time and from above 1GHz broadband to below 10 KHz resolution bandwidth, Spectrum data can be remade and analyzed, utilized about fundamental material of radio environment.

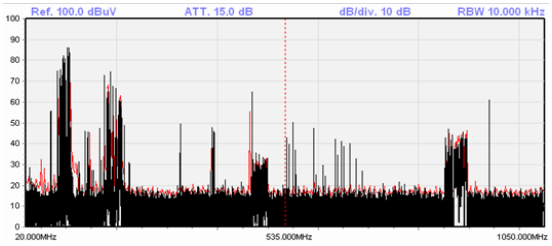

Fig.6 High-Speed Spectrum Measurement

Fig.7 Function of Spectrum Expansion

Fig.6 is screen using RBW 10 KHz about 20MHz~1050MHz frequency band, and Fig.5 is TV radio band screen using expansion function.

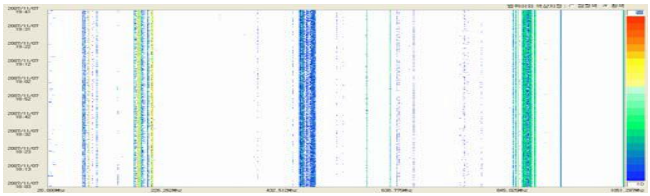

Fig.8 high-speed spectrum measurement spectrum analysis

After measurement is done, Fig.8 is screen of analyzing spectrum that is producing fundamental material for radio noise investigation.

IV. FREQUENCY USAGE EFFICIENCY INVESTIGATION MEASUREMENT

Frequency Usage Efficiency Investigation calculated shares about channel or bandwidth measurement repeatedly. And Frequency Usage Efficiency Investigation conduct statistics and analysis about diversity conditions (Frequency, classified time, a day of the week, day/night etc about Frequency, division bandwidth, kinds of radio station and expenses frequency) using the cumulative result of calculation value. And then, Frequency Usage Efficiency Investigation create reference file of channel or bandwidth using permission DB about allotment frequency and permission bandwidth for application to recovery of idleness frequency, allotment of new frequency and management of frequency.

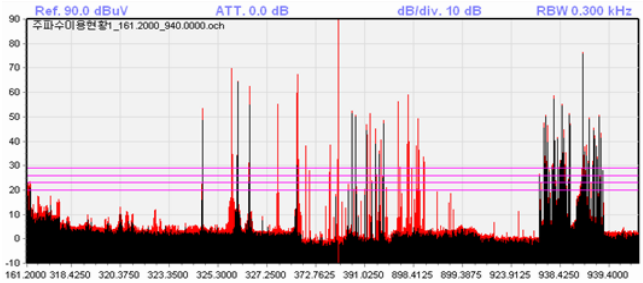

Fig.9 frequency usage efficiency investigation

Fig.9 is a spectrum graph screen about channel measurement mode of Frequency Usage Efficiency Investigation.

V. ILLEGAL RADIO EXPLORATION

The illegal radio exploration exposes an illegal radio station using without permission in 20 MHz ~ 3.2 GHz frequency band. It explores all frequency bands by channel or band scan. The signal exceeded threshold level recorded by demodulation receiver and utilized to an evidence data.

The channel measurement mode scans the maximum 1000 channels using the Memory Scan Mode (MSCAN mode) of a receiver and detects an illegal signal over the threshold level. The frequency of used channel file is the frequency judged illegally. The band measurement mode uses Frequency Scan Mode (FSCAN mode) of a receiver. It scan maximum one hundred thousand bands on a frequency interval of the legal step size in the set frequency and detects an

illegal signal over the threshold level. This mode references a database in advance and don't measure a permitted frequency band..

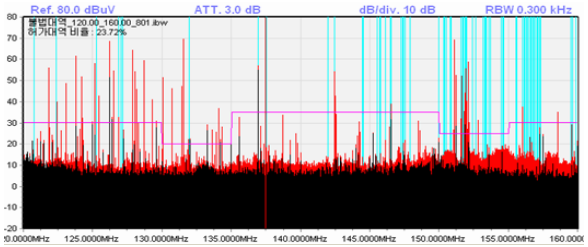

Fig.10 illegal radio exploration

Fig.10 is shown a result executing an illegal radio exploration in the band measurement mode. In case of detected signal over the threshold level, this mode demodulates the voice automatically. If the AFC (Auto Frequency Control) frequency is a non-permission frequency, it displays the measure frequency, AFC frequency, bandwidth, modulation type, signal level, detecting time and voice file name (.723). And the measurement results stored in database, the voice file stored in the file server

VI. CONCLUSION

Newly radio quality evaluation criteria about analog and digital signal of on-air, that is, mobile base station permitted between 20MHz and 30MHz, FM radio broadcasting station, CDMA, DMB is channel power, frequency deviation and declination, occupied bandwidth, and using this through spectrum analysis can function accurate and efficient analysis ever, and do broadband radio quality measurement of 10MHz. Also spurious and harmonic measurement, broadband high-speed spectrum measurement over 1GHz can analyze domestic radio environment, and through frequency usage efficient investigation can generate fundamental material for managing or supervising assigned frequency efficiently.

On the other hand, illegal radio exploration can detect and manage illegal radio station doing illegal action in domestic, so generate statistic material for executing fundamental policy of domestic radio management, also manage and supervise radio utilizing analysis data.

REFERENCES

[1] Draft Recommendation ITU-R March 2004.
[2] ITU, Handbook Spectrum Monitoring. Edition 2002
[3] Enforcement regulations of an electric wave low, Ministry of Information and Communication Republic of Korea
[4] "Research about method of radio quality measurement" Final Report, Radio Research Laboratory. 1997
[5] Research about reference of radio quality measurement, Electronics and Telecommunications Research Institute, 2001
[6] Technical Requirements for the Radio Equipment of Telecommunications Service, Radio Research Laboratory Notice No. 2005-24, Mar. 18. 2005
[7] Technical Standard of Radio Equipment for Broadcasting Service and the Broadcasting Standard Form, Radio Research Laboratory Notice No.2005-25, Mar. 18. 2005