

The Study and Analysis of the GPS Simulcast Radio System

陳達群、陳雍宗

E-mail: 9419715@mail.dyu.edu.tw

ABSTRACT

Since tel-communication technologies have been developed rapidly and precociously, the tel-communication methods become variably and convenience for people using them. The simulcast radio system is one of the method for special groups using it (e.g. police department, fire company, ambulance, airport service, trafficable control & maintenance...etc.). The system is different with 2G/3G system that provides some special functions (e.g. broadcast /walk-in talk-in mode, area selection, individual call, group call, Broadcast call, direct listening and interruption...etc.). Users can apply these functions to do what they are necessary to do such as different communication modes, group and system managements...etc. Based on its special characteristics, the Taiwan Area National Freeway Bureau (TANFB) has been erected the radio system for its control and maintenance groups using. This thesis investigates and analyzes the functional applications, design, erecting processing and testing of the radio system. I hope that this research is going to create some references for designing and erecting the radio system as the project of and “ intelligent network of TANFB - radio system ” in future.

Keywords : Simulcast Radio System、 Broadcast /Walk-in Talk-in mode、 Area Selection、 Individual Call、 Group Call、 Broadcast Call、 Dir

Table of Contents

第一章 前言	1.1研究背景與動機	1	1.2研究方法	1
1.3論文結構		2	第二章 同頻共波無線電話系統(Simulcast Radio System)之原理及應用說明	
2.1同頻共波無線電話系統之原理說明		3	2.2載波訊號涵蓋重疊區 (Overlap Region) 之訊號 精準度需求	4
2.3衛星同頻共波無線電話系統之原理說明		5	2.4同頻共波無線電話系統之應用說明	7
第三章 同頻共波無線電話系統 - 設備之功能及運作模式說明		9	3.1 GPS高穩定度頻率參考單元之應用說明	9
3.1.1 SC-320標準時序產生器 (Standard Clock Generator) 之功能說明		10	3.1.2 SC-330 GPS訊號參考模組 (GPS Signal Reference Module) 之功能說明	11
3.1.3 SC-331 GPS訊號同步模組(GPS Signal Synchronization Module) 之功能說明		12	3.2 GPS高穩定度頻率參考單元之運作模式說明	12
3.2.1 Motorola Oncore GPS接收器 之運作模式說明		13	3.2.2 GPS天線偵測電路 (ANTENNA SENSE CIRCUIT) 之運作模式說明	15
3.2.3 1PPS (ONE PULSE PER SECOND) 時序信號之運作模式說明		15	3.2.4 GPS輸出資料延遲之運作模式說明	16
3.2.5 Temex Time Smart SRO Rubidium SynClock+ 之運作模式說明		17	3.3等化與控制單元及等化與延遲控制單元之應用說明	19
3.3.1等化與控制單元 (Equalization and Processing Unit) 之功能、運作模式及架構說		20	3.3.2等化與延遲控制單元(Equalization and Delay Control Unit) 之功能、運作模式及架構說明	21
3.3.3數位等化與延遲處理單元 (Digital Equalizer & Delay Unit) 功能說明		23	3.3.4數位等化與延遲處理單元 (Digital Equalizer & Delay Unit) 數學運算模式說明	24
3.4比較選擇控制單元(Comparator/Voter)應用及 功能說明		28	第四章 案例探討 - 系統之設計、建置、測試及分析	
4.1國道高速公路中區交通控制系統 - 無線電話系統設計淺介		30	4.2系統之設計 - 系統之選擇	31
4.3系統之設計 - 高穩定度頻率參考單元 (High Stability Frequency Reference Module) 之選擇		33	4.4標準時序產生器 (Standard Clock Generator) 之選擇 - GPS	34
4.4.1 GPS之時間組成及訊號及訊息 (Signals and Data) 說明		36	4.4.2 GPS 時間及位置估算說明	38
4.5頻率參考標準單元 (Frequency Reference Standard, FRS) 之選擇標準		39	4.5.1頻率參考標準單元 (Frequency Reference Standard, FRS) 之選擇 - ?原子鐘	43
4.5.2 SRO?原子鐘 時序及頻率控制迴路模式 說明		43	4.5.3 SRO 頻率穩定狀態 (Frequency Stability) 趨勢說明	45
4.6系統之建置 - 無線電發射機之輸出功率 (Transmitter Power) 與訊號含蓋區域 之關聯性說明		46	4.7系統之建置 - 無線電發射機之輸出功率 (Transmitter Power) 及安裝地點與訊號 重疊涵蓋區 (Overlap) 之關聯性說明	48
4.8系統之建置 - 無線電發射機安裝地點與訊號 重疊涵蓋區 (Overlap) 之關聯性說明		50	4.9系統之建置 - 載波訊號延遲所需時間與傳輸 路由距離長短之關聯性說明	51
4.10系統之測試與分析 - 無線電波電場強度測試 及分				

析	52	4.11轉播站電磁波強度測試及分析	54	第五章 結論
5.1衛星同頻共波無線電話系統優缺點說明	58	5.2衛星同頻共波式無線電話系統相關缺點改善方案說明		
.	60	參考文獻		61

REFERENCES

[1] "Technical Proposal for Chung Shan Highway Simulcast Radio System, Issue-4" , Damozal Technologies Inc., Sep., 2002.

[2] "交通部臺灣區國道高速公路局中區交通控制系統工程 - 無線電話系統設備器材送審文件 - 核定板" , Aug., 2003.

[3] "What is Simulcast?" Daniels Electronics Ltd., Internet address: <http://www.danelec.com> .

[4] Oncore User ' s Guide, Version 5.0, Motorola, Aug., 2002.

[5] iSync+? Smart SRO SynClock+? Manual, Temex Time, Feb., 2004.

[6] "Simulcast Equalization System and Control Software" Convex Corporation, Nov. 2001.

[7] Jerome V. Krinock, "Automatic Equalization for a Simulcast Communication System" , Michigan Consolidated Gas Company, May 1982.

[8] John G. Proakis, "Digital Communication 4th Edition" , P.660~P.705, McGraw-Hill, 2001.

[9] "國道高速公路局中區交通控制系統工程 - 特訂條款 (下冊)" , 交通部臺灣區國道高速公路局, Sep., 2001.

[10] Peter H. Dana, The Geographer's Craft Project, Department of Geography, The University of Colorado at Boulder "Global Positioning System Overview" , Internet address: <http://www.colorado.edu/geography/gcraft/notes/gps/gps.html>, May, 2002.

[11] "Rb & GPS Technologies" , AccuBeat Ltd., Internet address: http://www.accubeat.com/attachments/attach_50_1022716.pdf, May, 2002.

[12] "Oscillators available for GPS167 GPS receiver OCXO, TCXO, Rubidium" , Meinberg Radio Clocks, Internet address: <http://www.meinberg.de/english/specs/gpsopt.htm>.

[13] "交通部臺灣區國道高速公路局中區交通控制系統工程 - 無線電話系統電場強度測試紀錄表" , Apr., 2004.

[14] Bill Gould and Jai Eu, "Using Synchronized Transmitters for Extended Coverage in FM Broadcasting" , Harris Corporation, May, 2004.

[15] Sylvain Ranvier, Helsinki University of Technology, "Path loss models" , Nov. 2004.

[16] "中華人民共和國國家標準電磁輻射防護規定GB 8702-88" , Mar., 88.