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SPECTRUM MONITORING STUDY Cayman Islands

Audit 2006 Final Report



NOTICE

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1 EXECUTIVE SUMMARY

In modern economies the importance of good reliable telecommunications is recognized as a key engine of development and investment. Functional telecommunications requires quick and efficient access to the radio frequency spectrum. Management of the radio frequency spectrum is an explicit function of government in all jurisdictions.

The Information and Communications Technology Authority of the Cayman Islands has taken steps to manage the spectrum resource effectively. A critical element in spectrum management is the ability to identify and monitor current users against a licensing database. As part of the Consultancy Services to develop and Implement a Modern Frequency Spectrum Management System (FSMS), Aerosystems International undertook base line monitoring of existing users of spectrum in the Cayman Islands. The Monitoring Project report summarizes the results of a spectrum usage audit conducted in the Cayman Islands in the month of November 2006.

Analysis of spectrum usage up to 3GHz indicated generally low utilization of the overall spectrum bands; most activity was found in the cell bands.

The audit activities provided the forum for training staff on a FSMS system, modern spectrum management practices and a discussion of short and long term goals for spectrum usage in the Cayman Islands. The audit also indicated current usage of the assignable bands in the region chosen by ICTA.

A great deal of work was accomplished with a great deal of valuable data being collected throughout the duration of the task. Again, the main objective was to ascertain if there was activity present in the frequency bands. The monitoring conducted at Treasure Island Resort revealed and confirmed where the activity was taking place. The analysis has been described as agreed upon, within this document. All snapshots and graphs have been documented in this report and are self-explanatory.

The occupancy scan that was conducted produced a large amount of data, which will enable ICTA to ascertain the amount of activity that is present in this geographical area. It would not be practical or desirable to attempt to print the volume of data collected during these scans. Instead, the ICTA is given the necessary PDF reports and instructions/guidance to present this information in an electronic format. Part of this information is also contained within this report.

Preliminary on-site analysis indicated that the noise floor in the Cayman Islands is generally within acceptable limits which by itself represent a good starting point to implement a sound spectrum management program in the country. However, some noise was detected in some sites (refer to spectrum analyzer snapshots).



With this supplied data in hand, ICTA should have sufficient information at hand, to move forward with their spectrum management program.

With the complexities of modern communications, ICTA will find it necessary in the short term to rely on foreign expertise to resolve some of the day to day challenges, as well as external resources for ongoing training of its spectrum management personnel. Aerosystems with its close links to the Government of Canada (Industry Canada) and a network of available resources is prepared to assist in the Cayman Islands' programs.

2 **RECOMMENDATIONS**

2.1 Identify and Eliminate Sources of Background Noise

At some locations, mostly in Hell West Bay region, background noise was detected. ICTA will have to identify the source of this noise and negotiate with the parties involved to insure the equipment is operated in such a fashion as to not to interfere with authorized users. As a prerequisite for identification of these background noise originators, ICTA will have to purchase and build out an automated frequency management system with a direction-finding component.

2.2 Identify and Eliminate Unauthorized Usage

With the lack of a sound licensing database it was impossible to ascertain or quantify the volume of unauthorized usage of the spectrum. ASI started the process of identifying unauthorized activities by comparing scanned occupancy data with the license information in hands. Later on, ICTA will have to identify the source of unauthorized usage if any, document unauthorized usage through inspection procedures, notify parties involved, and verify with users if indeed usage is unauthorized. If this is the case, ICTA will ensure through subsequent measurement, which either the unauthorized user ceases or document unauthorized usage for potential prosecution. ICTA will have to input coding data (indicating unauthorized usage) provided by consultant into an automated database in order to sufficiently manipulate the data. As a prerequisite for identifying and eliminating unauthorized usage, ICTA will have to purchase and build out an automated frequency management system with a direction finding component.

2.3 Identify Authorized Vacant Frequencies

In some cases, comparing scanned data with the license information could result in detecting channels that were authorized but appeared not to be occupied. ICTA will have to confirm through subsequent scanning, that these bands are indeed unoccupied by authorized users, notify users and query them as usage/intent to use the bands before making a decision concerning take back, reassignment and or sharing of the bands. In the larger context, the Authority may wish to conduct a review of the spectrum needs of current and potential users in order to ensure efficient long term planning.



2.4 WIFI Activities, 2.4 GHz

WIFI networks are widely used in the Cayman Islands and ICTA is aware of this fact and does not have any plans to issue licenses for WIFI use. For this reason and in agreement with ICTA, no special attention was given to WIFI. Since many tourists and professionals use WIFI enabled gadgets such as personal laptops, PDAs etc, we recommend that the government keeps the current liberal approach to the spectrum licensing of these widely available technologies that use low level RF signals. This policy could also apply to Family Radio Service (FRS) and General Mobile Radio Service (GMRS) frequencies.

2.5 New Spectrum for Cellular Bands

The overall audit revealed that a part of each cellular band is used. This being said, there is still a lot of space to add new service providers mostly in the 1800 MHz. No activity was found in the 1800 MHz in the east end of the island (Bodden Town and Frank Sound Road junction).

The Cayman Islands will benefit by allowing new local operators to setup their networks in the country which will serve a large number of locals and tourists, and enhance government revenues due to wider use of cell phones, not to mention a better service to the end users due to competition.

2.6 **Continuous Spectrum Management**

We strongly suggest that ICTA implements a basic spectrum management operation and radio license collection database to better service its clientele and insure a spectrum free of interference and complaints. Aerosystems recommends the use of a portable receiver for scanning the spectrum and generating occupancy loading charts to assist ICTA in selecting new frequencies for new licenses. The portable system could be installed in various locations around the country where there is a need for spectrum investigations. A receiver together with a spectrum analyzer and DF equipment, for example, could be used for that purpose.

2.7 Site Inspection

ICTA should establish an inspection program to make sure transmitter sites are properly installed with proper installation of RF cables, grounding, or antenna installation. Rusted towers and floating cables around a transmitter can be the source of inter-modulation and interference products. Aerosystems suggests implementing a site inspection program while the number of sites is small to eliminate any potential of signal interference.



2.8 Recommend Road Map

- Review the spectrum audit results, and assess the overall spectrum usage.
- With assistance of a consultant, review spectrum opportunities (e.g. cost recovery), new technology implications, auctions, future developments and opportunities, etc.
- Develop a spectrum vision.
- Initiate a program of public information, requesting current spectrum users to submit license application.
- Develop a Licensing Database as well as an occupancy and technical measurement database.
- Initiate a process of locating spectrum users who have not submitted license applications, but shown to be active in the spectrum audit.
- Put in place a monitoring system for ongoing monitoring and problem resolution.
- Process of site inspections to verify license data, and installation issues which may represent possible interference issues.
- Process of spectrum re-valuation and adjustment.
- Implement a Direction Finding Network to locate the source of transmission of target signals.



3 SUMMARY OF KEY RESULTS

Throughout the audit, spectrum usage activity was found during the monitoring at each site. All peak hour reports, hourly occupancy reports and channel amplitude histograms produced by the TMRS application are provided with this report.

All files gathered during the audit time spent in the Cayman Islands are delivered to ICTA. That same data has been evaluated and only channels with an occupancy level greater than 3% have been processed and forwarded in this report.

National Spectrum Usage Portrait

The next table shows the number of transmitters found in the FM broadcast band scan:

Freq MHz	Transmitters
88-108	15
108-118	1

The next table shows the number of active channels by band :

Freq MHz	Total Scanned Channels	Active Channels
118-174	3681	72
406-470	5120	28
850-900	1666	414
900-960	2001	215
1710-1990	9335	281
Total	21803	1010

The activity found in the Cayman Islands was relatively low, as expected. The busiest bands were the cellular bands, specifically the 850-900 MHz downlink. Altogether, a total of 1010 different channels were found active throughout the 24-hour detailed audit. This number includes all dates and corresponds to approximately 5% of overall usage in the Cayman Islands. This number is obtained by dividing the number of active channels (1010) over the total number of channels scanned (21803 Channels). It is important to differentiate between a channel and a frequency. The channel itself is what was assigned in the frequency list. This being said, the 1010 active channels represent less than 1010 active frequencies or sources because of the channel width.

A frequency can and will affect multiple adjacent channels if the scanned channel is not wide enough. By looking at the peak hour reports, the active frequencies can be easily identified since all adjacent active channels have the same source.



Taking under considerations the short scanning period, it is not possible to obtain accurate results when it comes down to identifying all active frequencies. For this reason, the numbers used in this report represent the whole spectrum as one unit instead of representing specific frequencies. To be able to do that, it would take months to determine the pattern of each frequency as well as its source. It is important to understand that these numbers are the result of a snapshot of the spectrum usage.

The table below summarizes the overall activity at all sites:

	Treasure Island Resort
Overall % Busy Channels	5%
Most Congested Bands	850-900 MHz
Irregular Activity	High noise in Hell West Bay (refer to sweeps snapshots)
Indication of Potential	Refer to "License Comparision.xls"
Unauthorized Usage	

The overall percentage of channels occupied is obtained by dividing the total number of active channels by the total number of channels scanned (~21000). The indication of potential unauthorized usage represents the total number of unlicensed frequencies. This is obtained by comparing the records provided by ICTA with the audit results.



4 AUDIT SCHEDULE

Date	Site
Thursday, November 9, 2006	Treasure Island Resort – Setup
Friday, November 10, 2006	Field of Dreams – Manual Sweeps
	Bodden Town – Manual Sweeps
Tuesday, November 14, 2006	Frank Sound Road – Manual Sweeps
	Hell – Manual Sweeps
	Tear Down and Shipping

4.1 Domestic Implications for the Government of the Cayman Islands

A more complete record (in electronic format) of licensed spectrum users (licensing database) in the Cayman Islands is essential for two reasons:

- 4.1.1 Technical management of the spectrum resource is necessary to ensure that as many users and as many uses can be accommodated as possible without harmful interference to one another. Without an accurate licensing system, technical management of the spectrum (electromagnetic compatibility between users and uses) is impossible.
- 4.1.2 Complete licensing records would greatly assist in ensuring that a proper economic return is provided to the Government for the use of the radio-frequency spectrum. Unlicensed users obviously do not pay fees. Licensed users therefore are carrying the entire burden of providing an economic return to the government for the use of the publicly owned spectrum resource.

A regular and vigorous physical presence by ICTA to seek out and correct unlicensed use of the spectrum in the Cayman Islands is necessary. The setting of revenue targets from spectrum licensing would encourage a more disciplined relationship between spectrum users and the Government. Each party would know what to expect from the other. No one likes to pay fees: that goes without saying. However, all users of the spectrum in the Cayman Islands would be more likely to conform to the government's management of the spectrum resource if they were convinced of the equity and consistency of both who pays fees and why fees are paid. The setting of realistic revenue targets from spectrum licensing (in consultation with the Finance Ministry) would help regularize this situation.



5 TASK DESCRIPTION

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5.1. Discussions and review of the local RF environment

Meetings were held with officials of ICTA to review the local RF environment. Meetings were attended by

- Mr. David A. Archold ICTA, Managing Director
- Mr. Mark Connors ICTA, Head of Economics & Regulation
- Mr. Greg van Koughnett ICTA, Head of Licensing & Compliance
- Mr. Echard McLaughlin Jr. ICTA, Licensing & Compliance Manager

Aerosystems International Inc gave one presentation.

5.2. Discussions on short & long term goals to be achieved

During the preparatory period, Aerosystems International Inc and ICTA officials conducted meetings and consultations to discuss the goals. During the briefings in the Cayman Islands with technical officers, goals were also discussed. The main goal, as indicated by these consultations, was to determine the extent and nature of spectrum usage from 88 to 3000 MHz.

5.3. Collection of sample data from the 88-3000 MHz frequency band

Approximately 5,000 pages (~5000 MBYTE) of data were collected from real-time spectrum surveillance at four different sites, 24 hours per day. This data is stored on a USB hard drive and is part of the deliverables to ICTA.

5.4. Occupancy measurements on selected frequencies

In consultation with ICTA, about 21000 frequencies were selected and occupancy measurements performed.

5.5. Report on collected spectrum data

The collected data set was prepared in electronic format and is part of the deliverables to ICTA.



6 THE CAYMAN ISLANDS FIELD AND SCANNING OPERATIONS

One of the major objectives of the on-site monitoring task in the Cayman Islands was to conduct field operations with the specific aim of discovering what degree of spectrum usage was present in the following band allocations:

Start Frequency	Stop Frequency	Step
88.0 MHz	108.0 MHz	100 kHz
108.0 MHz	138.0 MHz	25 kHz
138.0 MHz	174.0 MHz	12.5 kHz
406.0 MHz	470.0 MHz	12.5 kHz
850.02 MHz	960.0 MHz	30 kHz
1710.00 MHz	1990.02 MHz	30 kHz

The surveillance equipment used to accomplish this task was as follows:

- Spectrum Explorer, Agilent Mainframe E8408A S/N MY41001755, HP ADC E1437A S/N US37430344, CRC Filter VXI 1394 Board S/N CRC DF41B1, WJ Receiver WJ-8621 S/N 51,
- Spectrum Analyzer, HP Model 8594E S/N 3624A03258 with screen capture software
- Toshiba laptop computers
- D130 antenna
- Interad 5097 antenna
- LPD-830/A (1-18 GHz Directional)
- Power supplies, cables
- Appendix 1 Certificate of Calibration



7 SPECTRAL OCCUPANCY ANALYSIS

The occupancy scan that was conducted produced a large amount of data, which will enable the Government of the Cayman Islands to ascertain the amount of activity that is present in this geographical area. It would not be practical or desirable to attempt to print the volume of data collected during these scans. Instead, ICTA is given the necessary PDF reports and instructions/guidance to present this information in an electronic format. This information is also contained within this report.

A complete spectrum occupancy analysis was undertaken utilizing the Spectrum Explorer (SE). This study measured the hourly occupancy, signal level distribution, and transmission count information for specific frequencies in the following frequency bands

- 88 to 108 MHz
- 108 to 118 MHz
- 118 to 174 MHz
- 406 to 470 MHz
- 850 to 960 MHz
- 1710 to 1990 MHz

Frequency List

A complete list of discrete frequencies was developed in respect of the frequency bands. This list was presented to ICTA and necessary modifications were made to suit the needs of ICTA.

This frequency list was loaded into the SE, which in turn collected information on each frequency and stored this information into a single file for each calendar day.

The detailed frequency list will be provided in two Excel files: 88-118.xls and 118-1990.xls.



8 DETAILED SPECTRUM AUDIT

Signal Threshold Monitoring

The occupancy information collected by the SE utilizes a technique called signal threshold analysis. In this procedure, the SE collects detailed signal level measurements for each frequency in the frequency list and stores all the time-stamped amplitude measurements in a packed format. During analysis, a threshold level must be specified by the system, so that the amplitude measurements collected during the monitoring session can be compared against this level, to see if the signal level measured is above or below this user defined amplitude level. This in effect is applying a "software squelch" to the data. In the analysis, all signal levels measured below the threshold are considered as noise, and all signal level measurements above the threshold are considered as signal. Using this method, detailed amplitude signatures can yield occupancy information for all scanned frequencies.

Report Structure

The volume of information collected by the SE is extremely large. The next pages will illustrate the spectrum activities of all channels that have at least 3% of occupancy within any given hour of the scanning period Θ^{th} to the 14th of November 2006). All active channels will be represented in red bars. It should be clear that 3% activity is not a whole lot but for the sake of this report we are considering the 3% threshold to decide if a channel will be considered active or not.

An Excel file will be also provided to show the peak occupancy of all channels and the average occupancy per site within the scanned period. A peak occupancy hour represents the maximum occupancy in any given scanning hour during the scanning period.



8.1 **Treasure Island Resort – Detailed Occupancy Chart**

Location: Treasure Island Resort Latitude: 19 18 51.9 N Longitude: 081 23 03.5 W Altitude: 110 feet Date: November 9 – 14 2006



As expected, the scanning revealed low activity in the Cayman Islands. A total of 1010 channels, approximately 5% of the scanned spectrum, were found busy throughout the scanning period and the most congested ranges were the cell bands, specifically 850-900 MHz. The peak hour and hourly occupancy reports provided as part of the deliverables may be viewed to better understand which channels were busy at different times of the day.



118 MHz – 1990 MHz





118 MHz – 174 MHz





406 MHz – 470 MHz

406.0000	407.7625	409.5250	411.2875	413.0500	414.8125	416.5750	418.3375	420.1000	421.8625	423.6250	425.3875	427.1500	428.9125	430.6750	432.4375	434.2000	435.9625	437.7250	439.4875	441.2500	443.0125	444.7750	446.5375	448.3000	450.0625	451.8250	453.5875	455.3500	457.1125	458.8750	460.6375	462.4000	464.1625	465.9250	467.6875	469.4500



850 MHz – 960 MHz







1710 MHz – 1990 MHz



9 METHODOLOGY USED IN FIELD ACTIVITY SCANS

The primary consideration and objective of these scans was to discover what, if any, activity was present in certain radio frequency bands, capture the data and present it in a visual format. This operational methodology will enable the ICTA to ascertain which bands of interest are in use in the Cayman Islands and which bands currently have no activity in them.

At each site, a scan was conducted on the bands of interest using a calibrated spectrum analyzer and the correct antenna for each frequency segment. A preliminary 360-degree antenna sweep was taken to ascertain if activity was present and then the analyzer was placed in the "Maximum Hold" position and another 360-degree sweep was conducted. When the operator ascertained that satisfactory signals levels had been obtained, the sweep was frozen and the information (data) was passed to a laptop computer. At this time the "screen capture" was annotated as to frequency coverage, resolution bandwidth, video bandwidth and reference levels.

During these operations, the exact location of each measurement site was recorded from a Garmin III global positioning system.

The information presented in this report contains the data as described above. There is an individual page dedicated to the technical information from each specific band of interest at each of the visited sites. The name of the location, global position and amplifying data is also present on each sheet.

10 FIELD SCANNING OPERATION SITES

The next pages provide the snapshots of the spectrum in different sites in Grand Cayman using the spectrum analyzer.

- Field of Dreams Manual Sweep
- Bodden Town Manual Sweep
- Frank Sound Road Junction with Bodden Town Road Manual Sweep
- Hell Manual Sweep
- West Bay Town Hall Noise Test Sweep
- Centennial Towers West Bay-Noise Test Sweep

10.1 Field of Dreams

Site Longitude: 081 22 51.8 W Site Latitude: 19 16 32.4 N Site Elevation: 38 feet Date: November 10, 2006 Time: 11:30 am

The sweep at Field of Dreams gave a good representation of the spectrum usage in the area and confirmed the findings of the 24-hour scanning.

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25 MHz - 50 MHz

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108 MHz – 118 MHz

175 MHz – 275 MHz

850 MHz – 900 MHz





10.2 Bodden Town

Site Longitude: 081 16 03.7 W Site Latitude: 19 16 36.4 N Site Elevation: 69 feet Date: November 10, 2006 Time: 1:30 pm



The sweep at Bodden Town did not show as much activity in the 500 MHz range as that of Field of Dreams.



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900 MHz - 1000 MHz



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1500 MHz – 2000 MHz – Bodden Town Primary School Vertical Polarization





10.3 Frank Sound Road Junction with Bodden Town Road

Site Longitude: 081 10 56.8 W Site Latitude: 19 18 03.6 N Site Elevation: 26 feet Date: November 14, 2006 Time: 11:00 am



The sweep at Frank Sound Road junction revealed low activity in this area. In fact, the HF, FM broadcast and the cell bands were mainly the only active bands.



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92 MHz – 96 MHz



100 MHz – 104 MHz



 $108\ MHz-118\ MHz$



















10.4 Hell West Bay

Site Longitude: 081 24 19.7 W Site Latitude: 19 22 44.5 N Site Elevation: 80 feet Date: November 14, 2006 Time: 12:30 pm



Noise was discovered during the sweeps in West Bay. The sweep at Hell was no exception; refer to the snap shots of ranges below 50 MHz for more details. ICTA is urged to push this study a step further in order to identify the source of this noise.





12:33:42 NOV 14, 2006 ∕⊅2 REF -30.0 dBm AT 10 dB PEAK LOG 10 dB/ 6 3 2 ۰q 10 8 (MHz) 25.94 27.69 28.69 Pk 12345 Amplitude -64.82 dBm -64.93 dBm Amplitude -60.53 dBm -66.93 dBm (MHz) Freq Ρk Freq 33.81 6 7 -64.45 -62.65 -62.46 89 36.38 37.50 dBm -68.08 dBm -64.60 -66.53 30.19 dBm dBm 10 32.44 dBm 38.75 dBm 25.00 MHz RES BW 300 STOP 50.00 MHz SWP 20.0 msec START RΤ VBW 100 kHz kHz 25 MHz - 50 MHz



75 MHz – 125 MHz



92 MHz – 96 MHz





108 MHz – 118 MHz



175 MHz – 275 MHz












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10.5 West Bay Town Hall

Site Longitude: 081 24 14.8 W Site Latitude: 19 22 42.3 N Site Elevation: 60 feet Date: November 14, 2006 Time: 12:00 pm



The sweep at West Bay Town Hall confirms the noise found below 50 MHz in the West Bay region.





10.6 Centennial Towers West Bay

Site Longitude: Site Latitude: Site Elevation: Date: November 14, 2006 Time: 1:30 pm

Another location in West Bay, this time in front of Centennial Towers reveals the noise in the region.



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11 TMRS PREVIEW INSTALLATION

- Insert TMRS Preview CD-ROM into the CD-ROM drive
- Navigate to the \TMRS sub-directory and double-click on the setup.exe application.
- The installation dialogue box will be displayed, it is recommended that the installation defaults are not modified.
- The install routine will create a directory by default under the C:\Program Files\ called TMRS.
- A shortcut for the application will be inserted into Start -> Programs -> TMRS_SRMT.

i. TMRS Preview Application

Once invoked, the following menu will be displayed to the user:



To open the file which contains the scanned information, navigate through to the following menu

To select Open -> ESN (direct shortcut is Ctrl+E)

<u>File</u> <u>E</u> dit <u>O</u> ptions <u>H</u> elp		
<u>O</u> pen ▸	IRMA	Ctrl+I
<u>C</u> ompile	<u>E</u> SN	Ctrl+E
<u>S</u> ave To File	Log	Ctrl+L
Create ESN File For Filtered Frequencies		
Print Ctrl+P		
	-	
Frequency List		
d:\Temp\kasper\day389a-20000127.esn		
d:\Temp\kasper\day389-20000127.esn		
d:\Temp\kasper\day3vua-20000127.esn		
E <u>x</u> it Ctrl+X		



This will open a standard Windows dialogue box which will enable the user to navigate to the CD-ROM drive which contains the source data files. All scanned information is stored in the \log data\ sub-directory.

Once the data file has been selected the application will proceed with opening the source file. After the source file has been opened, the following panel will appear;

<u>G</u> eneral	Peak Occupancy Report	Hourly <u>O</u> ccupa	ancy Report	Channel Amplitude	<u>H</u> istogram	<u>C</u> ompile
Site Information Region Name JAMAICA Site Name KINGSTON Receiver Name CRC DAS Antenna Name Diskcone	Session Infor Data File Name Carl-19991203 Loop Time (s) 1.79 Start Date 03- Start Time 00:0 Stop Date 03- Stop Date 03- Stop Time 12: Number of Ses Number of Ses Number of Free	nation esn 12-1999 12-1999 12-1999 22:49 sions 13 nning Hours 13 juencies 273	User Info User Name Robin Jackma SCOMS ID 0 MS ID 0 <u>View I</u>	n 		



General Panel

In this panel the details of the scanning session are reported.

Site Information

- Region Name regional area where scan occurred
- Site Name specific monitoring site name
- Receiver Name specific receiver used to collect information
- Antenna Name specific antenna used to collect information

Session Information

- Data File Name name of raw data file
- Loop Time the total time in seconds required by the system to scan through the frequency list
- Start Date date monitoring session started
- Start Time start time of monitoring session
- Stop Date date monitoring session stopped
- Stop Time stop time of monitoring session
- Number of Sessions total number of scanning hours
- Number of Scanning Hours total number of scanning hours
- Number of Frequencies total number of frequencies in the scan list

a. User Information

- User Name Name of user, used in report generation
- SCOMS-ID Unique number selected by user to annotate scanning information collected in conjunction with interference investigation (may be left blank)
- MS-ID Unique number selected by user to annotate specific monitoring session (may be left blank)

View Load Report

• The load report details the specific information that was derived from the raw data file. This information covers all of the detailed technical information about the raw data file. This feature is used when a user wishes to make sure that the source data file has been correctly interpreted by the Preview application.



The Peak Occupancy Report provides a general overview of the peak hour of occupancy

<u>G</u> eneral	<u>P</u> eak C)ccupancy Report		Hourly <u>O</u> ccu	pancy Rej	port [Channel Amplitude <u>H</u> istogram	<u>C</u> ompile
Frequency S	Search (MHz)		G	•	Ζ			Filtered 1-25/36
Frequency	Date	Peak Hour	0 10	Minutes 20 30 40	50 60	Peak Value %		Threshold
937.1625 MHz	24-11-1999	12-13				23		0 dBuV
937.1750 MHz	24-11-1999	12-13				32		0 dBuV
937.1875 MHz	24-11-1999	14-15				37		0 dBuV
937.2000 MHz	24-11-1999	14-15				55		0 dBuV
937.2125 MHz	24-11-1999	14-15				84		0 dBuV
937.2250 MHz	24-11-1999	12-13				86		0 dBuV
937.2375 MHz	24-11-1999	12-13				79		0 dBuV
937.2500 MHz	24-11-1999	14-15				93		0 dBuV
939.5750 MHz	24-11-1999	17-18				34		0 dBuV
939.6000 MHz	24-11-1999	18-19				35		0 dBuV
939.6125 MHz	24-11-1999	14-15				12		0 dBuV
462.6125 MHz	24-11-1999	17-18				47		0 dBuV
118.3500 MHz	24-11-1999	09-10				37		0 dBuV
118.7000 MHz	24-11-1999	22-23				34		0 dBuV
119.3000 MHz	24-11-1999	20-21				13		0 dBuV
119.7750 MHz	24-11-1999	19-20				32		0 dBuV
121.3000 MHz	24-11-1999	08-09				47		0 dBuV
124.4750 MHz	24-11-1999	18-19				42		0 dBuV
124.6750 MHz	24-11-1999	07-08				22		0 dBuV
124.9250 MHz	24-11-1999	17-18		_		16		0 dBuV
125.4000 MHz	24-11-1999	08-09		_		12		0 dBuV
125.7750 MHz	24-11-1999	15-16		•		28		0 dBuV
127.0000 MHz	24-11-1999	07-08				36		0 dBuV
127.5750 MHz	24-11-1999	17-18				30		0 dBuV
128.2750 MHz	24-11-1999	15-16	_			23		0 dBuV

for all frequencies in the frequency list. In this report the following columns are found;

- Frequency: specific frequency in MHz
- Date: monitoring date
- Peak Hour: hour of the day where peak occupancy occurred
- Minutes Graph: graphical representation of the total number of minutes of occupancy in the peak hour
- Peak Value: numeric representation of the total number of minutes of occupancy in the peak hour in percent
- Threshold: signal threshold value expressed in dBuV
- Frequency: this field allows the user to search through the peak occupancy report to identify a specific frequency of interest. Once the frequency has been entered into the field, click on the "GO" button for the search to complete
- Keyboard Navigation
 - It is possible to scroll through the report by using the Pg UP/DOWN, HOME/END and cursor L/R/U/D. Pg UP/DOWN will cycle the report 25 frequencies at a time, while the HOME/END keys will advance the report to the first page/last page respectively
- Report Filters
 - o It is possible to filter the peak occupancy report by occupancy level. Left-



click on the report and a dialogue box will open which allows you to enter a minimum and maximum occupancy value for the occupancy filter. To clear this filter the user must reset the filter to 0-100% occupancy. If there is a filter active, the word "Filtered" will appear above the frequency counter readout in the upper right-hand corner of the panel

- Hyperlinks
 - In the peak occupancy report both the Frequency and Threshold values are active hyperlinks. By clicking on a specific frequency the user will be automatically moved to the hourly occupancy report for that frequency
 - By clicking on the threshold for a specific frequency, a sub-menu will appear which allows the user to re-specify a threshold value to be applied to the raw data file. It is not recommended that the threshold value be modified



Hourly Occupancy Report Panel



The Hourly Occupancy Report details the hourly occupancy level (in %) for each frequency in the frequency list. In addition to this information, the total number of transmission counts measured each hour for this frequency is displayed.

Features

- Frequency: specific frequency being displayed
- Site Name: site where monitoring occurred
- Date: monitoring date
- Start Time: start time of monitoring
- Stop Time: stop time of monitoring
- Frequency Counter: current frequency of total number of frequencies that is displayed
- Bar Chart: graph of # of minutes of activity for specific frequency for each hour of the calendar day (expressed as a %)

Operational Notes

• A specific frequency can be located through the frequency list drop down box



• Cursor Up/Dn/Lft/Rgt, and PgUP/Down, as well as Home/End keys can all be used to navigate through the frequency list



- The right-click menu for this report also contains navigation features as well as the ability to turn the transmission count information on/off
- The right-click menu for this report contains the "save to file" as well as the "print" functions for this report

Channel Amplitude Histogram Panel

The Channel Amplitude Histogram Report presents a graph which describes how the amplitude of the signal received at the monitoring location changed during the monitoring period. The graph has several distinct features:

- y-axis = % of total number of samples made on this specific frequency
- x-axis = signal level from -20 to 90 dBuV (0 dBuV = 1 microvolt)
- The signal threshold (or squelch level) is shown on the graph as a thin cyan colored line
- All amplitude level measurements that are below the signal threshold level are depicted in green
- All amplitude level measurements that are above the signal threshold level are depicted in red



With the graph the user can very quickly determine what the amplitude distribution on a given frequency, which can indicate what type of system is using the frequency (Private Commercial, Paging, Simplex, Duplex, etc)

Operational Notes

- A specific frequency can be located through the frequency list drop down box
- Cursor Up/Dn/Lft/Rgt, and PgUP/Down, as well as Home/End keys can all be used to navigate through the frequency list
- The right-click menu for this report also contains navigation features as well as the ability to turn the transmission count information on/off
- The right-click menu for this report contains the "save to file" as well as the "print" functions for this report
- The right-click menu allows the user to select linear of logarithmic scaling (logarithmic is recommended), as well as modify the signal threshold value graphically

Report Output

Under the File Menu, the user is presented with the following options:

<u>File</u> dit <u>O</u> ptions <u>H</u> elp	
<u>O</u> pen	•
<u>C</u> ompile	
<u>S</u> ave To File	
Create ESN File For Filtered Frequencies	
Print Ctr	l+P
Frequency List	
d:\mp\TMRS ESN Files\airvu900a-19991124.esn d:\Temp\TMRS ESN Files\Carl-19991203.esn d:\Temp\kasper\day389a-20000127.esn	
E <u>x</u> it Ctr	1+X



Selecting the Save To File option presents the following menu:

Save Options	×
Save Report	
C Save Hourly Occupancy Report	
Save Peak Report	
C Save Channel Amplitude Histogram Report	
Frequency Range	
Save Current Frequency Only	
C Save All Frequencies	
C Save Frequencies From/To	
Minious Frequency (MHc)	
Maximum Frequency (MHC)	
<u>Save</u> Cancel	



From this menu the user may select to save to an ASCII file any specific report, for any specific, or group of frequencies. The output is saved as a standard ASCII file which may be viewed in any standard word processor.

Example of Hourly Occupancy Report

Aerosystems International Inc Hourly Occupancy Report

Region Monitoring Date Peak Hour Receiver Name Frequency # of Freqs Loop Time SCOMS ID Report Date			:TCI :24-11-1999 :08-09 :CRC DAS :121.3000 MHz :44 :0.39 Sec :0 :18-02-2000						Monitoring Site Monitoring Time Peak Value Antenna Name Threshold # Scanning Hours File Name MS ID Author					2	: PROVO :00:00 - 23:59 :28 Min (47%) :Diskcone :3 dBuV :24 :airvu900a-19991124 :0 :Robin Jackman											
1	100																									
	90																									
0 0	80	 																								
0 C	70	 																								
C U	60																									
P A	50										* *										*					
Ν	40	ĺ							*		*		*						*		*			*		
C v	30	 	r						*	*	*	*	*	*	*	*	*	*	*	*	*	*		*		
т	50	+							*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	20	+		*				*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		+		*	*			*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	10	+ 	r r	*	* *	*	*	*	*	*	*	*	* *	* *	* *	* *	* *	* *	* *	* *	* *	* *	* *	* *	* *	*
– – HF		 ()	 1	 2	3	 4		6	7	8	9	10	 11	 12	 13	 14	 15	 16	 17	 18	 19	20	21	22	23



Example of Peak Occupancy Report

Aerosystems International Inc Peak Occupancy Report

Region		:TCI					Mor	nitor	ring	Si	lte	: PROV	0
Monitoring	Date	:24-1	11-199	9			Mor	nitor	ring	Тj	lme	:0000-	2359
Receiver Na	ame	:CRC	DAS				Ant	cenna	a Nar	ne		:Diskc	one
# of Freqs		:44					# 5	Scanr	ning	Ho	ours	:24	
Loop Time		:0.39	9 Sec				Fi	le					
Name	:airv	u900a	a-1999	9112	24.6	esn							
SCOMS ID		:0					MS	ID				:0	
Report Date	2	:18-0	02-200	00			Aut	chor				Robin	Jackman
Frequency	Peak Hr	(00 10	20	30	40	50	60	olo	Tł	nresho	old	
118 35000	09-10		 * * * * * *	 : * *					 37	0	dBuV		
118 70000	22-23		* * * * * *	* *					34	0	dBuV		
119 30000	20-21		* * *						13	0	dBuV		
119.77500	19-20	ċ	* * * * * *	* *					32	0	dBuV		
121.30000	08-09	ż	* * * * * *	* * *	* *				47	3	dBuV		
124.47500	18-19	÷	* * * * * *	* * *	•				42	2	dBuV		
124.67500	07-08	ć	* * * * *						22	0	dBuV		
124.92500	17-18	ć	* * * *						16	0	dBuV		
125.40000	08-09	ć	* * *						12	0	dBuV		
125.77500	15-16	ŕ	* * * * * *	r					28	0	dBuV		
127.00000	07-08	ć	* * * * * *	* * *					36	0	dBuV		
127.57500	17-18	ć	* * * * * *	* *					30	0	dBuV		
128.27500	15-16	r	* * * * *						23	0	dBuV		
128.80000	18-19	ć	* * * * * *	* * *	r				42	0	dBuV		
132.47500	07-08	ć	* * * * *						24	0	dBuV		
132.57490	19-20	ć	* * *						12	0	dBuV		
132.80000	19-20	ŕ	* * * * * *	* * *	* * *	* * *			67	0	dBuV		
133.30000	13-14	ŕ	* * * * *						24	0	dBuV		
133.40000	20-21	ŕ	* * * * * *	r					26	0	dBuV		
134.57500	07-08	5	* * * * *						21	0	dBuV		
134.92500	09-10	ć	* * * * *						24	0	dBuV		
135.05000	07-08	5	* * *						13	0	dBuV		
135.30000	15-16	7	* * *						13	0	dBuV		
135.62500	15-16	ć	* * * * * *	* * *	r				41	0	dBuV		



Example of Channel Amplitude Histogram Report

Aerosystems International Inc Channel Amplitude Histogram Report

Re Pe Fi Lo Re	egio eak ece: of cop COM	on toring Date Hour iver Name uency Fregs Time S ID rt Date	:TCI :24-11-1999 :08-09 :CRC DAS :121.3000 MHz :44 :0.39 Sec :0 :18-02-2000	Monitoring Monitoring Peak Value Antenna Na Threshold # Scanning File Name MS ID Author	Site Time me Hours	: PROVO :00:00 - 23:59 :28 Min (47%) :Diskcone :3 dBuV :24 :airvu900a-19991124 :0 :Robin Jackman
1	L00	Į				
	80	 				
	60					
	50					
	40					
	30					
	25	 				
00	20					
S A	15					
M P T						
L E S	10					
	5					
	3					
	2					
	1		l			
	0	 -		 	-	
		-20 -12 0	12	36	60	90



Aerosystems International Inc.



TestEquity LLC 2450 Turquoise Circle Thousand Oaks, CA 91320-1200

http://www.testequity.com

Certificate of Traceable Calibration

Report Number:	N138073A (Page 1 of 2)
Manufacturer:	Agilent/HP
Model Number:	8594E/010/041/101/119/130
Description:	SPECTRUM ANALYZER
Serial Number:	3624A03258
Procedure:	CAP-859XXX,OEM's (a),OEM's (m)
Received Status:	In Tolerance
Returned Status:	In Tolerance
recommend comment	

TestEquity LLC Prepared for: 2450 Turquoise Circle Thousand Oaks, CA 91320

Report Date: 2006-08-18 2006-08-18 Cal Date: Date Due:*

Technician:	ND
Temperature:	22 ° C
Humidity:	38 % RH

TestEquity LLC certifies that at the time of shipment the above listed instrument meets or exceeds all published restigative LLC certrices that at the time of singlineit the above fisted instrument increas of exceeds at plottstated specifications. It has been calibrated using standards with accuracies that are traceable to the National Institute of Standards and Technology (NIST) or other national laboratories, as well as MIL-STD-45662A and ANSI/NCSL Z540-1-1994. Accuracies have been derived from accepted values of physical constants, or have been derived by ratio type of self-calibrating techniques.

This certificate shall not be reproduced, except in full, without written consent of TestEquity LLC Unless otherwise indicated in the remarks section, calibration was performed in accordance with published specifications.

Customer Use Only: *The original equipment manufacturer's recommended calibration interval of this instrument is (12) months. If required by the customer's quality system, a method to record when the instrument is activated into service is provided as follows:

Date Activated: __

Date Due: ____

Remarks:

power sweep range verified manualy

Calibration Equipment Used:

Model Description SOP 02-034 GPS REFERENCE RECEIVER 8482A POWER SENSOR E4419B DUAL POWER METER 8482A POWER SENSOR 28N50-2 50 ohm Termination

Due Date 2009-04-04 2007-06-28 2006-08-24 2007-07-05 2006-11-05

Mad de Measurement certified by:_ Metrology Technician

Original - Form 1.02a



Aerosystems International Inc.



TestEquity LLC 2450 Turquoise Circle Thousand Oaks, CA 91320-1200

http://www.testequity.com

Certificate of Traceable Calibration

Report Number:	N138073A (Page 2 of 2)	Report Date:	2006-08-18
Manufacturer:	Agilent/HP	Cal Date:	2006-08-18
Model Number:	8594E/010/041/101/119/130	Date Due:*	
Description:	SPECTRUM ANALYZER		
Serial Number:	3624A03258		
Procedure:	CAP-859XXX,OEM's (a),OEM's (m)	Technician:	ND
Received Status:	In Tolerance	Temperature:	22 ° C
Returned Status:	In Tolerance	Humidity:	38 % RH
Prepared for:	TestEquity LLC		
	2450 Theomoise Circle		

Calibration Equipment Used Cont'd

Model Description MP752A Termination 11667A POWER SPLITTER 33120A FUNCTION/ARB WAVEFORM GENERATO 11582A ATTENUATOR SET 8563E/001/006 SPECTRUM ANALYZER 53132A/124 Universal Counter

Thousand Oaks, CA 91320

Asset ID 12471 12253 12043 12317 12394 12461

Due Date 2006-11-01 2007-03-13 2007-01-14 2007-06-22 2007-03-31 2006-10-22

Metrology Technician Measurement certified by:_

Original - Form 1.02a