Interference effects into analog radios are well characterized by average interference power. On the other hand, interference effects into digital radios are characterized by peak interference power (This is not universally understood since most practical interference cases are not time varying.). As long as the interference is not time varying, the peak interference power to average desired carrier power is typically converted to an average interfering power to average desired carrier power for convenience. Digital radio interference analysis based upon average interference power will lead to unreliable results if the interference power is time varying. The worst case errors occur when the interference is the strongest (assuming time constant statistical characterization of the interference).

In addition to the above interference considerations, interfering systems with large peak to average power ratios can create a nonlinear interference effect. High peak to average interference power can cause the radios to loose carrier lock and radio frame for low average interference power. The radio clock recovery and resynchronization time and the actual methods of performance tabulation (e.g., errored-seconds, degraded minutes) must then be considered in addition to the "theoretical" interference induced error performance.

A full understanding of the interference environment is necessary to allow us the be sure our analysis methodology is appropriate.

Best regards,

George Kizer

cc:Mail for: Dave Weinreich

Subject: Minutes of 2 GHz Transition Meeting on March 10
From: Sam Nguyen 3/14/95 10:26 AM
To: Jeffrey Binckes
To: Dan Swearingen
To: Nancy Thompson at Server2
To: Jack Hannon at Server2
To: Dave Weinreich at CTS_PO4
To: Raymond Crowell at CWS-OTHER

Introduction

The meeting was attended by representatives from Columbia Spectrum Management, MSS community (AMSC, COMSAT, IRIDIUM) and Fixed Service (National Association of Broadcasters, American Petroleum Institute and Utilities Telecommunications Council).

The purpose of the meeting was to continue the exchange of information on the usage of the 2 GHz by the fixed service and the discussion on the options of relocating versus rechannelizing Electronic News Gathering (ENG) channels to accommodate MSS uplinks, plus a description of an interference model available at COMSAT for analyzing frequency sharing between MSS and fixed service.

Another topic introduced by the Chairman was the FCC Order granting the request by the MSS community to have the Comment and Reply dates of the 2 GHz NPRM extended till May 5 and June 6, respectively.

Fixed Service - Common Carrier and Private Operational Fixed

Don Campbell from the FCC informed the group that the FCC would have the database of all of the U.S. spectrum assignments from 806 MHz and above available on the Internet some time during the week of March 13. This database would be current as of February 7, 1995 in most cases. However, Campbell cautioned that some of the data (e.g. Common Carrier) might still not be as current as those available from Comsearch because of the recent backlog experienced by the FCC in updating the data and the growth in license assignments for the Common Carrier. Campbell also indicated that Bellcore, as a member of the National Spectrum Management Association (NSMA), was in the process of developing a "reader-writer" program that could be used by the Fixed Service, including Broadcast Auxiliary Service, to obtain pre-formatted information on the usage of the spectrum by the different users.

This database would be useful not only for the FS but also for the MSS in assessing the sharing feasibility between the two services. The chairman provided a description of an interference model available from COMSAT to analyze the interference from the MSS satellite downlink into the FS systems and from the FS systems into the MSS satellite uplink. The model could be configured either using data based on typical traffic levels or on real FS system locations and characteristics or on both. The critical parameters needed for the FS would be: transmit EIRP, transmit peak gain, operating bandwidths, off-axis gain pattern, path length, and required C/I criteria. The results of the runs would be statistical in nature in showing: on how often a specified interference criteria would be met, the

distribution of interference level against frequency of occurrence; and the interference level against time.

Representatives from FS (John Reardon of API and Sean Stokes of UTC) felt that the interference model seemed to be a useful tool and should be reviewed by NSMA, the technical frequency coordinator for FS, including POF and CC. Once the model had been accepted by NSMA as the analytical tool for assessing interference into FS, it could be included in the Telecommunication Standard Bulletin as a new section dealing with MSS sharing with FS. NSMA would hold its next meeting on April 25, 1995.

Broadcast Auxiliary Service - Electronic News Gathering (ENG)

Tom Lusk of Columbia Spectrum Management confirmed that the cost for retuning the ENG equipment for a 16 MHz channel bandwidth would be minimal depending on the age of the equipment. According to Lusk, the new equipment would only require a change in the EPROM of the frequency generator. Kelly Williams indicated that NAB would need to obtain a proposal from the ENG equipment manufacturer detailing the exact changes required for both old and new transmitters and receivers for further consideration of this proposal. Williams reiterated that NAB would prefer shifting the first two ENG channels to 2110-2150 MHz over COMSAT's proposal to reduce the ENG channel bandwidths or the proposal to relocate all of the ENG channels at 2 GHz to higher bands at 4.5, 7 or 13 GHz, as suggested by Motorola.

Follow-on Actions

Comsat would solicit Microwave Radio Corp., the largest ENG equipment manufacturer, to provide a cost/technical proposal for retuning the ENG channel to 16 MHz. In addition, Comsat would perform interference modeling of MSS downlink into a real FS system consisting POF and CC obtained from the FCC latest database.

The next meeting will be held at the COMSAT Conference room, 1899 "L" Street, April 10, at 1:30-3:30 pm.

AMERICAN PETROLEUM INSTITUTE

Engineering Notes

DATE: June 14, 1995

FROM: Rick Smith

RE: Analysis Concerning COMSAT's Sharing Study for Mobile Satellite Service and Fixed Service Users in the 2.1 GHz range

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A. MISSING INFORMATION

There are details missing from data presented in the Comsat analyses, and discussed in the conference call, that are significant and require further explanation. For example, a fading model was mentioned in the conference call. We would like to review the model and its applications as it relates to the study, particularly in light of the fact that the impact is profound on the accumulation of analog system noise. It is not clear to us how a fading model could have actually been applied without some presumption of the relationship between RF and baseband performance, which is in fact specific-equipment dependent.

Likewise, it is not apparent to us that worst case hits were in fact included in the data presented in the spreadsheets and plots presented. COMSAT begins to develop a "worst case" on page 5 of Appendix II in its Comments in IB Docket No. 95-18. In this "worst case" scenario, the minimum discrimination angle for which calculations are given is 10 degrees. It appears that 17.5db of "off angle" discrimination has been assumed in calculating a resulting C/I of 57.6 db. It seems to us that at some point in time a direct hit is likely to occur. The 17.5db worth of antenna discrimination would then disappear, resulting in a worst case C/I of 40db. We are concerned that the simulation data does not reflect any hits in the 40's or low 50's. Please explain.

In addition, it is not clear what directional characteristics COMSAT assumed for the satellite transmitting antennas. We would like to know whether some space antenna discrimination benefit was included, since the combined EIRP of +51.4dbW mentioned on page 5 of Appendix II is about 4db less than the 10 log addition of the 80ea +36.2 dbW individual carriers. Please explain.

B. MORE STUDY IS NEEDED AND STANDARDS MUST BE DEVELOPED

We believe the level of interference from MSS into FS is not so low that we can agree with COMSAT's hasty conclusion that "sharing works unconditionally." We believe that a joint industry group, such as the T.R.14-11 Committee that developed Annex F of Bulletin 10-F for PCS coordination, is needed to properly study the feasibility of MSS/FS sharing and to develop any necessary interference and coordination standards.

Although the ITU and CCITT have established some minimum performance objectives for terrestrial microwave radio, and some of these standards have been incorporated into the FCC's Part 25 satellite rules, the issue of satellite interference into FS needs careful review. The higher power flux density levels necessary for direct communication with subscriber units, coupled with the potential for direct hits related to non-geosynchronous operation has changed the interference paradigm. The notion that problems have been nonexistent, or manageable, under the current Part 25 rules may be insignificant because limits were generally not pushed by geosynchronous satellites.

Guidelines are necessary to establish what is an acceptable amount of frequency protection, and to establish a calibration point for establishing responsibility in cases where buyouts become necessary.

C. FS INTO MSS INTERFERENCE POTENTIAL NEEDS TO BE DISCLOSED CONCURRENT WITH ADVANCING THE IDEA OF MSS INTO FS INTERFERENCE

While we are confident Comsat has spent many long hours devising schemes to reduce the effect of FS interference into MSS subscriber units, interference problems for MSS subscribers are inevitable. COMSAT has explained that the marketing impact of interference problems in urban areas is minimal. Many other, less expensive ways exist to make telephone calls, such as cellular, SMR, etc. These are the facilities most people would be using as a first choice over MSS. Nevertheless, MSS is purported to be a "world-wide" service. The average consumer may find it difficult to understand why it doesn't work in places like Los Angeles, California. A deliberate effort must be made to manage expectations should a decision be made to go ahead with MSS/FS sharing. This issue needs to be accurately disclosed for the FCC, investors, and consumers.

During our conference call, it was mentioned that subscriber units will be able to change frequency by over 1 MHz to "get out of the way" of a nearby FS system. It is important to keep in mind that in other countries, such as Canada, FS systems in the 2.1 GHz range may be licensed for bandwidths much greater than 800, 1600, or 3500 kHz.

D. SUMMARY

API is not persuaded by COMSAT's study that MSS/FS sharing is feasible in the 2.1 GHz range. API believes additional studies must be performed by industry groups with access to all necessary software and data, including any and all assumptions to made. API is also concerned that real problems exist for FS-into-MSS interference, and hopes that this issue can be addressed concurrently. API is concerned that consumers and the FCC not be misled about the level of interference from FS into MSS facilities. These issues must be fully disclosed before investment decisions are made and expensive MSS space segments are launched and placed in operation.

CREATING NEW TECHNOLOGY BANDS FOR EMERGING TELECOMMUNICATIONS TECHNOLOGY

Office of Engineering and Technology

OET/TS 92-1

EXCERPT FROM: "CREATING NEW TECHNOLOGY BANDS FOR EMERGING TELECOMMUNICATIONS TECHNOLOGY," OET/TS 92-1 JANUARY, 1992

TABLE 1: STATISTICAL DATA FOR 2 GHz BANDS

BAND	RADIO SERVICE	LICENSEES	FACILITIES	CHANNEL BW	AVG. PATH LENGTH	Types of Uses	Sample Licensees
1850-1990 MHz Private Radio Services	Local Gov't, including Public Safety	168	2011	5 MHz 10 MHz	19.8 miles	Fixed Point to Point Control, Voice & Data	LA Sheriff, State of Florida, City of Dallas
	Petroleum	67	2487				Shell, Chevron, Exxon
	Power	164	3197				Georgia Power, Dairyland Power Cooperative, Interstate Power
	Railroads	18	895				Union Pacific, Burlington Northern, Missouri Pacific
	Others	143	668				Citibank, Hewlett-Packard, Procter and Gamble
1990-2110 MHz Broadcast Services	Broadcast Auxiliary	916	7359	17 MHz	30.4 miles (fixed)	Fixed and Mobile Broadcast Auxiliary - STL, ICR & BAS	ABC, CBS, NBC, Westinghouse
2110-2130/ 2160-2180 MHz Common Carrier Services	Telephone/ Cellular Paging	481	6823	3.5 MHz	17.9 miles	Fixed Point to Point Cellular call to bus & local telephone remote to bus One-way Paging	Southwestern Bell, U.S West, McCaw, GTE
2130-2150/ 2180-2200 MHz Private Radio Services	Local Gov't, including Public Safety	549	4052	0.8 MHz 1.6 MHz	15.1 miles	Fixed Point to Point Control, Voice & Data	Commonwealth of Pennsylvania, State of California, Commonwealth of Virginia
	Petroleum	111	2933				Mobil, Amoco, Arco
	Power	258	3521				Pacific Gas and Electric, Southern California Edison, Allegheny Power
	Railroads	24	991				Atchison Topeka and Santa Fe Railway, CSX, Denver and Rio Grande Western
	Others	363	1538				Motorola, University of Maryland, Norstar bank
2150-2160 MHz Common Carrier Services	Multipoint Distribution	65	163	6 MHz	NA	Point to Multi-point Video Distribution (Wireless Cable)	Microband, Contemporary, Broadcast Data

EXHIBIT ONE

INTERNATIONAL TELECOMMUNICATION UNION
RADIOCOMMUNICATION SECTOR

Conference Preparatory Meeting

CPM Report on technical, operational and regulatory/procedural matters to be considered by the 1995 World Radiocommunication Conference

GENEVA, 1995

1.4.13 Summary of sharing constraints

Table 6 summarizes technical and operational constraints on MSS arising from co-primary (allocations in Article 8 table) sharing between MSS and other services. All of the subject sharing situations are subject to further study.

TABLE 6

General estimate of the feasibility of sharing between the MSS and other services in the range 1 - 3 GHz

Service sharing with MSS	Feasibility of sharing with MSS (Earth-to-space)	Feasibility of sharing with MSS (space-to-Earth)
Radiolocation	Moderate	Not applicable
Fixed	Poor	Moderate-Poor
Mobile Aeronautical (Telemetry)	Not applicable	Poor
Mobile (FPLMTS)	Poor	Moderate-Poor
Other Mobile	Poor	Moderate-Poor
Meteorological-Satellite (space-to-Earth)	Moderate-Good*	Not applicable
Meteorological Aids	Under Study	Not applicable
Aeronautical Radionavigation (satellite-based)	Under Study	Not applicable
Aeronautical Radionavigation (terrestrial-based)	Moderate	Not applicable
Radiolocation	Not applicable	Poor
Space Operation	Not applicable	Good
Fixed-Satellite	Moderate	Moderate
* Studies on sharing conditions are ongoing (see § 1.4.3)		

Legend:

Good: For diverse mobile-satellite systems, sharing of frequency bands is possible between services provided in the same or nearby geographic areas.

Moderate: Technical standards may be needed to enable sharing between stations located in nearby-to-distant geographic areas or orbit locations and the capacity for mobile-satellite systems would likely be quite limited (feasibility is highly dependent on the deployment of systems in the other service).

Poor: Sharing is impractical, i.e. little if any useful capacity would be obtained for mobile-satellite systems even with large distance or orbital separations between stations.

Figure 1

FCC's Proposed Re-allocation of 2 GHz Bands