CARS BAND CONGESTION

John P. Wong

CARS Microwave Branch
Cable Television Bureau
Federal Communications Commission

ABSTRACT

Cable systems operators are discovering that it is getting more and more difficult to locate spectrum space in the Cable Antenna Relay Service (CARS) band. With the advent of 400 MHz plus broadband technology, the CARS band is saturating at an alarming rate. Practically all of the newer and more sophisticated cable television systems make extensive use of CARS microwave in order to bring in a wider variety of programming. At this point in time, many of the urban and large suburban areas of the country are being wired for cable. The entry of cable into the cities further congest the already crowded CARS band around the metropolitan areas.

The CARS microwave band allocation scheme, as it exists today, simply cannot accomodate the needs of the cable industry. This paper will suggest an interim solution to help ease the existing CARS band congestion problem. In addition, the author will discuss some of the future possibilities for CARS band users.

INTRODUCTION

One of the biggest problems confronting the cable television industry today is the shortage of channels in the CARS microwave service. The escalating use of CARS band channels by cable system operators in lieu of trunk cable to deliver the various forms of programming has almost evaporated the available spectrum in many parts of the country. Recent technological advancements in coaxial cable channel capacity followed by improvements in microwave equipment design have manifested the wide spread use of large segments of the CARS band by individual cable systems.

As the CARS band saturates, cable television system engineers are beginning to realize the scarcity of channels in the CARS spectrum. They are discovering the increasing difficulties of locating vacant channels in the band. The possibility of frequency interference to existing authorizations are more probable than ever before. And the expenses associated with spectrum search have skyrocketed.

No longer can cable operators simply request frequencies from the Federal Communications Commission (FCC) in the CARS band without extensive interference studies. Advance consultations with neighboring cable systems as well as broadcasters are required since the FCC does not coordinate frequencies for the applicants.

In order to conserve the present CARS band frequency spectrum, collaboration between companies is more of a necessity than ever before, a wiser utilization of the microwave service is a requirement, and other alternatives must be considered. To facilitate for more efficient spectrum usage, choosen industry representatives must attempt to search and to provide for solutions.

Whatever the future of the CARS band maybe, the use of the CARS band frequencies should be created as a privilege and not a right. Finally, the electromagnetic spectrum, of which the CARS band is a part, is a non-renewable resource and ought to be treasured as such.

FCC REGULATIONS

The regulations governing the utilization of frequencies within the CARS band are listed under Part 78 of the FCC's Rules and Regulations (47 CFR 78). Incorporated in this part are the designated frequency channel assignments (47 CFR 78.18) within the frequency band from 12.70 to 13.20 GHz. The breakdown of the band is as follows:

1) Frequencies from 12.70 to 13.20 Ghz are shared between Cable Television System operators and Television Auxiliary Broadcast Stations.

2) Frequencies from 12.70 to 12.75 Ghz are shared with Fixed-Satellite Services.

3) Frequencies within the band from 13.15 to 13.20 GHz are reserved exclusively for the assignment of CARS pickup and Television pickup stations on a co-equal basis within a fifty kilometer radius of each of the top 100 television markets as listed in Section 76.51 of the Commission's Rules (47 CFR 76.51).

The frequency channel assignments for CARS stations are:

1) For FM transmission, allocated are three groups of channels with varying frequencies and differing bandwidths of no more than 25.0 MHz. There are 20 Group A channels, 20 Group B channels and 40 Group K channels. Channels assigned to Groups A and B have bandwidths of 25.0 MHz and Group K channels have bandwidths of 12.5 MHz. Corresponding Group A and Group B channels overlap and are separated by ascending bandwidths 12.5 MHz. Group A and Group K channels also overlap. Two Group K channels correspond to one Group A channel (e.g. the channel boundary of Channel AØ1 is 12.700 - 12.725 GHz, and the channel boundaries for Channels KØ1 and KØ2 are 12.7000 - 12.7125 and 12.7125 - 12.7250 GHz respectively).

2) For vestigial sideband AM transmission (AM) , assigned are four channel groups with bandwidths of 6 MHz or less. There are 42 Group C channels, 42 Group D channels, 42 Group E channels, and 32 Group F channels. Group C and Group D channels overlap and the respective channels in each group are separated by ascending bandwidths 59.2 MHz. Group E and Group F channels also overlap and their respective channels are separated by ascending bandwidths of 60 MHz. Because the fourth and the tenth channels in each AML group are intended for the transmission of pilot subcarriers and narrow band signals, they are allotted bandwidths of 4 MHz and 2 MHz respectively.

The above listed channel assignments are applicable only to CARS stations located outside the 50 kilometer perimeter of the top 100 markets. For CARS stations located with the radii of the delineated television markets, the number of usable CARS band channels are reduced to 18 Group A and Group B channels, 36 Group K channels, 33 Group E channels and 23 Group F channels. This condition further congests the spectrum around the major metropolitan areas.

In order to promote for more efficient use of the spectrum in the CARS band, the FCC incorporated numerous provisions into its rules encouraging spectral conservation measures. These provisions are as follows:

1) Applicants are required to justify the use of microwave channels over trunk cable.

2) Applicants of CARS fixed stations using FM transmission are encouraged to conserve spectral space by alternating Group A and Group B channels such that the adjacent radio frequency (RF) carriers are located 12.5 MHz apart.

3) Applicants for CARS stations are encouraged to apply and fill adjacent channels.

4) Applicants for CARS stations cannot utilize a channel that has a bandwidth greater than 12.5 MHz if the path length is less than ten miles unless sufficient justification is shown.

5) Applicants for Group K channels shall apply for adjacent channels and the requested channels shall overlap the least possible number of Group A channels unless sufficient cause if submitted.

6) Applicants are encouraged to coordinate the proposed frequencies with existing users and other applicants in area.

7) Transmitter peak output power levels are limited to less than 5 watts per channel.

8) Applicants are required to use antenna systems that comply with the Commission's established antenna standards in Section 78.105 of the FCC's Rules (47 CFR 78.105).

Also established in the FCC's Rules are various interference considerations for the CARS service band. They are:

1) Applicants are responsible for the selection of assignable frequencies which will be the least likely to result in interference to other licensees.

2) Applicants shall take full advantage of the latest state-of-the-art technologies to prevent interference to existing users.

3) All applicants, permittees and licensees are expected to cooperate fully and make reasonable efforts to resolve technological problems and conflicts that may prevent the most effective and efficient use of the band. The Commission will intervene only as a last resort.

TECHNOLOGICAL DEVELOPMENTS

The exponential growth of the cable industry fueled by recent technological developments will place an even greater pressure on the users of the CARS band. High capacity trunk cable, interactive cable television, teletext, line sync multiplex technique for data transmission, VHF FM data modems

and high definition television are some of the latest developments. To win franchises, cable system operators are compelled to propose maxima services the present state-of-the-art equipment can tolerate. These proposals almost inevitably place a heavy reliance upon the extensive use of the CARS band frequencies. With few exceptions, a large sophisticated cable system cannot be constructed without the wide-spread use of microwave. A typical downstream programming proposal for a 54 channel cable system will require approximately two-thirds of the 80 AM channels in the CARS band. That same proposal will span across three CARS channel groups usually using Channels CØ1 - C42, D33, EØ1 - EØ9 (note, if Harmonically Related Carriers (HRC) or Incrementally Related Carriers (IRC) are used, the Channels CØ4 - CØ9, D33, and EØ4 - EØ9 will be offset from their standard designated channel boundaries.). If upstream paths are also used, perhaps as many as 10 - 12 FM (Group K) or AM (Group E) channels will also be taken up. As one can see, once such a sophisticated cable communications system is constructed, the use of the CARS band in the area will be rendered almost inaccessible to other future users unless enormous coordination and collaboration efforts are made.

CARS FREQUENCY USAGE

The cost-benefits, the topographical requirements, the geo-political restrictions, the convenience as well as the explosion in satellite cable programming has drastically increased the usage of CARS microwave.

A statistical study of CARS band applications indicated that in the year 1977, there were little over eight hundred CARS band applications on file with the Commission. While in the year 1981, that number had more than doubled to approximately seventeen hundred applications. Comparing the same time periods, there were a seven-fold increase in the number of applications requesting 20 or more CARS band channels. In 1977, less than ten applications requested the use of more 20 channels whereas in 1981, that number had increased to approximately sixty. During the five year span from the year 1977 to the end of 1981, the number of CARS authorizations issued by the FCC has increased from about 900 to over 2200.

According to the 1981-82 Television Factbook, in 1980, the number of cable systems in the United States amount to about 4200. Comparing the number of CARS authorizations to the number of cable systems, only approximately half of the systems are presently using CARS microwave. Therefore, a potential for a doubling in users is likely.

Enormous the numbers may seem, we still have not consider future industry growth. Until now, the majority of the industry growth has mainly occurred outside of the large cities. The largest cities, such as New York, Los Angeles, Chicago, Philadelphia, Boston, etc., are still either completely unbuilt for cable or just underway. If past reliance upon the use of the CARS band is a trend. Then an even-more substantial expansion in use of the CARS band is imminent.

MAXIMIZING CARS CHANNEL USAGE

CARS band usage in areas surrounding eighteen of the top twenty five major television markets are saturated or are close to being saturated and cable operators in those areas are confronted with acute interference problems. To facilitate for more efficient utilization, cable companies will have to coordinate with each other. At the present time, coordination groups have been formed or are being formed around the various larger suburbs (New York, Los Angeles, San Francisco, Denver, etc.). The metropolitan New York area, one of the most congested locations in the country, is a prime example of coordination efforts at work. Because the different operators are willing to "talk" to each other, willing to coordinate before adding on new channels, willing to install frequency selective equipment, and are willing to cost-share the expenses, they are all using the CARS frequencies in that area with minimal interference to each other.

Another method to maximize channel usage is to minimize channel use redundancy, this can be accomplished by the use of interconnects between systems. Although one of the original intents of interconnection is to take advantage on the advertising time on local origination channels, a side benefit is the elimination of the redundant use of CARS channels. Interconnects has been operating in various parts of the country including the San Francisco Bay area, the New England area, and the New York Metropolitan area. To promote for more efficient usage, coordination and interconnection can alleviate some of the frequency congestion pains suffered by cable systems operators.

SUGGESTED INTERIM SOLUTIONS

To assist in easing the present congestion problems, the following measures are suggested:

1) Coordination between cable companies before the addition of new CARS channels.

2) Collaboration between cable operators to reduce the probability of frequency interference.

3) Cooperation to maximize CARS spectrum use.

4) Interconnection to reduce channel use redundancy.

5) Selection of higher performance antenna equipment to minimize frequency interferences.

6) Strict adherence of the Commission's guidelines which promote for more efficient channel use and less user interference.

FUTURE OF CARS BAND

The CARS spectrum can only accomodate a limited number of users. And the recent Commission decision to allow the use of the CARS band by Low Power Television (LPTV) operators,on a secondary basis, will exacerbate the present problems. With the possible influx of thousands of additional users (over 6500 applications for LPTV so far), interference within the band is more likely to occur. Expansion of the band into other areas of the microwave spectrum is one of the future solutions.

CARS band equipment manufacturers are or will be capable of making available equipment in the 18 GHz area. As a matter of fact, AML equipment has been originally proposed for and experimented at the 18 GHz area. If the microwave band segment between 17.7 GHz and 19.7 GHz are wholly allocated to CARS users, there can be a possibility for an increase of over 330 - 6 MHz AM channels. A major CARS equipment manufacturer has requested a minimum of 160 AM channels in that area to be alloted for CARS and Broadcast Auxiliary use. Unfortunitely, at this time, no portion of the mentioned spectrum is allocated specifically for CARS use (refer to General Docket No. 79-188, RM-3247, RM-3497). The number of comments filed by the cable industry and CARS equipment manufacturers requesting assignment of the 18 GHz area for CARS use has been disappointing (about 5). Such a lack of interest from the industry can only lead to a conclusion of indifference for CARS expansion in that area. It is apparent that the industry may want to or will be forced to look elsewhere for alternate solutions.

CONCLUSION

The CARS band is congested and will be more so as time goes by. In this era of "Unregulation" the FCC can only oversee and provide limited guidance to the industry. It is the ultimate responsibility of the cable television industry to provide for solutions upon which the future usage of the CARS band is dependent.

ACKNOWLEDGMENT

The author is grateful to Mr. Clifford H. Paul of the FCC for his guidance and assistance in the preparation of this paper.

Note: Opinions and suggestions which were discussed in this paper were those of the author alone, and did not necessarily represent the position of the Federal Communications Commission.