ORIGINAL FILE

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Redevelopment of Spectrum to Encourage Innovation In the Use of New Telecommunications Technologies	)	ET Docket No. 92-9
	)	
	)	RM-7981
	)	RM-8004

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Comments of the
Telecommunications Industry Association
Fixed Point to Point Communication Section

The Telecommunications Industry Association ("TIA") is a membership organization representing over 500 manufacturers of equipment used by all sectors of the communications industry. The TIA Fixed Point to Point Communications Section is the major industry group representing fixed point to point microwave manufacturers. The TIA Fixed Point to Point Communications Section* is pleased to submit these comments on behalf of its membership in the above-captioned Further Petition for Rule Making.

Respectfully submitted,

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December 11, 1992

* Alcatel Network Systems does not concur with the consensus expressed in these Comments.

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SUMMARY

TIA applauds the Commission's initiative to redevelop expeditiously spectrum for emerging technologies and commends the Commission's effort to create a technical and regulatory environment that will facilitate the transition of current users of the 2 GHz band to the 4, 6, 10, and 11 GHz bands. While TIA supports the Commission's proposal with respect to 1) dropping voice channel loading requirements and analog performance standards and substituting minimum digital system loading requirements, 2) minimum path lengths, 3) antenna characteristics, 4) emission and bandwidth limitations, 5) frequency diversity, and 6) automatic power control, TIA strongly believes that certain modifications to the proposed rules must be adopted to further the public interest goals of maximizing spectrum efficiency and utilization, facilitating the orderly migration of displaced 2 GHz users, minimizing the adverse impact to new and existing licensees and maintaining industry competitiveness. In TIA's view, these public interest goals must be met in order to protect existing microwave users in the relocation process and facilitate the rapid and efficient introduction of emerging technologies.

Specifically, TIA recommends that the Commission 1) modify the channel plan to incorporate 1.25 MHz channelization (rather than 1.6 MHz channels) and eliminate the proposed 400 and 800 kHz channels, 2) modify the narrowband and wideband channels in the lower 6 GHz band, 3) make high capacity allocations available in the 4 GHz band by increasing maximum bandwidths to 40 MHz, 4) make available a range of wideband and narrowband channels in the 11 GHz band, 5) require substantial justification for the

assignment of 15 GHz and below wideband channels (i.e., 10 MHz and greater channel bandwidths), 6) phase-in efficiency standards for digital microwave equipment, 7) establish identical interference protection criteria and coordination procedures for both private and common carrier systems, and 8) accelerate negotiations toward final arrangements with NTIA to establish terms for non-government licensee access to the 1.7-1.85 and 3.6-3.7 GHz bands.

TIA's modification proposals are designed to facilitate, not forestall the Commission's efforts to clear the 2 GHz band for emerging technologies as quickly as possible. TIA firmly believes that adoption of its proposed modifications in addition to the other technical rules proposed by the Commission will create the appropriate technical and regulatory environment to facilitate the orderly relocation of current users of the 2 GHz band to higher frequency bands. Indeed, TIA urges the Commission to expeditiously resolve these issues so that its members may undertake the necessary steps to begin manufacturing new equipment quickly for the displaced 2 GHz users.

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Technologies	)	RM-8004
	)	

COMMENTS OF THE
FIXED POINT-TO-POINT COMMUNICATIONS SECTION
OF THE TELECOMMUNICATIONS INDUSTRY ASSOCIATION

The Telecommunications Industry Association's Fixed Point-to-Point Communications Section ("TIA") hereby submits its comments in response to the Further Notice of Proposed Rule Making, released September 4, 1992, in the above-captioned proceeding (the "Notice"). Although the TIA generally supports the Commission's proposal to revise Parts 21 and 94 of the Commission's Rules to accommodate fixed microwave users relocating to higher frequency bands, it strongly recommends that certain modest changes be made to the proposed channelization plan and technical rules. These modifications are consistent with the TIA's full support of the Commission's expeditious redevelopment of spectrum for emerging technologies.

INTRODUCTION AND BACKGROUND

TIA is the principal industry association representing fixed point-to-point microwave manufacturers. TIA's members serve, among others, companies licensed by the Commission to use the 2 GHz private and common carrier bands to provide important and essential telecommunications services, including telephone companies, utilities, railroads, state and local governments, and cellular carriers. As a result of the Commission's recent reallocation decision in this docket, TIA members' 2 GHz user customers will be required to relocate to higher frequency bands to clear spectrum for an emerging technologies reserve band. TIA's members, as suppliers to the large and important 2 GHz market, are thus greatly concerned that the 2 GHz user relocation is accomplished in a manner that does not impair competition in the fixed microwave equipment market (and thus users' choice among diverse vendors and products), waste valuable spectrum, or unnecessarily increase user costs.

TIA urges the Commission to adopt channelization plans and technical rules for the higher frequencies -- including the specific modifications and additions proposed herein -- as expeditiously as possible so that fixed microwave manufacturers can quickly develop products to accommodate 2 GHz users who have migrated to higher frequency bands. The public interest requires that the Commission adopt technical standards and procedures that will permit an orderly, efficient transition of existing 2 GHz users to higher frequency bands shared between private and common carriers. It is also important that the technical plan adopted in this proceeding to govern the shared private and common

carrier use of higher bands sufficiently accommodates the increased demands for those bands.

Although the TIA supports the Commission's objective to facilitate the introduction of new emerging technologies in this and other proceedings, it is imperative that the Commission recognize that the channelization and other technical rules for the replacement bands established in this proceeding are critical to the existing microwave equipment industry and microwave users. To assist the Commission in adopting appropriate technical rules, TIA's members have carefully studied the Commission's proposal and support the majority of the proposed rule changes set forth in the Notice.[1/] The TIA members have concluded, however, that certain modest rule changes should be made. These modifications, if adopted, will not only maximize spectrum utilization and the orderly migration of displaced 2 GHz band users, but also will minimize the adverse impact to new and existing licensees, while maintaining industry competitiveness. Accordingly, TIA's proposed modifications will further the Commission's twin goals of protecting existing microwave users in the relocation process and facilitating the rapid and efficient introduction of emerging technologies.

To achieve those objectives, TIA specifically recommends that the Commission

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[1/] In particular, TIA supports the Commission's proposal with respect to (1) dropping voice channel loading requirements and analog performance standards and substituting minimum digital system loading requirements; (2) minimum path lengths, (3) antenna characteristics; (4) emission and bandwidth limitations; (5) frequency diversity; and (6) automatic power control.

adopt the following rule changes:

- Modify the channel plan to incorporate 1.25 MHz channelization (rather than 1.6 MHz channels) and eliminate the proposed 400 and 800 kHz channels;
- Modify the narrowband and wideband channels in the lower 6 GHz band;
- Make high capacity allocations available in the 4 GHz by increasing maximum bandwidths to 40 MHz;
- Make available a range of wideband and narrowband channels in the 11 GHz band;
- Require substantial justification for the assignment of 15 GHz and below wideband channels (i.e., 10 MHz and greater channel bandwidths);
- Phase-in efficiency standards for digital microwave equipment;
- Establish identical interference protection criteria and coordination procedures for both private and common carrier systems; and
- Accelerate negotiations toward final arrangements with NTIA to establish terms for non-government licensee access to the 1.7-1.85 and 3.6-3.7 GHz bands.

I. THE PROPOSED CHANNELIZATION PLAN SHOULD BE MODIFIED

TIA agrees with many of the elements of the channelization plan proposed in the Notice, but wise spectrum management requires that the Commission adopt certain specific modifications to the proposal. To assist the Commission in adopting an appropriate channelization plan that will meet user needs while addressing the Commission's spectrum conservation goals, TIA attaches hereto as Appendix A, a

detailed channelization plan for the 4 GHz, 6 GHz, 10 GHz and 11 GHz bands identified in the Notice. The principal features of this plan are discussed below.

A. A Channelization Plan Based on 1.25 MHz Channels Serves the Public Interest by Promoting Efficient Use of Scarce Spectrum and Utilizing Manufacturers' Existing Capabilities

TIA believes that the important public interest in promoting greater spectrum efficiency and better utilization of the present capabilities of the majority of equipment manufacturers dictates that the Commission adopt certain modifications to its 1.6 MHz-based channelization proposal. Specifically, TIA believes that a 1.25 MHz-based channelization plan is superior to the proposed plan because 1.25 MHz channels can be easily "stacked" to accommodate standard larger bandwidth channels[2] (e.g., 5, 10, 30 MHz) without any waste of valuable spectrum. In contrast, narrowband channels in a 1.6 MHz-based plan cannot be easily multiplied into 5, 10, 30 MHz standard bandwidth channels without inefficiently leaving spectrum "remnants." That is, under a 1.6 MHz-based channelization plan, 1.6 MHz narrowband channels multiplied into a 30 MHz

[2] This channelization proposal is consistent with the Commission's proposal to use 30 MHz, rather than 29.65 MHz, wideband channels in this band.

channel would waste the following amounts of spectrum:

Channel Bandwidth	# of Freq. Pairs	Wasted Spectrum
0.8 MHz	37	0.4 MHz
1.6 MHz	18	1.2 MHz
3.2 MHz	9	1.2 MHz

In contrast, no spectrum would be wasted in using 30 MHz channels under a 1.25 MHz-based channel plan:

Channel Bandwidth	# of Freq. Pairs	Wasted Spectrum
1.25 MHz	24	Zero
2.50 MHz	12	Zero
3.75 MHz	8	Zero

Based on TIA members' first-hand industry experience, following a 1.6 MHz-based plan will be certain to result in significant spectrum waste. In 1991, more than 70 percent of the 2 GHz digital microwave systems licensed used 3.5 MHz bandwidth channels. These systems, assuming comparable bandwidth needs, will use three 1.6 MHz channels (4.8 MHz) or a 5.0 MHz channel under a 1.6 MHz-based plan.

Not only would 1.25 MHz-based channel plan make good sense based on spectrum management and utilization considerations, it would also be entirely consistent with the existing channelization scheme in the other bands. Specifically, 1.25 MHz based channels correspond to the channelization plan employed for the 10 GHz band (e.g., 1.25, 2.5, 3.75, and 5 MHz). The 10 GHz narrowband channelization plan has success-

fully met the needs of microwave users operating above 2 GHz.[3] TIA believes that a similar plan will benefit the users relocated to the 6 GHz and 11 GHz bands.

B. 400 and 800 kHz Channels Should be Eliminated

TIA also recommends that the proposed 400 and 800 kHz channels be eliminated. After the migration from the 2 GHz to the higher bands, systems employing 400 or 800 kHz channels would not be cost-effective. Furthermore, the few existing users of 800 kHz analog radios in the 2 GHz band who migrate to higher microwave bands can be effectively accommodated in 1.25 MHz channels.

C. The Channelization Plan for the Lower 6 GHz Band Should Include Modified Narrowband and Wideband Options

TIA supports the Commission's proposal to incorporate ample flexibility in the channels in the 5.925-6.425 GHz ("lower 6 GHz") band by creating additional narrowband channel options. TIA recommends, however, that the Commission adopt certain modifications to its proposal for this band including, as discussed above, a rechannelization plan based on 1.25 MHz narrowband channels. Specifically, TIA proposes that the Commission's channelization plan for the lower 6 GHz plan include multiple 1.25, 2.5 and 3.75 MHz channels (rather than the .4, .8, and 1.6 MHz channels). TIA also proposes that several standardized 15 MHz channels be added to the 10 and 30 MHz channels proposed in the Notice.[4] Numerous displaced 2 GHz users are likely

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[3] Footnote 1 of the attached channelization plan states that narrowband channels in the upper 6 GHz band should be used before the narrowband channels in the lower 6 GHz band to preserve use of the 30 MHz channels in that band.

[4] These 15 MHz channels would be phased out after the bit efficiency transition period. TIA proposes a five year transition period.

to seek to relocate to this band for economic and technical reasons. The Commission will encourage greater utilization of this band by making a broad range of narrowband and wideband channels available and, as discussed above, adopting a 1.25 MHz-based channel plan for the 6 GHz and other bands identified in the Notice.

D. 40 MHz Channels Should Be Created in the 4 GHz Band

TIA proposes rechannelizing the 4 GHz band to incorporate 40 MHz wideband channels using the existing 20 MHz channel plan and stacking to increase spectral usage. TIA's members believe that the 4 GHz band is not the preferred frequency location for displaced narrowband 2 GHz users due to the potential for interference with satellite operations. Further, manufacturers are unlikely to produce equipment suitable for use in the 4 GHz band with a 40 MHz transmit/receive spacing that virtually precludes cost efficient narrowband use. Consequently, most fixed users will look to available spectrum in the 6 GHz, 10 GHz and 11 GHz bands. Nonetheless, TIA believes that wideband channels should be made available in the 4 GHz band to encourage radio use for future broadband network services.

E. A Range of Wideband and Narrowband Channels Should be Available in the 11 GHz Band

In addition to adopting a 1.25 MHz-based channel plan and maintaining the 40 MHz channels, TIA believes that the Commission will further more efficient spectrum utilization while serving the often diverse needs of fixed users by adopting a channel plan for the 11 GHz band that makes available a broad range of narrowband and wideband

channels.[5] TIA specifically recommends a channel plan for the 11 GHz band that makes the following channels available:

Bandwidth	No. of Channels Available
40 MHz	11
30 MHz	12
20 MHz	22
10 MHz	47
5 MHz	19
3.75 MHz	24
2.5 MHz	38
1.25 MHz	76

In contrast to the Commission's proposal to adopt only 10 MHz and 30 MHz channels in this band, TIA's proposed channel plan set forth above will permit users with diverse bandwidth needs to use 11 GHz frequencies without wasting spectrum. TIA's proposed changes to the 11 GHz plan will therefore achieve better spectrum utilization.

II. WIDEBAND CHANNELS UNDER 15 GHz SHOULD BE LICENSED ONLY UPON A SHOWING OF NEED AND SUBJECT TO STRICT IMPLEMENTATION REQUIREMENTS

While TIA believes that a number of wideband channels should be made available in the frequency bands below 15 GHz to accommodate high capacity systems, such channels should not be routinely assigned. Efficient spectrum management will become more important as demand for frequencies below 15 GHz increases as a result of the relocation of 2 GHz users. Given the competing demands for scarce spectrum, applicants for wideband channels (10 MHz and above) in the frequency bands below

[5] The proposed channelization is modelled after the lower 6 GHz band (e.g., two wideband channels have been subdivided into narrowband channels).

15 GHz should be required to justify their requests. Specifically, wideband applicants in these bands should be required to (1) demonstrate that their system requirements cannot be satisfied with narrow channels, and (2) submit a channel capacity implementation plan showing that at least 50 percent of the initial capacity of the wideband channels will be used upon licensing. TIA recommends that the Commission implement these requirements by requiring Part 94 applicants whose proposals are based on reselling excess capacity to submit contracts demonstrating the demand for, and the proposal to sell, such excess capacity. Operations licensed prior to the enactment of these new regulations would be "grandfathered" and not subject to the auditing or new loading requirements. Alternative enforcement mechanisms include allowing potential applicants to pay for a loading audit by either the Commission or "FCC certified auditors" for a final determination. Under this approach, the auditors would conduct an audit to be included in a report to the Commission of the actual usage of existing licensees.

III. NEW DIGITAL SPECTRAL EFFICIENCY REQUIREMENTS SHOULD BE PHASED IN OVER A 5-YEAR PERIOD

As the principal microwave equipment vendor association in this industry, TIA enthusiastically supports the adoption of rules that promote efficient spectrum management while meeting user needs. Accordingly, TIA agrees that minimum digital modulation requirements should be altered to reflect the need for greater efficiency. TIA believes, however, that the needs of users and equipment manufacturers would be best served by phasing in the new minimum spectral efficiency limits for digital equipment over

a 5-year period. (Under this approach, existing bit efficiency requirements would apply until the expiration of the five-year period.)

Imposing an immediate change to substantially tighter spectral efficiency requirements would render existing inventories and production lines worthless. Manufacturers, forced to play "catch up," would suffer severe economic hardships which may jeopardize competition and increase user costs. An immediate change in requirements would also place substantial financial burdens on users who would be forced to expand their existing networks employing dissimilar equipment (e.g., in purchasing extra spares early on) and threaten system reliability by requiring licensees to retrain personnel immediately. As a result, users would have to scrap equipment long before the end of its otherwise useful life.

By contrast, a five year phase-in period would not only relieve the burden on manufacturers of re-tooling, it would promote full and fair competition in the industry. A five-year transition period would allow users to maximize their current use of existing equipment and gradually expand their networks to incorporate equipment designed under the new standards.

Accordingly, TIA recommends that the following standards be incorporated in Section 21.122 of the Commission's rules:

Nominal Channel Bandwidth (MHz)	Minimum Payload Capacity (Mbits/s)	Typical Utilization
1.25 MHz	3	2xDS1
2.50 MHz	6	4xDS1
3.75 MHz	12	8xDS1
5.00 MHz	18	12xDS1
10.00 MHz	44	1xDS3/1xSTS1

Nominal Channel Bandwidth (MHz)	Minimum Payload Capacity (Mbits/s)	Typical Utilization
20.00 MHz	89	2xDS3 2xSTS1
30.00 MHz	134	3xDS3 3xSTS1/1xSTS3
40.00 MHz	178	4xDS3/4xSTS1

Microwave transmitters employing digital modulation techniques, with appropriate multiplex equipment, operating below 15 GHz and licensed five years after the enactment of these regulations, should be required to comply with these requirements. TIA also recommends that existing licensees shall be exempt (grandfathered) from complying with the new requirements during the five year transition period.

TIA proposes the above digital spectrum efficiency requirements after carefully balancing users' economic and technical considerations. Although the collective first-hand, practical industry experience of TIA's members indicates that the above plan strikes the optimal balance between these considerations, TIA would support a different efficiency plan should the Commission determine that other factors would justify different requirements, provided that they are phased-in during a five year period.

IV. THE SHARED COMMON CARRIER AND PRIVATE BANDS SHOULD BE SUBJECT TO A SINGLE TECHNICAL STANDARD AND INTERFERENCE PROTECTION SCHEME

TIA believes that the Commission must carefully develop technical rules for the replacement bands that will ensure, to the extent possible, that displaced users can operate as efficiently as possible. TIA recommends that private and common carriers be subject to the same interference standards. Based on its collective industry experience,

TIA submits that there is no significant technical or other reason to impose different interference protection standards for private and common carriers sharing frequencies on a co-primary basis. Operations in the same bands using substantially the same equipment should be accorded the same protection from interference.[6] Under this approach, both private and common carriers will be subject to the standards prescribed in Part 94. Both common and private carriers will benefit since the existing Part 94 standards have proven to provide sufficient protection and are administered by a recognized standards body, TIA, TR14.11. TIA also recommends that the existing prior coordination notice requirement in Section 21.100 of the Commission's rules,[7] be required for all users operating in the shared frequencies.

V. THE COMMISSION SHOULD DEVELOP GUIDELINES TO ADDRESS THE USE OF UNLICENSED RESERVE SPECTRUM TO ENCOURAGE BETTER SPECTRUM UTILIZATION

The Commission also solicits comments on formalizing the common practice of "reserving" channels in frequency coordination data bases for future growth. TIA believes that any "reservation" of "growth" channels should be administered by the Commission -- the entity charged by statute to determine spectrum assignments. Making initial determinations regarding the rights to "growth" channels and arbitrating disputes

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[6] The Commission has also acknowledged the growing convergence of interference standards for private and common carriers. See, Notice at para. 30. Further, imposing the same criteria private and common carrier fixed microwave applications will not complicate the Commission's application processing since Commission staff in Gettysburg now process all fixed microwave licenses.

[7] 47 C.F.R. § 21.100 (1991).

over spectrum is properly a Commission function. TIA recommends that unlicensed spectrum reserved by a user be made available for licensing by other users on a first come, first served basis upon a showing that no other channels can be coordinated. This standard will facilitate resolution of reserved spectrum channel disputes without the Commission's intervention and will foster better spectrum usage.

VI. GOVERNMENT SPECTRUM SHOULD BE MADE AVAILABLE TO ACCOMMODATE INCREASED SPECTRUM DEMAND

TIA believes that the designated spectrum above the 3 GHz band is not adequate to meet current and/or future spectrum needs of the private and common carrier microwave communication systems operating in those bands and the more than 29,000 users who will be required to migrate from the 2 GHz band. Moreover, personal communication services will likely generate substantial demands for microwave systems using higher bands to interconnect cell sites to switches. To avoid this inevitable shortage of spectrum in the bands above 3 GHz, TIA urges the Commission to aggressively pursue nongovernment access to the 1.70-1.85 GHz and the 3.6-3.7 GHz bands.

TIA is encouraged by the Commission's stated intention to initiate discussions with the National Telecommunications and Information Administration (NTIA) concerning the availability of spectrum allocated for government use. Notice at ¶¶ 20, 24. TIA firmly believes that with proper coordination, government and non-government users can happily co-exist in the 1.70-1.85 GHz and the 3.6-3.7 GHz bands. Accordingly, TIA urges the Commission to accelerate its negotiations with NTIA to facilitate non-government

access to the 3.6-3.7 and 1.70-1.85 GHz bands concurrent with the close of this proceeding.

VII. CONCLUSION

TIA commends the Commission for addressing in this proceeding the important technical issues facing 2 GHz users that will be required to relocate to higher frequencies in order to make room for services employing emerging technologies. While TIA fully supports the Commission's goals to foster introduction of emerging technology services, TIA strongly believes that the Commission must ensure that the channelization and other technical rules adopted to accommodate relocated users do not (1) undermine competition in the microwave equipment manufacturering industry, (2) waste valuable spectrum, or (3) unnecessarily increase user costs.

TIA supports most aspects of the Commission's proposed rules set forth in the Notice. Based on the collective extensive expertise and practical industry knowledge of the TIA's members, however, TIA herein strongly recommends that the Commission adopt certain specific changes to its proposed rules for the 4 GHz, 6 GHz, and 11 GHz rules that, in TIA's view, will further the important public interest goals at issue in this proceeding.

In particular, the Commission should adopt a 1.25 MHz-based channelization plan, adopt modified wideband and narrowband channel plans for these frequency bands, follow a phased approach to imposing new efficiency standards, revise the proposed interference standards and coordination procedures for the shared bands and proceed quickly to develop final arrangements for nongovernment use of government spectrum.

Provided that these modest changes are made to the Commission's proposed rules, TIA supports the Commission's proposal in the Notice and urges the Commission to complete this proceeding as soon as possible. An expeditious resolution of the issues raised in the Notice will permit equipment manufacturers to make available the necessary new products to relocated users quickly.

Dated: December 11, 1992

APPENDIX A

PROPOSED RECHANNELIZATION PLAN

PROPOSED RECHANNELIZATION SUMMARY

From (MHz)	To (MHz)	Available Bandwidth	40 MHz	30 MHz	20 MHz	15 MHz	10 MHz	5 MHz	3.75 MHz	2.5 MHz	1.25 MHz
1,850	1,990	140					7	5			
2,130	2,150	20								12 2)	24 3)
2,180	2,200	20									
2,110	2,130	20							5 1)		
2,160	2,180	20									
Displaced Channels		220		0			7	5	5	12	24
3,700	4,200	500	6		12						
5,925	5,930	5								2	4
6,175	6,180	5									
5,930	6,110	180		6		12	18				
6,180	6,360	180									
6,110	6,170	60		2		4	6	12	16	24	48
6,360	6,420	60									
6,170	6,175	5								2	4
6,420	6,425	5									
6,525	6,530	5								2	4
6,870	6,875	5									
6,540	6,570	30					3	4	4	6	12
6,710	6,740	30									
6,580	6,710	130					13	25	30	46	92
6,740	6,870	130									
Rechannelized 4 & 6 GHz		1330	6	8	12	16	40	41	50	82	164
10,550	10,615	65						13	17	26	52
10,615	10,680	65									
10,700	11,075	375	9	9	18		37				
11,230	11,605	375									
11,075	11,170	95	2	3	4		10	19	24	38	76
11,605	11,700	95									
Rechannelized 10 & 11 GHz		880	11	12	22	0	47	32	41	64	128
Total Rechannelization		2210	17	20	34	16	87	73	91	146	292

1) 3.5 MHz 2) 1.6 MHz 3) 800 KHz

3,700 - 4,200 MHz, 20.0 MHz bandwidth channels

	Transmit (receive) (MHz)	Receive (transmit) (MHz)	
1	3710	3750	
2	3730	3770	
3	3790	3830	
4	3810	3850	
5	3870	3910	
6	3890	3930	
7	3950	3990	
8	3970	4010	
9	4030	4070	
10	4050	4090	
11	4110	4150	
12	4130	4170	
13	4190	4198	1

1 Auxiliary channels available for unpaired use

3,700 - 4,200 MHz, 40.0 MHz bandwidth channels

	Transmit (receive) (MHz)		Receive (transmit) (MHz)
1	3720	. . . . .	3760
2	3800	. . . . .	3840
3	3880	. . . . .	3920
4	3960	. . . . .	4000
5	4040	. . . . .	4080
6	4120	. . . . .	4160

5,925 - 6,425 MHz, 1.25 Mhz bandwidth channels 1

	Transmit (receive) (MHz)	Receive (transmit) (MHz)
1	5925.625	6175.625
2	5926.875	6176.875
3	5928.125	6178.125
4	5929.375	6179.375
5	6110.625	6360.625
6	6111.875	6361.875
7	6113.125	6363.125
8	6114.375	6364.375
9	6115.625	6365.625
10	6116.875	6366.875
11	6118.125	6368.125
12	6119.375	6369.375
13	6120.625	6370.625
14	6121.875	6371.875
15	6123.125	6373.125
16	6124.375	6374.375
17	6125.625	6375.625
18	6126.875	6376.875
19	6128.125	6378.125
20	6129.375	6379.375
21	6130.625	6380.625
22	6131.875	6381.875
23	6133.125	6383.125
24	6134.375	6384.375
25	6135.625	6385.625
26	6136.875	6386.875
27	6138.125	6388.125
28	6139.375	6389.375