FCC MAIL ROOM

Before the
Federal Communications Commission
Washington, D.C. 20554

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In the matter of	)	
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Authorization and Use of Software Defined Radios	)	ET Docket No. 00-47
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FIRST REPORT AND ORDER

Adopted: September 13, 2001 **Released: September 14, 2001**

By the Commission:

I. INTRODUCTION

1. By this action, we amend Part 2 of our rules to create a new class of equipment for software defined radios (SDRs) with streamlined equipment authorization procedures. We anticipate that software defined radio technology will allow manufacturers to develop reconfigurable transmitters or transceivers that can be multi-service, multi-standard, multi-mode, and multi-band. Specifically, we are amending our equipment authorization rules to permit equipment manufacturers to make changes in the frequency, power and modulation parameters of such radios without the need to file a new equipment authorization application with the Commission. We will also permit electronic labeling so that a third party may modify a radio's technical parameters without having to return it to the manufacturer for re-labeling. These changes will facilitate the deployment and use of this promising new technology, which we believe will facilitate more efficient use of the spectrum.

II. BACKGROUND

2. Traditionally, radio transmitters must be approved for a specific set of technical parameters, including operating frequencies, output power, and types of radio frequency emissions. If any of these parameters are changed, the rules have required the grantee to apply for a new approval and wait until the approval is issued before the unit may be marketed with the changes.[1] Those rules were developed to address radio characteristics defined by hardware where actual physical changes to equipment were necessary to change operating parameters.

3. In comparison, in a software defined radio, operating parameters such as the frequency and modulation type are determined by software. The software generates a stream of digital data representing the desired radio signal, which is then converted to the actual radio signal that is transmitted.[2] The fact that these parameters are determined by software means that a software defined radio could be programmed to transmit and receive on any frequency and to use any desired transmission format within

[1] *See* 47 C.F.R. § 2.1043(a).

[2] A software defined radio can also be programmed to receive different radio signals. The incoming radio signal is converted to a stream of digital data, and the software in the radio can extract the transmitted information from this data.

the limits of its hardware design. This affords the user substantial flexibility to operate in multiple radio services consistent with the Commission's operating and service rules. The operating parameters of a software defined radio could be altered in the field by a software change. This is a significant technological advancement from traditional radios where technical characteristics are fixed at the time of manufacture and subsequently cannot be easily modified. However, this programmability requires changes to our equipment authorization rules to allow manufacturers to take advantage of the increased flexibility in software defined radios while ensuring that such equipment complies with our technical requirements.

4. In March 2000, the Commission issued a *Notice of Inquiry* seeking information from the public on a number of issues raised by the development of software defined radios.[3] Subsequently, in December 2000, the Commission issued a *Notice of Proposed Rule Making* (*Notice*) that proposed to define software defined radios as a new class of equipment and to simplify the authorization requirements for such equipment.[4] Fourteen parties filed comments in response to the *Notice*, and eight parties filed reply comments. A list of parties responding is included in Appendix B.

III. DISCUSSION

5. Upon reviewing the record, we conclude that it is desirable to revise our equipment authorization rules to accommodate the flexibility offered by software defined radios. The ability of software defined radios to be reprogrammed to new operating parameters in the field could have far reaching implications for the way the Commission allocates and licenses spectrum and authorizes radio equipment. Software defined radios could allow more efficient use of spectrum by facilitating spectrum sharing and by allowing equipment to be reprogrammed to more efficient modulation types. Their ability to be programmed could also enhance interoperability between different radio services. We find that it is possible to provide this flexibility in a manner that will ensure that software defined radios operate in compliance with the rules for the service in which they will operate. We therefore are adopting a definition of software defined radio and a streamlined procedure for making changes to the operating parameters of software defined radios. We are also adopting rules to permit electronic labeling of software defined radios and to require manufacturers to take steps to prevent unauthorized software modifications. These changes will provide greater flexibility to manufacturers to facilitate the deployment of software defined radios while fulfilling our statutory requirement to protect the public from harmful interference.[5] We will consider additional rule changes in the future as software defined radio technology advances.

A. Definition of Software Defined Radio

6. The *Notice* proposed to define a software defined radio, for regulatory purposes, as "...a radio that includes a transmitter in which the operating parameters of the transmitter, including the frequency range, modulation type or maximum radiated or conducted output power can be altered by making a change

[3] *See Inquiry Regarding Software Defined Radios, Notice of Inquiry*, ET Docket 00-47, 15 FCC Rcd 5930 (2000). This *Notice of Inquiry* sought comments on the state of software defined radio technology, how it could improve spectrum efficiency and interoperability between radio services, and changes would be needed to the equipment authorization rules as a result of the development of software defined radios.

[4] *See Authorization and Use of Software Defined Radios, Notice of Proposed Rule Making*, ET Docket 00-47, 15 FCC Rcd 24442 (2000).

[5] *See* 47 U.S.C. § 302.

in software without making any hardware changes."[6] We indicated that this definition was not intended to cover devices that use software simply to control functions such as power or frequency within a range approved by the Commission.[7] Receivers would not be covered under this definition.[8]

7. A number of parties recommended changes to our proposed definition of software defined radio. For example, Hypres, the SDR Forum and AirNet believe that the frequency range, modulation type and output power should all be software programmable for a radio to be classified as a software defined radio.[9] Motorola and the SDR Forum believe that a radio must be programmable in the field to be classified as a software defined radio.[10] The SDR Forum recommends including radios that use software to reconfigure existing firmware or hardware logic in the definition, while Cingular recommends excluding from the definition radios that use software simply to switch between different hardware defined power or frequency parameters.[11] Motorola believes that certain hardware changes such as installing memory containing new software should be permitted under the definition.[12] Nortel believes that the definition should take into account different levels of software, such as software, middleware and firmware. AirNet believes that the definition should provide a clearer and more concise interpretation of what constitutes a software change and a hardware change.[13] Cingular and NTIA believe that the definition of a software defined radio should include receivers because radios often have both transmit and receive capabilities.[14]

8. Based on the comments received, we are adopting the following regulatory definition for software defined radio that requires that at least one of the three operating parameters of frequency, modulation type or output power be software programmable. Our purpose in adopting this expansive definition of software defined radio is to foster development of this promising technology and to enable manufacturers to take advantage of the streamlined equipment authorization process, if they so desire.[15]

> *Software Defined Radio.* A radio that includes a transmitter in which the operating parameters of frequency range, modulation type or maximum output power (either radiated or conducted) can be altered by making a change in software without making any changes to hardware components that affect the radio frequency emissions.

As suggested by Motorola and the SDR Forum, changes such as the installation of memory modules and the reconfiguration of existing hardware or firmware logic would be permitted under this definition. We find that such changes should not exclude a radio from being considered software definable. However, we disagree that the definition needs to take into account different levels of software as suggested by

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[6] *See Notice* at ¶ 21.

[7] *See Notice* at footnote 37.

[8] All receivers except scanners are already under manufacturer's self-approval or are exempt from compliance with technical requirements because they have a relatively low potential for interference to radio services. Therefore, we did not propose changes to the regulatory treatment of receivers. *See* 47 C.F.R. § 15.101.

[9] *See* Hypres comments at 8, SDR Forum comments at 4 and AirNet reply comments at 3.

[10] *See* Motorola comments at 4 and SDR Forum reply comments at 3.

[11] *See* Cingular comments at 4 and SDR Forum comments at 4.

[12] *See* Motorola comments at 4.

[13] *See* Nortel comments at 4 and AirNet comments at 3.

[14] *See* Cingular comments at 4 and NTIA reply comments at 2-4.

[15] Manufacturers can still go through the regular process and obtain a new certification when changes to a previously approved software defined radio are made.

Nortel, because that would make the definition unnecessarily complicated. We decline to require a radio to be programmable in the field for it to be classified as a software defined radio. This could limit manufacturers' flexibility to make software definable radios that can be re-programmed to different operating modes post-manufacture at the factory but that are not intended for field re-programming. We also decline to include receivers in the definition for software defined radios. Receivers are subject to manufacturer's self-approval and have a relatively low potential for interference to radio services, so there is no need for the same regulatory changes for receivers that there is for transmitters.

B. Authorization Requirements

9. As noted above, the rules currently require most radio transmitters to be approved by the Commission or a designated Telecommunication Certification Body (TCB) before they may be marketed. When changes are made to the operating frequencies, output power, or types of radio frequency emissions of an authorized transmitter, the grantee is required to apply for a new approval and wait until the approval is issued before the equipment may be marketed with the changes.[16]

10. The rules allow two classes of "permissive changes" for authorized equipment without requiring a new approval.[17] Class I permissive changes include modifications that do not degrade the RF emissions from a device at the time of initial certification and do not require any filing with the Commission.[18] Class II permissive changes include modifications other than frequency, modulation or power that degrade the RF emissions from a device reported at the time of the initial certification.[19] Class II changes are authorized through a streamlined filing procedure that does not require the filing of a complete application form with all exhibits normally required for a new approval. Instead, the applicant simply files a description of the changes and measurement results showing the changed equipment continues to comply with the rules.

11. The transmitter authorization rules were developed at a time when transmitters were hardware based. At that time, changes to the frequency, modulation type, and power output of a transmitter were performed by making changes to the layout and physical components of electronic circuits. Such changes essentially resulted in a new device, so we required a complete new application form with all exhibits and required a new identification number on the device. However, in a software defined radio, changes to these operating parameters can be accomplished through a software change with no change in hardware. Requiring manufacturers to obtain a new approval for equipment when changes are made only to the software is unnecessarily burdensome because a new identification number must be used and the equipment already in the field may have to be recalled for re-labeling by the manufacturer. Therefore, we proposed in the *Notice* to develop a more streamlined authorization procedure for changes to the operating parameters of software defined radios.[20]

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[16] *See* 47 C.F.R. § 2.1043(a).

[17] *See* 47 C.F.R. § 2.1043(b)(1).

[18] *See* 47 C.F.R. § 2.1043(b)(2).

[19] The Commission's staff has in fact allowed certain changes in the frequency range of transmitters to be authorized as Class II permissive changes. Such changes have been permitted when the transmitter already had the capability of operating over the new frequency range, and the change could be made through the internal programming of the equipment without making any hardware changes.

[20] *See Notice* at ¶ 24.

1. Class III permissive change

12. We proposed that any changes in frequency, power, or modulation type of a software defined radio may be authorized as a new class of permissive change, which we proposed to designate as Class III. This would streamline the filing procedure for changes to approved software defined radios and would eliminate the need for a new identification number. We also proposed to require that the applicant for a Class III change submit test data showing that the equipment complies with the applicable requirements for the service(s) or rule parts under which the equipment will operate with the new software. The applicant would have to demonstrate compliance with the applicable RF exposure requirements. The Commission would notify the applicant when a permissive change is granted. Once a Class III permissive change was granted for a software defined radio with changes that affect the operating parameters, the new software could be loaded into units in the field. The record in the Commission's database for each authorized device would be amended to show the approved frequency range(s), power and modulation type(s) as it does now. Additional frequency ranges or other new technical parameters would be added to the database record for an authorization when a permissive change is granted.

13. The comments generally support the proposed new Class III permissive change, although some parties recommend specific changes or clarifications to certain aspects of our proposal.[21] The SDR Forum believes that allowing Class III changes would be a major improvement over the current rules.[22] Motorola states that the proposed Class III change can enable a more dynamic environment for changes than originally envisioned, while at the same time ensuring that interference and safety concerns are not compromised.[23] API believes that the proposed Class III change is sound and provides greater workability than alternative filing procedures.[24] However, Nortel believes that we should allow software defined radios to be approved under the Declaration of Conformity (DoC) procedure.[25] AirNet states it is not clear how the Class III change will streamline the authorization process because the testing and demonstrating compliance provisions appear to be the same as the original certification.[26]

14. We conclude that the proposed Class III change will benefit manufacturers by streamlining the equipment approval process. Manufacturers will no longer need to file a complete application form or much of the information required with a new certification application, which includes photographs, circuit diagrams and a description of the equipment.[27] In addition, permissive changes to existing equipment are processed on a faster track than new certifications. We find that the proposed Class III permissive change strikes the appropriate balance between reducing the regulatory burden on manufacturers and protecting the public from interference and safety hazards from radio equipment. Accordingly, we are adopting the

[21] *See* Motorola comments at 9, Clearwire comments at 5, AT&T comments at 2, Cingular comments at 5, API comments at 4, SDR Forum comments at 6 and FLEWUG comments at 5.

[22] *See* SDR Forum comments at 5.

[23] *See* Motorola comments at 9.

[24] *See* API comments at 4.

[25] *See* Nortel comments at 3-4. Declaration of Conformity (DoC) is a self-approval process in which the manufacturer has the equipment tested for compliance at an accredited laboratory. The equipment may be marketed as soon as it is found to be compliant without the need to file an application and wait for an approval. *See* 47 C.F.R. § 2.1071 *et. seq.*

[26] *See* AirNet comments at 4.

[27] *See* 47 C.F.R. § 2.1033.

Class III permissive change for software defined radios.[28] Additional issues related to this new permissive change are discussed below.

15. We find that self-approval is not appropriate for software defined radios at this time. As we stated in the *Notice*, equipment is generally placed in the self-approval category after the Commission has gained some assurance that manufacturers can and do produce equipment that complies with the rules.[29] Given the early state of software defined radio technology, some experience with the equipment is necessary before we can determine whether self-approval is appropriate. We expect to re-evaluate the appropriateness of allowing manufacturers' self-approval for software defined radios in a future proceeding.

2. Identification as a software defined radio.

16. The *Notice* proposed that Class III changes would only be permitted for a transmitter that was identified as a software defined radio in the original application for certification.[30] The purpose of this proposal was to identify which devices would be subject to the new rules. Motorola believes that Class III changes should be permitted to any capable radio without having required an original declaration as a software defined radio because it would eliminate concerns over the precise definition of the equipment.[31] Nortel believes that the Commission should develop a mechanism to reclassify previously approved devices as software defined radios even if they were not originally identified as such.

17. We will require the applicant to identify a software defined radio at the time an original application is filed in order for it to be eligible for Class III permissive changes. This will allow the application reviewer to determine which requirements the equipment must meet, such as the security features and labeling discussed below, and whether the applicant has demonstrated compliance with them. When applying for a Class III permissive change, the applicant must reference the initial declaration. We decline to establish a mechanism to reclassify previously approved devices as software defined radios. We find that such an approach would unnecessarily complicate the application process. Furthermore, additional supplementary information for existing equipment would have to be filed in any event. We note, however, that this approach would not prohibit the filing of a new request for an authorization as a software defined radio, permitting the device to be subsequently eligible for Class III permissive changes.

3. Third party permissive changes

18. We proposed to allow only the party holding the grant of equipment authorization for a software defined radio to file for a Class III permissive change.[32] The reason is that the party holding the grant of equipment authorization, which is indicated by the identification number, is responsible for ensuring that

[28] Any changes to a radio would have to ensure it remains consistent with the Commission's operating and service rules, e.g., eligibility, authorized frequency bands and power levels. We specifically note that we are not proposing to change Sections 80.203 and 90.203 concerning the programmability of frequencies by the user using external controls. *See* 47 C.F.R. §§ 80.203 and 90.203.

[29] *See Notice* at ¶ 24.

[30] *See Notice* at ¶ 26.

[31] *See* Motorola comments at 8.

[32] *See Notice* at 10.

equipment complies with the rules.[33] When a permissive change is made, the same identification number is used, indicating that the same party continues to be responsible for compliance with the rules. Allowing other parties to make permissive changes could result in questions of which party is liable if the changed equipment is subsequently found to be non-compliant.

19. Hypres, Nortel, Elite, Intel, Clearwire and the SDR Forum believe that the Commission should allow Class III permissive changes by third parties.[34] Hypres states that allowing parties other than the grantee to make changes will allow software developers to port their software to new hardware platforms without going through the manufacturer of each product.[35] Intel believes that the benefit of Class III changes will come in the enabling of thousands of independent developers, not simply easing the restrictions on the one original manufacturer.[36] The SDR Forum states that the Commission should not bar third parties from filing for Class III changes because that decision should be made in the marketplace rather than the regulations.[37] However, Motorola believes there are many potential problems in allowing third parties to make software changes, such as if the original manufacturer were to make hardware changes at a different time than a third party made software changes.[38] AT&T believes that Class III permissive changes should be limited to the original grantee to ensure that no unauthorized modifications are made.[39] Intel and the SDR Forum are concerned that our proposed rules could be interpreted to mean that third parties could not change application software in a radio that does not affect the radio frequency emissions.[40]

20. We adopt our proposal to allow Class III changes to be requested only by the grantee of equipment authorization to eliminate ambiguities about which party is responsible for the compliance of a device. This approach would not preclude third parties from being able to modify software defined radios in the field. We agree with the comments that it is desirable to provide a means to allow third parties to develop new and innovative software for software defined radios. This can be accomplished in two ways. First, the original grantee may authorize a third party to file an application with the Commission on its behalf as we permit now.[41] The original grantee would continue to be responsible for the continued compliance of the device. The second way is for a third party to obtain a new identification number for a device and become the party responsible for its compliance. The new identification number can be placed on the equipment through electronic labeling as discussed below. The rules we are adopting allow any party to install or make changes to application or other software in a radio that does not affect the authorized operating parameters.[42]

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[33] The first three characters of the FCC identification number identify the grantee of the equipment authorization. *See* 47 C.F.R. § 2.926.

[34] *See* Hypres comments at 8-9, Nortel comments at 6, Elite comments at 2, Intel comments at 7, and SDR Forum reply comments at 3.

[35] *See* Hypres comments at 8-9.

[36] *See* Intel comments at 7.

[37] *See* SDR Forum reply comments at 3.

[38] *See* Motorola comments at 16-18.

[39] *See* AT&T comments at 2.

[40] *See* Intel comments at 6 and SDR Forum comments at 4.

[41] *See* 47 C.F.R. § 2.911(c).

[42] *See* Section 2.1043(a) in the attached Appendix A. This rule is intended to clarify that any party may install software applications on a device that are separate from the software that controls the radio frequency operating parameters. For example, a wireless device may be designed to run software such as a web browser that does not affect the radio operating parameters.

4. Combined hardware and software changes

21. We proposed to allow Class III permissive changes only for equipment in which no hardware changes have been made from the originally approved device because this would eliminate ambiguity about which hardware and software combinations have been approved.[43] However, the *Notice* sought comments on whether we should allow a combination of hardware and software permissive changes in a single device.[44]

22. Some parties believe that combinations of hardware and software changes should be permitted.[45] Motorola recommends that we allow a Class III change to reflect concurrent changes to both software and hardware, when the hardware does not degrade desired, or increase undesired, emissions.[46] Motorola also recommends that Class III changes be permitted to a radio that has previously undergone a Class II change in hardware.[47] Nortel believes that allowing associated changes to hardware along with a Class III change may be necessary to obtain the best efficiencies that SDR systems have to offer, particularly in the early years of software defined radio development.[48] However, other parties believe that Class III changes should only be permitted on equipment that has had no hardware changes since the original approval.[49] API believes that combined hardware and software changes should not be permitted to protect users from combinations of changes that could have unknown or dangerous effects.[50] FLEWUG and AirNet agree that our proposal would eliminate ambiguity about which hardware and software combinations have been approved.[51] NTIA and Elite believe that Class III changes should not be permitted on equipment that has had hardware changes until the Commission has gained experience with this type of change.[52]

23. We will permit combinations of Class III permissive changes and Class I permissive changes to hardware in a single device. Class I changes do not degrade the radio frequency emissions from a device, so allowing such combinations of hardware and software changes should not cause any compliance problems. However, at this time we will not permit Class III changes to be combined with Class II hardware changes that could affect radio frequency emissions. This could cause ambiguity in which combinations of hardware and software are approved in a radio, making enforcement of the rules difficult. Also, as some comments noted, combinations of changes made at different times could have unknown effects on the interference potential and RF safety of a radio. In addition, we question whether a radio in which any hardware changes are necessary to change operating parameters should even be considered a software defined radio. However, we will consider revisiting this issue as the Commission and industry gain greater experience with software defined radios.

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[43] *See Notice* at ¶ 26.

[44] *See Notice* at ¶ 28.

[45] *See* Motorola comments at 11, Nortel comments at 6 and SDR Forum comments at 3.

[46] *See* Motorola comments at 11.

[47] *Id.*

[48] *See* Nortel comments at 6.

[49] *See* Hypres comments at 9, Elite comments at 2, Cingular comments at 5, API comments at 6-7, AirNet comments at 4, FLEWUG comments at 5 and NTIA reply comments at 10.

[50] *See* API comments at 6-7.

[51] *See* FLEWUG comments at 5 and AirNet comments at 4.

[52] *See* NTIA reply comments at 10 and Elite comments at 2.

5. Limit on the number of hardware and software combinations

24. The *Notice* sought comment on whether we should limit the number of hardware and software combinations permitted under a single authorization.[53] We noted that some transmitters are tested with multiple antennas to ensure they will comply in every configuration in which they will be used, and that allowing software variations could increase the number of hardware and software combinations existing under a single approval.[54] Motorola and Clearwire believe that no limit should be placed on the number of hardware and software combinations included under a single approval.[55] Motorola states that this would tend to inhibit common platforms that support a large variety of software configurations.[56] However, API believes that the number of Class III changes for a single device should be limited to aid the Commission in policing compliance with the rules.[57]

25. We agree with the commenting parties who argue that no limit should be placed on the number of hardware and software combinations. Such limits could inhibit common hardware platforms. We have no reason to expect that such a large number of combinations will exist for a particular device that a determination of compliance would be difficult. As noted above, we will not permit hardware changes that degrade the operating parameters to be made after the initial approval, which will help limit the number of hardware/software combinations under a single approval. We will continue to monitor this area and revisit this issue in the future if warranted.

6. Copy of radio software

26. The *Notice* sought comments on whether there is a need for applicants to submit a copy of radio software to the Commission. API believes that there is a need to supply software for analysis and enforcement purposes.[58] Clearwire believes that the applicant should submit either the software or unique identification information for the software with the Commission. However, Hypres, Motorola, Nortel and AirNet do not believe supplying a copy of the software is necessary.[59] Nortel states that review of the code would be difficult and a burden on the Commission.[60] AirNet is concerned that the software could reveal trade secrets, discourage manufacturers from designating equipment as software defined radios, and be a burden for the Commission to keep confidential.[61]

27. Review of software code by the staff would be difficult and time consuming and would not necessarily assist in determining whether a device complies with the rules. We believe that obtaining a copy of the code from an applicant would not be necessary for determining compliance in the great majority of cases. Accordingly, we will not routinely require applicants to supply a copy of the radio

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[53] *See Notice* at ¶ 28.

[54] *See Notice* at footnote 46.

[55] *See* Motorola comments at 14 and Clearwire comments at 7.

[56] *See* Motorola comments at 14.

[57] *See* API comments at 7.

[58] *See* API comments at 6.

[59] *See* Hypres comments at 9, Motorola comments at 13, Nortel comments at 6 and AirNet comments at 5.

[60] *See* Nortel comments at 6.

[61] *See* AirNet comments at 5.

software. However, we believe cases may arise wherein the staff may need to examine the software code used in a device as part of determining its compliance. We therefore may require the submission of software code on request.[62]

7. Filing fees

28. The *Notice* proposed to apply the filing fee for certification of transmitters used in licensed services to the new Class III permissive changes to reflect the staff time required to process these changes.[63] AirNet states that the filing fee should be reflective of the streamlined process.[64] Nortel notes that even under the streamlined procedures, the Commission will be required to perform various tasks, including reviewing filings and updating databases, and that the filing fees would ensure that the Commission has adequate resources to timely conduct the necessary reviews and approvals.[65]

29. While the filing procedure for permissive changes has been streamlined, Commission staff is still required to perform a technical review of the test data for compliance with the rules. We are therefore adopting the fee we proposed for Class III permissive changes. This fee reflects the expected review time for Class III changes and is the same as we require for approval of transmitters used in licensed services. Where a radio will operate under multiple rule parts, requiring increased review time, we will charge multiple fees as currently set out in the rules.[66]

C. Software Modifications

30. We tentatively concluded in the *Notice* that a means will be necessary to avoid unauthorized modifications to software that could affect the compliance of a radio. Because groups such as the SDR Forum and ETSI are still in the process of developing standards for encryption and digital signatures that could be used in software defined radios, we declined to propose specific requirements for authentication. Instead, we proposed a more general requirement that manufacturers take steps to ensure that only software that is part of a hardware/software combination approved by the Commission or a TCB can be loaded into a radio.[67] The radio software must not allow users to operate the radio with frequencies, output power, modulation types or other parameters outside of those that were approved. We proposed to allow manufacturers to use any appropriate means to meet these requirements and require them to describe the methods in the application for equipment authorization.[68]

31. The comments generally agreed with our proposals regarding software modifications. For example, the SDR Forum supports requiring equipment manufacturers to guard against unauthorized downloads, while leaving the choice of the specific method up to the manufacturer.[69] Intel states that the Commission appropriately refrains from proposing specific requirements for authentication and that the

[62] This could include the executable code or the source code and related documentation.

[63] *See* 47 C.F.R. § 1.1103.

[64] *See* AirNet comments at 4.

[65] *See* Nortel comments at 5.

[66] *See* 47 C.F.R. § 2.1033(c)(17).

[67] *See Notice* at ¶ 31.

[68] *Id.*

[69] *See* SDR Forum comments at 9.

market can be expected to continue to develop solutions to maintain the integrity of wireless networks.[70] Clearwire believes that the manufacturer should be responsible for ensuring that unauthorized parties cannot modify the software.[71] Hypres does not believe it is necessary for the Commission to make detailed rules about the security system to be used, only that the system is described in the application for certification.[72] Cingular wants the rules to expressly state that Commission approval can only be obtained upon a showing that unauthorized software modifications cannot be made, and that the authorization should be conditioned upon the continued integrity of the authentication or security system.[73] AirNet believes that manufacturers should have sufficient leeway to tailor authentication and security efforts to their specific needs.[74] NTIA believes that the Commission, in coordination with industry representatives, should examine security features such as authentication protocols that could be used to prevent unauthorized modifications to RF parameters.[75]

32. We find that a means is necessary to ensure that software changes cannot be made to a radio that will cause it to operate with parameters outside of those that were approved in order to prevent interference to authorized radio services. We decline to set specific security or authentication requirements at this time because they could hinder the development of the technology used to provide such security and could have the potential to be unduly burdensome on manufacturers. We note that industry groups are still in the process of developing security standards. We continue to believe that the best approach is to rely on a general requirement that manufacturers take adequate steps to prevent unauthorized changes to the software that drives their equipment. This will allow manufacturers flexibility to develop innovative software defined transmitting equipment while at the same time providing for oversight of the adequacy of such steps through the equipment authorization process. Accordingly, we are adopting the proposal in the *Notice* that manufacturers must take steps to prevent unauthorized software changes to a software defined radio. The precise methods of ensuring the integrity of the software in a radio will be left to the manufacturer, and the manufacturer must document the methods in the application for equipment authorization. However, it is possible that we may have to specify more detailed security requirements at a later date as software defined radio technology develops. Our intent is to focus on results that security efforts should achieve rather than the means that must be used. The SDR Forum has indicated that it is continuing to develop methods for the security and authentication of radio software and that it will report its findings to the Commission.[76] We will consider further input from industry and other government agencies in determining whether more detailed security requirements are necessary. We encourage all interested parties to submit relevant information within one year of adoption of this order.

D. Labeling

33. A major benefit of software defined radios will be the ability of manufacturers to produce radios intended to be programmed by third parties with unique or specialized software. To help realize this benefit, we proposed an option that would allow software defined radios to be equipped with an "electronic label" to display the FCC identification number by means of a light emitting diode (LED)

[70] *See* Intel comments at 9-10.

[71] *See* Clearwire comments at 7.

[72] *See* Hypres comments at 11

[73] *See* Cingular comments at 6-7.

[74] *See* AirNet reply comments at 8.

[75] *See* NTIA comments at 6.

[76] *See ex parte* letter from the SDR Forum dated July 20, 2001.

display, a liquid crystal display (LCD) or other similar method.[77] This would provide a method to re-label equipment in the field if a new approval were obtained by a third party for a previously approved device. We requested comments on whether there is a need for this capability, the means that should be required for accessing the information, and the information to be displayed.[78]

1. Need for electronic labeling

34. The SDR Forum supports electronic labeling because such labeling would avoid the need for expensive and inefficient physical labeling.[79] API also supports electronic labeling, arguing that end users would benefit from the ability to modify equipment labels in the field.[80] Motorola states that electronic labeling would simplify the process of delivering new products to market and would allow more information to be accessed than can be printed on a physical label.[81] In addition, several parties support permitting electronic labeling for equipment other than software defined radios.[82] However, Clearwire does not believe that electronic labels showing multiple FCC identification numbers are the best solution for showing which modes of operation are authorized for a particular radio. It believes that a single FCC identification number should be used for each hardware implementation, and that a publicly available database should list the software versions, operating parameters and parties responsible for the software.[83]

35. We will permit electronic labeling for software defined radios as proposed. This option will avoid the need for physical re-labeling of equipment when a party other than the original grantee makes changes to the radio software. We do not agree with Clearwire's proposal to require only a single identification number on each device. As we stated above, the FCC identification number is the indicator of which party is responsible for the compliance of a device and we have determined that only the original grantee may make changes to the operating parameters under the original identification number. At this time, we are only permitting electronic labeling for software defined radios.

2. Type of display

36. Several parties believe that we should allow means other than an LED or LCD screen for displaying the labeling information. Motorola believes that electronic labeling could take the form of a visible display device or an alternative means of extracting the information, such as a terminal.[84] Nortel believes that we should allow technologies such as web-based tools to display the label information.[85] Hypres does not believe it is feasible to incorporate a display on every software defined radio in a system because units may be mounted in closed cabinets. It believes that we should permit the identification numbers to be displayed on a central screen or remotely over the air.[86] AirNet states that there is a need

[77] *See Notice* at ¶ 29.

[78] *Id.*

[79] *See* SDR Forum comments at 8.

[80] *See* API comments at 4.

[81] *See* Motorola comments at 15.

[82] *See* Motorola comments at 15, Nortel comments at 7 and Elite comments at 2.

[83] *See* Clearwire comments at 6.

[84] *See* Motorola comments at 15. A terminal would be some sort of display device connected to the radio but possibly located some distance away.

[85] *See* Nortel comments at 7.

[86] *See* Hypres comments at 10.

for a means to display the identification information of equipment without integrated LED or LCD displays.[87] NTIA believes that any form of electronic labeling should be visible when the power is removed from the equipment.[88]

37. We are limiting electronic labeling to software defined radios with an LED, LCD or similar display device at this time because it would be significantly more difficult to an investigator or user to obtain the label information through a remote terminal or other device. As proposed, we are requiring that the electronic label be readily accessible, which could include, for example, a menu option or a hotkey. Additionally, the user manual must include information on how to access the electronic label. We are not requiring that the electronic labeling be visible when the power, such as the battery pack, is removed from the device. This would burden manufacturers by requiring them to install a backup battery and possibly additional switches and circuitry to display the identification information.

3. Information to be displayed

38. Cingular believes that electronic labels should display the FCC identification number, and that the display should change automatically based upon the hardware and software installed.[89] The SDR Forum believes that nothing about the required identification information should change, other than the means of display.[90] NTIA believes that all the information currently required on the label could be made available on the user display screen.[91] NTIA also wants the Commission to make clear what other information must be included on the electronic label, such as the authorized emissions or other regulated radio parameters.[92]

39. We agree with Cingular and will only require that the FCC identification number(s) associated with the software running in the radio be displayed on the electronic label. The other information that NTIA suggested including on the label is already in the Commission's database under the FCC identification number. The database is available to the public through our Internet site, so we do not believe it is not necessary to require information on the operating parameters on the electronic label.[93] Manufacturers may design their equipment to display any additional information they wish beyond what we require.

E. Other Matters

1. Testing

40. We tentatively concluded in the *Notice* that software defined radio technology has not matured to the point where it is possible to predict the radio frequency characteristics of a radio from either the hardware or software alone.[94] Therefore, we proposed that each combination of hardware and software

[87] *See* AirNet comments at 5.

[88] *See* NTIA comments at 7.

[89] *See* Cingular comments at 7.

[90] *See* SDR Forum comments at 8.

[91] *See* NTIA comments at 7.

[92] *See* NTIA comments at 7.

[93] The URL is www.fcc.gov/e-file/.

[94] *See Notice* at ¶ 18.

that a radio supports should be tested because it is the only way to ensure that equipment complies with the technical standards in our rules to prevent interference and to protect users from excessive RF radiation. We anticipated that testing each hardware/software combination that will be used in a software defined radio would be no more burdensome than testing each mode in which a radio operates, which is the existing process.

41. Motorola agrees that hardware and software should be tested together to ensure compliance with the emission requirements, and that such testing is no more burdensome than the current policies for multi-mode, multi-band devices.[95] NTIA, Cingular and Elite also believe that hardware/software combinations should be tested for approval to ensure that equipment complies with the rules.[96] NTIA wants the proposed rules clarified on whether all possible combinations of installed software need to be tested and how the removal of software will be addressed.[97] Hypres believes that testing each hardware/software combination is a reasonable initial approach, but that changes will be necessary as hardware and software offerings proliferate.[98] However, Vanu believes that testing each hardware/software combination could be burdensome.[99] It states that a software defined radio could be divided functionally into a transmitter unit that generates the radiofrequency signal and a separate hardware regulated signal processing unit that provides the baseband signal to the transmitter.[100] Vanu proposes that only the software that controls the transmit hardware be tested and that the signal processing software need not be evaluated.[101]

42. As proposed, we will require that software defined radios be tested for compliance with each software application under which the radio will operate. Except as provided below, where the hardware portion of the software defined radio can support multiple software applications, we will not require that the device be tested with combinations of software. We find no reason to believe that the presence of additional compliant software applications in the radio would affect the radio's performance or raise additional compliance issues. Where the radio is capable of operating with multiple software applications simultaneously, that is, the software defined radio can transmit simultaneously multiple signals or in multiple frequency bands, we will require that the radio be tested to ensure that the device complies with all applicable rules. For this case, we believe that additional testing is needed. For example, software defined radios that enable multiple simultaneous carriers could raise compliance issues with RF safety limits because the total output power would be increased or could produce intermodulation products that would result in emissions higher than those permitted under the rules. We anticipate that a relatively small number of software defined radios will have this capability to transmit multiple signals. We believe that this approach reasonably balances our need to ensure that devices comply with our rules and do not cause interference with the concerns expressed by some parties regarding burdensome testing requirements.

[95] *See* Motorola comments at 6.

[96] *See* NTIA comments at 3, Cingular reply comments at 4-5 and Elite comments at 1.

[97] *See* NTIA comments at 3.

[98] *See* Hypres comments at 6.

[99] *See* Vanu reply comments at 2.

[100] *See* Vanu reply comments at 4-6.

[101] *See* Vanu reply comments at 3.

2. Certification by Telecommunication Certification Bodies (TCBs)

43. In General Docket 98-68, we established the requirements for TCBs that are allowed to approve equipment in the same manner as the Commission.[102] In that proceeding, we stated that while we intended to use TCBs to certify a broad range of equipment, we found that certain functions should continue to be performed by the Commission. The functions included certifying new or unique equipment for which the rules or requirements do not exist or for which the application of the rules is not clear.[103] Because software defined radios are a new technology and many questions about the application of the rules may arise, we tentatively concluded in the *Notice* that TCBs should not be permitted to certify software defined radios or approve permissive changes to software defined radios for at least six months after the effective date of final rules adopted in this proceeding.[104]

44. Elite agrees that TCBs should not be permitted to certify software defined radios for at least six months after final rules are adopted.[105] NTIA believes that TCBs should not be permitted to certify software defined radios for at least two years to allow the Commission to verify that the current procedures and rules are sufficient.[106] AT&T wants the Commission to specify an indefinite time period during which only the Commission can certify software defined radios and should only permit TCBs to certify them when the time is appropriate.[107]

45. We believe that six months is a reasonable minimum time period to allow the Commission to gain experience with software defined radios and determine whether TCBs should be permitted to certify them. As the SDR Forum noted, we proposed six months only as a marker for reassessment and may extend the time period if necessary.[108] Accordingly, TCBs will not be permitted to certify software defined radios until at least six months after the effective date of the rules adopted in this proceeding. The Chief of the Office of Engineering and Technology acting under the existing delegated authority will determine when TCBs may certify software defined radios and will announce this decision by public notice.[109]

3. Enforcement

46. We recognized in the *Notice* that a non-compliant software defined radio has the potential to interfere with other radio services due to its potential to operate in multiple frequency bands.[110] We

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[102] *See In the Matter of 1998 Biennial Regulatory Review – Amendment of Parts 2, 25 and 68 of the Commission's Rules to Further Streamline the Equipment Authorization Process for Radio Frequency Equipment, Modify the Equipment Authorization Process for Telephone Terminal Equipment, Implement Mutual Recognition Agreements and Begin Implementation of the Global Mobile Personal Communications by Satellite (GMPCS) Arrangements*, Report and Order, FCC 98-338, 13 FCC Rcd 24687 (1999).

[103] *Id.* at ¶ 33.

[104] We currently do not allow TCBs to certify equipment requiring measurements of the specific absorption rate (SAR) of RF radiation by the body. No change in that policy is proposed.

[105] *See* Elite comments at 2.

[106] *See* NTIA comments at 7.

[107] *See* AT&T comments at 6.

[108] *See* SDR Forum reply comments at 4.

[109] *See* 47 C.F.R. § 0.241(g).

[110] *See Notice* at ¶ 34.

requested comments on whether we should enhance our enforcement capabilities due to the development of software defined radios and what particular changes we should make.[111]

47. Some parties believe that no changes in the Commission's enforcement capabilities are necessary.[112] The SDR Forum states that no enhanced enforcement capabilities are required for software defined radios because the existing safeguards are sufficient.[113] AirNet believes that software defined radios pose no more threat than other radio devices, and that the Commission's existing enforcement capability is more than adequate to prevent unauthorized modifications.[114] However, other parties call for increased enforcement capabilities.[115] API believes there is a need for enhanced enforcement capabilities because non-complying software defined radios could interfere with users who maintain critical infrastructure facilities. Elite recommends that the Commission enhance its enforcement capabilities because software defined radios could cause interference in multiple bands.[116] It states that the penalties for non-compliance should be severe enough to serve as a true deterrent.[117] Cingular wants the Commission to assess heavy forfeitures when interference is caused by a software defined radio that is not operating in accordance with its authorized parameters.[118]

48. We are not planning to increase our enforcement capabilities specifically for software defined radios because we have no reason at this time to expect significant compliance problems. However, we note that more of the routine application processing that has previously been handled by the Commission is now being performed by TCBs. This shifting of the workload will free up resources at our Laboratory that can be used to increase post-market surveillance on all types of equipment, including software defined radios. We cannot increase the maximum fines that may be issued for non-compliant equipment because they are limited by statute.[119] We will carefully assess the deployment of software defined radios in the market to determine whether any increased enforcement efforts are warranted and, if appropriate, whether other actions such as a faster revocation procedure for the authorizations of non-compliant software defined radios may be necessary.

IV. PROCEDURAL MATTERS

49. Final Regulatory Flexibility Analysis. The Final Regulatory Flexibility Analysis for this First Report and Order, pursuant to the Regulatory Flexibility Act, 5 U.S.C. § 604, is contained in Appendix C.

50. Paperwork Reduction Act Analysis. This First Report and Order contains either new or modified information collection(s) subject to the PRA of 1995, Public Law 104-13. It will be submitted to the

[111] *Id.*

[112] *See* SDR Forum comments at 14 and AirNet comments at 6.

[113] *See* SDR Forum comments at 14.

[114] *See* AirNet comments at 6.

[115] *See* Hypres comments at 12-13, Elite comments at 2, AT&T comments at 4, Cingular comments at 6 and API comments at 8.

[116] *See* Elite comments at 2.

[117] *Id.*

[118] *See* Cingular comments at 6.

[119] *See* 47 U.S.C. § 503(b)(2)(C). However the Debt Collection Improvement Act of 1996, Public Law 104-134 (110 Stat. 1321-358), states that the Commission must adjust the maximum forfeitures for inflation at least once every four years. *See* 47 C.F.R. § 1.80.

Office of Management and Budget (OMB) for review under Section 3507(d) of the PRA. OMB, the general public, and other Federal agencies are invited to comment. Public and agency comments are due **[60 days after date of publication in the Federal Register.]** Comments should address: (a) whether the new or modified collection of information is necessary for the proper performance of the functions of the Commission, including whether the information shall have practical utility; (b) the accuracy of the Commission's burden estimates; (c) ways to enhance the quality, utility, and clarity of the information collected; and (d) ways to minimize the burden of the collection of information on the respondents, including the use of automated collection techniques or other forms of information technology.

V. ORDERING CLAUSES

51. IT IS ORDERED, that Parts 1 and 2 of the Commission's Rules and Regulations ARE AMENDED as specified in Appendix A **[effective 120 days after publication in the Federal Register]**. This action is taken pursuant to Sections 4(i), 301, 302, 303(e), 303(f), 303(r), 304, 307 and 332(b) of the Communications Act of 1934, as amended, 47 U.S.C. Sections 154(i), 301, 302, 303(e), 303(f), 303(r), 304, 307 and 332(b).

52. IT IS FURTHER ORDERED that the Commission's Consumer Information Bureau, Reference Information Center, SHALL SEND a copy of this First Report and Order, including the Final Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

53. For further information regarding this First Report and Order, contact Hugh L. Van Tuyl, (202) 418-7506, Office of Engineering and Technology.

FEDERAL COMMUNICATIONS COMMISSION

Magalie Roman Salas

Magalie Roman Salas
Secretary

APPENDIX A: FINAL RULES

For the reasons set forth above, Parts 1 and 2 of Title 47 of the Code of Federal Regulations is amended as follows:

PART 1 – PRACTICE AND PROCEDURE

1. The authority citation for Part 1 continues to read as follows:

AUTHORITY: 47 U.S.C. 151, 154(i), 154(j), 155, 225, 303(r), 309.

2. Section 1.1103 is revised by adding the following new entry to the table:

§1.1103 Schedule of charges for equipment authorization, experimental radio services, and international telecommunications settlements.

Action	FCC Form No.	Fee amount	Payment type code	Address
1. Certification: * * * * * f. Class III permissive changes. * * * * *	Electronic 731 & Electronic or Paper 159...	495	ECC	Federal Communications Commission, Equipment Approval Services, P.O. Box 358315, Pittsburgh, PA 15251-5315

PART 2 – FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS

3. The authority citation for Part 2 continues to read as follows:

AUTHORITY: 47 U.S.C. 154, 302a, 303, and 336, unless otherwise noted.

4. Section 2.1 is amended by adding the following definition:

§ 2.1 Terms and definition.

* * * * *

(c) * * *

Software defined radio. A radio that includes a transmitter in which the operating parameters of frequency range, modulation type or maximum output power (either radiated or conducted) can be altered by making a change in software without making any changes to hardware components that affect the radio frequency emissions.

* * * * *

5. Section 2.925 is proposed to be revised by adding a new paragraph (e) and re-designating the existing paragraphs (e) and (f) as (f) and (g).

§ 2.925 Identification of equipment.

* * * * *

(e) A software defined radio may be equipped with a means such as a user display screen to display the FCC identification number normally contained in the nameplate or label. The information must be readily accessible, and the user manual must describe how to access the electronic display.

* * * * *

6. Section 2.932 is amended by adding a new paragraph (e):

§2.932 Modification of equipment.

* * * * *

(e) Manufacturers must take steps to ensure that only software that has been approved with a software defined radio can be loaded into such a radio. The software must not allow the user to operate the transmitter with frequencies, output power, modulation types or other parameters outside of those that were approved. Manufacturers may use authentication codes or any other means to meet these requirements, and must describe the methods in their application for equipment authorization.

7. A new Section 2.944 is added to read as follows:

§ 2.944 Submission of radio software

The grantee or other party responsible for compliance of a software defined radio, or the applicant for authorization of a software defined radio shall submit a copy of the software that controls the radio frequency operating parameters upon request by the Commission. Failure to comply with such a request within 14 days or such additional time as the Commission may allow may be cause for denial of authorization, forfeiture pursuant to § 1.80 of this chapter, or other administrative sanctions.

8. Section 2.1043 is revised to read as follows:

§ 2.1043 Changes in certificated equipment.

(a) Except as provided in paragraph (b)(3) of this section, changes to the basic frequency determining and stabilizing circuitry (including clock or data rates), frequency multiplication stages, basic modulator circuit or maximum power or field strength ratings shall not be performed without application for and authorization of a new grant of certification. Variations in electrical or mechanical construction, other than these indicated items, are permitted provided the variations either do not affect the characteristics required to be reported to the Commission or the variations are made in compliance with the other provisions of this section. Changes to the software installed in a transmitter that do not affect the radio frequency emissions do not require a filing with the Commission and may be made by parties other than the holder of the grant of certification.

(b) Three classes of permissive changes may be made in certificated equipment without requiring a new application for and grant of certification. None of the classes of changes shall result in a change in identification.

(1) A Class I permissive change includes those modifications in the equipment which do not degrade the characteristics reported by the manufacturer and accepted by the Commission when certification is granted. No filing with the Commission is required for a Class I permissive change.

(2) A Class II permissive change includes those modifications which degrade the performance characteristics as reported to the Commission at the time of the initial certification. Such degraded performance must still meet the minimum requirements of the applicable rules. When a Class II permissive change is made by the grantee, the grantee shall supply the Commission with complete information and the results of tests of the characteristics affected by such change. The modified

equipment shall not be marketed under the existing grant of certification prior to acknowledgement by the Commission that the change is acceptable.

(3) A Class III permissive change includes modifications to the software of a software defined radio transmitter that change the frequency, modulation type, output power or maximum field strength outside the parameters previously approved. When a Class III permissive change is made, the grantee shall supply the Commission with a description of the changes and test results showing that the equipment complies with the applicable rules with the new software loaded, including compliance with the applicable RF exposure requirements. The modified software shall not be loaded into equipment, and the equipment shall not be marketed with the modified software under the existing grant of certification, prior to acknowledgement by the Commission that the change is acceptable. A copy of the software shall be submitted to the Commission upon request. Class III changes are permitted only for equipment in which no Class II changes have been made from the originally approved device.

Note: Any software change that degrades spurious and out-of-band emissions previously reported to the Commission at the time of initial certification would be considered a change in frequency or modulation and would require a Class III permissive change or new equipment authorization application.

(4) Class I and Class II permissive changes may only be made by the holder of the grant of certification, except as specified below.

* * * * *

APPENDIX B: LIST OF PARTIES FILING COMMENTS

Comments

1. AirNet Communications (AirNet)
2. American Petroleum Institute (API)
3. AT&T Wireless Services, Inc. (AT&T)
4. Cingular Wireless LLC (Cingular)
5. Clearwire Technologies, Inc. (Clearwire)
6. Elite Electronic Engineering (Elite)
7. Federal Law Enforcement Wireless User's Group (FLEWUG)
8. Hypres, Inc. (Hypres)
9. Intel Corporation (Intel)
10. Motorola
11. Nortel Networks, Inc. (Nortel)
12. National Telecommunications and Information Administration (NTIA)
13. SDR Forum
14. Vanu, Inc. (Vanu)

Reply comments

1. AirNet Communications (AirNet)
2. Cingular Wireless LLC (Cingular)
3. Industrial Telecommunications Association, Inc. (ITA)
4. Intel Corporation (Intel)
5. National Telecommunications and Information Administration (NTIA)
6. SDR Forum
7. Sprint PCS
8. Vanu, Inc. (Vanu)

APPENDIX C: FINAL REGULATORY FLEXIBILITY ANALYSIS

As required by the Regulatory Flexibility Act (RFA),[120] an Initial Regulatory Flexibility Analysis (IRFA) was incorporated in the *Notice of Proposed Rule Making, Authorization and Use of Software Defined Radios.*[121] The Commission sought written public comment on the proposals in the *Notice*, including comment on the IRFA. This present Final Regulatory Flexibility Analysis (FRFA) conforms to the RFA.[122]

A. Need for, and Objectives of, the *First Report and Order.*

We are adopting changes to our equipment authorization rules in this Order to facilitate the deployment of software defined radios. The rule changes will streamline the equipment approval process and reduce the burden on applicants by eliminating the need to file a complete new application and physically re-label equipment when changes are made to the frequency, modulation type or output power of a software defined radio. In a software defined radio, functions that were carried out by hardware in the past are performed by software. This means that the operating parameters of the radio, such as the frequency and type of modulation, could be readily changed in the field. The rules previously required a complete new application and a new identification number on a permanently affixed label when changes to these operating parameters were made. The previous requirements could have discouraged the deployment of software defined radios to consumers.

B. Summary of Significant Issues Raised by Public Comments In Response to the IRFA

No comments were submitted directly in response to the IRFA. In addition, we have carefully examined all comments filed in response to the *Notice* and have determined that none specifically address the effect of the proposed rules on small entities.

C. Description and Estimate of the Number of Small Entities To Which Rules Will Apply

The RFA directs agencies to provide a description of and, where feasible, an estimate of the number of small entities that may be affected by the proposed rules, herein adopted.[123] The RFA generally defines the term "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction."[124] In addition, the term "small business" has the same meaning as the term "small business concern" under the Small Business Act.[125] A small

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[120] *See* 5 U.S.C. § 603. The RFA, *see* 5 U.S.C. § 601 *et. seq.*, has been amended by the Contract With America Advancement Act of 1996, Pub. L. No. 104-121, 110 Stat. 847 (1996) (CWAAA). Title II of the CWAAA is the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA).

[121] *See Authorization and Use of Software Defined Radios, Notice of Proposed Rule Making,* ET Docket 00-47, 15 FCC Rcd 24442, 24462 (2000).

[122] *See* 5 U.S.C. § 604.

[123] 5 U.S.C. § 603(b)(3).

[124] *Id.* 601(6).

[125] 5 U.S.C. § 601(3) (incorporating by reference the definition of "small business concern" in 15 U.S.C. § 632). Pursuant to the RFA, the statutory definition of a small business applies "unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register." 5 U.S.C. § 601(3).

business concern is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the SBA.[126]

The Commission has not developed a definition of small entities specifically applicable to Radio Frequency Equipment Manufacturers (RF Manufacturers). Therefore, the applicable definition of small entity is the definition under the SBA rules applicable to manufacturers of "Radio and Television Broadcasting and Communications Equipment." According to the SBA's regulation, an RF manufacturer must have 750 or fewer employees in order to qualify as a small business.[127] Census Bureau data indicates that there are 858 companies in the United States that manufacture radio and television broadcasting and communications equipment, and that 778 of these firms have fewer than 750 employees and would be classified as small entities.[128] We believe that many of the companies that manufacture RF equipment may qualify as small entities.

D. Description of Projected Reporting, Recordkeeping, and Other Compliance Requirements

We are establishing a new class of "permissive change" for software defined radios when changes are made to the software that affect the frequency, power or type of modulation. This class of change will require the manufacturer to submit a description of the software changes to the FCC or a designated Telecommunications Certification Body (TCB). The manufacturer will also be required to submit test data showing that the radio complies with the technical standards in our rules with the new software loaded. The new software cannot be loaded into radios until the FCC or TCB notifies the manufacturer that the changes are acceptable. The original FCC identification number for the equipment can continue to be used, so no re-labeling is required.[129]

We are also allowing an "electronic label" to be used on software defined radio transmitters as an alternative to the permanently affixed label the rules require for other types of devices. The equipment can display the FCC identification number by means of a liquid crystal display or similar screen.[130]

We are requiring manufacturers to take steps to ensure that only software that has been approved by the FCC or a TCB can be loaded into a transmitter. The software must not allow the user to operate the transmitter with frequencies, output power, modulation types or other parameters outside of those that were approved. Manufacturers may use authentication codes or any other means to meet these requirements, and must describe the methods in their application for equipment authorization.[131]

E. Steps Taken to Minimize Significant Economic Impact on Small Entities, and Significant Alternatives Considered

The RFA requires an agency to describe any significant alternatives that it has considered in reaching its proposed approach, which may include the following four alternatives (among others): (1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance or

[126] Small Business Act, 15 U.S.C. § 632 (1996).

[127] *See* 13 C.F.R. § 121.201, Standard Industrial Classification (SIC) Code 3663.

[128] *See* U.S. Department of Commerce, 1992 Census of Transportation, Communications and Utilities (issued May 1995), SIC category 3663.

[129] *See Order* at ¶ 14

[130] *See Order* at ¶ 35.

[131] *See Order* at ¶ 32.

reporting requirements under the rule for small entities; (3) the use of performance, rather than design, standards; and (4) an exemption from coverage of the rule, or any part thereof, for small entities.[132]

The rules adopted in this proceeding apply equally to all entities, including small entities. The rules streamline the approval process for changes to the operating parameters of software defined radios and give additional flexibility to manufacturers by permitting equipment to be labeled electronically instead of with a physical label. The benefits of these streamlined rules are granted to all entities in the same way, including small entities. There is no adverse impact on any entities large or small.[133]

A significant alternative we considered but rejected, which if adopted might have slightly reduced the burden on small entities, is to allow software changes to be approved under the Declaration of Conformity (DoC) procedure. DoC is a self-approval procedure in which the manufacturer has the equipment tested for compliance at an accredited laboratory. Once the equipment has been found to comply, it may be marketed without any approval from the FCC or a TCB. Although this alternative might have reduced the burden on small entities, we declined to adopt it because we believe that software defined radio transmitters require a higher level of oversight to ensure that they comply with the rules to prevent interference and protect users from excessive RF radiation. Certain radio transmitters are already permitted to be self-approved, and we are not making any change in the authorization requirements for them.

Even though the rules adopted in this *First Report and Order* affect all entities, including small entities, equally and confer the same benefits upon all entities, including small entities, we note that software defined radio is an evolving technology. If issues particularly involving smaller entities arise, these will be examined when we revisit this area in future proceedings. On careful reflection, we note that no commenter stated that any rule adopted herein impacts small entities in a manner different from larger entities.

Report to Congress: The Commission will send a copy of the *First Report and Order*, including this FRFA, in a report to be sent to Congress pursuant to the Congressional Review Act, *see* 5 U.S.C. § 801(a)(1)(A). In addition, the Commission will send a copy of the *First Report and Order*, including FRFA, to the Chief Counsel for Advocacy of the Small Business Administration. A copy of the *First Report and Order* and FRFA (or summaries thereof) will also be published in the Federal Register. *See* 5 U.S.C. § 604(b).

[132] *See* 5 U.S.C. § 603(c).

[133] This proceeding, therefore, may also be "certified" under the RFA. *See* 5 U.S.C. § 605(b).