

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

In the Matter of
Authorization and Use of Software Defined Radios
ET Docket No. 00-47

NOTICE OF PROPOSED RULE MAKING

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## I. INTRODUCTION

1. By this action, we propose to amend Part 2 of our rules to streamline the equipment authorization procedures for software defined radios (SDR). Specifically, we propose to define software defined radios as a new class of equipment with equipment authorization rules that reflect the additional flexibility incorporated into such radios. We propose to permit equipment manufacturers to make changes in the frequency, power and modulation of such radios without the need to file a new equipment authorization application with the Commission. We also propose to permit electronic labeling so that a third party may modify a radio's technical parameters without having to return to the manufacturer for re-labeling. We believe that these changes will facilitate the deployment and use of this new promising technology. The frequency and technology agility of software defined radios could increase the use of presently underutilized frequency bands.

## II. BACKGROUND

2. Traditionally, a radio transmitter is approved for a specific set of technical parameters, including the operating frequencies, output power, and types of radio frequency emissions. Under the current rules, if the grantee of the equipment authorization changes these parameters after a piece of equipment has been authorized, the grantee must apply for a new approval and wait until the approval is issued before the unit may be marketed with the changes.<sup>1</sup> These rules were developed to address radio characteristics defined by hardware. In comparison, the operating parameters of a software defined radio can be changed in the field by modifying its software. Such a change could violate the terms of the transmitter's equipment authorization by causing it to operate on frequencies or in modes that were not approved as part of the initial equipment authorization. In addition, our rules do not allow parties other than the grantee of the equipment authorization to make modifications to approved equipment.<sup>2</sup> Once a new approval is obtained by the original grantee, the current rules require the modified transmitter to be labeled with a new FCC identification number permanently affixed to the device.<sup>3</sup>

3. In a software defined radio, operating parameters such as the frequency and modulation type are determined by software. 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 the limits of its design, affording the user substantial flexibility to operate in multiple radio services. 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.

4. 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.

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<sup>1</sup> See 47 C.F.R. § 2.1043(a).

<sup>2</sup> See 47 C.F.R. § 2.1043(b)(3).

<sup>3</sup> See 47 C.F.R. § 2.925.

5. We view software defined radios as the result of an evolutionary process from purely hardware-based equipment to fully software-based equipment. In this regard, the process can be roughly described in three overlapping stages:

1) A hardware driven radio performs all transmit and receive functions in dedicated hardware. The transmit frequencies, modulation type and other radio frequency (RF) parameters are determined by hardware and can not be changed without hardware changes.

2) A digital radio performs part of the signal processing or transmission digitally, but is not programmable in the field. Processing may be done by digital signal processors, by fixed programs stored as firmware, or by dedicated hardware such as application-specific integrated circuits (ASICs).

3) A fully software driven, or software defined radio performs all signal processing in the digital domain using programmable digital signal processors, general purpose microprocessors, or field programmable gate arrays. All functions, modes and applications can be reconfigured by software.

6. The FCC Technological Advisory Council (TAC) has been studying issues related to the development and deployment of software defined radios. The Commission established the TAC in 1998 to provide technical advice and to make recommendations on the issues and questions presented to it by the Commission.<sup>4</sup> In May 1999, the Commission requested that the TAC assess and report on the current state of the art for software defined radios, cognitive radios, and similar devices and, to the extent possible, predict future developments for these technologies.<sup>5</sup> The TAC was also requested to suggest ways that the availability of such devices might affect the Commission's traditional approaches to spectrum management, as well as ways the agency could facilitate experimentation and commercial deployment of such devices. In response, the TAC issued a paper in August of 1999 discussing the evolution of software defined radio and its significant benefits in responding to the tremendous growth of mobile communications, as well as its potential role in designing, facilitating, operating and implementing a broad array of services and applications in the telecommunications and information transfer technologies.<sup>6</sup>

7. In March 2000, the Commission issued a *Notice of Inquiry (Notice)* on software defined radios.<sup>7</sup> The *Notice* was intended to solicit comments from as broad an audience as possible. Twenty-four parties filed comments in response to the *Notice*, and nine parties filed reply comments. A list of parties responding is included in Appendix B.

### III. DISCUSSION

8. The *Notice* sought comments in four broad areas related to software defined radios: 1) the state of technology, 2) improving interoperability between radio services, 3) improving spectrum efficiency

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<sup>4</sup> See *Public Notice, FCC Requests Nominations for Membership on the Technological Advisory Council*, released December 1, 1998. The TAC consists of 25 individuals from industry and academia, plus a designated Federal Officer. For a list of TAC members, please see <http://www.fcc.gov/oet/tac/members.html>.

<sup>5</sup> See *Official Requests from the Federal Communications Commission to the Technological Advisory Council*, dated May 26, 1999, available at [www.fcc.gov/oet/tac/requests.pdf](http://www.fcc.gov/oet/tac/requests.pdf).

<sup>6</sup> TAC documents on software defined radios are available at <http://www.fcc.gov/oet/tac/focusgroups.html>. To view them, click on the link for the Spectrum Management Website, then click on the link for software defined radios.

<sup>7</sup> See *Inquiry Regarding Software Defined Radios, Notice of Inquiry*, [ET Docket 00-47](http://www.fcc.gov/et/docket/00-47), 15 FCC Rcd 5930 (2000).

and spectrum sharing, and 4) the equipment approval process.<sup>8</sup> The comments received in each of these four areas are summarized below. In addition, we propose certain changes to our equipment authorization rules.

## A. Areas of Inquiry

### 1. State of Technology

9. The *Notice* asked for comments on the state of software defined radio technology, including the features that could be controlled by software, the capabilities of software defined radios, the technological limitations, and when software defined radios could be deployed commercially.<sup>9</sup> Based upon the comments, it appears that most features in a radio could eventually be controlled by software. For example, NTIA states that nearly every RF attribute subject to regulation is potentially software controllable, including tuning range, channeling, bandwidth, bit rate, modulation frequency, pre-emphasis, deviation ratio, power, pulse characteristics, and digital-to-analog (D/A) converter update rate.<sup>10</sup> Several other parties note the wide range of attributes that could eventually be controlled by software.<sup>11</sup> The comments also recognize that software defined radios could have multi-band, multi-mode and multi-function capabilities that are not present in current radios. For example, software defined radios could allow post-manufacture re-programmability, and common hardware platforms for manufacturers.<sup>12</sup> Software defined radios could also permit base stations of reduced size and enhanced technical flexibility at lower prices than base stations employing a separate transceiver for each radio frequency carrier.<sup>13</sup>

10. However, some commenters note that a number of limitations currently exist in software defined radio technology. NTIA states that software defined radios may have added size, weight and power consumption relative to a single function radio implemented in hardware. They may also be limited in their ability to reconfigure the analog RF front ends and transmitter output stages.<sup>14</sup> Operation across multiple bands requires that the transmitter have a highly linear power amplifier, and a receiver front end with a large dynamic range, high linearity and wide bandwidth.<sup>15</sup> In addition, several parties state that more work must be done to increase the bandwidth and dynamic range of D/A and analog-to-digital (A/D) converters and to increase the speed and decrease the cost and power consumption of digital signal processors and memory.<sup>16</sup>

11. We believe that the state of software defined radio technology is sufficiently developed to move forward at this time with proposed rules. As the comments indicate, the initial deployment of software defined radio technology is under way. The technology is continuing to develop and significant new technical capabilities will be possible. While the technology is currently only available in base stations,

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<sup>8</sup> See *Notice* at ¶ 8, ¶ 10, ¶ 12 and ¶ 18.

<sup>9</sup> See *Notice* at ¶ 9.

<sup>10</sup> See NTIA comments at 5.

<sup>11</sup> See SDR Forum comments at 8, AirNet comments at 5, and SBC comments at 5-6.

<sup>12</sup> See Bellsouth comments at B-4 and Motorola comments at 3.

<sup>13</sup> See SBC comments at 8 and 9, Hypres comments at 4, and AirNet comments at 6-7.

<sup>14</sup> See NTIA comments at 6-7.

<sup>15</sup> See SBC comments at 7.

<sup>16</sup> See Nortel comments at 3-4, Bellsouth comments at B-2 and SDR Forum comments at 9.

widespread handset use is expected within five years.<sup>17</sup> This technology should eventually allow control of virtually all parameters in a radio transmitter. We note that there are currently limitations such as cost, complexity, size and the speed of the circuitry, but the technology is improving.

## 2. Improving Interoperability between Radio Services

12. The *Notice* asked for comments on how software defined radios could improve interoperability between public safety agencies, improve interoperability between equipment and services using differing transmission standards, help move toward uniformity in standards, and facilitate transitions from one technical standard to another. The comments generally agree that software defined radios could help improve interoperability between public safety agencies, although that may not occur in the immediate future.<sup>18</sup> The comments also note that software defined radios have the potential to facilitate interoperability in commercial radio services, although there are a number of issues that need to be resolved, such as protocols, channel establishment procedures, authentication and fraud detection, before roaming between networks that support different standards is possible.<sup>19</sup> The comments describe a number of methods by which software defined radios could facilitate interoperability, including multiple channel operations, translation, smart antennas that can operate over multiple bands, multiband power amplifiers, tunable preselectors, interference cancellers, low noise synthesizers, wideband low noise amplifiers and mixers, high throughput digital signal processors (DSPs) and smaller chip packaging.<sup>20</sup>

13. While technical limitations remain, it appears that software defined radios could help improve interoperability between public safety agencies as well as between commercial radio services through their ability to handle different transmission standards. We tentatively conclude that there is no need to propose rule changes at this time to improve interoperability between radio services, but we will continue to monitor developments in this area as the technology develops.

## 3. Improving Spectrum Efficiency and Spectrum Sharing

14. The *Notice* requested comments on how software defined radios could improve the efficiency of spectrum use, the particular spectrum use functions that they could perform, the benefits of the spectrum sharing arrangements described in the *Notice*, and the changes to the Commission's spectrum allocations process that may be appropriate. Most commenters addressing this issue recognize the potential for software defined radios to improve the efficiency of spectrum use.<sup>21</sup> For example, Hypres states that software defined radios could have the ability to improve bandwidth utilization by the use of

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<sup>17</sup> See SDR Forum comments at 6, 12-13, Bellsouth comments at B-5,6, Vanu comments at 2, and SBC comments at 11.

<sup>18</sup> See NTIA comments at 13, PSWN reply comments at 2, and NCC comments at 2.

<sup>19</sup> See Harris comments at 5 and SBC comments at 12-13. A protocol is a set of rules that governs how information is sent from one point to another. Devices that use different protocols would not be able to communicate with each other, even if they were on the same frequency. Channel establishment procedures are the methods used by devices such as cellular handsets and base stations determine the frequency that will be used to communicate. Authentication and fraud detection determine whether a particular user is authorized to use a network, and whether a user is deliberately operating without authorization.

<sup>20</sup> See SDR Forum comments at 15, Vanu comments at 5, AirNet comments at 8, and NTIA comments at 13-14.

<sup>21</sup> See SDR forum comments at 15, Bellsouth comments at B-12, Motorola comments at 27 and NTIA comments at 15. The comments note that there are at least two definitions of the efficiency of spectrum use. One is spectral efficiency, expressed as bits per second per Hertz (BPS/Hz). This is a measure of the rate of data transmission within a given bandwidth. More efficient types of modulation result in a higher spectral efficiency. Another measure of efficiency is channel or utilization efficiency, which refers to the amount of a block of spectrum that is in use.

programmable filters and the ability to change characteristics in response to various signal/input rates, various environment conditions and conditions related to the density of users.<sup>22</sup> However, a number of parties express concern that the spectrum efficiency benefits of software defined radios are not yet technically or commercially feasible and no regulatory changes should take place at this time.<sup>23</sup> In addition, the Federal Law Enforcement Wireless Users Group (FLEWUG) is concerned that software defined radios could potentially disrupt public safety operations when looking for unused channels, and that the benefits of real-time frequency selection have yet to be determined.<sup>24</sup> A few parties suggest changes to the way the Commission currently allocates or licenses spectrum to allow greater spectrum sharing through greater flexibility and secondary use.<sup>25</sup> However, the majority of the parties believe that no changes should be made to the spectrum allocation rules at this time and caution the Commission that software defined radios are not a replacement for conventional spectrum management policy.<sup>26</sup>

15. We agree with the general consensus of the commenters that software defined radio technology shows significant promise to improve the efficiency of spectrum use in the long run. In our recently adopted Policy Statement on promoting spectrum efficiency through the development of secondary markets,<sup>27</sup> we noted the critical role that frequency agile equipment, such as SDR, will play in the ability of service providers to rapidly begin operations in a newly acquired band of frequencies or to operate economically on a term basis on leased spectrum. We tentatively conclude that there is no need to propose rule changes at this time to increase the efficiency of spectrum use as related to SDR, but we will continue to monitor developments in this area as the technology develops.

#### 4. Equipment Approval Process

16. The *Notice* sought comments on a number of issues related to the authorization of software defined radios, including the approval of radio hardware and/or software; the required compliance measurements<sup>28</sup>; the authorization process; the regulation of software changes; and the need for requirements to prevent unauthorized modifications to equipment.<sup>29</sup> A number of commenters believe that radio hardware and software should be approved together for software defined radios.<sup>30</sup> SBC states that an approval of the combination is necessary because the software controls the hardware, and a change in software could potentially put the equipment in violation of the rules. The SDR Forum believes that each possible combination of hardware and software that a radio will support should be tested in the same fashion that single mode systems are tested today. NTIA states that software defined radio technology has not matured to the point where it is possible to predict radio RF parameters from

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<sup>22</sup> See Hypres comments at 5.

<sup>23</sup> See SBC comments at 16, Nokia comments at 8, Bellsouth comments at B-13, and SDR Forum reply comments at 4.

<sup>24</sup> See FLEWUG reply comments at 3, 5.

<sup>25</sup> See Dandin *ex parte* comments at 5, SDR Forum comments at 22, and SDR Forum comments at 30.

<sup>26</sup> See SBC reply comments at 4, AT&T reply comments at 1, Nortel comments at 10-11, Bellsouth comments at B-15 – B-17, and Motorola comments at 27.

<sup>27</sup> See *In the Matter of Principles for Encouraging the Development of Secondary Markets for Spectrum, Policy Statement (Policy Statement)*, ¶¶ 1, 32-33, adopted November 9, 2000. An effectively functioning system of secondary markets would allow and encourage licensees to freely trade their unused or unneeded spectrum capacity, either leasing it temporarily, or on a longer term basis or selling unused frequencies.

<sup>28</sup> Part 2 of the rules requires the following measurements on transmitters used in licensed services: RF power, modulation characteristics, occupied bandwidth, spurious emissions at antenna terminals, field strength of spurious emissions and frequency stability. See 47 C.F.R. §§ 2.1046 through 2.1055.

<sup>29</sup> See *Notice* at ¶ 19.

<sup>30</sup> See SBC comments at 17, SDR Forum comments at 31, and NTIA comments at 18.

examining only the software or hardware. It further states that separate hardware or software approval will only be possible if a consistent predictable connection between the software and hardware can be established.<sup>31</sup>

17. Several parties suggest changes to the equipment authorization procedures for software defined radios. There was general consensus that the Commission's current equipment authorization procedures could be overly burdensome and could limit the benefits of the enhanced flexibility of software defined radios. A number of parties recommend manufacturer's self-approval for software defined radios instead of approval by the Commission.<sup>32</sup> The SDR Forum believes that changes should be made to the current labeling requirement.<sup>33</sup> It suggests that all information currently required to be displayed on the FCC label could be made available on a liquid crystal display (LCD) or light emitting diode (LED) display, which would eliminate the need to re-label equipment in the field when the software is changed. Lucent suggests a different approach of allowing software changes to be authorized as Class II permissive changes to avoid burdensome renumbering and re-labeling requirements.<sup>34</sup> We also received comments that the Commission needs to distinguish between software that affects the RF emissions from a device and software that does not.<sup>35</sup> We agree that changes to the authorization procedure for software defined radios, as discussed below, would facilitate the authorization and deployment of software defined radios. We seek comment on this tentative conclusion.

18. We agree that radio hardware and software should be approved together. Software defined radio technology has not matured at this point in time where it is possible to predict the RF characteristics of a radio from either the hardware or software alone. Therefore, we propose, as supported by the SDR Forum, that each combination of hardware and software that a radio supports should be tested. This is the only way at the present time to ensure that equipment complies with the technical standards in our rules to prevent interference and to protect users from excessive RF radiation. We anticipate that testing each hardware/software combination that will be used in a software defined radio would be no more burdensome than the current process which requires testing each mode in which a radio operates. We request comments on this tentative conclusion.

## **B. Proposed Rule Changes**

19. One of the major advantages of software defined radios is their ability to be reprogrammed in the field to operate in new frequency bands or in new transmission modes as technology changes. However, the current rules for authorizing radio equipment do not anticipate such modifications. As written, they could tend to discourage or inhibit the deployment and use of software defined radios. In this section, we propose rule changes to facilitate the deployment of software defined radios to consumers. Our proposals are limited to equipment authorization matters at this time, as commenters cited those rules as the most immediate regulatory barrier to the use of software defined radios in the near term. Specifically, we propose below a definition of software defined radios and a new alternative streamlined equipment approval process for such radios. We will continue to monitor the development of software defined radios and their implications for interoperability and spectrum management. We will propose additional rule changes in the future as warranted. We expect that this *Notice* will be the first in a series of actions to facilitate the deployment and use of this new technology.

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<sup>31</sup> See NTIA comments at 20.

<sup>32</sup> See Nortel comments at 8, Ericsson comments at 4 and Lucent comments at 3-4.

<sup>33</sup> See SDR Forum reply comments at 4.

<sup>34</sup> See Lucent reply comments at 2.

<sup>35</sup> See Nortel comments at 8.

20. In proposing new rules, we seek to ensure that our regulatory requirements keep pace with technology development. Consistent with this objective, we recognize that we must strike an appropriate balance between administrative burden and the need to ensure compliance with our technical rules. While we want to encourage the deployment of new software defined radio technology, we are concerned that the technical requirements in our rules continue to be met. We are specifically concerned about ensuring that changes to power levels are consistent with our RF exposure rules. We are also concerned with maintaining an ability to ensure that radios are only operated on approved frequency bands. We believe that the proposals we are making herein achieve the appropriate balance. However, we invite comment on other methods that may enable us to ensure that these objectives are met.

### 1. Definition of Software Defined Radio

21. We recognize that there is no universally accepted definition of a software defined radio. We stated in the *Notice* that many radios now contain microprocessor technology that can control functions such as frequency and power. Until recently, these functions were controlled by firmware<sup>36</sup> installed at the factory and are not readily changeable by the user. As noted above, radios are currently being developed that can be reprogrammed to new operating parameters in the field. To facilitate the development of these types of radios, we propose a new, more flexible equipment approval process. We propose the following definition of software defined radio to delineate what types of devices fall within the proposed new rules.

A software defined radio is 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 in software without making any hardware changes.<sup>37</sup>

We seek comments on the sufficiency of this definition or any alternative definitions that may be more appropriate.

### 2. New Class III Permissive Change

22. 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. If changes are made to the operating frequencies, output power, and types of radio frequency emissions after a piece of equipment has been authorized, the grantee must apply for a new approval and wait until the approval is issued before the unit may be marketed with the changes.<sup>38</sup> Changes to the operating parameters of a software defined radio in the field could violate the terms of the transmitter's equipment authorization by causing it to operate on frequencies or in modes for which it has not been approved. Even if a new approval were obtained, the current rules require the modified transmitter to be labeled with a new FCC identification number permanently affixed to the device,<sup>39</sup> which would be impractical in the case of software modification of equipment in the field.

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<sup>36</sup> Firmware is software installed in a device that is typically stored in a read only memory (ROM) or programmable read only memory (PROM).

<sup>37</sup> This definition is not intended to encompass cellular telephones that use software simply to control functions such as power or frequency within a range approved by the Commission pursuant to Part 22 of the rules.

<sup>38</sup> See 47 C.F.R. § 2.1043(a).

<sup>39</sup> See 47 C.F.R. § 2.925.



23. Our rules allow two classes of “permissive changes” for authorized equipment without requiring a new FCC identification number.<sup>40</sup> Class I permissive changes include modifications that do not affect the RF emissions from a device. No filing is required for such a change. Class II permissive changes include modifications other than frequency, modulation or power that affect the RF emissions from a device.<sup>41</sup> These 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.

24. The rules for authorizing transmitters were originally developed years ago 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 we required the equipment to be labeled with a new identification number. However, in a software defined radio, changes to these operating parameters could be accomplished in the field by a software change with no change in hardware. We agree with the comments that the current application filing and equipment labeling requirements could be unnecessarily burdensome for software defined radios and could inhibit their development. At the same time, given the early state of software defined radio technology development, we do not believe that a manufacturer’s self-approval approach, as suggested by some of the commenting parties, is appropriate at this time for software defined radio equipment. Equipment is generally placed in the self-approval category after the Commission has gained some experience that manufacturers can and will produce equipment that complies with the rules. Further experience with software defined radio equipment is necessary before we can determine whether self-approval is appropriate. We do believe, however, that some relaxation of the current equipment authorization procedures is appropriate. Thus, we propose to develop a more streamlined authorization procedure for changes to software defined radios.<sup>42</sup>

25. Specifically, we propose that changes in the frequency, power, and modulation type of a software defined radio could be authorized as a new class of permissive change, which we propose to designate as Class III. This would eliminate the need to re-label equipment when new software is loaded and would streamline the filing procedure for changes to approved devices. Software changes that do not affect these operating parameters would be treated as Class I permissive changes, so no filing would be required for them.<sup>43</sup> The applicant for a Class III change would submit test data showing that the equipment complies with the applicable requirements for the service(s) or rule parts under which it will operate with the new software loaded.<sup>44</sup> The applicant would also have to demonstrate

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<sup>40</sup> See 47 C.F.R. § 2.1043.

<sup>41</sup> 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.

<sup>42</sup> We are not proposing changes to the requirements for amateur radio transmitters at this time. See 47 C.F.R. §§ 2.815, 97.315 and 97.318. See also, *Extended Coverage High Frequency Transceivers*, Public Notice [62882](#), dated May 13, 1996.

<sup>43</sup> For example, changes to the user interface, such as information displayed, audio output or keyboard programming may be done through software changes that do not affect the operating parameters.

<sup>44</sup> 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 (continued....)

compliance with the applicable RF exposure requirements. The Commission would notify the applicant by letter when a permissive change is granted. Once a Class III permissive change has been granted for new software that affects the operating parameters, the software could be loaded into units in the field. The record in the Commission's database for each authorized device would 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.

26. We propose that the original certification application must identify the equipment as a software defined radio, and that only the grantee of the authorization for a software defined radio may file for a Class III permissive change. We also propose that Class III permissive changes may only be made to equipment in which no hardware changes have been made from the originally approved device to eliminate ambiguity about which hardware and software combinations have been approved. We recognize that while the filing procedure for permissive changes is streamlined, Commission staff is still required to perform a technical review of the new test data for compliance with the rules. Therefore, we propose 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.<sup>45</sup>

27. We seek comments on the proposals described above, including whether a new class of permissive change should be established, the type of information that should be submitted to show compliance with the service rules and RF exposure requirements, the appropriate filing fee for such changes, whether parties other than the grantee should be allowed to file for permissive changes.

28. In addition, we seek comments on whether this new class of permissive change should be limited to software changes only, whether we should allow a combination of hardware and software permissive changes in a single device, whether there is a need for applicants to submit a copy of radio software to the Commission, and whether we should place limits on the number of hardware and software combinations under a single approval.<sup>46</sup> We further seek comment on the benefits of the proposed new permissive change compared to the existing requirement for new identification numbers if we allow the alternative labeling method described below.

29. We believe that 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 application software. To help realize this benefit, we are proposing an option for software defined radios to be equipped with an "electronic label" to display the FCC identification number by means of a light emitting diode (LED) display, a liquid crystal display (LCD) screen or other similar method. 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. The information would have to be readily accessible in a manner that allows it to be easily viewed. We request comments on this proposal, including whether there is a need for this capability, the type of display that should be required, the means that should be required for accessing the information, and the information to be displayed. We recognize that not all transmitters that are potentially programmable would normally have an LED, LCD or similar display, so we also

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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.

<sup>45</sup> See 47 C.F.R. § 1.1103.

<sup>46</sup> For example, a spread spectrum transmitter approved under Part 15 of the rules may be tested with more than 20 different antennas to ensure it will comply with the rules in every possible configuration. Allowing multiple software variations as well would substantially increase the number of possible hardware/software combinations that could exist under a single approval.

request comments on whether manufacturers would need to add such displays to take advantage of the electronic labeling capability. We also seek comments on whether electronic labeling should be permitted for other types of equipment besides software defined radios.

### 3. Unauthorized Software Modifications

30. In response to the *Notice*, several parties raised issues related to unauthorized software modifications.<sup>47</sup> NTIA believes that software defined radios should be built to a common standard that uses authentication to ensure that radios can only run authorized waveform software, and that radios should have digital serial numbers to identify groups of users, such as commercial or government.<sup>48</sup> The SDR Forum notes that it is working with the European Telecommunications Standards Institute (ETSI) to develop a software download protocol that includes authentication, and that public-key technology can be used to provide encryption and digital signatures.<sup>49</sup> However, AirNet and Lucent believe that an authentication system for software is not necessary and could prolong the time to market for equipment.<sup>50</sup>

31. We tentatively conclude that a means will be necessary to avoid unauthorized modifications to software that could affect the compliance of a radio. However, groups such as the SDR Forum and ETSI are still in the process of developing standards for encryption and digital signatures. While we believe we may eventually have to adopt rules addressing software authentication, we believe it would be premature for us to propose specific requirements for authentication while standards are still under development. Accordingly, at this time we are proposing a more general requirement that manufacturers must 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. The software must not allow the user to operate the radio with frequencies, output power, modulation types or other parameters outside of those that were approved. Manufacturers may use authentication or any other means to meet these requirements, and must describe the methods in their application for equipment authorization. The grantee of an equipment authorization is responsible for ensuring the integrity of the authentication or security system. Failure to do so could result in the revocation of the authorization. We believe that this proposal would protect against harmful interference and safety hazards from software defined radios without interfering with the development of the technology. We request comments on this proposal, including whether it could impede legitimate third party software developers from developing applications for software defined radios. We also seek comments on the types of authentication standards that are likely to be developed, whether the standards should be industry developed or government sponsored, whether the standards should be voluntary or mandatory, and whether these standards would be applicable to all types of software defined radio equipment.

### 4. Other Matters

32. The comments support retaining the measurements required in Part 2 of the Commission's rules for radio transmitters.<sup>51</sup> AirNet and NTIA also state that additional measurements may be necessary. AirNet believes that radio equipment should be tested for linearity to ensure that software modifications

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<sup>47</sup> See *Notice* at ¶ 18-21.

<sup>48</sup> See NTIA comments at 26.

<sup>49</sup> See SDR Forum comments at 35-37.

<sup>50</sup> See AirNet comments at 15-16 and Lucent comments at 4.

<sup>51</sup> See SDR Forum comments at 32.

will not degrade out-of-band emission performance.<sup>52</sup> NTIA believes that tests should be performed on adaptive spectrum access algorithms and on signal distortions caused by digitization.<sup>53</sup> We do not believe that there is a demonstrated need to make any changes to the current required measurements in the rules, and thus decline to propose changes at this time. The current rules already address out-of-band emissions, and it has not been shown that signal distortions in software defined radios would be any worse than those in other radios. Therefore, there does not appear to be a need to propose additional requirements for linearity and other distortions. We note that the Commission's Technological Advisory Council (TAC) has been discussing "rule based systems" or logical algorithms for spectrum use by software defined radios.<sup>54</sup> In such a system, a software defined radio transmitter is programmed to follow a sequence of steps in locating frequencies to use. These algorithms may enable sharing of spectrum without causing interference to other users. The algorithms could vary from system to system and in different geographic areas of the country. We believe that such spectrum sharing has the potential to be beneficial. However, we believe it is premature to propose requirements on spectrum access algorithms because such technology is still under development. We seek comment on any policy impacts of such systems, the expected timing of their deployment, and whether any rule changes are necessary.

33. In General Docket 98-68, we established the requirements for TCBs that can approve equipment in the same manner as the Commission.<sup>55</sup> 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.<sup>56</sup> Because software defined radios are a new technology and we are proposing new rules to accommodate them, we expect that many questions about the application of the rules would arise. Therefore, we tentatively conclude 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.<sup>57</sup> We request comments on this tentative conclusion.

34. We believe that the rule changes we are proposing will allow manufacturers greater flexibility in obtaining approval for software defined radios and will facilitate deployment of this equipment to consumers. We further believe that the proposed requirements for authentication of software will provide a safeguard against unauthorized modifications of approved equipment. However, we recognize 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. Therefore, we request comments on whether we should enhance our enforcement capabilities and what particular changes we should make. For example, should we establish requirements prohibiting manufacturers or grantees from knowingly

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<sup>52</sup> See AirNet comments at 13.

<sup>53</sup> See NTIA comments at 21.

<sup>54</sup> We note that while engineers typically refer to "rule based systems", the term "rules" could be confused with the Commission's regulations. Therefore, we will use the term "algorithms" instead of "rules". Documents presented at the TAC are available at <http://www.fcc.gov/oet/tac/focusgroups.html>. In addition, a video recording of the September 27, 2000 TAC meeting is available online at <http://www.fcc.gov/realaudio/publicforums.html>.

<sup>55</sup> 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).

<sup>56</sup> *Id.* at ¶ 33.

<sup>57</sup> 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.

marketing software that would cause a software defined radio to operate in violation of the Commission's rules<sup>58</sup>? We request comments on this and any other matters that may be pertinent to software defined radios.

#### IV. PROCEDURAL MATTERS

35. As required by Section 603 of the Regulatory Flexibility Act, 5 U.S.C. § 603, the Commission has prepared an Initial Regulatory Flexibility Analysis (IRFA) of the possible economic impact on small entities of the policies and rules proposed in this document. The IRFA is set forth in Appendix C. Written public comments are requested on the IRFA. These comments must be filed in accordance with the same filing deadlines as comments filed in this *Notice of Proposed Rule Making* as set forth in paragraph 38, but they must have a separate and distinct heading designating them as responses to the IRFA.

##### Initial Paperwork Reduction Act of 1995 Analysis

36. This NPRM contains either a proposed or modified information collection. As part of its continuing effort to reduce paperwork burdens, we invite the general public and the Office of Management and Budget (OMB) to take this opportunity to comment on the information collections contained in this NPRM, as required by the Paperwork Reduction Act of 1995, Public Law 104-13. Public and agency comments are due at the same time as other comments on this NPRM; OMB comments are due 60 days from date of publication of this NPRM in the Federal Register. Comments should address: (a) whether the proposed 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.

37. This is a permit-but-disclose notice and comment rule making proceeding. *Ex parte* presentations are permitted, except during the Sunshine Agenda period, provided they are disclosed as provided in the Commission's rules. *See generally* 47 C.F.R. §§ 1.1202, 1.1203, and 1.2306(a).

38. Pursuant to Sections 1.415 and 1.419 of the Commission's Rules, 47 C.F.R. §§ 1.415 and 1.419, interested parties may file comments on or before **[75 days from date of publication in the Federal Register]** and reply comments on or before **[135 days from date of publication in the Federal Register]**. Comments may be filed using the Commission's Electronic Comment Filing System (ECFS), <http://www.fcc.gov/e-file/ecfs.html>, or by filing paper copies. *See Electronic Filing of Documents in Rulemaking Proceedings*, 63 Fed. Reg. 23,121 (1998).

39. Comments filed through the ECFS can be sent as an electronic file via the Internet to <http://www.fcc.gov/e-file/ecfs.html>. Generally, only one copy of an electronic submission must be filed. If multiple docket or rule making numbers appear in the caption of this proceeding, however, commenters must transmit one electronic copy of the comments to each docket or rule making number referenced in the caption. In completing the transmittal screen, commenters should include their full name, Postal Service mailing address, and the applicable docket or rule making number. Parties may

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<sup>58</sup> Marketing as defined by the Commission's rules includes selling, offering for sale, and advertising. *See* 47 C.F.R. § 2.803(e)(4).

also submit an electronic comment by Internet e-mail. To get filing instructions for e-mail comments, commenters should send an e-mail to [ecfs@fcc.gov](mailto:ecfs@fcc.gov), and should including the following words in the body of the message, "get form <your e-mail address>." A sample form and directions will be sent in reply.

40. Parties who choose to file by paper must file an original and four copies of each filing. If more than one docket or rule making number appear in the caption of this proceeding, commenters must submit two additional copies for each additional docket or rule making number. All filings must be sent to the Commission's Secretary, Magalie Roman Salas, Office of the Secretary, Federal Communications Commission, 445 12th Street, S.W., TW-A325, Washington, D.C. 20554. Comments and reply comments will be available for public inspection during regular business hours in the FCC Reference Center of the Federal Communications Commission, Room TW-A306, 445 12th Street, S.W., Washington, D.C. 20554.

41. Parties who choose to file by paper should also submit their comments on diskette. Such a submission should be on a 3.5-inch diskette formatted in an IBM compatible format using Microsoft Word or compatible software. The diskette should be accompanied by a cover letter and should be submitted in "read only" mode. The diskette should be clearly labeled with the commenter's name, proceeding (including the lead docket number), type of pleading (comment or reply comment), date of submission, and the name of the electronic file on the diskette. The label should also include the following phrase "Disk Copy – Not an Original." Each diskette should contain only one party's pleading, preferably in a single electronic file. In addition, commenters must send diskette copies to the Commission's copy contractor, International Transcription Service, Inc., 1231 20th Street, N.W., Washington, D.C. 20037.

42. Alternative formats (computer diskette, large print, audio cassette and Braille) are available to persons with disabilities by contacting Martha Contee at (202) 418-0260, TTY (202) 418-2555, or via e-mail to [mcontee@fcc.gov](mailto:mcontee@fcc.gov). This Notice of Proposed Rule Making can also be downloaded at <http://www.fcc.gov/oet>.

43. Written comments by the public on the proposed and/or modified information collections are due at the same time as comments on the NPRM. Written comments must be submitted by the Office of Management and Budget (OMB) on the proposed and/or modified information collections on or before **[60 days after date of publication in the Federal Register.]** In addition to filing comments with the Secretary, a copy of any comments on the information collection(s) contained herein should be submitted to Judy Boley, Federal Communications Commission, Room 1-C804, 445 12th Street, SW, Washington, D.C. 20554, or via the Internet to [jboley@fcc.gov](mailto:jboley@fcc.gov) and to Virginia Huth, OMB Desk Officer, 10236 NEOB, 725 – 17th Street, N.W., Washington, D.C. 20503, or via the Internet to [vhuth@omb.eop.gov](mailto:vhuth@omb.eop.gov).

44. Accordingly, IT IS ORDERED that pursuant to the authority contained in Sections 4(i), 301, 302, 303(e), 303(f), 303(r), 304 and 307 of the Communications Act of 1934, as amended, 47 USC Sections 154(i), 301, 302, 303(e), 303(f), 303(r), 304, and 307, this Notice of Proposed Rule Making IS ADOPTED.

45. IT IS FURTHER ORDERED that the Commission's Consumer Information Bureau, Reference Information Center, SHALL SEND a copy of this NPRM, including the Initial Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

46. To make cited sources more easily available to the readers, we are testing the use of hyperlinks to some FCC documents that are cited in this document. The World Wide Web addresses/URLs that we give here were correct at the time this document was prepared but may change over time. We do not have staff dedicated to updating these URLs, however, so readers may find some URLs to be out of date as time progresses. We also advise that the only definitive text of FCC documents is the one that is published in the FCC Record. In case of discrepancy between the electronic documents cited here and the FCC Record, the version in the FCC Record is definitive.

47. For further information regarding this Notice of Proposed Rule Making, contact Mr. Hugh L. Van Tuyl, Office of Engineering and Technology, (202) 418-7506, e-mail [hvantuyl@fcc.gov](mailto:hvantuyl@fcc.gov).

FEDERAL COMMUNICATIONS COMMISSION

Magalie Roman Salas  
Secretary

**APPENDIX A: PROPOSED RULES**

For the reasons set forth above, Parts 1 and 2 of title 47 of the Code of Federal Regulations are proposed to be 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. * * * * *	731 & 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 proposed to be 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 the transmitter, including the frequency range, modulation type and maximum radiated or conducted output power can be altered by making a change in software without making any hardware changes.

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5. Section 2.932 is proposed to be 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 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.

6. Section 2.1043 is proposed to be revised to read as follows:

#### **§ 2.1043 Changes in certificated equipment.**

(a) Except for Class III permissive changes, 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.

(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 affect the frequency, modulation type, output power or maximum field strength. 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.

(4) Class III permissive changes may only be made by the original grantee. Class I and Class II permissive changes may only be made by the original grantee, except as specified below.

\* \* \* \* \*

7. 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.**

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(e) A software defined radio may be equipped with a means such as a user display screen to display the information normally contained in the nameplate or label. The information must be readily accessible.

\* \* \* \* \*

**APPENDIX B: LIST OF COMMENTING PARTIES**Comments

1. AirNet Communications Corp. (AirNet)
2. American Petroleum Institute (API)
3. APCO
4. Amateur Radio Relay League (ARRL)
5. Bellsouth
6. Dandin Group
7. Educase
8. Ericsson
9. Harris Corp.
10. Hypres, Inc. (Hypres)
11. Industrial Telecommunications Association (ITA)
12. Lucent Technologies (Lucent)
13. Motorola
14. National Telecommunications and Information Administration (NTIA)
15. Network Technology Division
16. Nokia, Inc. (Nokia)
17. Nortel Networks, Inc. (Nortel)
18. Public Safety National Coordination Committee
19. Red Bat Communications
20. SBC Wireless (SBC)
21. SDR Forum
22. Shared Spectrum Company
23. Technological Advisory Council (TAC)
24. Vanu, Inc. (Vanu)

Reply Comments

1. AirNet Communications Corporation (AirNet)
2. AT&T Wireless Services, Inc. (AT&T)
3. Bellsouth
4. Federal Law Enforcement Wireless Users Group (FLEWUG)
5. Frederick G. Griffin (Cleve Watkins)
6. Lucent Technologies, Inc. (Lucent)
7. Public Safety Wireless Network (PSWN)
8. SBC Wireless, Inc. (SBC)
9. SDR Forum

## APPENDIX C: INITIAL REGULATORY FLEXIBILITY ANALYSIS

As required by the Regulatory Flexibility Act (RFA),<sup>59</sup> the Commission has prepared this present Initial Regulatory Flexibility Analysis (IRFA) of the possible significant economic impact on small entities by the policies and rules proposed in this *Notice of Proposed Rule Making (NPRM)*. Written public comments are requested on this IRFA. Comments must be identified as responses to the IRFA and must be filed by the deadlines for comments provided in paragraph 38 of this *NPRM*. The Commission will send a copy of this *NPRM*, including this IRFA, to the Chief Counsel for Advocacy of the Small Business Administration (SBA).<sup>60</sup> In addition, the *NPRM* and IRFA (or summaries thereof) will be published in the Federal Register.<sup>61</sup>

### A. Need for, and Objectives of, the Proposed Rules

A number of parties are currently developing software defined radio technology. 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 current rules do not prohibit software programmable radios. However, they require a new approval and a new identification number on a permanently affixed label when changes to the frequency, power or type of modulation are made. The requirement to re-label equipment in the field when a change is made could tend to discourage deployment of software defined radios to consumers. Therefore, we are proposing changes to our equipment authorization rules to facilitate such deployment. These changes would streamline the equipment approval process for software defined radios and would reduce the filing burden on applicants.

### B. Legal Basis

The proposed action is authorized under Sections 4(i), 301, 302, 303(e), 303(f), 303(r), 304 and 307 of the Communications Act of 1934, as amended, 47 U.S.C. Sections 154(i), 301, 302, 303(e), 303(f), 303(r), 304 and 307.

### C. Description and Estimate of the Number of Small Entities To Which the Proposed 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.<sup>62</sup> The RFA generally defines the term "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction."<sup>63</sup> In addition, the term "small business" has the same meaning as the term "small business concern" under the Small Business Act.<sup>64</sup> A small business

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<sup>59</sup> 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).

<sup>60</sup> See 5 U.S.C. § 603(a).

<sup>61</sup> See *id.*

<sup>62</sup> 5 U.S.C. § 603(b)(3).

<sup>63</sup> *Id.* 601(6).

<sup>64</sup> 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 (continued....)

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.<sup>65</sup>

The Commission has not developed a definition of small entities 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.<sup>66</sup> 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.<sup>67</sup> 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 propose to establish 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 would require the manufacturer to submit a description of the software changes to the FCC or a designated Telecommunications Certification Body (TCB). The manufacturer would 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 could not 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 could continue to be used, so no re-labeling would be required.

We also proposed to allow an "electronic label" to be used on software defined radio transmitters as an alternative to the permanently affixed label the rules currently require. The equipment would display the FCC identification number by means of a liquid crystal display or similar screen.

We further proposed that manufacturers must 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.

#### **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

(Continued from previous page) \_\_\_\_\_

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).

<sup>65</sup> Small Business Act, 15 U.S.C. § 632 (1996).

<sup>66</sup> See 13 C.F.R. § 121.201, Standard Industrial Classification (SIC) Code 3663.

<sup>67</sup> See U.S. Department of Commerce, 1992 Census of Transportation, Communications and Utilities (issued May 1995), SIC category 3663.

the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance or 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.<sup>68</sup>

We considered three alternatives to streamline the requirements for software defined radios, which will reduce the burden on small entities.

The first alternative, which we proposed in the NPRM, would permit changes in the frequency, power, and modulation type of a software defined radio to be authorized as a new class of permissive change. A new FCC identification number is not required for permissive changes, so there would be no need to re-label equipment when new software that changes the operating parameters is loaded. Permissive changes only require filing test data showing that the equipment complies with the applicable requirements in the rules with the new software. A complete application with exhibits including block diagrams, schematic diagrams, photographs and the users' manual is not required. Only the party holding the grant of equipment authorization may file for permissive changes.

The second alternative, which we proposed as an option in the NPRM, is to allow the FCC identification number to be displayed electronically rather than on a permanently affixed label. A major benefit of software defined radios will be the ability of manufacturers to produce radios intended to be programmed by third parties, including small entities, which could develop unique or specialized application software. The "electronic label" would help realize this benefit. It would provide a method to re-label equipment in the field without having to change a physical label if a new approval were obtained by a third party for a previously approved device.

The third alternative we considered 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 would reduce the burden on small entities, we declined to propose it because we believe that most 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 proposing any change in the authorization requirements for them.

#### **F. Federal Rules that May Duplicate, Overlap, or Conflict With the Proposed Rule**

None.

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<sup>68</sup> See 5 U.S.C. § 603(c).

## Separate Statement of Commissioner Susan Ness

*Re: In the Matter of the Authorization and Use of Software Defined Radios,  
ET Docket No. 00-47*

As I stated at the time we adopted our Notice of Inquiry, I am bullish about the prospect of “software defined radio” (“SDR”). SDR is a new generation of technology that would allow communications equipment to adapt to multiple standards and add service features without changes to the equipment’s hardware.

SDR holds the potential to enhance our participation in the global economy, to access new services, and to use the spectrum more efficiently. For example, SDR could facilitate the development of secondary markets for spectrum, because equipment could more easily operate under different parameters in different places. SDR could facilitate interoperability for users -- including public safety -- by making it easier to modify devices to communicate with each other. And SDR could facilitate global deployment of equipment, by making it easier for devices to operate in different bands and different modes, consistent with country allocations and rules.

To realize these benefits, however, we will have to alter our traditional equipment authorization process.

Let me be clear: our need to protect the public from harmful interference from non-compliant equipment is not diminished. But as we have found elsewhere with our regulatory framework, our legacy regulations for equipment approval may impede rather than facilitate innovation. Thus, we must focus on developing more flexible ways to assure the Commission and the public that equipment complies with our technical rules, and that health and safety of the public is not compromised.

Today, we propose several modest steps to facilitate the use of SDR. I encourage parties to think creatively on ways to ensure that equipment complies with our rules without impeding the development of new and useful technologies like Software Defined Radio. Any rules that would enable new and innovative products to reach the marketplace more quickly without compromising safety and interference protection for existing services would most certainly serve the public interest.