Excerpts from: Second Report and Order
GEN Docket No. 90-314

FCC UPCS Rules
Part 15 -- RADI0 FREQUENCY DEVICES

Subpart D-- Unlicensed Personal Communications Service Devices

§ 15.301 Scope.
This subpart sets out the regulations for unlicensed personal communications service (PCS) devices operating in the 1890-1930 MHz frequency band.

§ 15.303 Definitions.
(a) Asynchronous devices. Devices that transmit RF energy at irregular time intervals, as typified by local area network data systems.
(b) Coordinatable PCS device. PCS devices whose geographical area of operation is sufficiently controlled either by necessity of operation with a fixed infrastructure or by disabling mechanisms to allow adequate coordination of their locations relative to incumbent fixed microwave facilities.
(c) Emission bandwidth. For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. Compliance with the emissions limits is based on the use of measurement instrumentation employing a peak detector function with an instrument resolutions bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.
(d) Isochronous devices. Devices that transmit at a regular interval, typified by time-division voice systems.
(e) Noncoordinatable PCS device. A PCS device that is capable of randomly roaming and operating in geographic areas containing incumbent microwave facilities such that operation of the PCS device will potentially cause harmful interference to the incumbent microwave facilities.
(f) Peak transmit power. The peak power output as measured over an interval of time equal to the frame rate or transmission burst of the device under all conditions of modulation. Usually this parameter is measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used.

(g) Personal Communications Service (PCS) Devices [Unlicensed]. Intentional radiators operating in the frequency band 1890-1930 MHz that provide a wide array of mobile and ancillary fixed communication services to individuals and businesses.
(h) Spectrum window. An amount of spectrum equal to the intended emission bandwidth in which operation is desired.
(i) Sub-band. For purposes of this subpart the term sub-band refers to the spectrum allocated for isochronous or asynchronous transmission.
(j) Thermal noise power. The noise power in watts defined by the formula N=kTf where N is the noise power in watts, k is Boltzmann's constant, T is the absolute temperature in degrees Kelvin (e.g., 295 deg. K) and f is the emission bandwidth of the device in hertz.
(k) Time window. An interval of time in which transmission is desired.

§ 15.305 Equipment authorization requirement.
PCS devices operating under this subpart shall be certificated by the Commission under the procedures in Subpart J of Part 2 of this Chapter before marketing. The application for certification must contain sufficient information to demonstrate compliance with the requirements of this subpart.

§ 15.307 Coordination with fixed microwave service.
(a) UTAM, Inc., is designated to coordinate and manage the transition of the 1890-1930 MHz band from Private Operational-Fixed Microwave Service (OFS) operating under Part 94 of this Chapter to unlicensed PCS operations, conditioned upon the submittal and acceptance by the Commission of: 1) a funding plan that is equitable to all prospective manufacturers of unlicensed PCS devices, and 2) a plan for "band clearing" that will permit the implementation of noncoordinatable (nomadic) devices and, in particular, noncoordinatable data PCS devices, as promptly as possible. The responsibilities of UTAM, Inc., include, but are not limited to, relocation of existing OFS microwave stations pursuant to requirements established in ET Docket No. 92-9, negotiating costs of relocation, ensuring that comparable facilities are provided, and resolving any disputes of interference to OFS microwave operations from unlicensed PCS operations. These responsibilities shall terminate upon a determination by the Commission that interference to OFS microwave operations from unlicensed PCS operations is no longer a concern.
(b) Each application for certification of equipment operating under the provisions of this Subpart must be accompanied by an affidavit from UTAM, Inc. certifying that the applicant is a participating member of UTAM, Inc. In the event a grantee fails to fulfill the obligations attendant to participation in UTAM, Inc., the Commission may invoke administrative sanctions as necessary to preclude continued marketing and installation of devices covered by the grant of certification, including but not limited to revoking certification.
(c) An application for certification of a PCS device that is deemed by UTAM, Inc. to be noncoordinatable will not be accepted until the Commission announces that a need for coordination no longer exists.
(d) A coordinatable PCS device is required to incorporate measures to assure that it cannot be activated until installation at its authorized location is verified by UTAM, Inc.
(e) A coordinatable PCS device shall incorporate an automatic mechanism for disabling operation in the event it is moved outside the geographic area where its operation has been coordinated by UTAM, Inc. The application for certification shall contain a full explanation of the operation of the disabling mechanism and must satisfy the Commission that this mechanism cannot be easily defeated.
(f) At such time as the Commission deems that the need for coordination between unlicensed PCS operations and existing Part 94 Private Operational-Fixed Microwave Services ceases to exist, the disabling mechanism required by paragraph (e) will no longer be required.
(g) Operations under the provisions of this subpart are required to protect systems in the Private Operational-Fixed Microwave Service operating within the 1850-1990 MHz band until the dates and conditions specified in Section 94.59 of this Chapter for termination of primary status. Interference protection is not required for Part 94 stations in this band licensed on a secondary basis.
(h) The operator of a PCS device that is relocated from the coordinated area specified by UTAM, Inc., must cease operating the device until coordination for the new location is verified by UTAM, Inc.

§ 15.309 Cross reference.
(a) The provisions of Subpart A of this Part apply to unlicensed PCS devices, except where specific provisions are contained in Subpart D.
(b) The requirements of Subpart D apply only to the radio transmitter contained in the PCS device. Other aspects of the operation of a PCS device may be subject to requirements contained elsewhere in this Chapter. In particular, a PCS device that includes digital circuitry not directly associated with the radio transmitter also is subject to the requirements for unintentional radiators in Subpart B.

§ 15.311 Labelling requirements.
In addition to the labelling requirements of Section 15.19(a)(3), all devices authorized under this subpart must bear a prominently located label with the following statement:

Installation of this equipment is subject to notification and coordination with UTAM, Inc.

§ 15.313 Measurement procedures.
Measurements must be made in accordance with Subpart A, except where specific procedures are specified in Subpart D. If no guidance is provided, the measurement procedure must be in accordance with good engineering practice.

§ 15.315 Conducted limits.
An unlicensed PCS device that is designed to be connected to the public utility (AC) power line must meet the limits specified in Section 15.207.

§ 15.317 Antenna requirement.
An unlicensed PCS device must meet the antenna requirement of Section 15.203.

§ 15.319 General technical requirements.
(a) The 1890-1900 and 1920-1930 MHz sub-bands are limited to use by isochronous devices under the requirements of Section 15.321. The 1900-1920 MHz sub-band is limited to use by asynchronous devices under the requirements of 15.323.
(b) All transmissions must use only digital modulation techniques.
(c) Peak transmit power shall not exceed 100 microwatts multiplied by the square root of the emission bandwidth in hertz. Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.
(d) Power spectral density shall not exceed 3 milliwatts in any 3 kHz bandwidth as measured with a spectrum analyzer having a resolution bandwidth of 3 kHz.
(e) The peak transmit power shall be reduced by the amount in decibels that the maximum directional gain of the antenna exceeds 3 dBi.
(f) The device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. These provisions are not intended to preclude transmission of control and signaling information or use of repetitive codes used by certain digital technologies to complete frame or burst intervals.
(g) Notwithstanding other technical requirements specified in this subpart, attenuation of emissions below the general emission limits in Section 15.209 is not required.
(h) Where there is a transition between limits, the tighter limit shall apply at the transition point.
(i) The device must comply with IEEE C95.1-1991, "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz." Measurement methods are specified in IEEE C95.3-1991, "Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave." All equipment shall be considered to operate in an

"uncontrolled" environment. The application for certification must contain a statement confirming compliance with IEEE C95.1-1991. Technical information showing the basis for this statement must be submitted to the Commission upon request.

§ 15.321 Specific requirements for Isochronous devices operating in the 1890-1900 and 1920-1930 MHz sub-bands.

(a) Operation shall be contained within one of two channels starting with 1890-1895 MHz and ending with 1895-1900 MHz, or within one of eight channels that are 1.25 MHz in width starting with 1920-1921.25 MHz and ending with 1928.75-1930 MHz. Further sub-division of a 1.25 or 5 MHz channel is permitted with a reduced power level, as specified in Section 15.319(c), but in no event shall the emission bandwidth be less than 50 kHz.

(b) Intentional radiators with an intended emission bandwidth less than 625 kHz shall start searching for an available time and spectrum window at 1890 or 1920 MHz and search upward from that point. Devices with an intended emission bandwidth greater than 625 kHz shall start searching for an available time and spectrum window at 1930 or 1900 MHz and search downward from that point.

(c) Isochronous devices must incorporate a mechanism for monitoring the time and spectrum windows that its transmission is intended to occupy. The following criteria must be met:

(1) Before initiating transmission, devices must monitor the time and spectrum windows they intend to use for a period of at least 10 milliseconds to determine if the access criteria is met.

(2) The monitoring threshold must not be more than 30 dB above the thermal noise power for a bandwidth equivalent to the emission bandwidth used by the device.

(3) If no signal above the threshold level is detected, transmission may commence and continue with the same emission bandwidth in the monitored time and spectrum windows without further monitoring. However, occupation of the same combined time and spectrum windows by a device or group of cooperating devices continuously over a period of time longer than 8 hours is not permitted without repeating the access criteria.

(4) Once access to specific combined time and spectrum windows is obtained an acknowledgement from a system participant must be received by the initiating transmitter within one second or transmission must cease.

(5) If access to spectrum is not available as determined by the above, and a minimum of 40 duplex system access channels are defined for the system, the time and spectrum windows with the lowest power level below a monitoring threshold of 50 dB above the thermal noise power determined for the emission bandwidth may be accessed. A device utilizing the provisions of this paragraph must have monitored all access channels defined for its system within the last 10 seconds and must verify within the 20 milliseconds immediately preceding actual channel access that the detected power of the selected time and spectrum windows is no higher than the previously detected value. The power measurement resolution for this comparison must be accurate to within 6 dB. No device or group of cooperating devices located within 1 meter of each other shall occupy more than three 1.25 MHz channels, two 1.25 MHz channels and one 5 MHz channel, or two 5 MHz channels during any 10 millisecond period of time.

(6) If the selected combined time and spectrum windows are unavailable, the device may either monitor and select a different window or seek to use the same windows after waiting an amount of time randomly chosen from a uniform random distribution between 10 and 150 milliseconds.

(7) The monitoring system bandwidth must be equal to or greater than the emission bandwidth of the intended transmission and have a maximum reaction time less than 50xSQRT(1.25/emission bandwidth in MHz) microseconds for signals at the applicable threshold level but shall not be required to be less than 50 microseconds. If a signal is detected that is 6 dB or more above the applicable threshold level, the maximum reaction time shall be 35xSQRT(1.25/emission bandwidth in MHz) microseconds but shall not be required to be less than 35 microseconds.

(8) The monitoring system shall operate via the transmitting antenna, or an antenna with the same coverage area as the transmitting antenna, and shall be capable of measuring the power level of the monitored signal with an accuracy of +/- 3 dB.

(9) Devices that have a power output lower than the maximum permitted under the rules may increase their monitoring detection threshold by one decibel for each one decibel that the transmitter power is below the maximum permitted.
(d) Emissions shall be attenuated below a reference power of 112 milliwatts as follows: 40 dB between the channel edges and 1.25 MHz above or below the channel; 50 dB between 1.25 and 2.5 MHz above or below the channel; and 60 dB at 2.5 MHz or greater above or below the channel. For systems which further sub-divide a 1.25 MHz channel into X sub-channels, the following emission mask shall be followed: in the bands between 1B and 2B measured from the center of the emission bandwidth the total power emitted by the device shall be at least 40 dB below the transmit power permitted for that device; in the bands between 2B and 3B measured from the center of the emission bandwidth the total power emitted by an intentional radiator shall be at least 50 dB below the transmit power permitted for that radiator; in the bands between 3B and the 1.25 MHz channel edge the total power emitted by an intentional radiator in the measurement bandwidth shall be at least 60 dB below the transmit power permitted for that radiator. "B" is defined as the emission bandwidth of the device in hertz. Compliance with the emissions limits is based on the use of measurement instrumentation employing a peak detector function with an instrument resolution bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.
(e) The frame period (a set of consecutive time slots in which the position of each time slot can be identified by reference to a synchronizing source) of an intentional radiator operating in these sub-bands shall be 10 milliseconds/X where X is a positive whole number. Each device that implements time division for the purposes of maintaining a duplex connection on a given frequency carrier shall maintain a frame repetition rate with a frequency stability of at least 50 parts per millions (ppm). Each device which further divides access in time in order to support multiple communication links on a given frequency carrier shall maintain a frame repetition rate with a frequency stability of at least 10 ppm. The jitter (time-related, abrupt, spurious variations in the duration of the frame interval) introduced at the two ends of such a communication link shall not exceed 25 microseconds for any two consecutive transmissions. Transmission shall be continuous during the frame period defined for the device.
(f) The frequency stability of the carrier frequency of the intentional radiator shall be maintained within +/- 10 ppm over 1 hour or the interval between channel access monitoring, whichever is shorter. The frequency stability shall be maintained over a temperature variation of -30 to +50 degrees C at normal supply voltage, and over a variation in the primary supply voltage of 85 percent to 115 percent of the rated supply voltage at a temperature of 20 C. For equipment that is only capable of operating from a battery, the frequency stability tests shall be performed using a new battery without any further requirement to vary supply voltage.

§ 15.323 Specific requirements for asynchronous operation in the 1900-1920 MHz sub-band.
(a) Operation shall be contained within one of two 10 MHz channels: 1900-1910 MHz or 1910-1920 MHz. The emission bandwidth of any intentional radiator operating in this sub-band shall be no less than 500 kHz.
(b) All systems of less than 2.5 MHz emission bandwidth shall first occupy spectrum beginning nearest a channel edge, while systems of more than 2.5 MHz emission bandwidth will first occupy the center half of a channel. Devices with an emission bandwidth of less than 1.0 MHz may not occupy the center half of a channel if other spectrum is available.
(c) Asynchronous devices must incorporate a mechanism for monitoring the spectrum that its transmission is intended to occupy. The following criteria must be met:
(1) Before initiating a transmission burst, devices must monitor the spectrum window they intend to use for a period of time that is at least 50 microseconds.
(2) The monitoring threshold must not be more than 32 dB above the thermal noise power for a bandwidth equivalent to the emission bandwidth of the device.
(3) If no signal above the threshold level is detected, a transmission burst may commence in the monitored spectrum window. Once a transmission burst has started, an individual device or a group of cooperating devices is not required to monitor the spectrum window provided the intraburst gap timing requirement specified below is not exceeded.

(4) After completion of a transmission burst, an individual device or cooperating group of devices must cease transmission and wait a deference time randomly chosen from a uniform random distribution ranging from 50 to 750 microseconds after which time an attempt to access the band again may be initiated. For each occasion that an access attempt fails after the initial inter-burst interval, the deference time chosen shall double until an upper limit of 12 milliseconds is reached. The deference time remains at the upper limit until an access attempt is successful. The deference time is re-initialized after each successful access attempt.
(5) The monitoring system bandwidth must be equal to or greater than the emission bandwidth of the intended transmission and shall have a maximum reaction time less than 50xSQRT(1.25/emission bandwidth in MHz) microseconds for signals at the applicable threshold level but shall not be required to be less than 50 microseconds. If a signal is detected that is 6 dB or more above the threshold level, the maximum reaction time shall be 35xSQRT(1.25/emission bandwidth in MHz) microseconds but shall not be required to be less than 35 microseconds.
(6) The monitoring system shall operate via the transmitting antenna, or an antenna with the same coverage area as the transmitting antenna, and shall be capable of measuring the power level of the monitored signal with an accuracy of +/- 3 dB.
(7) Devices that have a power output lower than the maximum permitted under the rules may increase their detection threshold by one decibel for each one decibel that the transmitter power is below the maximum permitted.
(d) Emissions shall be attenuated below a reference power of 112 milliwatts as follows: 40 dB between the channel edges and 1.25 MHz above or below the channel; 50 dB between 1.25 and 2.5 MHz above or below the channel; and 60 dB at 2.5 MHz or greater above or below the channel. Compliance with the emissions limits is based on the use of measurement instrumentation employing a peak detector function with an instrument resolution bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.
(e) The frequency stability of the carrier frequency of intentional radiators operating in this sub-band shall be +/- 10 ppm over 10 milliseconds or the interval between channel access monitoring, whichever is shorter. The frequency stability shall be maintained over a temperature variation of -30 to +50 Celsius at normal supply voltage, and over a variation in the primary supply voltage of 85 percent to 115 percent of the rated supply voltage at a temperature of 20 degrees Celsius. For equipment that is only capable of operating from a battery, the frequency stability tests shall be performed using a new battery without any further requirement to vary supply voltage.
(f) An asynchronous transmission burst is a series of transmissions from one or more transmitters acting cooperatively. The transmission burst duration from one device or group of devices acting cooperatively shall be no greater than 10 milliseconds. Any intraburst gap between cooperating devices shall not exceed 25 microseconds.
(g) Individual unit intraburst transmissions shall be separated by a uniform random-duration interval evenly distributed between 50 and 375 microseconds.

<END SUBPART D>

FCC UPCS Technical Discusion

FCC discussion of UPCS technical issues, excerpted from PCS Decision (Second Report & Order in GEN Docket 90-314, Oct. 22, 1993)

3. Unlicensed PCS Devices

178. In the Notice, we indicated our principal concerns with regard to the operation of unlicensed PCS devices and services were: 1) minimizing, to the extent possible, interference between PCS users and to existing microwave users; 2) providing designers with the maximum technical flexibility possible to develop new products to meet consumer needs; 3) using the available spectrum efficiently; and 4) providing PCS services to as many consumers as possible. In light of these concerns, we proposed that unlicensed devices operate in the 1910-1930 MHz band and proposed general power output limits and a channelization plan that would accommodated three broad categories of PCS devices, as follows:

Band (MHz)	Channel BW	Proposed Peak Power Limit
1910-1920	10 MHz	1 watt
1920-1925	100 kHz	20 milliwatts
1925-1930	1.25 MHz	100 milliwatts

Additional specific technical requirements were proposed to further minimize interference, both PCS to microwave and PCS to PCS, and promote more efficient use of the available spectrum. These proposals addressed items such as Rlisten before talk," adaptive power control, requiring use of digital modulation, maximum power spectral density and spectral efficiency requirements, etc. Comments were also requested on the desirability of establishing an industry committee to develop detailed standards for unlicensed devices and also to serve as a focus point for negotiating relocation agreements with the existing Part 94 licensees within any spectrum set aside for unlicensed PCS operations.

179. The commenting parties generally support the Commission's objective of formulating technical specifications that minimize interference to existing users while providing maximum flexibility for technological design. The majority of commenting parties, however, oppose the proposed channelization plan and power limits. UTC, Edison Electric and Bell Atlantic, for example, state the proposed power limits will not protect adequately the existing fixed microwave users. Several parties present alternative channelization schemes. These plans range from a single band with no channelization to complex schemes providing multiple sub-bands and channel bandwidth with channel overlays.

180. Apple, in its comments, urges the Commission to allow an industry committee to develop detailed technical requirements for unlicensed PCS. WINForum, an industry alliance that represents 33 leading information technology companies, proposed a "spectrum etiquette" that provides for equal access and sharing of the available spectrum for all users. The etiquette divides the unlicensed spectrum into two equal sub-bands, one for time critical transmissions or isochronous (voice) transmissions and one for time independent transmissions or asynchronous (high speed data) transmissions. Each sub-band has its own unique etiquette which is a combination of channelization, power, transmission time limits, and channel access parameters.

181. The Commission invited comments on the WINForum etiquette. Most respondents, such as Motorola, AT&T, Northern Telecom, IEEE Project 802 and others, support the WINForum etiquette. Several parties requested changes in various technical aspects of the etiquette. Ericsson raises several concerns with the WINForum etiquette. Ericsson argues that the WINForum etiquette would preclude the use of certain wideband voice technologies and does not adequately define interference parameters between the two sub-bands. Ericsson presents an alternative etiquette that shares many common specifications with the WINForum etiquette. It differs, however, in that it does not include an asynchronous sub-band. Rather, Ericsson's approach would permit operation over several channels to accommodate high data rate transmissions.

182. BellSouth, Tadiran and InterDigital state that the FCC should not impose any channelization as called for in WINForum's isochronous etiquette. They state that to do so would unnecessarily limit the development of services to be offered. Omnipoint argues that the etiquette, which limits signals to 1.25 MHz sub-bands in the isochronous band, should be modified to permit signals up to 5 MHz in bandwidth to accommodate CDMA technology. Other parties state generally that they were not afforded an opportunity to have their views considered by WINForum and suggest that the etiquette should be submitted to a recognized standards body. Some commenters, such as Telocator, PCS Action, Southwestern Bell and Rockwell International Corporation, express concern that the WINForum etiquette may impede interoperability with licensed PCS devices because the etiquette does not provide for isochronous systems requiring more than 1.25 MHz bandwidth.

183. We believe that a "spectrum etiquette" is necessary to facilitate efficient use of the unlicensed PCS spectrum and minimize in-band and out-of-band interference. Further, we find that the WINForum etiquette, with some modifications, strikes an appropriate balance among the various factors that must be taken into account. The WINForum etiquette permits all users to have equal access to the available spectrum on a shared basis. The etiquette also ensures efficient use of the spectrum through use of such techniques as listen-before-talk and power reduction in high-use environments. The WINForum etiquette is fair to both voice and data PCS interests because it divides the available spectrum in half and applies a separate set of rules for each.
This approach permits the existing voice and data network manufacturers and service providers in their respective industries to merge their existing technology. This eliminates a potential impediment to the rapid introduction of data PCS devices by avoiding the need to develop additional interfaces. In contrast, we note that Ericsson's proposal for a single isochronous format with a periodic transmission requirement is not generally used by the high speed data community which implements an asynchronous for networking computer systems.

184. We believe it would be counterproductive to submit the etiquette to a recognized standards body for further review. We observe that the WINForum etiquette was developed on a consensus basis with broad-based industry participation. Further, the Commission has afforded all interested parties an opportunity to offer comments on the WINForum etiquette. The comments overwhelmingly favor the WINForum etiquette. We have taken into account the various modifications and adjustments suggested by the commenters, as discussed below. We are convinced that an etiquette developed by a standards body would ultimately contain many of the trade-offs and compromises that were a part of the WINForum process. We conclude that submittal of the etiquette to a standards body would result in unnecessary delays in introduction of unlicensed PCS to the public with no countervailing benefit. With regard to interoperability of unlicensed PCS devices with equipment that may be designed for the licensed spectrum, we note that the etiquette does not in and of itself preclude this possibility.

185. We find that a number of adjustments to the WINForum etiquette are necessary to further improve spectrum efficiency, add greater flexibility, and take into account the amount of spectrum allocated for unlicensed PCS. We are dedicating the 1900-1920 MHz spectrum for asynchronous operation and the 1890-1900 MHz and 1920-1930 MHz spectrum for isochronous operation. Thus, both voice and data PCS devices will have an even share of the lightly loaded spectrum at 1910-1930 MHz. Further, this arrangement provides a continuous 20 MHz of spectrum to better accommodate the broadband signals expected to be typical of data PCS devices. In response to the concerns of the commenters, we are providing additional flexibility in the 1890-1900 MHz isochronous band by permitting up to four 1.25 MHz channels to be grouped together to accommodate at least two systems with bandwidths up to 5 MHz. This action will facilitate the use of broadband technologies in at least a portion of the isochronous spectrum. We are also adopting somewhat more strict emission mask requirements to reduce adjacent channel interference and thereby improve spectrum sharing and efficiency.

186. We are implementing the etiquette by including it in the Part 15 technical standards for unlicensed PCS. Compliance with the requirements of the spectrum etiquette will be ensured by requiring

certification for equipment that operates in the unlicensed band following the procedures in Subpart J of Part 2 of the Rules. Measurements to demonstrate compliance with the technical standards must be made in accordance with the general measurement guidance provided in Part 15 and good engineering practice. If appropriate, the Commission may consider specific measurement procedures at a later time.

FCC UPCS Allocation Discussion

FCC discussion of UPCS allocations, excerpted from PCS Decision (Second Report & Order in GEN Docket 90-314, Oct. 22, 1993)

2. Unlicensed PCS Devices

79. In the Notice we tentatively concluded that an allocation for unlicensed PCS would be in the public interest and proposed to allocate 20 MHz for such use. The kinds of unlicensed applications that would be permissible under this allocation would include, but not be limited to, high and low speed data links between computing devices, cordless telephones and wireless PBXs. We indicated that this unlicensed approach could be expected to foster the rapid introduction of new PCS technologies by permitting manufacturers to introduce new products without the delays associated with the licensing of a radio service. We observed that unlicensed operation will need relatively clear spectrum and that 1910-1930 MHz currently is relatively lightly loaded. Accordingly, we proposed to designate the 1910-1930 MHz band for use by unlicensed devices on a co- primary basis with existing fixed microwave operations, on the condition that unlicensed PCS devices not cause interference to existing microwave stations or new microwave stations for which applications were on file as of July 16, 1992. We also requested comments on the feasibility of unlicensed PCS users and equipment manufacturers negotiating relocation agreements with incumbent microwave licensees.

80. With the exception of some existing fixed microwave users, the commenting parties generally support allocation of spectrum for unlicensed PCS operation. These parties indicate that unlicensed PCS will provide for the introduction of many new services and devices to meet a wide range of wireless voice and data communications needs. These parties further indicate that the ability to operate on an unlicensed basis will enable products and services to be introduced more rapidly than is possible on a licensed basis. Some of the unlicensed PCS applications envisioned by these parties include wireless LANs, advanced cordless telephones and new data communications systems and devices for linking personal computers.

81. Many commenting parties, however, maintain that the proposed 20 MHz allocation for unlicensed services is not sufficient to accommodate the projected demand for unlicensed PCS services. Apple Computer, Inc. (Apple), Hewlett-Packard Company, InterDigital, and the IEEE Project 802 Local and Metropolitan Network Standards Committee (IEEE Project 802)[72] advocate larger initial allocations of 35 to 70 MHz. Pulse Engineering Inc. estimates unlicensed PCS spectrum requirements at 90 MHz. AT&T estimates the requirements of unlicensed devices at 40 MHz for high-speed data and 25 MHz for voice and low-speed data. North American Telecommunications Association (NATA) maintains that data systems will require at least 40 MHz, and voice systems 40 to 50 MHz. Wireless Information Networks Forum (WINForum) estimates unlicensed spectrum requirements of 20 MHz for wireless PBX, 20 MHz for data, and 5 MHz for cordless telephones.[73] PacTel states that while the 1910-1930 MHz band is adequate to handle anticipated unlicensed simplex operation, additional bands at 1887.5-1910 and 1977.5-1990 MHz are needed for duplex operations. Ericsson asks that we consider a separate additional allocation of 100 to 150 MHz in the 5 GHz region for high-speed, high-capacity wireless LANs. Several parties, such as Apple, IEEE Project 802, Rose Communications, Inc., and Teknekron Communications Systems, also advocate a reserve for future unlicensed use.

82. The parties addressing unlicensed PCS issues almost universally express concern about possible interference from unlicensed PCS devices to existing fixed microwave operations. In this regard, parties representing both fixed microwave interests, for example Alcatel Network Systems, Inc. (Alcatel), API, and the Northwest Iowa Power Cooperative, and parties interested in the development of unlicensed PCS services and devices, such as Apple, Motorola and WINForum, submit that unlicensed devices cannot share the band with incumbent microwave licensees without risking unacceptable levels of interference. These parties also submit that the "nomadic" nature of such equipment would make it difficult to detect and eliminate sources of interference. UTC, Telocator, ROLM, NATA, Motorola, Hitachi and California

Microwave advocate creation of some form of industry consortium, committee, trade association or other entity to fund relocation of incumbent microwave licensees out of the band.

83. On May 14, 1993, the Unlicensed PCS Ad Hoc Committee for 2 GHz Microwave Transition and Management (UTAM) filed a proposal to establish a temporary open industry entity that would assume relocation and spectrum management functions for the unlicensed band pursuant to Section 332(b) of the Communications Act.[74] In its proposal UTAM recommends that we require, under our equipment authorization rules, that all unlicensed device manufacturers contribute to a fund from which UTAM would compensate incumbent licensees for relocation and finance its spectrum management efforts. UTAM further recommends that we permit early deployment of "non-nomadic" unlicensed PCS devices on a spectrum-sharing basis prior to complete band clearing.[75] We requested comment on UTAM's proposal in a Public Notice released May 18, 1993.[76]

84. The comments received in response to the Public Notice strongly support the concept of an industry entity such as proposed by UTAM. Many commenters, including AT&T, Industrial Telecommunications Association (ITA), McCaw, Motorola, NATA, Northern Telecom, PCS Action, Inc. (PCS Action), and ROLM, fully support the UTAM proposal as submitted. Others, mainly incumbent microwave interests and some potential PCS licensees, request more detail on the proposal and raise a number of specific issues on how such an approach would work in practice. For example, several parties question UTAM's ability to raise sufficient funds to pay for relocation of existing microwave facilities. Other parties question whether early deployment of non-nomadic devices should be allowed as proposed. Some commenters, such as Ameritech and the Association of American Railroads (AAR), express concern over this aspect of the proposal because of the perceived difficulty in controlling the operating location of such devices once initial frequency coordination has been accomplished. Southwestern Bell Corporation (Southwestern Bell), UTC and API oppose any deployment of non-nomadic devices prior to complete band clearing since they believe that the proposed safeguards against potential interference are inadequate.

85. API expresses concern that there should be a mechanism in place to ensure adequate capitalization of the entity before any band clearing commences. Omnipoint indicates that it is necessary to ensure that the royalty scheme creates a level playing field, and that such scheme be worked out in advance of any Commission approval of the entity. Xircom and AMT/DSST express concern that early deployment of non-nomadic devices will leave no room for nomadic devices by the time the band is cleared. PacTel expresses concern about lack of procedures for resolving internal unlicensed PCS industry disputes such as might arise over which geographical regions should be cleared first. The Public Safety Microwave Committee opposes any deployment of nomadic devices in the proposed unlicensed band since public safety microwave users are not required to move.

86. In its reply comments, UTAM indicates that it had proceeded to further develop its concept by incorporating an entity to function as a mechanism for unlicensed spectrum clearing and adopting a preliminary set of bylaws. The entity was incorporated under the name of UTAM, Inc., in the State of Delaware as a not-for-profit membership corporation. UTAM indicated that start-up capital for relocation and operating expenses would come from a combination of membership fees, outright funding from members, loan agreements with financial institutions, and royalties paid by manufacturers of unlicensed PCS devices. UTAM also proposes some further safeguards to address those parties concerned that non-nomadic devices may be moved after coordination. UTAM also clarifies that it intends to abide by the procedures established in ET Docket No. 92-9, and that its role will be limited to representing unlicensed PCS manufacturers' interests in interference and compensation disputes with incumbents.[77]

87. We continue to recognize the important opportunities that unlicensed PCS offers for creation of new services and technologies. The current Part 15 unlicensed operations have proven successful in bringing forth a wide variety of services and devices. Part 15 devices now are used to provide important services for business, such as control of manufacturing processes and anti-pilfering protection, and also essential health and safety functions such as medical patient monitoring and security and alarm systems. In addition, a large number of Part 15 devices like cordless telephones, garage door openers and electronic

toys serve to enhance consumer convenience and recreation. We believe that a substantial allocation dedicated for unlicensed PCS will have the potential to foster development of an even greater number and range of new wireless services and devices.

88. In view of the strong demand for unlicensed PCS predicted by those developing such services, we are allocating the 1890-1930 MHz band for unlicensed PCS services. We believe this 40 MHz will provide sufficient spectrum to meet the needs of a wide range of unlicensed PCS operations, including both voice and data uses. To ensure that unlicensed PCS uses do not cause interference to existing microwave operations, we are adopting the general approach recommended by UTAM. Further, we are designating UTAM as the coordinator for the transition of the 1890-1930 MHz band from fixed microwave service to unlicensed PCS, conditioned on UTAM's submission and our acceptance of: 1) a funding plan that is equitable to all prospective manufacturers of unlicensed devices, and 2) a plan for "band clearing" that will permit the implementation of nomadic devices and, in particular, nomadic data PCS devices, as promptly as possible.[78] We intend to obtain public comment on these plans before acting on them. With regard to relocation of existing microwave stations, UTAM's responsibilities will include administering the program, including negotiating costs of relocation, ensuring comparable facilities are provided, and resolving any disputes of interference to fixed microwave from unlicensed PCS operations. As with the licensed service, if interference disputes or agreement for relocation of incumbent fixed microwave facilities are not successfully negotiated, the matter may be referred to the Commission for a final decision.

89. We agree with UTAM and the commenters that at this time the locations of PCS devices must be controlled to avoid causing interference to incumbent fixed microwave licensees. UTAM's proposal to permit "coordinatable" devices during an initial transition period, during which UTAM would coordinate the locations appears to be a reasonable approach. As suggested by UTAM, such devices include unlicensed PCS devices and systems that are intended for one-way or two-way communications over limited geographic areas. They comprise both voice and data applications such as wireless PBXs and wireless data local area networks. These systems also may include associated portable devices, provided that the portable devices have been designed to operate under the control of a coordinated base station or within a limited coordinated service area. Subject to UTAM's submission, purely nomadic unlicensed PCS devices and systems in which the geographic location of the device cannot be controlled will not be permitted until the unlicensed spectrum is cleared or it can be shown that there is little risk of interference to the remaining incumbents.

90. As discussed above, we conclude that allowing access to this band for devices that can be coordinated will not preclude later implementation of nomadic devices because the technical rules that we are adopting, based upon the "WINForum etiquette," ensure access by both nomadic and non-nomadic data and voice devices. The 40 MHz of spectrum we are allocating for unlicensed PCS is sufficient to satisfy the demand for both nomadic and non- nomadic applications. By allowing the early introduction of non-nomadic devices, both data and voice, manufacturers will have a source of revenue that could be used to finance the relocation of fixed microwave operations. We note that many anticipated unlicensed PCS devices fall within the definition of non-nomadic because they will involve communications through a base station or network of base stations that can be controlled.

91. To ensure that incumbent microwave stations do not receive interference from unlicensed devices, we are requiring that any coordinatable unlicensed PCS device or system be coordinated through UTAM before being initially deployed or subsequently relocated.[79] In addition, we are requiring applicants for equipment authorization for unlicensed PCS devices to be participants in UTAM. As part of the equipment authorization process, all manufacturers will be required to demonstrate procedures to assure that the fixed portion of their system (i.e., the base station) will not be activated until installation at its authorized location is verified and that relocation of the system or device will not occur without recoordination. We also are requiring that manufacturers demonstrate that any movable components (i.e., handsets or terminals) of the device or system will be prevented from transmitting if those parts leave the coordinated area around the base station.

92. On September 13, 1993, Apple submitted an "Emergency Petition" addressing a number of issues related to operation and introduction of unlicensed PCS devices in the 2 GHz band.Apple's petition was filed three days before our "Sunshine Rules" resulted in cutting off all comment on the proceeding as a whole, including on the Apple petition.[80] Consequently, many parties did not have an opportunity to file comments supporting or opposing the petition.[81] We agree with Apple that the early introduction of nomadic PCS devices is desirable, and therefore that it is in the public interest to obtain public comment on the petition in order that we may be fully informed by all interested parties on these issues. Accordingly, by Public Notice we will solicit comment in response to the Apple petition. Further, we are delaying the effective date of rules related to Apple's petition for an additional thirty days to permit full consideration of the issues raised by Apple.

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[72] IEEE Project 802 is group within the IEEE that is chartered to develop standards for local and metropolitan area networks that provide high speed information transfer among computers on wire, optical and radio media.

[73] WINForum is an alliance of information technology companies that are working together to obtain and effectively employ spectrum for unlicensed, user-provided voice and data PCS.

[74] UTAM is composed of representatives from a broad range of equipment manufacturers interested in deploying unlicensed PCS devices. Members of UTAM include NATA, Telocator, AT&T, Alcatel, Ericsson, IBM, Intel, PCNS-NY, Metrocall, Motorola, Northern Telecom, Omnipoint, ROLM, Rose, Telesciences, and U S West.

[75] UTAM defines "non-nomadic" devices as those utilizing a fixed infrastructure and "band clearing" as the point in time at which interservice interference is no longer deemed a concern.

[76] See 58 Fed.Reg. 31183 (June 1, 1993).

[77] See Third Report and Order and Memorandum Opinion and Order, supra note 10, at paras. 34-35. In this document, the Commission strongly encourages parties unable to voluntarily conclude a relocation agreement to use alternative dispute resolution techniques. If voluntary negotiations are unsuccessful during the period prescribed, the parties may refer the matter to the Commission for resolution.

[78] At a minimum, such a plan should include estimated time tables and priorities for clearing significant portions of both subbands of the 1890-1930 MHz unlicensed band. The plan also should address specifically the issue of nomadic data PCS devices and how the plan ensures that such devices can be implemented as expeditiously as possible.

[79] We anticipate that UTAM will initially arrange for the preparation of exclusion zone maps detailing geographic areas and frequencies where coordinated PCS deployment would not cause interference to existing microwave operations; and that UTAM will maintain and update a database of all microwave links and unlicensed PCS systems/devices using the allocated spectrum. This would permit the tracking of deployed unlicensed PCS devices and systems. See UTAM ex parte filing dated September 14, 1993.

[80] 47 C.F.R. 1.1203 et seq.

[81] In response to Apple's petition, comments were filed by UTC, API and the Business Software Alliance.

FCC Public Notice
October 22, 1993

Broadband Personal Communications Devices (Unlicensed)
GEN Docket No. 90-314

In a petition filed on September 13, 1993, Apple Computer, Inc. (Apple) addressed certain issues related to operation of unlicensed Personal Communication Service (PCS) devices in the 2 GHz band. Subsequently, on September 23, 1993, the Commission adopted a Second Report and Order in GEN Docket No. 90-314 allocating the 1890-1930 MHz band for unlicensed devices and dividing the band equally between isochronous (principally voice) and asynchronous (data) operations. Technical rules also were adopted that are based upon a proposal submitted by WINForum, an industry group consisting of representatives of both data and voice unlicensed proponents. The rules adopted are intended to facilitate efficient use of the 2 GHz unlicensed band by both data and voice users and to minimize in-band and out-of-band interference. Further, the Commission selected the Unlicensed PCS Ad Hoc Committee for 2 GHz Microwave Transition and Management (UTAM), an industry group interested in the deployment of unlicensed devices, to coordinate the deployment of unlicensed devices with incumbent fixed microwave operations.

Apple's petition was filed three days before operation of the Commission's Sunshine Rule prohibited interested parties from filing additional comment on the proceeding as a whole, including on the Apple petition. See 47 C.F.R. 1.1203 et seq. Consequently, parties generally did not have an opportunity to file comments supporting or opposing the petition.[1] While the Commission adopted rules that respond to and consider the issues raised by Apple in its petition, the Commission stated in the Second Report and Order in this proceeding that it would be in the public interest to obtain comment on the petition in order that the Commission may be fully informed by all interested parties on these issues. Therefore, in the Second Report and Order the Commission said it would treat Apple's "Emergency Petition" as a Petition for Reconsideration and delayed for an additional 30 days the effective date of its adopted rules that relate to the issues addressed in Apple's petition for the purpose of obtaining comment on these issues.

Parties desiring to file comments addressing the issues raised in Apple's petition must reference GEN Docket No. 90-314 on the cover of their comments. Comments must be submitted by November 8, 1993. Replies to comments must be submitted by November 19, 1993.

The Apple petition, the WINForum comments and other related documents are available for inspection in the GEN Docket No. 90-314 file at the FCC Reference Center (Room 239), 1919 M Street N.W., Washington, DC 20554. Copies also may be obtained from the International Transcription Service, (202) 857-3800. For further information, contact Fred Thomas, Office of Engineering and Technology, (202) 653-6204.

[1] In response to Apple's petition, comments were filed prior to issuance of the Sunshine Notice on September 16, 1993 by the Utilities Telecommunications Council, the American Petroleum Institute and the Business Software Alliance.