

71. *Petitions and Replies.* PISC states that the 4 watt limitation for fixed devices needlessly burdens the promotion of more affordable broadband deployment in rural areas, and requests that higher power be permitted for TV bands devices operating on channels separated by 12 megahertz or more from a digital TV station.¹³⁷ WISPA states that the limit for fixed devices could be increased to 20 watts of transmitter power to facilitate more efficient and economical use of the white spaces, and that the Commission should adopt protection criteria that permit operation of fixed devices at increased power as the distance from protected signals increases.¹³⁸ Motorola supports PISC's and WISPA's requests to increase the power of fixed devices, while MSTV/NAB opposes them.¹³⁹ Shure opposes WISPA's request, stating that devices at this power level would interfere with wireless microphones far beyond the 1 km protection radius.¹⁴⁰ SBE opposes higher power for fixed TV bands devices because of the increased potential for interference to low power licensed stations that are entitled to protection.¹⁴¹ NCTA opposes to the requests of PISC and Motorola to increase the maximum allowable power of TV bands devices due to concerns about direct pickup interference.¹⁴²

72. PISC believes that personal/portable devices that rely on geo-location/database lookup should be able to operate with power above 100 mW if the device is separated from a licensed service by two or more available channels.¹⁴³ Adaptrum argues that the power limit for personal/portable TV bands devices should be increased to 250 mW but does not provide a clear description or analysis of how devices could operate at this higher power level without posing increased potential for interference.¹⁴⁴ Shure opposes this request, arguing that a 250 mW TV bands device near the edge of a wireless microphone's protected zone could interfere with the microphone.¹⁴⁵ Motorola requests that a maximum power level of 4 watts EIRP be allowed for vehicle mounted mobile devices that are wirelessly tethered to a fixed device or that have access to a database, and suggests that marketing of devices could be limited to users defined in Part 90 of the rules.¹⁴⁶ SBE opposes requests for higher power, arguing that the rules adopted in the *Second Report and Order* are already inadequate to prevent interference.¹⁴⁷

73. Adaptrum submits that sensing-only devices should be permitted to operate up to 100 mW instead of 50 mW, arguing that the 50 mW limit is arbitrary and was not explained in the *Second Report and Order*, and that a higher limit would provide an incentive for developers to push the envelope in sensor performance.¹⁴⁸ PISC also requests a power increase to 100 mW for sensing-only devices, arguing that 50 mW is insufficient for spreading connectivity beyond a single room and would not allow

¹³⁷ See PISC petition at 10.

¹³⁸ See WISPA petition at 15. Carlson Wireless and Federation of Internet Solution Providers support WISPA's request for higher power. See Carlson Wireless opposition at 3 and Federation of Internet Solution Providers opposition at 3.

¹³⁹ See Motorola opposition at 11 and MSTV/NAB opposition at 7.

¹⁴⁰ See Shure opposition at 10-12.

¹⁴¹ See SBE opposition at 11.

¹⁴² See NCTA opposition at 6-7.

¹⁴³ See PISC petition at 12.

¹⁴⁴ See Adaptrum petition at 5.

¹⁴⁵ See Shure opposition at 13.

¹⁴⁶ See Motorola petition at 16-18.

¹⁴⁷ See SBE opposition at 6-7.

¹⁴⁸ See Adaptrum petition at 9.

mesh networking of devices.¹⁴⁹ Shure argues that a 100 mW TV bands device would interfere with wireless microphones located beyond the range at which a -114 dBm sensing capability could detect the signals of wireless microphones operating at their typical operating power levels.¹⁵⁰

74. Some parties argue that the maximum permitted power for personal/portable devices operating on first adjacent channel should be reduced.¹⁵¹ Shure argues that personal/portable TV bands device first adjacent channel operations will harm incumbent authorized services and should be limited to a maximum power level of 10 mW, which is comparable to the power used by wireless microphones.¹⁵² SBE also argues that the 40 mW power limit for adjacent channel operation by personal/portable devices is too high and fails to provide an adequate level of protection for television viewers.¹⁵³ It further argues that the Commission's analysis used incorrect D/U ratios and made incorrect assumptions concerning antenna discrimination, interference distances and modulation types.¹⁵⁴ SBE argues that mobile DTV reception should be protected at a distance of 2 meters.¹⁵⁵ Rudman/Ericksen argue that the assumed 3 dB polarization discrimination factor between vertically polarized TV bands device antennas and DTV antennas is invalid because many DTV stations employ elliptical or circular polarization, back of TV set antenna loops that have vertical polarization are often used and the antennas of personal/portable TV bands devices can have any orientation.¹⁵⁶ MSTV/NAB claims that a personal/portable device operating at 1.5 mW on the first adjacent channel will not protect over-the-air broadcasts at the noise-limited contour level, and that the power levels adopted in the *Second Report and Order* are inadequate to protect reception of new mobile television services.¹⁵⁷ However, Dell/Microsoft argues that speculation about future broadcast service does not justify restrictions on adjacent channel power today.¹⁵⁸ Google and PISC believe that tighter restrictions on adjacent channel operation would make TV bands devices non-viable in major markets.¹⁵⁹ NCTA opposes to the requests of Adaptrum, PISC and Motorola to increase the maximum allowable power of TV bands devices as well as PISC's request to allow portable devices to operate on channels 5-13 due to concerns about direct pickup interference.¹⁶⁰

75. Several parties request that we adopt a power spectral density (PSD) limit. IEEE 802 states there is a need to allow TV bands devices to operate with narrower bandwidths while maintaining the same level of protection to incumbents that would be provided if the transmitter power were spread over a wider channel. It recommends specifying a maximum power spectral density limit of 8 dBm (conducted) in a 3 kHz bandwidth, and requiring the minimum occupied bandwidth of a TVBD signal to

¹⁴⁹ See PISC petition at 23.

¹⁵⁰ See Shure opposition at 12-13.

¹⁵¹ Some parties also argue that personal/portable devices should not operate on first adjacent channels; this issue is discussed below in the section "TV Channel Uses."

¹⁵² See Shure petition at 7. Dell/Microsoft and Google oppose Shure's request. See Dell/Microsoft opposition at 5 and Google opposition at 15-16.

¹⁵³ See SBE petition at 2-3.

¹⁵⁴ *Id.* at 5-8.

¹⁵⁵ *Id.* at 11.

¹⁵⁶ See Rudman/Ericksen petition at 12 and SBE petition at 5.

¹⁵⁷ See MSTV/NAB opposition at 3.

¹⁵⁸ See Dell/Microsoft opposition at 19.

¹⁵⁹ See Google reply to oppositions at 7 and PISC opposition at 19-20.

¹⁶⁰ See NCTA opposition at 6-7.

be at least 500 kHz to differentiate between a Part 74 wireless microphone and a TVBD.¹⁶¹ SBE believes that emissions from TV bands devices should be required to be wideband and noise-like with a minimum bandwidth of 4.5 megahertz and power measured over a 6 megahertz bandwidth.¹⁶² MSTV/NAB argues that TV bands device emissions should be required either to have a minimum bandwidth of 4.5 megahertz or to comply with a maximum PSD limit in a narrower bandwidth.¹⁶³

76. *Decision.* We are not convinced by the petitions for reconsideration that the power limits for unlicensed TV bands can be increased without also increasing the potential for interference to authorized services and therefore are affirming the power limits for fixed and personal/portable devices the Commission adopted in the *Second Report and Order*. In addition, as discussed below, we do not find that the power level of TV bands devices should be restricted to protect against direct pick-up interference to cable and satellite TV services. We do, however, recognize the need to address power considerations in TV bands device signals that occupy less than the full bandwidth of a TV channel and therefore are amending the rules to include power spectral density limits.

77. We decline to increase the 4 watt EIRP power limit for fixed devices and note that the Commission also considered and rejected a higher power limit for fixed devices in the *Second Report and Order*.¹⁶⁴ While the Commission previously observed that there are advantages to higher power levels for fixed devices, such as reduced infrastructure costs and increased service range, it did not adopt a higher power limit due to concerns about increased risk of interference in congested areas and a lack of experience with unlicensed wireless broadband operations in the TV bands. We also recognize the increased range provided by operation at higher power levels would be particularly desirable for some applications, including rural service and mobile operations as suggested by Motorola. We also understand that there may be situations where radio communications facilities could operate at higher power in TV white spaces without causing interference. However, we continue to conclude that because the extended range of such devices would significantly increase the potential for interference and also make it more difficult to identify sources of interference, it would not be appropriate allow higher power for unlicensed TV bands devices at this time. Indeed, such operation would be more appropriate under a licensed regime of regulation. We are therefore affirming the Commission's previous decision on fixed device power levels; we could re-visit the issue of higher power levels for TV bands devices on a licensed or unlicensed bases at some point in the future as may be appropriate.

78. We are retaining the current 100 mW maximum transmitter power limit for Mode I and Mode II personal/portable devices and decline to establish a new class of higher power vehicle mounted portable devices. As the Commission noted in the *Second Report and Order*, personal/portable devices generally pose a greater risk of harmful interference to authorized operations than fixed devices because these devices will change locations, making identification of both unused TV frequencies and the devices themselves, if interference occurs, more complex and difficult.¹⁶⁵ The Commission also noted the significant distances at which interference could occur from a personal/portable device operating at greater than 100 mW would make it very difficult to identify a device that is the source of interference.¹⁶⁶ We therefore decline to increase the power limit for personal/portable devices at this time.

79. Additionally, we are retaining the 50 mW power limit for sensing-only devices. The Commission stated in the *Second Report and Order* that the prototype TV bands devices it tested were

¹⁶¹ See IEEE 802 petition at 5.

¹⁶² See SBE petition at 13.

¹⁶³ See MSTV/NAB opposition at 8.

¹⁶⁴ See *Second Report and Order* 23 FCC Rcd 16847 (2008) at ¶106.

¹⁶⁵ *Id.* at 16849, ¶116.

¹⁶⁶ *Id.* at 16840, ¶84.

able to sense the presence of signals from incumbent services under some conditions, but were unable to do so in others, such as in noisy environments or in the presence of strong adjacent channel signals.¹⁶⁷ It further stated that these factors made it difficult to fully validate the performance of sensing technology and develop standards to ensure that devices relying on sensing alone would not cause interference. While the Commission believed that these problems could be solved and decided to permit sensing-only devices, it decided to limit these devices to 50 mW rather than 100 mW as permitted for other personal/portable devices out of an abundance of caution with regard to their interference potential.¹⁶⁸ We find that the Commission provided an adequate rationale for the 50 mW power limit for sensing-only devices and decline to change the power limit for these devices at this time.

80. We also decline to reduce the maximum permitted power for personal/portable devices that operate adjacent to occupied TV channels. In the *Second Report and Order*, the Commission recognized that there is a potential for TV bands devices to interfere with TV reception on adjacent channels, but found that such interference is unlikely to occur in the majority of situations if the power level is kept low. As with any interference analysis, certain assumptions were made concerning factors such as the separation distance from the potential source of interference to the receive antenna, the characteristics of the receiver, the type of transmit and receive antennas and any intervening terrain or obstacles. The petitioners are essentially challenging the assumptions the Commission used in its analysis in the *Second Report and Order*. We find that the Commission made reasonable assumptions and are upholding the 40 mW adjacent channel power limit. Specifically, we observe that interference to TV reception from a transmitter on adjacent channel would occur only when an adjacent channel signal level is substantially greater than the received TV signal level. Thus, adjacent channel interference would be most likely to occur in weak signal areas where an outdoor rooftop antenna is needed. In such situations, we find the Commission's assumed separation distance of 16 meters from a TV bands device to a rooftop TV antenna to be reasonable, as well as its assumption that the receive antenna will have horizontal polarization while the TV bands device has vertical polarization and that such a configuration will have a 3 dB polarization mismatch.

81. We find that assuming a TV receiver can reject adjacent channel signals at a -33 dB D/U ratio is reasonable because many receivers tested by the Commission have better performance than this, and because TV bands devices will comply with the stringent emission limits in the rules out-of-band emissions, which will limit emissions in the adjacent channel that could cause overload interference. Further, while SBE disputes the values the Commission used for TV antenna gain, it apparently considered only signals in the horizontal plane antenna pattern and not the additional attenuation resulting from the vertical difference in heights between the receive antenna and TV bands device. We note the arguments of SBE and MSTV that the Commission should assume a separation distance of two meters from TV bands devices to mobile DTV receivers. However, neither party provided an interference analysis or information about the characteristics of mobile DTV receivers, such as the sensitivity, adjacent channel D/U ratio that can be tolerated, antenna gain or directionality that could be used in an interference analysis.

82. With regard to Shure's request that we reduce the maximum power of TV bands devices operating adjacent to occupied channels, we note that wireless microphones operating under the Part 15 waiver are permitted to transmit with up to 50 mW, while Part 74 licensed microphones are permitted to transmit with up to 250 mW. Also, TV bands devices must use transmit power control to operate with the minimum power necessary for reliable communications and will therefore often operate at power levels below 40 mW. Thus, there is no significant power disparity between wireless microphones and TV bands devices. Further, as discussed below we are requiring TV bands devices to comply with power spectral density limits and to spread their energy to some degree within the TV channel of operation, while

¹⁶⁷ *Id.* at 16895, ¶257.

¹⁶⁸ *Id.* at 16895, ¶258.

wireless microphones operate with a relatively narrow bandwidth. The fact that wireless microphones use narrow bandwidths compared to TV bands devices means that the interference potential from TV bands devices is reduced because a wireless microphone receiver will receive only a portion of the energy transmitted by a TV bands device.

83. We agree that a PSD limit would help protect authorized services in the TV bands and are therefore requiring that the conducted output power of fixed and personal/portable TV bands devices comply with PSD limits. In the absence of a PSD limit, multiple devices with transmit bandwidths of significantly less than 6 megahertz could share a single channel, resulting in a total transmitted power within a channel significantly greater than the power limits for fixed or personal/portable devices. A PSD limit will prohibit high power concentrations in a single channel, which will reduce the interference potential to TV stations and other services in the TV bands. We are basing the PSD limit on the maximum permissible conducted output power spread across a transmit bandwidth of 6.0 megahertz, the full bandwidth of a TV channel. The resulting conducted PSD limits in a 100 kilohertz bandwidth are 16.7 mW (12.2 dBm) for fixed devices, 1.67 mW (2.2 dBm) for personal/portable devices, 0.83 mW (-0.8 dBm) for sensing-only personal/portable devices and 0.7 mW (-1.8 dBm) for personal/portable devices operating adjacent to occupied channels. We are adopting these PSD limits. We decline, however, to adopt minimum bandwidth requirements as requested by IEEE 802 and SBE. We find that a minimum bandwidth requirement could unnecessarily constrain the types of modulation that could be used with TV bands devices and is not necessary because the PSD limit has the same effect of preventing high power levels in a TV channel. We are also clarifying that a device that operates across more than one 6 MHz TV channel is still subject to the maximum power limits in Sections 15.709(a)(1) and (a)(2) of the rules – the allowable power does not increase with use of additional bandwidth beyond 6 megahertz.¹⁶⁹

c. Out of Band Emission (OOBE) Limits

84. In the *Second Report and Order*, the Commission required that TV bands device emissions in channels adjacent to the occupied channel be attenuated at least 55 dB below the highest average power in the occupied channel. Emission measurements in both the occupied channel and the adjacent channels are to be made with a minimum resolution bandwidth of 100 kHz and an average detector.¹⁷⁰

85. *Petitions and Replies*. Several parties request that the Commission modify the adjacent channel emission limits. IEEE 802 believes that the adjacent channel emission limits should be defined relative to the maximum allowable power in a 6 megahertz bandwidth, and that adjacent channel emissions should be measured in a 100 kHz bandwidth.¹⁷¹ It recommends that the required attenuation in the adjacent channel be increased from 55 dB to 72.8 dB to compensate for the differing bandwidths it recommends for measuring in-band and out-of-band power. IEEE 802 argues that without these changes, the maximum permitted adjacent channel emissions would be higher when a transmit bandwidth of less than 6 megahertz is used, because the power of adjacent channel emissions would increase by the same amount that the power of the transmitted signal increases within the 100 kHz measurement bandwidth. Motorola requests that the Commission clarify that the limit is 55 dB attenuation from the total in-band power transmitted by the TV bands device, and that out-of-band power should be measured in a 100 kilohertz bandwidth.¹⁷² Motorola also requests that if the Commission maintains the current emission measurement procedure, the minimum required attenuation should be reduced from 55 dB to 35 dB because an attenuation of 55 dB in adjacent channels is difficult to meet in consumer equipment operating at the power levels permitted by the Commission.

¹⁶⁹ See 47 C.F.R. § 15.709(a)(1) and (a)(2).

¹⁷⁰ See 47 C.F.R. § 15.709(c).

¹⁷¹ See IEEE 802 petition at 5.

¹⁷² See Motorola petition at 23.

86. The Wi-Fi Alliance requests that the Commission specify the attenuation in channels adjacent to the operating channel referenced to the average total power over the operating bandwidth, and that emissions measured in a 100 kHz bandwidth should be at least 39 dB below the average total power over the operating bandwidth.¹⁷³ MSTV/NAB argues that adjacent channel emissions should be measured relative to the maximum allowable power in the 6 megahertz operating channel and oppose the requests of Motorola and Wi-Fi Alliance because they would allow higher adjacent channel emissions than the current rules.¹⁷⁴ Rudman/Erickson claim that the emission mask is inadequate for VHF TV bands device operation because the Commission did not consider the protected contour values for VHF DTV stations, but they did not recommend an alternative.¹⁷⁵

87. *Decision.* We are modifying the rule for adjacent channel emissions to require that emissions be measured relative to the total in-band power in a 6 megahertz bandwidth, rather than in a 100 kHz bandwidth. This change will address the concerns raised by petitioners that the measured in-band power in a narrow bandwidth will vary depending upon the bandwidth of the transmitted signal. We will continue to require that the adjacent channel emissions be measured with a 100 kHz bandwidth, because a wider bandwidth would not be able to resolve emissions located just outside the channel of operation without being affected by the in-band power. The use of a 6 megahertz bandwidth for measuring the in-band power means that a higher reading will be obtained as compared to using a 100 kHz bandwidth, because the wider bandwidth will capture all the energy in a channel rather than only a portion of that energy. The 55 dB attenuation that the Commission adopted for adjacent channel emissions was based on the assumption that identical bandwidths would be used to measure both in-band and adjacent channel power, so we agree with IEEE that the currently required 55 dB attenuation should be increased to reflect the increased in-band measuring bandwidth while providing the same level of adjacent channel protection. As noted above, we will assume the maximum transmit bandwidth used to be the full 6 MHz channel. We will therefore base the increase in adjacent channel attenuation on a bandwidth ratio of 6.0 megahertz/100 kHz or 17.8 dB. Thus, we are revising the required adjacent channel attenuation to be 72.85 dB.

88. We decline to reduce the required adjacent channel attenuation as requested by Motorola and the Wi-Fi Alliance. Adjacent channel emissions from a TV bands device appear as co-channel emissions in an adjacent channel used by a TV station or other authorized service. Personal/portable TV bands devices are permitted to operate within the protected contours of adjacent channel TV stations, and fixed TV bands devices can operate as close as 0.1 kilometers outside the contours of adjacent channel stations and at significantly higher power than personal/portable TV bands devices. For these reasons, we find it necessary to limit adjacent channel emissions to the extent practicable to prevent interference to adjacent channel TV stations and other authorized services. We decline to modify the adjacent channel emissions limits for the VHF band as requested by Rudman/Erickson because they failed to describe or provide a justification for any specific changes to the rules.

d. Direct Pickup Interference

89. In the *Second Report and Order*, the Commission recognized the concerns of cable interests regarding the potential for direct pickup interference and their position that power levels should be limited to a lesser value.¹⁷⁶ It noted that FCC staff tests of three digital cable ready receivers, and anecdotal tests performed by the FCC staff in the laboratory and field, indicated that there is some potential for direct pickup interference to cable service from TV bands devices. The Commission observed that this direct pickup interference occurred at relatively close distances within the user's

¹⁷³ See Wi-Fi Alliance petition at 5.

¹⁷⁴ See MSTV/NAB opposition at 8.

¹⁷⁵ See Rudman/Erickson petition at 10.

¹⁷⁶ See *Second Report and Order* 23 FCC Red 16852 (2008) at ¶126.

premises and could be corrected by removing consumer-installed splitters and wiring that effectively reduce the shielding of interfering signals as well as reduce the desired signal levels available at the user's TV receiver. It also observed that in the FCC staff tests when just a cable converter box was used to connect directly to the TV receiver, interference declined dramatically and was virtually non-existent on the digital tier of channels. The Commission further observed in tests by the staff with a 10 meter separation between devices on separate sides of a wall, such as in a townhouse, interference did not occur at undesired signal levels below 100 mW for two receivers and slightly under 50 mW for a third. Based upon these observations and the fact the TV bands devices must incorporate transmit power control to limit their operating power to the minimum necessary for successful communications, the Commission decided that the risk of direct pickup interference is not sufficiently great to warrant a reduction in power that could impede the viability of certain TV bands device applications.¹⁷⁷

90. *Petitions and Replies.* NCTA argues that tests it commissioned in support of its petition for reconsideration show that TV bands devices will cause harmful direct pickup interference to cable services.¹⁷⁸ It claims that personal/portable devices operating at 100 mW will cause interference to television receivers up to 80 feet away through a wall.¹⁷⁹ NCTA states that many television receivers do not meet the Part 15 shielding requirements for cable ready receivers and that consumer in-home wiring is wholly inadequate to guard against signal ingress from 100 mW devices.¹⁸⁰ It disagrees that interference can generally be eliminated by removing consumer installed splitters and wiring or that dynamic power control is a solution because there are no parameters or specifications for the power level, and because devices may tend to operate at maximum power indoors.¹⁸¹ NCTA believes that maximum power for personal/portable devices should be 5 mW, but states that it would compromise on a level of 50 mW.¹⁸² It also claims that fixed TV bands devices operating on VHF channels can cause interference at a distance of 1,000 feet through a wall.¹⁸³ NCTA requests that the Commission adopt a minimum separation requirement for TV bands devices of 400 feet from 4 watt ERP fixed transmitters to buildings served by cable and limit fixed device power to 1 watt in urban areas where there is a difficulty in maintaining this separation distance.¹⁸⁴ DIRECTV states that satellite TV in-home architecture is susceptible to direct pickup interference and supports NCTA's requests to limit personal/portable device power to 50 mW and require minimum distance separations between fixed devices and buildings served by cable and asks that this protection also be extended to satellite TV service.¹⁸⁵

91. Several parties object to the requests by NCTA and DIRECTV to limit TV bands device power and establish minimum distance separations. Dell/Microsoft argue that NCTA did not test digital cable signals at the UHF frequencies on which personal/portable devices will operate, and that all TV receivers tested by NCTA appear to be able to withstand a 100 dBm field when tuned to digital signals.¹⁸⁶

¹⁷⁷ *Id.* at 16853, ¶126.

¹⁷⁸ See NCTA petition at 6.

¹⁷⁹ *Id.* at 7.

¹⁸⁰ NCTA petition at 7-8. Section 15.118(c) of the Commission's rules provide shielding requirements for analog cable ready consumer electronics products, 47 C.F.R. § 15.118(c).

¹⁸¹ NCTA Petition at 10-11.

¹⁸² *Id.* at 13.

¹⁸³ *Id.* at 13.

¹⁸⁴ *Id.* at 13.

¹⁸⁵ See DIRECTV opposition at 3.

¹⁸⁶ See Dell/Microsoft opposition at 10. They further argue that there will be few legacy analog system components remaining by the time white space devices are available to consumers, that many or most cable and DBS systems are not susceptible to the interference that concerns NCTA and DIRECTV, and that other devices such as 800 MHz cell

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In its reply to opposition, NCTA disagrees that direct pickup interference is not a problem with digital cable systems.¹⁸⁷ Google opposes a reduction in personal/portable device transmit power, arguing that dynamic power reduction, equipment suppliers' efforts and consumers' own corrective measures should be sufficient to alleviate the risk of direct pickup interference.¹⁸⁸ Motorola opposes NCTA's request for a 400 foot separation between buildings with cable TV service at 4 watt EIRP devices or a reduction in power to one watt, arguing that the limit was adopted after an exhaustive analysis by the Commission and industry and should not be decreased.¹⁸⁹ WISPA argues that NCTA's indoor test results are flawed by use of an inadequately characterized unshielded test area and leaky cables and that their indoor-to-outdoor extrapolation is flawed by invalid assumptions concerning antenna aim and wall attenuation.¹⁹⁰

92. *Decision.* We decline to reduce the maximum permissible power for personal/portable devices or to impose power and separation limits for fixed devices as requested by NCTA and DIRECTV. We first note that direct pickup interference is different from interference that can be received at the antenna of licensed over-the-air radio services such as broadcast television, low power auxiliary services or the PLRMS/CMRS. Interference can be caused to off-air reception of these services when an undesired signal on the same frequency as the transmitted signal exceeds some threshold at a receiver. By contrast, a cable system or satellite in-home wiring is a closed system in which the operator is not licensed to transmit on the frequencies used. No signal is transmitted over-the-air in those applications, rather direct pickup interference occurs when an undesired signal leaks into some part of the otherwise closed system, such as the cable, connectors, set top box or TV set. Thus, direct pickup interference results from a lack of immunity to undesired signals at some point(s) in the closed system of wiring and equipment. As noted above, the Commission has standards for regarding the ability of analog cable ready TV receivers to reject direct pickup interference.¹⁹¹ However, there are no rules regarding the ability of other components in a system to reject direct pickup interference, and selection of appropriate system components is the owner or cable/satellite TV operator's responsibility. In this regard, we generally do not believe it is appropriate to protect the operations of closed systems that use radiofrequency (RF) signaling from interference from radio services and operations that use the airways. In this regard, we observe that the operators/users of such systems have full discretion to design their equipment to be immune to ambient RF energy transmitted by radio systems that use the airways.

93. We also are not persuaded that direct pickup interference is a significant problem as NCTA states. Its testing revealed many of the same characteristics of direct pickup interference that the Commission's staff discovered during its testing. Specifically, NCTA determined that that the cables in a system are a significant source of direct pickup and that low quality (inadequately shielded) cables and connectors can result in substantially increased signal ingress. It also determined that analog systems are significantly more sensitive to direct pickup interference than digital systems. The Commission previously considered these factors when it established the power limits for TV bands devices in the *Second Report and Order*.¹⁹² We note that the NCTA tests assumed a worst case scenario in which the

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phones operate with higher power than TV bands devices and do not cause interference. See Dell/Microsoft opposition at 10 and reply to oppositions at 6-7. NCTA claims there is no significant use of the 800 MHz band by cable systems and that little frequency overlap is expected with new services in the 700 MHz band. See NCTA reply to oppositions at 2, 4.

¹⁸⁷ See NCTA reply to oppositions at 2, 4.

¹⁸⁸ See Google opposition at 16.

¹⁸⁹ See Motorola opposition at 12.

¹⁹⁰ See WISPA opposition at 12-15.

¹⁹¹ See 47 C.F.R. § 15.118(c).

¹⁹² *Id.* at 16852, ¶126.

cable signal level to a home is at the minimum level required by the rules, the TV bands device operates at the maximum power permitted by the rules and the maximum signal level is directed towards a TV receiver. In real world situations, the cable signal level may be greater than the minimum required, the TV bands device may operate at less than the maximum power due to the requirement to incorporate transmit power control, and the maximum TV bands device signal may not be directed toward a TV receiver, depending on the antenna directivity and orientation. These factors can have a greater impact on the potential for direct pickup interference than the power reductions requested by NCTA. We also note that NCTA's testing showed that some TV receivers can withstand signals levels greater than 100 mW without interference on digital channels, even assuming minimum cable signal input levels.¹⁹³ We further note that NCTA did not perform any tests using a cable converter box, which our testing showed, and which it agrees, could further reduce the potential for direct pickup interference.¹⁹⁴ In any event, notwithstanding NCTA's concerns for direct pickup interference and the possible mitigation of those concerns by elements in rules for TV bands devices, we find it inappropriate to limit the utility of TV bands devices by limiting their power to protect cable installations with inadequately shielded wiring or TV receivers that do not comply with the Part 15 shielding requirements.

C. TV Bands Database

94. In the *Second Report and Order*, the Commission required all fixed and Mode II TV bands devices to access a database to obtain information on the available channels at their location and required all unlicensed fixed TV bands devices to register their operations in this database.¹⁹⁵ The Commission stated that it will designate one or more entities to create and operate the TV bands database(s) and, as discussed above, has invited interested parties to apply for selection as database administrators.¹⁹⁶ The database(s) will be a privately owned and operated service that unlicensed TV bands devices must contact to obtain information on channel availability at the locations where they are operated and, in the case of fixed devices, to register their operation at those locations. In the case that multiple database administrators are selected, each device must contact a database service that the user or the manufacturer of the device selects. Database administrators are permitted to charge fees for registering fixed devices and providing lists of available channels to fixed devices and personal/portable devices. A TV bands database will be required to contain information on: 1) all of the authorized services that operate in the TV bands using fixed transmitters with designated service areas, including full service and low power TV stations, 2) the service paths of broadcast auxiliary point-to-point facilities, 3) the geographic regions served by PLMRS/CMRS operations on channels 14-20, 4) regions served by the Offshore Radiotelephone Service, and 5) the locations of cable headends and low power TV receive sites that are outside the protected contours of the TV stations whose signals they receive. In addition, a TV bands database will be required to contain the locations of registered sites where wireless microphones and other low power auxiliary devices are used on a regular or scheduled basis. The Commission did not establish any specific security requirements or protocols for communications between TV bands devices and the TV bands database.

95. The Commission required fixed and Mode II TV bands devices to re-check the database, at a minimum, on a daily basis to provide for timely protection of wireless microphones and other new or modified licensed facilities.¹⁹⁷ If a device fails to make contact with its database on any given day, it will

¹⁹³ See NCTA petition at Appendix 3, Tables 2 and 3. For example, three of the five TV receivers tested on cable channel 36 were able to reject signals greater than 100 mW in all orientations, and a fourth was able to reject signals greater than 100 mW in three out of four orientations.

¹⁹⁴ See *Second Report and Order* 23 FCC Red 16852 (2008) at ¶126 and NCTA petition at 10.

¹⁹⁵ *Id.* at 16877, ¶201.

¹⁹⁶ *Id.* at 16878, ¶204.

¹⁹⁷ *Id.* at 16879, ¶206.

be required to cease operating at 11:59 PM on the following day. Mode II devices are also required to re-establish their location coordinates and to access a TV bands database for a list of available channels each time they are activated or moved. The Commission further required that, if multiple database administrators are authorized, the database administrators are to cooperate to develop a standardized process for sharing data on a daily basis or more often, as appropriate, to ensure consistency in the records of protected facilities.¹⁹⁸ Finally, the Commission required that a database administrator make its services available to all unlicensed TV bands device users on a non-discriminatory basis.

1. Security

96. *Petitions and Replies.* Key Bridge argues that the Commission did not adequately address security risks with the geo-location/database approach and request that it require "strong counter party authentication" between databases and TV bands devices without specifying particular technologies or system architecture.¹⁹⁹ Other parties, including CWMU, MSTV/NAB and SBE, also argue that the Commission needs to adopt database security requirements.²⁰⁰ MSTV/NAB submits that the absence of security requirements for databases or communications between a database and devices will leave the database system open to hackers to falsely list certain channels as available.²⁰¹ It also expresses concern that because the Commission's decision allows database administrators to agree on a protocol, the Commission retains no authority to approve those protocols.²⁰² Google opposes Key Bridge's request, arguing that the Commission adequately addresses the issue of authentication by relying on database administrators to correct inaccurate data and by reserving the Commission's right to remove inaccurate or non-compliant information.²⁰³ Google also argues that each database administrator will implement appropriate security features without the need to require such features in the rules.²⁰⁴

97. *Decision.* On reconsideration, we find that it is important and necessary for TV bands devices and TV bands databases to incorporate reasonable and reliable security measures to minimize the possibility that TV bands devices will operate on occupied channels and cause interference to licensed services and to protect the operation of the databases and the devices they serve from outside manipulation. While the Commission did not explicitly require the incorporation of security measures in the *Second Report and Order*, we note that virtually all online transactions involving financial or other confidential information currently use security measures to protect against unauthorized viewing and/or alteration of information being sent and to ensure that only authorized users have access to information. We therefore expect that device manufacturers and database administrators will have access to and be able to incorporate the reliability and security measures needed to protect the contents of databases and communications between databases and TV bands devices or other databases. We are concerned that if a device uses channels provided through other than legitimate contact with a TV bands database or if a database administrator does not include appropriate security to avoid serving unauthorized devices or to prevent outside parties from altering its processing system and data records, there could be interference consequences ranging from mild to severe.

98. To achieve the necessary protection of databases and connections between devices and databases regarding channel availability, we are requiring that TV bands devices and database systems

¹⁹⁸ *Id.* at 16884, ¶222.

¹⁹⁹ See Key Bridge petition at 3.

²⁰⁰ See CWMU opposition at 7 and SBE petition at 22.

²⁰¹ See MSTV/NAB opposition at 15.

²⁰² *Id.* at 14.

²⁰³ See Google opposition at 18.

²⁰⁴ *Id.* at 18.

employ security measures follows. First, we are requiring that, for purposes of obtaining a list of available channels and related matters, fixed and Mode II TVBDs only be capable of contacting databases operated by administrators designated by the Commission. This will prevent TV bands devices from obtaining channel lists from unauthorized databases which may be invalid or inaccurate – we are particularly concerned about potential cases where a database would indicate as available channels that are used by authorized services. We also are specifying that TV bands databases must not provide lists of available channels to uncertified TV bands devices for purposes of operation (is acceptable for a TV bands database to distribute lists of available channels by means other than contact with TVBDs) in order to avoid facilitating the operation of unapproved and non-compliant devices. To facilitate these restrictions, we are requiring that database(s) verify that the FCC identification number (FCC ID) supplied by a fixed or personal/portable TV bands device is for a certified device. To implement this provision, we are also requiring that database administrators obtain a list of certified TVBDs from our Equipment Authorization System.²⁰⁵

99. We are further requiring that communications between TV bands devices and databases be transmitted using secure methods to prevent corruption or unauthorized modification of data. This requirement includes communications of channel availability and other spectrum access information between fixed and Mode II devices (it is not necessary for TVBDs to apply security coding to channel availability and channel access information that they simply pass through as such information will already be protected by the sending device).²⁰⁶ We are requiring that when Mode I devices communicate with fixed or Mode II devices for purposes of obtaining a list of available channels, they are to use a secure method that ensures against corruption or unauthorized modification of the data. In addition, a fixed or Mode II device must check with its database that the Mode I device has a valid FCC Identifier before providing a list of available channels.²⁰⁷ Also, we are requiring that contact verification signals transmitted for Mode I devices be encoded with encryption to secure the identity of the transmitting device and that Mode I devices using such signals accept as valid for authorization only the signals of the device from which they obtained their list of available channels. Finally, we are requiring that databases be protected from unauthorized data input or alteration of stored data. In order to accomplish this goal, the data base administrator is to establish communications authentication procedures that allow the fixed or Mode II devices to be assured that the data they receive is from an authorized source.

100. We are not requiring the use of specific technologies to meet these requirements, as we believe that database administrators and device manufacturers are in the best position to determine the appropriate methods to ensure compliance. Rather, we will require that applications for certification of TV bands device include a high level operational description of the technologies and measures that are incorporated in the device to comply with the security requirements. In addition, we are requiring that applications for certification of fixed and Mode II devices identify at least one of the designated TV bands databases that the device will have the ability to access for channel availability information and affirm that the device will conform to the communications security methods used by that database. With regard to MSTV/NAB's concerns about the possible problems with protocols developed after a database administrator is selected, there is no practical way the Commission could review a communication protocol in advance to provide absolute assurance that there are no security flaws with it. We will,

²⁰⁵ Our Laboratory Division will provide a means for database administrators to obtain a list of certified TVBDs from the database maintained in our Equipment Authorization System.

²⁰⁶ MSTV/NAB also express concern about the security of communications between client devices and a master or fixed device that provides their channel assignments. They suggest that, at a minimum, client devices should be required to transmit a unique identifier to minimize the risk that they receive information from an unreliable source. See MSTV/NAB opposition at 15-16. This issue is addressed below in the section on "Transmitter IDs."

²⁰⁷ As discussed above, we note that the rules do not permit personal/portable devices operating on a client basis to relay channel availability information from one client device to another client device unless some means is used to ensure that each device is operating within the parameters for its particular location.

however, take all reasonable steps in our examination of applications for certification to ensure that communications protocols are secure. In the event that flaws are discovered in a TVBD's security measures, the Commission will take steps to ensure that those measures are quickly corrected by device manufacturers and database administrators or to withhold or withdraw the authorization for operation of any affected devices.

2. Database Administrators

101. *Petitions and Replies.* SBE, CMWU and MSTV/NAB argue that that the Commission should designate a single database manager to perform all database functions.²⁰⁸ CWMU believes that the database operator should function under close supervision of the Commission with an advisory panel consisting of representatives of all stakeholders to ensure that control of its development and/or operation is not assumed by one faction, and that management is not hindered by an inability to reach agreements or compromises.²⁰⁹ SBE argues that multiple database operators would complicate device designs and the ability to prevent and control rogue database operators.²¹⁰

102. PISC argues that the Commission should permit the functions of a database to be split among multiple entities rather than requiring a single database provider to perform all functions.²¹¹ It believes that the database could consist of a repository service that would be responsible for creating, updating and maintaining a database, a separate query service for providing available channel information based on data in the repository, and a registration service for fixed TV bands devices.²¹² PISC requests that the Commission state its preference for a private but nonprofit database service.²¹³

103. Key Bridge believes that the Commission should proceed with its original intent to authorize multiple database administrators that cooperate to ensure data integrity and synchronization.²¹⁴ It disagrees with SBE that multiple databases will impose a burden on TV stations to ensure databases are accurate and cites the Internet Domain Name System as an example of a globally distributed public information service with multiple, privately operated database servers.²¹⁵ Key Bridge argues that there are significant risks with a monopoly administrator, including proprietary database access formats, poor operational performance and prohibitive pricing and fees.²¹⁶ It disagrees with PISC that the database administrator function should be deconstructed or that a non-profit organization should be preferred.²¹⁷ Key Bridge supports the Commission's original intent to permit more than one database administrator but does not want this to create a situation with potentially functionally overlapping but only partially competent service providers.²¹⁸

104. *Decision.* We are upholding the Commission's decision to allow the designation of multiple database administrators and will rely on market forces to shape the structure of the database

²⁰⁸ See SBE petition at 20, CWMU opposition at 6 and MSTV/NAB opposition at 13.

²⁰⁹ See CWMU opposition at 7 and reply to oppositions at 5.

²¹⁰ See SBE petition at 20.

²¹¹ See PISC petition at 12, 14.

²¹² See PISC petition at 13.

²¹³ See PISC petition at 15.

²¹⁴ See Key Bridge opposition at 3.

²¹⁵ See Key Bridge opposition at 2-3.

²¹⁶ See Key Bridge reply to oppositions at 3.

²¹⁷ See Key Bridge opposition at 5.

²¹⁸ See Key Bridge opposition at 6.

administration functions and service offerings, subject to the various requirements set forth in the rules. Under this approach, some providers may choose to provide a full panoply of services and others may choose to provide only a repository function or "look-up" service. As the Commission stated in the *Second Report and Order*, multiple database administrators could offer services on a competitive basis.²¹⁹ This would prevent a single party from obtaining monopoly control over the database, could provide an incentive for database operators to provide additional services beyond those required by the rules and could result in lower costs to consumers. We will permit the database functions, such as a data repository, registration and query services, to be split among multiple entities. This approach will allow for competition between providers of specific elements of the database function and encourage the provision of enhanced services not specifically required by the rules. We recognize Key Bridge's concerns about creating a situation in which some parties engaged in the process do not have full competency in all aspects of database administration, but no parties would be provide all the necessary database functions. We therefore are requiring that entities selected as database administrators will be held accountable for all aspects of database administration, including any functions performed by third parties. The nine proposals received in response to the Commission's November 25, 2009 public notice indicate that there are multiple parties seeking to be designated as TV bands device database managers, some as full-service operations and others as partial service providers. We are confident that market forces will result in the necessary and appropriate mix of database providers and third party entities that perform some aspect of the database function.

105. We disagree with SBE that designating multiple database administrators would complicate equipment design or limit the Commission's ability to control unauthorized database operators. Manufacturers would only have to design equipment to communicate with a single database, although they could design equipment to communicate with multiple databases if they choose. Further, designating only a single database administrator would not prevent unscrupulous parties from attempting to establish an unauthorized and inaccurate database, as parties could attempt this whether the Commission designates a single or multiple database administrators. Rather, the requirement to incorporate security in communications between TV bands devices and the databases will thwart unauthorized database operators.

106. We recognize that a complication of designating multiple database administrators is the need to synchronize licensing and registration information between databases. However, the rules already require this, and no party has shown that it is impractical to share information between TV bands device databases. We decline to establish an advisory panel to oversee the database as requested by CWMU. We find that this approach is unnecessary given that the Commission has already started the process for selecting the database administrators, and we are concerned that disagreements between panel members could potentially slow the development of the database. Rather, we will expect entities selected as a database administrator to cooperate in complying with the requirements for database coordination. We also decline to state a preference for a non-profit organization to run the database, as there is no evidence that a non-profit organization would administer a database better than a for-profit company.

107. In the *Second Report and Order*, the Commission stated that the database manager or managers would be selected by our Office of Engineering and Technology.²²⁰ Once the selection of a database manager or managers is completed there will need to be Commission oversight and management of the database administrator(s) and their functions. We are delegating authority for this oversight to the Chief of our Office and Technology under Part 0 of the rules, as set forth in Appendix B.

3. Re-check Procedures

108. *Petitions and Replies*. Shure asks that the Commission require TV bands devices to

²¹⁹ See *Second Report and Order* 23 FCC Rcd 16878 (2008) at ¶204.

²²⁰ *Id.* at 16812.

access frequency availability information in real time, near real time, or at a minimum of once every hour, and that the Commission reduce the time period when TV bands devices must stop transmitting if they cannot contact the database from 48 hours to four hours.²²¹ Sennheiser, MSTV/NAB, SBE and CWMU also support increasing the frequency of database contact.²²² MSTV/NAB argues that if TV bands devices check the database only once per day, they will fail to protect many wireless microphone operations.²²³ PISC and Google contends that requiring database look-up to protect registered microphone users in real time or substantially less than daily is unnecessary, possibly unworkable and would impose undue costs.²²⁴ PISC argues that microphone venues know well in advance when they will be operating.²²⁵

109. IEEE 802 and Wi-Fi Alliance recommend as an alternative to a daily database check by TV bands devices that each such device provide an internet contact address to allow the database to push changes in channel availability information to affected devices in near real time.²²⁶ Wi-Fi Alliance also suggests the alternative of allowing each fixed or Mode II device to receive a certificate for time-limited operation in the TV bands.²²⁷ Key Bridge states that an active channel management concept as proposed by IEEE 802 and WiFi Alliance could be accommodated without creating an undue burden on database administrators, but would require significantly expanded operational authority.²²⁸ SBE opposes Wi-Fi Alliance's recommendation because it would not require daily database checks for fixed TV bands devices.²²⁹

110. Motorola requests that Mode II devices be permitted to contact the database and download channel availability information for multiple locations that surround its current location and that it contact the database again only when it has moved beyond the range where the downloaded information is valid.²³⁰ It recommends that channel availability information be valid until 11:59 PM of the day after it was downloaded.²³¹

111. *Decision.* We are affirming the current requirement that fixed and Mode II personal/portable TV bands device check the database at least once per day. The majority of entries in the database will be fixed services, such as TV stations, TV translator receive sites, cable and satellite headends, fixed BAS links, and the PLMRS/CMRS facilities. These fixed services change channels or service areas infrequently, so we find that requiring a daily database check by TV bands devices is quite adequate to protect these services. The concerns expressed in the record about the need to increase the frequency of database contact relate primarily to protecting LPAS stations, and wireless microphones in particular. Even in the case of wireless microphones, most events for which users can register wireless microphones in the database occur at fixed locations where the required registration information will be

²²¹ See Shure petition at 15-16.

²²² See Sennheiser opposition at 4, MSTV/NAB opposition at 12, SBE petition at 21 and CWMU opposition at 7.

²²³ See MSTV/NAB opposition at 12-13 (itinerant wireless microphone incumbents cannot predict their spectrum needs or precise location 24 hours in advance).

²²⁴ See PISC opposition at 12 and Google reply to oppositions at 9.

²²⁵ See PISC opposition at 12.

²²⁶ See IEEE 802 petition at 6 and Wi-Fi Alliance petition at 2.

²²⁷ See Wi-Fi Alliance petition at 3.

²²⁸ See Key Bridge opposition at 3.

²²⁹ See SBE opposition at 7.

²³⁰ See Motorola petition at 19-20.

²³¹ *Id.* at 19-20.

known more than a day in advance. Thus, the main concern appears to be how to protect licensed wireless microphones that are used in applications where the location and/or channel are not known at least a day in advance, such as electronic news gathering. As discussed above, we are taking steps to ensure that some channels remain available for wireless microphones by prohibiting personal/portable devices from operating below channel 21, designating two channels in each market from among channels 14-51 where TV bands devices cannot operate, and prohibiting fixed devices from operating adjacent to occupied TV bands channels. We find that these measures will ensure that adequate spectrum is available for licensed itinerant wireless microphone users in the vast majority of situations. In this context, we also must consider that in most locations many channels will be available for wireless microphone use that are not available for TVBD use. Those channels can be used by wireless microphones for unscheduled events. We also observe that in the case of a major unplanned news event, broadcasters already coordinate their use of frequencies for wireless microphones and that at a site can share frequencies by avoiding operation of wireless microphones at the same time. We therefore decline to require more frequent database checks by TV bands devices which would substantially increase the amount of database traffic without significant benefit.

112. In re-affirming the daily re-check requirement, we also observe that the rules currently do not specify that a database provide the TVBD with information on changes in channel availability that occur over the course of the 24 hours before the next re-check. For example, if a database were to provide a TVBD with only a list of the channels that are available at 9:00 a.m. and there is a scheduled use of wireless microphones on one or more of those channels during the period 3:00 p.m. to midnight, the TVBD would not cease operating on the channels that became unavailable later in the day. It is our intention that a database provide TVBDs with information on the full schedule of channel availability over the course of the 24 hour re-check period plus the additional period of up to 24 hours that a device may continue to operate if it is not able to contact its database at the end of the re-check period. This is necessary to ensure that TVBDs do not cause interference to protected operations that use channels during part of a 24 hour period. Accordingly, we are amending our rules to provide that 1) a database must provide fixed and Mode II TVBDs with channel availability information that includes scheduled changes in channel availability over the course of the 48 hour period beginning at the time the TVBDs make a re-check contact and 2) fixed and Mode II TVBDs must adjust their use of channels in accordance with channel availability schedule information provided by their database.

113. As indicated above, because they have no geo-location capability to identify their location, we are requiring Mode I personal/portable devices to either receive a signal to verify contact from the Mode II or fixed device that provided its current list of available channels or contact a Mode II or fixed device at least once per minute to re-verify/re-establish channel availability. Under the new contact verification option, a "contact verification signal" will be an encoded identification signal that may be broadcast by a fixed or Mode II device for reception by Mode I devices to which the fixed or Mode II device has provided a list of available channels for operation. Such signal will be for the purpose of establishing that a Mode I device is still within the reception range of the fixed or Mode II device from which it received a list of available channels; reception of a contact verification signal will be presumed to verify that the list of available channels used by the Mode I device remains valid for purposes of the once per minute re-check requirement. We expect that this feature will be especially useful for improving efficiency in cases where several Mode I devices receive lists of available channels from the same fixed or Mode II device. We are not requiring that Mode II and fixed devices transmit contact verification signals in support of Mode I devices they serve; however, use of this option is strongly suggested. We are requiring that contact verification signals be encoded to ensure that they originate from the TV bands device that provided the list of available channels; the fixed or Mode II device transmitting a contact verification signal would need to provide a Mode I device it serves with decoding information at the time it makes an exchange contact with the Mode I device to provide a list of available channels. Mode I devices that receive contact verification signals will still be required to re-check with a fixed or Mode II device at least once a day. In addition, Mode II devices will be required to re-check/reestablish contact to obtain a list of available channels if they lose power. Collaterally, if a Mode II device loses power and

obtains a new channel list, it must signal all Mode I devices it is serving to acquire new channel list. We are also clarifying the requirement that Mode II devices re-check with their database when they move to specify that such devices must re-check only when they are moved more than 100 meters from the location at which they performed their last re-check. This will avoid the need for re-checking when a device is moved very short distances that would have a *de minimis* impact on potential interference and reduce the burden of the re-check function on the database and the Mode II TVBD.

114. We will permit database administrators and device manufacturers to develop a system to "push" channel availability changes and other information to TV bands devices if they choose. This capability could, for example, be used in the development of standards that allow more efficient sharing of TV spectrum by networks of TV bands devices. We will not, however, require that databases or devices incorporate this capability. To guard against the possibility that a device may miss updates pushed by the database and continue transmitting on a channel that becomes unavailable, devices that incorporate this capability must still function in the same manner as other TV bands devices and validate their channel at least once per day and cease operation no later than 11:59 PM the following day if they cannot validate the operating channel. The operation of such an information "push" system must be described in the application for certification. Any other clearing of channels, such as marking particular channels as unavailable in the database, may only be done under authorization by the Commission.

115. We also will permit Mode II personal/portable devices to load available channel information for locations beyond their current position and use that information in their operation. Mode II devices will be allowed to use such additional available channel information to define a geographic area within which they could operate on the same available channels at all locations. Allowing channel lists to be stored for more than a single location will allow for more efficient operation of portable devices by reducing the number of queries to the database and to support mobile operation. For example a Mode II TVBD could calculate a bounded area in which a channel or channels are available at all locations within the area and operate on a mobile basis within that area. Mode II TVBDs that use such an approach must contact the database when they have moved beyond the boundary of the area where their channel availability data is valid, and must re-check the database at least once each day like other Mode II devices even if they have not moved beyond the range where the data is valid.²³² Parties that incorporate the ability to load channel lists for multiple locations and operate within an area bounded into a device must describe in the application for certification how they will ensure the device operates only on available channels within the bounded area.²³³

4. Additional Service Features

116. *Petition and Replies.* PISC requests that the Commission require the TV bands database to be capable of reporting estimated signal strength data on adjacent TV channels in addition to available TV channels.²³⁴ Key Bridge requests that the Commission require TV bands devices to report in-service monitoring and active channel data to the database system.²³⁵ Motorola believes that more precise TV service area prediction models should be incorporated into the database to permit expanded adjacent

²³² CWMU recommends that personal/portable devices be required to re-check the database if they move more than 50 meters. See CWMU opposition at 7. Because the rules require a TV bands device to determine its location with an accuracy of 50 meters, and because the rules require the database to be re-checked when a personal/portable device moves, the rules already address CWMU's request.

²³³ We note that it is possible that the available channels within a bounded area will be different at different locations in that area. In such cases, the device would only be allowed to operate on those channels that are available at all locations within the bounded area.

²³⁴ See PISC petition at 16.

²³⁵ See Key Bridge petition at 5.

channel use by fixed devices without the need for rulemaking delay.²³⁶

117. *Decision.* Database administrators may perform additional functions besides those required by the rules, such as tracking active channel use if reported by the TV bands device, or sending additional information to a TV bands device to enable it to determine the "best" available channel to use. Such functions are not prohibited by the rules, and the ability to add additional functionality could allow multiple database operators to distinguish their services and could be useful in the development of industry standards to enable more efficient spectrum sharing. However, in the interest of keeping the rules simple and avoiding the imposition of unnecessary requirements that could hamper innovation, we decline to require TV bands devices to report additional information to the database beyond what the rules currently require. We also decline to require the incorporation of different (and currently unspecified) TV service area prediction models into the database as requested by Motorola. The rules currently prohibit adjacent channel operations by fixed devices, and there is insufficient record to change that requirement at this time.

5. Database Information

118. *Petitions and Replies.* PISC requests that the Commission require that all information in the TV bands database repository be made fully transparent and available to the general public online and a matter of public record.²³⁷ CWMU recommends that wireless microphone users be able to check and correct data, and Rudman/Ericksen recommends that all protected users be entitled to verify their TV bands device database entries free of charge.²³⁸ However, Key Bridge believes that requiring public disclosure of voluntary registration information could compromise business security and pose a competitive risk to the cable, satellite and WISP industries.²³⁹ It recommends that the requirement for database administrators to provide or delete information from the database be limited to publicly available data provided by the Commission or other government sources that is required for the fields specified in Section 15.713.²⁴⁰ WISPA requests that the Commission require fixed TV bands device operators to access and review the geo-location database prior to network deployment and choose an available channel that does not cause interference to nearby fixed TV bands device networks.²⁴¹

119. *Decision.* We will require that all information that is required by the Commission's rules to be in a TV bands device database be publicly available, including fixed TV bands device registration and voluntarily submitted protected entity (e.g., cable head ends) information. We will not require the public disclosure of information that a database manager may collect to support additional services (see discussion supra), provided that this information also is not required to be provided by our rules. We note that the registration of a protected entity in the database will preclude operation of TV bands devices on one or more channels over specific areas, and that there is the possibility of errors in the registration information. Although much of the data will come from Commission databases that already are public sources, errors could result from the inadvertent entry of incorrect data, or as a result of a party deliberately entering false data. We therefore find that it is appropriate to permit public examination of protected entity registration information to allow the detection and correction of errors. We also find that making fixed TV bands device registration information publicly available could assist parties in locating the source of any interference that occurs and contacting the device operator to correct it. With regard to Key Bridge's request concerning the Commission's requirement to provide or delete information from the

²³⁶ See Motorola petition at 20-21.

²³⁷ See PISC petition at 14.

²³⁸ See CWMU opposition at 7 and Rudman/Ericksen petition at 15.

²³⁹ See Key Bridge opposition at 5.

²⁴⁰ See Key Bridge petition at 7.

²⁴¹ See WISPA petition at 16.

database, we are clarifying that this requirement applies only to the information that the Commission requires to be placed in the database and not any other information that a database administrator collects beyond what the rules require.

120. We decline to require fixed TV bands device operators to access and review the database prior to network deployment and to select a channel that is not in use, because one of the general conditions of operation for Part 15 is that a party's use of a particular frequency does not give it rights over other parties to continued use of that frequency.²⁴² In addition, a TV bands device may need to operate on more than one available channel and may do so. However, we will permit database administrators to allow prospective operators of TV bands devices to query the database to verify whether there are vacant channels at a site where they wish to operate, and operators of TV bands devices may use information from the database to voluntarily coordinate their channel usage to avoid conflicts.

121. In reviewing the rules for the information to be included in a TV bands database, we observe that in the case of full power TV, Class A TV, low power TV and TV translator stations the Commission's Consolidated Broadcast Data Base System (CDBS) from which the TV station database records will be extracted in many cases includes multiple types of records for each station. For example, the database may include license, license application, special temporary authorization and construction permit applications for the same station and may also include more than one of each of these types of records for the same station.²⁴³ These multiple records can pose confusion in administering a TV bands database with respect to which records to extract for the database. It is our intention that the records in a TV bands database only reflect stations that are serving viewers. In the CDBS, only records for licensees and license applications imply that a station is providing service to viewers. We therefore are clarifying that a TV bands database is to include only TV station information from license or license application records. Given that a license application implies a change that is to the station's ongoing operations, we find that in cases where a station has records for both a license application and a license, a TV bands database should include the information from the license application rather than the license.²⁴⁴ We are amending our rules to add these clarifications.

6. Database Fees

122. *Petitions and Replies.* PISC recommends that the Commission ensure to the extent feasible that database fees are limited to a modest, one-time charge that can be easily incorporated into the retail price of a device.²⁴⁵ Key Bridge, on the other hand, believes that database operators and their clients should be allowed to freely negotiate among themselves to establish mutually acceptable price levels and fee structures.²⁴⁶ It also requests that database administrators and TV bands device manufacturers be permitted to negotiate commercial relationships for the registration of Mode II devices.²⁴⁷ SBE argues that the Commission did not consider the impact and cost on licensees of inputting data into the database, and that the cost of database maintenance should be calculated and the costs paid by new entrants benefiting from it, such as unlicensed equipment manufacturers.²⁴⁸ Dell/Microsoft disagrees with SBE that costs incurred when registering with the database should be billed

²⁴² See 47 C.F.R. § 15.5(a).

²⁴³ See 47 C.F.R. §§ 73.1635, 3533 and 3536.

²⁴⁴ Upon completion of construction a broadcast station may begin operations in accordance with its construction permit. The license application must be filed within 10 days thereafter. See 47 C.F.R. § 73.1620.

²⁴⁵ See PISC petition at 15.

²⁴⁶ See Key Bridge opposition at 6.

²⁴⁷ See Key Bridge petition at 6.

²⁴⁸ See SBE petition at 22.

to equipment manufacturers.²⁴⁹

123. *Decision.* We decline to establish a particular fee structure for database administrators. We find that database administrators are in the best position to manage their costs and fees. We disagree with SBE that registering protected entities with the database will have a significant impact on licensees or others. Many of the registrations will be for services at fixed locations such as fixed BAS links or satellite, MVPD or TV translator receive sites, and these only need to be registered once, and in the case of receive sites, only if they are located outside the protected contour of the TV station being received. Information for licensed services will come from Commission databases. Further, all such registrations are voluntary, so a party may choose not to register sites where it believes that interference from TV bands devices is unlikely to occur. We are, however, modifying Section 15.714(a) to remove the provision that database administrators may charge to register temporary BAS links. The Commission did not state in the *Second Report and Order* that database administrators could charge for registering temporary BAS links, and a provision stating that they could was inadvertently added to the rules.

7. Other Database Issues

124. *Petitions and Replies.* SBE requests that the Commission clarify that every TV bands device, including Mode II personal/portable devices, is required to contact the database before being allowed to transmit unless it is a Mode I device that is in contact with a fixed or Mode II device that has contacted the database and uses the list of channels provided by the fixed or Mode II device. SBE believes that such database contact is needed to prevent "daisy chains" of devices that obtain authorization through other devices that did not contact the database themselves.²⁵⁰ Key Bridge also requests that Mode II personal/portable devices be required to register with the database.²⁵¹ Dell/Microsoft opposes requiring registration of personal/portable devices and prohibiting conveying database information through multiple devices.²⁵² CWMU requests that we require that locations of wireless microphone venues and TV bands devices be accurate to +/-5 meters.²⁵³

125. *Decision.* Fixed and Mode II TV bands devices are allowed to contact a database for a list of available channels through other TV bands devices, provided they follow the rules and connect to an authorized database using the appropriate protocol, send their geographic coordinates and other required information and operate only on channels that the database indicates are available. The rules already permit this practice but do not allow the formation of "chains" of devices that did not access the database but merely pass-on a list of available channels.²⁵⁴ Therefore, no rule changes are necessary in this regard. We will not require Mode II personal/portable devices to register in the database, because this would substantially increase the number of registrations in the database, and each of these registrations would have to be updated as device changes locations, thus substantially increasing the database traffic. We also see no need for registration of these devices as a means to help identify a source of interference, as the interference range of personal/portable devices is in general relatively short. In this regard, we are correcting an error in Section 15.713(e)(4) of the rules which incorrectly states that Mode II devices must register on initialization. We will not require devices to provide coordinates accurate to +/- 5 meters because that is a higher degree of precision than necessary, and such accuracy may not be readily achievable by most devices.

²⁴⁹ See Dell/Microsoft opposition at 17.

²⁵⁰ See SBE petition at 21.

²⁵¹ See Key Bridge petition at 4.

²⁵² See Dell/Microsoft opposition at 17.

²⁵³ See CWMU opposition at 8.

²⁵⁴ See 47 C.F.R. § 15.711(g).

D. Use of TV Channels

1. TV bands Devices, Wireless Microphones and Low Power Auxiliary Stations

126. In the *Second Report and Order*, the Commission prohibited fixed TV bands devices from operating adjacent to occupied TV channels at this time, although it deferred a final decision on this issue and kept the record open pending the development of additional information demonstrating that a reliable method can be developed to allow adjacent channel operation.²⁵⁵ The Commission decided to allow both fixed and personal/portable unlicensed TV bands devices to operate on channels 21-36 and 38-51. In addition, the Commission allowed only fixed TV bands devices to operate on channels 2 and 5-13 and on channels 14-20 outside of areas where PLMRS/CMRS services operate.²⁵⁶ The Commission stated that allowing only fixed TV bands devices to operate below channel 20 would ensure that some channels remain available for use by wireless microphones and eliminate the possibility of interference from TV bands devices to public safety and other important communications operations in the PLMRS. While it believed that the geo-location/database and Mode I operation provisions of the rules would provide a high degree of assurance that PLMRS/CMRS, Offshore Radiotelephone Service and other authorized services on channels 14-20 are protected, the Commission chose a more conservative approach to protect the PLMRS/CMRS services from expected high numbers of nomadic personal/portable devices and affirmed its decision from the *First Report and Order and Further Notice of Proposed Rule Making* in this proceeding to prohibit personal/portable devices from operating on channels 14-20.²⁵⁷ In addition, in 13 major markets where certain channels between 14 and 20 are allocated for land mobile operations, the Commission designated two channels between 21 and 51 - i.e., the first vacant channels above and below channel 37 - where personal/portable TV bands devices could not operate, leaving those two channels available for low power auxiliary stations.²⁵⁸

127. *Petitions and Replies*. Adaptrum and Motorola ask that fixed devices be permitted to operate adjacent to occupied TV channels. Adaptrum submits several possible approaches for reducing interference power to TV receivers, including lowering TV bands device in-band transmission power, narrowing TV bands device transmission bandwidth, and lowering the out-of-band emissions limit for TV bands devices. Motorola argues that the adjacent channel prohibition for fixed TV bands devices could be eliminated if the rules allow for highly detailed terrain modeling that accurately predicts TV field strength.²⁵⁹

128. Dell/Microsoft, Motorola and PISC argue that prohibiting personal/portable devices below channel 21 is not necessary because the Commission has imposed rigorous geo-location and database querying on Mode II personal/portable devices and Mode I personal/portable devices are under control of a fixed or Mode II device.²⁶⁰ However, APCO, County of Los Angeles and LMCC express concern that interference protection relying on geo-location may not work as anticipated and thus oppose allowing personal/portable devices to operate on channels 14-20.²⁶¹ Shure opposes permitting personal/portable devices to operate below channel 21, arguing that TV bands devices would be less

²⁵⁵ See *Second Report and Order* 23 FCC Rcd 16869 (2008) at ¶178.

²⁵⁶ *Id.* at 16859, ¶148.

²⁵⁷ See *First Report and Order and Further Notice of Proposed Rule Making* in ET Docket Nos. 02-380 and 04-186, 21 FCC Rcd 12266, 12275 (2006) and *Second Report and Order* 23 FCC Rcd 16859 (2008) at ¶148.

²⁵⁸ See *Second Report and Order* 23 FCC Rcd 16862 (2008) at ¶157.

²⁵⁹ See Adaptrum petition at 3-5 and Motorola petition at 21.

²⁶⁰ See Dell/Microsoft petition at 5, Motorola petition at 11 and PISC petition at 25.

²⁶¹ See APCO opposition at 3, County of Los Angeles opposition at 3 and LMCC opposition at 5. Motorola states that concerns about operation on channels 14-20 could be addressed by removing the general prohibition on personal/portable devices operating on channels 5-13. See Motorola opposition at 15.

effective sensing at frequencies below channel 21 and that, if the integrity of the TV bands database is disrupted, devices that rely on it will pose the same interference threat as sensing-only devices.²⁶² NCTA opposes PISC's request to allow portable devices to operate on channels 5-13 due to concerns about direct pickup interference.²⁶³

129. PISC requests that the Commission eliminate the rule provision reserving two channels above 21 for wireless microphones in markets with PLMRS/CMRS operations. PISC argues that this reservation is needlessly wasteful in that the Commission already provides wireless microphones with more than enough spectrum and protection by excluding personal/portable devices on channels 5-20.²⁶⁴ Rudman/Ericksen argues that it is not necessary to reserve the first vacant channel above and below channel 37 for wireless microphones because the Commission can simply protect a point/radius for each wireless microphone in the ULS database.²⁶⁵ Sennheiser opposes elimination of the reserved channels, arguing that this would provide an advantage for TVBDs over wireless microphones.²⁶⁶

130. Other parties support increasing the number of TV channels on which TV bands devices may not operate to leave more channels available for wireless microphone use. Carlson Wireless, Motorola and WISPA recommend designating two channels in each market for use by wireless microphones.²⁶⁷ CWMU states that it is impossible to protect wireless microphone use for many television productions using only a few safe harbor channels,²⁶⁸ but it supports designating one channel in each metropolitan area for use by electronic news gathering for situations when it is impossible to register wireless microphone locations in advance.²⁶⁹ NAB/MSTV requests that the Commission expand the current set-aside of two channels in 13 markets to all markets and set aside additional safe harbor channels.²⁷⁰ Shure argues that six channels centered around channel 37 is the minimum amount of spectrum needed to support itinerant users.²⁷¹ Google opposes Shure's request to prohibit adjacent channel operation above channel 21, arguing that Shure's proposal would result in no available channels for TV bands devices in many or all urban markets and no economies of scale to make a nationwide network viable.²⁷² Google further argues that adequate channels for wireless microphones are available below channel 21 and that restricting availability above channel 21 would serve only to protect wireless microphones operating illegally.²⁷³

²⁶² See Shure opposition at 18-19.

²⁶³ See NCTA opposition at 6-7.

²⁶⁴ See PISC petition at 17.

²⁶⁵ See Rudman/Ericksen petition at 10.

²⁶⁶ See Sennheiser opposition at 4-5.

²⁶⁷ See Carlson Wireless opposition at 6, Motorola petition at 10 and WISPA opposition at 7-8 (wireless microphones should register in the TV bands database, access the database on the same terms as TV bands devices, and have co-equal, secondary status with them).

²⁶⁸ See CWMU opposition at 10. CWMU contends that the typical number of wireless microphones needed for various events is as follows: 50 for an average Broadway musical, 155 for a Monday Night Football telecast with an additional 40 for the National Football League, 1,000 for the Super Bowl, and 250-800 for a political convention.

²⁶⁹ See CWMU opposition at 12. PISC argues that blocking off TV channels exclusively for intermittent wireless microphone use such as electronic news gathering is a highly inefficient use of spectrum. See PISC petition at 18.

²⁷⁰ See NAB/MSTV opposition at 20 (the number of set-aside channels could be reduced over time as more spectrally efficient digital microphone equipment is deployed).

²⁷¹ See Shure opposition at 16.

²⁷² See Google opposition at 15.

²⁷³ *Id.*

131. *Decision.* We affirm our initial decision to prohibit fixed devices from operating on channels adjacent to occupied TV channels. While Adaptrum and Motorola provided general information on possible ways that fixed devices could operate adjacent to occupied TV channels, neither party provided sufficiently detailed information on the technical requirements that would be necessary to allow adjacent channel operation without interference and still permit operation of TVBDs. We also decline to change the designated channels where TV bands devices are prohibited from operating and, in this regard we also affirm our decision to prohibit personal/portable devices from operating below channel 21. As the Commission noted in both the *First Report and Order* and *Second Report and Order*, there is some potential for interference to PLMRS/CMRS services on channels 14-20 due to the nomadic nature of personal/portable devices, and we are taking a conservative approach to protect these services from interference and prohibit operation of personal/portable devices on these channels. In addition, we are affirming the prohibition on personal/portable devices on channels below 14 as well to help ensure that unused channels remain available for wireless microphones and other LPAS devices.

132. We are revising our rules to reserve two channels nationwide where TV devices are not permitted to operate to ensure that some spectrum remains available for wireless microphones and other LPAS stations. Reserving two channels nationwide will ensure that at least two channels remain available for wireless microphones in all markets. These channels will be the first channels on either side of channel 37 that are unoccupied by broadcast television stations or, if no channels are available on one side of channel 37, the first two channels nearest to channel 37.²⁷⁴ These reservations will provide channels to accommodate LPAS operations that are not at fixed locations that would have been protected under the spectrum sensing provisions we are eliminating herein. Such LPAS operations include electronic news gathering and other temporary on-site applications, where the operating channels and locations are not known sufficiently far in advance to register them in the database. We believe that the reservation of two channels nationwide, along with the additional channels will be available at the vast majority of locations that cannot be used by TVBDs, will provide more than sufficient spectrum to accommodate the vast majority of wireless microphone usage. This will allow protected operation of a minimum of 12-16 wireless microphones and other LPAS stations in a small geographic area.²⁷⁵ Further, the relatively low power of these stations limits their operating range to about 100 meters, allowing each vacant TV channel to be used at many locations in a TV market. We note that in many areas more than two channels will likely remain available for LPAS stations because fixed TV bands devices are not permitted to operate adjacent to occupied TV channels and personal/portable devices are not permitted to operate below channel 21.

133. Recently the Broadband Action Agenda announced an intention for the Commission to initiate rule making proceedings to increase spectrum efficiency and innovation in various frequency bands, including broadcast TV spectrum.²⁷⁶ In addition, the Commission has initiated a proceeding to consider changes the rules for wireless microphones that operate in the TV bands.²⁷⁷ If the Commission makes changes to the rules concerning the channels available for operation for TV and other authorized services, the channels available for use by unlicensed TV bands devices and wireless microphones could

²⁷⁴ To clarify this provision, the two reserved channels at a location are to be the same for all types of TVBD operations, i.e., fixed devices at any height and personal/portable Mode I and personal/portable Mode II at both power levels. Thus, if the first two unoccupied channels are adjacent to occupied channels, only 40 mW personal/portable devices would be affected by the reservations.

²⁷⁵ As discussed above, we are also providing for registration in TV bands databases of the channels used for wireless microphones at large performance venues where more than 12 microphones are used in order to protect the wireless audio operations at such facilities from interference caused by TVBDs.

²⁷⁶ See "FCC Announces Broadband Action Agenda", News Release, rel. April 8, 2010; see also <http://www.broadband.gov/plan/broadband-action-agenda.html>

²⁷⁷ See *supra* para. 11.

change, and any TV bands device or wireless microphone that operates on a channel that is later designated for another use would have to cease operation on that channel. Depending on the tuning range of the TV bands device, particularly personal/portable devices, or wireless microphone these radios could have a reduced operating range. We recognize that the anticipated Commission proceedings introduce some uncertainty for manufacturers of TV bands devices and could delay their deployment. To avoid this problem, manufacturers can design devices that have the capability to tune over a wider range of frequencies than the rules currently permit, but that incorporate measures to limit operation to the frequency range over which the device is certified.²⁷⁸ Manufacturers would therefore not have to redesign their equipment if the Commission modifies the permitted operating frequency range and could modify their equipment certification through a streamlined procedure.²⁷⁹ We also observe that manufacturers are contemplating that devices that connect to CMRS services, mobile and personal/portable devices, whole-home wireless networks and other wireless data systems that will use TV white space spectrum will also include Wi-Fi and Bluetooth communications technologies.²⁸⁰

2. Fixed Licensed Point-to-Point Backhaul Use

134. In the *Second Report and Order*, the Commission decided that it would not be practicable to authorize the use of TV white spaces on a licensed basis.²⁸¹ It concluded that the attributes supporting successful use of licensing - spectrum rights that are clearly defined, exclusive, flexible and transferable - would be difficult to accomplish in the TV bands if we were to maintain our goal of not affecting the interference protection status of existing services. The frequencies and amount of unused TV bands spectrum will vary at each location and could change as other primary users enter the band.²⁸² Instead, the Commission decided to allow low power unlicensed devices to operate on the TV white spaces at power levels no greater than 4 watts EIRP. First, it was concerned that operation at higher power levels would increase the risk of interference in congested areas and thus could make sharing spectrum between TV bands device users more difficult. Second, because the Commission did not have experience with unlicensed wireless broadband operations in the TV bands, it decided to take a cautious approach in setting power limits to minimize the risk of interference to authorized users of the TV bands.²⁸³

135. *Petitions and Replies*. FiberTower, Sprint Nextel, COMPTTEL and RTG ("FiberTower et. al.") argue that the Commission erred in failing to dedicate a portion of the TV white spaces for fixed, licensed use. It states that all mobile broadband networks need wireless backhaul and that there is a critical shortage of spectrum available for that purpose.²⁸⁴ FiberTower et. al. claim that the propagation characteristics of the white spaces are ideal for long range wireless backhaul, particularly in unserved and

²⁷⁸ This may occur, for example, when a radio operates on frequencies in the U.S. that differ from the frequencies that the radio operates on in other countries where it is marketed.

²⁷⁹ Manufacturers could certify a TV bands device as a software defined radio, which is defined as a transmitter in which the operating parameters including the frequency range can be modified through a software change. See 47 C.F.R. § 2.1. A transmitter in which the software is designed or expected to be modified by a party other than the manufacturer must be certified as a software defined radio and must incorporate measures to ensure that only software that has been approved with the transmitter can be loaded into it. See 47 C.F.R. § 2.944. A manufacturer can obtain approval to expand the frequency range of a previously approved software defined radio through a Class III permissive change, which is a modification to an existing certification. See 47 C.F.R. § 2.1043(b).

²⁸⁰ See *ex parte* letter of July 19, 2010 to Julius Knapp, Chief of the Commission's Office of Engineering and Technology from Atheros Communications, Broadcom Corporation, Consearch and others (19 companies and organizations) at 3.

²⁸¹ See *Second Report and Order* 23 FCC Rcd 16825 (2008) at ¶ 44.

²⁸² *Id.* at ¶ 46.

²⁸³ *Id.* at 16847, ¶106.

²⁸⁴ See FiberTower petition at 2.

underserved areas, and that because fixed point-to-point backhaul equipment is available now, fixed licensed operations would spur immediate broadband deployment to unserved and underserved areas.²⁸⁵ It further states that the Commission should have set aside six channels in the white spaces for fixed, licensed use in rural areas and authorized fixed, licensed operations in the white spaces in the third or greater adjacent channels existing in any market.²⁸⁶ FiberTower et. al. states that given the ubiquitous, nomadic nature of existing and proposed unlicensed devices, it will essentially be impossible for the Commission to authorize licensed use effectively after unlicensed devices already occupy the same frequencies.²⁸⁷ It requests that the Commission reconsider its decision before unlicensed devices are marketed to consumers.²⁸⁸

136. A number of parties oppose the petition of FiberTower, et. al.²⁸⁹ Dell/Microsoft, Google and PISC argue that backhaul is not an efficient use of the white spaces, the white spaces should not be licensed and the petition is repetitious.²⁹⁰ SBE does not believe that there are sufficient vacant TV channels to permit backhaul use. Community Broadcasters opposes FiberTower's request to reserve channels for backhaul use until after the Class A and low power television digital transition.²⁹¹

137. *Decision.* We decline to set aside TV channels for fixed licensed backhaul use as requested by FiberTower at this time. As indicated above, the Broadband Action Agenda recently indicated an intention that the Commission initiate rule making proceedings to increase spectrum efficiency and innovation in various frequency bands²⁹² including the broadcast TV spectrum.²⁹³ We intend to consider FiberTower's requests for spectrum for fixed licensed backhaul to support broadband services in the broader context of these future proceedings in order to better ensure a comprehensive approach to wireless rural backhaul in these bands. We disagree with FiberTower's contention that we should not delay in addressing its request for access to the TV bands because it would be impossible for the Commission to authorize licensed uses after unlicensed devices occupy the TV bands. Both fixed and personal/portable devices are to rely on a TV bands device database as their primary method for determining available channels. If the Commission makes changes to the rules concerning permissible channels of operation, imposes geographic area restrictions or makes other changes to the technical parameters for TV bands devices, these will be taken into account by the database administrator in determining available channels for TV bands devices. Therefore, any TV bands device that operates on a channel that is later designated for another use would cease operation on that channel after it performs its daily database check and the database indicates that the channel is no longer available for use. As we move forward, however, we are interested in pursuing the question of whether we can accommodate licensed rural backhaul in the white spaces within the UHF bands. Therefore, Commission staff will evaluate this possibility over the coming months, and will formulate and submit a recommendation on

²⁸⁵ *Id.* at 5.

²⁸⁶ *Id.* at 8.

²⁸⁷ *Id.* at 9.

²⁸⁸ *Id.* at 10.

²⁸⁹ For example, see Community Broadcasters opposition at 3, Dell/Microsoft opposition at 18, Google opposition at 19, PISC opposition at 2, and SBE opposition at 12. WISPA believes that wireless backhaul could be implemented in the white spaces by allowing 20 watts transmitter power in rural areas rather than reserving 36 megahertz of spectrum as requested by FiberTower and others. WISPA opposition at 12. As discussed above, we decline to increase the power limit for fixed TV bands devices.

²⁹⁰ See Dell/Microsoft opposition at 18, Google opposition at 20 and PISC opposition at 2.

²⁹¹ See Community Broadcaster's opposition at 3.

²⁹² See "FCC Announces Broadband Action Agenda", News Release, rel. April 8, 2010.

²⁹³ <http://www.broadband.gov/plan/broadband-action-agenda.html>

next steps to the Commissioners by the end of 2010.

E. Other Issues

1. Canada/Mexico Border Areas

138. The allotment and assignment of TV channels in the border areas with Canada and Mexico are subject to agreements with each of those countries. Low power TV assignments within 32 kilometers (20 miles) of the Canadian border must be referred to the Canadian authorities for approval.²⁹⁴ In addition, low power UHF TV stations that are located less than 40 kilometers (25 miles) from the Mexican border, and low power VHF TV stations that are less than 60 kilometers (37 miles) from the Mexican border, must be referred to the Mexican government for approval.²⁹⁵

139. In the *Second Report and Order*, the Commission decided that fixed TV bands devices should not be permitted to operate within the border areas specified in the Canadian and Mexican agreements until it has an opportunity "to negotiate any necessary changes to those agreements with Canada and Mexico."²⁹⁶ The Commission stated that fixed TV bands devices that operate with outdoor antennas at an EIRP of up to 4 watts "will be somewhat similar in operation to low power TV stations," and thus decided "in keeping with the low power broadcasting agreements with Canada and Mexico" that TV bands devices must comply with the distance separations from the border specified in the agreements.²⁹⁷ The Commission also applied the same distance restrictions on the use of lower powered unlicensed personal/portable TV bands devices within the border areas "to avoid any uncertainty in administering the agreements with Canada and Mexico."²⁹⁸ These border distance restrictions will be enforced for fixed devices and Mode II personal/portable devices through the use of their geo-location and database access capabilities. Devices operating in Mode I without a geo-location/database access capability will be prevented from operating in the border areas in that they will operate relatively close to an associated base station (fixed or personal/portable) that uses a geo-location/database access capability that will keep it from operating in the border areas.

140. *Petitions and Replies*. Tribal Digital Village (TDV) asks that the Commission reconsider its decision to ban the use of TV bands devices in the border areas with Mexico pending conclusion of negotiations with Mexico under the TV broadcast agreement with the U.S., which could delay the introduction of new services to their communities.²⁹⁹ TDB argues that the Commission offers no reasoned

²⁹⁴ See *Working Arrangement for Allotment and Assignment of VHF and UHF Television Broadcasting Channels under the Agreement between the Government of the United States of America and the Government of Canada Relating to the TV Broadcasting Service*, dated March 1, 1989. This agreement is available on the Commission's web site at <http://www.fcc.gov/ib/sand/agree/files/can-bc/can-tv.pdf>.

²⁹⁵ See *Agreement Amending the Agreement Relating to Assignments and Usage of Television Broadcasting Channels in the Frequency Range 470-806 MHz (Channels 14-69) along the United States-Mexico Border*, dated November 21, 1988. This international agreement is available on the Commission's web site at <http://www.fcc.gov/ib/sand/agree/files/mex-bc/lpuhfbc.pdf>. See also, the untitled amendment to the United States-Mexican agreement on VHF stations dated September 14-26, 1988, available on the Commission's web site at <http://www.fcc.gov/ib/sand/agree/files/mex-bc/lpvhfbc.pdf>. The agreements may require coordination at greater distances from the border depending on the ERP and HAAT of the LPTV station.

²⁹⁶ See *Second Report and Order* 23 FCC Rcd 16897 (2008) at ¶ 265.

²⁹⁷ *Id.*

²⁹⁸ *Id.* at 16897, ¶ 266.

²⁹⁹ See Tribal Digital Village petition at 1-2. Tribal Digital Village (TDV) is a consortium of 19 federally recognized American Indian tribes located in San Diego County, CA. TDV operates an extensive communications network supporting Tribal municipal buildings and programs and is interested in using TV bands devices for community networking. Parts of TDV's network lie within the exclusion zones along the Mexican border under the Commission's rules.

support for its decision.³⁰⁰ It argues that the Commission did not explain why it rejected arguments that the TV broadcast agreement with Mexico does not apply to unlicensed TV bands devices, nor why it concluded that the TV bands devices would be "somewhat similar in operation to low power TV stations" as a basis for its decision. TDV asks that, if the Commission determines that the existing agreement requires coordination with Mexico, the Commission should consider whether it can address its concerns by entering information on Mexican stations in the TV bands database, thereby satisfying the purpose of the agreement to avoid interference, or by decreasing the size of the exclusion zones in the border areas for unlicensed devices using variable power.³⁰¹ PISC believes that the Commission should re-examine the border exclusion zone because TV bands devices are unlicensed devices, not broadcast stations covered by those agreements.³⁰²

141. *Decision.* We are modifying our requirement for the operation of TV bands devices in border areas with Canada and Mexico, as discussed below. At the outset, we clarify that unlicensed devices are not covered by the TV broadcast agreements with Canada and Mexico, and thus we do not need to negotiate changes to those agreements as we stated in the *Second Report and Order*. We have historically applied these agreements to licensed operations which are well-defined and readily identified under our rules and in our databases, characteristics which do not apply to unlicensed devices. Nonetheless, because TV bands devices will operate in the same frequency bands and on the same channels as TV stations in those countries as well as in the U.S., albeit at lower power than licensed stations, we are sensitive to the need to avoid causing interference to TV broadcast operations in Canada and Mexico. We find merit in Tribal Digital Village's suggested option to protect Canadian and Mexican stations in the border areas by including information on the Canadian and Mexican stations in the TV bands database as protected services within those countries.³⁰³ We will do so, thereby ensuring that stations in those countries will be protected to the same level as stations in the U.S.³⁰⁴ We will discuss our decision with Canada and Mexico to ensure that information on their operations in the database will be timely and accurate.

2. Transmitter IDs

142. In the *Second Report and Order*, the Commission required fixed TV bands devices to transmit identifying information to ensure that they can be identified if interference occurs.³⁰⁵ It required the identification signal to conform to a standard established by a recognized industry standards setting organization and stated that it expects the identification signal to carry sufficient information to identify the device and its location.

143. *Petitions and Replies.* Motorola requests that the requirement for fixed TV bands devices to transmit an identification signal conforming to a yet-to-be developed industry standard be eliminated because the requirement could constrain systems to support a particular modulation and delay TV bands devices entering the marketplace due to the time required for the development of a standard.³⁰⁶ Adaptrum

³⁰⁰ *Id.* at 3-4.

³⁰¹ *Id.* at 5-6.

³⁰² See PISC opposition at 23.

³⁰³ The requirement that TV bands devices operate beyond a minimum distance of the protected contour of co-channel or adjacent channel TV stations would not apply to Canadian or Mexican signals received within the U.S.; those stations are only to be protected from interference within their national borders.

³⁰⁴ Because we are modifying our rules on this issue, we do not address TDV's argument that we did not explain how TV bands devices are somewhat similar to low power TV stations as a basis for our earlier decision not to allow TV bands devices to operate in the border areas.

³⁰⁵ See *Second Report and Order* 23 FCC Rcd 16847 (2008) at ¶108.

³⁰⁶ See Motorola petition at 22.