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

In the Matter of	)	
	)	
Deere & Company Request for Limited Waiver of	)	ET Docket No. 15-184
Part 15 Rules for Fixed White Spaces Device	)	

ORDER

Adopted: March 24, 2016 **Released: March 24, 2016**

By the Chief, Office of Engineering and Technology:

I. INTRODUCTION

1. By this Order, we grant waivers of certain Part 15 rules to Koos Technical Services, Inc. (KTS) and to Deere & Company (Deere) to permit the certification and operation of fixed white space devices in the 470-698 MHz frequency band[1] on off-road agricultural equipment. As discussed below, our action here will permit KTS to obtain an equipment certification grant for a fixed white space device that will be installed in Deere agricultural machinery, such as tractors, self-propelled harvesting machines, sprayers, etc., to provide a variety of agricultural applications. These fixed white space devices, which do not have integrated geolocation or professional installation capability, will operate in conjunction with the Deere onboard StarFire™ geolocation guidance system. We find that granting these waivers is in the public interest because they will provide for broadband machine-to-machine (M2M) data communications aimed at increasing crop yields and reducing food production costs, all without causing harmful interference or materially adding to spectrum congestion for other authorized users of this frequency band.[2]

II. BACKGROUND

2. Part 15 of the Commission's rules permits low-power radio frequency devices to operate without an individual license from the Commission. The technical and operating requirements are designed to ensure that unlicensed devices are unlikely to cause harmful interference to authorized radio services. Part 15, Subpart H permits unlicensed devices to operate on TV channels that are not in use by authorized services or by certain protected operations at a particular location.[3] These devices, which are

[1] The 470-698 MHz band is currently allocated primarily for broadcasting services. The Commission will repurpose some of this spectrum for new wireless services after it conducts an Incentive Auction. *See Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auction*, GN Docket No. 12-268, Report and Order, 29 FCC Rcd 6567 (2014) (*Incentive Auction R&O*).

[2] *See Deere & Company Request for Limited Waiver of Part 15 Rules for Fixed White Spaces Device* (Waiver Request), filed July 13, 2015, ET Docket No. 15-184. Although the Waiver Request was submitted by Deere who states it was filing on its own behalf and on behalf of KTS, it was jointly signed by both parties. We note that the Waiver Request refers to "Koos" rather than "Koss," the latter appearing to be a misspelling on the signature page of the Waiver Request. "Koos" is the name that appears in the Commission's equipment authorization database for this manufacturer at the address listed on the signature page of the Waiver Request.

[3] *See* 47 CFR Part 15 subpart H. In this Order, we use the term "authorized users" to include both licensed services and the other operations which white space devices must protect.

commonly referred to as white space devices, may be either fixed or personal/portable. To prevent harmful interference to broadcast television reception and other protected operations, white space devices must obtain a list of TV channels that may be used at their location from a white space database.[4]

3. Fixed white space devices must incorporate either a geo-location capability or be professionally installed.[5] They must also be able to access a database which provides a list of available TV channels at their location. Such devices must: 1) initially register with a white space database to enter their coordinates and antenna height above ground level, 2) obtain a channel list before operating, and 3) re-check the database at least once daily. If moved to another location or if its stored coordinates are altered, a fixed device must also re-register its new coordinates and antenna height.[6] Fixed devices are permitted to operate with up to one watt transmitter output power and generally may use an antenna that provides up to 6 dBi of gain to produce a maximum of 4 watts effective isotropic radiated power (EIRP).[7] Additionally, fixed device operation is limited to areas where the height above average terrain (HAAT) is 250 meters or less and with an installed antenna height of no more than 30 meters above ground level.[8] In contrast personal/portable white space devices have an incorporated geo-location capability,[9] also operate pursuant to a channel list provided by a database, but do not need to register with the database. Personal/portable white space devices must have a permanently attached integrated antenna and are limited to a maximum of 100 mw EIRP. Finally, personal/portable devices are always assumed to operate at a 3 meter maximum HAAT.

4. On July 13, 2015, Deere and KTS jointly filed a request seeking a limited waiver of Part 15 rules to use fixed white space devices manufactured by KTS in conjunction with Deere's StarFire™ GPS-enabled terminals to provide broadband connectivity in a machine-to-machine (M2M) application for agricultural operations in rural areas.[10] The Waiver Request seeks a waiver of the rules applicable to fixed, rather than personal/portable, white space devices for several reasons: (a) the KTS device, which is suited to Deere's needs, is designed to meet the technical rules for fixed white space devices and will only need to be modified to accept geo-location data from an external source; (b) the white space databases are programmed to calculate channel lists for fixed white space devices operating up to 4 watts EIRP; and (c) the databases are required to collect and retain registration data for fixed white space devices only.[11]

---

[4] *See* 47 CFR §§ 15.703(d), 15.703(f), 15.703(g) and 15.703(s).

[5] The Commission recently proposed to modify its rules to permit fixed white space devices to obtain their geographic coordinates from an external source that is connected to the fixed white space device when the internal geo-location capability does not function. *Amendment of Part 15 of the Commission's Rules for Unlicensed White Space Devices*, ET Docket No. 16-56, Notice of Proposed Rulemaking, FCC 16-23 (Feb. 26, 2016) (*White Space Geo-location NPRM*).

[6] *See* 47 CFR § 15.711(c).

[7] *See* 47 C... § 15.709(b) and (c). The Commission recently modified this rule to allow antenna gain up to 10 dBi and up to 10 watts EIRP for white space devices operating in less congested geographic areas as defined in 47 CFR 15.703(h). *See* Amendment of Part 15 of the Commission's Rules for Unlicensed Operations in the Television Bands, Repurposed 600 MHz Band, 600 MHz Guard Bands and Duplex Gap, and Channel 37, ET Docket No. 14-165, *Report and Order,* 30 FCC Rcd 9551 (2015) (*White Spaces R&O)*.

[8] The white space database calculates and uses each white space device's height above average terrain to determine the list of available channels. 47 CFR § 15.709(g)(1)(ii).

[9] Only Mode II personal/portable devices are required to incorporate a geo-location capability, 47 C.F.R. §15.703(j). Mode I personal/portable devices are not, but must operate under the control of either a Mode II or fixed white space device, 47 CFR § 15.703(i).

[10] Waiver Request at 1.

[11] Waiver Request at 7.

More specifically, the Waiver Request seeks a waiver of section 15.711(c)[12] for KTS[13] so that the fixed white space device can be certified under the Commission's equipment certification program even though it will obtain its location information from an external source rather than an incorporated geo-location capability or through professional installation. The Waiver Request also requests waivers of sections 15.703(f), 15.711(c)(1), and 15.711(c)(2)(iv) to permit the KTS fixed white space devices, to communicate with each other while they are in motion and to re-register with the white space databases when the farm equipment moving through the agricultural field approaches the ± 50-meter boundary measured from its original/latest registration location. Finally, the Waiver Request explains that the device will meet all other technical rules for fixed white space devices.[14]

5. The Office of Engineering and Technology (OET) released a Public Notice on August 21, 2015 seeking comment on the Waiver Request.[15] Two parties filed comments and two parties filed reply comments in response to the Public Notice.[16] All four parties were supportive of the Waiver Request. The National Association of Broadcasters (NAB) does not object to the request provided the Commission includes a number of safeguards to minimize the potential for harmful interference to TV reception.[17] The Enterprise Wireless Alliance (EWA) states that innovative uses of this spectrum should be broadly encouraged so that maximum utilization is derived.[18]

III. DISCUSSION

6. We are taking action here to permit one type of fixed white space device to be used for broadband machine-to-machine data communications to support agricultural applications in a carefully circumscribed way. These fixed white space devices are intended to be installed on agricultural machinery that will transmit real-time crop and equipment data via radio links to the farmhouse or to other farm machinery that are equipped with similar white space transmitters. The data transmitted will include real-time equipment operations and logistics monitoring, sensor status, agronomic data pertaining to the status of soil, planting, harvest, fertilizer, insecticide application and moisture levels.[19] By using white space technology in this way, commercial agricultural producers will be able to take advantage of state-of-the-art autonomous tractor operations, real-time equipment monitoring, and response to

[12] Subsequent to filing its waiver request, the Commission adopted new rules in the *White Spaces R&O* which renumbered many of the rule sections for which Deere seeks waiver. In this Order, we reference the rules as they are in effect today, rather than those specified by Deere. For example, the petitioners request waiver of section 15.711(b) which the Report and Order changed to section 15.711(c).

[13] Waiver Request at 8 and 11.

[14] Waiver Request at 7.

[15] *See Office of Engineering and Technology Declares the Deere & Company Request for Waiver of TV White Space Devices Rules to be a "Permit-but-Disclose" Proceeding for Ex Parte Purposes and Requests Comment*, *Public Notice*, DA 15-947, 30 FCC Rcd 8474 (2015).

[16] The Wireless Internet Service Providers Association and the Dynamic Spectrum Alliance filed comments. The National Association of Broadcasters and the Enterprise Wireless Alliance filed reply comments.

[17] NAB suggests the following conditions: (a) that the KTS device be directly connected to and receive location data from Deere's StarFire™ GPS system; (b) that the KTS device must re-register with the white space database and obtain a new channel list whenever the device moves more than 50 meters from its original location; (c) that the KTS device must cease transmitting if its connection to the StarFire™ GPS system is interrupted and cannot receive geo-location information through the connection; and (d) that the Commission permit only 300 units to be installed during the first twelve months of the waiver period to gain experience with the application and to provide the Commission with the opportunity to modify or lift these limits as needed. NAB reply at 1-2.

[18] EWA reply at 2-3.

[19] Waiver Request at 4.

equipment service and supply demands, dealer inventory tracking, etc.[20] Because a significant portion of farmland is in rural areas where reliable wireless communications may not be available or may be cost-prohibitive, but where white space spectrum in the 470-698 MHz band is typically in abundant supply, Deere's proposed use of white space technology will serve the public interest in implementing valuable broadband uses of spectrum resources that may otherwise lie fallow.

7. When the Commission decided to permit unlicensed devices to operate on vacant channels in the TV bands, it provided for two types of unlicensed devices: (a) fixed devices that operate from a fixed location with relatively higher power and could be used to provide wireless broadband access, and (b) personal/portable devices that use lower power and could take the form of Wi-Fi-like cards in laptop computers or wireless in-home local area networks. In doing so, the Commission adopted different technical rules for each type of device—*e.g*., power limits, antenna height, geographic and frequency separations, etc.—that, as applied to each type of device, would protect authorized services from harmful interference. Both types of devices are required to reliably obtain a list of channels that are available for their use at their geographic location using a method of geo-location and database access. The white space databases are programmed to calculate vacant channel availability based on the technical rules applicable to each type of white space device, and to collect and retain registration information only for fixed white space devices. Although the Waiver Request proposes to install the KTS device on farm machinery so that it may operate while in motion, it asks that we waive certain rules for fixed white space devices for this purpose, rather than proceed under the rules for personal/portable white space devices.

8. We are authorized to grant a waiver under section 1.3 of the Commission's rules if the petitioner demonstrates good cause for such action.[21] Good cause, in turn, may be found and a waiver granted "where particular facts would make strict compliance inconsistent with the public interest."[22] To satisfy this public interest requirement, the waiver cannot undermine the purposes of the rule, and there must be a stronger public interest benefit in granting the waiver than in applying the rule.[23] We are evaluating this waiver request under the rules for fixed white space devices, rather than under the rules for personal/portable white space devices, because (a) the device in question – in function and technical parameters of operation – is much more akin to the fixed devices,[24] (b) the permissible scope of its mobility is tightly circumscribed and more restrictive than what is permitted for personal/portable devices,[25] (c) the restricted parameters of operation under this waiver, coupled with the protective

[20] *Id.* at 4.

[21] 47 C.F.R. § 1.3. *See also ICO Global Communications (Holdings) Limited v. FCC*, 428 F.3d 264 (D.C. Cir. 2005); *Northeast Cellular Telephone Co. v. FCC*, 897 F.2d 1164 (D.C. Cir. 1990); *WAIT Radio v. FCC*, 418 F.2d 1153 (D.C. Cir. 1969).

[22] *Northeast Cellular, supra* at 1166; *see also ICO Global Communications, supra* at 269 (quoting *Northeast Cellular*); *WAIT Radio, supra* at 1157-59.

[23] *See, e.g., WAIT Radio*, 418 F.2d at 1157 (stating that even though the overall objectives of a general rule have been adjudges to be in the public interest, it is possible that application of the rule to a specific case may not serve the public interest if an applicant's proposal does not undermine the public interest policy served by the rule); *Northeast Cellular*, 897 F.2d at 1166 (stating that in granting a waiver, an agency must explain why deviation from the general rule better serves the public interest than would strict adherence to the rule).

[24] Waiver Request at 2 and 7. The KTS device will operate at up to 4 watts EIRP, the same power level permitted for fixed white space devices; the KTS device will be required to register in a white space database in the same fashion as the rules require for fixed white space devices; and the KTS device will not have a permanently attached antenna so that the antenna can be attached to the cab of the farm machinery, as permitted for fixed white space devices (personal/portable white space devices are required to have a permanently attached antenna). *See* 47 CFR §§ 15.709(a), 15.713(g), 15.709(g), respectively.

[25] Waiver Request at 3. The KTS device will only be installed on off-road agricultural equipment and operated within agricultural fields in rural areas; thus, the scope of its operational area is limited to a defined geographic area. To ensure that the KTS only operates on available TV channels within this area, the KTS device will reregister its

(continued….)

requirements from the fixed white space devices rules that will apply here, will provide as strong a safeguard against interference as the rules that apply to personal/portable devices,[26] and (d) application of the fixed white space devices rules avoids technical complexities and difficulties in utilizing the coordination functions of the white space databases, were the device in question treated as a personal/portable device authorized under the waivers and tailored restrictions that would be necessary to enable the proposed use.[27]

9. To enable the proposed use, we waive rule section 15.711(c) to permit KTS to certify a fixed white space device that will obtain its geo-location information from an external source—namely, Deere's StarFire™ GPS-enabled system—rather than require the device to incorporate a geo-location capability or to have a professional installer program the fixed device with geo-location information. We also waive rule sections 15.703(f), 15.711 (c)(1) and 15.711 (c)(2)(iv) so that the KTS device may be installed only on Deere farm machinery that is intended to operate off-road and is equipped with the StarFire™ GPS-enabled system. These waivers will permit the fixed white space devices to operate while in motion, to communicate with other fixed white space devices operating while in motion, and to re-register with the white space databases when the farm equipment will be more than 50 meters[28] from its last recorded geographic location.

(Continued from previous page)
location with a white space database as it approaches the 50-meter boundary measured from its last registration location. This approach differs from the rules for personal/portable devices which can move freely and access the database for an updated available channel list when its location changes by more than 100 meters from the location at which it last obtained an available channel list. *See* 47 CFR § 15.711(d)(2).

[26] Under the waiver that we grant today, the KTS device will operate under a mix of requirements applicable to fixed and personal/portable devices, but with more restrictions than for either type of device under our rules. Because the KTS device will operate at higher power than what is permitted for personal/portable devices, it will be required to reregister its position and obtain new lists of available channels within shorter movement distances than is required of personal/portable devices. In contrast, there is no registration requirement for personal/portable devices, which may operate up to 100 mW, and they must query the database for new lists of available channels when their location changes by more than 100 meters. *See* paragraph 9 and note 28 *supra*.

[27] A white space database calculates available channels based on whether it identifies the device as fixed or personal/portable because different technical rules (*e.g.*, power, antenna height, and frequency) apply to each, and the databases are already programmed to calculate available channels based on the different rules for each type of device. Fixed white space device registration information includes the device's FCC identifier and serial number so that the database can verify that it has been certified for use; the geographic coordinates for the device's location and the antenna height above ground in meters, which are used to calculate channel availability; and the name and contact information for the person responsible for the device's operation for use if harmful interference occurs. 47 CFR § 15.713(g). In contrast, when personal/portable devices query the database for a list of available channels, the devices provide the database only the FCC identifier and serial number and its geographic coordinates; the database assumes an antenna height above ground as set by rule. 47 CFR § 15.713(h). These differences are important in calculating lists of available channels. For example, interference distances increase with higher antenna heights. Fixed devices are limited to an antenna height above ground level of no more than 30 meters whereas no such restriction is imposed on personal/portable devices which must have a built-in antenna. 47 CFR § 15.709(g). Because the antenna mounted on farm machinery could be higher than 3 meters above ground level, using actual antenna height ensures that the list of available channels supplied to the KTS device properly accounts for all operations that merit protection whereas assuming a 3-meter antenna height could under protect those operations. This is less of a concern for personal/portable devices due to their lower power limit (a maximum of 100 mW EIRP).

[28] Deere and KTS propose that the KTS device would re-register with the database and obtain a new channel list when it moves ± 50 meters from its original location. We drop the "±" characterization here as it refers to the accuracy requirement for the geolocation system, but for the purposes of this waiver it is only relevant whether the device moves more than 50 meters from its last registered location regardless of direction. We also note that in the *White Spaces R&O*, the Commission modified the rules to remove the ± 50 meter geolocation accuracy requirement and replaced it with a requirement for white space devices to determine their location and their geo-location
(continued….)

10. We first address the waiver of rule section 15.711(c) for KTS so that it can request certification of its fixed white space device. Section 15.711(c) requires that a fixed white space device shall determine its geographic coordinates and antenna height above ground level from either an "incorporated geo-location capability or a professional installer."[29] Deere and KTS seek a waiver of these requirements because the KTS device will not have an integrated geo-location capability nor will it be "professionally installed." Instead, the white space device will obtain its geo-location data via connection to the StarFire™ precision navigation system onboard the Deere agricultural equipment.[30] The white space device will be connected to the StarFire™ navigation system by a physical wired data communication connection (such as Ethernet, USB or serial port).[31] Deere asserts that the StarFire™ system provides very precise geo-location data—often accurate to less than a foot—to provide the highly precise navigation needed to enable farm machinery to plant, water, fertilize, harvest, apply pesticides and perform other tasks.[32]

11. We find that Deere and KTS have demonstrated good cause for waiving the geo-location requirements in section 15.711(c) for fixed white space devices. The purpose of the rule is to ensure that white space devices will use vacant channels that are available at the geographic location where it is operating and thus not cause harmful interference to authorized users. The KTS device and the StarFire™ navigation system will be located on the same piece of farm machinery and connected by a physical wired connection and the latter will provide precise geo-location data to the former. Thus, granting this waiver will not undermine the purpose of this rule because the database, using location information from the navigation system, will provide a list of available channels to the white space device minimizing its potential to cause harmful interference to authorized users and other protected operations. Also, there is a stronger public interest benefit in granting this waiver than in strictly applying the rule. By allowing the KTS device to connect to an easily-accessible external navigation system, the potential for errors in installation will be minimized and costs reduced because geo-location data will be continuously and automatically obtained from the StarFire™ system. We note that the Commission has recently proposed to modify its rules to require that fixed white space devices include an internal geo-location capability, but to permit them to obtain their geographic coordinates from an external source that is connected to the fixed white space device when the internal geo-location capability does not function.[33] This waiver is conditioned on the outcome of that rulemaking proceeding, and may be modified by the Commission at that time. We thus find good cause exists for granting KTS a waiver of section 15.711(c), with the conditions described below, for certifying a fixed white space device.

12. We now address the request for waiver of certain Part 15 rules so that the KTS fixed white space device, which will be installed on Deere farm machinery, can operate while in motion. Because Deere is responsible for proper installation of the KTS device that meets the conditions of the waivers granted in this order on its agricultural equipment, we find that it is the appropriate party to hold responsible for the operation and registration of the KTS device under these waivers as conditioned and for resolving any interference complaints that may arise. We thus grant Deere certain waivers of our rules, as conditioned, even though it is not ostensibly the "operator" of the KTS device or the agricultural machinery. Although section 15.703(f), requires fixed white space devices to transmit and/or receive

(Continued from previous page)
uncertainty (in meters), with a confidence level of 95%. *See* 47 CFR § 15.711(b). When the white space device databases are upgraded to use this parameter, the KTS device will need to be upgraded to determine and transmit this parameter.

[29] 47 CFR § 15.711(c).

[30] Waiver Request at 6.

[31] *Id.* at 2.

[32] *Id.* at 5.

[33] *See supra* note 5.

radiocommunication signals at a "specified fixed location,"[34] the Waiver Request argues that the rules for fixed white space devices are best suited to its needs, *i.e.*, having the white space device operate on farm machinery while it is in motion. For example, it needs the higher power permitted for fixed devices (maximum 4 watts EIRP) rather than the low-power limits applicable to personal/portable white space devices *(*up to 100 milliwatts EIRP) due to the significant size of many of the agricultural fields in which this technology would be most useful. Also, because fixed white space devices are required to register with the white space databases, the databases are already capable of calculating available channels for fixed devices at their permitted maximum power. If we were to permit higher power for personal/portable devices, the databases would have to perform customized calculations to derive channel lists for those devices.[35] Further, Deere argues that registration of fixed devices with the databases provides another layer of assurance since information on the device, operator and contact information is readily available.[36]

13. The Waiver Request proposes several safeguards to ensure that the KTS fixed device will operate in a manner consistent with the plan for white space devices in the TV bands. First, section 15.711(c)(1) requires that if a fixed white space device is moved to another location or if the coordinates stored in the device are altered, the fixed device must re-register its new coordinates and antenna height with the database.[37] The Waiver Request proposes that the KTS device automatically contact the white space database to enter new geographic coordinates accurate to ± 50 meters and to request a new channel list appropriate for the new location, every time the equipment moving through the agricultural field approaches the ± 50-meter boundary measured from its original/latest registration location. Second, the Waiver Request proposes that, as required by section 15.711(c)(2)(ii), if an updated channel list shows that transmissions are no longer permitted on previously used channels obtained for its prior location, the device will cease transmitting on the unavailable channels and transmit only on channels permitted in the updated list. Third, the Waiver Request proposes that, analogous to the requirements in section 15.711(d)(2) for personal/portable devices,[38] the KTS device will not transmit if it moves beyond the ± 50-meter accuracy limit and for whatever reason, it is not able to enter new coordinates and obtain an updated channel list appropriate for those new coordinates. Fourth, the request proposes that if the link between the device and the onboard StarFire™ geolocation guidance system is interrupted for any reason, the device will cease transmitting until it is able to obtain geolocation data through that connection and, if necessary, re-enter data to reflect new coordinates ± 50 meters from the devices most recent location, and obtain an appropriately updated channel list from the database.[39]

14. The Waiver Request also proposes that the fixed white space device will register with the database and obtain channel lists either through a direct Internet connection, if available, or another fixed white space device, as permitted by section 15.711(c)(2)(iv).[40] The Waiver Request explains that, given the size of many agricultural fields, it may at times connect through a series of networked KTS fixed white space devices operating on farm machinery. To meet this need, the Waiver Request asks for a waiver of this rule if the rule is meant to limit communication to a single "hop" with another fixed white space device.[41] The Waiver Request states that in all instances, the KTS fixed white space device will

[34] 47 CFR § 15.703(f).

[35] Waiver Request at 7.

[36] *Id.*

[37] 47 CFR § 15.711(c)(1).

[38] 47 C.F.R. § 15.711(d)(2). Personal/portable white space devices must contact the white space database for a new channel list if its location changes by more than 100 meters from the location at which it last established its available channel list.

[39] Waiver Request at 3.

[40] 47 CFR § 15.711(c)(2)(iv).

[41] *Id.* at 2.

operate only on channels that have been identified for the requesting KTS fixed device as required by section 15. 711(c)(2)(iv), *i.e.*, it will not operate on channels provided for another fixed device.[42]

15. We find that Deere and KTS have demonstrated good cause for waiving the operational requirement in section 15.703(f) that fixed white space devices transmit and/or receive radiocommunication signals at a "specified fixed location" and for waiving the corresponding requirement in section 15.711(c)(2)(iv) that permits fixed devices to communicate with the database through another fixed device (*i.e.*, white space devices that transmit and/or receive at a "specified fixed location." Because fixed white space devices can operate at higher power than personal/portable white space devices, the rules limit their operation to specified fixed locations and require that the devices register their location and identifying information with the white space databases to ensure that these higher-power unlicensed devices do not cause harmful interference to authorized users. We note that these fixed devices will be used on farm machinery operating primarily in rural areas and in large agricultural fields where there are fewer broadcasters and widely dispersed television receivers, as noted by DSA.[43] We also note that any of the KTS fixed devices may access the white space database through either a single "hop" or a series of networked KTS fixed devices operating on farm machinery provided the list of available channels sent to each device is appropriate for its location. These factors, in conjunction with Deere's proposed operational and technical conditions, will mitigate the potential for harmful interference. Thus, we conclude that granting these waivers with conditions, addressed below, will not undermine the purpose of the rules. Also, there is a stronger public interest benefit in granting these waivers than in strictly applying the rule. Granting these waivers will support broadband M2M communications among farm equipment and a broad variety of agricultural applications aimed at increasing the efficiency of commercial agricultural producers' operations, materially increasing crop yields and reducing food production costs, thereby benefiting consumers and the economy. We thus find good cause for granting Deere waivers of sections 15.703(f) and 15.711(c)(2)(iv), with the conditions described below.

16. We also find that Deere and KTS have demonstrated good cause for waiving the registration requirement in section 15.711(c)(1) that fixed white space devices must re-register with a database whenever it is moved to another location or if its stored coordinates become altered. As explained above, the rules require fixed white space devices to operate at specified fixed locations that are registered with the database to ensure that these unlicensed devices do not cause harmful interference to authorized users or other protected services. However, the rules permit personal/portable white space devices to contact the database for updated channel lists when their location changes by more than 100 meters, rather than require continuous contact with the database. In this case, we will require that the KTS device re-register with the white space database when it approaches a position 50 meters from its last registered location.[44] We also note that the fixed white space device will be located on farm machinery within the defined boundary of an agricultural field. These factors, in conjunction with the proposed conditions, will mitigate the potential for harmful interference. Thus, we conclude that granting this waiver with conditions will not undermine the purpose of the rules. We also conclude, for the same reasons discussed above for waiving other fixed device operational rules, that there is a stronger public interest benefit in granting this waiver than in strictly applying this rule.

[42] *Id*. at 2-3. *See* 47 CFR § 15.711(c)(2)(iv).

[43] DSA comments at 2.

[44] We note that we are requiring the KTS device to re-register and obtain a new channel list from the database when it moves beyond 50 meters from its last registered point rather than the 100 meters the rules allow for personal/portable white space devices. *See* 47 CFR § 711(d)(2). We take this more conservative approach here because the KTS devices will operate at power levels much greater than what the rules allow for personal/portable devices; thus the distance over which interference could potentially be caused to TV reception is also greater.

17. To further ensure that harmful interference to authorized operations will not occur, we are imposing several conditions on both the certification, installation and operation of the fixed device under these waivers, as listed below.

SUMMARY OF WAIVER CONDITIONS

18. The following conditions shall apply to the waiver being granted to KTS for certification of the KTS fixed white space device:

a) The KTS device shall be certified for compliance with the technical specifications applicable to operation under 47 CFR Part 15.[45] However, compliance with the requirements of 47 CFR § 15.711(c) are waived to allow the device to obtain geo-location information from an external source.[46] This waiver may be modified by the Commission as a result of action it may take in ET Docket No. 16-56.

b) The KTS device shall be limited to a maximum of 4W (36 dBm) EIRP per 6 MHz.

c) The KTS device shall be capable of operation only when connected via a physical wired data communications connection (such as by Ethernet, USB or serial port) to a StarFire™ geolocation guidance system.

d) The KTS device shall incorporate capability to store its geographic coordinates and antenna height above ground level internally and to accurately transmit those coordinates to a white spaces database.

e) The KTS device shall incorporate the capability to determine when it has moved beyond a position located 50 meters from its last registered location and initiate a new registration with a white spaces database,

f) This waiver shall apply only to the KTS white space device as described herein, and a copy of this Order shall be provided with the application for certification of the device.

19. The following conditions shall apply to the waiver being granted to Deere to allow for operation of the KTS fixed white space device when installed on its agricultural equipment.

a) The KTS device may only be installed and operated on agricultural equipment equipped with an onboard StarFire™ geolocation guidance system and intended for off-road use, such as tractors, sprayers, harvesters, etc. Deere is responsible for ensuring that the KTS device operates under the terms of the waivers granted in this order.

b) The KTS device may only be used in less congested (*i.e.*, rural) areas as defined in 47 CFR § 15.703(h).

c) The KTS device shall automatically re-register its geographic location with a white space database to receive a new list of available channels every time the agricultural equipment approaches a position located 50 meters from its last registered location; otherwise the KTS must cease transmitting once it reaches a position located 50 meters from its last registered location. Deere is responsible for ensuring that the KTS device is properly registered with the

[45] *See also See* Knowledge Data Base (KDB) No. 416721, *Certification Test Procedures for White Space Devices Authorized under Subpart H of The Part 15 Rules*, available at https://apps.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?switch=P&id=50929.

[46] Application for FCC equipment certification for the KTS device shall include a detailed description of the security and device authentication protocol used between the KTS device and the StarFire™ geolocation guidance system.

white space databases initially and as it is operates under the terms of the waivers granted in this order.

d) The KTS device may access the white space database directly or through another KTS device, either by a single "hop" or a series of networked KTS fixed devices operating on farm machinery, provided the list of available channels sent to each device is appropriate for its location.

e) The KTS device shall be connected via a physical wired data communications connection (such as by Ethernet, USB or serial port) to the StarFire™ geolocation guidance system onboard the agricultural equipment and shall cease transmitting if that connection is broken.

f) The KTS device and StarFire™ geolocation guidance system shall communicate using a secure method that ensures that the KTS device obtains information only from the StarFire™ geolocation guidance system. The KTS device shall cease transmitting if it is unable to verify that it is receiving geolocation data from the StarFire™ geolocation guidance system.

g) The KTS device shall be limited to operating with a maximum conducted power of 1W (30 dBm) and a maximum of 4W (36 dBm) EIRP per 6 MHz under all installation conditions.

h) Deere is responsible for correcting any instances of interference that may arise, including disabling operation of the device.

20. Finally, we note that NAB requests that the Commission take a cautious approach and limit the number of units allowed under the waiver to no more than 300 devices during the initial twelve months of the waiver period. It states that this will allow the Commission and interested parties the opportunity to gain real-world experience with usage of this equipment, as well as the opportunity to put in place any changes or further protections necessary to prevent harmful interference.[47] We agree and thus we are limiting installation of the KTS device to no more than 300 units during the first twelve months of the waiver period. We also require Deere to promptly report any instances of interference to the Office of Engineering and Technology (OET). Should any interference to authorized users occur during the initial twelve month period, OET may impose additional restrictions on KTS and Deere, or cancel the waiver in whole or in part, depending on the nature and resolution of such interference.[48] If no interference cases are reported to OET, either by Deere, KTS or an affected party, during the initial twelve month period, the restriction on the number of KTS devices that may be installed under this waiver will be removed without OET taking any further action to modify this waiver.

IV. ORDERING CLAUSE

21. Accordingly, pursuant to authority in Section 0.31, 0.241 and 1.3 of the Commission's rules, 47 CFR Sections 0.31, 0.241 and 1.3, and Sections 4(i), 302, 303(e), and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. Sections 154(i), 302, 303(e), and 303(r), IT IS ORDERED that the requests for waiver of Section 15.711(c) of the rules, 47 C.F.R. §15.711(c), for Koos Technical Service, Inc. and Sections 15.703(f), 15.711(c)(1), and 15.711(c)(2)(iv) of the rules, 47 C.F.R. §§ 15.703(f), 15.711(c)(1), and 15.711(c)(2)(iv), for Deere & Company ARE GRANTED, subject to the conditions listed above. This action is effective upon release of this Order.

[47] NAB reply comments at 2.

[48] The operator of an unlicensed radio frequency device shall cease operating the device upon notification by a Commission representative that the device is causing harmful interference. 47 CFR § 15.5(c).

22. IT IS FURTHER ORDERED that, if no petitions for reconsideration or applications for review are timely filed, this proceeding SHALL BE TERMINATED and the docket CLOSED.

FEDERAL COMMUNICATIONS COMMISSION

Julius P. Knapp
Chief, Office of Engineering and Technology