Before the
Federal Communications Commission
Washington, DC 20554

In the Matter of	)	
	)	
Spectrum Needs for the Implementation of the Positive Train Control Provisions of the Rail Safety Improvement Act of 2008	)))	WT Docket No. 11-79
	)	

COMMENTS OF PTC-220, LLC

PTC-220, LLC ("PTC-220") hereby submits these comments in response to the *Public Notice* issued in the above-referenced proceeding.[1] PTC-220 was formed to oversee the development and deployment of interoperable positive train control ("PTC") communications systems in compliance with the requirements of the Rail Safety Improvement Act of 2008 ("RSIA"). PTC-220's mission to foster interoperability in support of PTC deployment is intended to benefit not only the owners of PTC-220, but the rail industry as a whole, to the extent adequate spectrum capacity is available.[2]

PTC-220 commends the Commission for recognizing industry concerns related to the availability of adequate spectrum suitable for the implementation of interoperable PTC, and for the Commission's consideration of possible actions to facilitate the acquisition of such spectrum by railroads. Below, PTC-220 provides responses to a number of questions posed in the *Public Notice.*

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[1] *See Wireless Telecommunications Bureau Seeks Comment on Spectrum Needs for the Implementation of the Positive Train Control Provisions of the Rail Safety Improvement Act of 2008*, Public Notice, DA 11-838 (rel. May 5, 2011) ("*Public Notice*").

[2] PTC-220 is currently owned by subsidiaries of BNSF Railway Company ("BNSF"), CSX Transportation Inc. ("CSX"), Norfolk Southern Railway Company ("NS"), and Union Pacific Railroad Company ("UP"), which constitute the nation's four largest freight railroads.

1. *"The Bureau seeks comment from stakeholders regarding the frequency bands and amount of spectrum needed to successfully implement PTC."*

The rail industry investigated a wide range of RF bands to support PTC. When 220 MHz spectrum became available, it was considered very attractive because its propagation characteristics are similar to 160 MHz, making it possible to use similar base station spacing. Major American railroads all currently support large 160 MHz base station networks, primarily used for train dispatching. Much of the infrastructure for the 160 MHz networks, such as real estate, buildings, power plants, towers, backhaul, etc., can be used for a network of 220 MHz base stations. Given this ability to leverage existing communications infrastructure, PTC-220 acquired spectrum in the 220-222 MHz band, obtaining four nationwide licenses, as well as additional economic area grouping ("EAG") and individual economic area ("BEA") licenses in certain parts of the country.

PTC-220 is working with radio design vendor Meteorcomm LLC ("Meteorcomm") to develop a data radio that can operate from 217.6 – 222 MHz.[3] This means that most of the spectrum in the Automated Maritime Telecommunications System ("AMTS") (217-218 / 219-220 MHz) and the Interactive Video and Data Service ("IVDS") (218-219 MHz) bands can also be used to support PTC, assuming the appropriate service rule waivers are obtained. The radio design requires simplex channels of 25 kHz each.[4] Thus, in cases where spectrum is licensed with smaller channel bandwidths (*e.g.*, 5 kHz), there must be enough contiguous channels that can be combined to form a 25 kHz channel.

[3] Engineering design constraints dictated that the radio's lowest tunable frequency be set at 217.6 MHz. Increasing the bandwidth of a radio's front end raises the noise floor and reduces selectivity. Thus, had the radios been designed to tune as low as 217.0 MHz, there would have been an unacceptable trade-off of increasing the radio's susceptibility to interference.

[4] 25 kHz was selected as the best channel size compromise after considering the trade-offs between large and small channels. Higher bandwidth channels can carry large quantities of data and are useful where there is high PTC traffic demand, but they can also be inefficient when PTC traffic demand is lower, reducing the ability to re-use channels given that fewer large channels can be crafted from a set quantity of spectrum.

In January of this year, PTC-220 contracted with Transportation Technology Center, Inc. ("TTCI") to perform spectrum analysis for railroad operations in multiple urban areas. Once completed, these dense urban studies should produce a spectrum needs analysis that will determine the amount of spectrum needed based on the train traffic, wayside infrastructure and base stations.

2. "[W]e seek comment on geographic areas where meeting the spectrum needs for PTC are likely to present the most challenges."

As noted above, PTC-220, with the assistance of TTCI, is still in the process of developing a model to predict the amount of spectrum that will be needed for PTC operations in any given urban area. However, PTC-220 has performed an initial evaluation of potential congested areas where PTC-220 spectrum capacity will be challenged due to the density of rail operations and infrastructure. This analysis was based upon the current understanding of PTC deployment as required by the RSIA and by Federal Railroad Administration ("FRA") regulations, and was limited to areas where current PTC-220 member railroads operate. This preliminary evaluation identified the following cities that could require additional spectrum to adequately support PTC operations:

Chicago, IL	Philadelphia, PA	Detroit, MI
Dallas/Ft. Worth metro	Portland/Vancouver	Denver, CO
Houston, TX	San Francisco/Bay Area	El Paso, TX
Kansas City metro	Seattle, WA	New Orleans, LA
Los Angeles, CA	St. Louis, MO	Salt Lake City, UT
Memphis, TN	Atlanta, GA	San Antonio, TX
Minneapolis/St. Paul metro	Birmingham, AL	
New York/Newark metro	Cincinnati, OH	

It is important to note that this list could change after the completion of TTCI's analysis, and additional areas may be identified once PTC-220 looks beyond the geographic areas of immediate interest to its members.

3. *“[W]e seek information regarding how the use of different frequencies and amounts of spectrum could affect the functionalities and components of a PTC system.”*

Assumptions about PTC base station coverage areas, and thus capacity requirements, derive directly from base station spacing. In turn, base capacity requirements determine the requirements for bandwidth, modulation characteristics, and over-the-air protocols. For reasons described above, PTC systems are being designed to operate in the 217.6 – 222 MHz band. While PTC protocols will support communications over alternative paths (*e.g.*, WiFi, cellular) where they are available and practical for use,[5] the 220 MHz channels remain the central common interoperable communications path.

The number of channels required for PTC operations in an area will be determined by two things: traffic load and the frequency reuse plan. From the early planning stages, great effort has been expended to limit over-the-air message traffic while still supporting full PTC functionality and providing some headroom capacity to accommodate future growth. Further, the sharing of base stations by multiple organizations in congested areas is a basic design principle intended to maximize efficient use of radio channels. PTC-220 has developed custom PTC traffic modeling tools to help predict channel loading levels in various operational situations. These models, coupled with models that simulate complex train movements of multiple operators, will help determine total spectrum needs from a traffic load perspective.

Besides the traffic load presented to the radio channels, the frequency reuse patterns that will limit co-channel interference to acceptable levels must be considered. Reuse requirements may easily imply a need for more channels than would be needed strictly from a channel loading perspective in some areas. PTC-220 is now engaged in analyses to determine the theoretical

[5] For example, large quantities of PTC data will need to be exchanged in train yards. In such locations, railroads may choose to utilize a WiFi network, which would have a much larger bandwidth capacity than the 220 MHz network.

requirements for reuse design. The results of these analyses will need to be validated with field trials. Because 220 MHz PTC radio equipment is not yet available, there is no final determination on the number of channels necessary to support PTC in all areas. It is clear, however, that congested rail areas with high densities of wayside PTC devices will need more channels than remote areas.

4. *"We also seek input regarding how aspects of various rail operations affect the amount of spectrum or frequencies needed to successfully implement PTC. Such factors could include the speed of train operations, the number of track lines in a certain geographic area, the amount of rail traffic on track lines, the temporal separation of trains, and the hours of operation of commercial services on a track line."*

While there are very few fully approved and commissioned PTC systems operating in the United States, the primary drivers for spectrum demand are frequency of train operations and density of wayside train signaling/routing infrastructure. The more trains in a given area, the higher the demand. The faster trains operate in a given area, the greater the radio coverage must be to provide a sufficient communications horizon for PTC to operate. More complicated track layouts with very dense arrangements of train signals, switches, and wayside infrastructure also increase the capacity demand. These factors intuitively affect demand independently, but can also act together to have a more profound impact. For example, a very high density of trains on a rail corridor with complex wayside infrastructure and on which high speed trains are operating will represent an extremely high demand.

Another important consideration is that radio coverage and capacity must be engineered to support peak demand operations. This requires identifying the scenario where the highest number of trains is operating at the highest demand on the specific track infrastructure being analyzed. Even if this peak only occurs for a few hours per day, the peak capacity must still be allocated at all times for that geographic area. (A good analogy is the building of highways to accommodate traffic during rush hour as opposed to Sunday at 2 a.m.) Because PTC-equipped trains must be supported by the communications system, any disruption or slowing of service will result in stopped trains, thereby reducing the effective railroad network throughput, even though track capacity is not the cause of the constraint.

5. "The Bureau also seeks comment on the spectrum coverage area that will be needed by the railroad industry for PTC implementation. For example, we seek input regarding the approximate amount of geography on either side of a track line where signal coverage is necessary to operate a PTC system, recognizing that a freight or passenger rail would not require spectrum solutions outside a certain distance from a track line."

The answer to this question depends in part on the "along track" coverage that is dictated by existing voice radio infrastructure. Assuming that existing infrastructure in a given area requires 30 miles of along track coverage in each direction, the use of an omni-directional antenna would result in a similar 30 mile coverage area adjacent to (*i.e.*, perpendicular to) either side of the track. In most cases, however, some form of directional antenna is used (resulting in off-track coverage distances that are typically less than on-track coverage distances), although the degree of directionality is often limited by the need to account for track curvatures which can be quite pronounced in areas with mountains or other special terrain features.

The license currently used for the Advanced Train Control System ("ATCS") provides a precedent for issuing "ribbon" licenses that authorize operations along railroad tracks. For example, the 900 MHz license issued to the Association of American Railroads for ATCS "is defined by a 140-mile wide swath or ribbon that tracks all of the railroad rights-of-way in the United States."[6] Ribbon licenses would likely be an acceptable solution for additional spectrum that may be made available for PTC use. PTC-220 believes that a similar 140-mile wide swath (*i.e.*, 70 miles on either side of the track) should provide a sufficient buffer zone between PTC and other, non-railroad operations.

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[6] *See* "Special Conditions" of call sign WPSF894.

6. *"[T]he Bureau seeks comment regarding policy actions that would further facilitate the acquisition of spectrum by railroads subject to the RSIA for PTC implementation."*

As explained above, spectrum in the 220 MHz, AMTS and IVDS services may be used for interoperable PTC operations. However, because the current service rules in those bands are not structured for PTC, waivers are required. Currently, there are at least two pending waiver requests relating to AMTS spectrum and one related to spectrum in the 220-222 MHz band.[7] Providing expedited review and approval of these requests would be enormously helpful, especially if the Commission were to make it clear that similar PTC-related waivers would be routinely granted in the future for railroads proposing to use 220 MHz, AMTS or IVDS spectrum for PTC purposes. The expeditious review and approval of transactions and waiver requests is paramount to reducing risk in PTC deployment strategies, particularly due to the tight timeframes required under the RSIA.[8] When the availability and use of spectrum is in question for extended periods of time, the railroads are unable to proceed with PTC system design, testing, and deployment.

Separately, the Commission should evaluate its inventory of spectrum in the 217.6 – 222 MHz range (keeping in mind the need for contiguous 25 kHz channels) and establish procedures for making that spectrum available for PTC use, especially in areas with the densest rail traffic. Releasing additional spectrum – which currently lies fallow – for PTC would serve the public interest by increasing spectrum efficiency, promoting public safety, and enabling the railroad industry to comply with the Congressional mandate to deploy PTC by 2015. .

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[7] *See* Application of Southern California Regional Rail Authority, FCC File No. 0004144435 (filed Mar. 11, 2010); Request of the National Railroad Passenger Corporation for Waiver of Certain Part 80 Technical Rules to Allow Construction of an Advanced Civil Speed Enforcement System in the Automated Maritime Telecommunications System Band, WT Docket No. 11-27 (filed Jan. 3, 2011); Application of Southeastern Pennsylvania Transportation Authority, FCC File No. 0004374234 (filed Sept. 2, 2010).

[8] *See, e.g.*, Letter from Edwin Kemp, President, PTC-220, LLC, to Marlene Dortch, Secretary, FCC, filed in EB Docket No. 11-71 (May 9, 2011) at 1-2 (explaining the particularly urgent need for additional spectrum for PTC in the Los Angeles Basin area).

7. *"We seek comment regarding whether it is possible for railroads or industry participants that already hold spectrum rights to facilitate PTC implementation for railroads, which are not currently FCC licensees or lessees, operating on the same track or in the same geographic area (e.g., urban area or FCC license area)."*

PTC-220 was created to efficiently utilize spectrum in support of PTC interoperability up to the limits of PTC-220's spectrum capacity, serving both member and non-member railroads. PTC-220 plans to make access to its spectrum available through non-exclusive spectrum manager lease agreements. Such arrangements will permit member and non-member railroads to construct infrastructure along their own tracks, and will establish a process for the sharing of infrastructure in congested areas. However, an important factor in facilitating spectrum interoperability is the adoption of standards for channel access protocols, frequencies, and channel assignments. The FRA's RSIA implementing regulations did not prescribe a method for adopting such standards. Railroads not wishing to conform to the same protocols used by PTC-220 may not be able to share the spectrum because of the risk of interference created by incompatible protocols. Therefore, those railroads may need additional spectrum in order to comply with the RSIA.

8. *"[W]e request information regarding any testing that has been performed on PTC systems (utilizing various frequency bands and amounts of spectrum) in the United States or in other countries."*

Much of the testing to date has been computer propagation modeling based on Meteorcomm radio performance information and initial drive testing using test transmitters to tune the computer model. Meteorcomm has released version 2 of its field test radio to the railroads for testing. Also, as part of an FRA grant, Meteorcomm has contracted with STI-CO Industries, Inc. to perform intermodulation and noise testing on the locomotive radio.

Below is a brief review of other train control systems that have been tested and/or deployed:

- *Positive Train Separation ("PTS").* As early as the 1980's, testing was performed on wireless-based train control or safety overlay systems such as PTS using 900 MHz

Advanced Train Control System ("ATCS") specifications and 160 MHz Advanced Railroad Electronic System ("ARES") specifications. Although both ATCS and ARES specifications testing produced some desired functionality, there were throughput limitations resulting from the need to meet certain PTS requirements.

- *North American Joint Positive Train Control ("NAJPTC").* In January 1998, the FRA in conjunction with the Association of American Railroads and the Illinois Department of Transportation, began a joint initiative to develop a high-speed PTC project for the St. Louis-Chicago corridor. Concurrent and subsequent railroad industry efforts directed toward advancing PTC technology development were subsequently integrated into the NAJPTC program. The NAJPTC project used the ATCS protocol at 900 MHz as the principal communications infrastructure. There were several project challenges, including bandwidth constraints in the ATCS network, which limited offered load to about 2400 bps.

- *Electronic Train Management System ("ETMS").* The current ETMS, operating at 44 MHz, also has some desired functionality but is lacking in meeting the Interoperable Train Control ("ITC") specification regarding wayside, base station and locomotive density requirements, propagation tendencies and locomotive noise performance.

- *Global System for Mobile-Railroads ("GSM-R").* In Europe, dedicated spectrum in the 876-880 MHz and 921-925 MHz bands is used for voice and data communications as well as for traffic control for railways (Electronic Train Control System). The European GSM and GSM-R (Railroads) protocols are used. Every GSM-R network requires constant, uninterrupted service and high availability, especially while moving at high speeds through diverse terrain.

9. "[T]he Bureau invites comment on any other pertinent issues regarding spectrum needs for successful PTC system deployment."

Additional Waivers. Although PTC-220 has already obtained the most important waivers needed to operate PTC using its 220 MHz licenses, its ongoing network design efforts have highlighted the implications of the antenna height and ERP limits applicable to the 221-222 MHz side of the band, contained in Section 90.729(b) of the Commission's rules.[9] This rule will severely restrict the usable deployment of the spectrum for wayside stations where a larger coverage profile is required, or where terrain issues such as tall trees will require higher antenna heights. PTC-220 is currently exploring design alternatives, but if acceptable alternatives cannot

[9] 47 C.F.R § 90.729(b) (setting a 50 watt maximum ERP limit, and reducing that limit for antenna heights greater than 7 meters above average terrain).

be developed, the Commission should expect an additional waiver request in the near term. Prompt Commission review of this request will be critical to avoiding design and deployment delays.

Enforcement Assistance. Given the vast scope of a new nationwide network that will operate on spectrum which to date has seen relatively little usage, it will not be surprising to discover instances of interference from unauthorized spectrum users, whether intentional or unintentional. While PTC-220 will take the first steps to identify the source of any such interference, PTC-220 hopes that it will be able to rely on the Commission's Enforcement Bureau for investigative assistance and for prompt follow-up on any complaints of interference that PTC-220 may file. Moreover, the Commission should make it clear that, as a safety service, PTC operations will be subject to the lower threshold of establishing "harmful interference."[10]

Conclusion

PTC-220 appreciates the Commission's interest in this matter, and looks forward to working cooperatively with the Commission and other railroads to ensure that adequate spectrum is available to fulfill Congress' directive to implement PTC by December 2015.

Respectfully Submitted,

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June 20, 2011

[10] *See* 47 C.F.R § 2.1(c) (defining "harmful interference" as "interference which endangers the functioning of a radio-navigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radio-communication service operating in accordance with these [International Radio] Regulations.").