Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	**)**	
	)	
Request of PTC-220, LLC for Waivers of	**)**	**WT Docket No. 08-256**
Certain 220 MHz Rules	**)**	
	)	
Systemwide Build-out Plan	**)**	

To: Chief, Wireless Telecommunications Bureau

PTC-220, LLC
SYSTEMWIDE BUILD-OUT PLAN

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EXECUTIVE SUMMARY

PTC-220, LLC ("PTC-220") is submitting this Systemwide Build-Out Plan for its 220 MHz licenses ("Licenses") that are to be used in the development and introduction of a nationwide positive train control ("PTC") system, which will be based on a narrowband technology that will allow for the efficient and intensive use of the spectrum. PTC-220's members represent the nation's four largest freight railroads: BNSF Railway Company ("BNSF"), CSX Corporation ("CSX"), Norfolk Southern Corporation ("Norfolk Southern"), and Union Pacific Corporation ("UP"). Once implemented, PTC technology will allow PTC-220 member railroads as well as other railroads using radios operating on PTC-220 frequencies to monitor train activity, prevent collisions, and enhance public safety. This Plan is submitted to satisfy the requirements of paragraph 16 of the Memorandum Opinion and Order ("Waiver Order") adopted and released by the FCC on June 25, 2009.[1]

I. ORGANIZATION OF 220 MHZ SPECTRUM FOR PTC

The subject licenses held by PTC-220 were originally organized as duplex pairs of five kHz channels. Because PTC applications require a higher throughput than can be accommodated on a five kHz channel, PTC-220 will aggregate five contiguous five kHz channels to form one 25 kHz PTC channel (as allowed under 47 C.F.R. § 90.733(d)). Further, because PTC is built on TDMA technology with Time Division Duplexing (TDD), it has no need for duplex pairing of channels. The FCC's Waiver Order (paragraph 18) granted relief from the base/mobile configuration requirements of 47 C.F.R. § 90.715, such that base stations may now

[1] *Request of PTC-220, LLC for Waivers of Certain 220 MHz Rules*, Memorandum Opinion and Order, 24 FCC Rcd 8537 (2009).

be used on either half (220-221 MHz or 221-222 MHz) of the band. These factors combine to allow four independent PTC channels under each of the 100 kHz licenses (WPOI701 and WPOJ271), and two PTC channels under each 50 kHz license (WPFR284 and WPFP444). The J Block REAG licenses (WPOI702, WPOI703, WPOI704, WPOI705, WPOI706, and WPOI708) offer two PTC channels, for a total of 14 nationwide, 25 kHz PTC channels.

II. TIMELINE OF THE RADIO SYSTEM DEPLOYMENT

A. PTC-220 LICENSES AND TARGET DATES

In light of the current nascent level of development of PTC and the immensity of undertaking deployment, at this early stage the railroads are unable to pinpoint the exact dates of implementation by individual site nor the specific licenses that will be used at each site, but can provide an estimation of license build-out by year as shown throughout the subsequent sections. As PTC evolves, specific dates and licenses will be determined for each site and included in the construction progress reports that are released every 6 months, as required per paragraphs 15 and 16 of the Waiver Order.

In 2012, when the first stations will be deployed by each of the PTC-220 member railroads, all of the nationwide and REAG licenses with contiguous channels will be placed into use.[2] EA licenses will be placed into use in accordance with the first stations planned to be deployed within their respective coverage areas. Table 1 below shows the estimated target year when each PTC-220 license will begin to be constructed and the expected level of construction by the end of 2012, in terms of the percentage of the total number of planned PTC sites within the licensed area. Figure 1 illustrates the distribution of the licenses in a nationwide map. PTC-

[2] As described in section V below, PTC-220 is still evaluating the ultimate disposition of seven licenses with non-contiguous channels.

220's six REAG licenses essentially form a *de facto* nationwide license and are identified by call signs in white letters on the map. PTC-220's EA licenses with contiguous channels are mapped (over the REAG licenses), along with their call signs in black letters.

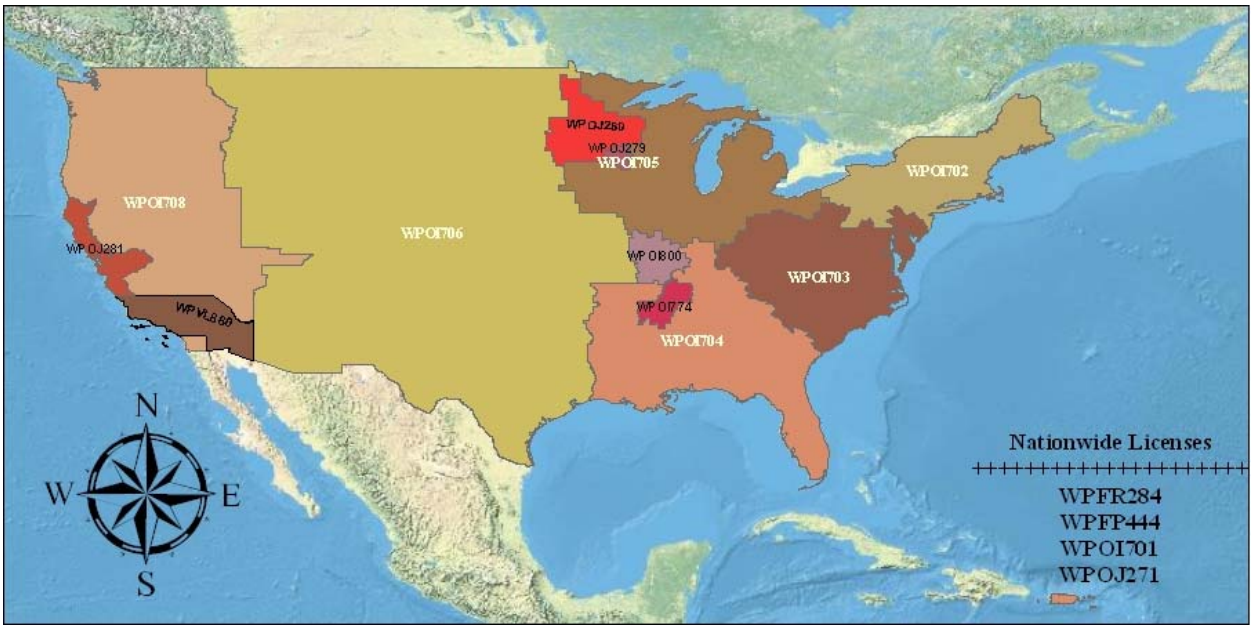

Figure 1 – Distribution of PTC-220 Licenses

Table 1 shows that PTC-220 intends to comply with the FCC's requirements that "*construction must occur in each individual license area, on each licensed channel block, in order to comply with the Commission's construction requirements.*" [Waiver Order, paragraph 14].

Table 1 – List of PTC-220 Licenses and Target Implementation

PTC-220 LLC Spectrum						
Call Sign	Description	Service Area	Block	Frequency	Target Date	Target Percent
WPOI701	Nationwide License	NWA255	L	220/221.400-450	2012	48
WPOJ271	Nationwide License	NWA255	M	220/221.700-750	2012	48
WPFR284	Nationwide License	US	1Q	220/221.125-150	2012	48
WPFP444	Nationwide License	US	1B	220/221.125-150	2012	48
WPOI702	Northeast	EAG001	J	220/221.960-.000	2012	70
WPOI703	Mid-Atlantic	EAG002	J	220/221.960-.000	2012	45
WPOI704	Southeast	EAG003	J	220/221.960-.000	2012	50
WPOI705	Great Lakes	EAG004	J	220/221.960-.000	2012	50
WPOI706	Central/Mountain	EAG005	J	220/221.960-.000	2012	50
WPOI708	Pacific	EAG006	J	220/221.960-.000	2012	75
WPOI774	Memphis, TN - AR- MS - KY	BEA073	E	220/221.850-900	2012	40
WPOI800	St. Louis, MO -IL	BEA096	E	220/221.850-900	2012	65
WPOJ279	Rochester, MN-IA-WI	BEA106	E	220/221.850-900	2012	100
WPOJ280	Minneapolis-St. Paul, MN-IIA-WI	BEA107	E	220/221.850-900	2012	30
WPVL860	Los Angeles - Riverside - Orange County, CA	BEA160	E	220/221.850-900	2012	80
WPOJ281	San Francisco - Oakland - San Jose, CA	BEA163	E	220/221.850-900	2012	95

B. PTC-220 BASE STATION SITE IMPLEMENTATION STRATEGY

The deployment of the PTC base station sites will begin in 2012 and all sites are to be completely operational before the federal deadline of December 31, 2015. Each railroad will implement its own deployment strategy, coordinating the construction of the radio network component with the overall PTC system deployment.

Figures 2 to 5 show graphically the distribution of the sites to be implemented by year per PTC-220 railroad. Figure 6 shows the distribution of all site implementations by year. Appendices A to D contain detailed layered maps for each railroad and Appendix E contains a detailed layered map showing sites from all railroads. Appendix H contains tables listing all the sites, their coordinates, and implementation year. Note that in addition to the base stations identified in this document, it is expected that other railroads will lease spectrum from PTC-220. It is not possible to identify those railroads, much less their sites, at this time.

[REDACTED]

Figure 2 – BNSF Base Station Site Implementation by Year

[REDACTED]

Figure 3 – CSX Base Station Site Implementation by Year

[REDACTED]

Figure 4 – Norfolk Southern Base Station Site Implementation by Year

[REDACTED]

Figure 5 – UP Base Station Site Implementation by Year

[REDACTED]

Figure 6 – Base Station Site Implementation for All Member Railroads by Year

The current development stage of the PTC radio communication system, as explained in section IV, prevents the full implementation of the radios at the sites before 2012, which explains the heavy site implementation in 2012, as shown in Figures 2 to 5. Installation work is already underway for the non-radio infrastructure at the sites, but there will be no PTC specification-compliant radio equipment available until 2012. Figure 7 projects the total number of sites for all the railroads.

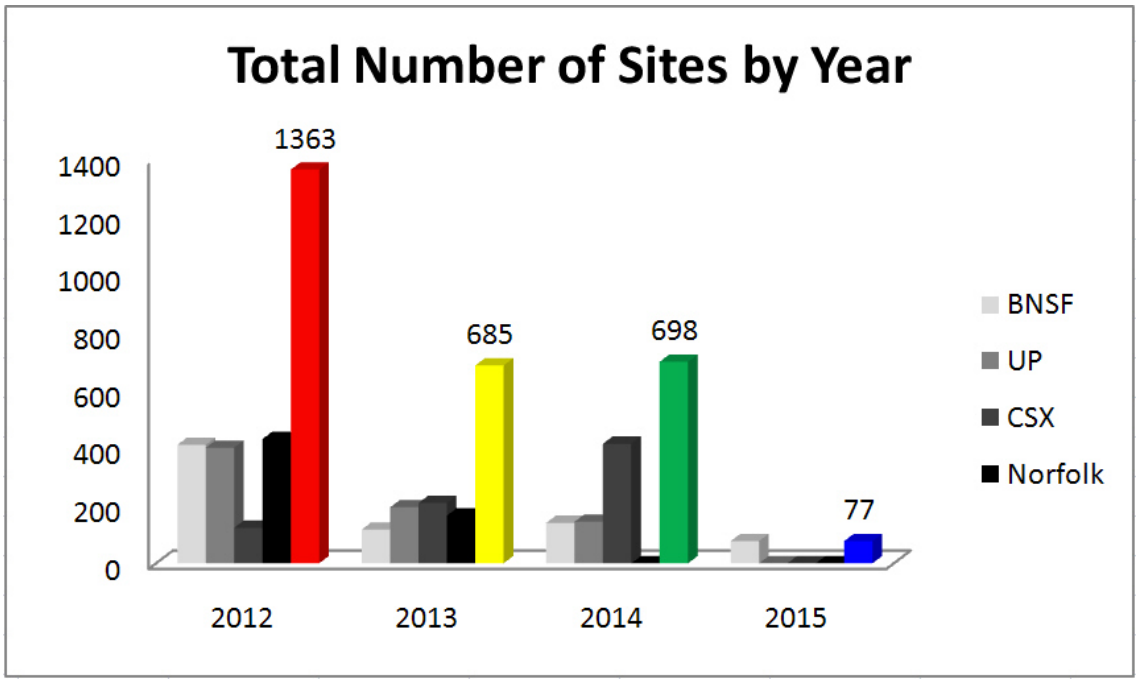

Figure 7 – Total Number of Base Station Sites Implemented by Year

Figure 8 shows that, according to the current plan, 48% of the sites will be implemented by the end of 2012, and 72% by the end of 2013. This indicates that the member railroads intend to satisfy the substantial service construction requirements for PTC-220's licenses before March 22, 2014 as required per paragraph 11 of the Waiver Order. Furthermore, this plan is consistent with the underlying purpose of the construction requirements – to ensure prompt delivery of services, prevent stockpiling and warehousing of spectrum, and promote investment in and deployment of new technologies.

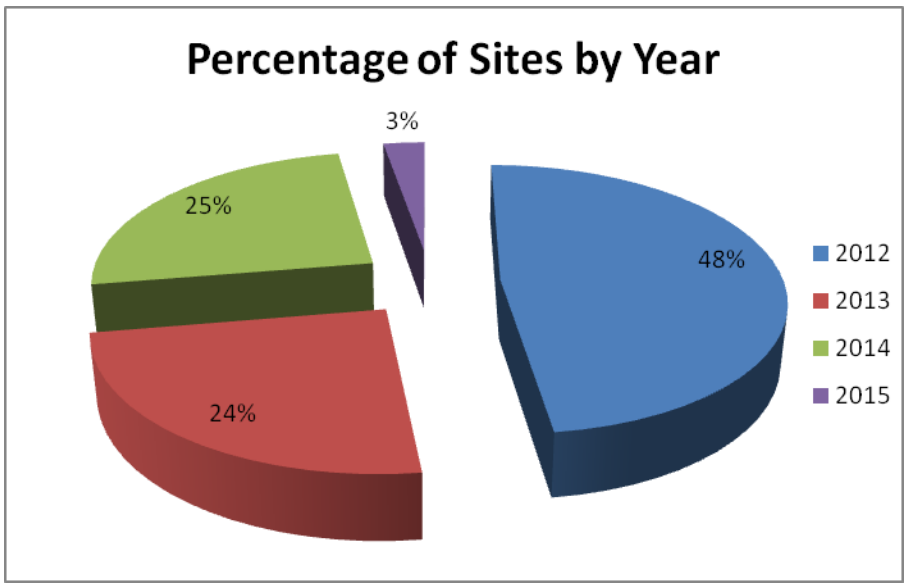

Figure 8 – Percentage of Base Station Sites Deployed by Year

C. WAYSIDE UNIT RADIO IMPLEMENTATION

Besides base stations, PTC-220 radios will be installed along the railroad tracks at wayside interface units ("WIUs"), collecting information from wayside components (such as signals, switches, etc.) and broadcasting their status to locomotives and office systems. Each one of those WIU radios will be associated with a base station as explained below. The WIU radios will be deployed with their associated base station.

III. SPECTRUM ASSIGNMENT DETERMINATIONS

Because it is premature to definitively identify which license and frequency channel will be assigned to each of the tens of thousands of specific PTC sites throughout the country, this Nationwide Build-out Plan instead presents the methodology that will be applied to determine assignments. Also provided are two representative cases, one being a typical (single railroad) subdivision, and the other being a dense urban environment with multiple railroads operating in close proximity.

D. IMPACT OF MESSAGE LOADING ON THE ASSIGNMENT OF CHANNELS

The assignment of spectrum channels for PTC is somewhat similar to a modern cellular phone system, as the system will utilize frequency reuse and TDMA technology; however, PTC has some additional characteristics that are relevant to the spectrum analysis:

- The coverage area is along railroad tracks
- Data messages being exchanged among the users of the system have unique characteristics and stringent delivery requirements

PTC has essentially two types of remote users of the communication system:

- Wayside Interface Units (WIUs) - Equipment located at points along the PTC track that broadcasts periodic status messages for the associated wayside component (signal, switch, etc.).
- Locomotives - Rolling stock that runs over the track and communicates PTC messages triggered by events related to train operations.

As WIUs broadcast their status periodically, their bandwidth consumption in specific locations within a determined region is fairly constant. Locomotives are usually moving and the messages originated by them are triggered by diverse events related to their operation, so their bandwidth consumption is variable and can only be determined by the analysis of the railroad operation. Thus, the effective coverage area of a base station will not be designed necessarily to maximize the reach for signal propagation, but also to accommodate the number of WIUs and trains operating within its coverage area, which cannot exceed the radio system capacity.

As an example, Figure 8 shows an illustration where two base stations are configured to provide service to different portions of a railroad line, each with a very distinct track configuration. While base station 1 covers a larger area than base station 2, it serves fewer WIUs

than base station 2. Base station 2 may also have to handle more simultaneous trains operating within its coverage area than base station 1.

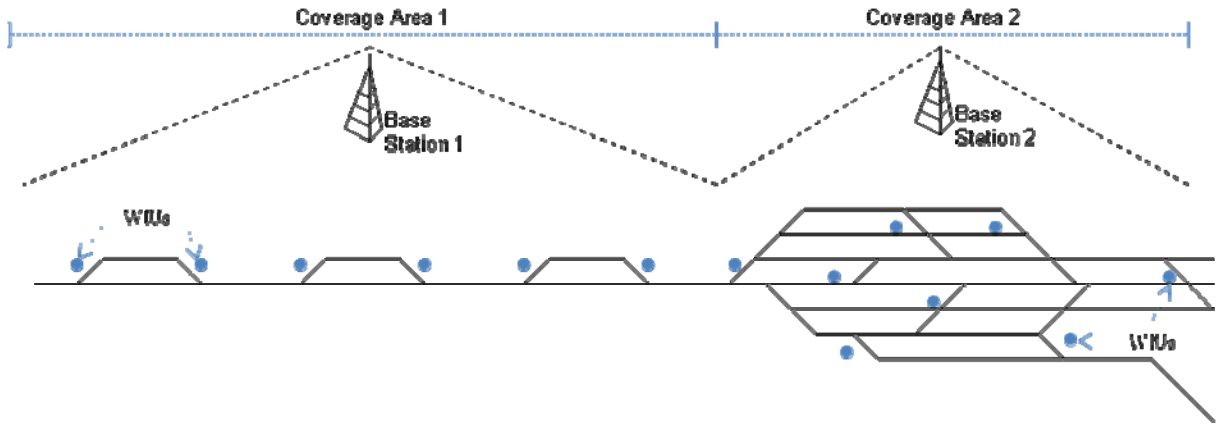

Figure 8 – Coverage Areas in Different Track Configuration

The message loading generated by the PTC users (WIUs and locomotives) becomes, then, a key component in determining the spectrum utilization of the system, as it has a strong influence in determining the required coverage area of the base stations.

The example shown in Figure 8 represents two typical track configurations: the area covered by base station 1 illustrates a *single line*, stand-alone rail, with sidings for train meets and passes, which is a typical configuration of tracks connecting major cities or major operational areas; the area covered by base station 2 illustrates a complex configuration of multiple tracks and often multiple railroads, which is a typical configuration of tracks in *dense urban areas* or major operational areas.

The message loading analysis for each of those track configurations – single line and dense urban area - is developed differently as described in sections II.E and II.F. In all cases, channel spacing is 25 kHz.

E. MESSAGE LOADING IN SINGLE LINES

The message loading analysis for a single line is less complex than for typical dense urban areas. In most cases, single lines are linear - almost a straight line connecting sidings and yards in a specific direction, and the message loading can be calculated by counting the number of wayside elements (*i.e.*, WIUs) and the peak number of trains that can operate simultaneously within a specific coverage area. Next, PTC operational characteristics are applied to determine the communications load at each base station. The peak number of trains can be obtained by statistical analysis of historical train traffic data with some projection of additional train traffic in future scenarios.

F. MESSAGE LOADING IN DENSE URBAN AREAS

Typically in dense urban areas, railroad lines have the following characteristics:

- many of the lines have multiple tracks;
- there is a higher concentration of wayside components per mile; and
- train traffic is heavy.

Besides the characteristics above, some dense urban areas are also a point of confluence of different railroad operators. The composite track configuration is typically two dimensional, often requiring more challenging frequency reuse. To optimize for these types of scenarios, the PTC-220 network is designed to allow shared use of a base station by more than one railroad. Figure 9 shows the track lines in the St. Louis area, highlighting some tracks from different railroad operators. The St. Louis area represents a typical case of a dense urban area with multiple railroad operators.

[REDACTED]

Figure 9 – St. Louis Area and Railroad Lines

Geographic areas such as the St. Louis area are more complex to analyze and an accurate message loading analysis is much more intricate than for a single line. In such cases, to achieve an accurate result, it is required to simulate the operation of the trains and the messages generated by them and by the WIUs. The simulation of the train operation in a network can determine more precisely when message traffic peaks will occur, how large they will be, when trains will stop and restart to move, how message traffic varies with daily and seasonal variations in operations, projections of future traffic increase or changes, and other dynamic events that

trigger PTC messages. A highly specialized PTC operations and communications simulation has been developed and will be applied to refine the build-out plan prior to implementation.

G. OTHER SPECTRUM ASSIGNMENT ISSUES

In addition to message loading, RF-related factors must be taken into account when determining the assignment of spectrum channels, as discussed below.

i. Propagation and Interference Analysis

Propagation and interference analysis is the most basic and fundamental aspect to determine the assignment of the available spectrum. A detailed study of the propagation and interference (particularly caused by co-channel assignments) must be developed to determine the carrier-to-interference (C/I) levels along the railroad tracks and the configuration of the base stations and WIUs (such as type, orientation and height of antennas, and effective radiated power). Propagation analysis must be carefully modeled in dense urban areas where obstacles and multipath effects can cause significant impacts in the signal levels.

Co-channel interference must be checked from the perspective of all PTC transmitters, not just base stations. WIUs and locomotive radios may cause interference. Figure 10 illustrates the service and interference contours of WIU radios and Figure 11 illustrates similar contours for locomotive radios.

The effects are shown in colors of gray, brown and black. In assigning frequencies by location, these interference plots are utilized to minimize interference. To the extent possible, adjacent frequencies are avoided in geographically adjacent areas and co-channels are kept far enough away to avoid interference.

In these propagation plots the inner circle represents the 38 dBu service contour and the outer circle, the 20 dBu interference contour.

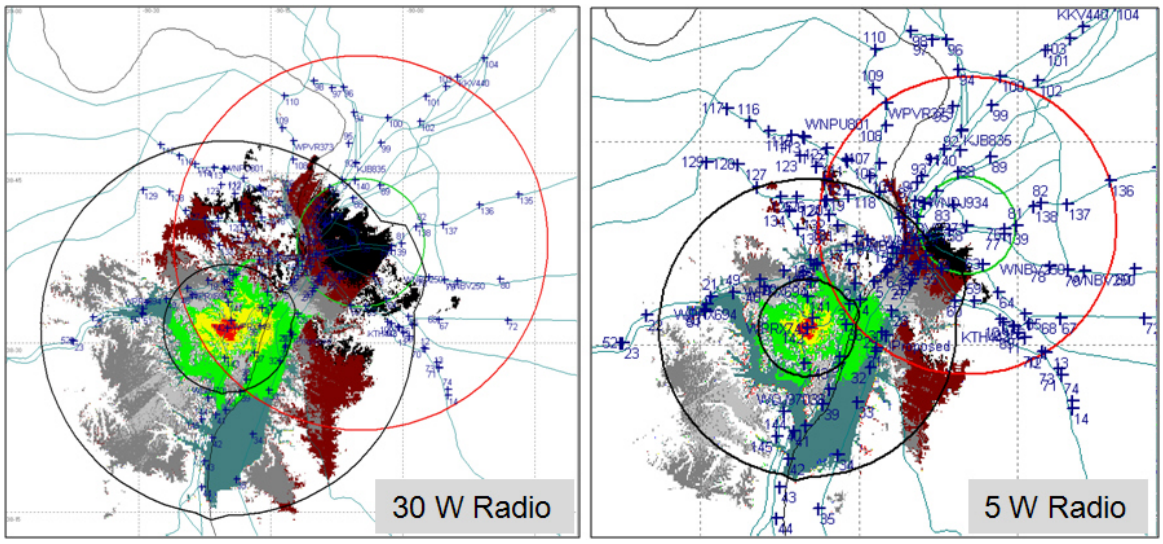

Figure 10 – WIU Radio Propagation Effects

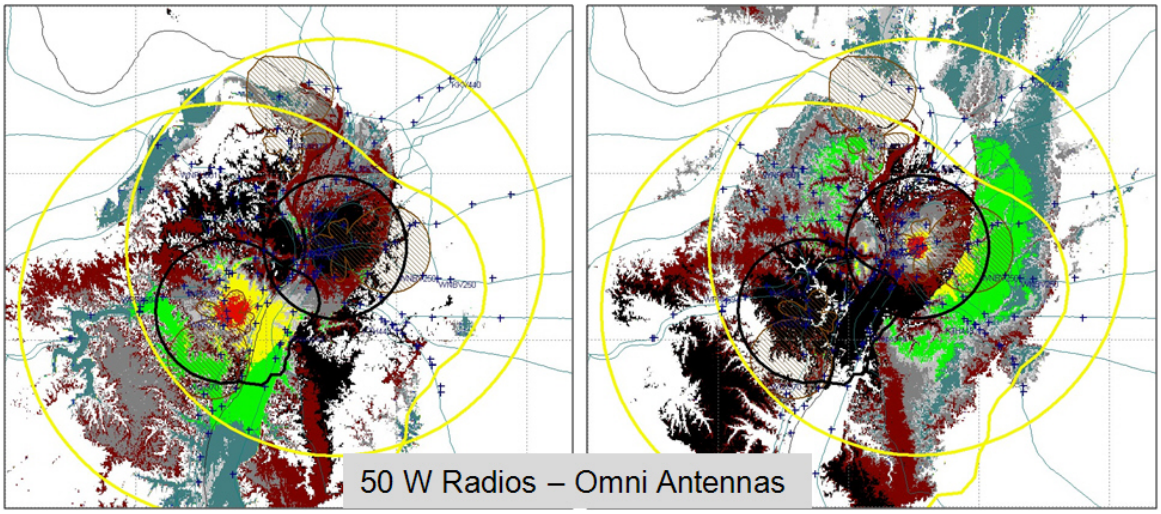

Figure 11 – Locomotive Radio Propagation Effects

The PTC-220 member railroads have agreed to all use the same tool for propagation modeling to facilitate exchange of service and interference contours. This state-of-the art tool also has some useful capabilities for frequency reuse planning. PTC-220 railroads are currently undertaking extensive field measurements to calibrate and validate the propagation model for use at 220 MHz.

ii. PTC High Availability Requirement

PTC is a mission-critical system and the radio communication network is the "spine" of the system. Any failure that causes interruption of the service provided by a base station may cause a significant impact in the railroad operation, not only in the coverage area of the base station, but for many miles beyond its limits.

To prevent such impacts, very high availability is required from the entire PTC radio system, including the base stations. There are some options to provide a higher availability to base station sites:

- Implement sites with dual components, in hot-stand-by configuration, allowing for automatic switch-over in case of failures.
- Alternate communication paths or channels, using onboard communications manager (cell data, WiFi in urban areas, PTC common channels or satellite).
- Configure the base stations with redundant overlapping coverage areas, so when a base station fails, the neighboring base stations can assume the message loading of the failed base station. Figure 12 illustrates a redundant overlapping configuration in a single line configuration.
- Alternatively to the previous option, configure the base stations with little overlap at normal power and increase power by adjacent base stations when one fails. This option complicates frequency assignments in shared urban areas with multiple, closely spaced lines, but is more feasible in single lines.

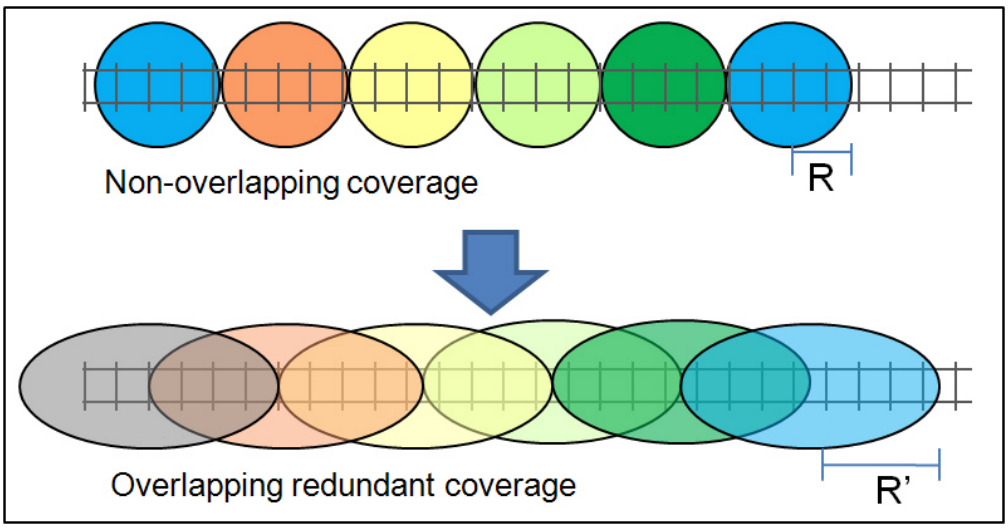

Figure 12 – Non-overlapping and Overlapping Coverage in Single Line

The overlapping redundant base station coverage is the preferred solution as it ultimately provides higher availability, immediately covering any case of failure in a single base station, including total loss of a base station or its irradiating components that might be caused, for example, by a lightning strike. In some situations, however, the preferred solution may not be feasible, in which case, one of the alternatives may be used or additional frequencies will have to be provided to make it achievable.

iii. Regulations and Restrictions

Regulations and restrictions determined by the FCC will also be followed, such as those described in CFR 47, Title 90 – Subpart T that govern licensing and use of frequencies in the 220 – 222 MHz Band, as modified by waivers granted to PTC-220 in the Waiver Order, to SMR Management (issued November 2, 2009) and to BNSF (issued January 22, 2010).

Particularly noteworthy are the additional restrictions associated with the J Block licenses at national borders per 47 C.F.R. § 90.715(c), differences between 220 and 221 MHz channels, and the requirement for "additional notification procedures" regarding the E Block licenses, in

accordance with paragraph 19 of the Waiver Order. PTC-220 acknowledges and plans to comply with these special requirements.

H. METHODOLOGY TO DETERMINE BASE STATION COVERAGE AND SPECTRUM ASSIGNMENTS

All the aspects listed in sections II.D, II.E, II.F and II.G – message loading, propagation and interference, high availability, regulations and frequency characteristics – have to be analyzed together to determine the base station coverage areas and the required spectrum, using the available PTC-220 licenses.

Figure 13 shows the generic steps of the PTC-220 methodology developed to address all of those aspects.

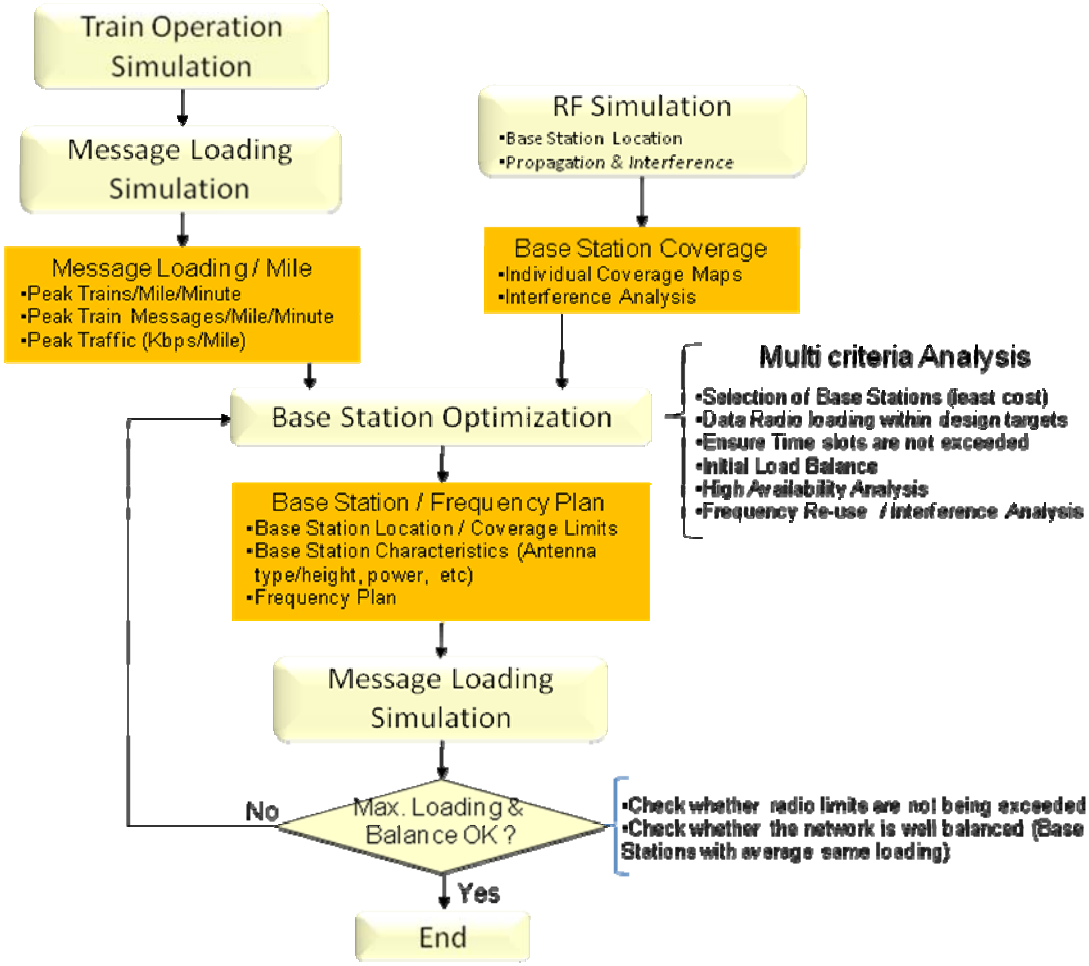

Figure 13 – PTC-220 Methodology Flow to Determine Spectrum Assignments

The first step of the methodology is the simulation of the railroad operation. By using a railroad network simulator, all the train movements over a determined period (such as a couple of weeks to allow for variations in operations and maintenance impacts) are generated, simulating an actual railroad operation. The simulated train movements are used as an input to a second simulator, the Message Loading Simulation, which simulates the PTC messages that would be exchanged during the railroad operation. The peak message traffic periods are retrieved from the outputs of the simulation, generating a message loading per mile for all the tracks being analyzed.

In parallel with the Message Loading Simulation, an initial study of the coverage area of the base stations is developed, using a RF simulation tool. The RF simulation tool is used to investigate propagation and interference effects, determining the best configuration of the base stations to reduce co-channel interference, optimize the use of frequencies, maximize C/I levels and provide high availability whenever possible. Existing RF Simulation tools also provide sophisticated models to simulate the clutter effects of propagation in urban areas (obstacles, multipath). At the end of this process, an individual coverage area (service and interference contours) for each base station is generated.

The message loading per mile is matched with the initial base station coverage areas in the next step, to investigate whether or not radio capacity limits are being exceeded and also whether the network is well balanced (*e.g.*, distributing the message loading evenly among the base stations). This process requires the analysis of diverse "what if" scenarios, such as trying different types or orientation of antennas, increasing or reducing the effective radiated power, adjusting antenna heights and so on. At the end of this iterative process, an implementation plan for the base stations will be generated, determining individual coverage areas for all base stations.

The Message Simulation is re-executed with the base station coverage areas from the implementation plan to check the radio limits and the balance of the system. If any problem is found, the configuration of the base stations needs to be revisited, re-executing the Base Station Optimization step again until an "optimal" solution is found.

I. STRATEGY TO DETERMINE THE SPECTRUM USAGE IN PTC

As described in previous sections, the determination of the base station coverage areas and consequently the required spectrum depends on the analysis of every PTC track segment of all the railroad lines. While some segments will be more easily analyzed, others, such as those in the St. Louis area, will require a more intricate analysis, which includes diverse simulations as described in section II.H.

Such congested urban scenarios present one of the more challenging tasks to PTC-220 LLC, besides the management of frequencies and site construction. The envisioned strategy is to develop studies for all the railroad segments in parallel with the overall PTC development, starting in the 4th quarter of 2010. To handle that, PTC-220 is hiring a specialized third-party company that will perform the required simulations and analysis.

J. SPECTRUM DEPLOYMENT EXAMPLES

This section shows sample results obtained with the detailed analysis of coverage studies and required spectrum for two typical railroad track configurations – a single line and a dense multi-line urban area, using the PTC-220 methodology described in section II.H. Analyses such as the ones described throughout this section will be developed for all the railroad segments.

The examples shown, however, are preliminary and their intention is to show some of the analysis and outputs generated. Some aspects of the analysis, such as train message loading and clutter effects (such as multipath and obstacles) were not considered yet.

K. SINGLE LINE EXAMPLE – BELLINGHAM SUBDIVISION CASE

The BNSF Bellingham subdivision is a typical single line case. Figure 14 shows the sample analysis with the resulting configuration, which has the following characteristics:

- Redundant overlapping coverage for high availability (all PTC tracks covered by at least 2 base stations)
- 1 common channel (license WPFR284 – 220.1375MHz), used at every base station throughout the nation
- 4 user data channels (licenses WPOJ271, WPOI708, WPOI701, WPFP444)
- Use of 4 existing VHF base stations as listed in Table 2 (with the associated PTC-220 frequencies to be used at those locations)
- 52 WIUs were covered by the 4 base stations

This BNSF line runs from the Canadian border to Everett, Washington. The antenna height and effective radiated power of each site was adjusted to provide adequate coverage with redundancy. The only exception was Galbraith Mountain, for which coverage was curtailed in order not to extend into Canada. None of the frequencies selected for these sites is adjacent to each other. The antennas used at these sites are bidirectional antennas, resulting in less potential interference in directions perpendicular to the track.

These stations are all above Line A and Canadian concurrence is required. As the time for construction of these sites approaches, a request for Canadian concurrence will be submitted far enough in advance to allow for reasonable delays in its approval.

Appendix F contains a detailed layered map of the Bellingham Subdivision Spectrum study.

[REDACTED]

Figure 14 – Bellingham Subdivision - Base Station Coverage and Spectrum

Table 2 – Bellingham Subdivision Existing VHF Stations and Planned PTC-220 Frequencies Used for Analysis

[REDACTED]

L. DENSE URBAN AREA EXAMPLE – ST. LOUIS CASE

As mentioned in section II.F, the St. Louis area is a good example of a dense urban area with multiple railroad operations, and PTC-220 developed a study to illustrate this typical case.

The development of this case required a much more elaborate analysis than the single line case, particularly to avoid co-channel interference.

Figure 15 shows the results obtained with the final configuration, which has the following assumptions and characteristics:

- The area covered is 40 kilometers from the center of St. Louis
- Assumed 38 dBu service contour
- Redundant overlapping coverage for high availability (all PTC tracks covered by at least 2 base stations)
- 1 common channel (license WPFR284 – 220.1375MHz)
- 14 existing VHF base stations were used (Table 3 lists the characteristics of the base stations and the associated PTC-220 frequencies to be used at those locations)
- A total of 346 WIUs were covered with 14 base stations
- C/I levels kept at 23 dB (more conservative)
- The 221 MHz stations are limited to a maximum power of 50 W and at a HAAT of 7 meters. If the HAAT is above 7 meters, the ERP must be reduced by 20 Log10 (HAAT/7). For those cases, the ERP was reduced accordingly.

In dense urban areas there are a number of considerations that must be kept in mind that can be much more challenging than in less dense areas. One consideration is providing enough communication channels to handle the required radio traffic. In the example of St. Louis below, the areas with the most traffic are covered by multiple base stations.

Another consideration is providing the necessary coverage without causing interference between stations. This requires a balance between the size of the service area and the number of frequencies used. A mixture of 220 MHz and 221 MHz stations were used to achieve the required coverage without interference.

One other consideration is that the talk-out and talk-back paths should be balanced. The coverage radius of the base station should not be so great that the units to which it is talking cannot talk back. This limits the coverage area of a base station and may require the use of more frequencies or ultimately, the reuse of co-channels.

Appendix G contains a detailed layered map of the St. Louis spectrum study.

[REDACTED]

Figure 15 – St. Louis Area - Base Station Coverage and Spectrum

Table 3 – St. Louis Area Existing VHF Stations and Planned PTC-220 Frequencies Used for Analysis

[REDACTED]

III. CURRENT STATUS OF RADIO DEVELOPMENT

The Interoperable Train Control ("ITC") committee,[3] in consultation with various industry groups, developed extensive requirements for a 220 MHz wireless PTC communications system. Meteorcomm LLC ("Meteorcomm") is developing a prototype data radio technology platform to meet these requirements.[4] Meteorcomm will take advantage of its current data radio system design for the prototype from the wireless communications network it developed for BNSF's PTC system called Electronic Train Management System ("ETMS").

Over the course of 2010, Meteorcomm is fully engaged in designing a production PTC Communications System, including software and 220 MHz radios for use in locomotives, wayside and base station locations that will ultimately be utilized in a nationwide interoperable

[3] The Interoperable Train Control Collaboration Agreement (ITC) is a signed agreement between BNSF, CSX, NS and UP, created to establish PTC interoperability standards.
[4] Meteorcomm, a provider of wireless data solutions, shares common ownership with PTC-220.

PTC system. In order to deliver a fully functional, integrated and tested reference design, Meteorcomm has created a program structure that consists of four main work-streams: radio development, messaging system software development, system management software development and integration testing.

The radio development includes both hardware and software components. Meteorcomm is creating a hardware reference design including wayside, locomotive and base station packaging and associated electronics suitable for third party manufacturing. Meteorcomm's goal is to have pre-production radios available by the end of Q3, 2011 for internal testing. At that time, Meteorcomm expects to release the preliminary hardware design package to manufacturers for review only. Assuming this goal is met, integrated radio testing is expected to be substantially completed by the end of Q4 2011 and full radio manufacturing production is expected to start in Q1 2012.

IV. PTC-220 PLANS FOR THE SEVEN NON-CONTIGUOUS CHANNEL LICENSES

As part of its 220 MHz spectrum inventory, PTC-220, LLC holds seven licenses (WPOJ272, WPOJ273, WPOJ274, WPOJ275, WPOJ276, WPOJ277, and WPOJ278) that are composed of non-contiguous five kilohertz channels. These licenses were acquired as part of a group of 220 MHz licenses from BNSF, in conjunction with BNSF becoming a member of PTC-220. Because PTC requires a minimum channel bandwidth of 25 kilohertz, these licenses cannot support PTC functionality or protocols.

PTC-220 is currently evaluating its options for these licenses, but it is very unlikely that they will be used in any way related to PTC. None of the information in this document regarding license deployment or build-out is intended to apply to these licenses.

V. CONCLUSION

For the foregoing reasons, PTC-220 respectfully submits this Systemwide Build-out Plan to comply with paragraph 16 of the Waiver Order.

Respectfully submitted,

/s/ Michele C. Farquhar

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November 1, 2010

APPENDICES

The appendices contain maps with multiple layers that can be displayed individually or together. When viewing the appendices with Adobe Acrobat, the icon shown below provides the means to select the individual layer(s) to be displayed.

APPENDIX A – BNSF NATIONWIDE LAYERED MAP

[REDACTED]

APPENDIX B – CSX NATIONWIDE LAYERED MAP

[REDACTED]

APPENDIX C – NS NATIONWIDE LAYERED MAP

[REDACTED]

APPENDIX D – UP NATIONWIDE LAYERED MAP

[REDACTED]

APPENDIX E – ALL MEMBER RAILROADS NATIONWIDE LAYERED MAP

[REDACTED]

APPENDIX F – BELLINGHAM CASE STUDY SPECTRUM MAP

[REDACTED]

APPENDIX G – ST. LOUIS CASE STUDY SPECTRUM MAP

[REDACTED]

APPENDIX H – LIST OF ALL MEMBER RAILROAD BASE STATIONS, COORDINATES AND IMPLEMENTATION DATES

[REDACTED]