

Application of Polaris PNT PBC
2018-02-16 – initially submitted
2018-03-16 – amended: *this is the amended copy.*

Response to Question 6: Research Project

The FCC provides the following guidance for this Response (numbers in brackets added):¹

Question 6: Research Project

Click on the appropriate button in response to the question. If the answer to this question is YES, please provide an exhibit with the following information:

[1] A description of the nature of the research project being conducted, a showing that the communications facilities requested are necessary for the research project involved, and

[2] a showing that existing communications facilities are inadequate.

Exhibits may be entered immediately after submitting this form or later by clicking on the ADD ATTACHMENTS button.

NOTE: When submitting this exhibit, please enter "QUESTION 6: STATEMENT OF RESEARCH PROJECT" in the description field and select "Text Documents" as the document type.

Responses

[1] Description of the nature of the research project being conducted:

Non-interfering bench and low-power testing of radios with non-radio devices for very wide-area precise Position, Navigation and Timing applications with licensed and unlicensed spectrum under sections 22.521, 90.259, 90.357, 90.377, 15.707.

[2] Showing that existing communications facilities are inadequate:

This following shows **that the existing communication facilities are inadequate** for the above [1] description of the nature of the research project being conducted:

In the Appendix hereto, below, the numbered items and www links pertain to the Applicant, Polaris PNT PBC, and its President Warren Havens, as manager of FCC radio spectrum licenses and systems, and related research: In addition to the following text of this section [2], these numbered items and links further shows why there are insufficient communication facilities.

A. The “[1] very wide-area precise Position, Navigation and Timing applications involved,” (see above) are based in large part upon using low-band VHF ‘paging’ spectrum in the 35 and 43 MHz ranges for “Meteor Burst Communications” (“MBC”) and other “Meteor Burst” radio signaling, for which currently there are no communication facilities in the United States at all.

In this regard, in this low-band VHF spectrum range:

¹ From: Federal Communications Commission (FCC) Experimental Licensing System – Conventional License User Manual Prepared for: Federal Communications Commission Office of Engineering Technology October 2016.

1. There are MBC radio systems used by the US Department of Agriculture (“DOA”) in its “SNOTEL” systems covering much of the United States for certain environmental monitoring (including the levels of snowpack in the mountain regions):

However, these do not provide for any [1] very wide-area precise Position, Navigation and Timing applications, and also these are not available for non-DOA uses.

2. Also, there are some University lead programs, such as the MIT programs at or based at its Mount Haystack facilities and programs in Massachusetts, that have antenna arrays used for radio astronomy, and earth-atmosphere meteor detection, that may be used for aspects of the facilities that the Applicant, Polaris, plans for the subject “[1] very wide-area precise Position, Navigation and Timing applications involved” (see above).

However, these antenna arrays do not provide for the majority of the components needed, and they would need too much work to reconfigure for the research involved: some of the technologies in these arrays, and some parts used, are practically usable, but not these constructed operational facilities per se.

B. The “[1] very wide-area precise Position, Navigation and Timing applications involved” (see above), are also based in large part upon use of spectrum in the mid to higher parts of the VHF range, up to 222 MHz, as well as some spectrum in the UHF range including in the 902-928 MHz range, on licensed and unlicensed basis.

The use of this spectrum involves, for the most part, one-way digital-radio broadcast to send GPS, GNSS correction signals to mobile things using “Network Real Time Kinematic (“Network RTK” or “N-RTK”) devices and systems, which obtain the correction data from the US NOAA CORS program (Continuously Operating Reference Station (or “CORS”): see <https://www.ngs.noaa.gov/CORS/> program that coordinates hundreds of N-RTK reference stations in the United States).

In this regard, in this these VHF and UHF spectrum ranges, there are no existing digital-radio broadcast communication facilities that have the required installed and configured equipment to support the “[1] very wide-area precise Position, Navigation and Timing applications involved.”

C. The equipment listed in this application are all SDR radio devices currently on the commercial market from well-established manufactures (e.g., the listed manufactures and models listed can easily be found by “googling”).² To use these, the Applicant will test them “as is” for experimental integration, but will also modify them (within the technical limitations of a grant of this application): they are thus all listed as “experimental” for the needed experiments.

The low to relatively low transmit power levels listed are sufficient for the planned testing (in large part inside a building on ground floor and to a limited extent with using rooftop antennas at the location and height listed in the application. Further testing at high power and higher height antennas at various locations is planned after testing under a grant of this application, but that will be pursued later in a separate conventional experimental license application.

² E.g., Lime Microsystems (Lime) and its SDR products are found here: <http://www.limemicro.com/> <http://www.limemicro.com/products/software-defined-radio/>

Appendix

1. Mr. Havens is the sole author of and has a depth of knowledge in the radio-systems and methods described in the following websites and all of the contents but for the publishes materials by listed other sources used in these websites: www.polarispnt.space and www.terranaux.com.
2. Mr. Havens was the originator, a contributor to, and the grant provider to the University of California Berkeley Study on high accuracy location wireless. Copy at: https://people.eecs.berkeley.edu/~kannanr/assets/project_loc/CHALOCBA.pdf. The Acknowledgements refer to a gift from ATLAS Wireless, LLC that was formed and managed by Havens, of Berkeley California to support various FCC-licensed spectrum based programs.
3. Mr. Havens was invited to, and prepared and submitted the following presentation to, the National Public Safety Telecommunications Counsel on certain new digital radio technologies and systems. Copy at: <http://www.npstc.org/download.jsp?tableId=37&column=217&id=1094&file=20080618-Havens-TETRA-v2.pdf>
4. Mr. Havens is the originator and author of “Advanced Railroad Wireless Using PTC as a Foundation...”. January 2014. By Warren Havens involving the 'Skytel' companies he managed. Copy at: <https://ecfsapi.fcc.gov/file/7521064429.pdf>
5. Mr. Havens is the originator, commissioned, and contributed to the paper: “LTE Deployments in the LMS band for ITS Radio Communications and Location,” by Nishith D. Tripathi, Ph. D. Copy at: <https://wireless2.fcc.gov/UlsEntry/attachments/attachmentViewRD.jsp?applType=search&fileKey=96967609&attachmentKey=18943468&attachmentInd=applAttach>
As this paper states, it was commissioned by the 'Skytel' companies (listed in item 4 above) managed by Mr. Havens. This paper is in FCC docket 06-49 regarding the LMS radio service.
6. Mr. Havens prepared the radio-frequency and licenses partition and disaggregation design for the Amtrak "corridor" license using AMTS spectrum shown in FCC records. See FCC DA 15-287 and related granted assignment applications, attached below with the corridor map.
7. Mr. Havens is the originator, commissioned and contributed to the study and paper: “Nationwide High Accuracy Positioning Infrastructure and Services, Including for Intelligent Transportation Systems: Background, Technology, Uses, Developments and Challenges. April 2, 2010, by C. Rizos to Skybridge Spectrum Foundation... Berkeley California (“SkyTel”). Copy at: <https://www.scribd.com/document/31932756/Chris-Rizos-to-Sky-Tel-Nationwide-High-Accuracy-Positioning-Infrastructure-and-Services-GNSS-Terrestrial-Including-for-Intelligent-Transportation-S>
8. Mr. Havens is the originator, commissioned and contributed the paper: Wireless for Railroads, by Ron Lindsay, 2011. Copy at: <https://www.scribd.com/document/53478557/Wireless-for-Railroads-By-Ron-Lindsey-April-2011>
9. The value of digital radio broadcast systems, in the VHF and UHF ranges indicated in this Attachment above, for the “[1] very wide-area precise Position, Navigation and Timing applications involved,” described above, is further shown in *following pages*.

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