July 8, 2024

Proposed Reorganization of the Lower 900 MHz Band: Issues and Implications for Tolling from an FCC Petition

On April 16, 2024, a petition was filed with the Federal Communications Commission (FCC), proposing a reorganization of the 902-928 MHz spectrum. U.S. electronic tolling operations use this portion of the band for its radio frequency identification (RFID). This paper summarizes the nature of the proposal and the results of an IBTTA member survey of issues for the toll industry.

Background

NextNav is a company that provides next generation positioning, navigation, timing (PNT) and 3D geolocation systems and services. They have been using portions of the lower 900 MHz radio frequency spectrum for years.

The company filed a rulemaking petition on April 16, 2024 with the Federal Communications Commission (FCC) seeking to rearrange the lower 900 MHz band (902-928 MHz band) to facilitate a terrestrial PNT network and 5G broadband[1]. The petition asserts that the creation of a unified solution to advance terrestrial PNT services is in the U.S. national interest. NextNav points to international geopolitical risks and orbital risks to satellites as threats to global positioning systems (GPS), which represent a single point of failure for systems vital to U.S. economic and military interests. The petition does not address the underlying commercial applications that could be advanced from the proposed restructuring and organization of the spectrum as a rationale for the proposal.

NextNav's FCC petition calls for a nationwide license for a contiguous 5 MHz band from 902-907 MHz for uplink communications and another 10 MHz contiguous band from 918-928 MHz for downlink purposes. This represents at least a 20% reduction in the portions of the spectrum currently in use by U.S. toll operations. NextNav seeks a nationwide license to support its control and use of the proposed band blocks by establishing a single licensee using these portions of the spectrum.

The petition suggests that NextNav would strive to minimize interference with existing users of the spectrum and seek solutions to coexist with existing applications in the spectrum. NextNav contends that coexistence between non-multilateration location monitoring systems (non-M-LMS), such as tolling, and the proposed NextNav operations is achievable. The petition cites the frequency flexibility employed by most non-M-LMS equipment deployments and the remaining 11-MHz block available without co-channel operations from NextNav as evidence of how coexistence within a reorganized band is achievable.

A rules supplement was filed with the FCC by NextNav on June 7, 2024, providing specific language updates recommended to the Part 90 FCC rules. This filing aims to establish flexible use concepts to the FCC regulations and to remove the command-and-control rules that govern multilateration location and monitoring service (M-LMS) licenses in the 902-928 MHz band. The FCC Part 90 regulations are a set of rules governing the use of radio frequencies in the Private Land Mobile Radio Service. The rules and corresponding certification process are intended to:

- Prevent interference among radio systems by ensuring devices operate within designated frequencies, guaranteeing clear and reliable communication;
- Promote market access, by requiring equipment manufacturers or distributors to certify FCC Part 90 compliance;
- Protect public safety for critical applications by ensuring uninterrupted communication and optimal performance during emergencies.

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[1] The original NextNav press release and FCC petition are available at: https://nextnav.com/lays-out-new-vision/
Seethe June 7, 2024 supplemental filing at: https://www.fcc.gov/ecfs/document/10607137757430/1

The June 7 supplement appears to add regulatory language that operations, such as electronic toll collection, may not cause harmful interference to Terrestrial Position Timing Navigation and Timing (TPNT) systems and must accept harmful interference from TPNT systems in the 902-907 MHz and 918-928 MHz band segments.

Inquiries with NextNav by toll industry technical experts about the testing that is underway to confirm the ability of their PNT system to coexist with existing toll operations did not inspire confidence or suggest transparency. Representatives of NextNav claimed to have engaged a third-party testing organization but could not identify specifics of the organization, their qualifications, or the nature of their investigation. Testing at the time had been limited to the TDM toll protocol. This protocol is likely to be less challenging than other tolling protocols because of its reliance on battery-powered on-board units and tight frequency operating ranges. Test plans of other toll protocols, including 6C, had not yet been established.

Overview of the FCC Petition and Proposal

The NextNav FCC petition seeks a restructuring of the 902-928 MHz spectrum providing two contiguous portions of the spectrum for an exclusive nationwide license for the purpose of establishing a cost-effective TPNT system.

The proposed TPNT system is designed to deploy a network of 5G New Radio ("NR") base stations for positioning reference signals to determine location and timing based on time of arrival. The collection of base stations would be coordinated from a station that serves as an absolute time source. The network of base stations would presumably be built out and supplemented over time as use cases and demand dictates the need for additional density. The base stations provide the X-Y axis positioning details. These are augmented by a series of barometric reference sensors that provide the Z axis coordinate location. Figure 1 depicts a basic illustration of the proposed PNT network architecture.

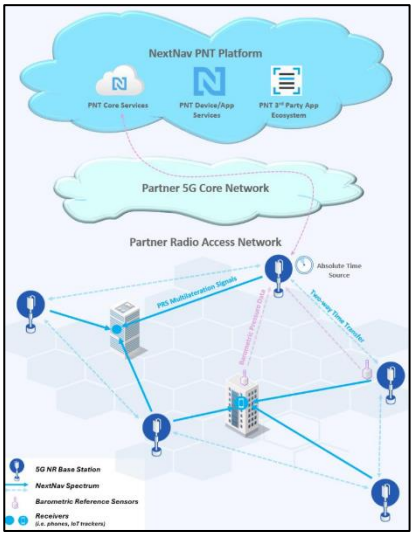

Figure 1. NextNav PNT Network Architecture

The use of 5G position referencing signals aims to make PNT services available to devices connected to a network of NextNav partners (i.e., in-network service providers), as well as to user devices connected to operators of other networks (i.e., out-of-network connections).

Figure 2 (below) illustrates the allocation of the spectrum as it exists today in the upper section of the graphic. Today, electronic tolling uses the gray "LMS" portions of the spectrum from 902-904 MHz and 909.75-921.75 MHz. The spectrum is used differently by different toll protocols and in different regions of the country. The current spectrum allocation and rules governing use allow local solutions to employ RF tuning to manage sources of local interference and maintain reliable tag reader performance.

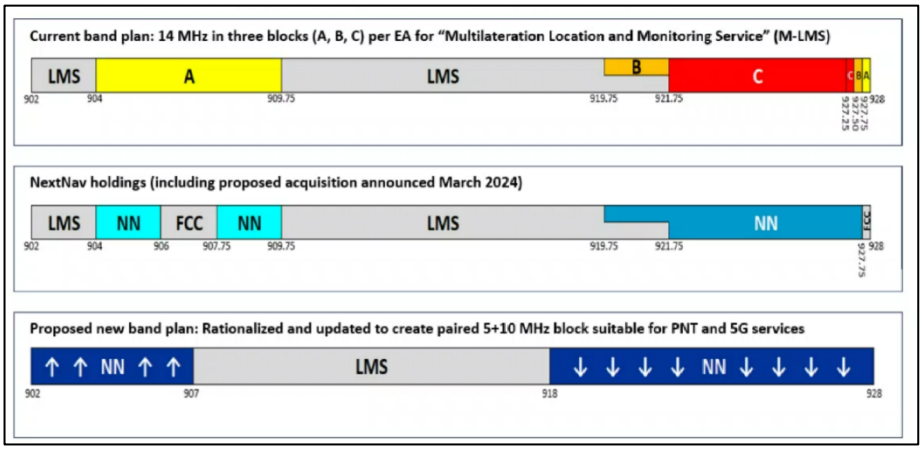

Figure 2. NextNav's Rebanding Proposal

The middle section of this graphic shows where NextNav has already acquired space at the upper end of the spectrum (in dark blue) and where they are actively bidding at auction to acquire additional space at the lower end of the spectrum (in light blue). The lower section of the graphic depicts the proposed new allocation of the spectrum being sought in the FCC petition. The dark blue sections indicate the frequencies that are sought to be exclusively licensed

The June 7 supplemental submission to the FCC proposes rule language changes to regulate that that operations currently authorized in the areas of the spectrum that would be licensed to NextNav must not cause harmful interference to the proposed TPNT system and must accept harmful interference from TPNT systems in the 902-907 MHz and 918-928 MHz segments of the band.

to NextNav for their proposed system. The effective outcome is an exclusive nationwide license to a single PNT system operator of current toll operating spectrum in the 902-907 MHz and 918.75-921.75 MHz bands. The unencumbered spectrum available to tolling would be reduced from 14 MHz to 11 MHz.

The June 7 supplemental submission to the FCC proposes rule language changes to regulate that that operations currently authorized in the areas of the spectrum that would be licensed to NextNav must not cause harmful interference to the proposed TPNT system and must accept harmful interference from TPNT systems in the 902-907 MHz and 918-928 MHz segments of the band. This would mean that if mutually acceptable coexistence is not technically feasible, toll operations have no recourse other than to cease and desist operations within those portions of the spectrum.

The original petition indicates that a simulation study of the proposed system verified that a 10-MHz downlink channel can provide a single-digit-meter positioning (i.e., within centimeters) and sub-20-nanosecond timing accuracy at a 95% confidence level. A key question related to these findings is whether a PNT system could function effectively with less than a 10 MHz dedicated downlink frequency, possibly with somewhat lower performance standards. Could such a compromise potentially restore some of the 918-921.75 MHz range that is encroached upon by the petition's proposed actions?

IBTTA Member Survey: Risk and Implications

In the absence of comprehensive and transparent test plans, and clear evidence as to how the proposed NextNav operations could coexist with deployed toll revenue collection systems in active use, IBTTA surveyed members for input on implications and risks to existing toll operations and systems. The survey focused on obtaining structured and consistent member input on a variety of issues, including:

- Do the proposed commercial applications in the spectrum present risks of interference for existing toll applications?
- Risk of signal bleed-over into the tolling spectrum?
- Will a narrowed range require toll system reader upgrades to restrict toll communication bandwidth more precisely?
- How is the future of transportation technology and applications impacted by private ownership of this range of the spectrum? How might government applications and interests be protected?

Overwhelmingly, the toll industry is concerned about the likely performance degradation of systems in active use and the corresponding costs of mitigation measures, risks of revenue loss, and effects of diminished customer satisfaction and confidence.

While 68 survey respondents completed parts of the survey, 28 fully completed survey responses were submitted. Of those, 71% were from toll operators, 18% from RFID equipment and systems suppliers, and 11% from technical consultants and other service providers. With the movements toward interoperability among many tolling organizations, the most popular tolling protocols in use and supported includes 6C, TDM, and SeGo, with 36% of respondents indicating that they also supported other protocols in their current operations.

Survey Results

Overwhelmingly, the toll industry is concerned about the likely performance degradation of systems in active use and the corresponding costs of mitigation measures, risks of revenue loss, and effects of diminished customer satisfaction and confidence.

Signal Interference and Degraded System Performance

The petition would reduce the frequencies available for tolling by at least 20%. With more limited band frequencies and new uses in the spectrum, interference with current operations is a significant concern.

The spectrum restructuring would result in more missed transponder reads on roadways and the need for toll operators to default to less reliable license plate image transactions. The consequences would be:

- lost revenue from uncollected image-based transactions;
- greater cost associated with license plate lookups and invoicing;
- customer service issues with valid electronic toll account holders being billed by invoice; and
- erosion of customer confidence and trust in the public revenue systems' ability to perform accurately and correctly.

The current band allocation allows flexibility in site plans to address local interference, which would be greatly diminished if the band were reorganized as proposed. System performance would be affected by:

- constrained options to manage local interference effectively, ultimately adding complexity in achieving system performance requirements and resulting in lost and more expensive transactions;
- the absence of adequate guard bands, increasing the likelihood of destructive interference; and
- high signal strengths and duty cycles in adjacent sub-bands, increasing activations of battery-powered toll transponders (tags), reducing battery life, requiring more frequent tag replacements, and causing more frequent tag failures.

Reduced frequency for non-multilateration location monitoring (non-M-LMS) systems in tolling may impact performance of some intelligent transportation systems services (ITS) services in densely populated areas. Implications include:

- degraded safety system performance for motorists and road operators to avoid traffic crashes, increasing fatalities, injuries, and property damage;
- reduced availability of reliable real-time traffic information for system operators and motorists to understand current conditions; and
- challenges for the growing congestion management and controlled access strategies (e.g., managed and express lanes) being employed in many regions.

A shift to strong broadband 5G systems would limit options for deployment of new toll sites due to constraints from coexistence with PNT base stations. Concerns include:

- constrained location options, driving design decisions, project costs, and efficiency of new tolling deployments; and
- new demands on off-site testing and certification to estimate on-site conditions and performance, as well as costly and disruptive on-site testing; and
- extended planning and project delivery schedules, and related costs of project delivery.

Cost and Disruption to Operations

Reduced and reallocated frequency would increase the cost of toll operations and maintenance and add disruptions to the system. Cost considerations include:

- all toll sites would need to be evaluated and potentially retuned, requiring new operating resources and placing new demands on specialized and limited technical skill sets;
- toll equipment retuning would become an ongoing and more frequent need to ensure system operation and validate performance considering the changing environment with new users in the spectrum;
- equipment retuning would require additional site licensing from the FCC;

- more off-site pre-tests and on-site testing and performance evaluations may be needed to minimize operating impacts;
- additional and more frequent system monitoring and adjustments will add to maintenance of traffic costs to support the work; and
- additional revenue loss will be associated with roadway and lanes closures to perform the work.

Business and Public Benefit Constraints from Limited Competitive Spectrum Availability

The petition seeks a nationwide and exclusive license to a single entity to overcome the fact that "the economics of building a widescale, standalone terrestrial PNT network are insurmountable." Limiting control of more than 57% of the spectrum already in use by public agencies and local and state governments to a single commercial entity would mean that:

- no allowances for guard bands would be required, increasing the likelihood of destructive interference;
- research and development of new devices will become more costly for manufacturers, and consequently more restrictive, stifling innovation in RFID transportation applications;
- there would be limited recourse to ensure responsiveness when issues arise in the absence of adequate regulatory measures and government control; and
- competitive, market-based technology solutions within the spectrum would be limited at a time when the transportation sector is striving to advance vehicle-to-everything (v2X) applications, in-vehicle mobile payment alternatives, and telecommunications solutions to innovate for greater safety, efficiency, and reliability of road networks.

Next Steps

IBTTA proposes the following next steps.

- Inform FCC of initial concerns, risks, and impacts to the toll industry and American motorists.
- Continue coordination with other users of the lower 900 MHz portion of the spectrum on responses and mutual interests, including those outside the transportation industry.
- Compile toll industry impact statement data, including:
    - traffic;
    - revenue;
    - number of impacted motorists;
    - number of RFID tags in circulation;
    - tag investment in active use;
    - number of RFID readers affected;
    - reader investment in use;
    - systems investment in place.
- Consider testing requirements and procedures in case the FCC entertains the petition.
- Prepare outreach and advocacy materials for public policy makers, federal officials, and members of Congress.