Montana Department of Transportation *December 2022*

R E S E A R C H P R O G R A M S

Project Summary Report: FHWA/MT-22-004/9922-807

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Analyze Business Models for Implementation and Operation of a Statewide GNSS RTN

https://www.mdt.mt.gov/research/projects/planning/gnss.aspx

Introduction

The Global Navigation Satellite System (GNSS), commonly known as the global positioning system (GPS), has become one of the fastest-growing emerging technologies delivering location services to various sectors. The applications of geospatial data span every sphere of modern-day science and industry where geographical positioning matters. The list includes navigation, agriculture, surveying, construction, transportation, forestry, mining, and many others.

The GNSS Real-Time Network (RTN) is a satellite-based positioning system using a network of ground receivers (also called base stations, reference stations, or continuously operating reference stations (CORSs)) to improve the accuracy of corrections in positioning data.

The network of reference stations extenuates the atmospheric and satellite orbit biases and improves the accuracy and precision of geospatial positioning through real-time corrections sent from a central processing center (CPC) to a rover. The utilization of ground sensors enables systems to have a range of 1 to 5 centimeters accuracy in positioning data.

Although statewide GNSS-RTN systems have not been around for long, the benefits of this new technology have been proven in the states where it was implemented. Recognizing the significant role and potential benefits this technology brings to the state economy and citizens, the state of Montana is interested in establishing a statewide GNSS-RTN system where accurate and reliable location data is made available throughout the state. To that end, this research project is intended to provide information that would help the state's efforts in the planning and implementation of the Montana GNSS-RTN system. Specifically, multiple tasks were successfully completed to gather the required information on all aspects of the GNSS-RTN system design, implementation, and operations.

What We Did

Four major tasks were carried out to achieve the project objective. They are listed as follows.

1. **Literature Review:** A literature review was carried out where information on GNSS-RTN technology, system design, applications, and business models were reviewed and summarized. This task used research articles, government publications, research reports, agency websites, and industry magazine articles to collect and compile information.

2. **State-of-the-Practice Assessment:** The state of practice in establishing and operating statewide GNSS-RTN systems was screened using a questionnaire survey for system owners/operators as well as interviews with technology vendors. The survey was conducted to learn about the current practices of building and operating the GNSS-RTN systems and providing accurate location services in different states around the U.S. Thirty-eight respondents submitted the survey representing 30 states. The interviews with technology vendors were important to learn about costs and recent trends in technology and system operations.

3. **Existing Infrastructure:** An assessment of all existing GNSS-RTN infrastructure in Montana was conducted in this task. The task identified aspects such as CORS ownership, sampling rate, location coordinates, mounting type, and the networks each station contributes to.

4. **Catalog Viable GNSS-RTN Business Models:** This task cataloged several distinct business models that were identified in the previous project tasks, namely, the literature review and the state-of-the-practice assessment. The business models were adequately described with a summary of the merits and demerits of each model. The task also included an overview of the conceptual elements of any GNSS-RTN business model to help understand the different possible models for building and operating the system. The business model conceptual elements included the CPC ownership/operation, CORSs ownership, CORSs operating and maintenance costs, and user access charges. Finally, a high-level assessment of all possible business models was performed using the following criteria: state control over the system, sustainability of the business model, and state financial obligations.

What We Found

The literature review task highlighted recent advancements in GNSS-RTN technology and outlined the most important conventional and emerging applications of the GNSS-RTN systems to provide a good understanding of the system and its potential uses. Further, information on GNSS-RTN business models was summarized, and best practices and guidelines were presented. Finally, system design considerations were reviewed by examining the characteristics of existing systems and reviewing available guidance.

The state-of-the-practice assessment gathered important information on current practices in building and operating the GNSS-RTN systems at the national level. Some of the major findings of the state-of-the-practice assessment are provided below.

- Most of the statewide GNSS-RTN systems surveyed are owned by state agencies (primarily Departments of Transportation or DOTs). Approximately 90% of the systems in the U.S. are based on CORSs with an average spacing of less than 70 km resulting in an accuracy of 2 -4 cm in location data. The GNSS-RTN systems often provide data as corrected coordinates, network corrections, post-processed data, and in fewer instances as virtual Receiver Independent Exchange Format (RINEX).
- The owners of the central processing centers (CPCs) are responsible for user and IT support service costs in approximately 64% of all the systems surveyed. In addition, the CPC owners are responsible for the cost of communication between the CPC and CORSs and for the cost of CPC maintenance.
- Approximately 60 % of GNSS-RTN systems offer entirely free access to both public and private users resulting in the majority of state agencies not generating revenues from user fees.
- The funding sources for the establishment of most of the statewide GNSS-RTN systems are either only state funds or some federal funds along with state funds. However, the funding sources for the daily operation of GNSS-RTN systems are state funds and users' fees, when used.
- In the process of incorporating privately-owned CORSs to statewide networks, some states provide incentives to the private owners in various forms such as unlimited access to data, access to value-added services, free or discounted subscription(s), and educational opportunities for schools that host CORSs.

The following project task characterized Montana existing GNSS-RTN infrastructure. At the time of executing the task, there was a total of 62 CORSs in Montana owned by both public and private entities, of which 57 are publicly owned. The Montana State Real-Time Network (MTSRN) was the largest public network in Montana; then consisting of 54 CORSs covering different parts of the state. Most of the CORSs in Montana provide a sampling rate of 15 seconds or less; with a considerable number of stations providing a sampling rate of 1 second.

For MTSRN stations with known information, the communication between CORSs and the CPC was almost equally split between the internet and the cellular service.

What The Researchers Recommend

Given the overall project findings, the researchers recommend the following:

1. Building public-private partnerships through incorporating existing CORSs owned by private and other public entities proved to be a cost-effective way for establishing statewide networks within fewer resources and shorter time spans. The existing GNSS-RTN infrastructure in Montana is significant, and this could potentially expedite the establishment of the statewide network while lowering financial obligations to the state.

2. Expanding the user base of the prospective statewide GNSS-RTN system is important for achieving sustainable operations of the system while maximizing benefits to the state's economy and its citizens. This requires a scheme for user access charges that is competitive with those that already exist in the region and other neighboring states.

3. The role of technology vendors/manufacturers in building and operating the Montana GNSS-RTN system should be assessed carefully in a way to maximize benefits to the state and leverage its expended resources.

For More Details . . .

The research is documented in Report FHWA/MT-22-004/9922-807, https://www.mdt.mt.gov/research/projects/planning/gnss.aspx.

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