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**THE NATIONAL TRANSPORTATION ATLAS DATABASE:
A SPATIAL FRAMEWORK FOR TRANSPORTATION STATISTICS**

by

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I. INTRODUCTION

1. The Bureau of Transportation Statistics (BTS) is the newest agency in the U.S. Department of Transportation (USDOT) as well as America's newest national statistical agency. It was authorized by Congress in 1991, and formally established a year later in December 1992. Its missions are to compile, analyze, and disseminate information on the condition and performance of the Nation's transportation systems; to collect information on intermodal transportation; and to enhance the quality and effectiveness of the USDOT's statistical programs.

2. BTS has pursued its missions very aggressively. In the few years since it has been established, BTS has produced over 100 published reports, ranging from the Transportation Statistics Annual Report, to directories of data sources and contacts for transportation information, to specific methodological and analytical reports covering a wide range of transportation topics. It has designed and conducted two national transportation surveys, one of domestic commodity flows and one of long distance personal trips. It has compiled and published 11 national transportation data sets on CD-ROM, including surface shipments of commodities between the U.S., Canada and Mexico; national waterway statistics; fatal traffic accidents; journey-to-work trips from the 1990 U.S. Census; and most recently, a multi-media CD of travel and tourism statistics from over 100 nations. It also created an Internet Web Site (www.bts.gov) that includes an on-line library of over 5000 transportation reports, access to all BTS data products, links to other transportation web sites worldwide, several discussion groups covering various transportation topics, and interactive transportation information such as on-time arrival statistics for all U.S. airlines and city pairs.

3. One of the data sets compiled and disseminated by BTS is the **National Transportation Atlas Database (NTAD)**. The NTAD is a collection of geo-spatial databases depicting U.S. transportation networks and facilities of "national significance." The collection includes:

- a) Transportation Infrastructure - major highways, railroads, transit guideways, navigable waterways, public use airports, water ports, intermodal railroad yards, railroad passenger stations, and transit stations.
- b) Transportation Services - Intercity and commuter railroad routes, commercial airline routes, auto and passenger ferry routes.
- c) Statistical Analysis Areas - State, county, and urbanized area boundaries, Congressional districts, National Transportation Analysis Regions, metropolitan statistical areas, national parks, and military installations.

4. The NTAD is one of BTS's foundation databases. It is the official data source for maps produced by BTS and most other USDOT agencies. The NTAD network distances were used by BTS analysts to calculate ton-mile and passenger-mile statistics for the Commodity Flow Survey and American Travel Survey, respectively. Overlays of NTAD networks on statistical areas are used by USDOT policy analysts to estimate national level statistics, such as percentage of

population within driving distance of a commercial airport, or the number of miles of Federal-Aid highways in a specific Congressional district.

5. Very few of the individual databases comprising the NTAD were created by from scratch by BTS. In fact, most of them were developed, and are still maintained, by other Federal agencies. Before the NTAD, however, many of the databases were only used internally by the agency, were of questionable accuracy or currency, and had little or no documentation. BTS worked with each of the agencies to standardize the formats, enhance the spatial accuracy, and provide a mechanism for disseminating the databases to anyone who wants them.

II. NTAD CHARACTERISTICS

6. All of the databases in the NTAD are in the public domain. They are available free of cost to anyone who asks for them, and are free of any restrictions on use or redistribution. Some of the NTAD databases have been incorporated into commercial products including Geographic Information Systems (GIS) and routing software.

7. All of the databases are being converted to a standard level of spatial accuracy. Currently, that accuracy is equivalent to a map scale of 1:100,000 (or an approximate error of about 50 meters). All of the networks are topologically connected (i.e., there are no gaps in the digitized lines). This allows the networks to be used by standard network pathbuilding algorithms to compute shortest paths, assign flows, or conduct more sophisticated routing.

8. A standard file format was created, and all of the NTAD databases have been converted to this format. The format separates most of the spatial information (i.e., geographic coordinates) from the attributes which describe the transportation feature. This makes it easier to update the more dynamic attribute information (e.g., number of enplanements at an airport) without having to replace the entire feature record. The spatial and attribute data are linked by means of a permanent feature identifier. Each file in the database also contains several standard fields that identify the NTAD version and revision number, and the date the record was last updated. Specific changes to each database are recorded in a published transaction file that is disseminated along with the database.

9. Most of the feature attributes in the NTAD are maintained and updated by the Federal agency responsible for overseeing that particular transportation mode. For example, the Federal Highway Administration (FHWA) updates the national highway planning network, the Federal Railroad Administration updates the railroad network's ownership and trackage rights, and the U.S. Army Corps of Engineers updates the national waterway network. BTS works with the responsible Federal agency to verify and correct the locational accuracy of each transportation feature.

III. NTAD DISSEMINATION

10. The NTAD is distributed in two ways by BTS. Once a year, BTS produces a CD-ROM containing an updated version of all of the NTAD databases. To date, BTS has produced three such CD-ROMs. The most recent version was released in July 1997. In addition, each NTAD database can be downloaded from the BTS Web Site. The Web Site provides a means of posting

interim releases of individual databases that may have been corrected, enhanced, or updated since the last release of the CD-ROM.

11. The BTS Web Site also provides a means whereby users can ask questions about the NTAD and report database errors back to BTS. Although every effort is made to verify the accuracy of each database before dissemination, many errors are not caught until the databases are used in specific applications. The existence of an on-line clearinghouse is one way for the user to provide important information back to the database developer to help improve the product. User-reported errors are first posted on the Web Site, while they are being verified by BTS or the database developer. Verified errors are then corrected and noted in the published transaction file.

12. One of the most recent enhancements to the NTAD has been the development of viewing and extraction software. The NTAD format consists of a set of fixed record length ASCII files that are easy to read and manipulate, but are not directly compatible with any commercial GIS software. Furthermore, BTS customers without GIS software wanted to be able to view the databases, even if they couldn't manipulate them. In response to these user requests, BTS developed a software program that reads the NTAD format, allows the user to extract the entire database or some geographic subsets of the database (e.g., by States or Federal regions), and then exports the files into one of several proprietary formats that can be read by commercial GIS software packages. A second program allows the user to view one or more of the NTAD layers, providing limited style selection, pan and zoom features, and printing capabilities. These programs currently can be downloaded from the BTS Web Site, and will be included with future releases of the NTAD CD-ROM.

IV. FUTURE INITIATIVES

13. As mentioned earlier, the NTAD is a foundation database for many other BTS activities. This is especially true for other activities conducted by the BTS Office of Geographic Information Systems. One major activity in which BTS participates is the National Spatial Data Infrastructure (NSDI) initiative. This program, which was authorized by President Clinton in 1994, involves the establishment of spatial data sharing partnerships among Federal, State, and local government agencies, and even private industry.

14. At the core of this initiative is the concept of spatial framework data. Framework data are those spatial features which are used over and over again in most cartographic and GIS applications to locate other features, provide orientation and perspective to a map, or establish controls points for locational accuracy. If high quality framework data could be developed and made available to the public, with little or no restrictions on use or redistribution, then GIS users could save substantial time and cost by not having to recreate these databases on their own. Instead they could focus their efforts on developing more detailed and accurate thematic spatial data. Moreover, the framework data would provide a consistency across spatial data layers which would improve the reliability and accuracy of spatial analyses conducted using the data.

15. The NSDI identifies seven themes of spatial data that constitute framework. They are: geodetic control, digital orthoimagery, elevation, hydrography, transportation, administrative boundaries, and cadastral. The USDOT, and BTS in particular, is responsible for development of standards and coordination for the transportation theme. The NTAD represents a baseline for the

transportation framework layer. While its current accuracy and level of coverage, particularly in the road layer, are inadequate for most local applications, many of the data model concepts and standards developed for the NTAD are transferable to the transportation framework. In addition, the NTAD provides a consistent and connected set of national transportation networks that can serve both as an index to more accurate local data, and as a default network in those areas where more detailed databases do not yet exist.

16. BTS is working closely with other key Federal agencies to determine the barriers and incentives to developing data sharing partnerships for transportation. BTS and the FHWA are currently engaged in discussions with the U.S. Geological Survey (USGS) and the Bureau of the Census that, hopefully, will lead to a Memorandum of Understanding to develop a single, transportation database layer that will be used by all Federal agencies for national level analyses.

17. BTS also has begun a program of site visits to State DOTs to learn about their GIS programs, including organizational structure and history, database development, current GIS applications, awareness of and participation in statewide spatial data programs, and research needs. Summaries of each site visit is being posted on the BTS Web Site to facilitate information exchange and encourage peer-to-peer communication among the State DOTs. The research priorities identified by the States will be used to guide a GIS in Transportation research program that BTS plans to initiate next year. Information on the State level transportation databases is being shared with NSDI partners at the State and Federal levels to identify potential contributions to the transportation framework layer.

18. In summary, the goal of the BTS Office of Geographic Information Services is to become the focal point for transportation spatial data and transportation GIS research in the United States. The NTAD provides a foundation database that can be used for national level transportation analyses and presentation, and a baseline for a more comprehensive national transportation framework data layer that will be a key component of the National Spatial Data Infrastructure. BTS is using its Web Site both to disseminate data and to facilitate information exchange throughout the transportation GIS community on new research, innovative applications, and available data. Finally, as lead agency for the coordination of transportation spatial data in the Federal Government, BTS is working to develop national standards for spatial data exchange that will meet the needs of all transportation data users.