AASHTO
GEOSPATIAL INFORMATION SYSTEMS
TRANSPORTATION SYMPOSIUM

SUMMARY REPORT

Twenty-Third Annual

GEOSPATIAL INFORMATION SYSTEMS FOR TRANSPORTATION SYMPOSIUM

To provide a forum for transportation officials from State, Province, Federal, and Municipal Agencies to discuss GIS and transportation issues

April 12 - 14, 2010

Workshops – April 11, 2010

Charleston, West Virginia

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2010 GIS-T SYMPOSIUM REPORT
Charleston, West Virginia

Overview of the GIS-T Symposium

The twenty-third annual Symposium on Geospatial Information Systems for Transportation (GIS-T) was held in Charleston, West Virginia from April 11 through April 14, 2010. The Symposium focuses on providing a forum for transportation professionals interested in the design and use of GIS-T. It brings together individuals from education, the private sector, and all levels of government for a full day of workshops and two and a half days of professional development. For the fifth year, the Symposium included a *Student Paper Contest* and a session for the winning papers to be presented. The Symposium also provided an excellent avenue for participants to network with peers to discuss emerging issues and concerns.

"Mountains of Opportunity" was chosen as the 2010 Symposium theme. The theme was in reference to the 2010 Symposium being held in West Virginia, which has a mountainous terrain. Additionally, Geospatial Information Systems (GIS), provide information and analysis opportunities that go beyond the tabular report. Although user-friendly maps are a key component of GIS-T, the geospatial analysis capabilities go beyond other practical means. Viewing data on maps, automating repetitive tasks, and improving data accuracy lead to better decisions and increased productivity. Finally, the symposium offered many opportunities to discuss issues, explore trends, and discover solutions to transportation information needs.

Throughout the course of the Symposium, a variety of key issues surfaced by means of a pre-symposium survey (*State Summary Report*), session papers, panel discussions, and the Symposium wrap-up. This report will identify key emerging issues and discuss how their impact might affect the GIS-T community.

A total of ninety-eight (98) professional abstracts were submitted during the Call for Presentations. The Program Committee rated the abstracts, selected sixty-nine (69) for inclusion in the program, and developed "like categories" for thematic presentation. The selected technical papers and abstracts are available through the GIS-T web page (http://www.gis-t.org). The *State Summary Report, Roll Call of States*, and the *State GIS Contacts* list can also be obtained from this site. Two topics for Panel Discussion were selected for presentation during the Symposium.

Emerging Issues and Opportunities for Further Study by the Transportation Information Technology Community

Although many issues related to GIS in Transportation were identified and examined during the course of the Symposium, a few emerged as new or overarching.

GIS-T Activities

The *Roll Call of States* revealed nearly half of the DOTs working at the enterprise level with data warehousing, applications, architecture, training, or database and server software migrations. An equivalent number were interested is discussing similar enterprise endeavors. The second most popular theme was the development of web applications,

particularly web portals. Linear Referencing (LRS) continues to be a widely discussed topic. However, many of the states cited LRS development in relation to HPMS, another common topic as the new submittal approaches. Other common themes were Ortho-photography, LiDAR, and mobile applications and field/GPS data collection. This increased desire to include geospatial technologies in diversified business processes has put new demands on GIS-T technologies and technologists.

Transportation for the Nation (TFTN)
The Transportation for the Nation initiative is an effort to develop a seamless transportation network nationwide. The network will be multi-modal and built from local and state networks. The intended benefit is monetary savings through coordinated development and integration. The state DOT's are trying to understand how TFTN will impact their business. The DOTs' questions are:

- What submittal requirements will be placed upon DOTs, if any?
- When will requirements be placed on DOTs?
- Will funding be tied to participation?
- Where does the Highway Performance Monitoring System (HPMS) fit?
- What is the Census Bureau's role?
- Whose data will be considered authoritative?
- Commercial vendors have TFTN like datasets largely complete; what is their role?
- Who is the intended audience/customer for this data set?
- How will the data be used?

Until the intended use, submittal requirements, and audience are determined, the DOTs' approach and position toward TFTN will be cautious. Many of the same questions and issues surfaced last year; they have not been resolved.

Linear Referencing System (LRS)
Linear referencing continues to be a conversational topic. Although a topic every year, this year's interest was related to the Highway Performance Monitoring System (HPMS) Submittal. DOT's are developing submittals based upon the new requirements – a GIS data layer. Linear referencing is a new component. Issues arise if a state does not have all highway attribution linearly referenced or are managing multiple referencing methods without a cross-walk.

Other Issues
During compilation of the *State Summary Report* and *Roll Call of States*, and through the course of the conference, other issues were identified for further study.

Questions were raised about measuring the effectiveness of American Recovery and Reinvestment Act (ARRA) funding. Although DOT's met many reporting requirements, the reporting value and the spending outcomes on employment were unclear.

A suggestion was made to convene a Peer Exchange concerning geospatial data for Asset Management. This is an extension of last year's issue – what is Asset Management. Perhaps a Peer Exchange could shed light on how it is being defined by DOT's and addressed by geospatial technologies.

As HPMS submittal in a new format draws near, it was asked how HPMS can be used for DOT performance measurements.

With all of the GIS web application and portal development occurring, response and page build times are an issue. Additionally, there is the complication of high performing commercial mapping sites setting expectations. How much is response time a factor in determining a web site's ease of use. What response times should be expected when building a database driven web map? A study of user experience and expectations for on-line mapping is needed.

Over the next year, the GIS-T industry will continue to assess, discuss and take action to gain knowledge and expertise in these and many other topics. Rapidly changing technology, data standards, expanding customer bases, and limited resources are just a few of the challenges to be met.

The 2010 GIS-T Symposium

Symposium Background
The GIS-T Symposium is sponsored by AASHTO and is affiliated with the Highway Engineering Exchange Program (HEEP), the Urban and Regional Information Systems Association (URISA), the Federal Highway Administration (FHWA), the Federal Transit Administration (FTA), Transportation Research Board (TRB), National Association of Regional Councils (NARC), American Metropolitan Planning Organizations (AMPO), U.S. Department of Transportation, Research and Innovative Technology Administration, National Association of Regional Councils and the American Society of Photogrammetry and Remote Sensing (ASPRS). The Symposium originated to provide:

- education
- information sharing with other transportation agencies
- exhibitor displays of new and current technology
- information for individuals who are facing similar problems in other transportation organizations

The Symposium is managed by a Task Force and organized by a Planning Committee. The Task Force is a seven-member group representing DOT's by the five (5) AASHTO regions, FHWA, and AASHTO. The Task Force members are also Planning Committee members. The Planning Committee is a larger group comprised of subcommittees for each of the Symposium organizing tasks, such as program development, moderators, local arrangements, technology hall, workshops, registration, publicity, student paper, emerging issues, *State Summary Report*, *Roll Call of States*, poster session, and web. This year's Symposium continued the focus on opportunities and issues of applying GIS technology to the business of transportation agencies.

Symposium Structure
The Symposium registration started on Sunday morning, April 11, 2010. The registrant demographics were 301 total attendees, from 39 states, the District of Columbia, Abu Dhabi in the United Arab Emirates, and Canadian Provinces (attendees and vendors from Ontario, and British Columbia).

A General Symposium Schedule is found in Appendix C.

Workshops were conducted on the Sunday before the Symposium start. This year, six half-day workshops were held. A Sunday evening technology hall reception signaled the Symposium kick-off. Twenty-five (25) exhibitors; including software companies, consultants,

and data and equipment suppliers were present. The technology hall exhibits were available through Wednesday; a second technology hall reception was held Monday evening.

The formal Symposium started Monday morning with welcomes from Hussein Elkhansa, West Virginia Department of Transportation Geospatial Information Section Head and GIS-T 2010 local host, Paul Maddox, Jr., Secretary of the West Virginia Department of Transportation, and Tom Smith, FHWA's Division Administrator in Charleston, West Virginia. The welcomes were followed by the keynote speaker.

The GIS-T 2010 Symposium keynote speaker was Mr. Carl, "Chuck" Kinder, Jr. Mr. Kinder played football at West Virginia, rose to the rank of Lt. Colonel in the U. S. Army, served in the West Virginia State Auditor's Office as Director of Training, and is a 2004 recipient of the "Distinguished West Virginian Award."

Mr. Kinder used personal and professional life stories from West Virginia to make several points about being productive inside and outside the professional life:

- Teams are made up of different people with different talents all bringing different perspectives. The key is to recognize the individual talents and then put them in the best position to succeed.
- Be observant and willing to learn from others. They are solving or have solved many of the problems we encounter.
- Identify diamonds in the rough and then utilize them.
- Be thankful for even the little things

Mark Sarmiento, of FHWA, next presented the *State Summary Report*. The *State Summary Report* (GIS-T Activities) section begins on page twelve (12). The *Roll Call of States* with other transportation agencies followed. The *Roll Call of States* is a tradition that provides an opportunity for a representative from each agency to introduce himself or herself and any other delegates from the agency. Each state was called alphabetically starting with the 2010 host state. Roll call allows all attendees to connect faces with names and helps people to make contacts and initiate conversation over the course of the Symposium. Van Colebank, AASHTO Region 2 Representative and roll call facilitator, challenged participants to use the roll call information to introduce themselves to others with similar interests. Copies of the *Roll Call of States* and *State GIS Contacts* can be found as appendices A and B in this report.

Monday afternoon consisted of two paper sessions with four concurrent technical tracks each.

A GIS Gallery exhibit displaying posters from transportation related agencies started with a session Monday evening before the technology hall reception. The session provided an opportunity for organizations to share their techniques and applications with peers in the GIS-T community. Attendees were able to vote on their favorite poster for the People's Choice Award. Additional awards were presented based on formal judging. The award recipients are listed on pages seventeen (17) and eighteen (18). Posters were exhibited for the duration of the Symposium.

Tuesday morning started with a panel discussion, "How Transportation for the Nation Benefits Me?" moderated by Patricia Solano, Koniag Technology Solutions and Rich Grady, Applied Geographics, Inc. Panelists were:

- Steve Lewis, US DOT, GIO
- Ron Vaughn, Federal Highway Administration
- Randy Fusaro, U. S. Census Bureau
- Dan Widner, National States Geographic Information Council

The discussion included a presentation from each of the panelists answering the question "What does TFTN mean to me?" TFTN refers to a collaborative effort to support the development of a publicly available transportation data set that would support each state's Spatial Data Infrastructure (SDI) and the NSDI. These panel members are active stakeholders in the pursuit of achieving TFTN. Each panelist talked about who are stakeholders, how TFTN would work, and the promotional and marketing efforts. The vision is a bottom up effort beginning with the locals, through the states TFTN. However, key differences in the panelists were also highlighted including maintenance procedures, crowd sourcing, authoritativeness, routing capability, and the private sectors role. Following the presentations, the audience was afforded time to ask questions and discuss issues.

A second panel was convened after the first. Those panelists were:

- Tammy Lang, Colorado DOT
- Skip Parker, NAVTEQ
- Melanie Seigler, Virginia DOT
- Dave Blackstone, Ohio DOT

The second discussion included a presentation from each of the panelists. A wider range of opinions were expressed by this panel. Each noted opportunities presented by TFTN and that local 911 call centers were the biggest beneficiary. The DOT's noted that without mandatory participation requirements, resources would not be dedicated to TFTN. Additionally, the private sector essentially has built TFTN, but licensing issues remain uninvestigated. Other notable comments: the federal government's ineffectiveness between agencies on enterprise GIS efforts and the varying degrees of local and regional GIS capabilities. Following the presentations, the audience was afforded time to ask questions and discuss issues.

Two more paper sessions with four concurrent technical tracks each were offered through mid-afternoon.

Tuesday's formal activities ended as the *Emerging Issues Forum* panel session explored TFTN 'like' efforts underway, particularly regarding homeland security. Jim Mitchell, of the Louisiana Department of Transportation and Development, assembled and moderated the session. The panel was comprised of stakeholders:

- Joe Hausman, Federal Highway Administration
- Mark Fiorentino, TeleAtlas
- Randy Fusaro, U. S. Census Bureau
- Raquel Wright, Federal Railroad Administration
- Costa Tudan , Department of Homeland Security

The primary speaker was Costa Tudan, Data Management Lead, Infrastructure Data Management Branch, Infrastructure Information Collection Division, Office of Infrastructure Protection, in the Department of Homeland Security.

Mr. Tudan discussed the Homeland Infrastructure Foundation Level Working Group (HIFLD). Its purpose is to aggregate information for a consistent operational picture addressing any activity related to national response. HIFLD also is charged with producing a national Homeland Security Infrastructure Program (HSIP) data set anyone can use.

HSIP has multiple levels of access, HSIP Freedom, is available publicly. HSIP Gold has restricted access. Only natural disaster locations are qualified to receive HSIP Gold. One unresolved issue is the definition of critical infrastructure. Locally deemed critical infrastructure is not necessarily viewed as critical at the federal level.

Wednesday morning's schedule consisted of two paper sessions with four concurrent technical tracks each.

During lunch, awards were distributed, individuals who contributed to the symposium's success were acknowledged, and door prize drawings were held.

The afternoon featured a Wrap-Up session, where the Symposium is "debriefed" by all interested attendees. This is where the Symposium is critiqued and ideas for next year's Symposium are first discussed. Discussions are organized topically and facilitated by the GIS-T Task Force Chair and key planning committee members. The topics covered were Workshops, Program, Panels, Key Note, Moderators, Technology Hall, Vendors, Emerging Issues, Student Papers, GIS Gallery, State Summary, and Roll Call.

Additional information for future Symposiums is derived from evaluation surveys. The surveys capture scores and opinions about all plenary, breakout, and social activities.

Workshops

Seventy Nine people signed up for workshops at the 2010 GIS-T Symposium. There were six half day workshops offered. TRB held a peer exchange on asset management in conjunction with the Symposium this year. Building upon that theme, we offered two workshops related to asset management.

MORNING SESSIONS

Workshop 1: GIS Technology, Interoperability and Asset Management

Instructor: Simon Lewis, AgileAssets

The vision for GIS has been as a data and application integrator. However, while at times achieving this goal, GIS can also act as an agency stove-pipe. GIS data is shared, but not as universally as it should. Transportation agencies run duplicate code to meet similar ends, with increased costs and sometimes varying results. Is the agency getting its full return on investment from it expenditures on GIS data and technology? Agency LRS update efforts to date have not always been successful -- why is this, and where is LRS best supported?

This workshop reviewed the different technical options for interoperating GIS and other transportation applications. It provided an agency check list for "agency GIS interoperability health". A number of best practice case studies of interoperating GIS and PMS, MMS, Safety, Bridge and other applications were provided.

 This workshop focused first on technology options. It is thus a complement to that offered by the Symposium in the afternoon, which focused more on aspects such as transportation asset strategy, data collection, GASB 34, etc. The workshop drew on the results of 2 years review undertaken by the Philadelphia Area Transportation GIS SIG, as well as work on IT best practices and successful transportation agency case studies from across the US." This workshop was signed up for by thirty (30) people.

Workshop 2: Introduction to Agile: Project Management & Development

Instructor: Allen Ibaugh, Data Transfer Solutions

Winkipedia describes Agile software development as "… a group of software development methodologies based on iterative development, where requirements and solutions evolve through collaboration between self-organizing cross-functional teams."This Agile Workshop was divided into two 2-hour sessions. The first session addressed agile project management practices and the second session covered agile software development and engineering practices. Both sessions provided general overviews of agile practices as well as discussions about the practical applications of each in a GIS software development environment.

The first part of the workshop was dedicated to discussing agile project management practices. This session included an overview of what agile is and how it differs from other more traditional development methodologies. It demonstrated how agile practices are used to manage scope, estimating project sizes and duration, and monitoring project task progress. Most importantly, it addressed the collaborative nature of agile practices in terms of managing client expectations, managing change, and ensuring the delivery of value to customers quickly and effectively. This session was appropriate for project manager as well as the development staff since it covered the foundations of agile practices for all team members.

The second half of the session focused on providing an overview of agile practices for software development and engineering. This session provided an overview of the Extreme Programming (XP) practices that are useful for agile development teams. This session was technical in nature and probably most appropriate for development teams. For project managers, it provided a basic understanding of how agile development practices differ from traditional development methodologies." Fourteen participants signed up for this session.

Workshop 3: Using LiDAR Project Data for Transportation Applications

Instructor: Chris Markel PA Dept. of Conservation & Natural Resources, PAMAP Program

This LiDAR Workshop focused on the use of LiDAR data for transportation applications. Thus, the workshop was centered on the use of airborne LiDAR data, and still touched base on the uses of mobile LiDAR mapping. Statewide LiDAR data projects have been completed in several states and are underway in many more. In addition, federal agencies such as the USGS and FEMA are encouraging and providing funds for large LiDAR acquisitions. This

large amount of available data can be very useful for GIS-T practitioners in a wide variety of disciplines, and the workshop will help attendees to understand what they can do in their own locations. The workshop was based largely on the Pennsylvania's PAMAP experience and discussed how the PAMAP data is used by PennDOT and others. However, experiences from other areas and practices were used and the attendees were able to apply the lessons to their own available data stores. The content is presented in outline form below.

1. **Statewide Programs and what they mean for transportation**. Discussion of statewide or other large-area LiDAR acquisitions, their status, what their purpose is, what the funding possibilities area.

2. **Data Particulars and Specifications**. What data is being acquired? What format? What are the specifications and accuracies? What exactly is the point cloud?

3. **Derived Data**. LiDAR projects usually include data processing to produce derivative products such as digital elevation models (DEM), contours, or digital surface models (DSM). What are the characteristics of these data products? How can they be used for transportation applications?

4. **Transportation Applications**. What has LiDAR data been used for? Examples of use for transportation applications such as identification of potential landslide areas, visualization, road modeling with elevation, etc.

5. **LiDAR Software**. What software products are available to use LiDAR data and derived products? What are the characteristics of the software? Demonstration of using LiDAR data by a software vendor or services provider for a particular application.

6. **CAD Environment**. What can be done with the data in the CAD/design environment? What software might be needed? What system requirements must be addressed? Demonstration of using LiDAR data in the design environment by a software vendor or services provider for a particular application.

7. **GIS Environment**. What can be done with the data in the GIS environment? What software might be needed? What system requirements must be addressed? Demonstration of using LiDAR data in GIS software by a software vendor or services provider for a particular application.

8. **Mobile LiDAR Mapping**. Discussion of mobile LiDAR, equipment used, data acquired, and applications. Current and potential uses of the data. Considerations of this platform for the future.

Thirty participants signed up for the LiDAR session.

AFTERNOON SESSIONS

Workshop 4: Let's Focus on Census Geography

Instructors: Ed Christopher – FHWA Resource Center & Michael Ratcliffe Chief, Geocartographic Products and Criteria Geography Division U.S. Census Bureau

Sponsored by the Census Transportation Planning Products (CTPP) Program

April 1, 2010 marked the 23rd time that the US population has been counted. As part of this process a variety of activities take place that affect those responsible for the geographical construct of the data. For example, new Urbanized Areas (UAs) will be defined, Traffic Analysis Zones (TAZs) constructed and Public Use Microdata Areas (PUMAs) built. During 2009, The Census Bureau developed new rules for defining urban area boundaries, Traffic Analysis Zones and the Public Use Microdata Areas.
Coupled with this, new Topologically Integrated Geographic Encoding and Referencing (TIGER)/Line shape files were released. In this workshop, participants received a general overview of these and other Census geographic information files as well as learning where to get and take home valuable resources.

The Census session was requested by thirty (30) participants.

Workshop 5: Iowa's Multi-level Linear Referencing System and Response to Minnesota's LRS RFI

Instructors: Eric Abrams (GIS Coordinator Iowa), Steve Kadolph (LRS Technical Expert,Iowa), Ryan Wylie (GIS Quality Administrator Iowa), Matthew Koukol and Thomas Martin (Minnesota DOT)

This workshop included an introduction to Iowa's Linear Referencing System (LRS), the NCHRP 20-27 Model Architecture, the AASHTO Technology Innovation Grant (TIG) Project and what Iowa and other lead state teams can do for other states under the TIG grant.

Part of the workshop showed how Minnesota's business requirements (producing a log point listing showing both business data and linear location) were accomplished. Minnesota's location data was entered into the Iowa LRS and then LRMs in this system were used to show both business and location information in a log point format.

This workshop included an introduction to Iowa's Linear Referencing System (LRS), the TIG Project and the NCHRP 20-27 Model Architecture. The discussion of Linear Referencing Methods (LRMs) covered how they are used by business data, the LRS including its components and what is required of business data to use these LRMS to give business data a common spatial location. Iowa demonstrated their LRS maintenance tool with an emphasis on quality control, change propagation, and business rules.

We showed how Iowa responded to Minnesota's Request for Information by leveraging their LRS to add the Minnesota data to the Iowa LRS data. The workshop demonstrated how LRM transformations were run to stage the business data against the added Minnesota LRS data including the temporal components (route changes, deletions, etc. over time). The creation of new business data was made by leveraging the Minnesota LRS data, staging the Minnesota business data against their LRS data, and finally creating a log point listing of that business data by using the Linear Referencing System. The MLRS session attracted twenty-six (26) students.

Workshop 6: URISA Certified Workshop - Asset Management: Planning, Strategy, and Implementation

Instructors: Allen Ibaugh, Data Transfer Solutions

Public and private agencies face continuous challenges to accomplish more with less as increases in demand, regulatory requirements, infrastructure deterioration, and political and economic forces have significantly outpaced increases in capital and operating budgets. Many of these agencies are turning to Asset Management to cope with these challenges and improve business performance and effectiveness. This workshop focused on several aspects of developing an asset management system that could help improve performance, reduce long-term costs, and maximize return on investment in infrastructure assets.

Specific topics included:
- Strategy and Planning
- Data Collection Methods
- Software Solutions
- Information Management and Decision Support Tools
- Evaluation and Performance Measures
- GASB34 Reporting
- Life Cycle Costs

Intended Audience:

This workshop was intended for utility, transportation, engineering, planning, and environmental managers and analysts of the public and private sectors.

Twenty participants selected this workshop.

State Summary Report

This is the fifteenth (15[th)] year that the GIS-T Symposium has conducted a survey of GIS activities at State DOT's. The survey was administered using a web-based survey instrument. The survey's purpose is to inventory the current state of practice, identify potential needs, and discover wide ranging topics for discussion. The result was a surprising ninety-eight percent (98%) response, with forty-nine (49) states and the Commonwealth of Puerto Rico submitting. The responses were up from eighty percent (80%) in 2009.

Five new questions were added this year to address the emerging issues facing State DOT's:
1. Does your agency plan to submit your GIS road network for use in HPMS? If so, which roads will be submitted?
2. Is your GIS road network routable?
3. If your GIS road network is routable, do you plan on submitting the routable network as part of HPMS?
4. Does your agency work with neighboring states/agencies to connect GIS road networks at the borders?
5. Does your agency share a GIS road network with State's E911 system? If not, do you plan to do so in the future?

GIS Organizations Structure and Development Stage

A majority of the States (41%) report having an organizational structure consisting of a GIS core unit, providing technical support to a much larger group of end-users throughout the agency. The equally prevalent structure (41%) is an "enterprise" GIS organization with agency-wide data integration.

The organizational location of GIS core units are evenly distributed between Planning (42%) and Information Services (37%) with 21% reporting other locations. Even in those States that have instituted an enterprise GIS, there is no significant difference in where the GIS core unit is located. Seventy-two percent (72%) report a core GIS staff size between one (1) and ten (10).

Eighty percent (80%) of the States responded that at least one staff member have a geography or a cartography background, sixty-two percent (62%) of States reported having staff with an information technology or computer science background. Thirty-five percent (35%) of the States reported having a certified GIS professional on staff. However, only six (6%) of respondents claimed certification was an important hiring consideration. Certification importance in hiring is down from twelve percent (12%) last year. However, those not sure of its hiring relevance was thirty-five percent (35%).

The allocation of GIS staff time across core functions shows an emphasis on road base map development and enhancement (22%). LRS maintenance and GIS technical support and training were second at seventeen percent (17%) each. The latter is evidence of the Roll Call of States indicating many were working on enterprise issues and support. These results are similar to 2009.

On average, respondents outsource less than thirty percent (30%) of their GIS application development work. The majority spend less than $500,000.

GIS Software

Respondents were asked to identify what software products were used for GIS analysis and web mapping by core and user staffs. Twelve (12) separate products from six (6) different vendors were identified. The most widely used products are from ESRI® in both core and distributed user groups; Bentley Microstation® was also prevalent. To a lesser degree states cited Intergraph® and Caliper® products and finally, AutoCAD® and MapInfo®.

Most States use commercial relational database management software (RDBMS) in combination with GIS software to manage their geo-spatial data. Oracle® is used by fifty percent (50%) of the States, either alone or in combination with other database software. Other commercial database software used by the States includes SQL Server® (34%), and Microsoft Access® (10%). The use of both Microsoft® products is down significantly from 2009.

ArcSDE® at sixty-two percent (62%) and Oracle Spatial® at thirty-five (35%) are the principal software packages used to manage the geo-spatial attributes in enterprise data warehouses. These numbers are relatively unchanged since 2009.

The reader should note that software questions permitted multiple answers from the same responder.

Web Applications

Questions were asked pertaining to web application development and costs. States' expenditures in this arena are wide ranging in the areas of hardware, software, services, data, and other needs.

Like the GIS desktop tools, the ESRI products represent a large percentage of deployments.

Road Centerline Networks and Other Geo-Spatial Databases

A key component of most transportation GIS activities is the road centerline network database. All States reported that they maintain a digital road centerline database. Both the spatial accuracy and coverage of these databases continue to improve. Fifty-eight percent (58%) of the States report that their road centerline databases have a spatial resolution of 1:5,000 scale or better. Much of the improved accuracy has been achieved through the use of high-resolution orthoimagery and/or kinematic GPS. With respect to coverage, seventy percent (70%) of the states report that their road centerline database includes all public roads; this is up from sixty percent (60%) in 2009. Twenty-one percent (21%) include only state and county routes; this is a drop of ten percent (10%) since 2009.

The majority of states (88%) distribute their transportation feature databases. Sixty percent (60%) distribute free of charge to whoever wants it. Most other States (30%) have policies that allow the data to be shared with other public agencies, but place restrictions on its use for commercial purposes and/or redistribution. Sixty-two percent (62%) reported having formal data sharing agreements with public or private entities. Ninety-six percent (96%) of states are fully or partially involved in state GIS coordination programs.

States were asked if they maintain any other statewide geo-spatial data layers, beyond the road centerline database. Many states responding reported that they also maintain some other geo-spatial database, generally other transportation networks or features, such as rail lines or airports. Other "framework" geo-spatial data maintained by State DOTs include political and administrative boundaries (51%), geodetic control points (42%), and ortho-imagery (25%). State DOTs are less likely to maintain other framework layers such as water features (21%) or elevation (20%).

Over half the respondents (51%) claimed they were not working with their neighboring states on geospatial matters.

Sixty-six (66%) percent of responding states reported including some local source data as a component of their roadway transportation data set, up slightly from 2009. Meanwhile, sixty nine percent (69%) do not include commercial data as part of their transportation network, down slightly from 2009.

Benefits and Costs of GIS Applications

Several questions introduced in 2006 regarding the perceived benefits and costs of geo-spatial technology were asked again in this year's survey. Enterprise data integration continues to be cited by most states as yielding the greatest benefit (62%), but unlike last year, not quite the most difficult and costly to implement. The honor goes to Asset Management in 2010. Last year, Asset Management was cited twenty-five percent (25%) less than Enterprise data integration. However, Asset Management was selected as the business where geospatial technology adds the most value.

Current Activities

Respondents were asked to list up to four of their current GIS activities for the *Roll Call of States*. Listed activities were grouped into similar categories and then ranked based on the number of times that they were cited by the respondents. Table 1 lists those GIS activities cited five or more times by the State DOTs. New to the table for 2010 are HPMS, GPS/Field/Mobile, and Asset Management. Falling off the list from 2009 were Project/Construction Management, Safety/Crash Analysis, Ortho Imagery, Video Log Integration, and Traffic Counting.

GIS Activity (Categories with at least 5 citations)	# of Citations
Enterprise applications	16
Development of web-based GIS applications/Portals	15
Migration to new GIS software / hardware	11
Road centerline database development / enhancement	10
Location referencing system	10
HPMS 2010	9
Asset/Pavement Management	8
Road inventory management	8
Roadside features / activities	8
GPS/Field Collection/Mobile	6
5-1-1 / Emergency Operations	6
Environmental / cultural analysis	6
Mapping / base maps	5

Table 1 - High priority GIS activities at State DOT's

The top three items on the list are all enterprise related. They imply GIS involvement in many areas of the business enterprise wide. The development of web based applications and portals, both Intranet and Internet, reflect the use of GIS for transparency, and data access and integration. Migrations to increased computing power and the latest technology are indicative of increased use and positions GIS for enterprise implementations.

HPMS appeared in smaller than anticipated numbers, could mean timing is involved. Last year was too early to appear on the list; this year the survey was too late. DOT's are finishing 2010 HPMS submittal preparations.

Student Paper Contest

For the fifth year, the GIS-T Symposium sponsored a *Student Paper Contest*. The contest is designed to encourage university students to develop solutions to current GIS-T issues. Students are judged on their ability to develop and document useful, original research based on GIS-T issues and to relay their research results in a complete, clear, and well-referenced paper

Eligibility Requirements were:

- The applicant must be a current enrolled student
- Only one paper contest entry per student is accepted
- Willingness to attend and present at the GIS-T Symposium

Submission Guidelines included:

- The paper was to be prepared by one author
- Be the original work of the author as much as possible (if a faculty member is listed as co-author, a letter from the faculty member confirming that the student was the primary author must be attached)
- Papers must have been submitted electronically in a sharable format
- Papers must have been written in English, utilizing good communication skills
- Paper must have been neither less than 4,000 nor more than 8,000 words (cover page and bibliography excluded)
- A cover letter from a faculty member verifying the author's graduate or undergraduate status and original contribution
- Front page included complete address, telephone, fax and e-mail information
- Winning papers presented at the Symposium and posted on the GIS-T website

Papers were judged by members of the GIS-T Planning Committee and were rated on the following categories:

- Significance of topic
- Literature review
- Data Analyses (if applicable)
- Interpretation
- Clarity of presentation
- Validity of conclusions
- Reader Interest

Two (2) entries were received. Both entries were deemed eligible and worthy. Therefore, each received an award. The two winners received $500.00, plus a symposium registration (including the social event), round trip airline tickets to Charleston, West Virginia, and four (4) nights stay at the conference hotel. The winners presented their paper at the *Student Paper Session* on Monday, April 12, 2010. Appendix D, in this report, contains the winning papers. Winning authors were:

EunSu Lee
North Dakota State University
Fargo, North Dakota

Paper: *Estimating Trip Diversion by Using Impedance Model in Flooding Regions*

Bin Mo (Owen)
California State University
Los Angeles, California

Paper: *GIS Network Analysis for Finding the Potential Metro Rail Ridership by Access Modes in Los Angeles County*

GIS Gallery

The 2010 GIS-T Symposium entries showcased the use of GIS technology to analyze data as well as cartographic skills. Posters were reviewed and the following awards given to:

Effective Cartography
- **1st Place: Michigan Department of Transportation**
  "Road and Trail Bicycle Guide"

- **Honorable Mention: City of Renton, Washington**
  "Implementing ESRI World Street Map Template"

- **Honorable Mention: Abu Dhabi Department of Transport**
  "Abu Dhabi Highways Map"

Use of Information
- **1st Place: Oregon Department of Transportation**
  "Freight Mobility"

- **Honorable Mention: Colorado Department of Transportation**
  "Intercity and Regional Bus Routes"

- **Honorable Mention: New Jersey Turnpike Authority**
  "Roadway Network"

State Official Transportation Map
- **1st Place: Michigan Department of Transportation**

- **Honorable Mention: Oklahoma Department of Transportation**

- **Honorable Mention: Colorado Department of Transportation**

<u>**Public Presentation**</u>
- **1st Place: North Carolina Department of Transportation**
  "Bridge Impact Study"

- **Honorable Mention: Oklahoma Department of Transportation**
  "Iowa Tribe Transportation Improvement Program"

- **Honorable Mention: Abu Dhabi Department of Transport**
  "Bus Routes"

<u>**People's Choice Award**</u>
- **Vermont Agency of Transportation**
  "Lake Champlain Byways Map"

<u>Concurrent Sessions</u>
During the Symposium, concurrent technical sessions were attended in large numbers.

Monday:

Linear Referencing	Student Paper
Recovery and Reinvestment Act	Highway Performance Monitoring
Web Tools I	GIS Tools I
Asset Management	Mobile GIS

Tuesday:

Enterprise GIS	Enterprise Data Efforts
Data Management & Integration	Transportation Network
GIS in Traffic Operations	Web Tools II
GIS in Resource Management	GIS in Planning

Wednesday:

Developments in Transportation GIS	Safety
National GIS Data Efforts	Integrating Legacy Systems
GIs Tools II	Data Collection
Routing	Local GIS

Symposium Summary

The twenty-third annual Symposium on Geospatial Information Systems for Transportation (GIS-T) was held in Charleston, West Virginia from April 11 through April 14, 2010. The Symposium identified emerging issues and technologies impacting the Transportation Information Technology Community. The Symposium included a selection of six (6) half day workshops; a technology hall with twenty-five (25) exhibitors; Mr. Carl "Chuck" Kinder, Jr., a 2004 recipient of the "Distinguished West Virginian Award", was the keynote speaker, *State Summary Report*, *Roll Call of States*, sixty-nine (69) paper presentations, *GIS Gallery, Student Paper Contest*, and three panel discussions complete the Symposium agenda. Appendix C in this report contains the General Schedule showing Symposium activities.

Technical papers presented at the Symposium are available along with their abstracts through the GIS-T web page (http://www.gis-t.org). The *State Summary Report*, *Roll Call of States*, *State GIS Contacts* list, and Symposium attendee list can also be obtained from this site.

GIS-T 2011 will be hosted by the Pennsylvania Department of Transportation