



Stakeholder Workshop:
Next-Generation Maintenance Model
Street Centerline Data
(*Minneapolis-St. Paul Metropolitan Area*)

Monday, September 26, 2011

Turn-Around Document

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EXECUTIVE SUMMARY

On September 26, 2011, over 20 representatives from state agencies, regional organizations, county and city governments, and private companies met at the Metro Counties Government Center in St. Paul. The purpose of the meeting was to discuss the current state of the shared need for a common, authoritative street centerline spatial dataset representing the seven-county, Minneapolis-St. Paul metropolitan area, which at some point could grow to include the entire state of Minnesota. During the workshop, present day issues were discussed and small group breakout sessions brainstormed potential systemic solutions that could be implemented in the near term, but would remain effective for the next 10 to 15 years.

This document is a compilation of workshop presentation, handouts, discussion notes, potential model documentation, and project-to-date material gathered from participants and distributed as pre-reading guidance.

Overall, consensus was reached that the current model is not sustainable and cannot support the current and emerging needs for shared centerline data. The group endorsed a vision that calls for transitioning from the current solution in which NCompass' proprietary street centerline dataset is licensed to a system that involves a federated, public-domain, transaction-based, collaborative maintenance model.

Each of the three breakout groups independently focused on different aspects of accomplishing this vision (technical, policy, and procedural). During the review of breakout session presentations, the group concurred that much of the material from all groups could be used to pursue the development of an integrated system of software applications, data workflow processes, organizational commitments, and dedicated authoritative data ownership with shared update responsibilities. All concurred that a federated, transaction-based, maintenance model for road segment identifiers would support current and future initiatives to address multi-modal routing functions and other data needs within roadway right-of-ways.

The idea of a system emerged at the workshop which the participants agreed should be further developed and serve as the foundation of the entire street centerline data management system. It involves assignment, by the assigned Road Authority¹, of a unique segment identifier for all road segments that reside within the system. It was agreed that having a known authoritative identification number, which could be included in all derivative datasets, would not only enable updates from multiple sources to be applied to the master file, but would also enable effective peer-to-peer communications between organizations who need to share road related information and associated attributes ranging from first responder dispatch to roadway maintenance and highway funding distribution.

It was agreed that the next step would be for the project consultant to propose a work plan, generally tackling two key objectives, to the extent possible, simultaneously:

- 1) Build the technical infrastructure and related policies and practices to create a “hub of communication” for identifying and sharing information about street centerlines.
- 2) Develop a strategy to transition from the current proprietary street centerline dataset, owned by NCompass Technologies and endorsed by MetroGIS as the Regional Street Centerline Dataset, to a public domain dataset consistent with the desire for a federated, transaction-based, collaborative maintenance model.

¹ The next phase of this study will include researching Mn statute for official definitions of “Address Authority” and “Road Authority”. For planning purposes, the following distinction is made: “Road Authorities” are responsible for the design, creation and maintenance of a road/street. “Addressing Authorities” are responsible for approving street names and property addresses.

WELCOME AND OVERVIEW

At 9:00 a.m. Randall Johnson, MetroGIS Staff Coordinator, introduced himself, welcomed the participants and thanked them for agreeing to participate in this workshop.

He briefly explained that the results of this forum are intended to frame options guide decision-making concerning how the MetroGIS community might go about transitioning from the current private sector owned regional street centerline data maintenance model to a federated and transaction-based model involving local road authorities contributing data on a transaction basis, as roads are added or data about existing roads is modified. He explained that although the current model has served some stakeholders well that the lack of a public domain model has also resulted in issues that have hampered progress to achieve a coordinated single systematic solution that minimizes costly duplication of effort.

Johnson closed his introductory comments by the stating this workshop is sponsored by MetroGIS to get into the issues and attempt to design a conceptual foundation for next-generation maintenance model that works for the broad stakeholder community. And in the coming months, this foundation would be used guide development on an actual model for testing.

In his closing, Johnson encouraged the participants to ignore the current organizational structure when offering a solution for it is highly possible that the needed structured most likely does not currently exist.

Johnson introduced Andy Buck, with AppGeo and the workshop consultant, who began his comments by asking each of the participants to introduce themselves and briefly comment on how street centerline data is used by their respective organizations. (*Editor's note: Following the workshop, each member was asked to offer a 1-2 sentence response to include in this document.*)

Buck then provided a brief summary of the day's program and summarized the current situation as he understood it based upon interviews over the summer with several major stakeholders to provide context for exploring issues and opportunities the remainder of the day.

Note to the reader: the presentation slides used to transition from one segment of the program to the next are presented in Appendix B.

DESCRIBE THE CURRENT CENTERLINE DATA SITUATION AND CONFIRM AND EXTEND THE STAKEHOLDER ISSUES LIST

Buck commented that many organizations representing the room began using street centerline data work with NCompass' (formerly The Lawrence Group's) data but over time added value for their internal business needs which has resulted in numerous derivative products exist and are proliferating, broad questions of who owns what, and no "single original source" to streamline the update process. He also mentioned that MetroGIS's efforts toward a regional address points dataset are germane to the concept for a transaction based next-generation street centerline dataset.

With the question "is there sufficient common ground to move to a transaction update model", Buck asked the participants to comment on the major issues that he had gleaned from the pre-workshop interview, in particular, has anything been overlooked, not satisfactorily explained. Does it make sense to deal with as one file or should some data needs be addressed through derivatives?

1) Needs to be multipurpose: Is there a practical way to solve this need?

R. Morey: Mn/DOT State Aid has a business need to determine # of miles within a jurisdiction, so does there need to be a node at the jurisdiction boundary?

Centerline of road: is it the ROW or pavement? Some groups need one, some the other.

Knippel: Scale-dependent cartographic issues, e.g., single- vs. double-line roads; are they physically separated?

Logman: Licensing hampers access by organizations outside of government. Also, derivatives make it difficult to determine the authorize source.

Swenson: Need to know left-and-right of each road segment, e.g., for voter precinct-finding apps

Buck: The situation is becoming more complicated due to next-gen 911 – when multiple spatial datasets are needed. What is the update process for that data? The worst case is critical related data are not synchronized.

2) Data Standards:

Issue: many standards. Critical need, how best to translate segment IDs between systems. Possible to have a common ID? Could be a solution if the different must remain intact. Could FGDC standards work? Do they meet every ones needs?

Need street data for non-metro areas that works with metro area data, including for Wisconsin. It was recognized that the current NCompass dataset includes data for 27 counties in Minnesota and 3 in Wisconsin.

Logman: Asked if we are talking about a regional solution that can be part of the statewide solution? Johnson responded yes noting that a MetroGIS guiding principle since its inception has been to think of itself as part of something bigger – that its solutions are intended to work interoperability with similar solutions implemented for the areas that surround the metro area counties, including Wisconsin in accordance with the vision of National Spatial Data Infrastructure (NSDI).

3) Timely Updates:

Johnson: NCompass currently provides quarterly updates under agreement with the Metropolitan Council because the Council does not have need to have more frequent updates but the agreement provides for monthly and weekly updates provided another organization(s) pay the additional fee. The total amount of modest additional fee over a five year period (\$9,117 and \$18,234, respectfully) was shared with the group. Several participants, who are current licensees of the NCompass dataset, mentioned that they were unaware this opportunity was available. They had not seen the notice that was sent to all past licensees when the new agreement went into effect this past January.

Chinander: Need road data much earlier in the road lifecycle than is currently received - once cities permit construction to begin and before plats are approved, before ground is broken. Need updates earlier too – some preliminary roads never get built or they are changed from the initial plans. Generally long before final plats are recorded and plat data are integrated into county datasets.

Weinberger: Concur that the federated, transaction based address point data update concept that MetroGIS is pursuing could apply to street centerline data as well.

Charboneau: NCompass currently works closely with schools and cities to capture street centerlines before final platted because services begin before final plats are recorded.

Knippel: Dakota County maintains it own street centerline dataset and currently and it is not costly to update. Talking about taking on risk to rely in someone else to update the data. If we elect to permit someone else to perform this update function how difficult to transfer to another provider in the future?

- Knippel: A couple cities are maintaining street centerline data separate from the County for the same reason that some counties are maintaining the data separately from the NCompass dataset – the NCompass dataset does not meet all of their needs.
- Buck: The issue of who the authoritative data owners are needs to be sorted out to migrate from current situation of numerous datasets, some of which have been derived from the NCompass dataset. Licensing will need to be sorted out to migrate to a single source of core data.
- Koukol: Mn/DOT has attempted a test a coordinated update system with Olmsted County. The test raised tough issues, more complex than had been anticipated even with cooperating partners didn't find a solution to each having a different definition of roads. Challenges occur even with a unique identifier. Reaching agreement on a standard approach will be a challenge.
- Brandt: Need to include a feedback/corrections loop to the system design.

General discussion about sources for update ensured – combination of imagery, schools and local producers. The group concurred that trust and reliability would be improved if the base was maintained in one location.

The group recognized the community has a big investment in existing datasets, so we're not beginning starting from scratch but also hard to give up control of data. Local producers raised a concern for incurring risk by using data produced by others. What factors would make the cities/counties want to give up the total control?

Concerns mentioned that that will need to be overcome involved: How stable is the provider? How much should an organization rely on an outside authority, especially a private sector one? Or even the state, given the state shutdown? Can we change the provider once they're chosen? Reliance on a single private sector vendor, assuming they have an ownership position, makes it difficult to transfer to a new vendor. This comment led to conclusion that the source data needs to be maintained in the public domain with the understanding that the private sector could be contracted with to manage the update function. The group also recognized that a cost benefit analysis of maintaining total control versus participating in a collaborative solution may be needed to decide the solution that is best for a particular organization.

The group wondered if the data could be effectively maintained by a single entity. The group also recognized the need to decide whether better to create a mechanism to share core data or would sending a variety of road related data to an aggregate custodian make sense to enable broadly share information to meet a variety of needs?

Charboneau: NCompass is open to a new model where they do not own the data. Cost would be involved.

Logman: Different needs in a different environment. What is transferable and what is not, level of responsibility from state to federal. Access to the data – transactional or public data. Additional layer to licensing issues. Growing demand and need by multiple entities and agencies.

Bitner: What else could we be doing to get data from the private sector (realty community) and 911 support to obtain data inputs.

Chinander: Street signage often doesn't match official street names.

Buck: What exactly is needed for a trustworthy dataset? It must be defined well. Does the community have a good understanding of who the Road Authorities are? Need to work closely with the Road Authorities to obtain timely updates and to resolve discrepancies discovered in order to maintain trust in the data. Need to get the changes applied to the derivative also applied to the source data.

Verbick Issue with who is the authoritative source. City staff (e.g., an engineer) thinks a road is in the wrong place, asks GIS technician to move it, and the change replicates throughout the system without any real checking or notification of anyone else.

Another example someone moves the centerline and it becomes the standard for police, trickles from one group to another and keep on going. How do you deal with the bottom up changes? And someone notices that change on a state level and disagrees. How do we address?

Gelbmann: We are talking about a “system” not just a “dataset”. It has data flows, an integrated process.

Isackson: Is there a tipping point where letting go of some local control is perceived as being more valuable to organizational efficiency? E.g. thorough partnering, accomplish investment now via routing-related improvements that cannot be accomplished on own.

Logman: Access to the street centerline data should be readily available to the public. How to move effectively to the NSDI vision with public and private sectors collaborating on maintenance and both having access.

Group: Don’t just focus on unmet needs and potential problems. Include benefits to different groups from having a more common solution, e.g., different groups such as counties, cities, Mn/DOT, could talk more clearly to each other; unified way to share resources.

Collectively, a common solution would be well worth it. But transition is hard and projects are always cheaper to do oneself (not all agreed with this). Needs an educational / outreach effort. Benefits are not going to happen immediately. Changes should go back to source so same data problems don’t keep resurfacing. Common definitions will need to be agreed upon.

4) Road Status

Concurred there is a need data for the range of statuses from designated, design approved (preliminary plat approval and basis of breaking ground) to built.

Johnson: Explained that the concept of creating a system by which local producers could provide “cartoon” data when preliminary plats are approved to be used as a supplement to built roads has been part of the MetroGIS vision for street centerline data for several years. He also mentioned that the current MetroGIS Address Points Editing Tool project will hopefully provide insight into how to act on this vision.

Norton: Confirmed that utilities need street location data at the preliminary plat approval phase.

Group: Who owns what? Example – Private access roads to malls? Who is the authority for getting this range of data into a system?

5) Attributes

MnDot could serve as steward for the entire state but cannot store all of the attributes maintained by others. Is there a systematic approach that allows these data to be stored in a common manner in which they can be shared between organizations?

6) Multiple Reference Systems:

How best to define. Is there a common definition? Where and how do address points fit in? Need an integrate system. Possible?

7) Road Names

How best to deal with nuances (aliases)? Is relational database design appropriate?

8) Jurisdiction:

Gaps in the data. Different update cycles. Who has jurisdiction for private roads (e.g., mall ring roads, apartments, mobile home complexes, internal system on corporate campuses)?

9) Incomplete Participation:

Differences in access policies will need to be resolved before complete participation. Some producers may elect to continue to concentrate on local needs – interoperability with adjoining areas not recognized as a need. If required to collect and manage data for roads to provide to a regional or state system, can expect some may require reimbursement since not seen as a local need. Keep in mind there will always be outliers.

Gelbmann: Need to articulate benefits to be gained from working together with counties, cities and MnDOT – benefit of a standardized approach to their internal operations. It's not just the funding, but benefits of a unified method. Gaining agreement on the content of a standard dataset will be critical. If work process improves, there is a benefit. System designs would help standardization and process. The big question is how to go about analyzing the benefit?

Knippel: Always cheaper for their own, there will always be someone who has to pay more and time consuming. Cost savings are in the long term but the costs in the short term will be higher. But concurs that a need exists to work toward a solutions where all are on the same page – politicals and staff.

Buck: Understanding the data creation, update, and distribution workflow is another set of issues. Each organization maintains a mandate until one or more formats are merged and promoted to establish a standard. What are the elements of a standardized system for centerlines? Are we looking at an aggregate model, a distributed model, or another alternative?

Prior to the break, Buck led a short discussion in preparation for the breakout sessions in which he asked the group to think about how crowd sources might become part of the solution.

Bitner: If we get to a point where everyone is calling a segment the same thing and change notices are routinely published, then the necessary feedback loops are engaged.

Chinander: Road authorities (those with authority to add and modify official road data –e.g., names, address ranges, etc) need to be in the loop-

Knippel: Think in context of what other organizations are planning to do in the next couple of years, e.g., Google, TeleAtlas, OpenStreetMap, national efforts.

At Johnson's suggestion, Buck closed the morning session with an overview of his work on the Transportation for the Nation initiative (TFTN) and how some of those lessons learned are expected to draw upon, in particular the consensus based model.

REFRESHMENT BREAK

The group took a break from 10:30 to 10:45 a.m.

BREAKOUT SESSIONS TO BRAINSTORM ALTERNATIVE MODELS

Each of the participants was pre assigned to one of three breakout sessions to ensure broad diversity of organizational perspective in each group. A recorder was assigned to capture the work of each group. See Appendix C for the breakout group assignments. The groups worked from 10:45 until around noon to develop a recommended course of action to address a series of questions provided by Buck. These questions were listed on a slide (see Slide # 7 in Appendix B) that was left up for all to view during the exercise.

LUNCH AND BREAK

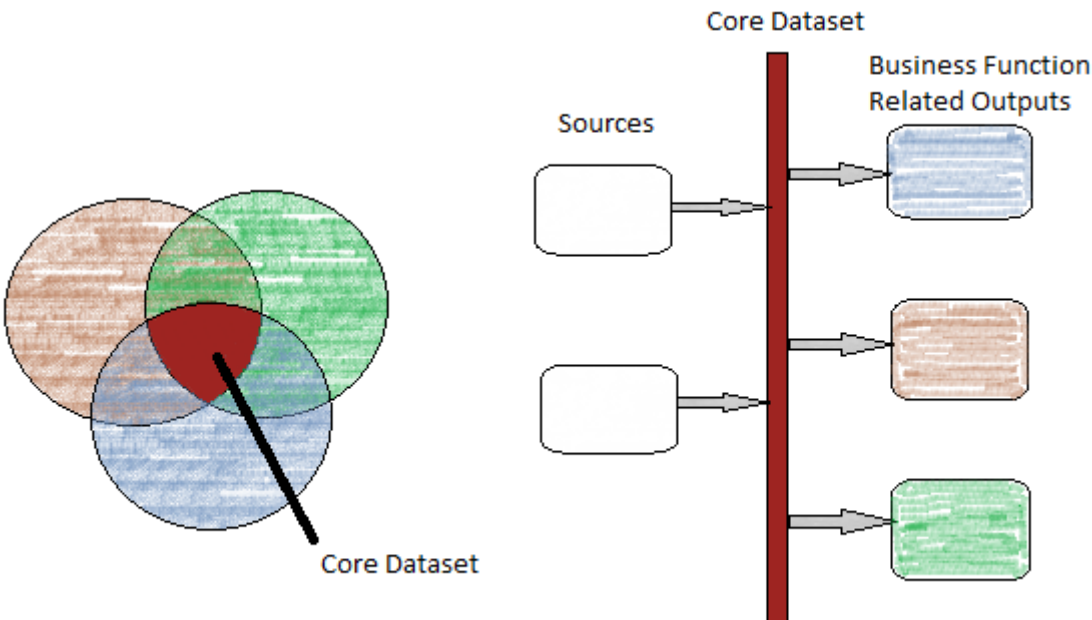
Box lunches were provided. The group broke from around noon to 12:30 p.m.

BREAKOUT SESSION REPORTING

A member of each of the three breakout groups summarized their respective group's work. See Appendices 3 and 4 for a summary of discussion within Breakout Groups 2 and 3 while developing their recommendations.

Breakout Group #1 (Fred Logman Presenter and Janie Norton Recorder)

1. **NAME:** Multiple Source, Single Core Dataset, Single Curator



2. **MAJOR MODEL ELEMENTS:**
 - a. **SOURCES:** Data is submitted by multiple sources. Sources are based on business function and authority. No discussion on methods of submission.
 - b. **UPDATES:** Daily automated updates after validation by source. Validation methods TBD.
 - c. **AGGREGATION:** Curator position will serve as aggregator. Curator will be responsible for standards enforcement, data conflict resolution, and possibly edge-matching.
 - d. **DISTRIBUTION:** Core dataset publicly available via a feature service(s).
3. **SOLVED:** This method should cut down on the number of requests that centerline authorities field from the general public. They can refer most requests to the publicly available dataset.
4. **NOT SOLVED:** This group did not get into the specific "hows". There will need to be further identification of current business practices to determine the processes that cause the least amount of additional work.
5. **RESOLUTIONS:** There will need to be a workgroup consensus.
6. **FUNDING:** How to fund was not really discussed with this group. Funding will need to be available for Curator position and application maintenance.

7. **OTHER POINTS:** Our group felt that this approach is very scalable. This model does not require immediate change. Organizations can start submitting data as they are able to implement the standards. Organizations can start receiving data before they are submitting data.
- Data standards are key to this model: spatial standards and attribute standards to be defined.
 - The possibility of having multiple datasets for different geometry accuracies was discussed with this group. There was not a consensus as to if this was feasible.

Large Group Discussion Points about the Group 1 Recommendation:

Buck: Funding needed to support the curator function. The amount would depend upon the number of participants.

Gelbmann: Flexibility provided for organizations coming into the system. Start small with early adopters and expand over time.

Knippel: Need to define the role of the curator. Yes, would be responsible for QA/QC, aggregation and advocating for providers.

Breakout Group #2 (David Bitner Presenter and Nancy Rader Recorder)

MODEL – “The Disambiguator”

Mission: Allow everyone to disambiguate

Provide a central dataset comprised of common segment identifiers. (To know with certainty which nodes and thus line segments they are referring to or linking to).

Main Characteristics of Model:

- Common ID to common segment (allows all stakeholders to do their own thing as long as the feature has a unique ID)
- Standard set of nodes
- Counties will still need to maintain data
- Use FGDC standards
- Source/producer friendly to easy to contribute to

Sources

- 100% buy-in from stakeholders
- Keep the bar for entry low
- Use FGDC standards for address points and address content
- Local address authorities provide the authoritative information
- Accommodate all levels of accuracy (for geometry)

Aggregation and Distribution

- Variety and keep as flexible as possible
- Part of transactional workflow

Issues Solved

- Provides an additional source of data. Easily allows interchangeable use of data produced by many organizations. **The disambiguous ID becomes a communication hub as opposed to trying to create a single dataset that everything to everybody.**
- Communication
- More control remains with local cities / agencies
- Expandable

Issues Not Solved

- Individual needs for additional or different segment node spacing; no one scheme will satisfy all needs
- Geometry and addressing standards

Funding

- This is a public function and responsibility (although much of the task may be outsourced to the private sector)
- Money should come from state and federal level
- Should be publicly owned and publicly available

Large Group Discussion Points - Group 2 Disambiguator Model

Q: Who does the 100% buy-in refer to?

A: Address authorities (*Editors' note – later in the discussion the group concurred that the term should be **Road Authority***)

Q: What do you mean by “keep the bar low”?

A: Basic enough so that all can participate.

Q: How do segments get put back together into a whole road? Is the ID a subset of a larger road?

A: They don't have to, but there are technical means to figure this out. If the nodes are topological, the system would know which other segments abutted. The key is to know that you are working with the same segment across systems.

Q: How do you deal with new road geometry? Would they be added quickly?

A: The workflow identifies which road authority assigns IDs. With buy-in and local control, information could be added quickly and users can pull data from any other data source using the same Road Authority assigned ID system. The Road Authority is still looked to provide data including preliminary streets.

Q: What motivates producers to participate?

A: Enter once and no need to distribute themselves to numerous other organizations.

Q: This sounds similar to a Mn/DOT project about 5 years ago that failed. Why would this work now?

A: Failure wasn't due to the theory; it was largely due to requirements, architecture, and technology of the time. This is a sort of a linear referencing system (LRS), which is covered extensively in literature, so we wouldn't need to reinvent. (*See NCHRP Report 460.*) If this were easy, ESRI would have solved it already; implementation is a challenge. Mn/DOT is exploring the idea again.

Q: If no geometry, how does it work? For example, for E911?

A: This model doesn't solve anyone's full problem. Instead, it allows different solutions to communicate. The important thing is that an addressing authority is involved.

Q: How to begin?

A: Start small, test/refine to start the process. Then scale up

Q: Who owns the data?

A: Provides opportunity for out-sourcing for maintenance but with understanding that data ownership is public.

Breakout Group #3 (Matt Koukol Presenter and Paul Tsimikas Recorder)

NAME: Descriptive model name or working title

1. Sources: how is source data collected
 - a. Who supplies the information? Design files, as builds, aerial imagery, plats, GPS
 - b. Need a representation of the road
2. Updates: How is the master centerline updated?
 - a. It need to be updated in real time, need to be better represented
3. Aggregation: how is the data aggregated

Real-Time Authoritative Maintenance Model (RAMM)

- All inputs subject to authoritative source approval
- All capable stakeholders input their information as it becomes available
 - Refine data as process continues
 - Concept/Predesigned
 - Design
 - Post construction

Model One: Ideal solution - one database.

Issue: It would require a mandate and appoint someone responsible.

How would the data be aggregated?

Model Two: Hierarchical Model

As RAMM, but counties assume more roles for QC, maintenance.

Counties aggregate data within the county

- a. QA/QC
- b. Submission
- c. Distribution the roles and responsibilities further (*is a word missing?*)

Tiered Model – State, County (Tribal), City and Public

State

County (Tribal) – Responsible for all private data

City

- Control is at lowest level possible
- County provides QA/QC, added value by improving geo
- Leverage county relationship

Public

Issues:

1. Not all capable stakeholders are capable, who assumes their work?
2. Rely on different stakeholders for updates
3. Not all shareholders have interest
4. Not all shareholders have funding
5. Complex system to design and implement (workflow)
6. Challenge to collect private road data (maybe tribal data as well)
7. Question about how to bring in tribal data

Assumptions:

1. Defined DB and Stewards *must be in place*
2. System and application *must be* in place to facilitate and hold data. Define DB and standards.
3. Input comes from a government source/entity
4. Cities and counties must approve inputs and then push the data to a regional, state and/or private sector aggregator for collection and distribution.

Solution(s):

1. Need a funded mandate
2. Input comes from a government source

	City	County	State
Design File	Pavement	Pavement	Pavement
As Built		Pavement	
Prelim Plat	Row, Conceptual	Row, Conceptual	Row, Conceptual
Aerial	Pavement	Pavement	Pavement
GPS	Pavement	Pavement	Pavement
Mental Image predesign	Conceptual	Conceptual	Conceptual
County Data			
State Data			
City Data			

Large Group Discussion Points - Group 3 Recommendation

Chinander: If a street centerline segment is updated, whose ID is used? The group concurred that if a particular stakeholder has a business need to split a road segment then they would add a new descriptor subject to its validation via an address authority. The original segment ID would be maintained to enable tracing the lineage of the changes.

Buck: It is in the public interest to eliminate derivative road centerline datasets. Need to address ownership issues created by derivative datasets whose source is the NCompass dataset. Charboneau restated that NCompass is here to participate in a solution good for all. The question to be resolved – how do we effectively eliminate the derivatives and move back to a common model?

Weinberger: Some counties are creating “event” based data (for LRS). Consider having them bring to the conversation.

Swenson: Hennepin County does not current have LRS capability but need it. In repose to a comment about issues related to moving from segment attributes to LRS events, Clark noted that tools exist to make this transition and maintain as a network.

Knippel: We are talking about a technology solution with distributed roles. Design small, leveraging personal relationships and improve overtime.

Koukol: Need to look for an existing software application, rather than attempt to develop one locally.

Gelbmann: We need to define ways to demonstrate early success to move the public domain process forward.

Bitner: Not about stakeholder business functions. Business solutions will build up alongside the core segment ID model whose purpose is to support sharing of a range of data for specified road segments.

TAKE AWAYS, NEXT STEPS AND WRAP UP

TAKE-AWAYS FROM RECOMMENDATIONS OF THREE BREAK OUT GROUPS:

Charboneau: Conclusion – If all three small group recommendations are combined, we have a solid foundation for a comprehensive solution.

Group: Refer to those organizations response for managing validating road related data as “Road Authorities” not “Address Authorities”. Generally, the organization with maintenance responsibility. “Road Authorities” for private roads are a special case that needs that needs

further thought. The idea nevertheless is that only **one authority has clear responsible for each road segment.**

We're talking about a "system" that relies upon road authorities to manage the IDs and a handful of core attributes. All stakeholders are allowed to add but there must be a way to ensure interoperability.

Collaborative model is a must to effectively meet variety of overlapping business needs and ownership of the data has to be in the public domain because so many stakeholders involved.

Concurred, that as part of the test bed for the design solution, a deliverable needs to be documenting value likely to be created via a public domain solution.

The test case needs to define a way to develop confidence in the data

A good liner reference system is needed. But counties, assumed to be key stakeholder, do not currently support. Also, a standard for the segmentation is not straight forward given the multitude of business needs involved. Agreed that the target should be the minimum needed to share information.

An Outreach Plan is needed to gain buy-in from political – but how best to go about encouraging some cities and counties to assume more responsibility. A key topic will be clearly defining roles and responsibilities and demonstrating to the prospective custodians of those responsibilities the value creation potential once the system is fully implemented.

Need to motivate road authorities to participate – 1) keep the participation bar low by aligning the content standards with those who do the most work (counties?) 2) need to link to as many other business processes as possible. Get the engineering side of the MNDOT, counties, MESB involved.

Complexity of roads needs to be included in the solution/model.

Buck: The conceptual components of a comprehensive solution shared by the group are consistent with the "hamburger model" proposed via the TFTN model.

Johnson: Offered an observation that this conversation has made it clear that pursuit of a solution to network/routing business function is a separate task from managing a foundation road segment IDs dataset, each requiring separate roles and responsibilities and custodian commitments.

NEXT STEPS:

Buck shared a conceptual work plan for the project and asked the participants if they had any comments or suggestions for next steps.

In response to a question from Logman about learns that might be learned from others around the country, Buck commented that he had preliminarily researched two main themes ideas that have surfaced elsewhere – central authority and aggregation models. He confided that the ideas brought to light at this workshop bridge these ideas and, as such, there is no existing model from which to easily apply to our work here. He also reiterated that the related effort to move toward a regional address point solution also sets this area apart from others.

All concurred that a stepped or iterative prototype model should be followed. Johnson mentioned that if one of more in-process MetroGIS projects do not move forward this fall, those funds might be able to be utilized to move faster on this project than had been originally anticipated.

Needs shared by the group:

- Digest the variables identified today
- Policy side – what is the best way approach? Who is going to fund and manage?
- Technical side – does the solution work for the broad community of desired participant?

The effort needs to be big enough to address the issues but small enough to make real progress. Buck, stated that he understood that this effort is not about solving specific road related business needs but rather creating something at the center capable of tying all the components together – coordination being the key.

WRAP UP:

Buck and Johnson thanked everyone for their participation and explained anticipated next steps that would begin with a sharing a summary of the workshop results with the participants to ensure that the recorders captured the proceedings as intended by the participants. The workshop adjourned at 2:30 p.m.

Appendix A



MetroGIS

Cooperation, Coordination, Sharing Geographic Data

Metro Area Street Centerline Stakeholder Workshop

(September 26, 2011)

Agenda

- Location:** Metro Counties Government Center (Mosquito Control)
[2099 University Avenue](#), St. Paul.
- Workshop Sponsor:** MetroGIS
- Facilitator:** Andrew Buck, AppGeo
- Objectives:**
- 1) Identify common issues and potential improvements to the current street-centerline data maintenance model managed by MetroGIS
 - 2) Build consensus among address authorities and data consumers for managing issues and choosing among alternatives for improvement

Questions to be answered:

- *Is a public/private partnership for shared street centerline data still practical?*
- *Can the current model for centerline maintenance be modified to fix common issues?*
- *Are there viable alternative models to address current business needs and constraints?*

Schedule:

- 8:30 Arrival and coffee/light snack
- 9:00 Describe the current centerline data situation
- 9:30 Confirm and extend the stakeholder issues list
- **10:30-10:45 Break**
- 10:45 Breakout sessions to brainstorm alternative models
- **11:45 – 12:15 Lunch and break**
- 12:15 Breakout session reports
- 12:45 Group discussion to identify which model(s) to further develop
- **1:30 – 1:45 Break**
- 1:45 Identify next steps for advancing a collaborative maintenance model
- 2:15 – 2:30 Workshop wrap-up

Workshop output:

- A concise set of **issues** that the new model(s) must address
- Articulate a high level **stakeholder consensus** for shared data maintenance model
- Actionable, results-oriented **to-do list** to initiate implementation and build momentum

Appendix B

Program Transition Slides



Exploring the Potential for a Collaborative Street Centerline Maintenance Model

Metro Area Street Centerline Data Initiatives Stakeholder Workshop



September 26, 2011

1

Today's Agenda: 8:30 – 2:30



- 8:30 Arrival and coffee/light snack
- 9:00 Describe the *current centerline data situation*
- 9:30 Confirm and extend the *stakeholder issues list*
- **10:30-10:45 Break**
- 10:45 Breakout sessions to *brainstorm alternative models*
- **11:45 – 12:15 Lunch and break**
- 12:15 Breakout session reports
- 12:45 Group discussion to *identify model(s) to develop*
- **1:30 – 1:45 Break**
- 1:45 *Identify next steps*
- 2:15 – 2:30 Workshop wrap-up



2

Current Centerline Situation



- NCompass data is licensed by MetroGIS
- Demand is becoming more sophisticated
- Routing, address points, etc. threaten status quo
- Integrated region-wide/state-wide/national needs
- Increasingly, counties are building their own data sets resulting in multiple centerline files
- There are a number of issues that challenge the current road centerline maintenance model
- Workshop to find common ground for the future



3

Centerline Issues



- **Requirement to be multi-purpose**
 - *Attributes, analysis, routing, geocoding, LRS, mapping, boundaries*
- **Derivative versus coordinated data sets**
 - *Should all files be kept in sync? How can all files be kept in sync?*
- **Data Standardization**
 - *Many formats, ID translation, NG9-1-1/NENA, FGDC transfer Standard?*
- **Timely Updates**
 - *Does near real-time works for all? What are the costs?*
- **Road Status**
 - *Designed, Approved, Built, Not built; Public, Private, Tribal, Federal*



4

Centerline Issues cont'd



- **Centerline Attributes**
 - *Demand for many but costly to store them all. Are joined tables feasible?*
- **Multiple Geographic Reference Systems**
 - *Baseline geometry, routing support, LRS, dynamic segmentation*
- **Road Name Aliases**
 - *Vanity, historic, common misspellings; one-to-many*
- **Jurisdiction**
 - *Gaps in coverage and update cycles: mall access roads, apartment complexes*
- **Incomplete participation**
 - *Local proprietary data, cost recovery, level of interest*
- **Lack of participant Resources**
 - *Lack of local resources (funding/expertise/personnel) to perform local tasks*



5

Break

10:30 – 10:45



6

Breakout Session Guidelines



- **Brainstorm**, all ideas are good, but stay focused on solutions
- Take time to **discuss solution options** (not issues!)
- Pick 1 or 2 models that **resolve the issues** discussed
- Whenever the conversation drifts, **refocus on describing solutions**
- Use the **template** as a documentation guide
- Each breakout group has a designated **recorder**
- Designate a **speaker to present** your model(s) to the full workshop



7

Breakout Session Output



- **NAME:** Descriptive model name or working title
 1. **SOURCES:** How is source data collected?
 2. **UPDATES:** How is the master centerline file updated?
 3. **AGGREGATION:** How is the data aggregated across jurisdictions?
 4. **DISTRIBUTION:** How is data distributed across jurisdictions
- **SOLVED:** Which issues does this model solve?
- **NOT SOLVED:** Which issues does this model not solve?
- **RESOLUTIONS:** How should the unsolved issues be addressed
- **FUNDING:** How is this model funded?
- **OTHER POINTS:** Are there other aspects of this model that should be discussed?



8

Lunch

11:45 – 12:15



AppGeo

9

Breakout Reports



- **15 Minutes** per group
- **Describe** your group's idea
- Tell us **why** you chose this model
- **Sell it** to us!
- Audience: **clarifying questions** only
- Debate comes next!

AppGeo

10

Which model(s)?



- *Is there one* model that stands out?
- Can *pieces of multiple* models be combined?
- Are there *themes* among models?
- What characteristics meet *common needs*?
- What *should be/not be* in the model
- This is *not our final answer*



11

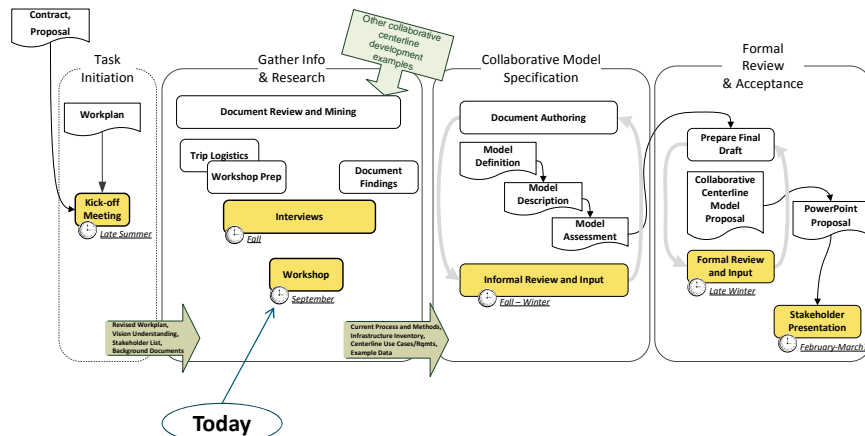
Break

1:30 – 1:45



12

Next Steps: Plan



13

Next Steps: Action



- What are the important **dates**?
- What are the next **tasks** to accomplish?
- Do **others** need to be included?
- What **governance** issues need attention?
- What about **funding**?
- What about **licensing**?



14



Thank You!

Randy Johnson, MetroGIS Project Manager

randy.johnson@metc.state.mn.us

Andy Buck, AppGeo Project Manager

abuck@AppGeo.com



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Appendix C

Roster of Participants

		<u>Break Out Group</u>
Ben Verbick (LOGIS)		1
Cassandra Isackson (MnDOT)	1	
Dave Brandt (Washington County)	2	
David Bitner (Metropolitan Airports Commission)		2
Fred Logman (MnGeo)	1	
Gary Swenson (Hennepin County)	2	
Gordon Chinander (Metropolitan Emergency Service Board)		2
James Bunning (Scott County)	3	
Joella Givens (MnDOT) (<i>Invited could not attend</i>)		-
John Slusarczyk (Anoka County)	1	
Jonathan Hoekenga (Metropolitan Council)	3	
Kevin Etherton for Kevin Nieuwsma (NCompass)		1
Larry Charboneau (NCompass)		2
Matt Koukol (Ramsey County)	3	
Matt O'Brien (LOGIS)		2
Paul Weinberger (MnDOT)		2
Perry Clark (Carver County)		3
Peter Morey (MnDOT)	1	
Randy Knippel (Dakota County)	3	
Rick Gelbmann (Metropolitan Council)	1	
Rick Morey (MnDOT)		2
William Brown (Hennepin County) (<i>Invited could not attend</i>)		-
<u>Workshop Support Team:</u>		
Andy Buck (AppGeo – Facilitator)		
Randall Johnson (MetroGIS)		
Janie Norton (MetroGIS)		1
Paul Tsimikas (MnDOT)		3
Nancy Rader (MnGeo)	2	

Kevin.etherton@guidek12.com

Appendix D (Breakout Group 2)

Additional Notes from Breakout Group Discussion (Nancy Rader, MnGeo – Recorder)

Other useful information may come out of this model (e.g., geometry, address ranges), but that is not the main purpose of the model. Additional info is more of a “side effect.”

Collaboration will happen outside this model (e.g., groups that need geometry for routing)

Don't ask local authorities to change much about what they're already doing.

Don't try to put too much in the central model. The bigger the system, the more complex it get and the more money it costs.

Meant to provide a mechanism for easy sharing; using standard ID#s lets you link to attributes maintained by different organizations.

Start by defining the core pieces:

- What are the most important uses for a street centerline dataset?
- How many of these uses can be accommodated with a common ID model?

We took a similar approach to parcel data in the '90s; do it again for street centerlines.

Do you need to have a core dataset or is it enough just to know who to go to? Don't keep data, but access it.

MetroGIS would need to maintain a list of points of contact for the address authorities; maintaining just this list is a lot of work.

Sources: As more cities and counties are creating their own datasets, they have less incentive to submit updates to NCompass. As a result, NCompass is spending more and more (too much) time finding and researching updates. For a common model to work, everybody (100%) has to agree to feed their updates to it. Address authorities would submit the information and NCompass (or other central organization) would moderate.

Some options to encourage 100% participation: Keep the bar low; make it a statutory requirement; provide funding. Authority would only have to submit updates to one place. Should have option to submit with a web app; shouldn't have to have GIS.

Centerlines and address points datasets should be reconciled with street names; however, for various reasons, sometimes these will never match.

Tie this information back into the tax system.

If there's a discrepancy in two datasets, very important to know who is the authority to check with to resolve (9-1-1, fire chiefs, building officials...)

Crowdsourcing or other unchecked editing: Prefer no information vs. information that might be 50% right.

Aggregation: accommodate multiple methods of upload.

Distribution: accommodate different methods, e.g., file, WMS. May need to have different levels of access, e.g., some 911 data may be restricted access.

Need not met:

Needs for different geometries. E.g., Survey-grade accuracy; paved vs. right of way centerline; survey on ground vs. COGO.

May need different segment IDs: to show breaks at boundaries of precincts; zip codes; non-standard address ranges; 911 zones... (or maybe not, maybe this is determined by GIS overlay analysis as needed)

Response to these unmet needs: Go back to defining which are the top priority needs and set requirements to meet those needs.

Washington Co. currently maintains 3 versions of road datasets: ROW, survey, centerline

Appendix E (Breakout Group 3)

Additional Notes from Breakout Group Discussion (Paul Tsimikas, MnDOT – Recorder)

- The data would trickle from one source and end up at one authoritative source.
- Public domain solution for a solution? Some concerns are there, but the framework is there. It could be a collaborative model and not tie it to a licensing model.
- Are there ways to show early success to show progress? It could come from a prototype with a county and a city – vertical tiering or a private entity such as utility company.
 - Maybe have some private funding from utilities or cable companies.
 - Maybe tie it to a streamlining process
 - Have to have something to protect your licensing fee. There is value and benefits from the communities, improve business processes and it's hard to quantify
- How does that data that comes from the address authority that all consumers reference from that data or derived data?
- NCHRP2027 – Linear Referencing have handles that theatrically for proposed solutions.
 - There are methods out there that handle this. It's best served that we not design here, but we need to find a common theme that is created by reliable authorities.
 - Need buy-in. As we collect authorities and come up with a common ID number to whomever wants information, they can use it as a central system.
 - Fields to consider are ID, status, owner, date, date proposed, date retired.
- Biggest problem is the derivative data set, the NCompass system provide some kind of key ID, anyone who derived key data kept that identifier.....feeding the main datacenter back.
 - Gives you the ability to communicate horizontally.
- Solves the derivative data set issue.
- How do we address the issues of any derivatives held in NCompass?
- What are the consumer groups we can identify and what are some of the business impacts so we don't have to come back to the table years later.
- Envision what the address authorities would be. There could be parallel markets that build upon that core system to provide the identifiers. It comes down to the confidence of the data. Not everyone believes it is good.
 - What do you need to do to build confidence? Does the city have confidence in its own data or another agency data?
- Who is the address authority and do they overlap? The address authority needs to be the source. Is it the locals by naming or who is delegated with coming up with the initial ID number?
 - Transfer of ownership would only happen one at a time.
- One issue would be that this system needs to be based on a good linear reference system. The counties do not have this. Counties data is not set up to tie them together.
 - Need to meet most people's expectation for business needs.
 - What level do we need to share information? A county might need to know a segment down to a foot. Some don't want to share that level of information. Finding out what level of segmentation would need to be discussed.
- The data modeling would take a significant amount of effort. The political issues are just as large. Organizations, cities, and counties assuming a role in some responsibilities that are greater than their need. How do we get them to understand their importance?
 - Could this scenario be dealt with in a test case? It could help identify the effort.
- Outreach side. Critical mass who want to work with us? Built it and they will come. Keeping the bar as low as possible? Iterative refinement over time?
 - Maybe link it to business processes.
 - Get agencies on board to be on the same sheet of music. NTSB, MnDOT, Transit, etc.
- Roles and responsibilities
- What obstacles will we encounter?

- Complexity of the need (LRS) must be elegant enough to be included for the haves and have not are able to utilize data.
- If we agree on common language, we can start with testing some items and keep it simple and let the database be what it is, if we customize too much, we will be right back where we are.

What do you need to do coming out of this meeting?

- Need to say you have a proven viable model
 - Timing standpoint – testing would be in the spring or fall to demonstrate value for a true iterative prototyping to flush out issues
- Three points - Policy side, technical discussion, and who is going to manage it, control it and fund it.
- Identify if something has been done in another state. Examples of successes or failures.

Appendix E

Recorder Notes – Large Group Morning Session

Notes prepared by Nancy Rader (MnGeo)

Mn/DOT State Aid has a business need to determine # of miles within a jurisdiction, so does there need to be a node at the jurisdiction boundary?

Need to know left-and-right of each road segment, e.g., for precinct-finding

Scale-dependent cartographic issues, e.g., single- vs. double-line roads; are they physically separated?

Centerline of road: is it the ROW or pavement? Some groups need one, some the other.

Just roads, or other transportation modes, e.g., bicycles?

Need road data much earlier in process (from city or county) when plats are approved, before ground is broken. Need updates too – some preliminary roads never get built or they are changed from the initial plans.

Street signage often doesn't match official street names.

What exactly do we need for a trustworthy dataset? Define it well.

We have a big investment already in existing datasets, so we're not starting from scratch.

Hard to give up control of data. How stable is the provider? How much should an organization rely on an outside authority, especially a private sector one? Or even the state given the state shutdown? Can we change the provider once they're chosen?

What factors would make the cities/counties want to give up the total control?

This is a "system" not just a "dataset". It has data flows, an integrated process.

Need non-metro info too.

Don't just focus on unmet needs and potential problems. Include benefits to different groups from having a more common solution, e.g., different groups such as counties, cities, Mn/DOT, could talk more clearly to each other; unified way to share resources.

Collectively, a common solution would be well worth it. But transition is hard and projects are always cheaper to do oneself (not all agreed with this). Needs an educational / outreach effort. Benefits are not going to happen immediately.

Other issues?

City staff (e.g., an engineer) thinks a road is in the wrong place, asks GIS tech to move it, and the change replicates throughout the system without any real checking or notification of anyone else.

Mn/DOT attempted a test with Olmsted County. Didn't find solution to each having a different definition of roads.

Changes should go back to source so same problems don't keep resurfacing.

Think in context of what other organizations are planning to do in the next couple years, e.g., Google, TeleAtlas, OpenStreetMap, national efforts.

Notes prepared by Paul Tsimikas (MnDOT)

Requirements to be multipurpose

Derivatives v coordinated data sets

Data Standardizations

FGDC standards – does this meet every ones needs?

- Translate ID numbers between systems, realign a street

Timely Updates

- NCompass does it quarterly, Metropolitan Council does not have need to have more frequent updates but provided for monthly and weekly updates in the contract with NCompass provided another organize(s) pay the additional fee. Johnson commented on the amount the additional fees.
- Where do updates come from? Photography, country or city that provides data,
- Having base data is better in one location for reliability would help.
- Cities know when a plat is approved, but the authority is the bounty county and city.
- Street signage – what is the official name?
- Have a centerline DB, but we need to maintain something we have. Letting go of an investment we already made. Risk and stability for relying on outside data. Risk is to depend on one private sector provider, maybe we want to transfer to another vendor? Dependant on stability of the service and need flexibility to choose who provides that service - Randy Verbick
 - License data for public reference file – Andy B
- Can data be maintained by a single entity? Challenge is to strip away everything to find a mechanism to share information on a data set to meet their needs, or is the aggregate model makes sense? And sent to an aggregate custodian? – Andy B
- Benefit cost, total control – do we need it and can we handle it? – Cassandra
- Centerlines from orgs outside the Metro, other states – David B
 - Central data set is 27 counties
- Lawrence Group owns the data. Open to a new model. Cost would be involved.
 - Different needs in a different environment. What is transferable and what isn't, and level of responsibility from state to federal. Fred
- Entities are changing on a constant basis – Andy
- The data has to be part of the bigger issue, from the county, other cities are making their own centerlines (have the capabilities)
- Need to get the derivative back to one level. – Andy B
- Access to the data – transactional or public data. Additional layer to licensing issues. Growing demand and need by multiple entities and agencies – Fred

Road Status

- Designated? Approved? Built?
- Is there a common definition that would help the discussion?
- Who owns what? Ex Access roads to the mall? Who is the authority for getting data into a system?
- Capturing the data for preliminary data which is approved by the planners.

Centerline

Multiple Geographic Reference Systems

Road Name Aliases

Jurisdiction

Incomplete participation

Lack of Participant Resources

- Benefits of working together with counties and cities with MnDOT. Have all that agreed upon for standard data set. Might be work while to discuss that. It's not just the funding, but benefits of a unified method. Rick G

- Always cheaper for their own, there will always be someone who has to pay more and time consuming. Selling this idea is tougher, the short-term impact is tough. Only going to work if everyone plays along – Randy
 - Would there be a way to analyze the benefit? - Randall
 - If work process improves, there is a benefit. System designs would help standardization and process – Rick G
 - Example of a municipal level would be for centerline, someone moves the centerline and it becomes the standard for police, trickles from one group to another and keeps on going. How do you deal with the bottom up changes? And someone notices that change on a state level. How do we change eliminate that.
 - Challenges occur even with a unique identifier. Tough to agree on standardization – Matt K
 - Understanding the workflow on how data gets from one place to another is one of the issues. – Janie . Everyone has their own mandates until someone say this is the standard. What are the elements of the system? Is the an aggregate model or is it a distributed model?– Andy B

Appendix F

Recorder Notes – Large Group Afternoon Session

Notes prepared by Nancy Rader (MnGeo)

Public should be in charge.

Milestones to demonstrate value would be a deliverable of testing.

How do IDs and archiving work if you split lines to add nodes (or make other changes)? That doesn't need to be determined at this stage.

We should look for solutions to leverage; we shouldn't build our own.

May need more attributes: ID, status, owner, date

If people have confidence in the dataset, they will use it.

Need one, and only one, authority to assign an ID to a particular line segment.

Many counties do not use LRS. Some create only when necessary, and then recreate when needed again.

At what level do we really need to share?

Other political and outreach / education issues? Get to who's NOT playing along.

Hard to create routing from the "hamburger"

Notes prepared by Paul Tsimikas (MnDOT) - *(Paul: general or internal to Group 2?)*

- The data would trickle from one source and end up at one authoritative source.
- Public domain solution for a solution? Some concerns are there, but the framework is there. It could be a collaborative model and not tie it to a licensing model.
- Are there ways to show early success to show progress? It could come from a prototype with a county and a city – vertical tiering or a private entity such as utility company.
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- Envision what the address authorities would be. There could be parallel markets that build upon that core system to provide the identifiers. It comes down to the confidence of the data. Not everyone believes it is good.
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 - Maybe link it to business processes.
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 - Roles and responsibilities
 - What obstacles will we encounter?
 - Complexity of the need (LRS) must be elegant enough to be included for the haves and have not are able to utilize data.
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- What do you need to do coming out of this meeting?

- Need to say you have a proven viable model
 - Timing standpoint – testing would be in the spring or fall to demonstrate value for a true iterative prototyping to flush out issues
- Three points - Policy side, technical discussion, and who is going to manage it, control it and fund it.
- Identify if something has been done in another state. Examples of successes or failures.

Appendix G

Summary - Pre-Workshop Stakeholder Interviews

(See next page)



MetroGIS Address Centerline Workshop Attendee:

Thank you for planning to attend the MetroGIS workshop next Tuesday in St. Paul. This document is being sent to you to provide some project background information and to describe some of the topics that will be discussed at the workshop. It is hoped that you will be able to review this document prior to the workshop. Please come prepared to discuss and expand upon the material enclosed.

On April 18, 2011, MetroGIS held an information sharing meeting with centerline stakeholders to initiate this project to explore the potential for a shared centerline maintenance model. After April meeting, conversations were held from June to August with a number of participants to develop a more in-depth sense of the issues involved and the needs of various stakeholder organizations.

This document contains the output from those conversations and other related research in the following sections:

- 1. Working set of centerline related issues**
- 2. Summaries of stakeholder conversations**
- 3. Potential centerline model examples**
- 4. Some relevant learning from there transportation for the nation (TFTN) project**

Context - Street Centerline Vision and Workshop

MetroGIS leaders firmly believe that public value creation potential can be increased if the street centerline data solution for the Minneapolis-St. Paul metropolitan area (Twin Cities Region) were to work in concert with the street centerline solution(s) maintained for the adjoining counties. Further, MetroGIS leadership believes that public value creation potential can be exponentially increased if the street center solution for the Twin Cities Region were to be interoperable with a statewide solution, and ultimately a functional component of the National Spatial Data Infrastructure (NSDI).

Accordingly, the subject exploration of technical; legal, and organizational implications of migrating to a collaborative, multi-participant system model for maintaining street centerline network for the Twin Cities Region is intended to not only be valuable to ... the greater MetroGIS community, including local government, but also offer insight for addressing a host of operational questions that underpin realizing the vision of the NSDI. Such a collaborative model is also expected to enhance the quality of the data available and assure that users at the local level will continue to find value in participating in the resulting data asset.

Issues

The issues below were identified during conversations with some stakeholders. These issues represent some of the concerns that must be addressed in order to develop a shared management model for collaborative maintenance of a road centerline file. This issues list will be discussed, expanded, and prioritized during the workshop session.

WORKSHOP OBJECTIVE: Identify common issues and potential improvements to the current street-centerline data maintenance model managed by MetroGIS

1. Requirement to be Multi-Purpose

A Metro-wide centerline file must support the many processes at multiple levels of government requiring timely and accurate centerline data. The specific use of the data determines the suitability of a centerline file's format and value-added capabilities. For instance, a centerline file used for routing does not necessarily need to be spatially accurate, but a centerline file used for mapping requires a high degree of cartographic accuracy.

This table shows some example uses of centerline data and related requirements based on stakeholder input received during interviews and other project meetings.

Use	Required Capability
Include only those road centerline segments necessary for current use	Baseline attributes: Status, functional class, speed limit
Advanced data analysis and system integration	Associated additional attributes: Augment baseline attributes with use specific attributes using a standard, published identification system
Emergency response: Dispatch, routing & analysis (e.g. travel time)	NENA standard, Network topology: Turn restrictions, divided highways, street direction, etc.
Address estimation	Address ranges
Map making	Spatial accuracy, alignment with orthoimagery, dynamic labeling
Local uses	Survey grade accuracy
Regional uses	Centerline segmentation at jurisdiction boundaries
Roadway management	Multiple linear referencing systems, dynamic segmentation

2. Derivative versus coordinated data sets

Commercial centerline data is available and maintained by NCompass (formerly The Lawrence Group—TLG). Though this data is licensed, via MetroGIS, by approximately 200 user organizations, for various reasons – some described in the interview write ups below – multiple centerline data consumers have created their own centerline files.

There are several instances where the *de facto* base centerline data, from NCompass, has been transformed into a derivative dataset to meet the requirements for a specific use. For instance, Local Government Information Systems (LOGIS), an intergovernmental consortium for facilitating public sector technology solutions, distributes the NCompass file to its members, but creates a derivative file for use in its emergency response dispatch system. Usually, these derived datasets cannot be updated to reflect changes in the original data resulting in duplicated data maintenance and a loss of ability to provide updates to production centerline files from a single centerline data steward.

3. Data standardization

There is no Metro-wide standard for road centerline data. Current data management methods derive locally formatted versions of the NCompass' centerline file or use an organization's own base file. These individually formatted datasets, each with their own update process, inhibit creation of an integrated Metro-wide centerline file for all local, county, and regional uses. Because there is no one standard method for identifying road centerline segments, each of the centerline files (state, county, NCompass) has a unique identification system. A mechanism for translating identification numbers between systems is necessary for an integrated solution.

Some systems, such as the Next Generation 911 (NG9-1-1) emergency response, require that centerline data match a specific standard, such as the National Emergency Number Association (NENA) standard required for NG9-1-1.

4. Timely updates

The NCompass centerline file is published quarterly. This update cycle is too lengthy for some users who instead update derived copies of the data. This update process essentially disconnects the locally updated copy from the original centerline data resulting in multiple authoritative centerline files and the risk that not all authoritative updates are applied to all centerline files.

5. Road status

Specific use determines which road segments should be contained in the centerline file. For instance, dispatch systems need roads that are under construction, but not roads that are only platted (designed and approved, but not built). Current centerline files do not have status codes or other attributes that allow users to filter the data to include only the appropriate segments. The general practice is to include only those segments that are needed for the intended use of the file, resulting in further file differentiation and difficulties in sharing data across organizations.

6. Centerline attributes

Because centerline data is used in many business processes, there is demand to associate many types of attributes with a line segment (e.g., speed limit, functional class, bus routes traversing segment, plat number). Not all users need, desire, or have the ability to access to all centerline attributes. A centerline file that spans the entire Metro area and contains all attributes desired will be too large for practical use. One management solution could store a minimal set of attributes (e.g., status, functional class, speed limit) within the authoritative centerline file and enable additional attributes (e.g., bus routes, has-bike-lane) to be joined via a published standard identification numbering system.

7. Multiple geographic reference systems

Various uses dictate the need for multiple geographic reference systems. For instance, the current NCompass centerline file provides baseline geometry and basic attributes but cannot directly support vehicle routing, linear reference systems (LRS), or dynamic segmentation.

8. Road name aliases

There are many needs for multiple names for road segments (e.g., vanity names, historic names, common misspellings). Current systems generally have a single name attribute per segment, which drives the creation of derivative local datasets to solve specific local needs.

9. Jurisdiction

Jurisdiction and timing issues related to inclusion of roads on private property (e.g., mall access roads, apartment complexes), tribal authorities, and federal property produce gaps in coverage and long update cycles.

10. Incomplete participation

Not all MetroGIS members have the same level of interest in creation of a shared centerline data management model. Some organizations view road centerlines as proprietary data. This perspective complicates or prohibits the use of that data in a centerline file accessible Metro-wide.

11. Lack of participant resources

Some of the organizations that are willing to participate in a shared maintenance model may not be able to provide sufficient resources to perform local tasks, such as resolving discrepancies between multiple centerline files.

Potential Collaborative Models (MetroGIS Community)

This section presents some initial models that could be developed to achieve collaborative maintenance of road centerline data. It is possible to combine elements from each of these models into a hybrid collaborative centerline maintenance model. These model options do not address issues regarding policies, procedures, and some of the complex process design requirements for dealing with issues raised above, such as linking additional centerline attributes and segment identification number translation.

WORKSHOP OBJECTIVE: Build consensus among address authorities and data consumers for managing issues and choosing among alternatives for improvement

1. MetroGIS address points model

MetroGIS has created a prototype application for managing address point data. In this model, local address authorities are responsible for identifying and creating changes via a shared, on-line geospatially-enabled data editing application. County or other organizations act as application hosting organizations. Periodically, the modifications are extracted and provided to an aggregator – in this case MetroGIS – for aggregation into a Metro-wide data set. This data set is then freely distributed to interested parties, including all organization that use the address point editing application so they can use it as a reference file that contains all address points for the Metro area. Essentially, the address authorities update the data, hosting organizations provide the application server infrastructure, and MetroGIS provides the aggregation and distribution functions.

2. Mn/DOT stewardship model

Mn/DOT could act as the data steward for a statewide road centerline file and has created an application (Road Closure Application – see Mn/DOT write-up below) that could be used to prototype a collaborative editing model. This model is essentially the same as MetroGIS address points model except that Mn/DOT would act as the hosting organization as well as the aggregator and distributor of centerline data.

3. Shared public/private partnership

While not explicitly a fully distribution and maintenance model, processes could be developed where a private company – such as NCompass— could receive updates from local address authorities, produce timely updates, and distribute a Metro-wide centerline file. The mechanism(s) for managing edits would likely be an on-line application similar to either the Mn/DOT Road Closure Application or the MetroGIS Address Points Editor.

4. Geowiki or modified geowiki

Crowd-sourcing techniques – similar to the Cyclopath process for biking trails – could be developed to allow constituents, rather than address authorities, identify updates to the data, and potentially to even perform the edits. An organization or private company providing stewardship services would host the wiki, approve the individual edits, perform the extensive quality assurance processes required of crowd sourcing, and act as the file distributor. Alternatively, this wiki approach could be modified to exclude direct crowd-based editing but would rather be an early warning system for identifying portions of the centerline file that need review and/or updates by authoritative editors.

Organizations/Individual interviews (*Conducted by AppGeo - June-August 2011*)

Minnesota Department of Transportation (Mn/DOT)

Dan Ross, Denise Hesselroth (HPMS), Peter Morey, and Joella Givens

- **Road Closure Application** – Mn/DOT has developed a publically accessible Web-browser application that displays roads throughout the state that have been closed to flooding conditions or flood related damage. This MS Silverlight viewer is combined with a Geocortex county/local road spatial data editing application to create a fully web-accessible system that allows local governments to identify and enter information about current road conditions in a secure editing environment. Mn/DOT offers this technology as a prototype, or model, which could be developed into a road centerline geospatial editor deployed throughout the state. As of 4/26/11, this viewer is being used by 64 of 87 Minnesota counties.
- **Highway Performance Monitoring System (HPMS)** – Federal money for Minnesota roads is distributed based on HPMS reporting submitted by Mn/DOT. In 2010, the Federal Highway Administration (FHA) required HPMS to begin use of a Linear Referencing System (LRS) as the basis for FHA reporting. The core centerline features reported via HPMS include the LRS begin/end points, intersections, highway ramps, and the road's functional class (ownership). HPMS will be migrating to a performance-based model soon. Data used for HPMS reporting is derived from Mn/DOT legacy mainframe Transportation Information System (TIS).
- **State Aid Roads** – Constitutionally, Mn/DOT is mandated to distribute highway tax funds in the form of state aid for local road maintenance. State aid money is distributed based on need determined by a geographically defined Vehicle Miles Traveled (VMT), road mileage owned by the county/municipality, and population. The state aid system is based on need as determined by roadway miles but will soon convert to a performance-based (quality) metrics. County/local governments – with a population greater than 5000 – have a fiscal incentive to report accurately the mileage of their roads that are eligible for state aid. This incentive could be used to integrate HPMS the road centerline maintenance processes. State Aid may need to convert to an LRS based system for integration with Mn/DOT's HPMS. 29% of Minnesota roads are County State Aid Highways (CSAH). 9% of Minnesota roads are Municipal State Aid Highways (MSAH).
- **External Attributes** – Not all centerline attributes are stored as part of the roadway centerline file. For instance, MetroGIS bus routes are not included as attributes of a centerline file, instead they separately managed and associated via segment identification numbers. Common centerline identification systems, likely more than one (e.g., true miles, mile markers), are needed to support the variety of business uses that require road centerline data.
- **Multiple road names** – Any road centerline system that will be used by more than one organization should have the capability of storing one, or more, name aliases for each road segment. Multiple common names associated with centerline segments accommodate alternative uses of the centerline file and increases matches on road name based searches.
- **Multiple Reference Systems** – A common centerline file will need to support multiple geographic reference systems / value added services. These methods were discussed:
 - Standard street segmentation with address ranges

- Geometry end points are linked to nodes via attributes rather than by spatial location. This removes the need for edge matching processes when combining data from multiple sources. Linked nodes can be used for routing, even if the segment endpoints do not align.
- Multiple Linear Referencing Systems (e.g., true miles *and* mile posts)
- **Multiple uses for data** – Not all data is applicable for all uses. For example, the lane width for Mn/DOT roads can be measured as the as-built pavement width or it can be stated as the width of the painted lane. In some areas, pavement is deliberately extra wide to give trucks an added safety margin during winter storms. For most uses, the painted width is sufficient, but for bicycle route planning, the actual pavement width is more valuable for use in bicycle route planning.
- **Municipalities desire survey grade data** – Local and county governments prefer that road centerline data be of survey grade accuracy (i.e., closely aligned with orthoimagery, not merely schematic) and include an LRS model in order to support all local needs for mapping and analysis.
- **Jurisdiction** – Multiple road ownership scenarios must be considered when creating a shared maintenance model. For instance, private roads, such as access roads for malls and multi-unit housing, are needed for first responder routing. In these cases, the local authority often serves as the data editing proxy for the owner of the private road. In another example, roads within closed Native American reservations should be included in a shared model. However, updates to reservation road data usually have a long lead-time and they are not necessarily integrated across all data aggregation processes.
- **Mn/DOT participation** – Since Mn/DOT has a financial interest (due to HPMS allocations, which are based on the number of miles within the centerline file), it is interested in exploring the idea of being the steward of a centerline file. The goal would be to create a statewide centerline file. However, the first step could be a pilot program for the Metro area. Because of space limitations (due to the number of road segments in the state), Mn/DOT would not be able to store all potential attributes of a shared centerline file.
- **Shared centerline file, benefits to Mn/DOT** – Mn/DOT sees several benefits to participating in a shared centerline model:
 - Higher quality, more accurate data that is maintained by local authorities
 - More timely data because update and aggregation cycles can be considerable shorter than the current quarterly updates produced by NCompass
 - Better utilization of data management resources at all levels

Washington County

Dave Brandt, GIS Manager

- Washington County formerly used NCompass centerline data. During the course of working with the new CAD/RMS 911 vendor to implement Next Generation 911 (NG9-1-1), Washington County realized that the NCompass data did not meet the county's needs. Some example issues include:
 - Washington County has a long history with The Lawrence Group (TLG is the predecessor to NCompass). In the early 1990s, Washington County provided TLG with centerlines developed from a cadastral mapping project and received the roads with attributes in exchange. Road centerlines were based on subdivision plats and are represented as platted roads, not necessarily as built roads. These "paper" roads are given a preliminary status and lack address information. Local processing filters out platted-only roads, but this is not

sufficient for NG9-1-1 where only usable and routable roads should exist in the road-centerline reference dataset.

- The quarterly updates to the NCompass centerline file are not adequate to meet Washington County's need for up-to-date road centerline data. Emergency response routing, and other needs, require updates that are as close to real time as possible to support internal operations.
- The NCompass data provides inadequate data for emergency services routing. For example, divided roadways are not always identified in the NCompass data. This gives the false impression that left turns are possible where physical barriers may exist.
- During NG9-1-1 planning and implementation, Washington County decided to migrate from a Centerline file based on NCompass data to an in-house-maintained road centerline file. The county Department of Survey and Land Management (Survey) has implemented a new process that maps the county's centerlines. Survey then compares centerline data to tax parcels to confirm address information. Local officials are also contacted for the current and accurate status of the road. Finally, field verification is used to ensure the accuracy of the data.
- In the past, prior creation of its own centerline file for NG9-1-1 implementation, Washington County provided updates to the road centerline file free-of-charge for incorporation into the NCompass road centerline data set. In return, the county used, and still requires, speed limit and functional class data from NCompass.
- Washington County recognizes that a Metro-wide centerline file (whether from NCompass or another source) would satisfy requirements that cannot be met by the county's centerline file:
 - The need for a regional centerline file for emergency response routing between counties
 - The need for a regional centerline file for geographic analysis that includes areas beyond Washington County
 - The need for attributes, such as speed limits and functional class, that are not currently maintained by the county
- There are also data license implications related to centerlines. Use of parcel data requires a license from the county. Since centerlines are considered part of the county's cadastral fabric, license restrictions controlling the creation of derivative data may apply to the county's new centerline file.
- Washington County may be willing to allow NCompass to consume the county's centerline data, but would not use the NCompass geometry for NG-9-1-1 for reasons stated above. The county would like to continue to receive the NCompass speed limit, functional class, and other attributes that are not currently maintained by the county.

Metro Emergency Services Board (MESB)

Gordy Chinander, GIS Manager

- The Next Generation 911 (NG9-1-1) process integrates geospatial data beginning with the routing of the initial call to proper Public Safety Answering Point (PSAP). Standardized, current, aggregated, and authoritatively maintained road centerline file is a core component of NG9-1-1.

- MESB, the MN Department of Public Safety, and the Minnesota Sherriff’s Association have combined efforts to develop a statewide road centerline solution for NG9-1-1, which envisions county administrators aggregating centerline updates, received from local address authorities, and submitting them to a statewide system. This system would become, in essence, the new de facto statewide address authority. This project focuses on collecting available data now, and then at some point in the future, distribution policies will be established.
 - This project will use the National Emergency Numbers Association (NENA) data standards for NG9-1-1. The local data accuracy standards that MetroGIS has established are used throughout the Metro area and will be followed unless superseded by a NENA requirement.
 - Much of the funding for this project is given in the form of active participation by existing personnel.
- Some centerline data related issues raised by MESB include:
 - Some individual counties are resisting being part of a state solution. Hennepin County, for instance, is concerned about data development cost recovery.
 - The de facto statewide centerline file from Mn/DOT does not have address ranges and is not suitable for NG9-1-1 routing.
 - A centerline used for emergency response needs to include roads under construction. Job sites can be dangerous and should be routable to the extent that the data exists. For instance, a new road in a subdivision that is under construction may not yet have assigned address ranges, but first responders still need to be able to get to the vicinity of a construction accident.
 - The Mn/DOT Road Closure Application (see Mn/DOT above) has been identified as a potential system that could be used as a data entry tool used by local address authorities to submit changes to centerline data. Updates to this database would be aggregated at the county level and then applied directly to a statewide reference file.
 - Standardization of data between counties (so that the data can be aggregated across all MESB counties) is an issue that complicates the MESB project. The property address, rather than the taxpayer’s address, is needed for NG9-1-1.
- Local address authorities need road data in one format as for local construction projects (e.g., Computer Aided Drafting & Design), but that data also needs to be formatted to the NENA standard for updates to the NG9-1-1 Public Safety Answering Point (PSAP) for Computer Aided Dispatch.
- MESB is working on Phase 1 of the NG9-1-1 with several counties (Chisago, Dakota, Ramsey, and Washington) to execute a step process for reconciling differences between adjoining centerline files.
 - Choose an established centerline file (NCompass or the county’s).
 - Validate and edit to ensure that Emergency Service Zones (ESZ) properly reflect the boundaries previously identified in the current 9-1-1 system’s Master Street Address Guide (MSAG). (MSAG is not used in the NG9-1-1 system).
 - Discrepancies between the GIS data and the MSAG are resolved and changes are made to appropriate files. Discrepancy research is generally being done by PSAP personnel. If the PSAP is understaffed (as most are), setting and keeping meeting dates has become an

identified obstacle. Engagement of county GIS departments has not been an issue, but it is identified as a potential area for concern as additional counties join the program.

- Accurate and up-to-date centerline file updates require synchronization between GIS and NG9-1-1 data to make certain that timely updates occur.

LOGIS

Ben Verbick, Matt O'Brien

- LOGIS is a consortium of municipal entities that provides member access to a number of LOGIS hosted business applications. Some Metro area counties are LOGIS members and use public safety services.
- LOGIS provides its members with updates to the Metro area NCompass road centerline file once updates are received by MetroGIS. This centerline file is generally used, by members, for dynamic annotations and other cartographic needs.
- A second road centerline file is currently used for LOGIS public safety dispatch and analysis (e.g., fire department travel time studies). The current system, originally based on NCompass data, was then edited by LOGIS to accommodate some inherent limitations (e.g., split road segments at municipal jurisdiction boundaries, address ranges are reversed from digitization order, no spatial query capability, and inability to perform address counts). The derived file was then made available for use by various public safety agencies and the LOGIS managed dispatch system. This data is used for address validation and interpolation, and routing. This public safety road centerline file was originally produced in a single output format. Over 8 years of use, the process and output files differentiated to support the various needs of public safety agencies making the maintenance of the data more difficult.
- The next generation 9-1-1 (NG9-1-1) system relies on address point data for address analysis and verification while the centerline file is used mainly for routing and a secondary source for address validation. Because the new system is less dependent on a centerline file, the topology rules are able to be relaxed. For these reasons, LOGIS is in the process of converting to a new road centerline file. This new file will be used for dispatch routing and theoretical address range look up (e.g. Where is the 400 block of Rice Street?). All other dispatch support relies on Address Point data. This new file will be implemented on rolling basis.
- The new centerline file will be based on the latest NCompass data, but with intentions to keep the file in sync with NCompass updates to the dataset. This arrangement will reduce the amount of LOGIS internal resources needed for maintaining the public safety road centerline file.
- The spatial accuracy of a road centerline file dictates how the file can be appropriately used. Since topology rules enforce compliance, spatial accuracy is not critical for routing operations. However, a spatially inaccurate file (e.g., centerlines do not align well with orthoimagery) is not sufficient for producing maps.

Metropolitan Council

Rick Gelbmann

- MetroGIS – sponsored by the Metropolitan Council, a Metropolitan Planning Organization (MPO) representing the 7 counties in the Twin-cities region – is a voluntary collaboration of MetCouncil organizations that use GIS technology.

- MetroGIS uses NCompass (formerly TLG) road centerline data for a number of analytical and mapping purposes including identifying bus routes and determining the functional class of roadways. MetCouncil has been authorized by NCompass to act as the distributor of NCompass' core product, geospatial data containing road centerlines for the metropolitan area, to approximately 200 licensed participants including counties, cities, academic institutions, watershed associations, school districts, the US Census, and several US states. The quarterly update cycle is too long and there may be demand for quicker updates, but that has not yet been articulated.
- MetroGIS has developed a derivative of the NCompass centerline data with added topology and segments split at key points, such as municipal boundaries. NCompass periodically provides MetroGIS with a file that contains the edits made to the centerline file. The edits are applied to the MetroGIS derived centerline file by matching with NCompass' TLGIDs. This version of the centerline file is not distributed to NCompass license holders. However, this example illustrates current processes for creating a new permutation of the source file when required to satisfy new user requests. For example, some users of the centerline file prefer segment breaks at railroad crossings, while others do not.
- Road centerlines have different key identification fields, depending on the organization using the data.
 - Mn/DOT uses the county state aide number
 - MetroGIS uses the TLGID (generated by NCompass)
 - Counties use the county road id

A centerline model that satisfies all uses would need to track multiple identification numbering schemes or to have an identification number translation mechanism.

- There are multiple methods for organizing centerline data into networks. Each method has features and limitations applicable to various uses.
 - Geometry – Line segment end points are connected to produce a road network
 - Linked node – Link segments are linked to nodes at intersections and boundary crossings based on ID numbers rather than coincident segment endpoints. Linked nodes are adequate for routing, but do not necessarily have the spatial accuracy adequate for map presentation
 - Linear referencing – Road network features (events) are identified by route number and linear distance from the start point of the route. Linear referencing systems are overlaid on top of a roadway.
 - Dynamic segmentation – A process that transform linear referenced data (events) into features that can be displayed and analyzed on a map.

A collaborative maintenance model that produces a single shared reference file, or a set of files derived from a single file, requires data identification standards that facilitate the use of the centerline data using and of the multiple network organization methods described.

- A common system could be designed that allowed for local storage of attributes associated with a centerline segment contained in a reference file. In order for this to be feasible, a transaction file that tracks ID number changes (e.g. segment splits) would be necessary.
- The prototype process for maintaining the MetroGIS address points file could be used as the basis for a maintenance model for centerlines. Address points are edited by local address authorities, who provide updated address point data to MetroGIS. MetroGIS aggregates these address authority

subsets into a Metro-wide address points database that is then used for the next round of address authority edits.

- Cyclopath is a geowiki that allows twin-cities cyclists to edit bike routes in collaboration with other cyclists. Cycloplan is a restricted access extension of Cyclopath designed for planning agencies to combine efforts with other planners. Cycloplan and Cyclopath encourage bike trail planning across jurisdictions, facilitates edge matching of bike trail data between jurisdictions, and is a mechanism for connecting trail planners with trail users

NCompass

Larry Charboneau

NCompass is a private company that creates road centerline data for 35 Minnesota counties. MetroGIS has worked with NCompass to develop a licensing model where MetroGIS distributes quarterly centerline file updates to over 200 governmental organizations in the seven county twin cities metro area. Andrew Buck interviewed Larry Charboneau, Shareholder of NCompass, by phone.

- The original plan for the MetroGIS centerline project included daily feeds from multiple sources to NCompass.
 - NCompass receives its most reliable notice of errors/changes from ambulance squads.
 - Real Estate agents also provide updates, but their input is treated more skeptically.
- Counties found it easier to modify a derivative version of the NCompass data rather than send transactions to NCompass. This causes two issues:
 - The two data sets are no longer synchronized; not all updates are applied to both files
 - If the county distributes centerline data that was originally based on NCompass data, intellectual property issues become a concern.
- NCompass prefers the original model, is supportive of this project, and wants to help wherever possible.
- Not all consumers of centerline data have the same business needs. NCompass attempts to provide for the greatest need. Sometimes that reduces the ability of the file to be applicable to other uses. Some examples were discussed:
 - An issue raised by other interviewees stated that the NCompass centerline data contains the actual address range and the theoretical address range.
- NCompass has a staff of three full-time employees dedicated to maintenance of the NCompass centerline file. Other schemes proposed for a shared maintenance model will have to account for data editing and validation resources.
- NCompass would like to be the designated data editor for a collaborative maintenance model for centerlines. They have the experience, are doing the work now in support of MetroGIS licenses in addition to their other clients.
- In addition to MetroGIS, the NCompass centerline file is licensed by School Districts, ambulance squads, e911 entities, and Gopher State one-call.
- No entity under the MetroGIS license has upgraded their contract to receive updates more frequently than quarterly. Several private companies have upgraded and receive updates more frequently.
- Private roads are in the NCompass data and are required for public safety response, but would not be maintained by local address authorities.
- The biggest hurdle, as seen by Larry C., is funding. His concern has two components:
 - MetroGIS is the sole funder for centerline updates. Having a single-sourced budget is risky. MetroGIS could, in some future administration, be de-funded which would greatly impact any funding for centerline maintenance.

- More funding is needed to increase the frequency of updates and to add features (e.g. LRS, multiple address ranges). Current levels of funding would not cover this extra work.
- The logistics of centerline file distribution should be reviewed and possible restructured. Some clients want data from surrounding counties, others do not. In addition to tailoring the fee for the licensee, maintenance and distribution costs are higher for data sets with larger geographic extents.

Transportation for the Nation (Selected excerpts from the 2011 Strategic Plan)

How Are Road Centerline Data Currently Created?

Generally speaking, the constituent parts of nationwide data are created from scratch by original data collection using a variety of methods that include:

- ★ Scanning and digitization of paper maps
- ★ Ingesting, older best available electronic data sources
- ★ On board vehicle GPS devices
- ★ Field surveys
- ★ Compilation from aerial imagery
- ★ Data are created via crowd-sourcing inputs on top of an initial data set

In addition to data creation, many of these same techniques are employed in data updating processes.

These methods may be employed by local and state governments and/or the private sector. Once created, existing state and local government data may be collected, standardized and incorporated into regional, statewide, and nationwide data sets by:

- ★ **Regional Metropolitan Planning Organizations** for local and regional planning and public safety
- ★ Statewide road centerlines for **State DOT**, statewide GIS and Public Safety
- ★ **Private sector** companies such as NAVTEQ and TomTom
- ★ TIGER from **US Census Bureau**
- ★ The National Map from **US Geological Survey (USGS)**
- ★ Volunteer developed **OpenStreetMap (OSM)**

Statewide Road Inventories

States DOTs and/or state GIS programs are increasingly creating statewide road inventories. Such inventories can be incorporated into nationwide data sets. There are several models and emerging best practices for statewide road inventory creation. The following sections provide several case studies on different approaches, including:

- ★ Activate local/county government to contribute
- ★ Public/private partnership
- ★ State DOT led efforts
- ★ State GIS Office collaborative efforts

Activate Local/County Government To Contribute

Ohio: Example of County Collaboration on Statewide Street Centerlines

- ★ The Location Based Response System (LBRS) is a partnership between state and local government to develop highly-accurate (+/- 1M), field-verified street centerlines and address point locations for the entire state.
- ★ The state has developed a set of standards and provides financial incentive to counties that participate and contracts with the county through a Memorandum of Agreement (MOA) to provide funds upon successful completion of a data collection and maintenance system meeting LBRS requirements.

This effort has resulted in the successful collaboration of many organizations working together to provide accurate centerline data throughout the state. The data are then available for use by both emergency response organizations and state and local geospatial programs.

Public-Private Partnership

New York: Example of a Public-Private Partnership to Create a Multi-purpose Centerline with Involvement from State GIS Office

- ★ In the late 1990s, New York State launched a statewide base mapping program utilizing GIS. Until this point, the New York DOT/DMV maintained their road data in both paper maps and legacy CAD systems.
- ★ Existing road data needed to be upgraded to conform to the new state standard which at the time adhered to a limited set of established standards focused mainly on Federal program regulations such as the Federal Highway Administration's Highway Performance Monitoring System (HPMS).
- ★ The original contract to develop the data, awarded in 2001 to TomTom (who went by GDT at the time), allowed the state to own whatever was built. In 2008, TomTom's contract ended and NAVTEQ was awarded a contract to continue to update and maintain the street data.
- ★ Program has now developed/licensed a single, statewide street centerline layer. These data are available to other agencies that are able to consume them to support multiple applications. In addition, county and local government GIS/Transportation initiatives are also provided access to these data.
- ★ A web portal where counties can upload/download data has been created. Submitted data are verified and incorporated in to the working set and then disseminated back to State and other entities such as NAVTEQ.

State DOT

Kentucky: Linkage of the Transportation Centerline to HPMS, other route-dependent datasets and E-911

- ★ In the late 1990's the Kentucky State Public Centerline project was originally conceived by the Kentucky Department of Transportation (KDOT) as a way to derive better statistical information and analytical products from all of the centerline data for the State. KDOT realized very early on that there was a need to move the State's geospatial data infrastructure in to a geographic information system (GIS) powered by a data model compiled entirely by linearly referenced and routable data.

- ★ Tremendous effort was put forth to contract with Area Development Districts (ADDs) from around the State to gain proper funding and the momentum needed to move forward with the project to collect all the centerline data from around the state.
- ★ These data became the foundation data layer that could be used by other agencies within the state, the Federal Highway Administration (FHWA) as well as the general public. These data and related activities cover original GPS collection, data dissemination, a recurring update cycle, population of the statewide E-911 repository and linkages between other data sources. The versatility and quality of these data would not have been possible without a high level of collaboration between all stakeholders within the State.
- ★ The resulting efforts have made for seamless submission to HPMS and help to enhance its performance and accuracy

State GIS Office

Michigan: Example of a State GIS Office Assisting the Michigan DOT

- ★ The Michigan State GIS office is currently undergoing an effort called the Transportation Data Stewardship Enhancement Plan. This initiative has been accomplished under a project funded as part of the National Spatial Data Infrastructure (NSDI), Cooperative Agreement Program (CAP) Category 5. The CAP grant program is administered by the Federal Geographic Data Committee (FGDC) housed within the U.S. Geological Survey (USGS).
- ★ The Enhancement Plan defines a framework and specific initiatives to enhance and expand the Michigan Geographic Framework (MGF) transportation data themes through building an environment that encourages broad participation through shared responsibility, shared costs, shared benefits, and shared control.
- ★ The program utilizes five full time staff members who work constantly to maintain the data through the use of standardized models and systematic workflows from the county level up to the State. These workflows help to identify changes in the road system and reduce the amount of error in the final data set. Because of the strict nature and use of the State data model, it has been reported that the State's submission to HPMS has had no errors over the past several years.
- ★ The Michigan State GIS office has assembled a robust and accurate road centerline that covers a majority of the State. These data meet the business requirements and accuracy standards for Michigan DOT. The data are also wholly owned by the State and freely disseminated without any vendor licensing restrictions or reliance on external partnerships.

Regional & Interstate Road Inventories

In addition to state-specific efforts, there have been initiatives that take a multi-state regional approach, or an intra-state regional approach. The examples profiled in this section include:

I-95 Corridor: Example of Multi-state Data Assemblage Challenges

- ★ In support of the I-95 Corridor Coalition, Cambridge Systematics is coordinating the development of a Corridor-wide information system that consolidates existing state roadway

network databases into a single multi-state roadway network to guide regional transportation planning and emergency management efforts.

- ★ The consolidated road network is comprised of the ‘best publicly-available’ road centerline databases from each of the 16 states and the District of Columbia, who are members of the I-95 Corridor Coalition. The individual state roadway databases are ‘stitched together’ at the state borders to form a topologically integrated network that can be used both for network analysis and for overlaying other data of interest, such as crashes, traffic, roadway conditions, and planned improvements.
- ★ Many variations in data contents and consistency for road datasets were encountered from state-to-state; but generally, useful and reasonably accurate road features were available to produce a public domain road network for the corridor that met the requirements of the project.
- ★ Doing this once was the “easy part”; the “hard part” is doing this on a regular, *repeatable* basis to keep the road network updated and current.
- ★ Looking back project participants observed that an alternative approach using a stripped down commercial roadway centerline network as a framework might have been easier. Such an approach would have relieved integration requirements, and improved the consistency and convenience of updates. The challenge with such an approach would have been ensuring and maintaining public domain accessibility, with no license restrictions to inhibit use.

Washington Pooled Funds: Example of a Multi-state, Regional Effort

- ★ The Washington State Transportation Framework project (WA-Trans) is an exemplary project for cooperation and partnership across all levels of government, including 8 federal agencies, 7 states, 14 Washington State agencies, 23 counties, 10 cities, 9 tribal governments, and 20 other private and public entities, to build a framework transportation data layer.
- ★ The primary goal of this project is to build a statewide transportation database using a continuously evolving and improving collaborative effort. WA-Trans has been working in cooperation with six other state departments of transportation to develop computer-based tools that facilitate transportation data sharing and integration. The computer-based tools portion of the project has been financed with federal funds, specifically Transportation Pooled Funds (TPF).
- ★ The WA-Trans program has shown that a successful framework data program can be executed at the state level in which data can be collected from a local level, integrated at a state level, and shared to all project participants while saving money and benefiting the users at all levels of government. In addition, having individual states coordinate with the local government agencies within their states is a model that has been successful and is a model that can be reproduced and expanded to create a national framework data set.
- ★ The incorporation of addressing into the WA-Trans program has proven that this collection of data plays a vital role in a Statewide Transportation Framework and addressing should be part of a national program to fully engage local government. Finally, it is critical to a state and/or a

national program to have adequate funding for not only infrastructure, tools, staffing and data, but also for outreach and communication efforts.

Northern Virginia Regional Routable Road Centerline

- ★ The Data Collection and Analysis project consisted of five jurisdictions in the Northern Virginia area, which are all Public Safety Answering Points (PSAP), as well as the Virginia Information Technology Agency (VITA) and the Virginia Department of Transportation (VDOT). All partners worked in active collaboration to develop a routable centerline data standard and data set usable by *computer-aided dispatch* (CAD) systems.
- ★ The purpose of this project is to enhance Virginia Geographic Information Network (VGIN) road centerline (RCL) to create a regional data set capable of supporting routing, geocoding, and persistent updates to local 911 map systems. It will allow for design, development, updating, and population of an enhanced RCL which will fully support each individual CAD system for data outside their own jurisdiction, while not forcing them to change the data model currently used in CAD.
- ★ The VGIN RCL project is considered a huge local success because of the communication and handshaking that occurs between the counties and the state DOT. This is an ongoing project that will eventually have a seamless flow from participating cities and counties up to the state and then back again to complete the round trip. Additional work on the project includes the development of maintenance tools and the integration of regional data into CAD systems.

Strengths & Weaknesses Of Current Situation (TFTN)

Strengths

- ★ Clear data theme responsibility for USDOT in OMB A-16 and need for increased collaboration across Federal agencies on geospatial data coordination.
- ★ Common interest across Federal agencies in a single data set for road centerlines for the nation, for all roads.
- ★ Widespread support across diverse stakeholders for the TFTN concept.
- ★ Availability of practical, operational models and best practices for statewide road inventories. Key best practices include collaborative approaches involving counties and also a multi-purpose outlook that involves transportation interests as well as other key stakeholders such as the 911 community.
- ★ Availability of several distinct alternatives to meet TFTN requirements

Weaknesses

- ★ Duplication of effort and spending at the federal level
- ★ The total amount of money currently being spent on road centerlines is unknown
- ★ Federal data set maintenance schedules not frequent enough for many local, regional and state uses.

- ★ State led road centerline efforts inconsistent across the country and can include duplication of effort and spending
- ★ Traditional state DOT data use does not consider locality needs for addressing and public safety
- ★ Accuracy and completeness challenges for rural area data sets
 - Particularly problematic for public safety use where accurate addressing is required
 - Private sector data strong in high demand urban areas but weaker in low demand rural areas

Opportunities & Challenges (TFTN)

Opportunities

- ★ Recognition within USDOT that nationwide roads, not just Federal-aid roads, are a business requirement, for example:
 - Mapping and displaying accident locations for Safety applications
 - Mapping and displaying asset inventories (e.g. bridges)
- ★ Increasing recognition by state DOTs that statewide road inventories are important and valuable for meeting mission requirements, especially in the context of HPMS, Bridge Inventory, and Safety applications
- ★ Next Generation 911 (NG911) is a potential driver for improved road centerline and address data quality
- ★ Momentum from data.gov and other initiatives to encourage open and transparent government and freely available and free-flowing government data

Challenges

- ★ Road data changes frequently and needs regular update, for instance annual, to keep current
- ★ Interagency/intergovernmental collaboration and the coordination of funding across agencies requires new relationships, agreements, and approaches
- ★ The pace of change in government tends to be slow, while the pace of change amongst commercial companies and private citizens can be very fast, especially when it comes to adopting new technology and innovative applications. Accelerating change in government practices is a particular challenge, and bureaucratic resistance to change tends to be high.
- ★ Inadequate funding to address requirements and achieve desirable outcomes

Strategic Goal (TFTN)

The overarching strategic goal for Transportation for the Nation is to:

Commence the development of **comprehensive, publicly available, nationwide transportation data sets**. Ultimately, Transportation for the Nation (TFTN) will encompass data sets covering multiple modes of transportation, however, the initial focus will be on producing a **road**

Vision (TFTN)

Given the complexity of roads data and the extremely wide variety of uses for such data (see Section 1.2), it is recognized that Transportation for the Nation by itself cannot meet the needs of all road data consumers. However, in light of the large amounts of existing, overlapping effort (see Section 1.3) aimed at creating road data, TFTN does aim to establish **shared baseline geometry** and **basic attribute** content that can be utilized by and built on by specific constituencies and users. The creation of TFTN should reduce redundancy in road data creation and maintenance thereby conserving resources that may enable investments in data quality improvement, data updating and value added complements to the baseline.

The Common Baseline

Transportation for the Nation will provide a common foundation that can be built on by a variety of public and private sector organizations. In order to limit complexity and facilitate rapid and efficient development, the common baseline should be as simple as possible. In this manner it can provide a lowest common denominator for the wide variety of road data uses. Potentially, the common baseline for TFTN could be as simple as:

- ★ Road centerline geometry for **all roads**, plus
- ★ Basic road centerline attributes that might include:
 - Persistent Road ID number
 - Road name
 - Road functional classification
 - Road status (e.g., open/closed to public traffic²)
- ★ Address range that can be used for location finding and to facilitate vehicle routing on road centerline network

It should be noted that there are varying opinions on whether, or not address ranges should be included in the common baseline. Given the fact that the original NSGIC vision for TFTN included addressing and given that TIGER, OSM and commercial centerline data sources include addressing, it is recommended that addressing be part of the common baseline.

In addition, it should be noted that while USDOT has a program orientation that can be focused on “public roads” or “public mileage” there are classes of “private roads” that fulfill important public functions, or require emergency response and thus belong in TFTN. Examples include roads on university campuses and ring roads associated with shopping malls. These types of roads need to be considered in the detailed planning that would follow this strategic plan.

² For example, some US Forest Service roads are never open to the public.

Value-Added Additions to the Baseline

If a common baseline was in place, a wide variety of stakeholders could build on this baseline to create more advanced data sets that would meet specific business requirements. Important examples of value added additions to a TFTN baseline that were identified in this study include:

- ★ **Linear referencing systems (LRS)** that can be used – most often by state and local Departments of Transportation – for the assignment of locations and attributes along a road centerline network
- ★ **Additional road attributes** that can be used to track business data associated with roads. Examples include pavement condition, speed limits, lanes and parking.
- ★ **Enhanced cartographic display** for variable road symbology, scale dependent labeling and the placement of highway shields
- ★ Coding to **identify road segments that constitute** political, administrative or census **boundaries**
- ★ **Advanced network topology** and attributes to enable **robust vehicle routing** including turn restrictions, vehicle restrictions, one-way streets and the integration of real-time traffic feeds.

One stakeholder from the private sector used the analogy of a fully featured road centerline being a “hamburger with special sauce and fixings.” Using this analogy, and as illustrated below, TFTN would comprise the beef patty and any number of additional condiments could be piled on top by consumers of the burger/data.