Timmons Group Introduction

Presenter: Russell Minich, Principal Timmons Group

- 50+ Years Serving Government and Private Industry
- 350+ Employees
- Geospatial, Engineering, Surveying
- 6 US offices thought out U.S.
- Award Winning ESRI Business Partner
Strategic Plan Update
Project Overview

Project Goals

- Insure GIS alignment with VDOT Mission
- Update / Define VDOT Business Unit geospatial analysis and data requirements
- Provide recommendations for improving E-GIS Team service to citizens and VDOT Business Units
Strategic Plan Update

Project Overview

Project Work Process

- Interviews
  - Business Units
  - Enterprise GIS Staff
  - IT Staff
  - Other State DOTs (Best Practices)

- Analysis
  - Town Hall Results / Interview Results
  - Strategy Development

- Recommendation Development
VDOT Mission

- VDOT will plan, develop, deliver, operate and maintain, on time and on budget, the best possible transportation system for the traveling public.
The VDOT E-GIS Program will facilitate turning data into actionable information through the development and implementation of geospatial systems and provisioning of supporting data.
VDOT E-GIS Goals

- Provide geospatial solutions to identified business problems
- Provision and manage identified key spatial data
- Facilitate coordination of VDOT geospatial solutions through committee
- Leverage internal capabilities and integration points
  - Data Warehouse
  - Roadware Imagery
Strategic Plan Components

Virginia Public & VDOT Business Units

- Governance
- Infrastructure
- COTS Software
- Data and Metadata
- Integration
- Web Services
- Custom Applications
Current - Centralized
- E-GIS manages the majority of the spatial information within the DOT
- Centralized servers
- Data access and control by E-GIS Team
Data Management Framework

- Recommended – Hybrid Model
  - Centralized servers
  - E-GIS Team
    - maintains base layers
    - facilitates access to GIS data
    - facilitates integration with data warehouse
  - Data custodians maintain business unit data
  - Select business unit data replicated on centralized servers
Future – Hybrid (direct editing e.g. NOVA)
- E-GIS staff responsible for base layers
- Business Unit data owners maintain their data
- Centralized data access through Enterprise GIS Data Repository
Future – Hybrid (disconnected editing e.g., TMPD)
- Remote / replication editing scenario
- Replication can be controlled to manage how pushes / pulls are completed (intervals / content etc).

Data Management Framework
Data Management Framework

- **Future – Hybrid (Mobile)**
  - Use of ArcGIS Mobile for bi-directional data update / visualization
  - Perform O&M
  - Capture New Features
  - Existing Feature Validation
ArcSDE Instances / Data Promotion

- Data edited / replicated to other business units would be branched from the “Edit” Instance

- Once accepted it would move through to production being actively tested against applications and other services
These production applications will integrate spatial content (with minimal business attributes) to data warehouse-managed content (business information).
Current VDOT Architecture

- Generalized view of current VDOT architecture supporting GIS applications
- Many single points of failure
- Few monitoring points for servers or services
Future VDOT Architecture

- Generalized view of future VDOT architecture

- **No** single points of failure

- Current efforts underway to provide fail-over

- Effort needs to be directed toward **scalability** / **load-balancing**
Strategic Plan Components

Virginia Public & VDOT Business Units

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[Diagram with a pyramid structure showing the hierarchy of components]
Geospatial Applications
COTS Applications - Current Situation

- Primarily an ESRI shop
- Limited Oracle Spatial usage
- Recent introduction of Microsoft Virtual Earth (VE) technologies
- Limited KML / Google Maps usage
Geospatial Applications
COTS Applications - Current Situation

- **ESRI Technologies Functional Usage**
  - Data Storage – ArcSDE
  - Data Management / Editing – ArcGIS Desktop
  - Visualization – ArcIMS
  - Spatial Analysis – ArcGIS Server / Desktop
  - Mobile Applications – ArcPad / ArcGIS Mobile (in development)

- **Usage**
  - ~Enterprise-wide
Geospatial Applications
COTS Applications - Current Situation

Oracle Technologies
- Data Storage – Oracle Spatial
- Data Management / Editing – Add-a-Shape CEDAR
- Visualization – None
- Spatial Analysis – None
- Mobile Applications – None

Footprint
- Currently only supporting CEDAR

* Includes ESRI technologies in the CEDAR solution for visualization
Geospatial Applications
COTS Applications - Current Situation

- Virtual Earth (VE) Technologies
  - Data Storage – None
  - Data Management / Editing – None
  - Visualization – Internet Explorer
  - Spatial Analysis – Routing / Trip Planning
  - Mobile Applications – None

- Footprint
  - Currently supporting 511 (in development)
  - Dashboard 3.0 (in development)
  - Trucking Website (in development)

* Solutions require ESRI technologies for backend data management
* Solutions require ESRI-based web-services for data delivery
Revisit the applicability and viability of VE / Google

- Potential as visualization interface
  - Need to make sure business requirements are supported

- Many limitations exist within VE
  - This has been seen with 511 VE
  - These are just now surfacing as its limits are being pushed
Geospatial Applications
COTS Applications - Recommendations

- Continue use of ESRI-based data maintenance applications

- Develop an implementation plan to migrate to ESRI’s ArcGIS Server suite across the next 1-3 years
  - Improved cartography / symbology
  - Improved mobile solutions with ArcGIS Mobile
  - ArcGIS Server will replace all current ArcIMS-based web sites
  - Improved geospatial networking and routing capabilities

* Will require architectural changes
* Performance currently an issue with ArcGIS Server – but can be solved with correct arch / due-diligence
Geospatial Applications
COTS Applications - Recommendations

- Research various technologies for imagery management outside of ArcSDE
  - Should be a near-term activity
  - 5.4 TB coming in new VA Statewide imagery set
  - ArcSDE is not a good option for storage / management
- Perform Vendor Shootout
  - ESRI Image Server
  - ERMapper Image Web Server
  - Intergraph TerraShare Raster
  - VGIN Web Services a possibility
    - Will potential require re-architecting many existing VDOT applications and services
Strategic Plan Components

Virginia Public & VDOT Business Units

- Governance
- Infrastructure
- COTS Software
- Data and Metadata
- Integration
- Web Services
- Custom Applications
Data – Current Situation

- E-GIS maintains approximately 130 GIS Base Data layers in production
- Many of these are EXTERNAL data sets (Federal etc)
- Many critical VDOT GIS data layers do not exist
- In some case, core business needs not supported
  - Geocoding and routing
  - Asset Management / CMMS
Current Enterprise GIS

- Metadata - Current Situation
  - Static HTML files built ~manually
  - Creation of content and publication to server require TIME and EFFORT
  - Integration of content into other business applications takes TIME and EFFORT or does not happen
Business Unit Data
Requirements

- Requirements Gathering Process
  - Collected from Business Unit Interviews
  - Presented, Discussed, and Ranked by Business Units / ITD at initial Town Hall meeting
Recommendations - Data Acquisition

- Derived Ranking from:
  - User ranking
    - Assigned weights to ranking
  - Considered time and cost
    - Acquisition
    - Maintenance
  - Organized by start year

<table>
<thead>
<tr>
<th>Cost Impact</th>
<th>Cost To Acquire</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>$100K +</td>
</tr>
<tr>
<td>2</td>
<td>$50K - $99K</td>
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<tr>
<td>3</td>
<td>3 = under $50K</td>
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<table>
<thead>
<tr>
<th>Time Impact</th>
<th>Time To Acquire</th>
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<tbody>
<tr>
<td>1</td>
<td>Over 12 months of work</td>
</tr>
<tr>
<td>2</td>
<td>Between 6 &amp; 12 months</td>
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<tr>
<td>3</td>
<td>Under 6 months</td>
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<table>
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<tr>
<th>User Rank</th>
<th>Weight Factor</th>
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<td>#4</td>
<td>2</td>
</tr>
<tr>
<td>#5</td>
<td>1</td>
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</table>
# Recommendations - Data Acquisition

<table>
<thead>
<tr>
<th>Data</th>
<th>Recommendation</th>
<th>Cost Impact</th>
<th>Time Impact</th>
<th>By Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pavement Information</td>
<td>Add pavement info into integrator.</td>
<td>2</td>
<td>1.5</td>
<td>1</td>
</tr>
<tr>
<td>LRS - Complete LRS</td>
<td>Complete LRS developed from HTRIS/RNS</td>
<td>2.5</td>
<td>2.5</td>
<td>1</td>
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<tr>
<td>Soils Data</td>
<td>Add SURGO Soils data to Data warehouse</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>RCL - Road addressing</td>
<td>Provide Road addressing (name and range) to support geocoding. ROUTE numbers and Addressing cross-referenced</td>
<td>2.5</td>
<td>2.5</td>
<td>1</td>
</tr>
<tr>
<td>Weather Information</td>
<td>Add Near real-time weather feed Capability to GIS</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Imagery - Statewide</td>
<td>VBMP 2006/2007 digital ortho imagery update</td>
<td>2</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Political boundaries</td>
<td>Jurisdictional political boundaries (Counties, Cities, Towns)</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
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</tr>
</thead>
<tbody>
<tr>
<td>Parcels - VDOT owned</td>
<td>Add Residual and surplus VDOT owned parcels</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>VDOT ROW</td>
<td>Add VDOT Right-Of-Way</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Elevation - Digital elevation data</td>
<td>Provide Elevation - DTM, TIN, Contours</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Parcels - Tax Parcels</td>
<td>Add Tax Parcel Data including geometry, ownership, value</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CADD drawings and Microfiche of old Design plans.</td>
<td>Provide access to CAD drawings and Microfiche of old Design plans.</td>
<td>2</td>
<td>1.5</td>
<td>2</td>
</tr>
<tr>
<td>RCL - Road condition ratings</td>
<td>Provide general road condition ratings</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Routing - Roadway status information</td>
<td>Provide Real time or near real time roadway status information</td>
<td>2</td>
<td>2.5</td>
<td>2</td>
</tr>
<tr>
<td>Bridge Condition assessment information</td>
<td>Consolidate and provide bridge condition assessment information - Data from HTRIS, PONTIS – bridge inspection system.</td>
<td>2</td>
<td>1.5</td>
<td>2</td>
</tr>
<tr>
<td>Routing - hauling permit and truck route mapping</td>
<td>Visualizing paths of hauling permits and truck routes. Referenced by route miles</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Hurricane Gates</td>
<td>Evacuation Route reverse flow gates</td>
<td>3</td>
<td>2.5</td>
<td>2</td>
</tr>
<tr>
<td>Routing - Evacuation Routes</td>
<td>Emergency Evacuation Routes</td>
<td>2.5</td>
<td>2.5</td>
<td>2</td>
</tr>
</tbody>
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</thead>
<tbody>
<tr>
<td>RCL - FHW/FEMA designation</td>
<td>Ability to view VDOT domain RCL designated as either FWY or FEMA routes. this should come from the HTRIS data</td>
<td>2.5</td>
<td>2.5</td>
<td>3</td>
</tr>
<tr>
<td>Survey Control monumentation to overlay on imagery</td>
<td>Survey Control monumentation to overlay on imagery</td>
<td>2.5</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Evacuation Routes</td>
<td>Emergency Evacuation Routes</td>
<td>2.5</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Karst geology</td>
<td>Karst geology formation location</td>
<td>2.5</td>
<td>2.5</td>
<td>3</td>
</tr>
<tr>
<td>Non-VDOT domain Roads</td>
<td>Add non-VDOT domain roads including local and federal land roads.</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Underground Storage Tanks</td>
<td>Location and attribute information on underground storage tanks</td>
<td>3</td>
<td>2.5</td>
<td>3</td>
</tr>
<tr>
<td>Routing - Freight data</td>
<td>Freight data linked to the VDOT RCL, Would like to know how many of what type of loads are going across the bridge</td>
<td>1.5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>sound wall inventory</td>
<td>sound wall inventory</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Emergency Shelter locations</td>
<td>Federal, State, and local Emergency shelter locations</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
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</tr>
</thead>
<tbody>
<tr>
<td>Bridge information</td>
<td>Add bridge information into integrator</td>
<td>3</td>
<td>2.5</td>
<td>4</td>
</tr>
<tr>
<td>Hydro - Watershed boundaries</td>
<td>Watershed boundaries, (Hydrology Unit Code boundaries)</td>
<td>2.5</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Crash event attribute information</td>
<td>More attribute fields for Crash information in Integrator.</td>
<td>3</td>
<td>2.5</td>
<td>4</td>
</tr>
<tr>
<td>Soil boring locations</td>
<td>Historical, current and future boring locations and attributes</td>
<td>2.5</td>
<td>2.5</td>
<td>4</td>
</tr>
<tr>
<td>Demographics – Employers</td>
<td>Population data – Employers</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Hydro -Ground water information</td>
<td>Ground water information</td>
<td>2</td>
<td>2.5</td>
<td>4</td>
</tr>
<tr>
<td>Elevation - LiDAR</td>
<td>LiDAR – 3d point model</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>RPA/RMA boundaries</td>
<td>Local Ches. Bay RPA/RMA locations</td>
<td>2</td>
<td>1.5</td>
<td>4</td>
</tr>
<tr>
<td>Demographics - Population density</td>
<td>Population data – density</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Storm Surge Models</td>
<td>Modeling to support planning and event management</td>
<td>1</td>
<td>2.5</td>
<td>4</td>
</tr>
<tr>
<td>Demographics – Shopping and retail sales</td>
<td>Population data – Shopping and retail sales</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>RCL - Detours</td>
<td>Pre-defined detours for each interstate exit</td>
<td>1.5</td>
<td>1.5</td>
<td>4</td>
</tr>
</tbody>
</table>
# Recommendations - Data Acquisition

<table>
<thead>
<tr>
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<th>Recommendation</th>
<th>Cost Impact</th>
<th>Time Impact</th>
<th>By Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utilities (Water, Sewer, fiber, etc…)</td>
<td>Add Public and private utilities (Water, Sewer, fiber, etc.)</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>VDOT Fuel Sites with associated attribute information</td>
<td>VDOT Fuel Sites with associated attribute information</td>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>RCL - Carriageway road representation on undivided hwy</td>
<td>Current RCL has only 1 CL on undivided highway. Need carriageway (travel direction) in all cases except 2 lanes undivided.</td>
<td>1.5</td>
<td>1.5</td>
<td>5</td>
</tr>
<tr>
<td>VDOT equipment Repair shops</td>
<td>Want location, services and hours for VDOT repair shops mapped.</td>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>USGS Gauge locations</td>
<td>USGS Gauge locations</td>
<td>2.5</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>
## Recommendations - Data Process / Workflow

<table>
<thead>
<tr>
<th>Task</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish Committee to review and implement data recommendations</td>
<td>1</td>
</tr>
<tr>
<td>Define Data Interoperability Standards</td>
<td>1</td>
</tr>
<tr>
<td>Coordinate with AMD on Roadware Asset Inventory Integration</td>
<td>1</td>
</tr>
<tr>
<td>Define Requirements for Routing Data Sets / Options</td>
<td>1</td>
</tr>
<tr>
<td>Incorporate ArcGIS Metadata Tools and XML Metadata into Standard Processes</td>
<td>1</td>
</tr>
<tr>
<td>Define process for incorporating as-built CADD file Features into GIS repository</td>
<td>1</td>
</tr>
<tr>
<td>Leverage CAD Files for GIS feature Creation</td>
<td>3</td>
</tr>
<tr>
<td>Define Interface to Data Warehouse from GIS</td>
<td>1</td>
</tr>
<tr>
<td>Leverage Data Warehouse for Business Information</td>
<td>2</td>
</tr>
<tr>
<td>Integrate Roadware Image viewer with GIS</td>
<td>2</td>
</tr>
</tbody>
</table>
Strategic Plan Components

Virginia Public & VDOT Business Units

Governance

Infrastructure

COTS Software

Data and Metadata

Integration

Web Services

Custom Applications

Solutions
Sources of Information

• Data exist in many places within VDOT
• This includes Business Applications and GIS
• Connectivity between these systems does not always exist
Integration Options

- Various options for integrating data exist –
- Directly linking GIS to each disparate Business Application
- **BAD Model**
Integration Options

A BETTER APPROACH

Integrate to business applications through the Data Warehouse (DW)

- DW’s role is an integration point
- Includes exception reporting / ETL tools
- Reporting Tools
- Offloads heavy lifting from GIS team
- Aligns with VDOT’s overall Strategic Plan
Source System of Record

Source A

- Identify Systems
- Identify required attributes
- Identify System of Record
- Integrate through Warehouse

Source B
Other Sources of Information

Other Valuable Sources of Data
• CADD Repository (Falcon)
• Microfiche Drawings
Example: Bridges
Spatially Managed in GIS
With Linkages to other Systems and Repositories
Integration with other Systems and Repositories

Key to Decision-making
Enhanced Decision Making

INFORMATION

- Inspections
- Maintenance
- Financials
- Specifications / Limits
- Projects / SYP
CAD Drawing Visualization within GIS

Query by UPC
Convert DWGs
By drawing type
CAD Drawing Visualization within GIS - Enhancement

Query by box
Pull back UPCs
## Recommendations

<table>
<thead>
<tr>
<th>Task</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define Interface to Data Warehouse</td>
<td>1</td>
</tr>
<tr>
<td>Integrate with Data Warehouse</td>
<td>2</td>
</tr>
<tr>
<td>Establish better relationship with Data Integrity Committee (Source of Record issues)</td>
<td>1</td>
</tr>
<tr>
<td>Work closely with ESB / SOA initiative group to ensure compliance</td>
<td>1</td>
</tr>
<tr>
<td>Revisit the CADDVIZ initiative</td>
<td>1</td>
</tr>
<tr>
<td>Research Document Management System / scanning for microfiche capture</td>
<td>3</td>
</tr>
</tbody>
</table>
Strategic Plan Components

Governance

Infrastructure

Data and Meta Data

Integration

COTS Software

Web Services

Custom Applications

Virginia Public & VDOT Business Units
VDOT Geospatial Direction

- Web Services - current situation
  - Expanding set of GIS web services exists
  - Most web services that exist were built to solve a specific business problem for a specific application (VOIS/511)
  - No management tier or architecture on top of the existing web services
    - Scalability
    - Availability
    - Security
    - Performance testing tools
    - None of these exist
Geocoding Services

- Function
  - Locating using an address or address using XY

- Types
  - Structure-based
  - Parcel-based
  - Road range-based
    - Intersection
  - Reverse geocoding

- Returns
  - Coordinates (x/y)
  - Map
  - Address candidates
VDOT Geospatial Functions

- Proximity Services
  - Function
    - Locate features from a point of origin
  - Types
    - Find Nearest (number to find)
    - Buffer (distance)
  - Returns
    - Features, coordinates and business information
    - Map
VDOT Geospatial Functions

- Overlay Services
  - Function
    - Cores through data layers returning underlying layer information
  - Types
    - Basic Intersect
    - Detailed Intersect
    - True Clip
    - Density Estimate
  - Returns
    - Features
    - Business information
    - Map
VDOT Geospatial Functions

Network Routing Service

Function
- Determines a route path based on impedances, speed limits, etc.

Types / Input
- Impedance – A cost Factor (time, speed, etc..)
- Travel Directionality – Uni or Bi directional
- Start / End points
- Stops – Multi stop Routing
- Connection Points – Network tracing

Returns
- Turn directions
- Map
Web Function Results

- **Derived Ranking from:**
  - User ranking
  - Assigned weights to ranking
- **Considered**
  - Development impact
  - Time to acquire
  - Source data availability

### User Rank

<table>
<thead>
<tr>
<th>User Rank</th>
<th>Weight Factor</th>
</tr>
</thead>
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<tr>
<td>#2</td>
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<td>1</td>
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### Development Impact

<table>
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<th>Development Impact</th>
<th>Development Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Difficult</td>
</tr>
<tr>
<td>2</td>
<td>Moderate</td>
</tr>
<tr>
<td>3</td>
<td>Easy</td>
</tr>
</tbody>
</table>

### Time Impact

<table>
<thead>
<tr>
<th>Time Impact</th>
<th>Time To Acquire</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Over 12 months of work</td>
</tr>
<tr>
<td>2</td>
<td>Between 6 &amp; 12 months</td>
</tr>
<tr>
<td>3</td>
<td>Under 6 months</td>
</tr>
</tbody>
</table>

### Availability Impact

<table>
<thead>
<tr>
<th>Availability Impact</th>
<th>Available Source Data and Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Not Available - Need to Create</td>
</tr>
<tr>
<td>2</td>
<td>Available - Needs Update</td>
</tr>
<tr>
<td>3</td>
<td>Available - Ready</td>
</tr>
</tbody>
</table>
Web Function Results

<table>
<thead>
<tr>
<th>Geospatial Services</th>
<th>Description</th>
<th>User Rank</th>
<th>Available Source Data and Infrastructure</th>
<th>Dev. Effort</th>
<th>Imp. Effort</th>
<th>Total Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>True Clipping</td>
<td>Returns that a “hit” occurred and includes the HIT PORTION of the associated attributes for “hit” features.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LRS</td>
<td>Linear Reference System</td>
<td>53</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse Geocoding</td>
<td>Returns a location’s address based on road name and address range features</td>
<td>51</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structure Geocoding</td>
<td>Determines a location based on a point address features</td>
<td>47</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parcel Address Geocoding</td>
<td>Determines a location based on a polygon address features</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smart Routing</td>
<td>Dynamic routing based on road conditions using the road network, attributes on each line segment, and conditions.</td>
<td>46</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Find Nearest</td>
<td>Inspects features from the layer of interest to determine which feature is closest.</td>
<td>36</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Down-stream Network Tracing</td>
<td>Locate all features downstream from a given stream segment</td>
<td>35</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density Estimation</td>
<td>Returns that a “hit” occurred and includes the ESTIMATED HIT PORTION of the associated attributes for “hit” features.</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Named Intersection Geocoding</td>
<td>Determines a location based on road names and geometric intersections</td>
<td>23</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Up-stream Network Tracing</td>
<td>Locate all Features upstream from a given point</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Geospatial Services Description

<table>
<thead>
<tr>
<th>Geospatial Services</th>
<th>Description</th>
<th>User Rank</th>
<th>Available Source Data and Infrastructure</th>
<th>Dev. Effort</th>
<th>Imp. Effort</th>
<th>Total Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffer</td>
<td>Inspects features from the layer of interest to determine which features fall within the buffer extent.</td>
<td>17</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Drive Time Analysis</td>
<td>Determines the distance traveled along a network from a start point given the road network and attributes on each line segment.</td>
<td>18</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>7.6</td>
</tr>
<tr>
<td>Detailed Intersect</td>
<td>Returns that a &quot;hit&quot; occurred and returns attributes of hit features</td>
<td>16</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>7.2</td>
</tr>
<tr>
<td>Road Address Range Geocoding</td>
<td>Determines a location based on road name and address range features</td>
<td>12</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Basic Intersect</td>
<td>Returns that a &quot;hit&quot; occurred (Boolean)</td>
<td>12</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Multi-stop Routing</td>
<td>Determines the lease cost route to visit defined stops given the road network and attributes on each line segment.</td>
<td>12</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>5.2</td>
</tr>
<tr>
<td>Simple Routing</td>
<td>Determines the lease cost route given the road network and attributes on each line segment.</td>
<td>11</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4.8</td>
</tr>
</tbody>
</table>
Service Oriented Architecture

- Supports the Web Function deployment and use
Many applications have similar requirements.

It makes sense to build generic functions, expose them, and use across applications.

- Integrator II
- LandTrak
- TREGDS
- VOIS
- Other

Geocoding Web Service
Create a set of reusable functions

- Standard inputs
- Returns specific response
- Map
- Coordinate
- Address

Functions access shared data

Chain together to solve business

Can be used by spatial and non-spatial systems

Intranet or Internet

- Add Event Widget
- Geocode Widget
- Map Widget
The same web services used for the web-based application will be used for the mobile component.

ROI goes way up.
Business Requirement
Locate a structure and get driving directions

75 Main St

Head north on S 14th St/US-360 0.3 mi
Turn right at E Broad St/US-250/US-33
Turn right onto Main Street
Recommendations

- **Custom Web Service Functions** – Moving forward
  - Focus on building “functions” to spatially enable the enterprise
  - Functions will be leveraged by GIS and non-GIS applications
  - Functions will be built in a generic manner
  - Functions will “chained” together to solve business problems
  - Prioritize development of web services
## Recommendations

<table>
<thead>
<tr>
<th>Task</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish Committee to review and prioritize App recommendations</td>
<td>1</td>
</tr>
<tr>
<td>Develop detailed function requirements, input, and output as part of implementation plan.</td>
<td>1</td>
</tr>
<tr>
<td>Focus more on “services” and less on “applications”</td>
<td>1</td>
</tr>
<tr>
<td>Define web services in a generic manner to support applications and business requirements</td>
<td>1</td>
</tr>
<tr>
<td>Perform due-diligence and requirements definition for Web Services Management Software and SOA framework</td>
<td>1</td>
</tr>
<tr>
<td>Revise system architecture to support management software and availability requirements</td>
<td>1</td>
</tr>
</tbody>
</table>
VDOT builds and maintains numerous custom applications that leverage spatial content.

- Many overlap in core functionality
- Most are “Viewing” intensive
- Few are “Decision” intensive
- Each requires care and feeding
- Each pulls computing horsepower
Custom Applications Recommendations

- Consolidate viewing intensive applications
  - Provides consistent user experience
  - Reduced overhead costs
  - Reduced computing resources
  - Shifts paradigm to “framework” from “one-off”

- Increase business unit decision support capabilities within custom applications
  - Reduce desktop GIS licenses and maintenance costs
  - Core to Mission Statement
  - Shifts paradigm from Data to Actionable Information
Leverage generic web services in new applications

- Provides a common framework for decision-making
- Empowers non-GIS applications with spatial decision support capabilities without the need for costly GIS tools
- Shifts paradigm to “framework” from “one-off”
Custom Applications
Recommendations

- Develop tools to manage map content and map services
  - Reduced overhead costs
  - Provides configuration management tools for map services
  - Helps GIS team manage mapping resources
Custom App - Integrator Current Status

- End User GIS portal for viewing VDOT and non-VDOT data
- Heavily used by business constituents
Custom App - Integrator
Current Status

- **Integrator** - current situation
  - Contains both useful and superfluous tools
  - Minimal reporting tools
  - Minimal decision support tools
  - Weak linkages to business information
  - No linkage to the Data Warehouse
  - Weak map-making and output capabilities
Custom App - Integrator

Recommendations

- Expand decision support functions, reporting, export and printing capabilities
- Include ability to add remote map services
  - Weather
  - Local Governments with parcel information / zoning
- Integrate with Data Warehouse
- Integrate with Falcon
  - Query by UPC to see all drawings / filtered drawings
  - Query spatially (i.e., drag a box on the UI) and have returned all projects in Falcon for this extent.
Custom App - Integrator

Recommendations

- Think - “framework” not “application”
- Think – “spatial portal” into
  - data warehouse
  - Falcon and other relevant information sources
- Enhance data query and discovery services
- Re-architect using generic web services and reusable components
- Include RoadWare Imagery in the new solution
Benefits:

- Provides consistent user experience
- Reduced overhead costs
- Reduced computing resources
- Shifts paradigm to “framework” from “one-off”
- Provides a common framework for decision-making
- Reduces desktop GIS licenses and maintenance costs
Strategic Plan Components

Virginia Public & VDOT Business Units

- Governance
- Infrastructure
- COTS Software
- Data and Metadata
- Integration
- Web Services
- Custom Applications
Governance

Definition:

“Assignment of decision rights & the accountability framework to encourage desirable behavior in the use of IT”
VDOT Geospatial Organizational Structure

- Current Situation
  - Centralized Data and Applications development
  - Limited Data Sharing btw. business units
  - Unclear roles and responsibilities for E-GIS
  - Minimal outreach and coordination through committees
Hybrid Model - Recommendation

- E-GIS Team
  - maintains base layers, servers, and software
  - provides training and analysis assistance to Business Units

- Business Unit Data Stewards
  - maintain business unit data
  - Select business unit data replicated on centralized servers

- Works well in with data warehouse environment
VDOT Geospatial Communications

- Communications - Current Status
  - No Agency Geospatial mission /goals
  - Business Unit Managers have had minimal planning input
  - Lack of E-GIS Team participation in Business unit project planning
  - Business Units unaware of existing GIS capabilities
Communications - Recommendations

- Establish E-GIS Program Mission
- Establish E-GIS Program Goals
- Schedule regular meetings with Business Unit Leadership (leadership level)
- Form User Groups / Committees
  - inter-divisional and multi-district/region
  - GIS Steering Committee
  - GIS Technical committee