

Maryland State Highway's Transportation Spatial Database

**A Common Data Foundation Supporting
GIS and CADD Interoperability**



Maryland State Highway Administration

ESRI UC August 2004

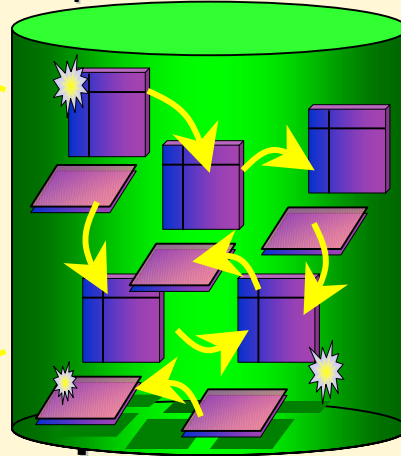
Today's Topics

- **The Transportation Spatial Database**
 - **Project Vision**
 - **Use Cases**
 - **Key Concepts**
 - **Architecture**
 - **Base Editing and Approval Process**
 - **Cartographic Production**
 - **Statewide Cooperative Centerline Program**
 - **Where We are Today**
 - **The Future**

Project Vision

**ArcGIS
Editing**

Spatial Database



**MicroStation
Editing**

DataViewer

**Cartographic
Publishing**

ArcIMS

Need Common Foundation: Data

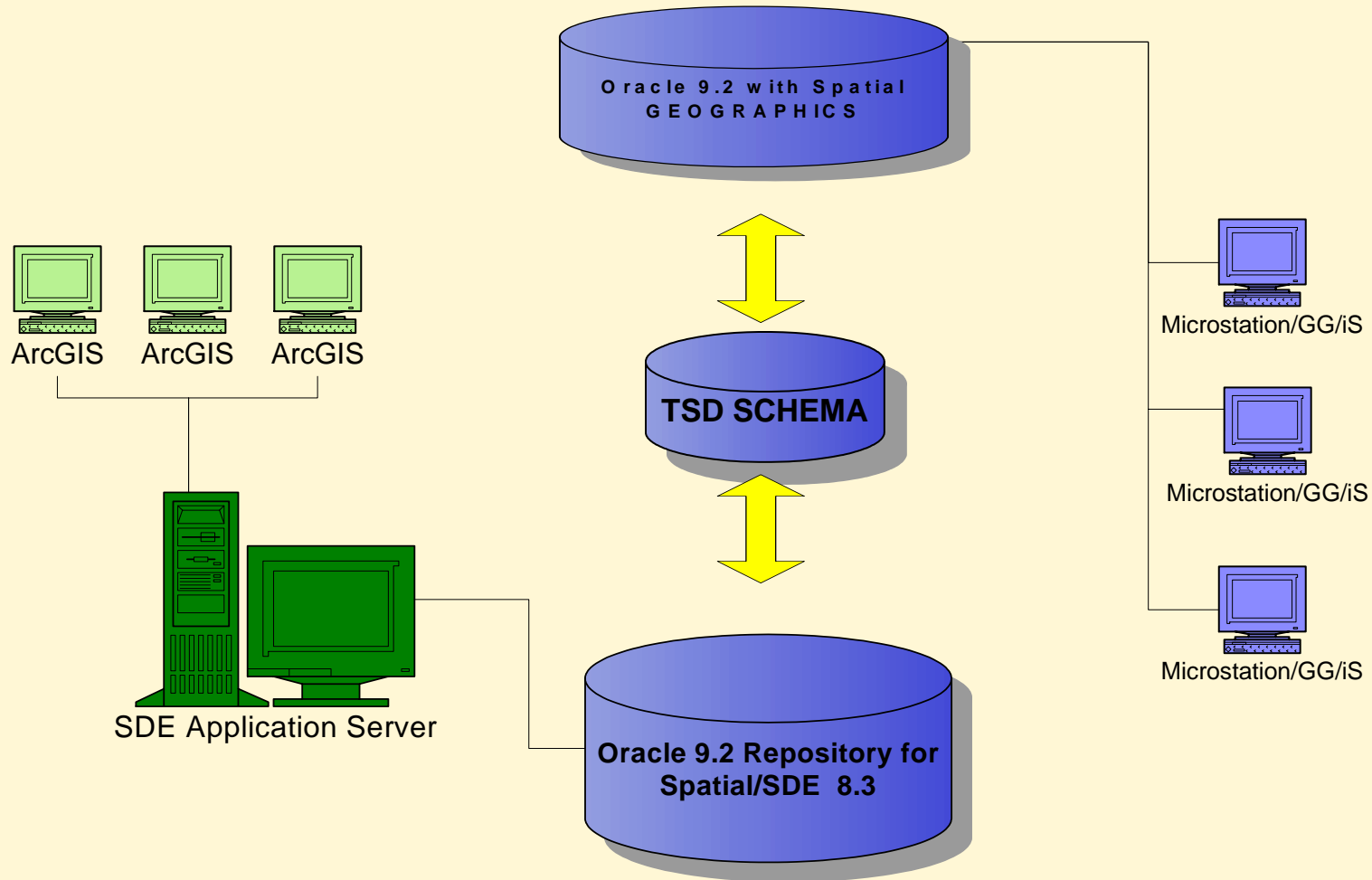
Use Cases Addressed In Model

- **Editing and Maintenance of Base Map Layers**
- **Editing and Maintenance of the Map Templates**
- **Route System Maintenance**
- **Temporality**
- **Projection Management**
- **Data Import and Export**
- **Map Production**
- **Data Query and Access**

TSD - Key Concepts

- **A Central Data Repository**
- **Interoperability - CAD and GIS**
- **Support Cartographic Production**
- **Support of GIS Analysis**
- **Efficiency/Ease of Use**
- **Security and QA/QC**

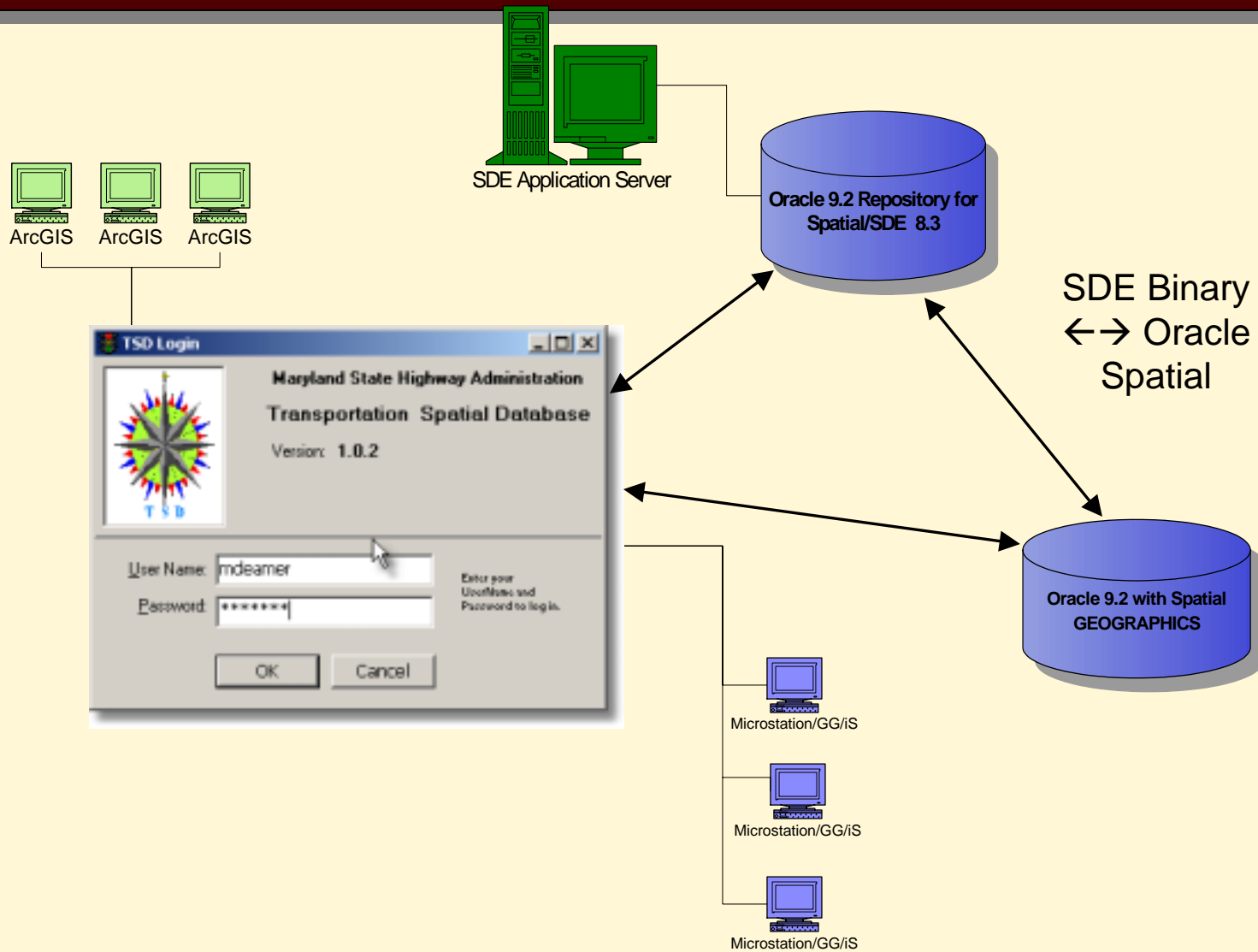
TSD Architecture



The TSD Application

- **Problem**: TSD requirements cannot be satisfied with an out-of-the box solution.
- **Solution**: A custom application written in MS Visual Basic and ESRI ArcObjects
 - Provides common interface for all users
 - Controls checkout/checkin / approval of data
 - Functionality based on defined user roles

TSD Application



A Central Data Repository

- **The Spatial Repository for all Cartography and GIS Products at Maryland SHA**
- **Base Data Concept – Most current & accurate**
- **Feature classes – Statewide, County, Other area**
- **Some Feature Classes Read Only**
- **Temporality - Retirement Tables**

Concept of “Base” Data

- **Base is Most Current Data**
- **Base is Most Spatially Accurate Data**
- **Base Edits Must Be Approved QA/QC**
- **Modified Features Go To Retire Tables**



Base Editing

- **Base Data is Checked Out for**
- **Editing Environment is ArcMap or Microstation**
- **Features Can be Added, Modified, or Retired**
- **Edits are Submitted for Approval**



Base Approval

Transportation Spatial Database - TSD

File Edit View Help

Workspace TSD Products Base Tables Base Check In

User: AllUsers

Feature Classes - Checked out

Feature Classes - Checked In

- POI_CIVIC - LGOUJY (ArcMap)
- POI_COMMUNITY - LGOUJY (ArcMap)
- POI_CONSERVATION_LANDS - LGOUJY (ArcMap)
- POI_CORRECTION_REHAB - LGOUJY (ArcMap)
- POI_GENERAL - LGOUJY (ArcMap)

TSD Base Layer: Edit Approval

Feature Class: Points of interest - Civic - P

Table Owner: W/P

Table Name: POI_CIVIC

User Name: LGOUJY

Checked Out: 6/15/2004 8:13:32 AM

Checked In: 6/25/2004 1:44:53 PM

Deviation Schema: TSDTEST

New Features (1) Modified Features (57) Rejected

Feature Name	Status
Barnesville Main Post Office	TSD...
Point of Rocks Main Post Office	TSD...
* Dealleville Main Post Office	TS...
* National Library of Medicine	TS...
* Poolesville Public Library	TS...
* Poolesville Town Hall	TS...
Frederick County Fire Department, Adamstown	TSD...
* Garrett Park Main Post Office	TS...
* West Bethesda Post Office	TS...
* Point of Rocks Town Hall	TS...
* Montgomery County Fire Department, Bethesda 26	TS...

Check here to show only for features where Validated=1

Select All

Preview Attributes Compare Approve Reject Complete check in... Done/Cancel

Preview

Base Feature Modified Feature

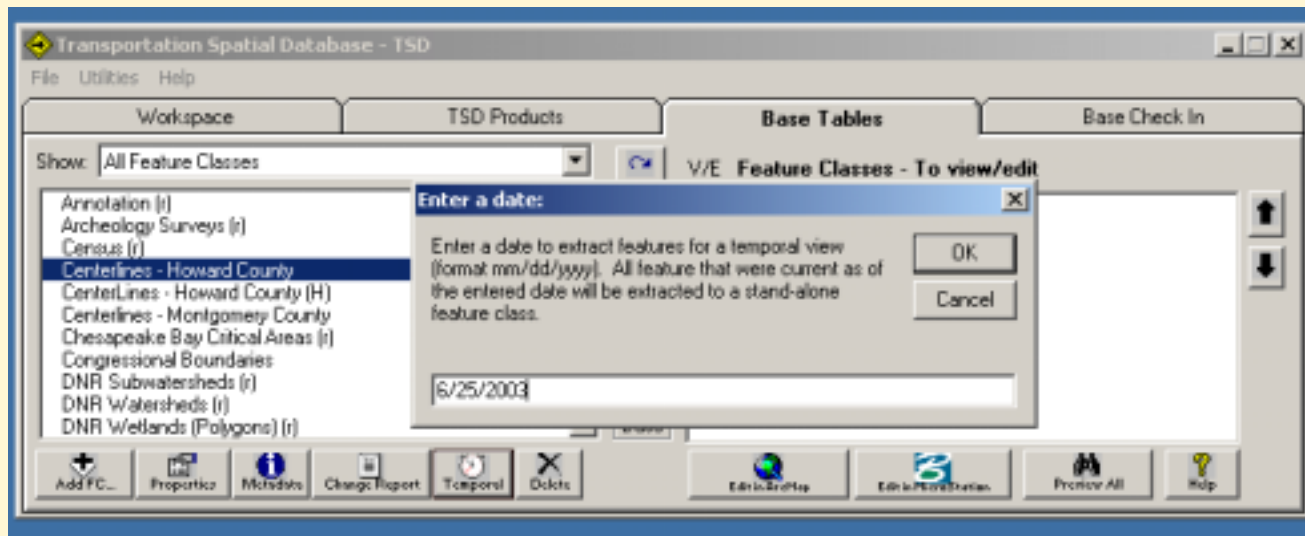
Start Transportation Spatial Da... Preview TSD Base Layer: Edit App... Untitled - Paint 1:57 PM

Temporality

- **Every feature class has an associated retire table**
- **When base feature geometry or attributes edited, a time-stamped version of the feature is moved to the retire table**
- **Features that are no longer “active” are also moved to the retire table**

Temporal Query

- **The TSD Application provides query capability to extract features from base and retire tables that were active as of a specified date.**

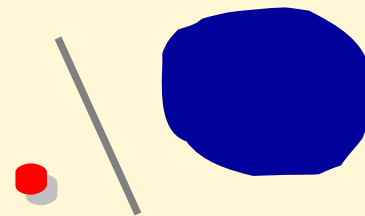


Interoperability - CAD and GIS

- **Base Editing in ArcMap or MicroStation**
- **Cartographic Production in MicroStation**
- **GIS Projects in ArcMap**
- **Use Best Tool for Specific Job**

Interoperability

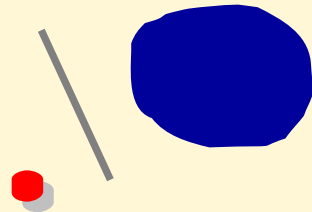
- “Standard” Geometry is Supported
- Symbology is Defined in the Database
 - Color, weight, type, fill, etc
- Attribution
- Annotation (TBD)



Applying Symbology

Base Symbology Tables

Lookup Tables



GRID_POINT_SYMBOL
<u>SYMBOL ID</u>
IN_LIBRARY
LIBRARY_ID
RGB_ID
WEIGHT_ID
FILL_STYLE_ID
FILL_RGB_ID
POINT_SIZE_ID
ANGLE
IMAGE_ID

GRID_POLYGON_SYMBOL
<u>SYMBOL ID</u>
IN_LIBRARY
LIBRARY_ID
RGB_ID
WEIGHT_ID
FILL_STYLE_ID
PATTERN_ID
FILL_RGB_ID
ANGLE

GRID_LINE_SYMBOL
<u>SYMBOL ID</u>
IN_LIBRARY
LIBRARY_ID
RGB_ID
WEIGHT_ID
STYLE_ID

GRID_ROUTE_SYMBOL
<u>SYMBOL ID</u>
IN_LIBRARY
LIBRARY_ID
DESCRIPTION

GRID_INDEX
<u>LAYER ID</u>
MAP_ID
MIN_X
MIN_Y
MAX_X
MAX_Y

LUT_RGB
<u>RGB ID</u>
GG_INDEX
RED_VAL
GREEN_VAL
BLUE_VAL

LUT_WEIGHT
<u>WEIGHT ID</u>
GG_WEIGHT
ARC_WEIGHT
DESCRIPTION

LUT_SIZE
<u>SIZE ID</u>
GG_SIZE
ARC_SIZE

LUT_IMAGE
<u>IMAGE ID</u>
IMAGE_NAME
LOCATION
IMAGE_TYPE
DESCRIPTION

LUT_STYLE
<u>STYLE ID</u>
ARC_STYLE
GG_STYLE
DESCRIPTION

LUT_LIBRARY
<u>LIBRARY ID</u>
ARC_NAME
GG_NAME
GG_LIBRARY
ARC_LIBRARY
ARC_CATEGORY
DESCRIPTION
LOCATION

LUT_FILL_STYLE
<u>FILL STYLE ID</u>
GG_FILL
ARC_FILL
DESCRIPTION

Support for Cartographic Production

- **Use MicoStation/iPlot for Standard Published Products**
- **Define Products Using a Template Approach**
- **Allow for Cartographic Adjustments to be Made to Base Features**
- **Allow for Some Features to be Excluded from Products**
- **Support Multiple Clipping Options**
- **Products are Assembled “on the fly” When Checked Out**

Cartographic Adjustments

- **Cartographic “license” applied to a base feature at product level**
- **Scale dependent adjustments**
- **Increase map readability, maintain correct base feature location**

Cartographic Adjustments

The screenshot displays a GIS application interface with three main windows:

- Transportation Spatial Database - TSD**: The main application window. The 'TSD Products' tab is active, showing a list of products. The 'Show:' dropdown is set to 'All products'. The 'Current Products' radio button is selected. The product list includes: Annapolis Town Map, Annapolis Town Map TM, Copy of Howard County TM, Demo Mtgy Watersheds, Demo grid dll, Howard - New 3.2.04, Howard County, Howard County 22, and Howard County 23 - Welcome Centers. The 'Cartographic Adj.' button is highlighted in the toolbar.
- Cartographic Adjustments**: A dialog box for editing a specific product. The 'Product ID' is 270 and the 'Name' is 'Annapolis Town Map TM'. Under 'Product Layers', 'GREENWAY LINE_1' is selected. Below this, a table lists the cartographic adjustments:

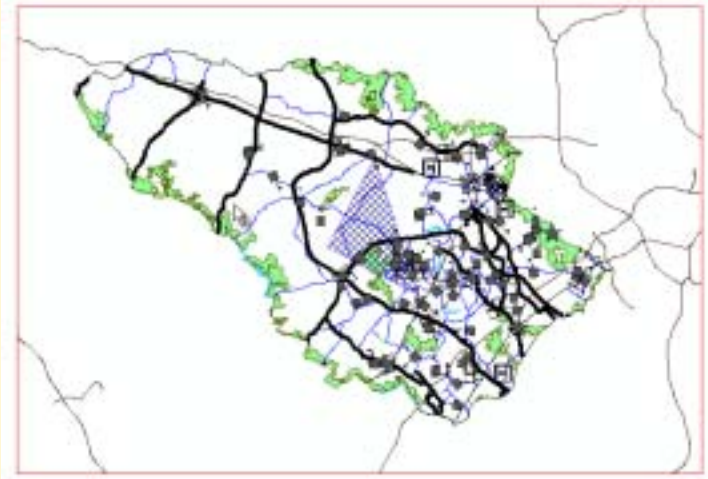
TSD ID	Name
906	EDGEWOOD AVE
916	MARGARET AVE
907	VIRGINIA ST
910	

Buttons at the bottom of this window include 'Preview Selected', 'Preview All', 'Compare To Base', and 'Delete'.

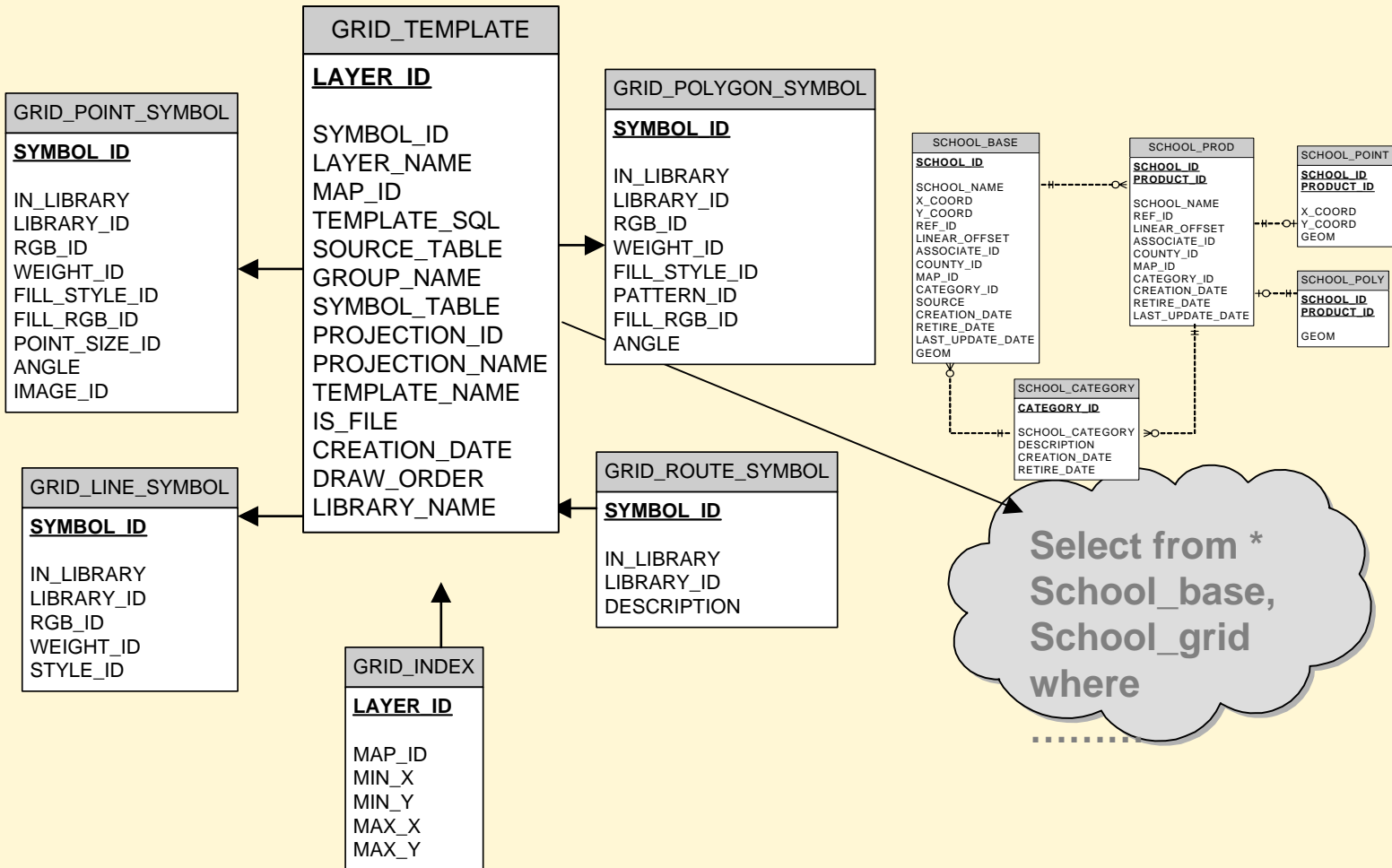
- Preview**: A window showing a visual comparison of the 'Base Feature' (blue line) and the 'Cartographic Adjustment' (green line) for the selected road. The legend at the bottom indicates that blue represents the 'Base Feature' and green represents the 'Cartographic Adjustment'.

Clipping Options

- **Products are not statewide so we need to extract data from base and clip to some defined extent(s)**
- **Any polygon layer can be used for spatial clipping**
- **Two Types of Clips**
 - **Overall product**
 - **(all layers)**
 - **Individual Layer**



Product Definition



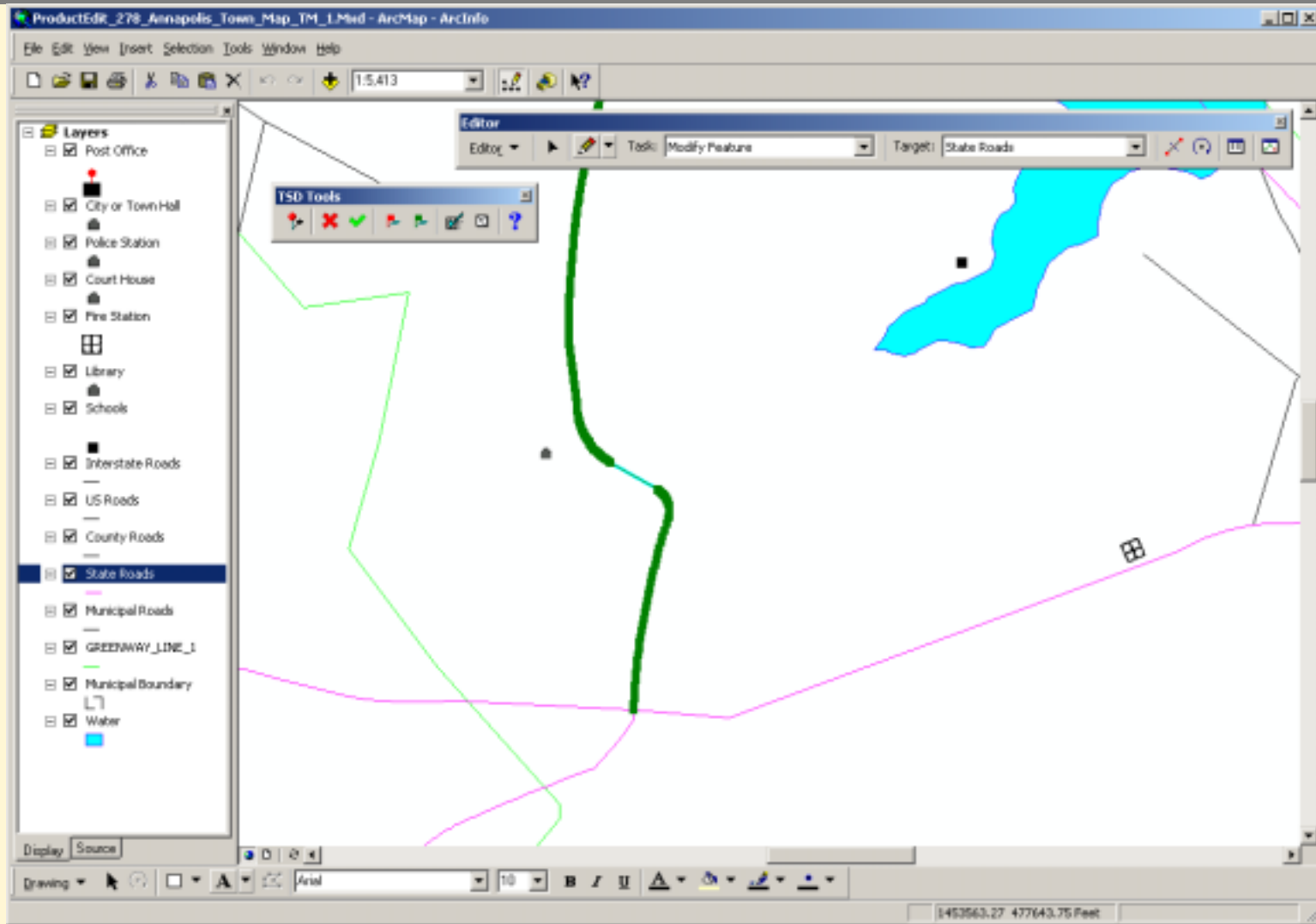
Product Definition

The screenshot displays the Transportation Spatial Database (TSD) software interface. The main window, titled "Transportation Spatial Database - TSD", shows a workspace with a list of products on the left and a "TSD Product" definition panel on the right. The "TSD Product" panel is for Product ID 221, named "Annapolis Town Map". It is a "Town Map" type, created on 12/2/2003 3:24:46 PM by user EBASS. The "Clip Using" is set to "MUN_CLIP_BOUNDARIES_1" and "Clip Where" is "MUNICIPALITY = Annapolis".

A secondary window, "TSD Product: Layer Properties", is open, showing details for Layer ID 1508. It is derived from the "165 - MD_ROADS" feature class. The layer name is "Municipal Roads", categorized under "Transportation". The query definition is "PREFIX = 'MU'". The layer was created on 1/8/2004 10:58:38 AM and last updated on 5/11/2004 2:47:43 PM. It uses the "Black Line - Line Weight 1" symbol for the ArcMap and "Roads, Municipal - Single Narrow Mason" for MicroStation. The level name is "3_14_Municipal Roads".

The desktop background shows various icons including Internet Explorer, Network Applications, Digital Map Conversion, SHA Mapping Database, TSD - Get Latest, HPES, TSD, and Microsoft Access. The taskbar at the bottom shows the Start button and several open applications, including "Transportation Spa...", "TSDScreens", "tsdProduct.bmp - P...", "TSD Product", and "TSD Product: La...". The system clock indicates 2:06 PM.

Product Editing



Products and Template Concept

- **A product is a Collection of Layers**
- **A Layer is a Filtered Feature Class (Spatial and Attribute)**
- **A Layer is Composed of Base Features and Cartographic Adjustments**
- **Layer Has Two Symbol Types**
 - **IPlot/ArcMap**
 - **MicroStation**
- **A Product Can be Copied and the Clip Changed to Produce a New Product**

What is the SHA Shared Centerline Program?

- **Work with local governments to build a highly accurate Statewide centerline of every public roadway with road names, addresses, alias road names, route numbers, route linear referencing, ramps, spurs, aux lanes, and both sides of divided highways**
- **Development of Common ID's for Sections of Roadway with County**
- **Use of same centerline where possible**
- **Use of linked/related centerline through unique ID's where different**
- **Help keep data up to date through digital spatial data updates on both sides**
- **Each party does what they do best**
 - Addressing from local government
 - Linear referencing from SHA





Attributes	
Property	Value
[-] Cline13	
[-] WAYOVER WAY	
OBJECTID	7498
STREET	WAYOVER WAY
FROMLEFT	10255
TOLEFT	10303
FROMRIGHT	10244
TORIGHT	10304
OWN_BY	County - Local Road
ZIPCODELEF	21046
ZIPCODERIG	21046
LEFTMUNICI	SCOL
RIGHTMUNIC	SCOL
MSLINK	6967
NLFID	13000CO1483
MP_DIRECTION	N
CAL_DIRECTION	N
ASSOC_ID_PREFIX	CO
EXIT_NUMBER	
RAMP_NUMBER	0
COUNTY	13
MUN_SORT	0
ID_PREFIX	CO
ID_RTE_NO	1483
MP_SUFFIX	
ROUTEID	13000CO1483 NN
ROADNAMELOCAL	WAYOVER WAY
ROADNAMESHA	WAYOVER WAY
GEOMEDIT	c
METADATA	<Null>
SHAUID	13000008184
SHAPE.LEN	829.8505

1 features



Attributes

Cline13

RAMP 2 FR MD 32 TO US 29

Property	Value
OBJECTID	1558
STREET	WB RT 32 TO NB RT 29 RAMP
FROMLEFT	0
TOLEFT	0
FROMRIGHT	0
TORIGHT	0
OWN_BY	Ramps/Service Roads
ZIPCODELEF	21046
ZIPCODERIG	21046
LEFTMUNICI	SCOL
RIGHTMUNIC	SCOL
MSLINK	1338
NLFID	13000RP0032
MP_DIRECTION	N
CAL_DIRECTION	N
ASSOC_ID_PREFIX	MD
EXIT_NUMBER	6
RAMP_NUMBER	2
COUNTY	13
MUN_SORT	0
ID_PREFIX	RP
ID_RTE_NO	32
MP_SUFFIX	
ROUTEID	13000RP0032 NNMD 6 2
ROADNAMELOCAL	WB RT 32 TO NB RT 29 RAMP
ROADNAMESHA	RAMP 2 FR MD 32 TO US 29
GEOMEDIT	c
METADATA	<Null>
SHAUID	13000000842
SHAPE.LEN	3320.8948

1 features

Project Information

- **Data model is flexible**
- **Neither entity edits other's data**
- **Neither entity can lessen quality of others data, only improve**
- **Only centerline becomes common**
- **County gets SHA Route ID, and measures**
- **Future work on “routeable” networks can be built on this foundation**

Data Development Process

- **Latest linear referencing technology used**
- **Flexible and sustainable**
- **SDE, ArcGIS/ArcObjects**
- **Extensive custom tools**
- **Tie data to inventory database of every road**
- **QC, touch, edit every road in database**
- **Process to handle exceptions**

Calibration Tool

The screenshot displays the 'Route Calibration' software interface for BALTOPSIDE County. The main window shows the following details:

- Route ID: 03000150095 NW
- Show: All Routes
- Int. Features: Mainline and Ramp Intersections
- Route Selection: Prefix: 25, Mun: 0 - NCAE, Inventory Direction: N, Rte No: 95, Suffix: , Calibration Direction: N, 37 K MEMORIAL HWY

The 'Intersecting Features' table lists the following data:

Stationing	Description	Intersection Type	Current Status
17.46/0/9.01	RAMP 3 FR IS 95 EB TO IS 695 MB (RP 95 HP 0)	RAMP INTERSECTION	Validated
17.59/0/8.89	IS 695 (WB/L) (0 HP 0)	MAINLINE INTERSECTION	Validated
17.69/0/8.78	BALTO BELTWAY (IS 695 HP 25.67)	MAINLINE INTERSECTION	Validated
17.81/0/8.66	RAMP 5 FR IS 695 SB TO IS 95 EB (RP 95 HP 0.23)	RAMP INTERSECTION	Validated
17.84/0/8.63	RAMP 7 FR IS 95 WB TO IS 695 SB (RP 95 HP 0)	RAMP INTERSECTION	Validated
17.87/0/8.6	IS 95 (WB/L) (0 HP 0)	MAINLINE INTERSECTION	Validated

An 'ArcMap' dialog box is open, asking to 'Attribute the selected point with milepoint = 17.690005340576?'. The dialog has 'Yes', 'No', and 'Cancel' buttons.

The map view shows a network of roads with various labels such as 'TRUMPS BELL', 'MONTAGUE BLVD', 'DORISWELL', 'TARPLEYS', 'BRADFORD', 'COLEGE', 'JONATHAN', 'DARTWRIGHT', 'SOUTH HILLS', and 'SOUTH'. The map is displayed at a scale of 975 feet.

TSD – Today

- **Development completed**
- **Testing/Training completed**
- **Currently loading and preparing data**
- **Developing initial products of each type**
 - **County Map, Grid Map, Town Map, State Map**
- **In Maintenance and Enhancement Mode**

Current Challenges

- **Attribution of All Data Takes Time**
 - **Working on Point Layers Now**
 - **Polygons Delivered, Will Begin Work Shaping Them to Fit Grid Maps**
 - **Working With Counties for All Road Linework**
- **Interim Solution May Be Part Old and New Until Data is Ready**
- **New Information Needs To Be Populated (other side of road, reverse mp, ramps)**

TSD – The Future

- **Imagery Integration**
- **Bring New Capabilities Agency-wide**
- **More and Better Metadata**
 - **maintenance metadata**
- **Additional Analysis Tools**
- **Develop Annotation Solution**
- **Integration of Calibration Tool**
- **Move to ArcGIS 9.x**



Summary

- **Created a repository of shared data**
- **Business processes have been refined/defined**
- **Better integration of data at SHA**
- **Shorter product life cycle for cartographic products**
- **More efficient production of special GIS projects**