

Developing New Hampshire's Transportation GIS Data Model

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Baker



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Introduction

New Hampshire DOT is in the process of implementing a new transportation data model

This presentation will explore:

- Existing data model
- Summary of key concepts of the data model
- Advantages and Impacts



New Hampshire DOT

- Currently in the process of updating all its GIS data at both the state and local levels
- Upgrading their current ArcGIS software to version 8.3
- Opportune time to review database architecture, existing procedures, and current data model

Existing NHDOT Data Model

- All attribute data stored in one large table (FAT table)
- Highly segmented
- Quite large and difficult to maintain

MAIN_KEY	TOWN	ROAD	RAMP	DIRECTIO	MILEPOINT	SECT_LEN	FEATURE	SURVEY_DA	FSECTION
"C2862	165	0051	J	B	0	0.097	RDI	3/18/1999	001
"C2905	165	0077	J	B	1.159	1.11	RDI	3/18/1999	002
"C2908	165	0078	J	B	2.293	0.982	RDI	3/18/1999	003
"C2909	165	0078	J	B	3.275	1.627	RDI	3/18/1999	004
"C2911	165	0080	J	B	0	0.241	RDI	1/1/1983	001
"C2912	165	0081	J	B	0	0.483	RDI	1/1/1983	001
"C2913	165	0081	J	B	0.483	0.499	RDI	1/1/1983	002
"C2914	165	0081	J	B	0.982	0.241	RDI	1/1/1983	003
"C2915	165	0081	J	B	1.223	1.481	RDI	1/1/1983	004
"C2916	165	0081	J	B	2.704	0.435	RDI	1/1/1983	005
"C2917	165	0082	J	B	0	0.177	RDI	3/18/1999	001
"C2927	165	0089	J	B	0	0.161	RDI	1/1/1983	001
"C2932	165	0094	J	B	0	0.761	RDI	3/18/1999	001
"C2939	165	0101	J	B	0	1.143	RDI	3/18/1999	001
"C2874	165	0061	J	B	1.915	1.287	RDI	3/18/1999	004
"C2875	165	0061	J	B	3.202	0.66	RDI	3/18/1999	005

Sample of NHDOT FAT Table

165	0081	J	B	0	0.483	RDI
165	0081	J	B	0.483	0.499	RDI
165	0081	J	B	0.982	0.241	RDI
165	0081	J	B	1.223	1.481	RDI
165	0081	J	B	2.704	0.435	RDI

Existing NHDOT Data Model

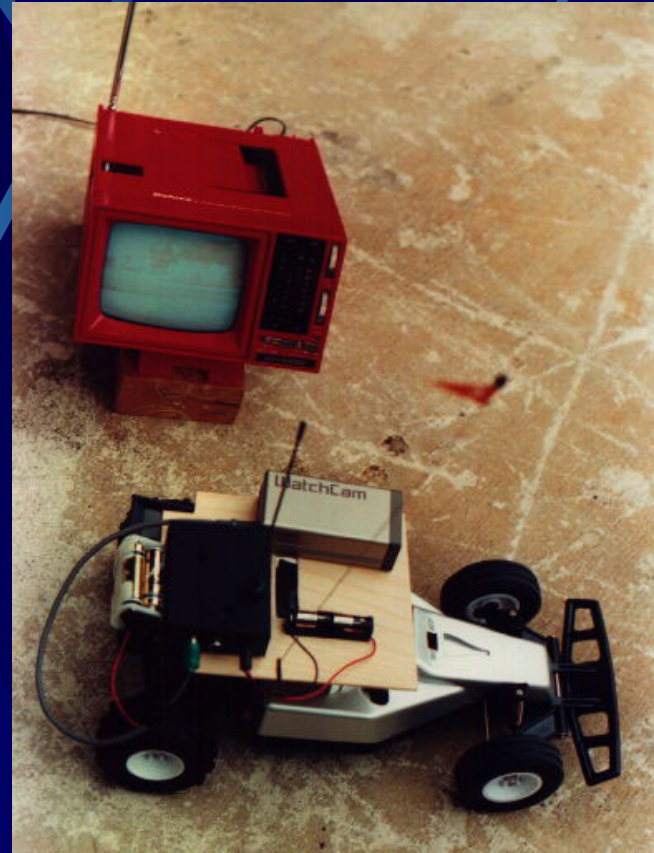
- Various linear referencing methods (LRM's) in use
- All maintain a reference to road inventory number (RDI)
- Topology maintained using anchor section –anchor node system (coverage topology)
- Network includes Interstate, US, and NH Routes
- Circles, ramps, and non-signed NHDOT routes included



Basis of Data Model

- New data model developed based on a simplified version of the UNETRANS data model

UNETRANS



Key Concepts

● Multiple Centerlines

- All carriageways are represented by unique Standard Route Identifier (SRI) and centerline depiction

● Segmentation

- Minimal segmentation on higher order routes
- Street name change segmentation on local roads

● Activation

- Year Activated and Retired

● Parent Routes

- Link to single-centerline representation for a route

Key Concepts

- Routing Layer

- Single routing layer called (Route Master)

- Sub-Types

- Six (6) sub-types for different route classification
 - Interstate
 - US
 - NH
 - Ramps
 - Circles
 - O-Roads



Standard Route Identifier

- New linear reference system developed utilizing a Standard Route Identifier (SRI)
- Unique alpha-numeric identifier for each route
- Statewide domain – not town based
- Includes ramps, circles, and O-roads
- Based on New Jersey's SRI model

PTTTRRRRSD

Where:

P = prefix

TTT = town code

RRRR = route number

S = suffix

D = direction

Route Hierarchy

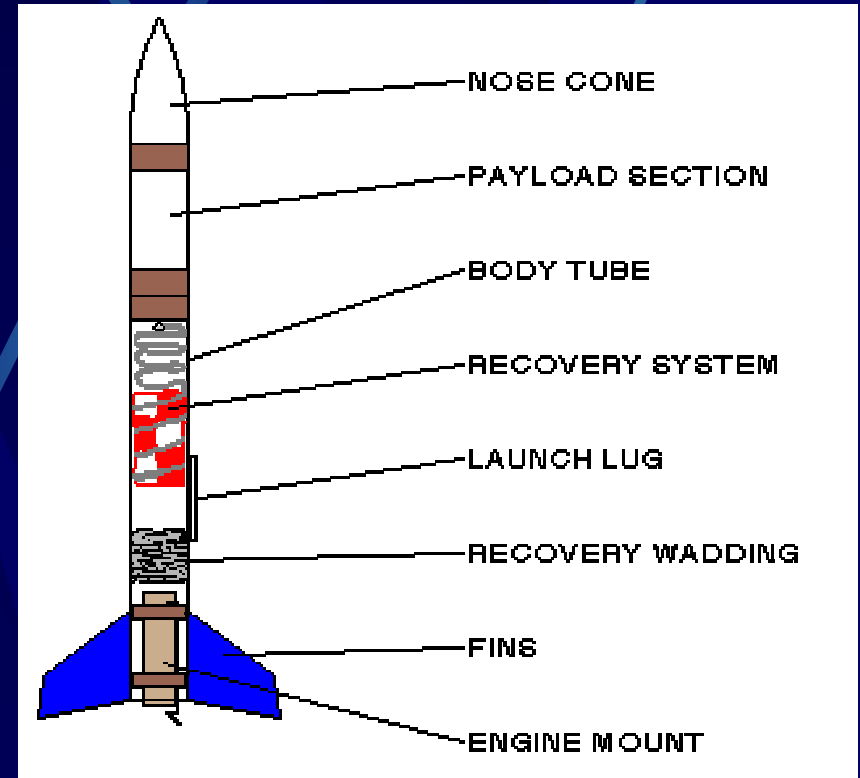
- Routes are categorized based upon jurisdiction
- Naming is keyed to position within the Route Hierarchy
 - Coincident Sections – Route segments will be broken when a route that is higher in the hierarchy runs coincident along the route

Interstate Routes
Circles
Ramps
US Highways
NH Routes
Turnpike Authority
O-Roads
Local Roads
Private Roads



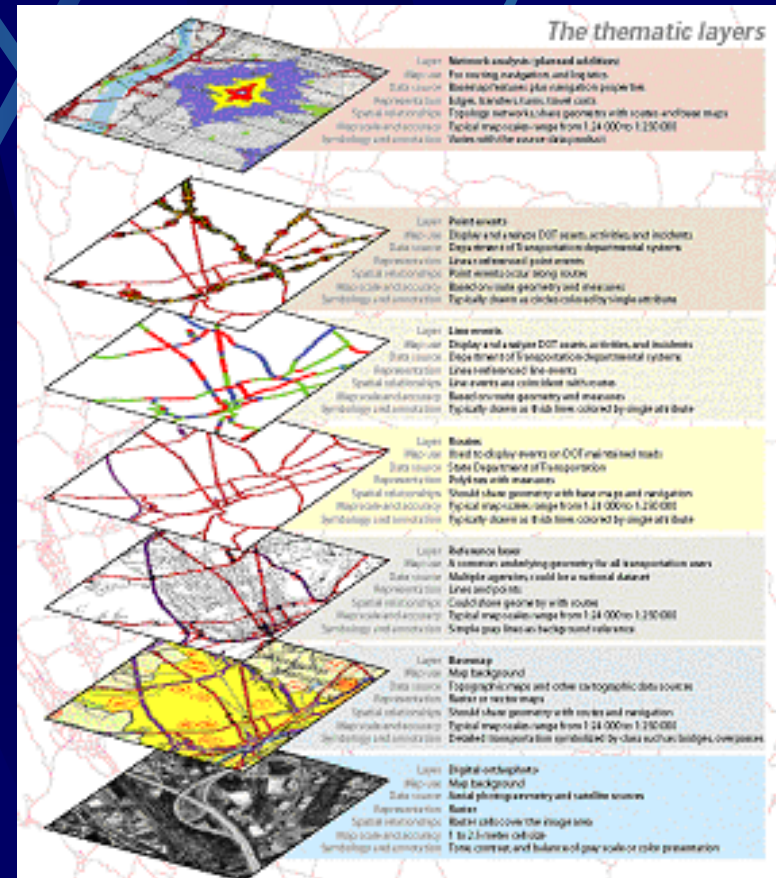
Components of the Transportation Data Model

- Geodatasets
- Event Tables
- Topology
- Domains




Geodatasets

- **Base Layers** – contain background information (orthophotos, water features, etc.)
- **Reference Layers** – Underlying geometry for other layers
- **Routing Layers** – contain route feature classes (Route Master)
- **Cartographic Layers** – annotation, route shields, etc.



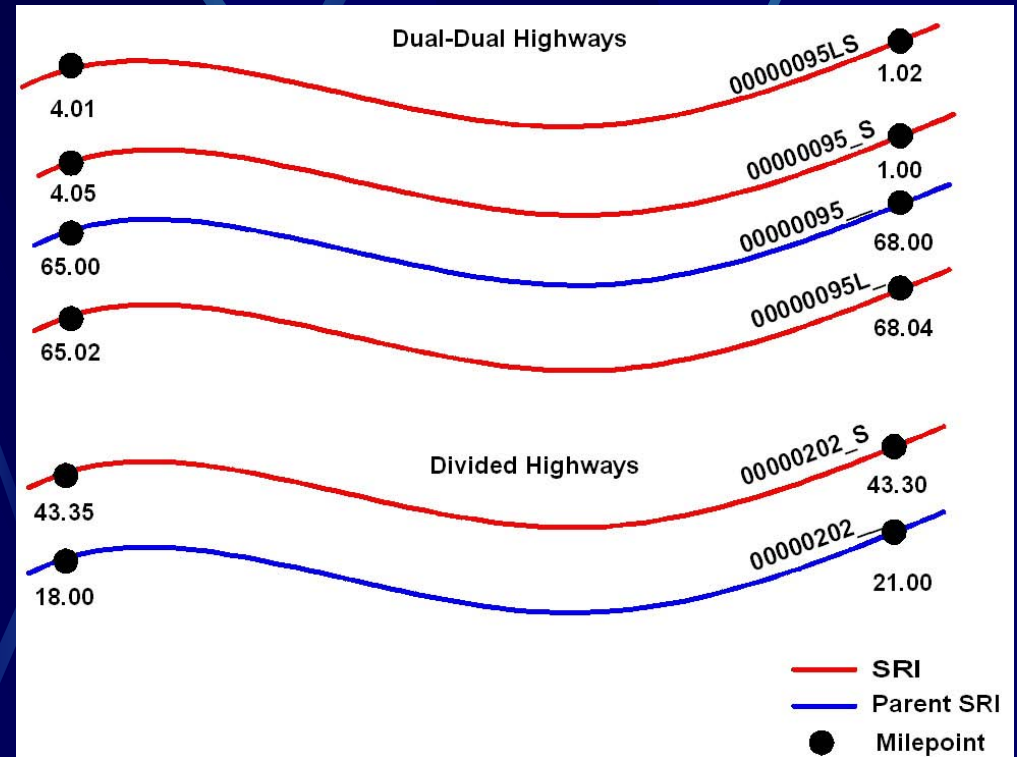
Geodatasets

- One main route feature class (Route Master)
- Minimal segmentation
- Parent SRI concept
- Temporal attribution

 Line Feature Class Route_Master							Geometry	Polyline
							Contains M values	Yes
							Contains Z values	Yes
Field Name	Data Type	Allow Nulls	Default	Precision	Scale	Length		
ObjectID	OID	No						
Shape	Geometry	No						
SRI	varchar	No				20		
Route_type	varchar	No				20		
Mp_Start	decimal	No		6	3	5		
Mp_End	decimal	No		6	3	5		
Street_Name	varchar	Yes				50		
Measured_Length	decimal	Yes		6	3	5		
Parent_SRI	varchar	No				20		
Parent_Mp_Start	decimal	No		6	3	5		
Parent_Mp_End	decimal	No		6	3	5		
Active	varchar	No				1		
Year_Active	varchar	No				4		
Year_Retired	varchar	No				4		

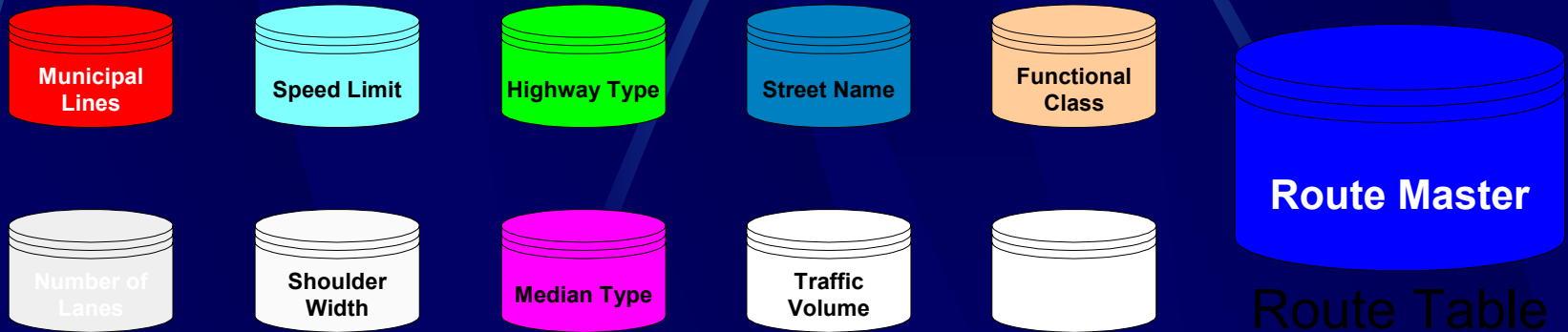
Parent SRI

- All route directions have a parent route (SRI) identified
- Parent route used for single centerline representation of divided routes during large scale mapping
- Ramps are linked by parent SRI to mainline routes



Event Tables

- Individual normalized tables for each attribute
- Indexed by SRI and milepost - can be referenced on one road network (Route Master)
- Contains two or three mandatory columns
 - SRI (for point and linear tables)
 - MP_Start (for point and linear tables)
 - MP_End (for linear tables only)



Topology

- Used to manage spatial relationships between geographic features
- Enables sharing of geometry between features and feature classes
- Allows for applications such as snow plowing, traffic modeling, oversize/overweight truck routing

Origin Feature Class	Topology rule	Comparison Feature Class
Route_Master	Must not overlap	Route_Master
Anchor_Section	End node must be covered by	Anchor_Nodes
Anchor_Section	Must be covered by feature class of	Route_Master
Route_Master	Must be covered by feature class of	Anchor_Section
Anchor_Nodes	Node must be covered by line of	Anchor_Section

Sample Topology Rules

Domains

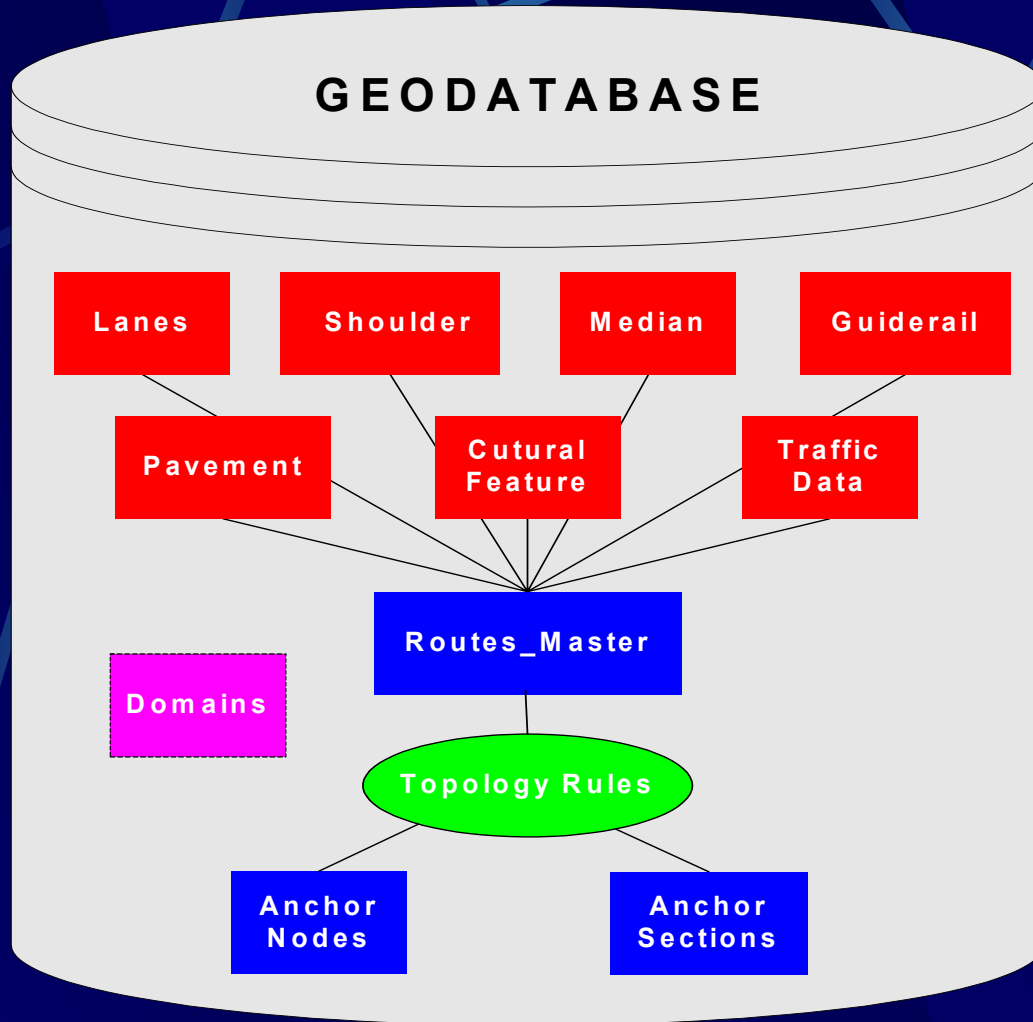
● Contain look-up values for event tables

- Municipal Names
- Pavement Type
- Intersection Type
- Speed Limits
- Functional Classifications
- Median Types
- Guiderail End Treatments
- Jurisdiction Names
- Range Domains
 - Speed Limits

Coded value domain
pave_type
Description: *pavement type list*
Split policy: *Default Value*
Merge policy: *Default Value*

Code	Description
1	Concrete
2	Bituminous
3	Brick or Block
4	Gravel
5	Dirt

The Geodatabase



Centerlines

Single Centerline

- Simpler
- Does not always match real-world conditions
- Mileposting can be inaccurate
 - Linear referencing can be inaccurate
- Poor at small scales

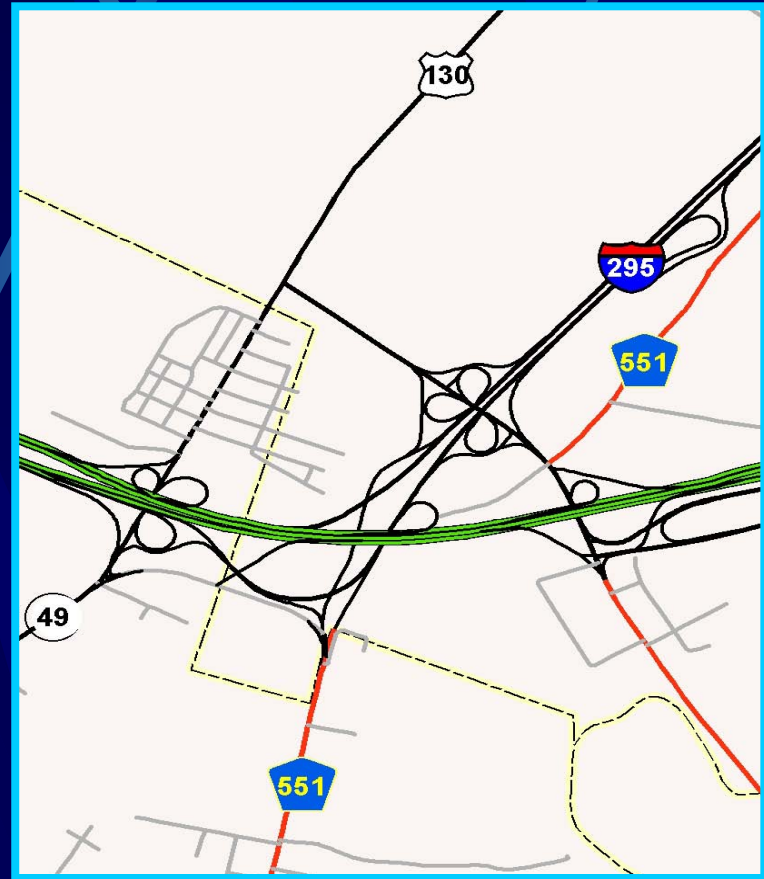
Dual Centerline

- More complex
- More closely matches real-world conditions
- Mileposting is more accurate
 - Linear referencing becomes more accurate
- Congested at large scales

Single Centerline

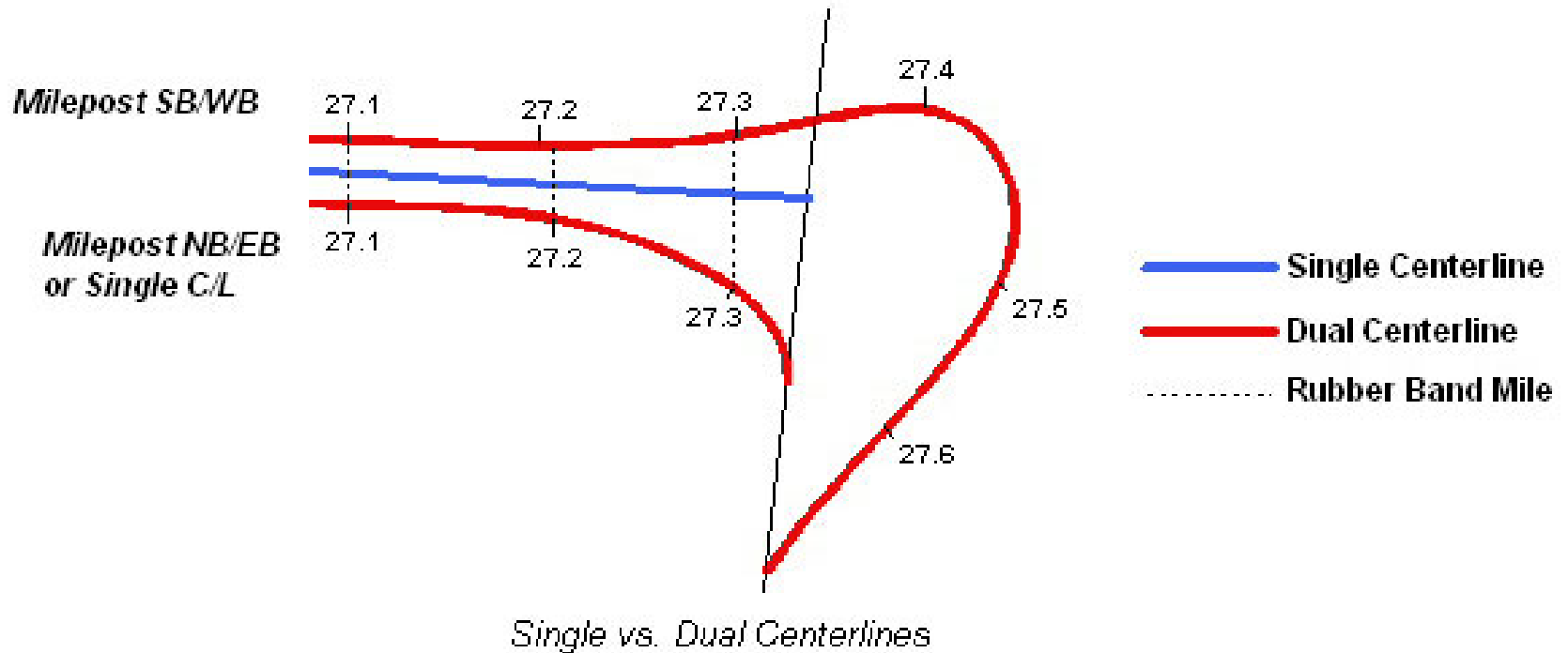


Dual Centerline



Mileposting Comparison

Single vs. Dual Centerlines

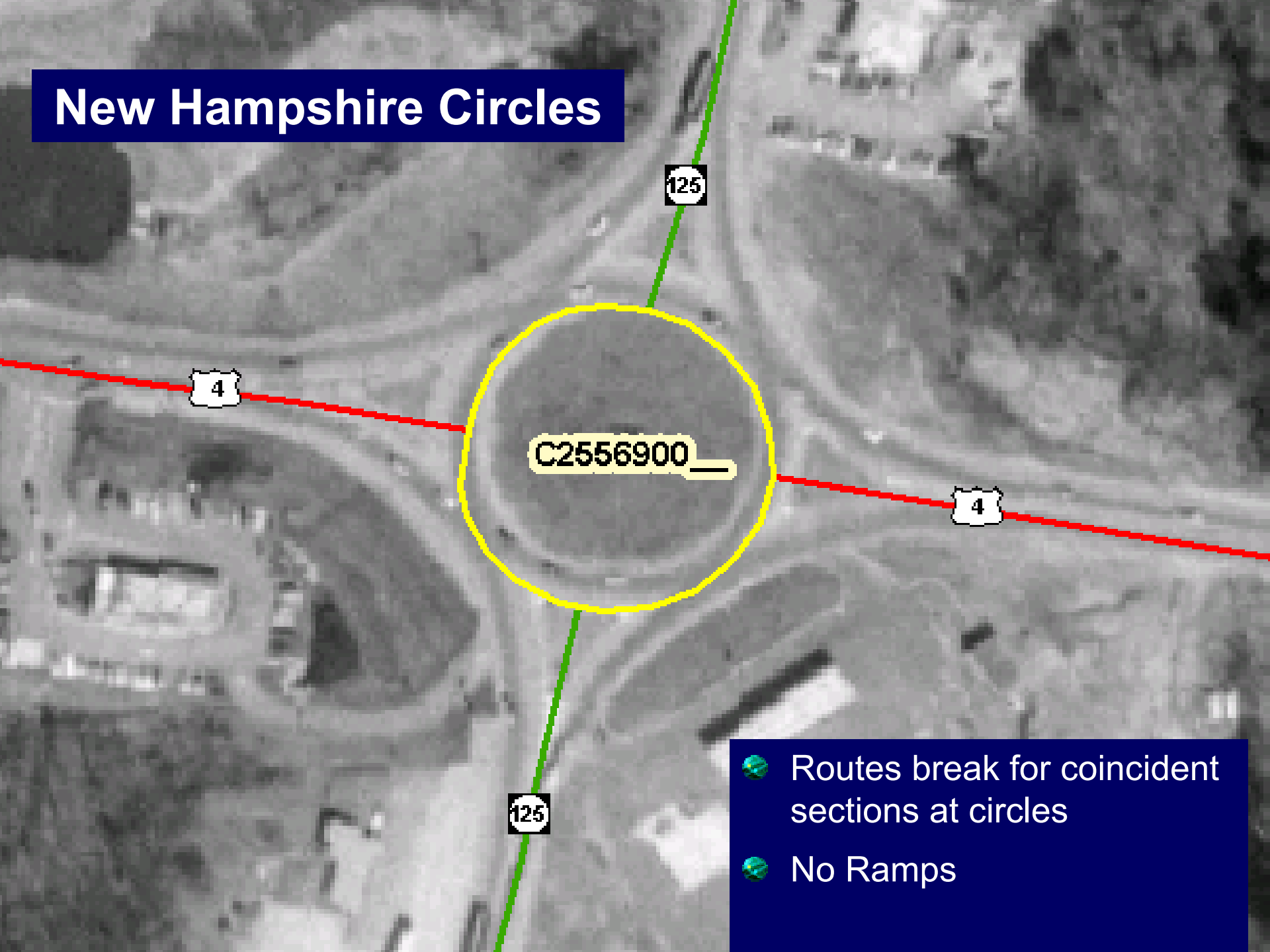


Divided Routes

- Dual centerline model requires rules for determining when to create a divided route



New Hampshire Circles

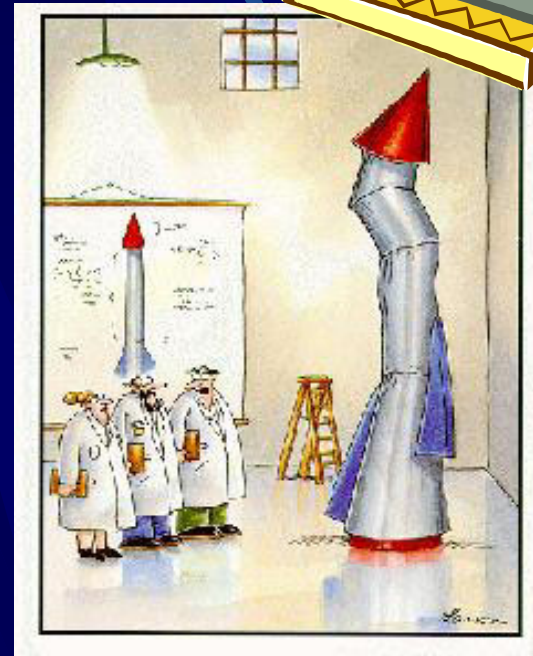
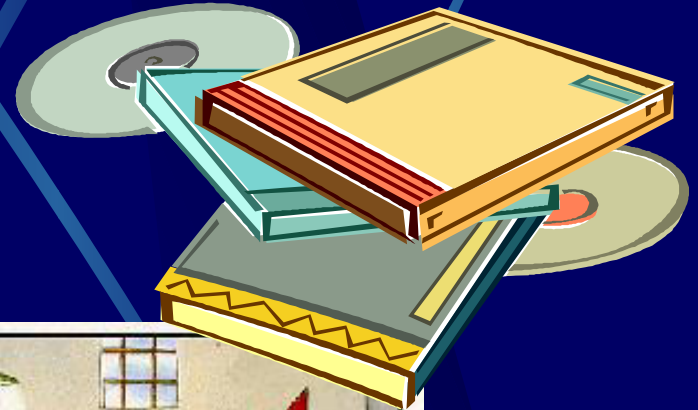


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- Routes break for coincident sections at circles
- No Ramps

Impacts of the New Transportation Data Model

- NHDOT system databases will need updating
- Learning curve associated with new model
- Conversion of LRS method in legacy data will take time



Advantages of the Transportation Data Model

- Easier to maintain
- More intuitive – real world
- One linear referencing system (LRS) eliminates conversion between various LRS's within a department
- Individual tables allow permissions to be set for multiple users



Conclusions

- Increased accuracy of spatial data
- Increased accuracy of linear referencing
- Data is easier to maintain and update
- Better decision support



Questions

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