VGIS HANDBOOK

PART 2 - STANDARDS SECTION G

ROAD CENTERLINE SPATIAL DATA STANDARD

Vermont Geographic Information System

Standard History

- August, 1995 - Original Standard introduced
- December, 1998 - Interim Standard approved by the VCGI Board and Technical Advisory Committee
- July, 2004 – Draft released for public review and feedback
- January, 2005 – Revised standard approved by the VCGI Technical Advisory Committee
  - Dropped "interim" designation.
  - VTrans is now "steward" and "data management coordinator".
  - Numerous modifications to *III. Maintenance Procedures* and *IV. Technical Appendices.*
  - Revised VTrans/RPC Data Exchange Protocol.
  - Extended standard to address ANSI/INCITS Transportation Standards requirements.

Acknowledgments

VCGI would like to thank the people who assisted in developing and reviewing this standard. Special thanks to the "original" Standards primary author Stephen Sharp (VCGI), and to all those members of the VCGI Technical Advisory Committee who contributed. Thanks also to members of the VGIS Community who provided comments, especially Jeff Nugent (WRC). VCGI would also like to thank those who contributed to previous versions of this Standard (Steve Bower, VGIS Standard for Updating the Road Centerline Data Layer).

I. INTRODUCTION

This document is divided into the following sections:

Preface

The Vermont GIS community has been diligent in its effort to promote standards, consistency, and coordination. Over the years this has led to a more "mature" spatial data infrastructure in the State of Vermont. A significant amount of effort has gone into the development, review, and completion of this Standard. The resulting communication between organizations -- particularly VCGI, the Vermont E-911 Program, the Vermont Agency of Transportation, representatives of Vermont=s regional planning commissions, and interested Federal agencies -- has enhanced each organization=s understanding of its own needs, as well as the needs of others.

The Standard was first drafted and endorsed by VCGI's **Technical Advisory Committee** (VTAC) in 1995. Back then it was called

"***Updating the Road Centerline Data Layer***". In 1997/98 the Transportation Theme Expert Group (TTEG), a subcommittee of the VCGI TAC, worked to revise the Standard. The TTEG facilitated a number of meetings between VCGI, VTrans, E911, and RPC representatives in an attempt draft a robust standard which would address coordinated maintenance of a single "master" road centerline data layer. This effort resulted in the drafting of a "***Technical Manual for the Development and Maintenance of Road Centerline Spatial Data - Version 1.3***". The VTAC used the "manual" to draft the "**Road Centerline Spatial Data – Interim Standard**", which was adopted in December, 1998. The VTAC revised the Standard again in 2004. The latest version includes a number of modifications which reflect technical and organizational changes in the maintenance of Vermont's road centerline data layer (RDS). The "interim" designation has been dropped from this version.

The VGIS community should extend its special thanks to the Standard's primary author Stephen Sharp (VCGI), and to all those who contributed., particularly VTrans Johnathan Croft (Vtrans). Thanks should also be extended to Vermont's Transportation Theme Expert Group (TTEG) and those who contributed to other standards used in the creation of this Standard (Steve Bower, VGIS Standard for *Updating the Road Centerline Data Layer*). We also owe thanks to the VCGI TAC for its revision of the document to its current form.

Purpose

This Standard is intended to draw together all documentation and references related to the development and maintenance of Vermont's master road centerline spatial data layer. It outlines the structure of Vermont's road centerline data layer (TransRoad_RDS), herein referred to as **RDS**. This document will act as a "road map" to the future of this data layer. This standard will be phased in over a period of time. It will not be implemented all at once. Financial and organizational constraints will dictate the pace of implementation.

Background

The original RDS data was digitized by Greenhorne & O'Mara Inc., Duluth, GA (1991-1992). Since then, many subsequent updates have been made by Regional Planning Commissions (RPCs), their contractors, and VCGI using various techniques. VCGI has historically been the "steward" of the RDS data layer, responsible for coordinating update efforts, and for quality control. However, VTrans took over as "steward" in 2004.

The Vermont E-911

In February 1996 the Vermont E-911 program engaged microDATA

Program

(St. Johnsbury, VT) to provide towns with GIS assistance in implementing Alocatable@ addressing. As a result the contractor enhanced the RDS data with the following items:

1. Refinement of road center lines using GPS technology.
2. Geo-coding of road centerlines with road name and address range information.

However, the Vermont E-911 program maintains their data to a different set of standards (E911 specific). As a result, this Standard does not apply to E911 road centerline data.

Note: Address range information was dropped from the master RDS layer in 2004. Refer to *III. Maintenance Procedures (Attributes: Some Special Cases)* for information on how road name information is maintained.

The Vermont Agency of Transportation=s Highway Mapping System Project

The Vermont Agency of Transportation (VTrans) deployed the "Highway Mapping System" (HMS) developed by IVS (Information Visualization Services, Burlington, VT) in 1998. The contractor developed an ARC/INFO user interface which enables editing and production of the General Highway Maps from the road centerline data (RDS). This system re-places the old system used to produce official highway maps for 328 towns, cities, villages, urban compacts and federal aid urban areas. The standards articulated in this document have been be implemented and in use by VTrans since 1999.VTransVTrans

Terminology

The following terminology is used in this Standard:

Road:	An open public or private way for the passage of persons and vehicles
Road segment:	Portion of a Aroad@ defined by a beginning and ending point (node)
ARC/INFO:	Commercial GIS software produced by ESRI (Environmental System Research Institute, Redlands, CA).
Arc:	A representation of a line in the ARC/INFO GIS, defined by a beginning and ending point (node).
Coverage:	An ARC/INFO computer representation of a data layer
Feature:	Representation of a Areal-world entity@ (e.g.: Aroad,@ Aroad intersection,@ Abuilding,@ etc.)
Feature Tracking:	Tracking of changes to individual features in the data layer; i.e., road segments
Framework:	Baseline data layer incorporated into the National Spatial Data Infrastructure (NSDI)

Event Table:	A tabular database containing information that can be associated with a linear reference system.
ROD_Segment:	"represents a linear section of the physical road system designed for, or the result of, human or vehicular movement; must be continuous (no gaps) and cannot branch; no mandates are provided on how to segment the road system except that data providers adopt a consistent method. Road Segment is the real world manifestation of the TRN_Segment as described in the Base Transportation Standard."* [1]
ROD_Point:	"a point along the roadway system which has some special significance either for starting or ending a road segment or for representing a significant position along the roadway system such as the start or cente r of a bridge or the center of an intersection. Road Point is the real world manifestation of the abstract feature class, TRN_Point as described in the Base Transportation Standard."* [1]
ROD_Path:	" defines a usage of an ordered list of whole or partial sections of physical roadway (i.e., road segments), e.g., an administrative route, such as Interstate 95, or a delivery route. Road path is the real world manifestation of the abstract TRN_Path as described in the Base Transportation Standard."* [1]
Anchor Point:	"represents a physical location in the field that can be unambiguously described so that it can be clearly located in the real world using its description. An anchor point is a link between the computer representation of the road system and the real world. An anchor point must occur at the ends of an anchor section."* [2]
Anchor Section:	"represents a section of roadway between two known and recoverable locations, i.e., anchor points. Anchor sections state the official, along the ground, length of a roadway segment." [2]

Additional Terminology

The intent of this Standard is to incorporate by reference additional authorities for specialized terms and, where possible, to identify and eliminate redundancies and conflicts. At this time the reader may want to review the following:

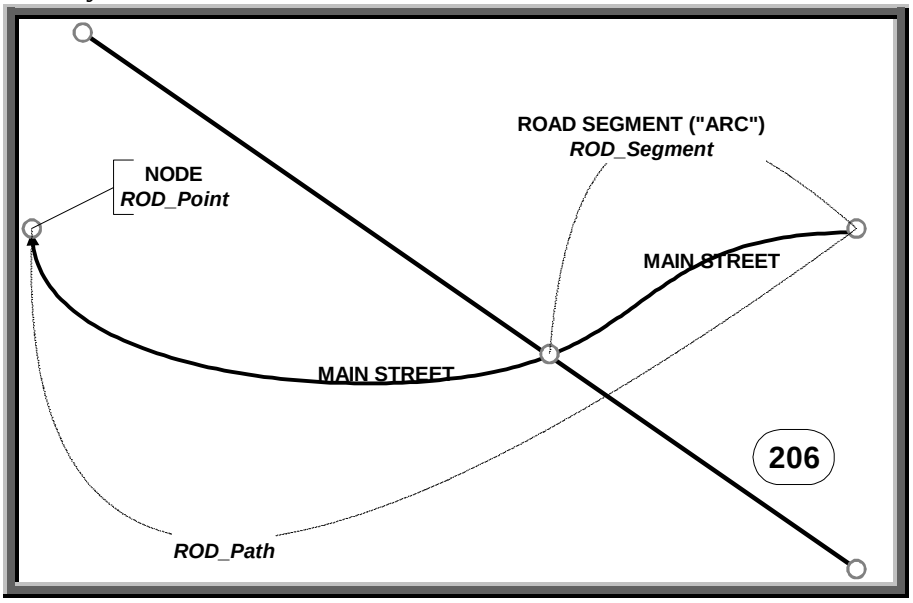
1. **VGIS Glossary**: The *Handbook* of the Vermont Geographic Information System (Part 5) includes a Glossary of basic GIS terminology.
2. **Geospatial One Stop Standards - Transportation**: National Spatial Data Infrastructure (NSDI) standards for Framework Transportation data.
    a. http://www.geo-one-stop.gov/Standards/Transportation/index.html

II. DATA DESIGN AND MODEL

The RDS data model has an inherent data structure based on the limitations of the ARC/INFO coverage data model.

Model Features

The following feature, illustrated in Figure 1, is represented in the RDS data layer.



Road Feature: A digital representation of a "real-world" entity called a "road". A road feature is defined by "road segments" (ROD_Segment). Road segments have uniform attributes. They are represented by a line (arc). The beginning and ending point of a road segment is defined by a "node" (ROD_Point). Each road segment has a unique identifier (FIPS8 + ARCID = FAID/RODSEG_ID) used for feature tracking. One or more ROD_Segments can define a ROD_Path, bounded by starting/ending ROD_Points. Other attributes associated with road segments are outlined in section IV of this standard. Figure 1 illustrates the relationships between road segments.

Attribute Tables & Field Structures

The RDS data model makes use of multiple related attribute tables. Each table has a different function. The table below provides a brief description of each attribute table.

TABLE NAME	DESCRIPTION
RDS.TIC*	Registration point attribute table
RDS.BND*	Boundary attribute table (defines spatial extent of data layer)
RDS.AAT	Arc attribute table (road "segment" attributes)
RDS.RDNAMES	Road name lookup table (linked via RDNAME item in AAT). Derived from E911 roadnames.dbf file.
RDS.NAT	Node attribute table
RDS.RODSEG	ANSI Transportation Standard - Road Segment lookup table. *Note: This table will be implemented as time and resources allow.*
RDS.RODPNT	ANSI Transportation Standard – Road Point lookup table. *Note: ANSI table will be implemented as time and resources allow.*
RDS.RODPATH	ANSI Transportation Standard – Road Path lookup table. *Note: ANSI table will be implemented as time and resources allow.*

- The RDS.TIC and RDS.BND tables are default ARC/INFO tables incorporated into all vector data layers.

The structure and items included in these tables are outlined below. Please refer to section IV of this standard for a detailed description of each item (and a listing of appropriate attribute codes).

NOTE: The fields with an asterisk "*****" in the RDS.AAT and RDS.NAT files are added via "post-processing" once the data has been edited/updated. Those with "**" address certain ANSI Transportation (Road) Standard requirements. Italicized fields identify those which will be updated from E911 sources.

TABLE NAME: RDS.AAT (Arc Attribute Table)

COL	ITEM NAME	WDTH	OPUT	TYP	N.DEC	ALTERNATE NAME
1	FNODE#	4	5	B	-	FNODENUM
5	TNODE#	4	5	B	-	TNODENUM
9	LPOLY#	4	5	B	-	
13	RPOLY#	4	5	B	-	
17	LENGTH	4	12	F	3	
21	RDS#	4	5	B	-	ARCNUM
25	RDS-ID	4	5	B	-	
29	RTNAME	12	12	C	-	RTNM
41	*RTNO	4	4	C	-	NO
45	HWYSIGN	12	12	C	-	HWYSN
59	AOTCLASS	2	2	I	-	ACL
61	SURFACE	1	1	I	-	SURF
62	FUNCL	2	2	I	-	F
64	NHS	1	1	I	-	
65	SCENIC	1	1	I	-	SC
66	LR_ETE	11	11	C	-	ETE_LR
77	*CTCODE	4	4	C	-	CTC
81	UA	1	1	I	-	
82	*RDNAME*	*6*	*6*	*I*	-	*RD*
88	**RDFLNAME*	*30*	*30*	*C*	-	*RDF*
118	LOCMETH	2	2	I	-	LM
120	SRCORG	2	2	I	-	SO
122	FIPS8	8	8	I	-	
130	ARCID	4	4	I	-	AID
134	UPDACT	1	1	C	-	UPD
135	*ARCMILES	7	7	N	3	RDM
142	AOTMILES	7	7	N	3	AOTM
	-- REDEFINED ITEMS --					
124	FIPS6	6	6	C	-	
122	FAID	12	12	C	-	**RODSEG_ID
59	AOTSURFCL	3	3	I	-	
66	LR_ETE_TYP	1	1	C	-	
67	LR_ETE_NUM	3	3	C	-	
70	LR_ETE_MOD	1	1	C	-	
71	LR_ETE_DIR	1	1	C	-	
72	LR_ETE_SUBT	1	1	C	-	
73	LR_ETE_NID	3	3	C	-	
76	LR_ETE_AID	1	1	C	-	
82	**RODPATH_ID	6	6	I	-	

TABLE NAME: RDS.NAT (Node Attribute Table)

COL	ITEM NAME	WDTH	OPUT	TYP	N.DEC	ALTERNATE NAME
1	ARC#	4	5	B	-	ARCNUM
5	RDS#	4	5	B	-	NODENUM
9	RDS-ID	4	5	B	-	
13	RDSNODE_ID	6	6	I	-	**RODPNT_ID
19	TWNBNDPT	1	1	C	-	

TABLE NAME: RDS.RDNAMES* (Road name lookup table)

COL	ITEM NAME	WDTH	OPUT	TYP	N.DEC	ALTERNATE NAME
1	MCODE	3	3	I	-	
5	RDNAME	6	6	I	-	
9	ARCID	8	8	I	0	
17	NAME	35	35	C	-	
52	UPDTSRC	3	3	C	-	
55	UPDTDT	7	7	C	-	
62	ODDSIDE	1	1	C	-	
63	ALIAS1	35	35	C	-	
98	STARTMI	7	7	N	3	
102	ALIAS2	35	35	C	-	
137	ALIAS3	35	35	C	-	
172	COM	30	30	C	-	
202	GPSFLG	1	1	C	-	
203	*FIPS8***	*8*	*8*	*I*	-	

** Based on VT E911's roadnames.dbf file schema*
*** Field not part of E911 table. Added by VTrans.*

TABLE NAME: RDS.RODSEG[1] (ROD_Segemnt Lookup Table)

COL	ITEM NAME	WDTH	OPUT	TYP	N.DEC	ALTERNATE NAME
1	RODSEG_ID	12	12	C		
12	AUTH_ID	5	5	C	-	
17	UPDDATE	8	8	D	-	
25	STARTRODPT	6	6	I	-	
31	ENDRODPT	6	6	I	-	
37	FMLENGTH	7	7	N	3	
44	FMUNITS	10	10	C	-	
54	SEGLENGTH	12	12	N	3	
66	SEGLUNITS	10	10	C	-	
76	RODSTATUS	1	1	I	-	

TABLE NAME: RDS.RODPNT[1] (ROD_Point Lookup Table)

COL	ITEM NAME	WDTH	OPUT	TYP	N.DEC	ALTERNATE NAME
1	RODPNT_ID	6	6	I		
7	PNTDESC	254	254	C	-	
260	PNTTYPE	1	1	I	-	
261	UPDDATE	8	8	D	-	

TABLE NAME: RDS.RODPATH[1] (ROD_Path Lookup Table)

COL	ITEM NAME	WDTH	OPUT	TYP	N.DEC	ALTERNATE NAME
1	RODPATH_ID	6	6	I		
12	AUTH_ID	5	5	C	-	
17	UPDDATE	8	8	D	-	
25	STARTRODPT	6	6	I	-	
31	ENDRODPT	6	6	I	-	
37	FMLENGTH	7	7	N	3	
44	FMUNITS	10	10	C	-	
54	PATHLENGTH	12	12	N	3	
66	PATHLUNITS	10	10	C	-	

Compatibility with National Standards

Numerous national and international initiatives have focused on the development of open geospatial standards. Most of these initiatives have been working toward the development of a National/Global Spatial Data Infrastructure (NSDI/GSDI). The Federal Geographic Data Committee (FGDC) has been the primary organization sponsoring the development of National (American) geospatial standards. The latest initiative sponsored by FGDC is referred to as the Geospatial One-Stop (http://www.geo-one-stop.gov).

The Geospatial One-Stop initiative has developed draft standards (ANSI/INCITS[1] standards) for each NSDI "framework" theme including Transportation*[1]. The draft Transportation standard includes five sub-standards; air, rail, roads, transit, and inland waterways. The draft roads sub-standard was reviewed by the VCGI Technical Advisory Committee (June 2004). The VTAC included specific extensions which support the following road objects defined in the draft ANSI Transportation Standard.

1. ROD_Segment
2. ROD_Point
3. ROD_Path

It should be noted that these extensions will be implemented as time and resources allow.

Tile Structure

The RDS data layer will be maintained in a town-based tiling scheme. This tiling scheme is designed to support data management requirements. However, the data can be Are-tiled@ into more Auser friendly@ formats for end users.

This tiling scheme has been implemented for one primary reason. The Vermont Agency of Transportation creates and manages Aofficial@

1 American National Standards Institute / International Committee on Information Technology Standards

town maps on a town-by-town basis. They utilize the RDS data layer in their AHighway Mapping System@. As a result, town-based tiles are the lowest common denominator.

The FIPS8 field (originally FIPS6) in the RDS.AAT table (arc attribute table) is what defines Atown ownership@. The coding of FIPS8 was originally based on the TBHASH data layer (refer to VGIS Data Catalog). However, changes have been made based on Aofficial@ VTrans maps. The FIPS8 coding of RDS is no longer consistent with any existing town boundary coverage. FIPS8 coding should always match Aofficial@ VTrans Town Highways Maps.

Linear Referencing

A Linear Reference System (LRS) provides users with the ability to associate point "events" or linear "events" along a "linear feature". Streams, roads, railroads, etc. are all linear features. Multiple "road segments" can be built into a single "route". Routes have a defined starting point, ending point, direction, length, and measurement system. For example, all of the "road segments" which comprise Interstate 91 (in Vermont) could be built into a single route. The start point would be the Massachusetts border and the end point would be Canada. The primary direction would be north (for the north bound lane), and the measurement system would be miles. Someone could then record the locations of accidents along Interstate 91 by collecting only the milemarker at which the accident occurred. The GIS would then be able to "dynamically" locate the accident along the Interstate 91 "route". Coordinate information would not be needed.

A LRS provides the ability to link attributes to linear features without segmenting or breaking the linear feature with pseudo nodes. This allows users to associate information along a linear feature, such as a road, without having to actually update or modify the characteristics of the features (split, unsplit, move , etc.).

The LR_ETE field is a LRS identifier used to identify roads routed by the Vermont Agency of Transportation (VTrans). This field is <u>not</u> used to build or create any additional route features within the RDS data layer. It is used to automatically generate an LRS coverage (eg: TransRoad_LRS2002) containing both End-to-End (ETE) and Town-based (TWN) routes on an annual basis. The derived LRS coverage is used by VTrans (and others) to map (dynamically segment) mileage based data (eg: accident locatio ns, traffic volumes, etc.)

Units & Coordinate System

Currently the RDS data layer is in the Vermont State Plane Coordinate System based on the North American Datum (NAD) of 1983. Coordinates are stored in meters. This is the standard map coordinate system used by the VGIS. The Vermont State Plane Coordinate System is a system of rectangular (X and Y) grid coordinates derived from a Transverse Mercator projection. This projection is used for states having a large north-south extent, such as Vermont.

Associating Information to the RDS Data Layer

Unique Feature Identifier: Each road segment (Aarc@) has a unique identifier (FIPS8 +ARCID). These IDs are primarily designed for feature tracking and quality control. However, users can potentially associate attribute information to specific Aarcs@ via this identifier.

Pros:

- User only needs FIPS8 + ARCID in their database
- Does not require Aaddress matching@ or Alinear referencing@ software

Cons:

- The user must Are-fresh@ their database as features are modified and retired
- Does not allow user to locate Apoint@ events
- User can only associate information along the entire length of the road segment with the assigned ARCID.

Unique Road Name: Most Aroad segments (Aarcs@) in a town-based RDS coverage have RDNAME (road name identifier) values. Some roads do not have an Aofficial@ E911 road name. These have a RDNAME value = 0. Usually one or more Aarcs@ in a town are assigned to a specified road name. A user can associate attribute information to these Anamed roads@ via the RDNAME identifier. This identifier is generally stable.

Pros:

- User only needs FIPS8 + RDNAME in their database
- Does not require Aaddress matching@ or Alinear referencing@ software

Cons:

- The user must Are-fresh@ their database as roads are renamed (which doesn=t occur very often)
- Does not allow user to locate Apoint@ events
- User can only associate information along the entire length of the road with the assigned RDNAME value; this will often include more arcs than the user may want.
- Some roads have RDNAME values = 0 (eg: legal trails, discontinued roads, etc.).

III. MAINTENANCE PROCEDURES

This section defines proper data maintenance and tracking procedures.

In brief, update procedures include the following:

- All attributes must be assigned valid values as described in section IV of this standard.
- Attribute updates do not need to be recorded.
- When data topology is modified (by adding, deleting, reshaping, splitting or joining arcs), the action will be recorded in a 1-character 'update action' field in the RDS.AAT file (UPDACT).

General Assumptions

Update procedures are based on the following general assumptions:

Data Management

VTrans is the current "data management coordinator" for the roads data, and has responsibility for assuring the data are updated in a consistent manner. Most references to VTrans in this standard are for convenience and should be read 'data management coordinator' (which could change in the future).

Town-based Updates

Updates to the RDS data layer will be made on a town-by-town basis.

Unique Version of the Current Data

At any given time there will be only <u>one</u> copy of the current data for each town, upon which updates are performed. VTrans will keep track of who has the current data.

VGIS Digital Data Conversion Standard

Any updates must follow the VGIS Standard for Digital Data Conversion (*VGIS Handbook*, Part 2, Section A). All updates must preserve proper topology: no intersecting arcs, no unnecessary pseudo nodes, no un-snapped nodes, no improper dangles.

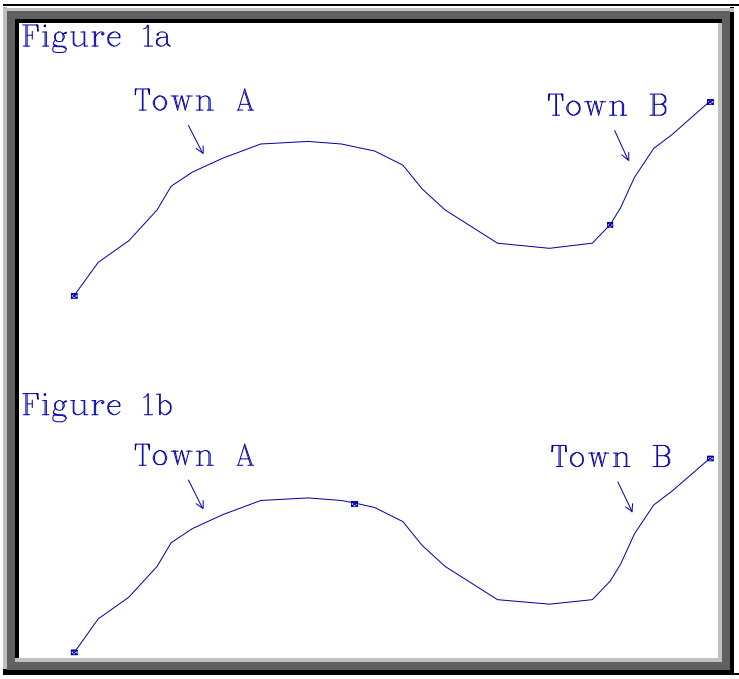
Tracking Updates

The ARCID is a unique "feature identifier" assigned to each arc in the RDS coverage. The UPDACT field is coded by VTrans in order to identify changes made to the feature (arc/road segment). This allows VTrans to document specific changes made to the data layer. The ARCID is also used for quality control.

Modifications to "arc topology" must be tracked via the UPDACT field in the RDS.AAT.
To enable this process, data developers must record any changes made to the arc topology in the UPDACT field with the following codes:

UPDACT	Action
A	Added arc (i.e., a new arc)
M	Moved arc (by reshaping the arc, moving a node, moving or deleting a vertex, or other action altering the shape o f the arc)
S	Split arc (both new arcs are coded 'S')
U	Unsplit arcs (originally 2 or more arcs)

Note that for S (split) and U (unsplit), the locations of the vertices are unchanged. The shapes (and combined lengths) of the arcs remain the same, but nodes have been added, removed or moved along the arcs.



Moving a pseudo node is sometimes required to modify the location where an attribute changes. For example, in Figure 1 a pseudo node needed to be moved to change the location of a town boundary (as determined by the FIPS8 codes for the two arcs). All of the attributes for the two arcs remain the same; only the location of the pseudo node has changed. This entails splitting and unsplitting the two arcs, and therefore would be coded as 'S' or 'U '.

Sometimes an arc may be modified more than once, in which case either of the appropriate UPDACT codes can be assigned. For example, an arc might be reshaped and then split. In such a case, the arcs could be coded with either a 'M' (moved) or an 'S' (split). Although it is not critical, it is preferable for the 'M' (moved) code to take precedence over the 'S' and 'U' codes (which don't alter the locations of vertices). Likewise, 'A' (added arc) takes precedence over other codes, so that if

an added arc is later split, the UPDACT code should remain 'A'. The coding hierarchy is outlined below:

UPDACT Hierarchy

1. A
2. M
3. S
4. U

It is not necessary to record changes to attributes.

Quality Control Procedures

VTrans has developed QC procedures for checking road attributes. Procedures include

- ?? Checks for invalid attribute values.
- ?? Incorrect topology: intersecting arcs errors, unnecessary pseudo nodes, un-snapped nodes, improper dangles, short arcs.
- ?? Checks for illogical combinations of attribute values (eg: a gravel state highway).

* Proper arc-to-arc connectivity must be maintained between towns at town boundaries.

Attributes: Some Special Cases

Several roads attributes are discussed below regarding the update process.

FIPS8 and UA

The FIPS8 code identifies the town to which each arc belongs, according to VTrans highway maps. The UA code is used to identify villages and urban compacts below the FIPS8 level. Agreement with VTrans highway maps is often based on the shape of the road, or on the measured distances on the VTrans maps. Therefore, the FIPS8/UA coding may not agree perfectly with VGIS BNDHASH layer or other town boundary layers. *Any time edits are made close to the town boundary, care must be taken to assure that the FIPS8 and UA codes are properly assigned*

Care must always be taken when assigning or modifying FIPS8 and UA codes as these are used to extract data by town or region. An arc with an incorrect FIPS8 code might not be included with that region in the future.

ARCID

The ARCID is unique within each town, hence the concatenation of FIPS8 and ARCID constitute a statewide-unique number for each arc. The ARCID is used for reporting errors, for quality control, and for

tracking modifications to the data over time.

Several actions warrant special consideration for the ARCID:

- **$** New arcs will be assigned new, unique ARCID codes by the data developer, such that the codes are unique to their towns. ARCID will never be reused.
- **$** If the FIPS8 code of an arc is changed (putting the arc into a new town), then the ARCID must be modified so that it is unique within the arc's new town. *Care must be taken to assure that unique ARCID codes are maintained when editing near a town boundary.*
- **$** When an arc is split, both arcs will be assigned new ARCIDs.
- **$** When two (or more) arcs are joined the resulting arc will be assigned a new ARCID.
- **$** When a pseudo node is moved, the two connected arcs will be assigned new ARCIDs

New ARCID codes should be added in sequential order, starting with the next available ARCID (1 more than the current maximum for the given town). ARCIDs will never be reused.

AOTCLASS The AOTCLASS field contains the Aofficial@ class as assigned by VTrans.

LOCMETH When roads are added, or if they are reshaped based on new information, the LOCMETH field must record the Amethod@ used to capture the information.

RDNAME & RDFLNAME Road names assigned to arcs via the RDNAME/RDFLNAME fields must be based on "official" E911 information only. VTrans will attempt to maintain synchronization with E911 roads data (excluding address range).

Review and Modification of this Standard

Proposed amendments to this document must be provided in writing to the VCGI Technical Advisory Committee (TAC). Amendments will be considered by this group and VTrans. The VGIS community will be provided with an opportunity to comment.

IV. TECHNICAL APPENDICES

This section includes detailed documentation of attribute coding schemes.

Attribute Coding Schemes

NOTE: All attribute definitions are based on "host" ARC/INFO implementation (with INFO as the database manager). The attribute definitions may differ when converted to xBase formats (or others). All field/attributes with an asterisk "*" identify items which are created and populated via "post-processing" techniques.

TABLE: RDS.AAT

Item Name: **FNODE#** Type: B Width: 4, 5 Decimals: 0
Attribute: Internal sequence number of the from-node of an arc
Source: Generated and managed by ARC/INFO software
Content: A unique internal sequence number assigned to all nodes in a coverage. This information supports arc-to-arc and arc-to-node connectivity.

Item Name: **TNODE#** Type: B Width: 4,5 Decimals: 0
Attribute: Internal sequence number of the to-node of an arc
Source: Generated and managed by ARC/INFO software
Content: A unique internal sequence number assigned to all nodes in a coverage. This information supports arc-to-arc and arc-to-node connectivity.

Item Name: **LPOLY#** Type: B Width: 4,5 Decimals: 0
Attribute: Internal sequence number of the left polygon; set to 0 since the RDS coverage does not contain polygons.
Source: Generated and managed by ARC/INFO software
Content: A unique internal sequence number assigned to all polygons in a coverage. In this case, the RDS coverage does not have any polygons, therefore all values are set to zero. However, this attribute is required due to ARC/INFO limitations.

Item Name: **RPOLY#** Type: B Width: 4,5 Decimals: 0
Attribute: Internal sequence number of the right polygon; set to 0 since the RDS coverage does not contain polygons.
Source: Generated and managed by ARC/INFO software
Content: A unique internal sequence number assigned to all polygons in a coverage. In this case, the RDS coverage does not have any polygons, therefore all values are set to zero. However, this attribute is required due to ARC/INFO limitations.

Item Name: **LENGTH** Type: F Width: 4,12 Decimals: 3
Attribute: Length of arc in coverage units (meters)
Source: Generated and managed by ARC/INFO software
Content: The length is based on the calculated distance along the arc between the from-node and the to-node.

Item Name: **RDS#** Type: B Width: 4,5 Decimals: 0
Attribute: Internal sequence number (record number) of the arc
Source: Generated and managed by ARC/INFO software
Content: Unique record number assigned to each arc.

Item Name: **RDS-ID** Type: B Width: 4,5 Decimals: 0
Attribute: User assigned feature ID
Source: Data management system - QA/QC system
Content: The values in this field are always unique. They are kept unique in order to assure the topological integrity of the data (including the ADD file)

Item Name: **RTNAME** Type: C Width: 12 Decimals: 0
Attribute: VTrans town number/highway number
Source: VT Agency of Transportation highway maps
Content: The RTNAME town highway number/name corresponds to the official number on the VTrans highway maps with an added prefix (ex: "I-89", "VT-12A", "TH-3", "US-4", etc). State and federal numbers will be unique for that highway for the entire state, while town numbered highways will only be unique for that town.

The following are valid prefix values:

I-	= Interstate
BR I-	= Interstate Business Route
BSp I-	= Interstate Business Spur
US-	= U.S. route
Alt US-	= U.S. Alternate Route
BR US-	= U.S. Business Route
BSp US-	= U.S. Business Spur
Old US-	= Old U.S. Route
Hist US-	= Historic U.S. Route
VT-	= Vermont Numbered Route
Old VT-	= Vermont Numbered Route - Old Route
Hist VT-	= Vermont Numbered Route - Historic Route
TH-	= Town Highway
NSH-	= Named State Highway
S-	= Other State Highway special cases
SF-	= Dept of Forest, Parks and Recreation Highway
NF-	= National Forest Highway

RTNAME = '-' is used for a blank (no data) value. The RTNAME field must not be empty.

Where a route has two route numbers (as shown on road signs), th e more local number (and prefix is used). For example, a route having both a State route number and a town route number is assigned the town route number (as shown on the VTrans highway maps).

The RTNAME field is <u>not</u> the same as RDNAME or LR_ETE. The R DNAME field refers to the roads Acommon name@ (via a relate to the RDS.RDNAMES table). For example, AMain Street@ may be considered Town Highway 5 (TH -5) by VTrans. In this situation the RTNAME would be ATH-5" and the RDNAME value would be 23 (which is AMain Street@ in the RDS.RDNAMES table). However, the same road could also be classified as AVermont Route 100" (VT -100). In this case, the LR_ETE field would be populated with AV100". The ALTNAME field in the RDS.RDNAMES table could also be used to sto re this information.

Note: Many cities and villages have named streets with no route numbers (mostly paved). There will be no entry for their route numbers even though they are official public roads. See AOTCLASS=93.

Item Name: * RTNO Type: C Width: 4 Decimals: 0
Attribute: VTrans town number/highway number
Source: *Generated from RTNAME (includes everything after the " -")
Content: Once updates are made t o the RDS data layer, "post processing" routines are used to populate this field from the RTNAME field. Everything after the dash " -" in the RTNAME field is transferred to this field. This field is NEVER updated directly. It should always match RTNAME.

Item Name: HWYSIGN Type: C Width: 12 Decimals: 0
Attribute: VTrans route sign in the Afield@
Source: VT Agency of Transportation - how the road is signed in the field
Content: The HWYSIGN corresponds to ho w the road is signed in the Afield@ by VTrans; with an added prefix (ex: "I-89", "VT-12A", "TH-3", "US-4", etc). State and federal numbers will be unique for that highway for the entire state, while town numbered highways will only be unique for that town .

The following are valid prefix values:

I-	= Interstate
BR I-	= Interstate Business Route
BSp I-	= Interstate Business Spur
US-	= U.S. route
Alt US-	= U.S. Alternate Route
BR US-	= U.S. Business Route
BSp US-	= U.S. Business Spur
Old US-	= Old U.S. Route
Hist US-	= Historic U.S. Route
VT-	= Vermont Numbered Route
Old VT-	= Vermont Numbered Route - Old Route
Hist VT-	= Vermont Numbered Route - Historic Route
TH-	= Town Highway

NSH- = Named State Highway
S- = Other State Highway special cases
SF- = Dept of Forest, Parks and Recreation Highway
NF- = National Forest Highway

HWYSIGN = '-' is used for a blank (no data) value. The HWYSI GN field must not be empty.

The HWYSIGN field is not the same as RTNAME. HWYSIGN should be consistent with how the road is signed by VTrans in the Afield@. RTNAME should be consistent with how the road is Amarked@ on the official VTrans Town Highway M aps. These don=t always match.

Item Name: **AOTCLASS** Type: I Width: 2 Decimals: 0

Attribute: Road class as shown on VTrans town highway maps

Source: VT Agency of Transportation highway maps

Content: This item will hold the official VTrans road class from the VTrans highway maps. All arcs must be assigned an AOTCLASS code.

In addition to the road class, the AOTCLASS field is used t o indicate the road 'type' (as for codes 11 to 19). Although this road type is not technically the road class, it is convenient to embed the 'type' information in the AOTCLASS code for generating maps with lookup tables. These 'type' codes needed for sta te routes and class 1 and 2 town highways, as well as for interstates and US routes.

AOTCLASS	Content
1 -4	Class 1-4 town highway, undivided (see 11 -19, 21-29)
5	State forest highway
6	US Forest Service (USFS) Forest Road
7	Legal trail
8	Private road, but not f or display on local maps. Some municipalities may prefer not to show certain private roads on their maps, but the roads may need to be maintained in the data for emergency response or other purposes.
9	Private road, for display on local maps
10	Not used; use AOTCLASS = 1 for undivided Class 1 Town Highway
11	North bound (for divided c enterlines)
12	South bound
13	East bound
14	West bound
15	Entrance/Exit ramp, Approach, Jughandle
16	Emergency U-turn
17	Rest area
19	Other Class 1 Town Highway (weigh stations, maintenance areas, etc.)
20	Not used; use AOTCLASS = 2 for undivided Class 2 Town Highway
21-29	Class 2 Town Highway; same road types as for 11-19
30	Vermont State Highway, undivided centerline (most Vermont Highways)
31-39	Vermont State Highway; same road types as for 11 -19
40	US Highway, undivided centerline (most US Highways)
41-49	US Highway; same road types as for 11 -19
50	Interstate, undivided centerline (not currently used)
51-59	Interstate, same road types as for 11 -19
81-83	Proposed Class 1-3 Town Highway
84	Proposed State Highway
85	Proposed US Highway
86	Proposed Interstate
87	Propose d ramp: Interstate
88	Proposed ramp: non -Interstate
89	Proposed private road
91	(code no longer used)
92	Military road, no public access
93	Public road from VTrans map, for which the clas s could not be determined. Most of these are named streets in urban areas, which are mostly class 3. From the original road centerline data, any road with CLASS = 99 (un known) but with a known SURFACE type was assigned AOTCLASS = 93
95	Road class under special review, usually temporary

96 Discontinued
97 (code no longer used)
98 (code no longer used)
99 (code no longer used)

Class 4 town highways on the VTrans General Highway Maps may include provisional class 4 roads. These are legally class 3, but have a class 4 level of service. These roads have been deemed "Not Up To Standard" and have been functionally reclassified as class 4. Towns do not receive any state aid for provisional class 4 highways.

Class 6 roads should include those classified as "Forest R oads" by the U.S. Forest Service, and maintained by the U.S. Forest Service. It does not include Forest Roads maintained by towns or the State of Vermont. Roads on Forest Service land that are not Forest Roads should be coded using a Class other than 6.

Item Name: FUNCL Type: I Width: 2 Decimals: 0
Attribute: Functional class code
Source: VTrans
Content: Functional classification codes are based on a federal classification system in use by VTrans. Functional classes distinguish between rural and transportation-defined urban areas (8 in Vermont). Therefore, proper assignment of this attribute requires that road arcs b e split at the rural/urban boundaries.

FUNCL	Rural/ Urban	Functional Class
0		Not part of Functional Classificati on System
1		Rural Principal Arterial - Interstate
2		Rural Principal Arterial
4		Rural Principal Arterial - Other (not other freeway); not a standard federal code
6		Rural Minor Arterial
7		Rural Major Collector
8		Rural Minor Collector
9		Rural Local
11		Urban Principal Arterial - Interstate
12		Urban Principal Arterial - Other Freeway
14		Urban Principal Arterial - Other
16		Urban Minor Arterial
17		Urban Collector
19		Urban Local
78	-----	Minor collector recommended for major collector upgrade (used only for ACRPC as of 4/11/94)
86	-----	Previously FEDAID='P' (FAP); likely FUNCL=6, a few will be 2
87	-----	Previously FEDAID='S' (FAS); likely FUNCL=7
94	-----	Previously FEDAID='U' (FAU), State and US routes; likely FUNCL=14 or 16
97	-----	Previously FEDAID='U' (FAU), other rout es; likely FUNCL=17

Item Name: NHS Type: I Width: 1 Decimals: 0
Attribute: National Highway System designation
Source: VT Agency of transportation
Content:
0 = Not on NHS
1 = NHS - Interstate
2 = ISTEA High Priority Corridor
3 = Non-Interstate STRAHNET
4 = STRAHNET Connector
5 = ISTEA High Priority Corridor/Non-Interstate STRAHNET
6 = ISTEA High Priority/STRAHNET Connector
7 = NHS - Principal Arterial
8 = NHS - Intermodal Connector

Item Name: SCENIC Type: I Width: 1 Decimals: 0
Attribute: Route identified as "scenic" by VTrans
Source: VT Agency of transportation highway maps
Content:
0 = Not designated as Scenic Highway

1 = Designated as Scenic Highway by local municipality
2 = Designated as Scenic Highway by VTrans

Item Name: SURFACE Type: I Width: 1 Decimals: 0
Attribute: Road surface type
Source: VT Agency of transportation highway maps
Content: SURFACE Content

SURFACE	Content
1	Hard surface (pavement)
2	Gravel
3	Soil or graded and drained earth
5	Unimproved/Primitive
6	Impassable or untravelled
9	Unknown surface type

Roads surface types are generally based on VTrans maps, or on regional/local review.

Item Name: LR_ETE Type: C Width: 11 Decimals: 0
Attribute: Route ID used to identify "routed" roads
Source: Assigned by VTrans
Content: This item contains an "End-to-End" LRS identifier used to identify routed roads. The LR_ETE can be broken do wn into the following components (or redefined items)

Route Type (LR_ETE_TYP):

I	= Interstate
U	= U.S. route
V	= VT signed route
S	= State highway (named, special cases, other routed roads)
A	= Alternate route
B	= Business route

Route Number (LR_ETE_NUM). The numeric portion of the highway number (3 digits), right justified in characters 2-4. For Named State Highways, Major Collectors and Urban Collectors, 4-digit codes are used (in characters 2-5).

Route # Modifier (LR_ETE_MOD). Used for a letter or special modifier, if needed.

Named State Highways, Major Collectors and Urban Collectors retain their full, 4-digit codes in common usage. For these, the Highway Number and Modifier are combined to form a 4-digit highway number.

For the three separate sections of Alternate U.S. 5, the modifiers (1 to 3) are:

A0051	=	Alternate US 5, St. Johnsbury
A0052	=	Alternate US 5, Newport
A0053	=	Alternate US 5, Derby

Valid Highway # Modifier characters include:

<letter>	=	Highway letter (e.g., the 'A' in Highway 2A)
<digit>	=	Special cases (e.g., Alternate U.S. 5); digit for a Named State Highway, Major or Urban Collector
' '	=	<blank>, if no modifier is needed and no subsequent components are needed for the LR_ETE
-	=	<dash>, if no modifier is needed but other LR_ETE components follow

Direction (LR_ETE_DIR). The direction character is included only if the highway is divided. However, it is NOT used for North/East bound mainline routes. The Direction character is only used with North/East bound Appro aches,

Connectors, Jughandles, Ramps, and Spurs Valid direction characters include:

' '	=	<blank>, if route is undivided and there are no subsequent LR_ETE_RTE components
W	=	Westbound (for divided routes)
S	=	Southbound (for divided routes)
E	=	Eastbound (for divided routes)
N	=	Northbound (for divided routes)

Examples:

LR_ETE	End-to-End Route
I089	= I 89 Northbound lane
I089-S	= I 89 Southbound lane
U002	= US 2 undivided portions
U002-W	= US 2 Westbound portions (where divided)
V003-NA020	= VT 3, Approach 20

Approaches generally use the same direction as the parent road.

Subtype (LR_ETE_SUBT): This field describes sections of road that are not on the main line yet have defined lengths recognized by the Agency. Valid codes include:

' '	=	<blank>, no subtype
A	=	Approach
C	=	Connector
J	=	Jughandle
R	=	Ramp
S	=	Spur

Numeric ID (LR_ETE_NID): The ID number represents different things according to the subtype.

Approaches and jughandles are numbered (initially) in ascending order from the start of the parent route in the primary direction. Numbers will increment by multiples of ten (ex:10,20,30,40,etc...). Gaps are left between numbers for future construction.

For ramps and spurs the number refers to the exit number for the parent route. A few ramps exit at locations that have no exit number. These have zeros in this field.

Where no ID is required in this field, blanks are used.

Alpha ID (LR_ETE_AID): This letter identifies ramps and spurs, as taken from the route logs except for two r amps at I 91, Exit 2, which were named A/B and C/D on the route logs. These have been renamed 'E' and 'F', respectively.

Where no ID is required in this field, a blank space is used.

Examples:

LR_ETE	End-to-End Route
U004	= US 4 Eastbound Divided Highway
U004-W	= US 4 Westbound Divided Highway
V100-NA010	= VT 100 Approach #10
B004-WJ010	= Business Rt US4 Westbound Jughandle #10
I089-SR009A	= I 89 Southbound Exit 9 Ramp

Item Name: ***CTCODE** Type:C Width: 4 Decimal s: 0
Attribute: VTrans County-Town code
Source: *Generated by relating FIPS8 to a lookup table containing CTCODE values

Content: The county-town code identifies the municipality in which each road falls. This field is NEVER updated directly. Post-processing routines will populate this field via the FIPS8 attribute.

Item Name: **UA** Type: I Width: 1 Decimals: 0
Attribute: VTrans Urban Area Code
Source: To be based on municipal boundaries and VTrans highway maps
Content: These Urban Area codes identify villages and other urbanized areas within the Minor

Civil Divisions specified by the FIPS8 codes. The codes include 'urban compacts' having separate VTrans Highway maps. The 1-digit code is used in conjunction with the FIPS8 code to uniquely identify each urban area.

Listed in order of FIPS6 codes, the UA codes include:

FIPS6	UA	RPC	Urban Area
1055	1	AC	Middlebury Urban Compact
3005	1	BC	Arlington Urban Compact
3010	1	BC	North Bennington Village
3010	2	BC	Old Bennington Village
3010	3	BC	Bennington Urban Compact
3025	1	BC	Manchester Village
3025	2	BC	Manchester Center Depot Urban Compact
5010	1	NV	West Burke Village
5020	1	NV	Groton Village
5035	1	NV	Lyndonville Village
5050	1	NV	South Ryegate Village
5055	1	NV	St. Johnsbury Urban Compact
7030	1	CC	Essex Junction Village
7030	2	CC	Essex Center Urban Compact
7045	1	CC	Jericho Village
9020	1	NV	Island Pond Urban Compact
11020	1	NW	Enosburg Falls Village
11080	1	NW	Swanton Village
13005	1	NW	Alburg Village
15010	1	LC	Cambridge Village
15010	2	LC	Jeffersonville Village
15025	1	LC	Hyde Park Village
15030	1	LC	Johnson Village
15035	1	LC	Morrisville Village
17005	1	TR	Bradford Village
17035	1	TR	Newbury Village
17035	2	TR	Wells River Village
19005	1	NV	Albany Village
19010	1	NV	Barton Village
19010	2	NV	Orleans Village
19035	1	NV	Derby Center Village
19035	2	NV	Derby Line Village
19085	1	NV	North Troy Village
21010	1	RR	Brandon Urban Compact
21035	1	RR	Fair Haven Urban Compact
21085	1	RR	Poultney Village
21090	1	RR	Proctor Urban Compact
21125	1	RR	Wallingford Urban Compact
21140	1	RR	West Rutland Urban Compact
23020	1	CV	Cabot Village
23045	1	CV	Marshfield Village
23065	1	CV	Northfield Village
23090	1	CV	Waterbury Village
25010	1	WR	Brattleboro Urban Compact
25010	2	WR	West Brattleboro Urban Compact
25060	1	WR	Newfane Village
25070	1	WR	Bellows Falls Village
25070	2	WR	Saxtons River Village
25080	1	WR	Townshend Village
25095	1	WR	North Westminster Village
25095	2	WR	Westminster Village
25100	1	WR	Jacksonville Village
27030	1	RR	Proctor Urban Compact
27035	1	SW	Chester-Chester Depot Urban Compact
27040	1	TR	White River Junction Urban Compact
27040	2	TR	Wilder Urban Compact
27050	1	SW	Ludlow Village
27090	1	SW	Springfield Urban Compact
27090	2	SW	North Springfield Urban Compact
27100	1	SW	Perkinsville Village

27115	1	SW	Windsor Urban Compact
27120	1	TR	Woodstock Village

Item Name: RDNAME Type: I Width: 6 Decimals: 0

Attribute: Road name code

Source: Locally assigned road names

Content: Road names are stored as an integer code, referencing look-up table RDS.RDNAMES. An integer code is used to minimize the space required used in the road centerline attribute table (RDS.AAT). Each named road will have a unique RDNAME value. *NOTE: Refer to the special note under III MAINTENANCE PROCEDURES – Attributes: Some Special Cases – RDNAME.*

Item Name: *RDFLNAME Type: C Width: 30 Decimals: 0

Attribute: Full road name

Source: *Generated from the NAME field in the RDS.RDNAMES table

Content: This field contains the complete road name as defined in the NAME field of the RDS.RDNAMES table. This field is populated by relating the the RDS.RDNAMES field using RDNAME as the relate/link field. This field should NEVER be updated directly. Post-processing routines will create and update this field. *NOTE: Refer to the special note under III MAINTENANCE PROCEDURES – Attributes: Some Special Cases – RDNAME.*

Item Name: LOCMETH Type: I Width: 2 Decimals: 0

Attribute: Method used to locate/digitize the road segment (arc)

Source: Refer to SRCORG

Content:

1= Visible on and digitized from a 1:5000 orthophoto (or better, as documented in the update record) with good degree of certainty as to location and correct RTNO attribute.

2 = Road not clearly visible on the orthophoto, but it appears that it probably was there at the time the photo was taken. Location estimated from the AOT maps, adjoining roads and land features.

3 = Not clearly visible on the ortho, location estimated from State Forest maps.

4 = No indication of the road on the orthophoto; apparently a new road built since the orthophoto was taken. Location estimated from VTrans maps.

5 = Road centerlines drafted onto orthophotos from engineering drawings and the like.

6 = Invisible on the orthophoto, but located based on town or other local knowledge of the area.

7 = Digitized centerline of the parcel (tax map) road right-of-way.

8 = Screen digitized from drafting by town officials onto maps of approximately 1:15,000 to1:20,000 scale.

9 = Coordinates captured via a GPS device utilizing Adead reckoning@ with typical horizontal accuracy within 5 meters

Item Name: SRCORG Type: I Width: 2 Decimals: 0

Attribute: Organization/project which created/updated the road segment (arc)

Source: Assigned when digitized, moved or reshaped

Content: This attribute identifies the organization or project which digitized the arc. When a road arc is digitized, moved or reshaped, the SRCORG code should be updated. The SRCORG codes will serve as a record of "who did it".

1 VCGI, original data (assigned Sept 1993)
2 VCGI, updated location
10 Addison County RPC
11 Bennington County RC
12 Central VT RPC
13 Chittenden County RPC
14 Northwest RPC
15 Lamoille County PC
16 Northeast VT Development Assoc.
17 Rutland RPC
18 Southern Windsor RPC (or its contractor)
19 Two Rivers-Ottauquechee RPDC
20 Upper Valley-Lake Sunapee RPC
21 Windham RPC
22 microData, incorporated by CVRPC
23 Incorporated from municipal updates
24 E9-1-1 GIS database development project (1996)
25 IVS Highway Mapping System Project
26 VTrans HMS updates

Item Name: **FIPS8** Type: I Width: 8 Decimals: 0
Attribute: Municipality (town, city, gore, grant) code
Source: VT Agency of Transportation highway maps
Content: The FIPS8 code identifies the municipality in which each road falls, as shown on the VTrans highway maps. The FIPS8 code is a modified version of FIPS6 (as listed in the Geographic Area Codes Standard of the VGIS Handbook). FIP S8 includes the FIPS state code (ex: 50 for Vermont) + FIPS6.

Some short road sections in the data fall outside of Vermont. These are assigned the FIPS8 code of the associated town with the state FIPS code of the adjoining state. Therefore, a FIPS8 of 90027115 indicates an arc in New Hampshire associated with the town of Windsor (50027115).

Item Name: **ARCID** Type: I Width: 4 Decimals: 0
Attribute: Arc identifier, unique by town/city/grant/gore
Source: Assigned by VCGI or data developer
Content: The ARCID is a unique arc identifier within each municipality (town, city, grant or gore). When combined with the FIPS8 codes, this provides a unique arc identifier statewide.

Item Name: **UPDACT** Type: C Width: 1 Decimals: 0
Attribute: Used for flagging the type of update made to an arc
Source: Assigned by organization performing updates
Content: Updated data sets received by VCGI are compared against the original data set provided to the data developer, and a record of changes made to the data will be generated. To enable this process, data developers must record any changes made to the arc topology in the UPDACT field with the following code:

UPDACT	Action
A	Added arc (i.e., a new arc)
M	Moved arc (by reshaping the arc, moving a node, moving or deleting a vertex, or other action altering the shape of the arc)
S	Split arc (both new arcs are coded 'S')
U	Unsplit arc (originally 2 arcs)

Item Name: ***ARCMILES** Type: N Width: 7 Decimals: 3
Attribute: Calculated mileage
Source: Arc LENGTH * .0006211371192
Content: The ARCMILES item indicates the mileage on each segment of road. ARCMILES is the primary basis for the RDNAME route system measurements. The ARCMILES item is necessary for rebuilding or remeasuring the RDNAME route system. The ARCMILES field is simply the product of the LENGTH * .0006213711. It is not intended to reflect or duplicate actual or official VTrans mileage.

Item Name: **AOTMILES** Type: N Width: 7 Decimals: 3
Attribute: Vermont Agency of Transportation "measured" miles
Source: VTrans records
Content: The AOTMILES item indicates the "official" VTrans mileage on each segment of road.

** Redefined Items **

Item Name: **FIPS6** Type: I Width: 6 Decimals: 0
Attribute: Municipality (town, city, gore, grant) code
Source: Last 6 bytes of FIPS8 field
Content: This field includes only the last 6 bytes of the FIPS8 field.

Item Name: **FAID** Type: I Width: 12 Decimals: 0
Attribute: FIPS8 + ARCID codes create statewide unique arc ID
Source: FIPS8+ARCID
Content: Refer to FIPS8 & ARCID

Item Name: **AOTSURFCL** Type: I Width: 12 Decimals: 0

Attribute: Concatenation of SURFACE + FUNCL used by VTrans to symbolize HMS maps
Source: SURFACE + FUNCL
Content: Refer to SURFACE & FUNCL

Item Name: LR_ETE_TYP, LR_ETE_NUM, LR_ETE_MOD, LR_ETE_DIR, LR_ETE_SUBT, LR_ETE_NID, LR_ETE_AID

?? - Refer to LR_ETE documentation.

TABLE: RDS.NAT

Item Name: ARC# Type: B Width: 4 Decimals: 0
Attribute: The internal ARC number points to one of the arcs (randomly selected) connected to that node.
Source: Maintained by ARC/INFO "build" and "renode" commands.
Content: The internal ARC number points to one of the arcs (randomly selected) connected to that node.

Item Name: RDS# Type: B Width: 4 Decimals: 0
Attribute: Internal sequence number of the node.
Source: ARC/INFO
Content: Internal sequence number of the node.

Item Name: RDS-ID Type: B Width: 4 Decimals: 0
Attribute: ARC/INFO feature ID. When an NAT is initially created, node IDs are automatically set equal to the node's internal sequence number.
Source: ARC/INFO
Content: Sequential number maintained by ARC/INFO. This is NOT a user-defined identifier. Refer to RDSNODE_ID instead.

Item Name: RDSNODE_ID Type: I Width: 8 Decimals: 0
Attribute: Unique RDS node identifier
Source: VTrans Highway Mapping System (HMS)
Content: This field contains a unique RDS node identifier assigned by VTrans' HMS system.

Item Name: TWNBNDPT Type: I Width: 6 D ecimals: 0
Attribute: Flags nodes which define a town boundary.
Source: VTrans
Content: This field is used to flag nodes which define a town boundary.
Y = Yes, this node define a town bounda ry
N = No, this node does not define a town boundary

VTrans/RPC Data Exchange Protocol

Overview:
This protocol defines the procedures used to facilitate exchange of road centerline data updates between the Vermont Agency of Transportation (VTrans) and Vermont's Regional Planning Commissions (RPCs). Collaborative maintenance of Vermont's "master" road centerline data layer (RDS) will reduce redundant data collection and improve data quality.

Objectives:
To improve data quality and promote efficient da ta management activities. Benefits include:

A. Reduce redundant data collection activities,
B. Improve spatial and attribute accuracy,
C. Provide a mechanism for RPCs to have input into the maintenance of Vermont's "master" RDS layer,
D. Help RPCs protect the investments they have made.

DATA EXCHANGE PROTOCOLS

This section includes detailed data exchange protocols that will guide how data will be exchanged between VTrans and Vermont's RPCs. It includes specifics on how changes will be flagged, transferred, and integrated into the "master" RDS layer.

Assumptions:

A. All edits will be done using Arc/Info (PC or Workstation)
B. VTrans reserves the right to reject changes (spatial and attribute) recommended by RPCs.

Procedures:
VTrans and the participating RPCs may engage in exchange of changes to the road centerline data layer. Each party will use the data exchange protocol to facilitate a consistent methodology of data update. Each party must adhere to the tenants set forth in this protocol to make this process is effective.

Data Exchange Flow

1. Participating RPC requests the latest RDS data directly from VTrans, Program Development Division – Engineering Services Section.
2. VTrans provides the requested data as either a post to an FTP site for download or via email. Data will be exchanged as

town tiles. Each town tile of RDS will be named as RDS with the FIPS6 suffix - RDS<fips6>. Updates must be performed on a town tile basis only.

3. RPC downloads data and imports into Arc/Info or other suitable software application that can maintain the data integrity and write out an ArcInfo Exchange File.
4. The RPC can then choose to update SURFACE, and also "tag" roads/arcs requiring spatial correction/update. The following fields must be added to the RDS.AAT file (by the RPC) in order to facilitate this work:
    a. ***SP_UPD*** (1 1 Integer)
        i. **0** = Spatially OK
        ii. **1** = Correct it using E911/RDS data
        iii. **2** = Use this arc to correct data (the arc does not have to be coded with any attributes except for these three new items. VTrans will conflate existing attribute data into the new arc). *Any existing arcs being deleted must be saved (PUT) to a coverage called DEL<fips6> (for backup and tracking).*
        iv. **3** = Spatial correction needed
    b. ***SP_NOTES*** (255 255 Character) – Text explaining problem with data in more detail (including source of location for any new arcs so VTrans can code the LOCMETH field).
    c. ***SF_UPD*** (1 1 Integer)
        i. **0** = SURFACE OK
        ii. **1** = SURFACE value has been changed by RPC.
    d. ***SF_NOTES*** (255 255 Character) – Text explaining why the SURFACE type has been changed including justification/documentation. It may be necessary for the RPC to include additional documentation.
    e. ***CL_UPD*** (1 1 Integer)
        iii. **0** = AOTCLASS OK
        iv. **1** = AOTCLASS value has been changed by RPC.
    f. ***CL_NOTES*** (255 255 Character) - Text explaining why the AOTCLASS type has been changed including justification/documentation. It may be necessary
    for the RPC to included additional documentation.
5. RPC submits updated data in an ArcInfo Exchange File (E00)

to VTrans for integration into the "master" RDS data l ayer.

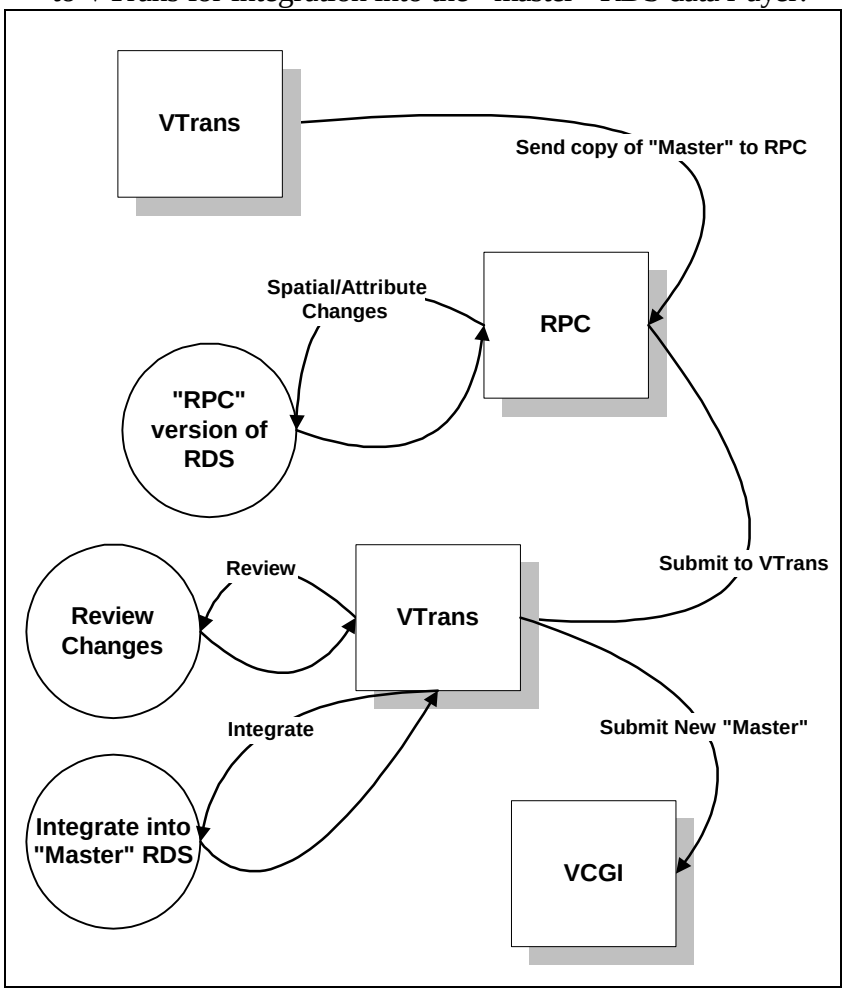


Figure 1 - Data Exchange Flow

Editing Standards

1. Existing arcs must NOT be split (splitting will be performed by VTrans).
2. Realigned arcs must be tagged with a SP_UPD > 0 and have information in the SP_NOTES field.
3. New arcs must be tagged with a SP_UPD > 0 and have information in the SP_NOTES field. Added arcs must NOT split or create intersections with existing arcs (set *INTERSECTARCS OFF*). (again, splitting will be performed by VTrans)
4. Nodes can be moved (pseudo or intersection), but all of the arcs that connect to that node must be tagged with a SP_UPD

> 0 and have information in the SP_NOTES field.

5. Changes in the SURFACE attribute must be accompanied by documentation (in the SF_NOTES field at a minimum).

Integration into "Master" RDS Layer:

Updated RDS coverages will be reviewed by VTrans using manual and automated routines. These routines will do the following:

A. Compare "master" RDS to updated version provided by RPC. Verify that ARCIDs match. Generate report of non-matching arcs.
B. Determine differences in SURFACE type between "master" and RPC version. Generate report.

Changes considered acceptable by VTrans will be integrated into the "master" RDS data using a combination of specialized programs and/or the Highway Mapping System edit environment. VTrans will add two fields to the RDS.AAT file (RPC version) to track changes that have been accepted or denied:

a. ***SP_ACCEPT*** *(1 1 Character)* ***Spatial Change Accepted***
   i. Y = Change accepted and integrated into "master".
   ii. N = Change NOT accepted.
   iii. H = Change on HOLD (decision pending and/or will be implemented in the future).

a. ***SF_ACCEPT*** *(1 1 Character)* ***SURFACE Type Change Accepted***
   i. Y = Change accepted and integrated into "master".
   ii. N = Change NOT accepted.
   iv. H = Change on HOLD (decision pending and/or will be implemented in the future).

VTrans will then submit the updated "master" RDS to VCGI for integration into the VGIS Data Warehouse. A copy will also be sent back to the RPC along with the original RPC RDS coverage containing the SP_ACCEPT and SF_ACCEPT flags.

Unacceptable Changes:

VTrans will make the determination as to whether spatial or attribute updates recommended by the RPC will be integrated into the "master" RDS layer. As noted above, the SP_ACCEPT and SF_ACCEPT fields will be used to track what was accepted or rejected. RPCs may choose to retain rejected changes in a separate layer for their own internal use.

REFERENCES

[1] Draft ANSI, *Geospatial One Stop Transportation Standard (Roads).* ANSI X.X.X2003, Definitions, forthcoming.
[2] NCHRP 20-27, *A Generic Data Model for Linear Referencing Systems,* National Cooperative Research Program of the Transportation Research Board.