
The Virginia Department of Transportation (VDOT) Information Technology Division (ITD) is announcing the quarterly release of the Roadway Network System (RNS) Linear Referencing System (LRS). The LRS is used within a Geographic Information System (GIS) by internal and external customers from many different divisions, agencies, organizations and privately held corporations. This allows these entities to display VDOT maintained roadways in a cartographic fashion and more importantly locate business data (events) that occurs at specific locations along the road.

Highlights

A total of **6,659 miles** (6,637 routes) were processed for the 13.4 release. A [processed route](#) indicates that a route was added or geometry and/or attribution (measures, sequences, etc.) of an existing route have been modified. The modification to an existing route could be a minor change such as an intersection being added to provide access to a new subdivision or as major as the inclusion of a road that did not previously exist in the [network](#). A complete list of processed routes is available upon request.

Processing Priorities: The new job based [route building process](#) allows for specific portions or locations on a route or multiple routes to be selected and added to a processing queue. Each job is classified with a type specification, allowing jobs to be prioritized in the queue according to requirements and/or need.

1. Inventory Change Requests ([ICRs](#)) for new additions and changes to the network. A total of 749 [route build](#) jobs were part of the ICR workflow, equating to 867 miles (3,669 [edges](#)).
2. Processing VDOT centerline bulk replacements as a result of the [VGIN](#) Centerline Transition for Fredericksburg district primary and secondary routes.
3. Existing problems that were fixed on US-60 westbound. Multiple [LRS Build](#) jobs were created and processed to resolve most of the issues identified by LRS users or through internal quality assurance. A few locations still require edits and/or reprocessing. All known issues have been patched in the edge based LRS types.

LRS FAQ: [Frequently asked questions](#) were added to the appendix of the release notes to aid new and existing LRS users.

Known Issues

Geometric Discrepancies → Ongoing: Users will notice small feature malformations (e.g. disjointed endpoints, misaligned segmentation, etc.); particularly where old features that have not undergone conflation intersect conflated features. Editors are monitoring topology with enhanced QA processes to improve the [network](#).

[UPDATE] Route Substitution Patch: Business LRS users prioritized fixes on US-60, US-1, US-301, US-460, SR-3, SR-33, SR-14, SR-198, SR-16. All of the routes had locations that were reprocessed or patched in the edge based LRS types for this release. SR-286 and SR-354 were also identified by VDOT business groups that need to be resolved by the 2014 quarter 3 release (LRS14.3) in order to accommodate the Maintenance Division [PMS](#) synchronization and field data collection of roadway inventory.

BACKLOG:

The issues below still remain except where indicated as fixed. The unresolved issues need one or more of the following: RIMS edit jobs created, job prioritization by the business, route edits performed, enhancement to the [route build](#) process and/or the route (or portions of) need to be rebuilt.

Note: Detailed weekly reporting provided to internal business units is used to track LRS Build progress for all know measure, sequence and gap issues.

Edge Based Jurisdiction Measure LRS ([SDE](#) [VDOT](#) [EDGE](#) [RTE](#) [OL](#) [JURIS](#) [MSR](#)) Errors:

The bulk of these issues were known and/or identified by Divisions within VDOT that heavily use the LRS in day-to-day business activities. They expend a tremendous amount of effort ensuring the LRS type(s) they utilize will suit business needs. The result is the provision of valuable feedback to the RNS team.

1. **[UPDATE] Edges with No Measure:** 363 secondary edges with shape length greater than a tenth mile and a measure sum of zero. These were all fixed during this cycle in the editing version and will be incorporated into the LRS as the routes in these jurisdictions are rebuilt.
2. **[FIXED] Self-overlapping edges (folded geometry):** A bug causing duplicate rows for institution routes was discovered and fixed. This was causing multiple identical measure values at the same vertices on the LRS.

Route Specific Errors:

3. **[FIXED] US-60WB:** Gaps and zero length measures.
4. **SR-7100** (Fairfax County Parkway): Gaps and zero length measures.
5. **Flip Direction:** Segment flips are not being respected when a gap in the route occurs (e.g. US-60W after the P route for overlap on I-64W).

v Looking Forward

Processing Queue: The queue has been enhanced to regenerate automatically as part of the nightly build. This includes the vast number of edits that are occurring across the commonwealth as every edge (i.e. record) is being conflated by the UCP.

Upcoming HPMS submittal: The next LRS release (14.1) will be utilized to produce the HPMS submission to the FHWA for 2013.

v Feedback

The RNS team wants to know how you utilize the LRS release products. We welcome suggestions and/or comments about data availability, usability, content, release notes subject matter, statistical analysis, quality control, issue resolution and ideas on how this data product could better suit your needs. Any input that is within our control to act upon will be considered, provided it maintains a uniform product that meets the needs of multiple customers and stays within budget constraints.

Send feedback to: GIS@VDOT.Virginia.Gov

Route Processing Statistics

The spatially enabled dual carriageway roadway network model that RNS uses allows for road centerlines to appropriately represent the real-world. An important aspect is that both prime (e.g. northbound/eastbound) and non-prime (e.g. southbound/westbound) directions for all route categories are maintained for this purpose.

Travel Miles

The statistics below represent comprehensive travel miles that are contained within the LRS. Distances where travel commences on multiple collocated routes (i.e. overlap one another as in the case of Interstate 95 southbound and Interstate 64 westbound) along the same roadway surface are accounted for in the summation of travel miles.

13.4 (current)		
	LRS Travel Miles	New Non- Prime LRS Travel Miles
Route Category		
Interstate	2,583.243	220.648
Primary	11,227.772	10,520.749
Secondary	49,674.378	49,563.672
City	2,335.095	2,332.184
County	319.145	319.310
Interstate Ramp	513.531	
Primary and Secondary Ramp	184.389	
Totals	66,837.553	62,956.563

13.3 (previous)		
	LRS Travel Miles	New Non- Prime LRS Travel Miles
Route Category		
Interstate	2,583.243	220.648
Primary	11,229.107	10,503.809
Secondary	49,699.333	49,592.129
City	2,334.916	2,332.001
County	319.145	319.310
Interstate Ramp	512.680	
Primary and Secondary Ramp	184.389	
Totals	66,862.813	62,967.897

Maintenance Miles

These figures portray the miles of road surface that VDOT maintains. Mileages only account for a single lane road surface.

13.4 (current)		
	LRS Maintenance Miles	New Non- Prime LRS Maintenance Miles
Route Category		
Interstate	2,499.733	0.147
Primary	9,813.933	2,944.365
Secondary	48,852.707	548.047
City	2,308.064	95.744
County	313.145	67.561
Interstate Ramp	512.140	
Primary and Secondary Ramp	182.399	
Totals	64,482.121	3,655.864

13.3 (previous)		
	LRS Maintenance Miles	New Non- Prime LRS Maintenance Miles
Route Category		
Interstate	2,499.733	0.147
Primary	9,816.660	2,925.687
Secondary	48,879.313	541.825
City	2,307.884	95.694
County	313.145	67.561
Interstate Ramp	511.289	
Primary and Secondary Ramp	182.399	
Totals	64,510.423	3,630.914

Appendix

Frequently Asked Questions

What is a LRS?

A Linear Referencing System (LRS) is a method of spatial referencing in which the locations of events (feature records) are described in terms of distances along a roadway from a defined starting point, for example a mile point. Each event is located by either a point (e.g. a crash) or a line (e.g. speed zone).

Who maintains the LRS?

VDOT's LRS is managed by the Roadway Network System (RNS) program whose primary focus is maintaining and storing the location of core business data events, such as crashes, railroad crossings, bridges, speed zones, pavement, traffic, road characteristics, and more. Within RNS, the LRS is constantly updated and is published as a consumable product every [calendar quarter](#). The LRS is used by internal VDOT systems (e.g. [RNS](#), [RIMS](#), [HPMS](#), [PMS](#), [Integrator](#), etc.) and external entities as the road network upon which business data is represented.

How can I get the LRS?

See the [Data Retrieval and Formats](#) section.

How are events represented (located)?

There are different means by which business data can be located on VDOT's LRS. These means are referred to as Linear Referencing Methods (LRM's). VDOT's LRS supports multiple LRM's:

- Route number with mile point (official state measure)
- Route with milepost
- Jurisdiction boundary with offset
- Intersection with offset
- X/Y with offset.

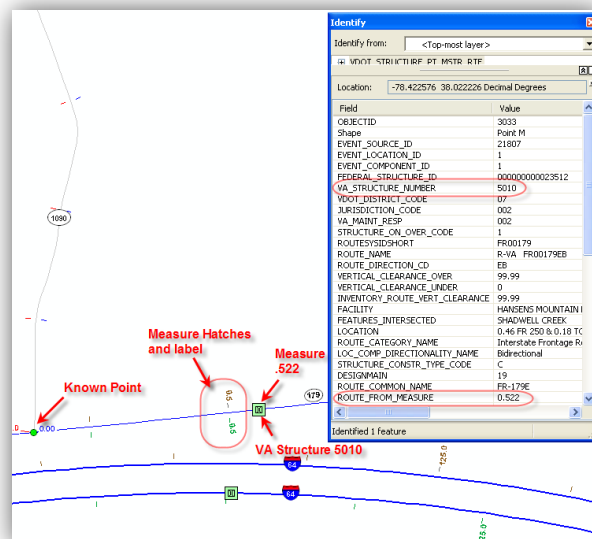


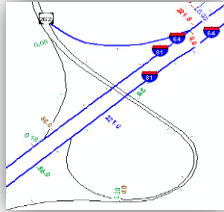
Figure 1: Location of a point structure on a route with a distance from a known point (i.e. route start).

How do I use the LRS (Map Package)?

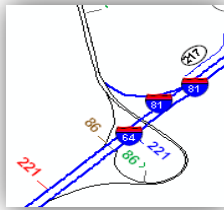
Note: more detail will be added in future releases.

- Blue: Northbound (prime)
- Red: Southbound (non-prime)
- Green: Eastbound (prime)
- Brown: Westbound (non-prime)

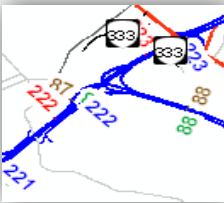
LRS hatches display route measures at different scales statewide (figure 1). Color coding is provided to help differentiate routes with measures



Below 1:10,000 - All routes with leader lines every 0.1 mile and measures every 0.5 mile



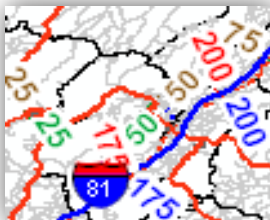
1:10,000 to 1:50,000 - East and Northbound Primaries with measures every 1 mile



1:10,000 to 1:100,000 - Interstates with measures every 1 mile



1:100,000 to 1:1,000,00 - Interstates only with measures every 20 miles



1:1,000,000 to 1:3,000,00 - Interstates only with measures every 25 miles

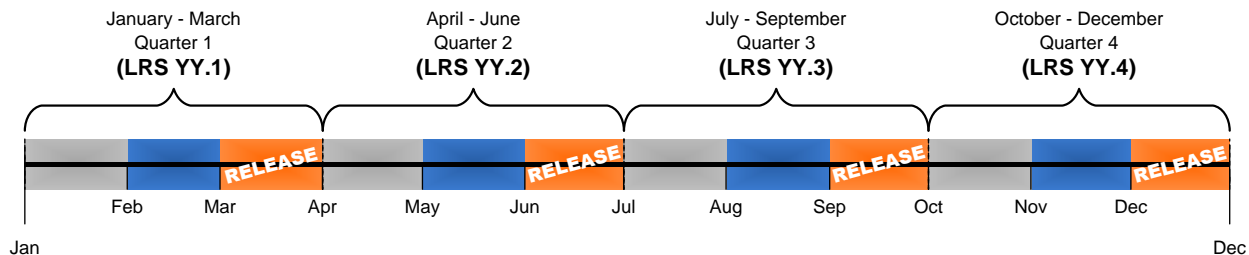
Release Version Naming Convention Explained

In an effort to differentiate between the RNS application and LRS data, a version naming convention was adopted. All data versions, “LRS Quarterly Releases” will be represented in this fashion: [Year].[Quarter Number] (i.e. quarter 4 in the year 2013 will be 13.4). The quarter numbering is based on calendar (not fiscal) quarters, and indicates the quarter for which the data is released (i.e. 13.4 will be released at the end of 2013 mid-December). This convention aids the end-users in quickly identifying the time-period of the LRS data.

LRS Release Schedule
 (Calendar Quarters)

NOTICE:

Data releases are targeted for the fifteenth day of the third month (orange) of each quarter. YY indicates two digit year (e.g. the year 2012 equals 12). This schedule does not guarantee the release will be available at the times indicated.



Feature Class Application Matrices

Abbreviation Key:

JURIS - Jurisdiction	MPST - Milepost	OL - Overlap
LRS - Linear Referencing System	MSR - Measure	RTE - Route
MAINT - Maintenance	MSTR - Master	SDE - Spatial Database Engine
MIN - Minimum	MV - Materialized View (i.e. a table once in geodatabase format)	TBL - Table

Official State Measure Layers

Feature Class Name/LRS Type	Uses	ARS	VA Traffic	PMS	RNS
SDE_VDOT_EDGE_RTE_OL_JURIS_MSR <ul style="list-style-type: none"> One feature per route centerline edge (segment between junctions or intersection nodes) Contains State and Country measures Includes overlap routes. 	Dynamically segment event data that contains County and/or State Measures	✗	✗	✓	✗
SDE_VDOT_EDGE_RTE_OVERLAP_LRS <ul style="list-style-type: none"> One feature per route centerline edge (segment between junctions or intersection nodes) Includes overlap routes 	Label overlapping route and/or street names	✗	✗	✗	✓
SDE_VDOT_RTE_MASTER_LRS <ul style="list-style-type: none"> One feature per route Only master routes are included 	<ul style="list-style-type: none"> Dynamically segment VDOT business data Labels for Statewide maps 	✗	✗	✗	✓
SDE_VDOT_RTE_OVERLAP_LRS <ul style="list-style-type: none"> One feature record per route Includes overlap routes 	<ul style="list-style-type: none"> Used directly within RNS Dynamic segmentation Local maps to show overlapping route name labels 	✗	✗	✗	✓
SDE_VDOT_LANE_COUNT_MSTR_RTE <ul style="list-style-type: none"> Number of lanes on master routes Calculated lanes prime and non-prime Derived from the source system of record 	Can be used to determine if LRS is divided	✗	✗	✗	✗

Milepost Measure Layers

Feature Class Name/LRS Type	Uses	ARS	VA Traffic	PMS	RNS
SDE_VDOT_EDGE_RTE_OL_MPST_LRS <ul style="list-style-type: none"> One feature per route centerline edge (segment between junctions or intersection nodes) Includes overlap routes Milepost measure provided for Interstates in the attributes and embedded M-values 	<ul style="list-style-type: none"> Street Maps to show overlapping route labels and/or street names All key network information about route such as intersection measures, id's, jurisdictions, etc. Dynseg public facing data 	✓	✓	✗	✗
SDE_VDOT_RTE_OL_MPST_LRS <ul style="list-style-type: none"> One feature record per route Includes overlap routes Milepost measures for Interstates embedded in M-values 	<ul style="list-style-type: none"> Dynamically segment shared data between VDOT and public facing systems when VDOT does not maintain the asset Local area maps to show overlapping routes 	✓	✓	✗	✗
SDE_VDOT_LANE_COUNT_MPST_RTE <ul style="list-style-type: none"> Number of lanes Calculated lanes prime and non-prime Derived from the source system of record Milepost measure provided for Interstates in the attributes and embedded M-values 	Can be used to determine if centerline is divided	✗	✓	✗	✗

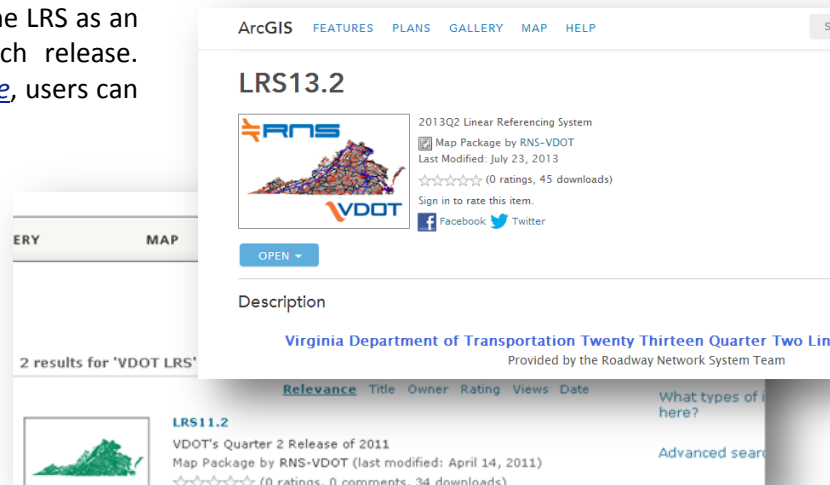
Other Layers

Feature Class Name/LRS Type	Uses	ARS	VA Traffic	PMS	RNS
MV_STRUCTURE_CAPACITY_PONTIS	Clearance Data for Structures	✓	✗	✗	✓
SDE_VDOT_INTERSECTION_W_XY <ul style="list-style-type: none"> LRS Junction locations with latitudinal and longitudinal coordinates provided in the attribution. 	Generalized placement of event data	✗	✓	✗	✓
SDE_VDOT_STRUCTURE_PT_MSTR_RTE <ul style="list-style-type: none"> Point features representing the beginning location of each structure along the master route. A replica of the spatial data view that is maintained in RNS by the Structures and Bridge Division. 	Display bridge and culvert events.	✓	✗	✗	✓
TBL_VDOT_MIN_MAINT_JURIS_MSR	Cross reference to convert business data between county and state measures	✗	✗	✓	✓

Data Retrieval and Formats

[LRS Map Packages](#) @ [ArcGIS Online](#)

The RNS Team publishes the LRS as an Esri map package for each release. When visiting [ArcGIS Online](#), users can search for “VDOT LRS”.



Secure [FTP](#) (SFTP) @ <ftp.VDOT.Virginia.Gov>

Please contact the Helpdesk at 804-786-1280 or caddsupport@VDOT.Virginia.Gov and **request access to the “VDOT-GIS” folder.**

Host: <ftp.VDOT.Virginia.Gov>
User: [obtain from [helpdesk](#)]
Pass: [obtain from [helpdesk](#)]

VDOT-GIS FTP LRS Tips and Tricks:

- READ the release notes:
- Feature Class Application Matrices
- (page 8) section to determine which files will best suit your needs.
- VDOT-GIS FTP does not support browser connections. Please use an SFTP client such as Filezilla, WS-FTP, etc.
- Clients external to the Commonwealth domain should set the ACTIVE transfer mode option.

SDE Connection @ VDOT's GIS Enterprise (Internal Use Only)

Contact GIS@VDOT.Virginia.Gov if you require assistance configuring an SDE connection, are having issues connecting to the GIS Enterprise or FTP.

Data Format Comparison

Format	Uncompressed	Zip compression (Level 9 "Ultra" deflate)	<i>Esri Map Package</i>		Esri Spatial Database Engine (SDE)**
			Transfer (compressed)	Storage (Uncompressed)	
Content	11 Personal Geodatabases (.mdb)	11 .zip files (Compressed .mdb)	1 Map Package (.mpk)	1 File Geodatabase and map document (.gdb containing ~180 related files + .mxd)	10 feature classes and 1 table (other related tables exist)
Size*	4GB	2GB	700MB	1.5GB	unavailable

MB = megabyte (1,024 kilobytes)

GB = gigabyte (1,024 megabytes)

*Data storage sizes are approximate

**Internal agency use only

File geodatabases offer many improvements over personal geodatabases. A few to mention that are specific to the LRS:

- Far more proficient at storing and displaying data, especially when speaking in terms of size and speed. This directly affects data consumers because less time will be spent downloading releases and release packages will take up significantly less disk space on workstation hard drives. Please see the *LRS Delivery Format Comparison* above.
- A particular enhancement that the RNS team often leverages is that the display of measure hatching is considerably faster.

Consumers must also be warned that file geodatabases also have caveats. Non-*Esri* users cannot directly access the tabular data within a file geodatabase, which is possible with personal geodatabases because a personal geodatabase is simply a Microsoft Access™ file. The RNS team recognizes that many data consumers may not use *Esri* products and also that users may not want the release as a comprehensive package, therefore the LRS will continue to be provided in the traditional personal geodatabase format downloadable through the FTP. More information on *Esri* Map Packages and file geodatabase format can be obtained by visiting the links listed below.

- ArcGIS.com - *What's new for sharing maps and data in ArcGIS 10*
- ArcGIS.com - *Types of geodatabases*
- Esri.com - *The Top Nine Reasons to Use a File Geodatabase*

Glossary

ARS: Department of Motor Vehicles Automated Routing Solution.....	1, 8, 9
Edge: Line segment (i.e. feature record) that constructs a route.	1, 3, 8, 9
ESRI or Esri: Environmental Systems Research Institute (http://www.esri.com/)	1
FHWA: Federal Highway Administration (http://www.fhwa.dot.gov)	1
FTP: File Transfer Protocol	1
GIS: Geographic Information System.....	1, 3, 10, 11
Hatch: See About hatching route feature classes (http://resources.arcgis.com/en/help/main/10.2/index.html#//003900000001n000000)	1
HPMS: Highway Performance Monitoring System (http://www.fhwa.dot.gov/policyinformation/hpms.cfm)	1
ICR:	1
Integrator: VDOT’s internal web based Geographic Information System	1
ITD: Information Technology Division.....	1
Localized Build: route maintenance in specific areas (i.e. locations) versus processing entire routes from start to end (i.e. statewide). See Route Build for further details.	1
LRS: Linear Referencing System	1, 2, 3, 4, 7, 8, 9, 10, 11
Measure Hatching: see Hatch	1, 11
MXD: ESRI ArcGIS map document file extension.....	1
Network, roadways represented as a Linear Referencing System.	1, 4, 9
PMS: Pavement Management System.....	1, 8, 9
Processed: see Route Build	1
Processing: see Route Build	1
QA: Quality Assurance	1
QC: Quality Control	1
Reprocessing: see Route Build	1
RIMS: Roadway Inventory Management System	1
RNS: Roadway Network System.....	1, 2, 3, 4, 7, 8, 9, 10, 11
Route Build: autonomous process that maintains (create and modify) routes in RNS	1, 2



Release Notes
Linear Referencing System
Version 13.4



UCP: Urban Conversion Project	1, 3
VA Traffic: Virginia Traffic Information (see VA511.org)	8, 9
VDOT: Virginia Department of Transportation	1, 2, 3, 4, 8, 9, 10, 11
VGIN: Virginia Geographic Information Network (Error! Hyperlink reference not valid.)	1