



June Meeting

6/8/2022

AGENDA

1. Announcements
2. California Department of Transportation
 - Using Roads & Highways in Pro
3. Esri Updates
4. Open Discussion

**** Please mute phones!! ****

ANNOUNCEMENTS

- ESRI User Conference
 - July 11th -15th - San Diego Convention Center
 - Registration Now Open
- GeoNet - Become a part of the ESRI Community
 - <https://community.esri.com/t5/roads-and-highways-user-group-rhug/gh-p/roads-and-highways-user-group-rhug>

California Department of Transportation

Using Roads & Highways in Pro

Andy Richardson and Gerry Schumacher

Esri Updates

Nathan Easley

Poll Question

Who is planning to attend the ERSI UC Conference?

RHUG Meetup Interest at the conference?

Open Discussion

RHUG Agile Asset Working Group

Meeting the 1st Wednesday of the month at 12:30 pm est

Please contact both

Kevin Hunt (NYS ITS) kevin.hunt@its.ny.gov and

Ryan Koschatzky (NCDOT) rjkoschatzky@ncdot.gov

for more information.

Upcoming Meetings / Contacts

Wednesday July 13th, 1:30-3pm

Contact Info:

Erin Lesh ealesh@ncdot.gov

Patrick Whiteford pwhiteford@azdot.gov

Ryan Koschatzky rjkoschatzky@ncdot.gov

Shaun Perfect sperfect@azdot.gov



Product Team Update RHUG meeting 6/8/22

Nathan Easley

Capabilities currently under development

- **Release stabilization**
- **Next release planning**

Support Incidents/Defects

- **BUG-000147512** – ArcGIS Event Editor displays an unexpected behavior when using the Linear Event widget with a traditional versioning enabled linear referencing system (LRS) dataset. The highlight cannot be cleared while the widget is opened. (Fixed in 11.0)
- **BUG-000146863** – Some unique value symbologies do not appear in ArcGIS Event Editor's Layers pane when using some styles (Fixed in 11.0)
- **BUG-000149112** – Adding calibration points to a route after a realignment does not update the route measure value (will be fixed in 3.1)
- **BUG-000149685** – Edit calibration point with date in the future gives error (will be fixed in 3.1)

Event Editing in Pro status

- Pro 3.0

- Create events via core editing tools (Create feature, etc.)
- Edit events via core editing tools (Move, update vertices, etc.)
- Create/Edit events via attribute table
- Configure new and update existing attribute sets
- Add single point events
- Add single line events
- Add multiple point events
- Add multiple line events
- Split Events

- Still planned to be added

- Merge Events
- Event Replacement
- Interactive Dynamic Segmentation via attribute sets
- Enhancements to Add Point/Line Event tools
 - Intersection Offset Method
 - Coordinate Method
 - Retire Overlaps option
 - Merge Coincident Routes option
 - Eyedropper tool
 - Continue from previous end measure option
 - Add to Dominant Route option
 - Measure translations

Other Announcements

- **Come see us at the UC next month**

<https://community.esri.com/t5/arcgis-roads-and-highways-blog/arcgis-roads-and-highways-uc-2022-agenda/ba-p/1177740/jump-to/first-unread-message>



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Caltrans Roads and Highways Implementation

ANDY RICHARDSON

GIS Specialist (Caltrans – Retired)

Senior GIS Analyst (Timmons Group)

Full Disclosure

- ▶ I was the technical lead to migrate Caltrans' LRS from GeoMedia to Roads and Highways
- ▶ Much of what I'll present was performed for Caltrans by a contractor
- ▶ I have almost no traditional Roads and Highways experience
- ▶ However:
 - ▶ I was very involved with the technical details and approach
 - ▶ I have a lot of LRS experience (20+ years) at Caltrans
 - ▶ Subsequently I've done some Pro R&H implementation work

Caltrans Postmile System



- ▶ Centerline-based system with some independent alignments (of different lengths)
- ▶ Postmiles reset to 0.0 at county boundaries
 - ▶ No more than three decimal places
- ▶ Temporality (Realignments, relinquishments, route adoptions) handled using Postmile Prefixes
 - ▶ Downstream portions are not re-postmiled

CO	RTE	RTESuf	PMPre	BPM	EPM	PMSuf
SCL	880			0.0	10.502	
ALA	880		R	0.0	1.949	
ALA	880			2.224	31.727	
ALA	880		R	31.727	33.92	
ALA	880		R	33.92	35.797	R
ALA	880		R	33.92	35.471	L
ALA	880	S		0.0	1.257	R
ALA	880	S		0.0	1.463	L

Three Linear Referencing Methods

- ▶ Postmile
 - ▶ State highways only (~15,000 miles)
 - ▶ Postmiles (measures) created in 1964, updated with realignments
 - ▶ >90% usage system across the Department
- ▶ Statewide Odometer (~15,000 miles)
 - ▶ State highways only, based on/derived from Postmiles
 - ▶ <10% usage system across the Department
- ▶ AllRoads
 - ▶ All public roads in California (~300,000 miles)
 - ▶ Geometry-based measures
 - ▶ Only since ~2015

History of Caltrans Linear Referencing Systems

- ▶ Caltrans Postmile System (1964)
 - ▶ Postmile Prefixes & Suffixes
- ▶ Transportation System Network (TSN) database (Oracle)
 - ▶ Temporal, not geospatial
 - ▶ Highway inventory system of record
- ▶ GIS-based:
 - ▶ Workstation ArcInfo (early 1990's)
 - ▶ ArcView (late 1990's)
 - ▶ ArcGIS Desktop (early 2000's)
 - ▶ GeoMedia/Oracle (~2015)
 - ▶ Roads and Highways (2019/2020)

Roads and Highways Implementation Projects

▶ Proof of Concept

- ▶ 2019-2020
- ▶ Transcend (now Rizing)
- ▶ Desktop/traditional R&H
- ▶ Two counties, entirety of routes passing through
- ▶ AllRoads, Postmile, Odometer
- ▶ Sample events from GeoMedia, TSN, HPMS
- ▶ We learned a lot!

▶ Statewide Migration

- ▶ March 2020-December 2020
- ▶ Rizing (was Transcend)
- ▶ **Pro R&H!!**
 - ▶ Handles the Caltrans Postmile System
- ▶ AllRoads, Postmile
 - ▶ *Odometer as Derived Network*
- ▶ GeoMedia Events:
 - ▶ Functional Class, NHS
- ▶ TSN Events (a few)
- ▶ HPMS Events (many)

Roads and Highways Implementation – Data Sources

- ▶ Networks
 - ▶ AllRoads, Odometer from GeoMedia
 - ▶ Postmile from GeoMedia event table
- ▶ Events
 - ▶ Functional Class, NHS from GeoMedia
 - ▶ Various TSN (referenced to postmiles – very clean)
 - ▶ HPMS (various spreadsheets, desktop GeoMedia, FHWA V8)
 - ▶ Major annual effort to sync up with LRS

Network Data Preparation (Statewide Migration)

- ▶ Figured things out during Proof of Concept project
 - ▶ FME from GeoMedia to ArcGIS, build routes in ArcGIS
- ▶ Various data issues & errors came to light during PoC:
 - ▶ LRS staff worked diligently to fix during four months prior to Statewide Migration project; this paid off big
 - ▶ Found and fixed a number of Postmile errors not easy to see as event table in GeoMedia
 - ▶ Discovered differences between GeoMedia/ArcGIS calibration on very long routes (two days of panic before workaround)
- ▶ Provided contractor (Rizing) with very clean data
 - ▶ Resulted in very clean networks returned

Pro Roads and Highways Configuration

- ▶ Create ALRS
- ▶ Create and populate Networks
- ▶ Create and populate Events

Pro Roads & Highways Configuration (ALRS)

- ▶ GP tools, no wizards
- ▶ ALRS must be in a Feature Dataset
- ▶ **Create LRS** / Create LRS From Existing Dataset GP tools
 - ▶ Create LRS will optionally create the Feature Dataset
- ▶ Editor Tracking, Global IDs, Branch Versioning
- ▶ Conflict Prevention (Modify LRS GP tool)

Pro Roads & Highways Configuration (Networks)

- ▶ **Create LRS Network**/Create LRS Network From Existing Dataset GP tools
- ▶ Multi-field RouteID :
 - ▶ Modify LRS Network, Modify RouteID Padding GP tools
- ▶ Modify Network Calibration Rules GP tool:
 - ▶ Gap offsets, Cartographic Realignment measure behavior
- ▶ Append Routes
- ▶ Delete Routes

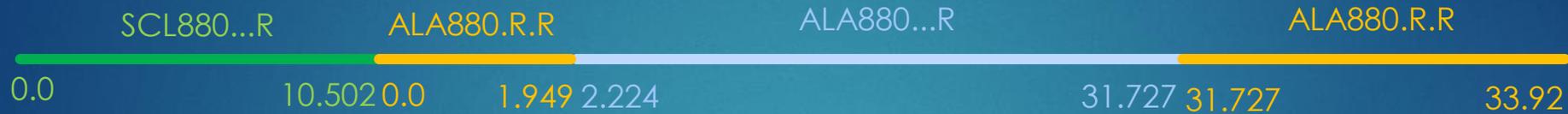
Pro Roads & Highways Configuration (Events)

- ▶ **Create LRS Event**/Create LRS Event From Existing Dataset GP tools
- ▶ Modify Event Behavior Rules GP tool
- ▶ Modify LRS Event GP tool
 - ▶ Related to events spanning routes on LINE networks
- ▶ Append Events

Caltrans Data Modeling and Migration

- ▶ Networks
 - ▶ Postmile, Odometer, AllRoads
- ▶ Events
 - ▶ GeoMedia, TSN, HPMS

Network Modeling and Migration (Postmile)



- ▶ Multi-part “Postmile Routes”
 - ▶ ALA880.R.R (above) is one route with two parts
- ▶ Calibrated with B/E measures, plus numerous internal “landmark” CPs
- ▶ RouteID is 10-character CCCRRRSPSA
 - ▶ Period (“.”) placeholder
- ▶ Configured as LINE
 - ▶ LineID for all above is 880._R

Network Modeling and Migration (Odometer & AllRoads)

- ▶ Odometer

- ▶ “Derived Network” from Postmile Network

- ▶ Generate Routes GP tool based on selected Postmile Routes

- ▶ Based on LineID (e.g., “880._R”)

- ▶ Measures are running sum of Postmile measures

- ▶ Matches calibration of Postmile routes

- ▶ AllRoads

- ▶ Simple geometric length measures, 2 CPs (B/E) per part, 0.001 gap offset

- ▶ Network to which all events are registered

PM RouteID	OD RouteID	BPM	EPM	BOD	EOD
SCL880...R	880._R	0.0	10.502	0.0	10.502
ALA880.R.R	880._R	0.0	1.949	10.502	12.451
ALA880...R	880._R	2.224	31.727	12.451	41.954
ALA880.R.R	880._R	31.727	33.92	41.954	44.147

Event Modeling and Migration

- ▶ All events registered to AllRoads network
- ▶ GeoMedia Events:
 - ▶ Could not use RouteID and Measures because:
 - ▶ ArcGIS recalculated geometry-based measures
 - ▶ Discovered differences between GeoMedia and ArcGIS
 - ▶ Had to DynSeg and create geometry in GeoMedia, then use Locate Features Along Routes (“LFAR”) in ArcGIS
- ▶ TSN Events:
 - ▶ Easy to construct Postmile Network RouteID from TSN attributes County, Route, Route Suffix, Postmile Prefix and Postmile Suffix

Event Modeling and Migration

- ▶ HPMS Events:
 - ▶ Accounted for almost half the total project costs
 - ▶ Data from various sources, traditionally a major sync-up effort with AllRoads each Q1
 - ▶ Used LFAR approach (similar to GeoMedia events)
 - ▶ Worst outcome of all migrated datasets

Post Migration (aka Production!)

- ▶ Configure Branch Versioning and Conflict Prevention
- ▶ Configure Portal (Members and Groups)
- ▶ Publish services
- ▶ ArcGIS Pro editing projects (aprx's)
- ▶ Deploy Event Editor configurations
- ▶ Training

Portal/Publishing Services

- ▶ Everything (almost) is services-based
- ▶ Portal:
 - ▶ Created the “RHAdmin” member to own everything
 - ▶ Created various Groups for Network editing, various Event editing
 - ▶ Must create Data Store in Portal (or GP tool in Pro)
- ▶ Publishing with Pro:
 - ▶ Sign in as RHAdmin
 - ▶ All R&H services require:
 - ▶ Linear Referencing, Versioning
 - ▶ Linear Referencing requires Feature Access

Network Editing

- ▶ ArcGIS Pro editing projects
- ▶ Must edit feature services
- ▶ Turns out this works great
 - ▶ Performance from home internet connection is far superior to previous direct database connections from office to data center
 - ▶ Staff were able to work effectively from home during COVID

Odometer Derived Network

- ▶ Odometer is Derived Network from Postmile LINE Network
- ▶ Any time a Postmile Route is edited:
 - ▶ Select all Postmile Routes with the same LineID
 - ▶ Generate Routes GP tool to recreate corresponding Odometer Route
- ▶ Postmile Network LINE configuration also supports R&H REST API **routeID**, **toRouteID** parameters in measureToGeometry function
 - ▶ i.e., events can span Postmile Routes as long as they're on the same LineID

Event Editor

- ▶ Publish necessary services with desired Group sharing
- ▶ Optionally create Portal Web Map
- ▶ Create Portal App (with App ID)
- ▶ Deploy/configure Event Editor applications
- ▶ We had to bypass our load balancing environment to avoid dropped authentications (Event Editor only)

Training

- ▶ Self-trained for Network editing
 - ▶ Related to scope, budget and timeline of the Statewide Migration
- ▶ Timmons Group provided three-day Event Editor training for HPMS staff through GIS services contract

Applications/Utilities

- ▶ All reference the Roads and Highways REST API
- ▶ C#
 - ▶ Postmile Validation tool
 - ▶ For non-GIS staff to validate postmiles in various databases, spreadsheets, etc.
 - ▶ ArcGIS Pro Postmile Toolbar AddIn
 - ▶ Replacement Postmile geocoder for legacy ArcMap AddIn
- ▶ Python
 - ▶ Postmile geocoder
 - ▶ Assign Postmiles to Feature Class
 - ▶ Point or Polyline
 - ▶ Assign RouteID/Measure to Feature Class
 - ▶ AllRoads & Odometer
 - ▶ Point or Polyline
 - ▶ Used extensively by HPMS
 - ▶ Translate Measures
 - ▶ Used extensively by HPMS

Esri Support



- ▶ Andy met with Nathan Easley and Amit Hazra for two days in April 2019 between Proof of Concept and Statewide Migration projects
 - ▶ This was extremely helpful understanding the possibilities and charting a direction
- ▶ Nathan was very responsive and supportive throughout our projects
 - ▶ Resolved bugs or limitations with patches or workarounds
 - ▶ Answered many questions and provided good advice



Questions?

ANDY RICHARDSON

andy.richardson@timmons.com

from Jim Mitchell to all attendees: 12:59 PM

How does the Post-mile system handle two concurrent routes that are going two different directions on the same ALRS Segment

Say a south to north and a west to east, on the same ALRS segment.

Caltrans does not really have route concurrency – where two “signed” routes are carried on the same roadway. In this situation, one route will have a gap on the concurrent section. For undivided highways we do have the two alignments (which are two separate Postmile Routes) sharing the same Centerline, so in that sense they are concurrent, but they are always measured in the same direction (all routes are either West to East or South to North, regardless of the travel direction).

from INDOT - Kevin Munro to all attendees: 1:00 PM

Andy, How do you ensure network edits to all LRMs take place the same way (no distance mismatches)? This is something INDOT struggled with enough to end up with a single LRM.

I'm not sure I fully understand the question, but here's two answers. One, all routes on the same roadway will (or should) reference the same Centerline. For an undivided state highway, there will be four routes on the same Centerline: The two Postmile alignments (R and L) and the two AllRoads alignments (R and L). So, the geometry for all four is identical.

Two, if the question is about ensuring the same measures (or measure length), for AllRoads (for which measures are geometry length) it doesn't matter, as the primary purpose of AllRoads is to carry Events, and once those Events get placed in Event Editor, they will be subsequently controlled by Event Behavior. Plus, they are only on the Right alignment (perhaps with one or two exceptions?). For the Postmile Network, we tightly control measures (Postmiles) with liberal use of Calibration Points. Standards are to have them at least at one- or two-mile intervals (not always possible in the Mojave Desert where there are very few landmarks), but they can be at every block in urban environments. Postmile values and locations are determined on the engineering side of the house and often based on design drawings, or possibly driven/odometer length in 1964.

from Mark Dietrich to all attendees: 1:04 PM

How do you keep the left and right side measures on a route in sync or do they run separate from each other?

For the AllRoads Network we don't try to keep them in sync. From the previous answer, the primary purpose of AllRoads is to carry Events, and once those Events get placed in Event Editor, they will be subsequently controlled by Event Behavior. Plus, they are only on the Right alignment (perhaps with one or two exceptions?).

For the Postmile Network, and from the previous answer, we tightly control measures (Postmiles) with liberal use of Calibration Points. Standards are to have them at least at one- or two-mile intervals, but they can be at every block in urban environments. Postmile values and locations are determined on the engineering side of the house and often based on design drawings. The Caltrans Postmile System is a centerline-based system, but Roads and Highways has both right and left alignments (with a small percentage of “independent alignments” where the alignments separate to go around obstacles, are of different lengths and are thus postmiled differently, until they join again). Where TSN (the System of Record database) has a landmark with postmile, Roads and Highways will have matching right and left Calibration Points.

from Jeromy Barnes to all attendees: 1:08 PM

If all your events are registered to the AllRoads network, are you translating to PostMile for other systems to use or for internal reporting purposes?

To be honest, Caltrans is not really there yet with Roads and Highways, but they will be. There is a separate project to modernize the TSN database (the state highway inventory System of Record) by bringing it into Roads and Highways. TSN includes numerous (about 50) Highway Inventory items (number of lanes, median type, shoulder width, access control, etc.) When that happens, Postmiles will be retained as attributes for every one of those Events rather than rely on Translation. That schema is already in place and is being used by the "placeholder" TSN events that we put into Roads and Highways. One problem with Translation is that Caltrans maintains only three decimal places of precision (0.001 miles), whereas Roads and Highways uses 7 (I think it's actually 6, with the 7th to properly round the 6th).

I will say, for HPMS, some of the data they report to FHWA comes from TSN. These data have Postmiles, but they need to be placed onto the AllRoads Network (which is the one submitted to FHWA), so there is a "Translate" Python script that calls the Roads and Highways REST API to translate Postmiles to AllRoads measures. This is going the opposite direction that you're asking about.

from Nicole Hanson to everyone: 1:01 PM

How many people do you have editing the network in ArcPro?

from Nicole Hanson to everyone: 1:03 PM

Does Caltrans have any external intergrations?

from Nicole Hanson to everyone: 1:07 PM

Do you have external agency/people editing events as well?

from Nicole Hanson to everyone: 1:17 PM

LRS Gateway... lol

from INDOT - Kevin Munro to everyone: 1:19 PM

Andy, How do you ensure network edits to all LRMs take place the same way (no distance mismatches)?

This is something INDOT struggled with enough to end up with a single LRM.

from Jesse Pearson to everyone: 1:19 PM

Does Caltrans use Data Reviewer for Server for error checking or do you use FME?

from INDOT - Kevin Munro to everyone: 1:21 PM

close enough, thanks!

from Kevin Hunt to everyone: 1:25 PM

Great presentation that gave me some ideas on how we can get started on the migration. Thank you Andy

from Sam Coldiron to everyone: 1:26 PM

If anyone hasn't seen it yet, the first couple RH in Pro trainings for ESRI Academy are up on the website. The 1st one how to set up a new RH in environment locally (not in Enterprise) just to get a feel for the data structure and how to set up an LRS, a Network, and Events. It's a great practice and first look at what your migration might look like.

<https://www.esri.com/training/catalog/621ea031a53818015ee38b4e/arcgis-roads-and-highways%3A-introduction-to-modeling-and-data-management-in-a-desktop-environment/>

from Sam Coldiron to everyone: 1:37 PM

From Nick Graf: Will any of the R&H sessions be hybrid?

from Nicole Hanson to everyone: 1:39 PM

Yes please!

from Kevin Hunt to everyone: 1:45 PM

• Use case documentation for LRS and Field workflows:

<https://community.esri.com/t5/roads-and-highways-user-group-rhug-questions/lrs-functionality-in-agol-support-field-operations/m-p/1047224#M456>

from Aaron Ferrari to all panelists: 1:50 PM
Great job. Thank you everyone!

from Kevin Hunt to everyone: 1:50 PM
Thanks Shaun!