User Level

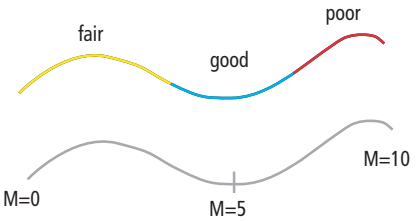
New/Casual — Advanced

Understanding Dynamic Segmentation

Working With Events in ArcGIS 8.2

By Jennifer Cadkin, ESRI Technical Industry Marketing Specialist

Dynamic segmentation is the process of transforming linearly referenced data (also known as events) that have been stored in a table into features that can be displayed and analyzed on a map. For example, a utility company may segment transmission pipes dynamically according to the quality of the pipe. Attribute information describing quality characteristics specific to each pipeline segment can then be maintained without splitting the pipeline network. The dynamic segmentation process imposes two requirements on the data. Each event in an event table must include a unique identifier and position along a linear feature. Each linear feature must have a unique identifier and measurement system.



Transmission Pipe 10 = A1

Event ID	Pipe ID	From_M	To_M	Rating
1	A1	0	3	fair
2	A1	3	75	good
3	A1	75	10	poor

The dynamic segmentation process for a pipeline

With the release of ArcGIS 8.1, ArcView, ArcEditor, and ArcInfo users have a common environment for the dynamic segmentation process. This is the second in a two-part article series covering dynamic segmentation concepts. The first installment, "Dynamic Segmentation in ArcGIS," appeared in the July–September issue of *ArcUser* magazine. It discussed the linear features used to perform dynamic segmentation including defining a route, migrating route data between data formats, and working with routes in ArcMap. This article discusses event data, including how to perform the dynamic segmentation process and work with events as features in ArcMap.

OBJECTID*	RKEY	MILE	ACCTYPE	ALCHOL	WEATHE
26	1	20	14	0	1
27	1	21	1	1	2
28	2	0.9	14	0	3
29	2	4.8	18	0	2
30	2	5	21	1	1
31	2	6.6	1	0	3
32	2	7.7	1	0	1
33	2	8.5	22	0	2

OBJECTID*	RKEY	FMP	TMP	TOT_NO_LAN	AVG_DLY_TRF
9	1	10.1	10.4	4	6350
10	1	10.4	10.7	4	6400
11	1	10.7	11.2	4	6300
12	1	11.2	11.9	4	6150
13	1	11.9	14.4	2	5200
14	1	14.4	19.2	2	3900
15	1	19.2	19.9	2	4050
16	1	19.9	21.3	2	3300

Event tables are thematic collections of events. The upper table describes point events. The lower table shows linear events.

What Is an Event?

There are two types of route locations—point and linear events—that can be modeled in ArcGIS 8.2. Point route locations describe discrete locations on a linear feature (such as the location of a pipeline leak) and require only one measure value. Linear route locations describe portions of a linear feature (such as pipeline cracking) and require two measure values, typically referred to as the From and To measures. Route locations and associated attributes stored in a thematic table are known as route events or simply events. A route location description requires a unique identifier for the linear feature and the measure value(s) appropriate to the event type. ArcMap uses this information to spatially render the event.

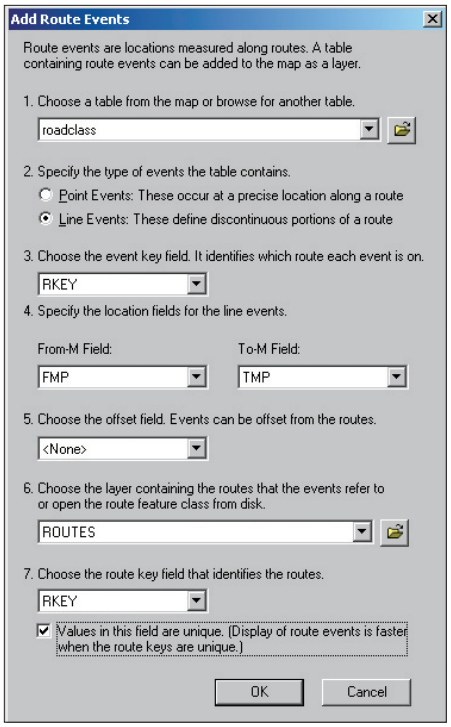
Dynamic segmentation in ArcGIS supports event tables in a number of formats including INFO, Microsoft Access, dBASE, Oracle, Microsoft SQL Server, delimited text files, and databases accessed via OLE DB providers. Some database formats provide advantages over others. By migrating tables to a geodatabase table, a user can leverage geodatabase functionality such as domains, field name aliases, and relationship classes. For more information on migrating tables to a geodatabase and geodatabase functionality refer to *Building a Geodatabase*, one of the manuals that comes with ArcGIS.

Adding Route Events

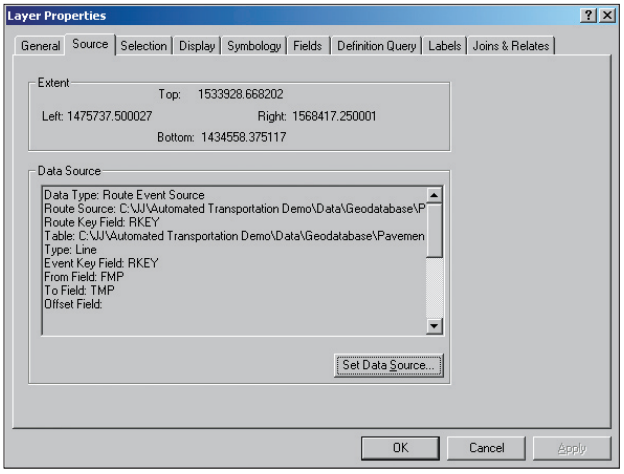
Events are transformed into features that can be displayed and analyzed on a map using a process called dynamic segmentation. The Add Route Events dialog box is used to transform an event table in ArcMap. There are two ways to access this dialog box. After adding the event table to the map document and clicking on the source tab in the Table of Contents, right-click on the event table and choose Create Route Events from the context menu. Alternatively, choose Tools > Add Route Events from the main menu and specify the input table (which does not need to be within the map document).

Once the event table has been specified, the type of event, the appropriate measure fields, the route identifier field, and the route feature class will also need to be specified. Any polylines with M feature classes present in the map document will appear in the route layer dropdown. Choose the desired route layer and specify the route identifier field. The referenced route layer does not have to be in the map document.

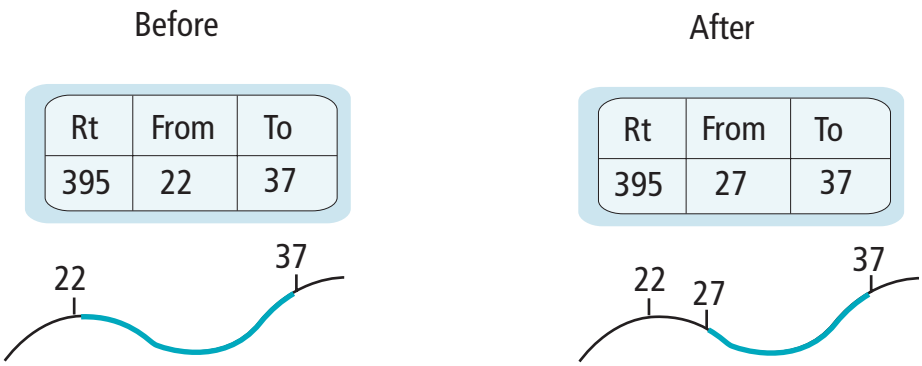
When spatial data is added to an ArcMap



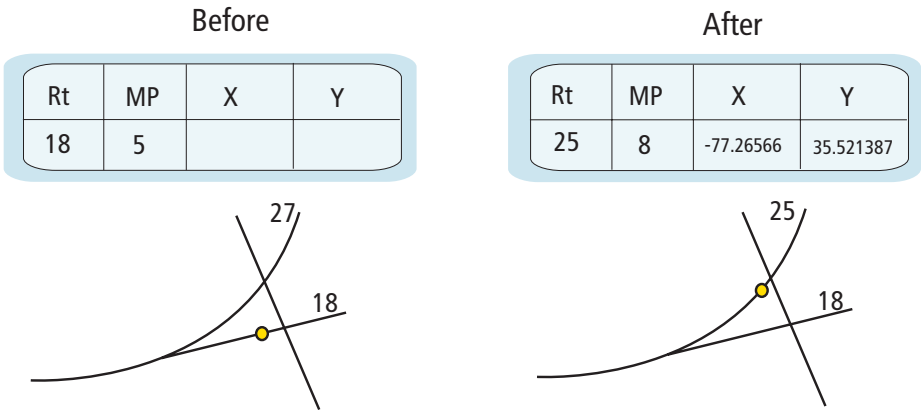
Use the Add Route Events dialog box to specify the table and fields used to create events.



A Route Event Source serves an event table as a dynamic feature class. Each row in the table is served as a feature whose shape is calculated on the fly when requested. This is the dynamic segmentation process.



Scenario 1: In this example, an event table containing information on a highway repaving project was edited following partial completion of the project. These changes in From and To measures are reflected in the map.



Scenario 2: An intersection sign was assigned to the wrong street in the database. When the sign location was corrected using GPS data, the route identifier was changed to the appropriate value in the table and the sign is now displayed in the correct location.

document—whether a shapefile, coverage, or geodatabase feature class—it is represented as a feature layer. Feature layers are based on feature classes, which in the geodatabase refer to objects that store features and have a field of type geometry. Because events are stored in tables and not feature classes, the dynamic segmentation process creates a feature class that does not store shapes. Feature shapes for events are dynamic (i.e., they are generated when needed). Event shapes will respond to any changes in the underlying linear features geometry or to changes in location descriptions in the event table. Event table editing will be covered in greater detail later in this article.

A dynamic feature class based on a route event table is called a Route Event Source. To view the data source, right-click on the layer, choose Properties and click on the Data Source tab. Click on the Set Data Source button to open the Add Route Events dialog box. If the links to either the event table or route layer have been broken, they can be reset.

An ArcMap layer based on a Route Event Source behaves like any other feature layer and can be edited, symbolized, buffered, queried, and hyperlinked. For instance, if a domain has been defined for a field in an event table, any feature layers based on that event

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table can symbolize features based on that domain. The definition of an event layer, including the Route Event Source information, can be saved as a layer file. An event layer, or a selection set from an event layer, can be exported to a persistent shapefile or geodatabase feature class. In addition, functionality built into ArcCatalog and ArcToolbox can be used to transform events stored in an event table into features that persist in either a shapefile or geodatabase feature class.

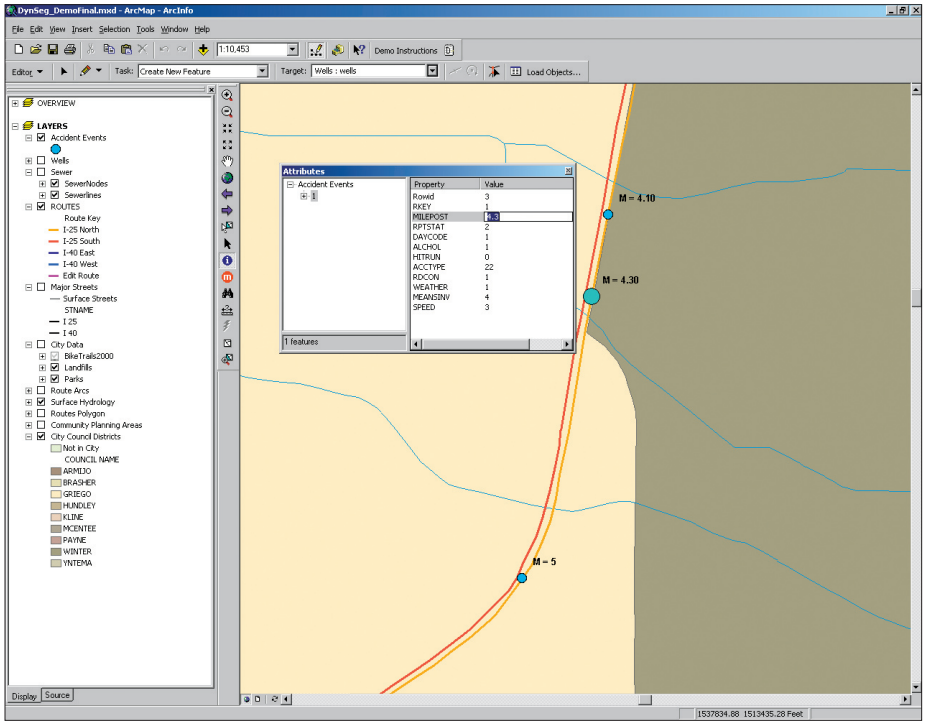
Editing Event Features

To edit event features, the event table must be in the ArcMap document and within the workspace participating in the edit session. Event attributes, including location description, can be edited using core ArcMap functionality. For additional information on working with tables in ArcMap refer to *Using ArcMap,* another manual that comes with ArcGIS.

To create a new event feature, open the event layer's attribute table, start an Editing session, and add a new row to the end of the table. At a minimum, populate the location description fields and any fields used for symbolization. To update existing event features, open the event attribute table, and start an Editing session. To change the shape of the event, modify the values in either the route identifier field or measure fields. Once edits to the location description have been committed, the shape of the event will be recalculated and will be displayed in the map document. In addition, any edits to the underlying linear feature geometry may cause a recalculation of an event location.

Once an event table is added as a feature layer, the attributes and geometry for the event feature layer can be analyzed using the same methods used for any other feature class in ArcGIS. For example, a transportation department that needs to report accidents that may have been affected by construction activities can select a set of event features describing the accidents, buffer these features, and use the resulting buffer to select features in a different layer containing information about construction projects.

In addition to spatial and attribute analysis, there are event-specific geoprocessing options available that provide additional analysis. Event geoprocessing performs geometric analysis on nonspatial data and outputs the resulting location description and attributes to a new event table. The resulting event table can be added to ArcMap as an event feature layer for display and further analysis. In the previous example, the transportation department could run a single event analysis that generates a new event table rather than the multistep process described.



Once an event table is added as a feature layer, it can be edited and analyzed like other feature layers.

Union and intersect, two types of overlay analysis, can be performed on any combination of event types. The union of the input events splits all linear events at their intersections. Performing an intersect on input event tables writes only overlapping events to the output event table. The geometry type of the event table resulting from an intersect operation will be the lower of the input geometries (e.g., overlaying a linear event table with a point event table will create a point event table).

Dissolving and concatenating events can help maintain the integrity of large event tables. These operations can be used to remove redundant information from an event table or break an event table with more than one descriptive attribute into separate tables. Both operations combine event records in tables that contain events on the same route that have identical values for specified fields. Dissolve will combine events when there is measure overlap and is available only for line event tables. Concatenate available for both line and point event tables combines events if the To measure of one event matches the From measure of the next event.

Note: *Future ArcGIS releases will contain new tools for creating and editing events. Event geoprocessing will be expanded to include event transformation from one route reference to another. All event geoprocessing options will be incorporated into the ArcMap interface.*

Event Locating Errors

The dynamic segmentation process transforms an event location description stored in an event table into a feature. During the dynamic segmentation process, events may be successfully located, partially located, or not located (resulting in an empty shape). There are many reasons why events might not locate successfully. A partially located line event can occur when the event's From or To measure value cannot be found on the associated route. A point event might fail to be located if it has an inaccurate route identifier or route measure.

When a table is dynamically segmented, error codes are generated. At ArcGIS 8.2, the error codes are available through the API. However, future releases of ArcGIS will make these codes accessible through the interface. Because event features are dynamic, the error codes are also dynamic. If a route is recalibrated and an event's measures no longer match the new calibration scheme, the event will have its locating code changed when the event is resegmented.

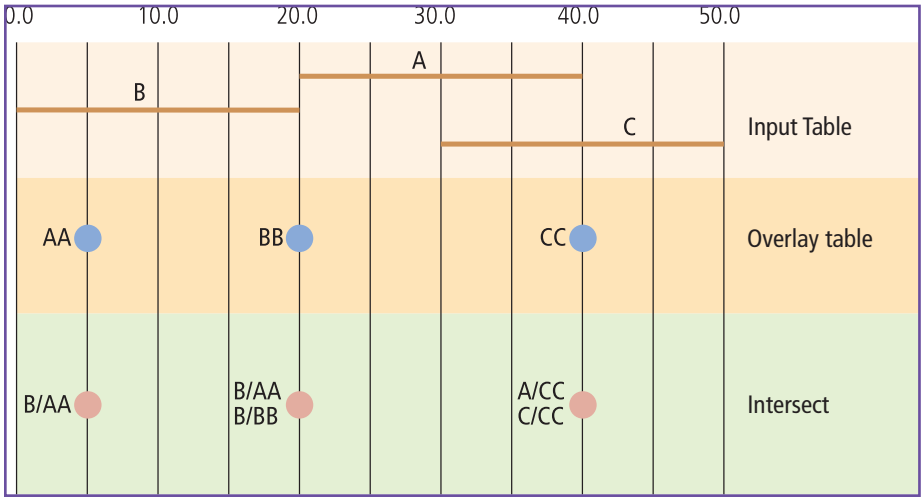
Distributing Dynamic Event Data

Just like any feature layer, a feature layer based on a Route Event Source can be saved with a map document or as a layer file so that

The IRouteMeasureEventGeoprocessor interface provides access to the event geoprocessing operations.

IRouteMeasureEventGeoprocessor : IUnknown	***Provides access to the route measure event geoprocessor properties and methods.***
BuildOutputIndex: Boolean	*Indicates whether an index is going to be built on the route ID field on the output result.*
InputEventProperties: IRouteEventProperties	*The input table's route event properties.*
InputSelection: ISelectionSet	*The input table's selection set.*
InputTable: ITable	*The input table.*
KeepZeroLengthLineEvents: Boolean	*Indicates whether zero length events should be included in the overlay result (line-on-line overlays only).*
OverlayEventProperties: IRouteEventProperties	*The overlay table's route event properties.*
OverlaySelection: ISelectionSet	*The overlay table's selection set.*
overlayTable: ITable	*The table to overlay with the input table.*
Concatenate (in concatenateFields: Variant, in OutputName: IDatasetName, in trackCancel: ITrackCancel, in ConfigKeyword: String) : ITable	*Concatenate events.*
Dissolve (in dissolveFields: Variant, in OutputName: IDatasetName, in trackCancel: ITrackCancel, in ConfigKeyword: String) : ITable	*Dissolve events.*
Intersect (in outputProperties: IRouteEventProperties, in OutputName: IDatasetName, in trackCancel: ITrackCancel, in ConfigKeyword: String) : ITable	*Intersect events.*
Union (in outputProperties: IRouteEventProperties, in OutputName: IDatasetName, in trackCancel: ITrackCancel, in ConfigKeyword: String) : ITable	*Union events.*

A line-on-point overlay involves the overlay of a point event table with a linear event table to produce a single point event table.



it can be shared with other ArcGIS users. With ArcGIS 8.2, additional products are available for distributing data. ArcIMS 4 with the ArcMap Server extension can serve ArcGIS 8.2 map documents containing event feature layers via a browser. The ArcMap Server extension knows how to interpret Route Event Source information and can display events as features in a browser. Publishing an ArcMap map document that contains event data using the ArcGIS Publisher extension allows users with ArcReader to view the data and does not require an ArcGIS license. These distribution scenarios require that the data be accessible to the distributed document.

Conclusion

With the information presented in this article, both new and transitioning dynamic segmentation users can take advantage of the dynamic segmentation functionality available in ArcGIS 8.2. An accompanying tutorial is available from the *ArcUser Online* Web site (**www.esri.com/arcuser**). This tutorial covers migrating an event table to a personal geodatabase, adding route events to an ArcMap document, and analyzing and editing event features.

For more information on the topics covered by this article, read *Linear Referencing and Dynamic Segmentation in ArcGIS 8.1*, a white paper which is available from the *ArcUser Online* Web site. The Transportation Data Model reference document includes information on implementing dynamic segmentation within a geodatabase and is also available from the *ArcUser Online* Web site. For detailed information on the objects and interfaces ArcGIS uses in the dynamic segmentation process, refer to *Exploring ArcObjects Vol. II—Geographic Data Management,* available from the GIS Store (**www.esri.com/shop**). AU

Companion tutorial available from *ArcUser Online*

About the Author

Jennifer Cadkin received degrees in geography and geology from the University of California at Santa Barbara. She began working for ESRI nearly four years ago as a technical industry marketing specialist. She creates demos and provides support for tradeshows and benchmarks.