



ArcView Tracking Analyst Extension

The Solution for Temporal Analysis

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Contents	Page
Product Overview	1
Product Design Concept	1
Product Positioning	1
Market Solutions	2
Transportation	3
Emergency Response	4
Event Analysis	5
Wildlife Monitoring	6
Military	7
Key Features Summary	8
New Theme Type—Tracking Theme	8
Robust Data Input Capabilities	9
Real-Time Display of Data	9
Time Management	10
Actions	10
Integration with Models	11
ArcView GIS Integration Tools	11
Platform Support	11

ArcView Tracking Analyst Extension

Product Overview

The dimension of time has always been an important aspect of the data used in today's geographic information system (GIS) and desktop mapping systems. Until now, those data have been underutilized due to the lack of adequate tools. The new ArcView Tracking Analyst extension provides the tools necessary for ArcView® GIS software users to effectively utilize time-related information.

ArcView Tracking Analyst brings essential temporal capabilities into the ArcView GIS environment. Both new and existing applications can benefit greatly from these additions. Until now, ArcView GIS applications have been restricted to using data that represent static time. This restriction has now been removed by the creation of a new, fully integrated theme type called a tracking theme.

Product Design Concept

The ArcView Tracking Analyst extension is designed to be a powerful complement to ArcView GIS. It provides capabilities for the visualization and analysis of time-related data by defining "GeoEvents" that consist of the following information:

- Time—The date and time of the event
- Position—The geographic location of the event
- Attributes—Object-specific characteristics and properties

These GeoEvents can be used to describe a variety of objects. The major categories of objects are

- **Moving Objects**—These are objects that change location over time. Examples of moving objects are vehicles, ships, planes, people, satellites, birds, and storms.
- **Discrete Objects**—These are objects that exist at only one position and at only one point in time. Examples of this type of object are lightning strikes, automobile accidents, and criminal incidents.
- **Stationary Objects**—These are objects that do not move but whose attributes change over time. Examples of this type of object are traffic monitoring sensors, weather stations, warehouses, and power stations.

Product Positioning

The ArcView Tracking Analyst extension enhances the overall ArcView GIS suite of products and solutions by adding the capability of handling the time dimension. It provides a set of tools, usable through Avenue™ software, for custom application development and for integration with existing applications.

ArcView Tracking Analyst is positioned as a sophisticated visualization and analysis tool that can be utilized for simple or complex applications. It can be used by itself or can be combined with other ArcView GIS extensions to create powerful applications for transportation, emergency response, military, and a host of other purposes. Some extensions and example applications that can be utilized with Tracking Analyst are

- **ArcView Spatial Analyst**—Flood monitoring with sensors that measure river height and use the digital elevation model (DEM) grid to show the overflow into surrounding areas
- **ArcView Network Analyst**—Tracking known locations of a fleet of vehicles and generating the shortest path to a specific destination based on the last known position of the vehicle
- **Internet Map Server**—Providing access to remote clients to obtain the latest update of objects the user is tracking/monitoring

Market Solutions

The potential uses of the ArcView Tracking Analyst extension within the ArcView GIS environment are nearly limitless. It has been designed to support applications of almost any size. The following are general categories of applications that can effectively utilize the Tracking Analyst extension:

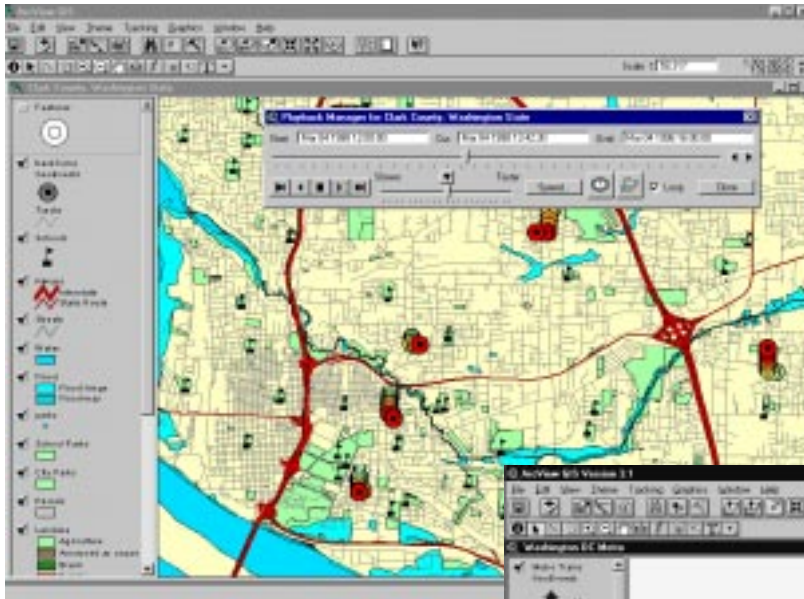
- **Tracking Changes in Location**—As objects move, their locations can be monitored in near real time and displayed on any ArcView GIS map or image. These changes can be easily seen and can be studied in detail based on speed, direction, or position.
- **Tracking Changes in Attributes**—Any object attribute that changes over time can be monitored and displayed. Fuel or payload of an aircraft or ship, the heart rate of a tagged animal, and the current temperature at a weather station are attribute examples.
- **Tracking Change in Patterns**—Patterns that vary over time are often difficult to discern. However, with the tools provided, these patterns can be much easier to detect and examine. As a result, solutions to complicated problems can be more clearly defined.

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Transportation

The ArcView Tracking Analyst extension's temporal analysis capability provides a variety of tools for the transportation industry. ArcView Tracking Analyst allows users to track real-time positional data of their fleet. A city may monitor its snowplow fleet, allowing the city to check on the status of which streets have been plowed or salted based on real-time data received from the field vehicles. However, ArcView Tracking Analyst is not limited to monitoring automobiles; other possibilities include traffic sensors, trains, airplanes, and status of traffic signals. The ArcView Tracking Analyst extension can monitor the status of a stationary object. Sensors that monitor traffic flow or the status of traffic signals can be monitored to study the amount of traffic at different times of the day or to notify workers when a traffic signal is out of service.

- Traffic Monitoring
- Vehicle Tracking
- Fleet Management



Vehicle Tracking

Washington Metro Rail Train Monitoring



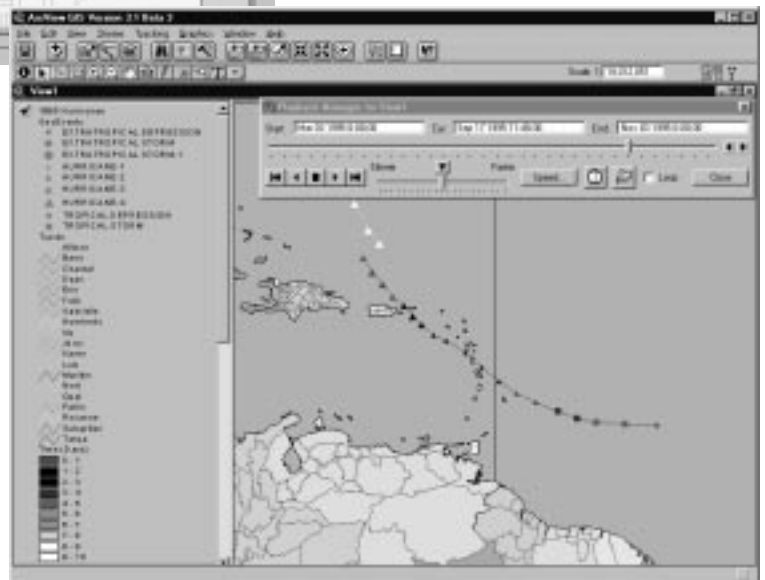
Emergency Response

One of the primary uses of the ArcView Tracking Analyst extension is in support of emergency response applications. Up-to-the-minute data are critical when managing response resources as emergencies unfold. ArcView Tracking Analyst provides the tools to receive data from different sources in a variety of formats and present these data in a common view. In a flood scenario, time-critical data could include river flow monitoring (measuring the height of the river), current locations of emergency response personnel and equipment, current capacity of medical facilities, storm tracking, and wind speed and temperature.

- Equipment Tracking
- Weather Station Monitoring
- Storm Tracking
- River Monitoring
- Emergency Facility Monitoring



River Monitoring, Vehicle Tracking, and Hospital Capacity

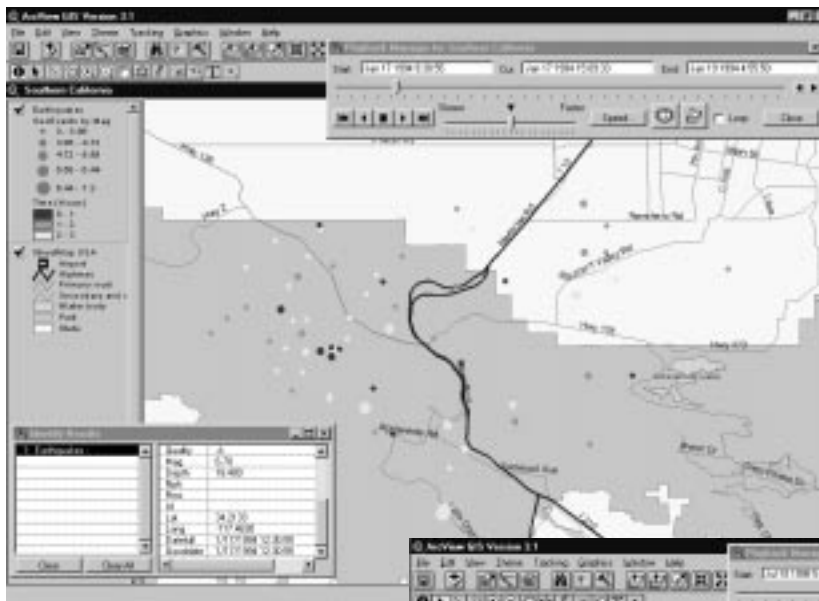


Hurricane Storm Tracking

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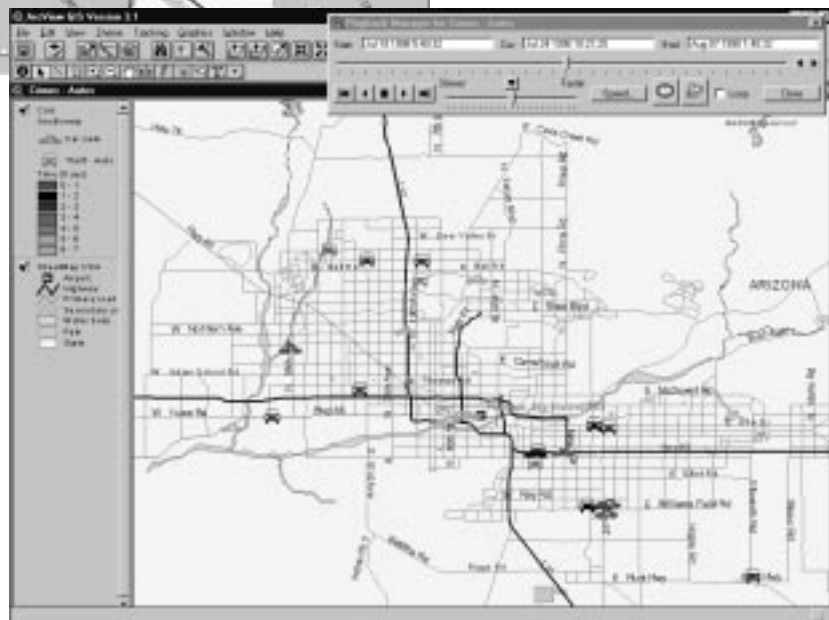
Event Analysis The ArcView Tracking Analyst extension is valuable for the analysis of discrete events. Patterns of these events (temporal and spatial) can be viewed and analyzed. The connection between a series of apparently random crimes could be seen as a possible crime spree by a single perpetrator. ArcView Tracking Analyst can also be used to examine the frequency and time separation of aftershocks following a major quake.

- Monitoring Lightning Strikes
- Monitoring Earthquakes
- Crime Analysis



Earthquake Monitoring

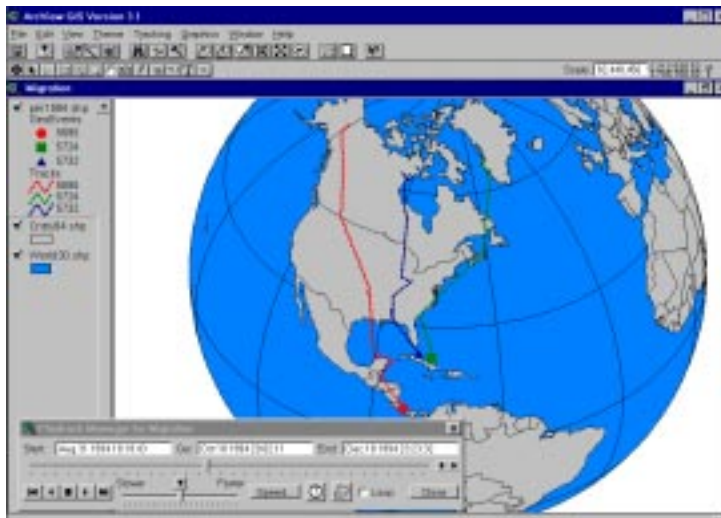
Crime Analysis: Car Jacking Incidents



Wildlife Monitoring

Tracking Analyst provides an ideal tool to track and monitor wildlife movements. Scientists can monitor wildlife positions and attributes as they happen. In addition, the past positions of the animals can be replayed to perform detailed analysis of daily movements or migratory patterns. The ability to study the animals' movement through time in ArcView GIS allows the incorporation of other data into the analysis. Examples of wildlife analysis that can be performed with ArcView Tracking Analyst include urban encroachment, effects of habitat loss, reintroduction of species, and effects of environmental conditions.

- Wildlife Habitat Relationship Analysis
- Home Range Analysis
- Wildlife Management
- Predator/Prey Relationships



Tracking Peregrine Falcon Migration

Monitoring Eagle Habitats



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Military ArcView Tracking Analyst is well suited for defense applications. Temporal information in conjunction with spatial data plays a critical role in battlefield assessment, monitoring equipment and personnel movement, and tracking emitters. ArcView Tracking Analyst in combination with ArcView Spatial Analyst provides analysis capabilities for cross-country mobility data overlaid with real-time updates from equipment in the field.

- Signal Detection
- Vehicle Tracking
- Force Movement
- Sensor Monitoring
- Satellite Tracking



Monitoring a Launch from Cape Canaveral

Satellite Tracking Using Input from Analytic Graphics Satellite Tool Kit (STK) Product

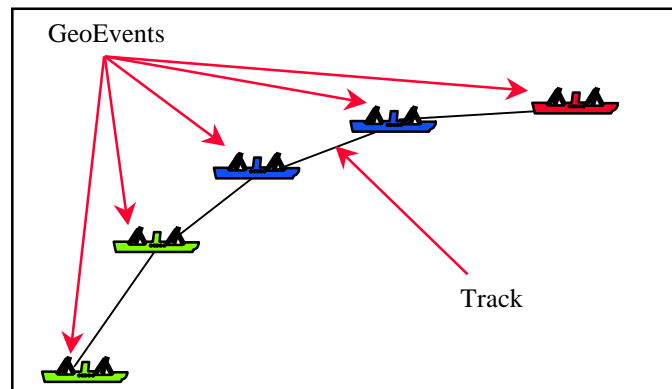


Key Features Summary

- New Theme Type—Tracking Theme
- Robust Data Input Capabilities
- Real-Time Display of Data
- Time Management
- Actions
- Integration with Models
- ArcView GIS Integration Tools
- Customization with Avenue

New Theme Type—Tracking Theme

Tracking Analyst introduces a new theme type to support spatial/temporal data—the tracking theme. The tracking theme is a compound feature made up of GeoEvents and tracks. A GeoEvent is an instance of an object in space and time (e.g., the location of an ambulance at 1:00 p.m.). The track is the derived path between two or more GeoEvents of the same object.



Tracking themes can be symbolized in a variety of ways:

- **GeoEvents**
 - By Attribute (default)
 - By Time
- **Tracks**
 - By Attribute Only

Other features in symbolizing a tracking theme include

- The capability to display only tracks or only GeoEvents. For example, a user may want to display only discrete events such as earthquake epicenters.
- The capability to show only the last known GeoEvent. This is a useful option for static objects that have attribute updates over time such as traffic monitoring sensors.

Robust Data Input Capabilities

Tracking Analyst can receive data from multiple sources, called connections, simultaneously. Each connection can feed positional data for one or more objects, allowing great flexibility and power.

Input data must be an ASCII character input stream, containing the following five required fields:

- Latitude
- Longitude
- Height
- Date/Time Stamp
- Track ID

ArcView Tracking Analyst accepts the standard global positioning system (GPS) format, NMEA. If an input source uses a data format other than NMEA, Tracking Analyst provides the method for creating a custom format specification file. This custom specification allows ArcView Tracking Analyst to accept virtually any source data.

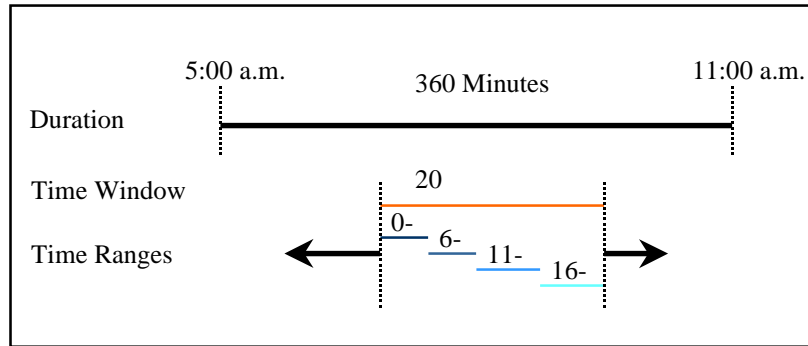
Real-Time Display of Data

Tracking Analyst provides the capability to accept data in real time. Throughput is thirty GeoEvents per second or more depending on the configuration of the machine (memory and CPU speed). Tracking Analyst allows these real-time updates to be displayed within the view without causing a refresh of the map display. Data can be accepted through two types of connections:

- **Local Connections**
 - Input Through COM Port
 - One Data Format (per local connection)
- **Custom Connections**
 - Input via TCP/IP Connections
 - Multiple Data Formats

Time Management

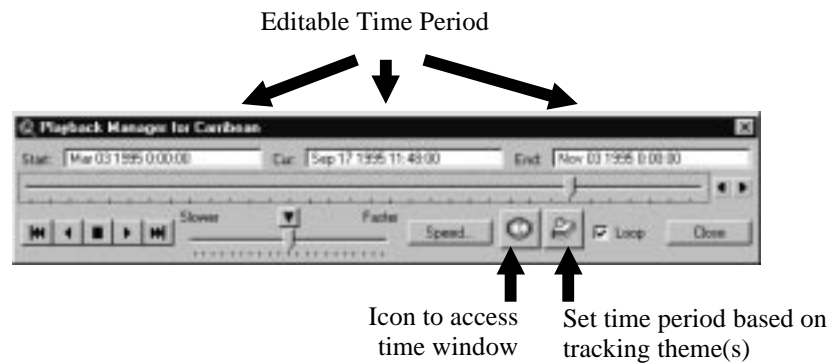
ArcView Tracking Analyst provides a set of tools to manage and visualize time within ArcView GIS. The time editor allows the user to define the time window for a view. The time window is the period of time that tracking data are displayed within the view. The time legend editor provides the mechanism for defining the number and color of time ranges. Time ranges are used to show the aging of GeoEvents within the defined time window through the use of color.



Time is managed at the view level. There are two modes of time within Tracking Analyst, real-time and playback. Real-time is the default mode for a view and, as mentioned previously, allows you to display data feeds live within ArcView GIS. The playback mode is invoked when the playback manager is activated.

The playback manager allows a user to

- Define the time period through which to view the data (past, present, and future—for use with models).
- Step through data at a specified time interval.
- Allow the continuous replay of specified time period, or looping.



Actions

Actions are a powerful feature of the ArcView Tracking Analyst that allows users to create event-initiated (location and/or attribute) rules. These rules are created and applied

at the tracking theme level through the tracking theme property panel. ArcView Tracking Analyst allows multiple actions to be associated with a tracking theme.

Actions are defined based on a combination of both attribute and spatial rules. To define the attribute rule, the action editor provides a query builder window similar to one used with ArcView GIS tables. To build the spatial rules, the user selects any polygon theme that is in the view and applies the rule when a GeoEvent enters or exits a polygon in the associated polygon theme.

After defining the rules, the user has a choice of choosing between three types of actions:

- **Highlights**—Adds an additional user-defined symbol under each GeoEvent that satisfies the action rule.
- **Suppression**—Hides each GeoEvent that satisfies the action rule. This type of action can be used as a method of filtering out data that do not need to be displayed.
- **Custom**—Executes an Avenue script for each GeoEvent that satisfies the action rule. This type of action is only applicable for real-time connections.

Integration with Models

ArcView Tracking Analyst has the capability to accept data from other programs that generate positional information. Tracking Analyst refers to these types of programs as "models." One example of a model program is satellite tracking. Included with the Tracking Analyst extension is a sample model application that integrates Analytical Graphics' Satellite Tool Kit (STK). Using the model's interface, Tracking Analyst makes requests to STK for generating satellite positional data. STK then returns the requested data to Tracking Analyst for display and manipulation in a tracking theme. Requests for satellite positions can be for current, historical, or future positioning.

In addition to the support for STK, Tracking Analyst comes with two models that include sample code libraries for use as examples of how to integrate user-developed models with Tracking Analyst.

ArcView GIS Integration Tools

- Tracking Theme to Vector Shapefile Conversion
 - To Point Shapefile
 - To Polyline Shapefile
 - To Polygon Shapefile
- Use of All ArcView GIS Capabilities and Commands for Legends, Preferences, Tables, and Layouts
- Customization with Avenue

Platform Support

ArcView Tracking Analyst Version 1.0 runs with ArcView GIS Version 3.1 with support for Windows 95/98, NT, and UNIX Solaris.



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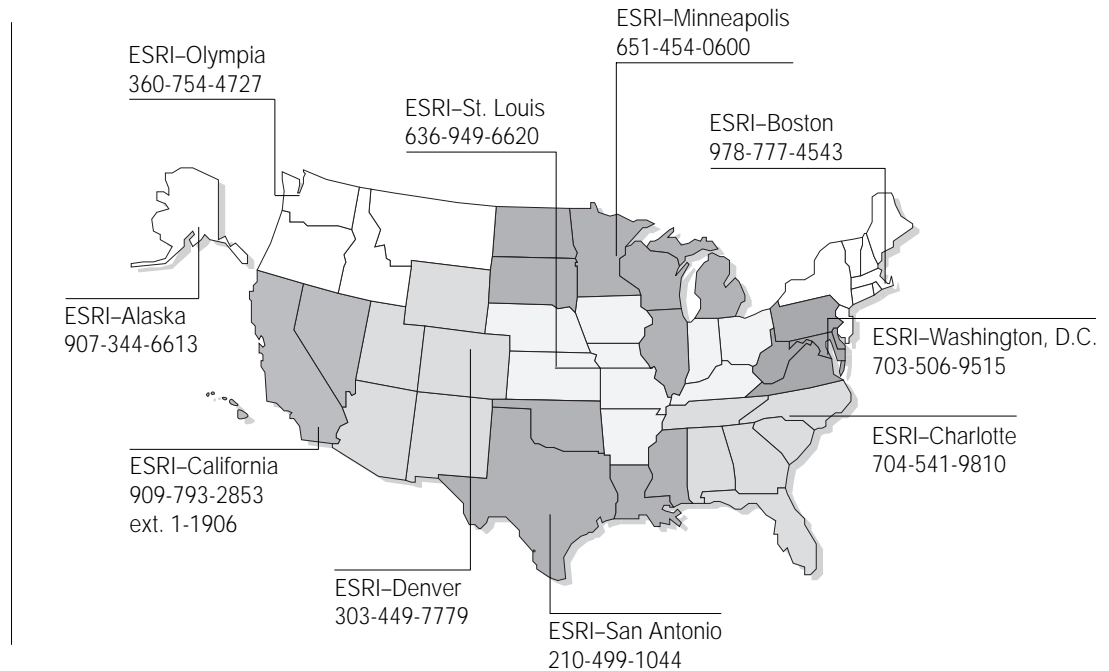
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