An Area Event System for Forest Management History

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An Area Event System for Forest Management History

Abstract An area event system is a data structure to represent overlapping and temporal area events. An area event represents an area where some event has occurred such as a stand, a harvest, or a forest fire. Each area event has three components: location, time, and attribute. Event location represents the shape and location of the event. Event time represents the temporal information common to all events. Event attribute represents information specific to the event type. Event locations are modeled using the Regions feature class. Event time and attribute information is modeled using relational tables.

Key Words Area event system, overlapping areas, spatial-temporal database, historical database

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Introduction

This paper presents a data structure to model how area events overlap in time. This data structure may be used to model several common geographic information system (GIS) databases such as an urban land base and mineral deposits and leases. This paper uses forest management as the example area event system.

A forest management GIS must meet the following requirements:

- Maintain accurate area. Area is a critical component of the system because all value estimates are dependent on area.
- Be compatible with the traditional stand-based system. A stand is the traditional unit of forest management.
- Be able to define features that occur only on portions of a stand or span multiple stands. This is a basic limitation of traditional stand-based systems.
- Be able to maintain historical (past) and planned (future) information.
- Be able to display time slices (time is constant).
- Be able to display cross sections in time: small area, time ranges from some minimum date to some maximum date.
- Be able to determine the area of stands and forest land in other boundary features such as parcels, roads, stream buffer zones, and utility rights-of-way.
- Be able to access forest information based on a user-defined identification schema. For example, stand information would be available via a compartment stand number.
- Be able to develop, save, and restore scenarios.

In addition to the above requirements two operational constraints are added:

- Timely updates and edits take precedence over all other operations. Even if all the above requirements are met, if the data structure is too complex to maintain it is useless.
- Optimize the access of the current condition of the forest. This may require sacrificing performance of history functions.

Area Event

Three components are used to describe where, what, when, and how about an area event.

Event Location

Defines the shape and location of the event. This answers where the event occurred.

Event Time

Describes what type of event occurred and when the event occurred. The event time component is the same for all events.

Event Attribute

Describes how the event occurred. Event attribute information varies with the type of event.

Each event location is associated with the event time and event attribute information that caused the creation of that event feature. **Figure 1** presents a simple diagram showing the relationship between the three event components.

Time Domain

One of the components of event time information is when an event occurred. There are different types of time that a temporal database can maintain (Snodgrass 1992).

Valid Time

The time a fact was true in reality. This is the time an event actually happened. Valid times are usually supplied by the user.

Transaction Time

The time the fact was present in the database as stored data. This is the time the event was entered into the database. Transaction times are usually system-generated times.

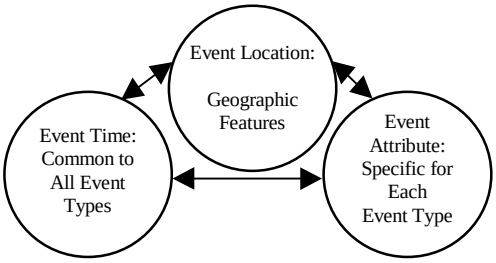
Historical Database

A database that supports valid time. A historical database will allow you to query the status of events during some time span.

Rollback Database

A database that supports transaction time. A rollback database will allow you to query which events were entered into the database during some time span.

Figure 1
Event Location, Time, and Attribute



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Bitemporal Database

A database that supports both valid time and transaction time.

The valid time and transaction time for an event may be different. Often events are recorded after they occur. And because many people or departments contribute to overlapping events, the order in which they are entered into the database is not usually the order in which they occurred in the modeled reality. The rollback capabilities contained in some database management systems maintain transaction time. Rollback capabilities allow you to ask what your database looked like at some date. Note that this date may not precede the date the database was installed. For example, if you installed your database in 1990 you would not be able to roll back your database before 1990.

Asking what your database looked like on a given date is different than asking what the events looked like on that same date. A historical database will allow you to establish views of events over the entire range of the valid times entered in the database. For example, with a historical database you would be able to display the state of your forest land base in 1980 if 1980 is within the range of valid times in the database, independent of when the database was installed.

The goal of the area event system design is to define a data structure that maintains valid times and allows historical queries. It will be assumed that transaction time will be maintained by the database management system or some other mechanism.

What Is an Event?

Within an area event system all area features are treated as events. For example, harvest, site preparation, and planting are events. But also stands and parcels are events. The logical leap is to think of stands and parcels as another event type. Within the forest management area event system, a stand is a very important event, as is a parcel in the ownership area event system. Treating all area features as the same type of object will facilitate the development of a standard set of operators to maintain, display, and query area events.

Statement of Purpose

The key to making a good area event system is to include only those events that signify changes in classification that affect the decision process. Too many events will simply complicate the data management. Each area event system should have a statement of purpose for determining whether a given event should be included or not.

Forest Management Events

The forest management area event system will consist of events that represent the area features that affect forest management decisions.

Land Base	Ownership boundaries
	Road areas
	Utility rights-of-way
	Stream buffer zones
Forest Management	Stand boundaries
	Forest management activities
	Site preparation
	Planting
	Premerchantable inventory

	Timber stand improvement	
	Merchantable inventory	
	Harvest	
Damage	Disease	
	Pest	Bark beetle, gypsy moth
	Physical	Fire, windthrow, tornado, hurricane, ice
Special Use	Endangered species	
	Endangered habitat	

The Event Composite

The event composite is made up of distinct parts, combining the typical or essential characteristics of individuals making up a group. The whole is greater than the sum of the parts.

Figure 2 is a conceptual diagram depicting how the forest management event types are combined to create the forest management composite.

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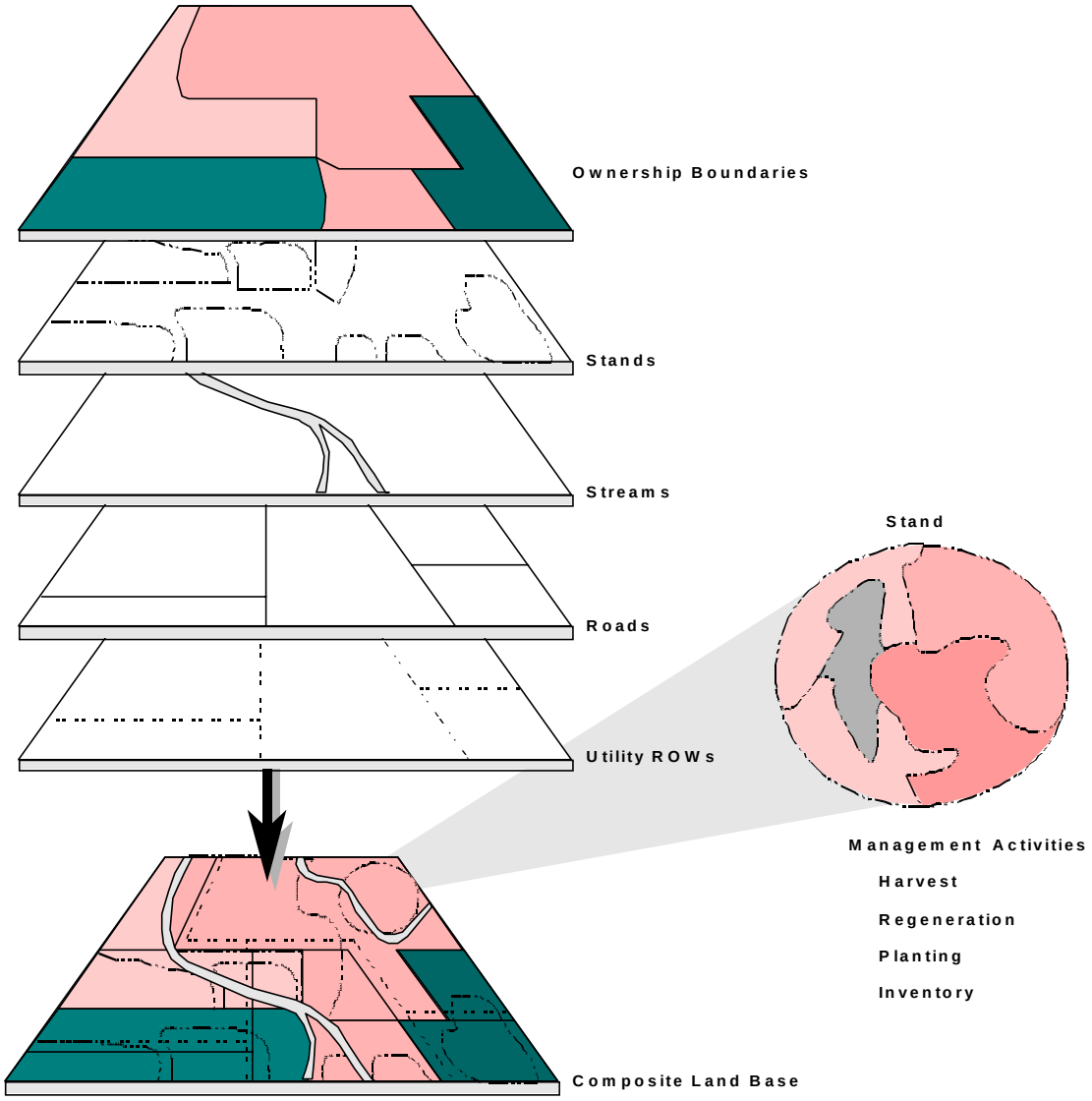
Figure 2
Forest Management Composite



The result of combining multiple event types into a single geographic data set is an event composite. The primary reason for combining these geographic features into one data set is to maintain the coincident boundaries. By combining these geographic features with coincident boundaries into one data set, the creation of slivers is minimized.

Some events cause new boundaries to be added to the event composite. For example, adding a new stand always adds new boundaries to the forest management composite. Other events do not affect the current boundaries in the forest management composite. For example, inventories are always dependent on stand boundaries, which are already

included in the forest management composite. Still other events, like site preparation, may correspond to existing stand boundaries or may require substand boundaries be added to the forest management composite.

You must decide what boundaries are critical and are required in the forest management composite. The question is, is the effort of adding substand boundaries worth the enhanced information obtained?

Land Base Features Affecting Forest Management Boundaries

The stand is the basic unit of forest management. To ensure accurate management of stand boundaries, other types of area features must be incorporated into the forest management composite. These include such features as road areas and utility right-of-way areas. This approach may slow down the edit process, but having these areas explicit in the forest management composite will facilitate easier and faster analytical operations. For example, under this data structure when a new road is added, one may need to buffer the road and update the stand boundaries based on the new road boundary. As a result, the edit process is more involved, but gross and net acreage calculations become much faster. It is no longer necessary to determine the buffer area of each right-of-way feature in a stand, as these areas are explicit in the forest management composite.

Forest Management Activities Affecting Forest Management Boundaries

The forest management database will also support multiple management activities associated with a stand. These are referred to as overlapping events and they may occur only on a portion of a stand (substand) or span multiple stands. Most forest management activities follow stand boundaries. For example, a harvest usually falls within the existing boundary of a stand. Some activities will not follow stand boundaries. In this case, additional event boundaries will have to be added to the forest management composite to account for the extent of the event.

Damage and Special Use Events Affecting Forest Management Boundaries

Damage implies that the forest has been damaged by pests, infection, or physical processes. Bug spot, fire, and windthrow are examples of damage. Special use implies that special management practices must be considered for this area. An endangered species zone is an example of a special use area.

Event Location

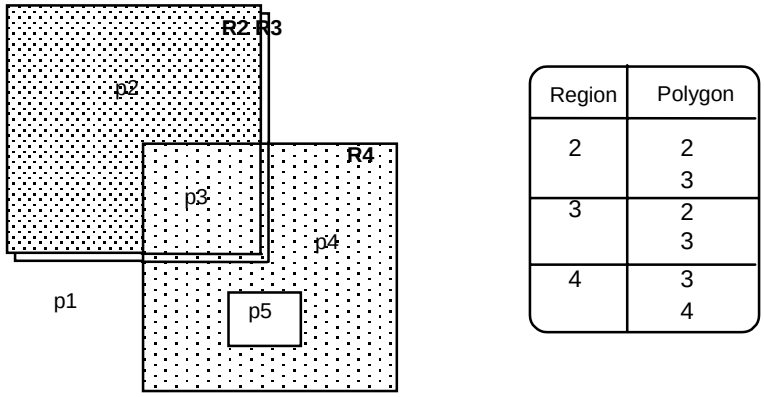
The basic premise of an area event system is that all events are made up of one or more polygons from the event composite. The feature class Region is used to define aggregations of polygons. **Figure 3** displays a simple diagram showing how polygons are combined to create regions.

Regions are grouped into subclasses. A given coverage may have more than one region subclass. Usually, like type regions are contained in the same region subclass. The polygons for an individual region do not need to be contiguous; therefore, a region may be discontiguous. A given polygon may belong to multiple regions; therefore, regions may overlap. Regions within a given subclass may overlap and regions across subclasses may overlap.

The event composite data set will contain one region subclass for each event type. For example, the forest management composite data set will have the following region subclasses: parcels, roads, stream buffer zones, stands, harvest, damage, special use, site

preparation, planting, premerchantable inventory, timber stand improvement, merchantable inventory, damage, and special use.

Figure 3
Simple Regions Graphic



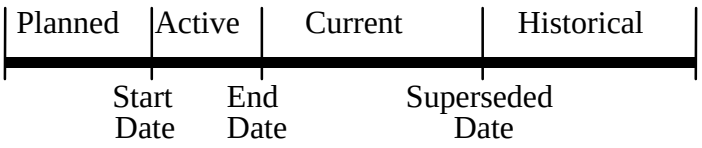
Event Time

All events share a common set of attributes. This serves as a unifying force for maintaining common information about when an event occurred and the status of the event. The event time information for all event types will be stored in one table (EVENT). The event dependent information will be stored in separate tables for each event type. For example, the event type HARVEST will have an event dependent table (HARVEST) that only contains harvest information.

Event Attribute	Description
Event ID	Unique event ID.
Event Type	Identifies the event type and the associated event dependent table that describes the details of the event. For example event type = HARVEST indicates that the detail information for this harvest event is in the HARVEST event dependent table.
Planned Start Date	Planned event start date.
Planned End Date	Planned event end date.
Start Date	Actual event start date.
End Date	Actual event end date.
Superseded Date	Date the event is superseded by another event or events. This date is initialized to a date far in the future. When the event is superseded, the superseded date is set to the start date of the event that superseded this event, and the event record is transferred to the history table.
Event Status	Planned, active, current, historical, suspended.
Approval status	Approved, failed, pending review.
Edit Status	Complete, map edit pending, attribute edit pending.
Map Edit	Did the event boundary require a map edit? Yes/No.
Comments	Miscellaneous comments about the event.

The date tuple (start date, end date, superseded date) records the transition points in the event time line. **Figure 4** presents the database time line, depicting the event periods and transition points. Note that this is the database view of the event time line. It starts in the planned period and ends with historical. The user view of the event time line would start with historical and end with planned.

Figure 4
Event Time Line



Planned Period — From the time the event was planned and entered into the database until the time the event is implemented.

Current Period — From the time the event is implemented until the event is superseded by another event or events (start date to superseded date).

Active Period — From the time the event is actively being implemented until the event is completed (start date to end date). The active period is a subset of the current period.

Historical Period — From the time the event is superseded until the event information is removed from the database.

Some events are not planned and will not have a planned period. If an active period is not relevant for a given event type, the start date will be the same as the end date. For example, a harvest event has an active duration. Harvesting starts at some time and is complete at some time. On the other hand, a stand simply becomes current at some time. The active period is not applicable for a stand event; therefore, start date is the same as end date.

Planned dates are maintained so that planned time frames may be evaluated against actual time frames. Large differences between planned and actual times frames may indicate flaws in basic planning assumptions.

The event status records the event's current period in the time line. Suspended status indicates that the event was in the active period but was suspended for some reason. The Approval Status item is a general event approval item for all events. Many events must be approved for final acceptance. More detailed failure codes are maintained on the event dependent tables.

The Edit Status and Map Edit items are used to track the editing status. These items are used to ensure that the referential integrity of the system is maintained. The event maintenance procedure will be described in a later section in this paper.

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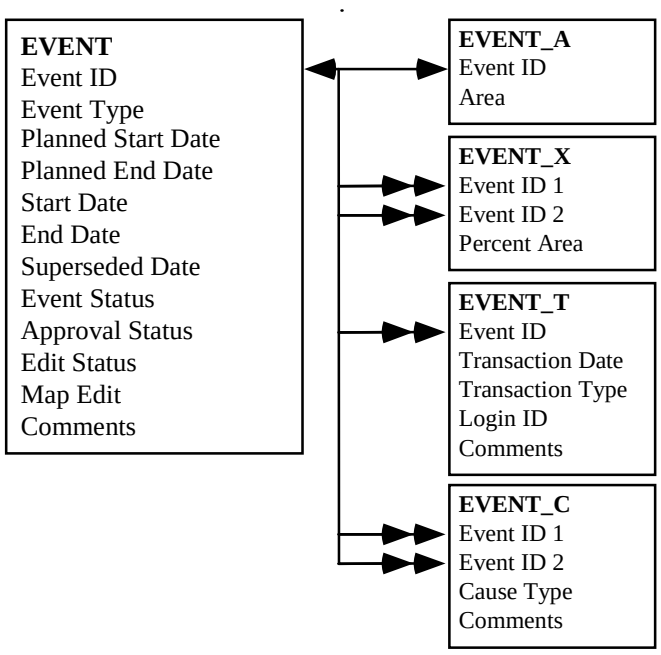
In addition to the primary event table, there are some auxiliary tables to store event area, overlap, transaction, and cause and effect relations. **Figure 5** is a diagram of the event table relations. The double arrows represent a one-to-many relationship, meaning that one record in the event table may be related to more than one record in the related table.

Figure 5
Event Tables



Event Area

The event area table (EVENT_A) is derived from the geographic database. For each event this table contains one record with the event ID and area. This table is maintained in the relational database so that area summaries may be performed in the relational database, independent of the geographic database.

Event Cross-Reference

From the geographic database, it is possible to derive an event cross-reference table (EVENT_X). For any given event, this table may be used to determine what other events overlap the event and what percent of the event is covered by each overlapping event.

Event 1 ID	Event 1 ID
Event 2 ID	Event 2 ID
Percent Overlap	Overlap area divided by the area of event 1

A special case of the event cross-reference table is the stand versus other events cross-reference table (STAND_X). This provides relational access to all the events that overlap a given stand. Special case cross-reference tables are a subset of the event cross-reference table. A special case cross-reference table may be created to improve overlap

queries for a specific event type. **Figures 6** and **7** show the general event cross-reference table relations and the stand event cross-reference table relations respectively. These tables may be used for queries such as selecting all other events that overlap an individual stand.

Figure 6
Event Cross-Reference

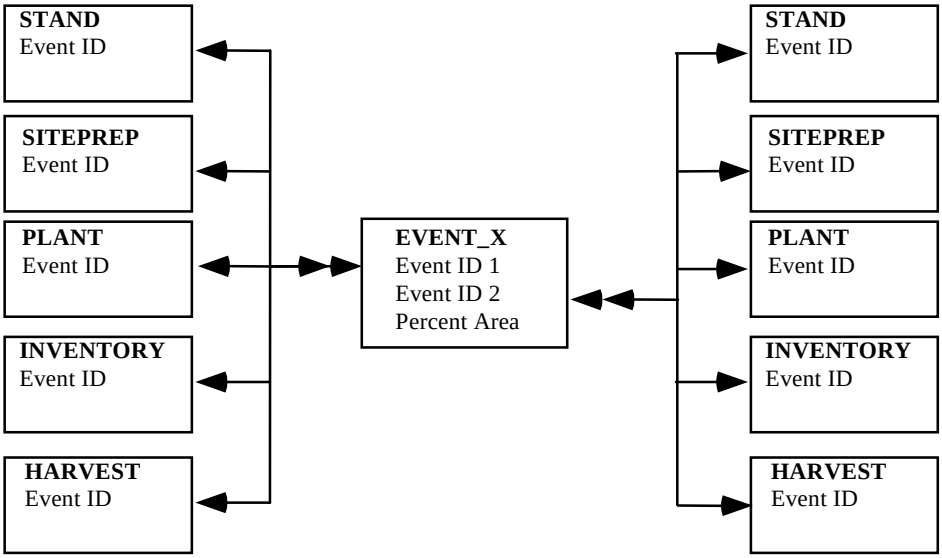
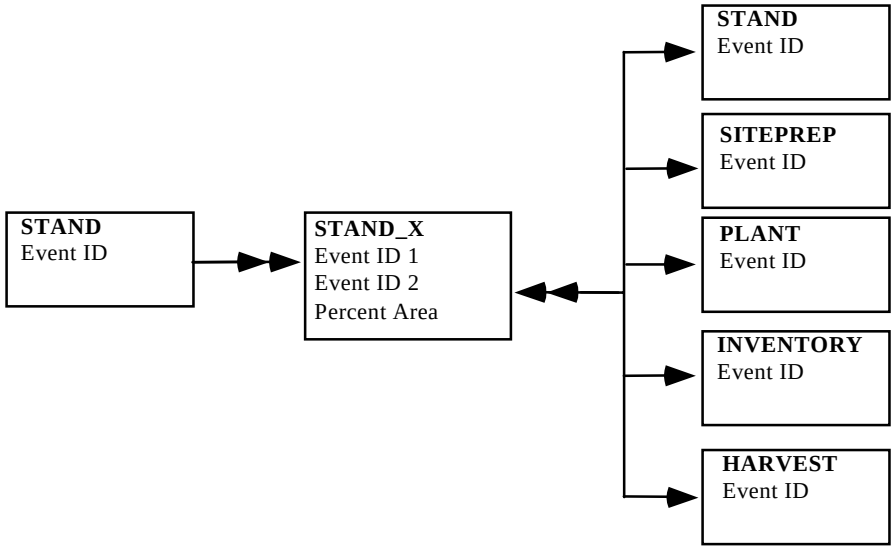


Figure 7
Stand Event Cross-Reference



Event Transactions

The event transaction table (EVENT_T) may be used to track database transactions associated with an event. This table will chronicle the movement of the event from the planned table to the current table to the historical table.

Event ID	Event ID
Transaction Type	Type of transaction such as enter planned record, move planned record to current table, enter current record, move current record to historical table, update, and enter graphic element
Transaction Date	System date the transaction occurred
Login ID	User login ID that performed the transaction
Comments	Comments

Event Cause

The purpose of the event cause table (EVENT_C) is to record cause and effect relationships. For example, you may be performing a planting because a previous planting has failed. The event cause table may be used to explicitly record this cause and effect relationship between the two events.

Event 1 ID	Event 1 ID
Event 2 ID	Event 2 ID
Cause Type	Reason the event occurred, such as another event failed or this is an error correction
Comments	Comments

It is also possible to imply this relationship without the event cause table. The event cross-reference table may be used to find all overlapping events. In the case of a planting, if the planting overlaps another planting, the previous planting was within five years, and the approval status is failed, then you can imply that this planting is being added because the previous planting failed.

Error Correction

Sometimes it will be necessary to modify an event boundary or attributes because new information indicates that the original event boundary or attributes were entered incorrectly. For example, an aerial photograph indicates that a stand boundary must be rectified. There are two correction options:

Option 1

Simply correct the incorrect information in question: Move the boundary or boundaries or edit the attribute information. In this case the event information is now up-to-date, but the old incorrect information is lost.

Option 2

Retain the incorrect event information because some activity such as planning or tax computation was based upon it and add a new event boundary, which is the correction of the incorrect event. If the event cause table is being used enter ERROR in the cause type. If the event cause tab e is not being used, enter the key word ERROR and the event ID corrected by this event in the comments field to maintain the link between the incorrect event and the correction.

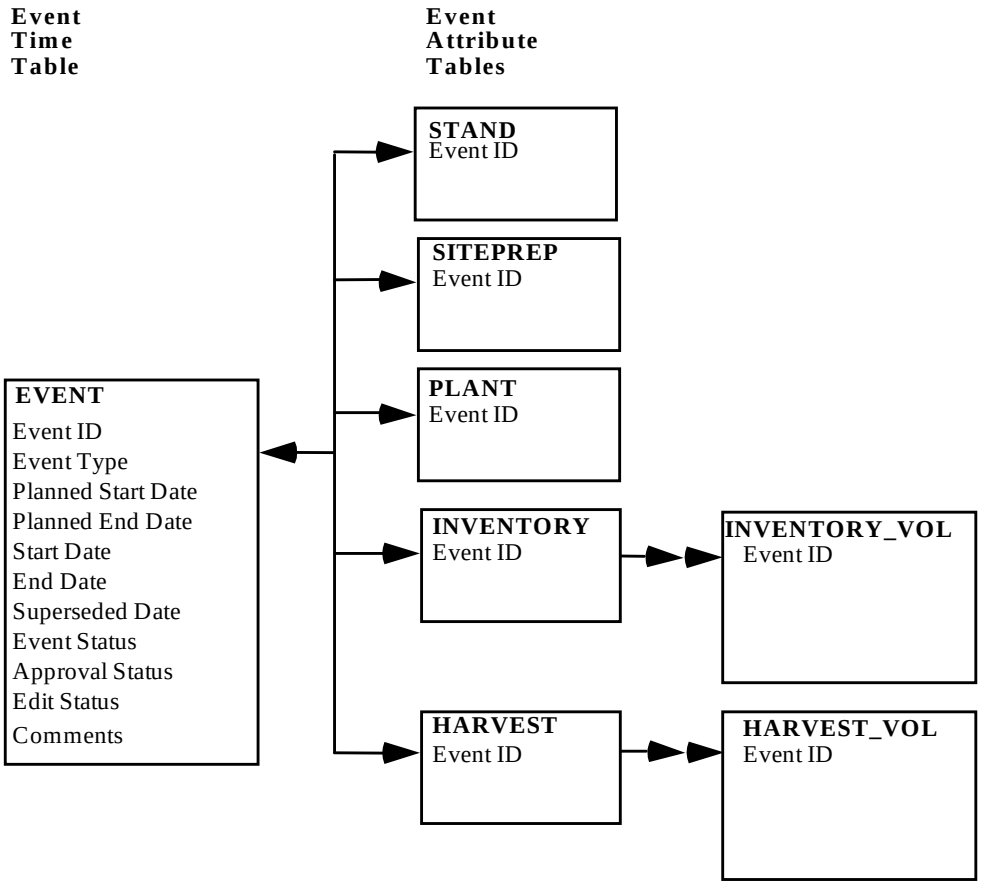
For each event error correction, you must decide which option to use.

Event Attribute

Many events have information that is unique to that event type. These events will have additional detail information in the event attribute tables. Each event attribute table has

event ID as the primary key or as part of a composite primary key. All other columns are dependent on database requirements. The event attribute table becomes the linkage to additional relation information. For example, the inventory and harvest events will have related volume information. **Figure 8** shows how some example event attribute tables are related to the event time table and to additional tables.

Figure 8
Selected Forest Management Event Dependent Tables



Area Event System Linkages

There are many different ways to view the relationships between the event location, event time, and event attribute tables.

Event Time to Event Attribute Tables

The relationship between the event time (EVENT) table and the event attribute tables was shown in **Figure 8.** Note that the event ID serves as primary key and foreign key on all tables.

Event Cross-Reference

The cross-reference relationship between events was shown in **Figures 6** and **7.**

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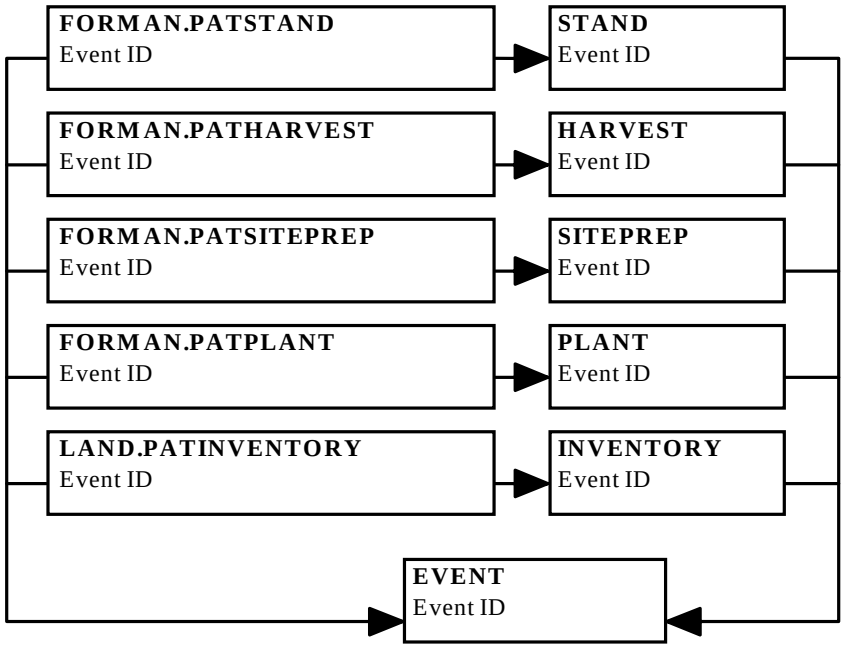
Event Location to Event Attribute Tables

Each event type represented by a region subclass (event area) will have a complementary event attribute table. This is a one-to-one relationship; each individual region in a given subclass will have an associated record in the appropriate event attribute table. **Figure 9** shows how the region feature attribute table is related to the event attribute table. In addition to the one-to-one relationship between the event location (regions) and the event attribute tables, these tables also relate to the event time table. This provides the order of events in time.

Figure 9
Selected Forest Management Region Subclasses



Work Plan to Operations Information Flow

The event time line in **Figure 4** shows that an event goes through three time periods. The event status determines how the event information is used.

Event Status	Use
Planned	Analysis, optimization, what if
Current	Current status
History	Analysis, what leads to good and bad results

Because an event has a consistent definition throughout its life cycle, the input form for the work plan (planned events) is equivalent to the input form for the current events. As an event goes from being planned to being current, the event status is updated and more detailed information will be input.

Area Event Maintenance

The following tasks must be completed when an event is entered into the system:

- Add record to the event time table.
- Add record to the event attribute table.
- Add feature to the event composite.

Event Activation

Entering a current event into the database requires both a graphic edit on the geographic database and the entry of an attribute record in the event attribute table. These transactions may take place at separate times. Usually the attribute information precedes the graphic editing. When a graphic edit or tabular edit is complete the edit status must be updated. If there is no record in the event table, then a unique event ID is retrieved from the event sequence and the record is added. The edit status is set to the opposite type of edit that is now being performed. If the event record is already present, the event ID is assigned to the graphic element or event dependent record and the edit status is set to complete.

Special Case: If there is no accurate boundary information, it may be necessary to represent the area as a percentage of some other event. In this case, instead of actually mapping the event, you enter a reference event and the percent overlap on the reference event directly into the event cross-reference table and set the map edit column in the event table to No. This indicates that the event area will not be derived from the geographic database but will be calculated based on the percent overlap of a reference event. The area of this event in the geographic database will be equivalent to the area of the reference event, but the relational database will maintain the estimated area based on the area of the reference event times the percent overlap. Insect damage is an example where this might occur. A forester will estimate 20 percent damage for a stand, but not actually map out the damage areas. In the geographic database the damage event will have the same location and shape as the reference stand. This geographic feature is useful for small-scale district or regional maps, but it is inaccurate and possibly misleading for large-scale maps.

Multiple Area Event Systems

A GIS database may be composed of multiple area event systems. For example, many forest product corporations have lands and minerals divisions in addition to the forest division. Each division will maintain its own area event system: forest management, land ownership, and minerals and leases. These three event systems will revolve around their own central event table. In order to separate the multiple area event systems, a unique prefix for each area event system is added to the standard event tables.

p = Event system prefix
pEVENT, pEVENT_X, pEVENT_A

For example:

FEVENT, FEVENT_X, and FEVENT_A for forest management
PEVENT, PEVENT_X, and PEVENT_A for ownership management
MEVENT, MEVENT_X, and MEVENT_A for mineral and lease management

In addition to being able to recognize the standard event tables for each area event system, the event IDs for all events across all area event systems must be unique. Treating all entities as events will allow reuse of the standard event management functions across all area event systems. Imposing unique event IDs across all area event systems will allow the combination of two area event systems to create an area event system with the same structure and unique event IDs to which the standard functions may be applied.

For example, if you want to cross-reference parcels and stands, then in the geographic database union the forest management composite with the ownership composite. In the relational database, union the forest management event table FEVENT and the parcel event table PEVENT. The resultant geographic data set and relational tables have the exact same area event system structure with forest management and ownership combined. Finding the parcel stand cross-reference simply requires executing the standard event cross-reference function where EVENT1 type is PARCEL and the EVENT2 type is STAND.

How to Maintain Unique Event IDs Across Multiple Event Systems

Requiring unique event IDs across all area event systems requires that there be many event IDs available. The event IDs are retrieved from sequences when a new event is added to the system. Three options are described to ensure that there are enough event IDs to accommodate the area event systems. The choice of implementation will affect how the Get next event ID function works.

Option 1

All event systems use one sequence table (EVENT_SEQ). This is a simple solution to the problem, but for very, very large systems this method may not supply enough unique IDs. This method allows for two billion (4-byte integer) events across the entire database.

Option 2

For each event system assign a unique prefix and sequence table. The event ID prefix and sequence table will be stored in the EVENT_SYSTEM table. The prefix must be unique across all event systems. The event ID will be a character string that is the concatenation of the prefix plus the next sequence number. This method allows for two billion events in each event system.

Option 3

For each event type assign a prefix and sequence table. The event ID prefix and sequence table will be stored in the EVENT_CODE lookup table. The prefix must be unique across all event types. The event ID will be a character string that is the concatenation of the prefix plus the next sequence number. This method allows for two billion events for each event type.

Literature Cited

Snodgrass, Richard T. "Temporal Databases" from Theories and Methods of Spatio-Temporal Reasoning in Geographic Space, edited by Frank, A., I. Campari, and U. Formentini. *Proceedings of the International Conference GIS—From Space to Territory: Theories and Methods of Spatio-Temporal Reasoning,* Pisa, Italy, 1992. Springer-Verlag, 1992. Lecture Notes in Computer Science 639.

Appendix A: Example Forest Management State Scenario

The purpose of this example is to show the physical state of the geographic and tabular databases through time. The example progresses from initial condition to simple event transactions and then to more complex event transactions.

State 1: Initial Condition, Four Stands

The EVENT table contains one record for each event that occurs. In this case the event type is STAND. The EVENT value is the unique event ID assigned when the event is entered in the system.

The STAND table contains one record for each stand in the forest management database.

There is an associated event area in the geographic database for each stand displayed above the stand table with its event ID. The event composite shows an overlay of all event areas. At initial condition, only the stand boundaries are present.

The STAND_EVENT table is a cross-reference of which events occurred on which stands. Since a stand always overlays itself 100 percent, these records are not entered in the STAND_EVENT cross-reference table.

Note that the historical geographic database contains both the historical and current events. This is done to allow history operations spanning all events, but the history tables only contain the historical information. The union of the current and history tables will contain all the events in the tabular database.

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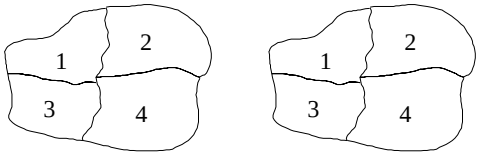
State 1: Initial Condition, Four Stands



COMPOSITE

STAND

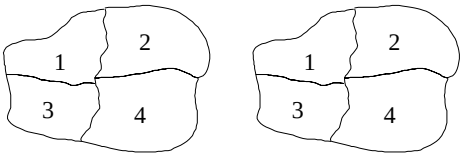
Event	Stand
1	001
2	002
3	003
4	004

STAND_EVENT

Event1 Event2 %

EVENT

Event	Type
1	STAND
2	STAND
3	STAND
4	STAND



COMPOSITE_HS

STAND_HS

Event Stand

STAND_EVENT_HS

Event1 Event2 %

EVENT_HS

Event Type

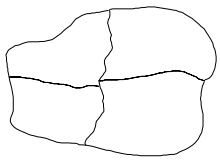
State 2: Inventory All Stands

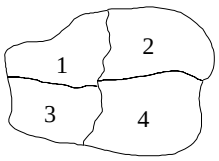
An inventory cruise is performed on each of the four stands. For each inventory cruise

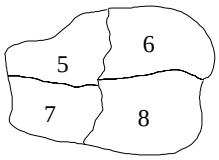
- Assign a unique event ID and add an inventory record to the EVENT table.
- Add an event dependent record to the INVENTORY table.

- Add an event area to the INVENTORY subclass in the geographic database. These inventory areas are created by duplicating the stand areas. The composite is not altered.
- Add STAND cross INVENTORY records to the STAND_EVENT table. The STAND_EVENT table is updated to include the relationship between the inventories and the stands that each inventory occurred on.

State 2: Inventory All Stands







COMPOSITE

STAND

Event	Stand
1	001
2	002
3	003
4	004

STAND_EVENT

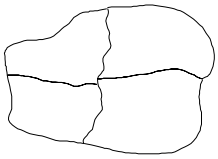
Event1	Event2	%
1	5	100
2	6	100
3	7	100
4	8	100

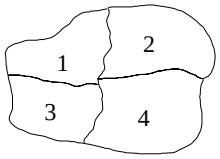
EVENT

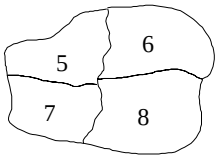
Event	Type
1	STAND
2	STAND
3	STAND
4	STAND
5	INVENTORY
6	INVENTORY
7	INVENTORY
8	INVENTORY

INVENTORY

Event	Type
5	CRUISE
6	CRUISE
7	CRUISE
8	CRUISE







COMPOSITE_HS

STAND_HS

Event	Stand

STAND_EVENT_HS

Event1	Event2	%

EVENT_HS

Event	Type

INVENTORY_HS

Event	Type

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State 3: Harvest Stand 1

To add a HARVEST event

- Assign a unique event ID and add a harvest event record to the EVENT table.
- Add an event dependent record to the HARVEST table.
- Add an event area to the HARVEST subclass in the geographic database. The harvest area is created by duplicating the stand area.
- Add a STAND cross HARVEST record to the STAND_EVENT table.

This harvest causes a bare land INVENTORY event to be added:

- Assign a unique event ID and add an inventory event record to the EVENT table.
- Add an event dependent record to the INVENTORY table.
- Add an inventory event area to the INVENTORY subclass in the geographic database. This inventory area is created by duplicating the stand area.
- Add a STAND cross INVENTORY record to the STAND_EVENT table.

Since harvest events supersede inventory events, the previous inventory performed on Stand 1 is moved to the history table INVENTORY_HS. The corresponding entry in the STAND_EVENT table for STAND 1, INVENTORY 5 is moved to the STAND_EVENT_HS table. The INVENTORY 5 event area is also removed from the INVENTORY subclass of the current geographic database.

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State 3: Harvest Stand 1

COMPOSITE

STAND

Event	Stand
1	001
2	002
3	003
4	004

STAND_EVENT

Event1	Event2	%
1	9	100
1	10	100
2	6	100
3	7	100
4	8	100

EVENT

Event	Type
1	STAND
2	STAND
3	STAND
4	STAND
5	INVENTORY
6	INVENTORY
7	INVENTORY
8	INVENTORY
9	HARVEST
10	INVENTORY

INVENTORY

Event	Type
6	CRUISE
7	CRUISE
8	CRUISE
10	BARELAND

HARVEST

Event	Type
9	CC

COMPOSITE_HS

STAND_HS

Event	Stand

STAND_EVENT_HS

Event1	Event2	%
1	5	100

EVENT_HS

Event	Type
5	INVENTORY

INVENTORY_HS

Event	Type
5	CRUISE

HARVEST_HS

Event	Type

State 4: Harvest Stand 4 and Part of Stand 2

This harvest requires that Stands 2 and 4 be partially combined, creating a new Stand 12. The remainder of Stand 2 becomes Stand 13. Whenever a stand boundary changes, a new stand must be entered into the system. The new stand may inherit the previous stand attributes. The harvest also causes the addition of a bare land INVENTORY event.

To add a HARVEST event

- Assign a unique event ID and add a HARVEST event record to the EVENT table.
- Add an event dependent record to the HARVEST table.

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- Add an event area to the HARVEST subclass in the geographic database. This harvest area is created by adding some new boundary lines to the event composite and aggregating the proper polygons.
- Add STAND cross HARVEST records to the STAND_EVENT table.

To add STAND events

- Assign a unique event ID and add STAND events to the EVENT table.
- Add event dependent records to the STAND table.
- Add event areas to the STAND subclass in the geographic database. These stand areas are created by aggregating the proper polygons from the event composite.
- Add STAND cross event records to the STAND_EVENT table.

To add an INVENTORY event

- Assign a unique event ID and add an INVENTORY event record to the EVENT table.
- Add an event dependent record to the INVENTORY table.
- Add an event area to the INVENTORY subclass in the geographic database. This inventory area is created by duplicating the stand area.
- Add a STAND cross INVENTORY record to the STAND_EVENT table.

Because stand events supersede other stand events, Stands 2 and 4 are moved to the STAND_HS history table and the associated event areas are removed from the current event geographic database.

Because a harvest event supersedes an inventory event, INVENTORY 8 is moved to INVENTORY_HS and the associated event area is removed from the current event geographic database.

The composite has been altered to contain the new harvest boundary, which also becomes the boundary for the new stand and inventory events.

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State 4: Harvest Stand 4 and Part of Stand 2

COMPOSITE

STAND

Event	Stand
1	001
3	003
12	005
13	002

STAND_EVENT

Event1	Event2	%
1	9	100
1	10	100
3	7	100
12	11	100
12	14	100
13	6	70

EVENT

Event	Type
1	STAND
3	STAND
6	INVENTORY
7	INVENTORY
9	HARVEST
10	INVENTORY
11	HARVEST
12	STAND
13	STAND
14	INVENTORY

INVENTORY

Event	Type
6	CRUISE
7	CRUISE
10	BARELAND
14	BARELAND

HARVEST

Event	Type
9	CC
11	CC

COMPOSITE_HS

STAND_HS

Event	Stand
2	002
4	004

STAND_EVENT_HS

Event1	Event2	%
1	5	100
2	6	100
4	8	100

EVENT_HS

Event	Type
2	STAND
4	STAND
5	INVENTORY
8	INVENTORY

INVENTORY_HS

Event	Type
5	CRUISE
8	CRUISE

HARVEST_HS

Event	Type

Appendix B: Area Event System Table Definitions

Geodata Set Name Composite

Feature Class

POLYGON	Composite base
REGION.event	Event boundaries where event = event type code

Description

This geographic data set contains features defining the area event boundaries. The event composite polygons are defined by the combination of all the event types.

Data Table	Table Type	Key	Item Name	INFO Def.	SQL Def.	Description
composite.AAT	AAT		FNODE#	4,5,B		From-Node Number
			TNODE#	4,5,B		To-Node Number
			LPOLY#	4,5,B		Left-Polygon Number
			RPOLY#	4,5,B		Right-Polygon Number
			LENGTH	4,12,F,3		Length
			composite#	4,5,B		Internal ID
			composite-ID	4,5,B,0		User-ID
composite.PAT	PAT		AREA	4,12,F,3		Area
			PERIMETER	4,12,F,3		Perimeter
			composite#	4,5,B		Internal ID
			composite-ID	4,5,B		User-ID
composite.PATevent	REG		AREA	4,12,F,3		Area
			PERIMETER	4,12,F,3		Perimeter
			event#	4,5,B,0		Internal ID
			event-ID	4,5,B,0		User-ID
		F	EVENT	4,10,B,0		Event ID
where event = event type code						
EVENT	DAT	PF	EVENT	4,10,B,0	I	Event ID
		F	EVENT_CODE	8,8,C	V(8)	Event Type
			PLAN_START	8,10,D	D	Planned Start Date
			PLAN_END	8,10,D	D	Planned End Date
			START_DATE	8,10,D	D	Actual Start Date
			END_DATE	8,10,D	D	Actual End Date
			SUPERSEDE_DATE	8,10,D	D	Superseded Date
		F	STATUS_CODE	1,1,C	C(1)	Active Status

		F	APPROVE_CODE	1,1,C	C(1)	Approval Status
		F	EDIT_CODE	1,1,C	C(1)	Edit Status
		F	MAP_EDIT_CODE	1,1,C	C(1)	Map Edit
			COMMENTS	128,128,C	V(128)	Comments
EVENT_A	DAT	PF	EVENT	4,10,B,0	I	Event ID
			AREA	4,12,F,3	N(11,3)	Area
EVENT_C	DAT	F	EVENT1	4,10,B,0	I	Event ID
		F	EVENT2	4,10,B,0	I	Cause Event ID
		F	CAUSE_CODE	4,12,F,3	N(11,3)	Cause Code
			COMMENTS	128,128,C	V(128)	Comments
EVENT_T	DAT	F	EVENT	4,10,B,0	I	Event ID
		F	TRANS_CODE	4,12,F,3	N(11,3)	Transaction Type
			TRANS_DATE	8,10,D	D	Transaction Date
			USER_ID	8,8,2	V(8)	Login ID
			COMMENTS	128,128,C	V(128)	Comments
EVENT_X	KEY	F	EVENT1	4,10,B,0	I	Event ID
		F	EVENT2	4,10,B,0	I	Overlapping Event ID
			PERCENT_AREA	4,6,F,2	N(5,2)	Percent Area
EVENT_CONTRACT	KEY	F	EVENT	4,10,B,0	I	Event ID
		F	CONTRACT	6,6,C	C(6)	Contract ID
EVENT_SEQ	SEQ		NEXTVAL	4,10,B,0	I	Event ID

Item Descriptions

EVENT	Unique event ID generated by the EVENT_SEQ sequence table.
EVENT_CODE	Event type identifies the evidence table that describes the details of this event. For example, EVENT_CODE = HARVEST indicates that the detail information for this harvest event is in the HARVEST table.
PLAN_START	Planned start date for the event.
PLAN_END	Planned end date for the event.
START_DATE	Actual start date.
END_DATE	Actual end date. Until STATUS = COMPLETE, the end date is the planned end date.
SUPERSEDE_DATE	Date the event is superseded. This date is initialized to a date far in the future. When the event is superseded, the superseded date is set to the actual start date of the event that superseded this event, and the event record is transferred to the history table.
STATUS_CODE	Active status: P = Planned, A = Active, S = Suspended, C = Complete.
APPROVE_CODE	Approval status: A = Approved, F = Failed, P = Pending review.
EDIT_CODE	Edit status: C = Complete, M = Map edit pending, A = Attribute edit pending. The edit status item indicates if an attribute edit still has a map edit pending or vice versa.

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MAP_EDIT_CODE	Y = Yes, N = No.
COMMENTS	Miscellaneous comments about the event.
AREA	Event area in square map units.
EVENT1	Event ID. This number relates to the EVENT item in any of the event detail tables.
EVENT2	Event ID. This number relates to the EVENT item in any of the event detail tables.
PERCENT_AREA	Percent of event area (EVENT1) affected. If the event area is mapped, this will be generated from the geographic database. If the event area is not mapped, the percent area will be input with the event detail information.
CAUSE_CODE	Cause type code.
TRANS_CODE	Transaction type code.
TRANS_DATE	Date the event transaction is entered in the table.
USER_ID	User login ID of the person who activated the event.
CONTRACT	Contract ID.
NEXTVAL	Unique event ID generated by the EVENT_SEQ sequence.

Notation

Table Types

AAT	Arc attribute table
PAT	Polygon attribute table
REG	Region attribute table
DAT	Relational database table
KEY	Key or cross-reference table
SEQ	Sequence table

Item Key Type

P	Primary key: The value in this column must uniquely identify the record.
F	Foreign key: The value in this column may be used to join to a related table.
N	Not null: The value in this column may not be null.
PF	Primary/Foreign key: The value in this column functions as both a primary and a foreign key.
	Otherwise the item may be any value (including null) within the valid definition range.

Item Name

If the item name contains _CODE, that item will have a lookup table of discrete values.

Item INFO Definition

B	Binary: Integer value, usually used for large integer values
C	Character
D	Date
F	Floating point
I	Integer (fixed width)
N	Floating point (fixed width)

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Item SQL Definition

C(n)	Character fixed width (n = number of characters)
D	Date
I	Integer: Large integer value
N(n)	Number: Integer fixed width (n = maximum digits)
N(m,n)	Number: Floating point number (m = maximum significant digits, n = digits after decimal)
V(n)	Varchar: Character variable width (n = maximum characters)

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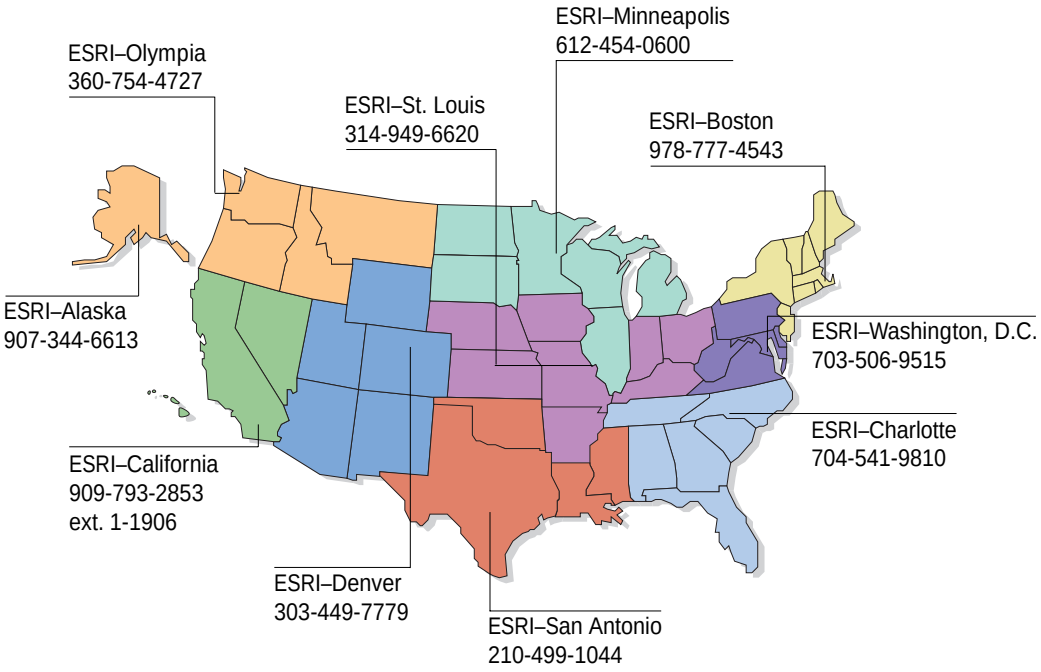

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Australia
61-9-242-1005

Canada
416-441-6035

France
33-1-46-23-6060

Germany
49-8166-677-0

Hong Kong
852-2-730-6883

India
91-11-620-3801

Italy
39-6-406-96-1

Poland
48-22-256-482

South Asia
65-735-8755

Spain
34-1-559-4345

Sweden
46-23-84090

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