I/Incident Analyst
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1. Introduction

The ability to analyze incident location is crucial in helping to determine why these incidents occur. Since most incidents have a positional quality, I/Incident Analyst can use this information to spot trends in frequency based on geography. The resultant analysis allows decision makers to target areas to effectively deploy resources and create intelligence products that detect spatial patterns to aid tactical analysis.

The distribution of incidents across geography is not random, and the ability to delineate areas of abnormal frequency is extremely valuable. I/Incident Analyst offers tools to assist in identifying these areas. Understanding where incidents occur and comparing locations with other factors – time, relative location to other geographic features, offense statistics, etc. – assist in defining areas of concern. I/Incident Analyst allows easy access to incident details and simple techniques to perform these types of analyses.

Incident mapping can help public safety agencies better service their citizens. I/Incident Analyst creates clear and simple maps that display the locations of incidents, and can be used to direct resources to places they are needed most. Additionally, policy makers in public safety agencies can use its complex maps to observe trends and track action on areas of high incident frequency. I/Incident Analyst can be used for:

- **Strategic Assessment**: Identify priority neighborhoods and the conditions experienced within them
- **Tactical Assessment**: Locate where tactics have been deployed and visualize their impact
- **Target Profiling**: Profile areas where suspects/offenders reside and the areas where they focus their activities
- **Pattern Analysis**: Identify emerging incident hot spots, or connect an incident series and predict where the offender may reside
- **Risk Analysis**: Identify areas at a higher risk of incidents occurring

Incident data can originate from many sources in various public safety agencies. It is important to be able to analyze this data directly from these sources, and then offer the analyzed data in a legible, functional presentation.

Law enforcement agencies at the local level respond to calls for service and handle matters that come to the attention of patrol officers. The majority of these will initially be recorded within the command-and-control (C&C) environment, with those that result in an allegation of crime being transferred to the crime recording or records management system (RMS) system.

When analyzing fire department operations, it is critical to reconstruct and improve upon incident response. It is important to analyze the stages of response as recorded in computer-aided dispatch (CAD) systems. Distances to incident and temporal analysis are also defining factors that add in optimal resource allocation.

Allocation of ambulance resources for emergency response are highly time sensitive, and the analysis of data captured in a CAD system is integral to better resource performance. I/Incident Analyst allows analysts to consider, explore, and study all of these data sources directly.
2. **I/Incident Analyst**

Intergraph’s I/Incident Analyst provides public safety agencies with a map-based C&C environment that helps them determine where an incident is occurring and how best to respond. Users can visualize caller locations, along with the locations of deployed resources. With global positioning systems (GPS), the locations of the resources can be as current as the last ping from the GPS. Linking intelligence databases to the C&C can give officers a “heads up” on what may be found at a particular location. Links to human resources systems can help dispatchers deploy appropriately skilled officers.

2.1 **Incident Mapping and Management Analysis**

Public safety managers are driven by a performance culture; therefore it is important to them to understand if specific incident types have increased or decreased during particular time periods. I/Incident Analyst offers the ability to conduct incident mapping and management analysis, providing a map that describes where incidents have increased or decreased, rather than providing bland tabular data that is often difficult to filter through and use for accurate decision making. This can be a huge step forward in communicating the problem to all management levels.

2.2 **Tactical Analysis**

Tactical analysis is about the here and now – what is happening within the current time frame and what can be done to control the activity. Many agencies use incident mapping on a daily basis to brief officers before they go on patrol, giving them the latest information on trends and patterns in their locality. I/Incident Analyst looks at the operational, or tactical, picture – using maps to understand whether current deployment patterns are having the desired effect.

2.3 **Incident Auditing**

Auditing takes a more strategic look at incident patterns. The trends and patterns identified over the longer term will influence the tactical analysis and prevention strategies put in place. For police agencies, incident auditing may look at offender and victim profiles to help understand who is offending against whom. Through its map interface, I/Incident Analyst identifies “virtual” communities who may be at risk.

2.4 **Problem-solving Incident Analysis**

As noted above, public safety delivery is driven by a performance culture. Initiatives and operations are established to deal with problems in particular areas. Where money is spent addressing issues, there is often a requirement to show to what degree the initiative was successful. I/Incident Analyst can monitor and evaluate the success of these operations. Particularly useful is the ability to show change in an area over time and to examine displacement issues. Mapping may also show a diffusion of benefit from the area of the operation to surrounding areas.
2.5 Geographic Profiling

For police agencies, this investigative methodology uses the locations of a connected, or linked, series of crimes to determine the most probable area of offender residence. Used predominantly in the serious and serial crime arena, it has helped investigators locate serial killers, rapists, arsonists, and kidnappers. It is now being used in any circumstance where an unidentified person is known to have carried out a series of crimes.

2.6 Monitoring, Assessment, and Performance Review

I/Incident Analyst provides problem-solving incident analysis, focusing on specific recurring events – whether it be vehicle crash sites, fire locations, or break and enters – by attempting to understand what are the underlying causes of problems at that location. Following the rationale that prevention of an incident is better than reactive response, it seeks to find practical responses to issues in a particular place. For example, analysis may identify a particular bar or club generating problems after midnight on a weekend; the response might be to work with the authorities to limit the license to 11:00 p.m. Analysis may also identify road locations with exceptionally high rates of vehicle collisions requiring ambulance response that could be abated by reduced speeds.
3. Architecture

I/Incident Analyst makes use of a Web service and XML configuration files to communicate with existing CAD, RMS, and other data sources. Users can easily modify the XML files and expand the fields being retrieved (i.e. more attributes), or even support other systems should there be a need. The graphical user interface (GUI) component of I/Incident Analyst consists of GeoMedia®, GeoMedia Grid, and GeoMedia WebMap components. Figure 1 below provides a graphical representation of the I/Incident Analyst architecture.

Figure 1: High-level Architecture of I/Incident Analyst
4. Installer

I/Incident Analyst is delivered like all other extension products (i.e., a menu and associated tool bars will be installed) within the GeoMedia environment. The prerequisite for I/Incident Analyst is GeoMedia. GeoMedia Grid includes I/Incident Analyst; however, I/Incident Analyst requires its own installer. The installer will install GeoMedia Grid, make all of the required registrations, add the I/Incident Analyst menu and tool bars, and uninstall all of the installed components.

Since I/Incident Analyst is built within the GeoMedia and GeoMedia Grid environments, the top-level commands will include all of the off-the-shelf GeoMedia and GeoMedia Grid commands and the I/Incident Analyst menu. Additionally, the I/Incident Analyst menu and tools bars will contain all of the commands for the product.

Query Builder, the central component within I/Incident Analyst, will create in-memory GRecordsets. These record sets will act as input into all the incident analysis and mapping commands (namely Pin Map, Incident Counts, Repeat Incidents, Hot Spot Mapping, Journey to Incident, Animate Map, and Temporal Reporting). The output from the incident analysis and mapping commands will either be in-memory GRecordsets, a query, or a feature class.

Figure 2 below provides a visual picture of the I/Incident Analyst command hierarchy. This figure outlines which commands are based upon GeoMedia objects and which are based upon GeoMedia Grid objects.
5. Data Access

Providing easy access to a variety of data sources is an essential requirement for law enforcement, and serves as the foundation of I/Incident Analyst. The data in the underlying data source is available through a Web service that, although implemented through GeoMedia for this solution, has no GeoMedia application-specific requirements. I/Incident Analyst users can easily connect to the I/CAD, I/LEADS, I/Warehouse, or NICHE databases, as well as other contextual information such as census information, parole data, etc. Users can also bring in .TXT, .XLS, .CSV files, and can specify field types such as date, time, and text. All connection types will use OLEDB to retrieve the data and a simple XML configuration document to manage the details. I/Incident Analyst uses a simple configuration document that determines what data source is available and how it should be structured.
6. Query Builder

I/Incident Analyst provides an intuitive, yet flexible, Query Builder (see Figure 3). Users can create queries via a user-friendly interface without having to use SQL. The interface expands as users drill down.

Once connected to their data source, users can define a subset of the data. I/Incident Analyst displays the results of a query as point locations of the incidents, in the map window, or as a data window. It provides the ability to store and reuse queries previously generated. All filtered attributes use a standard dialog that allows users to return multiple results for the attribute filter.

![Incident Query Builder and Date/Time Tab](image)

*Figure 3: Incident Query Builder and Date/Time Tab*
7. Query Manager

I/Incident Analyst creates and modifies incident queries. The Query Manager uses an identical interface to the Query Builder command (see Figure 4). The command allows users to review the properties of a previously created Incident Query generated by the Query Builder command. Users can modify the query parameters, save the query, save the query as a new query, delete the query, or redisplay the query in the map or data window.

![Query Manager](image)

*Figure 4: Query Manager*
8. Pin Map

I/Incident Analyst provides pin maps, like the one shown in Figure 5, which uses point symbols representing where incidents have occurred. These incident location maps have many uses. They are extremely helpful to those who patrol and investigate crimes, as it allows them to identify areas at risk to a specific type of crime. Pin maps place a point at the location of every incident that meets the query criteria.

Figure 5: Pin Mapping Example (traffic accidents with injuries in 2001-02; between 2:00 a.m. and 6:00 a.m.)
9. Incident Counts

I/Incident Analyst includes an incident count mapping command. Incident count maps are maps of thematic displays of polygons that count the incidents that fall within it (see Figures 6 and 7). These maps use color to represent different values among land units, such as police precincts, city voting districts, or census tracts. They can be expressed as simple counts (e.g. number of incidents in a define boundary) or as density values (e.g. number of incidents per square mile). Incident count maps offer map users a broader perspective of where incidents occur, without having to interpret a large number of individual locations.

Figure 6: Incident Count Mapping Command Dialog

Figure 7: Incident Count Map Example
10. Journey to Incident

I/Incident Analyst includes a Journey to the Incident mapping command (see Figures 8 and 9). This command enables users to display the location of an incident in comparison to the perpetrator of the incident, or an incident’s location in comparison to where the incident elements (cars, bikes, TVs, etc.) were recovered. The output is symbolized according to the location and offender or location and recovery. I/Incident Analyst displays a straight line symbolized with direction between the location and offender or location and recovery.

![Figure 8: Journey to Incident Command Dialog](image)

![Figure 9: Travel to Incident Example](image)
11. Repeat Incidents

I/Incident Analyst includes a repeat victimization mapping command (see Figures 10 and 11). Repeat victimization maps allow users to display locations where incidents occur more than once. The maps use symbol size and color to identify reoccurrence of incidents in the same location. The repeat victimization can be qualified by geographic location or by a common attribute value.

![Figure 10: Repeat Incidents Command Dialog](image)

![Figure 11: Repeat Incident Mapping (all false alarms for 2004, and top 20 percent of false alarms for 2004)](image)
12. Hot Spot Maps

Hot spot maps are the backbone of any incident analysis effort. I/Incident Analyst provides a number of commands for automatically extracting hot spots from a plot of incidents, helping police direct patrols where they are needed most. I/Incident Analyst presents a simplified hot spot map interface, allowing novice users to quickly create a variety of hot spot maps – density (Figure 12) and zone (Figure 13) – from a set of sparse points.

Figure 12: Thematic Hot Spot Mapping Example (dumpster fires 01-02)
I/Incident Analyst can also create isoline maps (Figure 14). Isoline maps are maps that contain linear features that represent lines of equal value. These maps are used to generalize and simplify isopleth maps. Contour maps are probably the most common example of isoline maps. I/Incident Analyst includes a single step command for generating isolines from isopleth maps. These maps are extremely useful at distilling complex information into a simple picture almost any map reader can understand; therefore, they are effective intelligence products for public education.
I/Incident Analyst takes a wizard-based approach to creating density maps, hot spot maps, and isoline maps. It gives them ultimate exposure to all the options (see Figure 15).

![Simple Hotspots](image)

This section of the wizard allows users to select an existing “area of interest” or create a new “area of interest” for defining what area the hot spot maps will represent. If users select and fill out one of the “create new” “area of interest” options, this command will create a new “area of interest” and add it to the existing “area of interest” list.

**Figure 15: Simple Hot Spot Analysis Command**  
(Note: Advanced hot spot command will be offered.)
13. Animate Map – Part 1

I/Incident Analyst also allows users to load multiple isopleth maps into a view and provides an intuitive set of tools to visualize change over time. Decision makers can use the change over time approach to assess the impact of incident reduction initiatives, determine their effectiveness, or identify emerging incident areas.

Users can configure the animation of the data (vectors and images) in the GeoMedia Map Window (see Figure 16). The dialog can be displayed and used to configure the data. It can then be collapsed to show only the playback controls. The collapsed mode will require less screen space and allow for a bigger display area for presentations.

Figure 16: Legend Animation Floating Palette
14. Animate Map – Part 2

I/Incident Analyst also enables users to extract data from a CAD and/or RMS system. This data is in the form of an in-memory feature class of points and includes metadata, such as the incident type and the time the incident was reported (epoch time). These tables are structured by the Query Builder and will always have this type of information. The epoch time will be used to drive the animation.

For example, users may use the Query Builder to extract car thefts for an entire year. They can use this query as input into the Query animation command, where the time interval is set to one month. I/Incident Analyst’s Legend Animation command performs queries on the fly against the in-memory query to produce 12 queries, then, in turn, display these in sequence as an animation.

The floating palette allows users to select a query (one that was built using the Query Builder) and enter an appropriate time interval for the animation (see Figures 17, 18, 19, and 20).

Figure 17: Query Animation Floating Palette
Figure 18: Query Animation (domestic dispute, January – April 2002)

Figure 19: Query Animation (domestic dispute, January – August 2002)

Figure 20: Query Animation (domestic dispute, January – December 2002)
15. Temporal Reporting

I/Incident Analyst provides a simple interface for the creation of incident/time-of-day histograms. Using either incident data or previously created incident queries, users can create histograms for the incident being queried. If a previously created incident query uses a date range, I/Incident Analyst will use the same date range. Otherwise, users must define a new date range. Users can pass aoristic constraints from the original query or define them. For aoristic analysis, I/Incident Analyst requires a start and end time for the aoristic range. Users will determine the histogram output as one of the following:

1. **24 Hour**: The histogram will show incidents as they occur in a 24-hour period over the input date range
2. **AM/PM**: Two histograms will be created, one for the AM time frame and one for the PM time frame that shows the incident counts for the date range
3. **Weekly**: The histogram will show incident counts by day of the week for the input date range

Additionally, users will be able to specify the histogram title, the x-axis title (time), and the y-axis title (incident count). (See Figures 21, 22, 23, and, 24 below.)
Figure 22: Incidents by Time Histogram

Figure 23: Incidents by Time of Day Histogram

Figure 24: Incidents by Day of Week Histogram
16. Summary

Incident mapping can help public safety agencies better service their citizens. I/Incident Analyst’s simple maps display the locations of incidents, and can be used to direct resources to places they are needed most. It fuses data from multiple sources and identifies spatial patterns from point locations. Additionally, decision makers in public safety agencies can use I/Incident Analyst’s complex maps to observe trends and track action in areas of high-incident frequency.