The Human Factors of Emergency Dispatch Mapping

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Mapping and Geographic Information Systems (GIS) are commonly interfaced with 9-1-1 and Computer Aided Dispatch (CAD) Systems as a dispatch decision support tool. In some communities the mapping is heavily used to verify 9-1-1 call addresses, while in other communities the mapping is rarely used though present.

This paper considers the role of mapping in emergency dispatch and the requirements to make dispatch mapping friendly and useful for emergency dispatchers who frequently have no training in cartography or GIS.

Introduction to Dispatch Mapping

Digital mapping and GIS have become typical tools at the 9-1-1 Public Safety Answering Point (PSAP). Emergency dispatchers often use the map to verify addresses and to recommend a route of travel for emergency crews during the call for service (CFS). In many communities, an accurate and complete map has become a critical component in managing emergency calls.

A well-designed mapping system quickly and accurately communicates the location of the emergency, usually via the address of the emergency call. As a communication and information tool, the map may be relied on heavily by some dispatchers and even has become part of their emergency dispatch standard operating procedure (SOP).

Additionally, dispatch mapping is being used for much more than just emergency dispatch. The role of the digital map and GIS is now supporting other functions including automatic vehicle location (AVL), wireless call mapping in support of the FCC Wireless mandate, computer aided dispatch (CAD) systems, crime analysis, and to support emergency operations systems.

Dispatch Environment

The typical PSAP is a secured portion of a building with dim lighting and many computers and radio equipment. The dispatcher plays a number of roles and must learn many different systems, while performing a stressful job.

Until very recently, the computer interfaces for most emergency dispatch software were limited to text interfaces on computer network terminals. Window interfaces and mouse-driven event operations were not common and today are still not the norm. In fact, the mouse can be a more awkward user interface than the input fields accessed by the user via the tab and function key. Simply put, the mouse requires the user to take his or her hands from the keyboard, losing critical time during emergency operations.

A typical dispatch center has access to multiple computer systems, with each piece often serving proprietary systems. For example, a 9-1-1 dispatcher has a computer for their 9-1-1 calls, a CAD system, a criminal records system, radio controls on a PC, and the digital mapping system on a separate computer system. This can result in as many as four monitors at a single dispatch position.

Map Software GUI

Simplicity is paramount in the design and operation of a dispatch mapping system. The graphical user interface (GUI) should be uncluttered to speed its use, intuitive so minimal training is required, and operated by single keystrokes with optional mouse support.

Normal Windows and Motif interfaces requiring menus and other mouse-interactions should be avoided in favor of simpler function key and tab-driven commands.

The software should automatically load in a predefined fashion with the restarting of the computer, with the appropriate files and screen settings and interfacing automatically occurring with CAD and 9-1-1 systems.

Discussions with multiple dispatch entities have revealed that all map commands should be accessible via tab key sequencing of commands, arrow key sequencing of commands, as well as a mouse button support.

Minimum commands merely include zoom in and out, as well as map pan/scroll. Manual address entry to geocode the call location is the only other interface required in this minimal configuration.

All dispatch entities agree that the map should be capable of automated geocoding and map zooming to the CFS. Some PSAPs indicated that a single map window was their preference, with zooming automated via any key touch. Others preferred a two-window map interface supporting different map scales of the CFS.

Map Features

All PSAPs agreed that too much mapping information is more troubling than not enough. Minimal mapping requirements were defined to include roads, houses, and driveways, if available.

Corporate limits and water features were defined as useful, but not absolutely necessary. Interestingly, text indicating the address of a house was also considered to be not mission critical, so long as the house in question could be queried to determine its address.

Emergency service zones (ESZ), parcels, section lines, and ortho imagery were all considered to present too much information to the dispatcher, and that actually distracted from the mission-critical role of the map. These data were deemed to be only needed by the manager of the PSAP or Emergency Operations Center (EOC) during complex operations.

All dispatch centers also agreed that a black background for the mapping information was preferred to a white screen. This is due to the dim lighting of the dispatch center and the fact that the other computer applications used in dispatch often have black backgrounds.

Map Symbology

Symbolization of the mapping data is perhaps more important with the amount of information available. Presenting the map data, i.e. roads, houses and driveways, in a clear manner is paramount.

Map symbolization was found to be critical for classifying roads, but not needed for classifying address locations. For example, interstates should be symbolized differently from city streets and jeep trails, whereas address locations do not require a different symbolization to distinguish houses from trailers and businesses.

In fact, the complex classification of address locations based on feature at the address in question actually makes the map more difficult to interpret. A simple square was preferred to represent the location of the address.

Additionally, dispatchers preferred a static mapping interface, similar to how a map is created with computer aided drafting system. Map interfaces created with a GIS tended to have much more variability in the presentation of the mapping information making the map more difficult to use. When using a GIS to prepare a map for emergency dispatch, it has been found that a consistent and static interface is preferred with very few options for the dispatcher to modify the interface and feature symbology.

Text Labels

Generally, all map dispatch users preferred how drafting systems, such as AutoCAD and MicroStation, handle text such as road names and addresses, compared to the dynamic labeling of road names and addresses in MapInfo and ArcView. The static labeling of the drafting systems allowed the map text to be placed such that the map was clear and easily understood. The dynamic labeling of the GIS software automatically places text at the scale of the view, and the labeling lacks aesthetics and clarity.

Dispatch mapping requires clear labeling and symbolization to convey as much information as possible to the dispatcher in the shortest period of time possible, without any confusion.

Text labeling is directly linked to the scale of the map being presented to the user. When drafting systems are used to make map annotations, the text is placed in accordance of the scale of the map to be published. With a GIS, text is typically not stored in a layer of data unto itself. Rather the text generated is dependent on the attributes in the database linked to a "project" or "workspace" and saving these "pseudo databases" with the text information is somewhat more problematic.

Display Scale

Dispatchers also generally preferred two methods of displaying maps. Some users prefer a single map window to appear with the caller's address in question, and then automatically zoom into a larger scale with a keystroke or mouse movement.

Other users prefer an overview map showing the entire county with the call location and a larger scale window with the map details.

Map Coordinates

Most users did not want to see a map coordinate grid indicating map coordinates. At most, they only preferred to see a coordinate readout of the mouse location in a status window.

Most map users in dispatch centers also have little preference for geographic or planar coordinates, such as latitude and longitude, state plane coordinates, or Universal Transverse Mercator (UTM) coordinates.

However, all users polled preferred the "shape" of their counties in State Plane Coordinates, as opposed to the east-west stretch occurring with maps in Latitude and Longitude or the slight rotation of maps projected at the edges of UTM zones.

A requirement of coordinate displays is the ability to display coordinates in latitude and longitude, regardless of the map coordinate system. The user must also be able to toggle between different coordinate display systems, such as decimal degrees, or degrees, minutes, decimal minutes, or degrees, minutes and seconds. This is because different users of GPS have limited coordinate displays, i.e. one helicopter will have one lat/long display while a helicopter from another hospital will use a different format. The dispatcher must be able to toggle between the different lat/long formats for the different users.

Geocoding & Other Queries

Upon first consideration, all dispatchers first believed that they automatically wanted the mapping system to display a map with the receipt of a 9-1-1 call. However, after lengthy consideration, this position was reversed for the following reasons:

- Not all emergency calls require a map of the caller's location;
- Calls often are not initiated from the location where the real emergency is located
- The 9-1-1 address information from the telephone company may be so poor that automated mapping is impossible, i.e. street spelling errors;
- In some circumstances, multiple emergency calls are initiated for the same emergency, i.e. a car accident, and with an automated map display, the map could in theory be automatically moving to another map location, when another, more important call is being managed.

Thus the automatic map display is desirable, but not likely to be used in the majority of dispatch centers. Rather, the ability to select from a pick list of the pending emergency calls or to manually key in the address in question is preferable.

An additional requirement for address queries includes the support for road name aliases. Also, support for wild cards in road name entry is very important.

Other queries that are desirable in a dispatch center are road intersections; the ability to place wireless call coordinates on the map, and the ability to manually enter a lat/long coordinate to find a user's GPS location.

Novice vs. Advanced User

In very special circumstances, the manager of a dispatch center may have some special dispatching mapping requirements.

These special requirements are not needed by the typical dispatcher and require greater expertise on the part of the user. Examples of these advanced features include:

- Load additional data layers such as ortho imagery, parcel fabric and other GIS data.
- Access to map customization and symbolization tools.
- Special emergency management functions such as plume analysis and polygon address selection tools.
- Administrative function to govern mapping displays for dispatchers.

The manager of the Emergency Operations Center or PSAP often may be the only staff with access to the functions because many dispatch managers want the mapping functions to be as simple and user error proof as possible.
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Summary

This paper considered the basic mapping functions required for mapping support in emergency management and 9-1-1 dispatch centers. Generally, simplicity is the most important mapping feature with bells and whistles not desired for all dispatchers. Of other interest is the lack of confidence many dispatch centers have in the quality of the 9-1-1 address records such as road spellings, enough lack of confidence, in fact, as to not desire a map to be generated automatically with each 9-1-1 call. The map is viewed more as a decision support tool by experienced users and is not necessary to support every emergency.