EENA Operations Document

Using and optimising GIS in an emergency response

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Table of contents

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1 Executive Summary

Access to complete, credible, easy-to-use and timely information about geographical objects and factors and their influence, are the prerequisites for making the right decisions when carrying out different tasks in different situations. By the development and introduction of technologies of geographic information systems (GIS technology) for the time being non-spatial data received spatial meaning and significance.

Potential benefits and possibilities of GIS are numerous, and are based on the fact that a large amount of spatial data stored in computer memory is displayed in the visual, simple and user friendly form.

Emergency management actions are developed and implemented through the analysis of information. The majority of information is spatial and can be mapped. Once information is mapped and data is linked to the map, emergency management action planning can begin. Once life, property, and environmental values are combined with hazards and risks, emergency management personnel can formulate mitigation, preparedness, response, and recovery needs.

Public safety has, during last years, been raised to a new level of public awareness. More than 60% of emergency calls in the EU are from mobile devices, the smart-phone penetration rates easily exceeded 50% in the member states – and citizens take ambient location information e.g. for location based services in daily life for granted. The tools used for public safety applications are rapidly evolving. Highly accurate GIS is a powerful tool to be used for public safety applications that either require or can benefit from it (computer aided dispatch system, record management system, public notification systems, etc.). The document explores ways in which a GIS systems and data can be used as a tool for analysis and support for decision making of Public Safety Answering Points (PSAP) within their coverage area.

2 Introduction

“A picture is worth a thousand words” (attributed to editor Arthur Brisbane)

"One look is worth a thousand words" (car supply advertisement)

"The drawing shows me at one glance what might be spread over ten pages in a book."(from the novel of Turgenyev)

2.1 Definitions

GIS stands for ’Geographical Information System’. GIS application is used to deal with spatial information on a computer.GIS is an integrated mapping system that takes words, numbers and other data that can be correlated to geography (i.e., location) from a database and visualizes them on a map, making the information easier to understand, analyze and work with. Here are a few definitions from the different user perspectives :

- A powerful *set of tools* for collecting, storing, retrieving, transforming, and displaying spatial data from the real world. (Burroughs, 1986)
- A computerised *database management system* for the capture, storage, retrieval, analysis and display of spatial (locationally defined) data. (NCGIA, 1987)
- A *decision support system* involving the *integration* of spatially referenced data in a problem solving environment. (Cowen, 1988)

Most precisely it is spatial representation, capture, storage, retrieval, analysis, display of information(attribute data) that is positioned to correspond to the same X, Y (and Z, if needed) coordinates throughout the various map layers. Its main the goal is to support the user in taking the most appropriate decision.

GIS takes mapping far beyond simply showing specific locations, e.g. a street address or an intersection. GIS-enhanced mapping can be used to deliver a great deal of additional information concerning the relationships between people, places and things. The correlation of physical locations to reveal relevant proximities and relationships is a key function of GIS systems and tools. Mapping specific locations of primary schools, for

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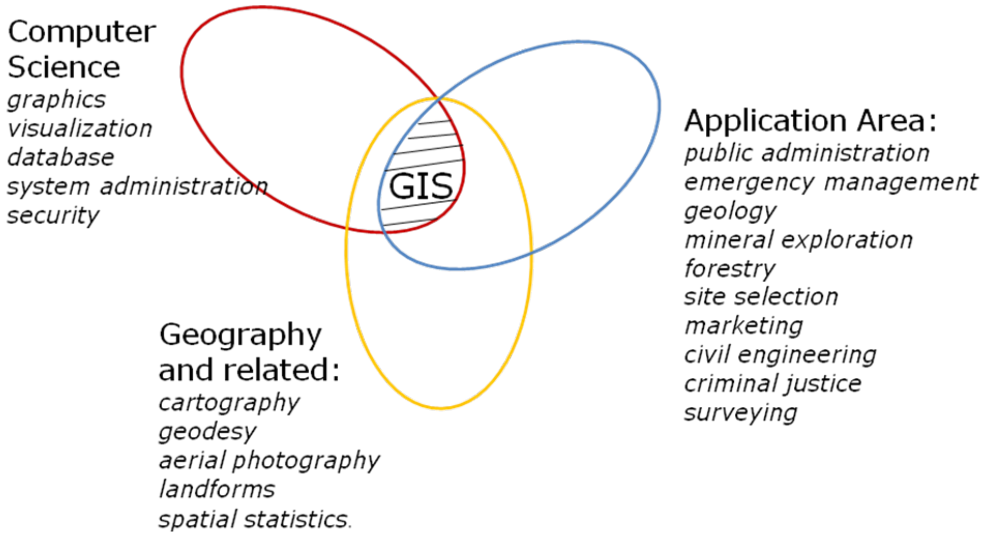
example, and correlating them with the locations of video surveillance cameras or fire and police stations reveals proximities and relationships between and among these key community structures, as well as with other locations in the community. Use of GIS can also help to map densities, such as which areas have the highest concentration of known gang members or the largest number of burglaries, helping to identify patterns and providing information to enhance community safety. GIS can even map change. It can reveal how areas and locations change over time, helping to gain insight on the short- and long-term impact of various events on a location, or to analyze change patterns to help anticipate future needs.

The geographical or spatial data represent real-world phenomena in terms of:

a) their position in relation to a known coordinate system;
b) their attributes which are not correlated with the position;
c) their spatial interrelationships that describe how they are connected.

GIS is defined as a database, but a significant difference compared to other databases consists of the fact that all information that GIS operates on are associated with their spatial references. Option that a large amount of spatial data, stored in computer memory, can be displayed in a visual, simple and user friendly way, is something that other technologies do not have.

SCIENTIFIC FIELDS AND APPLICATIONS



2.2 GIS Data Representation

The data used in GIS can be found in three main forms:

- Vector;
- Raster data
- Tables;

2.2.1 Vector data

Vector data are points, lines and polygons These data are the basis of every GIS. Points represent something that is defined by X and Y coordinates, i.e. position in space, for example, electricity consumers, places of arrest, site location of radar devices, individual cases of infection and so on. The lines represent everything that has a length: underground and overhead cables, communication systems, roads, rivers, etc. The shapes and polygons represent everything that fits within a limited area, either political, natural or administrative boundaries (state, municipalities, cities, parcels, etc.).

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2.2.2 Raster data

Raster data can be satellite images, aerial photo images (orthophoto) and the scanned data (analogue paper maps into digital format). Raster data offer the possibility of obtaining rapid spatial data for large areas, and is significantly less demanding regarding time and money than to vectorize map layers one by one. However, the picture is still one file, or one layer, from which it is not possible to take out a particular object and associate it with tabular data. Images can be displayed together with vector data, so-called hybrid graphics, which enables vectorization of only those objects that are essential in the work.

2.2.3 Tabular data

Tabular (attribute, descriptive) data is information that describes the objects on the map. It specifies characteristics at that location, natural or human-created. The spatial positional data in the tables enable GIS application to link a spread sheet with vector data.

GIS systems traditionally maintain spatial (denoting ***where***) and attribute data (***what, how much, when***) separately, then “join” them for display or analysis.

2.2.4 GIS file formats

GIS file formats are standards of encoding geographical information into a file. They are created mainly by government mapping agencies or by GIS software developers. There are numerous formats of files with spatial data in use both for raster and vector type. Most of them are proprietary, some of them related to the specific country (having in mind strategic importance for national defence and security) and some are related to the manufacturers who tried to establish de facto standards.
Some of the popular raster formats are:

- ADRG – National Geospatial-Intelligence Agency (NGA)'s ARC Digitized Raster Graphics – United States
- RPF – Raster Product Format, military file format specified in MIL-STD-2411
- Esri grid – proprietary binary and metadata less ASCII raster formats used by Esri
- GeoTIFF – TIFF variant enriched with GIS relevant metadata
- IMG – ERDAS IMAGINE image file format
- JPEG2000 – Open-source raster format. A compressed format, allows lossless compression.
- MrSID– Multi-Resolution Seamless Image Database (by Lizardtech)

Well known vector formats are:

- AutoCAD DXF – contour elevation plots in AutoCAD DXF format (by Autodesk)
- Digital Line Graph (DLG) – a USGS format for vector data
- Geography Markup Language (GML) – XML based open standard (by OpenGIS) for GIS data exchange
- GeoJSON – a lightweight format based on JSON, used by many open source GIS packages
- GeoMedia – Intergraph's Microsoft Access based format for spatial vector storage
- Shapefile – a popular vector data GIS format, developed by Esri
- Simple Features – Open Geospatial Consortium specification for vector data
- Spatial Data File – Autodesk's high-performance geodatabase format, native to MapGuide
- Well-known text (WKT) – A text markup language for representing feature geometry, developed by Open Geospatial Consortium.
- Well-known binary (WKB) – Binary version of Well-known text.
- Keyhole Markup Language (KML) – XML based open standard (by OpenGIS) for GIS data exchange

It is often necessary, in order to make file formats from one system readable by the other GIS system, to perform conversion between different formats.

2.2.5 GIS Standardisation process

As always, the understanding has come that the introduction of appropriate standards in collecting, preparing and maintenance of spatial information enables their use in various applications regardless of the source. International standards give organisations a way to abstract their business functionality in such a way that they will be able to swap in and out of vendors or use open source components. Geospatial standards are becoming increasingly important now, especially when international, regional, and national bodies are trying to build or/and harmonize their Spatial Data Infrastructures (SDI). Guided by this principle, during last years, most European countries, as well as a number of international organizations invested considerable effort and resources to the creation of standards of Spatial Data Infrastructure. Regional and national efforts led to a launching of initiatives to create and adopt of global standards in the scope of International Standardization Organization and regional within European Committee for Standardization (CEN),

International standardisation
ISO/TC 211[1] geographic information standards should specify methods, tools, and services for data management (including definition and description), acquiring, processing, analyzing, accessing, presenting, and transferring such data in digital/electronic format between different users, systems, and locations. The ISO TC211 family of standards defines rules and standardized schemata for the definition and description of geographic information and information management.

Regional standardisation
A pan-European body called the Comité Européen de Normalisation (CEN) is the main regional European standardization body and operates through the European Commission. CEN/TC (Technical Committee) 287 (Geographic Information) is responsible for development and publishing of geographic information standards. In the area of the Geographic Information, CEN works closely with the International Organization for Standardization (ISO). CEN standards are mandatory in Europe.

Industrial Consortia
One of most active industrial consortium involved in geo-spatial standard development and promotion is the Open Geospatial Consortium (**OGC**), formerly the Open GIS Consortium[2]. OGC has concentrated its efforts in the following areas:

- The encoding of information in software systems (data format standards and data transfer standards);
- The naming of features and feature relationships (data dictionaries);
- Schemas for descriptions of data sets (metadata).

The Open Geospatial Consortium (OGC) has worked closely with ISO/TC 211 since 1994. Many common work items now exist between the OpenGIS Consortium and ISO TC 211 that will result in OGC specifications being adopted as International Standards or Technical Specifications.
There are some differences between ISO and OGS procedures and products. ISO/TC 211 is the *de jure* formal standards technical committee. OGC is the *de facto* industry technical specification developer. ISO standards have a formal life cycle that includes official approval, publishing, and periodic revisiting once every few years. All international standards are reviewed at least once every three years (after publication) and every five years (after the first review) by all the ISO member bodies. OGC specifications can be used by users before formal approval and could be updated a few times in any given year.

The INSPIRE Directive
The INSPIRE directive came into force on 15 May 2007 and will be implemented in various stages, with full implementation required by 2019.
The INSPIRE directive aims to create a European Union (EU) spatial data infrastructure. This will enable the sharing of environmental spatial information among public sector organisations and better facilitate public access to spatial information across Europe.
A European Spatial Data Infrastructure will assist in policy-making across boundaries. Therefore the spatial information considered under the directive is extensive and includes a great variety of topical and technical themes.

INSPIRE is based on a number of common principles:

- Data should be collected only once and kept where it can be maintained most effectively.
- It should be possible to combine seamless spatial information from different sources across Europe and share it with many users and applications.

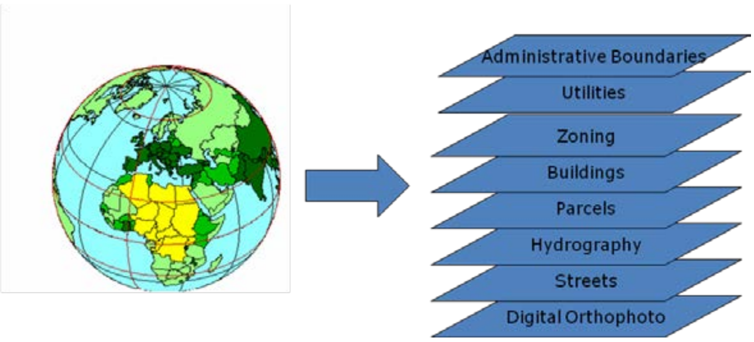
[1] http://www.isotc211.org/
[2] http://www.opengeospatial.org/standards

- It should be possible for information collected at one level/scale to be shared with all levels/scales; detailed for thorough investigations, general for strategic purposes.
- Geographic information needed for good governance at all levels should be readily and transparently available.
- Easy to find what geographic information is available, how it can be used to meet a particular need, and under which conditions it can be acquired and used.

INSPIRE uses CEN/TC 287, ISO/TC 211 and Open Geospatial Consortium standards and specifications.

2.3 Layers

GIS map projects are usually built by overlaying multiple datasets to provide more in-depth information on a specific location.



Data is organised by layers, with each layer representing a common feature.

Layers are integrated using explicit location on the earth's surface, thus geographic location is the organising principal.

Layers are comprised of **spatial** data which describes location (where) and **attribute** data specifying what, how much, when.

Layers may be represented in vector format as points and lines and in raster(or image) format as pixels. Raster layers can be combined with vector layers. The order in which layers are structured is very important in order to properly display the final result.

All geographic data has 4 properties: projection, scale, accuracy and resolution.

- **Projection:** the method by which the curved 3-D surface of the earth is represented by X,Y coordinates on a 2-D flat map/screen
  - distortion is inevitable
- **Scale:** the ratio of distance on a map to the equivalent distance on the ground
  - in theory GIS is scale independent but in practice there is an implicit range of scales for data output in any project
- **Accuracy:** how well does the database info match the real world
  - *Positional*: how close are features to their real world location?
  - *Consistency*: do feature characteristics in database match those in real world
  - *Completeness*: are all real world instances of features present in the database?.
- **Resolution:** the size of the smallest feature able to be recognized
  - for raster data, it is the *pixel* size

Generally, requirements for tighter specification lead to higher cost of the GIS system!

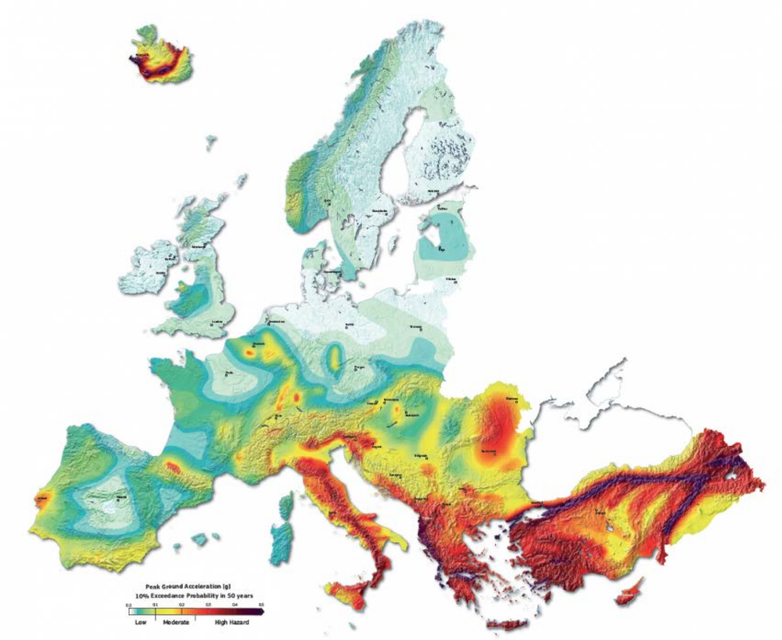
3 GIS for Improvement of Emergency Response

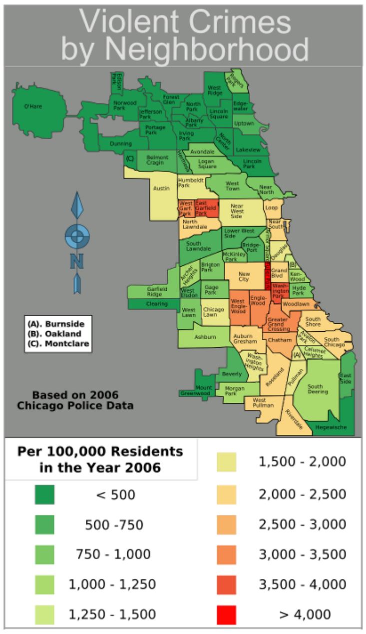
GIS uses geographic data and geospatial analysis to provide more accurate, more in-depth location information to dispatchers and first responders. GIS automates use of this information to improve response times and optimize situational awareness, leading to more effective incident resolution. It allows public safety agencies at local, regional and state-wide levels to view and work with the same consistent geographic data, helping to maximize inter- and intra-agency collaboration and coordination in the pursuit of safer communities.

3.1 Usage of GIS in Different Phases of Emergency Situations Management

It is generally agreed upon that there are four key stages to emergency management.

PLANNING & MITIGATION: Evaluating the potential types of disasters and developing plans for reducing their probability or their impact on life & resources.
Here the GIS can help in understanding the geography of vulnerability. It's hard to predict exactly what could happen in an emergency situation. However, even a rough estimate can be a huge help to emergency managers and decision makers who can use that information to develop plans for allocating resources and managing investigation or recovery operations. By collecting socio-economic and environmental data sources in a GIS, we can develop risk maps to highlight the potential impact of disasters on people and infrastructure but also to analyse the crime patterns and probability.





Examples show Europe earthquake frequency map and Chicago violent crime rate by neighbourhoods

In this phase we try to get answers on several major questions like:

- Who is at risk? How many people will be affected?
- What is the spatial and temporal extent of the vulnerability?
- What capacity does the population at risk have for coping with the disaster?
- What is the range of possible victim scenarios given different conditions?

PREPAREDNESS: Actions undertaken when mitigation efforts have not prevented or are unable to prevent a disaster from taking place.
GIS can support a key element of disaster preparation through computational simulation and modelling. A wide array of specialized modelling software extensions are available. This software enables users to tweak disaster parameters and simulate damage patterns due to storms, earthquakes, disease outbreaks, and fires. Different disasters present different types of opportunities for preparation - some, like terror attacks or earthquakes provide little or no warning time at all. Others, like hurricanes or other severe storms, may offer a window of opportunity where GIS can be used to coordinate evacuations and other types of preparation efforts (sandbagging levees, for example).
One way to prepare for disasters that offer little or no warning is to develop spatial computational models of disaster impacts and use a GIS to run simulations of hypothetical emergency situations.

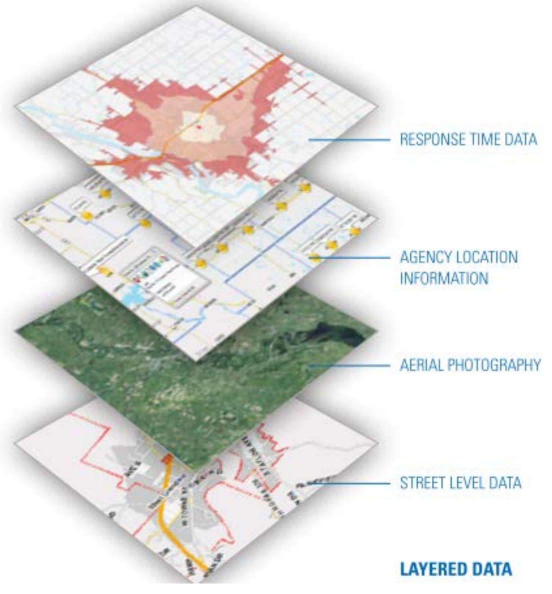
RESPONSE: Activities that occur in the wake of a disaster that are intended to identify and assist victims and stabilize the overall disaster situation.

Here comes the real time usage of GIS, one of the most important features of the system. More about this is discussed in the following chapters (Situational Analysis, Optimised Routing and Enhanced Analysis.

RECOVERY: Actions following a disaster that aim to restore human and environmental systems back to normal.
Recovery from a disaster can take a very long time and there are a wide range of roles that GIS can play in the recovery process. For example, GIS may be called upon to identify areas for redevelopment projects or to recalibrate vulnerability models to help predict future disaster impacts.

3.2 GIS And Situational Analysis

GIS maps deliver detailed situational awareness for dispatchers and first responders by geographically tying persons, processes and data together. Dispatchers, police officers, fire-fighters and EMTs can access a common view of GIS data such as street maps and agency boundaries projected on a map using longitude and latitude coordinates.



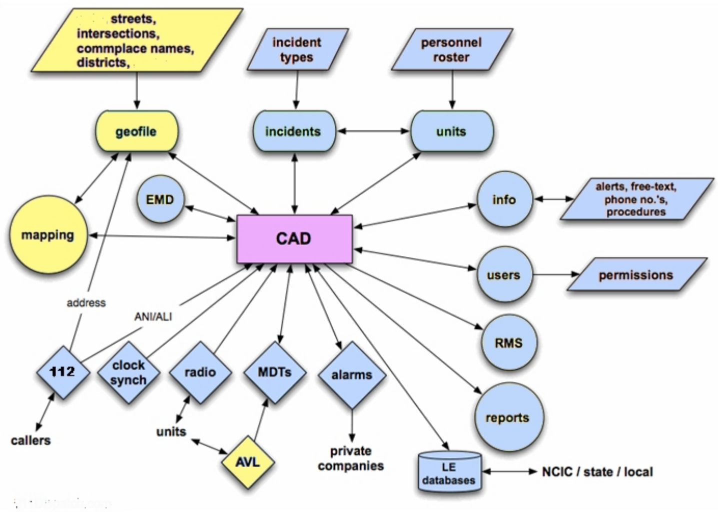
These maps help them assess the situation at a glance, and can be enhanced by overlaying other areas (or layers) of geographic importance like gang territories, location history or hydrant sites to present a complete picture of each incident and location. Other data — such as live video from street cameras or photos sent from mobile phones — can also be displayed to enhance awareness and safety. Because each responder is able to view exactly what others are seeing, it's also faster and easier to work together and coordinate with other jurisdictions and agencies. GIS-video integration enables point-and-click control of video cameras; security personnel can easily control camera movement such as pan, tilt, and zoom by pointing and clicking on a map. GIS-enabled video surveillance provides security for law enforcement personnel with live video as well as the spatial knowledge to best respond to any threat.

3.3 GIS-Optimized Call Routing

GIS systems help PSAPs solve many of today's call processing issues. In legacy systems, for example, GIS data is normally accessed *after* the call reaches the PSAP and is used to help dispatchers locate the caller. Efficient and effective response can be compromised due to missing or incomplete geographic data. This can lead to incorrect or imprecise routing and caller location determination, which can cause significant delays in response that may be life threatening for both citizens and responders. In NG112 systems, however, the comprehensive use of GIS datasets at all points along the emergency services networks helps eliminate the manual caller location lookup of today's traditional ALI systems. Instead, through the use of real-time caller location provided by the calling device itself and/or the mobile network operator, the call is automatically routed to the correct PSAP. Dispatch can therefore be faster and more accurate, dramatically improving outcomes.

3.4 GIS-Enhanced Analysis

By enabling the real-time mapping a variety of geospatial data, GIS shows at a glance a wealth of information that is tied to a location or area. By overlaying additional geospatial datasets, the system can reveal patterns in the data that might go unrecognized without this mapping functionality. This can help agencies to analyze data such as traffic accident and crime rate information to better view, investigate and understand geographic patterns to help remedy and resolve recurring problems in locations such as intersections and neighbourhoods.



3.5 CAD and GIS

Typical, traditional CAD schematics is shown in the picture. Parts that belong to GIS system are shown in yellow. GIS integration with dispatch applications has in most of the cases been limited to address verification and incident plotting on a map. However, today, GIS integration can create additional value in providing both the dispatchers and field personnel with situational awareness.

Most of nowadays CADs (used for call taking and dispatching) have integrated caller location identification, mapping of resources, mapping of streets and important objects, have the capability of best route calculation for the first responders, maintain the attribute files of addresses, possibility of calling the vehicles via radio by a click on the map etc.
Furthermore, CAD systems can integrate with a mobile data client (MDC). The MDC is merely an extension of CAD services on a portable laptop for in-vehicle use or on a handheld mobile data terminal. The MDC provides the mobile user with the capability of receiving incident data (caller name, address, incident type, etc.), sending messages to other mobile users and dispatchers, requesting and querying external databases, having information about environmental facts, proximity of objects etc. and it usually includes some type of mapping application.

GIS in the mobile environment provides field personnel with the ability to capture new information, geocode it, and send it back so that incident command can visualize incident progress. As such, it is strategically important that GIS become an integral part of any common operating picture IT infrastructure.

GIS functionality in Emergency Operations Centres enables distant agencies, unfamiliar with an area, to have the same knowledge as if they were locals. The ability to visualize information in the context of a map, such as premise history, stored preplans, and known risks and hazards, ensures any agency can function effectively and safely.

3.6 Public Safety GIS Uncertainties and Challenges

Fundamentally, a GIS system is only as good as its data, and data accuracy is essential for next generation call systems to deliver their substantial benefits. The reality is, when there are delays in emergency call response today, they are primarily due to data inaccuracy or missing and incomplete data. This is a major concern of today's public safety professionals wherever in the world they are located. The truth is, accuracy issues and update cycles with GIS, ALI and address data are to some degree a problem with virtually every PSAP in every city, region, state, province or country. Furthermore it is important to highlight the risk of over information of decision makers as the data that can be shared are enormous.

To meet the enhanced accuracy standards needed for NG112, a number of criteria must be met. The fundamentals of GIS — road centrelines, address locations and jurisdictional boundaries — must be both accurate and complete. Existing address and ALI databases must be synchronized with GIS data. It must be assured that boundaries in current GIS maps are accurate and that there are no gaps in emergency services zone coverage.

Furthermore, geographic data is not static; it's evolving and changing constantly. New roads, new buildings and new addresses, objects, infrastructure, are constantly being added in the service zones. The GIS database must be maintained so changes are regularly added and addresses are regularly updated; road names and addresses must also be standardized and consistent across all datasets. These records must be consolidated in a GIS repository that will provide more accurate data to the Emergency Call Handling and units dispatching. If the data isn't current, complete and accurate, safety can be compromised.

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4 GIS in the Cloud

4.1 Sharing GIS Resources

In today's 112 environment, PSAPs generally build their own GIS datasets. Each PSAP is an island of local information, with little or no uniformity between systems. That's about to change. Next generation emergency call systems are going to take a more regionalized approach as new features are developed for use by multiple PSAP partners at regional or state levels. That means there must be a more regionalized picture of GIS data. That also means that GIS mapping technology will become faster and more efficient providing access anywhere, anytime on any device.

Everything these days seems to be heading to the cloud. It is possible to store documents, images, contacts, calendars, presentations, articles, accounts, everything in the cloud. So it just seems logical that GIS is also heading that way. Most of the leading GIS vendors have developed Cloud GIS solutions or certainly thinking about it and a growing number of private companies are also moving in that direction. However, is "cloud GIS" also suitable solution for public safety and emergency response agencies? Here are some pros and cons:

4.2 Advantages of Cloud GIS

- **Data Access**
  - Access can be via any internet connection, anytime, anywhere. From fixed or mobile devices. Good Internet connection is mandatory. It can be released to its full power if broadband wireless data network is available.
- **Distribution of data**
  - The major advantage of the cloud GIS is that it makes the distribution of data, analysis and systems very simple. All users are guaranteed to have the same picture. Also updates of spatial and non spatial data are much easier to perform – only on the servers. No need to send data using DVD or downloading large datasets to update a local server.
- **Data Capture**
  - Having a cloud GIS allows data capture in real or near real time to be displayed directly onto desired system. There are also many successful applications of where data has been captured by the general public and verified and used by call takers / first responders.
- **Inter-agency cooperation**
  - Data exchange between different emergency agencies, as well as with other public safety stakeholders (municipalities, local governments, traffic authorities, military) is facilitated.
- **IT Management**
  - The need to have dedicated GIS Administrators will be reduced, it can be centralised.

4.3 Disadvantages of Cloud GIS

- **Data Access**
  - The way data is accessed can be seen as well as a disadvantage. Slow and interrupted Internet connection, lack of broadband coverage can jeopardize efficiency of GIS usage. Mission critical data must be available everywhere at any momentwith an optimal response time. This is why private communication networks have great advantage comparing to networks of public operators – their coverage, prioritisation algorithms, resilience, security features are built in a way to provide maximum effectiveness to public safety users.
- **Security**
  - Security is an important aspect of any system and it is important to make sure that the cloud GIS hosts have good security in place, and that sufficient security is applied on the telecommunication paths so that data is not accessed by users who should not be accessing it.

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- **Data Volume**
  - GIS data has always been big, taking up gigabytes on the server. In a cloud GIS solution there is both the time to migrate the data to the host server and also for end users to access and download. There are sampling softwares for web-based GIS so the end user may not notice issues if just viewing but downloads maybe a different issue.
- **External Hosting**
  - This can be a major concern as the cloud GIS hosting organisation may not have the same interests at heart as the user. It depends on a business model but PSAPs and emergency agencies, being non-profit organisations of special importance for the society should be treated in a special way. The important questions here are also redundancy servers, data backup, the server load calculation (other users on the server) etc.
- **Data Format**
  - What formats is the cloud GIS application serving the data out in. Do all organisations involved use the same data formats?

- **Customisation:**
  - It is not always possible to customise data that delivered by a web service.
- **Licensing:**
  - Some data/map services have a complicated license policy. For instance, sometimes, it is asked to calculate the number of request per day or per month. This is difficult to evaluate in case of emergencies.

4.4 Conclusions

GIS systems for emergency response represent a significant investment and an option to use cloud solutions will become more likely and more popular. An operator of e.g. commercial Location Based Services (information service that use location data to control features) can, in exchange for the licence, offer to government to provide GIS services, for emergency response agencies free of charge. However, these services can be trusted to commercial operator by having in mind all that was mentioned regarding security, resilience, reliability and redundancy.

Favourable solution could be the shared approach on the governmental level, a “controlled cloud” which should include, besides PSAPs and emergency agencies, also other services vital for functioning of the society like: environmental, energy, telecommunications, agriculture, administrative, statistical and others. In this case some parts of the GIS system should belong to the particular agencies and some will be common. Very important issue here is the ownership of data including capturing, storing, updating and using them.

GIS as a Service (GaaS). Geographical information systems more and more are being deployed as services. These services act as a unit of abstraction for providing, changing and viewing GIS information. Industry standards, mentioned earlier and their adaptation through INSPIRE, are the pivots for providing interaction between services on a Geo Application level.
Can be used as a Software-as-a-Service (SaaS)

- Centrally hosted
- Used on demand
- Subscription based licensing
- Reduce IT support costs

Can provide Geospatial Data-as-a-Service (DaaS)

- Irrelevant where the data resides
- Available everywhere
- Accessed on demand
- Centralized updating, enrichment and quality control of data

Can give access to Analysis-as-a-Service (AaaS)

- Accessed on demand
- Reduced need for own experts

5 A (Near) Futuristic Case Study

A FEW YEARS FROM NOW.

A little before noon, an 112 centre begins receiving reports of a growing mob action in the suburb. The cause is unknown, but the calls describe a dangerous scene. A group of people is rampaging through a small shopping-mall, threatening citizens and causing serious damage. Using caller location data provided by the mobile phones and/or the mobile network operator of persons reporting the incident, the 112 system automatically routes the calls and text messages to the PSAP best able to respond to the emergency. One caller sends video of a group of stores on fire, including a dry cleaning establishment housing dangerous chemicals.

As the calls come in, the system automatically displays caller location on a map of the vicinity, and dispatchers using the same map are able to see which police units are in the best position to respond. The video received from the caller is being sent to the first responders. They watch the video through special glasses and they can see the area map on MDT. The map also displays gang affiliations in the area, alerting first responders to which gangs are likely to be involved. Dispatchers can also see which fire stations are nearby, enabling them to send units equipped to deal with hazmat situations. They also can see that two primary schools are in the area, and should be placed on lockdown status with strong police presence. The maps, enriched with several layers of GIS data, also show the nearest hospitals from which to dispatch EMT units. Response is immediate, and the situation is resolved in short order, with fire and hazmat damage minimized, arrests made quickly and major injuries avoided.

6 EENA recommendations

Stakeholders	Actions
European Authorities	Continuous support of the standardisation process within ISO TC211 and CEN TC287
National Government	Continuous support of the standardisation process within ISO TC211 and CEN TC287 Formulation of national geo-information policy. Building and maintenance of fundamental national geospatial data sets. Implementation of national standards through profiles compatible with international and regional standards. Active participation in INSPIRE directive
National / Regional Authorities	Complete assessment of current mapping capabilities, including datasets, maintenance processes, standards and workflow policies. Defining the cooperation policies between different institutions / GIS users; data access principles; conversion rules. Building the relevant databases themselves and take the required actions to ensure that accurate, well-maintained GIS datasets are available when they're needed.
Emergency services	Undertake a thorough assessment of current GIS information, verifying accuracy and identifying and resolving gaps and inefficiencies in the agency's multiple datasets. Define cooperation needs with other agencies.
National telecommunication regulator Network operators	To provide legal and technical framework for call routing and PSAP selection based on GIS resource inventory. To complete and maintain GIS database of their resources (transmition networks, cellular networks, fixed telecommunication network)
Industry	Maintain cooperation and support interoperability through Open Geospatial Consortium

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