Making Data and Mapping Platforms More Relevant and Useful During Decision Support

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Abstract

Geographic Information Systems (GIS) and mapping platforms are used by stakeholders to provide a single identical display of relevant operational information in real time (i.e., critical infrastructure, hazards, deployed personnel, population stats, evacuation routes, etc.). When using GIS or geospatial mapping tools, intelligent decision making and the development of effective and valuable decision support services require collaboration between those who interpret the data (authors, analysts, and subject matter experts) and those who make decisions based on that data (managers and team leaders).

Achieving a “common picture” among multiple users in real time using mappable data and current technologies was limited to an individual's discovery and display of geospatial intelligence products on their interactive maps and the transmission to others of their desktop view using screen-sharing technologies such as WebEx or GoToMeeting. Remote participants saw only a broadcast image of the presenter's desktop while their own local map displays remained static, non-collaborative, and unable to incorporate the information shown in the presenter's desktop video stream. Furthermore, when the screen-sharing session was over, all remote users ceased to see the map with relevant information displayed.

GeoCollaborate™, a patent-allowed collaborative software, achieves total and true commonality and permits collaboration across all stakeholders accessing data using interactive web maps, GIS platforms, or Common Operating Pictures (COPs). In the same way that map services bring real-time map information to maps, GeoCollaborate™ is a network service that permits real-time data sharing and collaboration across an unlimited number of disparate web maps. The concept behind GeoCollaborate™ is simple: it lets anyone securely author the content of a lead web map, share content, and collaborate in real time or offline with other follower web maps with nothing more than a browser and a network connection.

Introduction

A web map (a COP or Common Operating Picture) is defined as an online platform shared by multiple stakeholders to provide a single, identical display of relevant operational information on a map (i.e., asset locations, deployed forces, sensors, critical infrastructure, severe weather conditions, etc.) and tools to mark and manipulate the data shared.

Collaboration while using a map is necessary for the presentation of geospatial information to multiple users, as well as the integration of multiple perspectives for shared understanding, information interpretation, and value-added analysis. In the era of big data and the growing need for improved decision making, collaboration is critical in bringing multiple stakeholders across multiple disciplines together and is essential to success.

The Problem

1. There is no true commonality in a Common Operating Picture (COP) map and much less true collaboration.

   Achieving a common picture in real time among multiple users has been limited to individual users manipulating an interactive map, displaying relevant data and information on it, and transmitting a view of their desktop using screen-sharing technologies to the other members of the collaborating group. At the end of the screen-sharing session, participants cease to see the presenter’s web map with the relevant information displayed.

2. Screen-sharing is adequate for presentations and webinars, but not for true collaboration.

   Screen-sharing participants are limited to a television-type viewing experience. They view but never actually receive maps or data. They have no access to the tools and functions displayed on a web map by the presenter during or after the screen-sharing session. When the role of presenter is passed to another participant of the screen-sharing session, all data that was displayed previously vanishes, making it impossible for new presenters to collaborate upon the previously displayed maps and data.

3. Screen-sharing typically requires third-party software installations and updates on the devices of all session presenters and participants.

   This is not always possible: Agencies and organizations usually prevent software upgrades or installations by other than authorized members of their IT departments who have administrative privileges to perform installations and upgrades.

4. Network disruptions or slow network connections make continuous streaming impossible and disrupt presentations.

   Screen-sharing services depend on third party streaming servers that may not meet government IT security standards and provide no guarantee of continuity during an emergency situation. Additionally, firewalls may block the transmission of data streams from screen-sharing sessions.

5. Private and/or sensitive data displayed on the presenter's screen is not blocked during a screen-sharing session.

   Participants of a screen-sharing session may be viewing data on the presenter's map that only the presenting user may be authorized to view. During screen-sharing the security credentialing that data originates with is unintentionally stripped off. Participants can take screenshots or pictures of data that they were never meant to see. Additionally, information in pop-ups or from other applications may be unintentionally shared with participants of the screen-sharing session.

6. Data vanishes when screen-sharing sessions end.

   Session participants are told that "Your screen-sharing session has ended." The displayed web map ceases to exist on their desktops leaving them with no visualizations or data for further analysis. Even if a video recording was made of the presentation, when viewed at a future time the data displayed cannot be manipulated or interacted with and quickly becomes outdated and no longer actionable.

The Solution

True collaboration occurs only when all participants receive, share, and collaborate with the same geospatial datasets and annotations, and have access to all the tools, functions, and data offered in the web map. At the end of each collaboration session, the full set of original datasets visualized and annotations created during the collaboration session must remain active on each collaborator's device, allowing stakeholders to perform further analysis and give other presentations.

Innovative Geospatial Collaboration Features

GeoCollaborate™ allows total and true commonality and collaboration across all stakeholders accessing data using web maps or COPs. All participants receive, share, and collaborate with the data and annotations and have access to all the tools, functions and data offered in the web map, or COP, before, during and after the real-time collaboration.

Using GeoCollaborate™, session participants connect to a session from their own web maps and automatically follow all the functions performed on the presenter's web map. Functions like dataset loading, layer stacking, map extent or Point of View (POV) changes, animation settings, drawings, and

annotations are replicated across all connected web maps, effectively creating a true geospatial Collaborative Common Operating Picture (C-COP). At the end of the session, or at any time during the session, any participant can disengage from the session to regain full control over their web map, which retains all the datasets and annotations visualized so far. Participants can then re-engage at any time if needed.

Lead presenter functions may be assigned through a username / password credentialing system, and may be passed to any of the collaboration participants with authorization at any time, allowing them to build upon the collaborative map already on their desktops. Username / password credentials can be added to all participants, if desired. As presenters relinquish lead functions, participants who become new presenters can add and, therefore, fuse their own geospatial datasets without losing the datasets and annotations that have been shared so far during the collaboration by other participants. At the end of each collaboration session, all participants have the full set of datasets shared and annotations created by all presenters during the collaboration on their personal web maps, which are still active on their individual computers.

GeoCollaborate™ enables the integration of external geospatial data into web maps in real time, even if they are not "built-in" the web map. Any lead presenter may add new geospatial data layers into the web maps from existing private or public geospatial data servers, or directly from the desktops of GIS analysts and stakeholders. All session participants will receive and visualize the new data layers added during collaboration on their own web maps.

GeoCollaborate™ is adaptive to different types of collaborative workflows: some require only one user to present to many attendees, as in the case of a subject matter expert briefing stakeholders and explaining the meaning of the data layers presented on the stakeholder's COP; other workflows require the passing of the presentation abilities to other participants, allowing any authorized session participant to take the lead without losing the map layers and annotations shared so far, and build upon previous leader presentations.

Additionally, GeoCollaborate™ allows for cross-geospatial web map collaboration, whether users connect from the same or different web maps. This is especially valuable when dealing with the increased complexity of intra- or inter-organization decision making and the presence of multiple stakeholders with multiple disparate web maps.

Benefits

GeoCollaborate™ solves the growing need for real-time collaboration without giving up vital tools and display functionality when accessing a web map from any device. It is performed without disrupting current workflows, regardless of the level of expertise of session participants.

GeoCollaborate™ is especially valuable when dealing with collaborators with little or no geospatial or mapping expertise; some stakeholders may go weeks or even months before they are able to put all their skills to use when using a web map. This downtime between incidents may cause stakeholders' skills to become stale. GeoCollaborate™ allows for hand-holding when accessing data-intense web maps. Subject matter experts and analysts can quickly and efficiently focus on geographic areas and turn on all relevant geospatial layers that busy stakeholders should be visualizing in real time. This includes data layers that can assist with decision making, but decision makers might not even know exist. Because the software is integrated with the mapping tools that are used operationally, the solutions also assist in reducing training time, while increasing training quality when using a web map.

Without relying on external services such as screen-sharing, GeoCollaborate™ allows all stakeholders to collaborate on a single, identical geospatial display of operational information. Session participants never lose their situational awareness since the collaboration is built upon the web map on each user's device. There are no screen switches or changes to the base map as new datasets or annotations are added by new lead presenters. All users receive, share and collaborate with the data and annotations and have

access to all the tools and functions offered in the web map before, during, and after the real-time collaboration. When a collaboration session is over, all participants have all the data to continue their own analysis or give presentations to others.

In order to provide a "trusted and secure information environment" that allows for the making of rapid but sound decisions even during urgent situations, GeoCollaborate™ does not interfere with, alter, or re-serve the geospatial data layers shared and currently available from the established authoritative data sources that publish and update accurate and reliable data on trusted servers. All participants receive the same relevant geospatial data directly from the established authoritative data sources, which will update in accordance with the data source settings regardless of the collaboration activity. If accessing the data requires authentication, GeoCollaborate™ will not interfere with or change those permissions, so lead presenters can collaborate at ease knowing that individual participants will not receive data they are not authorized to view.

Accessing geospatial data on mobile devices – both smartphones and tablets – requires the ability to decipher the amount of information that can be accessed properly and interacted with depending on the size of the screen. Many on-line web maps have multiple tabs and extensive menus to identify different types of information, whereas mobile devices will have a single chart or summary details to get a glimpse at what is occurring in a limited amount of space. GeoCollaborate™ empowers mobile users by collaborating with them and visualizing and annotating the operational data they need at the moment on their mobile device web map, without removing any web map functions they might need (annotations, zoom, pan, etc.).

GeoCollaborate™ is based on a client / server approach, which is designed to be cross platform and scalable, and can operate on any public or private server solution. The solution is designed to scale and take full advantage of modern cloud computing solutions and elastic clouds, which expand the bandwidth necessary on demand, based on user requirements, with no human intervention.

GeoCollaborate™ software and communication protocols are router and firewall safe, never using peer-to-peer communications (typically blocked by agency firewalls) or streaming servers. HTTPS / SSL (Secure Sockets Layer), the standard security technology for establishing an encrypted link between a web server and a browser, is used to ensure that all data passed between the web server and browsers remains private and integral. Additionally, GeoCollaborate™ is designed to survive slow, spotty, or intermittent network connections, which are typical during emergency situations; when network connectivity is regained, all datasets and annotations collaborated with will be received by the end-users.

Lead presenters no longer need to rely on the IT department or developers to change the contents of a web map or integrate new data layers into their web map. The GeoCollaborate™ user interface enables any user, regardless of their level of GIS expertise, to add information to the map. New data layers can come from existing private or public geospatial data servers or directly from the desktops of GIS analysts and stakeholders. They can be added by any presenter in a collaboration session.

GeoCollaborate™ recognizes the value of special mapping functions or unique geospatial capabilities that may already exist. Our unique software solutions allow for cross-web map and cross-platform (cross-COP) collaboration, which is important when organizations wish to keep current mapping capabilities (agency's current web maps, for example) and leverage past investments in GIS technology development, while infusing external data and expertise. Additionally, the collaborative capabilities are compatible and work with established workflows that use screen-sharing technologies that may currently be in use.

GeoCollaborate™ has already been used on multiple Commercial Off-The-Shelf (COTS) GIS platforms and web maps: ESRI ArcGIS (Online JavaScript and Flex viewers), Cesium, Google Earth & Google Maps (Desktop, Online JavaScript and Flex viewers), as well as free and open source and custom-made web maps (Java, JavaScript, ActionScript Flash, C#, etc.). It is fully compatible with OGC standard data services, such as WMS, JSON, Dynamic, Features, GeoRSS, CSV, KML / KMZ files, as well as all geospatial services and files compatible with the web maps used.

Proof-of-Concept Developed Through NOAA IDIQ Contract Task Order 1

In 2013, NOAA's National Weather Service (NWS) issued contract number DG133W-13-CQ-0041 to StormCenter as an SBIR Phase III contract in recognition of Mr. de Ameller's successful completion of NASA SBIR Phase I, Phase II, and Phase II-e(nhanced) contracts (NNX11CH53P and NNX12CA85C). The NWS wishes to integrate its weather products into state and local Emergency Operations Centers (EOCs). The NWS tasked the GeoCollaborate team with working with the Baltimore/Washington NWS Weather Forecast Office (WFO) in Sterling, VA and the Maryland Emergency Management Agency (MEMA) to develop a proof-of-concept collaboration capability that would allow NWS forecasters to improve the way in which they were providing Impact-based Decision Support Service (IDSS) to emergency managers. NWS project personnel were enthusiastic about the result, which is illustrated below by screen shots from NWS and MEMA devices.

National Weather Service (NWS) Maryland Emergency Management Agency (MEMA)

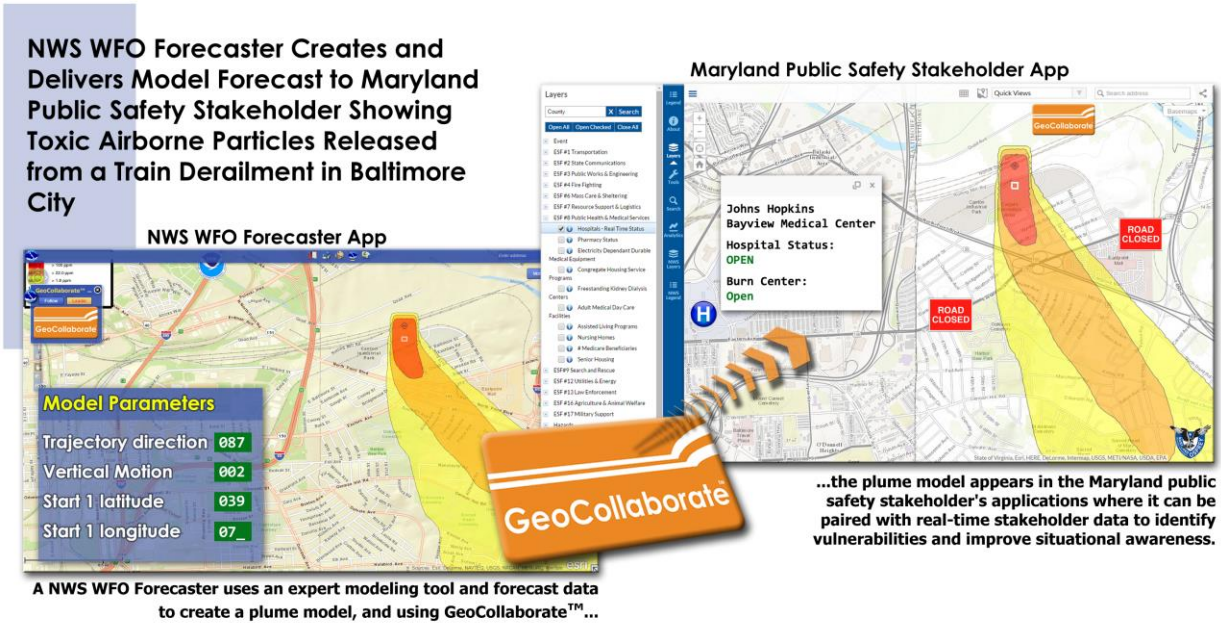

Fig 1- A HYSPLIT model run on an NWS office desktop PC showing airborne toxic materials from a train derailment shared within seconds with emergency managers on their web map applications using GeoCollaborate.

The team has provided NWS with a Collaborative Common Operating Picture (C-COP) in the form of an ESRI ArcGIS web map equipped with GeoCollaborate™ technology. Forecasters now have the ability to incorporate on-line and locally saved geospatial datasets as required, on demand, to collaborate with them. Additionally, this NWS C-COP enables real-time collaboration to occur with other COPs; NWS forecasters can now deliver weather and hazard information directly into the tools currently used by NWS partners, including public safety stakeholders.	OSPREY provides operational data and situational awareness to MEMA staff, government officials and other local, state and federal agency partners. The OSPREY system compiles data from various sources and returns a composite picture of Maryland. Information such as power outages, traffic flow, assets and vulnerabilities is shared and visualized. The team has provided MEMA with GeoCollaborate™ Participant Collaborative JavaScript code to run on the pre-existing OSPREY web map. Maryland Public Safety stakeholders can now collaborate with and receive weather and hazard information provided by NWS fused together with their operational data, greatly improving situational awareness and decision making.