

Interim Report (Draft)

2007 NSDI Cooperative Agreement Program

Category 2: Framework Client Development

Framework NSDI and Beyond:

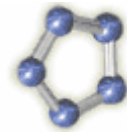
**Enhancing the Incident Response Community's
Strategic Advantage with Client Tools for Multimodal
Spatial Data Access**

The Carbon Project, a member of the geoLeaders Network

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Interim Report

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Report Type: Interim report

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Geographic Extent Served by Project: State of North Carolina, the United States and International areas

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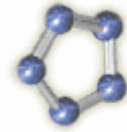
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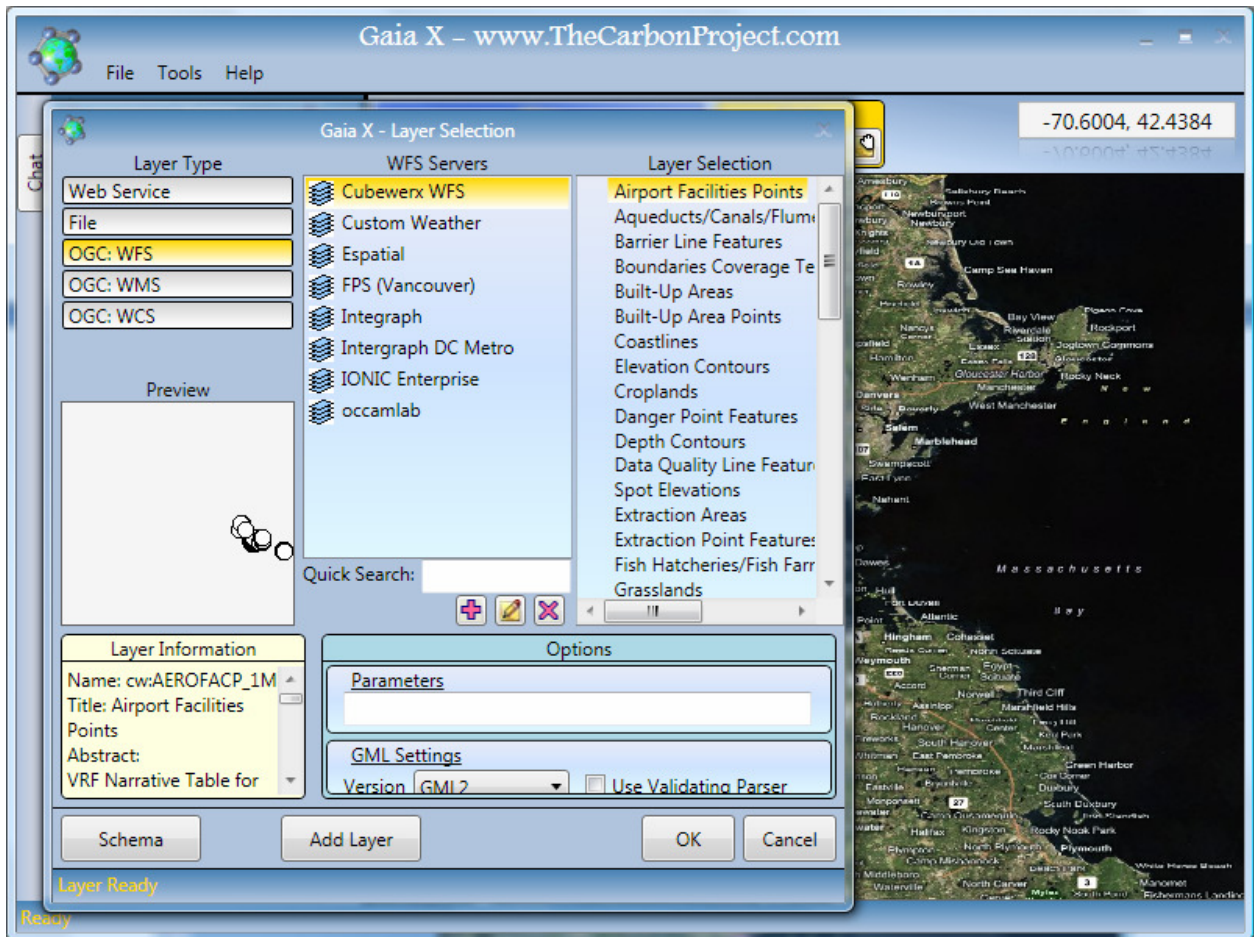
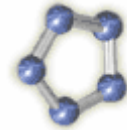


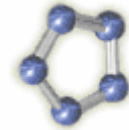
Figure 1 – Gaia X has a new look that provides a more exciting and engaging user experience – which makes using NSDI Framework WMS and WFS layers more attractive and engaging than some commercial map services, and definitely more flexible.

Project Narrative

In this project we implemented lessons learned from the previous versions of Gaia 3/IR developed as part of CAP 2006. This includes a complete update to the entire Gaia user experience and a redesign for the application using the latest Microsoft technologies, including .NET 3.x and Windows Presentation Foundation (WPF). *This redesign provides a far more exciting and engaging user experience – which we believe makes using NSDI Framework WMS and WFS layers more attractive and engaging than some commercial map services, and definitely more flexible.* In the project we also implemented many lessons learned from the previous versions of Gaia IR. This effort

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involved a full redesign of the peer-to-peer (p2p) community platform (CarbonCloud) to address previous challenges and provide an easy-to-use community tool for incident response and beyond.

We believe the NSDI community will benefit greatly from the new version of Gaia, which we call “Gaia X” – and this is a bold statement since community feedback indicates that the current version developed during the 2006 CAP project (available at <http://www.thecarbonproject.com/gaia.php>) is now the world’s most popular SDI viewer.

Samples of Gaia 3 in action with the NSDI are visible online at <http://carboncloud.blogspot.com/2008/01/spatial-and-situational-awareness.html>.

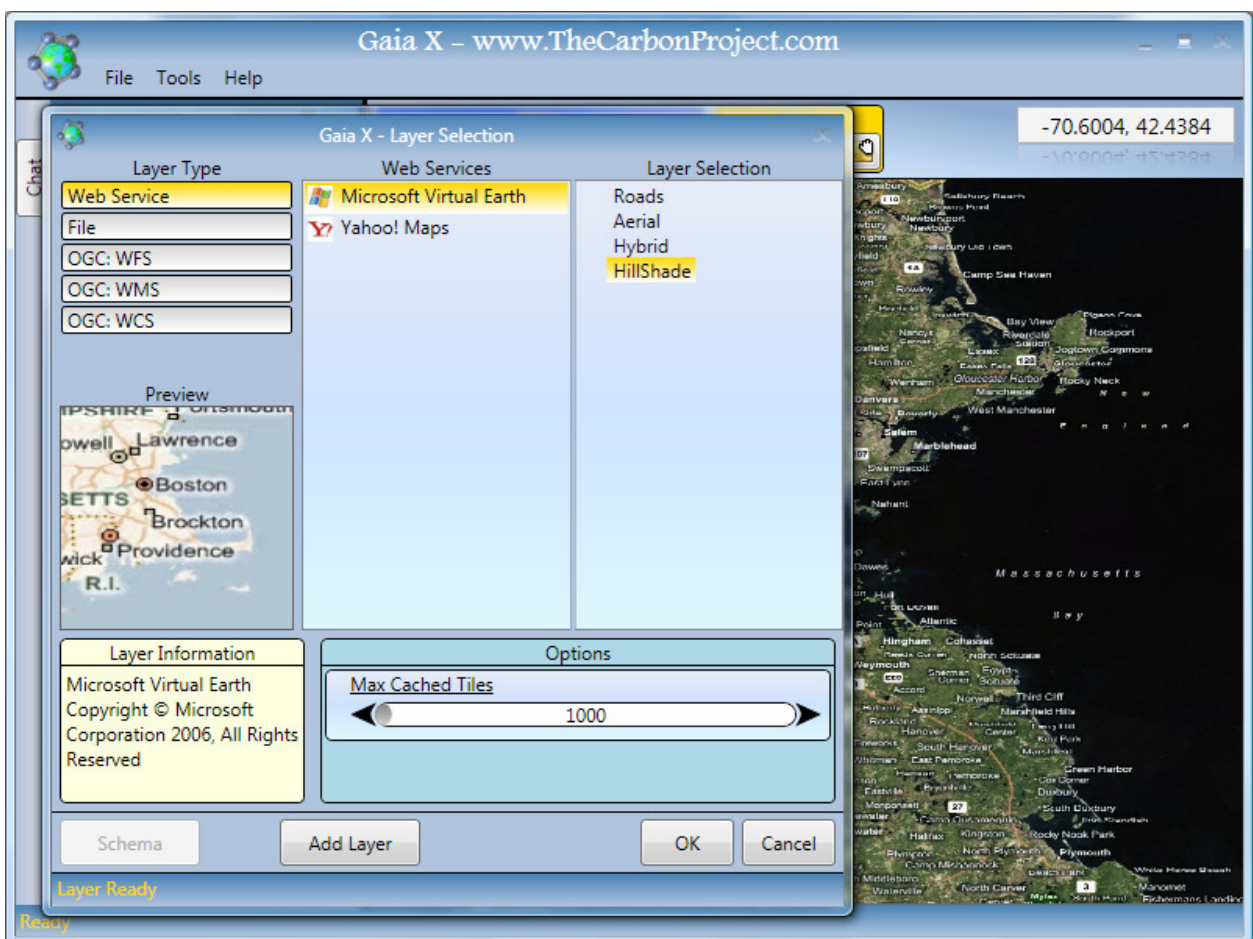
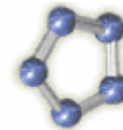


Figure 2 - Gaia X accesses and combine many different data sources, including framework vector data, tile-based mapping services like Microsoft Virtual Earth and emerging framework data sources like Google Earth KML



Our overall focus during this effort is to enhance the Incident Response community's operational advantage and develop a client tool that will provide peer to peer data sharing, universal access to online Framework vector data through WFS, and access to local government and user-generated geospatial content. The target user communities for this enhanced application are public sector organizations across the nation that conduct incident response activities of many differing levels of intensity on a daily basis.

While most if these users do not qualify as high-profile emergency events, State and Local Government Emergency Managers, Municipal First Responders, and the regulatory agencies still need to access a common operational view of incident information, framework data and information on toxic and hazardous chemicals. They also must be able to combine Framework data with other information, and to share this information seamlessly within their organization and with other support organizations using the CarbonCloud peer-to-peer network. The ability to combine Framework vector data with mapping services implemented by local governments and popular sources like Microsoft Virtual Earth and Google Earth is also vital to situational awareness. Many potential users of Gaia 3/IR also need the ability to share incident information over secure public safety mobile data networks as well. These networks provide a solution for voice and data transmission for emergency response purposes when other networks may be severed.

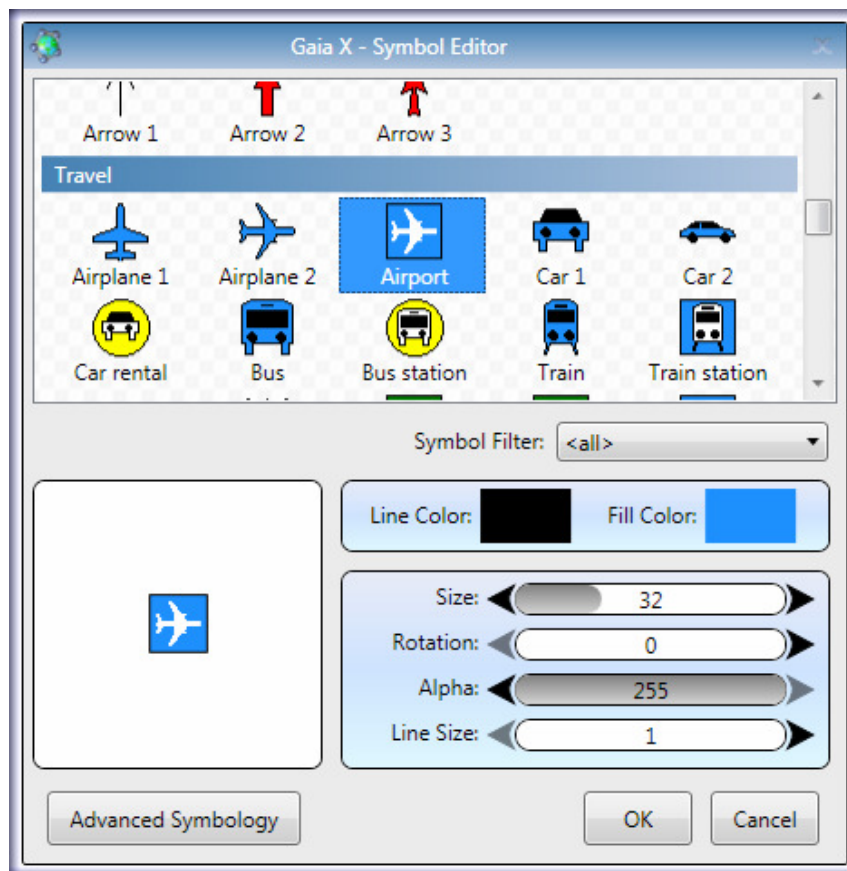
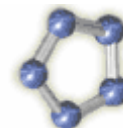


Figure 3 – Gaia X provides exciting and engaging Symbology Tools for Framework Data

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Gaia X is being developed to access and combine many different data sources, including a variety of framework vector data, tile-based mapping services and emerging framework data sources such as Google Earth KML. During this effort, The Carbon Project is developing Gaia X to provide the capability to access to online Framework vector data from OGC Web Feature Service (WFS) sources with advanced spatial and comparison operator - making online Framework vector data usable on a daily basis. We will also provide the ability to save Geospatial Notes from the CarbonCloud P2P network to persistent data stores, creating ability gather Notes for pertinent Groups, and to save these so they can be used in other business applications within agencies.

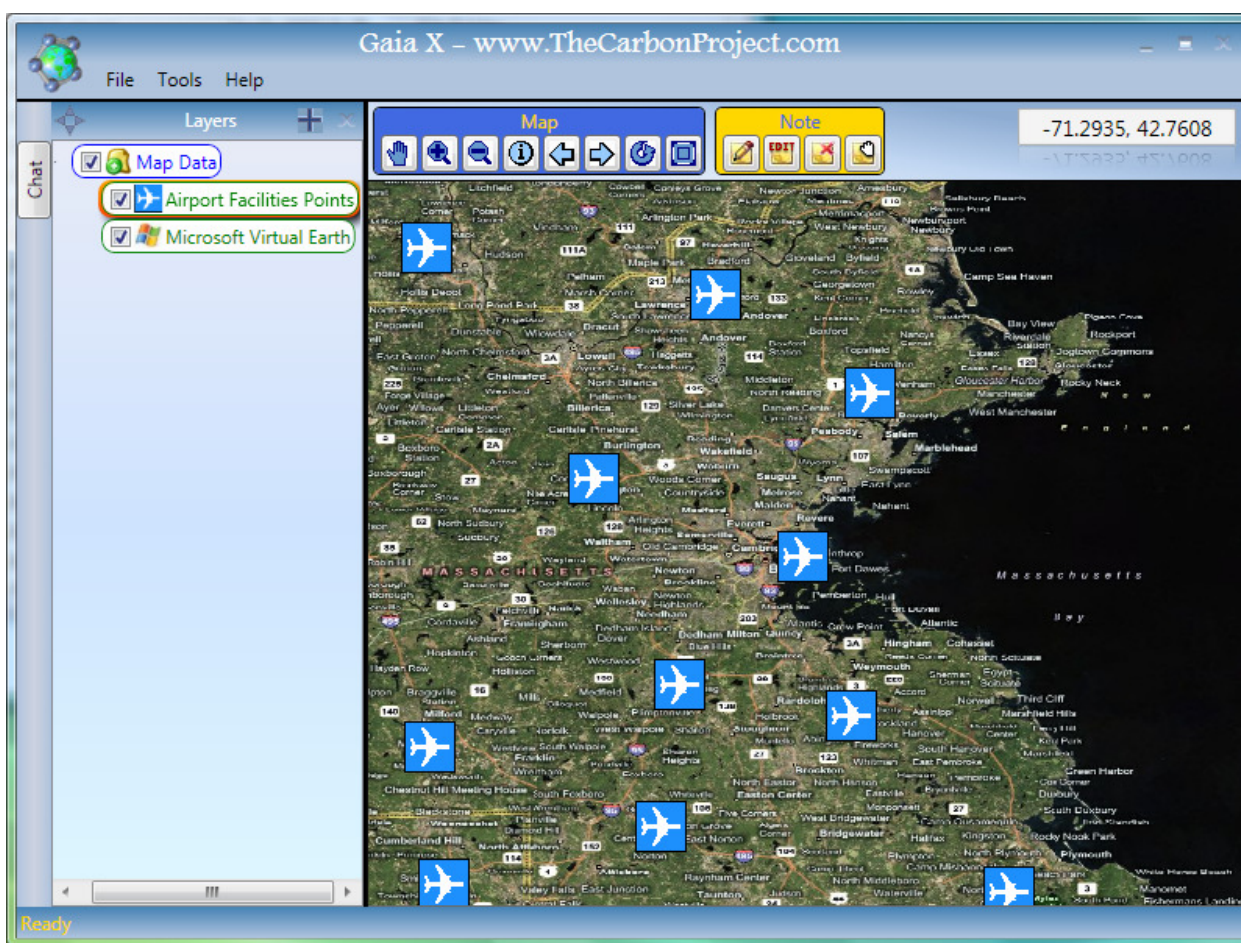
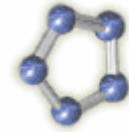


Figure 4 - Gaia X provides an attractive, exciting and engaging user experience for NSDI Framework Data Services



Challenges in the 2006 Gaia 3/IR version

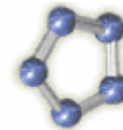
While the 2006 CAP project yielded the world's most popular SDI viewer, available now at www.thecarbonproject.com, we learned a number of valuable lessons during the development and testing of the 2006 version of Gaia 3/IR. The challenges were mostly related to the p2p network functionality and included –

- Gaia 3/IR installation was difficult and required special Microsoft packages and IT intervention.
- The server-less p2p network made it challenging to find peers at times.
- The server-less p2p network made it challenging for everyday users to understand connection issues.
- The IPv6 based p2p did not work for all systems and did not work well for all security configurations.
- The IPv6 based p2p used two external services on the global network.
- The IPv6 based p2p had limitations on the number of users in the peer cloud.
- The peers organization mechanism was hard for everyday users to understand.
- The end user demographic was a moving target – trying to adjust this complex system for different users was challenging.
- The application design was focused to a large degree on “GIS” users, which is not the most desirable design since the majority of Gaia users will not be familiar with GIS.

Addressing the Challenges

To address these challenges we decided to move beyond the IPv6-based server-less peer-to-peer architecture. We concluded that this solution has enormous potential for cutting-edge solutions, however it proved too hard to install and use for the average user. Instead, we chose a more traditional approach that uses a more client-server approach. This approach mimics the way the world's most popular online chat applications work, such as AOL Instant Messenger and Skype.

The new solution is called CarbonCloud CS and is designed as a platform solution that allows us to handle the communication between peers in a reliable and secure way. This platform is completely developed by The Carbon Project and does not rely on any external development or services, which caused challenges in the previous project. CarbonCloud CS handles security and configuration issues by accessing a proxy server,



and simplifies installation greatly. It also allows us to provide a more familiar user experience for finding peers, chatting and sharing information.

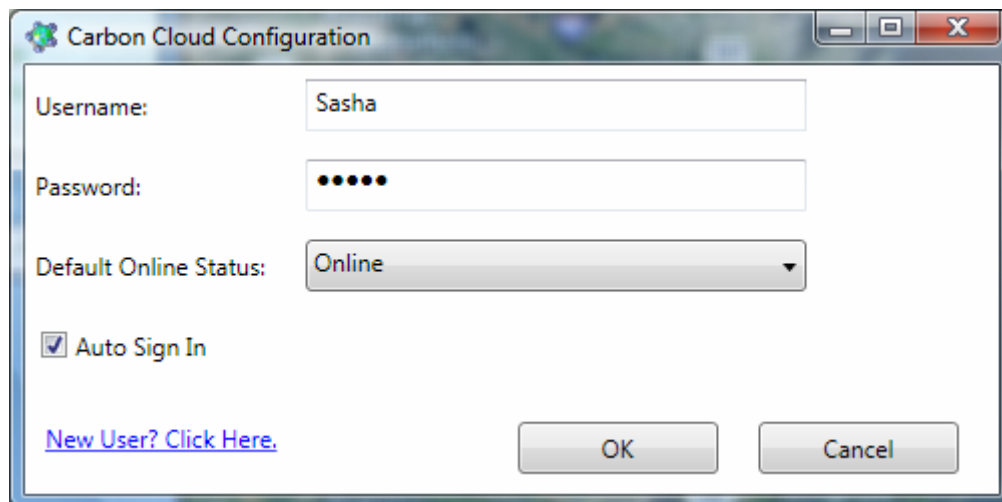
The overall peer-to-peer functionality is summarized as the ability to chat, multi-chat (single chat with multiple people), file transfer, map layers transfer and notes sharing, all that in a way that integrates into the new Gaia experience.

We also updated the overall Gaia user experience. We redesigned Gaia using the latest Microsoft development technologies, including .NET 3.x and Windows Presentation Foundation (WPF). This new look to Gaia provides a far more exciting and engaging user experience.

Progress

During the reporting period we have –

- Built a robust p2p framework: CarbonCloud CS (see CarbonCloud CS Overview)
- Added and tested community functionality in Gaia 3 (interim version Gaia X)
- Redesigned Gaia 3 using latest Microsoft .NET technologies and tested NSDI WFS access (Gaia X)



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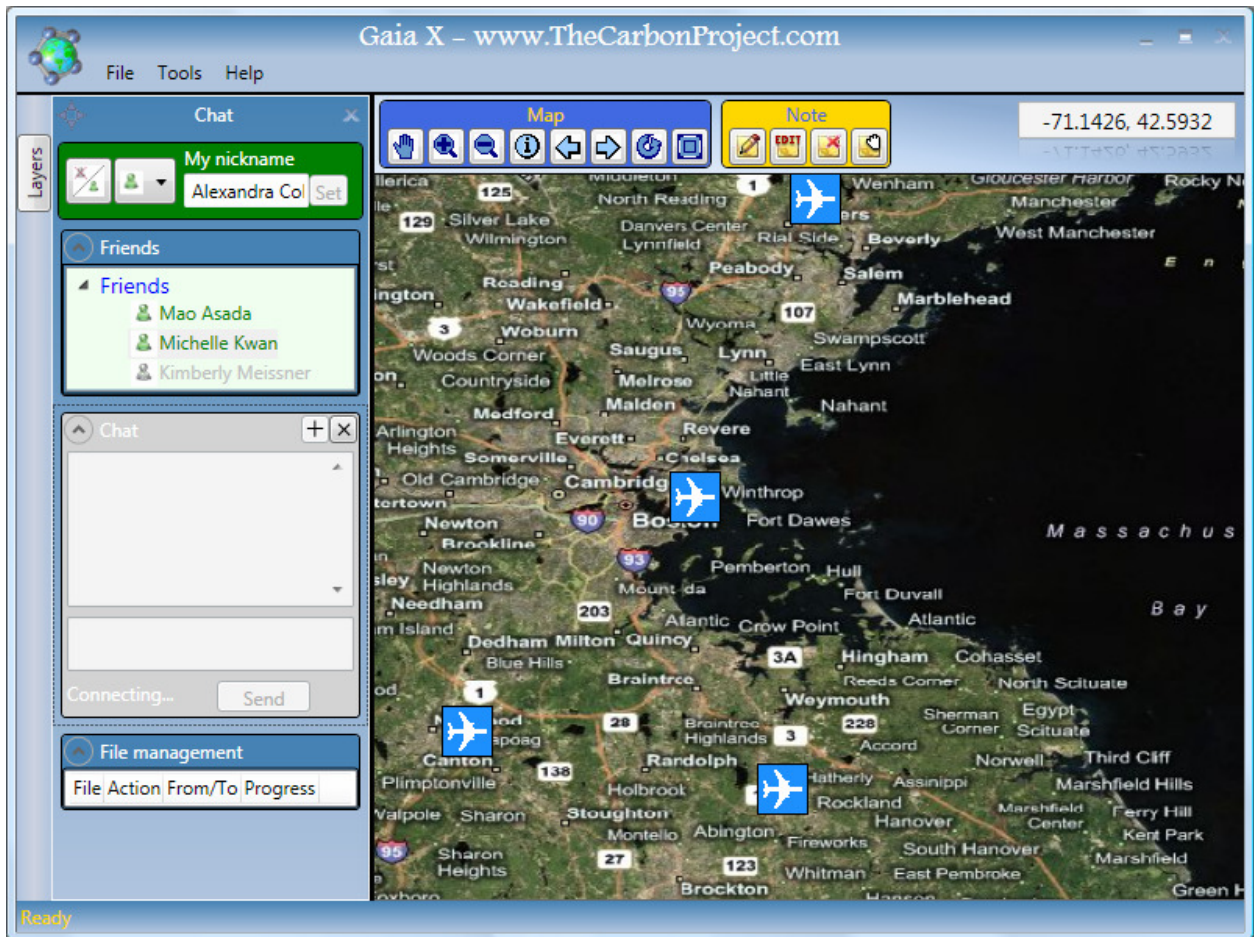
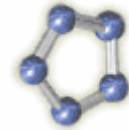
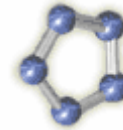


Figure 5 – Gaia X includes a full redesign of the peer-to-peer community platform (CarbonCloud) to address previous challenges and provide an easy-to-use community tool for framework data exchange, incident response and beyond

Remaining Work Related to Gaia Redesign

- Stress test the CarbonCloud CS platform
- Integrate the community functionality with Gaia X and test NSDI map layers exchange, notes creation/exchange, etc.
- Add specific functionality provided in Gaia 3/IR (National grid, GPS etc.)
- Document & package Gaia X for deployment
- Deploy CarbonCloud CS on production servers



CarbonCloud CS Background - Overview

CarbonCloud CS is a scalable platform that supports information sharing between peers. The platform is designed and developed to be a tool to allow developers to enhance solutions with social interaction, enabling enterprises to quickly add networking capabilities such as chat or file sharing to their software applications. With CarbonCloud CS software developers can enhance their solutions with functionality such as group chat, content sharing among friends, content search and more. The system is designed to connect millions of users and share data safely and securely, and supports any task in which information must be shared, and activities coordinated, among multiple people located in multiple places

Status of Data Access Activities

1. *What Framework data theme(s) will be accessed under this project?*

Our focus is on transportation, hydrography, governmental units Framework data theme(s) from the NSDI WFS.

2. *What is the data volume of Framework data anticipated for access (geographic coverage, dataset size, feature count)?*

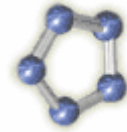
Hundred gigabytes (or more) of transportation, hydrography, governmental units Framework data from the NSDI WFS and other sources will be accessed via WFS during this project as well as terabytes of Orthoimagery, depending on the needs of Gaia X users. However, it is likely that the average Gaia X user will access Framework data for local areas, resulting in much lower data volumes.

3. *Who are the primary organizations providing data for this project?*

USGS, NCOneMap, The National Map, EPA, GlobeExplorer, Microsoft Virtual Earth, Yahoo! Maps, CubeWrx, USGS, North Carolina localities including Raleigh and Charlotte.

Status of Framework Client Development

1. *What is the status of software development?*



We have completed update to the entire Gaia user experience and a redesign for the application using the latest Microsoft technologies, including .NET 3.x and Windows Presentation Foundation (WPF). This redesign provides a far more exciting and engaging user experience – which we believe makes using NSDI Framework WMS and WFS layers more attractive and engaging than some commercial map services, and definitely more flexible. During this process, we also extended the FilterBuilder tool to enable to access a selective operational view of both Framework vector data services and toxic/hazardous chemical facility information for NC and other areas.

We have also implemented many lessons learned from the previous versions of Gaia IR. This effort involved a full redesign of the peer-to-peer (p2p) community platform (CarbonCloud) to address previous challenges and provide an easy-to-use community tool for incident response and beyond.

2. How will the client software be evaluated and quality assured?

The client software will be evaluated by a series of remote meeting workshops conducted as part of software evaluation and field testing activities. Overall quality assurance will be maintained as an integrated part of the Gaia X application development process (summarized in our proposal).

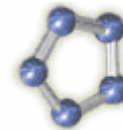
3. Describe your experience and purpose in accessing the data services?

Our engineering included a series of updates CarbonTools PRO to provide better access to NSDI data services (WFS) including the following enhancements:

- Improved support to WFS from various vendors
- Improved support to layer's namespace resolution
- Added support to the WFS 1.1 WGS84BoundingBox tag
- CarbonTools.Content.OGC.GML.Parser now supports the OGC WFS-G QueryResult and RelatedFeature response types
- WFS query uses feature type full namespace and preserve the namespace attribute in the Namespace property even if not using default namespace
- New methods FeaturesToGml.GetGML(BoundingBox bbox) & FeaturesToGml.GetGML3(BoundingBox bbox)
- FeaturesToGml.GetGML3(DataFeatures data, string schemaLocation) now sets the boundedBy value with an Envelope (GML 3.1.1)

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- GML parsers now overcomes more parsing exceptions without completely failing the process.
- CarbonTools.Content.OGC.WFS.QueryBuilder.BuildGetFeatureRequest() now puts an srsName attribute in the query (ask the WFS to re-project to this SRS)
- CarbonTools.Content.OGC.WFS.QueryBuilder.BuildGetFeatureRequest() now uses a spatial filter when using WFS version 1.1.0

These updates are summarized at

<http://www.thecarbonportal.net/modules.php?op=modload&name=News&file=article&sid=39&mode=thread&order=0&thold=0>. CarbonTools PRO is the foundation for Gaia X.

During this process we tested access to NSDI WFS described at <http://frameworkwfs.usgs.gov/>. A summary of our tests is shown in the figure below.

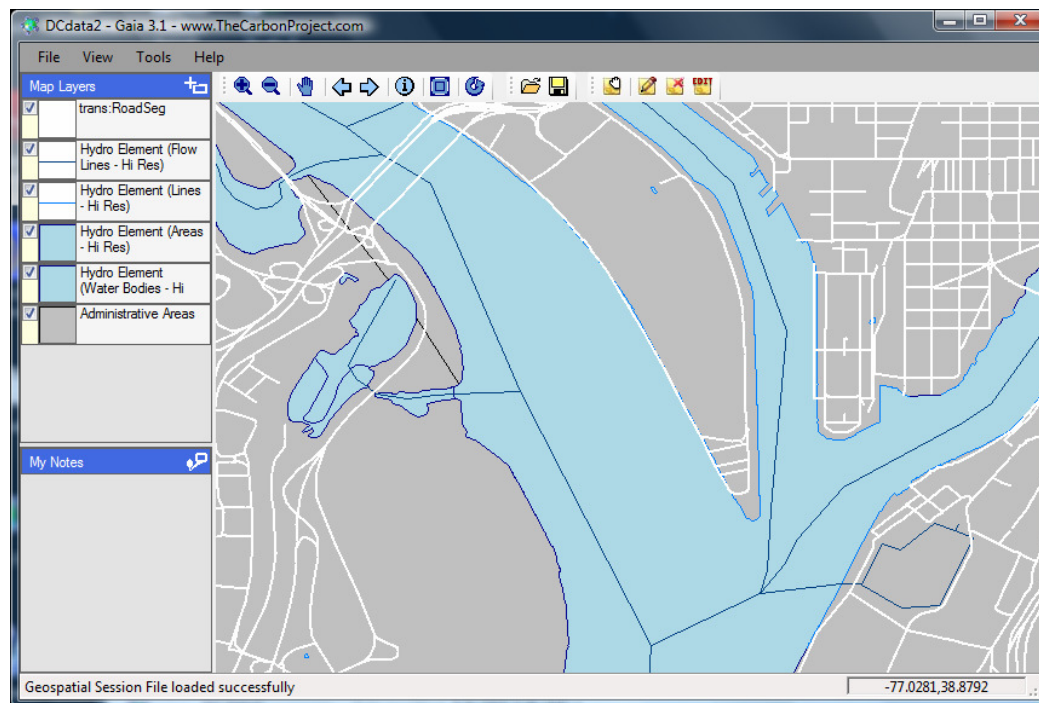
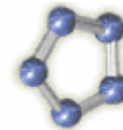


Figure 6 - NSDI Framework Data, including Road Segments and Hydrography displayed in the free Gaia 3.1 geospatial viewer application

The result of this testing indicated performance is adequate for accessing hydrography and road network data, however, methods such as GZIP should be considered to enhance performance. Performance enhancements to the Governmental Units data should also be considered, including some type of real-time "geometry simplification".



Our testing also indicated that NSDI Framework Services are utilizing nested properties and GMLSF Level 1. This approach is a potential forward step in representing geographic features from archaic methods used by traditional GIS. This is because many real world entities are more effectively described using nested properties. However, this structure may cause issues with advanced analysis functions. Level 1 schemas with nested properties are structured in the following manner -

```
<MyFeature>  
  <Prop1>value1</Prop1>  
  <Prop2>  
    <SubProp2>value2</SubProp2>  
  </Prop2>  
</MyFeature>
```

During this process the NSDI WFS Gaia Gallery was also developed. The NSDI WFS Gaia Gallery lets anyone access the NSDI WMS, preview the area they want, and then access the WFS. The Gallery is loaded with an assortment of NSDI WMS layers and a single NSDI WFS layer with just 100 features. This way, both the WMS and WFS service URLs are preserved in the GSF and people can easily tailor their views to whatever they need. This is now available as a download at

http://www.thecarbonproject.com/NSDIFrameworkService_GaiaGallery.gsf

Users may point a browser to it and Gaia 3.1 should kick it off, or it can be saved to the desktop and opened there.

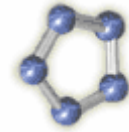
We also provided input into the developed of the NSDI WFS Usability Document located at http://geoleaders.com/NSDIFrameworkServices_Usability.pdf.

4. *Describe any internal or external users that are using this client.*

The current version of Gaia 3.1 is in use around the world by a number of organizations, including personnel from NCOneMap and others. Gaia X is still in development and testing and not in use by external users. The application will also be available for use a part of upcoming statewide projects hazardous incident response.

5. *Identify plans for promotion and distribution of this software.*

Gaia X will be freely downloadable from a link on the NC OneMap portal and The Carbon Project website. Outreach activities to inform NC local governments of Gaia 3/IR



will be conducted by members of the NC Geographic Information Coordinating Council, via announcements to NC listservs, and by presentations at community events.

Project Management

1. *Will this project's activities continue in the future?*

We hope so. National and international response to the Gaia 3.1 application has been very positive and the project team is working with various stakeholders to advance a coordinated set of activities to test and expand the application to Gaia X status (as described).

2. *Describe the next phase in your project.*

Next phase includes -

- Stress test the CarbonCloud CS platform
- Integrate the community functionality with Gaia X (layers, notes etc.)
- Add specific functionality provided in Gaia 3/IR (National grid, GPS etc.)
- Document & package Gaia X for deployment.
- Deploy CarbonCloud CS on production servers

3. *Requirements (more technical assistance, software, other)?*

None.

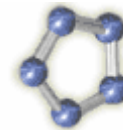
4. *What areas need work?*

Overall, the application development and the current phase of the project is going well (challenges have been described)

Feedback on Cooperative Agreements Program

1. *What are the program strengths and weaknesses?*

Strengths-Good management, fairly easy to understand the process and become engaged.



Weaknesses-We would like additional support in project continuation and partnering efforts.

2. *Where does the program make a difference?*

The program helps develop key elements of the NSDI. Overall, the program is making good progress but continued emphasis needs to be placed on promoting an online infrastructure of standards-based location content that can flexibly support operational incident response requirements. We suspect that funding issues are holding back development of this online infrastructure.

3. *Was the assistance you received sufficient or effective?*

Yes

4. *What would you recommend doing differently?*

We recommend maintaining a list of WFS-based Framework Data services. We are not able to identify these services using the GOS Portal. The result our testing indicated performance is adequate for accessing hydrography and road network data, however, methods such as GZIP should be considered to enhance performance. Performance enhancements to the Governmental Units data should also be considered, including some type of real-time "geometry simplification".

5. *Are there factors that are missing or need to consider that were missed?*

The CAP program may still wish to consider promoting development of online infrastructures of standards-based location content by coordinating with Homeland Security and critical infrastructure protection functions. For example, there is no reason why a low-cost program cannot provide grant incentives to hundreds of localities across the nation to make their own framework data available via simple Web Map and Features Servers so that these sources can be used for situational awareness in times of need, or used to guide tourists to key destinations on most other days. This type of investment is a "win-win" for the Nation.

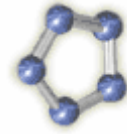
6. *Are there program management concerns that need to be addressed? Time frame?*

No

7. *If you were to do this again, what would you do differently?*

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Nothing, the program is functioning well for this project.