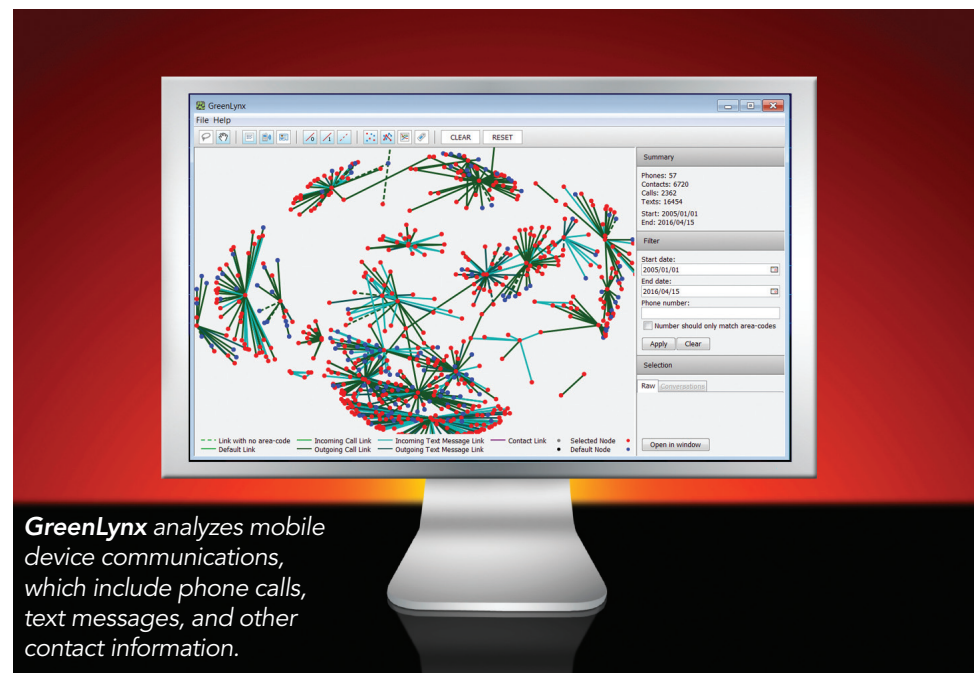


Have Green provides real-time analysis of large graphs with up to one million nodes, on a modest desktop computer, and is scalable to address larger needs. This broad architecture is tailored to client needs for different types of network graph-related problems.

Visualizing Semantic Graphs

A semantic graph is a network of heterogeneous nodes and links annotated with a domain ontology. In information analysis, semantic graphs are generated and applied in a visual analysis approach known as link analysis. Through link analysis, investigators query, draw, lay out and link people, facts, locations, events, objects and data in hopes of discovering key trends, patterns and insights. In today's analysis environment, however, users are bombarded with massive amounts of information from a multitude of sources. The vast amounts of information being fed into semantic graphs may easily overwhelm an analyst's cognitive capacity.

The Pacific Northwest National Laboratory is developing a new visual analytics capability that interactively analyzes semantic graphs with up to one million nodes. Our objective is to develop graph-based tools and environments that will enhance analysts' natural analytical capabilities to create, comprehend and analyze large semantic graphs—allowing analysts to effectively and efficiently perform in an information world that grows more complex daily.



IMPACT AND OUTCOMES

To date, we have developed ten major system prototypes to support Have Green components.

Greenland is our first prototype designed to support the Have Green system. Signature vectors extracted from a graph are projected onto a low-dimensional scatterplot through the use of scaling. Brushing, linking and clustering are used extensively to cross-examine different visualizations created by different signatures.

While Greenland provides a way to browse a large graph and look for clues, **Green-Sketch**, our second component, provides a graphical interface for users to query graphs.

A hallmark signature of a semantic graph is the rich information associated with its individual nodes and links. This graph metadata ranges from a short phrase to a full sentence to an entire paragraph and beyond. We have developed a practical prototype, known as **GreenArrow**, which allows users to browse this metadata interactively.

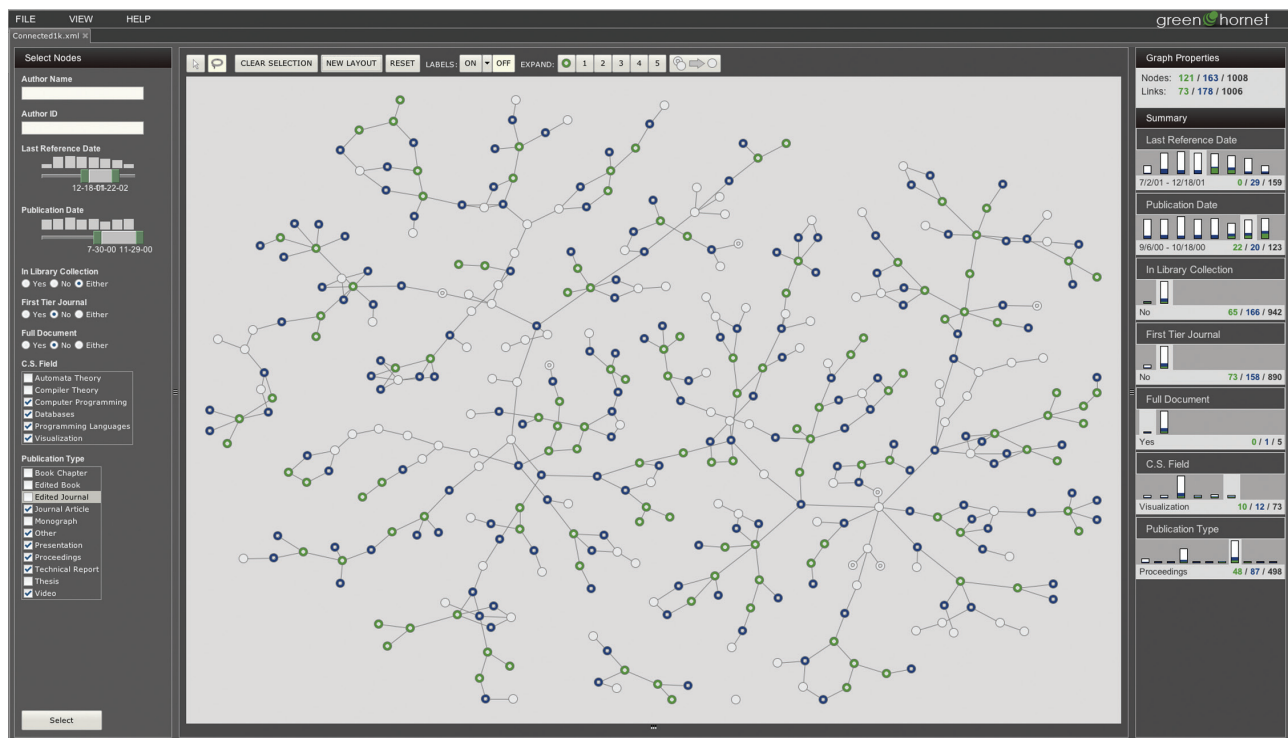
GreenMonster is another Have Green addition that addresses the scalability issue of our large semantic graphs. The requirement is to provide a capability to visualize semantic graphs with up to one million nodes adaptively and interactively on both desktop computers and handheld devices. GreenMonster supports analytic discourse through exploratory navigation.

GreenGrid was co-developed with the power grid industry to explore the planning and monitoring of the North American Electricity Infrastructure. It has been used to analyze information collected moments before the last major electric blackout in the Western United States and Canada. **GreenPAC** is another visual analytics tool that was developed to support contingency analysis of power grids. Both tools use the Have Green library to address the power grid industry's unique network and graph analytics issues.

GreenHornet is being developed to analyze big social networks. Among the signature technologies is a multiscale middle-out graph analytics approach that helps users visually analyze the structures and details of a social network with over a million nodes.

GreenTea and **GreenTrellis** are being developed for financial large transaction graphs. The matrix-based visual analytics prototypes will eventually be integrated into a large transaction analytics system that includes analytical components from multifaceted visualizations, timeline analytics, and a high-performance database using a client-server model.

GreenLynx is a lightweight mobile forensics analytics tool developed for the law-enforcement community to analyze mobile device communications, which include phone calls, text messages, and other contact information.



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ABOUT PNNL

Interdisciplinary teams at Pacific Northwest National Laboratory address many of America's most pressing issues in energy, the environment and national security through advances in basic and applied science. PNNL employs 4,600 staff, has an annual budget of nearly \$1 billion, and has been managed for the U.S. Department of Energy by Ohio-based Battelle since the laboratory's inception in 1965.

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