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C⁴ISR Geographic information systems

A shared view of the battlespace

The National Geospatial-Intelligence Agency is pioneering a geospatial visualization software tool that has far-reaching applications across the command-and-control and intelligence communities. NGA Program Manager **Susan Riley** discusses its features and benefits.

The Commercial Joint Mapping Tool Kit (CJMTK) is a comprehensive set of software components for the management, analysis, dissemination and visualization of geospatial information. The toolkit leverages the technical benefits and economies of scale of commercial geospatial applications with common, services-based software architectures consistent with the U.S. Defense Department's Joint Technical Architecture.

CJMTK is used to develop the map and imagery (geospatial) components of C2I mission applications and provides developers with the following benefits:

- Geospatial tools to support C2 Network-Centric Enterprise Services.
- Scalable enterprise solutions.
- Interoperability across mission applications.
- Enhanced spatial and analytical capabilities.
- Reduced integration costs.
- Increased efficiency and performance.

CJMTK integrates the best of government and industry capabilities into a common long-term solution that advances mission applications development into the next generation of interoperable systems for the war fighter.

It allows the distribution, analysis and visualization of geospatial intelligence over the network, empowering war fighters with timely and relevant information to respond quickly in a crisis. With the software embedded in C2I mission applications, users now have access to powerful standardized tools to improve interoperability and capability across multiple systems. Access is through the Network-Centric Enterprise Services of the Defense Information Systems Agency.

With its common platforms, software tools and processes, CJMTK enables a common view of the battle space that promotes end-to-end collaboration, from national leaders to tactical forces on the scene. As C2I systems migrate to using CJMTK, war fighters across the Global Command and Control System will have actionable intelligence where and when they need it.

Built on industry standards, the CJMTK has a single, scalable, open architecture with open development environments. CJMTK is composed primarily of commercial off-the-shelf software, so development costs of future enhancements are borne mainly by the vendors, which provide regular upgrades, extended functionality and training for the toolkit.

Northrop Grumman Information Technology of McLean, Va., is NGA's prime contractor for the CJMTK program. Subcontractors include Environmental

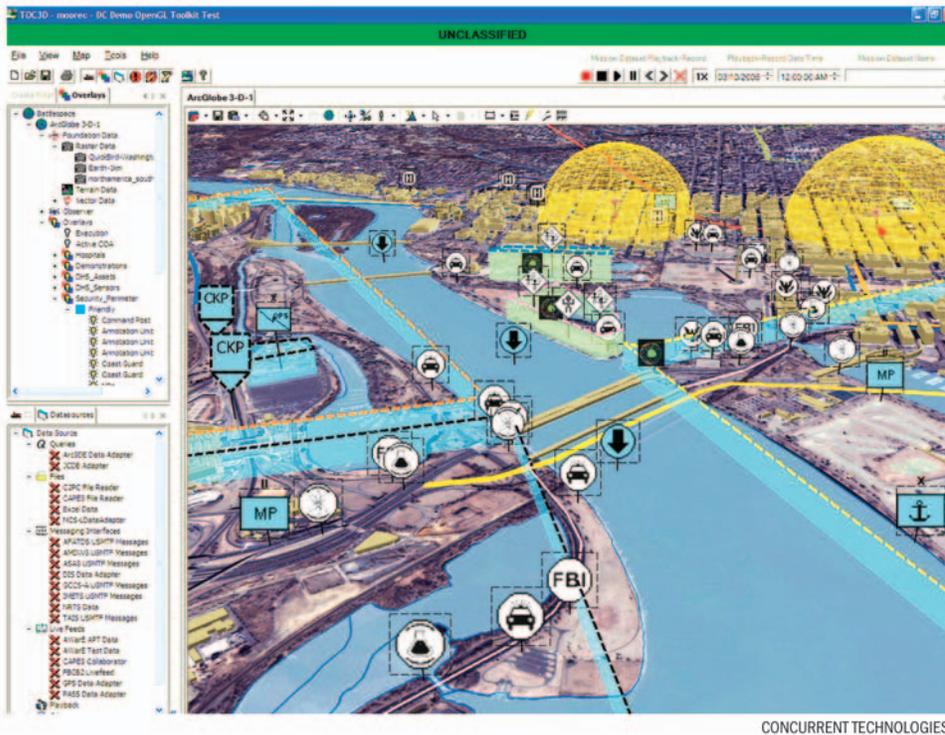
Systems Research Institute (ESRI) of Redlands, Calif.; Analytical Graphics Inc. (AGI) of Philadelphia; and Leica Geosystems AG of Switzerland.

The toolkit's primary component is ArcGIS, ESRI's enterprise geographical information systems (GIS) software platform. NGA's acquisition of the CJMTK led to an expanded leveraging capability within the commercial community. To satisfy NGA's requirements, ESRI, as part of its ongoing commercial development, added a client toolkit, which led to the commercial release of its ArcGIS Engine product. Thus, the CJMTK procurement produced dividend for a much greater community beyond the Department of Defense through this expanded commercial offering now available to all users who need GIS capabilities embedded in a broad range of applications.

The ArcGIS Engine, extended by the Spatial, 3-D, Enterprise Geodatabase Update, and MOLE extensions, is the foundation of the CJMTK client application development environment. Web-based capabilities are provided via an ArcIMS. Enterprise data server and management capabilities are provided via ArcSDE and a variety of commercial Relational Database Management System options.

The ESRI products include the raster engine from Leica Geosystems, which provides the capabilities for import/export/direct read of multiple image formats, pyramid layer manipulation, band/RGB (red-green-blue) management, histogram manipulation, contrast stretching, brightness and contrast control, layer transparency, and mosaics.

Additional sensor models from AGI add



CONCURRENT TECHNOLOGIES

the ability to calculate sub-satellite points and ground tracks, and to perform satellite intervisibility calculations, sensor footprint calculations, and selected sensor and radar performance predictions. Three-dimensional capabilities include the ability to create 3-D visualizations and interactive perspective viewing, query 3-D data, generate fly-through simulations, build surface models and perform line-of-site and "viewshed" analyses.

For those users requiring a pure Java solution, MapObjects Java Edition is an additional commercial offering providing a display/query client and server toolkit. These commercial products are supplemented with components developed by Northrop Grumman to provide additional government-specific functionality.

Of special note is the CJMTK program's success in converting many of the once-government-developed components to commercial components, which has resulted in reduced life-cycle maintenance costs to the government.

As a result of the 2004 requirements call to the Defense Department, a number of new capabilities have been added to the toolkit. As originally distributed, CJMTK supported Windows NT/2000 and Solaris 8 operating systems. Recently, support for Windows XP, Solaris 10, Red Hat Enterprise Linux 3 (Intel) and SUSE Linux Enterprise Server 9 (Intel) have been added. Also added was ESRI's ArcGIS Server, a comprehensive platform to build and deploy centralized GIS applications and services to support a services-oriented architecture. New functional capabilities in development include drawing MGRS grids, calculating magnetic variation, inclusion of feature height in line-of-sight calculations, and import of Electronic Navigation Chart and Raster Navigation Chart data.

Together, these software components comprise a comprehensive package that provides

enhanced visualization, analysis, dissemination and management capabilities for geospatial information. CJMTK's broad range of tools offers multiple options for the system developer integrating geospatial functionality into his mission application. It supports thick and thin client configurations, multiple development languages, and Web-based, scalable and centrally managed enterprise-level geospatially enabled applications.

There are three licensing agreements for CJMTK:

■ **Basic toolkit license.** For C2I mission applications that are part of the Defense Information Systems Agency's Common Operating Environment or Network-Centric Enterprise Services Community, CJMTK is distributed to authorized Defense Department mission application developers at no cost. They are authorized unlimited use for development and deployment within the guidelines of the license agreement.

■ **Extended user community license.** For Defense Department users who do not qualify for the toolkit license and want CJMTK technology and interoperability benefits, the CJMTK toolkit components and/or ESRI, AGI and Leica commercial products can be purchased through the CJMTK contract.

■ **Foreign military sales license.** For foreign governments that procure CJMTK-based mission applications or want CJMTK tools for integration in their mission applications, the CJMTK toolkit components or ESRI, AGI and Leica products can be purchased from the CJMTK contract utilizing the NGA's Foreign Military Sales process through a U.S. government sponsor.

The current contract includes 10 years of life-cycle support (through March 2014), which is provided at no cost to CJMTK users. Because it is a commercial off-the-shelf product, training for CJMTK system developers is provided through a readily available nationwide training regime from ESRI.

The CJMTK program maintains a Web site (www.cjmtk.com) that serves as a clearinghouse for information useful for mission application developers and other members of the CJMTK user community. Information on the site includes general information on government and commercial aspects of the software, reference implementations, requirements, help-desk support, and answers to frequently asked questions.

CJMTK has become a critical part of several active Defense Department mission applications, such as the Joint Global Command and Control System, the Army's Maneuver Control System, the Digital Collection Analysis and Review System, the Rifts Automated Trace Locator, the Digital Topographic Support System, the All-Source Analysis System, the Army Map Server, the Air Force's Theater Battle Management Control Systems and the U.S. Strategic Command Gateway. Individual users of those mission applications depend on the functionality of the CJMTK, while the mission application developers use the CJMTK to create the functionality in a design that meets mission-specific requirements.

CJMTK participated in the Coalition War-fighter Interoperability Demonstration (CWID) '05 by providing Web-based services for movement projection, position of advantage and line-of-sight for force protection and concealment using ArcGIS Server. Data services also were made available to the CWID participants via robust, scalable geospatial data servers using ArcSDE and ArcIMS. CJMTK will be a participant in CWID '06 and will demonstrate a services-oriented architecture for geospatial intelligence and its integration into the C2 environment through the upcoming CJMTK-based version of C2PC (Command and Control for the Personal Computer), Microsoft Windows-based software that allows users to exchange tactical position data with Unix-based systems such as the Global Command and Control System.

As CJMTK enters its third year of life-cycle support, there are now more than 200 named C2I mission applications within the U.S. Air Force, Army, Coast Guard, Marine Corps and Navy approved for CJMTK access. It is estimated that these mission applications will reside on about 150,000 individual computers. Integration and deployment of CJMTK within these systems will achieve the goals of increased capability and interoperability through the use of standardized, certified, commercial tools for the management, analysis, dissemination and visualization of geospatial information across the command, control and intelligence community. ■



ESRI
 380 New York Street
 Redlands, California
 92373-8100, USA
 Telephone: 909-793-2853
 Fax: 909-793-5953
www.esri.com/defense

For more information on ESRI, call
1-800-447-9778 (1-800-GIS-XPRT)
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