At the University of North Texas's College of Engineering, Director of the Center for Information Technology Randy Hunt envisions a day, not too far off, when the state's emergency responders can deliver help faster and more efficiently that ever before. His tools? A potent combination of geographic information system and Web services technology.

GIS has long been a staple of urban governments, utility companies, real estate developers, and others who depend on geographic information. In effect, GIS combines layers of data about a place to create a fuller and more accurate picture of that place. Trouble is, GIS tends to be static: a paper map, a demographic database. That's where Web services come into play. Loosely defined, Web services let applications share data, and even use other applications' capabilities, without regard to what operating system or platform those applications run on. Today, Web services offer the chance to update and enhance GIS data in real time—and that's where Hunt gets excited.
REAL HELP, NOW

Suppose a tornado strikes. With GIS Web services, "emergency operation centers capable of real-time data integration from their public safety department's 911 call center will be able to accurately track and deploy first responders to actual street addresses and to assess damage estimates against the tax assessor's real property values for emergency assistance grants," he explains. "These local data can be submitted in near real-time to FEMA [Federal Emergency Management Agency]."

This kind of real-time data integration, made possible by Web services, "is longed for by those whose data is trapped on paper forms," Hunt says.

It's not just disaster relief that stands to benefit. With GIS Web services, real estate developers can get the latest demographics without having to store massive amounts of data in their own systems. Utility companies can integrate accurate road maps with their own maps of telephone lines or gas lines. A wide range of possibilities exist—but first the technologists must do their part.

SETTING STANDARDS

Developers for GIS industry leader ESRI (www.esri.com) are using SOAP as the lingua franca to enable their broad line of GIS offerings as Web services. ESRI's Web services products support all the principal Web services, including .NET and J2EE, in a deliberate effort to keep the field as open as possible. "The introduction of Web services seems to not be associated with any single organization, and so people are not threatened by them and are willing to open up their systems to them," explains David Maguire, ESRI's director of products.

Beyond .NET and J2EE, several other standards govern the delivery of GIS as Web services. The Open GIS Consortium (www.opengeos.org), for example, has issued a series of guidelines describing exactly what sorts of data a GIS Web Service will deliver. The OGC's Open Location Services standard covers the mechanisms for tracking the location of moving objects. And ESRI has built an ArcXML standard to optimize the speed and functionality of information moving between different GIS products. And Microsoft has its own MapPoint standard, which drives its family of mapping products.

Each of the major Web services platforms has its advantages. As is true in almost any field, .NET gets the job done most efficiently for desktop-based applications, while J2EE is typically
the better choice for more widely distributed, heterogeneous systems. Maguire likes SOAP XML as an underlying technology in part because of its ability to move back and forth between these two leading standards.

This kind of openness is in fact a major requirement of any successful GIS Web Service. Given the diverse potential uses of GIS data, users might want to integrate that data with enterprise resource-planning systems, customer relations management data, billing information, work-order management systems, and so on. According to Maguire, creating custom interfaces between these systems is obviously expensive, so many are looking to Web services as a neutral playing field where these systems can interact generically.

**HOW IT HELPS**

The Geospatial Information & Technology Association (www.gita.org), a nonprofit educational association serving the global geospatial community, is another leading proponent of GIS Web services. In announcing a spring 2003 conference on the subject, GITA Executive Director Bob Samborski expressed unbounded optimism. "I think anyone entrusted with delivery of utility and government services needs to be aware of the powerful impact Spatial Web services will have on their day-to-day work," he said. "This is leading-edge education for positioning a utility, government agency, infrastructure management organization, or private sector business to be at the head of the line and ready to thrive as the economic situation improves."

Why all the excitement? It's a two-part situation, really: one that impacts both process and product.

First, there's the process of collecting GIS data. Normally, this requires a tremendous manual effort, either through surveys or data research and collection. Web services offers the possibility to easily locate and tap into existing geographic databases, which in turn offers significant labor-saving potential, explains Peter Batty, CTO at technology services firm TenSails and a GITA board member.

Take, for instance, the practice of geocoding, in which the user takes a street address and converts it into a map coordinate. It's time-consuming, and it depends on the accuracy of your maps. By accessing that data through a Web service, "the advantages of doing that are pretty clear," says Michael Goodchild, professor of geography at the University of California, Santa Barbara. "Apart from the fact that it is expensive to mount the service locally, I can also probably assume that when I get the service from some remote site, it is going to be based on a more up-to-date street map than the paper map that I would have locally."
Then there's the question of product, which, in the case of GIS, has typically meant reams of data, often recorded in the form of paper maps and charts. More recently, government entities, utilities, logging companies, and other users have sought out digital storage methods for this data. This practice has its drawbacks, however. Such vast quantities of data can be expensive and cumbersome to keep on hand, especially when they're not needed all the time. Here again, Web services offer relief by moving this data off site until it's needed.

Without Web services, "you would have to hunt for it, access it, copy it to your local machine, probably change the format. That typically might take you a week," Goodchild says. "Now you are doing it at electronic speed, and all of the issues of compatibility and format have been removed."

An obvious question arises. Say the user turns to a GIS Web services provider to deliver a code service or a package of geographic data. How do you know that the information is accurate? Most in the GIS community say the issue comes down to one of reputation management. "We have to rely on what we have always relied on," Goodchild says. The US Geological Survey, for instance, has always been considered a reliable source, "and that is no different from the way things have always been, even in the world of printed maps."

**LOOKING AHEAD**

How will GIS Web services work in the real world? At MapInfo, a provider of products and services that let companies take location information and build applications around that information, Senior Product Manager Scott Petronis sees all sorts of potential.

For example, imagine going to a credit card provider's Web site and finding all the ATM locations that accept that card. With Web services, that data could be updated automatically over time. Likewise, there might be manufacturers or other enterprise uses with global supply chains who need to track inventory over time and space. Here again, GIS Web services could fit the bill.

Before that happens on a large scale, however, Petronis says the alphabet soup of standards will need to sort itself out a bit. "It has been a long time coming for all of the different organizations who should have a say in how Web services operate. There has been a lot of difficulty in everyone coming to agreement over how things should work," he said. MapInfo's solution involves a J2EE-based back end that also uses XML over SOAP, with the Web Services Description Language as the primary interface—all compatible with the Universal Description,
Discovery, and Integration protocol. For the long term, though, it would seem to be anyone's guess. "A lot of the standards are at 1.0 or 1.x, so in some cases you are just kind of rolling the dice."

Then there's the money question. Looking at the potential for GIS Web services, "everybody is for it, in that it is technologically exciting, but it is not at all clear how to make money doing it," Goodchild says. "If I am selling data, I can sell it on a square-kilometer basis. But what do I do about someone who is using random areas for an extended period of time? I don't think anyone has a model for pricing that yet."

**CONCLUSION**

In the long run, though, Web services seems to offer significant potential gains for the GIS community overall. Beyond just making life easier, some say Web services could create whole new markets for GIS data. "It will open up a whole lot of potential application areas where spatial technology can be used," Batty says. "Areas that could not afford to devote people full-time to GIS now can make use of GIS data in ways they never could have before."