AT&T Broadband Ties IT Together

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It all started a couple of years ago when AT&T Broadband began engineering more than 15,000 miles of new cable telephony infrastructure and redesigning another 13,000 miles around Seattle, Washington. Almost immediately, our engineers encountered a huge obstacle -- the existing library of designs and maps contained almost no digital files, and numerous paper files were missing. In addition, the hundreds of subcontracted engineers who designed the original network used inconsistent symbology and cartography methods with no single, discernible standard.

If you work in the telecommunications or utility industries you have undoubtedly encountered a similar situation. As with most utilities, cable companies traditionally created and maintained paper libraries of detailed plant (network and equipment) drawings. Even in the past 10 years, as these documents became increasingly generated and stored using CAD, rarely did cable companies employ the software for tasks beyond drafting. Our industry was not making the most of the CAD data stored for engineering documentation, instead merely using the technology to create a picture while maintaining disparate spreadsheets and other databases to manage key assets.

Glossary

CAD: Computer-aided design

QC: Quality control

SQL: Structured query language

Thus, with the purchases of cable companies TCI in 1998 and MediaOne in 1999, AT&T Broadband -- which became the nation's largest provider of cable television and high-speed, content-enriched cable Internet and local phone service -- knew that it would have to develop efficient ways to integrate and manage the newly acquired equipment, networks, and records to streamline operations and better serve its more than 16 million customers. The rebuilding of the Seattle broadband network, which commenced in 1998, consequently provided an excellent opportunity for the AT&T Broadband Washington State Market to implement and test a new full plant design system. In a sense, we were going back to the drawing board by reinventing our CAD system as an integrated tool for designing and mapping AT&T's hybrid fiber-optic and coaxial cable network. Not only would the project serve as a test case for implementing similar systems in other AT&T markets, but it would also provide a leading-edge example to revolutionize how the broadband industry manages assets.

Untangling the knot From the beginning of the Seattle telephony plant project, the AT&T Broadband Washington State Market knew it wanted to build an intelligent network design system and ensure that all its components would function as an integrated whole without the use of proprietary software or licensing. We specifically wanted a system that could pinpoint the exact location of homes in relation to every

element of the plant; define the relationships of individual homes to public service answering points, rate centers, and municipal street address guides; and quickly identify issues in the network that affect customers' critical services.

These requirements pointed to the need for a one-source, query-capable database that could produce a visual product. With already more than 18,000 miles of plant infrastructure strung past 1.8 million homes in the state, however, the AT&T Broadband Washington State Market needed to hire contractors to help design and build the 15,000 miles of new network. Thus, our goal of creating a single integrated engineering design system necessitated that we develop and provide contractors with guidelines and specifications for building the network, as well as created standards for submitting engineering design documentation and drawings to us.

To this end, the Washington market engineering team first had to transform existing records to a standard digital format. We converted paper maps into digital format from scratch. When no record existed in digital or paper form, the team gave field engineers land parcel maps and sent them on walkouts to sketch and redline existing facilities.

Once we had all the files converted, we enlisted the help of a Canadian CAD and GIS development company to develop standard language and processes for building database models and to create guidelines for intelligent mapping. We provided the guidelines to the primary contractor we hired to coordinate all subcontractors involved with building the new telephony plant. This primary contractor was responsible for coordinating all engineering design documentation from the subcontractors, and providing the maps and data to AT&T Broadband engineers for QC.
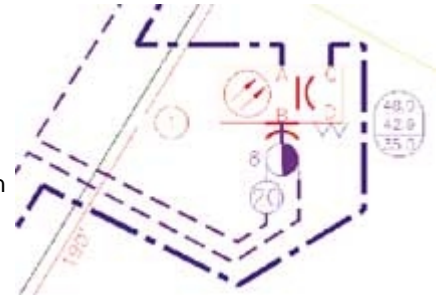
Figure 1. To ensure consistent documentation of its network from contractors, AT&T worked with its CAD/GIS consultant to develop graphic standards. This detailed view shows the standards for documenting a node feeding approximately 1,200 homes.

A graphic standard. It turned out, though, that creating guidelines and documenting the standard was not enough to ensure consistency. The maps received from subcontractors looked great but lacked a coherent description of the network. Although we required contract engineers to create designs and maps using specific software, each company employed different layers and symbols to represent the equipment. This variation slowed our QC considerably, especially because of the large volume of physical design documents we received. In addition, we initially had no automated tools for performing the task, instead enlisting the help of hundreds of employees to manually inspect and approve the submissions.
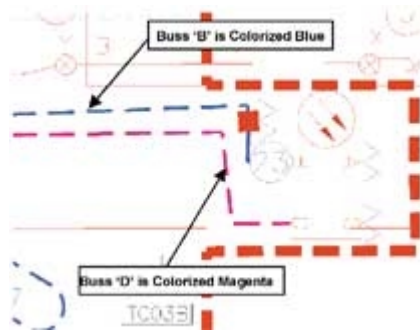
Figure 2. With ATT_MAppDR, engineers were able to quality-control subcontractor design files. For example, the program automatically colorizes individual coaxial feeds or busses. This colorization in turn automates the process of creating buss boundary polylines (thick, red, dotted line) as well as associating addresses to equipment upstream and downstream.

Thankfully, manual QC operations did not last long. Realizing the need for a more efficient means to ensure data quality and consistency, we again turned to the CAD and GIS firm we originally tapped to develop design processes and guidelines. This time we worked with them to hammer out a graphic standard (see Figure 1) as well as an automated drafting and QC application.

By 2000, we set up the application, known as the AT&T Mapping Application Drafting Assistant, or ATT_MAppDR for short, and were able to quickly catch up on our backlog of network design documentation QC (see Figure 2). Using automated routines we quickly converted symbology and other inconsistencies to our new graphic standard. As well, we deployed ATT_MAppDR to all subcontractors, enabling their engineers to perform tests themselves to see immediately if they adhered to our standards.

For field engineers, AT&T Broadband created a mobile version of its drafting and design tool. Now, engineers can edit features and data in the field as well as redline and sketch notes on the map display.

Almost immediately, the Washington State Market engineering team discovered that the cost of capturing design information fell significantly -- down almost one third. We were still creating the basic maps that every AT&T Broadband engineering team across the country is required to build, but we were getting the graphics in a standard format, which made the task of creating a complete, intelligent model of the plant easier.

A cohesive toolbox In 2001, about two-thirds of the construction on the Seattle Broadband network was complete, and for that segment, we had a full-plant engineering system, referred to simply as ATT_MApp, in place. All the tabular engineering data had been integrated with AT&T Broadband's database system and interfaced with our

CAD/GIS program, which stored most of the spatial data files, through standard object linking and embedding and database-compliant connections (see Figure 3).

Wanting to employ ATT_MApp to streamline other engineering processes, we soon began working with our CAD/GIS consultant to develop several other applications built on the base ATT_MApp data. Over the course of a year, we completed four additional engineering department applications to support map production and network operations.

Fiber. Our ATT_MAppFM (Fiber Module) application is a complete fiber-optic design, project tracking, and infrastructure documentation tool that automates the creation of splice documents and bills of material for construction. In addition, because it is built using the same connectivity model applied with ATT_MAppDR, we can conduct a most-probable-equipment-failure analysis throughout the network.

Steppin' out. For our in-field engineers we also developed the ATT_MAppWO (WalkOut) application. It is a mobile version of the drafting and design tool, optimized for pen-based computing. Engineers simply connect their laptop or handheld computer to the system back at the office and upload the views and data for a specific location by entering an address, place name, or equipment identification number. In the field, they can edit features and data or redline and sketch notes on the map display. Then, when they return from the field, engineers can upload their revisions to the server, which uses time stamps to resolve version control. Currently, the AT&T Broadband engineering team is laying the groundwork for incorporating the ATT_MApp connectivity model into the walkout application so that engineers can perform network traces and design operations directly in the field.

Radio inside. For managing other network components, we are also now building the ATT_MAppRF (Radio Frequency) and ATT_MAppIP (Inside Plant) modules. The inside plant application will model complete signal connectivity from its origin to termination, associating all equipment elements in the system. The radio frequency will manage the business logic behind coaxial networks. Both projects have now passed the scoping phase, and we expect to make them operational in the next 18 months.

Bound for the intranet Our engineering applications in the Washington State Market have helped to speed the department's operational tasks and save money as a result, garnering the praise of AT&T Broadband's corporate management in Denver, Colorado. However, it is the Web-based intranet applications that have caught the attention of the entire business.

We developed the ATT_MApp-IMS intranet application in conjunction with other engineering programs, but with the goal of extending the mapping information beyond the engineering department. Because AT&T Broadband's entire business depends on the careful management of our assets, we knew that all departments could benefit from the engineering map data to more effectively manage, query, report, and update the company's network information. And that is just what we made possible.

Figure 3 (Click to Enlarge). Now that data from corporate databases are integrated with spatial information stored in ATT_MApp, AT&T Broadband engineers have an efficient interface for accessing network design information. This view shows a complete node serving approximately 1,200 homes, with all connectivity and equipment data blocks to the right.

Integrated with other corporate databases, ATT_MApp-IMS offers the marketing department, sales staff, customer service, field crews, and finance office reporting features to query customer, demographic, and network equipment information. Indeed, there are few AT&T Broadband employees who can't access this information from their desktops via a Web browser-based map viewer.

Today, the system handles approximately 30,000 requests a month (and growing fast). Customer service representatives use it to answer customers' questions and start the order process immediately. (In the past, it sometimes took several days to discover whether service was even available in a neighborhood.) Sales and marketing departments exploit the portal to track projected growth and target new opportunities. The finance department employs ATT_MApp-IMS to quickly view maps of all the company's assets, tracking these against rate and billing boundaries. And operations uses the application to monitor service and match customer addresses to the network to identify outages, resolving an issue before the entire neighborhood calls to complain. Table 1 lists some of the most commonly used data and features of the ATT_MApp-IMS application.

Table 1

Intertwined optimization Of course, implementing the ATT_MApp-IMS application required additional customization of ATT_MApp. The engineering department had to integrate additional data, enhance functionality through custom programming, optimize and scale the application for multiple users, and create custom views to satisfy the unique requirements of users within various departments. All the data, functionality, and interface requirements were worked out through several departmental meetings and training sessions with staff throughout 2001.

Adding data. Because AT&T Broadband has geographically distributed departments (customer service centers

across the country can handle requests from all 13 markets, for instance), we needed to design the intranet application for a national scale. This would permit users to identify the location of any address in the country regardless of whether it existed in AT&T Broadband's databases. It also provided the basis for other markets to migrate their network data into the intranet application as they became ATT_MApp compliant.

By designing the intranet application for a national scale, though, we had to enable ATT_MApp-IMS to support multiple mapping coordinate systems and projections. We, therefore, used our GIS program's features to assign projections at the state level to ensure a contiguous map projection, workable for all relevant map layers for that state. Thus, as users zoom from a national to state-scale view, the projection automatically changes to accommodate the coordinate system settings for the current state's data.

In addition to national map data, we added orthophotos of our market to the intranet system to provide users with more contextual map information than vector lines showing the network. The imagery comprises aerial photographs at scales of 1:500 for low views and 1:4,000 for high views (see Figure 4).

Custom interfaces. So that users in different departments only see data relevant to their jobs, we require users to log in to ATT_MApp-IMS under a specific "department view." We did this by setting up virtual directories to authenticate users either by departmental groups or individually, employing standard challenge/response authentication.

Figure 4 (Click to Enlarge). To provide enterprisewide access to its network data, AT&T Broadband engineers created a CAD/GIS intranet portal. With the intranet application, users can identify equipment, track projects, and check service availability for customers. In this example, a user quickly checks an aerial photo for clues about the possible cause of an outage in a particular neighborhood.

Each department view leads to an entry viewpoint with a different core screen with application menus, map views, and reports tailored to the individual's departmental goals. We built the interfaces for different departments by customizing the system using different programming languages, as well as the GIS program's application programming interface.

In total, we created six interfaces. These include custom views for engineering, finance, construction, marketing, the Broadband Service Assurance Center in Fife, Washington (which is in charge of monitoring network performance), and the National Network Operations Center in Denver.

Performance and scalability. Because the CAD/GIS portal would be serving large amounts of data to many users, we also had to optimize the system for performance and scalability. To this end, we added some RAM to improve the speed of the servers, especially those with spatial data stored in relational databases. In addition, we fine-tuned our SQL queries to improve server response times.

The GIS's authoring and raster tools also offered many features for improving performance. For instance, using the GIS, our technical team sub-sampled air photos, carefully set scale/zoom display dependencies, and worked with both static and dynamic layers to increase response speeds.

The end result of our optimization gave the AT&T Broadband a very stable server. We currently support about 50 users simultaneously without any noticeable downgrade in performance and are planning to grow this amount to a few hundred in the coming year. We are confident that the system as configured will flawlessly handle this larger user base.

Wider connections The benefits of ATT_MApp have been tremendous. In engineering alone, because our system is not based on proprietary design software, we estimate $2.8 million in savings for the first year based on reduced costs for start-up software and resources. On top of this, we eliminated most of our annual maintenance costs because we own these applications outright.

AT&T Broadband is seeing savings from reduced operational costs outside engineering, as well. Instead of recording the same information in the field or on the phone while talking to a customer, employees are accessing the maps and equipment data that we already captured correctly the first time.

In the future, we are looking at ways to manage and distribute the data more efficiently to save even more money. For instance, we built central databases for the Web applications, but these sit apart from the original design files. Thus, we want to investigate storing our hundreds of separate design files in a single database for easier management.

In addition to central data storage, the engineering team is looking to develop mobile technologies that support service crews. We've got ATT_MAppWO for the field engineers, but the service crews are still left with paper maps or CDs of maps for use on laptops. We want to provide them with the equivalent of our Web mapping application, ATT_MApp-IMS, in a sturdy mobile-client device complete with wireless connectivity.

As we consider possible enhancements to the system, though, we haven't failed to step back and appreciate

what we've accomplished. AT&T Broadband's Washington State Market introduced a method to intelligently manage and share information with employees that is, for the most part, novel in this industry. To be sure, we employed tools from other industries, but we also put our own stamp on the system. Even more satisfying, our impressive results and savings gained attention across all 13 AT&T Broadband markets, and as a result, the company has made ATT_MAppDR a corporate standard nationwide.

Manufacturers AT&T Broadband's (www.attbroadband.com) Washington State Market built ATT_MApp using Autodesk's (www.autodesk.com) MapGuide 5 and Map 2000i. Kanotech Information Systems Ltd. (www.kanotech.com) from Edmonton, Alberta, Canada, served as AT&T Broadband's CAD/GIS consultant for system implementation. Contractors were required to submit design drawings in Autodesk's AutoCAD format. Attribute data are stored in Oracle (www.oracle.com) databases, with some spatial data maintained via Oracle 8i Spatial. AT&T Broadband also maintains some data within ATT_MApp as Microsoft (www.microsoft.com) SQL Server 2000 or MapGuide files. To customize ATT_MApp-IMS interfaces, the engineering team employed Macromedia (www.macromedia.com) ColdFusion 4.5, Java and Java Script, and Microsoft Visual Basic and Active Server Pages. The entire system runs on Windows NT, and intranet users access ATT_MApp-IMS via Autodesk's MapGuide Viewer.

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