

Light Age Network Modeling and Information Management for Cable Telecommunications

A Bentley White Paper

for Cable Telecommunications Professionals

Cyndi Smith, Solutions Executive Utilities and Communications, Bentley Systems

Jeff Eichler, President, Spatial Consulting



www.bentley.com

Introduction

Companies in today's rapidly changing cable telecommunications market must seize every opportunity to profit from their network investments. Bentley offers an open, integrated network modeling and information management solution that helps cable telecommunication companies increase revenues, minimize costs, and improve customer service.

Unlike firms in other once-impregnable industries, telephone companies and cable telecommunications companies are holding their own in today's challenging business climate. These industries had the foresight to invest in fiber optic cable, the technology with virtually unlimited capacity for transmitting digital data. In the early 1990s, the profit potential of fiber optics was still under debate. Nevertheless, these forward-thinking industries took the plunge. For years, much of that fiber remained dark. Not anymore. With today's digital technology advancements, these industries are not only recovering their investments but also building more networks of increasing complexity to offer previously unimagined services.

While telephone company networks are fundamentally a combination of fiber optics and copper, cable television distribution systems use a fiber/coaxial hybrid¹. Today, cable telecommunications companies deliver broadband services such as video on demand, high-definition television, and highly realistic interactive video games. Recently they've expanded their business models to include video conferencing, Voice over Internet Protocol (VoIP)², and other services once provided exclusively by telephone companies.

Now the telephone giants are also competing in the entertainment market. "Verizon recently added more than 90 new channels, including 71 high-definition (HD) channels, to its Fiber Optic Services (FiOS) TV lineup in Massachusetts³." Such news is prompting cable telecommunications companies to re-evaluate relationships with their telephone neighbors whose facilities occupy the same poles, underground routes, and rights-of-way as theirs do. Will they be rivals or partners?

Cable telecommunications and telephone providers are competing, certainly, but opportunities for partnering are becoming more common as cable, wire-line, and wireless technologies converge. For instance, using fiber already in the ground, several cable telecommunications companies have teamed with wireless providers to connect cell towers to the switched network for backhaul purposes. Very recently, several large cable telecommunications and wireless companies formed a partnership to provide fourth-generation (4G) broadband that allows customers to access the Internet from mobile devices⁴.

The telephone companies have had decades to build their best practices and information systems, and to establish the engineering, construction, maintenance, and customer services that have made the North American telecommunications network one

¹ "The Basics of Fiber Optic Cable: a Tutorial," SciLinks, <http://www.arcelect.com/fibercable.htm>

² "Career Guide to Industries," Bureau of Labor Statistics, December 18, 2007, <http://www.bls.gov/oco/cg/cgs020.htm>

³ "More Cable TV Choice for Consumers in Hanover, Mass.," Yahoo Finance, January 20, 2009, <http://finance.yahoo.com/news/More-Cable-TV-Choice-for-prnews-14103051.html>

⁴ "Clearwire Completes Transaction with Sprint Nextel and \$3.2 Billion Investment to Launch 4G Mobile Internet Company," Clearwire press release, Dec. 8, 2008, <http://www.clearwireconnections.com/pr/pressreleases/documents/pr-2008-12-01.pdf>

To stay competitive, the cable telecommunications industry must do more than meet consumer demands for increased bandwidth. It must design attractive service packages, provide more and improved services, and earn better returns on their investments.

of the best in the world. Cable telecommunications providers, on the other hand, have had less time to perfect their approach to information systems and network modeling, and to implement it for basics such as locating outages. Many are in the early stages of fully integrating their network model with enterprise systems such as customer care and billing. To stay competitive, the cable telecommunications industry must do more than meet consumer demands for increased bandwidth. It must design attractive service packages, provide more and improved services, and earn better returns on their investments. Moreover, as it makes inroads into commercial services and builds more intelligent and complex networks, this industry must be prepared to immediately restore service in the event of damage. With enterprises such as banks depending on its data links for money transfers, the service-level agreements for reliability now take on a whole new dimension.

This paper addresses the needs of cable telecommunications enterprises as they seek better ways to design and maintain their networks, manage their network information, leverage their investments, and earn profits for their shareholders. To help cable telecommunications enterprises meet these objectives, Bentley offers a complete solution that it originated and evolved by working closely with the industry. The solution allows cable telecommunications engineers to use a single interface to design and engineer for any medium – fiber, coax, copper, and all aspects of inside plant – for an end-to-end view of an intelligent network.

It also implements geospatial information technology that tracks and displays the entire network and indexes related documents and drawings by location. With just a mouse click or two, any user can view not only a specific network element but also its attributes, relationship to the network as a whole, and other related information. Furthermore, the solution provides mechanisms to integrate with various operational support systems (OSS) and ensures acceptance into enterprise IT environments through its ability to use Oracle Spatial as the persistent data-store for the network model. Using standard methodologies such as a service-oriented architecture (SOA), the solution enables organizations to fully benefit from their geospatial and engineering information.

Challenges

As advancing digital technology accelerates public demand for broadband services, cable telecommunications companies are competing with the telephone companies – and each other – to prevail in both the consumer and business markets. Now, more than ever, the cable telecommunications industry needs systems and tools to help them stem the onslaught of the competition. Its increasingly complex networks demand a flexible network model and integrated tools to design and maintain it. In addition, it needs web publishing tools for fast and economical information dissemination. And, most of all, it needs an open, integrated, and easy-to-use information management solution to control the tidal wave of data that threatens to swamp their operations. Access to such information has become a necessity for every department in the enterprise – mainstream BSS and OSS systems as well as engineering, installation, and repair services.

As they compete in a rapidly evolving business and technology climate, cable telecommunications companies face significant challenges. They need to use their existing networks efficiently, deal with service interruptions quickly and cost-effectively, optimize the network infrastructure, offer new services on short time-to-market schedules with minimal capital outlays, and develop short- and long-term plans and strategies for market growth.

In the race for subscribers, the winners will be those who reliably deliver the services they advertise, offer attractive and competitive service packages, and are the first to market with the latest technology breakthroughs. To achieve these goals, cable telecommunications companies must use their existing networks in new ways, and seize every opportunity that may offer additional revenue. At the same time, they need a flexible network model and engineering tools to build larger and more complex networks to support new services and potentially innovative partnerships. The hybrid nature of cable network architectures – a combination of coaxial, fiber, and inside plant – poses a challenge to engineers and designers, who need a comprehensive set of tools that supports the complete engineering of new, complex hybrid networks.

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Use Existing Networks Efficiently

New revenue possibilities for cable telecommunications companies are generated as a result of a request for service, which could come from several sources: a sales executive reporting that a commercial establishment wants to install security video, a call from a residential customer interested in Internet access, or even a competitor suggesting a cooperative venture utilizing combined network capacity.

Clearly, the first step to providing the requested service is to investigate existing network capacity and facilities. Where is the network fully used and where is capacity idle? To provide high definition channels for a new luxury hotel, for example, can it use a nearby fiber optic cable or will it be necessary to install additional cables? One solution is to send a technician to the location to examine the network equipment in place or check for spare capacity. But this can be expensive and time-consuming.

In order to know immediately where service capacity is available, cable telecommunications companies need systems that display their networks on detailed maps and correlate addresses with service capacity. This information could then be integrated with software that allows customer service representatives (CSRs) to automatically provision a service request by locating vacant paths, equipment, and access locations in relation to the customer’s address. In the case of voice service, the system would assign a telephone number and route the information to billing. Or if facilities were unavailable, the unfilled request could be routed to the appropriate engineering or planning department.

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Installers connecting the service on the premises also need network information as well as the rules and procedures for completing the job correctly. Otherwise, a second crew will have to be dispatched to complete or correct the work – a costly practice that cuts into revenue. And to service outages, repair crews would need to know the exact nature and location of the problem before being dispatched. With an integrated system, all these steps to providing service could be performed more cost-effectively and with greater customer satisfaction.

Restore Service Quickly and Cost-Effectively

Accurate network information is essential when provisioning service, but it is even more necessary when restoring service. It is very costly to send a technician into the field just to find out if the equipment in a vault is faulty or a building contractor has cut a cable. But without access to the complete network, a trouble dispatcher may need to do just that. Or, without knowing the exact nature of the trouble, a repair crew may arrive at a location only to discover that it doesn't have the right parts and tools to make the repair. In the case of storm damage, operations staff should be able to visually identify faults on the network maps to determine which subscribers are affected. Troubleshooters need immediate access to subscriber information from maps and records in order to trace the subscriber all the way back to the wire center or headend.

Delays in restoring service are expensive, not just in overtime for the crew but also in public relations. Repeated instances could cause a number of subscribers to transfer their service to another provider. More critical is a large wholesale business canceling its security system because of repeated service interruptions, which would leave it vulnerable to robbery.

Upgrade the Existing Network Infrastructure

Cable telecommunications companies spend billions of dollars striving for the optimal network at the lowest cost to maximize potential revenue. Meeting this goal starts with improving the efficiency of network planning and engineering.

While cable telecommunications companies have made successful inroads into business services, they are still primarily entertainment providers. They send broadband-hungry cable channels, movies, and games over hybrid networks that require a different set of engineering functionality for each type of network technology. These architectures are interconnected from customer premises to the headends and hubs. Not only is it necessary to design these hybrid networks, but the network connections must be intelligently modeled as well as show which network segments are fully used and where there is capacity for supporting more services. Once new network facilities are in place, it is essential to maintain flexibility in the network model as architectural changes and new products and equipment are introduced.

Offer New Services in Short Time Frames with Minimal Capital Outlays

Time-to-market is critical. Improvements in bandwidth capabilities are introduced every few months, and fourth-generation (4G) communication services are already on the market. Cable telecommunications companies need a solution for designing and building new network facilities as quickly as possible. Serviceability also is a critical issue. When a potential customer calls for service, just knowing whether the provider has cable running in close proximity to the desired location is key to service provisioning. Accurate, spatially positioned addresses and plant data are essential for this type of analysis.

To bring new services to customers quickly, cable telecommunications companies must analyze the entire workflow from marketing decision-making through to new service implementation, and identify the places where time is wasted. Does the marketing analysis take longer because the marketing staff is not trained in complex search techniques to pull the necessary data from databases? Do engineers waste time trying to integrate designs from separate applications for every cable type? Are there delays in communicating design changes to construction crews? Does network information produced in the design phase need to be manually entered into a business system before customers can be served? With too many delays, a company could miss that all-important first-to-market time frame.

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Lower Build-Out Costs for New Infrastructure

Capital outlay for new networks is enormous, and unexpected construction issues can add to costs. When designing network build-outs, engineers need to know the conditions on the ground and how to plan for them accordingly. The following scenario can add millions to the cost of a new construction project.

A company has obtained a permit for a network extension. The engineering department assumes that an agreement has been worked out with the power company and the telecommunications company for use of the right-of-way. Designers and engineers draw up their plans and a construction crew installs a conduit for the cable. Then, to everyone's surprise, a power company crew arrives to install poles – right on top of the cable conduit. Now the conduit has to be dug up, redesigned, and reconstructed. Ironically, another department had been informed of the power company's plans, but this information was in a database that the engineers could not access. This is just one example of why build-out costs are higher when engineers don't have access to up-to-date records.

Also, without software that makes automatic calculations, engineers are less productive. For example, calculations for transmission characteristics and strand loading are time consuming and prone to error when done manually.

Plan for Growth

Before making capital outlay decisions, planning and marketing need answers to the following questions: Where could the existing network be extended to offer additional

services? Where is network traffic the heaviest? Where is demand coming from? What are the new development and future growth areas? With the ability to view network locations in relation to demographic and other planning information, planners can answer these questions and make better decisions about network growth, service packaging, pricing, and more.

As plans get under way to extend service capacity, having accurate information about the network becomes critical. Planners need to know that the latest field information has been updated in the network data store. In addition, they need a comprehensive view of the network in relation to the area they plan to serve – streets, addresses, and topography – and, most importantly, they need to know the exact location of the cables, poles, splices, routers, hubs, and other equipment already in place.

Cable telecommunications companies can no longer tolerate lost revenue due to inaccurate records that cause network capacity to sit idly. They require a solution that can assist them in the planning phase to identify potential markets, define network facilities that can be built at a minimum cost, and optimize the build schedule. They also need to manage their network data to provide better, more economical customer service and increase their revenues.

Solution Overview

The Bentley communications solution helps cable telecommunications companies thrive in a dynamic technology environment and a competitive business climate. The solution provides the tools to maintain a comprehensive intelligent network model from the subscriber to the headend. Engineers are able to build the network model for all the varieties of architectures that make up the hybrid cable telecommunications network. At the core of the solution is Bentley's unique approach to managing information, one that allows companywide access to the broad range of information used in cable telecommunications enterprises. A specialized web browser for communications networks makes it easy to publish the information both internally and externally.



Figure 1: This diagram illustrates how the Bentley communications solution manages the network facility lifecycle from its inception as a customer service request through work order creation, design, approvals, construction, maintenance and finally planning for updates or replacement.

Solution Architecture

The communications solution is built around three core Bentley technologies: MicroStation®, Bentley's comprehensive engineering application; a geospatially enabled information management system; and a web publishing capability that makes it easy to disseminate information over the Internet, internally, or externally.

MicroStation is used by engineers of many disciplines to design, model, visualize, document, and map projects of all shapes and sizes. Within MicroStation, or from specialized tools built on top of it, design data can be linked to almost any coordinate system to ensure that the project is accurately located.

The Bentley® Geospatial Server provides access to an information management system that allows project teams, no matter where they are located or where they work, to have access to the latest project documentation. The network model can be persisted in a seamless Oracle Spatial database or tiled DGNs. All the intelligence in the network model, as well as related information in other file formats, is indexed and accessible by its location on the network map. The Bentley Geospatial Server is also the vehicle through which interoperability with other GIS and OSS data stores is driven.

The Bentley® Geo Web Publisher™ for Communications provides easy-to-use tools for publishing a wide range of maps, records, drawings, schematics, and reports to support engineering, permitting, construction, maintenance, and other operational activities.

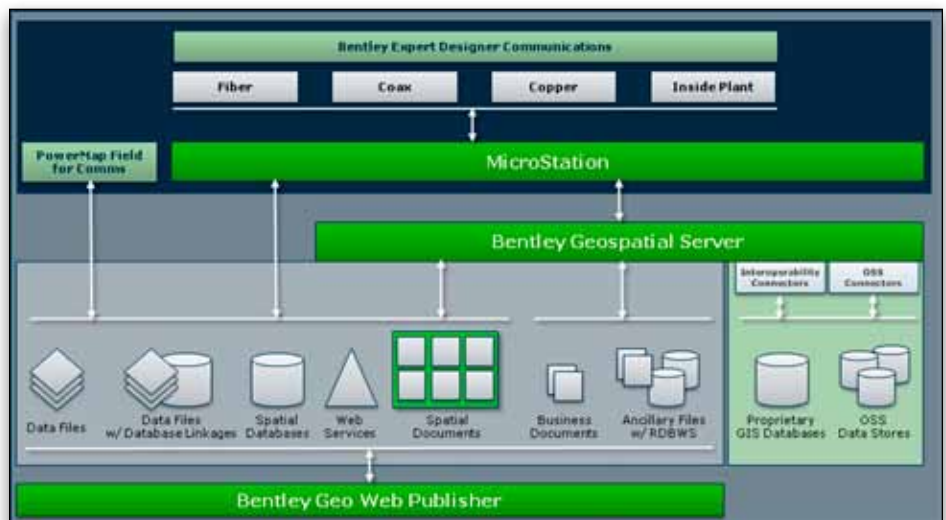


Figure 2: The Bentley communications solution architecture showing how the solution components are integrated.

Modeling the Network

As the cable telecommunications industry provides businesses and consumers with a greater variety of services, network engineering requirements become increasingly complex. The Bentley communications solution provides for this complexity with integrated applications for engineering and managing fiber, coax, copper, and inside plant

– all from the same interface. The solution also facilitates the re-use of design scenarios as a starting point for new designs. This capability saves design time for experienced designers and shortens the learning curve for new staffers.

One of the most significant features of the solution is that it allows the whole team – designers, engineers, and field personnel – to work from the same accurate model. As new network sections are designed, the changes can be seen by all, along with the design status – in progress, completed, awaiting approval, etc. Thus, the crews responsible for construction and repair understand the changes planned for their areas, and the engineering team knows about field modifications and, therefore, can plan accordingly.

In addition to providing all the necessary capabilities to complete the design, the solution supports the estimation process by providing design and material detail for use in estimating systems. Construction sketches and work packets for new construction and system upgrades can also be generated. This makes the approval cycle with either engineering management or the customer easier and faster because designs and drawings can be exchanged electronically and any changes can be incorporated quickly. This comprehensive end-to-end solution provides applications, support, and services from a single vendor across both the network lifecycle and engineering disciplines.

The solution performs network calculations during the design process for all types of network transmission media and also optimizes powering for coax networks. As designers insert, remove, or change network devices, network and design connectivity are maintained from outside to inside plant, allowing the network to be traced from port to customer. The solution interactively calculates the best design based on configurable equipment specifications.

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The fiber design toolset allows for the design, documentation, and maintenance of outside plant fiber networks, while accommodating all required fiber architectures including FTTx. Moreover, it offers additional capabilities for land-base development, strand mapping, and duct management. For coaxial cable engineering, the solution provides for analysis of an HFC network at any level, ensures accurate network documentation, and, after the design has been completed, the ability to power the plant based on user defined boundaries and shapes. For copper cable design, the solution performs designs, generates bills of materials and other detailed reports, and creates work prints, work order documentation, and a variety of map products.

The solution also allows for the design and documentation of the inside plant. Engineers can define, configure, and place equipment in racks and floor plans that visually depict the precise layout of the facility. Administrators can define a detailed library of frames (racks), equipment, slots, cards, and ports to be used in the design, along with a comprehensive set of validation and design rules.

To help new users become productive quickly, the solution offers a learning technology consisting of ready-to-use design elements, information structures, and data relationships based on engineering standards, company construction practices, and the design expertise of other users. Instead of starting from scratch, the new user can exploit existing knowledge and modify the design as necessary.

The integrated solution allows end-to-end connectivity management from the headend to the subscriber, which makes it possible to quickly troubleshoot network problems via network tracing functions, identify affected subscribers, and dispatch teams to the right spot. And the solution's web-publishing capabilities make it easy to distribute all kinds of documents and reports created from network data – maps, schematics, bills of materials, work orders, address lists, equipment locations – and publish them either internally or externally. For example, a bill of materials generated from a project design could be sent automatically to inventory personnel, allowing them to place parts orders immediately, thus avoiding construction delays due to unavailable materials. Or a construction crew supervisor could request a construction drawing directly from the laptop in his or her truck and, with a wireless connection, view it remotely in the organization's web browser or the field application Bentley® PowerMap Field for Communications.

Managing the Information

The Bentley communications solution allows full access to the network model and related information. Typically, the network model is managed in Oracle Spatial. Related information can be maintained in its native format – Excel spreadsheet, Word document, legacy CAD drawing, etc. – and is easily searched by technical and nontechnical users alike throughout the enterprise. This capability makes essential information available for a host of purposes, including network planning, project-team collaboration, marketing, accounting, customer service, new service evaluations, call-before-you-dig applications, and repair services. It also can be used to automate manual tasks. For example, it features a sophisticated work-order application called Bentley Expert Designer Communications with optional interfaces to job-management systems.

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The solution uses a geospatially enabled information management system that brings together information in spatial databases, drawings, business documents, and other media by associating information to a geospatial location. This allows information in enterprise databases, legacy and departmental systems, as well as project-based data, to be accessible to users through a spatial interface. Items in the network – such as a splice enclosure, a headend, or a rack with a piece of equipment in it – can be spatially linked to related information. To find information, the user can select a network item and view a list of the content related to it, or select a geographic area and view all associated content. This unique information management solution relies on spatial indexing rather than conversion to a common format, which can result in data loss. This process keeps all information in its original form to be found, viewed, and edited using tools launched directly from the Bentley solution interface.

Network information is needed and can be used by practically every cable telecommunications department. Since all project design team members work in the same integrated system, they can easily view and share each others' work. The operations department uses the network model for network monitoring, trouble ticketing dispatch, tracing to locate fiber outage, and highlighting affected customers. Engineering uses the intelligent network model for "Call Before You Dig" response, retrieving address information to determine where services are available, and for obtaining technical

information such as the amplifier, node or power supply feeding specific addresses. Engineering also uses the model for generating engineering inventory reports such as total cable footage, house counts within geographic areas, and counting specific devices within defined areas. From the field, staff can access information about a work order or view the existing network model, and, if need be, provide updated information to the engineering department to assure accuracy.

The business side of the enterprise also makes use of the intelligent network model. Billing services uses it for purging duplicate addresses, discovering serviceable addresses not in the billing system, managing accurate rate center and e911 boundary relationships, and facilitating accurate mailing by CASS-certifying addresses. Accounting can generate inventory reports on assets that can be used to facilitate franchise fee calculations, create duct and pole leasing invoices and payments, assemble reports for taxing authorities, and identify retransmission royalties.

Tools to extract network information for use in operational support systems (OSS) are provided in the solution, and more sophisticated, event-driven integration can be implemented by user organizations or Bentley Professional Services.

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Network Model Publishing Throughout the Enterprise

A specialized web application makes it possible to publish network model information throughout the cable telecommunications enterprise: a wide range of records, drawings, maps, schematics, and work orders, bills of materials, and reports to support engineering, permitting, construction, maintenance, and other operational activities. The open information management environment allows the documentation to be managed and workflows facilitated. For example, a customer service representative can use the web browser to access additional information to fulfill a service request. Or executives in a planning meeting could look at the network model to confirm the existence of a cable running near an office complex.

Using the Solution for Marketing Analysis

The Bentley communications solution provides excellent tools and data for marketing research and analyses. For example, by layering addresses of potential subscribers over a map of a network, researchers can see which commercial establishments are located close enough to existing facilities to be offered cost-effective services. They may also discover opportunities to partner with telephone companies serving the same areas. As another example, the ability to correlate a database of cell towers with cable locations can allow a cable telecommunications executive to propose the use of the cable network to connect cell towers with the telecommunications grid.

By overlaying the network model with information such as income levels, age levels, marital status, etc., marketing executives are better able to make decisions as to which cable channels to include in a service package and the appropriate pricing for a given geographic area. Other marketing and sales uses include correlating churn rates

with calls, locating high-demand service areas, identifying market trends, evaluating marketing campaigns, certifying network capability and services, and creating reports to identify and reduce repeated services.

The Bentley Communications Solution in Action

The following case studies illustrate how users have implemented the Bentley communications solution. Some of the benefits these companies have realized include:

- Rapid map production
- Direct data distribution over the company intranet, avoiding inaccuracies and redundant data entry
- Rapid design change turnovers to construction crews
- Increased productivity with fully attributed physical plant design
- Improved accuracy with real-world coordinates to locate infrastructure components and network assets.

Comcast Northern Division Upgrade Initiative

Comcast was founded in 1963 as a single-system cable operation. Today, it is the country's largest provider of cable services and one of the world's leading communications companies. It is focused on broadband cable, commerce, and content. It delivers digital services, provides Internet and broadband phone service, and develops and delivers innovative programming.

During a nine-year period, Comcast Northern Division used the Bentley telecommunications system to rebuild and upgrade 27,535 miles of physical plant. With the upgrade complete, the company uses the Bentley solution to maintain 38,000 miles of network to bring fiber-rich high bandwidth network to 3.25 million homes in New England. The upgrades created advanced service capabilities and increased network reliability. By bringing fiber closer to its customers' homes, Comcast created higher bandwidth capabilities and smaller service areas, forming the foundation of the advanced network by which all Comcast's services are delivered.

After researching the market, Comcast determined that MicroStation processes built the strong foundation that enhanced every other process. By creating MicroStation maps, Comcast was able to quickly disseminate necessary information to construction crews. Editing and changes were easily facilitated, providing rapid turnover, often overnight or even on the same day in some cases.

The Bentley solution enabled Comcast to attribute all mapped data in Oracle, which provided nearly limitless reporting ability. Various reports provided information relative to location data, statistical data, quality control abilities, address data, and more. Address management has played a large role in communicating engineering information to the billing system and other functional groups such as telephone provisioning and

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marketing. Maintenance programs such as battery replacement for power supplies can also benefit from location-based reporting.

Purchasing efficiency is created by extracting bill of materials data for all construction work right out of Oracle, and often an item can be directly matched to a part number in the purchasing system. This automation also improves accuracy in quantities of parts required. RF levels as well as current and voltage requirements are tracked throughout the network via Oracle, making amplifier setup and troubleshooting data easily available to field personnel.

The Bentley communications solution automated many drafting and engineering tasks and provided the means to link to Oracle databases. Not only did this increase efficiency in creating the maps for construction, but it also enabled the mass dissemination of all types of plant data in real time and near-real-time via the company intranet.

The fast pace of the upgrades during the peak years created extremely short timelines to turn over designs to construction teams. The Bentley solution allowed Comcast to meet extremely tight deadlines and to quickly turn revisions back to construction teams and project coordinators, maintaining full-capacity operating speed.

Upgrades to the areas were completed on time and on budget, paving the way for advanced service offerings.

Grande Communications Fiber to the Home Deployment

Grande Communications is a Texas-based communications company providing residential and business customers high-speed Internet, local and long distance telephone, and digital cable services over a single network. Grande is building a new, high capacity, fiber optic network from the ground up, using the latest technological advancements in broadband communications.

Having already deployed standard HFC and FTTC architectures, Grande Communications looked to the future to provide a stronger bandwidth position for its customers. That solution is FTTH (Fiber to the Home). The challenge of this project was to develop a strategy that proved FTTH was cost-effective, and to put in place a platform to support it. Unlike current architectures in which a single tap or terminal can serve any local customer, FTTH would require assigning a specific fiber to every new customer.

Grande began FTTH deployments in late 2004 and now offers the full suite of voice, video, and data services over a broadband PON (BPON) infrastructure. Initially the Austin and San Antonio markets were deployed, with other markets throughout Texas following.

Grande used the Bentley communications solution to design and model the project. From the model, preliminary bills of materials were produced and used to make comparisons among current plant design and various equipment vendors. The Bentley solution gave Grande the tool to not only design FTTH, but to also create the work orders necessary for each install on a daily basis, as well as provide bills of materials and design prints to the construction department.

Grande did not need to do any internal developing to handle the task, which saved many hours of in-house labor. It was also able to combine its resources by having all the design on a common server, allowing designers to complete the design for all markets from their local workstations. The solution allowed Grande to not only implement FTTH in a timely fashion, but to manage it as well. Only the Bentley solution gave them the complete package they desired.

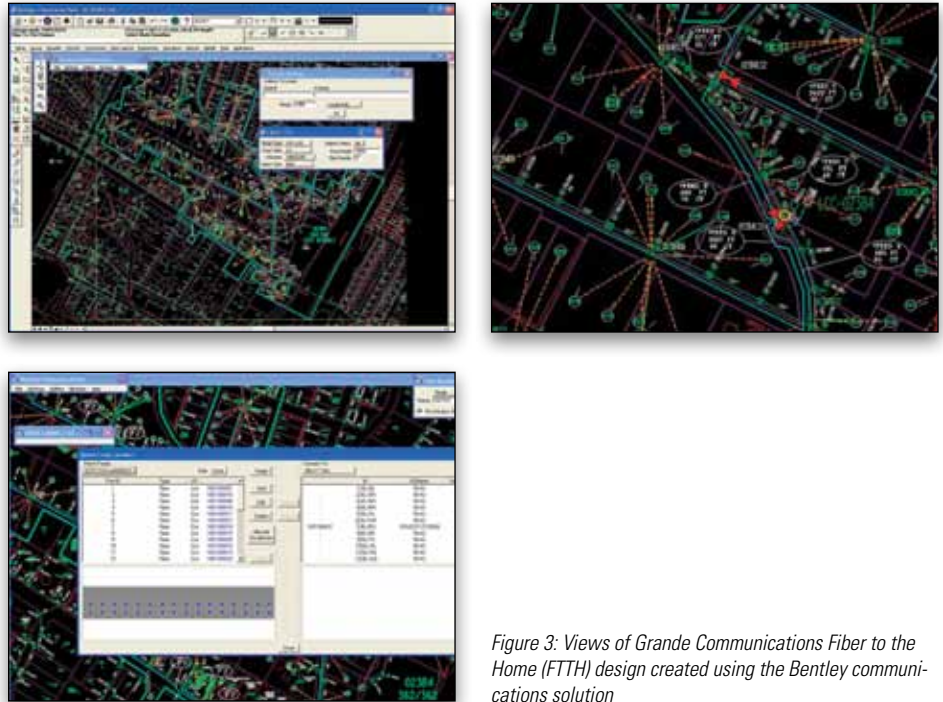


Figure 3: Views of Grande Communications Fiber to the Home (FTTH) design created using the Bentley communications solution

Precision Valley Communications' Projects

Precision Valley Communications is a nation-wide engineering, mapping, and design corporation for the telecommunications, cable telecommunications, and utilities industries. The company also provides subscriber service installation. Precision Valley Communications has been nominated for Bentley's Be Inspired program several years in a row. Recent nominations were for projects commissioned by Time Warner Cable in Maine and MetroCast in Connecticut.

Time Warner Cable: Inside Plant Documentation

Time Warner Cable awarded a contract to Precision Valley Communications to document all headend gear from the origin of the radio frequency (RF) and fiber data to the cable subscriber. The project scope entailed nine hub sites servicing Cumberland and York counties and the headend in Portland, Maine. Approximately 25,000 port connections were documented using Bentley's communications solution.

Precision Valley Communications headend technicians built, mapped, and modeled the network elements on site using the Bentley Inside Plant module installed on their portable laptops. Each completed hub site was then imported into Time Warner Cable's network model built with the Bentley solution. By directly entering the data into the complete network model from each hub site during the field data collection, Precision Valley personnel achieved significant time savings. The integrated Bentley solution allowed the company to eliminate a time-consuming and error-prone workflow step: deciphering field notes and manually entering the information to update the network model.

The key to the success of this project was the ability of Precision Valley Communications to provide Time Warner Cable with a fully documented network, including full connectivity from the inception of its broadband signals. Time Warner Cable is now able to provide true drawing schematic and data connections of its headend optical fiber plant nodes and splices including connections to the RF plant.

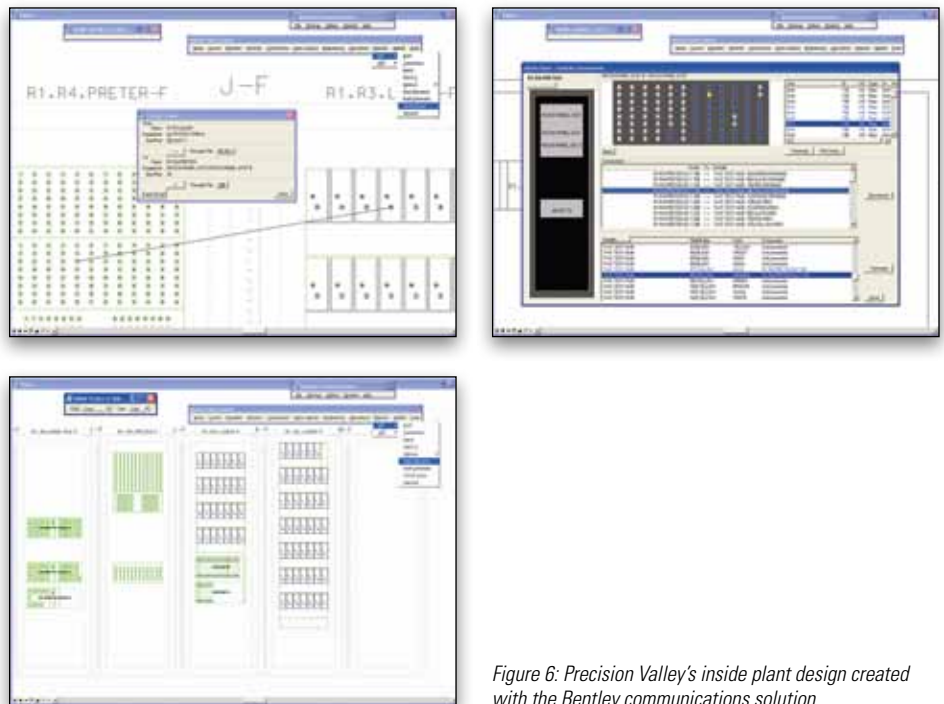


Figure 6: Precision Valley's inside plant design created with the Bentley communications solution

MetroCast: Fiber Upgrade Design

MetroCast of Connecticut commissioned Precision Valley Communications to upgrade its existing 550 MHz plant to 1 GHz to provide expanded voice, video, and data services. The Bentley communications solution made the workflow more efficient by allowing the employees in the CAD and design departments to work side by side on the project. The CAD group's work was easily seen and transferred to the design group and vice versa. The project was completed in several steps as described below.

Base Map Creation: An ETAK topographical base with custom road widths on the Connecticut State Plane Coordinate system was assembled in MicroStation. A map grid and numbering system were developed at a scale of 1"=100' to cover the entire state of Connecticut, providing MetroCast with the ability to keep all its systems on a consistent grid and provide room for future expansion. Using the map cut function in MicroStation, Precision Valley created and plotted 24-inch-by-36-inch maps for field walkout.

System Walkout: To create an accurate design for the upgrade, Precision Valley Communications personnel walked each street, identifying every piece of the existing system foot by foot and item by item for both aerial and underground plant, fiber optic cables, optical receivers, coax cables, amplifiers, taps, splitters, splices, power inserters, and power supplies. They also retrieved information for creating an accurate representation of the pole transportation infrastructure: pole numbers, pole types, transformer, utility attachments, homes, house and unit addresses, and feed locations.

Strand Mapping: Strand routing gathered from the field walkout was drafted using the Bentley solution's strand capability, adhering to SCTE engineering symbol standards as well as MetroCast project guidelines. Customer addresses were entered in an Oracle database for generating reports of various criteria, and each map was put through quality control measures to ensure that all field walkout information was drafted correctly and the address database was complied with USPS standards.

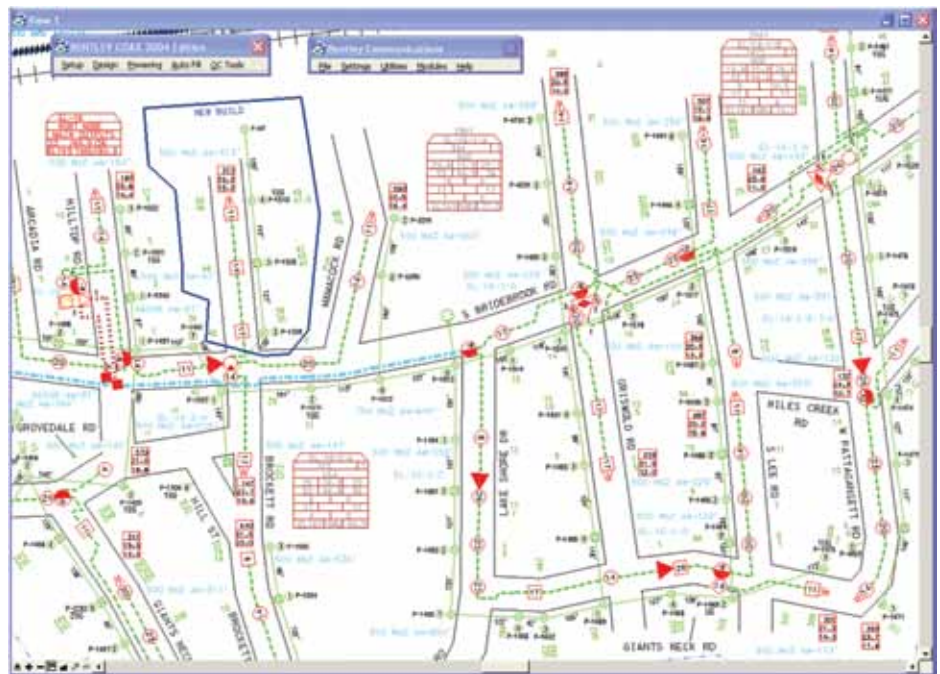


Figure 7: Strand and design in the Precision Valley Communications MetroCast upgrade

Optical Receiver Layout: Following the customer's guidelines, Precision Valley designers used a fencing tool in the Bentley solution to determine the total homes passed, not to exceed 500, in a given optical receiver (node) area or fiber service area. Once the

nodes were placed, the design was submitted to the customer for field verification and approvals, ensuring that the nodes would be located for the best possible accessibility.

Fiber Design Layout: A preliminary fiber route was made using the Bentley solution's fiber module. This allowed the designer to place the correct number of fibers to each node per customer guidelines (six in this case). The fiber route began from a headend and flowed throughout the designated towns, eliminating the need for three additional headends. Once the customer approved the routing, the node connectivity with the fiber cable was completed. Slack points, expansion loops, splice points, distances, and optical coupling (if needed) were placed using Bentley Fiber. Splicing diagrams and documentation as well as an itemized bill of materials were then sent to the customer.

RF Design: Engineers created an RF spec file containing all the active and passive equipment, operating level parameters, and insertion losses as well as the cable attenuation losses and loop resistance loss for system powering. From the node output(s), the RF layout was completed for each node area, maintaining the customer's required amplifier cascade maximums of node plus six. The goal was to hold as many active locations as possible using the smallest possible number of actives, passives, and power supplies while maintaining system integrity and ensuring the lowest possible operations cost. Like a giant puzzle, all the pieces needed to fit properly within the given node boundary.

Reports: Several reports were also provided upon request with the final design. A node report listed the node number, pole or pedestal location of the node, street location, total homes passed, and total miles in each node. The power supply report contained the PS number, where the pole or pedestal location was placed, street name, total current draw, and whether it is a standby or non-standby unit. Another report included the address listing and indicated the active, power supply, and node that serve each customer. Finally, an itemized bill of materials listed the equipment types and quantities of each device and whether the equipment is aerial or underground.

As-Built Changes: Once construction began, any field changes were submitted as as-builts by the customer. All changes were updated, powering was revisited if necessary, and all reports were finalized and labeled as as-built reports. The DGN files were sent to the customer for permanent record keeping. In the system used previously, updates had to be hand drafted and hand calculated from scratch, since any change removed what was previously completed. Now MetroCast will realize time and dollar savings for future changes as well as for record keeping and tracking.

Why Bentley?

As the world's leading company dedicated to providing comprehensive software solutions for the infrastructure lifecycle, Bentley believes in the vital role that infrastructure must play both in sustaining society and in sustaining the environment. Bentley has proven applications that help telecommunications engineers, architects, contractors, governments, institutions, utilities and owner-operators design, build and operate

The Bentley communications solution unites the engineering and design disciplines that build and maintain hybrid networks delivering more and more services to an expanding range of customers.

more productively, collaborate more globally and deliver infrastructure assets that perform more sustainably. Founded in 1984, Bentley has more than 2,700 colleagues in more than 50 countries, annual revenues surpassing \$500 million, and, since 1993, has invested more than \$1 billion in research, development, and acquisitions. Nearly 90 percent of the Engineering News-Record Top Design Firms are Bentley subscribers and a 2008 Daratech study ranked Bentley as the world's No. 2 provider of geospatial software solutions.

The Bentley communications solution unites the engineering and design disciplines that build and maintain hybrid networks delivering more and more services to an expanding range of customers. Featuring a unified interface, automated engineering calculations and time-saving, ready-to-use design elements, the solution helps users improve network integrity. It also facilitates workflows throughout the company and allows engineers to efficiently exchange drawings and other information with contractors and suppliers. Field tools give on-site technicians access to the network model, which reduces field errors, facilitates network updates, and ensures accurate as-builts returned to support operations and maintenance. Integration with OSS systems such as network management and workforce management enables optimal data flow from order inception to network activation. These advantages are achieved through an accurate, complete, and accessible representation of the network that is available to all departments, workflows, and OSS processes.

Successful cable telecommunications companies are prepared to give customers what they want, when they want it, and at a competitive price. They use their existing networks efficiently and expand them cost-effectively to offer new services to more customers. And they are able to meet the challenge that Pradeep Anand of Time Warner identified: manage their growing and diverse data so that, rather than a burden to engineers, it becomes a valuable information resource for the entire enterprise. The Bentley communications solution offers the key to maintaining a competitive and profitable position in today's challenging marketplace.