JPI's Jefferson at Dedham Station:

Verizon's First FiOS MDU

With one day's notice that FiOS would be available, JPI Partners grabbed for the brass ring

By Orrin Charm ■ *InfiniSys, Inc.*

It's no secret that Fiber-to-the-Premises (FTTP) is quickly becoming the preferred architecture for bringing data, video, telephone and future technologies to residential customers. But until recently, this was only true for single-family homes.

In MDU environments…equipment is typically clustered in dedicated telecommunications equipment rooms. Finding space for the fiber distribution equipment within each unit is not easy… apartments in MDUs tend to be smaller than single-family homes. Furthermore, the building electrical ground is often far from the ONT location in each unit.

Now with HDTV, IPTV, and other extremely bandwidth-intensive services in demand by single-family homeowners and MDU residents alike, MDU owners are also embracing advanced structured wiring systems, including fiber solutions, that will enable their buildings to remain competitive for years to come.

But when Verizon sought to bring its FiOS-branded fiber architecture to MDU properties, it found that single-family solutions did not fit multifamily design and building code requirements. At a pilot project with JPI Partners LLC in Dedham, Massachusetts, Verizon and JPI worked with InfiniSys Electronic Architects to create a Fiber-To-The-Apartment (FTTA™) solution that met everyone's needs.

Aerial view of Jefferson at Dedham Station under construction at the end of October 2005. There's no way to hang optical network terminals on the outside walls of mid-rises such as this.

The Jefferson at Dedham Station complex will attract commuters to downtown Boston. The typical demand in that area is by young professionals who got used to high bandwidth in college.

It wasn't easy. When Verizon told JPI that fiber services would be available at the Dedham site, JPI jumped at the opportunity even though construction was well under way, and no satisfactory solution for MDU FTTA existed! The stakes were high for Verizon, too. If FiOS is to be ubiquitous in urban areas, the MDU issues had to be solved.

Background

Verizon announced its FiOS service in 2003, designed to bring advanced voice, video, and data services directly to subscribers' premises over optical fiber, rather than the traditional twisted-pair and coaxial copper architecture. The physical components of the FiOS service were designed to suit single-family homes, where the Optical Network Terminal units (ONT's) would

typically be surface mounted on an exterior wall next to the electric service and ground of each home.

In MDU environments, however, and particularly with new construction projects, equipment is typically clustered in dedicated telecommunications equipment rooms. Finding space for the fiber distribution equipment within each unit is not easy, either – apartments in MDUs tend to be smaller than single-family homes. Furthermore, the building electrical ground is often far from the ONT location in each unit.

The challenge was to design a code-compliant inside and home-run wiring architecture that would accommodate all of the FiOS and structured wiring components within the unit space, meet both access and security needs, supply sufficient power, and provide suitable grounding. JPI turned to InfiniSys, Inc. of Daytona Beach, Florida, which has been designing the communications infrastructure for most JPI projects for over ten years. InfiniSys had also been working closely with Verizon on MDU deployment strategies for FiOS, giving it significant experience with both parties.

The ONT that Verizon had available was designed for outdoor installation – it is quite bulky and would not fit within any available space in the unit. The ONT was designed to be surface-mounted on an exterior wall and grounded directly to the building's primary service ground, which … create issues with building firewalls and violate electrical codes.

Adding Fiber Presents Challenges

The benefits of fiber are clear: Fiber offers much higher bandwidth, immunity from transients and grounding issues, better security than copper cabling and reduced long-term operating costs. However, it also presents some novel challenges.

Since fiber does not carry power, the power for the ONTs must be provided at the customer premises. In the event of a local power failure, the services would fail, including telephone service, which has traditionally been powered directly from the telephone company's Central Office (CO), and is considered to be a "lifeline" service.

As a result, FTTP installations must provide constant power to the ONTs. In single-family homes, this means that the ONT requires a connection to the home's electrical wiring, and also requires a battery back-up system.

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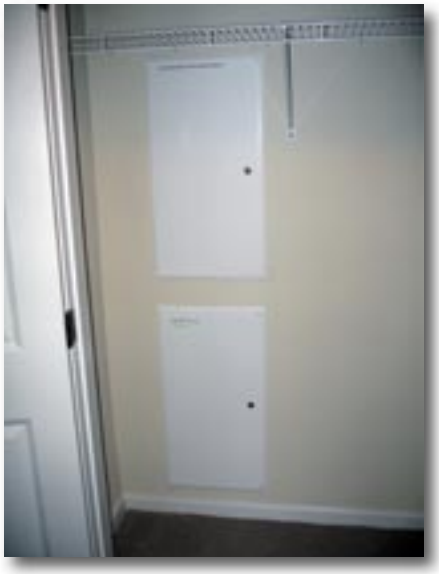
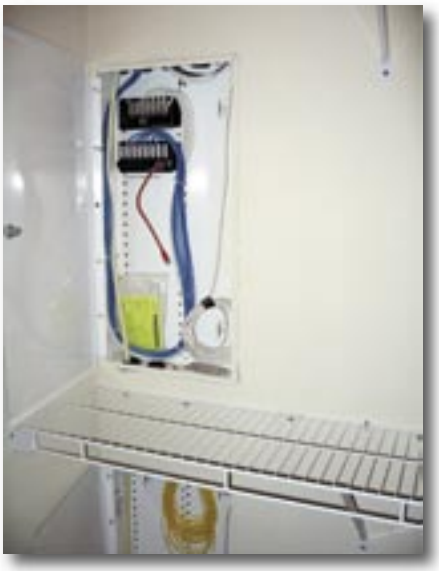
In a dense MDU setting, it is a challenge to provide space within each unit for the ONT, the power supply and the backup batteries – there is simply no space available for this additional equipment. InfiniSys realized that in-wall cabinets were the best solution, and quickly designed a new FTTA-capable Networked Apartment Commu-

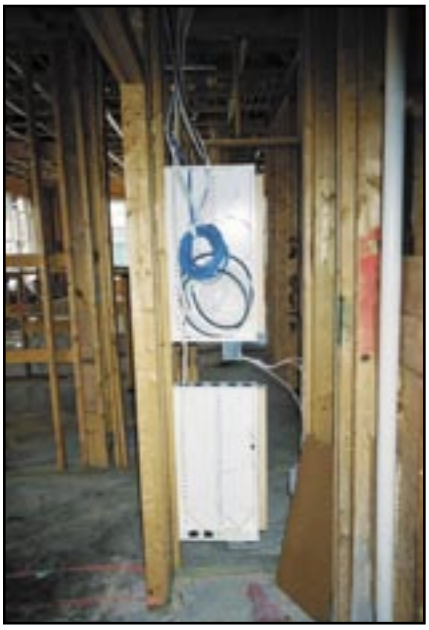


Residents see these two flush-mounted cabinets in a closet.



Cabinet wiring before adding the battery backups\ and ONT.

Customer premises equipment installed in residence cabinet.



Cabinets in the rough, before drywall.

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nications Gateway™ (NACG), which would house the Verizon FiOS components and the rest of the unit's distribution devices. Furthermore, by providing both power and grounding for all low-voltage devices within the cabinets, potential issues with both ground loops and damaging surges were avoided.

The new InfiniSys NACG™ actually comprises two flush-mounted cabinets, with one holding the Verizon FiOS components, and the other containing the other standards-based components of the unit's distribution system. Both cabinets are mounted in the same stud bay. The increased in-wall real estate and modular components allow for future expansion of the communications infrastructure, and separate access to the two cabinets alleviates possible regulatory concerns.

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Tight Schedules

JPI's Jefferson at Dedham Station development was originally planned with a conventional copper "Plain Old Telephone Service" (POTS) distribution plant. The day before prewiring – only two weeks before dry-walling was scheduled to begin – Verizon announced that it was upgrading the Central Office that would serve the site to FiOS.

As Henry Pye, JPI's Director of Resident Services and Technology, put it: "Less than 24 hours prior to the low voltage rough-in of Jefferson at Dedham, Verizon announced that the wiring center serving the site was being upgraded to FiOS.

Fortunately, InfiniSys had been working closely with the Verizon FiOS design team, and had begun to design several other slated JPI projects in Virginia and Maryland as FiOS deployment sites.

InfiniSys and JPI had less than two weeks to re-design, specify, and bid the FiOS upgrade, and commence construction to avoid impacting the overall construction schedule. The re-design and revised bids were completed within 10 days, and the additional NACG cabinets and fiber ducts were installed by the 14th day.

InfiniSys provided JPI with a complete set of engineered drawings detailing every component of the structured cabling and the FiOS system, from the site's Point of Entry (POE) to the terminations at each wallplate in the units. Also included in the documentation package were a detailed Scope of Work including testing instructions, a Bill of Materials and a 15-year warranty.

"Amazingly, working with the regional Verizon Outside Plant Engineering Team, InfiniSys and JPI were able to completely redesign, bid, negotiate, and execute the transition from a traditional POTS deployment to FiOS within 11 days. Micro-duct and additional structured wiring enclosures for the flush-mount SFU ONT were being installed within 14 days," said Pye.

"The overall construction schedule proceeded without delay; an astonishing achievement for a 300-unit, 8-building community."

Verizon was extremely (see "Amazingly" 2pps earlier!) responsive. Maureen Nolan and Paulette Alty from Verizon worked closely with Richard Holtz and Tom Stender of InfiniSys to meet the tight schedule and allow the installation contractors to proceed on schedule. According to Maureen, "This was an easy application, because all of the parties wanted the same thing. It was a pleasure working with Henry Pye at JPI – the fact that he was so knowledgeable about all of the technology and surrounding issues made it much easier for Verizon. Our biggest challenge is still educating our customers!"

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The low voltage installation was completed by Ken Maker, RCDD, and Tim Hooper from Connectivity Point Design and Installation, who had done several JPI installations in the Northeast, but had never pulled fiber micro-duct before. They installed the duct along with a quad-shield Series 6 and a spare Category 5e copper cable for conventional POTS voice services. Ken said, "Pulling the micro-duct was just like pulling an oversize coax cable. We were pleasantly surprised at how easily it was installed."

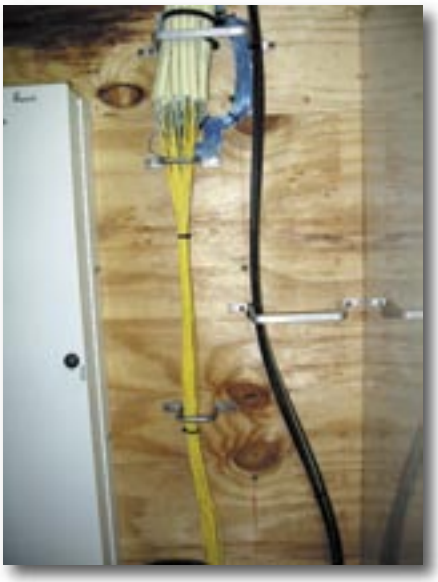
Ken Maker concluded, "It's obvious that the owners and designers of the project put a lot of thought into the technology infrastructure. The result is that the project is wired for the technology of today AND the technology for tomorrow. Connectivity Point was pleased to be a part of one of the first condo projects of this size in the area to get fiber to each unit.

"As a structured cabling contractor we expect to be installing more of this technology in future MDU projects."

Preparing for Fiber

Installing fiber facilities amidst the controlled chaos of a typical apartment construction site is a risky proposition. In order to simplify and coordinate the placement of the actual optical fibers, Verizon decided to install miniature fiber duct between the Building Communications Gateway closets and each unit. It was critical to install the duct during construction rough-in, because the access routes would be inaccessible once the drywall was installed.

Dura-Line Durethane 12mm Silicore duct for the blown fiber was installed from the Building Communications Gateways (BCGs) to each of the FiOS equipment enclosures, so the fiber could all be pulled at once after the rough construction was complete. This also allows for easy repairs and upgrades to the fiber in the future.



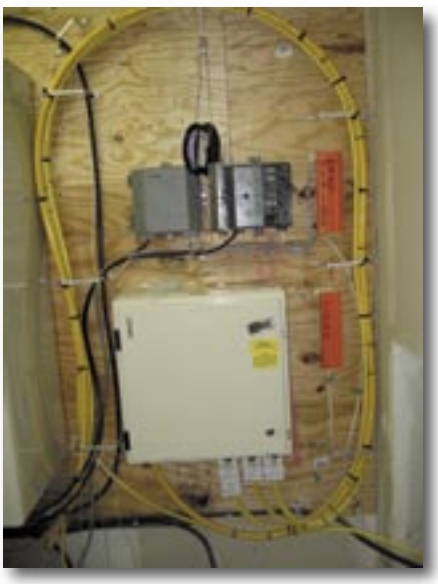
Building Communication Gateway end of the fiber runs.

Watch What You Pull

To minimize damage to the fiber during installation, Verizon first installed Dura-Line micro-duct to each unit. An interesting lesson was learned during the fiber installation: while the duct usually comes with a Teflon-coated pull string pre-installed, some of the duct arrived with a much smaller Kevlar pull string instead. Although it was much smaller and stronger, the Kevlar turned out to be abrasive, and tended to cut into the duct at bends.

As a result of the added friction, it took several installers and an air pump to pull out the Kevlar by hand, and pull in a new pull string, using many times the pulling tension recommended for the fiber home-runs, before they could pull in the fiber! Needless to say, Verizon and Dura-Line quickly replaced the remaining duct!

The micro-duct is far more impervious to damage than typical fiber cabling itself, and can be installed as part of a bundle with the conventional copper cabling run into each unit. The 12mm duct, which is also Plenum-rated, is relatively stiff. This made the installation a bit more time-consuming, but also made it difficult to kink or damage the duct during prewiring. There are also 8mm and 10mm ducts, which are more flexible, but must be installed more carefully to avoid kinks and hard bends.



At the Building Communication Gateway. Note the gentle bending radius of the fiber ducts.

Verizon pre-cut and pre-terminated the fiber strands, and installed them after the rough-in work was completed, but before drywall was installed. Verizon had originally intended to install the actual fiber as orders for the new services came in, but then decided to pull in all of the fiber as the rough-ins were completed. By installing in advance, Verizon was able to complete the work more efficiently, minimize trips to the site, and reduce inconvenience to the residents. Verizon was also able to avoid installing Remote Optical Terminals, which would have been required if it were to bring services over copper cabling to some units.

The FiOS equipment cabinets, which are identical On-Q/Legrand flush-mounted enclosures, were installed directly underneath the NACG cabinets, making connections between the cabinets straightforward. Each cabinet also has a grounded duplex AC outlet, providing both power and a bonded common ground for all electronics. This is critical to avoid ground loops and potential surges.

Verizon delivers all services to the property at the site's Main Communications Room, which is centrally located at the clubhouse to allow the service providers to access their systems at any time without disturbing the residents; however, the demarcation point for each unit is at the ONT in the closet. Verizon manages the electronics for the MDU FTTA FiOS system in the Building Communications Rooms and in the living units. The system is modular, so the service provider can change the electronics at either end to offer improved services as new technologies are introduced.

The optical fiber itself is more durable, easier to maintain, and takes up considerably less space than a comparable copper-based system. Also, the optical fiber is immune to RFI or EMI noise from proximity to electrical wiring or devices in long horizontal runs from the Building Communications Rooms to each unit, and eliminates potential issues with grounding or lightning and surge protection.

The structured cabling design followed ANSI/TIA/EIA-570-B Residential Telecommunications Cabling Standards.

Keeping Options Open

Although the Verizon FiOS service has the potential to offer a "Triple-Play" package of video, data and voice services, as JPI's Henry Pye says, "JPI believes in providing each resident a comprehensive package of the best possible services and technologies. Therefore, Comcast is also providing services

The Quick Download

Until recently, fiber-to-the-premise was possible only for single-family homes. In a span of 14 days, multifamily developer JPI changed that at its new apartment community in Dedham, Massachusetts – here's how:

- **MDU vs. Single Family – Know the Differences**

Space requirements, building codes, construction schedules, grounding issues and unit access are all vastly different in the MDU model. Do your homework before you start.

- **Trust Your Team**
  Brainstorm with your service providers, system engineers, and installers – their ideas might be just the answer you need for the challenges you're sure to face.
- **Hedge Your Bets**
  Fiber has shown great promise, but there aren't any guarantees. And residents expect choice anyway. Using fiber shows residents you're thinking ahead, but a secondary provider covers you under any circumstance.

over a traditional hybrid fiber and coax solution. Our residents have a choice between the two providers for all services."

Connectivity Point also installed an unused Category 5e cable from each unit to the BCG, just in case. As Pye said, "This was the first true FiOS MDU, and we hedged our bets."

Connectivity Point also installed a few copper-based telephone lines for fire alarms, elevator and pool telephones, and for emergency services. Those facilities are still not tariffed for FiOS, but fortunately, there was sufficient copper cabling available at the site to meet the requirements.

Summary

At the Jefferson at Dedham Station community, Verizon's FiOS fiber services use fiber cabling directly to the apartment, using the InfiniSys FTTA™ design, to offer state-of-the-art video, voice and data services now and into the future, over a single optical fiber. Residents have a choice of providers, can subscribe to a single provider at move-in with no hassles, and get all of their telecommunications services on a single monthly bill.

The property owner, JPI, has an infrastructure that ensures many years of service without the need for renovations or wiring upgrades. The fully engineered structured cabling system allows JPI to maintain control of its infrastructure, and gives it far more leverage in negotiating future service contracts than if it had left the cabling design decisions in the hands of the service providers.

To date, there have been no major change orders or problems with the FiOS. Henry Pye says the residents that have taken the service are extremely happy with the result. The successful FiOS installation at Dedham is the first of many JPI FiOS properties, and opens the doors for future MDU properties to enjoy the benefits of fiber-to-the-home services.

In addition to Dedham, InfiniSys was also commissioned to work on JPI developments slated for FiOS deployments in Alexandria, Virginia and North Bethesda, Maryland. The electronic architecture firm created the original MDU FiOS FTTA designs for these sites, which are scheduled to open in late 2006 and early 2007. InfiniSys is also currently designing another 2,000 JPI units for FiOS in Massachusetts, Connecticut, Maryland, and Virginia.

InfiniSys is working directly with Verizon to make FiOS an even better fit in both new and retrofit MDU installations. The company is also designing properties for JPI in Texas and Gray Development in California, where AT&T will provide services using its "Project Lightspeed" FTTA technology.

Fiber-To-The-Apartment is finally becoming the new standard for MDU communications services! **BBP**

About the Author

Orrin Charm is Systems Architect at InfiniSys. Henry Pye at JPI and Mike Whaling at InfiniSys contributed to this article.

Verizon's First MDU FiOS Deployment
Jefferson at Dedham Station
Dedham, Massachusetts

Hear Orrin Charm speak at this year's BBP Summit

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