PASSIVE OPTICAL NETWORK

Delivering Voice, Data and Video over Fiber

A Vision Technologies case study providing an overview of the design, installation and financial considerations of a Passive Optical Network for the new Marriott hotel, New York City.
VISION TECHNOLOGIES HELPS NEW YORK’S NEW MARRIOTT BECOME A PON PIONEER

Project background

In Manhattan, every square inch of usable space counts. For a 65-floor structure, energy bills are a huge line item to be managed. And for a hotel in the middle of one of the world’s most highly traveled cities, the ability to serve guests with world-class wireless access, telecommunications and in-room entertainment is a critical competitive advantage.

For reasons such as these, New York City’s newest Marriott became one of the first hotels in the world to carry voice, TV and data over a passive optical network (PON)—the same fiber technology that has been delivering FiOS to homes across the United States for over a decade.

However, the hotel’s original designs featured traditional Ethernet and copper cabling. Because PON wasn’t yet commonly used for enterprise and hotel networks at the time, the challenges and concerns of PON were better known than the benefits. How could voice, TV and Internet all work together on a converged network over one strand of fiber? Would splitting a signal up to 32 times negatively impact service reliability?

Drawing from their experience implementing such networks in enterprise, education, government and other facilities across the country, Vision Technologies saw the potential a PON could deliver for Marriott’s new high-rise hotel. The team addressed bandwidth (virtually unlimited with a PON solution), reliability and other technical concerns, and then presented a business case that convinced the building owners to implement a PON solution.

For upfront savings in terms of material, installation time and labor, PON enables the consolidation, streamlining and elimination of significant amounts of infrastructure.
Traditional Ethernet networks transmit data across heavy copper cables—typically one each for voice, TV and data. Each optical fiber on a PON, by contrast, can support multiple services.

Furthermore, PON solutions occupy a much smaller, lighter footprint. With a PON, a single optical fiber:

- Weighs roughly 1/12 the weight of the traditional “category” cable
- Can be less intrusively run through the walls
- Results in approximately a 50:1 reduction of plastic and a 3,000 pound savings per building on average

In contrast with the many switches throughout an Ethernet network requiring large storage closets equipped with rooms and racks, the passive splitters of a PON solution are roughly the size of a mini iPad, easily stored away in a small wall enclosure.

Furthermore, because PON fiber can span up to 12 miles compared with the 60-to-90 meters of a copper Ethernet solution, equipment closets were needed on only one out of three floors. This freed up the other two for housekeeping supplies, which results in big efficiencies and labor savings for a large hotel like the new Marriott.

For a network supporting 1,000 users, choosing PON instead of Ethernet translates into a 48 percent savings in capital expenditures alone. The case was compelling enough to persuade the building owners to make the switch.

**Key Activities**

The implementation team—which included Vision, Communication Outsourcing and Motorola—worked together to develop the plan for the new Marriott’s PON. The solution featured Motorola equipment, including two 1 x 32 splitters and one optical network terminal (ONT) per floor, and Swisscom equipment for the telecom piece. To give the hotel technology with ample room for growth, Vision proposed a turnkey gigabit passive optical network (GPON) instead of the Ethernet passive optical network solution that was the industry standard at the time.
Such foresight was fortuitous, as nearly two years passed between drafting the network plan and actually implementing it due to the extensive undertaking of bringing a 65-story hotel from blueprint to reality. And PON implementation couldn’t begin until the final stages of construction—after drywall was installed, carpet was laid and furniture bolted to the floors in each guest room (which is typical for hotels).

During this lengthy phase—with crews building the hotel itself and electricians pulling and terminating fiber—many of the next steps for Vision happened off site. They included coordinating with multiple service providers to determine vital details, like the number of strands on each splitter, the split ratio per PON port and how multiple “highways” over each fiber would deliver Marriott’s desired blend of voice, TV and data to each hotel room.

For television service, Vision and Teleautomation, the TV service provider, arranged for the delivery of the TV signal at a bandwidth that wouldn’t impact data transmission speed. Although Marriott only needed one-way signal transmission immediately (since pay-per-view was not offered in its guest rooms), the PON network’s ability to accommodate return paths gave the hotel the freedom to easily add on-demand videos and games in the future. (With a traditional Ethernet solution, such additions require extra electronics.)

The telecom piece involved working with Swisscom to plan out two virtually separated IP structures: one for the 6th through 33rd floors that would comprise the Courtyard hotel and another for the remaining floors, which is a Residence Inn. With a PON network, the core router is attached to the optical line termination in the data center, eliminating the need to have phone equipment throughout the facility. The PON does all the distribution.

For data, each room would be equipped with two types of service. A physical wired connection, delivered through the same box as the television and phone and accessed by guests via a hockey puck-shaped port on the desk, would support government and corporate guests who are prohibited from using wireless networks outside of their own facilities for security reasons. Meanwhile,
guests could use their laptops, tablets, smartphones and other devices via a wireless equivalent to what many enjoy at home.

Once building construction was ready for PON implementation, it was a rush to the finish line to get Marriott’s guest rooms up, running and ready for revenue-generating guests. The first step was to test the fiber installed by the general contractors’ electricians. Then the Vision team:

- Connected to the core network system and established uplinks
- Connected the phone system
- Started placing ONT devices in guest rooms to test for connectivity
- Programmed in the protocols and set-up information required for the VLAN set-up
- Integrated TV into the system so that signals rode independently from voice and data at a different bandwidth (enabling every TV in the PON to get an equal signal)

To efficiently bring all of the ONTs and other devices online, Vision created templates that enabled automatic software downloads when the system detected each box’s security number.

When installing a PON solution in a hotel, some of the greatest challenges can be related to the physical structure itself. For instance, an unconventional room layout, which can often be found in random rooms throughout a hotel, may not accommodate the standard set-up used in other rooms, necessitating extra time and planning on the part of the implementation team. Another hotel-specific quirk involves the placement of ONT devices within guest rooms. It is very important to keep these out of sight so curious guests cannot tamper with them.

In the Marriott installation, one of the culprits was a guest room mirror that, in the process of being mounted to the wall, resulted in a crushed fiber. Damage and the resulting repairs, requiring workers to cut through the wall, would have happened regardless of the network type, PON or traditional Ethernet. However, a PON
solution made the problem easier to find and fix. Through its precise remote diagnostic capabilities, the Vision team was able to hone in to within a foot of the affected area.

A PON solution’s remote diagnostics also are helpful for ongoing maintenance and network support. For instance, a network tech can log in at any time from his or her laptop, even from a different state, and spot an ONT that’s low on power within the three-hour window required to send someone out to change the battery. Network programming and provisioning also can be done remotely with a PON solution.

The final stage was testing. Vision tested 16 rooms at a time at maximum capacity: one person on the phone, another downloading videos, three or four using wireless devices and TVs turned on in the background. All passed with flying colors.

From start to finish, on site deployment of the new Marriott’s PON took roughly six weeks. Because a PON solution takes up less infrastructure space, especially in the ceiling, it requires 30 percent fewer people to install. In the case of the Marriott, Vision’s team of eight network engineers, ONT installers and project managers conducted the entire 65-floor implementation. Experience also enables a quick turnaround. Because Vision’s specialists are trained and certified in all of the major equipment manufacturers, and have experience with PON installations in other enterprise environments, the team was able to hit the ground running for the Marriott installation.

**Return on Investment**

Streamlined infrastructure and upfront implementation savings are just the beginning of the returns the new Marriott is anticipating for its investment. Compared with a traditional Ethernet network, a PON solution supporting 1,000 users is expected to generate 65 percent savings in overall operating expenses and 57 percent savings in total cost of ownership.

This ROI draws from a variety of areas, including:

**Energy efficiency**: With a PON, most components are passive and don’t require energy. Furthermore, because a PON does not have active units in its equipment closets, these closets don’t require air conditioning. This all results in a 68 percent
savings in power and cooling costs over traditional Ethernet solutions. In addition, the PON solution positions the new Marriott well for sustainability initiatives, such as LEED certification.

**Security:** The new Marriott’s PON solution uses 128-bit encryption to safeguard data, and because it’s fiber, there are no EMI signals radiating off the cable for a tapper to pick up on. Unlike traditional Ethernet networks, once a PON fiber is installed, tested and terminated, the only way to compromise it is by physically hacking into it. For reasons like these, PON is becoming the mandated networking solution for many U.S. government agencies. The new Marriott is ahead of the curve in a competitive and increasingly cybersecurity-sensitive marketplace.

**Troubleshooting:** PON eliminates many of the steps service techs must take when things go wrong. With multiple rooms and devices riding a single fiber, techs know that any problem is generally a programming issue that can be addressed swiftly and precisely via remote diagnostics. In contrast, tracking down such a problem with a traditional Ethernet solution generally involves on-site professionals running to the basement or a specific room to physically investigate matters.

**Maintenance:** The Marriott PON features carrier-class equipment by manufacturers such as Motorola, built for harsh conditions yet here installed in protected rooms. Vision specialists estimate that PON fiber infrastructure itself won’t need to be replaced for 25 years and that the hardware for 10 to 15 years, compared with a three- to five-year expected lifespan for traditional networking gear.

**Seamless customer experience:** By automatically distributing bandwidth to where it is needed, dynamic bandwidth allocation not only maximizes the Marriott’s
networking resources, it helps ensure that guests enjoy the best TV, voice and data experience possible. Because the switches are stacked, access to unused bandwidth is not typical with a traditional Ethernet network. Service availability also is better with a PON solution—“five nines” uptime (99.999%) versus the “three nines” (99.9%) with traditional networking.

Meanwhile, redundant backup systems for uplinks, processors, splitters and even ports ensure that PON-delivered services remain online for guests accustomed to constant voice, TV and wireless connectivity. For instance, a system can support two cards with the same information, meaning that a card can be replaced without causing an outage.

“Future-proofing” for competitive advantage: Looking ahead, the GPON solution offers 1.3 gigabits of bandwidth—a dramatic increase over the 400 to 500 megabits available in traditional hotel networks. This increase helps “future proof” the hotel for HDTV and new bandwidth-intensive games, entertainment offerings and guest-pleasing innovations on the horizon.

The Marriott NYC PON: Vital Statistics

- Building size: 65 floors, 650 rooms
- Equipment installed: Motorola, Cisco, Ruckus
- Services supported: Voice, data, TV, Wireless
- PON ports required: 28
- ONTs deployed: 650 (one per guest room)
- ONT’s deployed for wireless: 54