Corning Fiber to the Room Networks
An In-depth Analysis

Plotting A Course for the Future

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A. INTRODUCTION:

In mid-2018 *Engineering Plus*, *CompAdvise*, and *Qypsys* technology consultants/integrators conducted a network cabling and transport technology costing study analyzing three (3) hotel sizes (125 room, 500 room, and 1000 room) that are most often quoted and built. The purpose of this study was to analyze the cost of deploying a passive optical network in the hospitality setting and directly comparing that with the cost to deploy a traditional active network. The audience that this report was intended to serve was that of prospective hotel ownership groups, developers and major hotel flag technology leaders.

Over the past few years, the level of interest has grown exponentially in the desire to analyze the fiber to the room (FTTR) approach in various hotel size settings. The sales teams of the different manufacturers and integrators were often challenged with providing a direct cost comparison between the two technology approaches due to the fact there were so many variables to consider in cost. Major cost items such as the cabling, quantity of cabling routed to the room, labor, space and value of future proofing the network design is often hard to quantify and can differ based on materials used, location, union vs. non-union labor and hardware selection.

The team needed to select a technology manufacturer for the study, and after careful consideration, selected the Corning ONE™ SD-LAN offering enabling GPON Technology. Some of the key reasons their technology was selected include but not limited to:

a. The familiarity of the product line up by all vendors participating in the study
b. Recent deployments in the major market that the consultants operate within.
c. Increasing interest by major hotel flags and ownership groups in the approach.
d. The overwhelming success of the vendor collaboration in the design/approach.

B. OVERALL ACTIVE NETWORK VS. GPON NETWORK COST COMPARISON:

This section of the report discusses the costing for an Active/Traditional network to be considered against a GPON network installation.

For the sake of comparison, uplink and switch redundancy is not assumed in this costing exercise.

1. Active / Traditional Network: An active/traditional network consists of the core switch in the MDF, and edge switches in the IDF closets supporting the admin areas and guestrooms. The guestroom technology typically terminates into devices such as an access point featuring switch ports within the room to support guest technologies such as IPTV, voice and wired/wireless internet equipment. These devices then link to edge switches in the IDF closets and are most commonly aggregated in the closet and/or home run to the core via single mode or multi-mode fiber to the core/MDF.
2. FTTR Network: When utilizing the FTTR an Active Ethernet or PON are both valid approaches when considering not using the Active / Traditional Networking design. A GPON network is only one form of PON. When a PON is being implemented the design consists of the PON OLT in the MDF, and single-mode fiber routed to Passive Optical Splitters within the IDF closets that support the guestroom fiber connections. The guestrooms typically have a single ONT installed onto a wall plate affixed to the wall or located behind furniture/case goods to terminate one single mode strand and provide network connectivity to one or more Ethernet ports (with at least one usually providing POE+ power). These ONT network ports commonly support IPTV, voice and wired/wireless internet access point equipment.

FTTR is best applied to a property when the pathways for fiber can be engineered/designed in the most optimal fashion to take advantage of the ideal placement of IDF closets and shared infrastructure such as DAS technologies. Reductions in space and cooling can be best be achieved when the decision to use PON is made early or reflected in the basis of design.

The team started with a spreadsheet and laid out the cost centers to capture values which included:

- Layer 1 or cabling costs for the raw material inclusive of cabling, splitters and cable management.
- Layer 2 electronics: ONT's or switches.
- Labor: includes costs to install and integrate.
- Remote power: power for the ONT devices was assumed to be local AC or remote/DC power plant.

The team then added tabs to differentiate the union vs. non-union labor approaches, and category 6 (CAT6) cables assumed that the owner would select to run to the room. As an overall design consideration, the team compared each scenario with local and remote power.

- Union with and without remote power (3 cables)
- Non-Union with and without remote power (3 cables)
- Union with and without remote power (2 cables)
- Non-Union with and without remote power (2 cables)

The team then added a cost matrix to capture the costs of looking at union vs. non-union labor costs across the different room counts. From the population of these four (4) items, a total cost was calculated and then divided into the room count resulting in a cost per room which is a commonly used metric by many hotel owners and operators to analyze costs by.

C. APPROACH 1: TRADITIONAL/ACTIVE NETWORK

Assumptions: Includes all access switches, associated distribution layer, structured cabling, cable management, network engineering, and installation labor. Multiple scenarios with an IDF per every 1, 2, or 3 floors, depending on lengths. ***Excludes UPS and any AC power necessary to feed the switches.***

D. APPROACH 2: FIBER TO THE ROOM (FTTR) SOLUTION (CORNING ONE SD LAN)

Assumptions: Includes all network electronics, fiber cabling, optical splitters, cable management, network engineering, and installation labor. Multiple scenarios with an IDF per every 2, 3, 4, or 5 floors, depending on lengths. ***Excludes UPS and any AC power necessary to feed the ONTs. High-Cost Examples include Remote DC Power.***

The following tables illustrate CapEx costs to the owner for two unique network approaches in a hospitality setting. Approach 1 or Traditional Switched Ethernet is cited first. Approach 2 or Fiber to the Room is cited second. The table displays the lowest cost per room and highest cost per room for each scenario for the three (3) different sized properties. Neither table quotes hardware that is required in either approach at the core such as the core network switch or guestroom endpoints such as a wireless access point/switch. All active electronics and interconnects to the IDF closets, however, are included.

TRADITIONAL

IDF Count	4	13	25
Hotel Size (room count)	**125**	**500**	**1000**
Low Cost per Room	$1,062.00	$951.00	$901.00
High Cost per Room	$1,337.00	$1,218.00	$1,168.00

FTTR

IDF Count	2	7	13
Hotel Size (room count)	**125**	**500**	**1000**
Low Cost per Room	$1,080.00	$926.00	$878.00
High Cost per Room	$1,381.00	$1,220.00	$1,192.00

Caveats
Assumes all IP services (IPTV, VoIP, Data)
Assumes two (2) drops per room, and three (3) drops per room in each room count/labor scenario
Assumes both available AC and Remote DC power in each room count/labor scenario
Assumes IDF costs are identical in both approaches Includes no OPEX costs such as Maintenance

E. FTTR UPGRADE PATH/COST CONSIDERATIONS:

FTTR provides the hotel owner a unique upgrade path that is best suited to properties where higher degrees of bandwidth are likely to be needed in the near future. Should a property DAS be required, the solution becomes even more compelling. With the single mode fiber approach and using passive electronics from the OLT to the endpoint the same fiber used to support a lower bandwidth installation can be leveraged to a higher bandwidth installation by simply changing the endpoint electronics commonly referred to as the ONT.

Using PON in the hospitality setting also provides some additional benefits over active ethernet. These concepts are explored in greater detail below:

F. FTTR TECHNICAL ADVANTAGES:

In the team's experience, we found that selecting PON can provide additional benefits to the “end user” over a traditional active ethernet design because of the following points:

1. Initial setup time is considerably lower than a traditional active ethernet network considering cabling installation, switch and endpoint configurations when properly implemented.
    a. Largest time savings in using FTTR can be found in:
        1. Reduced cabling labor (most beneficial for cities requiring Union labor to be used)
        2. Reduced core and edge switch configuration labor

2. Limitations of traditional cabling are not present such as the distance of cabling runs or strict fill ratios within the conduit.
    a. The use of single mode fiber creates an infrastructure that provides enough capacity to support the next several generations of technologies and anticipated speeds.
    b. Provides 25-year or more warranty to the communications infrastructure.
3. The local area network does not need to have as many switches supporting the network design.
    a. When utilizing Passive Optical LAN Topology, each of the PON splits can support up to 64 end devices at a data rate of 2.4Gbps/1.2Gbps with a maximum span of 12+ miles.
4. Moves, adds and changes to the network design can be made to all the devices (ONT's) in a more global approach.
    a. Auto-provisioning of ONT's based on preconfigured profiles.
    b. Passive splitters can support any combinations of split ratios such as 1:4, 1:8, 1:32, 1:64, and 2x splitters as well.
5. Fiber communication is already secure by design.
    a. A fiber optic transmitter, cable, and receiver are needed to inspect traffic and in "practice" more difficult to tap. Alarmed fiber is already in use in many large governmental settings.
    b. Fiber optics are non-metallic and not susceptible to interference (EMI or RF).
    c. Fiber does not conduct electricity.
    d. Fiber can be impervious to outdoor conditions such as heat and moisture.
    e. Crosstalk is non-existent.
    f. Grounding is not required.

G. ECONOMIC ADVANTAGES:

FTTR can provide substantial savings in CapEx and OpEx compared to traditional network designs.

1. Can integrate property distributed antenna system (DAS) most efficiently compared to other side-by-side solutions.
2. Reduction in overall cabling to endpoints.
3. Reduction in IDF network closets.
4. ONT's are capable of being installed in the single gang wall plate.
5. Reduction or elimination of IDF closet cooling, and power.
6. Increased security to the overall network as closets are reduced in public areas.
7. Fiber cabling is smaller and lighter than CAT6 cables to run and support. Pathways can be reduced in size.
8. Cabling upgrades can be made simpler if original design anticipates refreshing properly.

H. BENEFICIARIES OF FTTR APPROACH:

1. **Architects**
   a. The most aesthetically pleasing way to run cable and less of it (if exposed).
   b. Able to hide cabling to high-density areas.
   c. Can locate ONT's in locations not visible to the naked eye.
2. **Low Voltage Engineers**
   a. Provide higher speed connectivity with less cabling.
   b. Require less cabling for densely populated areas.
   c. Time-tested communication cable delivery system.
   d. Industrywide familiarity and support options.
   e. 25+ year warranty available on cabling.
   f. The active network uses the same cabling core infrastructure.
   g. Provides a distributed power system that is predictable and future ready to power edge devices.
3. **Building Owners**
   a. The less costly solution for dense deployments.
   b. IT contractor familiarity to quote.
   c. Provides building upgrade path and lengthens the longevity of the asset.
   d. Comparable cost with other popular alternatives.
   e. Secure.
   f. Provide critical power to edge devices that would otherwise fail during a power outage or be at risk. Minimize legal risk.
4. **IT Management**
   a. Familiarity with cabling.
   b. High speed.
   c. High reliability.
   d. Easy to support.
   e. Relatively low-cost components.
   f. PCI compliant approach and can mimic a traditional network deployment from a logical security and segmentation perspective.
   g. Vendor support should converge in the near future.
   h. PON hardware is generally carrier grade with high mean time before failure.
   i. Enjoy backup power at a fraction of the cost if centralized/remote. Avoid triennial battery replacements throughout the property.
5. **Guests**
   a. High speed.
   b. High reliability.
   c. Very secure.
   d. Endpoints are often concealed and out of reach.
   e. Provides a path for future upgradability.

f. Easier for support to drill down to resolution faster as there are fewer points of failure between technologies.

6. **Administrative Staff**
    a. High reliability.
    b. Endpoints are often concealed and out of reach.
    c. PON environments tend to be better labeled and therefore easier to support pre/post opening.

I. SUPPORT CONSIDERATIONS:

There are many support benefits in using FTTR for your next hospitality project. Specifically, the top three that stand out are:

1. Reduced equipment footprint
    a. The horizontal fiber infrastructure leaving the IDF going to the individual guestrooms can take advantage of smaller diameter conduits to provide fewer pathways and/or higher density to large port groups.
    b. The smaller IT footprint in the MDF and commiserate reduction in IT spaces such as IDF closets leave less to manage from day to day. With centralized power and smart head end equipment adds/moves and changes are mostly automatic in reprogramming.
    c. The guestroom ONT footprint is also available in a single gang format to easily fit behind any wall mounted TV or within or under case goods for concealed use.
2. Greater programmatic control
    a. The uniformity of using the same manufacturer of the OLT and ONT allows for greater programmatic control, predictability, and expertise in troubleshooting and managing the passive network.
3. Uniformity of the hardware
    a. Using core and edge hardware from the same manufacturer allows for easier initial configuration, firmware compatibility/management, and vendor support pre and post opening.
    b. This single-vendor solution translates to the potential for a single management interface and easier management/learning-curve (when compared to managing multiple switches manufactured by different vendors on a traditional LAN).

J. 5 POINTS OF SIGNIFICANCE FROM ANALYSIS:

1. Installing FTTR is future-readying your hotel's infrastructure.
2. Once deployed, there is no need to change your cabling plant to increase your bandwidth.
3. Hardware provides telco-grade electronics which provides the highest degree of resiliency.
4. Ease of use and support, cloud access for support and maintenance.
5. Reliability of fiber compared to copper cabling.

K. TIPS AND TRICKS FROM THE FIELD:

1. Conduct installation sequencing conference calls early and often ahead of multi-vendor installation.
2. Inform everyone early of true hotel opening date and technology expectations for day one.
3. Schedule all critical vendors to have an onsite presence at the opening.
4. Obtain VLAN’s desired to use by the flag and agree what VLAN’s will be carried by AP’s in the guestrooms and lock down this list, so PON vendor knows what to make available.

   a. Evaluate if you are near the max VLAN limitation for the particular ONT you are using (not applicable to all PON ONT vendors).

5. In-room Category 6 cabling can be premade cable assemblies from the ONT to the end device.
6. Ensure all parties are aware of fiber termination type in closets and ensure it is recorded in low voltage drawings. Provide “dropbox” or similar link to all IT vendors and keep drawings current and synchronized across all trades.
7. Perform fusion splicing as close to the ONT installation timeframe as possible.
8. Perform ONT installation as close to opening as possible. Consider plastic wrapping installed ONT if significant dust will occur post installation in the guestrooms. Minimize dust as much as possible.
9. Solicit final room numbers from architect and distribute to IT vendors.
   a. Record serial numbers for ONT’s and map to architectural or final room numbers.
10. Ensure you have 1-2% spare ONT’s onsite in case the need to troubleshoot arises. (number correlates to total property room size)
11. Schedule your Head-end installation with your active network integration and try to overlap for cross-platform support
12. Document and publish if you are placing more devices on the ONT than just the access point. Clearly inform all parties as to what port 1 and port 2 (examples) will serve in terms of function.

L. CONCLUSION:

Our research has shown that definitive comparisons are extremely difficult due to variables such as union/non-union labor, ports/room, building size/shape, and traditional equipment brands/costs. We also see that, like traditional networks, the FTTR price per room trends down as the room count increases and at a slightly greater rate. The final finding is that, in most cases, there is not a major CAPEX savings or CAPEX increase using an FTTR approach. However, the long-term benefits and positive impact to total cost of ownership are undeniable.

A definitive CAPEX comparison has proven to be virtually impossible, given all of the variables. Details like the brand of traditional switches, a brand of category cabling, associated warranties, etc. can bring significant swings in the cost per port, cost per foot, and connectors needed to assemble a traditional network. Similarly, hotel brand guidelines vary greatly, impacting the ability to draw a consistent cost per room. Differences in electronics and infrastructure necessary to support IP services, analog voice, or RF video was an additional challenge. Add to these variables the differences in a union versus non-union labor or rates associated with direct work instead of subcontracting to general or electrical contractors and it becomes clear that the best way to estimate a cost per room is to deliver a typical range.

This study explored the variables associated with labor and port count but normalized on mid-range network electronics and cabling and eliminated the service differences by using only IP as a methodology to be able to draw conclusions from the differences in the typical ranges of the two approaches. Similarly, costs associated with telecom room space, power requirements, or pathways were not included to keep the focus on the hardware and cabling. A careful review of the table above should glean the following:

- Both approaches trend toward a lower cost per room as the room count increases
- FTTR represents a slight premium in a small property
- FTTR represents a similar cost in a midsize property
- FTTR represents a smaller cost in a large property
- The main difference in costs between the two approaches is largely represented by the use of remote DC power (There is no adder to traditional for their AC power needs)

- There is no definitive answer to which approach requires more or less CAPEX as design or labor variables could close the gap in either direction.
- The scenarios also specifically left out all potential impact of space, power, and pathway savings in an attempt to just compare networks and not their environments.
- A focus on the total cost of ownership, taking into consideration the lifespan of the electronics, the lifespan of the fiber infrastructure, and flexibility created by leveraging remote power to the solution.

Of course, this study was focused completely on the CAPEX comparison. It is worth note that had the study included a Total Cost of Ownership component, measured over a number of years, there would be no comparison. The longevity and future-readiness of the fiber are well documented. Potentially unlimited bandwidth in a cabling mechanism that will likely outlive its 25-year warranty is a very compelling advantage. While the telco-grade electronics carry no planned obsolescence or pre-determined end of life/support date they will probably require replacement in 10-12 years or when peripheral bandwidth/power requirements drive them out of service. This longevity still provides a longer lifespan than most traditional switch equipment deployments would.

Hotel refurbishment and network refreshes are well-known activities in most properties reaching a certain age. One of the greatest expenses in these projects is the rip and replacement of the network cabling. This activity usually carries the messy and very expensive proposition of cutting access hatches, creating pathways, and repairing the damage to walls and ceilings. The FTTR approach eliminates the necessity.

There has been a lot of attention put on the FTTR initiatives of the past several years. It is a relatively new and unfamiliar approach. As such, there has been a lot of attempts to combat its benefits with other copper-based solutions. A category cable to a wireless access point to leverage onboard ports or retaining analog connectivity or coax connectivity to phones and TV are good ways to extend the life of existing infrastructure or decrease the CAPEX in a new build, but they fail to address any of the long-term benefits afforded by the FTTR approach.

This study, minimally, should show that there is no significant CAPEX increase when building an FTTR network. And just as the appeal of this approach increases across size (ports, rooms, buildings), it should also increase dramatically when measured across time. This is an approach that is essentially cost neutral day one with significant TCO savings over a 15-20-year period.

M. TERMS/ABBREVIATION LIST

BOH	Back of House
DAS	Distributed Antenna System (Cellular)
FTG	Free to Guest
FTTR	Fiber to the Room
IPTV	Internet Protocol Television
GPON	Gigabit Passive Optical Network
LSP	LAN Service Provider
OLT	Optical Line Terminal
ONT	Optical Network Terminal
PON	Passive Optical Network
ROI	Return on Investment
CAPEX	Capital Expenditure (initial cost expenditure only)
OPEX	Operating Expenditure (cost over the life of the equipment use)

~ End of Report ~