

CHOOSING THE RIGHT HORIZONTAL CABLING SYSTEM > FOR HEALTHCARE ENVIRONMENTS

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WHITE PAPER

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EXECUTIVE SUMMARY

Installation of a cabling system in healthcare facilities involves consideration of many factors. The healthcare field provides one of the most demanding environments for a structured cabling system. Facilities are designed to operate for 50 years or longer. Adoption of 10GBase-T Ethernet is rapidly increasing and is expected to be the standard for the foreseeable future in healthcare facilities.

Applications running over healthcare networks such as Picture Archiving and Communication Systems, laboratory and radiological information, and Physician Order Entry systems require significant bandwidth. Infection control risk procedures and the nature of the healthcare environment place many restrictions on how and when changes to installed cabling can proceed.

Recabling a healthcare facility can cost 4 to 5 times the initial installation cost due to the environment of working in a 24/7 healthcare facility. Healthcare facilities have many sources of electromagnetic interference (EMI) and radio frequency interference (RFI) such as medical equipment, wireless communications, and generators that can significantly impact the performance of an Unshielded Twisted Pair (UTP) structured cabling system. IP convergence of Voice, Paging, Security, and Building Automation systems are adding to the diversity of systems structured cabling must support.

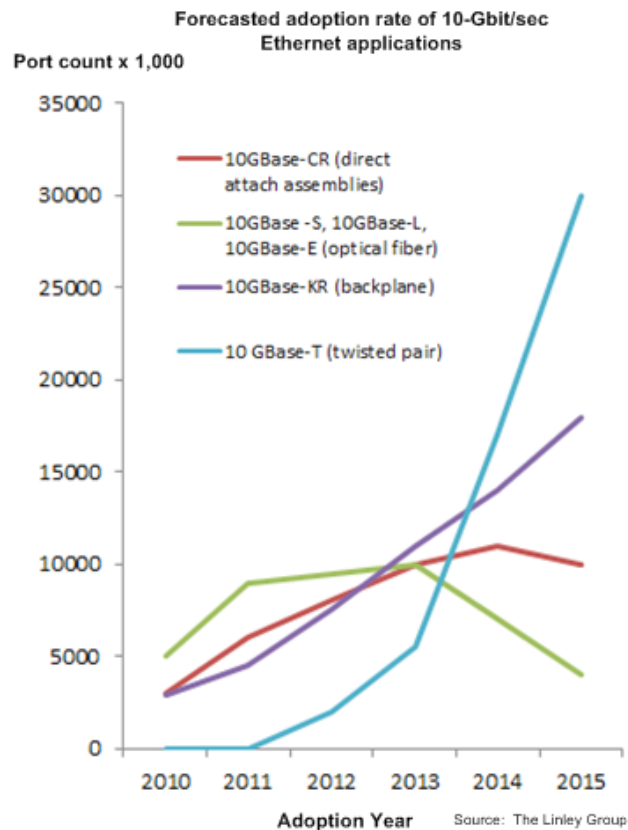
Patient Monitoring and Interactive Patient Systems are continually increasing in sophistication. Adoption and implementation of Power over Ethernet (POE) devices increases the temperature of the cabling system which adversely affects performance.

All of these factors point toward adoption of Category 6A F/UTP cable as the best solution when installing horizontal copper cable for your network infrastructure in healthcare facilities.

10GBase-T Adoption; Supports the Installation of Category 6A Cabling

A research report issued by The Linley Group (www.linleygroup.com) forecasts more than 2.7 million ports of 10GBase-T to ship in 2012 compared to the 182,000 ports shipped in 2011. The Linley Group's forecast shows a rapid increase in adoption of 10GBase-T for several different types of 10-Gbit/sec Ethernet applications over the next few years with 10GBase-T expected to become the most popular 10G application in 2014.

"Rapid adoption of 10GBase-T....over the next few years"



The Dell’Oro Group reports a similar increase in adoption of 10GBase-T. The Controller and Adapter 5-Year Forecast Report states that 10-Gbit/sec devices will grow at a compound annual growth rate (CAGR) of 33 percent over the next five years and exceed shipments of 1-Gbit/sec measured by ports in 2014. Adoption of Category 6A cable provides the foundation of a 10Gbase-T capable network that lower capacity Category 6 cable cannot support.

“A 30 Gigabyte file that takes 4 minutes to transmit at 1 Gigabit / second will take only 24 seconds at 10 Gigabits / second”

Healthcare Applications; Supports the Installation of Category 6A Cabling

The increasing adoption and use of electronic health information is contributing to a massive increase in traffic across healthcare networks. File sizes of digital x-ray images, MRI images and CT scans can reach 30 Gigabytes. Adoption of 10 Gigabit Ethernet can decrease transmission times by 90%. A 30 Gigabyte file that takes 4 minutes to transmit at 1 Gigabit / second will take only 24 seconds at 10 Gigabits / second. Quicker transmission of medical images improves the productivity of the medical staff and contributes to improved patient outcomes. Adoption of Category 6A cable ensures the lowest transmission times across all channel lengths. The following table demonstrates the difference in transmission times for the same file across different categories of cable.

Cable	Cable Speed	Transmission Time- 30 Gb file
Category 5e	100 Megabits / second	40 minutes
Category 6	1 Gigabit / second	4 minutes
Category 6A	10 Gigabits / second	24 seconds

IP convergence is also becoming a reality. Multiple cable systems will be consolidated on the structured cabling to support applications such as AV systems, facility controls, and patient monitoring systems. The increase in the diversity of applications on the cable plant suggests the most robust and longest lifespan cable should be installed to minimize disruption of operations. The adoption of Category 6A cable supports this dynamic.

Infection Control Impacts on Structured Cabling; Supports the Installation of Category 6A Cabling

Infection control is taking on increasing importance as the scope of Healthcare Associated Infections (HAI) has become known. A 2009

paper by the Centre for Disease Control and Prevention (CDC) estimated the total cost for HAI in the year 2007 to be between 28 and 33 billion dollars. About 10% of patients acquire an infection after admission, according to the CDC, resulting in over 1.7 million HAIs.

Approximately one-third of all hospital infection threats are airborne. To reduce the potential of airborne HAIs, Infection-control measures in a hospital environment include stringent regulations to contain airborne particles when removing ceiling tiles or other access to the plenum space is required. When performing moves, adds, or changes (MACs) to cable located in a plenum, the access areas to the plenum must be enclosed in a tent or the entire area around the access space may require isolation from the rest of the floor to prevent the spread of airborne contaminants.

“F/UTP cabling will minimize or eliminate the negative effects of EMI on the network”

In administrative and non-patient service areas where healthcare operations are not 24/7, work can be done after hours to reduce the impact on facility operations. In areas where operations occur 24/7, patient care and activities may be impacted and downtime for rooms and equipment connected to the cable plant may need to be scheduled. In either case, complying with infection control procedures will add time and cost to MACs for structured cabling. Installing the highest-performing cabling up front allows for the longest possible life cycle of the cable plant and minimizes the effect on patient care. Adoption of Category 6A cable supports the longest cable lifespan.

EMI in the Healthcare Environment; Supports the Installation of Category 6A F/UTP Cabling

The adoption and use of technology in healthcare creates an environment full of electromagnetic interference (EMI). EMI is generated from diagnostic and radiology equipment, wireless networks, and many other sources. This results in performance degradation on the network. Some of these devices in turn may be affected by EMI generated from the structured cabling. The TIA-1179 Healthcare Cabling standard recognizes the potential effects of EMI and suggests additional measures including isolation from or routing of cables around equipment capable of generating EMI. In addition TIA-1179 suggests testing cable performance while equipment is operating. F/UTP cabling will minimize or eliminate the negative effects of EMI on the network as well as protect equipment from EMI generated by the network. F/UTP cable includes a foil sheath around the four wire pairs that shields the cable from external EMI from other cables as well as other devices such as medical equipment that generates EMI. The benefits and advantages of using F/UTP cabling increases as the use of EMI generating equipment increases.

Power over Ethernet; Supports the Installation of Category 6A F/UTP Cabling

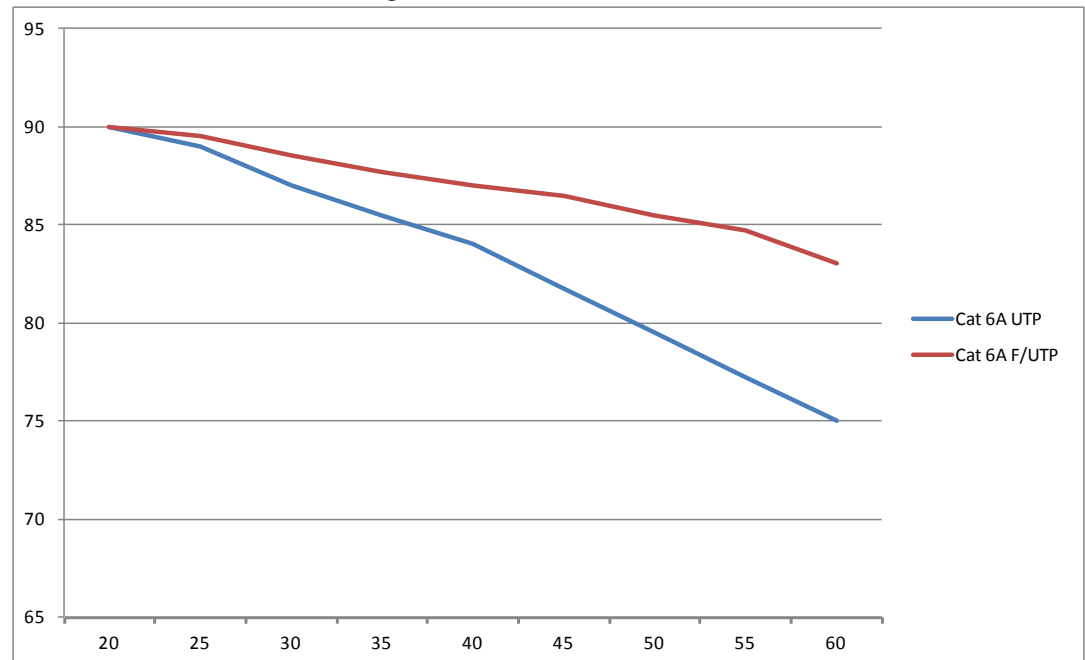
The IEEE 802.3at-2009 PoE standard, commonly known as PoE Plus, provides up to 25.5 W of power to a PoE device over a 4 pair cable. PoE Plus provides the capability for many more devices such as LCD displays, door access controls, pan-tilt-zoom cameras, and biometric sensors to receive power over the network. PoE allows for convergence of many systems that previously required separate cable systems to the structured cable system used by the network.

“PoE allows for convergence of many systems”

Delivering power via the cable causes a temperature rise within the cabling, which can result in increased insertion loss and potentially reduce network performance. The TIA standard addresses insertion loss by de-rating the cable as the temperature of the cable increases. As can be seen in the following graph, C6A F/UTP cable is de-rated less than unshielded cable. This allows F/UTP cable to support longer channels as temperatures and/or provide additional headroom on the channel.

TIA De-rating for Different Temperatures

Maximum Horizontal Cable Length (m)



Temperature (°C)

The superior performance of Category C6A F/UTP cable over unshielded cable at higher temperatures makes supporting POE and IP convergence easier.

TIA-1179 Recommendations; Supports the Installation of Category 6A Cabling

The TIA-1179 Healthcare Facility Telecommunications Infrastructure Standard accounts for the special needs and requirements presented in a healthcare environment. The topics discussed in this paper factored into the recommendations contained in TIA-1179. Following are a summary of recommendations that impact the choice of cabling.

"F/UTP cable eliminates the need to test for AXT"

- Category 6A cable is recommended for new construction to allow for the longest possible life cycle. This is consistent with the TIA 942 and IEC 24764 Data Centre standards.
- Enclosed pathways for cable should be considered in air-handling spaces to meet infection control requirements.
- Design cabling systems to support the longest possible lifespan to support the bandwidth requirements and mission critical nature of data transmission within healthcare facilities.

Advantages of Shielded F/UTP vs. Unshielded UTP Cable

Previous sections have discussed the advantage F/UTP cable has over UTP cable with respect to superior EMI performance, superior performance in high temperature environments, and elimination of signal radiation from the cable. In addition, shielded cable offers additional advantages.

- Reduced Outer Diameter for shielded cable compared to unshielded cable

The smaller diameter of F/UTP cable allows for more cables in each pathway or a reduction in the size of the pathway for the same number of cables.

- Elimination of Alien Cross Talk (AXT) testing

F/UTP cable eliminates the need to test for AXT. This reduces the cost and time required for testing of the cable plant. UTP cabling requires extensive testing for AXT.

- Ability to mix different categories of cable in the same pathway

Category 6A Unshielded Twisted Pair (C6A UTP) cable cannot be mixed with other categories of cable because of interference from alien cross talk. Networks using C6A UTP cable along with other categories of cable must employ separate pathways for C6A UTP cable. F/UTP cable can be mixed with other category cable in the same pathway.

“installing cable in a live healthcare environment can cost up to five times the installation cost when the facility is built”

- No issue with deformation of the jacket

UTP cable relies on the cable jacket to reduce AXT. Bending of the cable or deformation of the cable jacket by crushing in the cable pathway may reduce the effectiveness of the AXT protection provided by the jacket and create problems with transmission. F/UTP cable 360° foil maintains shielding in all circumstances.

- Simplified grounding and bonding

F/UTP cable provides a grounding and bonding mechanism within the cable. Unshielded cable does not provide this and requires external grounding and bonding.

Even if the C6A UTP cable passes testing during commissioning, any subsequent MAC can disturb the cabling and introduce AXT issues. These issues may be easy to detect but difficult to fix since the source of the AXT failure could be anywhere along the cable path. The potential of AXT failures coupled with the restrictions placed on accessing the cable plant in a healthcare environment and the TIA-1179 recommendation to enclose some cable pathways makes remediating AXT issues problematic.

Total Cost of Ownership

When installing a cabling system, costs beyond the initial purchase, installation, and testing costs must be considered. The cable plant is expected to be the longest living component of the network. Initial construction costs of a cable system are a fraction of the ongoing operation costs and costs to complete MACs. Replacement of cable in a live healthcare environment is the most difficult and potentially most costly component when upgrading an operational network. The cost of installing cable in a live healthcare environment can cost up to five times the installation cost when the facility is built. This is due to costs associated with working around the requirements and restrictions of an active healthcare facility. Any savings gained from installing a lower cost cable plant initially will be lost many times over after consideration of full life cycle costs.

The expected lifespan of the cabling system significantly impacts the total cost of the solution. If an organisation plans to occupy a building longer than the expected lifespan of the cable plant, removal costs of the existing cable must be included as part of the total cost evaluation as well as the purchase, installation, and testing costs of the replacement cable. Lost revenue caused by replacement of the cable system and incremental costs of replacing the cable plant in the existing facility must also be considered. For active facilities that operate 24/7 or are subject to Infection Control Requirements (ICR) procedures, replacement of the cable plant will impose

addition costs of complying with ICR procedures and/or forcing downtime of patient serving areas.

An analysis of installation costs for Category 6 UTP and Category 6A F/UTP cable at a healthcare facility showed per port installation costs as follows: Labour costs are based on a standard rate of \$65/hour. Cable cost is based on the use of plenum cable. Costs may vary by region.

“The expected lifespan of the cabling system significantly impacts the total cost of the solution”

Installation Costs		
Cable Type	Cost	Notes
C6 UTP	\$700 per port	Includes the cost of the cable, hardware, and installation and testing costs.
C6A F/UTP	\$1,050 per port	Includes the cost of the cable, hardware, and installation and testing costs.

Estimated Lifespan		
Cable Type	Cost	Notes
C6 UTP	5 years	Assumption is requirements of healthcare applications and upgrades of network equipment will require an upgrade to a 10Gb capable system in 5 years.
C6A F/UTP	15 years	Estimates for the lifespan of a C6A cable plant is 15 years.

Removal Cost		
Cable Type	Cost	Notes
C6 UTP	\$140 per port	Estimate of cost of labour and setup costs to meet infection control procedures and actual removal costs.

Upgrade Cost		
Cable Type	Cost	Notes
C6 UTP	\$4,000 per port	Assumption is C6 UTP cable will be replaced with C6A F/UTP cable.

“Consider the effect of the recabling project on patient and staff morale”

Facility Downtime Cost		
Cable Type	Cost	Notes
C6 UTP	\$? per port	Costs will vary with each installation. Potential costs include: <ul style="list-style-type: none"> • Lost productivity of workers disrupted by the recabling project • Lost revenue from any patient facilities that are closed during the recabling project

While not included, consideration of the effect of the recabling project on patient and staff morale and the potential effect on patient outcomes represents an additional cost to the healthcare provider.

Summary of costs over the 15 year lifespan of C6A cable.		
Activity	Cost - C6A F/UTP	Cost – C6 UTP
Initial Purchase, Installation, and Testing	\$1,050 per port	\$700 per port
Removal of Abandoned C6 Cable	N/A	\$140 per port
Purchase , Installation and Testing of 10G cable	N/A	\$4,000 per port
Facility Downtime Cost	N/A	?
Total	\$1,050 per port	\$4,840 per port + Facility Downtime

CONCLUSION

This paper has discussed the advantages of a Category 6A F/UTP cable solution over Category 6 cable and C6A UTP cable. Network products, healthcare applications, and infection control procedures support the adoption of 10GBase-T networks which require C6A cable.

TIA-1179 recommends Category 6A cable for any new construction in healthcare facilities. EMI generated in healthcare environments and the adoption of PoE devices supports the adoption of F/UTP cable to minimize disruption and maximise performance on the network. The risks and issues associated with UTP cable and the restrictions in the healthcare environment that make remediating these issues more costly and difficult provides a strong case for installing C6A F/UTP cable.

An analysis of Total Cost of Ownership shows the initial additional cost of installing a C6A F/UTP system is insignificant compared to the cost savings and efficiencies provided over the lifetime of the cable plant. The adoption of Category 6A F/UTP cable is the best solution when installing horizontal copper cable for your network infrastructure in healthcare facilities.