Information Technology Federation
Network Working Group

Recommendation for UM Campus Building Wiring Standard August 1999

Index *Page*

Information Technology Federation
Network Working Group

Recommendation for UM Campus Building Wiring Standard

By: Boys, Rich (SI) Hockett, Roy (ITCom) Hufziger, John (Fin Ops) Kjos, Dan (ITCom)
Maletta, Dan (EECS) Manor, Roger (EECS) Munce, Gary (ISR) Ogden, Jeff (Merit)
Palms, Andy (ITCom) Patel, Pradip (ITCom) Sarrica, Steve (H/Res Comp)
Singer, Chuck (MCIT) Weishan, Mark (LSA)

Charge

Network Working Group charge from ITFX: *"Consider the adequacy of existing building wiring plants to deliver the new services, and the extent to which new standards need to be set to guide upgrades of building wiring plans."*

Options, Considerations, and Current Practices

This paper focuses only on cabling systems that form the communications infrastructure within buildings at the University of Michigan. The Network Working Group evaluated fiber optic (FO) and Unshielded Twisted Pair (UTP) options for building riser and horizontal cabling solutions. The group also considered a wireless option in view of the current industry excitement with this technology. In an effort to come to an expedient recommendation the group employed the 80/20 rule. The evaluation and recommendation would focus on the "norm" and treat exceptions as they were encountered. With this as a foundation for discussion, category 3, 5, 5e, 6, and 7 UTP and fiber optic cable were discussed as options for the building horizontal cable infrastructure. In addition, the Anixter Levels '97 program was considered in terms of the specifications for Level 5, 6, and 7 (not to be confused with the Category 5, 6 and 7 specifications as described in the EIIA/TIA standards documents). High performance UTP and fiber optic cable were considered for the building riser infrastructure (verticle).

Horizontal Cabling

Category 3 UTP cable specifications and performance have been satisfactory for POTS (Plain O' Telephone Service), low speed data services and 10 Mb/s Ethernet. It is not satisfactory for the higher bandwidth needs of today's networking environment. The ITFX NWG found no reason to continue the use of Category 3 UTP cable and recommends that it no longer is offered as an option to the University community.

Category 5 UTP cable has provided the University years of good performance and has made the transition from 10 Mb/s to 10/100 Mb/s based applications very smooth. This

cable should provide satisfactory performance for 100 Mb/s networking applications. It is questionable as to whether it will provide adequate performance, over reasonable distances, for 1,000 Mb/s networking applications even though the current specification indicates that Cat 5 should support the new Gigabit ethernet standard. Some of the Category 5 UTP cable that has been placed on campus greatly exceeds the minimum performance standards as defined by TIA/EIA 568-A and should work satisfactorily for Gigabit technology. The quantity and location of this cable is not known since this cable was only tested to TIA/EIA 568 recommendations at the time it was placed.

Category 5e (enhanced Category 5) UTP cable provides a significant increase in performance over Category 5 UTP cable and will support the next generation network (1,000 Mb/s) at standards based distances. The cost differential between Category 5 and 5e is not significant enough to be a deterring factor in a cost/benefit analysis.

Fiber optic cable provides a significant improvement in performance over most UTP installations. The increased costs for this technology (cable installation and electronic costs) is producing zero demand for horizontal applications. The demand for this type of connectivity seems to be rather small and limited to research and development projects. The introduction of the Gigabit Ethernet standard has minimized interest in this technology for day to day desktop networking needs for the foreseeable future.

RG-6 coaxial cable is placed to end user locations requiring access to the campus UMTV service. This cable is placed only at the request of an end user.

Riser Cabling

Riser cabling refers to cables that link equipment in the main Building Communication Closet with equipment in the local distribution closets.

Unshielded twisted pair (UTP) riser cable for telephone service is installed as part of the campus telephony infrastructure. Typically the cost for this is covered by the project that supports the construction of a new building or renovation of an existing building. The number of cable pairs installed is dependent upon the size of the space to be served, the use of the space, and the number of proposed telephone sets plus a 20 % growth factor. The cost of future additions to this cable plant is born by ITCom unless the use of the cable is for non-telephony applications and the requesting party has a specific non-telephony use.

Fiber in the riser is installed on an as-needed basis. Departments require fiber as a integral part of a particular service they need - typically data networking. The size of the fiber is often minimized and sized for the specific application plus a few spares. A composite cable containing single mode and multi mode fibers is used. The size is usually recommended by ITCom but endorsed and paid for by the campus department.

Coaxial Cable risers are typically installed as needed. A large campus CATV system (UMTV) is in place but building distribution systems are only installed as needed.

Decisions and Recommendations

Building Horizontal Cabling

A. The ITFX NWG found no reason to continue the use of Category 3 UTP cable and recommends that it is no longer offered as an option to the University community.

B. The current Category 5 configurations offered on the ITCom Web page should be changed to reflect the additions and deletions as indicated on attachment A. It is recommended that the "***Minimum***" configuration for the University of Michigan be three Category 5e cables from the serving communications closet to a user outlet terminated with two phone jacks and two Category 5e data jacks. In addition, it is recommended that an "***Enhanced***" configuration be available, primarily to Medical Campus, consisting of four Category 5e cables from the serving closet to a user location terminated with two phone jacks and three Category 5e data jacks. Lastly, it is recommended that a third configuration "***High Density***" be offered, primarily for the School of Engineering, consisting of five Category 5e cables from the serving closet to a user location terminated with two phone jacks and four Category 5e data jacks.

C. The University of Michigan campus currently contains a large amount of Category 3 UTP cable. A rough estimate of cable on campus that is not Category 5 compliant is 40%, which translates to around 18,000 locations. Many buildings contain a mix of Category 3, Category 5, and coaxial cable for data connections. This will soon be compounded by the addition of Category 5e cable (and perhaps others). The University should have a ubiquitous high performance cable plant. The ITFX NWG highly recommends replacement of existing non-compliant building horizontal cable campus-wide on a building basis. A priority scheme, by building, needs to be developed and a replacement schedule developed. The ITFX NWG should be designated to develop this priority scheme. The benefits are:

1.) Ubiquitous horizontal cable plant that supports all services up to and including Gigabit networking topologies.
2.) Elimination of field surveys to verify cabling type to ensure that customer requests can be accommodated.
3.) Elimination of the large variety of existing cabling and connectors on campus.

Other possible options are identified below.

Option 1) Replacement of existing building horizontal cable campus-wide on a building floor basis. This would generally allow departments to upgrade the physical plant by work group and would facilitate administration of this resource quite well.

Option 2) Replacement of existing building horizontal cable as needed (current practice). This option is not endorsed by the ITFX NWG as it allows a wide variety of cables to be co-located in a single serving closet. This practice is resource intensive and often precludes rapid turn around times on service order activity. Every request for service in excess of 10Mb/s requires a field verification to confirm that the cable plant will support the requested service. If the cable will not, additional time and funding is needed to schedule and replace the cable. Funding issues often cause lengthily delays in service delivery.

D. Category 6 & Category 7 UTP cable was also evaluated. There is currently no standard for Category 6 and probably won't be for another year and a half. Additionally, it is the belief that the performance improvement is not significant enough to warrant consideration. Category 7 is anticipated to be a shielded cable, probably expensive, probably difficult to work with, and there is no foreseeable standard on the horizon. It is anticipated that the next quantum leap in horizontal cabling will be optical.

E. Fiber to the desktop was considered. Although it is an attractive solution from a performance perspective, a compelling technology that demands it could not be identified. Desktop machines are not currently shipped with a fiber interface therefore necessitating additional expense in external transceivers. In addition, the port density on hub equipment decreases and the interface costs increase with the use of fiber. Most existing network users do not use 10 Mb/s today. The new Gb/s will provide enough bandwidth to the desktop for the foreseeable future. Fiber to the desktop in the near future is viewed as a niche market and not a service that the ITFX NWG would endorse as a standard service offering.

F. In compliance with the ITFX request, the ITFX NWG discussed the possibility of wireless technologies as part of the building communication standards. The working group decided this technology was new enough that it could not be adequately addressed at this time. The working group will address this topic at a later time and requests the ITFX to identify the priority level of this project. Early discussion on this topic revealed the following:

- Wireless is not considered to be a substitute for wired.
- A wired installation is currently required to serve wireless installations (data and power wired to antenna locations).
- Leading technology vendors do not inter-operate.
- Installations are engineered according to the type of building construction and building layout which makes "standardizing" wireless difficult.
- Early adopters run a significant chance of equipment obsolescence or major upgrades within the first year to 18 months.
- The industry is too new to develop a campus "standard" yet.

G. The UM Plant Department has confirmed the requirement that raceways be used for all communication cabling. This provides maximum protection for the cable and minimizes interference from other utilities, especially electrical. The Network Working Group endorses continuation of this practice.

Building Riser Cabling

A. The current practice for sizing voice riser UTP cable is based on existing telephony practices and is endorsed by ITFX NWG.

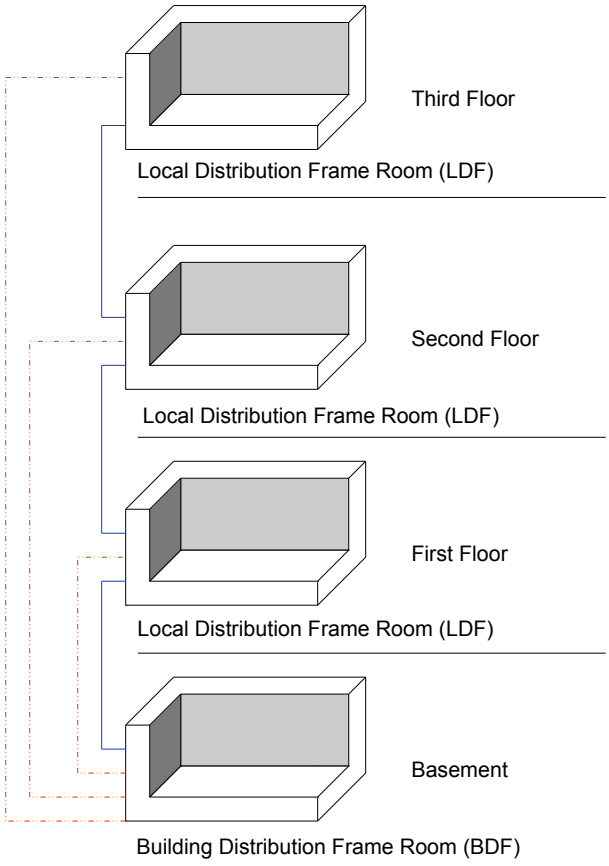
B. There is currently no standard for inter-closet (BDF and LDF's) category 5e cable for use in those instances where fiber may be too expensive to use due to the cost of electronics. The ITFX NWG recommends placement of 1 inter-closet category 5e cable per closet per floor plus 1 extra cable per riser (***see below sketch 1***)

C. It is highly recommended that building riser cable deployment be considered part of the campus communications infrastructure and funded in a model that provides consistency in installation throughout the campus and ensures adequate fiber cable in all communication closets for use by any faculty and staff. The current model of "fiber by demand" is not a good model for maximizing raceway, labor and other resources. The ITFX NWG recommends that a 24 fiber cable be installed from the building BDF to each building LDF. This cable should be composed of 12 single mode fibers and 12 multi-mode fibers.

D. The current practice on coaxial cable riser installs should continue - install per customer request.

Sketch 1

Typical Example for a 4 floor Building with one closet on each floor.



Inter-closet Cat 5e cables (Number of cables between any two closets = Number of floors + 1)

Inter-closet fiber cable (24 fibers - 12 singlemode and 12 multimode)

Attachment A

ITCom UTP Cabling Options

Existing UTP Configuration Options Available

Configuration	Phone Jacks	Ethernet Data Jacks	Cat 5 Data Jacks	Cat 5 Cables
Office Circuits				
Outlet One	2	2		2
Outlet Two	2		1	2
Outlet Three (standard)	2		2	3
Outlet Four	1		3	4
Special Circuits				
Outlet Two Special Circuit	2		1	2
Elevator or interior courtesy phone	1			1
Circuit for card reader, clock, alarm or other control	1			1

Recommended New UTP Configuration Options Suite

Configuration	Phone Jacks	Ethernet Data Jacks	Cat **5e** Data Jacks	Cat **5e** Cables
Office Circuits				
Minimum	2		2	3
Enhanced	2		3	4
High Density	2		4	5
Special Circuits				
Elevator or interior courtesy phone	1			1
Circuit for card reader, clock, alarm or other control	1			1
Other configurations are available				

**Note - Although a single gang outlet plate will accommodate up to 6 jacks, the minimum backbox for 4 cables or more should be a deep double gang box.

Attachment B

Standards and Reference Information

Standards and Reference Bodies

ANSI	American National Standards Institute
ICEA	Insulated Cable Engineers Association
ASTM	American Society for Testing and Materials
TIA	Telecommunications Industry Association
EIA	Electronics Industry Association
BICSI	Building Industry Consulting Services International
NEMA	National Electrical Manufacturers Association
NECA	National Electrical Contractors Association
UL	Underwriters Laboratories IEEE The Institute of Electrical and Electronics Engineers, Inc.

Standards Considered in Developing Recommendation

TIA/EIA-568-A	Commercial Building Telecommunications Cabling Standard
TIA/EIA-607	Commercial Building Grounding and Bonding Requirements for Telecommunications
TIA/EIA TSB 36	Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems
TIA/EIA TSB-75	Additional Horizontal Cabling Practices for Open Offices
NEC	National Electric Code
NFPA	National Fire Protection Association
NSC	National Safety Code