Kettering University

Voice/Data Communications Standards

University Building Standards

Version 1.7

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Information Technology
Kettering University – Information Technology

Change History

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Requirements Summary

1. Infrastructure Technical Specification for Kettering University

1.1. General Data Communication Requirements

A. Access Layer
   - Switched 10/100 Ethernet to each end device.
   - 1000 Mbps minimum uplink bandwidth with each switch supervisor engine configured to carry data traffic over one uplink to the distribution layer.
   - All access switches will have a second 1000 Mbps port available for manual recovery of failed uplinks.

B. Core/Distribution Layer
   - Terminate fiber uplinks from access layer (wiring closet) switches.
   - Provide switched 10/100/1000 connectivity to servers in the Academic Building server room, Campus Center Switch Room, and Mott Center Server room.
   - Route between VLANs supported in the access switches and the legacy network subnets.

C. The communications infrastructure at Kettering University includes 47 Telecommunication Closets (TC). The computer room, which serves as the Main communication closet (MC), is located inside the Academic Building. And a Secondary communication closet (SC), located inside the Campus Center Building.

D. The network design should support all data communications. The architecture of the new network leaves Kettering well positioned to implement video over the IP network should this become a future requirement.

E. The infrastructure will be flexible enough to support multiple Ethernet segments and will be scaleable for future use and growth.

F. The network will be manageable from the central computer room. Spares will be identified for swapping failed components.

G. All components used in the network will be proven solutions.

H. The new infrastructure will meet all IEEE and ANSI/TIA/EIA standards for structured wiring systems using CAT 6 unshielded twisted pair and single-mode/multi-mode fiber. All the hardware that is protocol dependent will be required to support industry standards for Ethernet (802.3) and TCP/IP. All network management software will support the industry standard SNMP protocol for managing TCP/IP based hardware.

I. All installation standards are to be met during the installation, including but not limited to:
   - IEEE 802.3 U Fast Ethernet Standard.
   - EIA/TIA 568B.2-1 Commercial Building Telecommunications Cabling Standard.
   - EIA/TIA 569 Commercial Building Standard for Telecommunications Pathways and Spaces.
   - EIA/TIA 606A Commercial Building Standard for Horizontal Labeling.
   - EIA/TIA 607 Commercial Building Grounding and Bonding.
   - EIA/TIA 526-14 Fiber Optic Testing Procedures.
   - NEC - National Electric Code (i.e. NFPA 70, Article 250, 300, 770, Chapter 2, 7, 8 etc.).
   - TSB-67 Performance Specs for UTP Cable Field-Tests.
• FCC Part 68 Connection of Premises Equipment & Wire to Regulated Network.

J. Existing equipment or cable should not be re-used but upgraded.

K. EIA/TIA T568B pin-outs to be used for data, USOC for voice.

L. All building data premise cabling will be terminated in the closets on RJ-45 Patch Panels, providing for quick moves, additions and changes. All 10/100/1000 connections within the Cisco switches will be RJ-45.

M. All cables labeled per EIA/TIA-606-A, Horizontal Labeling Conventions.

2. Kettering University Specific Requirements

2.1. Physical Requirements

2.1.1. Kettering University Requirements Summary
Guidelines concerning the number of communications outlets by room type are outlined below. Specific requirements for each room and each project shall be coordinated with the using agency at the onset of design for the project, the architect/engineer is cautioned that the Building Program also includes requirements, but may not be all inclusive regarding communication facilities. Therefore, the project architect/engineer must work closely with appropriate Using Agency and Voice/Data/Communications personnel during initial planning to assure total coordination and minimize the need for revisions or changes at the second or design development document submittal stage.

Faculty/Staff Offices - Each office shall have one communication outlet per 80 square feet. (Two CAT 6 Data per outlet and One CAT 6 Voice.) One communication outlet per designated occupant plus one spare cabled outlet for every two (2) occupants or fraction thereof or one communication outlet per 80 square feet whichever is greater.

This extra facility allows for future growth and/or high density office/business machines used concurrently with other staff activities.

Labs
One communications outlet for every 40 square feet of classroom space with 2 CAT 6 ports per jack. One designated Voice Jack (normally a wall phone).

2.1.2. End Device Connectivity Requirements
1. The horizontal links will include the 90-meter limitation of the horizontal basic link and up to six meters of patch cords and jumpers, which are used to join the patch panels and connecting blocks in the TC. If the equipment cable is used, then the total length of patch cords/jumpers, and equipment cables connected to the horizontal cross-connect should not exceed seven meters. The overall horizontal channel then encompasses the horizontal link and the three meters of equipment cord at the work area. The distance between the equipment in the work area and the active equipment in the TC shall be a maximum of 100 meters, regardless of media type.

2.1.3. Other Future Physical Requirements
This network has been designed to utilize 100% of the available jacks. Higher port density can be arrived at by adding additional switches. The network design will accommodate the addition of wireless access points at any time in the future. The Gigabit Ethernet architecture will provide a solid foundation for future deployment of video services over the IP network.
2.2. Functional Requirements

2.2.1. Facility Infrastructure Requirements
The following requirements have been identified for Kettering University:

A. If a project is for the design of new connections to the existing communications infrastructure, it must migrate into the existing communications infrastructure without impacting the existing production network.

B. Students at Kettering University expect network connectivity 24 hours per day, seven days per week. Therefore, the infrastructure must be available 24 x 7, with scheduled maintenance being the only exception.

C. The project includes informal training for support personnel on network troubleshooting, management of network components, and network component implementation.

D. The Main Computer Room is located in the Academic Building. The majority of servers are located in the Computer Room.

Assumptions

3. Assumptions for the Kettering University Network

A. Kettering University will purchase all data network equipment from the Build of Materials provided by Information Technology.

B. Jack specifications part number, quantity, and color will be the responsibility of Information Technology.

C. All building premises cabling will be Category 6 and terminated on RJ-45CAT6 patch panels in the closets. The Cable Installer will perform cable installation and termination.

D. Network Engineering will provide network electronics implementation support.

E. Additional or new server platform network interfaces and installation charges are not included in any design.

F. Existing production network and server connectivity must be maintained during the implementation of the network upgrade or addition.

G. The design solution provides for 100% utilization of the primary data drop at each jack location.

H. Wireless data network requirements must be addressed in detail for new construction. Sufficient network switch ports must be provided for a typical IEEE 802.11b/g/n wireless installation.

Constraints

4. Constraints for the Kettering University Network

4.1. Customer/Site
All closet locations and sizes have been designed to meet all IEEE and ANSI/TIA/EIA standards for structured wiring systems.

4.2. Critical Business Schedules
Information Technology Department must be made aware of any schedules that will interfere with installation.
5. **Network Logical Design**

5.1. **LAN Topology**
- VLANs will be established to provide broadcast domains of up to 254 devices per domain.
- The new LAN topology will provide a dedicated 10/100Mbps switched port for each device through an Access switch in the TC. Devices will be assigned to a VLAN based on the device type, location, and application.
- Access switch VLANs will be trunked over Gigabit Ethernet uplinks to a distribution backbone switch.
- Existing legacy network ATM ELANs will be connected to the new Cisco 6509 distribution switch.
- Routing will be handled by the Cisco 6509 MSFC routers. The backbone switch (distribution) will have redundant MSFC router modules running Hot Standby Routing Protocol (HSRP) and providing routing between VLANs.

5.2. **Proposed Active Components**
All closet uplinks will connect to the Gigabit Ethernet fiber ports on the Gigabit port line card located in the computer room. The C3750 switch was selected to satisfy requirements for all closet upgrades. The C3750, a non-modular, single power supply switch with 48 10/100 ports is also capable of dual Gigabit Ethernet uplinks to the 6509 distribution switch. All network jack hardware to be Hubbell brand, cable wire CAT 6 solid copper.

5.3. **Redundancy & Resilience**
The 6509 switch provides complete redundancy with the exception of a redundant chassis. This is a reasonable approach given the fact that the chance of chassis failure is very low. The remainder of components in this critical switch is completely redundant including: power supplies, supervisor cards, MSFC routers, Gigabit Ethernet cards, and 10/100 Ethernet cards. Single points of failure include the chassis, any single connection Gigabit Uplinks (the GBIC interface) and single server interface connections.

The 4006 chassis includes redundant power supplies, multiple Gigabit Ethernet uplink ports and multiple 10/100 cards. Single points of failure include the Supervisor Engine and the GBIC uplink interface if a single uplink is implemented.

The C3750 switch does not provide redundancy for any components. This is addressed by purchase of “on the shelf spares” which should be included in any proposal. This is a reasonable approach given the low port density of any potential outage.

The issue of providing redundant closet uplinks to the 6509 distribution switch is an optional point of redundancy. Providing redundant closet uplinks ensures that a link failure to the closet on the fiber or switch interface itself (short of a multi-fiber cut) will not take down a closet switch. Sufficient fiber is in place to provide this level of redundancy and the only additional electronic components required would be an added GBIC module on the closet switch and the distribution switch.

5.4. **Protocols**
TCP/IP and Novell’s IPX Protocol (Short-lived) will be the supported “routed” protocols. The MSFC routers support multiple routing protocols. Current routing is being accomplished with a combination of static routes and RIP v1. The recommended routing protocol is EIGRP due to its simplicity and superior performance.

5.5. **Network Addressing**
The current addressing scheme will extend into the new VLAN structure, bridging ELAN broadcast domains into VLANs. The 192.168.254.0/24 network has been selected as the new network management VLAN. Addresses for
all switches will be assigned from this subnet. This subnet is reserved for Network Electronics only. No other equipment should be addressed or have a connection on this VLAN. The standard designation is to use “VLAN1” as the management VLAN.

5.6. **Network Management**

All equipment is manageable via SNMP.

6. **Network Physical Design**

6.1. **Horizontal Wiring**

Category 6 - 4 pair cables will be used and will be terminated on Category 6 jacks. These cables will be run in the ceiling cable trays; J hooks and/or conduit to either surface mount or flush mount jack plates depending on the location of the jack plate.

6.2. **Backbone Cabling**

Optical Fiber

1. Installed transmission performance of optical fiber components shall meet the minimum requirements of ANSI/TIA/EIA-568-A.
2. All optical fiber runs shall be connected straight through, with no transpositions of fiber pairs or cores/strands.
3. The maximum pulling tensions for tight-buffered or loose tube optical fiber cable shall not exceed the cable manufacturer’s specifications.
4. As a minimum, the two-fiber cable bend radius shall not exceed 30 millimeters (1.18 inches). Compliance with the cable manufacturer’s bend radius specifications, which exceed the above limits, shall be met.
5. The optical fiber links shall pass through no more than two pieces of connecting hardware in a cross-connect.
6. The optical fiber connecting hardware shall be installed to provide the following:
   - A neat, well-organized installation, with optical fiber management and sound optical termination practices in accordance with manufacturer’s guidelines;
   - Color coding, labeling and documentation consistent with the intention of ANSI/TIA/EIA-606.
7. Optical fiber connecting hardware shall be protected from physical damage and from direct exposure to moisture and other corrosive elements.
8. Whether the 568SC optical fiber patch cords are used for cross-connections or interconnections to equipment, they should be in a cross-over orientation, so that position “A” goes to position “B” on one fiber, and position “B” to position “A” on the other fiber of the fiber pair.
9. If the connector can be separated into its simplex components, each end of the 568SC optical fiber patch cord shall be identified to indicate position “A” and position “B”.
10. The backbone and horizontal premises cabling shall be installed so as to pair an odd numbered fiber with the next consecutive even numbered fiber – fiber 1 with 2, fiber 3 with 4, and so forth – to form two-fiber transmission paths. Each premises cabling segment shall be installed in a pair-wise cross-over orientation, as follows:
    - Odd-numbered fibers are position “A” at one end and position “B” at the other end
    - Even-numbered fibers are position “B” at one end and position “A” at the other end

6.3. **Security**

Security to these rooms will be the sole responsibility of Kettering University. Access will be provided for Cable Crew at the time of installation.
6.4. Connections

6.4.1. Work Area Connections
Workstations will be attached to the Kettering University network at the user location through new jack faceplates. The jack faceplates will provide a 10/100Base-T connection (Ethernet). Jack position #2 and 3 for connection to a 10/100Base-T NIC at the user workstation (position #1 is for voice). This applies to all office locations. In the lab areas, Position 1 and 2 is for data and Position 1 may be used for voice if planned.

6.5. Telecommunications Closets
For newly renovated building or areas to connect to the Kettering University Campus, all cabling will be Category 6. Closets will utilize CAT 6 patch panels and all cable will terminate on these panels.

6.6. Test and Acceptance
To be provided by Installer Cable Crew. And submitted to IT for final approval.

6.7. Cable Layouts
Installation Practices

1. Proper practices shall be observed for horizontal and backbone cabling to ensure initial and continuing performance of the cabling system over its life cycle.
2. Cabling links shall be installed in a manner that facilitates labeling and documentation. Color-coding practices consistent with the requirements of ANSI/EIA/TIA-606A shall be adhered to.
3. The connecting hardware shall be protected from physical damage, and from direct exposure to moisture and other corrosive substances.
4. The connecting hardware shall be securely mounted on walls, floors, racks or other stable and accessible surfaces.
5. The connecting hardware and all other cabling system components shall be installed using proper cable preparation, orientation, mounting, and termination practices in order to minimize signal impairment. All practices shall be in full compliance with manufacturer’s guidelines.
6. Connecting hardware shall be installed to promote orderly, well-organized cable management.
7. Additional care shall be taken to ensure that cables are suitable for the environment in which they are installed. For example, temperature shall not adversely affect performance beyond the design limits of each link.
8. The maximum cable pulling tensions and minimum bend radius shall not exceed manufacturer’s specifications.
9. Cables shall be installed in pathways and spaces that afford adequate protection from weather and other hazards that are typical to the environment. Cable weight shall be taken into consideration.
10. Cable stapling of any recognized media type shall not be permitted.
11. Cables shall not be placed into a raceway, cabinet, enclosure, or other fixture. Nor shall it be placed over a bend delimiter or edge that is beyond the cable manufacturer’s bend radius requirements.
12. Cable support mechanisms – such as, hangers, rings, and hooks – shall not be spaced farther apart than 1.5 meters (5 feet). All manufactured raceways used for cables shall be installed according to the raceway manufacturer’s specifications.
   • Telecommunications cables shall be supported with devices designed for this purpose and shall be installed independent of any other structural component – for example, conduit, utility pipes.

6.8. Rack Layouts
Rack layouts to be provided by Information Technology Department.
6.9. Labeling Convention

Campus Horizontal Labeling Conventions in accordance with EIA/TIA-606-A, “Naming and Labeling of Network Elements & Cable” provides guidelines. Labeling provided by the installer. It should be noted, that by horizontal cabling we are referring to any piece of the cable plant that feeds directly from a Telecommunications Room out to a users outlet or work area. This includes cable that feeds out to a consolidation point in the work area.

Horizontal Cable and Outlet Boxes

1) Each end of the horizontal cable should be labeled on the outside jacket of the cable within 12 inches of the termination points.

2) Outlet boxes shall be labeled on the appropriate area with the name of the cable without the room designator. For example, the outlet connection for 0047-1A-1B05 should be labeled 1A-1B05.

3) A name is constructed combining the pertinent labels from the appropriate infrastructure elements. For purposes of saving cable tests, the full name should include the Owners designated room number, Telco Room number, rack number, patch panel letter and port number.

Example:
6.10. Wiring Connection Records

Wiring connection records to be provided by installer.

6.11. Office Jack Layout
6.12. Lab Jack Layout

7. Design Deviations

None identified.
8. Revisions

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Page 9

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Inserted CAT6 (for clarification)

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Page 13

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