Technology Cabling and Infrastructure Guide

Information Services – Instructional Technology – Technology Services

FCS Technology…Exceptional Service, Innovation, and Excellence

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FCS Technology: Who Are We & What We Provide

Forsyth County Schools is entering a new era in the use of classroom technologies. For many years we've weeded out all the extras, focusing our efforts on growing a standard set of hardware and software. Through this effort, our students and teachers can expand learning in powerful and important ways. More recently, Forsyth County implemented a *Bring Your Own Technology Program (BYOT)*. New thinking is springing up, not just about the tool's students have available to use, but about the way Technology Services provides support in all areas. We have seen the benefits of allowing students to choose tools to direct their own learning.

There are two guiding principles for classroom technologies that drive the work of Technology Services:

1. District efforts are focused on employing Grappling's Spectrum of Technology Uses. Of the three levels of the spectrum, Forsyth County Schools is increasing the transformational use of classroom technology, which is where students are information producers, not consumers and where students to go beyond existing information.
2. The second is a focus on the 4 C's of Transformational Learning including Creativity, Communication, Collaboration and Critical Thinking.

To support the school system's technology initiatives, Instructional Technology Specialists are assigned to each school to work with teachers to model teaching and learning strategies for technology integration.

Teachers and Administration participate in on-going professional development to experiment, initiate, and create new models of teaching and learning for dynamic and changing curricula.

Teachers throughout the district can now share resources, activities, and assessments through an online repository of digital learning objects.

The bottom line: Teachers are designing higher quality work for students, and we are achieving greater student engagement and improved scholastic performance.

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Network Infrastructure Guidelines

1. General requirements

1.1 On premise connectivity

All building closets (IDF) aside from the main closet (MDF) shall be provided with two or more separate links via fiber optic cabling (Multi Links on Multi Strands) to the main closet of the site. All closets within one physical building shall be provided with two or more separate links via fiber optic cabling (Multi Links on Multi Strands) to the main closet of the site (known as the MDF). Any building-to-building cabling must be in underground conduit unless a retrofit has been ordered where aerial (Under/Above Breezeways roofing, etc.) conduit installation is the only method possible. **See fiber specifications in section 1.4 and 2.**

FCS Technology will not provide Internet/WAN/LAN connectivity until all data rooms are secured, cleaned, climate controlled, and have stable power service as outlined in this document.

1.2 Data outlet type and distribution

All building spaces shall be provided with data outlets with stainless steel faceplates. Quantity and positions in accordance with the needs of the location or the requirements of the blueprint documents. **Data outlet layouts designed by a project architect or project manager shall be approved by the Forsyth County Schools Technology Department before preliminary acceptance.** Preliminary and final acceptances are conditional on receipt of documentation.

1.3 Wireless infrastructure

All building spaces shall be provisioned with **dual outlet Category 6A Bonded** data outlets for wireless access points (Wi-Fi, wireless APs) unless the blueprint documents or project plans deviate from this guideline. Due to this rapidly changing technology, design shall be performed only by the Forsyth County Schools Technology Department.

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1.4 Cabling etc. requirements

Any work involving installation, re-installation, modification, or movement of data outlets requires that the outlets be (re)tested and (re)certified**. All data outlets shall be RJ45 outlets to Category 6+ standard.** All horizontal cabling (i.e., cabling connecting RJ45 data outlets and/or fiber optics connecting closets and electronics) shall be made with approved products and terminated in data racks or cabinets in accordance with Section 5. **No cable run shall be longer than 328ft or 100m to include the length of patching cables.** Where necessary, a building shall be provided with more than one wiring center or IDF. **All four post rack layouts shall be designed by the Forsyth County Schools Technology Department ONLY.** Four-Post Racks should be floor mounted, unless authorized by Forsyth County Schools Technology with #6 green ground cable attached to each four post rack of all closets with ground lugs to be on bare metal. All data closets shall have their data cables and fiber optic cables dressed neatly. We require that any cables that are below ceiling height be dressed in color coded Velcro. Velcro must match the color of the cabling. This will be inspected by the Technology Department for approval. The installer will be required to provide 1 ft. Thin patch cords for every MDF/IDF. They will be color coded also according to the data jack it is installed in. Station side patch cords should be provided for the Wi-Fi locations, IP paging locations, IP Phone and VDU. Thin 3ft Cat6a yellow for Wi-Fi, 2 per Wi-Fi and standard 5ft cat6 for IP paging speaker. Thin 1 ft Cat6 black or IP phones for classrooms. Thin 7ft Cat6 black for IP phones for offices, 3 per office.

2. External services

2.1 External cabling and micro ducts

Data connections between buildings shall be made using fiber optic cables. Copper cables are not permitted between buildings. **The default standard for fiber optic cables is 12 strand armored single mode fiber.** Fiber optic interconnections between wiring closets and buildings shall be designed as shown in schematics by the Forsyth County Schools Technology Department. Wherever possible, interconnections between buildings shall be made using fiber in approved inner-ducts; between buildings these shall be installed within the normal 4-inch ducts. **Fiber optic cables for external connections shall be terminated in rack mounted metal termination boxes fitted with duplex LC connectors ONLY.** The patch panel boxes shall be appropriately sized to accommodate the needs of the closet plus future expansion. The rear cable entries shall be slotted to allow removal of the cable without the need to cut and re-terminate it. **Single-mode and multi-mode terminations shall not be mixed in the same fiber termination box unless prior approval is acquired.** Each pair in a fiber optic installation shall be fitted as a crossover. **Schools built in a campus design shall be connected with single mode fiber between all locations.**

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3. Wiring Closets

3.1 Access

Data closets shall be secure (lockable) rooms keyed to a district technology grand master. Key issue shall be restricted to Forsyth County Schools Technology Department staff members only. Access must be available to authorized Forsyth County Schools Technology Department staff members, including out-of-hours access. Closets shall be located so that access is from indoor public areas rather than departmental areas, which may be closed off, if possible. **Access to staff other than the Forsyth County Schools Technology Department and their contractors is prohibited.**
Access for contractors will be by arrangement with the Forsyth County Schools Technology Department. All data closets should have video surveillance and electronic access control. **MDF closets should be no smaller than 10' by 16'. IDF closets should be no smaller than 9' by 9'.** Both MDF/IDF should be centrally located on each floor within their coverage area. **Copper drops will never traverse from one floor to another.** In a multi-story building, it is ideal to have closets vertically aligned.

3.2 General design and layout

Data Closets shall consist of a dedicated room provisioned with appropriate services for lighting, power, and cooling. **The room shall not be used for storage or any other purpose not directly related to the delivery of Forsyth County Schools data services.** Data closets shall not be used for site power distribution equipment other than that dedicated to the operation of the data equipment unless not possible through retrofit. Certain other building services shall be excluded from data closets. These include but are not limited to water supplies, drains (including drainpipes), and heating pipes. There must be no water or liquid pathway, sources or outlets in the ceiling above the cabinet(s). This includes wastewater pipes, chilled water pipes, hot water pipes, sewer pipes, and rainwater downpipes unless it is not possible through retrofit.
New data closets shall be capable of accommodating an appropriate number of four post racks to meet total outlet count necessary with room for expansion. After construction and decoration, and before any active equipment can be fitted, the data closet shall be thoroughly cleaned to eliminate all dust and debris, including racks and the interiors of data cabinets. **Flooring in all data rooms should be polished concrete or waxed VCT (Five coats of wax required). MDF and all IDFs require 3/4" plywood backboard mounted to wall behind four post racks with building ground bar attached. Part # example: Panduit GB4B0612TPI-1.**

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3.3 Power and environment

Adequate ventilation and/or cooling shall be provided to maintain a nominal room temperature of 72 degrees Fahrenheit and no more than 50% relative humidity. Each data closet shall be provided with a dedicated 110/120-volt outlet fed from a dedicated main supply. Two circuits per cabinet in Data Center settings. Additionally, **two 30-amp 208/240-volt service outlets – one from house power and the other from a generator are required and shall utilize an L6-30 outlet.** Placement of outlets must be at the discretion of the FCS technology department. Each data closet must have building ground. The placement of the ground bar must be at the discretion of the FCS technology department.

4. Data outlet distribution

4.1 Design and planning

Data outlet quantities and locations shall be designed by or in consultation with the Forsyth County Schools Technology Department before construction. **Subject to the foregoing and the rest of this section, data outlet layout may be designed by a project architect or project manager but shall be approved by the Forsyth County Schools Technology Department.** Such approval shall be conditional on receiving lists of quantities and drawings indicating proposed layout. High-level data outlet quantities and locations for wireless AP's shall be designed by the Forsyth County Schools Technology Department. All data outlets shall be fitted in pairs, as "twin" or "dual" RJ45 outlets. All components of the installation shall be to bounded Category 6A standard for wireless and Category 6+ for all other drops, unless previously agreed with IT Services, shall be chosen from a single range of the products listed in Section 5, and shall only be installed by an installer approved by the manufacturer for that product range. In under-floor spaces, where outlets are to be in floor boxes, rigid conduit must be utilized. Where wiring runs are not in such spaces, they shall be enclosed in plastic latch duct on the surface of a wall. Designers should note that bounded Category 6A cable is significantly thicker than older types and should use one of the readily- available cable containment calculators to ensure adequate containment provision. Prior to commencement of cabling work, DWG, VISIO, or Blue Beam files shall be provided to the Forsyth County Schools Technology Department so that modeling software can be used to determine precise quantities and locations of all data outlets. Audio visual cabling will be addressed on a case-by-case basis, as it is no longer part of a standard building design used by Forsyth County Schools.

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4.2 Installation

4.3 Cabling

All data outlets shall be labeled in accordance with the Forsyth County Schools Technology Department. Cabling should be separated in the tray by type and/or color. All horizontal cabling (i.e., cabling connecting RJ45 data outlets) shall be installed with approved products contained in Section 5 and certified to comply with the relevant standards. Below ceiling cable bundles shall be secured with Velcro cable ties (**velcro color must match color of the cable)** or an equivalent cable tie designed to prevent any possibility of crushing or deforming the cable. Above ceiling may use standard cable "zip ties". All data cabling must be one continuous unjointed length from patch panel to outlet and shall not have splices or in-line connectors other than those
integral to the patch panel and the room outlet. No "consolidation points" shall be used. For reasons of warranty, cables shall not be installed by one contractor and terminated/tested by another unless by prior approval from the Forsyth County Schools Technology Department. Final acceptance of an installation is conditional on receipt of documentation by the Forsyth County Schools Technology Department as described in Section 8. Forsyth County Schools Technology Department will not patch or "make live" any outlet until it has been finally accepted as above. Please refer to attached drawing for a "Typical Rack" design. **Any ladder rack used should be one continual piece until a turn or joint is needed and should end at a logical place to meet cabling requirements.**

4.4 Cable Tray

Forsyth County Schools Technology should have the first 12" above the ceiling grid for the cable tray. All trays should be mounted to the wall and not ran down the center of halls. All cables that are not data or paging should not run through the cable tray. (Fire Alarm, Motion, Smoke Protectors, Keypads, Badge access provide their own pathway.)

Cable Tray Part Numbers

Main Halls-
12" Cable Tray – Black – WBT2x12BL
L bracket tray wall mount – Black – L BRACKET 12 BL
Corner bracket – Black – RADIUS CORNER SPLICE BL
Splice Kit (attaches basket together) – Black – SPLICE KIT BL
Office Halls-
6" Cable Tray – Black – WBT2x6BL
L bracket tray wall mount – Black – L BRACKET 6 BL

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4.5 Wireless

The requirement for design and layout by the Forsyth County Schools Technology Department for data outlets supporting wireless access points shall be included in any requirements for new or refurbished building work. Inclusion of dual data outlets for wireless access points shall be included in designs for corridors, open spaces, office space, classrooms, and other areas that may be advised by Forsyth County Schools Technology Department. Prior to commencement of cabling work, DWG, VISIO, or Bluebeam files shall be provided to the Forsyth County Schools Technology Department so that modeling software can be used to determine precise quantities and locations of dual data outlets for wireless access points. Wireless access points shall be provisioned and installed with due regard to wireless and client density, interference, propagation differences at different wavelengths including 2.4GHz and 5GHz and using different modulation techniques including but not limited to 802.11a/b/g/n/ac, interaction with neighboring wireless access points, and any building features or construction which may impede the signals. Dual data outlets using the bounded 6A standard for wireless access points shall be either wall mounted or securely fastened with termination boxes at above ceiling level, or such as to allow for ceiling mounted access points, to be decided by the Forsyth County Schools Technology Department according to the type and model of wireless access point planned. High-level outlets and mounting bracket positions for wall mounted access points shall be fitted at a height of approximately 9 feet from the floor. Data outlets intended to serve ceiling-mounted access points shall be in such a position as to be readily accessible to authorized Forsyth County Schools Technology Department staff without the use of specialist tools or equipment for the purpose of patching to the access point when fitted or serviced. Where external Wireless Access Points are required, weather proofed AP's shall be used.
See color coded guide for cabling requirements. All wireless cabling should be terminated in vertically adjoining patch panel locations. (See FCS Technology Staff for help with this.)

5 Preferred Structured Cabling Hardware

5.1 Four Post Cabinets – Typically used in MDF and IDF applications.

Panduit Part# R4P36CN or equivalent. Wire manager part number PE2VD06 for the 4 - post cabinet.

Wall Cabinets – Typically used in small IDF applications

Hoffman EWMW362436 Wall Cabinets

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5.2 Floor Standing Cabinets – Typically used in Data Center applications

Panduit Net-Access S-Type cabinet – Black – Example: N8522B

5.3 Overhead Cable Pathway (Ladders, etc.) – Typically used in Rack and Cabinet applications MDF and IDF applications – Below Ceiling Grid/Exposed

Chatsworth 12” Cable Runway - 10250-712 (Black)

Wall Bracket – 11312-712 (Black)

Waterfall – 12101-701 (Black)

Data Center applications – Below Ceiling Grid/Exposed

Chatsworth 12” Cable Runway - 10250-712

Wall Bracket – 11312-712

Waterfall – 12101-701

J-Hooks for Hallway and Common area applications when applicable – Above Ceiling hooks by Caddy Cat12, Cat32, Cat64 or equivalent.

5.4 Fiber Enclosures

Must supply a minimum of four extra adaptor slots for the MDF closet and two extra adaptor slots for the IDF closets.

MDF Rack Mount Enclosures

Panduit 4U Fiber Enclosure – FRME4 (Black)

Appropriate LC termination panels (SC or ST are not allowed)

IDF Rack Mount Enclosures

Panduit 1U Fiber Enclosure – FRME1 (Black)

Appropriate LC termination panels (SC or ST are not allowed)

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5.5 Structured Cable Plant and Jack Specifications

Panduit CAT6A UTP Cable matching the color codes in Section 5.9 Plenum Rated cable required for ALL above ceiling applications

Riser rated cable ONLY when specified otherwise

Panduit CAT6A Key Connect jacks matching the color codes in Section 5.9

5.6 Patch Panels

Panduit 1U 24 Port Modular Patch Panel – NKFPL24

Panduit 2U 48 Port Modular Patch Panel – NKFPL48

Panduit Net Key NKF2S 2 port Stainless Steel Face Plates with Labeling Pockets

(2,4, & 6 ports). Phone Wall Plate- KWPY.

5.7 Cable Management

Vertical Cable Management

Switch Rack: Panduit PE2VD06 - Install in between 4 post racks and both sides.

5.8 Patch Cables

Copper Patch Cable Specification: Bonded Category 6A and Category 6+ Panduit

Bonded Pair: 3ft, 7ft, 10ft, 15ft, 20ft, 25ft

MDF and IDF Panel to Switch Cross Connect: 1ft (Thin design cable only) Device

side: 7ft, 10, 15ft (20ft and 25ft for extended connection)

Fiber Patch Cable Specification: Single-mode patch, LC connectors

Panduit Fiber Patch Cables: 1m, 2m, 3m

MDF and IDF Enclosure to Switch & Switch to Switch Cross Connect: 1m, 2m, 3m

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5.9 Color Coding

Structured Cabling Color Coding: Cable Specs

Blue: General Data (including cameras and phones)
Yellow: Wireless Access Points

Jack Color Coding

White: Clear Touch – Cat6 NK688MWH

Off White: Future Classroom Camera – Cat6 NK688MOW

Blue: General Data – Cat6 NK688MBU

Yellow: Wireless Access Points – Cat6A NK6X88MYL

Blue: IP Phone Equipment – Cat6 NK688MBU

Green: IP Cameras/Access Control/Alarm – Cat6 NK688MGR

Purple: Intercom – Cat6 NK688MVL

Orange: HVAC/Electrical – Cat6 NK688MOR

Gray: Virtual Camera – Cat6 NK688MIG

Black: Access Control – Cat6 NK688MBL

Red: Alarm – Cat6 NK688MRD

Data Closet Copper Patch Cable Color Coding & Part Numbers

White: Clear Touch – Cat6 UTP28SP1WH

Off White: Future Classroom Camera – Cat6 UTP28SP1OW

Blue: General Data – Cat6 UTP28SP1BU

Yellow: Wireless Access Points – Cat6A UTP28X1YL

Blue: IP Phone Equipment – Cat6 UTP28SP1BU

Green: IP Cameras/Access Control/Alarm – Cat6 UTP28SP1GR

Purple: Intercom – Cat6 UTP28SP1VL

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Orange: HVAC/Electrical – Cat6 UTP28SP1OR

Gray: Virtual Camera – Cat6 UTP28SP1GY

Black: Access Control – Cat6 UTP28SP1BL

Red: Alarm – Cat6 UTP28SP1RD

Classroom Copper Patch Cable

White: Clear Touch – Cat6 UTPSP5WH

Off White: Future Classroom Camera – Cat6 UTPSP3OW

Blue: General Data – Cat6 UTPSP5BU

Yellow: Wireless Access Points – Cat6A UTP6A3YL

Blue: IP Phone Equipment – Cat6 UTPSP1BU

Green: IP Cameras/Access Control/Alarm – Cat6 UTPSP3GR

Purple: Intercom – Cat6 UTPSP3VL

Orange: HVAC/Electrical – Cat6 UTPSP3OR

Gray: Virtual Camera – Cat6 UTPSP3GY

Black: Access Control – Cat6 UTPSP3BL

Red: Alarm – Cat6 UTPSP3RD

***Fiber Patch Cable Specification*: LC OS2 9/125 (125 Microns) (Yellow)**

Panduit Fiber Patch Cables: 1m, 2m, 3m

MDF and IDF Enclosure to Switch & Switch to Switch Cross Connect: 1m, 2m, 3m

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6 Layout

6.1 General

Cabinet and rack layouts shall be designed by the Forsyth County Schools Technology Department. Contractors shall not install ladders, racks, patch panels or wire management until they are in receipt of final layout documents. General network racks are composed of groups of panels. Upper panels are for General Data, IP Phones, and WAP's. Lower rack panels are for IP Cameras and Access Control.

7 Vendor Staff Conduct and Regulations

7.1 General Conduct

Vendor staff members working for Forsyth County Schools are subject to general conduct or common-sense conduct observance. Profanity will not be tolerated. Any blatant use of profanity will result in that staff member being asked to leave the location where work is being performed. Violators of this rule will be immediately asked to leave the site and subsequent violations will result in permanent banning of the violators from the project site indefinitely. Vendor staff members must communicate in ways that do not disrupt the learning and administrative processes that occur throughout the day in our schools. (Example: Yelling down a hallway excessively).

7.2 Clothing and/or Uniform

Vendor staff members must wear uniform clothing which represents the vendor performing the work. Though we cannot enforce appearance of members 100%, it is requested that staff members have their shirts tucked in to project a more professional operation. Torn pants or shirts are not allowed. The wearing of backward hats is not allowed. Clothing must never contain the advertising of alcohol or tobacco products at any time.

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7.3 Alcohol and Tobacco Usage

The use of any alcohol, tobacco, or vaping products is not allowed in any building owned or operated by Forsyth County Schools. Violators of this rule will be immediately asked to leave the site and subsequent violations will result in permanent banning of the violators from the project site indefinitely.

7.4 Background checks and ID

All vendor staff members that work on projects in schools operated by Forsyth County Schools are required to pass a background check. The background checks are signed off by the offices of the superintendent. After a staff member is approved, the approved staff member must acquire a color-coded ID badge from the central office print shop before working in a school.

8 Acceptance of Services and Products

8.1 Documentation

Prior to final acceptance and payment, documentation must be provided showing all data cabling locations and where they correspond to regarding endpoint-to-endpoint mapping. Room numbers, Patch Panel slot labels and ports, and closet room number must be documented together. This is to aid in knowing where cables begin and end from each direction.

8.2 Building clean up

Prior to final acceptance and payment, all cleanup must be performed. This includes cleaning floors of debris, restoring ceiling tiles to their proper installed location, replacing damaged ceiling tiles or ceiling grids, and removing boxes for new parts and equipment.

8.3 Product Inspection

Prior to final acceptance and payment, a general inspection of parts and equipment will be performed to ensure that no damage has occurred during the installation process. Bent, scratched, and damaged equipment will not be accepted. This includes issues with threaded holes, latches, fasteners, and hinges that may be present.

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9 Acknowledgment of these guidelines

The below signature acknowledges that all guidelines have been read and understood by the service provider and all associates involved. Any deviation from these guidelines are subject to possible delay of payment unless prior approval was obtained for such deviations from the original design.

_____

Company Name

_____

Valid Signature

_____

Printed Name

_____

Job Title

_____

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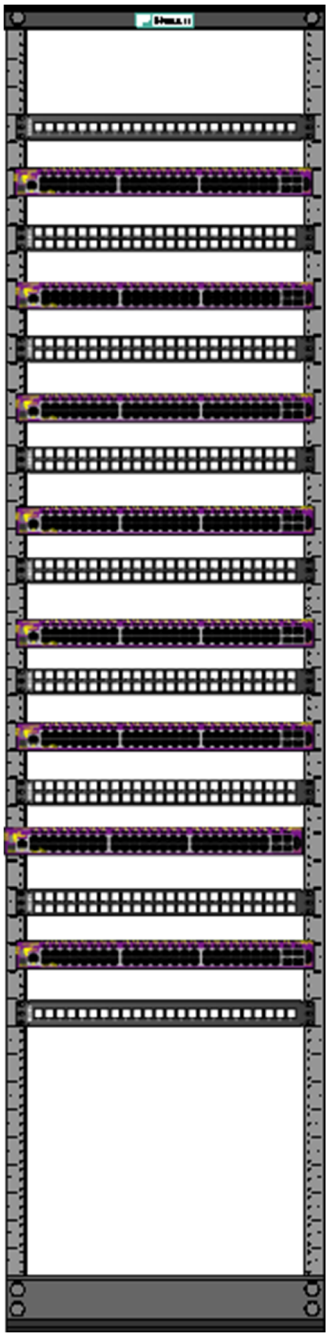
Appendix A

Typical Rack Design



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