



Arlington County Government Department of Technology Services

Network Infrastructure Standards

Prepared by DTS Network Operations Team
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1.0 REVISION NOTES

Current revision is 1.00

Revision Date: November 16, 2018

- Updated Standards
- (e.g.) madkins 11-27-2018: changed cable colors to match current ACG standard

2.0 INTRODUCTION AND PURPOSE

2.1 INTRODUCTION

DES construction project managers (PMs) work with contractors and the appropriate department(s) to design new or existing County buildings to meet departmental requirements. These buildings may be owned or leased by the County. As part of this process, DES construction PMs work with DTS construction and network teams to ensure the network infrastructure will meet the Network Infrastructure standards.

County buildings typically have unique construction designs from a typical office building due to the many different department (Public Safety, Environmental Services, Libraries, Parks and Recreation, etc.) requirements. Therefore, the typical DTS steps for supporting County building designs and network are as follows:

1. Review, comment and approve construction design will meet the following:
 - a. Understand network requirements: end-system cabling, phones, video, wireless and DAS needs.
 - b. Communication closet(s) location and size will meet network equipment and cabling requirements for the size of the building.
 - c. Cabling conduits (both external and internal) are in place to support wiring system requirements.
2. Once construction design is complete, DTS will provide TIP response to DES for approval, the TIP will include the following:
 - a. ConnectArlington fiber installation cost (if required).
 - b. Comcast CM or Verizon FiOS installation and monthly cost (if required).
 - c. Network equipment cost
 - d. Wireless heat map and WAP locations
 - e. Phones
 - f. Video systems
 - g. DAS equipment and cabling cost, working with DAS contractor
 - h. Engineering cost
3. Once the TIP is approved, DTS will provide the following documents /diagrams to provide contractors for building out the communication closet and installing cabling:
 - a. Communication closet(s) layout, see section 5.2.6 for sample diagram
 - b. Rack equipment vertical diagram, see section 5.2.7 for sample diagram
 - c. Network Infrastructure Standards Document (*this document*)
4. DTS will implement the following:
 - a. Develop IP addressing scheme
 - b. Network switches and UPS
 - c. Patch cables to switch
 - d. Wireless Access Points
 - e. ConnectArlington fiber (if required)
 - f. Comcast CM / Verizon FiOS (if required)
 - g. Install phones
 - h. Install video
 - i. DAS system, working with vendor

The Network Infrastructure Standards document specifies the minimum standards for ACG structured wiring systems. These are general requirements that allow for adjustments in today's ever growing and changing telecommunications industry. To accommodate specific requirements and design needs the Department of Technology Services may modify these specifications as needed.

As networking and industry standards evolve specifications for wiring and wiring support constantly change. **Before submitting a design or starting installation, all contractors and outside IT consultants must receive approval from DTS.** The designated specifications for products, material, and space requirements for Network Facilities are, however, standards for choosing material and products to be installed.

These specifications are to be used as a general guide for installing, testing, and documenting structure wiring systems. A collaborative effort between the installation contractor, architect/designer, the occupant, and DTS will finalize specifications for specific projects. Subject to final approval by DTS, specific detailed specifications will be based on the individual purpose of the space and will be a culmination of the collaborative effort between the parties involved.

2.2 PURPOSE

The purpose of this document is to ensure that all contractors create high quality bid documents that adhere to accepted industry standards and specifications. This is to be a starting point for collaboration between the interested parties.

The standards in this document are adapted from relevant industry standards and practices for cabling installations. They provide these benefits for the County:

- Support for best practices
- Provision of multi-vendor equipment and services
- Improved management of building space resources
- Reduced training requirements for support personnel
- Consistency of wiring at different locations
- Improved reliability of network cabling infrastructure
- Improve network reliability with communication closet standards
- Improved troubleshooting and fault isolation
- Improved ability to manage system moves, adds, and changes.



3.0 CONTACT INFORMATION

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4.0 CODES, STANDARDS AND REGULATIONS

4.1 OVERVIEW

Federal, State, and Local codes, rules, regulations, and ordinances will govern the work. If the contractor notes an item in the drawings or the specifications that presents a code violation, promptly call it to the attention of the Department of Technology Services in writing. Send written notice to the Network Standards Coordinator. Where the requirements of these specifications are more stringent than applicable codes, rules, regulations, and ordinances, the specifications will apply.

The design, manufacture, test, and installation of cabling networks at Arlington County will comply with manufacturer's requirements and will be in accordance with state codes, local codes, requirements of authorities having jurisdiction, and included but are not limited to the following agencies, standards, and publications:

4.2 AGENCIES

- ANSI** - American National Standards Institute
- BICSI** - Building Industry Consulting Service International
- EIA** - Electronic Industries Association
- FCC** - Federal Communications Commission
- FOTP** - Fiber Optic Testing Procedures
- IEEE** - Institute of Electrical and Electronic Engineers, Inc.
- NBC** - National Building Code
- NFPA** - National Fire Protection Agency
- NEC** - National Electrical Code
- TIA** - Telecommunications Industry Association
- UL** - Underwriters Laboratories

4.3 APPLICABLE STANDARDS

ANSI/NECA/BICSI-568 - Standard for Installing Commercial Building Telecommunication Cabling

ANSI/TIA/EIA-568-C.1 - Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements

ANSI/TIA/EIA-568-C.2 - Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted Pair Cabling Components

ANSI/TIA/EIA-568-C.3 - Optical Fiber Cabling Components Standard

ANSI/TIA/EIA-569-C - Commercial Building Standard for Telecommunications Pathways and Spaces

ANSI/TIA/EIA-606-A - The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

ANSI/TIA/EIA-607-A - Commercial Building Grounding and Bonding Requirements for Telecommunications

ANSI/TIA/EIA-526-7 - Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant

ANSI/TIA/EIA-526-14A - Measurement of Optical Power Loss of Installed Multi-Mode Fiber Cable Plant

ANSI/TIA/EIA-758-A - Customer-Owned Outside Plant Telecommunications Cabling Standard

4.4 APPLICABLE PUBLICATIONS

BICSI - Telecommunications Distribution Methods Manual

BICSI - Cabling Installation Manual

BICSI - LAN Design Manual

BICSI - Customer-Owned Outside Plant Design Manual

5.0 NETWORK FACILITIES

5.1 DEFINITION

Network facilities are spaces and secured rooms housing telecommunication and network equipment consisting but not limited to Data, Voice, Cable Television (CATV), Closed Circuit Television (CCTV) and Distributed Antenna System (DAS) components and their associated wiring. Secured rooms have stringent requirements due to the expense and complexity of the equipment in them and to its role supporting the County's telecommunications and network infrastructure. The types of network facilities are:

Main Distribution Frame (MDF) is the main DTS communication closet(s) service entrance into the building. This room is the location that ConnectArlington fiber, Comcast CM or Verizon FiOS service will be terminated and backbone equipment will be installed. The MDF will interconnect all the IDFs within the building and/or campus. There is usually one MDF at each building. Two MDFs will be required for larger building or a campus environment.

Building Distribution Frame (BDF) is the area where the demarcation closet of vendor services such as Verizon and Comcast will reside. This securable room is to be dedicated to this purpose, with no other building services sharing the space. A BDF closet is only required if the County is co-located with non-County tenants in the same building.

Intermediate Distribution Frame (IDF) is a DTS communication closet that provides for demarcation between the per-floor horizontal customer service cabling and the building's video, and data backbone cabling. This room contains the electronic equipment that transitions between the building backbone and the end user's telecommunications equipment. This securable room is to be dedicated to this purpose, with no other building services sharing the space.

IDFs are allocated on each floor of a building and house the communications equipment related wiring that services that specific floor. Several IDFs may be located on a single floor to maintain the cable length limitations specified under certain standards. The MDF communication closet also provides these functions for the floor it is located.

Fiber Optics Patch Panel (FOPP) is where backbone fiber terminates, and fiber optic patch cords are used to cross-connect cabling into equipment.

Main Cross-Connect (MC) is the cross-connect normally located in the BDF for cross-connection and interconnection of entrance cables, first-level backbone cables, and equipment cables.

Horizontal Cross-Connect (HC) is a group of connectors (e.g., patch panel or punch-down block) that allows equipment and backbone cabling to be cross-connected with patch cords or jumpers.

Telecommunications Enclosure (TE) is a secured case, cabinet, or housing for telecommunications equipment, cable terminations, and cross-connect cabling.

Network Facilities (NF) is the term used to describe rules that apply to all three types of distribution facilities on campus (MDF/IDF/BDF).

5.2 NETWORK FACILITY REQUIREMENTS

5.2.1 GENERAL

All work associated with NFs will comply with the National Electrical Code, and with state and local building codes. Follow the guidelines developed by **ANSI/TIA/EIA** and **BICSI** in both design and construction.

DTS must approve all variances.

IT network equipment will not be installed in the MDF/IDF until they are completely built, cleaned, and secured with the IT-approved card reader system.

To facilitate the proper installation, routing and placement of cables, NFs will be located to comply with TIA/EIA distance limitations and stacked one above the other whenever possible. The total distance of the cable path between the telecommunication outlet and its termination in the NFs will be less than 90 meters.

No plumbing, HVAC, or electrical conduit will pass through or above the NFs, except for sprinkler systems. Sprinkler heads will be caged and rated high temperature.

Under no circumstances will electrical or any other utility panels be in an NF.

Doors and Locks for NFs – A windowless, solid core door measuring 36” wide by 80” tall and swinging open out of the room is the minimum requirement. Locks are to be cored with a county standard BEST system to accept the NF standard keying as provided by DES. Keys for NFs will be available from DTS as needed and will be stored in the DTS key box within the CHP NOC. Equip all doors with an online card reader system per DES/Facility Management standards.

NFs – Secure NFs to ensure all areas in which information technology resources is stored remain protected from environmental concerns, hazards, and theft. Coordinate the security of the NFs with DTS. All NFs must be accessible by DTS staff 24/7. Ideally, NFs will be accessible from the main hallways. Building access instructions, including layout, and security POC information will be stored on DTS’s Network Team Library SharePoint site.

MDF/IDF Location(s) – The following are ideally guideline for locating MDF/IDF communication closets. DTS understands this may not viable within every building and open to discussion.

- MDF/IDF closet should be located on every floor that there are County end-system users. The reasons for this are as follows:
 - Reduces the need for Ethernet cabling and conduit requirements between floors.

- Simplifies maintaining IP addressing scheme. The IP addressing scheme is used by OEM to identify location of 911 calls from County phones and by Security team to quickly locate compromise or suspicious end-systems.
- MDF/IDF closets should be accessible from main hallways (not through office, conference room, etc.) and accessible 24x7.

Floors – Floor loading must be at least 150 pounds per square foot. Floors will be vinyl composition tile or sealed concrete. **ABSOLUTELY NO CARPETING OR BARE CONCRETE.**

Conduit Requirements – The following conduit between NFs are required to support the data/CATV/CCTV/DAS infrastructures:

- One 4" conduit from outside handhole to MDF – To support DTS services (ConnectArlington fiber).
- Two 4" conduits from outside handhole to BDF – To support Verizon and Comcast services to the building.
- Two 4" conduits from MDF and BDF – To extend Verizon and/or Comcast services to County offices.
- Two to four 4" conduits (building riser) between stacked NFs (MDF/IDF) – To support data/voice fiber optic cables, analog lines, CATV cabling and DAS cabling. The number of conduits is dependent on the number of stacked NFs within the building.
- Two 4" conduits between MDF and IDF in non-stacked NFs. – To support data/voice fiber optic cables, analog lines, CATV cabling and DAS cabling.

Conduits and Sleeves – To facilitate frequent additions, moves, and changes to the telecommunication systems, communications conduits are generously sized and labeled on both sides (to and from locations).

- Conduits entering the building are usually 4" with some type of sub-space partitioning.
- Conduits between building NF rooms are also usually 4".
- The use of flexible conduit is discouraged. If it is the only solution, increase its size by one trade size.
- Conduits between floors that interconnect NF rooms are stubbed 2" into the rooms with end caps.
- The 1" conduits servicing end users' information outlets are usually "stubbed" to above the ceiling, and from there to the nearest corridor/hallway telecommunications horizontal pathway leading to the IDFs.
- Minimum radii for conduits bends are:
 1. Internal diameter of less than 2" – bending radius is 6 times the internal diameter.
 2. Internal diameter of 2" or more – bending radius is 10 times the internal diameter.

- All sleeves must be fire sealed. Initial sealing of the sleeve penetration is to be completed by the sleeve installer.
- To prevent cable damage, all sleeves will be reamed and grommets placed before cable installation.

Building Riser – The building backbone riser system connects IDFs to each other and to the MDF room. DTS specifies separate cable systems to provide data, video, and voice needs. Riser (plenum) rated multi-pair copper cables, and single-mode fiber cables, along with their termination systems, are specified.

Cable Entrance – Riser or distribution cables entering/exiting the NF shall be via four-inch (4”) conduits, sleeved cores or cable trays. Include two additional conduits, sleeved cores, or cable trays above the current requirement to allow for future growth when possible.

Ceilings – There will be no suspended ceilings in the NFs. Whenever large cable projects require installation of new cable trays or overhead conduits and sleeves in existing NFs suspended ceilings shall be removed.

Ladder Rack – Ladder rack of 12” width shall be installed on three (3) walls at a height of 7’ whenever possible with minimum clearance of 4” from the ceiling. Ladder rack spanning the width of the room shall be installed on top of the telecommunication racks. Radius dropouts are to be used where the cable exits the tray to a lower elevation. Ladder Racks should be secured to the top of the Rack with a top plate.

Walls – Interior walls should be covered, floor to ceiling, with fire rate $\frac{3}{4}$ ” plywood and painted with 2 coats of a neutral color fire retardant paint; the fire rated stamp must be visible. Have the Fire Marshall’s office inspect and approve before painting. Paint should be (or be equal to): Flame Control Coatings, LLC. Flame Control NO. 20-20A. Fire Hazard Classification, ATSM E-84 (NFPA 255) Class “A”.

Fire Wall Identification – Fire walls should be painted with a neutral color fire retardant paint; the fire rated stamp must be visible.

Lighting – Lighting should be maintained at 500 lumens, measured at 3 feet above floor level. Use timer- or motion-type light switches, placed immediately inside the door. Use LED bright white lighting.

5.2.2 ROOM SIZING

MDF/IDF

Minimum room size is determined using the following table:

Table 1 – IT Room Size

Number of Active Data Drops Served**	Minimum Room Size
<48	10' x 10'
48 to 144	10' x 12'
>144	10' x 16'

** Active Data Drops Served:

- Two drops per cube
- Two drops per data monitor/AV device
- One drop per common area phones
- Two drops per wireless access point (WAP)
- DAS – If a DAS head-end is required to be in the space, then one (1) standard 19" rack is required next to DTS equipment rack, else plywood boards (4'x 8'x 3/4" fire retardant) mounted on all walls.

MDF/IDF's cannot have any water pipes within the room's interior space, routing horizontally on the floor directly above the room, or within the floor slab.

5.2.3 ENVIRONMENTAL CONTROL

A dedicated HVAC, separate than the building HVAC must be installed in each MDF/IDF. This HVAC should be ducted in and designed to maintain a room temperature of 68 to 70 degrees Fahrenheit with 30 – 55 percent humidity control with the full complement of equipment in the room. DTS shall provide the HVAC contractor with equipment BTU information. The following table can be used as a guide.

Table 2 - HVAC Specification

Number of Racks	BTU/Hr (max)	BTU/Hr (de-rated)	Tons of HVAC (max rounded down)
1	6,500	4,875	½ ton
2	13,000	9,750	1 ton
3	19,500	14,625	1 ½ ton

*These figures are derived as follows: (1) Each rack has two

power strips. (2) Each power strip is a separate 20A circuit. (3) Each circuit is de-rated at the breaker to 16A. (4) 16A X 120VAC = 1,920 watts per rack. (5) 1,920 watts X 3.4 = 6,528 BTU/Hr per rack. (6) 1 ton = 12,000 BTU/Hr.

5.2.4 ELECTRICAL

For NFs, all convenience electrical outlets shall be installed to a side wall in order that power cables can be run along the telecommunications racks. This will minimize the possibility of tripping hazards. There should be, at a minimum, one duplex convenience outlet on every wall immediately to the left and right of the door for general purpose use. These should be installed at industry standard height. All convenience outlets will be backed up via the building wide UPS or on emergency generator if there is no

building UPS. A stand-alone UPS shall be plugged into generator power if no centralized UPS is available.

At a minimum, there must be four 120-volt 20-amp Orange NEMA 5-20R dedicated outlets with each pair on a dedicated circuit with emergency generator back-up. These outlets must be located at a height of 7 feet. Conduit and outlets shall be connected to the outside of the ladder rack facing the rear of the equipment racks.

DTS must approve final design and layout of number, type, and location of outlets.

Power requirements for Network Facilities change depending on the type of building. Contact DTS for exact specifications on power in the Network Facilities.

All telecommunications circuits are to be clearly labeled on the circuit breaker panel and the circuit id number to be on the face plate of the outlets in the NFs.

A grounding bar measuring 12" long by 2" wide by ¼" thick with pre-drilled ¼" holes shall be installed. The ground bar must accept 2-hole lug connectors. The ground bar shall be connected to the main building ground using #2 or greater AWG copper wire.

All cable trays, ladder racks and equipment racks are to be grounded to the main building ground using #2 or greater AWG copper wire. Rack-mounted electrical outlets must be grounded to the rack ground in addition to any other NEC, state, or local building code grounding requirements.

When no building UPS is available a rack mounted UPS of appropriate size will be installed in every MDF/IDF. DTS will determine appropriate UPS devices. The size of the UPS is dependent on number of network drops supported by the closet. Electrical outlet types change depending on UPS type.

5.2.5 TERMINATION HARDWARE

DTS must approve the design layout for the placement of racks, rack hardware, and wall fields within the NFs.

Equipment Racks – Equipment racks will be standard heavy duty two-post including following specifications:

- Color: Black
- Height: 7'
- Material: Aluminum
- Mounting Width: 19"
- Rack Units: 45U
- Type: Two-post

- Holes: self-tapping????

All racks are to be properly anchored, with space allocated between racks for installation of vertical cable managers. Racks are to be mounted side by side as shown in Figure 1 and 2. Racks must be secured to the ladder rack via top plate.

Patch Panels – Approved patch panel types are listed in Appendix C. All jacks will be Category 6. Different colors are assigned to the various types of network connections. The exposed front of the jack must be the correct color. The jack colors are assigned as follows:

• Yellow	General Purpose, office, and lab connection
• Purple	Wireless Access Point connection
• Red	Security Cable
• White	AV connection

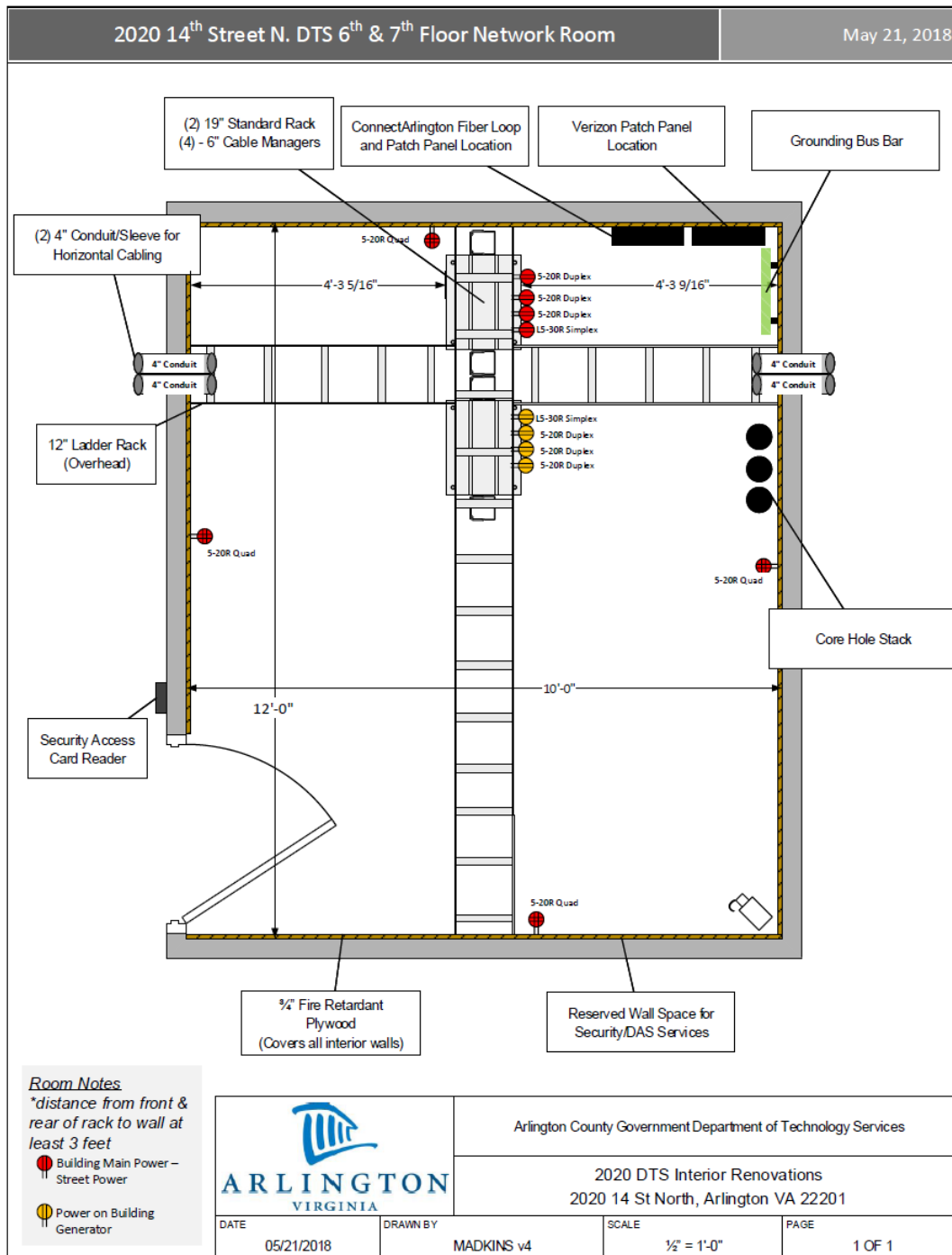
Rack Mounted Hardware – For MDFs, a minimum of eight Units (8U) are reserved at the top of each rack for fiber enclosures. For IDFs, a minimum of six Units (6U) are reserved at the top of each rack for fiber enclosures. Contact DTS for exact design, in some cases ConnectArlington fiber is installed in a wall mount enclosure.

Wall mounted Hardware – 25-pair or 50-pair 110 system kits shall be fastened to the plywood backboard and D-rings or jumper troughs used for wire management.

Wire Managers – Vertical wire managers will run the entire length of a rack, mounted on both sides of each rack. Vertical managers shall be 6 - 10” wide depending on amount of network drops. Horizontal wire managers will be installed under each 24/48-port patch panel as shown in Figure 2.

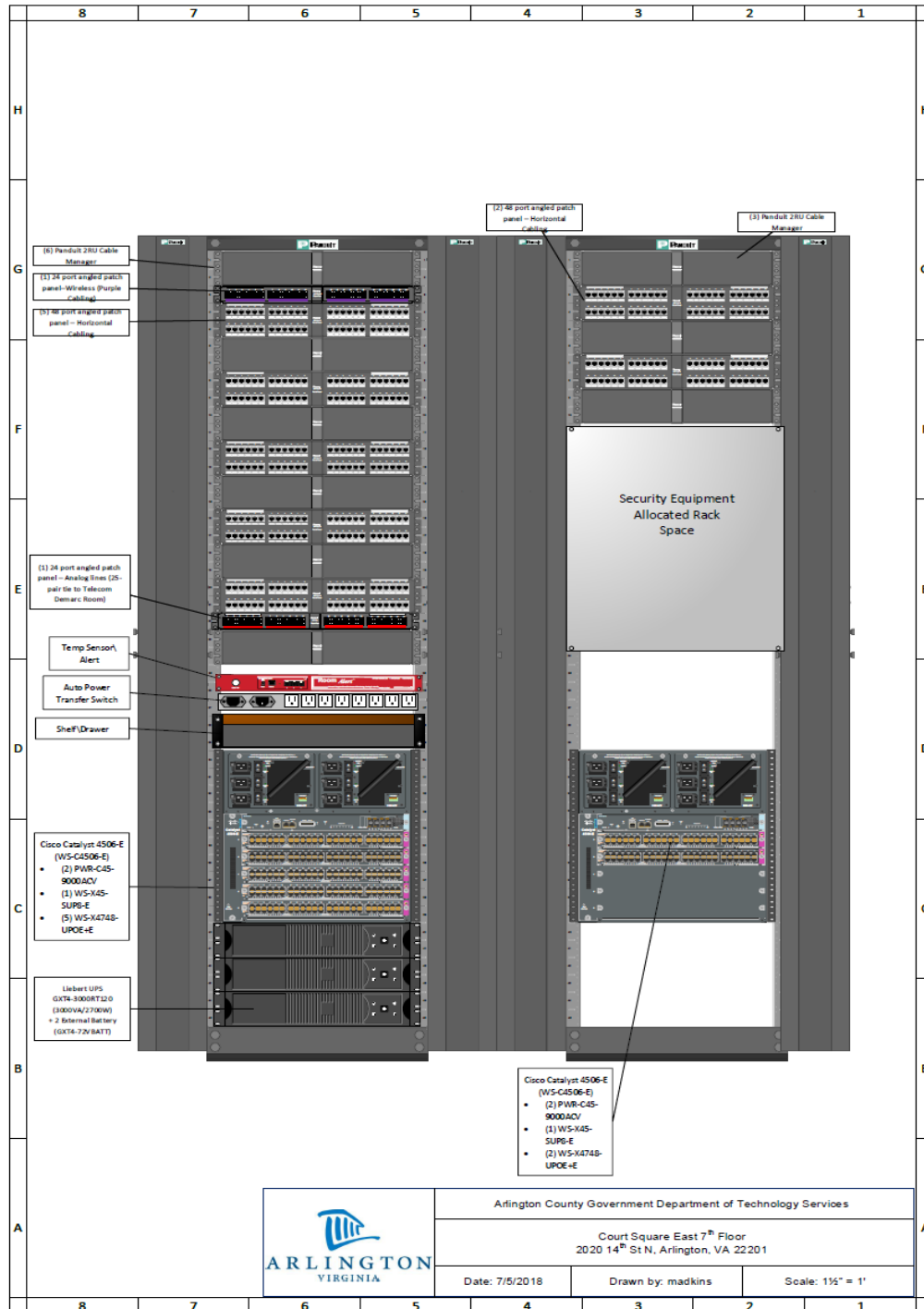
5.2.6 SAMPLE COMMUNICATION CLOSET LAYOUT (FIGURE 1)

DTS will provide DES PM detail communication closet layout diagram for each new closet following the completion of the construction design. A sample diagram is provided below.



5.2.7 SAMPLE EQUIPMENT RACK ELEVATION DIAGRAM (FIGURE 2)

DTS will provide DES PM detail equipment rack elevation diagram for each new closet following the completion of the construction design. A sample diagram is provided below.



5.2.8 ADDITIONAL REQUIREMENTS

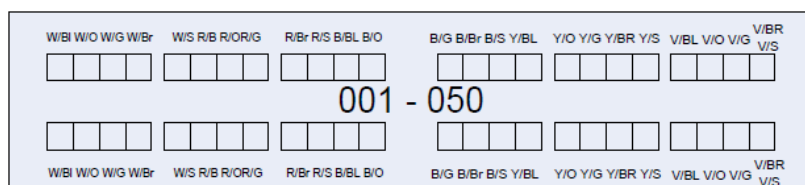
Riser and distribution cables leaving the BDF to MDF and IDF spaces shall be via four-inch conduit, sleeved cores with basket cable tray for horizontal runs. At least two additional conduits, sleeved core or cable tray with enough available space must be included in the design to provide for future growth. The number and size of conduits are determined by building square footage. All conduits will be sealed with appropriate fire stopping materials.

The MDF must have enough conduit runs to all IDFs. Two additional cores/conduits must be provided for future growth.

At a minimum, a 12-strand, single-mode fiber of 9/125 micron shall be installed between the MDF and each IDF. The fiber cabling shall be terminated with LC connectors, and installed in a FOPP mounted at the top of the equipment rack as provided in the equipment rack elevation diagrams, section 5.2.7. DTS must approve the final strand count.

In the NF's the riser copper cable shall be terminated on the patch panel in accordance with the drawing in Figure 3. Wire management is to be provided using D-rings or jumper troughs.

Figure 3



Building entrance protection for copper cabling shall be installed. This must consist of a building entrance terminal utilizing a two (2) foot fuse link between the outside cable plant splice and the protector module, with IDC type input and output terminals, 25-pair capacity and female mounting base, equipped with 230-volt solid state protector modules. Enough protector modules will be provided to completely populate all building entrance terminals.

5.2.9 LABELING

Properly label all Network Facilities that include equipment, racks, cabling, patch cables, terminating panels, and grounding bus bars. Refer to Appendix A for labeling conventions.

6.0 OPTICAL FIBER

6.1 GENERAL

DTS will no longer install Multi-Mode fiber optic cabling between MDF & IDF for network use. All new fiber optic cabling will be Single-Mode.

6.2 MINIMUM FIBER QUALITIES

Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding. The fiber shall be a matched clad design.

The single-mode fiber strands utilized in the cable specified shall conform to the ANSI/TIA/EIA-568-C and IEEE specifications.

6.3 MINIMUM REQUIREMENTS FOR OSP FIBER OPTIC CABLE

Optical fiber cables less than 144 fibers shall be of loose buffer tube configuration.

Optical fibers shall be gel free.

The fibers shall not adhere to the inside of the buffer tube.

All optical fibers and buffer tubes shall be color coded per EIA/TIA-598. In buffer tubes containing multiple fibers, the colors shall be stable during temperature cycling and not subject to fading or smearing onto each other or into the adjacent layers. Colors shall not cause fibers to stick together.

All fibers in the cable must be useable fibers and meet required specifications. The cable provided will be new, unused, and of current design and manufacture. The outer jacket shall be fungus resistant, UV inhibited, and water resistant, and shall have a non-wicking rip cord for easy removal. The outer jacket or sheath shall be free of holes, splits, and blisters. The outer cable jacket will be marked with "(Manufacturer's Name) Optical Cable", Sequential foot or meter markings, and year of manufacture. The height of the markings shall be approximately 2.5mm. The cable jacket shall contain no metal elements and shall be of a consistent thickness.

6.4 FIBER PHYSICAL PERFORMANCE

The fiber optic cable shall withstand water penetration when tested with a one-meter static head or equivalent continuous pressure applied at one end of a one-meter length of filled cable for one hour. No water shall leak through the open cable end. Testing shall be done in accordance with FOTP-82, "Fluid Penetration Test for Filled Fiber Optic Cable".

All cables will have tensile strength of greater than or equal to 2700N (Newtons) short term and 600N long term without exhibiting an average increase in attenuation greater 0.10 db (single-mode). Minimum bend radius for all cables will be less than or equal to 20 times the outside

diameter under installation tensile load and 10 times the outside diameter under long term tensile load.

6.5 OPTICAL FIBER CABLE INSTALLATION

Aerial installation of fiber optic cable is prohibited unless written approval is received from DTS management.

Cable runs will be installed in one continuous length, and without splices unless required by standard or approved design, from bulkhead connector to bulkhead connector, including service loops and repairs.

All cable shall be installed in a one-inch inner diameter inner duct when transitioning into conduit. A pull string shall be run in addition to the cable for future growth.

All fiber cable installations are to be 100 percent terminated. Plastic dust caps will be installed on all unused fiber terminations.

Terminated fiber strands will be installed in rack-mounted optical fiber distribution shelves (FOPP's).

Cable installation shall not exceed manufacturer specifications for tensile load, bend radius, and vertical rise. To assure that tension and torsion do not exceed manufacturer specifications all pulled cables shall be monitored during installation.

A minimum of three (3) inch and a quarter (1 ¼") corrugated inner-ducts will be placed inside each conduit of four (4) inch diameter. All optical fiber cable installations shall be placed in inner-duct up to the point the cable enters a terminating enclosure.

Lubricants may be used to facilitate pulling of cable, but the lubricant must not be harmful to the cable, the raceway, or personnel. J-Type Polywater is preferred.

Fiber patch cables secured by strap or other fasteners shall not be pulled so tightly that the outside cable sheathing is indented or crushed. Velcro is preferred to secure all fiber optic cabling. **No tie wraps are to be used when dressing/securing fiber optic cabling or patch cords.**

6.6 OUTSIDE PLANT (INFRASTRUCTURE CABLES)

When installing fiber optic cable in manholes/handholes between buildings, there shall be a **minimum of fifty (50) foot of service loops in each**. It shall be pulled in an inner-duct inside the manhole to prevent damage to the cable. No splicing is allowed in fiber cables between buildings. A copper tracer line should be run with all fiber that is in a non-metallic conduit. All manhole/pull boxes shall have GPS locations recorded and submitted to DTS.

At a minimum, a 48-strand, single-mode fiber of size 9/125 micron shall be installed to a DTS designated Core location. A minimum number of single-mode fiber shall be installed to a secondary building. This number is determined by the number of IDFs/BDFs in the given building

plus one spare multiplied by two. DTS must approve final strand counts. All installed single-mode cables are not to exceed 0.4 dB/km attenuation at 1310nm wavelength.

The AVERAGE/MAXIMUM fiber splice loss for single-mode fusion splices will be 0.05/0.3 dB and 0.10/0.3 dB for mechanical splices.

Sump pumps may be installed in manholes where flooding is a consistent problem.

6.7 INSIDE PLANT (RISER CABLE)

Fiber optic cable shall be tight-buffer tube construction.

At a minimum, a 12-strand, single-mode fiber of size 9/125 micron shall be installed. DTS must approve final strand counts.

Each buffer tube within a cable must be color coded with none of the same colors appearing in one cable. Each fiber within a buffer tube must be color coded with none of the same colors appearing in the same buffer tube.

The outer cable sheath construction will be of NEC Rated OFNP (PLENUM) Jacket – Flame retardant material.

Individual mated connector pair loss will be less than or equal to 0.20 db.

All fiber strands are to be terminated in accordance with industry standard color codes.

All single-mode fiber will be terminated with LC connectors.

Single-mode fiber patch cables will be terminated with “LC” connectors.

Bulkhead distribution cabinets and cable must be labeled in accordance with DTS labeling conventions defined in Appendix A.

A minimum of ten meters (33 feet) of extra cable shall be coiled and fastened to the NF plywood backboard as a service loop at each end of the cable.

7.0 INSIDE PLANT

7.1 ASBESTOS CLEARANCE

Certain County buildings constructed prior to 1970 may contain asbestos in the original construction materials used. Most of the materials detected with asbestos are blown-in ceiling insulation, floor tiles, walls, pipe insulation, and other construction materials. **Before beginning any cabling job, and especially prior to disturbing areas or making surface penetrations, an asbestos check and clearance must be granted for the location and scope of work to be performed.**

All cabling contractors will ensure that personnel they place on County premises will have Asbestos Awareness training and certification. The cabling contractor's Project Managers and technicians should be Asbestos Administrative Awareness-certified, with current credentials. Documentation will be provided to the County upon request.

The following procedures will be followed without exception by all personnel doing cable installation on behalf of Arlington County:

Step 1: If an asbestos concern develops, immediately notify your supervisor and contact the DTS Project Manager **before any work is done**. If an asbestos warning sign is evident, **do not enter room or area in question**.

Step 2: The DTS Project Manager will contact and coordinate with County operations and IT Management to verify the asbestos status of suspected room or area.

Step 3: DTS personnel and contractors will be notified by IT Management when it is possible to resume the original work suspended.

7.2 GENERAL

All network wiring shall be designed or approved by DTS.

All network wiring shall be run using suspension hooks, conduits, or approved cable tray. **Never attach cable to the ceiling grid support system**. Pull string shall be installed with cable when it is pulled in conduit that does not contain inner ducts.

7.3 BACKBONE CABLING

DTS must approve all optical fiber and copper backbone cable designs, materials, and sizes before installation.

At minimum, the building feeder must have 25 balanced twisted-pair (UTP) **Category 3** cable. It must be solid copper and 24 AWG.

At minimum, each IDF must have 25 balanced twisted-pair (UTP) **Category 3** cable. It must be solid copper and 24 AWG.

Note: Listed Type CMR, CMP, MPR and/or MPP (as required in the NEC 2012).

See Appendix A for approved labeling conventions for backbone cabling.

See Appendix B for approved backbone cabling manufacturers.

7.4 HORIZONTAL CABLING

All data cabling shall be continuous (no splicing) from the nearest NFs to the telecommunications outlet.

See Appendix A for approved labeling conventions for horizontal cabling.

Horizontal cabling will be 100 percent terminated in the NF to an approved, 19-inch, rack mountable, 48-port, 8-pin modular-to-Insulation Displacement Connector (IDC) that meets **Category 6 performance standards** and pinned to T568B standards. IDC color codes shall mimic telecommunications outlet jack color standards.

Solid copper, 24 AWG, 100 balanced twisted-pair (UTP) **Category 6** cables with four individually twisted-pairs, which meet or exceed the mechanical and transmission performance specifications in ANSI/TIA/EIA-568-C.2 shall be installed.

See Appendix B for listing of approved horizontal cabling materials manufacturers.

7.5 COPPER PATCH CABLES

All copper patch cables shall meet or exceed TIA/EIA-568-C.2-1 Category 6 and ISO 11801 Class E standards. Patch cables shall be constructed of 24 AWG solid copper cables and have a nominal diameter of .31 inches and be constructed of RJ-45 style plugs that meet or exceed IEC 6060J-7 specifications. Patch cables must provide strain relief. Copper patch cables will be labeled with the switch, port number and patch panel-port number on both ends of the patch cord. The approved types of cables are listed in Appendix C. Each connection must use an appropriate color cable on each end of a given network jack.

The cable colors are assigned as follows:

• Yellow	General Purpose, office, and lab connection
• Purple	Wireless Access Point connection
• Red	Security Connection
White	AV connection

7.6 TELECOMMUNICATIONS OUTLETS

Single-gang mounting plate with four (4) openings which might contain one or more of the following devices:

- Telecommunications Outlet – 8-pin modular, Category 6, un-keyed, **yellow**, pinned to T568B standards and be fully terminated.
- Wireless Outlet – 8-pin modular, Category 6, un-keyed, **purple**, pinned to T568B standards and be fully terminated. This will be terminated at the remote end on an appropriate jack mounted in a surface mount box.
- Security Camera/Intrusion Alarm Outlet – 8-pin modular, Category 6 un-keyed, **red**, pinned to T568B standards and be fully terminated.
- Blank Inserts – to be inserted in unused openings.

7.6.1 TELECOMMUNICATIONS OUTLETS

Telecommunication outlets shall be installed at industry standards heights (18 inches to center) unless otherwise noted.

A telecommunication outlet providing data services shall be located within 3m (10 feet) of its intended usage area.

A telecommunication outlet providing voice services only intended for wall phone use shall be installed in accordance with the standards of the Americans with Disability Act (ADA) requirements.

Faceplates must match the color and material of the surrounding wall outlets, subject to approval by DTS.

7.6.2 TELECOMMUNICATIONS OUTLETS

Faculty/Administrative Offices – At minimum One (1) telecommunication outlet consisting of two (2) data jacks. Additional outlets will be added upon a customer needs analysis and installed as needed.

Clerical/Staff Offices – At minimum One (1) telecommunication outlet consisting of two (2) data jacks. Additional outlets will be added upon a customer needs analysis and installed as needed.

Lab – At minimum One (1) telecommunication outlet per designated lab station consisting of two (2) data jacks.

Conference Rooms – One (1) telecommunication outlet consisting of two (2) data jacks. Additional outlets will be added upon a customer needs analysis and installed as needed.

General Purpose Classrooms – One (1) telecommunication outlet consisting of two (2) data jacks. Additional outlets will be added upon a customer needs analysis and installed as needed.

Note: After installation, a minimum of one data port will always remain active.

8.0 DOCUMENTATION AND SUBMITTALS

8.1 GENERAL

Direct Contracted Vendors must submit shop drawings, product data (including cut sheets and catalog information), and samples required by the contract documents to the DTS PM by email. Submit shop drawings, product data, and samples promptly enough and in appropriate sequence to cause no delay in the work or in the activities of separate contractors.

Provide a complete location table and spreadsheet with location detail for each wall jack:

- Jack number
- Room number
- Wall orientation (North, South, East, or West, or Power Pole if applicable)
- Landmark orientation and distance

The contractor is responsible for appending new installations to this documentation so that a complete, consolidated inventory of all installations and work completed by the contractor is maintained.

By submitting shop drawings, product data, and samples, the contractor represents that he or she has carefully reviewed and verified the related materials, quantities, field measurements, and field construction criteria. It also represents that the contractor has checked, coordinated, and verified that information contained within shop drawings, product data, and samples conform to the requirements of the work and of the contract documents.

DTS approval of shop drawings, product data, and samples submitted by the contractor shall not relieve the contractor of responsibility for deviations from requirements of the contract documents, unless the contractor has specifically informed DTS in writing of the deviation at time of submittal, and DTS has given written approval of the specific deviation. The contractor is responsible for deviations from requirements of the contract documents not specifically noted by the contractor in writing, and specifically approved by DTS in writing.

DTS approval of shop drawings, product data, and samples shall not relieve the contractor of responsibility for errors or omissions in such shop drawings, product data, and samples.

DTS review and approval, or other appropriate action upon shop drawings, product data, and samples, is for the limited purpose of checking for conformance with information given and design concept expressed in the contract documents. DTS review of such submittals is not conducted for the purpose of determining accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the contractor. The review shall not constitute approval of safety precautions or of construction means, methods, techniques, sequences, or procedures. DTS approval of a specific item does not indicate approval of an assembly of which the item is a component.

Do not perform work requiring submittal and review of shop drawings, product data, or samples, until DTS has approved the submittal.

General – submit:

- Backbone (riser) diagrams
- Optical loss budget calculations for each optical fiber run
- Project schedule, including all major work components that materially affect any other work on the project

Shop drawings – submit:

- Backbone (riser) diagrams
- System block diagram, indicating interconnection between systems components and subsystems
- Interface requirements, including connector types and pin-outs, to external systems and systems or components not supplied by the contractor
- Fabrication drawings for custom-built equipment
- Floor plans of NF service area with outlet locations marked
- One set shall be laminated and placed in the appropriate NFs

Product data – provide catalog cut sheets and information for:

- Wire, cable, and optical fiber
- Outlets, jacks, faceplates, and connectors
- All metallic and nonmetallic raceways, including surface raceways, outlet boxes, and fittings
- Terminal blocks and patch panels
- Enclosures, racks, and equipment housings
- Over-voltage protectors
- Splice housings

Samples – submit:

- All material submittals will be, when requested, provided from Appendix C

8.2 CONTRACTOR CERTIFICATION

BICSI and Manufacturer Certifications for On-Site Personnel

The contractor shall be a licensed Manufacturer Design and Installation Company. A copy of this certificate and or verification by the Manufacturer must accompany the contractor bid. No expired certifications and certificates issued under Manufacturer programs will be accepted as proof of certification.

The contractor must be a member of Building Industry Consulting Service International (BISCI).

When a contractor has been recommended for selection, DTS will only award final approval after the contractor has provided documentation that all on-site personnel have:

- 1)** BICSI Cert. **AND**
- 2)** Manufacturer Cert.

These certifications must remain in effect for all on-site personnel throughout the bidding process, installation, testing, documentation, and acceptance.

BICSI RCDD Credential

Before the project is awarded, the contractor must have at least one (1) Registered Communications Distribution Designer (RCDD) on staff, with Manufacturer approved certifications. The RCDD must approved the design, installation, and documentation of communications systems, and must make sure all Manufacturer Warranty documentation and requirements are met and submitted to the Manufacturer upon completion of the Project.

Subcontractor Certification

Do not subcontract installation of voice/data/video cabling, termination, or testing without the written consent of DTS and review and confirmation from the Manufacturer to DTS that the proposed subcontractor personnel have current and valid certifications.

Contractor Experience and References

The contractor must have at least five (5) years of satisfactory work experience on systems of this type and size.

Upon request by DTS, furnish a list of references with specific information regarding type of project and the contractor's involvement in providing equipment and systems.

Materials, Subcontractor Rights and Obligations, and Quality Assurance Inspections

Materials shall be new, and conform to grade, quality, and standards specified. Materials of the same type shall be a product of the same manufacturer throughout.

Subcontractors shall assume all rights and obligations toward the contractor that the contractor assumes toward Arlington County and DTS.

Quality Assurance inspections will be coordinated with DTS's Project Managers.

8.3 WARRANTY

Unless otherwise specified, unconditionally guaranteed in writing the materials, equipment, and workmanship for a period of at least fifteen (15) years from date of acceptance by DTS or twenty (20) years from date of manufacture.

8.4 DELIVERY, STORAGE, AND HANDLING

Protect equipment during transit, storage, and handling to prevent damage, theft, soiling, and misalignment. Coordinate with ACG for temporary secure storage of equipment and materials

during the project. Do not store equipment where environmental conditions fall outside manufacturer's recommendations. Do not install damaged equipment, remove from site and replace with new equipment.

8.5 SEQUENCE AND SCHEDULING

Submit schedule for installation of equipment and cabling. Indicate delivery, installation, and testing for conformance to specific job completion dates. As a minimum, dates are to be provided for bid award, installation start date, completion of station cabling, completion of riser cabling, completion of testing and labeling, cutover, completion of the final punch list, start of demolition, owner acceptance, and demolition completion.

8.6 USE OF THE SITE

When Arlington County deems it necessary to place site restrictions, use of the site shall be at ACG's direction.

Access to buildings wherein the work is performed shall be as directed by ACG.

The selected contractor will temporarily occupy the premises during the entire period of construction for conducting his or her normal business operations. Selected contractor will cooperate with the County and DTS to minimize conflict and prevent disturbance of the County's operations.

Do not interfere with ordinary use of streets, aisles, passages, exits, and operations of Arlington County Government, including those of DTS.

All contractors will adhere to the standards of Arlington County's Contractor Badge Program administered and provided by Facilities Management & Construction and will wear assigned contractor's badge on person in a clearly visible location.

When pulling cables in a County building or related off-site areas, all contractors shall provide proper safeguards at the reel location. This can be done with personnel or with appropriate safety barricades.

8.7 CONTINUITY OF SERVICES

Do not interfere with or interrupt existing building services unless prior arrangements have been made with Arlington County representative(s). The work shall be arranged to minimize down time.

Should services be inadvertently interrupted, immediately furnish labor (including overtime), material, and equipment necessary for prompt restoration of interrupted service.

8.8 DELIVERABLES TO DTS

At conclusion of the project - submit project record drawings and include:

- Approved shop drawings
- Plan drawings indicating locations and identification of work area outlets, nodes, NFs, and backbone (riser) cable runs
- Termination detail sheets for NFs
- Cross-connect schedules including entrance point, main cross-connects, intermediate cross-connects, and horizontal cross-connects
- Labeling and administration documentation
- Warranty documents for equipment
- Copper Certification test result printouts and CDs (electronic submissions must be sent to the DTS Project Manager)
- OTDR bi-directional test results
- OLTS Power meter test results

9.0 PROTECTION, GROUNDING AND BONDING

9.1 LIGHTNING PROTECTION

NFPA 70 (NEC) articles 250 “Grounding and Bonding” and 800 “Communications Circuits” cover general requirements for grounding, bonding, and protecting electrical and communication circuits. NFPA 780 “Lightning Protection” addresses zone protection.

Installing building entrance protection for copper cabling. This shall consist of a building entrance terminal utilizing a two (2) foot fuse link between the outside cable plant splice and the protector module with IDC type input and output terminals, 100-pair capacity and female mounting base, equipped with 230 volts, solid-state protector modules. Provide sufficient protector modules to completely populate all building entrance terminals.

9.2 GROUNDING

Grounding shall conform to ANSI/TIA/EIA 607(A) – Commercial Building Grounding and Bonding Requirements for Telecommunications, National Electrical Code, ANSI/NECA/BICSI-568 and manufacturer’s grounding requirements at minimum.

Bond and ground equipment racks, housings, messenger cables, raceways, and rack-mounted conduit.

Connect cabinets, racks, and frames to single-point ground that is connected to building ground system or NF grounding bar using #6 AWG green insulated copper grounding conductor.

9.3 BONDING

Use low-impedance bonding to assure electrical continuity between bonded elements.

All conduits terminating to cable trays, wire ways, and racks shall be mechanically fastened. When connected to a cable tray or rack, it must be connected with ground bushings, wire bonded to the tray or rack, and grounded to the main building grounding system or NF grounding bar using #6 AWG copper.

10.0 INSPECTION AND TESTING

10.1 INSPECTION OF WORK

The installation company shall have an RCDD on staff and full-time during all phases of the installation, including during testing and documentation. RCDD documentation shall be included in all responses to RFP/RFO.

10.2 Testing

10.2.1 FIBER OPTIC CABLING

Individual fiber strands shall be tested bi-directionally using optical time domain reflectometer (OTDR) and optical loss test sets (OLTS). An initial acceptance test is to be conducted on the reel with a second test completed after installation.

OTDR tests for single-mode fiber shall be conducted bi-directionally at 1310 and 1550 nm. Installation reports shall include the installed lengths for all fibers.

Cables will be rejected for broken strands or OTDR/OLTS tests that reveal a single fiber strand, or an entire cable is out of manufacturer specifications. A rejected cable shall be replaced at contractor expense. The OTDR and OLTS printouts must be delivered to Arlington County DTS within 10 business days of cable installation.

10.2.2 CATEGORY 3 UTP CABLING

Testing shall conform to ANSI/TIA/EIA-568-B.1 standard. Testing shall be accomplished using level 3 or higher field testers. Test each pair and shield of each cable for opens, shorts, grounds, and pair reversal. Correct any reversed or grounded pairs. Examine open and shorted pairs to determine if problem is caused by improper termination. If termination is proper, tag bad pairs at both ends and note on termination sheets.

If copper cables contain more than the 1 bad pair per 100, or if outer sheath damage is cause of bad pairs, remove and replace the entire cable.

These figures apply only to riser cables.

10.2.3 CATEGORY 6 UTP CABLING

Testing shall conform to ANSI/TIA/EIA-568B.1 standard. Testing shall be accomplished using level 3 or higher field testers.

If horizontal cable contains bad conductors or damaged outer jacketing, remove and replace cable.

11.0 FIRESTOPPING

11.1 GENERAL

Products may be in the form of caulk, putty, strip, sheet, or devices that shall be specifically designed to fill holes, spaces, and voids at communications penetrations. Firestopping materials shall adhere to substrates and maintain fire and smoke seal under normal expected movements of substrates, conduits, and cables. Use only approved filler material.

New and existing raceways, cable trays, and cables for power, data, and telecommunication systems penetrating non-rated and fire-rated floors, walls, and other partitions of building constructions shall be fire stopped where they penetrate new or existing building construction.

Firestopping shall be accomplished by using a combination of materials and devices, including penetrating raceway, cable tray, or cables, required to make up complete firestop.

Verify that cabling and other penetrating elements and supporting devices have been completely installed and temporary lines and cables have been removed.

11.2 APPLICABLE STANDARDS

The agencies in this section and their codes, standards, and regulations govern all firestopping work performed in Arlington County.

ASTM E814, Standard Method of Fire Tests of Through-Penetration Fire Stops

UL 1479, Fire Tests of Through Penetration Firestop Devices (XHCR) and Through Penetration Firestop Systems (XNEZ)

ASTM E 119, Fire Tests of Building Construction and Materials (For fire-rated architectural barriers)

2012 NFPA National Electrical Code, Section 800-52, Paragraph 2(B), Spread of Fire and Products of Combustion

NFPA 101 Life Safe Code: Mandated by the State of Virginia

NFPA 1 Uniform Fire Code: Referenced in 101 and has been adopted by County are our Fire Prevention Code

ANSI/NECA/BICSI-568, Standard for installing Commercial Building Telecommunications Cabling, Section 5, Clause 5.1 through 5.2.3, Firestopping

2015 edition of the BICSI Telecommunications Distribution Methods Manual, Chapter 15, Firestopping

Factory Mutual Approval Guide

ULC List of Equipment and Materials, VOL. II

11.3 INSTALLATION

Select appropriate type or types of through-penetration firestop or systems for each type of communications.

The time delay ratings for selected systems must match or exceed those of the associated fire-rated floors, walls, or other partitions of building construction.

Coordinate with trades constructing floors, walls, or other partitions of building construction to specify the size and shape of each opening to be constructed and device or system approved for use in each instance.

Coordinate each firestop selection with adjacent work for dimensional or other interference and for feasibility. In area's accessible to public and other "finished" areas, firestop systems work shall be selected, installed, and finished to the quality of adjacent surfaces of building construction being penetrated.

Use materials that have no irritating or objectionable odors when firestopping is required in existing buildings and areas that are occupied.

Provide damming materials, plates, wires, restricting collars, and devices necessary for proper installation of firestopping. Remove combustible installation aids after firestopping material has cured.

Install all firestops in accordance with the manufacturer's instructions to maintain the specific rating assigned by the independent testing laboratory.

- Existing raceways, cable trays, and cabling whether they are contained in the preceding structures or penetrate any existing building construction shall be fire stopped to the extent necessary to fill cavities that exist between existing building construction and existing communications penetrations or conduit sleeve, and between existing conduits and existing conduit sleeve.
- Assemblies consisting of individual steel-hat type restricting collards filled with intumescent type materials that surround communications penetration shall be used for nonmetallic raceways and cabling.

If required by inspecting authorities:

- Expose and remove firestopping to the extent directed by the inspecting authority to permit his or her inspection.
- Reinstall new fire stopping and restore work where removed for inspection.

12.0 AUDIO VISUAL

12.1 CONFERENCE ROOMS

Below is a list of recommendations from DTS for conference rooms. Cost listed are approximate and subject to change plus or minus based on room size, equipment added or subtracted, and manufacture.

12.1.1 SMALL CONFERENCE ROOM

Seating for 10 or less:

- 52"-55" Monitor w/tuner and integrated speakers
- Dedicated Desktop Computer
- HD Webcam w/microphone
- Cisco IP Speakerphone
- Cost: Approx. \$4,500 w/labor, computer not included in cost

12.1.2 MEDIUM CONFERENCE ROOM

Seating for 10 – 15:

- 60"-70" Monitor
- Sandbar w/HD Camera
- Dedicated desktop computer
- Audio Conferencing System
- Bluetooth visual display device
- Wall plate for guest mobile device
- Ceiling or tabletop microphones
- Ceiling speakers
- iPad Docking Station (iPad not included)
- Cost: Approx. \$25,500 w/labor, computer not included in cost

12.1.3 LARGE CONFERENCE ROOM

Seating for 20+:

- Projector (Laser)
- 130" Projection Screen
- HD Camera
- Dedicated desktop computer
- Audio Conferencing System
- Wall plate for guest mobile device
- Ceiling or tabletop microphones
- Ceiling speakers
- iPad Docking Station (iPad not included)
- Cost: Approx. \$25,500-\$32,00w/labor, computer not included in cost

13.0 WIRELESS DESIGN AND INSTALLATIONS STANDARDS

13.1 GENERAL

The wireless standards in this section are for indoor design only. Outdoor specifications are not included. Consult with DTS before designing for outdoor spaces.

DTS will design wireless network including WAP model numbers, enclosures and locations of WAP. The contractor will be responsible for implementing the Ethernet cabling from WAP to MDF/IDF communication closet and providing the purple Cat 6 Ethernet jumper cables.

13.1.1 INSTALLATION OF WAPs

WAP will be mounted in a visible and accessible location, preferably below the ceiling or on the walls. For maintenance purposes, WAPs must be mounted in a space no higher than 10-feet, avoiding objects like air conditioning units, vents, sprinkler systems, or anything that will interfere with the performance of the WAP.

Label wireless jacks on the ceiling grid with the NF number and the jack number, following the labeling convention in Appendix A. Label each WAP with the MAC address, NF number and jack number in a visible area on the WAP. Labels must be readable from the ground with no magnification.

If the WAP needs to be mounted in a non-standard location (e.g. exposed or recessed ceilings) contact DTS for alternative mounting solutions.

Install a secondary jack at all WAP locations to allow for future installations.

13.1.2 CABLING INSTALLATION IN THE NF ROOMS

All jumpers for wireless devices in the MDF / IDF communication closets should be purple patch cables. On the patch panels, all wireless station cables must be terminated with purple modules.

All wireless jacks must be connected to a gigabit port with POE+ (802.3at). DTS will be responsible for connecting patch cables from patch panel and network equipment,

Refer to cabling specifications outlined in section 5.0 Network Facilities for additional cabling standards in NF rooms.

14.0 DISTRIBUTED ANTENNA SYSTEM Distributed Antenna System Technical Specifications

- A. In a Resolution adopted by the Arlington County Board on October 22, 2013, the Board committed to using a standard fiber-based distributed antenna system for public safety communications. The specifications herein detail the standard system.
- B. This technical specification describes the standards for implementation of a Distributed Antenna System (DAS) for the purpose of improving public safety wireless communications within Arlington County Government (ACG) and Arlington Public Schools (APS) facilities.

7-1. Performance

- A. The DAS will meet or exceed the Minimum Downlink Receive Signal Level (RSL) as described in Table 20.

Table 1 - Minimum Downlink RSL

Band	Minimum Downlink RSL – dBm
Lower 700 MHz – BRS/EBS	-75
Cellular, 900 MHz, AWS, PCS	-85
700 MHz Public Safety, 800 MHz Public Safety	-85

- B. The contractor will confirm the frequencies used and guarantee coverage for all requested frequency bands according to Table 2 prior to the installation of the DAS.
- C. The DAS will meet the requirements of Table 2 in 95% of each floor within the building, to include the stairwells, elevators, basement, and garage.
- D. The DAS will comply with the latest edition of NFPA 1.
- E. The DAS will transmit the requested frequency bands simultaneously over one passive component installation.
- F. To accommodate periodic changes within frequency bands, the DAS will be capable of reconfiguration, without additional hardware or software, to meet the requirements of Table 2.

7-2. Expansion

- A. The DAS will be capable of supporting the following frequencies by modifying only the active components of the system. Additional components will comply with the specifications herein.

Table 21 - Supported Frequencies

Band	Uplink - MHz	Downlink - MHz
Commercial 700 MHz	698-716, 776-787	728-746
700 MHz Public Safety	799-805	769-755
800 MHz Public Safety	806-824	851-869
Cellular	824-849	869-894
900 MHz	896-902	935-941
AWS	1710-1755	2110-2155
PCS	1850-1915	1930-1995
BRS/EBS	2496-2690	24996-2690

- B. Active Distribution. Active components will be interconnected only with single-mode fiber optic cable.
- C. Remote Management. The DAS will provide for remote configuration, control, and monitoring of active components.
- D. SNMP (Simple Network Management Protocol) Alarm Reporting. The DAS will be deployed with SNMP alarm reporting technology capable of third party integration.
- E. The DAS will be connected to a backup generator providing 8 hours of continuous power.
 - 1. Active components of the DAS shall be housed in a NEMA type 4 enclosure by the manufacturer.
- F. Approval. The Contractor will design and implement a DAS capable of receiving approval of or certification from the wireless carrier(s) operating a respective band.

7-3. Substitutions

- A. Substitutions of DAS components will be accepted at the discretion of the County. A substitution that fails to meet or exceed the specifications described herein will not be considered.

The Contractor will submit the following information with any request for substitution:

- 1. Product sample (passive only; cables, connectors, etc.)
 - 2. Hardware/software manual (active only)
 - 3. Detailed product specifications
 - 4. Independent test results verifying product specifications
 - 5. Mean Time Between Failure (MTBF) data (active only)
 - 6. Written guarantee from the manufacturer that the substitution will be supported and available for 10 years from the date of system acceptance
 - 7. For components required for commercial carrier signals, written guarantee from the respective commercial carrier that the substitution is approved for use within the commercial carrier's network
- G. Contractor Qualification and Workmanship
 - 1. The Contractor will provide documentation demonstrating five (5) years of experience designing, installing, and commissioning DAS solutions of a similar scope and complexity.
 - 2. The Contractor will provide documentation demonstrating employee certification from the manufacturer of the active components of the DAS.
 - H. The Contractor will comply with the latest editions of the National Electrical Code, National Electrical Safety Code, National Contractor's Association Standard of Installation, relevant local regulations, and manufacturer's instructions during the design, installation, and commissioning of the DAS.

7-4. Submittals

- A. The following submittals will be delivered with the bid response.
 - 1. Component data sheets
 - 2. Donor and in-building antennae
 - 3. Coaxial cable, connectors, splitters, combiners, and couplers
 - 4. Fiber optic cable and connectors
 - 5. Bi-directional amplifier(s)
 - 6. Fiber optic master unit(s)
 - 7. Fiber optic remote unit(s)

8. Network Management unit(s)
- B. Design Documents
 1. RF link budget
 2. Overlay of system components on floor plans
 3. Donor antenna(e) and grounding drawings
 4. Bill of Materials (BOM)
 5. Sample Statement of Work (SOW)
 6. Sample Acceptance Test Plan (ATP)
 7. Recommended spares
- C. Warranty Documents
 1. Manufacturer's warranty of components
 2. Contractor's system warranty
- D. The following submittals will be delivered prior to the Notice to Proceed (NTP).
 1. Final RF link budget
 2. Overlay of system components on floor plans
 3. Donor antenna(e) and grounding drawings
 4. Bill of Materials (BOM)
 5. RF propagation modeling
 6. Signal to Noise Interference Ratio (SNIR) map
 7. Description of the method used to avoid the interference of uplink and downlink frequencies
 8. Maintenance Service Contract
 9. Statement of Work (SOW)
 10. Acceptance Test Plan (ATP)
- E. The following submittals will be delivered at close out.
 1. As-built drawings indicating:
 - a. Donor antenna, grounding, and lightning protection details
 - b. Cable routing, splitters, couplers, and in-building antenna locations
 - c. Active component locations, layout, and configuration
 2. Test reports indicating:
 - a. Compliance with the requirements of Table 2
 - b. Sweep testing results for all coaxial cable runs
 - c. Optical Time Domain Reflectometer (OTDR) results for all fiber optic cable runs
 3. Hardware and software manuals for all active components
 4. Warranty Documents
 - a. Manufacturer's warranty of components
 - b. Contractor's system warranty
 - c. Manufacturer's extended warranty

7-5. Warranty

- A. Manufacturer's Warranty
 1. 1-year limited warranty from the date of system acceptance on active components
 2. 5-year limited warranty from the date of system acceptance on splitters, couplers, and in-building antennae
 3. 20-year limited warranty from date of system acceptance on coaxial cable, fiber optic cable and connectors
- B. Contractor's Warranty

1. The Contractor will warrant the performance of the DAS, as described in Section V, for 1 year from the date of system acceptance.
- C. Manufacturer's Extended Warranty
 1. The Manufacturer will administer a follow-on program through the Contractor to provide support and service to the County. The program will cover a certified system, defined as a DAS installation performed by a certified contractor using certified components while following all the Manufacturer's installation instructions, recommendations, and best practices. The program will include:
 2. A 20-year warranty, provided by the Manufacturer and the Contractor, on all coaxial cable, fiber optic cable, and connectors
 3. An assurance that, during the 20-year warranty, the DAS will support current and future modulation formats in the frequency bands for which it is designed
 4. The Manufacturer and Contractor, using a schedule agreed upon by the County, will remediate any failure of the DAS whether during ATP, normal use, or the upgrade of the DAS to support additional frequency bands.
 5. The Manufacturer will maintain ISO Quality Control registration for the facilities that manufacture any component of the DAS.

7-6. Components

A. Broadband Donor Antennas:

Broadband Donor Antennas will feature a multi-band design, accommodating Cellular, PCS, LMR and AWS frequencies in a single small antenna.

1. Electrical:
 - Frequency bands, 806 - 960 MHz and 1710 - 2200 MHz
 - VSWR ≤ 1.8
 - Gain: 806-960 ≥ 10.5 dBi, 1710 - 2200 ≥ 12 dBi
 - Maximum input power: 100 watts
 - Polarization: Vertical
 - Front-to-back ratio: 806 - 960 ≥ 18 dB, 1710 - 2200 ≥ 20 dB
 - Impedance: 50 Ω
 - Azimuth Pattern: As proposed by the manufacturer to meet the performance specifications in this Section.
2. Mechanical:
 - Radome material: UV-protected ABS
 - Pigtail cable: RG58, plenum rated
 - Connector: 50 Ω N Type Female
 - Mounting: Pole
 - Environmental
 - Temperature: -40 °C to +60 °C
 - Lighting protection: Direct ground
 - Waterproof level: IP 66
 - Wind Speed, maximum: 125 mph
 - Approved Manufacturer: Andrew CELLMAX-EXT-CPU or equivalent, in accordance with Section III.

B. 700 MHz LMR Yagi Donor Antennas:

1. Electrical:

- Frequency band, 746 - 806 MHz
- VSWR $\leq 1.5:1$
- Gain: ≥ 11.1 dBi
- Maximum input power: 100 watts
- Polarization: Vertical
- Front-to-back ratio: ≥ 15 dB
- Impedance: 50 Ω
- Beam width, Horizontal, degrees: 60
- Azimuth Pattern: As proposed by the manufacturer to meet the performance specifications in this Section.

2. Mechanical:

- Connector: 50 Ω N Type Female
- Mounting: Pole
- Environmental:
- Temperature: -40 °C to +60 °C
- Lighting protection: Direct ground
- Waterproof level: IP 66
- Wind Speed, maximum: 125 mph
- Approved Manufacturer: Andrew DB498-PS or equivalent in accordance with Section III.

C. Omni-Directional Coverage:

Omni-Directional Coverage antennas will feature a multiband design, accommodating multiple frequency bands in a single small antenna.

1. Electrical Band 1:

- Frequency Band: 698 – 800 MHz
- VSWR: $\leq 1.8:1$
- Gain: ≥ 1.5 dBi
- Maximum input power: 50W
- Impedance: 50 Ω
- Beamwidth, Horizontal: 360° omnidirectional
- Beamwidth, Vertical: 80° nominal
- Return Loss: 10.9 dB

2. Electrical Band 2:

- Frequency Band: 1710 – 2700 MHz and 800 – 960 MHz
- VSWR: $\leq 1.5:1$
- Gain: ≥ 1.5 dBi @ 800–960 MHz and ≥ 5.0 dBi @ 1710 – 2700 MHz
- Maximum input power: 50W
- Impedance: 50 Ω
- Beamwidth, Horizontal: 360° omnidirectional
- Beamwidth, Vertical: 65° nominal
- Return Loss: ≤ 13.9 dB

3. Mechanical:

- Connector: 50 Ω N Type Female
- Mounting: Thru-hole ceiling mount
- Radome material: ABS, UV resistant
- Pigtail cable: KSR195, plenum rated

4. Environmental:
 - Application: Indoor
 - Operating Temperature: 40 °C to +60 °C (40 °F to +140 °F)
 - Relative Humidity: Up to 100%
5. Regulatory Compliance/Certifications: **RoHS 2002/95/EC**
 - Approved Manufacturer: Andrew CELLMAX-O-CPUSE or equivalent, in accordance with Section III.

D. Directional Coverage Antennas:

Directional coverage antennas will feature a multi-band design, accommodating multiple frequency bands in a single small antenna.

1. Electrical Band 1:
 - d. Frequency Band: 698 – 800 MHz
 - e. VSWR: $\leq 1.8:1$
 - f. Gain: ≥ 1.5 dBi
 - g. Maximum input power: 50W
 - h. Impedance: 50 Ω
 - i. Beam width, Horizontal: 360° omnidirectional
 - j. Beam width, Vertical: 80° nominal
 - k. Return Loss: 10.9 dB
2. Electrical Band 2:
 - a. Frequency Band: 1710 – 2700 MHz and 800 – 960 MHz
 - b. VSWR: $\leq 1.5:1$
 - c. Gain: ≥ 5.0 dBi @ 800 – 960 MHz and ≥ 6.0 dBi @ 2170 – 2700 MHz and ≥ 8.0 dBi @ 1710 – 2170 MHz
 - d. Maximum input power: 50W
 - e. Impedance: 50 Ω
 - f. Beamwidth, Horizontal: 90° nominal
 - g. Return Loss: ≤ 13.9 dB
3. Mechanical:
 - a. Connector: 50 Ω N Type Female
 - b. Mounting: 4-hole wall mounting plate
 - c. Radome material: ABS, UV resistant
 - d. Pigtail cable: RG58, plenum rated
4. Environmental:
 - a. Application: Indoor
 - b. Operating Temperature: 40 °C to +60 °C (40 °F to +140 °F)
 - c. Relative Humidity: Up to 100%
5. Regulatory Compliance/Certifications: **RoHS 2002/95/EC**
 - a. Approved Manufacturer: Andrew CELLMAX-D-CPUSE or equivalent, in accordance with Section III.

E. Fiber Optic Cable and Connectors:

1. General Specifications:
 - a. Cables will be six-strand or greater, designed for point-to-point applications as well as mid-span access, and will provide a high-level of protection for optical fiber installed in interior building environments.

- b. Higher optical fiber count cables will use a sub-unitized design with color-coded subunits for easy identification.
- c. Single-mode optical fibers will be 8.3 μm and use standard colored tight-buffered construction.
- d. The single-mode optical fiber will be dispersion-unshifted optical fiber that meets ITU-T G.652c standards.
- e. Cable will provide optimum performance over entire wavelength range from 1260 to 1625 nanometers.
- f. Cable will support new and emerging applications that use extended E band, 1360 to 1460 nanometers.
- g. Cable will also support existing and legacy single-mode applications that traditionally operate in 1310 and 1550 nanometer regions.
- h. Cable will deliver a cost-effective upgrade path by expanding available wavelengths by 50 percent supporting 16 Channels of coarse wave division multiplexing (CWDM) on a single optical fiber and up to 400 Channels of dense wave division multiplexing (DWDM) on a single cable.
- i. Fire ratings: Riser, plenum, and/or LSZH
1. Approved Manufacture: CommScope Fiber Optic Cable containing TeraSpeed Single Mode Optical Fiber. As an example, P-006-DS-8W-FSUYL, 6-strand breakout cable single-mode fiber or equal in accordance with Section III.

F. Fiber Optic Pigtails:

1. General Specifications:
 - a. To maintain channel integrity, optical fiber patch cords and pigtails will be fabricated to meet the performance parameters corresponding to the optical fiber cable approved product type specified below. Patch cord and pigtail plug connectors will be equipped with boots and will have same colors as related optical fiber backbone cables, unless specified or indicated otherwise. Optical fiber patch cords and pigtails will be available with the following options as specified or indicated:
 - b. Termination types: SC-APC
 - c. Connector/cable configuration: Simplex and duplex
 - d. Fire ratings: Riser, plenum and/or LSZH
 - e. Patch cord outside diameters: 1.6 millimeters (0.063 inches) and 3.0 millimeters (0.118 inches)
 - f. Pigtails: Ruggedized and tight-buffered optical fiber—0.9 millimeters (0.035 inches) outside diameter
2. Lengths: As specified or indicated
3. Approved Manufacturer: CommScope TeraSpeed single reinforced buffered 900 μm , LightScope ZWP single-mode fiber, angled polished connector or equivalent, in accordance with Section III.

G. Air Dielectric, Plenum Rated Cable:

1. Material Characteristics:
 - a. Jacket: Halogenated, Fire-Retardant
 - b. Outer Conductor Material: Corrugated Aluminum or Corrugated Copper
 - c. Inner Conductor Material: Copper-Clad Aluminum Wire
2. Electrical Characteristics:
 - a. Impedance: $50 \pm 2.0 \Omega$

- b. Frequency Band: 1 - 8800 MHz
- c. Peak Power Rating: ≥ 40.0 kW
- 3. Mechanical Characteristics:
 - a. Diameter Over Jacket: $\leq .627$ in
 - b. Minimum Bending Radius: ≤ 5 in
 - c. One Time Minimum Bending Radius: ≤ 3 in
- 4. Attenuation Characteristics:

Plenum Rated Cable Attenuation

Frequency: MHz	Attenuation: dB/100ft
150	≤ 0.848
450	≤ 1.53
800	≤ 2.105
2000	≤ 3.564

Standard Conditions: VSWR 1.0, ambient temperature 20 °C (68 °F)

- 5. Approved Manufacturer: Andrew HL4RP-50A, AL4RPV-50A or equivalent, in accordance with Section III.

H. Foam Dielectric Cable:

- 1. Material Characteristics:
 - a. Jacket: Non-halogenated, Fire-Retardant
 - b. Outer Conductor Material: Corrugated Copper
 - c. Inner Conductor Material: Copper-Clad Aluminum Wire or Copper Tube
- 2. Electrical Characteristics:
 - a. Impedance: $50 \pm 1.0 \Omega$
 - b. Frequency Band: 1/2" Nominal: 1 - 8800 MHz, 7/8" Nominal: 1 - 5000 MHz
 - c. Peak Power Rating: ≥ 40.0 kW
- 3. Mechanical Characteristics:
 - a. Diameter Over Jacket: 1/2" Nominal: $\leq .630$ in, 7/8" Nominal: ≤ 1.1 in
 - b. Minimum Bending Radius: 1/2" Nominal: ≤ 5 in, 7/8" Nominal: ≤ 10 in
 - c. One Time Minimum Bending Radius: 1/2" Nominal: ≤ 2 in, 7/8" Nominal: ≤ 5 in
- 4. Attenuation Characteristics: 1/2" Nominal

Foam Dielectric Cable Attenuation

Frequency – MHz	Attenuation – dB/100ft
150	≤ 0.815
450	≤ 1.447
800	≤ 1.968
2000	≤ 3.251

Standard Conditions: VSWR 1.0, ambient temperature 20 °C (68 °F)

- 5. Attenuation Characteristics: 7/8" Nominal:

Foam Dielectric Cable Attenuation

Frequency – MHz	Attenuation – dB/100ft
150	≤ 0.417
450	≤ 0.744
800	≤ 1.014
2000	≤ 1.683

Standard Conditions: VSWR 1.0, ambient temperature 20 °C (68 °F)

6. Approved Manufacturer: Andrew LDF4-50A, FXL-540-NHR, FXL-780-NHR or equivalent, in accordance with Section III.

- I. Splitters, Combiners, Couplers, Coax Jumpers and Connectors:
 1. Approved Manufacturer: Andrew or equivalent, in accordance with Section III.

- J. 10-10: BDA: The BDA(s) will be of modular design and use digital filtering to mitigate interference and accommodate public safety radio and commercial wireless carrier coverage.
 1. Characteristics
 - a. Operating Temperature Range: -33 °C to +50 °C
 - b. Chassis: Will be of modular design with ≥ 4 frequency bands per 19" chassis. Chassis will not exceed four Rack Units (RUs) in height.
 - c. Filtering: Digital
 - d. Separate Control: Each RF amplifier will be capable of adjusting and controlling power levels for each commercial wireless carrier when multiple commercial wireless carriers share a single amplifier.
 - e. FCC Part 90.219 Type Classification: Class A narrowband for LMR/SMR/ESMR frequency bands
 - f. Alarming: Will support both SNMP and SMS using wireless modem.
 - g. Mounting Options: Will support rack, wall and pole mounting.
 - h. Frequency Bands Supported: 380 - 512 MHz LMR, 769 - 806 MHz LMR, 806 - 869 MHz LMR/SMR/ESMR, 896 - 941MHz LMR/SMR/ESMR, 824 - 894 MHz Cellular, 1710 - 1755 MHz AWS, 1900 - 1950 MHz PCS
 2. Compliance:
 - a. NFPA: The BDA will comply with NFPA-1 2009 Edition Annex O In-Building Public Safety Radio Enhancement Systems.
 - b. FCC: Will be FCC type certified.
 3. Approved Manufacturer: Andrew Node A or equivalent, in accordance with Section III.

- K. Fiber Optic Master Unit: The Fiber Optic Master Unit will convert radio over coax to Radio-Over-Fiber (RoF) for distribution to Fiber Optic Remote Units.
 1. Characteristics
 - a. Transmission Media: Single-mode fiber at 1310 nm
 - b. Operating Temperature Range: +5 °C to +40 °C
 - c. Impedance: 50 Ω
 2. Chassis:
 - a. Will be of modular design capable of supporting ≥ 32 Remote Units per 19", 5 RU chassis
 - b. Will support redundant power supplies
 - c. Will have the capability to remotely power the Remote Units via composite fiber optic cable

3. Automatic Gain Control (AGC): Will provide AGC for optical loss compensation
4. Optical Budget: Will support ≤ 3 dB optical budget (~3 km or 2 miles)
5. Auxiliary Channel: Will provide an input to support 400 to 2700 MHz for future expandability
6. Interlink: Will support one fiber or two fibers bi-directional optical link for distances up to 20 km with a 10dB optical budget
7. Remote Supervision:
 - a. Will support the TCP/IP protocol, SNMPv2, FTP, HTTP, Telnet, and be fully compatible with general purpose SNMP managers
 - b. Remote access will be available via Point-to-Point Protocol (PPP), over circuit-switched/packet data and wired/wireless modems
 - c. Each Active device will be manageable via a Web GUI
8. Auto Mapping: Each board position will be automatically mapped during system turn-up
 - a. Frequency Bands Supported: 380 - 512 MHz LMR, 769 - 806 MHz LMR, 806 - 869 MHz LMR/SMR/ESMR, 896 - 941MHz LMR/SMR/ESMR, 824 - 894 MHz Cellular, 1710 - 1755 MHz AWS, 1900 - 1950 MHz PCS and 2496 - 2690 MHz BRS/EBS.
 - b. Approved Manufacturer: Solid Alliance Multi-Carrier or equivalent, in accordance with Section III.

L. 10-12: Fiber Optic Remote Units:

The Fiber Optic Remote Unit converts the RoF signal back to radio over coax, as well as provides filtering so that multiple frequency bands can reside over the same passive cable and antenna infrastructure.

1. Characteristics
 - a. Operating Temperature Range: +5 °C to +40 °C
 - b. Impedance: 50 Ω
 - c. Power Consumption: ≤ 105 watts, maximum
2. Output Power per Carrier at Antenna Port:

Output Power

Band – MHz	Output Power – dBm
Analog 700	27
GSM 700	27
Analog 800 and 850	27
GSM 850 and 850	31
GSM 850 and 850 at band edges	29
iDEN 800 and 850	26
iDEN 800 and 850 at band edges	24
CDMA 800 and 850	29
CDMA 800 and 850 at band edges	27
Analog 900	29
iDEN 900	23
CDMA 1700	30
W-CDMA 1700	28
Analog 1900	31

GSM 1900	31
CDMA 1900	29
W-CDMA 1900	27

3. MTBF (excluding external power supply): $\geq 160,000$ hours
4. Physical: The Remote Unit will consist of the following:
 - a. Ingress Protection: IP31 or equivalent
 - b. Frequency Bands supported: 769 - 806 MHz LMR, 806 - 869 MHz LMR/SMR/ESMR, 896 - 941MHz LMR/SMR/ESMR, 824 - 894 MHz Cellular, 1710 - 1755 MHz AWS, 1850 - 1995 MHz PCS
 - c. Optical Port: 2xSC-APC connector (separated uplink/downlink)
 - d. Antenna Port: Single 50 Ω N type female connector
 - e. Auxiliary Ports: Two SMA female for future add-on modules
5. Uplink Noise Figure:
 - a. LMR 700, LMR 800, Cell850: ≤ 7.5 dB
 - b. LMR 700, LMR 800, Cell850 at band edges: ≤ 9.5 dB
 - c. LMR 900: ≤ 8.5 dB
 - d. AWS: ≤ 7.5 dB
 - e. PCS 1900 extended: ≤ 7.5 dB
6. Approved Manufacturer: Solid Alliance ROU or equivalent in accordance with Section III.

7-7. Maintenance

- A. The Contractor will provide an optional 1-year maintenance contract, capable of annual renewal, covering preventative maintenance, system monitoring, spares, failure remediation, equipment repair, and response time.

7-8. Installation

- A. The Contractor will design, install, commission, and test the DAS according to the Manufacturer's instructions and recommendations.
- B. The Contractor will install the DAS according to the SOW as accepted by the County.

7-9. Acceptance Testing

- A. The Contractor will complete the acceptance testing according to the ATP as described in Subsection VI.B.10.
- B. Acceptance testing will confirm compliance with the requirements as described in Section V.

7-10. In-Building First Responder Network Testing Protocol

- A. When an emergency responder radio coverage system is required at a location, the building/location owner shall have the radio system tested to ensure that two-way coverage of the building reveals a minimum signal strength of -85 dBm on 95 percent of each floor to include hallways, stairwells, and elevator lobbies within the building's area. In addition, the quality of radio signal should be no less than Delivered Audio Quality (DAQ) 3.4 as defined by the Telecommunications Industry Association (TIA). A test shall be performed upon completion of installation and EACH year thereafter to ensure adequate coverage is maintained.
- B. The test procedure shall be conducted as follows:
 1. Each floor of the building shall be divided into a grid of 20 approximately equal areas.
 2. The test shall be conducted using a calibrated portable radio.

3. The test shall be considered failed if more than two nonadjacent grid areas do not meet the signal strength requirements.
- C. In the event that three nonadjacent areas fail the test, in order to be more statistically accurate, the floor shall be divided into 40 equal areas. The test shall be considered failed if more than four nonadjacent grid areas do not meet the signal strength requirements. If the system fails the 40- area test, the system shall be modified to meet the 95 percent coverage requirement.
- D. A test location approximately in the center of each grid area shall be selected for the test. The radio shall be enabled to verify two-way communications to and from the outside of the building through the public agency's radio communications system. Once the test location has been selected, that location shall represent the entire area. If the test fails in the selected test location, that grid area shall fail. Prospecting for a better location within the grid area shall not be allowed.
- E. The gain values of all amplifiers shall be measured and the test measurement results shall be kept on file within the building so that the measurements can be verified during annual tests. In the event that the measurement results become lost, the developer shall be required to rerun the acceptance test to reestablish the gain values.
- F. As part of the installation a spectrum analyzer or other suitable test equipment shall be utilized to ensure false oscillations are not being generated by the subject signal booster.
- G. The antennas, cable, and other passive components of the system shall be rated to operate at least between 400MHz and 5.0 GHz.
- H. The minimum qualifications of the system designer, tester and lead installation personnel shall include:
 1. A valid FCC-issued General Radio Operators License; and
 2. Certification of in-building system training issued by a nationally recognized organization or school or a certificate issued by the manufacturer of the equipment being installed.
 3. Personnel may be exempt from these requirements upon successful demonstration of adequate skills and experience satisfactory to the County Manager or designee.
 4. The minimum requirements to submit to Arlington County DTS shall include:
 - a. Copy of valid FCC-issued General Radio Operators License (Electronic Form Acceptable).
 - b. Construction/Installation Specifications for the building.
 - c. Test of the Distributed Antenna System, Floor by Floor (Signal Strength Verification)

7-11. In-Building First Responder Network Monitoring Requirements

- A. Systems installed shall be continuously monitored, capable of sensing failures, and configured to report such failures to an approved monitoring company via auto-dialer devices over the public switched network. The system must report, at a minimum, the following conditions:
 1. Main power disruption
 2. Back-up power failure
 3. Transmitter/Receiver failure
- B. When an alarm is received, the owner and/or monitoring company shall immediately notify the Arlington County Emergency Communication Center (ECC) at 703-741-3005, providing the building address, type of failure reported, and estimated time of the outage if known. When the system is restored back to normal operations, the owner and/or monitoring company shall notify the ECC at the number above of the restoration of service.

APPENDIX A

DTS CABLE LABELING STANDARDS AND CONVENTIONS

Labels will be used on all fiber optic and copper cabling, including Outside Plant cables, risers, horizontal (station), and fiber and copper patch cables. The labeling scheme shall be TIA/EIA 606A compliant or better. Labeling shall also extend to racks, cabinets, and patch panels used for terminations. Label materials shall meet all applicable fire codes and be resistant to the environment and have a life span equal to or greater than that of the product to which they are applied. All labels shall be machine printed unless otherwise approved by DTS in writing. Contact DTS for associated building code and NF # used in labeling.

FIBER OPTIC CABLE

OSP CABLE

Label Outside Plant (OSP) cable at each end, specifying the far-end building name, building number, single-mode, and the strand count. Label the cable at the entrance and exit points of the tunnel system or if it enters a conduit. Place the label between 12 and 36 inches from the conduit, or at the closest point that it is clearly visible. Label the cable along its length at 100-foot intervals or the closest point that maintains clear visibility. On labels in the tunnels system, specify the building name and NF number for both ends of the cable and specify the strand count. Label termination panels at both ends with far end building name, NF number, single-mode, and the strand count. On termination panels, use both machine printed labels and the manufacturer's label card. Each separate 6 or 12-strand panel insert shall have a factory panel label, and each strand's terminations shall have factory label or install applied, machine printed label with the strand number for that cable. If there is a factory supplied label for the cover or door, use it to indicate cable numbers and strand number. Contact DTS for building codes, and labeling conventions.

RISER CABLE

Label each riser cable originating in a fiber Entrance Facility and its interconnecting equipment or NF on both ends of the cable with the far-end Entrance Facility, equipment, or NF number and strand count. Label termination panels using factory supplied labels or approved machine printed labels and specify far-end Entrance Facility, NF number, Panel Position, and strand count. Contact DTS for building codes, and labeling conventions.

FIBER OPTIC PATCH CABLES

Fiber optic patch cables shall be duplex cables that are yellow for single-mode. The patch cord shall be labeled on each end, specifying the source and destination of the cable. DTS will install all patch cables connecting equipment.

COPPER CABLE

OSP OR FEEDER CABLE

Label Outside Plant (OSP) cable on each end with the far-end building name, building number, and the pair count. Apply a label at a point within 12 to 36 inches of the point where a cable leaves the tunnel and enters a conduit, or at the nearest location to maintain visibility. Include the name and number of the building the cable is entering, along with the pair count. Label the

cable along its length in the tunnel at 100-foot intervals and at every turn in a location that maintains clear visibility. Each label shall contain the building name and number at each end and the pair count. The protector blocks at each end shall be labeled with the cable number, far-end building name and number, and pair count. The cable number will be supplied by DTS.

RISER CABLE

Riser cables shall be labeled on each end with the far-end Entrance Facility, equipment, or NF number and the pair count. Termination panels shall specify the far-end Entrance Facility, equipment, or NF number. At the point where individual pairs are terminated, label as every fifth (5th) pair point. Contact DTS for labeling conventions.

TELECOMMUNICATIONS OUTLETS

Mark faceplates with an ultra-fine tip, black, permanent Sharpie, then cover with a machine printed label, such as a P-touch type label (this ensures that if the label is lost the faceplate identification remains). In the NF, after the first panel has been filled (1-48) the other panels must be labeled in continuous sequencing (49-96, etc.). Other cable contractors may have installed cables at these facilities. Locate all of the other equipment or NF locations at the site to determine the correct labeling sequence to be used for the new equipment or NF. Examples of faceplate labels are included in this Appendix.

EXAMPLES

FIBER LABELING

CONTACT DTS FOR EXACT LABELING SCHEME. LABELING IS TO FOLLOW AS BELOW.

There will be two areas labeled on each fiber panel:

1. The top of panel will be labeled with the Building code, Room code, rack/row number, rack position, and panel position. See example below.
2. Far end panel location will be labeled on the ports with Far end panel name, and port location. See example below.

Termination Panel Backbone Fiber:

XXX-XXX-1-1-A1 – A12 [Building Code # - NF # - Rack # – Panel Location - Strand #]

FIBER PATCH CABLE LABELING

This needs to be at the end of each patch cord.

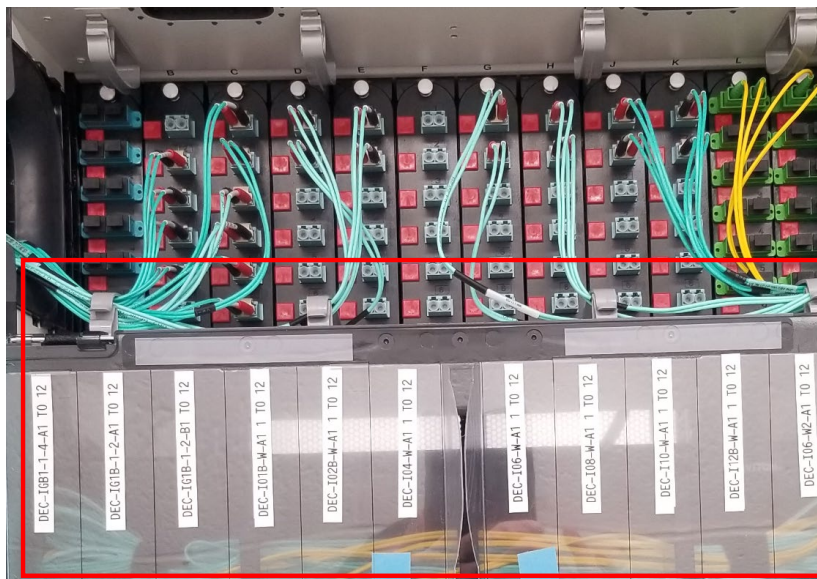
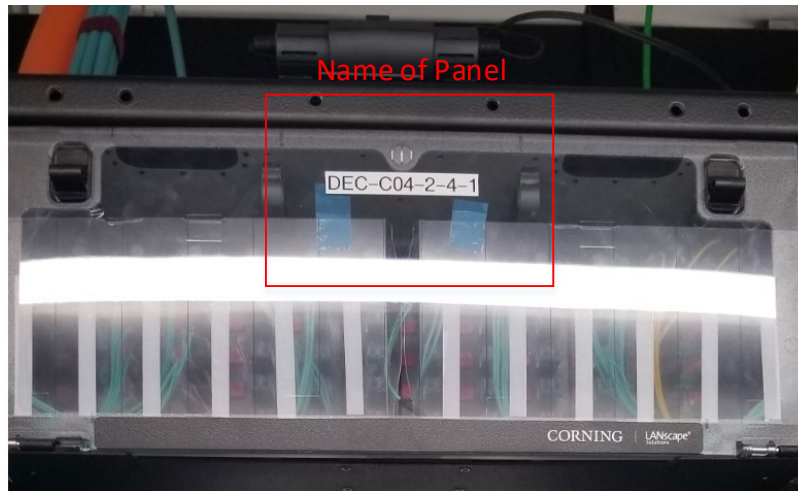
Fiber Port Number – Equipment Port Number or Fiber Port Number for pass-thru

DEC-C04-2-4-1-A5/6

DEC-C04-CORE-1 Et1/0/1

FIBER LABELING

FIGURE 4: FIBER LABELING ILLUSTRATION



COPPER LABELING

Patch panel: each panel will have an alphanumeric design, each jack number on the patch panel will be determined by NF Floor Location, Closet #, and port # as shown in Figure 5.

Faceplate: each faceplate will have an alphanumeric design; each jack number will be determined by the Patch panel termination location. The cable will be labeled the same at the patch panel and the faceplate. See figure 5.

PATCH PANEL AND DATA DROP

FIGURE 5: PANEL AND OUTLET LABELING

X-XXX-XXX [Floor # Closet # - Data Drop #]

4-I01-083

4 – Fourth Floor of building

I01 – Intermediate Communications closet # 1 (1st IDF room on the 4th Floor)

083 – Data drop number

COPPER PATCH CABLE LABELING

This need to be at each end of the patch cord.

X-XXX-XXX [Floor # Closet # - Data Drop #]

4-I01-083

4 – Fourth Floor of building

I01 – Intermediate Communications closet # 1 (1st IDF room on the 4th Floor)

083 – Data drop number

RACK LABELS

Label the top of each rack with the rack number. Rack's should be labeled left to right, front to back. Each rack should have a unique label. See example below:

XXX-01 [NF name, Rack #]

M01-01

M01 – MDF on 1st floor

01 – 1st rack

APPENDIX B

APPROVED MANUFACTURERS

RACKS

- Chatsworth Products Inc.
- CommScope
- Panduit
- Ortronics

PATCH PANELS

- Siemens Angles Patch Panels
- If substitutions are made the Contractor must provide vendor specifications which then must be approved by the County or DTS Project Manager before the cable is installed

CABLE COPPER

- CommScope
- If substitutions are made the Contractor must provide vendor cable specifications which then must be approved by the County or DTS Project Manager before the cable is installed

CABLE FIBER

- Dow Corning-single mode fiber
- If substitutions are made the Contractor must provide vendor cable specifications which then must be approved by the County or DTS Project Manager before the cable is installed

CABLE MANAGEMENT

- Ortronics Horizontal and Vertical
- Panduit Horizontal and Vertical

TELECOMMUNICATIONS OUTLETS

- Siemens
- Panduit

BASKET TRAY AND LADDER RACKS

- Chatsworth Product Inc.

APPENDIX C

PARTS LISTING

TABLE 4 – COMMUNICATIONS COMPONENT SPECIFICATION

Component Type	Model Type	Part #
Communications Outlet	Seimens Duplex Modules	Part # CT-C6-C6-02
	Seimens Single Gang Faceplates	Part # CT4- FP- 02
	Seimens Quad Gang	Part # CT8- FP- 02
	Panduit 2 Port surface box	Part # CBX2IW-AY
	Panduit 4 Port surface box-	Part # CBX4IW-AY
	Panduit CAT6 Jack module-	Part # CJ688TGyl
	Panduit 6 Port Face-plate-	Part # CFPE6IWY
	Panduit 2 Port Face-plate-	Part # CFPL2IWY
	Panduit 3 Port System Furniture Plate	Part # CFFPKE3BL
	Panduit Blank module insert	Part # CMBIW-X
Patch Panel	Seimens 48 Port Patch Panel	Part # HD6-48T4 568A Wiring
Wire Management	Ortronics Horizontal Wire Management	Part # OR-808040410
	Panduit Vertical Wire Management	Part # 577820
	CPI Vertical Relay Racks	Part # 55053-503
Building Entrance Terminals	Krone 25 Pair BET	Part # 6659-1-025-18/XX
	Krone 50 Pair BET	Part # 6659--1-050-29/XX
	Krone 100 Pair BET	Part # 6659-1-100-14/XX
	Krone 10 Pair Protector Magazine w/ fail safe 230V	Part # 6659-2-050-09
Fiber Termination Equipment	Corning Fiber/Glass	
	Corning 24 Port Housing (rack mount)	Part # PCH-01U
	Corning 48 Port Housing (rack mount)	Part # PCH-02U
	Corning 144 Port Housing (rack mount)	Part # PCH-04U
	Corning Splice Housing	Part # CSH-03U
	Corning 4R Splice Trays for 12 Heat Shrink Corning 2R Splice Trays for 12 RTV Fusion	Part # M67-110 Part # M67-060
	Corning Duplex 12 SMF LC-APC Module w/ Pigtails	Part # CCH-CP12-B3-P03RH
	Corning Duplex 12 OM3/4 MM LC Module w/Pigtails	Part # CCH-CP12-E4-P03SH

APPENDIX D

PROJECT COMPLETION FORM

TABLE 5 – PROJECT COMPLETION/DTS MOVE IN READY FORM

Deliverables	DTS PM Initials	Date	DES PM/General Contractor Initials	Date
DTS Move In Ready				
Network Facilities Secured?				
HVAC operational?				
Network Facilities Cleaned and dust Free?				
Network Facilities Floors sealed/covered?				
All Work in Network Facilities Complete?				
Project Completion				
All station cabling installed and documented?				
All fiber optic riser and backbone cabling installed and documented?				
All copper testing complete and labeled?				
All fiber testing complete and labeled?				
All Electrical outlets operational and labeled?				