

BNL COMMUNICATIONS INFRASTRUCTURE SPECIFICATIONS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENT

A.The Contractor is responsible to adhere to the contents of the Communication Infrastructure Specifications.

1.2 SCOPE OF WORK

A.Work covered by this Section shall consist of furnishing labor, equipment, supplies, materials, and testing unless otherwise specified, and in performing the following operations recognized as necessary for the installation, termination, labeling of multi-pair copper cable and fiber optic cable as described on the Drawings and/or required by these specifications.

B.Contractor shall provide closures and all associated hardware necessary for the routing and management of communications cabling as shown on the Drawings and/or required by these specifications.

C.All test documentation in electronic format shall be submitted to the F&O Project manager with copies to Network Services prior to BNL acceptance.

1.3 INTENT OF DRAWINGS AND SPECIFICATIONS

A.These Specifications, together with the Drawings accompanying them, are intended to depict the installation requirements necessary to support this Project. Contractor shall furnish materials shown and/or called for on the Drawings but not mentioned in the Specifications, or vice versa, that are necessary for the installation and support of communications cabling, whether specifically called for in both. In addition, Contractor shall provide incidental equipment and materials required for the completion of systems included in this contract whether or not specified or shown on the Drawings.

1.4 DEFINITIONS

A.MDF (Main Distribution Frame) - The MDF is designated as the point where the outside plant cable terminates in the building. This includes fiber/twisted-pair cabling coming from the utility telecom manhole.

B.IDF (Intermediate Distribution Frame) - That point which connects to the MDF with riser cables and distributes horizontal wiring to the rooms. In some situations, a MDF may serve this function.

C.Data Outlet - The Standard Network outlet, whether flush or surface mounted. This consists of (2) CAT 6 cables for Data Applications. Network devices terminate at floor IDF or in such cases where IDFs do not exist, at the MDF.

D.Outside Plant - All transmission facilities (Copper or Fiber cabling) used in the distribution of network from the MDF in one building to the distribution point for that particular service.

E.Riser Cable – Network cables extending vertically (or horizontally, in some cases) between the MDF and each area IDF.

F.Horizontal Cable - That wiring which extends from a MDF or IDF to the room device outlet or other designated location.

PART 2 - PRODUCTS

2.1 COMMUNICATIONS MATERIALS

A.General

1. The materials and products specified herein reflect the minimum acceptable standards of fabrication and manufacture.
2. All materials and products supplied by the Contractor and specified herein are to be new, unused, of first quality and in original packaging or shipping containers or as shown on drawings.
3. New building construction and/or existing building renovations will utilize (2) CAT 6 cables and termination hardware. Network Outlets shall conform to T568A wiring standard.
 - a. Cat6A should be used in instances where 10Gb/s is required.
 - b. Cover plate for network outlet shall be office white.
 - c. All unused faceplate openings should be covered with a blank insert.

B.Station End

1. See Appendix A for a listing of materials to be used at the station end. Substitutions are only permitted if approved by BNL Network Engineering.

C.MDF/IDF

1. Equipment Racks and Materials:
 - a. 4-post racks with 6" vertical cable managers on all sides should be utilized.
 - b. There should be at minimum 36" clearance surrounding the racks.
 - c. Within each rack 1RU horizontal cable managers must be installed between each copper patch panel. Please see Drawings for locations.
 - d. All racks installed require power outlets mounted at the rear base of each rack.
 - 1 quad 120v/20a on normal power in each powered rack
 - 1 quad 120v/20a on emergency power in each powered rack
 - e. All racks must be grounded and bonded.
 - f. See Appendix B for approved part numbers. Substitutions are only permitted if approved by BNL Network Engineering.
2. MDF/IDF dimension recommendations based upon the number of racks required (clearance included):
 - a. Single Rack: 10 FT (W) x 10 FT (D) x 8 FT (H)
 - b. Two Racks: 12 FT (W) x 10 FT (D) x 8 FT (H)
 - c. Three Racks: 14 FT (W) x 10 FT (D) x 8 FT (H)
 - Recommended for IDFs in new construction or if space is available.
 - d. Four Racks: 16.5 FT (W) x 10 FT (D) x 8 FT (H)
 - Recommended for MDFs in new construction or if space is available.
 - e. Five Racks: 19 FT (W) x 10 FT (D) x 8 FT (H)
3. All IDFs and MDFs should be conditioned to support equipment within the room.
4. Terminal Backboards:
 - a. Backboards shall be provided by Contractor at MDF and IDF's as specified on drawings.
 - b. Backboards shall be ¾ in treated, fire-retardant plywood sized as required and secured to wall at 16 IN O.C.
 - c. Backboards shall be mounted 2 FT-0 IN above finished floor and not above 6 FT-0 IN A.F.F.
 - d. Backboards should be labeled.

5. Data Patch Panels:
 - a. Patch panel should match appropriate jack type.
 - b. Patch panels should be 2ru 48 port quick ports.
 - c. 1RU horizontal cable managers should be placed above and below each patch panel.
 - d. See Appendix C for part numbers. Substitutions are only permitted if approved by BNL Network Engineering.
6. Fiber Optic Terminations:
 - a. Fiber optic splice enclosure shall be mounted at the top of the equipment frame for termination of the fiber. This will occupy the top rack unit spaces.
 - b. For all fiber optic panels, enclosures and connectors see Appendix D. Substitutions are only permitted if approved by BNL Network Engineering.
 - c. All terminations should be fusion spliced. Mechanical splices must NOT be used.

2.2 COPPER CABLES

A. General

1. Copper cables must meet all the ANSI/TIA 568 C.2 requirements.
2. Cables should be kink-free.
3. For inside and outside copper cables see Appendix E. Substitutions are only permitted if approved by BNL Network Engineering.

B. Inside Station cables

1. Must be plenum rated.
2. Conform to existing building wiring.
3. New construction and major renovations will use Cat6.
4. Cat5E and Cat6 cable should be Blue and Cat6A should be Violet.

C. Inside Riser cables

1. Must be plenum rated conforming to ANSI/TIA 568-C.2.
2. Conform to existing building wiring.
3. New construction and major renovations will use Cat3.

D. Outside Cables

1. Underground cables shall be designed for direct burial or duct application
2. Copper shall be of 22gauge insulated conductors.
3. There shall be a filling compound between the pairs and core wrap.
4. The core wrap shall be between the conductors and the shield.
5. It shall have a corrugated aluminum shield applied longitudinally with an overlap.
6. The outer jacket shall be of polyethylene construction to provide protection against direct sunlight, atmospheric temperature changes and stresses expected in standard installations.
7. Underground cables are to be run, terminated & tested by contractor at building and Node.
8. Building Entrance Protectors should conform to ANSI/NFPA70 Article 800.90 section A and UL 497/497A.
9. BNL will have representative at building and/or Node to supervise installation.

2.3 FIBER CABLES

A. General

1. Must conform to existing building wiring.
2. Fiber count will be specified by Network Services.
3. It must have a rip cord.

4. New construction and major renovations will use OM4 if the distance is less than 400 meters.
 - a. Any distance over 400 meters will require Single Mode fiber.
 - b. Or, otherwise specified

B. Inside Multi Mode Riser:

1. Must be Optic Fiber Non-conductive Plenum (OFNP) rated.
2. Must be tight buffer

C. Inside Single Mode Riser:

1. Must be OFNP rated.
2. Must be tight buffer
3. Meet ITU-T G.652 specifications.

D. Outside Fiber:

1. Fiber cable must be Loose Tube.
2. Meet ITU-T G.652 specifications.
3. It must have a filling compound.
4. It must contain strength members.
5. The cable should contain dielectric material.
6. The cable must have a sheath and inner jacket of 1.44mm.

PART 3 - EXECUTION

3.1 COMMUNICATIONS INSTALLATION

A. General:

1. This Section describes the installation locations for the products and materials, as well as methods and Owner's Standards associated with the Communications Installation portions of the Project. These specifications, along with the drawings and other owner supplied specifications shall be followed during the installation.
2. The contractor is required to be currently listed as a certified installer and provide personnel for communications installations who are certified for the manufacturer.
3. The contractor is to install all materials plumb, square and in a workman-like manner.
4. The contractor is required to supply all necessary tools, equipment, accessories, safety equipment, protective clothing, etc., as customary for the craft and necessary for the installation.
5. The contractor shall verify space requirements and locations with owner before starting cable installations and terminations.
6. The contractor shall verify the cable type and jacket rating required with the owner before starting cable installation.
7. The contractor shall verify existing cable fill in skeletal conduit, raceway or cable tray system before installation of additional cables so as not to exceed 40 percent cable fill. contractor will be responsible for installation of additional skeletal conduit, raceway or cable tray where additional cables to be added will exceed the 40 percent cable fill.

3.2 SKELETAL AND EMPTY STATION CONDUITS

A. Provide a nylon pull cord in each empty conduit to facilitate future installation of cables.

- B. Provide a nylon pull cord in each empty conduit and extended in raceway to openings for faceplates to facilitate future installation of cables.
- C. When copper cables are removed from conduits, a nylon pull cord will be placed in the conduit to facilitate future installation of cables if there is no existing pull cord. Also add a tracer in the conduit as the cable is being removed if there isn't one already.
- D. For new conduits, a tracer shall be added to the conduit to facilitate cable and/or conduit toning for mark-outs.

3.3 COPPER RISER CABLE INSTALLATION

- A. Refer to project drawings as applicable for cable quantity, sizes and routing.
- B. Cables shall be terminated in order on wiring blocks as specified. Layout is to be provided by owner's representative.
- C. All cable terminations to be made using impact tool designed for patch panel termination.
- D. Contractor is responsible for obtaining and following manufacturer's installation instructions for correct termination of cables and wire management at wiring block.

3.4 COPPER NETWORK STATION CABLING

- A. The copper horizontal cabling will be terminated at the IDF or MDF on patch panel.
- B. Horizontal cabling shall be terminated such that it adheres to the manufacturer's specifications.
- C. Owner to provide future cross terminations to campus switch.

3.5 WIRELESS ACCESS POINTS

- A. There will be 2 cat6a cables run per wireless access point.
- B. Wireless access points will be mounted on drop ceilings where the ceiling is below 12 feet and the standard mounts can be used. The jack will be mounted above the ceiling tile in the locations identified by Network Engineering.
- C. In areas where the ceiling is higher than 12 feet or not compatible with the standard WAP mounts, wall mounts will be used. Wireless access points will be mounted on the wall no higher than 12 feet – no lower than 7 feet. The jack will be mounted on the wall at the height of the WAP in the area indicated by Network Engineering.

3.6 FIBER OPTIC RISER AND SITE CABLING INSTALLATION

- A. Refer to project drawings as applicable for cable quantity, sizes and routing.
- B. Fibers shall be terminated and installed in the connector panel in color code order. This is a straight through connection. Layout is to be provided by owner's representative.
- C. All terminations shall be fusion spliced.
- D. Contractor is responsible for obtaining and following manufacturer's installation instructions.
- E. The contractor is responsible for terminating all fibers within a fiber optic cable.

3.7 LABELING

- A. All horizontal cables shall be labeled with self-laminating marking tape, Brady ID-Pro labeler, Brother P-Touch labeling system or equivalent. All wiring blocks, patch panels, and faceplates shall be labeled with Brady ID-Pro labels or Brothers P-Touch labeling system. Identification shall be as follows:
- B. At the MDF and IDF, the vertical cables (copper riser) shall be labeled horizontally at each end with the information indicating termination of the opposite end of the cables. This shall include floor level, MDF/IDF room number and cable number. Place label on a visible part of cable close to wiring block for ease of identification after termination.
- C. At the MDF or IDF end, the horizontal (station) cables shall be labeled with the information indicating termination of the opposite end of the cables. This shall include room location and jack designation. Place label on a visible part of cable within 12 IN of termination point for ease of identification after termination. Size of letter and numbers shall be legible. ITD will provide jack numbers.
- D. At the rooms, the horizontal (station) cables shall be labeled 4 IN from termination. This shall be visible by removing outlet cover plate. For rooms with multiple outlet locations, identification would begin with the first receptacle to the left of the main entrance to the room and continuing clockwise around the room. Size of letters and numbers shall be as indicated above.
- E. At the MDF and IDF, vertical cables are terminated on their respective patch panels. Label only 1st and last pairs on each row. Place cable number of riser cable on wiring block label in center of label.
- F. At the IDF, data horizontal cables are terminated on their respective patch panels, with jacks on the panels labeled in ascending number order. All horizontal cables from same room should be terminated in sequential order at the patch panels. Single 4-pair cables will be labeled with a room location and a jack designation. Place label on visible part of the cable within 1 IN of the termination.
- G. At the rooms, the jacks will be labeled on the faceplates with room number and proper jack designation as follows: XXX-YY-ZZZ
 - 1. XXX = Building number
 - 2. YY = Floor
 - 3. ZZZ = jack number (001, 002, etc.)
 - 4. Size of letters and numbers on labels for patch panels and jacks shall be legible.
 - 5. Jack numbers are assigned by Network Services.
- H. At the MDF/IDF patch panels, labeling will be in the YY-ZZZ format.
 - 1. YY = Floor
 - 2. ZZZ = jack number (001, 002, etc.)
 - 3. Size of letters and numbers on labels for patch panels and jacks shall be legible.
 - 4. Jack numbers are assigned by Network Services.
- I. Jack assignments must match one-for-one at the MDF/IDF and the room locations.
- J. BNL to provide instruction for labeling of elevator phones, ETS phones, Fiber Optic, and other special circuits.
- K. All riser cables shall be labeled at each end with the information indicating: 1) Cable origination building number, 2) Cable origination room number, 3) Floor level, 4) type of cabinet (cat 5E, Fiber Optic, ETC.), 5) rack number, 6) Block number, 7) Terminal Number.

3.8 GENERAL CABLE INSTALLATION

- A. Cable lengths within boxes shall be adequate to permit installation and removal of device for inspection without damage to cable or connections (minimum of 12 IN).
- B. Cable bends shall not be greater than that recommended by the manufacturer of the cable.
- C. Care shall be taken so as not to damage cable during the installation process and that manufacturer's pull tension specification is not exceeded.
- D. Route cables so that no horizontal Data cable exceeds 100 meters between wiring closet termination and device jack termination. Contact Owner's Representative if this is not possible with closet location.
- E. Provide a minimum 8 FT - 0 IN and maximum 10 FT - 0 IN of slack. Loop at the wiring closets to be contained in the cable tray. Smaller slack loops may be required at MDF racks.
- F. Within wiring closets, cables shall be snugly wrapped using Velcro reusable cable ties, a minimum of every 3 FT - 0 IN for cable organization. Cable ties shall be tightened so as not to deform cable jackets and thus affect cable performance.
- G. Cable fill in station conduits, skeletal conduits, raceway and cable tray shall not exceed 40%.
- H. Contractor shall leave drag in conduit.
- I. Ensure a kink-free cable installation.
- J. All conduits shall be properly sealed.

3.9 CABLE TESTING

A. General

- 1. BNL representative may witness field tests.
- 2. BNL may perform independent testing up to 100% of the installation.
- 3. All test documentation in electronic format shall be submitted to the F&O Project manager with copies to Network Services prior to BNL acceptance.
- 4. Contractor will incur all costs for retesting and consumables required by unacceptable test results.
- 5. Daily Test Equipment Preparation: Properly configure cable test equipment each day before testing and include the following:
 - a. Verify that the test equipment is functioning properly.
 - b. Verify that the test equipment is still within the manufacturer's calibration expiration date.

B. Copper Station Cable

- 1. Use an industry approved certification tester for the appropriate cable type.
- 2. The cable installation should pass EIA/TIA category testing standards.

C. Copper Underground Cable Test: Use a Dynatel 900 Series Subscriber Loop Tester or equivalent (CAT 3 and/or CAT 5) to automatically perform the following tests.

- 1. Voltage on line
- 2. Resistance
- 3. Opens
- 4. Longitudinal Balance
- 5. Sweep Loss
- 6. Single Tone Loss
- 7. Loop Resistance
- 8. Resistance Balance

9. Load Coils
10. Loop Current
11. Noise
12. Power Influence
13. Capacitance Balance
14. Slope

D. Fiber Optic Cable and Component Test

1. Use an industry approved certification tester for the appropriate cable type.
2. The cable installation should pass EIA/TIA category testing standards.
3. Test results should include:
 - a. Cable length
 - b. DB Loss for each fiber
 - Singlemode fiber should not exceed 1db/Km total loss plus 2db loss for components end-to-end at 13xx nm. (Eg. 2Km cable should be no more than 4db loss end-to-end including fiber and components.)
 - Multimode (OM4) fiber should not exceed 1.5db/Km total loss plus 2db loss for components end-to-end at 13xx nm. (Eg. 2Km cable should be no more than 5db loss end-to-end including fiber and components.)
4. For site cables where contractors are responsible for terminating only one end, OTDR traces shall be recorded by the contractor and submitted to the BNL project manager.

3.10 AS-BUILT INFORMATION

- A. Contractor shall provide as-built information to owner to accompany all test result information.
- B. As-built information shall be in red-lined format on a copy of construction drawings. Indicate location of all communication outlets, if different than original drawing, skeletal or riser conduit changes, and all additions and deletions pertaining to telecommunications.
- C. If construction drawings are not utilized, contractor shall provide all communication outlet designations on an accurate scaled floor plan or submit electronically.

3.11 SYSTEM WARRANTY REQUIREMENTS

- A. Contractor shall provide a warranty for fiber and copper cabling
- B. Contractor shall perform all labeling requirements and provide testing documentation for verification as described herein.

END OF SECTION

Communications Infrastructure Specifications 1-4-18.Docx

Appendix A: Products:

Leviton 2 Port Faceplate – 41080-2WP

Leviton 4 Port Faceplate – 41080-4WP

Leviton 6 Port Faceplate – 41080-6WP

Leviton Cat5E Quick-Port Jack – 5G110-BE5

Leviton Cat6 Quick-Port Jack – 61110-BE6

Leviton Cat6A Quick-port Jack – 6110G-RP6 (Purple denotes Cat6A)

Leviton Blank Inserts – 41084-BW

Appendix B: Racks / Cabinets:

- 1) APC AR203A
 - A. NetShelter 4 Post open frame rack with 44U SQUARE HOLES
- 2) APC AR8675
 - a. Performance, Vertical Cable Manager for 2 & 4 Post Racks, 84"H x 12"W, Double-Sided with Doors
- 3) APC-AR8612
 - a. 1RU Horizontal Cable Manager

Appendix C: Copper Patch Panels:

Leviton Quick-Port Cat5e - 5G270-U24 (24 Port)

Leviton Quick-Port Cat6 – 69270-U48 (48 Port)

Leviton Quick-Port Cat6 – 69270-U24 (24 Port)

Appendix D: Fiber Enclosures, Panels, Pigtails, Trays and Connectors:

1. Rack Mounted Fiber Panel

PCH-04U with splice tray M67-112

For PCH-04U use splice tray holder PC4GOVSPLC

For Single Mode fiber use Connector Panel – CCH-CP24-A9

For Multimode Fiber use Connector Panel – CCH-CP24-E4

2. Wall Mounted Fiber Panels:

For less than 72 fibers – WCH-04P with splice tray M67-048 or 078

For more than 72 fibers – WCH-06P with splice tray M67-048 or 078

For each fiber panel use splice tray holder WCH-SPLC-4-8

For Single Mode fiber use Connector Panel – CCH-CP24-A9

For Multimode Fiber use Connector Panel – CCH-CP24-E4

3. Pigtails:

12 FIBER 9/125 3 METER SM PIGTAIL LC/UPC

12 FIBER OM4 3 METER MM PIGTAIL LC/UPC

Appendix E: Copper Cables:

Cat5E – Beldon 1585a D15U1000

Cat6 – Beldon 2413 D15U1000

Cat6A – Beldon 10GXW13 0071001

Cat5E Black Outside rated – Mohawk 5EXHO4P24-BK-R-MOH-NR