Appendix 3F(i) – Cable Infrastructure Standard

1. STRUCTURED CABLING

1.1. General Requirements

1.1.1. Standards

1.1.1.1. Comply with the following standards (contractor must use the most current versions) when designing, installing and testing structured cabling:

.1 TIA / EIA 526- 7 and TIA / EIA 526-14 standards for Optical Power Loss measurement of single mode and multimode fibre cable plant

.2 TIA / EIA - 568B.1, B.2 and B.3 Commercial Building Cabling Standards and Optical Fibre Cabling Standards.

.3 TIA / EIA-569 Commercial Building Standard for Telecommunications Pathway and Spaces

.4 TIA/EIA – 606-A Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.

.5 ANSIA/TIA/EIA – 607A (J-STD-607-A-2002) Commercial Building Grounding and Bonding Requirements for Telecommunications.

.6 ANSI/TIA-942-2 Telecommunications Infrastructure Standard for Data Centers.

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

.8 ANSI/TIA-1179 Healthcare Facility Telecommunications Cabling Standard and all referenced documents

.9 ANSI/TIA TSB-162 “Telecommunications Cabling Guidelines for Wireless Access Points.

.10 BICSI TDM, TCIM, NTS, OSP and WD manuals.

1.1.2. The demarcation shall meet the requirements of the service provider.

1.1.3. The complete installation shall be installed and tested by a Belden certified contractor.

1.2. Products

1.2.1. General

1.2.1.1. All horizontal cabling products that are installed for data, and voice, when combined, shall meet Category 6. The products installed for the end-to-end solution shall have been tested by an

independent testing agency, such as UL or ETL, to ensure that the integrated system installed meets channel performance.

1.2.1.2. The structured cabling system shall be a complete, **end-to-end Belden system**.

1.2.1.3. Provide a 25 year manufacturer's extended product, performance, application, and labour warranty that will warrant all passive components used in the technology infrastructure. Additionally, this warranty will cover components not manufactured by the technology infrastructure Manufacturer, but approved by the technology infrastructure manufacturer for use in the technology infrastructure.

1.2.2. Cable

1.2.2.1. All horizontal telecommunications cabling shall be BELDEN IBDN solid Category 6 certified or better.

1.2.2.2. All horizontal and structured cabling will be colour coded as follows:

.1 Data/VOIP/Videoconferencing – BLUE

.2 Wireless Access Points - ORANGE

.3 CCTV – GREY

.4 Patient Education/Entertainment systems – YELLOW

.5 Nurse Call - RED

.6 Patient Physiological monitoring – GREEN

.7 RTLS - White

1.2.2.3. All cables installed shall meet the flame-spread requirements of the local authority.

1.2.3. Termination Hardware

1.2.3.1. All data drops shall be terminated on Category 6, 8 position modular (RJ45) jacks at the work areas.

1.2.3.2. All 8-position modular jacks (RJ45) terminations shall be made using the TIA/EIA 568A pin configuration.

1.2.3.3. All horizontal cables shall terminate in the TRs using IDC cross connects on the wall.

1.2.3.4. In new rooms (PER, SER, TR), IDC shall be mounted on Belden 12-Connector GigaBix mount. GigaBix cable management module shall be installed behind GigaBix mount to facilitate cable routing.

1.2.3.5. Manufactured standoff (AX102190) shall be installed behind GigaBix management ring.

1.2.3.6. All data drops shall be extended from a separate IDC cross connect to a rack mounted 8-position modular plug (RJ45) using a harness cable.

1.2.3.7. Separate GigaBix mount shall be used to terminate the horizontal cables, and voice and data riser cables in each room (PER, SER, TR).

1.2.3.8. Apart from the dedicated physiological monitoring network outlets which shall be green, all data, and voice jacks shall be the same colour (white).

1.2.3.9. All cables routed in modular furniture shall be terminated on 4 port Belden Keyconnect Modular Furniture Adapter jacks mounted on manufacturer's adapter plates anchored to the modular furniture. The Adapter snaps directly on industry standard 70 mm x 35 mm cutout in the adapter plate. Adapter part number is BeldenCDT AX10092 series. Adapter colour shall be the same as the adapter plate. Coordinate locations and type during detailed design.

1.2.4. Voice Gateway Cabling

1.2.4.1. Both the PER and SER will have a rack installed to house the required voice gateways. For each rack, a 48 port UTP patch panel shall be installed at the top section of the rack at 1U space below last fiber patch panel with tie cables terminated on GigaBix connector just above the harness cable field.

1.2.4.2. For each voice gateway rack, install 200 pair Category 3 unshielded twisted pair cables. Within the rack, provide cabling to facilitate Cisco VG224 gateways using male RJ21 connectors. Provide cabling and connectors as required to accommodate equipment supplied by a third party provider such as Hospitality Networks. The other side of the cables to be terminated on IDC blocks.

1.2.5. Fiber Patch Panels

1.2.5.1. Fiber cables shall be terminated in a rack mounted Belden UltraHigh Density Housing with Ultra modules and LC connectors at each end. Belden UltraHigh Density Housing shall be installed at the top section of all racks or cabinets in the telecommunication rooms (TR, PER and SER)

1.2.5.2. All Fiber cables shall be mechanically terminated using LC connectors for new installs and SC and ST for existing installs. Any damage, scoring or pitting within the Fiber core (regardless of test result) shall result in re-termination by Project Co using a new connector. Any re-termination is done at no cost to the Authority.

1.2.6. UTP Patch Panels

1.2.6.1. UTP tie cables shall be terminated in 24 or 48 port angled patch panel.

1.2.6.2. UTP patch panel shall be installed at the top section of the rack or cabinet in the telecommunication rooms (TR, PER and SER) at 1U space below the last fiber patch panel.

1.2.6.3. All UTP tie cables shall be terminated on GigaBix connector just above the harness cable field.

1.2.7. Harness Cables, Cross Connect Cables and Patch Cords

1.2.7.1. Harness Cables are installed from the IDC cross connect in the telecommunication rooms (TR, PER and SER) to the Authority's equipment installed on the racks and bundled per individual switch in groups of 48 and breakout into bundles of 24 for accessing the switch from the left and right vertical cable management channels. Vertical cable management channels shall be adjusted forward in front of relay rack to provide sweeping bend radius for harness cables exiting its side hole to the switch. No adjustment is needed when Belden rack and vertical cable management channels are used.

1.2.7.2. The harness cables shall be 4-pair 23 AWG solid Category 6 of the same colour and shall meet the requirements of TIA/EIA 568-C.2-10 standard for Category 6.

1.2.7.3. The quantity of harness cables to be supplied shall equal to 75% of the number of horizontal data and spare cables installed raised to the next increment of 48 i.e. if 100 horizontal data cables are installed then 75 harness cables raised to the next increment of 48 will require 96 harness cables. The harness cables shall be all the same colour. One end of the patch cord shall have an 8 Position Modular Plug (RJ45 plug) with a tab guard installed. The other end shall be terminated on the IDC wall.

1.2.7.4. Copper harness cables shall be provided as part of the structured cabling system.

1.2.7.5. If the Authority does not supply the rack mount equipment during cable installation, Project Co will coordinate with the Authority regarding the placement of the harness cables on the rack.

1.2.7.6. The quantity of equipment patch cords shall be 75% of the horizontal data cables. Patch cords shall be 4 bonded-solid pair Category 6 with 8 Position Modular Plug (RJ45 plug) with a tab guard at both ends. 33% of these patch cords will be 7ft long , 50% will be 10ft long and 17% will be 15ft long

1.2.7.7. The quantity of test patch cords shall be 10% of the horizontal data cables per TR. Minimumof 2 per TR. Patch cords shall be 3.0m long (10ft.) and 4 pair. Each end shall match the IDC system installed, i.e. if wall distribution IDC is BIX then patch cords to have BIX ends.

1.2.8. Racks

1.2.8.1. For TRs with 24 or less data drops the data harness cables shall be dressed from the GigaBIX connectors over to the 483 mm swing-out wall mount rack. The overall height of the rack shall be 890 mm high. Overall depth shall be 635 mm. The rack shall have the EIA universal hole spacing using 10-32 threaded holes. Product shall be Belden, Electron Metal, Mid Atlantic or an alternate approved by the Authority.

1.2.8.2. Relay frame style racks shall be seismically supported to seismic risk zone 3.

1.2.8.3. For TRs with more than 24 data drops the data harness cables shall be dressed from the GigaBIX connectors over to a 483 mm relay frame style rack. Provide 1 relay style rack for every 1632 horizontal data cables. The overall height of the rack shall be 2134 mm high with at least 44 rack units. The rack shall have the EIA universal hole spacing using 10-32 threaded holes. The relay frames shall be complete with universal vertical channels (top to bottom) having hinged covers, for vertical cable management, on both sides.

1.2.9. Cable Management in Telecommunication Rooms (PER, SER, TR)

1.2.9.1. Provide all cable management as required.

1.2.9.2. Install cable management on hinged side of wall mount racks. Provide 4 D rings for vertical cable management on the hinged side of the wall frame.

1.2.9.3. The horizontal cable managers for the wall mounted IDC terminations shall consist of D rings, cable managers, spaced as per manufacturer's recommendation.

1.2.10. CATV System

Each CATV outlet shall be cabled with a braided copper shielded RG6 cable terminated on an F series connector. The cover plate

shall have an F series bulkhead for the termination of the cable. Each cable shall be home run to the CATV distribution point in the serving TR. The CATV distribution point in each TR shall be home run to the CATV distribution point in PER with a RG11 cable. The CATV distribution point in the PER shall be home run to EF-A and EF-B with a 40 mm coaxial cable unless otherwise designed. Following star-wired structured cabling topology, the cable distance between any two termination points shall not exceed 90 m.

1.3. Design

1.3.1. Provide a voice intra-building backbone riser cable comprising a 100 pair, Solid, Category 5E certified and shall be installed from both primary equipment room ("PER") and secondary equipment room ("SER") to each Telecommunications Room ("TR"). The voice riser cables shall be installed in a star wired configuration. Terminate the cable on IDC terminations at each end. Provide cable management accessories as recommended by the Manufacturer.

1.3.2. Provide a 100 pair, solid, Category 5E certified intra-building backbone entrance tie cable from Entrance Facility A (EF-A) to the PER. Install a physically diverse 100 pair, solid, Category 5E certified intra-building backbone entrance tie cable from Entrance Facility B (EF-B) to the SER. Terminate the cable on IDC terminations at each end. Provide cable management accessories as recommended by the Manufacturer.

1.3.3. Provide four 100 pair, solid, Category 5E certified intra-building backbone tie cables between the PER and SER. Terminate the cable on IDC terminations at each end. Provide cable management accessories as recommended by the Manufacturer.

1.3.4. Provide 96 Category 6 cables between the PER and SER. Terminate the cable on IDC terminations at each end. Provide cable management accessories as recommended by the Manufacturer.

1.3.5. Provide a tight buffered fiber cable between the fibre terminations rack and all server and network racks. The fiber shall be 12 strand OS2 Belden single mode enhanced and 12 strands OM4 multi mode. The fiber cables shall be terminated in a rack mounted Belden UltraHigh Density Housing with Ultra modules and LC connectors at each end. If crimp connectors are used they shall be the style that has the fibre pre-loaded and polished at the factory.

1.3.6. Provide a tight buffered fiber cable between the PER and SER fibre terminations rack. The fiber shall be 128 strand OS2 Belden single mode enhanced and 128 strands OM4 multi mode. The fiber cables shall be terminated in a rack mounted Belden UltraHigh Density Housing with Ultra modules and LC connectors at each end. If crimp connectors are used they shall be the style that has the fibre pre-loaded and polished at the factory.

1.3.7. Provide from each of the PER and SER fibre terminations racks a tight buffered fiber cable to each TR. The fiber shall be 12 strand OS2 Belden single mode enhanced and 24 strands OM4 multi

mode. The fiber cables shall be terminated in a rack mounted Belden UltraHigh Density Housing with Ultra modules and LC connectors at each end. If crimp connectors are used they shall be the style that has the fibre pre-loaded and polished at the factory.

1.3.8. Provide data cabling from both the PER and SER to each remote building. All Facility inter-building data cable shall be outside plant cable, loose tube gel filled, all dielectric cable. The fiber shall be 12 strand OS2 Belden single mode enhanced and 24 strands OM4 multimode. If crimp connectors are used they shall be the style that has the fiber preloaded and polished at the factory. Manufacturer recommended breakout/fan-out kits with fan-out tubing shall be used. If the cable is routed underground it shall be installed in conduit. The conduit shall be sized with 100% spare cable capacity based on a 40% fill.

1.3.9. Provide an analog voice cable from both the PER and SER to each remote building. All Facility inter-building analog voice cabling shall be shall be outside plant cable type. Provide a 25 pair UTP, 22 AWG cable to support all requirements for the Facility and remote buildings. The cable shall have a filled core. Provide primary protection on both ends as required by the local authority. If the cable is routed underground it shall be installed in conduit. The conduit shall be sized with 100 % spare cable capacity based on a fill of 40%. Terminate the cable on IDC terminations.

1.3.10. Where raceway size is not specified, the raceway shall be sized to not exceed a 28% fill ratio after all the cables are installed assuming there are two 90º bends in the run. Where there are zero bends in the raceway, the fill ratio shall be increased to 40%.

1.3.11. Provide one (1) data drop from TRs to each location where network connectivity is required for other systems (including security systems, fire alarm, power meters, elevator phone, hydro utility metering, etc.). Coordinate with each service or system provider for the exact number of cables and locations. These cables shall be for data or voice and will not be differentiated (all cables regardless of use will be terminated as data cables).

1.3.12. For data connection to UPS units, modems (ADSL, eADSL, Fax, etc.), and Servers (Print, Security, Clinical, etc.), a 48 port angled UTP patch panel shall be installed at the top section of the rack or cabinet at 1U space below last fiber patch panel with tie cables terminated on GigaBix connector just above the harness cable field.

1.3.13. Each work area (telecommunications) outlet shall consist of a minimum of two 4-pair Category 6 cables, with additional spare data redundancy as noted elsewhere. Category 6 termination technique shall be used. No differentiation will be made between data and voice cables. All these horizontal cables including those from wireless access point outlets shall be terminated on GigaBIX termination hardware located in a Telecommunications Room ("TR").

1.3.14. The PER, SER and TRs shall not be shared with electrical or mechanical equipment and ducting.

1.3.15. If the total quantity of data or the total quantity of voice drops required plus the quantity of additional future drops known to be served on a floor is less than 12, then the horizontal cables can be terminated in the TR above or below that floor. This is based on the same tenant occupying both spaces. If the horizontal cable is routed to the adjacent floor, then a 10 m coil of spare cable will be left in the ceiling space of the floor (aligned with the TR where the cables are terminated). This will permit the cable to be re-terminated in a future TR on that floor.

1.3.16. The TRs shall be designed and sized as per ANSI/TIA-1179 Healthcare Facility Telecommunications Cabling Standard.

1.3.17. Where more GigaBIX blocks are required for Backbone (riser) or voice cabling, additional columns of GigaBIX blocks shall be added to the wall termination field. The additional wall space required shall be reflected in the design layout of the telecommunication rooms (TRs, PER and SER).

1.3.18. Multiple TRs on the same floor shall be interconnected with minimum 300mm wide cable tray or at least one 3" conduit.

1.3.19. The TR shall be accessible from a corridor with 914 mm wide and 2000 mm high working clearance. Access to the TR must be provided so as to not interrupt normal business workflows and provision of healthcare services.

1.3.20. In small TRs that do not have forced ventilation, the door shall be provided with door grille at the top and at the bottom of the door. Where door is part of a fire separation, the door shall be provided with "Anemostat" fusible link louvre at the top and at the bottom of the door.

1.3.21. All walls in the TRs, PER and SER shall be covered with 19 mm G1S plywood backboard installed between the floor and 2440 mm AFF, capable of supporting attached equipment. Counter-sunk screws shall be used to secure the plywood to the walls. Plywood should be either fire rated plywood painted white or plywood covered with two coats of white fire retardant paint.

1.3.22. For TRs that support an area greater than 500 m^2, and for the PER and SER, the cable termination wall shall be a 150 mm deep cavity BIX wall covered with 20 mm, G1S plywood surface, smooth on both sides. Plywood should be either fire rated plywood painted white or plywood covered with two coats of white fire retardant paint on each side.

1.3.23. Cables shall be routed through the wall spaces and plywood openings to the back of GigaBIX mounts. Exact locations of openings shall be engineered to suit BIX frame layout.

1.3.24. The TRs, PER and SER shall ***not have a false ceiling*** (unless required to maintain the integrity of the ceiling plenum). If codes permit the door shall swing 180^o out and be lockable. If the door

must swing in then the room shall be redesigned to accommodate lost area from door swing-in.

1.3.25. All telecommunication rooms (TRs, PER and SER) shall be secured with Access Controls (card reader and electric strike).

1.3.26. Wall, floor and ceiling finishes shall be light in colour to enhance closet lighting. All telecommunication rooms (TRs, PER and SER) floor coverings shall be anti-static sheet product. Vinyl tiles are not acceptable.

1.3.27. Walls shall be full height to the underside of the above floor slab. Where this is not possible, the height of the closet ceiling shall be higher than the height of the hallway ceiling, and the distance between the top of the entry hallway tray and the closet ceiling shall maintain a clearance of 600 mm.

1.3.28. Penetrations through fire-rated walls, floors and ceilings shall be fire-stopped using products that are easily removable for future cable installations.Lighting fixtures shall be mounted at a minimum of 2800mm AFF.

1.3.29. Mesh type tray (Cablofil or Flextray) shall be provided around the perimeter of the closet and across and over relay racks and server cabinets. The tray shall be mounted @ 2.7 M AFF.

1.3.30. A minimum of one equipment rack shall be supplied and installed in each telecommunication room (TRs, PER and SER). The layout of the equipment in the rack and the exact placement of the racks, cable tray and termination fields shall be submitted for reviewed by the Authority.

1.3.31. Each equipment rack shall be plumbed and leveled, and solidly anchored to the floor with bolts, washers and brackets. Bonding of rack to ground shall be as per TIA/EIA J-STD-607A.

1.3.32. Where two or more racks are mounted side by side, they shall be bolted together with a vertical cable management channel in between using metal bolts and washers.Access clearance of 1 m in the front and 750 mm at the rear of equipment racks is mandatory. Access clearance of 1 m at the rear of server cabinets is mandatory. Supply server cabinets complete with anchoring brackets where required. Where several rows of racks are located side by side, the spacing between the rows shall be a minimum of 1 m. A minimum clearance of 150 mm shall be maintained between one side of an equipment rack and the wall.

1.3.33. All installations shall be reviewed by a structural engineer and shall be certified as being suitably seismically restrained for post-disaster facilities.

1.3.34. Conduit penetration into the telecommunication rooms (TRs, PER and SER) at ceiling height shall protrude no more than 50 mm without a bend and be a minimum 600mm clear above the cable tray.

1.3.35. A cage shall be installed on all sprinkler heads for mechanical protection.

1.3.36. A drip tray shall be installed if sprinkler head is located above Telecommunications equipment rack.

1.3.37. Project Co shall provide two NEMA 5-20R receptacles which are dedicated for connection to equipment in the equipment rack. One receptacle shall be on the centralized facility UPS power, the other on Conditional power.

1.3.38. Project Co shall provide additional quadplexes, each served with a dedicated 15A, 120V circuit, spaced at not more than 1830mm intervals around the TR perimeter walls. Consult with the Authority to determine the type of power required (UPS, Vital, or Conditional). Actual quantity of receptacles provided shall be sufficient to accommodate all wall mounted equipment, plus 2 spare quadplexes.

1.3.39. The HVAC serving the telecommunication rooms (TRs, PER and SER) shall be designed to maintain a temperature between 18-24º C with a relative humidity between 30 and 55 percent. The HVAC system shall be designed to maintain these requirements 7x24 hour operation. Detailed heat load shall be calculated at time of design.

1.4. Entrance Cable Protectors

1.4.1. Leave wall space for entrance facility terminations and protectors in the EFs.

1.5. Demarcation Requirements

1.5.1. For protection against network downtime, Project Co shall identify and provide redundant physical routing that provides the most protection by placing outside plant fibers and coppers in separate, physically diverse routes to immediately take over if cables are damaged.

1.5.2. Project Co shall coordinate with the service provider regarding entrance cable requirements to the Facility and remote buildings on the campus.

1.5.3. The supply and installation of the jumper wire between the demarcation and the tie or riser cables will be supplied and installed by the service provider.

1.5.4. Project Co shall install the appropriate cable types from all service/access provider Entrance Facilities to the Authority's PER and SER.

1.5.5. Project Co shall coordinate with the service/access providers for the required connector types.

1.5.6. Provide all necessary Belden UltraHigh Density and Ultra module hardware.

Project Co shall request inspections and coordinate with the Authority Having Jurisdiction (AHJ), Inspection Authorities, Utilities/Access Providers and the Authority's Representatives

during installation of the communication system cabling during the Construction, including at the following stages:

1.5.6.1. cable rough-in;

1.5.6.2. telecommunication rooms (TRs, PER and SER) construction;

1.5.6.3. testing; and

1.5.6.4. completion.

1.6. Wireless Design

1.6.1. All aspects of the wireless network design will be co-ordinated with the Authority and is subject to the Authority's approval.

1.6.2. TSB-162 provides guidelines for pre-cabling a building using a grid approach. The pre-cabled grid makes the building ready for a wireless infrastructure at any time simply by plugging into a wireless access point. The square cell structure helps designers determine approximately where APs will be located for seamless wireless coverage resulting in an upfront approximation of how many APs and how much cabling will be required for the WLAN.

1.6.3. A grid is a collection of uniform cells where each cell is a square.

1.6.4. The size for a square is 10.0 m x 10.0 m for seamless wireless access point coverage for both 5 Ghz frequency range (802.11a) and 2.4 GHz (IEEE 802.11b/g).

1.6.5. The size of the cell and the number of required wireless access points per cell will depend on coverage, bandwidth, types of applications, network usage patterns, quality of service and number of users.

1.6.6. The wireless outlet is located at the center of the square cell, either above or below the drop ceiling.

1.6.7. This allows the flexibility to move the access point anywhere within the square using patch cord that is up to 0.707 times X in length, where X is the length of a side of the square. For X equal to 16m, the maximum length of the patch cord is 11.8m. The maximum length of the patch cord allowed is 13.0m.

1.6.8. Power will be delivered through the horizontal cabling utilizing IEEE 802.3af complaint equipment at both ends. This eliminates need to install local power outlet within vicinity of the wireless access point.

1.6.9. IEEE 802.11g standard for wireless local area networks offers transmission over short distances at theoretical maximum of 54 megabits per second (Mb/s). Effective data throughput for each wireless access points in an indoor office environment are as follows:

1.6.10. 20-22 Mb/s for distances of 15 m to 18 m.

1.6.11. 15-20 Mb/s for distances of 18 m to 21 m.

1.6.12. 10-15 Mb/s for distances of 21 m to 24 m.

1.6.13. 5-10 Mb/s for distances of 24 m to 36 m.

1.6.14. Dividing the data throughput value by the maximum number of stations expected to associate with the wireless access point provides the estimated throughput for each workstation.

1.6.15. These ranges are consistent with recommended cell size in TSB-162.

1.6.16. An RF assessment with spectrum analyzer is required to determine the suitability of a 2.4 GHz (IEEE 802.11b/g/n) or 5 GHz (IEEE 802.11a) WLAN operations in the environment on a channel by channel basis and to ensure a minimum signal to noise ratio of 20 dB is available at all potential WLAN device locations. The RF planner shall determine exact cell size and placement of the AP based on site survey of signal strength capacity, and roaming in attempts to meet bandwidth and user requirements, and to provide seamless coverage as users move around an area.

1.7. Wireless Installation

1.7.1. One wireless access point is required for every 10.0m x 10.0m for seamless coverage, regardless of the type of material within the building.

1.7.2. Regardless of the location and mounting method of the wireless access point, the following installation parameters must be met:

1.7.3. A single data drop shall be provided to a telecommunications outlet serving each wireless outlet. Optionally, four-fiber multimode optical fiber cables may also be installed.

1.7.4. The horizontal cable length from the serving TR to the outlet shall not exceed 80m.

1.7.5. Two - Category 6 or higher patch cords shall be plugged into each wireless outlet. The maximum length of the patch cord allowed is 13m. They shall be coiled and supported at the wireless outlet location. The use of a patch cord between the telecommunications outlet and the AP enables moving the AP around within the cell for specialized coverage.

1.7.6. Wireless access points shall not be located less than 3.6m from finished floor. Below this level, an enclosure must be used if the environment is considered insecure.

1.7.7. Mounting arrangements include wall-mount above drop ceiling, wall-mount below drop ceiling and in-the-grid ceiling mount.

1.7.8. The method of mounting the outlet shall suit the level of security at each location.

1.7.9. Administrative areas with high human traffic do not require taking high security measures.

1.7.10. Hallways that are not patrolled or monitored are considered highly insecure environments and must have the appropriate high security measures applied.

1.7.11. Classrooms, lecture theatres, patient and staff lounges or any other insecure environments must have the appropriate high security measures applied.

1.7.12. Locate, mount and provide grounding, type of service cable and enclosures for outdoor wireless access points in accordance with the applicable CEC and BC Building Code requirements.Documentation /

1.8. Labeling

1.8.1. Distribution terminals shall use standard TIA/EIA colour coding on all terminations as follows:

1.8.1.1. Green = Termination of network connection on the customer side of the demarcation point

1.8.1.2. White/Silver = Termination of cables originating from common equipment (PBXs, computers, LANs and multiplexers).

1.8.1.3. Brown = Interbuilding backbone.

1.8.1.4. Purple = First-level backbone. Riser/backbone and between PER/SERBlue = Stations served directly from closets, i.e. horizontal wiring.

1.8.1.5. Gray = Second-level backbone.

1.8.2. Faceplate Work Area (Fig. 3&4)

1.8.2.1. Faceplates shall have the following labels:

.1 TR ID# " – " room # at the top of plate. Brother P Touch or an equivalent approved by the Authority.

.2 Jack # directly above or below jack. Brother P Touch or an equivalent approved by the Authority.

1.8.3. Telecommunication rooms (TRs, PER and SER)

1.8.3.1. Telecommunication room Terminal ID Assignments

.1 All telecommunication rooms (TRs, PER and SER), shall have unique alpha numeric room numbers assigned, example - "SBBL-01A" in accordance with the main room number assignment process.

.2 The numbers and not the background shall be 50 mm high engraved on lamacoid in permanent Blue on Yellow background. It shall be placed on a visible location at the top of the GigaBix wall whenever feasible and secured by screws at four corners. Project Co will label TRs in consultation with the Authority.

1.8.3.2. UTP Horizontal Cabling

.1 Horizontal UTP cable terminations in the telecommunication rooms (TRs, PER and SER), on GigaBIX block shall be typewritten on blue labels and be sequentially numbered.

.2 Voice and data horizontal cables shall be identified at each termination end with a unique number at the outlet jack and at the GigaBIX designation strip.

Example: BBBB-01A-052
BBBB Represents the room number of the Telecommunications room
01A Represents the room number of the jack
052 Represents unique jack ID.
(WP) Represents wireless point labeled after unique jack ID.

1.8.3.3. Horizontal UTP cable numbering at each end of the cable sheath shall be identical to the associated jack number with the format "BBBB-01A-CXXX"

Example: BBBB-01A-052
BBBB Represents the room number of the telecommunications room
01A Represents the room number of the jack
052 Represents unique jack ID.
(WP) Represents wireless point labeled after unique jack ID.

1.8.3.4. Harness cable numbering at each end of the cable sheath shall be typed written on white labels and be sequentially numbered with the format R1-X-01 to 48.

Example: R1-G01
Cable code for Archibus use only:
Example: BBBB-01A-R1-G01.
R1 First Rack in TR or PER/SER
G Is the 7th group of harness cables. The lettering sequence is from top to bottom of rack.
01 Represents the port on the equipment

1.8.3.5. Patch Panel Tie Cables - Patch panel tie cable numbering at each end of the cable sheath shall be typed written on white labels and be sequentially numbered with the format R1-P1-01 to 48. They shall be terminated on GigaBix connector just above the harness cable field.

Example:R1-P1-01.
Cable code for Archibus use only:
Example: BBBB-01A-R1-P1-01.
R1 First Rack in TR or PER/SER
P1 Is the 1st UTP patch panel in the rack. The lettering sequence is from top to bottom of rack.
01 Represents the port on the patch panel

1.8.4. Backbone Cabling

1.8.4.1. Data Copper - Where ProjectCo installs Category 5e UTP cables in the Backbone, these cables shall be grouped in incremental counts of six and identified on each end of the cable with a label.

The associated GigaBIX designation strip at each end shall be identified with a purple label. NOTE: Where the quantity of Backbone data cables required is small, the cables shall be grouped and terminated onto the same GigaBIX block as voice. Voice field shall populate upper half of the block and data the lower half.

Example:BBBB-01A/BBBB-02B-D1 to D6.
Cable code for Archibus use only:
Example: BBBB-01A/02B-D1.

BBBB	Represents the Building Code
01A	Represents from 1st floor TR A, Backbone GigaBIX.
02B	Represents to 2nd floor TR B, Backbone GigaBIX.
D1	Represents Backbone data cable unique ID (individual 4 pair cable).

1.8.4.2. Voice Copper Backbone

.1 Where ProjectCo installs Category 5E UTP cables in the Backbone (riser) from PER and SER to each of the TR's, these Backbone cables shall be identified at both ends and on the GIGABIX designation strips. Minimum number of cable pairs between any 2 points shall be 25.

.2 On the GigaBIX designation strip in the TR, the Backbone cable numbering shall appear sequentially starting at "001" at the top left-hand corner of the first Backbone GigaBIX block. Next mount shall continue the sequence if required.

Example:BBBB-01A/BBBB-02B-V1(1-50).
Cable code for Archibus use only:
Example: BBBB-01A/02B-V1.

BBBB	Represents the Building
01A	Represents from 1st floor TR A, Backbone GigaBIX.
02B	Represents to 2nd floor TR B, Backbone GigaBIX.
V1	Represents 1st group (sheath) of voice cables.
(1-50)	Represents number of pairs inside cable sheath.

1.8.4.3. Fiber

Intra-building Backbone (riser) fiber optic cables from PER and SER to each of the TR's, shall be labeled at each end within 6 cm from end of cable sheath with permanent self-adhesive label with minimum 3 mm high characters. Cable numbering shall have the format

Example:BBBB-01AR1P1/BBBB-02BR1P1-F1(cable type).
Cable code for Archibus use only:

Example:	BBBB-01A/02B-F1.
BBBB	Represents the Building

01AR1P1	Represents from 1st floor TR-A, Rack 1, UHD Panel 1.
02BR1P1	Represents to 2nd floor TR-B, Rack 1, UHD Panel 1.
F1	Represents Fiber optic cable #1.
(cable type)	Represents (12 SM) and/or (12 – 50MM10G, 50MM1G, 62.5MM).

1.8.4.4. Entrance Cable

.1 Inter-building Backbone (entrance) fiber optic cables shall be labeled at each end within 6 cm from end of cable sheath with permanent self-adhesive label with minimum 3 mm high characters. Cable numbering shall have the format

Example:	RMH-01A/MRM-01B-F1 (cable type).
Cable code for Archibus use only:	
Example:	RMH01AMRM01BF1.
RMH-01A	represents abbreviated building name (Ridge Meadow Hospital), 1st floor TR-A.
MRM-01B	represents abbreviated building name (Maple Ridge Medical), 1st floor TR-B.
F1	represents Fiber optic cable #1.
(cable type)	represents (12 SM) and/or (12 – 50MM10G).

1.8.5. The IDC blocks at the demarcation and the IDC output from the Voice Gateways, if used, should be labeled with the unique pair number and destination TR. The labeling shall also be provided at the input and output terminations for the Voice Gateways. Use manufacturer's labels with sequential pair number neatly printed on the label, and the appropriate colour coding as previously identified (white/silver).

1.8.6. ProjectCo shall complete cable information spreadsheet provided by the Authority in Excel format. Provide a hard (binder) and soft copy of the completed spreadsheet to the Authority and mount one printed copy of the completed form on the interior side of the door of each telecommunication room (TRs, PER and SER) in a transparent plastic pocket.

1.8.7. "As Built" drawings shall conform to the Authority's AutoCAD drawing template layers and Standards Symbols (refer to FH-Facilities Planning). Project Co shall forward these "As Built" drawings to the Authority in hardcopy and in electronic form. A copy of the "As Built" drawing showing the jack numbers associated with that specific telecommunication rooms (TRs, PER and SER) shall be mounted on the interior side of the door of that telecommunications room in a transparent plastic pocket holder.

1.8.8. The "As Built" drawings shall show all telecommunications jacks and the associated label for each jack. The drawing legend shall be

shown on each page. The drawings shall also show any cable tray and major conduit that are used for the telecommunications system, and all telecommunication rooms (TRs, PER and SER) with label ID. The “As Built” drawings shall include a riser diagram showing all data, intercom, and voice riser cables.

1.9. Installation

1.9.1. All cabling will be installed in conduit and cable tray except that J-hooks may be used as permitted in Schedule 3.

1.9.2. Installation shall follow the standardized telecommunication rooms (TRs, PER and SER) designs and TIA/EIA standards. The installation shall meet the requirements of industry practices as recommended by the manufacturer whose products are being installed, and the TIA/EIA Standards (except where this Technical Standard differs). The Installation shall also meet the BICSI Telecommunications Cabling Installation Manual.

1.9.3. Install cable from the communications outlet to the TR serving that area. The cables shall be continuous.

1.9.4. Terminate the cable on the appropriate termination hardware.

1.9.5. Install and terminate the 4 pair harness cables from the IDC terminations to the Authority's equipment on the rack.

1.9.6. All horizontal cables shall be terminated in the work area. No cables shall remain unterminated in the ceiling space.

1.9.7. Walls shall have102 mm x 102 mm outlet boxes installed with a single gang mud ring.

1.9.8. Outlets shall not be installed back-to-back inside the wall. A minimum 150 mm horizontal clearance shall be maintained between the two.

1.9.9. All outlets shall be positioned to clear millwork and furniture and to enable easy and unobstructed access. A 27 mm conduit shall be installed from the outlet box to the ceiling space.

1.9.10. The conduit shall have a grounding bushing installed in the ceiling space and be installed such that the minimum bend radius of the cable is not exceeded. If the wall is an existing internal partition with no insulation then a low voltage mounting bracket with open wiring is acceptable providing a grommet is used at all stud/plate penetrations.

1.9.11. Conduit shall be EMT or rigid steel.

1.9.12. Flexible metallic and PVC conduit shall not be used in pour concrete unless specified.

1.9.13. All conduits shall have sweeping bends with inside radius of no less than six times the internal diameter of the conduit. For conduit 50mm or larger, the radius shall be no less than ten times the internal conduit diameter. Fittings such as LB type joints shall not be used.

1.9.14. Conduits shall be attached to the edge of cable tray with a conduit bracket designed for this purpose. If this is not possible, conduit shall be stubbed within 150 mm above the tray and terminate in a bonding type bushing.

1.9.15. Where conduits are mounted high above cable tray, 90º bends for conduits shall be provided with conduit ends stubbed 150 mm above the tray in a bonding type bushing. This water fall effect shall reduce the strain on cables.

1.9.16. When installing cable in conduit, cable fill shall not exceed 40% fill ratio where there are zero bends in the raceway, and not to exceed 28% where there are two 90º bends in the run.

1.9.17. A pull tape shall be left in all raceways after installation of the cables. Pull tape shall be Greenlee 4435 or approved equal.

1.9.18. All empty raceway shall be clearly and permanently marked at both ends to indicate destination and function.

1.9.19. Conduits and cables containing line voltage conductors (including branch circuit wiring) shall not be supported from the supports used for Telecommunications cable trays or from the trays themselves.

1.9.20. When zone conduit system is used, connect the system to each room ceiling space entered with a minimum 300 mm X 300 mm X 150 mm deep pull-box. Conduits to outlets in the room shall be from this pull-box.

1.9.21. When zone conduit system is not installed in readily accessible false ceiling space, access hatches shall be installed at a nominal spacing of 9m.Conduits shall be installed inside the wall.**Surface Raceway**

1.9.21.1. Multi-outlet surface raceway shall be minimum 120 mm high x 90 mm deep with cut-outs and hardware for mounting faceplates.

1.9.21.2. Non-metallic surface raceway shall be manufactured by Panduit or approved equal. Except as noted, colour of Panduit shall be off-white on painted surfaces and grey on unfinished concrete surfaces.

1.9.21.3. Surface raceway extending into the ceiling shall connect to the conduit extending from the cable tray with the appropriate fitting or pull box.

1.9.21.4. When installing cable in surface raceway, cable fill shall not exceed 40% fill ratio where there are zero bends in the raceway, and not to exceed 28% where there are two 90º bends in the run.

1.9.22. Pull Box

1.9.22.1. Unless specified otherwise, the minimum size of a pull box shall be 300 mm X 300 mm X 150 mm deep.

1.9.22.2. In a zone conduit system, pull boxes shall be provided such that conduit length shall not exceed 9 m and the number of 90o bends shall not exceed two.

1.9.23. Maintain manufacturer's recommended spacing from RF and EMI sources. Where such separation is not possible install the cables in grounded metallic conduit.

1.9.24. To avoid electromagnetic interference, the following minimum clearances shall be maintained:

1.9.24.1. 1200 mm from large motors or transformers.

1.9.24.2. 300 mm from conduit and cables used for electrical power distribution.

1.9.24.3. 120 mm from fluorescent lighting.

1.9.25. Pathways shall cross perpendicular to fluorescent lighting and electrical power cables or conduits.

1.9.26. Leave 305 mm of cable coiled in the outlet box (or coiled behind the wall if a low voltage mounting bracket is used) at the wall jack location.

1.9.27. If power poles are used leave 3 m of spare cable coiled in the ceiling space above the power pole to permit relocation of the power pole. Properly support cable coil to the structure.

1.9.28. If power poles use surface mount boxes, they shall be securely anchored to the pole using self-tapping screws. Use of self-adhesive pad alone is insufficient.

1.9.29. Avoid the use of infloor duct systems in concrete pours for data/voice cabling in all new buildings.

1.9.30. Cable installed in accessible ceilings shall be supported with open top cable supports (J hooks). The J-supports shall be located from 1220 mm to 1530 mm on centers to adequately support and distribute the cable's weight. These types of supports may typically hold up to fifty 6.4 mm diameter cables. Suspended cables must be installed with at least 8 cm of clear vertical space above the ceiling tiles and support channels (T-bars). The maximum cable sag permitted is 305 mm. For large quantities of cables (>30) that converge at or near the TR and other areas, provide cable trays or other special open supports that are specifically designed to support the required cable weight and volume.

1.9.31. In all retrofit situations, the type of cable tray shall match existing installs. The new section of cable tray shall be connected to the existing cable tray. Existing tray end shall be re-worked to suit tie-in.

1.9.32. For installation details of mesh type tray (Cablofil or Flextray) and EZ Path firestop device through fire rated wall

1.9.33. Mesh tray (min. 300mm wide) and drop outs shall be installed around the perimeter of the Closet and extend over equipment rack or rows of equipment racks. Drop-outs shall be installed where cables drop vertically to terminate on termination wall or to equipment racks. Do not cut tray for cable exit, instead use only Cablofil dropouts that attached to the tray side with dropouts

hanging over the tray. Tray layout shall be confirmed with the Authority

1.9.34. Perimeter tray in Telecommunications room shall be offset about 250mm from wall to tray edge to allow Cablofil dropouts to drop into GigaBix cable management modules. For large install using false wall, the offset maybe wider at about 350mm. Adjust on site to suit.

1.9.35. Dropouts shall be provided when cables exit hallway cable tray.

1.9.36. Where horizontal cables pass though a fire separation wall, install sleeve to protect cables. Sleeve to be sized for no greater than 40% fill. Firestop sleeves once the cables are installed.

1.9.37. If the cables are installed in non-accessible ceilings the cables shall be installed in continuous conduit. The minimum size conduit shall be ¾".

1.9.38. All cable shall be supported to the structure independent of the electrical/mechanical systems and the suspended ceiling.

1.9.39. All cables shall be installed parallel to the grid lines of the building.

1.9.40. Cabling shall be consolidated in building corridors to minimize disruption to occupants.

1.9.41. Install a minimum of three 102 mm sleeves in the floor to interconnect the telecommunication rooms (TRs, PER and SER).. The ducts shall be positioned against the wall to the left of the GigaBIX termination fields. These sleeves shall be used to distribute riser cables. Firestop sleeves once the cables are installed with an approved re-enterable sealing material.

1.9.42. For underground entrance ducts, the duct size shall be 100 mm. A minimum of two 100 mm entrance ducts shall be installed. One duct shall be reserved as spare. Bends are not recommended; if required there should be no more than two 90º bends.

1.9.43. Riser ducts in the telecommunication rooms (TRs, PER and SER) shall protrude 100 mm above finished floor level and shall be encased in concrete. The ducts shall protrude 50 mm below the floor slab into the ceiling space of the telecommunication rooms (TRs, PER and SER) below.

1.9.44. If a telecommunication rooms (TRs, PER and SER) cannot be vertically aligned with the one above or below, or if it cannot be vertically aligned with the EF, a horizontal backbone pathway shall be used to connect them.

1.9.45. In telecommunication rooms (TRs, PER and SER) and other areas where cables will be bundled, use 25 mm Velcro straps to support/bundle the cables at 300 mm intervals. Provide 100% spare cable capacity in the Velcro straps. Tie wraps are not acceptable.

1.10. Grounding

1.10.1. Install grounding system as per ANSI/EIA/TIA 607A.

1.10.2. Install a complete grounding system to each telecommunication rooms (TRs, PER and SER) and bond all equipment. This shall include a ground bus in the TRs, PER and SER. Connect ground bus to system ground for the facility.

1.10.3. Ground busses

1.10.3.1. PER and SER: electro-tin plated copper busbar – (TMGB), c/w two 50 mm insulated standoffs, with a minimum dimension of 100 mm wide X 300 mm long X 6 mm thick.

1.10.3.2. TR: electro-tin plated copper busbar (TGB), c/w two 50 mm insulated standoffs, with a minimum dimension of 50 mm wide X 300 mm long X 6 mm thick.

1.10.3.3. All busbars shall be **pre-drilled** with standard NEMA 10-32 bolt holes.

1.10.4. Bonding conductors shall be identified at both ends with data plate cable marker complete with double straps to indicate where the destination end of the conductor is located, such as 'Telecom Closet BBBB-01A' or 'Entrance Rm 123'.

1.10.5. Bonding conductors shall be as short as possible and routed with a minimum of bends. All bends made on the conductor shall be sweeping bends.

1.10.6. Where practicable, all bonding conductors shall be installed without a splice. Where a splice is necessary, it should be accessible and located in a Telecommunications space. Conductors shall be spliced using irreversible compression-type connectors, exothermic welding, or equivalent. All joints shall be adequately supported and protected.

1.10.7. Bonding connections shall be made with bolts, crimp connectors, clamps, or lugs specifically designed for the purpose.

1.11. Testing

1.11.1. Category 6 UTP testing shall conform to current ANSI/ TIA/EIA – 568C.2-10 standard. Testing shall be accomplished using Fluke's latest Digital Cable Analyzer field tester with GigaBIX channel adapters. Channel link testing procedures shall be used to certify the system. The latest Fluke Microcode Revision Upgrade shall be installed in all testers. **NO SUBSTITUTE TESTERS WILL BE ALLOWED.** The tester shall comply with the accuracy requirements for the level III field testers as defined in the TIA/EIA-568-C.2 Standard. It shall be calibrated within the calibration period recommended by the vendor. All testers used must be maintained as per Fluke's recommendations (including all test heads, cords and consumables) and all test technicians must have had Fluke training within the last year.

1.11.2. After testing, Project Co shall supply to the Authority a complete set of UTP test results on CD format in addition to the required hard copy. **NOTE:** the Authority is using the Fluke Networks Link Ware software. **NO other format will be accepted**.

1.11.3. Test Category 5E Intra-building voice backbone cables and intercom riser cables to TIA/EIA-568-C.2 series.

1.11.4. Test all the installed twisted-pair horizontal links from the harness cable in the TR to the equipment patch cord at the Telecommunications wall outlet against the "Channel Link" performance limits specification as defined in the TIA/EIA-568-C.2 series. For inter-building voice backbone cables using Category 3, test for continuity and polarity only; the test results need not be submitted but Project Co must sign off the test results indicating the testing has been completed and everything is acceptable.

1.11.5. 100% of the installed cabling links must be tested and must pass the requirements of TIA/EIA-568-C.2 Standard. Any failing link must be diagnosed and corrected.

1.11.6. Test each fiber strand using an optical power meter to ensure the actual power losses are less than the expected losses (calculated). Submit actual test results with calculated losses for review. For calculated losses use .3 dB per splice, .5 dB per connector pair, and the manufacturer's published cable losses.

1.11.7. Initially test every Fiber within the Fiber optic cable with a light source and power-meter utilizing procedures as stated in ANSI/TIA/EIA-526-14A: OFSTP-14 *Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant,* and ANSI/TIA/EIA -526-7: *OFSTP-7 Measurement of Optical Power Loss of Installed Singlemode Fiber Cable Plant.* Measured results shall be within manufacturer's loss budget calculations. If loss figures are outside this range, test cable with optical time domain reflectometer to determine cause of variation. Correct improper splices and replace damaged cables or connectors at no cost to the Authority.

1.11.8. All components shall be fully assembled and labeled prior to field-testing. Any testing performed on incomplete cable systems shall be redone on completion of the work. The following test parameters shall be adhered to:

1.11.8.1. .1 Multimode fiber optic cables shall be tested at 850 nm and 1300 nm.

1.11.8.2. .2 Singlemode fiber optic cables shall be tested at 1310 nm and 1550 nm.

1.11.8.3. .3 Testing procedures shall utilize "Method B" – one jumper reference.

1.11.8.4. .4 Bi-directional testing of optical Fibers is required.

1.11.9. Supply a complete set of fiber optic test results on CD format of all fiber optic tests performed in addition to the required hard copy to the engineer or project manager so they can be forwarded to the client.

1.11.10. For Gigabit Ethernet compliant certification (IEEE std 802.3z application), use test equipment which uses a VCSEL (Vertical

cavity surface emitting laser) at 850 nm (compliant with 1000BASE-SX) and an FP laser at 1310 nm (compliant with 1000BASELX).

1.11.11. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall be allowed to execute the tests. Appropriate training programs are limited to installation certification programs provided by BICSI and its authorized training partners, the Association of Cabling Professionals (ACP) and recognized cabling Manufacturers in the industry

1.11.12. All test results shall be provided to the engineer or project manager in electronic format, as above, so they can be forwarded to the client.

1.12. RCDD and Contractor Qualifications

1.12.1. Consulting Engineer

1.12.1.1. Project Co will ensure that the RCDD retained by Project Co is in good standing and has performed minimum seven years of telecommunications infrastructure design.

1.12.1.2. Forward all of the RCDD's certifications and references to the Authority for its approval.

1.12.1.3. Project Co will cause the RCDD to approve and stamp all work prints relating to telecommunications infrastructure design including all TRs, work area outlets, riser diagrams and logical and detail designs.

1.12.2. Telecommunications Contractors' Qualifications

1.12.2.1. Certified Contractors and Technicians

.1 .1 Any telecommunications contractors retained by Project Co for the Project must be fully approved and certified by Belden.

.2 All project managers and technicians performing cable system installation work shall be current Belden certified. On the Authority's reasonable request, provide certified copies of all technician certification cards. Technicians must be current employees of the Telecommunications Contractor.

.3 Any telecommunications contractors retained by Project Co for the Project will have a certificate of manufacturer's certification issued minimum 3 years before the Effective Date.

.4 Any telecommunications contractors retained by Project Co for the Project shall have satisfactory performance records on cabling infrastructure systems of the type and size required for the Project. Names,

addresses and telephone numbers of references for projects completed shall be submitted upon request by the Authority.