

## **SECTION 27 60 60 – IN-BUILDING DISTRIBUTED ANTENNA SYSTEM**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This section includes the minimum requirements for the extension of the existing in-building cellular distributed antenna systems (DAS).
- B. The Contractor shall coordinate all efforts regarding this system through DFW ITS.
  - 1. Kevin Hollingshead – DFW Airport Information Technology Services – (972) 973-2371
- C. The Contractor shall engage the Owner's System Maintenance Vendor for system engineering, coordination with the Wireless Service Providers, installation and integration of the Cellular DAS system. Always engage and coordinate this effort through DFW ITS.
  - 1. Ali Nemati – Cell Site Capital, LLC – (469) 951-9109
  - 2. Judith Chin – Cell Site Capital, LLC – (845) 325-8526
- D. The DAS system shall be installed to provide uniform, consistent coverage to all public and non-public areas, including American Airlines back-of-house and operational spaces. Coverage within the non-public areas shall be coordinated with American Airlines' Wireless team during the design process to ensure their business operational needs are met.
  - 1. Raymond Barrilleaux - American Airlines - (972) 814-3456
- E. Fiber optic cabling and termination requirements are provided under Section 27 13 00 – Communications Backbone Cabling.

#### **1.2 DEFINITIONS AND TERMS**

- A. The following list of terms as used in this specification is defined as follows:
  - 1. dBm Decibel-milliwatts
  - 2. BICSI Building Industry Consulting Service International
  - 3. CDMA Code Division Multiple Access
  - 4. CR Communications Room
  - 5. DAS Distributed Antenna System (or In-Building antenna system)
  - 6. DFW Dallas Fort Worth International Airport
  - 7. Ec Signal Average Energy
  - 8. EVDO Evolution Data Optimized
  - 9. FRU Fiber Optic Remote Unit
  - 10. Io Interfering Co-channel
  - 11. ISO International Standards Organization
  - 12. LTE Long Term Evolution
  - 13. MCR Main Communications Room
  - 14. MHz Megahertz
  - 15. NEMA National Electric Manufacturers Association
  - 16. NFPA National Fire Protection Association
  - 17. No Spectral Density of Noise
  - 18. PCS Personal Communications Service

19.	RF	Radio Frequency
20.	RSCP	Reference Signal Code Power
21.	RSRP	Reference Signal Received Power
22.	RSSI	Received Signal Strength Indication
23.	STD	Standard
24.	TIA	Telecommunications Industry Association
25.	UL	Underwriters Laboratories
26.	UMTS	Universal Mobile Telecommunications System
27.	UTP	Unshielded Twisted Pair
28.	WCDMA	Wideband Code Division Multiple Access
29.	WSP	Wireless Service Provider

### 1.3 SYSTEM DESCRIPTION

- A. The Contractor shall extend the existing DAS system in a manner that will receive WSP Approval for use with the WSPs' macro networks.
- B. Upon commissioning, the DAS extension shall provide coverage for the WSPs listed below on all frequencies currently being used by the designated WSPs in the existing market.
  - 1. AT&T Wireless
  - 2. T-Mobile
  - 3. Verizon
- C. Design Criteria:
  - 1. The DAS extension shall be carrier format neutral, capable of supporting multiple WSPs, and capable of supporting all active Cellular, PCS, and LTE frequencies including 700 MHz, 800 MHz, 1900 MHz (PCS), and 1700 MHz / 2100 MHz (AWS).
  - 2. The system shall be scalable and adaptable to emerging technologies and designed to be adaptable for current and future re-banding efforts.
  - 3. Singlemode fiber optic cable shall be used for active distribution. In-line amplifiers are not allowed.
  - 4. The DAS extension shall provide 95% coverage in all spaces, for commercial frequencies. The DAS system shall be an extension of the existing campus wide system, and shall meet the same performance requirements as the existing campus wide system.
  - 5. Contractor shall state the assumed channel loading and frequency bands for the proposed WSP in-building coverage. Prior to installation, contractor shall confirm the channel loading and frequency use in the serving area and shall guarantee coverage for these channels per the criteria listed above.
  - 6. The contractor shall explain the method used to avoid downlink and uplink interference.
  - 7. The System shall have the capability for separate control over each WSP, to allow the ability to adjust and control power levels without disturbing other services/operators.
  - 8. The System shall support WSP in a modular architecture, so services can be added or removed without requiring new infrastructure, without readjustment of signal power levels, or disturbing existing services.
  - 9. The System shall not impede any management features or functionality of any attached network and/or device management system.
  - 10. The System shall allow for proactive management and end-to-end alarming of active electronics.

#### **1.4 CONFLICTS**

- A. This installation shall be made in strict accordance with the Specifications, Drawings, any applicable codes, referenced publications and standards. In case of conflicts between the aforementioned, notify the Owner in writing prior to commencement of affected work.

#### **1.5 SCHEDULING**

- A. The Contractor shall comply with all scheduling requests established by Owner, both prior to commencing Work, and during construction. The Contractor shall provide a detailed schedule of work to be performed.

#### **1.6 REQUIREMENTS**

- A. The Contractor shall be responsible for providing the WSP with information each WSP requires to approve connection of the DAS extension.
- B. The contractor shall provide all management, supervision, personnel, engineering, equipment, tools, materials, subcontractors, and transportation necessary to design, install, maintain, adjust, and repair all the DAS system components in accordance with:
  - 1. The manufacturer's recommendations and specifications.
  - 2. Industry standards and codes including but, not limited to National Electric Safety Codes, National Electrical Code, etc.
  - 3. Federal, State, and local regulations.
  - 4. Federal environmental standards.
  - 5. Federal Communications (FCC) guidelines.
  - 6. Occupational Safety and Health Administration (OSHA) regulations.
- C. Verification that all the components specified and installed meet the criteria specified by the respective component manufacturer, supplier and designer is the responsibility of the Contractor.
- D. The contractor shall have personnel certified in propagation and predictive analysis for such systems.
- E. The contractor shall perform a Radio Frequency (RF) Spectral Analysis of the facility to fully understand existing signals and noise levels at this location. Based on the results of the RF Spectral Analysis, the contractor shall ensure their design fully protects this system from harmful interference and shall ensure emissions from this system do not interfere with other systems in or around the structure, particularly the Public Safety DAS (refer to section 28 05 43) and other wireless systems.
- F. Prepare a system design package with drawings and supporting data to the level of detail sufficient to specify the following:
  - 1. Design drawings including equipment placement, riser diagrams, and floor layouts, pathway and cable distribution.
  - 2. Include specifications of all proposed system equipment and software, breakdowns including locations, quantities, dimensions, electrical and any applicable HVAC requirements of all equipment. Provide elevation drawing of the proposed head end configuration.
  - 3. Provide documentation confirming frequency loading requirements.

4. Provide predictive analysis of proposed design showing that the design and performance metrics are being met. Models per frequency band to ensure the proper signal coverage.
5. Provide a brief overview of how the design of the proposed system will account for and mitigate passive intermodulation distortion (PIM).
6. Provide equipment list by manufacturer, model number, quantity, and warranty.
7. Contractor shall work with and coordinate the design with the selected WSPs to ensure it is acceptable, and to obtain written rebroadcast approval by the WSPs.

G. Installation

1. All installation tools, special equipment and testing apparatus required to accomplish field connections and related work as described herein shall be furnished by the Contractor at no additional cost.
2. The Contractor shall procure and install all passive and active equipment necessary to install, operate, and maintain the DAS extension.
3. The Contractor shall commission and test the DAS extension in accordance with the manufacturer's instructions and WSP requirements.
4. The Contractor shall facilitate WSP activation activities and be present at the time of commissioning of each WSP.
5. After all signal sources are commissioned and operational, the contractor shall perform a post installation survey validating the operation and performance of the entire system

H. The requirements as given in this document are to be adhered to unless revised by the Owner in writing.

I. The Owner reserves the right to waive these requirements at any time.

## 1.7 SUBMITTALS

A. Comply with provisions of Division 01.

B. Submittal requirements prior to start of construction:

1. Product Data Submittal
2. Shop Drawings Submittal: Shop drawings shall include the following information:
3. System or functional block/line diagrams
4. Plans indicating equipment, antenna, and/or component locations, cable routes, and other installation information
5. Coverage plans, showing the design RF coverage (signal strength) for each frequency band required
6. Equipment and/or wall / rack elevations, showing equipment layout, space requirements and integration with other systems (outside the scope of the DAS)
7. Installation details for antenna mounting, specialty cable hangers, and other components unique to the System, and other information that depicts the intended installation

C. Submittal Requirements Prior To Acceptance Testing:

1. Acceptance Testing Procedures Submittal: describes in detail the procedure for testing the System's performance, and balancing the System's signal strength, including a description of the test data (or an example of the test report). The Contractor shall demonstrate that the desired services have been successfully deployed and tested.
2. Test procedure shall include the following tasks:
  - a. RF site survey post system deployment.
  - b. RF cable sweep measurements; which includes insertion loss and return loss.

- c. Benchmark system levels and settings which include transmit output power levels and receive sensitivity.
- D. Submittal Requirements at Close Out:
  - 1. Submit as-built drawings indicating:
    - 1) Cable routing, splitters, couplers and coverage antenna locations
    - 2) Active component locations, layout and configuration
  - 2. Test Reports
    - 1) Submit accepted ATP reports confirming all of the requirements of subpart 1.9 have been met.
  - 3. Field Reports: Submit sweep-testing results for all cable runs.
  - 4. Field Reports: Submit OTDR test results for all fiber runs.
  - 5. Operation and Maintenance Data: Submit hardware and software manuals for all Active Components.
  - 6. Warranty Documents:
    - 1) Submit for all manufactured components specified in this Section.
    - 2) Submit Contractor's System Warranty.
    - 3) Submit Manufacturer's Extended Warranty

## 1.8 QUALITY ASSURANCE

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner.
- B. Strictly adhere to all BICSI and TIA recommended installation practices when installing the systems described in this specification.
- C. Contractor's Qualifications:
  - 1. Firms regularly engaged in the design and installation of Distributed Antenna Systems and that have five (5) years of installation experience with systems similar to that required for this project.
  - 2. Provide references to include client names, phone numbers and a summary of project details. These references will be checked, and the clients will be asked questions relative to the performance of your company.
  - 3. Provide verification that installation personnel responsible have been properly trained to install the products described in this Section.
- D. Manufacturer's Qualifications:
  - 1. Firms regularly engaged in manufacture of products of the types, ratings and capacities required for this project; whose products have been in satisfactory use in similar service for not less than five (5) years, with production capabilities per applicable NEMA standards.
- E. Material and Work specified herein shall comply with the applicable requirements of:
  - 1. NECA 1 – Standard for Good Workmanship in Electrical Construction, 2015
  - 2. ANSI/TIA-568.0-D – Generic Telecommunications Cabling for Customer Premises, 2015
  - 3. ANSI/TIA-568.0-D-1 – Generic Telecommunications Cabling for Customer Premises – Addendum 1, 2017

4. ANSI/TIA-568.1-D – Commercial Building Telecommunications Cabling Standard – Part 1: General Requirements, 2015
5. ANSI/TIA-568.1-D-1 – Commercial Building Telecommunications Cabling Standard, Addendum 1, 2018
6. ANSI/TIA-568.3-D – Commercial Building Telecommunications Cabling Standard – Part 3: Optical Fiber Cabling and Components Standard, 2016
7. ANSI/TIA-568.4-D – Commercial Building Telecommunications Cabling Standard – Part 4: Broadband Coaxial Cabling and Components Standard, 2017
8. ANSI/TIA-569-D – Telecommunications Pathways and Spaces, 2015
9. ANSI/TIA-569-D-1 – Telecommunications Pathways and Spaces, Addendum 1: Revised Temperature and Humidity Requirements for Telecommunications Spaces, 2016
10. ANSI/TIA-606-C – Administration Standard for Telecommunications Infrastructure, 2017
11. ANSI/TIA-607-C – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises, 2015
12. ANSI/TIA-526.7-A – Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant, 2015
13. ANSI/TIA-758-B – Customer-Owned Outside Plant Telecommunications Infrastructure Standard, 2012
14. NFPA 70 – National Electric Code, 2017
15. UL 13 – Standard for Safety for Power-Limited Circuit Cables
16. UL 444 – Standard for Safety for Communications Cables
17. BICSI – Telecommunications Distribution Methods Manual, 13th Edition
18. BICSI – Information Technology Systems Installation Methods Manual, 7th Edition
19. Applicable codes and directives of authorities having jurisdiction

F. Work:

1. The Work shall be performed in compliance with the applicable manufacturer's installation instructions, Standards, and certifications listed herein, the Contract Documents, and governing codes and regulations of the authorities having jurisdiction.
2. The drawing and specification requirements govern where they exceed Code and Regulation requirements.
3. Where requirements between governing Codes and Regulations vary, the more restrictive provision applies.
4. Nothing in the Contract Documents grants authority or permission to disregard or violate any legal requirements.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials factory-packaged in containers or reels and handle in accordance with manufacturer's recommendations. Store in a clean, dry space and protect products from damaging fumes and traffic. Handle materials carefully to avoid damage.
- B. Storage space on project site may be limited. Contractor shall coordinate delivery and arrange storage of materials and equipment with the Owner.
- C. Components sensitive to damage in a harsh environment shall be stored off-site and delivered as needed.
- D. Provide protective covering during construction to prevent damage or entrance of foreign matter.
- E. Contractor is responsible for on-site security of tools, test equipment and materials.

- F. Replace at no expense to Owner, product damaged during storage, handling or the course of construction.

#### **1.10 INTELLECTUAL PROPERTY**

- A. Should patented articles, methods, materials apparatus, etc., be used in this Work, the Contractor shall acquire the right to use same. The Contractor shall hold the Owner and his agents harmless for any delay, action, suit, or cost growing out of the patent rights for any device on this Project.
- B. Should copyrighted software be used in this Work, the Contractor shall acquire the right to use same. The Contractor shall hold the Owner and his agents harmless for any delay, action, suit, or cost growing out of the copyrights for any software on this Project.
- C. All software required for the complete operation of the system as specified herein shall be delivered with either full Ownership transferred to the Owner or a non-time limited license to use on each machine it is installed on, including the right to make backup copies.

#### **1.11 PROJECT CONDITIONS**

- A. Verify conditions on the job site are applicable to this Work. Notify Architect in writing of discrepancies, conflicts, or omissions promptly upon discovery.
- B. The Drawings diagrammatically show cabling and arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install Work as shown, recommend solutions and/or submit drawings to the Architect for approval, showing how the Work may be installed.

#### **1.12 MATERIAL PURCHASES**

- A. Latest Technology
  - 1. Products and materials shall be purchased by the Contractor in a timely manner to meet construction schedules but shall not be purchased so far advanced of the date(s) of installation that they become technologically obsolete or replaced with newer technologies.
  - 2. In the event the manufacturer(s) of submitted products and materials have upgraded or replaced their products and materials with newer or improved technologies at the time of purchase, the newer or improved products or materials shall be provided unless they are incompatible with the rest of the DAS, or so directed by the Design Consultant.
  - 3. Latest technology products and materials shall be operationally and functionally equivalent or superior to the submitted products and materials. These products shall be submitted to the Design Consultant for approval, before ordering.

#### **1.13 WARRANTY**

- A. Warrant labor and product to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics, following Contractor Warranty requirements defined in Division 01. Should a failure occur within the Contractor's warranty period, the Contractor shall provide all labor and materials necessary to restore the system to the condition required for the Final Test and Acceptance for this Contract, at no cost to the Owner.

- B. All surplus parts and pieces to the installation shall be maintained as a spare parts inventory at the building site. Parts replaced during the warranty period shall have a warranty matching that of the original part from date of replacement.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. The Cellular DAS system shall be an extension of the existing campus wide system, and shall meet the same performance requirements as the existing campus wide system.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. The existing cellular DAS distributes commercial radio frequency signals for the primary purpose of in-building commercial telephone voice and data communications. It is to remain active and operational.
- B. The existing head-end equipment may require additions and modifications to support the expansion project. This equipment is required to be fully operational at all times. Any modifications or additions must be done in a manner that preserves service continuity of the system.
- C. The cellular DAS is a continuously active communication system that is required to be operational at all times. If any portion of the DAS is damaged as a result of pre-construction or construction activities, it is to be repaired and restored to its original performance.
- D. The Cellular DAS is monitored and alarmed with an automated Network Management System. Contractor shall be responsible to properly notify all parties involved in the Cellular DAS network whenever any equipment or cabling in the active system is involved in construction activities.

### **3.2 EXAMINATION AND PREPARATION**

- A. Prior to the start of this Section's installation Work, examine Communications Rooms and Pathways for completeness, compatibility with the Work of this section, and readiness for connections with the Work of this section.

### **3.3 INSTALLATION**

- A. The contractor shall design, install, commission and test the DAS in cooperation with the WSPs, according to the manufacturer's instructions and recommendations.
- B. Project Management Services: The Contractor shall assign a single point-of-contact to this project with overall responsibility for communications and ultimate delivery of contracted materials, installation, performance criteria, and services. This POC shall be responsible for interfacing with the Owner, General Contractor, Engineer, and their own subcontractors. The PM shall present the design iterations to the Owner, coordinate cable routes with the Engineer, coordinate on-site



construction activities with the General Contractor, shall manage the process to coordinate bringing wireless operators into the facility, and shall close out the project with the Owner.

- C. The Contractor shall coordinate the installation and schedule with the Owner and General Contractor prior to the start of installation activities. Once the Owner and General Contractor have accepted the coordination and schedule, the Contractor may proceed with installation.
- D. The Contractor shall balance the System component (e.g., antenna) signal strength to the device signal levels.
- E. The Contractor shall perform an active wireless survey demonstrating performance. From this survey, produce an active survey report, including floor plans.
- F. Equipment to be installed in accessible locations which may include above ceiling or DFW Comm Rooms, where practical.
- G. All equipment and associated passives shall be permanently affixed to walls and/or structural building elements with mounting systems that allow for immediate mounting and removal (snap-on mounts with permanent bolting after).
- H. Coaxial cable testing shall be conducted on every cable after cable termination. Testing shall provide Return Loss and Distance to Fault measurements for each test. Testing shall be in accordance with BICSI TDMM approved standards.
- I. The fiber optic cabling in this system shall be terminated with the manufacturer's recommended connectors. All fiber optic connectivity must meet or exceed the DAS manufacturer's specifications.
- J. Fiber optic cable testing shall be conducted on every cable and fiber optic strand after cable termination. Testing shall provide Optical Path Loss, Distance to Fault and reflection coefficient measurements for each test. Testing shall be in accordance with BICSI TDMM approved standards.

### **3.4 LABELING**

- A. All cables must be labeled every fifty feet with "Property of DFW DAS, Contact DFW ITS Ali Nemat (972) 973-5300." Labeling shall comply with Section 27 05 53 of the specifications.

### **3.5 ACTIVATION AND TESTING**

- A. The DAS extension activation shall include the turn-up and test of DAS equipment and any required modules without WSP signals connected. This process shall be continued until all equipment is completely operational. Signal levels may require some tuning to meet proper levels required for optimum system operation.
- B. Prior to the connection of live WSP signals, DAS testing shall be in accordance with OEM recommendations, but shall include the injection of CW source signals at both the headend and at the remote antenna locations. Overall system performance and gain shall be measured and compared to the system design. All system settings and testing records shall be transmitted at the end of the project.

- C. Contractor shall also be responsible to activate cellular DAS NMS connectivity for use with equipment before commercial RF signals are connected to the system.
- D. After the DAS extension activation and the connection of WSP RF signals, the contractor shall perform complete walk-testing of the system coverage and performance throughout the coverage area to confirm performance. Walk-testing shall be performed using automated test equipment and accurate floor plans of the structure.
- E. Present the completed System and wireless services to the Owner, including functionality, features, ongoing maintenance, and warranty procedures. Demonstrate to Owner system operation, including signal strength at select locations. Turnover at least one set of both electronic records and printed records, per the Owner's request.

### **3.6 TEST REPORTS AND AS-BUILT DRAWINGS**

- A. Provide Coaxial Cable test reports subsequent to testing in the ACTIVATION AND TESTING Article of this Section.
- B. Provide Fiber Optic Cable Testing reports subsequent to testing in the ACTIVATION AND TESTING Article of this Section.
- C. Provide Activation reports subsequent to testing in the ACTIVATION AND TESTING Article of this Section.
- D. Provide CW Source test reports subsequent to testing in the ACTIVATION AND TESTING Article of this Section.
- E. Provide Walk Test coverage and signal level reports subsequent to testing in the ACTIVATION AND TESTING Article of this Section.

### **3.7 ACCEPTANCE**

- A. Complete the acceptance testing as prescribed in the accepted Testing Procedures submittal.
- B. Acceptance testing shall confirm performance in accordance with the PERFORMANCE REQUIREMENTS Article of this Section.

### **3.8 FINAL INSPECTION AND CERTIFICATION**

- A. Punch the Work of this Section compliant to the requirements of Section 270500 (Common Work Results for Communications)
- B. Comply with system acceptance and certification requirements of Section 270500 (Common Work Results for Communications)

**END OF SECTION 27 60 60**