

Office of Information Technology  
Anne Arundel County, Maryland

Compliant Public Safety In-Building Two-  
Way Radio Communications  
Enhancement System Requirements

Revised April 5, 2024

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## Introduction

Anne Arundel County, Maryland has adopted NFPA 1, Fire Code, 2018 Edition (NFPA1-2018) as its Fire Code, NFPA 101, Life Safety Code, 2018 Edition (NFPA101-2018) as its Life Safety Code, and NFPA 1221, Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems, 2016 Edition (NFPA1221-2016) as its standard for Communications Enhancement Systems. NFPA1-2018 and NFPA101-2018 provide requirements for reliable public safety radio system coverage in occupancies, and NFPA1221-2016 provides requirements for the design, installation and maintenance of communications enhancements systems.

Modern building design and construction techniques, especially those required to satisfy requirements for LEED-certified building designs, make it difficult or impossible for the County to provide reliable two-way radio coverage for first responders operating inside of buildings. Two-way radio communications enhancement systems help ensure the safety of building occupants and first responders by extending the coverage of a public safety communications system to the interior areas of the building through the use of special bi-directional amplifiers (BDAs) and a network of indoor antennas strategically located to provide reliable public safety radio system coverage throughout the interior of a building. The BDA and network of antennas is sometimes collectively known as a Distributed Antenna System (DAS).

DAS systems must be designed, installed, maintained and repaired by qualified personnel to ensure that they meet the County's coverage reliability code requirements and do not cause unintended harmful interference to County or State radio systems or other users of the RF spectrum licensed by the Federal Communications Commission (FCC).

The FCC requires that DAS systems be either operated by the licensee of the public safety radio system, or explicitly authorized by the licensee. Additionally, the licensee must enter the DAS into a nationwide registry maintained by the FCC, so the appropriate parties can be contacted should the DAS cause interference to radio systems operated by any FCC licensee.

The County operates an APCO-25 Phase 2 compliant, 22 site, 12 channel 800 MHz digital simulcast trunked public safety radio system for first responder communications. The County's Office of Information Technology (OIT) has responsibility for the day-to-day operation, maintenance, and management of the public safety radio system. Additionally, the State of Maryland operates a statewide APCO-25 Phase 2 compliant 700 MHz digital trunked public safety radio system that is also used by County and State first responders in Anne Arundel County.

This document is intended to provide guidance to building owners and developers who are contemplating projects in the County that are required to meet the

requirements of NFPA 1221 2016, and to DAS system installation firms operating in the County and installing NFPA 1221 2016 compliant systems to meet the County's Emergency Services Communications code requirements.

## Summary of Requirements for Owners

When the NFPA 1 Fire Code and the International Building Code, as adopted by Anne Arundel County, require reliable in-building public safety radio system coverage:

All commercial, multi-unit residential, governmental and educational occupancies must have reliable in-building public safety radio communications coverage that meets the requirements of NFPA 1221 2016, and the radio coverage requirements set forth by the County in Table 1, for both the County 800 MHz and State 700 MHz radio systems. BDA/DAS systems installed to satisfy radio coverage requirements shall also adhere to the system technical parameters provided in Appendix A for both the County 800 MHz and State 700 MHz radio systems.

*Table 1 – Anne Arundel County radio coverage requirements*

<p><b><u>Inbound signal strength</u></b></p>	<p><u>A minimum inbound signal strength of -90 dBm shall be provided throughout the coverage area for the Anne Arundel County 800 MHz system and the State of Maryland 700 MHz system.</u></p>
<p><b><u>Outbound signal strength</u></b></p>	<p><u>A minimum outbound signal strength of -90 dBm shall be provided throughout the coverage area for the Anne Arundel County 800 MHz system and the State of Maryland 700 MHz system.</u></p>
<p><b><u>Balanced uplink/downlink path operation</u></b></p>	<p><u>All passive and active components used in the BDA/DAS shall provide equal uplink/downlink levels of insertion loss, passive gain or active gain.</u></p>
<p><b><u>Voice audio quality</u></b></p>	<p><u>A minimum voice audio quality of DAQ 3.4 shall be provided throughout the coverage area for the Anne Arundel County 800 MHz system and the State of Maryland 700 MHz system. DAQ 3.4 is defined as “Speech understandable without repetition, some noise/distortion present”</u></p>

<p><b><u>Coverage area reliability in critical areas</u></b></p>	<p><u>Fire command centers, fire alarm control panel locations, fire pump rooms, exit stairs, exit passageways, elevators, elevator lobbies, standpipe cabinets, sprinkler valve locations, areas of refuge and other areas deemed critical by the County shall be provided with 99% floor area reliability coverage for the Anne Arundel County 800 MHz system and the State of Maryland 700 MHz system.</u></p>
<p><b><u>Coverage area reliability in general building areas</u></b></p>	<p><u>All other interior levels and areas of the building not defined as critical shall have 90% floor area reliability coverage for the Anne Arundel County 800 MHz system and the State of Maryland 700 MHz system.</u></p>

**Occupancies that meet public safety radio coverage reliability requirements without radio communications enhancement systems:**

In some occupancies, such as those with smaller footprints, or those located in close proximity to County or State transmission sites, it may be possible to achieve reliable public safety radio communications coverage throughout the occupancy and meet code requirements without the use of a radio communications enhancement system. Public safety radio coverage in these occupancies must meet the same radio coverage reliability requirements as those occupancies that require a radio communications enhancement system for both the County 800 MHz and State 700 MHz systems (See Table 1). In cases such as these where a radio communications enhancement system is not required, the County will accept an independent certification of compliance with code requirements for reliable in-building public safety radio coverage.

- A firm qualified in the engineering and design of two-way radio communications enhancement systems shall be engaged to assist with this determination and provide the required certification for eligible occupancies.
- For buildings not equipped with two-way radio communications enhancement systems, testing for signal strength, audio quality and area coverage reliability compliance and certification must be performed when all construction and interior finishing work is complete, under full foliage conditions, between the May 1 and October 1. Testing for this certification shall be conducted for both the County 800 MHz and State 700 MHz radio systems. Building owners/developers must submit all test documentation

and a Certificate of Radio Coverage Compliance, signed and sealed by the engineer of record, stating that County 800 MHz and State 700 MHz public safety radio system coverage reliability within the occupancy meets the signal strength, audio quality and area coverage reliability requirements set forth in Table 1, and was tested in accordance with the provisions set forth in NFPA 1221 2016 A.11.3.9. OIT will issue loaner portable radios to integrators upon request to accomplish the required DAQ testing.

- The Certificate of Radio Coverage Compliance shall be posted at the fire alarm control panel, or at the main electrical panel if no fire alarm control panel is present.

### **Occupancies requiring radio communications enhancement systems to meet radio coverage reliability requirements:**

In occupancies where two-way radio communications enhancement systems are required in order to meet code requirements for County 800 MHz and State 700 MHz radio system coverage, two-way radio communications enhancement systems and related equipment must meet all County, NFPA 1221 2016 and IBC 2018 requirements. More specifically, the requirements of Table 1, Appendix A and the following NFPA 1221 2016 sections are incorporated herein by reference:

- *Section 9.6 Two Way Radio Communications Enhancement Systems*
- *Section 11.3.9 (Annual testing)*
- *Annex A.11.3.9 Test Procedures*
- NOTE: In cases where a County requirement is more stringent than a requirement defined in NFPA 1221, the County requirement shall take precedence.
- Systems shall be designed to provide compliant coverage area reliability for both the County 800 MHz system and the State 700 MHz system.
- Building owners/developers must submit plans for the design of proposed two-way radio communications enhancement systems to OIT staff for review, and approval of the selected donor site(s).
- Building owners/developers must apply for and obtain a Retransmission Authorization from OIT prior to commissioning the two-way radio communications enhancement system. The Retransmission Authorization is required by the FCC and is the System operator's proof that the County and State have granted permission to operate equipment that uses radio frequencies licensed to the County and the State<sup>1</sup>. Provisional Retransmission Authorizations

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<sup>1</sup> See 47CFR90.219(b)(1)(i)

are issued for initial system activation, optimization and testing and are valid for one year from date of issuance. Final Retransmission Authorizations are issued upon successful commissioning of the system. Final Retransmission Authorizations remain valid indefinitely, provided that the Operator performs annual system maintenance and testing as required by NFPA 1221 2016 Section 11.3.9 (Annual testing), and A.11.3.9, *Annual Tests*, or unless otherwise rescinded by the County or the State.

- Two-way communications enhancement systems shall be operated, maintained and tested annually in accordance with manufacturer's instructions, FCC rules and regulations, and the requirements of NFPA 1221 2016 Section 11.3.9 (Annual testing), and A.11.3.9, *Annual Tests*. Operators shall provide proof of annual system maintenance and testing upon request by the County or the State.
- Equipment used by the two-way radio communications enhancement system must be type accepted by the FCC.
- The two-way radio communications enhancement system must be operated in accordance with FCC rules and regulations at all times.
- The two-way radio communications enhancement system shall not cause interference to County or State radio systems or equipment, or to systems or equipment operated by any other FCC licensee.
- Building owners/developers must submit as-built documentation, in soft copy format (e.g., PDF) to OIT after testing is completed.
- All active equipment (BDAs, Line Amplifiers, Remotes, etc.) shall be labeled with a "To Report Problems with this Equipment" label, providing the company name, contact name, telephone number, email address and business address of the party responsible for care and maintenance of the equipment.

### **Sensitive Compartmented Information Facilities**

Sensitive Compartmented Information Facilities (SCIFs) are enclosed areas inside of occupancies specifically designed for handling of classified information. SCIFs are often found inside of buildings occupied by government and defense agencies and contractors.

Intelligence Community Standard Number 705-1, "Physical and Technical Standards for Sensitive Compartmented Information Facilities" requires that SCIF design and construction be compliant with the NFPA 1 Fire Code and the NFPA 101 Life Safety Code. Accordingly, in Anne Arundel County, reliable first responder radio coverage must be provided inside of SCIFs. In-Building Two-Way Radio Communications Enhancement Systems must be provided if needed to ensure reliable first responder radio coverage inside of the SCIF.



In-Building Two-Way Radio Communications Enhancement Systems installed in SCIFs can be designed and equipped for automatic and manual activation to ensure that the security of the SCIF is not compromised by the operation of the coverage enhancement system. In such cases the following requirements apply:

- The In-Building Two-Way Radio Communications Enhancement System shall be equipped to automatically activate in the event of a building fire alarm smoke or heat detection event, manual pull station alarm, sprinkler system water flow detection, clean agent suppression discharge or any other fire alarm condition.
- The In-Building Two-Way Radio Communications Enhancement System shall be equipped with a clearly marked manual activation switch to allow manual activation of the coverage enhancement by first responders upon their arrival at the occupancy. The manual activation switch shall be located at the fire alarm annunciator or fire alarm control panel at the building's main entrance. Manual activation of the coverage enhancement system shall not require the use of special keys or other restrictions and shall not require the involvement of building staff. The automatic and manual activation capabilities shall be tested annually to ensure proper functionality.
- The SCIF area can be equipped with visual beacons or similar visual annunciator devices to alert staff working in the SCIF when the coverage enhancement system is active such that staff can take appropriate steps to protect sensitive information.

## Initial Determination Process

- In all new buildings and existing buildings that are modified, minimum County 800 MHz and State 700 MHz radio signal strength must be provided. An applicant submits building plans to the Anne Arundel County Department of Inspections and Permits for review.
- Inspections and Permits plan review staff will provide a plan comment as part of the building permit review stating that compliant public safety radio coverage is required for the occupancy, including the installation of a two-way radio communication enhancement system if necessary to meet code requirements.
- The applicant is directed OIT for additional information. This Compliant Public Safety In-Building Two-Way Radio Communications Enhancement System Requirements document is provided upon request and is available for download from the Anne Arundel County Fire Marshal web site.
- The applicant proceeds with the **Radio Communications Enhancement System Implementation Process** described below.

In certain occupancies, such as those with smaller footprints, or those located in close proximity County and State transmission sites, it may be possible to achieve reliable public safety radio communications coverage throughout the occupancy and meet code requirements without the use of a radio communications enhancement system. Public safety radio coverage in these occupancies must meet the same reliability requirements as those occupancies that require a radio communications enhancement system.

- The applicant engages the services of a qualified integrator or consultant to assess available radio coverage at the location of the occupancy and determine if County 800 MHz and State 700 MHz public safety radio coverage reliability in the occupancy will meet code requirements after it is fully constructed and finished, without the use of a two-way radio communications enhancement system, and under full foliage conditions.
- Once construction is complete, and prior to occupancy, owners/developers must submit all test documentation and a Certificate of Radio Coverage Compliance, signed and sealed by the engineer of record, stating that County 800 MHz and State 700 MHz public safety radio system coverage reliability within the occupancy meets the signal strength, audio quality and area coverage reliability requirements set forth in Table 1 and was tested in accordance with the provisions set forth in NFPA 1221 2016 A.11.3.9.
- The Certificate of Radio Coverage Compliance shall be posted at the fire alarm control panel, or at the main electrical panel if no fire alarm control panel is present. Testing for coverage reliability compliance and certification must be

performed under full foliage conditions, between the months of May and September.

- **If testing determines that County 800 MHz or State 700 MHz public safety coverage reliability does not meet code requirements, a compliant radio communications enhancement system must be installed and tested prior to issuance of the certificate of occupancy.**

# Radio Communications Enhancement System Implementation Process

The County has defined the following process for owners or developers planning new occupancies or modifications to existing occupancies that require a radio communications enhancement system to ensure operation of the Anne Arundel County public safety communication system inside buildings.

## 1. Conduct System Planning and Design

The applicant includes an NFPA 1221 2016, IBC 2018 and County compliant two-way radio communication enhancement system in the design requirements for the project, designed to provide compliant coverage for the County 800 MHz and State 700 MHz radio systems. A qualified integrator or installation firm is retained by the developer to design, install and activate the two-way radio communications enhancement system as a part of the building project. OIT provides consultation assistance to the integrator/installer and directs the selection of the donor site(s) for the proposed two-way radio communications enhancement system. The applicant must obtain a separate low-voltage permit to cover the installation of the two-way radio communication enhancement system. The fire alarm contractor is responsible for the fire alarm permit application, and integration of the radio communications enhancement system into the fire alarm supervisory notification/alarm panel.

## 2. Submit Retransmission Application

Integrator/installer completes a Retransmission Application for each BDA headend in the system design. Retransmission Applications must include the Low Voltage Permit Number assigned for the work. Owner submits Retransmission Application(s) and proposed design documentation (system design diagrams, bill of materials and floor plan diagrams) to OIT.

## 3. OIT Creates Entry in FCC Signal Booster Database

OIT utilizes the contact information provided in the Retransmission Application to create an entry for the two-way radio communications enhancement system in the FCC's Signal Booster database for both the County and State frequencies.

**Applicants, integrators and installers should not create entries in the FCC Signal Booster database for proposed two-way radio communications enhancement systems that will operate on frequencies licensed to the County.**

## 4. OIT and State review application and issue Provisional Retransmission Authorization

OIT and the State conduct a technical review of the proposed design. Upon approval of the design, OIT and the State issue a signed Provisional Retransmission

Authorization to owner, which authorizes operation of the system for the purposes of installation, testing and optimization. The Provisional Retransmission Authorization is valid for a period of one year from date of issuance.

## **5. Perform System Installation**

The integrator/installer proceeds with installation of the approved system in accordance with the project's plan and schedule. Substantial design changes from those specified in the initial design must be approved by OIT and the State (e.g., selection of a different donor site, selection of different model BDA, selection of a different donor antenna, additions or changes to number of line amplifiers in the design, and changes to the equipment room location in the building).

Updated OIT and State review and approval is not required for minor changes that do not impact the number of active amplification devices used by the system or impact the donor site (e.g., changes to the number or location of indoor coverage antennas in the design).

The two-way radio communication enhancement system should not be activated for optimization and testing without prior OIT and State authorization. OIT and/or the State may, at their sole discretion, require that an initial desense test be conducted prior to initial activation to ensure that no harmful interference occurs to the County's 800 MHz radio system or the State's 700 MHz radio system.

Integration with supervisory notification/alarm panel(s) shall comply with the requirements of NFPA 1221 2016 9.6.13.1 and must be completed prior to fire alarm and two-way radio communication enhancement system testing.

## **6. Perform Pre-Commissioning Activation and Optimization**

Integrator/installer posts the Provisional Retransmission Authorization at the headend location(s). The integrator/installer notifies OIT staff when ready to activate the system for the first time.

If required by OIT and/or the State, an initial desense test is coordinated for the first activation of the system.

The integrator/installer conducts system activation and optimization. OIT will issue loaner radios to integrators for system commissioning and testing upon request.

## **7. Perform Fire Alarm/Two-way Radio Communications Enhancement System Testing**

The integrator/installer coordinates scheduling of initial OIT BDA system inspection and testing with OIT. OIT shall inspect the system for the following criteria:

- Compliance with NFPA installation requirements

- Donor antenna orientation
- Grounding, bonding and general workmanship
- Actual signal strength and DAQ in the occupancy consistent with integrator's test results submittal
- Coverage reliability
- Proper commissioning, testing and as-built documentation
- Fire alarm control panel integration
- Donor site desense

Upon successful completion of testing, OIT staff will affix an OIT inspection sticker to the BDA equipment to indicate completion of OIT testing to Fire Marshal's Office staff. The BDA system and fire alarm control panel integration will then receive final inspection by members of the Fire Marshal's Office.

## **8. Submit As-Built Documentation**

The integrator/installer provides test results and full system as-built documentation to OIT in soft copy (e.g., PDF) format. OIT and the State issue a Final Retransmission Authorization. The Final Retransmission Authorization must be posted at all headend location(s). OIT adds the as-built documentation to the system archives.

## **9. Issue Certificate of Occupancy**

The Department of Inspections and Permits issues a Certificate of Occupancy after all requirements for occupancy are met, including the following:

- Successful OIT and Fire Marshal's Office inspection
- Receipt of required documentation
- Posting of Final Retransmission Authorization(s) at the system headend(s)
- Posting the "To Report Problems with this Equipment" label providing the company name, contact name, telephone number, email address and business address of the party responsible for care and maintenance of the equipment on all active system components

## **10. Annual System Testing and Maintenance**

The building owner retains services of a qualified firm to conduct annual system preventive maintenance and assist with annual testing. The building owner coordinates annual testing of the two-way radio communications enhancement system with annual testing of other fire alarm and fire safety systems. Annual testing of two-way radio communications enhancement systems shall be performed in accordance with the requirements of NFPA 1221 2016 Section 11.3.9 (Annual testing), and A.11.3.9, *Annual Tests*.

# Sample Retransmission Authorization

## ANNE ARUNDEL COUNTY, MARYLAND 700/800 MHz RETRANSMISSION AUTHORIZATION

AUTHORIZATION NUMBER: FRA-YYYYMM-NNN

Anne Arundel County, Maryland (the County) and the State of Maryland (the State) hereby grant authorization to name of operator (Operator) to operate a Two-Way Radio Communications Enhancement System (the System) on frequencies licensed to the County and the State of Maryland by the Federal Communications Commission (FCC) at the following location:

Site Name: site name  
Site Address: street, city, state, zip  
Latitude: latitude                      Longitude: longitude  
FCC Booster ID: FCC Booster ID  
Site Contact: site contact

This Retransmission Authorization is subject to the following conditions:

1. Retransmission Authorizations remain valid indefinitely, provided that the Operator performs annual system maintenance and testing as required by NFPA 1221 2016 and unless otherwise rescinded by the County or the State. This Retransmission Authorization shall be posted conspicuously at the BDA headend location.
2. The System shall be operated, maintained and tested annually in accordance with manufacturer's instructions, FCC rules and regulations, and the requirements of NFPA 1221, Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems, (National Fire Protection Association 2016). Operator shall provide proof of annual system maintenance and testing upon request by the County.
3. The System shall not cause interference to radio systems or equipment operated by the County, the State, or any other FCC licensee.
4. Operator shall promptly resolve any interference that occurs to radio systems or equipment operated by the County, the State, or any other FCC licensee, up to and including deactivation of the System, if necessary, until such time that the interference is corrected.
5. In the event of an outage of the System, Operator shall notify the Anne Arundel County Fire Marshal in accordance with the regulations, policies and procedures for reporting any fire alarm/fire safety system outage.
6. Operator shall provide access to the System for inspection upon request by the County, the State, or the FCC.
7. A separate Retransmission Authorization shall be obtained for each headend location used in the system design and posted conspicuously with the headend equipment.
8. The County and State, as FCC licensees for their respective frequencies, reserve the right to terminate this Retransmission Authorization at their sole discretion.

\_\_\_\_\_ Date: date issued

Jeremy D. Magorka, Chief, Telecommunications Services, Anne Arundel County, MD

\_\_\_\_\_ Date: date issued

(name), (title), State of Maryland

Revised February 18, 2021

# Sample Retransmission Application

**OFFICE OF INFORMATION TECHNOLOGY, ANNE ARUNDEL COUNTY, MARYLAND  
700/800 MHz RETRANSMISSION APPLICATION**

<b>INSTRUCTIONS:</b> Provide all information requested on the Retransmission Application. Include system design diagrams, bill of materials and floor plan diagrams as separate attachments. Complete a separate form for each BDA headend in the design. The information provided will be used to create a record for the proposed system in the FCC Signal Booster registry in accordance with FCC rules. A Provisional Retransmission Authorization will be issued for system startup upon review and approval by County and State staff. Systems shall not be activated prior to issuance of the Provisional Retransmission Authorization. The County or State, at their sole discretion, may require an initial desense test when the system is activated for the first time, to ensure that no harmful interference is occurring to nearby donor sites. The Provisional Retransmission Authorization will indicate if the initial desense test is required. Submit completed application electronically via email to 800MHz@aacounty.org. For questions, email to 800MHz@aacounty.org or contact Chief, Telecommunications Services at (410) 222-2020.		
<b>1. SITE INFORMATION</b>		
Site Name:		
Site Address:		
Low Voltage Permit Number (Issued by Anne Arundel County Department of Inspections and Permits):		
Site Description (type of construction, number of floors, interior square footage):		
Site Latitude and Longitude:		
BDA Manufacturer and Model:	Class:	Total System Delay in $\mu$ s:
BDA Headend Location:		
Number of Line Amplifiers or Fiber Remotes:	Line Amplifier/Fiber Remote Manufacturer and Model:	
Type of System:	<input type="checkbox"/> 700/800 MHz Public safety only <input type="checkbox"/> Multiple carrier neutral host <input type="checkbox"/> Other (describe below)	
<b>2. BUILDING/DEVELOPMENT OWNER CONTACT INFORMATION</b>		
Owner:		
Owner address:		
Point of contact:	Email:	
Work phone:	Mobile phone:	
<b>3. SITE ACCESS OR TECHNICAL CONTACT INFORMATION (will provide access for inspections and testing)</b>		
Company:		
Address:		
Point of contact:	Email:	
Work phone:	Mobile phone:	
<b>4. SYSTEM INTEGRATOR/INSTALLER/MAINTAINER</b>		
Company:		
Address:		
Point of contact:	Email:	
Work phone:	Mobile phone:	
<b>5. PREPARER SIGNATURE AND DATE:</b>		
Signature:	Date:	
Print name and title:		



# Sample Inspection Form

**OFFICE OF INFORMATION TECHNOLOGY, ANNE ARUNDEL COUNTY, MD  
PUBLIC SAFETY BI-DIRECTIONAL AMPLIFIER FINAL SYSTEM INSPECTION AND ACCEPTANCE TESTING**

<b>INSTRUCTIONS:</b> Complete all items on this page before starting the test. Confirm that a valid calibration certificate or sticker is available for any spectrum analyzers or other measurement equipment used for the test. Provide the manufacturer, model numbers and serial numbers for the portable radios used in the test. On the following pages, for each test or inspection item requirement, indicate if the item passes or fails by writing "P" or "F" in the <b>Pass/Fail</b> column. If an item fails, describe the deficiency in the <b>Comments</b> column. Retest or reinspect failed items once they are remediated, during the same visit if practical. Schedule a retest date if necessary. For items that successfully pass the retest, write "P" in the <b>Retest Pass</b> column. For any items that cannot be inspected or tested, write "CNI" in the <b>Pass/Fail</b> column and document the reason in the <b>Comments</b> column. OIT representative to sign this form once all tests and inspections are successfully completed.		
<b>Site Name:</b>		<b>Selected Donor Sites:</b>
<b>Site Address:</b>		
<b>City:</b>	<b>State:</b>	<b>Zip:</b>
<b>OIT Inspector(s): (PRINT names and phone numbers)</b>  Jeremy Magorka 443-699-6804 Jack Anderson 703-851-5459		
<b>System Integrator and Representative(s): (PRINT company name(s), representative name(s), phone numbers)</b>		
<b>Owner Representative(s): (PRINT company name, representative names, phone numbers)</b>		
<b>Initial System Test Date:</b>		<b>System Retest Date (if applicable):</b>
<b>Test Equipment Manufacturer/Model:</b> ANRITSU S412E	<b>Test Equipment Serial Number:</b> 1916028	<b>Last Annual Calibration Date:</b> 4/2024
<b>Test Radio 1 Manufacturer, Model # and Serial #:</b> APX8000-579CTT8385		<b>Test Radio 2 Manufacturer, Model # and Serial #:</b> APX8000-579CTT8386
<b>Test Radio 3 Manufacturer, Model # and Serial #:</b> N/A		<b>Test Radio 4 Manufacturer, Model # and Serial #:</b> N/A

Site Name:				Page 2 of 5
Req. Ref.	Test/Inspection Description	Pass/ Fail	Comments	Retest Pass
AACO	Inspect donor antenna installation first. Verify proper donor antenna azimuth visually or with a compass if donor site is not visible. Donor antenna shall be properly oriented towards the selected donor site. If necessary, correct donor antenna orientation. While at donor antenna location, inspect donor antenna installation workmanship and grounding.			
AACO NFPA	Inspect installation workmanship for compliance with NFPA 1221 2016 (BDA and battery backup comply with NFPA [12 hour battery, NEMA-4 or 4X enclosures, BDA enclosure painted red, alarm annunciator provided, power and control wiring in EMT, plenum rated coax as required by code, transmission lines properly and professionally secured throughout the building, any fiber in dedicated innerduct, cables, indoor antennas labeled, no splices, etc.).			
AACO NFPA	Measure donor/distribution antenna isolation, system gain plus 20 dB or greater as required by manufacturer.			
AACO NFPA	Conduct donor site desense testing (no measurable or observable increase to donor site noise floor or reduction in effective receiver sensitivity) by monitoring effective receiver sensitivity at the donor site with the BDA system powered off, then on.			
AACO NFPA	Test battery backup functionality by disconnecting AC power and observing uninterrupted operation of the BDA system.			
AACO NFPA NEC	Inspect and test grounding components. Donor antenna and system components shall be grounded in accordance with NFPA/NEC (bonded to single point ground reference or building steel, coaxial SPD installed near coax entry point, AC powered equipment equipped with AC SPD, ground wires separated from other conductors and mounted on standoffs, active electronic equipment bonded to single point grounding system or building steel.) All paint must be removed from painted grounding points. Ground connections shall be protected with anti-oxidation compound.			
AACO NFPA	Verify BDA alarm functionality at FACP:  <input type="checkbox"/> Donor antenna malfunction <input type="checkbox"/> RF device failure <input type="checkbox"/> Low [70% depleted] battery capacity <input type="checkbox"/> Active system component failure (if appl.) <input type="checkbox"/> Loss of normal power <input type="checkbox"/> Battery charger failure			

Site Name:				Page 3 of 5
Req. Ref.	Test/Inspection Description	Pass/ Fail	Comments	Retest Pass
AACO NFPA	Confirm BDA propagation delay meets County specification of 8.0 $\mu$ s or less. Check overlap areas near windows and outside perimeter of occupancy for multipath distortion.			
AACO NFPA	For locations with a SCIF, confirm automatic and manual activation of SCIF coverage. SCIF coverage shall automatically activate in the event of a building fire alarm smoke or heat detection event, manual pull station alarm, sprinkler system water flow detection, clean agent suppression discharge or any other fire alarm condition. Additionally, there shall be a clearly marked manual activation switch located at the fire alarm annunciator or fire alarm control panel at the building's main entrance.			

Site Name:				Page 4 of 5
Req. Ref.	Test/Inspection Description	Pass/ Fail	Comments	Retest Pass
AACO NFPA	<p>Conduct 700/800 MHz grid testing per NFPA 1221 2016 A.11.3.9 to confirm commissioning coverage testing. Each floor of the occupancy shall be gridded according to the requirements of A.11.3.9 (20'-80' grids depending on floor area to be tested, at least 20 grid cells). Measure and record downlink signal strength and roundtrip DAQ from the center of each grid. Critical areas (fire command centers, fire alarm control panel locations, fire pump rooms, exit stairs, exit passageways, elevators, elevator lobbies, standpipe cabinets, sprinkler valve locations, areas of refuge and other areas deemed critical by the County must pass with 99% area reliability. Other general areas of the occupancy must pass with 90% area reliability. A grid must exhibit both 3.4 or greater DAQ and -90 dBm or greater downlink RSSI to pass. DAQ ratings shall be according to the following:</p> <p><b>DAQ 1:</b> Unusable; speech present but unreadable</p> <p><b>DAQ 2:</b> Understandable with considerable effort; frequent repetition due to noise/distortion</p> <p><b>DAQ 3:</b> Speech understandable with slight effort; occasional repetition required due to noise/distortion</p> <p><b>DAQ 3.4:</b> Speech understandable with repetition only rarely required; some noise/distortion</p> <p><b>DAQ 4:</b> Speech easily understood; occasional noise/distortion</p> <p><b>DAQ 4.5:</b> Speech easily understood; infrequent noise/distortion</p> <p><b>DAQ 5:</b> Speech easily understood</p> <p>See A.11.3.9 for further instructions regarding adjacent grid failures, etc. Attach grid test results to this test documentation upon successful grid test completion.</p>			

Site Name:				Page 5 of 5
Req. Ref.	Test/Inspection Description	Pass/ Fail	Comments	Retest Pass
AACO System Tech Info	Confirm correct BDA programming for current and future Anne Arundel County frequencies.  Class B: 851-861 MHz  851.1375      855.8375 853.3250      856.0125 852.6875      856.1625 854.5125      856.4125 853.8375      856.5125 854.7125 854.1875  (Includes -45 MHz uplink channels)			
MDFIRST System Tech Info	Confirm correct BDA programming for MDFIRST frequencies.  Class B: 769-775 MHz  <b>AACO                      Greenbury                      Tracys Lnd</b> <b>Simulcast                      ASR:                      ASR:</b> 769.50625      769.26875      771.15625 770.45625      770.76875      771.88125 771.45625      771.31875      772.23125 772.43125      771.70625      772.85625 773.08125      772.78125      773.68125 773.83125      773.96875      774.45625 774.13125 774.78125  (Includes +30 MHz uplink channels)			
AACO	"In Case Of Problems" label and Retransmission Authorization posted at the headend and active equipment			
<b>OIT SIGNATURE</b>				
The signature below confirms that the undersigned Anne Arundel County Office of Information Technology representative has witnessed and/or conducted successful testing and inspection of the Public Safety Bi-Directional Amplifier System at the above captioned occupancy.				
Print Name:		Signed:		Date:

## Appendix A - System Technical Criteria

Public safety agencies operating in Anne Arundel County utilize the County's 22 site, twelve channel Motorola ASTRO25 P25 Phase 2 TDMA 800 MHz simulcast trunked radio system and the Maryland FiRST statewide 700 MHz simulcast trunked radio when operating in Anne Arundel County.

Integrators shall design and configure BDA/DAS equipment to pass the frequencies that are currently used in the County's Motorola ASTRO25 P25 Phase 2 TDMA 800 MHz simulcast trunked radio system, and the MD FiRST 700 MHz system. Each system shall be designed and configured for balanced uplink/downlink path operation. All passive and active components used in the BDA/DAS shall provide equal uplink/downlink levels of insertion loss, passive gain or active gain. It is strongly recommended that BDA equipment deployed in Anne Arundel County be configured for Class B broadband operation to ensure compliance with the County's  $\leq 8\mu\text{s}$  propagation delay requirement. Channelized systems are permitted, provided that the propagation delay does not exceed  $8\mu\text{s}$ .

The following system technical data is provided to assist two-way radio communications enhancement system designers.

1. **Radio coverage requirements:** see Table 1.
2. **Isolation:** A minimum of 20 dB isolation, or greater if required by the equipment manufacturer, shall be provided between the donor antenna and the service antennas inside of the building.
3. **Delay:** Total propagation delay introduced by the system shall not exceed  $8\mu\text{s}$ .
4. **Frequency Configuration:**

*Table 2 - Class B 700/800 MHz Frequency Configuration*

Band	Uplink	Downlink
800 MHz	806-816 MHz	851-861 MHz
700 MHz	799-805 MHz	769-775 MHz

Table 3 - System Frequencies

System	Channel	Downlink	Uplink
AACO	1 (Pri. CC)	851.1375	806.1375
AACO	2 (CC)	853.3250	808.3250
AACO	3 (CC)	852.6875	807.6875
AACO	4 (CC)	854.5125	809.5125
AACO	5	853.8375	808.8375
AACO	6	854.7125	809.7125
AACO	7	854.1875	809.1875
AACO	8	855.8375	810.8375
AACO	9	856.0125	811.0125
AACO	10	856.1625	811.1625
AACO	11	856.4125	811.4125
AACO	12	856.5125	811.5125
MD FIRST AACO SIMULCAST CELL	1	774.13125	804.13125
MD FIRST AACO SIMULCAST CELL	2 (CC)	773.83125	803.83125
MD FIRST AACO SIMULCAST CELL	3	773.08125	803.08125
MD FIRST AACO SIMULCAST CELL	4	772.43125	802.43125
MD FIRST AACO SIMULCAST CELL	5	771.45625	801.45625
MD FIRST AACO SIMULCAST CELL	6	770.45625	800.45625
MD FIRST AACO SIMULCAST CELL	7	769.50625	799.50625
MD FIRST AACO SIMULCAST CELL	8	774.78125	804.78125
MD FIRST GREENBURY POINT ASR	1	769.26875	799.26875
MD FIRST GREENBURY POINT ASR	2	770.76875	800.76875
MD FIRST GREENBURY POINT ASR	3	771.31875	801.31875
MD FIRST GREENBURY POINT ASR	4	771.70625	801.70625
MD FIRST GREENBURY POINT ASR	5 (CC)	772.78125	802.78125
MD FIRST GREENBURY POINT ASR	6	773.96875	803.96875
MD FIRST TRACY'S LANDING ASR	1	771.15625	801.15625
MD FIRST TRACY'S LANDING ASR	2	771.88125	801.88125
MD FIRST TRACY'S LANDING ASR	3	772.23125	802.23125
MD FIRST TRACY'S LANDING ASR	4	772.85625	802.85625
MD FIRST TRACY'S LANDING ASR	5 (CC)	773.68125	803.68125
MD FIRST TRACY'S LANDING ASR	6	774.45625	804.45625

## 5. Site Information:

Table 4 – Anne Arundel County 800 MHz Site Information

Anne Arundel County ASTRO25 TDMA 800 MHz Site Locations								
Site	Lat deg	Lon deg	Site AMSL'	TX Antenna	Gain dBd	Az deg	HTC'	ERP W
Arnold Wells	39° 02' 13.10" N	76° 28' 55.27" W	122.0	Sinclair SC412-HF2LDF(D02-E5765)	11.5	0	266	278.6
Arundel Center	38° 58' 45.79" N	76° 29' 41.33" W	34.00	RFI CC807-09-T2	9.0	0	68	186.2
Arundel VFD	38° 59' 18.85" N	76° 40' 13.47" W	161.2	Sinclair SC412-HF2LDF(D02-E5765)	11.5	0	266	278.6
Broad Creek	38° 58' 48.84" N	76° 33' 59.42" W	104.0	Sinclair SC412-HF2LDF(D02-E5765)	11.5	0	584	160.3
Brooklyn Park	39° 13' 19.08" N	76° 36' 43.83" W	141.6	RFI COL-811-870	9.0	0	160	196.3
Crownsville	39° 00' 43.69" N	76° 36' 14.53" W	163.7	RFS/Bogner BMR12-A	14.3	45	440	381.9
Davidsonville	38° 54' 13.13" N	76° 39' 01.06" W	110.4	Sinclair SC412-HF2LDF(D02-E5765)	11.5	0	266	278.6
Eastern	39° 07' 30.88" N	76° 31' 29.11" W	120.0	Sinclair SC412-HF2LDF(D02-E5765)	11.5	0	307	263.6
Friendship	38° 44' 41.12" N	76° 35' 16.01" W	145.4	Sinclair SC412-HF2LDF(D02-E5765)	11.5	0	266	278.6
Gambrills	39° 01' 54.25" N	76° 41' 34.10" W	110	Sinclair SC412-HF2LDF(D02-E5765)	11.5	0	354	242.1
Glebe Heights	38° 54' 57.69" N	76° 32' 25.68" W	103.7	Sinclair SC412-HF2LDF(D02-E5765)	11.5	0	181	278.6
Greenbury	38° 58' 44.50" N	76° 27' 15.20" W	13.78	RFS BMR12-A	14.3	315	410	417.8
Hotel District	39° 11' 58.23" N	76° 40' 55.4" W	221.5	RFI COL-811-870	9.0	0	64	222.8
Jessup	39° 08' 14.23" N	76° 45' 13.95" W	256.0	Sinclair SC412-HF2LDF(D02-E5765)	11.5	0	251	286.4
MD City	39° 05' 31.01" N	76° 48' 37.81" W	296.9	RFS BMR10-O	10.0	0	93.5	274.2
Millersville	39° 05' 56.08" N	76° 37' 20.37" W	101.0	Sinclair SC412-HF2LDF(D02-E5765)	11.5	0	306	263.6
Northern PD	39° 12' 31.30" N	76° 38' 27.60" W	154.8	Sinclair SC412-HF2LDF(D02-E5765)	11.5	0	170	334.2
Piney Orchard	39° 04' 41.31" N	76° 42' 43.47" W	169.5	Sinclair SC412-HF2LDF(D02-E5765)	11.5	0	179	331.1
Shipley	39° 09' 16.30" N	76° 42' 58.08" W	198.1	RFS BMR12-H	15.4	315	121	812.8
Solley	39° 10' 50.00" N	76° 32' 59.10" W	102.7	Sinclair SC412-HF2LDF(D02-E5765)	11.5	0	406	220.8
Sudley	38° 48' 47.91" N	76° 34' 42.24" W	118.0	Sinclair SC412-HF2LDF(D02-E5765)	11.5	0	482	190.5
Waysons	38° 47' 45.57" N	76° 40' 48.21" W	130.7	Sinclair SC412-HF2LDF(D02-E5765)	11.5	0	266	283.1



Table 5 - State of Maryland 700 MHz System Site Information

State of Maryland ASTRO25 TDMA 700 MHz Site Locations								
Site	Lat deg	Lon deg	Site AMSL '	TX Antenna	Gain dBd	Az deg	HTC'	ERP W
Sandy Point AA Simulcast	39° 01' 13.50" N	76° 24' 32.7" W	19.6		10.0	280	165	350.0
Solley AA Simulcast	39° 10' 50.00" N	76° 32' 59.10" W	102.7		12.0	210	315	512.9
Armory AA Simulcast	38° 59' 10.0" N	76° 31' 59.0" W	78.7		7.0	0	220	278.6
Crownsville AA Simulcast	39° 00' 44.4" N	76° 36' 12.9" W	180.0		8.0	300	307	218.0
BWI AA Simulcast	39° 11' 18.3" N	76° 40' 33.4" W	141.0		8.0	0	116	290.0
Millersville AA Simulcast	39° 05' 54.4" N	76° 37' 31.9" W	97.4		7.0	0	440	290.4
Millersville AA Simulcast	38° 54' 13.13" N	76° 39' 01.06" W	110.4		8.0	0	155	499.0
Greenbury Point ASR	38° 58' 44.5" N	76° 27' 15.2" W	14.0		5.0	270	325	130.0
Tracy's Landing ASR	38° 47' 08.1" N	76° 35' 54.4" W	99.0		7.0	0	310	158.5

## Appendix B – 47CFR90.219, FCC rules governing use of Signal Boosters

### §90.219 Use of signal boosters.

This section contains technical and operational rules allowing the use of signal boosters in the Private Land Mobile Radio Services (PLMRS). Rules for signal booster operation in the Commercial Mobile Radio Services under part 90 are found in §20.21 of this chapter.

(a) *Definitions.* The definitions in this paragraph apply only to the rules in this section.

*Class A signal booster.* A signal booster designed to retransmit signals on one or more specific channels. A signal booster is deemed to be a Class A signal booster if none of its passbands exceed 75 kHz.

*Class B signal booster.* A signal booster designed to retransmit any signals within a wide frequency band. A signal booster is deemed to be a Class B signal booster if it has a passband that exceeds 75 kHz.

*Coverage area of a PLMRS station.* All locations within the normal reliable operating range (service contour) of a PLMRS station.

*Deploy a signal booster.* Install and/or initially adjust a signal booster.

*Distributed Antenna System (DAS).* A network of spatially separated antenna nodes connected to a common source via a transport medium that provides wireless service within a geographic area or structure.

*Operate a signal booster.* Maintain operational control over, and responsibility for the proper functioning of, a signal booster.

*Signal booster.* A device or system that automatically receives, amplifies, and retransmits signals from wireless stations into and out of building interiors, tunnels, shielded outdoor areas and other locations where these signals would otherwise be too weak for reliable communications. Signal booster systems may contain both Class A and Class B signal boosters as components.

(b) *Authority to operate.* PLMRS licensees for stations operating on assigned channels higher than 150 MHz may operate signal boosters, limited to the service band for which they are authorized, as needed anywhere within the PLMRS stations' service contour, but may not extend the stations' service contour.

(1) PLMRS licensees may also consent to operation of signal boosters by non-licensees (such as a building owner or a signal booster installation

contractor) within their service contour and across their applicable frequencies, but must maintain a reasonable level of control over these operations in order to resolve interference problems.

(i) Non-licensees seeking to operate signal boosters must obtain the express consent of the licensee(s) of the frequencies for which the device or system is intended to amplify. The consent must be maintained in a recordable format that can be presented to an FCC representative or other relevant licensee investigating interference.

(ii) Consent is not required from third party (unintended) licensees whose signals are incidentally retransmitted. However, signal booster operation is on a non-interference basis and operations may be required to cease or alter the operating parameters due to a request from an FCC representative or a licensee's request to resolve interference.

(2) [Reserved]

(c) *Licensee responsibility; interference.* PLMRS licensees that operate signal boosters are responsible for their proper operation, and are responsible for correcting any harmful interference that signal booster operation may cause to other licensed communications services. Normal co-channel transmissions are not considered to be harmful interference. Licensees are required to resolve interference problems pursuant to §90.173(b). Licensees shall act in good faith regarding the operation of signal boosters and in the resolution of interference due to signal booster operation. Licensees who are unable to determine the location or cause of signal booster interference may seek assistance from the FCC to resolve such problems.

(d) *Deployment rules.* Deployment of signal boosters must be carried out in accordance with the rules in this paragraph.

(1) Signal boosters may be used to improve coverage in weak signal areas only.

(2) Signal boosters must not be used to extend PLMRS stations' normal operating range.

(3) Signal boosters must be deployed such that the radiated power of each retransmitted channel, on the forward link and on the reverse link, does not exceed 5 Watts effective radiated power (ERP).

(4) Class B signal boosters may be deployed only at fixed locations; mobile operation of Class B signal boosters is prohibited after November 1, 2014.

(5) Class B signal booster installations must be registered in the FCC signal booster database that can be accessed at the following URL:

[www.fcc.gov/signal-boosters/registration](http://www.fcc.gov/signal-boosters/registration).

- (6) Good engineering practice must be used in regard to the radiation of intermodulation products and noise, such that interference to licensed communications systems is avoided. In the event of harmful interference caused by any given deployment, the FCC may require additional attenuation or filtering of the emissions and/or noise from signal boosters or signal booster systems, as necessary to eliminate the interference.
- (i) In general, the ERP of intermodulation products should not exceed  $-30$  dBm in 10 kHz measurement bandwidth.
  - (ii) In general, the ERP of noise within the passband should not exceed  $-43$  dBm in 10 kHz measurement bandwidth.
  - (iii) In general, the ERP of noise on spectrum more than 1 MHz outside of the passband should not exceed  $-70$  dBm in a 10 kHz measurement bandwidth.
- (7) Signal booster passbands are limited to the service band or bands for which the operator is authorized. In general, signal boosters should utilize the minimum passband that is sufficient to accomplish the purpose. Except for distributed antenna systems (DAS) installed in buildings, the passband of a Class B booster should not encompass both commercial services (such as ESMR and Cellular Radiotelephone) and part 90 Land Mobile and Public Safety Services.
- (e) *Device Specifications.* In addition to the general rules for equipment certification in §90.203(a)(2) and part 2, subpart J of this chapter, a signal booster must also meet the rules in this paragraph.
- (1) The output power capability of a signal booster must be designed for deployments providing a radiated power not exceeding 5 Watts ERP for each retransmitted channel.
  - (2) The noise figure of a signal booster must not exceed 9 dB in either direction.
  - (3) Spurious emissions from a signal booster must not exceed  $-13$  dBm within any 100 kHz measurement bandwidth.
  - (4) A signal booster must be designed such that all signals that it retransmits meet the following requirements:
    - (i) The signals are retransmitted on the same channels as received. Minor departures from the exact provider or reference frequencies of the input signals are allowed, *provided that* the retransmitted signals meet the requirements of §90.213.

- (ii) There is no change in the occupied bandwidth of the retransmitted signals.
  - (iii) The retransmitted signals continue to meet the unwanted emissions limits of §90.210 applicable to the corresponding received signals (assuming that these received signals meet the applicable unwanted emissions limits by a reasonable margin).
- (5) On or after March 1, 2014, a signal booster must be labeled to indicate whether it is a Class A or Class B device, and the label must include the following advisory
- (1) In on-line point-of-sale marketing materials,
  - (2) In any print or on-line owner's manual and installation instructions,
  - (3) On the outside packaging of the device, and
  - (4) On a label affixed to the device:

“WARNING. This is NOT a CONSUMER device. It is designed for installation by FCC LICENSEES and QUALIFIED INSTALLERS. You MUST have an FCC LICENSE or express consent of an FCC Licensee to operate this device. You MUST register Class B signal boosters (as defined in 47 CFR 90.219) online at [www.fcc.gov/signal-boosters/registration](http://www.fcc.gov/signal-boosters/registration). Unauthorized use may result in significant forfeiture penalties, including penalties in excess of \$100,000 for each continuing violation.”

[78 FR 21564, Apr. 12, 2013]