



# TCOMM911 IN-BUILDING ERCES DESIGN APPROVAL PROCESS

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# TCOMM911 IN-BUILDING ERCES DESIGN APPROVAL PROCESS

## Definitions

AGC - Automatic Gain Control.

AHJ - Authority Having Jurisdiction.

BDA – Bi-Directional Amplifier receives, amplifies, and broadcasts radio signal back and forth from a radio site allowing re-transmission using a DAS inside a building.

DAQ - Delivered Audio Quality.

DAS – Distributed Antenna System are the antennas located throughout a building that connect to a BDA allowing two-way communication using an external radio network.

dB: A method for specifying the ratio of two signals, which is equal to 10 times the log of the ratio of the power of the two signals.

dBd: Power ratio in decibels of a signal compared to a reference dipole (defined as 2.15 dBi).

dBi: Power ratio in decibels of a signal compared to an isotropic radiator.

dBm: Power ratio in decibels of the measured power referenced to one milliwatt.

DL – Downlink is the link from the radio system to the end user.

ERCES – Emergency Radio Communication Enhancement System, also referred to as BDA/DAS, or DAS.

ERP - Effective Radiated Power.

FCC Class A - A signal booster is deemed to be a Class A signal booster if none of its passbands exceed 75kHz.

FCC GROL - General Radiotelephone Operator License.

P25 Phase 2 - A suite of standards focusing on interoperable radio communications. Phase 2 is time-division multiple access (TDMA).

TCERN – Thurston County Emergency Radio Network - The new P25 digital radio network for first responders.

TCOMM911 – Thurston 911 Communications - The agency that owns and operates the TCERN system infrastructure and 911 emergency dispatch center.

TCOMM911 Radio Systems Department – The radio department is responsible for the system performance of TCERN.

TDI - Time Domain Interference.

UL - Uplink is the link between the end user and the radio system.



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## Design Approval Process

### 1.1. Purpose

Thurston 911 Communication (TCOMM911) has instituted design review and approval for in-building ERCES (Emergency Radio Communication Enhancement Systems, also referred to as BDA/DAS or DAS) operating within Thurston County to:

- Better integrate radio operator approval with fire AHJ approval processes.
- Verify adherence to TCOMM911 technical criteria and the uplink validation process. See the appendix for links to supplemental documentation.
- Reduce risk to property developers and ERCES vendors when commissioning ERCES.

### 1.2. Limitation of Authority

Successful completion of the TCOMM911 design approval process does not preclude or guarantee approval by the local fire code authority, building authority, or any other authority having jurisdiction.

### 1.3. TCOMM911 ERCES Design Submittal Process

ERCES design submittals (refer to section 2) are submitted to TCOMM911 via email to [RadioHelpDesk@tcomm911.org](mailto:RadioHelpDesk@tcomm911.org).

Upon receipt, TCOMM911 will:

- Review the submittal for conformance to this document as well as the TCOMM911 technical criteria document.
- Document the review using the ERCES Design Checklist.
- Report status and send a copy of the ERCES Design Checklist to the submitter.
- Deficiencies, if any, will be documented in the checklist. Requests for modification of design documentation will be made via email to the submitter.
- Approval of design documentation will be communicated via a signed checklist sent by email to the submitter.

### 1.4. Design Changes After Approval

Reapproval is required for any design changes materially impacting RF propagation or system performance. Resubmittals should be made as a new request by email to [RadioHelpDesk@tcomm911.org](mailto:RadioHelpDesk@tcomm911.org). A copy of the previously granted approval must be included. Examples of changes requiring reapproval include but are not limited to:



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- Substitution of active (powered) ERCES components.
- Relocation of the donor antenna.
- Orientation of the donor antenna to a different donor site.
- Relocation of a ERCES service antenna more than 10 feet.
- Link budget adjustment due to changes in directional couplers, splitters, tappers, or the addition or removal of more than 50' of coaxial cable.

## 1.5. Next Steps Following Design Approval

Following receipt of design approval, ERCES vendors will:

- Install ERCES.
- Obtain signatures from property owner/developer on rebroadcast agreement.
- Obtain test radios from TCOMM911.
- Perform and submit the Uplink Validation checklist.
- Schedule Uplink Validation with TCOMM911 technical staff.
- Demonstrate Uplink Validation performance.

Note that design approval from TCOMM911 is not a substitute for building permits that may be required.

Upon satisfactory completion, TCOMM911 will execute a rebroadcast agreement with the property owner.

## Design Submittal Requirements

### 2.1. Transmittals

Transmittals will be submitted via the service portal and must include a point of contact for response to this request.

Documents must be submitted in a flattened (non-editable) PDF format using a secure cloud storage service such as Box, OneDrive, DropBox, Google Drive, etc.

Submittals must include the following:

1. ERCES designer qualifications (NICET In-Building Public Safety Communications (IB-PSC) Certified).
2. ERCES construction floor plans.



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3. ERCES donor antenna information (make, model, RF parameters, etc.).
4. ERCES one-line diagram.
5. ERCES equipment list.
6. ERCES equipment cut sheets for each component.
7. ERCES performance calculations.
8. ERCES coverage predictions using industry recognized software like iBwave.
9. A fully executed TCOMM911 Rebroadcast agreement.

All documentation must comply with the following requirements:

- Documents should follow ASME or ISO standards and must be of sufficient quality and free of extraneous markings to be legible.
- Color is permitted but documents must be legible in grayscale.

## **Transmittal Details**

### **2.2. ERCES Designer Qualifications**

In addition to the FCC GROL and a certificate issued by the manufacturer of the equipment being installed, TCOMM911 highly recommends that ERCES designers have a NICET In-Building Public Safety Communications (IB-PSC) Certification.

#### Pass/Fail Criteria:

- Proof of certification must be included.

### **2.3. ERCES Construction Floor Plans**

All drawings:

- Must match the same orientation.
- Documentation must follow ASME or ISO drafting standards and be legible to distinguish items. Hand drawn floor plans will not be accepted.
- Must show the location with unique labels of each cable, splitter, coupler, tapper, antenna, BDA, fiber-fed remote, and donor antenna.

#### Pass/Fail Criteria:

- Drawings must conform to requirements.



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## 2.4. ERCES Donor Antenna Information

TCOMM911 will specify the donor site to be used. If, for any reason, there are questions regarding donor site selection, please contact TCOMM911 at [RadioHelpDesk@tcomm911.org](mailto:RadioHelpDesk@tcomm911.org).

ERCES donor information must be submitted as one of the construction floor plans, conforming to the requirements in 3.3. When considering a ERCES and radio coverage, please consider the following from the TCOMM911 technical criteria:

ERCES donor information shall include the following:

- Google Earth elevation profile between building location and specified donor site (TCOMM911 retains the right to require use of an alternate donor site).
- Straight-line distance to the donor site.
- Google Earth 1/4 mile surroundings view with donor azimuth indicated.
- Indication on roof floor plan of proposed donor location.

### Pass/Fail Criteria:

- All items must be present.
- Donor line of sight shall be unobstructed, or explanation shall be provided as to why obstructed line of sight is the best choice.

## 2.5. ERCES One-Line Diagram

ERCES one-line diagram(s) must be submitted as one of the construction floor plans, conforming to the requirements in 3.3.

ERCES one-line diagram(s) must show interconnection of all system components displayed on a building elevation.

### Pass/Fail Criteria

- All items must be present.

## 2.6. ERCES Equipment List

ERCES equipment list shall include the following components if present:

- BDA.
- Fiber head-end.
- Fiber-fed remote.



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- Fiber jumpers and connectors.
- Coaxial cable.
- Donor antenna.
- ERCES/Service antennas.
- Lightning arrestor.
- Splitters/Couplers/Tappers.
- External filters.

For each component in the equipment list, provide:

- Manufacturer.
- Model number.
- Options or Licenses as appropriate.
- Quantity.
- Unit (if length of cable).

### Pass/Fail Criteria

- All items must be present.

## **2.7. ERCES Equipment Cut Sheets**

Manufacturer information sheets shall be provided for each item on the ERCES equipment list. Any effort to minimize sales literature and only provide RF transmission equipment specifications is appreciated.

Conformance to the TCERN ERCES Technical Criteria (see appendix) will be demonstrated through the equipment cut sheets. Mark up documents with boxes or arrows to describe how these are met.

### Pass/Fail Criteria:

- All items must be present.

## **2.8. ERCES Coverage Predictions**

- Conforming to the requirements in 3.3, provide coverage predictions using industry standard tools like iBwave for each floor and area receiving ERCES coverage on individual floorplans.





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- Provide a legend for the prediction color code, including the percent of floor area receiving at least the indicated level of signal.
- Any portion of the building where coverage is planned to be provided by either through-floor signal or macro coverage must be clouded and noted. Through-floor coverage notation must also describe the material composition of the floor and the expected attenuation.

### Pass/Fail Criteria:

- All items must be present.
- Minimum downlink signal strength of -95dBm in 95% of coverage area, and 99% of critical areas.

### **TCOMM911 Rebroadcast Agreement**

Attach a completed rebroadcast agreement signed and dated by the property owner.

### Pass/Fail Criteria:

- Completed rebroadcast agreement submitted.

### **References**

**TCOMM911 In-Building ERCES Technical Criteria** available at <https://tcomm911.org/in-building-ERCES-resources/>

#### **FCC 90.219**

<https://www.law.cornell.edu/cfr/text/47/90.219>

#### **NFPA 1221**

<https://www.nfpa.org/codes-and-standards/nfpa-1221-standard-development/1221>

#### **TIA Project 25**

[http://standards.tiaonline.org/standards/technology/project\\_25/index.cfm](http://standards.tiaonline.org/standards/technology/project_25/index.cfm)

#### **TSB-88.1-E**

[https://global.ihc.com/doc\\_detail.cfm?document\\_name=TIA%20TSB%2D88%2E1&item\\_s\\_key=00504960](https://global.ihc.com/doc_detail.cfm?document_name=TIA%20TSB%2D88%2E1&item_s_key=00504960)

#### **WAC 51-54A-0510 – Emergency Responder Communication Coverage**

<https://app.leg.wa.gov/wac/default.aspx?cite=51-54A-0510#:~:text=The%20building%20shall%20be%20considered,building%20meet%20the%20signal%20strength>



# TCOMM911 IN-BUILDING ERCES DESIGN APPROVAL PROCESS

## Appendix A – TERN ERCES Technical Criteria

### Definitions

BDA	Bi-Directional Amplifier. Sends and receives radio signals from an external radio network
DAS	Distributed Antenna System. Antennas inside a building connected to a Signal Booster to facilitate in-building radio communications
DAQ	Digital Audio Quality – A measure of understandability of a digital radio transmission
ERCES	Emergency Responder Communication Enhancement System (Often referred to as a BDA/DAS)
FCC	Federal Communications Commission. Responsible for radio frequency management nationally
NFPA 1221	National Fire Protection Agency
TCERN	Thurston County Emergency Radio Network – Digital P25 Phase 2 radio network providing radio communications to emergency services in Thurston County
TCOMM911	Owner and operator of TCERN
WAC	Washington Administrative Code

### Implementation Date

The date of compliance to the technical criteria defined in this document is **September 1, 2024**.

### Standards

The technical criteria in this document complies with the latest edition of the following codes and standards:

FCC 47 CFR 90.219 – Use of Signal Boosters

NFPA 1221 - Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems

WAC 51-54A-0510 - **Emergency responder communication coverage**



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## Signal Booster Specifications

For **new** Signal Booster, either due to new construction or retrofits/repairs:

- The Signal Booster must be capable of FCC Class A channelized operation.
- Segregation of cellular and public safety signals is required at every component and signal distribution level.
- The uplink signal from the ERCES donor antenna to a donor RF site shall be no stronger than 20dB above the donor site noise floor (-95dBm to -105dBm) as measured at the receiver of the RF donor site.
- All repeaters, transmitters, receivers, signal-booster components, remote annunciators and operational consoles, power supplies, and battery charging system components shall be listed and labeled in accordance with UL 2524, Standard for In Building 2-Way Emergency Radio Communications Enhancement Systems.
- For ERCES projects requesting design approval after September 1, 2024, the Signal Booster shall support AGC. AGC will be fast enough to prevent the near-far effect of a strong signal from an in-building DAS antenna making it hard for a receiver to hear a weaker signal from a radio site on the external macro P25 network. This could be due to adjacent-channel interference, co-channel interference, distortion, capture effect, dynamic range limitation, or similar.
- The Signal Booster must be equipped with uplink squelch.
- The Signal Booster must be equipped with per filter Automatic Gain Control/Automatic Level Control.
- The Signal Booster must be equipped with anti-oscillation monitoring.
- The Signal Booster must be equipped with a web-based graphical user interface for control and configuration.

## Signal Booster Configuration

- If a donor antenna exists, isolation shall be maintained between the donor antenna and all inside antennas to a minimum of 20dB above system gain.
- Signal Booster filters shall be programmed with a maximum of 3 channels per filter.
- All **TCOMM911** frequencies relevant for the installation location shall be programmed into the Signal Booster. Frequency lists will be provided on a case-by-case basis by TCOMM911.
- Signal Booster uplink squelch settings shall be at least 5dB greater than DAS uplink input noise floor.



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## Donor Antenna

- Donor antenna shall be a directional antenna.
  - Donor antenna frequency range shall support the 700MHz public safety band, 769-805 MHz.
- For all ERCES projects requesting design approval after September 1, 2024, the donor antenna must comply with the following specifications:
  - A horizontal beamwidth of 30 degrees or less.
  - A vertical beamwidth of 30 degrees or less.
  - Front to back ratio of 20db or greater.
- The Donor antenna must be permanently installed and oriented with an unobstructed view of one donor site. This criterion is concerned principally with near field obstructions such as parapets, HVAC units, ducting, screen walls, etc. Other obstructions in the line of sight, such as buildings, will be considered by personnel authorized by TCOMM911 during uplink validation.
- The Donor antenna must be oriented to the site specified by TCOMM911.
- Filters may be required to mitigate the effects of nearby saturating cellular signals or other saturating signals identified at the site.

## Fiber DAS

- TCOMM 911 recommends that campus and multi-building developments minimize the number of over-the-air BDAs by using fiber DAS.
- For ERCES projects requesting design approval after September 1, 2024, TCOMM 911 recommends that DAS added to campuses or developments, with the characteristics noted below, should incorporate the new building's DAS into the fiber ERCES, rather than adding a new Signal Booster.
  - Existing DAS infrastructure within 1000', as determined by the two nearest points of the buildings,
  - Ownership of the land between the buildings, or,
  - An active easement supporting telecommunications infrastructure to cross a throughfare or other property.

## Signal Testing

- Max per channel donor site uplink receive level shall be less than -80dBm at input to radio.



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- Donor site uplink receive noise floor contribution, as viewed by a spectrum analyzer at the repeater multi-coupler, shall be minimal (i.e. less than 1dB).
- Upon request from -TCOMM911, -the building owner shall demonstrate to the fire code authority that ERCES is necessary to achieve successful public safety radio communications at the property. If the fire code official determines necessity has not been demonstrated, TCOMM911 may deny permission to rebroadcast the TCERN signal at the property.

## **Installation Workmanship**

Prior to Uplink Validation:

- The donor antenna must be permanently installed and aligned.
- All interior antennas must be installed and connected.
- All active components must be installed per manufacturer's guidelines and configured for operation.

## **Donor Sites**

- See "Technical Criteria Frequencies and Donor Sites."

## **Frequency Tables**

- See "Technical Criteria Frequencies and Donor Sites."

## **System Performance**

- Maximum Propagation delay of the ERCES (signal booster system) shall be 18us microseconds, or as otherwise approved by TCOMM911.
- Should the maximum propagation delay be exceeded within the building, there shall be a minimum differential of 18 dB between the signal a portable radio receives from the signal booster and the signal a portable radio receives from the macrosystem.
- The downlink gain of the signal booster shall be optimized such that the indoor distribution antennas do not transmit more power than required to prevent bleeding of RF outside the building.
- Macrosystem dominance will be tested at 3 feet from entrance and emergency egresses.
- Exterior DAQ will be tested with the ERCES operational to ensure communications outside the building are not degraded. DAQ of less than 3.0 with the ERCES operational will not be accepted.

## **Process**

- ERCES vendors must receive a copy of the signed re-broadcast agreement between the property owner and TCOMM911 prior to turning on the ERCES to begin system commissioning and



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optimization. All ERCES commissioning and optimization activities must be carried out without transmitting on or otherwise connecting to TCERN.

- Permission to transmit on or connect to TCERN will not be granted until UL validation is complete, and a Rebroadcast Agreement is signed with TCOMM911.