



Emergency Responder Communication Enhancement Systems (ERCES)

Tom Doyle – Vice Chairman APCO Spectrum & Technology Committee

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ERCES

- Definition and History
- Components
- Key Stakeholders – AHJ & FCC License Holder
- National and Local Code Requirements
- Radio network interference minimization
- ERCES Trends
- Best 3rd-party sources for more information

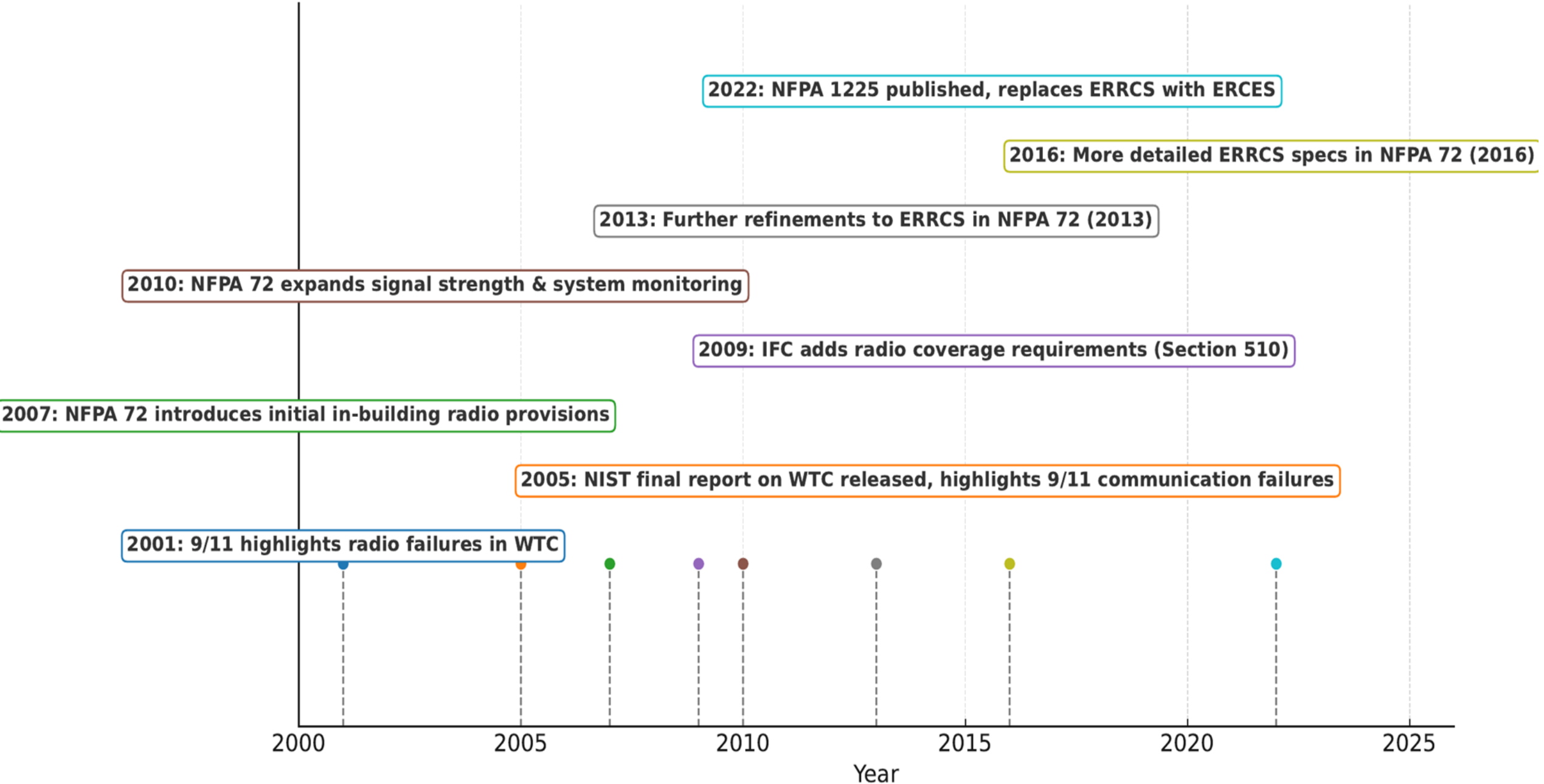
Spectrum & Technology Committee

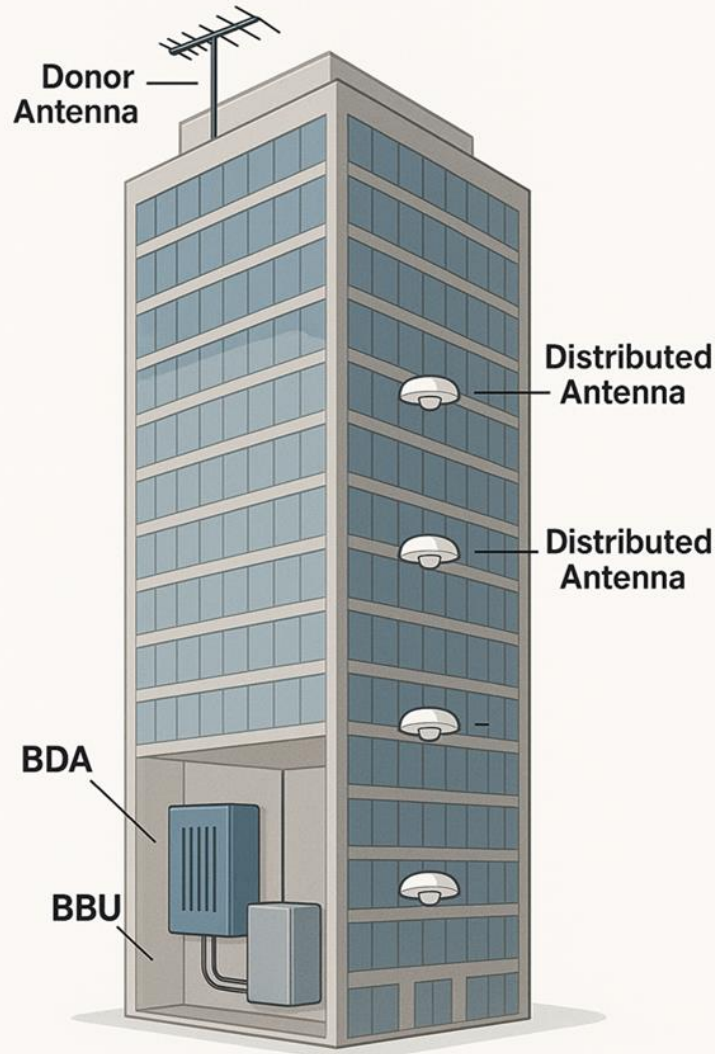
- This presentation is the output from the APCO Spectrum & Technology Committee's monthly meeting and Goal 1 Group tasked with: "Provide members with information on Emergency Responder Communication Enhancement Systems (ERCES), also referred to as Bi-Directional Amplifiers (BDAs)."
- Spectrum & Technology Committee management
 - John Lemmon - Chairman
 - Christine Massengale – Group Leader
 - Farokh Latif – Staff Liaison
 - Stephen Devine – CTO APCO
- Group 1 Members:
 - Tom Doyle: Vice Chairman
 - Jesse Griggs: TN APCO
 - Nathan Jackson: Guilford Metro 911, NC
 - Joshua Mann: APCO Frequency Advisor, NH
 - Matt Franke: Captain, Butler County Sheriff's Office Communications Section Commander
 - Sean Douglas: PSERN Operator, Engineering Manager
 - Steve Ingram: CAD/MSAG Administrator, Town of Cary 911 Center
 - Mike Kionka: Engineer, DHSEM Colorado
 - Justin Shawley: Bus Dev Mgr, Datamark

ERCES – Definition

- ERCES = Emergency Responder Communication Enhancement System
- A system installed in buildings to ensure that public safety radio communications—used by fire, police, and other emergency personnel—are reliable and strong throughout the entire structure, including basements, stairwells, and other areas where signal reception is typically weak.
- AKA Public Safety Distributed Antenna System (DAS)

Timeline: Evolution from ERRCS to ERCES (2001-2022, incl. 2005 NIST Report)





MAJOR COMPONENTS OF AN ERCS

Components - Simple

Donor Antenna – Captures the radio signal from the public safety radio network outside of the building.

BDA – Bi-Directional Amplifier- Amplifies the radio signal in both directions. Usually co-located with Fire Alarm Panel System to which it interconnects for monitoring and alerting.

DAS – Distributed Antenna System. Interior service antennas Distributed around the building where there are radio dead zones.

BBU – Battery Back Up. Ensures the system operates during power Outage (12 or 24 hours based on code).

ERRCS Primary Components

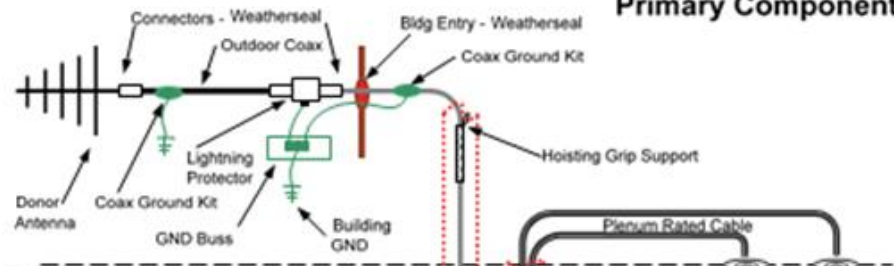


Figure 1A

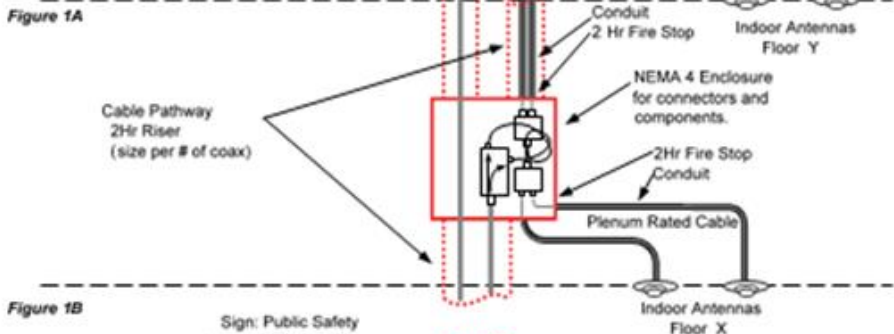
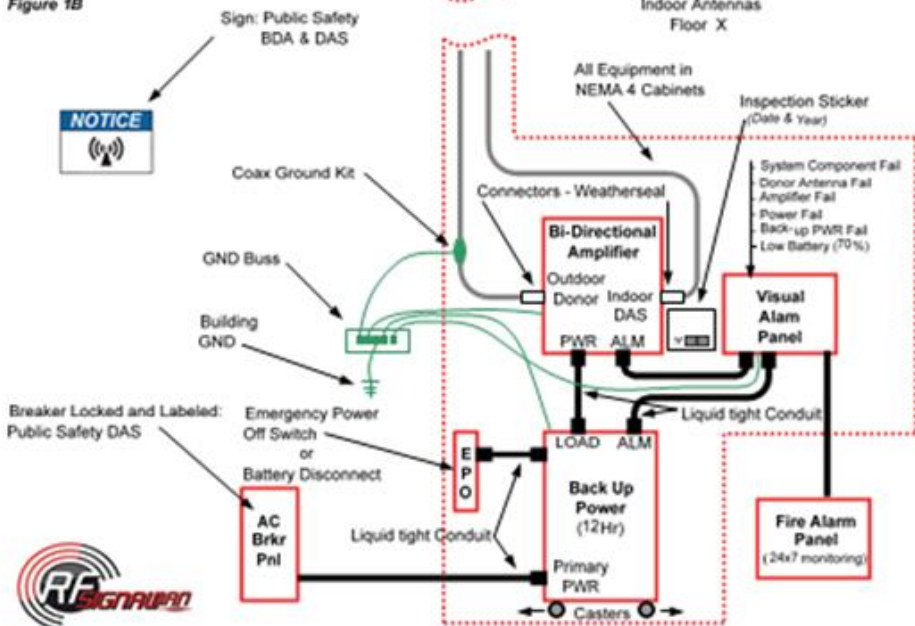


Figure 1B



Components - Advanced



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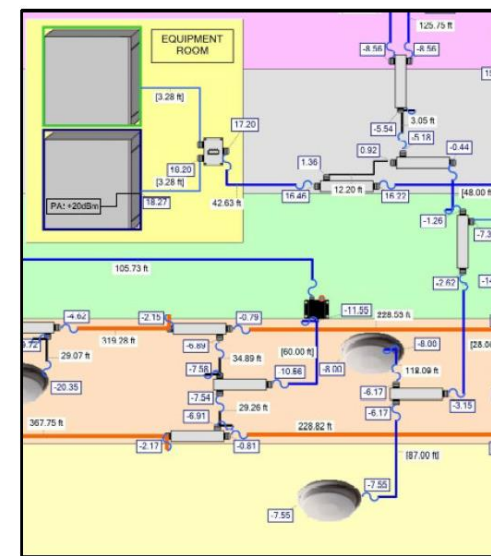
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Emergency Responder Radio Communications Systems (ERRCS) Technical Requirements

Version 2.0

Effective January 1st, 2024

Exhibit D – Link Budget Diagram Example



Key Stakeholders: AHJ & FCC License Holder

DAS RACI Matrix

Tasks Stakeholders	DAS technical criteria	Design DAS	DAS Authorization	DAS Installation Permit	Construct DAS	Commission DAS	Certificate of Occupancy	Maintain DAS
Building Owner	I	A	C	I	A	A	R	A
DAS Vendor	I	R	R	R	R	R	R	R
Fire Code Official	A	I	C	A	R	I	A	C
Frequency Licensee	R	I	A	I	I	R	I	C
Responsible - The people who take action to get the task done.				Accountable - The person who owns the task or deliverable. (Who will be held accountable?)				
Consulted - The group(s) who will help complete the task.				Informed - The group(s) that need to be up to date on the task's progress.				

AHJ –
Authority
Having
Jurisdiction =
Fire Code
Official

FCC
Licensee

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Authority Having Jurisdiction (AHJ)

◆ AHJ (Authority Having Jurisdiction)

The AHJ is typically the **local fire marshal** or **building department official** responsible for code enforcement. Their roles include:

Responsibility	Description
Code Compliance	Ensures ERCS is installed in accordance with NFPA 1225 , IFC , and local fire code requirements.
Coverage Verification	Requires and reviews radio signal coverage testing (grid test or 20-grid test) before and after installation.
System Approval	Approves system design, components, and installation methods—often requiring submittal of engineered plans.
Annual Inspections	May mandate annual recertification/testing of the system.
Survivability Enforcement	Enforces survivability standards (e.g., 2-hour fire-rated cable pathways in critical areas).
Right to Disable	Can order shutdown or correction of a system that causes harmful interference or doesn't meet public safety requirements.

In most jurisdictions, the AHJ works in the Fire Department.

FCC Licensee Holder

◆ FCC License Holder (Typically the Public Safety Radio System Owner)

This is the entity (usually the local government or public safety agency) that holds the license to operate the public safety radio frequencies used inside the building via the ERCES. Their roles include:

Responsibility	Description
Frequency Authorization	Grants permission to rebroadcast their licensed frequencies inside the building. This is required under FCC Part 90 rules.
Signal Integrity	Ensures that the ERCES does not interfere with the public safety radio system (no noise, oscillation, or feedback).
Final Sign-Off	May require testing to validate that their network is not degraded and may need to approve or witness acceptance testing.
Revocation Rights	Has the right to request shutdown of a system causing interference to their network.
No Re-Radiation Without Approval	FCC regulations (Part 90.219) make it illegal to amplify or retransmit a public safety frequency without express approval from the license holder.

In most jurisdictions, the FCC License Holder is the City/County radio organization.

AHJ vs FCC License Holder

Summary Table

Role	AHJ	FCC License Holder
Enforces code?	✓ Yes (NFPA/IFC)	✗ No
Grants frequency use?	✗ No	✓ Yes
Approves system design?	✓ Yes	Often involved or consulted
Performs inspections?	✓ Yes (initial + periodic)	Occasionally (for system impact)
Can shut system down?	✓ Yes (non-compliance)	✓ Yes (interference)
Legal authority source	Local jurisdiction/fire/building code	Federal license (FCC Part 90)

National and Local Code Requirements

- Many jurisdictions have written ERCES requirement documents that outline what codes are currently enforced, and other relevant information like required frequencies and radio transmit locations.
- The AHJ owns and enforces the code.
- Some jurisdictions don't have written requirements and will enforce the state fire code.
- APCO members should know the AHJ, the relevant code, and the existence or non-existence of a requirements document and the individual responsible for ERCES in the radio division.

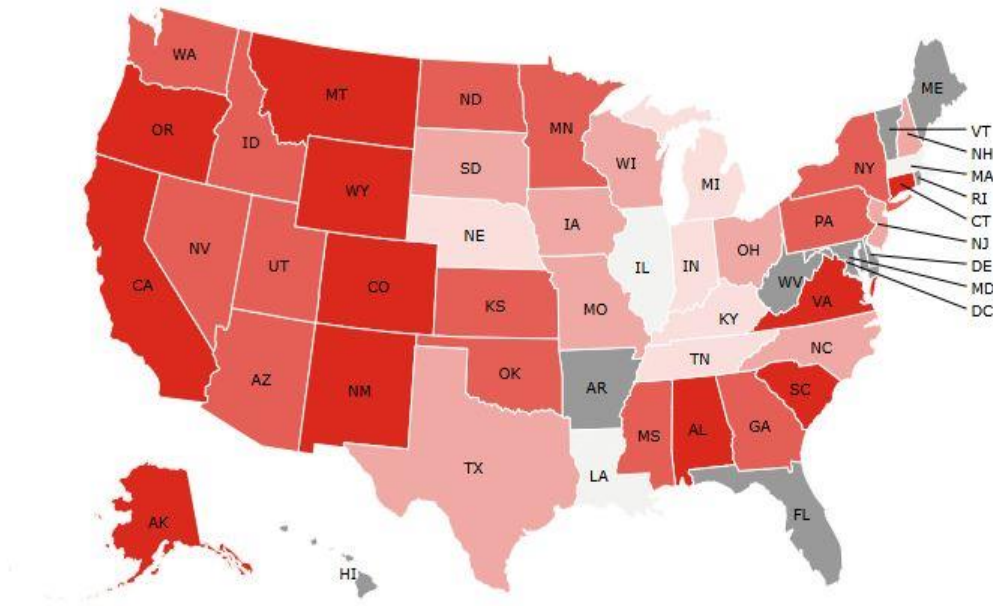
National and Local Code Requirements

- ERCES are defined by several national, state, and local codes.
 - Signal strength requirements, grid testing, cable pathway survivability, battery backup
 - Fire alarm supervision, annual testing requirements
 - Etcetera
- National
 - National Fire Protection Association (NFPA 1225)
 - International Fire Code (IFC Section 510)
 - Federal Communications Commission (FCC CFR Title 47, Part 90)
 - Underwriter's Laboratory (UL 2524)
- State
 - State Fire Commission
 - State Building Commission
- .Local
 - San Francisco Addendum G (e.g.)

IFC Code Adoption

INTERNATIONAL FIRE CODE® (IFC®)

ADOPTION MAP



MAP KEY

Edition of code currently in effect by state:

- 2021 IFC®
- 2018 IFC®
- 2015 IFC®
- 2012 IFC®
- 2009 IFC®
- Local Adoptions
- No state-wide IFC adoption

Adoption information is provided for states where the IFC is adopted statewide, adopted statewide for certain categories of buildings, or adopted by a state body to guide local code adoption.

IFC versus NFPA

Summary of Relationships

- IFC is the enforcement vehicle—it tells you *when* and *where* ERCES is required.
- NFPA 1221/1225 are technical standards—they tell you *how* to build and maintain those systems.
- IFC 2018 → NFPA 1221
- IFC 2021 → NFPA 1225

IFC 2018 (NFPA 1221) versus IFC 2021 (NFPA 1225)

Category	2018 IFC	2021 IFC
Terminology	ERRCS (Emergency Responder Radio Communication System)	ERCES (Emergency Responder Communication Enhancement System)
Signal Strength Requirements	-95 dBm minimum in 90% of building, critical areas loosely defined	-95 dBm in 95% of critical areas, 90% of building; stricter definitions
Coverage Testing	Testing required but grid testing size and method not clearly defined	Grid testing clarified (20'x20' or 40'x40'), critical areas listed
Battery Backup	12-hour backup encouraged but not consistently enforced	12-hour battery backup or generator now mandatory
Cable Survivability	Survivability mentioned, but less specific on rating/classification	Backbone/riser cable in 2-hour fire-rated enclosures or approved method
Annual Testing Requirements	Annual inspection required, but coverage testing details limited	Explicit annual signal, battery, and component testing required
Permitting	Permit required, general documentation	Detailed permit submission, including plans and equipment specs
AHJ Authority	AHJ has some discretion, critical areas not clearly listed	AHJ empowered to define critical areas and require retesting
System Deactivation	No specific procedure defined	Clear process added for system deactivation if not needed

Radio network interference minimization

- ERCES function by having a donor antenna connect to the outdoor macro radio network. (Except NYC)
- An incorrectly designed or operating ERCES can cause interference with the outdoor radio network.
- It is the role of the FCC Licensee to identify and remediate interference issues.
 - Radio Shop expertise
 - If not, contact the macro radio vendor
 - Discuss with the internal ERCES resource and AHJ
 - Contact the building owner who is responsible for contacting the ERCES integrator
- Turn the system off until the interference issue is identified and resolved.

ERCES Trends

- More stringent certification for designers, installers, and integrators – FCC GROL is not sufficient
 - NICET (Multiple Tiers)
 - Ongoing credentialing
- Adoption of national codes at the local level
 - Varies by county and city
- Evolution from LMR only to LTE/LMR/WiFi (Cellular frequencies/FirstNet)
 - Dual-band ERCES systems (LMR + LTE)
 - LTE / Cellular critical for 911
- New building materials and more innovative architectural practices may balance RF transparency with code compliance
 - Reduce signal attenuation from the outdoor radio network

ERCES Trends

- AI-Powered Grid Testing and Monitoring Impact
 - Automated grid testing with drones or robots in large or hazardous buildings
 - Continuous system performance monitoring, flagging degradation before it impacts reliability
 - Predictive failure analysis based on environmental or traffic conditions

This will enhance system resilience and help meet the new NFPA 1225 maintenance requirements.

- Advanced Battery and Power Technologies
 - ERCES survivability requirements demand battery backup and long runtime. Improvements in solid-state batteries or fuel cells could:
 - Extend runtime and reduce battery footprint
 - Lower maintenance requirements
 - Allow for renewable-powered ERCES in off-grid or wildfire-exposed locations

Best 3rd-party sources for more information

The most comprehensive single source of information about ERCES is the Safer Buildings Coalition Complete ERCES Handbook.

<https://erceshandbook.com/>

The NFPA 1225 primarily has information about building codes applicable to ERCES.

<https://www.nfpa.org/product/nfpa-1225-standard/p1225code>

The FCC lists their requirements for ERCES (which they call "Signal Boosters"), along with their mandatory registration process for Class B broadband systems:

<https://www.fcc.gov/wireless/bureau-divisions/mobility-division/signal-boosters/part-90-signal-boosters>

Interested persons can search for existing Class B ERCES registrations or register a new or existing system.

Comba (an ERCES manufacturer) has some good technical articles on their website, primarily aimed toward ERCES installers:

<https://combausa.com/tech-briefs/>



Thank you for your time

Remarks from John Foley,
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