Public Safety Whitepaper

Hidden Risks to Public Safety Communications

Managing Interference, Uplink Performance, and RF Complexity



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Part 1

Public Safety Communication Problems

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Public Safety Communications Are Under Increasing Pressure

Reliable communications are critical during emergencies, yet modern public safety communications systems face growing challenges maintaining reliable in-building coverage and operational readiness. Increasing RF density, aging infrastructure, cellular congestion, and modern construction materials have made reliable in-building communications more difficult than ever.

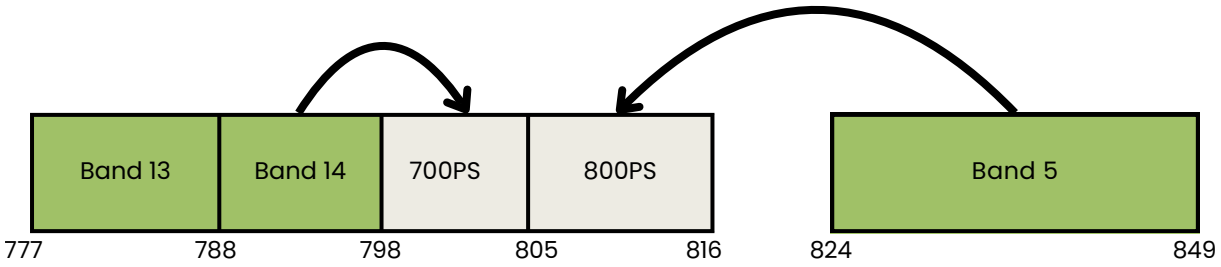
At the same time, emergency response operations now depend on a combination of:

- Land Mobile Radio (LMR)
- ERCES Infrastructure
- FirstNet and Cellular Connectivity
- Real-time Data Communications.

As these systems become more interconnected, failures in coverage, monitoring, or RF management can directly impact emergency communications reliability and operational coordination.

Why it matters

When communications fail, responders may lose contact with command staff, emergency teams may be unable to coordinate effectively, and critical information may not reach personnel when it is needed most.



LMR and Cellular Bands Coexist

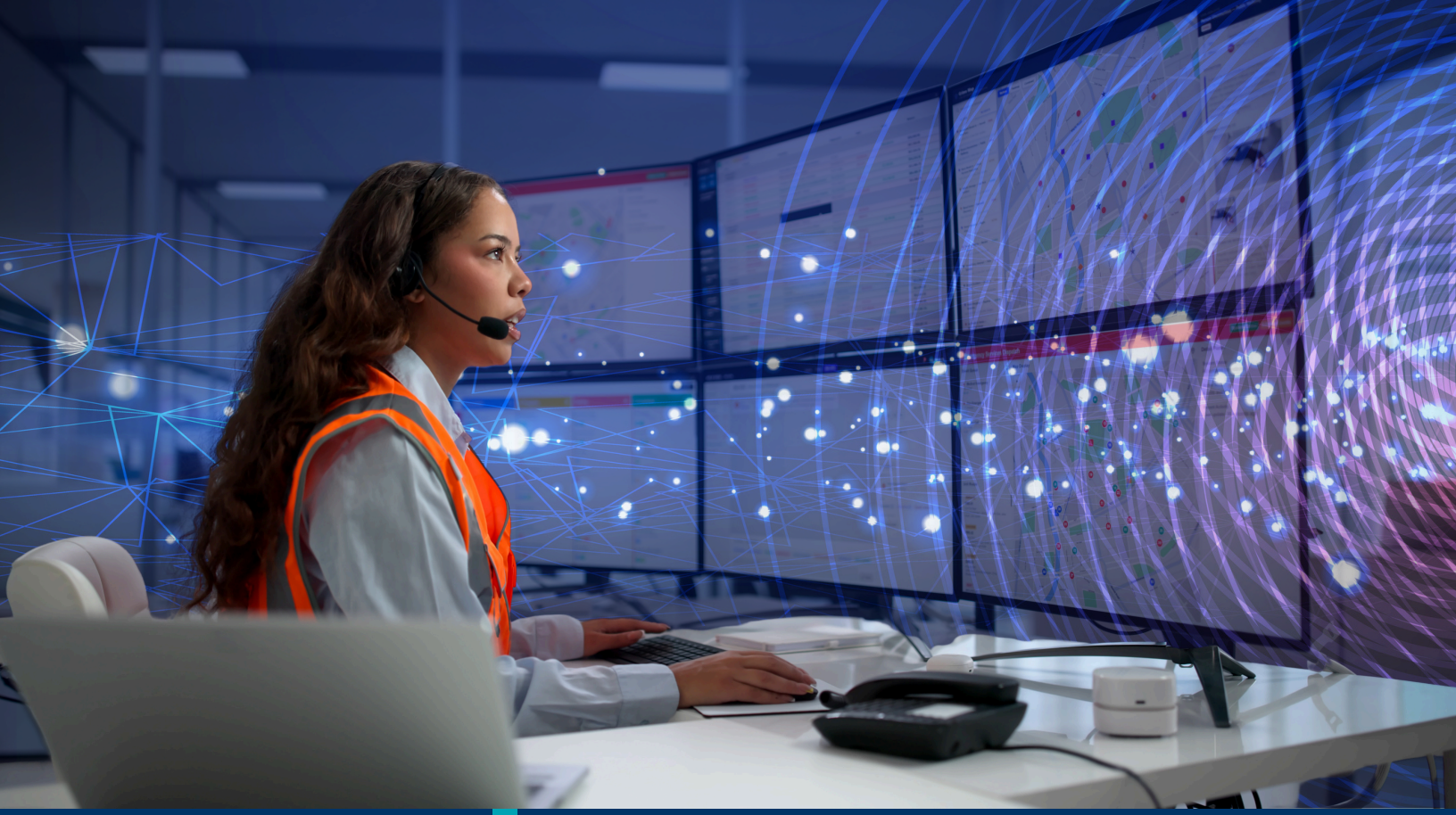
Increasing RF Complexity

The Department of Homeland Security has identified in-building communications as a continuing challenge for first responders due to:

- Concrete and Steel Construction
- Low-emissivity Glass
- Underground Spaces
- Dense Urban RF Environments

As more wireless systems, DAS deployments, and 5G infrastructure are introduced, RF environments become increasingly complex. This increases the risk of:

- Interference
- Uplink Noise
- Near-far Performance Problems
- Hidden System Degradation.



Part 2

Four Critical ERCES Reliability Challenges

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The Four Critical ERCES Reliability Challenges

Noise + Interference

The Challenge:
Wanted and unwanted signals impacting network performance

The Impact:
Degraded system performance

Talk-In / Talk-Out Performance

The Challenge:
Eliminating communication coverage gaps

The Impact:
Spotty communications for those furthest from antennas

System Monitoring / Assuring Availability

The Challenge:
Ensuring the highest availability

The Impact:
System availability may be compromised during emergencies

Changing RF Environments

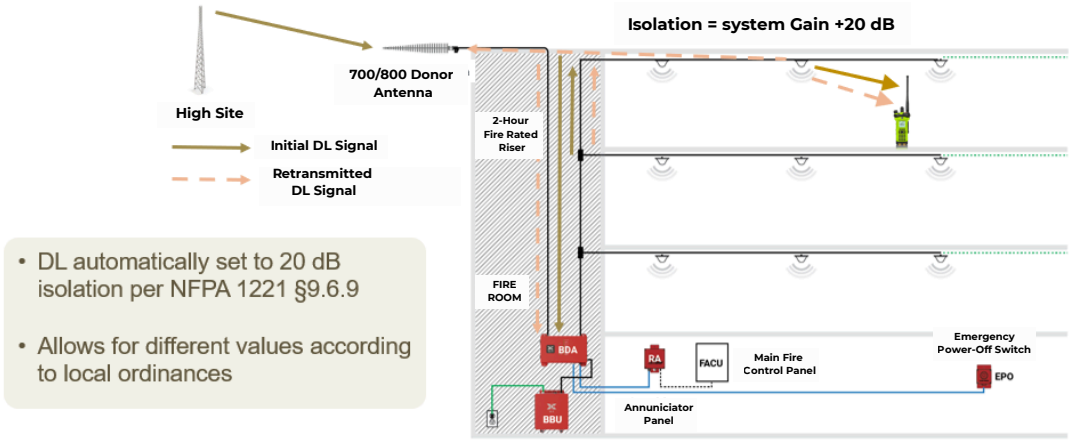
The Challenge:
Increasing deployment of Public Safety DAS and BDA systems introduces additional interference sources

The Impact:
Increased potential for network outages

1 Noise + Interference

When signals and noise impact network performance.

Modern ERCES systems operate in increasingly dense RF environments where public safety radio systems must coexist with, cellular DAS, LTE and 5G infrastructure, neighboring BDA systems, and other wireless networks.



Automatic Measurement of Isolation and Setting of Gain Eliminates Oscillation (*Nextivity*)

Three Critical Design Challenges

1. Uplink Level Control

Improper uplink amplification can transmit excessive noise back toward the donor site, reducing receiver sensitivity and negatively impacting overall network performance. Intelligent uplink level management helps maintain stable signal quality while reducing the risk of network interference.

2. Oscillation Elimination

The figure above shows the Improper isolation between donor and server antennas can create oscillation and interference that degrade communications performance.

3. RF Coexistence

As more ERCES, DAS, LTE, and 5G systems are deployed, public safety communications systems must increasingly coexist within dense RF environments. Proper filtering, isolation, and uplink management help reduce adjacent-system interference and support long-term RF stability.

Solution: Modern Approaches to RF Stability

Modern ERCES design minimizes uplink noise through controlled gain management, donor/server antenna isolation, and intelligent filtering. Proper antenna placement and RF isolation help prevent oscillation while supporting coexistence with neighboring wireless systems.

Here is a real-world deployment example: In a multi-building EV manufacturing facility ranging from 200,000–600,000 ft², dense steel and metal construction created significant public safety and cellular signal challenges. An ERCES deployment helped provide strong 700/800 MHz coverage and FirstNet connectivity throughout the site.

2 Talk-In / Talk-Out Performance

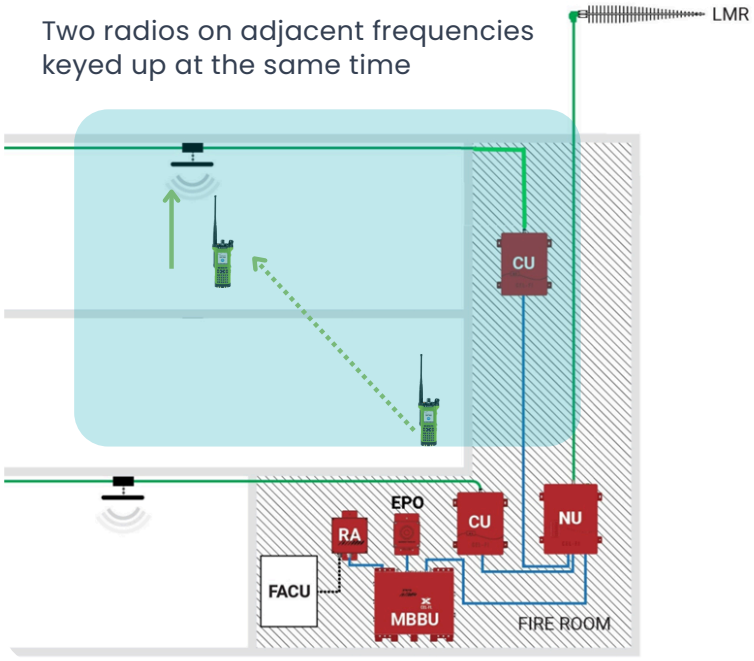
When network "dead spots" affect the reliability of either inbound or outbound talk performance.

Talk-In ≠ Talk-Out

Reliable public safety communications depend on both:

- Downlink Performance ("talk-in"),
- Uplink Performance ("talk-out")

In many cases, responders may hear dispatch clearly while their return transmission fails due to weak uplink performance. These hidden communication failures can create dangerous coverage gaps during emergency operations.



The Near-Far Problem

The Near-Far Problem occurs when radios located close to a server antenna overpower weaker radios located farther away inside the building. This can create inconsistent uplink performance and hidden communication dead zones where responders may hear dispatch clearly but cannot reliably transmit back. These issues are especially common in: stairwells, underground spaces, parking garages, and heavily reinforced buildings.

Solution: Improving Uplink Reliability

Reliable Talk-Out performance depends on balanced uplink design — not signal strength alone. Modern ERCES engineering uses:

- uplink balancing,
- adaptive gain control,
- and uplink validation testing

to reduce hidden communication dead zones throughout the building.

Real-World Deployment Example

A rural emergency dispatch facility with subterranean rooms experienced severe in-building coverage limitations due to dense construction materials. Improved indoor coverage helped support operational readiness for emergency training and response coordination.

3

System Monitoring & Assuring Availability

Coverage alone does NOT guarantee system reliability.

ERCES systems are often tested during commissioning and AHJ acceptance, but system conditions can change over time.
Equipment failures, donor signal degradation, antenna faults, and infrastructure changes may occur long after a system has passed inspection.

Hidden System Failures

Modern ERCES systems contain multiple interconnected components that may degrade over time due to:

- Environmental Conditions
- Infrastructure Changes
- Donor Signal Fluctuations
- Power Interruptions
- Antenna Failures



Nextivity WAVE Monitoring helps ensure systems are operating properly at all times

Why Monitoring Matters

Modern ERCES systems contain multiple interconnected components that require continuous supervision, including:

- Donor Antennas
- Server Antennas
- Signal Paths
- Power Systems
- Alarm Interfaces

Without visibility into these components, failures may remain hidden until the system is needed during an emergency.

Solution: Continuous System Visibility

Continuous monitoring helps identify:

- Donor Signal Loss
- Antenna Faults
- Infrastructure Changes
- System Alarms
- Performance Degradation

before they impact emergency communications reliability.

Real-World Deployment Example

An 800,000 ft² convention center expansion required reliable public safety communications across multiple zones. Continuous system monitoring helped provide visibility into system health and infrastructure status, supporting long-term communications reliability and operational readiness.

4 Long-Term RF Environment Changes

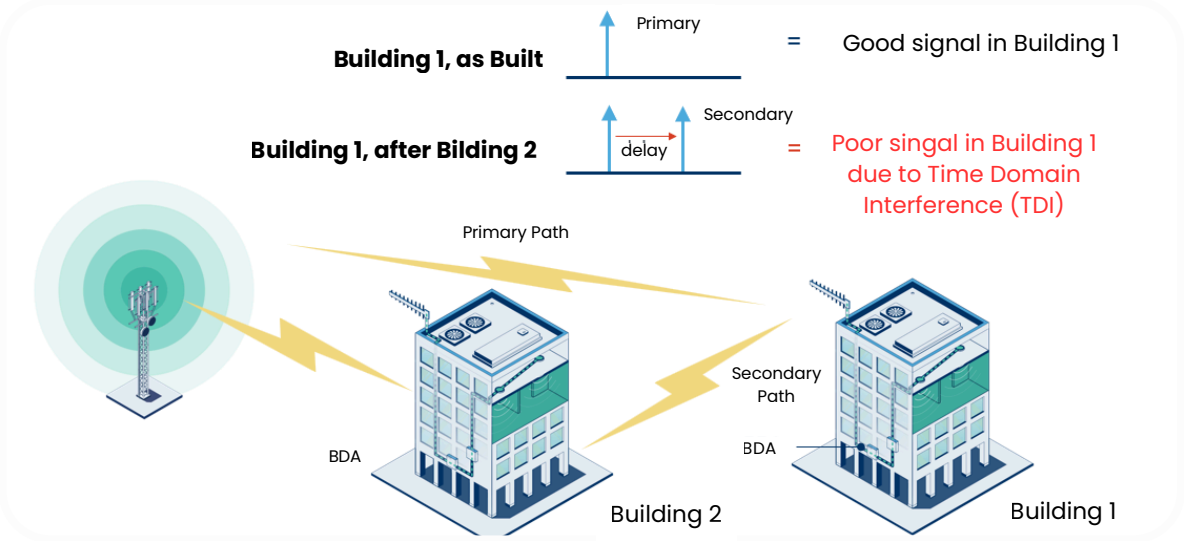
Why evolving RF environments impact long-term ERCES performance.

The Impact of Growing RF Density

As more ERCES, DAS, LTE, and 5G systems are deployed, public safety communications systems must increasingly operate within dense and continuously evolving RF environments.

Newly deployed systems may unintentionally introduce the following that impacts neighboring public safety communications systems:

- Uplink Noise
- Donor Degradation
- Adjacent-band Interference
- Oscillation



As deployment of BDA systems increase, they may start to interact with each potentially causing network outages.

Solution: Adapting to Changing RF Environments

Environmental RF conditions may change gradually over time as neighboring wireless systems are added, modified, or reconfigured.
Without ongoing donor signal visibility and RF monitoring, these changes may negatively impact ERCES performance without immediate detection.

Modern ERCES systems must adapt to the changing RF conditions over time. Such as:

- adaptive gain management,
- donor signal monitoring,
- and RF performance visibility

help maintain stable operation as neighboring wireless environments evolve.



Part 3

ERCES Requirements and What You Need to Know

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ERCES Requirements and What You Need to Know

Emergency Responder Communication Enhancement Systems (ERCES) are critical infrastructure that help ensure first responders can communicate effectively inside buildings during emergencies.

Key Points:

- Critical for public safety radio communications
- Required for Certificate of Occupancy (CoO) for new construction
- Existing buildings may need enhancements to meet current standards
- Codes and enforcement requirements continue to evolve

New Construction:

- ERCES coverage is required for Certificate of Occupancy
- Must meet local fire authority requirements
- System certification required by fire chief/marshal

Existing Buildings:

- May require ERCES compliance testing
- Schools and public buildings may require coverage for growing safety concern
- May require upgrades as local radio networks are upgraded

What you need to know

- Compliance requirements continue to expand
- Non-compliance can delay occupancy and create liability issues

As public safety communications environments continue to evolve, organizations must address more than signal strength alone. Reliable ERCES performance increasingly depends on effective RF management, uplink reliability, continuous monitoring, and long-term system adaptability.

The ERCES challenges — interference, Talk-In/Talk-Out performance, monitoring gaps, and environmental RF changes — continue to impact public safety communications systems across modern buildings and complex wireless environments.

As expectations for public safety communications reliability continue to grow, system design, monitoring, and operational readiness will remain critical to supporting emergency response coordination and occupant safety.

Engineering Principles for Reliable ERCES Design

Designing for Real Emergency Conditions

- Automatic Isolation Management
- Adaptive Uplink Control
- Near-Far Mitigation
- Pre-Inspection Uplink Validation
- Real-Time Talk-In/Talk-Out Optimization
- Active Antenna Supervision

SAFER BUILDINGS COALITION™ Member

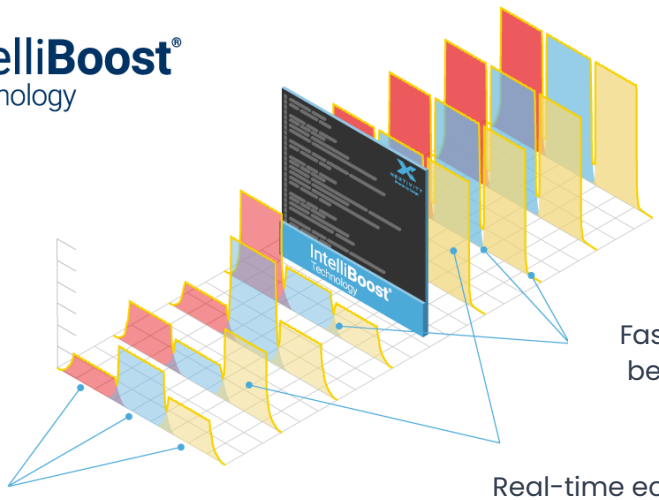


In-Building Cellular Coverage
In-Building Code Compliance (ERCES)

These design principles are implemented in the Nextivity SHIELD platform. *Nextivity SHIELD* ERCES systems are designed to overcome these pain points to ensure consistent top performance and support more reliable public safety communications performance.

1. NO NOISE Guarantee – Set Uplink and Downlink Gain based on automatic isolation measurements
2. Automatically adjusts Uplink Transmission Power
3. Industry's most robust solution to combat Near-Far Effect (advanced Near-Far mitigation)
4. Talk-Out Guarantee –Allows Talk-Out performance to be evaluated before AHJ acceptance testing, helping reduce the risk of inspection failures
5. Unparalleled real-time Talk-In / Talk-Out Performance
6. Antenna monitoring with Active Server Antennas

IntelliBoost® Technology



Fast AGC algorithms for best-in-class near-far performance

Special purpose processing filters and measurement filters supporting per-channel processing

Real-time echo measurement to maintain donor-service antenna isolation, eliminate oscillation, interference potential, and prevent network interference

About Nextivity

Intelligent Cellular DAS and Public Safety Coverage Solutions

Nextivity designs intelligent cellular DAS coverage solutions that help organizations communicate, operate, and innovate with confidence. Headquartered in San Diego, CA, Nextivity develops and delivers advanced in-building cellular, public safety, private 5G, and IoT networking solutions that bring reliable connectivity indoors. Our solutions increase communication, productivity, quality of life, and safety and security for the people and systems that need to stay connected with “always on” reliability.



Nextivity brings the power of the network inside buildings

About Alliance

Alliance Corporation distributes equipment for wireless network infrastructure, in-building signal enhancement solutions, cellular broadband systems, next-generation 5G networks, fixed wireless, private enterprise networks, and wireline services.

What Alliance Offers

100+ leading technology solutions. Site solutions, cable & assemblies, towers, accessories, broadband & DAS radios. With facilities in the US, Canada & Mexico, we provide custom cabling solutions to meet the needs of the customers.

We provide pre and post-sale technical support, engineering, radio configuration, and training services. Alliance serves telecommunication carriers, fixed wireless broadband service providers, OEMs, systems integrators, resellers, and contractors in education, enterprise, federal government, military, healthcare, industrial, municipal government, oil and gas, mining, public safety, security, utilities, and transportation industries.

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Learn more about ERCES system design and public safety communications reliability.
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