Emergency Responder Radio Coverage Systems (ERRCS)

Fire Code, Enforcement + Compliance

2020
Introduction

About VeriDAS Technologies

▪ **WHO:** Marc Zucker, President + Co-Founder
▪ **WHAT:** Distributed Antenna Systems (DAS) Integrator: Public Safety + Cellular
▪ **WHERE:** Headquartered in St. Louis: National Service Area
▪ **WHY:** Emergency Responder Radio Coverage Systems (ERRCS):
  ▪ Enforcement & Compliance of IFC 510
  ▪ Planning & Designing for ERRCS
  ▪ Budgeting & Scheduling for ERRCS
Back Story

Indoor Radio Coverage is So Critical for First Responders, IFC Mandated It in 2009 and AHJ’s Make Certificates of Occupancy Contingent Upon Compliance

- 9/11 & Terrorist Threats (office buildings, towers, etc.)
- Active Shooters (schools, community centers, malls, hotels, etc.)
- Medical Emergencies
- Tornados, Floods & Fires
RF Basics  Obstructions + Interference Affect In/Out-Bound RF Signal

- **LOCATION:** Distance, Azimuth + Elevation from Nearest Public Radio Tower
- **SURROUNDINGS:** Dense Urban Areas, Large/ Tall Nearby Structures + Heavy Foliage
- **SIZE + SHAPE:** Large Buildings, Multiple Floors, Building Configuration + Campuses
- **STRUCTURE:** Stairs, Elevator Shafts, Garages, Locker Rooms, Mechanical Rooms + Below Grade
- **MATERIALS:** Glass (Low E, Coated), Insulation, Concrete, Steel + Metal Roofs/Siding
- **INTERFERENCE:** Servers, Electrical Equipment, LED Lighting, Machinery, Power Lines, etc.
**Problem**  
Signal Can’t Penetrate Building Envelopes + Interior Structures

- **Signal Level (RSSI dBm)**
  - Distance
    - +50 dBm
    - +20 dBm
    - -50 dBm
    - -70 dBm
    - -95 dBm

- **Distance**
  - 2 Miles = 100 dB free space loss

- **Building envelope attenuates signal by 20 dB**
- **Not enough signal inside** - -70 dBm

- **Problem** Signal Can’t Penetrate Building Envelopes + Interior Structures
Solution: Install a Signal Amplification System

Signal Level (RSSI dBm) vs Distance

- 2 Miles = 100dB free space loss
- BDA System provides 70dB of gain
- Brings channel power to +20dBm
- Plenty of signal distributed throughout building
Emergency Responder Radio Coverage System
Engineered System of Antennas & Repeaters Capture, Re-Broadcast + Amplify Public Safety Radio Signal Inside

- **ROOFTOP DONOR ANTENNA:** Sends/receives signal from nearest Public Safety radio tower

- **VERTICAL BACKBONE:** Coax/ fiber cable connects active ERRCS equipment in Headend Room to Rooftop Donor Antenna + active equipment to passive components on each floor

- **PASSIVE COMPONENTS:** Omni-Directional Antennas, splitters, connectors, couplers + coax/ fiber cable distribute signal throughout the building

- **ACTIVE EQUIPMENT:** BDA, Battery Backup Unit + Alarm Panel located in ERRCS Headend Room
Less is More: Keep it Simple, Streamlined + Minimal

Meet Code, Cap RF Emissions + Prevent Extraneous Interference So ERRCS Doesn’t Negatively Impact the PS Radio System

- Rooftop Donor Antenna: 1 per system (consider location)
- ERRCS Headend Room: 1 room for headend equipment
- Bi-Directional Amplifier (BDA): 1 Class A, Public Safety rated BDA per system
- Fiber: Fiber backbone + headend allow for future expansion (campus)
- Alarm Panel: 1 per active component
- Battery Backup Unit (BBU): 1 per active component
- In-Building Antennas (DAS): Use fewest possible antennas to limit RF emitting devices
- Partial System: Only amplify areas without adequate coverage
Warehouse/ Distribution Center
700,000 SF; 1 Level
Data Center
300,000 SF; 2 Levels
Office

160,000 SF; 4 Levels
Hotel

350,000 SF; 23 Levels
Apartment Campus w/Fiber Infrastructure

16 Building Campus
30,500 SF; 3 Levels (Each Bldg.)
The Big Questions

- Which jurisdictions enforce IFC 510?
- Which projects require an ERRCS?
- What are the specs for an ERRCS?
- How do you plan for an ERRCS?
- How much do you budget for an ERRCS?
- Where do you include ERRCS in the construction timeline?
Recommendations

- Plan for ERRCS
- Design for ERRCS
- Budget for ERRCS
- Schedule for ERRCS
Plan for ERRCS

▪ Expect ERRCS will be enforced

▪ Expect enforcement of most current IFC (2018) & NFPA 72 and/or 1221 (2019)

▪ Expect a system will be needed (until testing proves otherwise)

▪ Expect all structures (including garages) will need a system (if campus or 300K+ SF)
Design for ERRCS
Include the ERRCS Infrastructure in Building Plans

✓ Headend Room for Active ERRCS Equipment (i.e. IDF, Electrical, IT/Telecom, etc.)
  ▪ 2-hour Fire Rated
  ▪ Adequate Wall Space: 6’x8’ with 3’ Clearance
  ▪ 120V 20 amp Dedicated, Lockable Circuits w/ #2 Isolated Ground
  ▪ Fiber Connectivity Termination (if campus and/or 300K SF+)
Design for ERRCS

Include the ERRCS Infrastructure in Building Plans

✓ Vertical Pathway for ERRCS Backbone
  ▪ NFPA 72 & 1221, 2019: 2-hour Fire Rated
  ▪ Continuous from Headend Room to Roof
  ▪ NEMA-4 Enclosures @ Every Floor to Protect Passive Backbone Components
  ▪ 2” EMT with Fire-Rated Coax* for the Donor Antenna
  ▪ 2” EMT with Fire-Rated Coax* for the DAS

* ½” DragonSkin™ Fire-Rated Coaxial Cable is $100+/linear foot
Certified to meet UL 2196 Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control & Data Cables
Design for ERRCS

Include ERRCS in Campus-Wide Fiber Optic Plans

✓ Fiber Optic Network Infrastructure Between Buildings/ Structures (if campus)
  ▪ 2-hour Fire Rated
  ▪ Single Strand of Single-Mode Fiber
  ▪ SC-APC Connectors Installed Between Buildings
Design for ERRCS

Include ERRCS in Code Analysis

✓ RF Signal Testing for IFC 510 Code Compliance (most recent versions IFC & NFPA)
✓ ERRCS System Installation IF Test Results Warrant
Design for ERRCS

Include ERRCS in Project Specifications

✓ ERRCS Specifications
  ▪ RF Signal Testing for IFC 510 Code Compliance
  ▪ ERRCS System Installation IF Test Results Warrant

✓ Electrical Specifications
  ▪ Install 120V 20 amp dedicated, lockable circuits w/ #2 isolated ground in ERRCS Headend Room
  ▪ Install fiber connection termination in ERRCS Headend Room (if campus)

✓ Fire Alarm Specifications
  ▪ Include expanded FACP capacity (modules) to support ERRCS 5-7 supervisory alarm points
  ▪ Connect ERRCS 5-7 supervisory alarm points to FACP

✓ Roof Specifications: include roof sealing after penetrations for ERRCS donor antenna
## Schedule for ERRCS

<table>
<thead>
<tr>
<th>Stage</th>
<th>Activities</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLANNING</td>
<td>RF Signal Testing Quote + ERRCS System Installation Allowance (budget not to exceed)</td>
<td></td>
</tr>
<tr>
<td>DESIGN</td>
<td>Code Analysis: RF Signal Testing + ERRCS System Installation (if test results warrant)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ERRCS Headend Room Design with (6’x8’x3’) Wall Space &amp; 120V 20 amp power supply</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ERRCS Vertical Pathway Design (continuous from Headend Room to Roof): 2 runs of 2” EMT</td>
<td></td>
</tr>
<tr>
<td>CONSTRUCTION</td>
<td>Build ERRCS Headend Room</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Install ERRCS Vertical Pathway</td>
<td></td>
</tr>
<tr>
<td><strong>80% Completion</strong></td>
<td>RF Signal Testing to determine code compliance + Test Report</td>
<td>1-3 days</td>
</tr>
<tr>
<td></td>
<td>ERRCS Engineering &amp; Quote (if test results warrant)</td>
<td>5 days</td>
</tr>
<tr>
<td></td>
<td>AHJ System Design Review/Approval</td>
<td>5 days</td>
</tr>
<tr>
<td></td>
<td>ERRCS System Installation</td>
<td>30-60 days</td>
</tr>
<tr>
<td></td>
<td>Acceptance Testing + AHJ Inspection</td>
<td></td>
</tr>
<tr>
<td>CERTIFICATE OF OCCUPANCY</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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# Code Variations + Evolution

<table>
<thead>
<tr>
<th>Criteria</th>
<th>NFPA 72; 2016 Chapter 24.3 &amp; 24.9</th>
<th>NFPA 72; 2019 Chapter 12, 24.3 &amp; 24.9</th>
<th>NFPA 1221; 2019 Chapter 9.6</th>
<th>IFC 2012 New: 5.10 Existing: 1103.2</th>
<th>IFC 2015 New: 5.10 Existing: 1103.2</th>
<th>IFC 2018 New: 5.10 Existing: 1103.2</th>
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</thead>
<tbody>
<tr>
<td><strong>New Buildings</strong></td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>New: 5.10</td>
<td>New: 5.10</td>
<td>New: 5.10</td>
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<tr>
<td><strong>Existing Buildings</strong></td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Existing: 1103.2</td>
<td>Existing: 1103.2</td>
<td>Existing: 1103.2</td>
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<tr>
<td><strong>Radio Coverage</strong></td>
<td>NA</td>
<td>NA</td>
<td>Per AHJ specifications</td>
<td>95%: all areas all floors -95 dBm</td>
<td>95%: all areas all floors -95 dBm</td>
<td>95%: all areas all floors DAQ: 3.0 (in/out)</td>
</tr>
<tr>
<td><strong>Signal Strength</strong></td>
<td>NA</td>
<td>NA</td>
<td>DAQ 3.0 (in/out)</td>
<td>-95 dBm (in/out)</td>
<td>-95 dBm (in/out)</td>
<td>-95 dBm (in/out)</td>
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<tr>
<td><strong>Installation &amp; Design</strong></td>
<td>Per NFPA 1221</td>
<td>Per NFPA 1221</td>
<td>Manufacturer’s Specs</td>
<td>NA</td>
<td>NA</td>
<td>Per NFPA 1221</td>
</tr>
<tr>
<td><strong>Pathway Survivability</strong></td>
<td>Vertical Path: 2-hr enclosure</td>
<td>Level 3: -Cable: 2-hr -Enclosure: 2-hr</td>
<td>Match bldg’s fire rating</td>
<td>NA</td>
<td>NA</td>
<td>Per NFPA 1221</td>
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<tr>
<td><strong>Active Components in NEMA-4 Enclosures</strong></td>
<td>NA</td>
<td>NA</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td><strong>Battery Backup Unit (BBU)</strong></td>
<td>NA</td>
<td>NA</td>
<td>12 Hours</td>
<td>12 Hours</td>
<td>24 Hours</td>
<td>12 Hours</td>
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<tr>
<td><strong>Supervisory Alarming</strong></td>
<td>NA</td>
<td>NA</td>
<td>✓</td>
<td>NA</td>
<td>✓</td>
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<tr>
<td><strong>Annual Re-Certification</strong></td>
<td>Per NFPA 1221</td>
<td>Per NFPA 1221</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
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Code Enforcement
Phased Checks + Balance Process

- **BUILDING PLAN REVIEW:** New Construction, Additions (& Existing) + Major Renovations
- **RF TESTING/SITE SURVEY:** Unamplified Signal Strength Inside Dried-In Structure
- **SYSTEM DESIGN/ PLAN REVIEW:** RF Engineered System Design, BOM + Predictive Model
- **INSTALLATION AUTHORIZATION:** AHJ, Building Dept + PS Radio System Administrator
- **20 GRID RF TEST:** Post Installation RF Signal Test + Report
- **AHJ INSPECTION:** Inspection of System Installation + Performance
- **CERTIFICATE OF COMPLIANCE:** Letter of Compliance from FCC Technician
- **ANNUAL RE-CERTIFICATION:** Test Active System Components + 20 Grid RF Test
Integrator’s Role

Pre-Construction > System Installation > Sign Off > Annual Inspections

- **MEET WITH ARCHITECT + ENGINEER:**
  Early Recommendations: Headend Location, Rooftop Donor Antenna, Cable Routes, Timeline + Budget

- **CONFIRM AHJ REQUIREMENTS:**

- **CONFIRM RADIO SYSTEM REQUIREMENTS:**
  Contact PS Radio System FCC Licensee Re: System, Control Channel(s), Frequency(s) + Towers

- **CONDUCT RF SIGNAL TESTING:**
  RF Analysis of In-Building Unamplified Signal Coverage + Donor Signal Strength

- **PRODUCE SYSTEM DESIGN:**
  Engineered iBwave ERRCS System Design, BOM + Predictive Signal Coverage Model

- **SECURE APPROVALS:**

- **INSTALL SYSTEM:**
  Penetrations, Cable + Active & Passive Components: Donor Antenna, BDA, DAS, BBU, Alarm Panel, Etc.

- **CONNECT TO FACP:**
  Fire Alarm Contractor Connects ERRCS Supervisory Alarm Points to FACP

- **COMMISSION, START UP + TEST:**
  Commission, Start Up + Post Installation 20 Grid RF Signal Test

- **ACCEPTANCE TESTING:**
  Accompany AHJ Inspection/ Acceptance Testing

- **CLOSEOUT PACKAGE:**
  As-Built System Design, RF Test Report, Cert. of Compliance, Data Sheets & Owner’s Manuals + Warranty

- **ANNUAL RE-CERTIFICATION:**
  Yearly System Test + 20 Grid RF Signal Test
Discussion + Q&A
Thank You