

In-Building Coverage Overview for Utah Communications Authority Shareholders



TECHNOLOGY
DIVISION



Alias

Public Safety DAS (Distributed Antenna System)

Emergency Responder Radio Coverage Enhancement System (ERCES)

Emergency Responder Radio Communication System (ERRCS)

Radio Enhancement System (RES)

Public Safety Radio Enhancement System

Public Safety Radio System

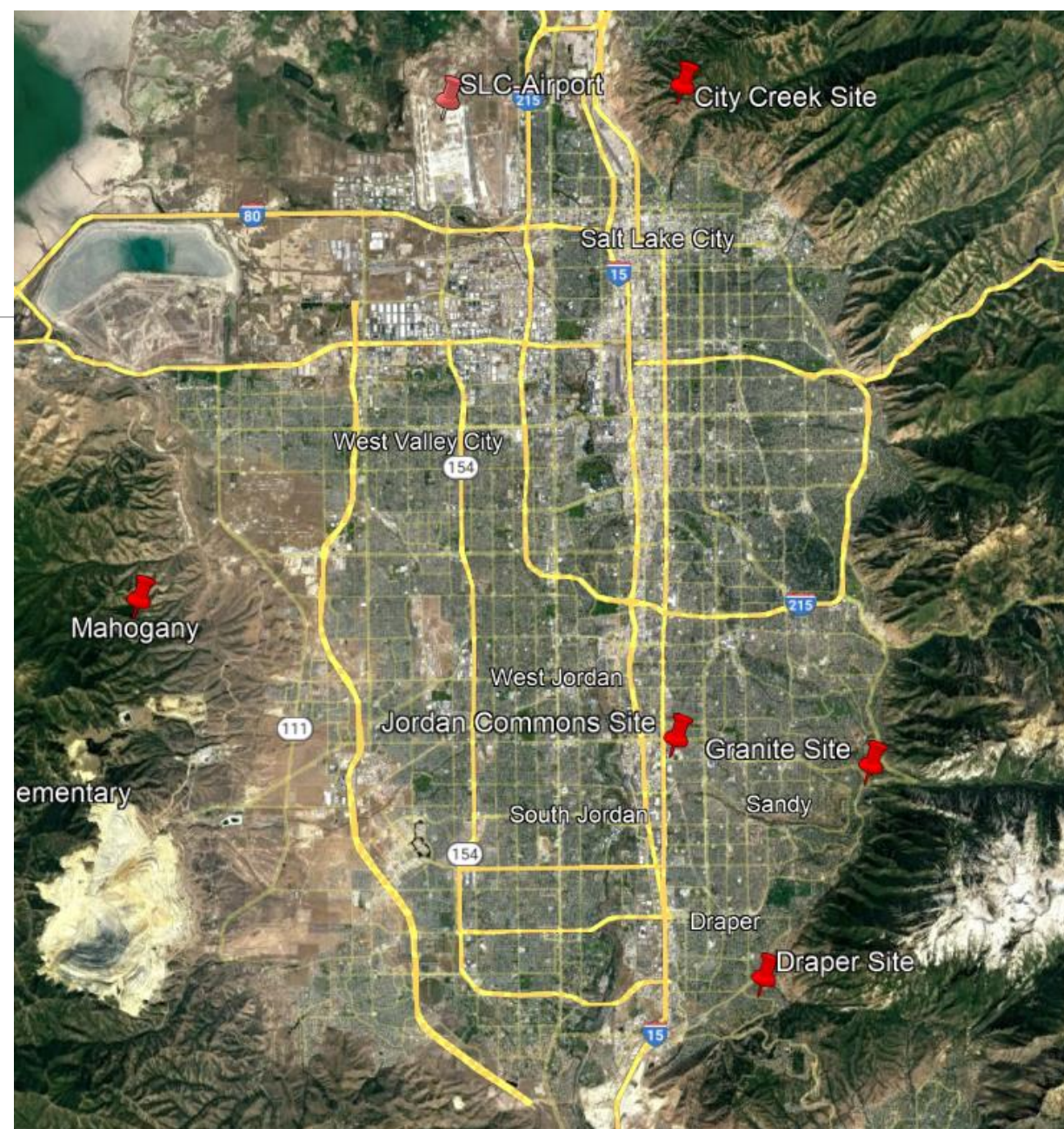
Emergency Response System

Two-Way Radio Communications Enhancement System (TRCES)

Why an In-Building System?



Interoperability



Local In-Building Ordinances

Washington

Bellevue
Kirkland
Mercer Island

Nevada

Clark County
Las Vegas
Sparks

California

Burbank
Costa, Mesa
Folsom
Glendale
Irvine
Ontario
Rancho Cucamonga
Riverside
San Diego
Roseville

Arizona

Scottsdale
Tempe
State of Arizona (dev)

Colorado

Broomfield
Summit
County

Texas

Grapevine

Utah

Tooele (2002-2003)

Lehi

New England

Sarpy County

Pennsylvania

West Whiteland

Massachusetts

Boston

Cambridge

Connecticut

West Hartford

Wisconsin

Bayside

Muskego

Minnesota

Edina

Illinois

Hampshire

Moline

Schaumburg

Virginia

Arlington

Richmond

Mississippi

Boloxi

Florida

Broward County

Coral Gables

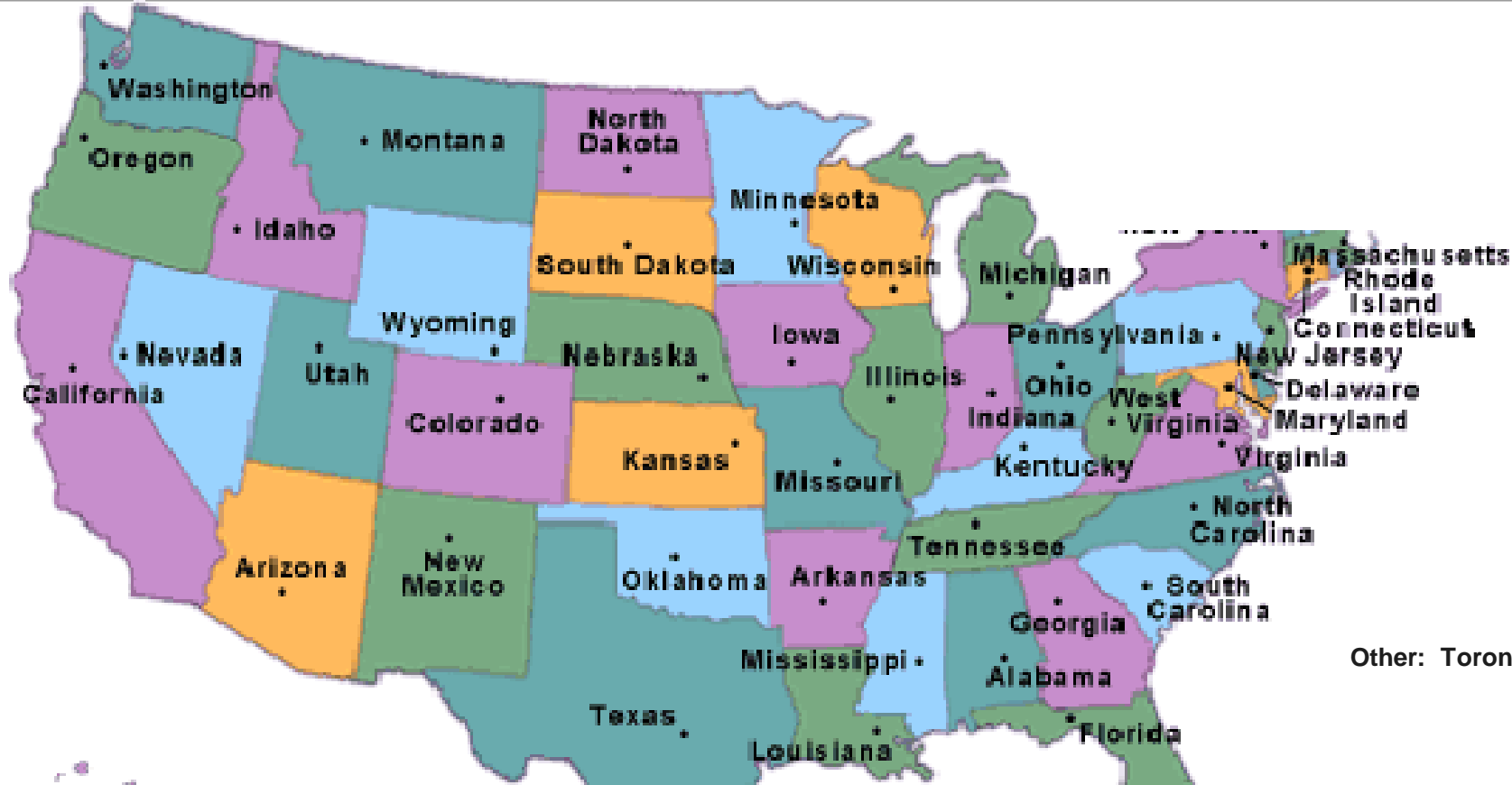
Edgewater

Fort Lauderdale

Palm Beach

St. Petersburg (dev)

Other: Toronto, Canada; Singapore



2009 it was introduced into the National Fire Code

- International Fire Code (IFC) Section 510 w/Appendix J
- National Fire Protection Association (NFPA) 72 Annex 0
- NFPA 1221



State of Utah

GARY R. HERBERT
Governor

SPENCER J COX
Lieutenant Governor

Department of Administrative Services

KIMBERLY K. HOOD
Executive Director

Division of Facilities Construction and Management

P. JOSHUA HAINES
Director

THE FOLLOWING STATEWIDE CODES HAVE BEEN ADOPTED BY THE STATE LEGISLATURE AND SIGNED INTO LAW BY THE GOVERNOR. THE FOLLOWING CODES BECOME EFFECTIVE JULY 1, 2013.

- 2012 edition of the International Building Code (IBC), **to include Appendix J**, Issued by the International Code Council.

Utah's Adaptation of Utah Fire Code 2013 General Session

International Fire Code

SECTION 510

◦ EMERGENCY RESPONDER RADIO

510.1 Emergency responder radio coverage in buildings.

- **When required by the fire code official.** All buildings shall have approved radio coverage for emergency responders within the building based upon the existing coverage levels of the public safety communication systems of the jurisdiction at the exterior of the building. This section shall not require improvement of the existing public safety communication systems.

National Fire Code 2018

- 510.1 Emergency responder radio coverage in **new** buildings.
 - **When required by the fire code official.** All **new** buildings shall have approved radio coverage.....
- 510.2 Emergency responder radio coverage in **existing buildings**. Existing buildings shall be provided with approved radio coverage for emergency responders as required in Chapter 11. (construction requirements for existing buildings)

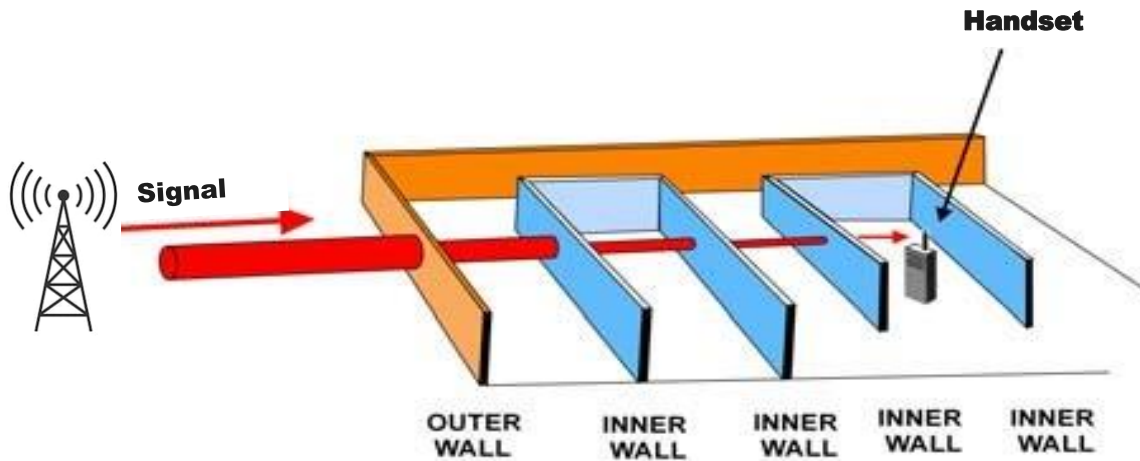
1103.2 Emergency responder radio coverage in existing buildings.

Existing buildings other than Group R-3, that do not have approved radio coverage for emergency responders in the building based on existing coverage levels of the public safety communication systems, shall be equipped with such coverage according to one of the following:

1. Where an existing wired communication system cannot be repaired or is being replaced, or where not approved in accordance with Section 510.1, Exception 1.
2. Within a time frame established by the adopting authority.

Exception: Where it is determined by the fire code official that the radio coverage system is not needed.

What Causes Poor Signal?



BUILDING WALL PENETRATION SIGNAL LOSSES

SIGNAL STRENGTH IS IMPAIRED BY:

RF interference



Low-E glass windows



Underground structures



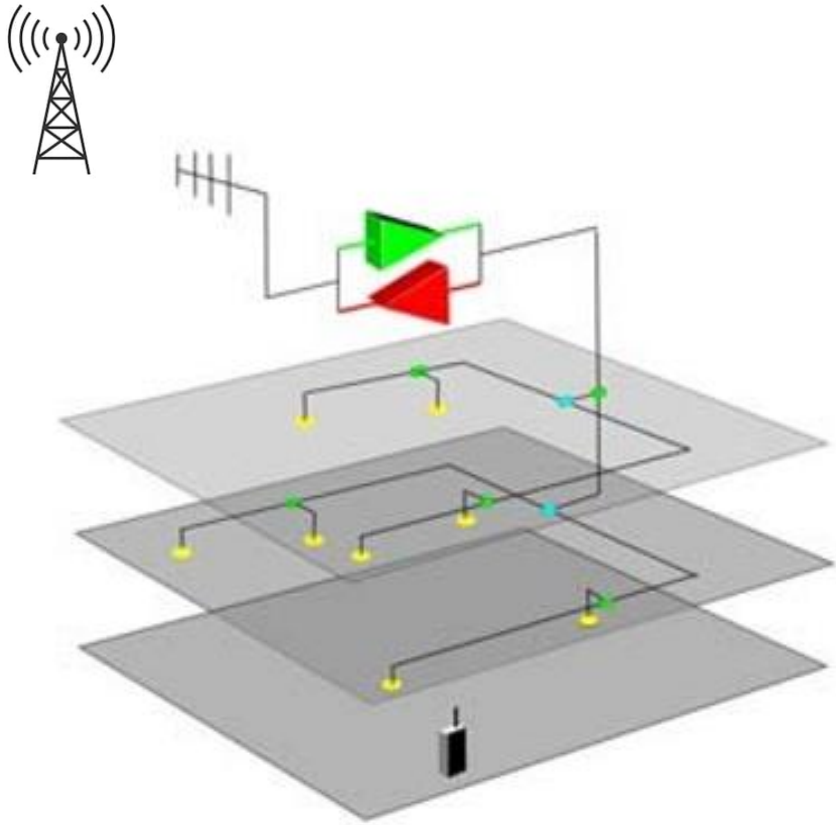
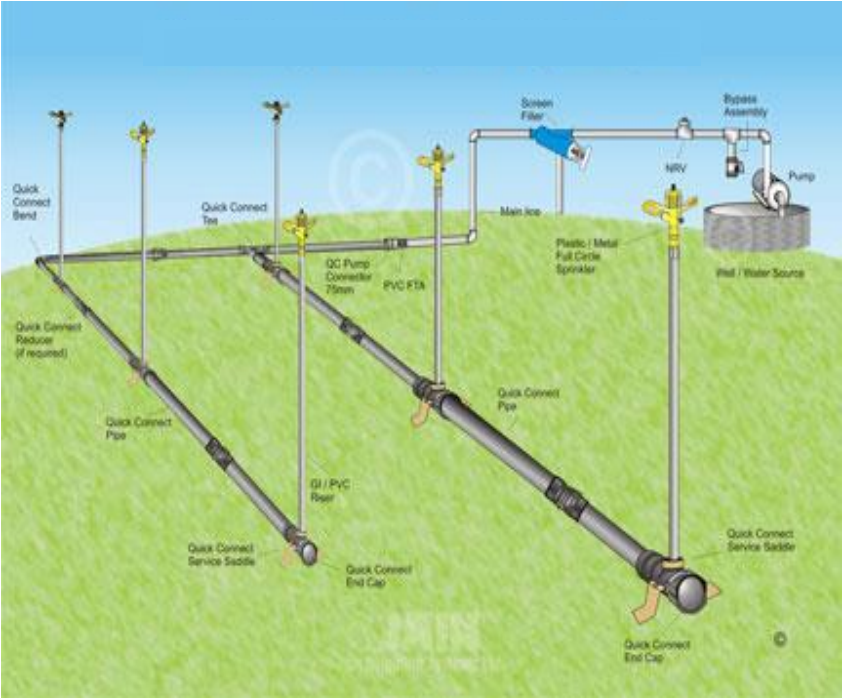
Obstructions



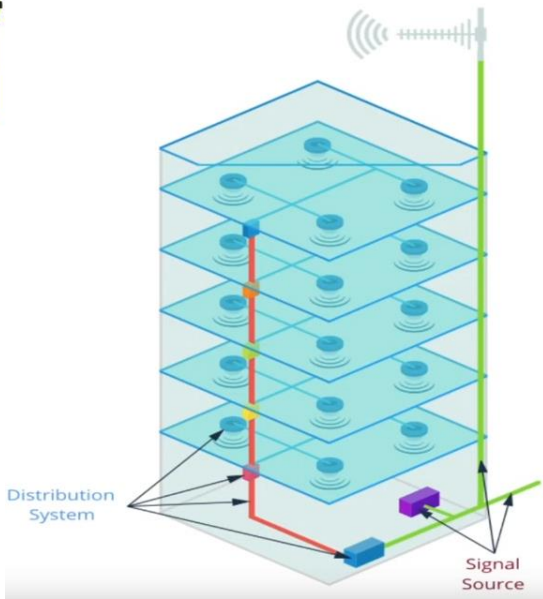
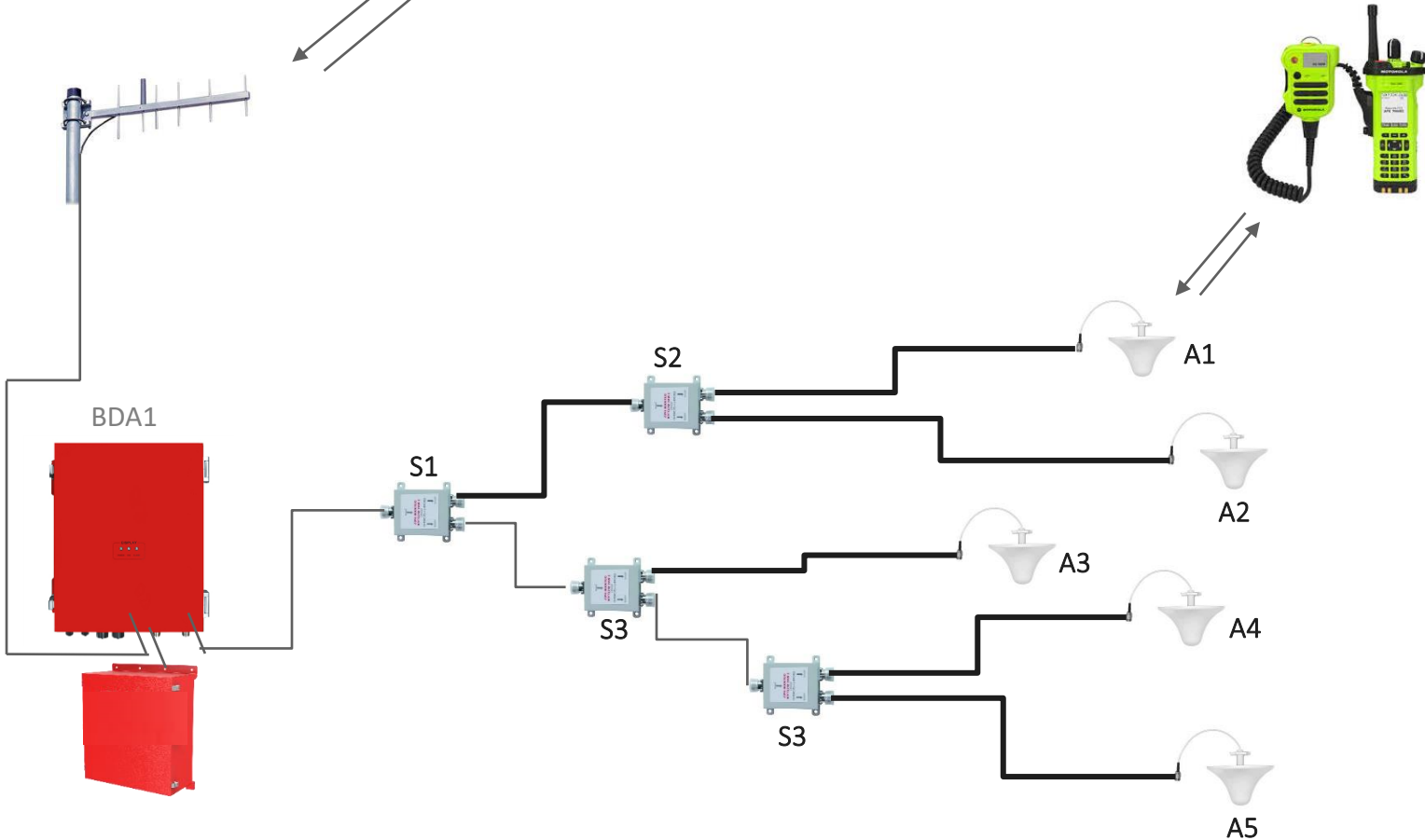
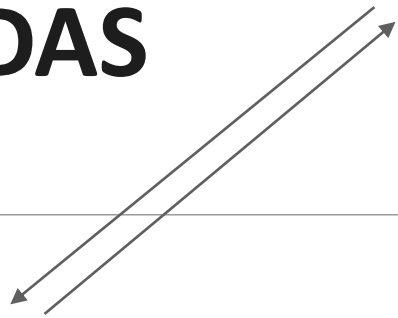
Building materials

- 6+ Million commercial buildings in the U.S.
Who is going to pay for it?

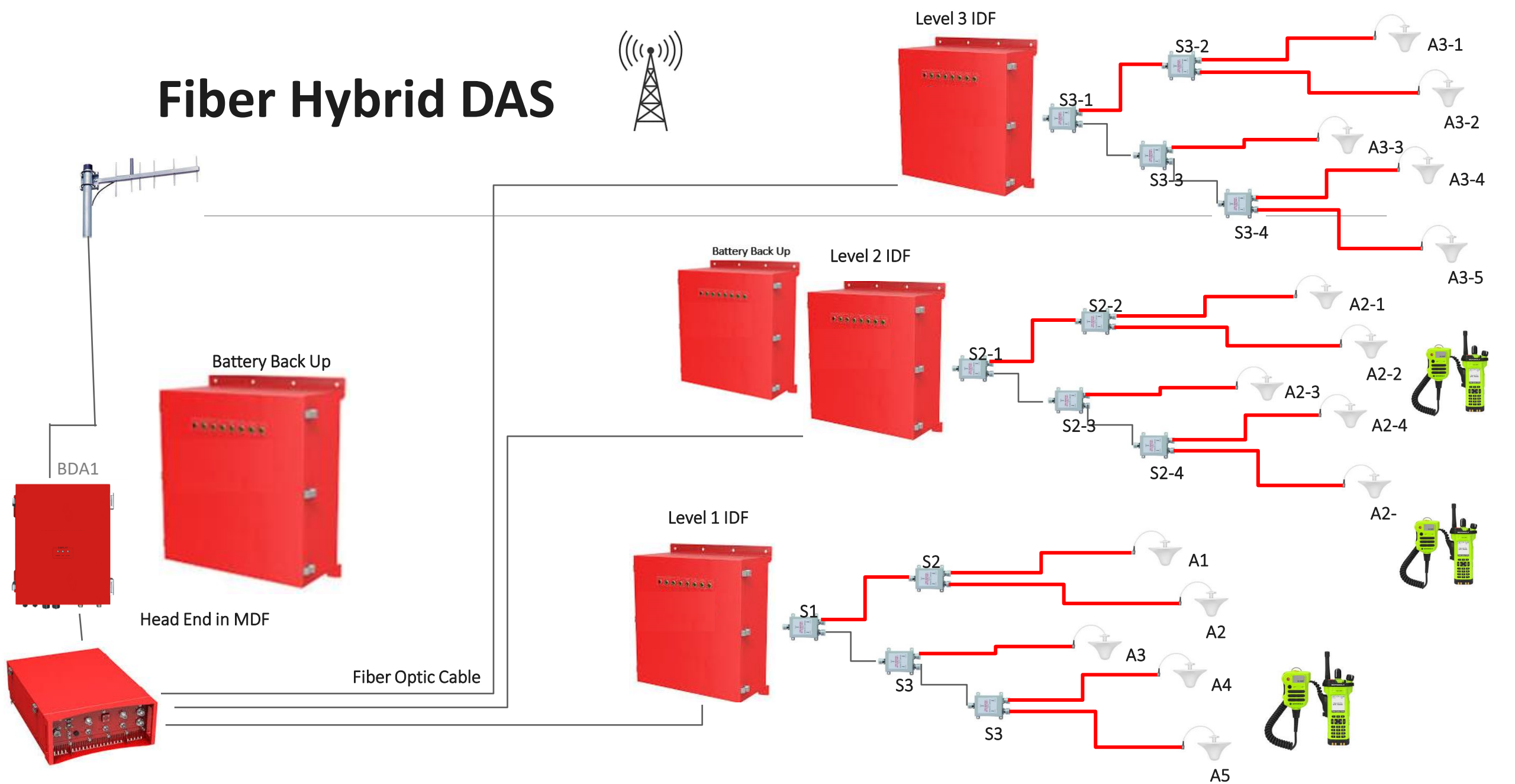
Distributed Antenna System



Passive DAS



Fiber Hybrid DAS



Class A or Class B Amplifier

Class A or “Channelized”

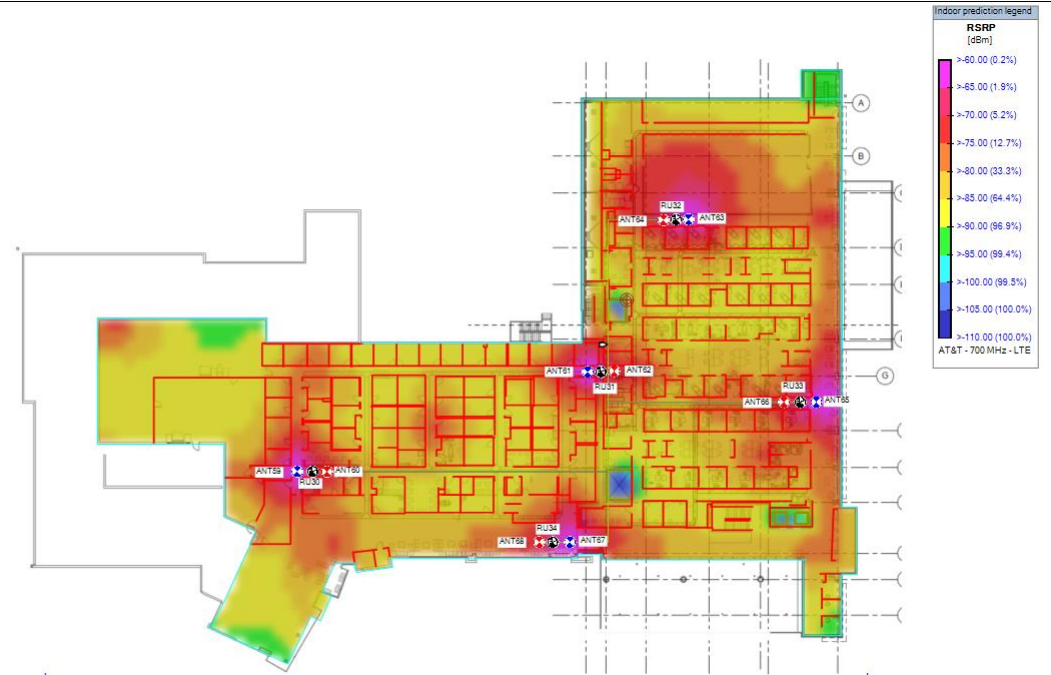
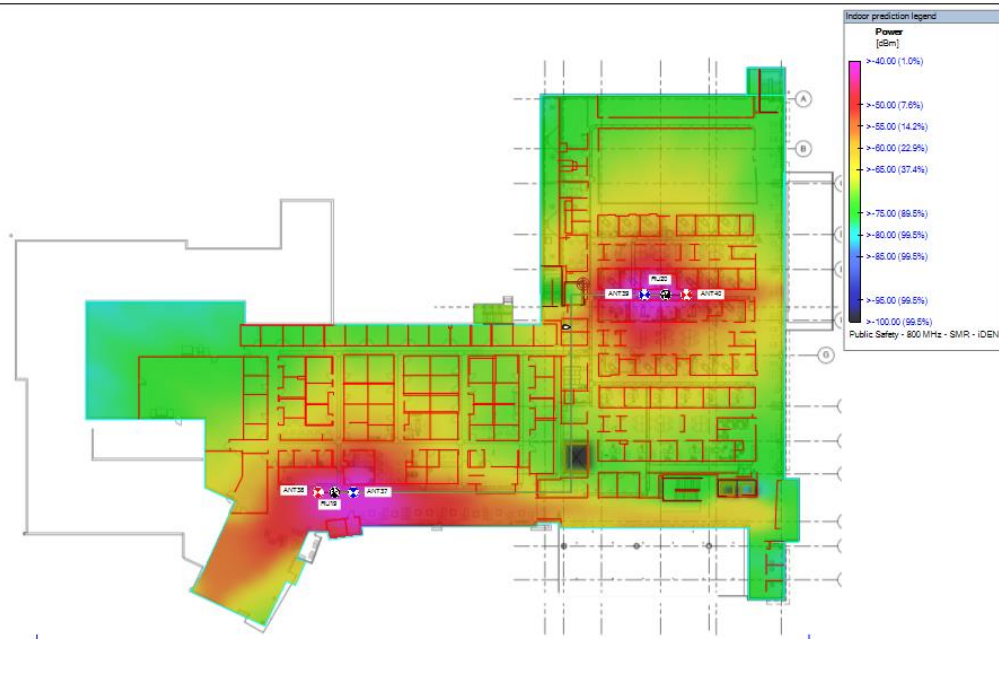
- No passbands exceed 75Khz
- **30% more cost than Class B**
- Detailed setup. Handles **8-32 Channels**
- Less noise than Class B
- No Near-Far Affect
- **Not Scalable (new freq's added)**
- **TDI (Time Delay Interference) ranges between 15-100us**

Class B or “Passband”

- Any passband exceeds 75Khz
- 30% less cost than Class A
- Easy setup. Requires Registration with FCC.
- **More noise than Class A**
- **Can cause Near-Far Affect**
- Scalable (new freq's added)
- TDI (Time Delay Interference) less than 10us

P25 Phase I can handle up to 32us delay and P25 Phase II wants less than 15us (us=microseconds)

Near Far Issue- affects the Class B



The ERCES Process

New Construction

- Bids under Electrician (Div 27 Low Voltage)
- **Lowest bid** / Construction budget
- Specs are written by Electrical Engineering Firm
- Certificate of Occupancy



Existing

- Direct to owner
- Typically, no budget
- Already have Certificate of Occupancy



Technical Criteria

510.4.2.2 Technical criteria. **The fire code official shall maintain a document providing the specific technical information** and requirements for the emergency responder communications coverage system. This document shall contain, but not be limited to, the various frequencies required, the location of radio sites, the effective radiated power of radio sites, the maximum propagation delay in microseconds, the applications being used and other supporting technical information necessary for system design.

- Name of site
- Location
- Channels
- Control Channel
- Call Sign
- ERP
- Interference Issues

Who at the AHJ level is qualified to put together this info?

Permit

IFC 510.3 Permit required. A construction permit for the installation of or modification to emergency responder radio coverage systems and related equipment is required as specified in Section 105.7.6. Maintenance performed in accordance with this code is not considered a modification and does not require a permit.

NFPA 72 105.7.6 Emergency Responder Radio Coverage System

A construction permit is required for installation of or modification to emergency responder radio coverage systems and related equipment. Maintenance performed in accordance with this code is not considered to be a modification and does not require a construction permit.

- Salt Lake City now charges \$205 for a 5-year permit including filing of the annual inspections.

Retransmit Agreement

UCA must ensure that the integrity of its network is maintained so that we can provide needed Emergency Communication Services. **The FCC requires UCA to maintain control over any transmitting device that operates within UCA' assigned frequencies.** Repeaters, bi-directional amplifiers and similar radio frequency enhancements on your premises may negatively impact the UCA network.

Accordingly, any entity that installs a device that transmits UCA frequencies must first obtain UCA approval to use the frequencies and must provide UCA with 24/7 access and contact information for any device and/or system transmitting within UCA frequency band. **UCA has the right to shut down any system that interferes with the UCA network.**

- 47 Code of Federal Regulations 90.219 states you MUST have permission from the licensee, and they are responsible for interference as well.
- NFPA 1221 9.6.5.1 requires coordination with licensee
- **Associate it with a permit**

FCC Signal Booster Registration

<https://signalboosters.fcc.gov/signal-boosters>

Utah shows 122 Public Safety Band BDA Registrations as of 1 March 2022

61-Hunt Electric
20-Church of Jesus Christ of Latter-Day Saints
17-BYU
16- Other Integrators
2-Intermountain Health Care
1-Weber State University
1-eBay
1-West Valley City
1-SL County
1-So Jordan
1-Amazon

FCC Title 47, Part 90, Subpart I, 90.219, Use of Signal Boosters

“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. Unauthorized use may result in significant forfeiture penalties, including penalties in excess of \$100,000 for each continuing violation.”

Minimum Qualifications of Personnel

510.5.2 Minimum qualifications of personnel. The minimum qualifications of the system designer and lead installation personnel shall include **both** of the following:

1. A valid FCC-issued general radio operator's license. **GROL**
2. Certification of In-Building system training issued by an approved organization or approved school, or a certificate issued by the manufacturer of the equipment being installed.

These qualifications shall not be required where demonstration of adequate skills and experience satisfactory to the fire code official is provided.



Testing



P25 RSSI



P25 RSSI

| |
|-------------------------------|
| ● -50 ≤ X < Above (7.79%, 12) |
| ● -55 ≤ X < -50 (8.44%, 13) |
| ● -60 ≤ X < -55 (9.74%, 15) |
| ● -65 ≤ X < -60 (12.34%, 19) |
| ● -70 ≤ X < -65 (15.58%, 24) |
| ● -75 ≤ X < -70 (8.44%, 13) |
| ● -80 ≤ X < -75 (12.99%, 20) |
| ● -85 ≤ X < -80 (11.69%, 18) |
| ● -90 ≤ X < -85 (9.09%, 14) |
| ● -95 ≤ X < -90 (3.25%, 5) |
| ● -100 ≤ X < -95 (0.65%, 1) |
| ● -105 ≤ X < -100 (0.00%, 0) |
| ● -110 ≤ X < -105 (0.00%, 0) |
| ● Below ≤ X < -110 (0.00%, 0) |

P25 SNR



P25 SNR

| |
|------------------------------|
| ● 40 ≤ X < Above (0.00%, 0) |
| ● 20 ≤ X < 40 (0.00%, 0) |
| ● 15 ≤ X < 20 (0.00%, 0) |
| ● 10 ≤ X < 15 (0.00%, 0) |
| ● 5 ≤ X < 10 (0.00%, 0) |
| ● 0 ≤ X < 5 (0.00%, 0) |
| ● -5 ≤ X < 0 (100.00%, 154) |
| ● -10 ≤ X < -5 (0.00%, 0) |
| ● -15 ≤ X < -10 (0.00%, 0) |
| ● -20 ≤ X < -15 (0.00%, 0) |
| ● Below ≤ X < -20 (0.00%, 0) |

DAQ vs. RSSI



The inbound (and Outbound) signal level shall be sufficient to provide not less than a Delivered Audio Quality (DAQ) of 3.0 or an equivalent Signal-to-Interference-Plus-Noise Ratio (SINR) applicable to the technology for either analog or digital signals.

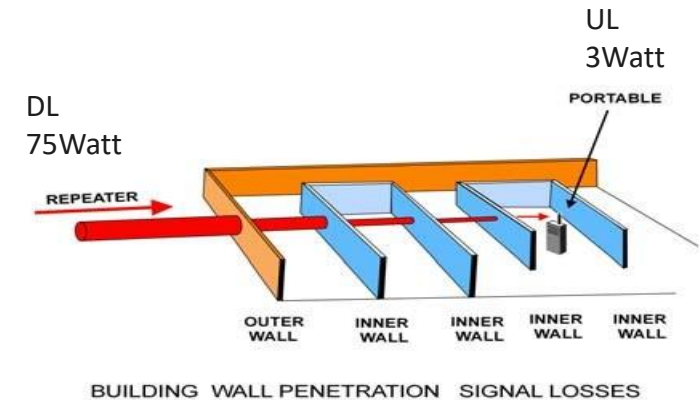
- (1) DAQ 1: Unusable, speech present but unreadable.
- (2) DAQ 2: Understandable with considerable effort. Frequent repetition due to noise/distortion.
- (3) DAQ 3: Speech understandable with slight effort. Occasional repetition required due to noise/distortion.
- (4) DAQ 3.5: Speech understandable with repetition only rarely required. Some noise/distortion.
- (5) DAQ 4: Speech easily understood. Occasional noise/distortion.
- (6) DAQ 4.5: Speech easily understood. Infrequent noise/distortion.
- (7) DAQ 5: Speech easily understood.

Testing Procedures- Acceptance Test

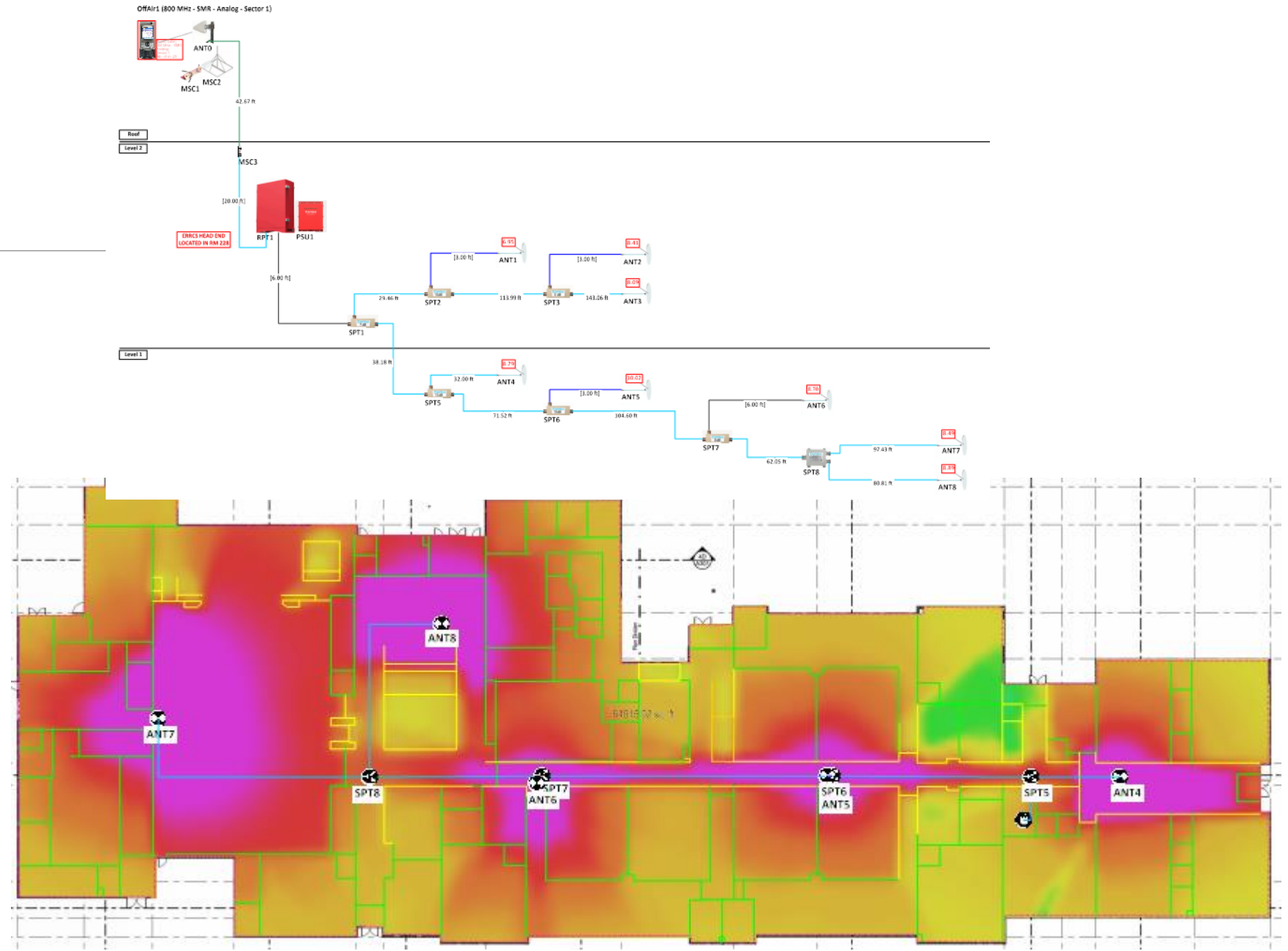
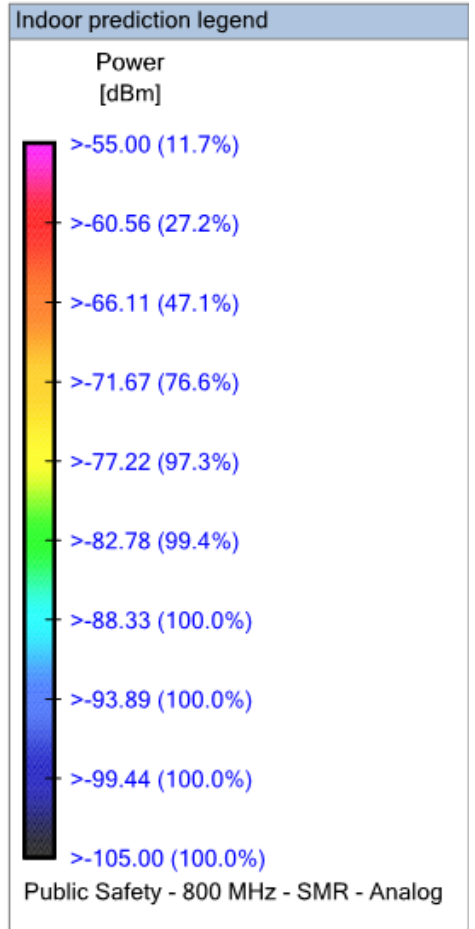


Divide floorspace into 20 equal parts- 2 areas is failure (10%).
 Divide floorspace into 40 equal parts- "Failure of not more than two nonadjacent test areas shall not result in failure of the test. If the system fails the 40-area test, the system shall be altered to meet the 95-percent coverage requirement"

| Grid | Area | DL Power (dBm) | DL DAQ | UL Power (dBm) | UL DAQ |
|------|------|----------------|--------|----------------|--------|
| 1 | 1 | -81.29 | 3.5 | -95.33 | 2 |
| 1 | 2 | -83.32 | 3.5 | -97.94 | 3 |
| 1 | 3 | -84.70 | 3.5 | -98.73 | 2 |
| 1 | 4 | -73.01 | 4 | -87.04 | 3 |
| 1 | 5 | -73.20 | 4 | -87.24 | 3 |
| 1 | 6 | -77.92 | 3.5 | -92.04 | 3 |
| 1 | 7 | -80.98 | 3.5 | -95.04 | 2 |
| 1 | 8 | -77.76 | 3.5 | -91.84 | 3 |
| 2 | 1 | -71.85 | 4 | -85.94 | 3.5 |
| 2 | 2 | -71.27 | 4 | -85.34 | 3.5 |
| 2 | 3 | -72.26 | 4 | -86.34 | 3.5 |
| 2 | 4 | -72.56 | 4 | -86.64 | 3.5 |
| 2 | 5 | -75.73 | 4 | -89.84 | 3 |
| 2 | 6 | -76.47 | 3.5 | -90.54 | 3 |
| 2 | 7 | -74.47 | 4 | -88.54 | 3 |
| 2 | 8 | -68.43 | 4 | -82.54 | 3 |
| 3 | 1 | -70.52 | 4 | -84.64 | 3 |
| 3 | 2 | -73.52 | 4 | -87.64 | 3 |
| 4 | 1 | -73.96 | 4 | -88.04 | 3 |
| 5 | 1 | -78.67 | 3.5 | -92.74 | 3 |



RF Design





Alarming

Section 510.4.2.5 System monitoring.

The emergency responder radio enhancement system shall be monitored by a listed fire alarm control unit, or where approved by the fire code official, shall sound an audible signal at a constantly attended on-site location.

Automatic supervisory signals shall include the following:

1. **Loss of normal AC power supply.**
2. **System battery charger(s) failure.**
3. **Malfunction of the donor antenna(s).**
4. **Failure of active RF-emitting device(s).**
5. **Low-battery capacity at 70-percent reduction of operating capacity.**
6. **Failure of critical system components.**
7. **The communications link between the fire alarm system and the emergency responder radio enhancement system.**

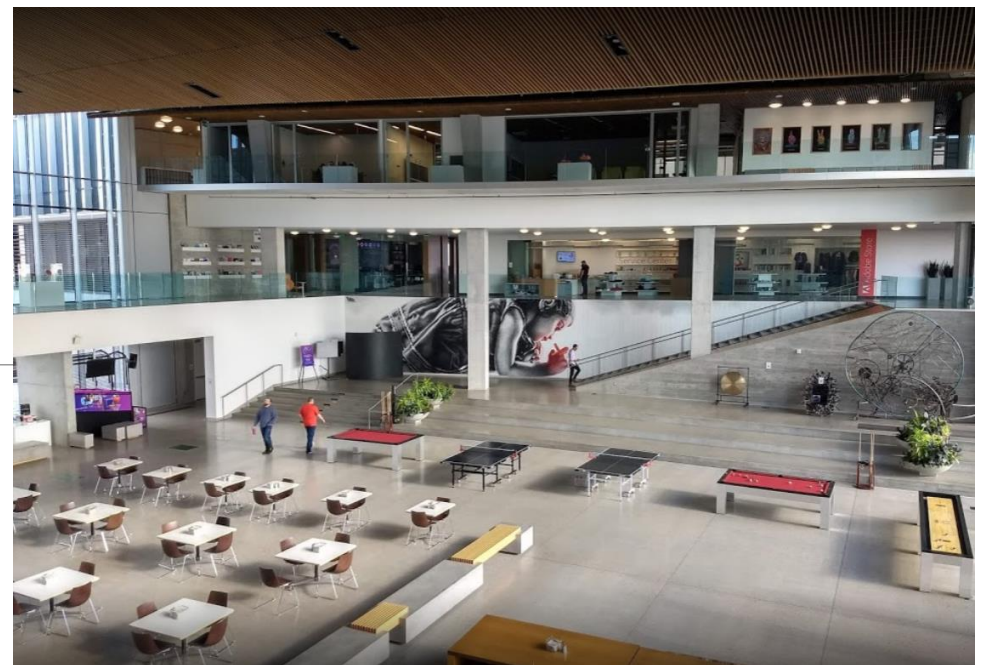
Supervisory Alarm-does not go to Fire Department

Proof of Compliance and Annual Testing

510.6.1 Testing and proof of compliance. The owner of the building or owner's authorized agent shall have the emergency responder radio coverage system shall be inspected and tested annually or where structural changes occur including additions or remodels that could materially change the original field performance tests.

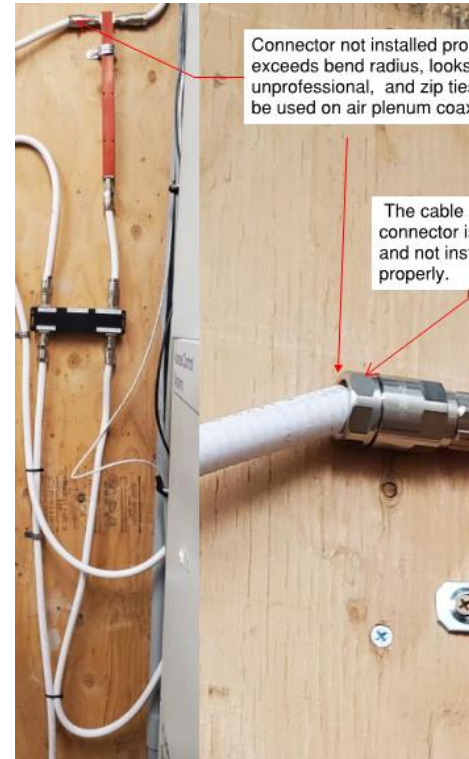
- Tooele
- Permit process will ensure some sort of visibility and tracking for annual inspections
- Compliance Engine

2013



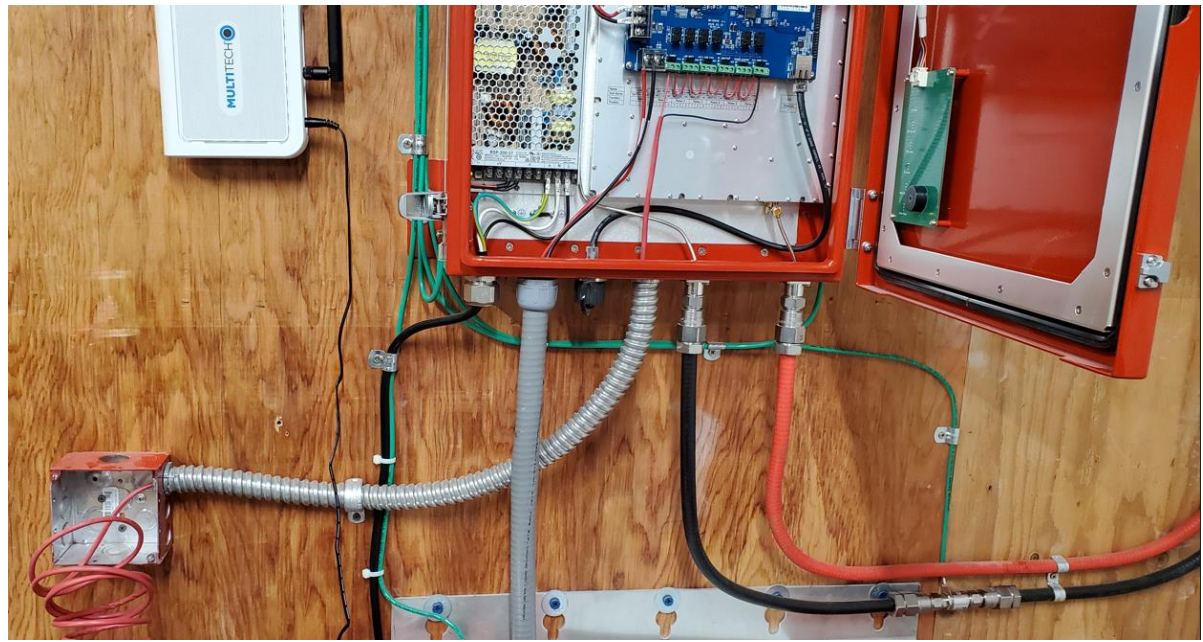
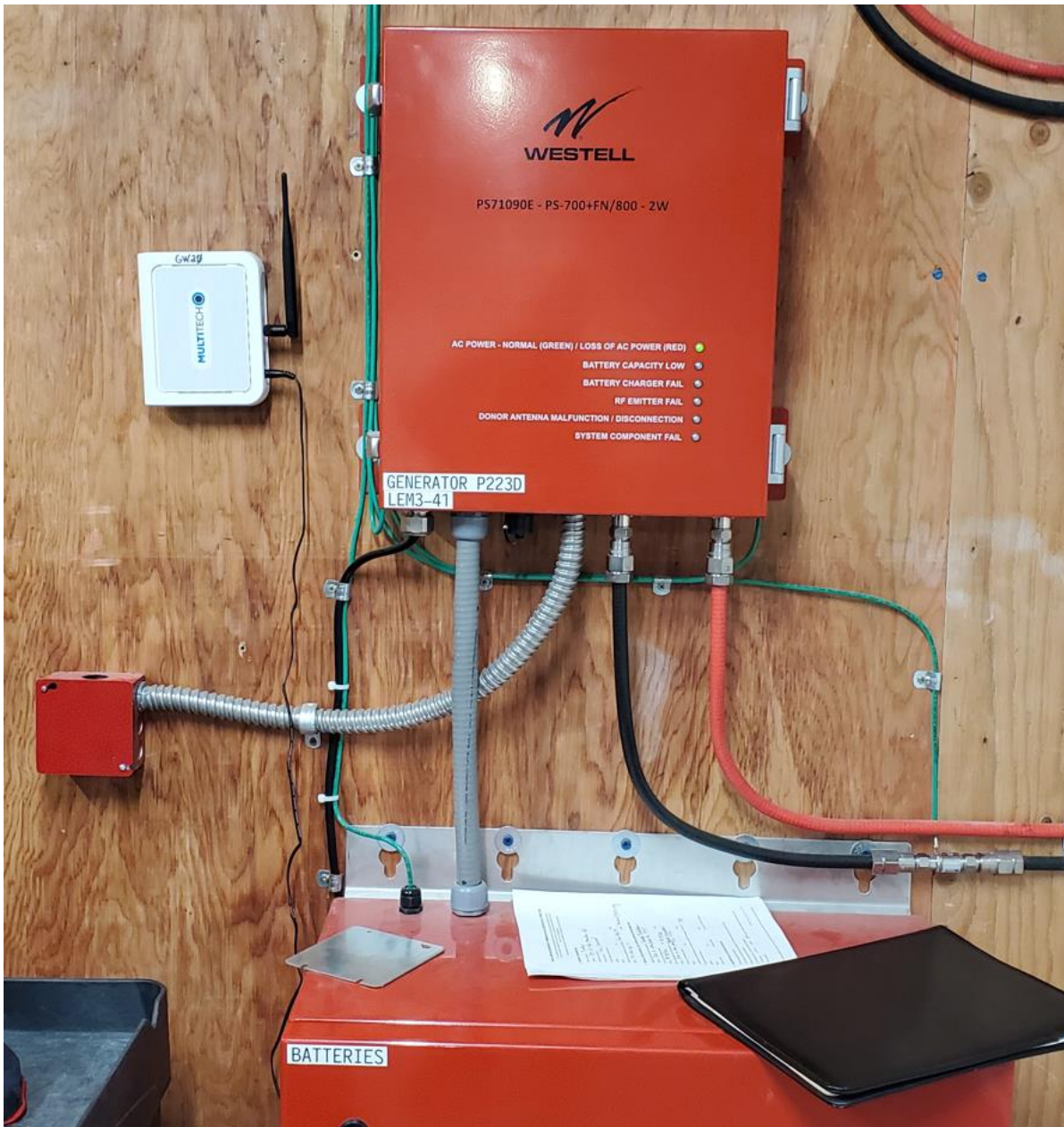
2020



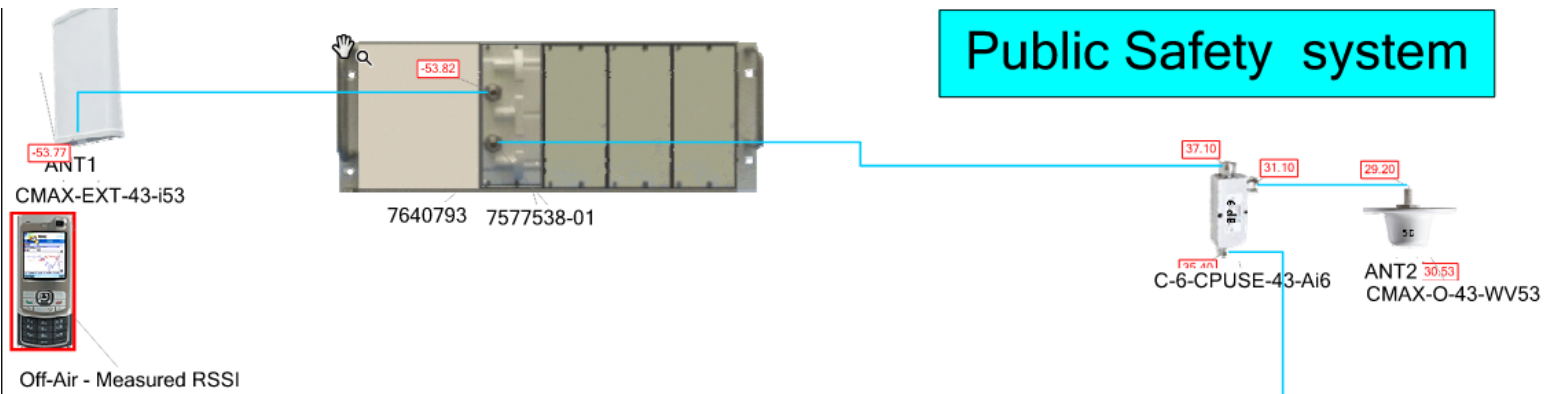


Examples of poor workmanship





Public Safety system



Level 4

ANT 1 supports level 3 and level 4

Level 3

Level 2

ANT 2 supports level 1 and level 2

Level 1



Recommendations

1. Work on the required technical document for your area
2. Inform your people to look for and report in-door coverage problem areas
 - Police/EMS leaders should talk to the Fire Marshall
 - Schools should check with School Resource Officers
3. Make sure building owners are being notified up front- Plan review
4. Have buildings tested –its better to test than to just mandate something
5. Report changes in coverage – this could be a recently added amplifier degrading fringe coverage

Questions & Thank You!



To Learn More Visit:
www.HuntElectric.com

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