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THE IMPACT OF CHANGING **FIRE** **CODES** IN THE PUBLIC SAFETY COMMUNICATION INDUSTRY

By Sun Kim

Public safety communication is increasingly entering the public eye after being the quiet giant of the in-building wireless communication industry for so many years. This is evident in the way mobile carriers have brought their own public safety efforts closer to consumer-facing branding, from AT&T's FirstNet® and Verizon's Frontline to T-Mobile's Connecting Heroes program. There are also more stringent, clearly defined regulations for ensuring two-way emergency responder communications in buildings like Underwriters Laboratories' UL 2524, Second Edition, which is now required as part of the latest National Fire Protection Association (NFPA) and International Fire Codes (IFC) codes.

The growth in public safety is hardly surprising, considering an escalating number of emergencies are placing first responders in hazardous situations, such as active shootings and wildfires, where they need to effectively communicate over radio or cellular devices. The Federal Communications Commission (FCC) estimates that improving one minute of 9-1-1 response time would save 10,000 lives in the U.S. each year.¹ With 80 percent of these calls generated by a cell phone and 65 percent taking place inside buildings, the importance of emergency responder communication enhancement systems (ERCES) cannot be understated.

Even though public opinion can sway decision-making in this industry, nothing changes the trajectory of public safety communications like the NFPA and IFC fire codes. It is important for ICT professionals to identify and interpret the major changes to the latest NFPA and IFC codes to better prepare themselves for the future.

WHAT ARE THE MOST RECENT CODES, AND HOW DOES THE PROCESS WORK?

In the past, the NFPA and IFC fire codes were revised on a three-year cycle, a year apart from each other. For example, the most recent NFPA codes related to public safety communication were revised in 2022 compared to IFC in 2021. Once the NFPA consolidated 1061 (Standard for Public Safety Telecommunications Personnel Professional Qualifications) and 1221 (Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems) to create a singular NFPA 1225 in 2022, the Standards Council changed the update cycle to five years. However, this is something they hope to revert because innovation in emergency communication happens much more frequently than a half decade. Today, there is discussion of advanced public safety technologies that will influence code before then such as NG9-1-1, Z-axis, and the use of the 4.9 GHz band for localized, bandwidth-intensive applications for mission-critical public safety use cases.

Currently, the codes and sections that impact public safety communications include IFC (Section 510), NFPA 72 (Chapter 24), NFPA 1221 (Section 9.6), and NFPA 1225 with primary focus on Chapter 18, 20, and the Annex.

Although NFPA 1061 and NFPA 1221 consolidated to become the new NFPA 1225 in the most recent code version, certain authority having jurisdictions (AHJs) may still use codes from previous years and, therefore, reference them separately. While NFPA and IFC provide a set of standards and guidelines to follow for ERCES design, installation, and implementation, it is up to the AHJ of a particular region to interpret and enforce them. AHJs must adopt specific versions of codes to enforce by ordinance, whether it is model codes in their entirety or slightly amend them depending on local laws and regulations. AHJs may interpret codes and standards slightly differently for their respective areas of authority. The most recent code edition may not be adopted in your jurisdiction, and in some states, codes are adopted by local governments generally through an action of the city, county, or territory.

It is challenging for ICT professionals to specify systems and installations based on different code years, local addendums, and interpretations. This often means altering cost analysis and installation strategies depending on which guidelines are enforced. Fortunately, system integrators and other stakeholders can take steps to amend a particular county code that may alleviate unnecessary complications or costs.

The first option helps resolve code issues in the middle of its revision cycle. If a certain code is seemingly ambiguous, organizations and institutions can submit a tentative interim amendment (TIA) to the NFPA Standards Council for consideration. For example, the Safer Buildings Coalition (SBC), a not-for-profit organization providing thought leadership and education on advancing effective in-building communication policies, ideas, and technologies, already has submitted seven active TIAs for consideration by the Standards Council. The NFPA states that an issued TIA automatically becomes a Public Input for the next edition of the standard and is then subject to all of the procedures of the standards development process. TIAs are published in NFPA News, NFPA LiNK®, the National Fire Code Subscription Service (NFCSS), and any further distribution of the standard after being issued by the Standards Council.

The second option is related to changing which code or standard year is enforced by a jurisdiction specifically for ERCES.



A stakeholder is within legal rights to petition the state under Equivalency and assert a different version of the fire code should be enforced than the one currently being observed in that jurisdiction. For example, if a jurisdiction is observing NFPA 2019 but local code officials are adamant NFPA 1225 would allow building owners significant cost savings, they could request adoption of that standard only for ERCES while still abiding by NFPA 2019 standards otherwise. There are several jurisdictions in Florida that enforce this today.

In general, it is these mechanisms that make it important for ICT professionals to understand the changes happening in the NFPA and IFC codes so they can take appropriate action should it be advantageous to their business or customers.

WHAT ARE THE BIGGEST CHANGES IN THE LATEST NFPA AND IFC CODES?

While there are many incremental changes in the NFPA 1225 and IFC 2024 codes, there are a handful that emerge as being the most impactful to communication professionals.

Pathway Survivability: One of the changes with the most financial implications for system integrators and building owners is pathway survivability in NFPA 1225 (Section 18.12). This refers to the impact temperature has on the transmission and functional and operational quality of the signals in a fire-rated and non-fire-rated environment. In previous versions of the code, the pathway survivability of the ERCES had to match the fire rating of the building. Now, if a building is not a high rise and has an NFPA 13 sprinkler system installed, it no longer requires conduit on the passive side. This means significant cost savings up to a third of what it would be with conduit.

The implications of this are so significant that many jurisdictions within Florida, which is moving to NFPA 1221–2019 edition on December 31, 2023, will now require NFPA 1225 for ERCES specifically for this reason. Jacksonville was the first to successfully petition the state for this by using the equivalency language from the NFPA, followed by Orlando and Miami-Dade counties. It would not be much of a surprise to see this happen statewide eventually.

Converged Networking: The second major change to NFPA 1225 is in Section 18.6, 18.11, and the Annex, which allows for converged systems and now calls out the ability to use any modulation technology including newer transmission technologies such as LTE and 5G. Converged or shared infrastructure refers to a deployment where both public safety and commercial wireless bands can share a single enclosure or infrastructure. Previous code versions were less clear on how shared communications would operate when using multiple bands beyond traditional radio. NFPA 1225 is now less about radio communications and more about communications across all frequency bands, which may include traditional SMR, LMR, etc., and newer transmission technologies, such as LTE and 5G. This will dramatically change the capability of public safety communications systems.

Section 18.6.3 states, “Systems that share infrastructure with non-public safety services shall ensure that the coverage and performance of the public safety communications channels are not degraded below the level of performance identified in Sections 18.8 and 18.9, regardless of the amount of traffic carried by the non-public safety services.” In other words, as long as the commercial equipment is up to the specification of the ERCES and does not harm the public safety connectivity, it is allowed to share infrastructure. If allowed by your AHJ, this will prove to greatly incentivize building owners to purchase commercial equipment when installing their ERCES because of the reduction in installation costs and long-term management.

For the time being, many AHJs are still hesitant to allow for this, but the momentum has begun to shift in favor of converged systems thanks to NFPA 1225. Today, most AHJs do not allow shared infrastructure on the active side of the ERCES but are okay with

sharing on the passive side of the system. Several school systems in Florida are beginning to change this and allow shared infrastructure of active and passive for both the public safety and cellular systems.

UL 2524: Outside of NFPA and IFC, there was not another modeling language for ERCES until UL 2524. UL 2524 was written by the Standards Technical Panel (STP) within UL for In-building 2-Way ERCES. It represents the most rigorous set of standards to ensure emergency responders can communicate with one another in and around commercial buildings. UL 2524, second edition, covers products including repeater, transmitter, receiver, signal booster components, remote annunciators and operational consoles, power supply, and battery charging system components.

UL 2524 used to be just a proposed standard (i.e., not part of the national model fire codes) but has since been mandated by IFC 2021, Section 510.4 and NFPA 1225, Chapter 18.12.1.3. Both state that the equipment used must be listed in accordance with UL 2524. For ICT professionals, a UL 2524 listing makes it easier to select an ERCES that is compliant with AHJ-enforced codes, and makes it easier for AHJs to enforce wireless product code testing and approval due to its UL 2524 certified mark and corresponding QR code.

Rigorous Testing: There was always testing required in previous codes, but never to the extent it is listed in NFPA 1225. For the first time, NFPA 1225 has Chapter 20 and the Annex, which details the initial testing that must be conducted for approval along with annual operational testing to verify system performance and outlines the detailed quantitative test that now must happen every five years. The primary testing descriptions are as follows:

- Annual operational tests must include at least one quantitative delivered audio quality (DAQ) test in accordance with 18.9.1 and 18.9.2. Additional quantitative tests are required if a floor exceeds 128,000 ft² (≈11,892 m²).
- Signal boosters must be tested to verify that the gain is the same as it was during the initial installation and acceptance or set to optimize the performance of the system.
- Backup batteries and power supplies shall be tested under load for a period of one hour.
- Other active components shall be checked to verify operation within the manufacturer's published specifications.
- A spectrum analyzer or other suitable test equipment shall be utilized to ensure spurious oscillations are not being generated by the subject signal booster.
- Where a donor antenna is used, isolation in accordance with Section 18.10 shall be verified.
- An inspection shall be made to evaluate if the building's structural changes or alterations that have been made impact the communications coverage of the system as required in Section 18.8.

Changing from Height to Square Footage

Requirements: It is hard to believe, but the NFPA and IFC code language only went into effect more than a decade ago, beginning in 2009. Since then, the only size measurement to determine whether a building must install an ERCES was 75 ft (≈23 m) in height. The problem? Many corporate campuses, distribution centers, and buildings today that house thousands of people are well under 75 ft (≈23 m) tall and are hundreds of thousands of square feet. Of course, many AHJs realize how preposterous it is to not have a public safety system in these instances and often enforce it anyway at the local level. However, in IFC 2024, they will be amending the minimum requirements for ERCES to 12,000 ft² (≈1,115 m²), which will likely impact some buildings that were able to get by through this loophole and avoid getting a system for their certificate of occupancy.

There are many other code changes as well, and you can see the vast majority of them in Figures 1 and 2.

PUBLIC SAFETY CODE REFERENCE: NFPA

	NFPA 72 - 2013	NFPA 1221 - 2016	NFPA 1221 - 2019	NFPA 1225 - 2022
In-Building Solution Required	NFPA 1 Sec. 11.10	NFPA 1 Sec. 11.10	NFPA 1 Sec. 11.10	NFPA 1 Sec. 11.10
Permit Required	Yes, Sec. 24.5.2.1.2	Yes, Sec. 9.6.6	Yes, Sec. 9.6.6	Yes, Sec. 18.7
Pathway Survivability for Coaxial Cable Required	2 Hours for Riser Coaxial Cable - Sec. 24.3.6.8	2 Hours for Riser Coaxial Cable - Sec. 9.6.2.1.3	Backbone Cable Routed Through Enclosure Matching Bldgs. Fire Rating Sec. 9.6.2.3	Yes, Sec. 18.12.3.3, 18.12.3.4, 18.12.3.5, & 18.12.3.6
Plenum Rated Coaxial Cable Required	Yes, Riser & Feeder Coaxial Cable Sec. 24.3.6.8	Yes, Riser & Feeder Coaxial Cable - Sec. 9.6.2.1.1	Yes, Backbone & Antenna Distribution Cables Sec. 9.6.2.1	Yes, Backbone & Distribution Antenna Cables Sec. 18.12.3.1
Lighting Protection Required	Not addressed in Sec. 24.5.2	Yes, in accordance with NFPA 780 - Sec. 9.6.3	Yes, Sec. 9.6.3 Installed per NFPA 780	Yes, Sec. 18.4
Isolation of Donor Antenna Required	Yes, 15 db - Sec. 24.5.2.3.3	Yes, 20 db - Sec. 9.6.9	Yes, 20 dB Above System Gain Sec. 9.6.9	Yes, Sec. 18.3.3.2 & 18.10
Battery Backup Required	12 Hours - Sec. 24.5.2.5.5.2	12 - Sec. 9.6.12.2	12 Hours Battery or Generator Sec. 9.6.12.2	Yes, 12 Hours Battery or Generator - Sec. 18.13.2
Signal Strength & Area Coverage Required	-95 dBm - Sec. 24.5.2.3 90% General - Sec. 24.5.2.2.2 99% Critical - Sec. 24.5.2.2.1	DAQ 3.0 - Sec. 9.6.8 90% General - Sec. 9.6.7.5 99% Critical - Sec. 9.6.7.4	DAQ 3.0 - Sec. 9.6.8 90% General - Sec. 9.6.7.4 99% Critical - Sec. 9.6.7.3	DAQ 3.0 - Sec. 18.9 95% General - Sec. 18.8.4 99% Critical - Sec. 18.8.3
Monitoring By Fire Alarm Required	Yes - Sec. 24.5.2.6	Yes Sec. 9.6.13	Yes - Sec. 9.6.13 & Chapter 10 of NFPA 72	Yes, Sec. 18.14 & Chapter 10 of NFPA 72
Cabinets for Equipment & Battery Backup Required	Yes, NEMA 4/NEMA 4X - Sec. 24.5.2.5.2	Yes, NEMA 4/NEMA 4X - Sec. 9.6.11.2	Yes, NEMA 4/4X & NEMA 3R for Batteries Sec. 9.6.11.2	Yes, NEMA 4/NEMA 4X Batteries - NEMA 3R - Sec. 18.3.1
Monitor Antenna Malfunction Required	Yes, Donor Antenna - Sec. 24.5.2.6(2)(a)	Yes, Donor Antenna - Sec. 9.6.13.1(2)(a)	Yes, Donor Antenna - Sec. 9.6.13.2.1(5)	Yes, Sec. 18.14.1.2(2)(a)
System Acceptance/Testing	Sec. 24.5.2.1.2 & 14.4.10	Sec. 9.6.4, 11.3.9 & 11.3.9.1	Sec. 9.6.4, 11.3.9 & 11.3.9.1	Yes, 18.5 & Sec. 20.3.10.1, See Annex
Listing of Equipment	Not Specifically Addressed	Not Specifically Addressed	Specific Listing Requirement TBD by the AHJ	Yes, Sec. 18.12.1.3
Mounting of Donor Antenna	Not Specifically Addressed	Not Specifically Addressed	Not Specifically Addressed	Yes, Sec. 18.3.3
Noise Floor Requirement	Not Specifically Addressed	Not Specifically Addressed	Not Specifically Addressed	Yes, Sec. 18.9.3
Compliance with FCC Part 90.219	Not Specifically Listed in the Standard, Required by Federal Law	Not Specifically Listed in the Standard, Required by Federal Law	Not Specifically Listed in the Standard, Required by Federal Law	Yes, Sec. 18.7.2 & A. 18.7.2 Also Req. Under FCC Rules in the U.S.
Frequency License Holder Approval Required	Yes, under FCC Part 90.219	Yes, under FCC Part 90.219	Yes, Sec. 9.6.2, 9.6.6.1 & 9.6.6.2	Yes, Sec. 18.2.1, 18.7 & 18.12.1.1
Communication Antenna Density/Near Far	Not Specifically Addressed	Not Specifically Addressed	Yes, Sec. 9.6.7.6	Yes, Sec. 18.3.4
Frequencies Required May Include LTE, FirstNet	All assigned frequencies & any modulation technology Sec. 24.5.2.4	All assigned frequencies & any modulation technology Sec. 9.6.10	All assigned frequencies & any modulation technology Sec.	All assigned frequencies & any modulation technology
Dedicated Annunciation Required	Where Required, Sec. 24.5.2.6.2	Where Required, Sec. 9.6.13.2	Where Required, Sec. 9.6.13.2	Where Required, Sec. 18.14.2
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FIGURE 1: NFPA code changes.



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PUBLIC SAFETY CODE REFERENCE: IFC

	IFC - 2015	IFC - 2018	IFC - 2021	IFC 2024 DRAFT
In-Building Solution Required	Sec. 510.1	Sec. 510.1	Sec. 510.1	Sec. 510.1 Note: Exception for One-Story Buildings Less than 12,000 Sq. Ft.
Permit Required	Yes, Sec. 510.3	Yes, Sec. 510.3	Yes, Sec. 510.3	Yes, Sec.
Pathway Survivability for Coaxial Cable Required	Not Specifically Addressed in Sec. 510. Referenced in 2013 NFPA 72 Sec. 24.3.6.8	Yes, Sec. 510.4.2. Reference to NFPA 1221. ** Also See NFPA 1221 TIA 16-2	Yes, Sec. 510.4.2 Reference to NFPA 1221	Where Required in NFPA 1225 2022 Edition
Plenum Rated Coaxial Cable Required	Not Specifically Addressed in Sec. 510. Referenced in 2013 NFPA 72 Sec. 24.3.6.8	Yes, Sec. 510.4.2. Reference to NFPA 1221	Yes, Sec. 510.4.2 Reference to NFPA 1221	Yes, Sec. Reference to NFPA 1225
Lighting Protection Required	Not Specifically Addressed in Sec. 510	Yes, Sec. 510.4.2 Per NFPA 780 as Referenced in NFPA 1221	Yes, Sec. 510.4.2 Per NFPA 1221 Sec. 9.6.3 Installed per NFPA 780	Yes, Sec. Reference to NFPA 1225
Isolation of Donor Antenna Required	Not Specifically Addressed in Sec. 510	Yes, 20 db - Sec. 510.4.2.4 (4)	Yes, 20 db - Sec. 510.4.2.4 (4)	Yes, 20 db Above System Gain - Sec.
Battery Backup Required	24 Hours - Sec. 510.4.2.3	12 Hours - Sec. 510.4.2.3 or 2 Hours Battery with Emergency Generator	12 Hours - Sec. 510.4.2.3 or 2 Hours Battery with Emergency Generator	12 Hours - Sec. Or 2 Hours Battery with Emergency Generator
Signal Strength & Area Coverage Required	-95 dBm - Sec. 510.4.1 95% General - Sec. 510.4.1 99% Critical - Not Specifically Addressed in Sec. 510	DAQ 3.0 - Sec. 510.4.1.1 95% General - Sec. 510.4.1 99% Critical - Sec. 510.4.2 Reference to NFPA 1221	DAQ 3.0 - Sec. 510.4.1.1 95% General - Sec. 510.4.1 99% Critical - Sec. 510.4.1	DAQ 3.0 - Sec. 95% General - Sec. 99% Critical - Sec.
Monitoring By Fire Alarm Required	Not Specifically Addressed in Sec. 510 - See 2013 NFPA 72	Yes, Sec. 510.4.2.5	Yes, Sec. 510.4.2.5	Yes, Sec.
Cabinets for Equipment & Battery Backup Required	Yes, NEMA 4 - Sec. 510.4.2.4 (1) & (2)	Yes, NEMA 4/NEMA 3R - Sec. 510.4.2.4 (1) & (2)	Yes, NEMA 4/NEMA 3R - Sec. 510.4.2.4 (1) & (2)	Yes, NEMA 4/ NEMA 3R - Sec.
Monitor Antenna Malfunction Required	Not Specifically Addressed in Sec. 510	Yes, Donor Antenna - Sec. 510.4.2.4(4)	Yes, Donor Antenna - Sec. 510.4.2.4(4)	Yes, Signal Source Sec.
System Acceptance/Testing	Sec. 510.5.3	Sec. 510.5.3	Yes, New Systems Sec. 510.5.4 Annual - Sec. 510.6.1	Yes, Sec.
Listing of Equipment	Not Required by Sec. 510	Not Required by Sec. 510	Yes, Sec. 510.4	Yes, Sec.
Mounting of Donor Antenna	Not Specifically Addressed in Sec. 510	Not Specifically Addressed in Sec. 510	Yes, Sec. 510.5.1	Yes, Sec.
Noise Floor Requirement	Not Specifically Addressed in Sec. 510	Not Specifically Addressed in Sec. 510	Not Specifically Addressed in Sec. 510	Yes, Sec. Reference to NFPA 1225
Compliance with FCC Part 90.219	Yes, Sec. 510.5.4	Yes, Sec. 510.5.4	Yes, Sec. 510.5.5	Yes, Sec.
Frequency License Holder Approval Required	Yes, under FCC part 90.219 Referenced in Sec. 510.4	Yes, under FCC part 90.219 Referenced in Sec. 510.4	Yes, under FCC part 90.219 Referenced in Sec. 510.5	Yes, Sec.
Communication Antenna Density/Near Far	Not Specifically Addressed in Sec. 510	Yes, Sec. 510.4.2.8	Yes, Sec. 510.4.2.8	Yes, Sec. 18.3.4
Frequencies Required May Include LTE, FirstNet	Yes, Sec. 501.6.2 Additional Frequencies Made Available by FCC	Yes, Sec. 501.6.2 Additional Frequencies Made Available by FCC	Yes, Sec. 501.6.2 Additional Frequencies Made Available by FCC	Yes, Sec. Also See NFPA 1225 A3.3.63
Dedicated Annunciation Required	Not Specifically Addressed in Sec. 510	Sec. 510.4.2 Where Required by NFPA 1221	Sec. 510.4.2 Where Required by NFPA 1221	Sec. Where Required by NFPA 1225
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FIGURE 2: IFC code changes.



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The public safety communications industry is one of the largest fast-growing segments of wireless communications in the world. Fortunately for those who are in the industry, it is mandated and required by nearly every jurisdiction and is only becoming more important as public safety communication enters further into the public consciousness.

It is important for every ICT professional to follow and understand the changes to the code to provide the optimal installation for building owners, deliver potential cost benefits, and offer system integrators a competitive advantage over those who are less privy to code cycles. There have already been major changes and enhancements in NFPA 1225 and upcoming IFC 2024 that will change the way they do business. The evolution of these codes and standards will allow buildings and facilities of many shapes and sizes to be safer for the building inhabitants and our first responders.

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1. “Mission: Feel Safe Inside! Vision: Eliminate In-Building ‘Wireless Dead Zones.’” *Safer Buildings Coalition*, 2022, www.saferbuildings.org/mission.