Are Multi-Carrier Data Modes Illegal in Amateur Radio?

The Key Issues with Emission Designators in Part 97

Mike McGinty raised a legitimate question about the interpretation of Part 97 rules regarding emission types and digital codes, particularly for multi-carrier data modes like LTE. The core of the issue appears to be in two parts of 47 CFR Part 97:

1. Definition of Emission Types (§97.3(c)): This section defines authorized emission types for amateur radio, including RTTY and data emissions with specific designators where only "a digital code of a type specifically authorized in this part may be transmitted." (https://www.ecfr.gov/current/title-47/chapter-I/subchapter-D/part-97)

2. RTTY and Data Emission Codes (§97.309): This section lists both specified digital codes that are authorized, and conditions under which unspecified digital codes may be used depending on frequency band and other requirements. (https://www.law.cornell.edu/cfr/text/47/97.309)

The potential contradiction arises because §97.307(f)(8) authorizes "A RTTY or data emission having designators with A, B, C, D, E, F, G, H, J or R as the first symbol; 1, 2, 7, 9 or X as the second symbol; and D or W as the third symbol" (https://www.law.cornell.edu/cfr/text/47/97.307)

while the definition in §97.3 appears to be more restrictive for

some emission types.

The LTE Question

LTE (Long-Term Evolution) uses OFDMA (Orthogonal Frequency-Division Multiple Access), which is a multi-carrier modulation technique. The emission designator for such transmissions could be something like G7W or D7W based on emission designator standards. There is ambiguity about whether this precisely fits within the authorized emission types in Part 97.

Possible Interpretations

There are several ways to interpret these rules:

1. **Strict Interpretation**: Only specifically listed emission designators are allowed, making some modern digital modes (including amateur LTE implementations) potentially unauthorized.
2. **Liberal Interpretation**: The rule allowing "unspecified digital codes" (§97.309(b)) encompasses modern digital modes as long as they meet bandwidth and other technical requirements. Modes includes the way they are emitted and we don't really have a problem.
3. **Documentation-Based Interpretation**: As Paul Williamson suggested, there may be an "established understanding with FCC" that emission modes can be unspecified *in the same way* that digital codes can be unspecified, as long as the full details of the mode are published.

Is There any Existing FCC Guidance or Documentation?

After Paul suggested that there might be a letter or document that addresses this, I made attempts to search and asked around. While I was unable to find specific FCC guidance documents or formal letters directly addressing this question for amateur radio LTE or similar modern multi-carrier digital modes, I can say that there is precedent for the FCC taking a more permissive approach to new digital modes:

1. In 2016, the FCC proposed rule changes to remove limitations on the symbol rate for amateur radio data transmissions while maintaining bandwidth limitations (https://www.federalregister.gov/documents/2016/08/12/2016-19085/amateur-radio-service-rules-to-permit-greater-flexibility-in-data-communications) I assert that this shows a general trend toward technical flexibility.
2. The provision in §97.309(a)(4) indicates that "An amateur station transmitting a RTTY or data emission using a digital code specified in this paragraph may use any technique whose technical characteristics have been documented publicly" (https://www.law.cornell.edu/cfr/text/47/97.309) which strongly suggests openness to innovation within specified categories and is a rule widely used by experimenters. There are no reports of restrictions, repercussions, or negative outcomes when amateur operators have relied upon public documentation for digital codes not otherwise specified.

This begs the question: Can we assume that "An amateur station transmitting a RTTY or data emission may use any emissions technique whose technical characteristics have been documented publicly"?

Interpretation

The interpretation of amateur radio service rules regarding multi-carrier modes like LTE falls into a gray area that hasn't been explicitly addressed by the FCC. The concern that Mike raises is therefore valid - there is tension between the specific emission designator definitions and the broader allowances for unspecified digital codes.

Paul's suggestion that "there is an established understanding with FCC that emission modes can be unspecified in the same way that digital codes can be unspecified, as long as the full details of the mode are published" aligns with the spirit of amateur radio's experimental nature, but I couldn't find formal documentation supporting this understanding.

Given the FCC's trend toward embracing technical innovation while maintaining good spectrum practices, this is indeed potentially a "bear best left unpoked" as Paul suggested, unless the amateur radio community seeks formal clarification through a petition for declaratory ruling from the FCC.

We could take the opportunity to suggest clarifying language that would explicitly encompass modern multi-carrier digital modes while maintaining appropriate technical standards and interference protection.

Option 1: Adding Specific Commercial LTE Emission Designators

Commercial LTE typically uses emission designators like G7W, D7W, or W7D, depending on the specific implementation. Simply adding these to the list of authorized designators would be a

straightforward and easy approach, but it has some serious limitations:

1. It would address only the current implementation of LTE without future-proofing for evolving technologies.
2. It might not address other multi-carrier modes beyond LTE.
3. It would require updating the rules again for each new technology.
4. It doesn't really fit into the Delete, Delete, Delete 25-133 proceeding because it's adding and not taking away.

Option 2: Comprehensive Modernization Approach

A more forward-looking approach would be to amend 47 CFR Part 97 with language that explicitly embraces modern digital techniques while maintaining appropriate technical standards.

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I. INTRODUCTION

1. In this Notice of Proposed Rulemaking (or comment,
or reply-to), we share proposed amendments to Part 97
of the Commission's Rules governing the Amateur Radio
Service. These proposed rules clarify and update the
authorized emission types for digital communications.
These proposed changes aim to explicitly accommodate
modern multi-carrier digital modes, such as those based
on orthogonal frequency-division multiplexing (OFDM)
technologies, while maintaining appropriate technical
standards and interference protection.

II. BACKGROUND

2. The Commission's rules in Part 97 define various
emission types authorized for amateur radio operators
in § 97.3(c) and specify standards for RTTY and data
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emissions in § 97.309. These rules were established before many modern digital communication techniques were developed and in some cases do not clearly accommodate innovative technologies now commonly used in other radio services, including highly popular and efficient multi-carrier modulation methods.

3. Multi-carrier modulation techniques, such as those used in LTE (Long-Term Evolution) and other OFDM-based systems, offer significant advantages for efficient spectrum use and robustness against interference. Amateur radio operators have adapted these technologies for experimentation and improved communications, but questions have arisen about whether such modes are fully compliant with existing Part 97 emission designator requirements.

III. DISCUSSION

4. We propose to amend Part 97 to clarify that modern multi-carrier digital modes are authorized for amateur radio communications, provided they comply with other technical parameters specified for the relevant frequency bands. For example, a multi-carrier mode that exceeds the entire allocated bandwidth of an amateur band would obviously not be an authorized transmission. Specifically, we propose the following changes:

A. Proposed Rule Changes

5. We propose to amend § 97.3(c)(2) as follows:

(2) Data. Telemetry, telecommand and computer communications emissions having
   (i) designators with A, B, C, D, E, F, G, H, J, R or W as the first symbol, 1, 2, 7, 9 or X as the second symbol, and D or W as the third symbol;
   (ii) emission J2D; and
   (iii) emissions A1C, F1C, F2C, J2C, and J3C having an occupied bandwidth of 500 Hz or less when

transmitted on an amateur service frequency below 30 MHz.

6. We further propose to amend § 97.309 by adding a new paragraph (c) as follows:

(c) An amateur station may transmit any digital emission using a multi-carrier modulation technique, including but not limited to orthogonal frequency-division multiplexing (OFDM), provided that:
   (1) The emission complies with all bandwidth limitations specified in § 97.307 for the frequency band in use;
   (2) The technical characteristics of the emission have been documented publicly;

B. Effect of Proposed Changes

7. These proposed changes would explicitly authorize the use of multi-carrier digital modes like those based on OFDM technology, including amateur adaptations of LTE and similar systems. Adding "W" as an authorized first symbol in emission designators would encompass cases where the carrier is modulated using combinations of amplitude and angle modulation or where multiple carriers are employed. The additional provisions in § 97.309(c) would ensure that such operations maintain the experimental and open nature of amateur radio while preventing misuse.

8. We believe these changes would eliminate ambiguity while promoting technical innovation in the Amateur Radio Service. The requirement for public documentation of technical characteristics would maintain the educational and experimental purposes of the service.

IV. CONCLUSION

9. The proposed rule changes would modernize Part 97 to

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explicitly accommodate contemporary digital
communication technologies while preserving the
fundamental purposes and technical disciplines of the
Amateur Radio Service.
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Option 3: Harmonization with International Approach

Another approach would be to harmonize with the ITU Radio Regulations' approach to emission classification, which might provide more flexibility. This would involve referring directly to the ITU emission classification system rather than listing specific designators, focusing on bandwidth limitations and interference protection rather than specific emission types, and (like above) establishing that any emission type that meets technical parameters is permitted unless specifically prohibited.

Recommendation

Option 2 provides the most comprehensive solution as it explicitly addresses multi-carrier modes including OFDM-based systems like LTE, adds the emission designator first symbol "W" which is used for combined or multi-carrier modulation, and creates a framework that can accommodate future innovations *without requiring constant rule updates*. We want to maintain the core principles of amateur radio regarding openness and documentation while also preserving technical standards and doing all we can to prevent interference. Option 2 is the one most likely to resolve Mike's concern that "all ham multi-carrier data is illegal”.

Comments and critique welcome and encouraged!

With Mike’s permission, it would be great to include the original

question and context in our April newsletter.

-Michelle Thompson, for Mike McGinty, with Paul Williamson