Contesting with Error-Correcting Modes: The Early Years

With the first 8 years of shortwave contesting with FT modes behind us, here's a look at where we stand today.

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FT8 and FT4 modes have created a unique operating experience. They allow for weak-signal communication over long distances in poor conditions by offering time-slot cycles and forward error correction (FEC) techniques. Operators can't read messages while they're being received (which was the case for RTTY and PSK), and they can't perform any tasks in between contacts. After decoding a message, they have only a few stressful seconds to make their operating decisions before the transmit cycle starts again. Additionally, use of the *auto-sequencer* (which automatically selects the next message to send) means operators only need to click a button after each contact. FT contesting is both stressful and relaxing.

A Contest Within a Single Audio Bandwidth

If you entered an FT contest in a single-band category when these modes first came out, that meant you worked the entire contest within a single audio bandwidth. The waterfall in Figure 1 shows 4 kHz bandwidth, which is empty below 400 Hz (these frequencies should be avoided because many receivers have difficulty receiving there). The band is crowded until around 2.5 kHz; above that, many stations can't receive. The premium frequencies lie between 500 Hz and 2 kHz. Strong DX stations found their place from 2 to 3 kHz. The spectrum is usually empty above 3 kHz.

In his January 2019 *QST* article, "FT8 in the ARRL RTTY Roundup," Joe Taylor, K1JT, shared that operating FT modes in higher frequencies was more common at that time, but this seems to have changed. Operators select the recommended subbands (7.090 MHz, 14.090 MHz, etc.), but this is not just habit — *WSJT-X* decodes from the lower frequencies first. Operators set the auto-sequencer to reply to the first decoded message, so the lowest frequency is selected first in every pileup.

It's also a logical result of *split-mode operation* (transmitting on one frequency and listening on another). In the beginning, operators moved their upper sideband frequencies freely. This worked because operators using the *search-and-pounce method* (tuning across the bands and listening to CQ calls) responded on the exact same frequency of the CQ call, but it's no longer possible. Figure 1 explains why. For simplicity, let's assume all operators use 2 kHz bandwidth. Operator A runs CQ, but it's crowded. Operator B, using the search-and-pounce method, moves up by 1 kHz and now sees 2 to 3 kHz, but that doesn't help. A frequency above 2 kHz might be available, but there, operator A can't hear operator B's signal. Operator B could call CQ, but that still doesn't help them much, because operator A can't hear them above 2 kHz, and operator C can't hear them below 2 kHz. If operator A responds below 1 kHz, or operator C responds above 3 kHz, then operator B won't hear them.

Shortening the Contact

If you want to become a faster SSB operator, you need to talk faster. This isn't the case with FT modes,

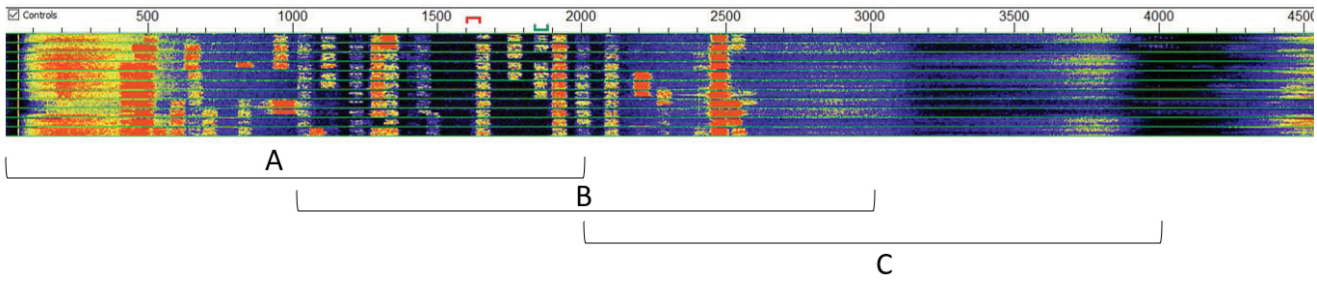

Figure 1 — A waterfall example from the 2022 WW Digi Contest with 4 kHz audio from USB frequency 21.090 MHz. Bandwidths A, B, and C visualize portions of the spectrum that stations with 2 kHz bandwidth might see.

because they have a fixed time-slot length. The standard contact format is unnecessarily long; search-and-pounce stations and *run stations* (those actively transmitting and looking for contacts) can both make a contact with a single transmission, but they experience different challenges.

Run station operators often omit sending "73" messages; "RR73" triggers logging in *WSJT-X*, so they can confidently log upon receipt of this message. Transmitting "73" communicates no useful information when operating FT modes because the contact is already logged. If run stations can maintain a pileup, they need fewer CQ time slots (see Figure 2). Now, run stations can transmit "RR73" in reply to **CALL**, **MY CALL**, **EXCHANGE** (see Figure 3), because a new *WSJT-X* feature can highlight "73" messages as if they were a CQ, which will benefit the run method. However, run stations can't maintain a pileup indefinitely because the exchange is not repeated. Run station *rates* (the speeds at which contacts are made) suffer most when they need to call CQ for extensive durations without replies.

Search-and-pounce station operators answer CQs with **CALL**, **MY CALL**, **ROGER**, **EXCHANGE**. Run operators then answer with "RR73," and the search-and-pounce operator omits "73," as shown in Figure 4. Search-and-pounce station rates drop when someone else is selected in pileups. These operators also suffer when they're not received by a run station. If a run operator keeps sending CQ, then the search-and-pounce operator knows they aren't being received. But if a run station works a pileup, then search-and-pounce stations can't distinguish between not being selected and not being received.

Your chosen strategy depends on the changing numbers of available run and search-and-pounce stations. When everyone is operating with the search-and-pounce method, then you should choose the run method because you'll maintain a pileup. Similarly, if everyone is using the run method, then you should operate as a search-and-pounce station because there won't be any pileups, and you'll get the first reply while they waste time calling CQ. Adapt your strategy to the behavior of others, but know that they will too. It's fascinating to operate these dynamic FT contests!

The Conundrum of High Error Rates

One surprising lesson from the early FT contests was that logbook error rates were higher with error-correcting modes, as noted in the May 2020 *NCJ* article "FT4 and FT8 Contesting" by Steve Franke, K9AN, et al. Operators had less experience. Error rates

31615	Tx		1132	~	CQ WW OE1GAQ JN88
31630	3	0.6	1133	~	OE1GAQ LC0A JP40
31630	-11	0.1	1969	~	OE1GAQ DH1OL JN39
31630	19	0.1	552	~	OE1GAQ DM3X JO63
31645	Tx		1132	~	LC0A OE1GAQ R JN88
31700	1	0.6	1133	~	OE1GAQ LC0A RR73
31700	17	0.0	552	~	OE1GAQ DM3X JO63
31700	-11	0.8	927	~	OE1GAQ G6KHW IO91
31700	-14	-0.1	922	~	OE1GAQ EA3FP JN11
31715	Tx		1132	~	DM3X OE1GAQ R JN88
31730	16	0.0	552	~	OE1GAQ DM3X RR73
31730	-11	0.5	1969	~	OE1GAQ GH1OL JN39
31730	-11	0.8	928	~	OE1GAQ G6KHW IO91
31730	-13	0.1	922	~	OE1GAQ EA3FP JN11
31745	Tx		1132	~	DH1OL OE1GAQ R JN88
31800	-14	0.5	1970	~	OE1GAQ DH1OL RR73
31815	Tx		1132	~	CQ WW OE1GAQ JN88

Figure 2 — Run stations need a CQ time slot, plus a single time slot per contact (shown in yellow). In this example, I worked a pileup as a run station. I ran CQ, then the auto-sequencer (with Call 1st enabled) replied to the first station in the pileup, LCØA. Once that contact was logged, I replied to the next station, DH1OL. I don't waste time slots on "73"; I either reply or run CQ.

stayed high, but now it's a choice. It's a gut feeling as to whether others logged you. Of course, the cost is a higher chance of not being logged (*not in log*, or *NIL*), but my own NIL stayed around 5.5% (2020), 5.9% (2021), 3.8% (2022), and 3.7% (2023). I won't double or triple my contact length because it might reduce my NIL by 3%.

Logging Insecurities and Unreliable Channels

In the early years, operators were cautious when logging contacts — after all, you were penalized when the other station didn't log. It was like the Two Generals' Problem — two parties need to make an agreement while communicating over an unreliable channel. Here's how it might go in amateur radio:

1. A run station sends CQ.

2. A search-and-pounce station answers the call.

3. The run station receives the answer, but the search-and-pounce station doesn't know if their message got through. If the run station operator logs the contact, but the search-and-pounce operator doesn't, then the run operator will get penalized. So, the run station operator sends a message back.

4. The search-and-pounce station receives the run operator's message. They now know that the other station received their second message, but the run station doesn't know if their message will get through.

```
55745  Tx        1327 +  CQ WW OE1XTU JN88
55752 -17  0.3  1328 +  OE1XTU F5LMJ JN28
55800  Tx        1327 +  F5LMJ OE1XTU R JN88
55802  Tx        1327 +  F5LMJ OE1XTU RR73
55807  15 -0.1  1698 +  OE1XTU G2U IO91
55807 -17  0.2  1326 +  OE1XTU F5LMJ 73
55815  Tx        1327 +  G2U OE1XTU R JN88
55816  Tx        1327 +  G2U OE1XTU RR73
55822  18 -0.1  1698 +  OE1XTU G2U 73
55830  Tx        1327 +  CQ WW OE1XTU JN88
```

Figure 3 — Run stations can make a contact with a single transmission (plus CQ) by acknowledging a **CALL**, **MY CALL**, **EXCHANGE** reply with **CALL**, **MY CALL**, **RR73**. You can see from the timestamps in the left column that I quickly changed to a different message manually.

So, the search-and-pounce operator sends a message back. And so on.

There is no solution to the Two Generals' Problem. No amount of "RRR," "RR73," or "73" will ensure that the other operator logged the contact. Early on, we treated FT contacts like the Two Generals' Problem, but they're not. First, you aren't blindly initiating contacts with random call signs — you're responding to a CQ. Wireless communication channels are, in theory, reciprocal, and your answer should be received. You've received their message, so you logged the contact. Our operating insecurities caused the logging errors, but now we're more confident. FT is just another unreliable mode when bands are overcrowded in contests. Error correction didn't change that aspect of contest operations.

Low Scores of the Early Years

The only thing that mattered in the first years of FT operations was taking this fledgling contest mode seriously and operating more hours. The disputed WW Digi Contest category is Single Operator, All Band; high power doesn't provide much advantage. You're guaranteed a worldwide top-10 finish in other categories if you're willing to put in the time.

Contact Rates

Standard FT8 operations can yield 60 contacts per hour with two transmissions per contact, or 120 contacts per hour with single-transmission contacts. FT4 doubles single-transmission contacts to 240 per hour. Additionally, top-scoring single operators operate Two Bands Synchronized Interleaved QSOs (also known as 2BSIQ), which can further double their contact rates.

Boyan Petkov, LZ2BE, holds a record rate of 116 contacts per hour, which isn't even close to a theoretical maximum of 480 contacts per hour. The audio bandwidth limits the number of available stations to about 30 FT4 or 60 FT8 signals. Having more stations available for a contact (not just the improved reception of weak signals over FT4) is a huge reason that FT8 is still popular in contest operations. Contact rates can also be lost to inefficiency (not getting selected as search-and-pounce, not getting a reply as run, having messages lost in propagation, and experiencing interference).

```
01730  24   0.4  2611 ~  CQ WW R3ST KO94
01746  Tx        1179 ~  R3ST OE1GAQ JN88
01747  Tx        1179 ~  R3ST OE1GAQ R JN88
01800  23   0.4  2612 ~  OE1GAQ R3ST RR73
01815  Tx        1179 ~  CQ WW OE1GAQ JN88
```

Figure 4 — A typical search-and-pounce contact that was made in 2022. Run station R3ST received only one message: **CALL**, **MY CALL**, **ROGER**, **EXCHANGE**.

Operators switch time slots, rotate antennas, hop between FT4 and FT8, and change bands. Top rates are not determined by FT time-slot structure, but by skilled operators.

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All figures provided by the author.

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Strays

QST Congratulates...

Ron Brandon, N4AH, on the publication of his memoir, *CQ DX: My Lifelong Addiction to Ham Radio*. The book chronicles Ron's decades-long journey through the world of DXing, culminating in a climactic DX contact with the remote Scarborough Reef in the South China Sea. The book will be available on Amazon.