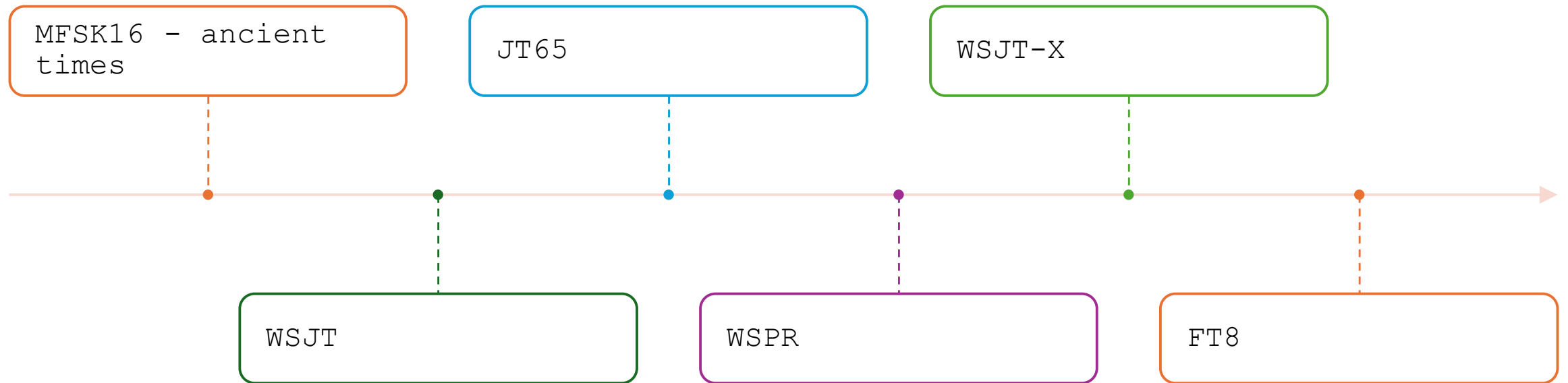


Lessons learned when implementing FT8

Daniel Paul



Why and how we got here



Complete FT8 QSO

1. Hello?
2. Hello.
3. Can you hear me?
4. Yep pretty well...can you hear me?
5. Yep, well see ya.
6. Talk later!

1. CQ call
2. Response
3. Signal Report
4. Confirmation
5. Confirmation and goodbye
6. Goodbye

FT8 Mode & Code

Coding: LDPC + CRC

Modulation: 8-FSK

Symbol rate: 6.25 symbols/second

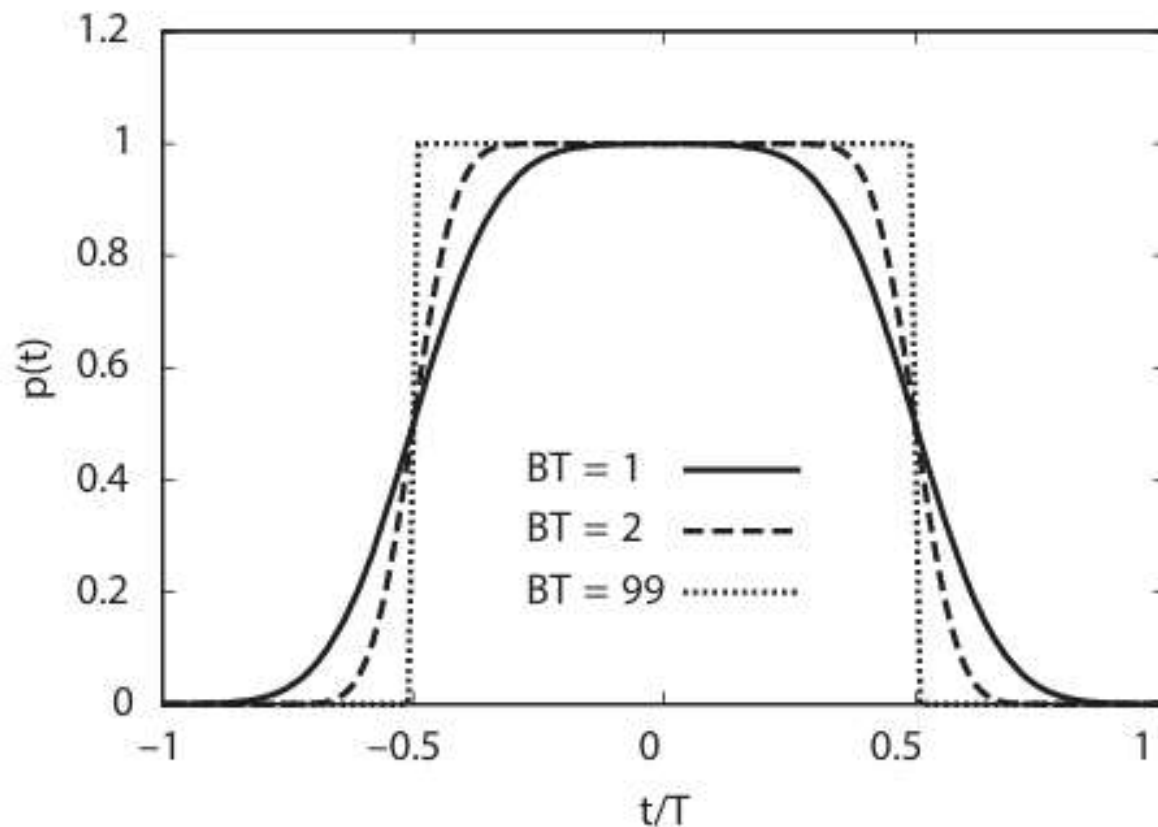
Block size: 174 bits (91 information + 83 parity bits)

Message structure: 77 bit payload, 91 bits after encoding, 174 bits after LDPC

Tone spacing: 6.25 Hz between 8 tones

Transmission time: 12.64 seconds per message

Generated waveforms & bit fields



$$s(t) = A \cos(2\pi f_c t + \phi(t))$$

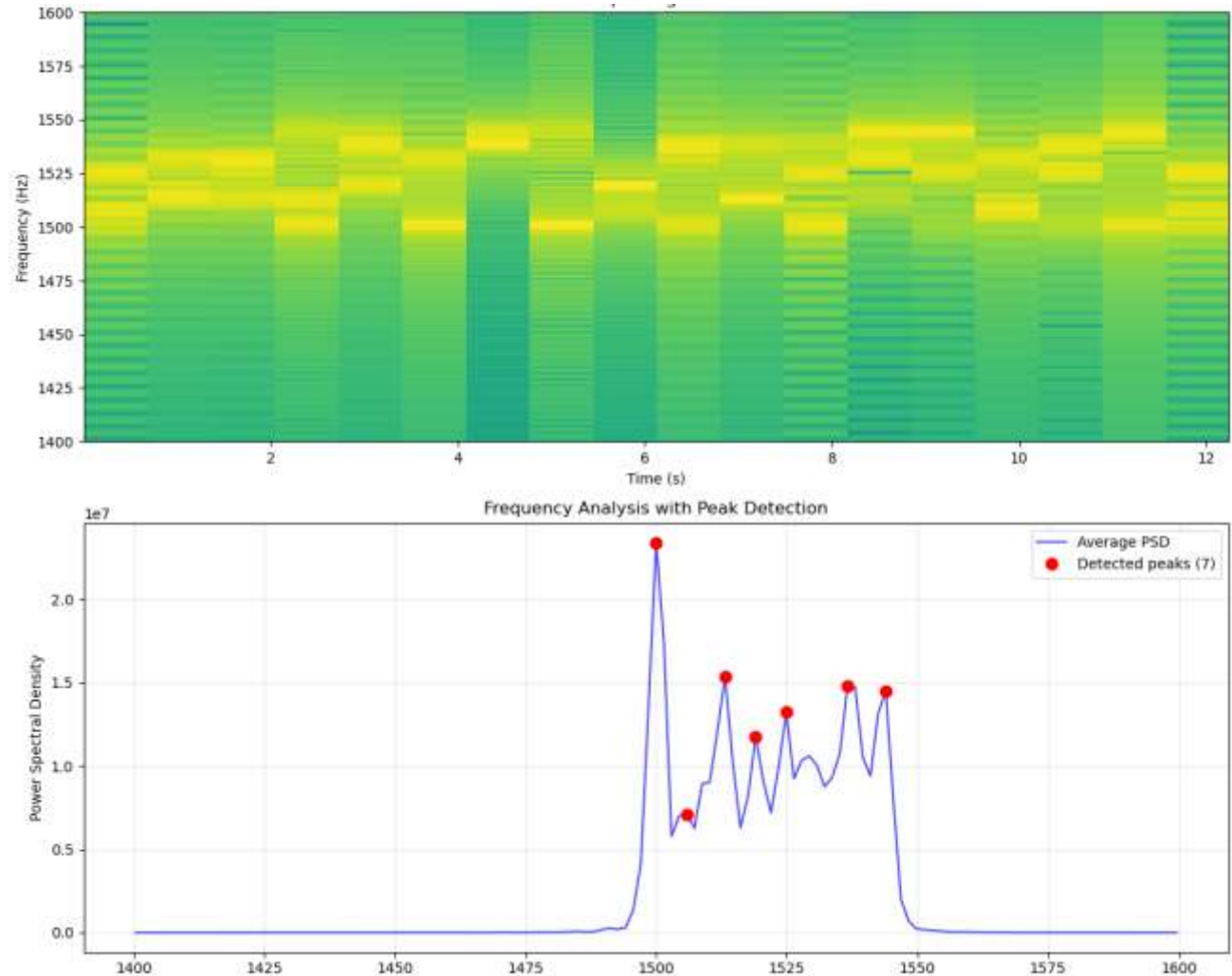
$$p(t) = \frac{1}{2T} \left[\operatorname{erf} \left(kBT \left(\frac{t}{T} + 0.5 \right) \right) - \operatorname{erf} \left(kBT \left(\frac{t}{T} - 0.5 \right) \right) \right]$$

Table 1 - Defined message types for the 77-bit payloads of FT4, FT8, and MSK144.

Type	i3, n3	Purpose	Example message	Bit-field tags
0.0		Free Text	TNX BOB 73 GL	f71
0.1		DXpedition	K1ABC RR73; W9XYZ <KH1/KH7Z> -08	c28 c28 h10 r5
0.3		Field Day	K1ABC W9XYZ 6A WI	c28 c28 R1 n4 k3 S7
0.4		Field Day	W9XYZ K1ABC R 17B EMA	c28 c28 R1 n4 k3 S7
0.5		Telemetry	123456789ABCDEF012	t71
1.		Std Msg	K1ABC/R W9XYZ/R R EN37	c28 r1 c28 r1 R1 g15
2.		EU VHF	G4ABC/P PA9XYZ JO22	c28 p1 c28 p1 R1 g15
3.		RTTY RU	K1ABC W9XYZ 579 WI	t1 c28 c28 R1 r3 s13
4.		NonStd Call	<W9XYZ> PJ4/K1ABC RRR	h12 c58 h1 r2 c1
5.		EU VHF	<G4ABC> <PA9XYZ> R 570007 JO22DB	h12 h22 R1 r3 s11 g25

Encoder Construction

- Step 1: Message generation (text to PDU)
- Step 2: PDU-to-stream converter
- Step 3: Standard stream processing



Implementation lessons

- GNU radio 3.8 vs 3.10
- Python binding (pybind11)
- Cmake configuration
- Porting algorithms into C++ from Fortran
- Synchronous message stream processing vs async messages – PDUs

Next Steps and Acknowledgements

- Decoder completion and more QA testing
- Only then on-air testing
- Thank you Marcus and Wylie!!!