

No-cost Software for Portable DXing:

- Digital Modes
- Propagation Prediction

— Plan before you go!

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2018 April 3
to: BRARA



Hardware and Software Make the Difference

- A basic radio supports Morse, Phone
- Add a small computer and DAC/sound card to evolve into a Basic SDR System
 - software supports digital modes
 - includes high-sensitivity weak signals modes
- When to use your Basic SDR System:
 - software for HF propagation planning

Building the Basic SDR

- “A Software-Defined Radio (SDR) System is a radio communication system which uses software for the *modulation* and *demodulation* of radio signals” [2004]*

* https://web.archive.org/web/20040329020313/https://en.wikipedia.org/wiki/Software-defined_radio

Adding Basic SDR Capability

- “A Software-Defined Radio (SDR) system is a radio communication system which uses software for the *modulation* and *demodulation* of radio signals” [2004]*
- “A basic SDR system may consist of a **personal computer** equipped with a **sound card**, or other **analog-to-digital converter**, preceded by some form of **RF front end** [2009]*



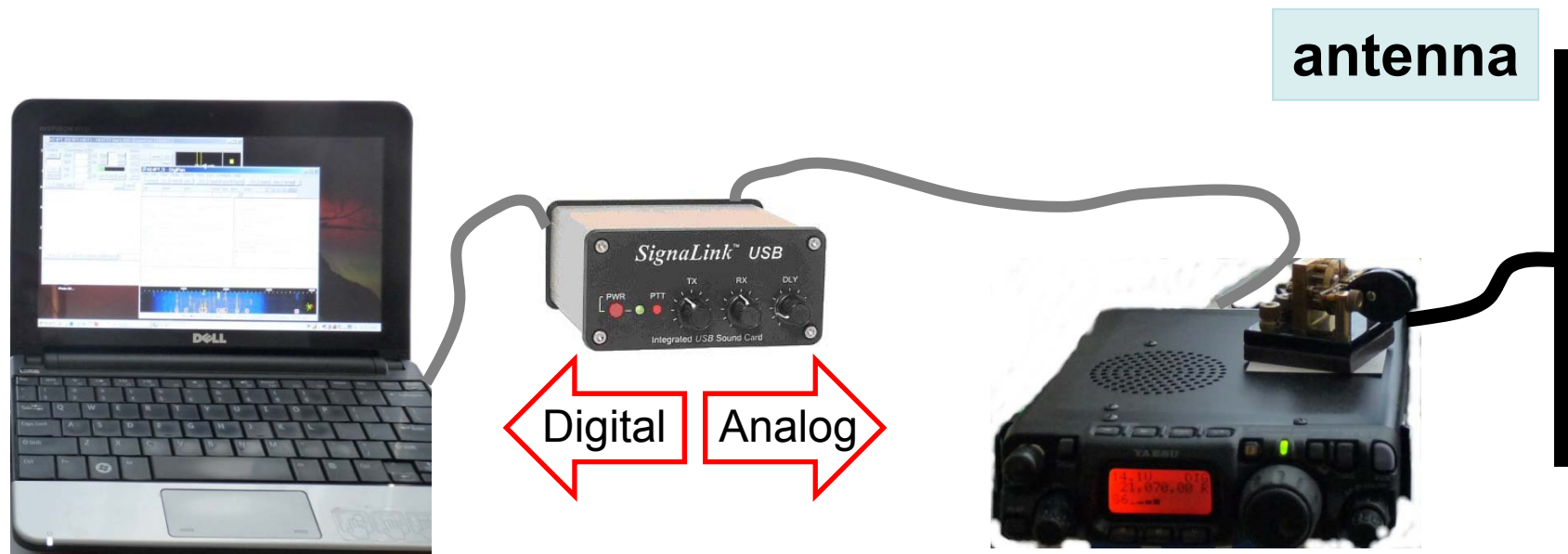
* https://web.archive.org/web/20090331022507/https://en.wikipedia.org/wiki/Software-defined_radio

Adding Basic SDR Capability

- “A Software-Defined Radio (SDR) system is a radio communication system which uses software for the *modulation* and *demodulation* of radio signals” [2004]*
- “A basic SDR system may consist of a personal computer equipped with a sound card, or other analog-to-digital converter, preceded by some form of RF front end [2009]*
- ... Such a design produces a radio which **can receive and transmit widely different radio protocols** (sometimes referred to as waveforms) **based solely on the software used**” [2018]*

* https://en.wikipedia.org/wiki/Software-defined_radio

A Basic SDR System: plug and play



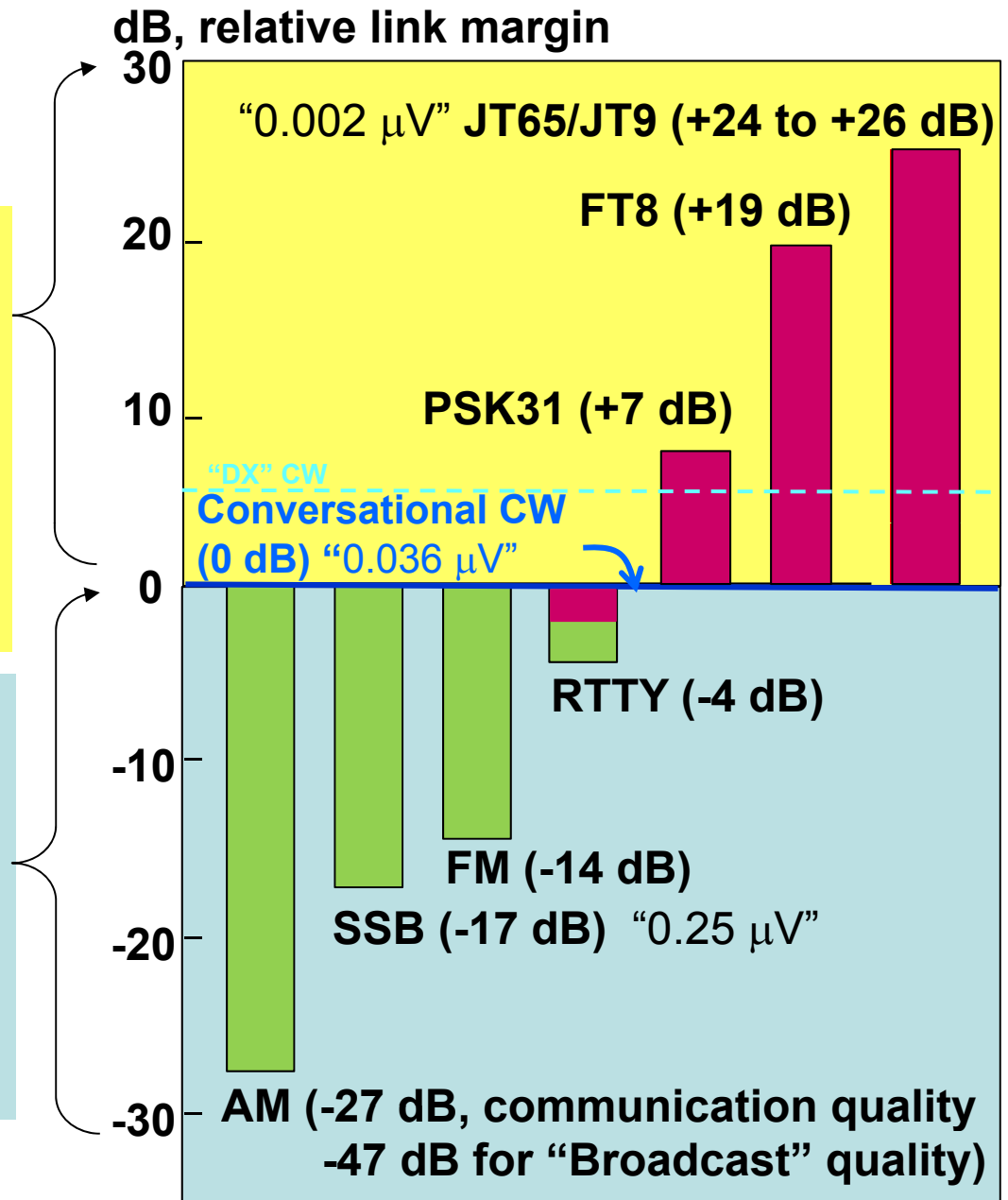
Computer and Software:
Adds “software defined radio” capability

Signalink-USB:
D \leftrightarrow A interface sound card with PTT

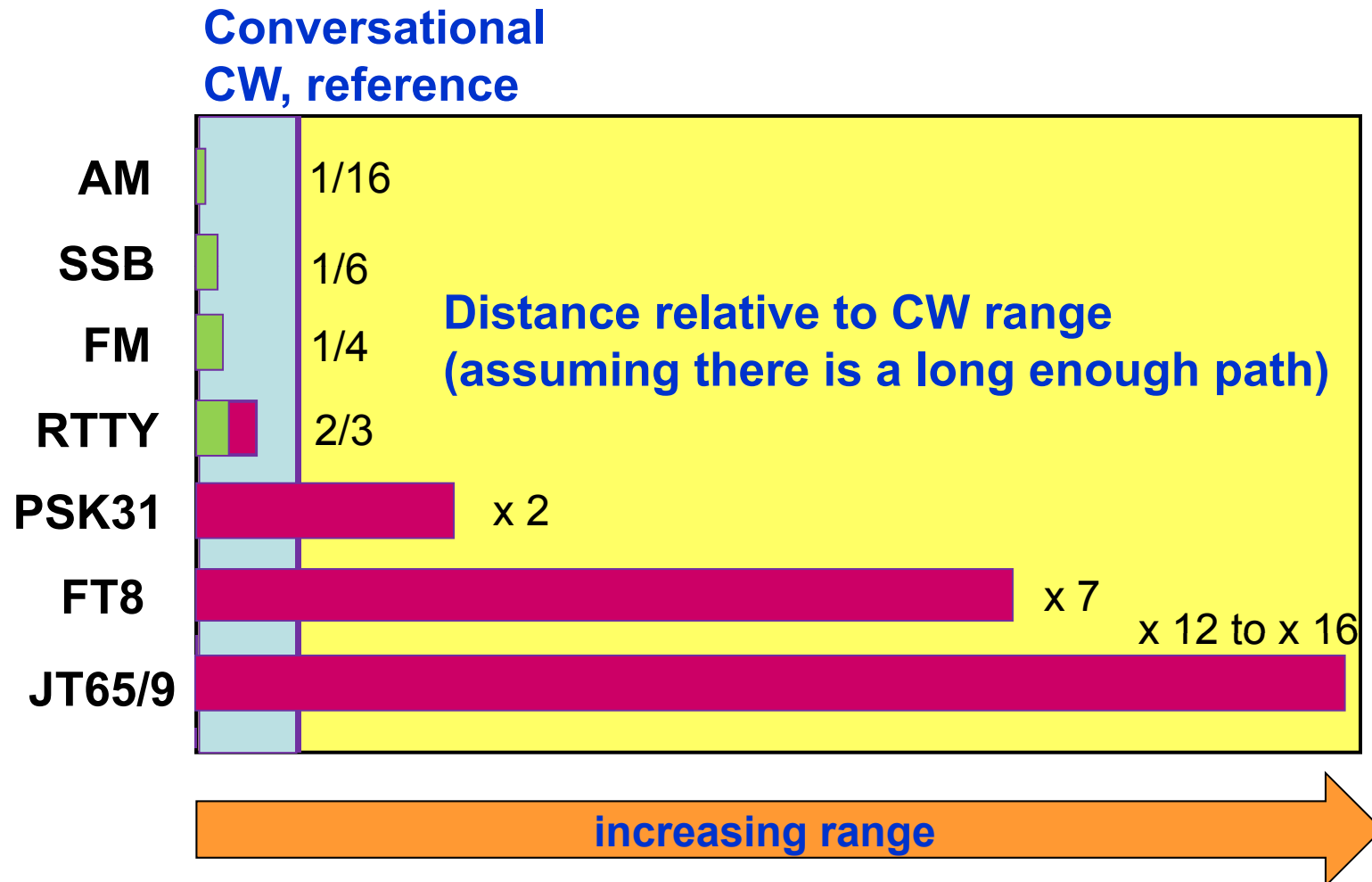
Radio:
Upper Digi/SSB for all digi-modes, last IF: 300 — 2800 Hz

Why SDR?

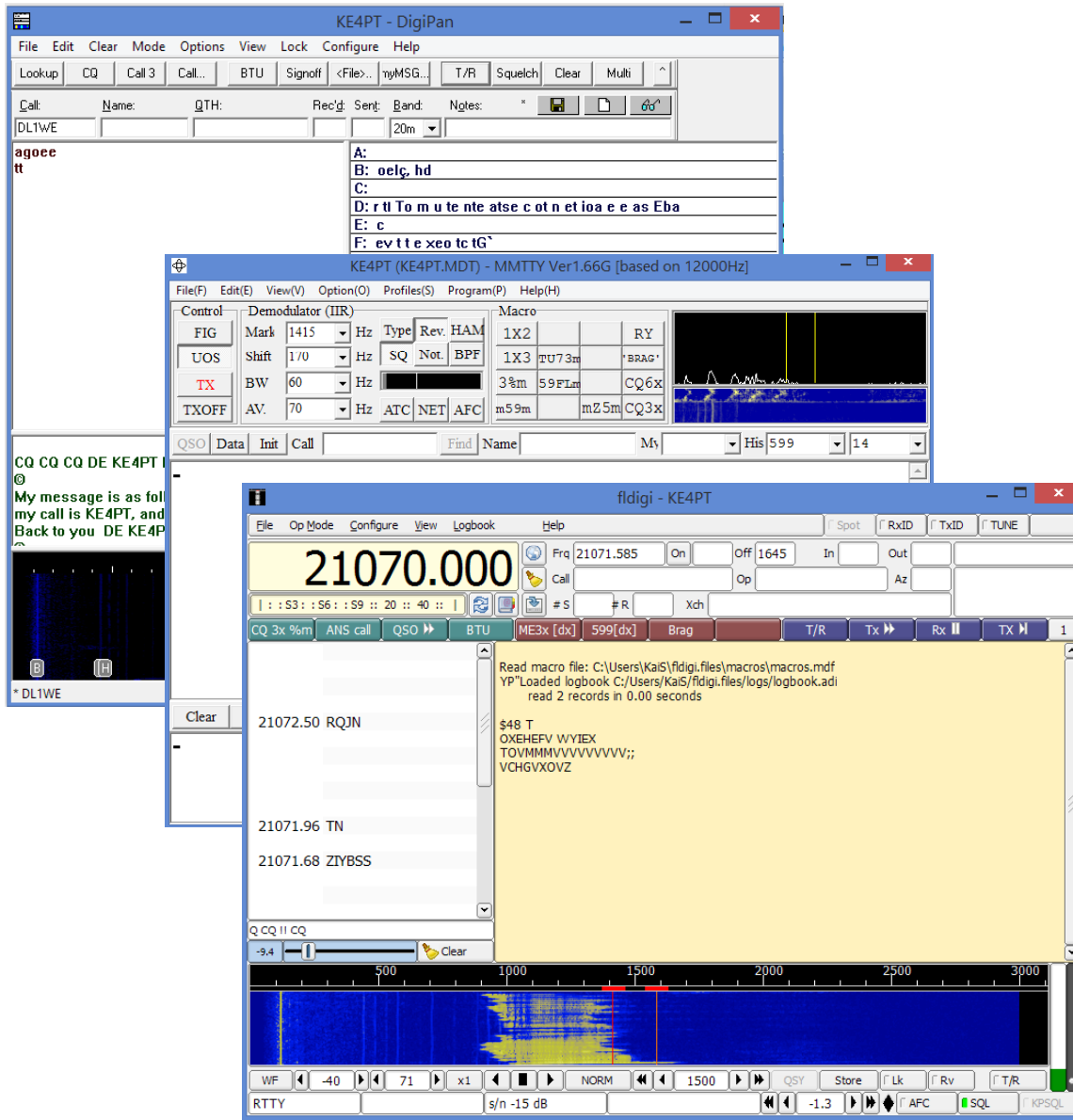
- Basic SDR System supports Software Defined Modulation: can turn “0.25 μV ” into “0.002 μV ”
- Basic Radio has native support for Morse CW, voice and *sometimes* RTTY



What the **SDR System** Buys You

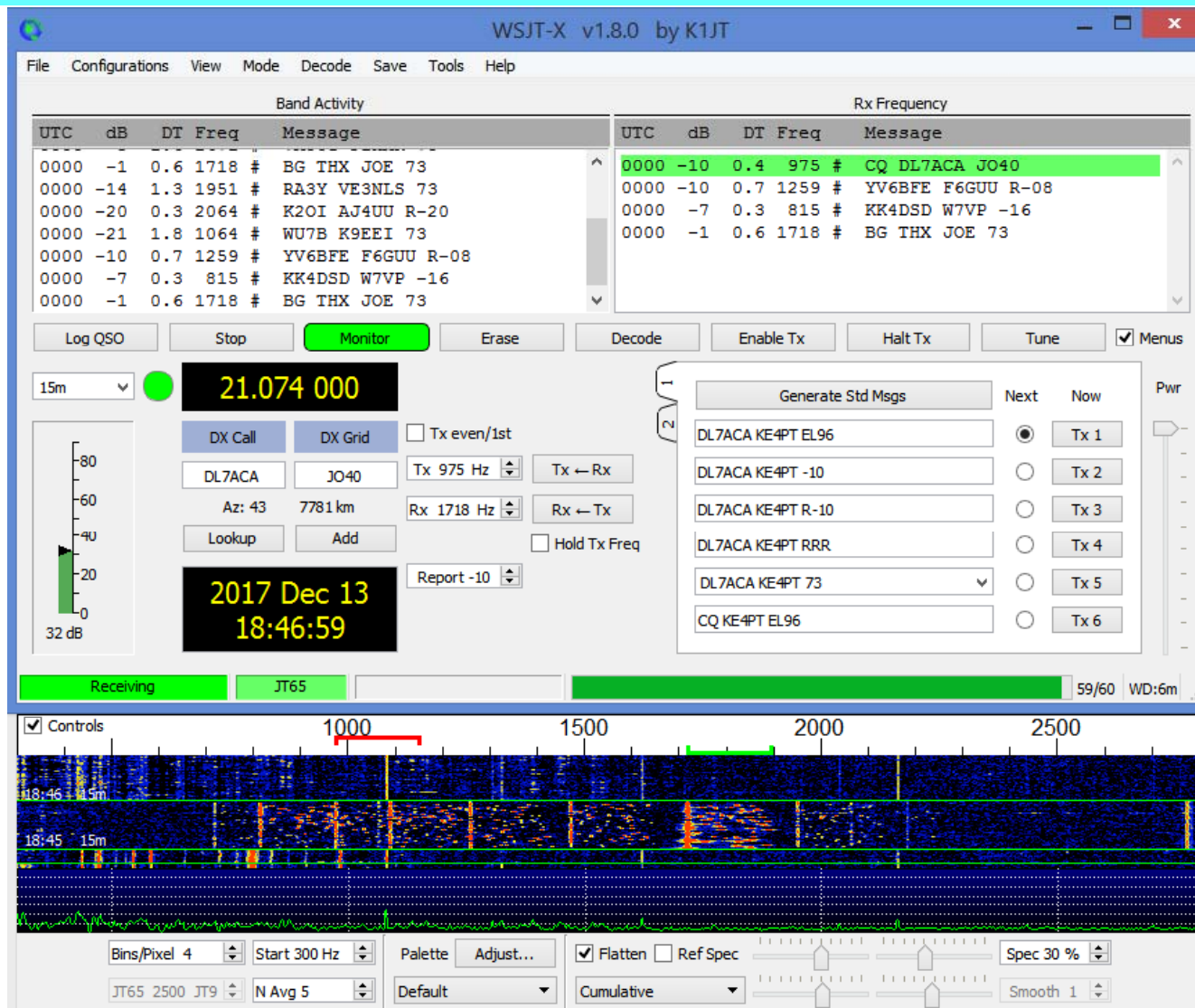


Free Digital Modulation Software



- **Digipan** for PSK (only)
- **MMTTY** for RTTY (only)
- **FLDIGI** for dozens of digital modes, including PSK and RTTY
- More *free* software being produced!

WSJT-X Weak Signal Modes



- **WSJT-X** supports **JT9, JT65, FT8** modes + more
- The Payoff: Can add up to **26 dB** of link margin vs. CW
- See: “WSJT-X Modes”, QST, Oct and Nov 2017

The *WSJT-X* Modes

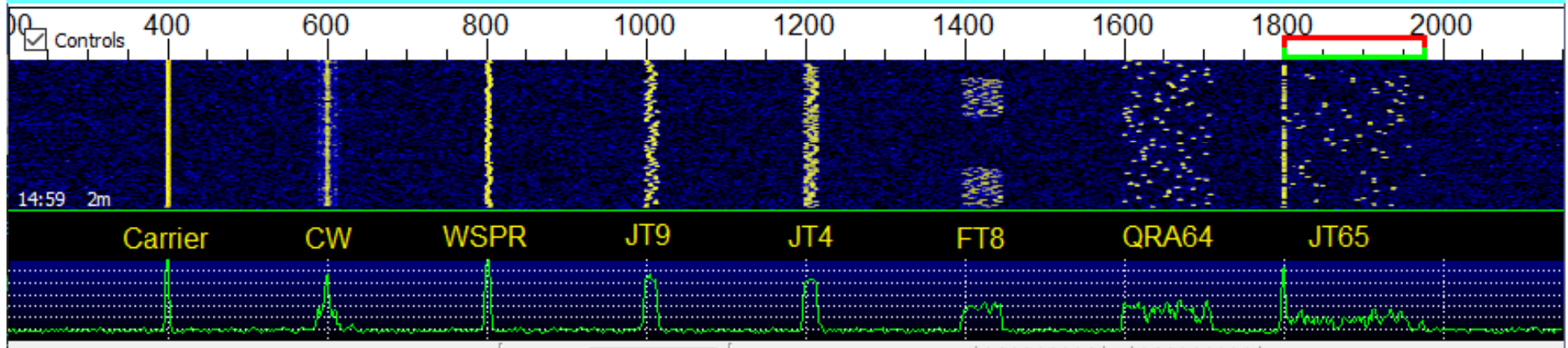


Table 1: Parameters of the Slow *WSJT-X* Protocols

Bandwidths (BW) are for the narrowest submodes. S/N threshold is referenced to a 2,500 Hz bandwidth at a 50% probability for decoding of an unfading signal.

Mode	FEC type (n,k)	q m	Modulation	Keying rate, baud	BW, Hz	Sync energy fraction	TX duration, s	S/N threshold, dB
FT8	LDPC(174,87)	1 3	8-FSK	6.250	50.0	0.27	12.6	-20
JT4	C(206,72)	1 2	4-FSK	4.375	17.5	0.50	47.1	-23
JT9	C(206,72)	1 3#	9-FSK	1.736	15.6	0.19	49.0	-27
JT65	RS(63,12)	6 6#	65-FSK	2.692	177.6	0.50	46.8	-25
QRA64	QRA(63,12)	6 6	64-FSK	1.736	111.1	0.25	48.4	-26
WSPR	C(162,50)	1 2	4-FSK	1.465	5.9	0.50	110.6	-28

#Modulation includes one additional tone used for synchronization.

Source: Joe Taylor, K1JT, Steve Franke, K9AN, and Bill Somerville, G4WJS, "Work the World with *WSJT-X*, Part 2: Codes, Modes, and Cooperative Software Development", QST Nov. 2017.

Propagation Software: when to best use your Basic SDR System

- *Is there a viable propagation path?*
- *Tilt the propagation odds in your favor by planning!*

Use the free stand-alone HamCAP 1.9:

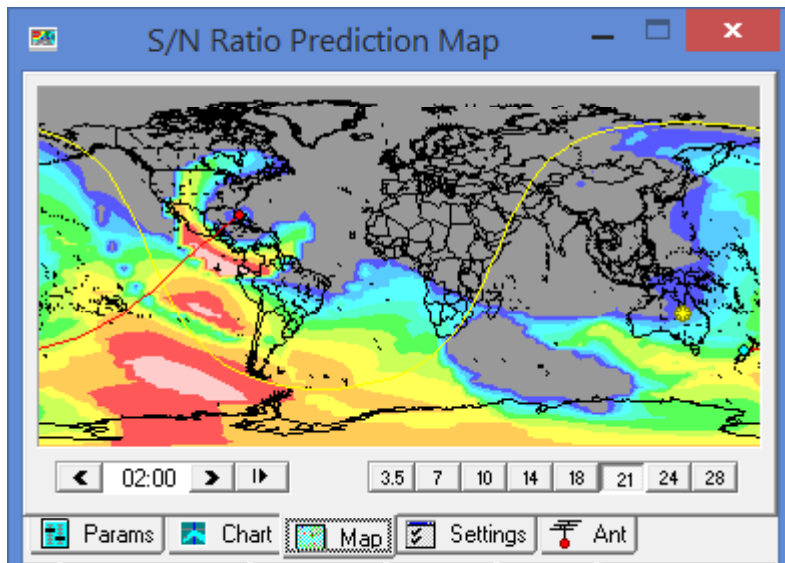
www.dxatlas.com/hamcap/

and / or:

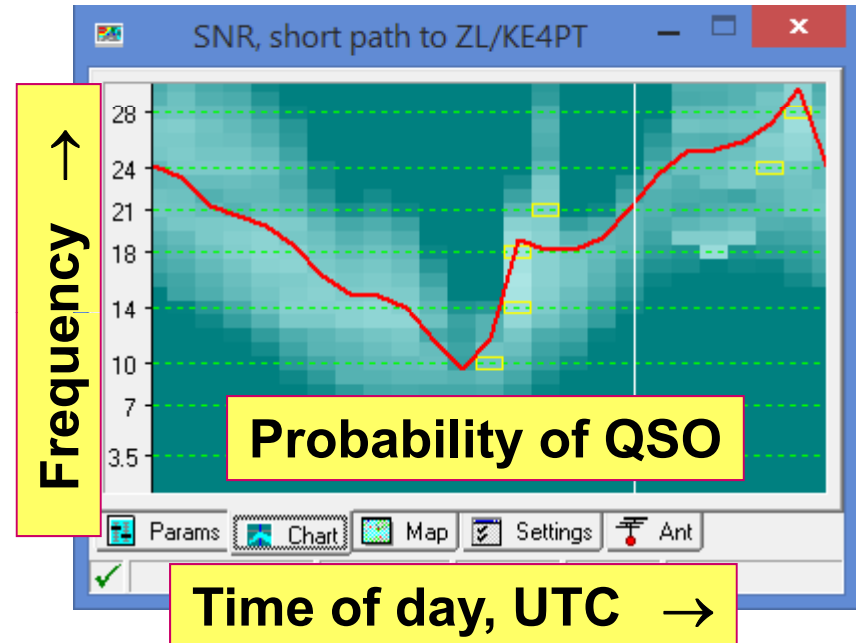
Use the free on-line VOACAP tool:

www.voacap.com/p2p/index.html

HamCAP 1.9 (Free!)

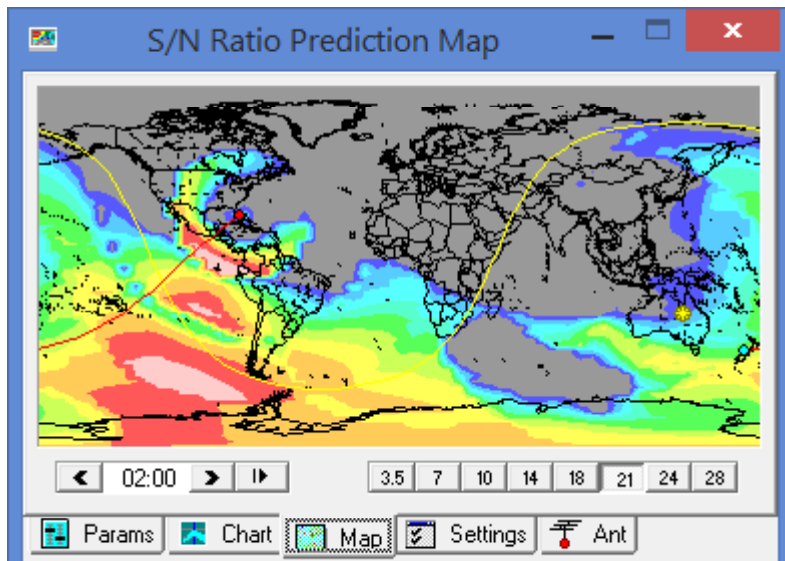


SNR chart: need 24 dB for CW

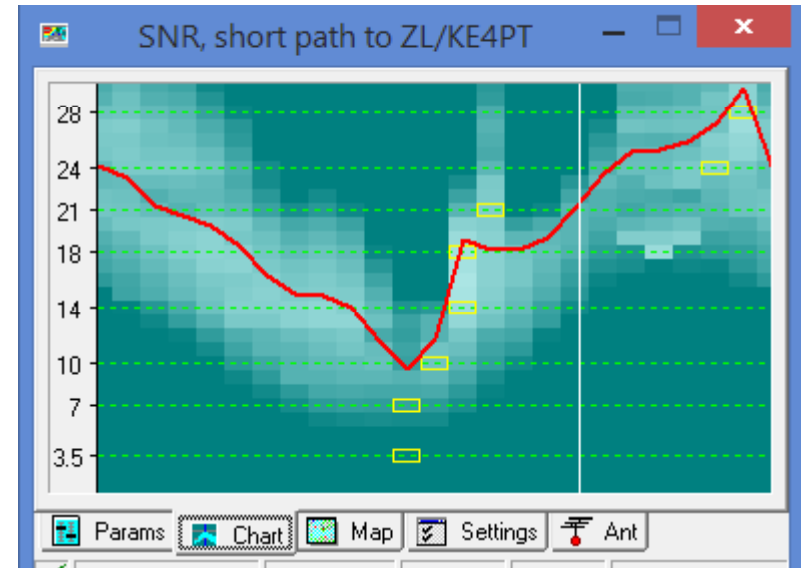


- VOACAP engine, GUI by Alex Shovkoplyas, VE3NEA
- Stand-alone or integrates with *IonoProbe* and *DXAtlas*
www.dxatlas.com/Download.asp

Digital Modes with HamCAP



SNR chart: need 24 dB for CW,
for other modes, *artificially*
select an equivalent higher
transmit power level according
to the Table, then look for the
24 dB SNR levels on the map.



<i>Mode</i>	<i>Margin, dB</i>	<i>Equivalent Power, 5 W radio</i>
CW	0	5 W
PSK31	7	25 W
FT8	19	500 W
JT65	24	1,500 W

VOACAP Online for FREE General Use: www.voacap.com/p2p/index.html

File Edit View History Bookmarks Tools Help

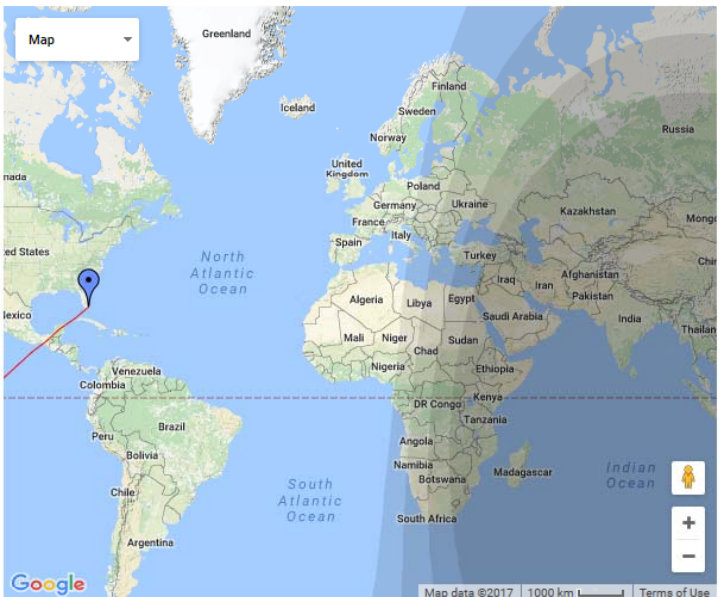
VOACAP Online - professional... X

www.voacap.com/p2p/index.html

hamcap

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Map



Map data ©2017 1000 km Terms of Use

To RX: 13115 km, 8149 mi, 79 ° Grayline: 2017-04-02 17 : 27 Set Reset

Propagation Params

Es: No Model: Auto

SSN: Min.TOA: 0.1 °

Today's Sunrise/Sunset Times (UTC)

	Transmitter		Receiver	
GND	18:39	06:11	11:10	23:38
D	18:08	06:42	10:45	00:04
F	17:28	07:22	10:10	00:38

Transmitter Site

QTH: ZL2 Wellington

Name: Wellington Loc calc

Latitude: -41.2800 [-90..90]

Longitude: 174.7700 [-180..180]

TX antenna: Dipole @ 10M (33ft)

TX power: 500 W

TX mode: CW

Specials: Swap TX-RX Short-path v Unset Home

Current point: Set Home

Receiver Site

QTH: << Select a location >>

Name: RX Loc calc

Latitude: 26.0000 [-90..90]

Longitude: -80.0000 [-180..180]

RX antenna: Dipole @ 10M (33ft)

Noise level: Quiet (153)

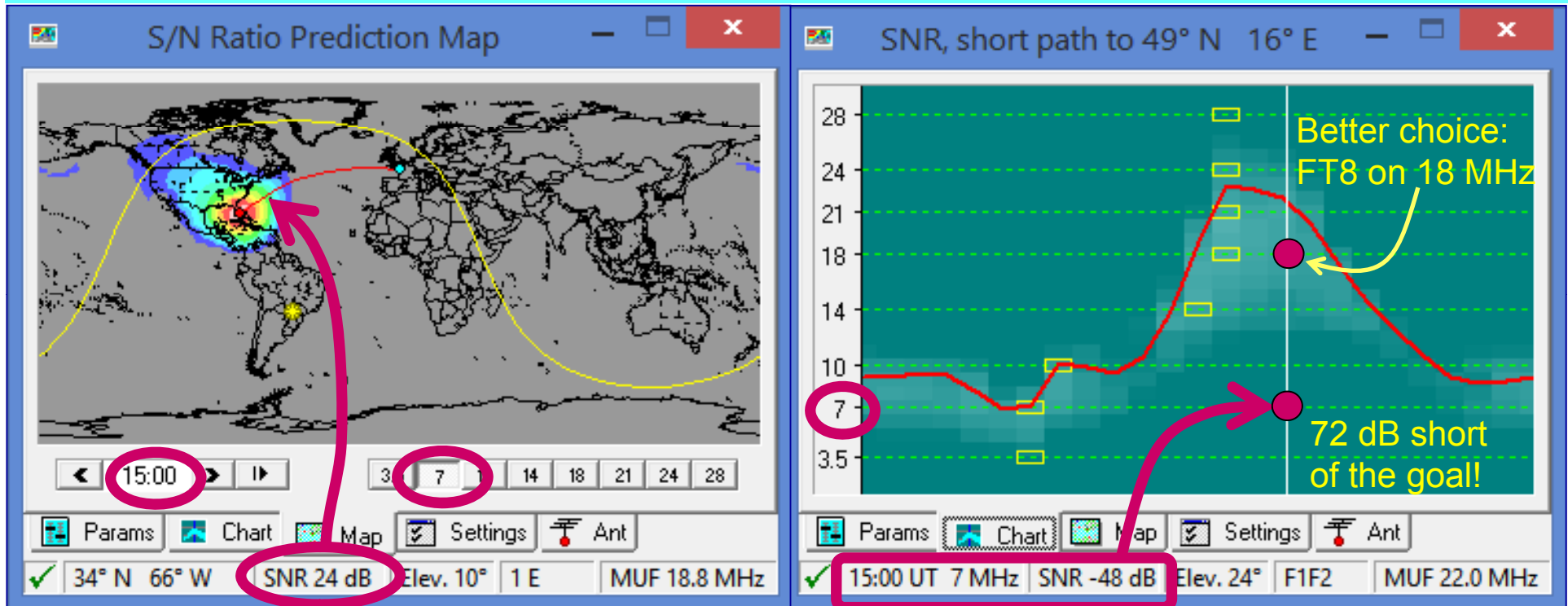
Run prediction!

Fill in the blanks!

Built-in modes: CW, SSB, AM-broadcast

But: you can 'fool it' for JT65, JT9, FT8 and other modes by using the "inflated" equivalent transmit power from the Table!

“Great Expectations”

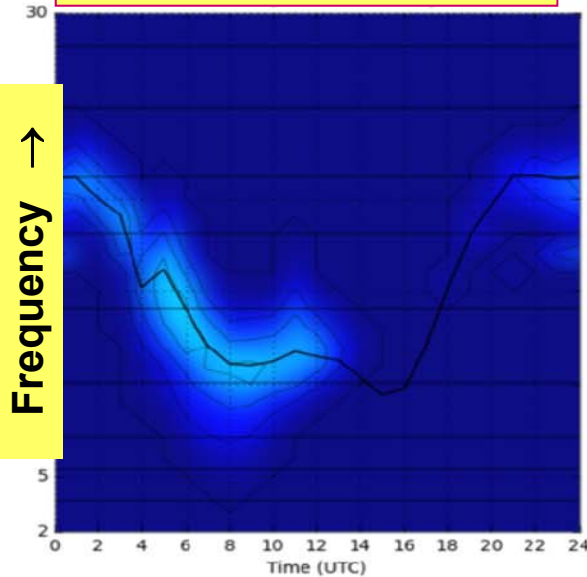


- A local Ham set up a portable QRP station at a local park
- He expected to work Europe on 40 m CW with an inverted V antenna
- He worked just a single nearby station (within the yellow coverage contour)! **PLAN BEFORE YOU GO – Avoid Disappointment!**

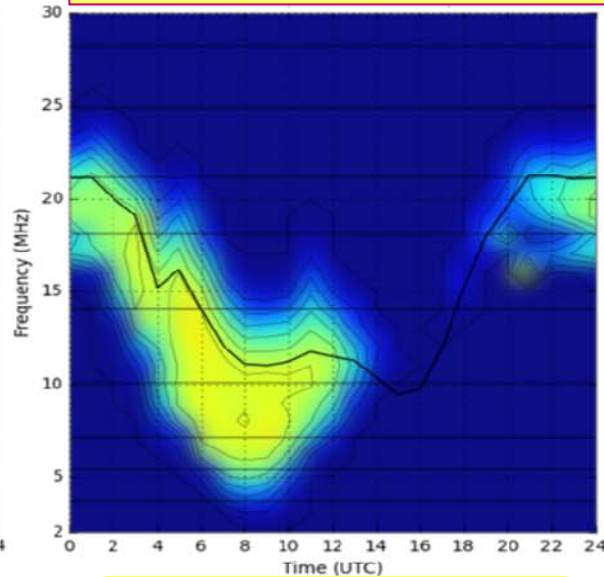
Planning before Going ZL ↔ FL

“Fool” www.voacap.com/prediction.html into predicting other digital modes:

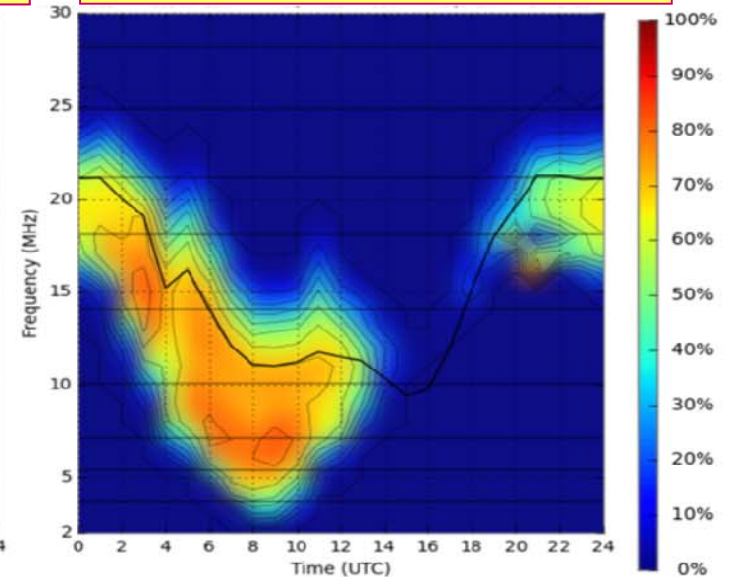
For *CW* at 5 W:
Select ‘CW’ at 5 W



For *FT8* at 5 W:
Select ‘CW’ at 500 W



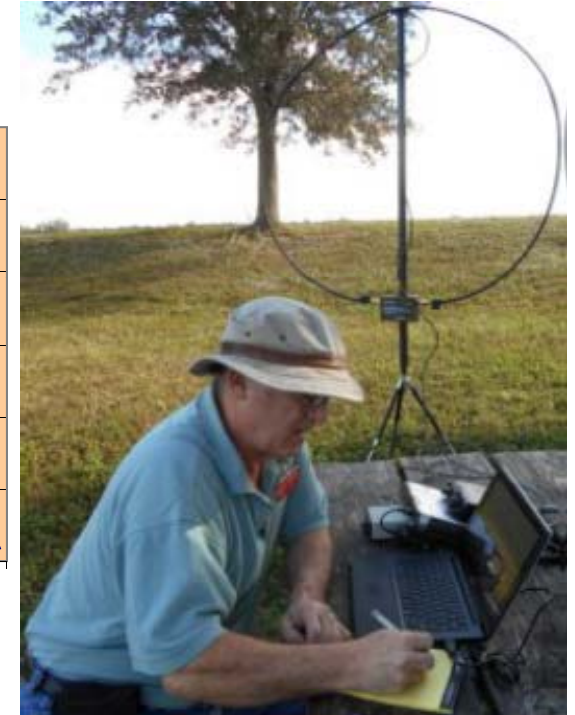
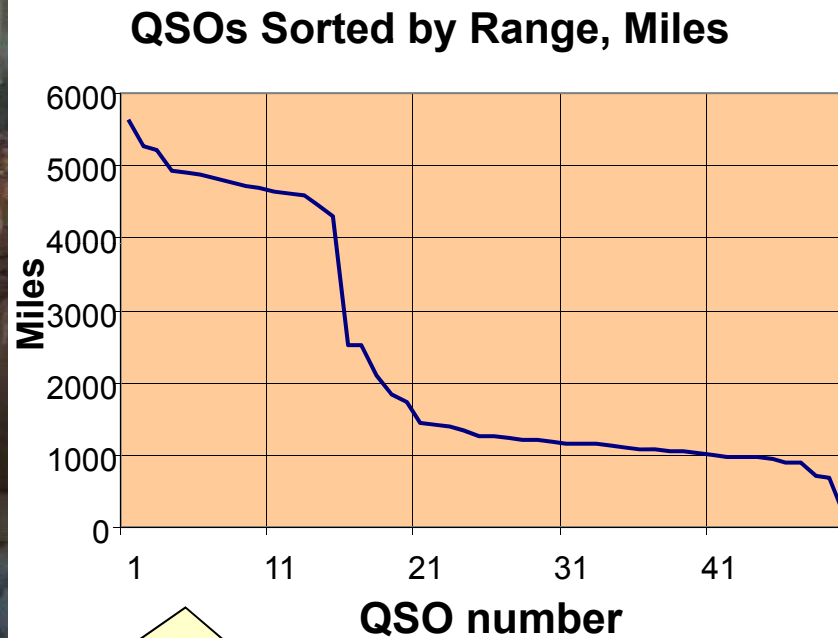
For *JT65* at 5 W:
Select ‘CW’ at 1500 W



Time of day, UTC →

Bonus: for PSK31 at 5 W select ‘CW’ at 25 W

More Planning: Living Room and Field Testing



Initial tests from inside my Coral Springs, FL living room: **demonstrated 5,630 mile path**

**However...
The ZL ↔ FL path
is 8,135 miles!**

Further tests from Vista View Park in Broward County, FL; **verified the equipment list**

Putting it into Practice ZL ↔ FL

(there were some 'gravity' issues)

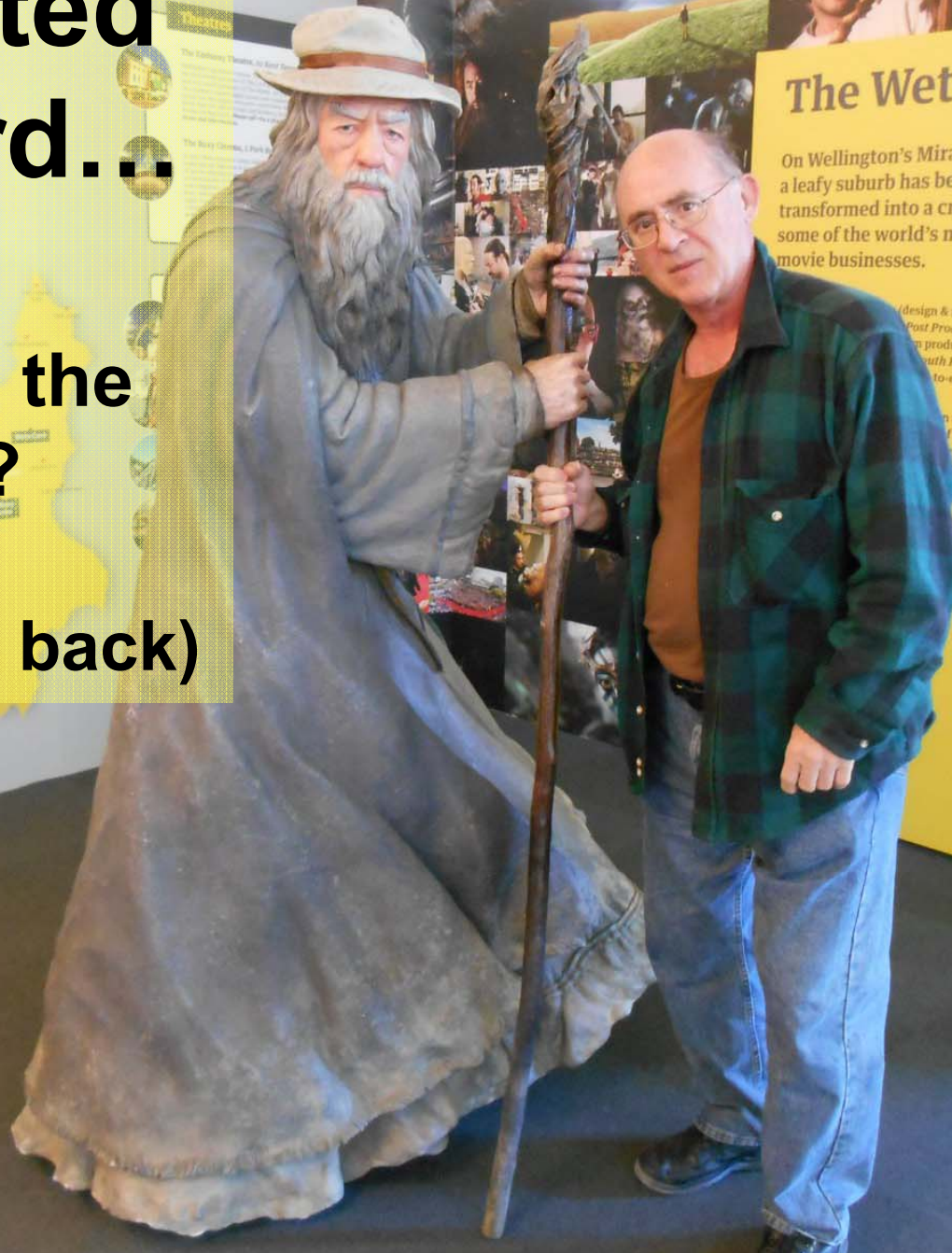


Image by Chris Dean, KD7CNJ

**Consulted
a Wizard...**

**...or was it the
software??**

(got my hat back)



The Weta Group story

On Wellington's Miramar Peninsula, a leafy suburb has been quietly transformed into a creative hub for some of the world's most respected movie businesses.

(design & manufacturing), Weta Digital Post Production (post-production production), Stone Street Studios South Hire (movie equipment), the to-end capability and resources

on their origins as a place of fancy are the norm and how grand, can be realized the international movie Zealand.

unders and their evolution ning industry leaders is a and creative vision.

CAVE

ENJOY A 'BEHIND-THE-SCENES' GLIMPSE INTO WETA WORKSHOP

Book online or with one of the i-SITE staff today!

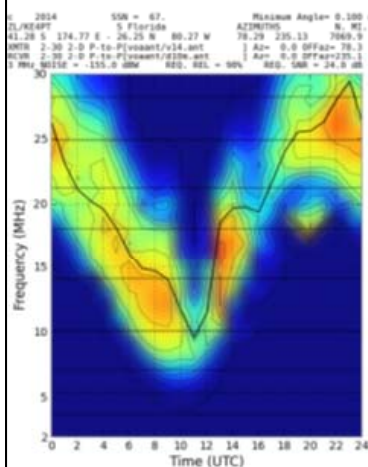
That's the Theory!

What about the Practice?

Propagation Prediction ZL ↔ FL
www.voacap.com/prediction.html

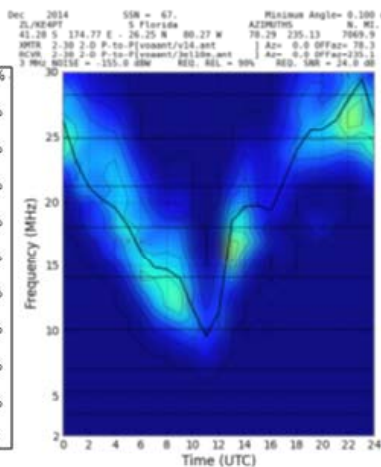
JT65 at 5 W (same as CW at 500 W)

Circuit Reliability (%)



CW at 5 W

Circuit Reliability (%)



- JT65 should be robust,
- CW will be “iffy”

?

Wizard's Choice of Portable Station Sites

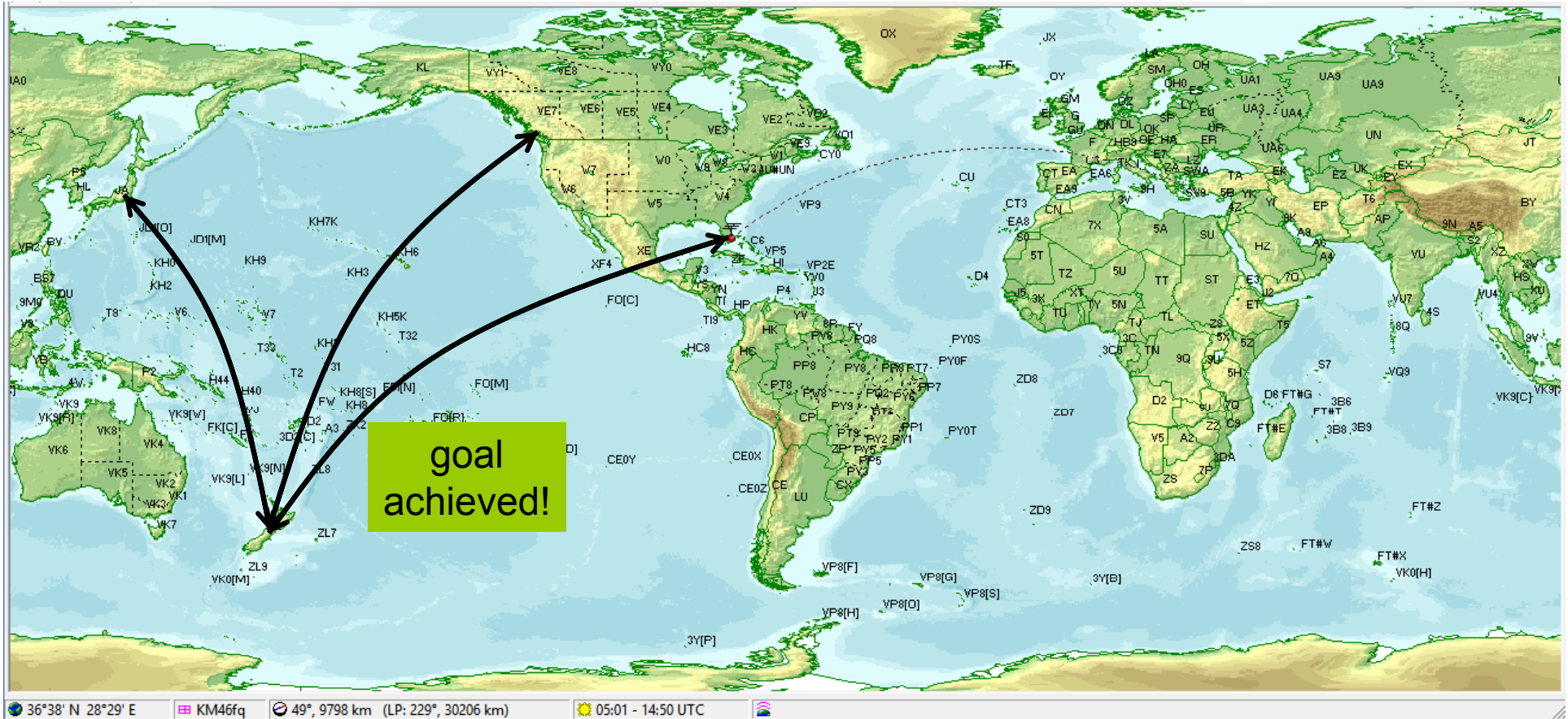


JT65 from Frank Kitts Park,
Wellington, New Zealand,
radio site #1



CW from Mount Victoria,
Wellington, New Zealand,
radio site #2

Worked Three Countries on JT65



There is a lot of Pacific Ocean between ZL and populous land masses to East and North East: **it's 8,100 miles or nothing!** 22

Results

Contacts followed predictions!

- 2 hours allocated for JT65, made a handful of contacts in 3 countries
 - *best was 3,254 miles per watt*
- 2 hours allocated for CW, but no contacts!

A scenic photograph of a coastline. In the foreground on the left, a person wearing a light-colored bucket hat and a dark jacket is looking out over the landscape. The middle ground features a steep, green hillside with some tall, dry grasses. In the background, a large body of water (likely a bay or harbor) stretches across the frame, with a city and distant mountains visible on the horizon under a cloudy sky.

**Thank You,
73, es gd DX**

de KE4PT

