

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]*



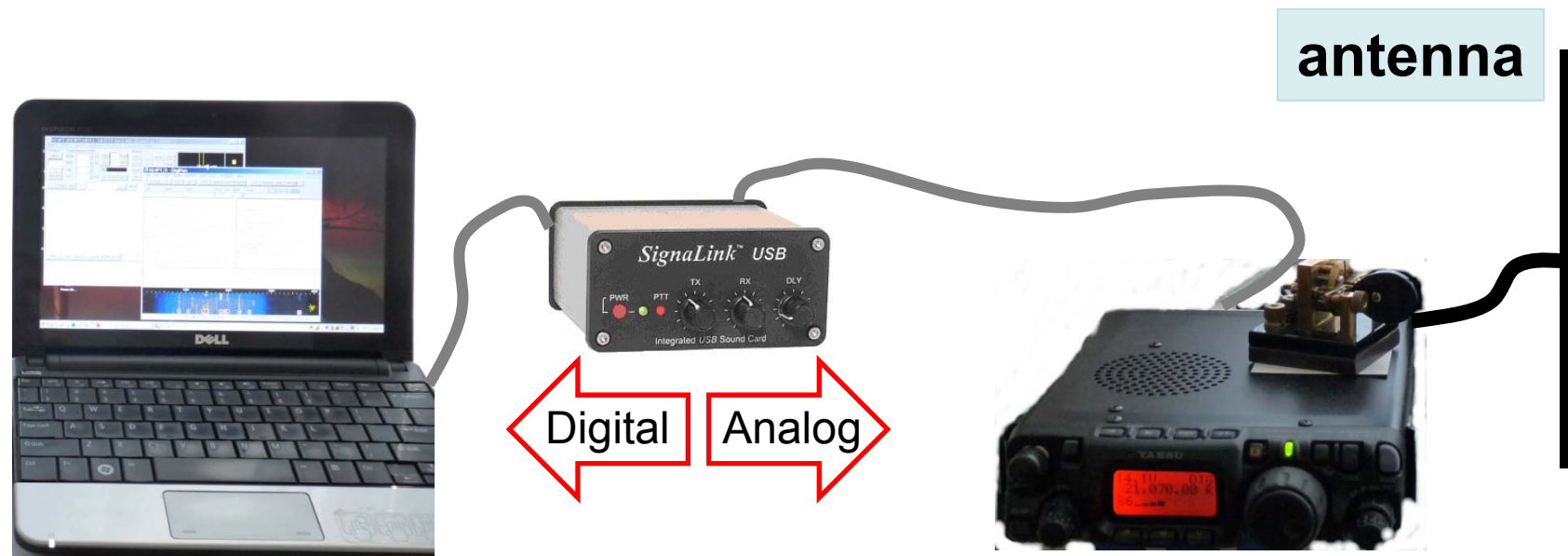
* https://web.archive.org/web/20090331022507/https://en.wikipedia.org/wiki/Software-defined_radio

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

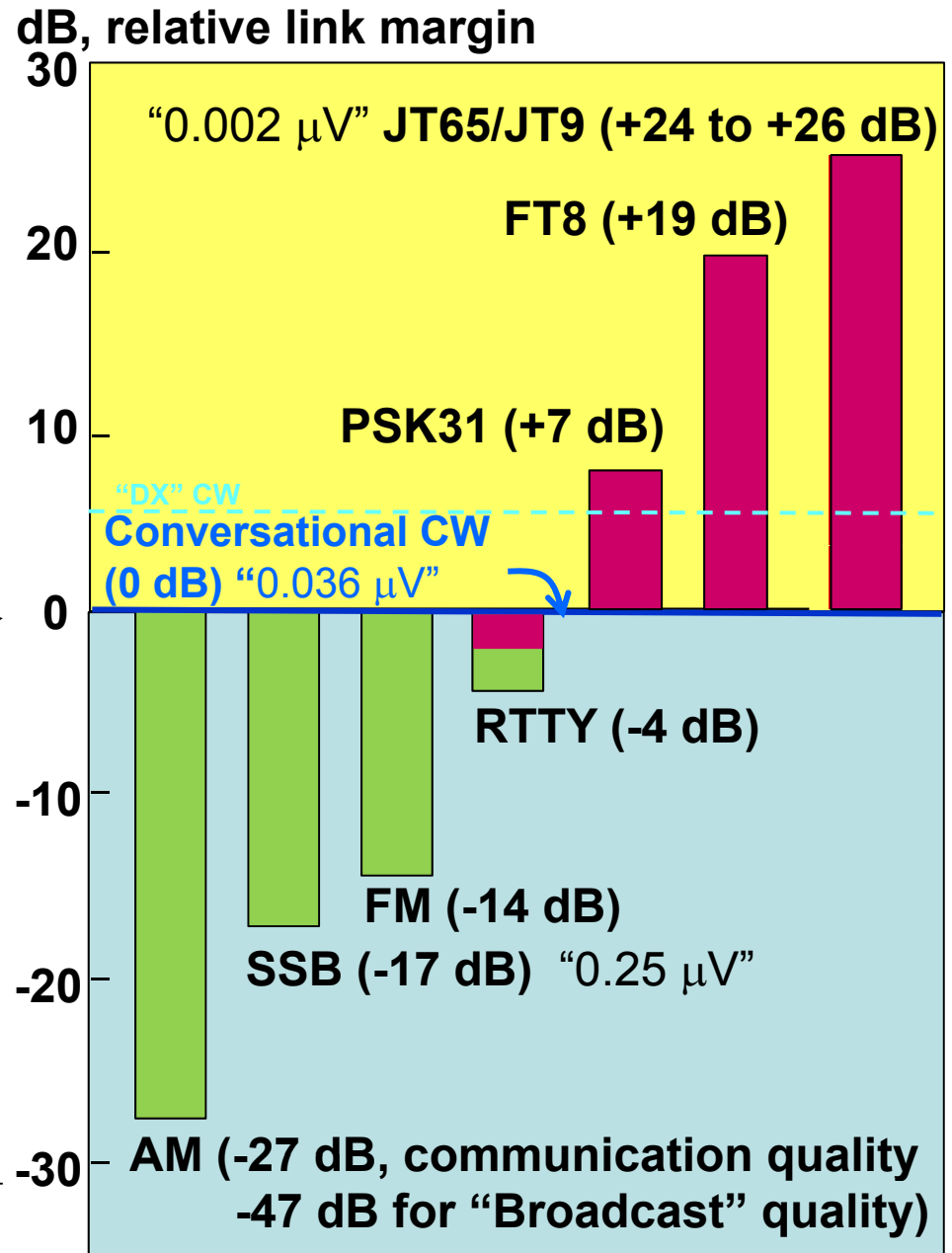
Signalink-USB:
D \leftrightarrow A interface sound card with PTT

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

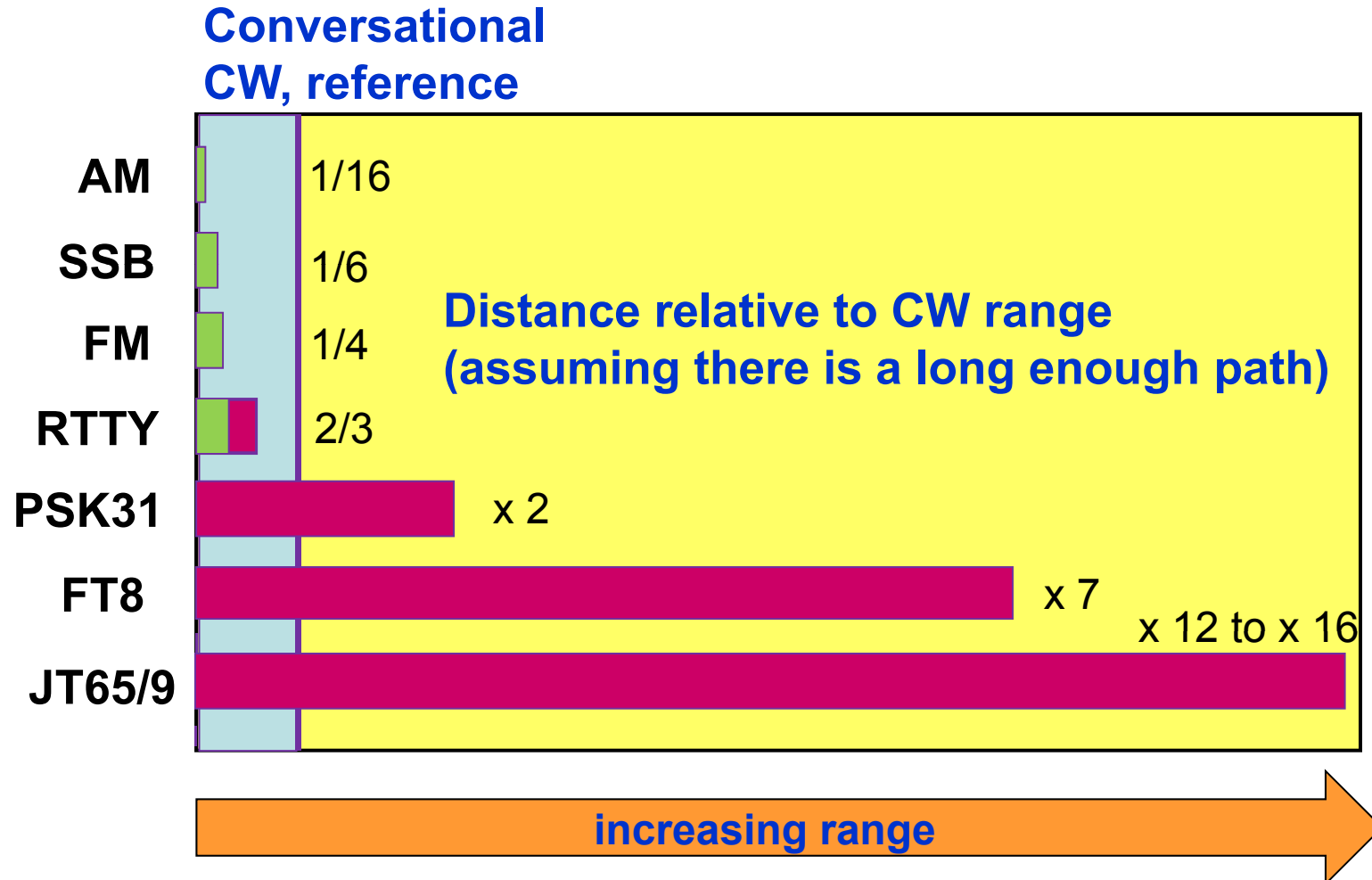
Why SDR?

- Basic SDR System supports Software Defined Modulation: can turn “0.25 μV ” into “0.002 μV ”

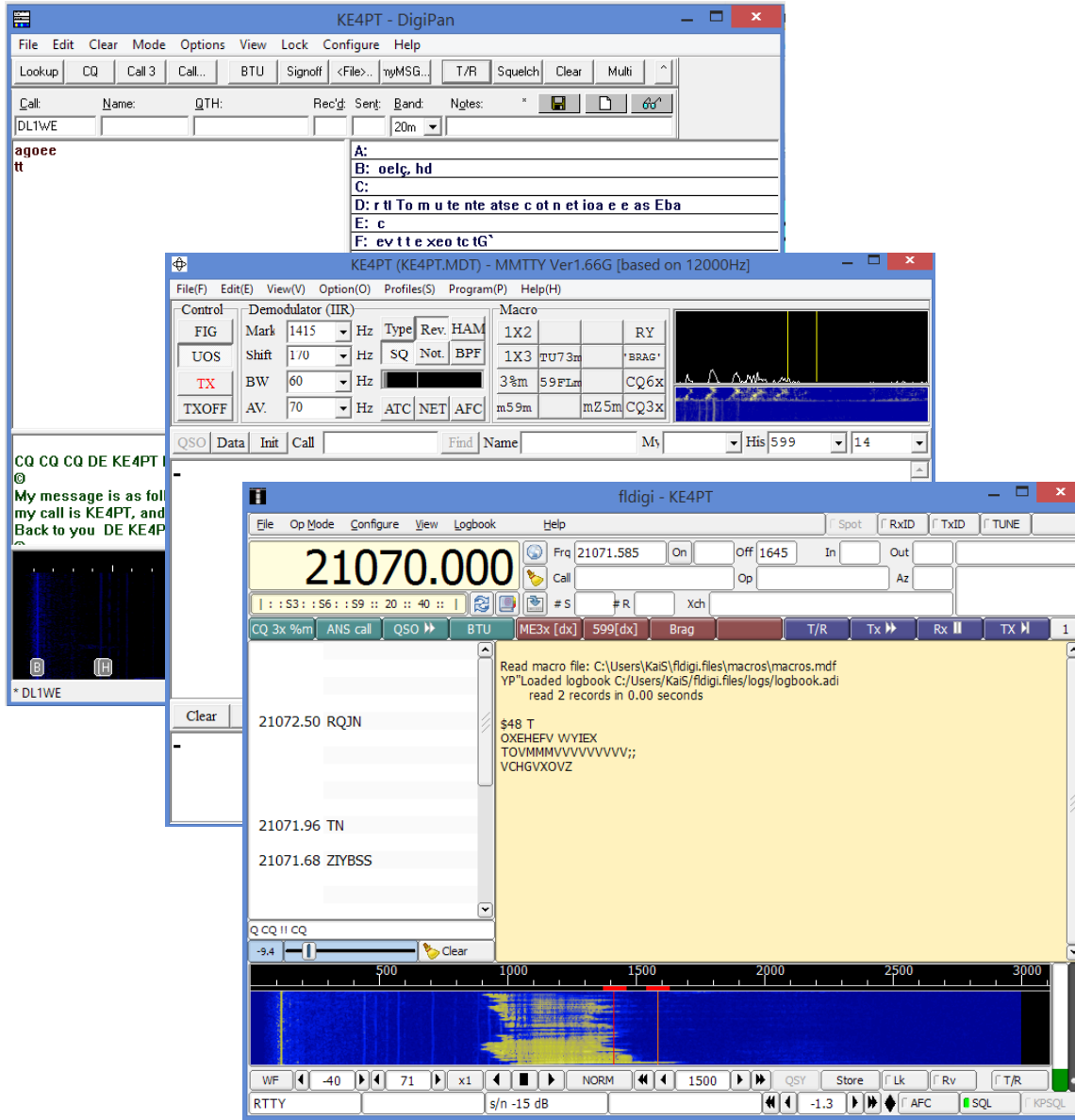
- Basic Radio has native support for Morse CW, voice and *sometimes* RTTY



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

The screenshot shows the WSJT-X v1.8.0 software interface. The window title is "WSJT-X v1.8.0 by K1JT". The interface is divided into several sections:

- Band Activity:** A table with columns UTC, dB, DT, Freq, and Message. It lists several received signals, including "BG THX JOE 73", "RA3Y VE3NLS 73", "K2OI AJ4UU R-20", "WU7B K9EEI 73", "YV6BFE F6GUU R-08", "KK4DSD W7VP -16", and "BG THX JOE 73".
- Rx Frequency:** A table with columns UTC, dB, DT, Freq, and Message. It lists received signals, including "CQ DL7ACA JO40", "YV6BFE F6GUU R-08", "KK4DSD W7VP -16", and "BG THX JOE 73".
- Control Panel:** Includes buttons for "Log QSO", "Stop", "Monitor", "Erase", "Decode", "Enable Tx", "Halt Tx", "Tune", and "Menu". It also features a frequency display showing "21.074 000" and a date/time display showing "2017 Dec 13 18:46:59".
- Generate Std Msgs:** A section with a table for generating standard messages. The table has columns "Next" and "Now". The messages listed are: "DL7ACA KE4PT EL96", "DL7ACA KE4PT -10", "DL7ACA KE4PT R-10", "DL7ACA KE4PT RRR", "DL7ACA KE4PT 73", and "CQ KE4PT EL96".
- Waterfall Plot:** A spectral display showing signal activity over time. The x-axis represents frequency in Hz, ranging from 1000 to 2500. The y-axis represents time, with labels for "18:46 15m" and "18:45 15m".
- Settings:** Includes controls for "Bins/Pixel 4", "Start 300 Hz", "Palette Adjust...", "Flatten", "Ref Spec", "Spec 30 %", "Cumulative", and "Smooth 1".

- *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

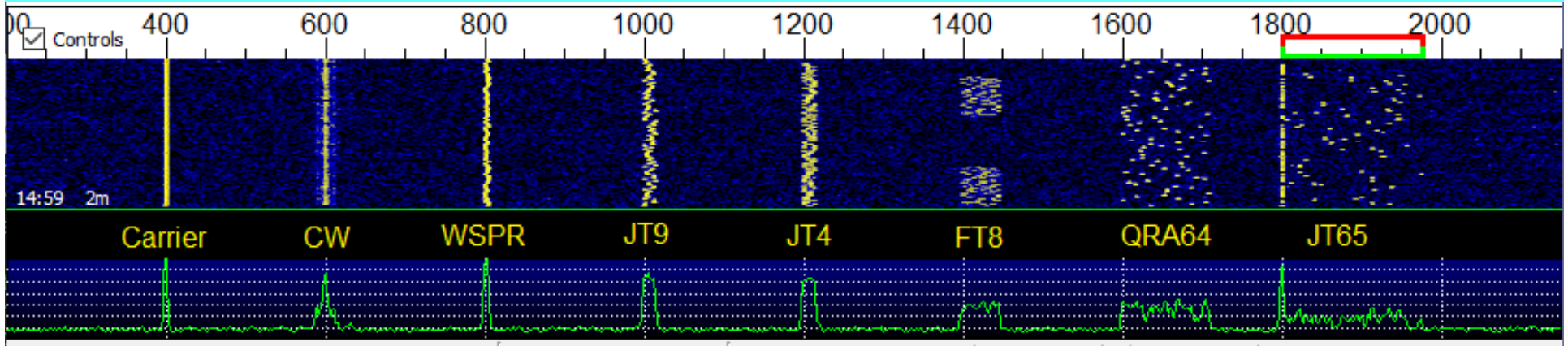


Table 1: Parameters of the Slow *WSJT-X* Protocols

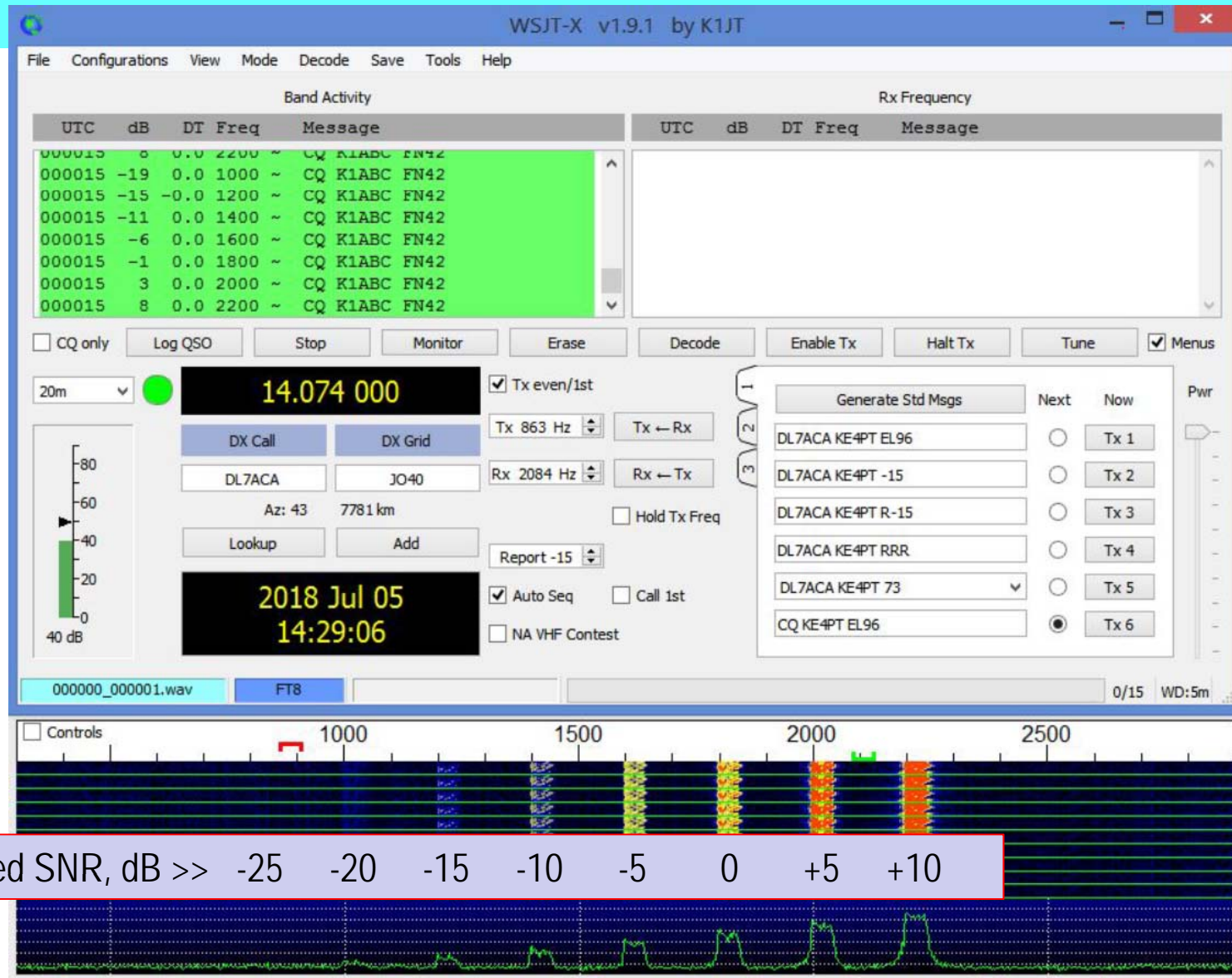
Bandwidths (BW) are for the narrowest submodes. S/N threshold is referenced to a 2,500 Hz bandwidth at a 50% probability for decoding of an unfading signal.

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.

FT8 at Various SNRs



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:

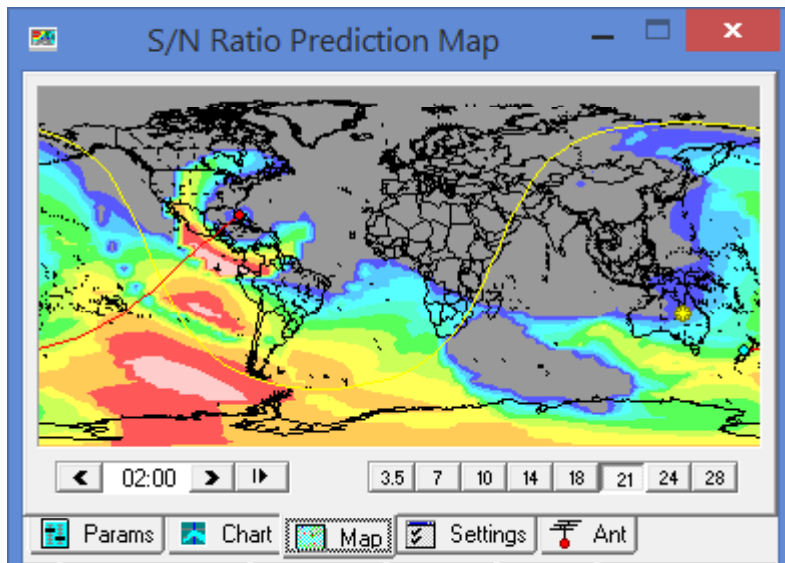
www.dxatlas.com/hamcap/

and / or:

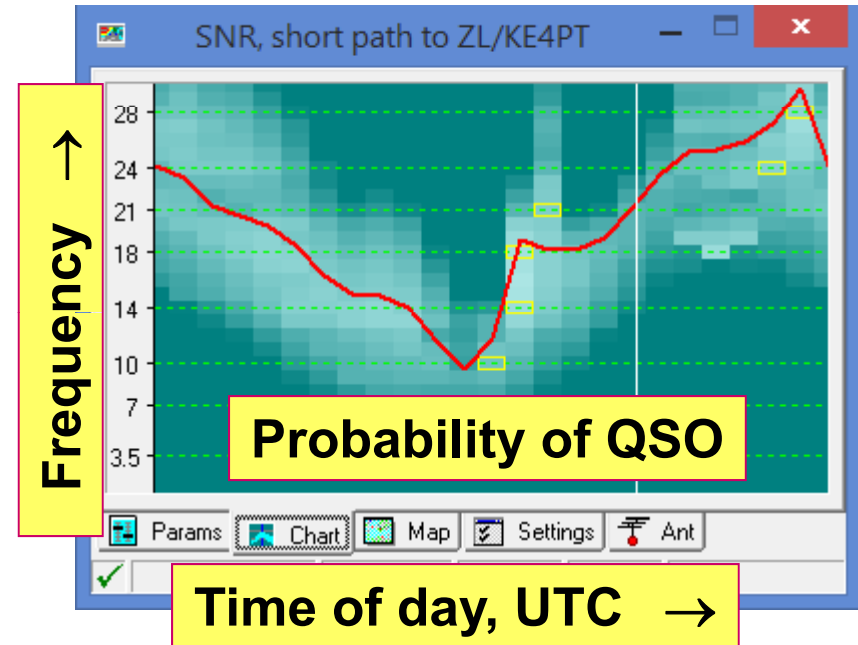
Use the free on-line VOACAP tool:

www.voacap.com/p2p/index.html

HamCAP 1.9 (Free!)

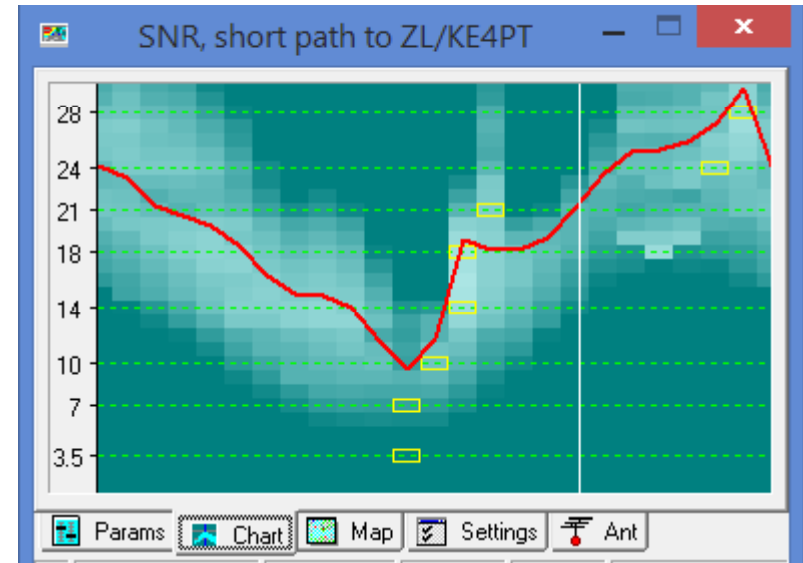
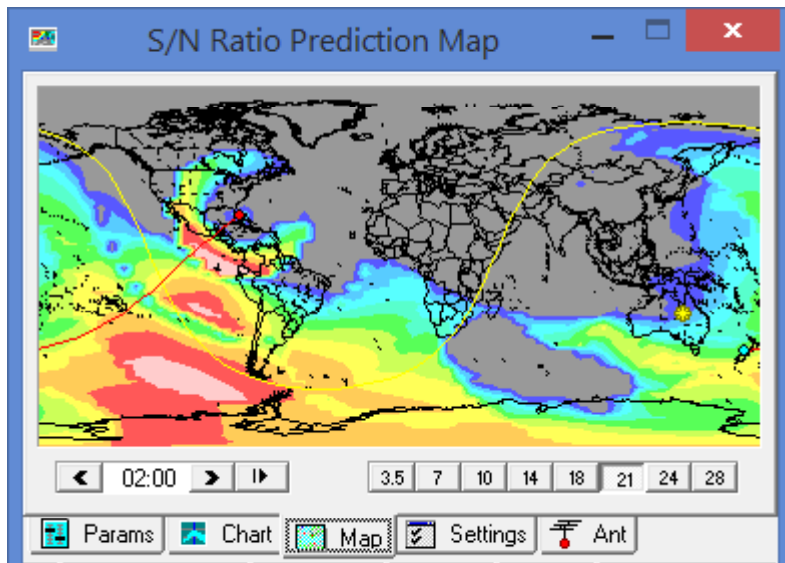


SNR chart: need 24 dB for CW



- VOACAP engine, GUI by Alex Shovkopyas, 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

Most Visited BoA ARRL.org-Mail ddt-mail Google Drive QRZ CallBk 1x1Call USPTO FreePat MorePATENTS Google Translate Library | Victoria U

Map

Greenland Iceland Norway Sweden Finland Russia Poland Ukraine Kazakhstan Mongolia United Kingdom France Germany Italy Turkey Iraq Iran Afghanistan Pakistan India Thailand Algeria Libya Egypt Saudi Arabia Sudan Nigeria Kenya Tanzania Angola Botswana Madagascar Namibia South Africa

North Atlantic Ocean South Atlantic Ocean Indian Ocean

Google

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

Current point: Set Home Unset 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!

23UT
80M
100%

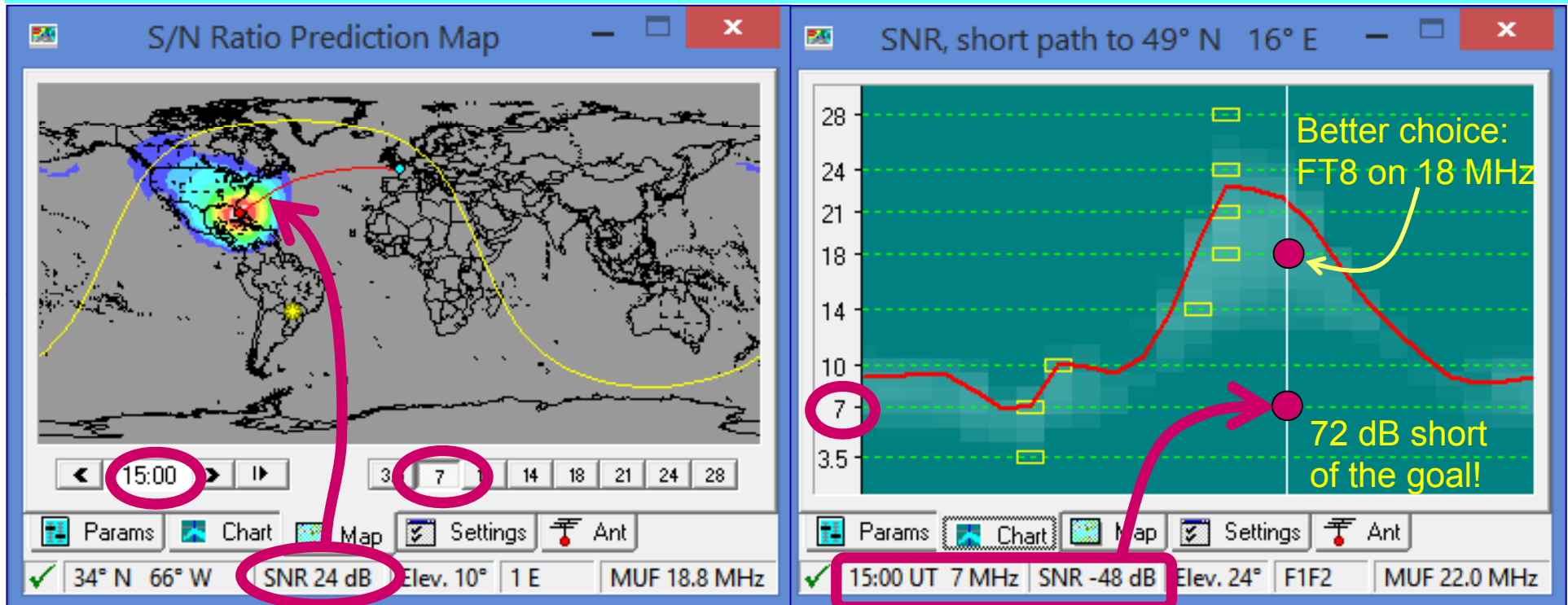
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

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”

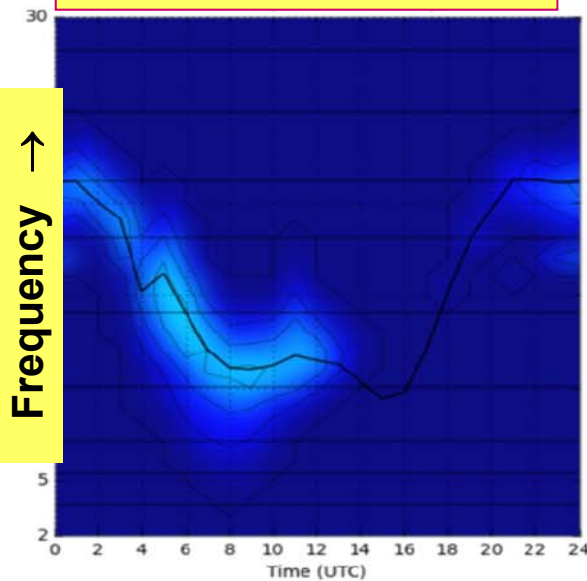


- A local Ham set up a portable QRP station at a local park
- He expected to work Europe on 40 m CW with an inverted V antenna
- He worked just a single nearby station (within the yellow coverage contour)! **PLAN BEFORE YOU GO – Avoid Disappointment!**

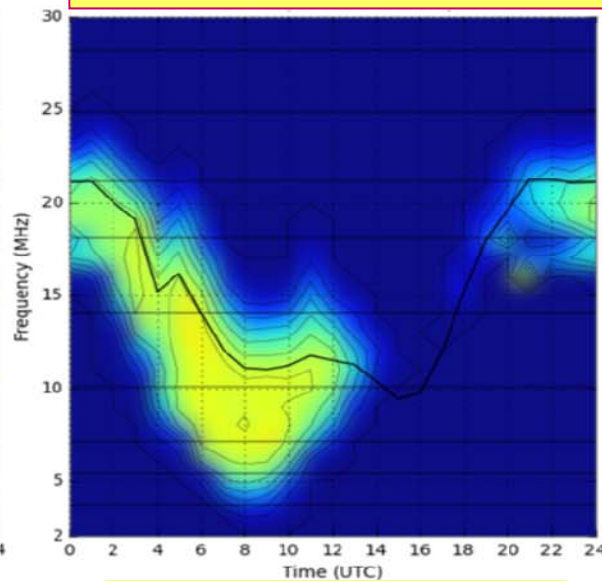
Planning before Going ZL ↔ FL

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

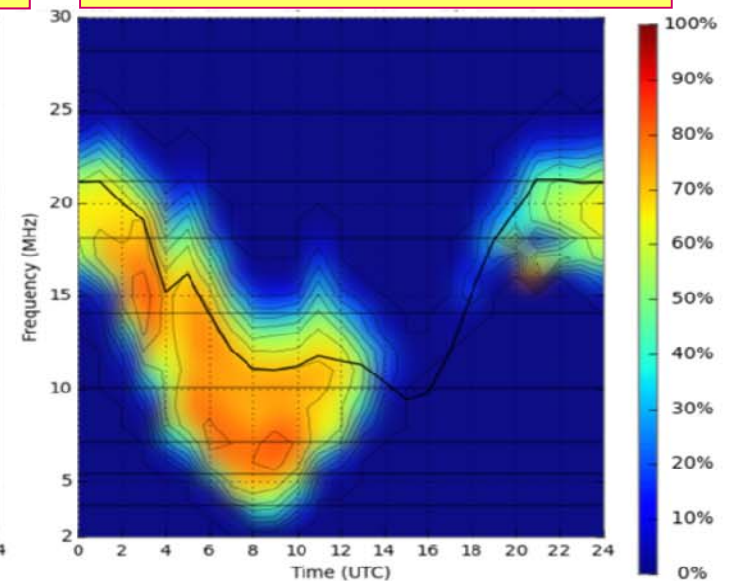
For CW at 5 W:
Select ‘CW’ at 5 W



For FT8 at 5 W:
Select ‘CW’ at 500 W



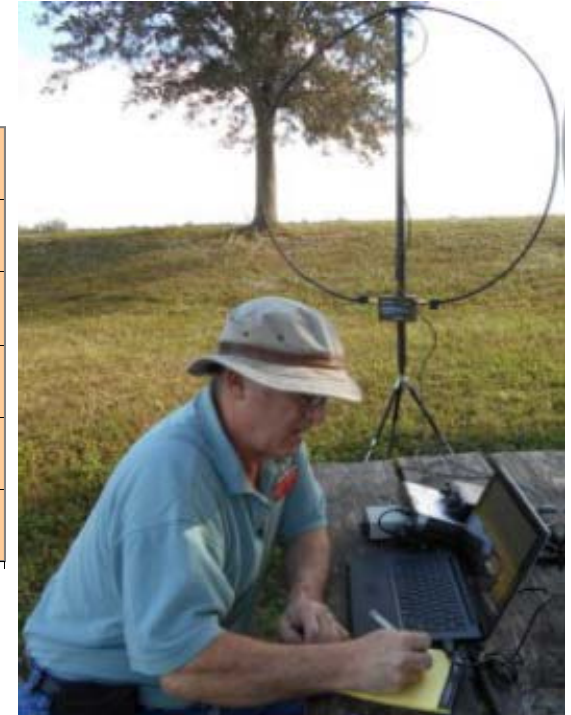
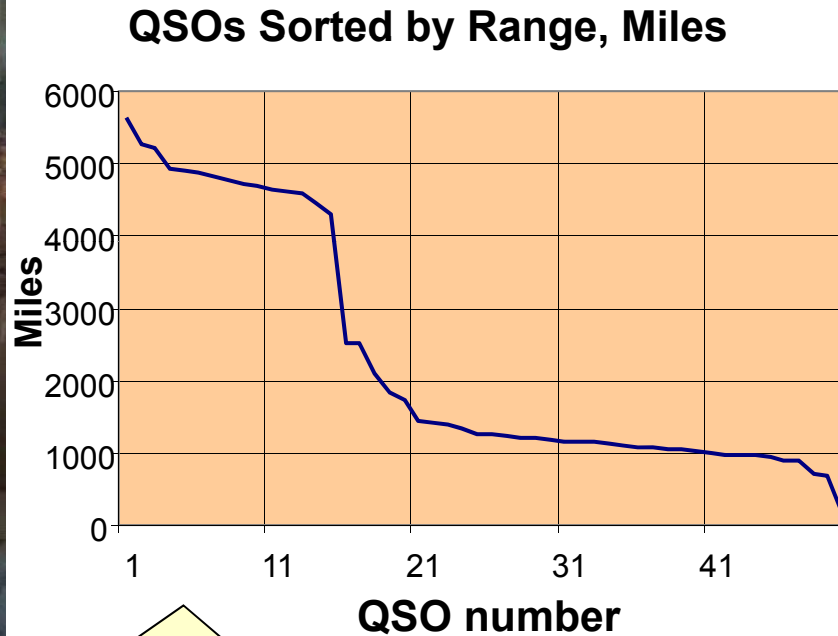
For JT65 at 5 W:
Select ‘CW’ at 1500 W



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)

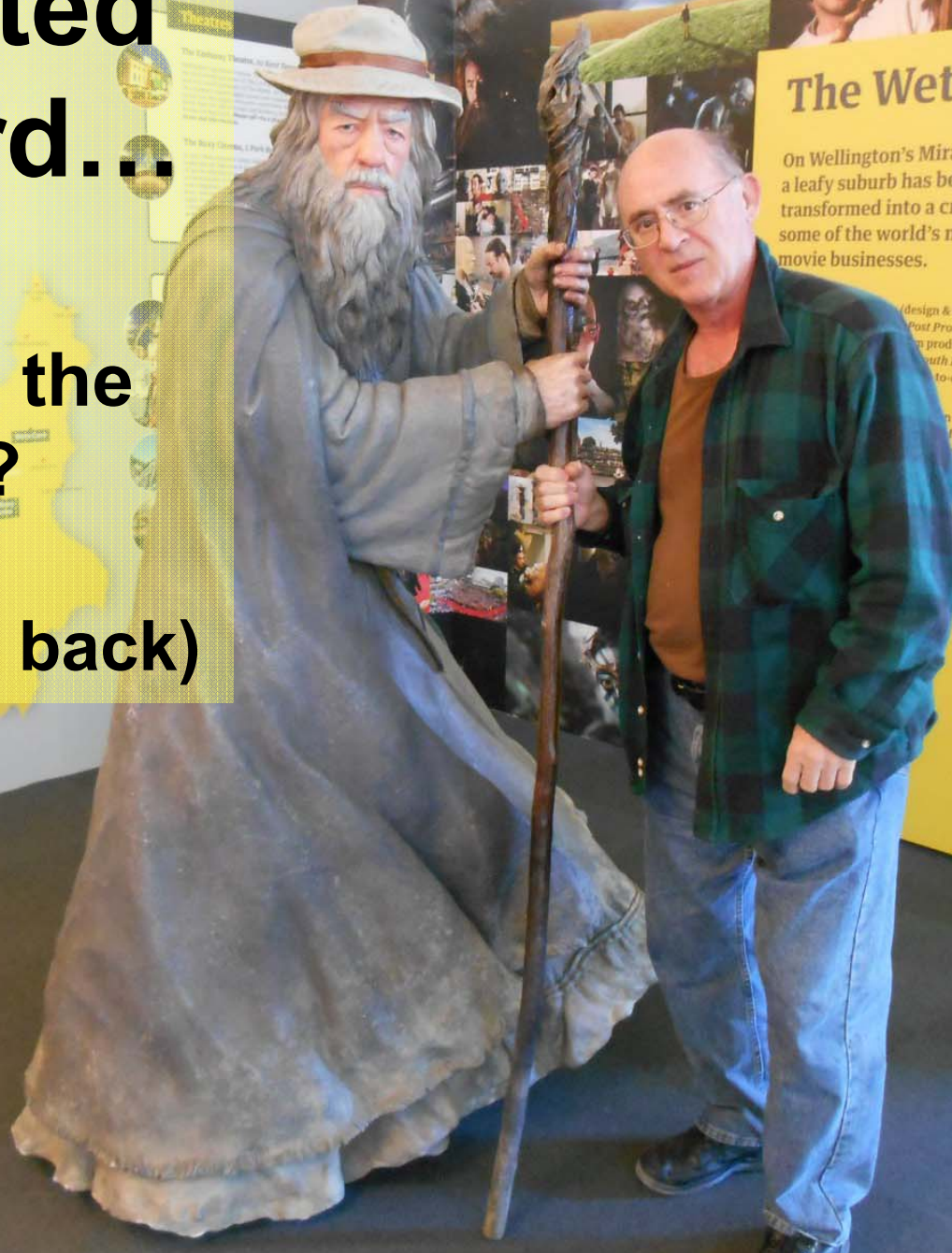


Image by Chris Dean, KD7CNJ

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 (equipment hire (movie equipment), the to-end capability and resources

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

founders and their evolution in the industry leaders is a testament to creative vision.

Richard Taylor and Peter Jackson

Richard Taylor and Peter Jackson

Richard Taylor and Peter Jackson

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Richard Taylor and Peter Jackson

CAVE

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

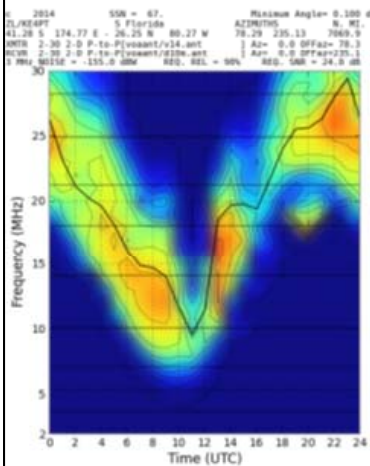
Book online or with one of the WETA staff today!

That's the Theory!

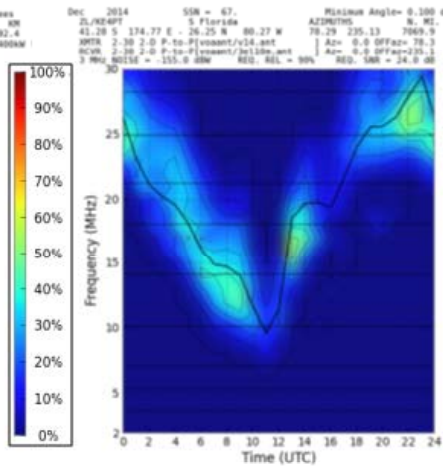
What about the Practice?

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 (%)



?

Wizard's Choice of Portable Station Sites



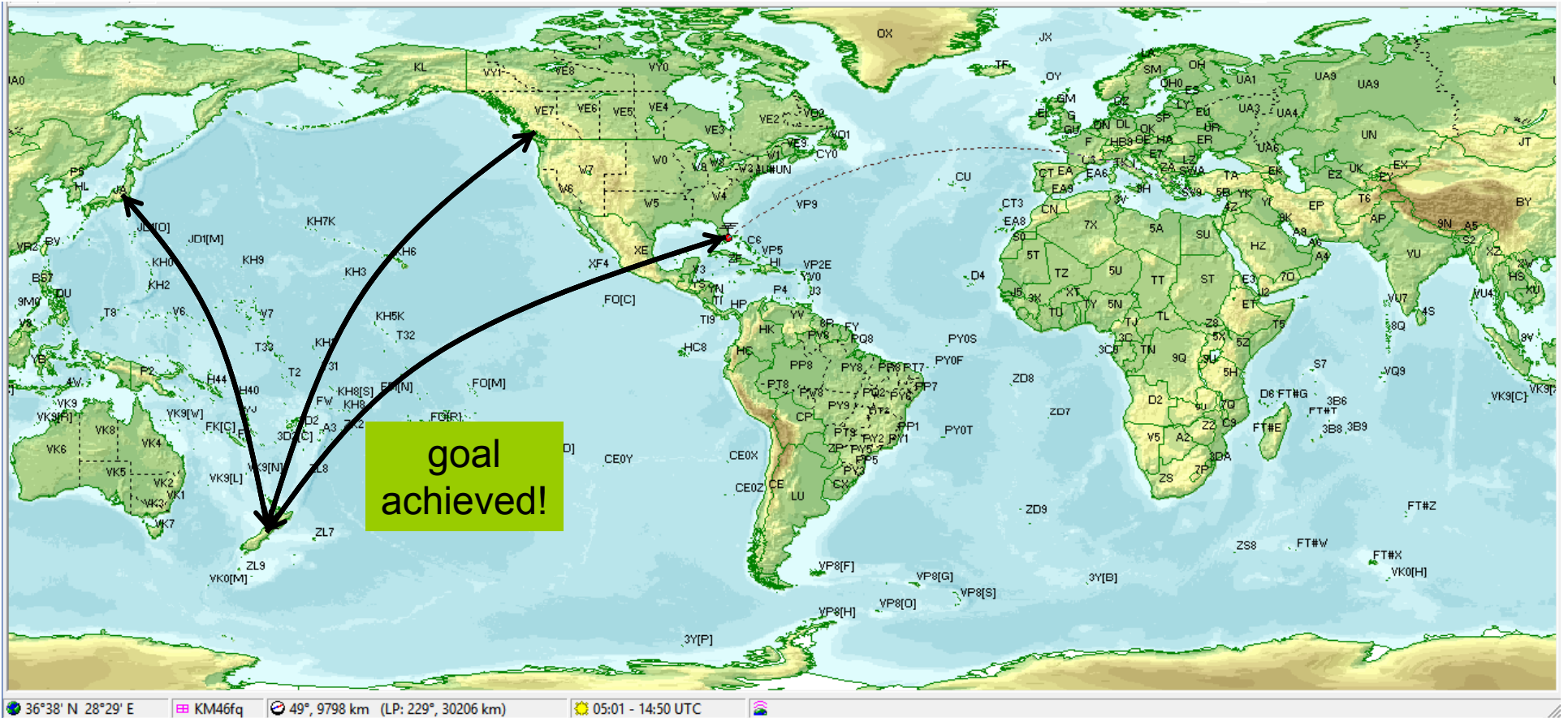
JT65 from Frank Kitts Park,
Wellington, New Zealand,
radio site #1



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

- JT65 should be robust,
- CW will be "iffy"

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!** 23

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 photograph showing a person in profile on the left, wearing a light-colored bucket hat and a dark jacket. They are looking out over a scenic coastal landscape. The foreground is filled with green bushes and tall, dry grasses. In the middle ground, a large body of water (a bay or harbor) stretches across the frame, with a small boat visible. The background features rolling hills and mountains under a cloudy sky.

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

de KE4PT

