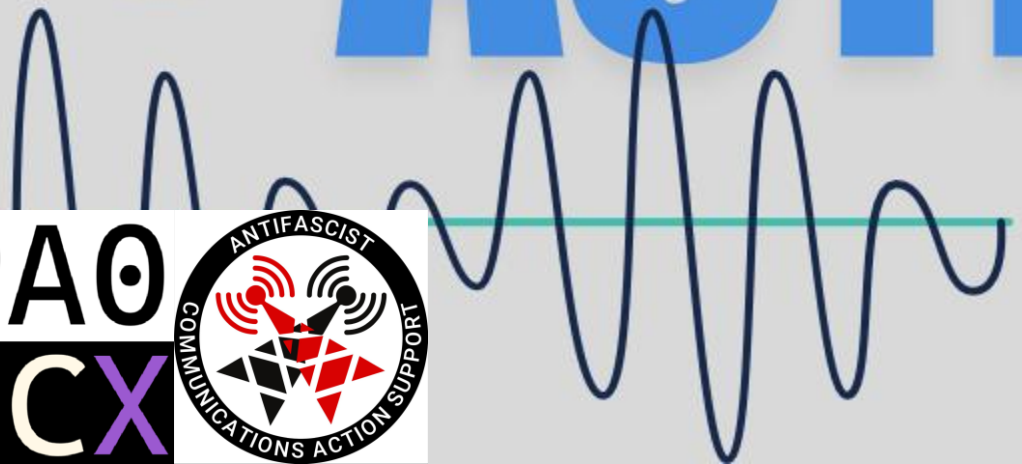
INTRODUCTION + Q&A

COMMS FOR ACTIVISTS

8 FEB
19:00



PA0
JCX

ANTIFASCIST COMMUNICATIONS ACTION SUPPORT

First things first…

Disclaimer and common-sense talk.

2 minutes.

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- **Don’t transmit on frequencies in use by Emergency Services**

Basic terminology

Basic terminology & radio theory.
15 minutes.

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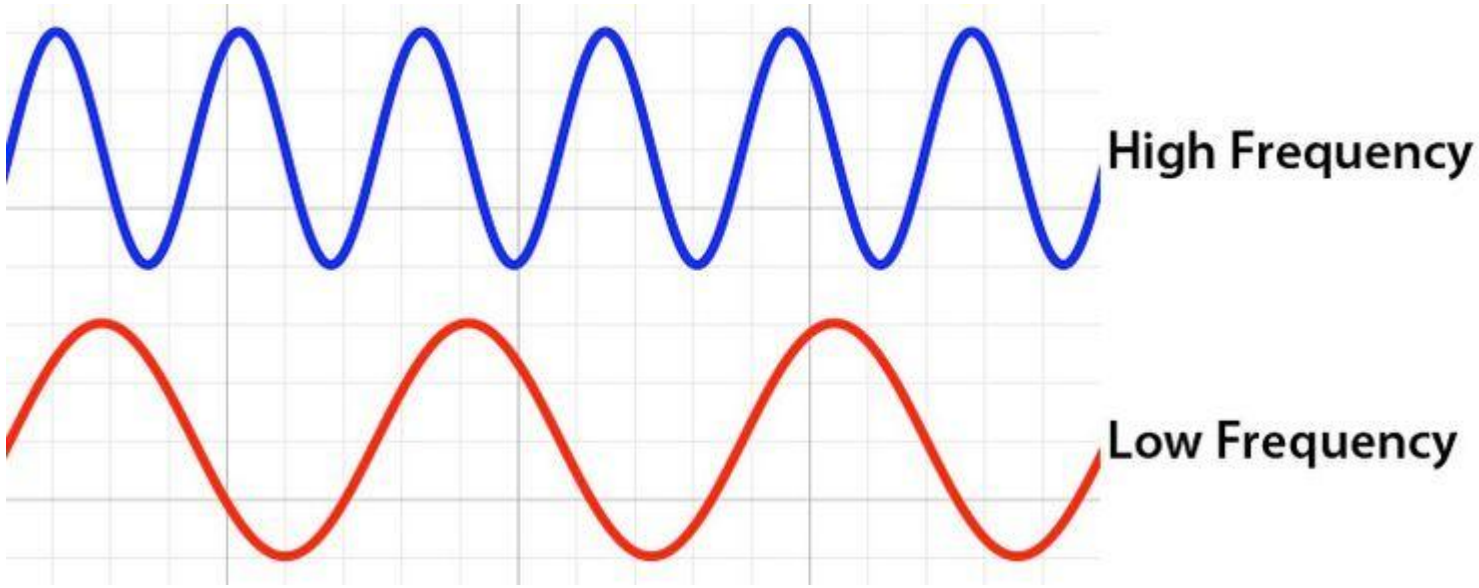

Basic terminology

- **Bands** Slices of frequency spectrum sorted by frequency
  - **MF** Medium Frequency 300 kHz – 3 MHz
  - **HF** High Frequency 3 MHz – 30 MHz
  - **VHF** Very High Frequency 30 MHz – 300 MHz
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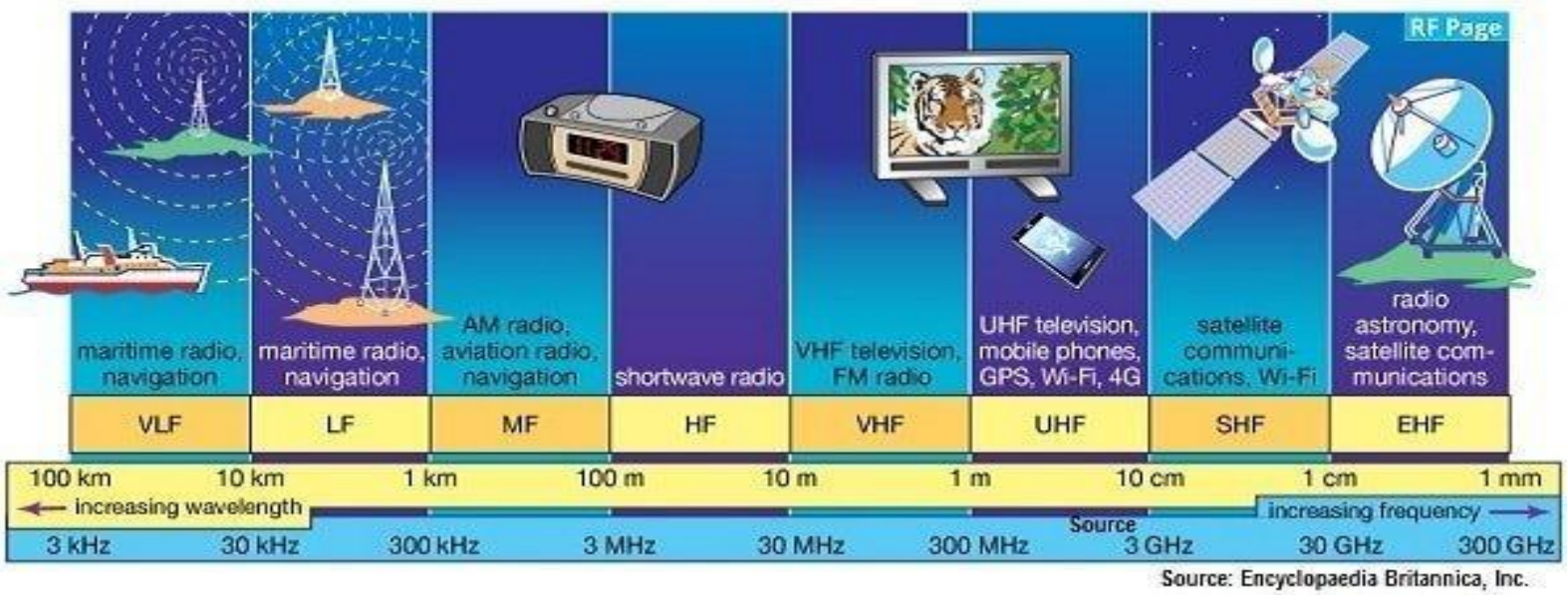

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- **Example**: Signal of **446.000.000 Hz** = **446 MHz** is an **UHF**-signal

Basic terminology

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  - Radio waves travel at **speed of light (*c* *or* *v*)**
  - Speed of light is **~300.000.000 meter per sec.**

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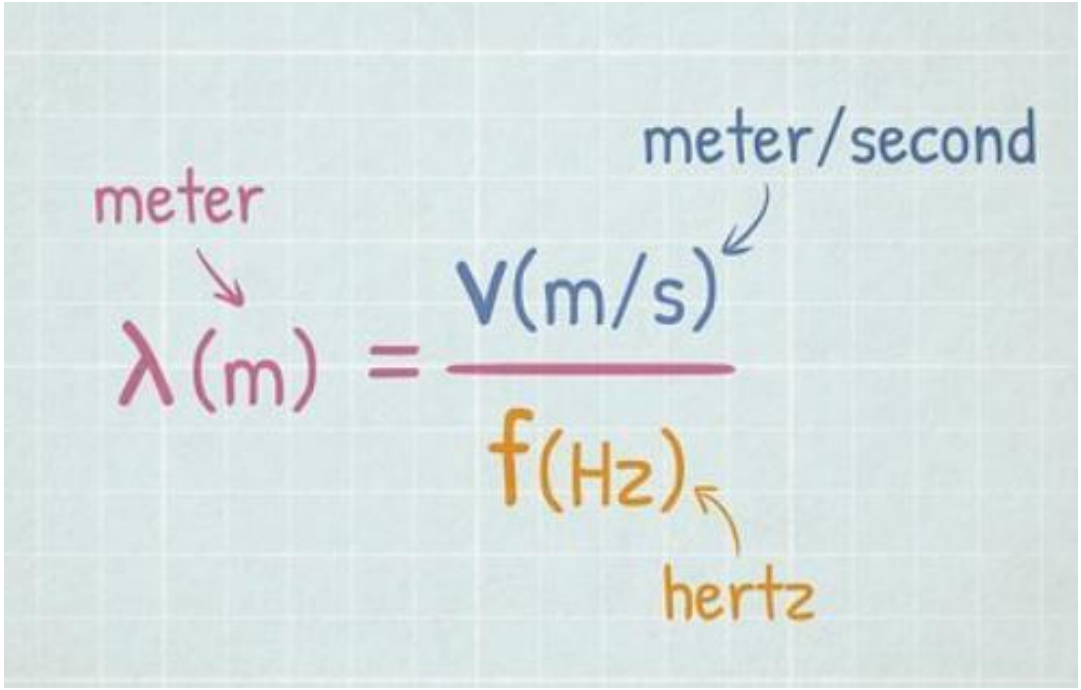

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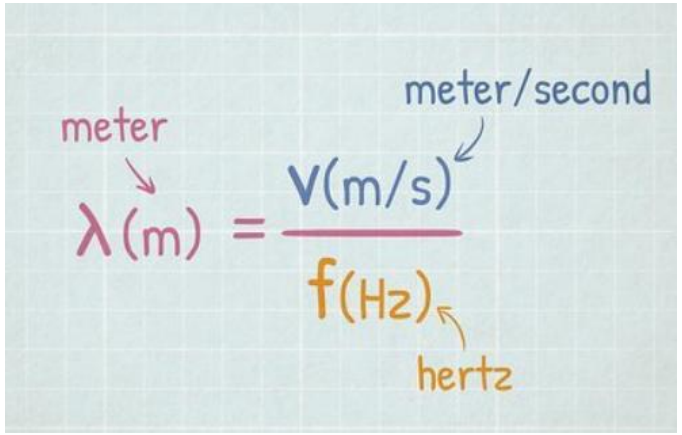

- **Examples**
  - 300 MHz (300.000.000 Hz) travels 1 meter during 1 oscillation
  - 100 MHz (100.000.000 Hz) travels 3 meter during 1 oscillation
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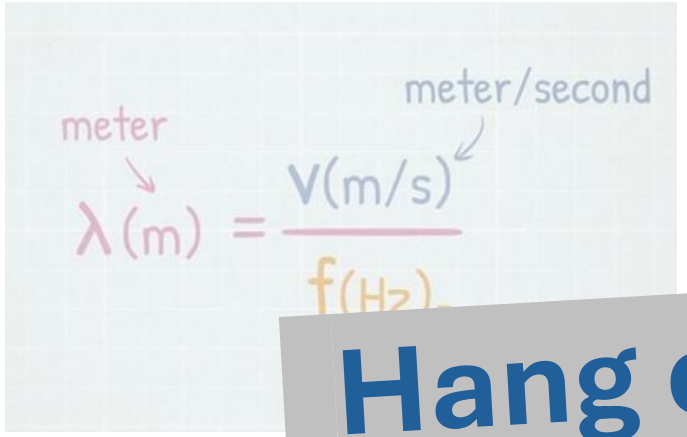

Hang on, I will get to the point!

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Basic terminology – **Stitching it together**

Often, a specific frequency or **small part of a frequency band** is called by its **wavelength** in ‘**meter**’ or ‘**centimeter**’:

By knowing a certain frequency or it’s wavelength, it’s easy to look up where its for, what is legally allowed and what its capabilities are.

Some important examples are coming up!

Basic terminology – **MF/HF Bands**

Name / Wavelength	Frequency	Band
- Medium Wave (**MW**)	531 kHz – 1.8 MHz	(MF)
- **160**-meter band	1.8 – 2.0 MHz	(MF)
- **80**-meter band	3.5 – 4.0 MHz	(HF)
- **40**-meter band	7.0 – 7.2 MHz	(HF)
- **20**-meter band	14.0 – 14.5 MHz	(HF)
- **15**-meter band	21.0 – 21.5 MHz	(HF)
- **11**-meter band (**CB**)	27.0 – 27.4 MHz	(HF)
- **10**-meter band	28 – 30 MHz	(HF)

Basic terminology – **VHF/UHF Bands**

Name / Wavelength	Frequency	Band
- **3**-meter band (**FM**)	88.0 – 108.0 MHz	(VHF)
- **Airband** **don't TX**	108 – 137 MHz	(VHF)
- **2**-meter band	144 – 146 MHz	(VHF)
- **P2000** **don't TX**	169.650 MHz	(VHF)
- **C2000** **don't TX**	380.0-400.0 MHz	(UHF)
- **70-centimeter** band	430.0-440.0 MHz	(UHF)
- **LPD (LoRa 433)**	433.0 – 434.8 MHz	(UHF)
- **PMR446**	446.0 – 446.2 MHz	(UHF)

Basic terminology – **UHF/SHF Bands**

Name / Wavelength	Frequency	Band
- **SRD 868** (LoRa)	868 - 870 MHz	UHF
- **4G LTE** (cell phone)	600, 700, 850, 1.700, 1.900, 2.000, 2.100 and 2.500 MHz	UHF
- 5G	< 1 GHz to > 24 GHz	(UHF/SHF)
- **23-centimeter** band	1.240 MHz - 1.300 MHz	(UHF)
- **13-cm** band (**ISM**)	2.300 – 2.450 MHz	(UHF)
- **WiFi** / **Bluetooth**	2.402 – 2.482 MHz	(UHF)
- **5 GHz** (WiFi)	5.150 – 5.895 MHz	(SHF)

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Feel free to watch this back later
Copy available at pa0jcx.nl/cfa2026

What are ‘COMMS’?

What are comms?

- Shortened from the word **COMMUNICATIONS**
  - The concept of exchanging information between two entities
- Two people talking
- Birds chirping
- Reading a book
- Sending an email
- Doomscrolling on Instagram
- Telephone call
- Using radio equipment
- This presentation

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nms?

word **CO**

nanging info

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BRIAR

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ZELLO

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BRIAR

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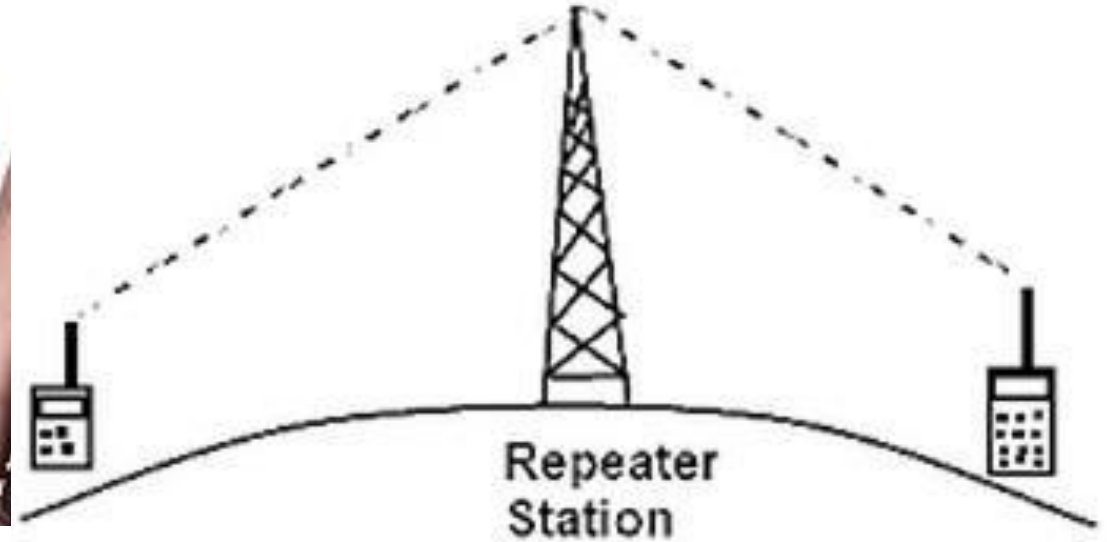

VHF UHF Repeater

- Doomsc
- Telephon
- **Using ra**
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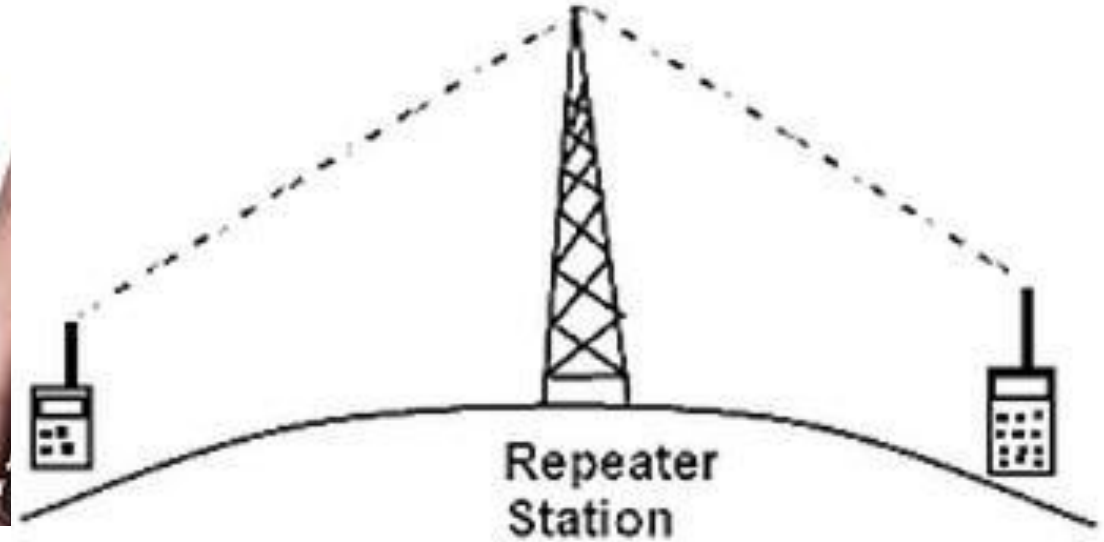
ZELLO

BRIAR



VHF UHF Repeater

ZELLO

BRIAR


RETEKESS
POWER
FM
CH00
89.8MHz
AM/FM/SW RADIO MP3 REC PLAYER
MODE
FM/AM
SW
MENU
MEMO
REC FILE
VOLUME
REC
DEL
V115
IsatPhone2
READY
RELIABLE
ROBUST
inmarsat
IsatPhone


RTL-SDR
FM / DAB+ / ADS-B Receiver
TCXO 0.5 PPM R820T
RETEKESS
V115
MEMO
MENU
REC FILE
VOLUME
REC
DEL
IsatPhone2
READY
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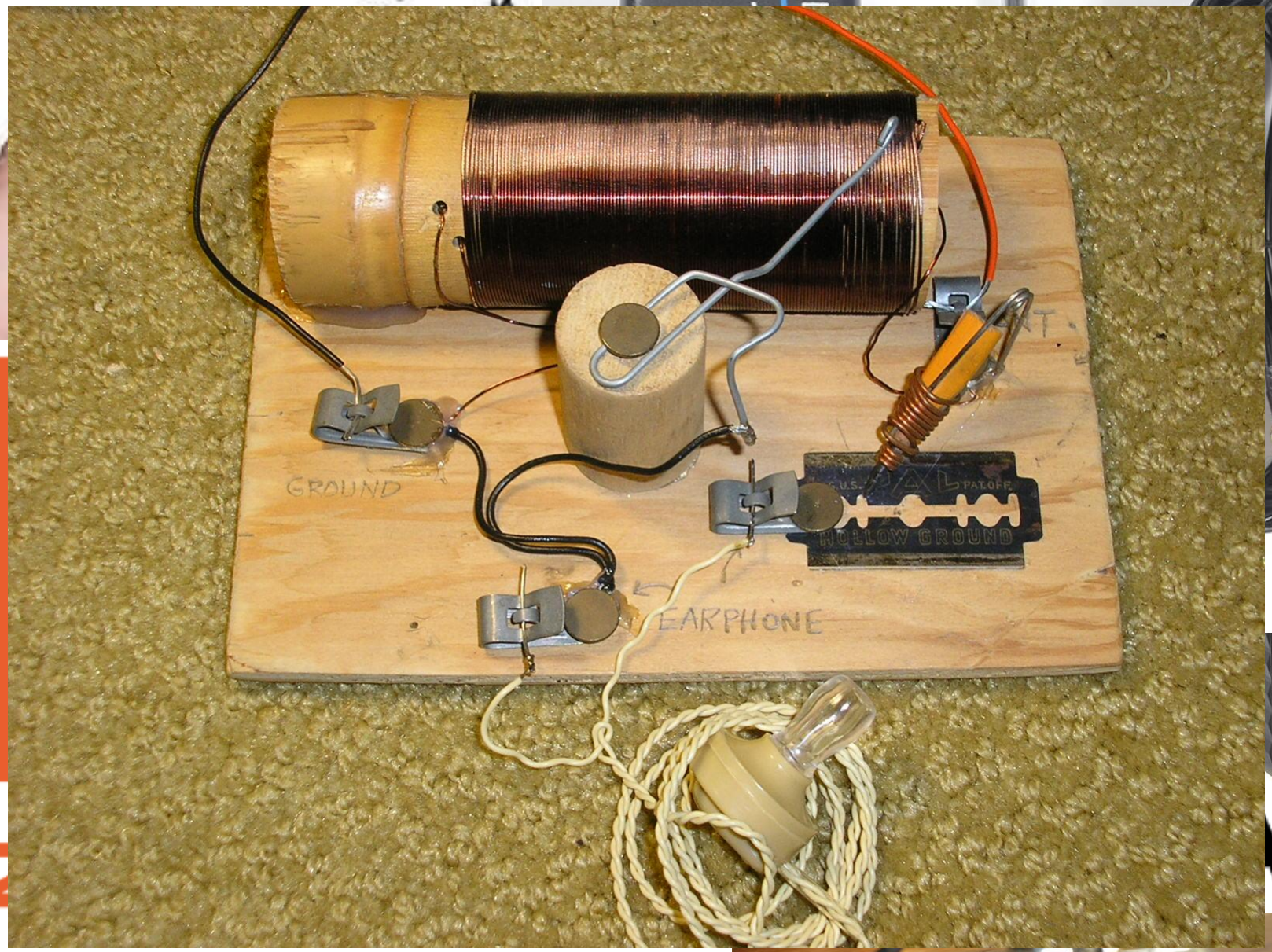
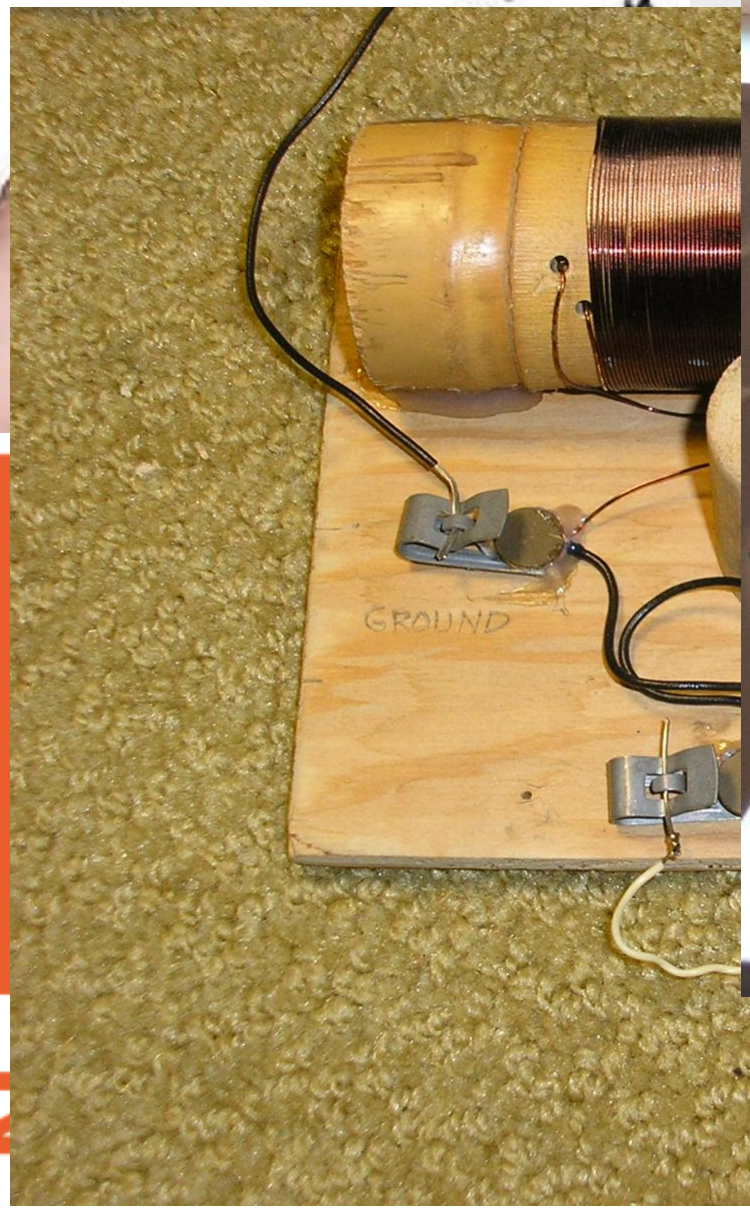
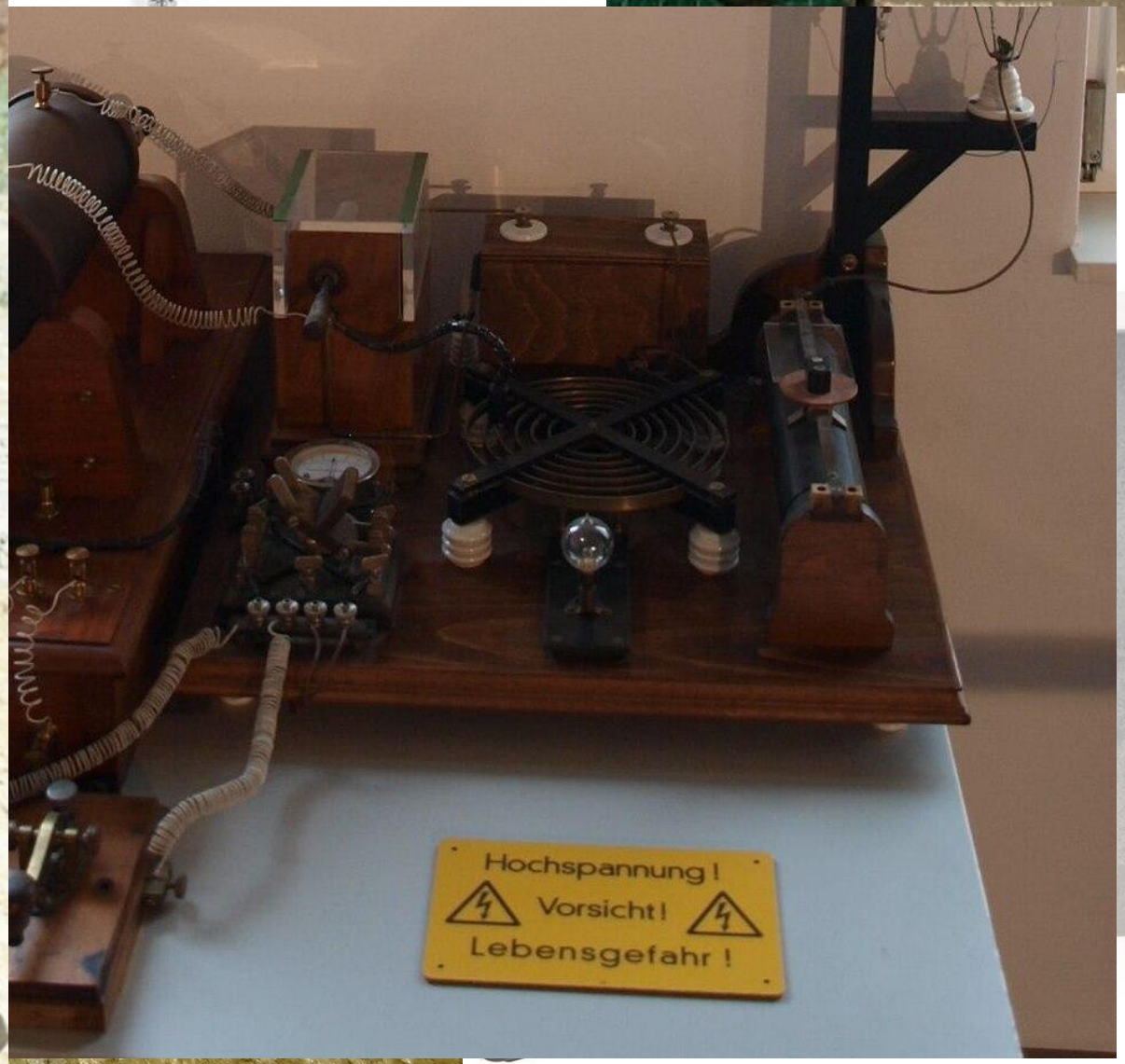
IsatPhone
inmarsat
ZELL
AR


GROUND
EARPHONE
HOLLOW GROUND


GROUND


Hochspannung!
Vorsicht!
Lebensgefahr!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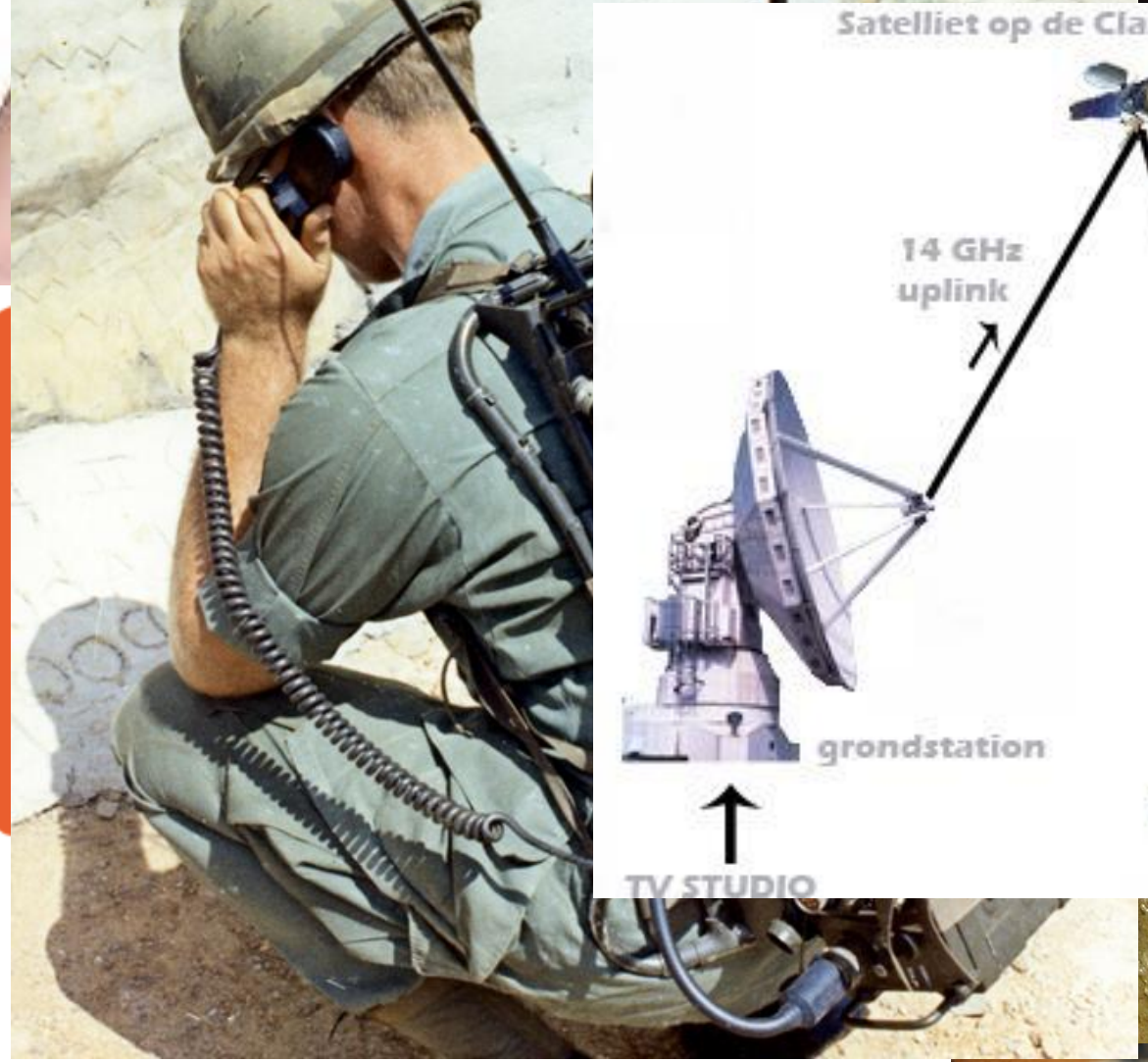
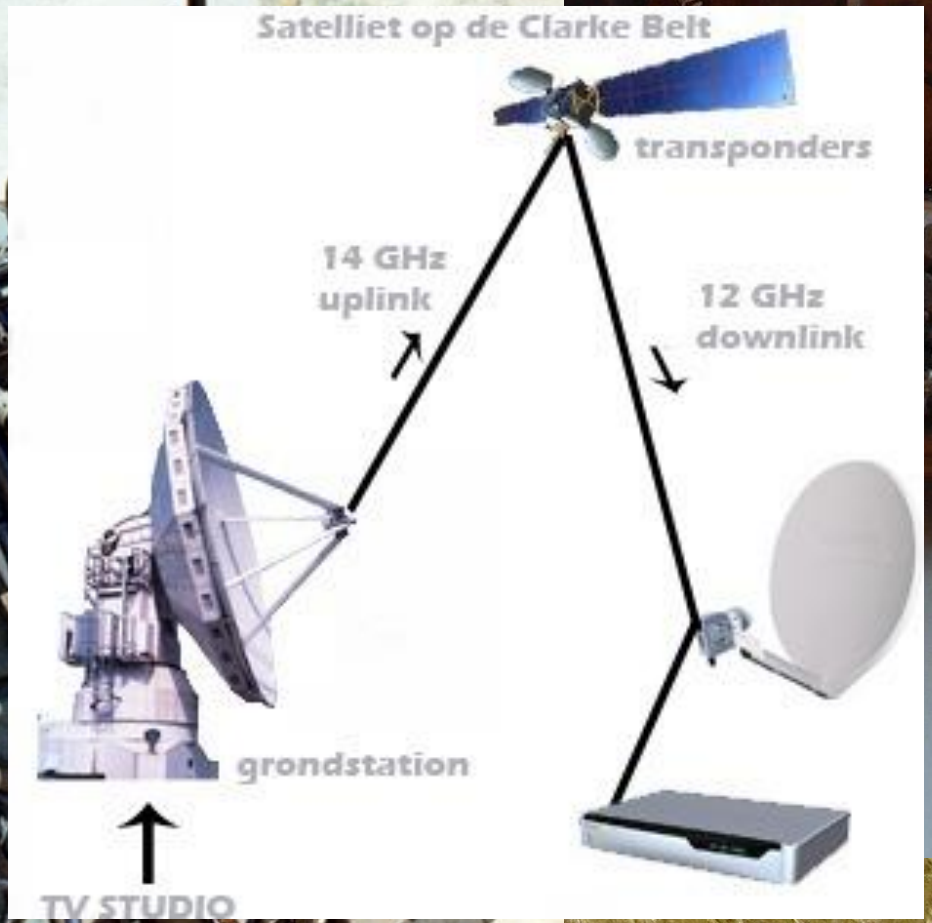
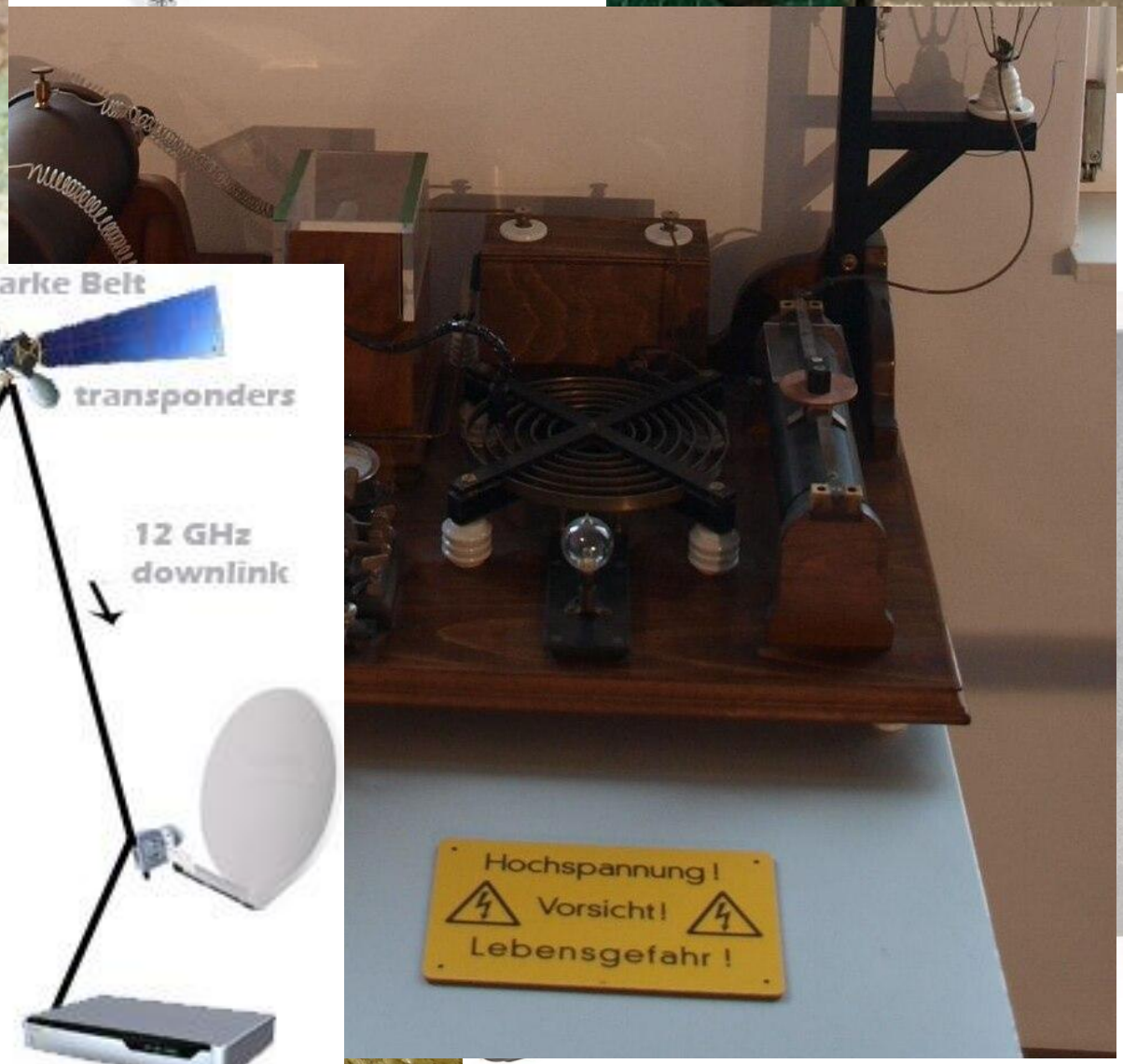



Satelliet op de Clarke Belt
transponders
14 GHz
uplink
12 GHz
downlink
grondstation
TV STUDIO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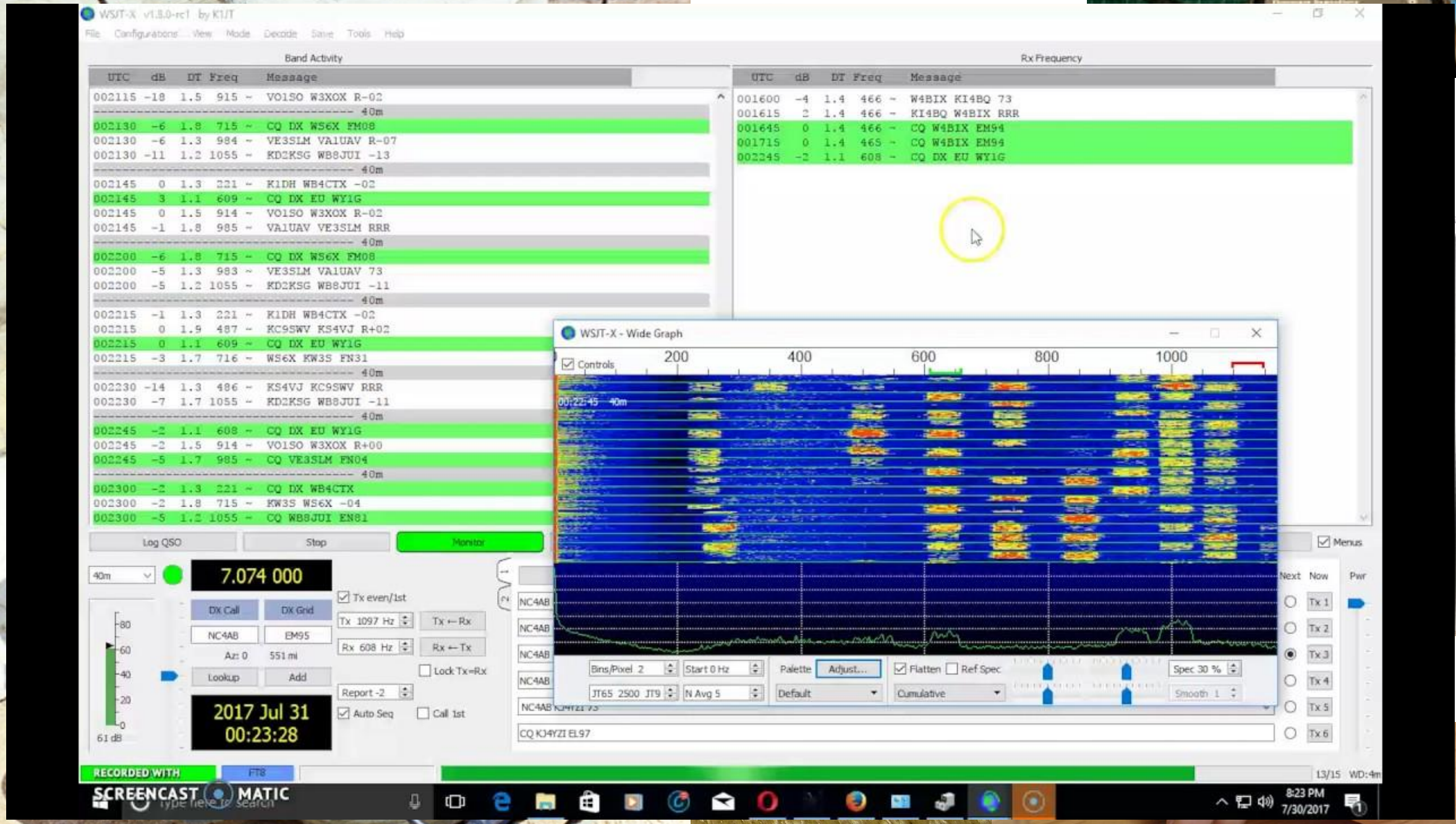
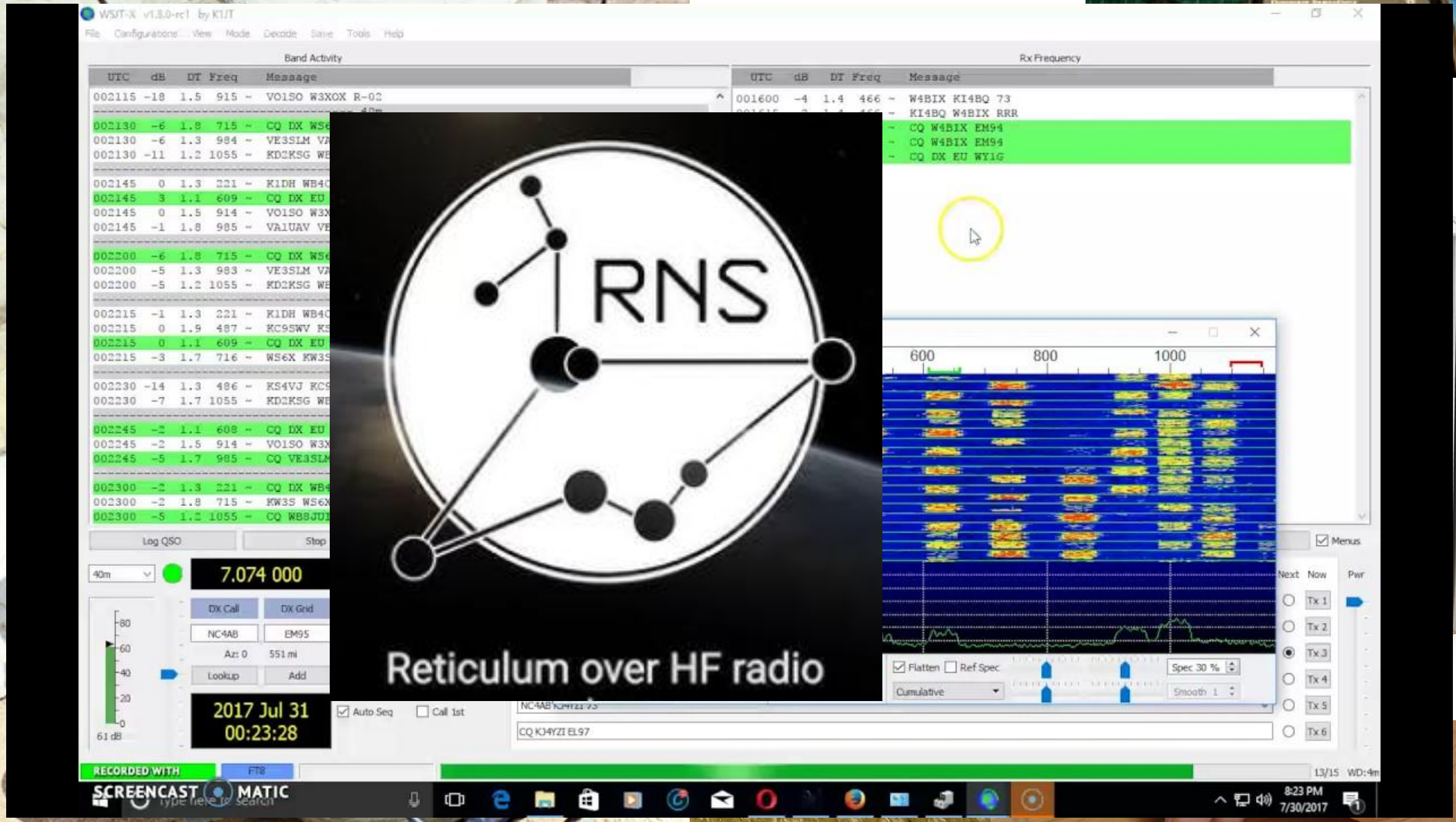
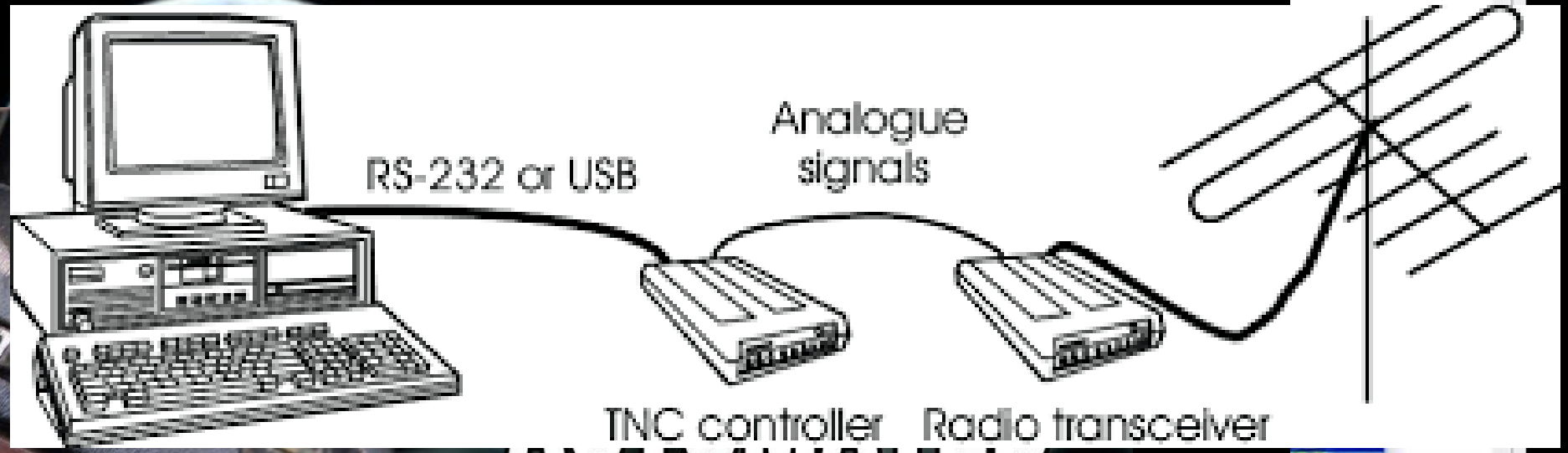

WSJT-X v1.8.0-rc1 by K1JT
File Configurations View Mode Decode Save Tools Help
Band Activity
UTC dB DT Freq Message
002115 -18 1.5 915 ~ VO1SO W3XOX R-02
---------- 40m
002130 -6 1.8 715 ~ CQ DX WS6X FM08
002130 -6 1.3 984 ~ VE3SLM VA1UAV R-07
002130 -11 1.2 1055 ~ KD2KSG WB8JUI -13
---------- 40m
002145 0 1.3 221 ~ K1DH WB4CTX -02
002145 3 1.1 609 ~ CQ DX EU WY1G
002145 0 1.5 914 ~ VO1SO W3XOX R-02
002145 -1 1.8 985 ~ VA1UAV VE3SLM RRR
---------- 40m
002200 -6 1.8 715 ~ CQ DX WS6X FM08
002200 -5 1.3 983 ~ VE3SLM VA1UAV 73
002200 -5 1.2 1055 ~ KD2KSG WB8JUI -11
---------- 40m
002215 -1 1.3 221 ~ K1DH WB4CTX -02
002215 0 1.9 487 ~ KC9SWV KS4VJ R+02
002215 0 1.1 609 ~ CQ DX EU WY1G
002215 -3 1.7 716 ~ WS6X KW3S FN31
---------- 40m
002230 -14 1.3 486 ~ KS4VJ KC9SWV RRR
002230 -7 1.7 1055 ~ KD2KSG WB8JUI -11
---------- 40m
002245 -2 1.1 608 ~ CQ DX EU WY1G
002245 -2 1.5 914 ~ VO1SO W3XOX R+00
002245 -5 1.7 985 ~ CQ VE3SLM FN04
---------- 40m
002300 -2 1.3 221 ~ CQ DX WB4CTX
002300 -2 1.8 715 ~ KW3S WS6X -04
002300 -5 1.2 1055 ~ CQ WB8JUI EN81
Rx Frequency
UTC dB DT Freq Message
001600 -4 1.4 466 ~ W4BIX KI4BQ 73
001615 2 1.4 466 ~ KI4BQ W4BIX RRR
001645 0 1.4 466 ~ CQ W4BIX EM94
001715 0 1.4 465 ~ CQ W4BIX EM94
002245 -2 1.1 608 ~ CQ DX EU WY1G
WSJT-X - Wide Graph
Controls
200 400 600 800 1000
00:22:45 40m
Log QSO
Stop
Monitor
Menus
40m
7.074 000
DX Call
DX Grid
NC4AB
EM95
Az: 0 551 mi
Lookup
Add
Tx even/1st
Tx 1097 Hz
Rx 608 Hz
Tx ← Rx
Rx ← Tx
Lock Tx=Rx
Report -2
Auto Seq
Call 1st
2017 Jul 31
00:23:28
61 dB
Bins/Pixel 2
Start 0 Hz
Palette
Adjust...
Flatten
Ref Spec
Spec 30 %
JT65 2500 JT9
N Avg 5
Default
Cumulative
Smooth 1
Next
Now
Pwr
Tx 1
Tx 2
Tx 3
Tx 4
Tx 5
Tx 6
CQ KJ4YZI EL97
RECORDED WITH
FT8
13/15 WD:4m
SCREENCAST MATIC
8:23 PM
7/30/2017


RNS
Reticulum over HF radio
WSJT-X v1.8.0-rc1 by K1JT
Band Activity
Rx Frequency
Log QSO
Stop
7.074 000
DX Call
DX Grid
NC4AB
EM95
Lookup
Add
2017 Jul 31
00:23:28
Auto Seq
Call 1st
CQ KJ4YZI EL97
RECORDED WITH
FT8
SCREENCAST MATIC
8:23 PM
7/30/2017


WINLINK
Global Radio Email
Reticulum over HF radio
7.074 000
2017 Jul 31
00:23:28
RECORDED WITH
SCREENCAST MATIC

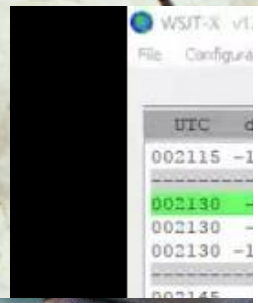

HAM RADIO Q&A
APRS:
AUTOMATED
PACKET
REPORTING
SYSTEM
YAESU
SUBMERSIBLE
SCAN MHz
146.865
144.390
WSJT-X
Menus
Next
Now
Pwr
Tx 1
Tx 2
Tx 3
Tx 4
Tx 5
Tx 6
Spec 30 %
Smooth 1
8:23 PM
7/30/2017

HAM RADIO Q&A



AUTOMATED PACKET REPORTING SYSTEM

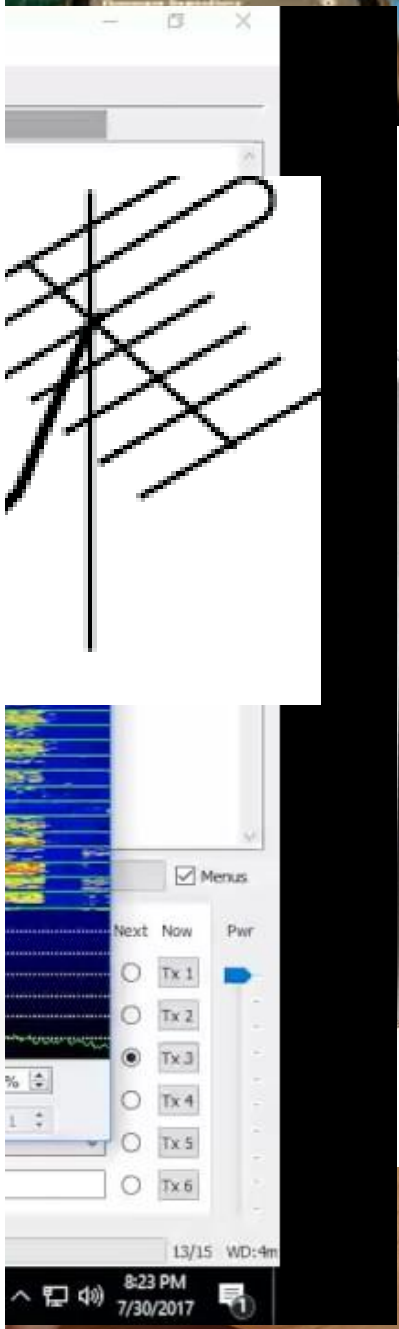

HAM RADIO Q&A
TP-LINK
TP-LINK
TP-LINK
4G
transceiver
Menus
Next
Now
Pwr
Tx 1
Tx 2
Tx 3
Tx 4
Tx 5
Tx 6
Spec 30 %
Smooth 1
13/15
WD:4m
8:23 PM
7/30/2017


WSJT-X
File
UTC
002115 -1
002130
002130
002130 -1


HAM RADIO Q&A
SCAN MHz


TP-LINK


MINI 4 PRO


Menus
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Tx 1
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WD:4m
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7/30/2017

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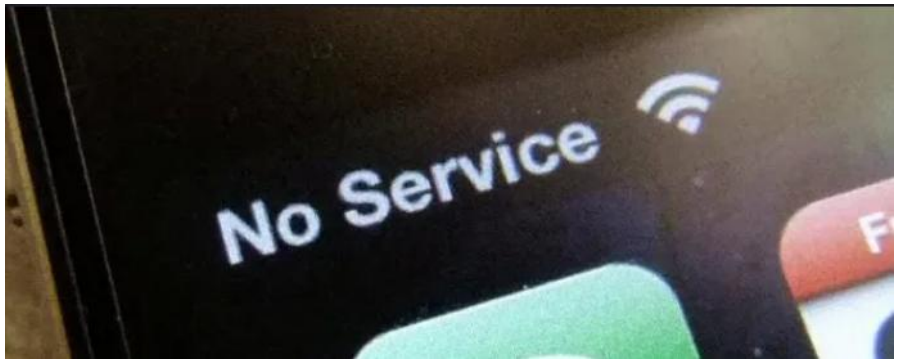
- Yes, but…



- Cell tower and service dependency
- Government can shut down access or tap
- Can contain personal info or metadata
- Traceable to single entity

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- **As primary tool**

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- **As primary tool**
  - More control
  - Direct P2P communication possible
  - Fast to initiate contact
  - No or limited dependency on third parties

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Both reasons are <u>valid</u> and <u>complementary</u>

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Range: **.5-5-50-500-5000 rule**

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Budget: **CPO (Cost Per Operator)**
Range: **.5-5-50-500-5000 rule**
Utility: **Casual**, **Tactical** or **Strategic**

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Range: **.5-5-50-500-5000 rule**
Utility: **Casual**, **Tactical** or **Strategic**
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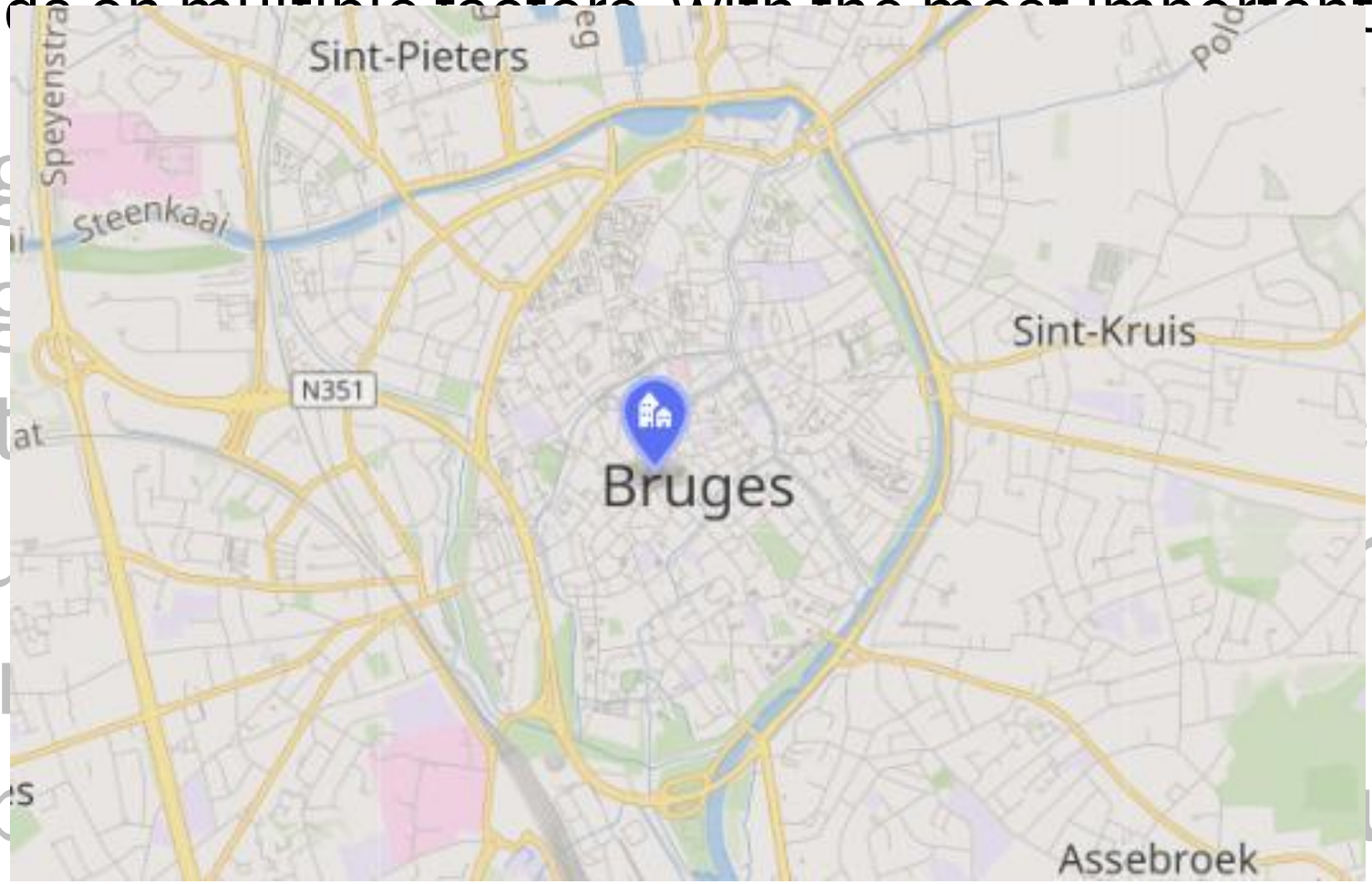

Budget: **CPO** (*Cost Per Operator*)

A CPO of **<50 euro** can come become compromising

A CPO of **>100 euro** can have diminished returns fast

A CPO of **50-100 euro** is a healthy aim to have for groups

Budget: **CPO** (*Cost Per Operator*)

- Example of a **too low** CPO:
  - Action group just buys *Baofengs* for 30 euro each (**CPO = 30**)
  - Factory shipped antennas are not great and will affect usable range
  - Reception is poor, AO (= *Area of Operations*) coverage not guaranteed

Solution:

- Buy better antennas for better reception and transmission
- Costs: 20 euro each, making total costs 20 euro per operator (**CPO = 50**)
- Result: Better reception, AO coverage improved

Budget: **CPO** (*Cost Per Operator*)

- Example of a **too high** CPO:
  - Action group (10 members) wants a HF rig of 2.000 euro. (**CPO = 200**)
  - Action group also needs walkie-talkies for tactical coordination
  - Investment did not help group goals; AO not covered by tactical comms

Solution:

- Buy a decent used 500 euro rig and decent new walkie-talkies
- Total **CPO = 100** (500 for the HF-rig and 500 for 10 x Baofeng + antenna)
- Result: Still HF capabilities, proper tactical comms, 1.000 in the bank

Budget: **CPO** (*Cost Per Operator*)

- Example of a **healthy** CPO:
  - Action group (10 operators) wants to set up mesh communications
  - 10 Lilygo T-Decks are bought and prepared for use with Meshtastic
  - A LoRa board with decent antenna as repeater + powerbank for power
  - Total costs ~900 euro (**CPO = 90**)
  - All members have comms, there is AO coverage by mesh repeater

- Another example of a **healthy** CPO:
  - Action group (20 operators) buys walkie-talkies and a VHF/UHF-repeater
  - Walkie-talkies + antenna's: 1000 euro. Repeater: 400 + 100 euro battery
  - Total cost: 1500 euro. **CPO = 75**. Comms established, AO is covered

Range: **.5 5 50 500 5000+** rule

Range in kilometers	Examples
0.5 km = **neighborhood**	PMR446 walkie-talkies, Mesh nodes
5 km = **village** or **city district**	High power HT's, Mesh repeaters
50 km = **city** or **intercity**	UHF/VHF repeater, Mesh network
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So, What is NVIS ???

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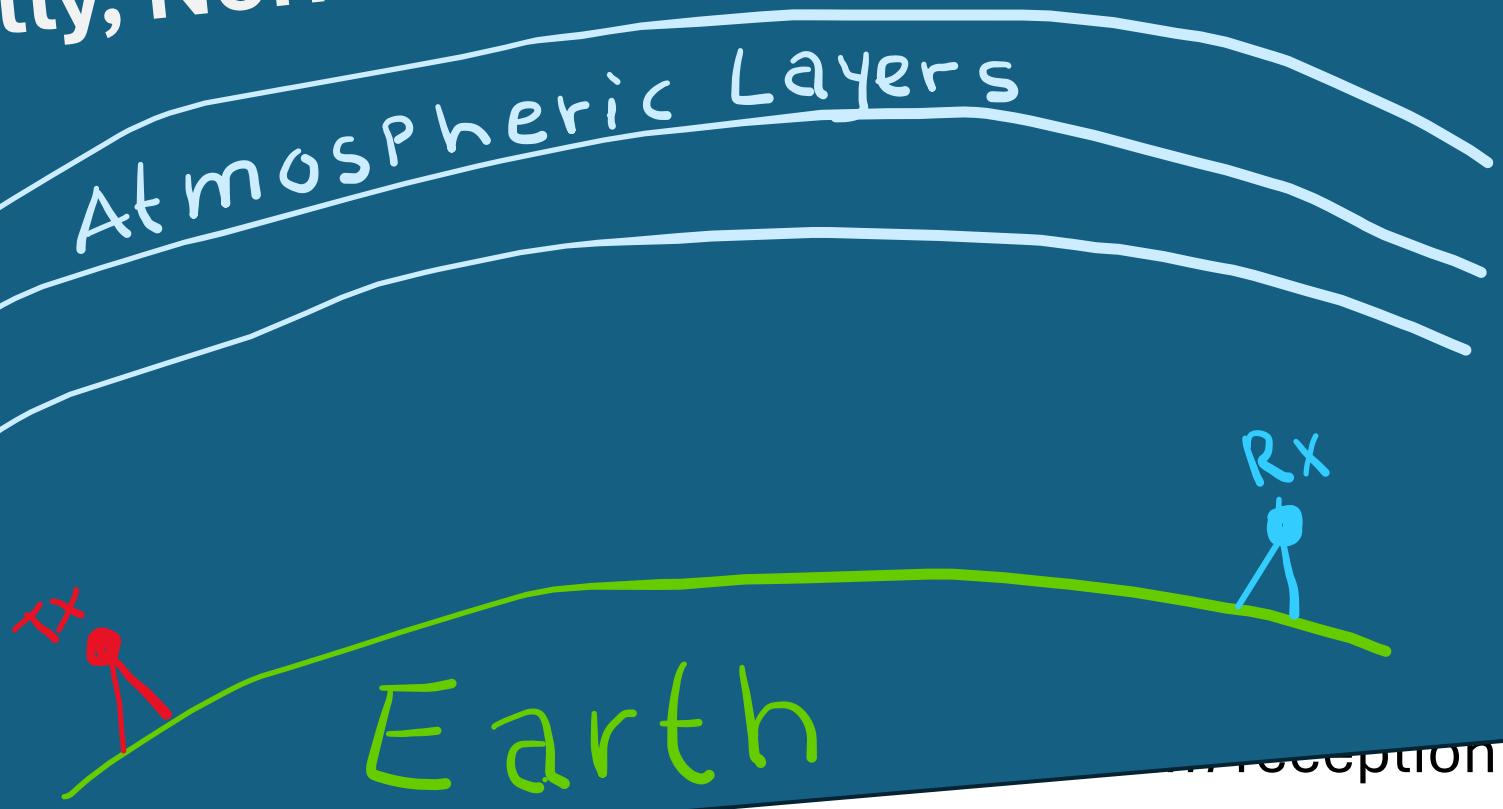

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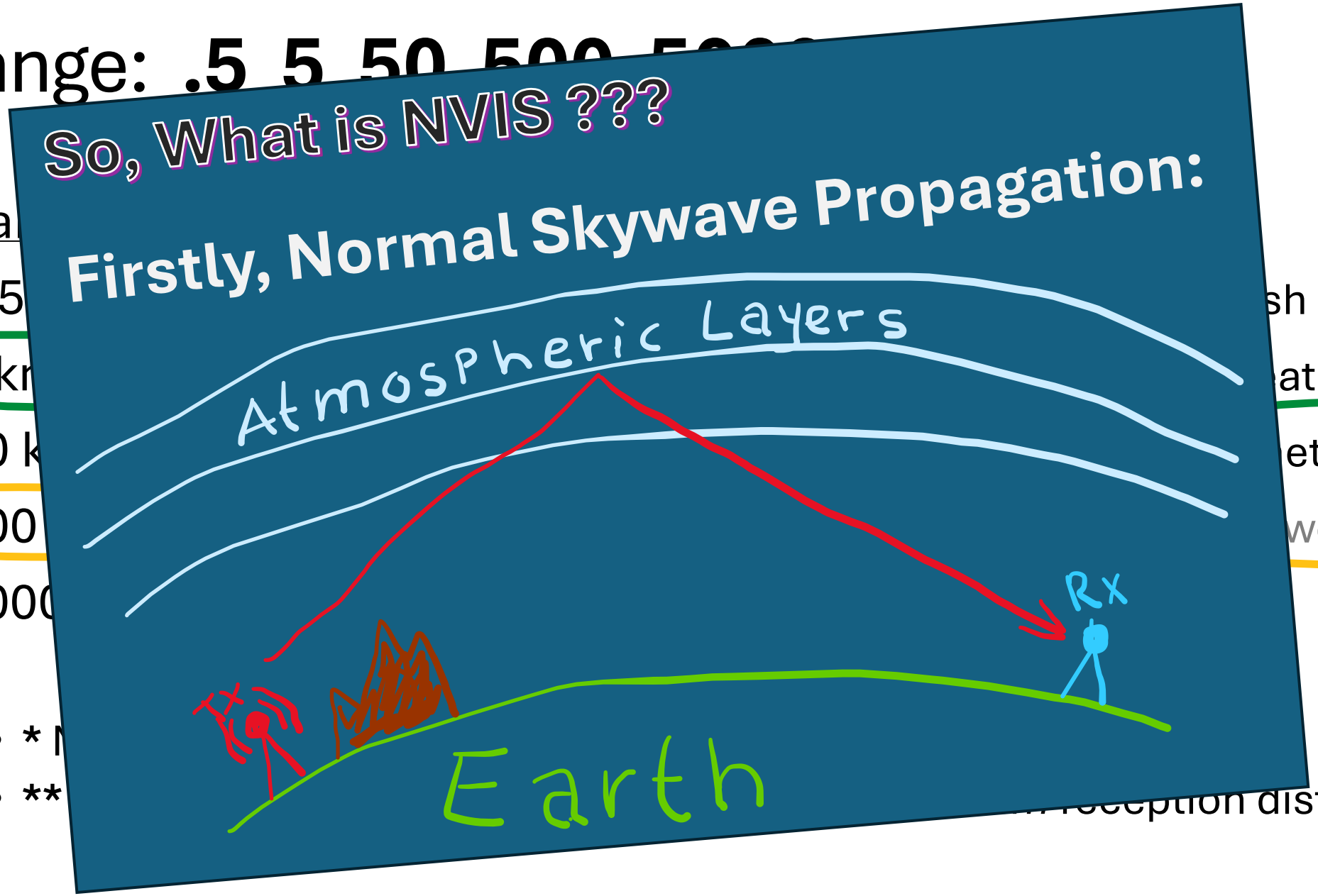

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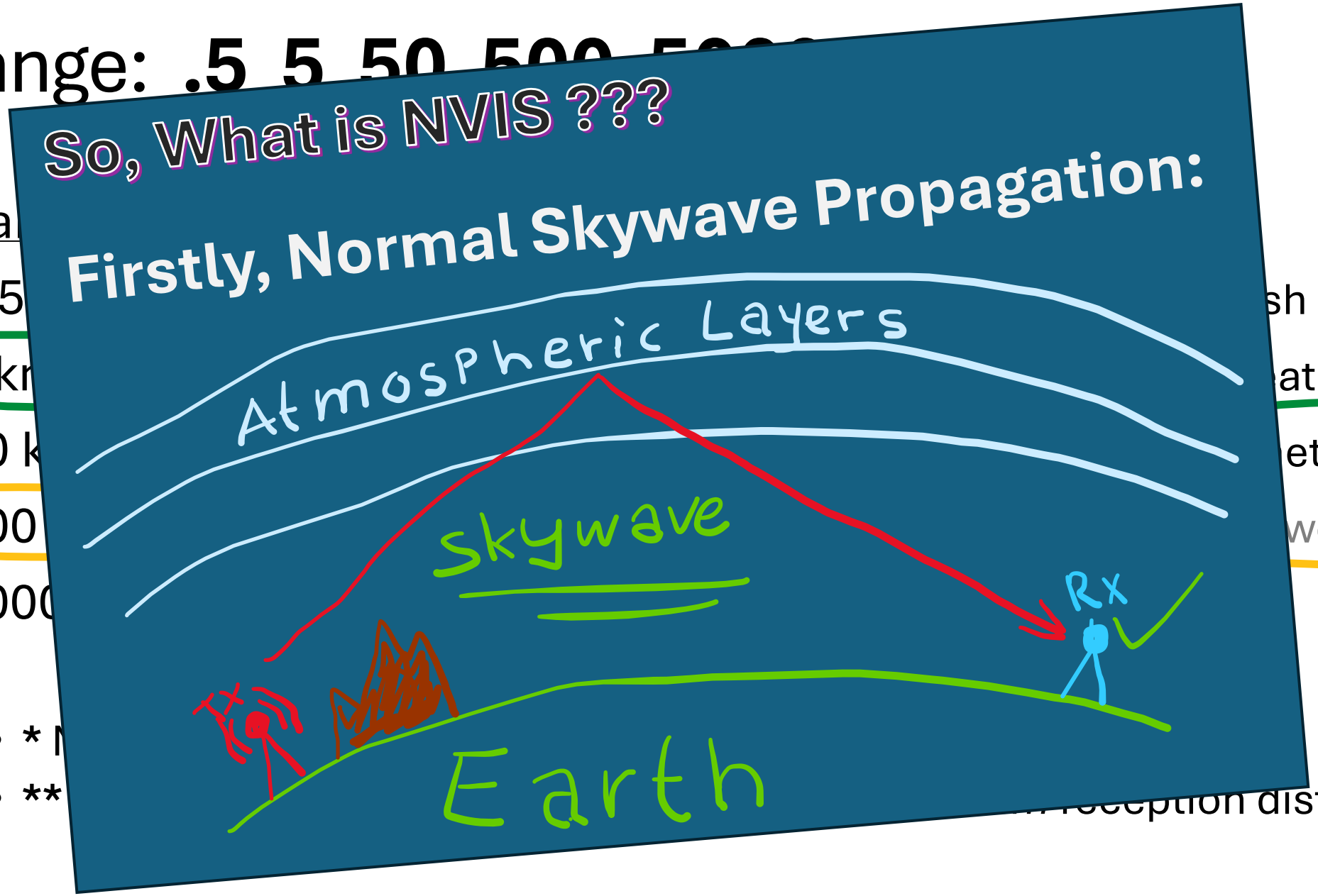

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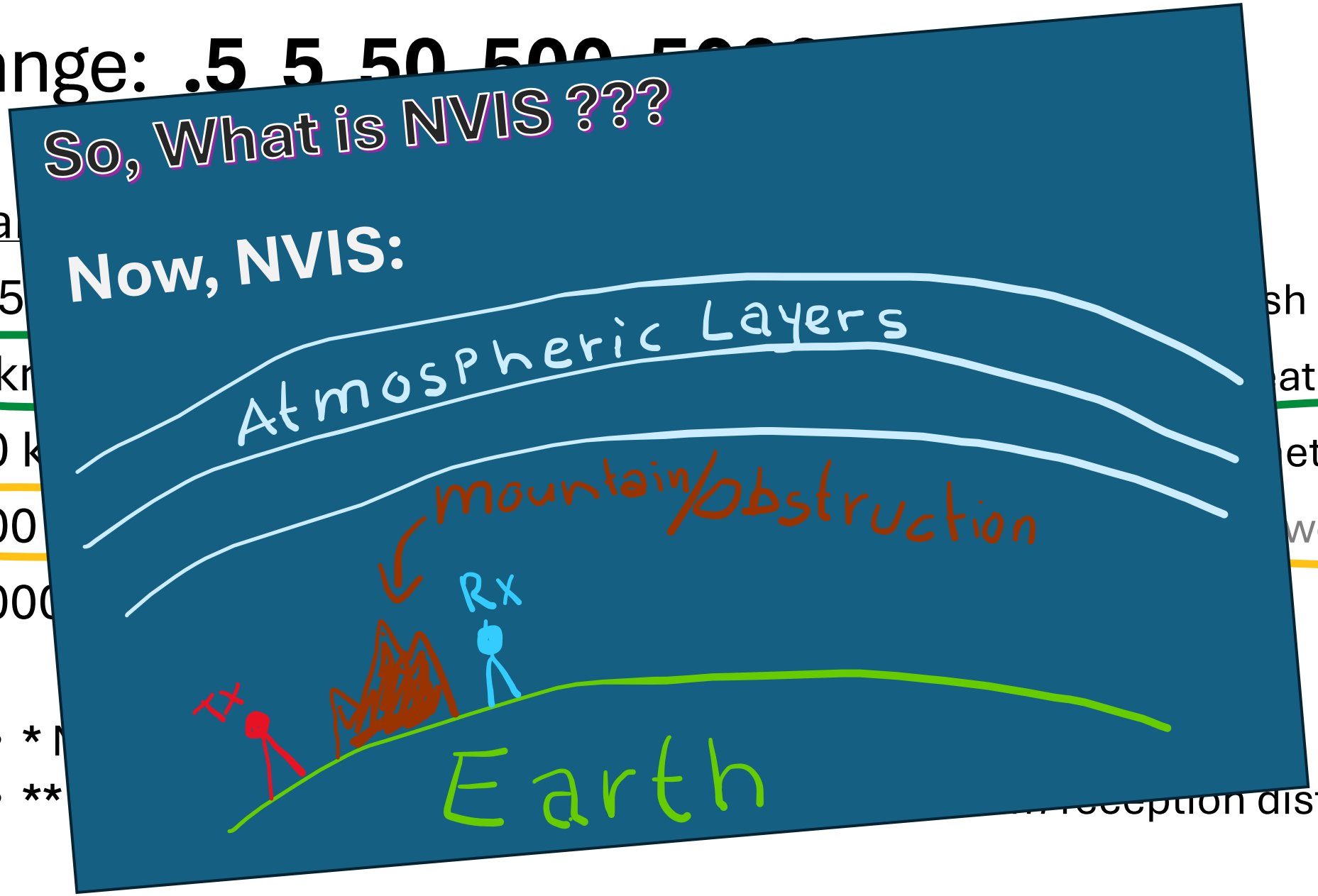

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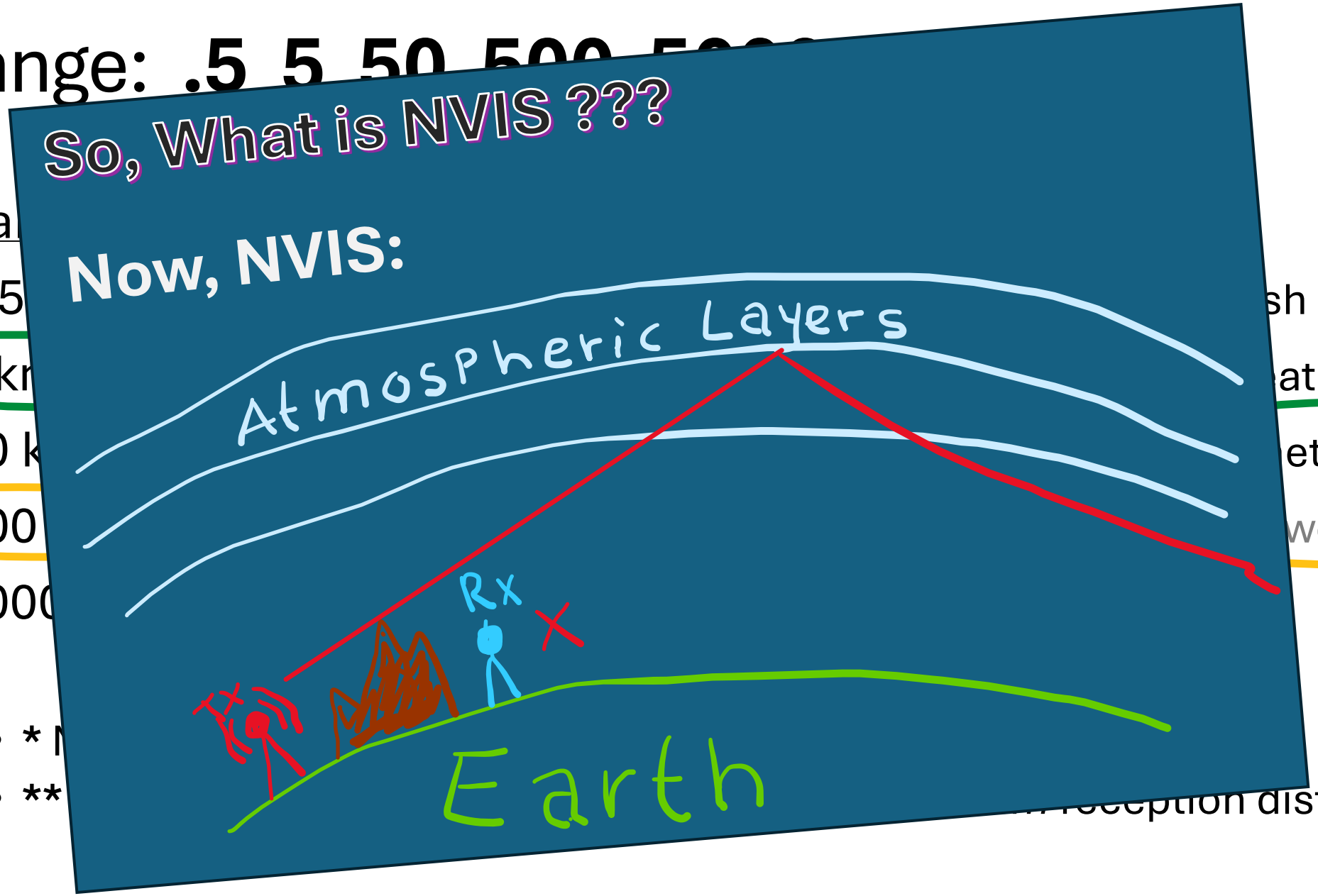

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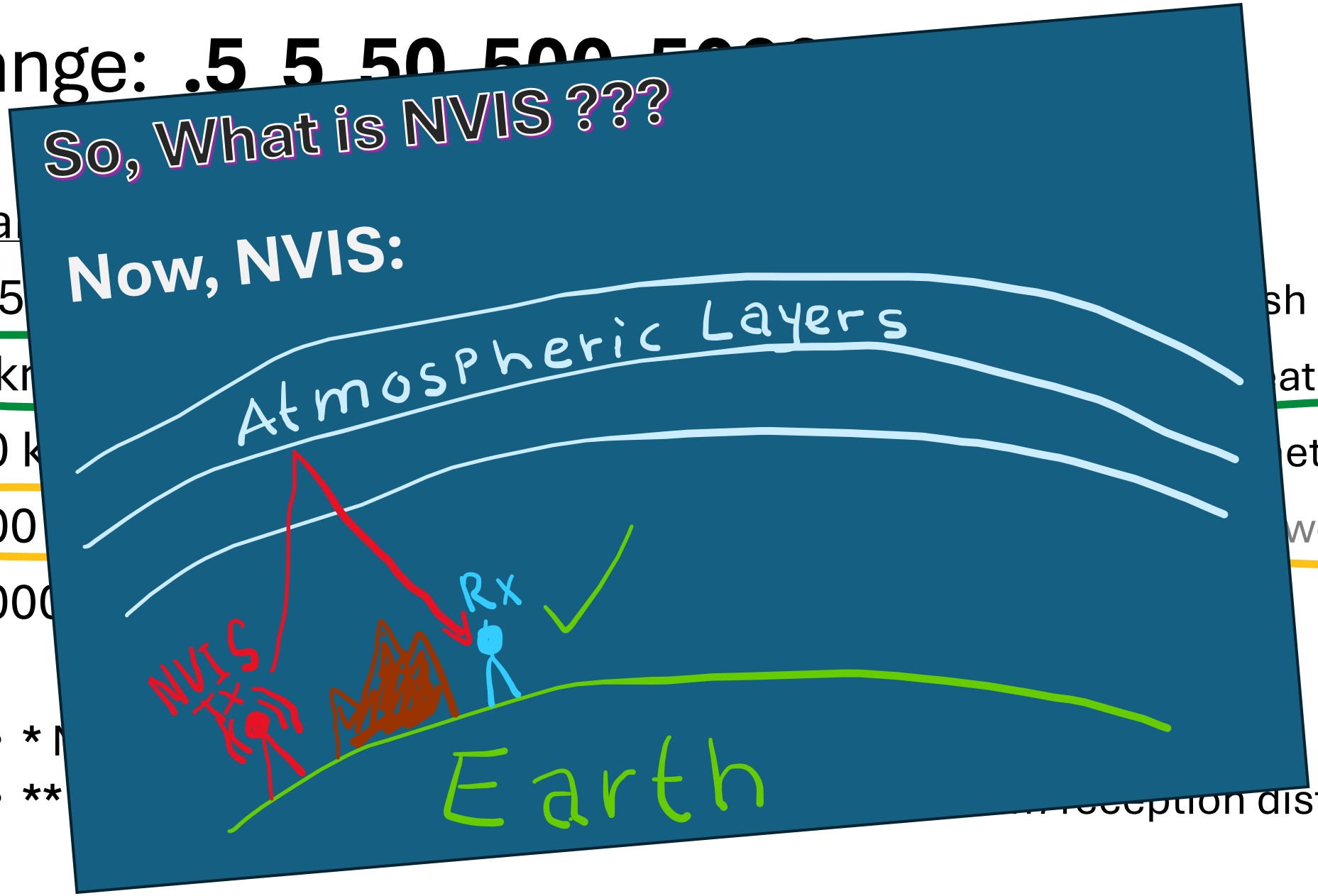

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So, What is NVIS ???

Now, NVIS:

- Requires HF-frequencies to work
- Upper MF-frequencies can work during the night.
- NVIS is achieved by arranging the antenna in such a way that a lot of the radiated energy is directed straight upwards, into the sky.
  Hence ‘Near Vertical Incidence Skywave’
- NVIS works best between 160 and 40 meter.
  - 40 meter during the day
  - 80/160 meter at night

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Range: **.5 5 50 500 5000+** rule

- Considerations for **0.5 KM** (500m or **neighborhood**):

- (d)PMR Walkie-Talkies
- LoRa 868 Meshtastic
- LoRa 868 MeshCore
- Direct WiFi P2P via socalled *cantenna,* high-gain direct link or physical link
  - Can be connected to Reticulum

Range: **.5 5 50 500 5000+** rule

- Considerations for **5 KM** (**village** or **city district**):

- UHF/VHF 1-5 Watt walkie-talkies (*Baofeng*) + repeater
- LoRa 868 Meshtastic (non-repeating nodes + properly set up repeater)
- LoRa 868 MeshCore + central placed repeater
- LoRa Reticulum Rnodes + high gain antennas
- WiFi P2P via socalled *cantenna* or high-gain direct link (rooftops/towers)
  - Can be integrated with Reticulum

Range: **.5 5 50 500 5000+** rule

- Considerations for **50 KM** (**city** or **intercity**):

- UHF/VHF 1-5 Watt walkie-talkies (*Baofeng*) + multiple repeaters
- LoRa 868 MeshCore + multiple repeaters
- LoRa 868 Reticulum Rnodes + high gain antennas + multiple transport nodes
- WiFi P2P via socalled *cantenna* or high-gain direct link (50m+ height only)
  - Can be integrated with Reticulum
- HF NVIS Low power < 10 Watt

Range: **.5 5 50 500 5000+** rule

- Examples to consider for:

• 0.5 KM	(d)PMR Walkie-Talkies, LoRa mesh
• 5 KM	5-Watt HT's (Baofeng with good antenna), LoRa Mesh + repeater, 25-Watt Mobilophone
• 50 KM	5-Wt HT's + UHF/VHF-repeaters, LoRa Mesh + repeaters, 25-Watt Mobilophone + UHF/VHF repeater, HF-NVIS,
• 500 KM	HF-NVIS, Satcom
• 5000 KM	HF-skywave, Satcom

Range: **.5 5 50 500 5000+** rule

- Antennas have major influence on your range
  - Antennas gain (the higher, the more range, but also the more directional)
  - Placement height: from 30MHz and up: higher = better
  - Antenna quality: Good antenna's are resonant to specs and have low SWR
- The feedline (coax) will come second
  - Short, low-loss coax of decent quality is preferred
  - For mobile use: take the beefiest cable you can comfortably carry/use
- Transmitting power only comes last
  - If your antennas and feedline are selected and prepared for the AO, then you can adjust TX power to cover the AO, but not more than the AO.

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Only RX station benefits :-(↗

Range: **.5 5 50 500 5000+** rule

- Concluding considerations

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- **Concluding considerations for range**

- Test for yourself and your action group what works.
  - There are a LOT of variables that decide your effective range
  - The .5.-5-50-500-5000 rule will only work approximative
  - Only by testing your equipment for your setting in your AO you will know what will work or needs adjusting
- Do not exceed range willingly beyond your AO (security risk)

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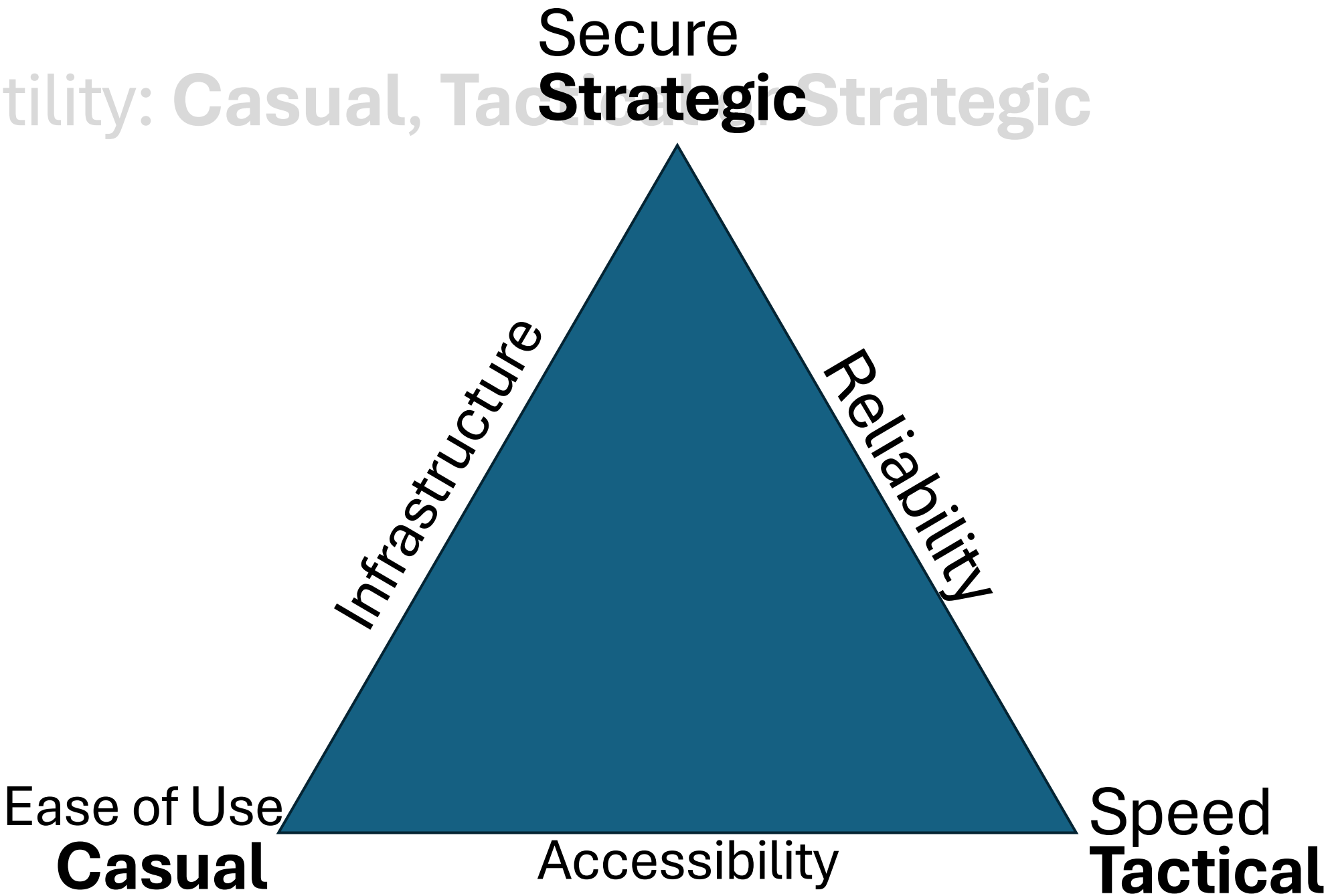
- Example: Smartphone: easy to use, can be used in light tactics and by using the right apps, can be somewhat secure.

Utility: Casual, Tactical, Strategic



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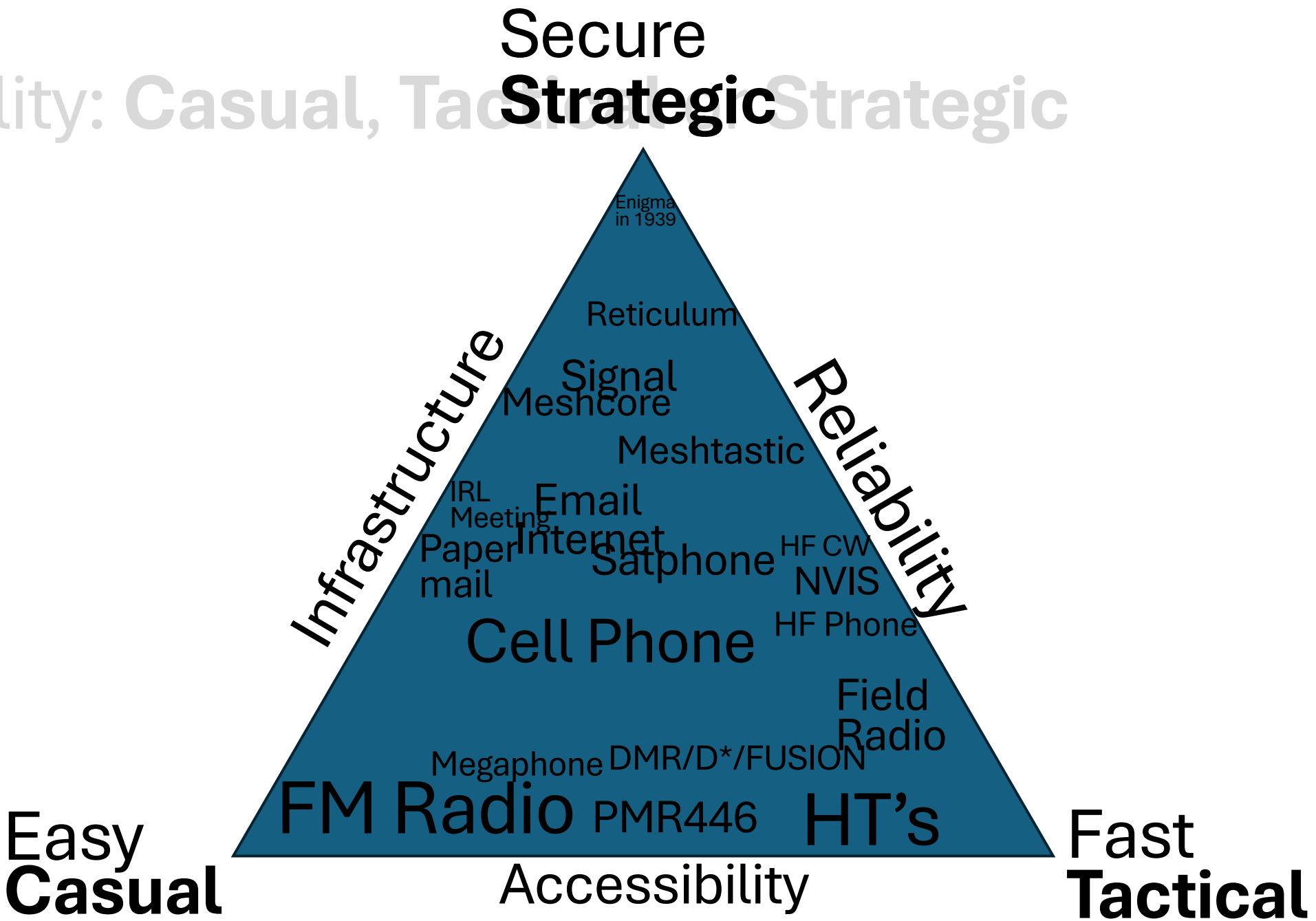

Utility: **Casual**

- Casual comms consideration
  - Easy to use
  - Ergonomic
  - Readily accessible equipment and parts
  - No learning cure, or shallow at best
  - ‘Just works’, no difficult setups required
  - Not easy to break any laws

- Examples:
  - FM Radio receiver
  - HF NVIS
  - Kids Walkie-Talkies (PMR446, LPD 433 or SRD 868)

Utility: **Tactical**

- Tactical comms consideration
  - Fast to use
  - Durable in adverse conditions
  - Focussed on "*Get the message from A to B*" less, but not least on security
  - Learning curve allowable if user settings are easy to remember or fast to look up
  - No or low latency allowed

- Examples:
  - Durable, 'rugged', walkie-talkies + repeaters
  - Military Field radio
  - HF (NVIS) radio (limited)
  - Meshtastic (separate private channels, no public channels)

Utility: **Strategic**

- Strategic comms consideration
  - Security is important
  - Often requires long-range capabilities
  - Rather sees comms not being established over comms being compromised
  - Learning curve is often steep; cryptography
  - Latency is second to security
  - Often used in tandem with tactical comms

- Examples:
  - Encrypted radio stations with HF(NVIS)-capabilities
  - Military Field radio with HF(NVIS)-capabilities
  - Meshcore (up to 50 KM) or Reticulum propagation netw. from 50+ KM

Utility: **Casual**, **Tactical** or **Strategic**

Takeaways and considerations:

- Ask yourself the question: What am I wanting to achieve?
  - Just casual comrade chatting, low-risk? Consider leaning to Casual
  - Speed is important during actions? Consider leaning to Tactical
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Central Command: Brokers between tactical teams or between a tactical teams and strategic layers.

- Single point of failure
- Requires skills in tactical AND strategic comms
- Can be efficient to filter out not-mission critical comms.

Evironment: **Residential** or **Rural**

When range or AO way less than 50KM, consider:

- **VHF** in **rural areas** or at **sea**
- **UHF** in **cluttered areas** or in **city centers**

When range or AO is about 50 KM, consider:

-Crossband repeaters: **Uplink UHF**, **Downlink VHF**

-**HF NVIS** (if no repeaters available)

When range way more than 50 KM but less than 500, consider:

-**HF NVIS** in **rural areas**

-**Lora 868 (Reticulum)** propagation/transport network **between cities**

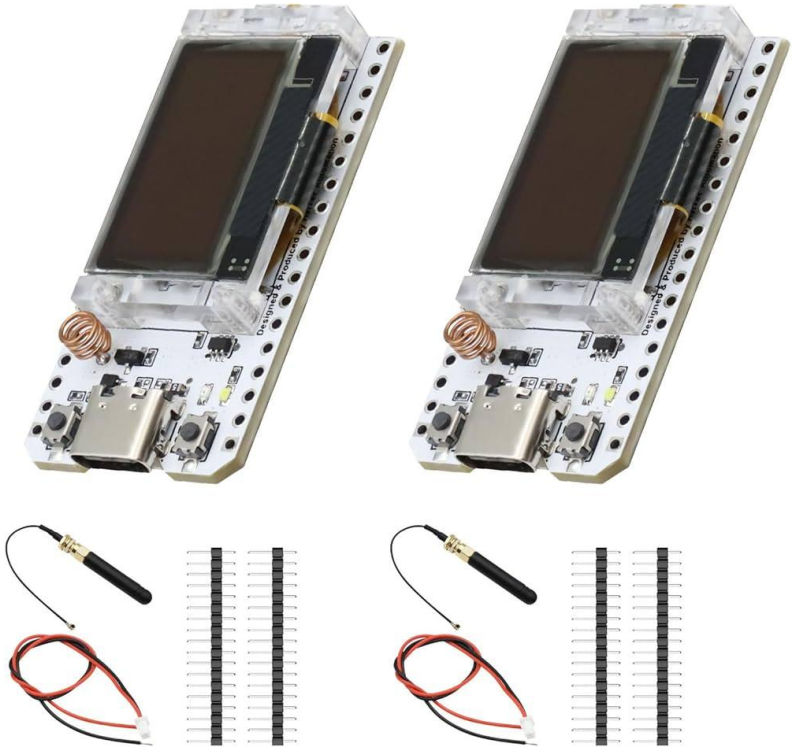
Anything above 500 KM**:**

-HF Radio: JS8Call, Packet (Reticulum) or Voice (‘phone’)

Simplicity: **Easy-to-use** or **skills required**

This is one of the most overlooked steps.

- Often: “Just use X” (bare pcb with ESP32 and LoRa)



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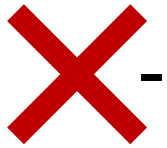

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- In the end the only goal was tactical *point-A* to *point-B* comms at a city centre at low-risk action

- Cheap PMR446 walkie-talkies were the right tool, takes a minute to learn and are easy-to-use

Simplicity: **Easy-to-use** or **skills required**

Some considerations from my own experience

- Does the tool I want to propose actually help us?

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    - Do I prefer the tool because I only like it myself?
    - Do I prefer the tool, because this is what the AG needs?

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My own experience: I like the tool ‘for’ others, because I like them myself.

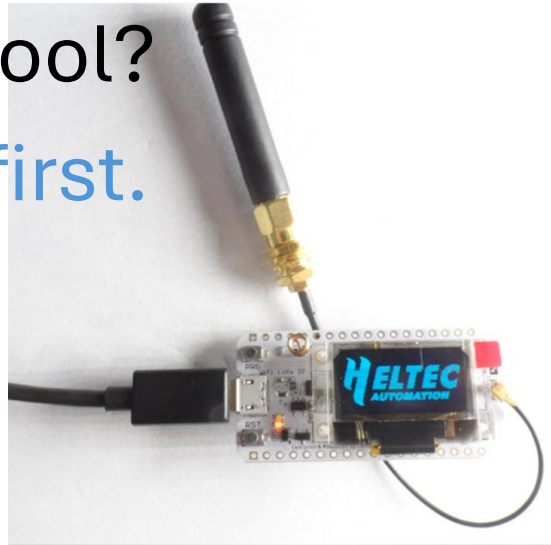
This can be risky, because the tools I like, are not always the tools we need.

Simplicity: **Easy-to-use** or **skills required**

If there are comms, radios or equipment you are considering for your action group, always ask yourself the question:

How long is it going to take for the other comrades To get onboard with the proposed comms tool?

Be honest to yourself. Do honest research first.



Simplicity: **Easy-to-use** or **skills required**

If there are comms, radios or equipment you are considering for your actio… ourself the q…

Done! Finally… 124 Slides XD
Thanks for surviving and watching
Let's do the Q&A Now

… the other comrades … proposed comms tool?

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