

So What the Heck Is
This Radio Thing,
Anyway?

Who am I?

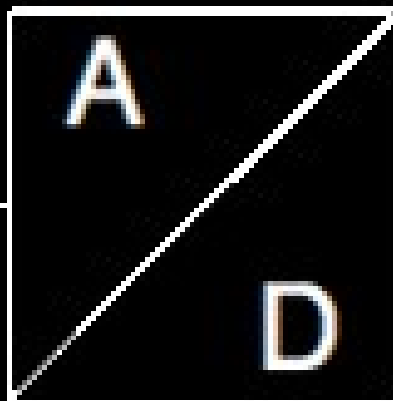
Computer geek, ham radio operator, electronics fiddler,
RC pilot, cat and dog servant, etc...

A Brief History of Radio

- Spark-gap transmitter (late 1800s to early 1900s)
- Crystal radio receiver (early 1900s through around 1930)
- Vacuum tubes (early 1900s)
- Transistor radios (mid-1950s onward)
- Software-defined radios (mid-1980s, more widespread mid-90s)

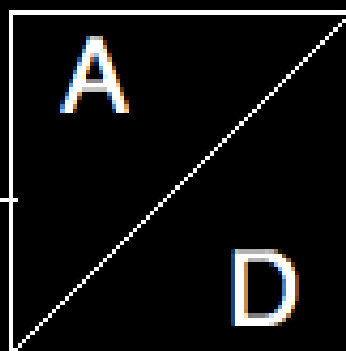
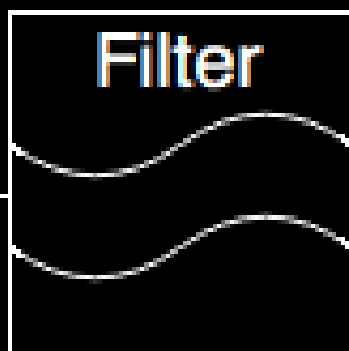
What is SDR?

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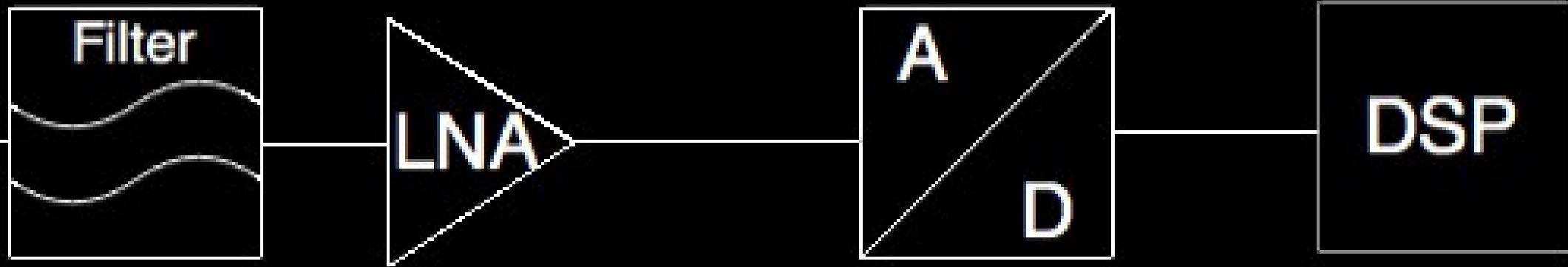


DSP

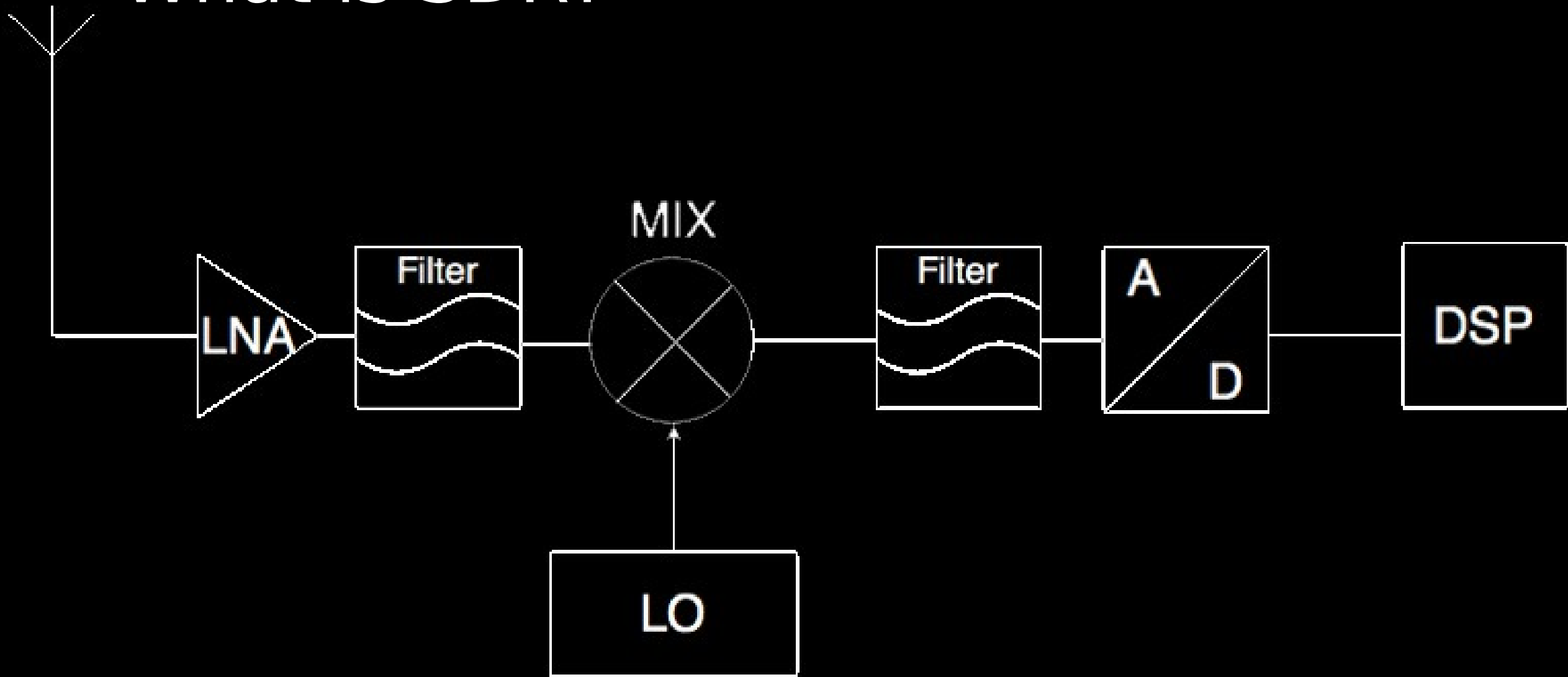
What is SDR?



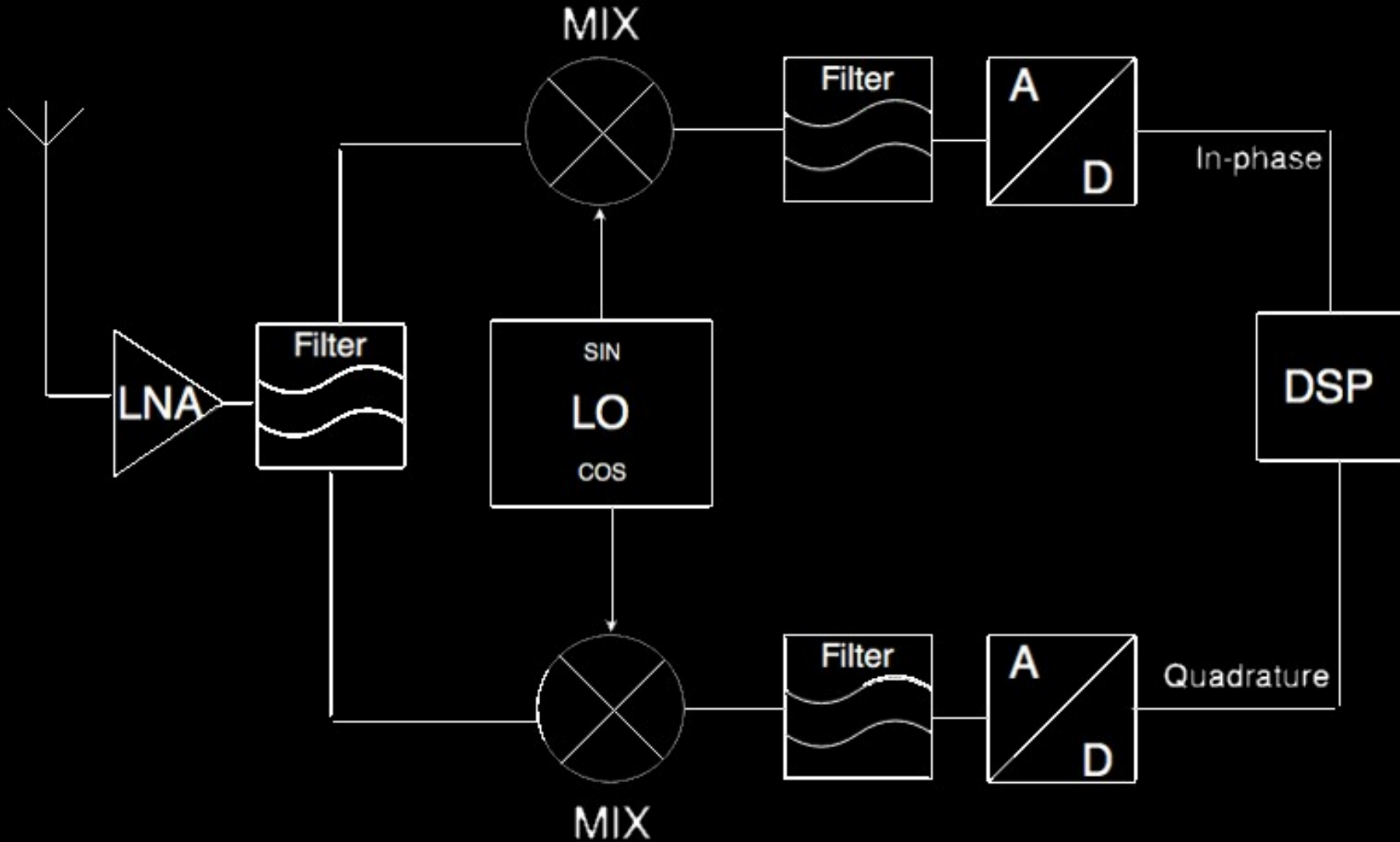
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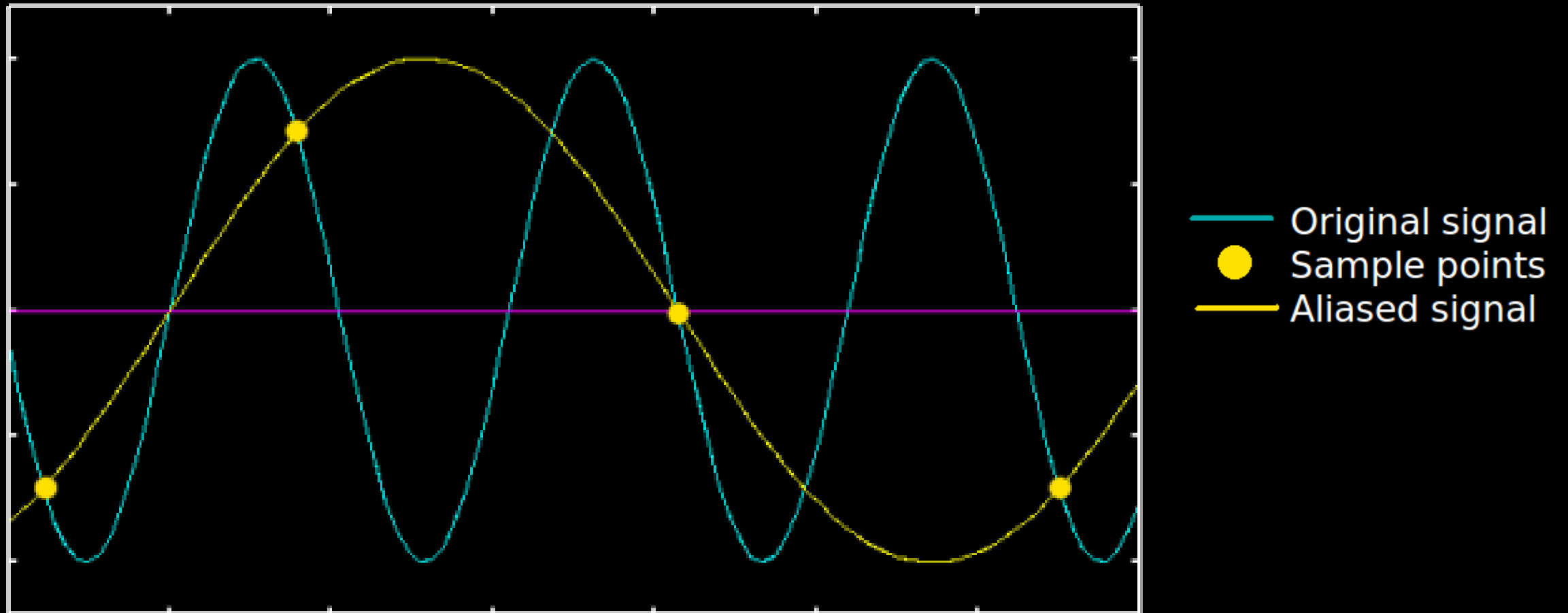


What is SDR?



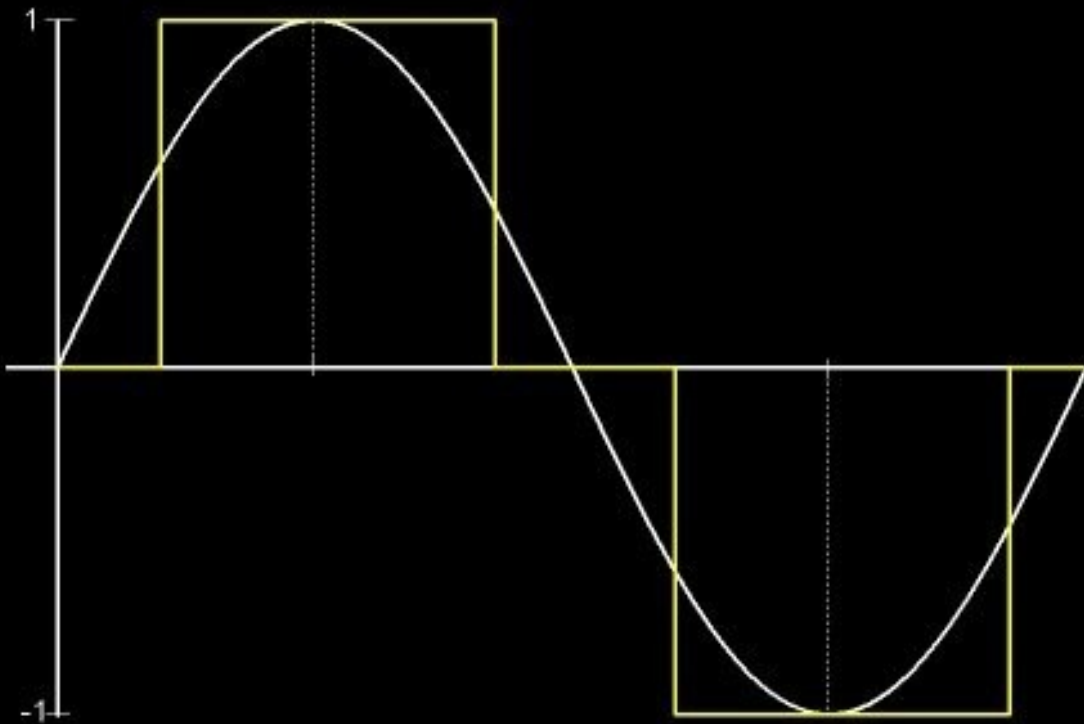
You mentioned this Nyquist guy...

Sample at a rate at least twice the frequency of the signal, otherwise...

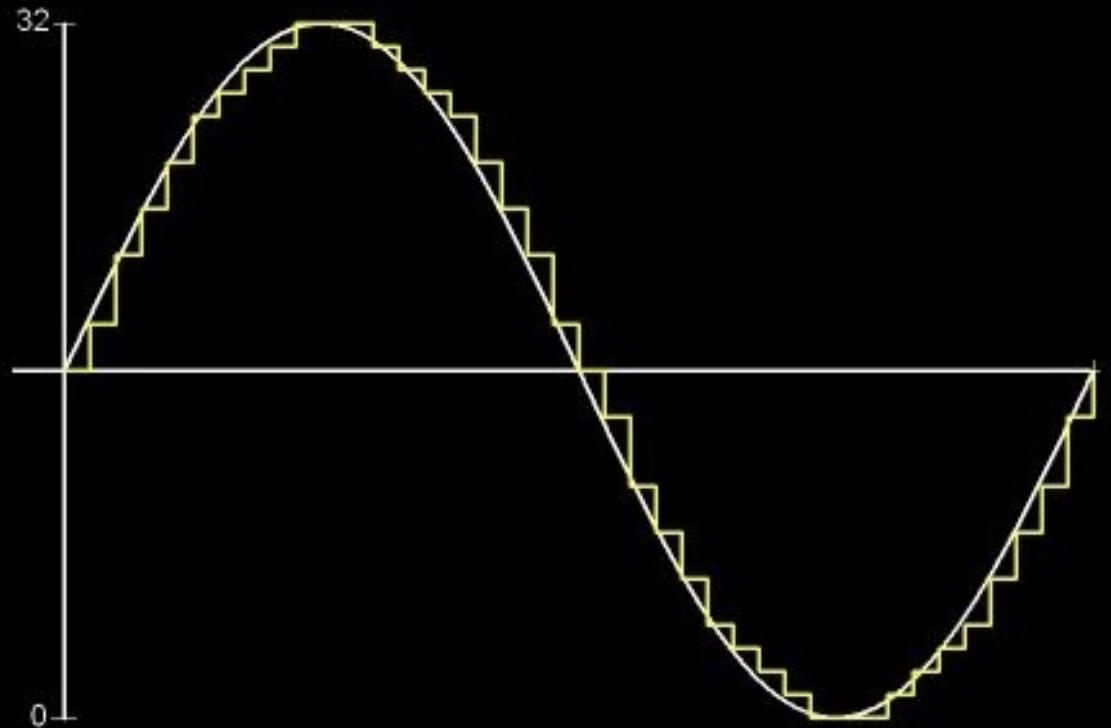


Is sample rate the only important thing?

Bit depth is important to amplitude-modulated signals & dynamic range



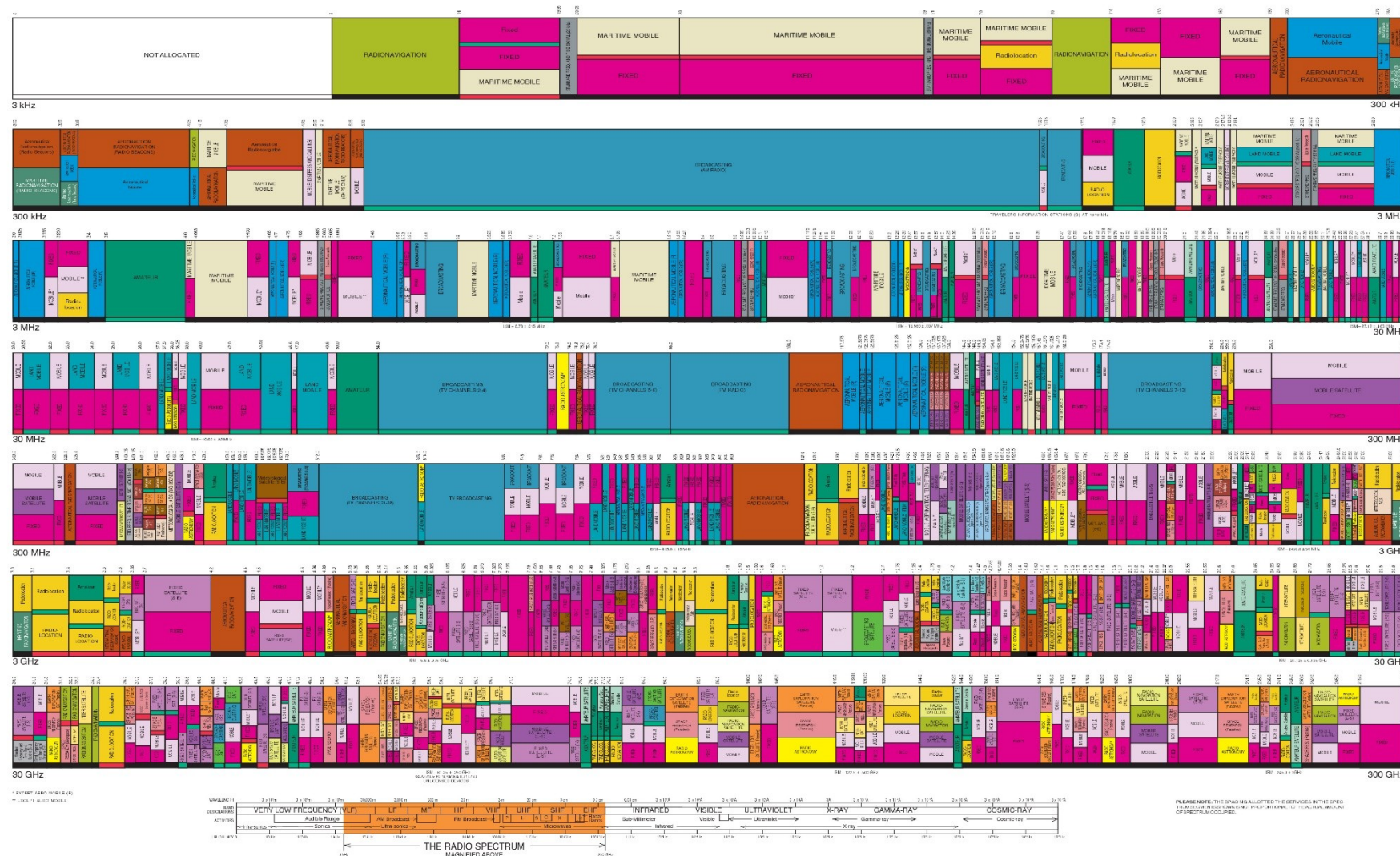
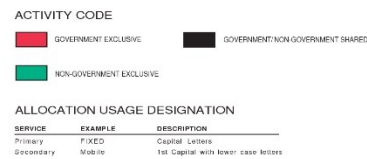
a)



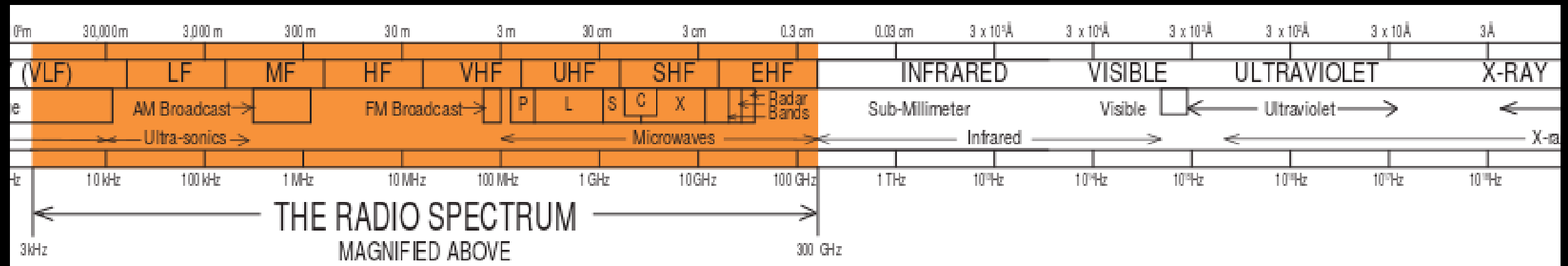
b)

Okay, so what are we actually receiving?

UNITED STATES FREQUENCY ALLOCATIONS THE RADIO SPECTRUM



Okay, so what are we actually receiving?

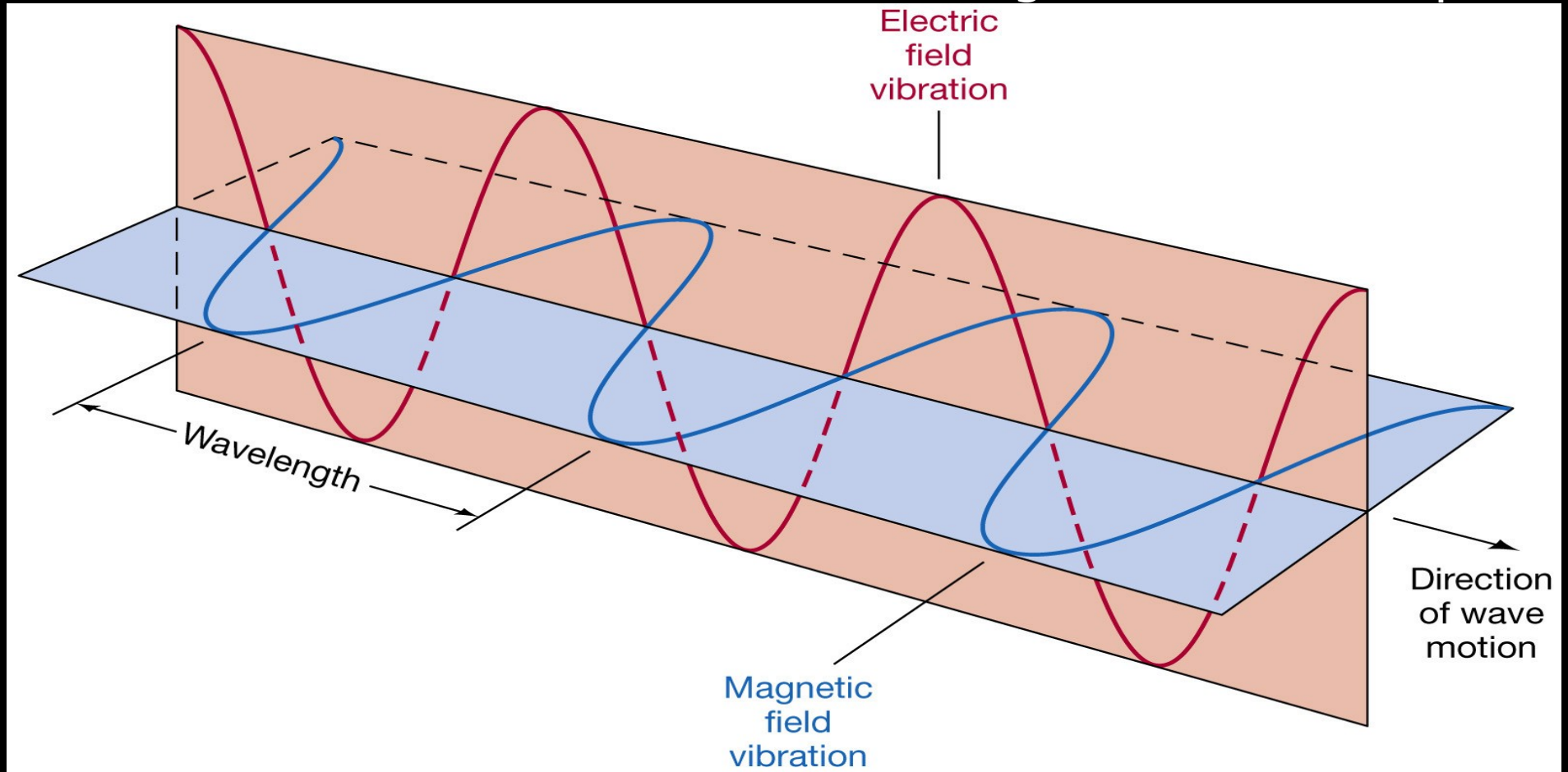


Okay, so what are we actually receiving?

	MOBILE (R)	132.0125
	AERONAUTICAL MOBILE (R)	136.0
	AERONAUTICAL MOBILE (R)	137.0
	MOB. SAT. (S-E)	137.025
	MOB. Sat. (S-E)	137.175
	MOB. SAT. (S-E)	137.825
	MOB. Sat. (S-E)	138.0
	FIXED	
	MOBILE	
	AMATEUR	144.0
	AMATEUR	146.0
	AMATEUR	148.0
	MOBILE SATELLITE (E-S)	149.9
	RADIONAV-SATELLITE	150.05
	FIXED	
	MOBILE	150.8
	FIXED	152.855
	LAND MOBILE	
	FIXED	154.0
	LAND MOBILE	156.2475
	MARITIME MOBILE	157.0375
	MARITIME MOBILE	157.1875
	MARITIME MOBILE	157.45
	FIXED	161.575
	MARITIME MOBILE	161.625
	LAND MOBILE	161.775
	MARITIME MOBILE	162.0125
	FIXED	
	MOBILE	173.2
	Land Mobile	173.4
	MOBILE	174.0

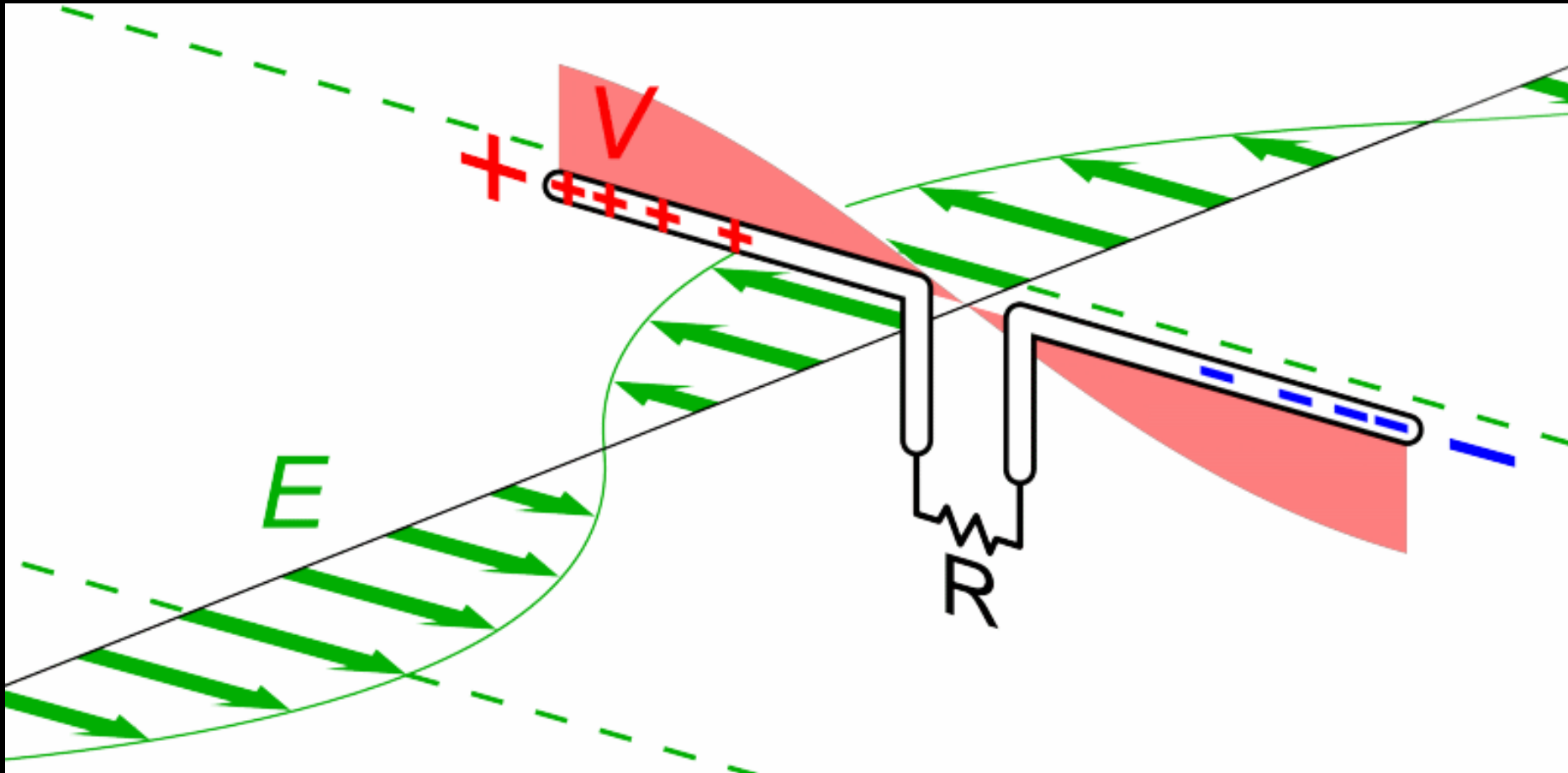
But what is an electromagnetic wave?

Transverse wave with electric field and magnetic field components



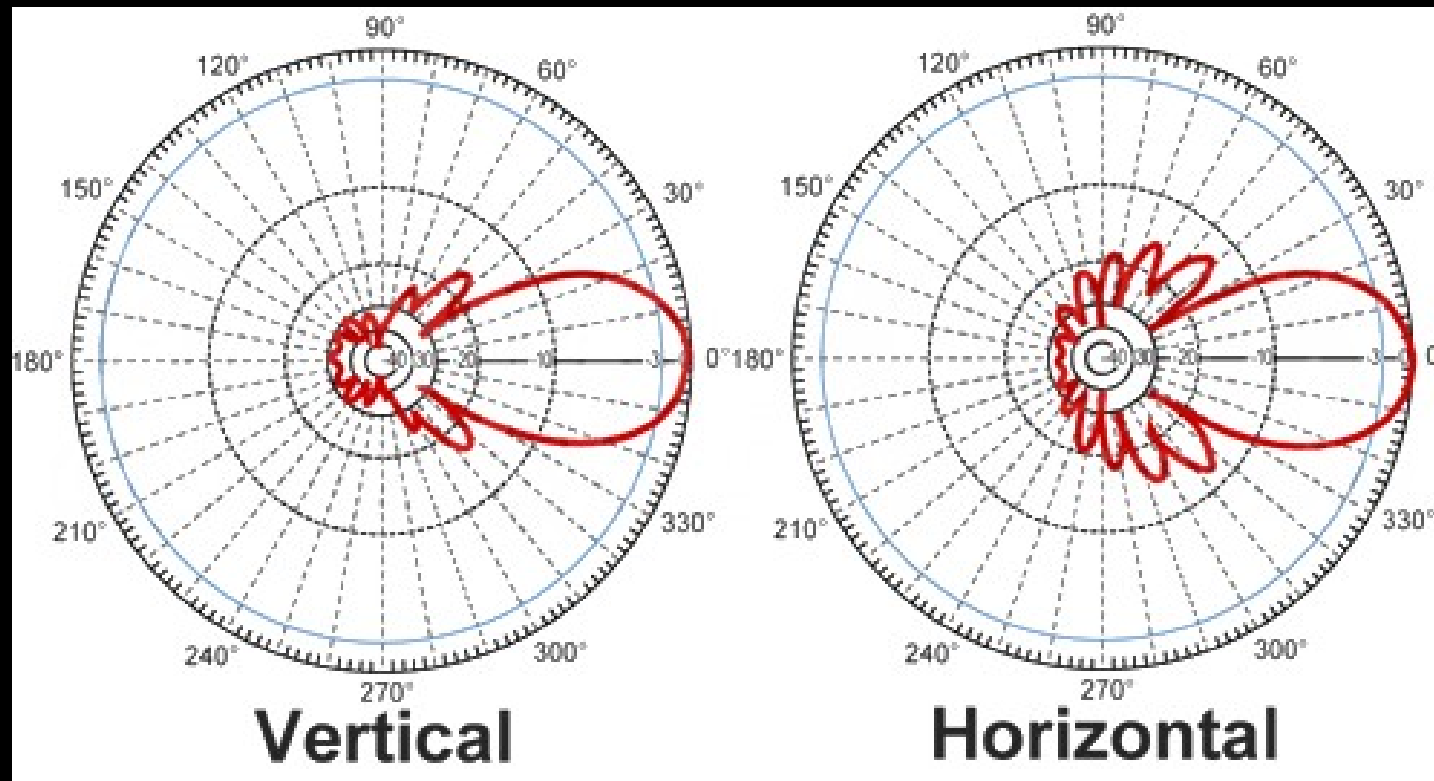
How do we receive the wave?

With an antenna!



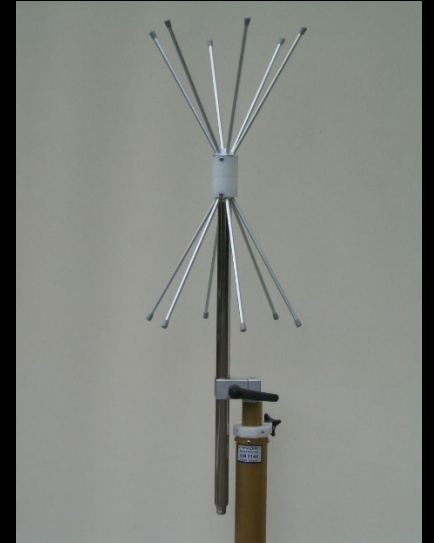
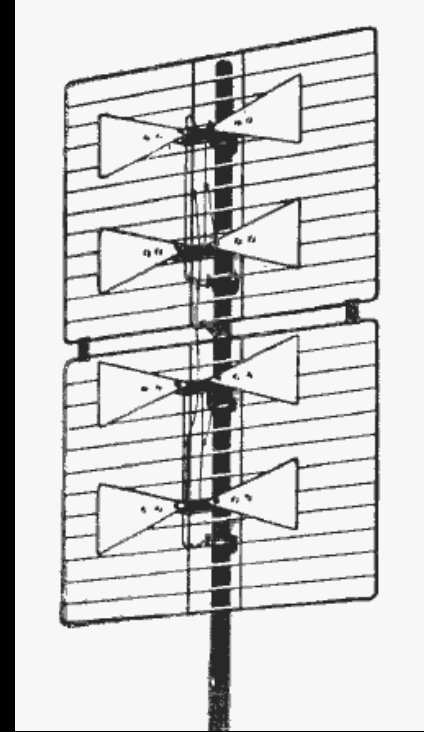
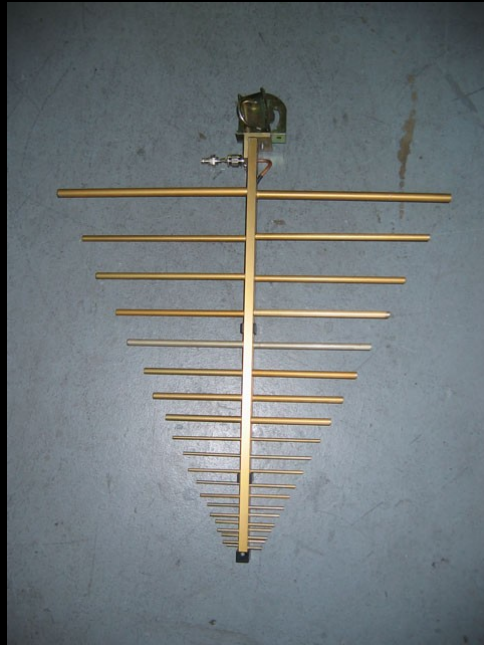
Tell me more about antennas...

- Tuned to radiate for frequency and bandwidth
- Gain expressed in dBi (tTX power expressed in dBm)
- Polar radiation charts



MOAR ANTENNAS

Many different types...



So how do we use all this to communicate?

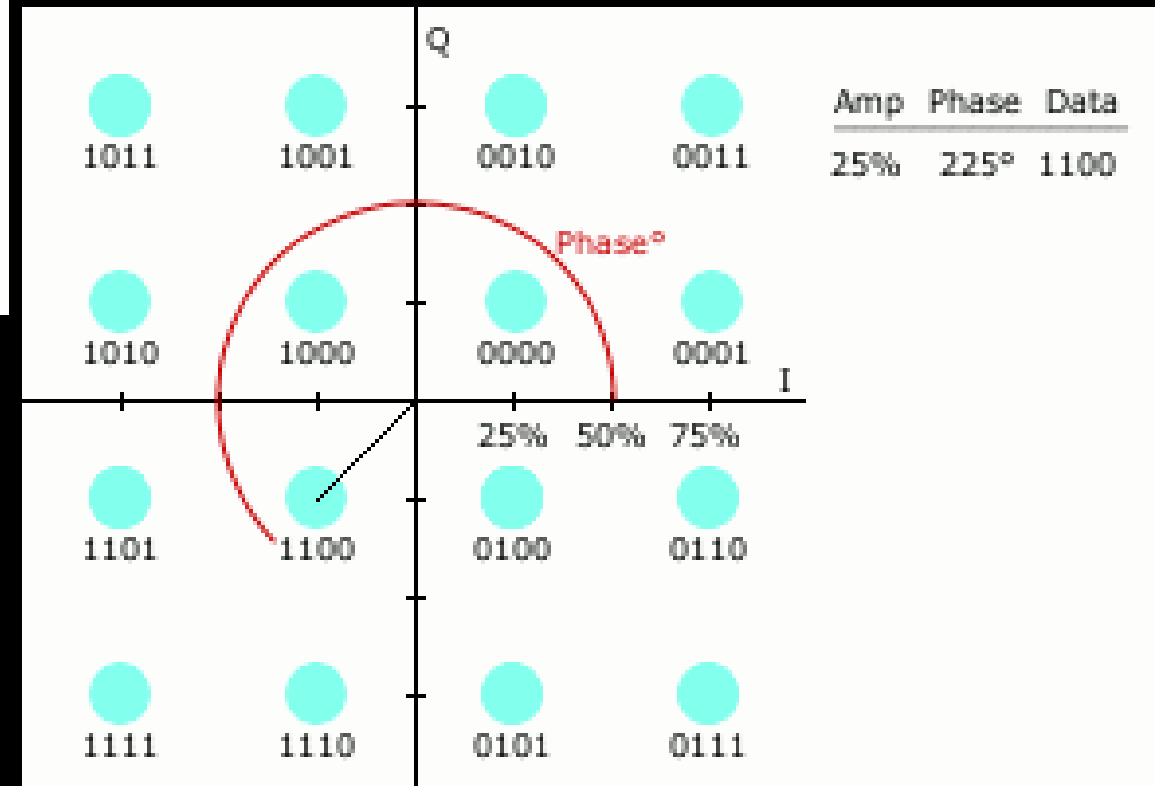
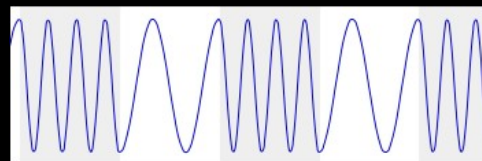
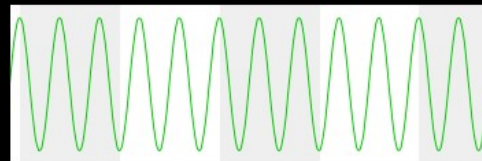
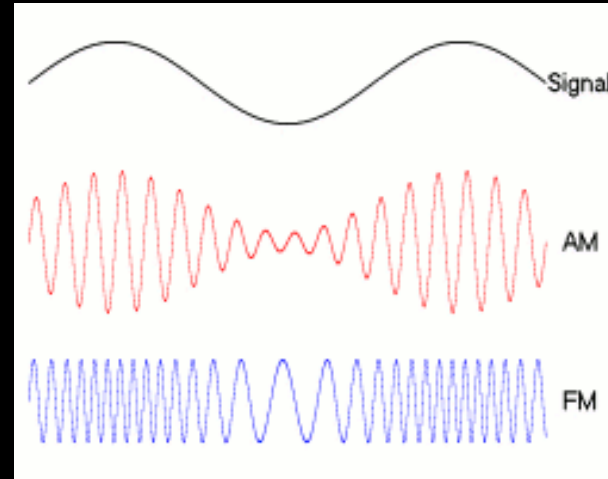
- Modulation!

- Analog

- AM
 - FM

- Digital

- OOK
 - FSK
 - PSK
 - QAM
 - OFDM



Just how much data can we send?

Ask information theorists!

- Channel capacity
- Shannon-Hartley theorem

- Example: $Capacity \approx 0.332 \times Bandwidth \times 10 \log(10) \frac{Signal}{Noise}$
 - 20MHz bandwidth
 - -70dB signal
 - -90dB noise
 - 86mbit/sec
 - Better SNR? -60dB signal, -110dB noise, 112mbit/sec
 - Double bandwidth? -60dB signal, -110dB noise, 40MHz BW, 225mbit/sec

Where do I go to learn more?

- For RF:
 - Amateur Radio license! Today (Tuesday) at 7pm
 - <http://conham.org/exams.html>
 - <http://www.kb6nu.com/study-guides/>
 - <http://www.arrrl.org/ham-radio-license-manual>
 - ARRL Handbook, <http://www.arrrl.org/arrrl-handbook-2015>
 - RF for non-RF engineers, <http://www.ti.com/lit/ml/slap127/slap127.pdf>
 - NXP RF Basics, <https://www.youtube.com/watch?v=FVmTooGICNc>
- For SDR:
 - Michael Ossman's videos, <http://greatscottgadgets.com/sdr/>
 - Wireless CTF training, <http://sdr.ninja/training-events/sdr-wctf/>

How do I find you?

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