FCC Technician License Course

2014-2018 FCC Element 2
Technician Class Question Pool

Presented by:
Tamiami Amateur Radio Club (TARC)

WELCOME

- To the first of 4, 3-hour classes presented by TARC to prepare you for the FCC Technician Class Amateur Radio Service license test.
- Today we will cover Chapters 1 and 2 of the ARRL Ham Radio License Manual, 3rd Ed.
- Everything you need to know is in this manual

Meet Your Instructors

AndyDurette

KB1HIP

Extra Class

Paul Nienaber

KN4BAR

General Class

Course Outline

- **Welcome to amateur radio**
- **Radio and Signals Fundamentals**
- **Amateur Radio Equipment (HT & 2M, 70cm)**
- **Electricity, Components and Circuits**
- **Propagation, Antennas and Feedlines**
- **Communicating with other hams**
- **Amateur Radio Equipment (HF)**
- **Licensing regulations**
- **Operating regulations**
- **Safety**
- **Test preparation and review**

What is Our Goal ?

Our goal during this class is for each of you to achieve the Technician Class Amateur Radio License!

- The license will authorize you to operate an Amateur Radio (Ham Radio) transmitter.
- See hand out for test sites, dates, and times
- Test with TARC and we will pay the $15 testing fee!

What Hams Do

- Communicate
- Participate
- Experiment
- Build
- Compete
- Serve their communities
- Life-long learning

Only 3 Classes of License

- ~~Novice~~
- Technician
- General
- ~~Advanced~~
- Extra

Morse Code ???

NONE!

Feb 23, 2007

FCC has eliminated

Morse Code!

Find your License:

http://wireless.fcc.gov/uls

Steps to Get Your License

- Study the material in the *Ham Radio License Manual.*
- Review the questions in the back of the book
- Take interactive practice exams. (SEE HAND OUT)
- Pass a proctored 35-question multiple choice test.
  - Questions pulled directly from the question pool.
  - Need to answer 26 questions correctly.

2014- 2018 Question Pool

35 of 426 Questions on the Test. Changes Every 4 Years on July 1st

T1 FCC Rules (9)
T2 Operating Procedures (5)
T3 Propagation (3)
T4 Ham Radio Practices (4)
T5 Electrical Principles (3)
T6 Circuit Components (2)
T7 Practical Circuits (2)
T8 Signals and Emissions (2)
T9 Antennas & Feedlines (2)
T0 RF Safety (3)

Passing Score is 75 %. You can miss 9 questions and still pass!

What is Amateur Radio ?

Amateur (or Ham) Radio is a **personal** radio service authorized by the **Federal Communications Commission (FCC)**.

- To encourage the advancement of the art and science of radio.
- To promote the development of an emergency communication capability to assist communities when needed.
- To develop a pool of trained radio operators.
- To promote international good will by connecting private citizens in countries around the globe.

Through ham radio, you will become an ambassador for your community and your country.

Why Be a HAM ?

There are many unlicensed radio services available. (Family Radio Service or FRS, Citizens Band or CB)

Ham radio is authorized:

- Fewer restrictions.
- More frequencies (channels or bands to utilize).
- More power (to improve range and quality).
- More ways to communicate.
- It's free to operate your radio.

With Privilege Comes Responsibility

- Because ham radios are much more capable and have the potential of interfering with other radio services.
- Because ham radios have unlimited reach. They easily reach around the globe and into space.
- FCC authorization is required to ensure the operator is qualified to operate the ham radio safely, appropriately and within the rules and regulation – that is why you are here.

For whom is the Amateur Radio Service intended? (T1A01)

A. Persons who have messages to broadcast to the public

B. Persons who need communications for the activities of their immediate family members, relatives and friends

C. Persons who need two-way communications for personal reasons

D. Persons who are interested in radio technique solely with a personal aim and without pecuniary interest

For whom is the Amateur Radio Service intended? (T1A01)

A. Persons who have messages to broadcast to the public

B. Persons who need communications for the activities of their immediate family members, relatives and friends

C. Persons who need two-way communications for personal reasons

D. **Persons who are interested in radio technique solely with a personal aim and without pecuniary interest**

What is the FCC Part 97 definition of an amateur station? (T1A10)

A. A station in an Amateur Radio Service consisting of apparatus necessary for carrying out radio communications

B. A building where Amateur Radio receivers, transmitters, and RF power amplifiers are installed

C. An radio station operated by a non-professional

D. Any radio station for hobby use

What is the FCC Part 97 definition of an amateur station? (T1A10)

A. **A station in an Amateur Radio Service consisting of apparatus necessary for carrying out radio communications**

B. A building where Amateur Radio receivers, transmitters, and RF power amplifiers are installed

C. An radio station operated by a non-professional

D. Any radio station for hobby use

What agency regulates and enforces the rules for the Amateur Radio Service ? (T1A02)

A. FEMA
B. The ITU
C. The FCC
D. Homeland Security

What agency regulates and enforces the rules for the Amateur Radio Service ? (T1A02)

A. FEMA
B. The ITU
C. **The FCC**
D. Homeland Security

Radio Signals and Waves

- **In alternating current (sine wave) the electrons flow in one direction one moment and then the opposite direction the next moment (a cycle)**
- **Radio waves (electromagnetic radiation) are sine waves. Also called EMR or RF**
- **Radio waves are used to carry the information you want to convey to someone else (modulation)**
- **Radio waves travel at the speed of light**

Wave Vocabulary

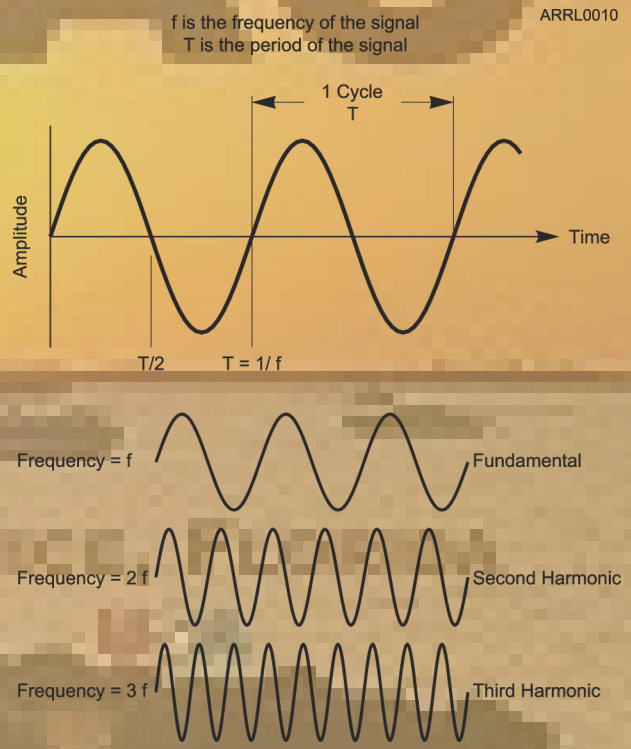
As we study radio waves, we will learn some new terms

- **Amplitude**
- **Frequency (Hertz)**
- **Period**
- **Wavelength (Meters)**
- **Harmonic**

f is the signal frequency

T is the period of the signal

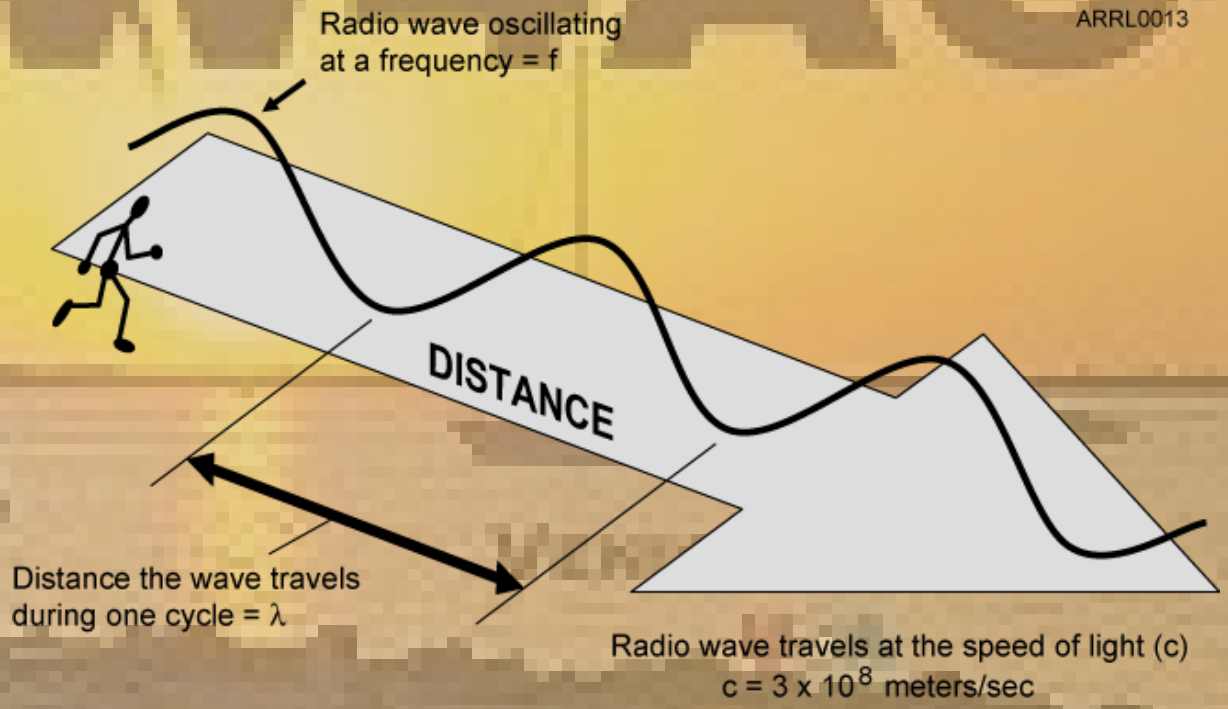
T = 1/f



Wave Length or λ

The distance a radio wave travels during one cycle

One complete change between magnetic and electric fields



$\lambda = c/f = 300 / f$ in MHz

Wave Length Derivation

$\lambda = c/f$ SO a 1 MHz signal has a wave length of:

300,000,000 / 1,000,000 OR $300 \times 10^6 / 1 \times 10^6$

Simplified to 300 / 1 OR 300 meters

Hence **$\lambda = 300 / f$ in MHz**

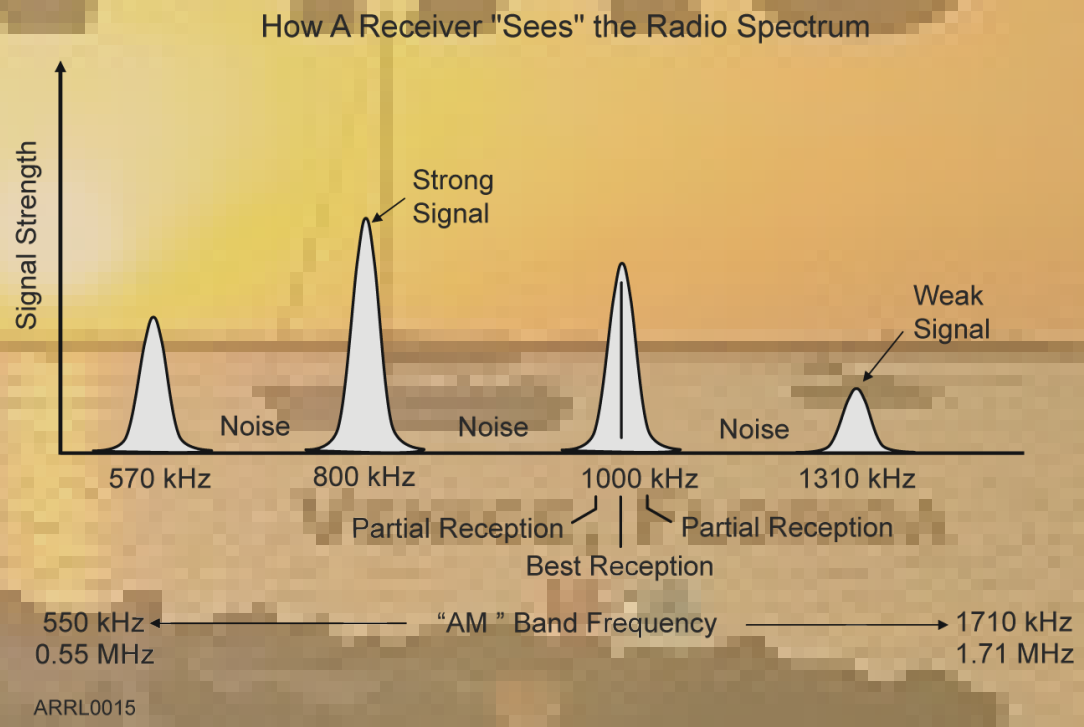
IF 1 m = 3.28 feet, then 300 meters = 984 feet

Wave Length & Frequency Band

Frequency	λ = 300/ f in MHz	HAM BAND
146.730 MHz (VHF)	300/146.73 = 2.045 M	2 meter band
7.240 MHz (HF)	300/7.240 = 41.436 M	40 meter band
14.225 MHz (HF)	300/14.225 = 21.090 M	20 meter band
436.000 MHz (UHF)	300/436.000 = 0.688 M	70 centimeter band

What a Radio Receiver Sees

- Signals received at some frequency and amplitude
- Strong signals have high amplitude
- A signal has a “center frequency” and some partial signal strength on either side of the center frequency
- Noise is always present to a receiver ---” static “



Signal Strength – Decibel (dB)

- **The "Bell" is a unit of measure of sound intensity.**
- **A decibel is 1/10 of a Bell**
- **Very wide range, from a whisper to an explosion!**
- **Measured on a logarithmic scale as 10 log (p_1 / p_0)**
- **dB is the ratio of two quantities as a power of 10**

Signal Strength – Decibel (dB)

Exam Questions T5B09, 10 and 11

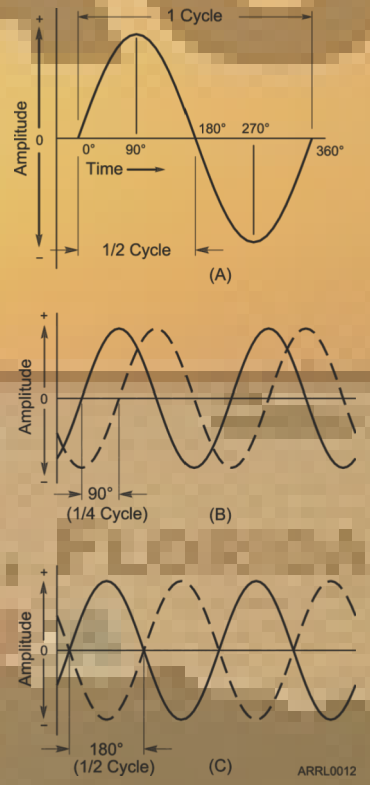
- **T5B9 The approximate amount of change, measured in decibels (dB), of a power increase from 5 watts to 10 watts is 3dB.**
- **T5B10 The approximate amount of change, measured in decibels (dB), of a power decrease from 12 watts to 3 watts is -6dB.**
- **T5B11 The approximate amount of change, measured in decibels (dB), of a power increase from 20 watts to 200 watts is 10 dB.**

“Phase” Shifting of a Wave

Position within a cycle is called a “phase”

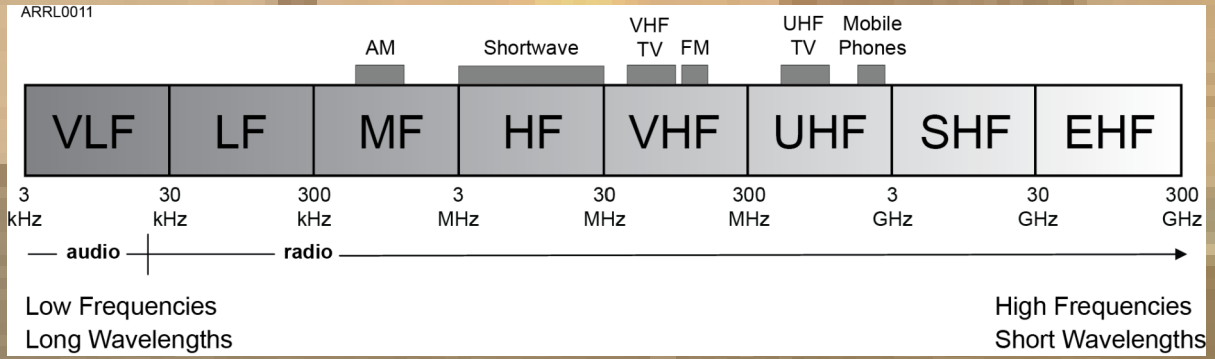
Think of a circle:

- There are 360 degrees in a full circle
- There are 360 degrees in a full wave
- There are 180 degrees in a half wave
- There are 90 degrees in a quarter wave



RF Spectrum

- **The RF Spectrum is the range of wave frequencies which will leave an antenna and travel through space**
- **The RF Spectrum is divided into segments of frequencies that have a unique behavior**



RF Specturm Ranges

Range Name	Abbreviation	Frequency Range
Very Low Frequency	VLF	3 kHZ – 30 kHZ
Low Frequency	LF	30 kHz – 300 kHz
Medium Frequency	MF	300 kHz – 3 MHz
High Frequency	HF	3 MHz – 30 MHz
Very High Frequency	VHF	30 MHz – 300 MHz
Ultra High Frequency	UHF	300 MHz – 3 GHz
Super High Frequency	SHF	3 GHz – 30 GHz
Extremely High Frequency	EHF	30 GHz – 300 GHz

Numbers and the Metric System

- **Dealing with Very Big and Very Small Numeric Values**
- **In electronics we deal with large and small numbers**
- **The international metric system provides a method of dealing with the wide range of values**

International System of Units (SI)

- Giga- 1,000,000,000
- Mega- 1,000,000
- Kilo- 1,000
- deci- 1/10
- centi- 1/100
- milli- 1/1000
- micro- 1/1,000,000
- nano- 1/1,000,000,000
- pico- 1/1,000,000,000,000

Numbers Example Question

T5B01

How many milliamperes is the same as 1.5 amperes?

A. 15 milliamperes
B. 150 milliamperes
C. 1500 milliamperes
D. 15000 milliamperes

Numbers Example Question

T5B01

How many milliamperes is the same as 1.5 amperes?

A. 15 milliamperes
B. 150 milliamperes
C. 1500 milliamperes
D. 15000 milliamperes

Numbers Example Question

T5B04

How many volts are equal to one microvolt?

A. One one-millionth of a volt
B. One million volts
C. One thousand volts
D. One one-thousandth of a volt

Numbers Example Question

T5B04

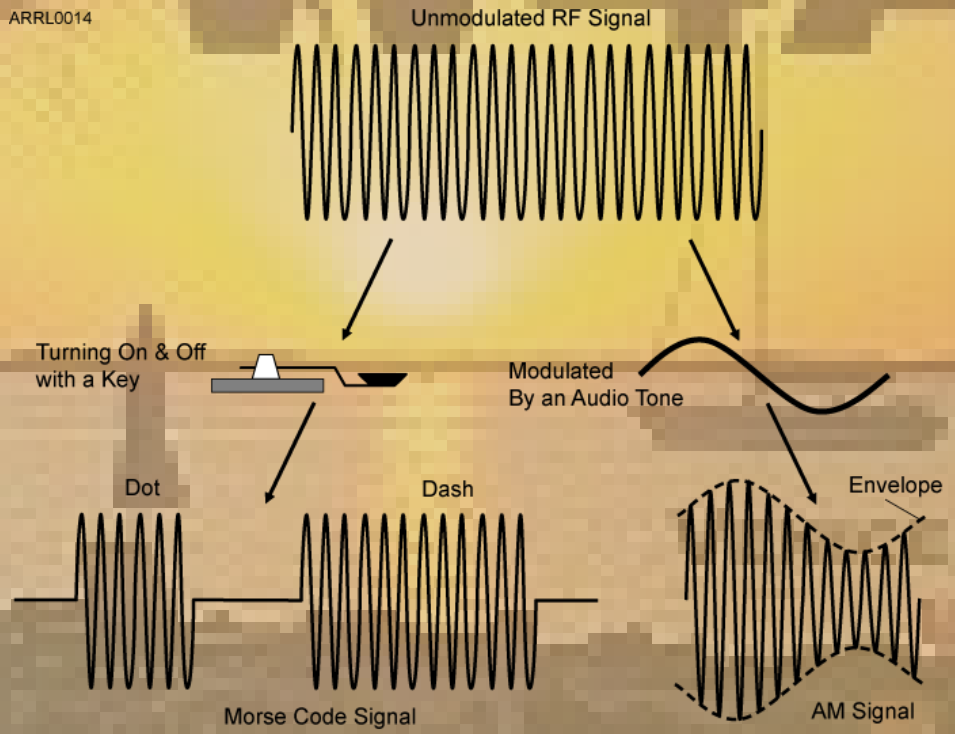
How many volts are equal to one microvolt?

A. One one-millionth of a volt
B. One million volts
C. One thousand volts
D. One one-thousandth of a volt

Add Information - Modulation

- When we imprint some information on the radio wave, we modulate the wave
  - Turn the wave on and off
  - Voice AM and FM
  - Data
- Different modulation techniques are called modes
  - CW continuous wave or morse code
  - Phone or voice communications (AM, FM, SSB)
  - RTTY (radio teletype)
  - PSK (phase shift keying)

Morse Code – on and off

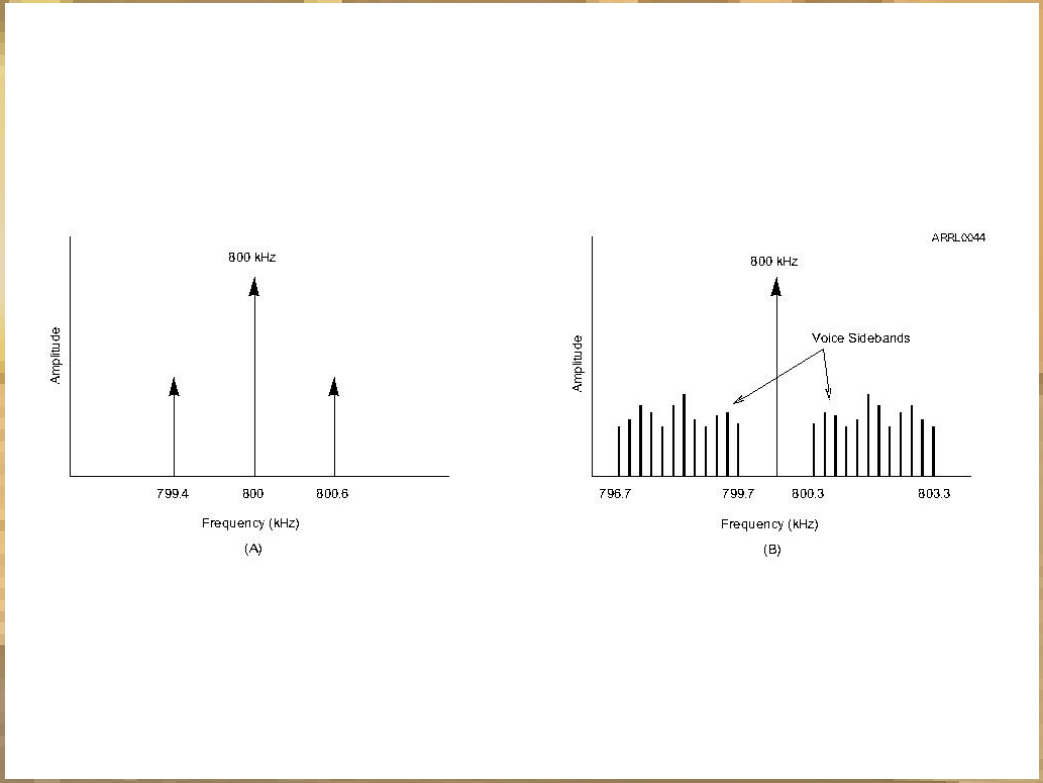


Amplitude Modulation (AM)

- In AM, the amplitude of the carrier wave is modified in step with the waveform of the information (voice)
- Combining Voice with an RF carrier produces 2 identical sidebands
- Most voices range from 300 hertz to about 3000 Hz
- Our hearing range goes to about 20 kHz

AM Voice Modulation

- Center frequency or “carrier” and two sidebands, upper and lower (USB and LSB)
- Both sidebands have information (voice)
- Earliest Voice Mode Used
- Note AM mode band width of 6 kHz 803 – 797 = 6 kHz
- CW bandwidth is only 150 Hz



Single Sideband Modulation (SSB)

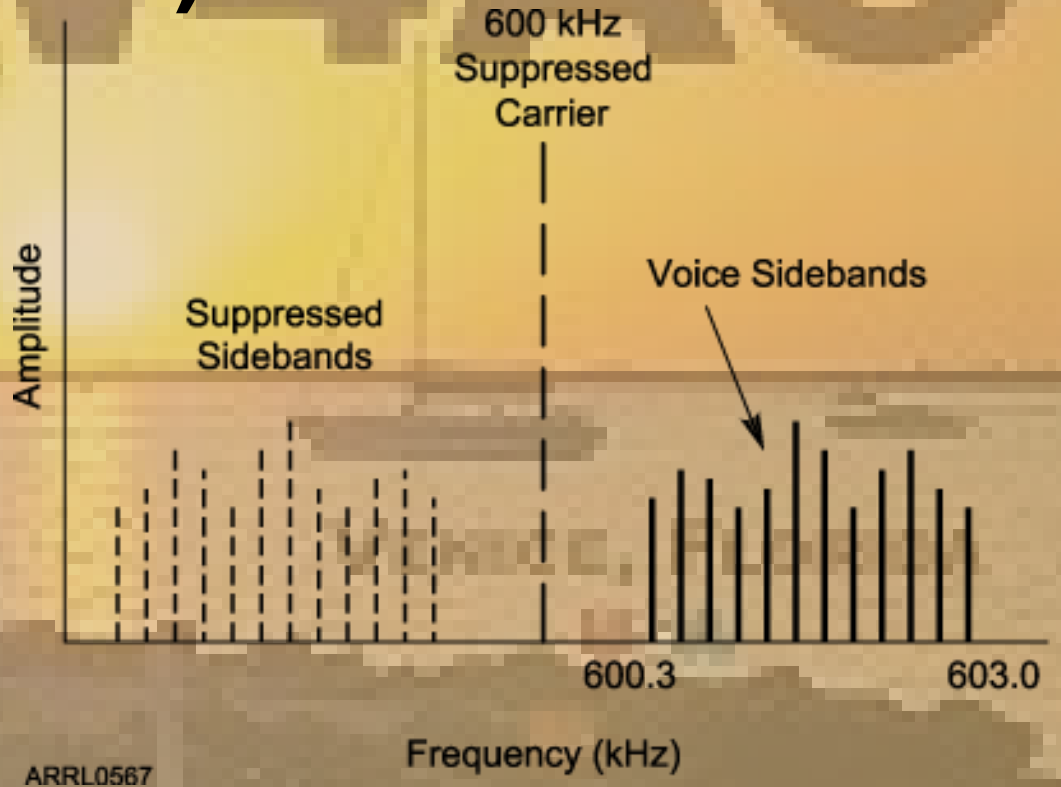
- Combining Voice with an RF carrier produces 2 identical sidebands
- We can improve efficiency of transmission by transmitting only one sideband and then reconstruct the missing sideband at the receiver
- More efficient than AM modulation
- Cleaner more powerful audio signal
- Only uses 3 kHz of bandwidth, half of AM!

Single Sideband Modulation (SSB)

- 10 MHz and up uses USB
- Below 10 MHz uses LSB

- No “Rule” for this, just by convention

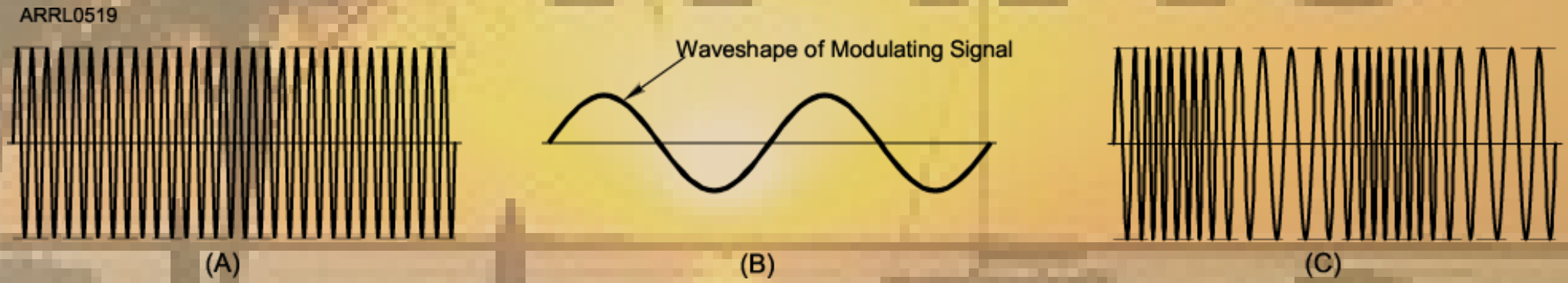
- There are some exceptions



Frequency Modulation (FM)

- **Instead of varying amplitude,** if we vary the frequency in step with the information waveform – FM is produced
- **We shift the frequency of the** transmitter up and down to carry information
- The amount of frequency variation is called carrier deviation or just plain "deviation".
- Speaking too loud can increase bandwidth to 15 kHZ or more.
- Excessive deviation can:
  - Cause interference to adjacent signals
  - Exceed band limits when operating near edge of a band

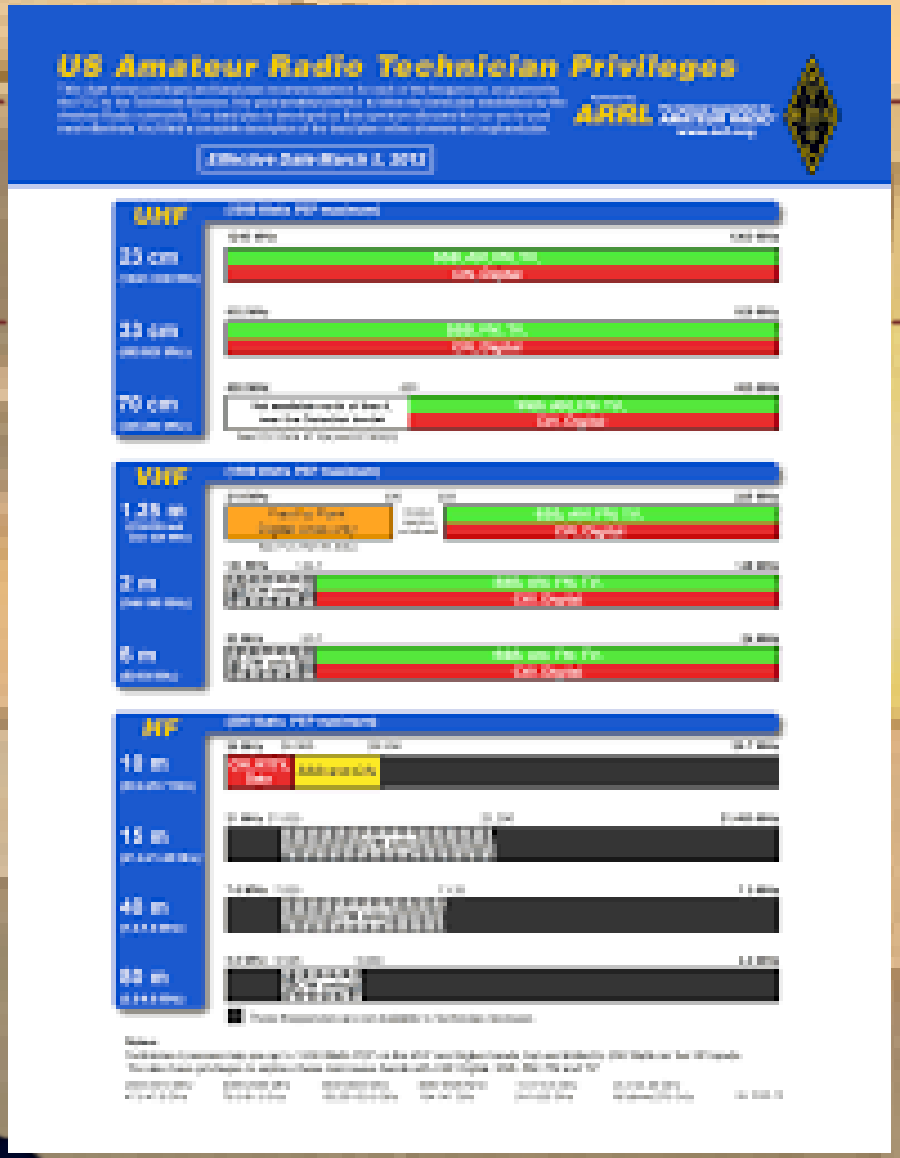
Frequency Modulation (FM)



- FM can be used for data transmissions as audio tones
- An acoustic modem with an RF signal
- Everything old is new again!

Signal Bandwidth Summary

Type of Signal	Typical Bandwidth
AM voice	6 kHz
AM broadcast	10 kHz
SSB voice	2 to 3 kHz
SSB digital	500 to 3000 Hz
CW	150 Hz
FM voice	10 to 15 kHz
FM broadcast	150 kHz



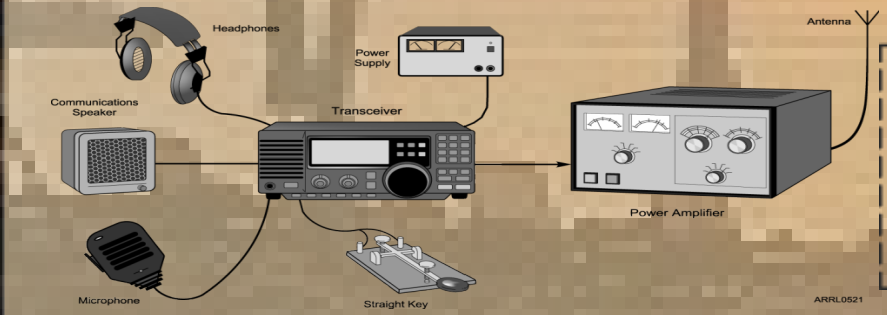
Technician Band Plan

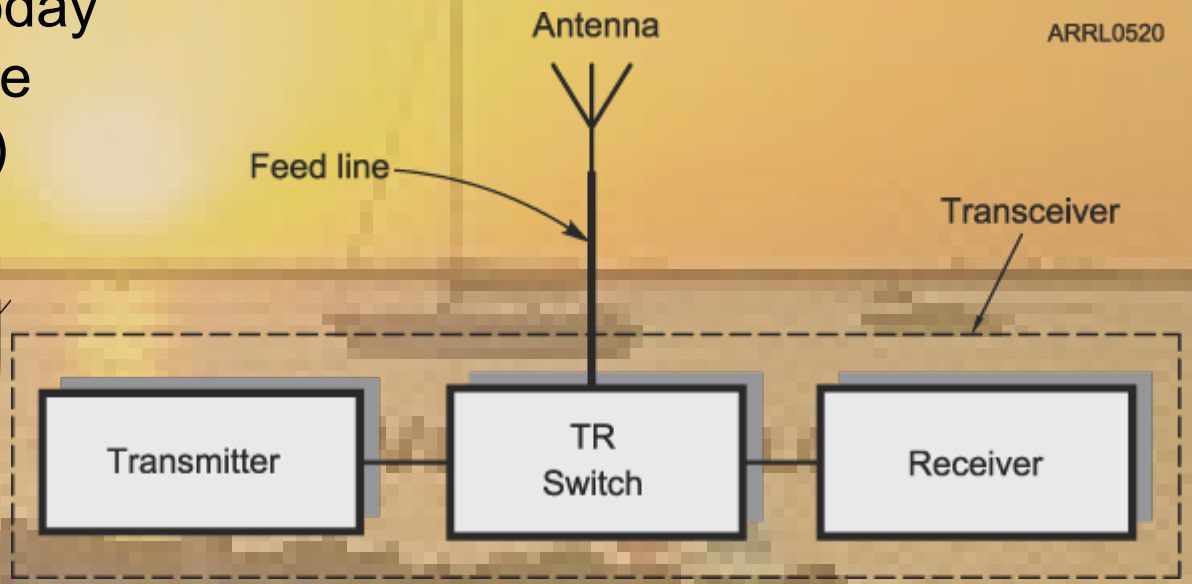
- Full privileges on 2M and 70cm (VHF and UHF)
- VERY restricted on the HF bands (10M to 80M)

- **SO...what can you do?**
  - Repeaters
  - SARNET
  - Digital radio (new)

Station Equipment

- Simple "block diagram"
- "Transceiver" is the norm today
- Most radios need a separate "**power supply**" (AC to DC)
- Commonly called a "**rig**"





Handie-Talkies (HT) Radios

Tytera (TYT), BoaFeng (BF), and others <$100

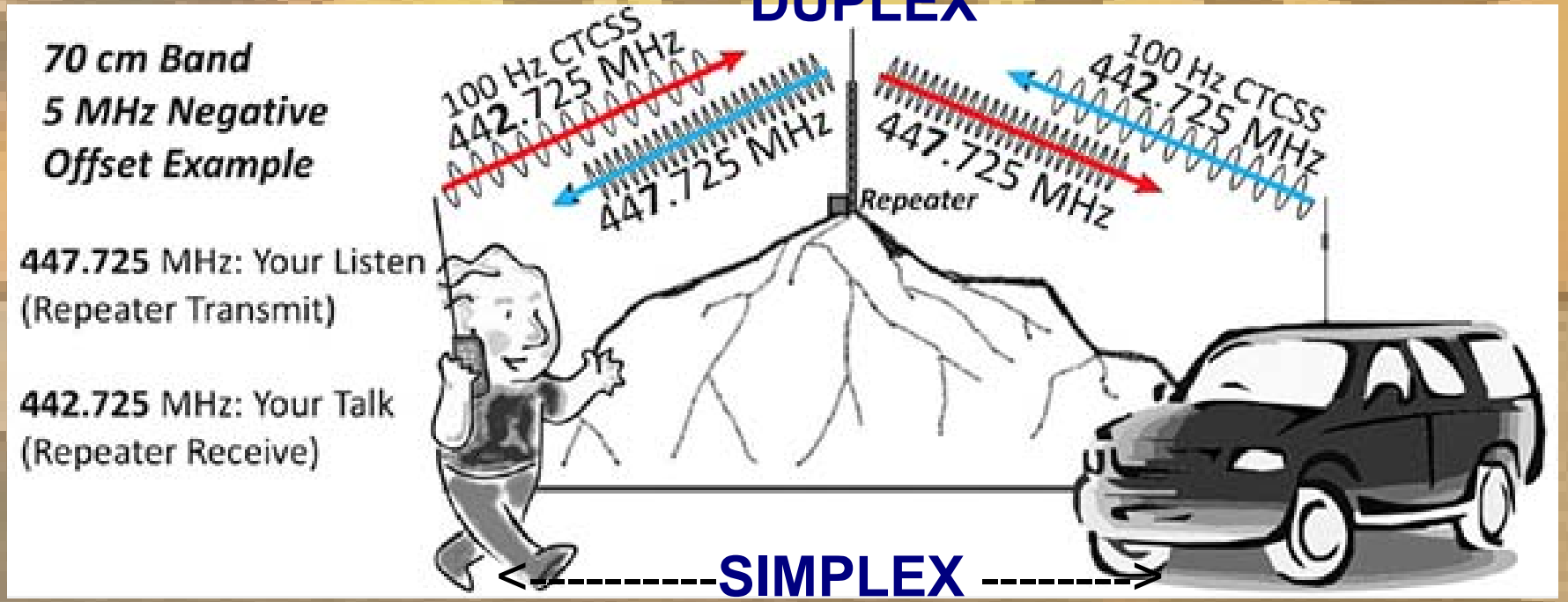
Yaesu, Kenwood, iComm, Alinco, etc. (>$100)

- Low cost
- Use repeaters
- Talk world-wide with new digital modes
  - DMR
  - C4FM
  - D-Star

Introduction to Repeaters

- Repeater: An amateur station that simultaneously retransmits the transmission of another amateur station on a different channel or channels
- Why? A powerful repeater transmitter located at altitude greatly increases the effective range of weaker hand held and mobile radios.
- Work the neighborhood on the repeater. Work the world on HF.
- Repeaters are most common on the 2m and 70cm ham bands

How a Repeater Works



Repeater Access Tones

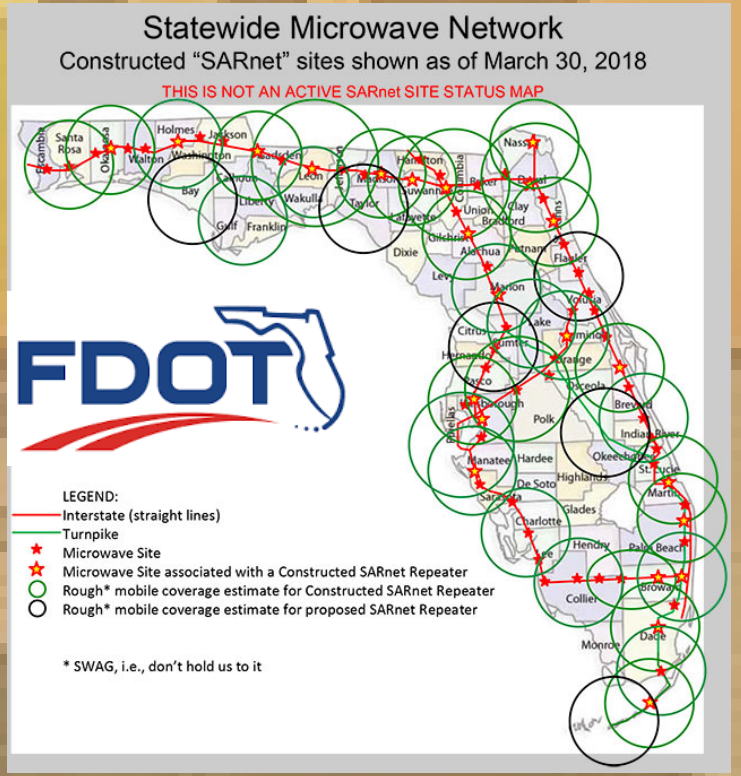
- These tones are called by various names (depending on equipment manufacturer)
  - CTCSS – Continuous Tone Coded Squelch System
  - PL - Privacy codes or tones
- Tones are generally programmed into the radio along with frequency and offset
- Example: 146.655 (+) PL 141.3

Area Club Repeaters

- North Port Amateur Radio Club, http://w4npt.org/
  147.120 (-) PL 136.5
- Tamiami Amateur Radio Club (Venice) http://tamiamiarc.org/
  146.805 (-) PL 100.0 and 444.100 DMR (+) color code 1
- Sarasota Emergency Radio Club, http://n4ser.org/
  146.730 (-) PL 100 and 444.700 DMR (+) color code 1
- State Amateur Radio Network (SARNET) (FLDOT)
- https://www.sarnetfl.com/ 444.800 (+) PL 100

FLDOT SARNET

- State Amateur Radio Network (SARNET). https://www.sarnetfl.com/
- A FLDOT project open to amateur radio use
- Over 30 repeaters around the state all “linked” together.
- Talking on one is talking on ALL!
- NOT an open net during emergencies



Repeater Operations

- **Listen**! If nobody is there, then the repeater is not in use. Give your call sign once.
- If the repeater is busy, wait for a break and give your call sign ONCE.
- DO NOT "KER-CHUNK" THE REPEATER
- When calling another station, always give the other station's call sign first, then yours.
- ID every 10 minutes and at the end of the conversation (QSO), you need not ID after every exchange.

Question

What is the term used to describe an amateur station that is transmitting and receiving on the same frequency?

A. Full duplex communication

B. Diplex communication

C. Simplex communication

D. Half duplex communication

Question

What is the term used to describe an amateur station that is transmitting and receiving on the same frequency?

A. Full duplex communication

B. Diplex communication

C. Simplex communication

D. Half duplex communication

Question

What is the most common repeater freguency offset in the 2 meter band?

A. plus 500 khz
B. Plus or minus 600 khz
C. Minus 500 khz
D. Only plus 600 khz

Question

What is the most common repeater freguency offset in the 2 meter band?

A. plus 500 khz

B. Plus or minus 600 khz

C. Minus 500 khz

D. Only plus 600 khz

Question

What is an appropriate way to call another station on a repeater if you know the other station's call sign?

A. Say "break, break" then say the station's call sign
B. Say the station's call sign then identify your call sign
C. Say "CQ" three times then the other station's call sign
D. Wait for the station to call "CQ" then answer it

Question

What is an appropriate way to call another station on a repeater if you know the other station's call sign?

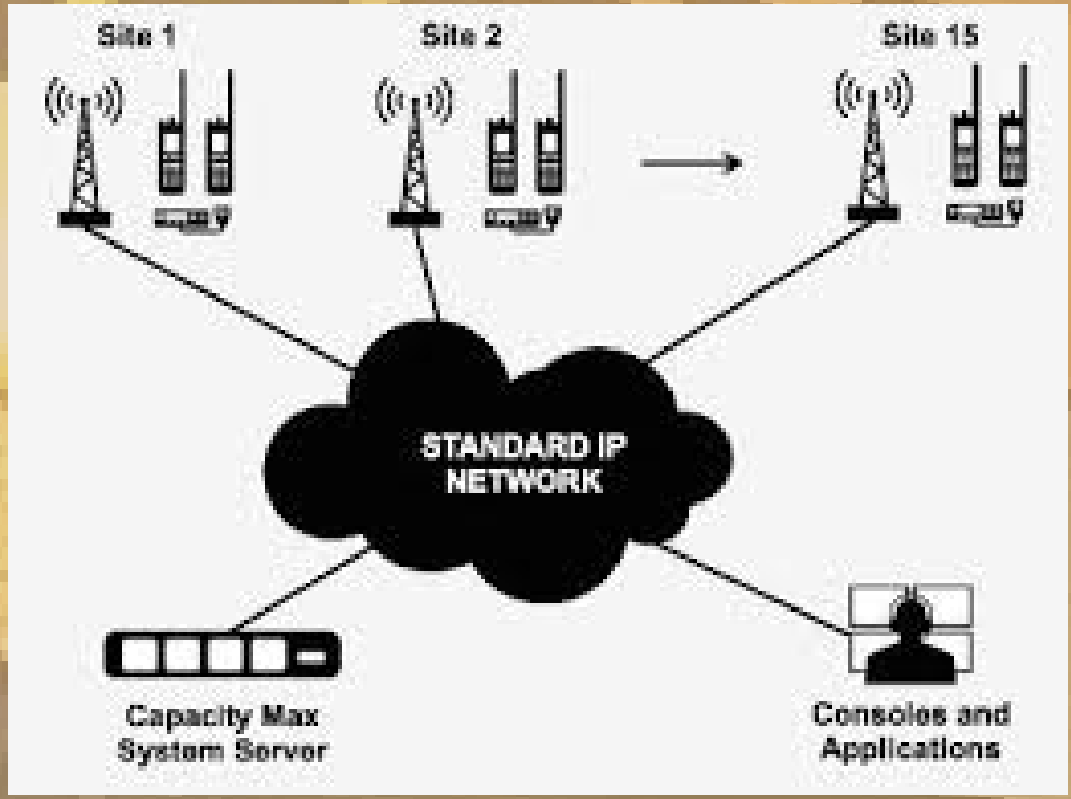
A. Say "break, break" then say the station's call sign
B. Say the station's call sign then identify your call sign
C. Say "CQ" three times then the other station's call sign
D. Wait for the station to call "CQ" then answer it

Digital Radio

DMR
DIGITAL MOBILE RADIO

C4FM
DIGITAL CLEAR VOICE
Clear and Crisp Voice Technology

D-STAR
DIGITAL



Digital Radio Programming

- Requires a DMR ID: http://www.dmr-marc.net/
- Makes use of a "**code plug**" to ID the station, and the "**channels**" and "**contacts**" to be used.
- Uses a "**color code**" instead of a PL tone
- Use of "**time slots**" (1 and 2) allow 2 conversations at one time
- More info: http://tamiamiarc.org/dmrinfo

IRLP and Echo Link

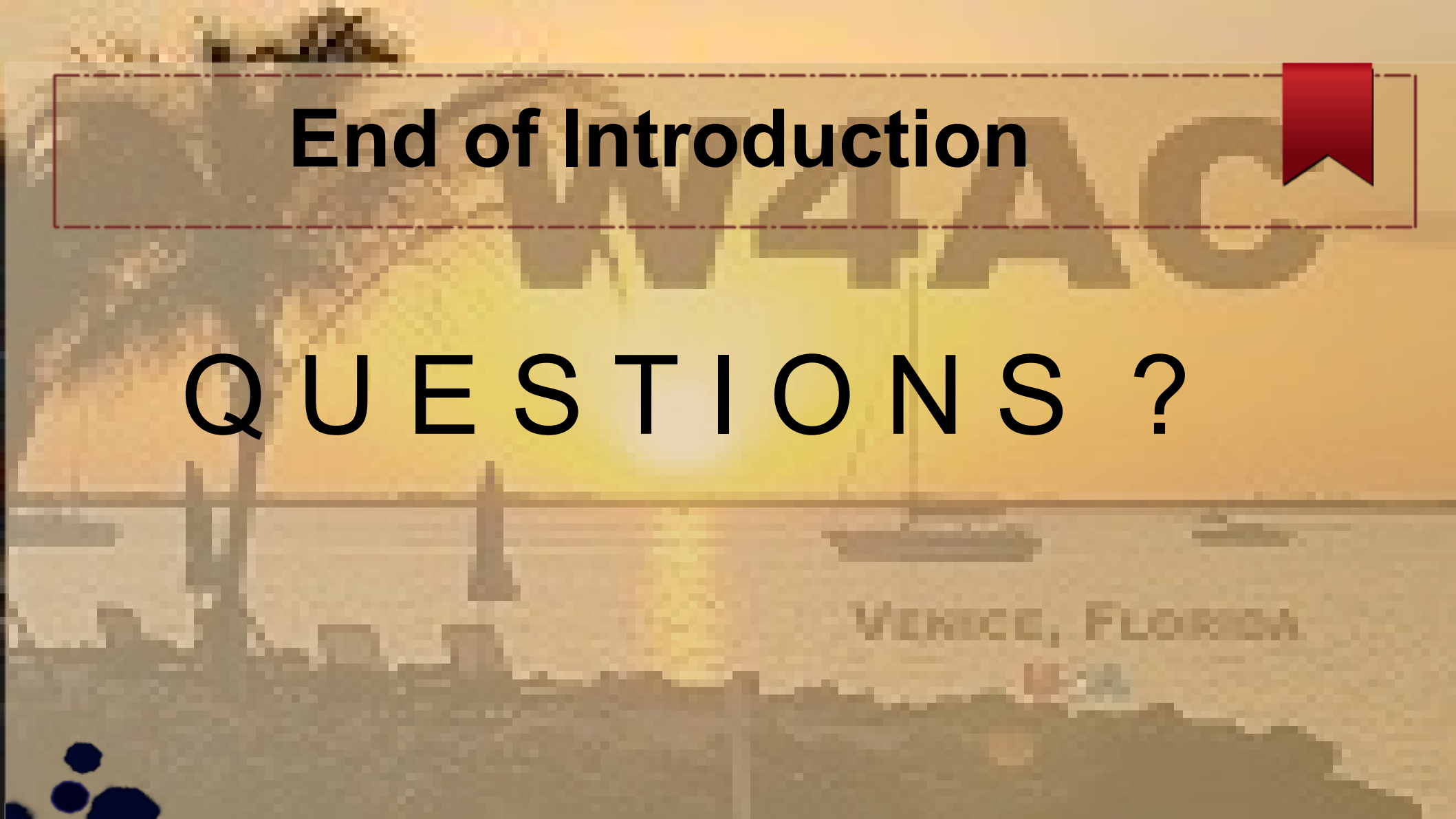
- Services that make use of the Internet to link repeaters
- Repeater owners must subscribe.Not all do.
- **Internet Radio Linking Project – IRLP**
  - http://www.irlp.net/
  - Uses DTMF tones to “connect” to other repeaters
- **Echo Link** **http://echolink.org/**
  - Must be a licensed ham and register with site
  - With an app, can use a computer, cell phone or tablet to connect to a repeater in the echo link system

SO …… What Can You Do ?

A LOT !

Tecnician Class

End of Introduction



QUESTIONS ?