
# Technician License Class

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## Technician Class

# Chapter 6

# Communicating with Other Hams

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# Band Plans

Definitions and Finding Band Plans.

- Band plans list what portions of each band are used for different types of operations.
  - Gentlemen's agreements based on accepted usage.
  - Not officially a part of the FCC rules, but….

> **§ 97.101(a)** In all respects not specifically covered by FCC Rules each amateur station must be operated in accordance with good engineering and good amateur practice.

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# Band Plans

Definitions and Finding Band Plans.

- Band plans:
  - Group together operations using the same or similar types of modes.
  - May protect certain portions of a band for weak signal work.
  - May reserve certain portions of a band for "DX" contacts.
  - Specify repeater frequency pairs & simplex channels for VHF/UHF FM operations.

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# Band Plans

Definitions and Finding Band Plans.

- Definitions.
  - DX Window – A portion of the band reserved for contacts with stations outside of the lower 48.

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# Band Plans

Definitions and Finding Band Plans.

- Definitions.
  - Weak Signal – Operations on VHF, UHF, & above involving long distances where the expected signals are much weaker than local signals.
    - Normally CW or SSB.
      - Every band from 50 MHz & up has segments available to CW and SSB operations.
    - Earth-moon-earth (EME).
      - a.k.a. – Moonbounce.

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# Band Plans

Definitions and Finding Band Plans.

- Definitions.
  - Satellite Uplinks & Downlinks – Frequencies used by earth stations to send transmissions to or receive transmissions from amateur radio satellites.
  - Simplex – Transmitting and receiving on the same frequency.

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# Band Plans

Definitions and Finding Band Plans.

- Definitions.
  - Repeater Inputs & Outputs – The pairs of frequencies used by repeaters.
  - Control Links – Frequencies used to control repeaters, remotely-controlled stations or satellites.

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# Band Plans

Definitions and Finding Band Plans.

- Definitions.
  - Beacons – Automated transmissions used to tell when a band is “open” to a given location.
    - A network of low-power, automated transmitters around the world used to detect propagation conditions.
      - HF & 6m.

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# Band Plans

Definitions and Finding Band Plans.

- Definitions.
  - Calling frequencies.
    - Frequencies used to establish contact.
      - After contact is made, move to another frequency to talk.
      - Only have to monitor one frequency instead of entire band.
      - Can be useful for detecting band openings.

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# Band Plans

Definitions and Finding Band Plans.

- Who makes band plans?
  - The amateur community as a whole.
    - The band plans evolved over years of common usage.
  - Sometimes special interest groups pick out frequencies to “hang out” on.
    - QRP on 7040 kHz.
    - AM on 3885 kHz.
    - SSTV on 14.230 MHz.
    - etc.

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# Band Plans

Why Band Plans are Needed.

- The FCC rules do not go far enough in providing for a fair distribution of the available band space to various types of operations.
- By their nature, FM communications work better when “channelized”.
  - A standard band plan allows amateurs to readily use repeaters outside of their home area.

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# Band Plans

Why Band Plans are Needed.

- Rules about band plans.
  - Band plans are considered “good amateur practice” by the FCC.
    - When a conflict arises, the FCC will normally side with the station following the band plan.

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**T1B10 -- Where may SSB phone be used in amateur bands above 50 MHz?**

A. Only in sub-bands allocated to General class or higher licensees
B. Only on repeaters
C. In at least some portion of all these bands
D. On any band as long as power is limited to 25 watts

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**T2A10 -- What is a band plan, beyond the privileges established by the FCC?**

A. A voluntary guideline for using different modes or activities within an amateur band
B. A list of operating schedules
C. A list of available net frequencies
D. A plan devised by a club to indicate frequency band usage

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**T2A11 -- What term describes an amateur station that is transmitting and receiving on the same frequency?**

A. Full duplex
B. Diplex
C. Simplex
D. Multiplex

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# Making Contacts

Fun with Phonetics.

- When communicating by amateur radio, you will be exposed to (and will be using) a phonetic alphabet, or “phonetics”.

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# Making Contacts

Fun with Phonetics.

- A *phonetic alphabet* is a standard set of words where each word represents a letter of the alphabet.
  - First letter of the word is the letter that the word represents.
  - The FCC encourages the use of phonetics when identifying your station.
    - §97.119(b)(2)

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# Making Contacts

Fun with Phonetics.

- The use of a standard phonetic alphabet avoids confusion.
  - Many English letters sound the same.
    - B, C, D, E, G, P, T, V, Z
    - F, S
    - M, N
  - Letters are pronounced differently in different languages.
    - e.g. -- In German, "Y" is pronounced "Upsilon".

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# Making Contacts

Fun with Phonetics.

- The preferred alphabet is the International Radiotelephony Spelling Alphabet.
  - a.k.a. -- ICAO Phonetic Alphabet.
  - a.k.a. -- ITU Phonetic Alphabet.
  - a.k.a. -- NATO Phonetic Alphabet.
  - a.k.a. -- Military Phonetic Alphabet.

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# Making Contacts

| Letter | Phonetic | Pronunciation |
|---|---|---|
| A | Alpha | **AL**-fah |
| B | Bravo | **BRAH**-voh |
| C | Charlie | **CHAR**-lee |
| D | Delta | **DEL**-tah |
| E | Echo | **ECK**-oh |
| F | Foxtrot | **FOKS**-trot |
| G | Golf | **GOLF** |
| H | Hotel | hoh-**TEL** |
| I | India | **IN**-dee-ah |
| J | Juliett | **JEW**-lee-ett |
| K | Kilo | **KEY**-loh |
| L | Lima | **LEE**-mah |
| M | Mike | **MIKE** |

| Letter | Phonetic | Pronunciation |
|---|---|---|
| N | November | no-**VEM**-ber |
| O | Oscar | **OSS**-cah |
| P | Papa | pah-**PAH** |
| Q | Quebec | keh-**BECK** |
| R | Romeo | row-**ME**-oh |
| S | Sierra | see-**AIR**-ah |
| T | Tango | **TANG**-go |
| U | Uniform | **YOU**-nee-form |
| V | Victor | **VIK**-tah |
| W | Whiskey | **WISS**-key |
| X | X-ray | **ECKS**-ray |
| Y | Yankee | **YANG**-key |
| Z | Zulu | **ZOO**-loo |

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# Making Contacts

Fun with Phonetics.

- The use of country names or names of major cites is common.
  - e.g. – Denmark, Germany, Tokyo, Yokohama, etc.
- Avoid non-standard or “cute” phonetics.
  - Especially for DX contacts.

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# Making Contacts

Repeater Contacts.

- If you want to talk to anyone who will answer:
  - **Listen to make sure the repeater is not in use.**
  - Ask if the repeater is in use.
  - Say your call sign.
    - Some operators may add “MONITORING” or “LISTENING”.

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# Making Contacts

Repeater Contacts.

- If you want to talk to a specific station:
  - **Listen to make sure the repeater is not in use.**
  - Ask if the repeater is in use.
  - Say their call sign.
  - Say “THIS IS” or “FROM”.
  - Say your call sign.

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# Making Contacts

## Repeater Contacts.

- During the contact:
  - Identify your station legally.
    - Every 10 minutes.
    - At the end of the conversation.
  - Keep transmissions short.
    - To comply with FCC rules, repeaters have a time-out timer limiting each transmission to 3 minutes or less.
  - Leave breaks between transmission to listen for another station needing to use the repeater.
    - Courtesy beep.

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# Making Contacts

## Repeater Contacts.

- Signal reports.
  - Remember, you are receiving the signal from the **REPEATER**, and not from the station you are talking to!
    - **S-meter readings are meaningless!**


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# Making Contacts

Repeater Contacts.

- Signal reports.
  - Give a verbal description of how well the repeater is hearing the other stations.
    - Full quieting – No noise is heard along with signal.
    - White noise – Some noise is heard along with signal.
    - Scratchy – Noise almost as strong as voice.
    - Mobile flutter or picket-fencing – Rapid fading due to multi-path conditions.
    - Breaking up – Occasional words or syllables heard, mostly inaudible.

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# Making Contacts

Repeater Contacts.

- Signal reports.
  - If you receive a report that your signal is strong, but distorted, you may be:
    - Off frequency -- A signal that is slightly off frequency may still be received by the repeater, but the audio may be distorted.
      - Check your frequency.
    - Overmodulating – A signal that is overmodulated may sound distorted.
      - Adjust your microphone gain setting.
      - Speak more softly.
      - Move the microphone farther away from your mouth.

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**T2A04 -- 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 with 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

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**T2A09 -- What brief statement indicates that you are listening on a repeater and looking for a contact?**

A. “CQ CQ” followed by the repeater’s call sign
B. The station’s call sign followed by the word “monitoring”
C. The repeater call sign followed by the station’s call sign
D. “QSY” followed by your call sign

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**T7B10 -- What might be a problem if you receive a report that your audio signal through an FM repeater is distorted or unintelligible?**

A. Your transmitter is slightly off frequency
B. Your batteries are running low
C. You are in a bad location
D. All of these choices are correct

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# Making Contacts

Simplex Channels.

- Always try to use simplex rather than a repeater, if practical.
  - Frees up the repeater for those who need it.
  - Most transceivers have a *reverse split* or simply *reverse* function.
    - Allows you to listen to the repeater input frequency.
    - If you can hear the other station on the repeater input frequency, then you know that you are able to communicate on a simplex channel.

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# Making Contacts

Simplex Channels.

- Same rules apply for making a contact as for repeater contacts.
  - **Listen to make sure the frequency is not in use.**
  - Ask if the frequency is in use.
- Signal reports.
  - S-meter readings are somewhat useful, but for FM contacts, a verbal description is more meaningful.

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# Making Contacts

Simplex Channels.

- The band plans specify several frequencies for FM simplex operations.
  - Located in between the repeater input & output frequency segments.
  - One simplex frequency on each band is designated the National Emergency and Calling Frequency.
    - 6m → 52.525 MHz.
    - 2m → 146.520 MHz.
    - 70cm → 446.000 MHz.

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# Making Contacts

Simplex Channels.

- Emergency and Calling Frequencies.
  - Monitor calling frequency for potential contacts and emergencies.
  - Once contact is established, move to a different simplex channel.
    - Emergency contacts need not move.

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**T2A02 -- What is the national calling frequency for FM simplex operations in the 2 meter band?**

A. 146.520 MHz
B. 145.000 MHz
C. 432.100 MHz
D. 446.000 MHz

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**T2B01 -- How is a VHF/UHF transceiver's "reverse" function used?**

A. To reduce power output
B. To increase power output
C. To listen on a repeater's input frequency
D. To listen on a repeater's output frequency

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**T2B09 -- Why are simplex channels designated in the VHF/UHF band plans?**

A. So stations within range of each other can communicate without tying up a repeater
B. For contest operation
C. For working DX only
D. So stations with simple transmitters can access the repeater without automated offset

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# Making Contacts

## The Origin of CQ.

French was, and still is, the official language for international postal & radiocommunication services. The word, *sécurité,* was used to mean "safety" or "pay attention".

It is still used in this sense in international telecommunications.

The letters CQ, when pronounced in French, resemble the first two syllables of *sécurité*, and were therefore used as shorthand for the word.

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# Making Contacts

## SSB, CW, and Digital Contacts.

- Amateurs the world over use “CQ” to mean “calling any station”.
- CQ can be restricted to certain groups of stations, if desired.
  - CQ DX.
  - CQ TEXAS.
  - CQ EUROPE.
  - CQ CONTEST, etc.

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# Making Contacts

SSB, CW, and Digital Contacts.

- If you want to talk to any station that will answer using voice:
  - **Listen to make sure the frequency is not in use.**
  - Ask if the frequency is in use.
  - Say "**CQ**" three times.
  - Say "**THIS IS**".
  - Say your call sign **phonetically** twice.
  - Listen for answer.

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# Making Contacts

SSB, CW, and Digital Contacts.

- If you want to talk to a specific station using voice:
  - **Listen to make sure the frequency is not in use.**
  - Ask if the frequency is in use.
  - Say their call sign once.
  - Say "**THIS IS**".
  - Say your call sign 1-2 times.
  - Listen for answer.

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# Making Contacts

SSB, CW, and Digital Contacts.

- If you know the other station being contacted, the use of phonetics when sending his or your call sign may not be necessary, but the use of phonetics is always acceptable.

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# Making Contacts

SSB, CW, and Digital Contacts.

- If you want to talk to any station that will answer using CW or digital modes:
  - **Listen to make sure the frequency is not in use.**
  - Ask if the frequency is in use
    - Send "**QRL? DE <your call>**".
      - "DE" is a French word that means "from".

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# Making Contacts

SSB, CW, and Digital Contacts.

- If you want to talk to any station that will answer using CW or digital modes:
  - Send "**CQ**" three times.
  - Send "**DE**".
  - Send your call sign two or three times.
  - Send "**K**".
    - "K" is a procedural signal that means "go ahead".
  - Listen for answer.

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# Making Contacts

SSB, CW, and Digital Contacts.

- If you want to talk to a specific station using CW or digital modes:
  - **Listen to make sure the frequency is not in use.**
  - Send their call sign 1-3 times.
  - Send "**DE**".
  - Send your call sign 1-3 times.
  - Send "**K**" or "**KN**".
  - Listen for answer.

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# Making Contacts

SSB, CW, and Digital Contacts.

- During the contact.
  - Avoid “doubling”.
    - On voice, say “**OVER**” or “**GO AHEAD**” at the end of each transmission.
    - On CW or digital modes send “**K**” or “**KN**” at the end of each transmission.

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# Making Contacts

SSB, CW, and Digital Contacts.

- Breaking in.
  - It is usually considered poor manners to break in on a conversation in progress.
  - Break in by saying/sending your call sign at the break between transmissions.
  - Saying “BREAK BREAK” followed by your call sign denotes an emergency.

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**T2A05 -- How should you respond to a station calling CQ?**

A. Transmit "CQ" followed by the other station's call sign
B. Transmit your call sign followed by the other station's call sign
C. Transmit the other station's call sign followed by your call sign
D. Transmit a signal report followed by your call sign

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**T2A08 -- What is the meaning of the procedural signal "CQ"?**

A. Call on the quarter hour
B. Test transmission, no reply expected
C. Only the called station should transmit
D. Calling any station

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**T2A12 -- What should you do before calling CQ?**

A. Listen first to be sure that no one else is using the frequency
B. Ask if the frequency is in use
C. Make sure you are authorized to use that frequency
D. All these choices are correct

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# Making Contacts

Procedural Signals.

- Procedural signals are words, phrases, or special characters that have a specific meaning.
- Used to increase communications efficiency.
- On voice, procedural signals are words or phrases called *prowords*.
- On CW & digital modes, procedural signals are special characters called *prosigns*.
  - 1 or 2 characters.
  - If 2 characters, sent as a single character on CW.

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# Making Contacts

Procedural Signals.

| Proword | Prosign | Meaning |
|---|---|---|
| OVER | K | End of transmission & response is expected. |
| | KN | End of transmission & only called station should respond. |
| OUT | SK | End of transmission & no response is expected. |
| | AR | End of message. |
| ROGER | R | Message received. |
| WILCO | | Message received & will comply. |

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# Making Contacts

Q-Signals.

- The letter “Q” followed by 2 additional letters.
  - Originally developed by commercial radio telegraphers for traffic handling.
  - Conveys an entire thought or sentence.
  - Adding a “?” changes it to a question.
  - Primarily intended for CW or digital operations.
    - Commonly used on voice.
      - “Purists” used to say that using Q-signals on voice was poor operating technique, but it is accepted practice now.

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# Making Contacts

Q-Signals.

| Q-signal | Meaning | | Q-signal | Meaning |
|---|---|---|---|---|
| QRM | Interference (signals). | | QSB | Your signals are fading. |
| QRN | Interference (noise). | | QSL | I acknowledge receipt. |
| QRO | Increase power. | | QSY | Change frequency. |
| QRP | Decrease power. | | QTH | My location is ___. |
| QRX | I will call you again at ___. | | | |
| QRZ | I am calling you. | | QLF | |

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**T2B10 -- Which Q signal indicates that you are receiving interference from other stations?**

A. QRM
B. QRN
C. QTH
D. QSB

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**T2B11 -- Which Q signal indicates that you are changing frequency?**

A. QRU
B. QSY
C. QSL
D. QRZ

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# Making Contacts

DXing and Contesting.

- Different on-air activities provide an incentive to get on the radio.
- Learn about propagation as you search for specific stations on various bands.
- Improve your operating skills.
- Have fun!

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# Making Contacts

DXing and Contesting.

- DXing.
  - DX is an abbreviation meaning *distance*.
  - Trying to contact stations as far away as possible has been a tradition since the first days of radio.
  - Contacting stations far away is called *DXing* or *working DX*.

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# Making Contacts

DXing and Contesting.

- DXing.
  - On HF, DX means stations in other countries.
    - You would be surprised by what constitutes another country!
  - On VHF/UHF, DX means stations outside your normal coverage area.

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# Making Contacts

DXing and Contesting.

- Contesting.
  - Try to make as many contacts as possible during a specific time period.
  - May be limited to specific bands and/or modes.
    - **NEVER** any contests on 60m, 30m, 17m, or 12m.
  - Must accurately exchange specific information as efficiently as possible.
    - Excellent way to improve emergency operating skills.

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# Making Contacts

DXing and Contesting.

- Contesting.
  - In a contest, speed is of the essence, so the following rules apply:
    - Always send your complete call sign.
    - Only send what is necessary to complete the contact.
      - No extraneous information such as name, QTH, etc.
    - Do not attempt to contact the same station more than once on the same band and mode.

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# Making Contacts

DXing and Contesting.

- Contesting.
  - Operating in a VHF or UHF contest is different than chatting on your local FM repeater.
    - Use weak-signal techniques.
    - Use CW and/or SSB modes.
    - Use horizontally-polarized antennas.
    - Requires a VHF or UHF multi-mode transceiver.

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# Making Contacts

DXing and Contesting.

- Contesting.
  - ARRL Sweepstakes.
  - State QSO Parties.
    - Some **REALLY** strange awards.
  - VHF/UHF contests.
  - RTTY contests.
  - CQ World Wide DX Contest.
  - Contest calendars.
    - http://www.hornucopia.com/contestcal

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# Making Contacts

DXing and Contesting.

- Contesting.


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# Making Contacts

DXing and Contesting.

- Contesting.


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# Making Contacts

DXing and Contesting.

- ARRL Field Day.
  - Set up a portable operation using emergency power and make as many contacts as you can in a 24-hour period.
    - Most clubs set up a multi-station operation.
    - Any station in North America can participate.
  - Largest operating event of the year.
  - Like a contest except no awards.
    - Just bragging rights.
  - 4th full weekend in June.

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# Making Contacts

DXing and Contesting.

- ARRL Field Day.
  - Some groups concentrate on setting up under emergency conditions.
  - Some groups concentrate on making as many contacts as possible.
  - Some groups use Field Day as a social event.
    - Lots of food!!!
  - Some groups try for all three.

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# Making Contacts

DXing and Contesting.

- ARRL Field Day.

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**T8C03 -- What operating activity involves contacting as many stations as possible during a specified period?**

A. Simulated emergency exercises
B. Net operations
C. Public service events
D. Contesting

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**T8C04 -- Which of the following is good procedure when contacting another station in a radio contest?**

A. Sign only the last two letters of your call if there are many other stations calling
B. Contact the station twice to be sure that you are in his log
C. Send only the minimum information needed for proper identification and the contest exchange
D. All of these choices are correct

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# Making Contacts

Jargon.

- Jargon.
  - Hams almost have a language of their own.
  - Many words & expressions are common, but have special meanings in amateur radio.

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# Making Contacts

Jargon.

- Handle – Name.
  - Amateurs used it long before the CB'ers did.
- Old Man (OM) – Male amateur of any age.
- Young Lady (YL) – Female amateur of any age.
- Silent Key (SK) – Amateur who has passed away.

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# Making Contacts

Jargon.

- XYL – Wife.
- Harmonic(s) – Child or children.
- Fine Business (FB) – Excellent.
- 73 – Best regards (sort of).
- 88 – Love and kisses.
- Final – Last transmission of contact.

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# Making Contacts

Jargon.

- Ragchew (Ragchewing) – Long conversation.
- Reading the Mail – Listening to another conversation.
- Roundtable – Several hams in one conversation.
  - Generally take turns in some order.
    - "Go around the table".
- DX (DX'ing) – Contacting other countries.

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# Making Contacts

Jargon.

- 807 – Beer or other adult beverage.

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# Making Contacts

Locations on the Grid.

- You normally tell the other operator where you are located.
  - Method varies.
    - May be as simple as city & state or country.
    - May be latitude & longitude.
    - Maidenhead Locator System.
      - a.k.a. – “Maidenhead grid” or simply “grid” or “locator”.
      - Especially popular for VHF/UHF/microwave operations.
      - In some HF contests, the value of a contact is determined by the grid.

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# Making Contacts

Locations on the Grid.

- Maidenhead Locators.
  - Adopted at a VHF/UHF conference in Maidenhead, England, in 1980.
  - Developed by Dr. John Morris, G4ANB.

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# Making Contacts

Locations on the Grid.

- Maidenhead Locators.
  - The earth is divided into 18 rows of 18 fields.
    - A field is 10° latitude high by 20° longitude wide.
    - A field is denoted by a pair of upper-case letters (A-R, A-R).
  - Each field is divided into 100 squares.
    - A square is 1° latitude high by 2° longitude wide.
    - A square is denoted by a pair of numbers (0-9, 0-9).

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# Making Contacts

Locations on the Grid.

- Maidenhead Locators.
  - Each square can be divided into 24 rows of 24 subsquares.
    - A subsquare is 2.5’ latitude high by 5’ longitude wide.
    - A subsquare is denoted by a pair of lower-case letters (a-x, a-x).
    - No 2 points in the same subsquare are farther than 7.5 miles apart.
      - Any point on the earth can be specified with good precision with only 6 characters.

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# Making Contacts

Locations on the Grid.

- Maidenhead Locators.
  - For example:
    - The locator for W1AW in Newington, CT, is **FN31** or **FN31pr**.
    - The locator for K9DUR's QTH is **EM69** or **EM69gn**.

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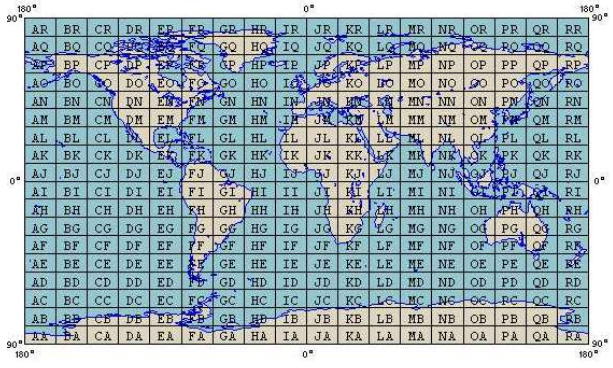
# Making Contacts

Locations on the Grid.

- Maidenhead Locators.

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**T8C05 -- What is a grid locator?**

A. A letter-number designator assigned to a geographic location
B. A letter-number designator assigned to an azimuth and elevation
C. An instrument for neutralizing a final amplifier
D. An instrument for radio direction finding

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# Making Contacts

Awards.

- You can get certificates or plaques for certain operating achievements.
  - a.k.a. – Collecting “wallpaper”.

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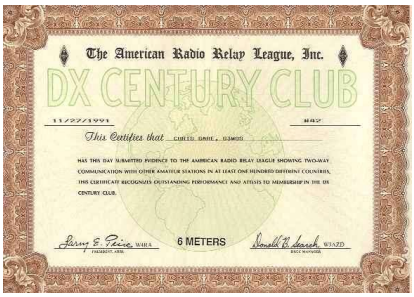
# Making Contacts

Awards.

- DX Century Club (DXCC).
  - Contacting 100 different DXCC entities (countries).

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# Making Contacts

Awards.

- Worked All States (WAS).
  - Contacting all 50 states.


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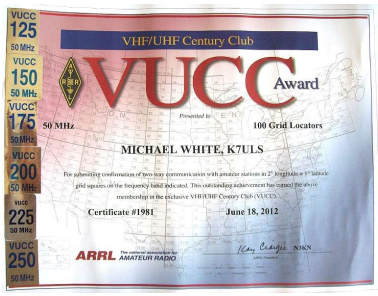
# Making Contacts

Awards.

- VHF/UHF Century Club (VUCC).
  - Contacting 100 grid squares on VHF/UHF.

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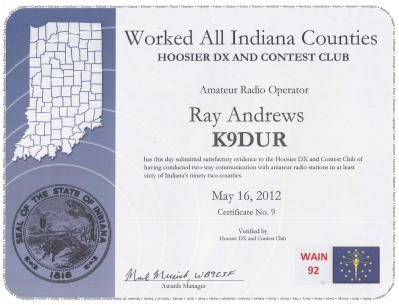
# Making Contacts

Awards.

- Worked All Indiana (WAI).
  - Contacting 60, 75, 85, or all 92 Indiana counties.

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# Making Contacts

Over the River and Through the Woods.

- Radio Direction Finding (RDF)
  - a.k.a. -- Fox Hunting.
  - Need receiver with directional antenna.
  - Can be a casual club activity or a competitive event.
  - RDF is good training for real-world situations.
    - Stuck transmitters.
    - Interference & jamming.
    - Search and rescue (SAR).
      - ELT's & EPIRB's.

89

# Making Contacts

Over the River and Through the Woods.

- Radio Direction Finding (RDF)

90

**T8C01 -- Which of the following methods is used to locate sources of noise interference or jamming?**

A. Echolocation
B. Doppler radar
C. Radio direction finding
D. Phase locking

91

**T8C02 -- Which of these items would be useful for a hidden transmitter hunt?**

A. Calibrated SWR meter
B. A directional antenna
C. A calibrated noise bridge
D. All of these choices are correct

92

# Making Contacts

Video.

- Amateur Television (ATV)
  - Same as commercial analog TV.
    - National Television Standards Committee (NTSC).
  - 430 MHz or higher.
- Slow Scan Television (SSTV)
  - Sending snap-shot pictures.
  - HF.



93

**T8D04 -- What type of transmission is indicated by the term "NTSC?"**

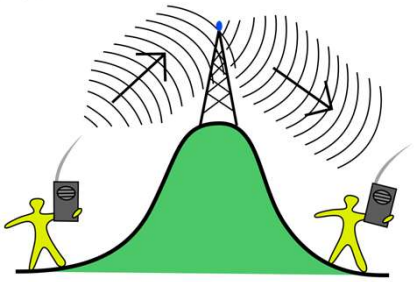
A. A Normal Transmission mode in Static Circuit
B. A special mode for earth satellite uplink
C. An analog fast scan color TV signal
D. A frame compression scheme for TV signals

94

# Using Repeaters

Repeaters.

- As a Technician class licensee, you will undoubtedly be using repeaters.



95

# Using Repeaters

Repeaters.

- Repeaters are located in high locations and enhance the range of VHF & UHF stations, especially mobile & handheld stations.
- Repeaters use duplex operation.
  - The repeater receives on frequency “A” and simultaneously re-transmits what is received on frequency “B”.
  - A user transmits on frequency “A” and receives on frequency “B”.

96

# Using Repeaters

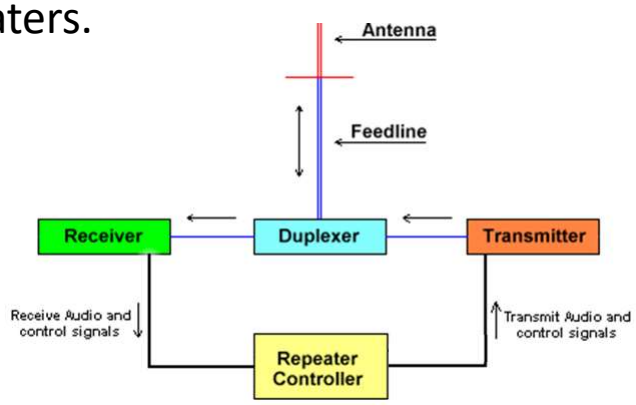
Repeaters.

- Basic Repeater System.
  - All equipment at same location.
  - May use the same or separate antennas.
    - A duplexer is used to isolate the transmitter & receiver.
  - Components:
    - Transmitter.
    - Receiver.
    - Antenna system & duplexer.
    - Controller.

97

# Using Repeaters

Repeaters.




98

# Using Repeaters

Repeaters.

- A device called the repeater controller allows the repeater transmitter & receiver to work together.
  - Repeater controller functions:
    - Activates the transmitter when a signal is received.
      - Limits transmissions to a maximum of 3 minutes.
    - Provides a way for the repeater to identify itself.
    - Controls access to the repeater.
      - CTCSS tones, etc.
    - May allow the repeater to be controlled from a remote location.
    - May allow the transmission of pre-recorded announcements.

99

# Using Repeaters

Repeaters.

- Repeater controller.
  - Time-out timer.
    - Most repeater controllers include provisions to limit the length of a single transmission to 3 minutes or less.
      - Required for stations operating under automatic or remote control.
    - Timer normally resets when repeater transmitter stops transmitting or when a “courtesy beep” is heard.
      - A short period of time between a user stopping transmitting & the courtesy beep ensures that another station can break in if necessary.

100

# Using Repeaters

Repeaters.

- Multiple-site repeaters.
  - Some repeaters may be split between different sites.
    - Transmitter at one site & receiver at another.
    - Transmitter & receiver at one site & additional receivers at other sites.
    - Auxiliary transmitters and/or receivers, a telephone line, or an internet connection are used to link the different locations together.

101

# Using Repeaters

Repeaters.

- Multiple-site repeaters and linked repeaters need some means of connecting sites together.
  - Telephone.
  - Internet.
  - Radio.
    - A radio link is called an auxiliary station.
    - Usually on 1.25m or 70cm bands.

102

# Using Repeaters

Repeaters.

- Open, special use and private repeaters.
  - Most repeaters are “open” repeaters.
    - Any amateur is welcome to use the system for any legitimate amateur radio purpose.
  - Some repeaters are “closed” or private repeaters.
    - Use of the repeater is restricted to “authorized” users.
      - e.g. - Club members, subscribers, etc.
  - Some repeaters are “special use” repeaters.
    - Use of the repeater is restricted to certain types of use.
      - e.g. - Emergency communications & drills, etc.

103

# Using Repeaters

Repeaters.

- Accessing a Repeater.
  - Set the radio to the repeater output frequency.
  - Set the correct offset.
    - Probably set automatically by the radio.
  - Set any required access tone.
  - Adjust the squelch control until the noise just goes away.
  - **Listen to see if repeater is in use.**

104

# Using Repeaters

Repeaters.

- Accessing a Repeater.
  - Press the PTT button and say your call sign followed by "**TESTING**".
  - Release the PTT button.
    - You will hear the repeater carrier for a second or two followed by a brief burst of noise.
      - The burst of noise is called a "squelch tail".
      - You may also hear a short tone (courtesy beep).

105

# Using Repeaters

Finding Repeaters.

- Look at the band plan.
  - Tune across the band segments that are listed as "repeater outputs".
  - Use transceiver's *scan* function to look for active frequencies.
- Use a repeater directory.
  - Printed.
  - Online.


106

# Using Repeaters

Finding Repeaters.

- Once you have found a repeater, you need to know 3 things:
  - The repeater output frequency.
  - The repeater input frequency or shift (a.k.a. -- split).
  - Any access tones or codes required.

107

**T4B05 -- What does the scanning function of an FM transceiver do?**

A. Checks incoming signal deviation
B. Prevents interference to nearby repeaters
C. Tunes through a range of frequencies to check for activity
D. Checks for messages left on a digital bulletin board

108

# Using Repeaters

## Repeater Offset or Shift.

- Repeaters receive on one frequency (input) and transmit on another (output).
  - Repeaters are normally referred to by their output frequency.
    - e.g. – 146.685 MHz or just ”685”.
  - Difference between the input and output frequencies is:
    - Called the repeater offset, split, or shift.
      - $f_{input} - f_{output}$
    - The offset is specified by the band plan.

109

# Using Repeaters

## Repeater Offset or Shift.

| Band | Repeater Output Frequency | Offset |
|---|---|---|
| 10m | 29.6-29.7 MHz | -100 kHz |
| 6m | 51.0 MHz to 52.0 MHz | -500 kHz |
| | 52.0 MHz to 54.0 MHz | -1.0 MHz |
| 2m | 145.1 MHz to 145.5 MHz | -600 kHz |
| | 146.6 MHz to 147.0 MHz | -600 kHz |
| | 147.0 MHz to 147.4 MHz | +600 kHz |
| 1.25m | 223.0 MHz to 225.0 MHz | -1.6 MHz |
| 70cm | 442.0 MHz to 446.0 MHz | +5.0 MHz |
| | 446.0 MHz to 450.0 MHz | -5.0 MHz |

110

# Using Repeaters

Repeater Offset or Shift.

- Most modern transceivers automatically set the shift when tuned to a repeater segment in the band plan.

111

**T2A01 -- What is a common repeater frequency offset in the 2 meter band?**

A. Plus or minus 5 Mhz
B. Plus or minus 600 kHz
C. Plus or minus 500 kHz
D. Plus or minus 1 Mhz

112

**T2A03 -- What is a common repeater frequency offset in the 70 cm band?**

A. Plus or minus 5 Mhz
B. Plus or minus 600 kHz
C. Plus or minus 500 kHz
D. Plus or minus 1 Mhz

113

**T2A07 -- What is meant by "repeater offset?"**

A. The difference between a repeater's transmit and receive frequencies
B. The repeater has a time delay to prevent interference
C. The repeater station identification is done on a separate frequency
D. The number of simultaneous transmit frequencies used by a repeater

114

# Using Repeaters

Linked Repeater Systems.

- Two or more repeaters may be linked together so that they all retransmit the same communications simultaneously.
  - Increased coverage area, or
  - Different bands, or
  - Both.

115

**T2B03 -- Which of the following describes a linked repeater network?**

A. A network of repeaters in which signals received by one repeater are transmitted by all the repeaters in the network
B. A single repeater with more than one receiver
C. Multiple repeaters with the same control operator
D. A system of repeaters linked by APRS

116

# Break

117

# Using Repeaters

Repeater Access Tones.

- Often repeater operators need to prevent unwanted signals from activating the repeater.
  - Distant signals intended for a different repeater on the same frequency.
  - Interference from other nearby transmitters.
- There are 3 common methods used.

118

# Using Repeaters

Repeater Access Tones.

- A continuous sub-audible tone.
  - Continuous Tone-Coded Squelch System (CTCSS).
    - a.k.a. – Private Line® (PL)
- A tone burst at the beginning of a transmission.
  - A single tone or series of tones.
  - A single 1800 Hz tone is common in Europe.
- Digital Coded Squelch (DCS).
  - A continuous stream of sub-audible digital data.

119

# Using Repeaters

Repeater Access Tones.

- Most common method in the US is CTCSS.
- Most transceivers have a “Tone” setting.
  - Frequency – Frequency of the sub-audible tone.
  - Encode (ENC) – Transmit a sub-audible tone to access the repeater.
  - Decode (DEC) – Must receive a sub-audible tone from the repeater to open the squelch.
  - Encode-Decode – Both ENC & DEC.

120

# Using Repeaters

Repeater Access Tones.

- A repeater directory will tell you if a tone is needed to access a repeater.
- Often the repeater itself will tell you if a tone is needed as part of a voice identification.

121

**T2B02 -- What term describes the use of a sub-audible tone transmitted along with normal voice audio to open the squelch of a receiver?**

A. Carrier squelch
B. Tone burst
C. DTMF
D. CTCSS

122

**T2B04 -- Which of the following could be the reason you are unable to access a repeater whose output you can hear?**

A. Improper transceiver offset
B. You are using the wrong CTCSS tone
C. You are using the wrong DCS code
D. All these choices are correct

123

# Using Repeaters

Digital Repeater Systems.

- Several systems have been developed to link repeaters over the internet.
  - IRLP.
  - Echolink.
  - D-STAR.
  - WIRES II.
  - DMR.

124

# Using Repeaters

Digital Repeater Systems.

- Most repeater systems that are linked over the internet use audio tones to select what remote repeater you are linked to.

125

# Using Repeaters

Digital Repeater Systems.

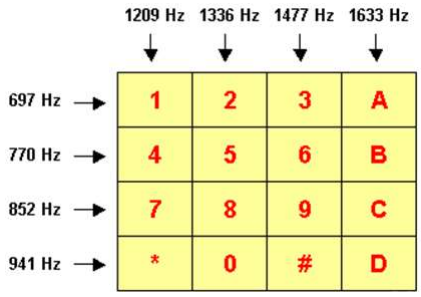
- Dual-Tone Multi-Frequency (DTMF).
  - Developed by Bell Labs for telephone dialing.
    - Touch-Tone®
  - 4 low frequency & 4 high frequency audio tones are sent in pairs to encode 16 different signals.

126

# Using Repeaters

Digital Repeater Systems.

- Dual-Tone Multi-Frequency (DTMF).




127

# Using Repeaters

Digital Repeater Systems.

- IRLP & Echolink use the voice-over internet protocol (VoIP) to link repeaters over the internet.
  - Same technology used by online telephone providers such as Skype, magicJack, BasicTalk, etc.

128

# Using Repeaters

Digital Repeater Systems.

- IRLP requires that all audio input to the system come from a radio link.
  - Computer users can listen to conversations, but cannot talk.
- EchoLink allows input from a computer.
  - Users must hold a valid amateur radio license.

129

# Using Repeaters

Digital Repeater Systems.

- Making an IRLP or Echolink contact.
  1. Use the DTMF keypad on your transceiver to enter the local repeater access code to request internet connection.
     - Varies from repeater to repeater.
     - May require membership in a club.
  2. Use the DTMF keypad on your transceiver to enter the 4-digit node ID of the remote repeater.
  3. You are now linked to the remote repeater.

130

# Using Repeaters

Digital Repeater Systems.

- D-STAR.
  - Public protocol developed by the Japan Amateur Radio League (JARL).
    - Can send voice or data.
  - Currently Icom & Kenwood are the only manufacturers selling D-STAR capable equipment in the US.
- WIRES II.
  - Proprietary system developed by Yaesu.
    - Voice only.

131

# Using Repeaters

Digital Repeater Systems.

- DMR (Digital Mobile Radio).
  - DMR was developed by Motorola for the Land Mobile Radio Service.
    - Several other manufacturers also make DMR radios.
  - DMR uses time-division multiplexing to put 2 simultaneous digital signals on a single 12.5 kHz wide channel.

132

# Using Repeaters

Digital Repeater Systems.

- DMR (Digital Mobile Radio).
  - Digital codes called *color codes* are used to access a specific repeater.
    - Similar to CTCSS on an analog repeater.

133

# Using Repeaters

Digital Repeater Systems.

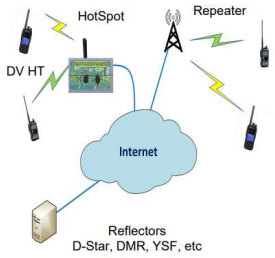
- DMR (Digital Mobile Radio).
  - A central network controller organizes conversations into *talk groups*.
    - Each group has its own ID or code.
    - Can only talk to other stations in that group.
    - Groups allow several different conversations to share a channel without interfering with each other.
  - Each radio is programmed with a *code plug* which contains access information for all of the talk groups that it will be accessing.

134

# Using Repeaters

Digital Repeater Systems.

- Hotspots.
  - Act as a gateway to connect your digital transceiver to the internet.
  - Allow access to digital radio systems if not in range of a repeater.
  - Allows cross-mode access.
    - e.g. – Access DMR using a D-Star radio.




135

**T2B06 -- What type of signaling uses pairs of audio tones?**

A. DTMF
B. CTCSS
C. GPRS
D. D-STAR

136

**T2B07 -- How can you join a digital repeater's "talk group"?**

A. Register your radio with the local FCC office
B. Join the repeater owner's club
C. Program your radio with the group's ID or code
D. Sign your call after the courtesy tone

137

**T2B12 -- What is the purpose of the color code used on DMR repeater systems?**

A. Must match the repeater color code for access
B. Defines the frequency pair to use
C. Identifies the codec used
D. Defines the minimum signal level required for access

138

**T4A10 -- What function is performed with a transceiver and a digital mode hot spot?**

A. Communication using digital voice or data systems via the internet
B. FT8 digital communications via AFSK
C. RTTY encoding and decoding without a computer
D. High-speed digital communications for meteor scatter

139

**T4B07 -- What does a DMR "code plug" contain?**

A. Your call sign in CW for automatic identification
B. Access information for repeaters and talkgroups
C. The codec for digitizing audio
D. The DMR software version

140

**T4B09 -- How is a specific group of stations selected on a digital voice transceiver?**

A. By retrieving the frequencies from transceiver memory
B. By enabling the group's CTCSS tone
C. By entering the group's identification code
D. By activating automatic identification

141

**T4B11 -- Which of the following must be programmed into a D-STAR digital transceiver before transmitting?**

A. Your call sign
B. Your output power
C. The codec type being used
D. All these choices are correct

142

**T8C06 -- How is over the air access to IRLP nodes accomplished?**

A. By obtaining a password that is sent via voice to the node
B. By using DTMF signals
C. By entering the proper internet password
D. By using CTCSS tone codes

143

**T8C07 -- What is Voice Over Internet Protocol (VoIP)?**

A. A set of rules specifying how to identify your station when linked over the internet to another station
B. A technique employed to “spot” DX stations via the internet
C. A technique for measuring the modulation quality of a transmitter using remote sites monitored via the internet
D. A method of delivering voice communications over the internet using digital techniques

144

**T8C08 -- What is the Internet Radio Linking Project (IRLP)?**

A. A technique to connect amateur radio systems, such as repeaters, via the internet using Voice Over Internet Protocol (VoIP)
B. A system for providing access to websites via amateur radio
C. A system for informing amateurs in real time of the frequency of active DX stations
D. A technique for measuring signal strength of an amateur transmitter via the internet

145

**T8C09 -- Which of the following protocols enables an amateur station to transmit through a repeater without using a radio to initiate the transmission?**

A. IRLP
B. D-STAR
C. DMR
D. EchoLink

146

**T8C10 -- What is required before using the EchoLink system?**

A. Complete the required EchoLink training
B. Purchase a license to use the EchoLink software
C. Register your call sign and provide proof of license
D. All these choices are correct

147

**T8D02 -- What is a "talkgroup" on a DMR repeater?**

A. A group of operators sharing common interests
B. A way for groups of users to share a channel at different times without hearing other users on the channel
C. A protocol that increases the signal-to-noise ratio when multiple repeaters are linked together
D. A net that meets at a specified timeon

148

**T8D07 -- Which of the following describes DMR?**

A. A technique for time-multiplexing two digital voice signals on a single 12.5 kHz repeater channel
B. An automatic position tracking mode for FM mobiles communicating through repeaters
C. An automatic computer logging technique for hands-off logging when communicating while operating a vehicle
D. A digital technique for transmitting on two repeater inputs simultaneously for automatic error correction

149

# Nets

Nets and Roundtables.

- Often you may find yourself talking to more than one station at once.
  - If it is just an informal or impromptu gathering with no formal organization it is called a *roundtable*.
  - If it is a structed group, often scheduled in advance, it is called a *net*.

150

# Nets

Roundtables.

- If you wish to join a roundtable already in progress, simply transmit your call sign during a break between transmissions.
- Always try to pass the conversation to the next person in turn, keeping the same order.
- Always specify who you are passing the conversation to.

151

# Nets

Nets.

- The term *net* is short for *network*.
- Nets evolved over the years to share and exchange information in an organized way.
- Nets fall into three different categories:
  - Social.
  - Traffic.
  - Emergency and public service.

152

# Nets

Types of Nets.

- Social nets.
  - Groups of amateur gathering together to discuss a common topic or just to chit-chat.
  - Most common type.
  - Least formal.

153

# Nets

Types of Nets.

- Social nets.
  - A special type of social net is the mobile service net.
    - Caters to mobile operators.
      - Traffic conditions.
      - Place to meet other stations while traveling.
    - Most are on 40m.
      - 7251 kHz -- South Coast Amateur Radio Service (SouthCARS).
      - 7255 kHz -- East Coast Amateur Radio Service (EastCARS).
      - 7258 kHz -- Midwest Amateur Radio Service (MidCARS).

154

# Nets

Types of Nets.

- Social nets.
  - Maritime Mobile Service Net.
    - Nautical weather conditions.
    - Other support of maritime mobile stations.
    - 14.300 MHz.

155

# Nets

Types of Nets.

- Traffic nets.
  - *Traffic* refers to formal messages that are relayed via amateur radio.
  - Messages are sent using a formal structure to ensure accuracy & efficiency.
    - The **MOST** important job is to transmit the message **EXACTLY** as received.
  - Most traffic nets are part of the *National Traffic System (NTS)*.

156

# Nets

## Net Structure and Participation.

- In every formal net, one station is designated the *net control station* (NCS).
  - The NCS acts as a “traffic cop” to ensure the efficient flow of information.
- Follow check-in and check-out procedures.
  - Listen to learn how the net operates.
  - Normally, check-in instructions will periodically be transmitted by the NCS.

157

# Nets

## Net Structure and Participation.

- Communications discipline is vital.
  - Learn and follow procedures.
  - Speak only when directed, and only to whom directed.
  - Stations may send emergency traffic at any time, but still under the direction and control of the NCS.
    - At a break between transmissions say the word “emergency” or “priority” followed by your call sign. The NCS will immediately acknowledge you, and advise you to send your emergency or priority traffic.

158

# Nets

Net Structure and Participation.

- On emergency nets, maintaining net discipline is especially important.
  - Once you have checked into the net, **DO NOT TRANSMIT** unless specifically told to do so by the NCS.
  - Emergency traffic will **ALWAYS** be handled before any other traffic.

159

**T2C02 -- Which of the following are typical duties of a Net Control Station?**

A. Choose the regular net meeting time and frequency
B. Ensure that all stations checking into the net are properly licensed for operation on the net frequency
C. Call the net to order and direct communications between stations checking in
D. All these choices are correct

160

**T2C05 -- What does the term "traffic" refer to in net operation?**

A. Messages exchanged by net stations
B. The number of stations checking in and out of a net
C. Operation by mobile or portable stations
D. Requests to activate the net by a served agency

161

**T2C07 -- Which of the following is standard practice when you participate in a net?**

A. When first responding to the net control station, transmit your call sign, name, and address as in the FCC database
B. Record the time of each of your transmissions
C. Unless you are reporting an emergency, transmit only when directed by the net control station
D. All these choices are correct

162

# Nets

Exchanging Messages.

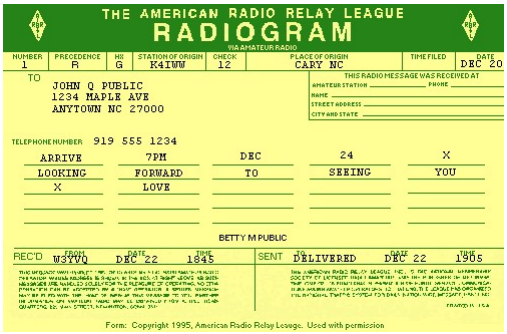
- The most import task is to accurately and efficiently transfer information.
  - Not just emergency & disaster nets.
- To improve efficiency, a standardized message format called a *Radiogram* is used.
  - a.k.a. – Formal message.

163

# Nets

Exchanging Messages.

- Radiogram.



THE AMERICAN RADIO RELAY LEAGUE
RADIOGRAM
VIA AMATEUR RADIO

| NUMBER | PRECEDENCE | HX | STATION OF ORIGIN | CHECK | PLACE OF ORIGIN | TIME FILED | DATE |
|---|---|---|---|---|---|---|---|
| 1 | R | G | K4IWW | 12 | CARY NC | | DEC 20 |

TO
JOHN Q PUBLIC
1234 MAPLE AVE
ANYTOWN NC 27000

THIS RADIO MESSAGE WAS RECEIVED AT
AMATEUR STATION _____ PHONE _____
NAME _____
STREET ADDRESS _____
CITY AND STATE _____

TELEPHONE NUMBER 919 555 1234

| | | | | |
|---|---|---|---|---|
| ARRIVE | 7PM | DEC | 24 | X |
| LOOKING | FORWARD | TO | SEEING | YOU |
| X | LOVE | | | |

BETTY M PUBLIC

| REC'D | FROM | DATE | TIME | SENT | TO | DATE | TIME |
|---|---|---|---|---|---|---|---|
| | W3YVQ | DEC 22 | 1845 | | DELIVERED | DEC 22 | 1905 |

Form: Copyright 1995, American Radio Relay League. Used with permission

164

# Nets

Exchanging Messages.

- Formal messages include the following parts:
  - Preamble.
  - Address.
  - Text.
  - Signature.
  - Operator notes (optional).

165

# Nets

Exchanging Messages.

- Preamble.
  - The preamble contains:
    - Information about how the message is to be handled.
    - Information needed to identify the message and to help track the progress of message through the NTS.

166

# Nets

## Exchanging Messages.

- Preamble.
  - Number – A number assigned by the originating station to uniquely identify the message.
  - Precedence – Not the importance of the message, but rather how quickly the message needs to be handled.
    - **EMERGENCY**
    - **P**riority
    - **R**outine
    - **W**elfare

167

# Nets

## Exchanging Messages.

- Preamble.
  - Handling Instructions – A 3-letter code giving instructions on how to handle the message (optional).
  - Station of Origin – The call sign of the station originating the message.
  - Check – The number of words or groups of characters in the message.
    - Used to check that the message was accurately received.

168

# Nets

Exchanging Messages.

- Preamble.
  - Place of Origin – City & State where the message was originated from.
  - Time – The time that the message was originated.
    - The time is usually omitted.
  - Date – The date that the message was originated.

169

# Nets

Exchanging Messages.

- Address.
  - The complete name and address of the person that the message is to be delivered to.
    - If possible, include a telephone number.

170

# Nets

## Exchanging Messages.

- Text.
  - The text of the message comes after the address.
  - Keep the text short and simple.
    - Normally 25 words or less.
  - ARRL Numbered Radiograms.
    - ARRL Numbered Radiograms are a list of pre-defined sentences or phrases that are commonly used to reduce the number of words required to send the message.

171

# Nets

## Exchanging Messages.

- Signature.
  - Name of the person(s) sending the message.
- Operator notes.
  - Additional information to assist the stations handling the message. Often instructions on the route to be used for a reply.

172

# Nets

Exchanging Messages.

- Phonetics.
  - Standard ICAO phonetics should be used when necessary to eliminate confusion:
    - All proper names.
    - Words that sound similar but with different spellings/meanings.
      - To, too, two.
      - Mail, male.
      - etc.
    - Non-words.
      - FEMA, ARES, RACES, PL259, etc.

173

**T2C03 -- What technique is used to ensure that voice messages containing unusual words are received correctly?**

A. Send the words by voice and Morse code
B. Speak very loudly into the microphone
C. Spell the words using a standard phonetic alphabet
D. All of these choices are correct

174

**T2C08 -- Which of the following is a characteristic of good traffic handling?**

A. Passing messages exactly as received
B. Making decisions as to whether messages are worthy of relay or delivery
C. Ensuring that any newsworthy messages are relayed to the news media
D. All of these choices are correct

175

**T2C10 -- What information is contained in the preamble of a formal traffic message?**

A. The email address of the originating station
B. The address of the intended recipient
C. The telephone number of the addressee
D. Information needed to track the message

176

**T2C11 -- What is meant by "check" in a radiogram header?**

A. The number of words or word equivalents in the text portion of the message
B. The call sign of the originating station
C. A list of stations that have relayed the message
D. A box on the message form that indicates that the message was received and/or relayed

177

# Communications for Public Service

Public service communications includes two different categories of operations:

- Communications support for emergencies & disasters.
  - Severe weather, earthquakes, hurricanes, etc.
  - Disaster preparedness drills.
- Communications support for public service events.
  - Parades, walk-a-thons, etc.
  - Good training for actual emergencies.

178

# Communications for Public Service

Public Service Operating Guidelines.

- Safety first!
  - Do not become part of the problem.
- Maintain radio discipline.
- Do not be part of the event.
  - Your role should be strictly communications.
- Protect personal information.
  - **NEVER** send confidential information via radio without consent.

179

# Communications for Public Service

Public Service Operating Guidelines.

- Never speculate or guess.
  - If you don't know the answer, go to an event official.
- Never give out unauthorized information.
  - Only event officials should talk to the media or to the general public.

180

# Communications for Public Service

## Public Service Operating Guidelines.

- Tactical Communications.
  - Communications at the scene of the event is normally done using informal traffic.
    - Normally VHF or UHF only.
    - Use of tactical call signs can improve efficiency.
      - e.g. – EOC, Race Control, Shelter 1, etc.
      - **Normal identification using your FCC-assigned call sign is still required!**
        - **At end of each exchange.**
        - **Not less than every 10 minutes.**

181

# Communications for Public Service

## ARES and RACES.

- ARES and RACES are the two largest groups of amateur radio operators providing emergency communications.
- ARES is an organization.
- RACES is a radio service.
- Many amateurs who are members of ARES are also certified to operate in RACES.

182

# Communications for Public Service

ARES and RACES.

- Amateur Radio Emergency Service (ARES).
  - Part of the ARRL field organization.
  - Not defined in the FCC rules.
  - Supports both governmental and non-governmental agencies.
    - EMA, Red Cross, etc.

183

# Communications for Public Service

ARES and RACES.

- Radio Amateur Civil Emergency Service (RACES).
  - Part of FEMA, SEMA, or local EMA.
  - Defined in the FCC rules.
    - § 97.407.
  - Supports governmental agencies.
  - Stations must be registered with EMA.
  - Only transmit communications authorized by EMA.
  - Presidential War Powers Act.

184

## T1A10 -- What is the Radio Amateur Civil Emergency Service (RACES)?

A. A radio service using amateur frequencies for emergency management or civil defense communications
B. A radio service using amateur stations for emergency management or civil defense communications
C. An emergency service using amateur operators certified by a civil defense organization as being enrolled in that organization
➡ D. All these choices are correct

185

## T2C04 -- What is RACES?

A. An emergency organization combining amateur radio and citizens band operators and frequencies
B. An international radio experimentation society
C. A radio contest held in a short period, sometimes called a “sprint”
➡ D. An FCC part 97 amateur radio service for civil defense communications during national emergencies

186

## T2C06 -- What is the Amateur Radio Emergency Service (ARES)?

A. A group of licensed amateurs who have voluntarily registered their qualifications and equipment for communications duty in the public service

B. A group of licensed amateurs who are members of the military and who voluntarily agreed to provide message handling services in the case of an emergency

C. A training program that provides licensing courses for those interested in obtaining an amateur license to use during emergencies

D. A training program that certifies amateur operators for membership in the Radio Amateur Civil Emergency Service

187

# Communications for Public Service

Threats to Life and Property.

- Providing emergency communications is one of the basic purposes of the Amateur Radio Service as specified in the FCC Rules.
- Emergency communications have absolute priority over all other types of communications.

188

# Communications for Public Service

Threats to Life and Property.

- The FCC may declare a “temporary state of communications emergency”.
  - Prohibit normal communications on or near frequencies used for disaster relief operations.

189

# Communications for Public Service

Threats to Life and Property.

**§97.403 Safety of life and protection of property.** No provision of these rules prevents the use by an amateur station of any means of radiocommunication at its disposal to provide essential communication needs in connection with the immediate safety of human life and immediate protection of property when normal communication systems are not available.

190

# Communications for Public Service

Threats to Life and Property.

- The FCC rules **always** apply to the operation of an amateur radio station.
- However….

191

# Communications for Public Service

Threats to Life and Property.

- §97.403 means that, **when necessary because of an immediate threat to life or property**, an amateur may:
  - Transmit on frequencies not available to his license class.
  - Transmit on frequencies not available to the Amateur Radio Service.
  - Communicate with stations that are not in the Amateur Radio Service.

192

**T2C01 -- When do the FCC rules NOT apply to the operation of an amateur station?**

A. When operating a RACES station
B. When operating under special FEMA rules
C. When operating under special ARES rules
D. FCC rules always apply

193

**T2C09 -- Are amateur station control operators ever permitted to operate outside the frequency privileges of their license class?**

A. No
B. Yes, but only when part of a FEMA emergency plan
C. Yes, but only when part of a RACES emergency plan
D. Yes, but only in situations involving the immediate safety of human life or protection of property

194

# Communications for Public Service

Threats to Life and Property.

- Distress Calls.
  - There are 3 internationally recognized emergency signals.
    - Safety signal.
    - Urgency signal.
    - Distress signal.

195

# Communications for Public Service

Threats to Life and Property.

- Distress Calls.
  - How to send an emergency signal.
    - Send signal 3 times.
    - Identify your station.
    - Send information about emergency.
      - Type of emergency.
      - Location.
      - Type of assistance needed.
    - Listen for response.
    - Repeat.

196

# Communications for Public Service

## Threats to Life and Property.

- Distress Calls.
  - How to respond to a distress call:
    - Suspend all other communications **IMMEDIATELY**!
    - Write down **EVERYTHING** the station in distress transmits.
    - Make certain that you are the station who can **BEST** handle the emergency.
    - Answer the station.
    - Contact the appropriate authorities.

197

# Communications for Public Service

## Threats to Life and Property.

- Distress Calls.
  - Sécurité -- Safety signal.
    - The French word “sécurité”, which means safety.
    - Important safety information, normally concerning meteorological conditions.

198

# Communications for Public Service

## Threats to Life and Property.

- Distress Calls.
  - Pan-Pan -- Urgency signal.
    - From the French word “panne” which refers to a mechanical failure or breakdown.
    - Emergency, but no immediate threat to life or property.

199

# Communications for Public Service

## Threats to Life and Property.

- Distress Calls.
  - Mayday -- Distress signal.
    - From the French phrase “venez m’aider” which means “come help me”..
    - Emergency with an immediate threat to life or property.
    - The Morse code distress signal is SOS.
      - Originally “CQD”.
      - The Titanic sent both CQD and SOS

200

# Communications for Public Service

## Threats to Life and Property.

- Emergency Communications Training.
  - Join a local emergency communications group.
    - ARES, RACES, SATERN, etc.
    - Participate in drills and exercises.
  - ARRL on-line training.
  - FEMA on-line training.
  - Annual Simulated Emergency Test (SET).
  - Put together a “go-kit”.

201

# Communications for Public Service

## Threats to Life and Property.

- Emergency Communications and Your Employer.
  - The FCC Rules state, “No amateur station shall transmit…communications in which the station licensee or control operator has a pecuniary interest, including communications on behalf of an employer….”
  - Amateur radio clubs made up of employees of a company are permitted.
    - Communications must not be “on the clock”.

202

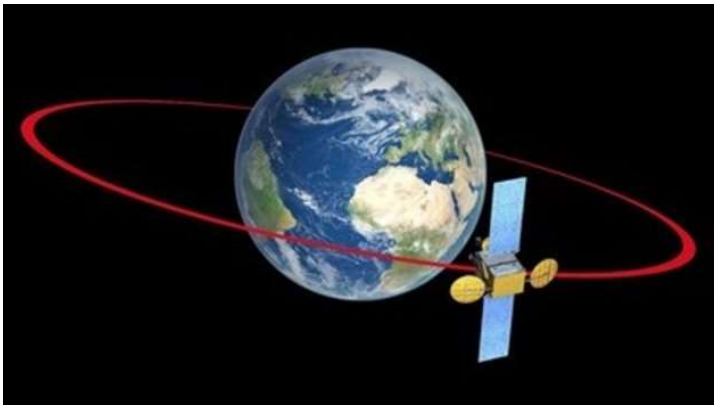
# Communications for Public Service

Threats to Life and Property.

- Emergency Communications and Your Employer.
  - An amateur **MAY** provide communications on behalf of their employer, **IF**:
    - The communications are during an emergency preparedness or disaster readiness test or drill.
    - If the tests or drills are not sponsored by a government agency, they are limited to 1 hour per week, or up 72 hours duration twice a year.

203

# Satellite Operating



204

# Satellite Operating

Amateur Radio Satellites.

- Most people think that the first non-governmental satellite was Telstar I.
  - Launched on July 10, 1962.
  - Owned by AT&T.

205

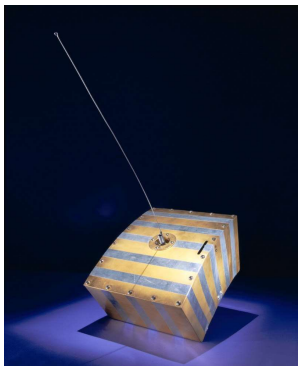
# Satellite Operating


206

# Satellite Operating

Amateur Radio Satellites.

- Actually, it was OSCAR 1.
  - **O**rbital **S**atellite **C**arrying **A**mateur **R**adio.
  - Launched on December 12, 1961.
  - World's 1st "piggy-back" satellite.
  - Owned by Project OSCAR, Inc.
    - Mostly members of the TRW Radio Club of Redondo Beach, CA.

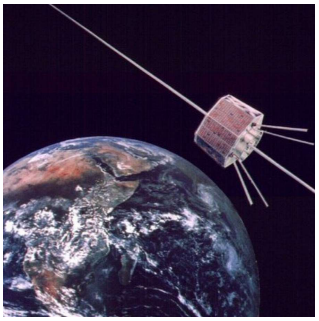


207

# Satellite Operating

Amateur Radio Satellites.

- Amateur radio operators have built and launched more than 50 satellites since OSCAR I first sent "HI" in Morse code on 145 MHz.

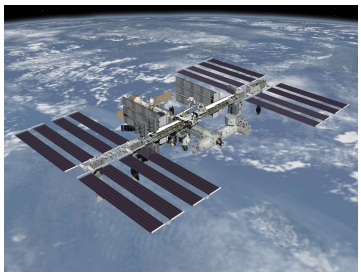


208

# Satellite Operating

## Amateur Radio Satellites

The International Space Station (ISS).



International Space Station (ISS)

Reid Wisemann, KF5LKT, making 2m contacts during Field Day 2014.

209

# Satellite Operating

## Amateur Radio Satellites

- There are several amateur radio stations on the International Space Station (ISS).
  - 2m FM voice station.
  - 2m & 70cm FM voice repeaters.
  - 2m & 70cm packet mailboxes.
  - 2m & 70cm APRS Digipeater

210

# Satellite Operating

Working the International Space Station.

- ISS 2m FM voice/SSTV station call signs:
  - NA1SS – US operators.
  - RS0ISS – Russian operators.
  - DP0ISS – German operators.
  - OR4ISS – Belgian operators.
  - IR0ISS – Italian operators.

211

# Satellite Operating

Working the International Space Station.

- Any amateur whose license allows them to transmit on the 2m and 70cm bands may enjoy working the ISS.
- Further information, including frequencies, can be found at:

https://www.amsat.org/amateur-radio-on-the-iss

212

**T1B02 -- Which amateurs may contact the International Space Station (ISS) on VHF bands?**

A. Any amateur holding a General class or higher license

B. Any amateur holding a Technician class or higher license

C. Any amateur holding a General class or higher license who has applied for and received approval from NASA

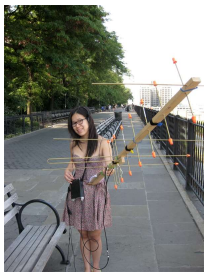
D. Any amateur holding a Technician class or higher license who has applied for and received approval from NASA

213

# Satellite Operating

Amateur Radio Satellites.

- Talking through a satellite may sound complicated, but it isn't.
- Some satellite repeaters can be accessed using a dual-band handheld radio with a hand-held 2m/70cm beam.



214

# Satellite Operating

Amateur Radio Satellites.

- Contacts can be made by any amateur radio operator whose license allows them to transmit on the satellite uplink frequency.

215

# Satellite Operating

Amateur Radio Satellites.

- FCC rules limit satellite uplink and downlink frequencies to portions of certain bands:
  - 10m --29.300 MHz to 29.510 MHz.
  - 2m -- 145.800 MHz to 146.000 MHz.
  - 70cm -- 435 MHz to 438 MHz.
  - 23cm -- 1260 MHz to 1270 MHz.
  - 13cm -- 2400 MHz to 2510 MHz.
  - 13cm -- 2430 MHz to 2438 MHz.

216

**T1E02 -- Who may be the control operator of a station communicating through an amateur satellite or space station?**

A. Only an Amateur Extra Class operator
B. A General class or higher licensee with a satellite operator certification
C. Only an Amateur Extra Class operator who is also an AMSAT member
D. Any amateur allowed to transmit on the satellite uplink frequency

217

**T1E02 -- Who may be the control operator of a station communicating through an amateur satellite or space station?**

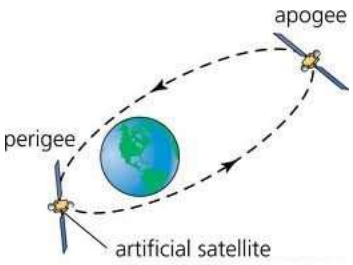
A. Only an Amateur Extra Class operator
B. A General class or higher licensee who has a satellite operator certification
C. Only an Amateur Extra Class operator who is also an AMSAT member
D. Any amateur whose license privileges allow them to transmit on the satellite uplink frequency

218

# Satellite Operating

Satellite Definitions.

- Apogee.
  - The point in a satellite's orbit where it is farthest from the earth.
- Perigee.
  - The point in a satellite's orbit where it is closest to the earth.

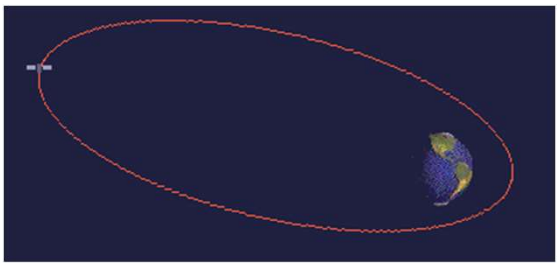



219

# Satellite Operating

Satellite Definitions.

- Elliptical orbit.
  - An orbit with a large difference between apogee and perigee.



220

# Satellite Operating

Satellite Definitions.

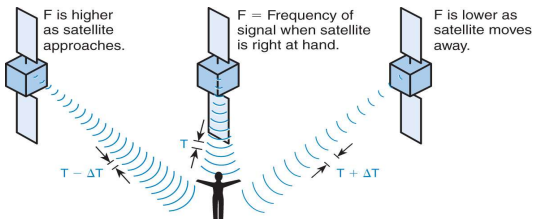
- Low Earth Orbit (LEO).
  - An orbit up to 1200 miles above the surface of the earth.

221

# Satellite Operating

Satellite Definitions.

- Doppler shift.
  - An apparent change in the frequency of a satellite's signal caused by its motion relative to the receiving station.




222

# Satellite Operating

## Satellite Definitions.

- Spin fading.
  - A rapid change in signal strength caused by the satellite spinning and changing the polarization of the transmitted wave.

223

# Satellite Operating

## Satellite Definitions.

- Beacon.
  - A satellite beacon is a signal from the satellite containing information about the satellite.
- Space station.
  - The FCC defines an amateur radio space station as any station located more than 50 km (31 miles) above the surface of the earth.

224

**T1A07 -- What is the FCC Part 97 definition of a space station?**

A. Any satellite orbiting the earth
B. A manned satellite orbiting the earth
C. An amateur station located more than 50 km above the Earth's surface
D. An amateur station using amateur radio satellites for relay of signals

225

**T8B05 -- What is a satellite beacon?**

A. The primary transmit antenna on the satellite
B. An indicator light that shows where to point your antenna
C. A reflective surface on the satellite
D. A transmission from a satellite that contains status information

226

**T8B07 -- What is Doppler shift in reference to satellite communications?**

A. A change in the satellite orbit
B. A mode where the satellite receives signals on one band and transmits on another
C. An observed change in signal frequency caused by relative motion between the satellite and Earth station
D. A special digital communications mode for some satellites

227

**T8B09 -- What causes spin fading of satellite signals?**

A. Circular polarized noise interference radiated from the sun
B. Rotation of the satellite and its antennas
C. Doppler shift of the received signal
D. Interfering signals within the satellite uplink band

228

## T8B10 -- What is a LEO satellite?

A. A sun synchronous satellite
B. A highly elliptical orbit satellite
C. A satellite in low energy operation mode
D. A satellite in low earth orbit

229

# Satellite Operating

Tracking a Satellite.

- Satellite tracking program.
  - To be able to know when a satellite is above the horizon and what direction it is, you need to use a satellite tracking program.
  - The satellite tracking program will need to know the *Keplerian elements* for the satellite you want to track.
    - The Keplerian elements are a set of numbers that allow the tracking program to calculate the location of a satellite at any given time – past or future.

230

# Satellite Operating

## Tracking a Satellite.

- Satellite tracking program.
  - The Keplerian elements for a satellite are available on line.
    - Your satellite tracking program may be able to download then automatically.
  - Using the Keplerian elements, the tracking program will be able to display real-time maps of satellite locations, path trajectories, and even the amount of doppler shift.

231

# Satellite Operating

## Tracking a Satellite.

- Satellite tracking program.
  - Examples of the many satellite tracking programs are:
    - SatScape.
    - Orbitron.
    - SatPC32.
  - Even available for SmartPhones.

232

**T8B03 -- Which of the following are provided by satellite tracking programs?**

A. Maps showing the real-time position of the satellite track over the earth
B. The time, azimuth, and elevation of the start, maximum altitude, and end of a pass
C. The apparent frequency of the satellite transmission, including effects of Doppler shift
D. All of these choices are correct

233

**T8B06 -- Which of the following are inputs to a satellite tracking program?**

A. The weight of the satellite
B. The Keplerian elements
C. The last observed time of zero Doppler shift
D. All of these choices are correct

234

# Satellite Operating

Operating via Satellites.

- The satellite operating mode denotes the uplink & downlink frequency bands.
  - The mode consists of a pair of letters.
    - 1st letter = uplink frequency band.
    - 2nd letter = downlink frequency band.
    - e.g. - Mode U/V means 70cm uplink & 2m downlink.

235

# Satellite Operating

Operating via Satellites.

- Satellite Operating Mode Designators.

| Designator | Band |
|---|---|
| H | 15m (21.0 MHz to 21.45 MHz)<br>10m (28.0 MHz to 29.7 MHz) |
| V | 2m (144 MHz to 146 MHz) |
| U | 70cm (435 MHz to 438 MHz) |
| L | 23cm (1.26 GHz to 1.2 GHz) |
| S | 13cm (2.4 GHz to 2.45 GHz) |
| C | 5cm (5.8 GHz) |
| X | 3cm (10.45 GHz) |
| K | 1.2cm (24 GHz) |

236

# Satellite Operating

Operating via Satellites.

- There are three main types of satellites:
  - FM repeaters.
  - Linear transponders.
  - Digital store-and-forward.
- Between the three types of satellites, nearly all operating modes can be sent using satellites.
  - FM, SSB, CW, & data.

237

# Satellite Operating

Operating via Satellites.

- The satellite beacon is a signal transmitted by the satellite with information about the health and status of the satellite.
  - Beacon sends data via:
    - CW (most common).
    - RTTY.
    - Packet.
  - You can tell when a satellite is in range by listening for its beacon.

238

# Satellite Operating

Operating via Satellites.

- How much power should I use?
  - FCC rules say always use the minimum power necessary to make the desired contact.
  - Too little power and you may not be heard.
  - Too much power and the signals from other users can be blocked.
  - If your received signal from the satellite is about the same strength as the satellite beacon, you are using the right amount of power.

239

**T8B01 -- What telemetry information is typically transmitted by satellite beacons?**

A. The signal strength of received signals
B. Time of day accurate to plus or minus 1/10 second
C. Health and status of the satellite
D. All of these choices are correct

240

**T8B02 -- What is the impact of using excessive effective radiated power on a satellite uplink?**

A. Possibility of commanding the satellite to an improper mode
B. Blocking access by other users
C. Overloading the satellite batteries
D. Possibility of rebooting the satellite control computer

241

**T8B04 -- What mode of transmission is commonly used by amateur radio satellites?**

A. SSB
B. FM
C. CW/data
D. All of these choices are correct

242

**T8B08 -- What is meant by the statement that a satellite is operating in U/V mode?**

A. The satellite uplink is in the 15 meter band and the downlink is in the 10 meter band
B. The satellite uplink is in the 70 centimeter band and the downlink is in the 2 meter band
C. The satellite operates using ultraviolet frequencies
D. The satellite frequencies are usually variable

243

**T8B011 -- Who may receive telemetry from a space station?**

A. Anyone who can receive the telemetry signal
B. A licensed radio amateur with a transmitter equipped for interrogating the satellite
C. A licensed radio amateur who has been certified by the protocol developer
D. A licensed radio amateur who has registered for an access code from AMSAT

244

**T8B012 -- Which of the following is a way to determine whether your satellite uplink power is neither too low nor too high?**

A. Check your signal strength report in the telemetry data
B. Listen for distortion on your downlink signal
C. Your signal strength on the downlink should be about the same as the beacon
D. All of these choices are correct

245

# Questions?

246

# Technician Class

# Next Week

## Chapter 7

## Licensing Regulations

247