Technician Class Course

Session 1

ARRL The national association for AMATEUR RADIO

WHAT IS AMATEUR RADIO?

ARRL The national association for AMATEUR RADIO

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.

ARRL The national association for AMATEUR RADIO

A true story…

Indian amateur radio operator, Bharathi VU2RBI, demonstrates Amateur Radio to local students in Port Blair, Andaman Islands, a few days before the 2004 Indian Ocean earthquake.

http://www.hamradio.in/forum/viewtopic.php?p=7556

ARRL The national association for AMATEUR RADIO

"OLE VIRGINIA HAMS"
AMATEUR RADIO CLUB INC.
MANASSAS VIRGINIA
W4OVH
WORLDWIDE FRIENDSHIP THROUGH AMATEUR RADIO

What Do Hams Do?

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

ARRL The national association for AMATEUR RADIO

What Makes Ham Radio Different?

- There are many unlicensed radio services available.
- Ham radio is authorized:
  - Less 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.

ARRL The national association for AMATEUR RADIO

With More Privileges Comes More 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.

ARRL The national association for AMATEUR RADIO

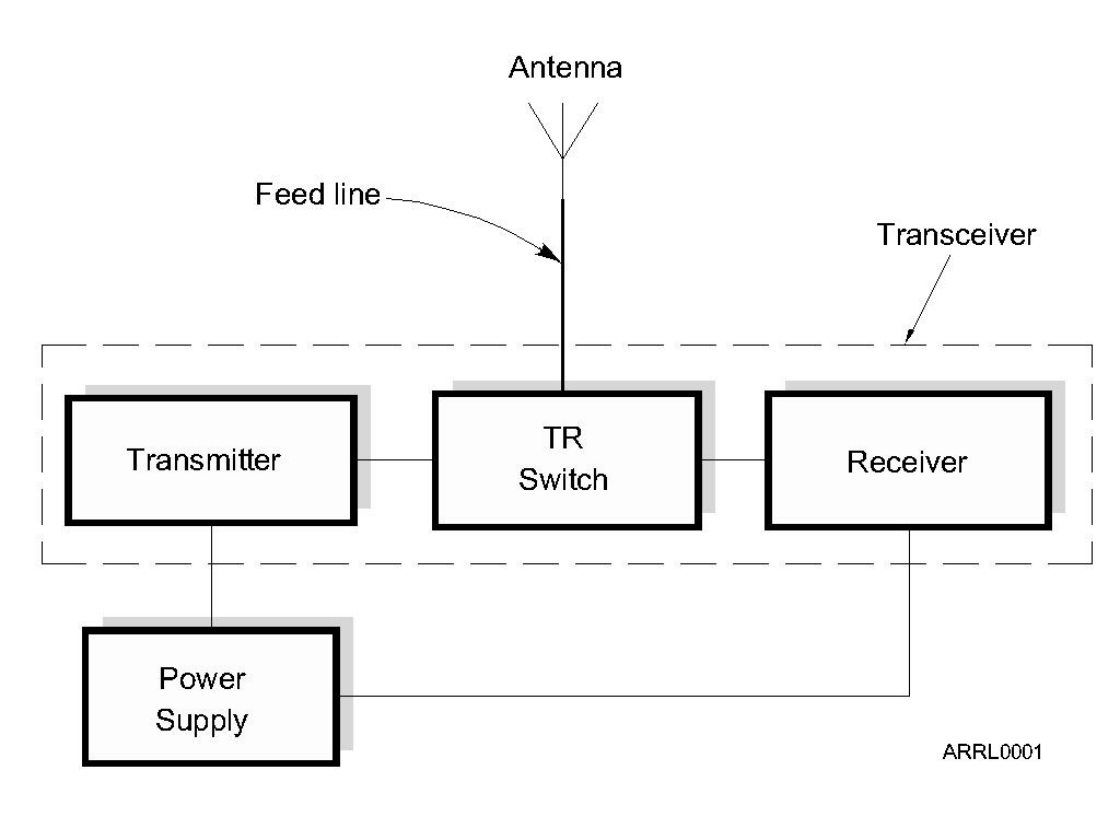
EQUIPMENT DEFINITIONS

ARRL The national association for AMATEUR RADIO

Basic Station Organization

- Station Equipment
  - Receiver
  - Transmitter
  - Antenna
  - Power Supply
- The Transceiver
- Accessory Station Equipment

The Basic Radio Station



ARRL The national association for AMATEUR RADIO

The Receiver and Controls

- Main tuning dial for received frequency (or channel) selection.
- Frequency display.
- Volume control.
- Other accessory controls for mode (kind of information to process), filters (to mitigate interference), etc.

The Transmitter and Controls

- Main tuning dial for transmitted frequency (or channel) selection.
- Frequency display.
- Power control (transmitted signal strength).
- Other accessory controls for mode (kind of information to process), etc.

The Transceiver

- Transceiver = **Trans**mitter + Re**ceiver**
- Most modern transmitters and receivers are combined in one unit – called a transceiver.
  - Saves space
  - Reduces cost
- Many common controls and electronic circuits are shared in the transceiver.

Antenna

- The antenna exposes your station to the world.
  - Facilitates the radiation of your signal into space (electromagnetic radiation).
  - Intercepts someone else's signal.
- Most times the transmitting and receiving antenna are the same antenna.
- Connected to your station by a connecting wire called a feed line.

Transmit/Receive (TR) Switch

- If the station antenna is shared between the transmitter and receiver, the TR switch allows the antenna to be switched to the transmitter when sending and to the receiver when receiving.
  - In a transceiver, this TR switch is inside the unit and requires no attention by the operator.

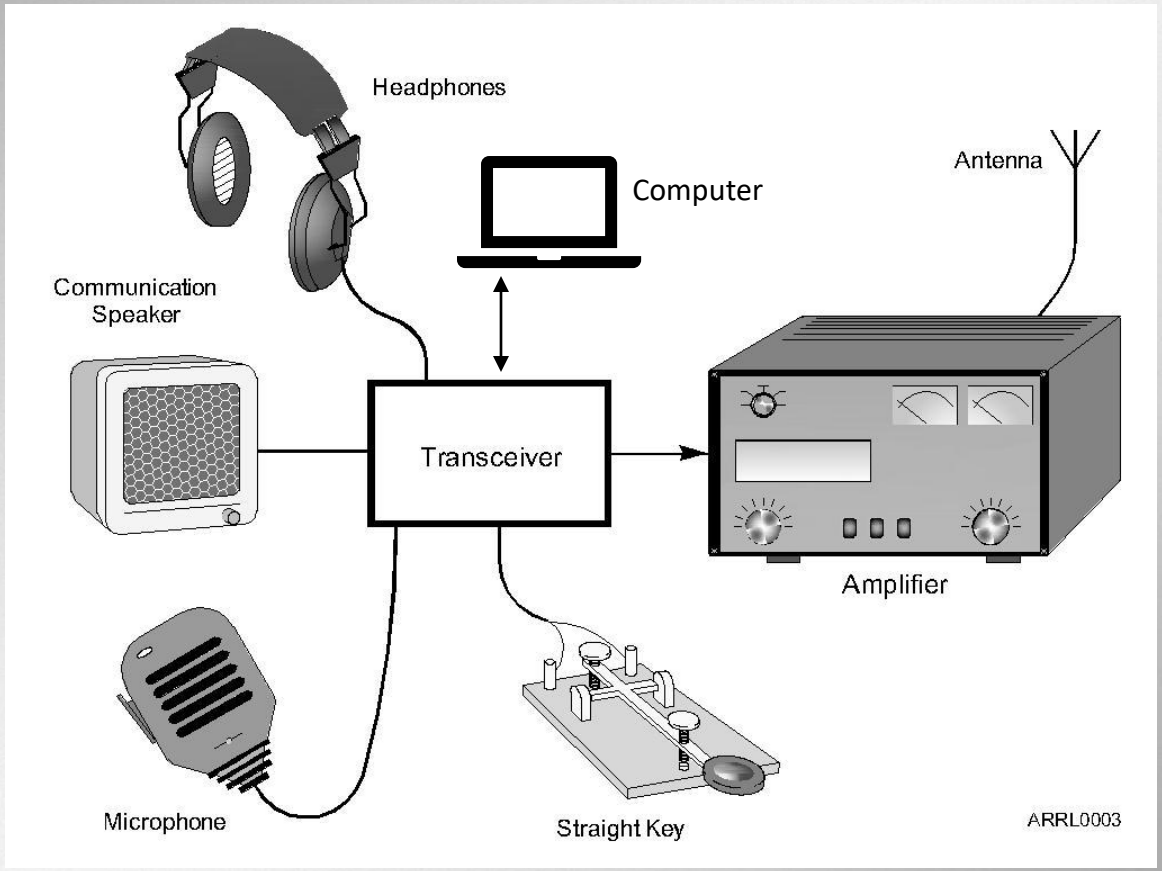
Power Supply

- Your radio station needs some sort of power to operate.
  - Battery
  - Household current converted to proper voltage
  - Alternative sources

Basic Station Accessories

- Human interface accessories:
  - Microphones
  - Speakers
  - Earphones
  - Computer
  - Morse code key
  - TV camera
  - Etc.
- Station performance accessories:
  - Antenna tuner
  - SWR meter (antenna match checker)
  - Amplifier
  - Antenna rotator (turning antenna)
  - Filters
  - Etc.

Accessory Equipment



ARRL The national association for AMATEUR RADIO

REPEATERS

ARRL The national association for AMATEUR RADIO

A Little Vocabulary First

- Simplex
  - Transmitting and receiving on the same frequency.
  - Each user takes turns to transmit.
  - Is the preferred method if it works.

A Little Vocabulary First

- Duplex
  - Transmitting on one frequency while simultaneously listening on a different frequency.
  - Repeaters use duplex.
  - Output frequency – the frequency the repeater transmits on and you listen to.
  - Input frequency – the frequency the repeater listens to and you transmit on.

Repeaters

- Repeaters are automated stations located at high places that receive and then retransmit your signal – simultaneously.
  - Dramatically improves range (compared to line-of-sight communications)
  - Satellites are repeaters, too!
- The basic components of a repeater are the same as your station: receiver, transmitter, antenna and power supply.

ARRL The national association for AMATEUR RADIO

Repeaters

- But, repeaters are transmitting and receiving at the same time using the same antenna.
- This requires a very high quality and specialized filter to prevent the transmitted signal from overpowering the receiver.
- This specialized filter is called a duplexer.

Repeater Duplexer

Four-cavity Duplexer

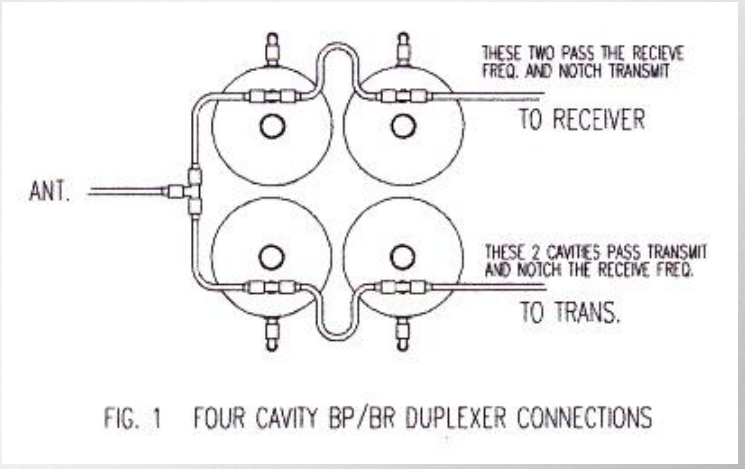


FIG. 1 FOUR CAVITY BP/BR DUPLEXER CONNECTIONS

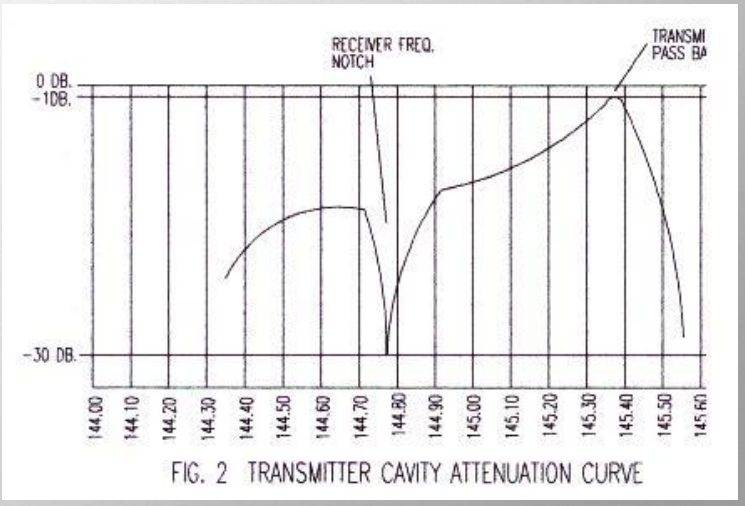
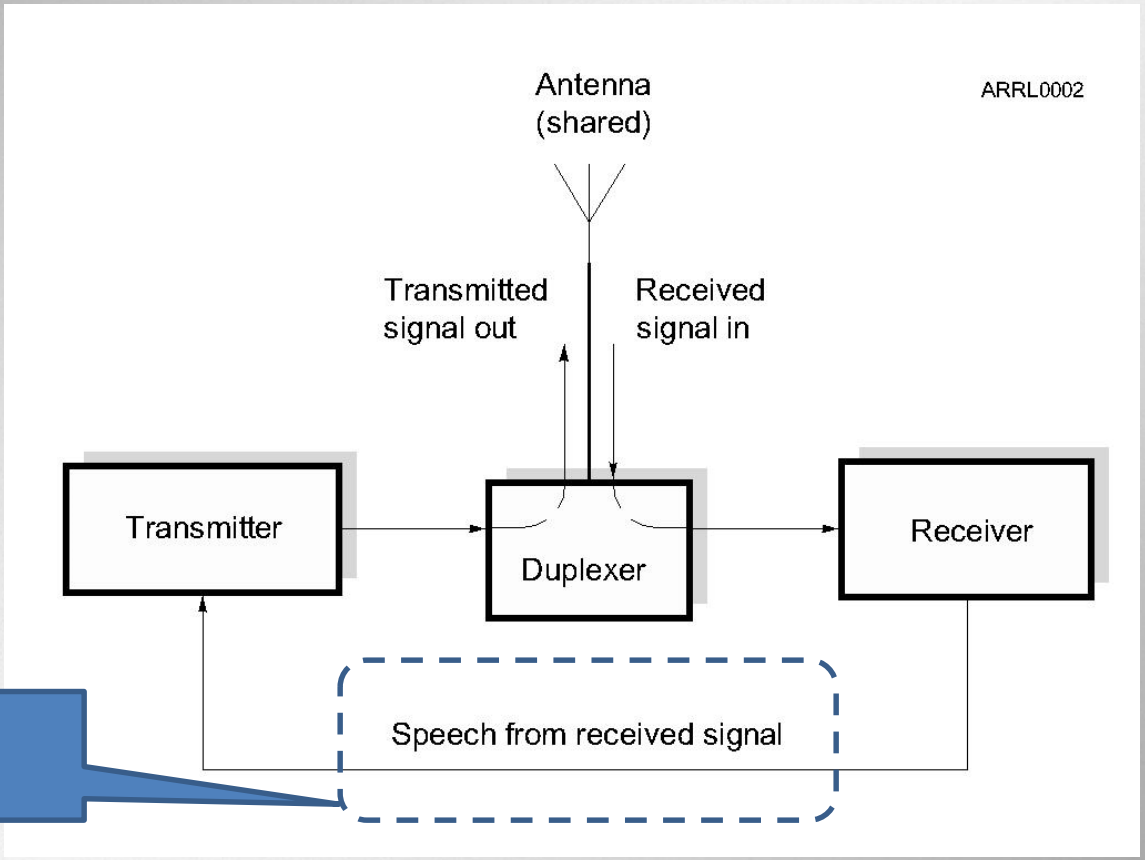


FIG. 2 TRANSMITTER CAVITY ATTENUATION CURVE

ARRL The national association for AMATEUR RADIO

Repeater



ARRL The national association for AMATEUR RADIO

Repeater Controller

- Computer that controls the repeater operation.
  - Station identification (Morse code or synthesized voice).
    - Same ID requirements as you have. (every 10 minutes)
  - Time-out protection.
    - Sometimes called the “alligator.”
    - Protects against continuous transmission in the event of a stuck PTT or long-winded hams. (typically 3 minutes)
  - Courtesy tone – repeater time-out timer reset.

Repeater Signal Flow

Handheld A

146.37 MHz

146.97 MHz

Repeater

146.97 MHz

146.37 MHz

Handheld B

ARRL The national association for AMATEUR RADIO

Typical Repeater Directory Information

- Output frequency.
- Frequency split.
  - and therefore the input frequency.
- Repeater access tones (if any).

Freq.	Location	Area	Site Name	Call	Sponsor	CTCSS
§ 145.19(–)	Salt Lake	WasFrnt	Little Farnsworth Questar	W7IHC		123.0
§ 145.21(–)	Salt Lake	WasFrnt	State Capitol	AA7JR	UVHFS	None

ARRL The national association for AMATEUR RADIO

"OLE VIRGINIA HAMS" AMATEUR RADIO CLUB INC. MANASSAS VIRGINIA W4OVH WORLDWIDE FRIENDSHIP THROUGH AMATEUR RADIO

Repeater Output Frequency

- Repeaters are frequently identified by their output frequency.
  - "Meet you on the 146.97 machine."
    - Here the specific frequency is used.
  - "Let's go to 97."
    - Here an abbreviation for a standard repeater channel is used meaning 146.97 MHz.
  - "How about the OVH repeater?"
    - Here the repeater is referenced by the sponsoring club name.

ARRL The national association for AMATEUR RADIO

"OLE VIRGINIA HAMS"
AMATEUR RADIO CLUB INC.
MANASSAS VIRGINIA
W4OVH
WORLDWIDE FRIENDSHIP THROUGH AMATEUR RADIO

Repeater Frequency Split

- The split, shifts, or offset frequencies are standardized to help facilitate repeater use.
- There are + and – shifts depending on the plan.
- Different bands have different standardized amounts of shift.

Table 3-2
Standard Repeater Offsets by Band

Band	*Offset*
10 Meters	–100 kHz
6 Meters	Varies by region: –500 kHz, –1 MHz, –1.7 MHz
2 Meters	+ or -600 kHz
1.25 Meters	–1.6 MHz
70 cm	+ or -5 MHz
902 MHz	12 MHz
1296 MHz	12 MHz

ARRL The national association for AMATEUR RADIO

Repeater Access Tones

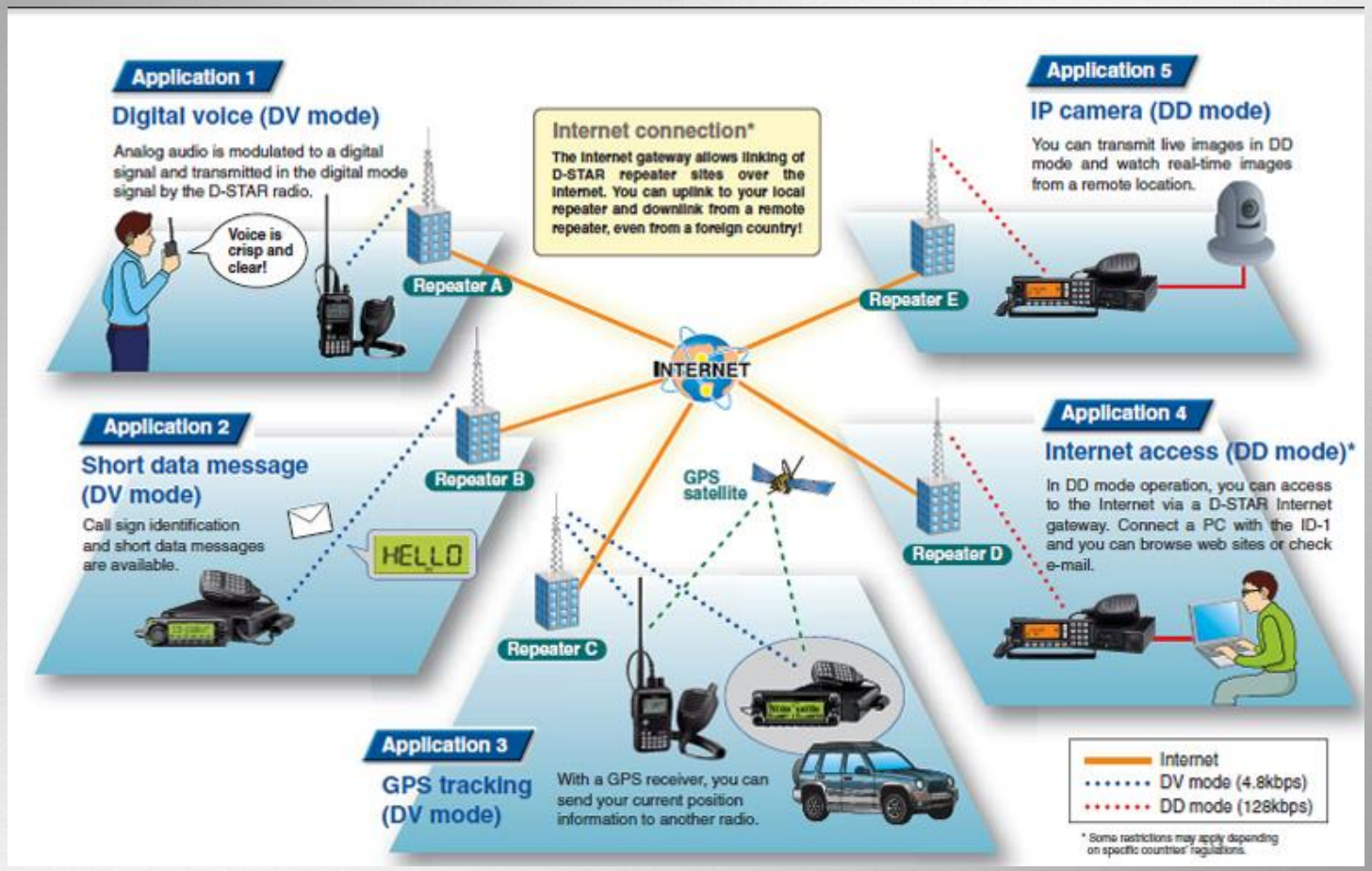
- Sometimes multiple repeaters can be accessed at the same time unintentionally.
- To preclude unintentional access, some repeaters require a special sub-audible tone to be present before the repeater controller will recognize the signal as a valid signal and turn on the repeater.
- These tones are called by various names (depending on equipment manufacturer).
  - CTCSS (Continuous Tone Coded Squelch System)
  - PL (Private Line)
  - Privacy codes or tones

ARRL The national association for AMATEUR RADIO

Repeater Access Tones

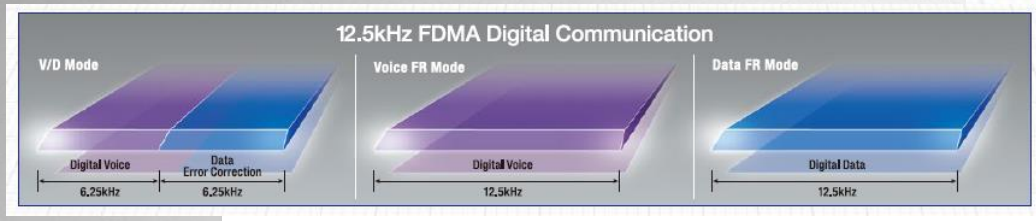
- Access tones are usually published along with repeater frequencies.
- Could also be announced when the repeater identifies.
  - "PL is 123.0"
- Tones are generally programmed into the radio along with frequency and offset.

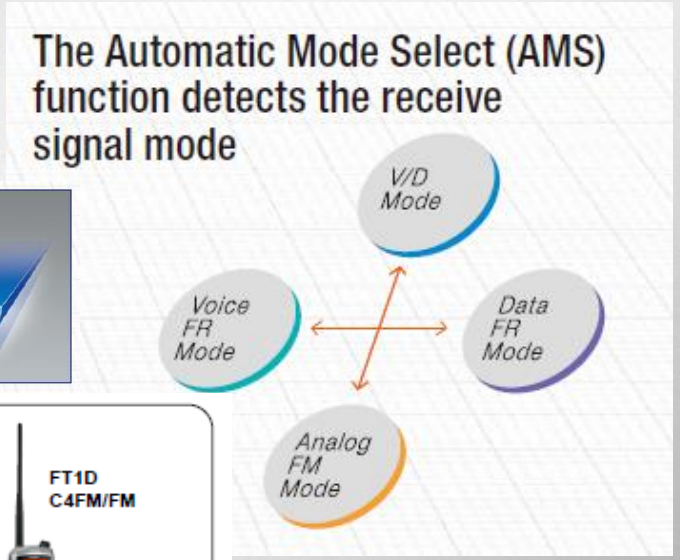
D-STAR Repeater Signal Flow

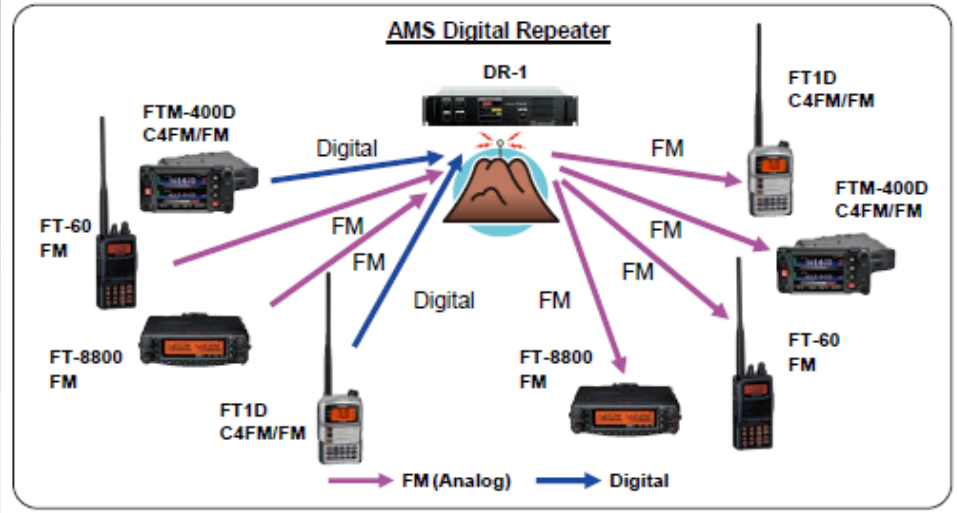


ARRL The national association for AMATEUR RADIO

FUSION Repeater Signal Flow







ARRL The national association for AMATEUR RADIO

DATA MODES

ARRL The national association for AMATEUR RADIO

Data Modes

- Connecting computers via ham radio.
  - Some systems use radio to connect to Internet gateways.
- The bulk of the work is done by specialized modems or computer software/sound card.
  - Terminal Node Controller (TNC).
  - Multiple Protocol Controller (MPC).

Data Modes

- Keyboard-to-keyboard Modes
  - Packet Radio
  - Winlink 2000 (email-like application)
  - D-RATS (for D-STAR data)
  - Mesh Networks (AREDN, etc.)

Packet TNC – MPC

- Provide digital interface between computer and radio.
  - Package the data into proper format.
  - Convert digital data into audio tones representing 1s and 0s of digital data.
  - Send/receive tones to transceiver.
  - Control the transceiver.

Packet TNC and MPC

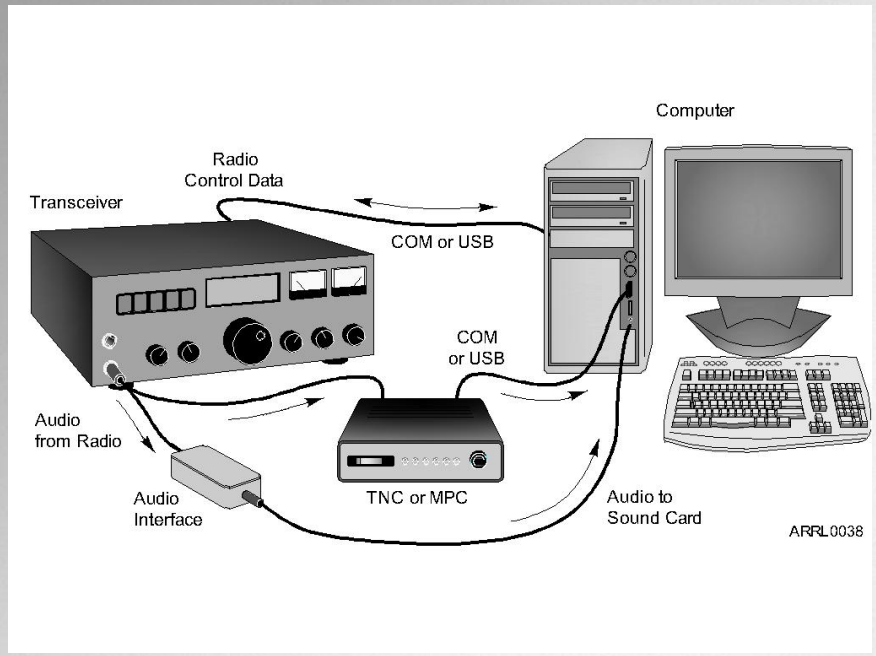
TNC

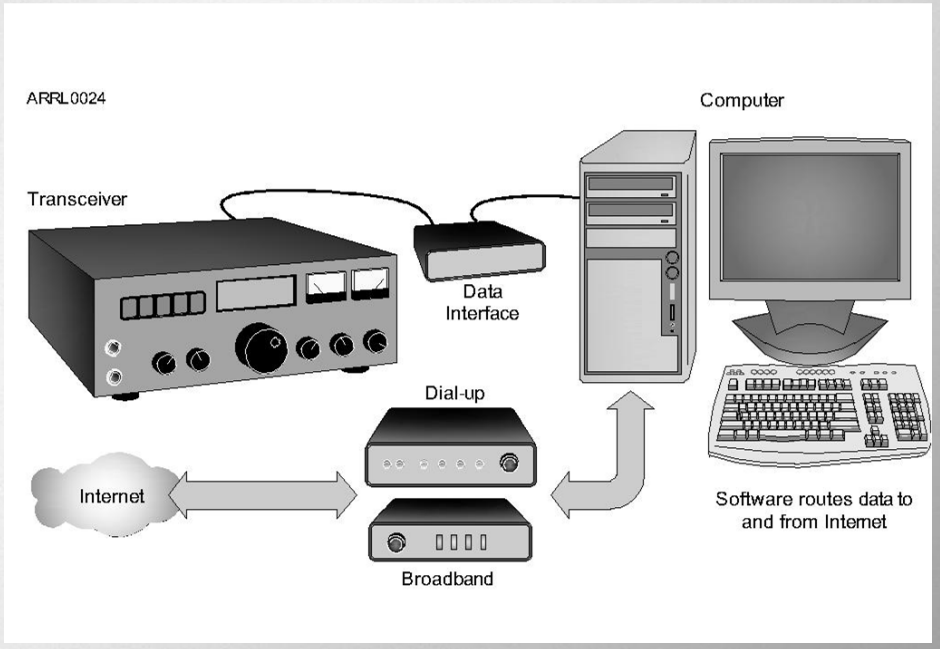
MPC

ARRL The national association for AMATEUR RADIO

"OLE VIRGINIA HAMS"
AMATEUR RADIO CLUB INC.
MANASSAS VIRGINIA
W4OVH
WORLDWIDE FRIENDSHIP THROUGH AMATEUR RADIO

Data Station Setup

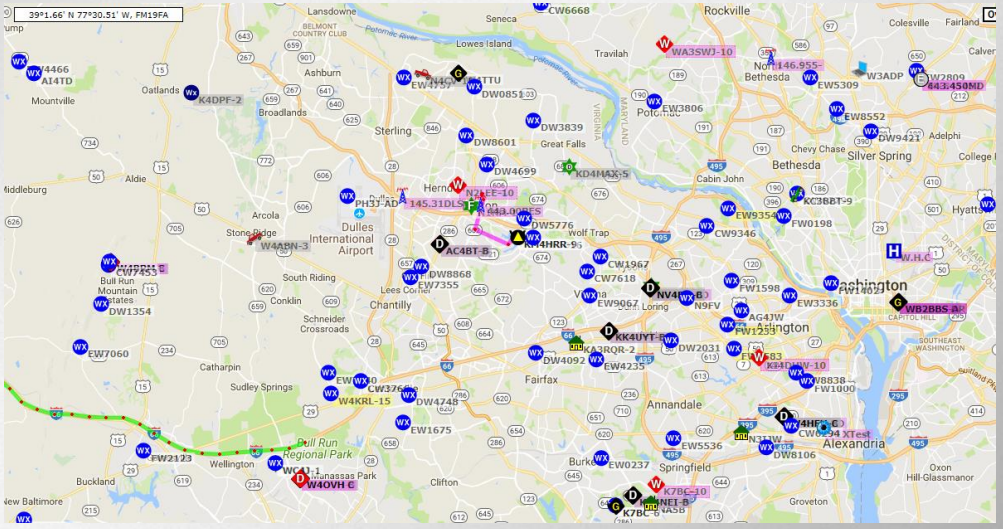




ARRL The national association for AMATEUR RADIO

APRS

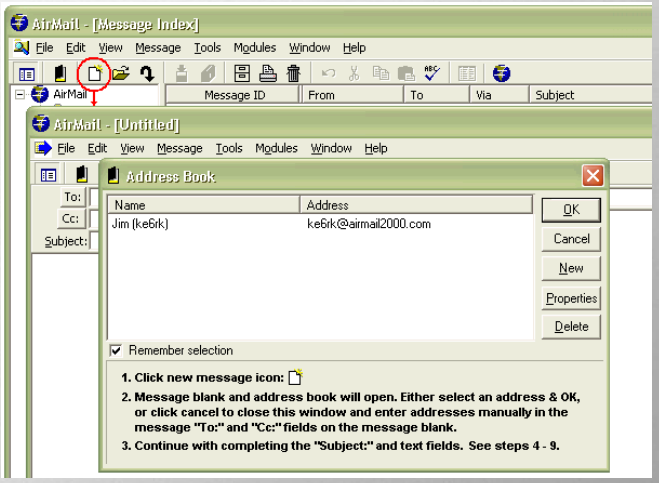
- Automatic Packet Reporting System
- GPS + Packet Radio + Computer
- Position reporting and tracking, weather, etc.



ARRL The national association for AMATEUR RADIO

Winlink

- Packet Radio + Application Software (RMS Express)
- Email-like functionality
- Radios linked to internet-hosted email servers



ARRL The national association for AMATEUR RADIO

Mesh Networking

AREDN™
AMATEUR RADIO EMERGENCY DATA NETWORK

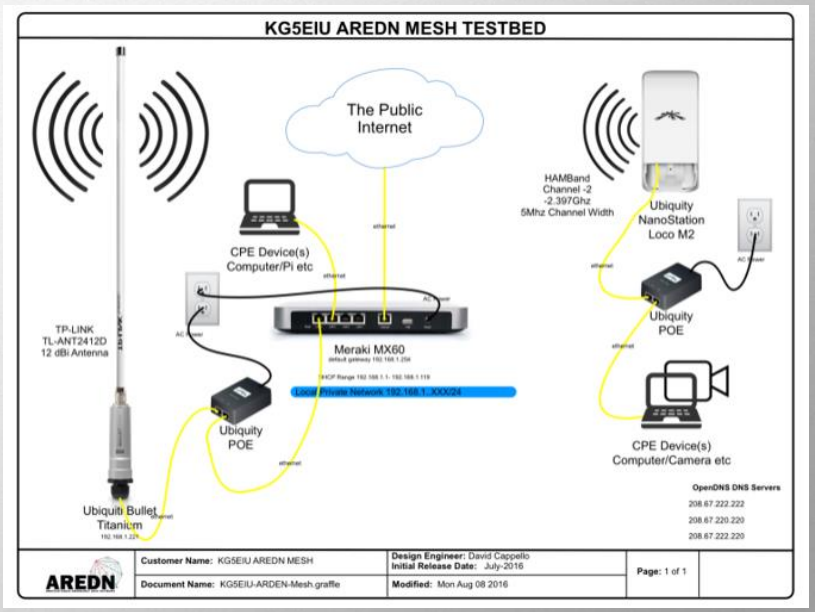
Search

Amateur Radio Emergency Data Network

Login | Register

Broadband-Hamnet™
HSMM-MESH™

High-speed networking using "repurposed" commercial WiFi equipment operating in the ham bands



ARRL The national association for AMATEUR RADIO