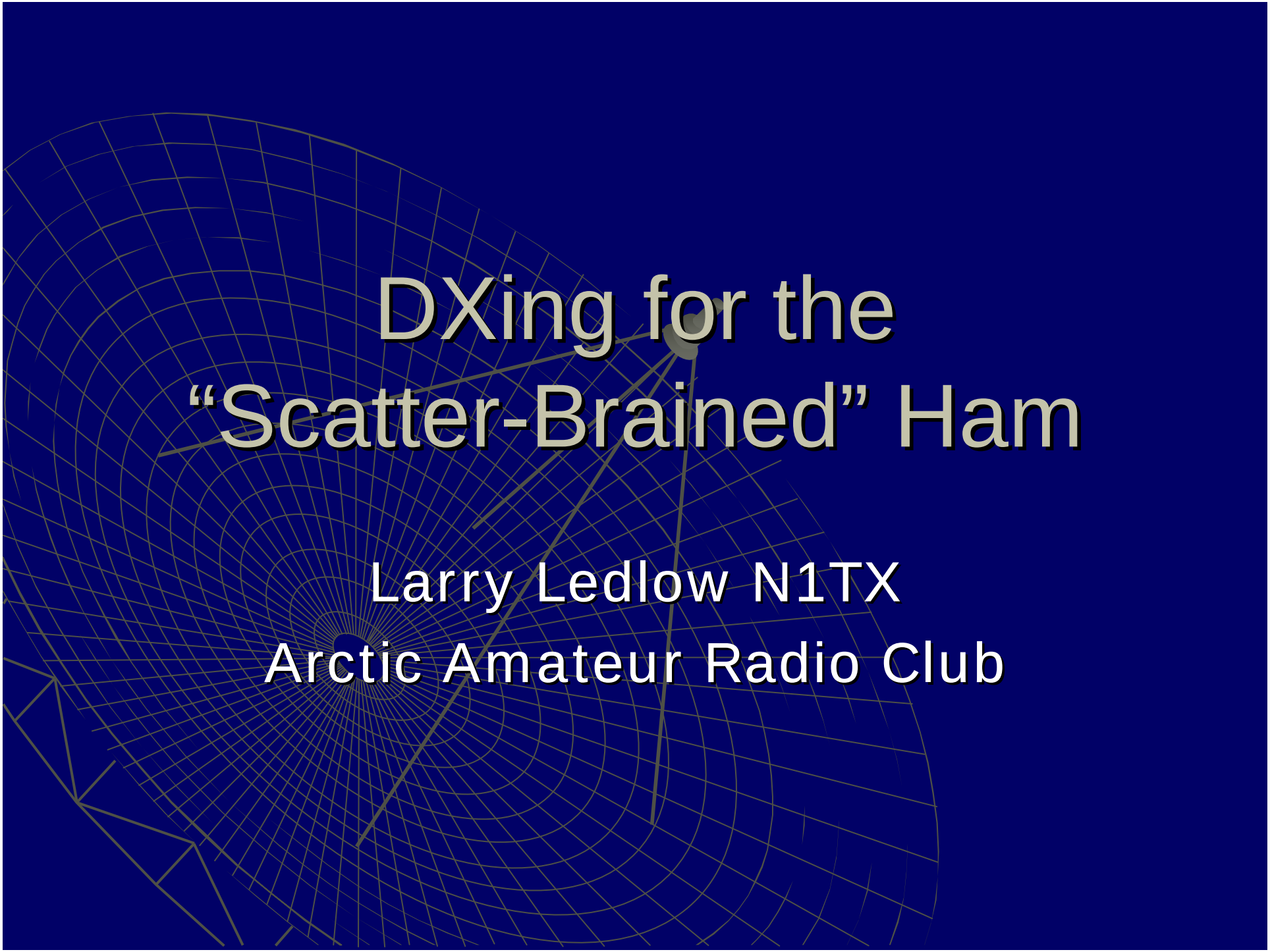
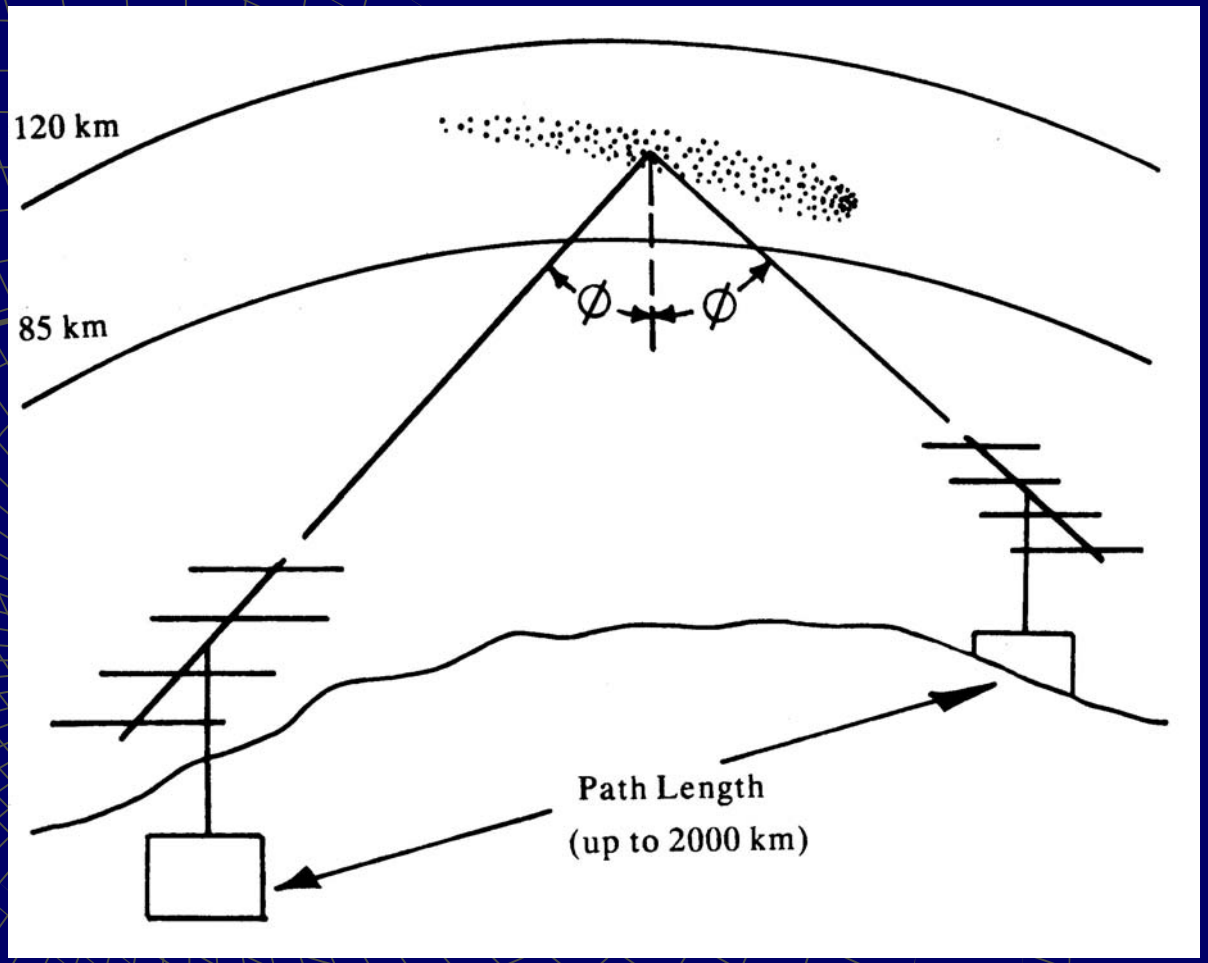


DXing for the "Scatter-Brained" Ham

Larry Ledlow N1TX
Arctic Amateur Radio Club

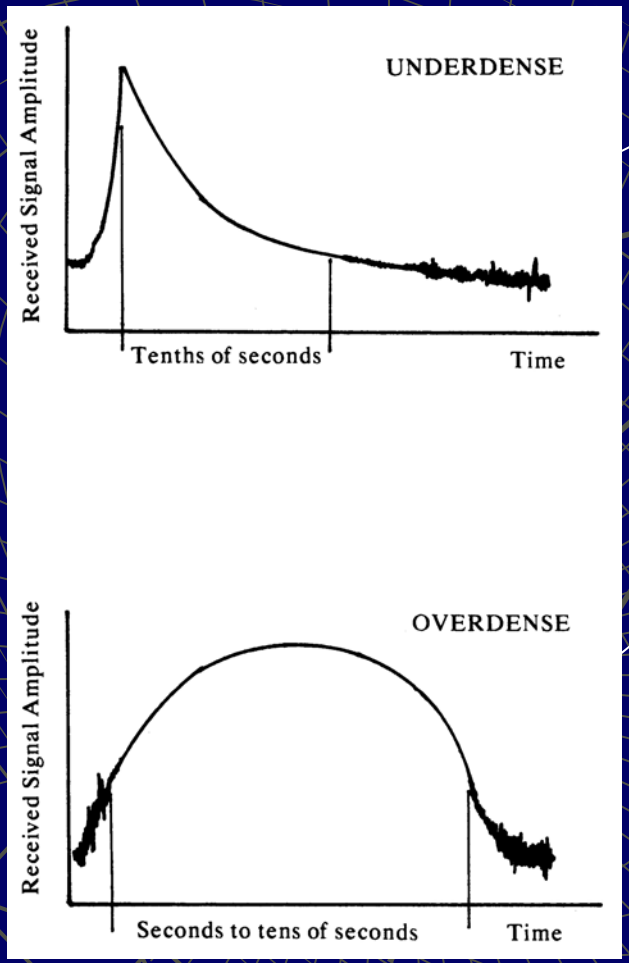
Meteor Burst (or Scatter)



Meteor Burst

- About 1 trillion particles enter the earth's atmosphere each day traveling 10-75 km/second
- Energy is converted to heat, and vaporized atoms create ionized trail.
- Shape is long, thin paraboloid
- Duration trail will support comms depends on intensity (size and speed of meteor) as well as frequency used.

Meteor Burst



Most common from small meteors. Use for data and high-speed CW

Meteor showers bring larger meteors. Voice possible with longer bursts.

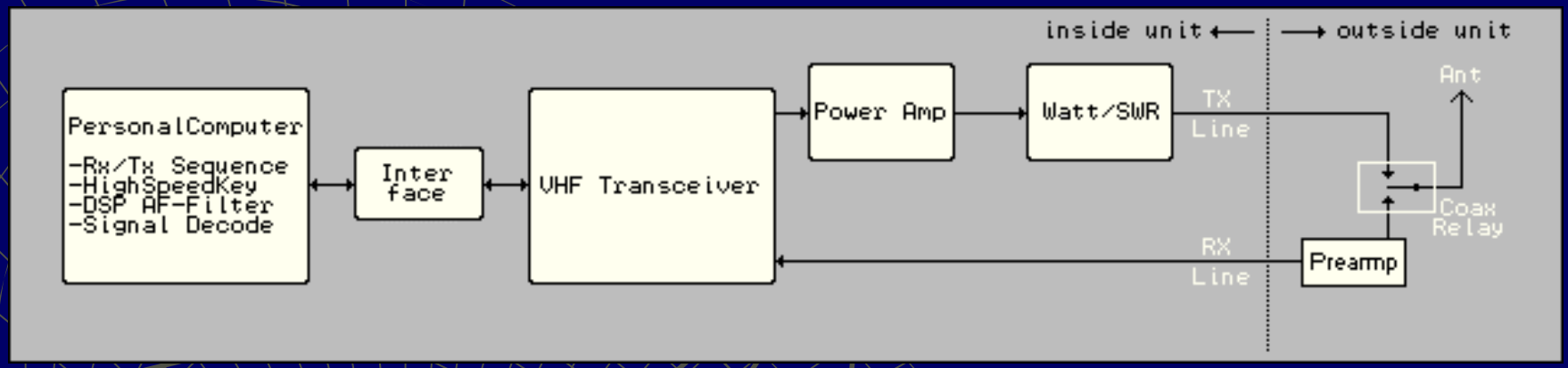
Meteor Burst

- Alaskan Meteor Burst Communication System became operational in 1977
- Used by five federal agencies
  - BLM: Contact with remote survey teams.
  - National Weather Service: Contact with remote weather stations.
  - Soil Conservation Service: Snow pack monitoring.
  - USGS: River monitoring
  - US Army Corps of Engineers: Environmental data from the system.
- USAF also used MBC for remote radar data

Meteor Burst

- Commercial systems operate 30-50 MHz.
- Six meters well-suited, but 144 MHz also successful during meteor showers
- Multiple modes supported
  - High-speed CW (800-1200 wpm!)
  - Data (FSK441, JT6M)
  - Voice only on long-duration bursts
- Specialized protocols for calling and signal reporting
- Scheduled QSOs can be completed in about 30 mins

Meteor Burst



- PC and soundcard interface
- Medium to high-gain antenna with low-noise pre-amp
- Typical 100-150W on 6m with 4- or 5-element yagi

Meteor Burst

- http://www.uksmg.org/deadband.htm (6m MBC how-to)
- http://www.qsl.net/w8wn/hscw/papers/hscw-sop.html (Operating procedures)
- http://pulsar.princeton.edu/~joe/K1JT/index.htm (K1JT software)
- http://www.kolumbus.fi/oh5iy/mssoft/mssoft.html (MS-Soft by OH5IY)

Troposcatter

- Are you a FM-er and stick to a local repeater or local simplex?
- **How would you like to have a range of 3-400 km** on 2 meter or 70 cm with simple equipment?!?
- With 10W SSB on 144 MHz and a 10 dB horizontal antenna, the range on troposcatter is over 300 km!
- With 100W SSB and a 15 dB antenna in the clear, **you can make contacts over 500 km anytime!**
- Troposcatter works from 50 MHz to over 10 GHz!

Tropospheric Scatter

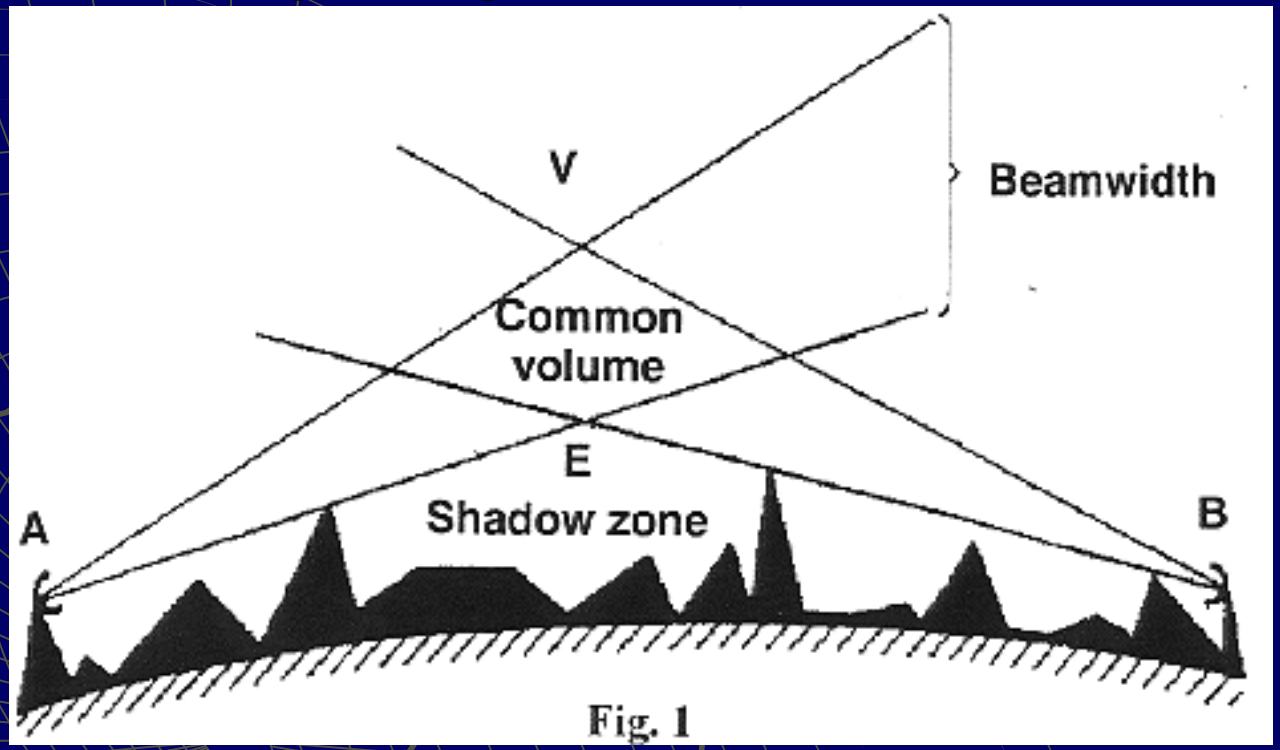


Fig. 1

- Uses atmospheric turbulence to scatter radio signals, some of which is directed to over-the-horizon stations. Path distance ~700 km.

Troposcatter

- Troposcatter is always there 365 days and nights a year
- Signal strength is reliable
  - Signal strength often +10 dB during summer or high pressure
  - Path loss increases at about 10 dB per 100 km up to 500 km and somewhat more slowly at the longer distances
- The scatter angle should be as small as possible,
  - Each degree of scatter angle costs 9-12 dB in signal strength
- Polarization of the transmitted signal is well preserved

Troposcatter

The military used troposcatter for decades before satellite communications were commonly possible. In Alaska, 120' White Alice Communications System antennas were large "signposts" across the bush from 1956 until about 1979.

Troposcatter

- But <u>you</u> don't need massive 120-foot billboard antennas to use this propagation mode.

	Commercial interest	**Amateur interest**
Range	2-400 km	4-800 km for real DX.
Reliability	Over 99,9% wanted	Less than 50% OK for a marginal QSO.
Fading	Reduces bandwidth or bit flow	Only fast fading >50 Hz may degrade intelligence. Slow fading may give QSO in up periods.
Bandwidth	Large, 15-60 phone channels	Small, SSB= 2 kHz, CW=100 Hz
Location	Choose "the best QTH" and pay for it...	Home is home, choosing a good QTH is only possible for portable operation.
Enhanced propagating conditions	Unwanted; interference problems	Wanted; means more QSO's

Troposcatter

- Terrain and antenna height are very important
- Flat or downward-sloping preferred
- Main antenna lobe should point close horizon
  - Easier For 144 and 432 MHz than for 50 MHz
  - 10m antenna height: @ 432 MHz = 1º, 144 MHz = 3º, 50 MHz = 9 º elevation angle
- A downward slope will give lower angle of radiation.

Troposcatter

- Troposcatter will support 144 MHz to over 10 GHz.
- 70 cm may have greater range than 2m
  - Lower noise level in the sky means you can take better advantage of a low-noise preamplifier in your 70 cm receiver
  - Greater path loss is compensated by a larger antenna gain, given the same physical dimensions of the antenna
- Troposcatter gives you >300 km range day and night all year round with 10W SSB + beam.

Troposcatter

- http://www.dxzone.com/cgi-bin/dir/jump2.cgi?ID=5936 (Intro by OZ1RH)
- http://www.grantronics.com.au/docs/StkYagis.pdf (How to stack antennas for more gain)
- http://www.directivesystems.com/ (High-gain antennas and accessories for VHF-microwave)
- http://www.arcticflash.com/ (White Alice history, photos, stories)

Precipitation Scatter

- The range of frequencies between about 2 and 10 GHz has very low noise.
  - Man made noise is pretty rare (except from other microwave uses),
  - Almost no static noise from spark sources, and galactic noise is fairly low.
- Microwave interaction with small objects makes for interesting propagation.

Precipitation Scatter

- Tom Williams WA1MBA calls 10 GHz “A Rainy Day Band”
- Rain drops (and snow flakes) begin to scatter 10 GHz signals, because their size is a significant fraction of wavelengths
  - Rain droplets range in size from about 0.5 mm to 3 mm
  - The wavelength of 10 GHz signals is around 3 cm.
- Two stations pointing to a rain storm or snow squall can use scattered signals to communicate.

Precipitation Scatter

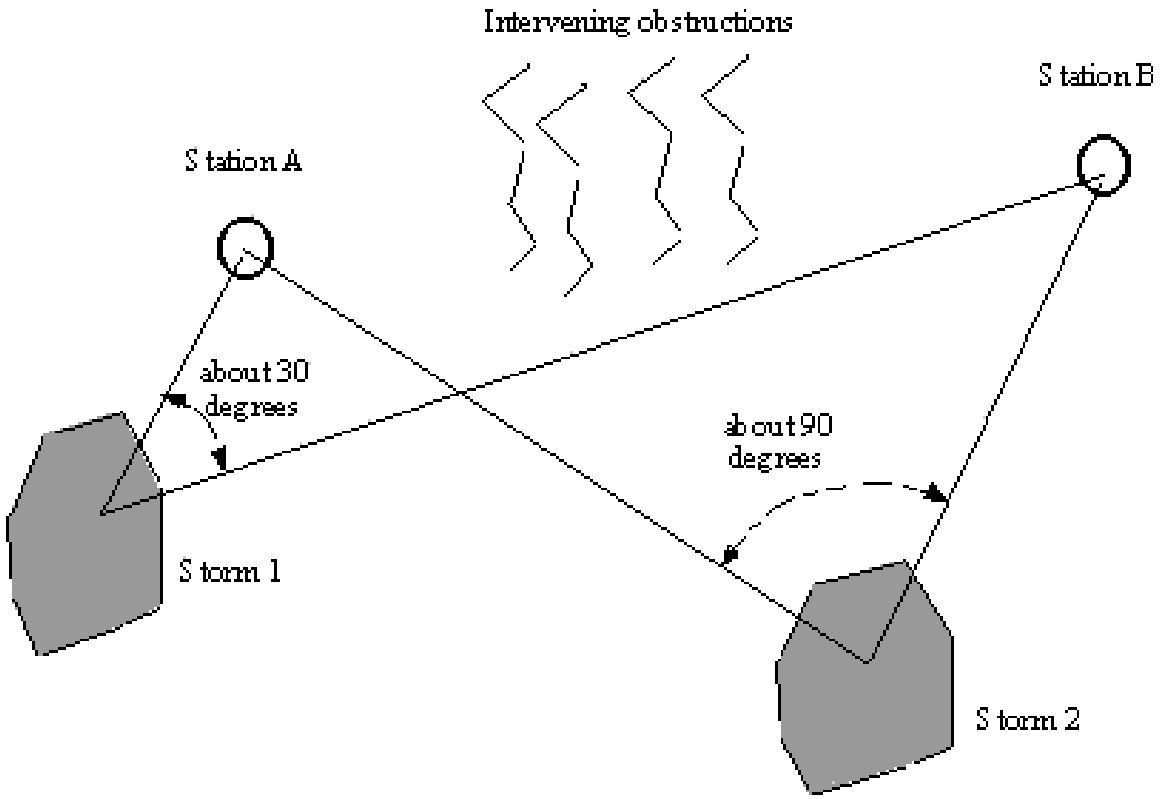


Figure 3. An example situation. The two stations are much more likely to communicate via storm 1 than storm 2 because storm 2 presents a 90 degree angle.

Precipitation Scatter

- One characteristic of precipitation scatter is Doppler shift of the signals.
- Each rain droplet or snowflake is moving in a different direction with a slightly different velocity
- The path length is changing, and the frequency is shifted.
- Usually, a CW note becomes quite "fuzzy"
- The sound is very much like Aurora propagation on 2 meters and can sound like strong noise.
  - Voice is nearly impossible to understand
  - A good excuse to learn CW or use software to decode

Precipitation Scatter

- http://www.wa1mba.org/10grain.htm (Detailed article on rain scatter)
- http://www.wa1mba.org/micros.htm (Intro to microwaves)
- http://members.ozemail.com.au/~tecknolt/10Ghz/10gpresent.htm (Getting Started on 10 GHz)
- http://www.downeastmicrowave.com/ VHF-microwave kits and antennas