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PROPAGATION

The Science of Predicting VHF-and-Above Radio Conditions

Bouncing VHF Signals Off "Shooting Stars"

Several times each year VHF enthusiasts are presented with the exotic operating opportunity created by shooting stars. The intense ionization caused by a meteor's demise as it burns its way into our atmosphere can be enough to reflect or refract VHF radio signals, making possible radio communication between two stations beyond line-of-sight, if only for a very short moment.

Reflecting VHF radio signals off meteor trails during one of the year's annual meteor showers is an activity that has been enjoyed for decades. Now new methods and techniques are being developed and explored using modern computing power. The newest tools even allow radio contact during periods outside the major meteor showers.

It is typical during major meteor showers for hundreds of two-way contacts (QSOs) to be made. I've even had the joy of making a few quick contacts between my meager station (a vertical mobile antenna tuned for 6 meters, with 100 watts on SSB) and stations up to two states away. This was accomplished during the *Leonids* meteor shower a few years ago. With the newest software tools, and with good equipment and a good antenna, along with prearranged schedules, many amateur radio weak-signal communicators make quite a few contacts all year long.

Most schedules in North America between VHF meteor-scatter DXers are for SSB QSOs. When using SSB, a 15-second sequence is standard, where the westernmost station calls first, and the rest of the minute is spent listening for the reply from the called station. Most often a QSO is completed on a long burn lasting several seconds. However, because most meteors only last from close to one-quarter second to a couple of seconds, there's usually not nearly enough time to get much information through on SSB.

This is overcome by using high-speed CW. If you tried to keep a 2-meter meteor scatter schedule with a station some 1000 miles away, you might hear five to ten short "pings" (a burst of radio propagation caused by the rapidly formed and short-lived meteor-trail ionization) lasting anywhere from a tenth of a second up to two seconds in length. A ping under a half of a second would be absolutely useless on sideband. Enter high-speed CW. With HSCW you could realize a speed of 2000 letters per minute (2000 lpm). In that same half-of-a-second ping 16 letters could be propagated to the receiving station. That is enough for a complete exchange and signal report! High-speed CW is more commonly called high-speed meteor scatter, or HSMS.

To ensure that only one station is transmitting at a time during a schedule, HSMS stations in North America transmit on alternate minutes. Typically, the westernmost station transmits on the even-numbered minutes while the easternmost station transmits on the odd-numbered minutes. During a minute, a meteor may fly between the two stations and briefly reflect a VHF radio signal. The QSO is completed when both stations have heard each other's callsign, a signal report (or some other piece of information), and the final "Roger." On 2 meters schedules usually last a half hour to one hour. I'll dig deeper into this mode later on in the column.

Meteor Scatter Mode

Meteors are particles (debris from a passing comet) ranging in size from a speck of dust to a small pebble, and some move slowly while some move fast. When you view a meteor you typically see a streak that persists for a little while after the meteor vanishes. This "streak" is called the "train" and is basically a trail of glowing plasma left in the wake of the meteor. Meteors enter Earth's atmosphere traveling at speeds sometimes well over 158,000 miles per hour. The trains can last from several seconds to several minutes.

Meteor-scatter propagation is a mode where radio signals are refracted off these trains of ionized plasma. The ionized trail is produced by vaporization of the meteor. Meteors no larger than a pea can produce ionized trails up to 12 miles in length in the *E* layer of the ionosphere. Because of the height of these plasma trains, the range of a meteor-scatter contact is between 500 and 1300 miles. The frequencies that are best refracted are between 30 and 100 MHz. However, with the development of new software and techniques, frequencies up to 440 MHz have been used to make successful radio contacts off these meteor trains. On the lower frequencies, such as on 6 meters, contacts may last from mere seconds to well over a minute. The lower the frequency, the longer the specific "opening" made by a single meteor train. A meteor train that supports a 60-second refraction on 6 meters might only support a 1-second refraction for a 2-meter signal. Special high-speed methods are used on these higher frequencies to take advantage of the limited available time.

A great introduction by Shelby Ennis, W8WN, on working meteor scatter is found at <http://www.amt.org/Meteor_Scatter/shelbys_welcome.htm>. OZ1RH wrote "Working DX on a Dead 50MHz Band Using Meteor Scatter," which is a great working guide <http://www.uksmg.org/deadband.htm>. W4VHF has also created a good starting guide at <http://www.amt.org/Meteor_Scatter/letstalk-w4vhf.htm>. Links to various groups, resources, and software are found at <http://www.amt.org/Meteor_Scatter/default.htm>.

Perseids Meteor Shower

One of the most reliable yearly meteor showers is the *Perseids*. This shower, like other meteor showers, is named after the constellation from which it first appeared to have come. The shower's constellation is Perseus, which is located near Cassiopeia. *Perseids* favor northern latitudes. Because of the way Comet Swift-Tuttle's orbit is tilted, its dust falls on Earth's Northern Hemisphere. Meteors stream out of the constellation Perseus, which is barely visible south of the equator.