Appendix F
Communications Information

Time Signals

Standard radio and audio frequency transmissions are made continuously by the Central Radio Propagation Laboratory, National Bureau of Standards, Washington, D.C., over stations WWV and WWVH. Both stations broadcast on 5, 10, and 15 MHz (15,000 kHz). Signals are sometimes weak in the mornings.

These broadcasts are interrupted at times for maintenance purposes. The standard audio frequencies are interrupted at two minutes before each hour, and every five minutes thereafter (e.g., 1958, 2003, 2008, etc.), resuming after an interval of two minutes. Thus, you can take a series of checks at, say, 2000, 2005, 2010 etc. During the two-minute intervals, Eastern Standard Time (GMT minus 5 hours or NZ time minus 17 hours) is announced by voice, and GMT time is signalled slowly in morse code. A 0.005-second pulse may be heard as a faint click every second, except for the 59th second of each minute; this gives a warning of the return of the audio tone exactly on the hour, 5 minutes past, 10 minutes past, etc.

The BBC's General Overseas Service also broadcasts its "six pips" time signal on the hour throughout the day, and is accurate to one tenth of a second. (The sixth pip marks the minutes, e.g., 2000, 2300 etc.) These can be picked up in the usual shortwave bands between 9.0 and 9.8 MHz, 11.6 and 12.1 MHz, and 15.0 and 15.5 Mhz.

Some Physical Impacts of HF and VHF Radio-Traffic Interference

Daylight:

Time of day impacts HF communications. Change in the zenith angle of the sun (the angle of the sun above the horizon) influences HF. When the zenith angle is greater, HF communications are generally better. Conversely, when the zenith angle of the sun is smaller, HF communications are generally not as good. Experience in the Antarctic has been that HF communications begin to deteriorate mid-to-late evening, local McMurdo time and are at their weakest during early morning hours, local McMurdo time. There is less variance in the angle of the sun over the horizon nearer the Poles.

Solar Flares and Sunspot Activity:

The ionosphere occasionally becomes disturbed as it reacts to certain types of solar activity. Solar flares are an example; these disturbances can affect radio communications in all latitudes. Scattering of radio power by ionospheric irregularities produces fluctuating signals (scintillation), and propagation may take unexpected paths.

At high-frequency (HF), and sometimes at very high-frequency (VHF), a sudden ionospheric disturbance (SID) of radio signals may appear as a short-wave fade (SWF). This disturbance may last from minutes to hours, depending upon the magnitude and duration of the flare.

Solar flares also create a wide spectrum of radio noise; at VHF (and under unusual conditions at HF) this noise may interfere directly with a wanted signal. The frequency (as in times of occurrence) with which a radio operator experiences solar flare effects will vary with the approximately 11-year sunspot cycle; more effects/interference occur during solar maximum (when flare occurrence is high) than during solar minimum (when flare occurrence is very low). A radio operator can experience great difficulty in transmitting or receiving signals during solar flares.

During times of increased sunspot activity, HF radio communications operate best at higher frequencies. During times of decreased sunspot activity, lower frequencies will provide better HF communications.

The peak of the solar max is predicted to occur sometime before 2002. The probability for severe magnetic storms may extend through 2005.

Energetic Particle Effects:

On rare occasions a solar flare will be accompanied by a stream of energetic particles (mostly protons and electrons). The more energetic protons, traveling at speeds approaching that of light, can reach Earth in as little as 30 minutes. These protons reach the upper atmosphere near the magnetic poles. The lower regions of the polar ionosphere then become heavily ionized, and severe HF and VHF signal absorption may occur. This is called a polar cap absorption (PCA) event. PCA events may last from days to weeks, depending upon the size of the flare and how well the flare site is magnetically connected to Earth. Polar HF radio propagation often becomes impossible during these events.

Geomagnetic Storm Effects:

Sufficiently large or long-lived solar flares and disappearing filaments (DSF) are sometimes accompanied by the ejection of large clouds of plasma (ionized gases) into interplanetary space. These plasma clouds are called coronal mass ejections (CME). A CME travels through the solar wind in interplanetary space and sometimes reaches Earth. This results in a world-wide disturbance of Earth’s magnetic field, called a geomagnetic storm. Another type of solar activity, known as coronal hole (CH) produces high-speed solar wind streams that buffet Earth’s magnetic field; geomagnetic storms that may be accompanied by ionospheric disturbances can result.

These ionospheric disturbances can have adverse affects on radio signals over the entire frequency spectrum, especially in auroral latitudes. In particular, HF radio operators attempting to communicate through the auroral zones during storms can experience rapid and deep-signal fading due to the ionospheric irregularities that scatter the radio signal. Auroral absorption, multipathing, and non-great-circle propagation effects combine to disrupt radio communications during ionospheric storm conditions. During large storms the auroral irregularity zone moves equatorward. These irregularities can produce scintillations that adversely impact phase-sensitive systems on frequencies above 1 GHz (e.g., the Global Positioning System). Geomagnetic storms may last several days, and ionospheric effects may last a day or two longer.