GPS Networking, Inc.
Experimental License Application
Pueblo, Colorado

EXHIBIT 2

In this exhibit, GPS Networking, Inc. presents information about the GPS signals which are proposed to be used under this experimental license. More detail on the existing GPS signal formats (P-code and C/A-code) can be found in the GPS Interface Control Document (ICD-200), available on the Web at http://gps.laafb.af.mil/y2000/icd200c.pdf.

The GPS system transmits two signals known as the clear/access (C/A-code) signal and the precise (P-code) signal. (The P-code is currently encrypted for broadcast into another code known as Y-code.

C/A-code

The C/A code signal is a spread-spectrum signal produced by binary phase shift keying (BPSK) modulation of a carrier signal by a digital bit stream known as the C/A code. The C/A code is a repeating bit sequence 1023 bits long chosen from a particular family of so-called "Gold codes." Each GPS satellite transmits a different Gold code from this family as its C/A code. Gold codes are used because the maximum interference ("cross-correlation") between any two Gold codes from the same family is known to be small. The GPS satellites all transmit their C/A codes on the same frequency, but this cross-correlation property allows each signal to be distinguished from the others. This technique is known as code division multiple access (CDMA).

The C/A code is transmitted using BPSK at a rate of 1.023 Mbps, so that it repeats exactly 1000 times per second. This generates a (sin x)/x type of signal with a main lobe and smaller side lobes. The nulls between the side lobes are located at the center frequency plus or minus N times 1.023 MHz, where N is any integer. The occupied bandwidth of this signal (47 CFR 2.202), computed by direct numerical integration of a mathematically perfect unfiltered signal, is approximately 21.2 MHz. The actual C/A-code signal transmitted by the GPS satellites is transmitted through the same filter used for the P-code signal (described below). The occupied bandwidth of the resulting signal is slightly narrower at approximately 20.5 MHz.

The C/A code signal is further modulated by stream of navigation data bits transmitted at 50 bps. This data bit stream is synchronous with the C/A code so that exactly 20 repetitions of the C/A code are transmitted during each data bit. The data bits are transmitted by inverting the C/A code during data bits equal to "one".

Although the "necessary bandwidth" (47 CFR 2.202) is part of the "emission designator" (47 CFR 2.201), the method for calculating the necessary bandwidth of the C/A code signal is not obvious from the regulation. Using the occupied bandwidth rather than the necessary bandwidth, the emission designator for the C/A code signal as transmitted by a GPS satellite would be 21M2G1D or perhaps 20M5G1D.

P-Code

The P-code signal is a spread-spectrum signal produced by binary phase shift keying (BPSK) modulation of a carrier signal by a digital bit stream known as the P-code. The P-code is an extremely long pseudo-random bit stream generated by combining the outputs of four feedback shift registers. The P-code repeats once per week because the generator is reset once per week.
Further details of the P-code generator are available in ICD-200.

The P-code is transmitted using BPSK at a rate of 10.23 Mbps. Again, this generates a (sin x)/x type of signal with a main lobe and smaller side lobes. The nulls between the side lobes are located at the center frequency plus or minus N times 10.23 MHz, where N is any integer. The GPS satellites filter this signal so that only the main lobe is transmitted. The main lobe is 20.46 MHz wide. Because no filter is perfect, the frequency allocation for each GPS frequency is a total of 24 MHz wide including guard bands. The actual filter characteristic for the GPS satellites is not specified in ICD-200. Reasonable guesses for the occupied bandwidth of the actual transmitted P-code signal range from 20.5MHz to just under 24 MHz.

The appropriate emission designator for a GPS signal appears to be 24M0G1D.