

Spread Spectrum Description of the V2K System

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The Velocity 2000 (V2K) system is a code division multiple access (CDMA) system which uses a combination of Walsh codes and an augmented (511 + 1) chip pseudo-noise (pn) direct-sequence code to provide isolation with respect to both in-net users and out-of-net users. The intrinsic chipping rate (baud rate) for this system is 2.56 Mcps. The burst QPSK symbol rate is 80Ksps. As each symbol contains two 'bits', the burst bit rate is 160 Kbps.

The Walsh code is a 32 bit code. A different selection from the Walsh ensemble is selected for each different subscriber, the control channel, and the pilot channel. A total of 24 subscribers may be serviced by any one base station. Thus, a total of twenty- six codes may be in use within any one WLL region. A new Walsh symbol is generated once every chip time . The Walsh code repeats after 32 chip times.

The pn code is a direct sequence code. As with the Walsh code, a new pn symbol is generated once every chip time. This code repeats once every 512 chip times.

The subscriber data is a QPSK symbol, which lasts for one repetition of the Walsh code, i.e., 32 chip times. This means that, unlike the Walsh and pn symbols, the QPSK symbol does not change every chip time. Instead, it lasts $32/2.56e6 = 12.5$ usec. Because the modulation is QPSK, two bits are transmitted during this time.

Every symbol transmitted over the air is the XOR (exclusive OR) of the Walsh symbol, the pn chip, and the QPSK data symbol.

The Walsh codes provide isolation for in-net users; the 512 chip pn code provides isolation for out-of-net users.

The theoretical processing gain for the Walsh code is infinite. That is, ideal isolation between in-net users would be available given that the codes are perfectly aligned and no channel distortions occur. Because channel distortions occur, and because the codes can suffer misalignment, this ideal is not attained. This is of no consequence to anyone except an in-net user and is not a measure of our ability to reject in-band interference ("processing gain").

Instead, only the ratio of the symbol rate and the chipping rate are of consequence to part 15 requirements. The remainder of this memo computes the available processing gain based upon these two parameters

The processing gain of the V2K system is easily computed by classical techniques. Specifically, the processing gain for QPSK systems is known to be the ratio of the chipping rate to the symbol rate. There are 32 chips per symbol. Thus, the processing gain is:

$$10 \log(32/1) = 15.1 \text{ dB}$$