Waste of Bandwidth Due to Spreading is Offset by Multiple Users

Spreading results directly in the use of a wider frequency band (by a factor corresponding exactly to the "processing gain" mentioned earlier), so it doesn't spare the limited frequency resource. That overuse is well compensated, however, by the possibility that many users will share the enlarged frequency band.

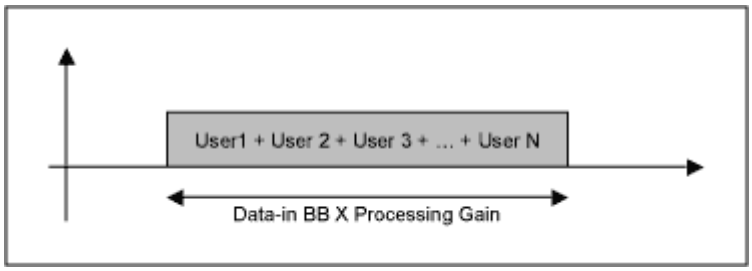

Figure 4.

SS is Wideband Technology

As opposed to regular narrowband technology, the SS process of spreading is a wideband technology. W-CDMA and UMTS, for example, are wideband technologies that require a relatively large frequency bandwidth (compared to that of narrowband radio).

Resistance to Interference, and Anti-jamming Effects

This characteristic is the real beauty of SS. Intentional or un-intentional interference and jamming signals are rejected because they do not contain the SS key. Only the desired signal, which has the key, will be seen at the receiver when the despreading operation is exercised.

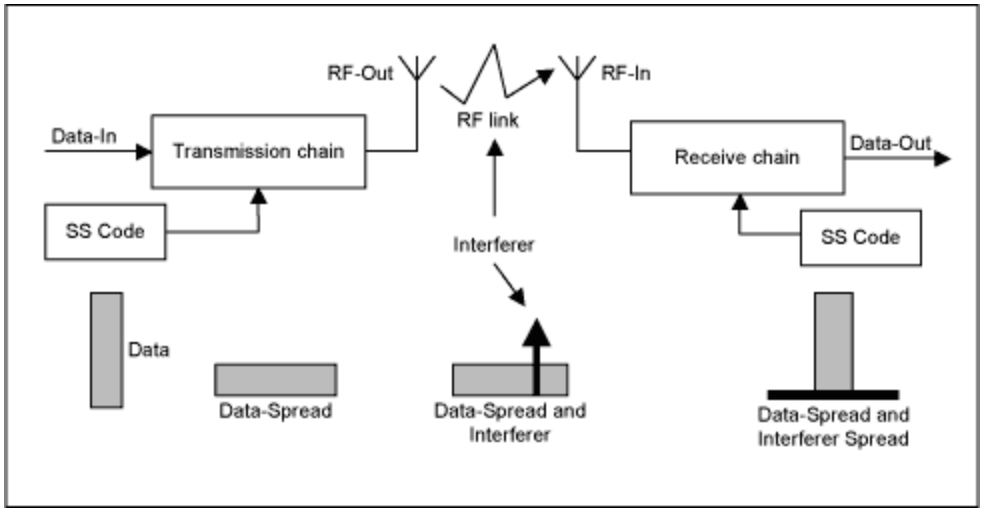

Figure 5.

You can practically ignore the interference (narrowband or wideband) if it does not include the key used in the despreading operation. That rejection also applies to other SS

signals not having the right key, which allows different SS communications to be active simultaneously in the same band (such as CDMA). Note that SS is a wideband technology, but the reverse is not true. Wideband techniques need not involve SS technology.

Resistance to Interception

Resistance to interception is the second advantage provided by SS techniques. Because non-authorized listeners do not have the key used to spread the original signal, they cannot decode it. Without the right key, the SS signal appears as noise or as an interferer (scanning methods can break the code, however, if the key is short.) Even better, signal levels can be below the noise floor, because the spreading operation reduces the spectral density (total energy is the same, but it is widely spread in frequency). The message is thus made invisible, an effect that is particularly strong with the DSSS technique. Other receivers cannot "see" the transmission; they only register a slight increase in the overall noise level!

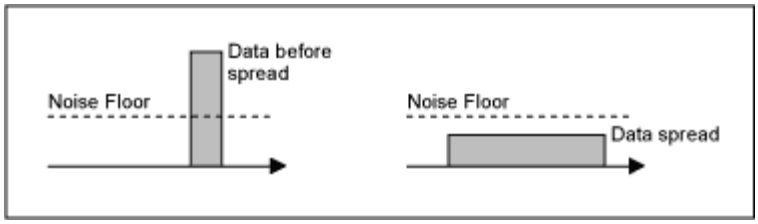

Figure 6.

Resistance to Fading (Multipath Effects)

Wireless channels often include multiple-path propagation, in which the signal has more than one path from the transmitter to the receiver. Such multipaths can be caused by atmospheric reflection or refraction, and by reflection from the ground or from objects such as buildings.

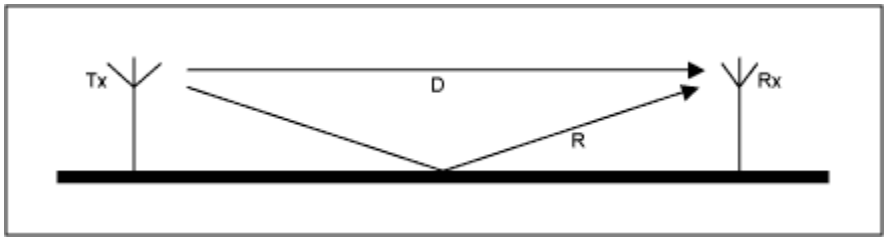

Figure 7.

The reflected path (R) can interfere with the direct path (D) in a phenomenon called fading. Because the despreading process synchronizes to signal D, signal R is rejected even though it contains the same key. Methods are available to use the reflected-path signals by despreading them and adding the extracted results to the main one.

SS Allows CDMA

Note that SS is not a modulation scheme, and should not be confused with other types of modulation. One can, for example, use SS techniques to transmit a signal modulated via FSK or BPSK. Thanks to the coding basis, SS can also be used as another method for implementing multiple access (the real or apparent coexistence of multiple.