these (shorter!) correlation cycles it would have cycled through all 32768 possibilities. Since the correlation period of 4095 chips is about (1/8) of the case where N=32767, the elapsed time taken to examine all possibilities is cut down by a factor of 8!

In the existing design I have included 3 ABCs which, when the search process starts (after reset) initialize their first choice in an evenly spread manner over the 32768 possible choices. The resulting performance in terms of time-to-first-acquisition is quite gratifying.

Example 6

When the receiver is first installed and powered up, it may not know which RF channel is being used by the CDMA Service provider. I provide an autonomous search process whereby each of the possible RF center frequencies is qualified as a "possible CDMA channel". The rationale is that a CDMA signal has a spectrum that is, ideally, flat across the frequency band. Nominally the frequency band occupied by the CDMA signal extends for (approximately) 600 kHz on either side of the carrier. Thus the bandwidth is roughly 1.2 MHz ("one-sided"; i.e. considering only positive frequencies). The inventive frequency plan can translate the RF carrier down from f_0 to f_D, preserving this 1.2 MHz one-sided bandwidth. By deriving a spectral flatness measure I can ascertain whether the received signal is "CDMA-like" (incidentally, pure white noise will look "CDMA-like"). I have used my Digital Signal Processing (DSP) device to establish the power content at 5 (narrow-band) frequencies corresponding to $f_{D_1} f_D \pm \Delta f$ and $f_D \pm 2\Delta f$ where $\Delta f = (1/16) f_s \approx 300$ kHz. Thus I have 5 power values and if the ratio of the largest to the smallest is not very much greater than 1, then the spectrum is flat and the channel is "CDMA-like". To account for measurement noise and some non-stationarity behavior because of the (small) sample size, I have set the ratio as 4. That is, if the ratio is less than 4 then the channel is classified as "CDMA-like".

While dwelling on the same RF channel I compute the 5 powers as the average of several (as many as 8 or 16) "snapshots" to minimize the impact of measurement noise. Each "snapshot" comprises 10000 (consecutive) samples from the A/D converter. The 5 filters are implemented sequentially on the stored snap-shot. The classification scheme is enhanced by keeping the ABCs running while the snapshots and filter calculations are being done. After the filter calculations are done I look at the largest value of correlation seen over the duration. If this correlation value is large, then the channel is declared "CDMA-like" regardless of the power ratio.

Advantages of the Invention

A pilot tracking approach, representing an embodiment of the invention, can be cost effective and advantageous for at least the following reasons. The invention can improve pilot channel tracking accuracy. The invention can reduce the computational load in the design. In fact I achieve the same performance as the matched filter without the awesome computational burden on the matched filter and the technique is simple enough to incorporate in an off-the-shelf FPGA.

All the disclosed embodiments of the invention described herein can be realized and practiced without undue experimentation. Although the best mode of carrying out the invention contemplated by the inventors is disclosed above, practice of the invention is not limited thereto. Accordingly, it will be appreciated by those skilled in the art that the invention may be practiced otherwise than as specifically described herein.

For example, the individual components need not be assembled in the disclosed configuration, but could be assembled in virtually any configuration. Further, although the correlator circuit described herein can be a physically separate module, it will be manifest that the correlator circuit may be integrated into the apparatus with which it is associated. Furthermore, all the disclosed elements and features of each disclosed embodiment can be combined with, or substituted for, the disclosed elements and features of every other disclosed embodiment except where such elements or features are mutually exclusive.

It will be manifest that various additions, modifications and rearrangements of the features of the invention may be made without deviating from the spirit and scope of the underlying inventive concept. It is intended that the scope of the invention as defined by the appended claims and their equivalents cover all such additions, modifications, and rearrangements.

The appended claims are not to be interpreted as including means-plus-function limitations, unless such a limitation is explicitly recited in a given claim using the phrase "means for." Expedient embodiments of the invention are differentiated by the appended subclaims.

REFERENCES

1) CDMA Systems Engineering Handbook, Jhong Sam Lee and Leonard E. Miller; Artech House Publishers (Boston, London) 1998.

2) CDMA: Principles of Spread Spectrum Communication, Andrew J. Viterbi, Addison-Wesley, 1995.

3) Mobile Station-Base Station Compatibility Standard for Dual-Mode Wideband Spread Spectrum Cellular System, TIA/EIA/IS-95-A, 1995.

What is claimed is:

1. A method for tracking a pilot channel signal to discipline an oscillator, comprising:

downconverting an RF signal from a RF center frequency f_{RF} to an intermediate center frequency f_L where f_L is greater than or equal to a chip rate f_c wherein downconverting includes incorporating bandpass filtering to remove extraneous signals while passing said pilot channel signal;

converting a signal format from analog to digital using a single analog-to-digital converter employing a sampling rate of f_s to create a digital signal {s(n)};

employing a correlation circuit to establish a correlation between {s(n)} and locally generated versions of I-channel and Q-channel PN signals, $\{I_{PN}(n)\}$ and $\{Q_{PN}(n)\}$, respectively;

generating an estimate of a frequency error of the oscillator using correlation values corresponding to (2M+1) time shifts of $\{I_{PN}(n)\}$ and $\{Q_{PN}(n)\}$, the (2M+1) time shifts being $K-\Delta_M$, $K-\Delta_{(M-1)}$, . . . , $K-\Delta_2$, $K-\Delta_1$, K, and $K+\Delta_1$, $K+\Delta_2$, . . . , $K+\Delta_{(M-1)}$, $K+\Delta_M$, where a time shift of K corresponds to a time shift that provides a maximum correlation value, and M is greater than or equal to 1; and

disciplining the oscillator using the estimate of the frequency error of the oscillator,

wherein correlation values between the digital signal {s(n)} and at least one locally generated version of I-channel and Q-channel PN signals $\{I_{PN}(n)\}$ and $\{Q_{PN}$