Fig. 4. Probability density function for SINR for $E_s/\sigma^2=20$ dB for our proposed scheme with different number of users.

E. Complexity

The process of spreading each bit on space, time and frequency in a parallel manner was considered to be a complicated issue [20]. However, the proposed OFDM-CDMA has efficient mapping in bit allocation in space, time and frequency without degrading overall system performance, and therefore it is less complex. In other OFDM-CDMA systems, RAKE receiver is widely used to take advantage of the entire frequency spread of a particular bit, that adds to overall system hardware complexity. In our proposed open-loop MIMO OFDM-CDMA, RAKE receiver is not needed as each bit is spread in time and frequency, occupying different time and frequency slots, where each bit is spread to ensure frequency independence as shown in fig. 2. Also, other systems that use space-time-frequency (STF) coding as in [16], has more complexity than our proposed system. Their spreading technique uses space-time block codes or space-time trellis codes and then uses subcarrier selectors to map signals to different OFDM frequency subcarriers. Our proposed STF spreading method does not involve coding or precoding, just bit spreading to maintain signal orthogonality.