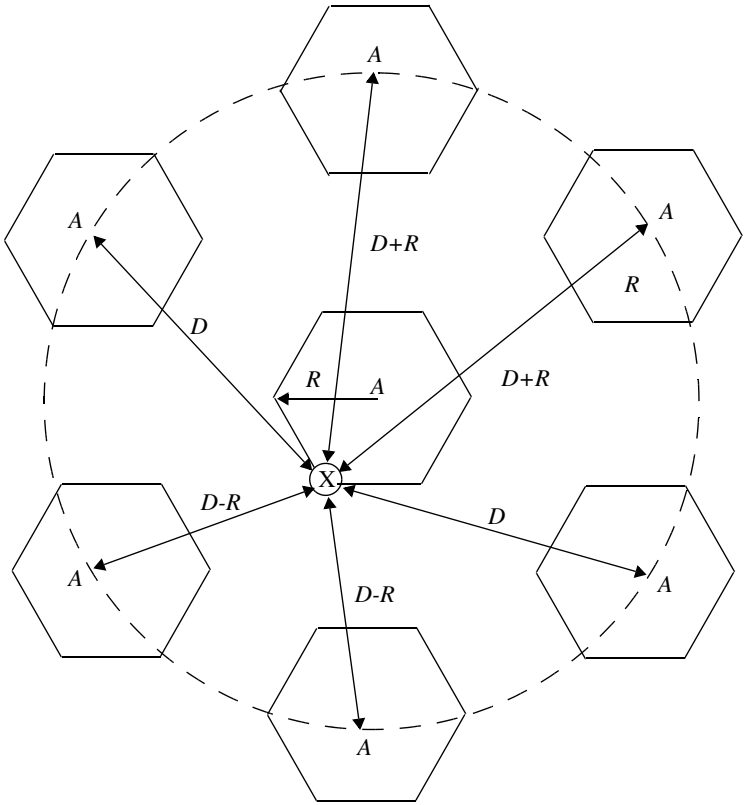


**Figure 3.5** Illustration of the first tier of co-channel cells for a cluster size of $N = 7$. An approximation of the exact geometry is shown here, whereas the exact geometry is given in [Lee86]. When the mobile is at the cell boundary (point $X$), it experiences worst case co-channel interference on the forward channel. The marked distances between the mobile and different co-channel cells are based on approximations made for easy analysis.

For $N = 7$, the co-channel reuse ratio $Q$ is 4.6, and the worst case $S/I$ is approximated as 49.56 (17 dB) using Equation (3.11), whereas an exact solution using Equation (3.8) yields 17.8 dB [Jac94]. Hence for a seven-cell cluster, the $S/I$ ratio is slightly less than 18 dB for the worst case. To design the cellular system for proper performance in the worst case, it would be necessary to increase $N$ to the next largest size, which from Equation (3.3) is found to be 9 (corresponding to $i = 0$, $j = 3$). This obviously entails a significant decrease in capacity, since 9-cell reuse offers a spectrum utilization of 1/9 within each cell, whereas seven-cell reuse offers a spectrum utilization of 1/7. In practice, a capacity reduction of 7/9 would not be tolerable to accommodate for the worst case situation which rarely occurs. From the above discussion, it is clear that co-channel interference determines link performance, which in turn dictates the frequency reuse plan and the overall capacity of cellular systems.