

*Abstract*—This paper studies the impact of node density on the end-to-end throughput and delay in multi-hop wireless networks. In existing work, each packet is most assumed to be relayed through one cell at each hop and the hop progress is approximated by the square root of a cell area, which does not correspond to the actual hop progress in the real network. In this paper, we calculate the hop progress by taking into account the effect of node density (i.e., the number of nodes within the transmission range of each node), and obtain the required hop count for a multi-hop path. Based on the result, we further discuss the scaling relations between node density and throughput and delay in multi-hop wireless networks. The effects of power control on the scaling relations are also examined. The results show that the impact of node density on the throughput and delay scaling is significant. Specifically, with a larger node density, the required hop count is reduced, resulting in exponential growth of the throughput. However, larger node density incurs more contentions among neighboring nodes. Consequently, it causes linear degradation in throughput. With our model, this trade-off is readily observed.

*Index Terms*—Throughput and delay scaling, multi-hop wireless networks.