Effect of changing sensor count (with T=5, target rate = 0.3), averaged over 5 runs

	Avg. Time Until First Node Dies	Avg. Network Throughput	Average Delay Per Packet	Avg. Time Until 1st Target Detection
100 sensors	50.78 seconds	33.45 Kbits per second	2.72 seconds	8.31 seconds
150 sensors	50.9 seconds	49.3 Kbits per second	4.34 seconds	9.94 seconds
200 sensors	47.4 seconds	55.91 Kbits per second	2.62 seconds	6.88 seconds
250 sensors	39.06 seconds	61.16 Kbits per second	3.42 seconds	6.188 seconds

From this data, it appears that the average sensor node's lifespan decreases with the more sensors there are being simulated. This is likely due to the fact that with less sensors, there are less targets being recorded (as less area is covered), which means less energy is spent on recording, transmitting, and receiving data, where as more sensors will have more data to transmit, which will drain the energy of nodes in those routes. The average network throughput increased along with the number of sensors that were simulated, which is likely because more nodes were active and helped transmit the packets faster. The delay per packet didn't change drastically among the 5 averages I took for this experiment, but the average time until detecting the first target decreased as the number of sensors increased. This makes sense since the more sensors there are, the more ground that is covered, which means that it's more likely for a sensor to detect a target sooner. Based off of this information, I would suggest for the network developer to increase their sensor count if they desire a higher network throughput, and if quicker target detection is desired. However, this comes at the cost of requiring more energy for each node as they will be a lot more active.

Effect of changing wake-up interval T (with sensor count at 150, target rate at 0.3), averaged over 5 runs

	Avg. Time Until First Node Dies	Avg. Network Throughput	Average Delay Per Packet	Avg. Time Until 1st Target Detection
T = 0.1	3.62seconds	50.57 Kbits per second	0.06 seconds	6.06 seconds
T = 5	45.495 seconds	46.15 Kbits per second	4.97 seconds	9.8575 seconds
T = 7	45.97 seconds	35.24 Kbits per second	4.47 seconds	12.92 seconds
T = 10	57.85 seconds	22.45 Kbits per second	12.3 seconds	14.94 seconds

From this data, it is clear that the smaller the wake-up interval T (how long the sensor nodes sleep before probing for targets and/or sending packets), the shorter it takes for the first node to die. This makes sense since a node that is constantly probing will end up recording and transmitting more data compared to a node which only probes once every few seconds. This also explains why the sample with the lowest T value also had the most network throughput, and the least delay per packet and average time until it detected the first target. Nodes that don't sleep will constantly be transmitting information, which leads to an increased network throughput and extremely low delay per packet (as nodes never have to wait for their destination node to wake up), and targets will be detected immediately since all of the nodes are awake to capture them. From this information, I would suggest for the network developer to decrease their wake-up interval if they desire better results for average network throughput, average delay per packet, and average time until detecting the first target. However, the cost of this is that the nodes will die much faster than another simulation in which the nodes sleep for longer.

<u>Effect of changing target rate (with sensor counter at 150, T = 5), averaged over 5 runs</u>

	Avg. Time Until First Node Dies	Avg. Network Throughput	Average Delay Per Packet	Avg. Time Until 1st Target Detection
Arrival Rate = 0.1	91.48 seconds	21.28 Kbits per second	3.7 seconds	10.5 seconds
Arrival Rate = 0.3	51.51 seconds	39.02 Kbits per second	2.72 seconds	3.82 seconds
Arrival Rate = 0.5	37.6 seconds	59.67 Kbits per second	1.96 seconds	2.55 seconds

This data shows that a higher arrival rate of targets results in a decrease in node lifespan, an increase in average network throughput, a decrease in average delay per packet, and a decrease in average time until the first target is detected. The decrease in node lifespan is likely due to the fact that more targets means more data to be collected by the nodes, which will keep them actively recording and transmitting longer, which requires much more energy than a simulation with fewer targets to record. The increase in average network throughput is likely due to this as well, as more targets will result in more data being transmitted, which increases the overall network throughput. The decrease in average delay per packet could be attributed to the fact that with less targets to record, more nodes stay asleep, which results in buffers filling up and packets being delayed. If a group of nodes is kept active due to a high number of targets, they will transmit packets in their buffer much sooner than a group of nodes that sleeps until they check their buffer for packets to transmit. Lastly, the average time until detecting the first node decreases as the arrival rate of targets increases, which makes sense since the more targets there are, the faster they will be detected. Based off of this information, I would suggest for the network developer to account for their target arrival rate by allotting for more energy and network throughput beforehand, as the network would crash without it.