A MEASUREMENT STUDY OF A SENSOR/ACTUATOR NETWORK FOR METEOROLOGICAL OBSERVATIONS

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In Distributed Collaborative Adaptive Sensing (DCAS) networks like the CASA testbeds [1] the data network itself is a crucial part of the overall system. Without timely transport of weather data from the radars to the control node and control data from this central node back to the radars an optimal operation of the DCAS network cannot be guaranteed. For example, if data from one radar arrives with a significant delay, the decision of how to steer the radars in the following heartbeat will not be optimal since the optimization component of the Meteorological Command and Control (MC&C) considers outdated information to determine the optimal scan set. Analyzing the data network performance of DCAS systems is important for two reasons. First, in many cases (like in the CASA IP1 testbed [2]) at least the first hop from the radars will be a wireless link due to the remote locations of the radars where wired data networks will often not be available. Due to the nature of these wireless links their capacity is not constant which is different from wired links. This variety in bandwidth capacity could lead to performance impairment on the application level. Second, weather can impair the quality of wireless links. This issue is especially crucial in the case of weather radar networks. In situations of weather in the radar networks its flawless performance is important. Therefore, it has to be investigated how weather impairs the quality of wireless links.

This paper presents data and analysis of network measurements in in the IP1 testbed in Oklahoma during the 2008 Spring Experiment and the Western Massachusetts Off-the-Grid testbed [3]. Network measurement studies have been performed for a variety of network architectures and applications. Recently, such studies have also been performed for sensor networks([4],[5]). To the best of our knowledge, no such network measurement has been performed for an operational sensor/actuator network where closed-loop control of the sensors is essential. From a network point of view, the testbed we performed our measurement in is different from most sensor networks as follows. In this testbed high-bandwidth radar data are sent from the sensor nodes to the sink while very low-bandwidth control data are periodically transmitted from the sink to the nodes.

The motivation for this measurement study is to perform a deeper analysis of the network performance of DCAS networks. On the application level, the operation of the IP1 testbed for two spring seasons (which is the climatological most active time of year in this part of Oklahoma) has shown no significant shortcomings in network performance that would have had an impact on the overall functionality of the testbed. But investigations on a network level have not been performed so far. The goal of a detailed measurement on the network level of this sensor network testbed is to investigate if i) network capacity is sufficient, ii) the physical network in use will support future sensor network traffic, and iii) atmospheric conditions have an impact on the quality of the network links.

Table 1. Trace data information

Date	Duration (hours)	Amount of trace data (MB)			
		KCYR	KLWE	KRSP	KSAO
05-01-2008	14	1828	1402	1393	1906
05-05-2008	56	6182	6450	5872	7966
05-14-2008	15	2268	1955	1672	1828
05-22-2008	23	3488	2632	2624	3837
05-24-2008	35	5038	4229	4073	6049
05-26-2008	12	1874	1411	920	2122

To achieve the two above mentioned goals we collected 155 hours of trace data while the testbed was operational, providing data to end-users. This resulted in a total of more than 94 Gbytes of trace data. Table 1 summarizes the trace data of the measurements performed in the IP1 testbed.

In the full paper, we will give an overview on the IP1 testbed and the measurement setup and results from a series of measurements are presented and analyzed. In addition, we will present results from measurements in the Western Massachusetts Off-the-Grid testbed. In this case, the network consist of 802.11b wireless links.

1. REFERENCES

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