Document Type: Tutorial
NI Supported: Yes
Publish Date: Aug 24, 2009

LabVIEW WSN Pioneer Performance Benchmarks

Table of Contents

1. Overview
2. Power Benchmarks
3. Acquisition Rate Benchmarks

Overview

By using the NI LabVIEW WSN Module to target and customize NI WSN measurement nodes, you can control power usage and data acquisition rates. For many applications, you can increase performance by deploying LabVIEW code to the node that modifies how data is acquired and when radio messages are transmitted to the gateway. However, to achieve increased performance, one must understand the tradeoffs between longer battery life and faster acquisition rates and the necessary increase in code complexity. To learn more about the operation and execution of applications on an NI WSN measurement node, visit LabVIEW WSN Pioneer - Under the Hood.

The purpose of this document is to provide power consumption and acquisition rate benchmarks when running a LabVIEW WSN VI on an NI WSN measurement node. It will detail how the benchmark was performed and discuss considerations that must be made to maximize node performance.

Power Benchmarks

By default, WSN nodes are programmed to send acquired data to the gateway via a radio message at each sample interval. Therefore, when setting the sample interval of the node to one second (1 Hz), the radio on the node is powered up at the same rate. Battery life can be increased by programming the node so data is not transmitted at each sample interval. As can be seen in Table 1, the power savings are significant.

Sample Interval	Transmit Interval	Battery Life (months)
1 Second	1 Second	**1.36**
1 Second	10 Seconds	**5.88**
1 Second	100 Seconds	**7.96**
1 Second	1000 Seconds	**8.03**
5 Seconds	5 Seconds	**6.33**
5 Seconds	50 Seconds	**24.71**
5 Seconds	500 Seconds	**25.99**
5 Seconds	5000 Seconds	**26.99**
60 Seconds	60 Seconds	**36.0**

Table 1: Battery life achieved through slower transmit rates

Note that a transmit interval beyond 100 seconds has a limited effect on power savings. This is a result of the node's heartbeat signal which causes the radio to power up and transmit status information to the gateway once every 61.0 seconds if no radio transmission has occurred in that time period. Therefore, regardless of the transmit interval, the node will power up the radio at least once every 61 seconds to maintain the network connection.

This benchmark tests the power usage savings by programming the node as shown in Figure 1. The sample interval is set in the start case and the transmit interval is programmed by performing a modulus on the number of samples taken and sending back every 1, 10, 100, or 1000 samples. This behavior would be beneficial in a program that is used to average or threshold data samples, cases where data does not need to be returned to the host after every sample.

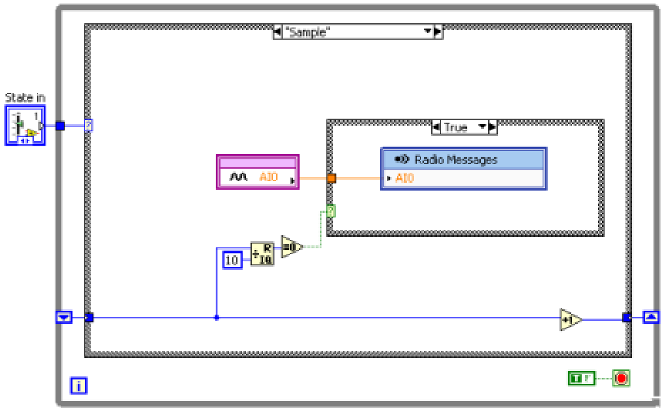

Figure 1: Power usage test application

Although other factors can influence the battery life of WSN nodes, only the radio usage was investigated in this benchmark as the radio has the most significant power consumption of all components on the node.

Acquisition Rate Benchmarks

By default, the NI WSN-3202 analog input node is limited to a sample interval of one second and the NI WSN-3212 thermocouple node is limited to a sample interval of two seconds. This is due to radio communication times between the node and gateway. While this limit on the communication rate is set, the local sampling rate on the node can be increased by programming the node with the NI LabVIEW WSN Module. The resulting acquisition rates of an NI WSN-3202 analog input node are displayed in Tables 2 and 3.

Analog Input Benchmark			
Test	**Time (s)**	**Sample Interval (s)**	**Rate (Hz)**
1 Channel	2.564	0.02564	39.00[1]
4 Channels	10.255	0.10256	9.75[1]

Table 2: Acquisition times and rates for recording 100 samples of analog data

[1]Higher analog input sampling rates can be reached by utilizing the sensor power property for each channel. For more detail on this method, refer to NI Community: Achieve Faster Analog Input Sampling Rate with LabVIEW WSN.

Digital Input Benchmark			
Test	**Time (s)**	**Sample Interval (s)**	**Rate (Hz)**
1 Channel	0.098	0.00098	1020.40
4 Channels	0.391	0.00391	255.75

Table 3: Acquisition times and rates for recording 100 samples of digital data

This benchmark test was setup as shown in Figures 2 through 5 on a NI-WSN 3202 Voltage Node. Within the sample case of the target VI, the onboard clock is sampled before and after taking 100 samples. This sample time was averaged over 10 runs to provide the acquisition times in Table 2. The sample rate was then calculated based on the average acquisition time.

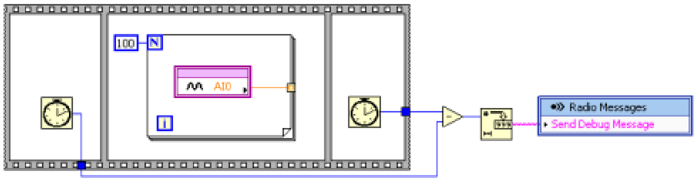

Figure 2: Single-channel analog input test application

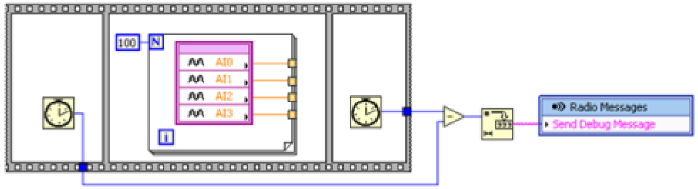

Figure 3: Multiple-channel analog input test application

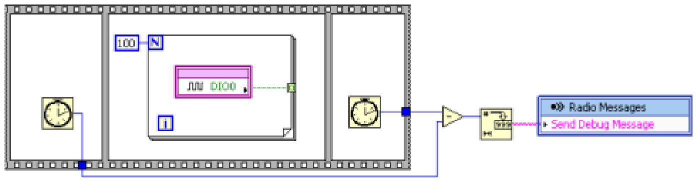

Figure 4: Single-channel digital input test application

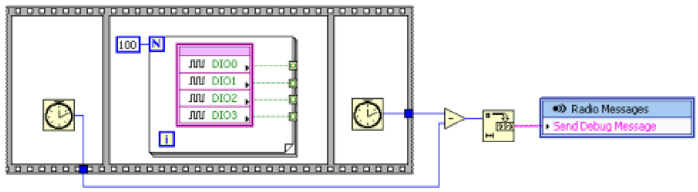

Figure 5: Multiple-channel digital input test application

It is important to note that these benchmarks perform local finite acquisitions and all the samples cannot be sent to the host at the same rate the data is acquired. The examples can however, be used to sample data at a faster rate which can be analyzed, stored on the node, or returned to the host over several sample iterations.