

An Economic Analysis of Issues Driving Sensor Network Costs

by

James Wiczer

Sensor Synergy, Inc.

1110 W. Lake Cook Rd. Suite #340

Buffalo Grove, IL 60089

email: jwiczer@sensorsynergy.com - Tel (847) 353-8200

During the difficult task of selecting which technologies to include in the design of a new product, tangible reasons are frequently sought to justify “gut-feeling” decisions. In determining whether to apply a new technology approach to a product under development, imprecise near-term financial benefits and intangible long-term returns are frequently invoked as adequate justification for selecting and utilizing new technology.

In fact, the economic advantages associated with applying new technology often becomes an extremely important aspect in determining whether this new product will fail or succeed. Curiously, the “true” economic advantage of applying a new technology may be overshadowed by the ability to quantify or articulate the value of this technology.

This talk will discuss some of the economic issues associated with implementing sensor-to-network interface capabilities. During this presentation, real-world motivations for networking sensors will be identified and summarized. A brief review of the underlying technologies necessary to interface sensors and actuators to networks will be presented. Some common misconceptions and inaccurate network interface cost comparisons will be explained.

During this talk, we will compare and contrast two of the most common sensor-to-network interface approaches. Current costs for two of these solutions will be included using dollar values based on product data sheets used in sensor-to-network implementations.

Finally, economic and technology factors effecting future implementations will be discussed.

What are the Real Motivations to Interface Sensors and Networks

- Remote Monitoring to Reduce Operational Costs – Reduce Staffing Requirements
- Remote Monitoring for Better Asset Management and Preventive Maintenance
- Remote Monitoring for Integrating Enterprise Information
- Remote Monitoring for Improved Supervisor/Administrative Insights
- Remote Monitoring for Hazardous Environments
- Remote Monitoring for Difficult or Inaccessible Locations

What's Involved in Connecting a Sensor to a Network

- Determining Sensor Data Format/ Electronic Data Sheet Capabilities
- Acquire Sensor Data, Convert Data to Digital Form, and Format Data per Pre-Determined Data Template
- Mechanism to Hand-Off Data to Network Processor
- Network Processor – Data Acquisition Communications
- Hardware to Perform OSI Equivalent Layered Network (Stack) Operations (TCP/IP)
- Format to Send Data Across Network

It only costs \$15 to buy a Network Interface Card for my PC, why not an inexpensive “Network Interface Unit” for my Sensors?

- The BIG Difference in these two situations is the amount of “Silicon Intelligence” Available”.
- When Networking PCs, the Networking Requirements can Utilize the Hardware and Software Capabilities of the PC.
- When Networking Sensors, CPU-like Capabilities and Other Resources are Needed and must be added to the Sensor via Hardware

Are Sensors Ready for Tight Integration of Networking Capabilities?

- Some Sensor Technologies (silicon-based) are amenable to higher levels of Integration and Can Benefit from tight Integration of Network Capabilities to a Sensor Transducer Element
- However, some Sensor Technologies are Incompatible with Tight Integration of Additional “On-Chip” Intelligence.
 - Case by Case Analysis is Required (See my article in the Sensors Expo Spring 2001 Proceedings “Smart Interfaces for Sensors” pp. 27-32)

Why Not Use a Single Separate Super-Chip to do the Network Interface Stuff?

- A Single “Custom” FPGA, ASIC or Other Single Chip Solution is not likely to Solve the problem of Networking Sensors because All of the Features Described Above Still Need to Be Included.
- A “Single-Chip” May be Sophisticated Enough to Contain All of the Necessary Features for Interfacing One Type of Sensor, but there are many types of Sensors – each will require customization for the sensor to network interface elements (listed above)
- New Costs will be Incurred to Configure Software and Hardware Features in the programmable “Super-Chip” for the next Sensor
- Currently, even the Super-Chip Approach, requires other support ICs (e.g. Net Silicon) to make a complete solution.

What’s a Smart Sensor and Does Anyone Care?

- Smart Sensors Provide Self-Identifying Capabilities to Networked Clients
- Smart Sensors Provide Capabilities for Electronic Data Sheets, Remote Calibration, and a Common Approach to Sensor Specific Issues – Triggering, Error Correction, Calibration Coefficients, Measurement Units
- Smart Sensors Solve the Problem of Standard Sensor Network Interface Communication Protocols
- Smart Sensors May Not be the Correct Solution for Most Sensors, Smart Interfaces May be Better Solutions for Many Types of Sensors (See my article “Connectivity : Smart Sensors or Smart Interfaces” in the ISA Emerging Technologies Conference Proceedings Sept. 2001)
- Depending on the “Exposure” of a Sensor to the Outside World and the Electronic Interface to a Sensor, Smart Sensors May be Useful or May become a Burden – Case-by-Case, Application Specific Analysis Required

Cost Issues Relating to Interfacing Sensors to Networks

Quantity, Quantity, Quantity!

- Cost-effective sensor networking requires a substantial quantity of the same type of sensor
- This goal needs an appropriate target sensor market with a large enough demand (quantity) to achieve low cost. The NRE is non-trivial - if you can't amortize this over a large enough number of users the low cost goal goes out the window.

Where is this technology going?