Serial Implementation of IEEE 1451.2-1997 for Data Acquisition Applications

Robert N. Johnson

Telemonitor, Inc.

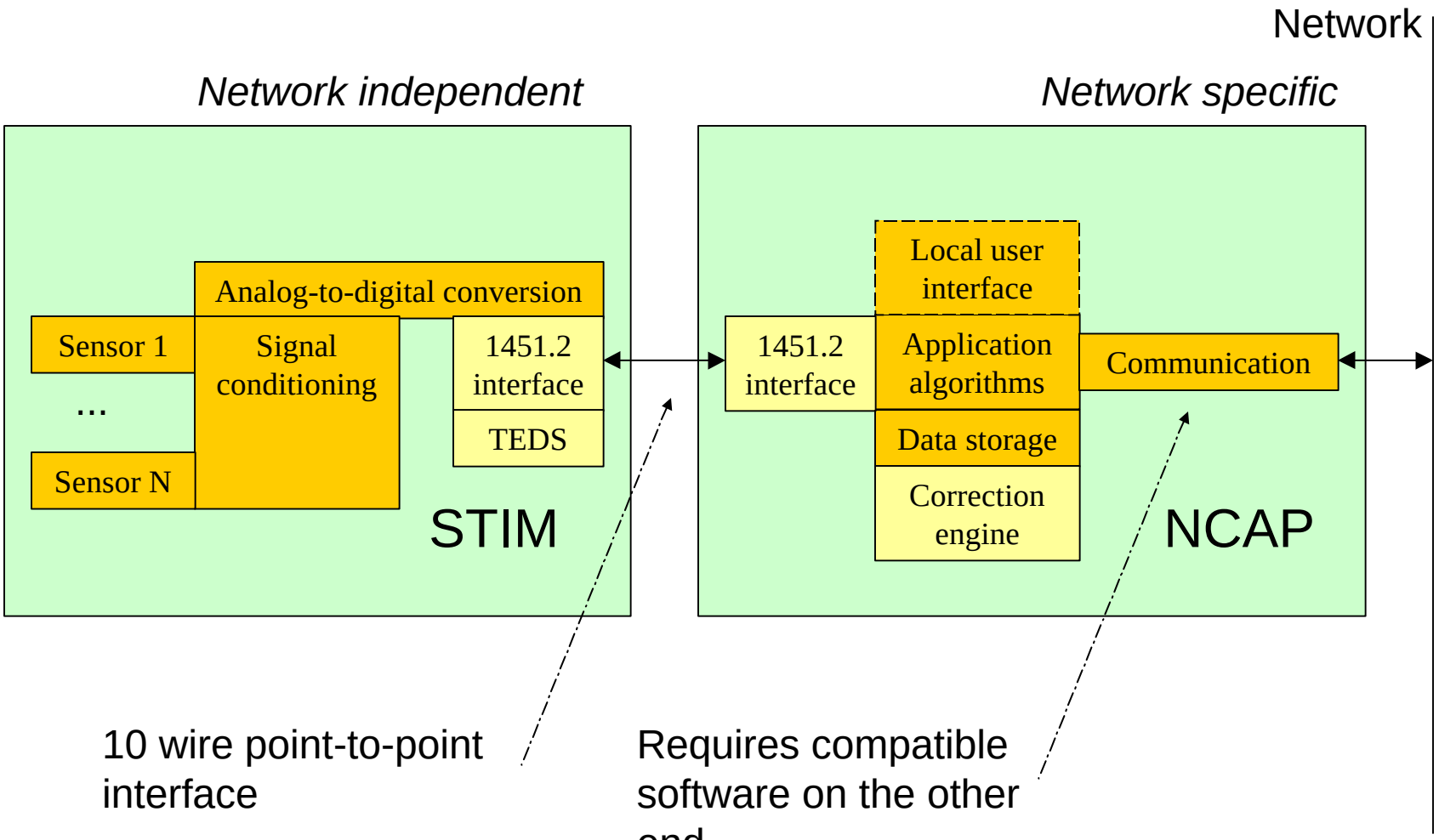
robertj@telemonitor.com

June 3, 2003

Outline

- Brief review of IEEE 1451.2-1997
- Proposed enhancements
- Earlier demonstration hardware
- Serial smart sensor interface for DAQ applications
- Next Steps

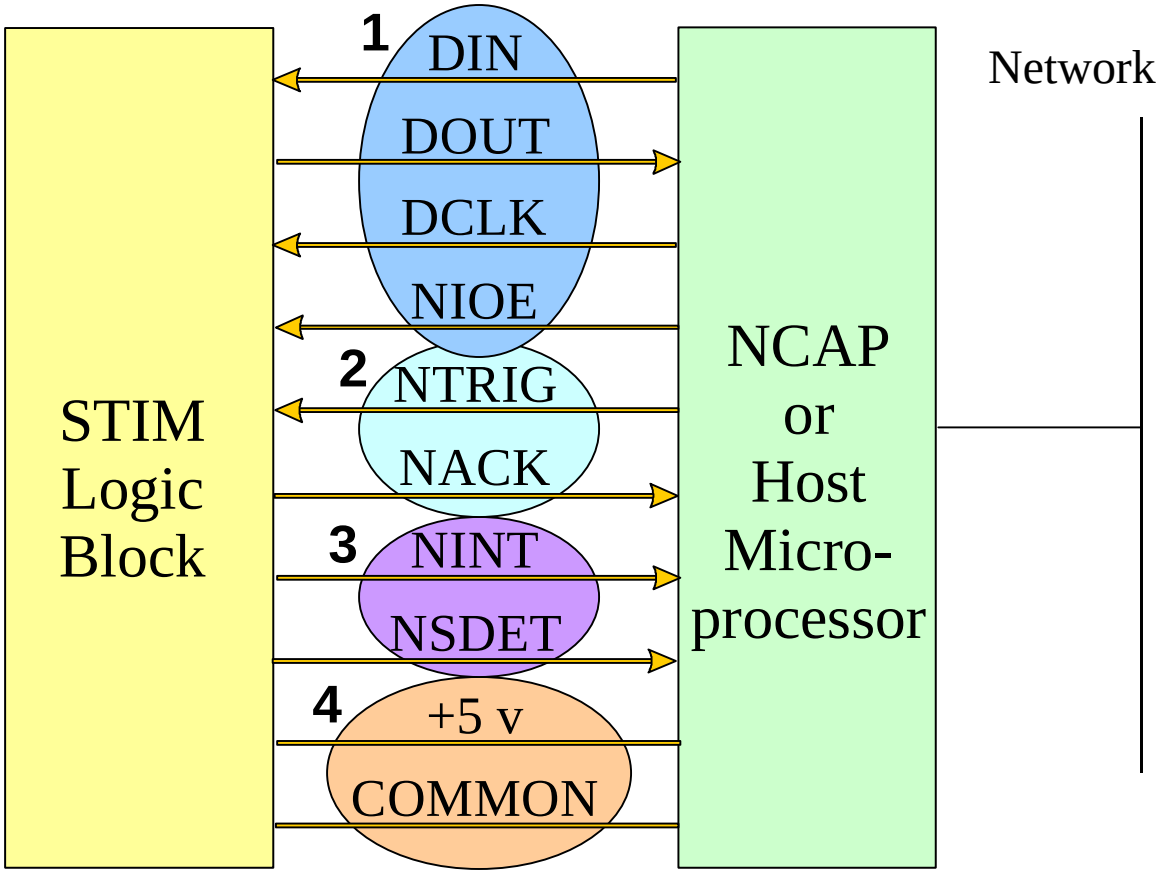
IEEE 1451.2 smart sensor model



IEEE 1451.2 hardware interface

1) Communication/framing
2) Triggering/handshaking
3) Interrupts and hot swap
4) Power

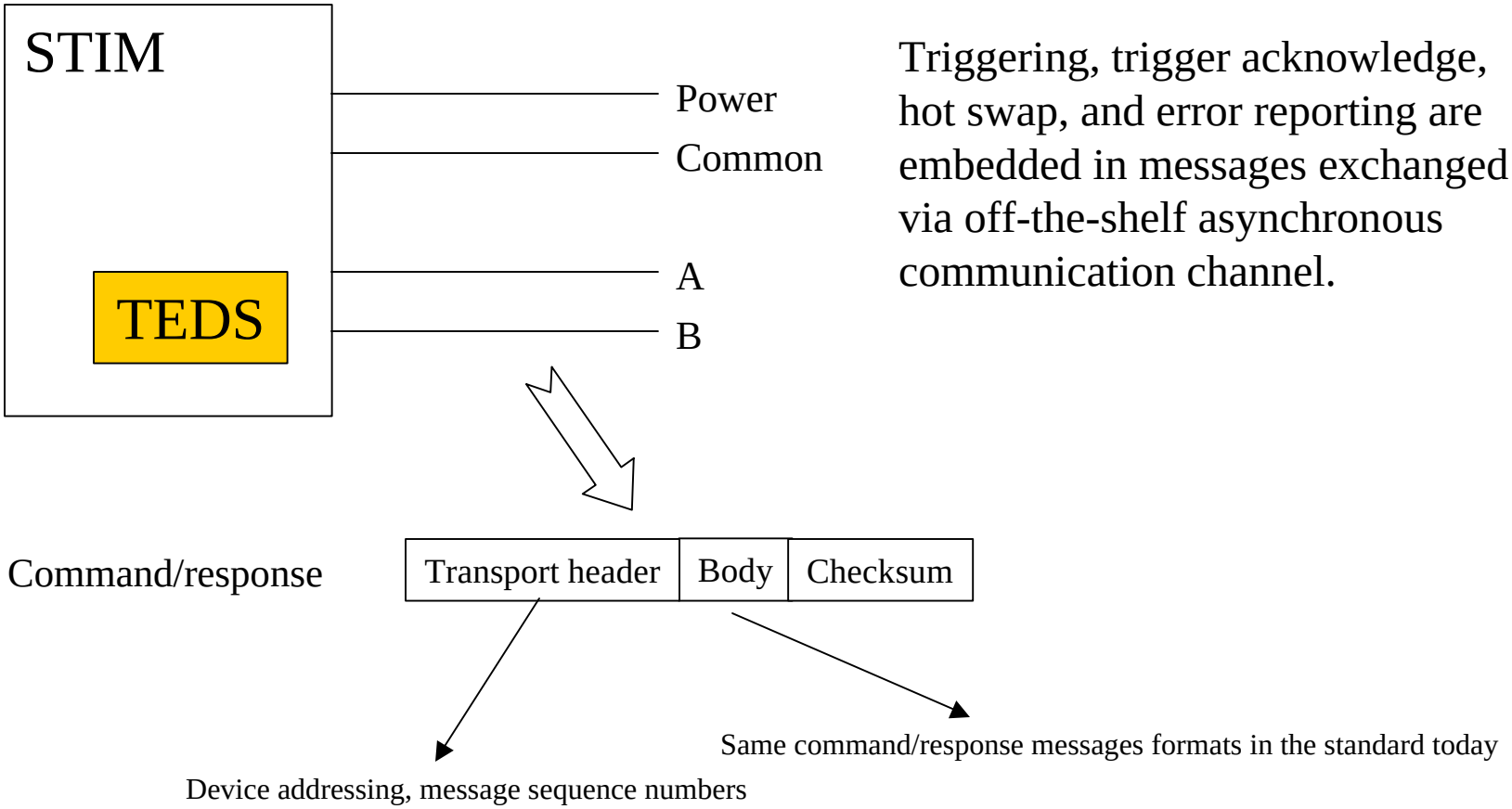
Intended for closely -coupled systems



Proposed enhancements to IEEE 1451.2

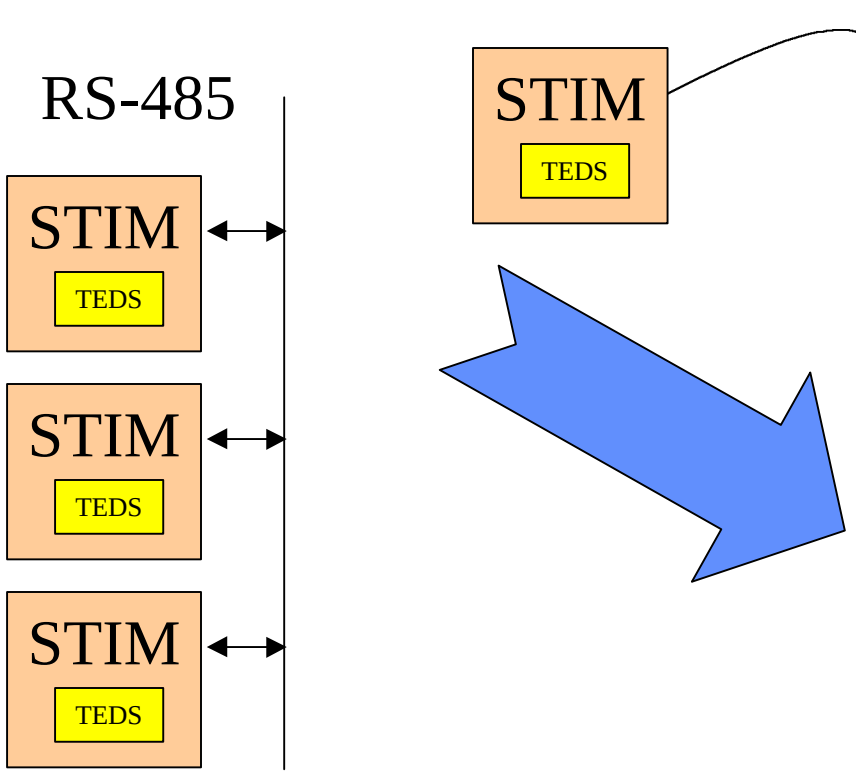
- Primary enhancements:
  - Partition the TEDS
  - Alternative physical layers
  - Partition the standard
- Secondary enhancements:
  - Enhance the TEDS
  - Add functions
  - Standalone function
  - Corrections and additions

Alternate physical layers



Triggering, trigger acknowledge, hot swap, and error reporting are embedded in messages exchanged via off-the-shelf asynchronous communication channel.

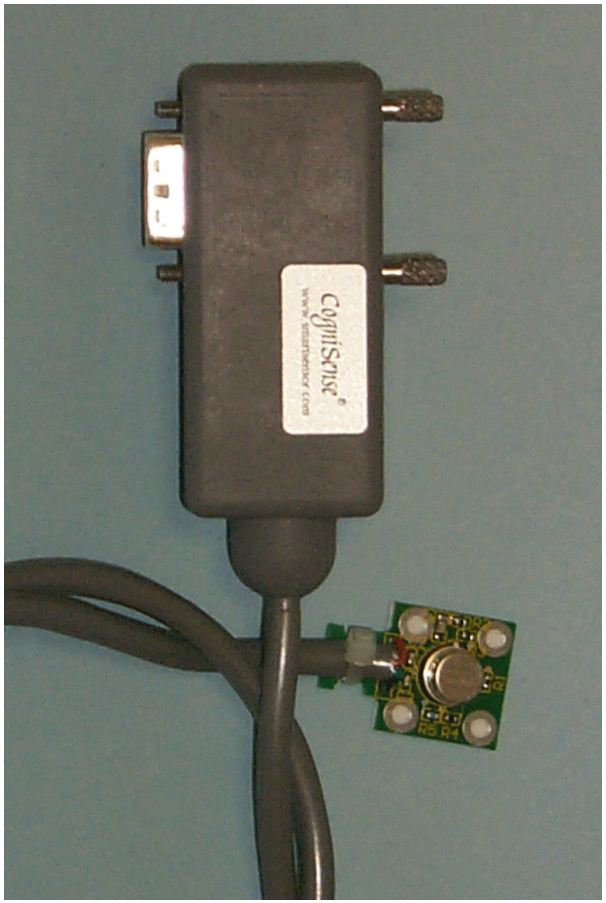
New connectivity enabled by enhancements



Connectivity to existing communication ports:

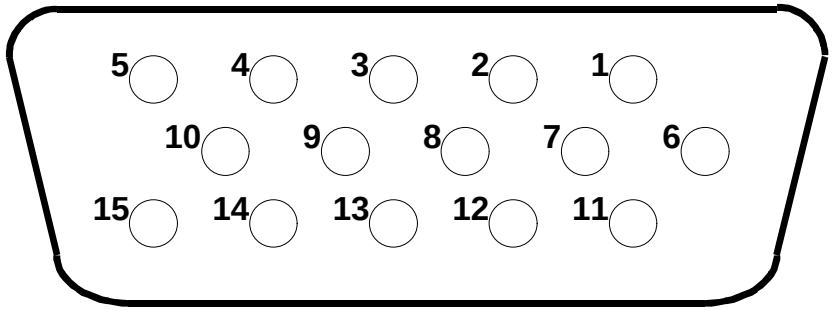
- Computers
- Programmable logic controllers
- PC plug-in cards
- Instruments
- NCAPs

Original STIM-in-a-connector hardware



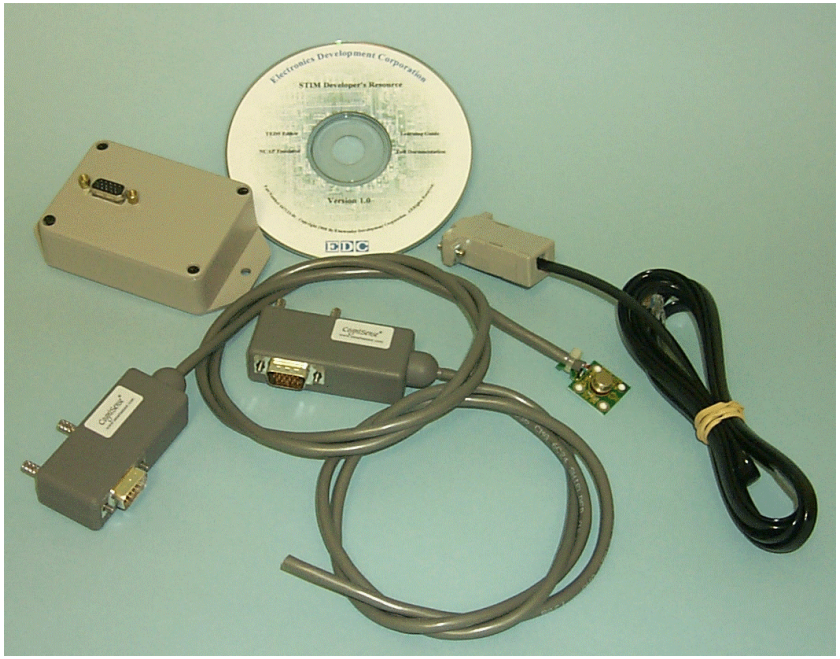
- Signal conditioning, signal conversion, TEDS contained in the connector
- Encapsulated for ruggedness
- Transducer attached to fixed cable to maintain integrity of TEDS
- Supports both sensors and actuators
- High-density 15-pin “D”-shell connector

STIM connector pin assignments



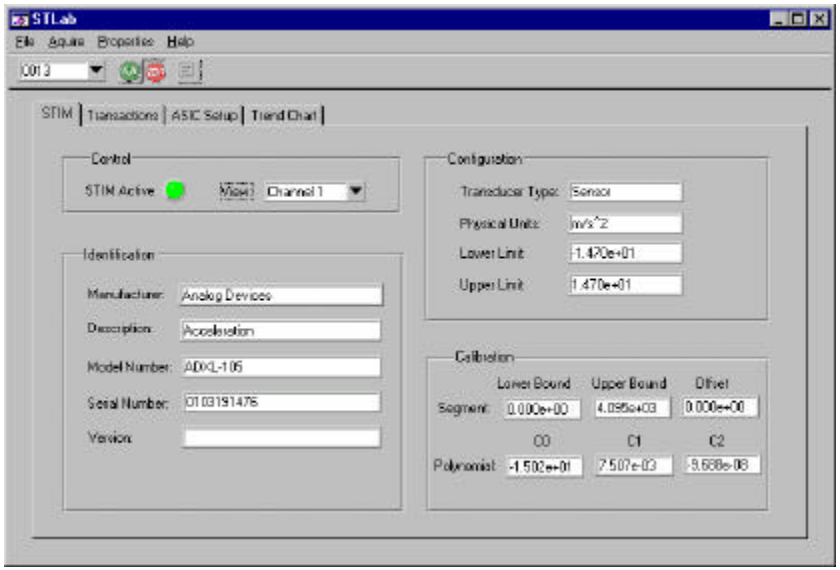
Pin number	Signal name	Direction for NCAP	Direction for STIM
1	DCLK	OUT	IN
2	DIN	OUT	IN
3	DOUT	IN	OUT
4	NTRACK	IN	OUT
5	COMMON (GROUND)	POWER	POWER
6	NIOE	OUT	IN
7	NIO_INT	IN	OUT
8	NTRIG	OUT	IN
9	POWER (+5 VDC)	POWER	POWER
10	NSDET	IN	OUT

Earlier Smart Transducer Interface Kit



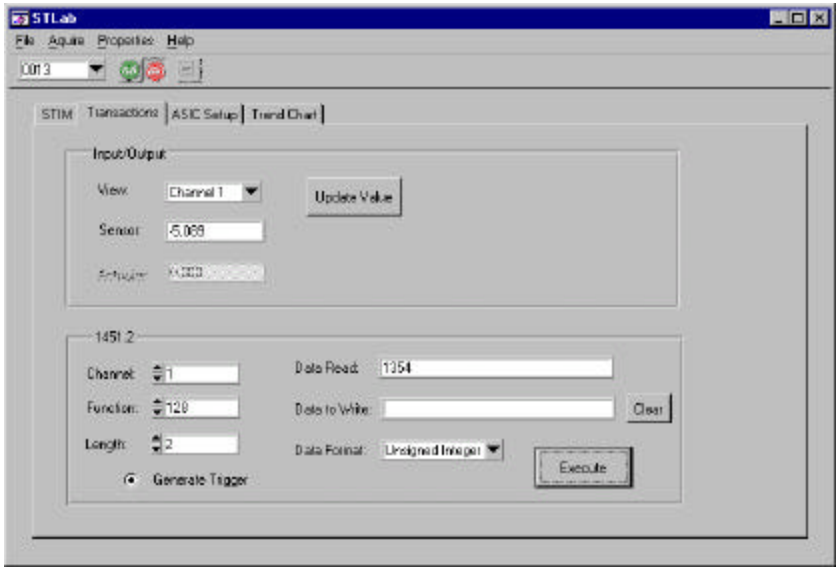
- Based on STIM-in-a-connector hardware
- CogniSense® electronics
  - Signal conditioning and conversion
  - TEDS in EEPROM
- RS-485 network node (NCAP)
- RS-485 to RS-232C converter
- Serial encapsulation of IEEE 1451.2-1997 messages to PC-based host software

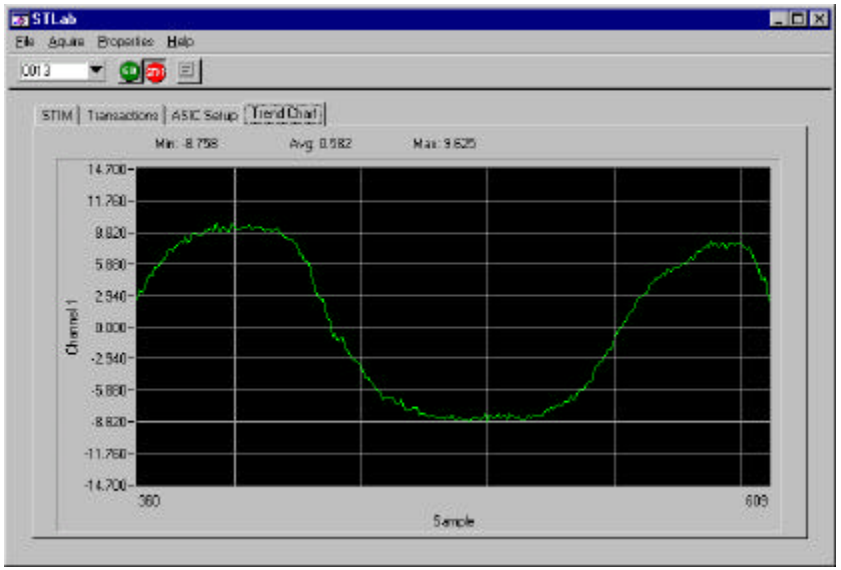
PC host software



- Supports network protocol:
  - Multi-drop (RS-485)
  - Discovery (bit dominance)
  - Command-response mode
  - Streaming data mode (pseudo TDMA)
  - Host controls trigger
- Supports all IEEE 1451.2-1997 STIM transactions
- Correction engine in PC host

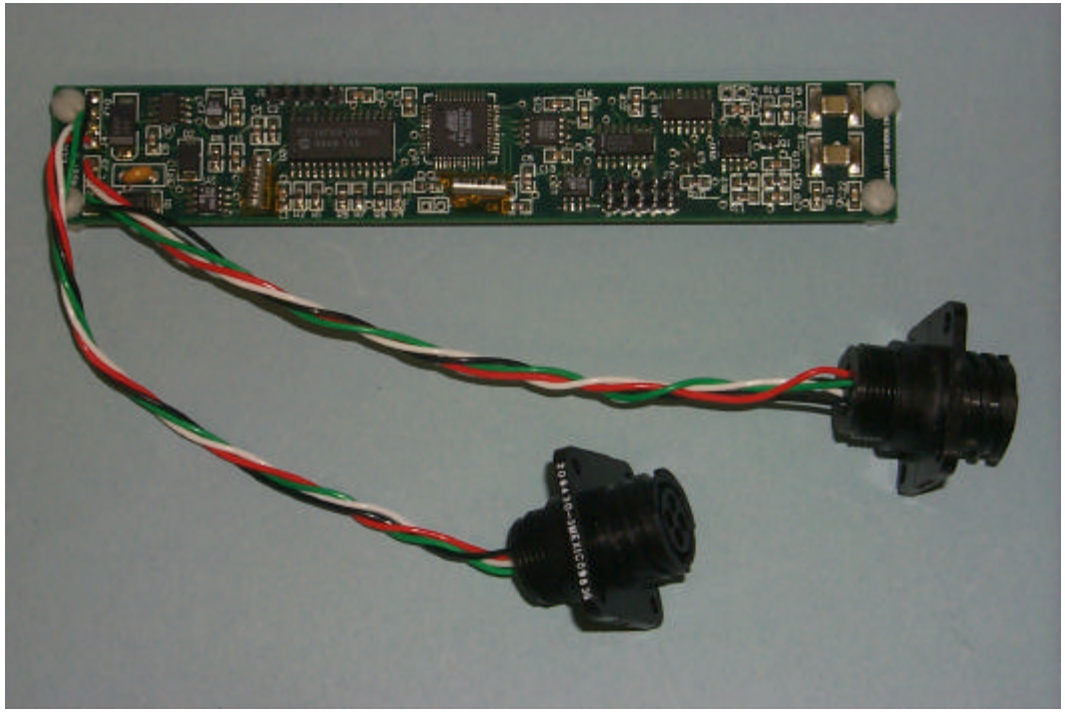
PC host software, con't.





- Screen shots show IEEE 1451.2 operation modes:
  - Individual STIM transaction
  - Streaming data

Serial interface smart sensors for DAQ



- Combined STIM and RS-485 NCAP electronics
- Used with multiple channels and multiple devices on single network
- Serial interface to PC-based host software

Serial message packet format

Field #	Description	Value	Size (bytes)
1	Header	0xAA	1
2	Header	0x55	1
3	Node Identifier	0 - 255	1
4	Length of Data	1 - 29	1
5	Data		1-29
6	Checksum	0 - 255	1

- Philosophy: Keep it simple to support small (8-bit) STIMs
  - Unique headers with byte stuffing in body
  - Short packets (but no limit on number of packets)
  - Simple 8-bit checksum

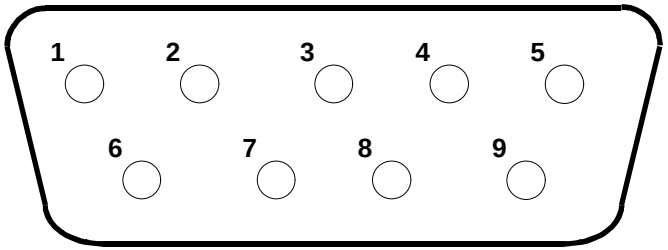
STIM transaction messages

Function Code (hex)	Description	Parameters	Parameter Info	Response Code (hex)
21	Write a message to the STIM. Performs a complete write data transfer with the STIM module.	Function Channel Data	0 - 255 0 - 255 1 - 29 bytes	91
22	Read message from the STIM. Performs a complete read data transfer with the STIM module.	Function Channel Number of bytes to read	0 - 255 0 - 255 1 - 29	A2
23	Initiate a STIM data transfer. Start a read or write block transfer with the STIM module. Use with function 24 and 25 to write or read large blocks of data.	Function Channel	0 - 255 0 - 255	80
24	Write a block of data to the STIM module.	Data	1 - 29 bytes	80
25	Read a block of data from the STIM module.	Number of bytes to read	1 - 29	A5
26	End the STIM data transfer. Ends the read or write block transfer started with function 23.	None		80
2F	Abort a STIM function. Terminates the given STIM function. If the parameter value is 0xFF, all STIM functions are terminated.	Function code to abort	byte	80
31	Set the channel and data length for the trigger function. This command sets the STIM channel and the amount of data the node will read upon completing a local or global trigger.	Channel Number of bytes to read	0 - 255 1 - 29	80
32	Generate a local trigger. Hardware triggers the STIM module attached to the node and returns the data read from the channel specified using function 31.	None		A2

Future plans for serial smart sensor

- Update for recent higher performance application
  - Higher speed
  - More channels
  - Harsh environment
- DB-9 (UART) version of STIM-in-a-connector
  - Control lines for low power operation
  - RS-485 option on same connector
- Support IEEE 1451.2 enhancement Working Group
- Gage interest in reviving Smart Sensor Interface Kit to support smart transducer development

RS-232C/RS-485 smart sensor interface



Pin number	Signal name	Signal Type	Signal Description
1	V+	Power	Input power to sensor
2	RxD	Input	Received data
3	TxD	Output	Transmitted data
4	SRQ	Output	Sensor request for service (logic 0, positive voltage)
5	GND	Power	Ground for power and RS-232
6	RS-485B (+)	Bi-directional	Positive side of RS-485 communications
7	RTS	Output	Sensor ready for communications
8	CTS	Input	Communicator ready for communications
9	RS-485A (-)	Bi-directional	Negative side of RS-485 communications

Notes on Connector Pins

1. Electrical characteristics of pins 2, 3, 4, 5, 7, and 8 are as defined in EIA RS-232C.
2. RS-232C Serial port is a DTE device except the logical use of pins 4, 7, and 8 is as described in this data sheet.
3. Electrical characteristics of pins 6 and 9 are as defined in EIA RS-485.

Please visit the IEEE 1451 section of the Emerging Technology Pavilion.

Will be demonstrating the serial interface and STIM-in-a-Connector hardware on Wednesday, June 4, 2003.

Questions/Discussion?