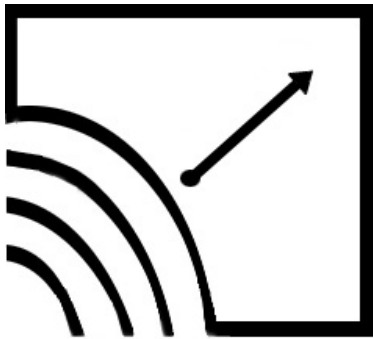


# Esbu – A sensor bus based on the SPI serial interface



Esensors

**Dr. Darold Wobschall**

Esensors, Inc.

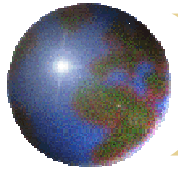
Amherst, NY 14226, USA

**Hari Sai Prasad K.**

Graduate Student

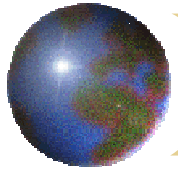
SUNY at Buffalo

Amherst, NY 14260, USA



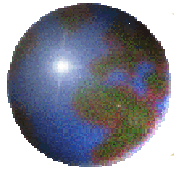
# Overview

- Smart Transducer architecture
- Network Sensor Block diagram
- Ebus Interface
- Monitoring Example
- Summary

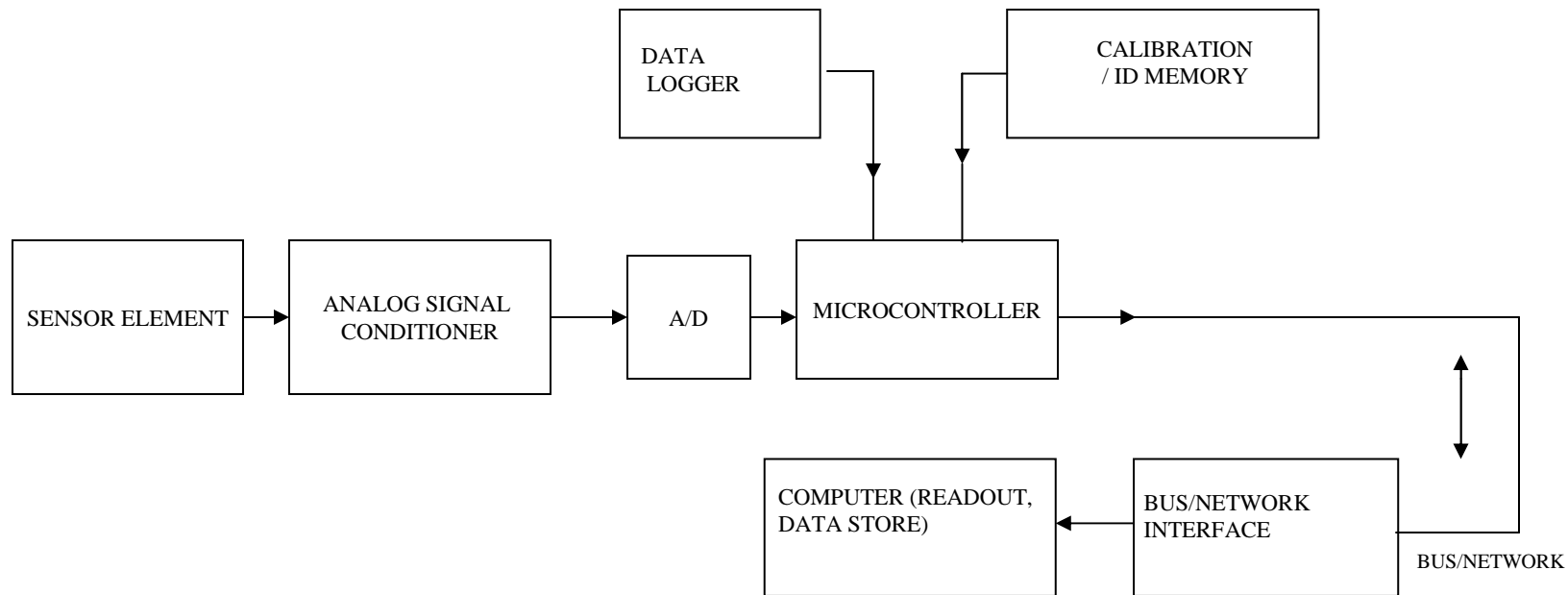


## Sensor Networks and Busses

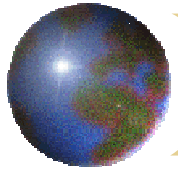
- ❖ Smart sensors without a network have limited applications (and not very smart)
- ❖ Multiple network standards available and used (each best for specific applications)
- ❖ *Examples:* Fieldbus, CAN (Device-net & SDS), LonWorks, Modbus, ARCnet, HART
- ❖ Lack of standards inhibit wider use of smart sensors
- ❖ No universal standard in spite of efforts to establish one (multiple standards likely for many years)



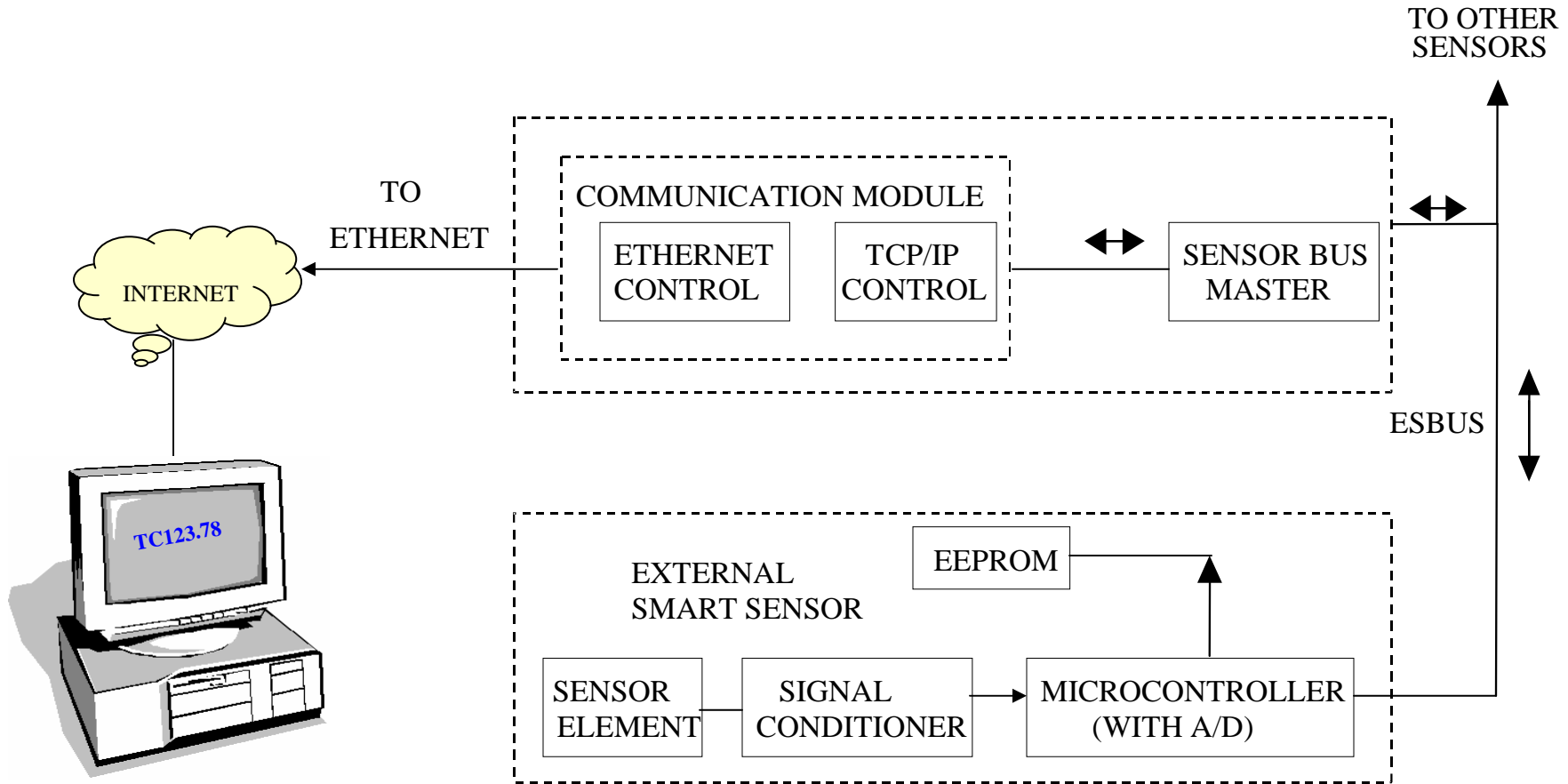
# Generic Smart Sensor Block Diagram

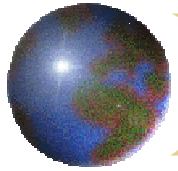


- Sensor with microcontroller, signal processor and calibration
- Network/Bus Interface



# Websensor Block Diagram





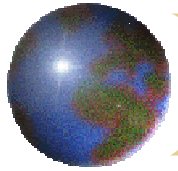
# Esbu Interface

6 wire sensor bus with modular connector based on modified SPI

- Local Bus Options considered

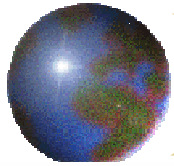
RS232, RS485, I2C and SPI Serial Buses

- SPI was selected because of wide availability, simplicity, low cost, and variable clock rate
- Optical Isolators provide networking capability

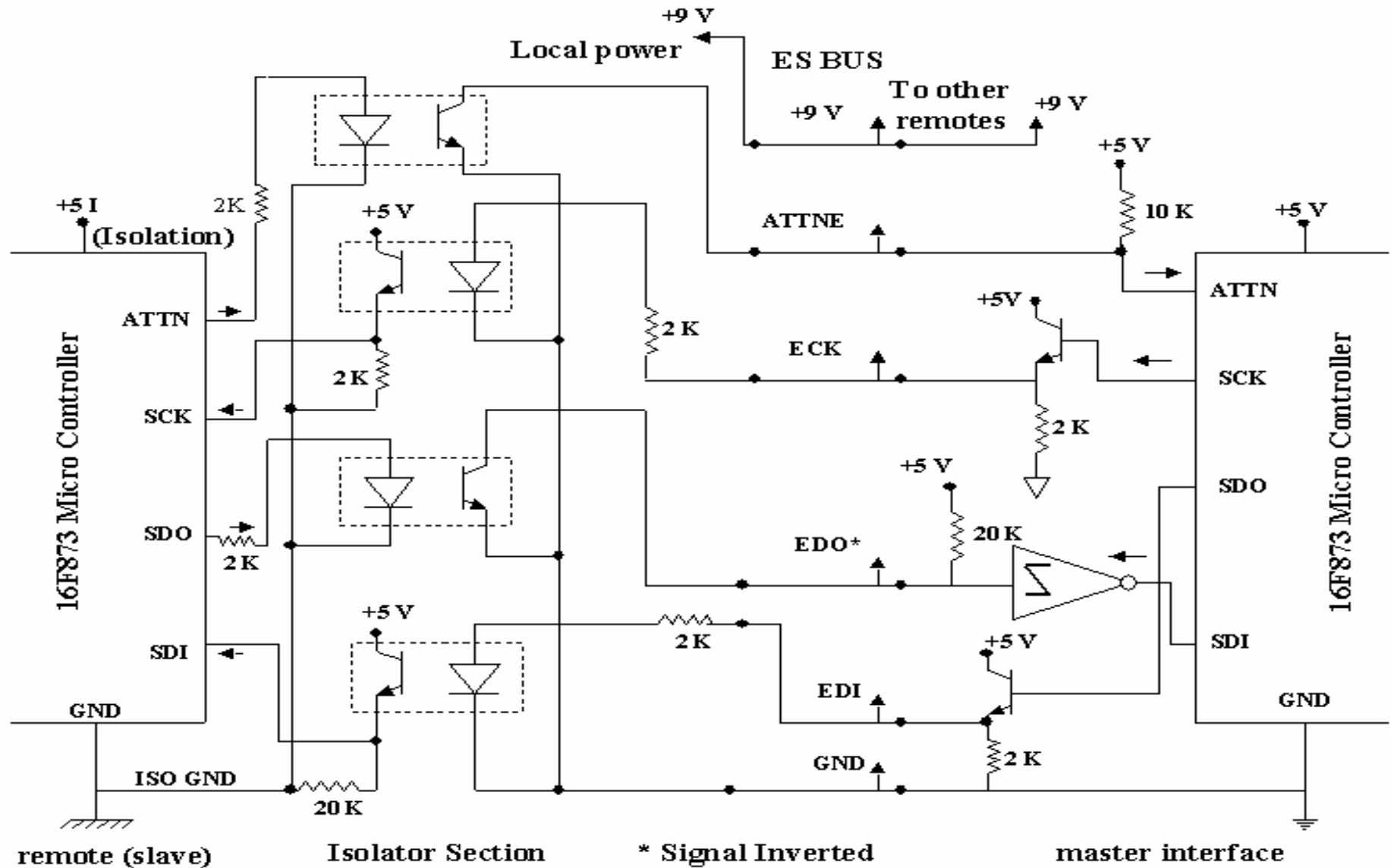


# *Esbu* Description

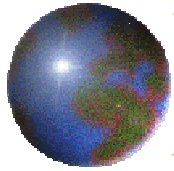
- Based on SPI serial interface
- Byte of data is exchanged between the master and slave
- Optical isolators provide ground isolation for safety and noise reduction
- Data is transmitted from master along EDI lines
- The signal is connected to the data input to SPI serial bus on microcontroller
- Sensor information from slave are transmitted on EDO line to output of remote sensor
- Data line is connected to SDO in sensor end.
- Isolated DC to DC supply is used to retain ground isolation (optional)



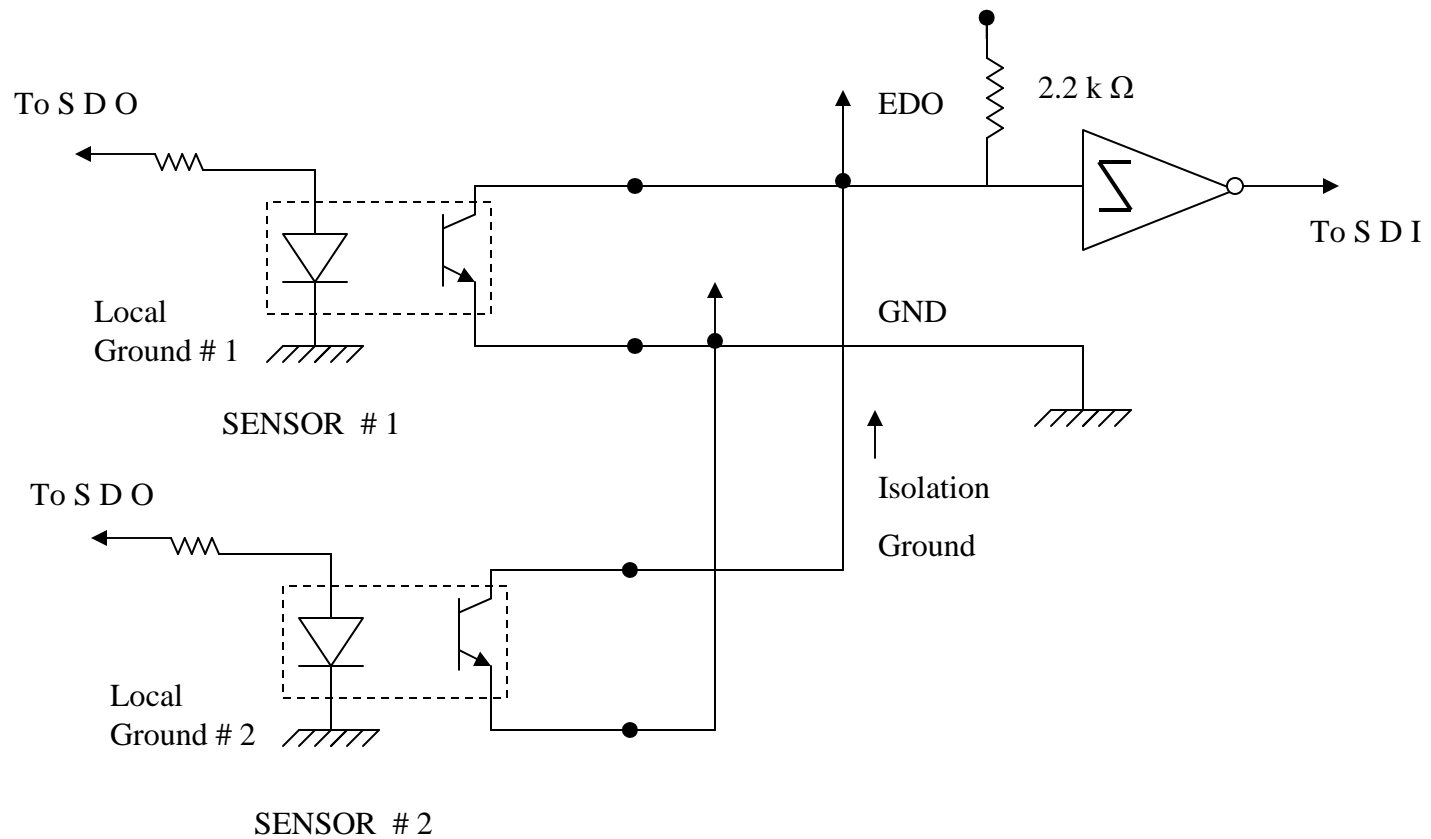
# Esbu Circuit Diagram

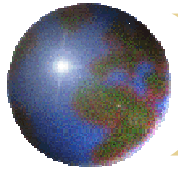




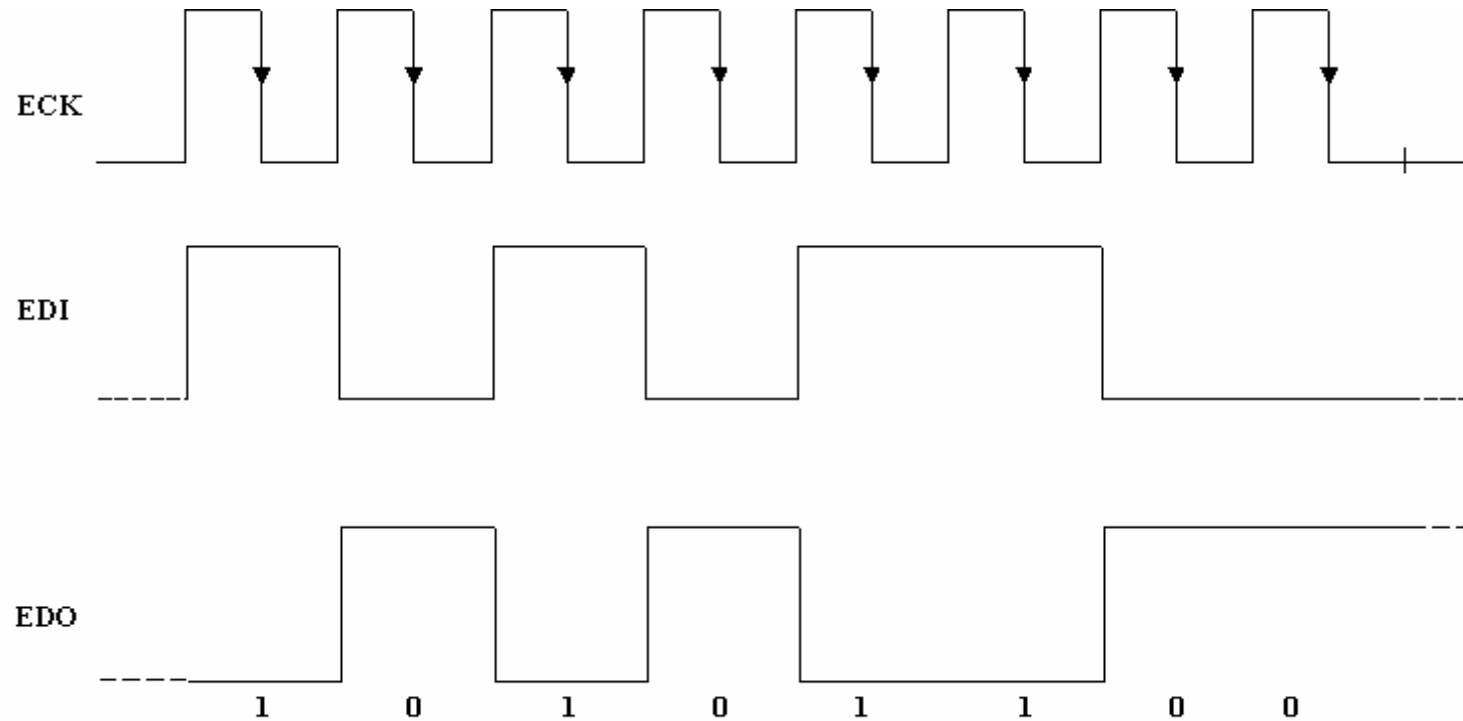


# Esbu Circuit Showing Open collector multiplexing on EDO

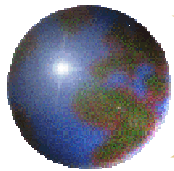




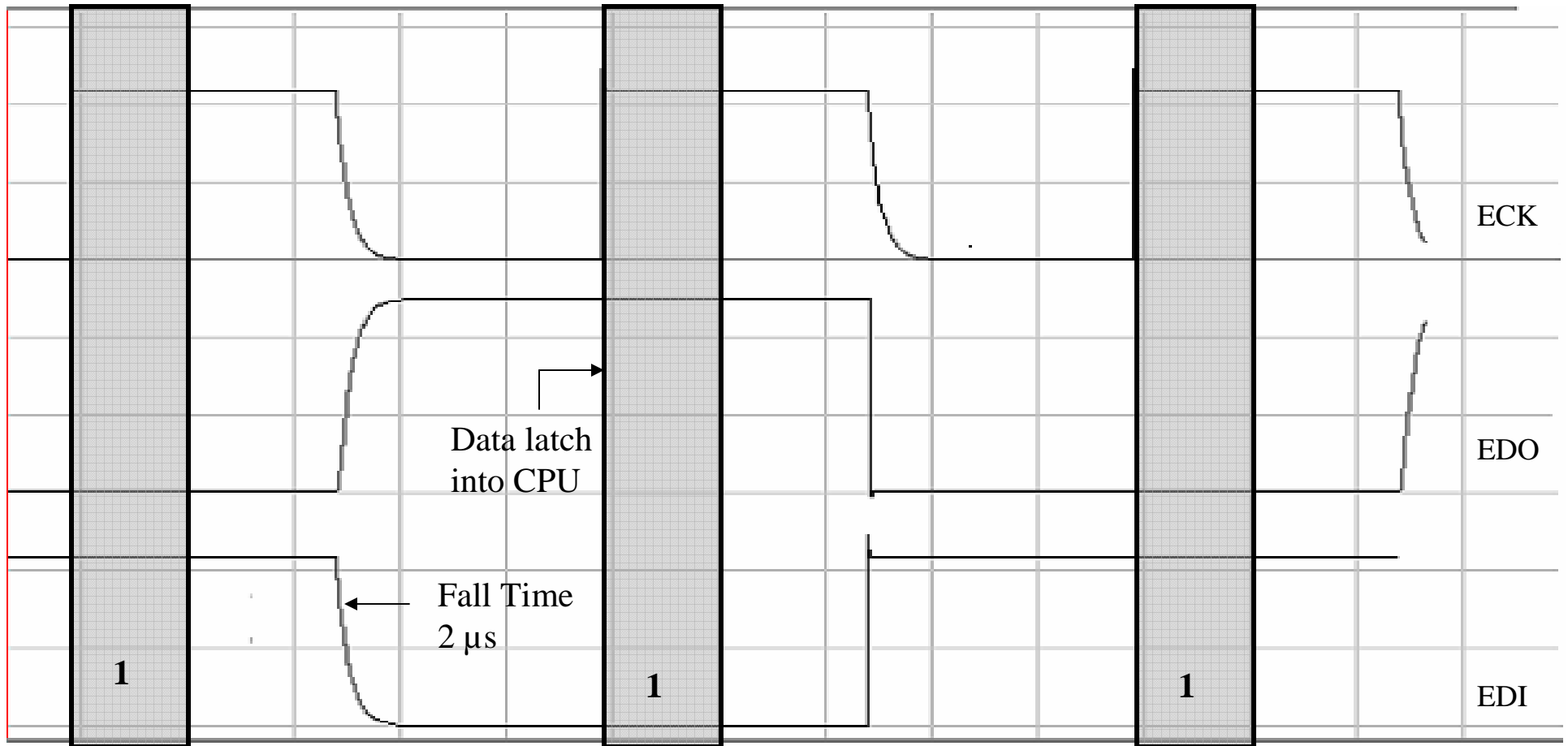
# Esbus Waveform



Note: EDO is Inverted



# Waveform Details – Simulated

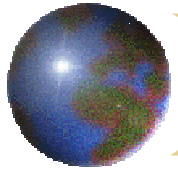


Amplitude : 2 V / div

Time base : 0.02 ms/div

Clock Frequency : 10 KHz

Line Length : 30 meter (1 μf)



## Data format transmitted to/from sensor over the Ebus and Internet

### Command from Website to Sensor

<http://localhost/index.php?action=chart&group=2&Sensor=0&%date=1&cdate=2001.06.01>

General header: Eiiiiicfw

E = 1<sup>st</sup> byte (ASCII)

iiii = sensor model (4 char)

c = channel # (1 char, hex)

f = format [1 for standard

Ebus format]

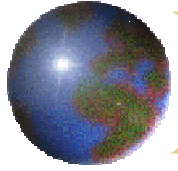
w=status/attention byte

Data: ssddd.dd (3 of these)

ss is sensor parameter type (e.g.  
temperature)

d is sensor data; 6 digits

. is decimal point, placed anywhere



# Example : HVAC Monitor

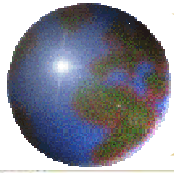
Measures temperature, Illumination and Relative humidity of Commercial Buildings

EM01a010 Header

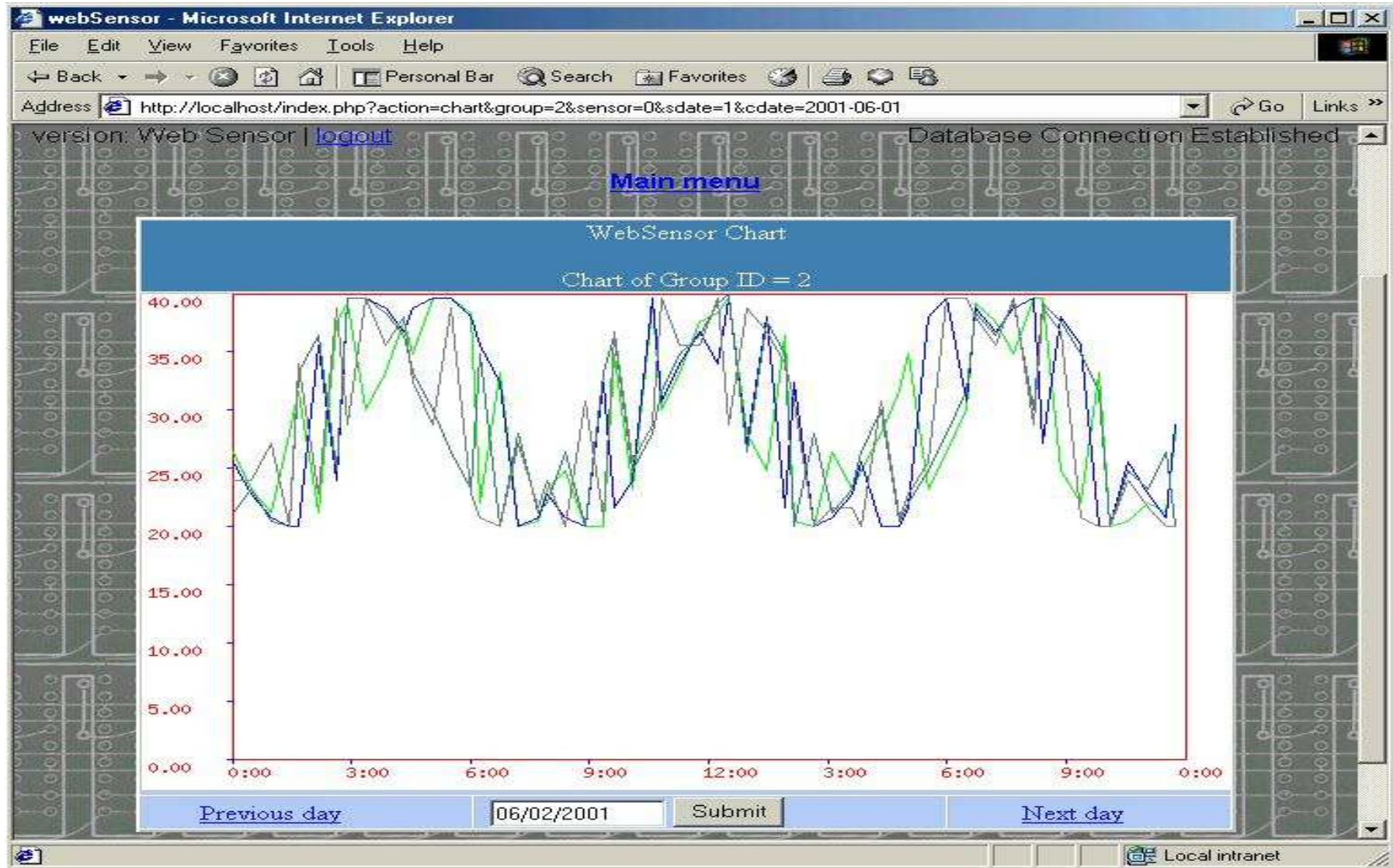
TC123.78    Temperature

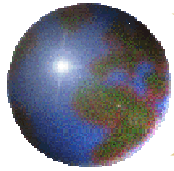
I1142.57    Illumination

H046.87    Humidity



# Sensor Monitoring Website





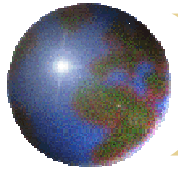
# Photos of Websensor



Digital Power Meter



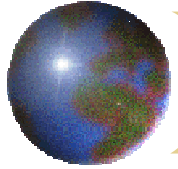
HVAC Monitor



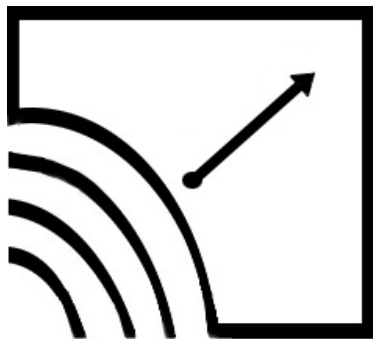
# Summary

- Smart Sensor with a digital network have been developed
- Sensor data is transmitted through the Internet in an Email format (TCP/IP)
- A local bus (Esbu) based on SPI facilitates interconnection of groups of sensors at the measurement site.





# Contact Address



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