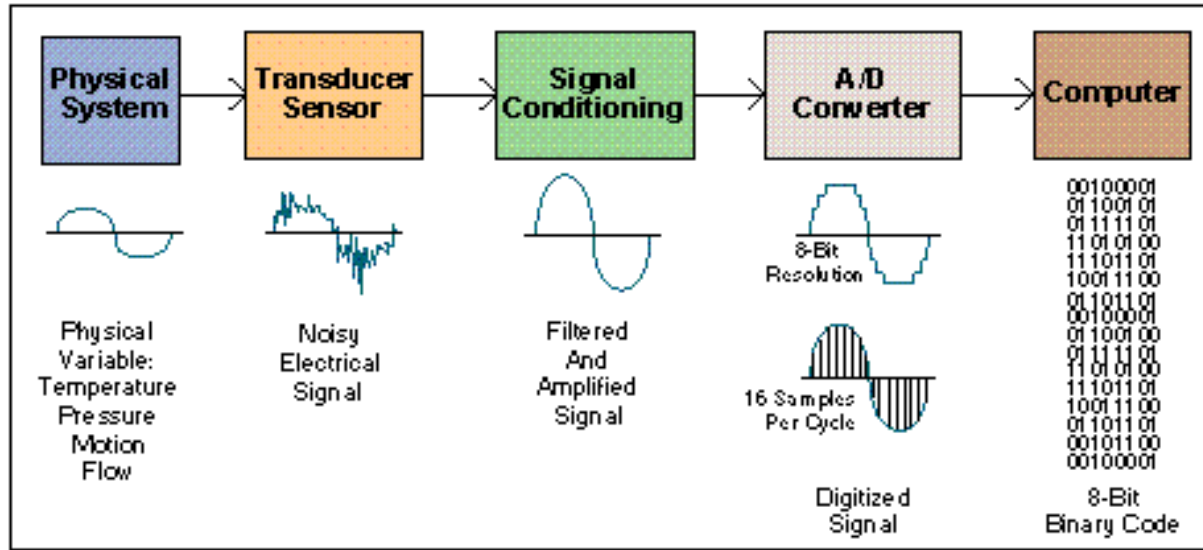


Sensor Nodes

Data Acquisition System Block Diagram



A data acquisition system consists of many components that are integrated to:

- Sense physical variables (use of transducers)
- Condition the electrical signal to make it readable by an A/D board
- Convert the signal into a digital format acceptable by a computer
- Process, analyze, store, and display the acquired data with the help of software

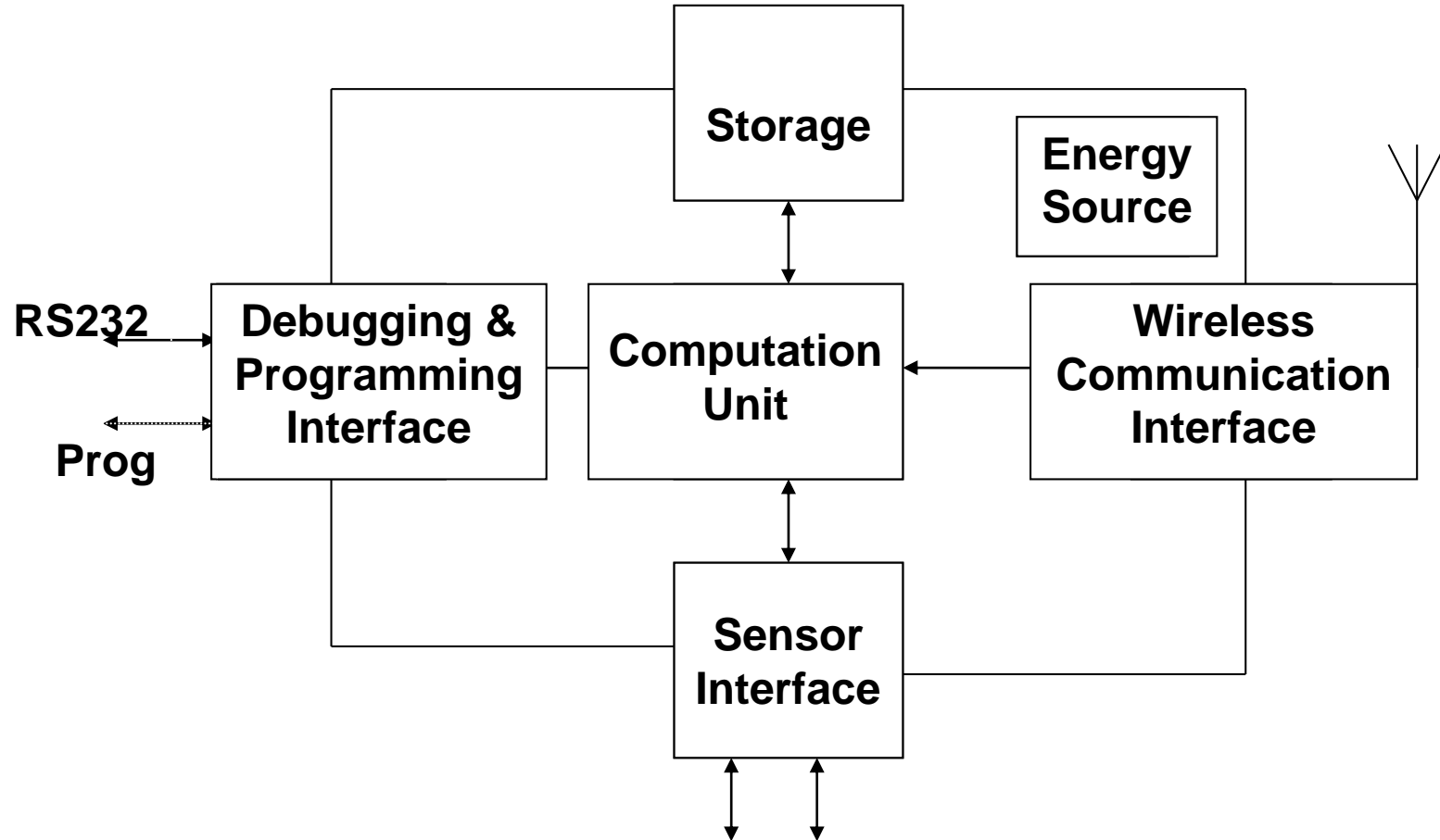
A data acquisition system having smart sensors & which transmits data wirelessly can be said to be a

Wireless Sensor Network.

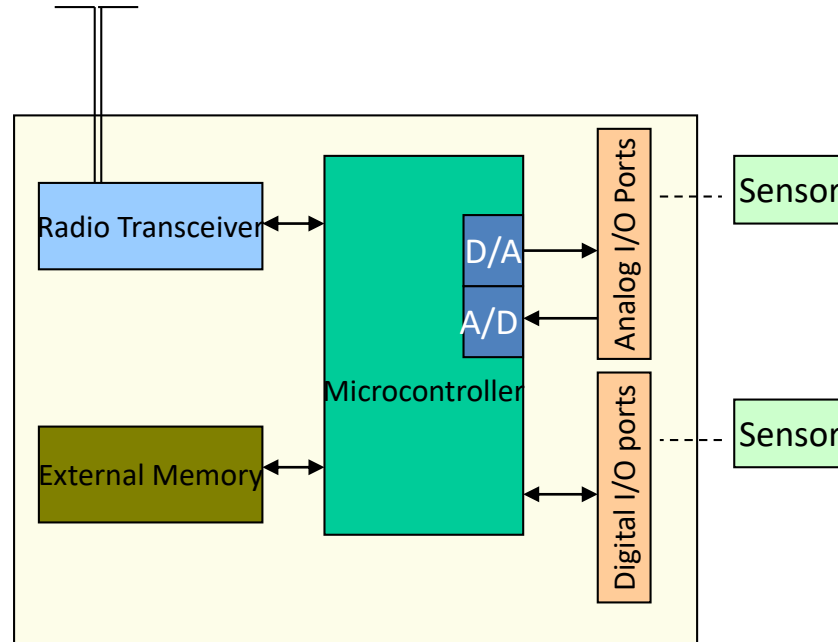
Wireless sensor network

- Consists of large number of **sensor nodes**, densely deployed over an area.
- **Sensor nodes** collaborate with each other, measuring the surrounding physical parameters.
- Sensed measurements are transformed into digital signals and processed, to reveal some information about the phenomena monitored.
- Sensor nodes have short radio transmission range. Hence they work together, collaboratively, to gather and transmit the data / information gathered.

Basic Smart Sensor Node Architecture



Mote / Sensor Node



- A very low cost low power computer
- Monitors one or more sensors
- A Radio Link to the outside world
- Are the building blocks of Wireless Sensor Networks (WSN)



A sensor node (mote)

- 8K RAM, 4Mhz processor
- magnetism, heat, sound, vibration, infrared
- wireless (radio broadcast) communication up to 100 feet
- costs ~\$10 (right now costs \$200)

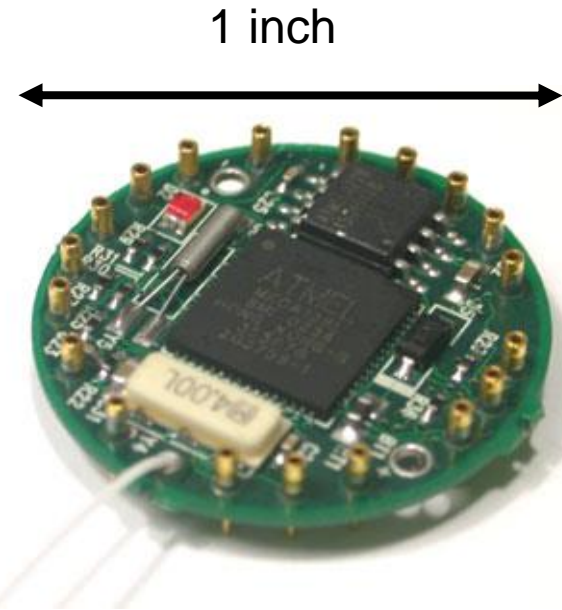
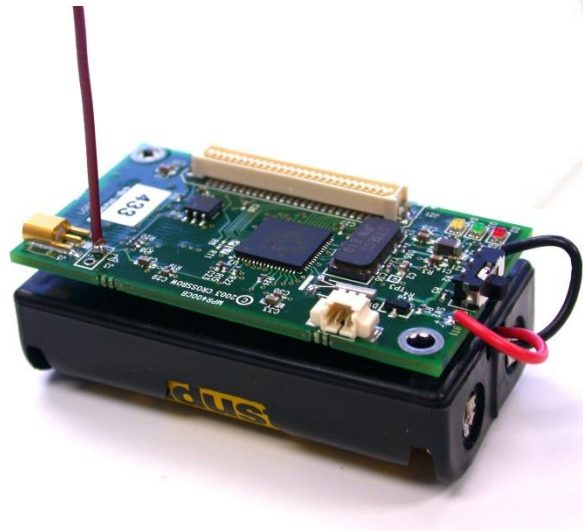
Match-box Sized Node

- Mica series, XSM node, Telos
- 8-bit microprocessor, 4MHz CPU
 - ATMEGA 128, ATMEL 8535, or Motorola HCS08
- ~4Kb RAM : holds run-time state (values of the variables) of the program
- ~128Kb programmable Flash memory
 - holds the application program
 - Downloaded via a programmer-board or wirelessly
- Additional Flash memory storage space up to 512Kb.

Grain Sized Node

- ✓ Powered by inductive coupling to a transmission from a reader device to transmit a message back
- ✓ Available commercially at very low prices
- × Computation power is severely limited
 - × Can only transmit stored unique id and variable
- × Hard to add any interesting sensing capability

- ATmega128 CPU
 - [Self-programming](#)
- Chipcon CC1000
 - FSK
 - Manchester encoding
 - Tunable frequency
- Low power consumption
 - 2 AA battery = 3V



mica



mica2



mica2dot



micaZ



telos



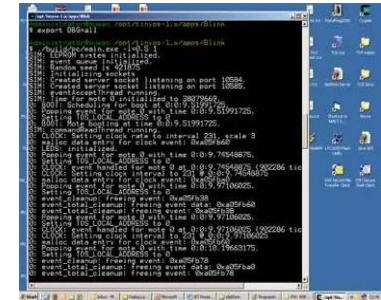
telosb



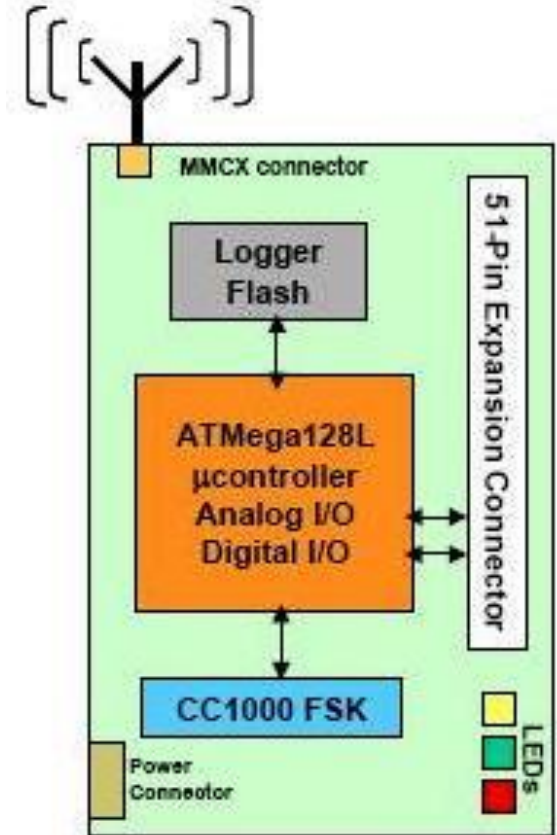
rene2



pc



- Extremely popular mote
- 8-bit AVR Controller
- FSK radio
- Data-logger flash

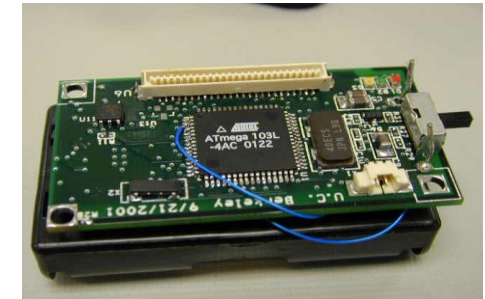
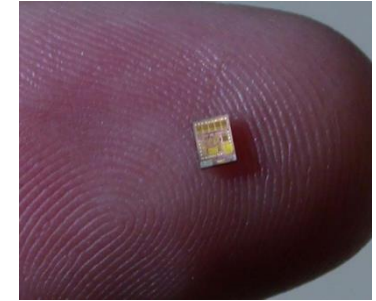


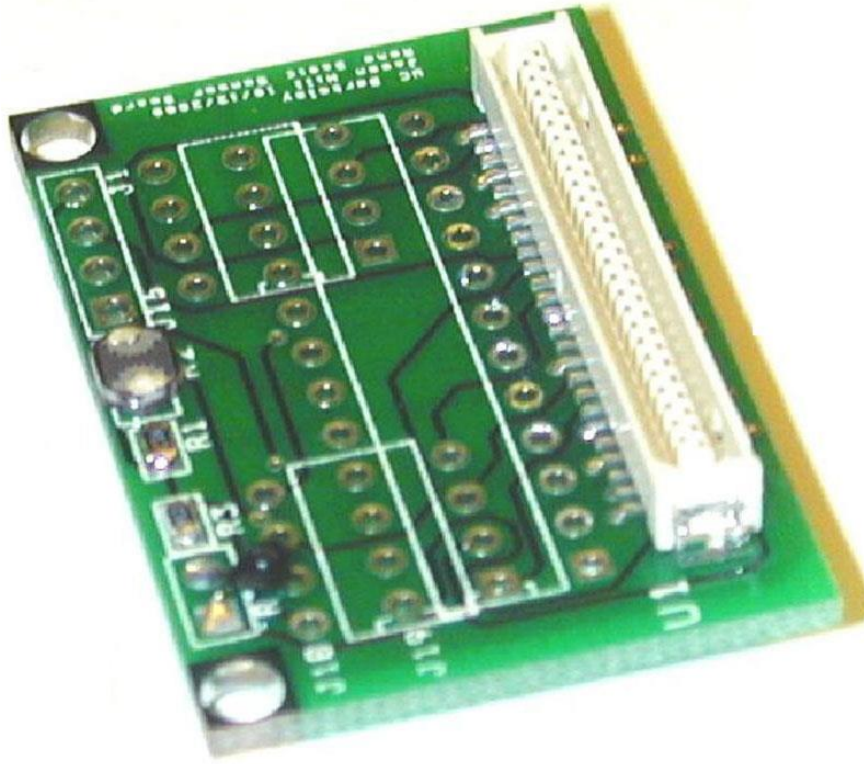
Taxonomy of Sensor Nodes

Sr. No	Size of sensor	Mobility of sensor	Power of sensor	Computation logic & Storage capability of sensor	Sensor mode	Communication apparatus or protocols of sensor
1	Large	Mobile	Self replenishable	High end processor & storage	Multimodal, physics	Multihop, mesh with dynamic routing
2	Small	Static	Battery, hours-days	Mid range processor & storage	Multimodal, chemistry-biology	Single hop with static routing
3	Microscopic		Battery weeks-months	Low end processor & storage	Single function, physics	
4	Nanosopic		Battery years		Single function, chemistry-biology	

Types of sensor platforms

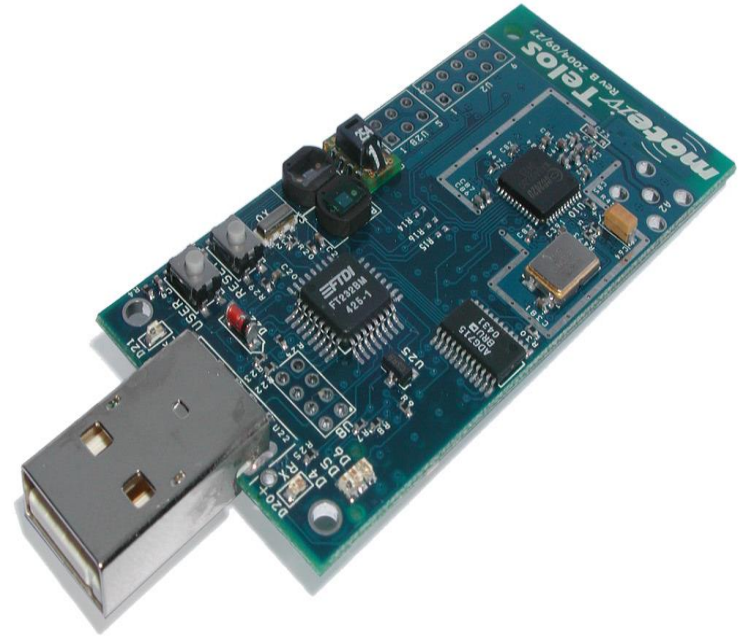
1. RFID equipped sensors
2. Smart-dust tags
 - typically act as data-collectors or “trip-wires”
 - limited processing and communications
3. Mote/Stargate-scale nodes
 - more flexible processing and communications
3. More powerful gateway nodes, potentially using wall power





- Light (Photo)
- Temperature
- *Prototyping* space for new hardware designs

- Low Power
 - Minimal port leakage
 - Hardware isolation and buffering
- Robust
 - Hardware flash write protection
 - Integrated antenna (50m-125m)
 - Standard IDC connectors
- Standards Based
 - USB
 - IEEE 802.15.4 (CC2420 radio)
- High Performance
 - 10kB RAM, 16-bit core, extensive double buffering
 - 12-bit ADC and DAC (200ksamples/sec)
 - DMA transfers while CPU off



Brick-sized node: Stargate

- Mini Linux computers communicating via 802.11 radios
 - Computationally powerful
 - High bandwidth
 - Requires more energy (AA infeasible)

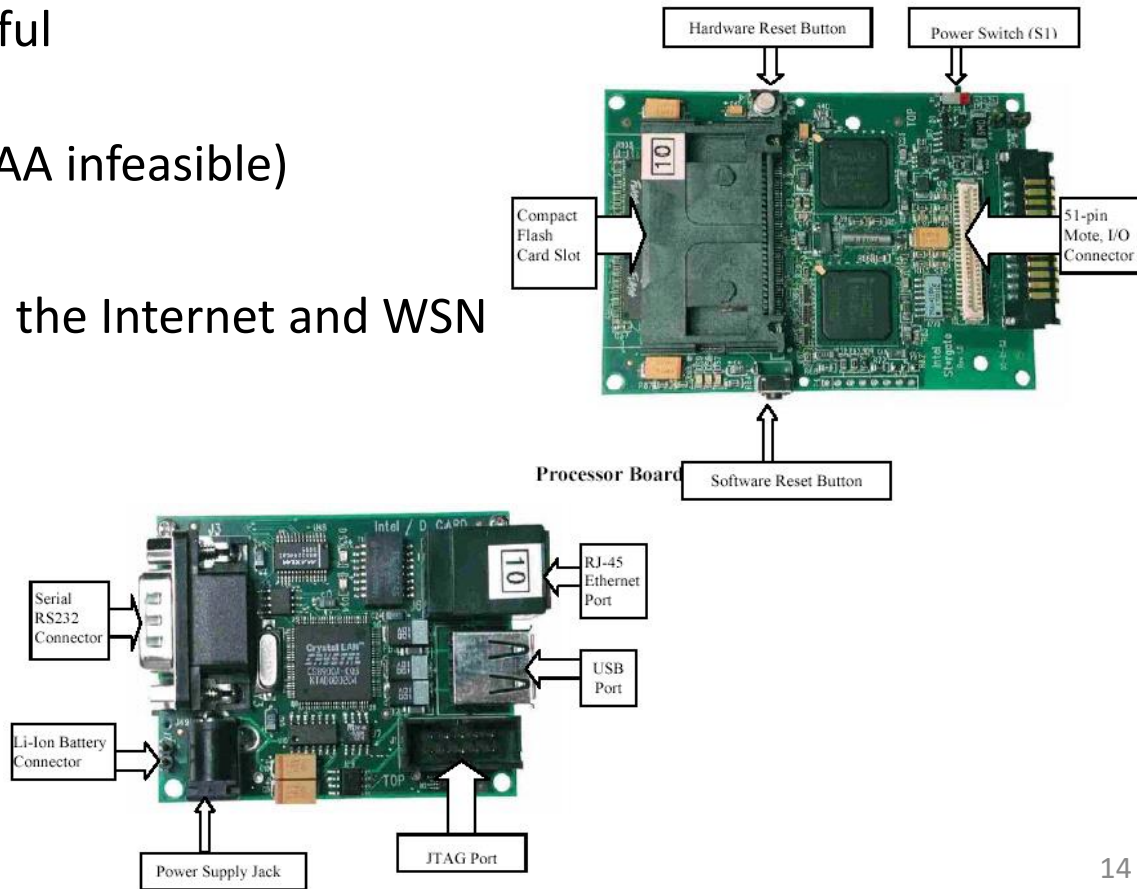
- Used as a gateway between the Internet and WSN

Hardware

- RFID, Spec
- Mica2, XSM, Telos
- Stargate

Software

- TinyOS



What is a smart sensor ?

A smart sensor is a device that can compute, communicate and sense the environment

What makes sensors smart ?

- Self Identification & Self Diagnostic
- Time Awareness
- Digital Output
- Provide software functions like Signal processing, Data logging
- Conforms to a standard data & control protocol

Thank You!