WELCOME !

Prithvi Security

Computer Network Security and Implementation of Wireless Sensor Networks

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Know about our C.E.O

Pradipta Kumar Ghosh, Sole Trader of Prithvi Security, M.Sc.(Data Telecommunications Networks) from University of Salford, Manchester(UK), MBA, MCSE, and have more than 15 years experience in the field of IT business sector / industry.

Pradipta invited by Association of Computer Machinery (ACM), New York, US for delivering lecture on 'Rabin's Scheme and RSA Cryptography and Conversion of Power'.

He has extensive experience in managing IT infrastructure and operations at a senior level as well as demonstrated capabilities in project management and proven ability to lead target teams.

You may follow us on :

https://www.linkedin.com/company/prithvisecurity

Sensor

- A device that measures or detects a real-world condition, such as motion, heat or light and converts the condition into an analog or digital representation. An optical sensor detects the intensity or brightness of light, or the intensity of red, green and blue for color systems.

- ***A sensor is a small hardware device which is capable of generating response to change in physical environment.***

- ***Although sensors are of different type which are application specific but desired characteristics of a sensor node are small size and low power consumption***

Wireless Sensor Networks

Wireless sensor network (WSN) is a wireless network consisting of spatially distributed autonomous devices using sensors to cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants, at different locations .

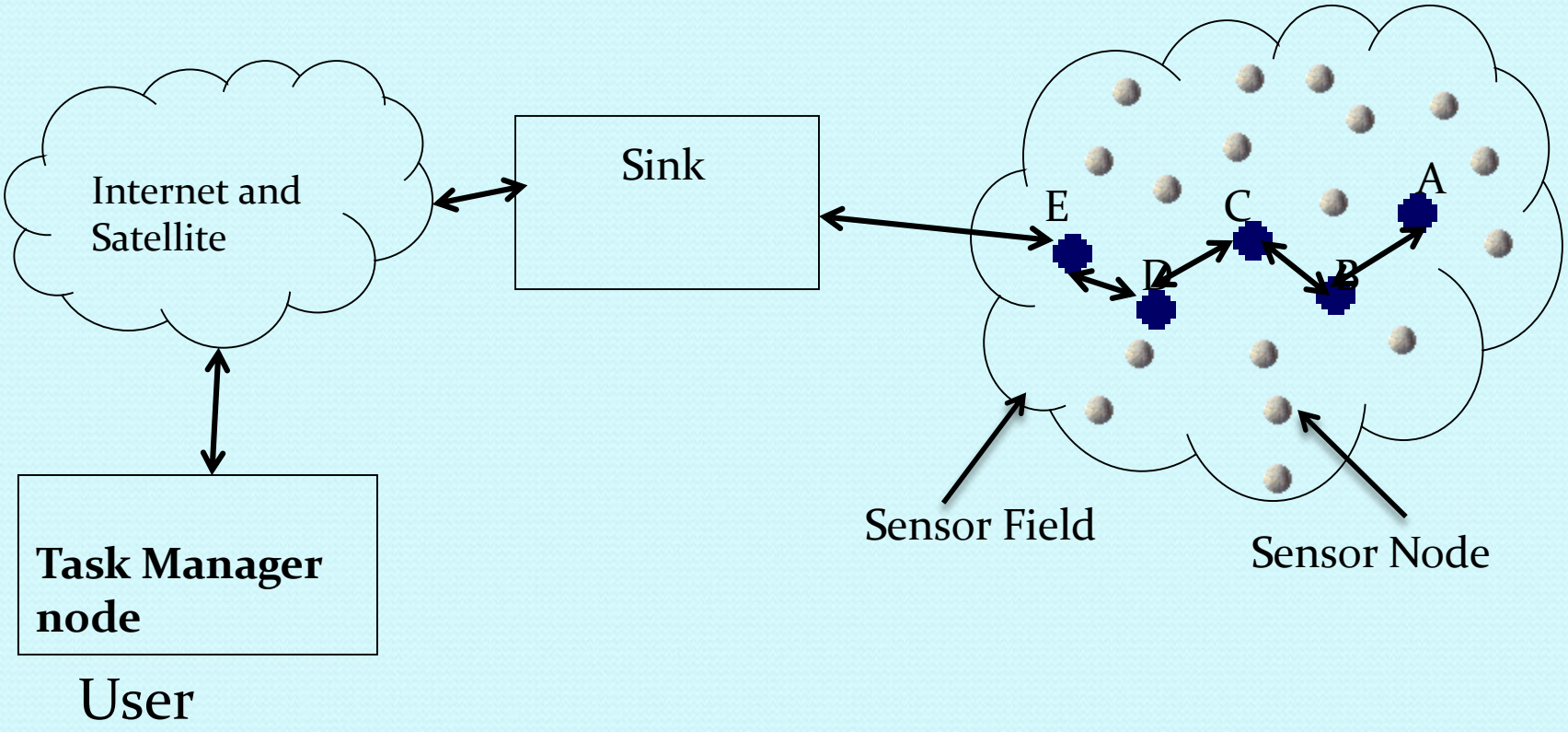
Wireless Sensor Networks

- A collection of sensing devices that can communicate wirelessly
- Each device can sense, process, and talk to its peers
- Typically, centralized collection point (sink or base station)

Sensor Node

A sensing node has 3 basic components:

- **CPU**
- **radio transceiver**
- **sensor array**



Sensor Node deployment and Communication Infrastructure

The role of Wireless Sensor Networks is essentially that of a monitor. What is being is monitored can usually be placed within one of the three groups:

- Area Monitoring: i.e., monitoring somewhere; examples include the Environment or area alarms (intrusion etc.)

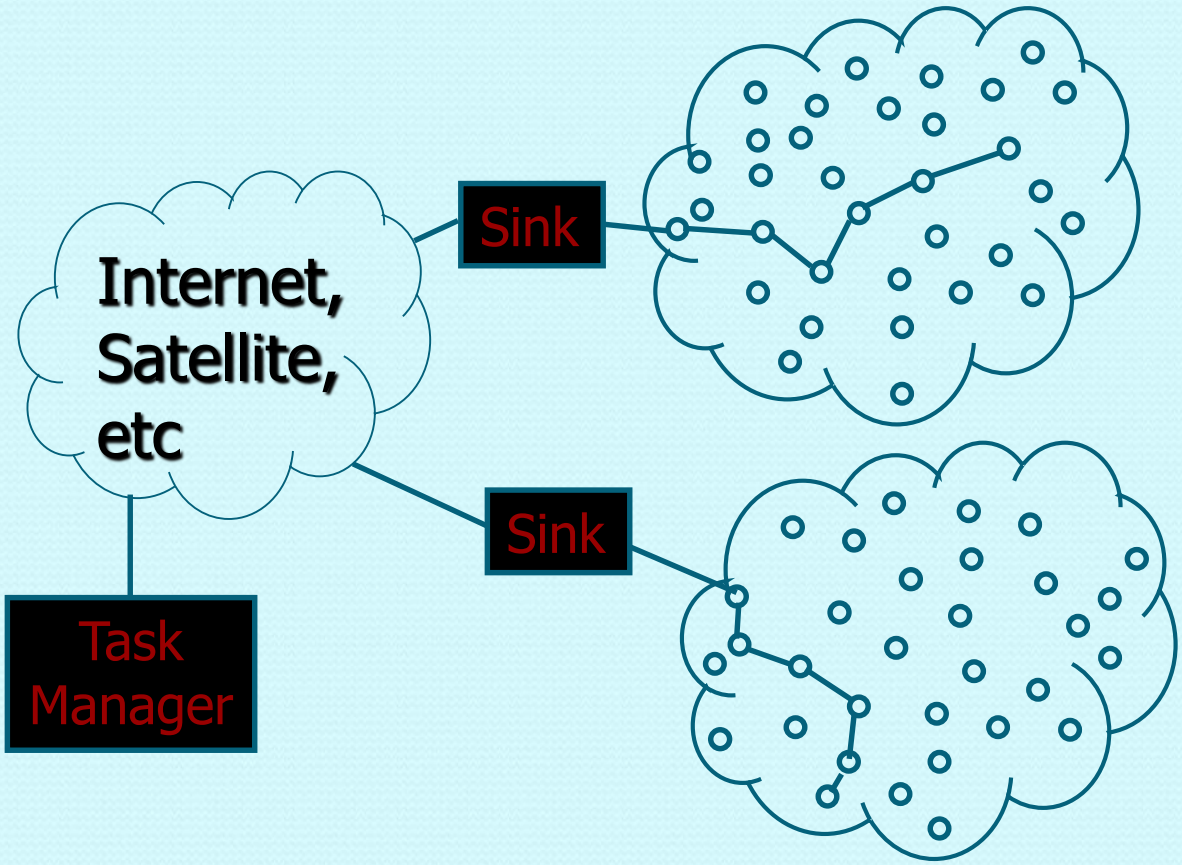
- Entity Monitoring: i.e., monitoring something; examples include a civil structure (bridge, building etc.) or a human body.

- Area-Entity Interaction Monitoring: i.e., monitoring something, somewhere in context; examples include natural disaster sites, asset tracking or a manufacturing process.

There is presently great interest in Wireless Sensor Networks (WSNs). To clarify the issues, we have needed to separate technology push from market pull. Performing this separation has shown the push to often be greater than the pull. In particular, we have found no killer application for WSNs, although we expect a steady growth in the future market based on a diversity of industrial and automation application. WSNs are among the 5 emerging and innovative technologies that will change the world, for the better.

Sensor Network Concept

- Sensors nodes are very close to each other
- Sensor nodes have local processing capability
- Sensor nodes can be randomly and rapidly deployed even in places inaccessible for humans



- Several thousand nodes
- Nodes are tens of feet of each other
- Densities as high as 20 nodes/m3

A WSN typically has little or no infrastructure. It consists of a number of sensor nodes (few tens to thousands) working together to monitor a region to obtain data about the environment.

Sensor nodes can organize themselves to communicate with an access point
Sensor nodes can collaboratively work

Soil Moisture etc.

Mote

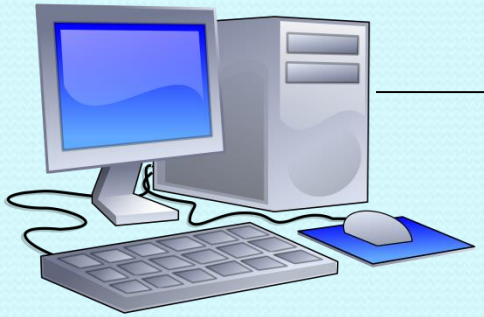
Server

Communication's barrier

Sensor field

Gateway

Internet

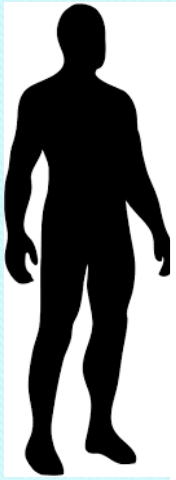


USB Connection

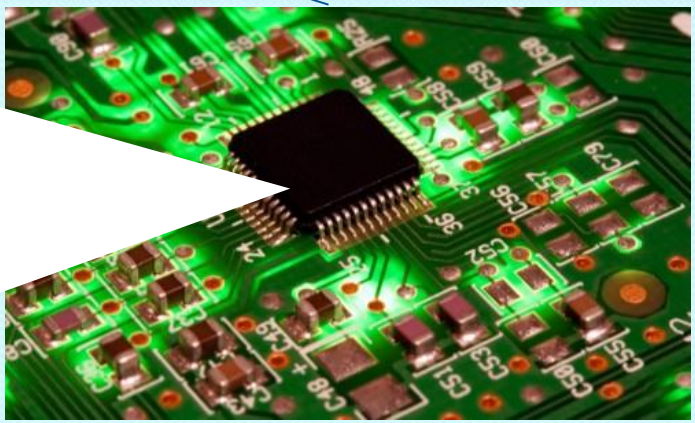
Gateway

Base Station

Radio Link



Human



Node

Hardware Requirements

- **Motes:** A mote is a low-powered computer with a radio transmitter capable of forming ad-hoc communication with other motes. A mote may be connected to one or more sensor boards.

- **Gateway:** A gateway is device which is responsible for injecting queries into the sensor network, gathering responses from the network, and presenting the responses to the user's workstation. The gateway interacts with the user directly or remotely through mobile communication network.

Processes and services

Wireless Ad-hoc Sensor Networks (WSNs)

Wireless Ad-hoc Sensor Networks (WSNs) are quickly gaining popularity due to the fact that they are potentially low cost solutions to a variety of real- world challenges. WSNs have significant impact upon the efficiency of Military and Civil Applications, Disaster Detection and Management, e.g., earthquake, cyclone, flood, fire etc., Air and Water Pollution Control, Tele-health, Medical monitoring and micro-surgery; which may be classified into three classes:

- Data Collection
- Surveillance, and object tracking

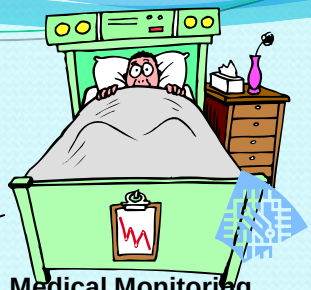
- **Monitoring workstation:** The monitoring workstation is a PC with required compatible software installed, and is used by the user to configure the WSN, to submit queries to the network, or to view the data collected by the network.

Machine Monitoring

Sensor

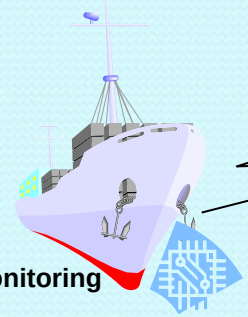
Animal Monitoring

Vehicle Monitoring



Medical Monitoring

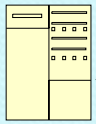
Wireless Data Collection Networks



Ship Monitoring

Management Centre (Database, Large Storage, and Analysis

BSC(Base Station Controller, and Processing)



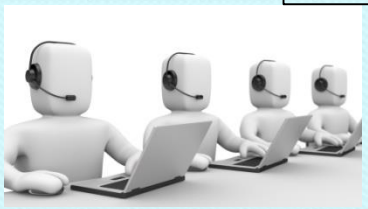
BST

Data Acquisition Networks

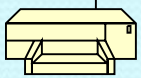
Data Distribution Network

Roving Human Monitor PDA

Any where and any time access

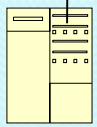


Online Monitoring



Printer

Transmitter



Server

Wireless Wi-Fi, Bluetooth, Cellular Network(CDMA, GSM)

Wireless(Ethernet WLAN Optical)

Laptop

Cellular Phone

Computer

Applications

WSN applications can be classified into two categories:

- ***Monitoring***
- ***Tracking***

Monitoring applications

- ***indoor/outdoor environmental monitoring viz., agriculture, air / water pollution***

- ***health and wellness monitoring, power monitoring, inventory***

- ***location monitoring, factory and process automation viz., pipeline***

- ***seismic and structural monitoring.***

Tracking objects

- *humans*
- *vehicles.*

Advantages of WSNs over traditional methods

- *Wide coverage*
- *Long monitoring periods*
- *No individual tracking*
- *Data available directly to researcher's location*
- *Land and Aquatic Coverage*

Different Types of Sensors

- Acoustic, sound, vibration sensor
- Chemical sensor
- Fire sensor
- Environment, weather, moisture, humidity sensor
- Optical, light, imaging, photon sensor
- Pressure sensor
- Thermal, heat, temperature sensor

WSN Operating Systems

- TinyOS
- Contiki
- MANTIS
- Btnut
- SOS
- Nano-RK

TinyOS:

- **Event-driven programming model instead of multithreading**

- **TinyOS and its programs written in nesC**

TinyOS Characersitics:

- **Small memory footprint**
  - **non-preemptable FIFO task scheduling**
- **Power Efficient**
  - **Puts microcontroller to sleep**
  - **Puts radio to sleep**

- **Concurrency-Intensive Operations**
  - **Event-driven architecture**
  - **Efficient Interrupts and event handling**

- **No Real-time guarantees**

Commercial Use

- **Cost:** The devices should have relatively low cost.

- **Availability:** The devices should be easily available and continue to be so

.

- **Unlicensed usage:** The devices should be usable without requiring any form of licensing, e.g., for use of the RF spectrum, or for the use of firmware or software which is used or modified during course of our work.

- **Ease of Use:** The devices chosen must be easy to program and must have software toolkits.

- **Interworking and gateways:** It should be easily possible to allow interworking of the sensor devices with other convenient network technologies, e.g., Internet Protocol (IP) gateways for sensors allowing inter action between the internet world and the world of the sensor network.

- **System Software:** There is a choice of operating system, but the officially supported platform is *TinyOS*, commonly accepted open-source development environment for sensor applications

WSN Emulators

- TOSSIM
- ATEMU
- Avrora
- EmStar

Market Information

As per the report of ON World, in 2018 global annual Wireless Sensor Network market revenues, including equipment and services, will reach $102 billion, up from $23 billion in 2013. Residential application will account for more than half of unit shipments in 2018. During the same period, commercial, industrial and municipal WSNs are projected growth at a 38% compound annual growth (CAGR).

Despite a challenging economy, the industrial Wireless Sensor Network (WSN) market has doubled over the past two years. A recently completed ON World survey of 216 industrial automation professionals, in collaboration with ISA, HART Communication foundation (HCF) and the Wireless Industrial Networking Alliance (WINA), points to increasing WSN adoption and expanding markets.

When ON World started researching industrial wireless sensing 10 years ago, deployments of more than 20 nodes were rare. Today, network densities are increasing, and several sites have deployments of more than 3000 nodes. Within the next 5 years, installed wireless industrial field devices will increase by 553 % when there will be nearly 24 million wireless-enabled sensors and actuators, or sensing points, deployed worldwide. By 2016, 39% of deployed nodes will be used for new applications that are uniquely enabled by WSN technology.

Another report from Forecast Technologies Players, WSNs market will grow to $1.8 billion by 2024.

Overall we conclude that the WSN market is still at an early stage. Many of the providers are small or start-up companies rather than integrated large players. Thus indicates that the market still has to develop confidence in the use and acceptability of WSNs.

Competitors

Some examples of companies and new entrants in WSNs include:

- ArchRock
- Coronis
- Crossbow
- Emerson Process Management
- GE Sensing
- MeshNetics
- Moteiv
- NEC
- Sensicast / Adaptive Wireless UK

Project

Established major sensor / controls suppliers

- Siemens
- Honeywell (Partnering with Crossbow Inc.)

Although, the devices should be easily available and continue to be so.

Major Customer Group

- Government

1. Defense Department

2. Police

- University
- Shopping Complex
- Building
- Hospital and Nursing Home
- Environment and Pollution Control Department
- Meteorological Department etc.
- Railways / Airports

Conclusion

WSNs can be deployed almost anywhere (including underwater and underground).

The following organizations use WSNs for their industrial purpose:-

 British Petroleum (BP)

BP use WSNs for detecting hazardous storage condition for its petrochemical products and for continuous vibration monitoring of the engines of oil tanks.

 The **Pentagon building use WSNs extensively.**

 Intel use sensor network for monitoring the state of semiconductor fabrication equipments to determine if the machines are about to fail.

 Boeing's use its" pressure belt" sensor networks for measuring pressure distribution on the wing surfaces of airplanes.

 Space Exploration: NASA's Jet Propulsion Laboratory use sensor networks for exploring other planets or asteroids.

Thank You