WPAN CFA

Harshal Chhaya

Texas Instruments

hchhaya@ti.com

Application Scenario for WPAN

- Network of personal computing devices in a classroom environment

-

Need for a New Standard

- A classroom network:
  - does **not** need range (typical range < 10m)
  - does **not** need ad-hoc networking (has well defined network control)
  - does **not** need support for telephony
 - does **not** need roaming/hand-off between networks

all of which are part of LAN stds and add complexity, cost, power

System Characteristics

- Characteristics of the educational network environment
  - 1. There is a teacher (control)
  - 2. A concentrated set of nodes
  - 3. Nearby cells (classrooms)
  - 4. Moderate high bandwidth
  - 5. Very cost sensitive
  - 6. Long battery life (24 hrs)
  - 7. Data reliability/premium on usability/self-correcting/redundancy

Well-defined Control (Teacher)

- One primary controller
- No peer-peer communication

Teacher
(controller)

Students
(portable units)
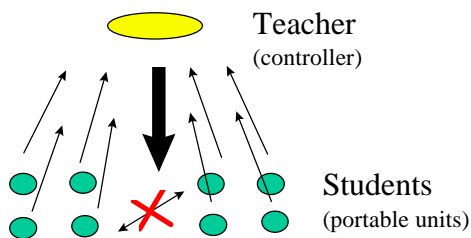
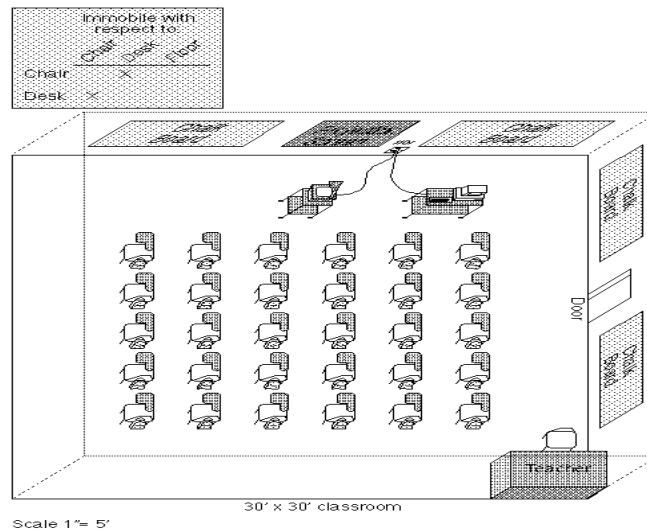# Concentrated Set of Nodes

- Typical classroom
  - 30 (school) - 128 (college) students in a room
  - Maximum distance from teacher < 15m
  - Distance between students (nodes) ~ 1 m
  -

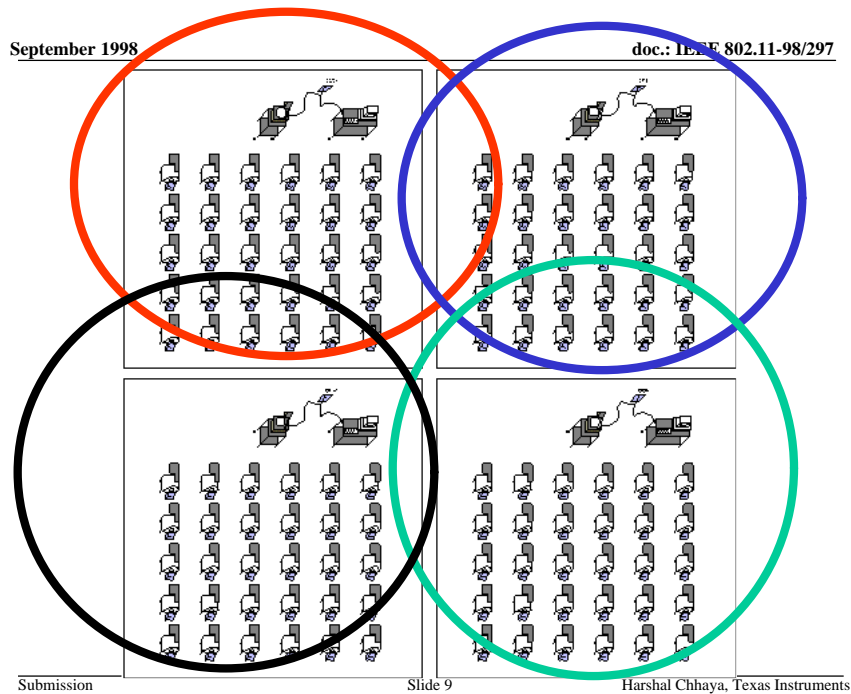Medusa project: Seating Layout #1a

Scale 1"= 5'

30' x 30' classroom

Adjacent Networks

- Adjoining classrooms create co-located networks
- Neighboring networks should **not** interfere
- Implies limited communication range for hand-held units

Submission   Slide 9   Harshal Chhaya, Texas Instruments

Moderately High Bandwidth

- Desired: 1-2 Mbps
- Data types:
  - Bulk transfers (broadcast)
  - Multimedia streams
  - Interactive sessions

Submission   Slide 10   Harshal Chhaya, Texas Instruments

Very Cost Sensitive

- Network devices are PDAs, calculators, data loggers etc.
- Cost: US$ 100-200
-
- The price premium for networking cannot exceed 20% of the cost of the endpoint devices
-

Strict Power Requirements

- Devices are battery powered
- Peak power drain: 100 ma @ 3V
-
- The network and endpoint devices must be capable of continuous uninterrupted operation for an entire working day
-

Network Reliability

- An unreliable network is unusable - too disruptive
- Worst case should be a slow down

System Features

- Network should be scalable from classrooms (~30 students) to lecture halls (~100 students)
- Should support outdoor networking (field trips etc.)
- Presence of minimal emitters - data loggers, pointing devices etc.
- Various classroom cells connected via (wired?) School LAN

PHY Considerations

- IR
  - Pluses
    - Negligible interference with other consumer devices
    - Cheap
    - Physically contained
    - No regulatory constraints (no EMI issues)
  - Minuses
    - Line of sight propagation
    - Degradation in direct sunlight

PHY Considerations

- RF
  - Pluses
    - Not line-of-sight
    - Variety of vendors/technologies
  - Minuses
    - Interference with adjacent cells (classes)
    - Regulatory constraints
    -

PHY Considerations

- No clear choice!

MAC Characteristics

- Fair: access to network should be position independent
- Power efficient: a battery life of 8-12 hrs, ideally more
- Support for bulk transfers, isochronous and asynchronous data
- Cheap to implement: network devices are not computationally powerful

Theory of Operation

- Devices within controller's sphere of influence can join the network
- Once "logged in", they use the network to transfer data
- Mechanics of data-transfer are MAC-dependant
- Network devices can access other networks (school LAN, Internet) via the controller

Theory of Operation (Contd.)

-
- Adjacent networks (cells) should not interfere
- Their controllers may communicate via another network (school LAN)

Why Is This Interesting?

- Completely untapped market
- ~ 10 million communications capable hand-held devices in schools
- Solve the "last 10 m" problem
- Allow access to vast resources on the Internet
- Support NSF initiatives
- Socially relevant

Submission   Slide 21   Harshal Chhaya, Texas Instruments

WPAN application: Classroom network

-

-

Comments/Questions?

Submission   Slide 22   Harshal Chhaya, Texas Instruments