WPAN CFA

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Application Scenario for WPAN

• Network of personal computing devices in a classroom environment

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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

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
Adjacent Networks

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

- Desired: 1-2 Mbps
- Data types:
  - Bulk transfers (broadcast)
  - Multimedia streams
  - Interactive sessions
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 handheld devices in schools
- Solve the “last 10 m” problem
- Allow access to vast resources on the Internet
- Support NSF initiatives
- Socially relevant

WPAN application: Classroom network

Comments/Questions?