

Lecture 3

CS 621 Mobile Computing

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Several slides and images in this presentation have been taken from Prof. Nityananda Sarma's class notes/ppt.
Several images have been taken from the book Mobile Communication by Jochen Schiller.

Recap: Challenges in Mobile Computing

- Wireless Channel
- Mobility
- Device Limitation

Recap: Challenges in Mobile Computing

- **Wireless Channel**
- Mobility
- Device Limitation

Recap: Bit Error Rate

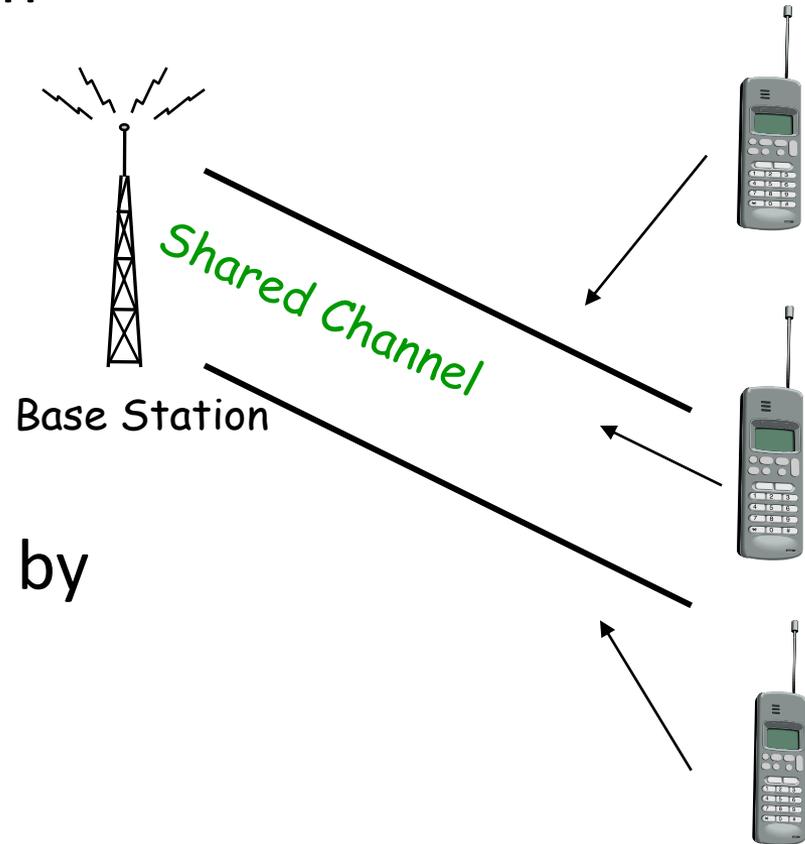
- Optical fiber: 10^{-11} or 10^{-12}
- Mobile channel:
 - Good quality: 10^{-6}
 - Actual condition: 10^{-2} or worse

Thus,

- For wireline systems, it is assumed that the channel is error free
- Many protocols are designed with this assumption
- These protocols do not work well in a wireless environment
 - e.g. TCP (*Packet loss is only due to congestion, not due to error in channel*)

Recap: Multiple Transmitters

- For wireline systems, we can simply install new cables to increase capacity.
- For wireless systems, the channel can only be shared by the users.
 - Capacity does not increase.



Recap: Interference

- **Interference** is a phenomenon in which two waves superpose to form a resultant wave of greater or lower amplitude.
- In communications and electronics, interference is anything which modifies, or disrupts a signal as it travels along a channel between a source and a receiver.^[Wikipedia]

Recap: Interference

- While transmission over different wires typically does not USUALLY cause interference, this is an important issue in wireless transmission.
- Multiuser Interference
 - Radio signals of different users interfere with each other
- Self-Interference
 - Multipath effect
 - Phase-shifted images of the signal at the receiver interact and may cancel the entire signal, (i.e. destructive interference).

Recap: Interference Management

- How to manage multiuser interference?
 - i.e. how to share the channel?
 - Multiple Access Problem
 - FDMA, TDMA, CDMA, etc.
 - Media Access Control
 - Aloha, CSMA, etc.

Recap: Signals

- Physical representation of data
- Data exchange through the transmission of signals
- Signal parameters (amplitude, freq and phase shift) represents data values
- $g(t) = A_t \sin(2\pi f_t t + \varphi_t)$
- A signal can be represented in time domain (oscilloscope), frequency domain (spectrum analyzer) and phase domain (signal constellation diagram)

*Decibel Gain and
a few simple problems*

Decibel Gain

- As signal propagates along a transmission medium, there will be a loss, attenuation of signal strength.
- To compensate, amplifiers may be inserted at various points to impart a gain in signal strength.
- **Decibel gain $G(\text{db}) = 10 \log_{10} (P_{\text{out}}/P_{\text{in}})$**

Decibel Gain

- As signal propagates along a transmission medium, there will be a loss, attenuation of signal strength.
- To compensate, amplifiers may be inserted at various points to impart a gain in signal strength.
- **Decibel gain $G(\text{db}) = 10 \log_{10} (P_{\text{out}}/P_{\text{in}})$**
- **Prob:** If a signal with a power level of 10mW is inserted onto a transmission line and the measured power some distance away is 5mW, the loss can be expressed as :
- $L(\text{db}) = -G(\text{db}) = -10 \log(5/10) = 10 \log(10/5) = 3 (\text{db})$

Decibel Gain

- **Prob:** Consider a series in which the input is at a power level of 4 mW, the 1st element is a trans line with a 12 dB loss, 2nd element is an amplifier with a 35 dB gain, and 3rd element is a trans line with a 10 dB loss. The net gain/loss is = ?, Output power = ?:
- Net gain = $-12 + 35 - 10 = 13$ dB
- Therefore, $P_{out} = 79.8$ mW

Challenge 2

- Wireless Channel
- **Mobility**
- Device Limitation

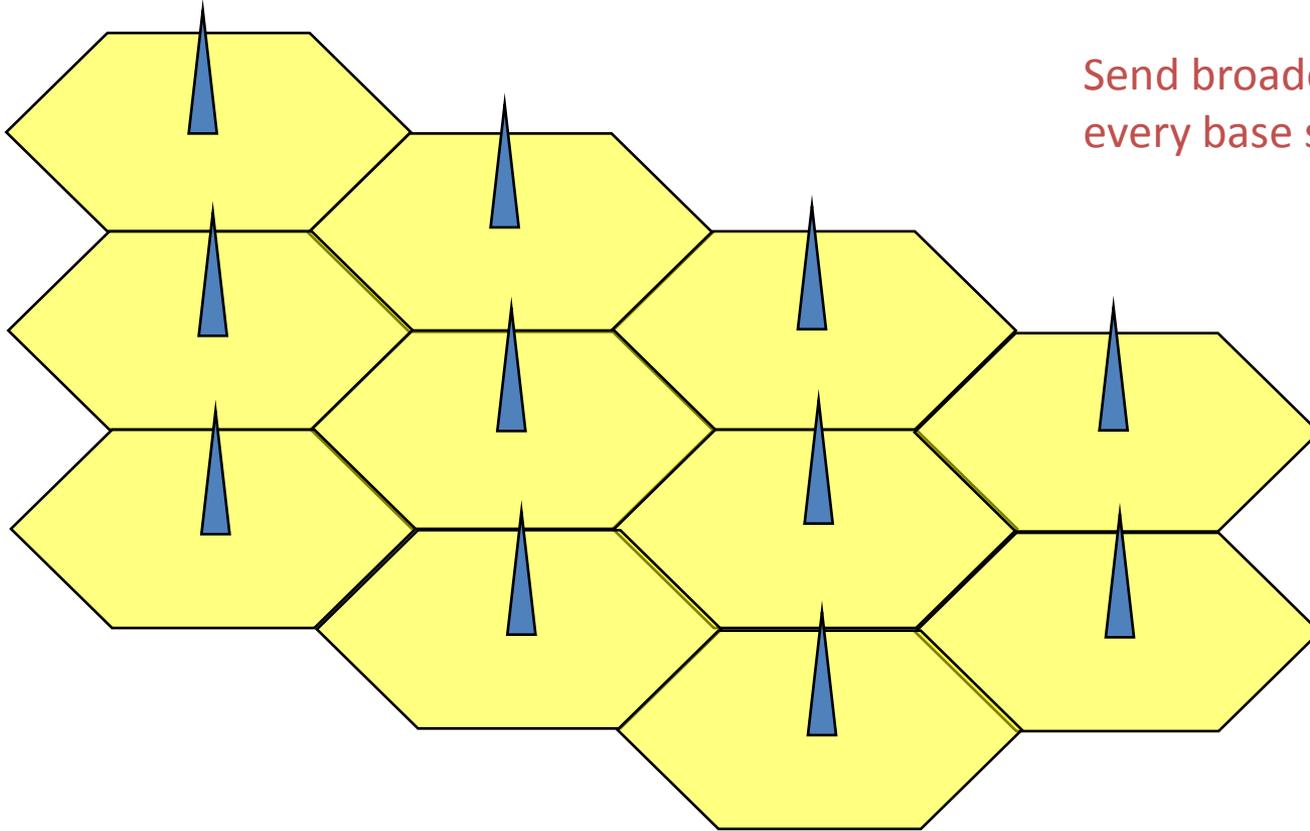
User Mobility

- Location Management Problem
 - How does the network know where the intended recipient of a message is currently located?

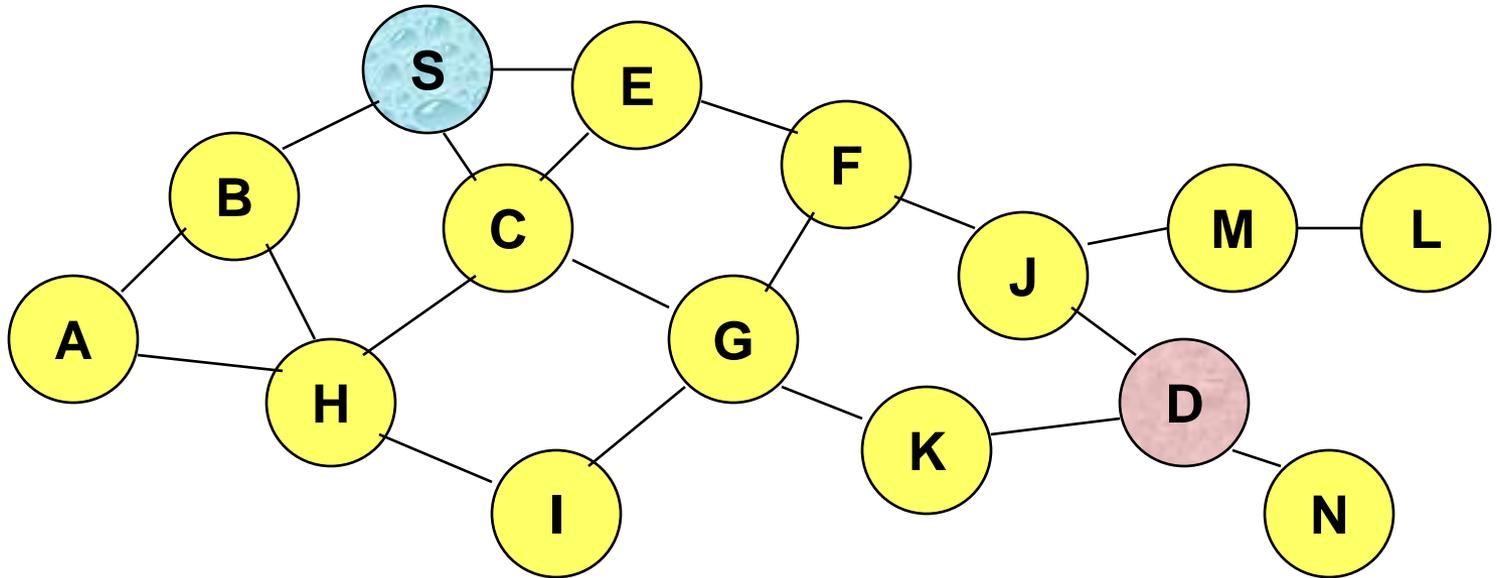
Cellular Scenario

Where is 9435055555?

Send broadcast messages from every base station???



WSN scenario



How to find a suitable path from source S to destination D?

Challenge 3

- Wireless Channel
- Mobility
- Device Limitation

Device Limitations

- Resource Poor
 - Limited memory
 - Limited computational power
 - Small display
 - Limited battery life

- Mobile Applications

Mobile Applications

- Vehicles
 - transmission of news, road condition etc
 - ad-hoc network with near vehicles to prevent accidents
- Emergencies
 - early transmission of patient data to the hospital
 - ad-hoc network in case of earthquakes, cyclones
 - military ...
- Traveling salesmen
 - direct access to central customer files
 - consistent databases for all agents
 - mobile office
- Web access
 - outdoor Internet access
 - intelligent travel guide with up-to-date location dependent information
- Location aware services
 - find services in the local environment, e.g. printer
- Information services
 - push: e.g., stock quotes
 - pull: e.g., nearest cash ATM
- Disconnected operations
 - mobile agents, e.g., shopping
- Entertainment
 - ad-hoc networks for multi user games

Application Adaptations for Mobility

- System-transparent, application-transparent
 - the conventional, “*unaware*” client/server model
- System-aware, application-transparent
 - the client/proxy/server model
 - the disconnected operation model
- System-transparent, application-aware
 - dynamic client/server model
 - data broadcasting/caching
- System-aware, application-aware
 - the mobile agent model

THANKS!