Control based Mobile ad-hoc networking program

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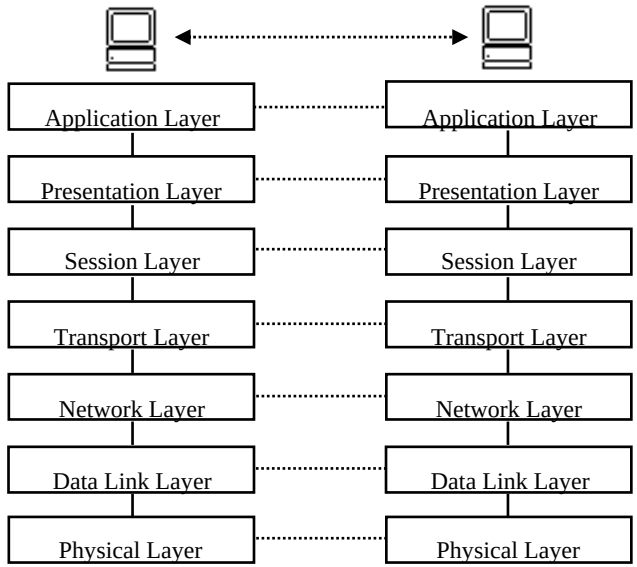
Tension between performance and architecture

- Success of Internet is due to its architecture
  - Hierarchy of layers
  - Peer-to-peer protocols
  - Allows plug-and-play
  - Longevity
  - Important for proliferation of technology



- Performance: The short term vision
  - "*Putting a link between layer A and layer B can improve performance by x%*"
  - Consequences of this approach
    - » Spaghetti code
    - » Not modular
    - » Not upgradeable
    - » No longevity
    - » High per unit cost: Value of a communication medium = Number of adoptees

- Architecture: The long term view
    - » Mass production = Reduced cost over long term

- Tension between Performance and Architecture

A random sample of cross layer design proposals

- Several suggestions for cross-layer design
  - Signal stability based routing
  - Transmit power based routing
  - Battery life based routing
  - Topology control using transmit power adjustment
  - Topology control using angle of arrival information
  - Power control by monitoring end-to-end throughput
  - Power control for energy efficiency
  - Traffic based sleeping strategies
  - TCP modifications for energy efficiency
  - Routing for improving network lifetime
  - Adaptive rate, adaptive power MAC protocols
  - QoS schemes based on routing and MAC parameters
- What are the consequences?
- What interactions are possible?
- What does the resulting code look like?
- What is the resulting architecture or lack of it?
- Longevity? Upkeep?

Need for a holistic perspective …

- Architecture is important
- Interactions exist
- Need to change the thrust of the work in cross-layer design to a more holistic perspective
  - Design schemes which have no adverse interactions with other layers or cross-layer design now (holistic across layers)
  - Design schemes good against other future bright ideas in any cross-layer (holistic across time)
- Research community needs to
  - Adopt a holistic perspective
  - Exercise caution

Approaches to be used

- Network Information Theory
  - What are the ultimate limits?
  - Provide strategic guidance on appropriate abstractions and architecture
- Nonlinear Optimization of Wireless Networks
  - Generalized network utility maximization subject to physical and performance constraints
  - Nonlinear convex optimization, duality, and distributed algorithms
  - Elucidate architectural structures of protocol stack
- Control theory based approach to protocol design
  - Dynamic system viewpoint, feedback based, stability and performance focus
  - Joint design of MAC, Congestion Control and Routing Algorithms for Resource Allocation
- Adaptation and Learning based algorithms
  - Theoretical as well Biologically based
- Experimentation
  - Hardware
  - Software
  - System integration
  - Demos