Integrating Wireless and Wireline Networks

Architectures of Seamless User-centric Networks

Department of Electrical and Computer Engineering at Boston University

Ayman Al-Awadhi

Jeffrey Carruthers

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Agenda

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- Motivation
- Scenarios Description
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- Examples
- Conclusion

Introduction

- The proposed network decides on the behalf of the user which network is optimal to use in case of having multiple networks
- Also, this network will make the transition between protocols transparently so that the user will not bother transferring manually
- To achieve this goal, many issues have to be taken into consideration: handoffs, data rates, protocols, packet format, overlay networks, cost, size, etc.
- This network can potentially used for both data packets and multimedia applications
- This integrated network can be the core of the beyond 3G networks.

Motivation

- Users need continuous high-speed connectivity as they move beyond the coverage of wireline networks
- No single standard or technology is capable of being optimized for all applications
- Vertical models of networks will not help much anymore
- Horizontal model for the networks is suggested where every participating network is optimized for certain applications

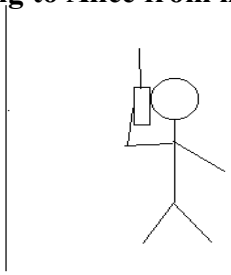
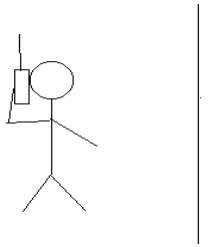
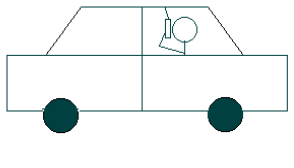
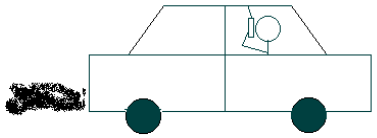
Horizontal Integration of Networks

- Technological Advantages:
  - Integrating existing optimized networks each for certain applications provides superior performance comparing to vertical approach
  - Integrating at physical and datalink layers provides high data rate support
- Economical Advantages:
  - Huge investment in infrastructure, current networks, can not be replaced with new design
  - Significant expertise in current technologies suggests lower implementation cost

Voice Scenario Description

- Bob is talking to Alice using his cordless phone
- Bill knocked the door
- Bob continued the phone call with Alice, as he was moving outside his home
- Then, Bill suggested that he and Bob go to the nearby restaurant to have a dinner
- Bob and Bill headed to the restaurant by car, and Bob was still continuing the phone call with Alice

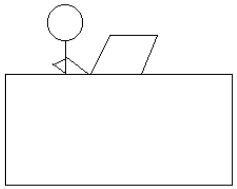
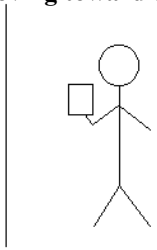
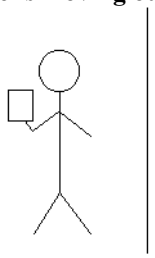
Voice Traffic Scenario

a. Bob talking to Alice from his home 	**b. Bob is moving outside his home** 
c. Bob entered Bill's car 	**d. Bob and Bill are moving away.** 

Data Scenario Description

- Bob is at his house reading the online version of the Boston Globe on his PC, which is connected to a wired network
- While he was in the Sports Section, using her mobile handset Alice called him inquiring about going out to a restaurant.
- Just before Bob finished an interesting Red Sox article, Alice arrived and called Bob to get out
- Bob continued reading the article using his wireless handset (palm pilot) as the article automatically transferred to his handset

Data Traffic Scenario

a. Bob is reading an article	b. Bob is moving toward the door	. c. Bob is moving outside
		

Research Paths

- Develop Scenarios where networks are viewed to users as one unit
- Horizontal integration is done at interfaces in physical and datalink layers
- Develop path loss models
- Investigate handoffs
- Investigate intranetwork handoffs
- Investigate current technologies and develop hybrid model for proposed network
- Pinpoint future research directions

Selecting Candidate Technologies

- TCP/IP: This dominant wireline technology resides in the network and transport layers of the OSI model, i.e., over the layers of interest in this research
- ATM: This revolutionary technology that can reside in any layer of the OSI model will enable us research the problem in a different way
- CDMA: The dominant technology of the 3G wireless systems resides in the layers of interest in the OSI model, physical and datalink layers

TCP/IP Issues

- TCP/IP is designed for low propagation losses environment, e.g. wireline
- Support of QoS: hard delay guarantees
- Congestion control algorithms failure in wireless environment
- Network asymmetry problem in wireless environment

ATM Issues

- ATM is designed for abundant resources environment: high speed wireline links
- To guarantee QoS, ATM protocol maintains virtual circuits (VC) and virtual paths (VP)
- End-to-end QoS support is harder in noisy environment such as wireless
- ATM header fading

CDMA Issues

- Power control: open loop, closed loop
- Handoffs: voice handoff between 1.9Ghz cdmaOne system to 2.4GHz W-CDMA system
- Need for synchronization
- Usage of Rake receiver: complexity of system
- Interfacing with other protocols

Conclusion

- Horizontal integration approach is used to achieve seamless user-centric network
- Investigation is done at physical and datalink layers
- Use current technologies as building blocks for hybrid model resulted by this research
- Results of this project opens the frontiers to achieve the goals of 4G systems: Integrating wireless and wireline networks seamlessly