



# Introduction to Wireless Overlay Networks

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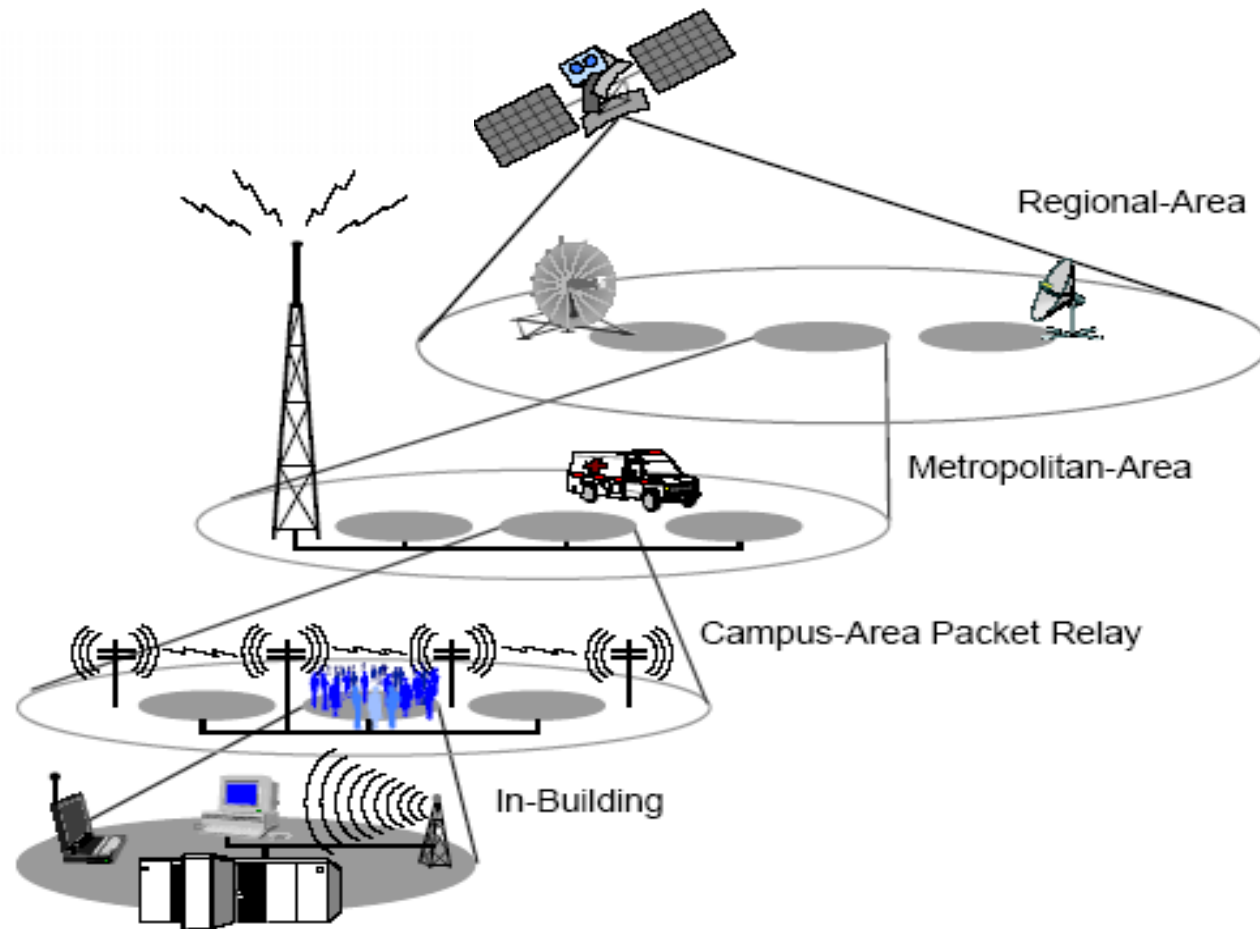
# Outline

- Introduction
- Problems and Solutions
- Examples of Wireless Overlay Networks
- Research Issues
- Conclusion
- Reference

# Introduction

- Wireless Overlay Networks (WON) are heterogeneous wireless networks whose coverage areas are overlapped
- Higher levels in the hierarchy provide larger coverage area but lower bandwidth, and lower levels in the hierarchy provide higher bandwidth but smaller coverage area

# Introduction (cont'd)



Wireless Overlay Networks Structure



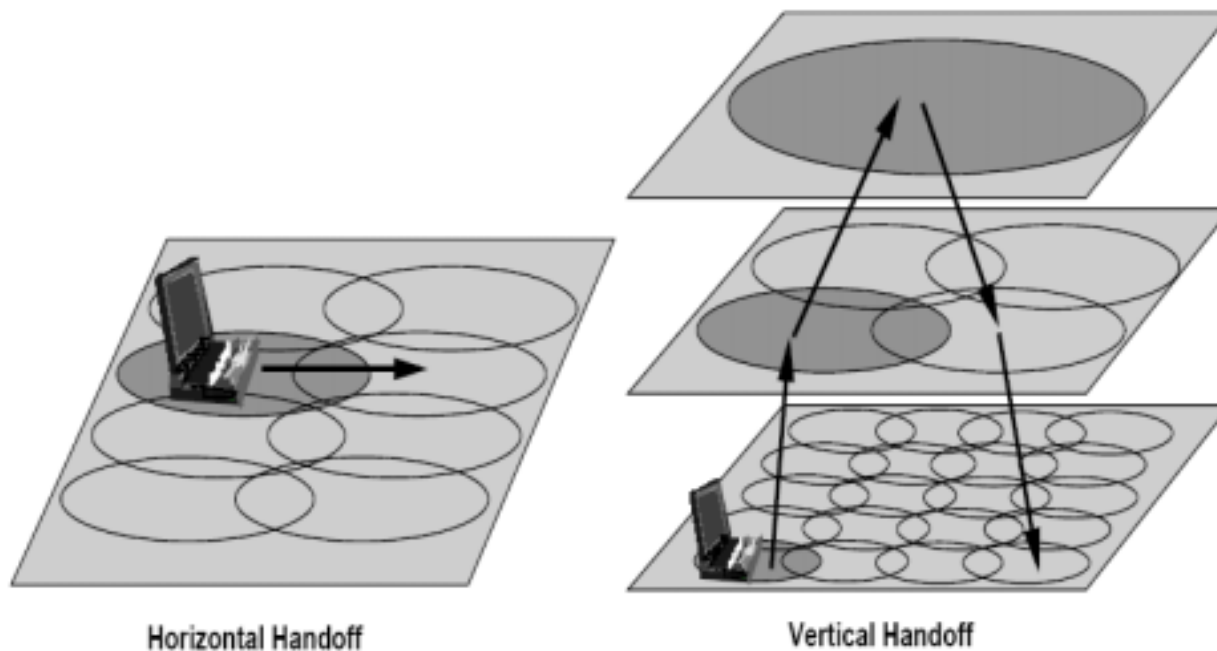
# Introduction (cont'd)

- The Mobile Terminal (MT) must have multiple network interfaces to access different types of wireless network
- MT is able to switch between different wireless networks

# Problems and Solutions

- Handoff latency

- Handoff in WON differs from the handoff in today's cellular network



# Problems and Solutions (cont'd)

## ■ Handoff latency

- The overhead in vertical handoff will be bigger than the overhead in horizontal handoff
- Different wireless networks possess different system architecture
  - Bandwidth
  - Latency
  - Capacity

# Problems and Solutions (cont'd)

## ■ Packet loss

- Packets destined to a MT may be lost while the MT is in handoff process

## ■ Ping-pong effect

- MT may handoff forth and back frequently and degrade the connection's performance



# Problems and Solutions (cont'd)

## ■ MT power management

- MT may have two or three, even four different networks interfaces
- To use a particular wireless network, the correspondent interface must be on
- Turn on all interfaces is the best way but the MT can not afford

# Problems and Solutions (cont'd)

## ■ System discovery

- How does the MT know what wireless networks are available?
- MT may turn on all its network interfaces to detect the existence of different networks, but obviously this won't work

# Problems and Solutions (cont'd)

## ■ Solutions

- Mobile IP is adopted to support mobility between different wireless networks
  - All-IP networks
- Packet multicasting is used to avoid packet loss in the handoff process
- Dwell timer to avoid ping-pong effect
  - Wait until the MT become stable

# Examples of Wireless Overlay Networks

## ■ MIRAI

- Part of e-Japan project
- MIRAI stands for Multimedia Integrated network by Radio Access Innovation
- An independent common access network (Basic Access Network) is used for system discovery and paging

# Examples of Wireless Overlay Networks (cont'd)

- Integration of WLAN and 2.5G(GPRS)
  - Mobile IP is used for mobility management
    - HA and FA functions are implemented at GGSN and SGSN in GPRS, and in the BS of WLAN
  - Multi-channel is used to decrease the loss of packet
  - Continuously monitor the RSS of GPRS and WLAN to get necessary information for the decision of handoff

# Research Issues

## ■ Handoff decision

- In horizontal handoff the Received Signal Strength (RSS) is the most important factor to decide the handoff
- Find out the right time to handoff
- Other factors can be considered:
  - Application running on the MT
  - MT moving speed
  - MT power
  - Cost to access different wireless networks

# Research Issues (cont'd)

## ■ MT power management

- MT with multiple network interfaces can not turn on all its interfaces at same time -> waste of power

## ■ QoS

- Different wireless networks have different bandwidth, capacity and latency
- Application should be able to change its interface and QoS level according to the current network's environment

# Conclusion

- Wireless overlay networks is the trend of next generation wireless network
- Wireless overlay networks will permit MT to use appropriate network at appropriate moment to provide maximum user satisfaction



# Reference

- *WLAN-GPRS integration for next-generation mobile data networks*, Salkintzis et al., IEEE Wireless Communications, Volume: 9 Issue: 5
- *Vgsn : A Gateway Approach To Interconnect Umts/Wlan Networks*, S. Tsao and C. Lin, IEEE PIMRC2002
- *WCDMA and WLAN for 3G and beyond* , by H. Honkasalo et al., IEEE Wireless Communications, Volume: 9 Issue: 2
- *Wireless LAN Access Network Architecture for Mobile Operators*, J. Ala-Laurila et al, Nokia, IEEE Communications Magazine, Nov 2001
- *Vertical Handoffs in Wireless Overlay Networks*, by Stemm, Katz, 1996
- *Handoff in Hybrid Mobile Data Networks*
- *Towards a Complete Solution to Mobility Management for Next-Generation Wireless System*, Q. Wang and M. Abu-Rgheff
- *The Mobile IP Handoff Between Hybrid Networks*, by Yu Liu et al., IEEE PIMRC2002A *Hybrid Network Model for Cellular Wireless Packet Data Networks*, GLOBECOM 2002
- *Buffering Requirements for Lossless Vertical Handoffs in Wireless Overlay Networks*
- *Integration of 802.11 and Third-Generation Wireless Data Networks*, INFOCOM 2003
- *HOPOVER: A New Handoff Protocol for Overlay Networks*, ICC 2002
- *Handoff Procedure for Heterogeneous Wireless Networks*, GLOBECOM 1999