Handover Mechanism of Mobile WiMAX (802.16E) with Wi-Fi Technology

- **Omar Al-Trad, student Member IEEE**
- **Nabil Al-Rousan, student Member IEEE**

Wi-Fi: Wireless Fidelity
WiMAX: Worldwide Interoperability for Microwave Access

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Road Map

❑ WiMAX 802.16e-Specifications

❑ Mathematical Analysis

❑ Hard Handover Mechanism

    ❑ SNR based Handover

    ❑ Effect of Scanning Interval on handover

    ❑ QoS based Handover

❑ Second Phase Initial Results

❑ Conclusion

❑ Future Work

❑ References

WiMAX Specifications

- ❑ ʃEEE 802.16e-2005
    - ▪ Air Interface for Fixed and Mobile Broadband Wireless Access Systems

	802.16-2004 WiMAX	802.16e 2005 WiMAX
Standard	802.16-2004 (June 2004	802.16e (December 2005)
Access	Fixed, nomadic	Fixed, nomadic, portable and mobile
Modulation	OFDM	OFDMA
Service providers Targeted	DSL and cable modem service providers, wireless and wired ISPs	Mobile operators, DSL and cable modem service providers, wireless and wired ISPs
Subscriber unit	Outdoor or indoor CPE, eventually PCMCIA card	Indoor CPE, PCMCIA card, mini-card built in laptops

WiMAX Specifications

- ❑ IEEE 802.16-2004
  - ▪ Air Interface for Fixed Broadband Wireless Access Systems
- ❑ IEEE 802.16e-2005
  - ▪ Air Interface for Fixed and Mobile Broadband Wireless Access Systems
- ❑ WiMAX Forum
  - ▪ Formed in June 2001 to promote conformity and interoperability of the standard
  - ▪ http://www.wimaxforum.org/

WiMAX: Worldwide Interoperability for Microwave
IEEE: Institute of Electrical and Electronics Engineers

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Mathematical Analysis

- The power received at the MS node

$$P_r[mW] = \frac{P_L G_t G_r}{P_L(d) L}$$

- The antenna gain $G = \frac{4\pi A_e}{\lambda^2}$

- The signal to noise ratio

$$SNR[dB] = \Pr[dBm] - N[dBm]$$

- Scanning process according to

$$SNR[dB] = Pt + Gt + Gr - PL(d) - L - N$$
$$N[dBm] = -174[dBm] + 10\ logB + F[dB]$$
$$SNR_{TH\_S}[dB] \geq 20\ dB$$

- handover process according to

$$SNR(TBS) - SNR(SBS) \geq 0.4(dB)$$

Pt: Transmitted power,
L: Loss factor
Gt, Gr: Transmitter, Receiver Gain
PL: Path loss

A_e: Effective Aperture
F: Noise
B: Bandwidth

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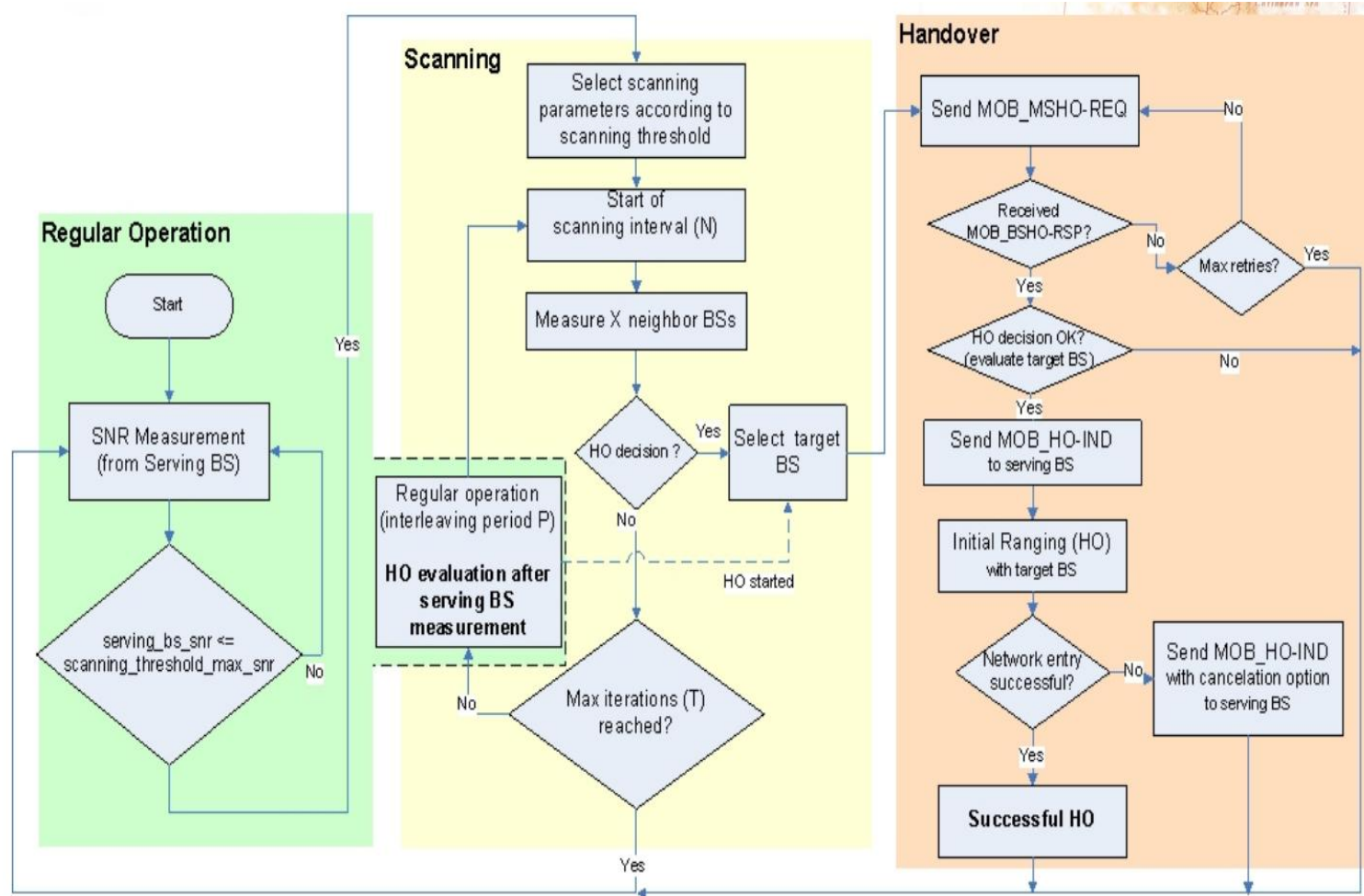
❑ Future Work

❑ References

Hard Handover Mechanism

❑ ƒHandover control: Mobile initiated or BS initiated

❑ ƒHard handover process

- Network topology acquisition

- Process of BS advertising network topology or MS scanning neighbour BSs to acquire network topology

- Handover process

Process of associating with target BS and disassociating with serving BS

- ƒCell Reselection: scanning and association process

- ƒHO Decision and Initiation

- ƒSynchronization to DL of Target BS

- ƒRanging, network re-entry with Target BS
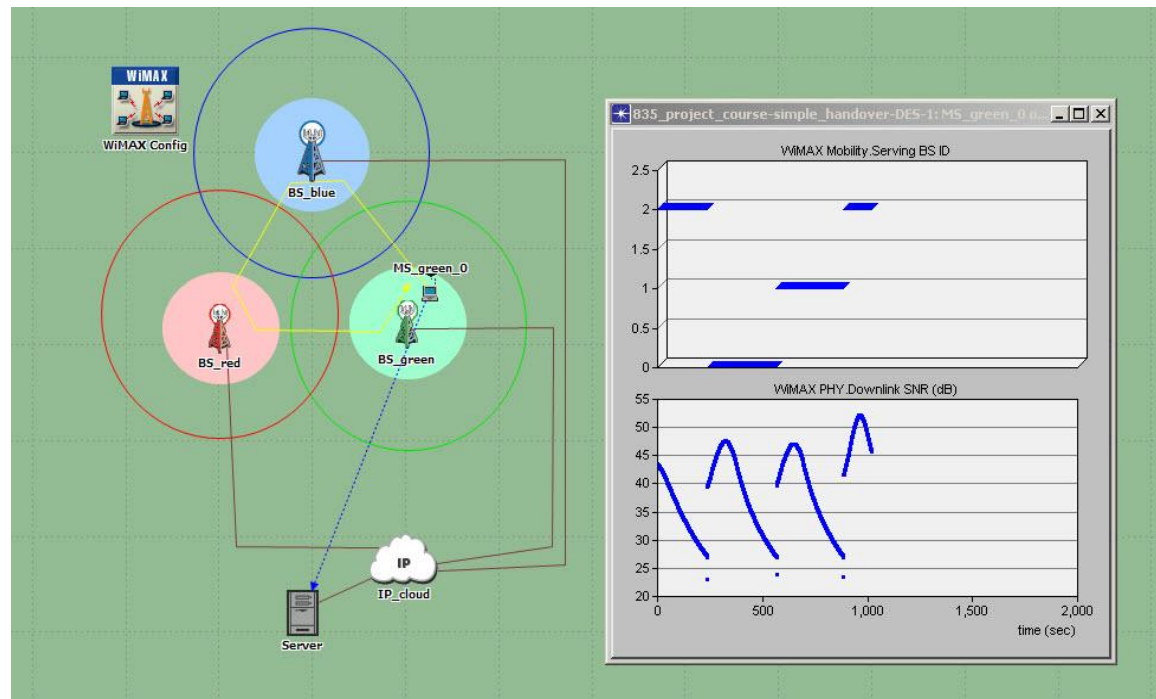
- ƒTermination of MS context with Serving BS

Hard Handover Mechanism

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SNR based Handover
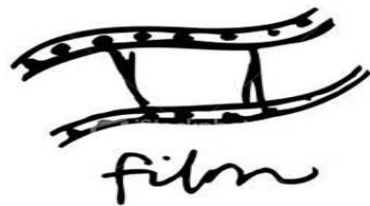
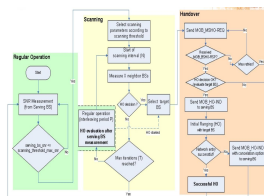MS: Mobile Station
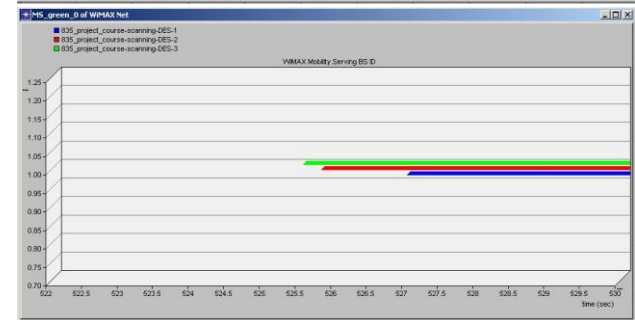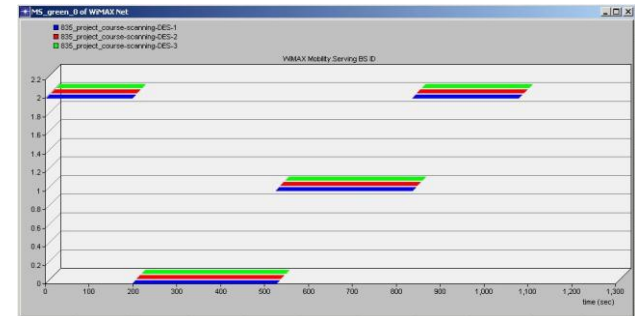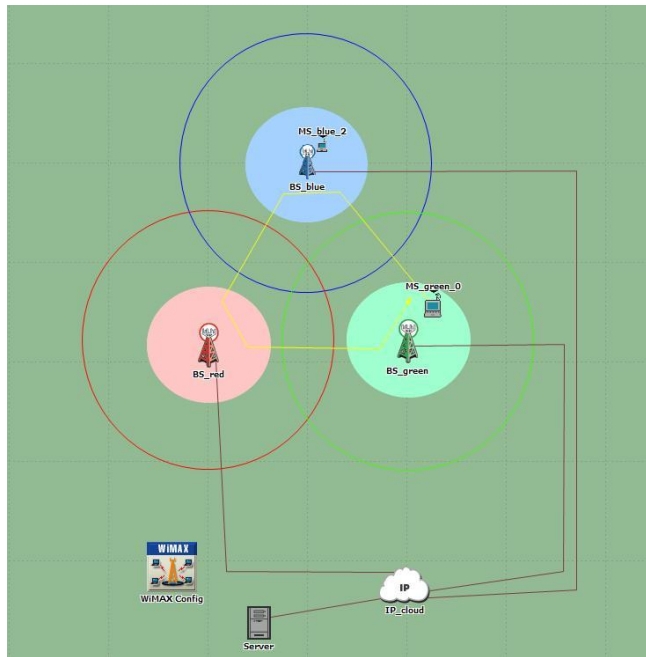BS: Base Station
SNR: Signal To Noise Ratio

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Effect of Scanning Interval on handover

QoS is characterized by the service level prediction that indicates the level of service expected by MS from target BS. According to the criteria:
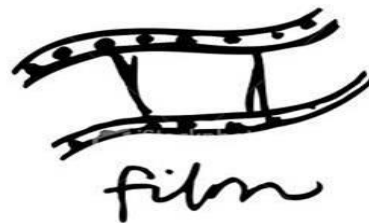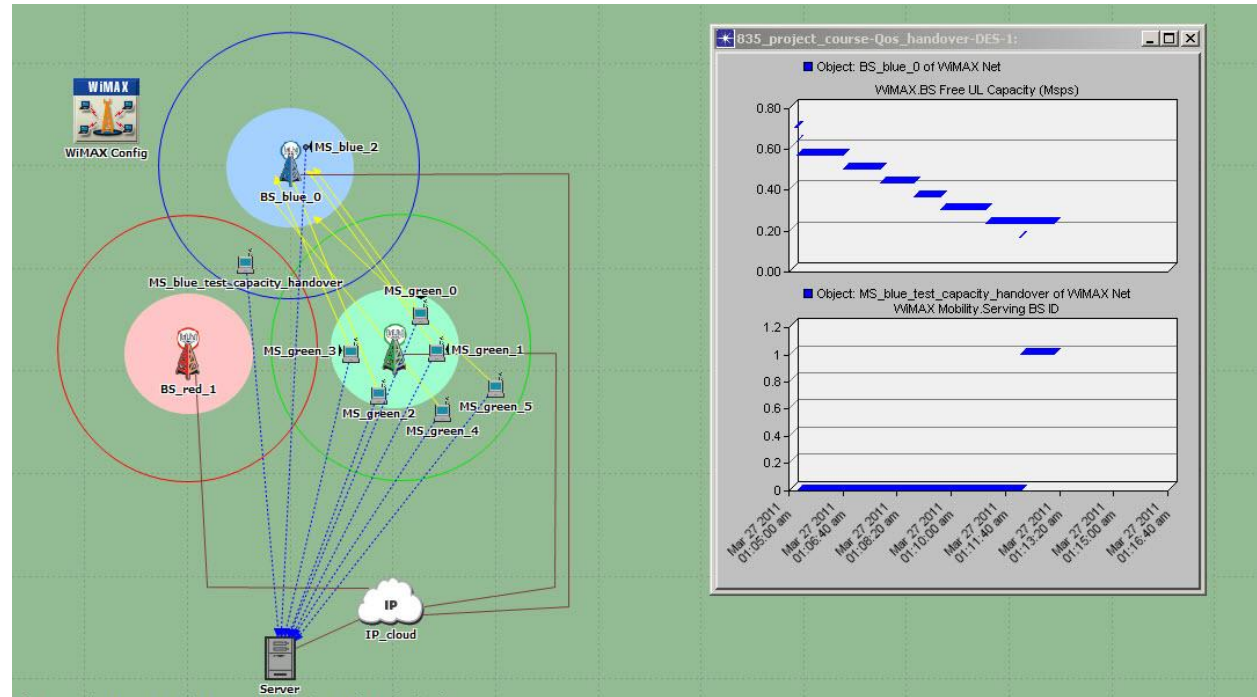
$$(current\ capacity) \leq 0.75 * (maximum\ capacity)$$

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QoS Criteria Handover

QoS: Quality Of Service
UL: Uplink
DL: Downlink

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Second Phase Initial Results

- Challenges we faced:
  - Criteria to choose the handover process
    - User defined, cost.. etc.
    - Software defined:
      - SNR
      - Capacity
      - QoS
  - Modifying the physical port of the WLAN adding some control process for switching between the heterogeneous technology

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Conclusions

- Designing the network in a way to maximize its capacity and improve QoS promised.

- Changing handover parameter which effect the performance of the network.

- Successfulness in the first step improve the over-whole process.
  using advanced technique in the physical layer effect upper layer algorithms as well as improve the coverage area of the network and its performance.

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Future work

- Derive a mathematical model which can express the various parameters that effect Handover mechanism.

- Implement this Handover mechanism between heterogeneous network i.e., vertical handover between Wi-Fi and WiMAX. But due to time limitation we postponed the other phases to be completed later.
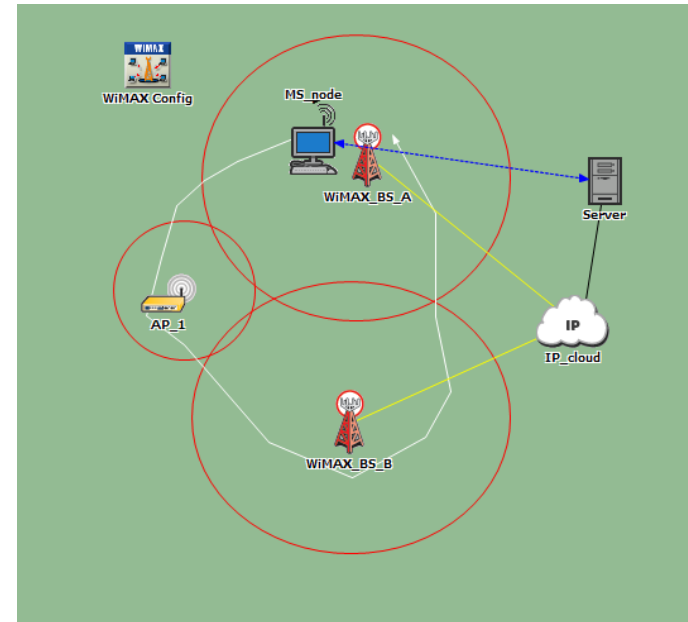
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Thank You!
Q&A