Simulation of Radio Resource Management for Handover in WCDMA Network

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Outlines

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- Traffic types and generation
- Simulation parameters
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Introduction

WCDMA (Wideband Code Division Multiple Access) is a high speed 3G cellular network standard.

This project will simulate a downlink transmission WCDMA network in a 7-cell cluster especially for handover in WCDMA using Matlab, and compare the results under different situations.
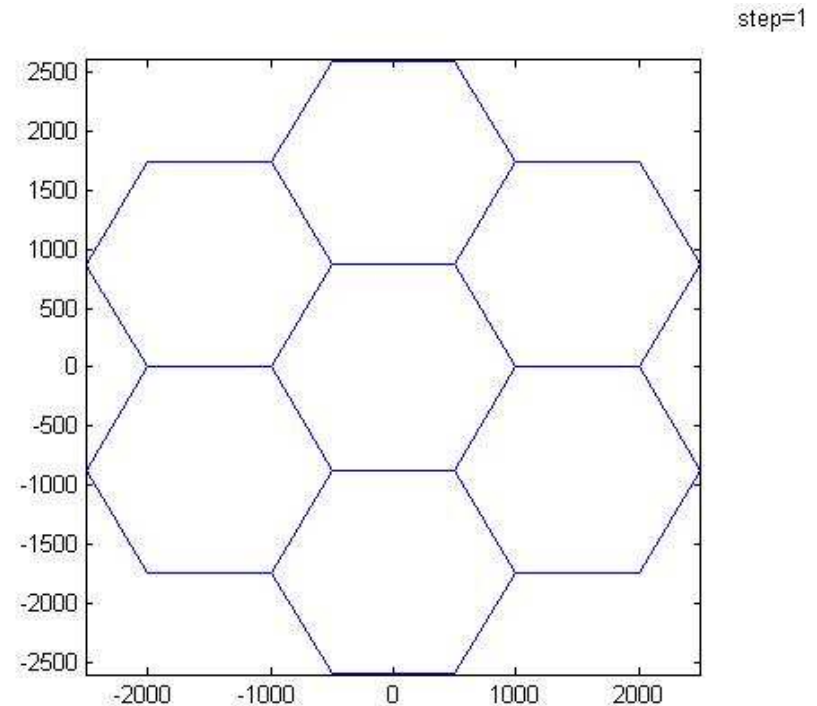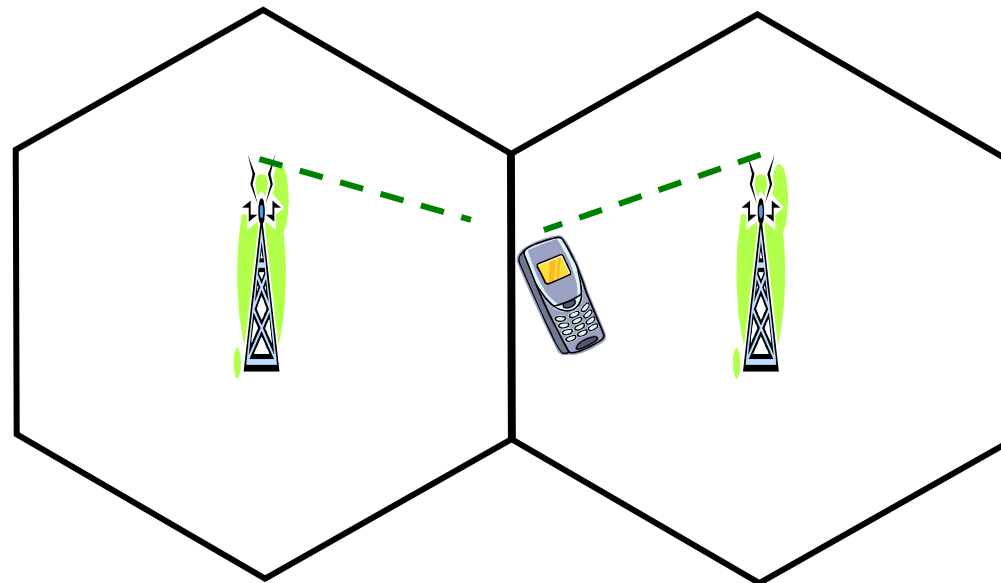

Figure1 Overview of simulation area

Handover (Handoff)

▶ The process of transferring an ongoing call or data from one channel to another.

▶ Hard handover: usually is called 'break-before-make'.

▶ Soft handover: used in CDMA network. Simultaneously connected to two or more cells 'make-before-break'.

Example of hard handover

Traffic Classes

Traffic Classes	Representative Application
Conversational	VOIP (8-32kbps)
Streaming	Video Streaming (128kbps)
Interactive	Web browsing (varying)
Background	E-mail (varying)

Table1 Traffic Classes and Representative Application

In the simulation, VOIP and video streaming are treated as CBR traffic but with different transmission rates. Interactive and Background traffic are treated as burst traffic.

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Node Movement

► Directional random walk:

- A mobile node is initiated randomly with one of the 6 directions to move.

- Every second a node makes a move based on the speed randomly set at beginning of simulation.

- A fluctuation is given at each move so that the node may move to other directions with small chance.
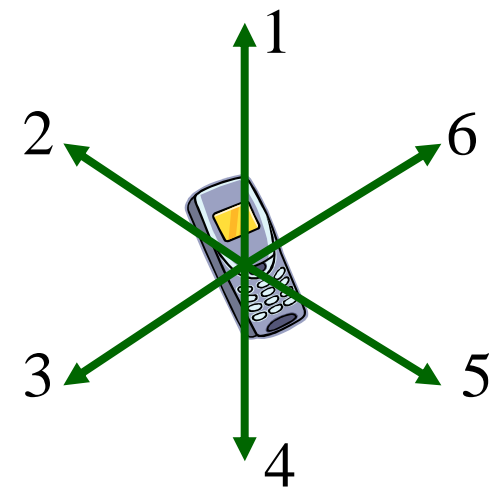
Nodes Movement

A torus area is established in the simulation to cope with edge effect.
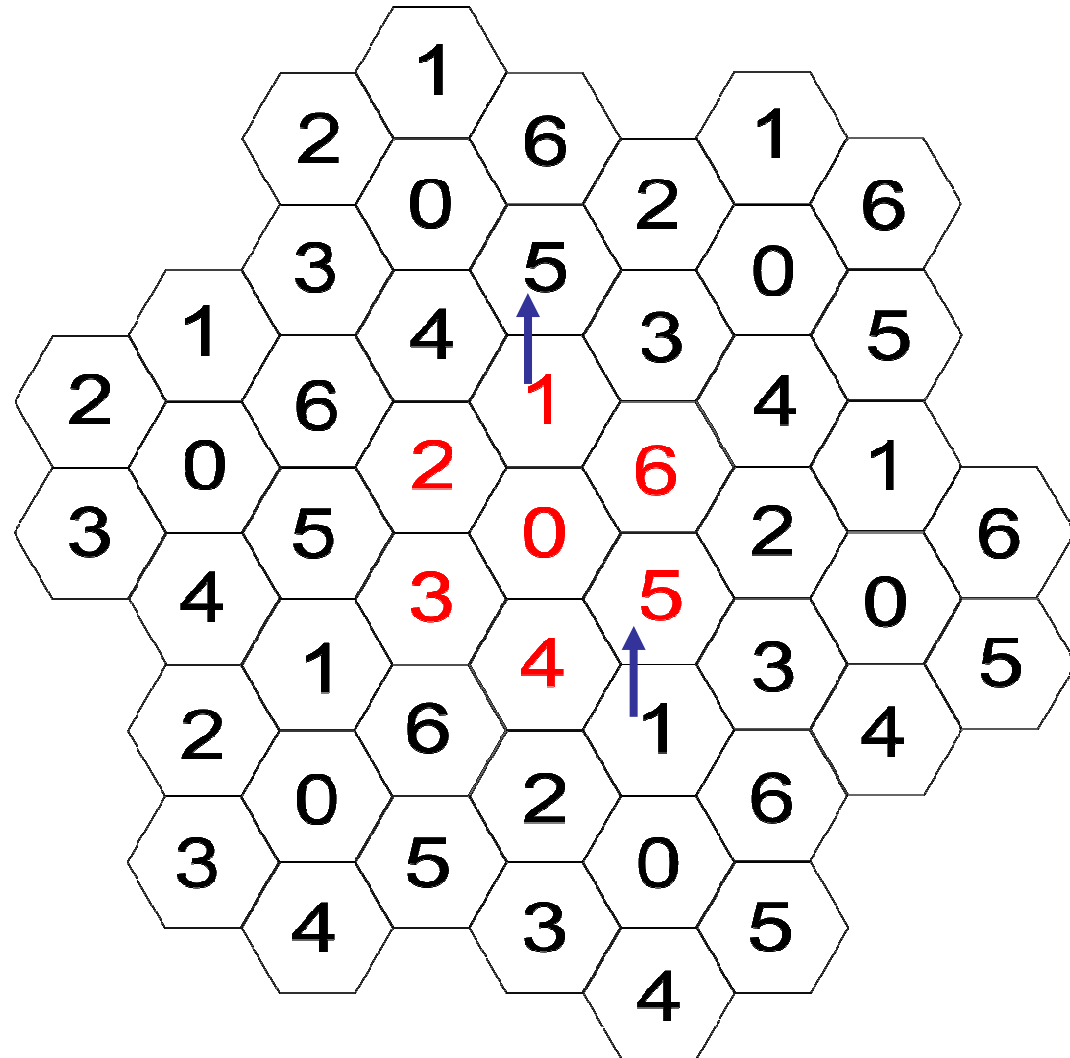Example: a mobile node moves out of cell 1 with direction 1 will move into cell 5.

Figure2 Nodes Movement

Traffic Types & Spreading Codes Assignment

- Priority for different kinds of traffic:

  Ongoing CBR traffic > Handover CBR traffic > new CBR traffic > Burst traffic

- For burst traffic: Proportional assignment

- OVSF: Orthogonal Variable Spreading Factor. Spreading factors available from 4 to 512.
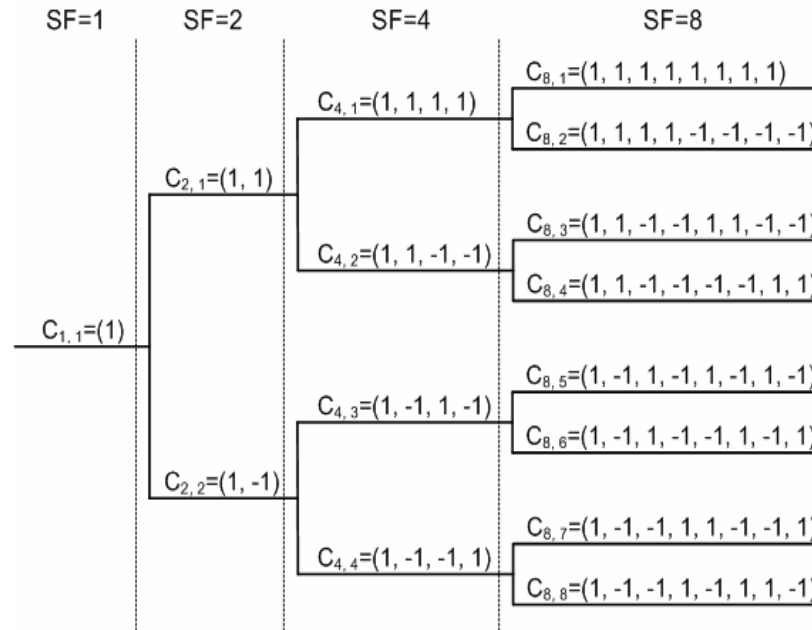

Figure3 OVSF code tree

Spreading Code Pool

▶ To simplify the design, a spreading code pool with all the available SF=512 codes are managed by the base stations.

▶ With half-rate coding, the basic rate for a SF=512 code becomes

$$r_b = 3.84 Mcps / 512 \times \frac{1}{2} = 3.75 kbps$$

▶ So that a 8kbps voice channel with be assigned 2 SF=512 codes. There are totally 512 such codes in one cell. The code assignment is managed by the base station.

Traffic Generation

▸ CBR Traffic

Probability: a mean probability is given by user, the system generates an **uniformly distributed random** number, if the random number is greater than the mean probability, traffic happen.

Duration: an average duration is given by user, a **normally distributed random number** with this specific mean is generated by system. The **default standard deviation** of this distribution is 'mean/4'
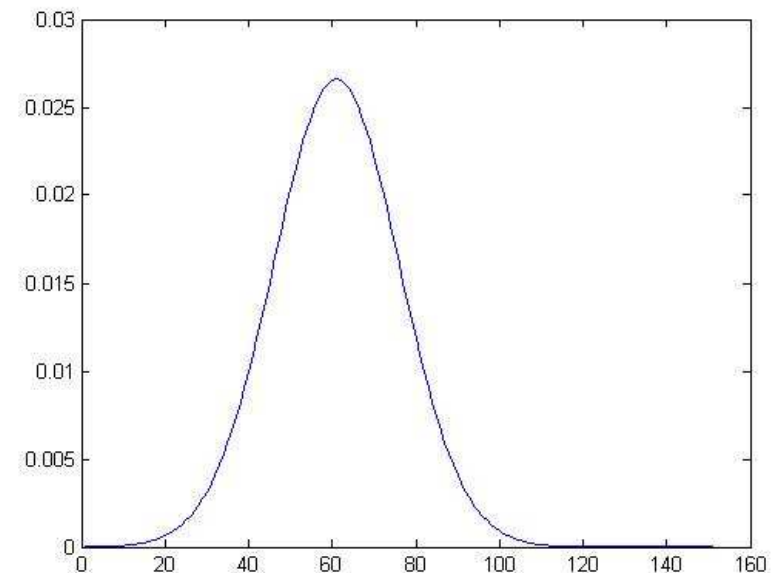

Figure4 Probability Density Function (pdf) of normal distribution with mean=60, standard deviation=15

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Traffic Generation

▶ Burst Traffic

Burst traffic follows the **Poisson Distribution**. An average burst packet coming rate and the size of one packet is given by user. A **uniformly distributed** random number is generated by system.

According to the inverse of Poisson cumulative distribution function (cdf) with specific mean, we can get the number of packets for each random number.
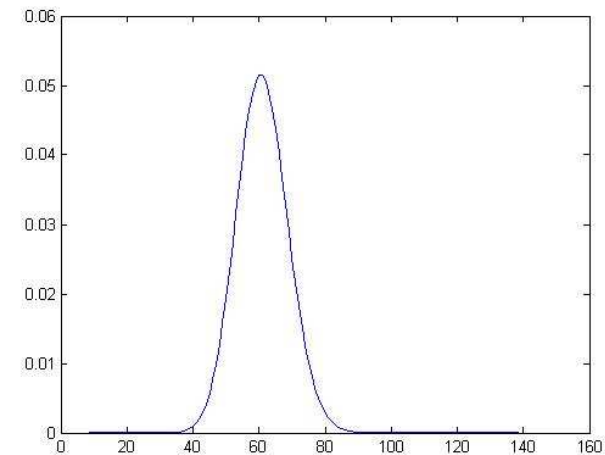

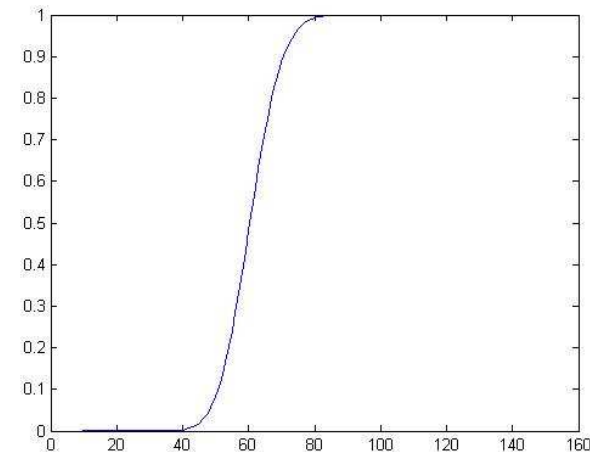Figure5 pdf of Poisson Distribution with mean=60

Figure6 cdf of Poisson Distribution with mean=60

Important Parameters

▶ Here are some important parameters used in simulation:

Simulation time

number of users

CBR coming rate: how many CBR traffics for one user in a given T time

Voice traffic average duration

Video traffic average duration

Average burst traffic rate: average burst packet coming rate for one user

Burst packet size: the size of each burst packet unit

Minimum moving velocity

Maximum moving velocity

Simulation Result (Burst traffic delay)

Parameters:

Same:
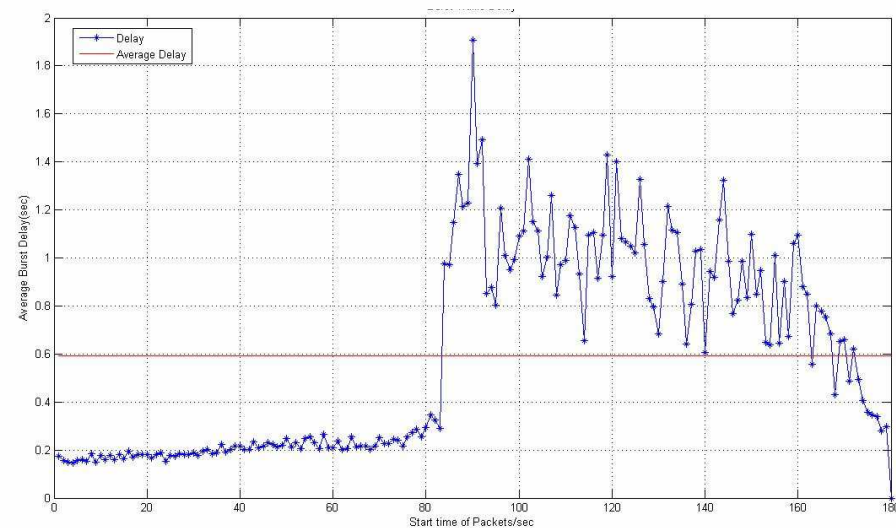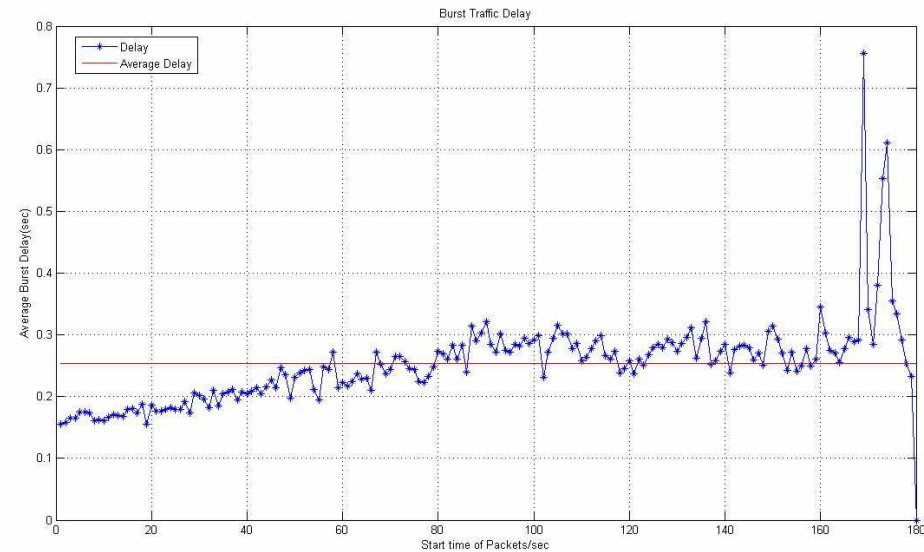
Sim time=180s

N=100

CBR=8/hour

voice=70s

video=60s

b_rate=0.3/s

b_size=10kb

Diff:

Speed=20-40km/h

Speed=60-120km/h

Simulation Result (CBR Satisfying Ratio)

Parameters:

Same:
- Sim time=180s
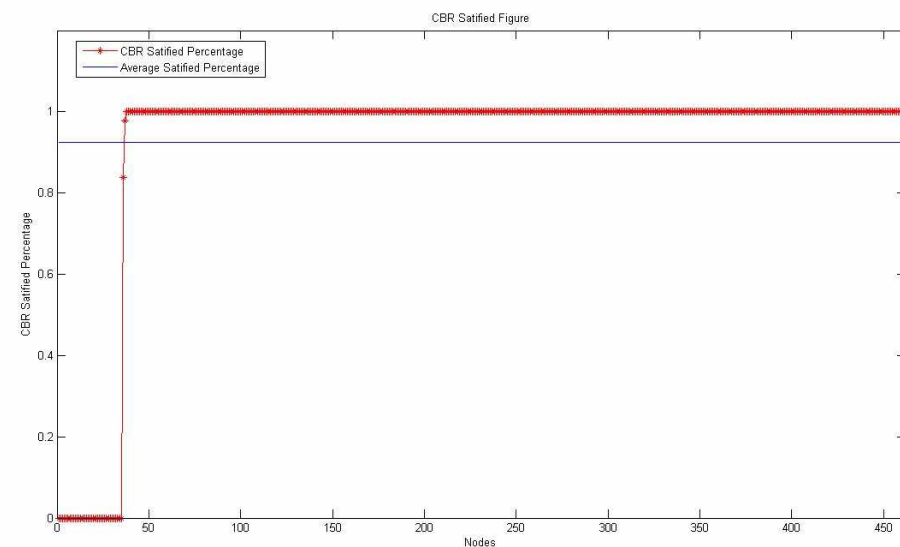- N=100
- voice=70s
- video=60s
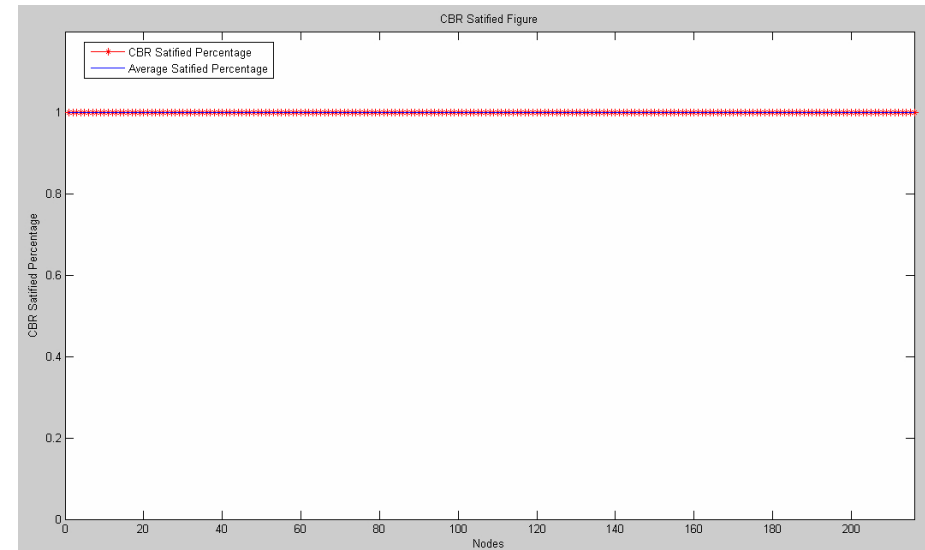- b_rate=0.3/s
- b_size=10kb
- Speed=20-40km/h

Diff:
- CBR=8/hour
- CBR=16/hour

Simulation Result (Handover Ratio)

Parameters:

Same:

    Sim time=180s

    N=100

    b_rate=0.3/s

    b_size=10kb

    Speed=20-40km/h
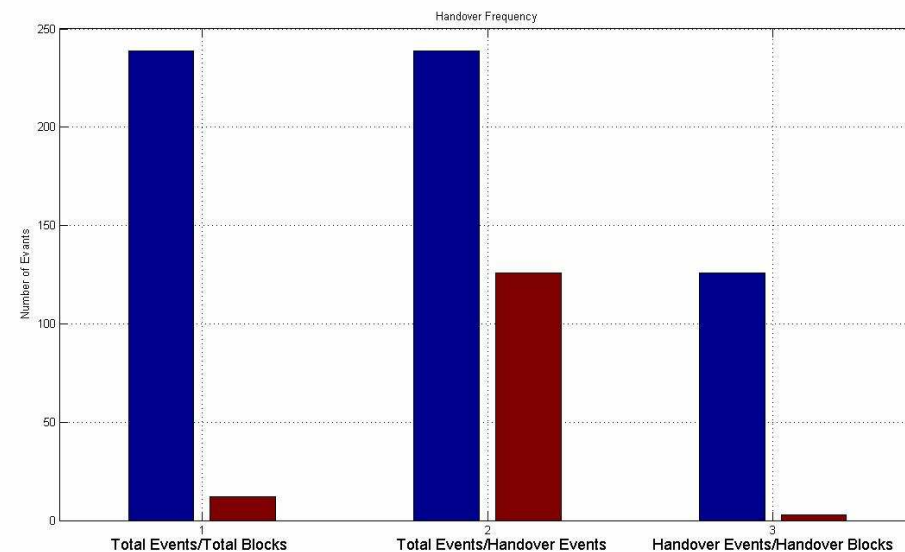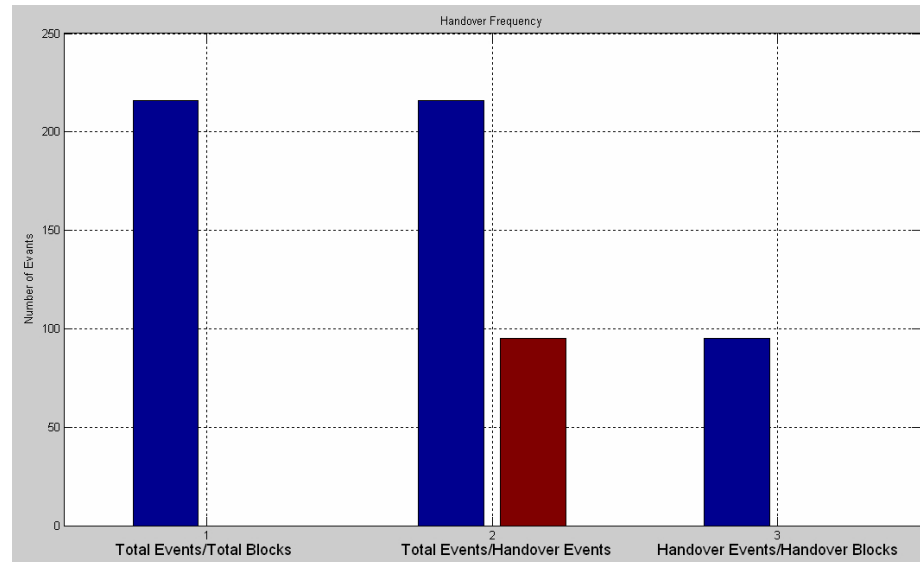
Diff:

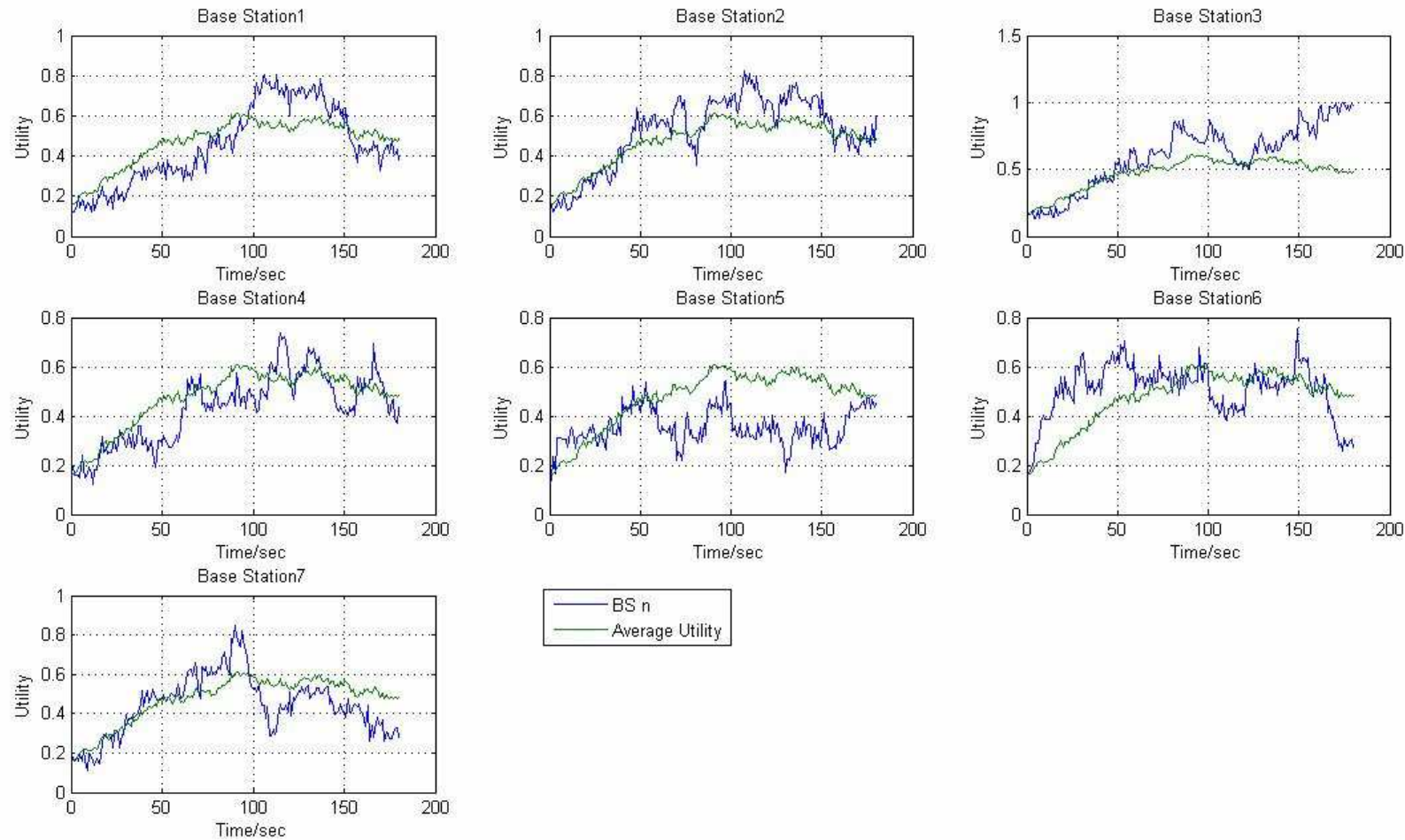   voice =70s video =60s Vs. voice =105 s video =90s

Simulation Result (Base station Utilization)

Conclusion

▶ About 2000 lines of source codes written in MATLAB.

▶ Topics cover WCDMA basics, traffic generation & properties, probabilities & statistics, programming & debugging, etc. The project yields a nice starting for future cellular research.

▶ MATLAB is a suitable tool for simulator design (manipulating data, math functions, and plotting).

▶ Reasonable results are obtained from simulations.

Thank you very much for you attention!

Questions?