TEKNILLINEN KORKEAKOULU
TEKNISKA HÖGSKOLAN
HELSINKI UNIVERSITY OF TECHNOLOGY

Soft Handover Performance study in the Direct Sequence WCDMA Radio network Simulator

Author: Yang Fang / Communication Laboratory

Supervisor: Professor Sven-Gustav Häggman
Instructor: PH.D Michael Hall

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TEKNISKA HÖGSKOLAN
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Handover Introduction

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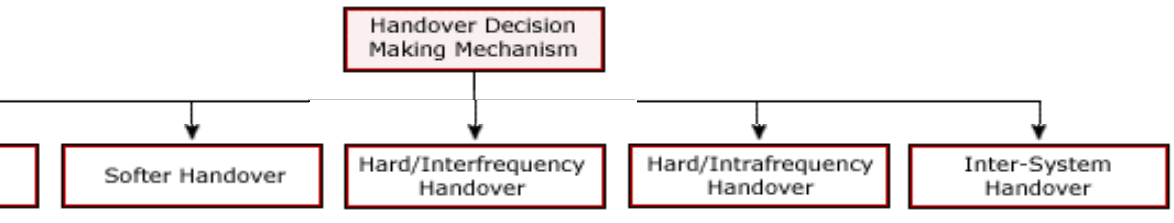
Handover Introduction



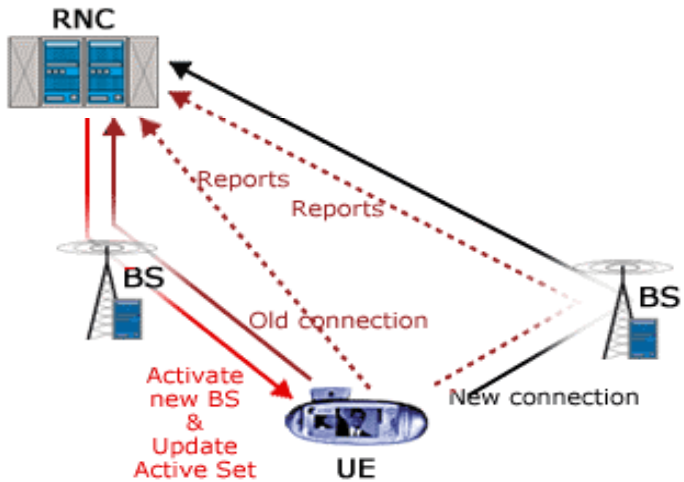
Handover Decision Making Mechanism

During an active connection the UE and base station(s) continuously measure the neighbouring cells and teminals in the neighbouring cells respectively (signal strength, quality, interference level) and report the measurement results to the RNC.

The RNC checks whether the reports meet any criteria triggering handover.

If the criteria are fulfilled, the new connection is established (hard handover) or added to the the active set (soft handover).

When commanded by the RNC the UE activates the new connection.



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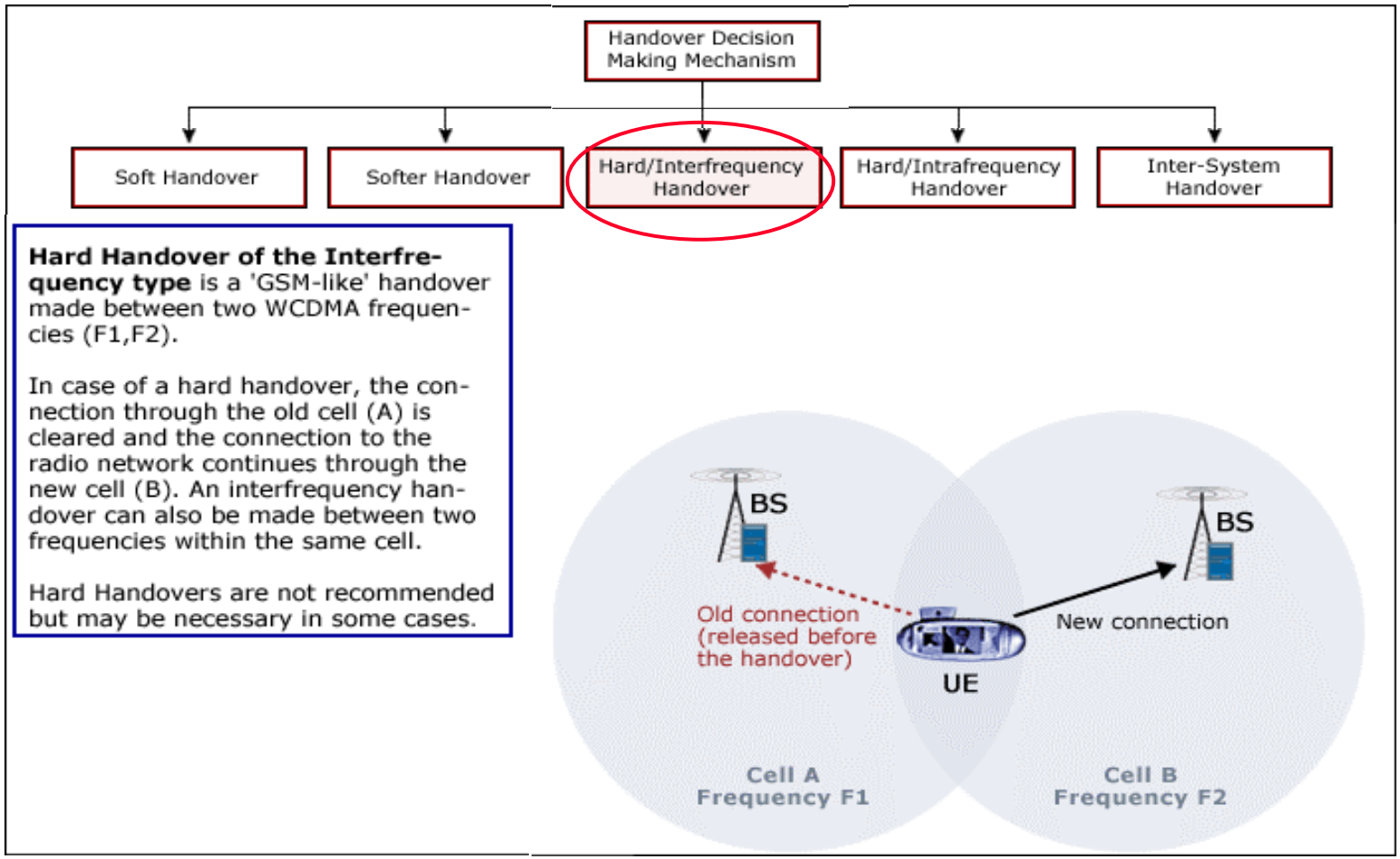
Handover Introduction --- Interfrequency Handover



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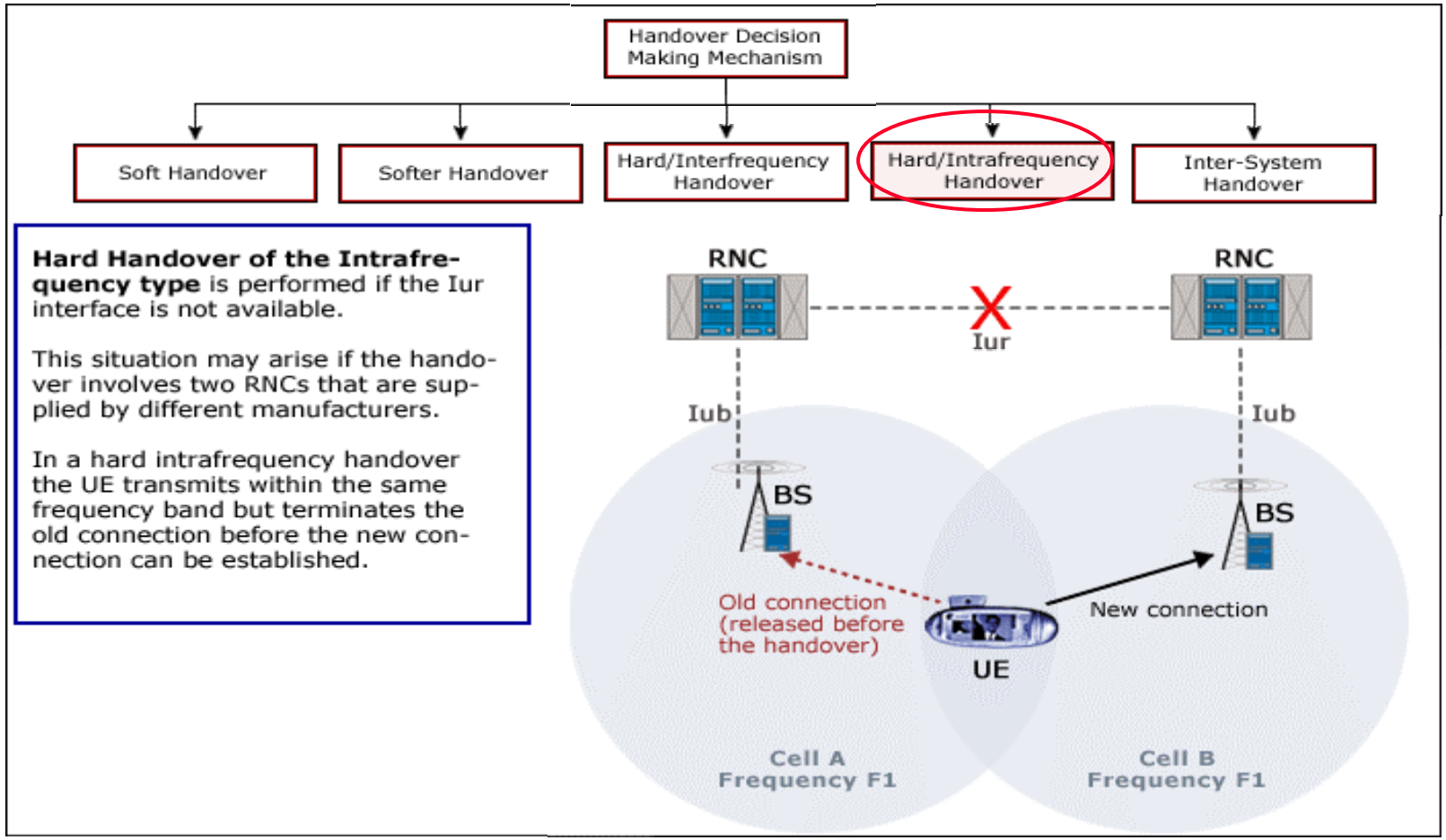
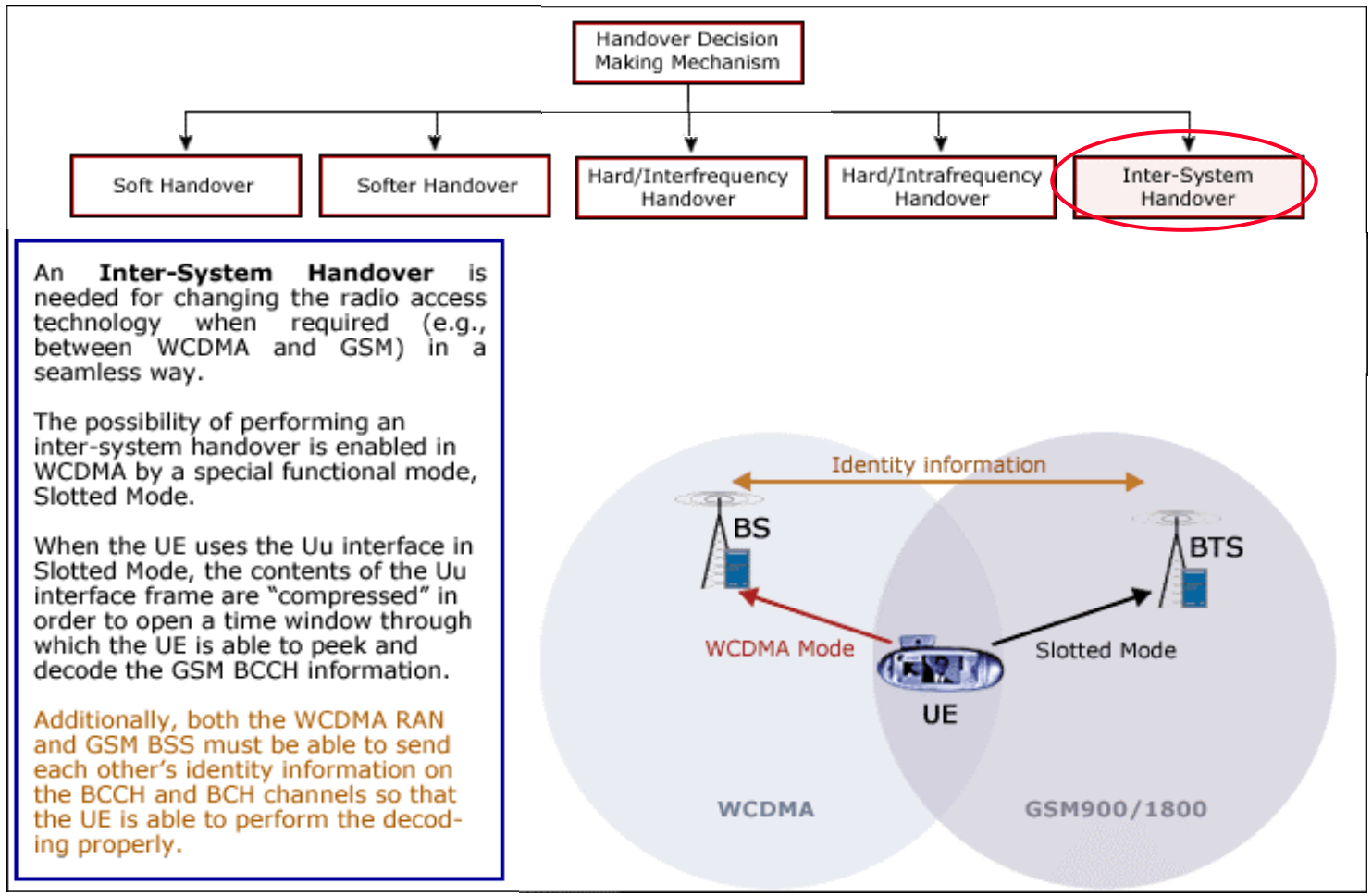
Handover Introduction --- Intrafrequency Handover



Handover Introduction --- Intersystem Handover



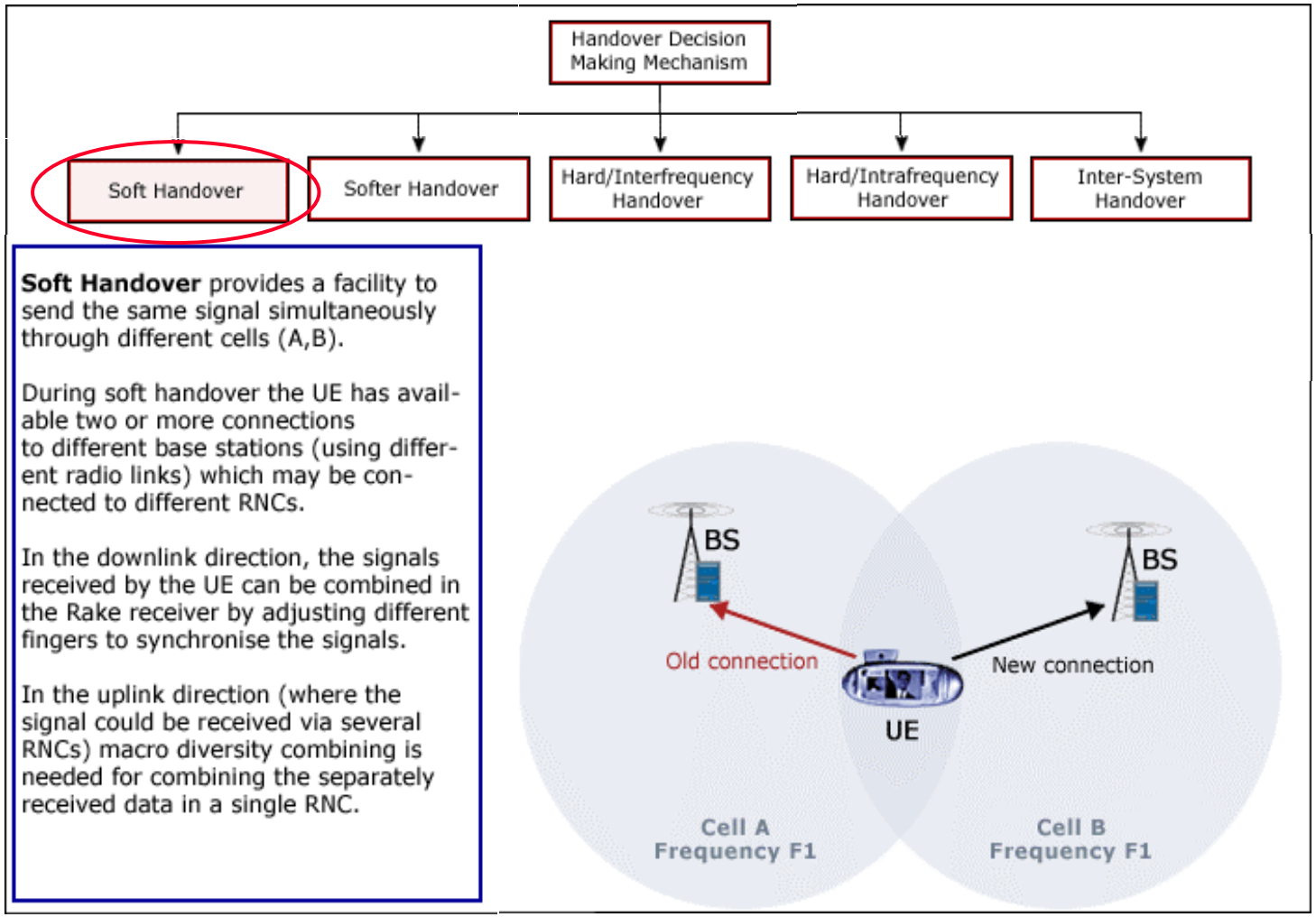
An **Inter-System Handover** is needed for changing the radio access technology when required (e.g., between WCDMA and GSM) in a seamless way.

The possibility of performing an inter-system handover is enabled in WCDMA by a special functional mode, Slotted Mode.

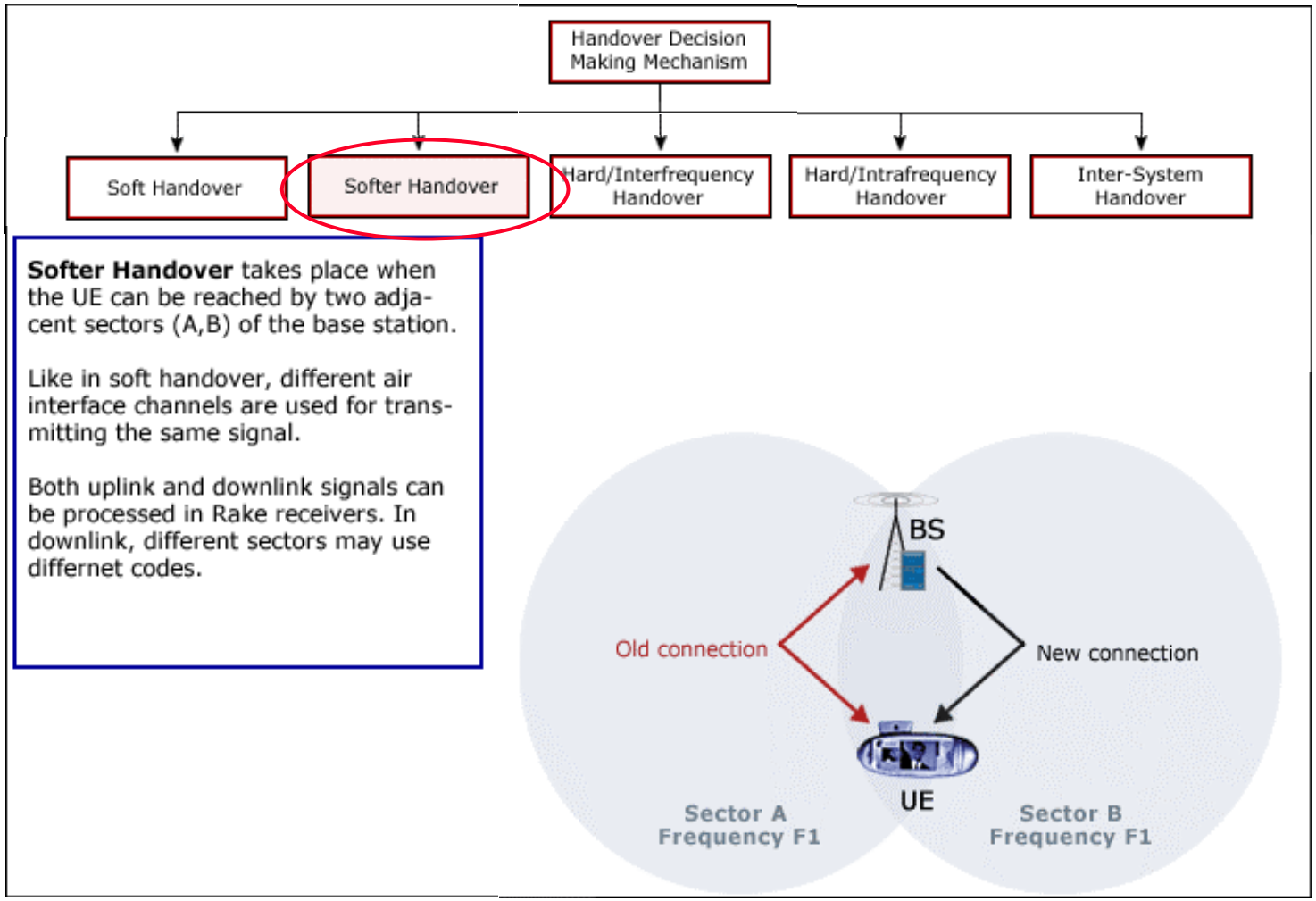
When the UE uses the Uu interface in Slotted Mode, the contents of the Uu interface frame are "compressed" in order to open a time window through which the UE is able to peek and decode the GSM BCCH information.

Additionally, both the WCDMA RAN and GSM BSS must be able to send each other's identity information on the BCCH and BCH channels so that the UE is able to perform the decoding properly.

Handover Introduction --- Soft Handover



Handover Introduction --- Softer Handover



NETSIM Introduction

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NETSIM Introduction

- NETSIM - simulation tool for study of planning methods and control algorithm for WCDMA cellular Radio Network
- Platform: Unix
- Language: C
- NETSIM can simulate: Voice and data service, packet switched traffic, circuit switched traffic, different user behavior, Radio network control functions (HO, Admission, Power Control)
- Simulation result: System capacity as a function of traffic, performance of network control algorithm, etc.

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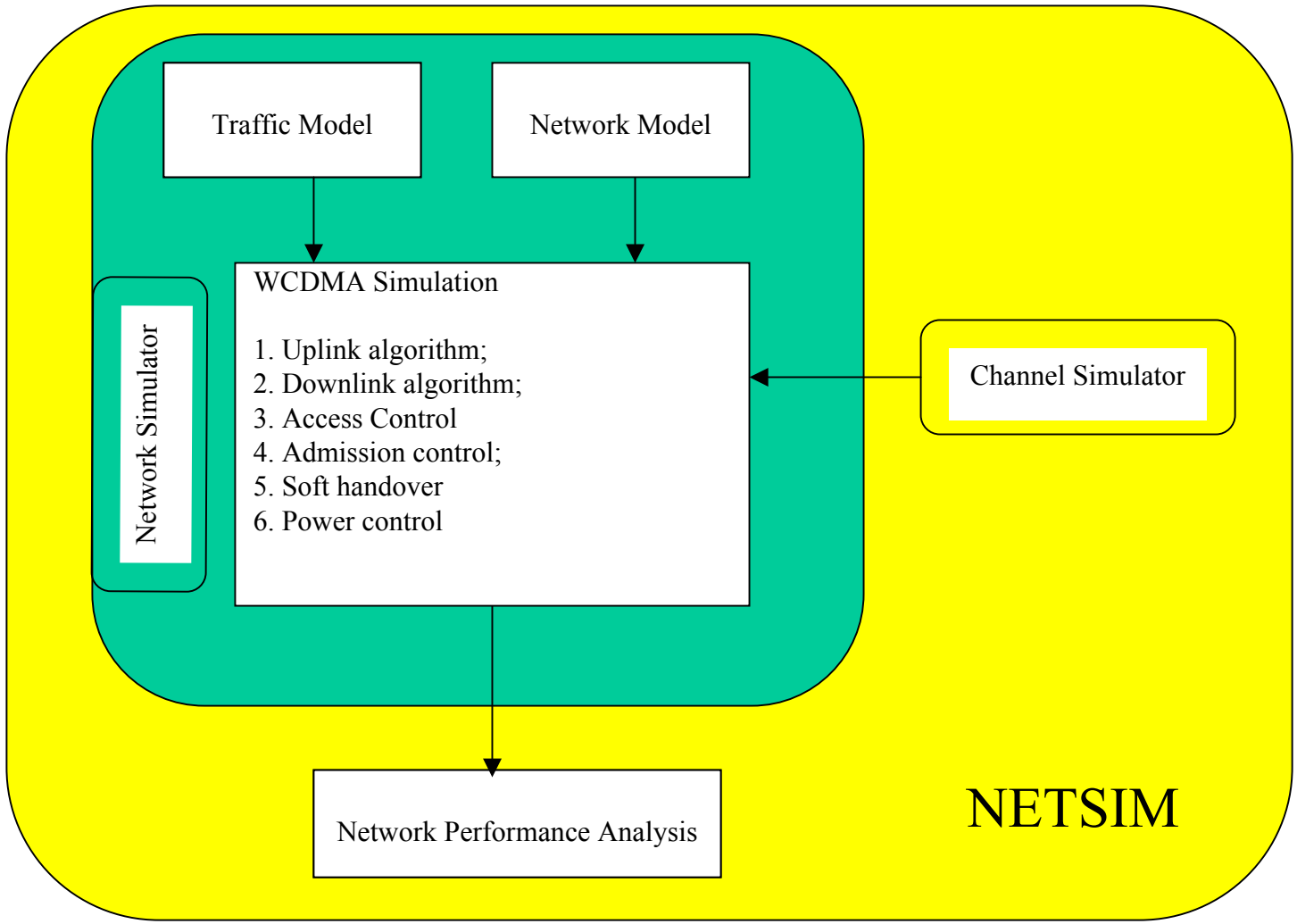
NETSIM Structure and Modules --- Structure



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Channel Simulator of NETSIM

- Current version using Raytracing model
- Impulse response is

$$h(t) = \sum_{k=0}^{K-1} a_k \delta(t - t_k) \exp(j\theta_k)$$

- Advantage: Model considered as accurate
- Disadvantages: Computing intensive (large Memory and long simulation time required)

Map of simulation environment

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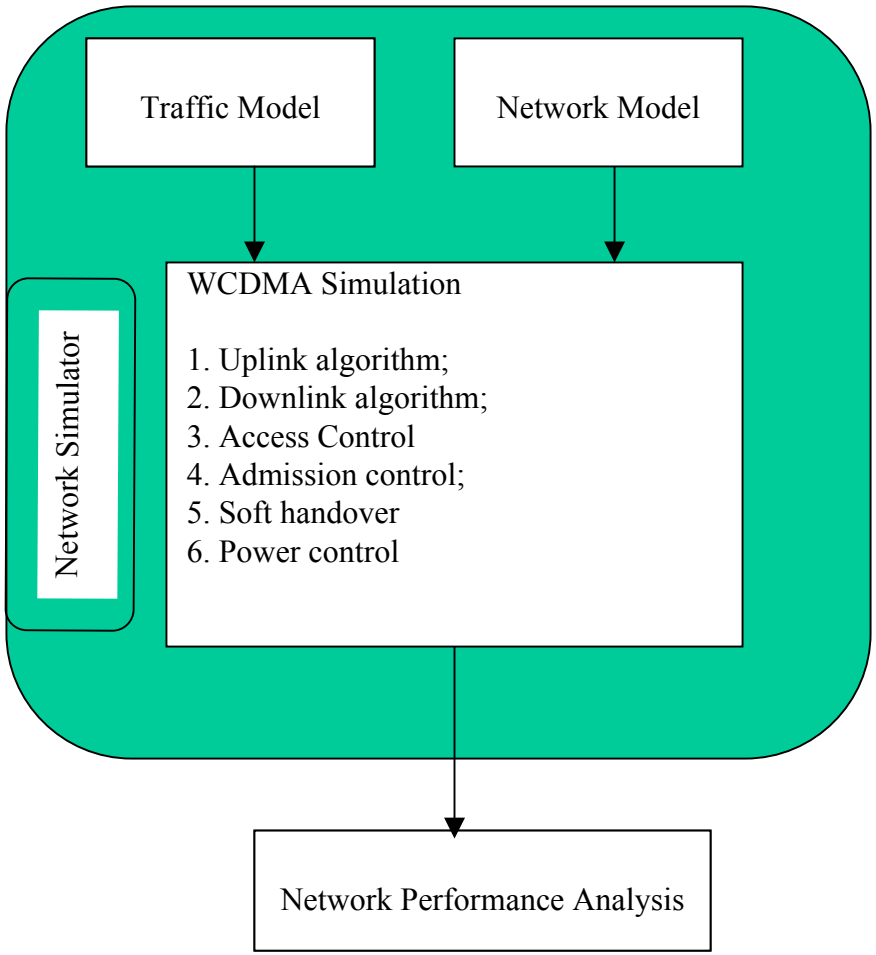
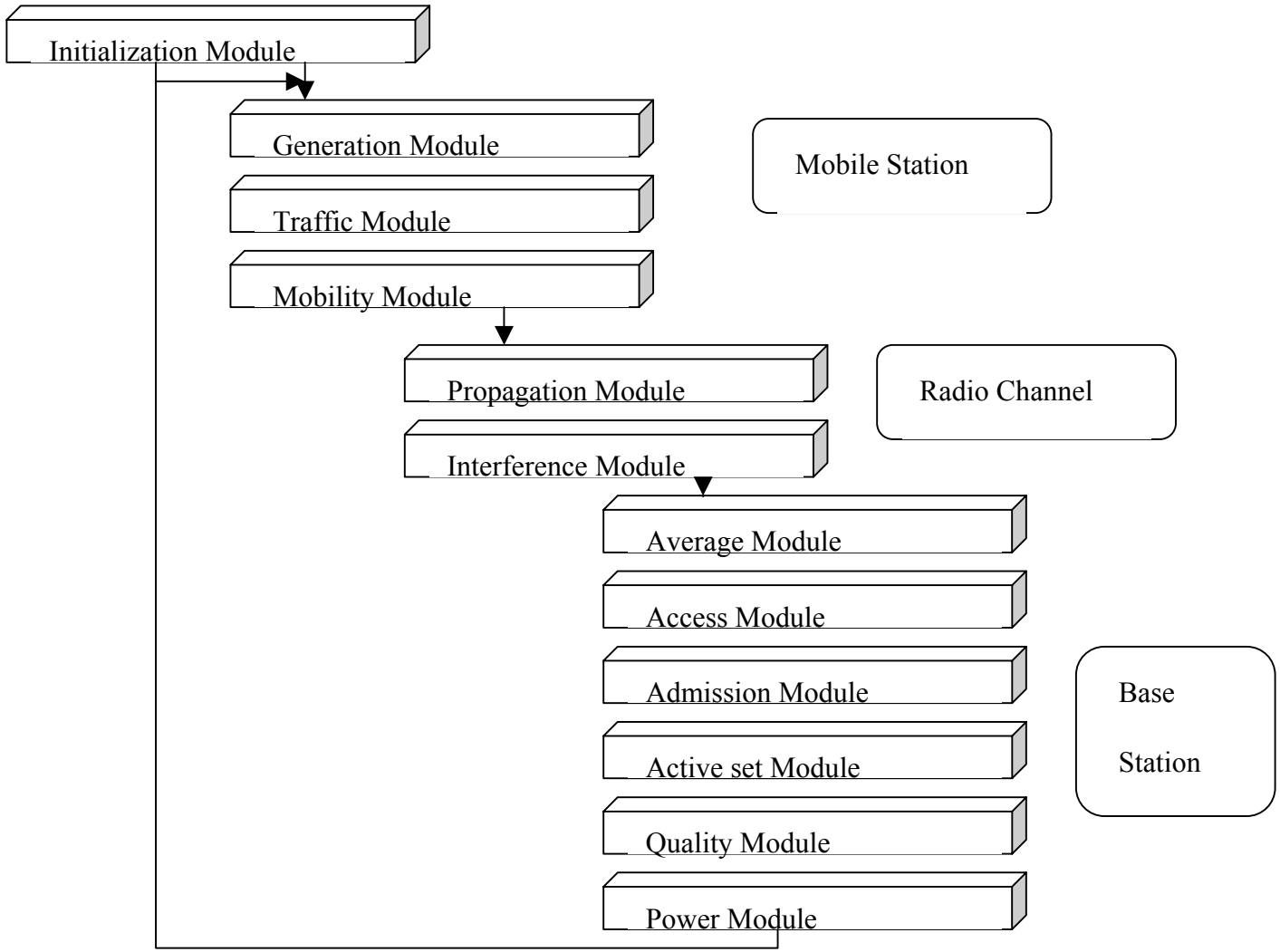
Network Simulator of NETSIM

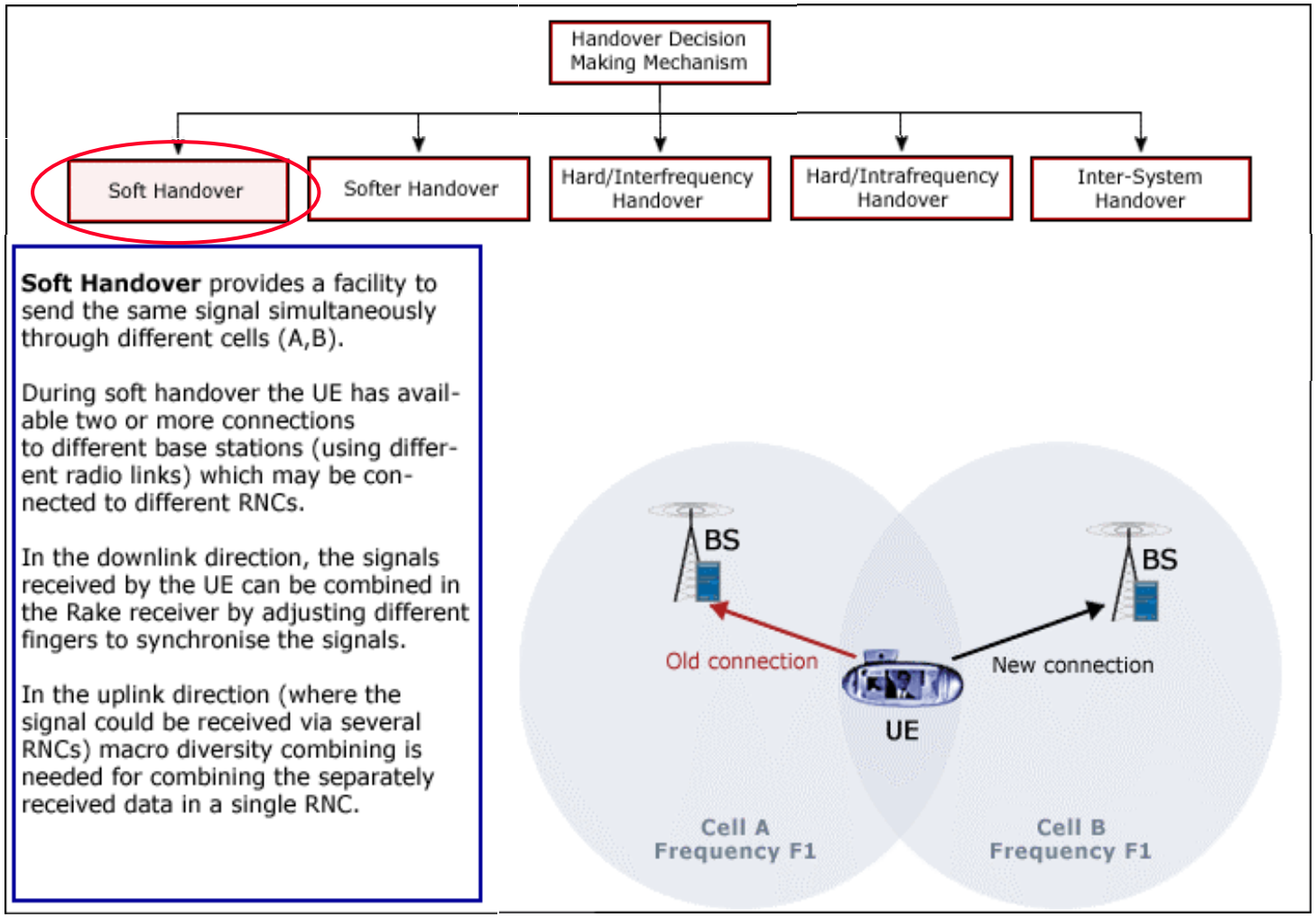


NETSIM Structure and Modules --- Modules



Soft Handover algorithms Introduction

Handover Introduction --- Soft Handover



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Soft Handover algorithm Introduction

--- "Window-average" algorithm

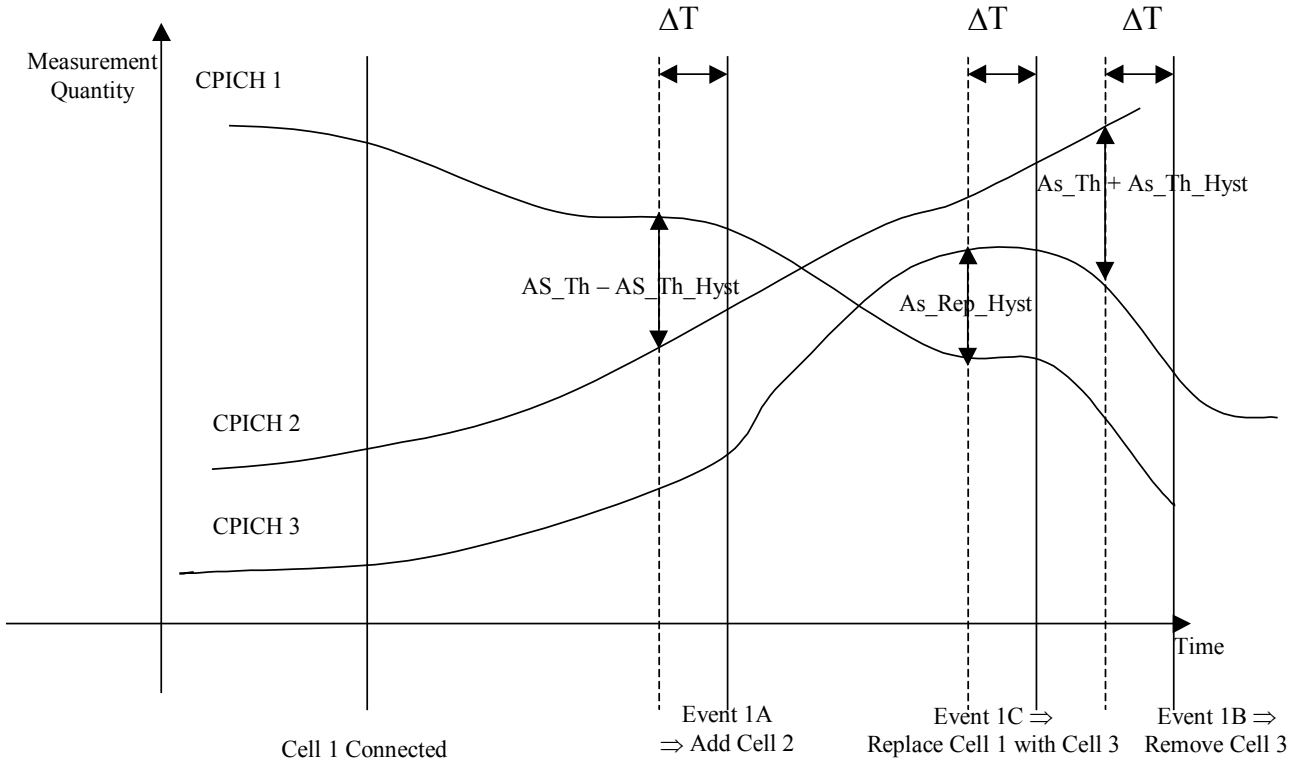

Figure of window-average algorithm from 3GPP 25.922_3/02

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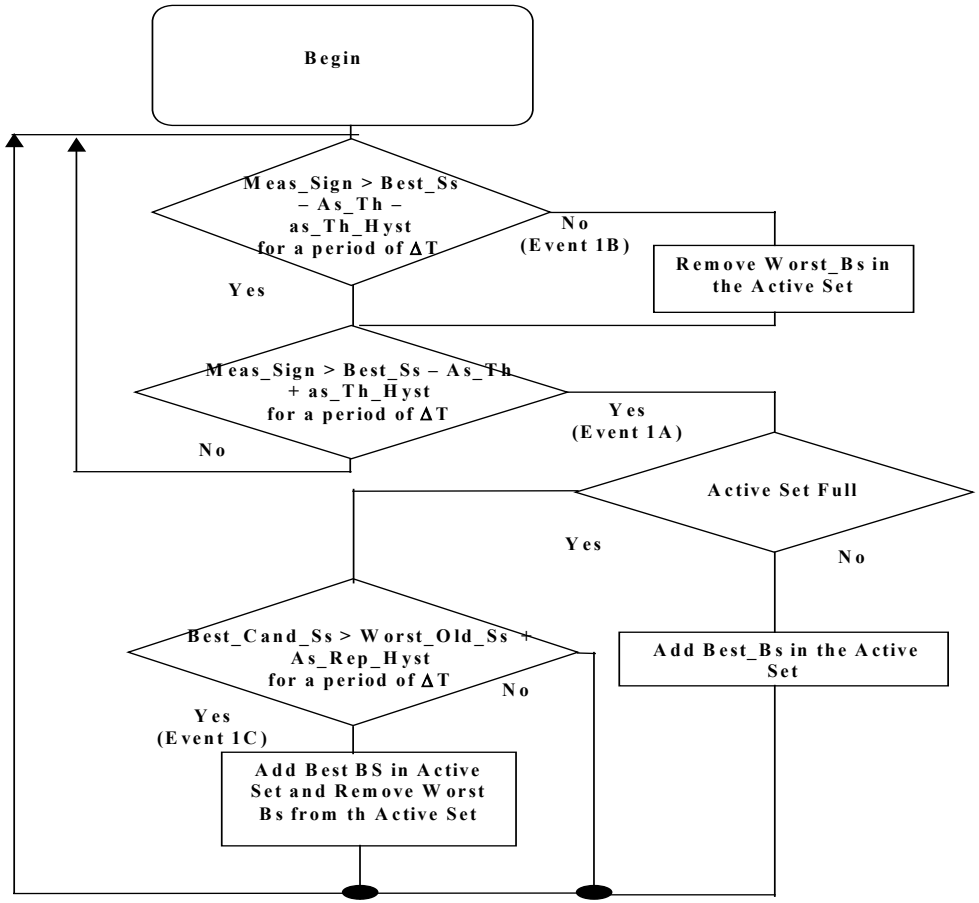
Soft Handover algorithm Introduction

--- "Window-average" algorithm flow chart



Flow chart of window-average algorithm from 3GPP 25.922_3/02

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TEKNISKA HÖGSKOLAN
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Parameters for “Window-average” algorithm

Parameters:

• AS_Th	Threshold of Marco-diversity gain in “Window-average” algorithm
• AS_Th_hyst	Hysteresis of AS_Th
• AS_Rep_hyst	Replacing Hysteresis in “Window-average” algorithm
• HO_Add_time	Evaluating window size to add candidate to active set list
• HO_Drop_time	Evaluating window size to drop one from active set list

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Soft Handover algorithm Introduction

--- “Real-time” algorithm

- Always connect to the cells with better or best signal quality
- Swap the cells in the active set frequently
- Response quickly to the change of the communication channel
- No window to evaluate the receiving signal
- Soft handover gain is fixed (equal to the Marco-diversity gain)

Parameters for “Real-time” algorithm

Parameters:

- AS_3_ratio — Marco-diversity gain when using 3 active set in the Soft handover procedure in “Real-time” algorithm
- AS_2_ratio — Marco-diversity gain when using 2 active set in the Soft handover procedure in “Real-time” algorithm

Simulation result and Performance study

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TEKNISKA HÖGSKOLAN
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Performance study for different algorithms

--- "Window-average" algorithm (1-1)

AS active Threshold	3.98(equal to 6 dB)
AS active Threshold Hysteresis	1.58(equal to 2 dB)
AS active Replacement Threshold Hysteresis	3.98(equal to 6 dB)
AS active Handover add window size	0.5(second)
AS active Handover drop window size	0.5(second)

Group 1 Parameters set

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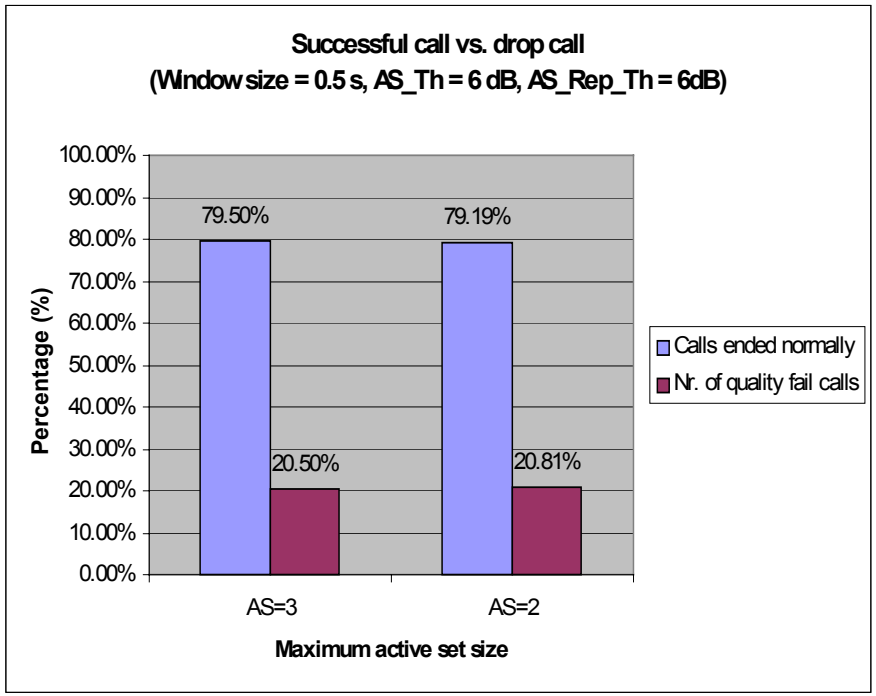
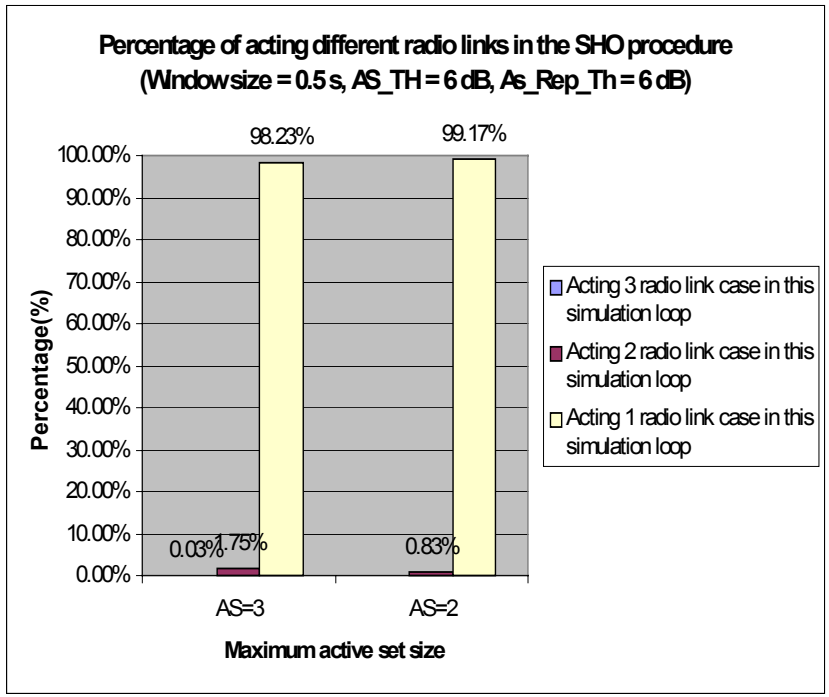
Performance study for different algorithms

--- "Window-average" algorithm (1-2)





Simulation result of parameter set group1

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Performance study for different algorithms

--- "Window-average" algorithm (2-1)

AS active Threshold	2.512(equal to 4 dB)
AS active Threshold Hysteresis	1.58(equal to 2 dB)
AS active Replacement Threshold Hysteresis	2.512(equal to 4 dB)
AS active Handover add window size	0.5(second)
AS active Handover drop window size	0.5(second)

Group 2 Parameters set

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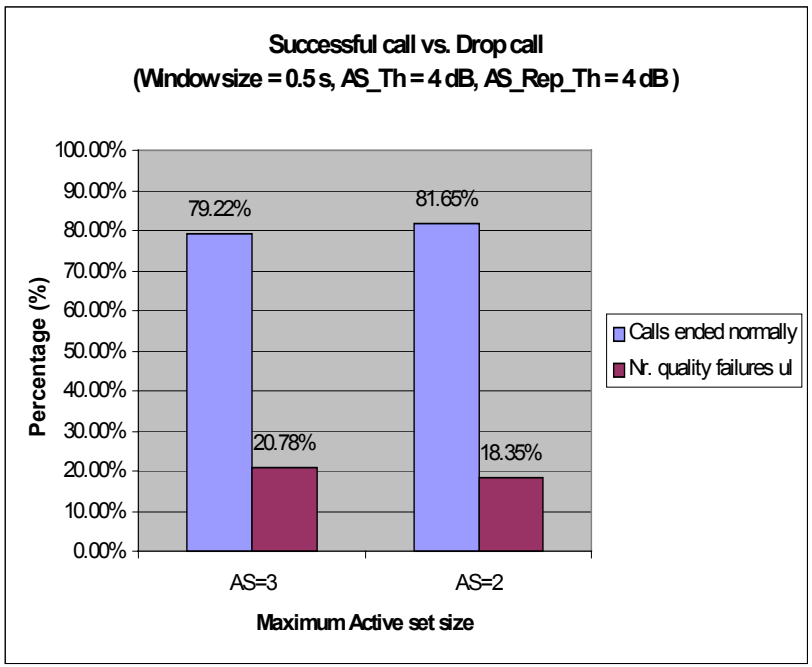
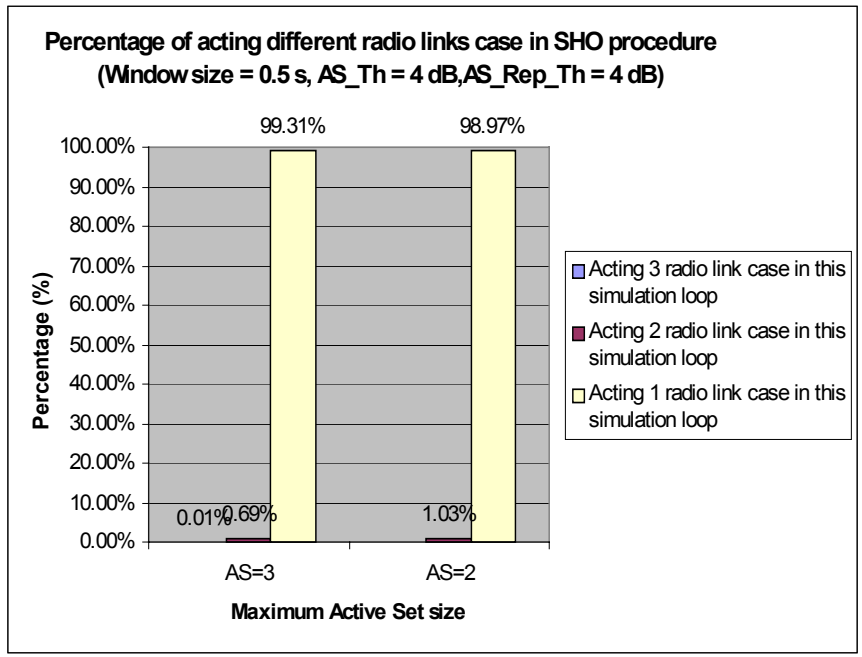
Performance study for different algorithms

--- "Window-average" algorithm (2-2)





Simulation result of parameter set group2

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Performance study for different algorithms

--- "Window-average" algorithm (3-1)

AS active Threshold	2.512(equal to 4 dB)
AS active Threshold Hysteresis	1.58(equal to 2 dB)
AS active Replacement Threshold Hysteresis	2.512(equal to 4 dB)
AS active Handover add window size	0.1(second)
AS active Handover drop window size	0.1(second)

Group 3 Parameters set

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TEKNISKA HÖGSKOLAN
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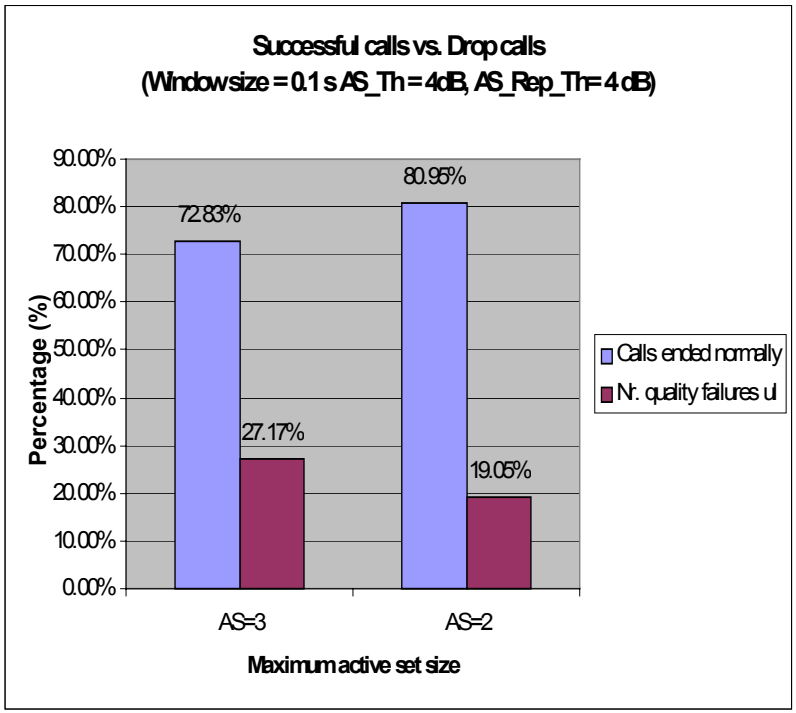
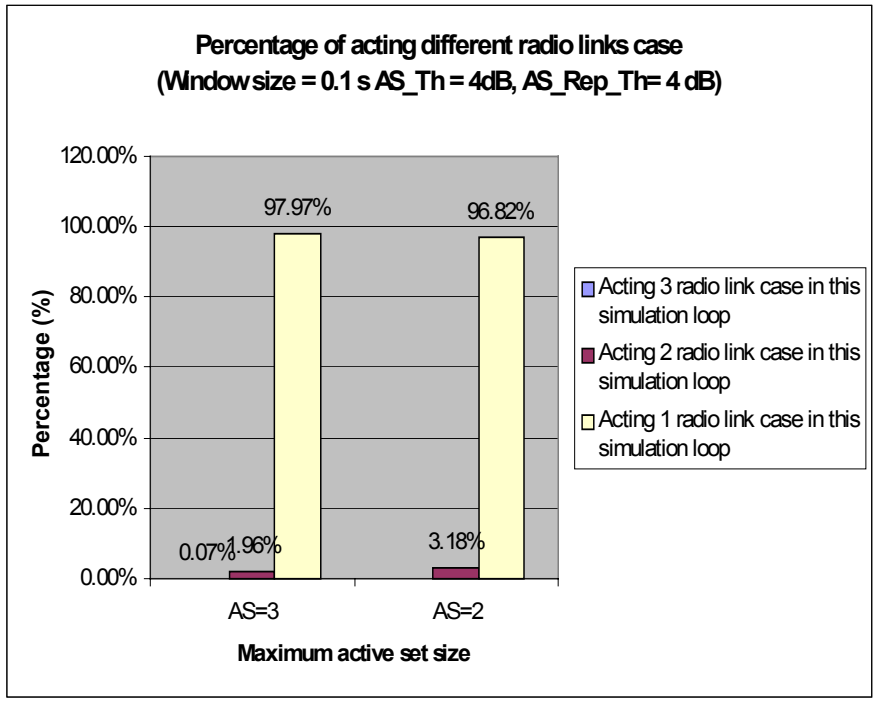
Performance study for different algorithms

--- "Window-average" algorithm (3-2)





Simulation result of parameter set group3

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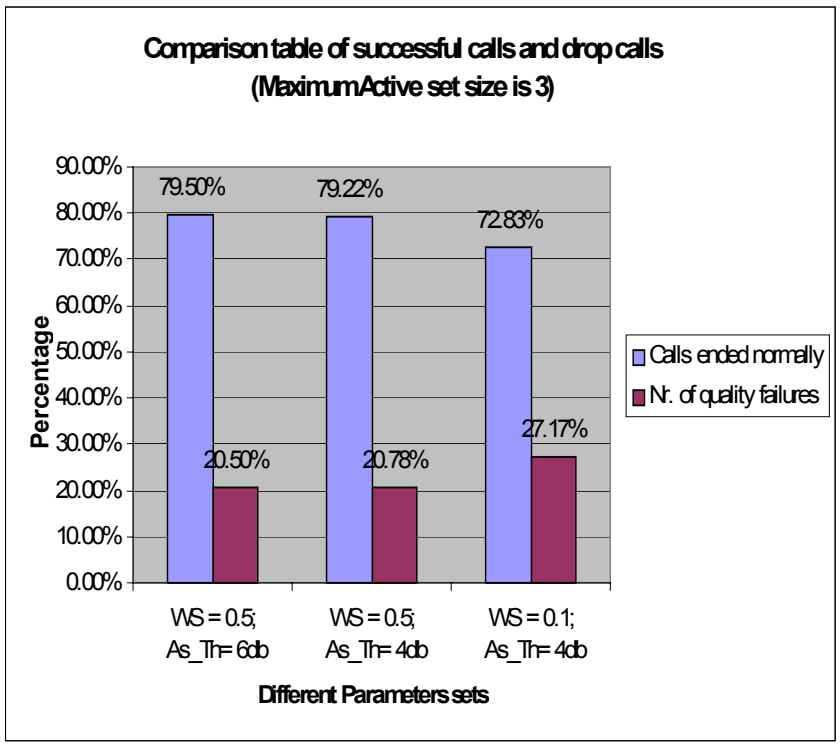
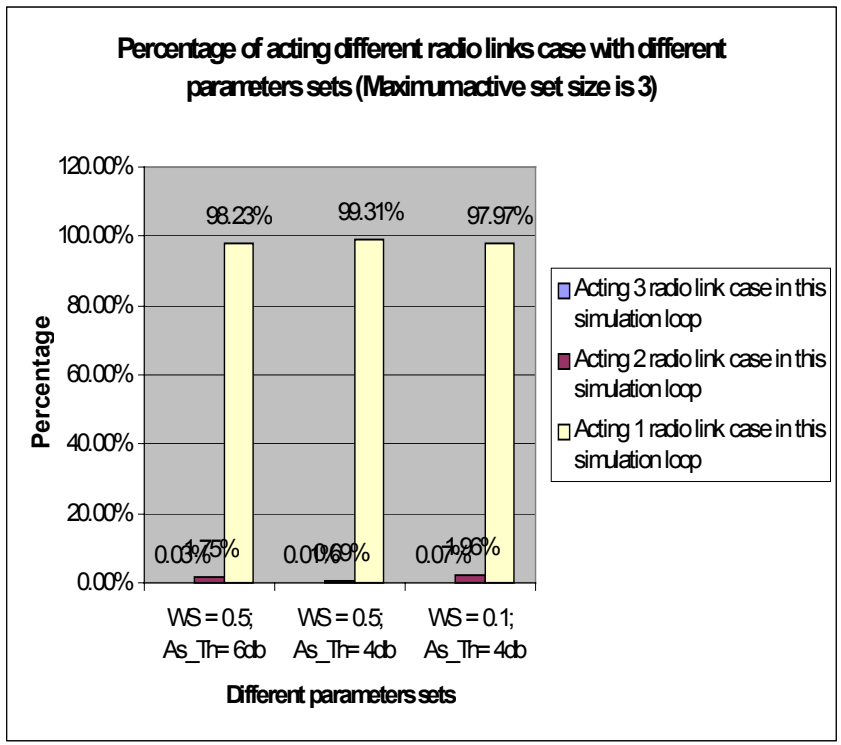
Performance study for different algorithms

--- "Window-average" algorithm summary(1)





Simulation result of different parameter sets of "Window-average algorithm" (AS=3)

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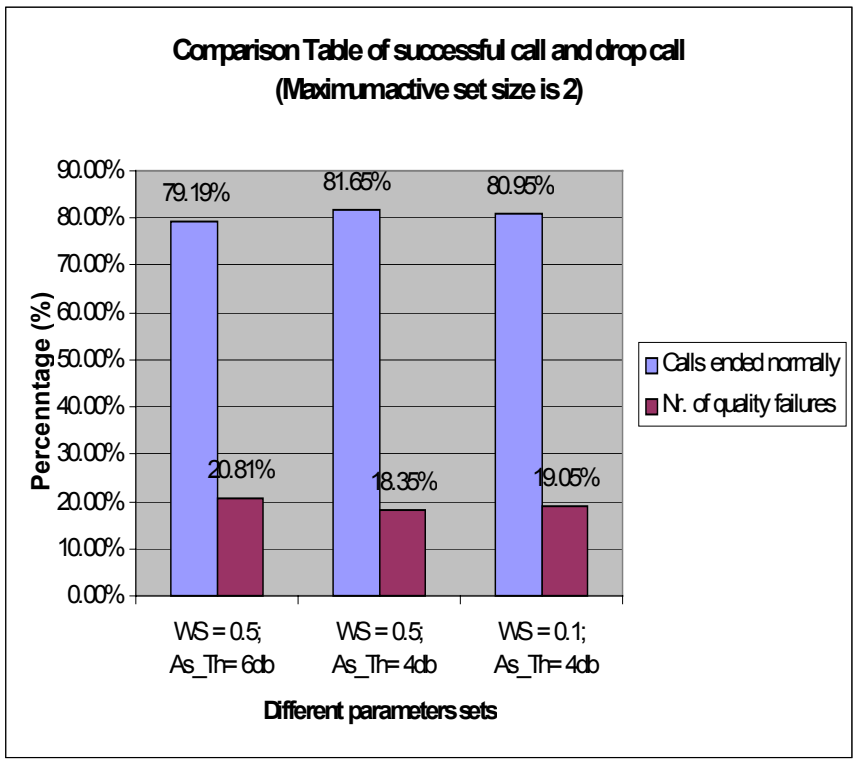
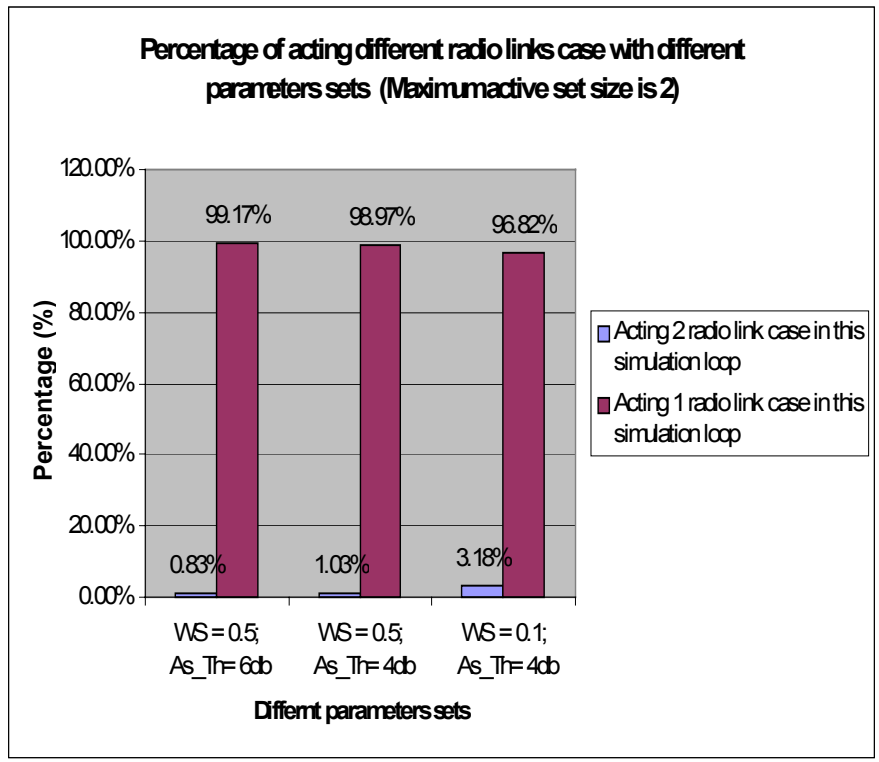
Performance study for different algorithms

--- "Window-average" algorithm summary(2)





Simulation result of different parameter sets of "Window-average algorithm" (AS=2)

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Performance study for different algorithms

--- "Window-average" algorithm summary(3)

Conclusion:

- The performance is a little better when the active set size is 2
- In most time of the call procedure, the communication between the MS and BS only using one radio link
- It's difficult for find the optimal parameters set for the "Window-average" algorithm, we have to try a lot of parameters sets to get one better solution for the "Window-average" algorithm

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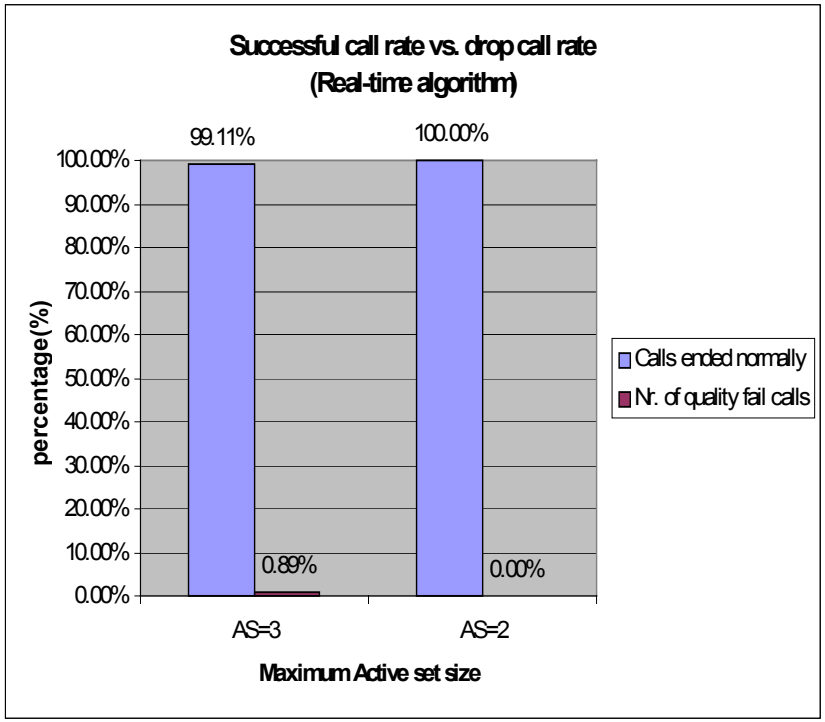
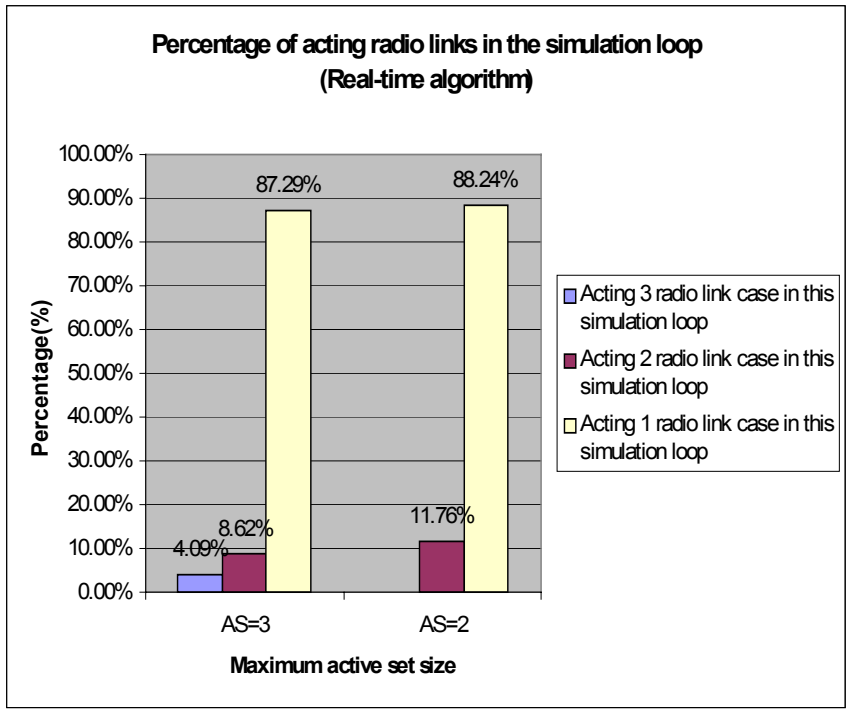
Performance study for different algorithms

--- "Real-time" algorithm simulation result





Simulation result of "Real-time" algorithm

Performance study for different algorithms

--- "comparison between two algorithms

Conclusion:

- The "Real-time" algorithm is better than "Window-average" algorithm
- The "Real-time" algorithm always adopt the better channel for the conversation. But the "window-average" algorithm need some average window to adopt the optimal link

Drop call trace tool

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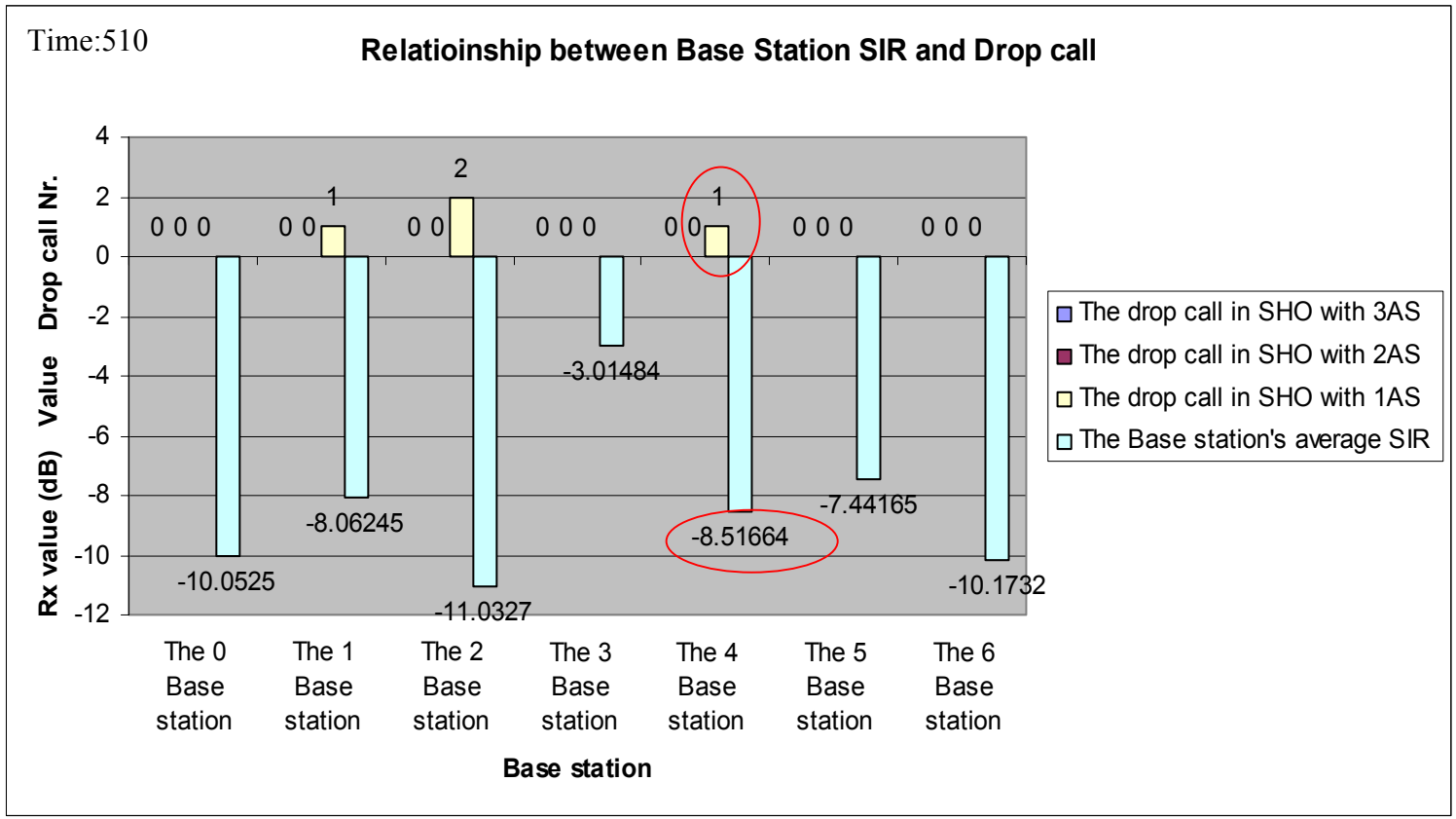
Drop call Trace tool

--- Network drop call situation in Time 510



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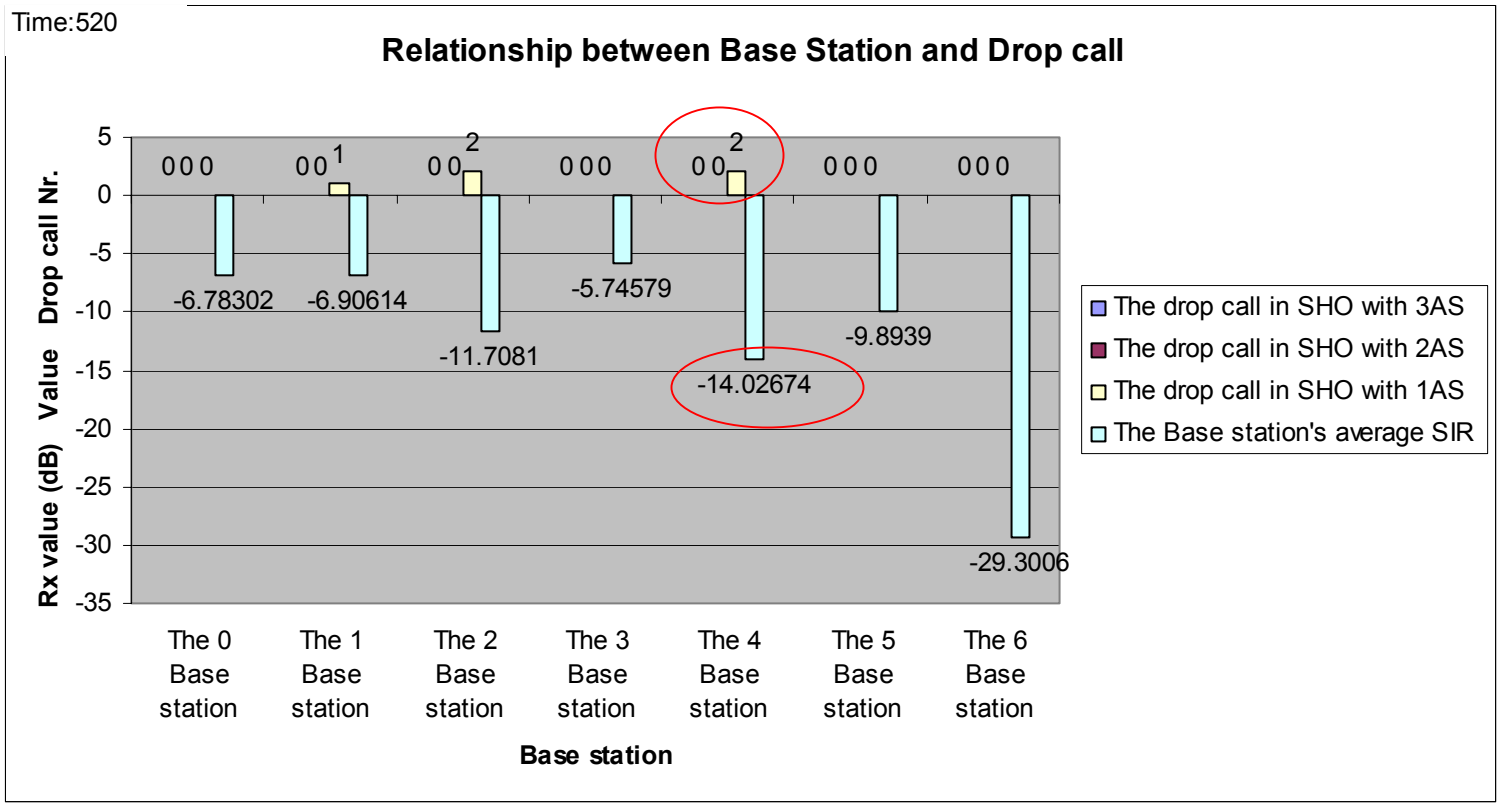
Drop call Trace tool

--- Network drop call situation in Time 520



Future Work

Future work

- More simulations with different parameters set are needed
- The Packet data service performance with different SHO algorithms is need to be investigated
- More drop call trace analysis tool need to be integrated in NETSIM

Thank you!

Questions?