

Handoff between Base Station and Mobile Moving in RSS with Hysteresis

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Abstract:

Mobile handoffs are a process very sensitive where measures the strengths of the signal and compare with the threshold to make decision of handover the mobile to new cell while the mobile is moves between cells where it measure signal strengths and quality for nearby base station where assist the network in deciding the optimal moment to handover to new cell where in this paper we use two methods, RSS with Hysteresis and with threshold

Key Word: cell size, RSS Hysteresis, threshold, Handover .

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I. Handoff

It is a process of transferring a call to another bas station, when a user crosses the boundary between adjacent cells while a call is in progress (2) as shown Figure (1) below.

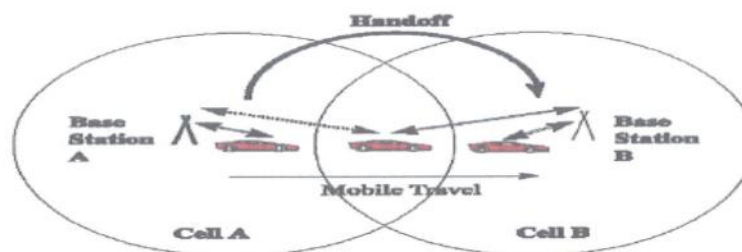


Figure (1): Handoff Scenario in Cellular Systems

The handoff can occur even if the user is not actively involved in a, call where the systems will automatically handoff and a user among cells as long as the mobile is trued on and the user is moving where the procedure of handoff are (7):

- 1- The mobile win try to identify appropriate new base station to handoff
- 2- The mobile also will try to find available voice channel to switch into if not the mobile will hang with old channel until the power signal become weak below the threshold voltage and the call will be dropped.
- 3- Also a good issue here is to find the optimal handoff time, it is very important in which to decrease the handoff number.

The handoffs are n10st commonly based on the signal power with threshold voltage, because if the mobile signal power (P_{min}) is equal to the handoff power (P_{ho}) that will lead the mobile to try to find power signal from the nearest cell to handoff into it.

* There are two discussions that should be in mind where try to handoff (7):

The mobile position: is the mobile approaching the cell boundary or not.

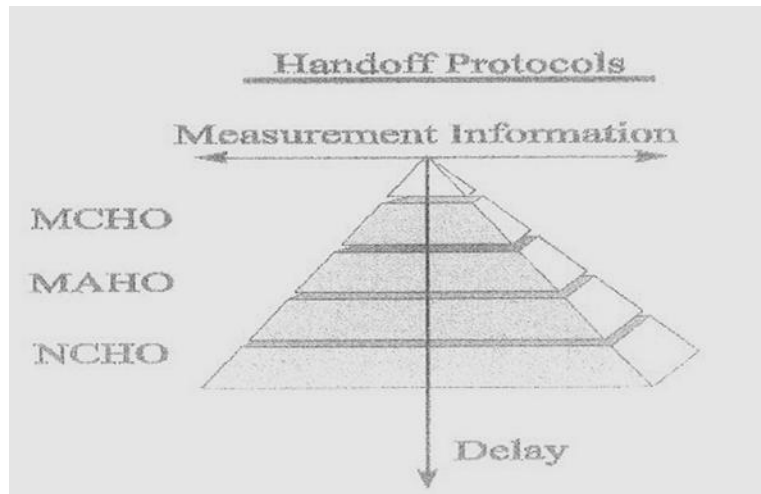
Mobile speed: how fast mobile is moving that will lead to quicker handoffs

* The handoff mechanism can be classified into three types (12):

1- Network controlled handoff (NCHO): the network makes a handoff decision based on measurements of the Received Signal Strength (RSS) of the mobile station (MS) at a number of base station (BS), (Centralized).

2- Mobile assisted handoff (MAHO): distributes the handoff decision process. The mobile station (MS) makes measurements, and the Mobile Switching Center (MSC) makes decisions. 3- Mobile controlled handoff (MCHO): the mobile station (MS) is completely in control of the handoff process (Distributed).

Figure (8) below shows the delay time and information provided by each mechanism.



Figure(2): Handoff Delay and Measurement Information for Handoff mechanisms

II. Types of Handoffs

There are two types of handoff (10):

Hard Handoff

Here the base station or mobile will be involve in detecting the signal power level, if the power signal for the base station become equal to the power signal of handoff threshold voltage, then the servicing base station contact the neighboring base station (cell) which directs them to begin monitoring the reverse its power level, one of the monitory base station reports a sufficiently strong signal from the mobile this base station will assign a new voice channel to the mobile (provided it has extra channels available) then the mobile breaks off (hard) its old connection with the servicing base station and establishes a new connection with the new base station (new cell), but if the new base station dose not have extra channel available, the servicing old base station will maintain a connection with the mobile until the signal power level drops below a certain threshold, if so then the base station will lose the mobile's signal and in the process causing the call to be dropped (10).

Soft Handoff

Here, the approach is different than above, where the mobile establishes a connection with the new base station while it is still connected to the old base station, so the mobile will be communicating with two base station over two separate channels at the same time where the old connection will dropped only after it becomes to weak to be sustained as shown in Figure (9), it is common in the CDMA (10).

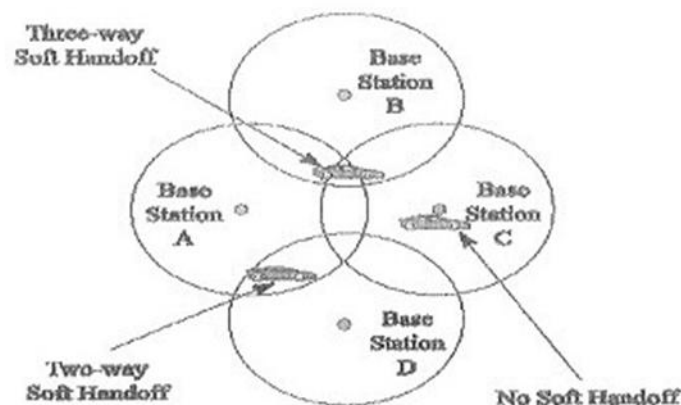


Figure (3): Generic Soft Handoff Scenarios in a Cellular System

III. Mobil Communication Principles

Each mobile use separate radio channel to talk to the cell site (12). The cell site talks to mobiles at once, using one channel per mobile. Channels use a pair of communication one frequency the forward link for transmitting from the cell site and one frequency the reverse link for the cell site to receive calls from the users (12). The radio energy dissipate over distance so mobile must stay near the base station to maintain communication as shown in Figure (4) below

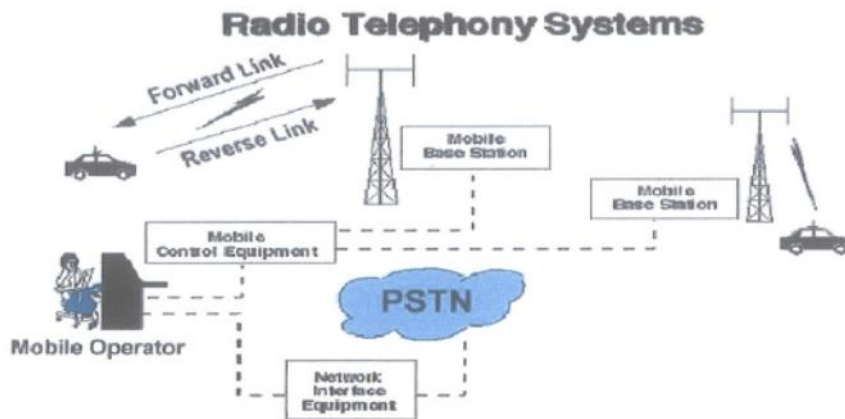


Figure (4): radio telephony system

Early mobile telephone system Architecture it was structured similar to television broadcasting (6) with very powerful transmitter located at the highest spot in an area would broadcast to a radius of up to 50 kilometers (6). The cellular concept is instead of using one powerful transmitter it placed any low power transmitters throughout a coverage area by dividing the region into different small area called (cells) with low power transmitter here the system capacity could be increased as shown in the figure (5)

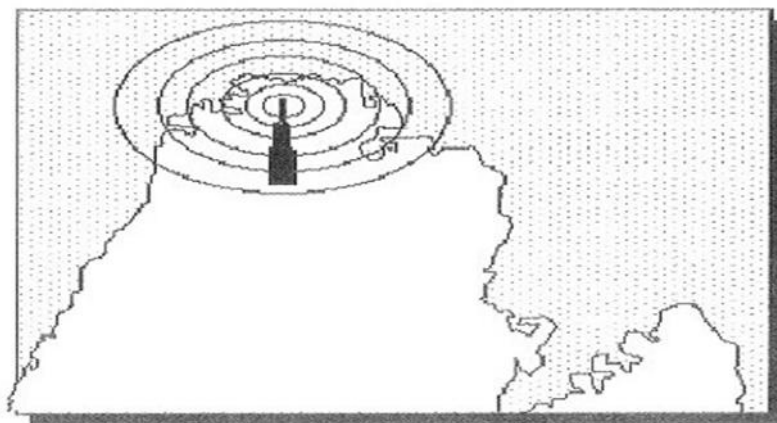


Figure (5): Early mobile telephone system architecture

IV. Handoff in Cellular Network

Here we will discuss the different algorithms used in handoff decision making in a Micro-cellular network. The scenario is shown in Figure (6) below the car is communicating with BS (1). The car starts moving away from BS(1) toward BS(2), as the car moves away the Received Signal Strength (RSS) from BS(1) decreases and the RSS from BS(2) increases. At a certain point received power from BS (1) becomes weak and the car starts to search for another BS which can provide a stronger signal in our case it is BS(2). We are going to study two algorithms in this case (8).

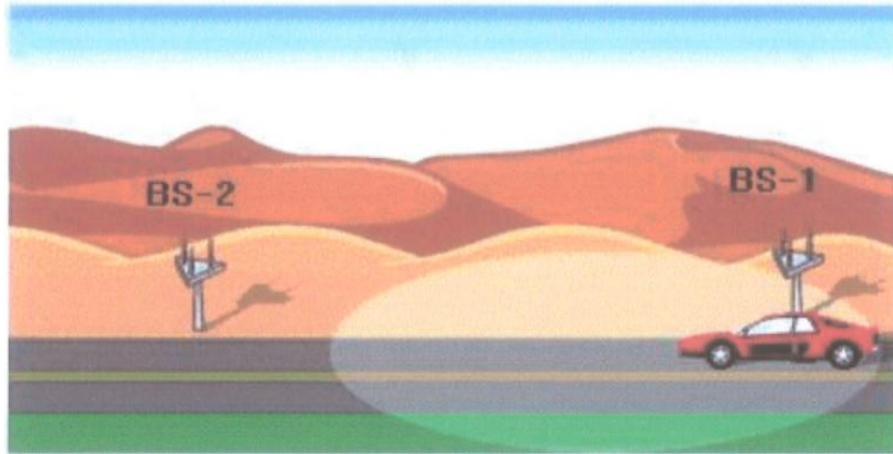


Figure (6) -car is moving from BS (1) towards BS (2)

V. Handoff Decision Making Algorithms

1- RSS with hysteresis in RSS

In this method, similar to previous methods primary metric for handoff decision is still RSS. However, MS selects a different base station whenever the RSS from a base station is more than the RSS from the current base station plus a hysteresis (given constant parameter) value, Figure (7) shows the flow chart for this algorithm (12),

2 - RSS with hysteresis in RSS and threshold

This method is a combination of the above with the threshold voltage, If the RSS from, the current base station drops below a certain threshold the mobile host selects the BS which provides RSS, which is more than the RSS from the current base station plus a hysteresis, Figure (7) shows the flow chart for this two algorithms (12).

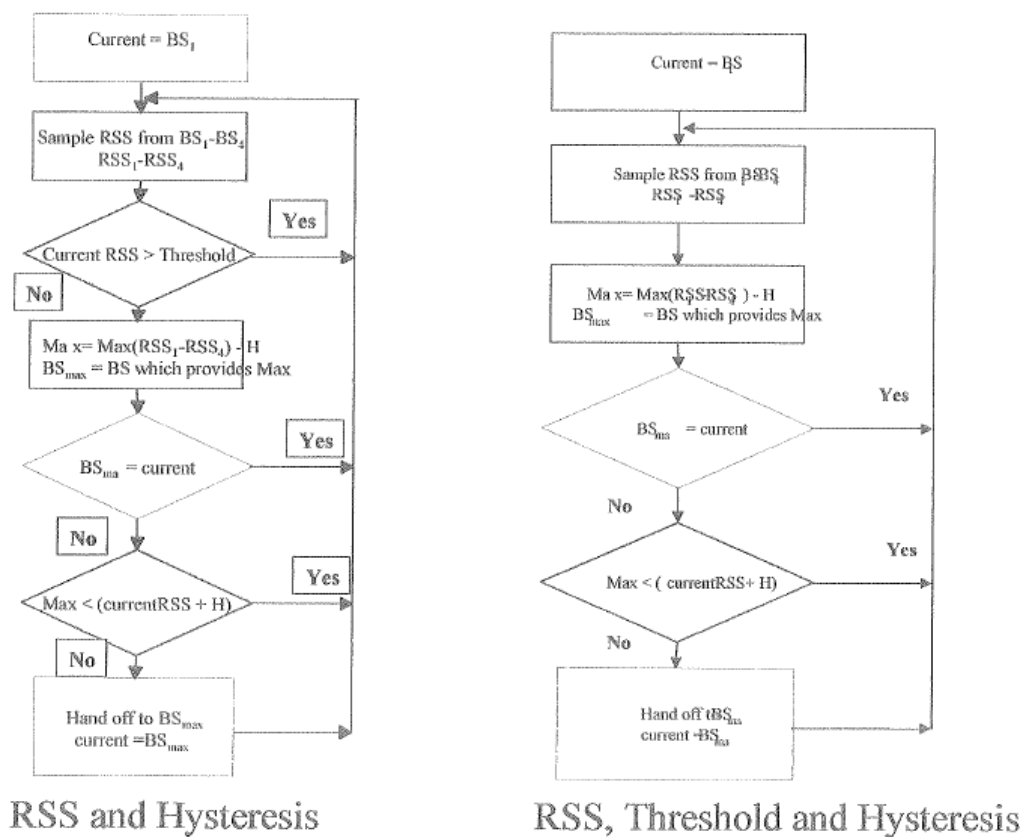


Figure (7): Flow chart of handoff algorithms

VI . Handoff Initiation

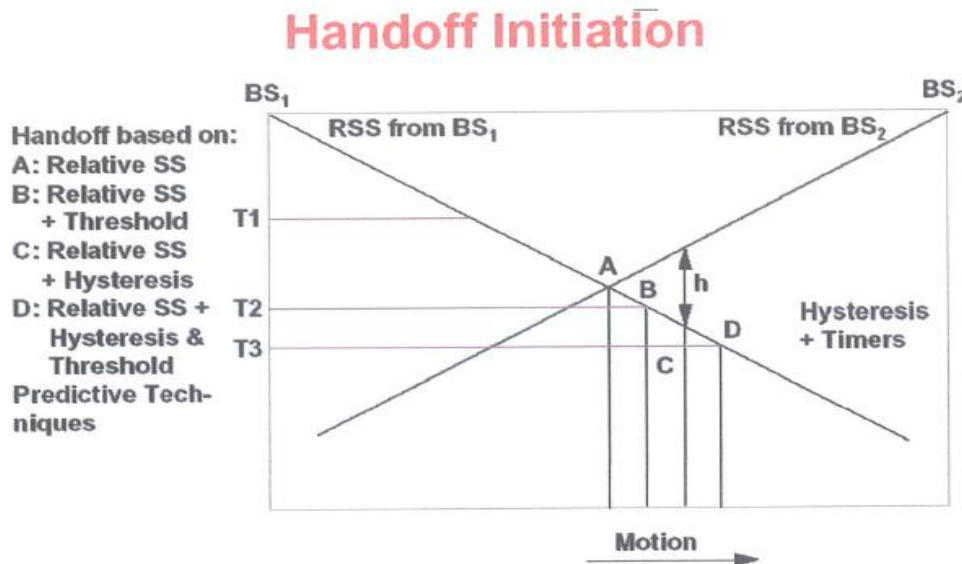


Figure (8): Handoff Initiation

As shown in the figure (8) above. For an Mobile Station (MS) BS(2), the averages signal strength of BS(2) increases in the handoff decision based on RSS criteria will be triggered at point (A) in the figure. While in decision based on RSS with threshold handoff is triggered if the average signals strength the serving BS (1) drops below T (2) threshold value the handoff will initiated at point (B), While in decision based on RSS with the hysteresis handoff is triggered if the average signal strength of the serving BS(1) drops below T(2) hysteresis value the handoff will initiated at point (C). Finally in decision based on RSS with threshold and hysteresis the handoff is triggered if the average signal strength of the serving BS (1) drops below T(3) the handoff will be triggered in this case at point (D) (9). The first two criteria's were not in our count, but the last two were. The Received Signal Strength (RSS) equation at any distance is (12):

$$\text{RSS} (d) = P_t - P_o - [10a \log (d) + 10b \log (d/g)] + s(d) \quad (1)$$

d = distance between the mobile host and base station in meter

$a = b = c = 2$ constant

$g = 150$ define as path loss constant

P_t = Base station transmit power in dB

P_o = the power will loss it in first meter in dB

$S (d)$ = is the correlated log normal fading

For Handoff Initiation

Here will divide this part into two algorithms.

1- RSS with hysteresis in RSS

The parameters have taken from (12).

a- The car in Figure (1) is walking from BSI toward BS2 with a constant speed of 1 m/Sec.

b- The distance of BS (1), is $R = 250$ m

c- The sampling frequency is 10Hz, in another words MS measures RSS in every 0.1 Sec

d- For this part which we use hysteresis we assume Hysteresis = 5 dB

Here will use equation (19), so its parameters are

d = distance between the mobile host and base station in meter

$a = b = 2$

$g = 150$

P_t = Base station transmit power in dB = 20 dB
 P_0 = the power will loss it in first meter in = 38 dB
 $S(d)$ = is the correlated log normal fading

For this simulation you can generate a random vector like this:

$$\alpha = e^{-\left(\frac{1}{85}\right)}$$

$$\sigma_1^2 = 8$$

$$\sigma_2^2 = \sigma_1^2 \cdot (1 - \alpha^2)$$

$$S(1) = \sigma_1 \cdot N(0,1)$$

$$S(i) = \alpha \cdot S(i-1) + \sigma_2 \cdot N(0,1)$$

Where $N(0,1)$ is a normal random variable with 0 mean and 1 variance. **Note:** The first point of the simulation must be at $d = \sqrt{g} = \sqrt{150}$ and the last point should be at $d = 2R - \sqrt{g} = 500 - \sqrt{150}$. In this study used only Received Signal Strength (RSS) with Hysteresis as shown in Figure (28), from result (1) you can see the car was hanging with BS (1) RSS in the columns until it comes to handoff from BS (1) to BS (2) after distance $d = 285.974$ m. The Matlab program

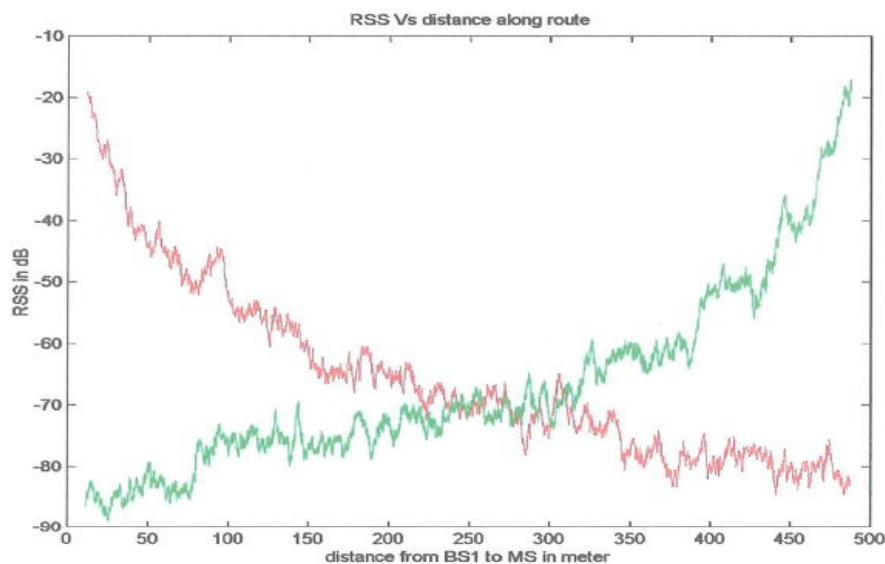


Figure (9)- distance from Base Station (1) to the Mobile Station in meter Vs. RSS) in (dB)

2 - RSS with hysteresis in RSS and threshold

The parameters have taken from (12).

- a- The car in Figure (14) is walking from BS1 toward BS2 with a constant speed of 1 m/Sec.
- b- The distance of BS(1), is $R = 250$ m
- c- The sampling frequency is 10 Hz, in another words MS measures RSS in every 0.1 Sec
- d- For this part which we use hysteresis we assume Hysteresis = 7dB
- e- For the part which we use a threshold we assume Threshold = -68 dB

Here will use equation (1), so its parameters are.

d = distance between the mobile host and base station in meter

$a = b = 2$
 $g = 150$
 P_t = Base station transmit power in dB = 20 dB

P_0 = the power will loss it in first meter in = 38 dB

$S(d)$ = is the correlated log normal fading

For this simulation you can generate a random vector like this:

$$\alpha = e^{\left(\frac{1}{85}\right)}$$

$$\sigma_1^2 = 8$$

$$\sigma_2^2 = \sigma_1^2 \cdot (1 - \alpha^2)$$

$$S(1) = \sigma_1 \cdot N(0,1)$$

$$S(i) = \alpha \cdot S(i-1) + \sigma_2 \cdot N(0,1)$$

Where $N(0,1)$ is a normal random variable with 0 mean and 1 variance.

Note: The first point of the simulation must be at $d = \sqrt{g} = \sqrt{150}$ and the last point should be at $d = 2R - \sqrt{g} = 500 - \sqrt{150}$

In this study used Received Signal Strength (RSS) with Hysteresis and threshold as shown in from result (2) you can see the car was hanging with BS (1) RSS in the columns until it comes to handoff from BS(1) to BS (2) after distance $d = 343,9474$ m, this algorithm is better than above, because the Mobile Station can hold with original BS (1) before its handoff the BS (2), that could minimize the number off handoff per cell. The Matlab program.

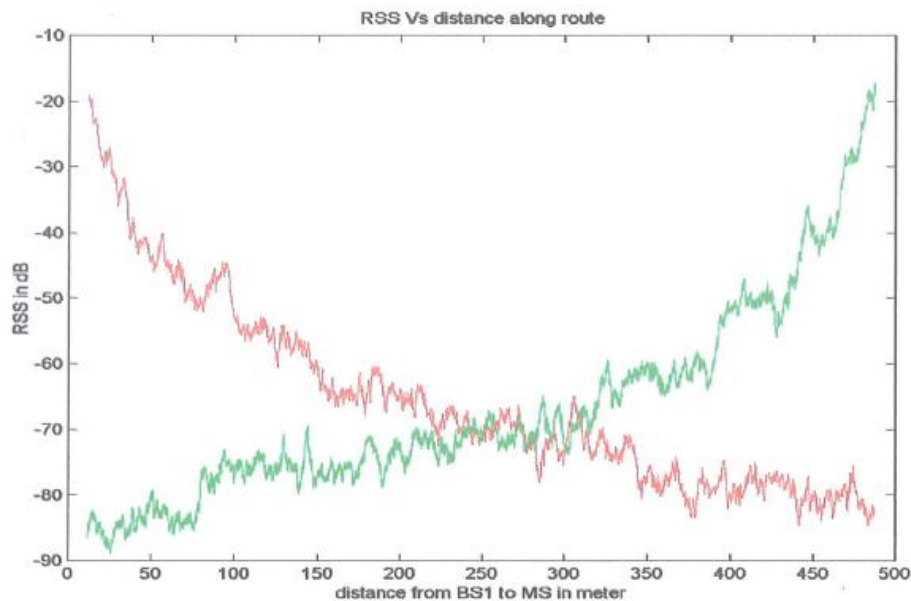


Figure (10) – distance from Base Station (1) to the Mobile Station in meter Vs. RSS in (dB)

VII. Conclusion

Handoff initiation will use two algorithms to determent the distance could the mobile handoff the nearest base station.

*RSS with hysteresis:

As we see the car was driving in constant speed hanging with the BS (1), after distance 285.974 meter the signal become weak so the call handover to the nearest cell with stronger signal BS (2). The hand over here happened after the original signal become below the two values of received signal strength (RSS) and the hysteresis. The result (1) shows the distance of handover below.

Result (1)

Columns 2701 through 2712

1 1 1 1 1 1 1 1 1 1 1 1

Columns 2713 through 2724

1 1 1 1 1 1 1 1 1 1 1 1

Columns 2725 through 2736

1 1 1 1 1 1 1 1 1 1 1 1

Columns 2737 through 2738

1 2

>> d1(2738)

ans=

285.9474

***RSS with hysteresis and threshold:**

As we see the car was driving in constant speed hanging with the BS (1), after distance 343.9474 meter the signal become weak so the mobile will monitor the nearest cell with stronger signal BS (2) to handover the call. The hand over here happened after the original signal become below the three values of received signal strength (RSS), the hysteresis and the threshold. The result (2) shows the distance of handover.

Result (2)

Columns 3265 through 3276

1 1 1 1 1 1 1 1 1 1 1 1

Columns 3277 through 3288

1 1 1 1 1 1 1 1 1 1 1 1

Columns 3289 through 3300

1 1 1 1 1 1 1 1 1 1 1 1

Columns 3301 through 3312

1 1 1 1 1 1 1 1 1 1 1 1

Columns 3313 through 3318

1 1 1 1 1 2

» dl(3318)

ans =

343.3474

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