

Cellular Networks

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1 About Cellular Networks

A Cellular Network (also known as a mobile network) is a communication network where the last link is wireless. The Cellular Network is distributed over land areas called cells.

Every cell contains at least one fixed-location transceiver known as a base station. The cells altogether provide Cellular Network coverage over larger geographical areas.

In a Cellular Network, handover is a process of transferring an ongoing call or data session from one channel to another channel, where both are connected to the same core network. This way, user equipment such as mobile phones, can communicate even if the user is moving across different cells.

Cellular Networks use non-IP protocols and run standalone. So, you cannot connect Cellular Networks to Internetworks.

Note: NetSim Cellular Networks library contains two such Cellular Network standards: Global System for Mobile communication (GSM) and Code-Division Multiple Access (CDMA).

2 Simulating Cellular Networks

You simulate a Cellular Network to see how the Cellular Network works.

To simulate Cellular Networks in NetSim:

1. Open NetSim and click **New Simulation > GSM** or **CDMA**.
2. Create a Cellular Network by using the following:
 - a. Add a Base Transceiver Station (BTS) – click the Base_Station icon on the toolbar and place the BTS in the grid.
 - b. Add a Mobile Switching Centre (MSC) – click the MSC icon on the toolbar and place the MSC in the grid.
 - c. Add a Mobile Station (MS) – click the Mobile_Station icon on the toolbar and place the mobile station in the grid.

Note: If you change the settings of the grid, then ensure that you place the mobile station in the BTS's coverage area.

Note: You cannot place a mobile station over another mobile station.

3. Connect the devices in the Cellular Network by clicking the **Wired/Wireless** icon on the toolbar.
4. Configure an application as follows:
 - a. Click the **Application** icon on the toolbar.
 - b. Specify the source and destination device in the network.
 - c. Specify other parameters such as method and type of the application.
5. Set the properties of the BTS, MSC, MS, and the application as follows:
 - Right-click a BTS, MSC, MS, click **Properties** and modify the interface and layers' properties to your requirement.
6. Simulate the Cellular Network as follows:
 - a. (Optional) Click the Plots, Packet Trace, and Event Trace icons on the toolbar to enable them.

For more information about Plots, Packet Trace, and Event Trace, see Chapter 7, Results and Analysis in the User Manual.
 - b. Click the Run icon on the toolbar.
 - c. Set the simulation time and click **OK**.

3 Featured Examples

NetSim contains some example configuration files to simulate and understand how Cellular Networks work.

To simulate these examples, click **Examples > Cellular-Networks > GSM** or **CDMA** in the NetSim Home Screen.

You can change the default values of the parameters in these examples and see how they affect the performance of the Cellular Network.

3.1 Example 1: GSM Handover

You simulate GSM handover to understand how an ongoing call is transferred from one channel to another.

The network you model from the example configuration file meets the following specifications:

- A network with 2 BTSes, 1 MSC, and 2 mobile stations and a unicast application running on one of the mobile stations.
- The mobile stations are placed within the range of the BTSes.

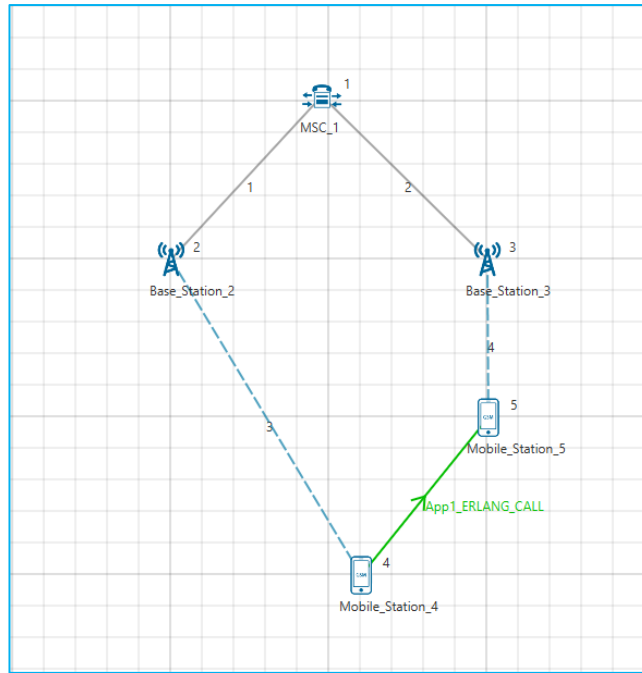
NetSim uses the following defaults for this example:

- BTSes and mobile stations stationed on present locations in the grid.
- Mobile_Station_4 moves with a random walk model set at 20 meters/second.

To simulate GSM handover in NetSim:

1. Open NetSim and click **Examples > Cellular-Networks > GSM-Handover**.

The NetSim UI displays the following Cellular Network.



2. See that by default NetSim has placed 2 BTSes: Base_Station_2 at (300, 200) and the Base_Station_3 at (500, 200).
3. See that by default NetSim has placed 2 mobile stations: Mobile_Station_4 at (420, 400) and the Mobile_Station_5 at (500, 300).
4. See that by default NetSim has assigned a mobility model and velocity of movement to both mobile stations. To do so:

- a. Right-click **Mobile_Station_4** and click **Properties**.

The Mobile_Station_gsm pop-up window appears.

- b. NetSim has set the Mobility_Model to RANDOM_WALK and the Velocity(m/s) to 20 meters/second.
- c. Click **OK**.
- d. Repeat steps (a), (b), and (c) for **Mobile_Station_5**. In step (b) change the velocity to 0 meters/second.

5. See that by default NetSim has configured the multicast application. To do so:

- a. Click **Application** on the toolbar.

The Configure Application pop-up window appears.

- b. NetSim has specified 4 in Source_ID field.
- c. NetSim has specified 5 in Destination_ID field.
- d. NetSim has specified 1 (second) in the Inter_Arrival_Time (in the CALL area) field.
- e. NetSim has specified 1000 (seconds) in the Duration field (in the CALL area).
- f. Click **OK**.

The following figure illustrates step (d) and (e).

CALL	
Duration_Distribution	CONSTANT
Duration(s)	1000
Inter_Arrival_Time	1
IAT_Distribution	CONSTANT

6. Simulate GSM handover. To do so:

- a. Click the **Run** icon located on the toolbar.

The **Run Simulation** pop-up window appears.

- b. Retain the default settings in the Simulation Configuration tab (Simulation Time = 250).
- c. Click **OK**.

After NetSim simulates GSM Handover, NetSim displays the Simulation Results window.

7. Interpret the results. To do so:

- a. Click **View Animation** on the toolbar and view the packet animation.

You will see **Mobile_Station_4** undergoing the handover process from Base_Station_2 to Base_Station_3.

- b. Click **Cellular metrics > MS Metrics** in the left area and check the **Detailed View** check box in the MS Metrics_Table.

See the Handover Request the Mobile_Station_4 sent.

The following figure illustrates step (b).

MS Id	Call Generated	Call Blocked	Call Blocking probability	Channel request sent	Call request sent	Call request received	Call accepted	Call rejected	Handover request	Call dropped	Call dropping probability
4	2	0	0.000	6	1	0	0	0	5	0	0.000
5	0	0	0.000	1	0	1	1	0	0	0	0.000

Note: GSM handover happens by distance from the BTS, that is, hard handover. LTE handover happens by the signal-to-noise ratio (SNR), that is, soft handover.

3.2 Example 2: CDMA Handover

You simulate CDMA handover to understand how an ongoing call is transferred from one channel to another.

The network you model from the example configuration file meets the following specifications:

- A network with 2 BTSes, 1 MSC, and 2 mobile stations and a multicast application running on one of the mobile stations.
- The mobile stations are placed within the range of the BTSes.

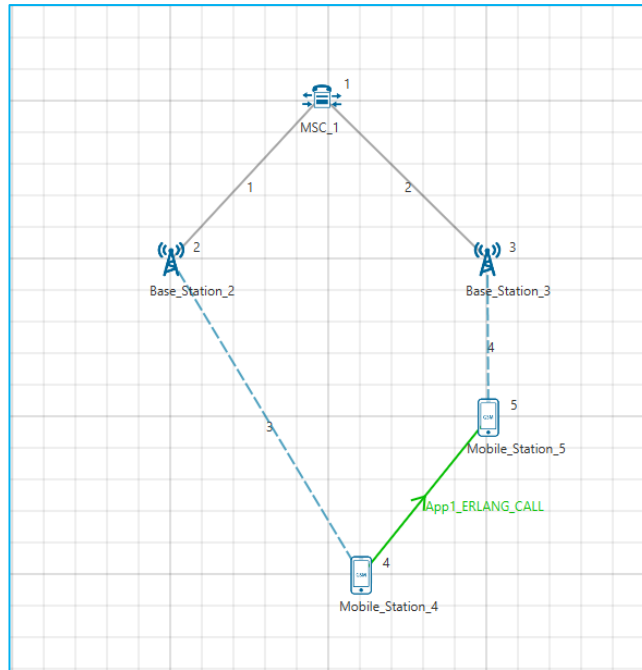
NetSim uses the following defaults for this example:

- BTSes and mobile stations stationed on present locations in the grid.
- Mobile_Station_4 moves with a random walk model set at 20 meters/second.

To simulate CDMA handover in NetSim:

1. Open NetSim and click **Examples > Cellular-Networks > CDMA-Handover**.

The NetSim UI displays the following Cellular Network.



2. See that by default NetSim has placed 2 BTSes: Base_Station_2 at (300, 200) and the Base_Station_3 at (500, 200).
3. See that by default NetSim has placed 2 mobile stations: Mobile_Station_4 at (420, 400) and the Mobile_Station_5 at (500, 300).
4. See that by default NetSim has assigned a mobility model and velocity of movement to both mobile stations. To do so:

- a. Right-click **Mobile_Station_4** and click **Properties**.

The Mobile_Station_gsm pop-up window appears.

- b. NetSim has set the Mobility_Model to RANDOM_WALK and the Velocity(m/s) to 20 meters/second.
- c. Click **OK**.
- e. Repeat steps (a), (b), and (c) for **Mobile_Station_5**. In step (b) change the velocity to 0 meters/second.

5. See that by default NetSim has configured the multicast application. To do so:

- a. Click **Application** on the toolbar.

The Configure Application pop-up window appears.

- b. NetSim has specified 4 in Source_ID field.
- c. NetSim has specified 5 in Destination_ID field.
- d. NetSim has specified 1 (second) in the Inter_Arrival_Time (in the CALL area) field.
- e. NetSim has specified 1000 (seconds) in the Duration field (in the CALL area).
- f. Click **OK**.

6. Simulate CDMA handover. To do so:

- a. Click the **Run** icon located on the toolbar.

The **Run Simulation** pop-up window appears.

- b. Retain the default settings in the Simulation Configuration tab (Simulation Time = 250).
- c. Click **OK**.

After NetSim simulates CDMA Handover, NetSim displays the Simulation Results window.

7. Interpret the results. To do so:

- a. Click **View Animation** on the toolbar and view the packet animation.

You will see **Mobile_Station_4** undergoing the handover process from Base_Station_2 to Base_Station_3.

- b. Click **Cellular metrics > MS Metrics** in the left area and check the **Detailed View** check box in the MS Metrics_Table.

See the Handover Request the Mobile_Station_4 sent.

The following figure illustrates step (b).

MS Id	Call Generated	Call Blocked	Call Blocking probability	Channel request sent	Call request sent	Call request received	Call accepted	Call rejected	Handover request	Call dropped	Call dropping probability
4	2	0	0.000	6	1	0	0	0	5	0	0.000
5	0	0	0.000	1	0	1	1	0	0	0	0.000

4 Note: Release on Unsupported Basis

From NetSim v10 onwards, we have not added new features for the GSM & CDMA protocol libraries. Source codes for GSM and CDMA protocol libraries are available but Tetcos does not provide technical support for these libraries.

5 Latest FAQs

You can refer to the up-to-date FAQs about NetSim's Cellular Networks library at <https://tetcos.freshdesk.com/support/solutions/folders/14000107855>.