

## Experiment 4

### Wireless Sensor Networks & Wi-Max Networks

#### Objective:

- A) To simulate a cluster based Wireless Sensor Network (WSN) with 18 nodes, two cluster heads and a base station (i.e., PAN coordinator) and analyse the performance.
- B) To Simulate a Wi-Max network with two base stations and 10 nodes in each cell. Analyse the performance with multiple traffics.

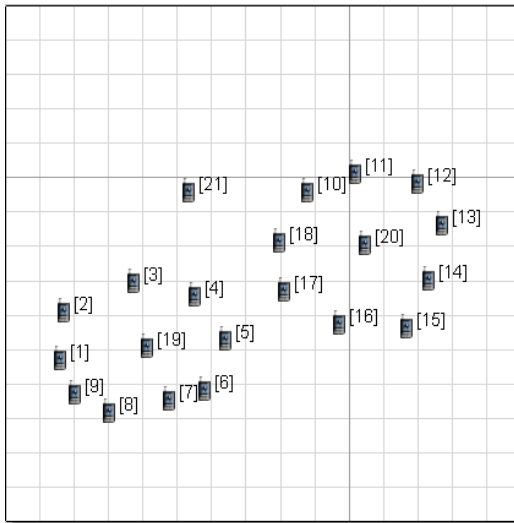
#### Procedure:

A) Go to File → new → save as → wsnnetworks

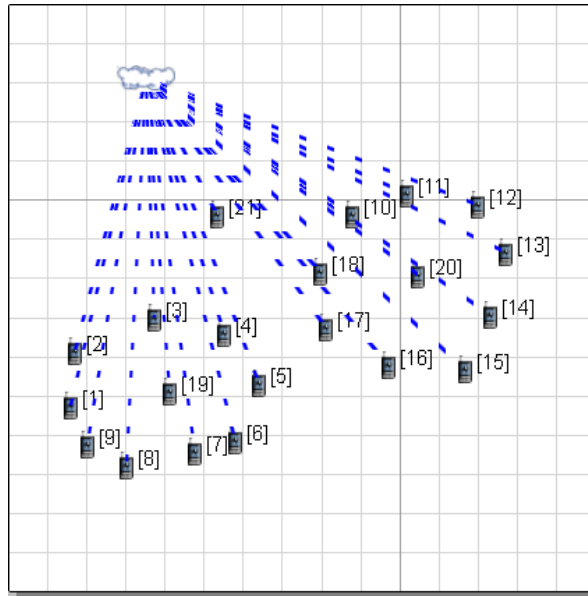
Select Scenario Properties → General Settings → Give Experiment Name, Simulation Time:300 Seconds

Terrain → Scenario Dimensions → 1000 x 1000 meters

**Step 1:** Select “default” device (present under Standard Tool Set) and place the nodes on canvas as follows:

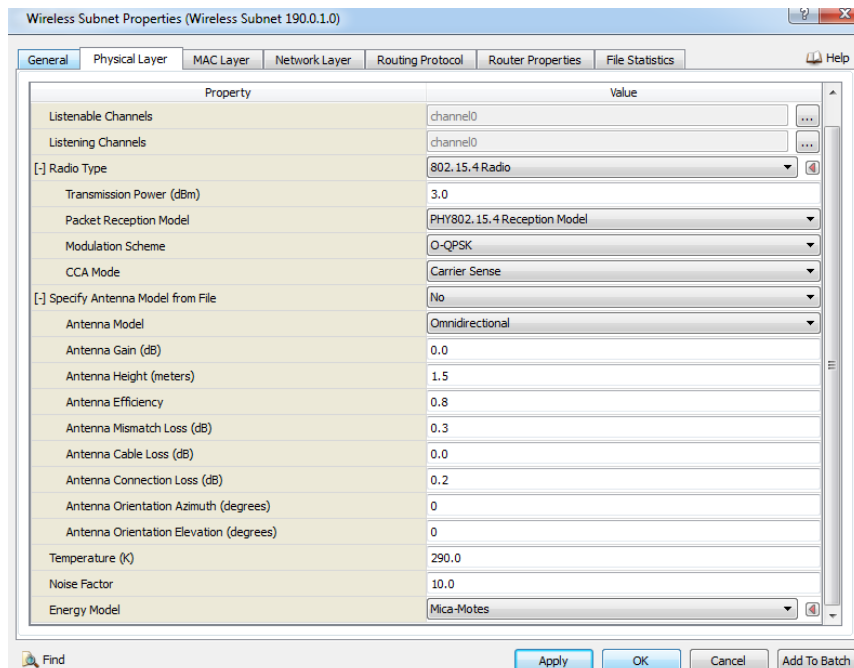


Select all the nodes in the Canvas, select Wireless Network (under Network Components) and place on the Canvas.

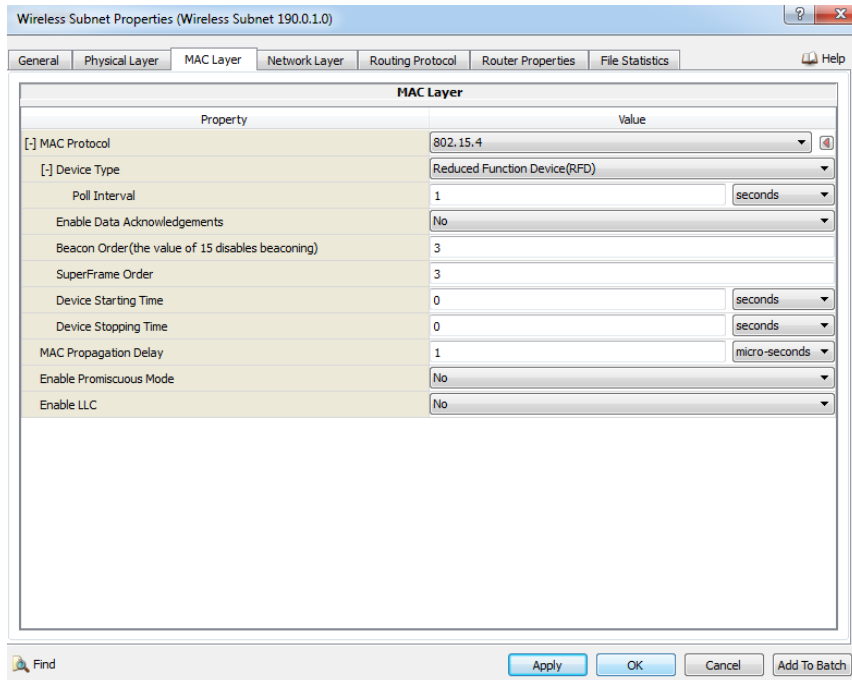


**Step 2:** Go to Table View → Networks → select subnet properties right click, properties

Under Physical Layer → Radio Type: 802.15.4 Radio, Energy Model: Mica-Motes



## MAC Layer: change MAC Protocol: 802.15.4

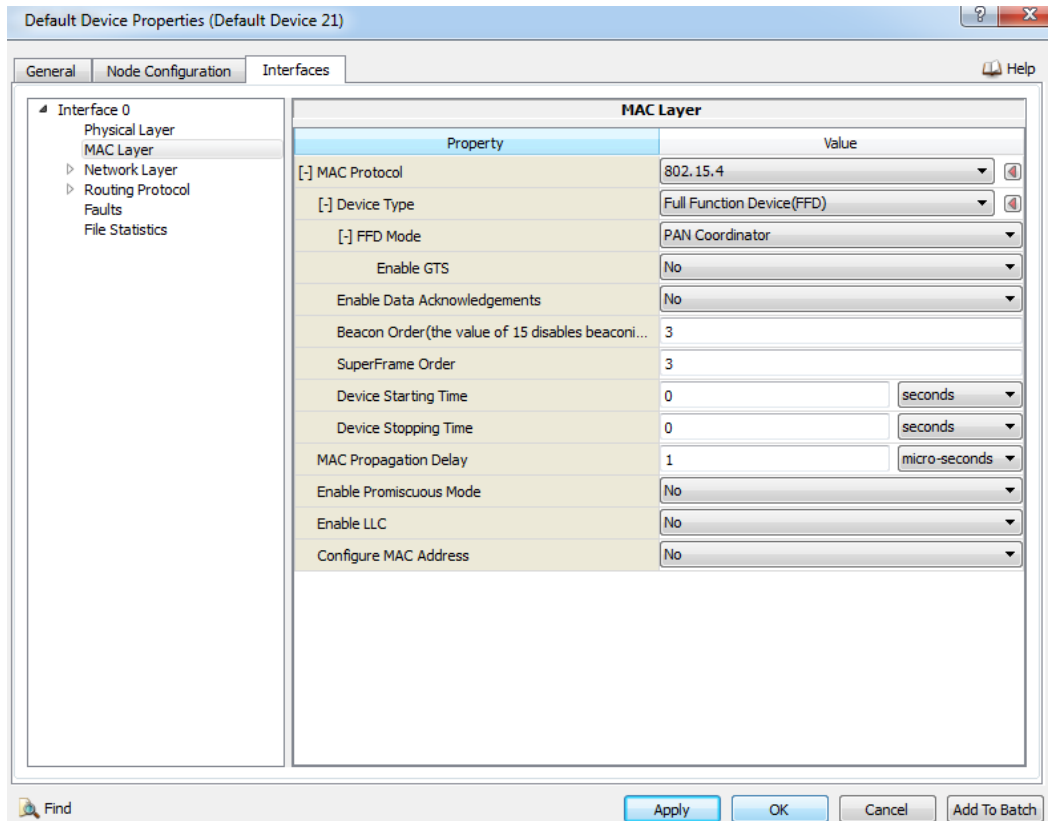


### Step 3: To make node as Coordinator:

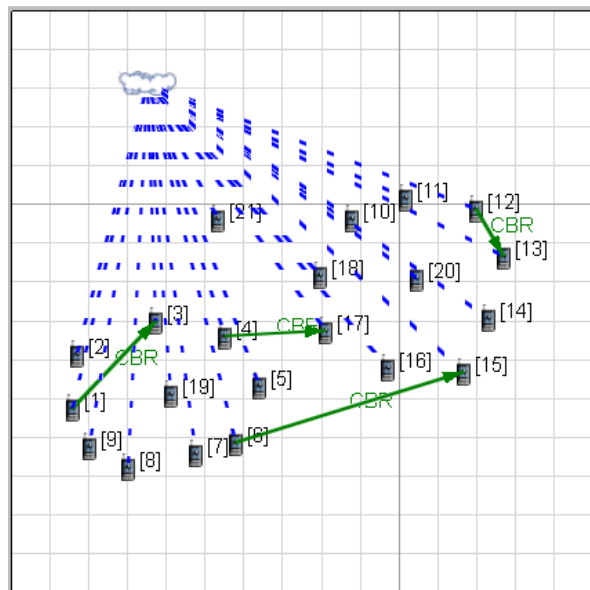
Select the two nodes on Canvas (which you want to make the coordinators), right click, properties, Node Configuration → Interfaces → MAC Layer → Device Type: Full Function Device (FFD), FFD Mode: coordinator.

### Step 4: To make a Node as PAN Coordinator:

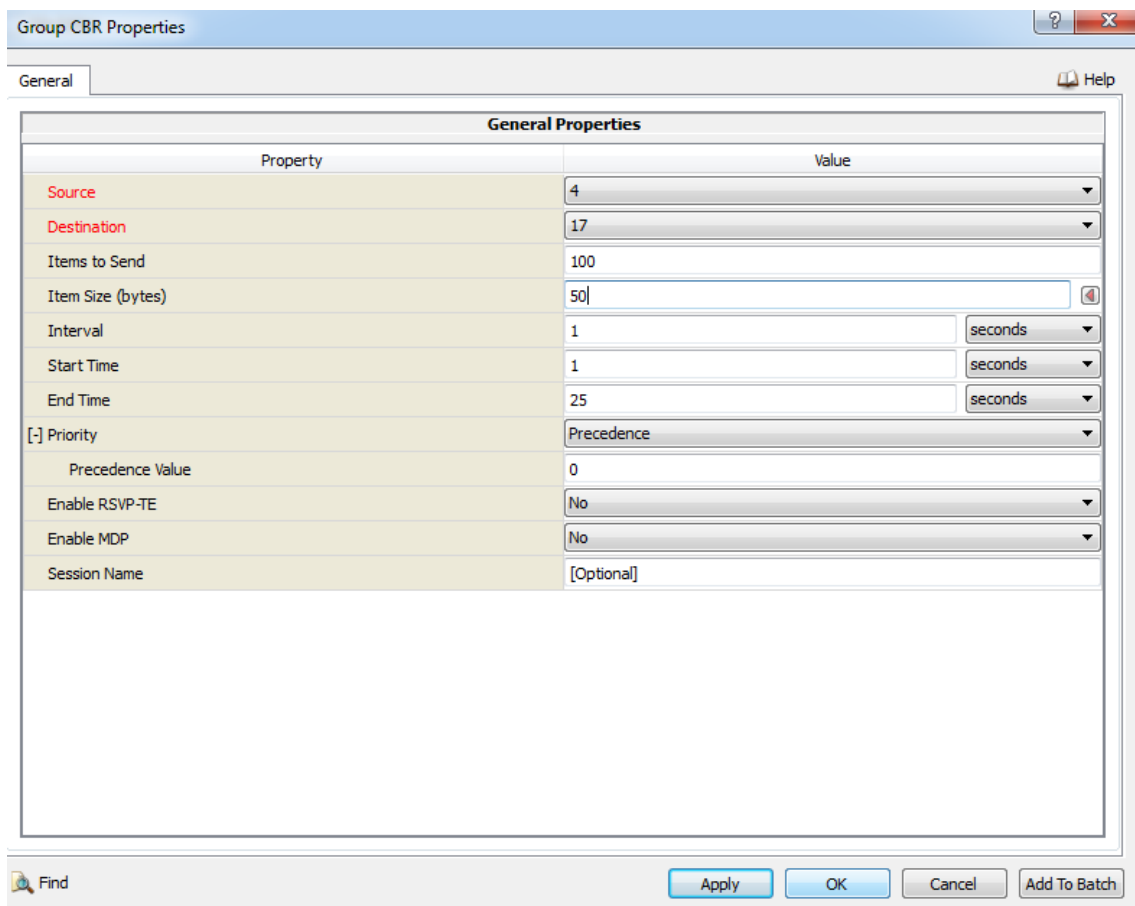
Select the node on Canvas (which you want to make the PAN coordinator), right click, properties, Node Configuration → Interfaces → MAC Layer → Device Type: Full Function Device (FFD), FFD Mode: PAN coordinator.



**Step 5:** Create CBR Traffic: Select few pairs of nodes and give CBR Traffic.



**Step 6:** Go to Table view → Applications → select all the CBR connections → right click, properties → Item Size (bytes): 50 (it must be less than 70 bytes)

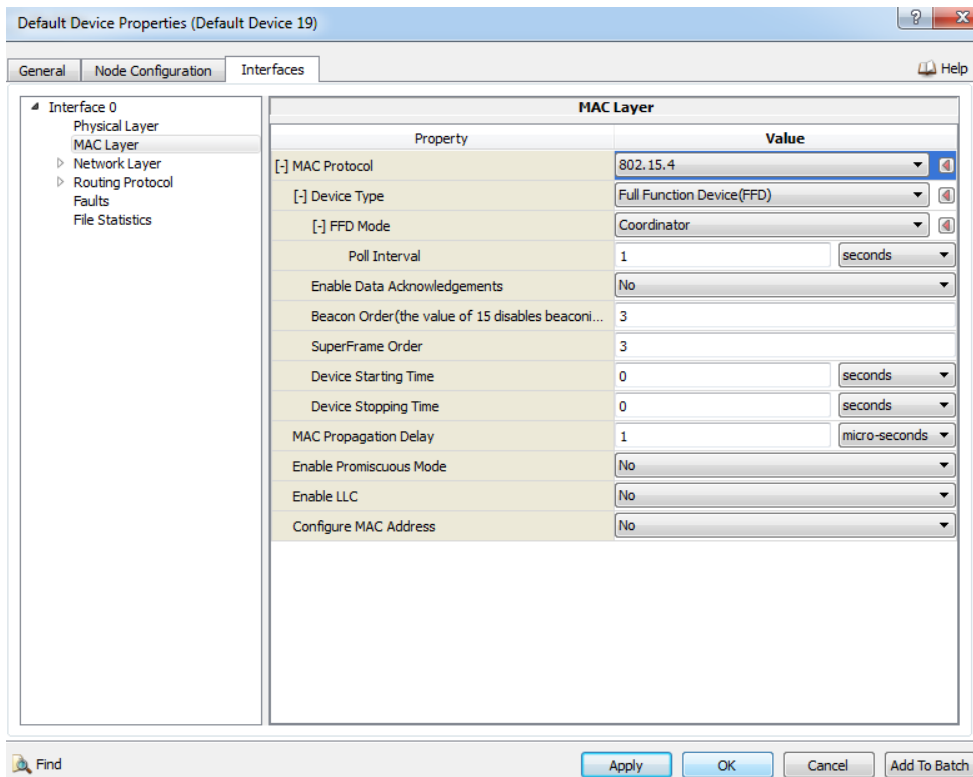


The screenshot shows the 'Group CBR Properties' dialog box with the 'General' tab selected. The dialog contains a table of properties and their values. The 'Item Size (bytes)' property is highlighted, and its value is 50. The 'Interval', 'Start Time', and 'End Time' properties have units of 'seconds'.

Property	Value
Source	4
Destination	17
Items to Send	100
Item Size (bytes)	50
Interval	1 seconds
Start Time	1 seconds
End Time	25 seconds
[ - ] Priority	Precedence
Precedence Value	0
Enable RSVP-TE	No
Enable MDP	No
Session Name	[Optional]

At the bottom of the dialog, there are buttons for 'Find', 'Apply', 'OK', 'Cancel', and 'Add To Batch'.

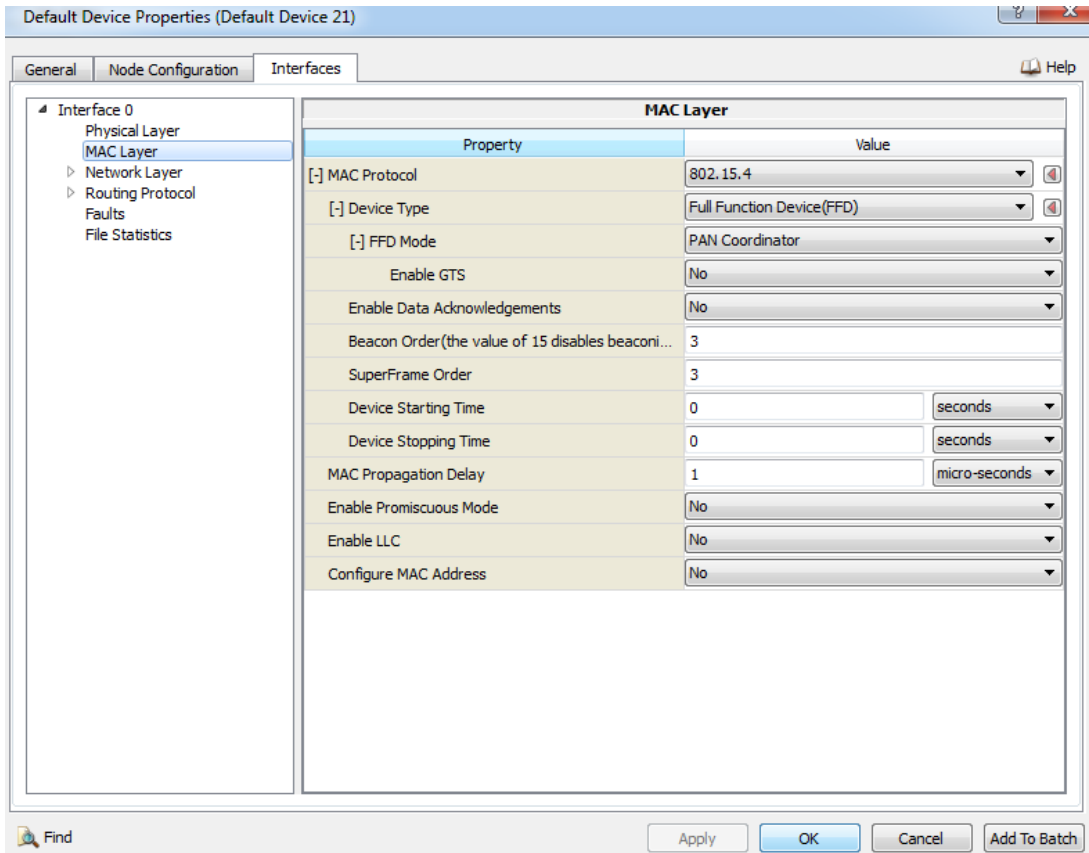
**Step 7:** Save the Scenario, Run Simulation, Play and Analyze Statistics of Current Scenario.



**Step 8: To make a node as PAN Coordinator:**

Select the node, right click, properties

Interfaces → MAC Layer → Device Type: Full Function Device (FFD), FFD Mode: PAN Coordinator



**Step 9:** Create CBR Traffic between some pairs of nodes.

Go to Table view → Applications → select all the CBR applications, right click, properties → Items to send: 0, Item size (bytes):50, End Time: 0

CBR Properties

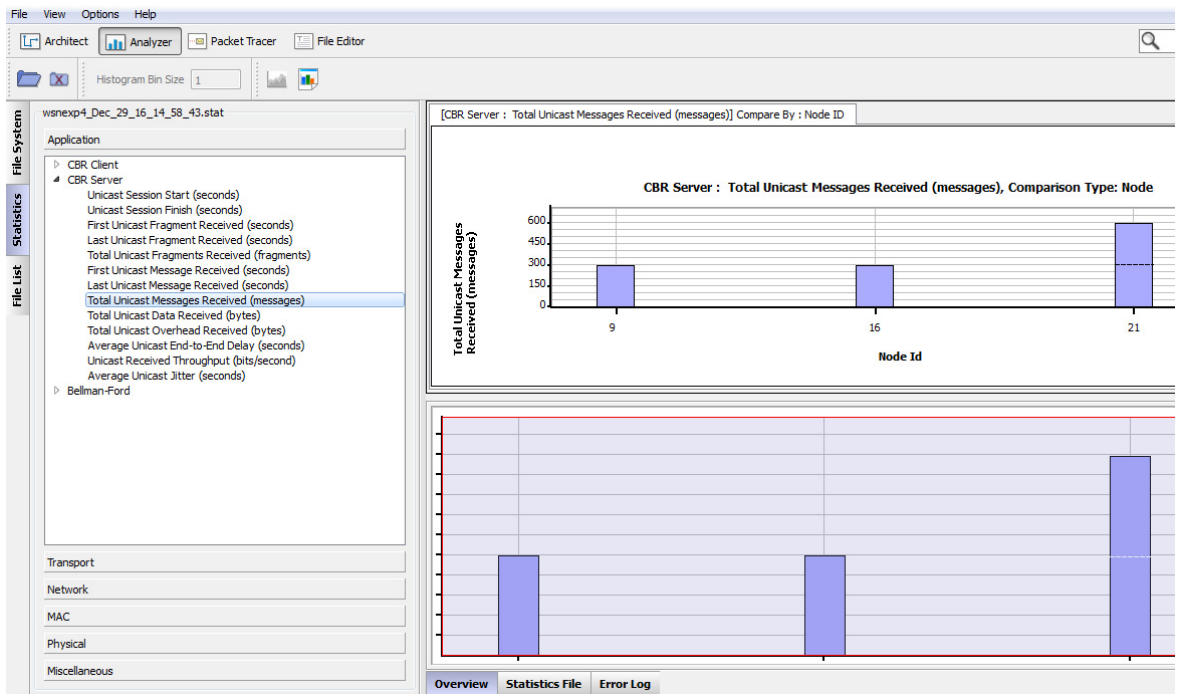
General Help

Property	Value
Source	1
Destination	9
Items to Send	0
Item Size (bytes)	50
Interval	1 seconds
Start Time	1 seconds
End Time	0 seconds
[.] Priority	Precedence
Precedence Value	0
Enable RSVP-TE	No
Enable MDP	No
Session Name	[Optional]

Find Apply OK Cancel Add To Batch

**Step 10:** Save the Scenario, Run Simulation, Play, and Analyze Statistics of Current Scenario. Verify the Total Unicast Messages received at server, End-to-End Delay, Throughput, and Jitter.

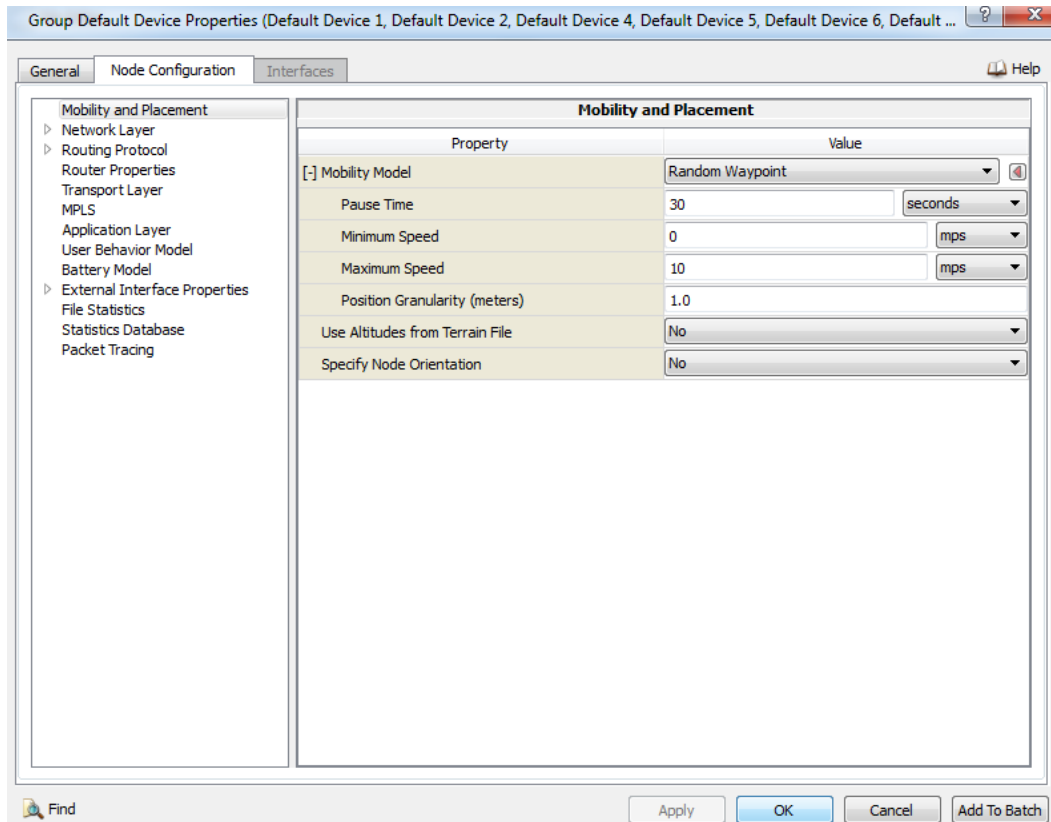




## To create Mobility for Sensor Nodes:

Go to Table view → Nodes → select all the nodes, right click, properties → Node Configuration → Mobility and Placement

Mobility Model: Random Waypoint



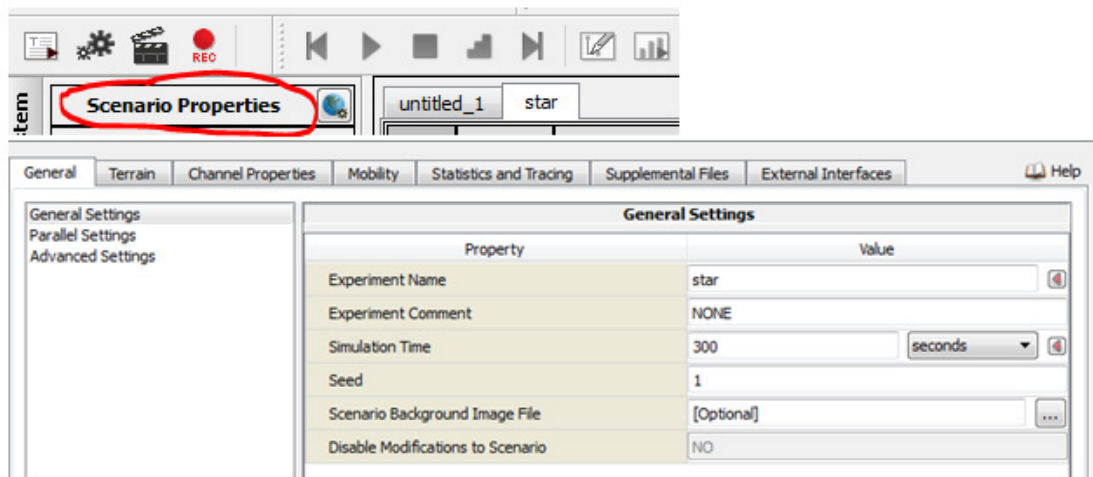
Save the Scenario, Run Simulation, Play and Analyze Statistics of Current Scenario.

Observe the Total Unicast Messages Received, End-to-End Delay, Throughput, and Jitter.

B) **Procedure:** Go to file → New → Save as → WiMax

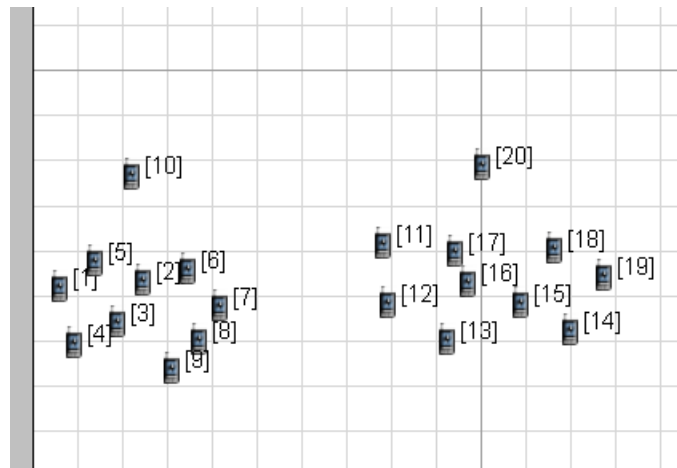
Go to scenario properties → General setting → Give experiment name and simulation time

Click Apply, Ok

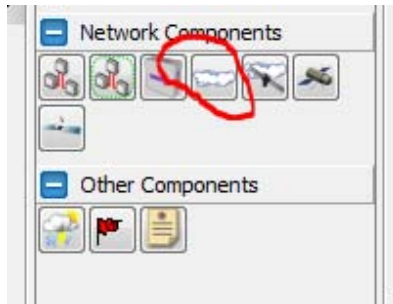


Keep the default value in other fields  
Click Apply and Ok.

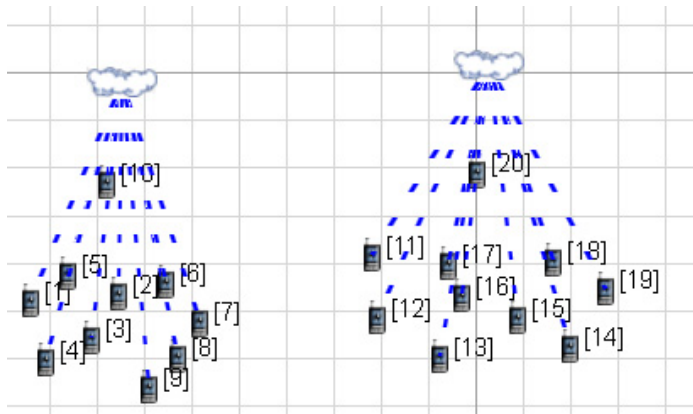
**Step 1:** Place nodes: in such way that one node in each as a base station (cluster head: in this 10<sup>th</sup> and 20<sup>th</sup> are the base)



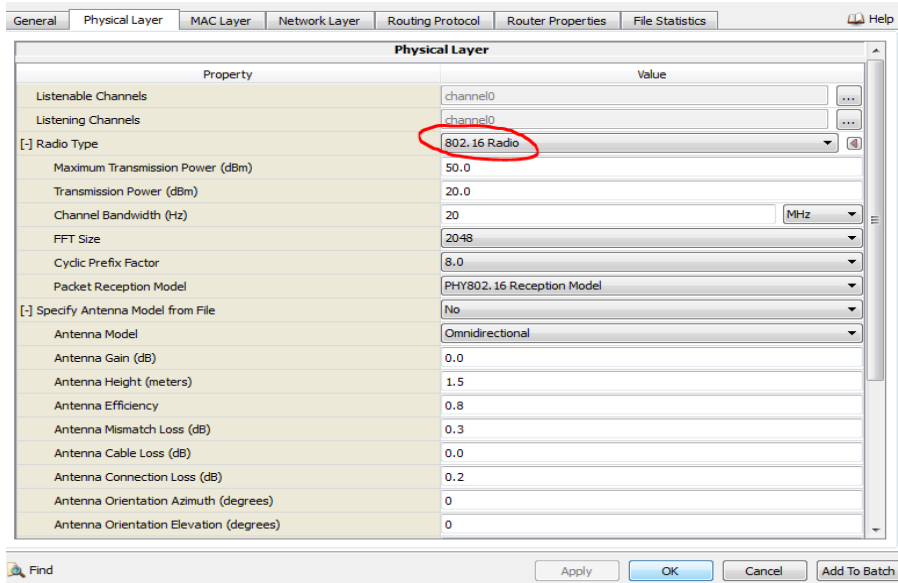
Select set of 10 nodes and place subnets for each set



Right Click on subnet go to properties



**Step 2:** Go to physical layer and set radio type: 802.16 radio (it's for Wimax) and energy model (optional)



General	Physical Layer	MAC Layer	Network Layer	Routing Protocol	Router Properties	File Statistics
Cyclic Prefix Factor		8.0				
Packet Reception Model		PHY802.16 Reception Model				
[-] Specify Antenna Model from File		No				
Antenna Model		Omnidirectional				
Antenna Gain (dB)		0.0				
Antenna Height (meters)		1.5				
Antenna Efficiency		0.8				
Antenna Mismatch Loss (dB)		0.3				
Antenna Cable Loss (dB)		0.0				
Antenna Connection Loss (dB)		0.2				
Antenna Orientation Azimuth (degrees)		0				
Antenna Orientation Elevation (degrees)		0				
Temperature (K)		290.0				
Noise Factor		10.0				
[-] Energy Model		Generic				
Power Amplifier Inefficiency Factor		6.5				
Transmit Circuitry Power Consumption (mW)		100.0				
Receive Circuitry Power Consumption (mW)		130.0				
Idle Circuitry Power Consumption (mW)		120.0				
Sleep Circuitry Power Consumption (mW)		0.0				
Supply Voltage (volt)		6.5				

Find Apply OK Cancel Add To Batch

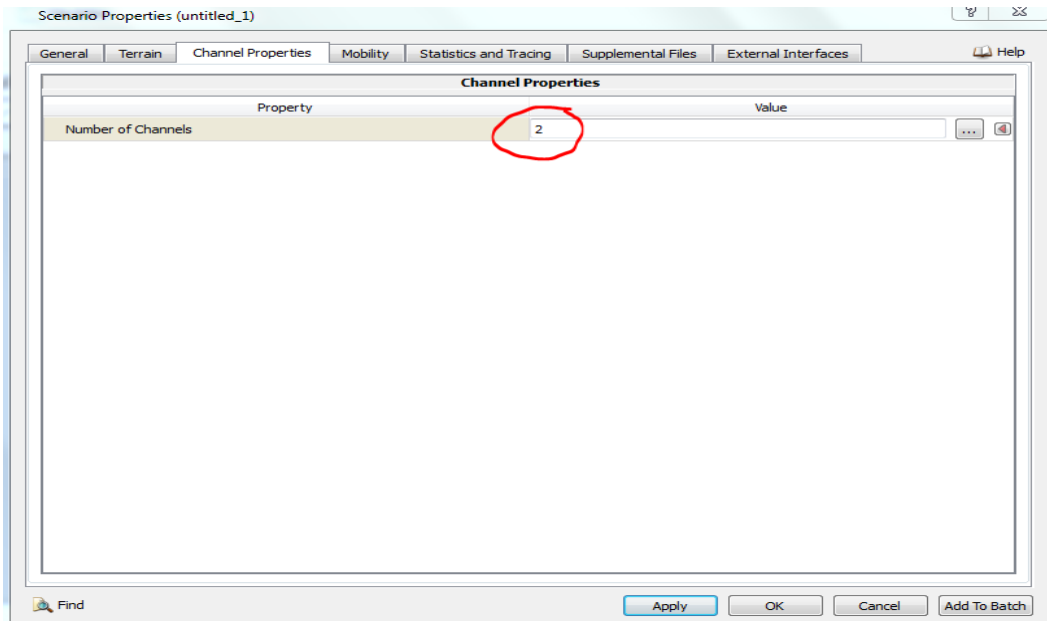
Go to MAC layer and set MAC protocol as (802.16)

General	Physical Layer	MAC Layer	Network Layer	Routing Protocol	Router Properties	File Statistics																														
<table border="1"> <thead> <tr> <th colspan="2">MAC Layer</th> </tr> <tr> <th>Property</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>[-] MAC Protocol</td> <td>802.16</td> </tr> <tr> <td>[-] Station Type</td> <td>Subscriber Station</td> </tr> <tr> <td>Wait DCD Timeout Interval</td> <td>25 seconds</td> </tr> <tr> <td>Wait UCD Timeout Interval</td> <td>25 seconds</td> </tr> <tr> <td>Service Flow Timeout Interval</td> <td>15 seconds</td> </tr> <tr> <td>Enable Packing</td> <td>No</td> </tr> <tr> <td>Ranging Type</td> <td>Normal</td> </tr> <tr> <td>Contention-based Bandwidth Request Type</td> <td>Normal</td> </tr> <tr> <td>Enable Mobility Mode (802.16e)</td> <td>No</td> </tr> <tr> <td>Enable ARQ</td> <td>No</td> </tr> <tr> <td>MAC Propagation Delay</td> <td>1 micro-seconds</td> </tr> <tr> <td>Enable Promiscuous Mode</td> <td>No</td> </tr> <tr> <td>Enable LLC</td> <td>No</td> </tr> </tbody> </table>							MAC Layer		Property	Value	[-] MAC Protocol	802.16	[-] Station Type	Subscriber Station	Wait DCD Timeout Interval	25 seconds	Wait UCD Timeout Interval	25 seconds	Service Flow Timeout Interval	15 seconds	Enable Packing	No	Ranging Type	Normal	Contention-based Bandwidth Request Type	Normal	Enable Mobility Mode (802.16e)	No	Enable ARQ	No	MAC Propagation Delay	1 micro-seconds	Enable Promiscuous Mode	No	Enable LLC	No
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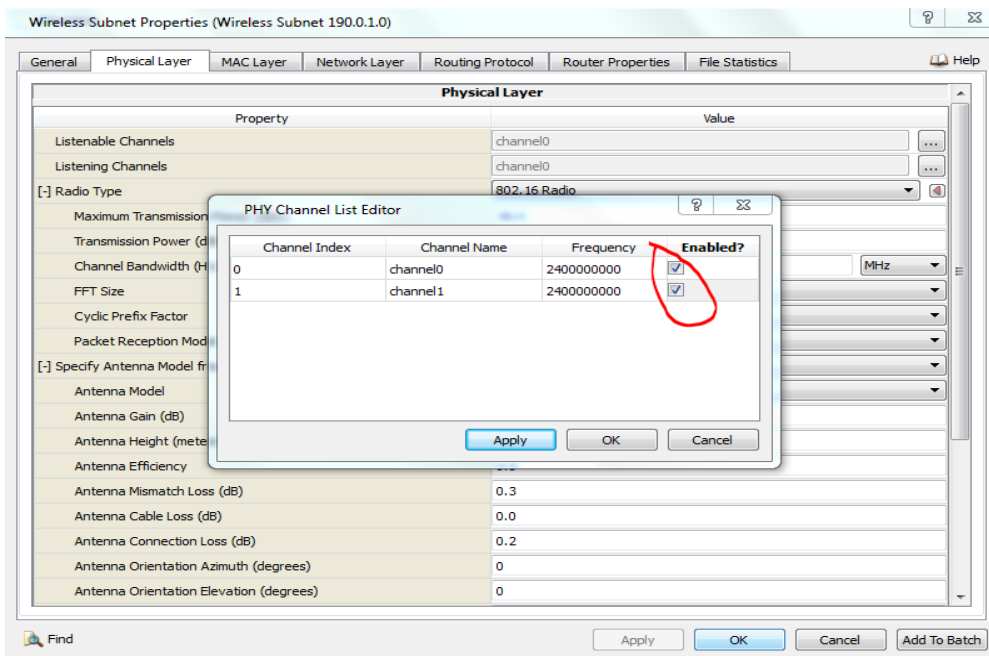
Find Apply OK Cancel Add To Batch

Similarly set all the parameters for other subnet

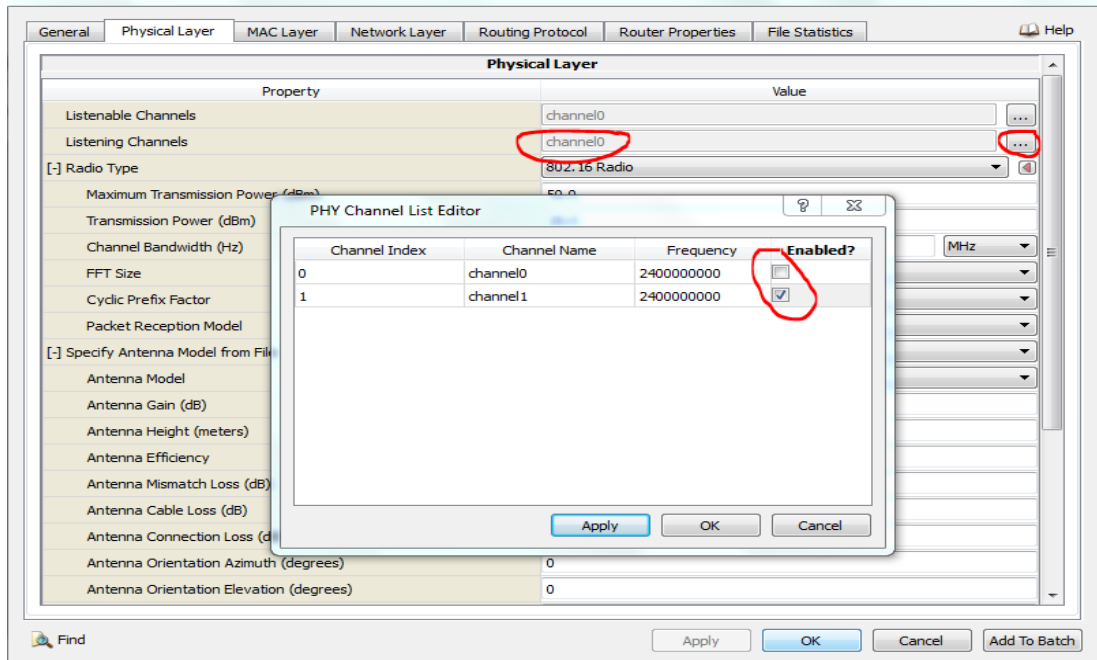
**Step 3:** Go to scenario properties to configure channels (Number of channel = 2, 1 channel is for one base hence for two base 2 channels are required). Apply and OK



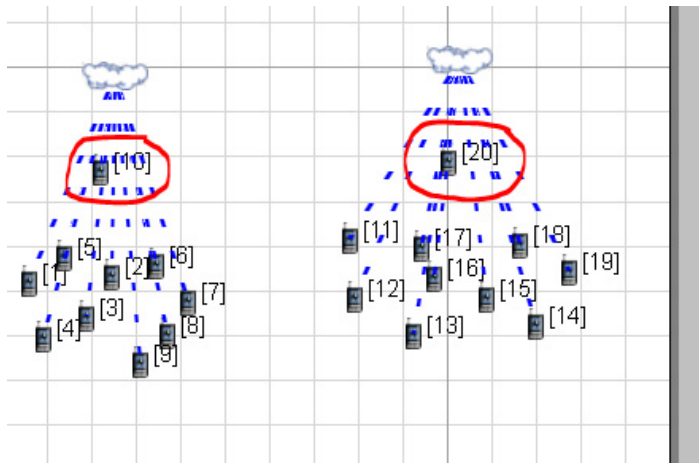
**Step 4:** Go to subnet properties: Click physical layer and go to Listenable channel activate both channels. Click Apply and Ok (This is for first subnet)

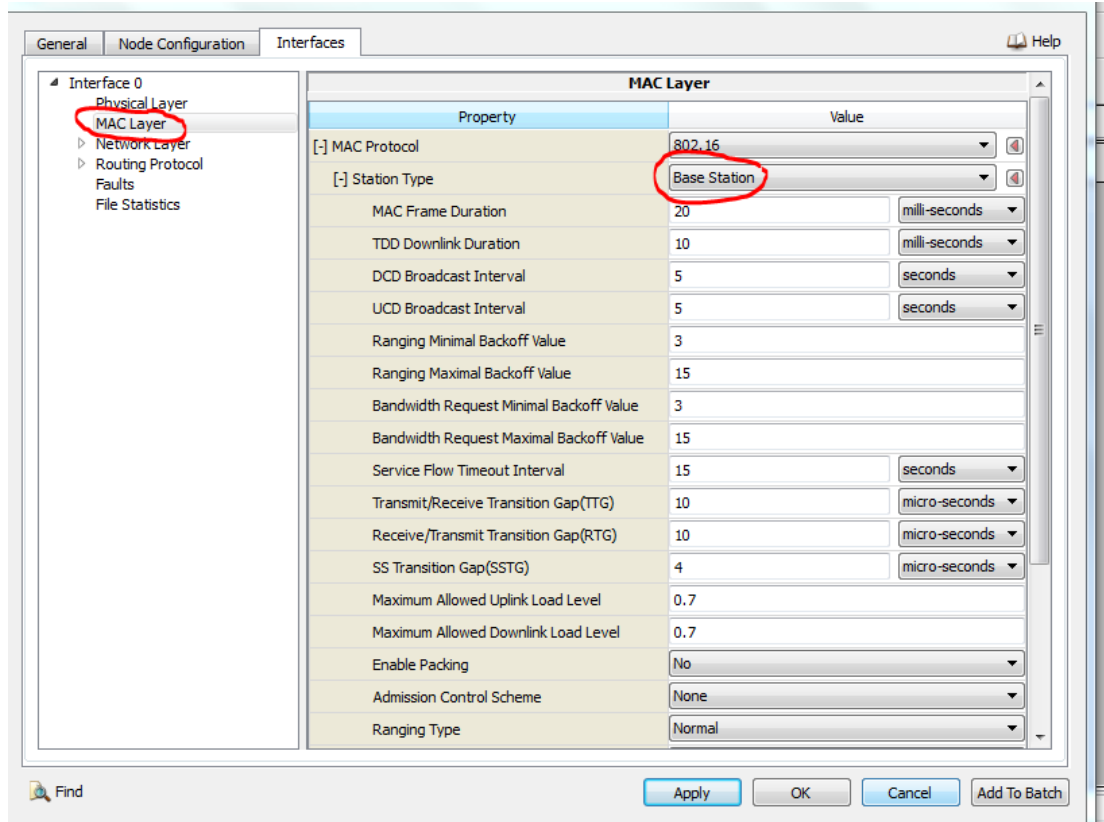


Go to subnet properties click physical layer and go to Listening channel activate channel 1. Click Apply and OK (This is for second subnet)

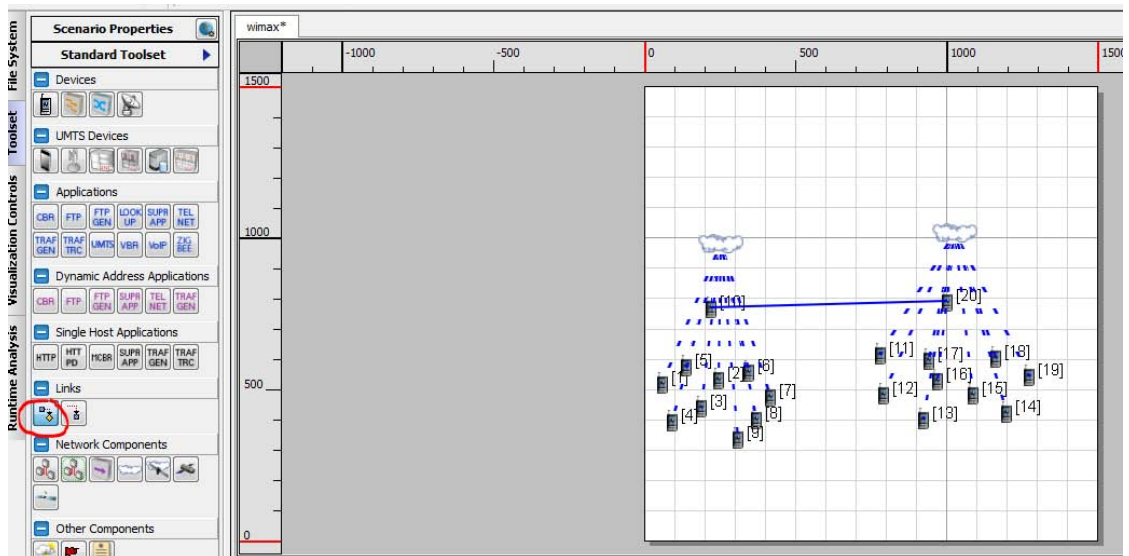


**Step 5:** Select 10<sup>th</sup> node properties to make 10<sup>th</sup> node as Base Station. Similarly for 20<sup>th</sup> node as Base station



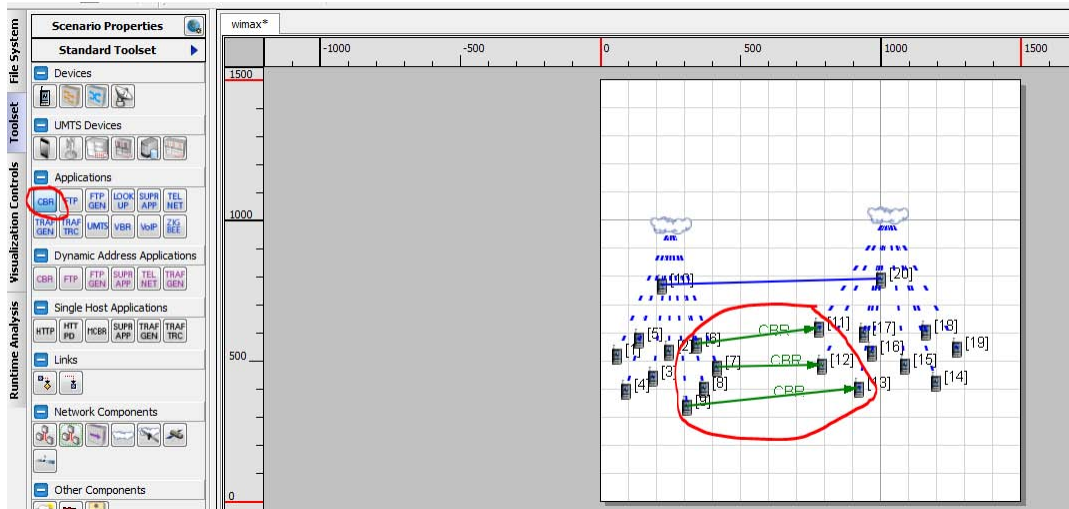


Link between two base stations: click on the link and connect two base stations





**Step 6:** Configure the traffic between the nodes: Click on the CBR and connect through the CBR to insert traffic using CBR.



To configure CBR (constant bit rate): go to table view under applications select all by right clicking and again right click on properties

General

Help

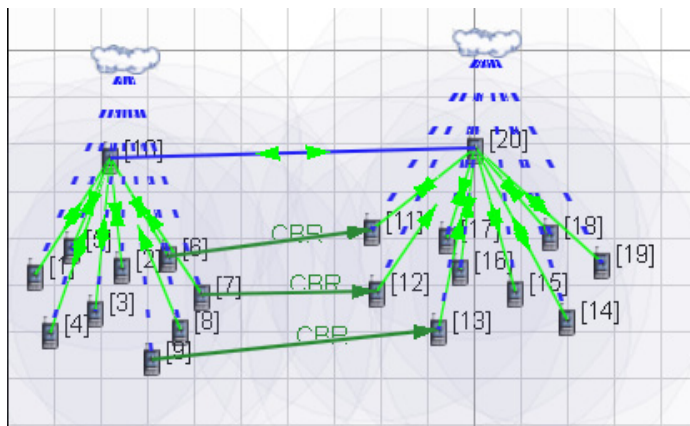
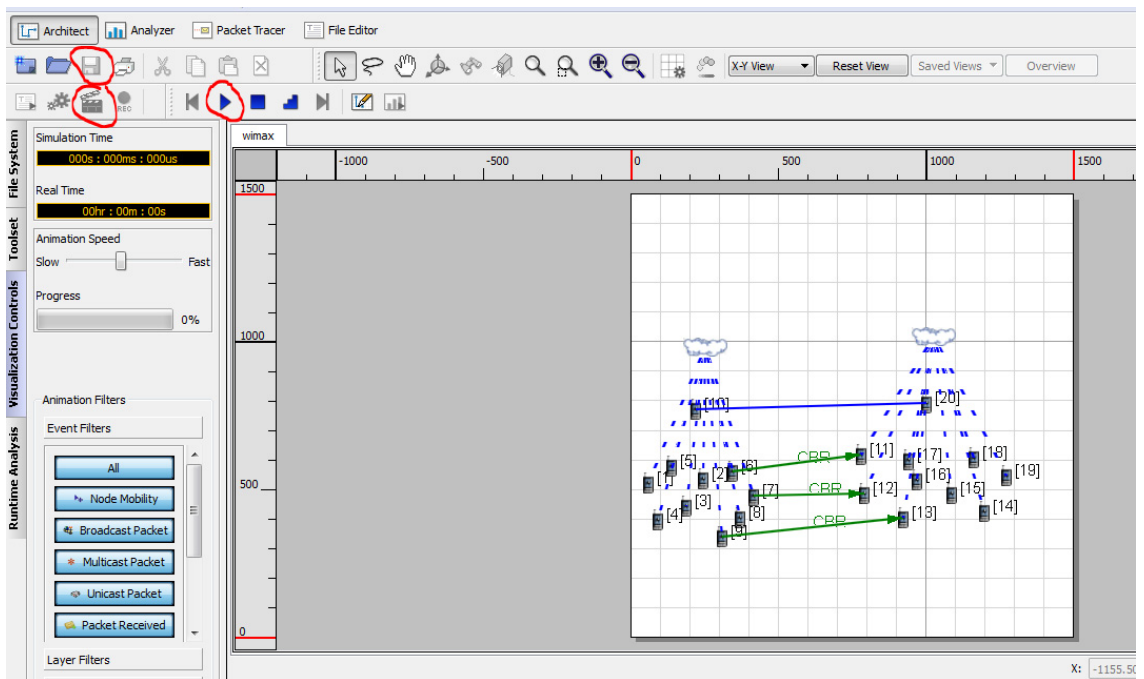
**General Properties**

Property	Value
Source	6
Destination	11
Items to Send	100
Item Size (bytes)	512
Interval	1 seconds
Start Time	1 seconds
End Time	25 seconds
[.] Priority	Precedence
Precedence Value	0
Enable RSVP-TE	No
Enable MDP	No
Session Name	[Optional]

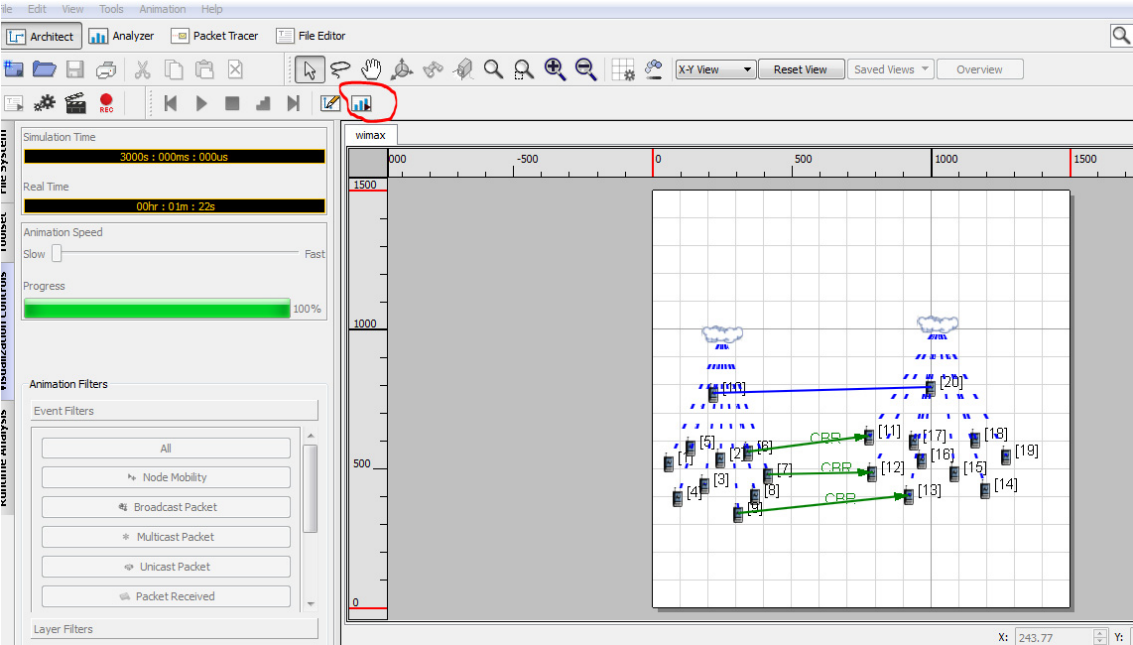
Find

Apply OK Cancel Add To Batch

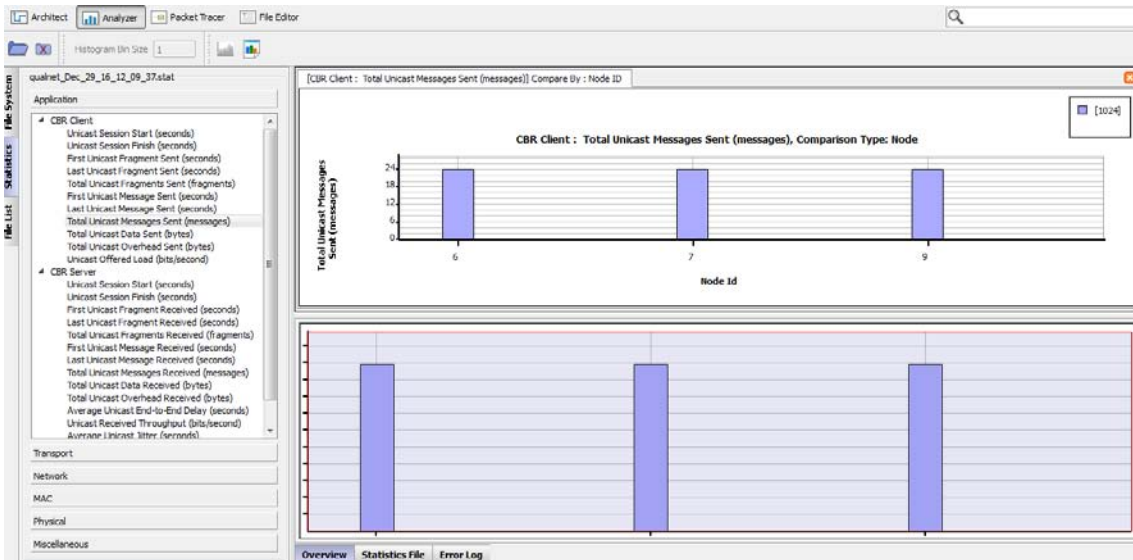
## Step 7: Save the scenario, run and play



After simulation click analyse



Total unicast message sent



# Total unicast message received

