### EXata学习(02): WiFi 场景篇

2022-11-08

目标: 熟悉EXata自带场景

内容: exata/5.1/scenarios/下的各场景实例

- 1. 几个小问题:
  - a. 关于仿真流量的颜色: 蓝色是指示为外部流量,而绿色为仿真流量: Blue color is used for animation effects of packet events for traffic from external sources while green is used for simulated traffic.
  - b. GSM场景中如何设定节点的类型? MS、BS或MSC
    - i. 在Node Configuration的Network Layer配置中,一旦指定Netowrk Protocol为 GSM Layer 3,则可以 在弹出的 GSM Node Type中选择 Mobile Station、Base Station 或 Mobile Switching Cneter之一。

| Mobility and Placement   | Netwo                                      | rk Layer                                  |                     |  |  |  |
|--|--|---|---------------------|--|--|--|
| Schedulers and Queues  | Property                                   | Value                                     |                     |  |  |  |
| QoS Configuration  | [-] Network Protocol                       | GSM Layer 3                               |                     |  |  |  |
| ARP  | GSM Node Configuration File                | Specify GSM Configuration F               | ile in Supplemental |  |  |  |
| DHCP     DNS     Fixed Communications     Routing Protocol     Router Properties     Transport Layer     MPLS     Application Layer     Network Management     User Behavior Model     Battery Model     O S Resource Model     External Interface Properties     Faults | GSM Node Type Mobile Station               |   |                     |  |  |  |
|  | IP Fragmentation Unit (bytes) Base Station |   |                     |  |  |  |
|  | Enable Explicit Congestion Notification    | Mobile Station<br>Mobile Switching Center |                     |  |  |  |
|  | [-] Enable ICMP                            | Yes                                       |                     |  |  |  |
|  | Is ICMP Router? No                         |   |                     |  |  |  |
|  | [-] Enable Redirect                        | Yes                                       |                     |  |  |  |
|  | Redirect Retry Time                        | 1   | seconds             |  |  |  |
|  | Allow Override of Non-Static Routes        | Yes                                       | •                   |  |  |  |
| File Statistics<br>Statistics Database   | Router Advertisement Life Time             | 1800                                      | seconds             |  |  |  |
| Packet Tracing   | Minimum Router Advertisement Interval      | 450                                       | seconds             |  |  |  |
|  | Maximum Router Advertisement Interval      | 600                                       | seconds             |  |  |  |
|  | Maximum Number of Solicitation             | 3   |                     |  |  |  |
|  | Enable ICMP Error Messages                 | No  | •                   |  |  |  |
|  | Configure as a Link 16/IP Gateway          | No  |                     |  |  |  |
|  | Enable Mobile IP                           | No  |                     |  |  |  |

c. 如何给BS增加 GSM 接口?:添加一个wireless subnet,把所有的基站加入它。

## 2. 复现Product Tour中的Wireless Demo 场景【参考EXata5.1–Product Tour中Sec 3 Creating Simulation Scenarios】

- a. 创建一个新场景: myWiFi, 设定仿真时间320s
- b. 拷贝地形文件夹和图标文件:WiFiDemo/urban;AccessPoint.png,router-color.png
- c. 设置地形: Terrain-》Scenario Dimension: 1000x1000; Urban Terrain Format: Qualnet Format; Number of Terrain Files: 1 ...==>选定Urban\下的mapdata001.xml。





#### 3D view:



d. 设定Channel属性: Channel0默认 2.4 GHz; Channel1设为 2.5GHz



e. 创建网络拓扑: 放置 6 个default devices, 2 个 wireless subnet, 1 个 wired subnet, 如下图



i. 放置 Access Point:

- 切换到3D view
- 在两个楼顶各放置1个default device,设定坐标分别为(290,520,100)、(690,520,50),修改节点的精确坐标在画布的右下角:



- ii. 创建Links
  - 1. 连接节点5-7、6-8
  - 2. 连接节点5和6到wired subnet (Hub)
  - 3. 连接1, 3, 7到左侧的wireless subnet
  - 4. 连接2, 4, 8到右侧的wireless subnet



#### f. 设定节点 1 的移动模式 (mobility pattern)

i. 选择小红旗在Other Components;

- ii. 点击节点1;
- iii. 点击目标位置,连续点击预期路线上的点,形成预期轨迹
- iv. 右键结束。



v. 设定waypoint的时间(以设定节点移动速度):双击任一个小红旗,进行Waypoint设定,即节点到达各 个位置的时间表

| Nodes        |   |    |                 | Waypoint | host1 📒   |   |         |   |
|--------------|---|----|-----------------|----------|-----------|---|---------|---|
| ost1<br>ost2 |   | ID | Simulation Time | X        | Y         | Z | Azimuth |   |
| osta<br>osta | 1 | 0  | 0 seconds       | 174.868  | 346.174   | 0 | 0       | ſ |
| ost5<br>ost6 | 2 | 1  | 10 seconds      | 211.226  | 406.30607 | 0 | 0       | ( |
| ost7<br>ost8 | 3 | 2  | 20 seconds      | 262.968  | 409.102   | 0 | 0       | ( |
|              | 4 | 3  | 30 seconds      | 314.709  | 407.704   | 0 | 0       | ( |
|              | 5 | 4  | 40 seconds      | 365.052  | 409.102   | 0 | 0       | 1 |
|              | • |    |                 |          |           |   |         | Ľ |

g. 创建Application Session:在节点1和2之间创建一个CBR业务



#### **h.** 设定参数

i. 节点1-4(无线移动节点)参数设定

- 1. Table View: Nodes中选择节点1-4, 右键Properties。
- 2. 设定Routing Protocol为AODV

| Mobility and Placement   | Routing                            | Protocol         | -        |  |
|--|------------------------------------|------------------|----------|--|
| Hetwork Layer     □ Routing Protocol   | Property                           | Value            |          |  |
| BGP Configuration     Router Properties  | [-] Routing Protocol IPv4          | AODV             |          |  |
| Transport Layer  | Network Diameter (hops)            | 35               |          |  |
| Application Layer  | Node Traversal Time                | 40 milli-seconds | •        |  |
| ···· Network Management<br>···· User Behavior Model  | Active Route Timeout Interval      | 3 seconds        | -        |  |
| - Battery Model  | My Route Timeout Interval          | 6 seconds        | -        |  |
| External Interface Properties     File Statistics     Statistics Database     Packet Tracing | Maximum RREQ Retries               | 2                |          |  |
|  | Route Deletion Constant            | 5                |          |  |
|  | Enable Hello Messages              | No               | -        |  |
|  | Enable Local Repair                | No               | -        |  |
|  | Enable Better Route Search         | No               | -        |  |
|  | Enable Acknowledgement Processing  | No               | -        |  |
|  | Maximum Number of Buffered Packets | 100              | _        |  |
|  | Maximum Buffer Size (bytes)        | 0                |          |  |
|  | Open Bi-directional Connection     | No               | •        |  |
|  | TTL Start                          | 1                |          |  |
|  | TTL Increment                      | 2                |          |  |
|  | TTL Threshold                      | 7                |          |  |
|  | RREQs Replied by Destination Only  | No               | •        |  |
|  | Enable IP Forwarding               | Yes              | <u> </u> |  |

 3. Table View: Interfaces中选择节点1-4的Interface0,设定MAC Layer: Station Association Type:Dynamic; Station Scan Type: passive; Configure Handover RSS Trigger: Yes 【复习 WiFi接入过程】

| nterface 0                            |                                    | MAC Layer |   |
|---------------------------------------|------------------------------------|-----------|---|
| MAC Layer                             | Property                           | Value     |   |
| ± Network Layer<br>± Routing Protocol | [-] MAC Protocol                   | 802.11    |   |
| File Statistics                       | Short Packet Transmit Limit        | 7         |   |
|                                       | Long Packet Transmit Limit         | 4         |   |
|                                       | RTS Threshold (bytes)              | 0         |   |
|                                       | Stop Receiving after Header Mode   | No        | J |
|                                       | [-] Station Association Type       | Dynamic   | • |
|                                       | SSID                               | TEST1     |   |
|                                       | [-] Set as Access Point            | No        | ŀ |
|                                       | Initial Channel                    | 0         |   |
|                                       | [-] Station Scan Type              | Passive   | - |
|                                       | Max Channel Time (TUs)             | 400       |   |
|                                       | [-] Configure Handover RSS Trigger | Yes       | • |
|                                       | Handover RSS Trigger (dBm)         | -83.0     |   |
|                                       | Enable Power Save Mode             | No        | 1 |
|                                       | Enable PCF                         | No        | 1 |
|                                       | Set Mesh Parameters                | No        | j |
|                                       | Enable Directional Antenna Mode    | No        | j |
|                                       | Security Protocol                  | None      |   |

# 1. 修订路由器 Icon: Table View: Nodes中选择节点5、6,右键Properties,在General页面的 2D Icon栏选择urban\文件夹中的router-color.png

| Group Default Device Properties (Default Device 5, Default [ | Device 6)                     | ?<br>([]) He |
|--|-------------------------------|--------------|
|  | val Drapartias                |              |
| Brapacty   | volue Volue                   |              |
| Node Name  | Value                         | 4            |
| 2D Icon  | F:/ex/myWiFi/router-color.png |              |
| 3D Icon  | default.3ds                   |              |
| Scale Factor for 3D Icon (percent)                           | 100                           |              |
| Scale Factor for Node Highlights in 3D View (percent)        | 100                           |              |
| Initial Heading Direction of 3D Icon (degrees)               | 0                             |              |
| Partition  | 0                             |              |
|  |                               |              |
|  |                               |              |

2. 在Node Configuration页的Routing Protocol栏选择AODV

| Mobility and Placement                        | Routing                            | a Protocol |               |  |
|---|------------------------------------|------------|---------------|--|
| Network Layer     Pouting Brotocol            | Draparty                           | Value      |               |  |
| Router Properties                             | [-] Routing Protocol IPv4          |            | - al          |  |
| - Iransport Layer<br>MPLS                     | Network Diameter (hops)            | 35         |               |  |
| Application Layer                             | Node Traversal Time                | 40         | milli-seconds |  |
| User Behavior Model                           | Active Route Timeout Interval      | 3          | seconds       |  |
| ···· OS Resource Model                        | My Route Timeout Interval          | 6          | seconds V     |  |
| External Interface Properties File Statistics | Maximum RREO Retries               | 2          |               |  |
| Statistics Database<br>Packet Tracing         | Route Deletion Constant            | 5          |               |  |
|   | Enable Hello Messages              | No         |               |  |
|   | Enable Local Renair                | No         |               |  |
|   | Enable Better Route Search         | No<br>No   |               |  |
|   | Enable Acknowledgement Processing  |            |               |  |
|   | Maximum Number of Buffered Packets |            |               |  |
|   | Maximum Ruffer Size (hytes)        | 0          |               |  |
|   | Open Bi directional Connection     | No         |               |  |
|   |                                    | 1          | <u>`</u>      |  |
|   |                                    |            |               |  |
|   |                                    | 2          |               |  |
|   |                                    | /          |               |  |
|   | RREQs Replied by Destination Only  | No         |               |  |

iii. 节点7和8(AP)参数设定

- Table View: Nodes选择7和8, 右键Properties
- Node Configuration的Routing Protocol IPv4: AODV

| Default Device Properties (Default                             | Device 7)                          |          | ? ×                 |
|--|------------------------------------|----------|---------------------|
| General Node Configuration In                                  | terfaces                           |          | 🚇 Help              |
| Mobility and Placement   | Routing                            | Protocol | <u> </u>            |
| Routing Protocol   | Property                           | Value    |                     |
| Router Properties     Transport Layer                          | [-] Routing Protocol IPv4          | AODV     |                     |
| MPLS<br>Application Laver                                      | Network Diameter (hops)            | 35       |                     |
| Network Management   | Node Traversal Time                | 40       | milli-seconds 💌     |
| <ul> <li>User Behavior Model</li> <li>Battery Model</li> </ul> | Active Route Timeout Interval      | 3        | seconds 🖃           |
| OS Resource Model  | My Route Timeout Interval          | 6        | seconds 🗨           |
| File Statistics<br>Statistics Database<br>Packet Tracing       | Maximum RREQ Retries               | 2        |                     |
|  | Route Deletion Constant            | 5        |                     |
|  | Enable Hello Messages              | No       | •                   |
|  | Enable Local Repair                | No       | •                   |
|  | Enable Better Route Search         | No       | •                   |
|  | Enable Acknowledgement Processing  | No       | •                   |
|  | Maximum Number of Buffered Packets | 100      |                     |
|  | Maximum Buffer Size (bytes)        | 0        |                     |
|  | Open Bi-directional Connection     | No       | •                   |
|  | TTL Start                          | 1        |                     |
|  | TTL Increment                      | 2        |                     |
|  | TTL Threshold                      | 7        |                     |
|  | RREQs Replied by Destination Only  | No       | •                   |
|  | Enable IP Forwarding               | Yes      | <b>•</b>            |
|  |                                    |          |                     |
| 👢 Find   | Ap                                 | oply OK  | Cancel Add To Batch |

• 检查确定节点7和8的两个接口:无线接口的MAC为802.11,有线接口MAC为Abstract Link MAC。

• 无线接口MAC: Station Association Type: Dynamic; Set as Access Point:Yes

| terface 1                             |                                  | MAC Layer |          |
|---------------------------------------|----------------------------------|-----------|----------|
| MAC Layer                             | Property                         | Value     |          |
| Network Layer Routing Protocol        | [-] MAC Protocol                 | 802.11    |          |
| BGP Configuration     File Statistics | Short Packet Transmit Limit      | 7         |          |
|                                       | Long Packet Transmit Limit       | 4         |          |
|                                       | RTS Threshold (bytes)            | 0         |          |
|                                       | Stop Receiving after Header Mode | No        |          |
|                                       | [-] Station Association Type     | Dynamic   | <b>•</b> |
|                                       | SSID                             | TEST1     |          |
|                                       | [-] Set as Access Point          | Yes       | •        |
|                                       | Beacon Start Time (TUs)          | 1         |          |
|                                       | Beacon Interval (TUs)            | 200       |          |
|                                       | DTIM Period (beacon intervals)   | 3         |          |
|                                       | Relay Frames                     | Yes       |          |
|                                       | Enable Power Save Mode           | No        |          |
|                                       | Operating Channel                | 0         |          |
|                                       | Set as Point Coordinator         | No        |          |
|                                       | Set Mesh Parameters              | No        |          |
|                                       | Enable Directional Antenna Mode  | No        |          |
|                                       | Security Protocol                | None      |          |

• 设定两个无线子网运行在不同的信道: 左侧子网Channel0, 右侧Channel1. 设定节点8的无线 Interface (Interface0) 运行在Channel1, (对比节点7是运行在Channel0, 回顾在Scenario

| Properties. Channel Properties y mumber of Channels A | <sup>v</sup> roperties: | 页中Number of Channels为 2) |
|---|-------------------------|--------------------------|
|---|-------------------------|--------------------------|

| Default Device Properties (Defaul | t Device 8)                         | ?                       | ×        |
|-----------------------------------|-------------------------------------|-------------------------|----------|
| General Node Configuration I      | nterfaces                           | μ. I                    | Help     |
| 🕀 Interface 1                     | Long Packet Transmit Limit          | 4                       | <u> </u> |
| Interface 0     Physical Laver    | RTS Threshold (bytes)               | 0                       |          |
| MAC Layer                         | Stop Receiving after Header Mode    | No                      |          |
|                                   | [-] Station Association Type        | Dynamic 🗾 🔳             |          |
| File Statistics                   | SSID                                | TEST1                   |          |
|                                   | [-] Set as Access Point             | Yes 💽 🔳                 |          |
|                                   | Beacon Start Time (TUs)             | 1                       |          |
|                                   | Beacon Interval (TUs)               | 200                     |          |
|                                   | DTIM Period (beacon intervals)      | 3                       |          |
|                                   | Relay Frames                        | Yes                     |          |
|                                   | Enable Power Save Mode              | No                      |          |
|                                   | Operating Channel                   | 1                       |          |
|                                   | Set as Point Coordinator            | No                      |          |
|                                   | Set Mesh Parameters                 | No                      |          |
|                                   | Enable Directional Antenna Mode     | No                      |          |
|                                   | Security Protocol                   | None                    |          |
|                                   | Specify Network Security Parameters | No                      |          |
|                                   | MAC Propagation Delay               | 1 micro-seconds 💌       |          |
|                                   | Enable Promiscuous Mode             | No                      |          |
|                                   | Enable LLC                          | No                      |          |
|                                   | Configure MAC Address               | No                      | -        |
| 🙇 Find                            | Aj                                  | pply OK Cancel Add To B | atch     |

• 修改7和8的Icon: Access Point.png; 【3D Icon也可采用png文件,并非一定采用 3ds格式文件】

| neral Node Configuration Interfaces                   |                              |    |
|---|------------------------------|----|
| Gene  | ral Properties               | _  |
| Property  | Value                        |    |
| Node Name   |                              |    |
| 2D Icon   | F:/ex/myWiFi/AccessPoint.png |    |
| 3D Icon   | default.3ds                  |    |
| Scale Factor for 3D Icon (percent)                    | 100                          |    |
| Scale Factor for Node Highlights in 3D View (percent) | 100                          |    |
| Initial Heading Direction of 3D Icon (degrees)        | 0                            |    |
|   |                              |    |
|   |                              |    |
| ind<br>● 到这里,场景如下图:                                   | Apply OK Cancel Add          | То |
| ind<br>• 到这里,场景如下图:                                   | Apply OK Cancel Add          | To |

**b**(1]

x

CBR

**1**[2]

设定两个子网的可听信道Listenable Channels: Channel0和Channel1。Table View: Networks页
 选择两个Wireless Subnets,一起设定

| General Physical Laye  | r     | MAC Layer   Network | k Layer   Rou | ting Pro | tocol   Router F | Properties   Fi | e Statistics | Ľ,     | Help  |
|------------------------|-------|---------------------|---------------|----------|------------------|-----------------|--------------|--------|-------|
|                        |       |                     | Physica       | al Layer |                  |                 |              |        |       |
|                        |       | Property            |               |          |                  | Value           |              |        |       |
| Listenable Channels    |       |                     |               | channe   | 10               |                 |              |        |       |
| Listening Channels     |       | DHV Channel List (  | Editor        |          | -                | 2 X             |              |        |       |
| [-] Radio Type         |       |                     | Luitoi        |          |                  | · ^             |              | •      |       |
| [-] Enable Auto Rat    | e Fa  | Channel Index       | Channel N     | ame      | Frequency        | Enabled?        |              | -      |       |
| Data Rate              |       | 0                   | channel0      |          | 240000000        | •               | Mbps         | -      | Í     |
| Transmission Pov       | wer   | 1                   | channel1      |          | 250000000        | <b>V</b>        |              |        |       |
| Transmission Pov       | wer   |                     |               |          |                  |                 |              |        |       |
| Transmission Pov       | wer   |                     |               |          |                  |                 |              |        |       |
| Transmission Pov       | wer   |                     |               |          |                  |                 |              |        |       |
| Receive Sensitiv       | ity a |                     |               |          |                  |                 |              |        |       |
| Receive Sensitiv       | ity a |                     |               |          |                  |                 |              |        |       |
| Receive Sensitiv       | ity a |                     |               |          |                  |                 |              |        |       |
| Receive Sensitiv       | ity a |                     |               |          |                  |                 |              |        |       |
| Estimated Direct       | tiona | ,                   |               | Apply    | OK               | Cancel          |              |        | F     |
| Packet Receptio        | n M   |                     |               | мрру     |                  | Cancer          |              | •      | Ī     |
| [-] Specify Antenna Mo | del f | from File           |               | No       |                  |                 |              | •      | Ī     |
| Antenna Model          |       |                     |               | Omnidi   | ectional         |                 |              | -      | Ĩ     |
| Antenna Gain (d        | B)    |                     |               | 0.0      |                  |                 |              |        | Ē     |
| Antenna Height         | (me   | eters)              |               | 1.5      |                  |                 |              |        | Í 🗾   |
| à, Find                |       |                     |               |          | Apply            | ок              | Cancel /     | Add To | Batch |

 修改右侧子网正听信道为Channel1: Table View: Network页选择右侧无线子网,在Physical Layer页中修改Listening Channels:为Channel1

| Wireless Subnet Properties (Wirele  | ess Sub | onet 190.0.2.0) |                            |                    |               |               |        | ?       | $\times$ |
|-------------------------------------|---------|-----------------|----------------------------|--------------------|---------------|---------------|--------|---------|----------|
| General Physical Layer MAC La       | yer     | Network Layer   | Routing Protocol           | Router Pr          | operties   Fi | ile Statistic | cs     |         | Help     |
|                                     |         | Р               | hysical Layer              |                    |               |               |        |         | •        |
| Property                            |         |                 |                            | Value              |               |               |        |         |          |
| Listenable Channels                 |         |                 | channel0,cha               | channel0, channel1 |               |               |        |         |          |
| Listening Channels                  |         |                 | channel1                   | channel1           |               |               |        |         |          |
| [-] Radio Type                      |         |                 | 802.11b Rad                | 802.11b Radio      |               |               |        |         |          |
| [-] Enable Auto Rate Fallback PHY   |         | PHY Channe      | IV Channel List Editor ? X |                    |               |               |        |         |          |
| Data Rate                           |         | Channel In      | day Channel                | Nama               | Francisco     | - Cashl       | s da l | -       |          |
| Transmission Power at 1 Mbp         | os (dBr | Channel Ind     | dex Channel                | Name 24            | Frequency     |               | ea?    |         |          |
| Transmission Power at 2 Mbp         | os (dBr | 1               | channel1                   | 25                 | 500000000     |               |        |         |          |
| Transmission Power at 6 Mbp         | os (dBr | -               |                            |                    |               | -             |        |         |          |
| Transmission Power at 11 Mb         | ops (dE |                 |                            |                    |               |               |        |         |          |
| Receive Sensitivity at 1 Mbps       | s (dBm  |                 |                            |                    |               |               |        |         |          |
| Receive Sensitivity at 2 Mbps (dBm  |         |                 |                            |                    |               |               |        |         |          |
| Receive Sensitivity at 6 Mbps (dBm  |         |                 |                            |                    |               |               |        |         |          |
| Receive Sensitivity at 11 Mb        | ps (dBr |                 |                            |                    |               |               |        |         |          |
| Estimated Directional Antenr        | na Gain |                 | Sel                        | ect or unselect    | a             |               |        |         |          |
| Packet Reception Model              |         |                 | cha                        | innel to edit the  |               |               |        | •       |          |
| [-] Specify Antenna Model from File |         |                 |                            | Арріу              | ок            | Canc          | el     | •       |          |
| Antenna Model                       |         | _               | Omnidirection              | nal                |               |               |        | •       |          |
| Antenna Gain (dB)                   |         |                 | 0.0                        |                    |               |               |        |         |          |
| Antenna Height (meters)             |         |                 | 1.5                        |                    |               |               |        |         | -        |
| 🙇 Find                              |         |                 |                            | Apply              | ОК            | Canc          | el A   | dd To E | Batch    |

#### Ⅴ. 应用属性

● Table View: Application,双击CBR业务,设定属性如下。【注: Item to Send: 0代表无穷】

| 6                 | Seneral Properties |           |
|-------------------|--------------------|-----------|
| Property          |                    | Value     |
| Source            | 1                  |           |
| Destination       | 2                  |           |
| Items to Send     | 0                  | 3         |
| Item Size (bytes) | 512                |           |
| Interval          | 0.05               | seconds 💌 |
| Start Time        | 5                  | seconds 💌 |
| End Time          | 315                | seconds 💌 |
| [-] Priority      | Precedence         |           |
| Precedence Value  | 0                  |           |
| Enable RSVP-TE    | No                 |           |
| Enable MDP        | No                 |           |
| Session Name      | [Optional]         |           |

vi. 保存、运行。

i. 分析结果

i. 点击下面按钮分析运行结果



ii. 查看Applicationceng: CBR Client 和 CBR Server, 【Tip: 鼠标悬停在数据柱上,将显示数值】CBR Client发送6200 packets, 而CBR Server接收到 6152个,说明有丢包产生。







iv. 局部放大:右侧上下有两个图,上图是下图红框部分的放大,默认二者等大,可以用左键点选需要放大的区域;右键返回。



v. 点击Architect返回网络架构视图;点击Switch to Design Mode,可以重新修改配置,重新运行仿真。