EXata 学习(04): GSM切换场景Step by Step

目标:一步一步重现GSM 两基站间切换场景

素材: D:\Scalable\exata\5.1\scenarios\cellular\gsm\handover下的handover.config

1. 创建和配置场景

- a. 空白场景: 1500x1500, 命名为myHandover
- b. 设定Channel Properties: 仿照Handover场景例子,设定系统有32个Channel。可以有两种方法添加信道:
 1)复制handover.config例子中的Channel部分,Channel数越多越有效。注意:修改完场景文件后需要重新载入才能生效。2)在Scenario Properties->Channel Properties->Number of Channels...中进行手动添加和设置。注意:这32个信道频率的特点:偶数信道0,2,4,。。。,30为高频段,从935.0MHz-938MHz,0.2MHz-个Channel;奇数信道1,3,5,...,31为低频段,从890MHz~893MHz,同样每个0.2MHz-个。【0.2MHz是GSM系统标准的信道间隔】
- 2. 创建网络拓扑
 - a. 添加8个default devices,其位置大致与handover例子场景一致:一个拟作为MSC,4个拟作为BS,3个拟作为MS。
 - b. 为方便识别,先修改ICon: 2D和3D ICon都修改为 png 文件;从D:\Scalable\exata\5.1\gui\icons拷贝 GSM-BS、GSM-MSC和GSM-MS的png文件。修改各default devices的 ICON 和名字
 - c. 此时由于没有Wired Links,所有8个节点构成一个基于802.11b的default wireless subnet.如下图所示



- d. 添加Links:
 - i. 有线连接MSC和各BS;
 - ii. 创建一个Wireless Subnet,无线连接各BS;**注意**:不连接各MS【<mark>思考</mark>:为什么呢?】 iii.



- iv. 观察Table View: Networks中网络地址的变化:目前有4个有线子网、1个默认无线子网和1个无线子网。所有MS属于默认无线子网,所有BS属于另一个无线子网。此时,运行仿真,系统按默认接口协议进行路由信息交换。此时,加载在MS1和MS2之间加载CBR业务是可以的,但加载GSM Call运行中途会出错。
- 3. 配置网络协议
 - a. 配置MSC: Node Configuration: Network Layer: 配置Network Protocol为 GSM Layer 3, GSM Node Type 为Mobile Switching Center,然后应用。在Interfaces页卡检查各接口的Network Layer 协议和节点类 型是否为GSM Layer 3和Mobile Switching Center。注意:此时运行会有出错提示: "Node [1] Could not find GSM-NODE-CONFIG-FILE",此时在Scenario Properties的Supplemental Files页卡中的"GSM Node Configuration File"仍未指定(待自动生成的文件)。
 - b. **配置BS公共属性**:公共属性通过Wireless Subnet来统一设置, Table View: Networks, 双击Wireless Subnet行:
 - i. Physical Layer页卡:
 - Listenable Channels: 激活所有Channels; Listening Channel选择Channel 0;
 - Transmission Power (dBm) : 20.0; Receive Sensitivity (dBm): –110.0; Receive Threshold (dBm): –90.0;
 - Packet Reception Model选择"BER-based Reception Model",并在Number of BER Tables中指 定gmsk.ber文件(可在GSM诸多例子中找到)。

	Physical Layer		
Property	Value		
Listenable Channels	nel26, channel27, channel28, channel29, channel30, channel31		
Listening Channels	channel0		
-] Radio Type	GSM 💌		
Data Rate	270.833 Kbps		
Transmission Power (dBm)	20.0		
Receive Sensitivity (dBm)	-110.0		
Receive Threshold (dBm)	-90.0		
[-] Packet Reception Model	BER-based Reception Model		
Number of BER Tables	1		
-] 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	None		

- ii. MAC Layer页卡:
 - MAC Protocol: GSM, BS Downlink Control Channel等与单独BS相关的属性暂时维持不变,在后续各节点Interfaces设置中完成。

	MAC Layer
Property	Value
-] MAC Protocol	GSM 💌
GSM Node Type	Base Station
BS Downlink Control Channel	[0]
Location Area Code	1
Cell Identity	1
Channel Range	0-3
Neighboring Base Stations	0-0-0
MAC Propagation Delay	1 micro-seconds
Enable Promiscuous Mode	No
Enable LLC	No

iii. Network Layer页卡:

 Network Protocol: GSM Layer 3; GSM Node Type: Base Station【注意:如果将MS保护在此 无线子网中,则此节点类型无法选择】如果在MAC Layer页卡中GSM Node Type默认类型不对, 这里Apply之后应该会更正过来。

Wireless Subnet Properties (Wireless Subnet 190.0.5.0) ? X				
General Physical Layer MAC Layer Network Layer Routing Protocol Router Properties File Statistics 🕮 Help				
General	General Properties			
QoS Configuration	Property	Value		
Cyber ARP	[-] Network Protocol	GSM Layer 3		
Fixed Communications	GSM Node Configuration File	Specify GSM Configuration File in Supplemental F		
	GSM Node Type	Base Station 💌 ᆀ		
	IP Fragmentation Unit (bytes)	2048		
	Enable Explicit Congestion Notification	No		
	Enable Mobile IP	No		
à, Find	Арр	Ny OK Cancel Add To Batch		

- **c. 配置BS特有属性**:特别是各BS的小区地址分配,这部分技术含量较高。将对各BS GSM无线接口的MAC按 以下方案进行配置。
 - 配置BS1: Table View: Nodes, BS1-》Interfaces-》Interface 1 (GSM无线接口)页卡选MAC Layer;
 - BS Downlink Control Channel: [0]
 - Locatioin Area Code: 1 【即 LAC】
 - Cell Identity: 1 【CID按每个BS三个Cell的间隔递增,目前按单小区基站设定】
 - Channel Range: 0-3 【每个BS 4个信道分配】
 - Neighboring Base Station:暂时可空,等所有BS配置完信道、LAC和CID后再来Check选取其余基站。
 - 配置BS2: Table View: Nodes, BS2-》Interfaces-》Interface 1 (GSM无线接口)页卡选MAC Layer;
 - BS Downlink Control Channel: [8]
 - Locatioin Area Code: 1 【即 LAC】
 - Cell Identity: 4 【CID按每个BS三个Cell的间隔递增,目前按单小区基站设定】
 - Channel Range: 8-15 【每个BS 8个信道分配】
 - Neighboring Base Station:暂时可空,等所有BS配置完信道、LAC和CID后再来Check选取其余基站。
 - 配置BS3: Table View: Nodes, BS3-》Interfaces-》Interface 1 (GSM无线接口)页卡选MAC

Layer;

- BS Downlink Control Channel: [16]
- Locatioin Area Code: 1 【即 LAC】
- Cell Identity: 7 【CID按每个BS三个Cell的间隔递增,目前按单小区基站设定】
- Channel Range: 16-23 【每个BS 8个信道分配】
- Neighboring Base Station:暂时可空,等所有BS配置完信道、LAC和CID后再来Check选取其余基站。
- 配置BS4: Table View: Nodes, BS4-》Interfaces-》Interface 1 (GSM无线接口)页卡选MAC Layer;
 - BS Downlink Control Channel: [24]
 - Locatioin Area Code: 1 【即 LAC】
 - Cell Identity: 10 【CID按每个BS三个Cell的间隔递增,目前按单小区基站设定】
 - Channel Range: 24-31 【每个BS 8个信道分配】
 - Neighboring Base Station:暂时可空,等所有BS配置完信道、LAC和CID后再来Check选取其余基站。
- 分别设置BS1-BS4的Neighboring Base Station:勾选所有备选。完成设置后,各基站无线接口MAC层 配置如下:

Default Device Properties (Default Device 2)					
General Node Configuration	Interfaces		🖾 He		
⊡ Interface 0		MAC Layer			
Physical Layer	Property Value				
MAC Layer	[-] MAC Protocol	GSM	- 4		
Routing Protocol	GSM Node Type	Base Station			
File Statistics	BS Downlink Control Channel	[0]			
	Location Area Code	1			
	Cell Identity	1			
	Channel Range	0-3			
	Neighboring Base Stations	8-1-4 16-1-7 24-1-10			
	MAC Propagation Delay	1 micro-	seconds 💌		
	Enable Promiscuous Mode	No	•		
	Enable LLC	No	•		
	Configure MAC Address	No	•		

General | Node Configuration Interfaces

Interface 0 Interface 1	MAC	Layer
Physical Layer	Property	Value
MAC Layer	[-] MAC Protocol	GSM 💌 🛃
Routing Protocol Faults	GSM Node Type	Base Station
File Statistics	BS Downlink Control Channel	[8]
	Location Area Code	1
	Cell Identity	4
	Channel Range	8-15
	Neighboring Base Stations	0-1-1 16-1-7 24-1-10
	MAC Propagation Delay	1 micro-seconds 💌
	Enable Promiscuous Mode	No
	Enable LLC	No
	Configure MAC Address	No

Default Device Properties (Default Device 4)

? ×

General Node Configuration	nterfaces	🟳 Help		
Interface 0 Interface 1	MAC Layer			
Physical Layer	Property	Value		
MAC Layer	[-] MAC Protocol	GSM 🔽 🚽		
E Routing Protocol	GSM Node Type	Base Station		
File Statistics	BS Downlink Control Channel	[16]		
	Location Area Code	1		
	Cell Identity	7		
	Channel Range	16-23		
	Neighboring Base Stations	0-1-1 8-1-4 24-1-10		
	MAC Propagation Delay	1 micro-seconds 💌		
	Enable Promiscuous Mode	No		
	Enable LLC	No		
	Configure MAC Address	No		

Default Device Properties (Default Device 5)

×

?

General Node Configuration	interfaces	🚇 Help		
⊡ Interface 0	MAC Layer			
Physical Layer	Property	Value		
MAC Layer Network Layer	[-] MAC Protocol	GSM 🔽 🛃		
Routing Protocol	GSM Node Type	Base Station		
File Statistics	BS Downlink Control Channel	[24]		
	Location Area Code	1		
	Cell Identity	10 4		
	Channel Range	24-31		
	Neighboring Base Stations	0-1-1 8-1-4 16-1-7		
	MAC Propagation Delay	1 micro-seconds 💌		
	Enable Promiscuous Mode	No		
	Enable LLC	No		
	Configure MAC Address	No		

d. 配置有线链路属性

🚇 Help

■ Table View-》Networks, 多选全部Link, 设置其Network Protocol为GSM Layer 3

 \times

×

Group Point-to-point Link Properties (Link 190.0.1.0, Link 190.0.2.0, Link 190.0.3.0, Link 190.0.4.0) ?

F	oint-to-point Link Properties		🚇 Help
	General	Network	Protocol
Fixed Communications	Property	Value	
	Routing Protocol ARP	[-] Network Protocol	GSM Layer3 🗾 🔳
	Background Traffic	GSM Node Configuration File	Specify GSM Configuration File in Supplemental F

e. 此时运行仿真,会提示出现Trace Header 错误;去掉所有MS则,没有错误提示。

Group Point-to-point Link Properties (Link 190.0.1.0, Link 190.0.2.0, Link 190.0.3.0, Link 190.0.4.0) ?

Point-to-point Link Properties Help		
General	Network	Protocol
Fixed Communications	Property	Value
Routing Protocol ARP	[-] Network Protocol	GSM Layer3 🗾 🚽
Background Traffic File Statistics	GSM Node Configuration File	Specify GSM Configuration File in Supplemental F

4. 终端配置

a. 共有属性:与BS公共属性配置类似,通过default wireless subnet进行配置:Table View--》Networks,

双击Default Wireless Subnet

- i. Physical Layer:
 - Listenable Channels: 激活所有Channels; Listening Channel选择Channel 0;
 - Transmission Power (dBm) : 20.0; Receive Sensitivity (dBm): –110.0; Receive Threshold (dBm): –90.0;
 - Packet Reception Model选择"BER-based Reception Model",并在Number of BER Tables中指 定gmsk.ber文件。
- ii. MAC Layer: 添加控制信道列表[0 8 16 24], 注意与各BS的控制信道保持一致

Wireless Subnet Properties (Default Wireless Subnet 169.0.	.0) ? >		
General Physical Layer MAC Layer Network Layer Routing Protocol Router Properties File Statistics 🕮 Help			
MAC Layer			
Property	Value		
[-] MAC Protocol	GSM 🗾 🚽		
GSM Node Type	Mobile Station		
GSM Control Channel List	[0 8 16 24]		
MAC Propagation Delay	1 micro-seconds 💌		
Enable Promiscuous Mode	No		
Enable LLC	No		

- iii. Network Layer: 默认IPv4,不需要设置为GSM Layer 3,所有GSM例子均如此,原因暂时不祥。但是 在Node Configuration中Interface的Network Layer必须为GSM Layer 3,如下继续配置。经检验,也 可以在Default Wireless Subnet中进行Network Layer设置为 GSM Layer 3,则各MS Interface的 Network Layer也会更正过来。无论如何,确保各MS节点的Interface各层协议正确。
- iv. Table View-》Nodes: 点击各MS进行Node Configuration和Interfaces配置。

V. 此时运行仿真仍然会提示"GSM-NODE-TYPE not specified"错误,还是需要对MS的节点类型进行手动

设置。错误提示如下:

-----Nov 13, 2022 3:17:55 pm -----Launching simulator/emulator: D:/Scalable/exata/5.1/bin/exata.exe with args: myHandover.config -np 1 -interactive 127.0.0.1 4001 -with-snt-gui -friendly -simulation myHandover_Nov_13_22_15_17_55
EXata Developer Version 5.1
Kernel Version: 12.10
Build Number: 201310091
Build Date: Oct 9 2013, 18:55:48
EXATA_HOME = D:\Scalable\exata\5.1
Attempting license checkout (should take less than 2 seconds) ...Loading scenario myHandover.config
Assertion (wasFound != FALSE) failed in file ..\libraries\cellular\src\mac_gsm.cpp:2411
GSM-NODE-TYPE not specified

vi. 手动配置MS的GSM Node Type: 在myHandover.config文件中Node Configuration部分添加[6 thru 8]

GSM-NODE-TYPE GSM-MS,

	[2 thru 5]	GSM-HANDOVER-MARGIN 0.0
	[1 thru 5]	NETWORK-PROTOCOL GSM-LAYER3
	[1]	HOSTNAME MSC
	[2]	HOSTNAME BS1
	[3]	HOSTNAME BS2
	[4]	HOSTNAME BS3
	[5]	HOSTNAME BS4
	[6]	HOSTNAME MS1
i	[7]	HOSTNAME MS2
5	[8]	HOSTNAME MS3
	[1]	GSM-NODE-TYPE GSM-MSC
	[2 thru 5]	GSM-NODE-TYPE GSM-BS
)	[6 thru 8]	GSM-NODE-TYPE GSM-MS

vii. 关闭场景文件重新加载,此时将运行正常。此时,没有加载业务,通过Analyzer应能查看到 成功的 Location Update过程。



5. 加载GSM Call业务

- a. 在MS2(节点7)和MS3(节点8)之间添加一个GSM Call应用;
- b. 设定从10s开始,持续时长200s, 【注意不要超出仿真时长!】

GSM Call Properties		? ×
General		🕮 Help
	General Properties	
Property		Value
Source	7	•
Destination	8	•
Call Start Time	10	seconds 💌
Call Duration	200	seconds 🗾 ᆀ

C. 重新运行, 观测结果。此时会看到7和8之间完成了一个呼叫



6. 设定节点运动状态:采用Waypoint模式设定节点7的移动轨迹

a. 设定轨迹,并编辑时间间隔,修订速度,结果如下



Mobility W	/aypoint Editor							?	×
	Nodes	Waypoint MS2							
MS1 MS2			ID	Simulation Time	X	Y	Z		A_
MS3 MSC		1	0	0 seconds	1129 . 65	311.938	0		0
BS1 BS2 BS3 BS4		2	1	10 seconds	970.653	237.306	0		0
		3	2	20 seconds	834.367	247.040	0		0
		4	3	30 seconds	717.551	285.979	0		0
		5	4	40 seconds	633.183	337.897	0		0 🗸
		┛							•
					Apply	01	(Ca	ancel

b. 运行结果看,节点7执行了3次切换

myHandover_Nov_13_22_16_43_15.stat	[GSM_MS : Handovers Performed] Compare	Bv : Node ID					
Application							
Transport							
Network	GSM_MS : Handovers Performed, Comparison Type: Node						
GSM_MS	3.4						
Traffic Packets Received Channel Request Sent	3.2.						
Channel Assignments Received	2.8						
Location Update Request Sent Location Update Accept Received	2.6.						
Cals Received	2.2.						
- Calls Completed Handovers Performed	2. Si 1.8.						
B GSM_MSC	- 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0						
GSM_BS Traffic packets (On Air) Sent	1.4. 1.2.						
Channel Requests Received Channel Requests Received Channel Assignment Attempts Failed	1						
Channels Assigned Channels Released	0.8.						
	0.4.						
Measurement Report Received Handovers Completed (Incoming MS)	0						
Handovers Attempted (Outgoing Handovers Completed (Outgoing M	6	7	8				

C. 运行过程中动态观察各BS的IP流量变化,Run仿真之后,Play之前,菜单Animation-》Dynamic

Statistics-》Scenario Dynamic Statistics... 中选择"IP: Number of Packets Received".可以动态随着节点 7的移动,基站节点流量的变化,如下图所示。

Scenario Dynamic Statistics	? ×
✓ IP: Number of Packets Received	Per Node
Update Interval Time	
Apply	OK Cancel







I Node TDs

0.0