NB-IoT

BIG DATA &
NETWORK
ENGINEERING

李杰
jie.14.li@Nokia.com

NOKIA

Technical Details

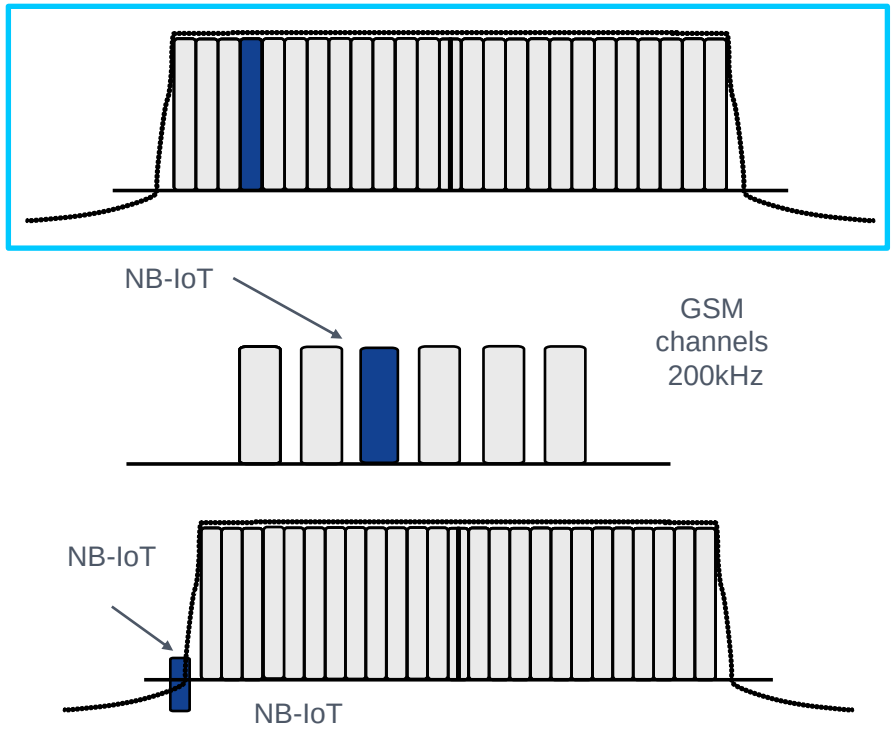
NB-IOT

Introduction

NB-IoT 200kHz - Modes of operation

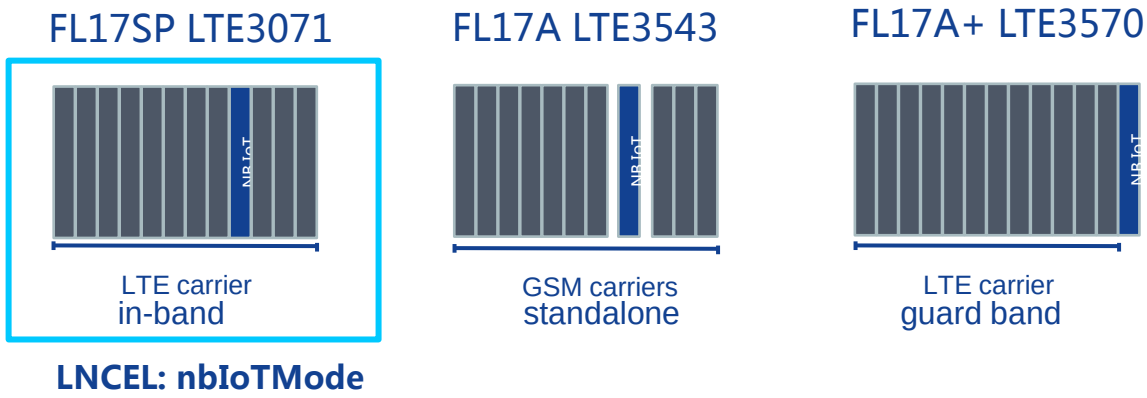
3GPP defines 3 different modes of operation for NB-IoT:

- **“In-band模式”与传统LTE小区共享软硬件资源，利用原有LTE小区的一个或几个PRB作为NB-IoT载波(FL17SP)**
- “Stand-alone模式”不与传统LTE小区共享软硬件资源，利用例如GERAN系统中的频段资源，替换其中的1个或几个GSM载频，作为NB-IoT载波；或者建立一个全新的NB-IoT小区(FL17A)
- “Guard-band模式”与传统LTE小区共享软硬件资源，利用LTE载波保护频带内未用资源作为NB-IoT载波(FL17A+)



LTE 3071 NB-IoT Overview

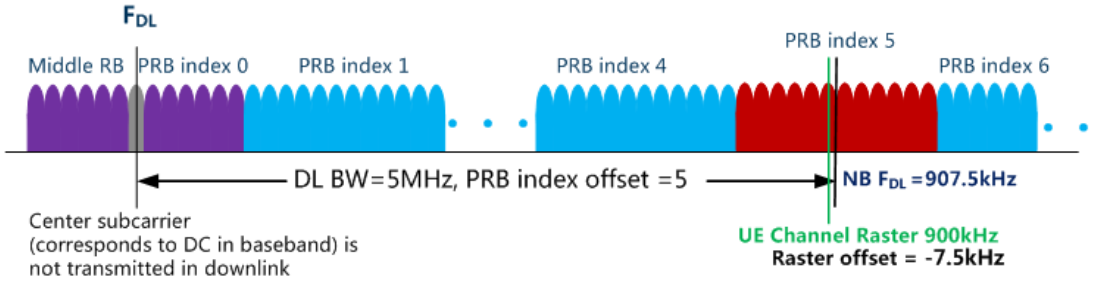
- LTE 3071 采用 3GPP Rel. 13 **in-band NB-IoT** 技术.
- New cell concept and deployment options for LTE:
  - 只支持FDD半双工模式，不支持TDD
  - 上下行各使用180 kHz的带宽（即一个PRB）
  - 下行使用OFDMA,15kHz子载波宽度，目前只可配置2TX模式，最大编码QPSK
  - 上行使用SC-FDMA,目前只支持15kHz single-tone，2RX，支持BPSK和QPSK
  - 数据传输通过SRB，不再建立DRB。可以使用IP和NoneIP



LNCEL: nbIoTMode

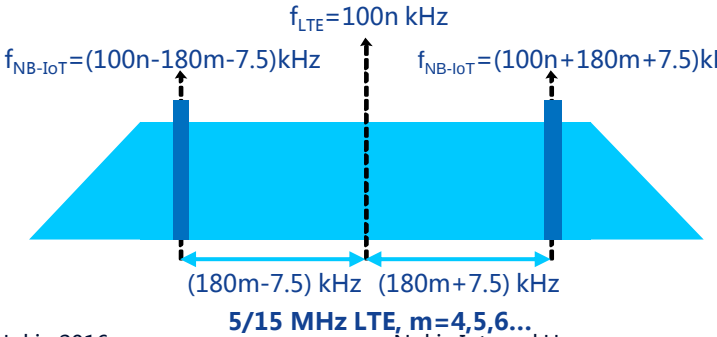
Technical Details
Channel Raster

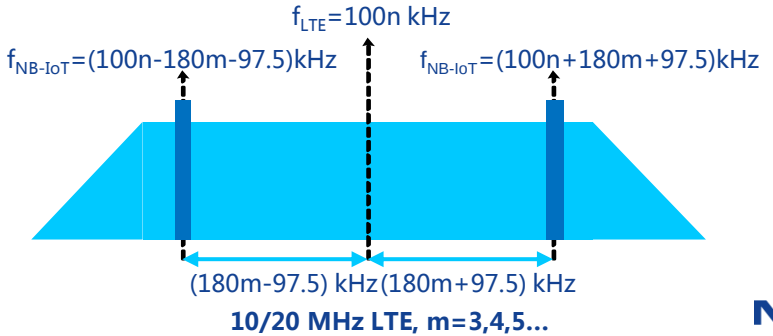
- 3GPP中规定分配给LTE载频间隔为100kHz,并且在信道中心子载波中有一个15kHz的DC载波。 NB-IoT 载波中心与PRB中心对齐。因此在选择下行PRB时，需要选择频率靠近整100kHz的PRB
- NB的中心频率与LTE频率中心即100kHz的位置存在一定的偏移量，偶数PRB与奇数PRB偏移量



10/20MHz - {**2.5kHz**, 17.5kHz, 22.5kHz, 37.5kHz, 42.5kHz}.

5/15MHz - {**7.5kHz**, 12.5kHz, 27.5kHz, 32.5kHz, 47.5kHz}.





Technical Details
PRB selection for in-band operation

- NB-IoT UE 遵循 3GPP 栅格搜索; 意味着不会延每个PRB中心搜索, 而是 100kHz 的步长重复搜索
- NB-IoT 载波需要用于UE初始接入，因为频率误差必须控制到最小。同时PRB索引偏移量为(+/-7.5 or 2.5 kHz)作为锚载波***(NBIOT_FDD: inbandPRBIndexDL)***，不能占用带宽中间6个PRB，因为有同步信道和广播信道。

PRB index	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
PRB offset	12	11	10	9	8	7	6	5	4	3	2	1		1	2	3	4	5	6	7	8	9	10	11	12
PRB frequency	5832.5	6012.5	6192.5	6372.5	6552.5	6732.5	6912.5	7092.5	7272.5	7452.5	7632.5	7812.5		8187.5	8367.5	8547.5	8727.5	8907.5	9087.5	9267.5	9447.5	9627.5	9807.5	9987.5	10168

if (odd bandwidth and offset <0) FDL_delta = - 180*m - 7.5kHz

if (odd bandwidth and offset >0) FDL_delta = + 180*m + 7.5kHz

LTE system bandwidth	5 MHz	10 MHz	15 MHz	20 MHz
DL PRB indices	2, 7, 17, 22	4, 9, 14, 19, 30, 35 40, 45	2, 7, 12, 17, 22, 27, 32, 42, 47, 52, 57, 62, 67, 72	4, 9, 14, 19, 24, 29, 34, 39, 44, 55, 60, 65, 70, 75, 80, 85, 90, 95

- NB-IoT UL PRB ***(NBIOT_FDD: inbandPRBIndexUL)***可以配置到除PRACH/PUCCH以及host小区中动态PUCCH的区域外任何.
  - PRB from the outer region outside area in host LTE cell by PUCCH blanking.
  - PRB from the inner region of PUSCH. The adjacent PRB near PUCCH is preferred to avoid uplink resource fragment if dynamic PUCCH is not enabled.

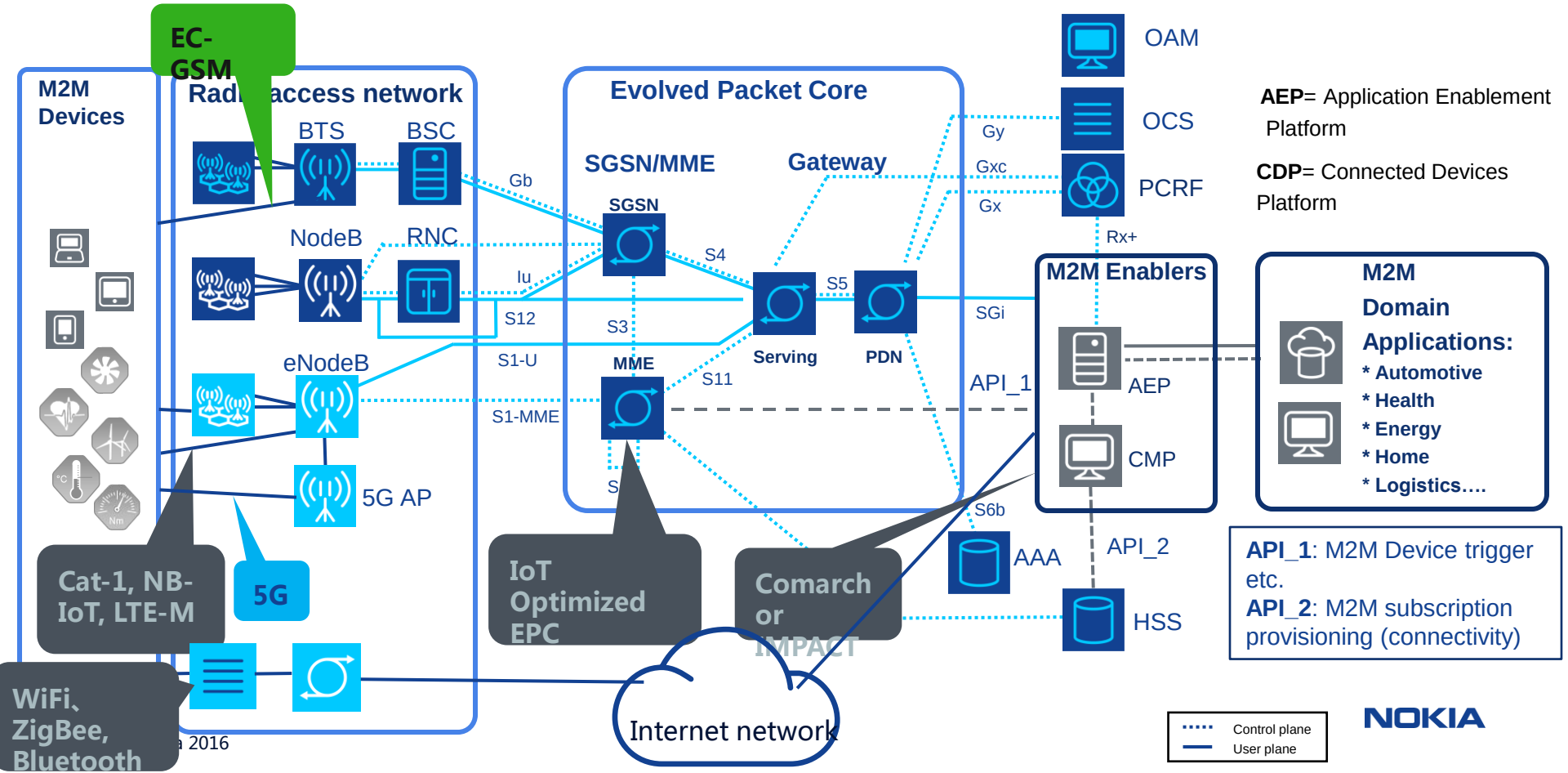
Technical Details
NB-IoT – In-Band链路预算

- 最大小区损耗（MCL）为164dB

Channel	NPBCH	NPDCCH	NPDSCH	NPUSCH	NPUSCH	NPRACH
Data rate (kbps)			0.44	0.31	0.36	
Transmitter						
Max Tx power (dBm)	46	46	46	23	23	23
(1) Actual Tx power (dBm)	35	35	35	23	23	23
Receiver						
(2) Thermal noise density (dBm/Hz)	-174	-174	-174	-174	-174	-174
(3) Receiver noise figure (dB)	5	5	5	3	3	3
(4) Interference margin (dB)	0	0	0	0	0	0
(5) Occupied channel bandwidth (Hz)	180,000	180,000	180,000	15,000	3,750	3,750
(6) Effective noise power = (2) + (3) + (4) + 10 log ((5)) (dBm)	-116.4	-116.4	-116.4	-129.2	-135.3	-135.3
(7) Required SINR (dB)	-12.6	-13.0	-13.7	-12.8	-6.6	-5.8
(8) Receiver sensitivity = (6) + (7) (dBm)	-129.0	-129.4	-130.1	-142.0	-141.9	-141.1
(9) Rx processing gain	0	0	0	0	0	0
(10) **MCL** = (1) –(8) + (9) (dB)	**164.0**	**164.4**	**165.1**	**165.0**	**164.9**	**164.1**

升级准备及步骤

NB-IoT网络拓扑图示



NB-IoT配置要求

Release information

Release/version	RL release	eNodeB	NetAct
FDD LTE	FDD-LTE 17SP	FL17SP及以上版本	NA17.2+SP1706，OMS17 CORR12
TDD LTE	-	-	-
Flexi Zone Micro (FZM/FZP)	-	-	-
Flexi Zone Controller (FZC)	-	-	-
Single RAN	-	-	-

Core：
需要新建vEPC：IoT Optimized EPC

Release information – general

HW & IOT	HW requirements	MME	SAE GW	UE	Specified by 3GPP
	FSMF System Module, (AirScale System Module support is planned as a separate feature)	vEPC		Rel. 13 Cat-NB1	Rel-13 TR 45.820

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IN-BAND软件版本及相关介绍

0.5TD及以上版本全部默认支持CRs，请注意终端是否开启CRs功能

NO.	in-band software short name	supported functionalities	eNB file name	BTS Site manager	recommanded SCF only for NB-IoT	Stability and Performance from LAB	SW Repository ID
	in-band E2(172) FS17SP 0.2TD	in-band IoT Cell Setup + UE Attach + data transfer with restrictions. Supported only single UE. Supported only FSMF platform	FL17SP_ENB_0000_000172_000001_release_BTSSM_downloadable.zip	FL17SP_BTSSM_0000_000292_000000.zip	RecommendedCommissioning_20170315.zip	Attach is stable. DL throughput is stopped after some time (20s – 3 mins),need reset UE. CMCC LAB: UL DL 10k bit/s; CUC: UL DL 10K bit/s ;	https://online.networks.nokia.com/SWD/?access_key=MTI1NDMy
2	in-band E2(302) FS17SP 0.3TD(w/o CRs)	in-band IoT Cell Setup, UE Attach and data transfer Only single UE. FSMF platform only	FL17SP_ENB_0000_000302_000000_release_BTSSM_downloadable.zip	FL17SP_BTSSM_0000_000300_000000.zip	NB-IoT_RecommendedCommissioning_20170403.zip	Attach is stable. DL throughput stability is better. In CMCC LAB, it could continue several minutes until stop it manually. CMCC LAB: UL DL 10k bit/s; CUC: UL DL 10K bit/s ;	https://online.networks.nokia.com/SWD/?access_key=MTI4OTQy
3	in-band E2-2(496) FS17SP 0.5TD(with CRs)	include 2 new 3GPP CRs	FL17SP_ENB_0000_000496_000002_release_BTSSM_downloadable.zip	FL17SP_BTSSM_0000_000313_000000.zip	NB-IoT_RecommendedCommissioning_FL17SP_47905_2.zip	verify quacomm 9206 with 0.5TD.	https://online.networks.nokia.com/SWD/?access_key=MTI4MDY5
4	FL17SP 1.0TD(with CRs)	no new functionalities in NB-IoT	FL17SP_ENB_0000_000645_000000_release_BTSSM_downloadable.zip	FL17SP_BTSSM_0000_000322_000000.zip	--	a little stable about DSP crash issue in HuNan CUC, PR241384. achieve LTE FDD UL 37.29Mbps DL 86.42 Mbps in NB host cell.	https://online.networks.nokia.com/SWD
5	FL17A_0.0TD	Interworking with legacy LTE limited to L3 call/data transfer from macro cell; support LTE3668 coverage enhancement with restriction.	FL17A_ENB_0000_000063_000000_release_BTSSM_downloadable.zip	FL17A_BTSSM_0000_000303_000000.zip	LTE3668_ExampleCommissioning_64repNPRACH.zip	L900 download throughput is improved(average 13.4Mbps)	https://online.networks.nokia.com/SWD
6	FL17A 1.0TD	3-Jul-17	support RF Sharing	FL17A_ENB_0000_000204_000019	BTSSiteEM-FL17A-0000_000302000009	Commissioning_LTE3669Demo_20170629.zip	no many test on site now.	https://online.networks.nokia.com/SWD

Standalone软件版本及相关介绍

如果需要使用No.1-9 版本需要在enb上打knife，E5-1(No.10)以上版本直接升级即可（带CRs）请注意终端是否开启CRs功能

NO.	stand-alone software short name	supported functionalities	eNB file name	BTS Site manager	recommanded SCF only for NB-IoT	Stability and Performance from LAB
1	stand-alone E5(191973)+(0305_036028) + Knife 0329(CTC only)	stand-alone base function	FL00_FSM3_9999_170305_036028	BTSSiteEM-FL00-0000_000284+knife	1. use recommanded parameter from R&D(download with software) 2. SCF collection folder:https://sharenet-ims.int.net.nokia.com/Open/554794330	Attach is stable. Data transfer perform as well as in-band 0.3TD. CMCC LAB: UL DL 11.2k bit/s with 1400 bytes TP;
2	stand-alone E5(0305_036028) + Knife 0329(for CMCC and CUC)	stand-alone base function				
3	stand-alone E5(0421_036761) + Knife 0426(w/o CRs)	stand-alone base function with +20db code	FL00_FSM3_9999_170421_036761	BTSSiteEM-FL00-0000_000294_000000 + 294 knife(need change frenquency by SCF in CTC)		Achieve attah and data transfer. NPDSCH repetition = 16(DL MCS = 10), NPUSCH = 4(UL MCS = 5), which we can attach UE and also transfer UL/DL traffic.
4	stand-alone E5(0421_036761) + Knife 0426(with CRs)	stand-alone base function with +20db code				
5	stand-alone E5(0421_036761) + Knife 0426(w/o CRs)+Knife0509	support MCL=154db coverage enhancement; Fix the NRS power over SIB				Achieve MCL=154db in CMCC lab and CUC lab. And could see 3db increace in SIB NRS power information.
6	stand-alone E5(0421_036761) + Knife 0426(with CRs)+Knife0509					
7	stand-alone E5(0421_036761) + knife0511 (w/o CRs)	support MCL=164db coverage enhancement; support NPRACH format 0(CP=66.7us)				Attach is successful and IP traffic can work with MCL=164 but not stable in CMCC LAB.(without CRs)
8	stand-alone E5(0421_036761) + knife0511 (with CRs)					
9	stand-alone E5(0421_036761) + knife 0523(with CRs)				3 recommanded SCFs with SW	verify S111 scenario;support NPDCCH AL=1
10	Stand-alone E5(0421_207571) E5-1	support NPRACH 3 coverage level and paging	FL00_FSM3_9999_170421_207571		no formal recommanded SCF now	support NPRACH 3 coverage level and paging
11	E5-2 Stand-alone(170421_214683)	support SIB3,4,5,14,16;GAP;enhance paging;eDRX and single-UE t-put in 3 coverage level	FL00_FSM3_9999_170421_214683	294 + knife	get detail from early drop introduction	get DL 20Kbps, UL 13Kbps single UE t-put in CE0.

CRs介绍

3GPP CRs (non-backward compatible):

- R1-1703913 36.211 CR0337r2 Cat-F Correction on the scrambling of NPDSCH carrying the BCCH - targeted to active mid of April (scrambled one),
- R1-1703964 36.211 CR0353 Cat-F NPBCH symbol rotation for interference randomization in NB-IoT

NB-IoT升级路径

注：升级过程中，必须带着TRS传输配置文件升级，升级到LN7.0后先配置传输数据再进行后续的升级工作。不然一旦遇到本地LMP ping不通，同时TRS丢失而无法远程登录，导致BBU将无法恢复，只能返厂维修！！根据需要IN-BAND或standalone选择相对应的基站软件版本，下载地址：https://online.networks.nokia.com/SWD?command_id=5802&IS_POSTED_BACK=Y

In-band模式软件升级路径

可参考如下软件升级路径：

① LN_WN_FDSW1.0（FSMF出厂版本）

② LN7.0（563_13）或者 LN7.0_ENB_1407_581_42

③ FL16_ENB_0000_001566_000000 ->FL16A_ENB_0000_002227_000000

④ FL17SP_ENB_0000_000172_000001或者 FL17SP_ENB_0000_000302_000000

⑤ FL17SP_ENB_0000_000496_000002

⑥ FL17A_ENB_0000_000063_000000

Stand-alone模式软件升级路径

可参考如下软件升级路径：

① LN_WN_FDSW1.0（FSMF出厂版本）

② LN7.0（563_13）或者 LN7.0_ENB_1407_581_42

③ FL16_ENB_0000_001566_000000 ->FL16A_ENB_0000_002227_000000

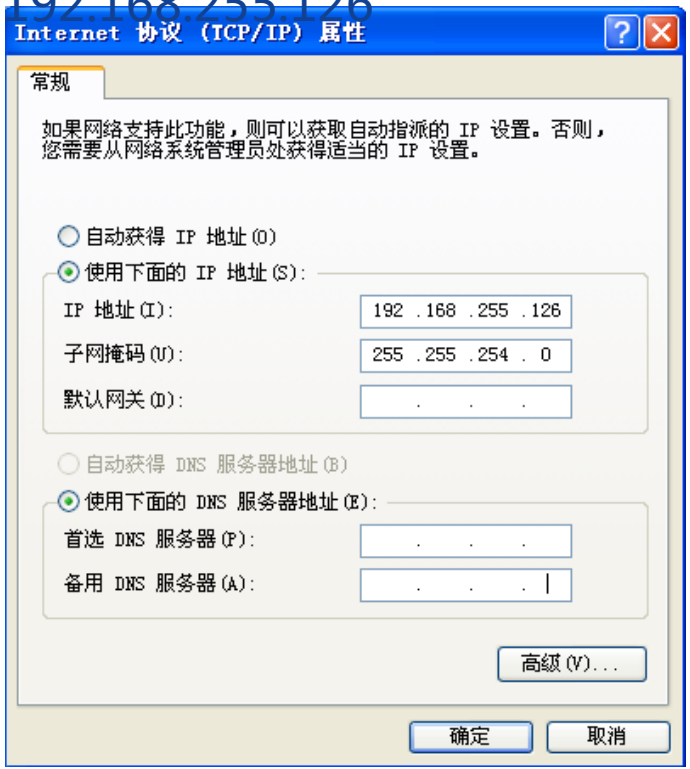
④ FL17SP_ENB_0000_000172_000001或者 FL17SP_ENB_0000_000302_000000

⑤ FL00_FSM3_9999_170421_036761+0523 knife

⑥ FL00_FSM3_9999_170421_207571

NB-IoT升级步骤

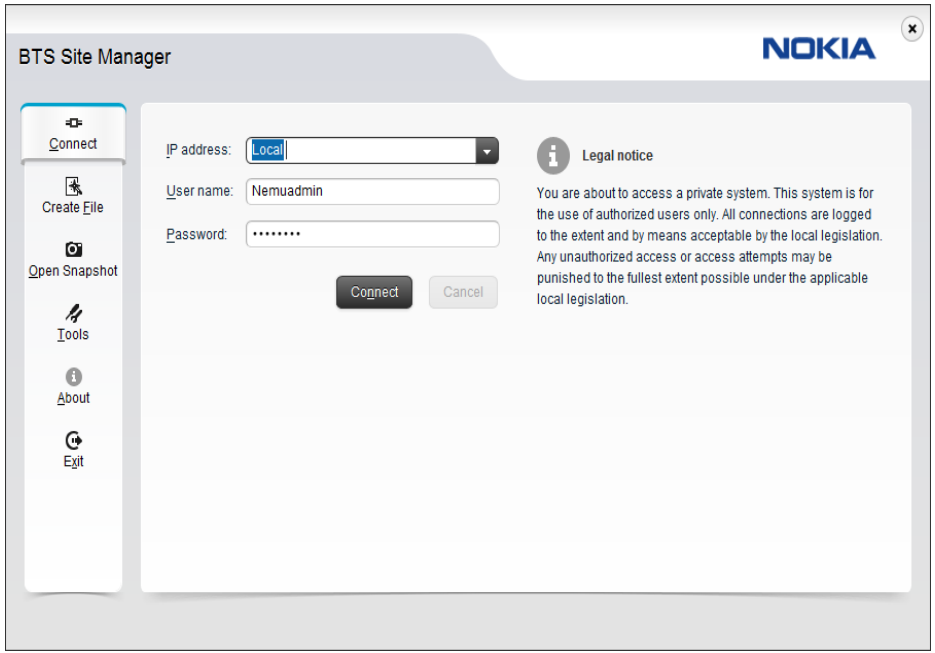
1.设定本机IP地址
192.168.255.126



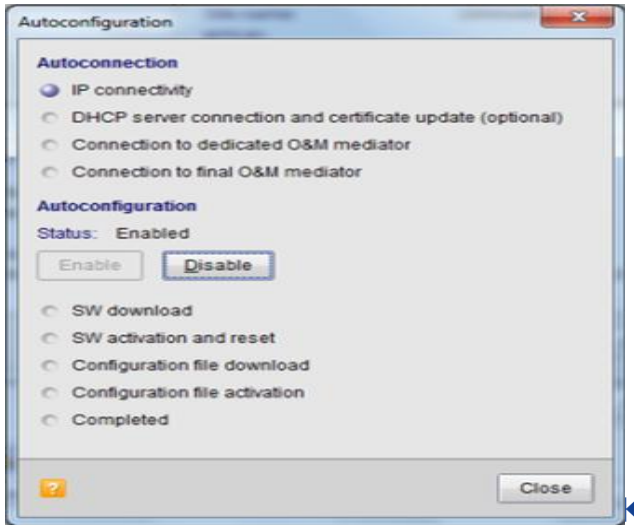
2. 本地PC通过网线连接eNodeB，连接PC（SiteManager）至 eNB的本地维护口（LMP）

NB-IoT升级步骤

3. 使用BTS Site Manager输入用户名、密码并连接到BBU进行软件版本升级；用户名：Nemuadmin ，密码：nemuuser。

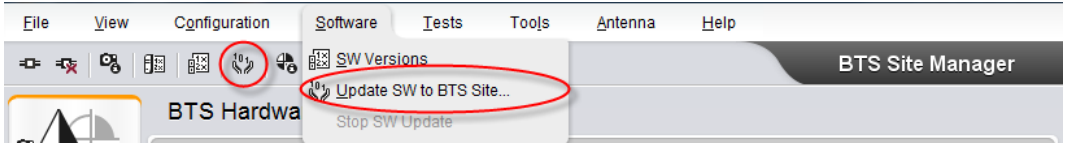


4. 登陆至Site Manager后，会出现Autoconfiguration的对话框，这时基站可以通过自连接自配置的方式从网管上下载软件包和配置文件，目前不通过这种方式对基站进行升级和配置，所以点击Disable，后再点击Close，将其关闭即可。

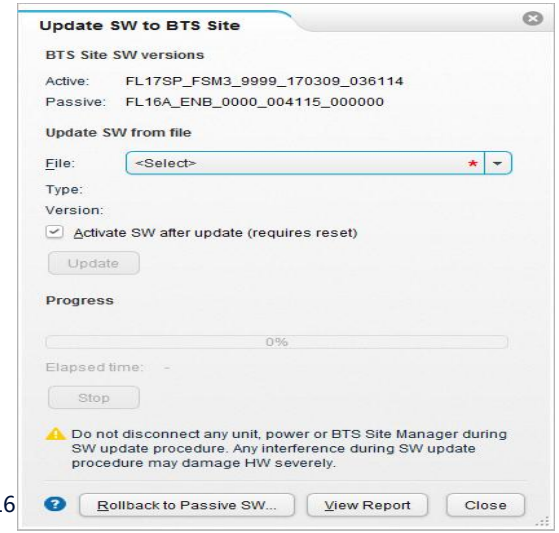


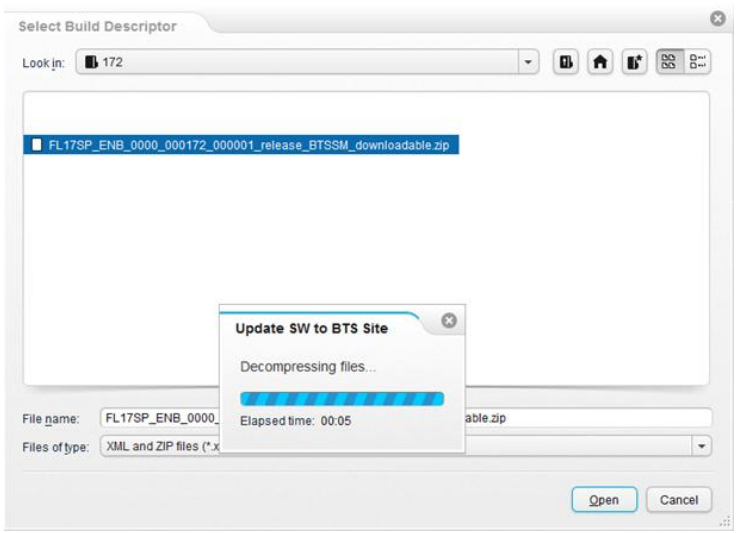
NB-IoT升级步骤

5. 点击菜单栏上Software->Update SW to BTS Site，或者点击工具栏中的升级图标。



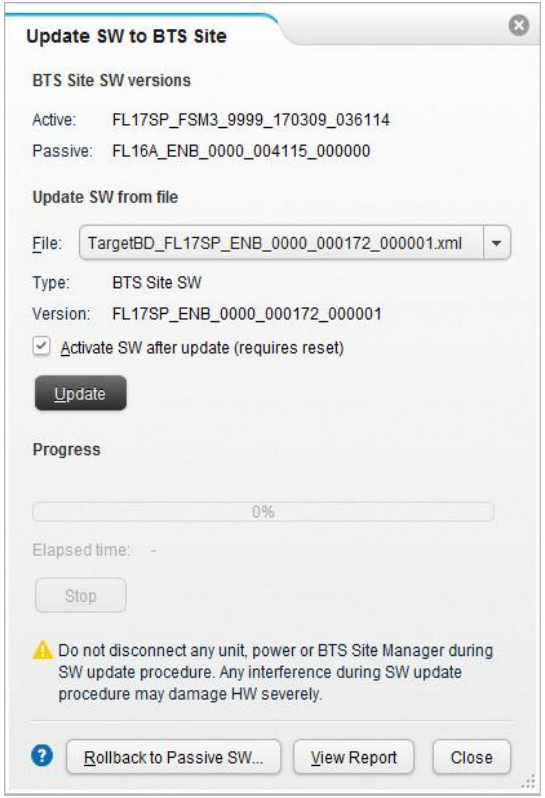
6. 检查并记录当前BTS的active和passive版本，选择目标软件包（参考软件升级路径章节进行软件包选择并升级），电脑上的软件路径建议为全英文路径，点击Open。

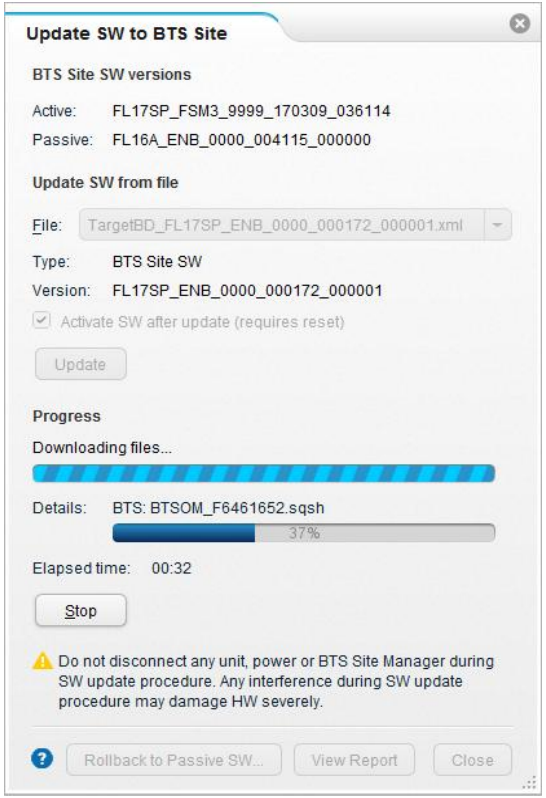




NB-IoT升级步骤

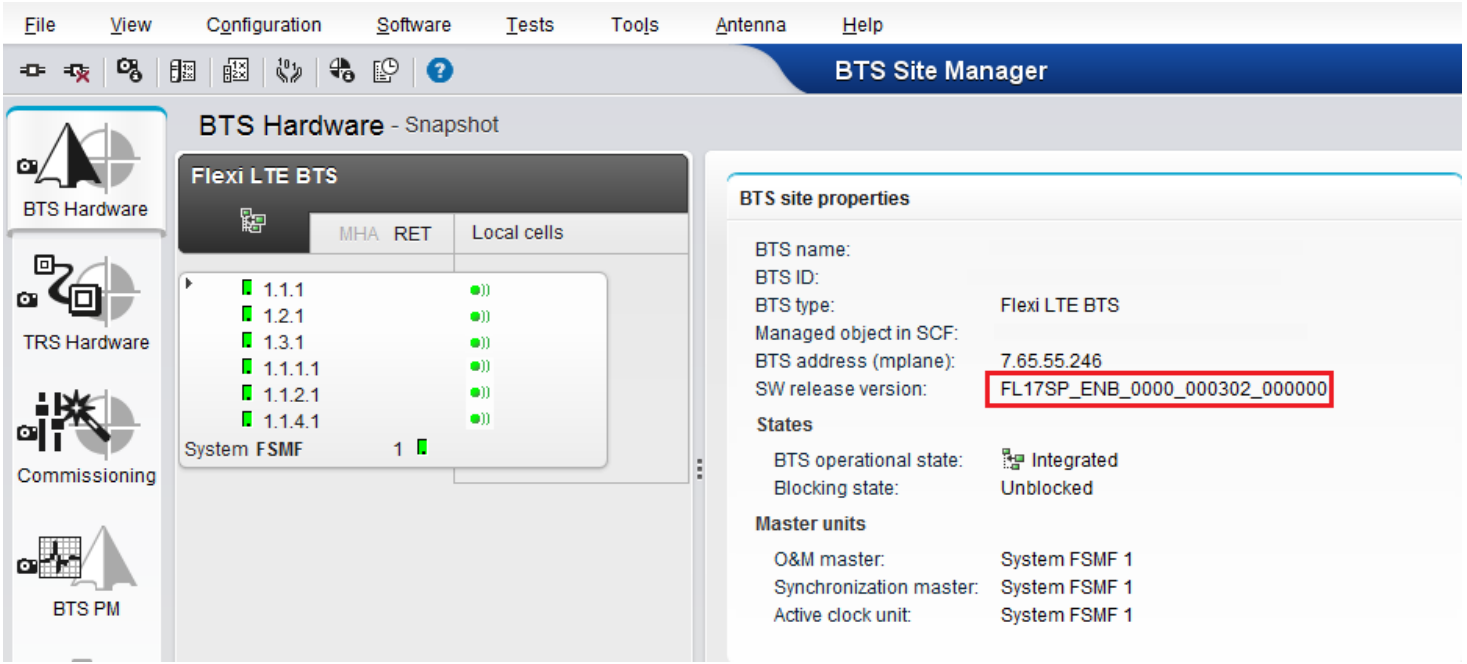
7. 勾选软件激活的选项，软件下载完成后直接执行软件激活，点击Update执行，file download completed完成后，基站会执行reset操作。（注意从出厂版本升级后立刻配置好TRS数据）





NB-IoT升级步骤

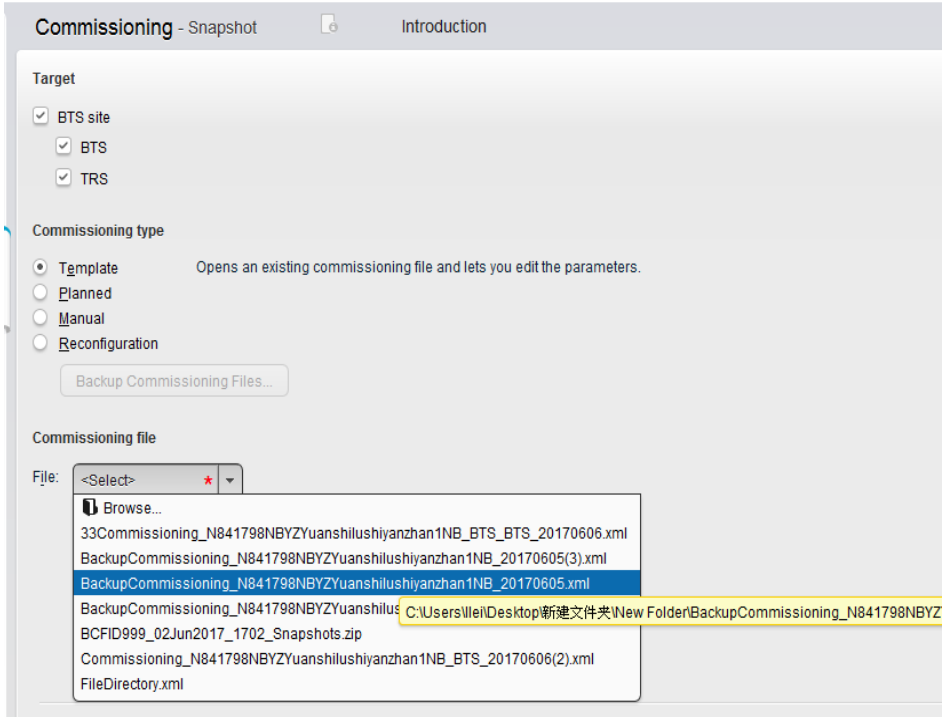
8. 基站重启完成后，点击菜单栏上Software-> SW Versions，查看软件版本；或者点击BTS Hardware中“Flexi LTE BTS”，查看SW release version



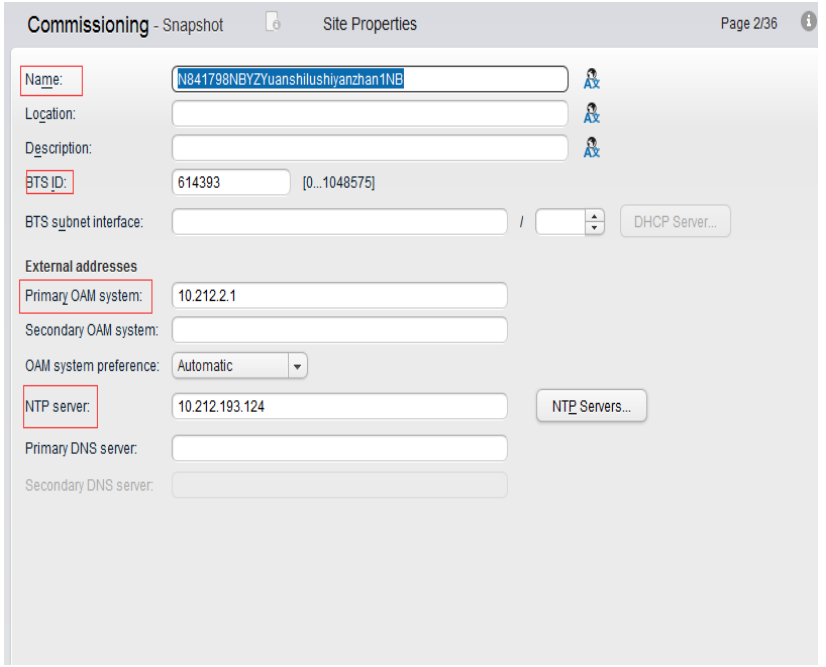
数据配置

TRS配置

1. 点击Commissioning，选择BTS site中选“TRS”，Commissioning type选“Template”，Commissioning file选择提供的TRS配置文件。

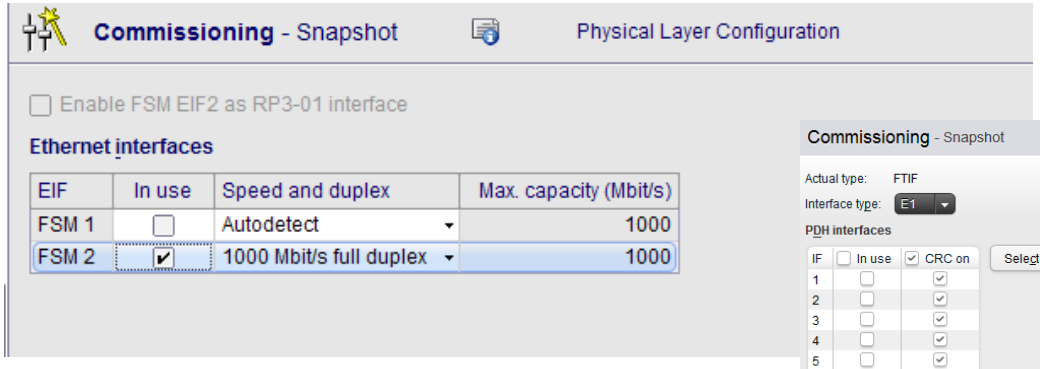


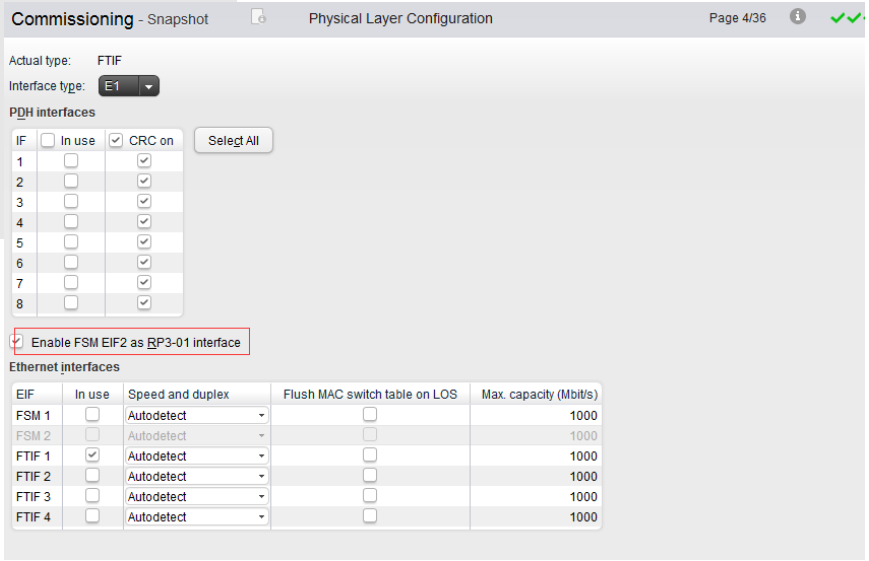
2. 检查确认并修改eNodeB name、BTS ID（eNodeB ID）、Primary/Secondary OAM system IP地址和NTP server IP地址



TRS配置

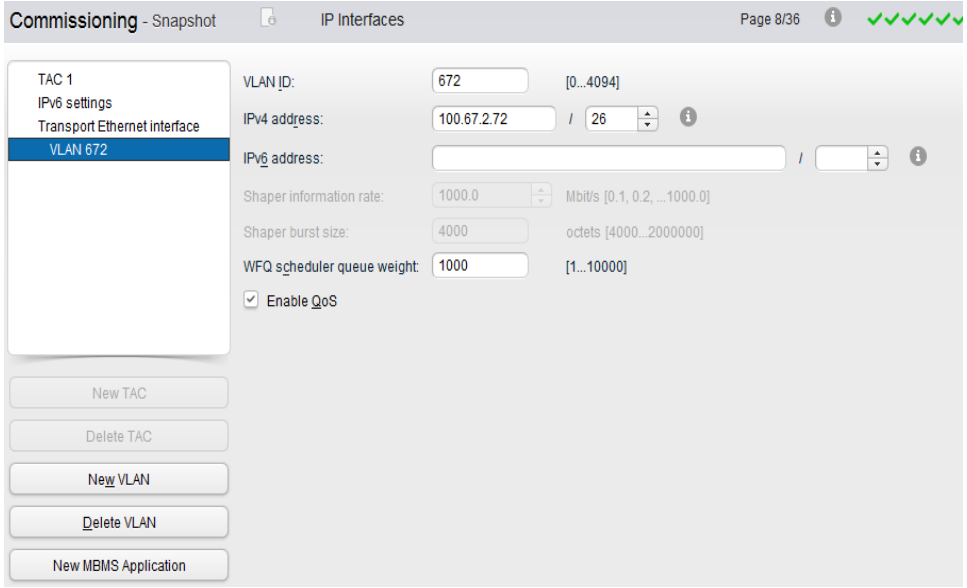
3. 选择物理传输端口，选择FSM2，即EIF2/RF6口。在RF6口需要连接RRU，开启RFShareing的情况下一定要勾选Enable FSM EIF2 as RP3-01 interface



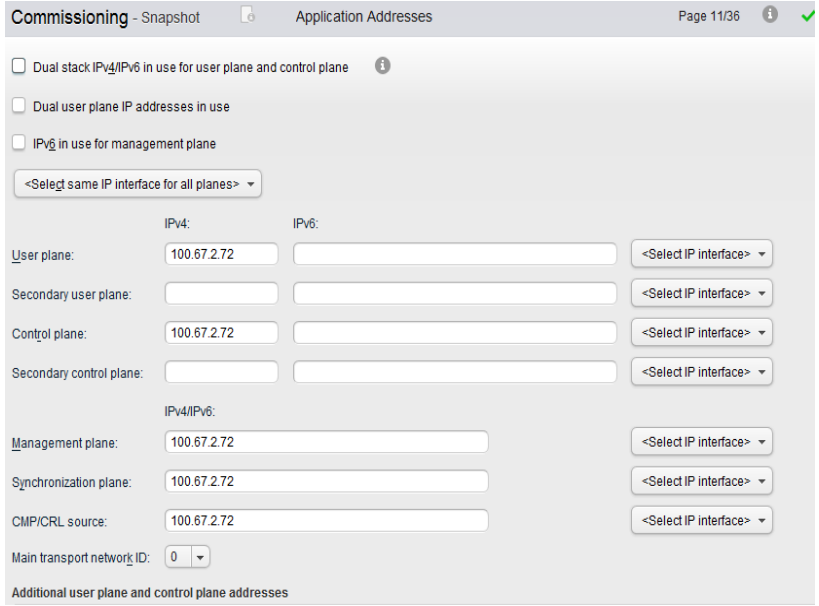


TRS配置

4. 配置基站IP，检查确认基站的VLAN ID、IP地址及子网掩码（根据传输规划填写），并点选Enable QOS（业务面VLAN）。

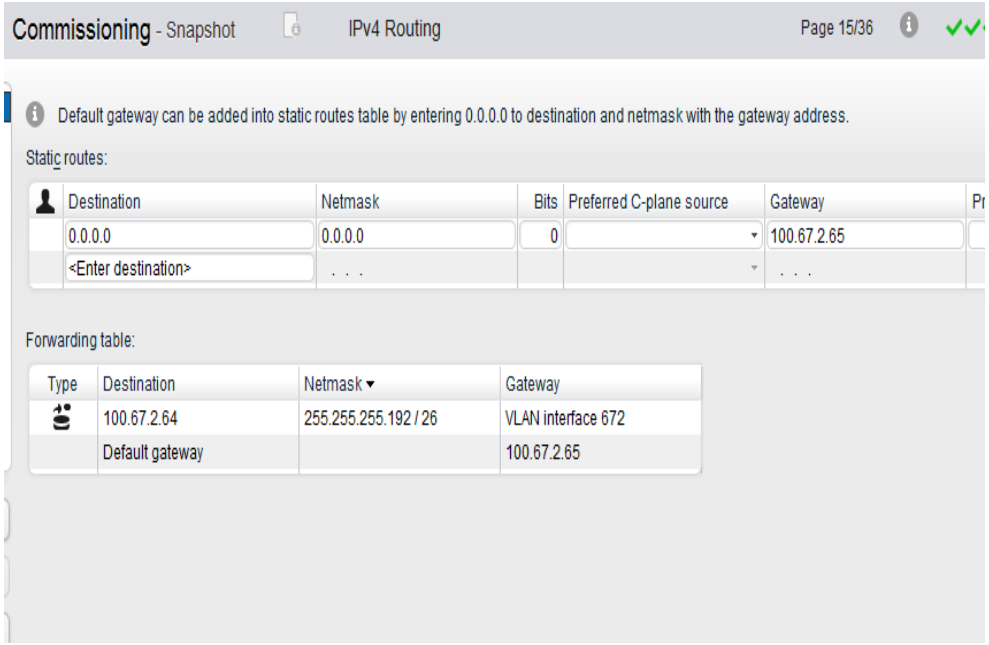


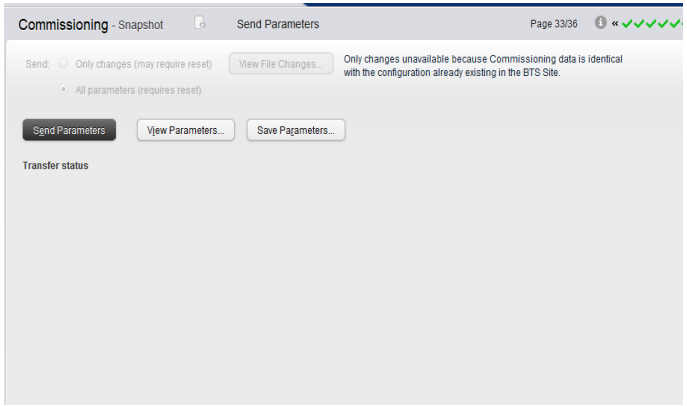
5. 检查站点的用户面、控制面、管理面、同步面IP地址



TRS配置

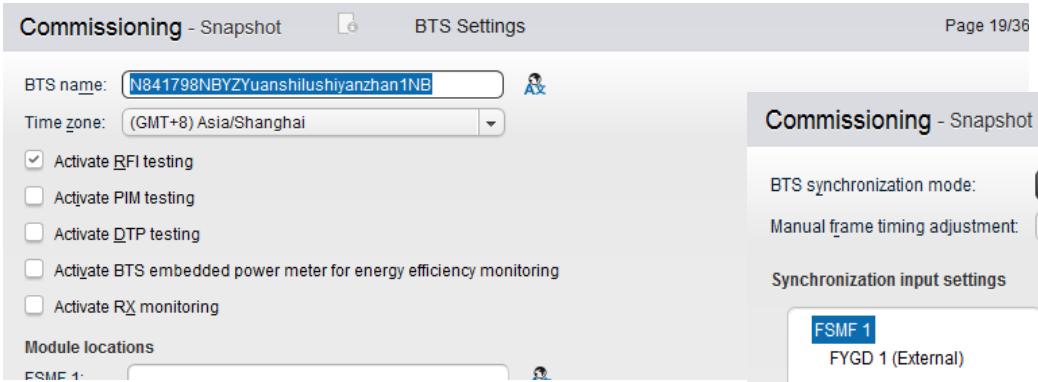
6. 传输路由配置，确认站点Gateway设置。并下发

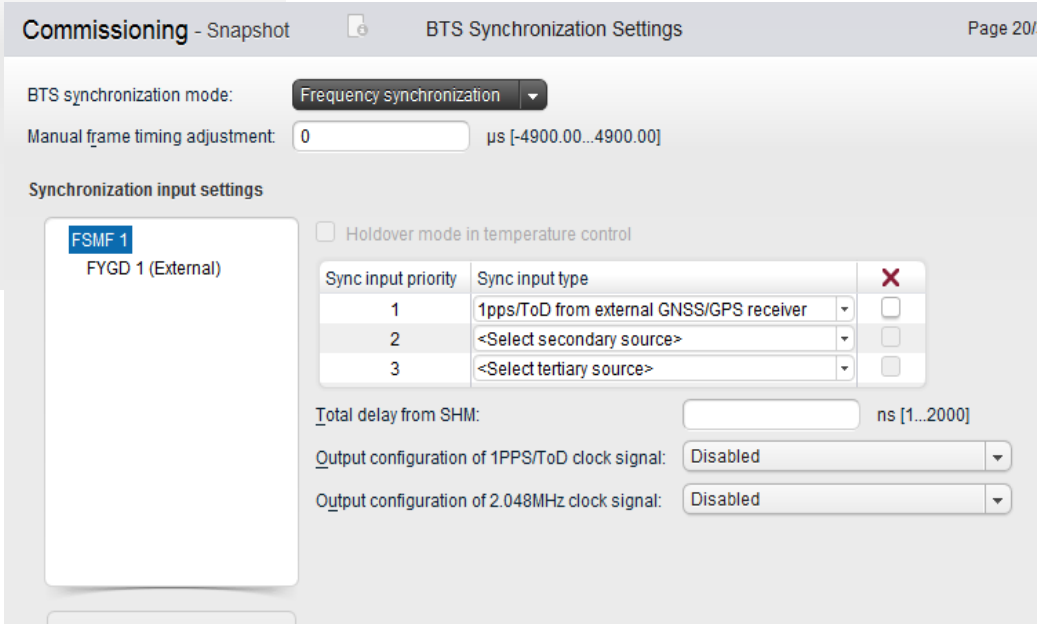




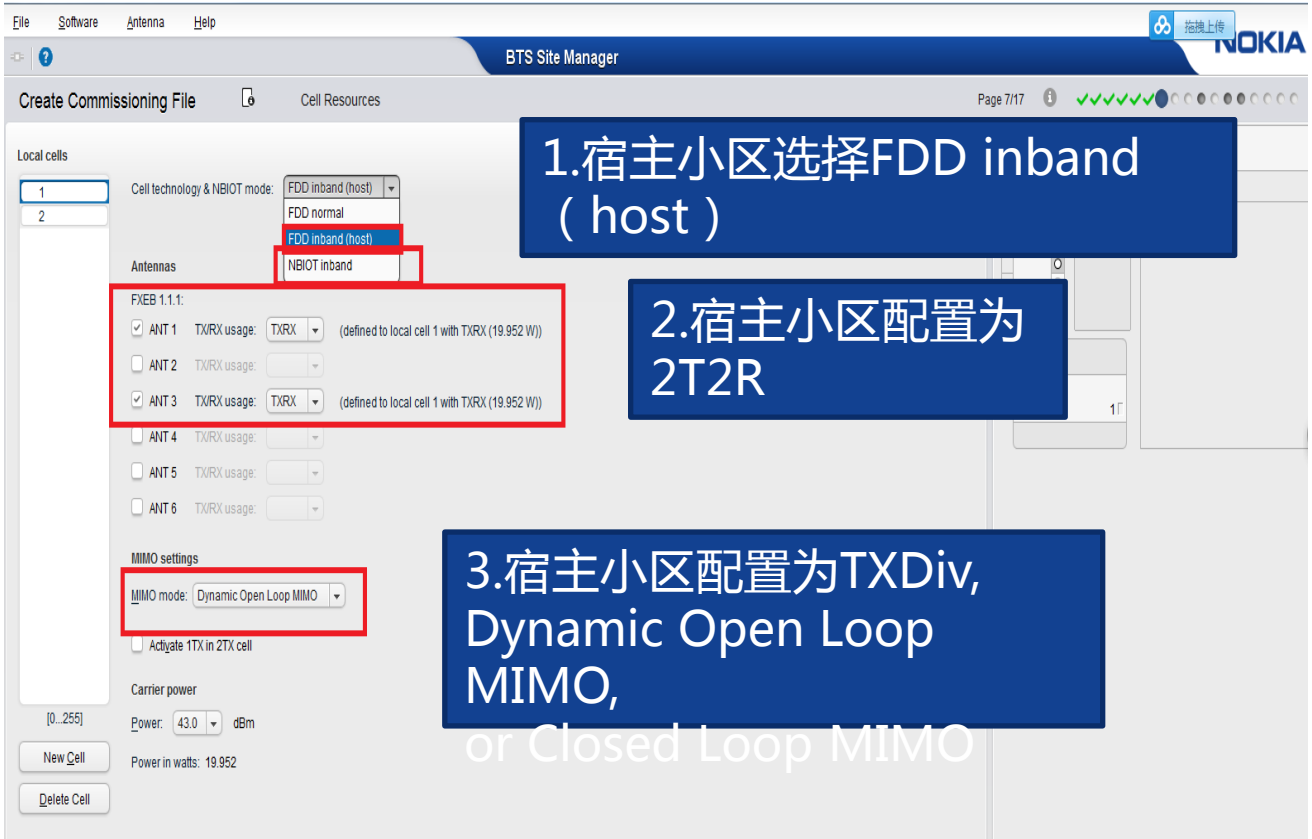
BTS配置

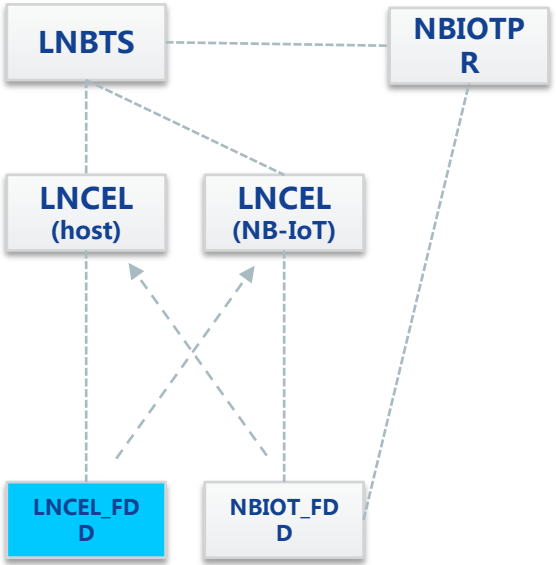
1. BTS级的参数，BTS name，时区。设置时钟源



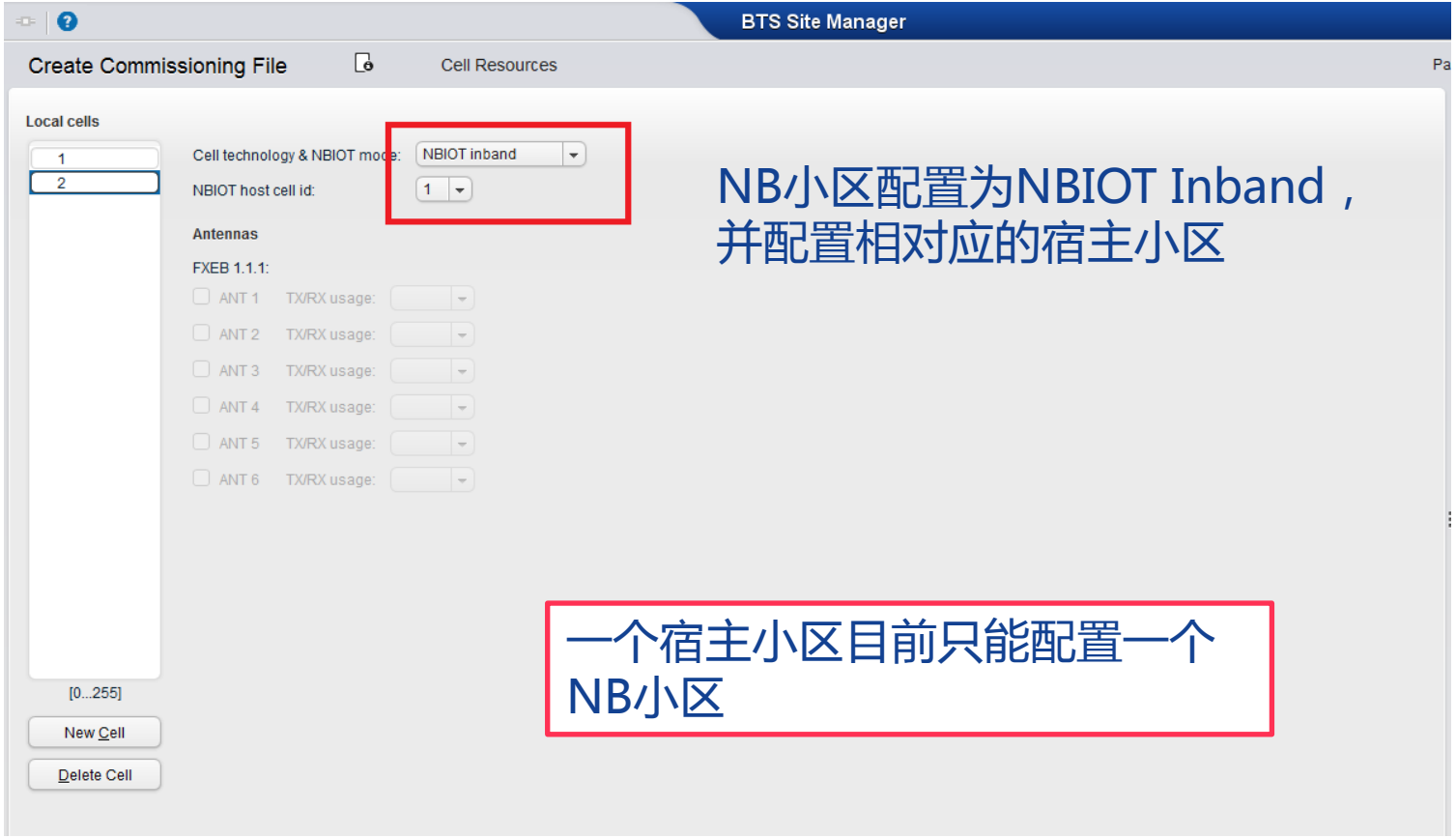


In-band NB-IoT无线配置





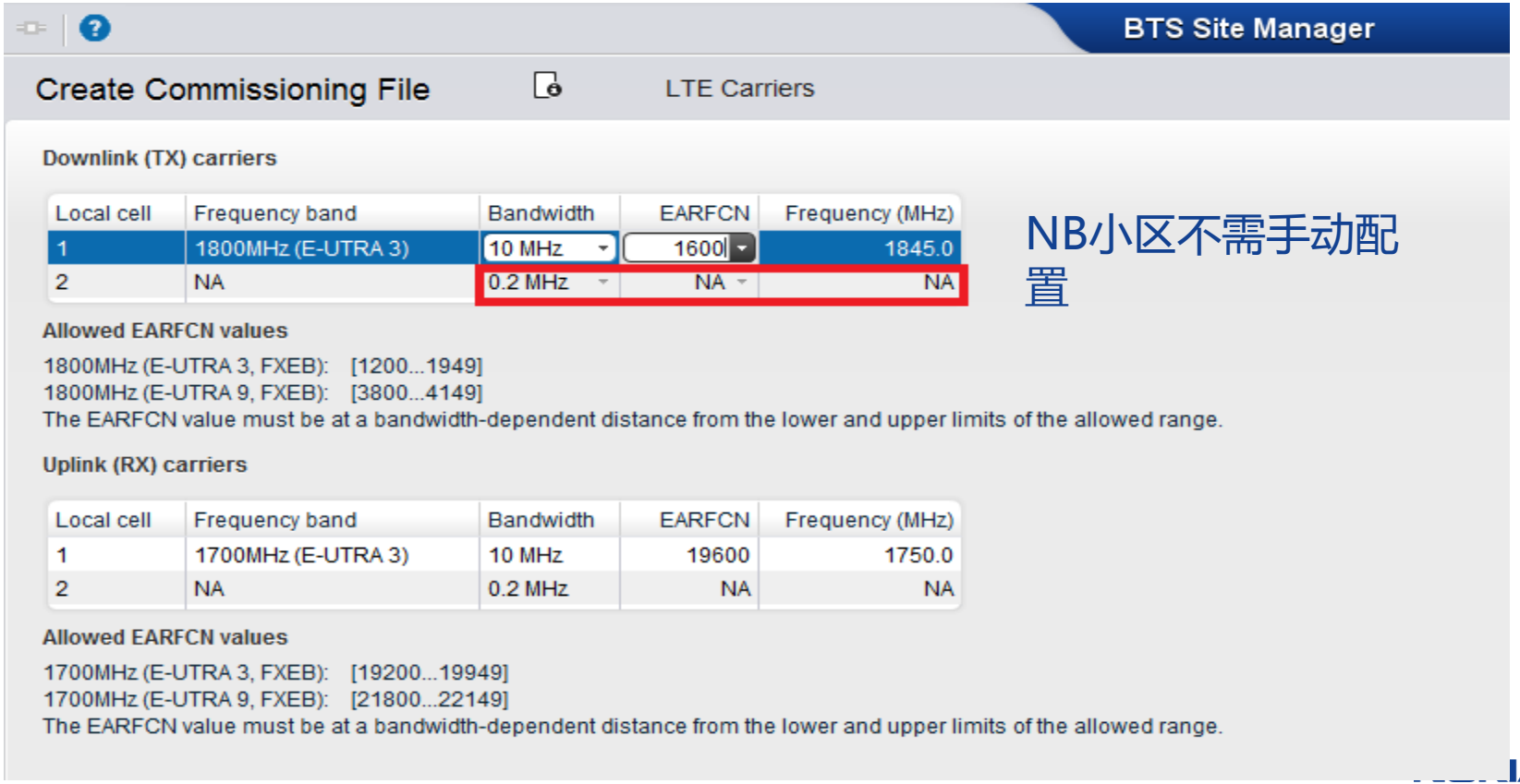
In-band NB-IoT配置



NB小区配置为NBIOT Inband，并配置相对应的宿主小区

一个宿主小区目前只能配置一个NB小区

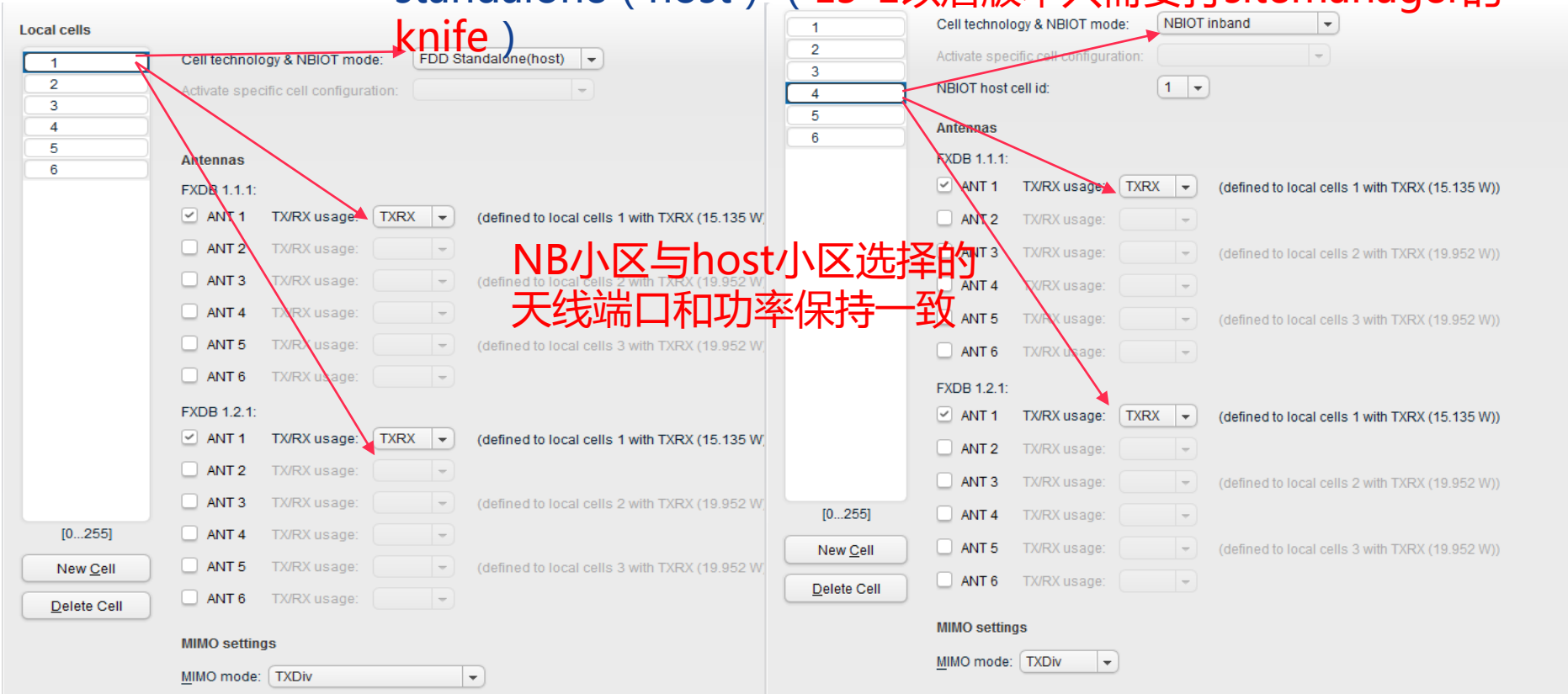
In-band NB-IoT配置



NB小区不需手动配置

SA NB-IoT配置

SA基于inband的模式打入knife后可以在配置中设置为standalone（host）（E5-1以后版本只需要打sitemanager的knife）



SA NB-IoT配置

Sitemanager打knife，只需将替换对应SM文件夹中的文件后可以再配置页选择带宽为1.4MHz

Downlink (TX) carriers

Local cell	Frequency band	Bandwidth	EARFCN	Frequency (MHz)
1	900MHz (E-UTRA 8)	1.4 MHz	3775	957.5
2	900MHz (E-UTRA 8)	1.4 MHz	3775	957.5
3	900MHz (E-UTRA 8)	1.4 MHz	3775	957.5
4	NA	0.2 MHz	NA	NA
5	NA	0.2 MHz	NA	NA
6	NA	0.2 MHz	NA	NA

Allowed EARFCN values

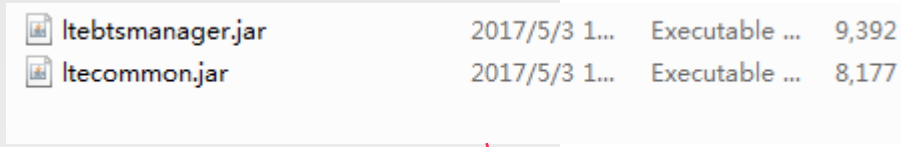
900MHz (E-UTRA 8, FXDB): [3450...3799]
The EARFCN value must be at a bandwidth-dependent distance from the lower and upper limits of the allowed range.

Uplink (RX) carriers

Local cell	Frequency band	Bandwidth	EARFCN	Frequency (MHz)
1	900MHz (E-UTRA 8)	1.4 MHz	21775	912.5
2	900MHz (E-UTRA 8)	1.4 MHz	21775	912.5
3	900MHz (E-UTRA 8)	1.4 MHz	21775	912.5
4	NA	0.2 MHz	NA	NA
5	NA	0.2 MHz	NA	NA
6	NA	0.2 MHz	NA	NA

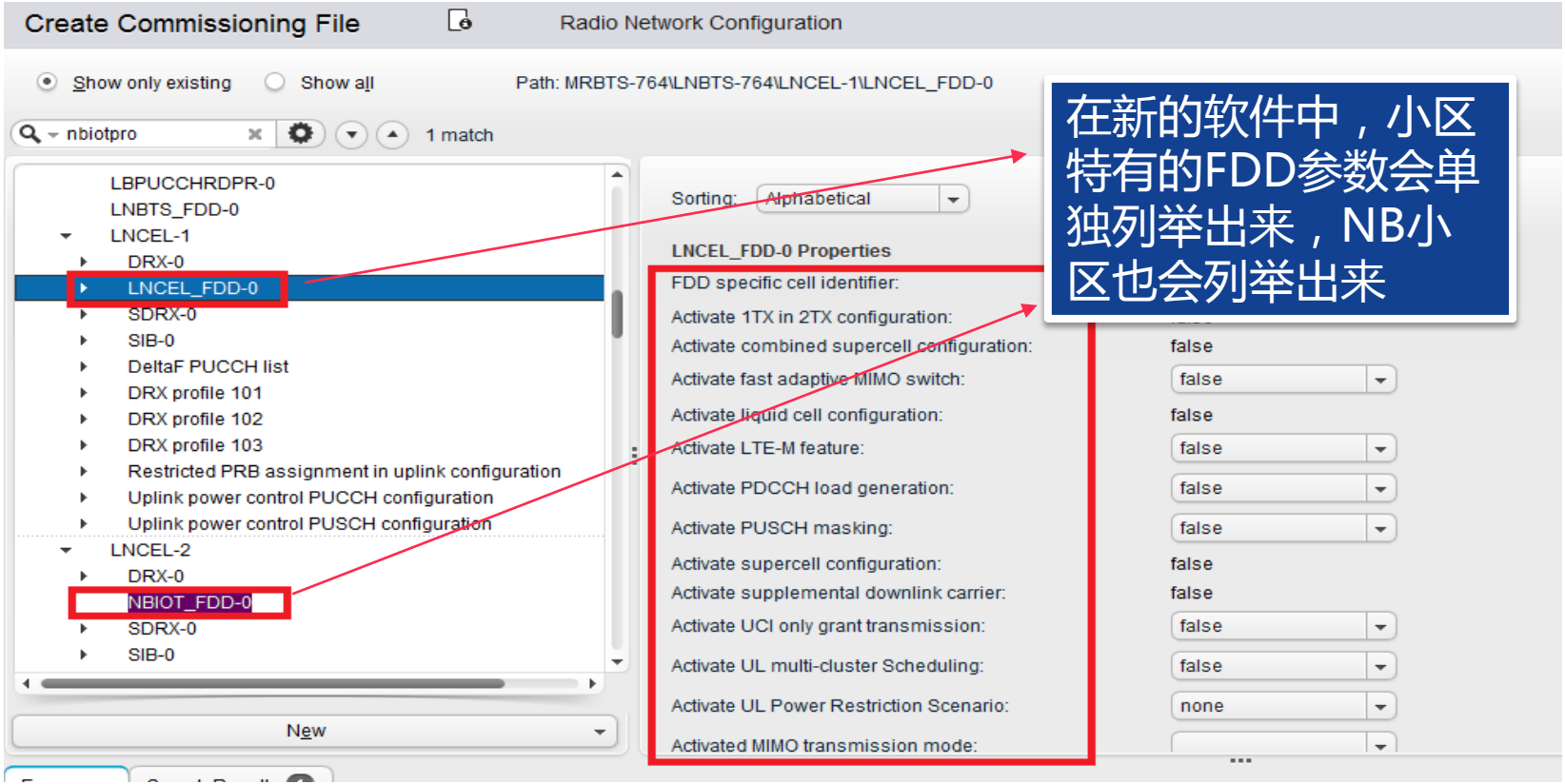
Allowed EARFCN values

900MHz (E-UTRA 8, FXDB): [21450...21799]
The EARFCN value must be at a bandwidth-dependent distance from the lower and upper limits of the allowed range.



C:\Program Files (x86)\NSN\Managers\BTS Site\BTS Site Manager\NodeManagers\FL00_BTSSM_0000000294_000000

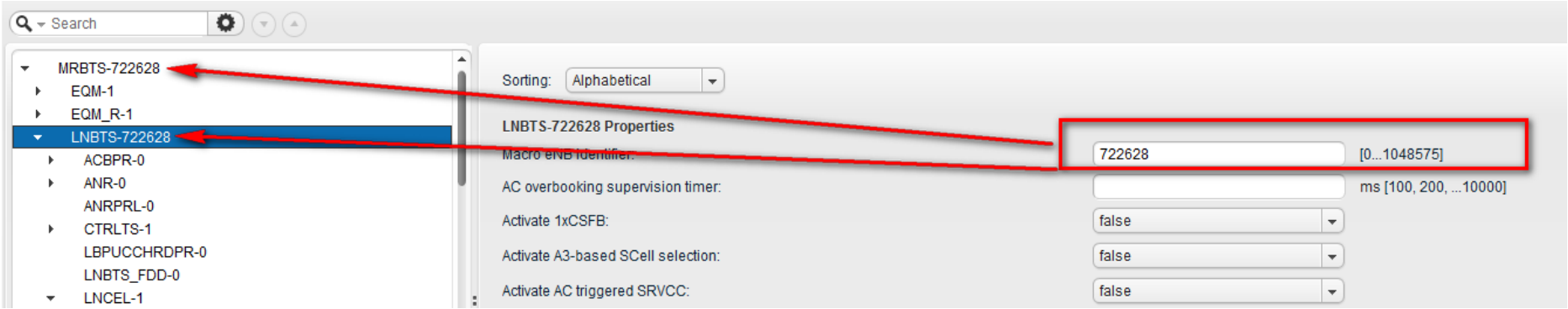
NB-IoT配置



NB-IoT配置

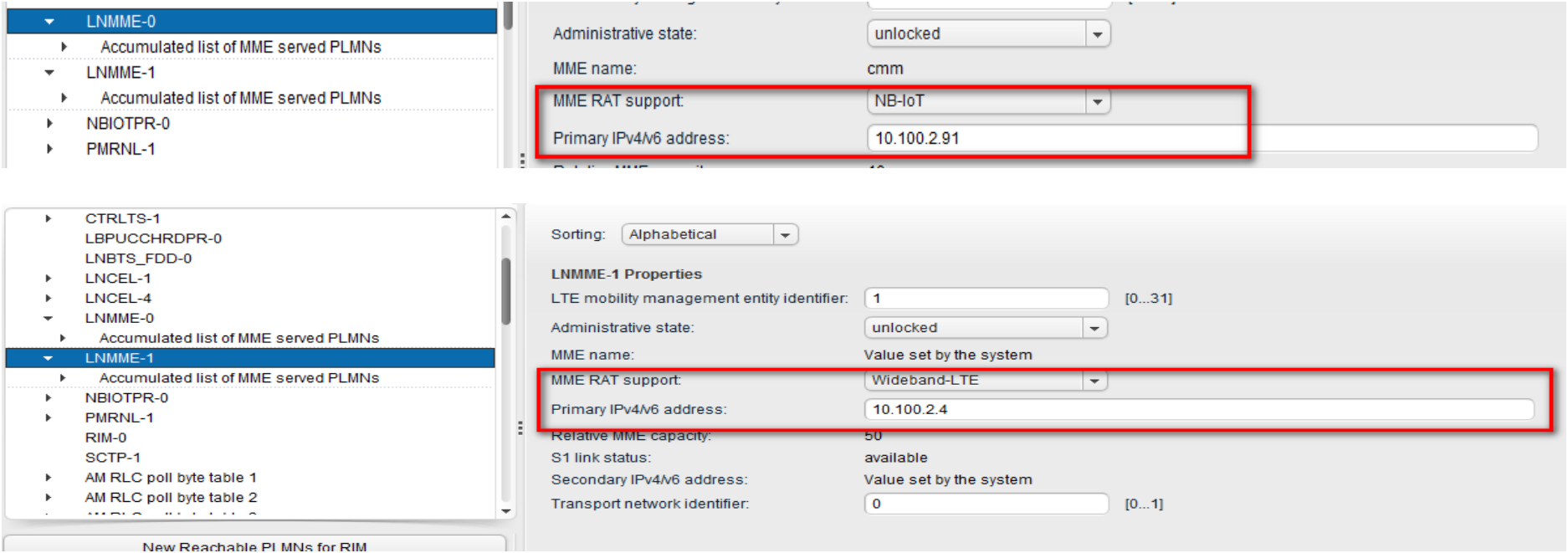
Max number of allowed ANR managed object instances:	4000	[0...50000]
Max number of LNADJ instances:	128	[0...256]
Maximum number of pre-emptions:	20	[1...32]
Maximum RSSI for interference-aware UL-PC:	-70	dBm [-90, -85, ...-6
MCC in PLMN:	460	[0...999]
Measurement cycle on configured SCells:	sf320	
Min UE-AMBR downlink for carrier aggregation:	512	kb/s [64...150000]
Min UE-AMBR uplink for carrier aggregation:		kb/s [64...150000]
Minimum of baseband pool resources:		% [1...100]
MME assignment mode:	selectZeroCapacityToo	
MNC in PLMN:	1	[0...999]
MNC length in PLMN:	2	[2...3]
Mobility profile selection mode:	spid	

修改BTSID及



NB-IoT配置

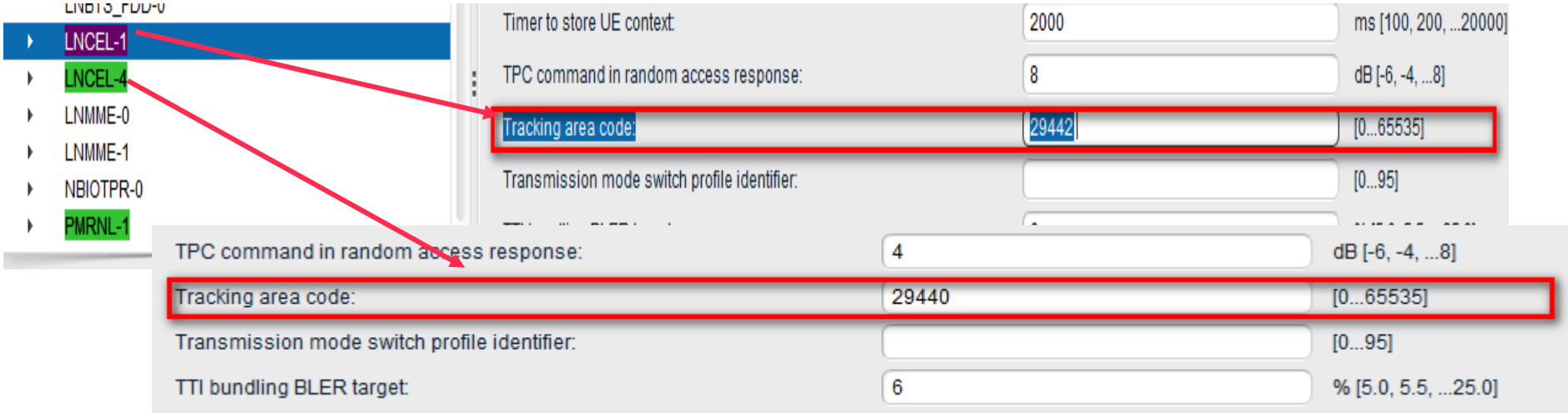
NB-IoT网络的MME与现网的分别配置



NB-IoT配置

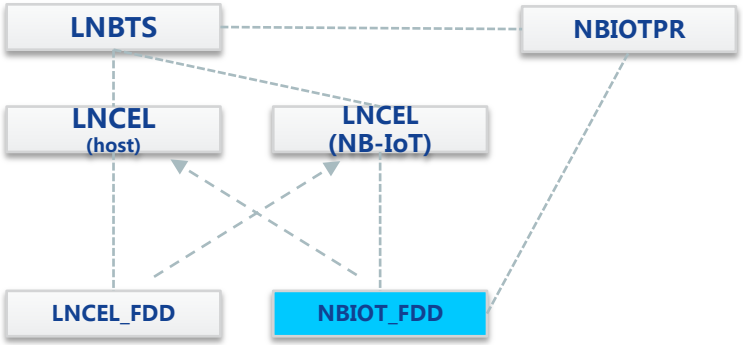
NB小区与HOST小区PCI必须一致

NB小区与HOST小区TAC必须不同



NB-IoT配置

NB-FDD关键配置



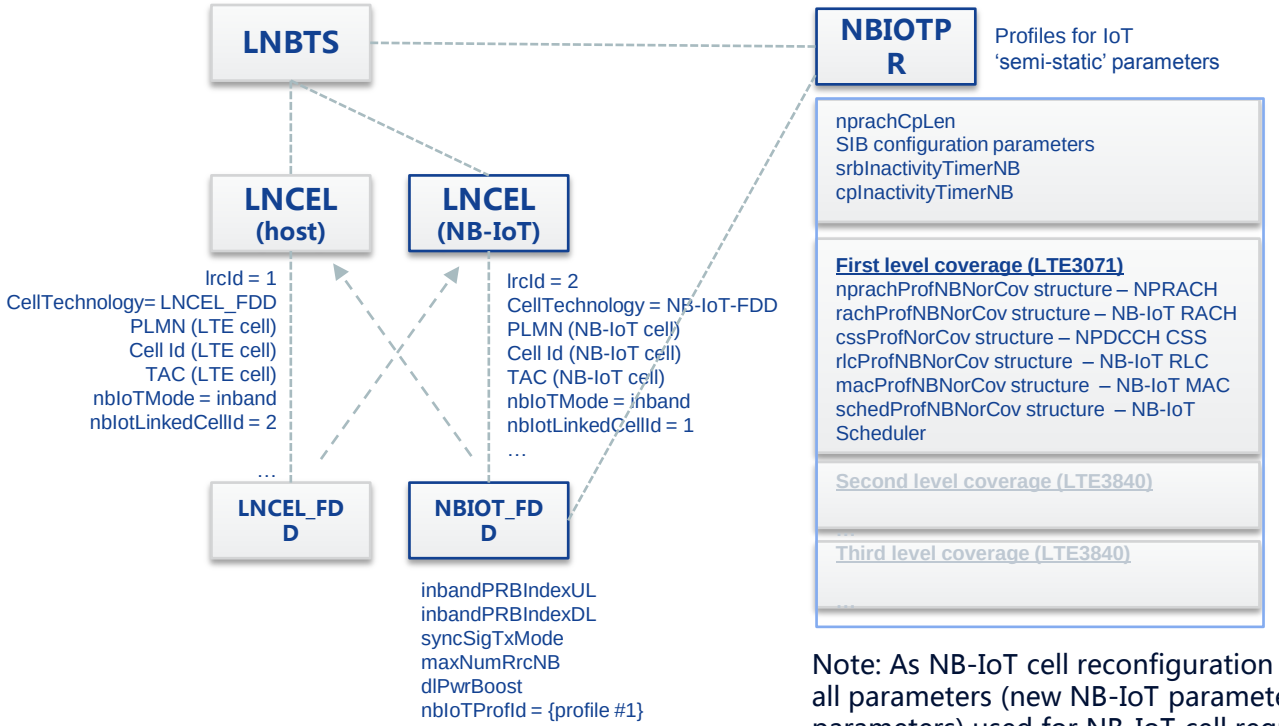
NB-IoT Downlink MIMO mode:	TXDiv	
NB-IoT standalone EARFCN Downlink:	0	
NB-IoT standalone EARFCN Uplink:	0	
NBIoT inband downlink PRB index:	4	[0...99]
NBIoT inband uplink PRB index:	4	[0...99]
NPRACH RSRP Threshold-1:	-120	dBm [-140...-43]
NPRACH RSRP Threshold-2:	-130	dBm [-140...-43]
Number of Coverage Levels:	3	[1...3]
Starting Coverage Level supports Paging Optimization for NB-IoT:	First level	
Synchronization signals transmission mode:	TxDiv	
Uplink channel bandwidth:	0.2 MHz	

建议使用PRB：20M→4
（上下行一致）5M →2
1.4M→1

覆盖等级切换门限设置

覆盖等级配置数量及paging起始等级

Configuration Management

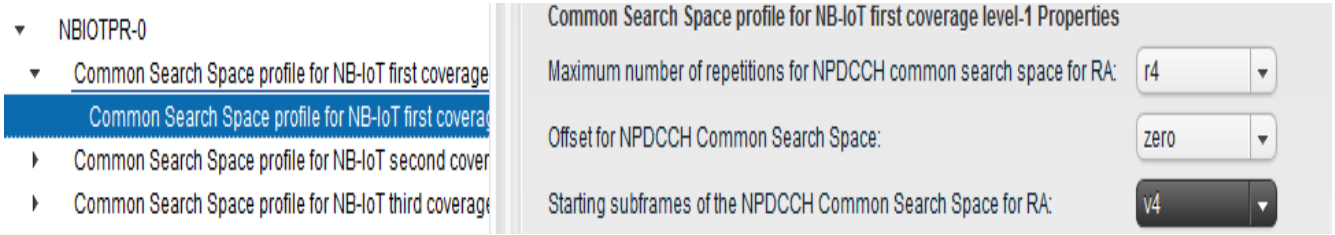


- New NBIOT_FDD MOC grouping NB-IoT relevant parameters
- NBIOTPR Profiles for IoT 'semi-static' parameters
  - With LTE3071 parameters for first level coverage only
  - Second and third coverage levels with LTE3840

Note: As NB-IoT cell reconfiguration is not supported in current release all parameters (new NB-IoT parameter, re-used LNCEL and LNBTS parameters) used for NB-IoT cell requires cell lock to take effects.

NB-IoT配置

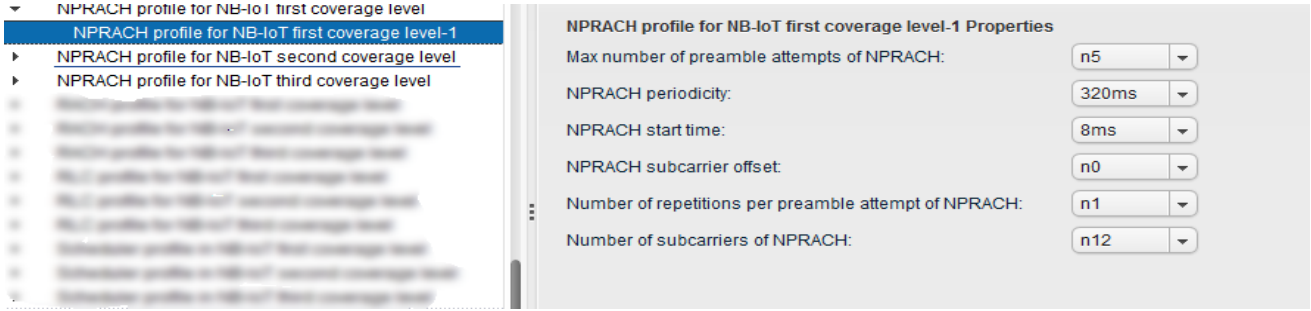
公共搜索空间参数



npdcchMaxNumRepRa	npdcchMaxNumRepRa等于iniNpdcchNumRepRa使得每个搜索周期只能调度一个用户的上行或下行，严重影响同时传送用户数。改为r4并将npdcchStartSfRa改为v2后出现Attach不成功问题
npdcchStartSfRa	设为v16影响下行调度频度和速率，但尝试改到V2和V8后出现Attach不成功问题

NB-IoT配置

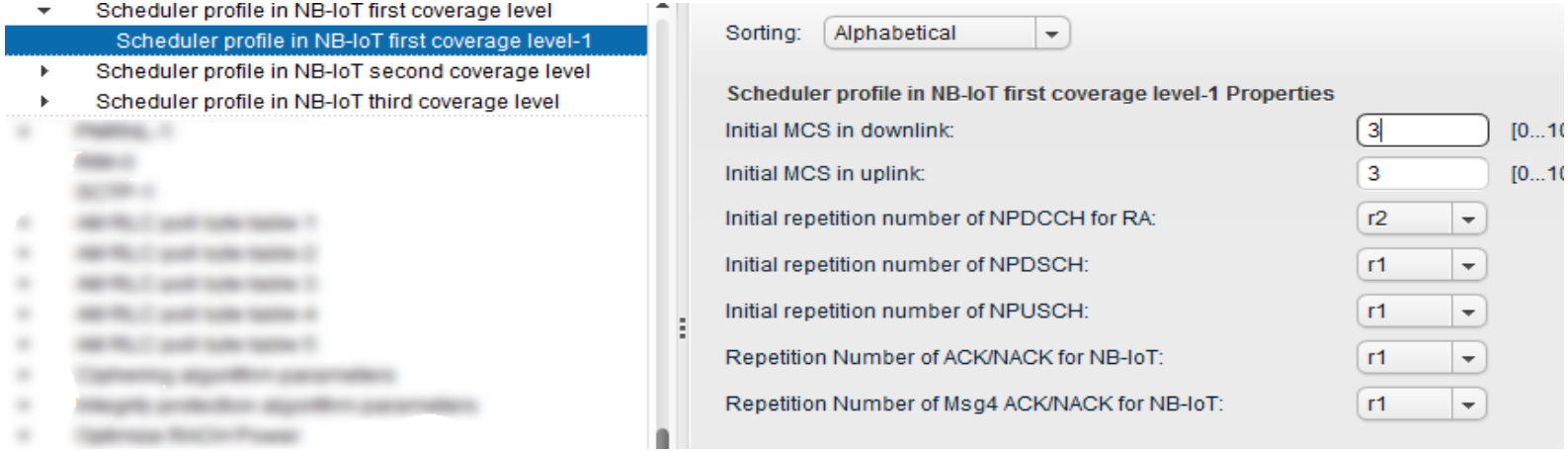
nprach参数



nprachNumSubcarriers	Follow北京实验室设置，没有尝试过n48
nprachSubcarrierOffset	可能会导致NPRACH和UCI时频冲突；设置为n12不起效，甚至无法接入
nprachPeriod	感觉NPRACH周期过小、重复次数过多可能导致Ping时延急剧增加，但不确定，未来得及尝试
nprachNumRepPreamble	感觉NPRACH周期过小、重复次数过多可能导致Ping时延急剧增加，但不确定，未来得及尝试
nprachStartTime	MCL164配置中设置到256ms时，大部分情况下，Attach走到ID RESP后可能RLC层收到了AUTH REQ的DL Data但NAS层不显示，无法走下去了。改为8ms后Attach正常。

NB-IoT配置

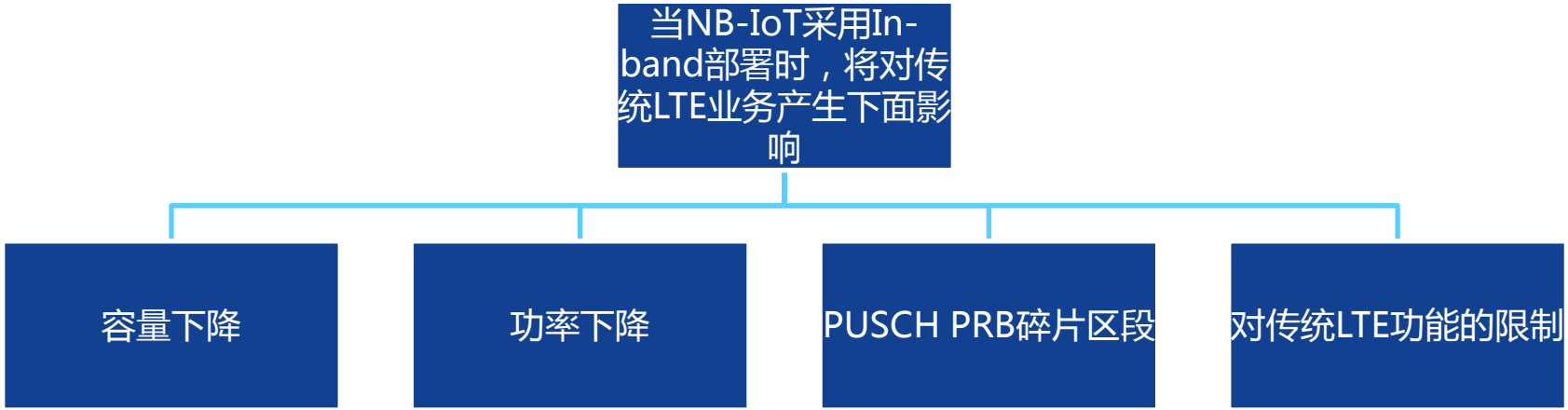
物理信道重复次数及初始MCS



iniMcsDl	MCL164参数在极限点（MCL>157）测试发现上下行MCS从0改为1以后Attach成功率明显提升、Ping时延明显缩短
iniMcsUl	MCL164参数在极限点（MCL>157）测试发现上下行MCS从0改为1以后Attach成功率明显提升、Ping时延明显缩短
iniNpuschNumRep	NPUSCH重复非常耗时，所以在MCL154中兼顾性能和覆盖情况下，尽量少用NPUSCH重复

In-band部署对传统LTE的影响

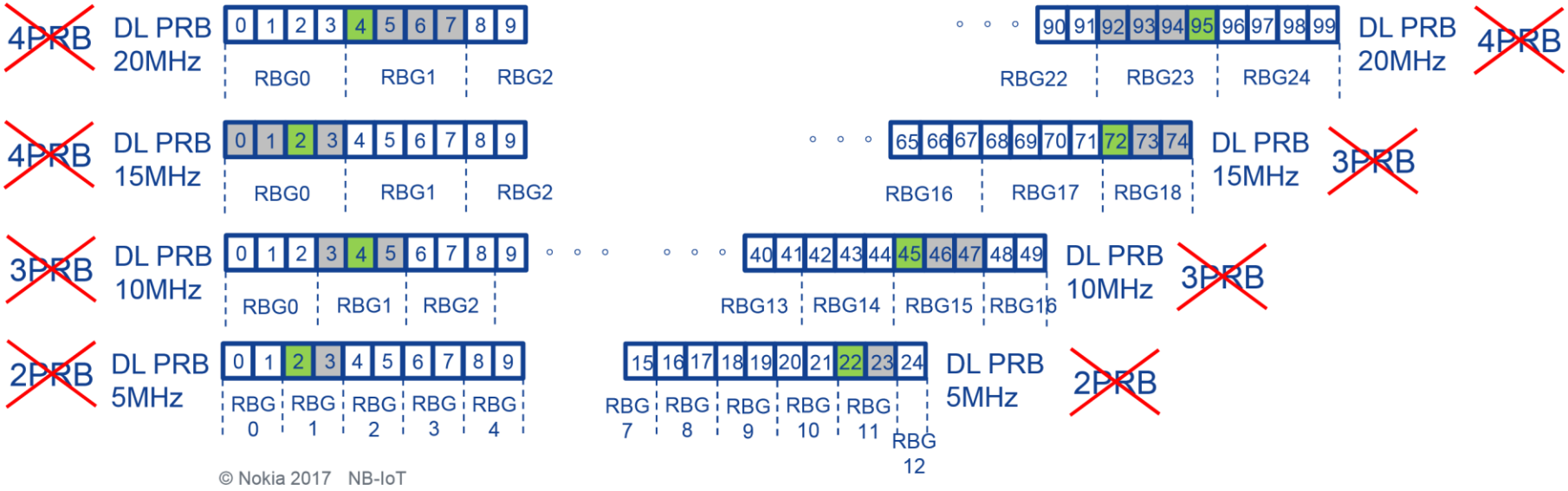
Technical Details



In-band部署对传统LTE的影响—容量下降

- 在诺基亚实现方案中， 与NB-IoT PRB冲突的整个RBG都不能使用
- 即便NB-IoT小区中没有业务

	5 MHz	10 MHz	15 MHz	20 MHz
RBG Size	2	3	4	4
PRB Total	25	50	75	100

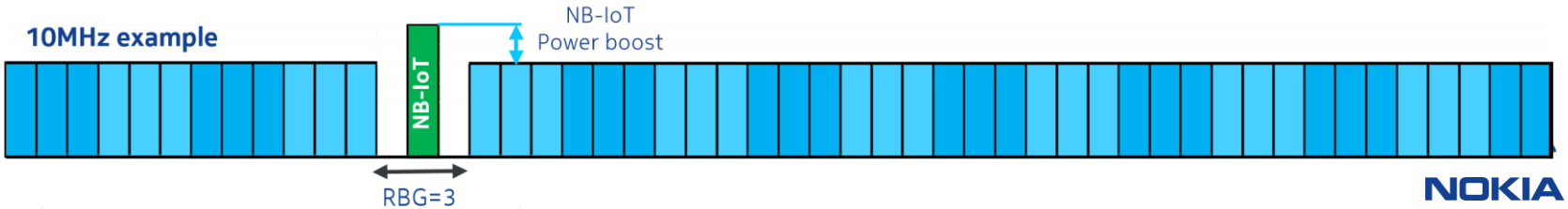


In-band部署对传统LTE的影响—发射功率下降

基站发射功率下降

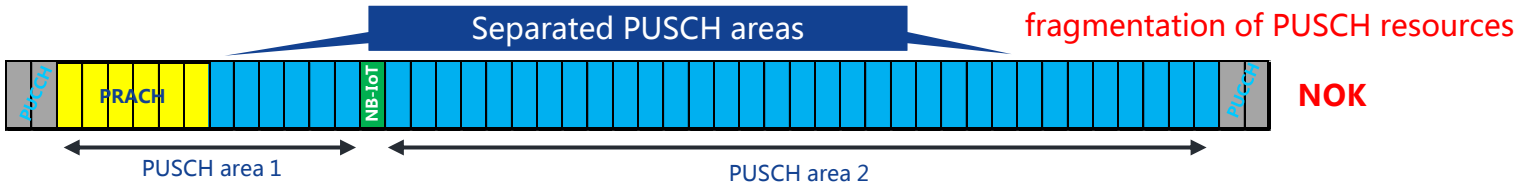
- NB-IoT PRB下行功率可以Boost最多6 dB。
- 这些功率都是从传统LTE PRB中获取的
- 对传统LTE PRB功率只会有少量影响

	5 MHz	10 MHz	15 MHz	20 MHz	
RBG Size	2	3	4	4	PRB
PRB Total	25	50	75	100	
DL Power Total	20	20	20	20	Watts
Power per PRB	0.80	0.40	0.27	0.20	Watts
NB-IoT Power Boost	6	6	6	6	dB
NB IoT PRB Tx Power	3.18	1.59	1.06	0.80	Watts
Unused PRB within RBG	1	2	3	3	PRB
Unused DL Power	0.8	0.8	0.8	0.6	Watts
Power Deficit	1.58	0.39	0.00	0.00	Watts
Legacy Cell PRB to remove Power Deficit	23	47	71	96	PRB
Legacy Cell Power Reduction per PRB	0.07	0.01	0.00	0.00	Watts
Legacy Cell Power Reduction per PRB	0.4	0.1	0.0	0.0	dB



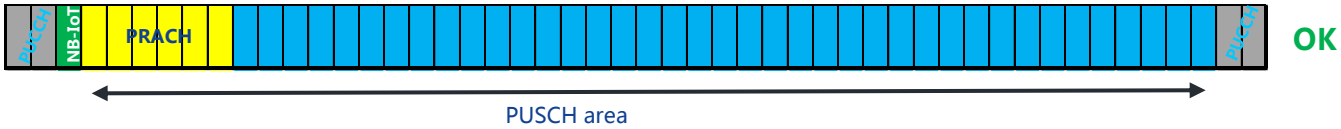
In-band部署对传统LTE的影响—PUSCH碎片

- In-band部署时，NB-IoT上行PRB号可以与其下行PRB号不同，即采用非对称的上下行PRB
- 如果上行NB-IoT PRB位于PUSCH区域的中间部位，将PUSCH分为两块区域，那么将会导致传统LTE 只能分配其中的一块的PUSCH资源给UE，称为PUSCH碎片
  - 只有R10 UE在支持双PUSCH资源集
  - 对于UE来说，这是一个可选功能

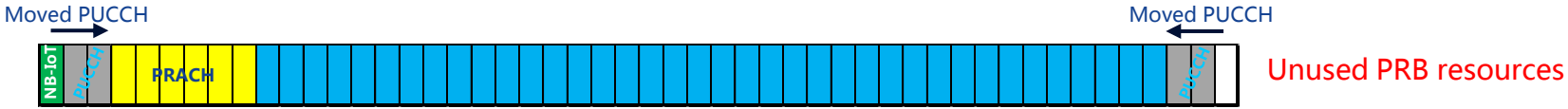


In-band部署对传统LTE的影响—PUSCH碎片

- 如果动态PUCCH分配（LTE1800: Dynamic PUCCH Allocation）没有激活，上行NB-IoT PRB可以简单置于PUSCH PRB的一端，介于PUCCH PRB与PUSCH PRB区域之间
- - 注意避开PRACH区域(有参数prachFreqOffset决定)

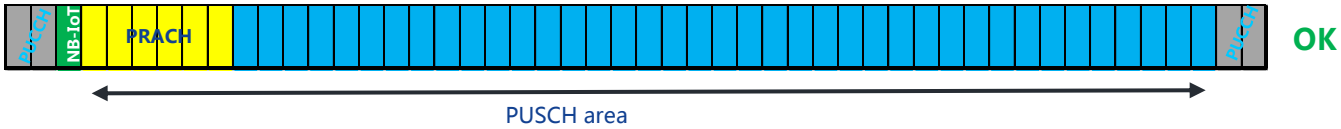


- 也可以利用LTE768: Flexible UL Bandwidth功能，清空最外端的两个PRB，将NB-IoT置于其中一个PRB上，这样另一端的一个PRB将被浪费掉

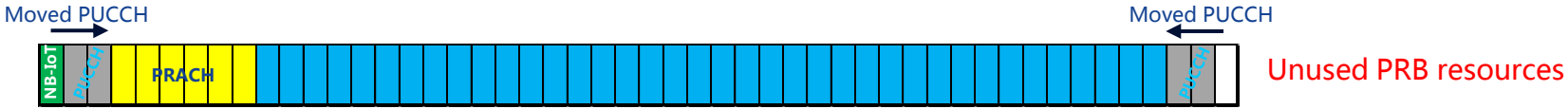


In-band部署对传统LTE的影响—PUSCH碎片

- 如果动态PUCCH分配（LTE1800: Dynamic PUCCH Allocation）没有激活，上行NB-IoT PRB可以简单置于PUSCH PRB的一端，介于PUCCH PRB与PUSCH PRB区域之间
- - 注意避开PRACH区域(有参数prachFreqOffset决定)

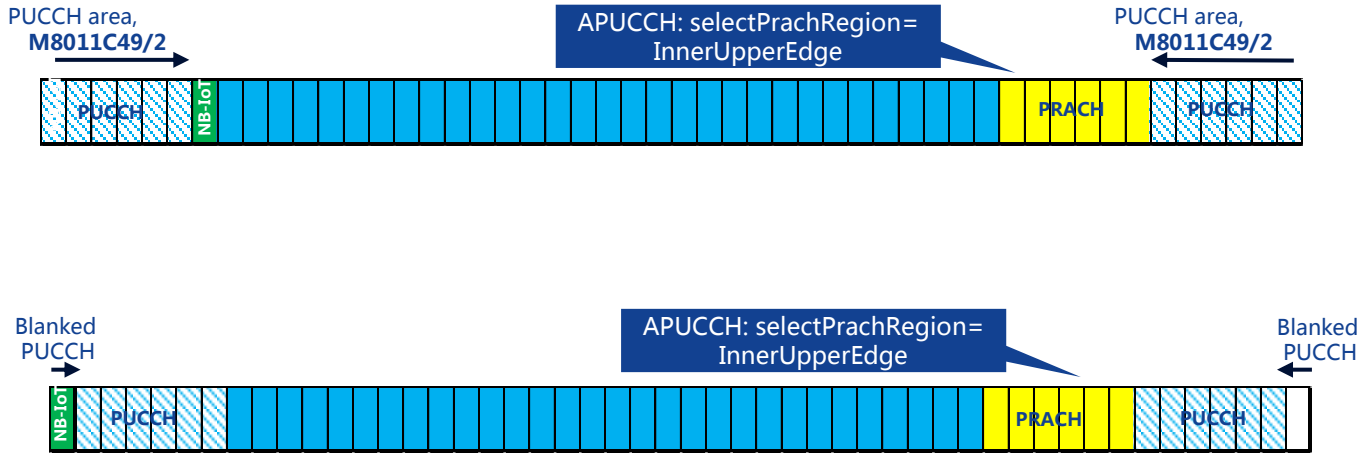


- 也可以利用LTE768: Flexible UL Bandwidth功能，清空最外端的两个PRB，将NB-IoT置于其中一个PRB上，这样另一端的一个PRB将被浪费掉



In-band部署对传统LTE的影响—PUSCH碎片

- 如果动态PUCCH分配已 激活，上行NB-IoT PRB位置有两种选择：
- - 可以在PUSCH PRB区域远端选择一个PUCCH不可能用到的PRB用作NB-IoT。
- - 也可以利用LTE768: Flexible UL Bandwidth功能，清空最外端的两个PRB，将NB-IoT置于其中一个PRB上，这样另一端的一个PRB将被浪费掉。



In-band部署对传统LTE的影响—部分功能禁用

以诺基亚为例，部署In-band NB-IoT以后，下面功能在传统LTE小区上需要被关闭：

- ***MBSFNCEL: mbsfnCellId, actMBMS***，eMBMS需要被关闭，即在LNCEL中不配置MBSFNCEL Object
- ***LNBTS: actCRAN=false*** ，如果一个eNB中配置了NB-IoT小区的话，该eNB将不能支持CRAN
- ***ULCOMP: ulCoMpCellList, actUlCoMp***，NB-IoT小区及其LTE施主小区不能进入上行CoMP小区列表中
- ***LNCEL: actEicic=false***， NB-IoT会对eICIC ABS子帧产生干扰
- ***LNCEL: actMicroDtx=false***， MicroDTX会影响NB-IoT
- ***LNCEL: actOtdoa=false***， OTDOA PRS与NB-IoT见会互相干扰
- ***LNCEL: csgType=openAccess***，NB-IoT的LTE施主小区不能设置为CSG小区
- ***LNCEL_FDD: actCatM=false***， NB-IoT和Cat-M不能在同一个小区中激活
- ***LNCEL_FDD: actCombSuperCell=false***， Combined Supercell需要特别的DSP部署
- ***LNCEL_FDD: actLiquidCell=false, LNCEL_FDD: actSuperCell=false***， Super Cell和Liquid cell需要特别的DSP部署；另外，Liquid cell的TM9 CSI-RS会干扰NB-IoT


NOKIA