5G TECHNOLOGY UPDATE REDCAP

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ROHDE&SCHWARZ

Make ideas real
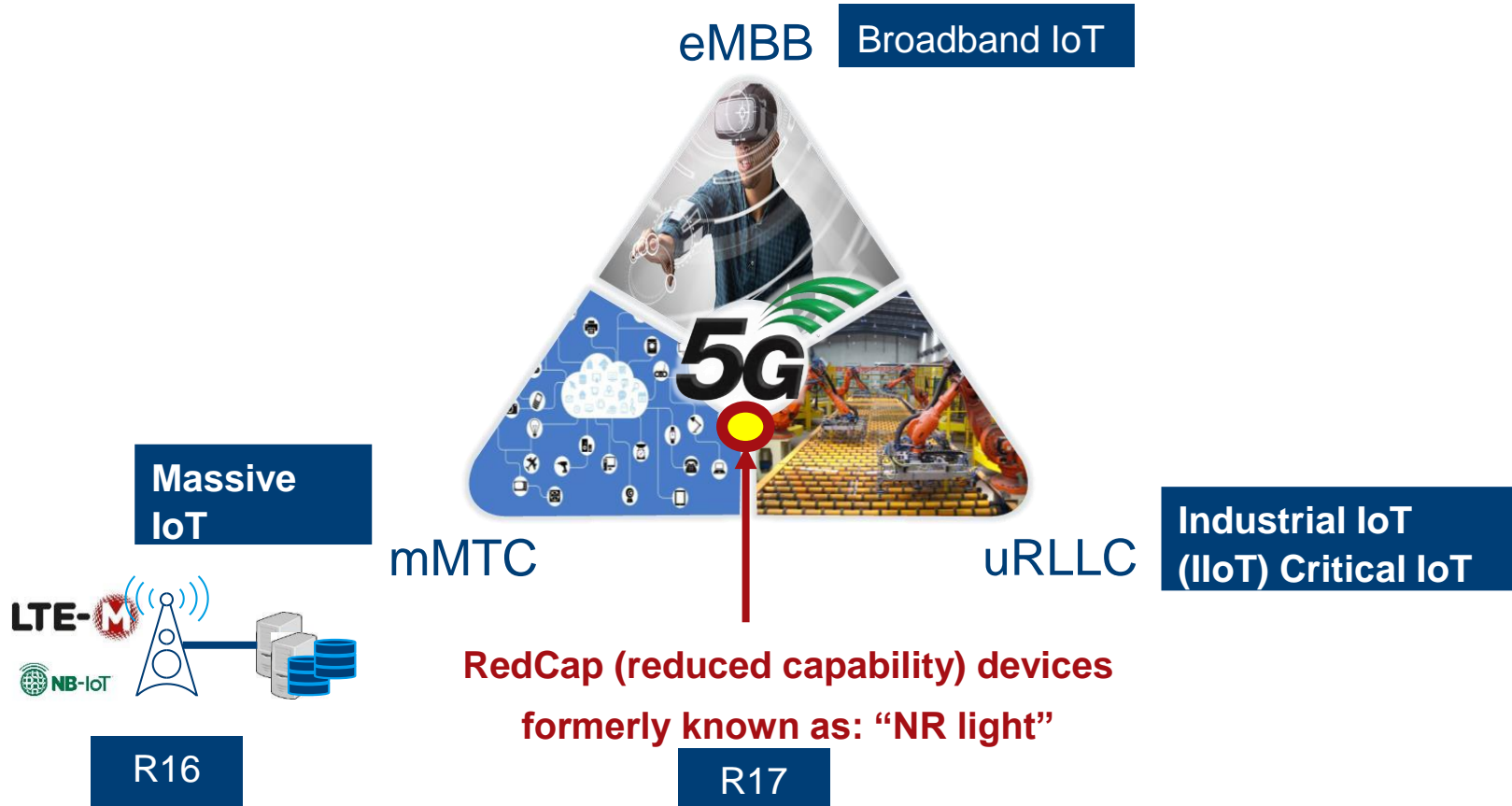
5G REDCAP R17

Reduced capabilities

BWP operation

RedCap specific cell access restrictions
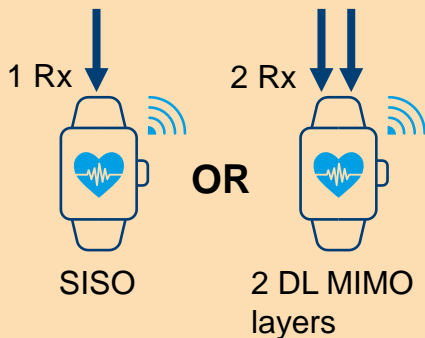
RedCap early indication

RRM measurement Relaxation
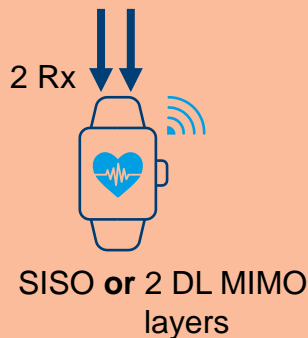
Power saving with eDRX

IOT CLASSIFICATION IN 5G

eMBB — Broadband IoT

Massive IoT

mMTC

uRLLC — Industrial IoT (IIoT) Critical IoT

RedCap (reduced capability) devices formerly known as: "NR light"

R16

R17

REDUCED CAPABILITY (REDCAP)

FR1 max. BW 20 MHz
DL: 256QAM optional

1 Rx   2 Rx

OR

SISO   2 DL MIMO
             layers

FR2 max. BW 100 MHz

2 Rx

SISO **or** 2 DL MIMO
layers

FR1 and FR2

1 Tx

SISO

► Half duplex FDD type A (full duplex optional)

► No support for: CA, MR-DC, DAPS, CPAC and IAB → **only NR-SA**

► **UE processing timeline not relaxed**

CPAC Conditional PSCelladdition/change

REDUCED CAPABILITIES

Lower transmit power	PC7 for n257, n258, n261 with min peak EIRP 16,4 dBm	
number of DRBs	8 mandatory	16 optional
PDCP SN and RLC AM SN length	12 bits mandatory	18 bits optional
RRM measurement / reporting relaxation	low mobility/stationary, not at cell edge → optional	
256QAM FR1 DL	optional (ModulationOrder)	
64QAM low SE MCS tables	optional (dl-64QAM-MCS-TableAlt / ul-64QAM-MCS-TableAlt)	

REDCAP UE CAPABILITY

Definitions for parameters	Per	M	FDD TDD DIFF	FR1-FR2 DIFF
longSN-RedCap-r17 **Indicates whether the RedCap UE supports 18 bit length of PDCP sequence number. This capability is only applicable for RedCap UEs.**	UE	No	No	N/A
am-WithLongSN-RedCap-r17 **Indicates whether the RedCap UE supports AM DRB with 18 bit length of RLC sequence number. This capability is only applicable for RedCap UEs.**	UE	No	No	N/A
supportOf16DRB-RedCap-r17 **Indicates whether the RedCap UE supports 16 DRBs. This capability is only applicable for RedCap UEs.**	UE	No	No	
rrm-RelaxationRRC-ConnectedRedCap-r17 **Indicates whether UE supports Rel-17 relaxed RRM measurements in RRC_CONNECTED as specified in TS 38.331.**	UE	No	No	No

REDCAP UE CAPABILITY

Definitions for parameters	Per	M	FDD TDD DIFF
supportOfRedCap-r17 **Indicates that the UE is a RedCap UE with comprised of at least the following functional components:** – **Maximum FR1 RedCap UE bandwidth is 20 MHz;** – **Maximum FR2 RedCap UE bandwidth is 100 MHz;** – **Support of RedCap early indication based on Msg1, MsgA (if UE indicated support of twoStepRACH-r16) and Msg3 for random access;** – **Separate initial UL BWP for RedCap UEs;** – **Separate initial DL BWP for RedCap UEs;** – **UE-specific RRC-configured DL BWP with CD-SSB or NCD-SSB; - NCD-SSB based measurements in RRC-configured DL BWP.** **A RedCap UE shall set the field to supported.**	UE	CY	No

LARGE RANGE OF REDCAP DEVICES POSSIBLE

cost, size, throughput power consumption →

Capabilities →

FR1 only, 1Rx, no 256QAM, half-duplex only……

FR1/2, 2Rx, MIMO, 256QAM, full-duplex……

Details of impact on e.g. cost for the UE depending on features: TR 38.875

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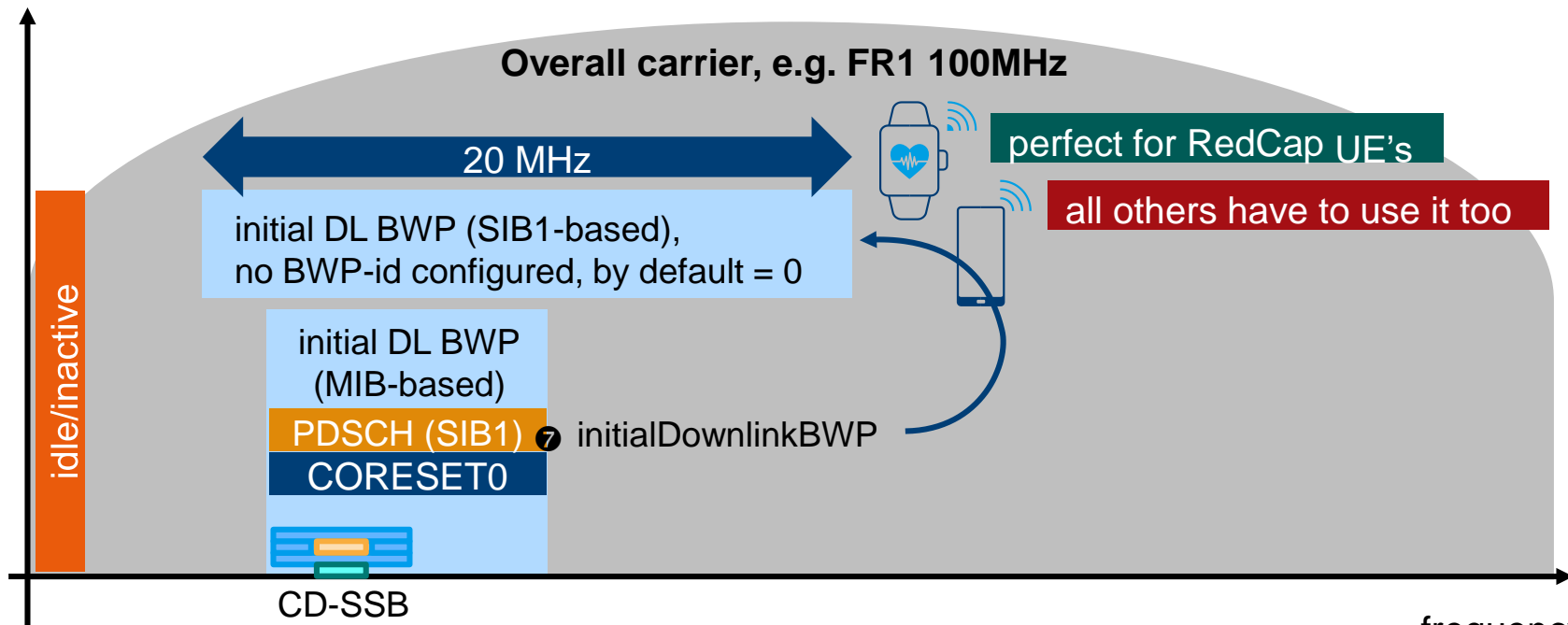
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R15 CONCEPT + R17 REDCAP UE

Overall carrier, e.g. FR1 100MHz

20 MHz

perfect for RedCap UE's

all others have to use it too

initial DL BWP (SIB1-based),
no BWP-id configured, by default = 0

initial DL BWP
(MIB-based)

PDSCH (SIB1) ❼ initialDownlinkBWP

CORESET0

idle/inactive

CD-SSB

frequency

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SYSTEM INFORMATION

hyperSFN
eDRX-AllowedIdle
eDRX-AllowedInactive

FeatureCombinationPreambles
featurePriorities [0..7]
- *redCapPriority*
- *slicingPriority*
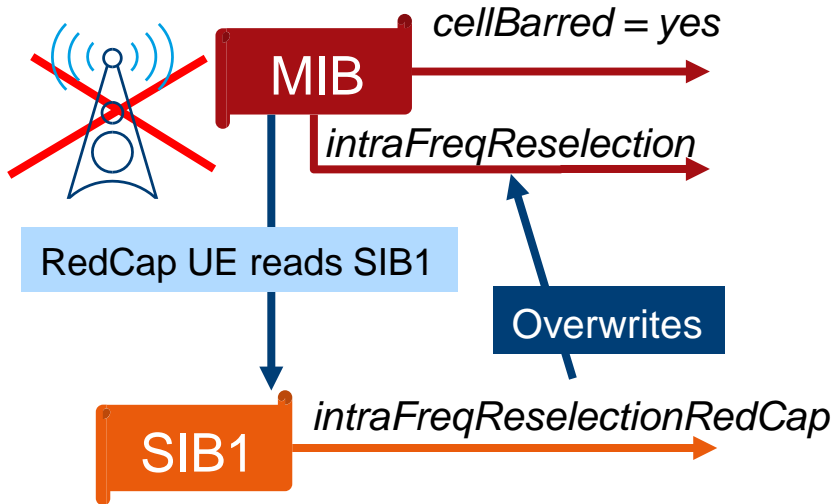- *msg3-Repetitions-Priority*
- *sdt-Priority*

SIB1

RedCap-ConfigCommonSIB
- *cellBarredRedCap1Rx*
- *cellBarredRedCap2Rx*

SIB2 → *relaxedMeasurement*

SIB4 → *InterFreqCarrierFreqInfo*

redcapAccessAllowed

REDCAP: CELL BARRING

IFRI: Intra Frequency Reselection Indicator

Scenario 1: General cell
barring is active Intra

cellBarred = yes

MIB

intraFreqReselection

RedCap UE reads SIB1

Overwrites

SIB1   *intraFreqReselectionRedCap*

No UE allowed to select this cell, not even for emergency calls

non-RedCap UE:
allowed: may re-select another cell on same frequency **not allowed:** may re-select another cell on different frequency
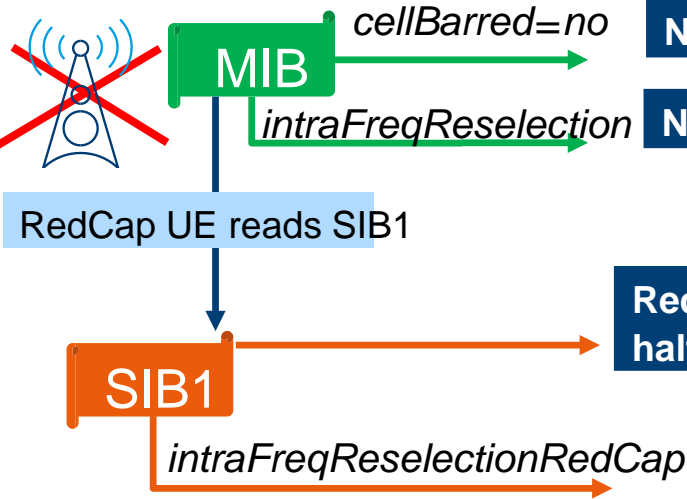RedCap UE: ignores this, uses SIB1 info instead

RedCap UE:
allowed: may re-select another cell on same frequency
not allowed: may re-select another cell on different frequency

REDCAP: CELL BARRING

Scenario 2: RedCap specific cell barring is active

Intra-frequency cell reselection: two-step procedure MIB / SIB1

cellBarred=no

MIB

No general access restriction activated

intraFreqReselection

Not important as cell is not barred

RedCap UE reads SIB1

SIB1

RedCap specific cell access restrictions (1 or 2 RX, half Duplex) are activated

intraFreqReselectionRedCap

RedCap UE:
allowed: may re-select another cell on same frequency
not allowed: may re-select another cell on different frequency

REDCAP: CELL BARRING

SIB4 → InterFreqCarrierFreqInfo

SIB4 → redcapAccessAllowed
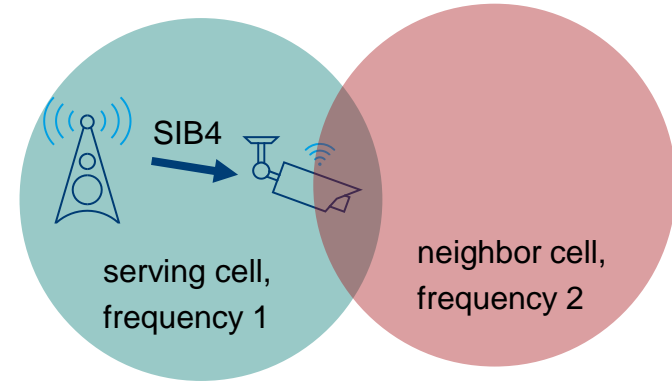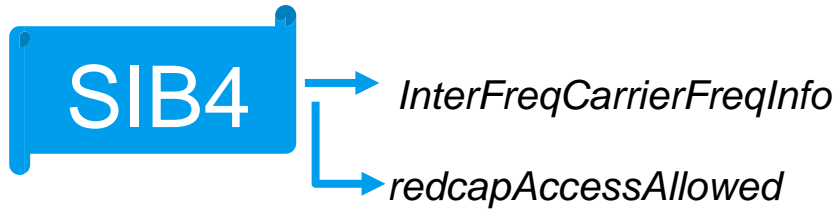
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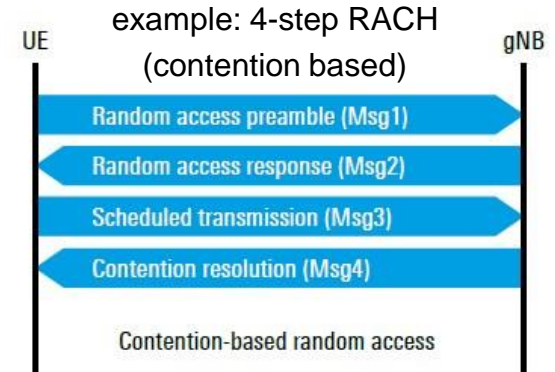
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REDCAP EARLY INDICATION

RACH

"I am a RedCap UE"
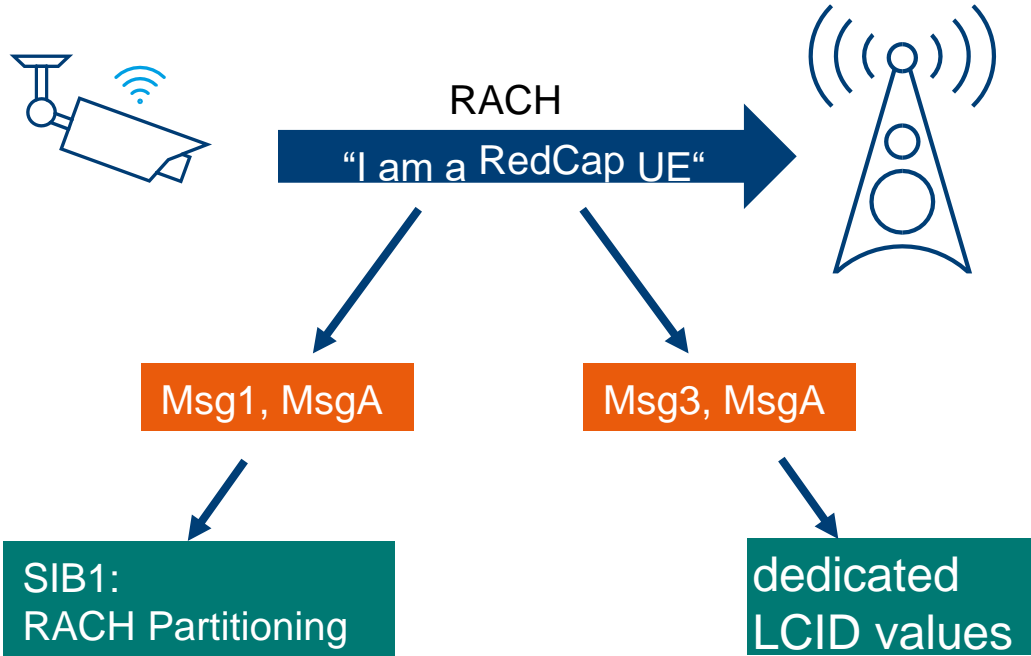
need to know as early as possible to not exceed the UE capabilities (e.g. max BW for BWP)

Msg1, MsgA

Msg3, MsgA

SIB1:
RACH Partitioning

dedicated
LCID values

example: 4-step RACH
(contention based)

UE		gNB
	Random access preamble (Msg1)	
	Random access response (Msg2)	
	Scheduled transmission (Msg3)	
	Contention resolution (Msg4)	

Contention-based random access

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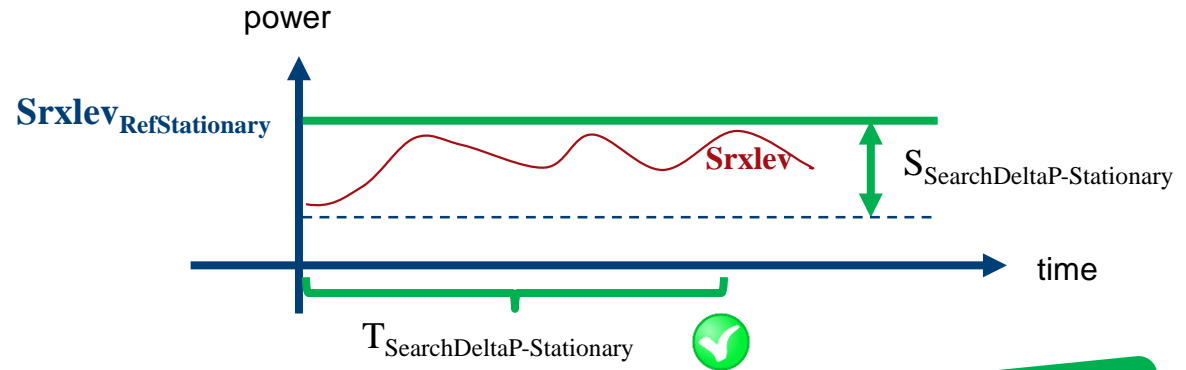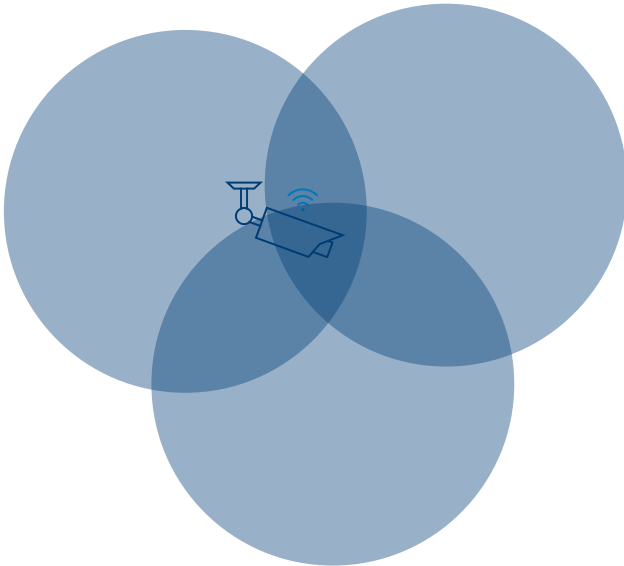RedCap specific cell access restrictions

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RRM MEASUREMENT RELAXATION STATIONARY CRITERION

Idea:

If UE does not move, less frequent neighbor
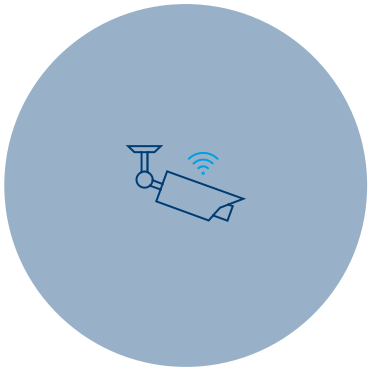cell measurements are sufficient

"stationarity fulfilled if received power doesn't change a lot"

RRM MEASUREMENT RELAXATION NOT AT CELL EDGE (NACE) CRITERION

Idea:

If UE does not move **and** is not at cell edge, even less frequent neighbor cell measurements are sufficient

$Srxlev > S_{SearchThresholdP2}$

$Squal > S_{SearchThresholdQ2}$ (optional)

"UE not at cell edge if power / quality is high enough"
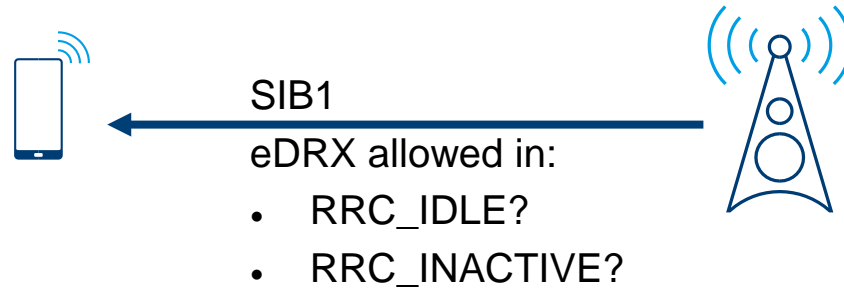
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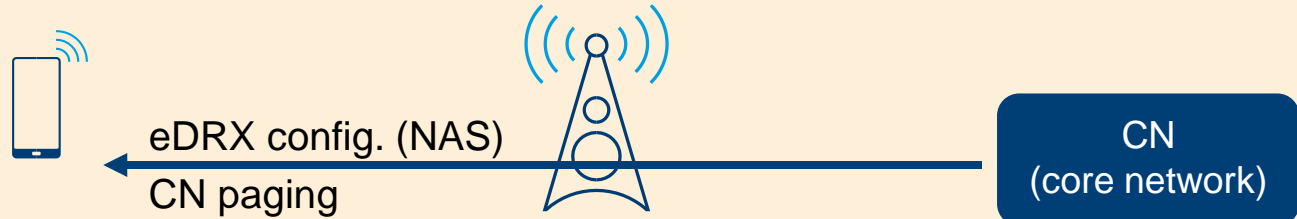
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EDRX FOR RRC_IDLE AND RRC_INACTIVE

SIB1

eDRX allowed in:

- RRC_IDLE?
- RRC_INACTIVE?

EDRXFOR RRC_IDLE AND RRC_INACTIVE

RRC_IDLE

eDRX config. (NAS)

CN paging

CN
(core network)

2.56s → 10485.76s (≈ 2.91 hours)

RRC_INACTIVE

eDRX configuration

RAN paging

CN paging

CN
(core network)

2.56s → 10.24s

eDRX for RRC_INACTIVE only if eDRX for RRC_IDLE configured. eDRX cycle for INACTIVE shorter or equal to the IDLE mode eDRX cycle.

DEMO