

# Inter-RAT MRO

## What are the important KPIs?

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# Outline

- Inter-RAT mobility scenario
- MRO objectives
- Motivation for inter-RAT MRO
- Inter-RAT mobility problems and KPIs
- Inter-RAT vs. Intra-RAT & intra-frequency
- Conclusion

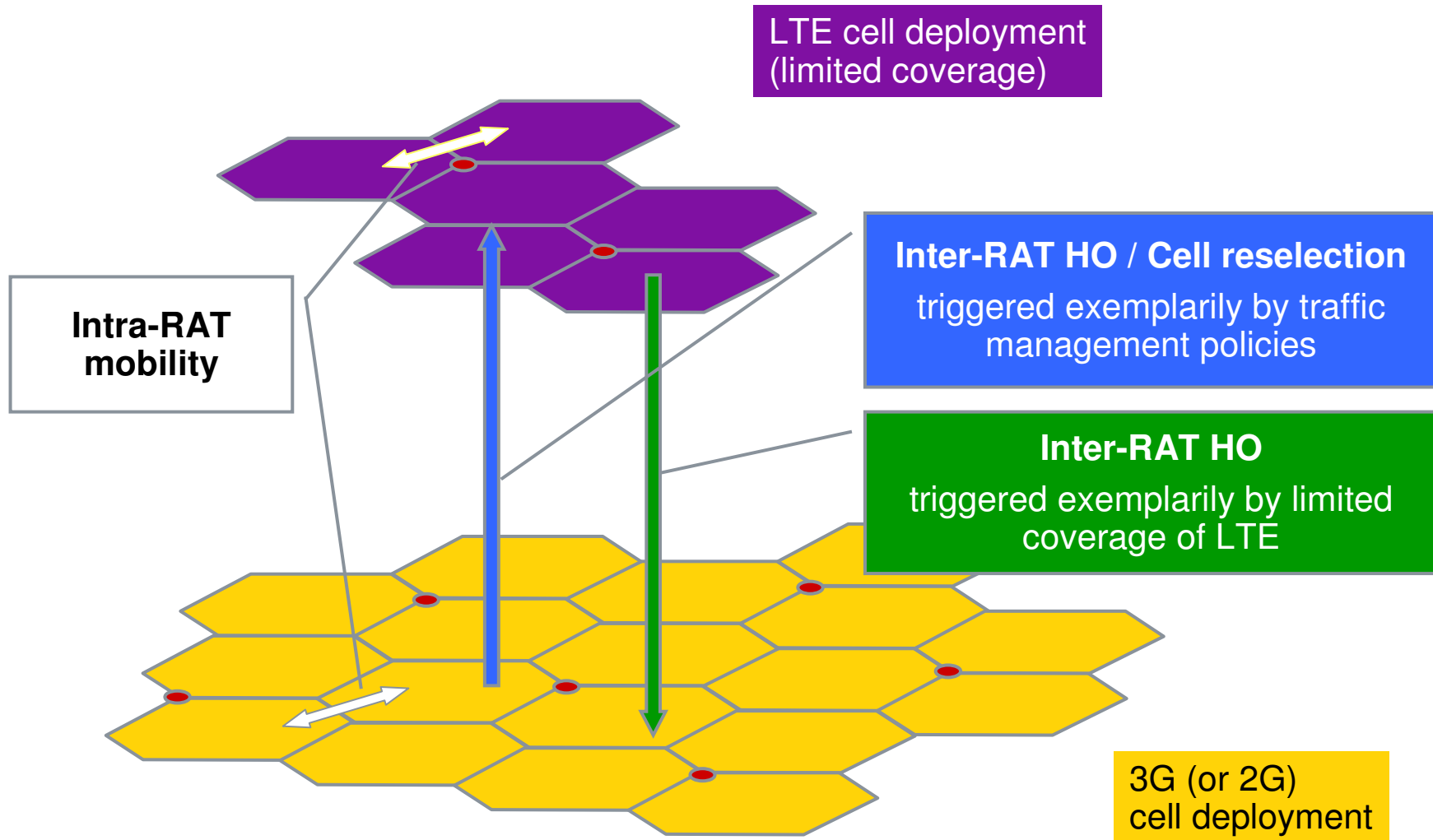
## Abbreviations:

RAT: Radio Access Technology

MRO: Mobility Robustness Optimization

KPI: Key Performance Indicator

# Inter-RAT mobility scenario



# MRO objectives

- Generic MRO aspects
  - Replacing or minimizing the human intervention of mobility optimization tasks
  - Automatically adapting of the mobility-related cell parameters based on evaluation of performance counters
  - Dynamically improving the network performance in terms of mobility in order to provide improved end-user experience as well as increased network capacity
- Inter-RAT MRO aspects
  - Automated alignment of thresholds and trigger event between different RATs
  - Automated adapting of inter-RAT mobility parameters acc. to changing traffic steering policies

# Motivation for inter-RAT MRO

- Deployment of 1<sup>st</sup> LTE roll-out phase will be concentrated on relevant traffic hotspot areas
- Full coverage provided by overlaying 2G/3G network
- Consequently, the limited LTE coverage will result in many inter-RAT handovers
- Trouble-free operation of the inter-RAT handovers is very important for operators from day one on
- Consistent joint parameter optimization among different RATs is difficult with traditional optimization means  
→ An autonomous approach is required

**Inter-RAT MRO is highly demanded SON feature**

# Inter-RAT mobility problems

## Failure events (RLF / drop) during inter-RAT HO

Too late Inter-RAT HO

Too early Inter-RAT HO

HO to wrong cell in new RAT

HO to wrong RAT

## Unwanted inter-RAT HO events

Ping-pong back to same cell in RAT1

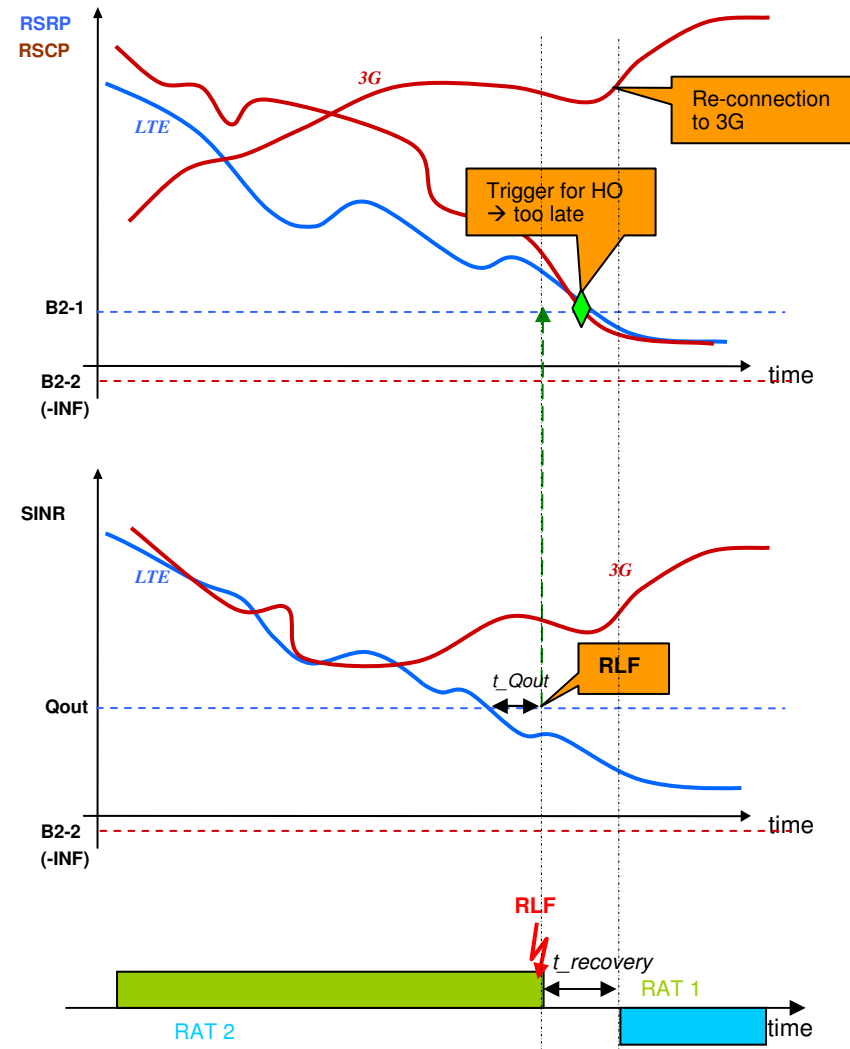
Ping-pong back to different cell in RAT1

Short stay (2nd HO is an intra-HO in new RAT)

Short stay (HO to yet another 3rd RAT)

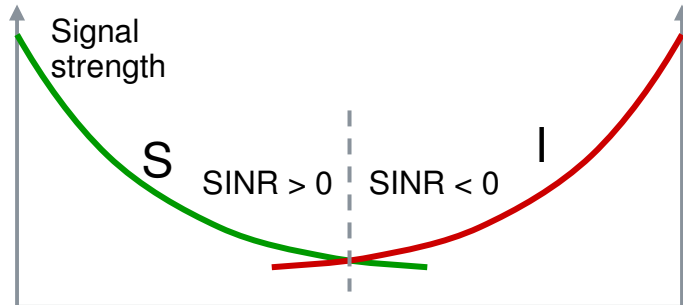
# Problem case: Too late inter-RAT HO (exemplarily)

- HO is triggered by signal strength (RSRP in case of LTE)
- RLF is triggered by SINR (below  $Q_{out}$ )
- LTE end-of-coverage  
→ no interference  
→ bad S(I)NR due to weak signal
- RLF happens in RAT 1 before inter-RAT HO has been triggered
- After a certain time interval ( $t_{recovery}$ ) UE reconnects to another RAT (RAT 2)

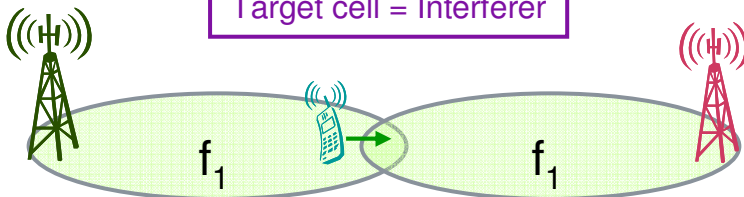


# Impact of interference during HO

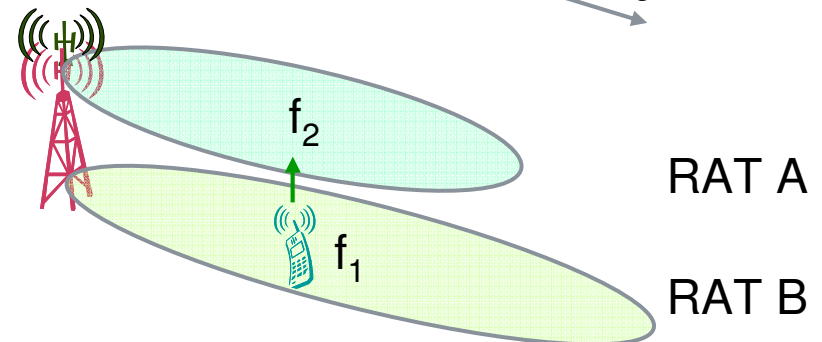
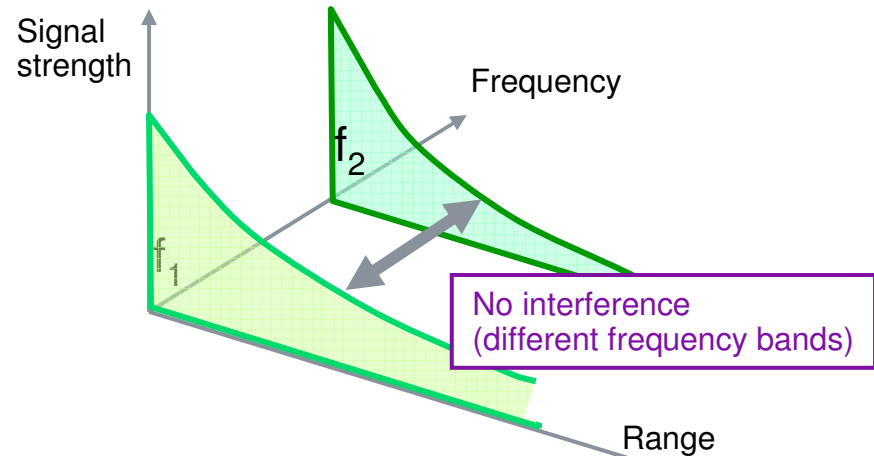
## Intra-RAT & intra-frequency



Target cell = Interferer



## Inter-RAT / inter-frequency





# Inter-RAT vs. Intra-LTE / intra-frequency mobility

## Inter-RAT mobility ...

- does not suffer from interference between source and target cell
  - No “cell edge problem” (neighbor cell interference from reuse  $N=1$ )
  - Large area where UEs can be connected either to source or target cell with good signal quality (could be whole cell area in case of co-sited cells)
  - Conservative thresholds avoid RLF-affected HO problems as “too late inter-RAT HO” on expense of coverage of one RAT and number of inter-RAT HOs (eventually even unnecessary HOs)
- is quite often policy-driven (traffic steering) and not dominantly caused by radio condition (e.g. end-of-coverage)

# Inter-RAT vs. Intra-LTE / intra-frequency mobility

## Inter-RAT mobility ...

- is missing X2-interface between source and target cell
- cannot utilize regular UE measurements
  - Inter-RAT UE measurements have to be triggered (measurement event reporting)
  - Measurement gaps required → additional costs

# Critical use case: Mismatch of mobility parameters among RATs

## Traffic steering policy in 3G:

Handover to LTE whenever LTE coverage is there, e.g.

$$3A-2 = RSRP > -125\text{dBm}$$

independent from the 3G signal quality

## Traffic steering policy in LTE:

Handover to 3G, if LTE coverage gets bad:

$$B2-1 = RSRP < -123\text{dBm}$$

and 3G coverage is sufficient, i.e.

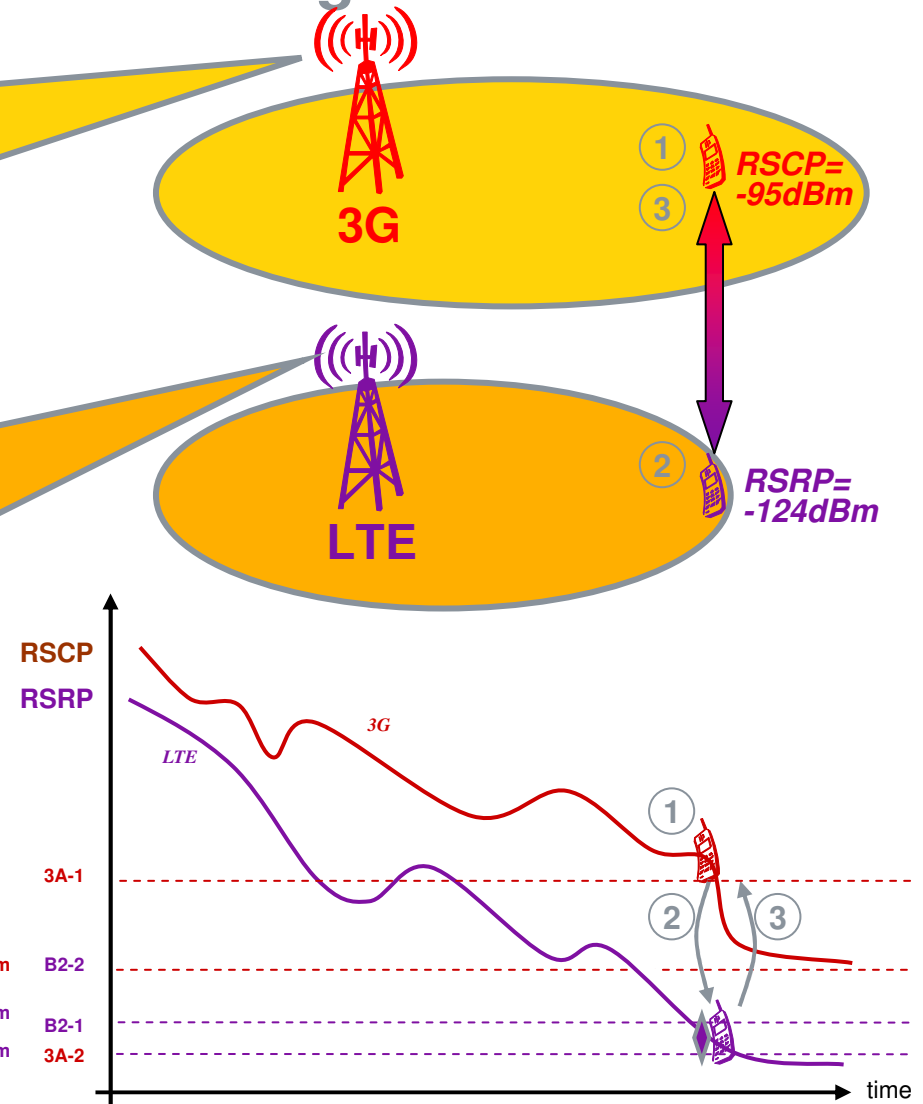
$$B2-2 = RSCP > -108\text{dBm}$$

- ① UE is setup in 3G and realizes that the measured LTE signal strength is  $> -125\text{ dBm}$
- ② Handover to LTE and realizing inter-RAT trigger events B2 are fulfilled
- ③ Handover back to 3G  $\rightarrow$  Pingpong

RSCP = -108 dBm

RSRP = -123 dBm

RSRP = -125 dBm



# Conclusion

- RLF affected mobility issues can be accomplished easier than in intra-LTE case due to missing interference between source and target cell
- Unnecessary HOs (e.g. pingpongs) due inconsistent thresholds among RATs are quite likely, due to
  - uncoordinated parameter configuration
  - changing traffic steering policy
- Pingpongs are critical in inter-RAT case, since
  - inter-RAT measurements yield connection interruptions
    - danger of packet loss
    - danger of missed paging attempts
    - capacity reduction

Unnecessary HOs as Pingpong  
must get higher significance in inter-RAT MRO



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**Thank you !**



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