

Interworking of traffic steering and mobility robustness optimization in multi-RAT scenarios

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Outline

- Multi-layer / multi-RAT deployments
- Inter-RAT mobility
- Traffic steering (TS) and MRO objectives
- Inter-RAT mobility problems / failure types
- MRO – TS inter-working analysis
 - HO cause agnostic
 - HO cause aware
- Conclusion

Abbreviations:

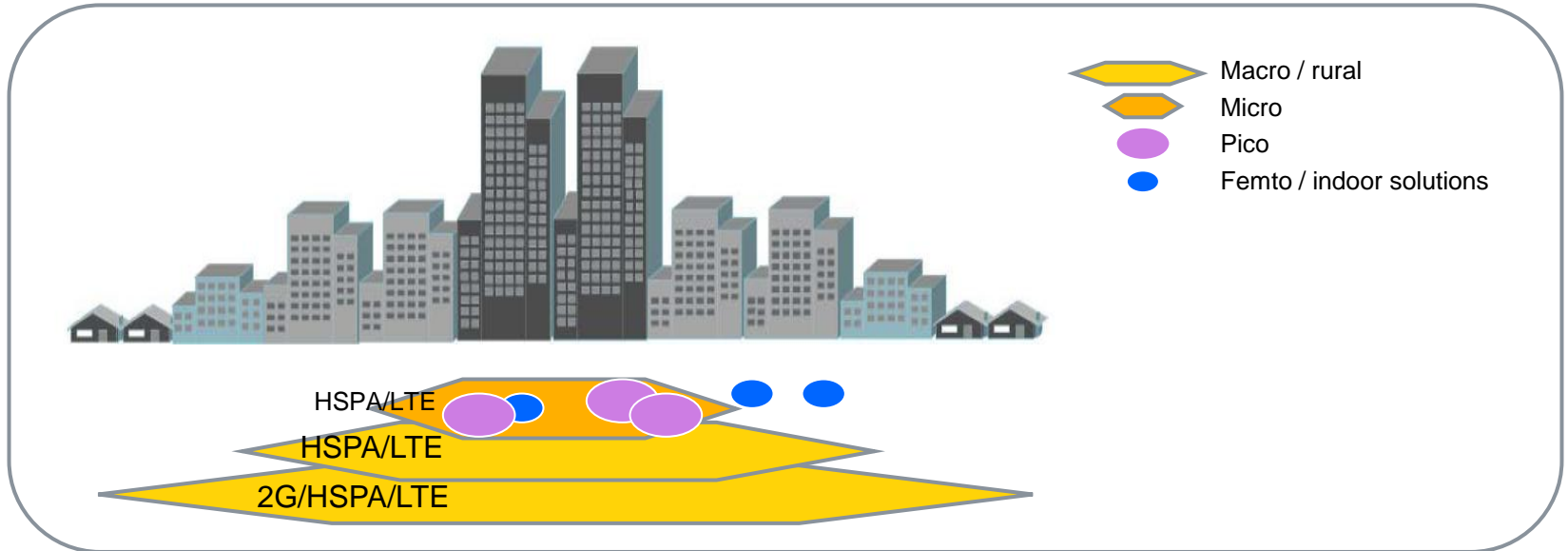
HO: Handover

MRO: Mobility Robustness Optimization

RAT: Radio Access Technology

TS: Traffic Steering

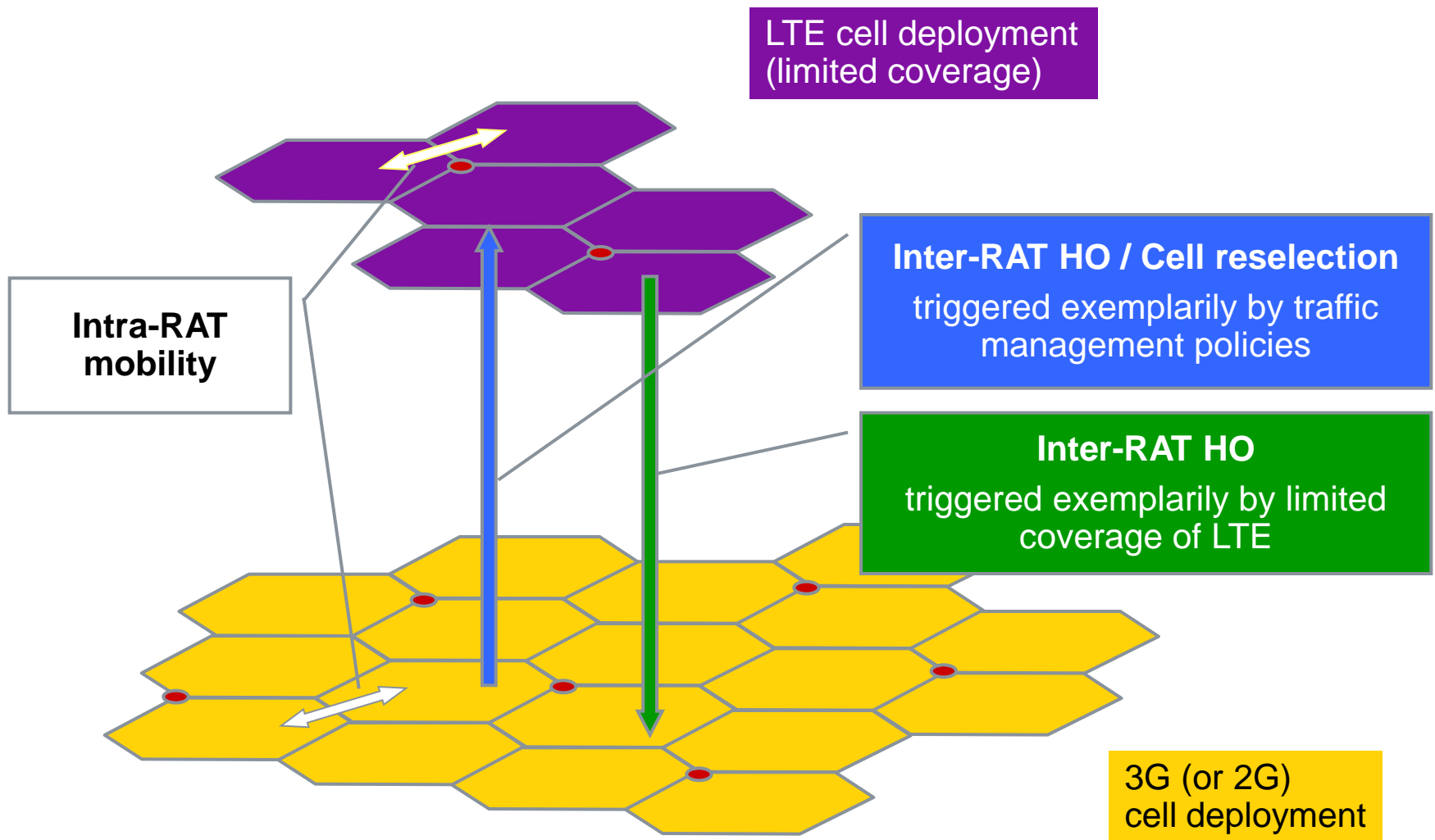
Multi-layer deployment



Operators are faced with multiple overlapping radio network layers (multilayer networks) due to

- Evolving towards more efficient technologies (HSPA, LTE) while keeping legacy deployments
- Coverage and capacity layers (heterogeneous network)
- Provisioning of various UE capabilities

Inter-RAT mobility (cell change) use case



Traffic Steering (TS) objectives

Traffic steering in **idle** mode (Re-selection for camping in preferred RAT)

Drivers:

- Enhanced connection setup times
- Reduced signalling and measurement complexity
- UE battery savings

Traffic steering in **active** mode (Inter-RAT handover to preferred RAT)

Drivers:

- Load balancing, energy saving, maximizing network capacity
- Service dependent RAT change
- Change in user traffic demands

Mobility robustness optimization (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

- Specific inter-RAT mobility problems
- Extension of root cause analysis among various RATs

Inter-RAT mobility problems

3GPP currently considers following inter-RAT MRO problems:

Problem type	Scenario	RLF	Status
Too late inter-RAT HO (LTE → 3G)	Limited LTE coverage	yes	High prio in Rel'11
Too early inter-RAT HO (3G → LTE)	Limited LTE coverage	yes	High prio in Rel'11
Too late inter-RAT HO (3G → LTE)	LTE 800 in rural 3G limited to urban/suburban	yes	Low prio in Rel'11
Too early inter-RAT HO (LTE → 3G)	LTE 800 in rural 3G limited to urban/suburban	yes	Low prio in Rel'11
Too early inter-RAT HO w/o RLF (LTE → 3G)	Limited LTE coverage	no	Specified in Rel'9 "Unnecessary inter-RAT HO"
Inter-RAT ping pong	both	no	Low prio in Rel'11

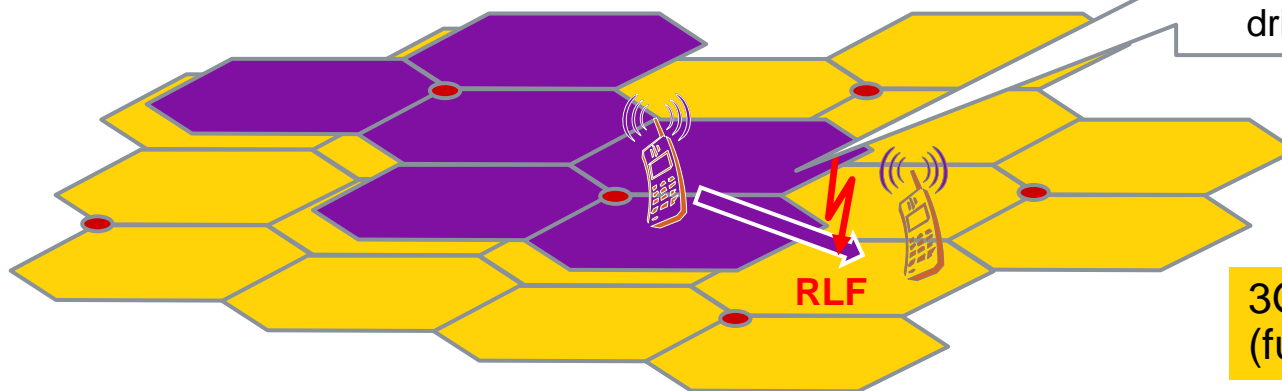
Example: Too late inter-RAT LTE-to-3G

Definition:

- RLF occurs while UE is connected to a LTE cell.
- Inter-RAT handover to 3G might have been initiated (e.g. target cell preparation is ongoing), but UE is still under control of LTE cell.
- UE reconnects to a 3G cell

LTE cell deployment
(limited coverage)

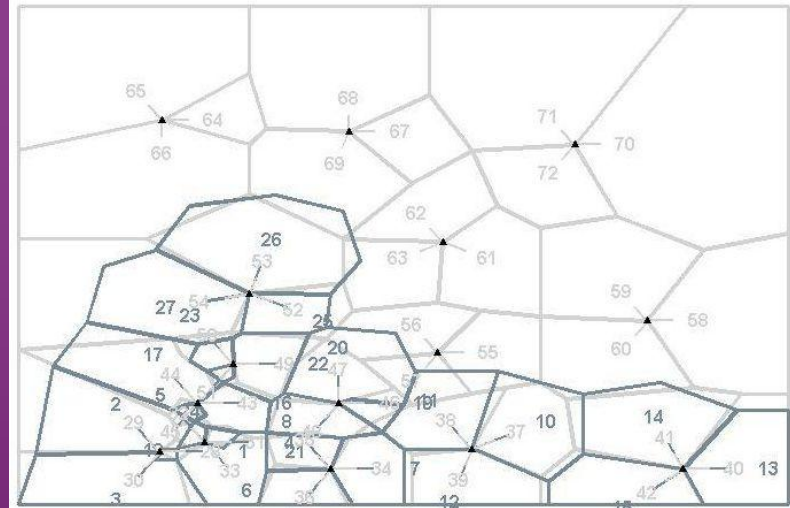
UE leaving LTE
coverage:
→ Necessary radio-
driven HO



3G cell deployment
(full coverage)

Analysis with simple traffic steering rule

Scenario:
Limited LTE coverage
Case A: LTE → 3G
Case B: 3G → LTE



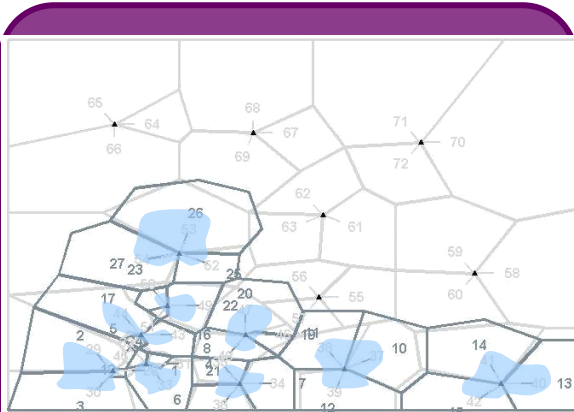
TS rule (exemplarily)

- LTE-capable UEs using data services should use LTE, i.e.
 - should stay in LTE as long as possible
 - should be handed over to LTE as early as possible

Limited LTE coverage (case A)

**Handover: LTE → 3G
(leaving LTE area)**

HO trigger: LTE inter-RAT mobility parameter B2
TS rule: Stay in LTE as long as possible

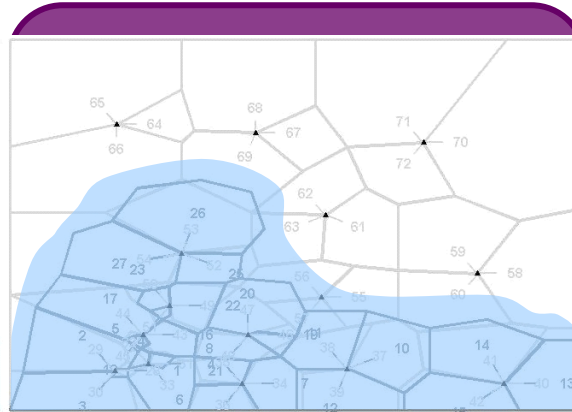


Conservative setting of mobility parameter in order to avoid RLFs

Problem:
TS rule violated
→ reduced LTE coverage

MRO problem type:
“Unnecessary inter-RAT HO” specified in Rel’9

→ MRO can react

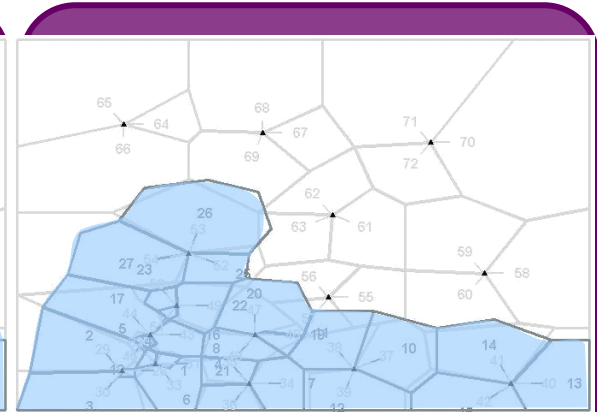


Aggressive setting of mobility parameter to follow TS rule

Problem:
RLF, missed HO

MRO problem type:
“Too late inter-RAT HO”

→ MRO can react



Optimal parameter setting achieved by MRO

→ Maximum LTE coverage fulfils TS target

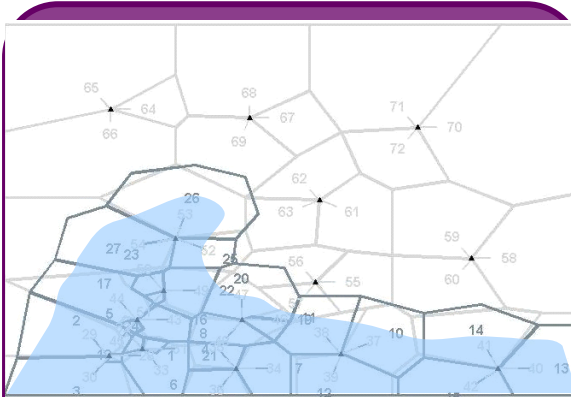
→ No RLFs fulfils MRO target



Limited LTE coverage (case B)

Handover: 3G → LTE (entering LTE area)

HO trigger: Traffic steering in 3G (e.g. specific trigger event)
TS rule: Enter LTE as early as possible



Relaxed setting of TS-related mobility parameter in order to avoid RLFs

Problem:

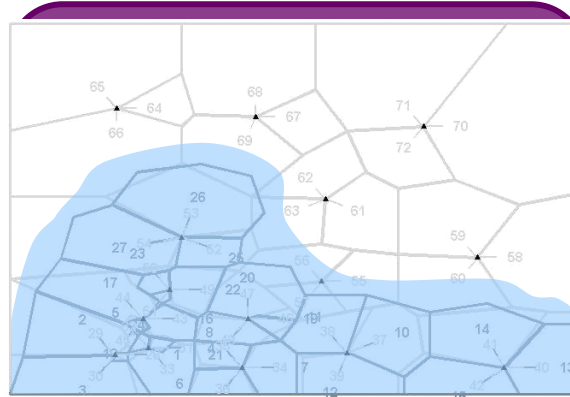
TS rule violated

→ too late inter-RAT HO
w/o RLF

→ reduced LTE coverage

MRO problem type:

n/a



Aggressive setting of TS-related mobility parameter to follow TS rule

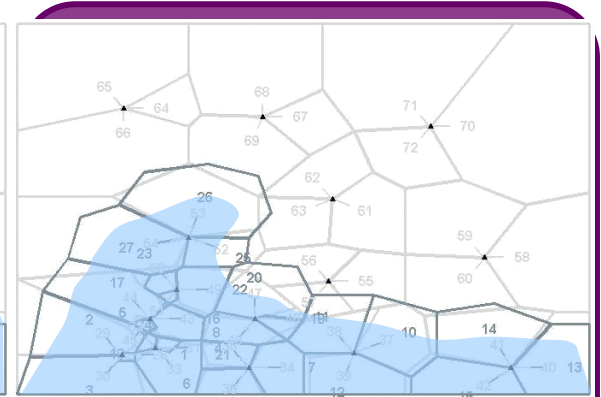
Problem:

RLF immediately after HO
and reconnection in 3G

MRO problem type:

“Too early inter-RAT HO”

→ MRO informs TS



Optimal setting is not achievable, since counterpart missing



MRO and TS inter-working aspects

Case A (Limited LTE coverage && LTE→3G):

- Radio-driven HO, i.e. the related trigger parameters are under responsibility of MRO
- TS-related inter-RAT mobility problem type “Unnecessary inter-RAT HO” serves as counterpart for “Too late” RLF-afflicted handovers

→ correction of pure radio-related HO parameter

→ no further TS inter-working, even though TS-related “KPI” is used

Case B (Limited LTE coverage && 3G→LTE):

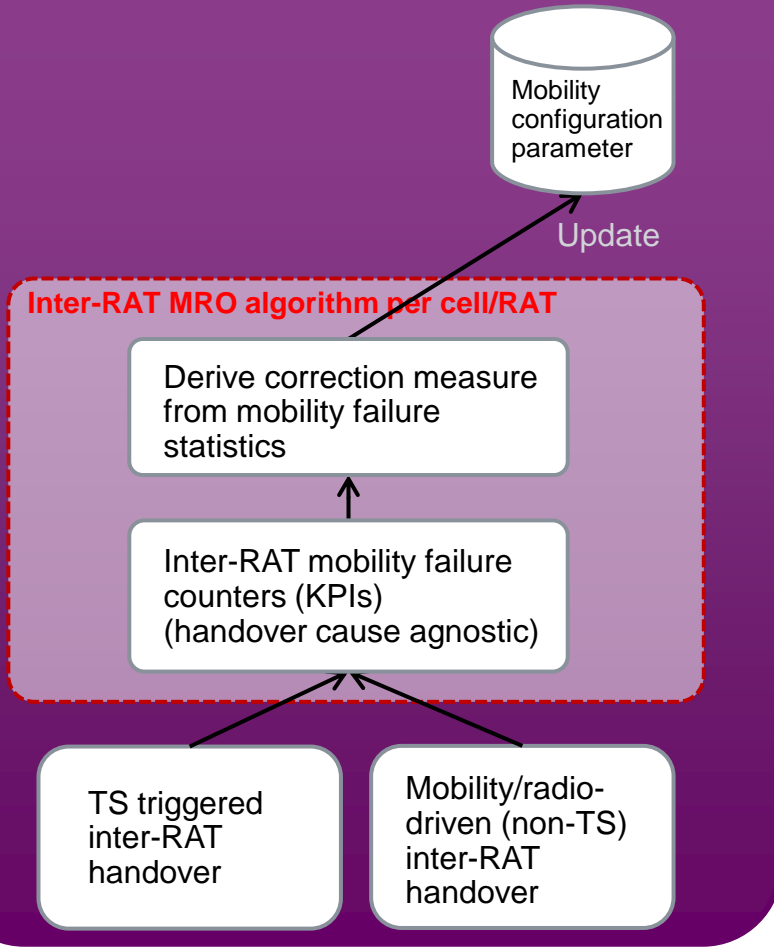
- “pure” TS-driven HO dependent on operator specific policy as long as there are no 3G coverage issues
- TS is triggered by different criteria (incl. different HO trigger parameters), but in case of mobility problems MRO will least to detect and count them

→ How should MRO treat the failures of TS initiated handovers?



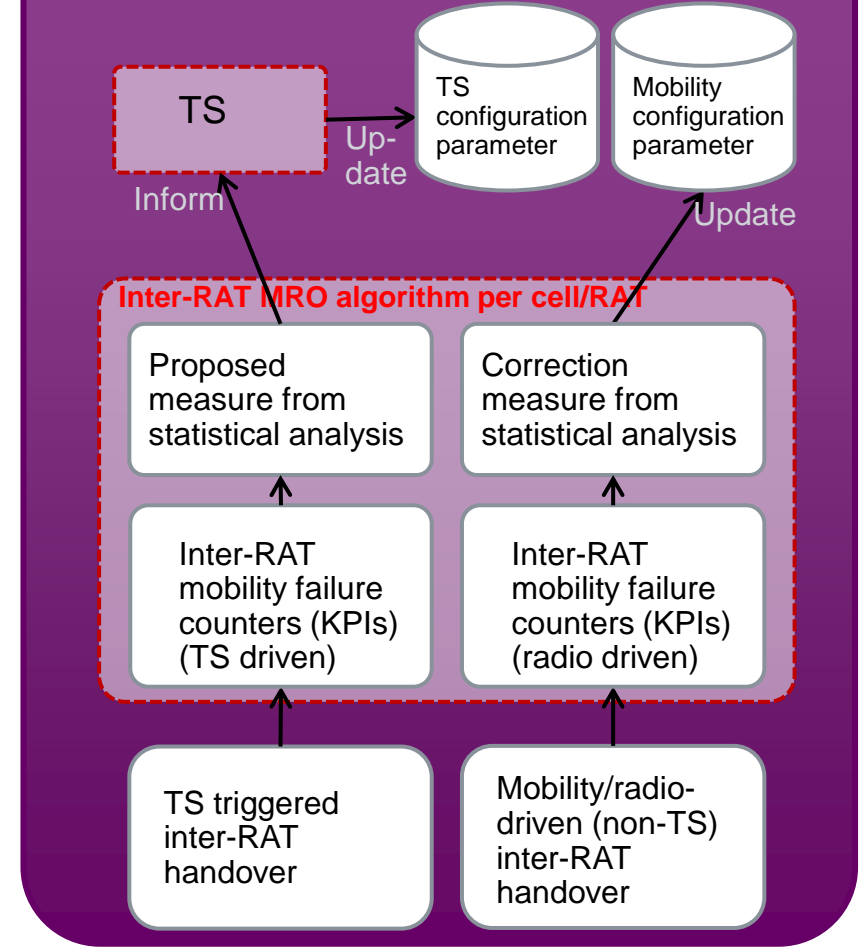
MRO options for TS inter-working

Handover cause agnostic

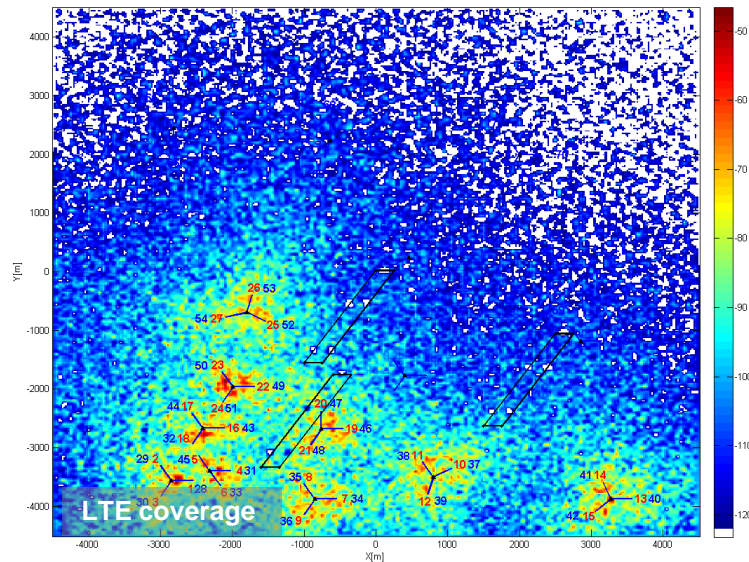
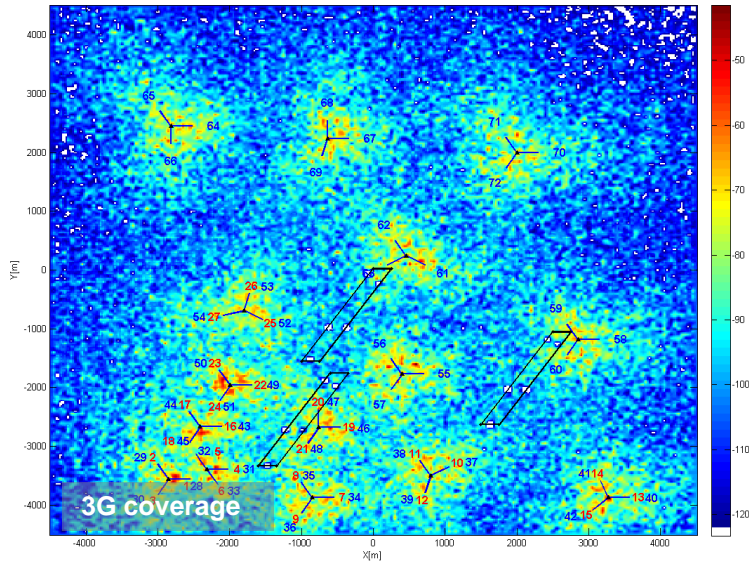


vs.

Handover cause aware



Simulative investigation



- **Inter-RAT MRO algorithm**

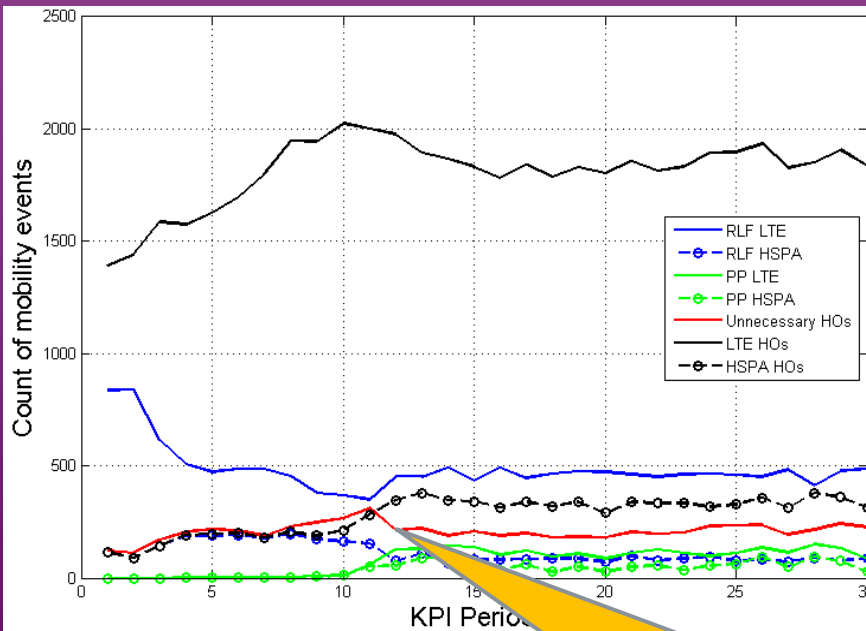
A. Awada, B. Wegmann, I. Viering and A. Klein, "Self-Optimization Algorithm for Inter-RAT Configuration Parameters," IEEE International Symposium on Wireless Communication Systems 2011 (ISWCS'11), November 6-9, 2011.

- **Inter-RAT mobility parameters being (cell-specifically) optimized:**

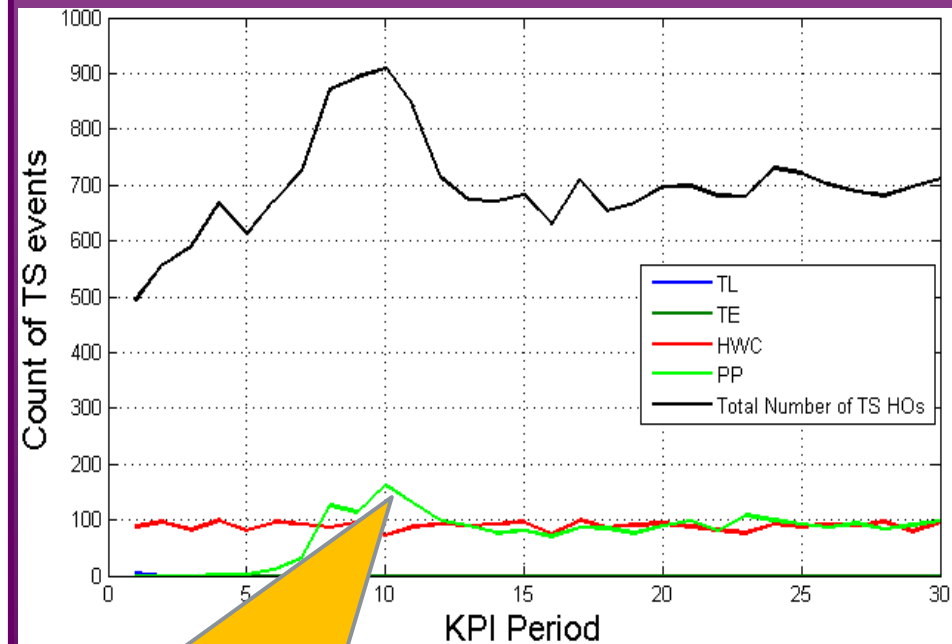
RAT	Trigger parameter	Quantity	Initial setting [dBm]	MRO
LTE	B2_1	RSRP (LTE)	-125	yes
	B2_2	RSCP (3G)	-107	yes
3G	3A_1	RSCP (3G)	-110	yes
	3A_2	RSRP (LTE)	-122	yes
	TS_3A_1	RSCP (3G)	-96	no
	TS_3A_2	RSRP (LTE)	-118	no

Handover cause aware MRO treatment

Radio driven mobility failure counters

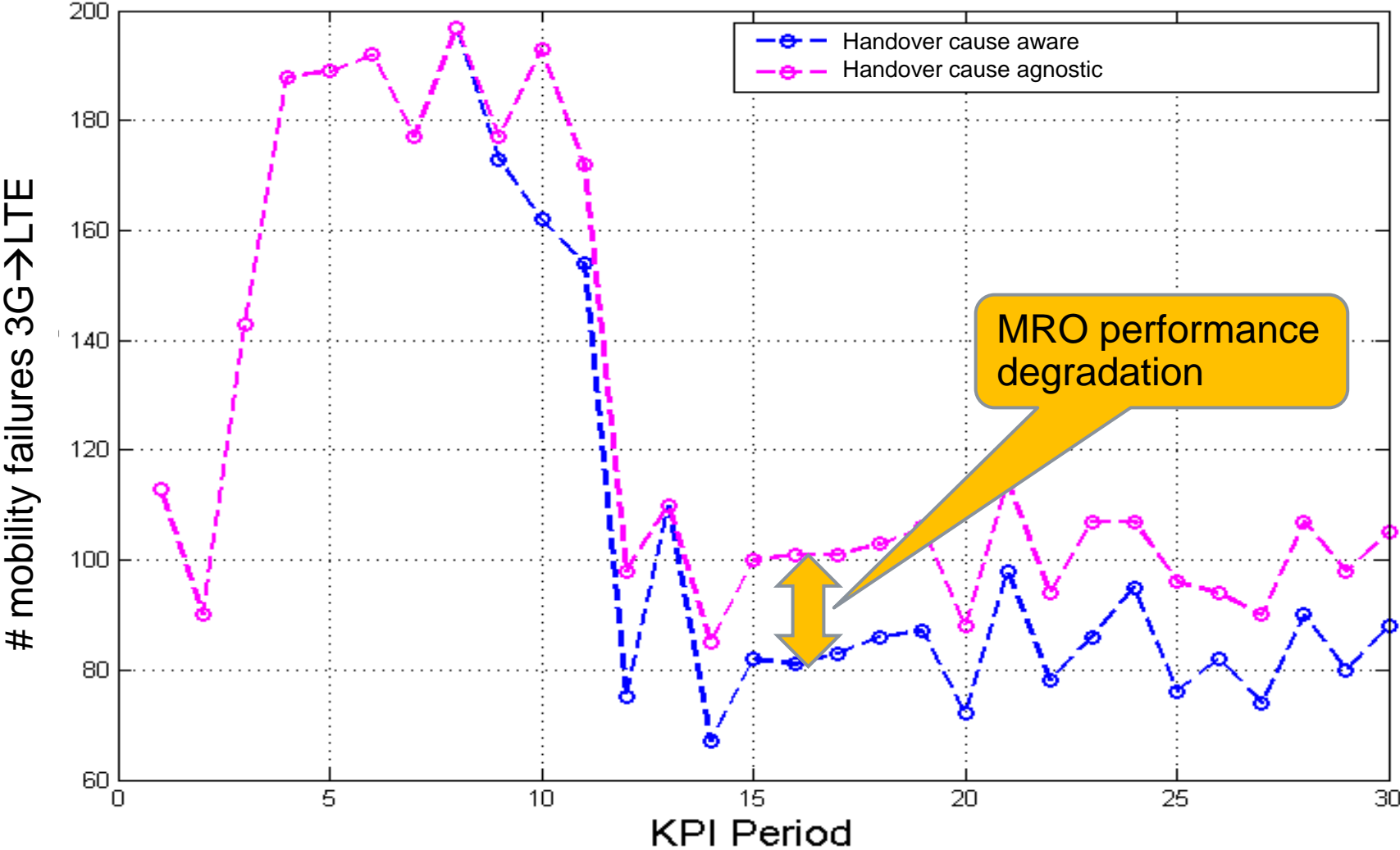


TS driven mobility failure counters (only 3G→LTE)



Increase of PP of TS-initiated HOs resulting from changes done by MRO for radio-driven mobility parameters

MRO performance impact



Conclusion

Inter-RAT mobility ...

- due to traffic steering (e.g. load balancing) or
- radio driven when reaching end-of-coverage

Mobility failures irrespective of the cause are detected by MRO

Proper interworking of MRO and traffic steering

- MRO separates failures depending on handover cause
- MRO corrects non-TS failures automatically
- MRO informs TS about allowed/correct parameter setting

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Thank you !

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