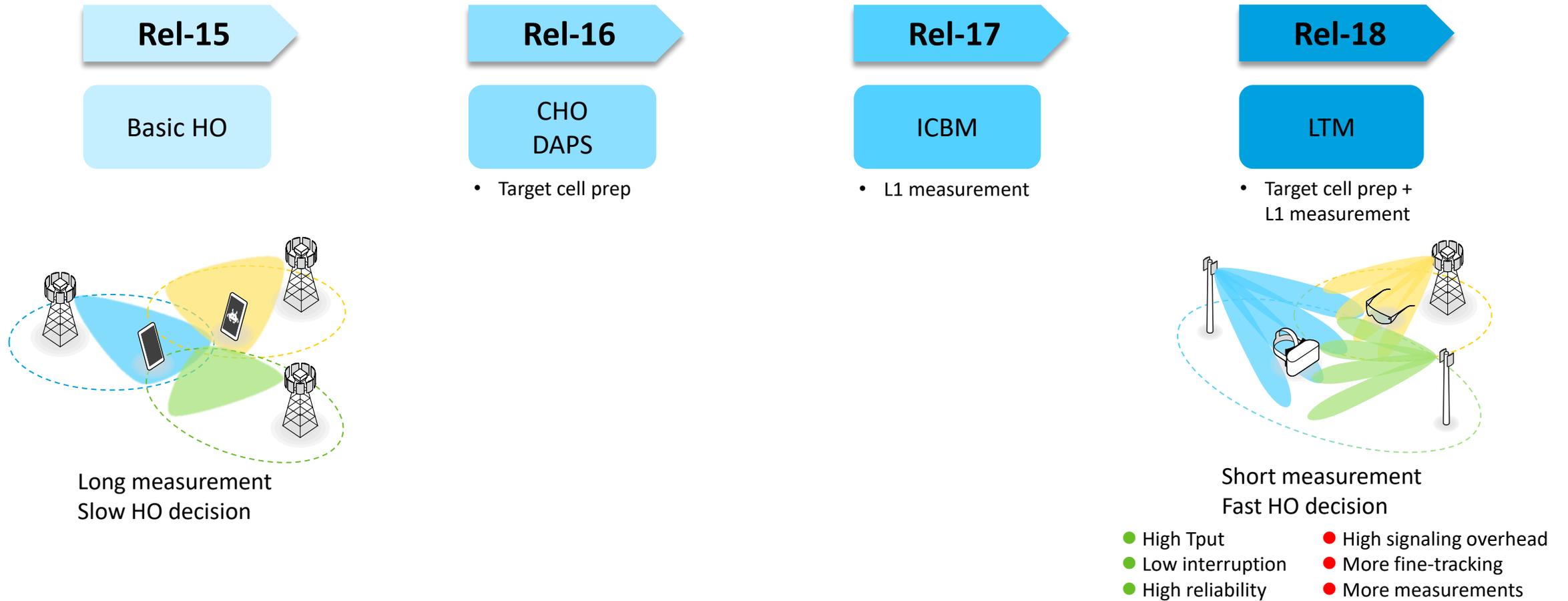


[RAN2-led] Study on AI-based Mobility

[SI]

NR Mobility: conventional rule-based mobility

Rel-15 through Rel-18



NOTE: a detailed evolution diagram can be found in [RWS-230122](#)

CHO: conditional HO
DAPS: dual active protocol stack
RWS-230123 – MediaTek Inc.

ICBM: inter-cell beam management
LTM: L1/L2 triggered mobility

Motivation

Limitation of Rule-based Mobility Mechanism

- Rule-based mobility performs well in normal mobility scenarios
 - with acceptable complexity and overhead
 - has been repeatedly verified and systematically improved in deployments
- but cannot achieve optimum performance in extreme scenarios (FR2 and/or high mobility)
 - It is reactive by design
 - The overall mobility procedure (incl. measurement, report and HO/cell switch) is not fast enough to adapt to channel variations in extreme mobility scenarios.
 - It features high a) complexity b) measurement effort c) signaling overhead for suboptimum mobility performance in these scenarios
 - New capacity-hungry services like e.g. XR require a reliable mobility connection with high throughput and low latency
- Need for
 - Optimum mobility performance with minimum measurement and overhead in both FR1 and FR2
 - Shift from conventional reactive mobility mechanism to proactive data-driven mechanism (with autonomous optimization without human intervention)

Proposal

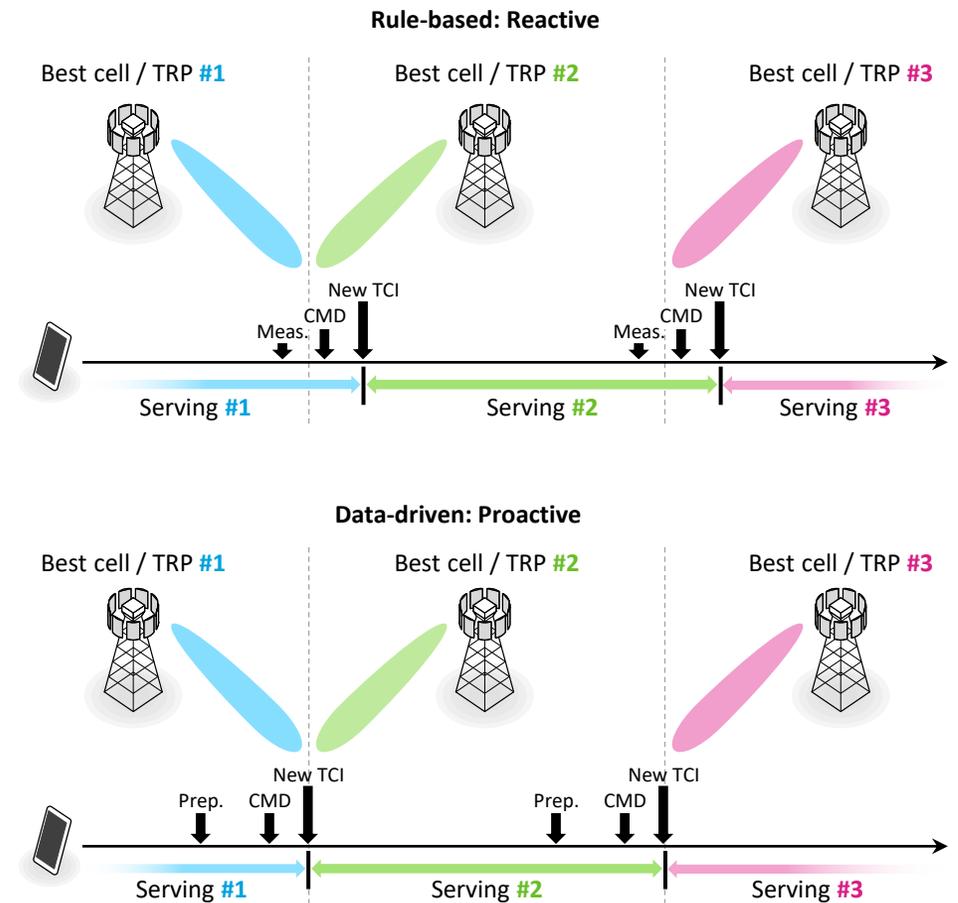
[1/5]

- Targets

- Improve mobility performance
- Reduce measurement effort
- Reduce signaling overhead

- Use cases

- AI-based target cell prediction
 - Predict when to HO to which cell/beam
 - AI/ML for LTM
- AI-assisted RRM measurement
 - Extend AI-based BM across multiple cells



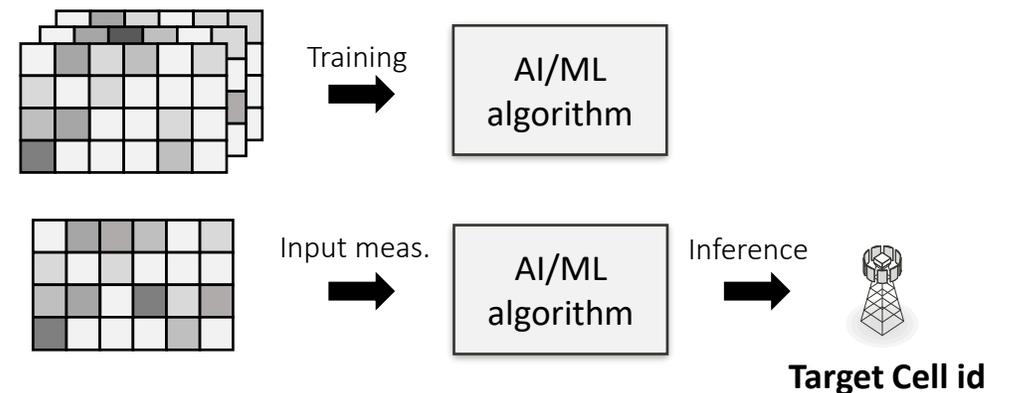
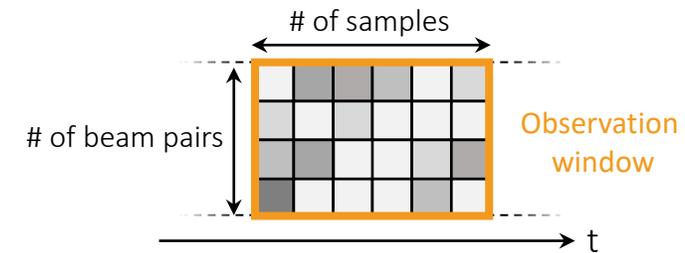
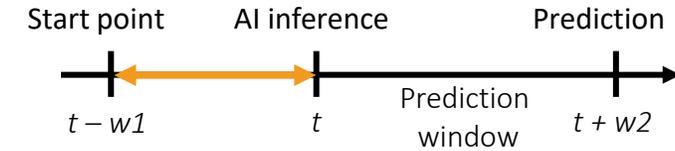
Proposal

AI-based Target Cell Prediction

[2/5]

- Basic Algorithm

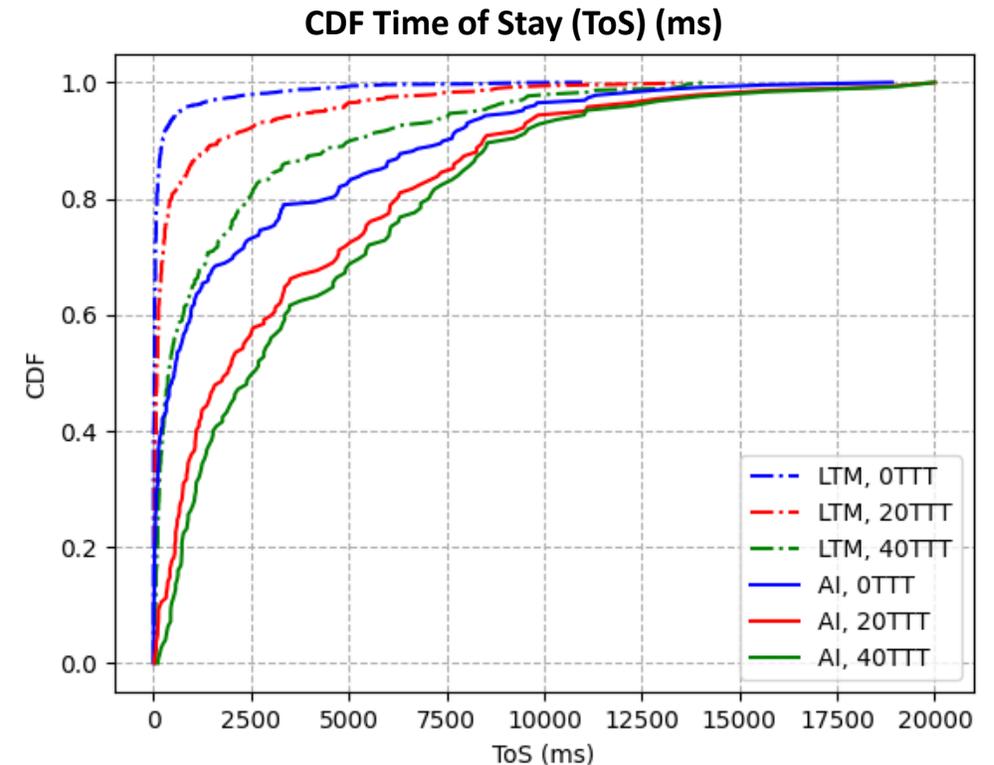
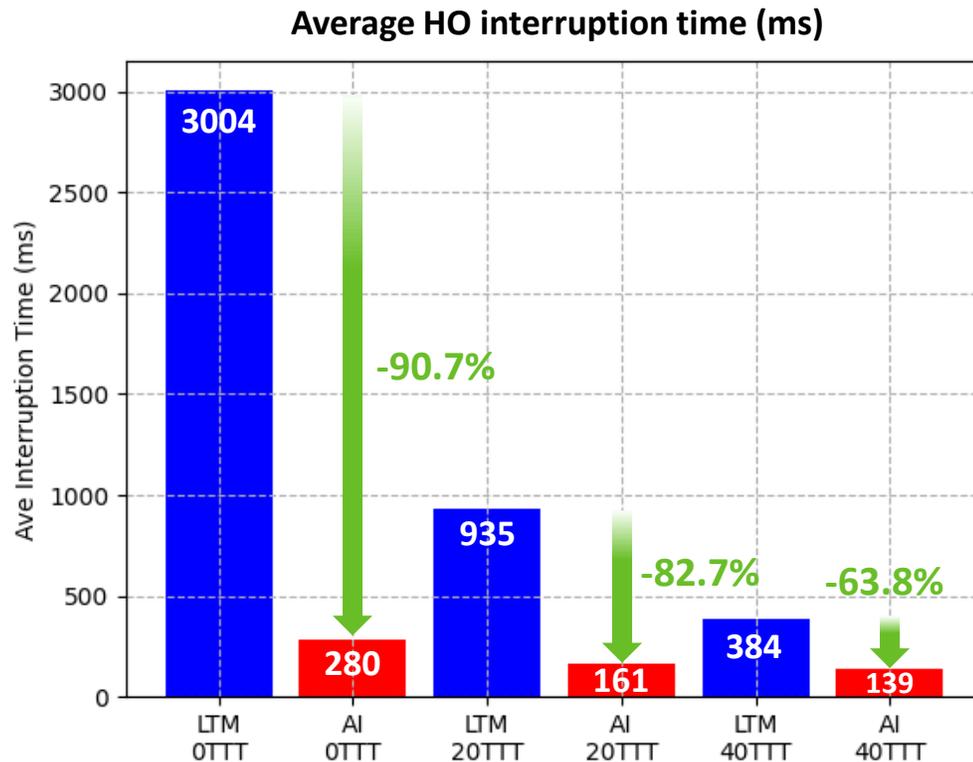
- To learn the pattern from the dataset and
- To predict target cell from previous measurement
- Inputs: each beam pair's RSRP, CSI, etc.
- Output: Target Cell id
- AI Model: CNN, LSTM, Transformer, etc.



Proposal

AI-based Target Cell Prediction – Evaluation

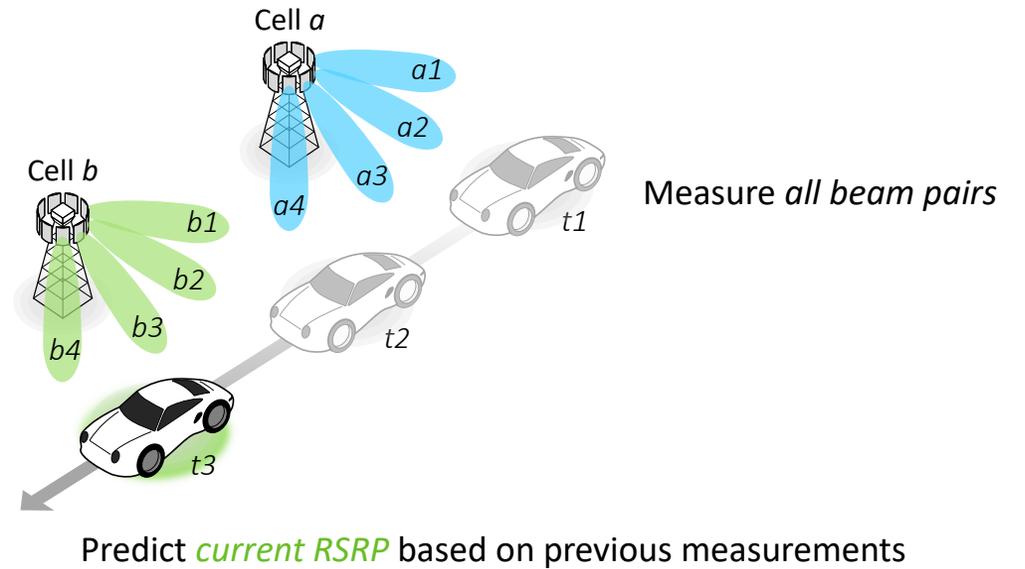
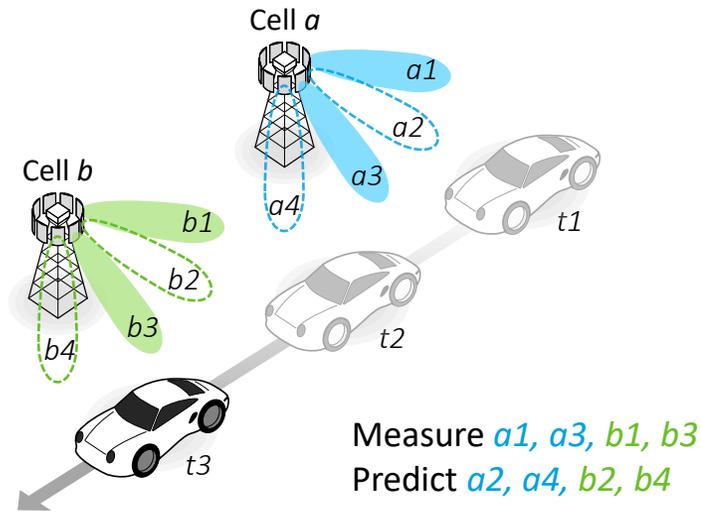
AI can **reduce the HO interruption** time and **lengthen Time of Stay** by making the cell switch decision based on multiple future step predictions



Proposal

AI-assisted RRM measurement

- Spatial-domain cell/beam prediction across cells
- Temporal-domain cell/beam prediction across cells



Consider both intra-frequency and inter-frequency RRM measurements

Proposal Summary

[5/5]

- **AI-based target cell prediction**
 - Reduce mobility latency and improve mobility reliability by making mobility faster and accurate in space and time
 - Reduce HO interruption and improve throughput
 - Prediction can be at UE-side or network side
- **AI-assisted RRM measurement**
 - Predict RRM measurement to reduce measurement effort and need for measurement gaps
- **Scenarios: Mobility in both FR1 and FR2**
- **Proposal: Agree to consider AI-based mobility as a RAN2-led study item in Rel-19.**

Proposal (Objectives)

SA/CT Dependency: (Yes)

Key Message: To study the applicability and benefits of AI/ML techniques for mobility

Objective I: Identify the mobility use cases which can obtain benefits from AI/ML techniques[RAN2]

- HO execution enhancement: target cell prediction, improve mobility performance and UE throughput
- RRM measurement enhancement: beams/cell prediction of serving/neighbor cell of intra-frequency/inter-frequency, for overhead and latency reduction

Objective II: Evaluate the performance benefits of AI/ML-based algorithms for the agreed use cases [RAN2]

- Methodology based on statistical models for system level simulation
- KPIs: Determine the common KPIs and corresponding requirements for the AI/ML operations, determine the use-case specific KPIs and benchmarks of the selected use-cases

Objective III: Assess potential specification impact [RAN1/RAN2/RAN3/RAN4]

- Data collection through L1 measurement and reports for model training, inference and monitoring [RAN1]
- Protocol aspects: mobility procedure with AI/ML techniques, the potential specification of the AI Model lifecycle management, dataset construction for training, validation and test, configuration and control procedures (training/inference), management of data and AI/ML model [RAN2]
- Signaling/procedure over Xn and F1 interface to support mobility procedure with AI/ML techniques [RAN3]
- Interoperability and testability aspects, e.g., (RAN4)

NOTE: The framework, terminology and high-level principle for AI-assisted mobility is based on the Rel-18 study on AI/ML for radio interface

Expected TU

RAN	2024												2025 [Calendar TBC at the time of writing]												2026		
	Q1			Q2			Q3			Q4			Q1			Q2			Q3			Q4			Q1		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
	103			104			105			106			107			108			109			110			111		
R1	115b	116		116b	117			118		118b	119		119b	120		120b	121			122		122b	123		123b	124	
R2	124b	125		125b	126			127		127b	128		128b	129		129b	130			131		131b	132				
R3	122b	123		123b	124			125		125b	126		126b	127		127b	128			129		129b	130				
R4	109b	110		110b	111			112		112b	113		113b	114		114b	115			116		116b	117		117b	118	
R1		0		0	0			0		0	0.5			0.5		0.5	0.5										
R2				2	2			2		2	2			2		2	2			2							
R3				0	0			0		0.5	0.5			0.5		0.5	1			1							
R4 RD				0	0			0		0	0			0		1	1			1							
R4 RF				0	0			0		0	0			0		0	0			0							

Study TU

Feature TU



Thank You!

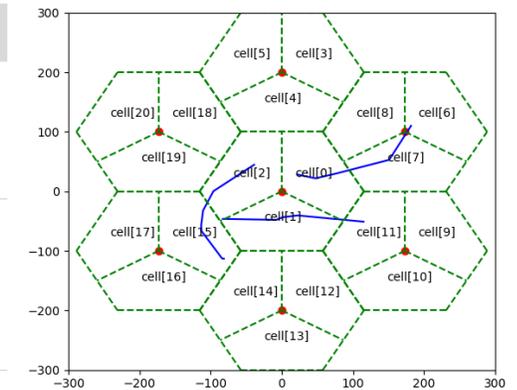
Appendix: Simulation Assumptions

AI-based Target Cell Prediction

Parameter	Value
NW Topology	21 cells with ISD-200m 7 sites, 3 sectors/cells per site
Channel model	UMa
UE moving speed	30km/h
Frequency and BW	FR2 @30GHz
SCS	60KHz
System BW	100MHz
Antenna setting (M,N,P,Mg,Ng)	BS (4,8,2,1,1) MS (1,2,2,1,2)
Beam setting	Tx beam: 24 Rx beam: 1
BS antenna height	25m
UE antenna height	1.5m
BS Tx power	46dBm
HO execution time	25ms

- Linear trajectory model with random direction change
 - As for eval. of AI/ML for BM (Option 2) agreed in RAN1#109
 - UE moves along a selected direction within a given time interval and changes direction at the end of the time interval

Parameter	Value
Time interval distribution	Exponential distribution: average 5s, granularity 100ms
Change direction (angle difference)	uniform distribution within $[-45^\circ, 45^\circ]$
Run time per UE trajectory	20s
UE speed	30km/hr



Three different UE trajectories (illustration)