

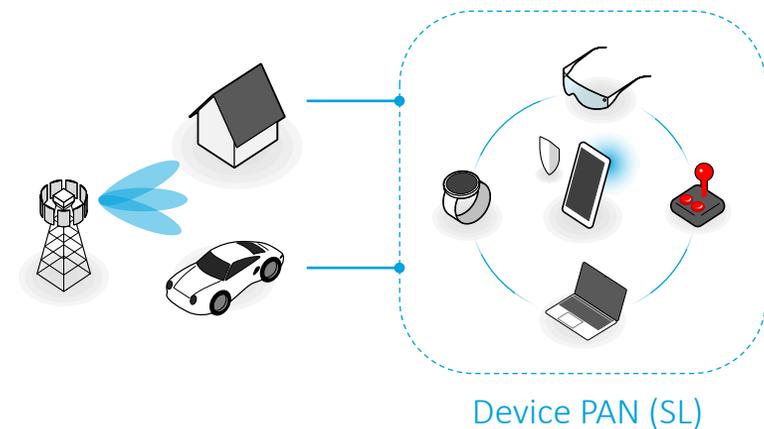
# **[RAN1 led] Sidelink Enhancements**

## **[WI]**

# Motivation

- Some imbalance between Uu and SL performance (e.g. Tput, Latency) can lead to:
  - Forced perf. degradation for Relay-based coverage extension;
  - Unnecessary restriction of services/application running over SL
- Increasing interest and demand for proximity communication between devices incl. tethering, collaborative computing
- Very-low-power operation in unlicensed spectrum is introduced/being introduced in regulations
  - This enables low power, low-cost solutions whilst also reducing interference (for China, LBT is also not required)
  - Without LBT this provides a sound environment for low-latency device-device communication e.g. XR
- SL FR2 (licensed) study in R18

- Scenarios
  - Incl. indoor, in-car
  - Proximity network incl.
    - Wearable devices
    - In-car communication
    - Collaborative computing
  - SL tethering XR
    - SP to XR headset rendering



# Proposal

[1/2]

- SL FR1
  - CA
    - Licensed+ licensed
    - Licensed + unlicensed
    - Unlicensed + unlicensed
  - Very-low-power (VLP) Operation for SL-U
- Specify support for SL FR2 (licensed)
  - Beam: initial pairing, management, recovery, etc.
  - Cast type: broadcast/unicast
  - (FR2+FR2 CA)
  - Frequency band: FR2-1

SA/CT Dependency: No

Key Message: Introduction of remainign SL enh. incl. SL CA in FR1, support for SL in FR2 licensed [incl. FR2 CA], and support for Very Low Power (VLP)

**Objective I: Support SL-CA [RAN2-led]**

- Support SL-CA at least for FR1 with following band combinations: [RAN2/RAN1]
  - Licensed + Licensed
  - Licensed + Unlicensed
  - Unlicensed + Unlicensed at least for FR1.
- RF/RRM impact by SL-CA [RAN4]

NOTE: no SL CA FR1+FR2

**Objective II: Support SL FR2 for operation in the licensed band (FR2-1) [RAN1-led]**

- Support SL operation for unicast and broadcast inc. initial beam pairing, beam maintenance, beam recovery [RAN1/RAN2]
- RF/RRM impact by SL FR2 [RAN4]

**Objective III: Very-low-power operation mode in SL-U for power saving, complexity reduction and interference mitigation [RAN1-led]**

- Study and Specify VLP operation for SL-U in accordance with regulatory requirements [RAN1/RAN2]
- RF/RRM impact by VLP operation for SL-U [RAN4]

# VLP for SL-U

## NR-U perf. in NR-U+SL-U with diff SL-U Max Tx power

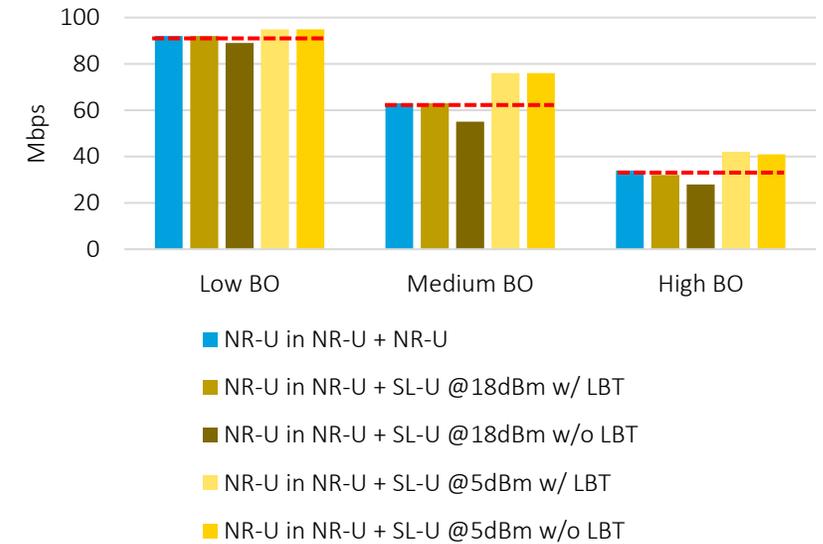
- Assumption: 5 SL-U Pairs with 5 NR-U UEs served by 3 NR-U BSs
- Observations
  - LBT is necessary to stabilize system interference especially for non-coordinated SL-U deployment with higher max transmission power (18dBm)
  - Compared with higher SL-U max Tx power (18dBm), the UPT of NR-U can be improved for the case of lower SL-U max transmission power (5dBm) for both LBT and no-LBT in coexistence scenario

Traffic loading	Low load				Medium load				High load						
	BO range for NR-U in NR-U + NR-U: 10%~25%				BO range for NR-U in NR-U + NR-U: 35%~50%				BO range for NR-U in NR-U + NR-U: above 55%						
Scenario	NR-U in NR-U+NR-U	NR-U in NR-U+SL-U		NR-U in NR-U+NR-U	NR-U in NR-U+SL-U		NR-U in NR-U+NR-U	NR-U in NR-U+SL-U		NR-U in NR-U+NR-U	NR-U in NR-U+SL-U				
	SL-U Max Tx power [dBm]	-	18	18	5	5	-	18	18	5	5	-	18	18	5
SL-U LBT	-	YES	NO	YES	NO	-	YES	NO	YES	NO	-	YES	NO	YES	NO
UPT [Mbps]	92	92	89↓	95	95↑	63	63	55↓	76	76↑	34	32	28↓	42	41↑
Delay [ms]	7.21	7.46	8.01	6.73	6.73	22.84	23.16	25.39	9.47	9.53	159	182	203	43.41	45.77
BO	16%	19%	19%	17%	17%	35%	36%	43%	35%	35%	55%	57%	58%	53%	54%

Max Tx power (dBm)	18	5
Avg serving distance(m)	15.5	5.8
Pairing RSRP (dBm)	-82	-82

EDT=-72dBm; CW=127

Avg. UPT of NR-U



CW: Congestion Window (#sensing slots - 9μs per slot)

# VLP for SL-U

## SL-U perf. in NR-U+SL-U with diff SL-U Max Tx power

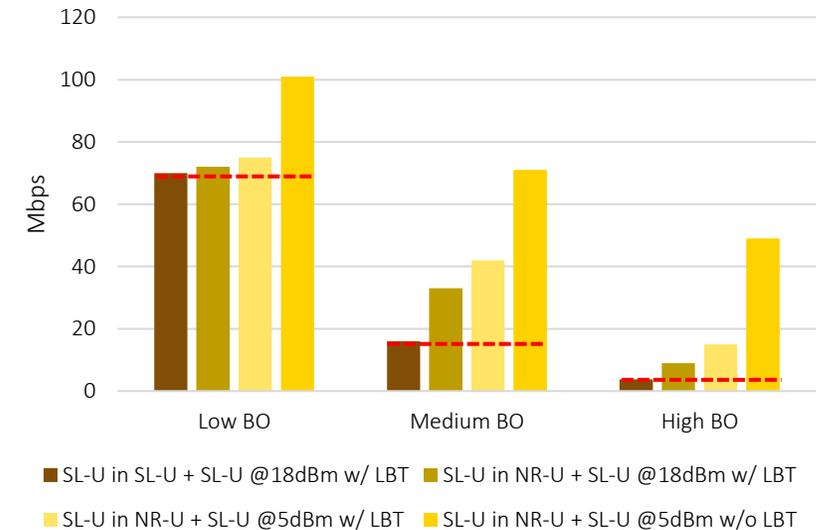
- Assumption: 5 SL-U Pairs with 5 NR-U UEs served by 3 NR-U BSs
- Observations
  - Compared to higher SL-U max Tx power (18dBm), the UPT performance of SL-U can be improved for the case of lower SL-U max Tx power (5dBm) for both cases of w/ LBT and w/o LBT in the coexistence scenario.
  - The best UPT perf of SL-U can be achieved for the case of lower SL-U max Tx power (5dBm) together w/ no-LBT operation in the coexistence scenario

Traffic loading	Low load				Medium load				High load			
	BO range for NR-U in NR-U + NR-U: 10%~25%				BO range for NR-U in NR-U + NR-U: 35%~50%				BO range for NR-U in NR-U + NR-U: above 55%			
Scenario	SL-U in SL-U+ SL-U	SL-U in NR-U+ SL-U			SL-U in SL-U+ SL-U	SL-U in NR-U+ SL-U			SL-U in SL-U+ SL-U	SL-U in NR-U+ SL-U		
	SL-U Max Tx power [dBm]	18	18	5	5	18	18	5	5	18	18	5
SL-U LBT	YES	YES	YES	NO	YES	YES	YES	NO	YES	YES	YES	NO
UPT [Mbps]	70	72↑	75↑↑	101↑↑↑	16	33↑	42↑↑	71↑↑↑	3.8	9↑	15↑↑	49↑↑↑
Delay [ms]	10.7	10.3	9.0	5.9	130	56.7	49.5	9.4	392	320	212	16.7
BO	17%	16%	15%	8%	84%	63%	54%	29%	99%	89%	83%	56%

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Avg. UPT of SL-U



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# 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
	<b>103</b>			<b>104</b>			<b>105</b>			<b>106</b>			<b>107</b>			<b>108</b>			<b>109</b>			<b>110</b>			<b>111</b>		
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		1		1	1			1		1	1			1		1	1										
R2				0.5	0.5			0.5		0.5	0.5			0.5		0.5	0.5			0.5							
R3				N/A	N/A			N/A		N/A	N/A			N/A		N/A	N/A			N/A							
R4 RD				0	0			0		0.25	0.25			0.25		0.25	0.25			0.25		0.25	0.25			0.25	
R4 RF				0	0			0		0.25	0.25			0		0	0			0							

Study TU  
Feature TU



NOTE: RAN4 RF TU for potential frequency bands related issues for CA and FR2 if any 7

**Thank you!**