3GPP TSG RAN Meeting #65
Edinburgh, Scotland
9 - 12 September 2014

RP-141120

Agenda Item: 14.1.1

Motivation for Study on Elevation Beamforming/FD-MIMO for LTE

Samsung

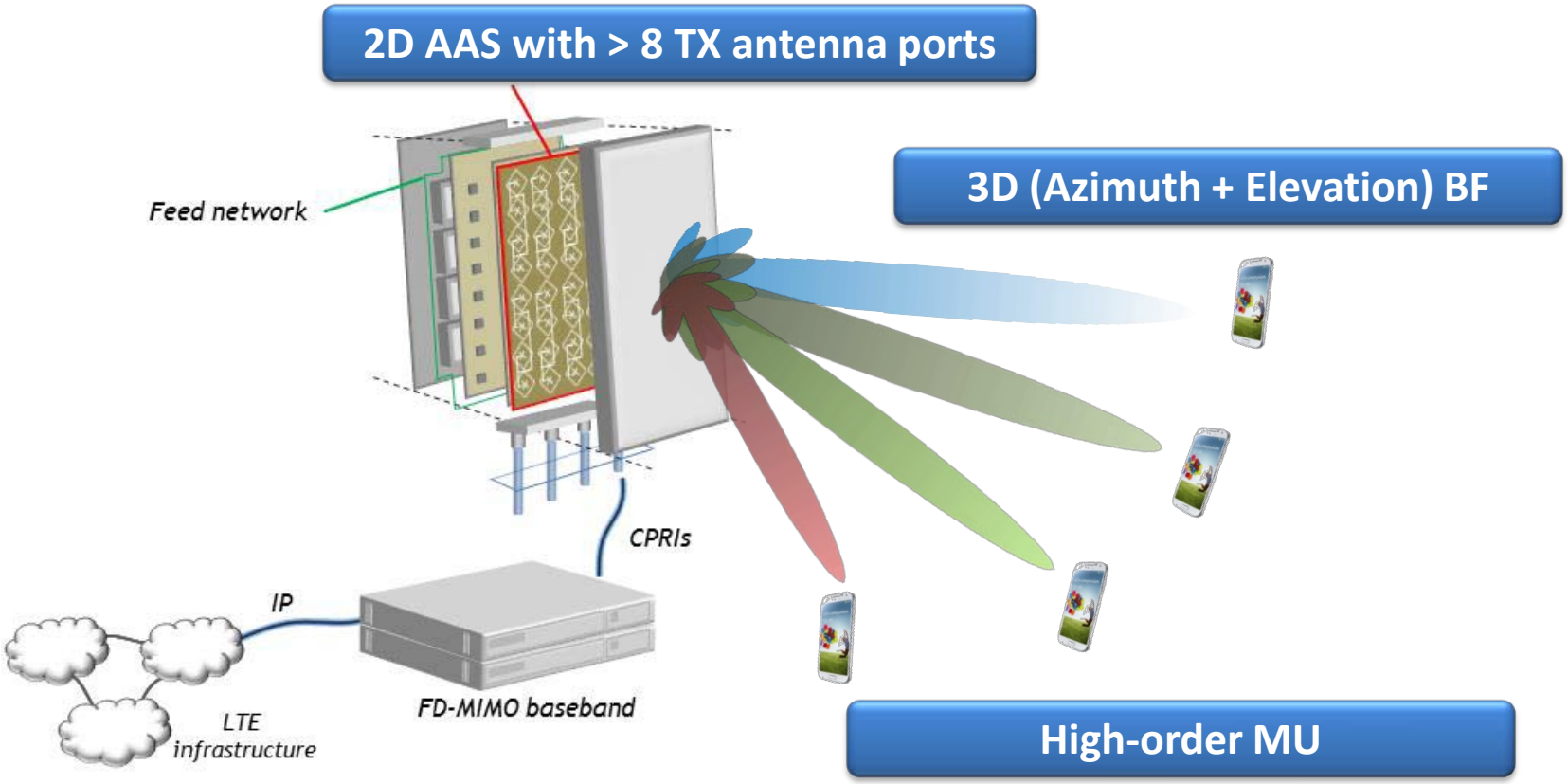
Introduction

- Many contributions were submitted to RAN workshop on Rel-12 and onwards discussing AAS, elevation beamforming and full-dimension MIMO (FD-MIMO)
  - RWS-120002, Release 12 for C4 (Cost, Coverage, Coordination with small cells and Capacity), NSN
  - RWS-120003, Views on Rel-12, Ericsson & ST-Ericsson
  - RWS-120005, Views on Release 12, Orange
  - RWS-120006, Views on Rel-12 and onwards for LTE and UMTS, Huawei Technologies, HiSilicon
  - RWS-120011, Where to improve Rel-12 and beyond: Promising technologies, NEC
  - RWS-120014, Towards LTE RAN Evolution, ALU
  - RWS-120029, Views on LTE Rel-12 & Beyond, CMCC
  - RWS-120034, Views on 3GPP Rel-12 and Beyond, ZTE
  - RWS-120046, Technologies for Rel-12 and onwards, Samsung

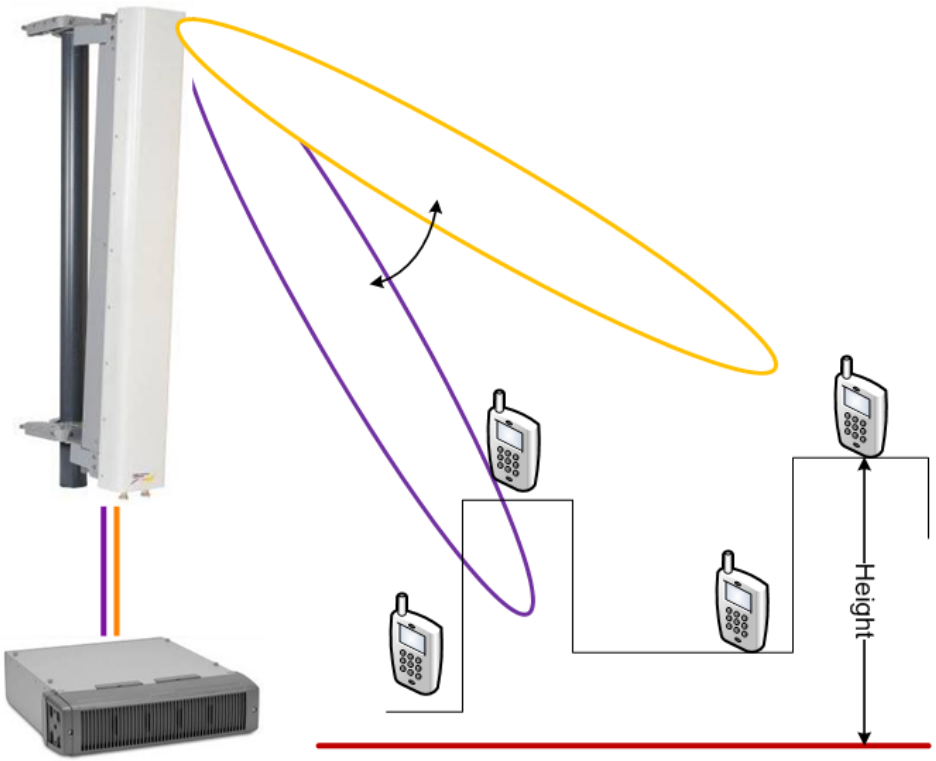
- FS_LTE_3D_channel SI (RP-122034, RP-130811) is now completed, hence it is right time to initiate a SI on Elevation Beamforming/FD-MIMO

Full-Dimension MIMO

Solution for enhanced capacity demand for both macro and small Cells



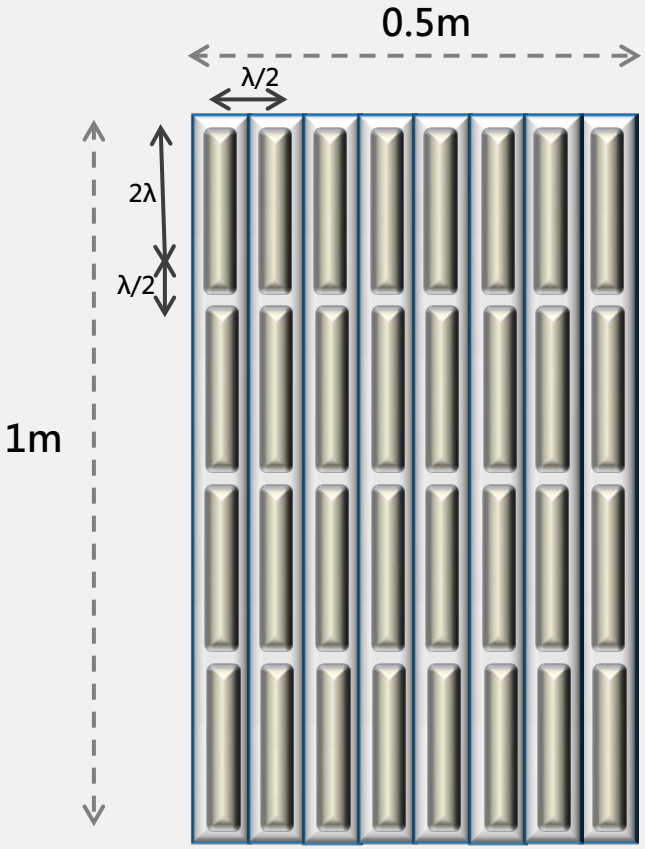
Elevation beamforming



Showing the size of an AAS column @2 GHz band with 8 total ports (4 ports in elevation at +/-45^0 each)

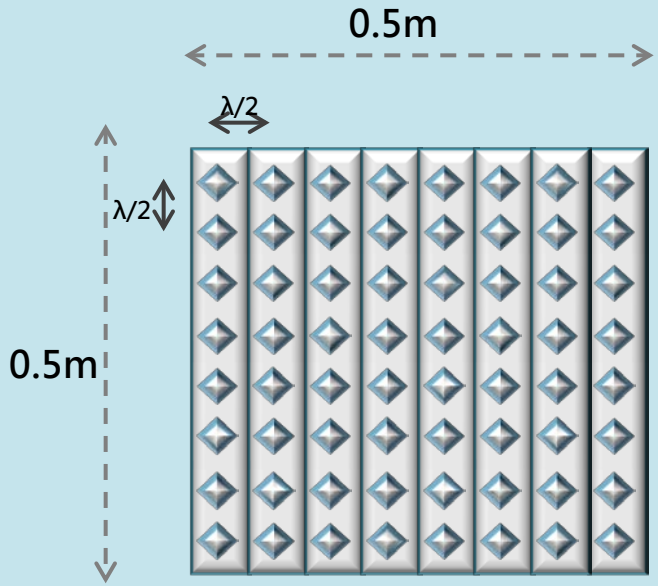
- Supports Vertical sectorization and UE Specific elevation beamforming
- Up to 8 Tx Antenna Ports
- Elevation dimension is used to dynamically focus energy to UEs at different floors
- MU-MIMO in elevation dimension is attractive due to narrow angle spread

Examples of 2D AAS Form Factor



Eg. 1: 8x4 with subarrays each comprising 4 elements with analog beamforming

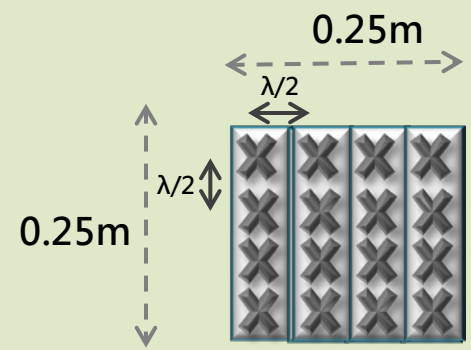
Macro Cells



Eg.2: 8x8 array with full digital beamforming across 64 elements

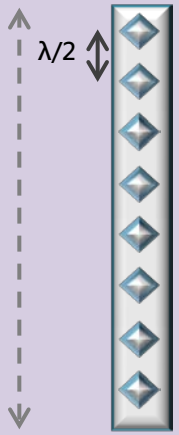
Macro Cells

λ=12cm
@ 2.5GHz



Eg.3: 4x4 full-digital cross-pol array

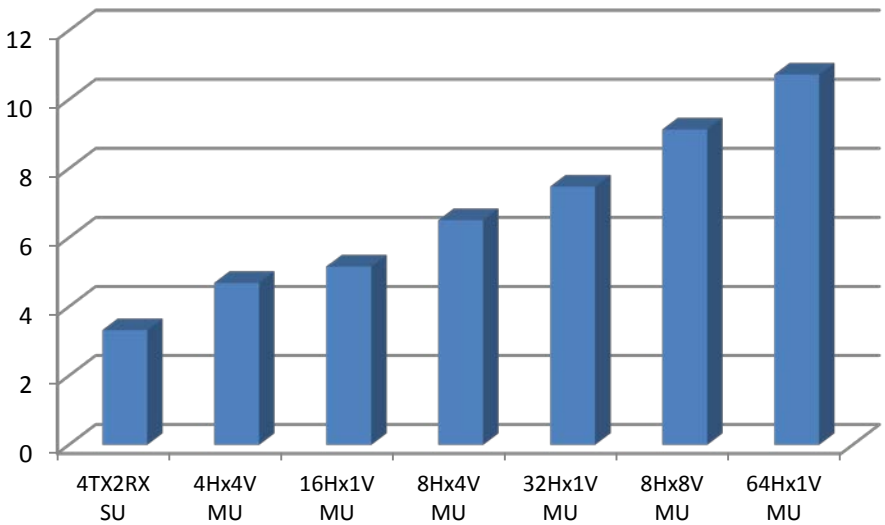
Small Cells



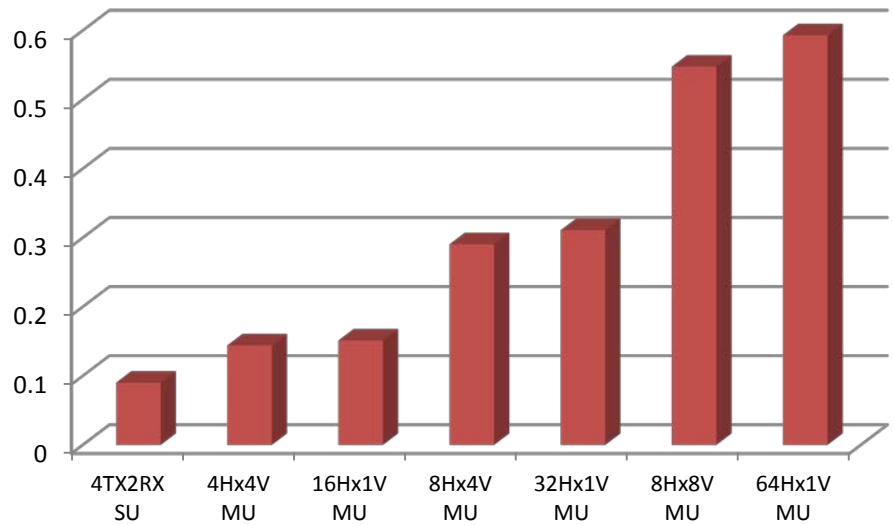
Eg.4: 1x8 array. Digital elevation beamforming

FD-MIMO antenna panel form factor is well within practical range

Preliminary Performance Analysis



Average cell throughput



Cell edge throughput

- 57 sectors, 10 full-buffer UEs/sector
- 3D-UMa with ideal CSI

BS Antenna configuration	4Tx 2RX SU	(4Hx4V) MU, $d_H=d_V=0.5\lambda$	(8Hx4V) MU, $d_H=d_V=0.5\lambda$	(8Hx8V) MU, $d_H=d_V=0.5\lambda$	(64Hx1V) MU, $d_H=0.5\lambda$, $d_V = 0.5\lambda$
Half power beamwidth (H, V)	(70, 10)	(65, 65)	(65, 65)	(65, 65)	**(65, 65)**
Cell average throughput (bps/Hz)	3.320	4.690	6.523	9.14	**11.96**
Cell edge throughput (bps/Hz)	0.090	0.143	0.290	0.570	**0.630**

Overall Plan

- The study aims to understand performance benefit of standard enhancements targeting two-dimensional antenna array operation (including a single column of cross-poles) with {8, 16, 32, 64} transceiver units (TXRUs) per transmission point, where a TXRU has its own independent amplitude and phase control
  - Phase 1: Identify antenna configurations and evaluation scenarios, and evaluate the performance of Rel-12 downlink MIMO using 3D channel model with realistic non-full buffer traffic model
  - Phase 2: Study enhancements and assess the performance benefit of enhancements to the standard. Develop design principles for the identified techniques and identify potential specification impact

- Intention is to finalize a follow-up work item targeting Rel-13

- **Expected outcome and time scale**

New specifications [If Study Item, one TR is anticipated]						
Spec No.	Title	1st rsp. WG	2nd rsp. WG(s)	Presented for information at plenary#	Approved at plenary #	Comments
TR36.xxx	Feasibility study on elevation beamforming/FD-MIMO for LTE	RAN1		RAN#66	RAN#67	

- **RAN time budget proposal**

RAN #65										Q4/2014									RAN #66
R1L	R1U	R2L	R2U	R2J	R3	R4RF Core	R4RD Core	R4RF Perf	R4RD Perf	R1L	R1U	R2L	R2U	R2J	R3	R4RF Core	R4RD Core	R4RF Perf	R4RD Perf
78bis	78bis	87bis	87bis	87bis	85bis	72bis	72bis	72bis	72bis	79	79	88	88	88	86	73	73	73	73
3										**4**									

RAN #66					Q1/2015				RAN #67
R1L	R1U	R2L	R2U	R2J	R3	R4RF Core	R4RD Core	R4RF Perf	R4RD Perf
80	80	89	89	89	87	74	74	74	74
5									