

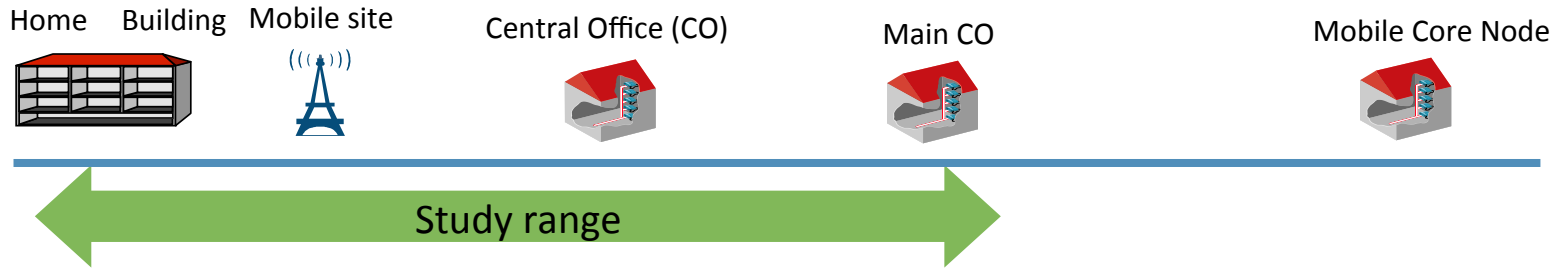
# *Fixed–mobile Convergence: Structural convergence*

## *Technology dimensioning and cost modelling*

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# Geo model – key parameters



Numbers per Main CO area

	Ultra dense urban	Urban	Sub-urban	Rural
Avg. number of COs	1	2.9	5.9	10.8
Avg. Main CO area size	2 km <sup>2</sup>	15 km <sup>2</sup>	142 km <sup>2</sup>	615 km <sup>2</sup>
Avg. number of buildings	2,440	6,850	20,400	22,000
Avg. number of homes	15,820	44,500	51,000	33,000
Avg. number of cabinets	100	285	380	325
Avg. Macro BS density	4 / km <sup>2</sup>	1.5 / km <sup>2</sup>	0.2 / km <sup>2</sup>	0.05 / km <sup>2</sup>
Avg. number of Macro BS	8	23	29	31
	Number of public outdoor SC*			
Min. case (3 per Macro BS)	24	69	87	0
Med. case (10 per Macro BS)	80	230	290	
Max. case (30 per Macro BS)	240	690	870	

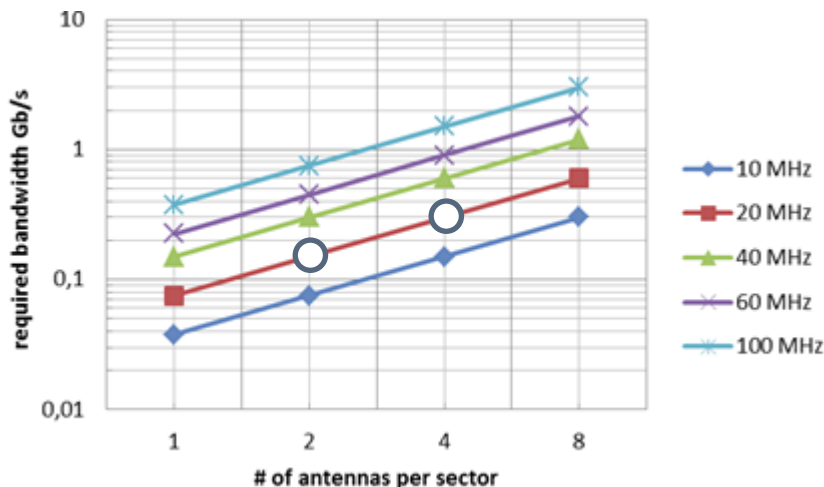
Distances

	Ultra dense urban	Urban	Sub-urban	Rural
Distances BS ↔ CO				
Avg.	0.5 km	1.5 km	2.5 km	3.5 km
Max.	2 km	3 km	4 km	5 km
Distances CO ↔ Main CO				
Avg.	-	1.9 km	5.9 km	15.6 km
Max.	-	10 km	30 km	50 km

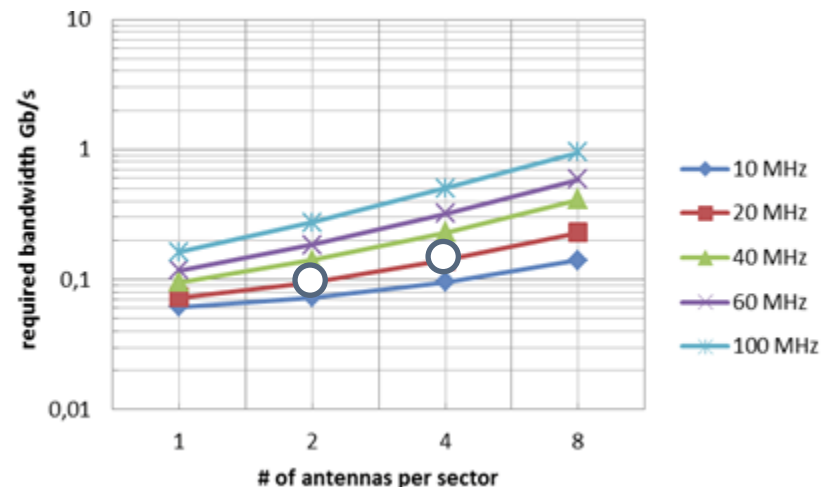
\* Public indoor small cells to be considered additionally if needed

# Required Backhaul bandwidth for a typical macro site

Data traffic S1 per macro site\*



Co-ordination traffic X2 between sites\*



Assumption on X2 traffic:  
50 Mb/s base rate + 0.3 x S1 traffic

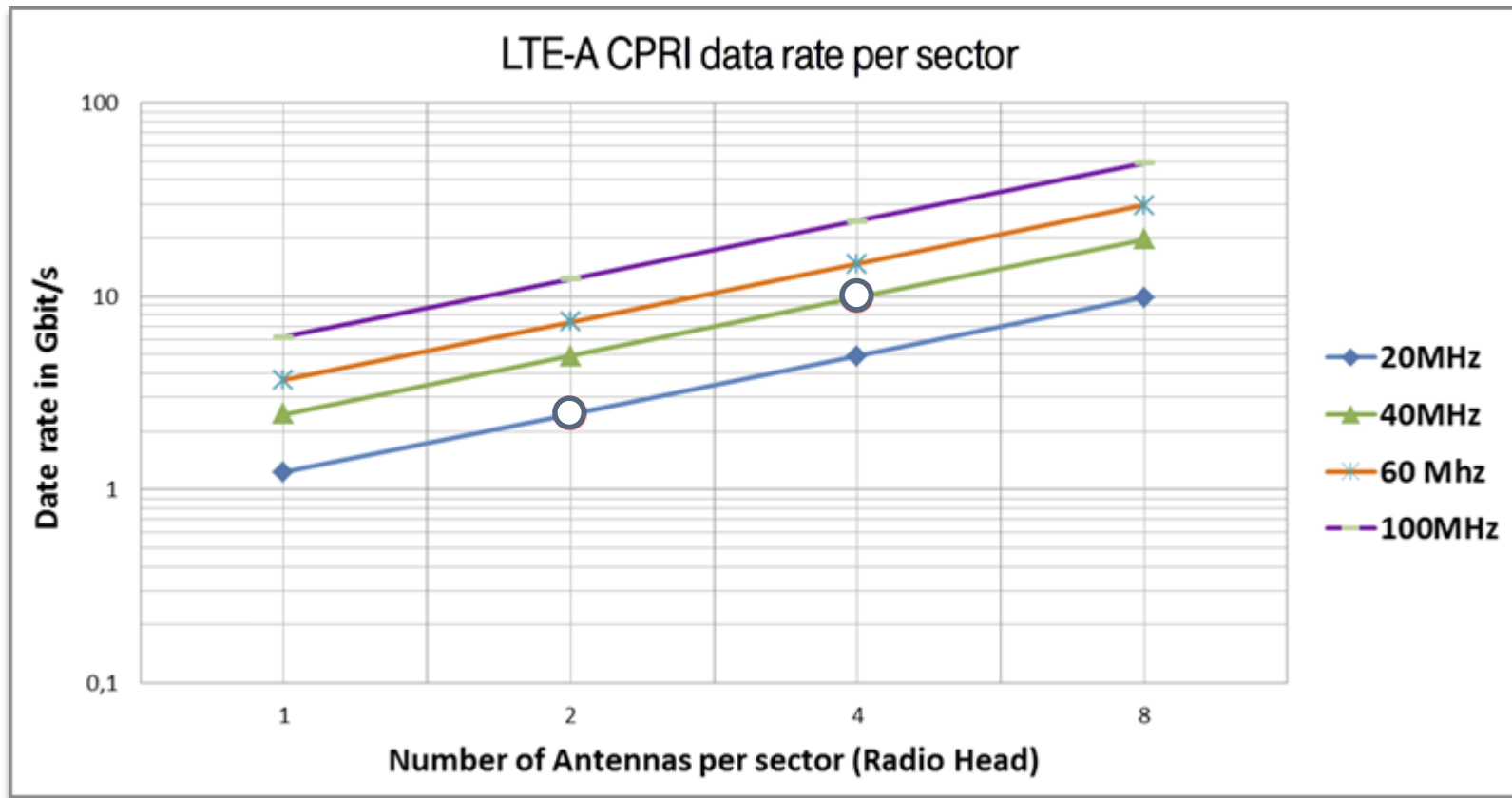
Considered for dimensioning example:

- Macro BS: 40 MHz with 4x4 MU-MIMO = 830 Mbps per macro base station
- Small cell Var.1: 20 MHz with 2x2 MIMO = 245 Mbps per small cell
- Small cell Var.2: 40 MHz with 4x4 MIMO = 830 Mbps per small cell

MIMO and larger spectrum as well as additional X2 traffic drive the need for >1G backhaul links

\*According to NGMN backhaul dimensioning rules: backhauling with peak data rate of one sector is sufficient for a site

# ***Fronthaul – LTE-A data rate of radio interface as function of radio bandwidth & antennas***



- Considered for dimensioning example:
    - LTE-A Macro BS: 40 MHz with 4x4 MIMO = 10 Gbps per sector → 3 CPRI links per MBS (Daisy chaining of 2 frequency carriers per sector each 20MHz / 5 Gbps)
    - GSM/UMTS Macro BS: 1 Gbps for three GSM sectors and 3 Gbps for three UMTS sectors → 2 CPRI links per MBS (Daisy chaining of 3 sectors per technology)
    - LTE-A Small cell Var.1: 20 MHz with 2x2 MIMO = 2.5 Gbps per sector
    - LTE-A Small cell Var.2: 40 MHz with 4x4 MIMO = 10 Gbps per sector
- } 1 CPRI link per SC each

**CPRI data rate scales linear with number of antennas and radio bandwidth!**

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