Active antenna systems in RAN

Performance, challenges and evolution

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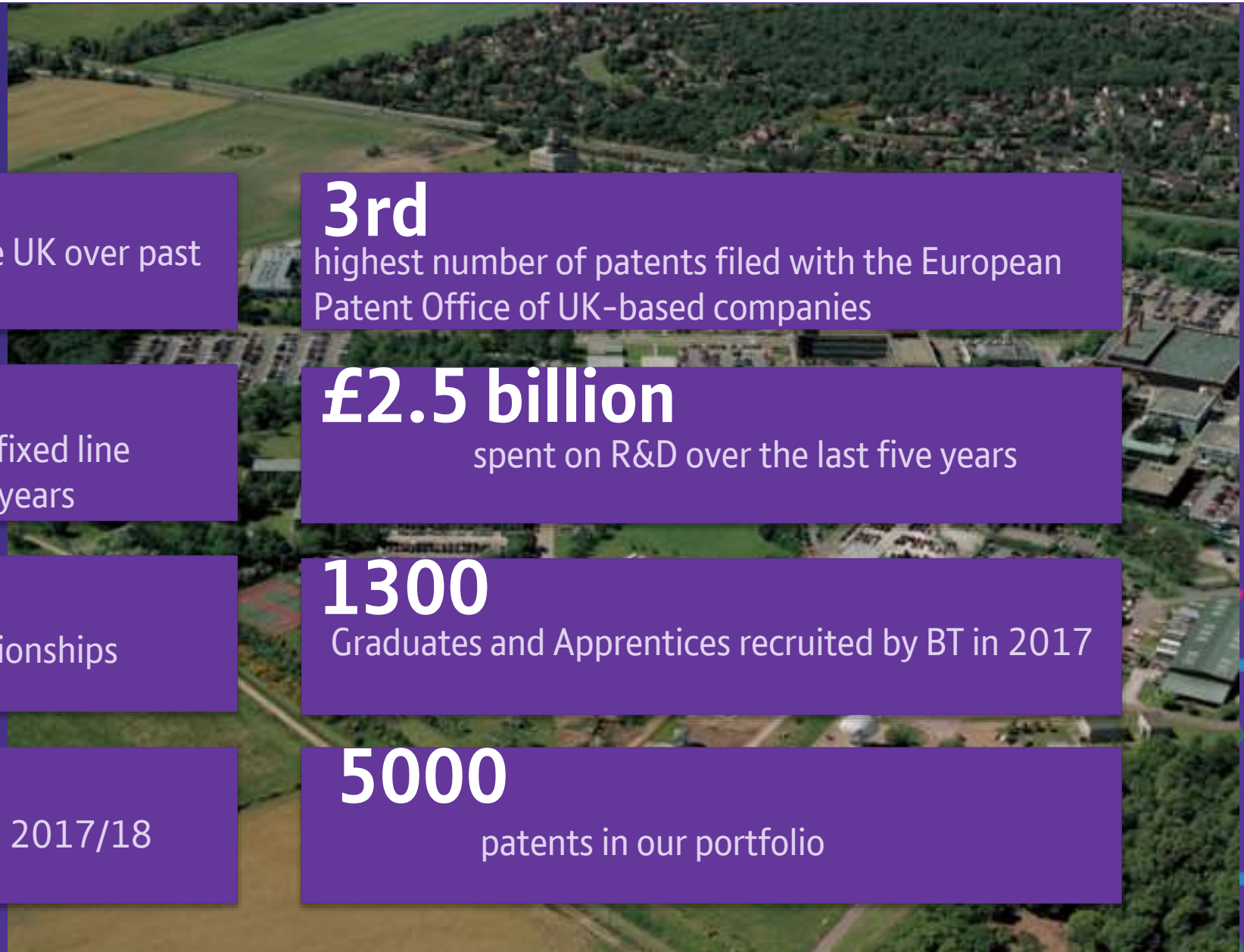
Overview

1. Capacity gains from active antennas and MU-MIMO
2. How these gains are achieved
3. Summary & future outlook

BT Research and Innovation



3rd
largest investor in R&D in the UK over past ten years*

3rd
highest number of patents filed with the European Patent Office of UK-based companies

2nd
largest investor in R&D in the fixed line telecoms sector over past ten years

£2.5 billion
spent on R&D over the last five years

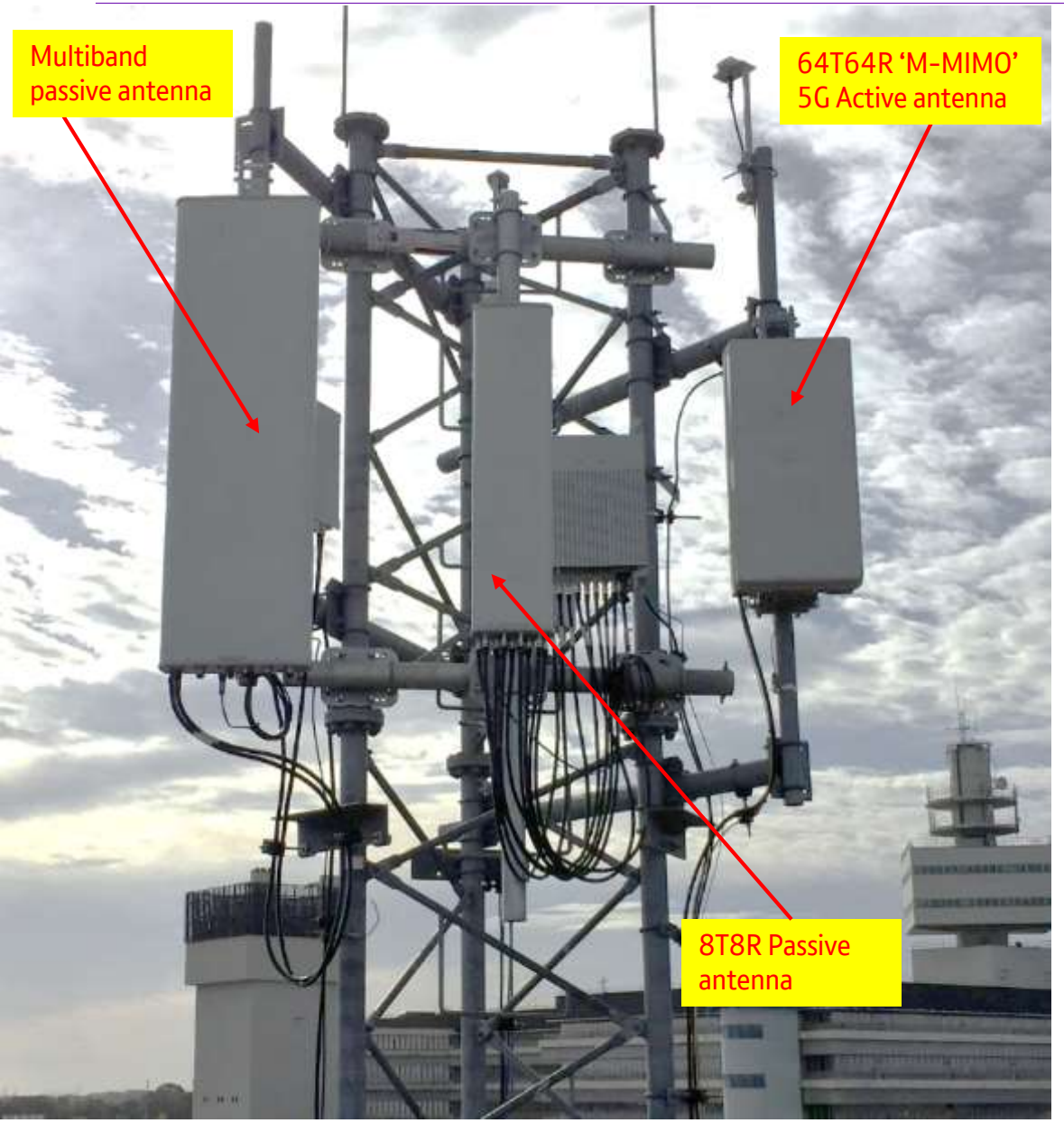
30+
Direct university research relationships

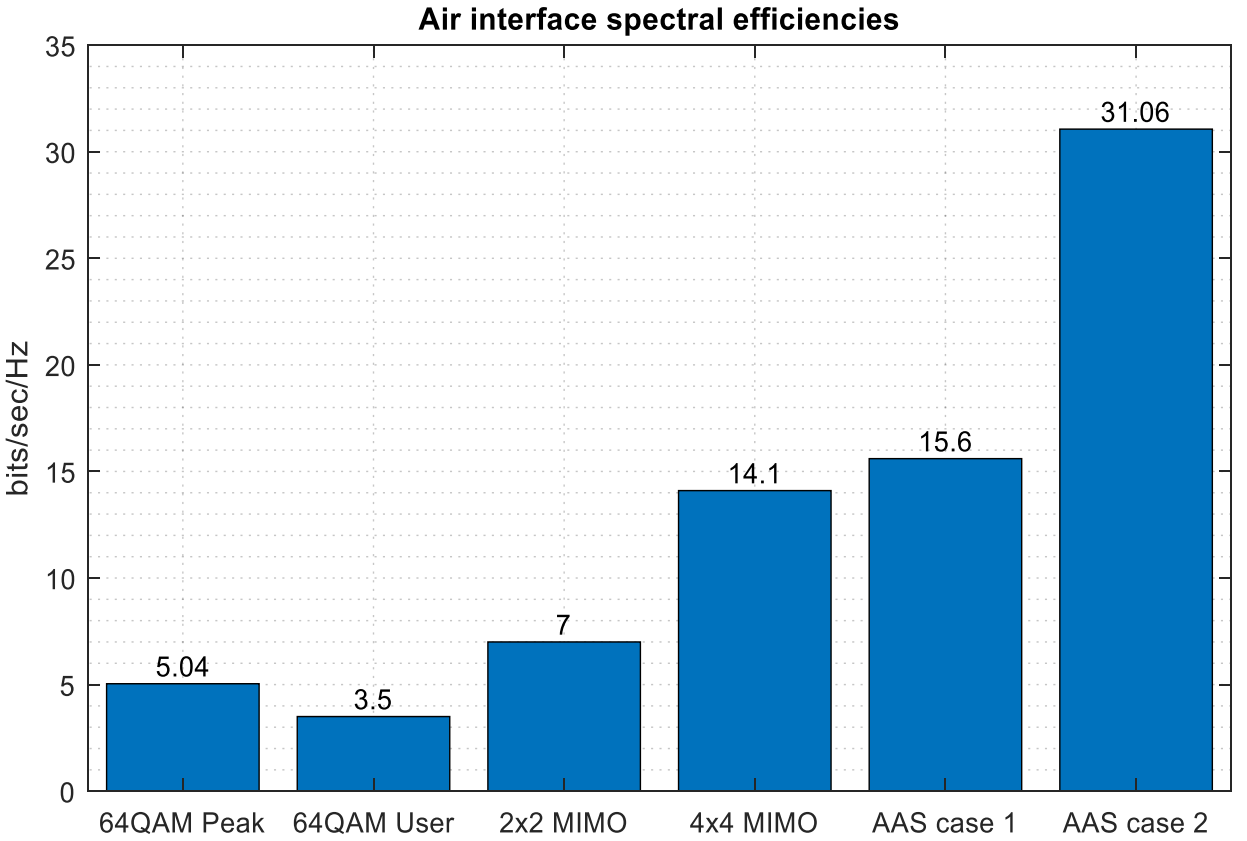
1300
Graduates and Apprentices recruited by BT in 2017

97
Number of inventions filed in 2017/18

5000
patents in our portfolio

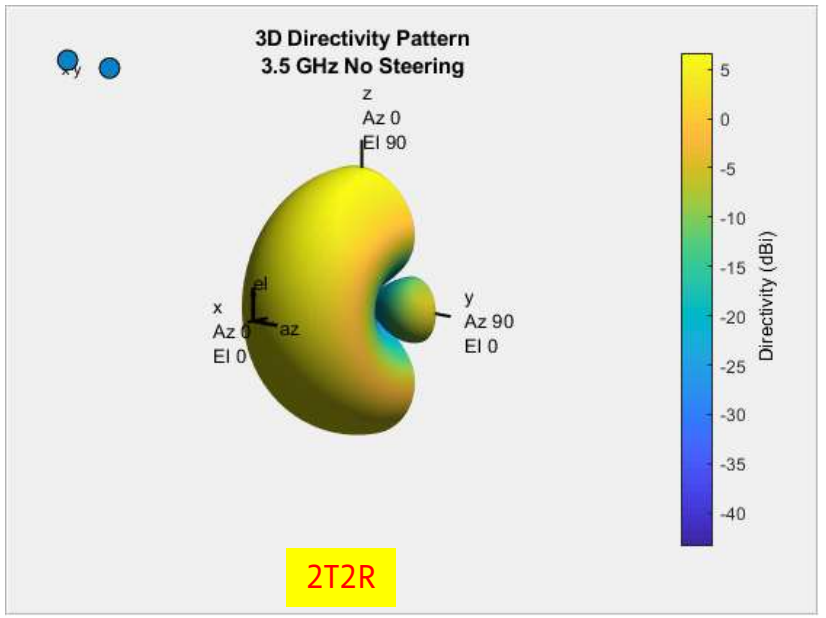
Active antenna systems & spectral efficiency





Calculated and measured cell spectral efficiencies, R&D trials.

How does it work? 1/2



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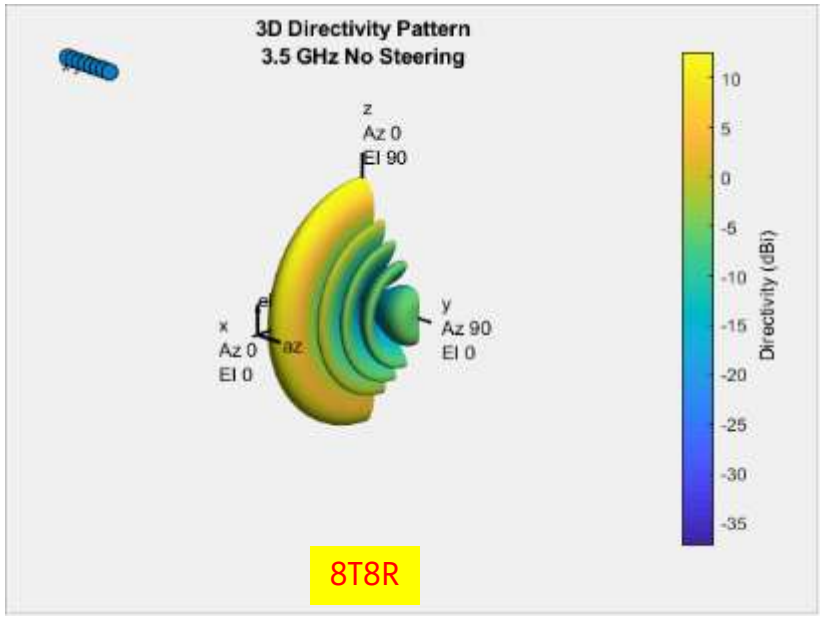
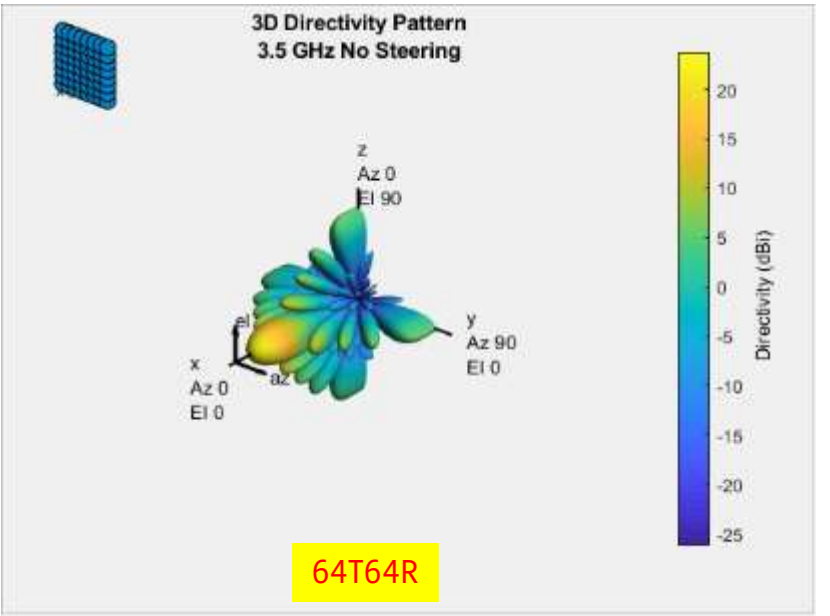


8T8R



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- **Antenna elements** redistribute input signal energy as E/M radiation
- **Antenna arrays** adjust superposition of E/M wave fronts
- **Baseband processors** control antenna arrays, e.g. point beams and nulls towards users or multipath directions

Array patterns are for simplified antenna configurations.

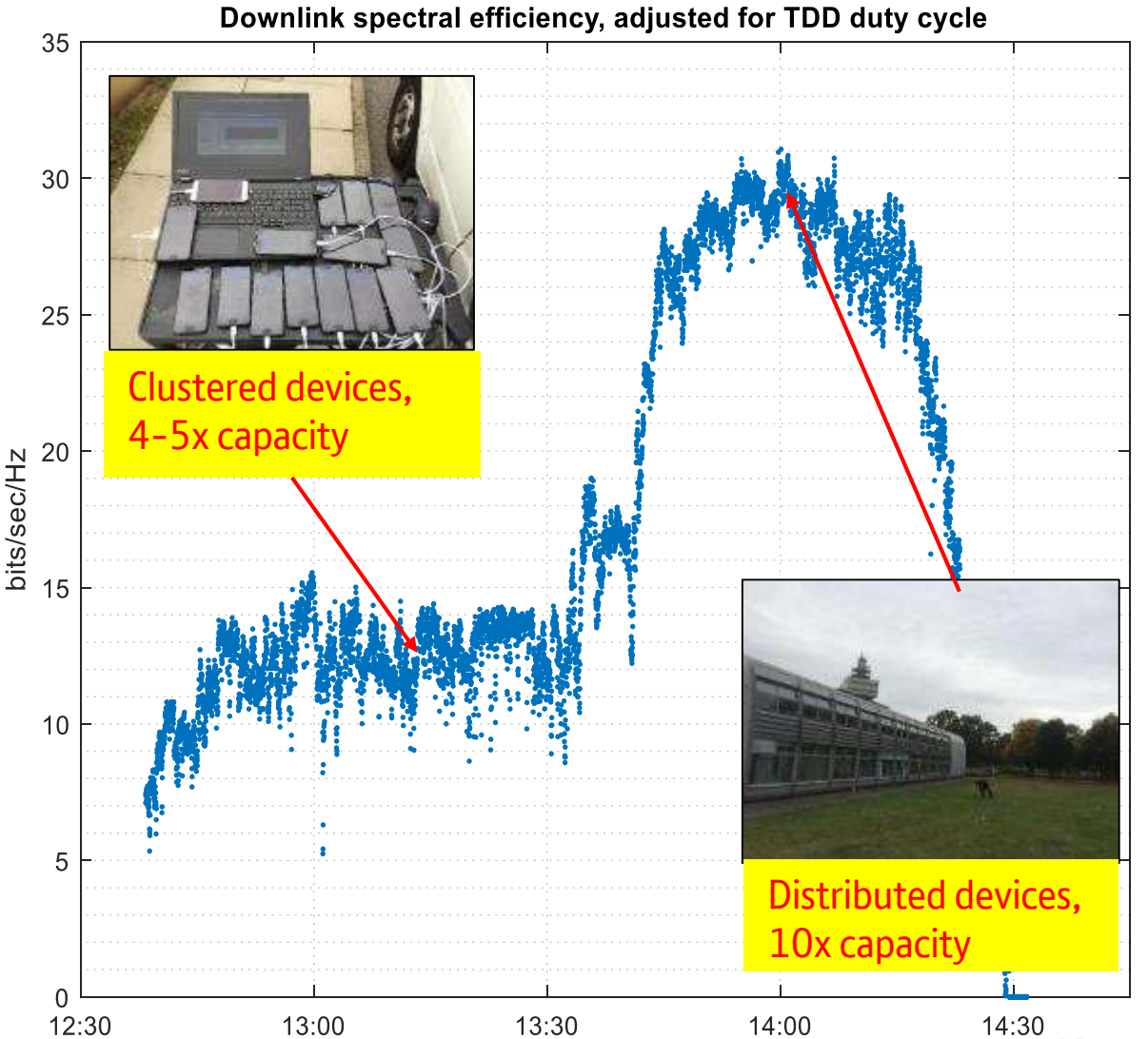
How does it work? 2/2

- **LTE TM7 peak user** DL spectral efficiency is ~3 bits/sec/Hz;
- This is adjusted to approx 76% DL symbols in a frame

- **Clustered user devices:** propagation conditions are highly correlated, yet cell efficiency achieves 5x of TM7;

- **Well-spaced user devices:** cell performance increases to 10x of TM7 due to better inter-user discrimination;

- Performance highly dependent on the operating environment, including clutter and user distribution.



Cell capacity comparison relative to single-layer TDD Config 2.

Summary & future outlook

Takeaway points:

1. Active antenna systems do provide cell capacity gains;
2. Fundamental principle is constructive/destructive addition of wave fronts – no magic here;
3. Actual performance depends on operating environment, including user distribution specifics;

Key points for future evolution:

- What are the practical limits of M-MIMO?
  - Academic results suggest infinite capacity – how much of that translates to practice?
- What are the efficient ways of measuring and predicting performance?
  - How do we deal with user-specific reference signals?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