



Mitigation of Human Exposure to RF Fields in Downlink of Millimeter-Wave Cellular Systems

Imtiaz Nasim and Seungmo Kim

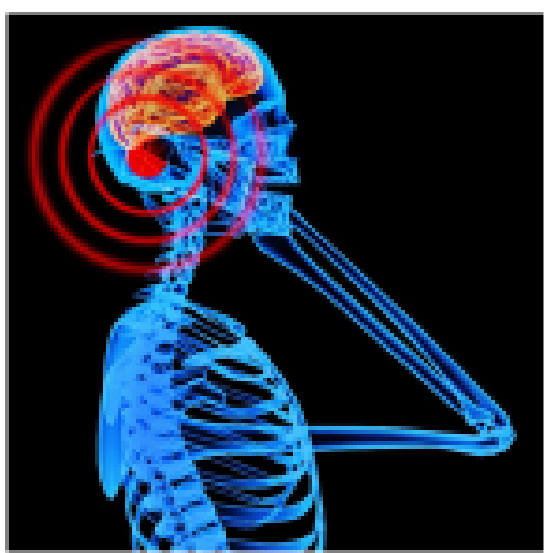
Introduction

- Cellular communications use electromagnetic waves!



State-of-the-Art

- Uplink



- Reduction of Tx power
 - May not be suitable for future cellular communications systems that require very high data rates

Motivation (1/2)

- Harness two main changes in future cellular networks

1. More transmitter devices

- Due to
 - Operation in very high frequency bands
 - Proliferation of small-cell networks
 - Proliferation of Internet of Things (IoT)
- Higher threats
 - Higher chance of human exposure to RF fields

Exploit as

- Wider selection of alternative beamforming paths

Motivation (2/2)

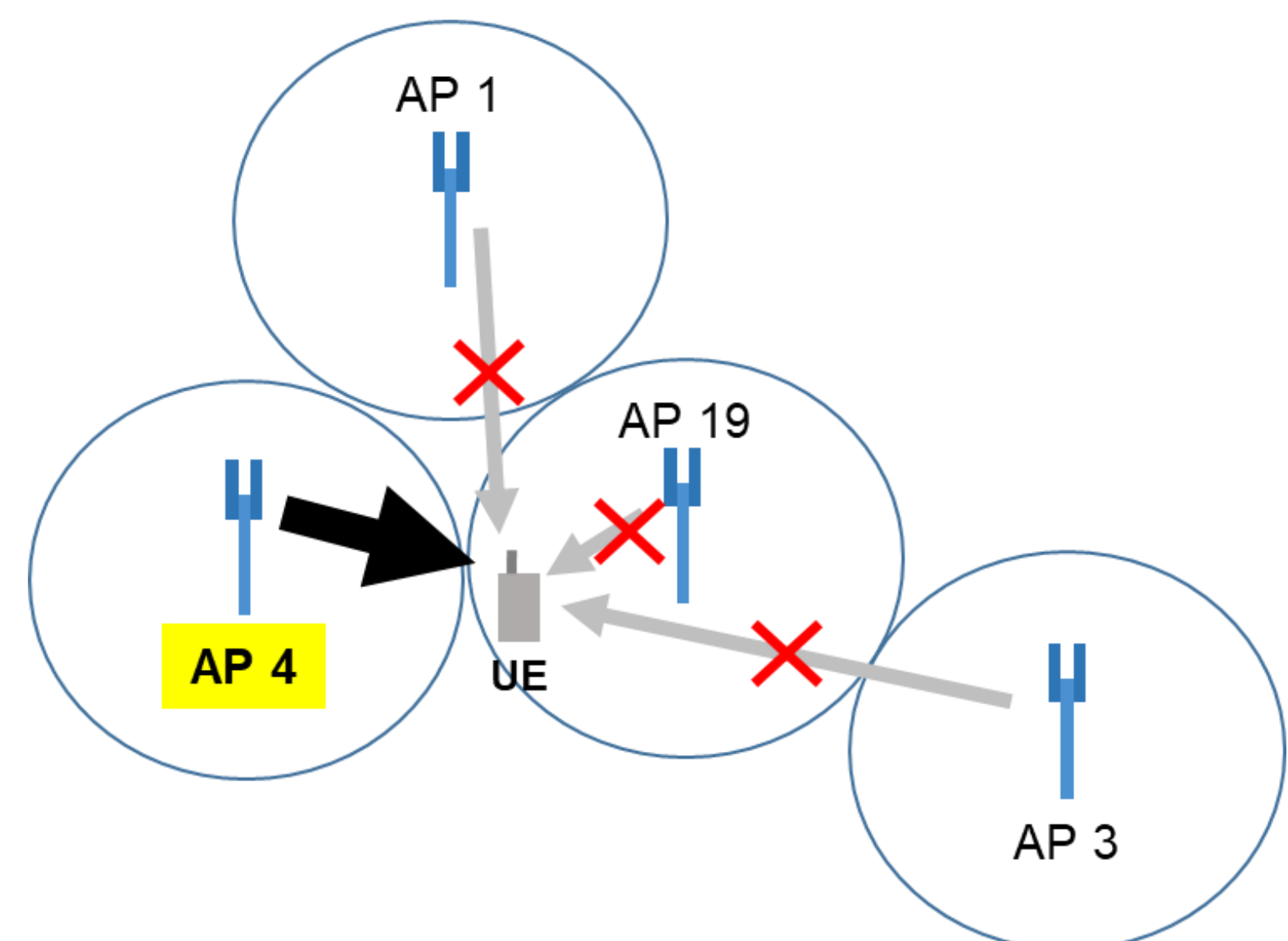
2. Narrower RF beams

- Due to
 - Operation in very high frequency bands
 - Technical enhancement in integration of antenna elements
- Higher threats
 - Higher concentration of RF energy per beam

Exploit as

- Finer target on a desired receiver

Proposed Protocol



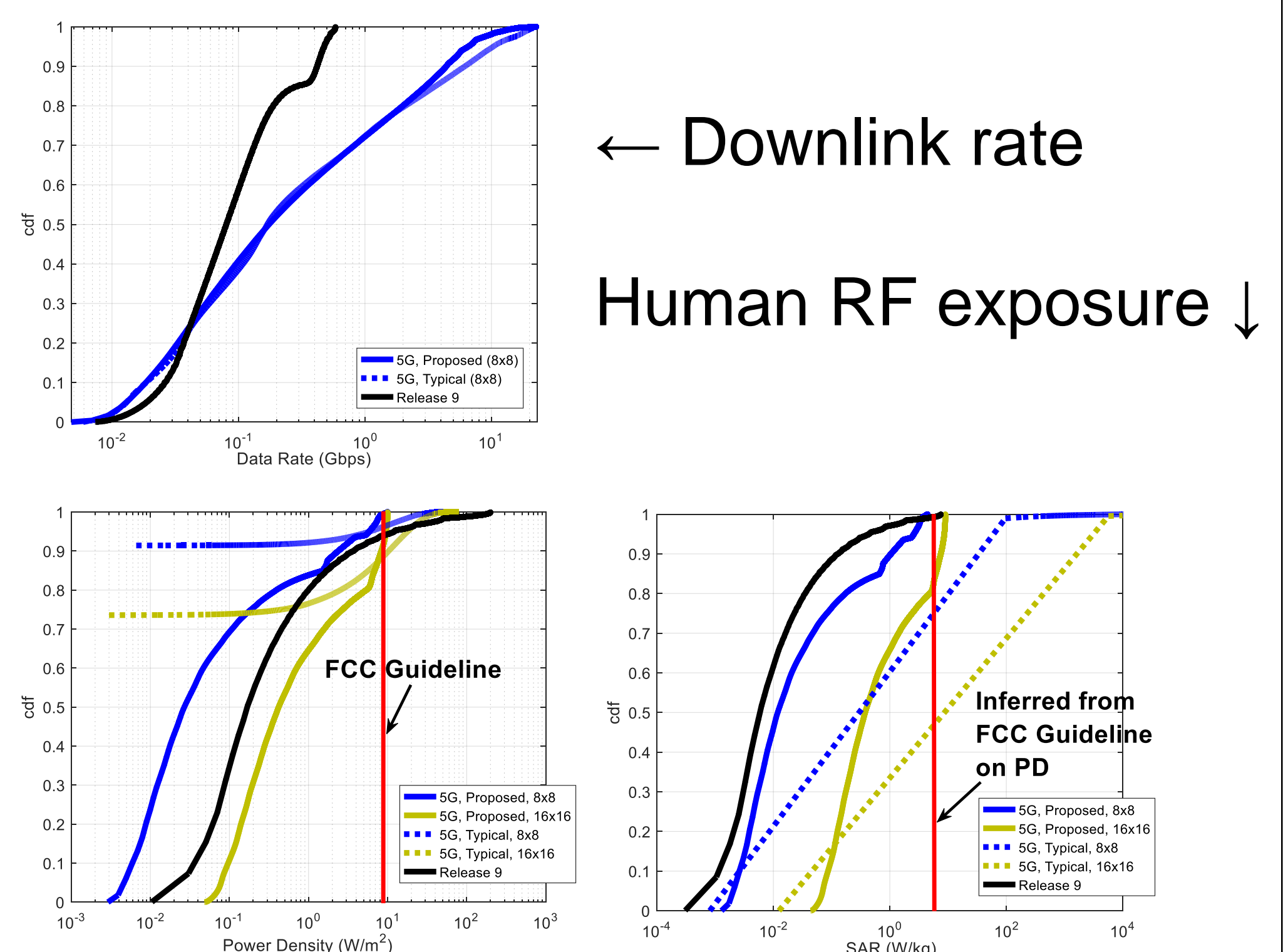
Typical protocol

AP	1	2	3	4	...	19
Data rate (Gbps)	8	3	8.2	5		8.6

Proposed protocol

AP	1	2	3	4	...	19
PD	11	6	12	8		13
Data rate (Gbps)	8	3	8.2	5		8.6

Results



Conclusions

- In the mmW standard, downlink is also worth notice.
- Our proposed protocol suppresses human RF exposure with small performance degradation.