

5G Networks and Signal Propagation

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Role of base stations (towers)

- Cells become smaller in size, but there are many more of them.
- To cover a city, we need a dense deployment of base stations.

Basic idea

The radio signal from the base station to the user attenuates along the path:

$$P_{\text{rx}} \propto \frac{1}{d^\alpha},$$

where d is the distance to the base station and $\alpha \approx 2\text{--}4$ is the path loss exponent.

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- Harder to cover large areas with a single tower.
- **Line-of-sight** (LoS) becomes very important.

Noise and signal-to-noise ratio

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Interference in a cellular network

Sources of interference

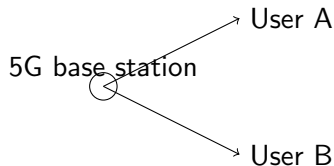
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Effect

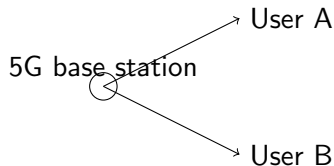


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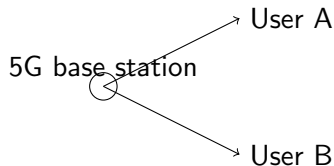
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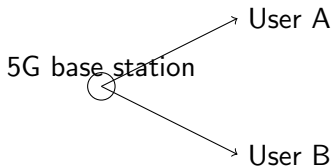
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Mitigating noise and interference

① Multiple access and scheduling

Careful allocation of frequencies and time slots between cells and users.

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Many small base stations, shorter distances, better SNR.

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④ Adaptive modulation and coding

With high SNR we use high data rates; with low SNR we switch to more robust schemes.

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- To cope with these problems we use MIMO, beamforming, small cells and smart radio resource management.

Idea for improvement: add real numbers for data rates and carrier frequencies of a concrete operator.