# 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.

# Signal propagation in 5G

## Basic idea

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

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

where $d$ is the distance to the base station and $\alpha \approx 2$–$4$ 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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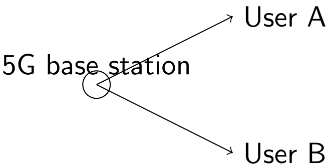

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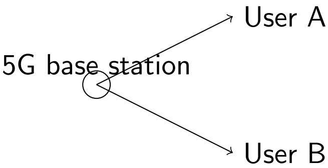

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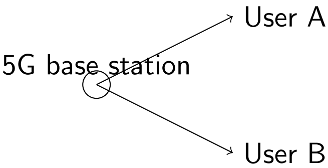

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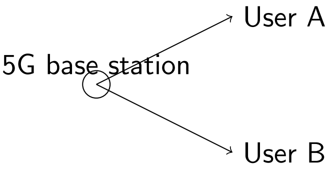

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4. Adaptive modulation and coding
   With high SNR we use high data rates; with low SNR we switch to more robust schemes.

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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.