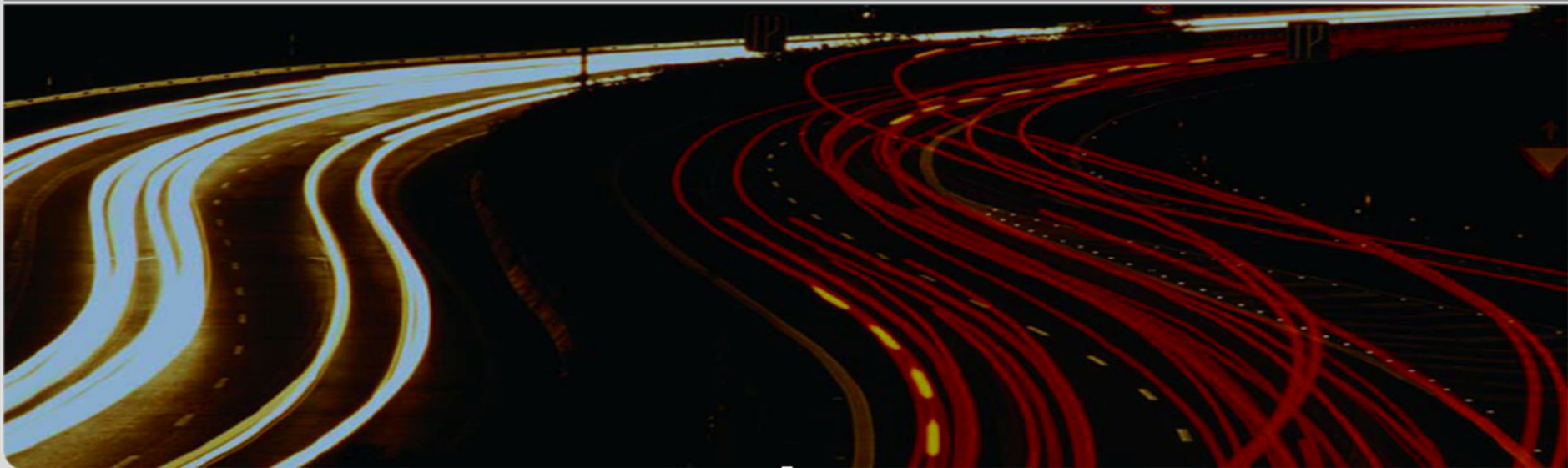


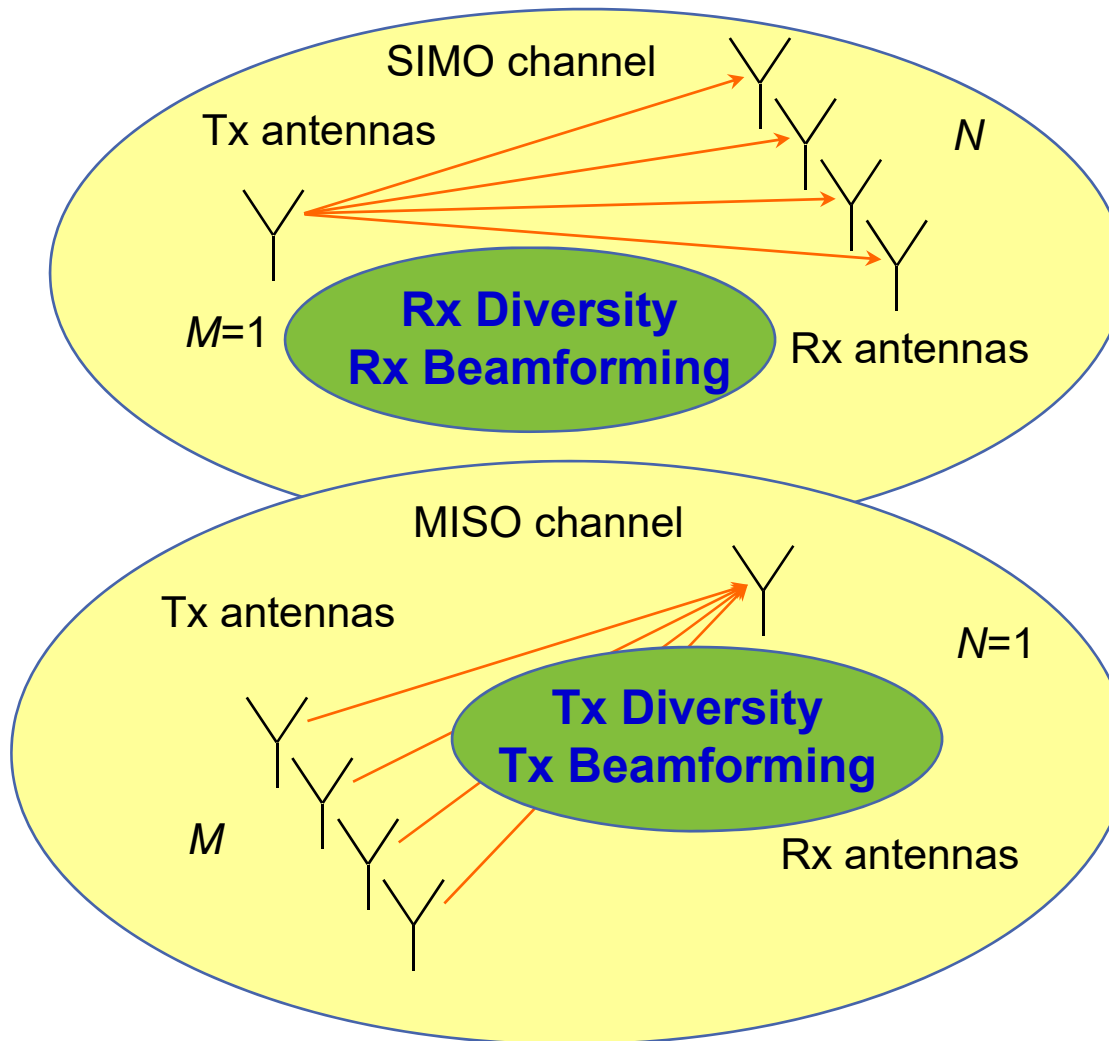
MIMO Introduction

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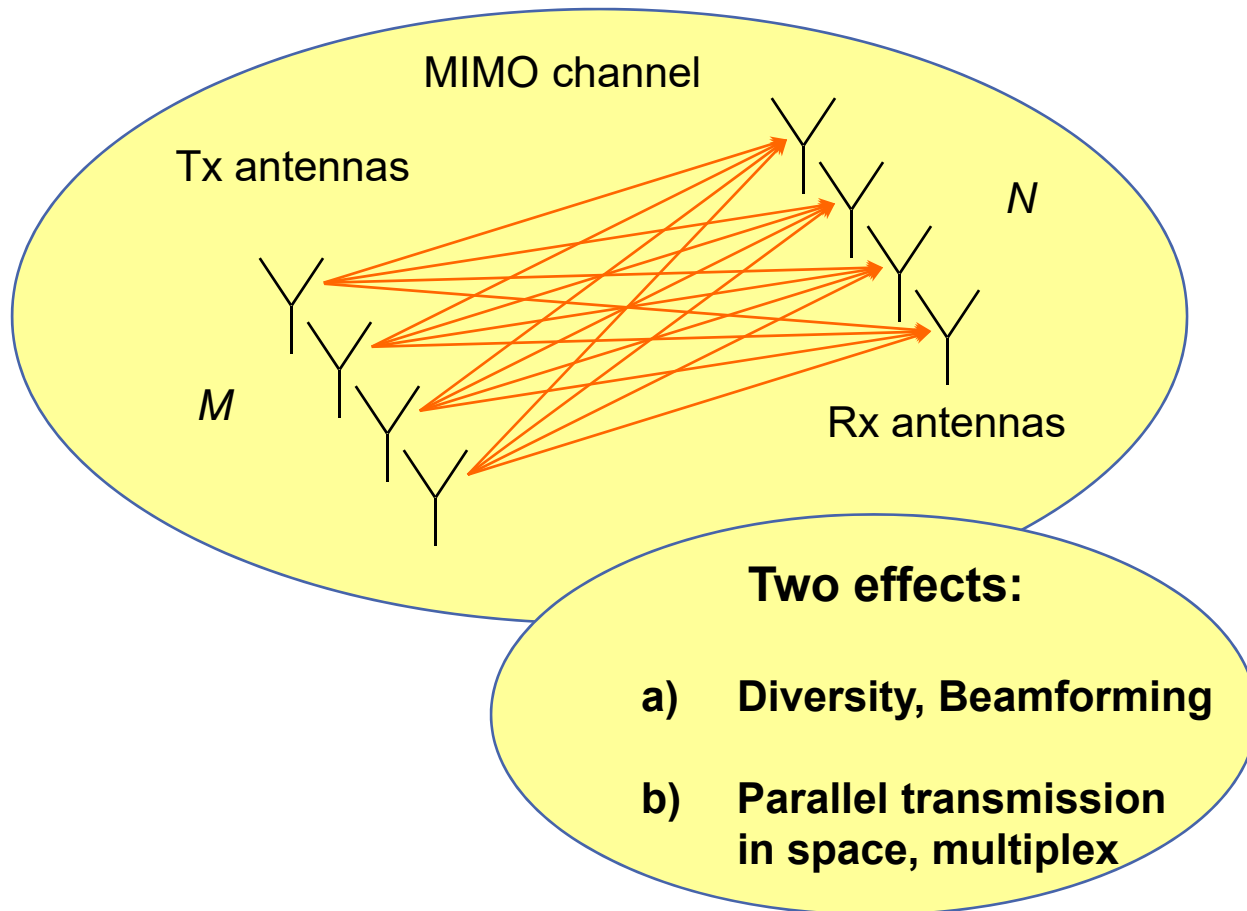


SIMO plus MISO =?

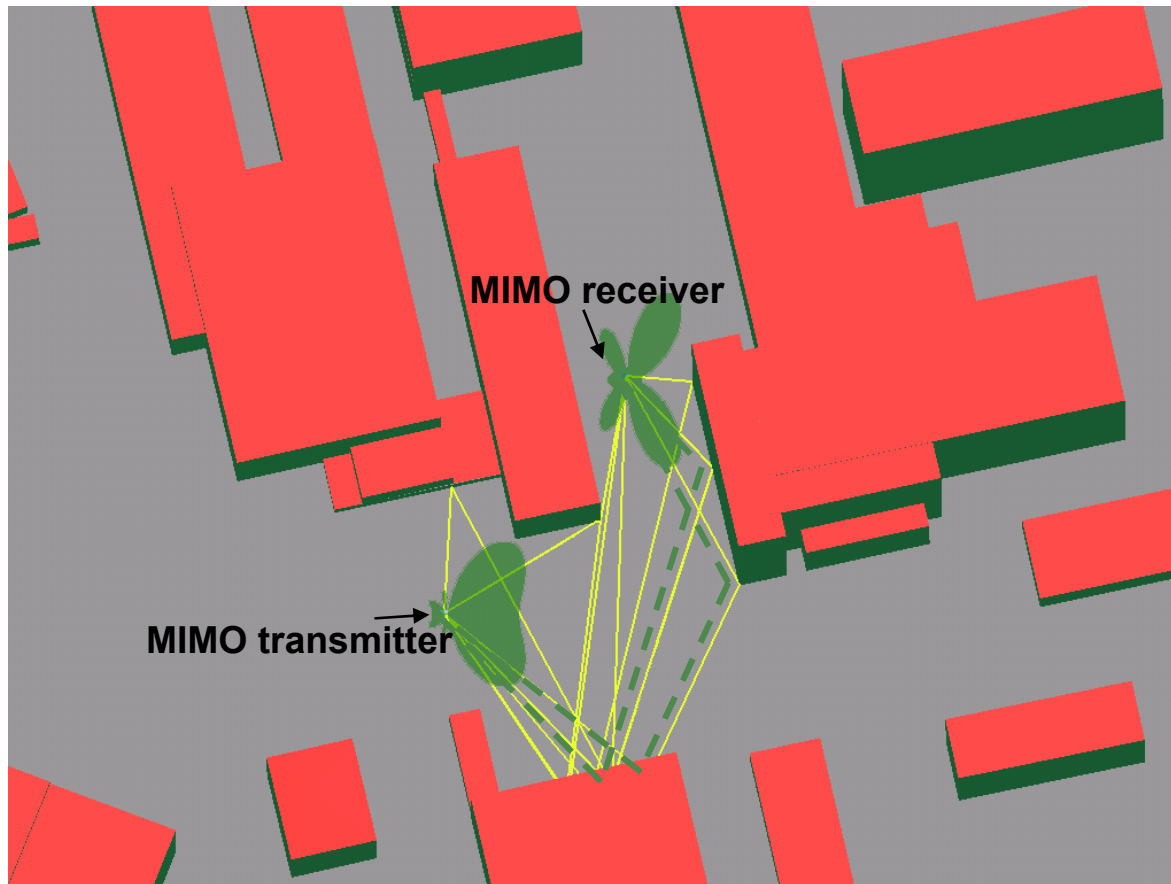


- Rx diversity
- large effect for independent Rayleigh fading channels
- SNR / BER improvement

- Tx diversity, space-time-coding (STC)
- large effect for independent Rayleigh fading channels
- SNR / BER improvement

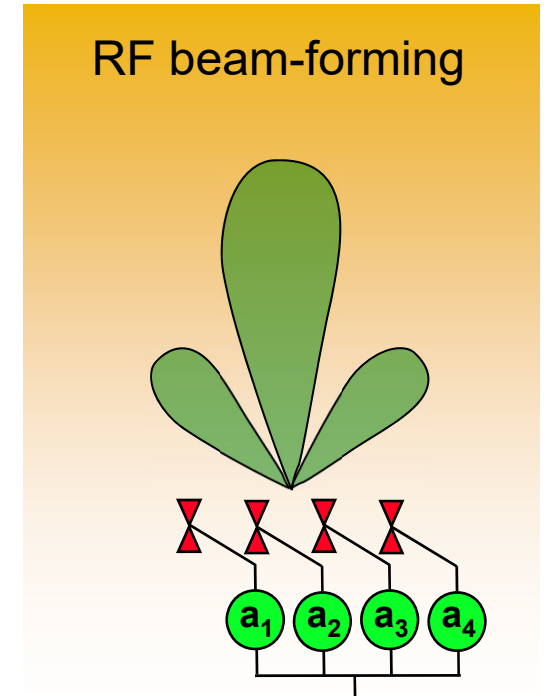


RF Beam-forming for a Single Channel



building
propagation path

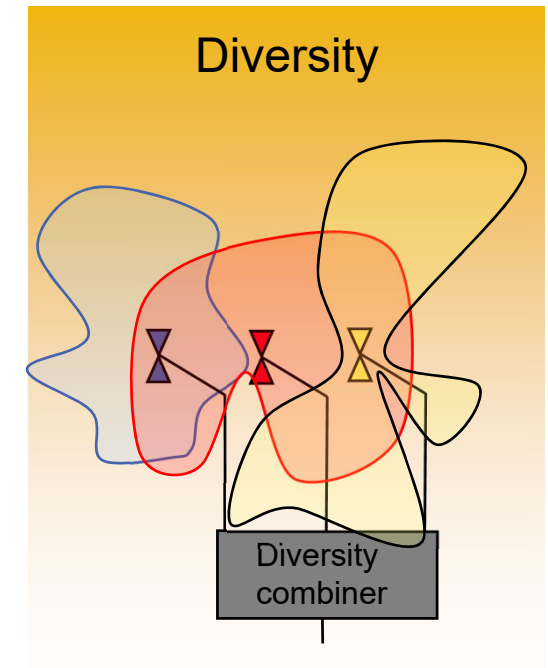
1. sub-channel
with channel state information



4 dipole lin. array, $\lambda/2$ spacing

a_i = phase/amplitude weighting

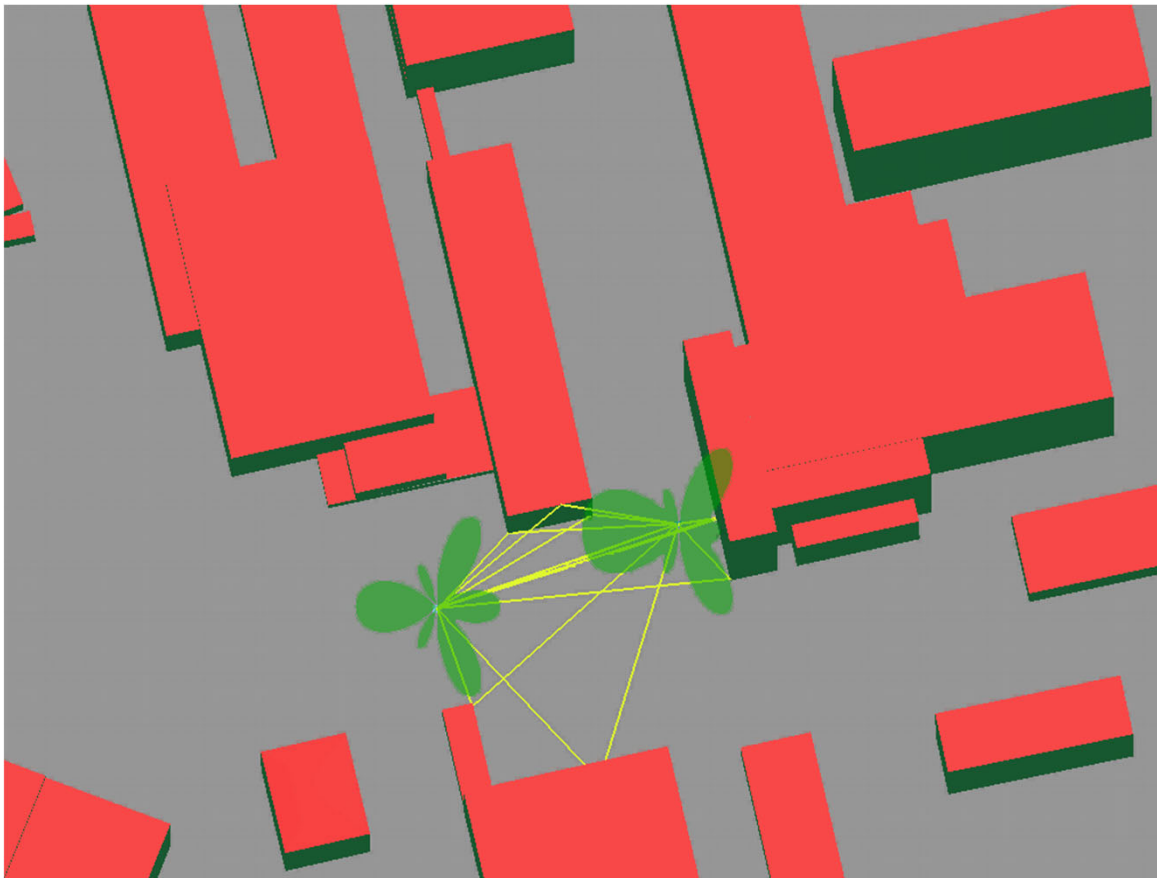
Diversity with Simultaneous Beams



Multiple, simultaneous beams

- building
- propagation path

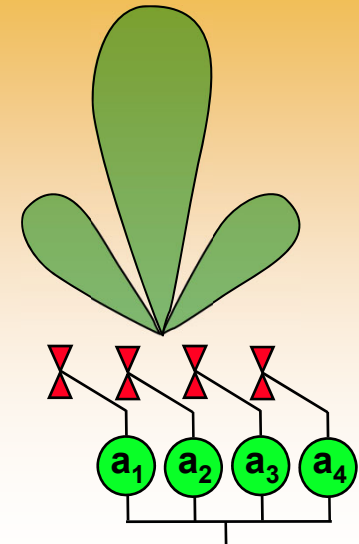
Beam-forming and Multiplexing



 building
 propagation path

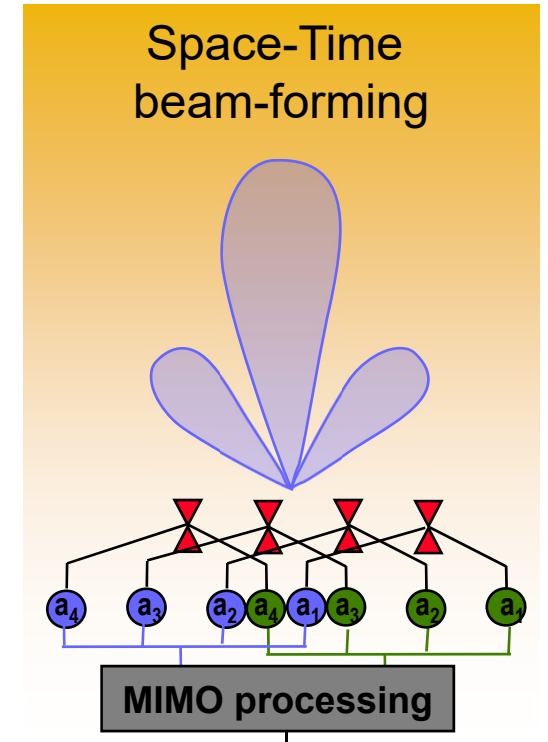
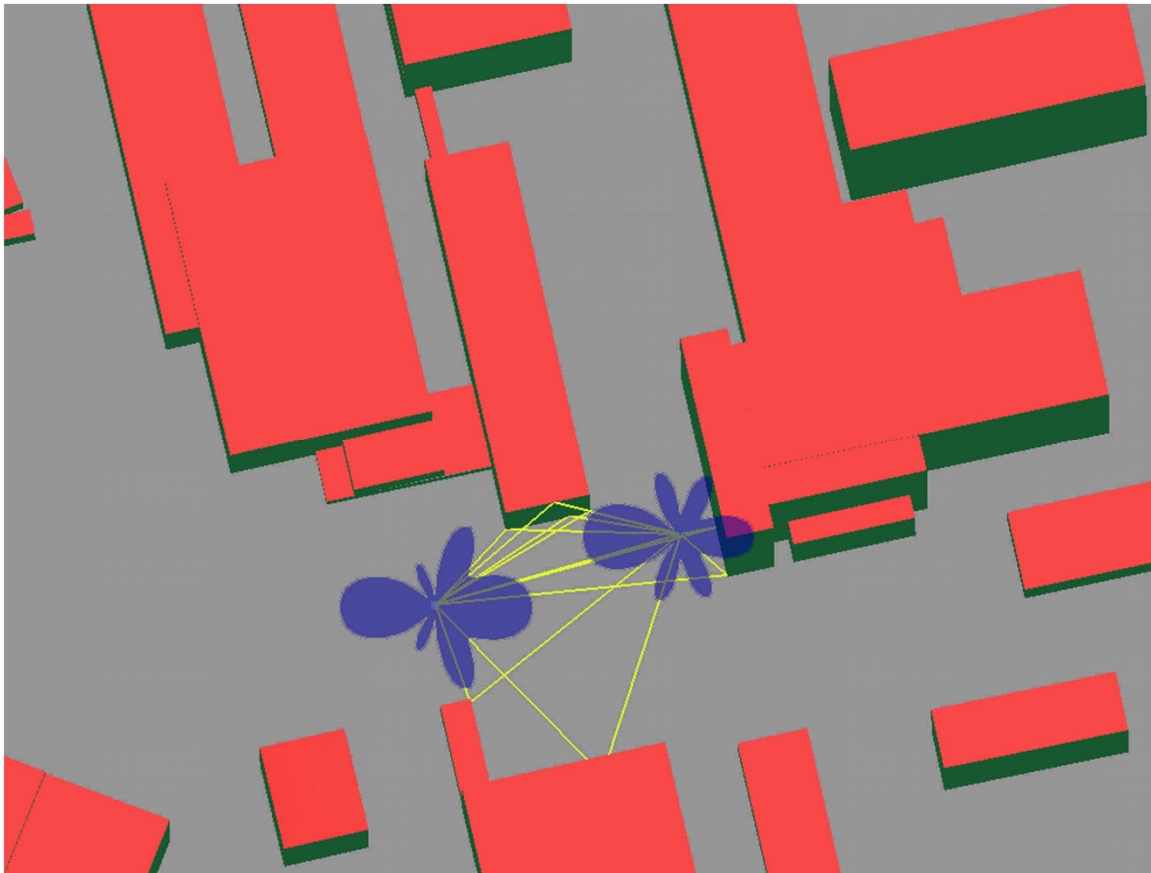
 1. sub-channel
with channel state information

RF beam-forming



4 dipole lin. array, $\lambda/2$ spacing

Beam-forming and Multiplexing

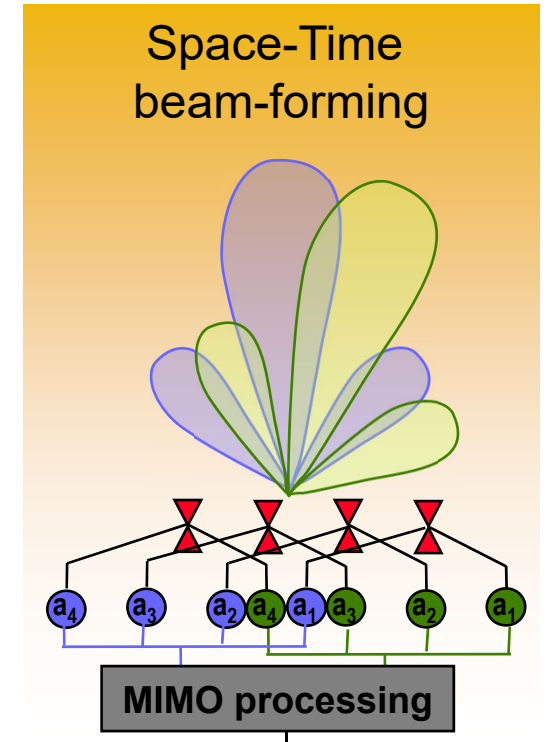
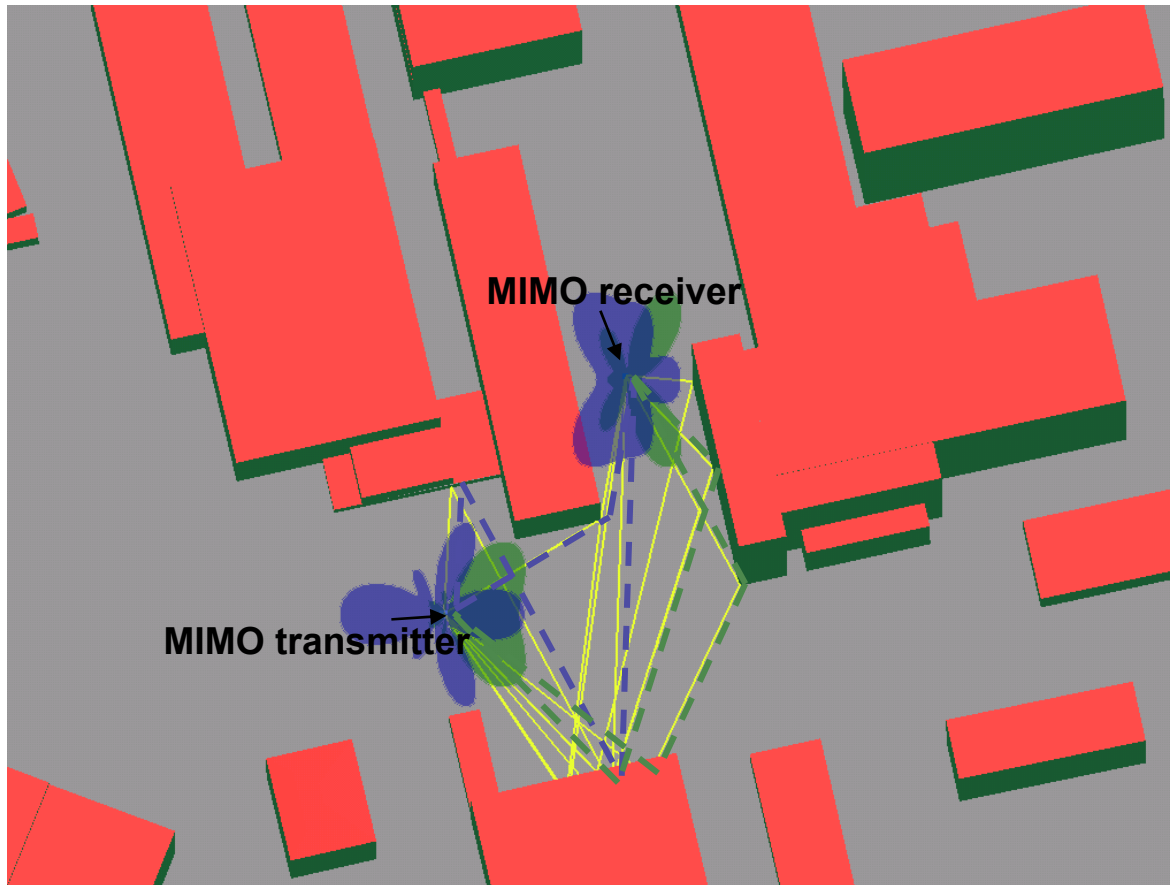


4 dipole lin. array, $\lambda/2$ spacing

 building
 propagation path

 2. sub channel
with channel state information

Beam-forming and Multiplexing

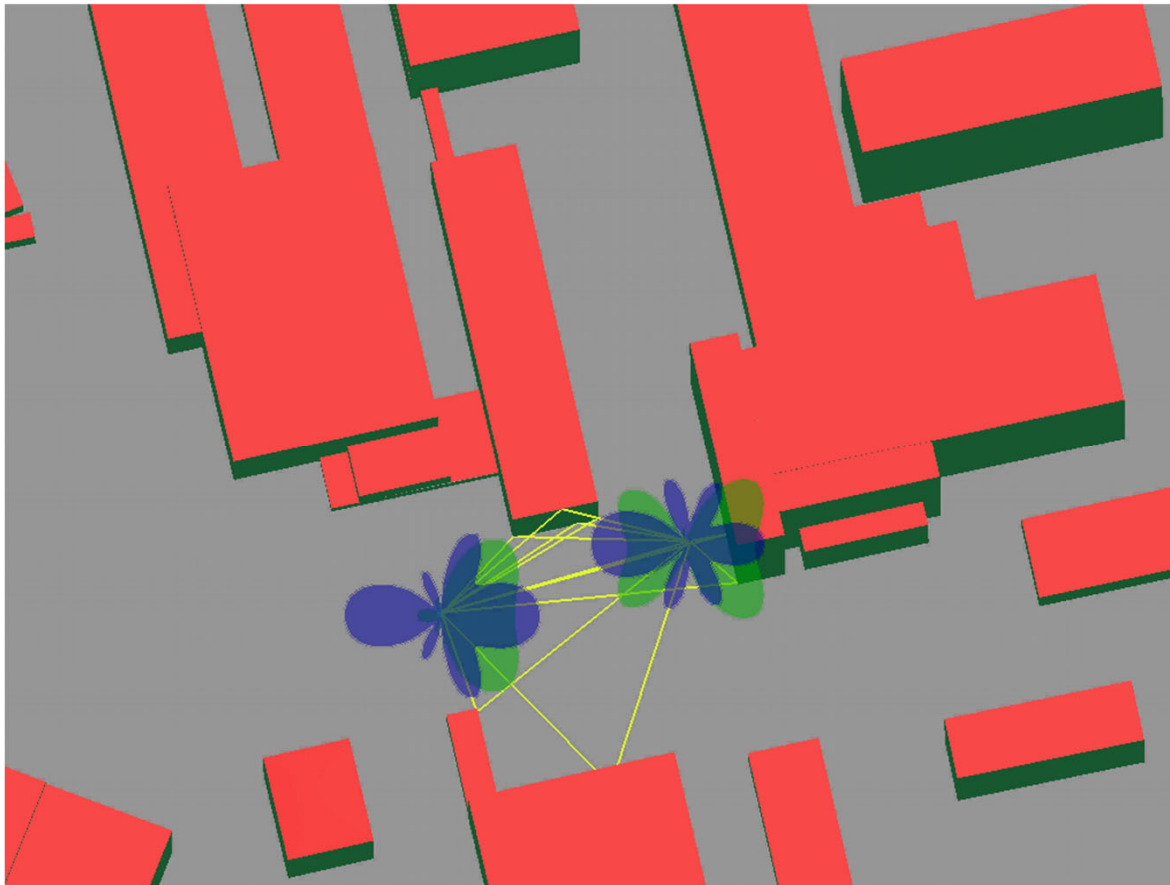


4 dipole lin. array, $\lambda/2$ spacing

building
propagation path

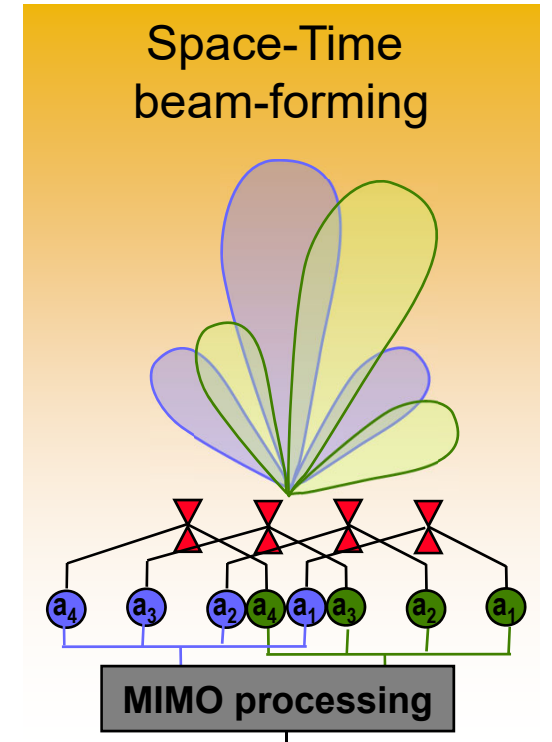
1. sub channel
2. sub channel
with channel state information

Beam-forming and Multiplexing

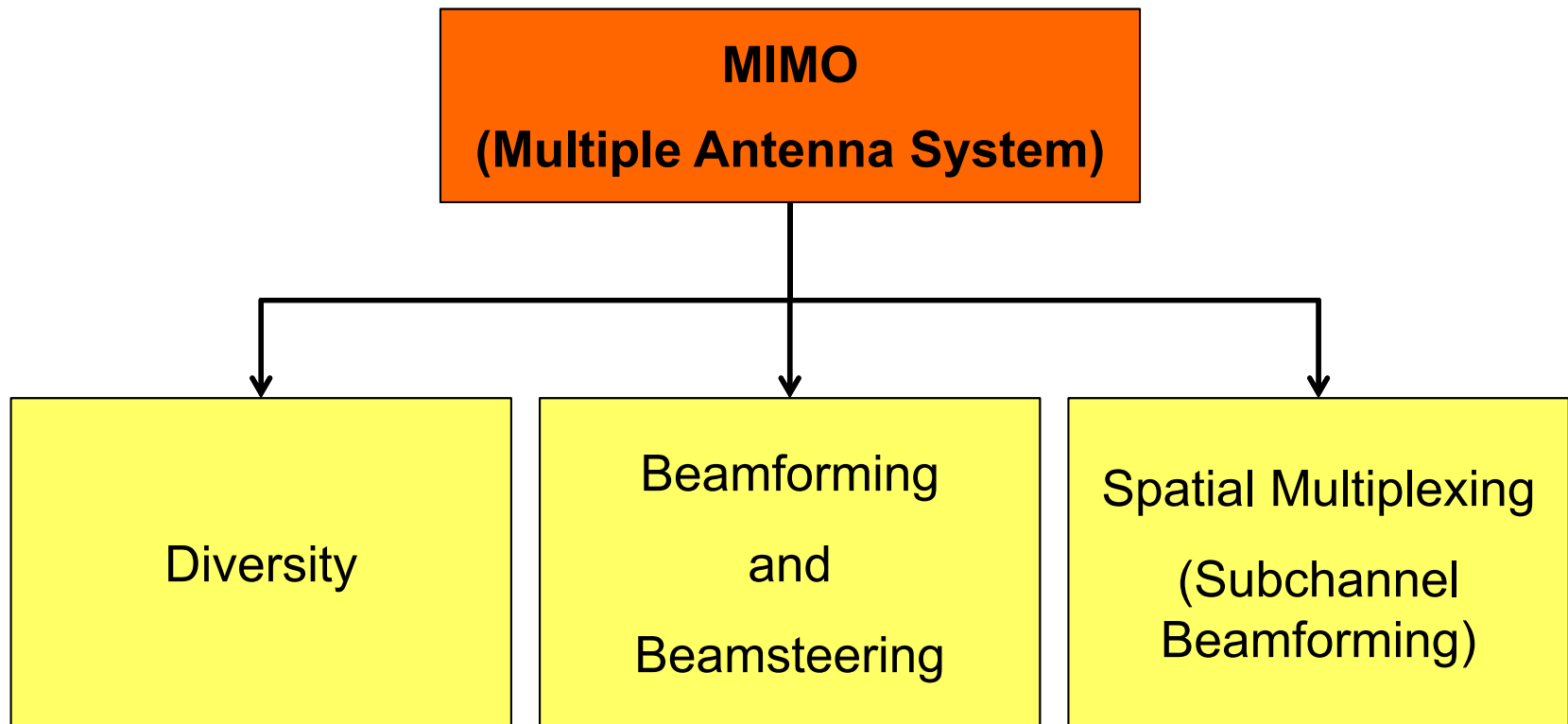


 building
 propagation path

 1. sub channel
 2. sub channel
with channel state information



4 dipole lin. array, $\lambda/2$ spacing



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