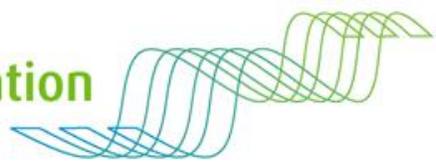


Large Scale Antenna Systems

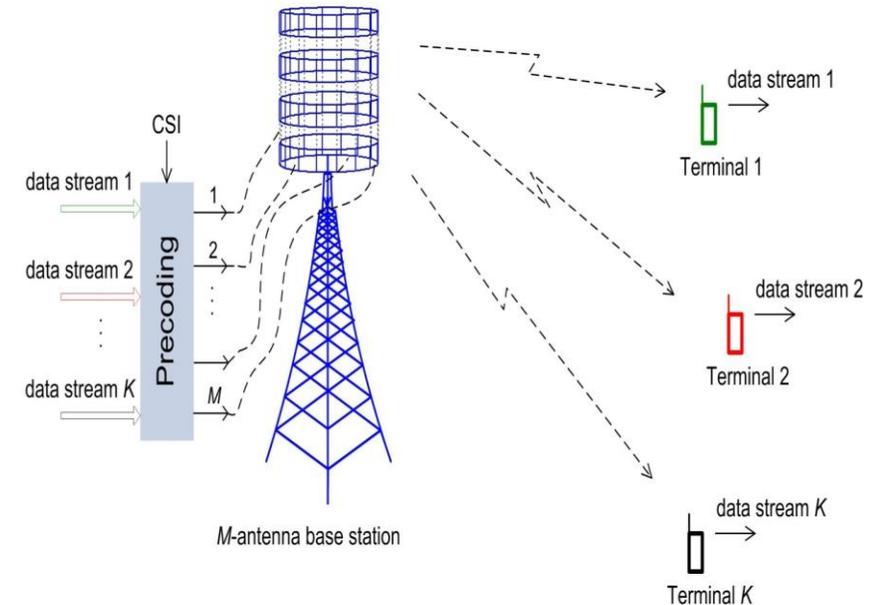




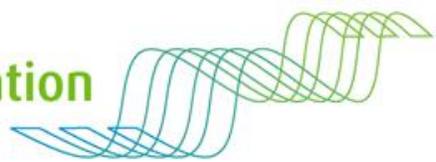
Large Scale Antenna System (LSAS)

CHALLENGE AND BREAKTHROUGHS

- Base stations today serve users by means of bulky antennas that radiate power in 120-degree sectors
- Challenge is to direct power to user where it is needed
- Large number of small, low-power, individually controlled antennas create user-selective data beams
- Adding more antennas permits more selective beams
 - Less radiated power needed
 - More users can share the same spectrum
 - Power control ensures uniformly great service



LSAS Enables High Energy Efficiency and Throughput Through Directed Radiation

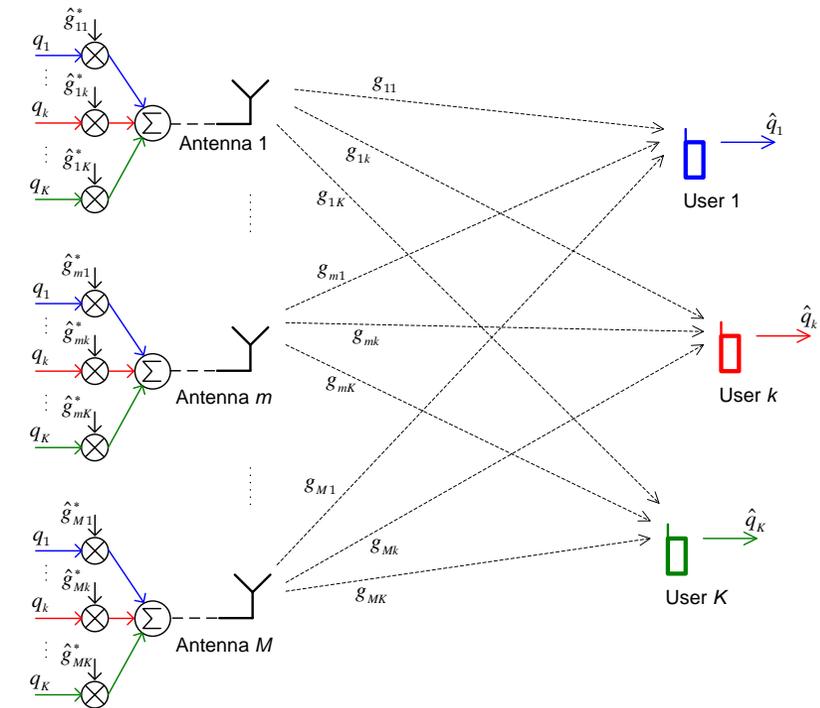


Large Scale Antenna System (LSAS)

KEY ACCOMPLISHMENT AND RESULTS

- Developed a new power model to include RF generation, internal electronics, LSAS computations
- Semi-analytical multi-cell performance simulations
- LSAS optimization: trade-off between radiated energy efficiency and internal power consumption
- Adaptive scheduling with discontinuous transmissions to maximize energy efficiency

Deployment Scenario	Dense Urban	Urban	Suburban	Rural
Energy Efficiency Gain	14,000	11,000	2,500	1,600



Support for Wireless Traffic Growth with Dramatic Energy Efficiency Improvements