

China Academy of Telecommunication Technology ■

3GPP TSG RAN Meeting #99

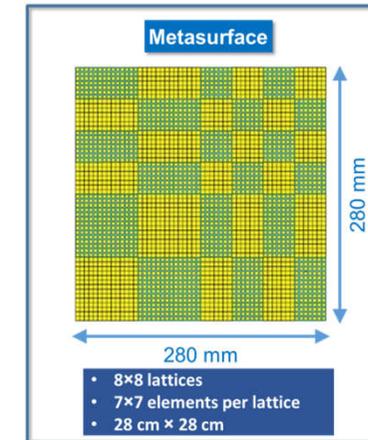
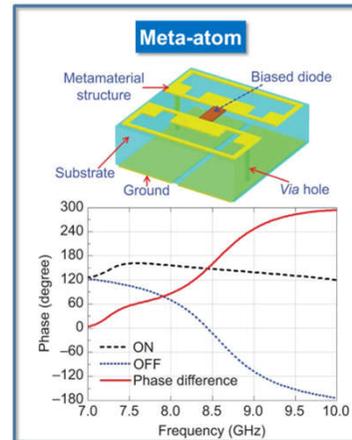
Rotterdam, Netherlands, March 20-23, 2023

大唐电信集团 RP-230402

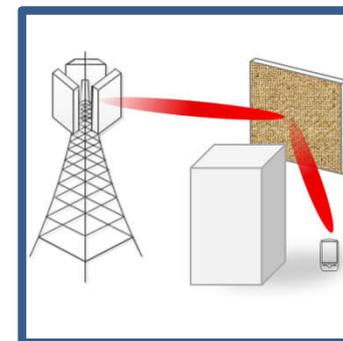
# Reconfigurable Intelligent Surface(RIS) based wireless transmission system for NR

# Background

- Reconfigurable intelligent surface (RIS) has attracted much attention due to its low cost and energy consumption, small volume, light weight, programmability, and ease of deployment
- RIS can be deployed as reflective panels to reflect signals
- Deployment of RIS can expand the coverage of each cell to avoid frequent cell handovers and overcome shadowing effects
- With RIS, expected spatial propagation characteristics can be deliberately constructed, and the degrees of freedom of wireless channels can be effectively improved



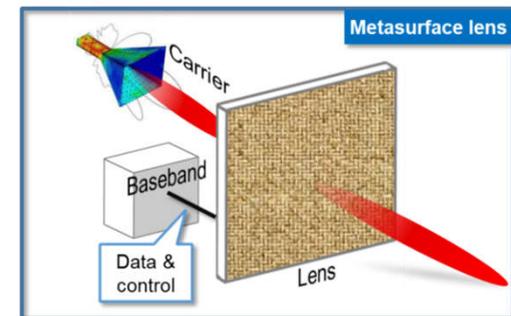
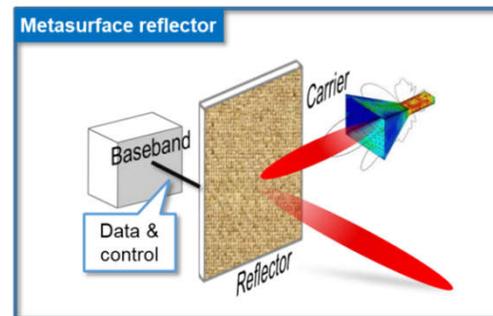
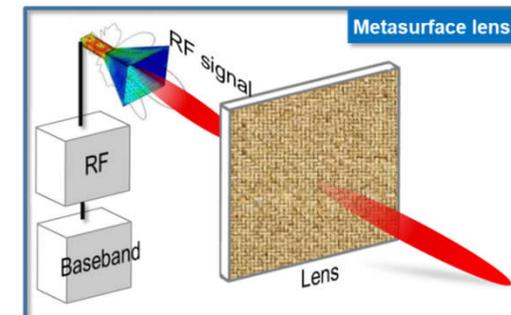
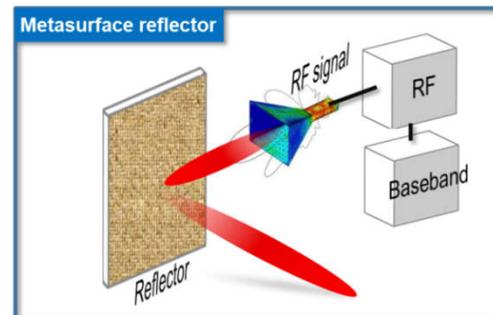
Cui T J , Qi M Q , Wan X , et al. Coding metamaterials, digital metamaterials and programmable metamaterials[J]. Light Science & Applications, 2014, 3(10):e218.



RIS relay

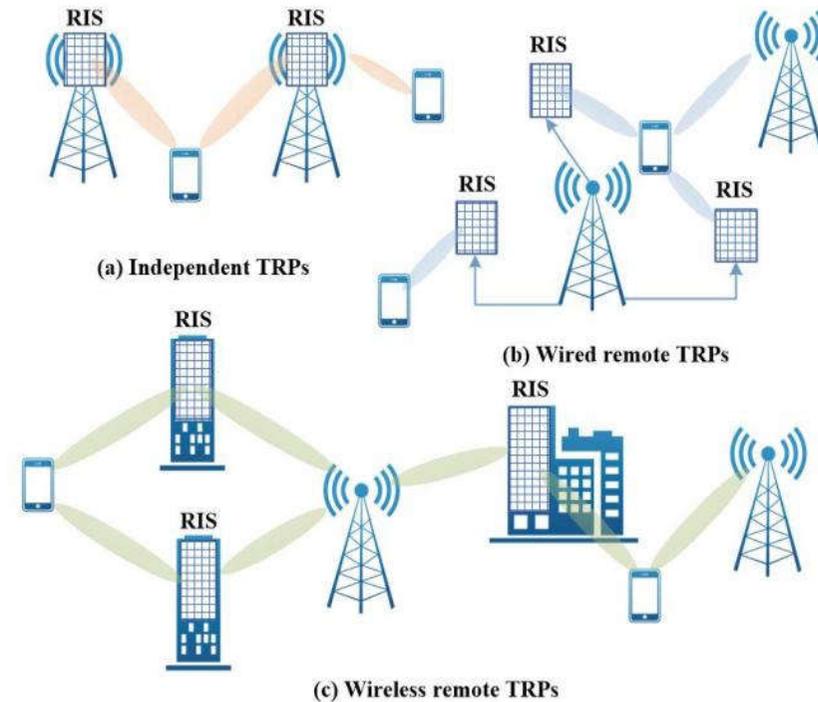
# Localized massive MIMO based on RIS

- RIS can also be used to replace analog array in traditional hybrid beamforming architecture
- By using RIS, the number of components like RF chains, phase shifters, and power amplifiers is reduced, the cost and energy consumption of the transmitter decline
- Modulation and beamforming can even be achieved simultaneously by space-time coding on RIS



# Distributed massive MIMO based on RIS

- In distributed massive MIMO system, RIS arrays are deployed separately in multiple transmit and receive points (TRPs) located in different locations. For example,
- (a): Independent TRPs composed of RF and RIS
- (b): TRPs with wired remote radio units (RRUs) composed of the feeder and RIS
- (c): Beams reflected from multiple RISs can be utilized in coordinated multiple points transmission/reception (CoMP).



# Channel modeling of RIS

## Stage 1: Without element-level modeling of RIS

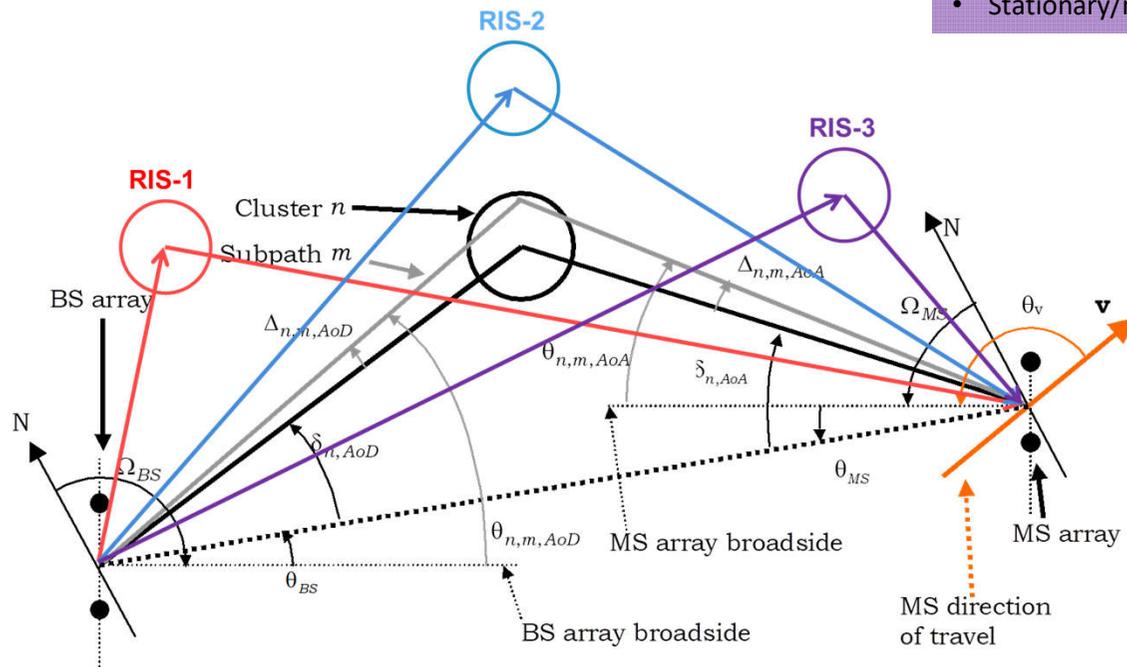
- Modeling of the composited channel with RIS
- Typical deployment scenarios
  - RIS deployed close to BS (e.g. Tx array)
  - RIS deployed close to UE (e.g. Rx array)
  - RIS deployed in the middle of BS-UE link (e.g. relay)

## Stage 2: With element-level modeling of RIS

- Radiation pattern of RIS element is modeled
- Only stationary far field modeling is considered

## Stage 3: Complete modeling of RIS

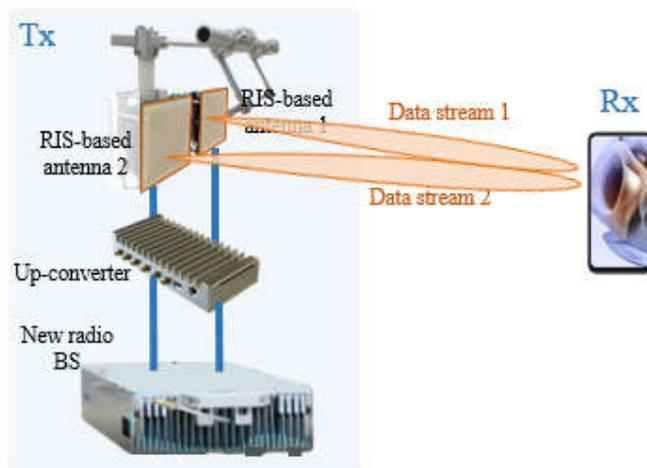
- Radiation pattern of RIS element is modeled
- Stationary/non-stationary far/near field modeling



Field measurement platform of RIS

# RIS-based massive MIMO prototype

- Support dual-layer massive MIMO transmission with NR base station & UE
- Number of elements/panel: 1024
- Carrier frequency: 26.6GHz
- Bandwidth: 800MHz



# Potential areas of study

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- Channel measurement and modeling
  - Scenario models
    - Indoor, outdoor, O2I, etc.
    - LoS/NLoS
    - Far field, near field
  - Array models
    - Modeling of different RIS structures
    - Modeling of radiation patterns
  - Considered links
    - BS-RIS
    - RIS-UE
    - BS-UE
  - Methodologies
    - Geometry-based stochastic models
    - Map-based/ ray-tracing
    - Hybrid models
- Air interface
  - Access/backhaul links
  - Synchronization & broadcasting
  - Beam management for BS-RIS/RIS-UE/BS-UE links
  - CSI enhancement
  - Inter-cell interference mitigation
  - Coordination transmission/reception based on RIS

# טכניקה אלה

