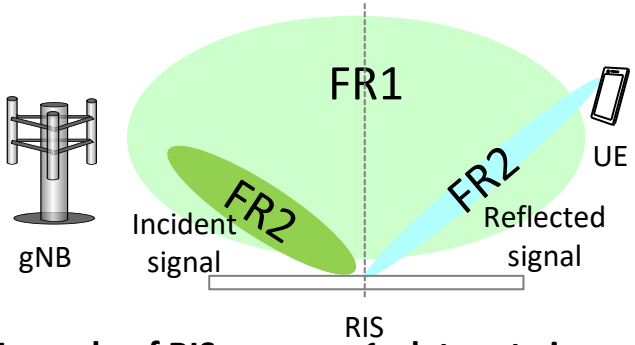
3GPP TSG RAN Rel-19 workshop **RWS-230261**
Taipei, June 15 - 16, 2023
Agenda Item: 5
Document for: Discussion

Views on RIS for Rel-19

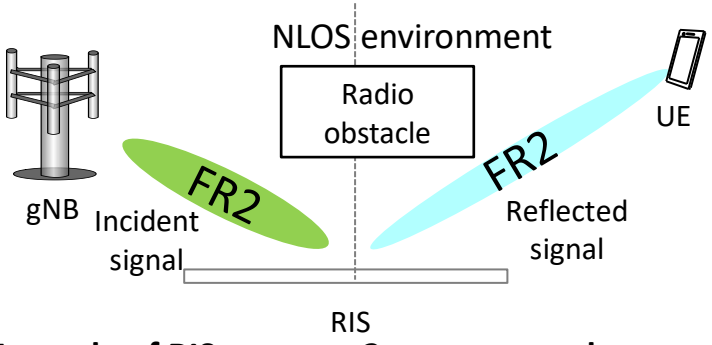
NTT DOCOMO, INC.

Introduction

- Overview of Reconfigurable intelligent surface (RIS)
  - RIS is a new device for network deployment with flexible and cost effective approach with comparing new types of network nodes, such as Integrated Access and Backhaul (IAB), RF repeater, and Network-controlled Repeater (NCR).
  - RIS is composed by reconfigurable scattering components
    - » Direction of reflected signal can be controlled
    - » No RF amplifier is necessary, so that power consumption can be minimized
    - » Beam gain can be obtained by narrow beams and number of RIS beams may be increased
- Use cases
  - Example 1: data rate improvements
    - » UE and gNB are connected via FR1, and RIS is only operated using FR2 when high data rate transmission is required for the UE
  - Example 2: coverage enhancements
    - » RIS always operates for coverage extension (e.g. to cover NLOS areas for FR2)



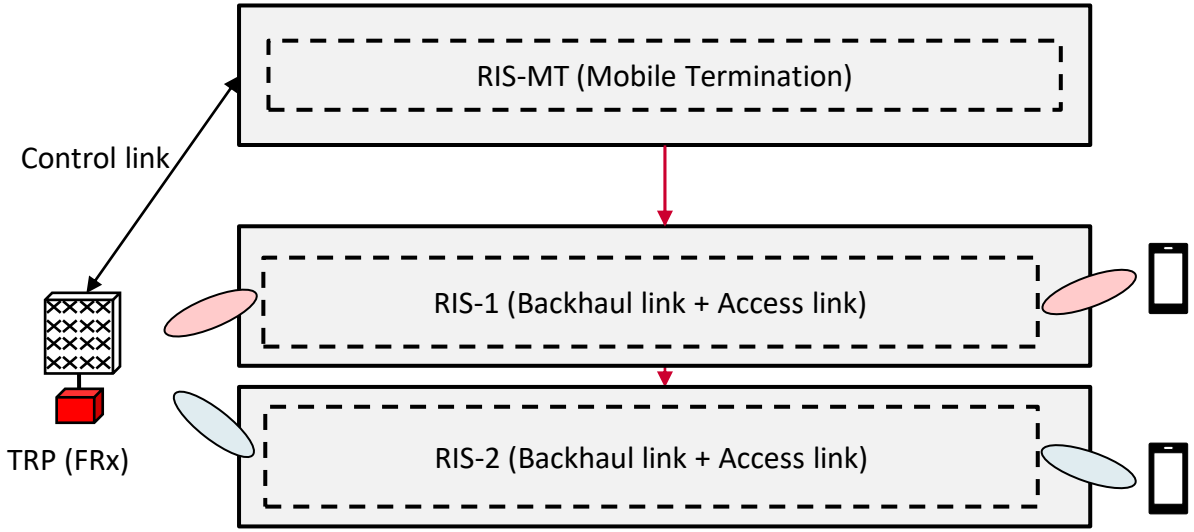
Example of RIS use case 1: data rate improvements



Example of RIS use case 2: coverage enhancements

Motivation

- RIS-type NCR
  - RIS can be implemented based on the Rel-18 NCR framework, but there are several differences between the Rel-18 NCR and RIS-type NCR implementations.
  - With accurate beamforming control that generates a beam from RIS to the dedicated UE, RIS-type NCR is expected to significantly improve the SNR for a coverage hole area. Thus, it can facilitate operation in high frequency band such as FR2.
  - It is worth studying the system model of RIS-type NCR and its potential gain in practical networks and necessary specification enhancements to achieve such performance gain.



- Differences between NCR and RIS-type NCR

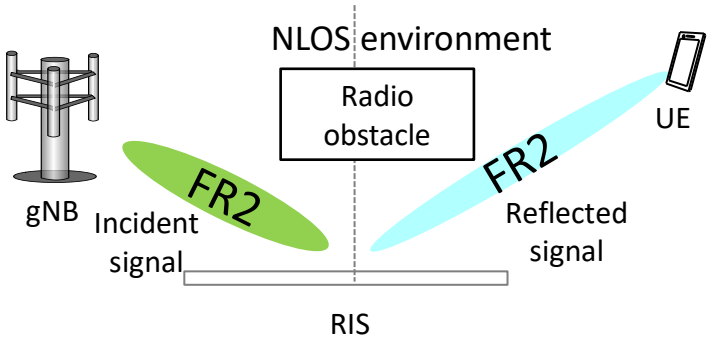
	Rel. 18 NCR	RIS-type NCR
Operation mode	Actively rx., amplify, and tx. the signal	Passive tune
RF chains	2 for backhaul and access links, respectively	No
Thermal noise	Present and be amplified during forwarding	No
Array scale	Small or medium array with limited beam number	Can be a large surface w/ ultra-large-scale array
Beamforming	Several beams to cover a designed area	Spotlight beams, each of which covers a small area

Proposal

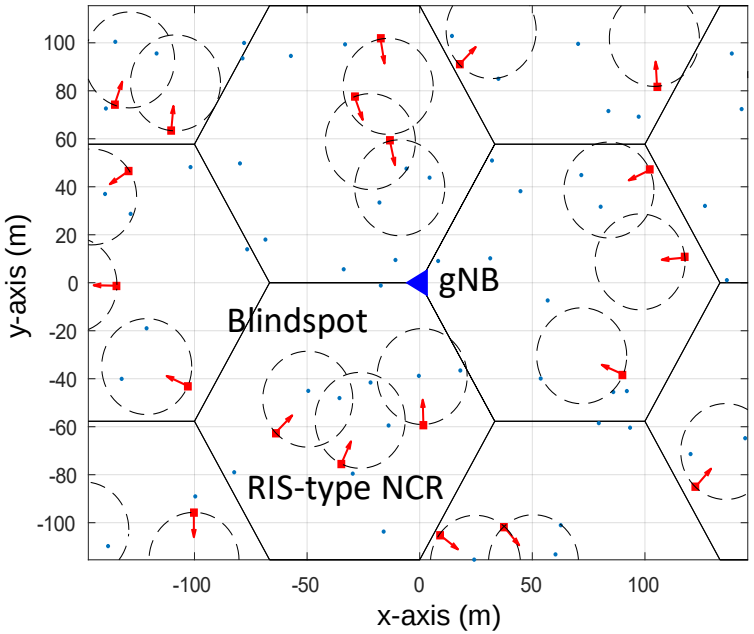
- Scope for SI on RIS in Rel-19
  - Study system model and channel model
    - » Study the differences between R18 NCR (and its enhancements) and RIS-type NCR, especially on how to model a RIS-type NCR
    - » Study near-field channel model for RIS with large antenna array
  - Study evaluation methodology and performance evaluation
    - » Study the link and system level scenarios and assumptions on evaluating the performance of RIS-type NCR
    - » Identify the potential gain of RIS-type NCR
  - Study potential specification impact based on Rel-18 NCR framework
    - » Identify the specification impacts of RIS-type NCR. Some potentials may include:
      - – Enhanced beam management for RIS-type NCR beams
      - – Enhanced SSB for RIS-type NCR beams
      - – Enhanced RRC signalings for RIS-type NCR configuration reports

[Appendix] FR2 Coverage Enhancements with RIS-type NCR

- FR2 coverage could be enhanced with the help of RIS-type NCR for blind-spot areas, e.g.,
  - RIS-type NCR with 0.5m x 0.5m can eliminate the blind spot effect
  - RIS-type NCR with 1m x 1m can achieve 8dB SINR improvement in average compared to deployment w/o RIS-type NCR

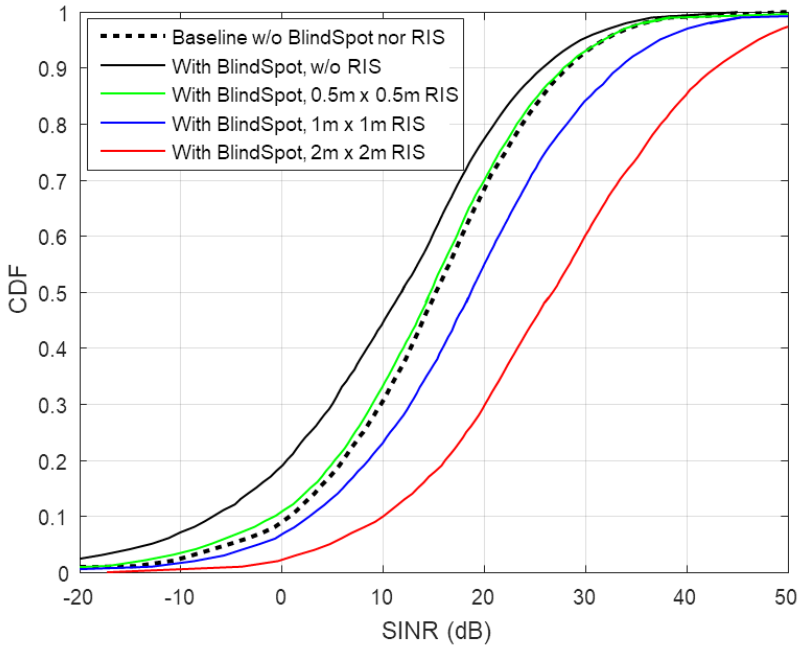


RIS-type NCR for area with blindspot



- mmWave Dense Urban scenario w/ 3 blind-spot areas (circles) per sector and 3 RIS-type NCRs (red dots w/ arrow indicating the orientation) deployed correspondingly

Geometry



- 0.5m x 0.5m RIS-type NCRs eliminate the impact of blind-spot areas
- Larger aperture size further improves the performance

NTT docomo