

Introducing Reconfigurable Intelligent Surfaces for 5G-Advanced

3GPP TSG RAN Rel-18 workshop

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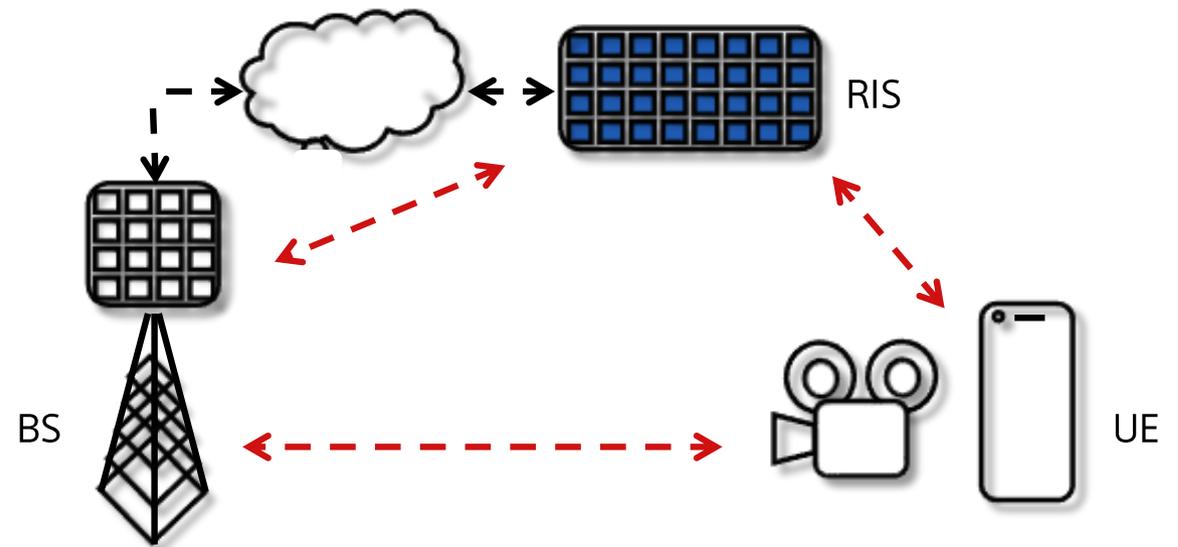
What are intelligent surfaces?

- Broadly speaking, intelligent surfaces are electromagnetically active man-made structures that can be used to reshape the propagation environment such as to improve capacity, coverage and energy efficiency.
- They come in several flavors:

Type	Characteristics
Reflecting intelligent surfaces, a.k.a. reconfigurable intelligent surfaces (RISs)	Semi-passive and low-cost, due mainly to passive elements, i.e., no signal amplification or digital processing.
Relaying intelligent surfaces	Provide signal amplification but no signal regeneration or digital processing.
Active intelligent surfaces	Fully digital signal generation, i.e., extra-large massive MIMO.

Reconfigurable intelligent surfaces for 5G-advanced

- Of the three types of intelligent surfaces, RISs approach maturity, and the technology is becoming widely available. Thus, it is time to turn attention to standardization.
- RISs can improve coverage and capacity in general and in particular for the following use cases:
 - Remote video production.
 - Immersive VR.
 - Industrial IoT.
 - Home entertainment.
 - Indoor office.



Study phase: Start with channel model

- A channel model should be in place before an evaluation of the benefits of introducing RISs can be done, e.g., outage and peak data rates.
- At least the following aspects should be covered in a study:
 - Simulation scenarios and network layout
 - Indoor and outdoor scenarios for frequency ranges 1 and 2.
 - RIS device modeling
 - Sizes and topologies under consideration.
 - Radiation pattern of unit cells, codebook design, polarization properties, amplitude/phase shift quantization, state-dependent radiation efficiency.
 - Propagation aspects
 - Whether near-field and spherical-wave propagation effects need to be modeled.
 - Modeling of Tx-Rx, Tx-RIS, RIS-Rx, including pathloss, NLOS/LOS, large-scale parameters (DS, AS, SF, K).
 - Modifications to statistical channel models, e.g., CDL models, to account for RISs deployment density.

Study phase: Identify PHY and upper layer impacts

- The introduction of reconfigurable intelligent surfaces is expected to have impact on the standard. The following aspects, related to physical layer, are proposed for study:
 - Initial access.
 - Beam management.
 - RS enhancements, including CSI-RS/DMRS, for channel estimation.
 - CSI feedback reporting.
 - Interference management.
- There are further aspects, related to upper layers, that may also require study:
 - Whether dedicated signaling, including interface/protocol, between the BS and the RIS devices is needed.
 - Mobility management and RIS device selection.
 - Whether interfaces/protocols from so-called “smart repeaters” could be reused, if adopted for 5G-advanced, may also be investigated.

Proposal for the Introduction of Reconfigurable Intelligent Surfaces in 5G-Advanced

- Depending on the time available for new topics in Rel-18, it is proposed to study Reconfigurable Intelligent Surfaces and start with SI that will address the channel model for RIS.

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