Agenda Item: 9.13 Other NR document
Source: KDDI

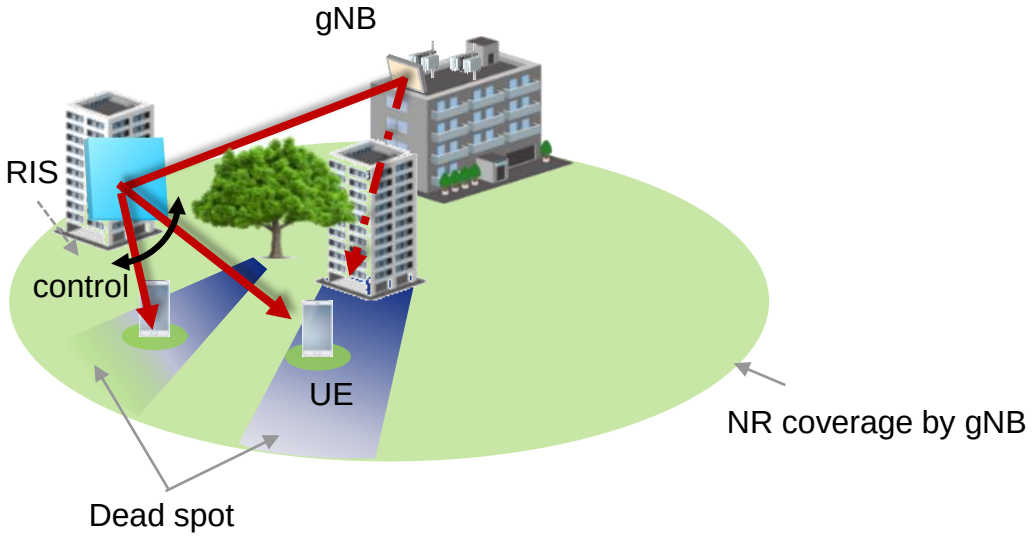
RP-230464

Discussion on Reconfigurable Intelligent Surface in Rel-19

KDDI Corporation

Motivation

- **Although many operators have deployed NR in FR2, the propagation loss and blockage make many dead spots even within the area. For more use of FR2, the service area of FR2 should be provided for users to access to the link wherever they need.**
- **NCR discussed in Release 18 extends the coverage. However, since the dead spot is generated in the various location in the area, it is difficult to cover all of the dead spot by NCR in the view of economy and ecology.**
- **To address the aforementioned problems, we consider RIS becomes a key technology. Since RIS controls the reflection direction in wide range, it can provide the FR2 service to the user in various location of dead spot without adding the gNBs and NCRs.**



Current status of RIS（1/2）

- **Although RIS was research phase at the start time of Release 18, there are remarkable progresses after Release 18;**
- **Merit of RIS compared to other technology:**
  - **Although the merits of the RIS were not clarified at the start time of Release 18, it is clarified in [1] and well-known that the RIS is available technique to enhance the dead spot.**
  - **Utilizing the electrically large RIS, the transmission distance of RIS is enhanced and it is not inferior so much to the conventional repeater. Then, the merits of the RIS is addressed the hardware complexity.**
  - **The size of RIS becomes an important parameter to maximize the merits of RIS.**

	Passive Surface	RIS	Repeater
Hardware complexity	◎ ：low	○：medium (diodes, liquid crystal, etc.)	×：high (amplifier, mixer)
SNR to distance from BS	×：Small size: short range ○：Large size: Medium range	×：Small size: short range ○：Large size: Medium range	◎ ：Long range
Angular range	×：Narrow	◎ ：Wide	◎ ：Wide

[1] M. Di Renzo *et al.*, "Reconfigurable Intelligent Surfaces vs. Relaying: Differences, Similarities, and Performance Comparison," in *IEEE Open Journal of the Communications Society*, vol. 1, pp. 798-807, 2020.

Current status of RIS（2/2）

■ Feasibility RIS design and parameters:

- **Although there are a few feasibility design at the start time of Release 18, many operators and vendors demonstrated various types of RIS after Release 18.**
- **The parameters and restrictions are summarized in [2], [3] and it is shown that various types of RIS is applicable for the dead spot enhancement in FR2.**
- **Since the performance depends on the design architecture, the difference should be considered for the RIS standardization.**

		Feasibility RIS design				
		RF-MEMS	PIN diodes	Varactor diodes	MOSFET	Liquid crystal
Parameters and constraints	Working frequency	< 40GHz	< 110GHz	< 20GHz	< 200GHz	> 20GHz
	Power consumption	Low	Medium	High	Low	Low
	Responsibility	μs	ns	ns	ns	ms
	Insertion loss	Low	Medium	High	Medium	High
	Digital/Analog control	Digital	Digital	Analog	Digital	Analog
	Cost	Medium	Low	High	Medium	Medium

[2] R. Liu, *et al*., "Simulation and Field Trial Results of Reconfigurable Intelligent Surfaces in 5G Networks," in *IEEE Access*, vol. 10, pp. 122786-122795, 2022,.
[3] H. Matsuno, *et al*., "Development of a Direction-variable Liquid Crystal Meta-surface Reflector," in Proc. 2022 IEEE International Conference on Communications (ICC2022), 2022, pp. 4854-4859.

Summary

The remarkable progress of RIS after Release 18 clarified the merit of RIS and available design architecture. RIS became an available technique to enhance the dead spot in FR2.

- **This contribution proposes the standardization of RIS in Release 19.**
  - **Since the RIS became an available technique to enhance the dead spot, we consider RIS is at the stage of standardization.**

- **This contribution further proposes the standardization of RIS as the enhancement of NCR.**
  - **Since the characteristics of RIS such as reflection pattern is controlled via network, a part of network controlled architecture will be available in common. Therefore, a part of standardization of RIS and NCR will be discussed in the same time to save the discussion time.**