What are the Promising Use Cases for RIS in 6G?

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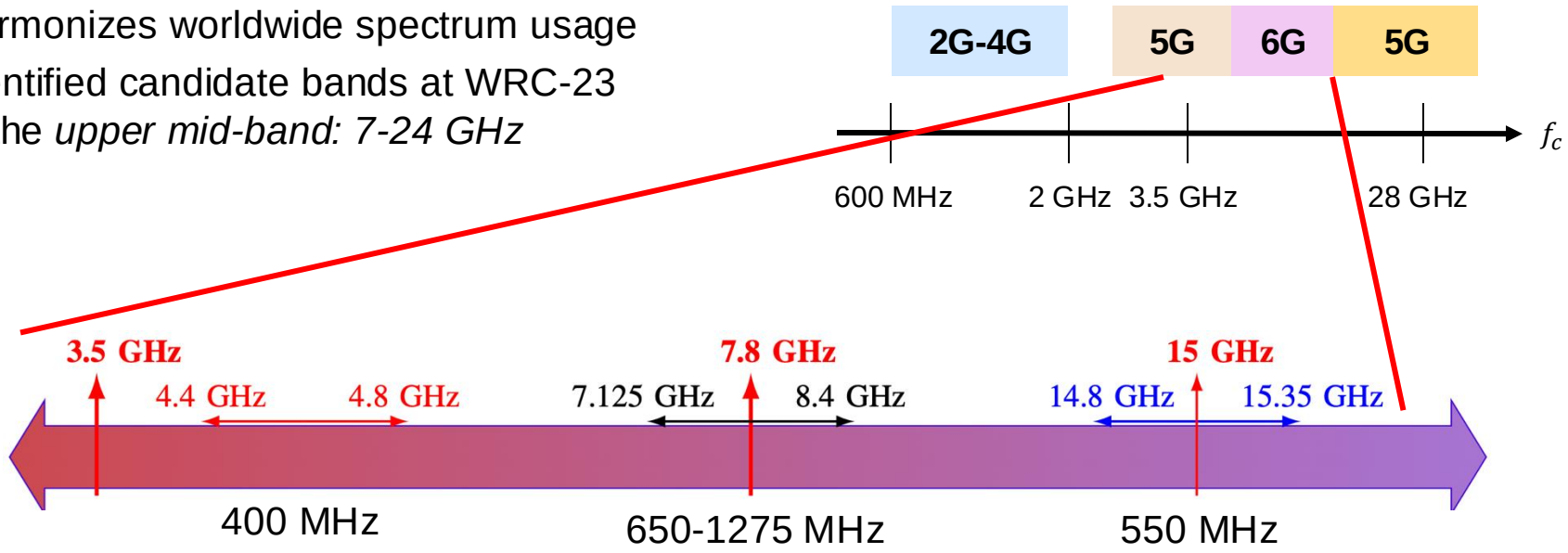
Candidate Bands for 6G

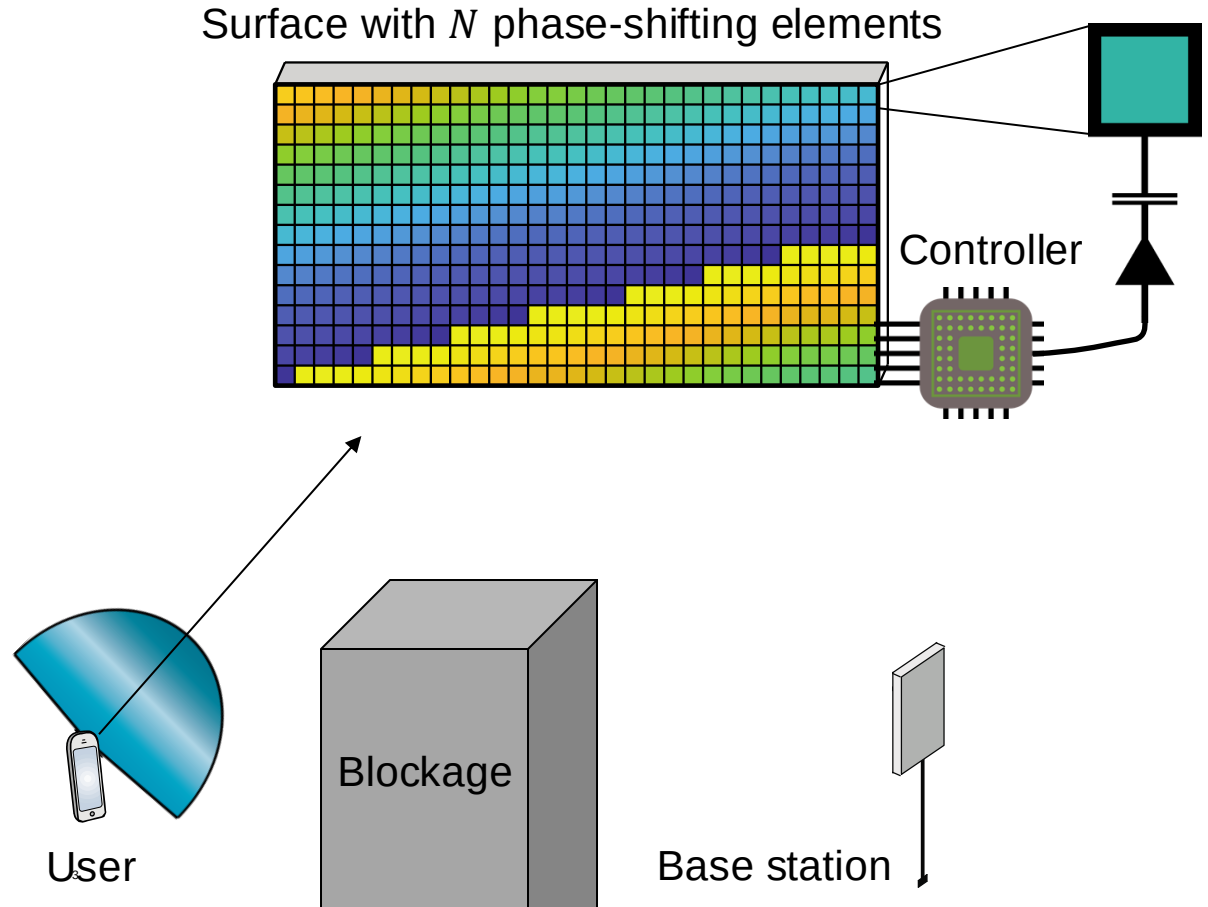
International Telecommunications Union (ITU)

- Harmonizes worldwide spectrum usage
- Identified candidate bands at WRC-23 in the *upper mid-band: 7-24 GHz*



Is there a role for RIS in these bands?

Reconfigurable Intelligent Surface (RIS)



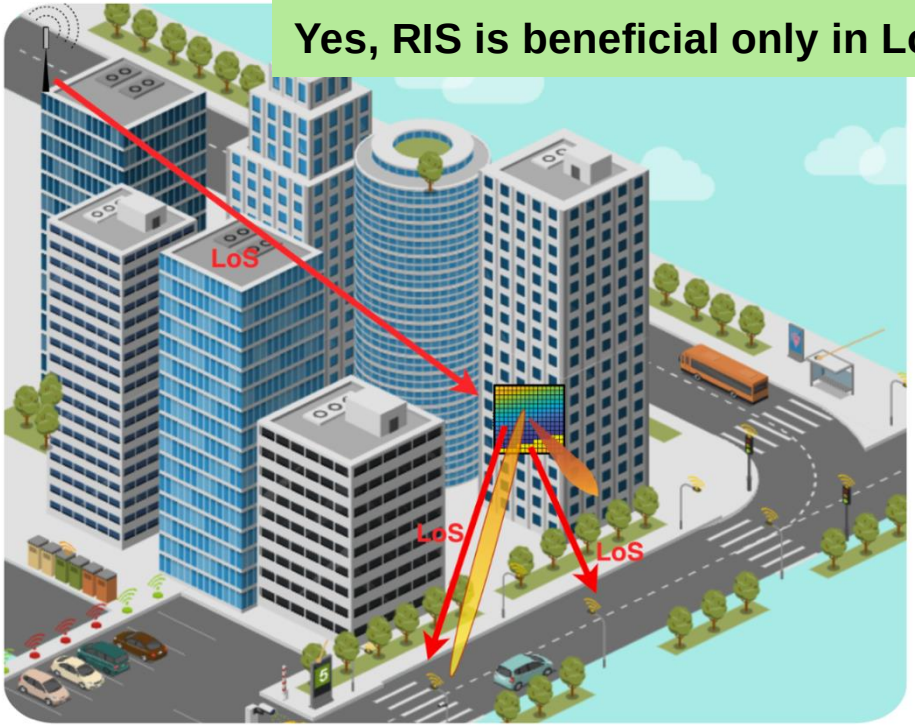
A frequency-flat operation

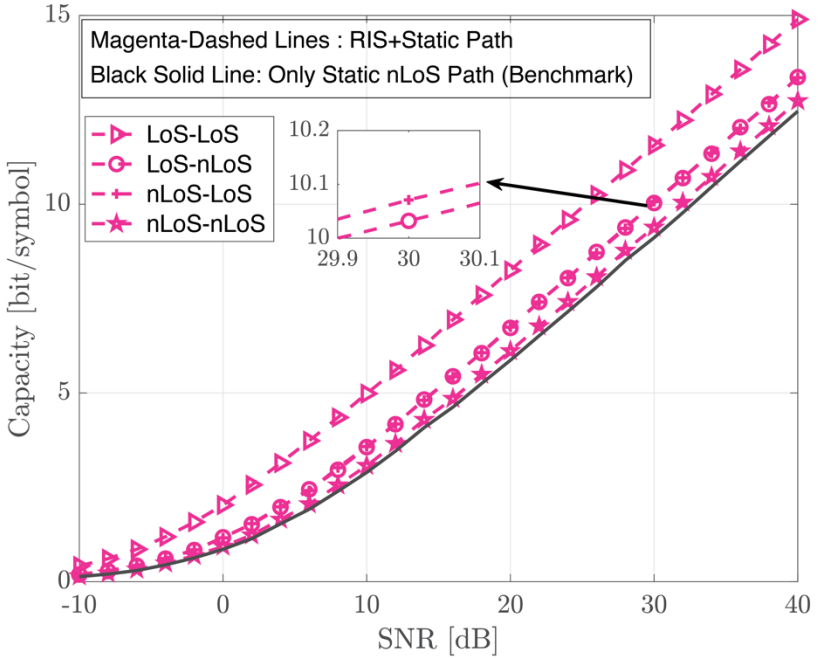
But 6G bands are wide!

Only effective with line-of-sight (LoS) channels?

Use Case 1: Fixed Wireless Access

Yes, RIS is beneficial only in LoS!

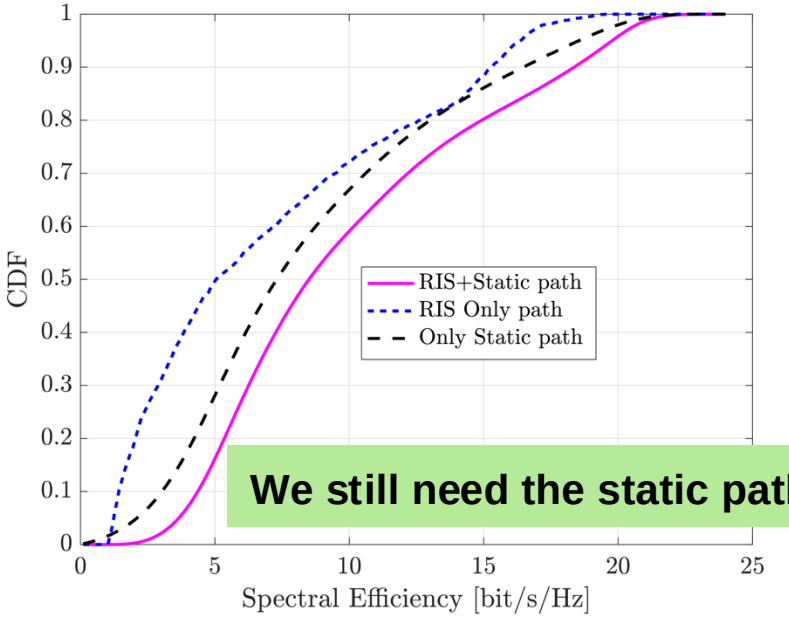




Transmitter and receiver within 100 m

$N = 2000$ RIS in the middle, 7.8 GHz

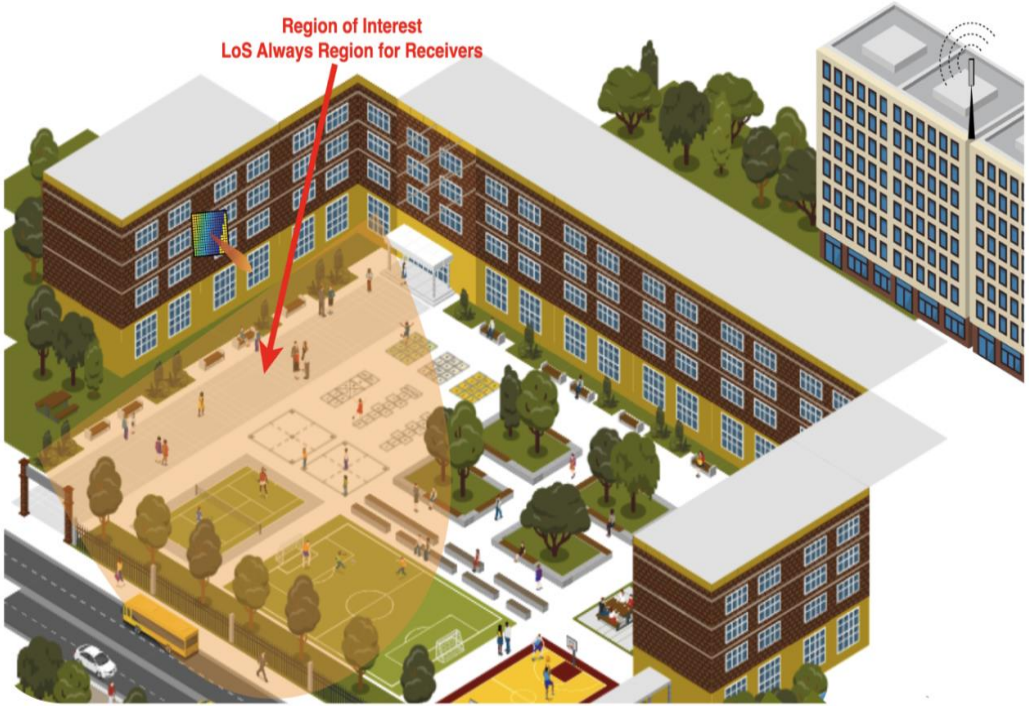
Use Case 2: Enhanced Capacity Within A Cell

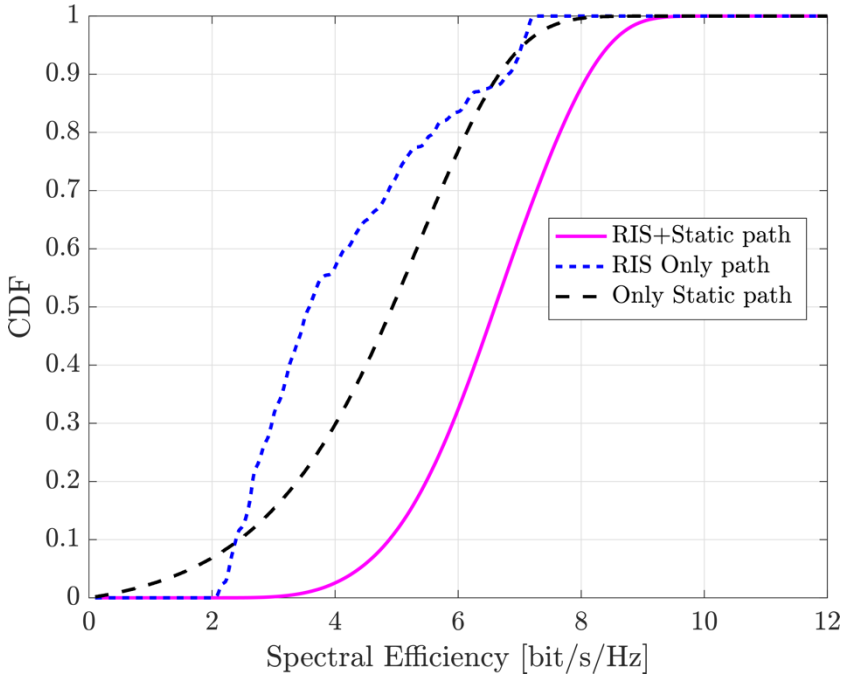


We still need the static path!

LoS to base station, realistic LoS probability

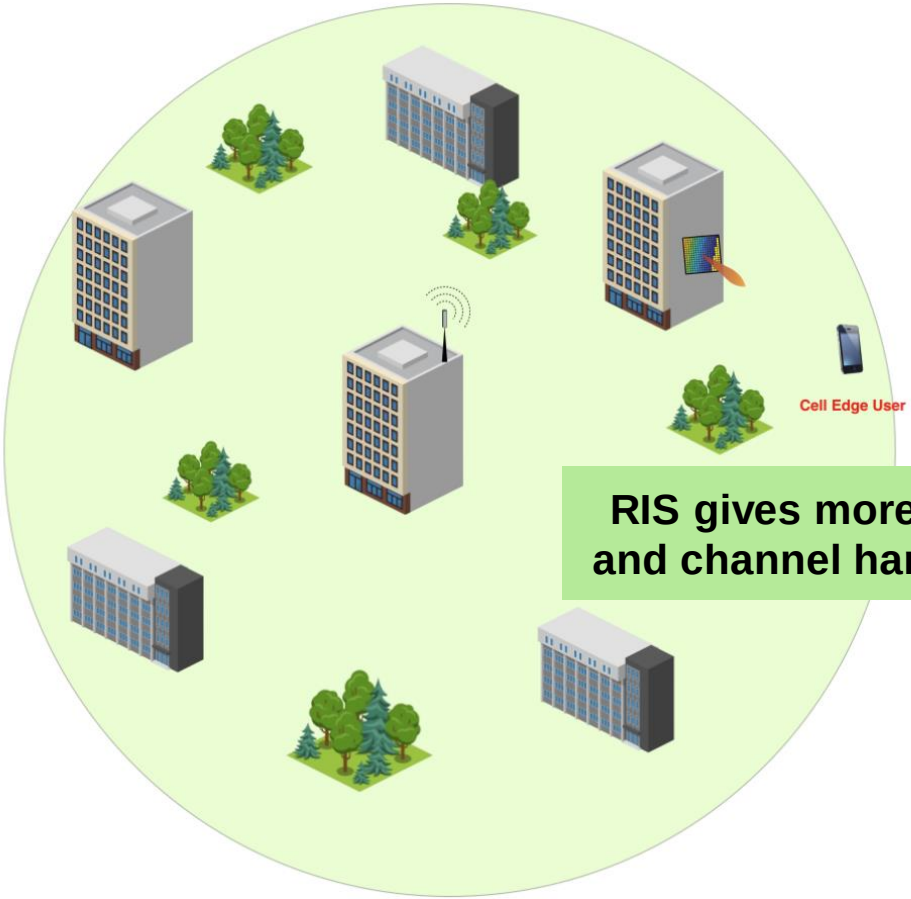
Use Case 3: Capacity Improvement in a Region of Interest

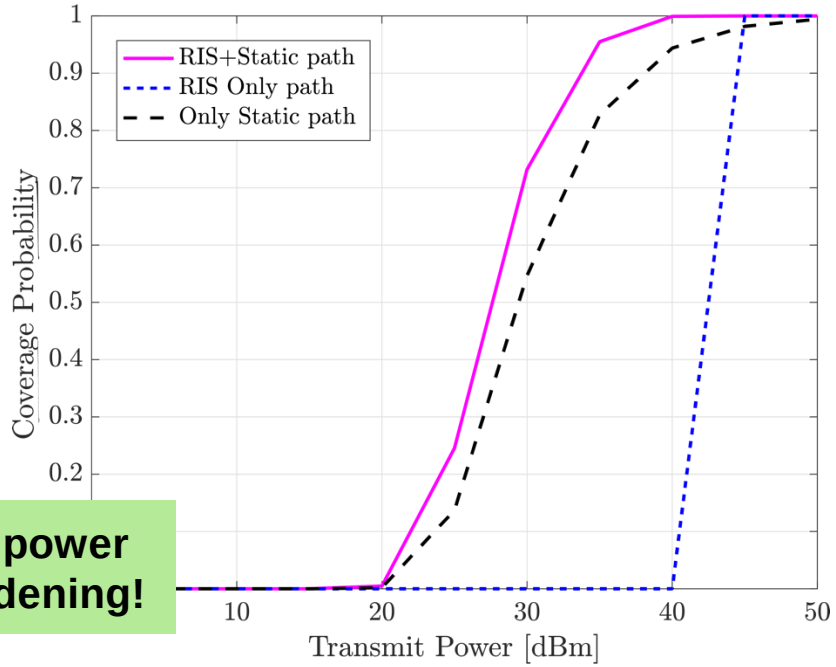




Larger gain since always LoS

Use Case 4: Reliability for Cell-Edge Users



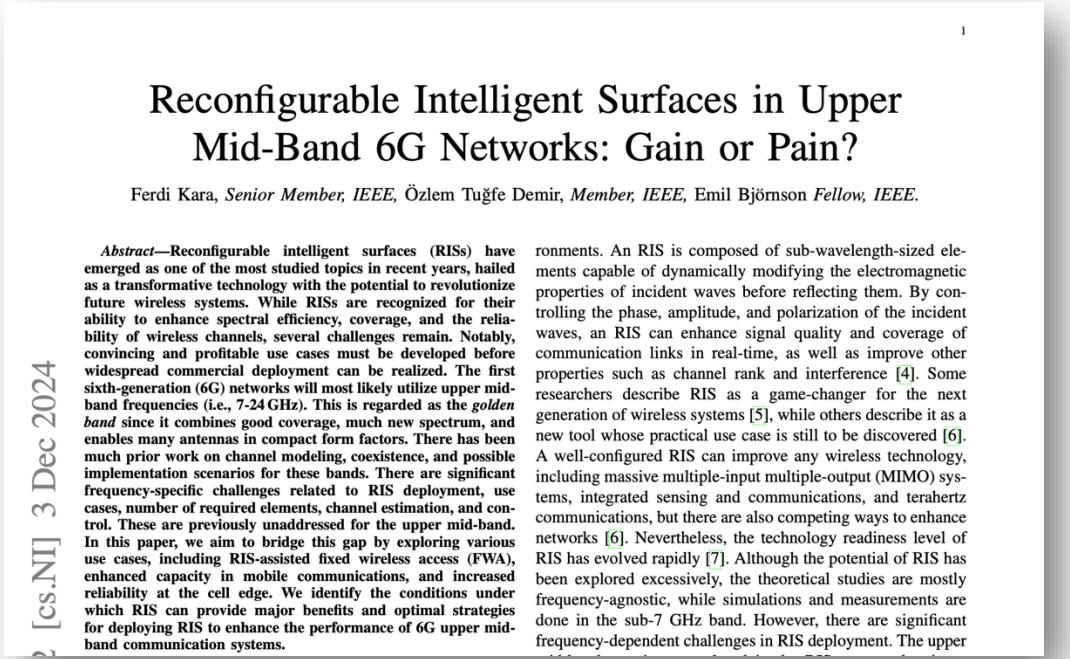


RIS gives more power and channel hardening!

Four use cases

Clear but modest gains

Learn more in the paper:



Reconfigurable Intelligent Surfaces in Upper Mid-Band 6G Networks: Gain or Pain?

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***Abstract*—Reconfigurable intelligent surfaces (RISs) have emerged as one of the most studied topics in recent years, hailed as a transformative technology with the potential to revolutionize future wireless systems. While RISs are recognized for their ability to enhance spectral efficiency, coverage, and the reliability of wireless channels, several challenges remain. Notably, convincing and profitable use cases must be developed before widespread commercial deployment can be realized. The first sixth-generation (6G) networks will most likely utilize upper mid-band frequencies (i.e., 7-24 GHz). This is regarded as the *golden band* since it combines good coverage, much new spectrum, and enables many antennas in compact form factors. There has been much prior work on channel modeling, coexistence, and possible implementation scenarios for these bands. There are significant frequency-specific challenges related to RIS deployment, use cases, number of required elements, channel estimation, and control. These are previously unaddressed for the upper mid-band. In this paper, we aim to bridge this gap by exploring various use cases, including RIS-assisted fixed wireless access (FWA), enhanced capacity in mobile communications, and increased reliability at the cell edge. We identify the conditions under which RIS can provide major benefits and optimal strategies for deploying RIS to enhance the performance of 6G upper mid-band communication systems.**

ronments. An RIS is composed of sub-wavelength-sized elements capable of dynamically modifying the electromagnetic properties of incident waves before reflecting them. By controlling the phase, amplitude, and polarization of the incident waves, an RIS can enhance signal quality and coverage of communication links in real-time, as well as improve other properties such as channel rank and interference [4]. Some researchers describe RIS as a game-changer for the next generation of wireless systems [5], while others describe it as a new tool whose practical use case is still to be discovered [6]. A well-configured RIS can improve any wireless technology, including massive multiple-input multiple-output (MIMO) systems, integrated sensing and communications, and terahertz communications, but there are also competing ways to enhance networks [6]. Nevertheless, the technology readiness level of RIS has evolved rapidly [7]. Although the potential of RIS has been explored excessively, the theoretical studies are mostly frequency-agnostic, while simulations and measurements are done in the sub-7 GHz band. However, there are significant frequency-dependent challenges in RIS deployment. The upper

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