Introduction

The future of Cellular Communication looks euphoric with the development and implementation of 6th Generation (6G) wireless networks. [1] By the year of 2022, the number of connected devices is expected to reach up to 28.5 billion among which, 12.3 billion is envisioned to be mobile-compatible networks. Ever since, there has been an increasing demand for better data rates [4], [6], low-latency services [3] and efficient wireless communication systems. The on-going deployment of 5G networks [1] clearly manifests the characteristic limitations of the system and since then the development of 6G wireless networks became the hottest topic in communications research. The revolutionizing applications of 6G wireless systems include high-speed mobile networks, smart homes, high-speed multimedia data streaming, holographic (optical) media processing, and next generation artificial intelligence (AI) applications [5]. A lot of challenges were faced during the course of the development of 5G/6G networks like user capacity, beamforming [4], [7]. In the past, many solutions came up as a response to the problems faced but the concept of Large Intelligent Surfaces was a breakthrough technology among all of those. Since there has been a massive increase in the number of mobile users, the energy and the radiation of the base-station antennas are expected to increase for the future wireless systems. But base-stations installed with LLS can tremendously reduce the energy consumption since these surfaces are essentially low-power modules.

Objectives

• To design the passive and active unit cell (patch antenna) in HFSS simulation tool and analyse its radiation parameters and performance
• To simulate and ensure the compatibility of RF PIN diodes using ADS software
• To design a microstrip line testbench and fabricate it using chemical etching process for testing the integrity of diodes using a network analyzer
• To develop a microcontroller setup for biasing the diodes in the array unit cells and for debugging applications. Also, program the microcontroller using Arduino and MATLAB

Methodologies

• The PIN diodes enable the re-configurability for the antenna array unit cells and hence were selected carefully based deep analysis of their losses in Keysight ADS and Ansys HFSS simulation platforms
• In order to verify the real-time losses and characteristics, a microstrip line testbench was designed and fabricated using chemical etching process
• The testbench lines were soldered with PIN diodes and the measurements were carried out using a vector network analyzer in the THz electronics laboratory
• Finally, a microcontroller circuitry with registers, LEDs, interconnections was setup for biasing the PIN diodes in the active reflectarray antenna.

Results

The reflectarray unit cells were co-designed and assembled in HFSS. Parallelly, the RF PIN diodes were selected and tested successfully using a network analyzer where it displayed excellent qualities to act a switch for enabling the reconfigurability of the large intelligent surfaces. The microcontroller was programmed in arduino cc platform and MATLAB. The work for the next phase of this project has been initiated where focus is shifted towards the sensing network that determines the incoming signals and informs the LIS the direction of the user and the base-station

References