Project Report for Supervisors

FPGA-Based RF Front-End Configuration

Project Summary

This project involves the development of an FPGA-based control system for an RF front-end. The FPGA configures the RF front-end devices through SPI communication, ensuring flexible and dynamic frequency control.

Key Features

- **Automated Device Configuration**: The system sends SPI commands to configure local oscillators and expanders.

- **Modular Design**: Individual controllers for each device allow for easy expansion.

- **Efficient Arbitration**: A built-in arbiter prioritizes SPI transactions.

- **Scalability**: Future updates will enable remote control from a host PC via GNU Radio.

Current Status

- **Core Functionality Implemented**:

    o SPI Master for serial communication.

    o LO Controller for frequency synthesis.

    o Expander Controller for I/O management.

    o Top-level logic for system integration.

- **Testbench Completed**:

    o Successfully verifies data transmission and SPI transaction sequencing.

Next Steps

- **Host Communication**: Implement Ethernet-based register configuration.

- **Real-World Testing**: Validate FPGA interactions with physical RF components.

- **Optimization**: Improve SPI performance and error handling.

Impact & Benefits

- **For Research & Education**: Provides a modular, reconfigurable SDR testbed.

- **For Industry**: Demonstrates FPGA-based RF control techniques applicable to wireless communications and signal processing.

This project establishes a foundation for FPGA-controlled RF systems, with potential applications in SDR, satellite communications, and advanced wireless networks.