

# FPGA-Based Traffic Light Controller with Priority System

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## Abstract

This project presents a Verilog-based traffic light controller implemented on an FPGA with a priority override system for emergency vehicles. The system ensures safe and intelligent management of traffic lights at a four-way junction while giving immediate priority to emergency signals. Designed for real-time response and low-latency operation, the system is simulated on Vivado and suitable for Spartan FPGA boards.

## Introduction

Traffic congestion and delays at intersections are a major concern in urban cities. This project uses FPGA hardware and Verilog HDL to implement a 4-way traffic signal controller. An additional feature ensures priority for emergency vehicles (ambulance, fire trucks) by detecting signals and overriding the regular light sequence to allow safe passage.

## Objectives

1. Design a 4-way traffic light controller using Verilog.
2. Implement emergency vehicle priority logic.
3. Deploy on a Xilinx Spartan FPGA board.
4. Simulate the system using Vivado or ModelSim.

## System Design

The system uses a finite state machine (FSM) that cycles through four directions: North, East, South, and West. Each direction has red, yellow, and green signals. Emergency inputs (4-bit) are monitored. If a high signal is detected in any direction, the FSM immediately transitions to give green

to that direction. Verilog HDL is used to implement the logic.

## **Tools and Technologies Used**

- Verilog HDL
- Xilinx Vivado
- ModelSim (for simulation)
- Spartan FPGA development board

## **Results and Conclusion**

The project successfully simulates a smart traffic light controller that gives immediate green signal access to emergency vehicles. The FSM-based logic ensures that each direction receives fair access in normal conditions, while prioritizing emergencies effectively. This system improves traffic management, safety, and responsiveness.