ECE4810J LAB 5 Group 8 Report

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November 2024

Contents

1 Overview

In this lab, we learned more about ASIC design flow. We have explored the influence of design constraints and technology nodes on the PPA, learned about the macro placement flow in OpenROAD and setting up a new design with OpenROAD.

2 OpenROAD

2.1 Exercise 1: Creating a Pareto Curve

2.1.1 Total power & Area vs. Max Frequency

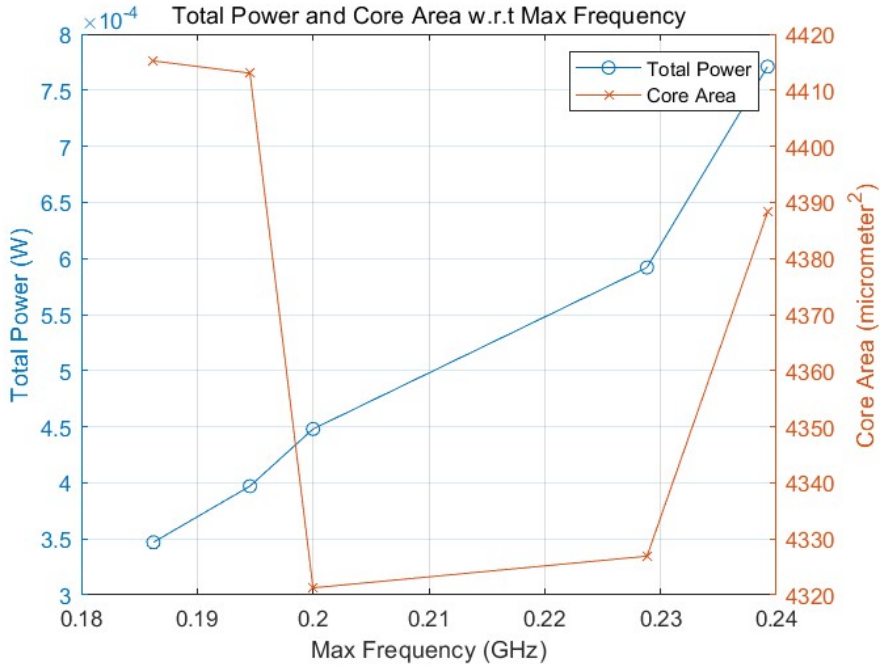

Figure 1: Total power & Area vs. Max Frequency

2.1.2 Total power vs. Max Frequency

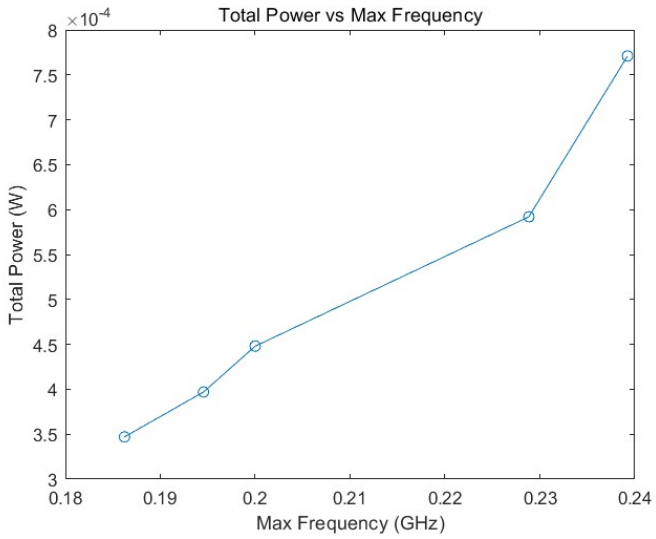

Figure 2: Total power vs. Max Frequency

2.1.3 Area vs. Max Frequency

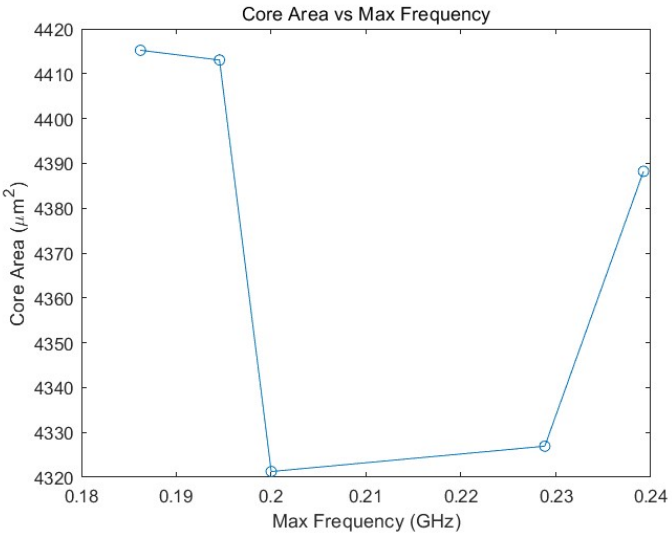

Figure 3: Area vs. Max Frequency

2.2 Exercise 2: Scaling a Design Across Technologies

2.2.1 Total power and Area vs Max Frequency

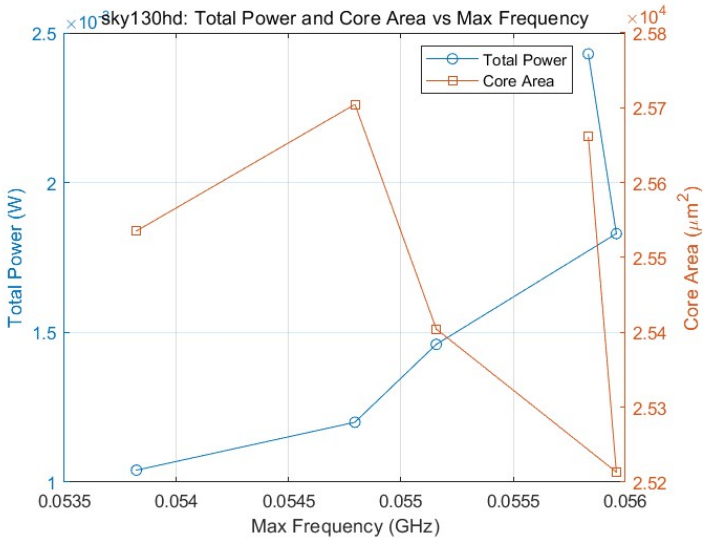

Figure 4: sky130hd: Total Power & Area vs Max Frequency

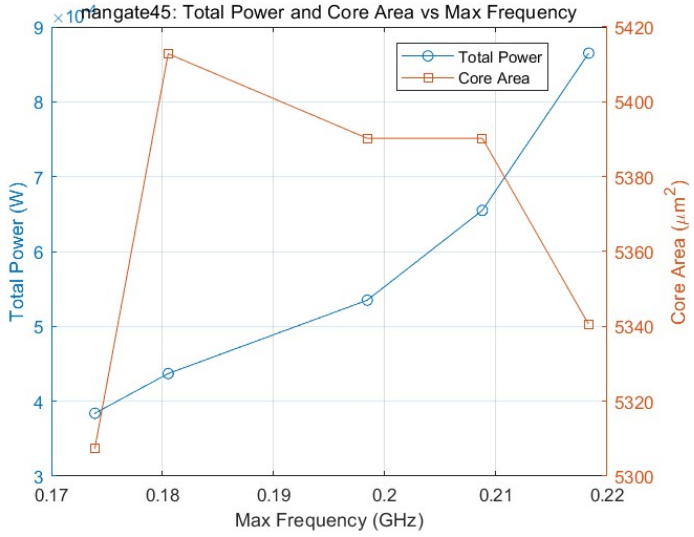

Figure 5: nangate45: Total Power & Area vs Max Frequency

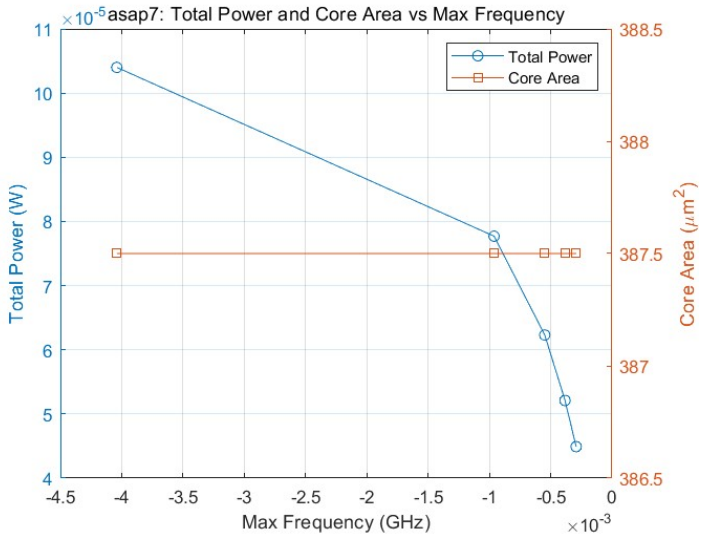

Figure 6: asap7: Total Power & Area vs Max Frequency

2.3 Exercise 3: Setting Up a New Design with OpenRoad-flow-Scripts

2.3.1 Target RTL

We used the given **counter.v** with minor adjustment:

```
module counter #(
    parameter WIDTH = 64
)(
    input wire clk,
    input wire rst,
    output [63:0] count
);

reg [63:0] count;

always @(posedge clk) begin
    if (reset) begin
        count <= WIDTH'b0;
    end else begin
        count <= count + WIDTH'b1;
    end
end

endmodule
```

2.3.2 Goal

We aimed to maximize performance by achieving the worst slack of **zero**.

2.3.3 Simulation and Analysis

First, we choose **nangate45** for simulation with 3 different combinations of Core Utilization and Place Density for different constraints.

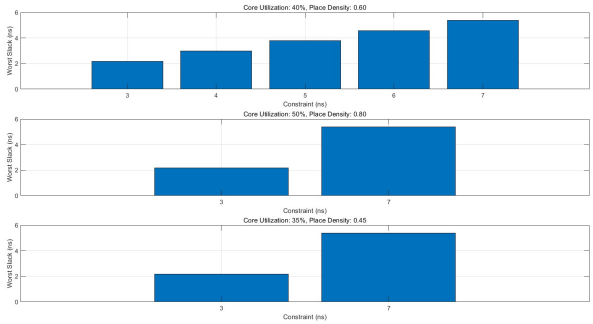

Figure 7: Worst Slacks with nangate45

We found that, with nangate45, it is hard to achieve worst slack below 2ns. Therefore, we changed the platform to **sky130hd**.

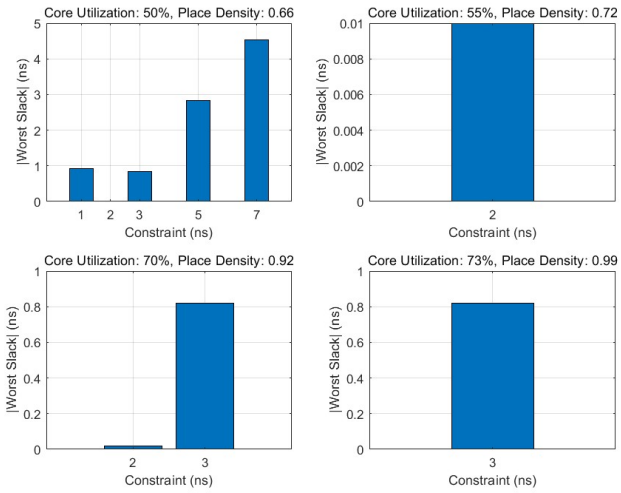

Figure 8: Worst Slacks with sky130hd

We discovered the significant reduction in worst slack, and we could achieve 0 worst slack with **2ns** constraint, Core Utilization **50%**, and Place Density **0.66**.

We exclude **asap7**, as it shows the significantly largest worst slack.