
EE434
ASIC & Digital Systems

Lab 4

ECO Buffer Insertion
(Encounter)

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Preparation for Lab4

- Download the following file into your working directory.
 - `wget http://eecs.wsu.edu/~ee434/Labs/lab4.tar.gz`
- Unzip it.
 - `tar xvfz lab4.tar.gz`

Launch Encounter

- `source edi.sh`
- `encounter`
- Click “File” → “Import Design...” → “Load...” and import “bi.globals”. Click “OK”.
- In your Encounter terminal, enter “defln bi.def” to load a pre-designed layout.
- In your Encounter GUI, press “f” to refresh the window. You should see the following.

The image shows a screenshot of a PCB design software interface. On the right side, there is a 'Layer Control' panel with a list of layers and their corresponding colors and patterns. The layers listed are:

- Instance
- Instance
- Block
- Std. Cell
- Cover Cell
- Physical Cell
- I/O Cell
- Area I/O Cell
- Black Box
- Module
- Net
- Cell
- Blockage
- Row
- Floorplan
- Partition
- Bump
- Power
- Grid
- Track
- Congestion
- Multiple Color
- Miscellaneous
- Wire&Via
- active(M0)
- Via 01
- metal1(M1)
- via1(V12)
- metal2(M2)
- via2(V23)
- metal3(M3)
- via3(V34)
- metal4(M4)
- via4(V45)
- metal5(M5)
- via5(V56)
- metal6(M6)

Each layer has a small colored square with a pattern next to it, and two red arrows to its right. A green arrow points to the 'active(M0)' layer. The status bar at the bottom contains the text: 'Click to select single object. Shift+Click to de/select multiple object' followed by a 'Q' icon, 'SelNum:0', '(86.772, -540.987)', and 'Placed'.

User Interface

- Click your mouse left button: select an object(s).
- Click your mouse right button, hold, drag, and release: zoom-in
- Press “f”: Fit.

Timing

- This is a combinational circuit.
- $g_out = \sim(g_in[0] \text{ AND } g_in[1])$
- Timing constraint: 500ps
- Layout width: 5,000um
- Run “report_timing -net” to check timing.

Buffer Types

- BUF_X1
- BUF_X2
- BUF_X4
- BUF_X8
- BUF_X16
- BUF_X32

How to Insert a Buffer

- Click “Optimize” → “Interactive ECO...”
- Click the “Add Repeater” tab.
- Either type the name of the target net (“g_out” in this example) or click the net in the GUI window with your mouse left button and click “get selected” in the ECO window.
- For the “New Cell” box, choose “BUF_X8”.
- Then, click “Location”.
- You can type the target coordinate or click “get coord” and click a target buffer insertion location in the layout. It will automatically fill in the coordinate text box.

Add Repeater

Add Instance

Change Cell

Del Repeater

Display Buffer Tree

Net: g_out

get selected

Terminals:

All Terminals

Listed Terminals

Draw Terminals

New Cell: BUF_X8

Place Mode

Default

Don't Place Cells

Location: First Buf/Inv X 3499.6955 Y 1.671

get coord

Second Inv X Y

get coord

Relative distance wire cut to the sink (%): 0.5

Offload:

By Slack (ns):

By Location: X Y

get coord

Radius (um):

Apply

Eval

Eval All

Add to WhatIf List

Mode

Close

Help

How to Insert a Buffer

- Click “Apply”. This will insert a buffer into the specified location for the specified net.
- Click “Close”.
- In the Encounter terminal, run “report_timing –net” to see the timing info.
- The slack decreased from “-2.365ns” to “-1.436ns”.

```
Analysis View: NG_view_typ
- External Delay          0.000
+ Path Delay              0.500
= Required Time          0.500
- Arrival Time           1.936
= Slack Time             -1.436
Clock Rise Edge          0.000
+ Input Delay             0.000
= Beginpoint Arrival Time 0.000
+-----+-----+-----+-----+-----+-----+-----+
| Pin          | Edge | Net          | Cell   | Delay | Arrival | Required |
|-----|-----|-----|-----|-----|-----|-----|
| g_in[1]      | ^    | g_in[1]      |        |        | 0.000   | -1.436   |
| U1/A2        | ^    | g_in[1]      | NAND2_X1 | 0.000 | 0.000   | -1.436   |
| U1/ZN        | v    | FE_ECON0_g_out | NAND2_X1 | 0.227 | 0.227   | -1.209   |
| FE_ECOC0_g_out/A | v    | FE_ECON0_g_out | BUF_X8  | 1.211 | 1.437   | 0.002   |
| FE_ECOC0_g_out/Z | v    | g_out        | BUF_X8  | 0.317 | 1.754   | 0.318   |
| g_out        | v    | g_out        | VBI     | 0.182 | 1.936   | 0.500   |
+-----+-----+-----+-----+-----+-----+-----+
encounter 5> █
```

ssh://daebyun@dhs1.eecs.wsu.edu:22

Note

- If you insert a buffer into a net, it splits the net into two nets.
- Thus, when you insert another buffer after that, you should make sure that you are inserting a buffer into a right net.

Goal

- Satisfy the given timing constraint.
- Minimize the total buffer size.
- Due 23:59pm, Apr. 26.
- What to submit
 - Final DEF file (see the next slide)
 - Final timing report (screen capture or copy&paste)
 - Total buffer size (the sum of X#).
 - A brief description of the optimization approach you used.

How to Generate DEF

- In the Encounter terminal, type
 - `defOut -floorplan -netlist -routing <filename>`
 - for example
 - `defOut -floorplan -netlist -routing Kim.def`