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Encoder Digital Circuit Design.

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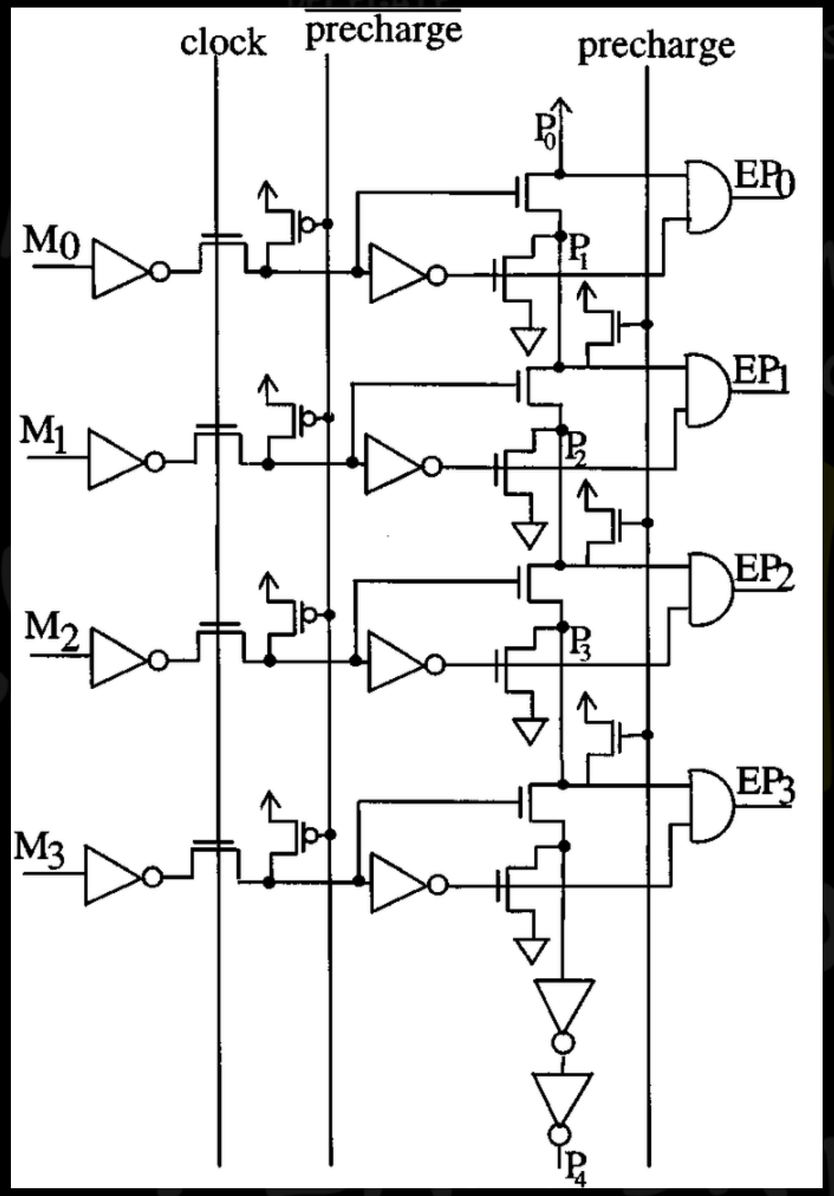
Introduction

Digital encoders are essential components in digital circuitry, used to convert input data from one format to another. They play a crucial role in various applications, including data communication, memory addressing, and signal processing. In this discussion, we will explore four different types of digital encoders and their designs:

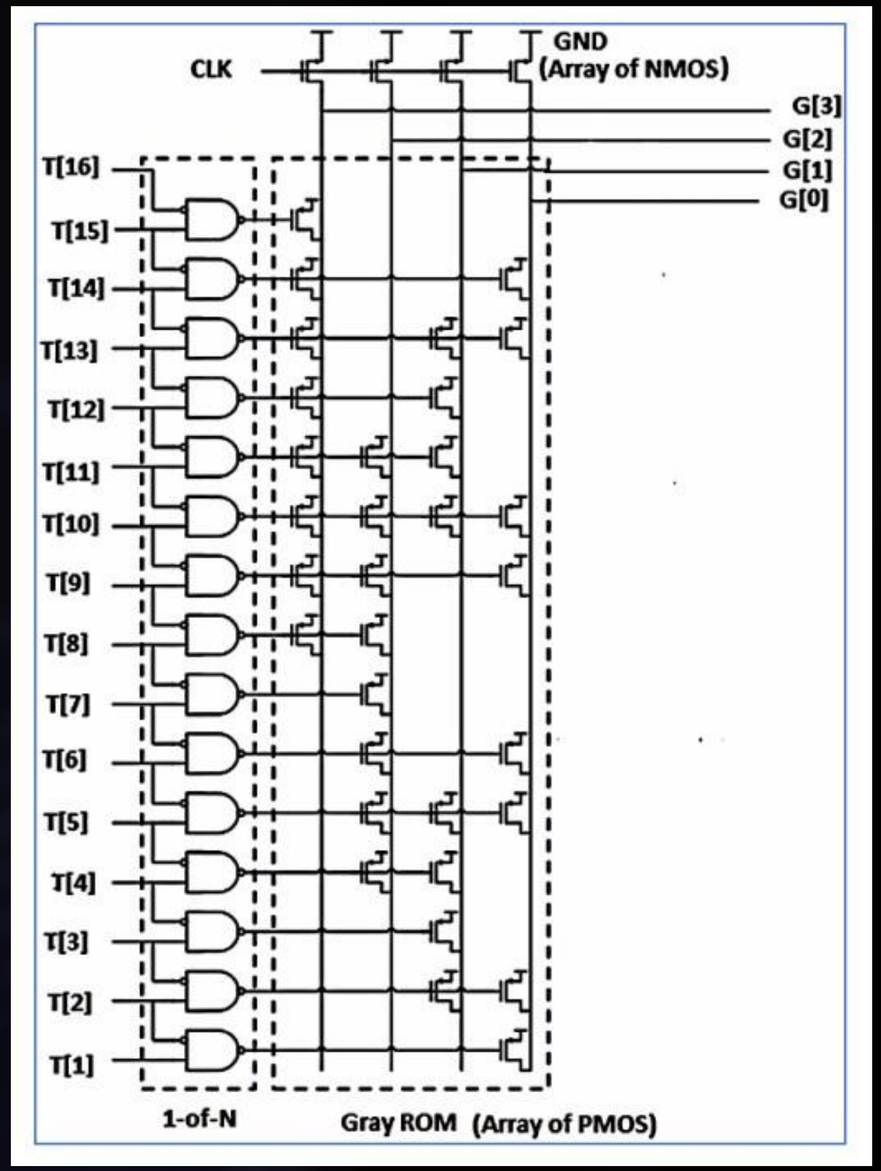


4-Bit Priority Encoder:

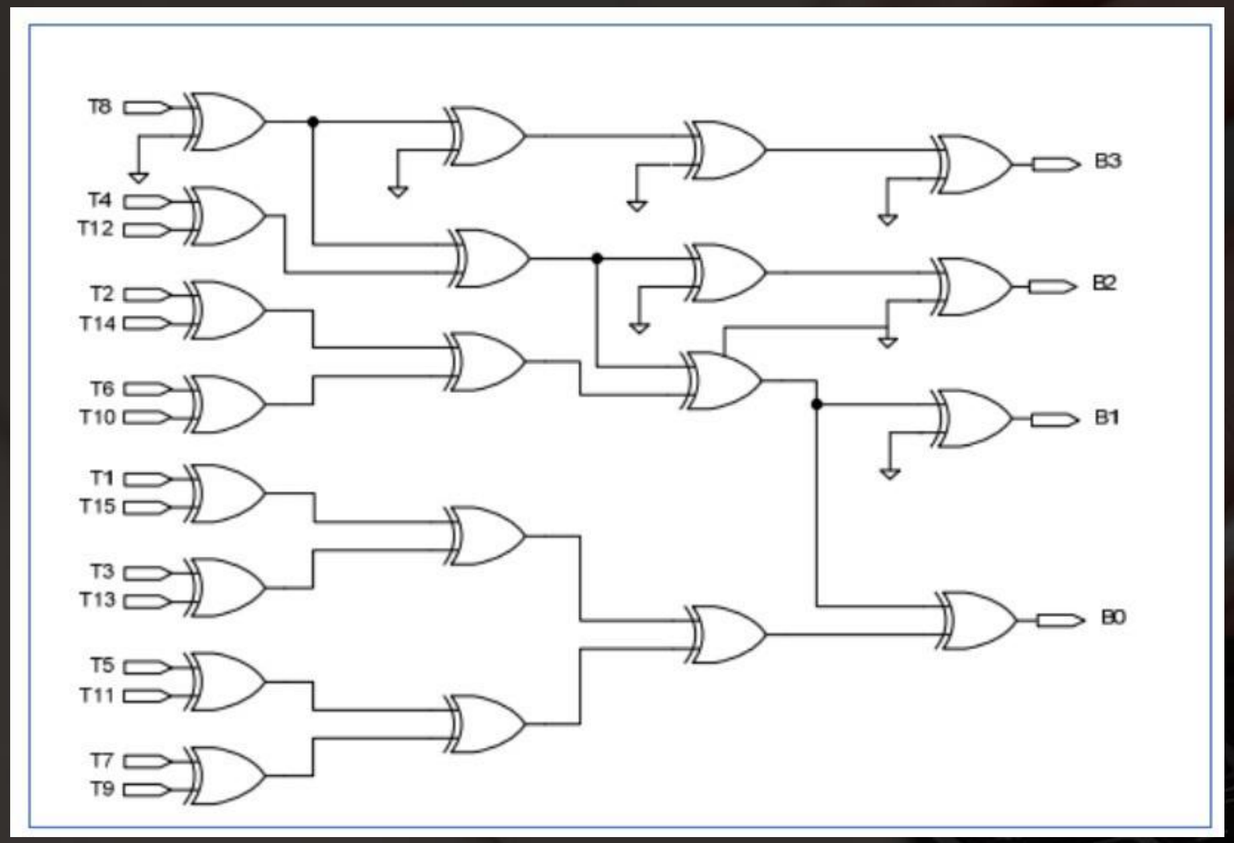
A 4-bit priority encoder is a fundamental digital circuit that prioritizes multiple input lines and encodes them into a binary code. Priority encoders are commonly used in microprocessors and memory systems to handle interrupt requests and address prioritization. The encoder assigns a unique binary code to the highest-priority active input line, allowing the processor to identify and process the most critical task.

4-Bit Gray ROM-based Thermometer to Gray Encoder:

Gray code is a binary numeral system where two consecutive values differ in only one bit. This property is valuable in various applications, such as rotary encoders and position sensors. A ROM (Read-Only Memory) based thermometer to Gray encoder is designed to convert a thermometer code, where only one bit is high at a time, into a Gray code representation. This conversion is useful in applications requiring precise position sensing and control.



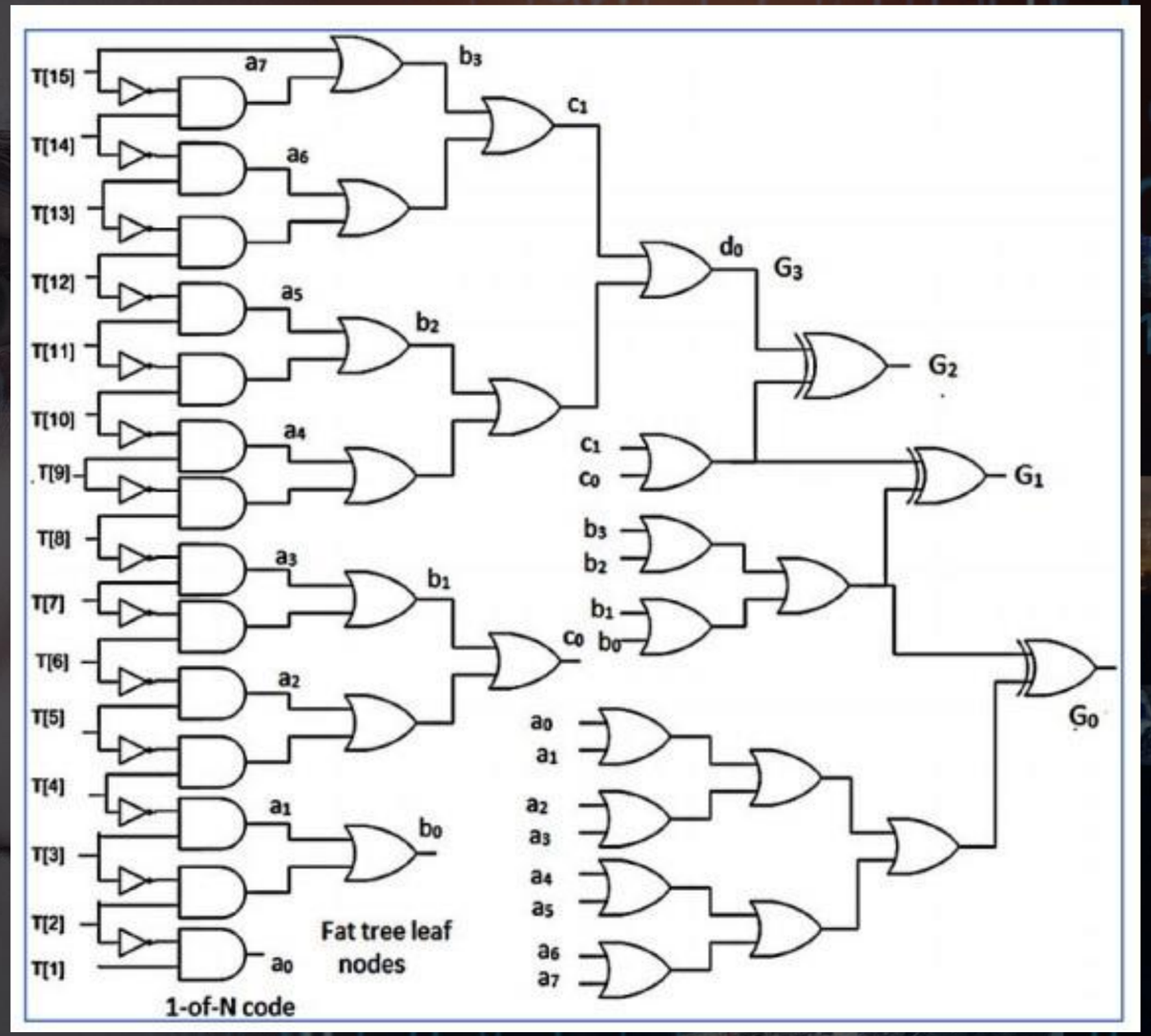
Encoder Implemented in XOR Gates:

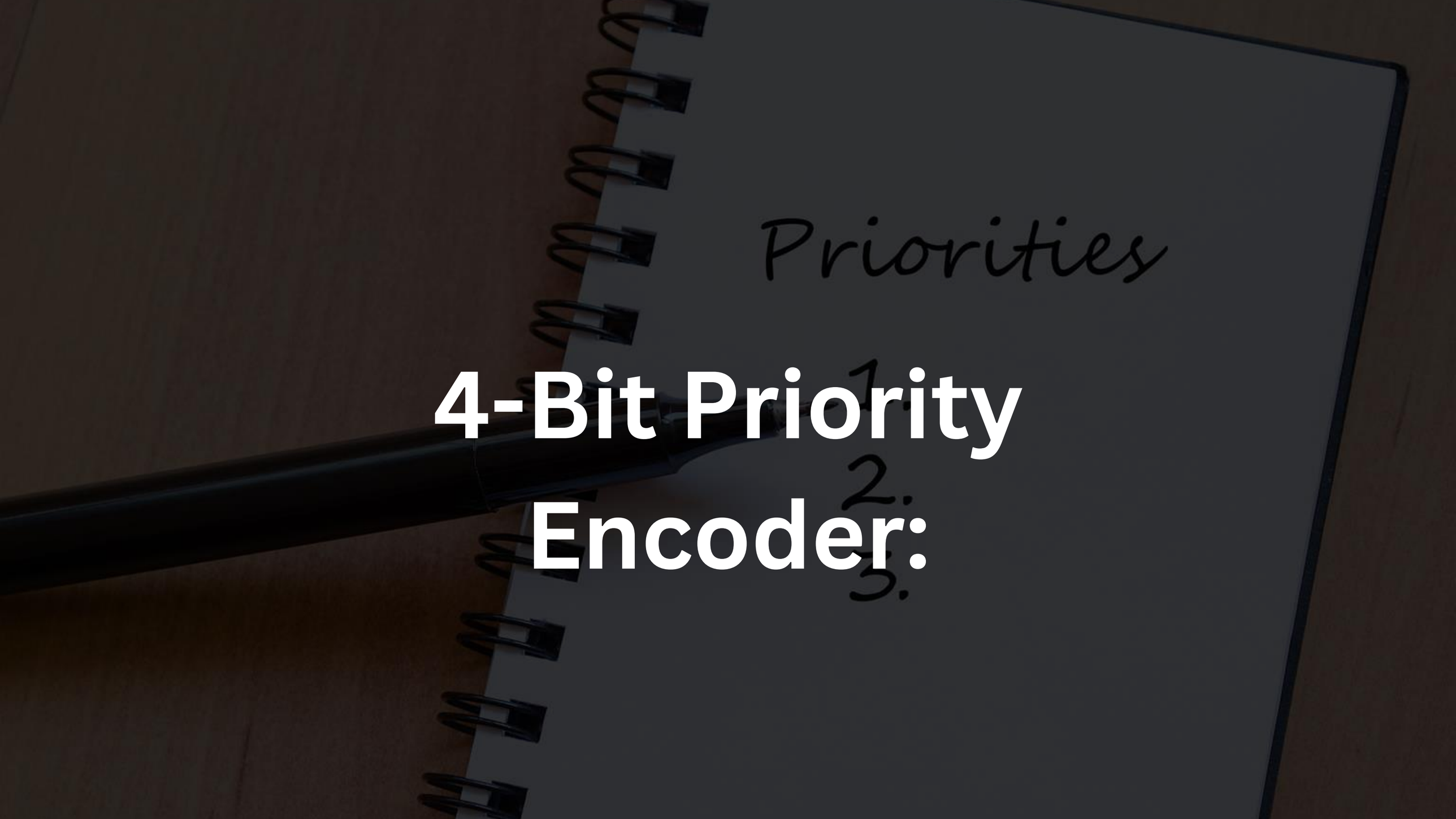


XOR (Exclusive OR) gates are fundamental logic gates that perform binary addition without carry. An encoder implemented using XOR gates takes multiple input lines and encodes them into a binary output. XOR-based encoders are efficient and widely used in various applications, including data compression, error detection, and signal multiplexing. They provide a straightforward way to convert input data into a binary format.

Conventional Fat Tree Encoder:

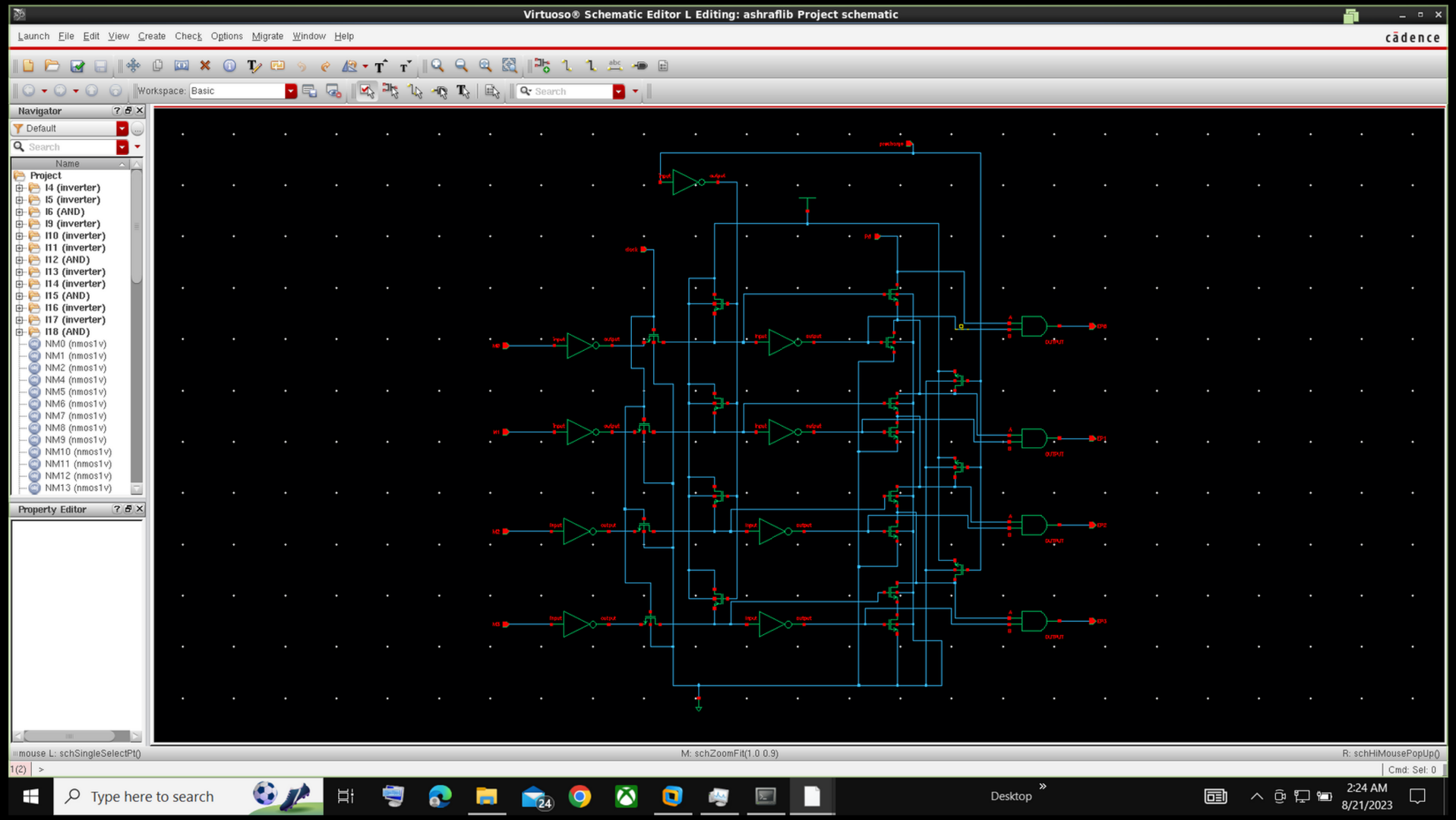
A conventional fat tree encoder is a specialized type of encoder used in networking and routing systems. Fat trees are hierarchical network topologies that are highly fault-tolerant and scalable. In this context, a fat tree encoder is responsible for mapping network addresses or requests to appropriate paths within the network. These encoders are critical for load balancing and efficient data routing in large-scale data centers and high-performance computing environments.



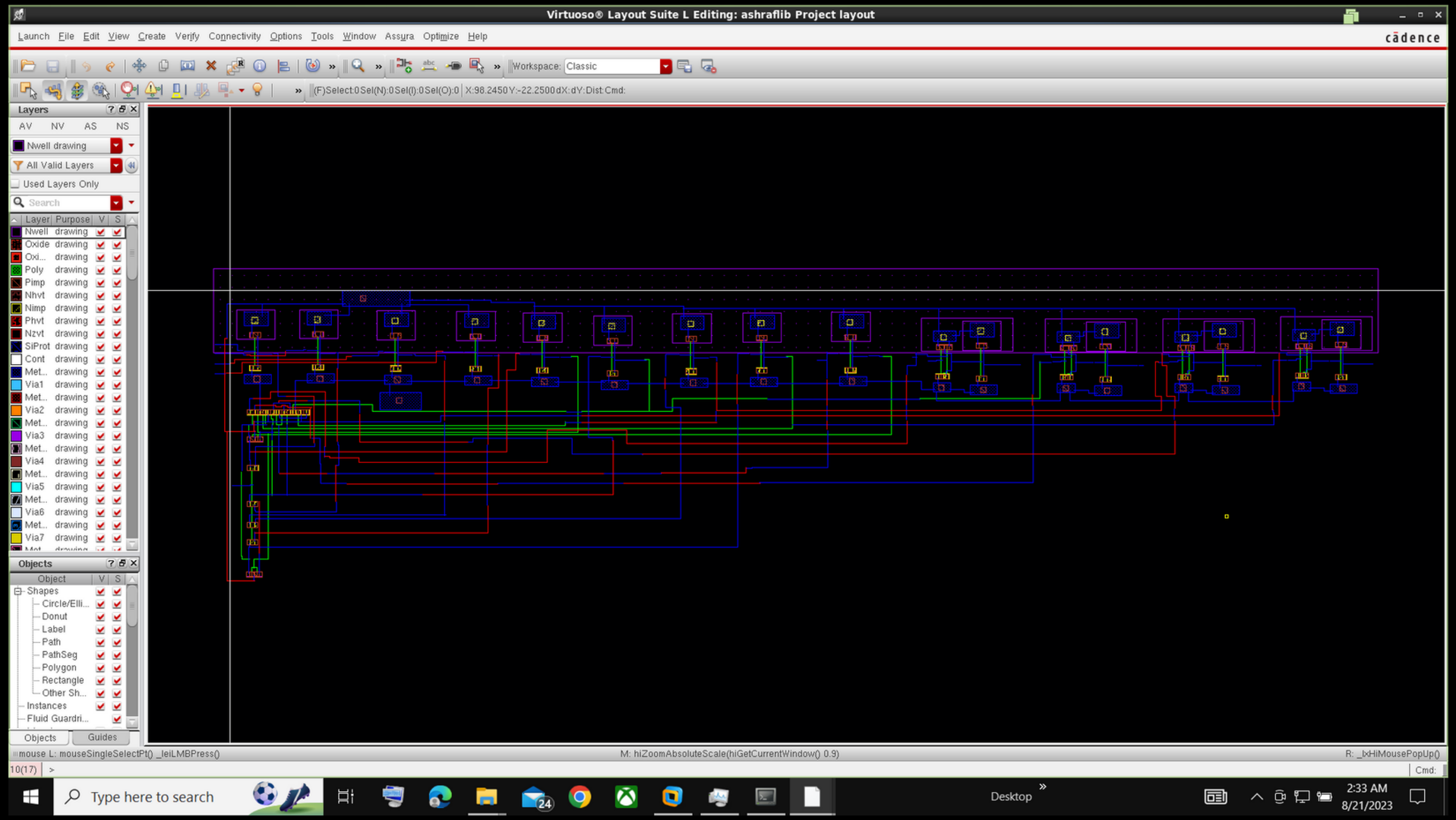


4-Bit Priority Encoder:

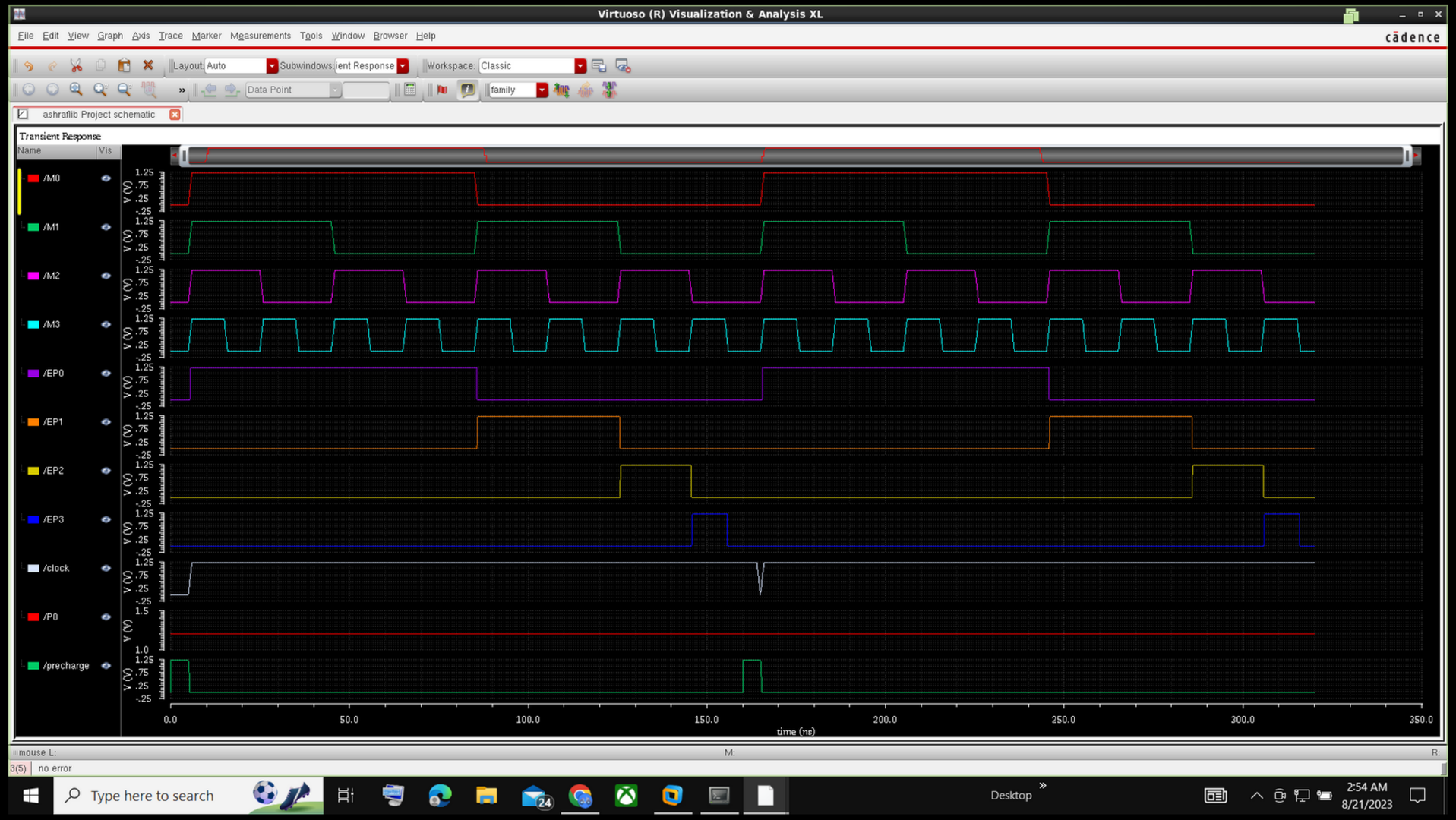
4-bit priority encode



Layout:

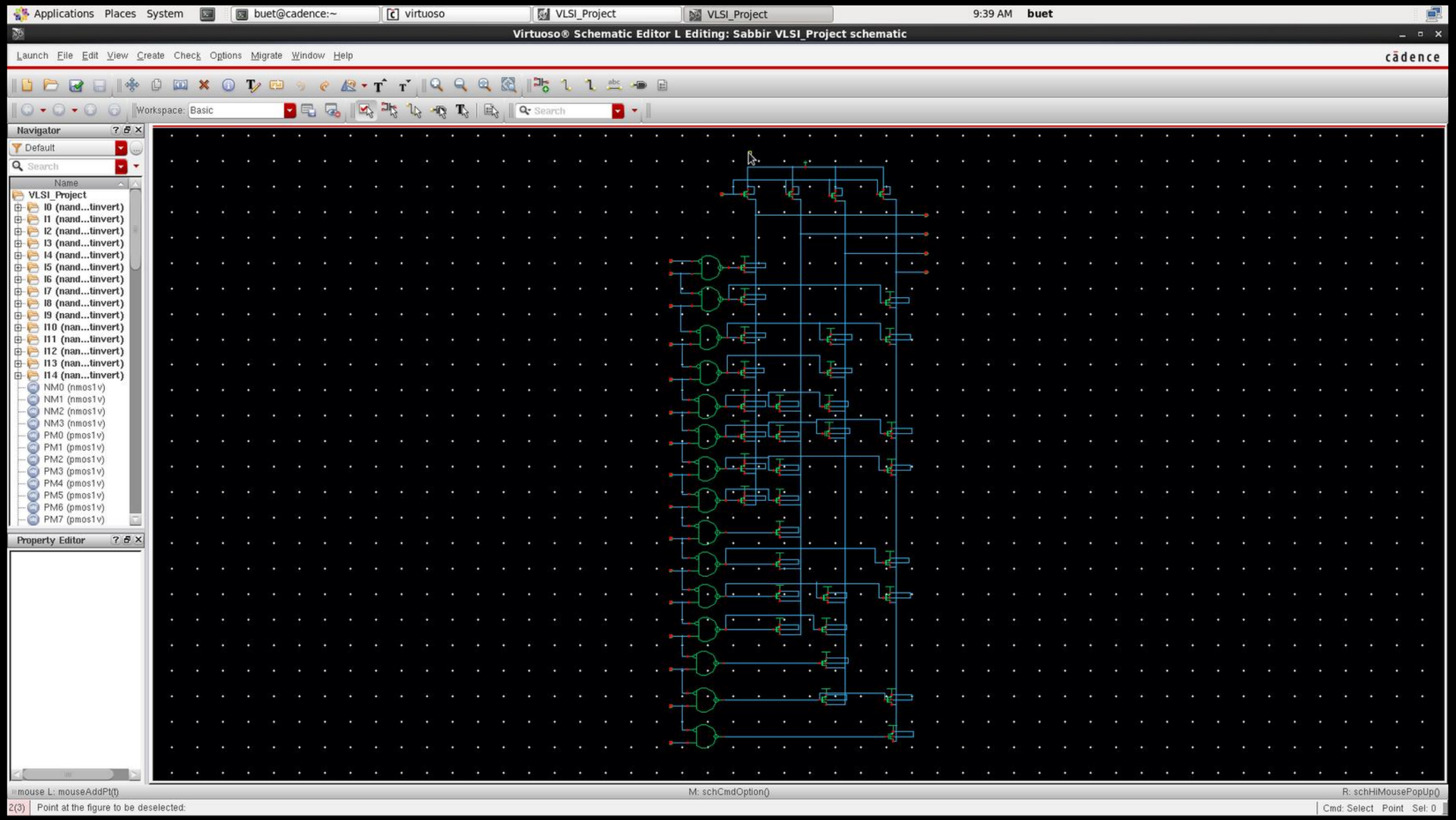

Virtuoso® Layout Suite L Editing: ashraflib Project layout
Launch File Edit View Create Verify Connectivity Options Tools Window Assura Optimize Help
cadence
Workspace: Classic
(F)Select:0Sel(N):0Sel(I):0Sel(O):0 X:98.2450 Y:-22.2500 dX: dY: Dist: Cmd:
Layers
AV NV AS NS
Nwell drawing
All Valid Layers
Used Layers Only
Search
Layer Purpose V S
Nwell drawing
Oxide drawing
Poly drawing
Pimp drawing
Nhvt drawing
Nimp drawing
Phvt drawing
Nzvt drawing
SiProt drawing
Cont drawing
Via1 drawing
Via2 drawing
Via3 drawing
Via4 drawing
Via5 drawing
Via6 drawing
Via7 drawing
Objects
Object V S
Shapes
Circle/Elli...
Donut
Label
Path
PathSeg
Polygon
Rectangle
Other Sh...
Instances
Fluid Guardri...
Objects Guides
mouse L: mouseSingleSelectPt() _leiLMBPress()
M: hiZoomAbsoluteScale(hiGetCurrentWindow() 0.9)
R: _lxHiMousePopUp()
10(17)
Cmd:
Type here to search
Desktop
2:33 AM
8/21/2023

Output:

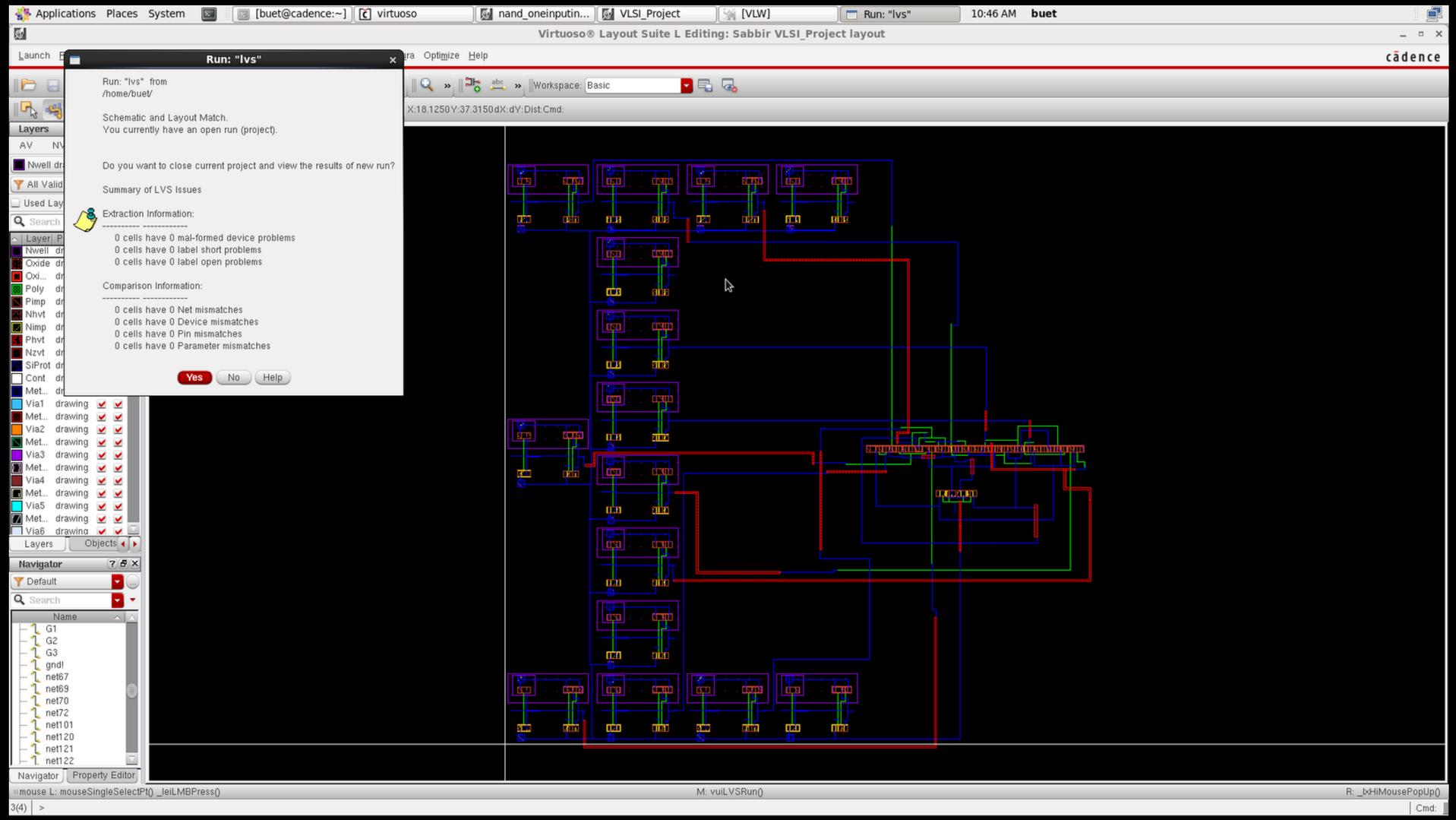

Virtuoso (R) Visualization & Analysis XL
File Edit View Graph Axis Trace Marker Measurements Tools Window Browser Help
cadence
ashraflib Project schematic
Transient Response
Name
Vis
/M0
/M1
/M2
/M3
/EP0
/EP1
/EP2
/EP3
/clock
/P0
/precharge
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
time (ns)
no error
Type here to search
Desktop
2:54 AM
8/21/2023

4-bit Gray ROM based Thermometer to Gray encoder

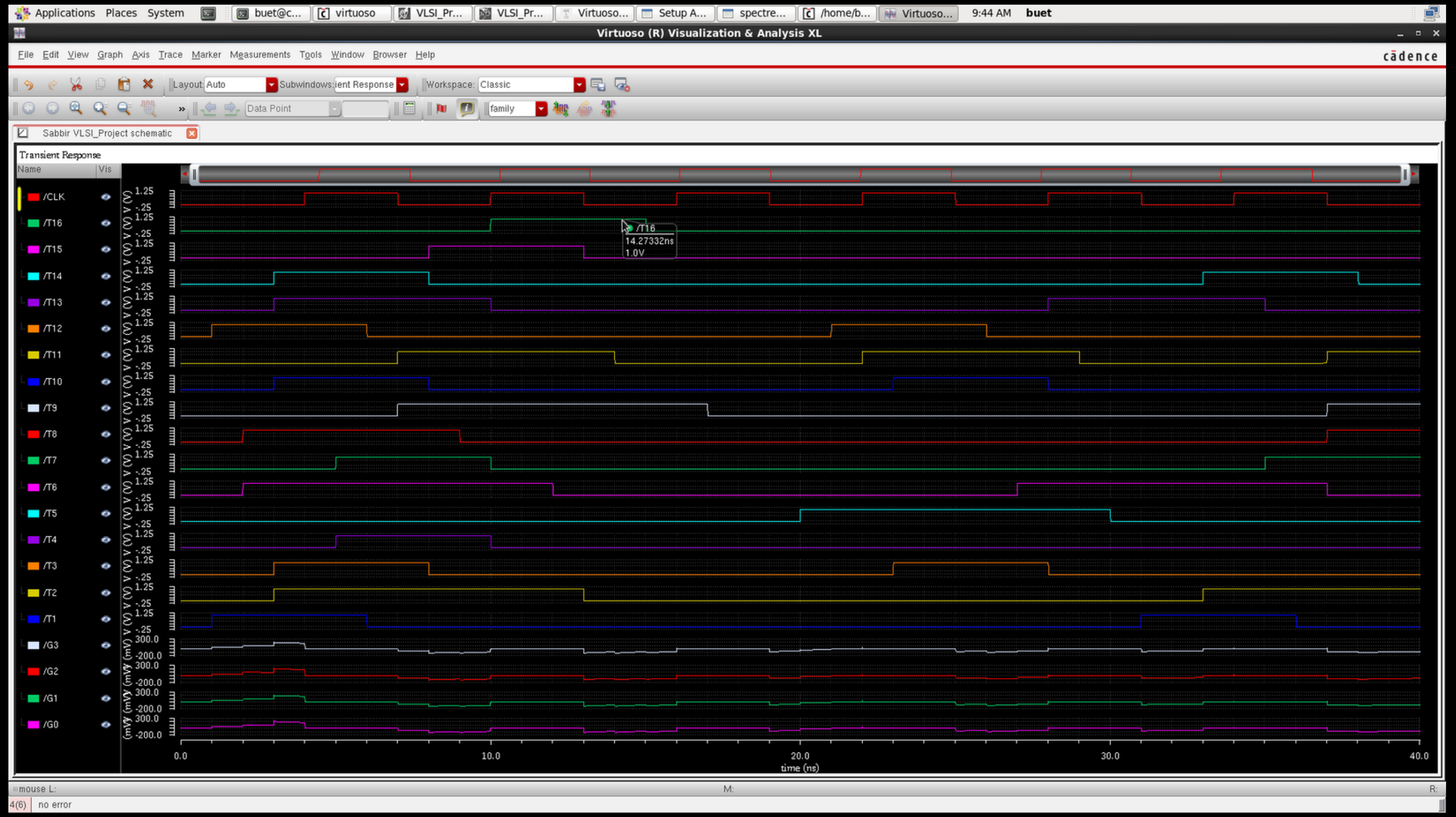
4-bit Gray ROM based Thermometer to Gray encoder



Layout:

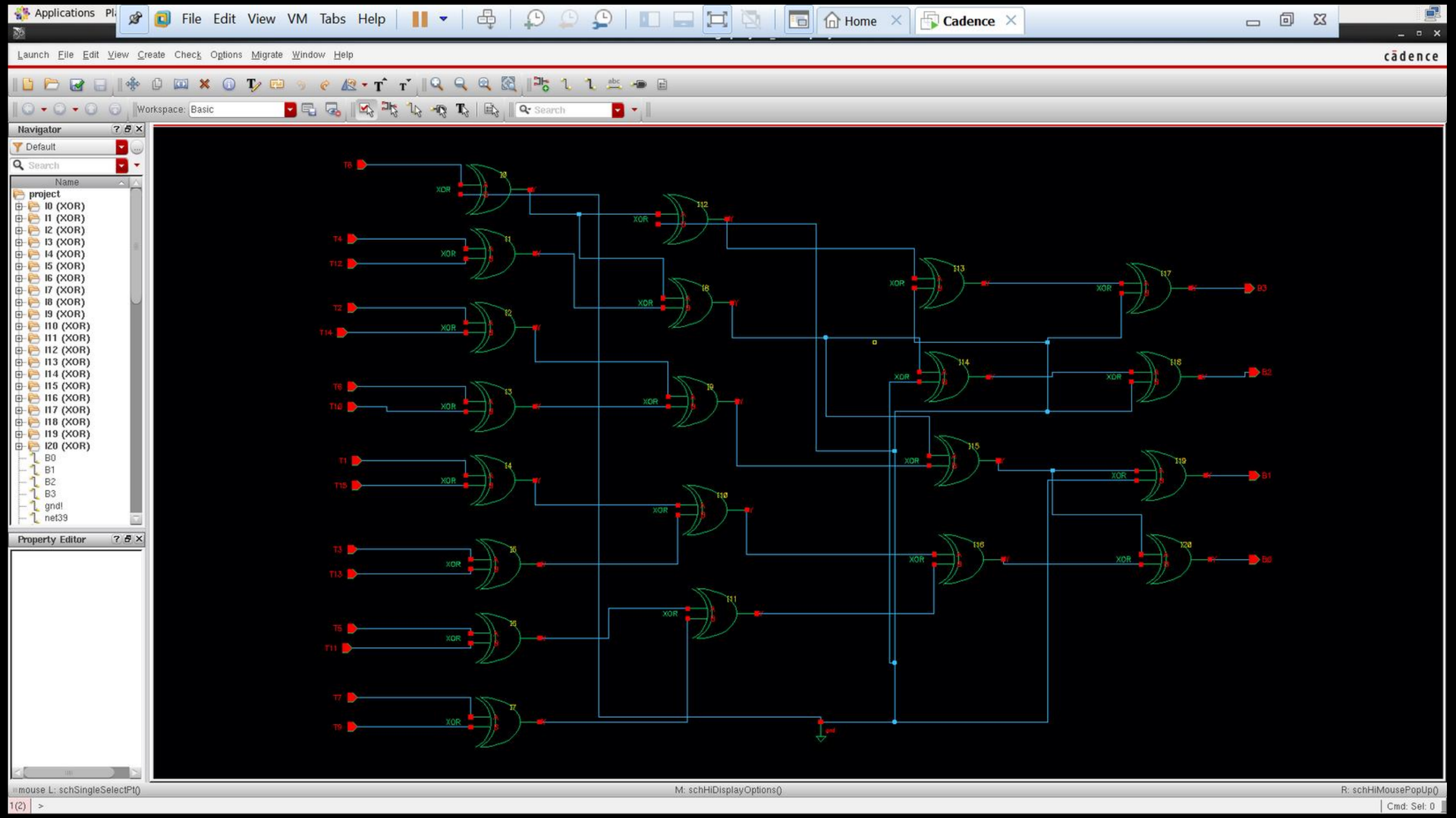

Applications Places System
[buet@cadence:~]
virtuoso
nand_oneinputin...
VLSI_Project
[VLW]
Run: "lvs"
10:46 AM
buet
Virtuoso® Layout Suite L Editing: Sabbir VLSI_Project layout
Launch
Optimize
Help
cadence
Workspace: Basic
Run: "lvs"
Run: "lvs" from
/home/buet/
Schematic and Layout Match.
You currently have an open run (project).
Do you want to close current project and view the results of new run?
Summary of LVS Issues
Extraction Information:
0 cells have 0 mal-formed device problems
0 cells have 0 label short problems
0 cells have 0 label open problems
Comparison Information:
0 cells have 0 Net mismatches
0 cells have 0 Device mismatches
0 cells have 0 Pin mismatches
0 cells have 0 Parameter mismatches
Yes
No
Help
Layers
Navigator
Default
Search
Name
G1
G2
G3
gnd!
net67
net69
net70
net72
net101
net120
net121
net122
Navigator
Property Editor
mouse L: mouseSingleSelectPt() _leiLMBPress()
M: vuiLVSRun()
R: _lxHiMousePopUp()
Cmd:

Output:

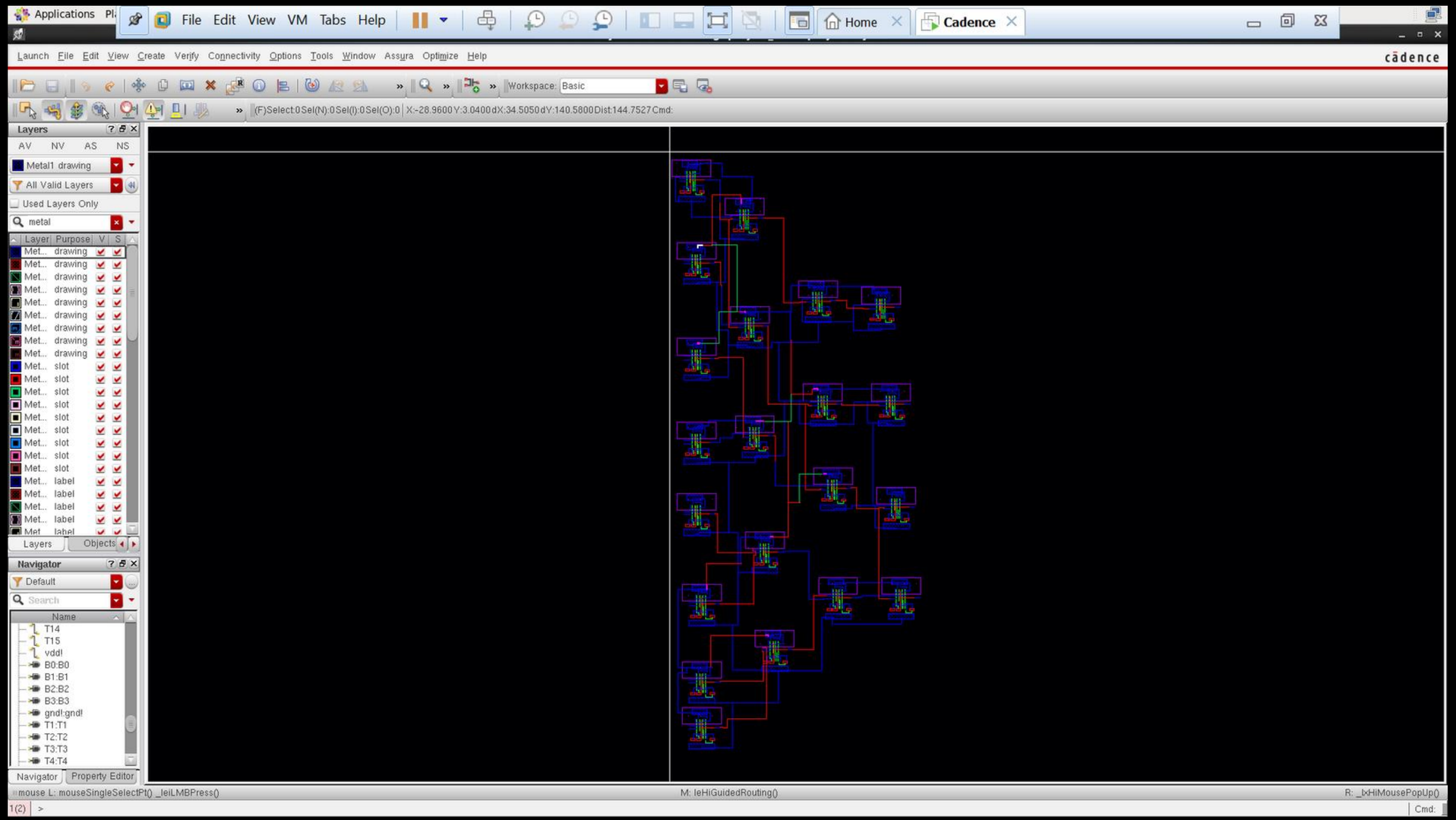

Applications Places System
Virtuoso (R) Visualization & Analysis XL
File Edit View Graph Axis Trace Marker Measurements Tools Window Browser Help
cadence
Sabbir VLSI_Project schematic
Transient Response
Name
Vis
/CLK
/T16
/T15
/T14
/T13
/T12
/T11
/T10
/T9
/T8
/T7
/T6
/T5
/T4
/T3
/T2
/T1
/G3
/G2
/G1
/G0
/T16
14.27332ns
1.0V
1.25
-.25
300.0
-200.0
0.0
10.0
20.0
30.0
40.0
time (ns)
mouse L:
M:
R:
4(6)
no error

The encoder implemented in XOR gates

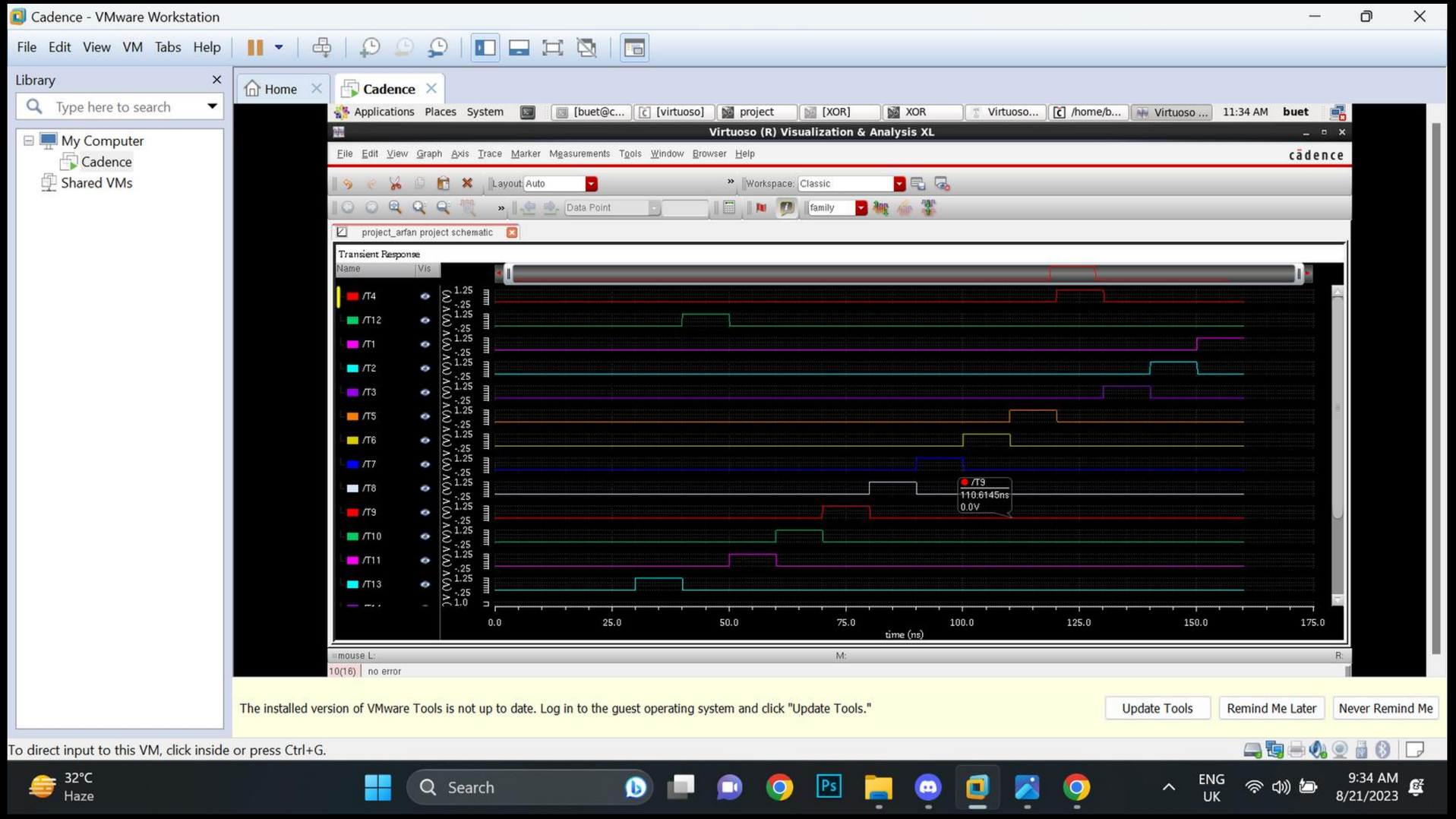
The encoder implemented in XOR gates



Layout:

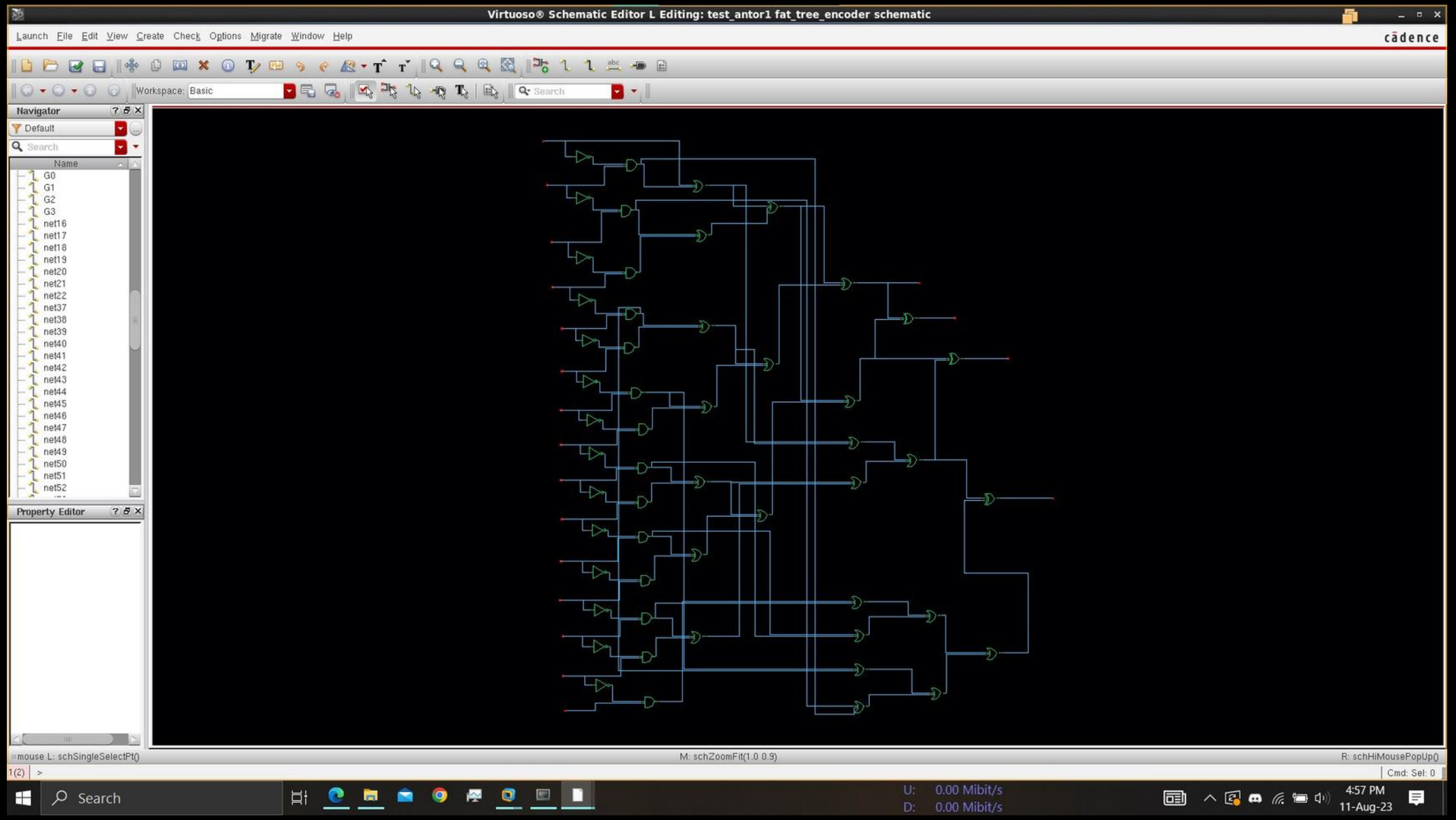

Applications
File Edit View VM Tabs Help
Home
Cadence
Launch File Edit View Create Verify Connectivity Options Tools Window Assura Optimize Help
cadence
Workspace: Basic
(F):Select:0 Sel(N):0 Sel(I):0 Sel(O):0 | X:-28.9600 Y:3.0400 dX:34.5050 dY:140.5800 Dist:144.7527 Cmd:
Layers
AV NV AS NS
Metal1 drawing
All Valid Layers
Used Layers Only
metal
Layer Purpose V S
Met... drawing
Met... slot
Met... label
Layers Objects
Navigator
Default
Search
Name
T14
T15
vdd!
B0:B0
B1:B1
B2:B2
B3:B3
gnd!:gnd!
T1:T1
T2:T2
T3:T3
T4:T4
Navigator Property Editor
mouse L: mouseSingleSelectPt() _leiLMBPress()
M: leHiGuidedRouting()
R: _lxHiMousePopUp()
1(2)
Cmd:

Output:

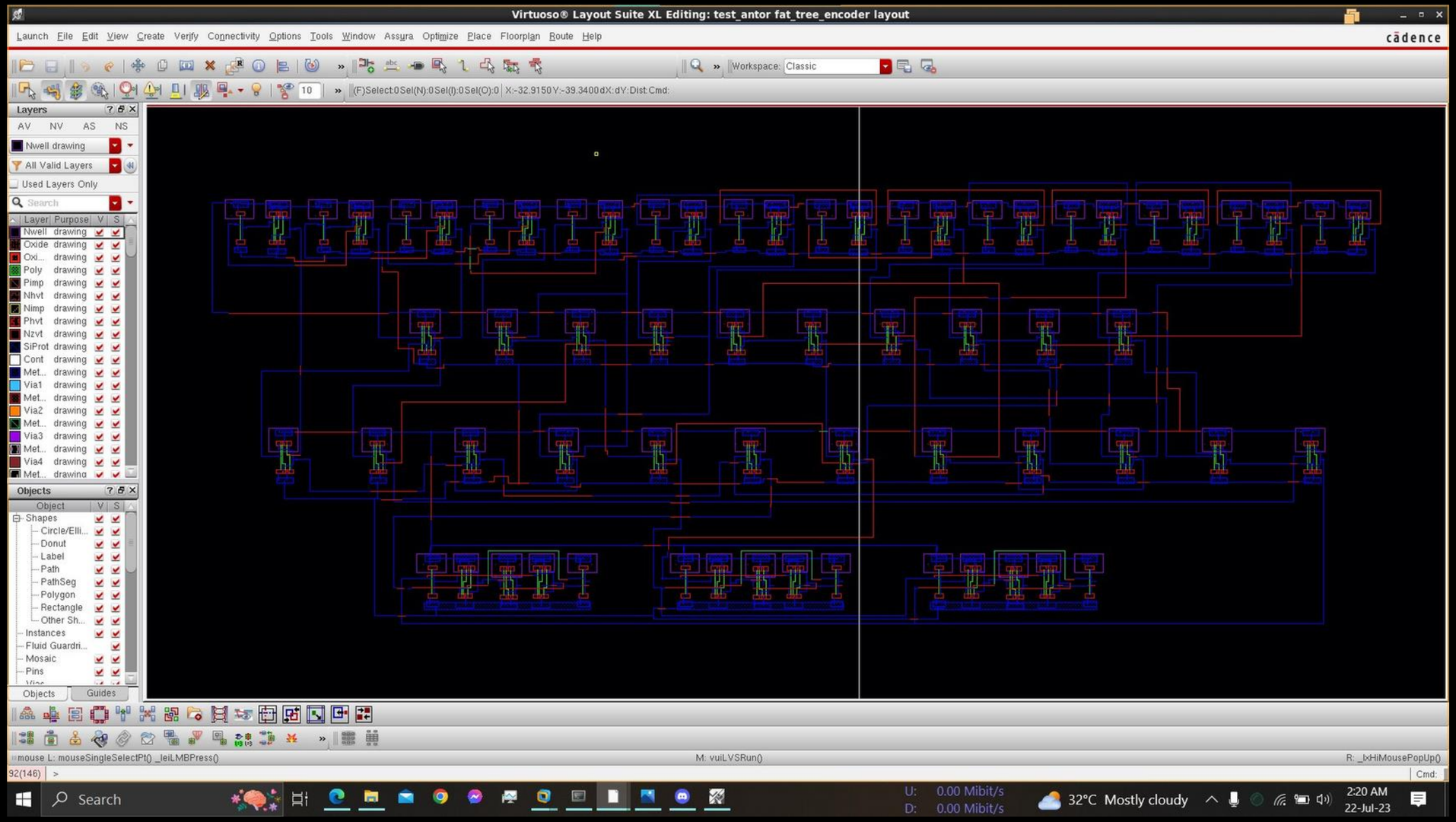

Cadence - VMware Workstation
File Edit View VM Tabs Help
Library
Type here to search
My Computer
Cadence
Shared VMs
Home
Cadence
Applications Places System
Virtuoso (R) Visualization & Analysis XL
File Edit View Graph Axis Trace Marker Measurements Tools Window Browser Help
cadence
project_arfan project schematic
Transient Response
Name
Vis
/T4
/T12
/T1
/T2
/T3
/T5
/T6
/T7
/T8
/T9
/T10
/T11
/T13
/T9
110.6145ns
0.0V
0.0
25.0
50.0
75.0
100.0
125.0
150.0
175.0
time (ns)
The installed version of VMware Tools is not up to date. Log in to the guest operating system and click "Update Tools."
Update Tools
Remind Me Later
Never Remind Me
To direct input to this VM, click inside or press Ctrl+G.
32°C
Haze
Search
ENG
UK
9:34 AM
8/21/2023

Conventional Fat tree encode

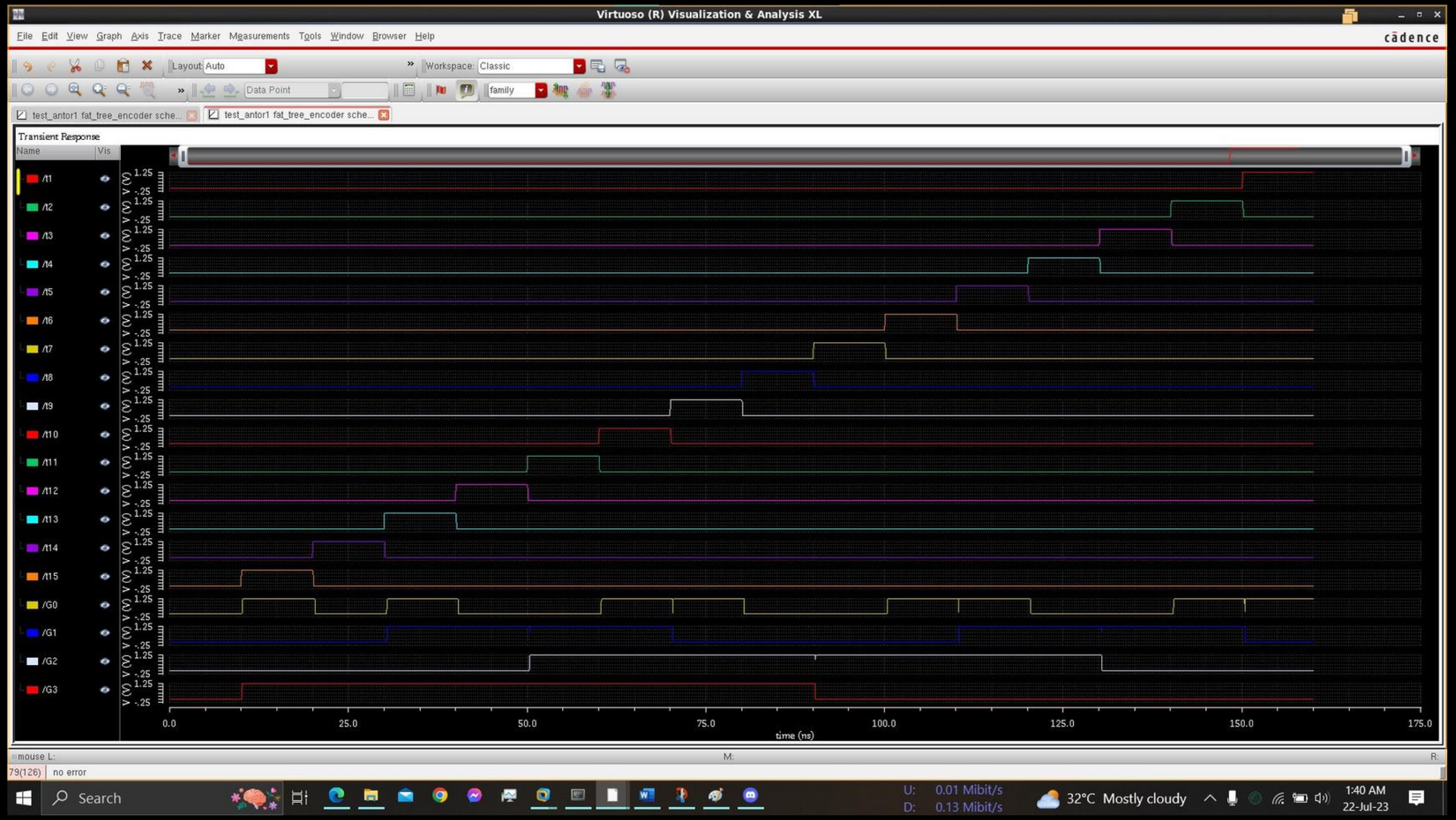
Conventional Fat tree encode



Layout:


Virtuoso® Layout Suite XL Editing: test_antor fat_tree_encoder layout
Launch File Edit View Create Verify Connectivity Options Tools Window Assura Optimize Place Floorplan Route Help
cadence
Workspace: Classic
Layers
Nwell drawing
All Valid Layers
Used Layers Only
Objects
Shapes
Instances
Fluid Guardri...
Mosaic
Pins
Objects
Guides
mouse L: mouseSingleSelectPt() _leiLMBPress()
M: vuiLVSRun()
Search
32°C Mostly cloudy
2:20 AM
22-Jul-23

Output:


Virtuoso (R) Visualization & Analysis XL
File Edit View Graph Axis Trace Marker Measurements Tools Window Browser Help
cadence
Layout: Auto
Workspace: Classic
Data Point
family
test_antor1 fat_tree_encoder sche...
test_antor1 fat_tree_encoder sche...
Transient Response
Name
Vis
/I1
/I2
/I3
/I4
/I5
/I6
/I7
/I8
/I9
/I10
/I11
/I12
/I13
/I14
/I15
/G0
/G1
/G2
/G3
1.25
.25
0.0
25.0
50.0
75.0
100.0
125.0
150.0
175.0
time (ns)
mouse L:
M:
R:
79(126)
no error
Search
U: 0.01 Mbit/s
D: 0.13 Mbit/s
32°C Mostly cloudy
1:40 AM
22-Jul-23

Truth Table

T15	T14	T13	T12	T11	T10	T9	T8	T7	T6	T5	T4	T3	T2	T1	G3	G2	G1	G0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	1	1
0	0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	1	0
0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	1	1	0
0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	1	1	1
0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	1	0	1
0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	1	1	0	0
0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	1	1	0	1
0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	1	1	1	1
0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	1	1	1	0
0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1

THANK YOU