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MOSCONE WEST CENTER
SAN FRANCISCO, CA, USA

A Novel Solution for Fast and Efficient Custom Bus Routing with User-defined Reference Wire and Combination of Segmented Bus Option

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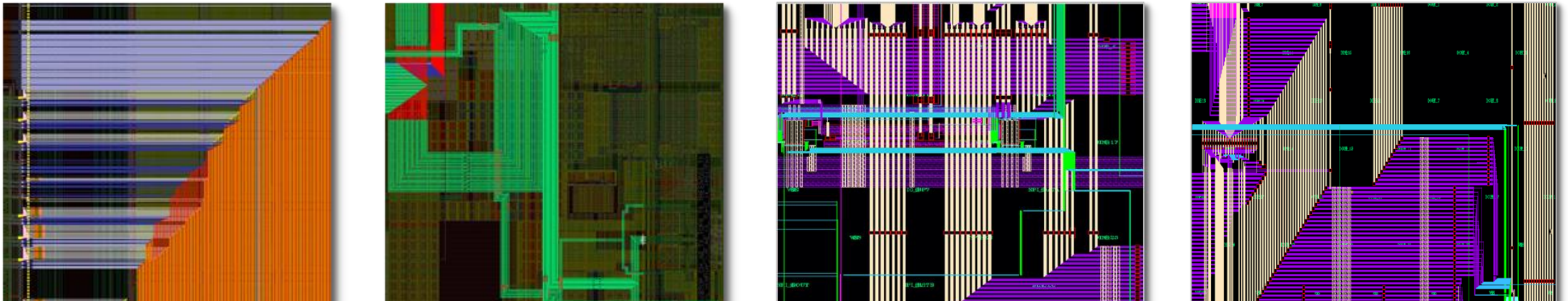
Cadence Design Systems*

SAMSUNG



Motivation

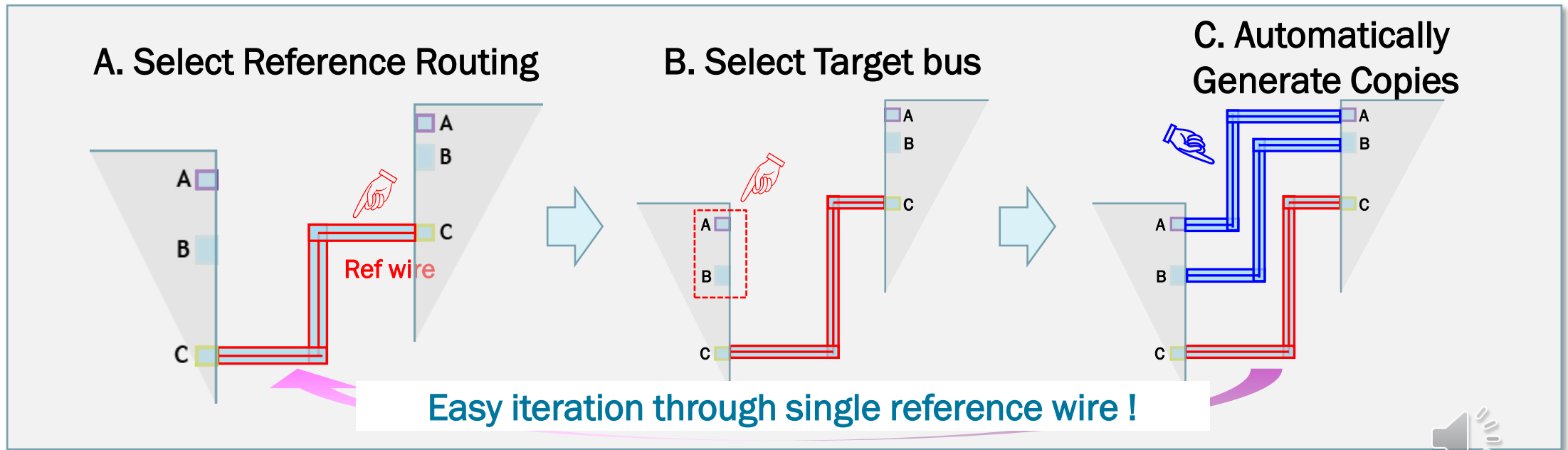
- The analog/mixed IP and product have large number of bus routing
- To ensure quality, all bus routings have been drawn manually
 - Matching, IR drop, EM, and Noise prevention are required
- TAT is increasing as Metal, Via, Coloring and DFM rules are complicated at advanced node



Goal: Developing a new solution that satisfies both quality and TAT ! 

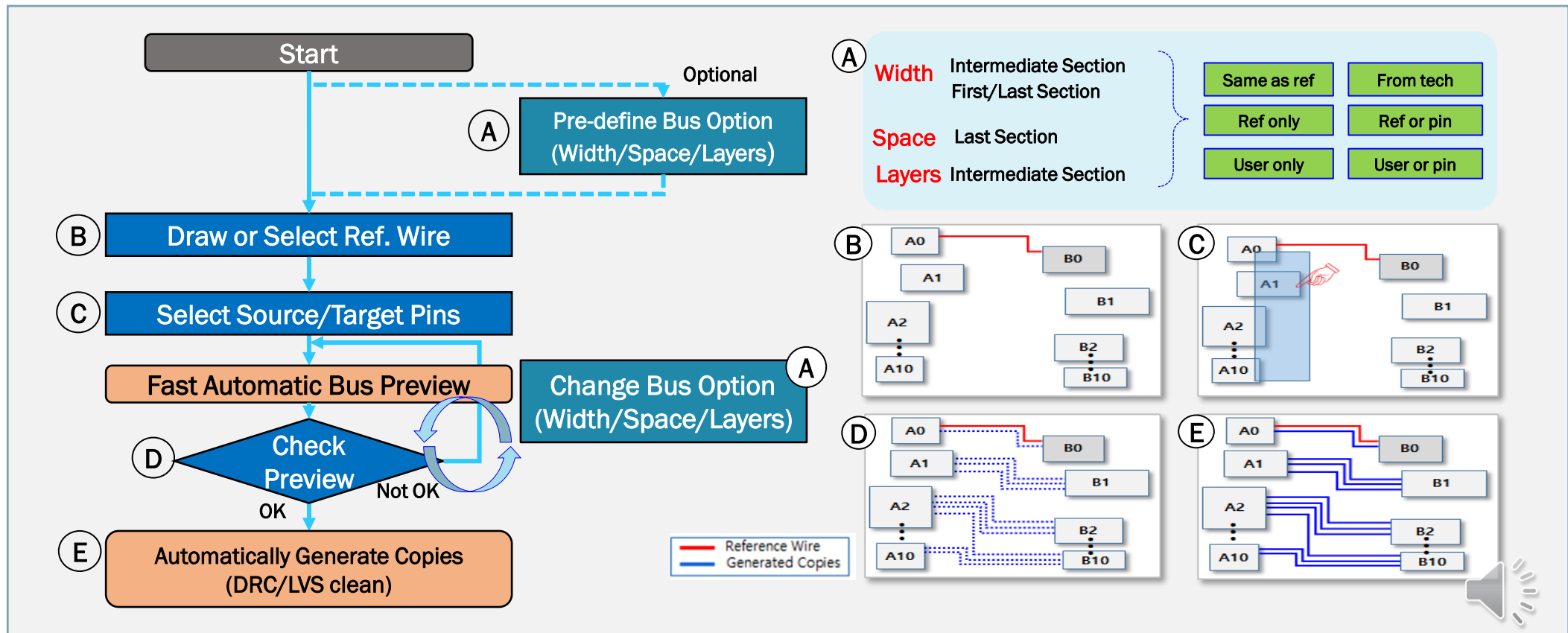
Main Idea

- The user draw a reference wire that reflect user intention
 - Routing path, Metal & Via pattern, Vertical/Horizontal layer, Metal Width
- Generate large number of copies of bus wires at a single execution
 - Various custom bus patterns are supported using predefined bus options



Proposed Flow

- The user set a predefined bus option before executing Copy-Route
- Design Change Case: Modify single Ref. Wire ↔ Re-generate Copies



Palette

Layers

Valid Used Routing

Search: Filter Filter

Active: Nwell drawing

AV NV AS NS

Context: gpd045

Name	Vis	Sel
All Layers		
Layer	Purpose	V S
Nwell	drawing	✓ ✓
Oxide	drawing	✓ ✓
Oxide_thk	drawing	✓ ✓
Poly	drawing	✓ ✓
Pimp	drawing	✓ ✓
Nhvt	drawing	✓ ✓
Nlvt	drawing	✓ ✓
Nimp	drawing	✓ ✓
Phvt	drawing	✓ ✓
Plvt	drawing	✓ ✓
Nzvt	drawing	✓ ✓
SiProt	drawing	✓ ✓
Cont	drawing	✓ ✓
Metal1	drawing	✓ ✓
Via1	drawing	✓ ✓
Metal2	drawing	✓ ✓
Via2	drawing	✓ ✓
Metal3	drawing	✓ ✓
Via3	drawing	✓ ✓
Metal4	drawing	✓ ✓

Objects

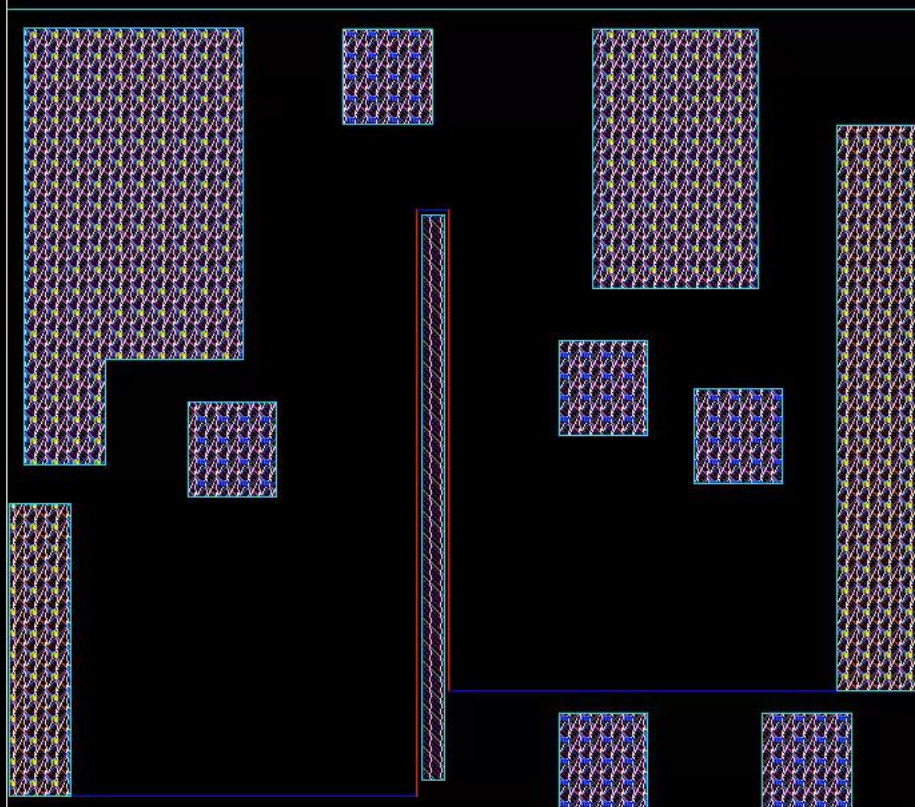
Objects	V	S
Instances	✓	✓
Pins	✓	✓
Vias	✓	✓
Label	✓	✓
Shapes	✓	✓
Mosaic	✓	✓

Objects Grids

Navigator Palette

CopyRoute in Routing Assistant

Ease the routing of a large bus over a long distance according to a ref wire topology



Routing

Setup Wire Bus CopyRoute

Spacing

Intermediate Sections From tech

User 0

First/last Sections Enable

From tech

User 0

Vias

Preserve cut classes

Layers

Intermediate Sections Same as ref

Pattern (repeat: i1 i2...)

Preview

Show preview

Effort Low High

Clear preview when cmd ca

Copies

In group

With Errors All

Annotate Copies

Out of layer range

Top Metal111

Bottom Poly

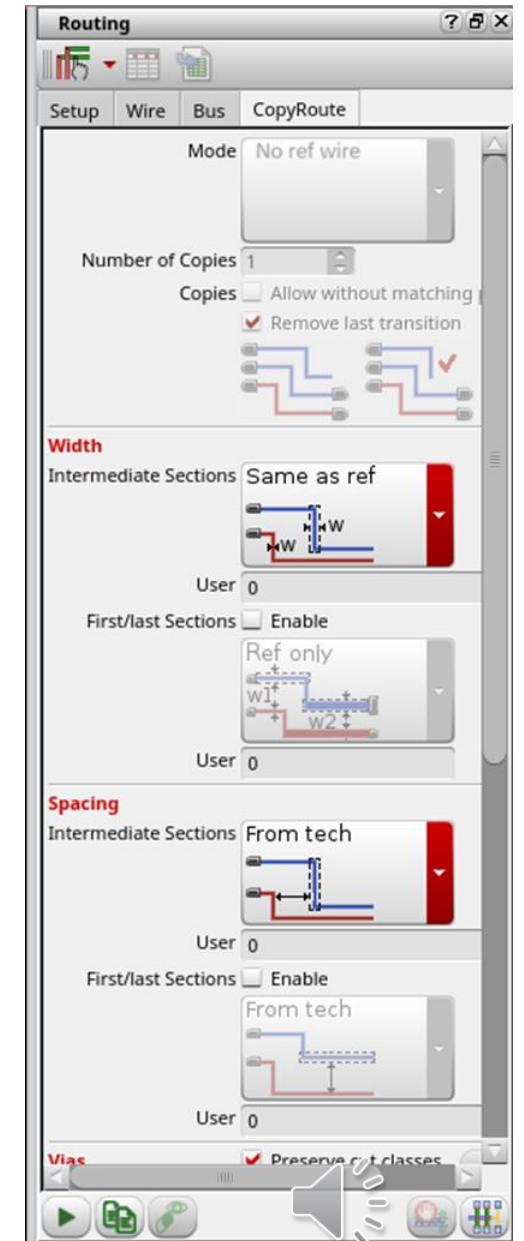
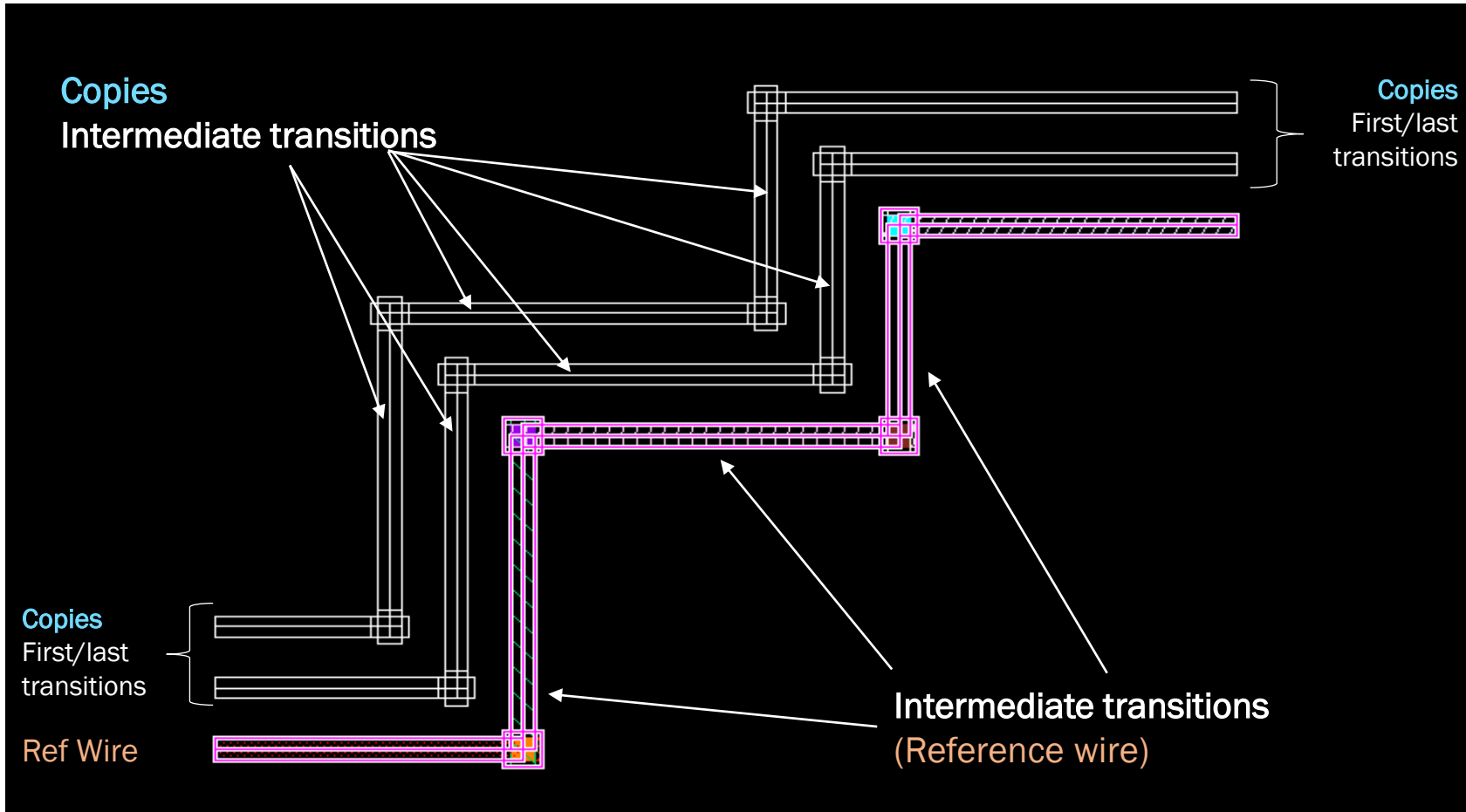
Outside routing area

y0 drawing

Annotation Browser Routing

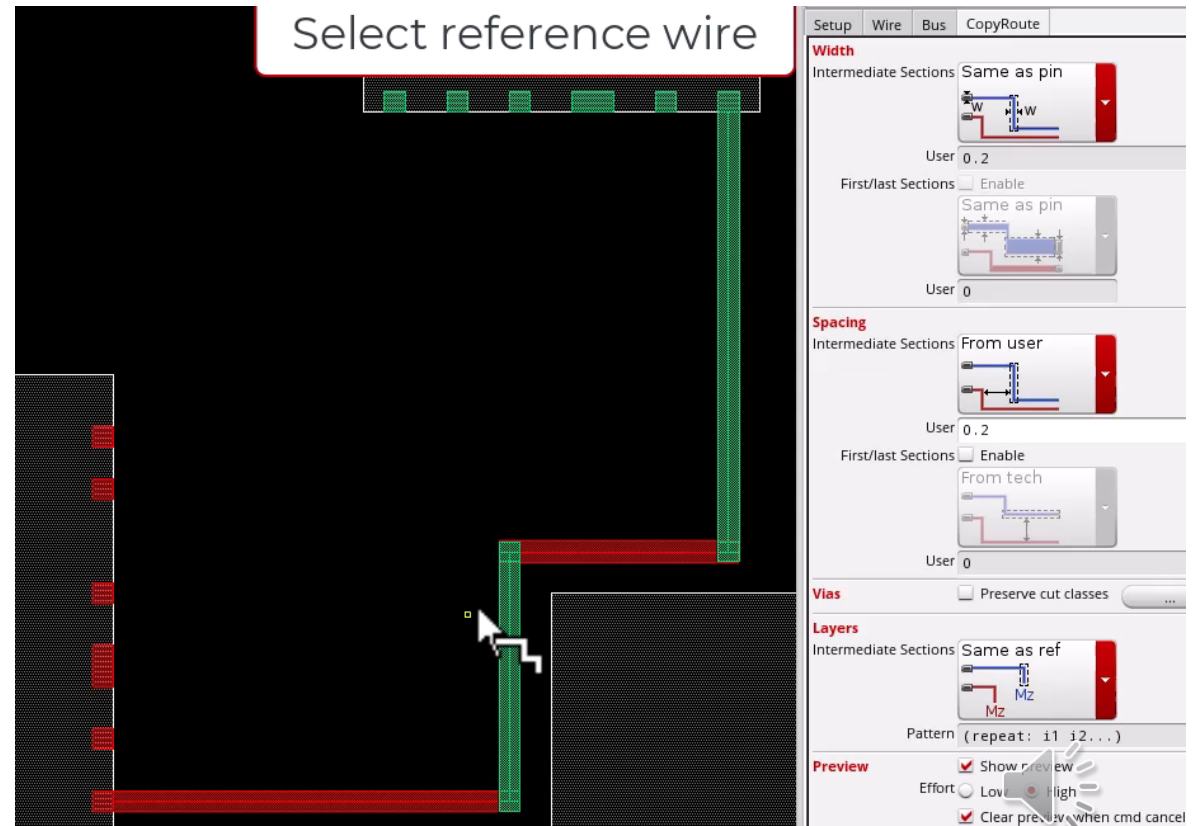
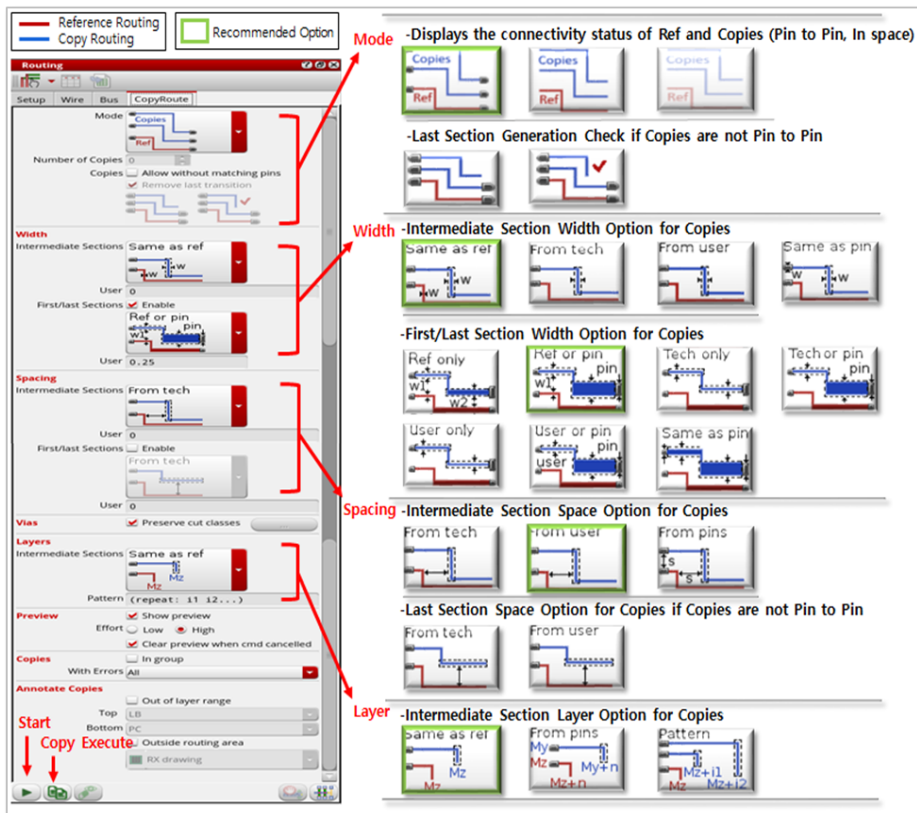
Copy Route

- Consist in creating copies from a reference wire



Copy Route Option : Width/Spacing

- Multiple options to customize the bus width + spacing + layers
- Default settings are used in 95% of the cases



Copy Route Option : Layers

- Target layers drives the layer of the intermediate transitions

Layers

Intermediate Sections

Same as ref



Pattern (repeat: i1 i2...)

M2

Intermediate transition layer
follows ref wire → M2

Copy

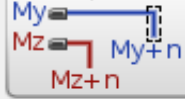
M2

Reference wire

Layers

Intermediate Sections

From pins



Pattern (repeat: i1 i2...)

+1

M4

M3

Copy

+1

M2

M1

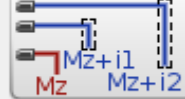
Reference wire

Intermediate transition layer
M3 pin +1 → M4

Layers

Intermediate Sections

Pattern



Pattern 4

M6

Intermediate transition layer
Pattern (+4) → M6

+4

M2

Copy

Reference wire

Evidence

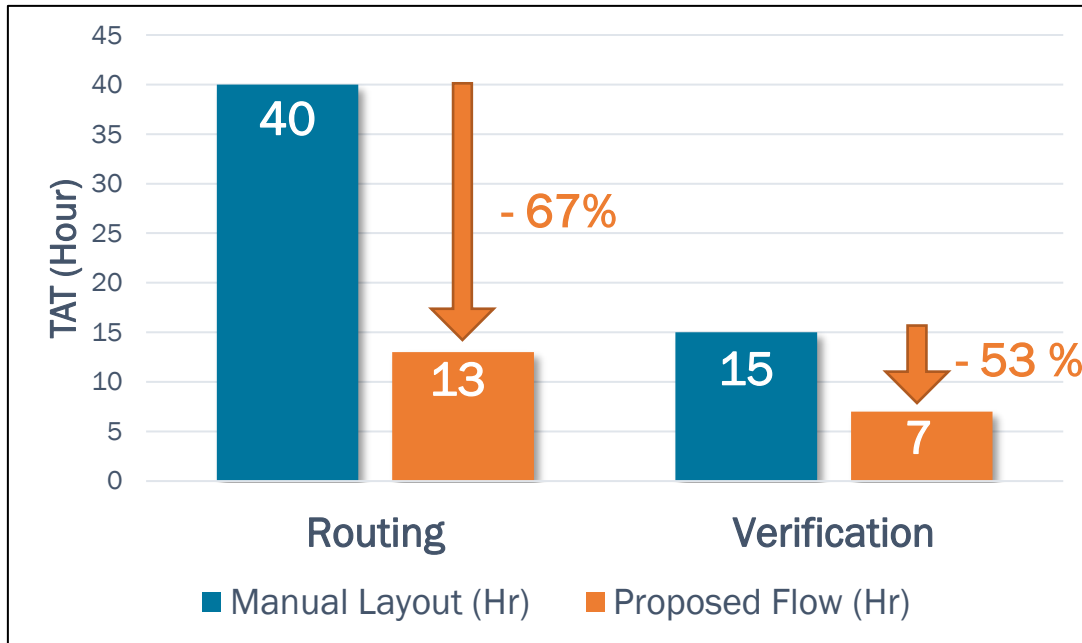
- Pilot tests were carried out at 3nm IP MPW
- Copies generated based on user drawn wire

Meet custom routing requirement and quality

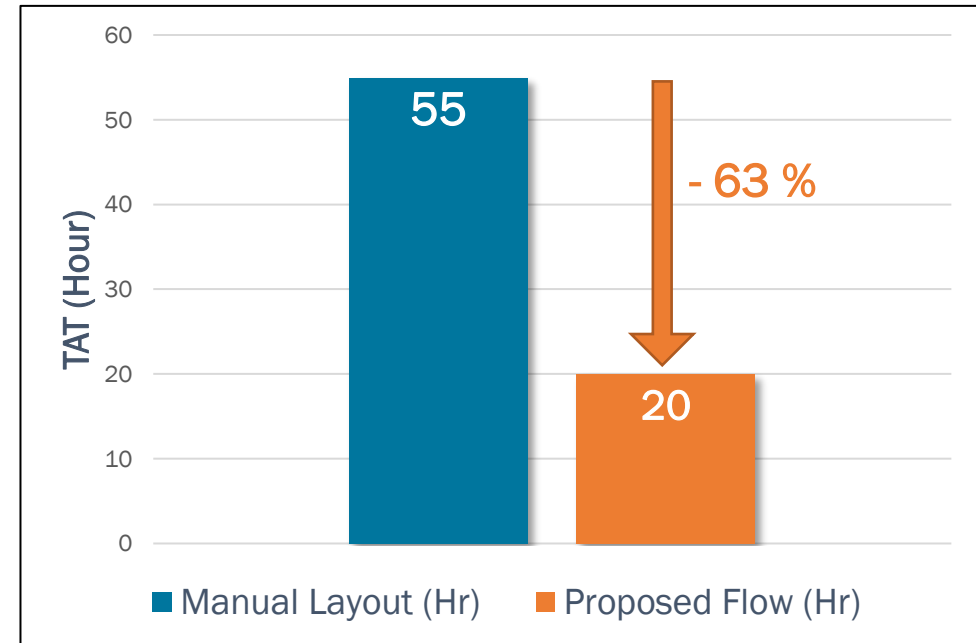


Evidence

- **Total TAT reduction** of the proposed solution is **63%**
 - [55 → 20hr, 35hr saved at routing + verification] compared to the TAT of manual layout flow



Bus Routing Step TAT Comparison



Total TAT Comparison



Summary

- Developed Solution and GUI under **collaboration** of **SLSI** and **Cadence** (released as official feature of Virtuoso Studio)
- The copy route feature lets you work incrementally and generate thousands of bus wires.
 - **Ease the routing of a huge bus** over a long distance by using a single bit as topology reference.
 - **Support** reference wire connected to **pins** but as well as in **space**.
 - Make **easier the addition of bit** to an already routed bus.
 - **Customize** the **width** and the **spacing** of the copies.
 - Copies are **DRC correct**.
- Improved productivity (**63% TAT reduction**)

