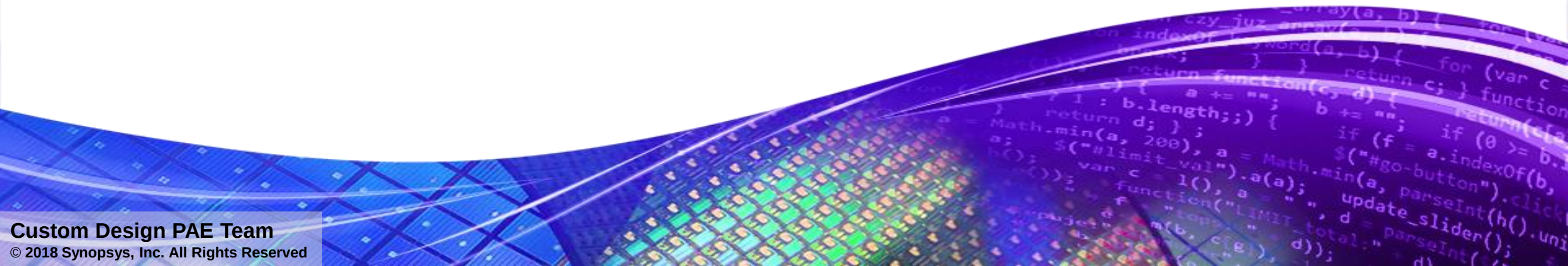
SYNOPSYS®
Silicon to Software™

Custom Compiler

Layout Editor (LE)
Design Entry

O-2018.09

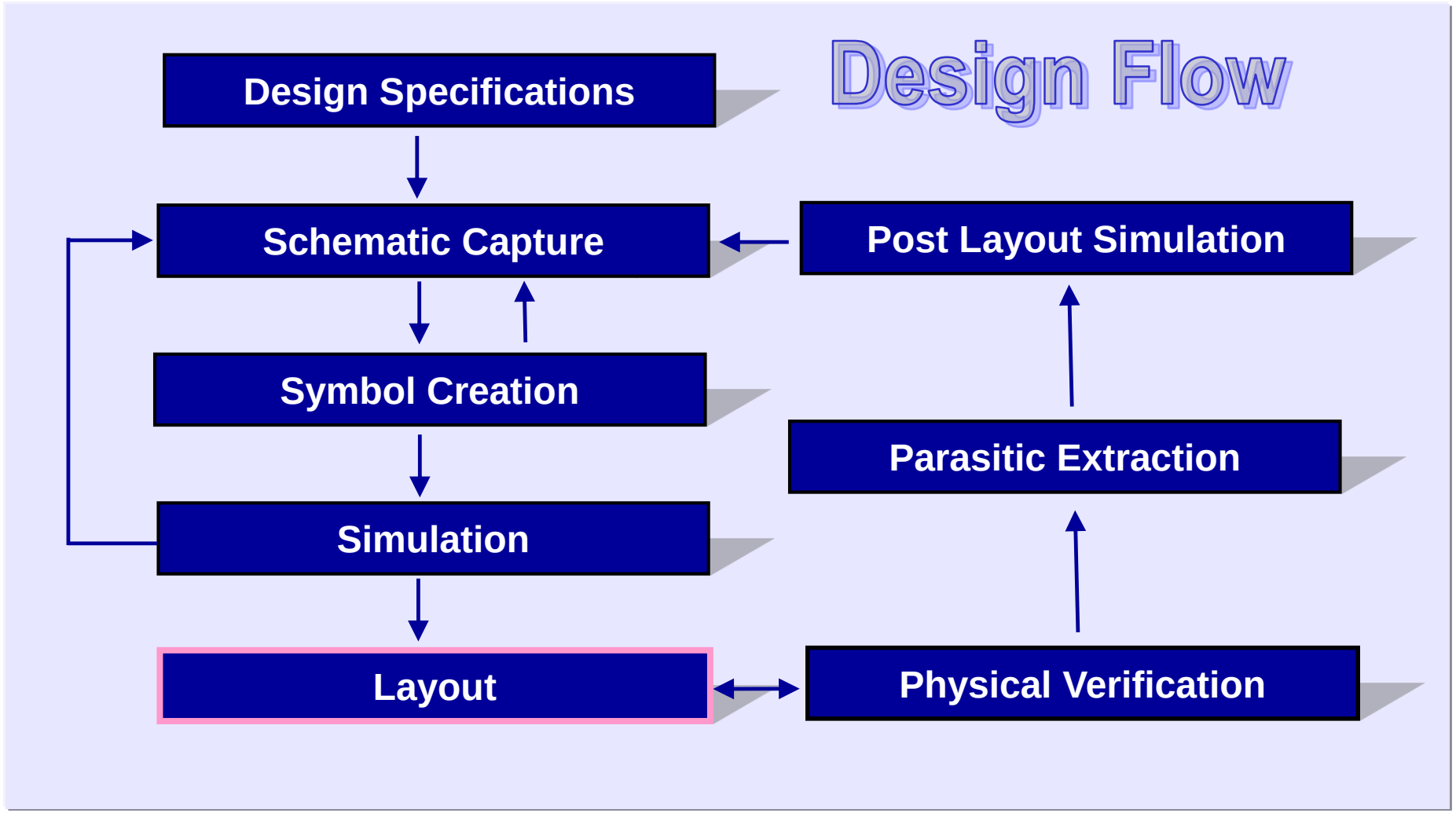


Custom Design PAE Team

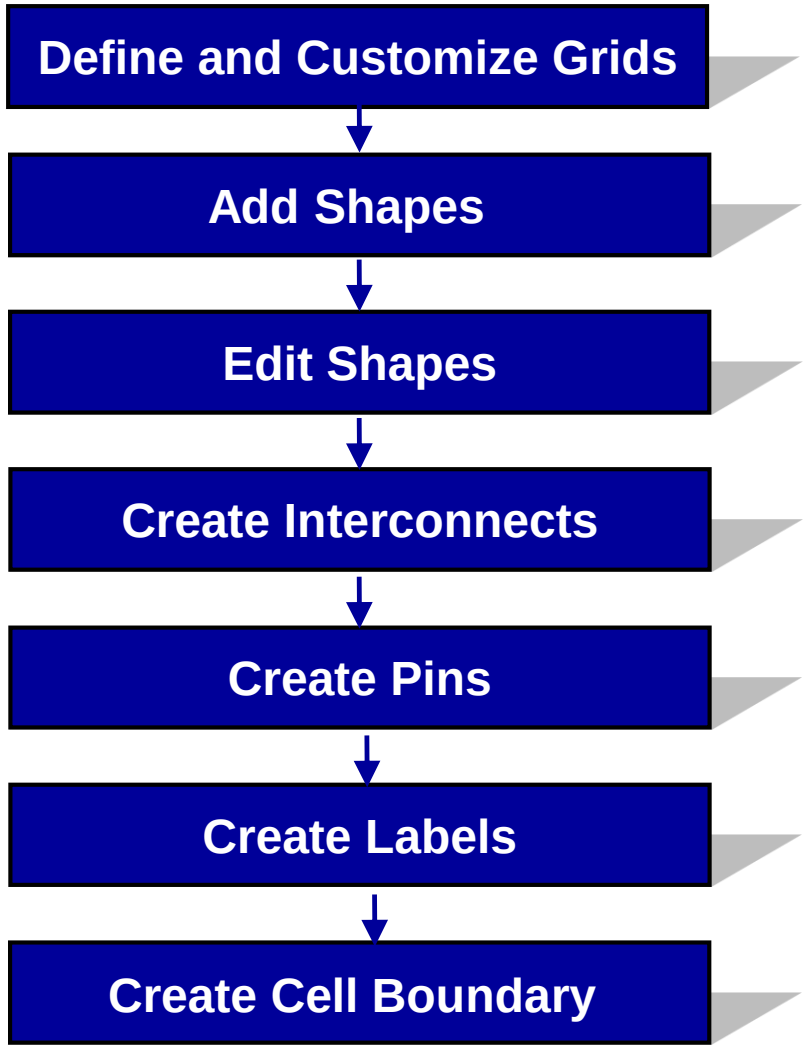
Unit Objectives

- **After completing this unit, you will be able to:**
  - Define and use grids
  - Navigate in the layout
  - Use the Object Layer Panel
  - Create shapes using data creation functions
  - Edit shapes using data editing functions
  - Use clipboard commands

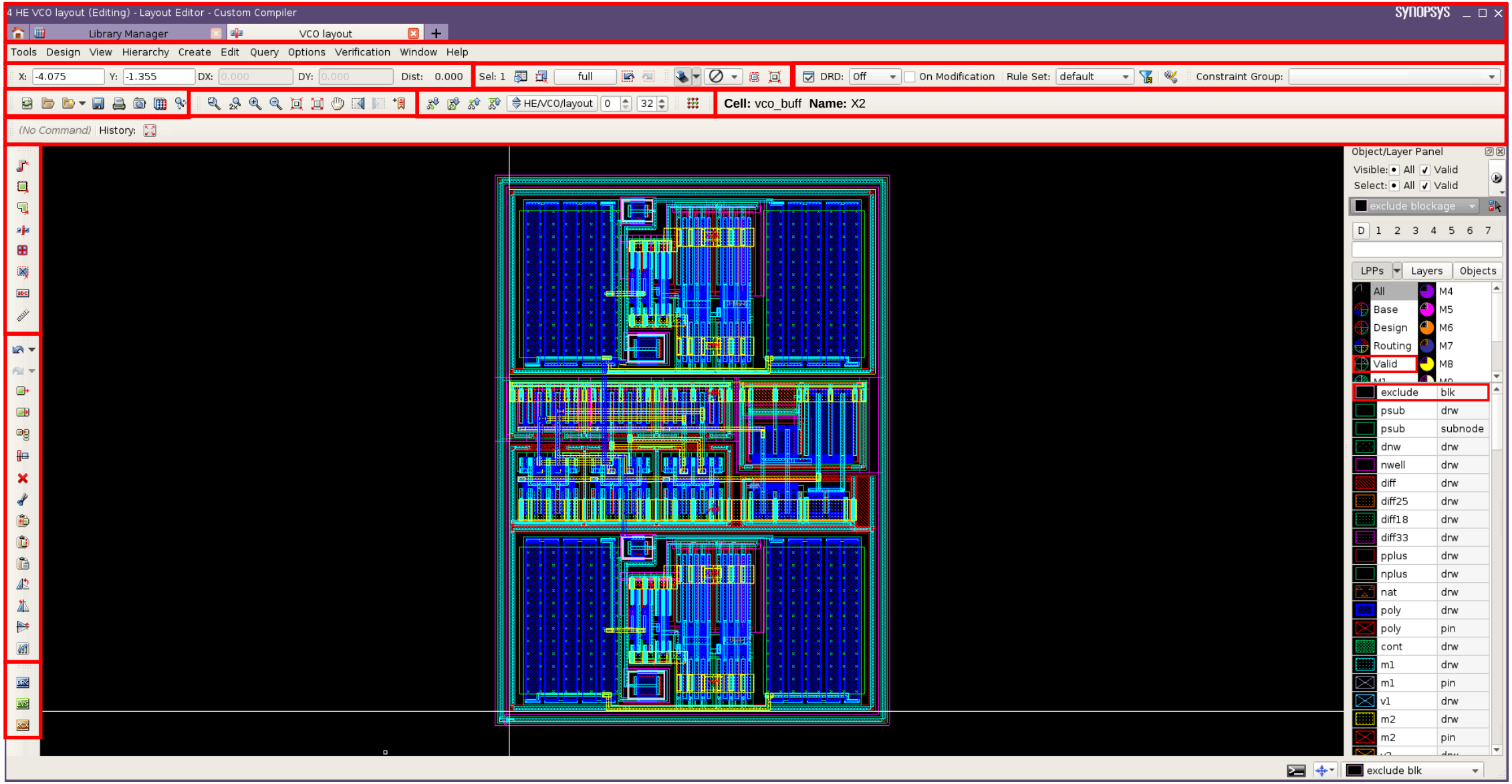
Full Custom Compiler Flow



Design Creation Flow



Layout Editor: Main Window

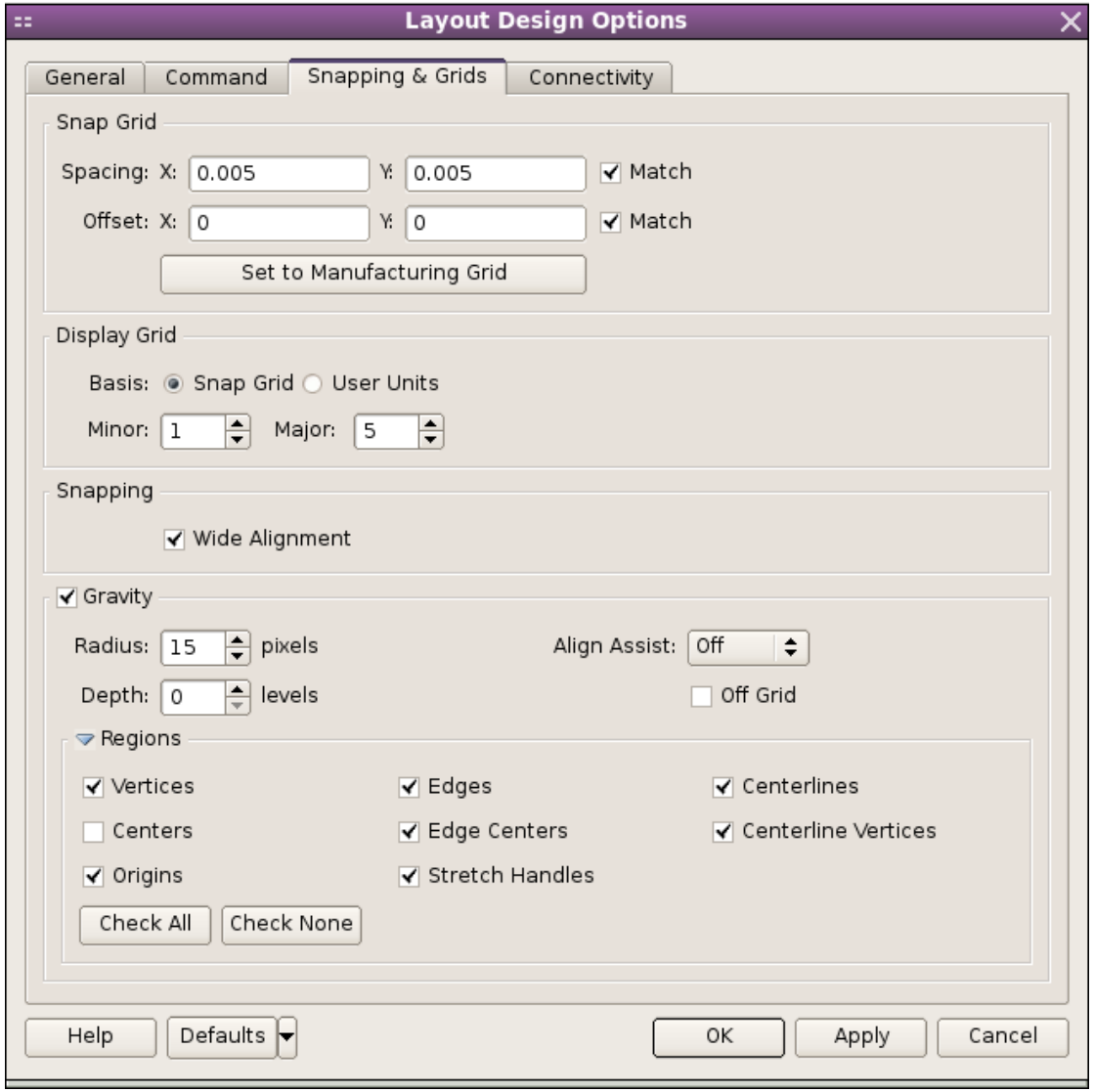


Layout Navigation

- **Changing Viewports Keys**
  - ‘F’ (Fit design), ‘Ctrl-T’ (Fit Selected)
  - ‘Z’ (Set Viewport), ‘Shift-Z’ (Out), ‘Ctrl-Z’ (In)
  - ‘Mouse wheel’ (In/Out), ‘Button3-Drag’ (Out)
  - ‘W’ (Previous view), ‘Shift-W’ (Next View)
- **Bookmark**
  - View > Bookmark > Add
  - Save current viewport as a bookmark
    - Bookmark’s name added to same menu
- **Pan**
  - ‘Click & Drag’ for manual pan
  - Enter coordinates to pan to location

Grids

- **Grids**
  - Manufacturing
  - Snap
  - Display
- **Wide Alignment Snapping**
  - Enable snapping to fin grid
- **Gravity**
  - Snap cursor to object
  - “G” bind key to toggle gravity on/off



Technology File

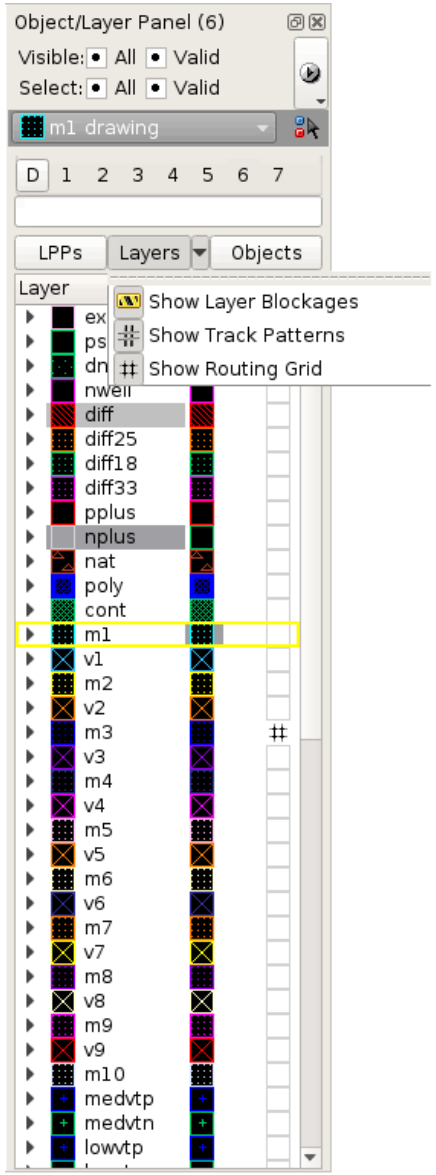
- **A Technology File is unique to each process**
- **Required for creating an OA library for layouts**
- **A Technology File contains:**
  - Definition of layers and purposes
  - Association between layers and purposes [LPP]
  - Layer Rules
  - Via Definitions
  - Controls like grid, technology parameters,…
  - Constraint Groups
  - MultiPartPaths
  - Display packet for each LPP

Layer Purpose Pair (LPP)

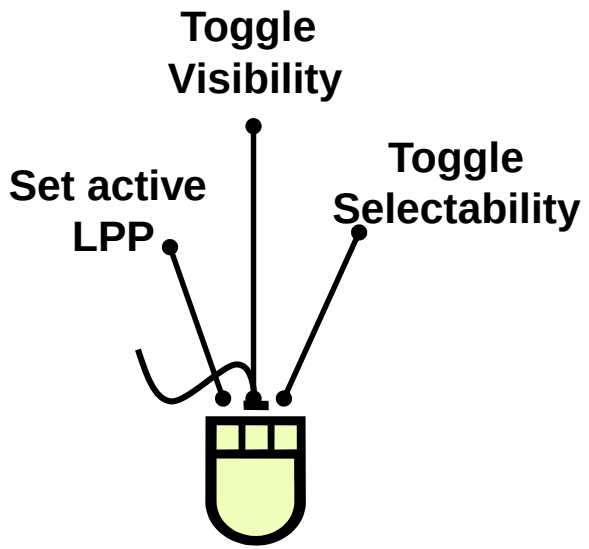
- **Layer Purpose Pair (LPP)**
  - All layers must be referenced with a Layer Name/ Number and a Purpose Name/Number.
    - Example metal1(layer);drawing(purpose)
  - Commonly used purpose types are
    - Drawing
    - Annotation
    - Fill
    - Slot
    - Blockage
    - Text
- **User defined Layers (0-199):Purposes (0-222)**
- **System Reserved Layers (200- 254): Purposes (-8 to -1 and 223-255)**

Object Layer Panel

Object Layer Panel (OLP)



- **Consolidate all LPP under each layer**

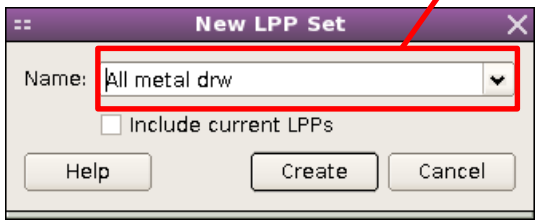


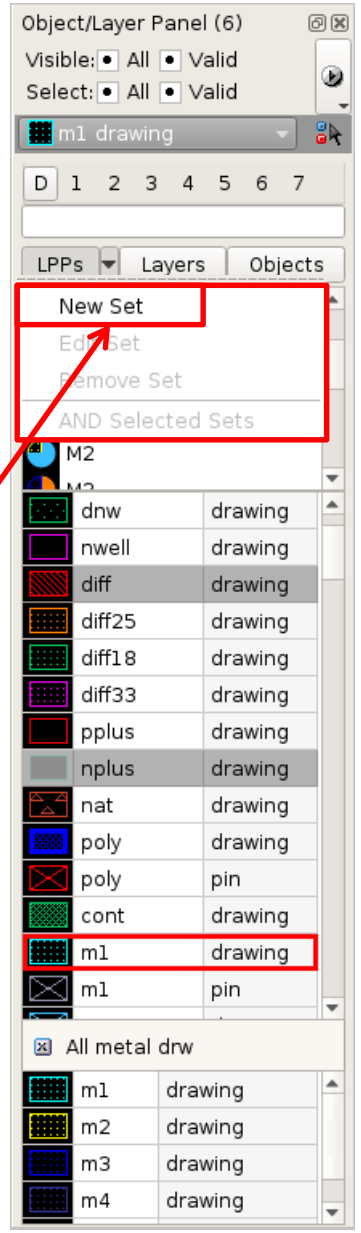
Filter per layer

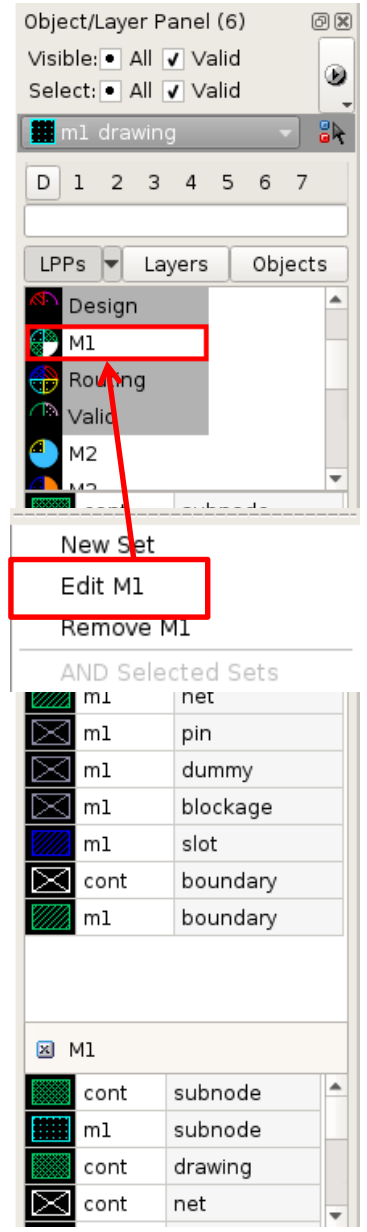
- Blockages
- Route guides (ICC mode)
- Track pattern
- Routing grid

OLP: LPP Sets

- **Used to filter user defined LPPS**
  - Create set for LPPs
    - Enable New Set from drop down menu
  - Drag and Drop LPP into set
  - User can rename or delete set
  - The set is available for the entire library
  - Ability to modify or hide build in LPP sets

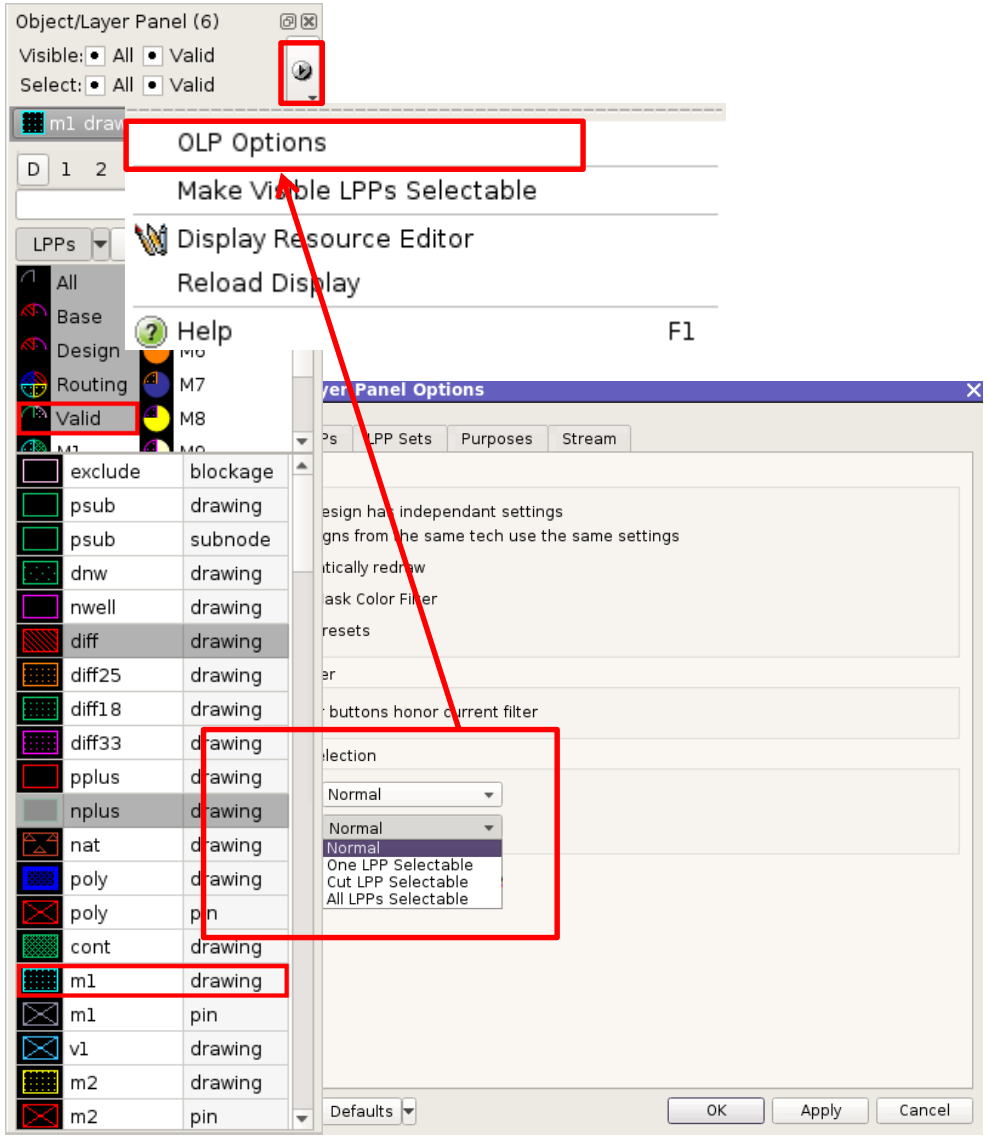






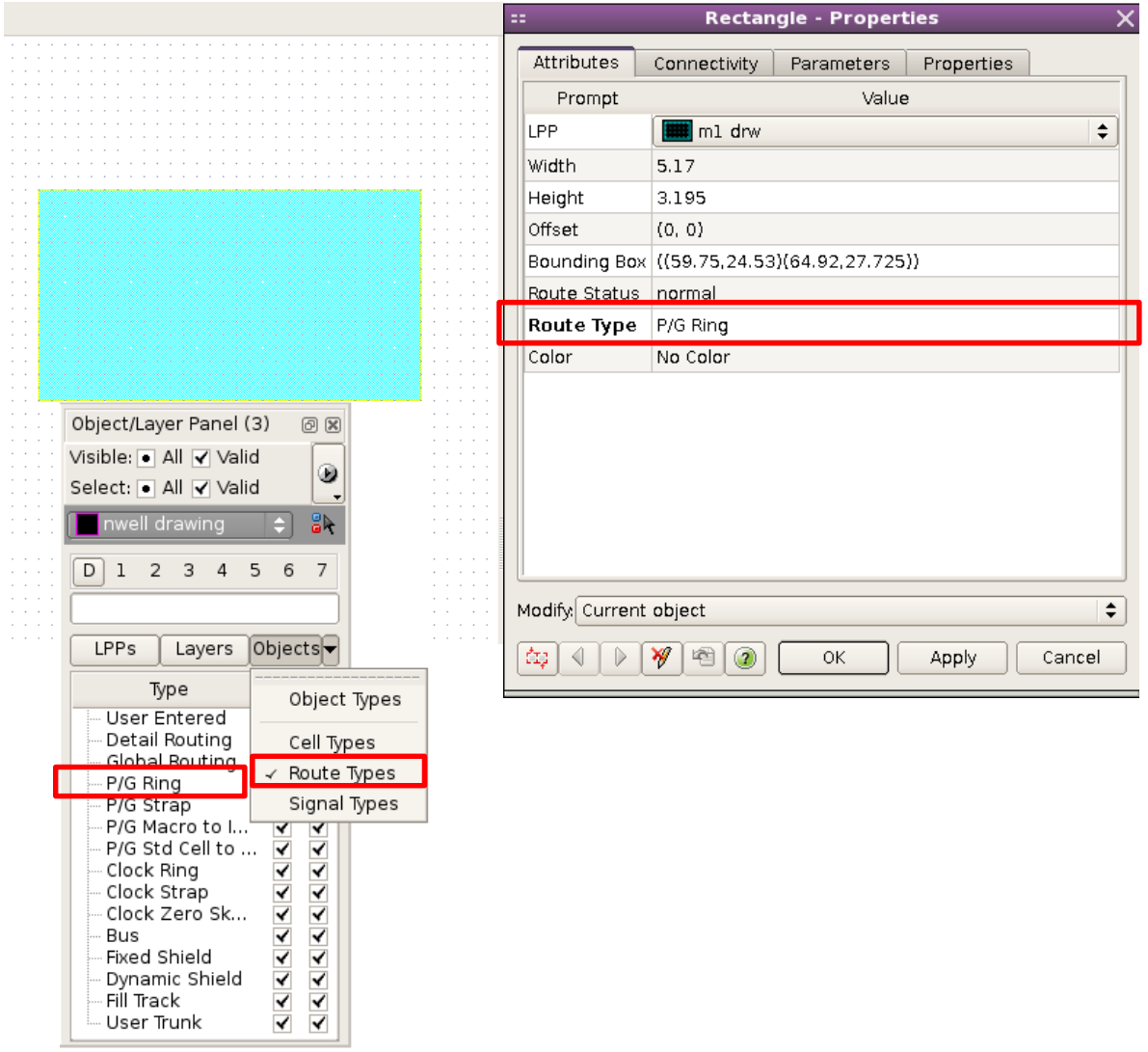
OLP: Via & Instance Selection

- **Via and Instance selection using LPP**
  - One selectable LPP
  - All selectable LPP
- **Easy way to filter Vias and Instances**
- **Use model:**
  - Make selectable only the required layers
  - Use the pull down menu from OLP Assistant
  - Select Via or Instance Selection proper option
- **Ability to Make all Visible LPPs Selectable**



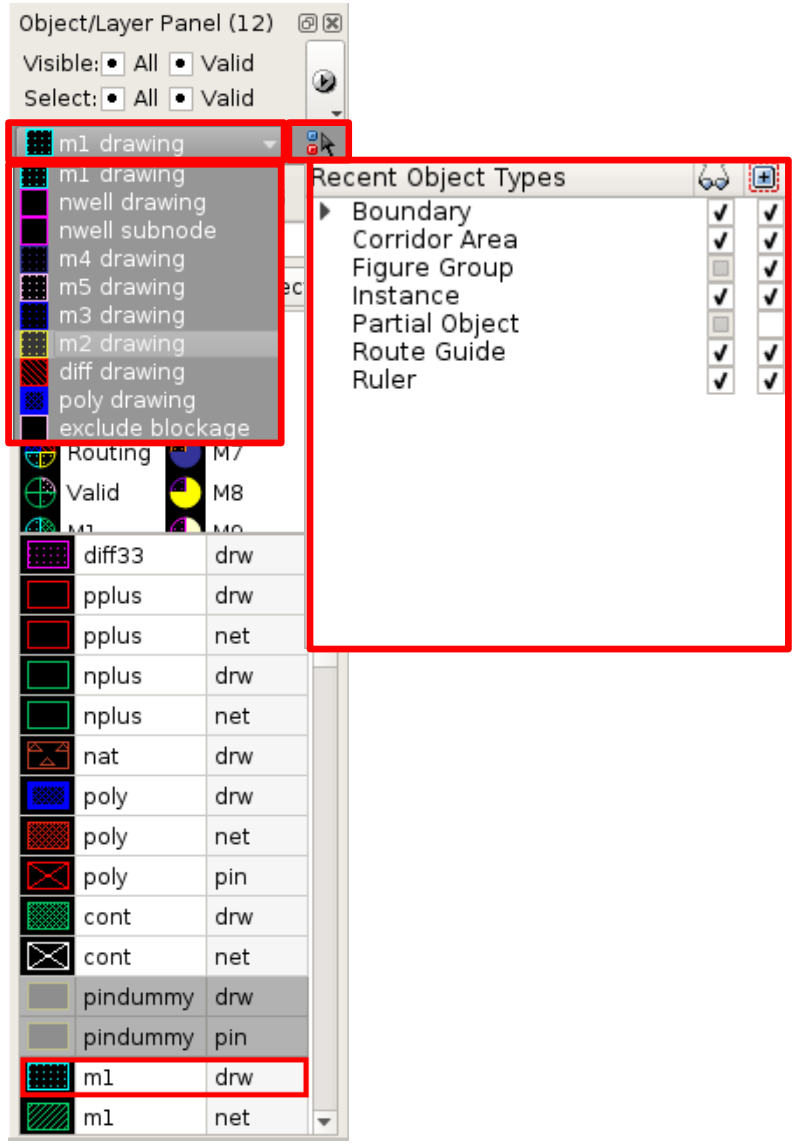
OLP: Objects Controlling from Objects Tab

- The Objects tab shows Object Types, their visibility and selectability settings.
- Making an object type invisible will also make it unselectable.



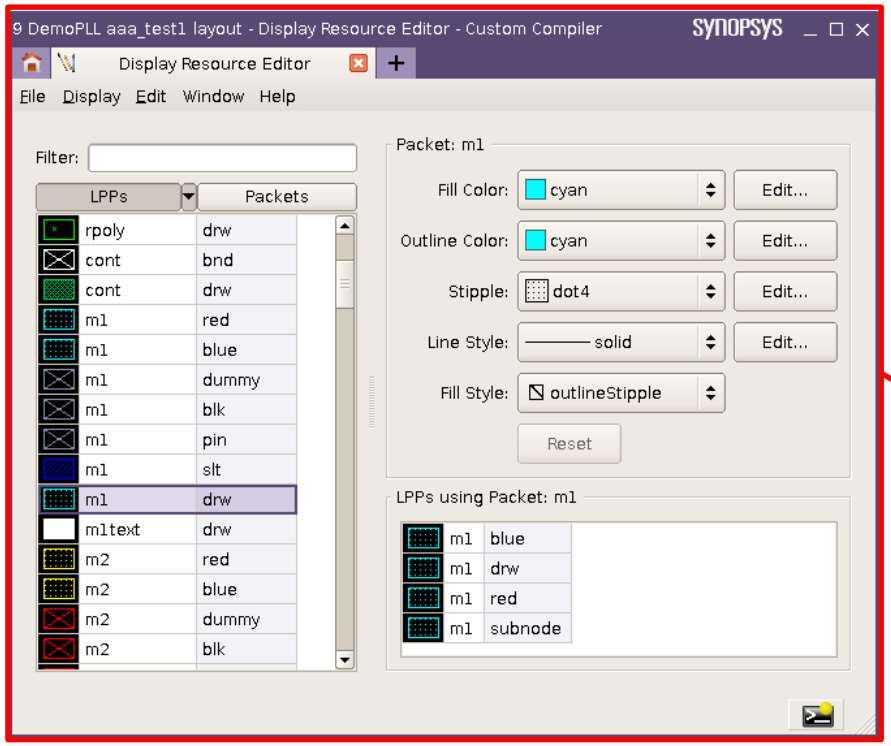
OLP: Recently used LPPs and Objects

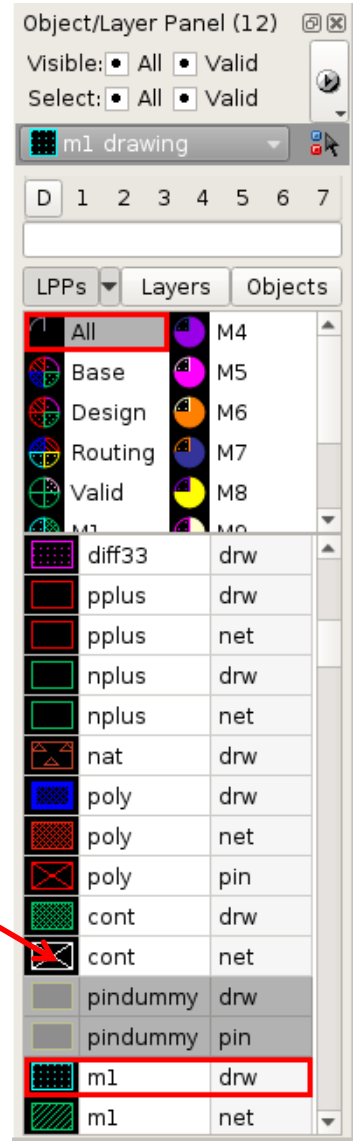
- **Ability to view and use recent LPPs and change attributes for recent objects**



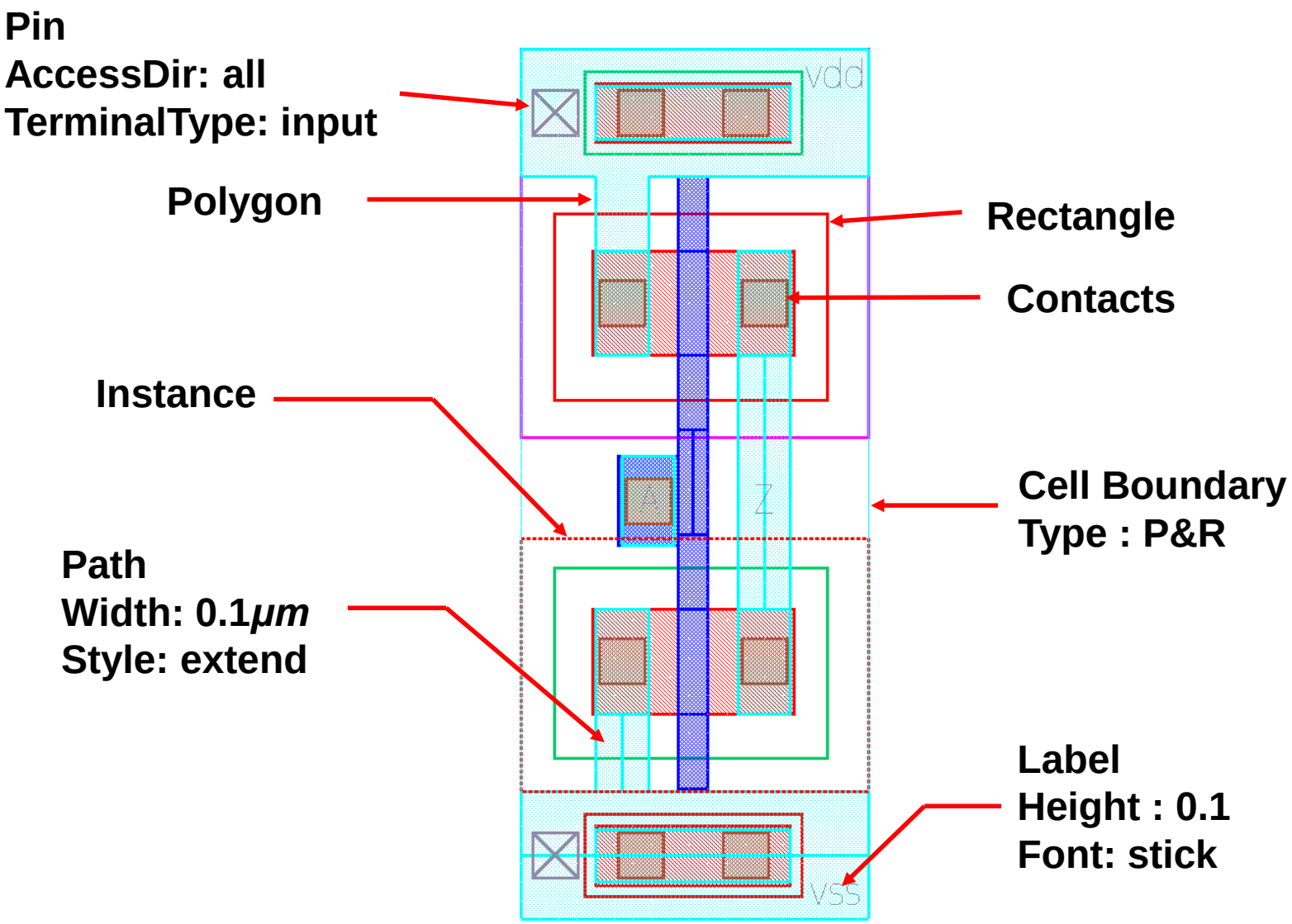
OLP: Changing LPP color and pattern

- **Double click on LPP in OPL panel will open Display Resource Editor for that LPP**
  - Gives ability to directly modify LPP color and pattern





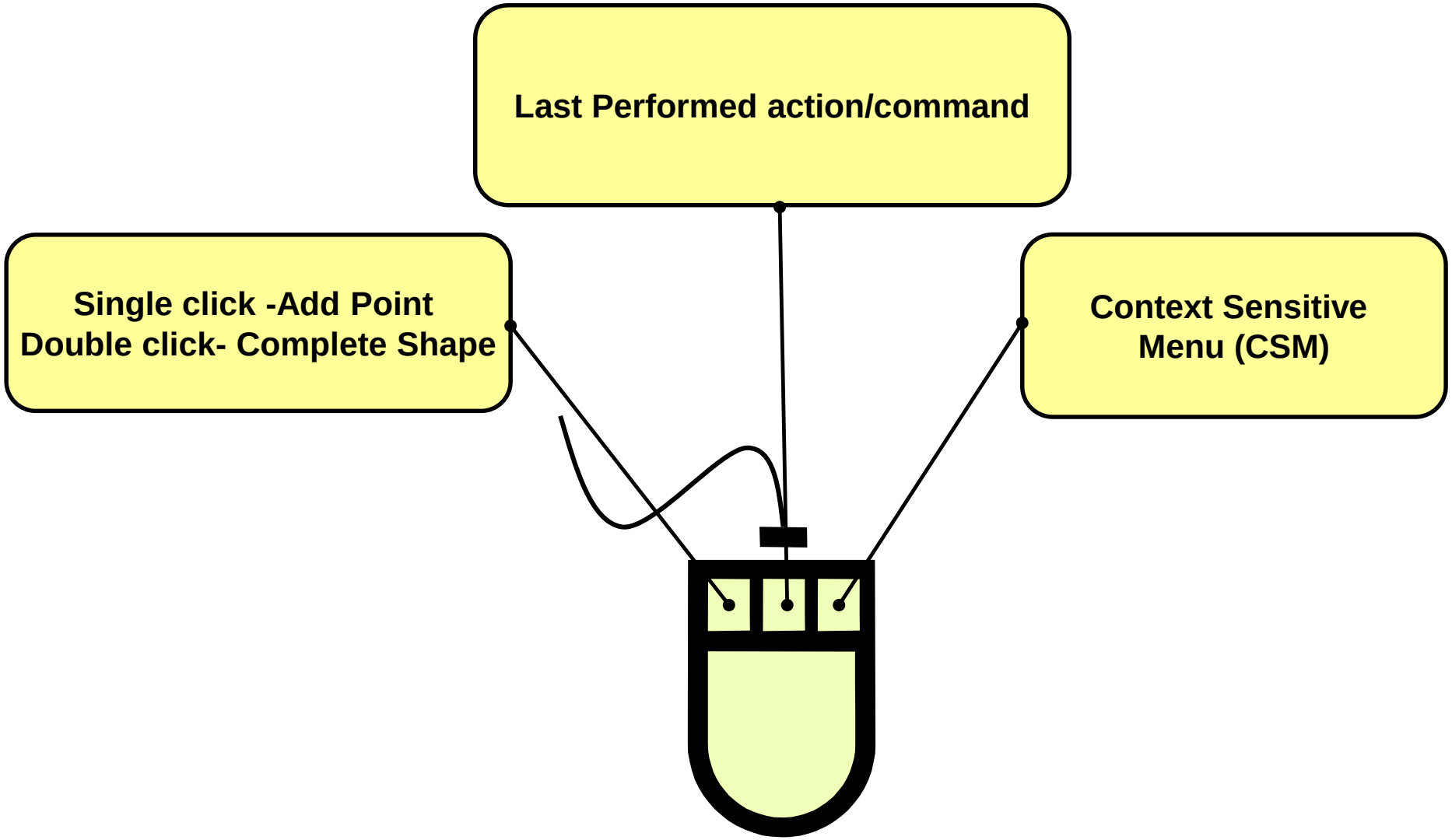
Inverter Layout



Data Creation

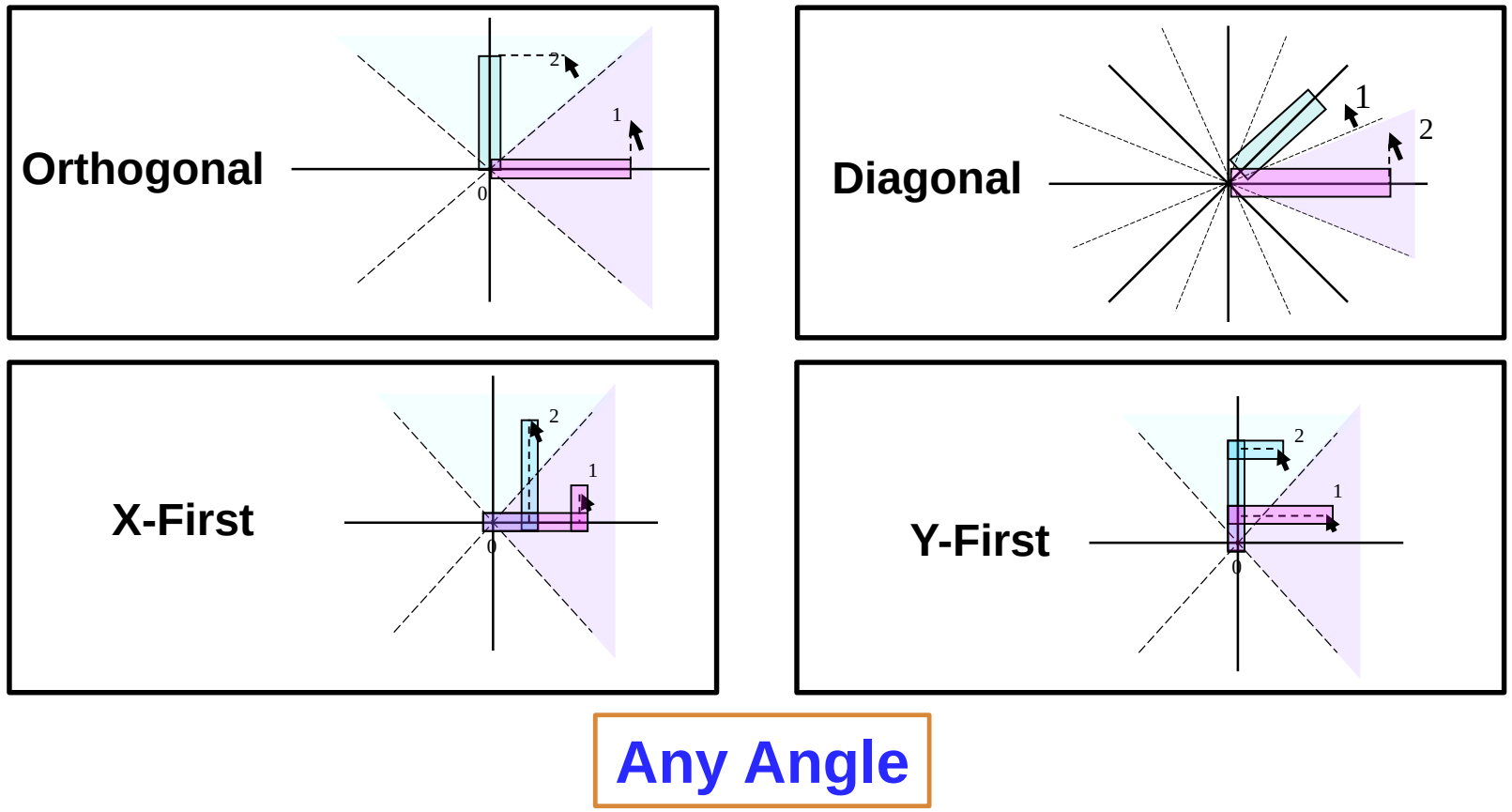
- **Set active LPP**
  - Can be defined inside/outside the command.
- **Add points**
  - LMB
    - OR
  - Default Bindkey <Spacebar>
- **Points entered can be removed using <BackSpace>**
- **Data creation commands repeat until aborted (‘Esc’)**
- **Some commands can be nested**
  - Ex.: Ruler with all editing and creation commands

Data Creation Functions: Mouse Operations



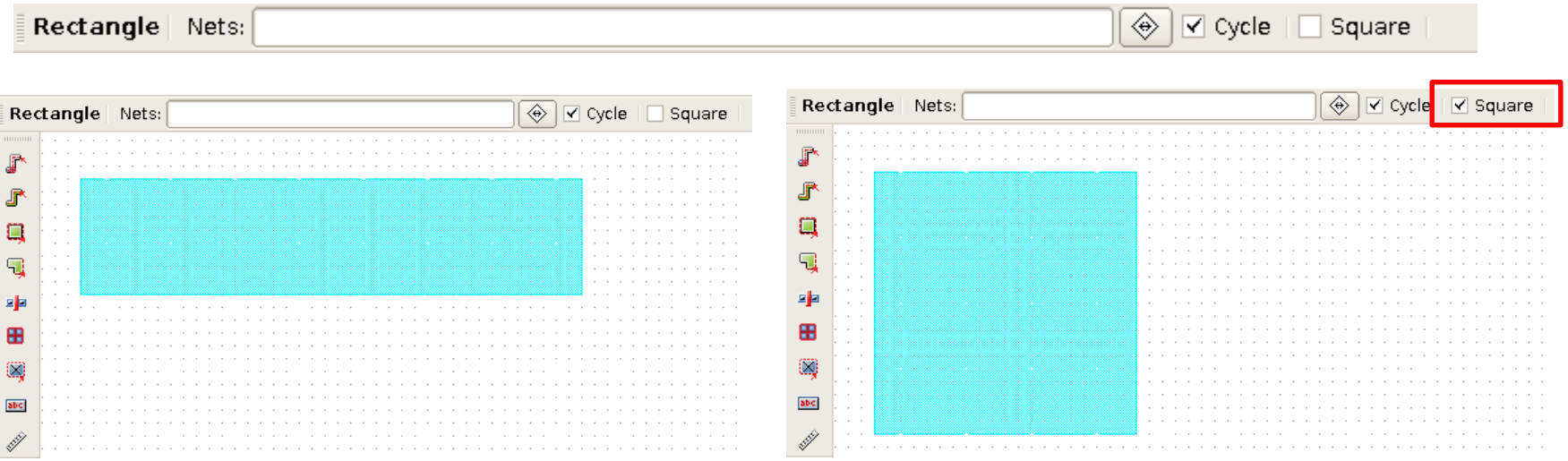
Data Creation: Common Options

- **Net Names**
- **Cycle (Name Stacking)**
  - For commands that support multiple names.
- **Angle Modes**



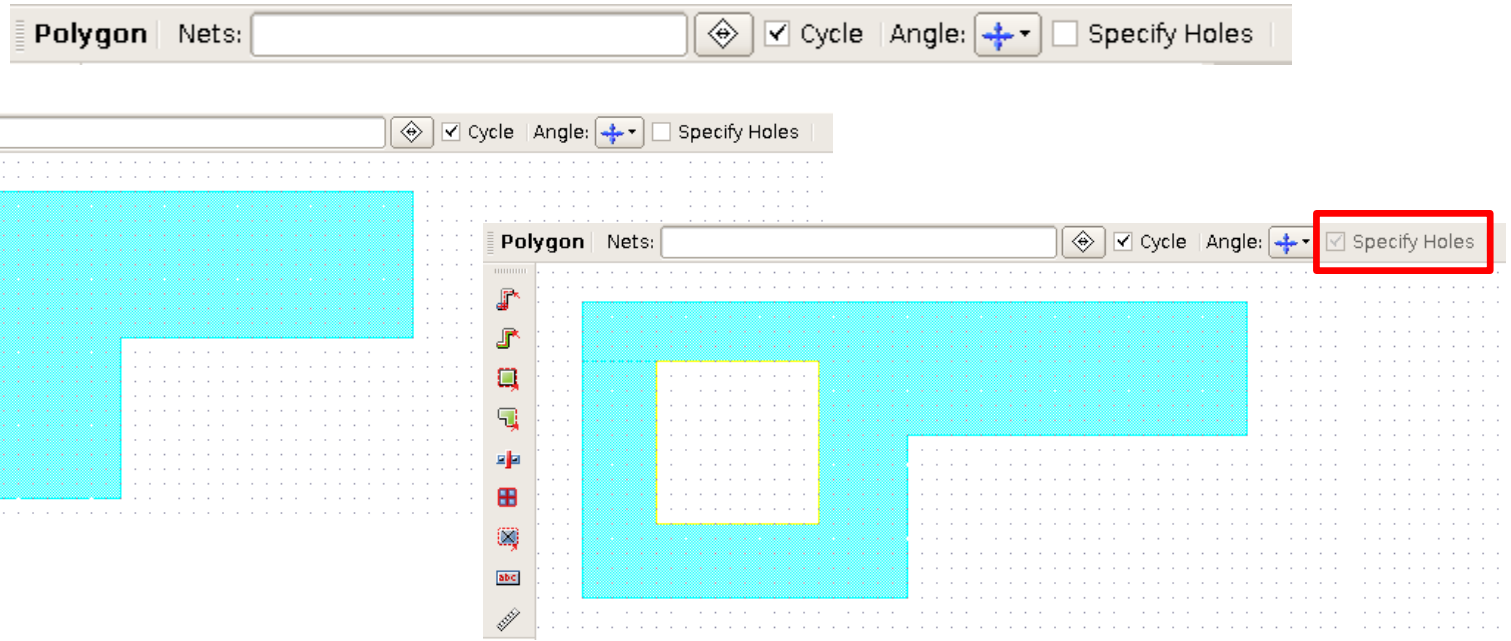
Create Rectangle

- Menu Create → Rectangle
- Bindkey ‘R’
- Supports Cycle for Nets’ names
- Supports “Square” option for rectangle creation



Create Polygon

- Menu Create à Polygon
- Bindkey ‘Shift+P’
- Supports Cycle for Nets’ names
- Supports all Angle modes
- Supports “Specify Holes” option



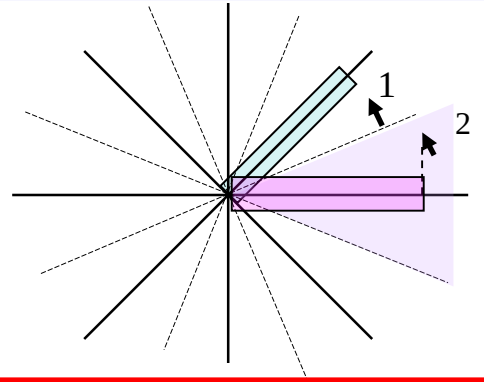
Create Interconnect

- **Manual routes paths/pathsegs can be created using Create > Interconnect command**
- **Manual routes of n-number of parallel connections (bus) can be created using Create > Bus command**
- **Use model is similar to data creation commands**
  - Set active LPP
  - LMB to enter the point
  - Command is modal
  - <BackSpace> to remove the point
  - <ESC> to exit the command
- **Supports**
  - Snapping to tracks
  - Infix mode

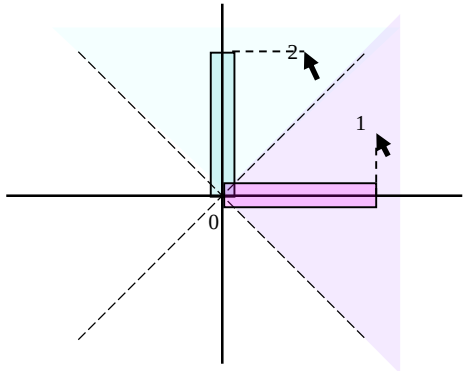
Angle Modes

- **Any Angle**
  - Only for paths

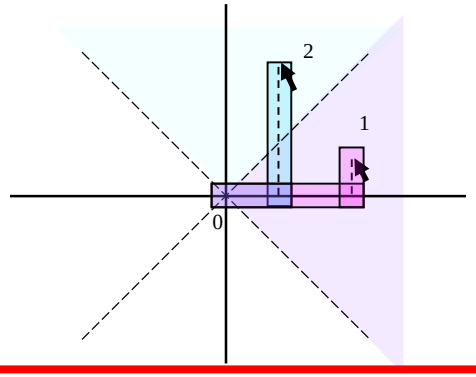
- **Diagonal**
  - Paths
  - PathSegs



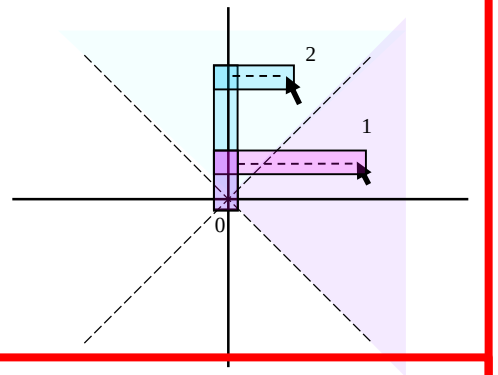
- **Orthogonal**
  - Paths
  - PathSegs



- **X- First**
  - Paths
  - PathSegs



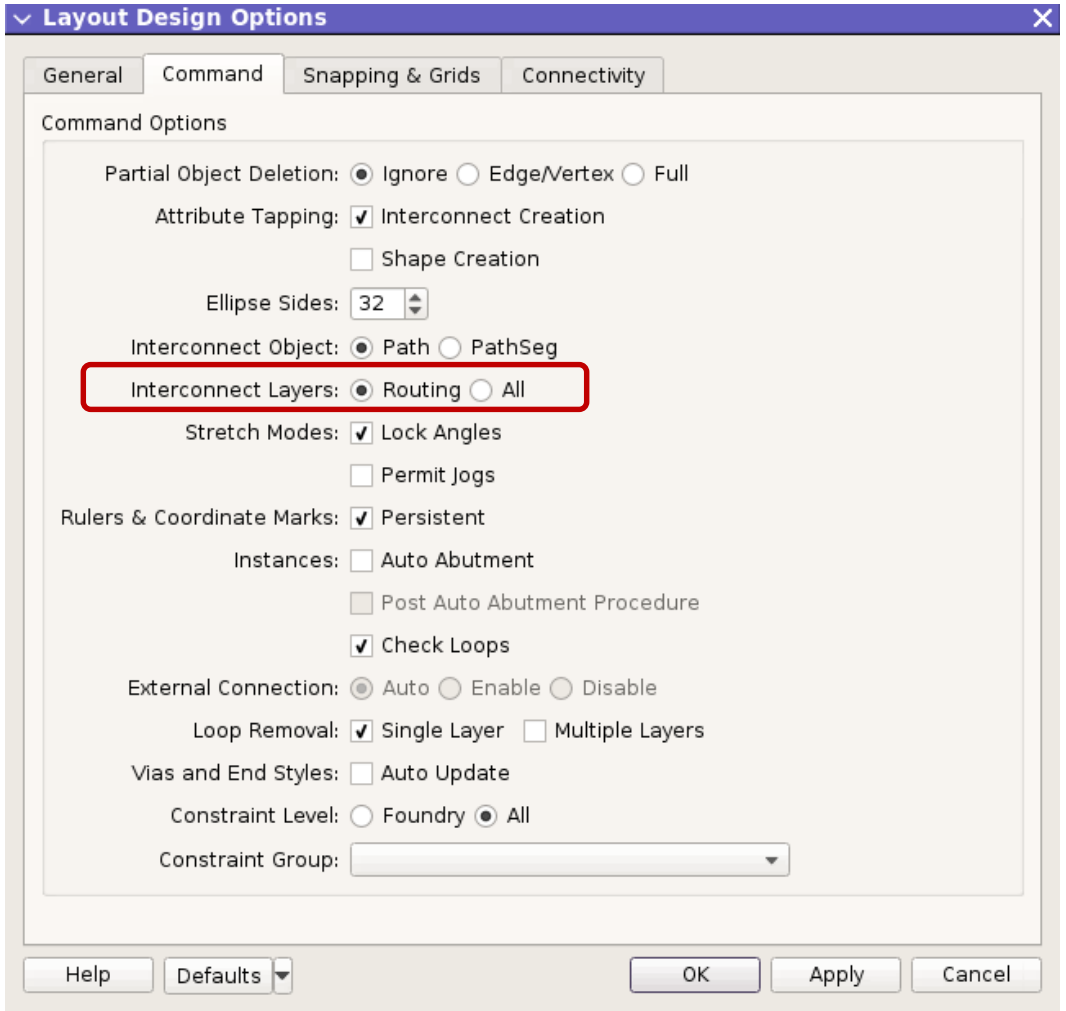
- **Y- First**
  - Paths
  - PathSegs



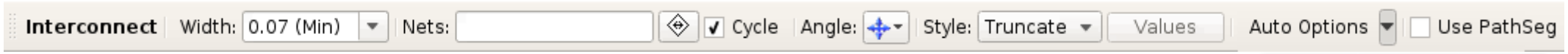
Support Track Snapping

Create Interconnect: Options

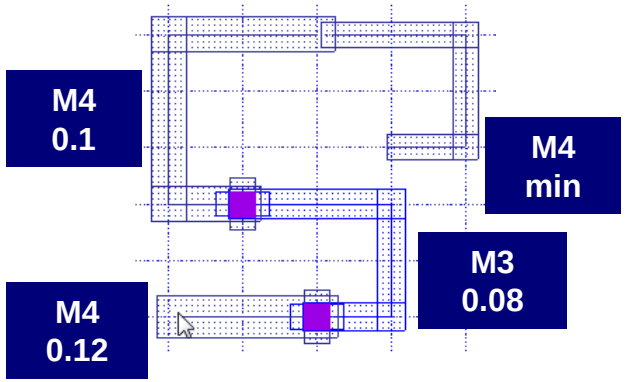
- **Ability to switch between Routing and Non-routing layers**
- **Options -> Design -> Command**
  - Option name - Interconnect Layers
  - Default is Routing

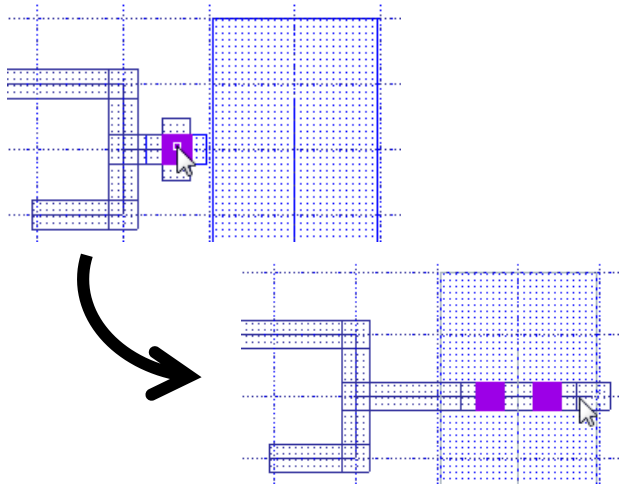


Create Interconnect: Options



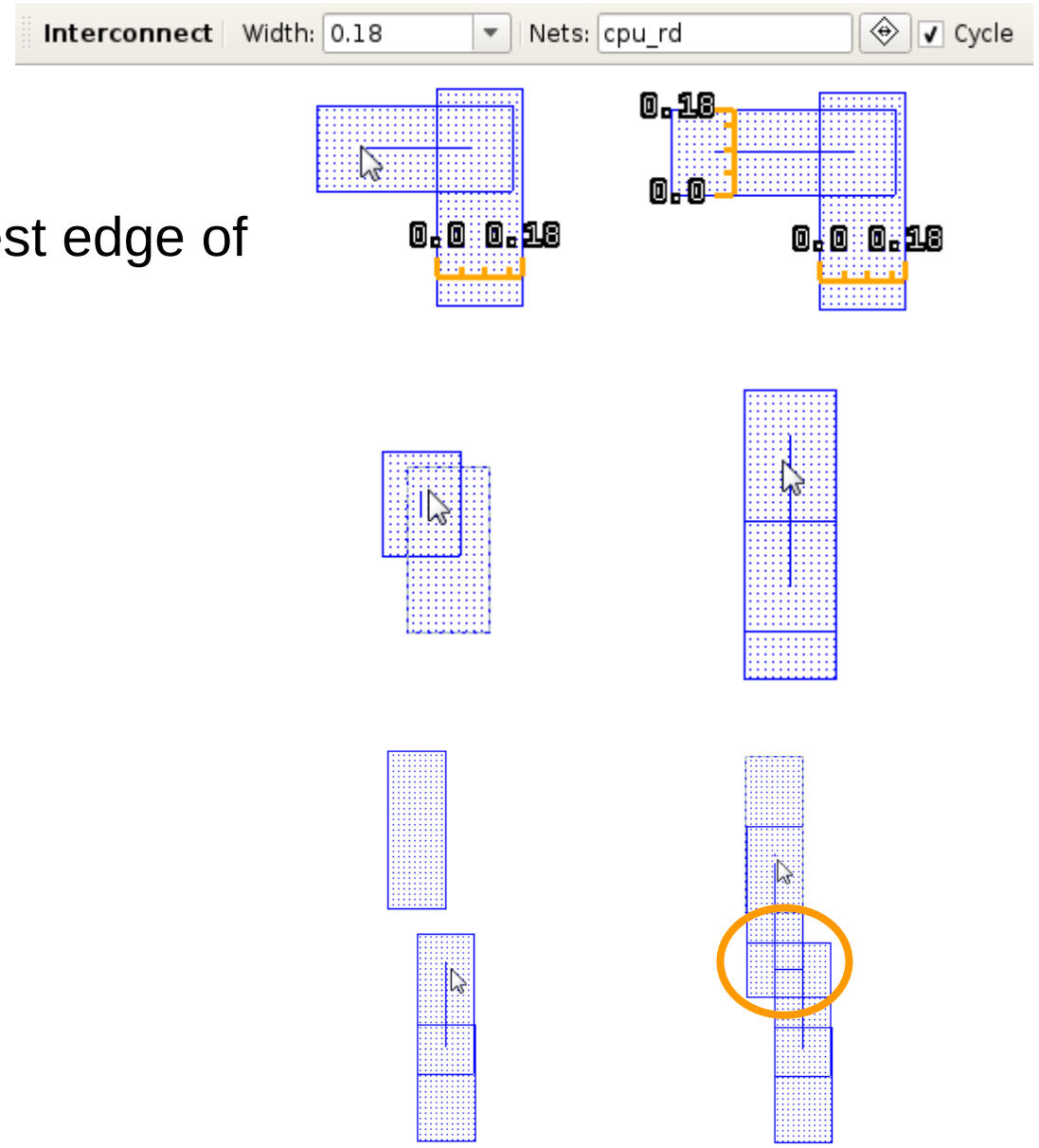
- **Change Width**
  - Applied to current connected path segments on same LPP
  - Remembers width value for each LPP
- **Tap**
  - Pick up LPP from start point
- **Auto Terminate**
  - Single click completion on same net objects
- **Adjust Via**
  - Maximize number of vias
  - Only with Auto Terminate





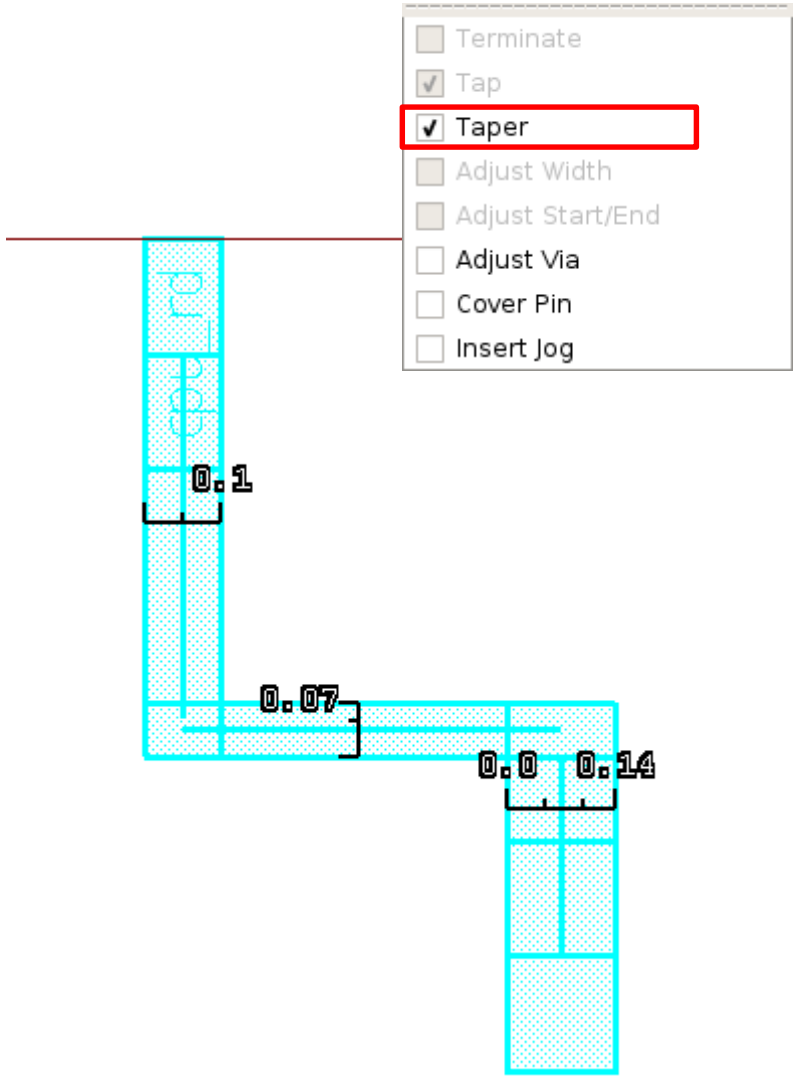
Create Interconnect: Options

- **Adjust Width**
  - Picks up length of the smallest edge of rectangle
- **Adjust Start/End**
  - Aligns edges
  - Overrides tracks
- **Insert Jog**
  - Paired with Adjust End
  - Single jog inserted to align



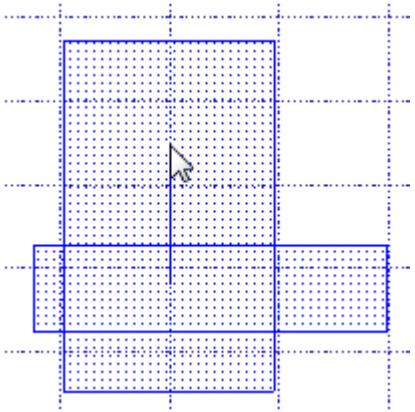
Create Interconnect: Taper Option

- **Defines whether interconnect will support auto taper**
- **If Taper is enabled**
  - Terminate, Tap and Adjust Start/End are ON by default
- **Use model**
  - Width updated to target objects for start and end segments
    - COT field not changed unless Adjust Width is ON
  - After adding a new point (path, pathSeg or via)
    - Width constraint used, or
    - Width from COT used

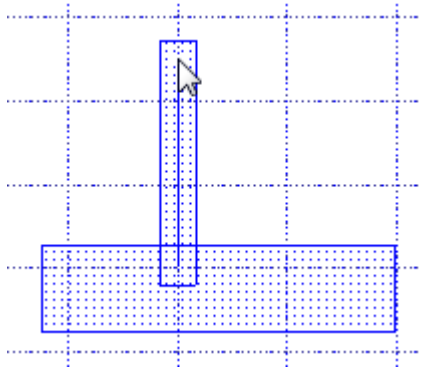


Create Interconnect: Width Toggle

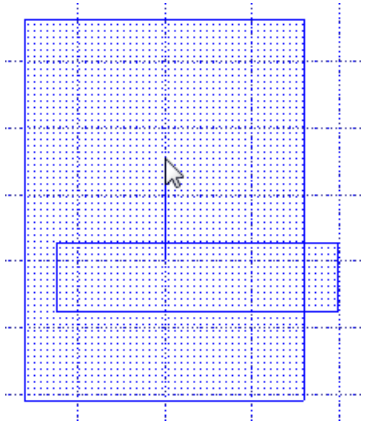
- “Shift-4” toggles width to use
  - Last width



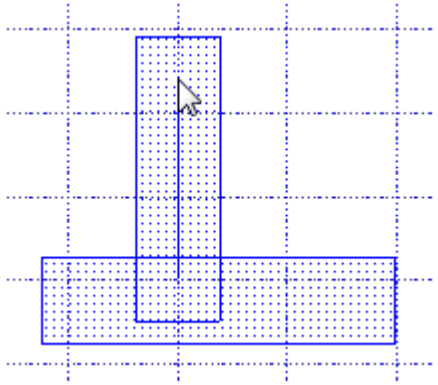
  - minWidth



  - AO maximum dimension

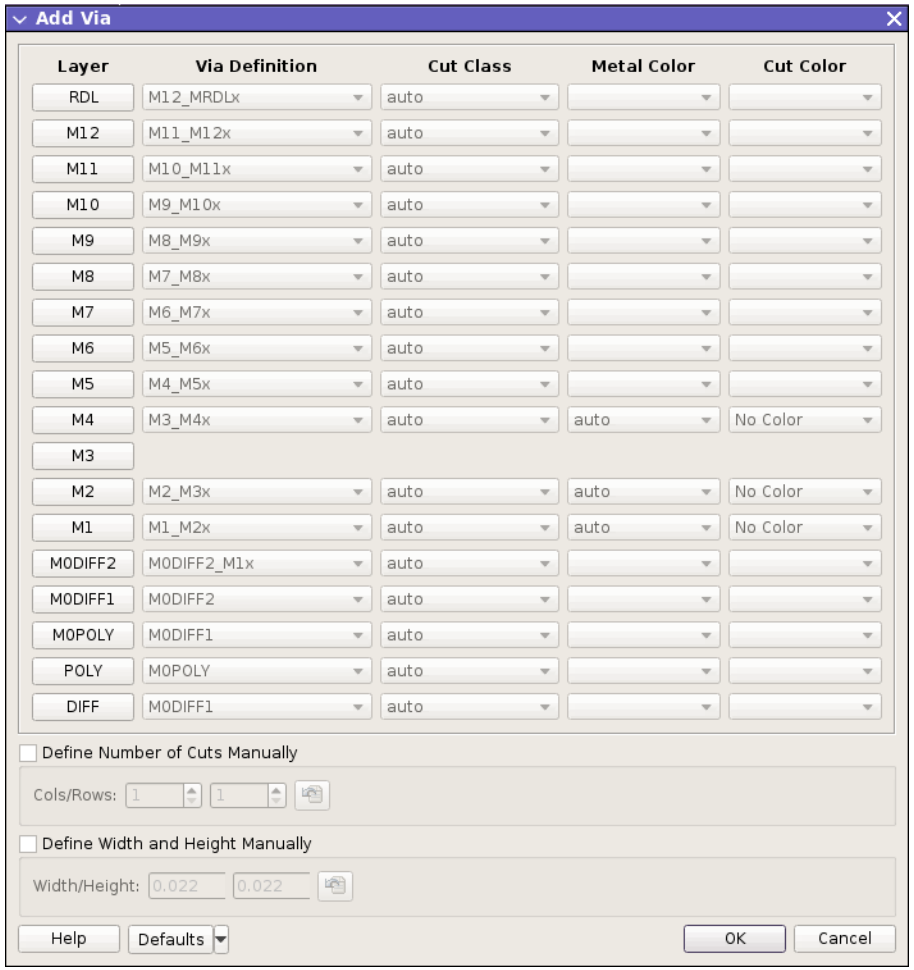


  - AO minimum dimension



Create Interconnect: Via insertion

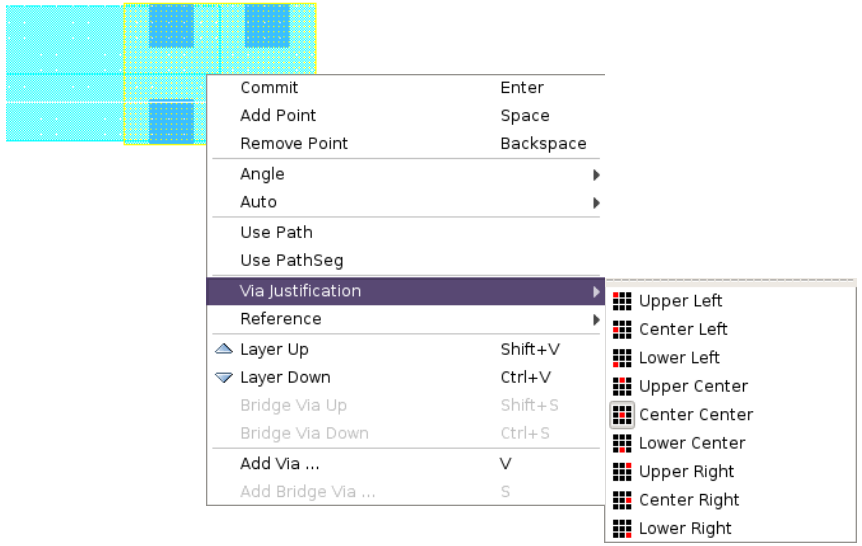
- **Change layer from CSM**
  - Layer Up
  - Layer Down
- **Add Via interface**
  - Activated from CSM or bindkey
  - Honors validRoutingVias
    - Set in Constraint Editor
- **Bindkeys to rotate vias**
- **Supports bridge via during the interconnect creation**
  - The Bridge Via definition in technology are required.
  - Use the CSM menu or bind keys Shift+S / Cntr+S / S to apply bridge via

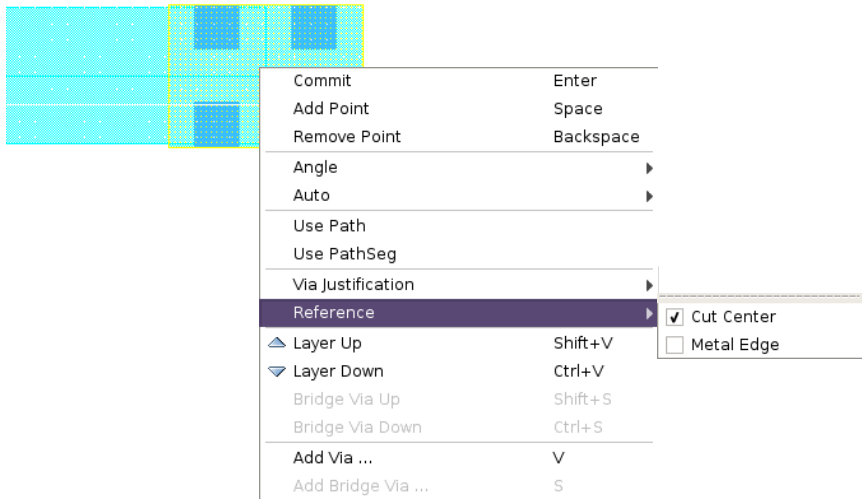


Bindkey	Function
Ctrl-Shift-Button3	Rotate90 layer2 enclosure
Shift-Button3	Rotate90 via
Ctrl-Button3	Rotate90 layer1 enclosure

Create Interconnect: Via Alignment

- **Allows to align vias or via arrays during interconnect creation**
  - Can select Via Justification from CSM menu
    - Default is “Center Center”
  - Can select reference from CSM menu
    - Possible to select Cut or Metal as reference
    - Default is Cut

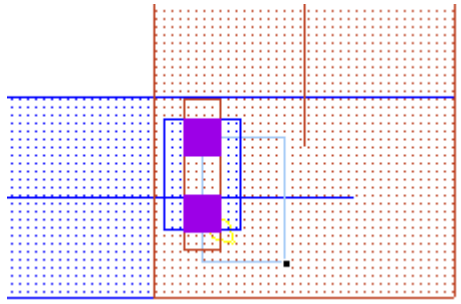




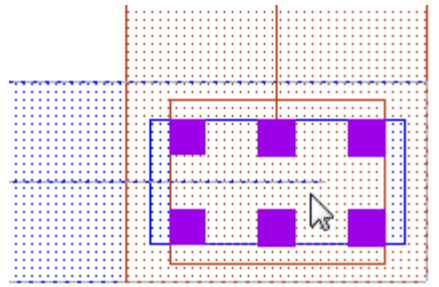
Add Via

- **Create > Via**
  - Bindkey ‘O’

- **Manual Use Model**
  - Select via definition
  - Click for single via or draw region

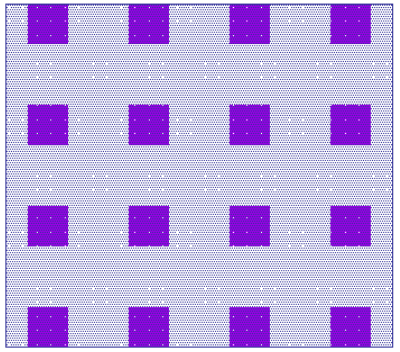


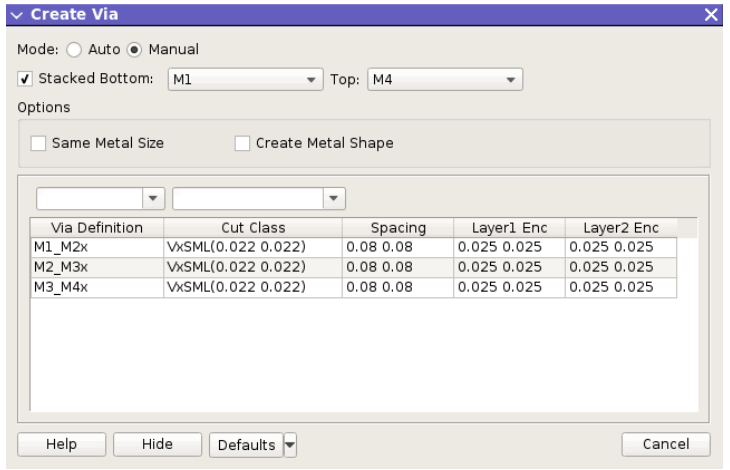
- **Auto Use Model**
  - Fill overlap of shapes on same net
  - Only adds vias for the specified nets if in Nets widget are specified any
  - Click or draw region
    - Applies to all overlaps within region

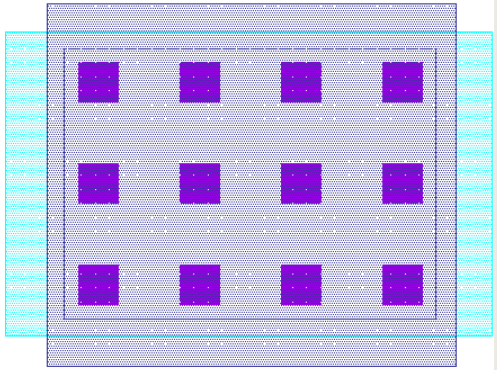


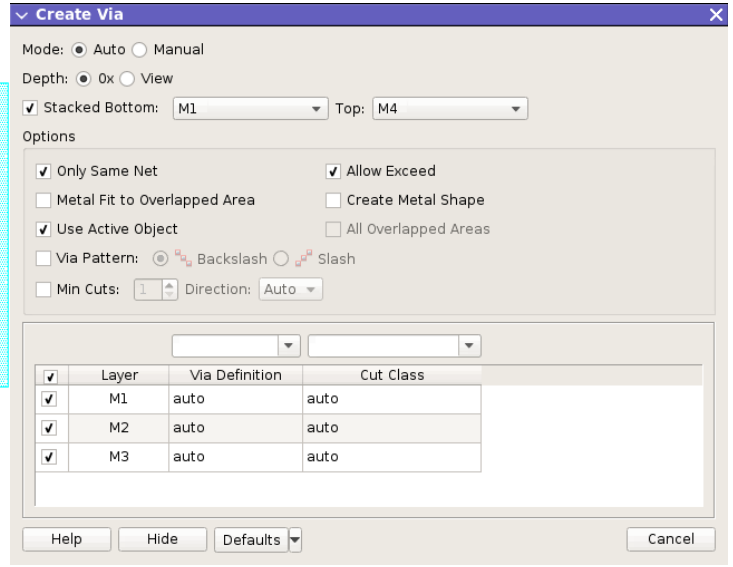
Stacked Vias Creation

- **Ability to create stacked vias at once**
  - Manual Via Creation
    - Specify bottom and top layers for stack via
    - Draw area where vias should be created
  - Auto Via creation
    - Specify bottom and top layers for stack via
    - Move cursor to overlapped area and click to place via stack.



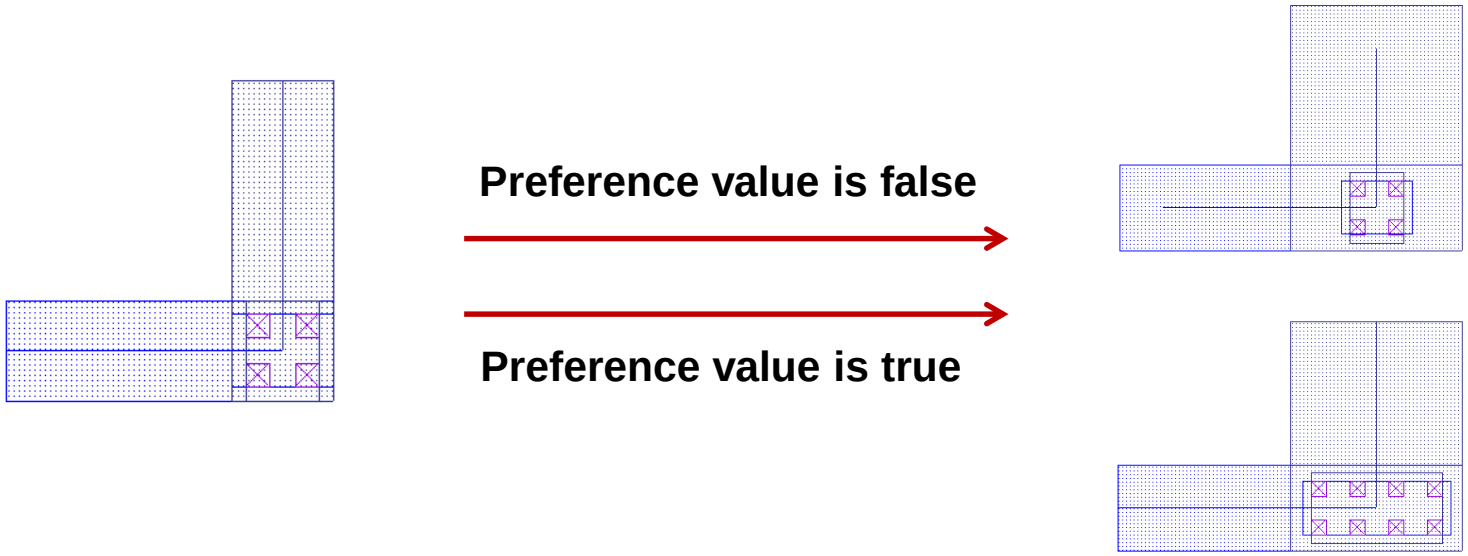






Automated Via & End Styles Resizing

- **Custom Compiler LE will automatically adjust vias and end styles**
  - Preference leUpdateConnectedViasAndEndStyles
    - Values are “true” or “false”; default “false”
  - Resizing applies to paths only whenever width changes



Active vs Selected Set and CSM

- **Active Objects are objects under the cursor**
  - Identified by white dash outline highlight
- **Selected objects default target for any command**
  - Identified by yellow outline
- **CSM - Context sensitive menu specific to objects**
  - Show with Button2 (middle) click
  - If both active and selected objects are present
    - CSM is brought up for the selected objects

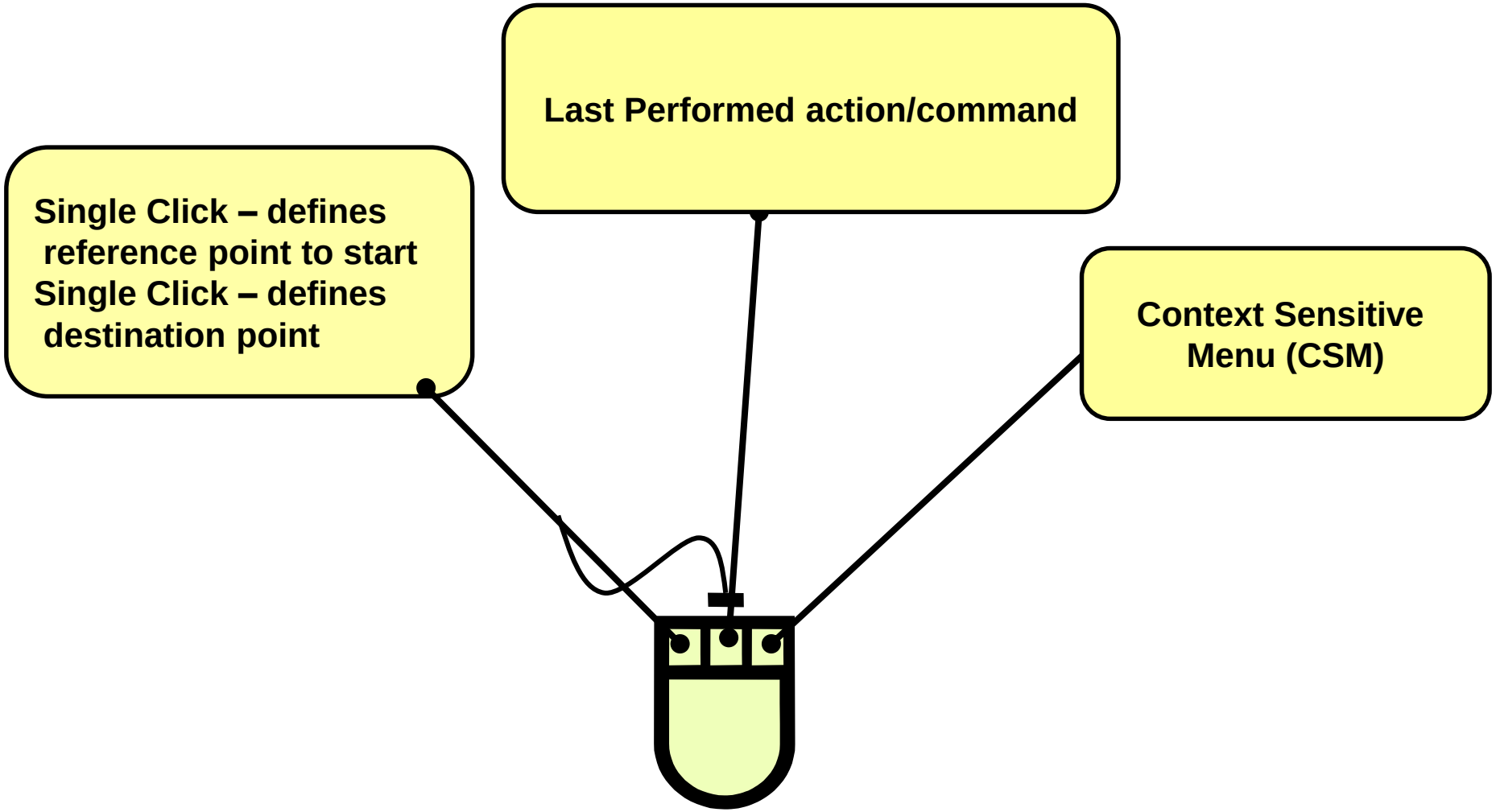
Command Selection Modes

- **Full vs Partial selection modes**
  - Objects can be edited in full (default) or partial selection mode
- **Commands set selection mode automatically**
  - Depending on expected object type to operate on
  - ‘Stretch’ changes the selection mode to partial selection
  - ‘Move’ changes the selection mode to full selection mode
- **Pre Selection vs Post Selection operations**
  - Pre-select objects before editing
    - Command aborts after editing, objects remain selected
  - Select objects after calling command
    - Command stays after editing, objects are then deselected

Selecting Objects

- **Select with Mouse**
  - ‘Button1’ to select the active object
    - Cycle through objects with ‘1’ and ‘2’ keys
    - Object type given in Active Object toolbar
      - Options > Display ‘Object Information’ to also show with cursor
  - ‘Button3-Drag’ to draw selection region
  - Combine ‘Shift’ and ‘Ctrl’ with previous keys
    - To add or remove objects from the selection set
- **Deselect**
  - Bindkeys ‘Ctrl-D’ or ‘Button1’ with no active object

Data Editing Functions – Mouse Operations

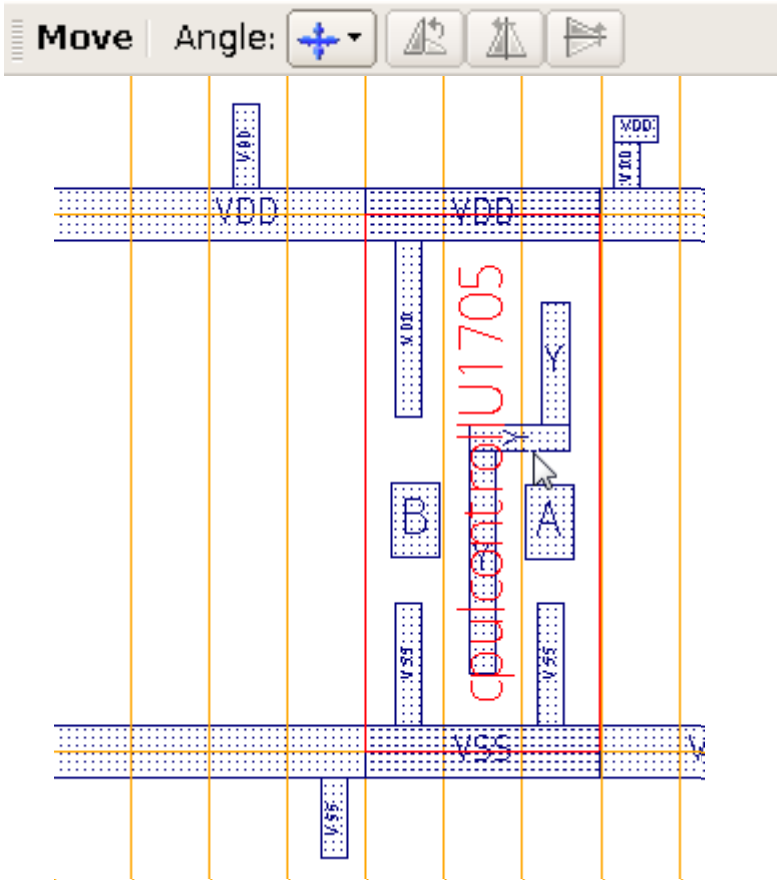


Data Editing: Common Options

- LMB to select
- <Backspace> removes the last point entered
- Supports Pre-Selection and Post_Selection modes
- Supports all angle modes
- Some commands can be nested

Move

- **Menu Edit > Move**
- **Bindkey ‘M’**
- **Snaps standard cells to row sites**
- **Fine incremental move**
  - Select Objects
  - Click Button1 to start move
  - ‘Ctrl-Arrow’: medium
  - ‘Shift-Arrow’: fine

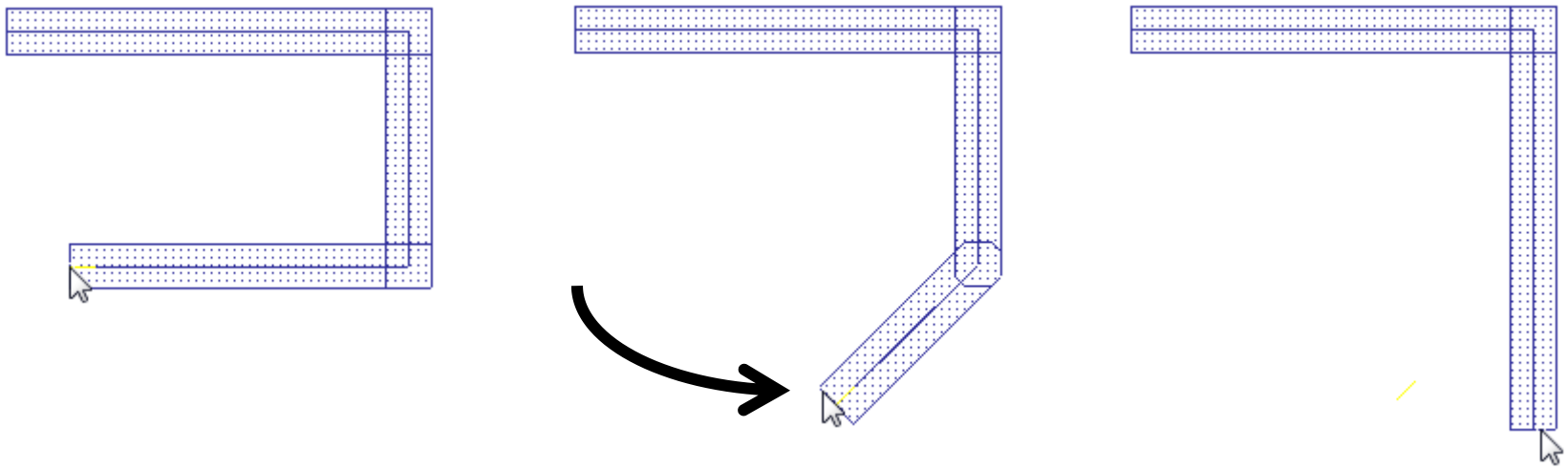


Copy

- **Supports fully selected objects**
- **Rows / Cols**
  - Number of rows/cols to be created for the selected objects
- **Supports Interactive and predefined spacing modes for Rows/Cols**
- **Supports the Group option during copy**
- **Copy and change LPP with PE**
- **Copy command to keep previous Rows/Cols values**
  - `db::setPrefValue leCopyResetRowsCols -value false`

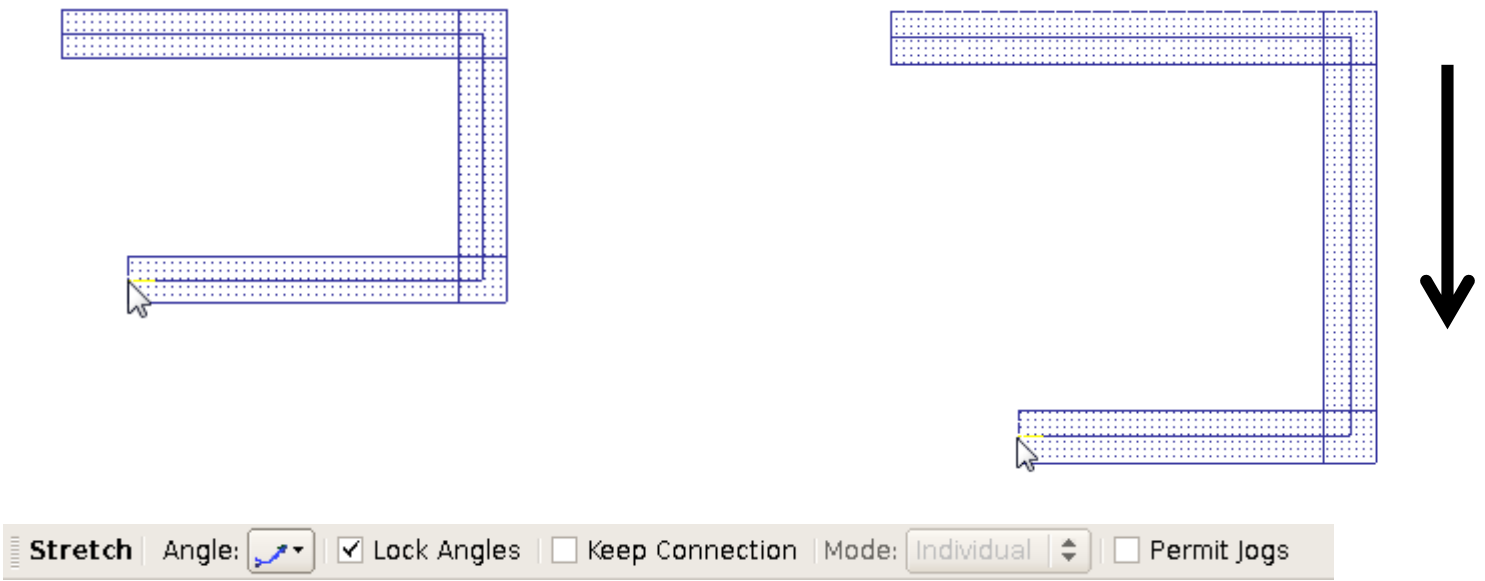
Stretch

- Partial selection mode set automatically
- Snap paths to active tracks, std cells to rows
- Lock Angles “off”



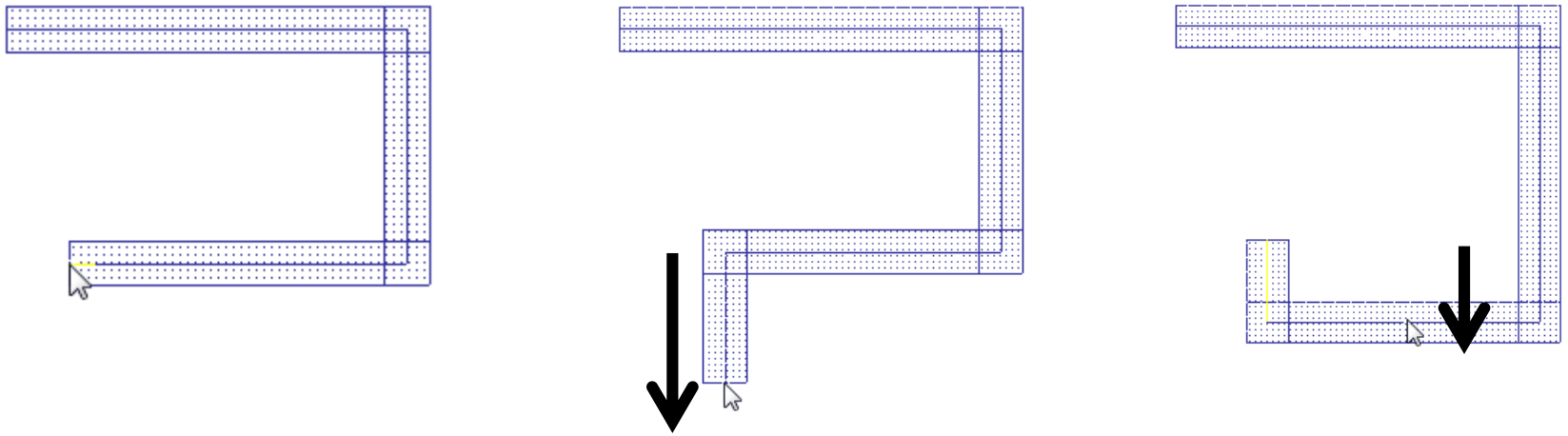
Stretch

- Partial selection mode set automatically
- Snap paths to active tracks, std cells to rows
- Lock Angles “on” and “Any Angle”



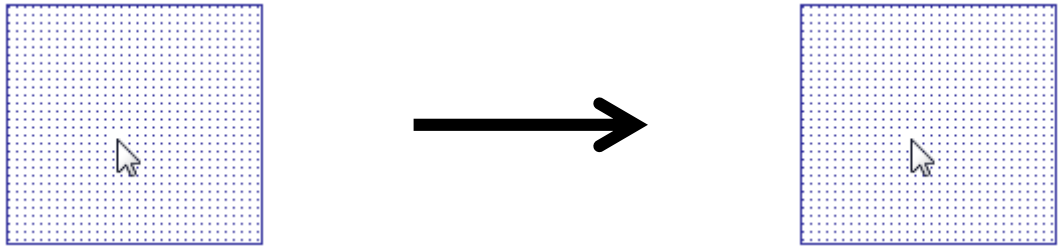
Stretch

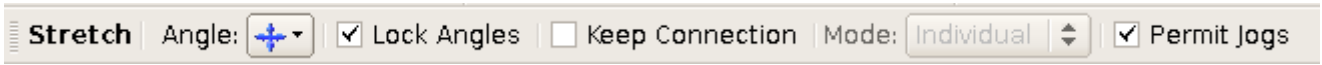
- Partial selection mode set automatically
- Snap paths to active tracks, std cells to rows
- Lock Angles “on”, “Orthogonal” angle
- Permit Jogs “on”



Stretch

- Partial selection mode set automatically
- Snap paths to active tracks, std cells to rows
- Lock Angles “on”, “Orthogonal” angle
- Permit Jogs “on”
- Move objects if whole object is selected





Stretch: Keep Connected

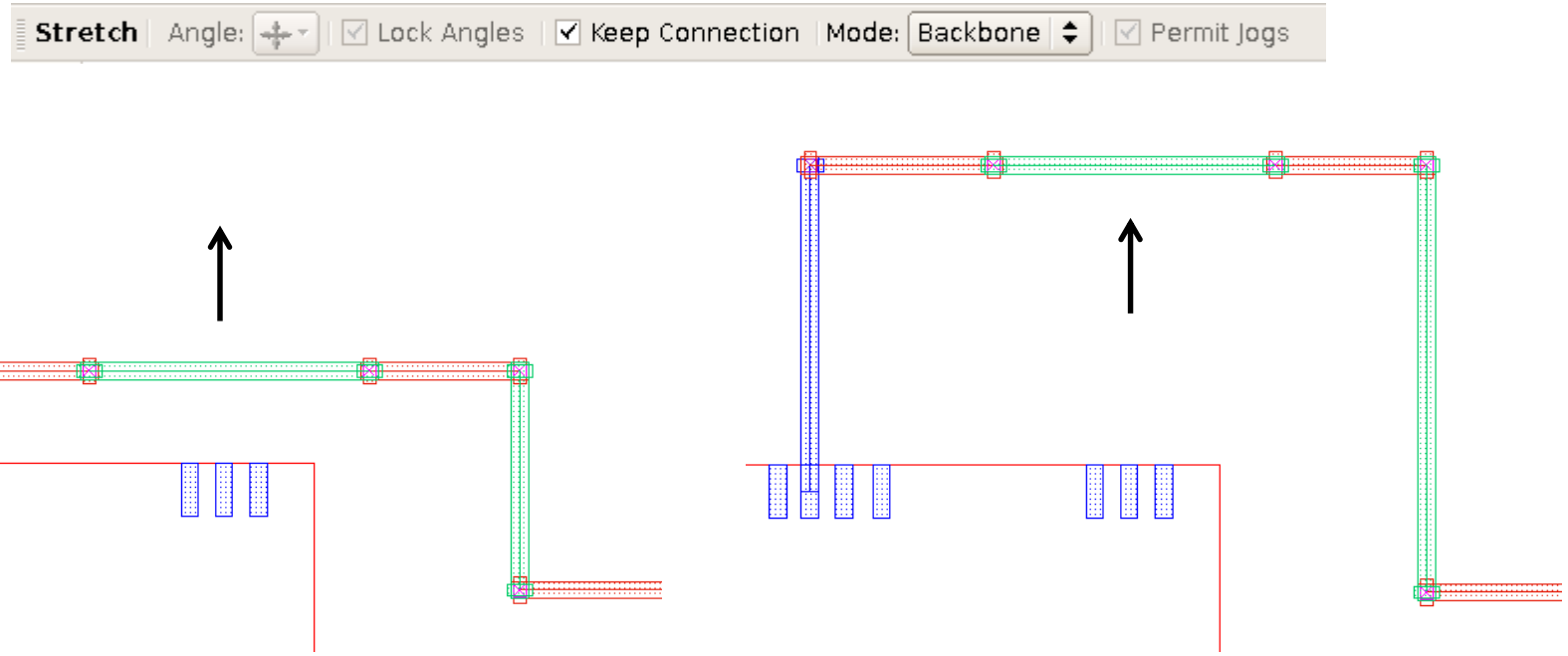
- **Enables preservation of connections between the stretched object and its connected wire objects**
- **Preserves connections for**
  - External connections: Path/PathSeg/Via connecting to instance pin or 0X pin
  - Internal connections: Path/PathSeg/Via connecting to other Path/PathSeg/Via on same wire
  - Partially selected objects for Path/PathSeg/Via, or fully selected objects for Path/PathSeg/Via/Instance/Pin
- **Stretched objects can be partially or fully selected**
- **Angle Mode and Permit Jogs options not work in Keep Connection mode**

Stretch: Keep Connected Backbone Mode

- Stretches all other Path/PathSeg/Via's that form part of the same backbone as the stretched object to preserve the backbone topology

  Preferences: leStretchConnectionAware –value true

  leStretchConnectionAwareMode –value *backbone*

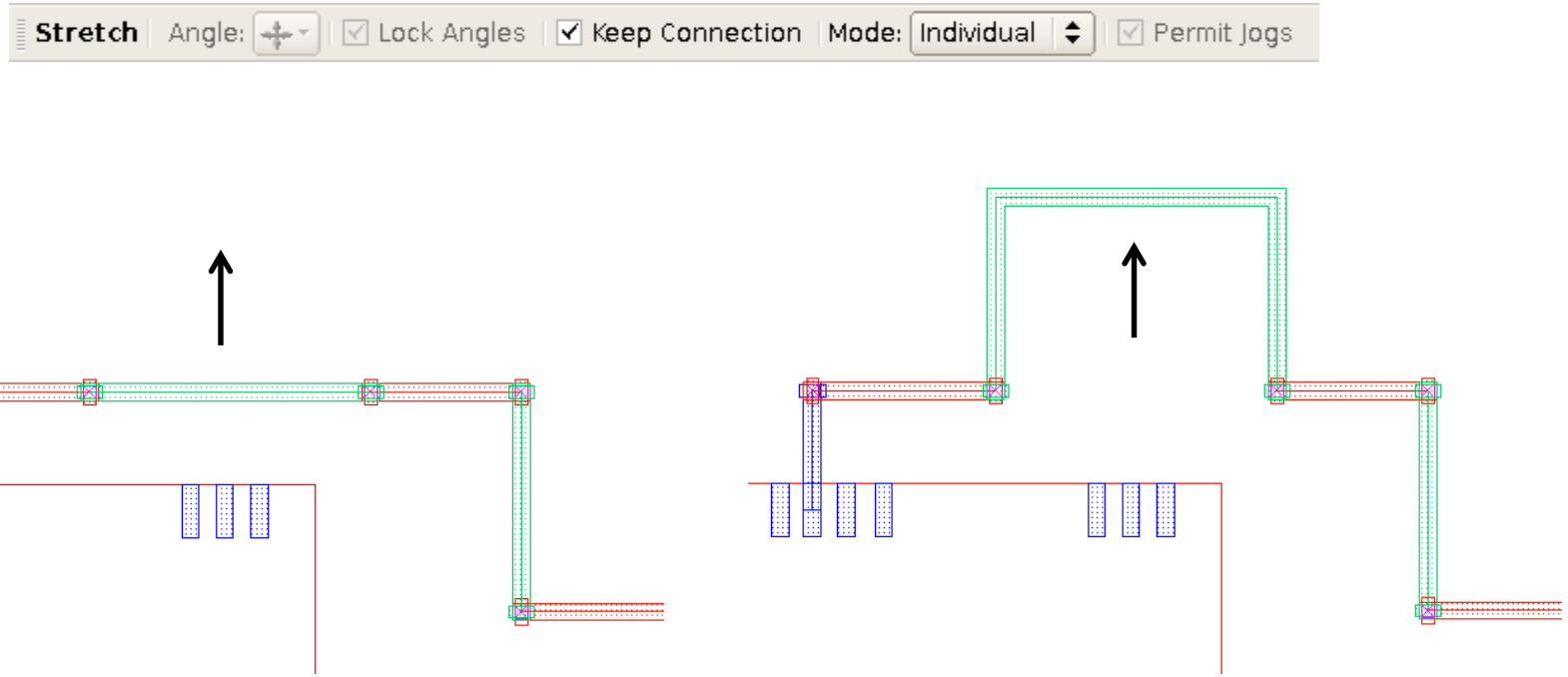


Stretch: Keep Connected Individual Mode

- Stretches only the individual object regardless of its backbone topology

  Preferences: leStretchConnectionAware –value true

  leStretchConnectionAwareMode –value individual

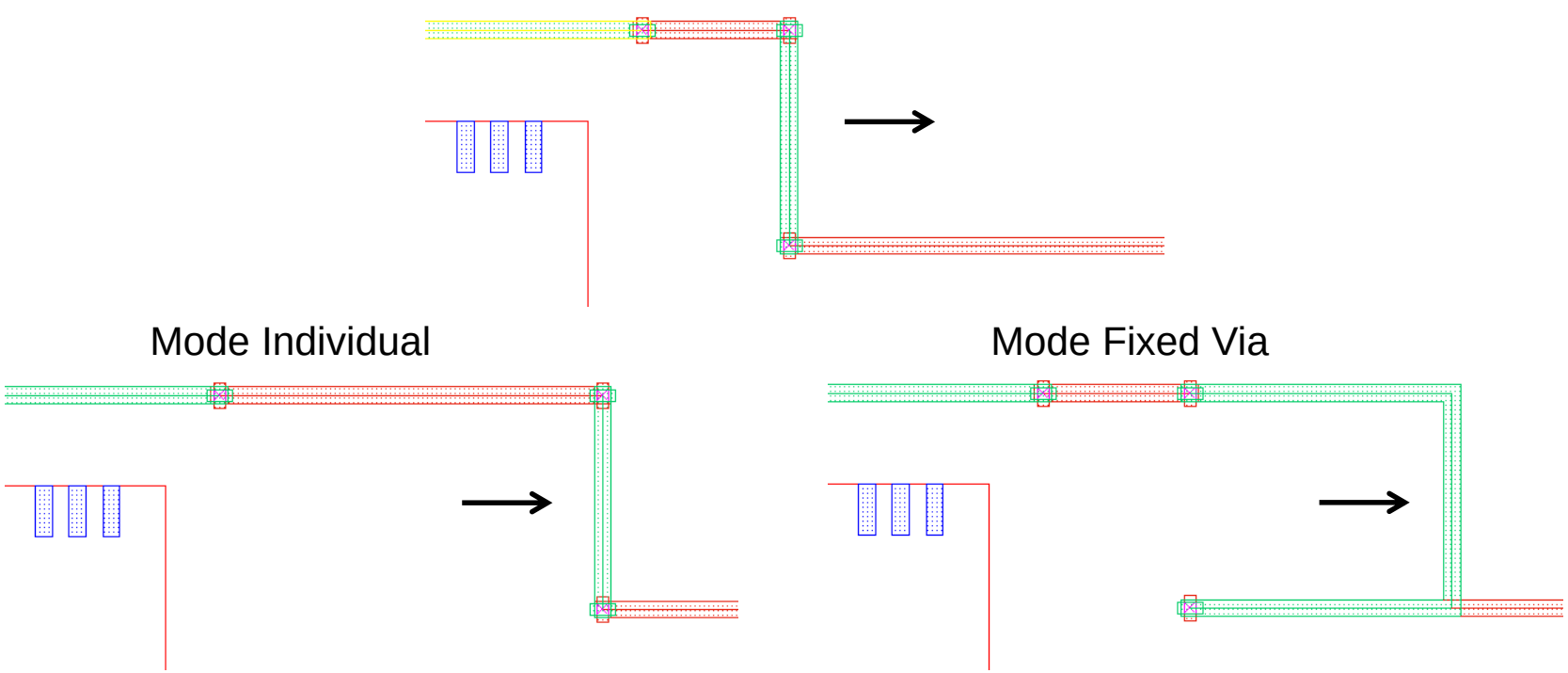


Stretch: Keep Connected Fixed Via Mode

- Stretches only the individual object regardless of its backbone topology

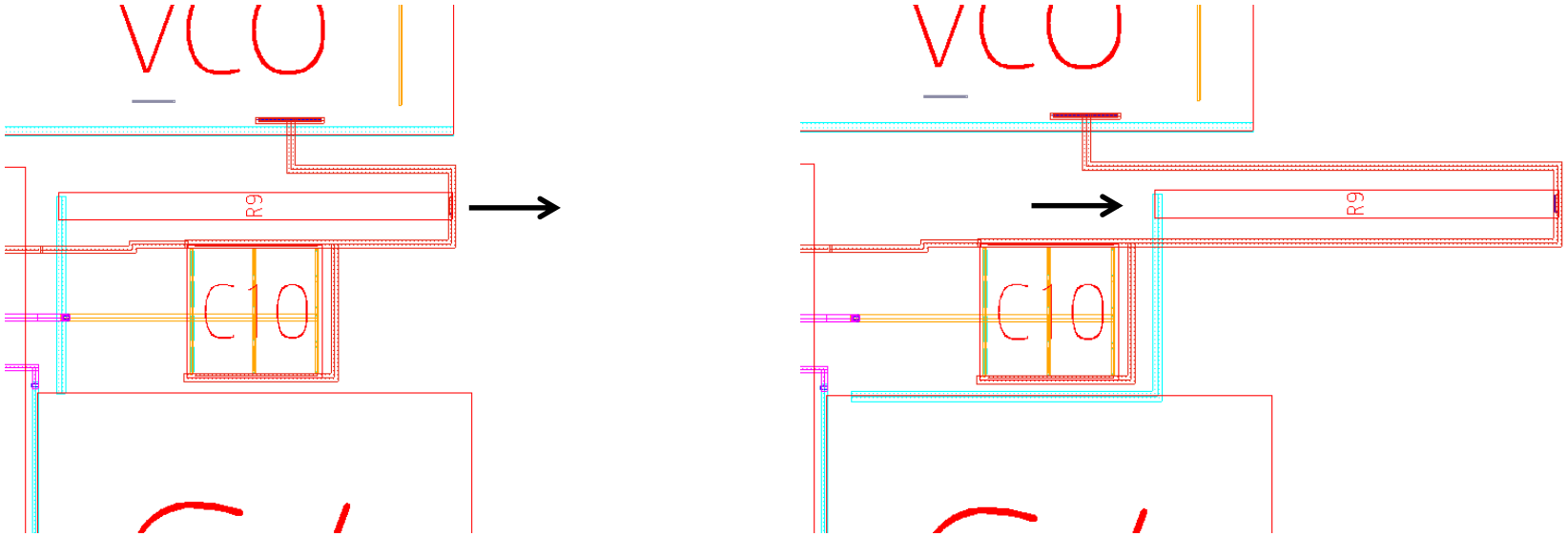
  Preferences: leStretchConnectionAware –value true

  leStretchConnectionAwareMode –value fixedVia



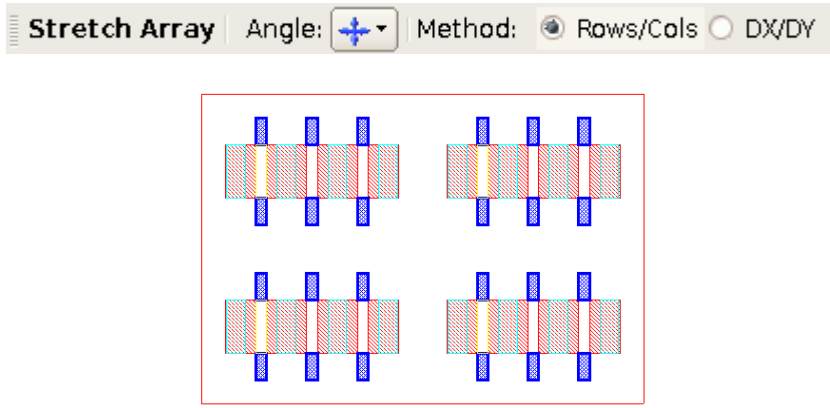
Stretch: Keep Connected Instances and Pins

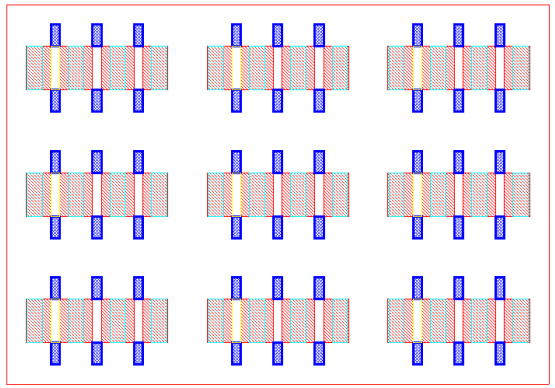
- **Preserves connections to instance pins and 0X pins when stretching them**

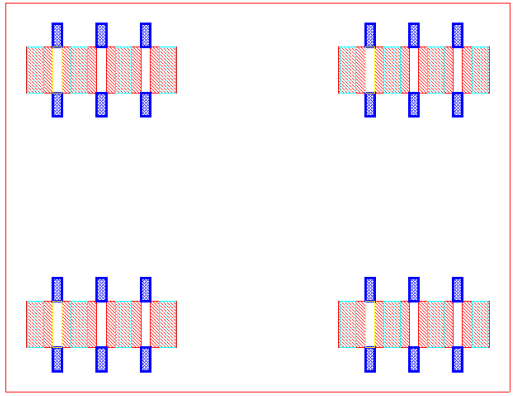


Stretch Array

- **Stretch command of array instance**
  - **Edit -> Stretch Array**
- **Method: “Rows/Cols” or “DX/DY”**
  - Rows/Cols: change numbers of Row and Column while keeping same DX and DY
  - DX/DY: change DX and DY while keeping same Row and Column



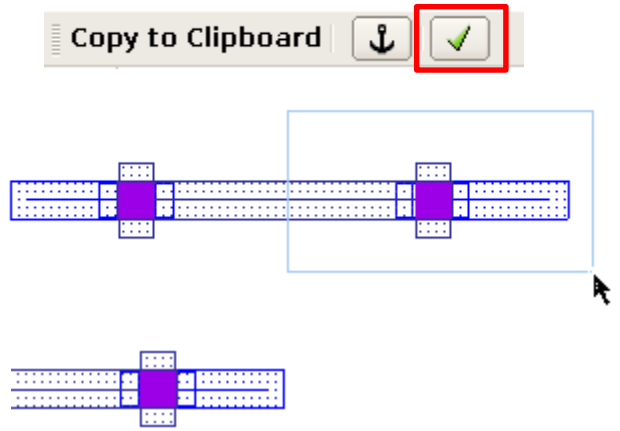


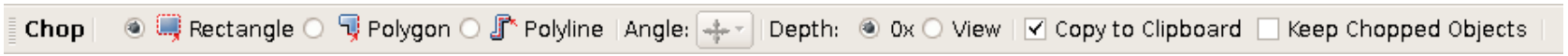



```
db::setPrefValue leStretchArrayMethod -value “Rows/Cols”|”DX/DY”
```

Clipboard Commands

- **Edit > Clipboard > Copy | Cut | Chop**
  - Bindkeys: Copy ‘Ctrl-C’, Chop ‘Shift-C’
- **Do not copy instances in an ICC design**
  - Need to preserve the design netlist hierarchy
- **Use model**
  - Select objects
    - Apply in COT
  - Draw Chop region
  - Paste
    - Bindkey ‘Ctrl-Y’





Clipboard Commands

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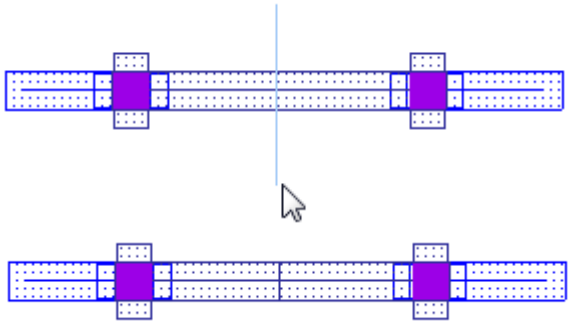
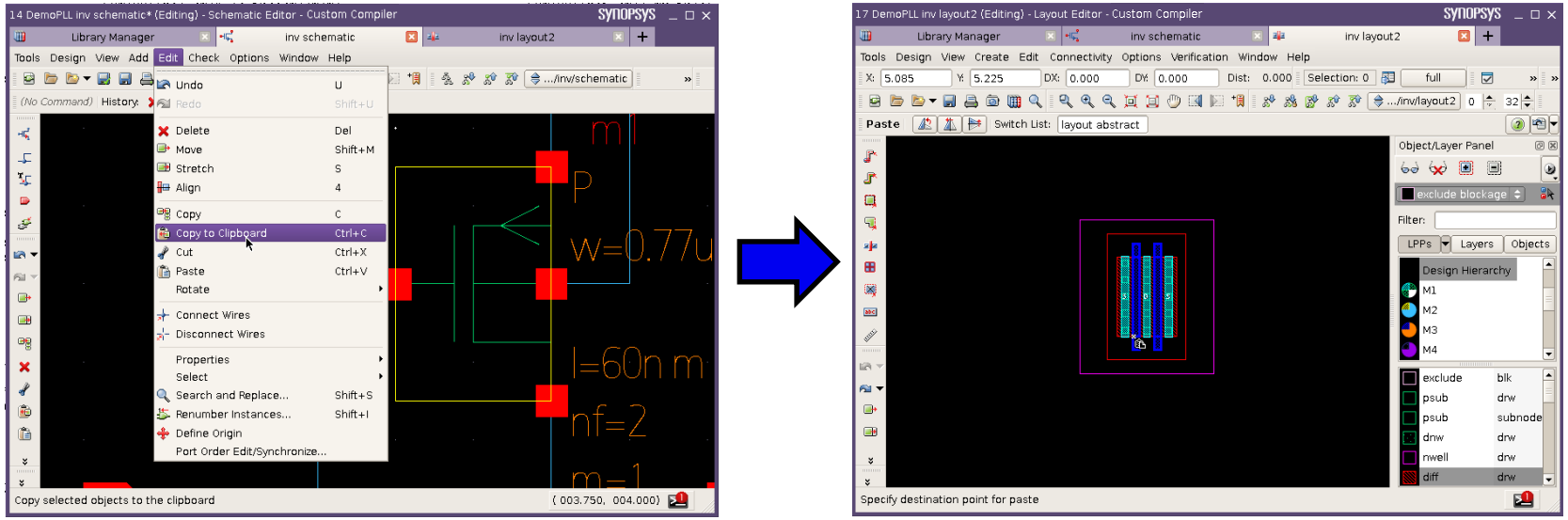


Clipboard Commands

- **Clipboard Copy/Paste functionality enhanced to allow copy of schematic/symbol instances from the schematic view to the layout view**
  - The layout view master is placed in the layout view
  - No connectivity info is copied
  - Naming is copied
  - Supports scalar and vectored instances
  - M-factor parameter is ignored, number fingers (“nf” parameter) supported

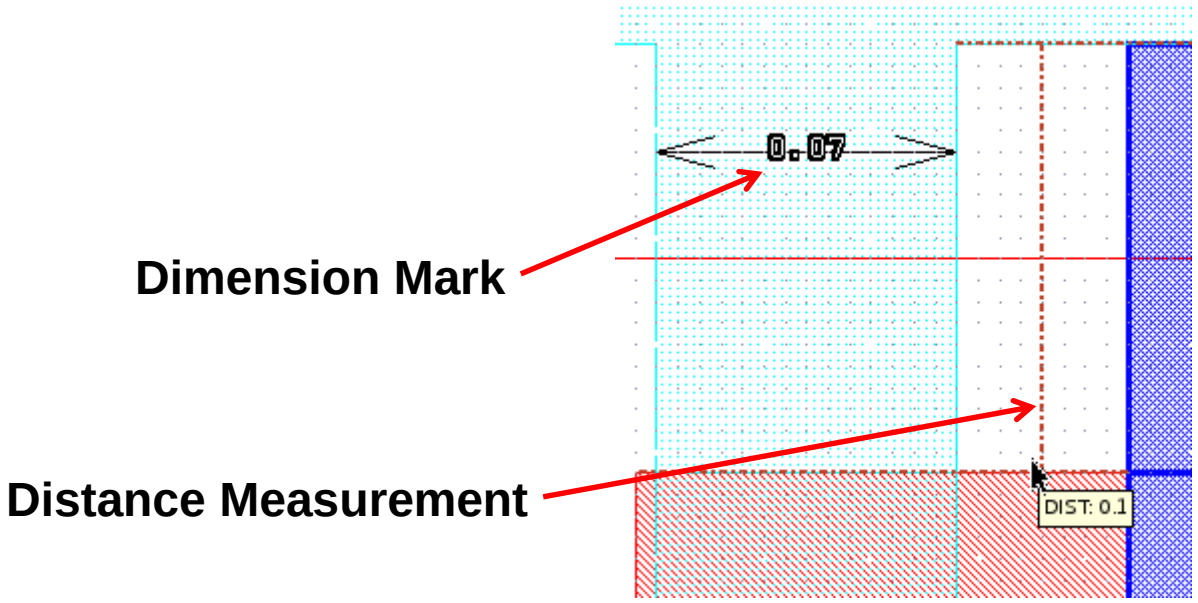


Transaction History

- **Window → Assistant → Transaction History**
- **One per design context**
- **Bindkeys**
  - “U” to undo, “Shift-U” to redo
  - “Button2” to recall last command

Distance and Dimension Marks

- **Allows to measure distance between edges**
  - Can place measurement object on commit
    - Linear Ruler
    - Circular Ruler
    - Dimension Mark



Coordinate Input

- **Allows to input coordinates during creation or editing**
  - Can input absolute coordinates as X and Y
  - Can input relative coordinates as DX and DY
  - Use Enter button to commit

Test for Understanding

- **Gravity setting is used to set the view level: True / False**
- **LPP stands for …**
- **When “Cycle” is true and Net Name: “a” “b”, after first shape creation, Net Names field is left with:**
  - a
  - b
  - a b
  - is empty
- **When active and selected object is present, middle-click brings CSM for :**
  - Active object
  - Selected object
  - Layout Editor canvas

Lab 1: Design Entry

30 minutes

Goals:

- Create inverter layout using data creation/editing functions