

# Enter the Dragon!



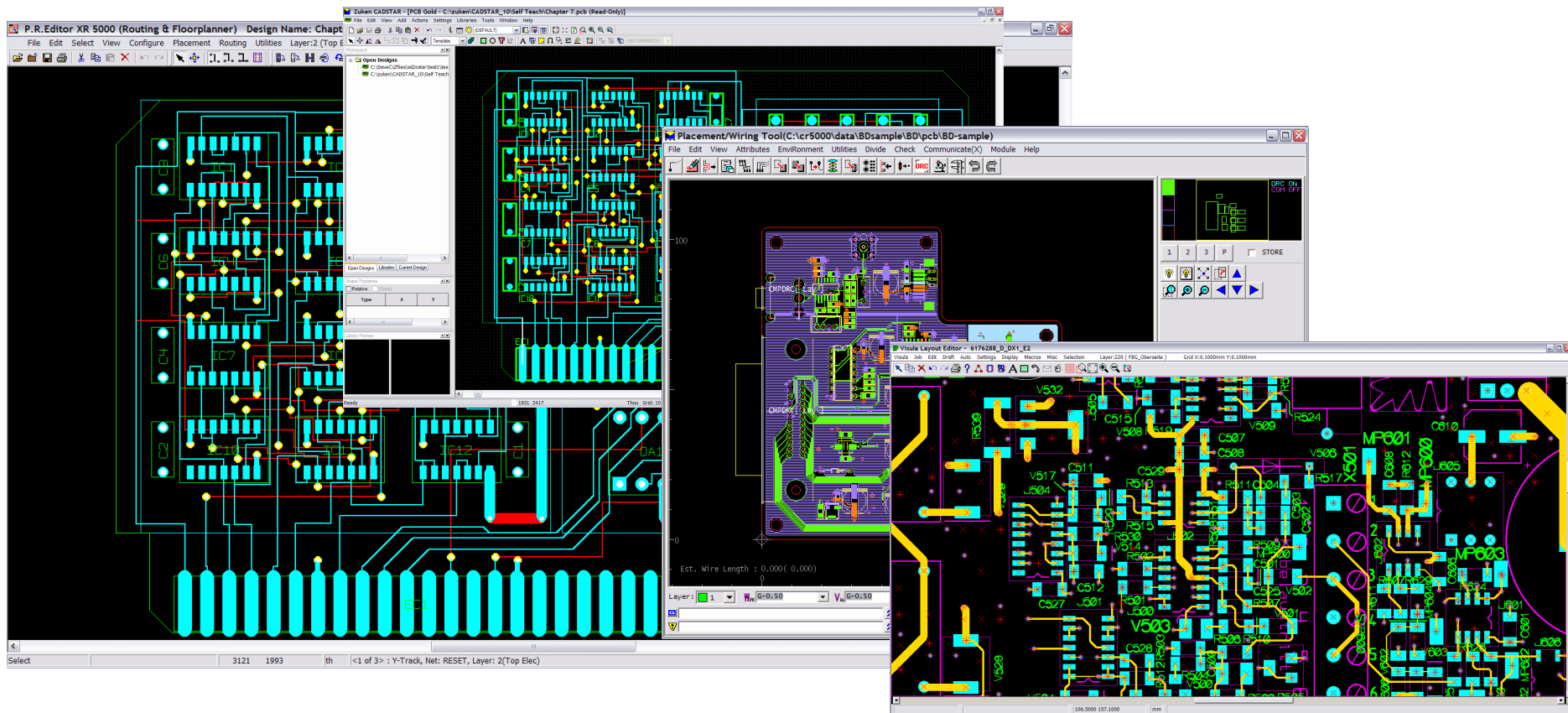
Jeroen Leinders  
CADSTAR Distribution Manager



# One Place & Route Editor - Many Hosts!



- Zuken's Place & Route Editor is delivered into multiple host CAD systems
  - CADSTAR, CR-5000 (and Visula)
- Zuken's philosophy has many advantages for CADSTAR



# Zuken's Place & Route Editor



- Zuken's Place & Route Editor contains more than just **Interactive Placing & Routing**
  - It offers **Placement** of components
  - It offers **Push-Aside** while moving components
  - It offers **Re-Route after Move**, so you hardly need manual updating of the routing pattern after moving a component
  - It allows to Route and Re-route your connections using Push-Aside and the **Activ-45 Router**, while your Design Rules are checked on the fly
  - It offers **Bus Routing** (also called Trunk Routing)
  - It offers **Interactive Lengthen or Delay Controlled Routing**
  - It offers **Impedance Controlled Routing**
  - It offers **Differential Pair Routing**
  - And many more...

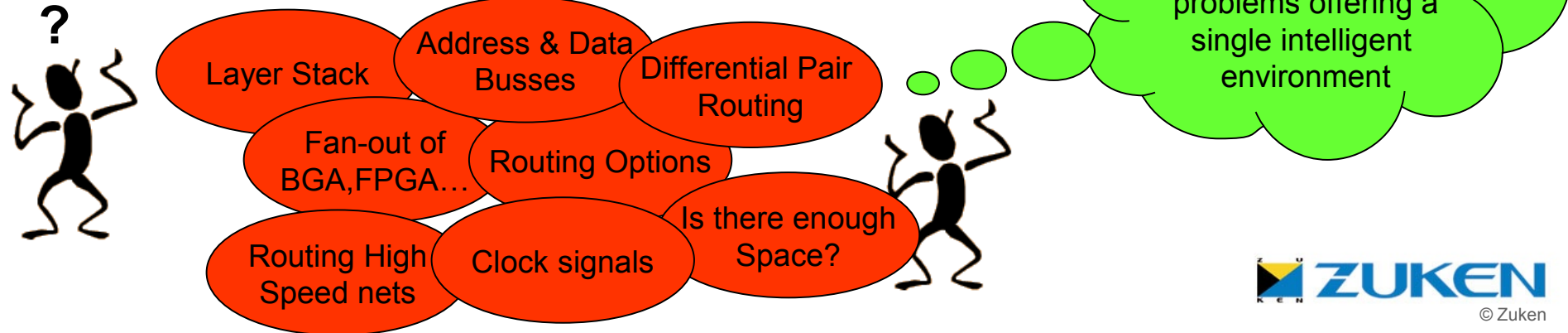
# Zuken's Place & Route Editor



- **So having all this great Interactive Place & Route functionality, why would YOU need an Auto Router?**
- **WHO is actually using an Auto Router?**
- **WHY don't people like Auto Routing?**

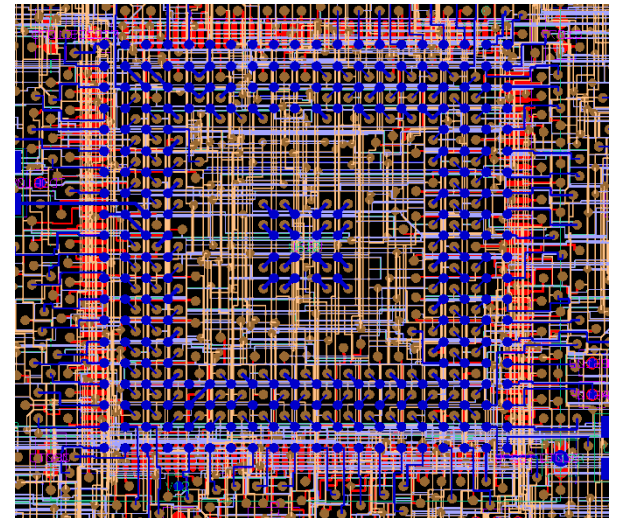
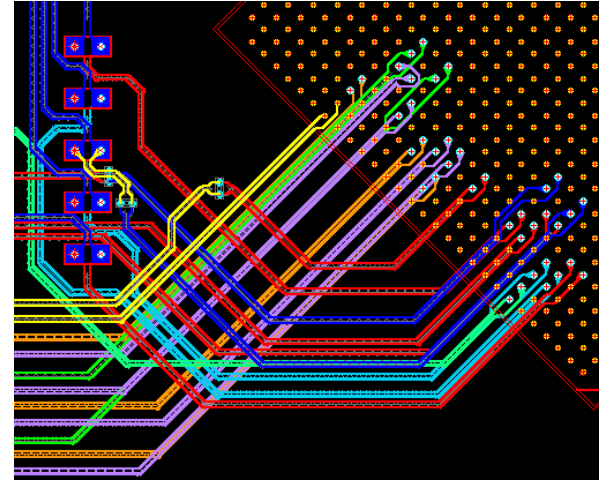
# Why Many People Don't Like Auto Routing?

- Main reasons people don't like auto routing:
  - Too complicated to set up (a kind of black art)
    - Options may be confusing (or too many options)
    - Often don't know how an option may affect a result
    - You need to be an expert in the tools, it takes time to setup
  - As a result it may not have completed the design
    - If number of failures are too great, time to manually complete may be as long as interactively routing the whole design from start!
  - The routed results may not look like it were routed interactively (aesthetics)
    - Often quality of routing is judged by appearance rather than fit for purpose
  - Results might actually not fit for purpose
    - Skew in Differential Pairs
    - Lengths are too long and you might need to re-work the place



# Do I need an Auto-router?

- Design cycle times need to be reduced
  - Competitive markets
  - Manual routing can be slow and expensive
  - Set up time will be small compared to manual routing time (if of course the routing results are good)
- Increased complexity in technology means interactive routing is impractical
  - Too much to think about for one person, too many constraints
  - Chip manufacturers even produce guidelines on how to design using their chipsets
- High-speed design is increasingly driven by the engineer
  - Not being traditionally a routing expert
  - Requires automation to do the job more effectively



## Getting interested?

# Zuken's new Auto-router Technology

Lightning P.R. Editor (Dragon) (Beta Auth) Design Name: ZWWest

File Edit Select View Configure Placement Routing

Routing Strategy

Use	Operation	Text	Item	Layers	Settings	Target
1	<input checked="" type="checkbox"/> Fan-out - Outwards		Components IC1001...	By Layer Name: WSP...	Effort: 10, Via: L...	No Targets
2	<input checked="" type="checkbox"/> Fix		Components IC1001...	By Layer Name: WSP...	Effort: 10, Via: L...	No Targets
3	<input checked="" type="checkbox"/> Autoroute		Diff Pairs All Diff Pairs	By Layer Name: WSP...	Passes: 10, Effort...	No Targets
4	<input checked="" type="checkbox"/> Fix		Diff Pairs All Diff Pairs	By Layer Name: WSP...	No Settings rece...	No Targets
5	<input checked="" type="checkbox"/> Autoroute		Netz: All Nets	By Layer Name: WSP...	Passes: 10, Effort...	No Targets
6	<input checked="" type="checkbox"/> Refine Routing		Netz: All Nets	By Layer Name: WSP...	Passes: 10, Effort...	No Targets
7	<input checked="" type="checkbox"/> Unfix		Components IC1000, IC1001...	By Layer Name: WSP...	Effort: 10, Via: L...	No Targets

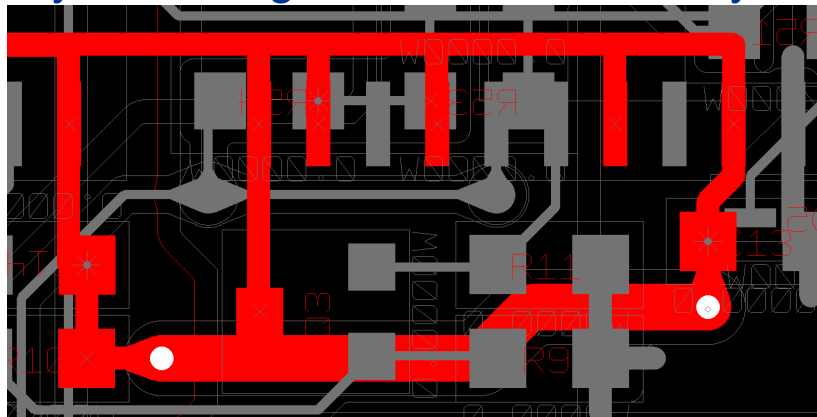
Unleash the Power of the Dragon

**ZUKEN**

# How is the Autorouting process different from Manual Routing?



- Routing your design using the Dragon Routing Platform is different from routing manually
- Manual routing allows flexibility with design settings
- For Example:
  - You can route manually changing track widths to fit through gaps
  - Design rules may be ignored when routing manually
  - The Autorouter can only use the optimal or necked width
  - The Autorouter can only ever work to the given design rules
  - You will need to change these rules in order to improve completion in the cases where you have ignored these manually



# How do you Approach a Complex Routing Task?



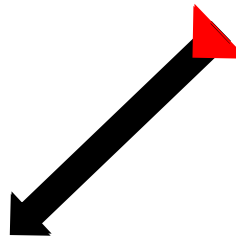
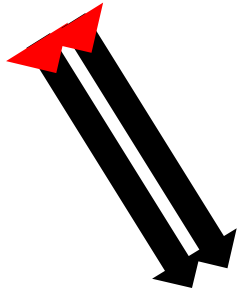
- How do you approach a complex routing task?
- You
  - Establish key facts about design
    - Layers, number of nets, High speed requirements, Diff Pairs...
  - Break problem down into a series of smaller tasks in priority order
  - Identify any routing blockers and resolve these
    - Conflicting/unachievable constraints
    - Placement/Design rule problems
  - Start the routing process
  - Iterative improvement to optimise/finalise routing
- What kind of automation is required to optimise this process?

# Enter the Dragon



## Dragon™

AutoRouting Platform



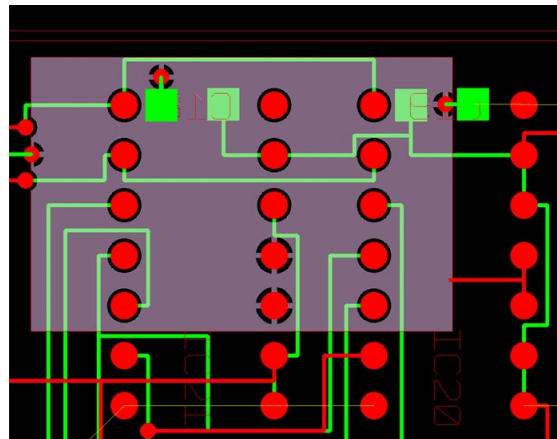
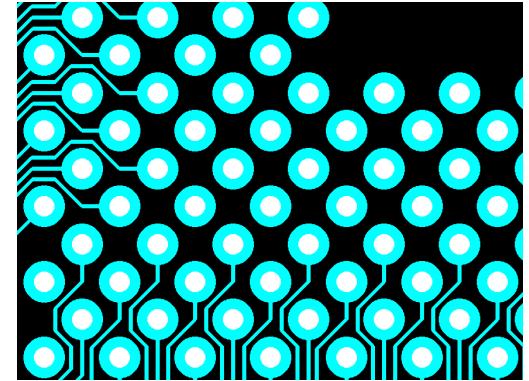
The screenshot displays several windows from the Dragon AutoRouting software. The 'Routing Consultant' window is the primary focus, showing a list of items with severity levels (Design, Info, High) and a detailed 'Item Explanation' for a routing issue. The explanation includes metrics like 'Grid loss percentage = 79.70', 'Natural Grid = 0.2030', and 'Effective Grid = 1.0000'. It also provides a text-based analysis of the routing problem. Below the explanation, there are progress bars for 'Overall Progress' and 'Current Task', both showing 100% completion. At the bottom of the window, there are buttons for 'Report...', 'Opt...', 'Ret...', and 'Opt...', with the 'Ret...' and 'Opt...' buttons circled in red.

The screenshot shows the 'Routing Strategy' window, which contains a table with columns for 'Jsel', 'Operation', 'Text', 'Items', 'Layers', 'Settings', and 'Target'. The table lists two operations: 'Fan-out - Outwards' and 'Fix'. Below the table, a PCB layout is visible, showing a complex network of multicolored traces (yellow, green, blue, purple) connecting various components on a board. The layout is overlaid on a grid of yellow circles representing vias or pads.

**Strategy and Routing Targets** are two key concepts introduced by Dragon. All or part of a strategy can be run. If targets are set for a strategy step automatic updates to router settings can be made during repeat of a step in order to meet a target. Strategies can also be saved/reloaded, allowing repeatability and reuse across designs.

# Overview of New Dragon Modules – Prodigy

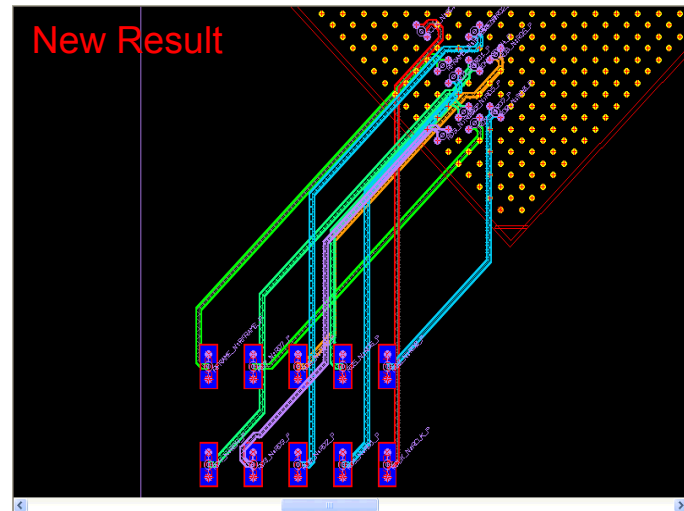
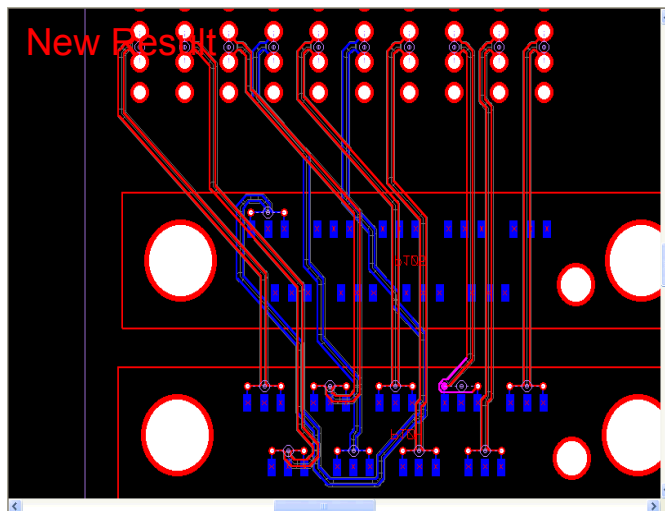
- Prodigy - New tuned, native 45-degree Autorouter
  - Optimised for high performance in high density areas
  - Optimised for achieving shortest total net length and via counts
  - Supports the same functionality as the existing Autorouter
- More exit directions for pads
  - NE,SE,SW,NW added allowing greater flexibility for routing
  - Any – allowing any angle from a pad. E.g Round pads
- Autorouting to positive copper
  - Will make use of auto-repour functionality in existing router to repour areas of affected copper



# Overview of New Dragon Modules – Paragon



- Paragon - Integrated, innovative Differential Pair routing
  - 45-degree differential pair autorouting based on recent advances in network theory
- Functionality
  - Does not remove any fixed pre-routed sections of Differential Pair
  - Improved completion
    - 45-degree routing of Differential Pairs
    - Enhanced rip up and re-try (can allow multiple passes)
  - Minimises skew and uncoupled length by concurrently considering multiple 'gather point' locations



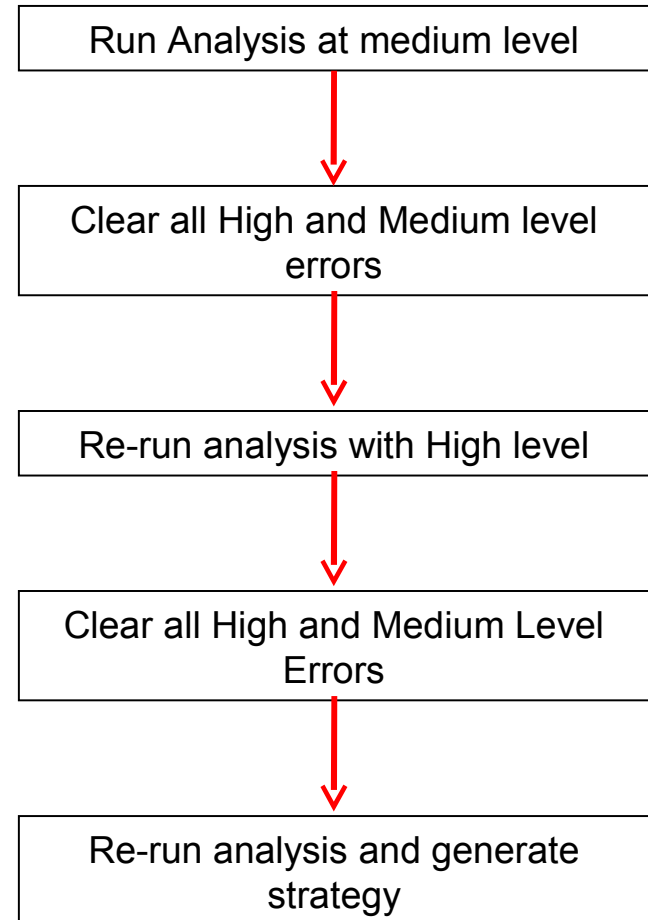
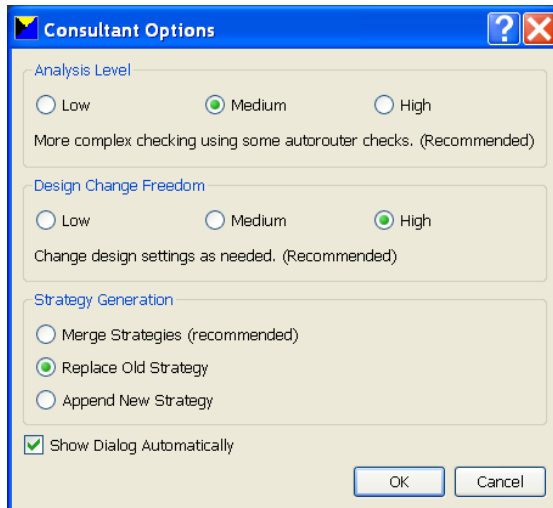
# How Do I Use Dragon?



- A suggested work flow for using Dragon
  - Run Routing Consultant on your design
  - Fix High and Medium level errors and re-run analysis
  - Strategy Generation
  - Refinement of strategy
  - Running the routing strategy
  - Review and iterative refinement of strategy and routing results
- Following slides give some more detail and examples

# Running the Routing Consultant

- Run the Routing Consultant on your design before routing
- Routing Consultant will
  - Identify any potential routing blockers
  - Generate a first level strategy from which to base the routing of your design



# Running the Routing Consultant



- Reasons for running the medium level checks first
  - The higher the level of checks the longer the run time
  - This will identify the first level or errors that should be cleared
  - High level checks will take longer if there are errors in the design that the medium level checks have already identified
- What type of errors should I clear?
  - You should resolve all High and Medium level errors
  - High level errors can result in 'Hard Fails' during the run of the Autorouter

Pass	Att'd	Routed	Hard Fails	Fails	Errors	Vias	Length	Time
1	161	53	11		96	97	3169.2264	00:00:32

Pass number: 1

Save As... Print... ? Interrupt

# How do I investigate Consultant Errors?



## Example - Potential Track to Item error

- Click on the hyperlink for the first pin in the report
- Try to manually route out of this pin with 'errors allowed' turned off and finish at a point away from the pin

If track is routed from these pins, the track will be in error against other items.

Component	Pins
<a href="#">C2</a>	1
<a href="#">C8</a>	1
<a href="#">C9</a>	2
<a href="#">C10</a>	1
<a href="#">C11</a>	1
<a href="#">C12</a>	1
<a href="#">C13</a>	1
<a href="#">C14</a>	1
<a href="#">C15</a>	1
<a href="#">C16</a>	1
<a href="#">C17</a>	1
<a href="#">C18</a>	1
<a href="#">C19</a>	1
<a href="#">C20</a>	1
<a href="#">C21</a>	1
<a href="#">C22</a>	1
<a href="#">C23</a>	1
<a href="#">C24</a>	1
<a href="#">C25</a>	1
<a href="#">C27</a>	1

Buttons: Save As..., Print..., Close

Routing Setup

General | High Speed | Pusher | Trunking | Composition | Fan

Options

- Errors Allowed
- Allow Pin Swaps
- On-line DRC

Passes: 10

Effort: 10

Angle: 45

Activ-45

- Enable Activ-45

Tidy Rectangle Size: 0.000

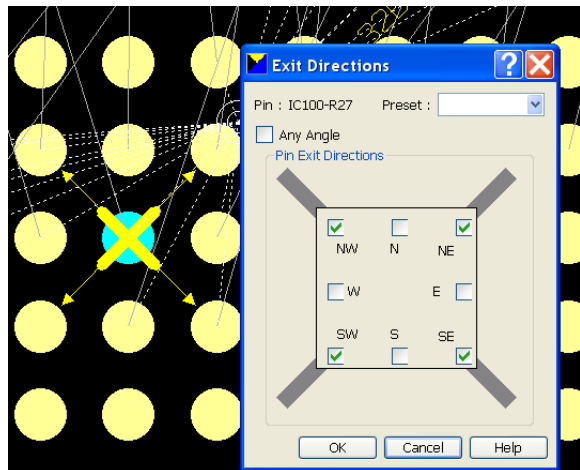


General Tab of Routing Setup

# How do I investigate Consultant Errors?

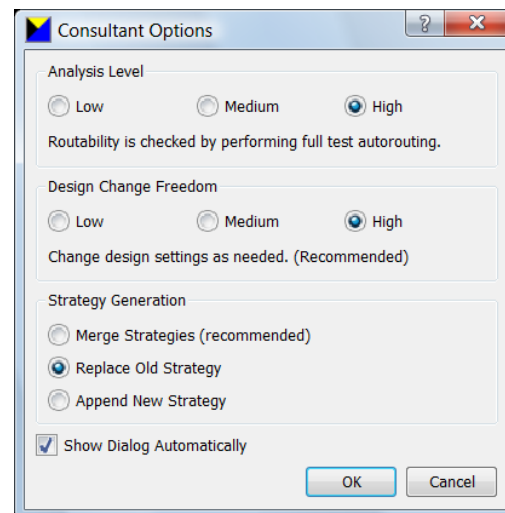
## Example - Potential Track to Item error (contd)

- Run a batch check in the area around the route
- You may find that you have track to pin errors
  - Could be due to track width being too large
  - Could be a spacing problem
  - Could be an exit direction problem
- You could resolve this by modifying any of the above
  - The exit direction dialog now shows graphically on the canvas what the exit directions are



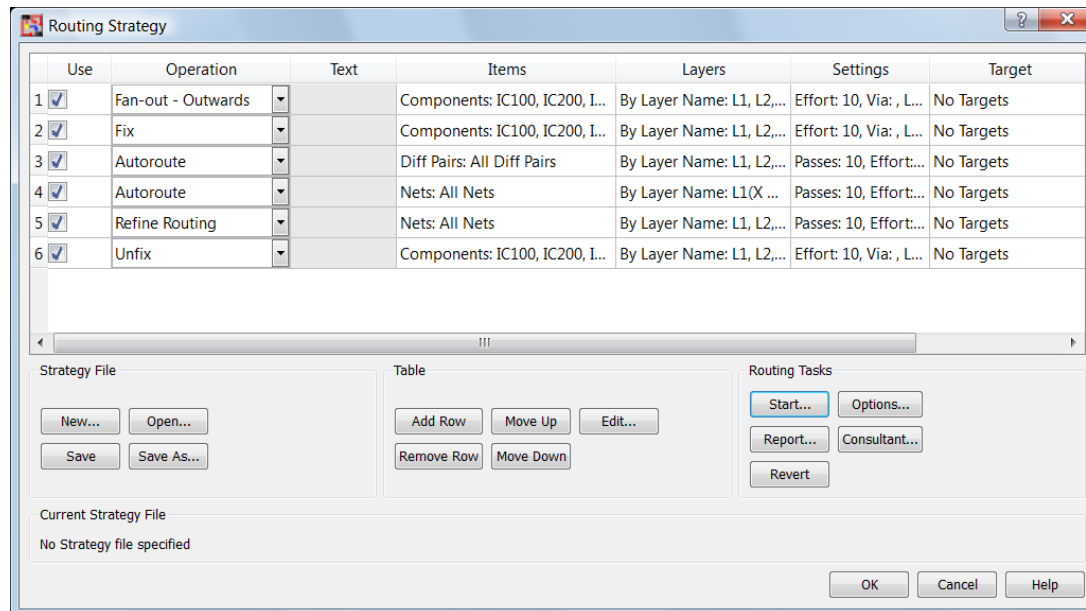
# Strategy Generation

- After clearing the High and Medium level severity items press 'Continue' to generate a strategy
  - It is recommended that this is done with 'Design Change Freedom' set to high
    - Allows the consultant to modify design settings as required
    - This will generate a strategy without targets as the router will be able to modify settings as required to optimise routing results



# Strategy Generation

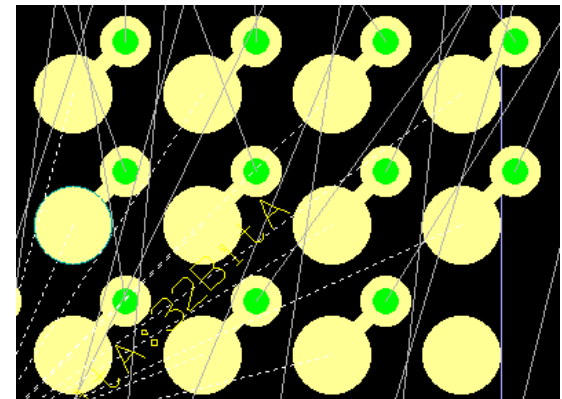
- The strategy generated will be a good basis from which to start routing your design
- Strategy generation will be updated in future releases as a result of user feedback
  - Will minimise the user interaction required with the strategy



# Strategy Generation – Fan-out tips



- The strategy generated will run a Fan-out in the outwards direction
  - This will generate an outwards pattern using a single via at the minimum Via to pin spacing for the design.
  - If there is a through hole via definition, then this is the one that will be used
- The fan-out generation can be altered to improve routing completion
  - Generate fan-out vias over the pads
  - Use Spiral vias
  - Limit the layer range of the fan-out
  - Use a different Via



Default outwards pattern

# Autoroute



- High Speed designs will have two autorouting steps generated
  - One for the differential pairs
  - One for the single traces
- You may wish to add an extra step to the strategy in-between these to fix the diff pairs
  - This will stop the single trace routing modifying the Differential Pairs

Use	Operation	Text	Items	Layers	Settings	Target
<input checked="" type="checkbox"/>	Fan-out - Outwards		Components: IC100, IC200, I...	By Layer Name: L1, L2,...	Passes: 1, Effort: ...	No Targets
<input type="checkbox"/>	Fix		Components: IC100, IC200, I...	By Layer Name: L1, L2,...	Effort: 10, Via: , L...	No Targets
<input type="checkbox"/>	Autoroute		Diff Pairs: All Diff Pairs	By Layer Name: L1, L2,...	Passes: 10, Effort:...	No Targets
<input checked="" type="checkbox"/>	Fix		Diff Pairs: All Diff Pairs	By Layer Name: L1, L2,...	No Settings nece...	No Targets
<input type="checkbox"/>	Autoroute		Nets: All Nets	By Layer Name: L1(X ...	Passes: 10, Effort:...	No Targets
<input type="checkbox"/>	Refine Routing		Nets: All Nets	By Layer Name: L1, L2,...	Passes: 10, Effort:...	No Targets
<input type="checkbox"/>	Unfix		Components: IC100, IC200, I...	By Layer Name: L1, L2,...	Effort: 10, Via: , L...	No Targets

Extend

Pins To Fan-Outs       Items in Areas       Templates To Copper

Pins To Nets       Nets to Trunking

# Autoroute



- You can add a step to route the power nets first
  - This could be before the routing of differential pairs
  - Your strategy may look as below

Use	Operation	Text	Items	Layers	Settings	Target	
1	<input checked="" type="checkbox"/>	Fan-out - Outwards		Components: IC100, IC200, I...	By Layer Name: L1, L2,...	Effort: 10, Via: , L...	No Targets
2	<input checked="" type="checkbox"/>	Fix		Components: IC100, IC200, I...	By Layer Name: L1, L2,...	Effort: 10, Via: , L...	No Targets
3	<input checked="" type="checkbox"/>	Autoroute		Nets: All Power Nets	By Layer Name: L1, L2,...	Passes: 10, Effort:...	No Targets
4	<input checked="" type="checkbox"/>	Autoroute		Diff Pairs: All Diff Pairs	By Layer Name: L1, L2,...	Passes: 10, Effort:...	No Targets
5	<input checked="" type="checkbox"/>	Fix		Diff Pairs: All Diff Pairs	By Layer Name: L1, L2,...	No Settings nece...	No Targets
6	<input checked="" type="checkbox"/>	Autoroute		Nets: All Nets	By Layer Name: L1(X ...	Passes: 10, Effort:...	No Targets
7	<input checked="" type="checkbox"/>	Refine Routing		Nets: All Nets	By Layer Name: L1, L2,...	Passes: 10, Effort:...	No Targets
8	<input checked="" type="checkbox"/>	Unfix		Components: IC100, IC200, I...	By Layer Name: L1, L2,...	Effort: 10, Via: , L...	No Targets

Strategy File: New..., Open..., Save, Save As...

Table: Add Row, Move Up, Edit..., Remove Row, Move Down

Routing Tasks: Start..., Options..., Report..., Consultant..., Revert

Current Strategy File: No Strategy file specified

OK Cancel Help

High Speed Nets  Components with Pin Count at least: 0

Items

- Electrical Nets
- Busses
- Differential Pairs
- Power Nets**
- Components
- Routing Areas
- Attributes

Items in this Design

- Power Nets

Clear  Hide Net Items Shown as Busses or Diff Pairs Remove

Extend

Pins To Fan-Outs  Items in Areas  Templates To Copper  Filter Net Items

Pins To Nets  Nets to Trunking  Pins  Connections

Tracks and Vias:  Fixed  Semi-Fixed  Unfixed

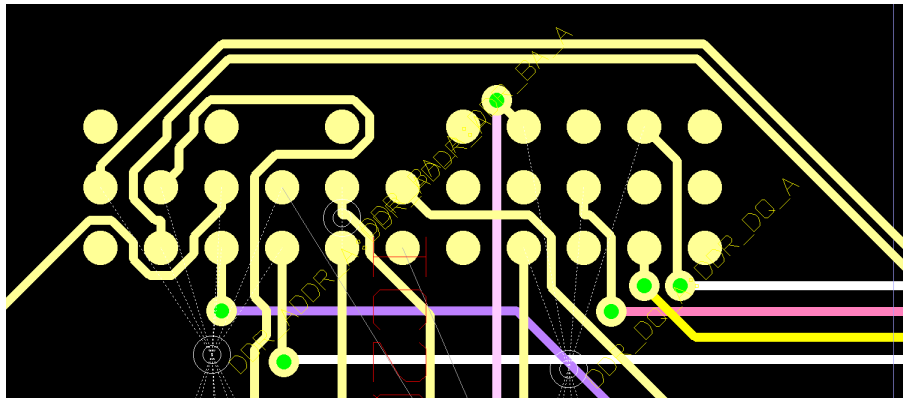
Description: Nets: All Power Nets  Always Generate Auto

Open... Save As...  Frame Selection OK Apply Cancel Help

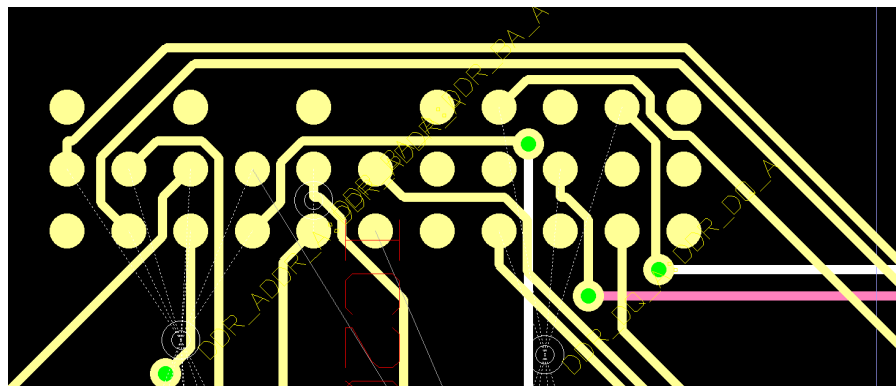
# Refine routing



- It is recommended that you run the Refine Routing tool after completion of the autorouting steps
  - Will optimise net lengths
  - Will tidy up the routing pattern in some areas



Before



After