Detailed Routing Methods

Detailed routing has generally evolved out of four basic approaches: maze routing, line probe routing, left-edge routing, and greedy channel scanning. The problem is formulated as a routing area containing connection points or *pins* on a rectilinear (usually rectangular) region or *channel*. Pins can be located on any of the four sides of the region or within the region. The connection points are generally constrained to reside in certain layers to make them easier to connect to.

Even single-layer routing problems are NP-complete, which means that an optimal solution cannot be achieved in a reasonable time. For this reason, detailed routing solutions are heuristic in nature. The factors in determining a solution's usability are the number of terminals, net width, via restrictions, boundary shape, number of layers, and net types such as power, ground, and clock wires.

Maze routers abstract the channel routing problem with a grid-based model. Wires are restricted to follow paths along the grid lines. Routing is accomplished by laying down wires on the grid one at a time. Obstacles are modeled as disallowed portions of the grid. Therefore, maze routing can handle arbitrary obstacles.

Line probe routers scan in the x and y directions searching for line segments from either the source or the destination. Scan lines do not project beyond obstacles, so obstacles are avoided by a subsequent probe of the line segments orthogonal to the ones from the previous pass.

Left-edge routers sort wires by the boundary formed by the leftmost and rightmost pins. It orders wires one at a time using a greedy method that places segments into tracks. It fills tracks one at a time, packing segments to minimize unused space in a track. The route is complete when all wires have been assigned to a track.

Greedy channel routers divide the channel into horizontal tracks and vertical columns. This approach works on one vertical column at a time, scanning from left to right. The approach is termed "greedy" because each column is optimized individually, although the entire channel is not guaranteed to be optimal. The greedy router sweeps from column to column, trying to join segments of nets assigned to multiple tracks. The greedy channel scan is capable of providing fast solutions but cannot be easily extended to handle arbitrary obstacles.

The over-the-block detailed router used in PA_Route uses a completely different approach based on a graph. The graph represents horizontal and vertical constraints of the wires.

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