Channel Router Limitations

Doglegs only allowed at terminal positions (1)
Cannot route some channels (2 & 3)
Won't consider multiple trunks for a signal (4)
Greedy Channel Router

Complex "greedy" router that produces excellent results:
Foreach column
1. Bring in top and bottom connections in a minimal manner
2. Free tracks by collapsing split nets
3. Add jogs to bring split nets closer together
4. Add jogs to bring nets closer to top/bottom edge (based on next terminal)
5. Widen channel if needed for top and bottom connections
6. Extend to next column
Step 1, Greedy Channel Router

1. Bring in top and bottom connections in a minimal manner
   1a.) Go to empty track or track already carrying that signal, whichever closer
   1b.) If top & bottom conflict, pick shortest
   1c.) If top and bottom are same, use straight connection if no other option
   1d.) If no options, wait until step 5 to add tracks
Step 2, Greedy Channel Router

2. Free tracks by collapsing split nets, using the following tie-breakers:
   2a.) Free the most tracks (merging a non-continuing net frees 2, others 1)
   2b.) Keep uncollapsed nets as far from the edges as possible
   2c.) Maximize the vertical wire (get as much work done as possible)
Steps 3 & 4, Greedy Channel Router

3. Add jogs to bring split nets closer together
4. Add jogs to bring nets closer to top/bottom edge (based on next terminal)

In both cases, maximize vertical wire (get as much work done as possible)
Steps 5 & 6, Greedy Channel Router

5. Widen channel if needed for top and bottom connections
   Add new track as close to the middle as possible
6. Extend to next column
Greedy Channel Router Example

1. Bring in top and bottom connections in a minimal manner
2. Free tracks by collapsing split nets
3. Add jogs to bring split nets closer together
4. Add jogs to bring nets closer to top/bottom edge (based on next terminal)
5. Widen channel if needed for top and bottom connections
6. Extend to next column

```
   1  2  3  4  5  6  7  8  9  10  11  12
   0  1↑ 2↑ 5↓ 7↓ 1↓ 6↓ 0  2× 9↓ 0  0
```

```
A
B
C
D
E
F
```

```
4↓ 3↓ 5↑ 3↓ 5× 4× 7× 1↓ 3× 1× 6× 9×
```

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Switchbox Description

Describe channel as list of nets connected to terminals on top and bottom
(0 = no terminal)

Goal: route without adding rows/columns (or by adding minimum)
Prioritize nets (fanout, criticality)
Give control of track/column position to nearest terminal on that track/column
Delay layer assignment as long as possible
If later router makes earlier router work,
  return to that router

Foreach net
  Route with corners
Foreach unrouted net
  Use patterns
If unrouted net
  relax ownership & use patterns
Foreach unrouted net
  Use maze router
Assign layers
Beaver Corner Router

If two terminals are on adjacent sides, and no intervening terminals of same net
  Route with right angle connection
If 4 terminals, one on each side
  Resolve cycle by avoiding blocking other routes
Beaver Control

Control of a portion of a track/column is given to the closest unrouted terminal in that track/column.

Relinquish control to other terminal, or uncontrolled, once routed.

Except for doglegs, no-one can route through a region they don't control.

Relax control after 1st pass of pattern router:

Terminals only control to their nearest escape point.

Note: unit-length dogleg crosspiece allowed to violate control.
Beaver Pattern Router

Try to connect terminals (or disconnected nets) with one of these patterns

1. Straight line
2. Dogleg with unit-length crosspiece
   (Note: crosspiece allowed to violate control, since probably in same level)
3. Right angle
4. Dogleg with long crosspiece
5. Horseshoe
Beaver Pattern Router Example

Pattern
- Straight
- Unit dogleg
- Right angle w/via
- Dogleg w/two vias
- Horseshoe w/two vias

1. Straight in no-ownership region
2. Unit length dogleg
3. Straight
4. Dogleg
5. Horseshoe
Beaver Layer Assignment

Delay assignment as long as possible
  Assign when wires cross
  Assign remaining at end

Assignment rules (in order):
1.) Minimize vias
2.) Use “typical” layer for that direction
Beaver Example

Corner

Pattern
  Straight
  Unit dogleg
  Right angle w/via
  Dogleg w/two vias
  Horseshoe w/two vias
  Pattern w/relaxed ownership

Maze

Assign layers

1. Corner - release control
2. Unit dogleg - release control
3. Straight - release
4. Unit dogleg - release control

5. Corner, 4 conflicts on other corner
6. Corner routes, release control