ECE 671 – Lecture 10

Routers

Data plane and control plane

Routers

input ports   switch fabric   output ports

network interface — IP forwarding — switch interface

switch interface — scheduling — network interface

layers 1 & 2   layer 3   local interconnect   layer 3   layers 1 & 2
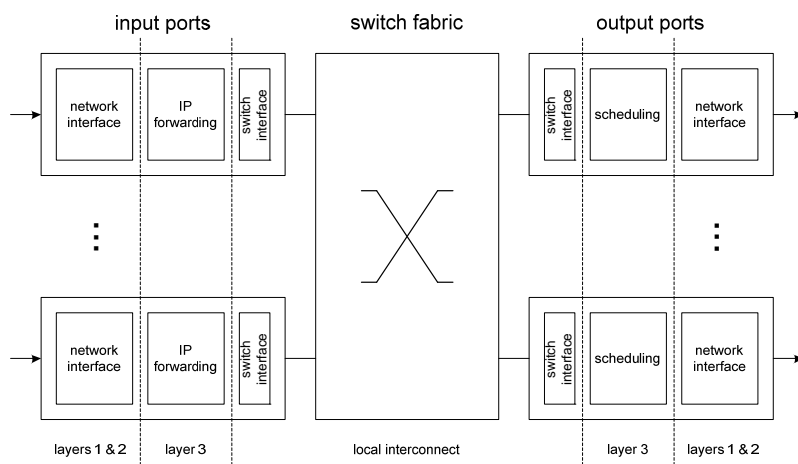
Physical view

- Input and output "folded" onto same line card
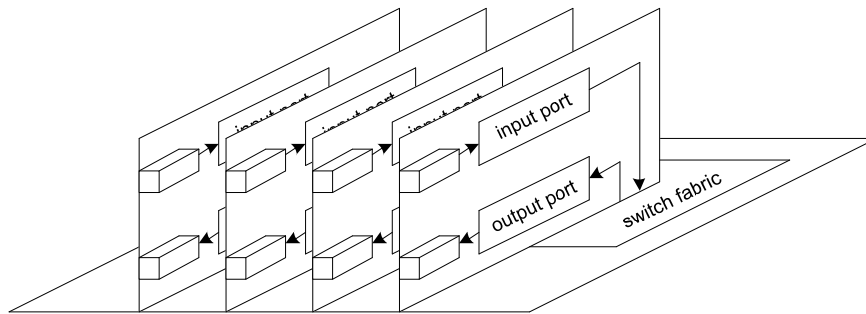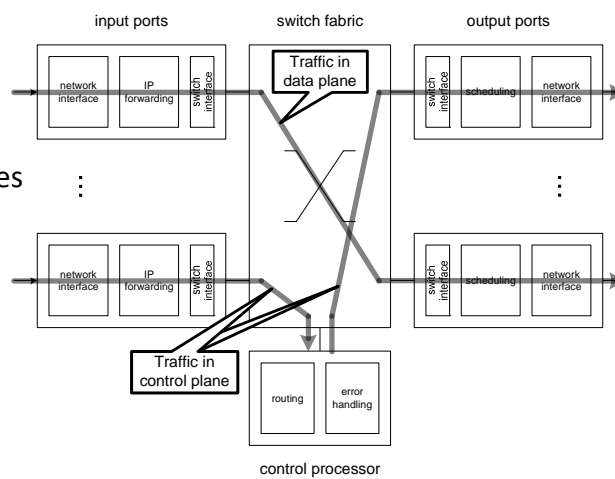
Data plane vs. control plane

- Data plane:
  - Regular traffic
- Control plane:
  - Routing updates
  - Error handling
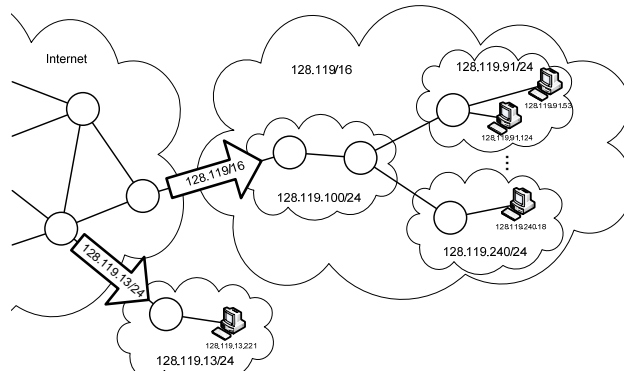 - Etc.

Prefix matching

- Data plane needs to perform prefix matches
  - Determine longest matching prefix for destination address
- Prefixes stored in forwarding information base (FIB)
- Where do FIB entries come from?

Routing

- Shortest path routing
- Centralized approach
  - Each node has full "view" of network
  - Each node calculates shortest path using routing algorithm
  - "Link state algorithm"
  - (Exchange of link information always decentralized)
- Distributed approach
  - Each node computes best path without full view
  - Shortest path computed as link information is exchanged
  - "Distance vector algorithm"
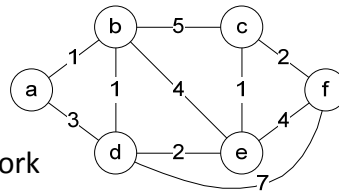
Link state algorithm

- Link cost of all links is broadcast to all nodes
- Dijkstra's algorithm to find shortest path to all nodes
  - Each node calculates its own tree
- Notation:
  - $D(v)$ is least cost to v in current iteration
  - $p(v)$ is previous node along least cost path
  - N' is subset of nodes with guaranteed least cost paths
- Algorithm
  - Initialization:
    - N'={u}
    - For all nodes v: if neighbor of u then $D(v)=c(u,v)$, else $D(v)=\infty$
  - Loop until N'=N:
    - Find $w \notin N'$ with minimum $D(w)$ and add w to N'
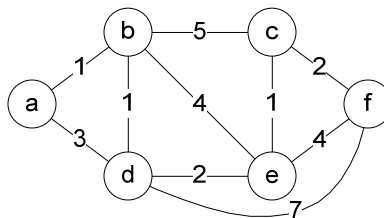   - For each neighbor v of w ($v \notin N'$): $D(v)=\min(D(v),D(w)+c(w,v))$

Link state algorithm

- Example

- Iterations

step	N'	D(b),p(b)	D(c),p(c)	D(d),p(d)	D(e),p(e)	D(f),p(f)
0						
1						
2						
3						
4						
5						

Link state algorithm

- Example

- Iterations

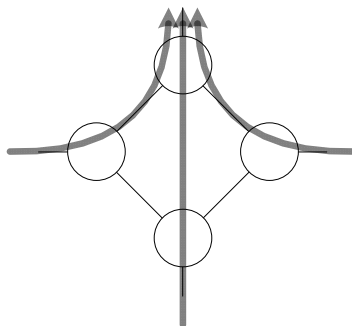| step	N'	D(b),p(b)	D(c),p(c)	D(d),p(d)	D(e),p(e)	D(f),p(f)
0	{a}	1,a	∞	3,a	∞	∞
1	{a,b}		6,b	2,b	5,b	∞
2	{a,b,d}		6,b		4,d	9,d
3	{a,b,d,e}		5,e			8,e
4	{a,b,c,d,e}					7,c
5	{a,b,c,d,e,f}					

Link state algorithm

- Can we adjust link weights based on traffic?
  - Could avoid congestion
- What is the problem?

Link state algorithm

- Traffic-based link weights may cause instability:

6