Router Design

Two Key Network-Layer Functions

- *forwarding:* move packets from router's input to appropriate router output
- *routing:* determine route taken by packets from source to dest.
  - routing algorithms

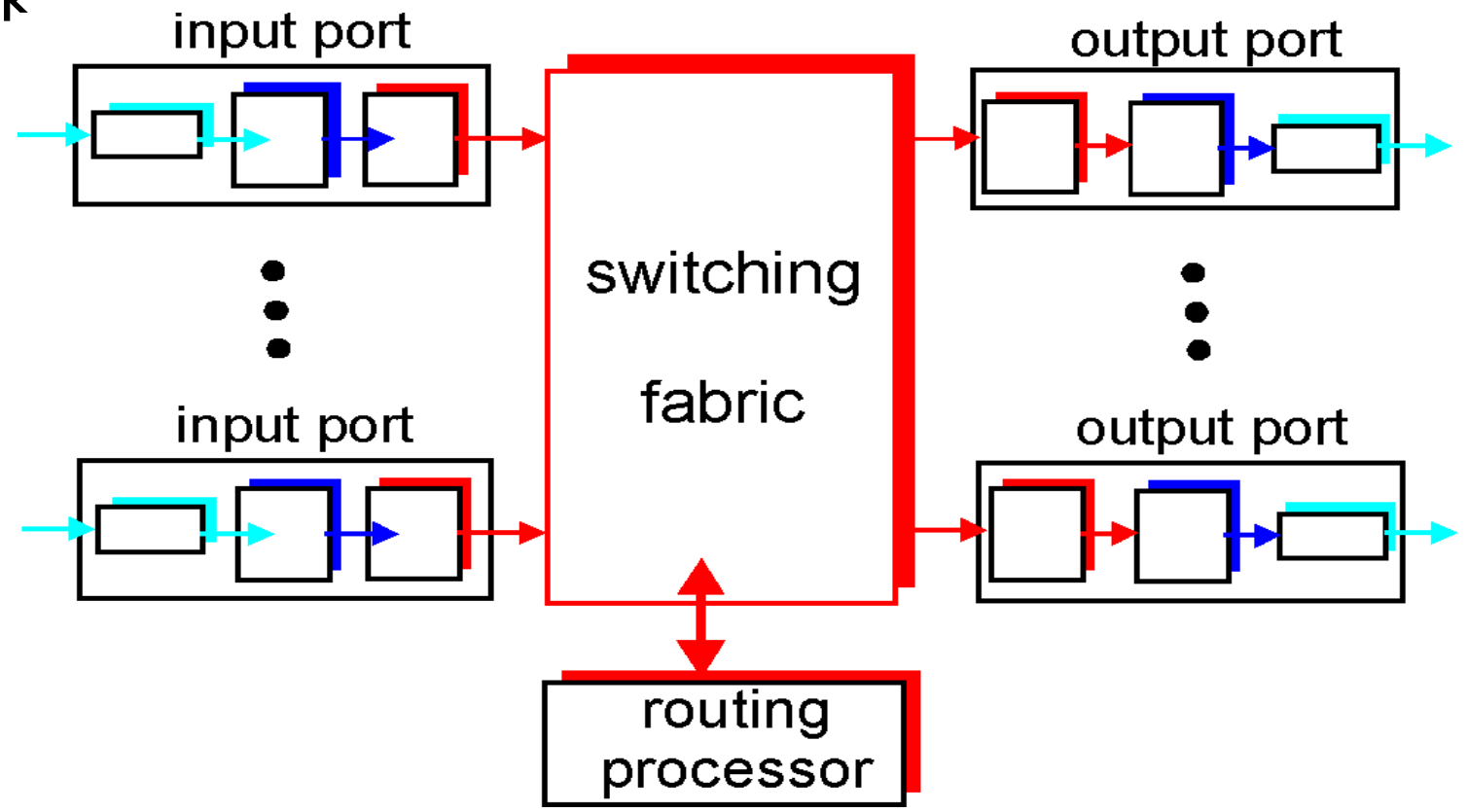
analogy:

- routing: process of planning trip from source to dest
- forwarding: process of getting through single interchange

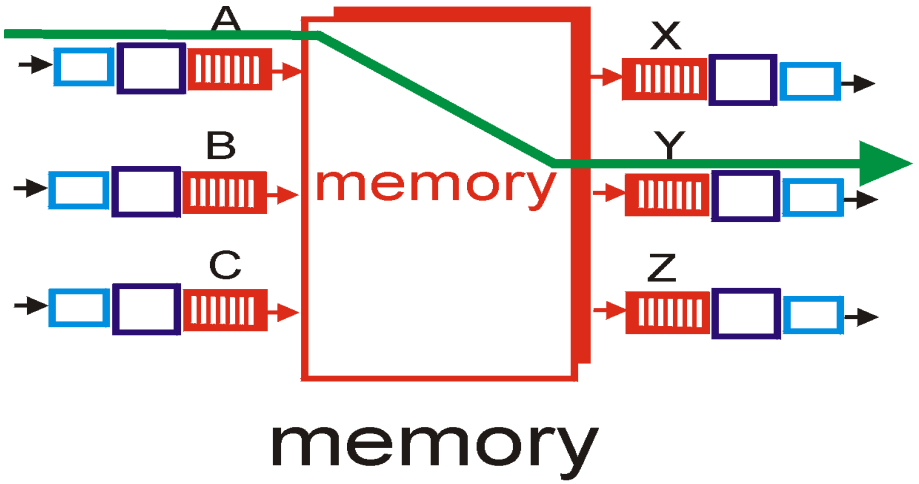
Router Architecture Overview

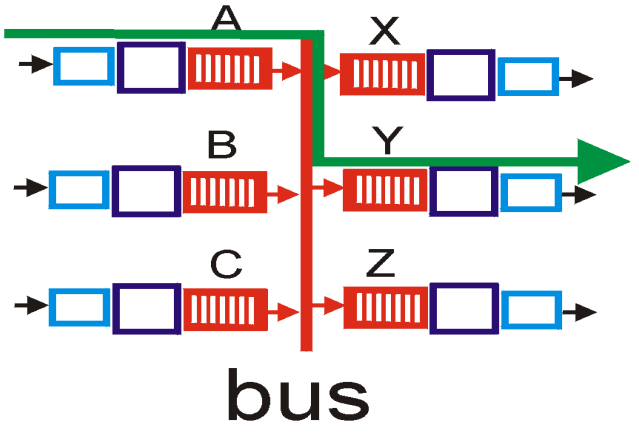
Two key router functions:

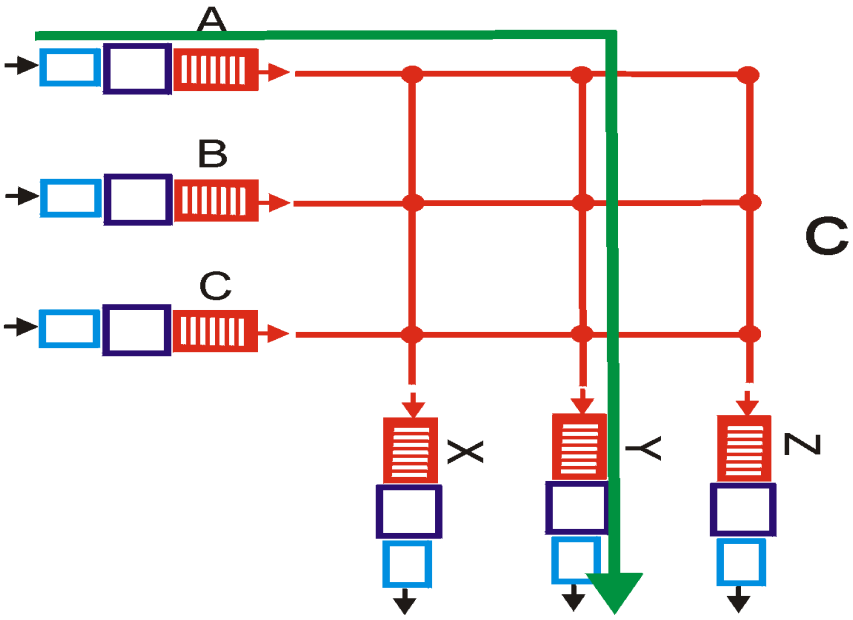
- run routing algorithms/protocol (RIP, OSPF, BGP)
- *forwarding* datagrams from incoming to outgoing link



Three types of switching fabrics



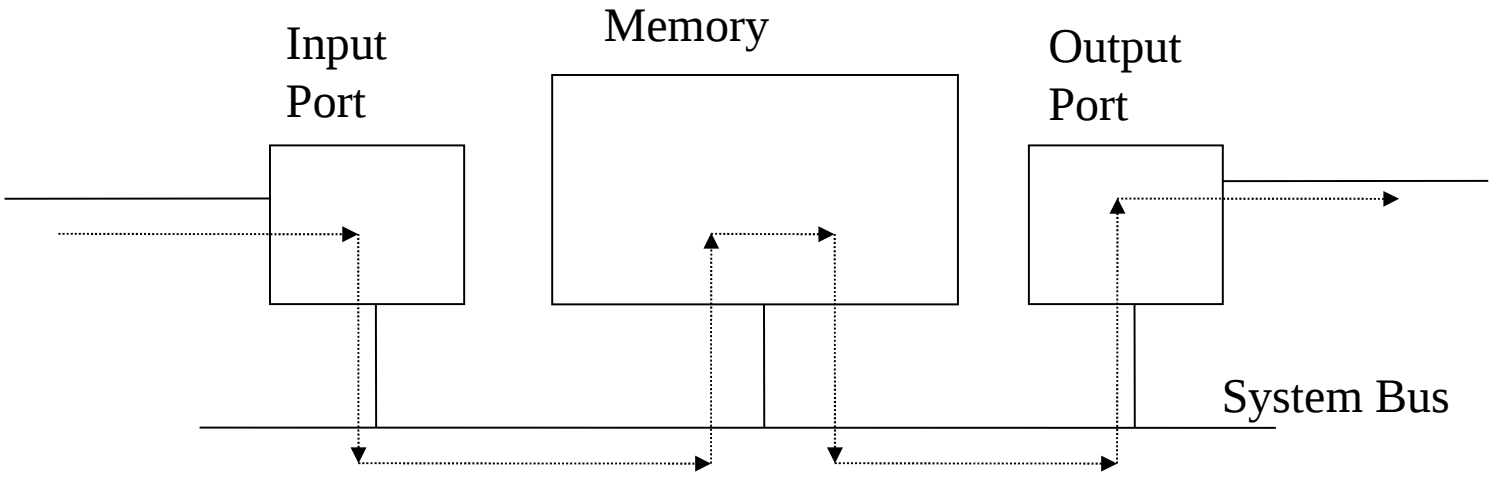




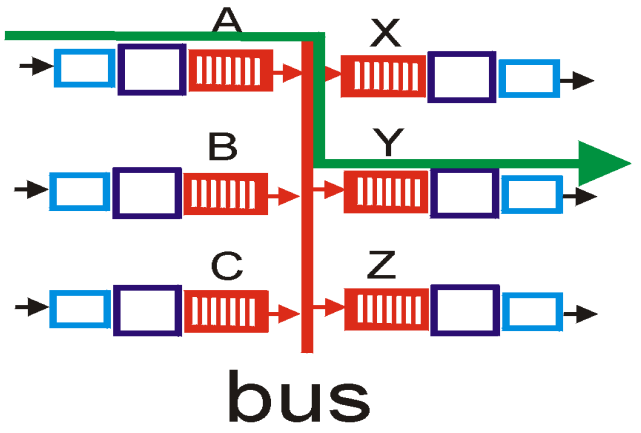
crossbar

Switching Via Memory

- Traditional computers with switching under direct control of CPU
- packet copied to system's memory
- speed limited by memory bandwidth (2 bus crossings per datagram)



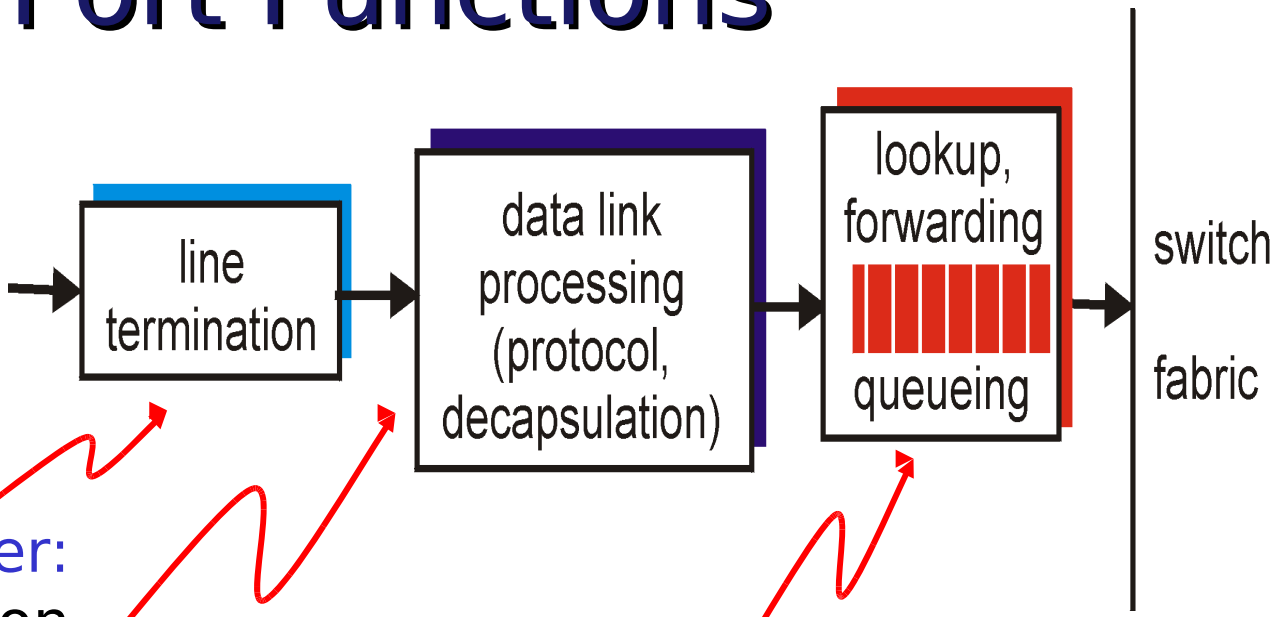
Switching Via a Bus



- datagram from input port memory

  to output port memory via a shared bus
- bus contention: switching speed limited by bus bandwidth
- 1 Gbps bus, Cisco 1900: sufficient speed for access and enterprise routers (not regional or backbone)

Input Port Functions



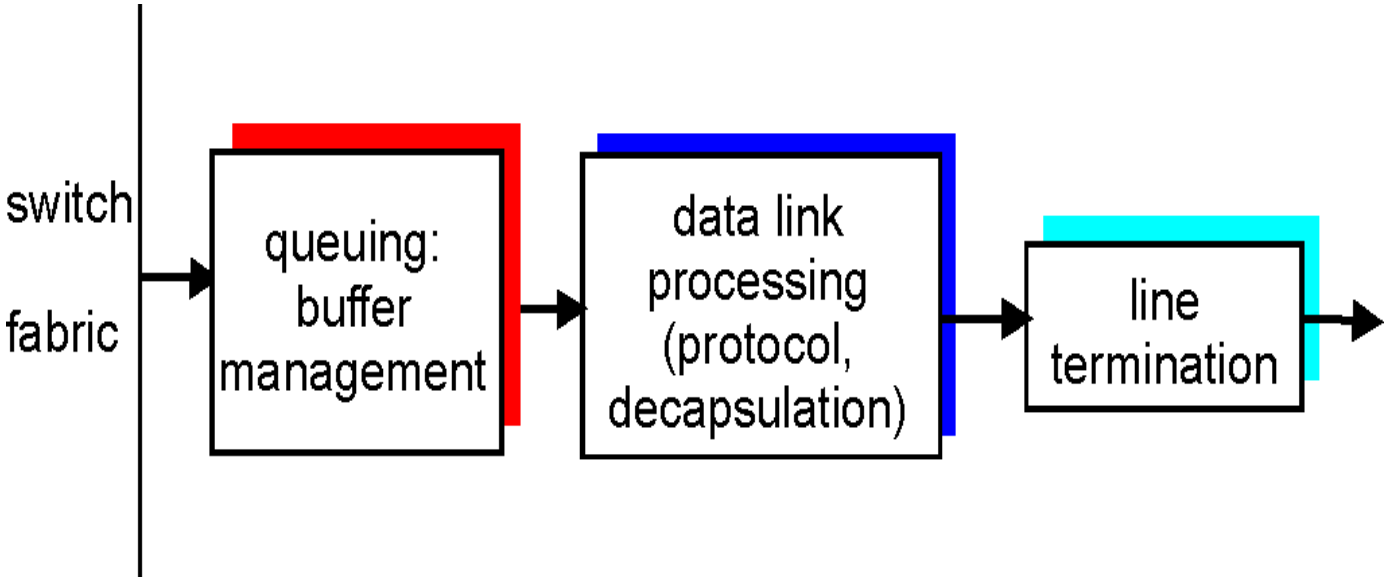
Physical layer:
bit-level reception

Data link layer:
e.g., Ethernet

Decentralized switching:

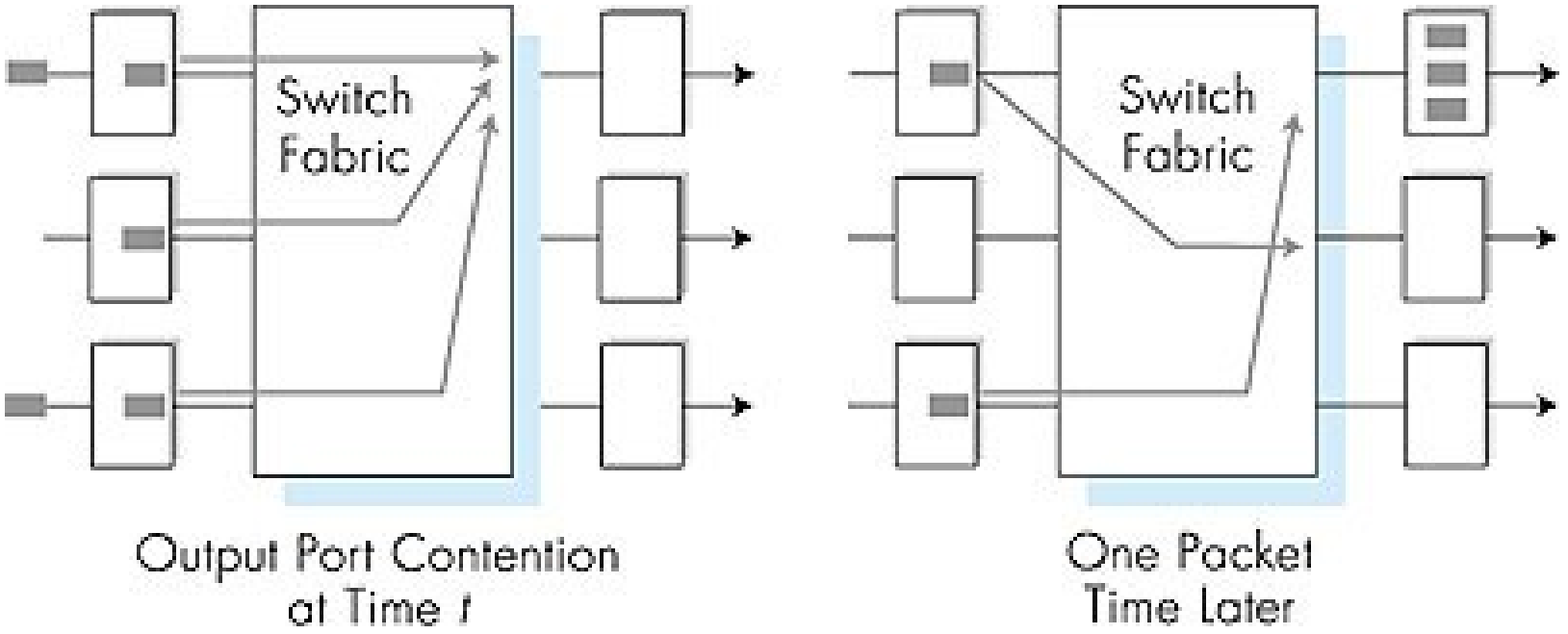
- given datagram dest., lookup output port using forwarding table in input port memory
- goal: complete input port processing at 'line speed'
- queuing: if datagrams arrive faster than forwarding rate into switch fabric

Output Ports



- *Buffering* required when datagrams arrive from fabric faster than the transmission rate
- *Scheduling discipline* chooses among queued datagrams for transmission

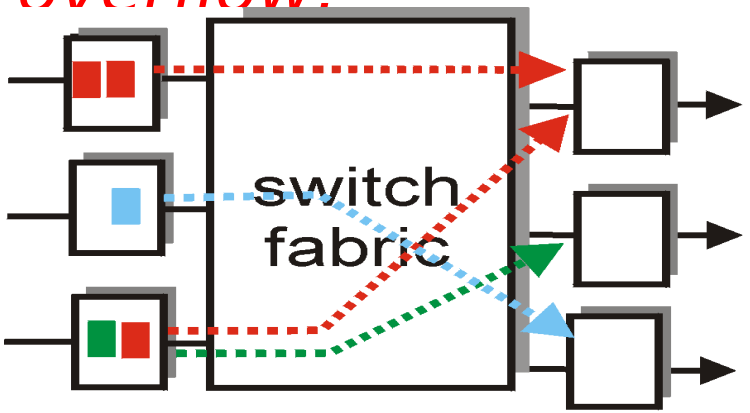
Output port queueing



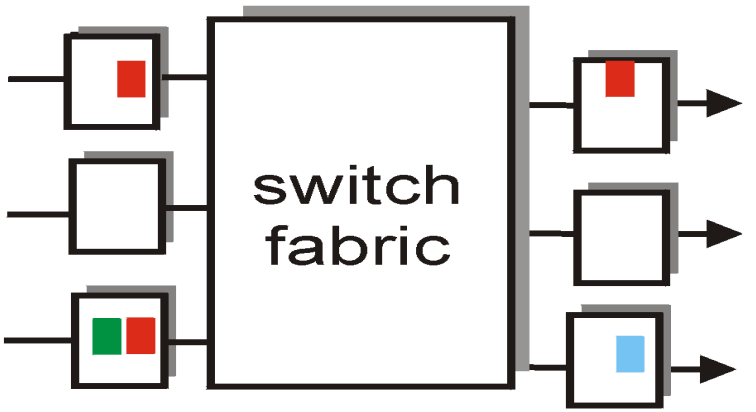
- buffering when arrival rate via switch exceeds output line speed
- queueing (delay) and loss due to output port buffer overflow!

Input Port Queuing

- Fabric slower than input ports combined -> queueing may occur at input queues
- Head-of-the-Line (HOL) blocking: queued datagram at front of queue prevents others in queue from moving forward
- *queueing delay and loss due to input buffer overflow!*



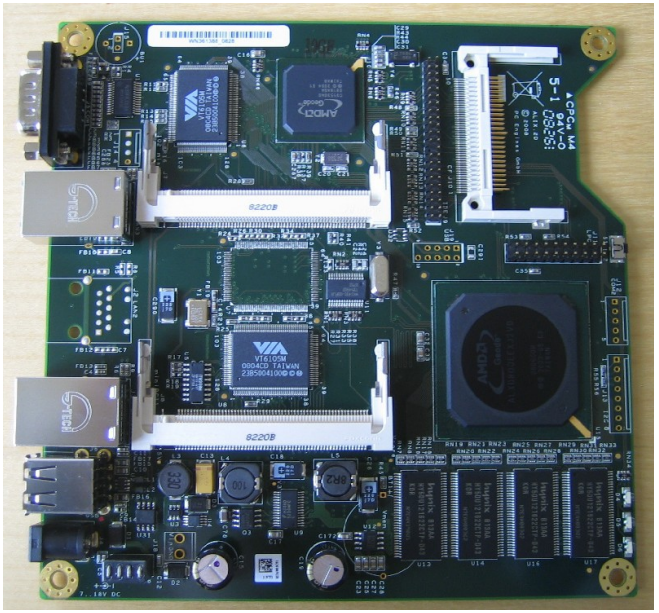
output port contention
at time t - only one red
packet can be transferred



green packet
experiences HOL blocking

Hardware

- ALIX 2C2 embedded system board (500MHz AMD Geode Processor, 2 MiniPCI slots, 2 Ethernet ports, CF slot)
- 8GB Compact Flash Memory
- 2 Atheros chipset-based 802.11 a/b/g MiniPCI Wi-Fi cards
- 4 2 omni-directional pigtail antenna for 2.4 GHz
- 5 Aluminum Enclosure



Software Base

- **Linux Voyage 0.5.2**
- **GCC**
- **MadWiFi driver**
- **TCPDump***
- **MySQL database server***

Ref: http://calnode.calit2.net/