Lab 4
Dynamic Routing

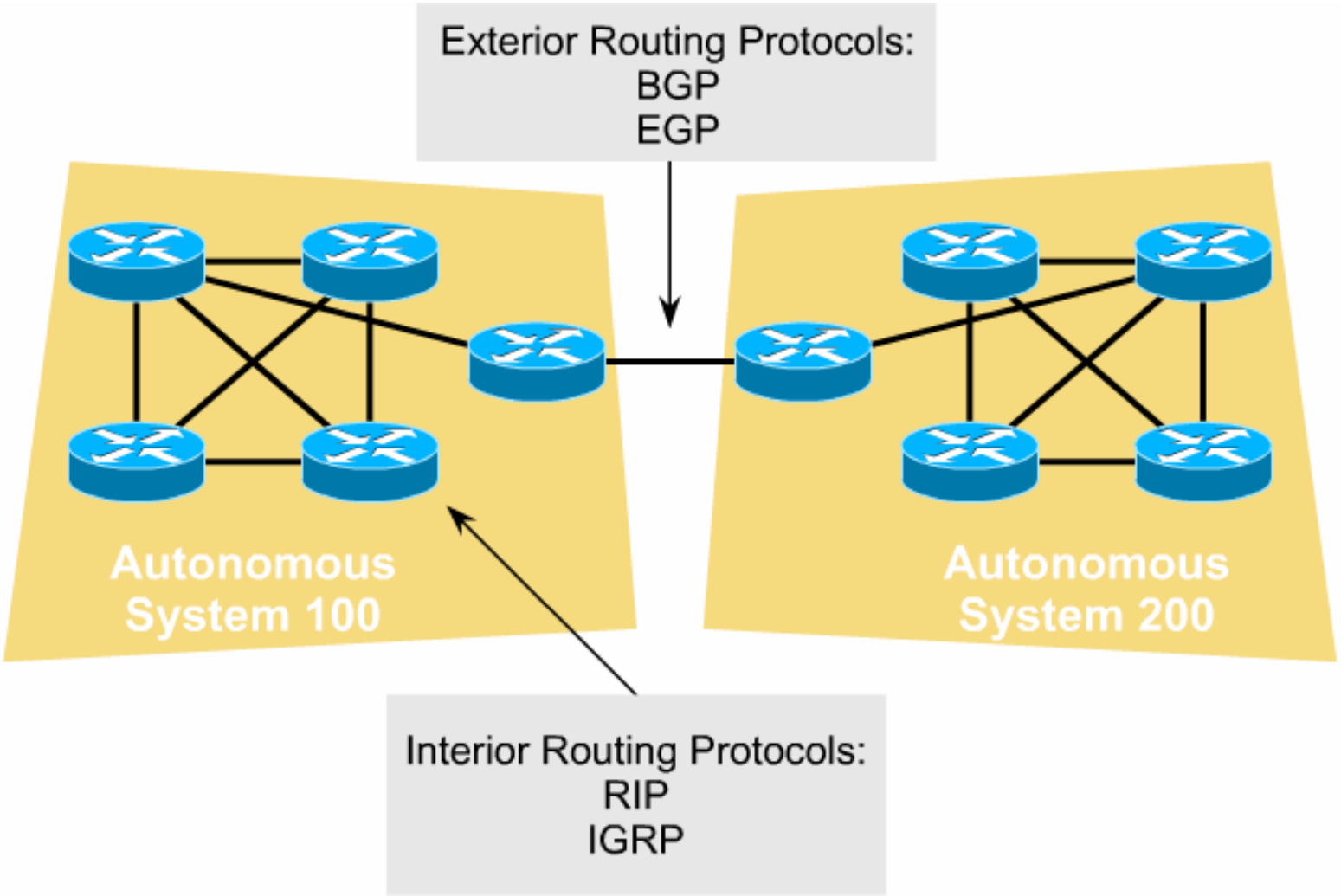
CS144 Review Session

Based on slides by: Samir Selman

Administrivia

- Lab 4 – Due on Nov 11th
- Lab 3 – Due yesterday
- Can take extension upto midnight, Sunday – grade capped at 90%
- Grading - max(Lab3,Lab5)

Routing - Overview



Routing Information Protocol (RIP)

- Routing protocol
  - Based on Bellman-Ford, Distance Vector algorithm
  - Intra-domain protocol or Interior Gateway protocol
  - 'cost' or 'metric' is usually hop count
- Limitations :
  - Limited to networks whose longest path is 15 hops
  - Relies on “counting to infinity” to resolve situations like routing loops
  - Employs fixed metrics to compare alternative routes

Implementation – Lab 4

- Subset of RIP Version 2.
- You will implement the basic RIP procedure, split horizon with poisoned reverse,triggered updates and timer mechanism.
- You will need to focus only on the RIP part of the router; we have supplied you with the 'dr' binary.
- Binary relies on API implemented in a shared library to handle dynamic routing. This library will be implemented by you.
- You will write code in dr_api.h and dr_api.c.

RIP Basic Procedure

- Every router has a forwarding table with an entry for every possible destination network.
- Routing table entry - (destination-address, metric, next-hop, time-stamp)
  - Destination-address : Given by a network address and a network mask (X.X.X.X/Y).
  - Metric : Sum of costs of links traversed to reach destination.
  - Next-hop : Ipv4 address of next router on the path to destination.
  - Time-stamp : Used for route time-outs.

RIP Packet Format

1-octet command field	1-octet version number field	2-octet unused field	2-octet AFI field	2-octet route tag field	4-octet network address field	4-octet subnet mask field	4-octet next hop field	4-octet metric field

- Command field – Indicates whether packet is a 'request' or 'response'
  - Request – Ask a router to sent part of/entire routing table.

    (Do NOT worry about RIP requests in this lab)
  - Response – Can be a periodic routing update or a reply to a request.
- Version – V2 of RIP
- AFI – Address Family Identifier (AF_INET)
- Route tag field – *not used in the lab, replaced by pad*

Packet format contd.

1-octet command field	1-octet version number field	2-octet unused field	2-octet AFI field	2-octet route tag field	4-octet network address field	4-octet subnet mask field	4-octet next hop field	4-octet metric field

- Network address – IP address for the entry
- Subnet mask – mask for the entry
- Next hop – IP address of next hop to which packet is forwarded
- Metric – 'hops' denoting number of routers that have been traversed in the path to destination

  - Maximum 15 hops; 16 - unreachable

Routing Updates

- Send routing updates:
  - At periodic intervals
  - Triggered updates – when a router changes a metric to a route
- Send RIP reply message containing whole routing table to all neighbors every 10s.
- Triggered updates – when an interface goes down, or cost of a local interface changes.

Route timeout

- Dynamic Route :
  - Route learned from a neighboring router.
  - Have a time-stamp (ttl) field associated with every entry.
  - Set time-stamp value to current time when you receive an update.
  - Check periodically for expired entries (current-time – updatetime>20s)
  - Set cost to infinity if entry expires.
- Local Route :
  - Directly-connected networks
  - Next-hop IP = 0
  - Have an invalid TTL = -1

Routing loops

- Split horizon with poisoned reverse:

  - Prevent routing loops involving two nodes

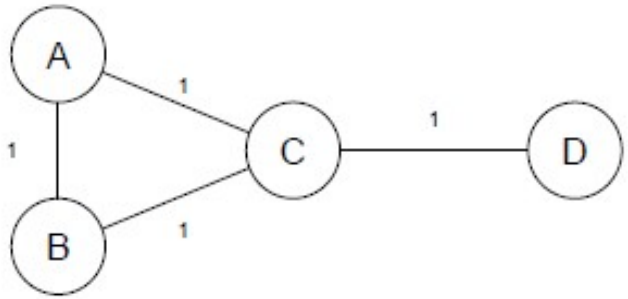
  - advertise information back to source with cost INFINITY.

  - loops with more than 2 nodes? e.g. a->b, b->c, c->a ?

  - Loop will be resolved only when metric reaches infinity and then the network involved is declared unreachable.

  - Speed up convergence using triggered updates.

Counting to Infinity with a Split Horizon



Distance from D	A	B	C	D
❶ Stable point	2	2	1	0
❷ Link CD fails				
❸ C believes D unreachable (SH)	2	2	∞	
❹ C sends update to A and B				
❺ C's update reaches B	2	∞	∞	
❻ A sends periodic update	2	3	∞	
❼ C's update reaches A	∞	3	∞	
❽ B sends periodic update	∞	3	4	

Lab 4: Code

- Touch only methods starting with safe_(threading handled already)
- **safe_dr_get_next_hop(ip)** : called when router needs to know how to route a packet; returns the outgoing interface and ip address of next hop
- **safe_dr_handle_packet** : called when router receives a dynamic routing packet.
- **safe_dr_handle_periodic()** : called periodically by router.
- **safe_dr_interface_changed** : called when an i/f goes up or down, or link cost changes
- **dr_init** : Use to initialize any data structures.

Running the lab

- Start lvns server

  - ./lvns -t simple.topo

- If the server is running on the same machine as the dr instance, you can start a router which takes control of a node named 'dr1' like this:

  - ./dr -v dr1

- If you are running dr from a separate location, specify server's address and port explicitly.

  - ./dr -v dr1 -s myth5.stanford.edu -p 9999

Start Early!
Good luck!