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Chapter 5.4 Routing Among the ISPs: BGP

5.4.1 Internet Inter-AS Routing: BGP

- **Border Gateway Protocol (BGP)** is the inter-domain routing protocol. It is *"the blue that holds the Internet together"*.
- BGP provides each AS a means to:
  - **External BGP (eBGP)**: to obtain subnet reachability information from neighbouring ASes.
  - **Internal BGP (iBGP)**: to propagate reachability information to all AS-internal routers.
  - to determine "good" routes to other networks based on the reachability information and policy.
- BGP allows a subnet to advertise its existence to the rest of the Internet.
- Note that gateway routers run both eBGP and iBGP protocols.
- In a **BGP session**, two BGP routers (peers) would exchange BGP essages over a semi-permanent TCP connection. They advertise paths to different destination network prefixes. Thus, BGP is a *"path vector" protocol*.
- When an AS gateway router advertises a path to another AS gateway router, it promises that it will forward datagrams via that path.
- The advertised network prefix includes BGP attributes such that the "route" = prefix + attributes.
- Two important attributes are:
  - **AS-PATH**: a list of ASes which the prefix advertisement passed.
  - **NEXT-HOP**: the IP address of the router that begins the AS-PATH.
- In **policy-based routing**, gateways receiving route advertisements use **import policy** to accept or decline a path (an example policy is to never route through AS Y). AS policies also determine whether to advertise a path to other neighbouring ASes.
- See examples of eBGP and iBGP in action on **slide 5-45** and **slide5-46**.
- BGP messages can be exchanged between peers over a TCP connection.
- BGP messages include:
  - **OPEN**: Opens a TCP connection to a remote BGP peer. Also used to authenticate OPEN messages sent by a peer.
  - **UPDATE**: Advetises a new path or withdraws an old one.
  - **KEEPALIVE**: Keeps a connection alive when there are no UPDATES.
  - **NOTIFICATION**: Reports errors in previous messages. Also used to close a connection.

- A router may learn about more than one route to the destination AS. In such a case, a route is selected based on:
  1. Local preference value attribute: policy decision.
  2. Shortest AS-PATH.
  3. Closest NEXT-HOP router: hot potato routing.
  4. Additional criteria.
- **Hot potato routing** chooses the local gateway that has the least intra-domain cost. It does not take into account the inter-domain cost. See an example of this in action on **slide 5-51**.
- If an ISP only wants to route traffic to and from its customer networks and does not want to carry traffic between other ISPs, it can *choose not to advertise* the path to its neighbour. See an example on **slide 5-52 to 5-53**.

5.4.2 Why Split Between Intra- and Inter-AS Routing

- **Policies**:
  - Inter-AS: Admins want control over how its traffic is routed and who goes through its net.
  - Intra-AS: Has a single admin, so no policy decisions are needed.
- **Scale**: Hierarchial routing saves table size and reduces update traffic.
- **Performance**:
  - Intra-AS focuses on performance.
  - Inter-AS allows policies to sometimes take precedence over performance.