Interdomain Routing: Border Gateway Protocol (BGP)

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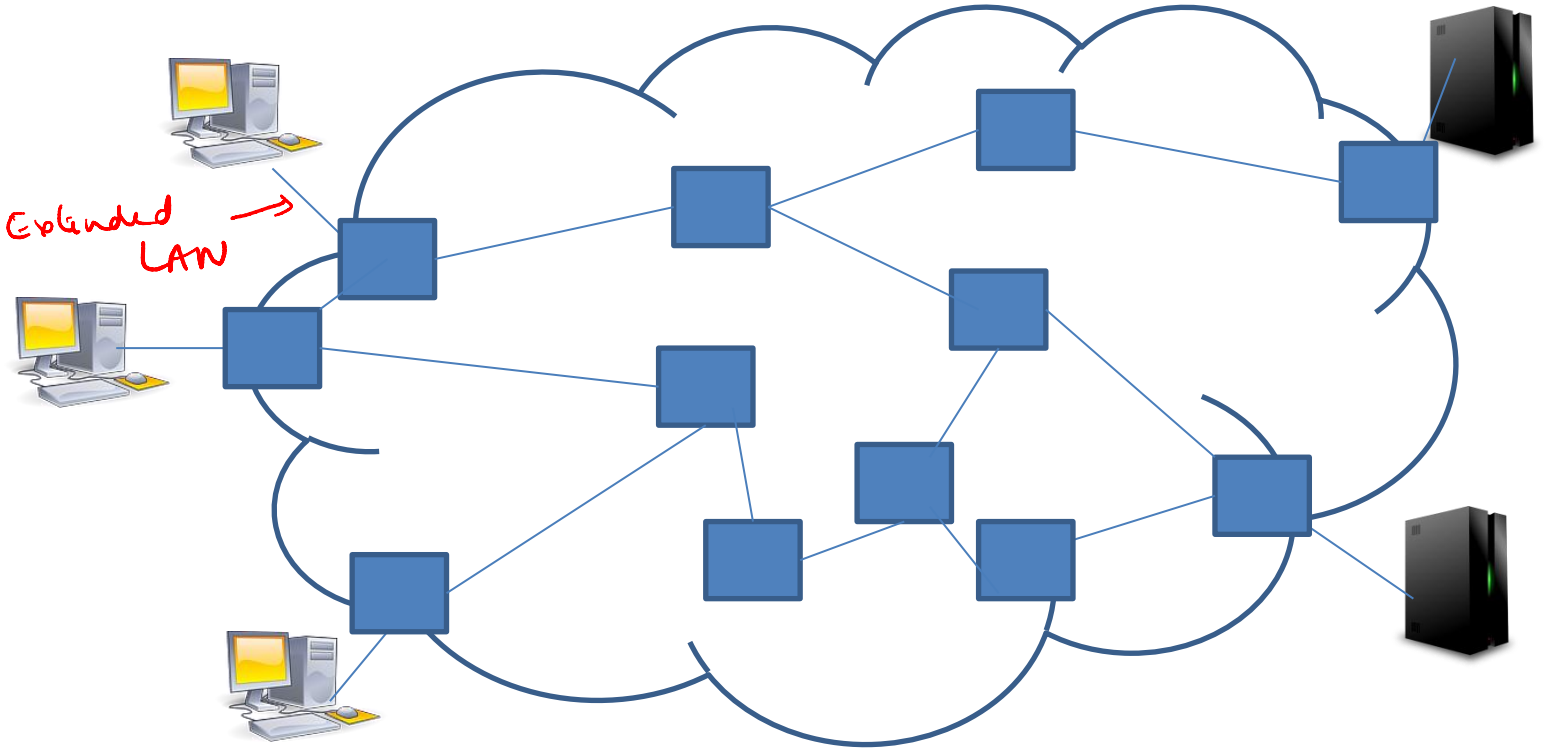
Background

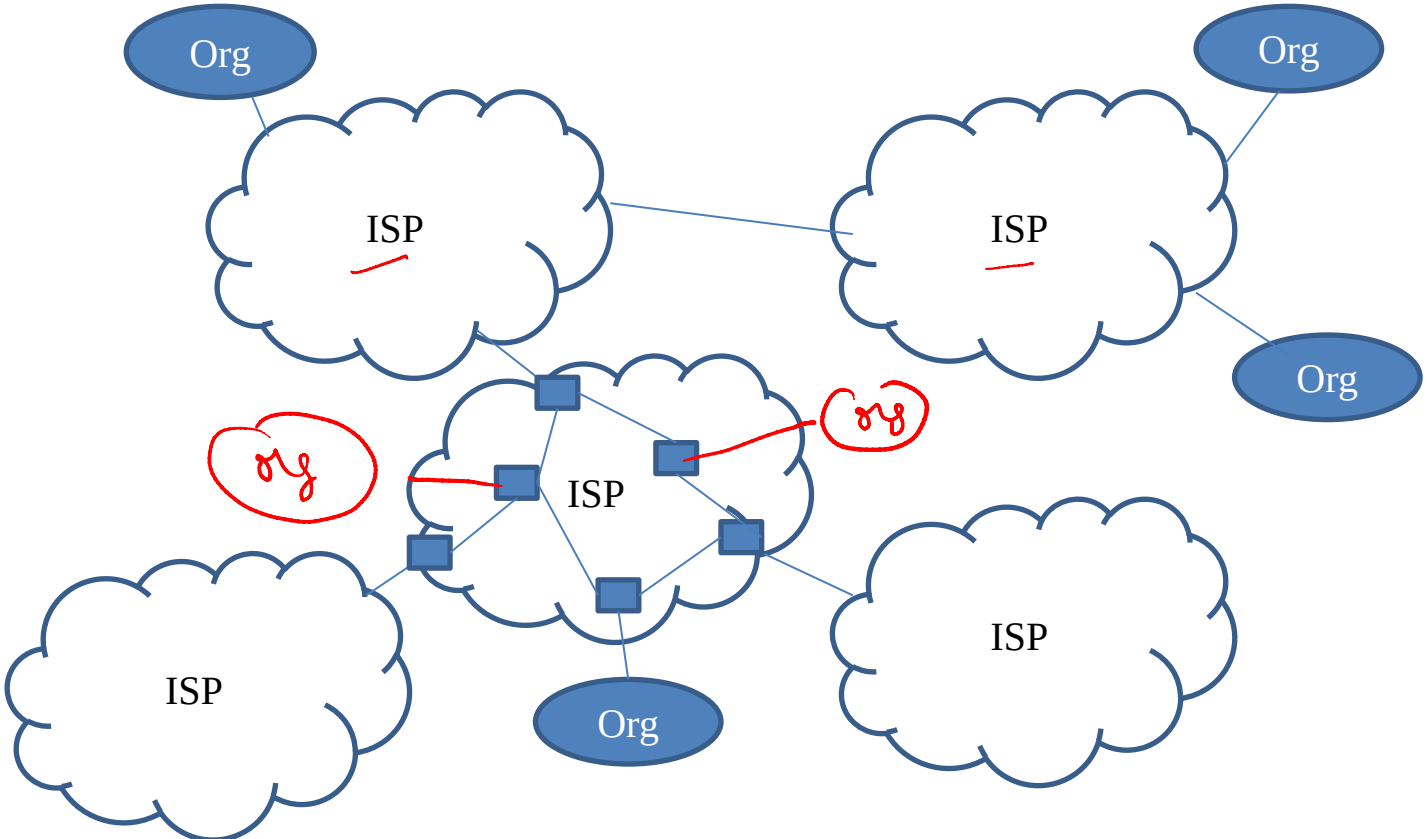
- Routing process builds forwarding tables at routers
- Two types of algorithms: DV and LS
- Routing in Internet is lot more complex: Need to handle policy, scale and performance
- BGP protocol is extremely complex
  - Many issues still not well understood, very few possess good knowledge of the protocol

Internet Architecture – v1

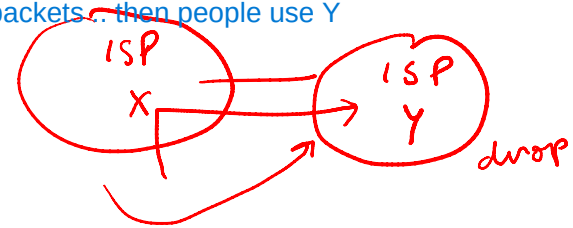


Wish it were so!

Internet Architecture – v2



What if ISP Y drops X's packets.. then people use Y



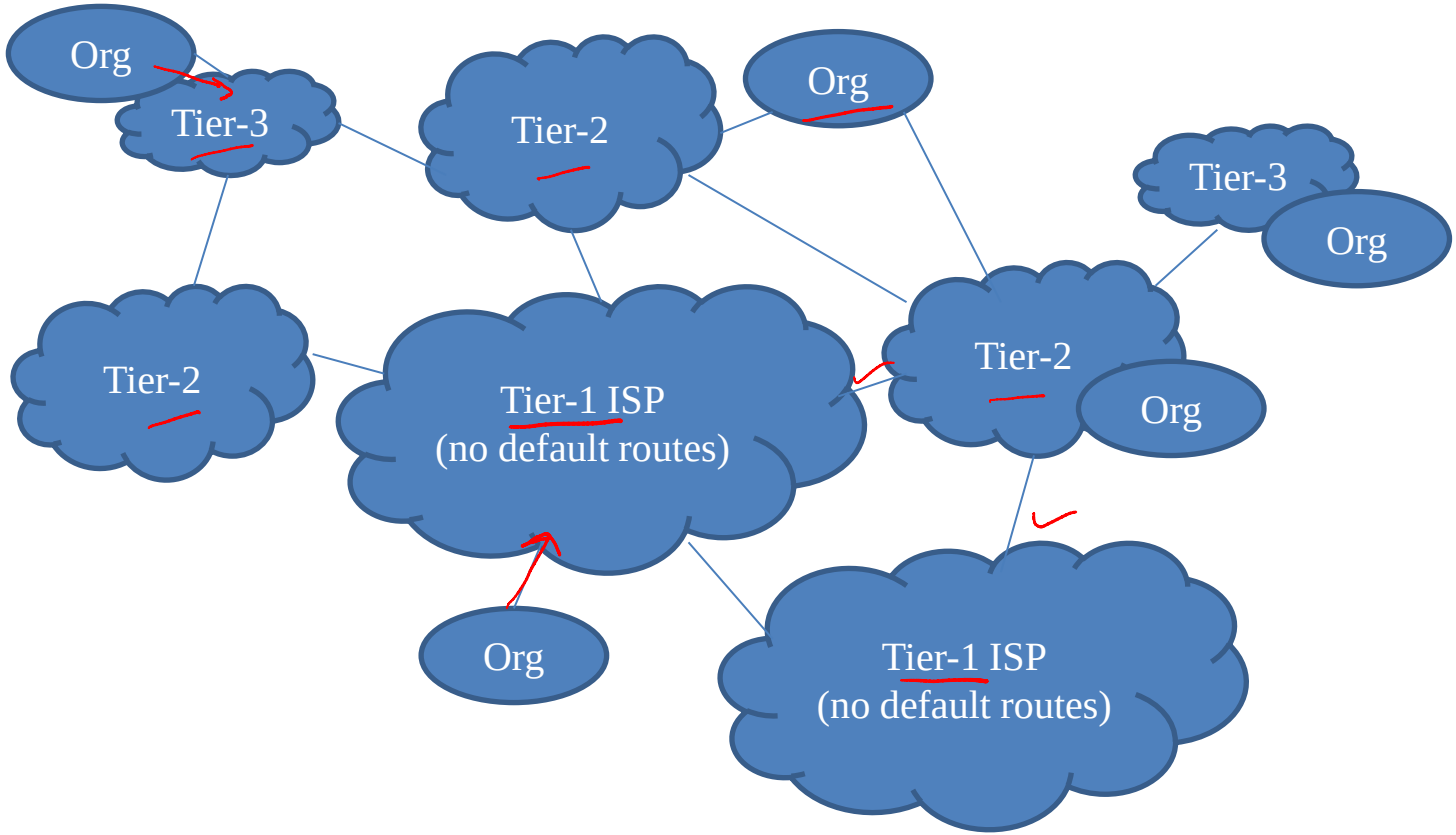
Reality

- Connectivity, Cooperation and Competition
- Many ISP's want complex policies
- Not all ISP's are equal
  - Tier1, Tier 2, Tier3
- Scalability is a big concern

Tier2 takes help of Tier1 to reach more globa adresses

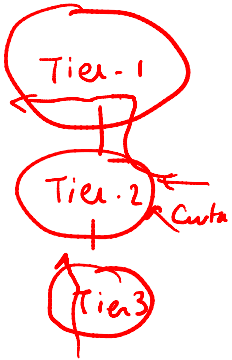
T3 also uses T2/T1

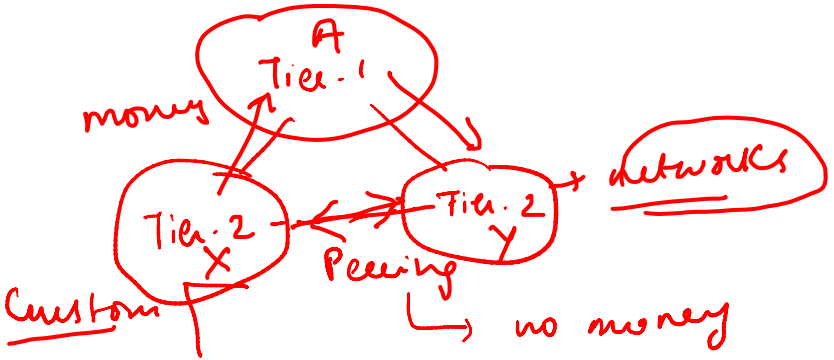
Internet Architecture – V3



Relations between ~~ASs~~ ISPs

- Transit: provider/customer relation; typically financial settlement is involved
- Peering: Mutual access to subset of routing tables; typically no financial settlement involved





why send X-A-Y and pay to A if u can send to Y directly and also Y can send to X

Routing in the Internet

- Autonomous System == Routing Domain: Controlled by a single administrative entity
  - Network within an organization; network within an ISP
- Routing problem: Two aspects
  - Routing within an AS
  - Routing between ASs

Routing within an AS

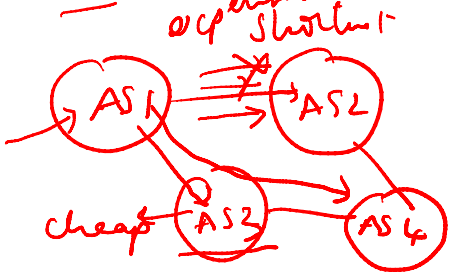
- Intradomain routing: Employs interior gateway protocol (IGP)
  - E.g. OSPF, RIP
- Focuses on finding 'optimal' paths within the domain
- Different AS can implement different IGPs within

Routing across ASs

- Interdomain routing: Employs exterior gateway protocol
  - Border Gateway Protocol (BGPv4)
- Focuses on Reachability, Policy and Scalability
- Needs to be common across ASs

Policies

- Dictated by political, security and economic consideration
- No transit through certain ASs
- Use a specific AS only if there are no other routes to destination
- Traffic from X country can't go through Y country
- Traffic starting or ending at Google can't go through Facebook



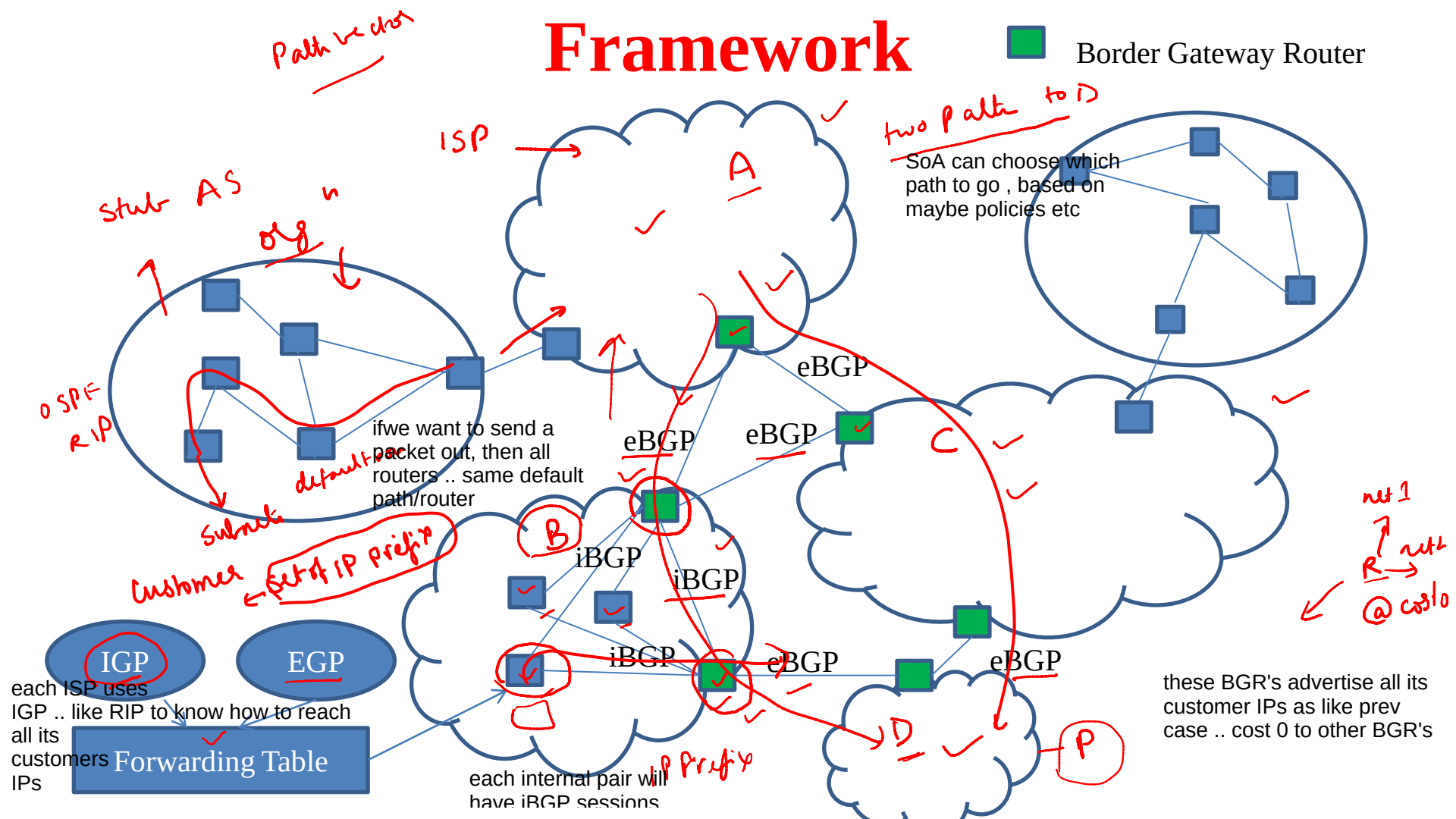
Break

Routing across ASs

application layer process

- BGP messages exchanged using TCP, port 179.
- eBGP: Facilitate inter-AS communication
  - Routers are in different ASs, often directly connected
- iBGP: Facilitate communication
  - Routers within same AS, need not be directly connected
  - Install learned routes (via eBGP) within AS

Framework


Border Gateway Router
ISP
A
two path to D
SoA can choose which path to go , based on maybe policies etc
stub AS
eBGP
eBGP
eBGP
C
B
iBGP
iBGP
iBGP
eBGP
eBGP
D
P
OSPF
RIP
default
subnet
Customer
Get IP prefix
if we want to send a packet out, then all routers .. same default path/router
IGP
EGP
each ISP uses IGP .. like RIP to know how to reach all its customers IPs
Forwarding Table
each internal pair will have iBGP sessions
IP Prefix
these BGR's advertise all its customer IPs as like prev case .. cost 0 to other BGR's

Summary of Framework

- Border gateway routers employ eBGP to exchange IP prefix information
  - Underlying route determination (which next hop AS to take) is based on path vector
  - An AS need not export all the IP prefixes it has learnt (to be covered under exporting routes)
  - When there are multiple routes to a given destination, policy takes precedence over optimality (to be covered under importing routes)

Summary of Framework

- Learned information via eBGP is injected within AS via iBGP sessions
  - Border gateway routers form a mesh of iBGP sessions with all routers within AS
- A forwarding table at a router is dictated by both the IGP and EGP protocols