CSE 461 Section 7

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The interdomain routing problem

Each AS determines its own routing policies

- One AS only wants to send and receive packets from the internet
- One AS can carry transit traffic for others if you pay this service

Political considerations

- Never send traffic from the Pentagon on a route through Iraq

Security considerations

- Traffic starting or ending at Apple should not transit Google

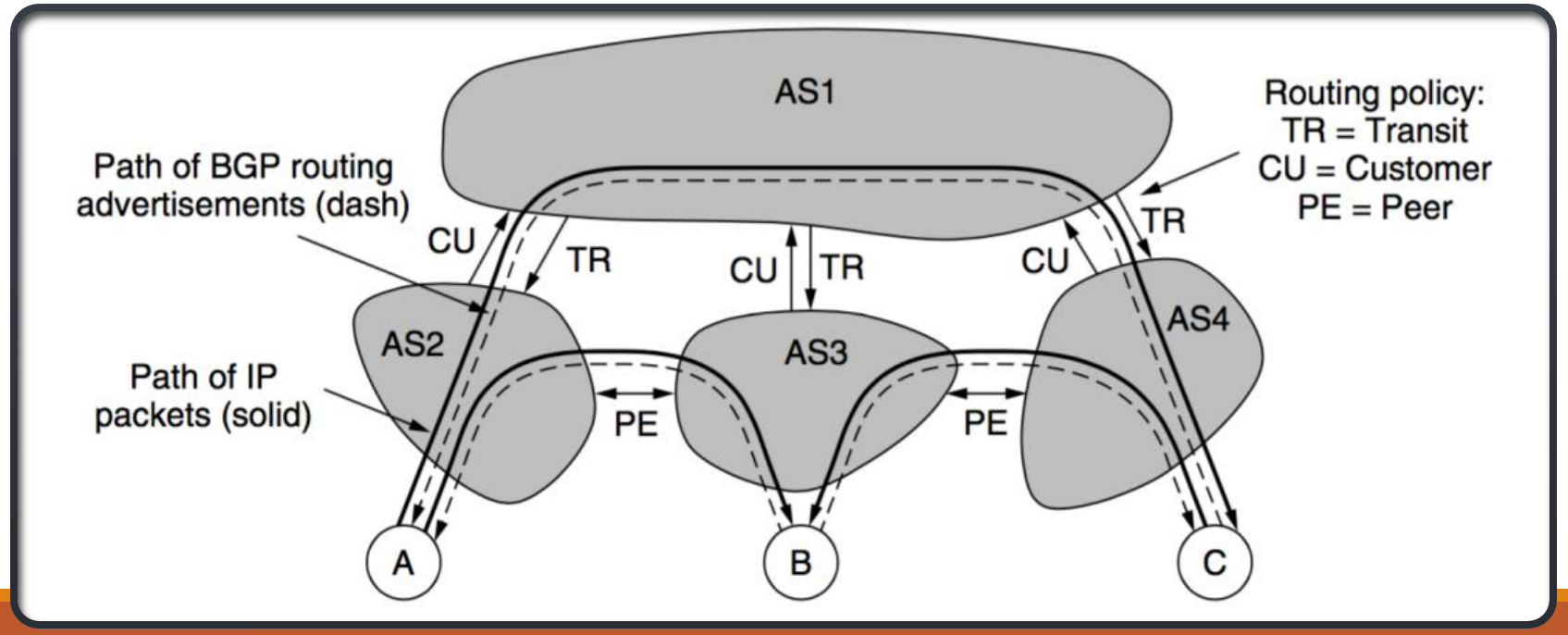
Economic considerations

- Use cheaper service

Routing Policy Example

Routing policy decides what traffic can flow over which links between ASes

Provider, Customer, Peer



Terminology

Autonomous system traffic

- Local traffic: originates at or terminates on nodes within AS (intradomain routing)
- Transit traffic: traffic that passes through an AS

Types of Ases

- Stub AS: has only one single connection to one other AS (local traffic only)
- Multihomed AS: has connections to more than one other AS but refuses to carry transit traffic
- Transit AS: connections to more than one other AS that is designed to carry both transit and local traffic

BGP Basics

Types of routers:

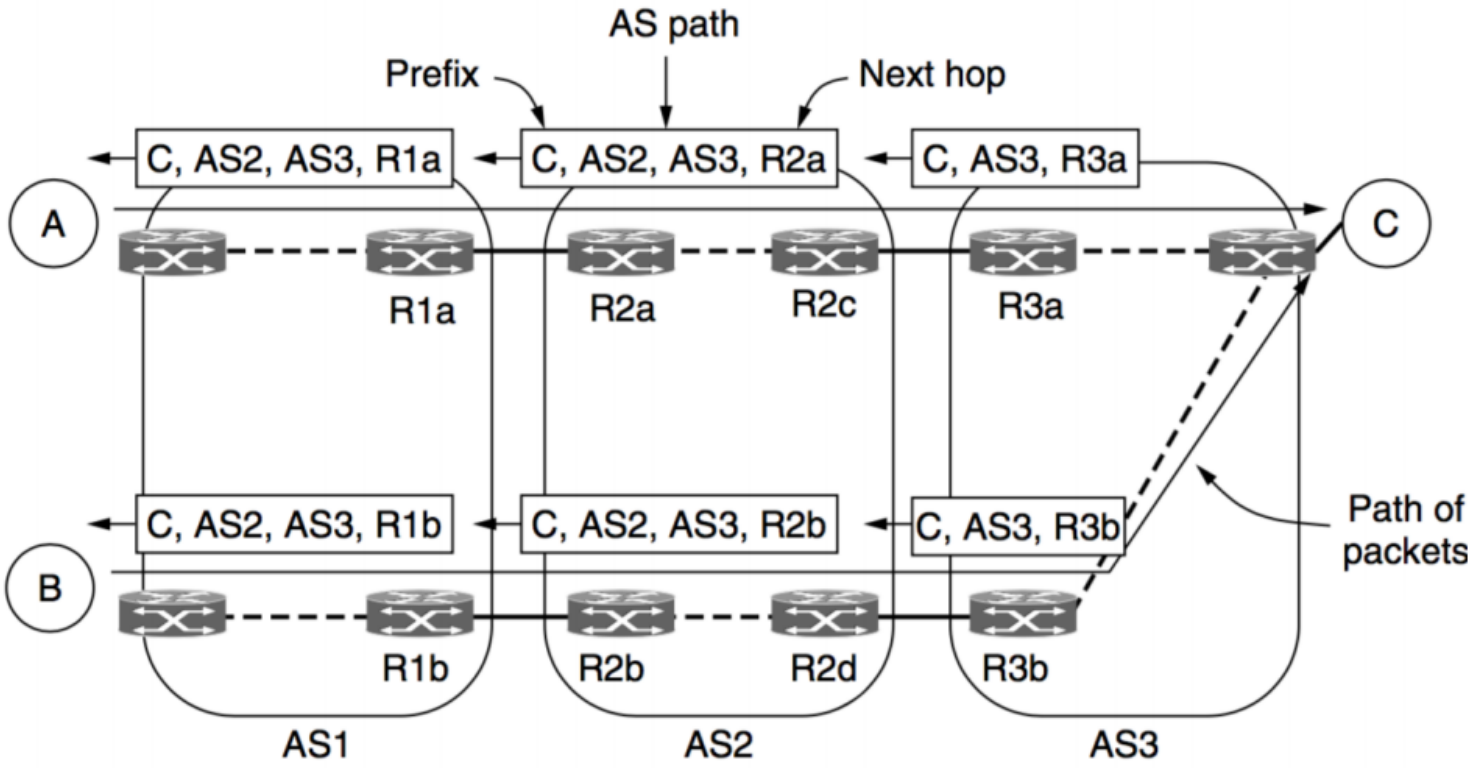
- Border router: packets enter and leave the AS
- BGP Speaker: handles advertisements, usually the same as border routers

Path-vector protocol

- Not distance vector or link-state
- AS Path: list of autonomous systems to reach a particular network
- Built on TCP

BGP Route Advertisement

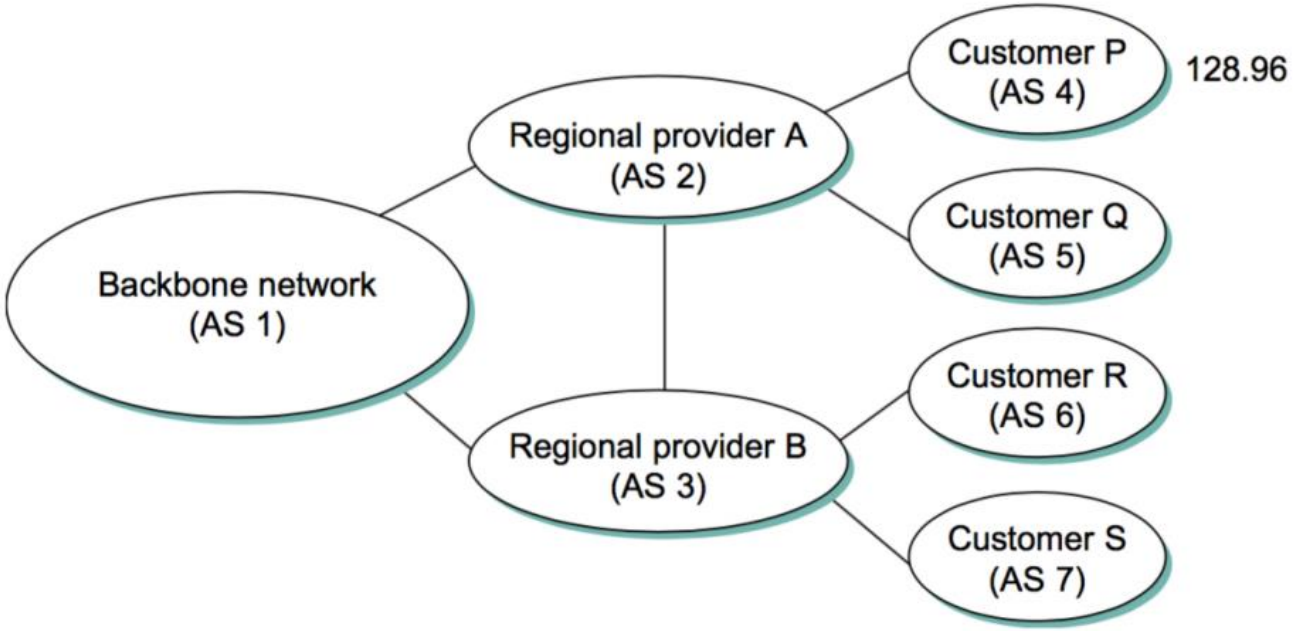
Each BGP speaker prepends its own AS number to the route



Loop Detection

Assign each AS a unique number

- BGP current version: 16 bits (is this enough?)



Route selection

- Routes via peered networks are favored over routes via transit providers
  - Free!
- Shorter AS paths are better
- Prefer the route that has the lowest cost within the ISP
- Only advertise routes that are good enough for you
- Allow route withdrawal

One example

Consider the following network with 6 Ases

- AS1 is the provider for AS2, AS3, and AS4
- AS2 is the provider for AS5
- AS3 is the provider for AS5 and AS6
- AS5 and AS6 have a peer agreement

UDP

User Datagram Protocol

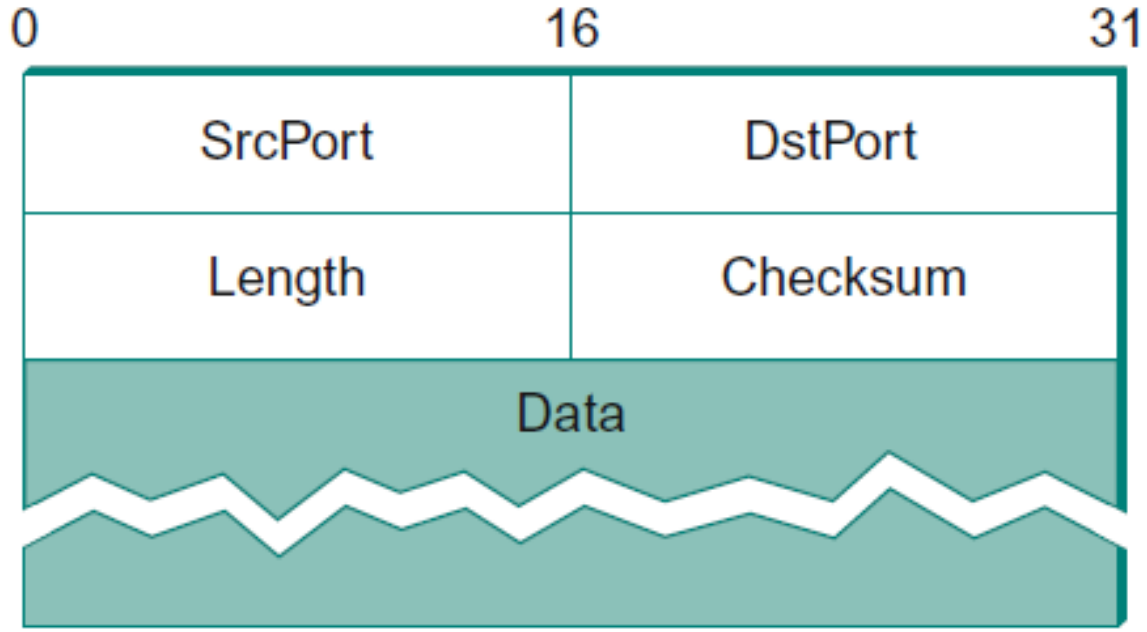
Single layer abstraction above direct host-to-host connection

- Allows process-to-process communication
- Each process on a given host needs to share a single network link

Build application specific protocols on top

UDP

Ports!



UDP

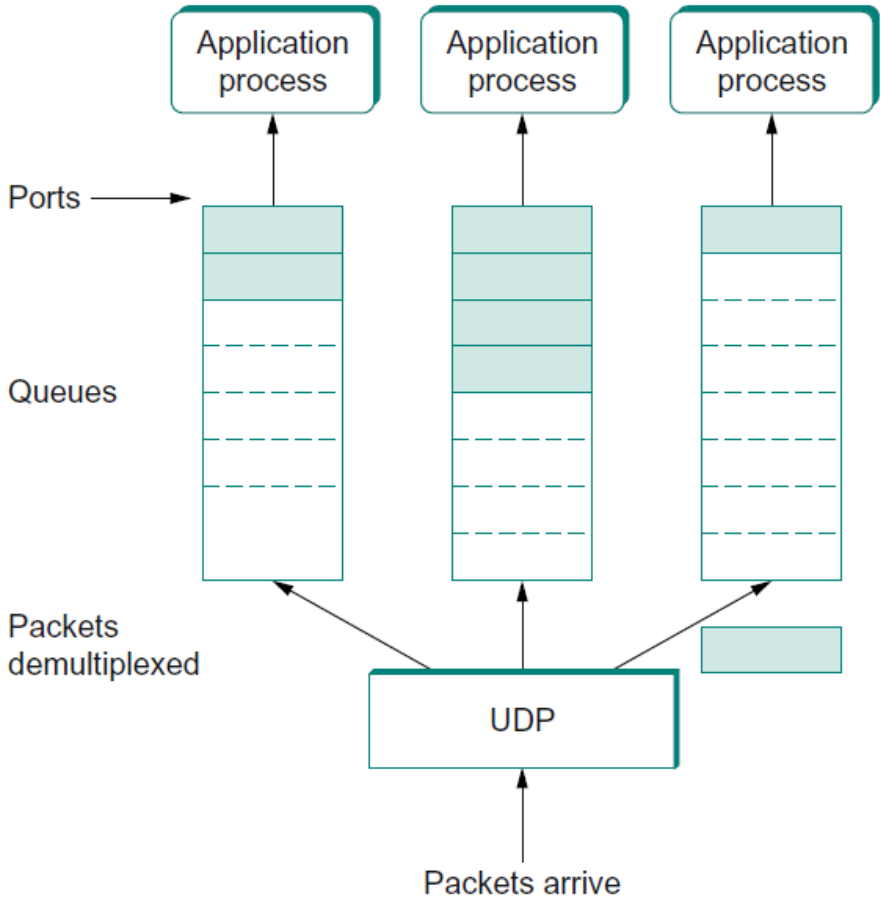
Packets are buffered per port in a queue

No flow-control

No order guarantee

No reliability mechanism

Does provide checksum



TCP

Tranmission Connection Protocol

Supports multiple processes with ports (like UDP)

Guarantees

- Reliability (every packet will be received)
- In order

Flow control

Two-way stream

TCP Requirements

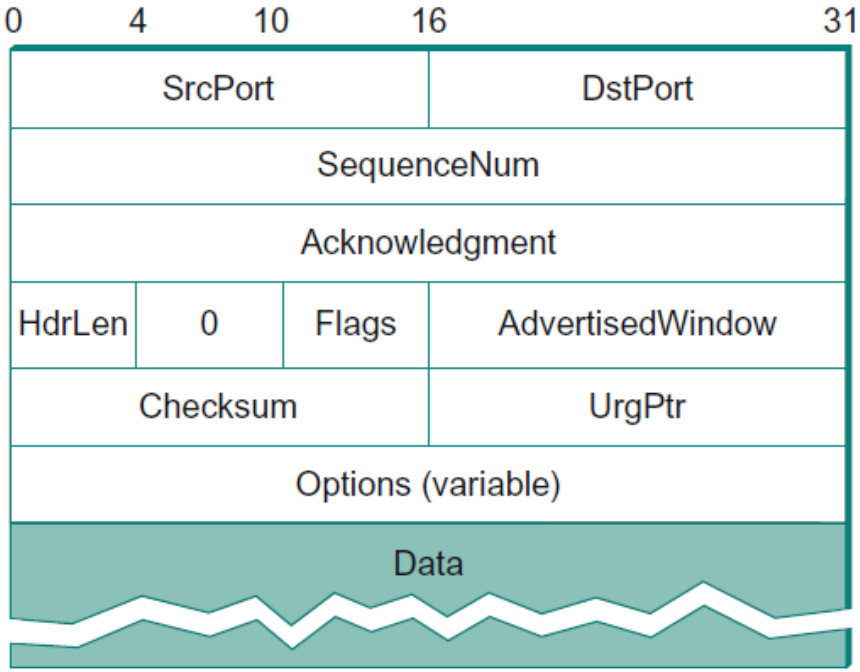
Connection establishment phase

Adaptive retransmit

Reordering packets

Flow Control

Network Congestion



More Protocols to Consider

Remote Procedure Call (RPC)

- Largely in distributed systems

Real-time Transport Protocol (RTP)

- Built on UDP
- Interactive applications
- Streaming applications