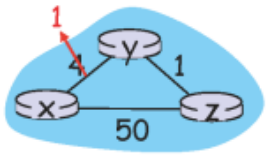
네트워크계층6

작성일시	@2022년 10월 31일 오후 9:30
강의날짜	@2022/10/31
편집일시	@2022년 10월 31일 오후 10:08
분야	네트워크
공부유형	스터디 그룹
복습	☐
태그	

Distance vector: link cost changes

link cost changes:

- node detects local link cost change
- updates routing info, recalculates distance vector
- if DV changes, notify neighbors



"good news travels fast"

t_0: *y* detects link-cost change, updates its DV, informs its neighbors.

t_1: *z* receives update from *y*, updates its table, computes new least cost to *x* , sends its neighbors its DV.

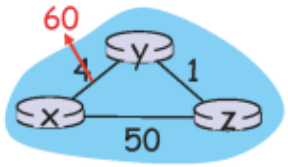
t_2: *y* receives *z*' s update, updates its distance table. *y*' s least costs do *not* change, so *y* does *not* send a message to *z*.

Network Layer 4-91

Distance vector: link cost changes

link cost changes:

- node detects local link cost change
- *bad news travels slow* - "count to infinity" problem!
- 44 iterations before algorithm stabilizes: see text



poisoned reverse:

- If Z routes through Y to get to X :
  - Z tells Y its (Z's) distance to X is infinite (so Y won't route to X via Z)
- will this completely solve count to infinity problem?

Comparison of LS and DV algorithms

message complexity

- ***LS:*** with n nodes, E links, O(nE) msgs sent
- ***DV:*** exchange between neighbors only
  - convergence time varies

speed of convergence

- ***LS:*** $O(n^2)$ algorithm requires O(nE) msgs
  - may have oscillations
- ***DV:*** convergence time varies
  - may be routing loops
  - count-to-infinity problem

robustness: what happens if router malfunctions?

LS:

- node can advertise incorrect *link* cost
- each node computes only its *own* table

DV:

- DV node can advertise incorrect *path* cost
- each node's table used by others
  - error propagate thru network

Chapter 4: outline

4.1 introduction

4.2 virtual circuit and datagram networks

4.3 what's inside a router

4.4 IP: Internet Protocol
- datagram format
- IPv4 addressing
- ICMP
- IPv6

4.5 routing algorithms
- link state
- distance vector
- hierarchical routing

4.6 routing in the Internet
- RIP
- OSPF
- BGP

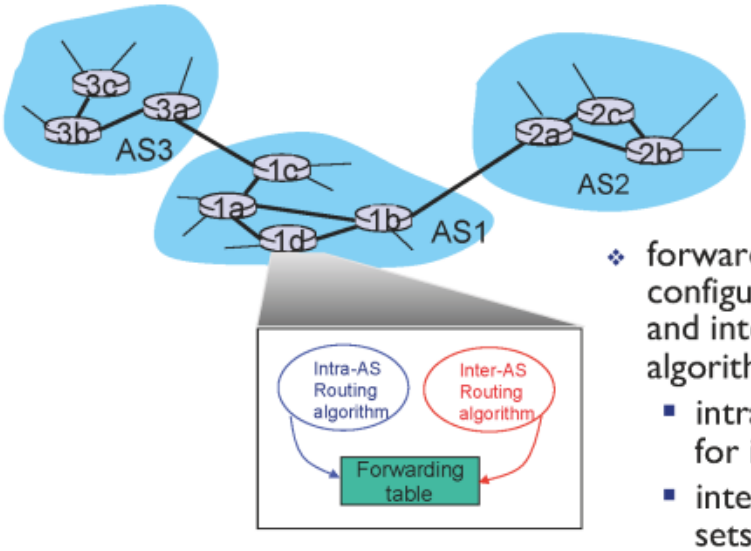
4.7 broadcast and multicast routing

소스에서부터 목적지까지 cost를 구하기 위해

결과는 같다!

라우터들 link state 가능한가? 비현실적

Interconnected ASes



- forwarding table configured by both intra- and inter-AS routing algorithm
  - intra-AS sets entries for internal dests
  - inter-AS & intra-AS sets entries for external dests

Network Layer 4-98

각각의 네트워크들은 내부에서는 라우터 알고리즘들이 가능 최적의 경로 가능

네트워크 간의 라우터들은 또 다름

Hierarchical routing

our routing study thus far - idealization

- all routers identical
- network "flat"

… *not* true in practice

scale: with 600 million destinations:

- can't store all dest's in routing tables!
- routing table exchange would swamp links!

administrative autonomy

- internet = network of networks
- each network admin may want to control routing in its own network

Hierarchical routing

- aggregate routers into regions, "autonomous systems" (AS)
- routers in same AS run same routing protocol
  - "intra-AS" routing protocol
  - routers in different AS can run different intra-AS routing protocol

gateway router:

- at "edge" of its own AS
- has link to router in another AS

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PART I

AS: Autonomous Systems

Autonomous Systems (ASes)

An autonomous system is an autonomous routing domain that has been assigned an Autonomous System Number (ASN).

> … the administration of an AS appears to other ASes to have a single coherent interior routing plan and presents a consistent picture of what networks are reachable through it.
>
> RFC 1930: Guidelines for creation, selection, and registration of an Autonomous System

자치권을 가진 라우팅 도메인 각각 AS는 자신만의 고유한 number를 가짐

AS Numbers (ASNs)

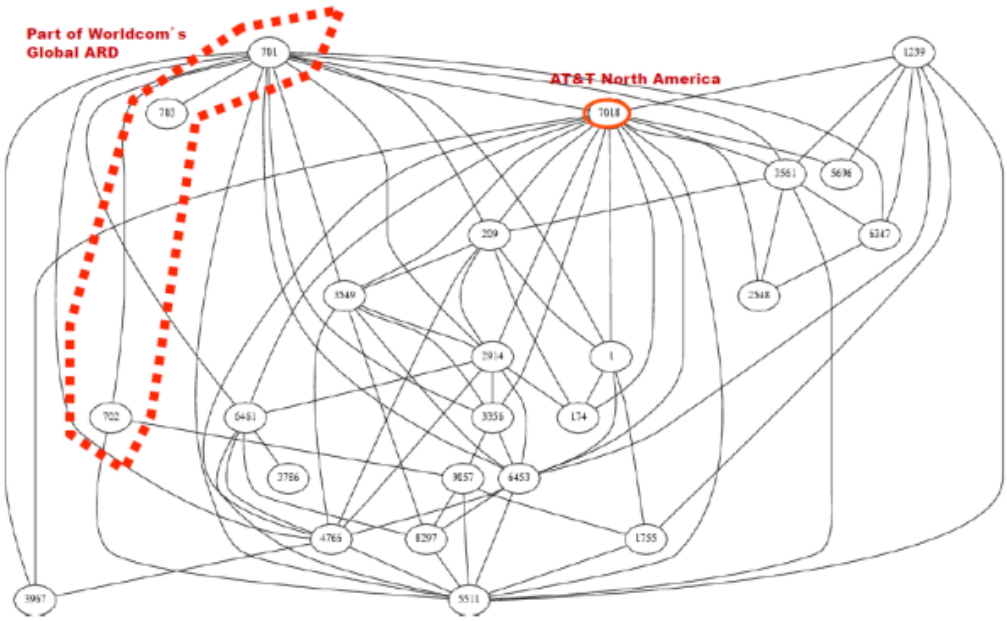
ASNs are 16 bit values.
64512 through 65535 are "private"
Currently over 11,000 in use.

- **Genuity (f.k.a. BBN): 1**
- **MIT: 3**
- **Harvard: 11**
- **UCLA: 52**
- **AT&T: 7018, 6341, 5074, ...**
- **Sprint: 1239, 1240, 6211, 6242, ...**
- **Hanyang Univ: 9322**
- **Idaho Regional Network: 62870**
- **...**

ASNs represent units of routing policy

현재 전세계에 존재하는 네트워크 갯수가 62870개 정도

AS Graphs Can Be Fun



The subgraph showing all ASes that have more than 100 neighbors in full graph of 11,158 nodes. July 6, 2001. Point of view: AT&T route-server

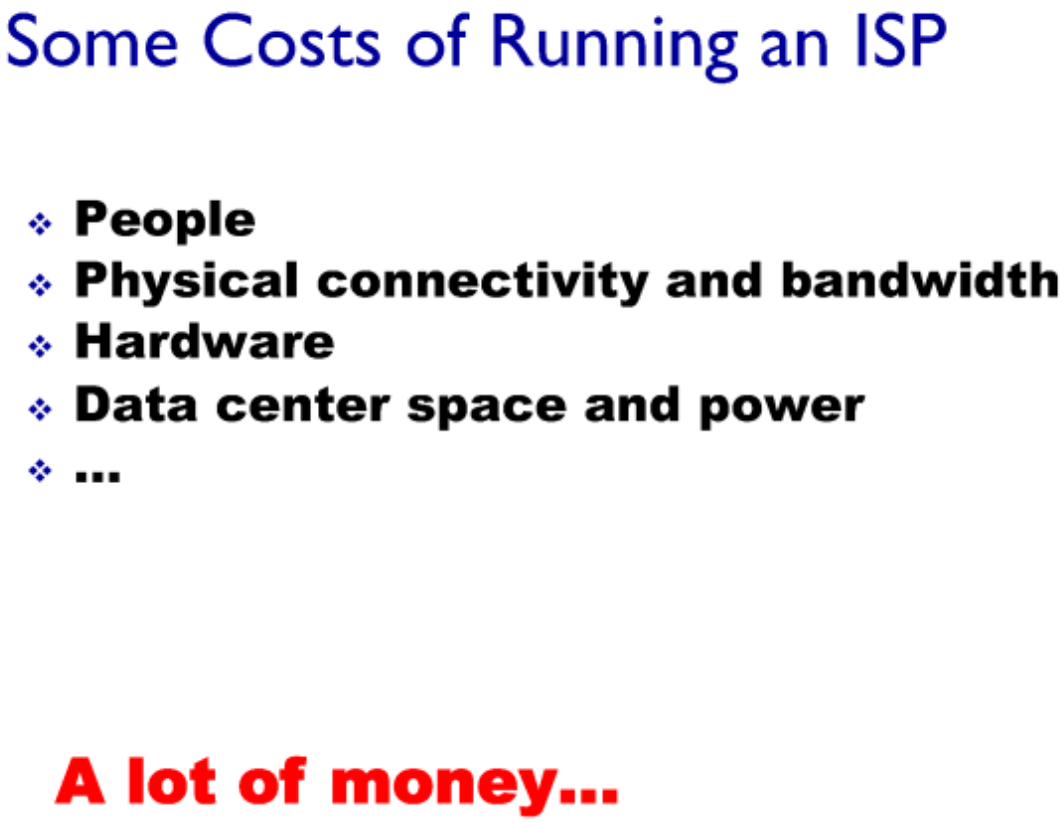
AS끼리 전용선을 연결

PART II

Relationships Between Networks

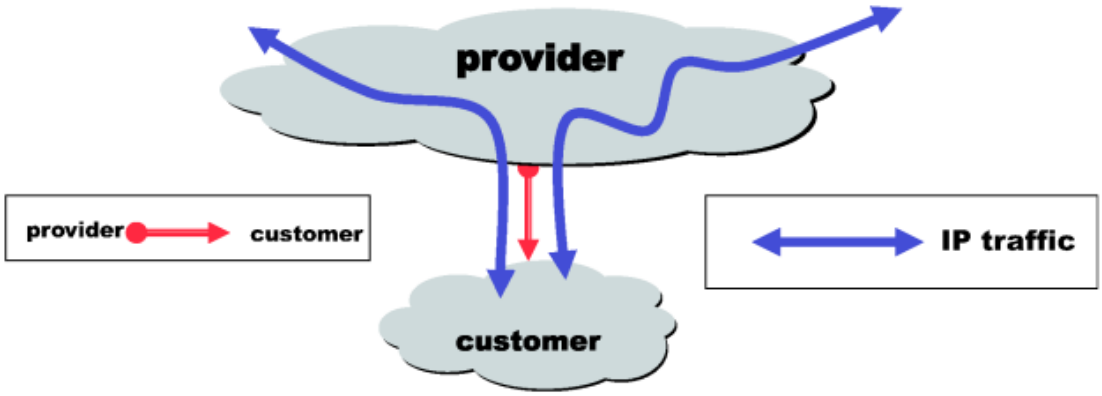
특수한 관계에 대해 얘기

60000개 넘게 존재하는 AS가 실제로 따지고보면 미국이랑 룩셈부르크는 다른 것처럼 서로 간의 위상이 다름 → 그들간의 특수한 관계가 있음



AS를 운영하기 위해 돈이 많이 필요함

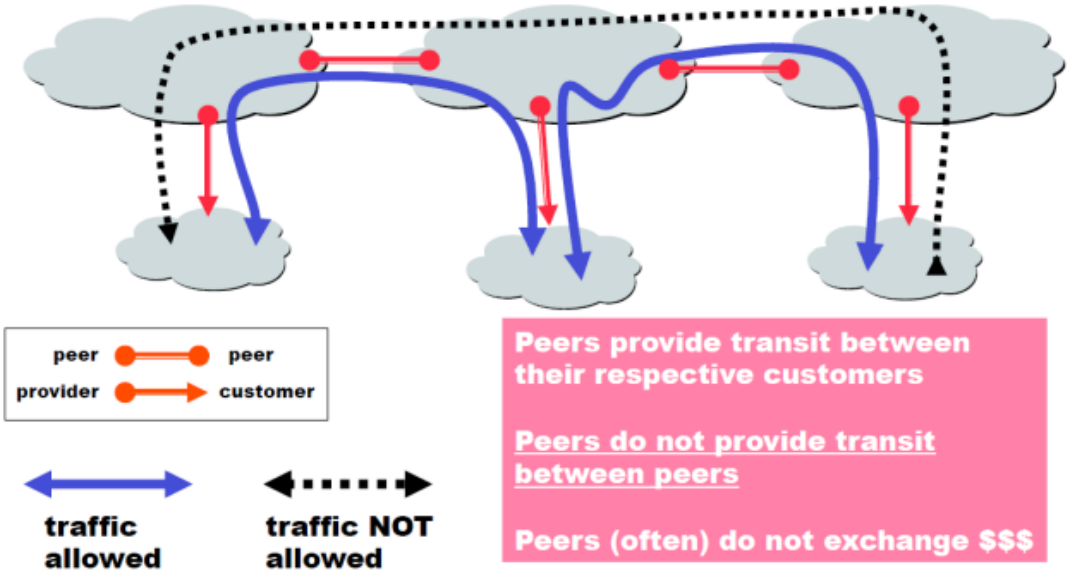
Customers and Providers



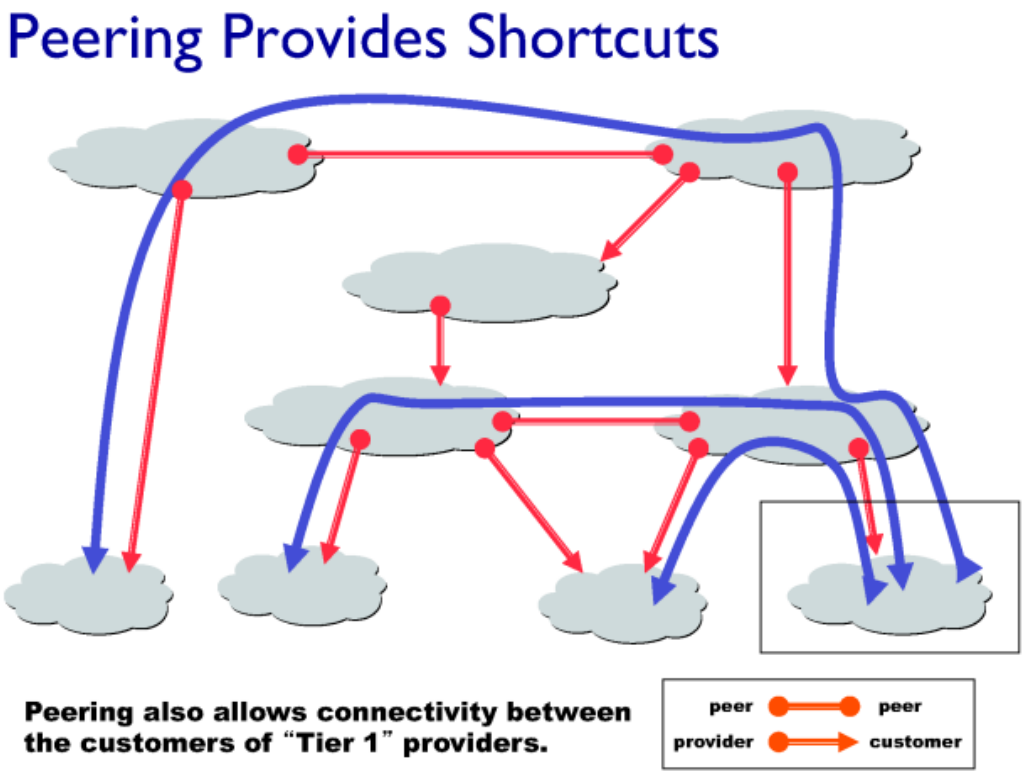
Customer pays provider for access to the Internet

인터넷을 제공하는 provider와 돈을 내고 사용하는 customer

The "Peering" Relationship



검은색 트래픽은 허용되지않음 돈을 안 주니까



갑을 관계가 아닌 동등, 비슷비슷 한 관계 ex) kt skt

PART III

Implementing Inter-Network Relationships with BGP

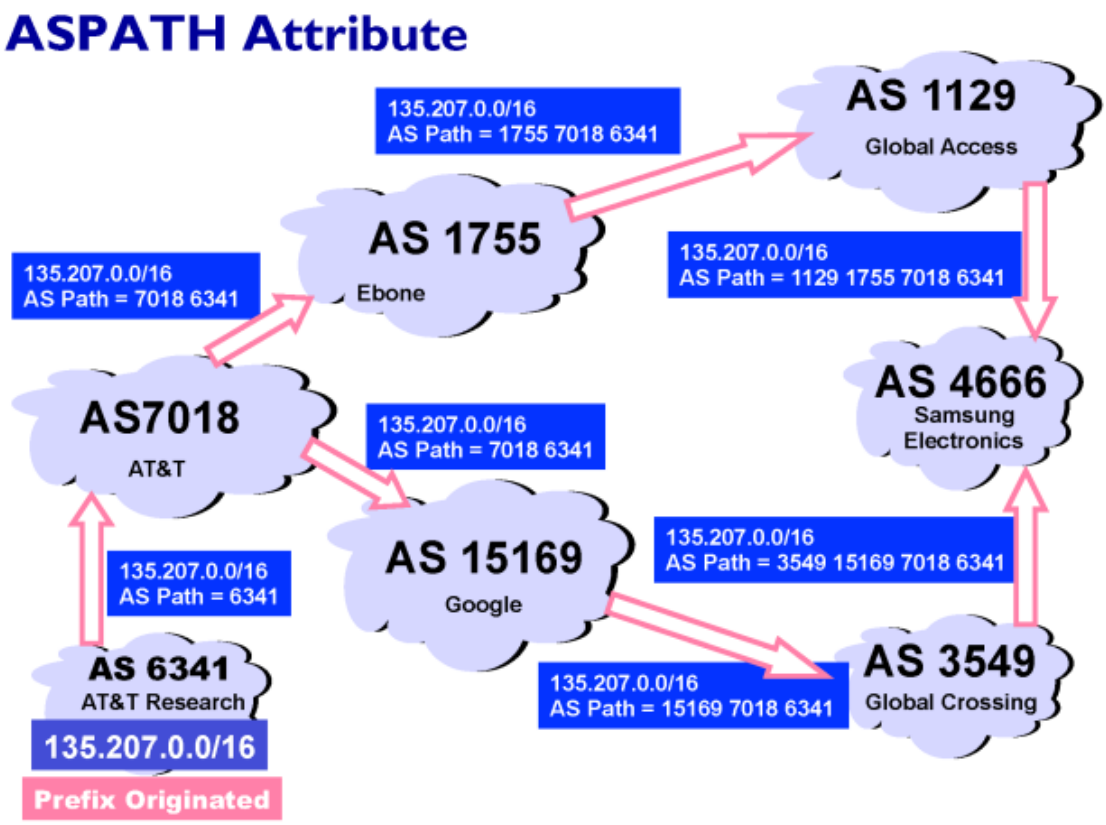
BGP = Border Gateway Protocol

BGP-4

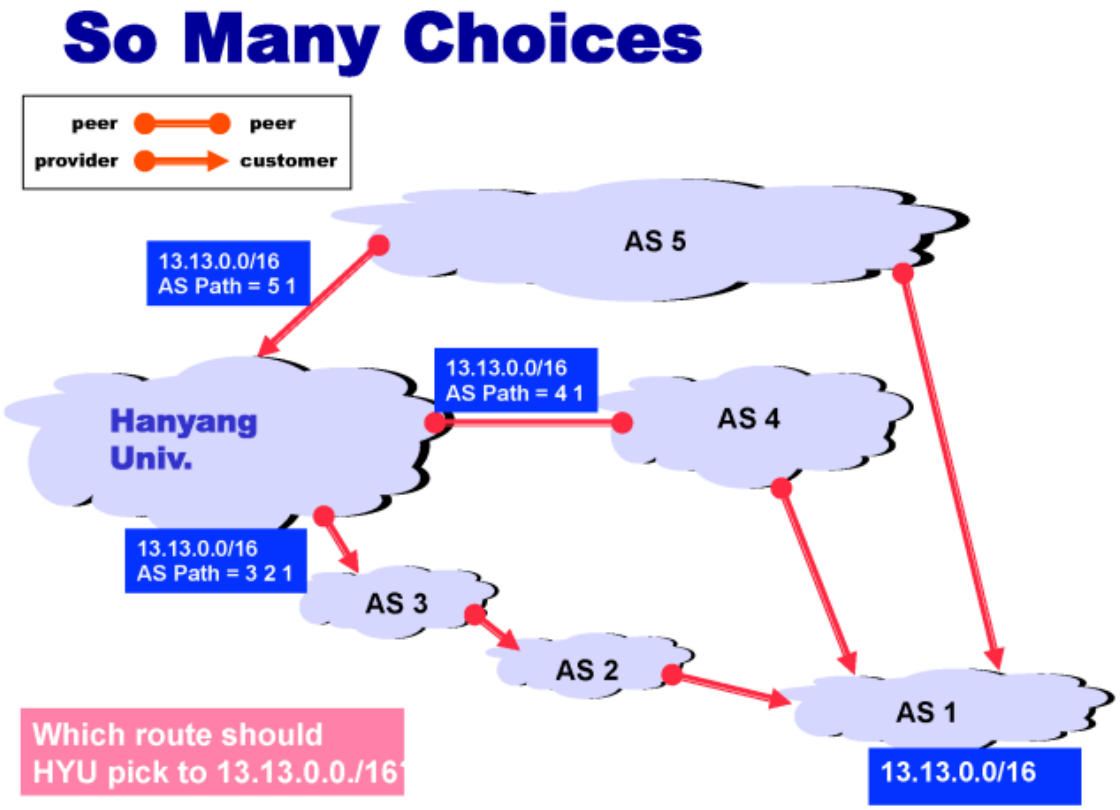
- **BGP** = **B**order **G**ateway **P**rotocol
- Is a **Policy-Based** routing protocol
- Is the **de facto EGP** of today's global Internet
- Relatively simple protocol, but configuration is complex and the entire world can see, and be impacted by, your mistakes.

- **1989 : BGP-1 [RFC 1105]**
  - **Replacement for EGP (1984, RFC 904)**
- **1990 : BGP-2 [RFC 1163]**
- **1991 : BGP-3 [RFC 1267]**
- **1995 : BGP-4 [RFC 1771]**
  - **Support for Classless Interdomain Routing (CIDR)**

무조건 최적화 시키는게 cost가 아니라 AS간의 정책에 따라서 좌우됨



싫어하고 트래픽 거쳐가기 싫은 아이는 정책적으로 안 지나감



prefix를 advertising하는데 가장 우선순위 : 최소 cost :

AS 내부에서는 최단 경로

외부에서는 경제적인 경로

결론적으로 최단의 경로는 아님

Intra routing은 최단 경로

LOCAL PREFERENCE!