ELEN 4017

Network Fundamentals

Lecture 21

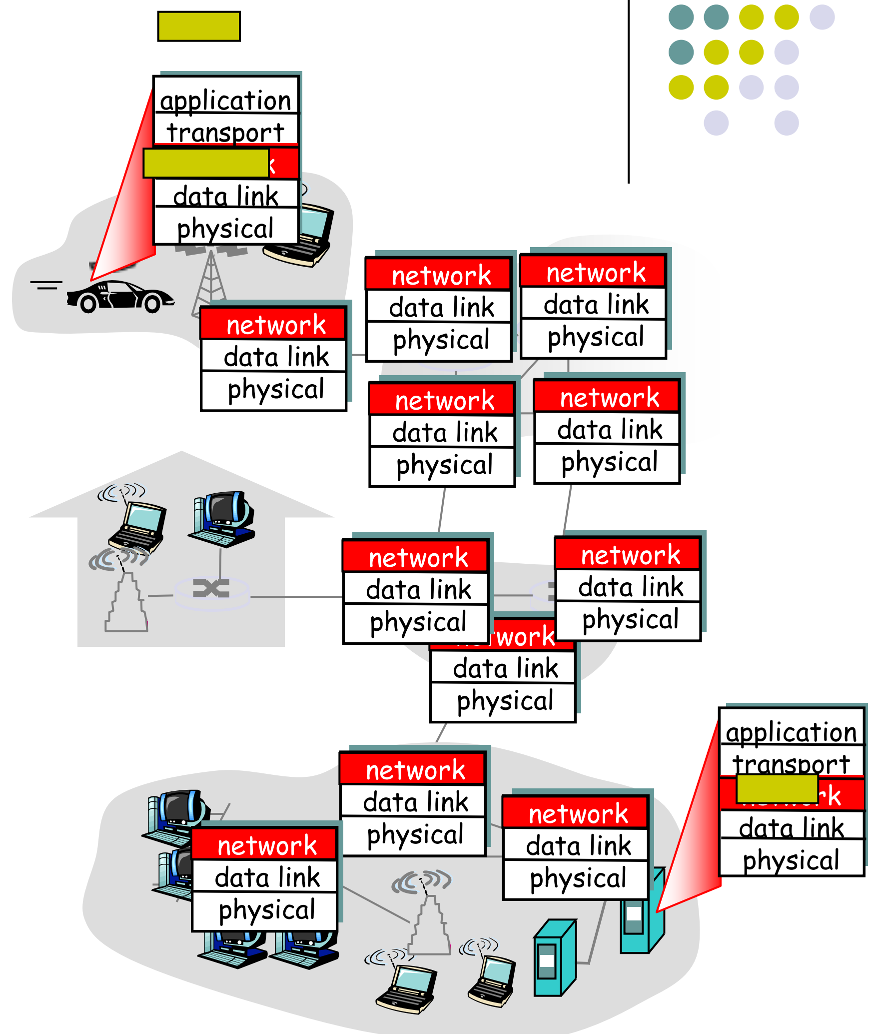
Purpose of lecture

Chapter 4: Network Layer

- Recap
- Forwarding
- What’s inside a router ?

Network layer

- transport segment from sending to receiving host
- on sending side encapsulates segments into datagrams
- on rcving side, delivers segments to transport layer
- network layer protocols in *every* host, router
- router examines header fields in all IP datagrams passing through it



Purpose of lecture

Chapter 4: Network Layer

- Recap
- Forwarding
- What’s inside a router ?

Forwarding operation

- Consider a **32 bit** destination address.
- If forwarding table had an entry for every possible address, this would require 4 billion entries.
- How can we then reduce this and achieve correct forwarding?

Ranges of addresses

Destination Address Range	**Link interface**
11001000 00010111 00010**000 00000000** through 11001000 00010111 00010**111 11111111**	0
11001000 00010111 00011000 **00000000** through 11001000 00010111 00011000 **11111111**	1
11001000 00010111 0001**1001 00000000** through 11001000 00010111 0001**1111 11111111**	2
Otherwise	3

Prefix matching

- For this case, its **not necessary to explicitly list each entry** in the forwarding table, since we have **groups**.
- We could employ a **prefix match**.
- **If the key in the prefix table is a prefix of the destination address**, then it is matched and then the output interface is used.
- If not, the next key is checked.
- If no match occurs then a default interface is chosen.
- Can you see a problem with the algorithm ?

Prefix match	Link interface
11001000 00010111 00010	0
11001000 00010111 00011 000	1
11001000 00010111 00011	2
otherwise	3

Longest prefix matching rule

- Since there is a possibility of multiple matches, the rule is extended to match the **longest prefix**.
- Consider keys for interface 1 and 2.

Prefix match	Link interface
11001000 00010111 000**10**	0
11001000 00010111 000**11 000**	1
11001000 00010111 000**11**	2
Otherwise	3

An example from telecommunications

- Every subscriber has a **unique address** – as defined by **ISDN numbering plan** (E164 standard)
- Consider a Vodacom subscriber number 082 123 4567.
- Within SA the number **82 123 4567** is unique
- South Africa also has a country code assigned as **27**
- Thus the globally unique number is **27 82 123 4567**
- Incidentally, the 0 is just a trunk access code, indicating the destination dialled is national.

Configuring charging bands

- The aim is to configure **different charging bands** dependent on the destination dialed.
- Thus the following charging plan is required:

Destination	**Price per min**
Vodacom subscriber	1.00
Cell-C subscriber	1.50
MTN subscriber	2.00
Destination in U.K	10.00
Destination in U.S	15.00
Vodafone partner in U.K	7.00

- This charging can be done by using prefixes.
- The longest prefix matched is the chosen tariff.
- What is the flaw with the method below for SA ?

Destination	**Prefix**	**Price per min**
Vodacom subscriber	2782, 2772	1.00
Cell-C subscriber	2784	1.50
MTN subscriber	2783	2.00
Destination in U.K	44	10.00
Destination in U.S	1	15.00
Vodafone partner in U.K	44171	7.00
Other SA destinations	**27**	**2.50**

Tree indexing for performance

- The longest prefix search is also termed a **prefix-tree** or **best fit** search.
- The reason for naming it prefix tree is that the data is often indexed in a **prefix tree to make searching more efficient**.

Destination	**Prefix**	**Price per min**
Other SA	27	2.50
Vodacom	2782	1.00
Vodacom discounted	2782 123	0.80
U.K.	44	10.00
Vodafone partner	44171	7.00