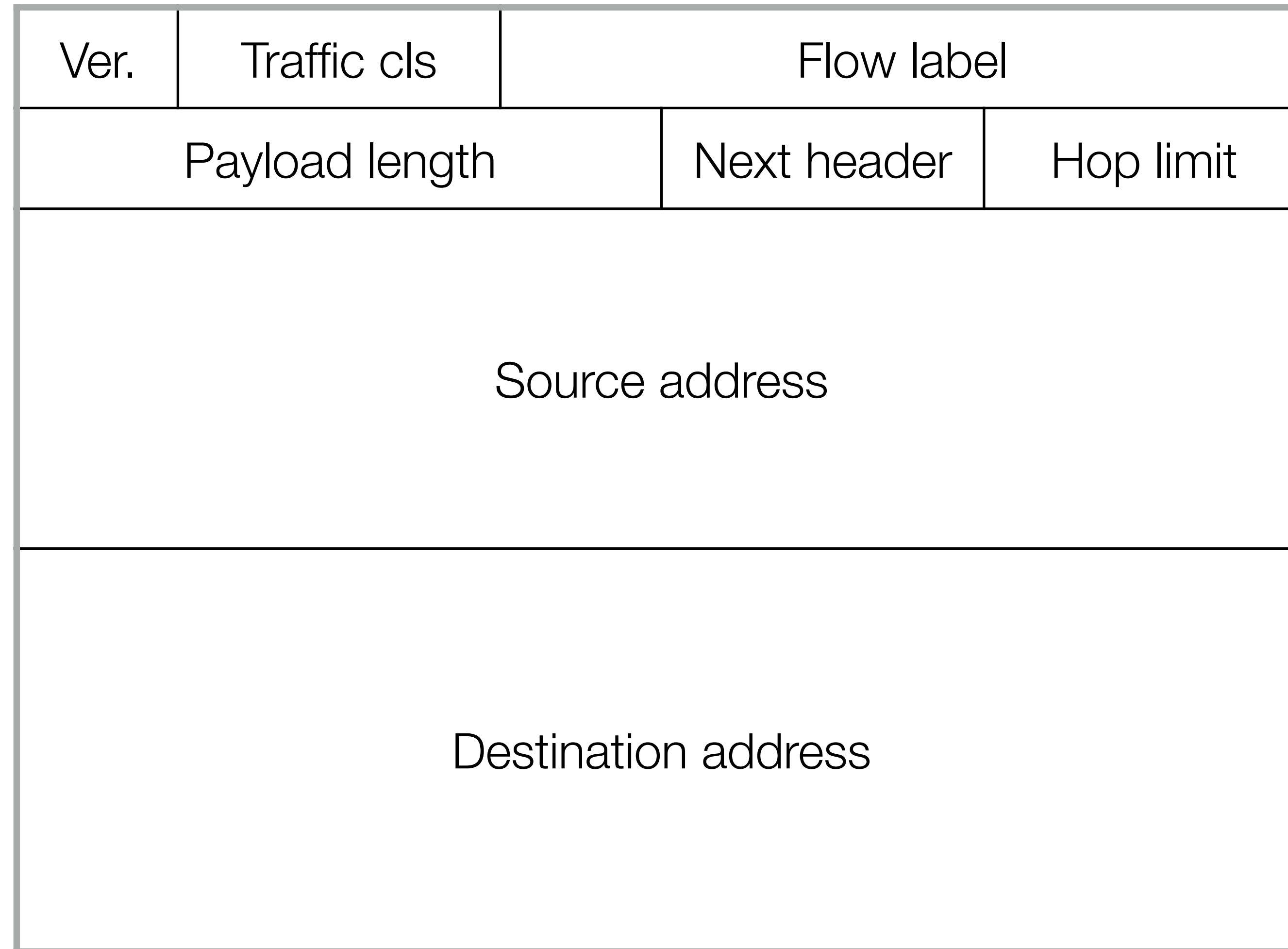# CS 725/825 & IT 725
Lecture 19
Network Layer

November 12, 2025

IPv6 - Protocol Design

▸ Keep the good stuff...

– unreliable datagram service

– TTL, TOS (for compatibility)

▸ Eliminate the unnecessary...

– no fragmentation (only as an option)

– no header checksums

▸ Address the issues...

– longer addresses and more

IPv6 Header

Ver.	Traffic cls	Flow label		
Payload length			Next header	Hop limit
Source address				
Destination address				

IPv6 Address Representation

▸ An IPv6 address is represented by 8 groups of 16-bit hexadecimal values separated by colons (:)

▸ Can be abbreviated:

– omit leading zeroes in a 16-bit value

– replace one group of consecutive zeroes by a double colon

▸ Example:

– 2606:4100:38c0:9::5   vs 2606:4100:38c0:0009:0000:0000:0000:0005

Special Use IPv6 Addresses

▸ ::/128 - Unspecified address

▸ ::1/128 - Loopback address

▸ ::FFFF:0:0/96 - IPv4-mapped address

▸ FE80::/10 - Link-local unicast

▸ FF00::/8 - Multicast

Routing

▸ Approaches:

– First find a path from source to destination and then follow it… (Source Routing)

– Go to the first corner, ask for direction to the next corner that is on the way to the destination*. Repeat until you reach the destination… (Hop-by-hop Forwarding)

* Routing tables give you that information

Routing Table Content

▸ Automatically populated with entries based in local L2 configuration

▸ Static entries - added by the network administrator

▸ Dynamic entries - added by dynamic routing protocols

Static configuration
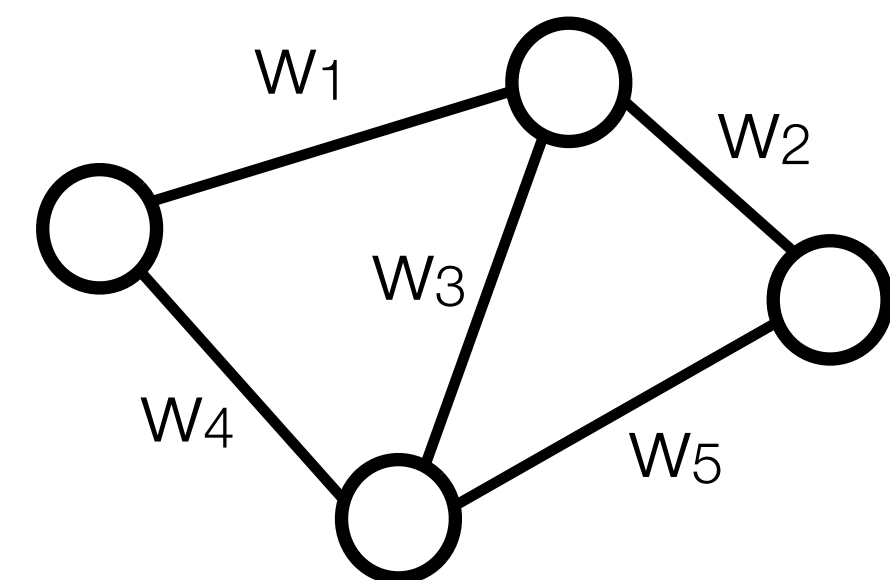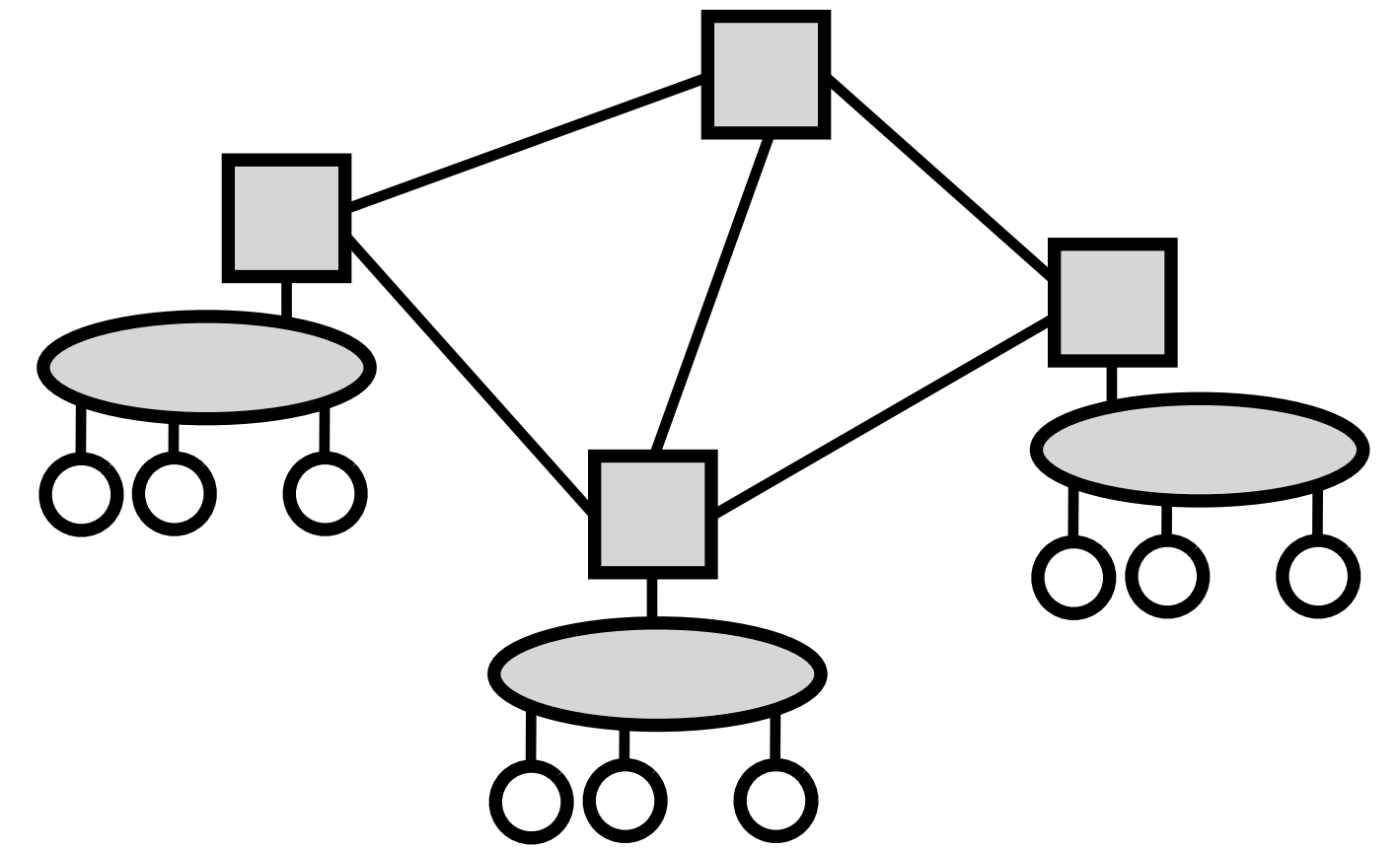
Routing protocol domain

L2 configuration
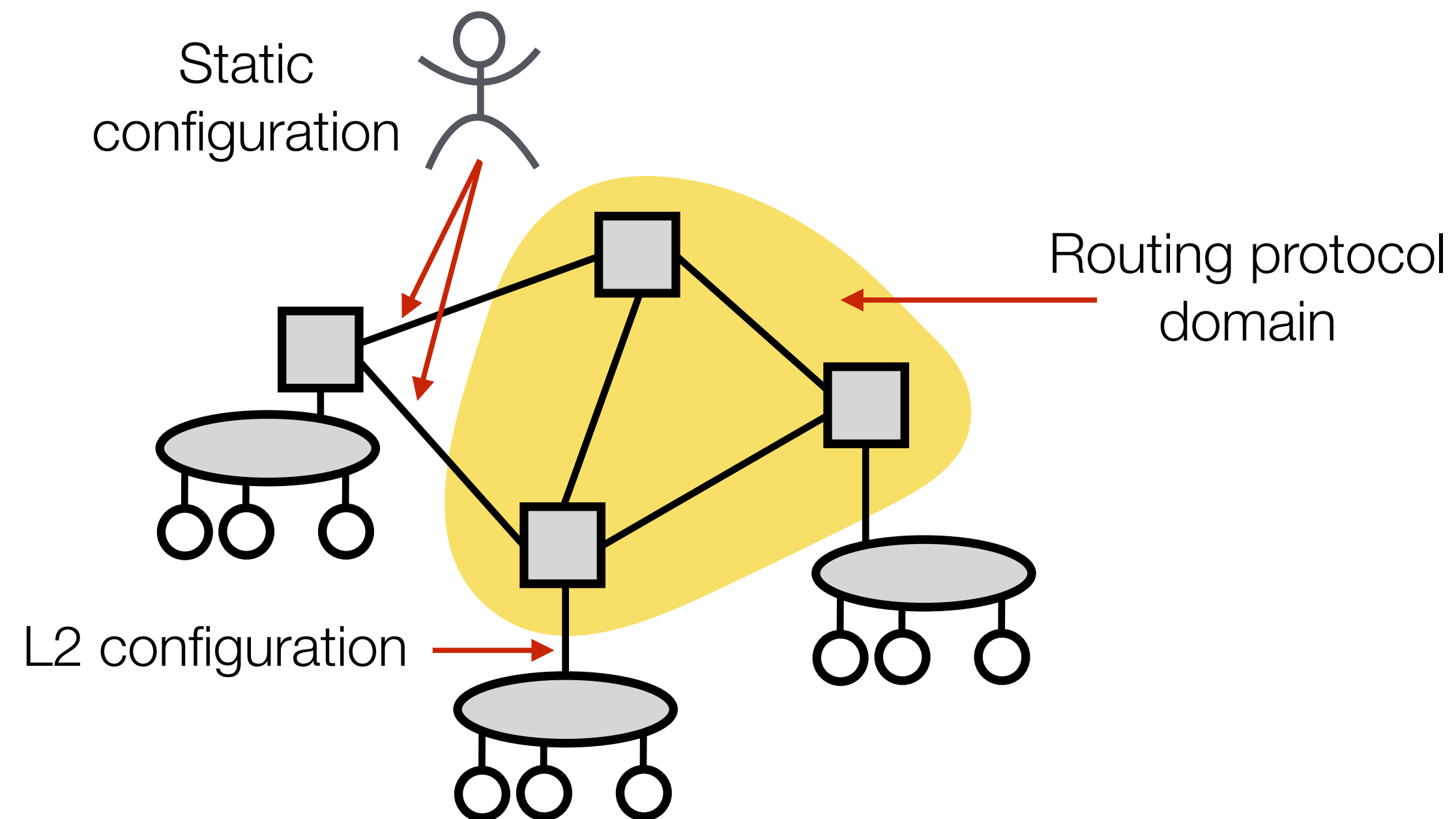
Routing

▸ Finding a good path from source to destination
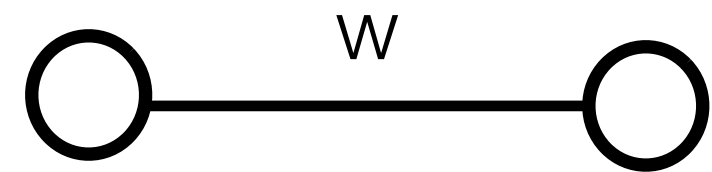
 – topology discovery

 – route selection

▸ Network as a graph...

 – links (point to point and L2 subnets) and routers

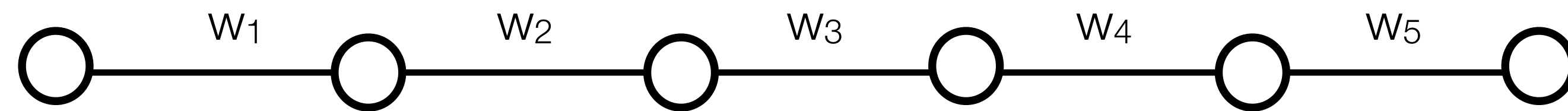 – destinations are typically L2 subnets, not individual nodes

 – links may have "weights"

Link weights

▸ What is a good measure of "weight" of a link?

▸ Weight of a path?

Link & Path Measures

▸ Link measures:

– Throughput / bit rate

– Latency

– Loss probability

– Availability

– Current load

– Security

– Monetary cost

▸ Path measures:

– Sum

   Latency

   Monetary cost

– Min/Max

   Throughput / bit rate

– Product

   Loss probability

Trivial routing methods

▸ Hot potato routing (not practical)

– send to randomly chosen outgoing link…

▸ Flooding (not practical)

– send a copy to every outgoing link…

▸ Limited flooding

– every packet has a sequence number (together with the source address, this makes a copy of a packet uniquely identifiable)

– send a copy to every other outgoing link

– keep track of forwarded packets so that copies are sent only once