



μ

μ μ

μ
μ

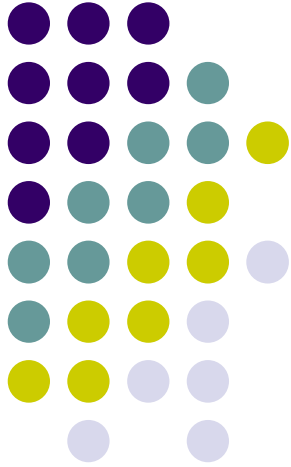
μ

&

.

μ

::



- μ host-host-

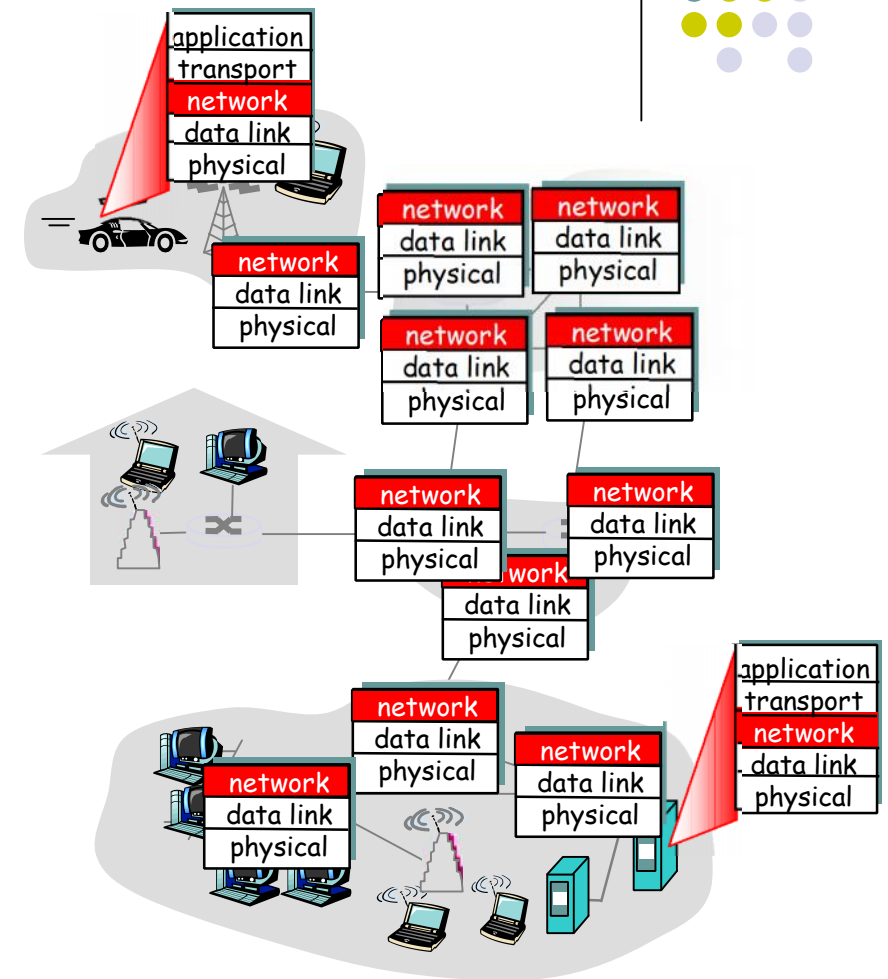
- μ μ μμ

- μ μ μ

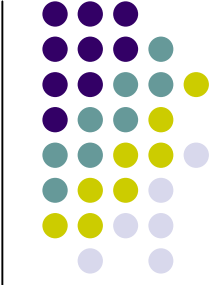
- μ μ μμ

μ

(1)



μ



(2)

μ

$:\mu$

μ



μ

$:$

μ



μ

$\mu .$



μ

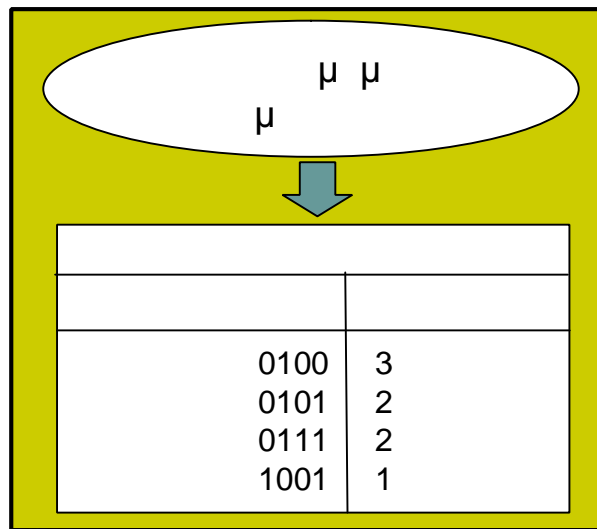
μ

μ

3



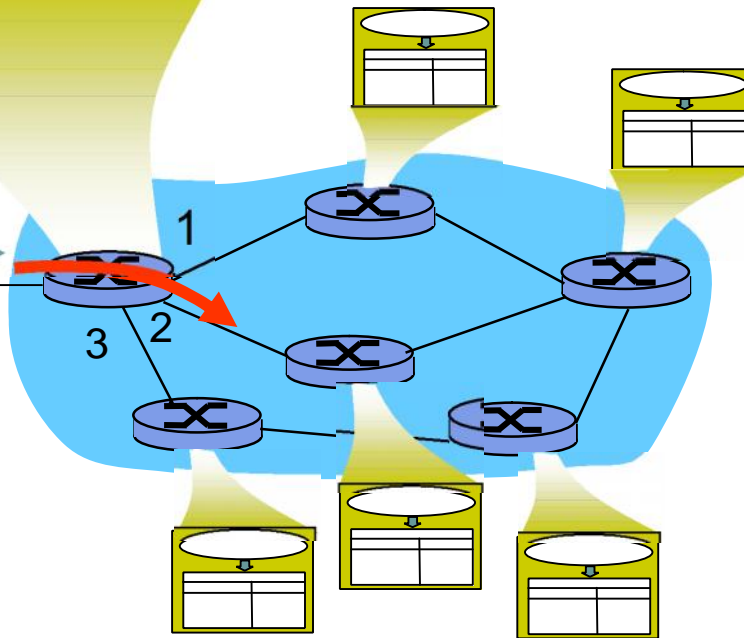
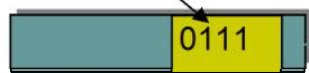
μ



μ

μ

ίδα
πακέτου



μ



μ

μ

μ

μ

$\mu\mu$

μ

μ

μ

μ

μ

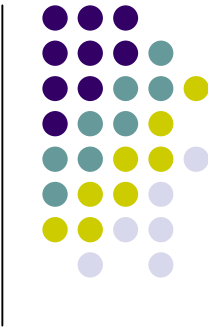
μ

μ

μ

μ





μ

μ



μ

μ

, μ

μ
μ

μ

,

μ

μ

«

»

μ

μ

μ



«

»

μ



μ

(. .

μ

,

)

μ

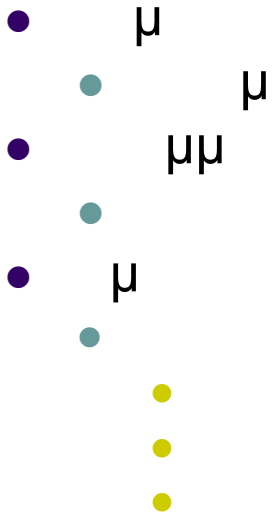
μ

μ



(1)

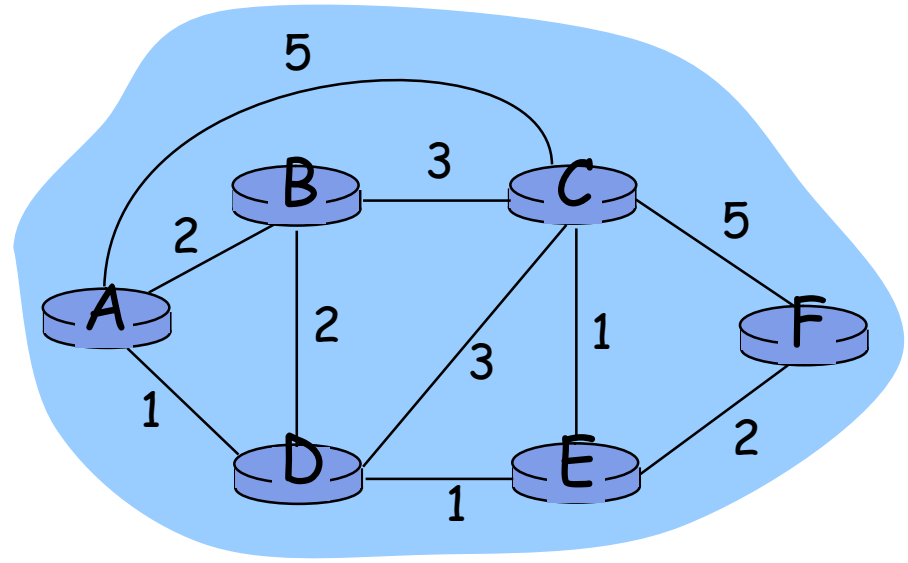
μ



μ

μ

μ



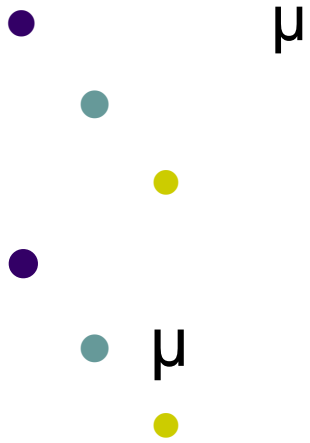
μ

7



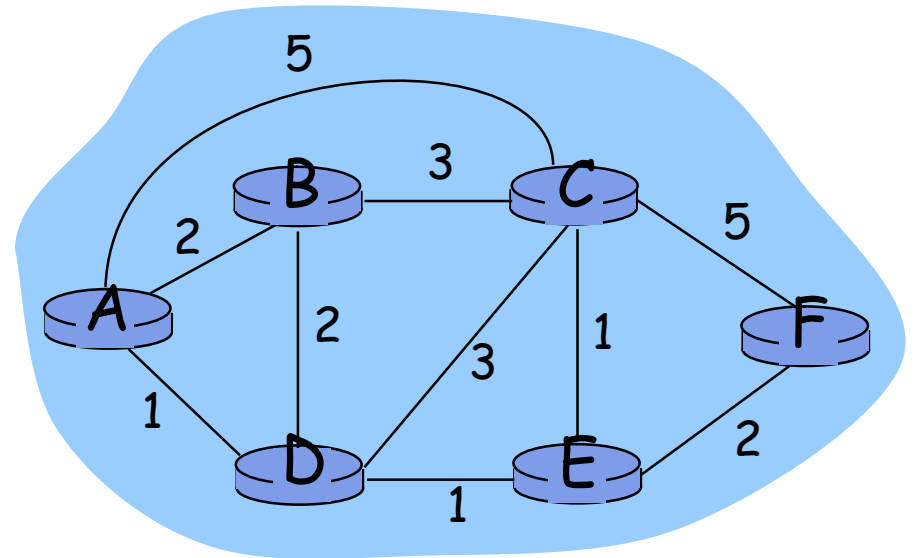
μ

(2)



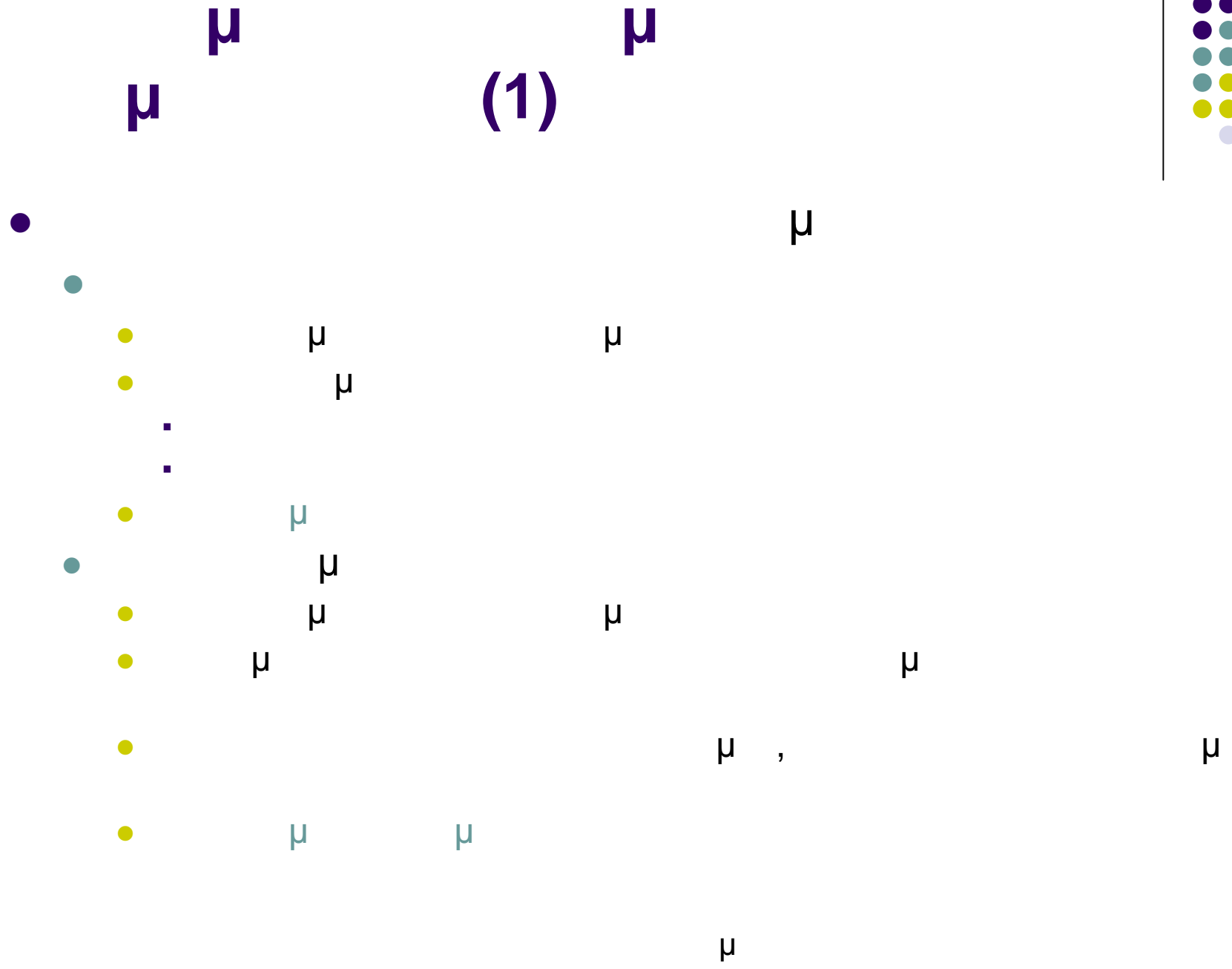
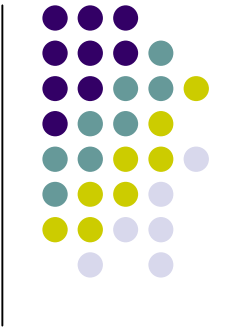
μ
C: ADEC

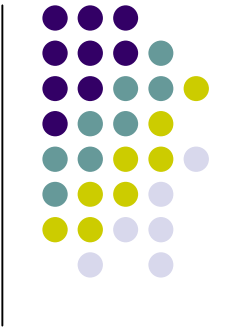
μ
 μ
C: ABC



μ

8





μ

μ

(2)

μ

μ

μ

μ

μ

μ

μ

μ

μ

μ

μ

μ

μ

μ

μ

μ

μ

μ

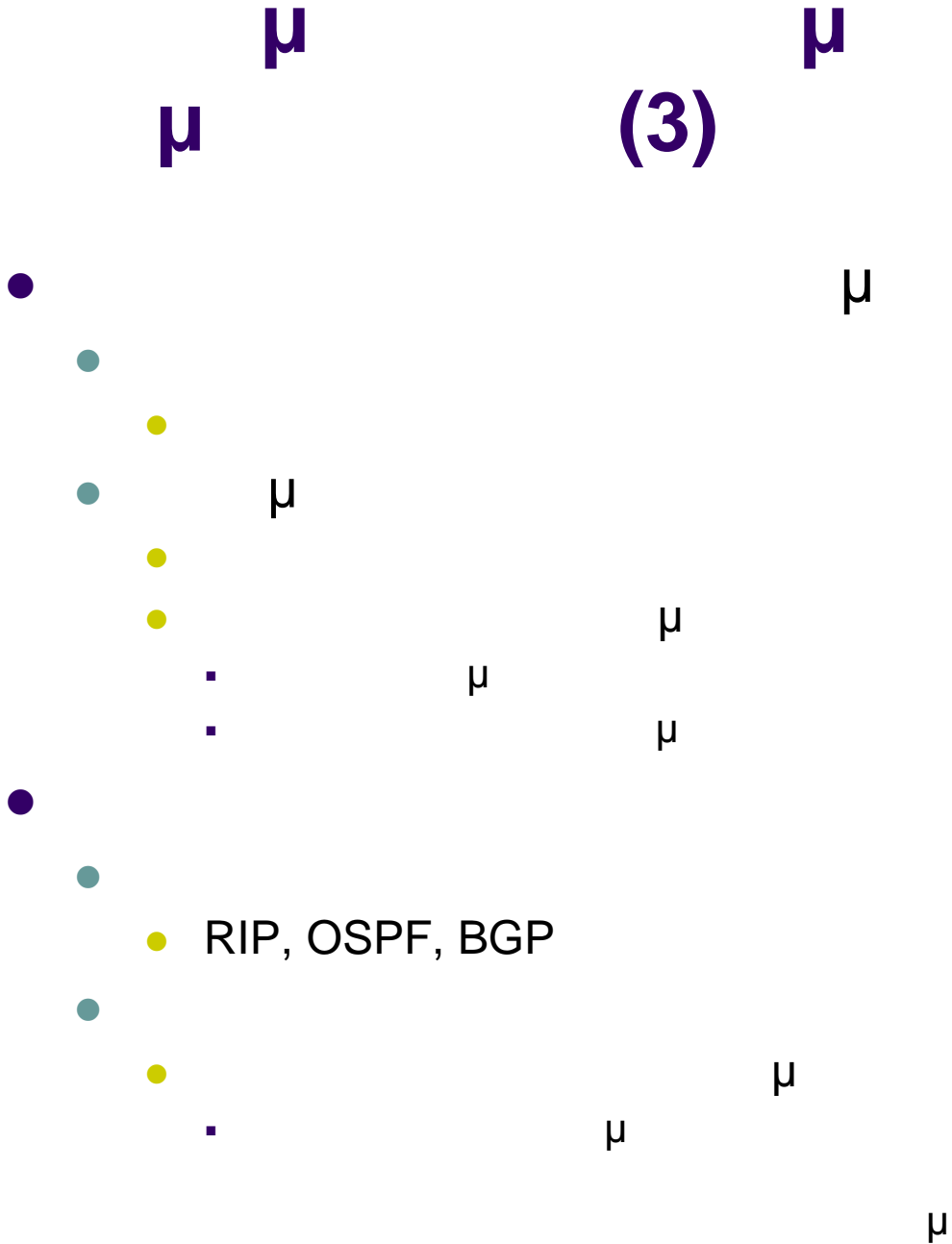
μ

μ

μ

μ

μ

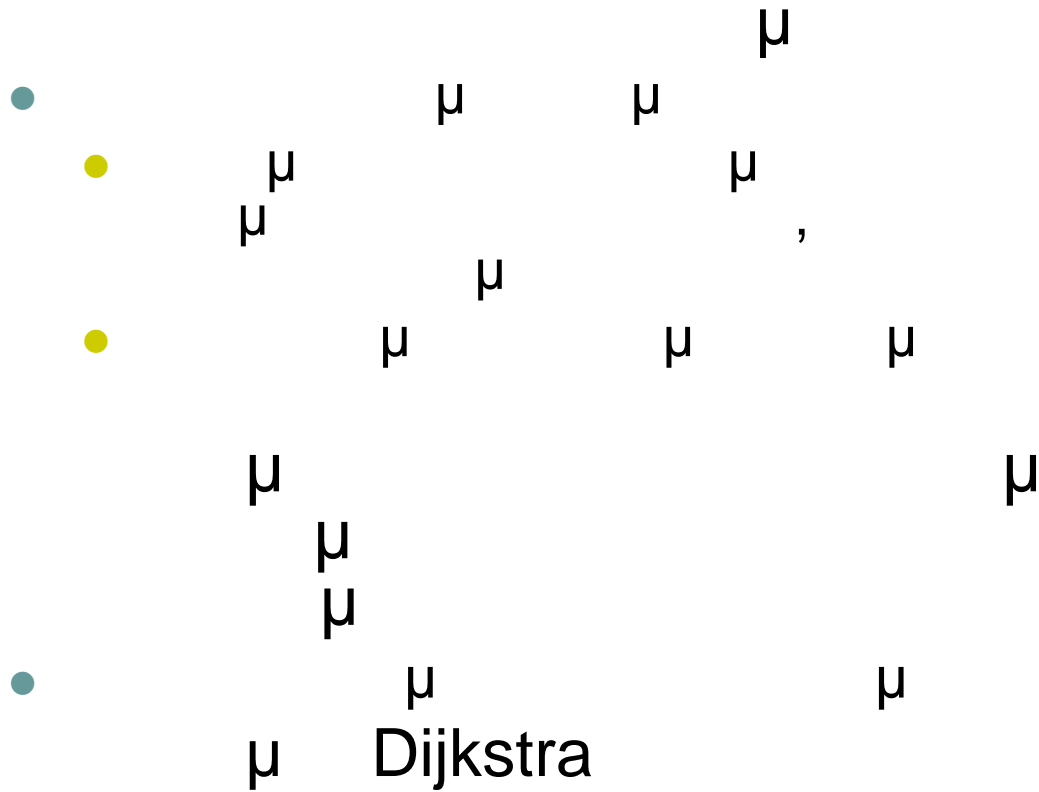




μ μ
(1)

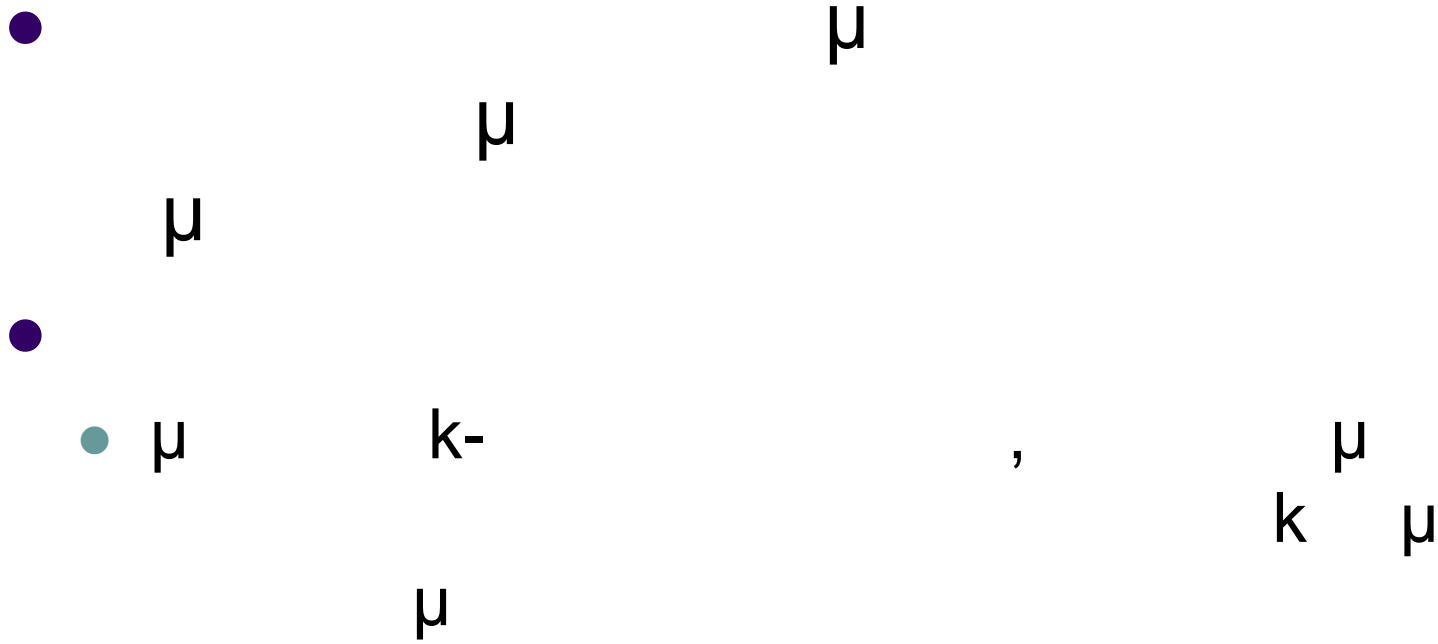
- Link State (LS)

-



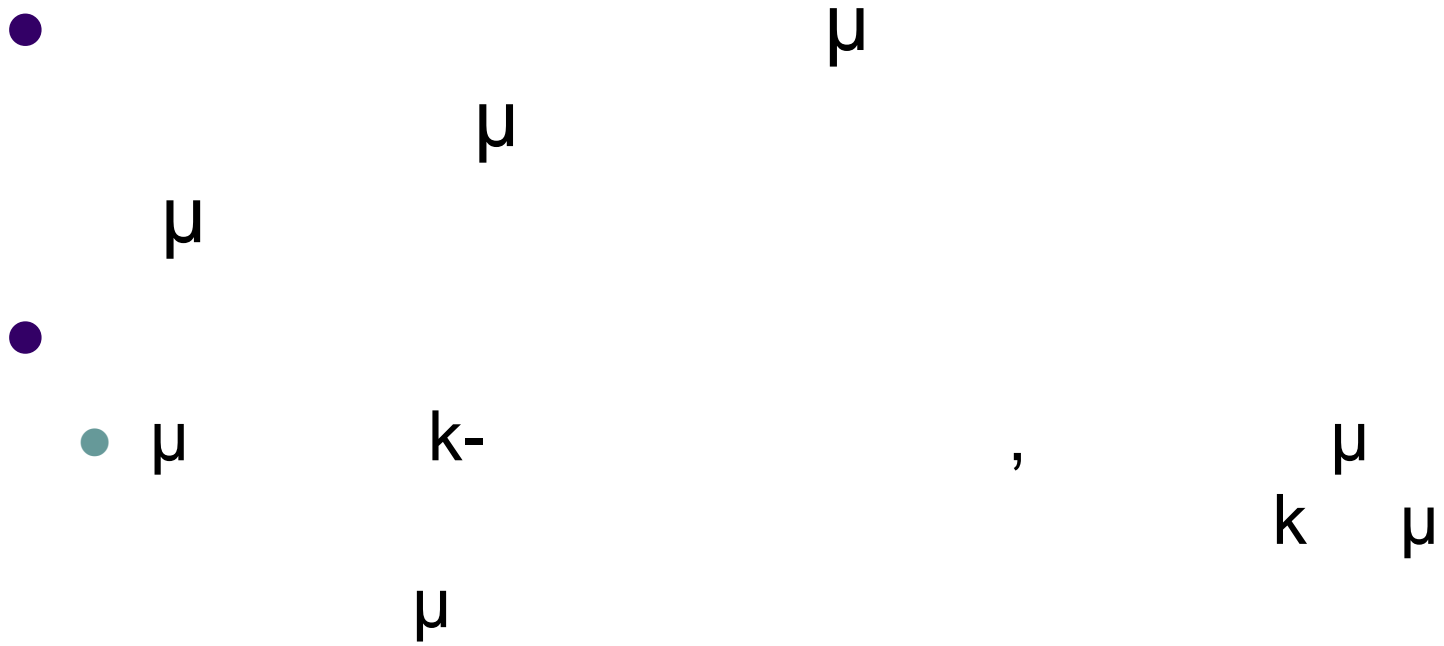


μ Dijkstra (1)





μ Dijkstra (2)





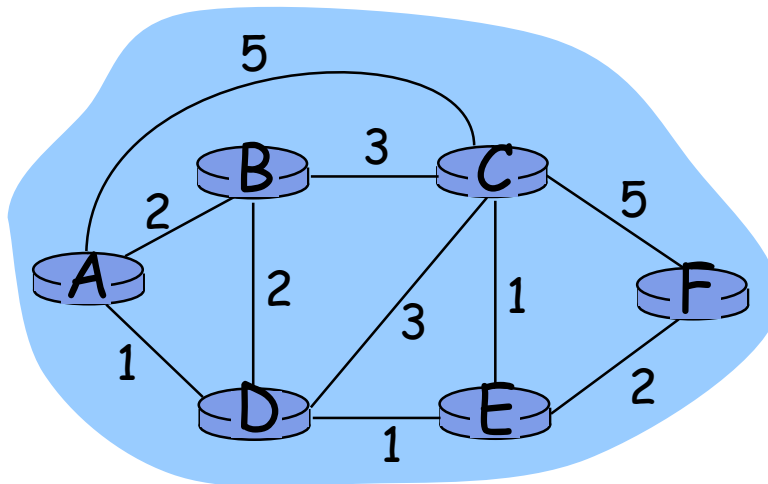
μ Dijkstra (3)

```
1 Initialization:  
2 N' = {u}  
3 for all nodes v  
4   if v adjacent to u  
5     then  $D(v) = c(u,v)$   
6     else  $D(v) =$   
7  
8 Loop  
9   find w not in N' such that  $D(w)$  is a minimum  
10  add w to N'  
11  update  $D(v)$  for all v adjacent to w and not in N' :  
12     $D(v) = \min( D(v), D(w) + c(w,v) )$   
13  /* new cost to v is either old cost to v or known  
14     shortest path cost to w plus cost from w to v */  
15 until all nodes in N'
```



μ Dijkstra - μ

μ	N	D(B),p(B)	D(C),p(C)	D(D),p(D)	D(E),p(E)	D(F),p(F)
0	A	2,A	5,A	1,A		∞
1	AD	2,A	4,D		2,D	∞
2	ADE	2,A	3,E			4,E
3	ADEB		3,E			4,E
4	ADEBC					4,E
5	ADEBCF					

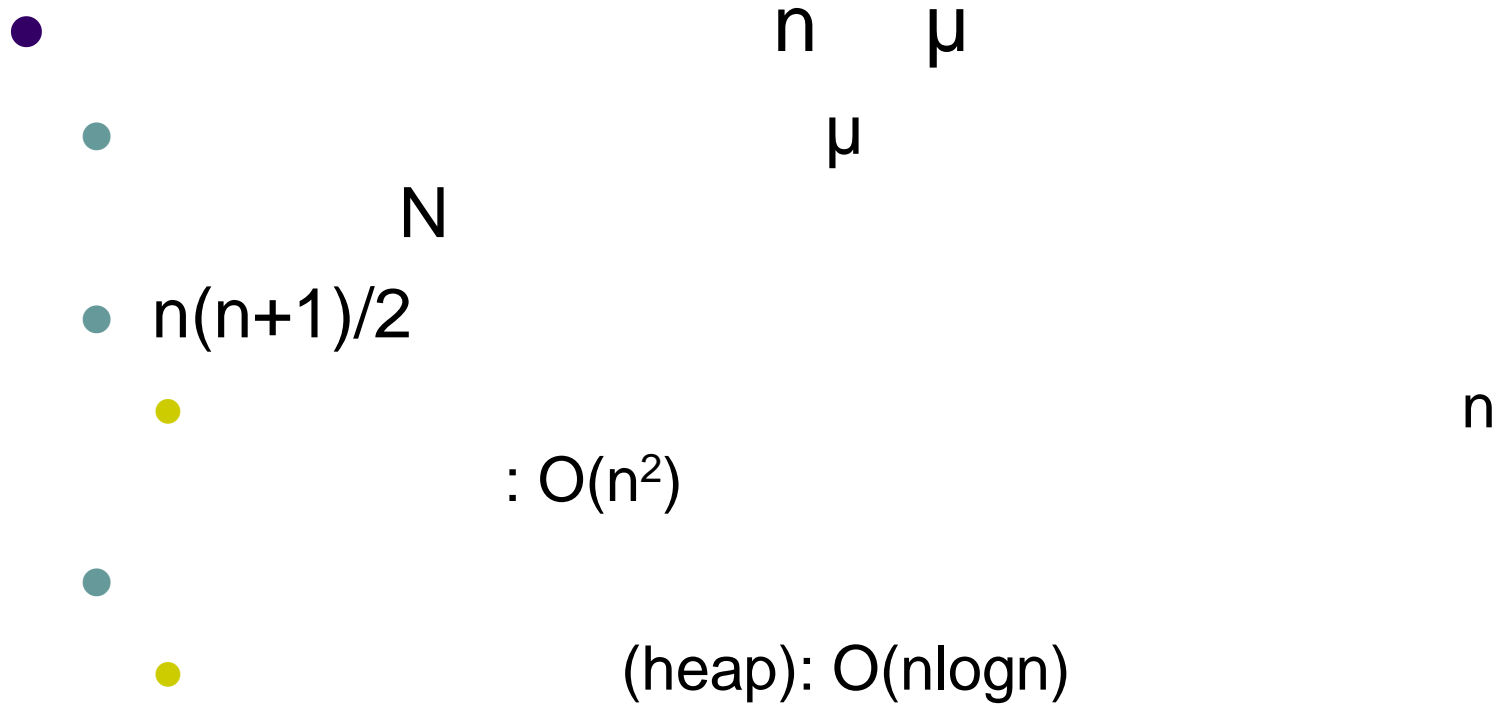


Πίνακας Προώθησης

	επόμενος κόμβος	κόστος διαδρομής
A		
B	B	2
C	D	3
D	D	1
E	D	2
F	D	4



μ Dijkstra -





μ Dijkstra - μ

• μ

•

μ :

μ

μ

•

•

μ

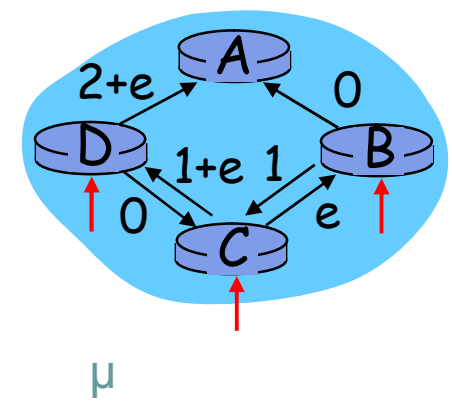
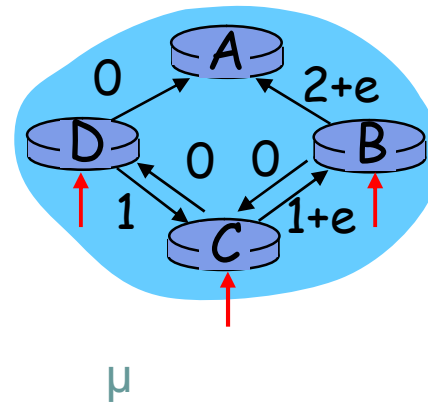
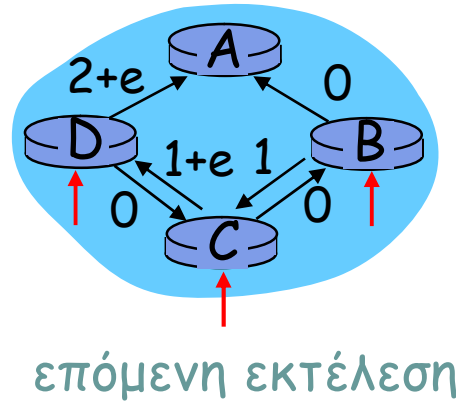
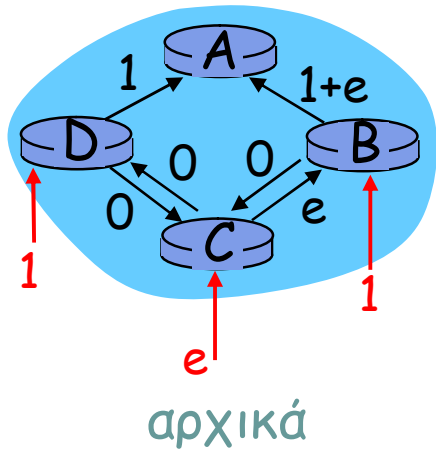
μ

μ

μ

•

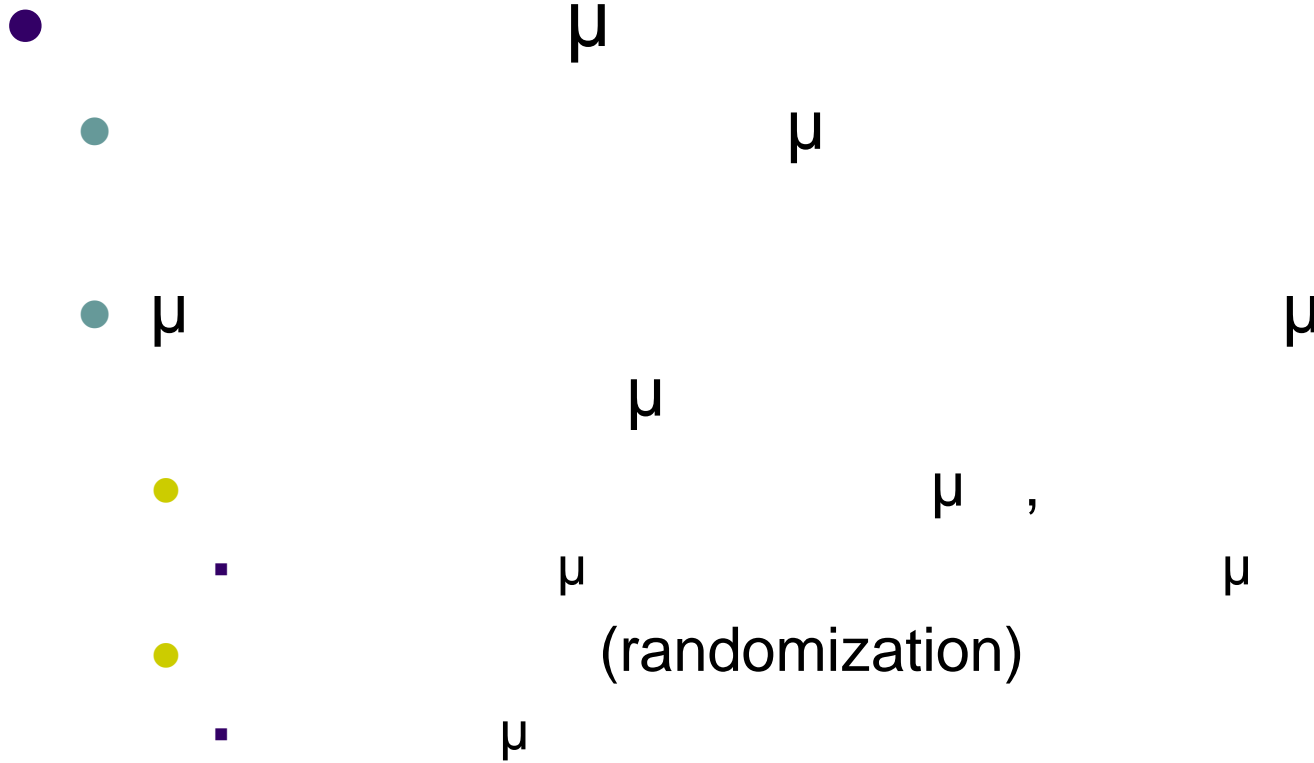
μ



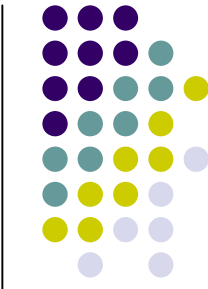
μ



μ Dijkstra -

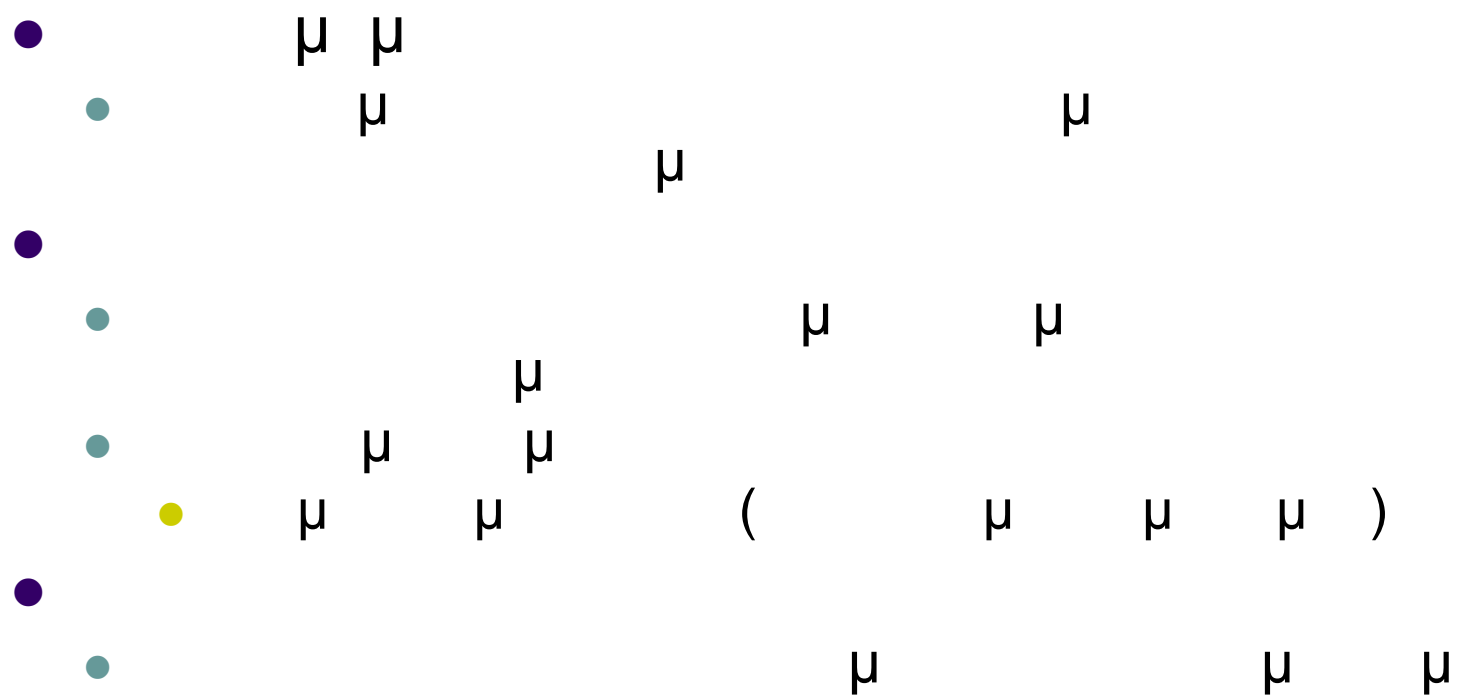


(randomization)



$\mu \quad \mu$
 $\mu \quad (1)$

- Distance Vector (DV)





$$\mu \quad \mu \quad (2)$$

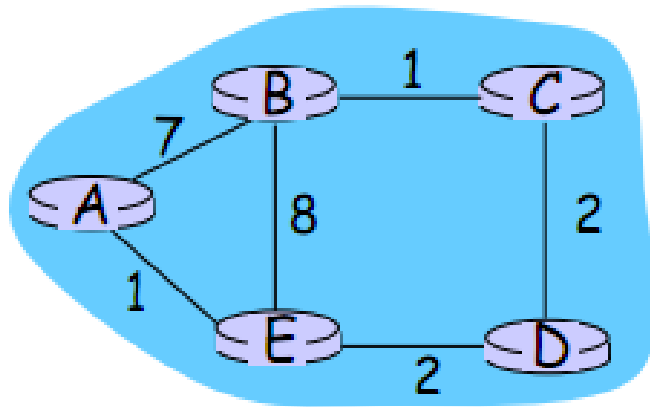
- $\mu \quad \mu \quad :$
- μ
- $\mu \quad \mu \mu \quad \mu$
- $\mu \quad \mu$

- $D^X(Y,Z) = c(X,Z) + \min_w \{D^Z(Y,w)\}$

$Y, \mu \quad Z$



- μ



$D^E()$	A	μ B	μ D
A	1	14	5
B	7	8	5
C	6	9	4
D	4	11	2

- $D^E(A,B) = C(E,B) + \min_w \{D^B(A,w)\} = 8 + 6 = 14$
- $D^E(A,D) = C(E,D) + \min_w \{D^D(A,w)\} = 2 + 3 = 5$
- $D^E(C,D) = C(E,D) + \min_w \{D^D(C,w)\} = 2 + 2 = 4$



μ

-

μ

μ

μ

μ

:

,

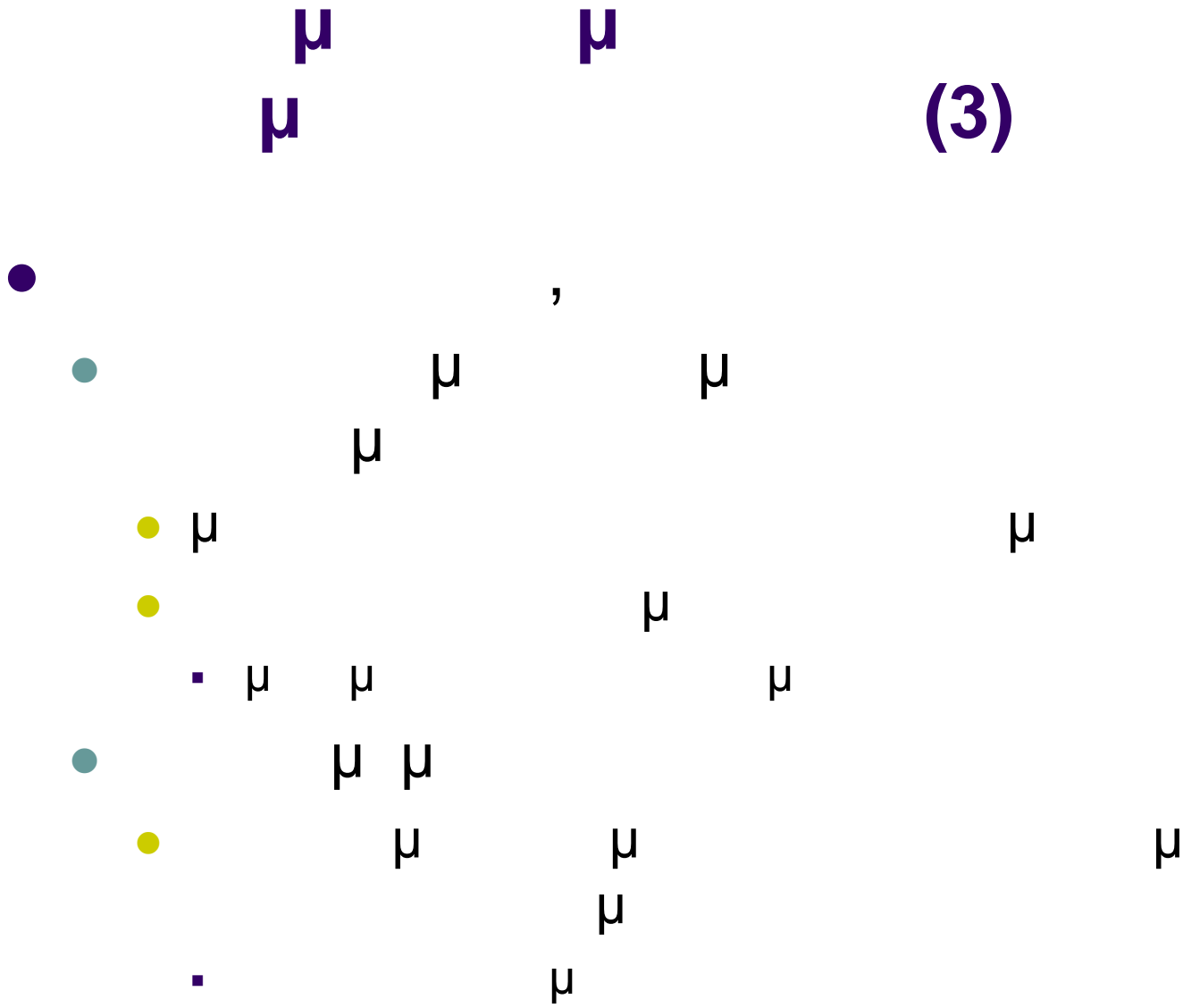
A, 1
 B: D, 5
 C: D, 4
 D: D, 2

$D^E()$	A	B	μ D
A	1	14	5
B	7	8	5
C	6	9	4
D	4	11	2

μ

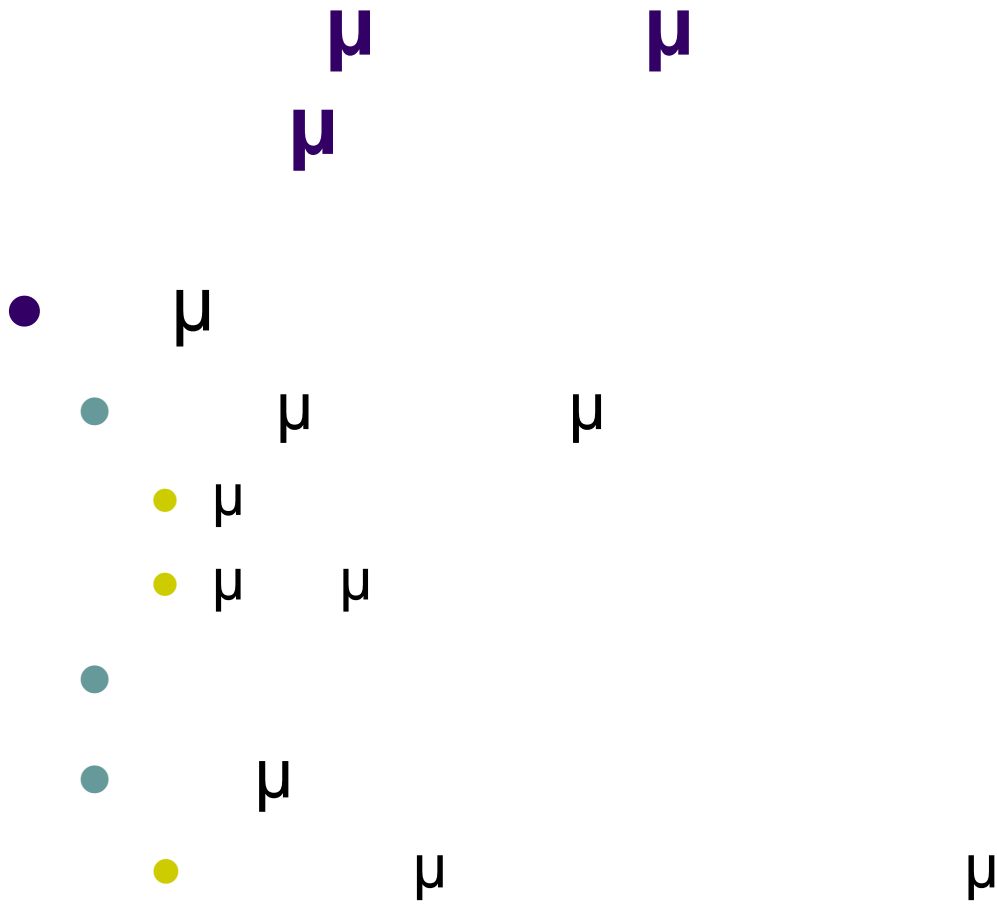


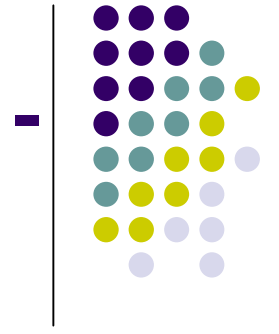
(3)





(4)





μ
 μ
 μ

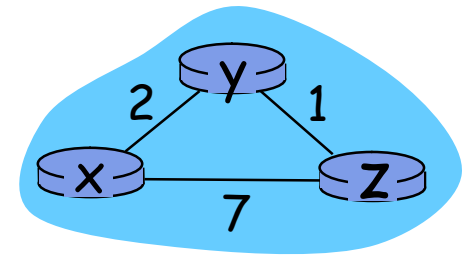
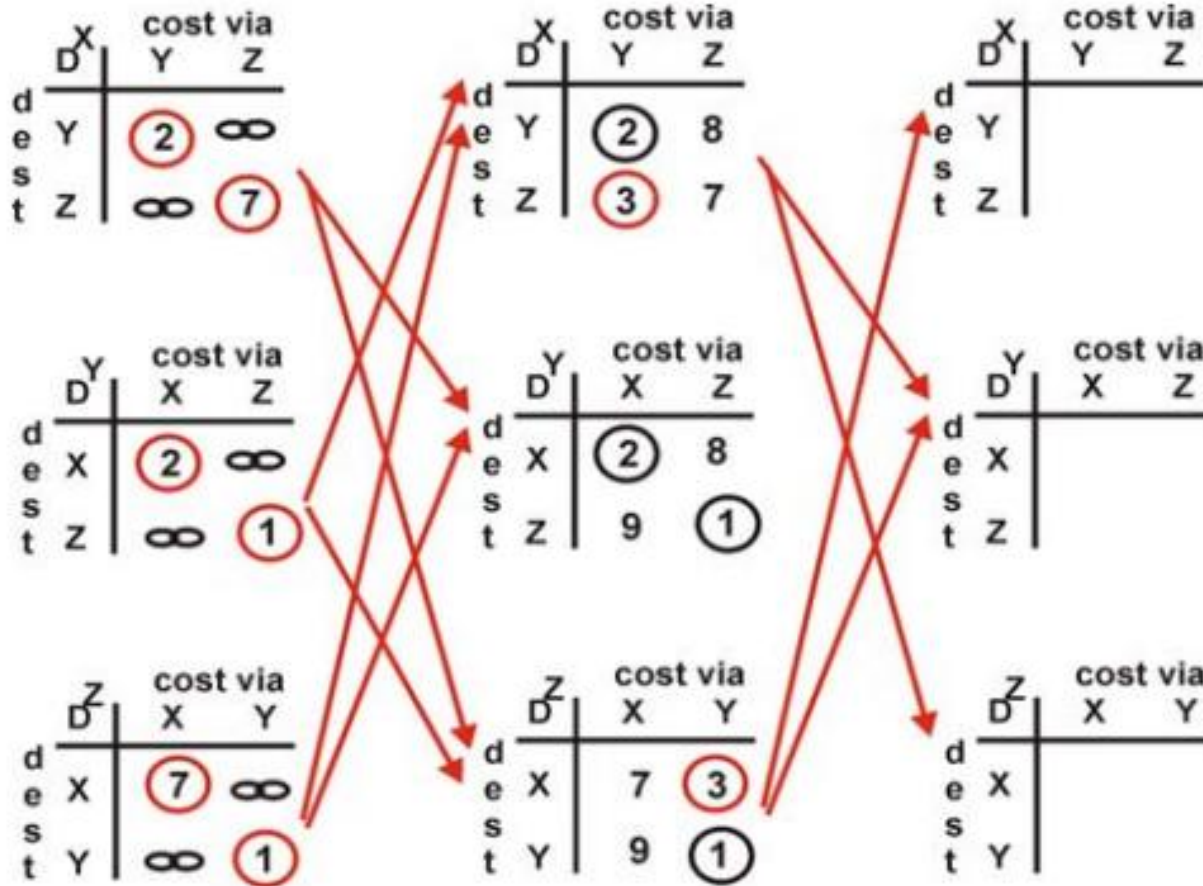
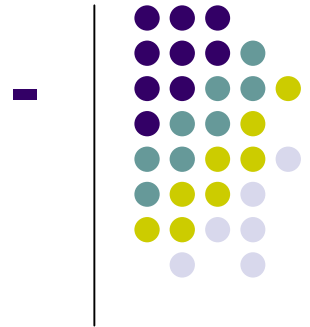
μ
 μ
 μ
 μ
 μ
 μ
 μ
 μ
 μ
 μ

μ

μ

μ
μ

μ



μ

DV –

(1)

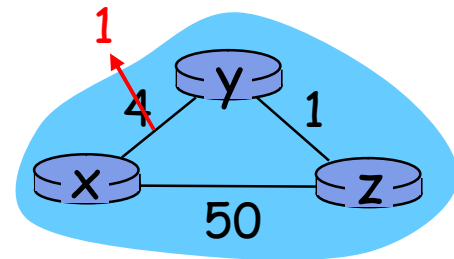
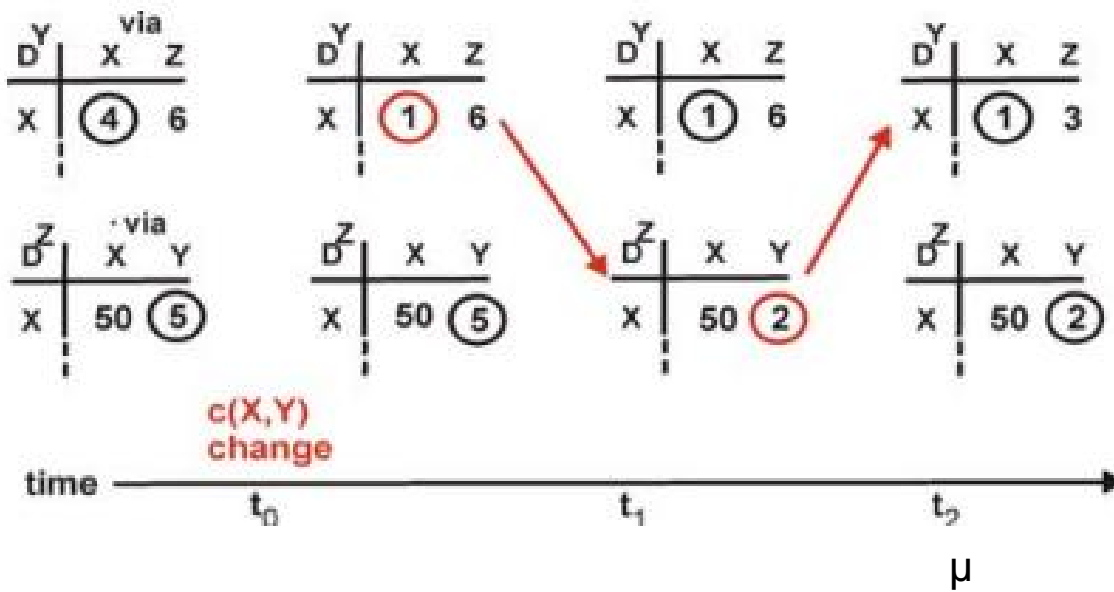


-

• μ (μ)

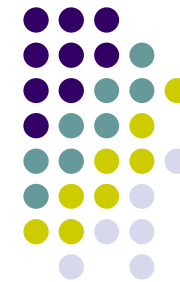
• μ

• μ , μ



DV –

(2)



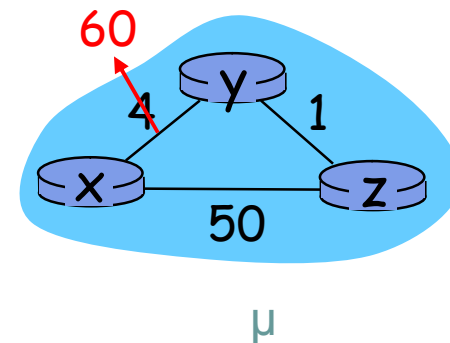
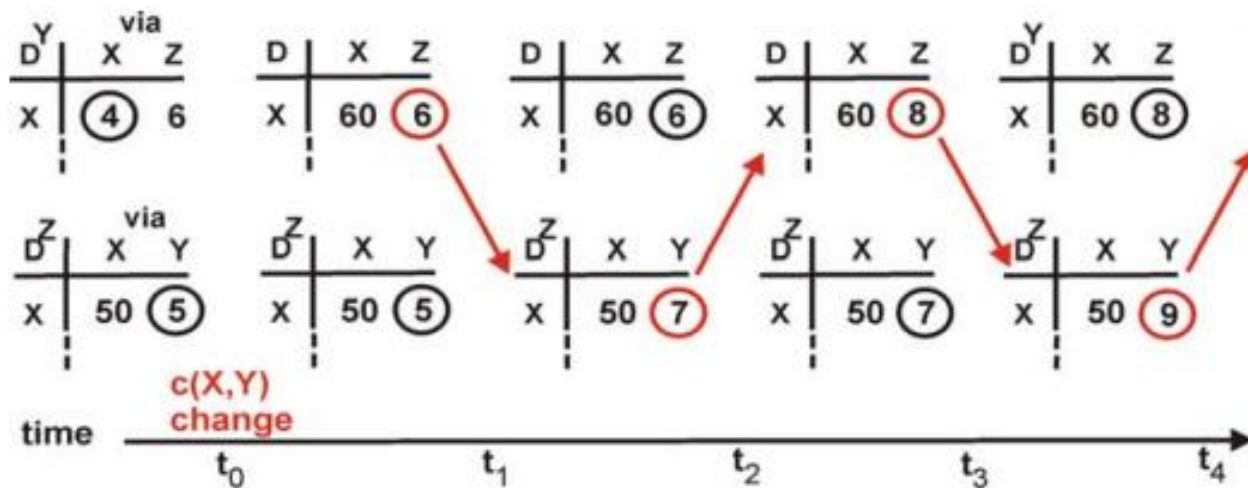
μ

μ

μ « μ

μ

»



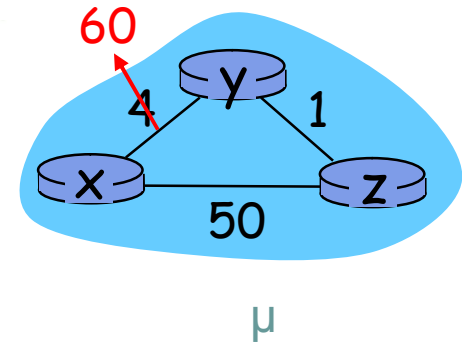
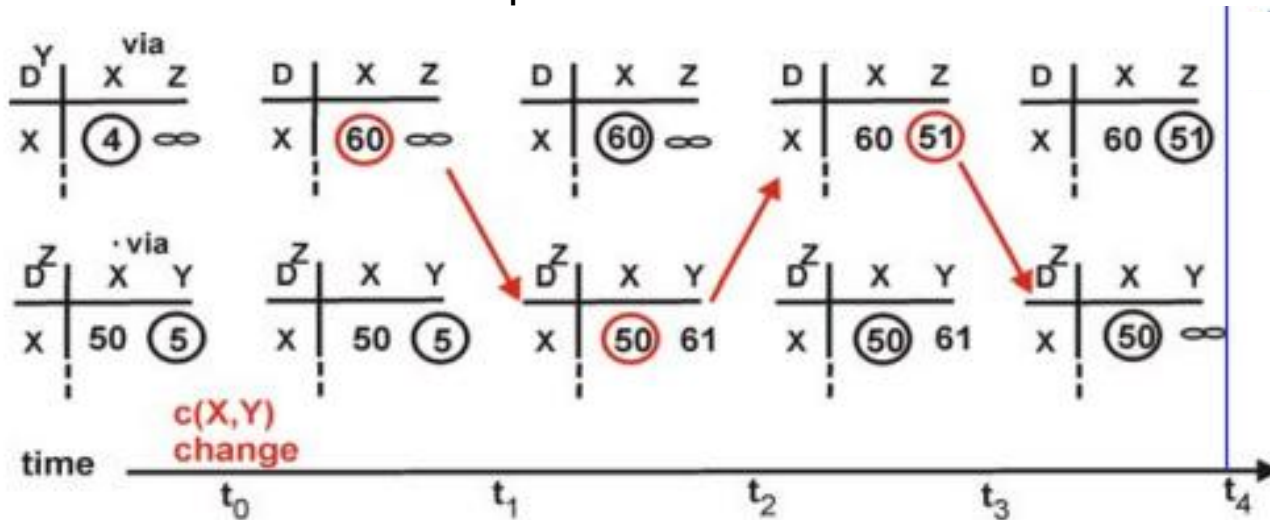
μ



DV – poisoned reverse

- Poisoned reverse

- μ « μ » ()
- ... Y X
- μ « μ μ » μ
- μ
- μ





(1)

μ
 μ

Link State (LS)

Distance Vector (DV)

•

•

•

•

LS: μ

μ

μ

μ

(nE)

•

μ

μ

•

DV:

μ

μ

μ

μ

•

•

•

LS:

μ

$O(n^2)$

•

•

DV:

•

μ

•

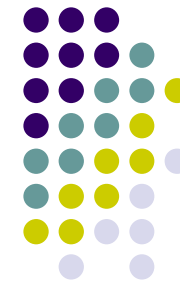
μ

« μ

μ

»

μ



(2)

μ
 μ

μ

μ

LS:

μ

μ

μ

μ

DV:

μ

μ

μ

μ

μ

μ

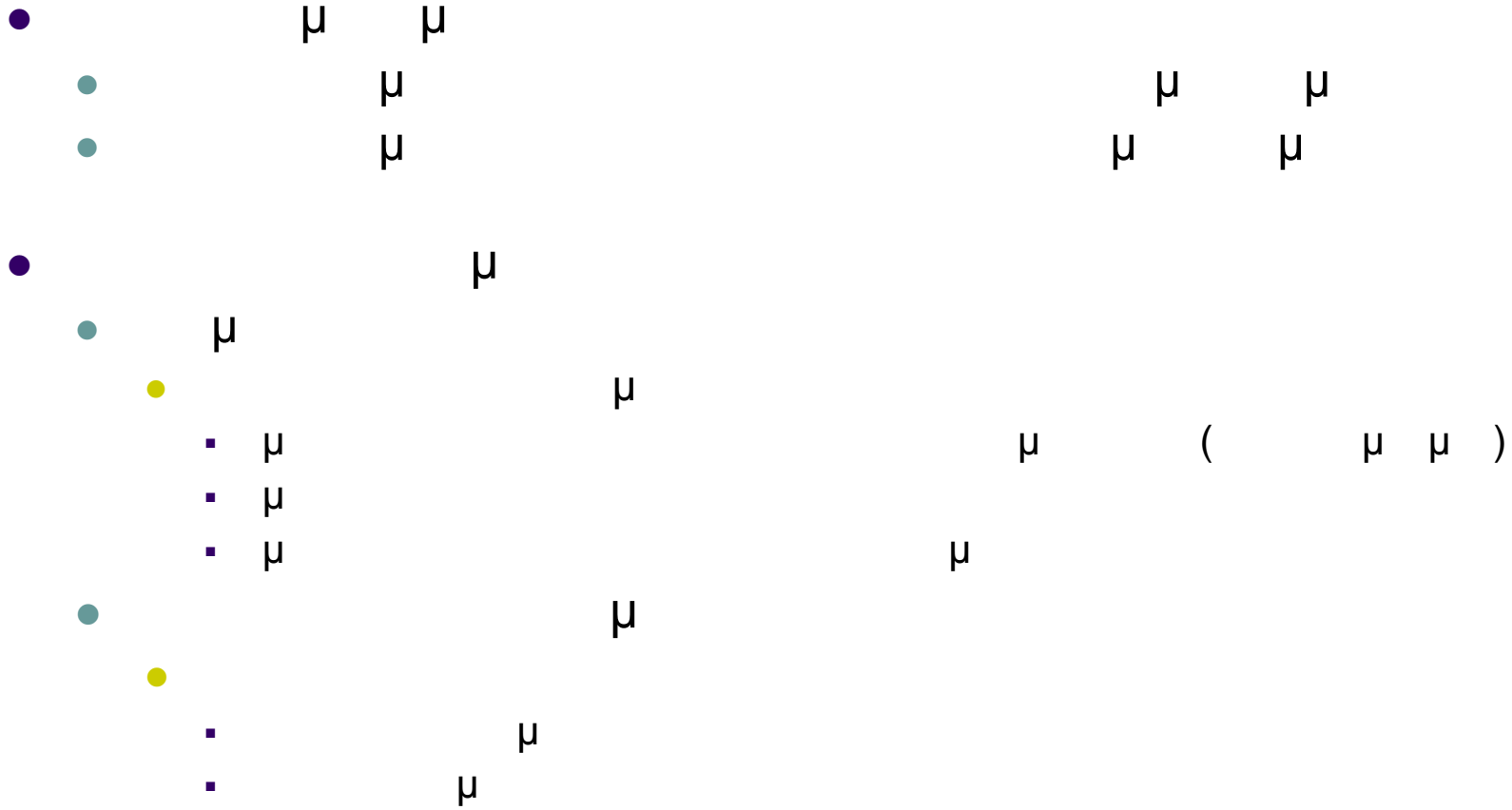
μ

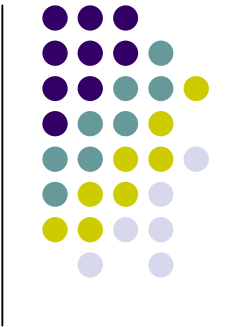
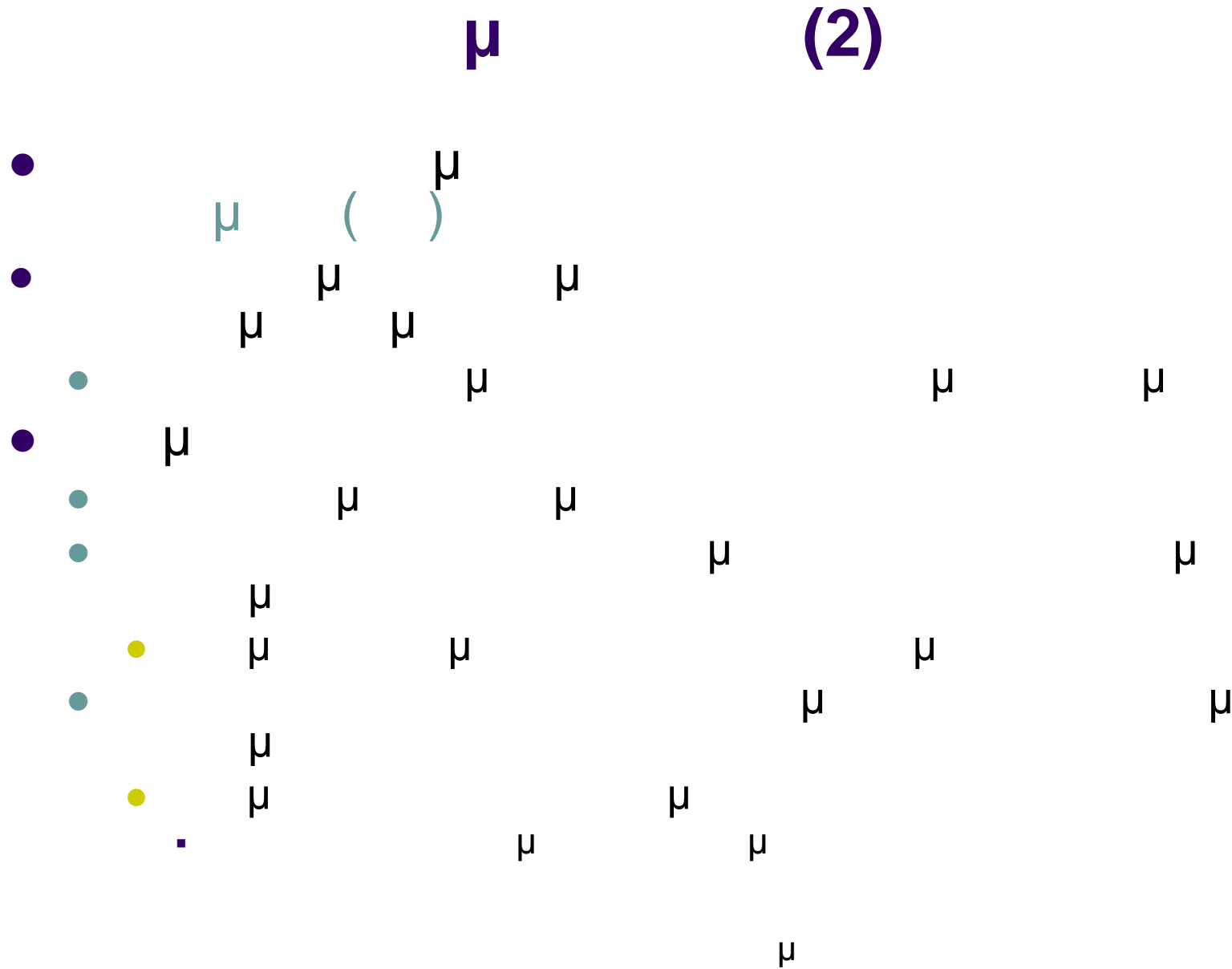
μ



(1)

μ

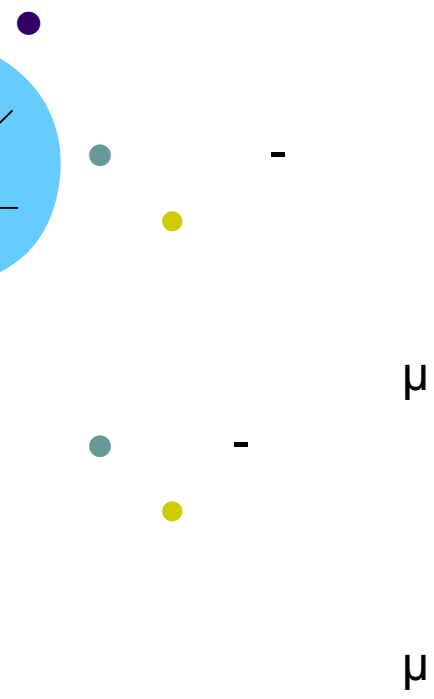
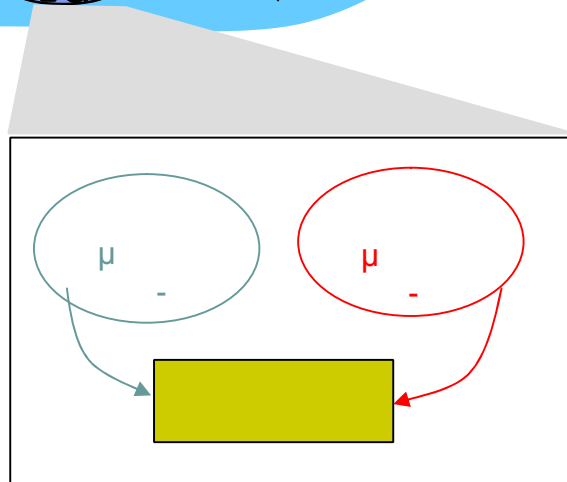
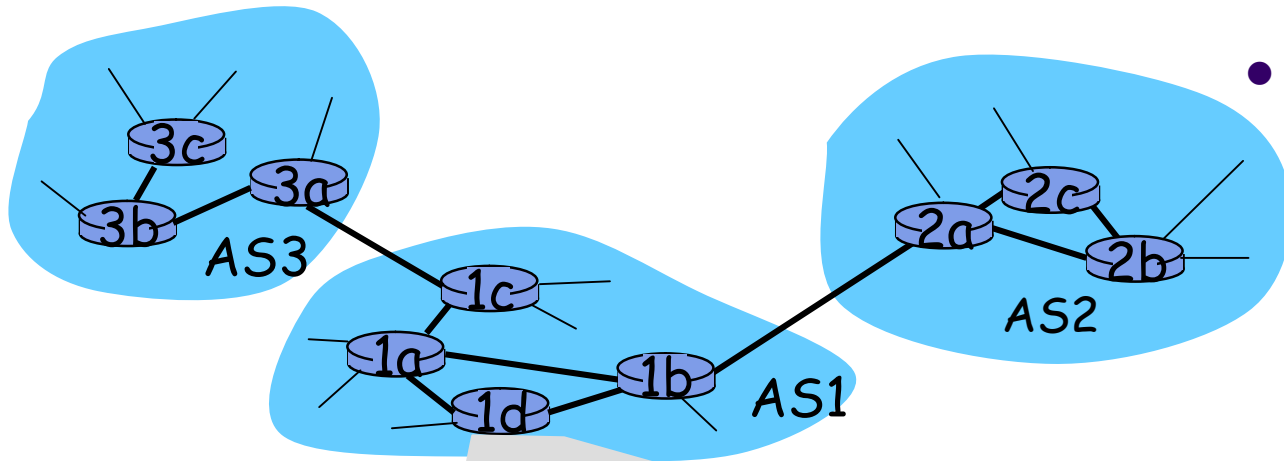




μ



μ (3)





(4)

μ

μ

μ

μ

-

(

)

-

μ

μ

-

μ

μ

μ

μ

μ

μ

μ

μ

μ

μ

μ

μ

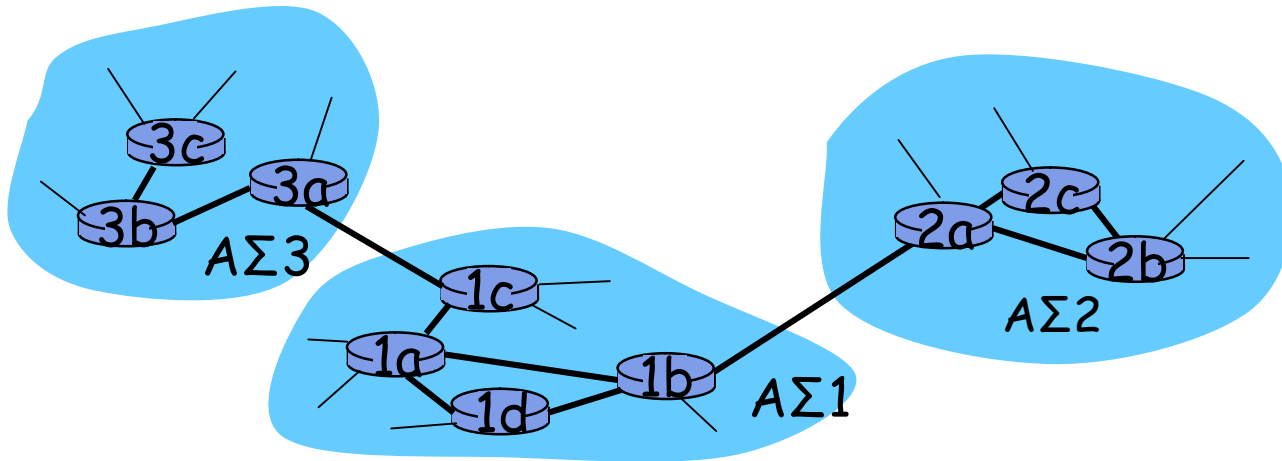
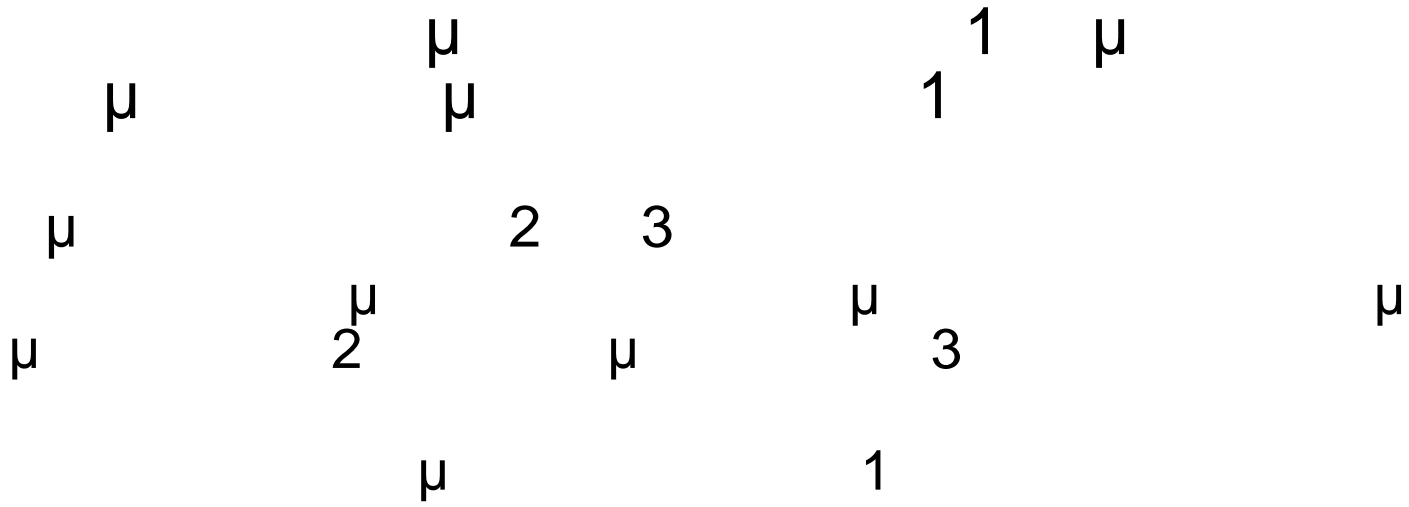
μ

μ



μ

-

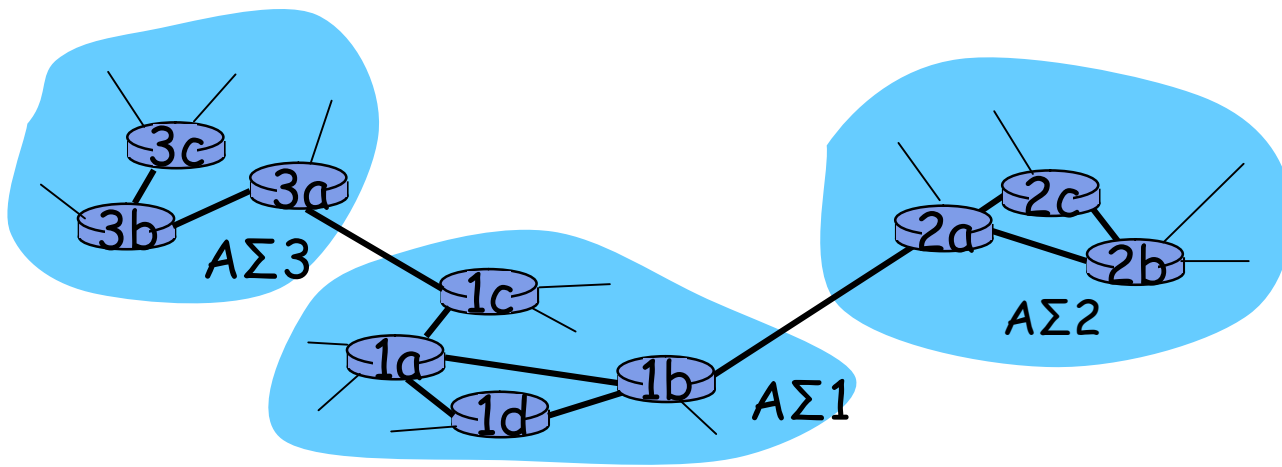
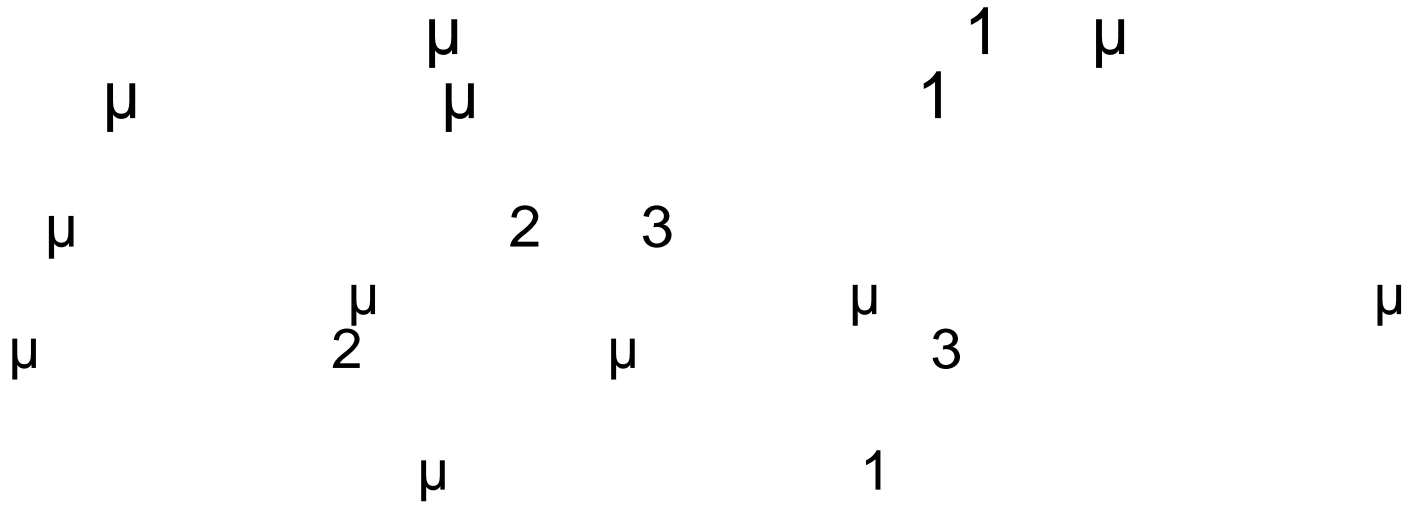


μ



μ

-



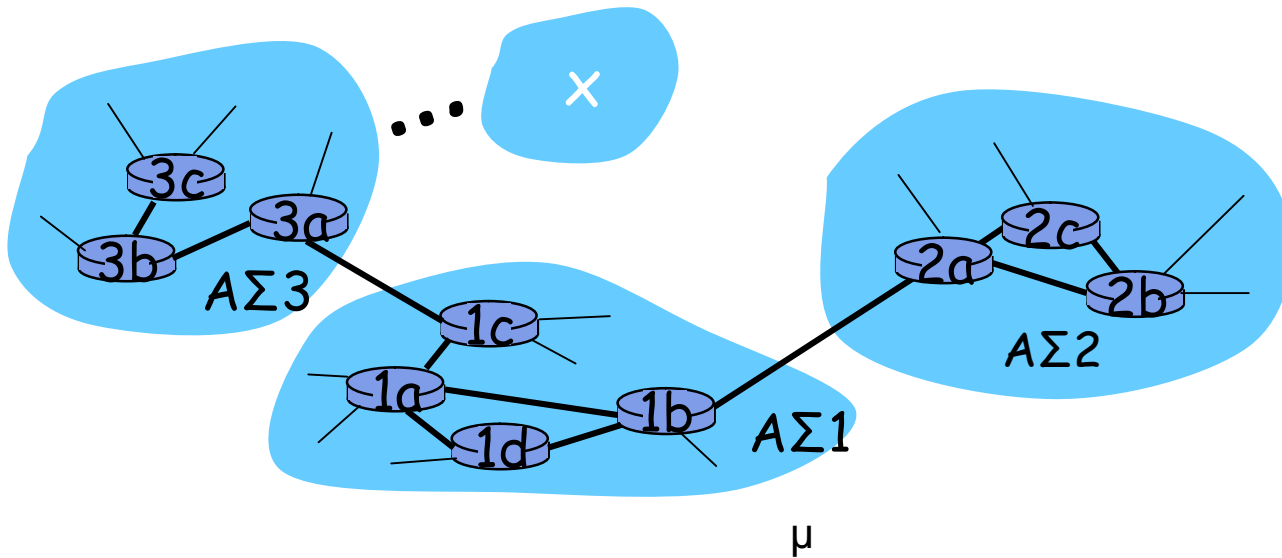
μ



μ - (1)

1d

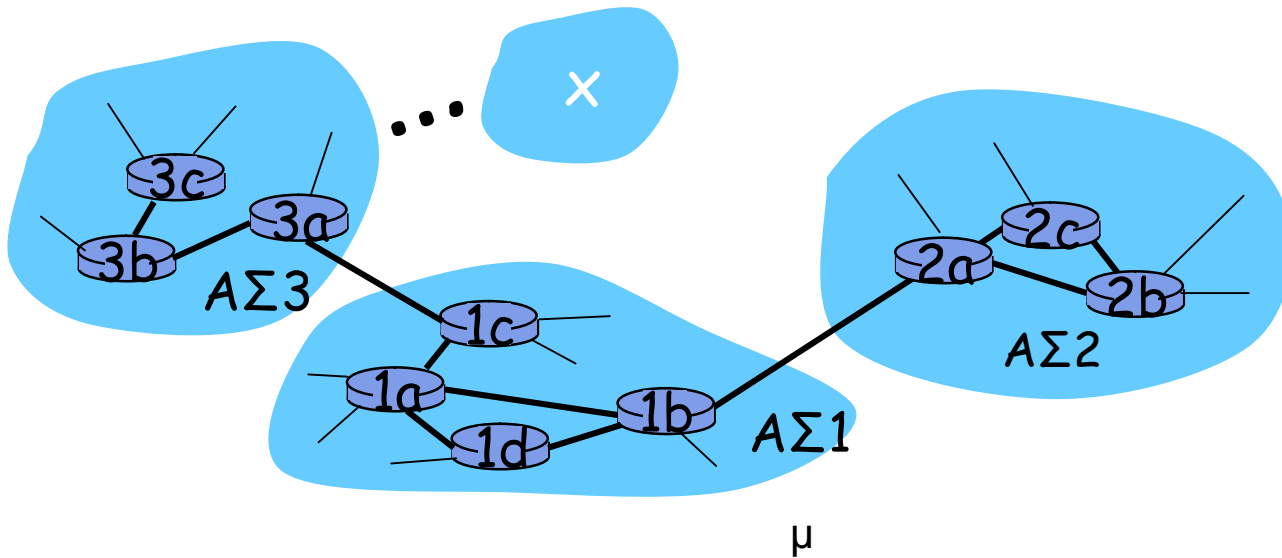
μ μ μ
 \circ μ 1d
 \cdot μ (1c, 1b) 1μ μ
 \bullet 3 (1c) μ 2 (1b) μ μ
 \bullet O μ μ μ





μ - (2)

\bullet μ 1d
 μ | μ
 \bullet μ 1d
 (, l) μ 1c.

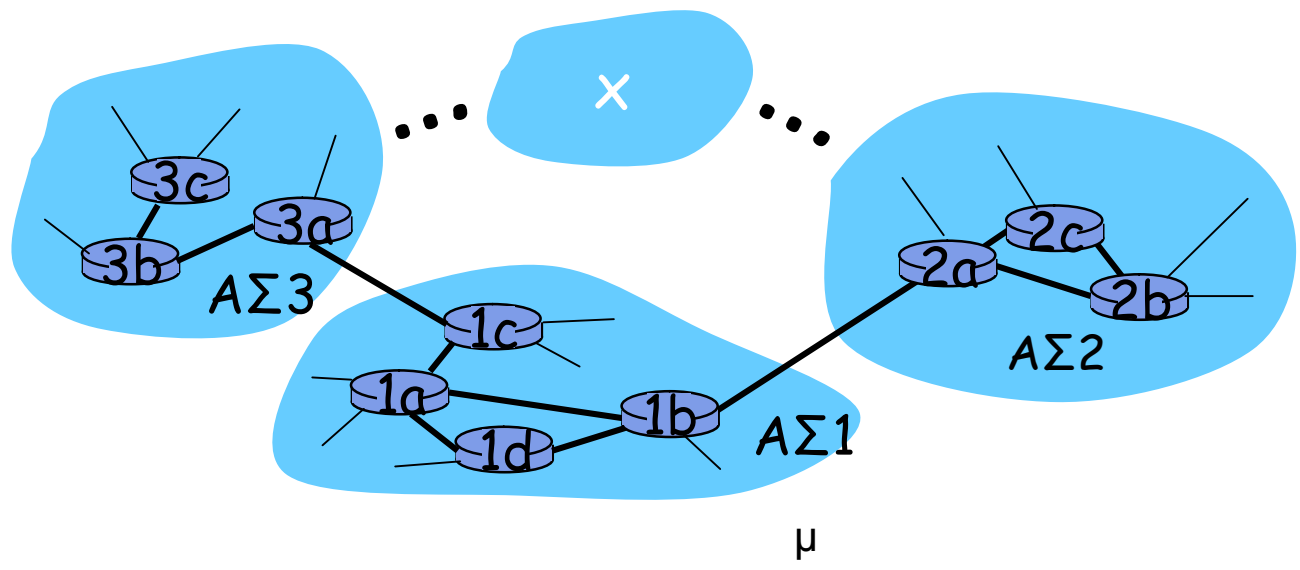


μ μ - (3) -



μ μ μ μ μ μ μ μ
 o μ μ μ μ μ μ μ
 μ μ μ μ μ μ μ μ
 3 (1c) μ 2 (1b) μ μ μ
 μ μ μ μ μ μ μ μ

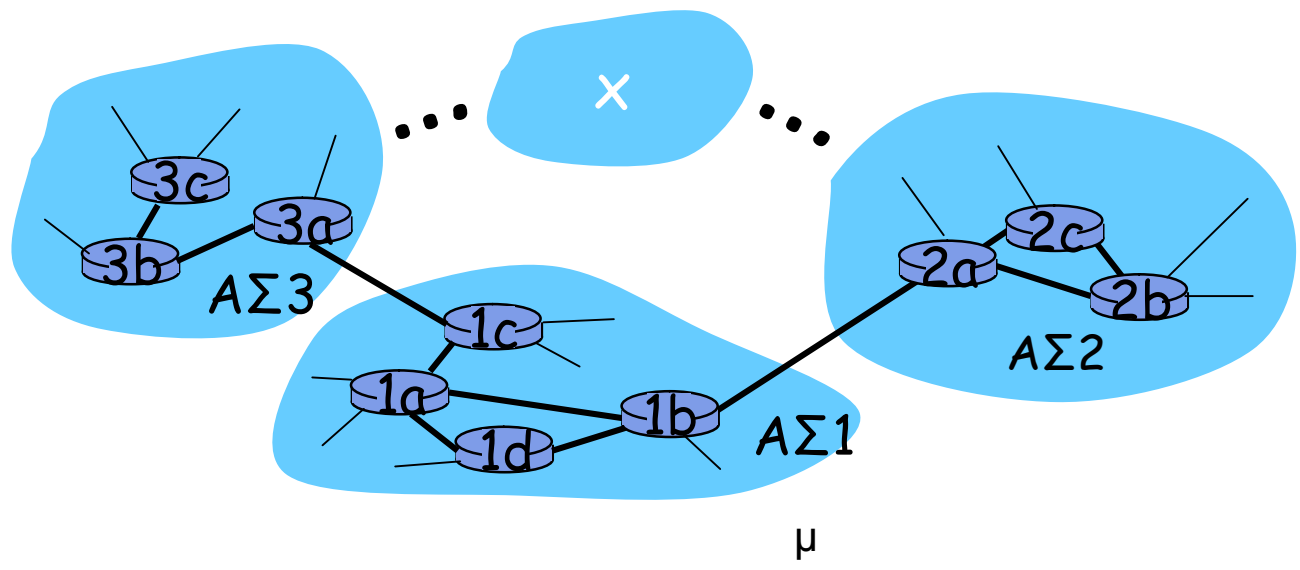
1d



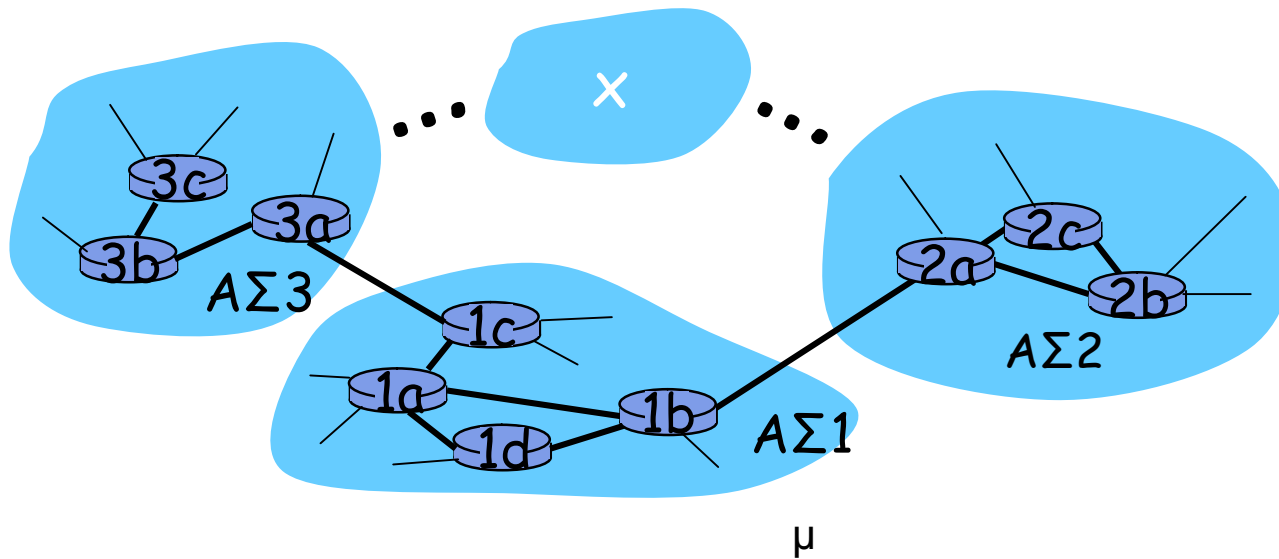
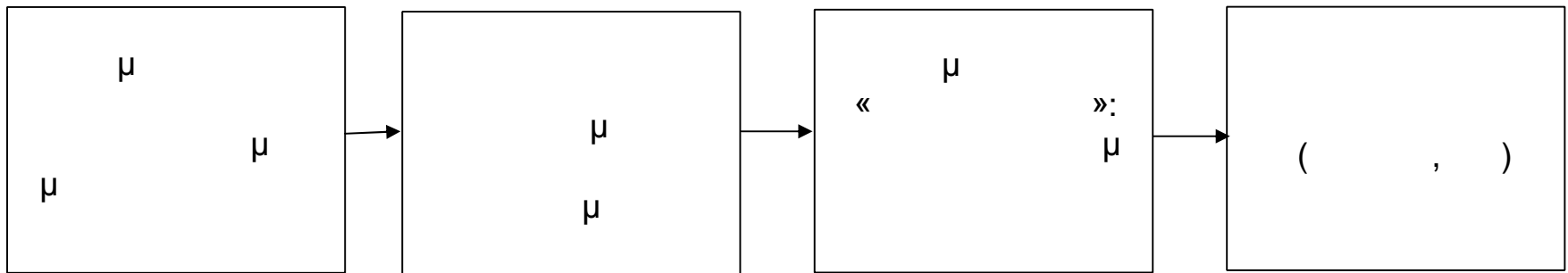
μ μ - (4) -

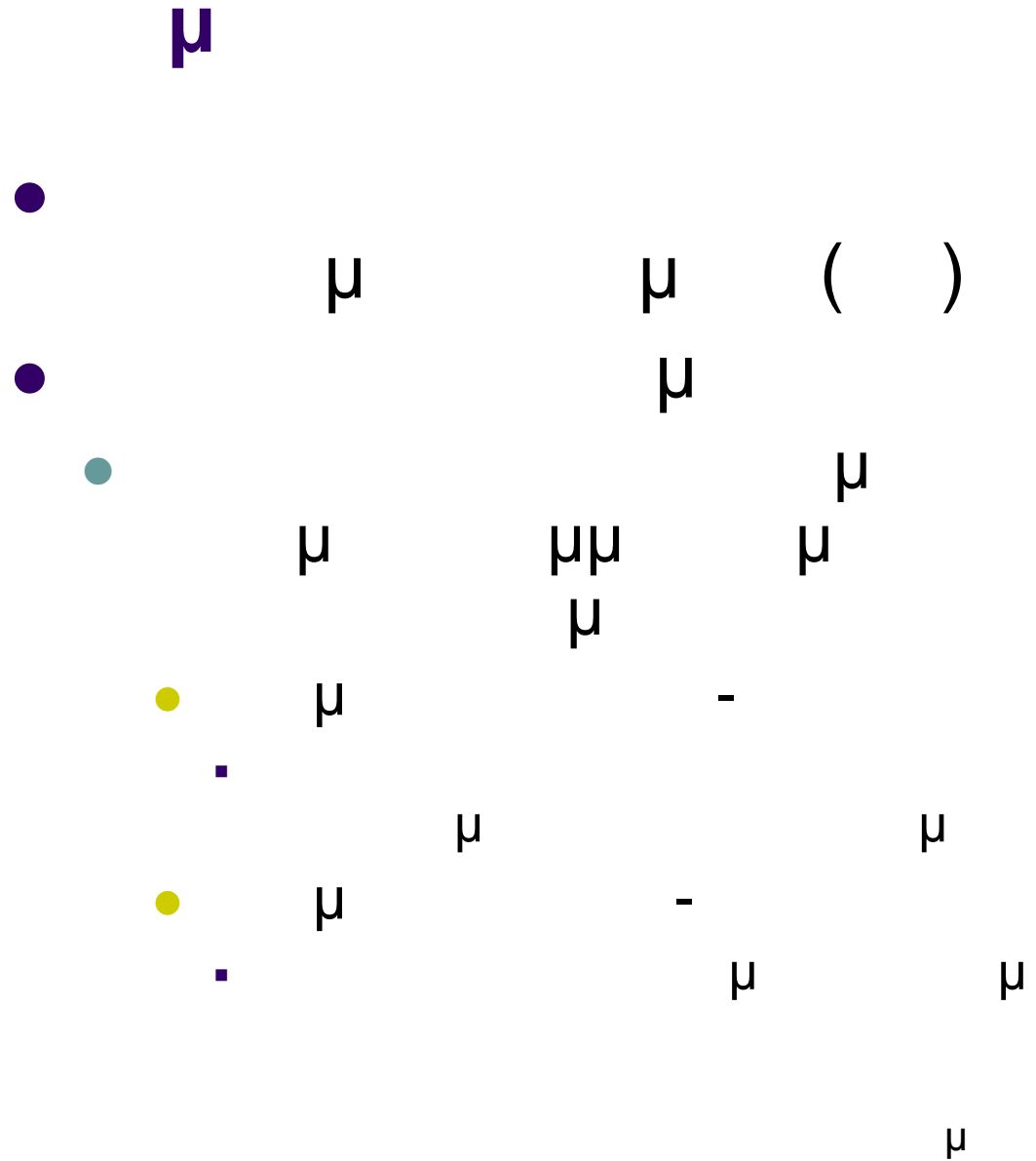


μ 1d μ
 μ « μ » μ



μ - (5) - μ







μ

-

(Interior

- Gateway Protocols – IGP)

μ

μ

-

μ

- RIP: Routing Information Protocol

●

ARPANET

- OSPF: Open Shortest Path First

●

μ

- IGRP: Interior Gateway Routing Protocol

●

Cisco



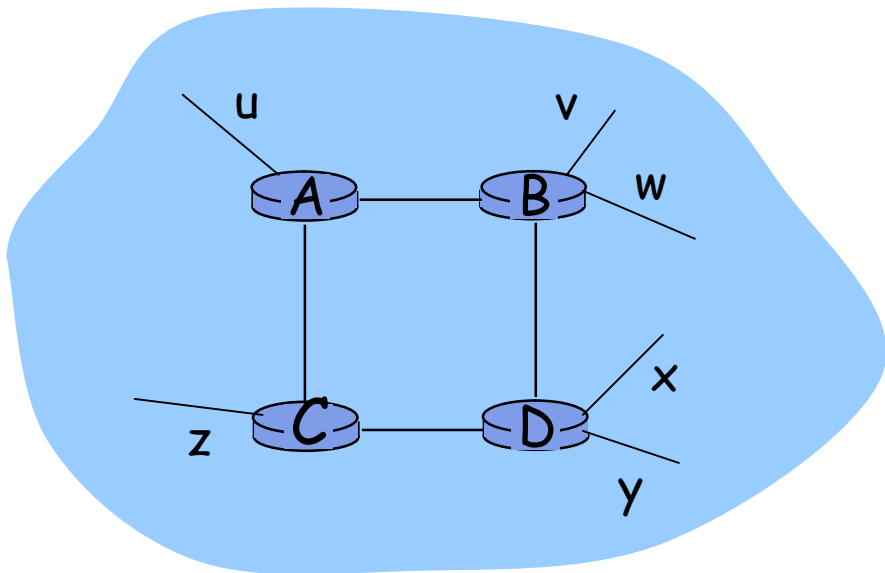
o μ (RIP) (1)

- 1982 BSD
- Unix
- μ
- μ μ (μ 1)
- μ μ μ 15 μ

ο μ (RIP) (2)



μ μ μ μ μ μ
 μ μ μ μ μ μ
 RIP 30 sec μ 25

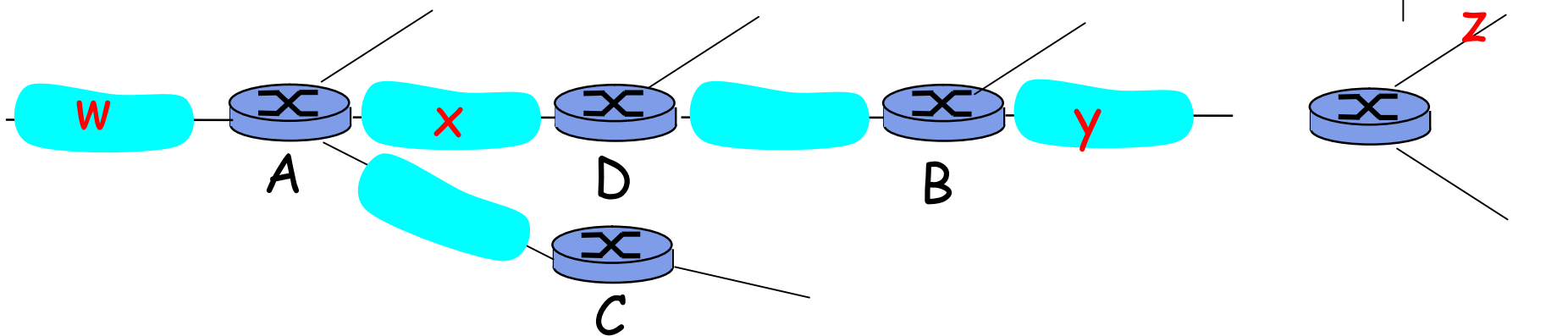


Από το δρομολογητή A στα δίκτυα:

<u>προορισμός</u>	<u>άλματα</u>
u	1
v	2
w	2
x	3
y	3
z	2

RIP -

μ (1)



Δίκτυο Προορισμού	Επόμενος Δρομολογητής	Αριθμός αλμάτων ως των προορισμό
W	A	2
Y	B	2
Z	B	7
X	--	1
....

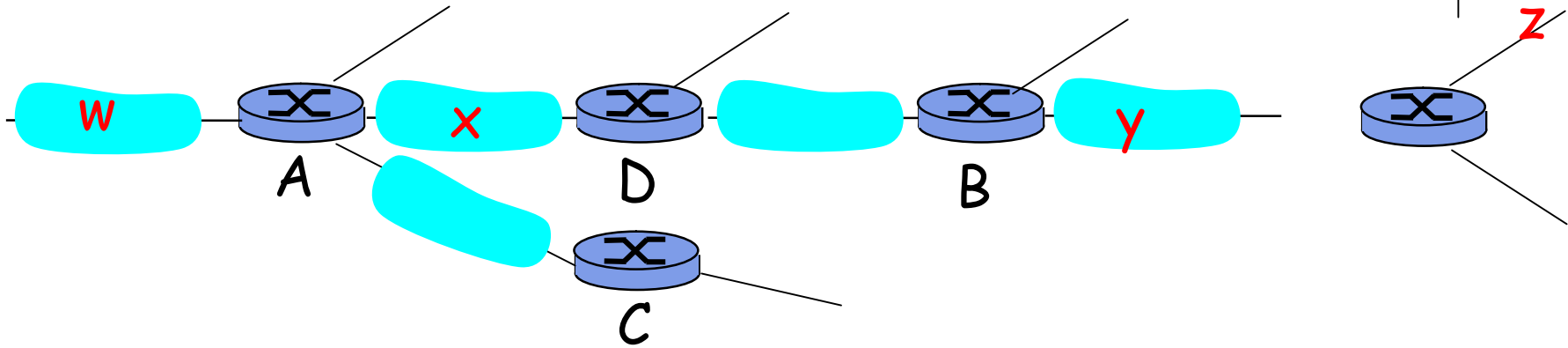
Πίνακας δρομολόγησης στον D

Προορ.	Επ.Δρ.	Άλμ.
w	-	1
x	-	1
z	C	4
....

Αγγελία από τον A στο D

RIP -

μ (2)



Δίκτυο Προορισμού	Επόμενος Δρομολογητής	Αριθμός αλμάτων ως των προορισμό
w	A	2
y	B	2
z	B A	7 5
x	--	1
....

Πίνακας δρομολόγησης στον D

o μ
(RIP) (3)



RIP

180 sec



μ

μ

μ



μ

μ



μ

μ



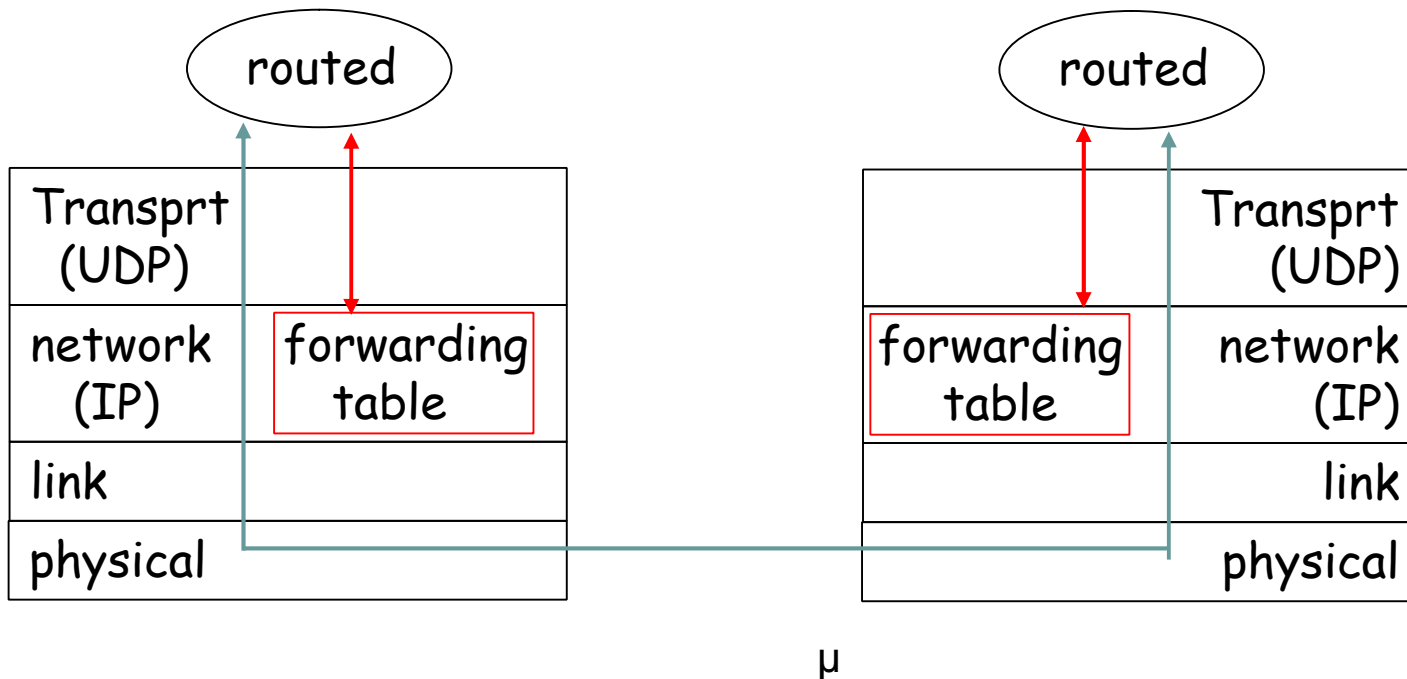
μ

RIP Unix (1)



RIP

- μ μ UDP (520) μ μ IP
- μ UDP
- routed Unix μ
- μ μ μ μ routed





RIP Unix (2)

- “netstat -rn”

Destination	Gateway	Flags	Ref	Use	Interface
127.0.0.1	127.0.0.1	UH	0	26492	lo0
192.168.2.	192.168.2.5	U	2	13	fa0
193.55.114.	193.55.114.6	U	3	58503	le0
192.168.3.	192.168.3.5	U	2	25	qaa0
224.0.0.0	193.55.114.6	U	3	0	le0
default	193.55.114.129	UG	0	143454	
- μ fa0, le0,

qaa0
- μ default
- (loopback): 127.0.0.1
- μ : 224.0.0.0



OSPF (1)

o μ

μ

•

•

«

»:

μ

μ

RIP

(Link State)

•

•

•

μ

•

μ

μ

Dijkstra

•

μ

▪

μ 1

▪

μ

μ

▪

μ

▪

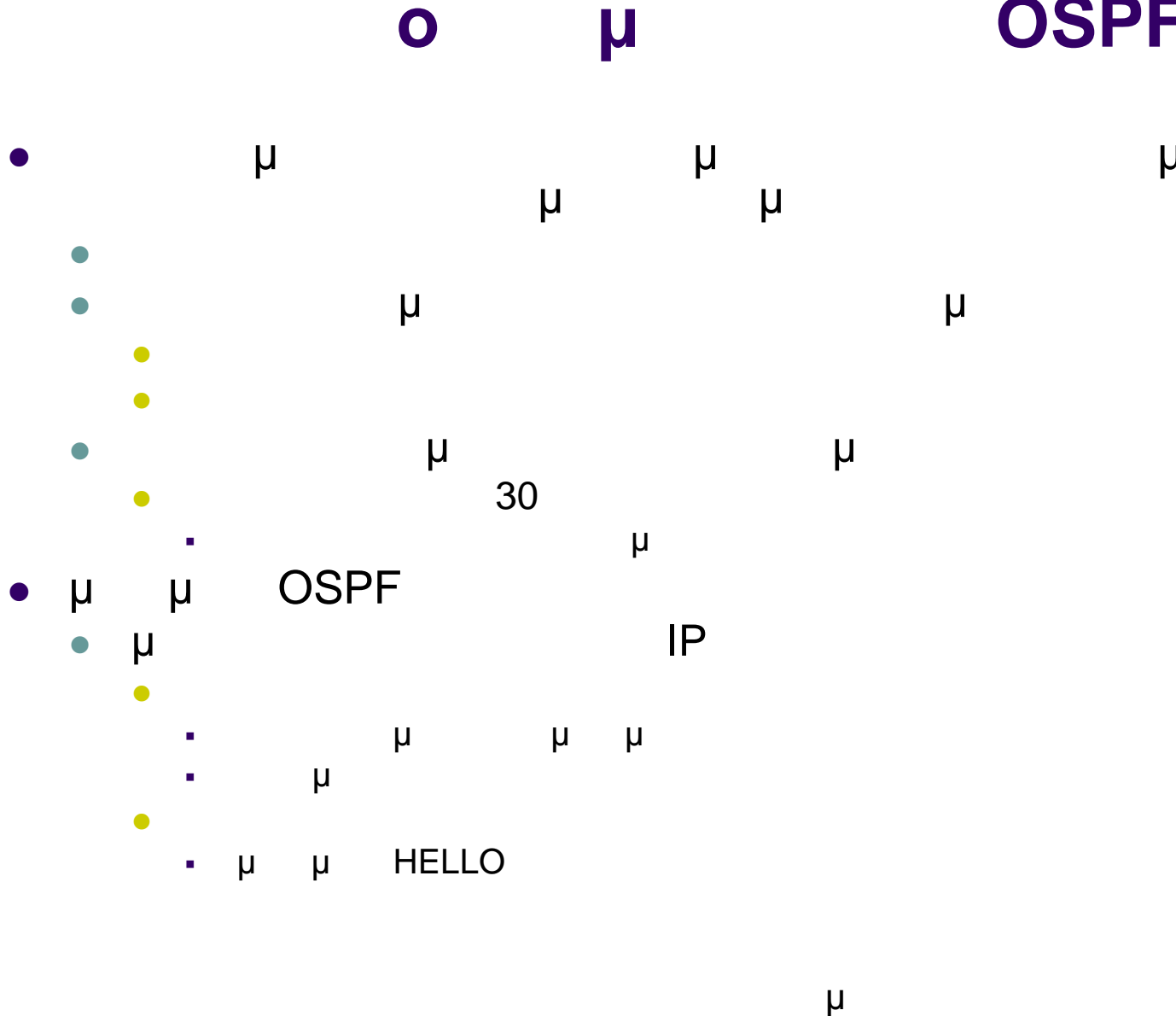
μ

μ

μ

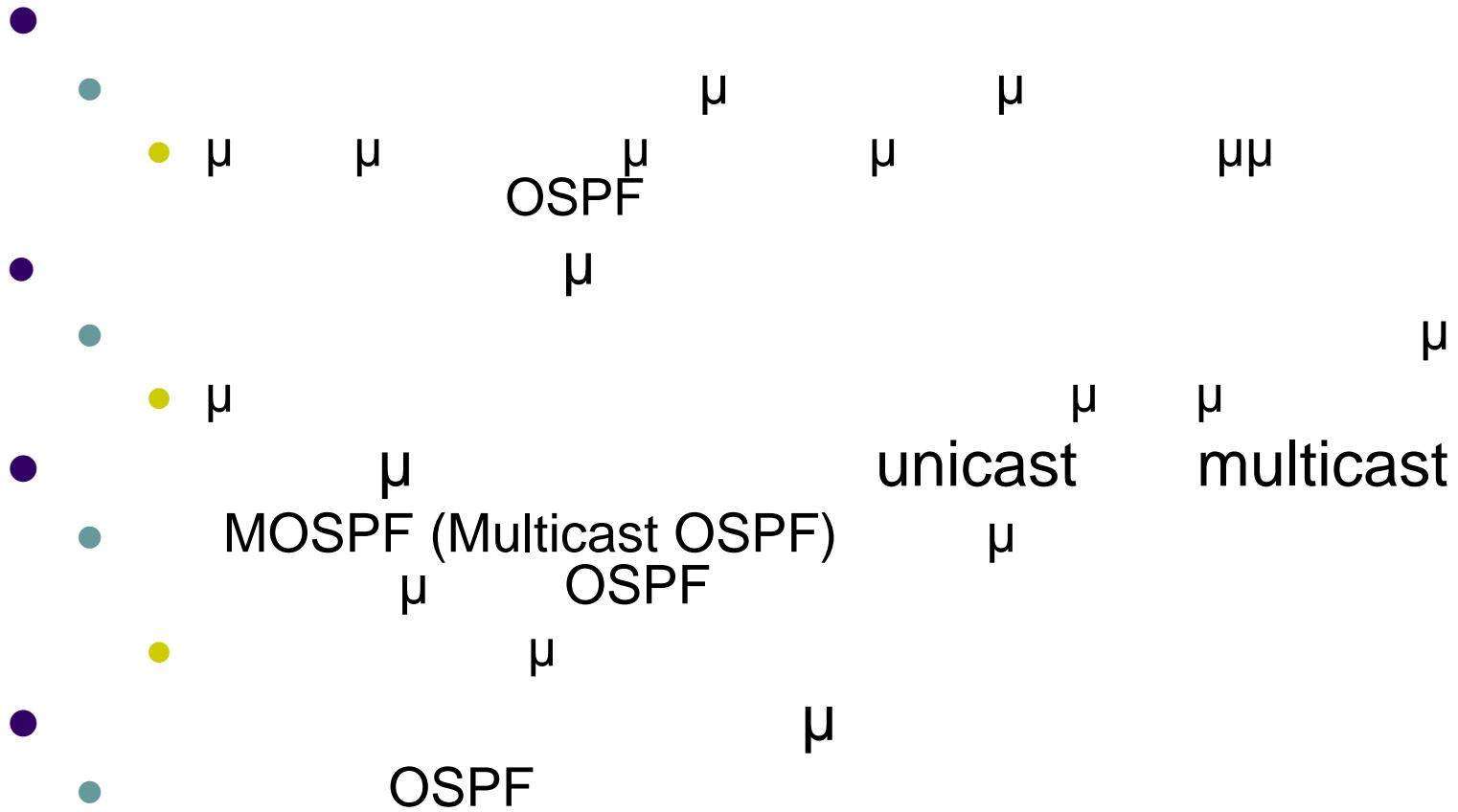


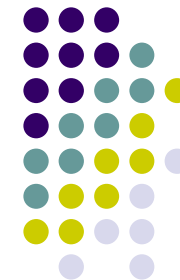
OSPF (2)



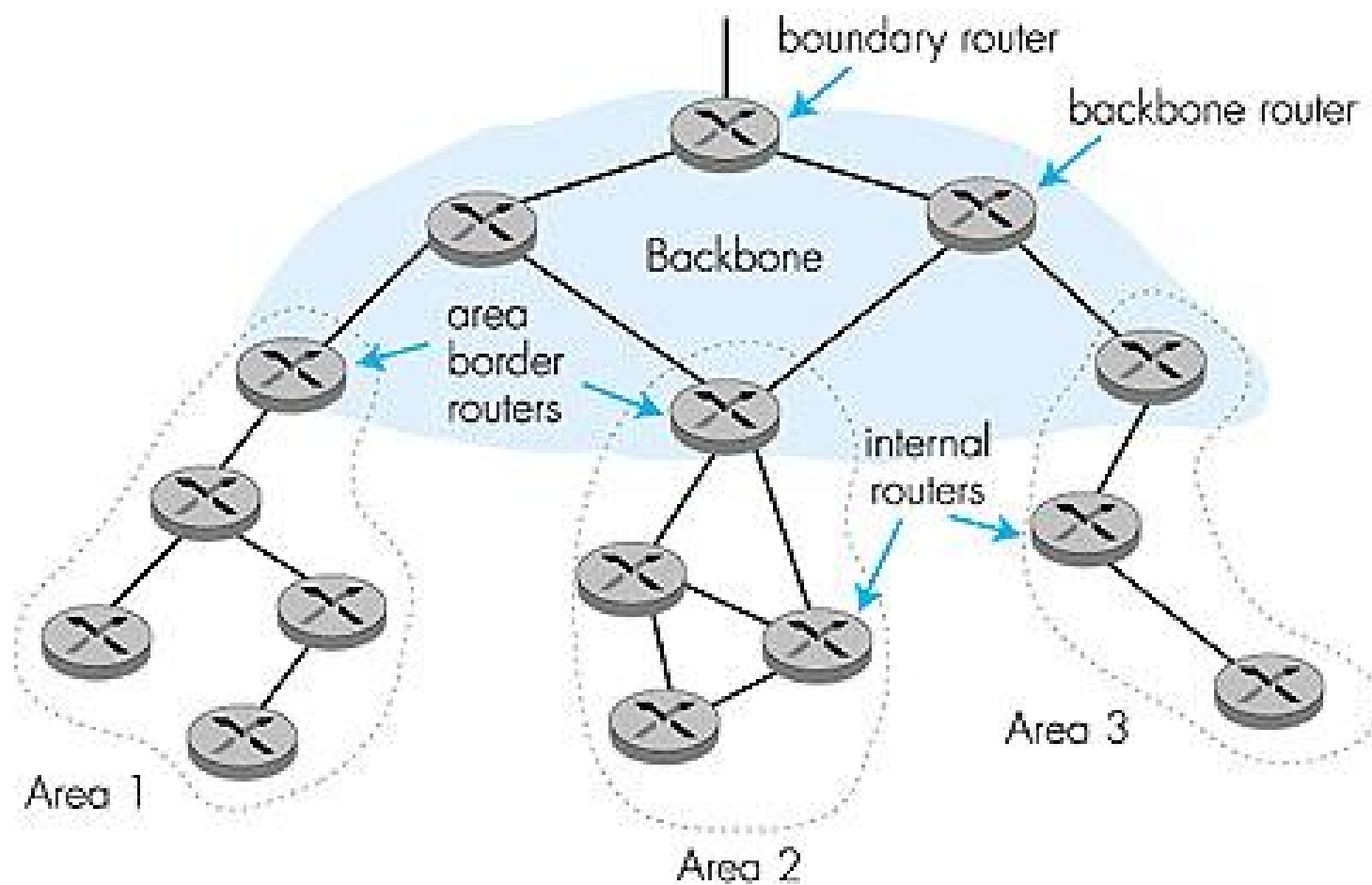


RIP) OSPF (



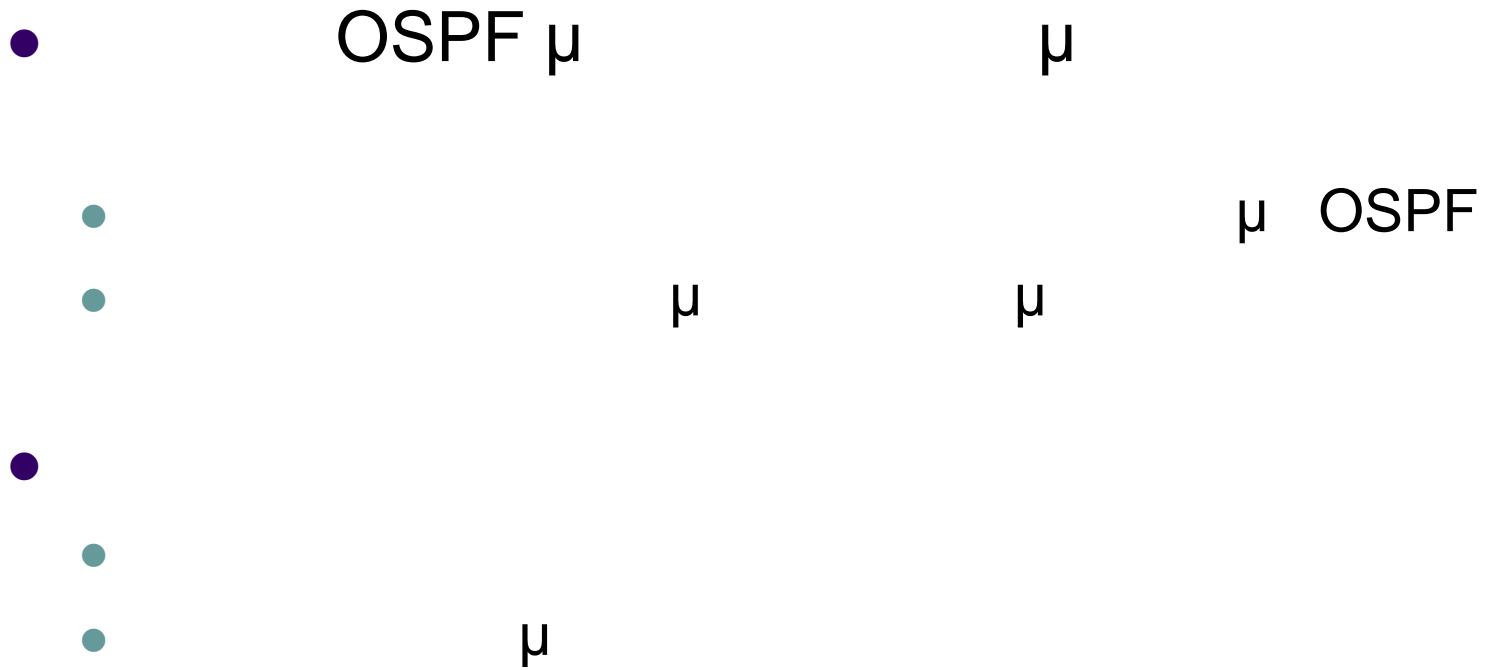


OSPF (1)



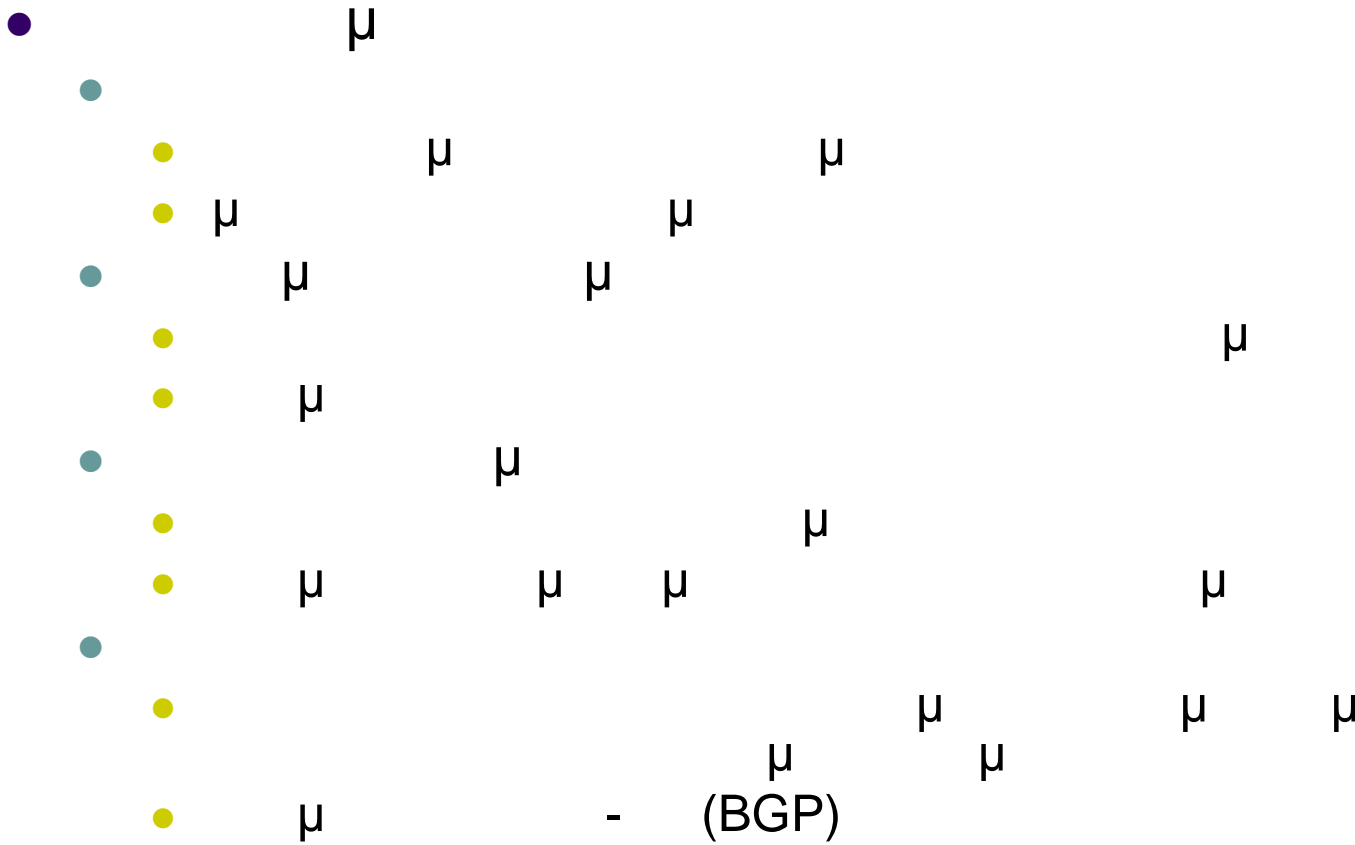


OSPF (2)





OSPF (3)





μ

μ

(BGP) (1)

μ

• μ
BGP)

μ

μ

(Border Gateway Protocol -

•

μ

μ

•

μ

μ

•

μ

μ

•

μ

(μ μ BGP)

•

μ

μ

•

μ

μ

•

μ

μ

μ

•

μ

μ

μ

(Autonomous System Number – ASN)

•

μ

μ

μ

μ

ICANN

•



(BGP) (2)

μ

μ

μ

μ

μ

μ

μ

μ

«

»

μ

μ

μ





μ

μ

μ

(BGP) (3)

•

BGP

•

BGP (External BGP – eBGP)

•

μ

μ

•

BGP (Internal BGP – iBGP)

•

μ

μ

•

μ

•

μ μ

•

•

μ

•

μ

μ

▪

μ

μ

:

μ

μ

▪

μ

μ

μ

μ



μ

μ

μ

(BGP) (4)

BGP



μ

μ

μ

μ

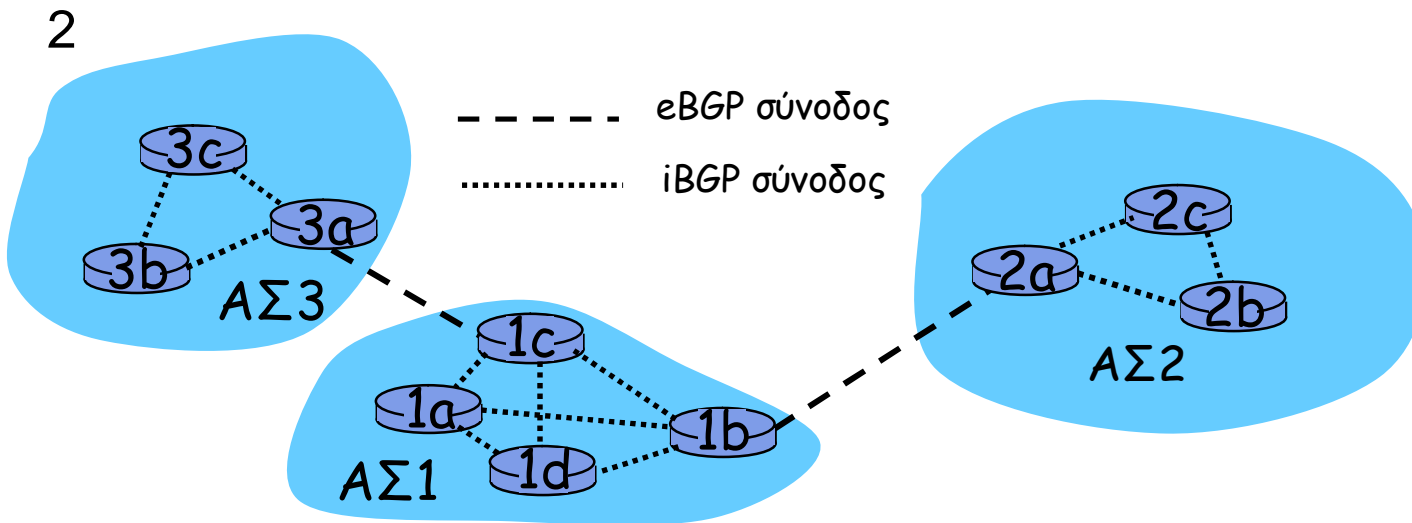
μ



μ (1)

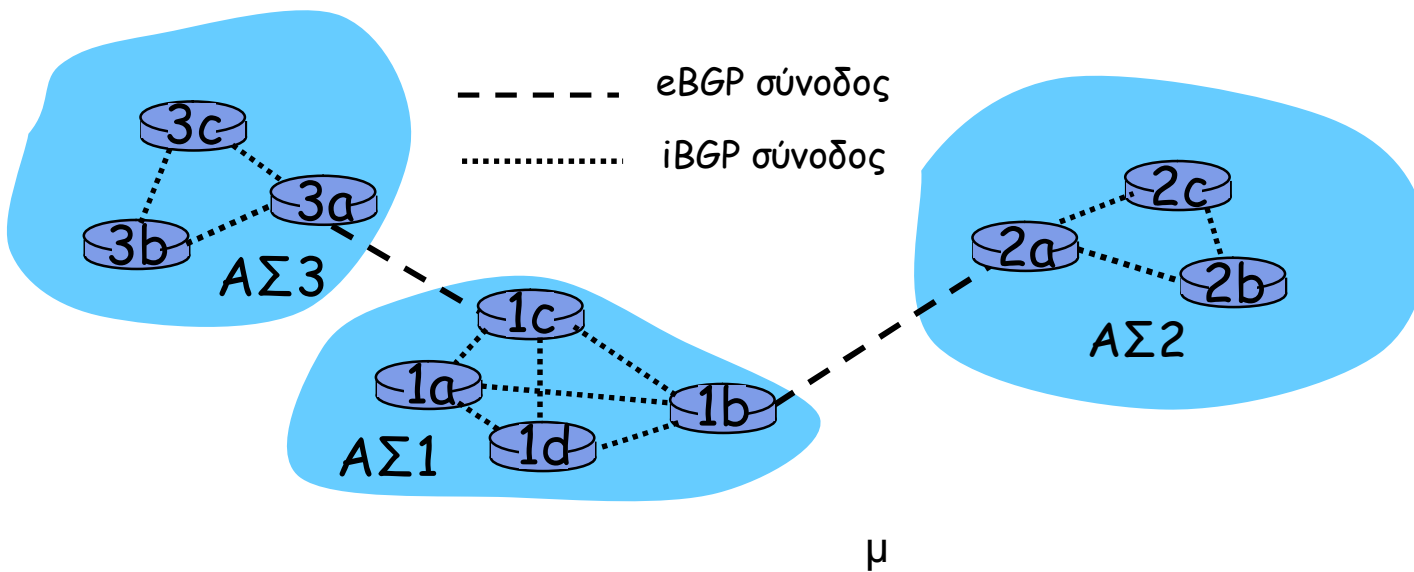
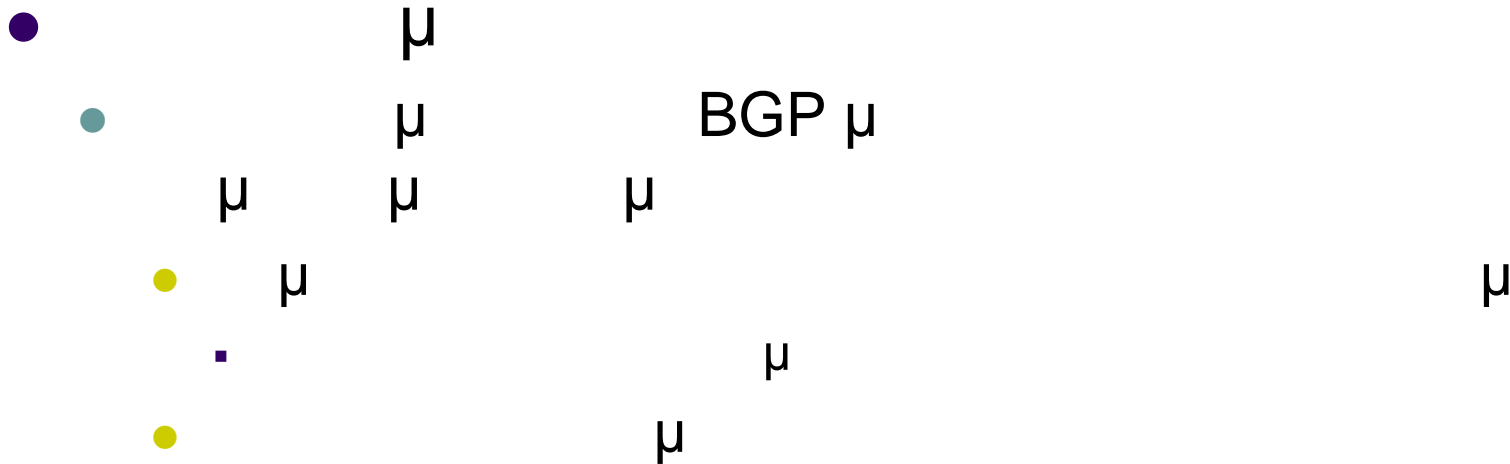
- μ μ μ BGP BGP μ μ
- μ μ μ = « μ »
- ,

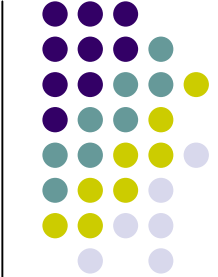
- . . 2 μ 1, 2 « 1 »





μ μ (2)





μ

μ

μ

μ

BGP

μ

BGP,

μ

μ

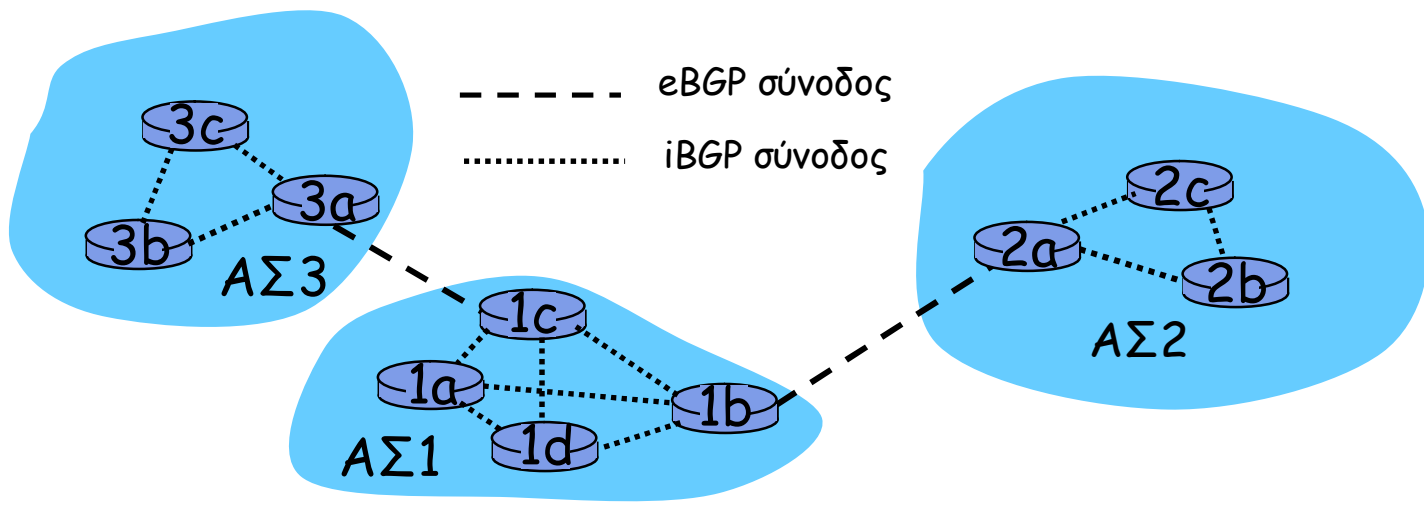
μ



(1)

μ

- eBGP μ 3 1c, 3
- μ 1c μ , μ μ iBGP 1
- μ 1b μ μ μ eBGP μ 1b 2
- μ μ μ , μ μ



μ



(1)

μ

μ

μ

μ

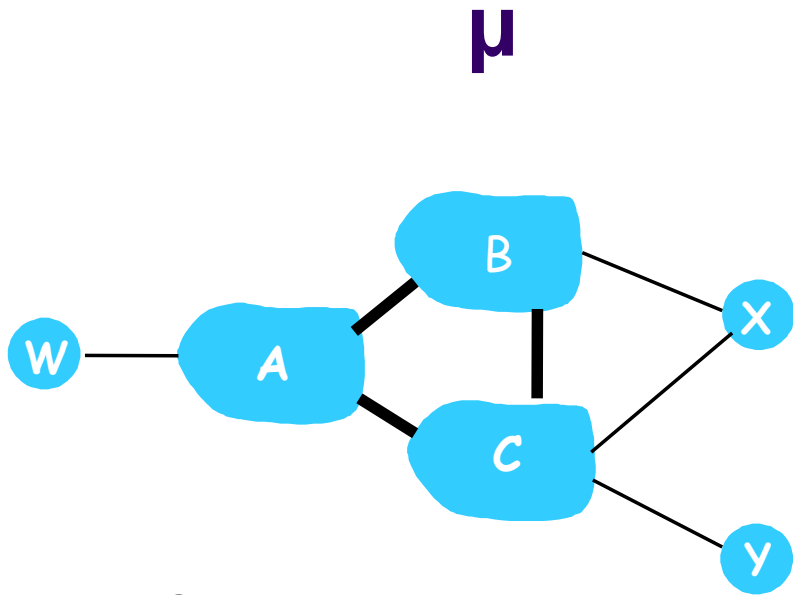
μ

μ

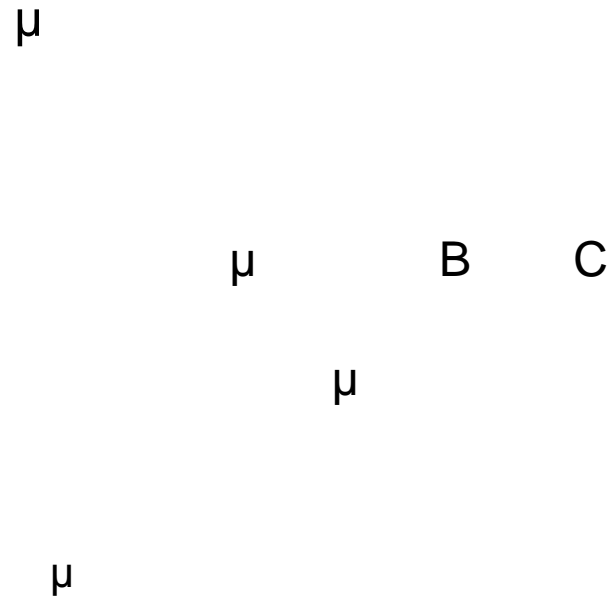
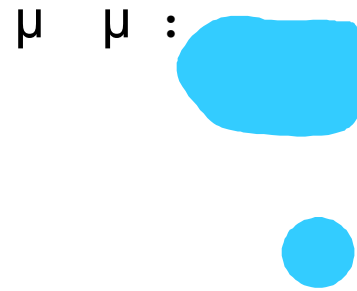
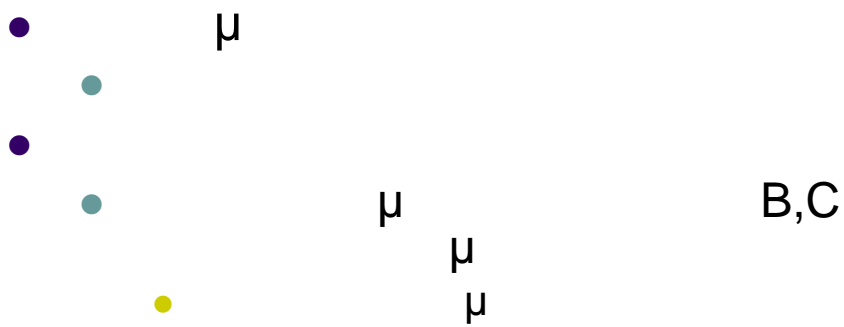




(2)



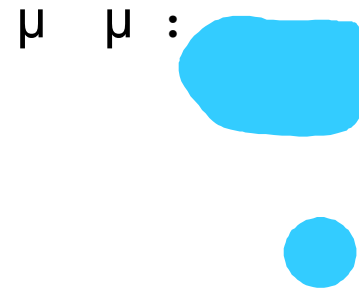
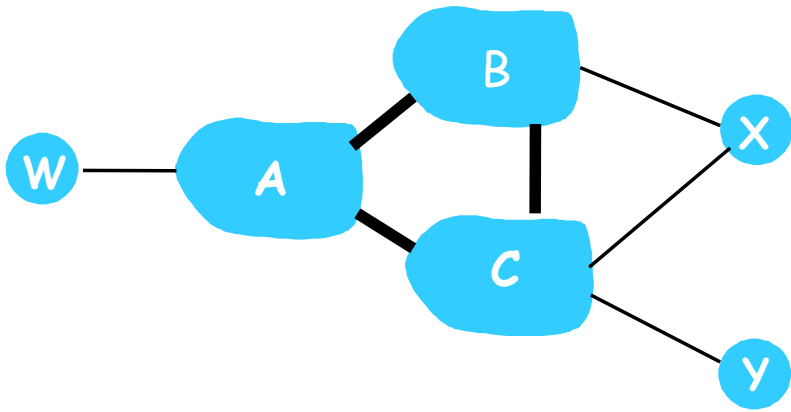
- A,B,C:
- X,Y,W:
- X:





(3)

μ



- A μ AW B
- B μ BAW X
- B μ BAW C?
- , W C μ CBAW,
- B C μ w μ A
- B μ

μ



μ

-

-

•

•

-

:

μ

μ
μ

•

-

:

μ

,

μ

•

μ

•

μ

μ

μ

,

μ

μ

,

μ

μ

,

•

•

-

:

•

-

:

μ

μ

μ