

# **Network Layer**

## **Routing Algorithms / Protocols**

# Network Layer

Two main functions at the Routers

**1. Forwarding**

**2. Routing**

**What is the difference between forwarding and routing ?**

# What is forwarding ?

## Forwarding

is a **switching** action taken by a router  
when a packet arrives at a port

Router '**switches**' or '**forwards**' a packet  
from an **input port**

Router forwards the packet based on **a forwarding table** which is  
already created in the router  
....now **the question is ...who creates forwarding  
table ?**

## How is the forwarding table created ?

This is where **ROUTING** is used

Forwarding tables are created by **executing** the function called **ROUTING**

This is most intelligent function of the Router.

Every router executes a specified distributed algorithm called as **Routing algorithm**

Objective of routing algorithm ~~is to find out the best route to all the destinations,~~  
~~translate that in to a forwarding table.~~

The term **Routing** is slightly confusing.  
It sounds like sending a packet in a ( best possible) route.  
No...that is not routing

Probably term **ROUTING** may be replaced with the phrase

**Best Route Estimation**

**A routing table can be  
either  
static  
or  
dynamic.**

# ROUTING PROTOCOLS-Basics

A static table is one with **manual entries**

Suitable for **small private network** ( Intranet )

**Disadvantages**

**Very tedious**

to create

and

update table

*whenever there are changes in the network*

# ROUTING PROTOCOLS-Basics

. A dynamic table is one that is

**updated periodically**

**or**

**automatically**

**when there is a change somewhere in the Internet.**



## **ROUTING PROTOCOLS-Basics**

**A routing protocol  
is a combination of rules and procedures  
that lets routers  
to compute  
best route from a router to a destination subnet**

**A routing protocol  
is nothing but  
execution of  
Routing algorithm**

# What is the meaning of Shortest Path ( Best path or Best Route ?)

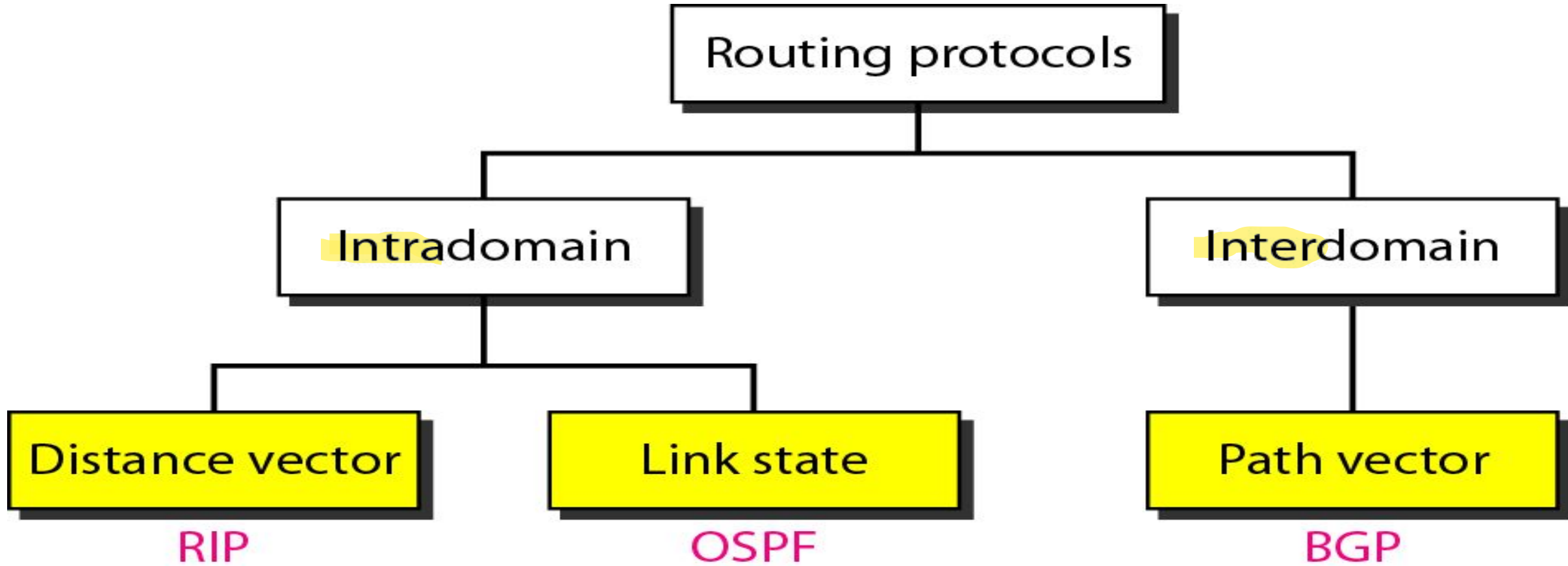
Shortest path can be one or more of the following

- Geographical Distance
- Number of hops
- Efficiency of the routes
  - Bandwidth
  - Mean queue length
  - Measured delayand other factors
- Communication cost

## METRIC

- Is a cost assigned for passing through a network
- the total metric of a particular route is equal to the sum of metrics of networks along the route
- Shortest path attributes are defined in the Routing protocols
- E.g. RIP uses number of hops as the attribute

# Popular routing protocols



**Let us get introduced to  
popular routing algorithm**

**DISTANCE ROUTING ALGORITHM**

**which is used by the popular protocol**

**Routing Information Protocol ( RIP )**

## Distance Vector Routing –Phillosophy

1. Each router estimates the **best route** to a destination network (subnet) by **collecting data from all its neighboring routers**
2. Each router **shares** the estimated best route with **all its the neighboring routers.**
3. This is a **continuous process** that happens throughout the network, in a distributed way.

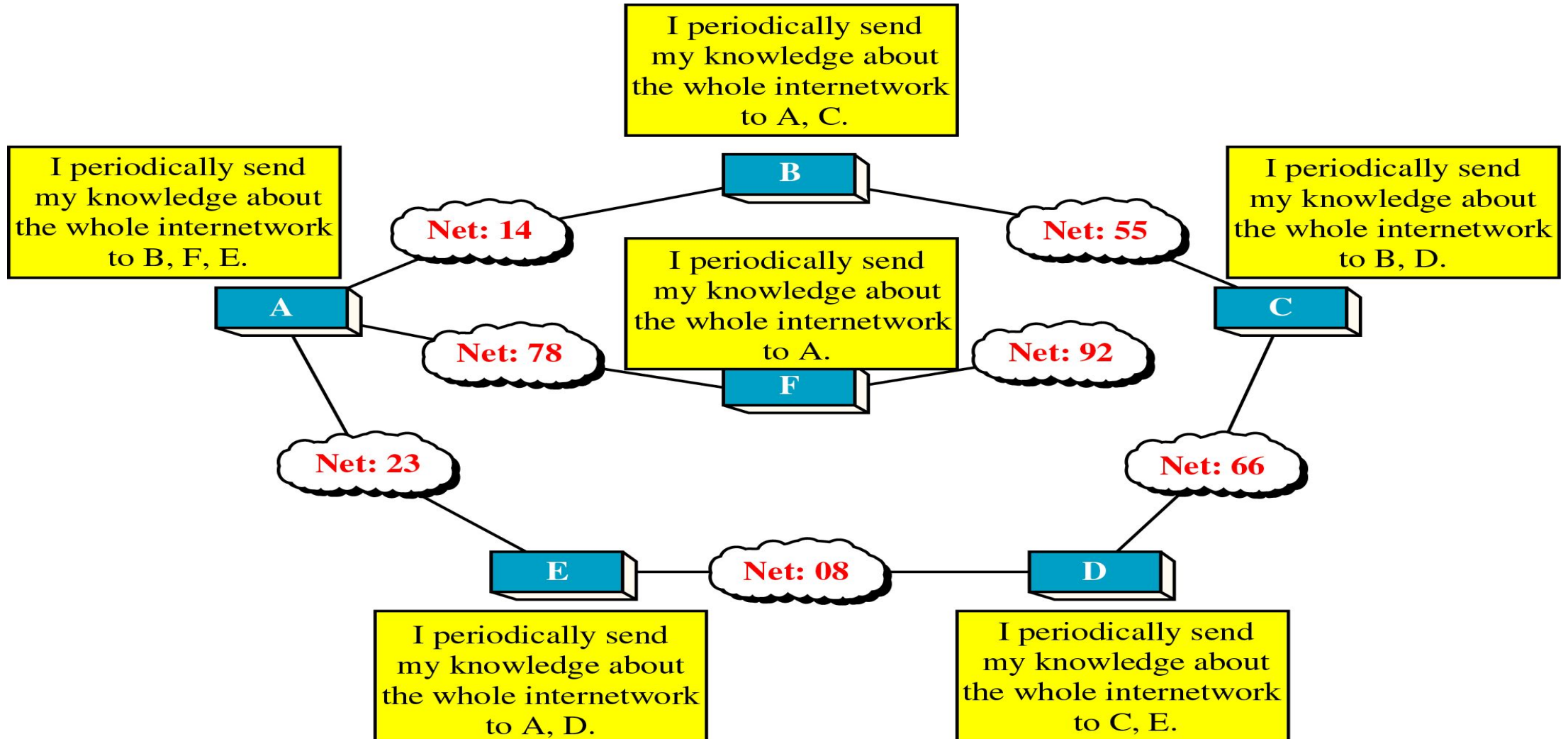
# Distance Vector Routing – Basic Principle

1. Each router maintains a table ( VECTOR ) giving
  - **best known distance** to each destination
  - **which line** to use to get there
2. Each router exchanges information periodically with the neighbors

Each router is assumed to know the 'distance' to each of its neighbors

# The Concept of Distance

## Vector Routing





## Distance Vector Routing Algorithm – Steps

- Step#1 Find out who are all the neighboring routers  
- by sending A 'hello' ( PING) packet and getting the reply from the active neighbors
- Step#2 Get the 'distance vector' from all the neighbors
- Step#3 Use Bellman-Ford equation to find out the  
**updated minimum cost to every destination**  
As a result new 'distance vector' is computed
- Step#4 Share the new 'distance vector' to all the neighbors

# How is the best route or least cost route is computed ?

## Simple algorithm

### Bellman-Ford Equation

to estimate

$d_x(y)$  = least-cost path from x to y

Then

$$d_x(y) = \min_v \{ c(x,v) + d_v(y) \}$$

where min is taken over all neighbors v of x

# Distance Vector Algorithm

$c(x,v)$ : cost to each neighbor  $v$

$d_v(y)$  : Least distance from  $v$  to  $y$

**An Illustration  
concept of  
Bellman –Ford equation through  
an analogy**

**What is the best distance from DSCE campus  
to  
Majestic bus stand ?**

DSCE

campus

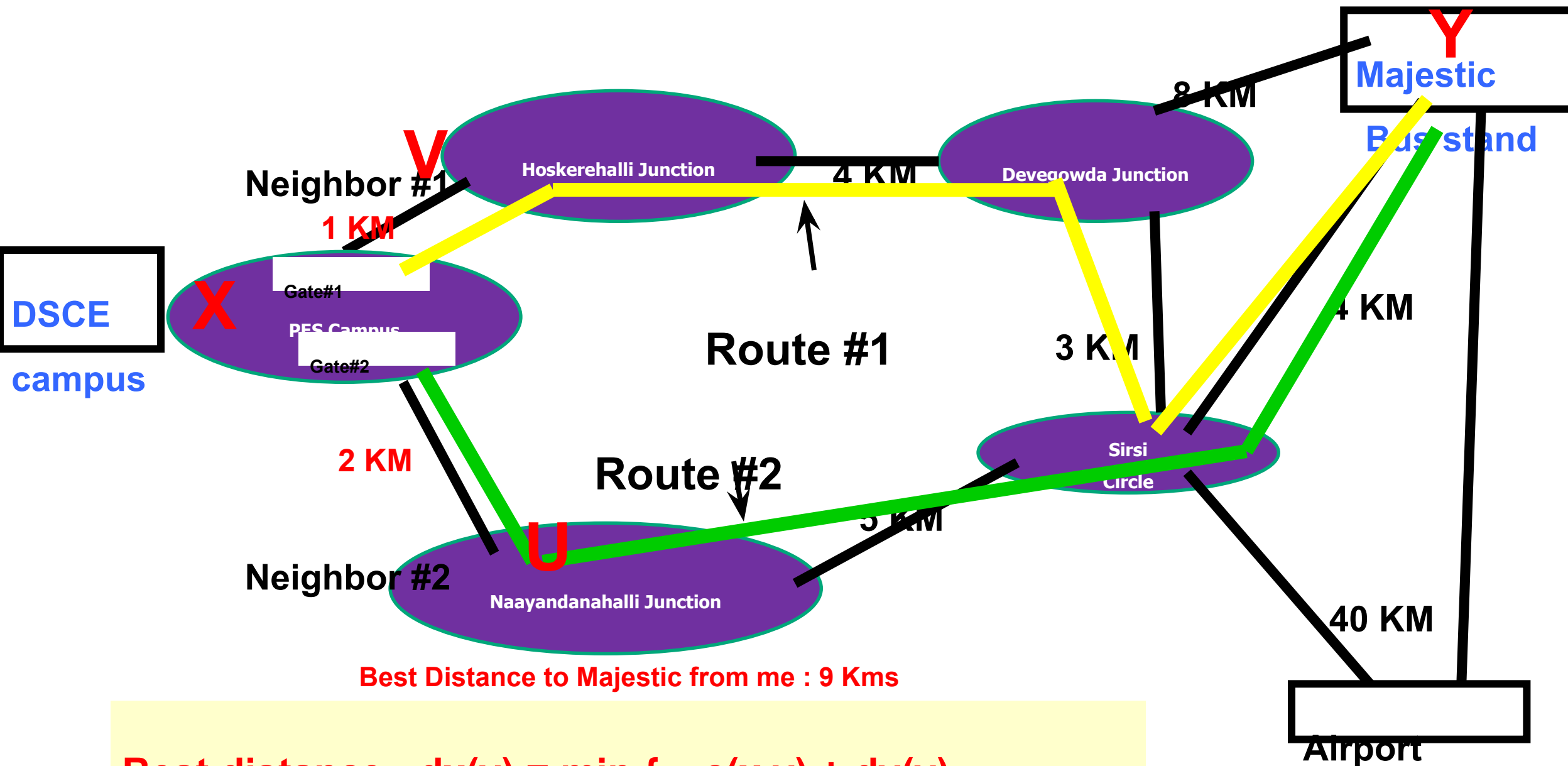
X

$dx(y)$

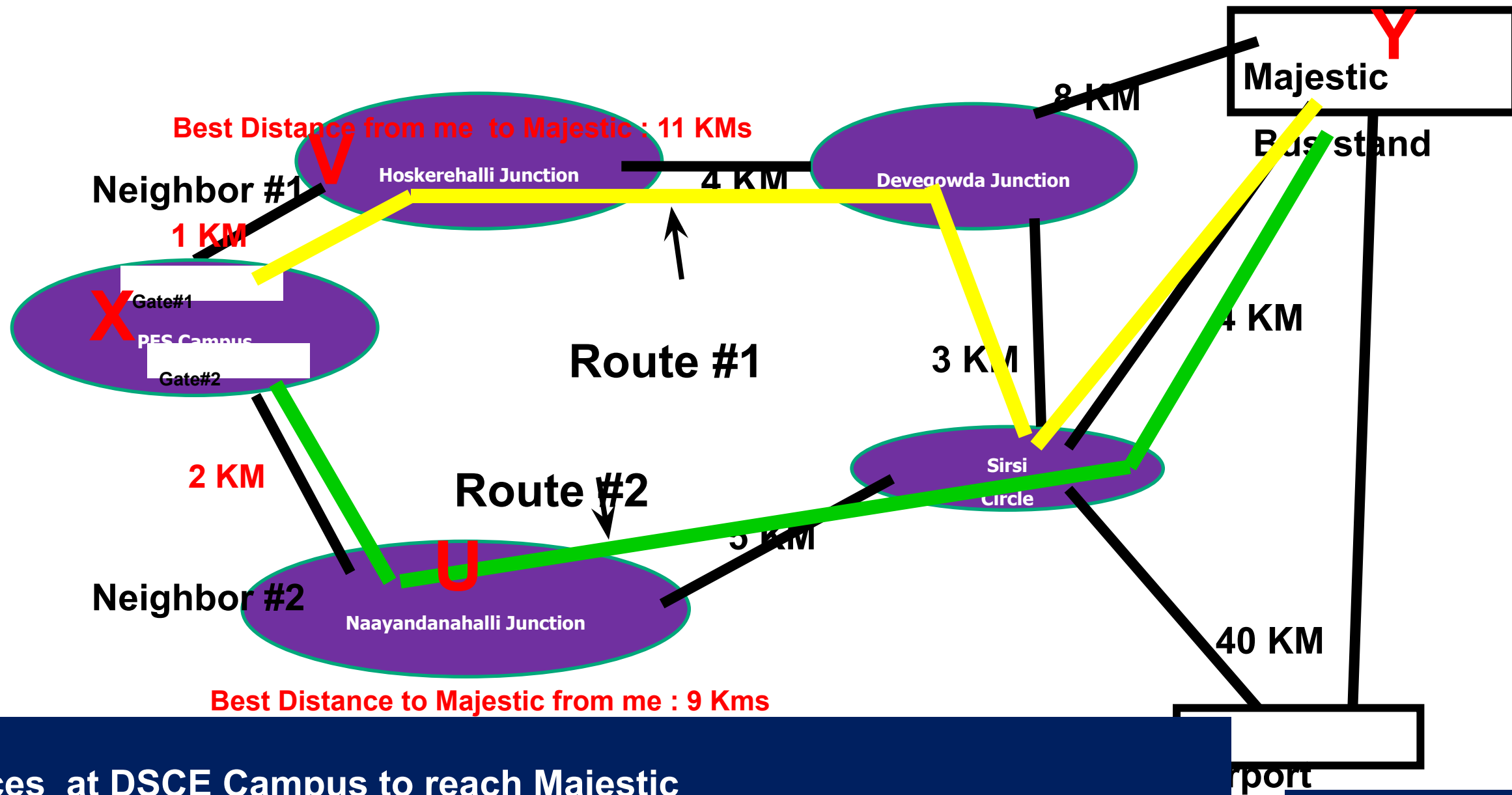
Best ( least) Distance ???

Y  
Majestic

Bus stand



$$\text{Best distance} - dx(y) = \min \{ c(x,v) + dv(y), C(x,U)+du(Y) \}$$



Choices at DSCE Campus to reach Majestic

Route#1 : through Gate#1 thru'Hoskerehalli : ( 1 + 11)=12KMs

Best route

# When is the 'distance vector table' shared ?

- 1. Periodic update**  
at equal intervals as defined in the protocol
- 2. Triggered update**  
Whenever some change happens in the cost