# SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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## DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING


## COURSE NAME :19IT401 COMPUTER NETWORKS

II YEAR /IV SEMESTER

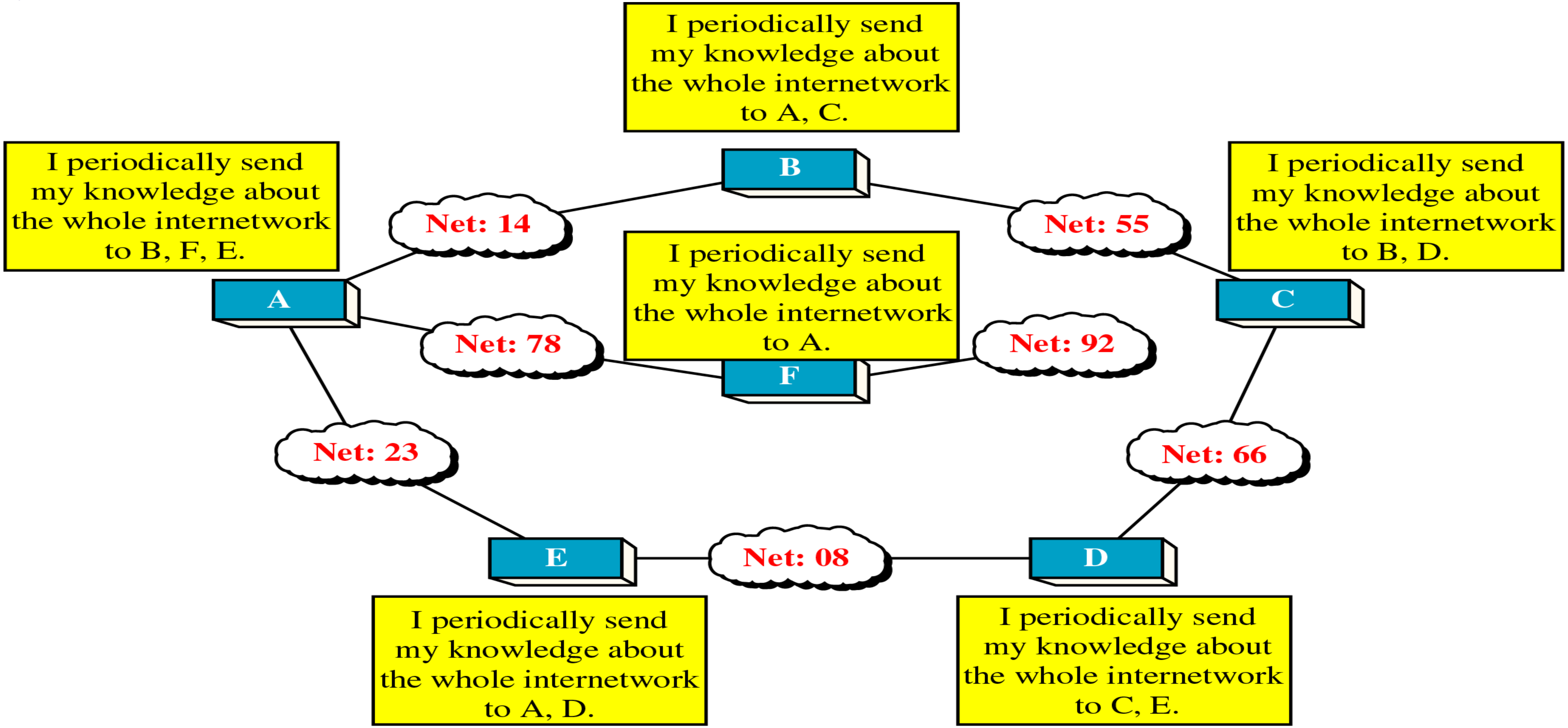
Unit 3-NETWORK LAYER

Topic 8 : Routing algorithms

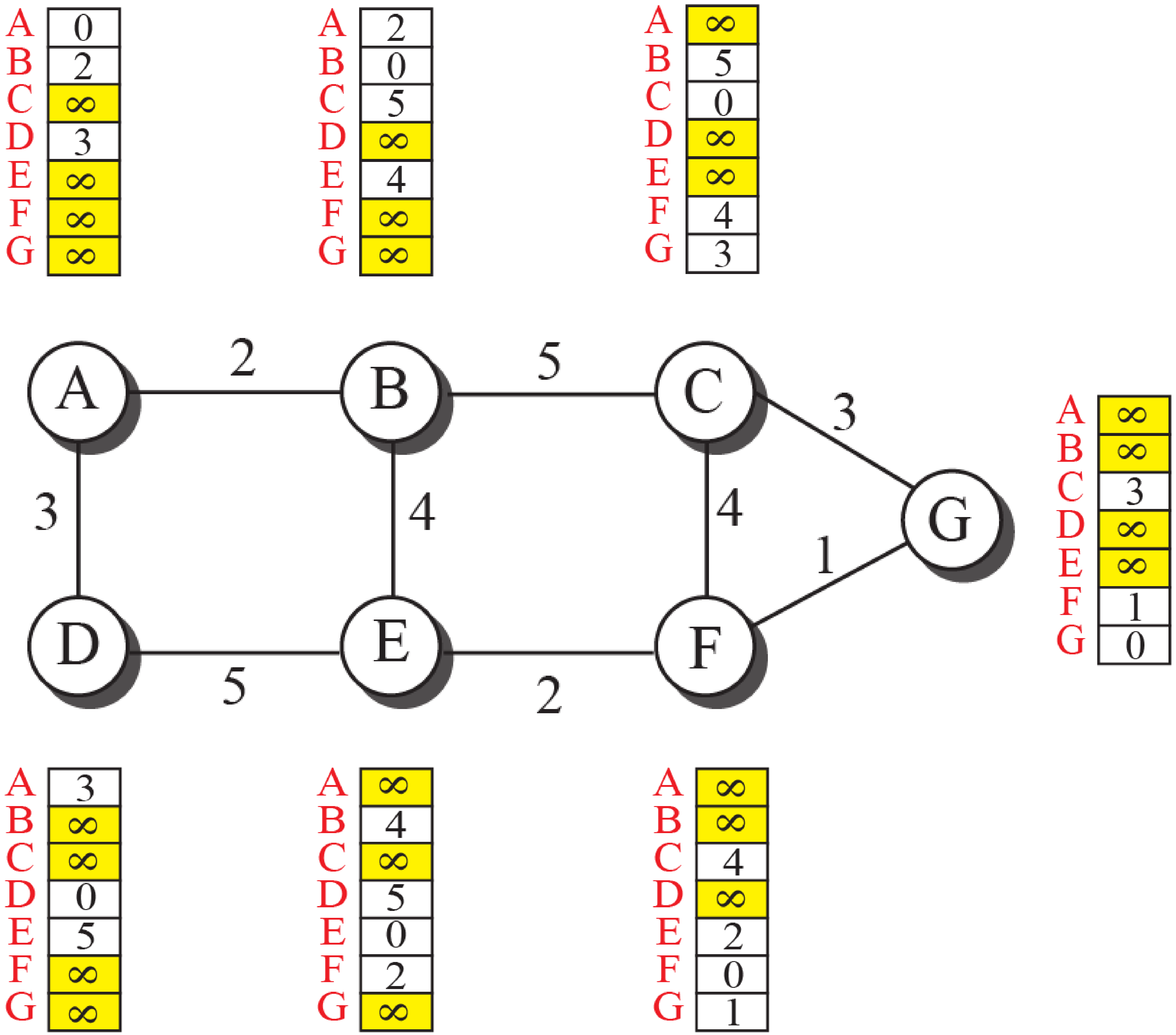
# Distance-Vector Routing

- In distance-vector routing, the first thing each node creates is its own least-cost tree with its immediate neighbors.
- The incomplete trees are exchanged between immediate neighbors to make the trees more and more complete and to represent the whole internet.
- We can say that in distance-vector routing, a router continuously tells all of its neighbors what it knows about the whole internet (although the knowledge can be incomplete).

# The Concept of Distance Vector Routing



# The first distance vector for an internet



# Figure 20.6: Updating distance vectors

| | New B | Old B | A |
|---|---|---|---|
| A | 2 | 2 | 0 |
| B | 0 | 0 | 2 |
| C | 5 | 5 | ∞ |
| D | 5 | ∞ | 3 |
| E | 4 | 4 | ∞ |
| F | ∞ | ∞ | ∞ |
| G | ∞ | ∞ | ∞ |

B[ ] = min (B[ ] , 2 + A[ ])

a. First event: B receives a copy of A's vector.

**Note**:
X[ ]: the whole vector

| | New B | Old B | E |
|---|---|---|---|
| A | 2 | 2 | ∞ |
| B | 0 | 0 | 4 |
| C | 5 | 5 | ∞ |
| D | 5 | 5 | 5 |
| E | 4 | 4 | 0 |
| F | 6 | ∞ | 2 |
| G | ∞ | ∞ | ∞ |

B[ ] = min (B[ ] , 4 + E[ ])

b. Second event: B receives a copy of E's vector.

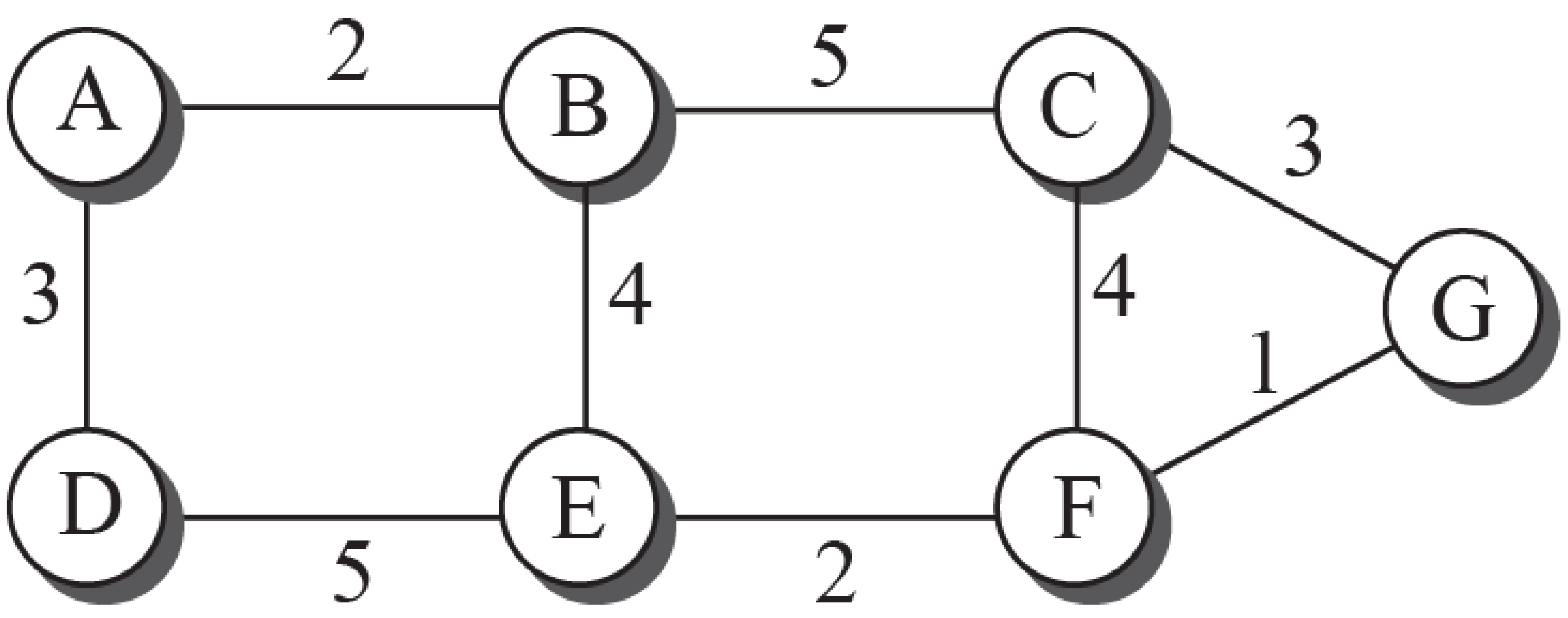
## Table 20.1: Distance-Vector Routing Algorithm for A Node

```
Distance_Vector_Routing ( )
{
      // Initialize (create initial vectors for the node)
      D[myself] = 0
      for (y = 1 to N)
      {
            if (y is a neighbor)
                  D[y] = c[myself][y]
            else
                  D[y] = ∞
      }
      send vector {D[1], D[2], …, D[N]} to all neighbors
      // Update (improve the vector with the vector received from a neighbor)
      repeat (forever)
      {
            wait (for a vector Dw from a neighbor w or any change in the link)
            for (y = 1 to N)
            {
                  D[y] = min [D[y], (c[myself][w] + Dw[y])]        // Bellman-Ford equation
            }
            if (any change in the vector)
                  send vector {D[1], D[2], …, D[N]} to all neighbors
      }
} // End of Distance Vector
```

# Link-State Routing

- This method uses the term link-state to define the characteristic of a link (an edge) that represents a network in the internet.
- In this algorithm the cost associated with an edge defines the state of the link.
- Links with lower costs are preferred to links with higher costs; if the cost of a link is infinity, it means that the link does not exist or has been broken.

# Figure 20.8: Example of a link-state database




a. The weighted graph

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| A | 0 | 2 | ∞ | 3 | ∞ | ∞ | ∞ |
| B | 2 | 0 | 5 | ∞ | 4 | ∞ | ∞ |
| C | ∞ | 5 | 0 | ∞ | ∞ | 4 | 3 |
| D | 3 | ∞ | ∞ | 0 | 5 | ∞ | ∞ |
| E | ∞ | 4 | ∞ | 5 | 0 | 2 | ∞ |
| F | ∞ | ∞ | 4 | ∞ | 2 | 0 | 1 |
| G | ∞ | ∞ | 3 | ∞ | ∞ | 1 | 0 |

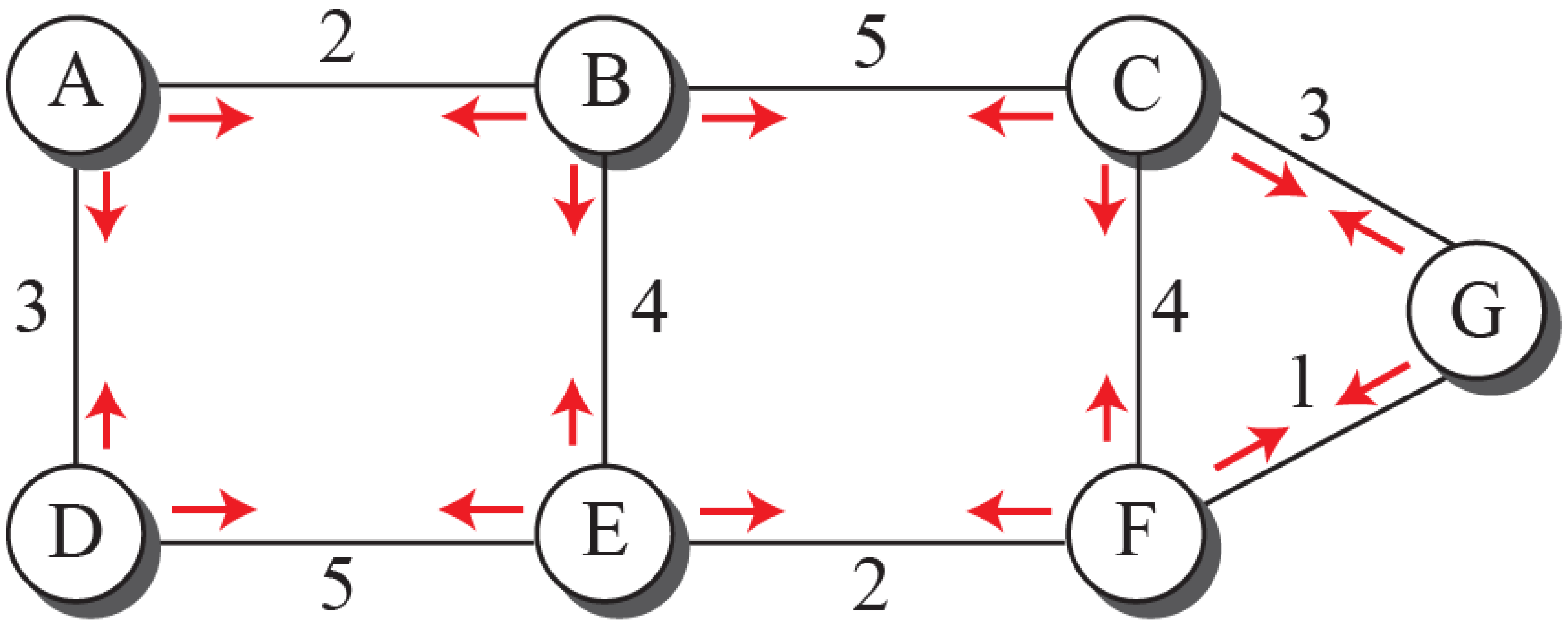
b. Link state database

# Figure 20.9: LSPs created and sent out by each node to build LSDB

| Node | Cost |
|---|---|
| B | 2 |
| D | 3 |

| Node | Cost |
|---|---|
| A | 2 |
| C | 5 |
| E | 4 |

| Node | Cost |
|---|---|
| B | 5 |
| F | 4 |
| G | 3 |




| Node | Cost |
|---|---|
| C | 3 |
| F | 1 |

| Node | Cost |
|---|---|
| A | 3 |
| E | 5 |

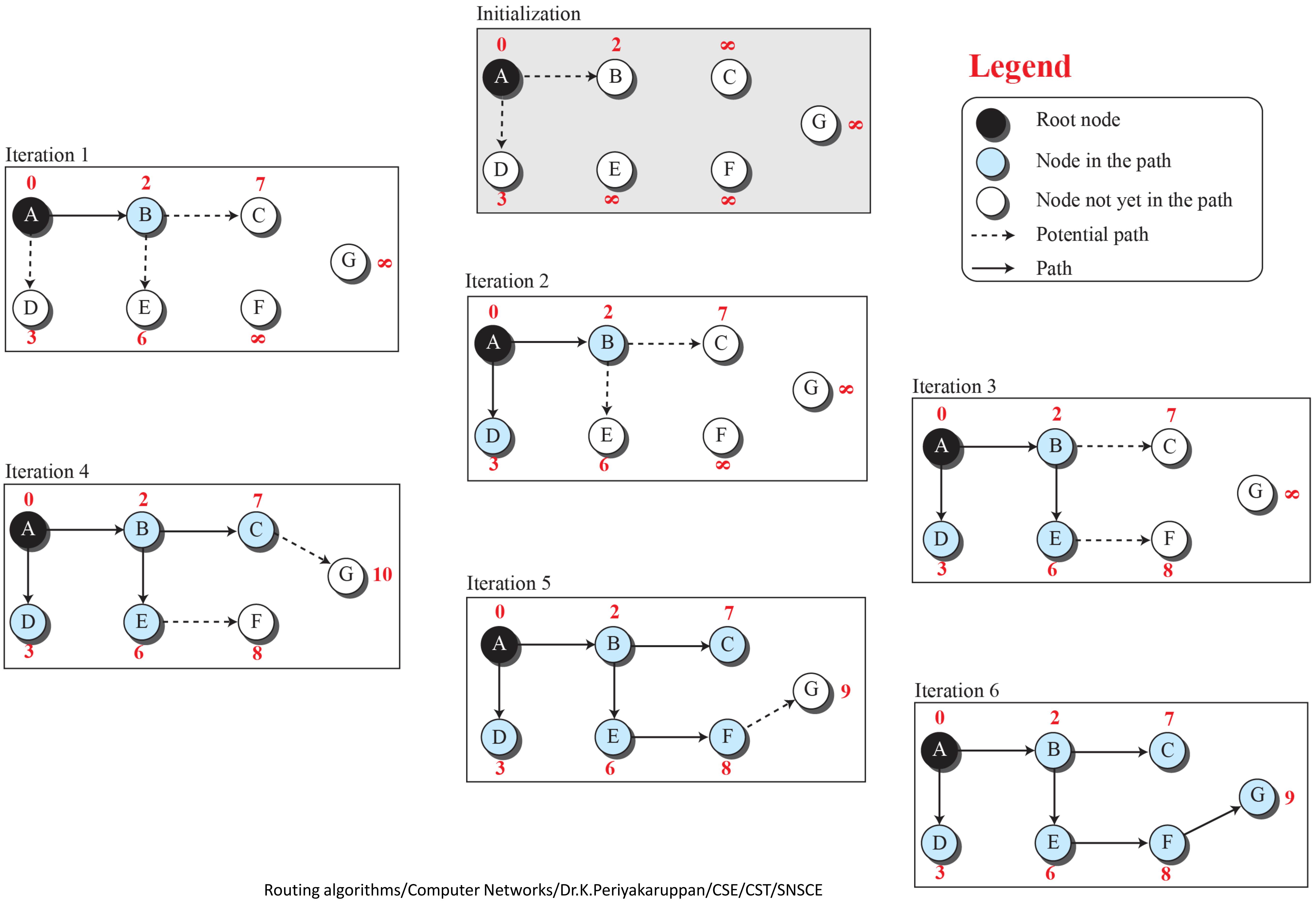
| Node | Cost |
|---|---|
| B | 4 |
| D | 5 |
| E | 2 |

| Node | Cost |
|---|---|
| C | 4 |
| E | 2 |
| G | 1 |

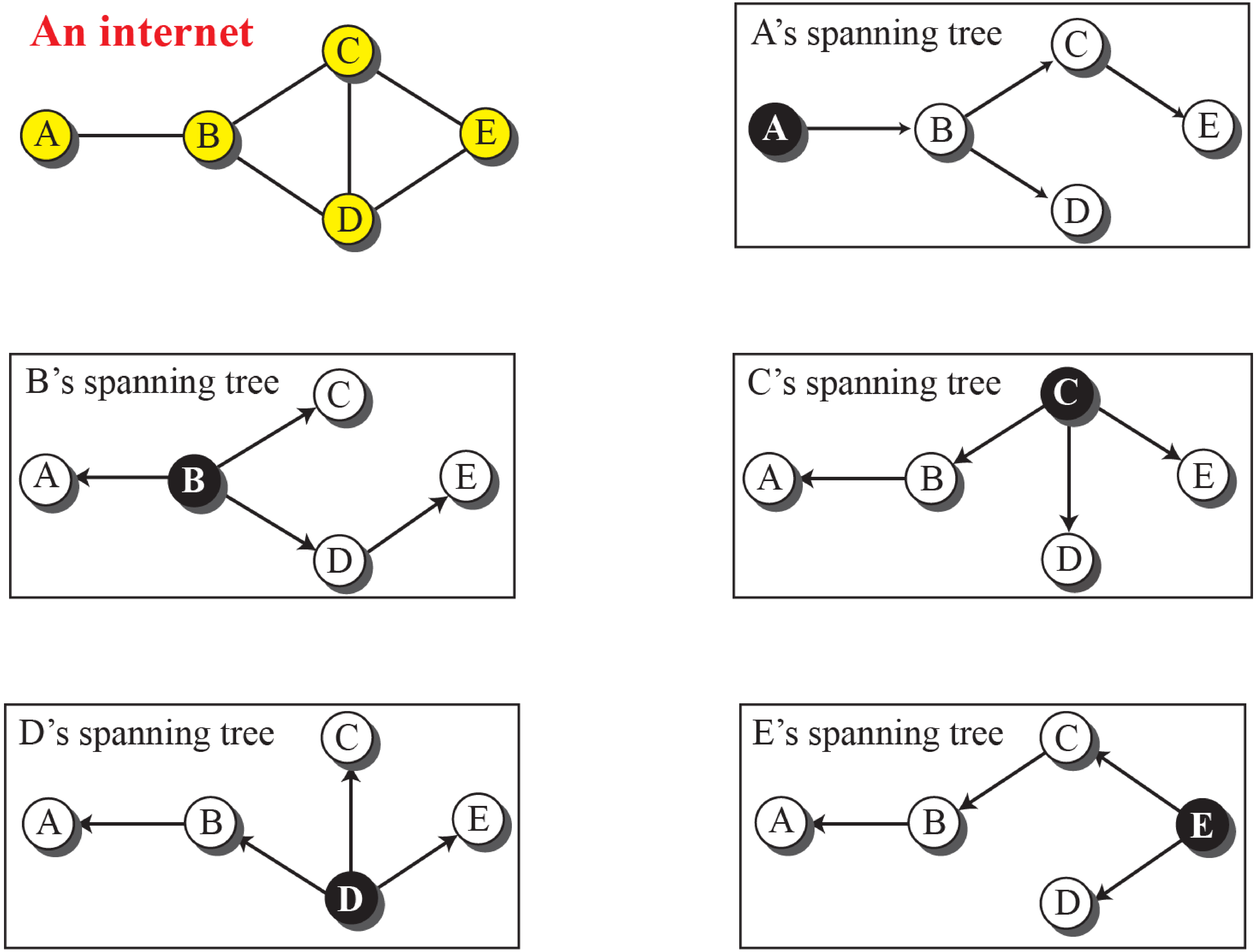
# Table 20.2: Dijkstra's Algorithm

```
Dijkstra's Algorithm ( )
{
    // Initialization
    Tree = {root}                       // Tree is made only of the root
    for (y = 1 to N)                    // N is the number of nodes
    {
        if (y is the root)
            D[y] = 0                    // D[y] is shortest distance from root to node y
        else if (y is a neighbor)
            D[y] = c[root][y]           // c[x][y] is cost between nodes x and y in LSDB
        else
            D[y] = ∞
    }
    // Calculation
    repeat
    {
        find a node w, with D[w] minimum among all nodes not in the Tree
        Tree = Tree ∪ {w}               // Add w to tree
        // Update distances for all neighbor of w
        for (every node x, which is neighbor of w and not in the Tree)
        {
            D[x] = min{D[x], (D[w] + c[w][x])}
        }
    } until (all nodes included in the Tree)
} // End of Dijkstra
```

## Figure 20.10: Least-cost tree



# Figure 20.11: Spanning trees in path-vector routing

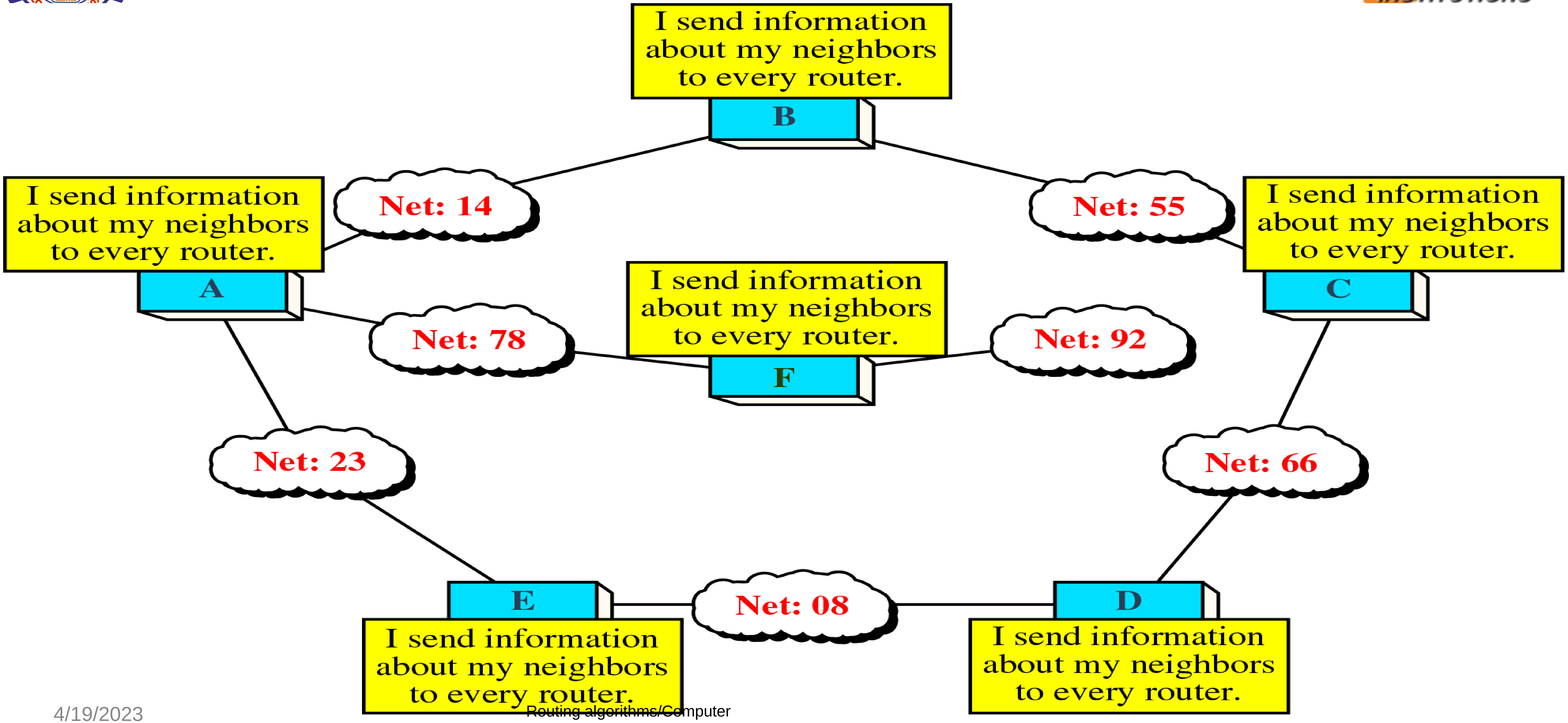


# Path-Vector Routing

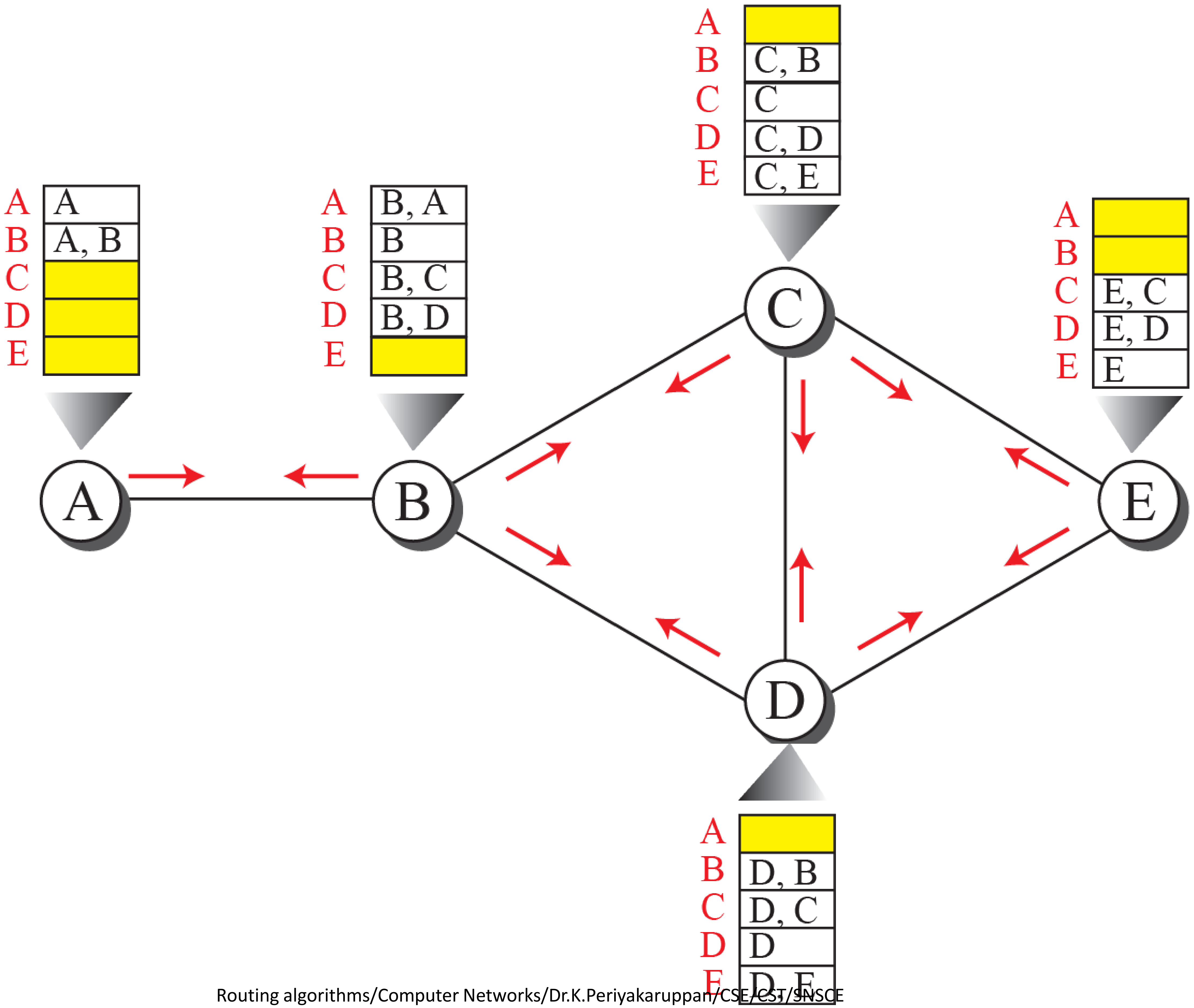
- Both link-state and distance-vector routing are based on the least-cost goal.
- However, there are instances where this goal is not the priority. For example, assume that there are some routers in the internet that a sender wants to prevent its packets from going through.
- In other words, the least-cost goal, applied by LS or DV routing, does not allow a sender to apply specific policies to the route a packet may take.
- To respond to these demands, a third routing algorithm, called path-vector (PV) routing has been devised.

Figure 21-24

# Concept of Link State Routing



# Path vectors made at booting time



# Updating path vectors

| | New C | Old C | B |
|---|---|---|---|
| A | C, B, A | | B, A |
| B | C, B | C, B | B |
| C | C | C | B, C |
| D | C, D | C, D | B, D |
| E | C, E | C, E | |

C[ ] = best (C[ ], C + B[ ])

Event 1: C receives a copy of B's vector

**Note:**
**X [ ]: vector X**
**Y: node Y**

| | New C | Old C | D |
|---|---|---|---|
| A | C, B, A | C, B, A | |
| B | C, B | C, B | D, B |
| C | C | C | D, C |
| D | C, D | C, D | D |
| E | C, E | C, E | D, E |

C[ ] = best (C[ ], C + D[ ])

Event 2: C receives a copy of D's vector

# Path-vector algorithm for a node

```
Path_Vector_Routing ( )
{
    // Initialization
    for (y = 1 to N)
    {
        if (y is myself)
            Path[y] = myself
        else if (y is a neighbor)
            Path[y] = myself + neighbor node
        else
            Path[y] = empty
    }
    Send vector {Path[1], Path[2], ..., Path[y]} to all neighbors
    // Update
    repeat (forever)
    {
        wait (for a vector Path_w from a neighbor w)
        for (y = 1 to N)
        {
            if (Path_w includes myself)
                discard the path                         // Avoid any loop
            else
                Path[y] = best {Path[y], (myself + Path_w[y])}
        }
        If (there is a change in the vector)
            Send vector {Path[1], Path[2], ..., Path[y]} to all neighbors
    }
} // End of Path Vector
```

# Assessment

a).What is DVR algorithm?
b) What is LSR algorithm?
c) What is path vector routing algorithm?
d)Compare the above routing algorithms

# Reference

**TEXT BOOKS**

Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013.

**REFERENCES**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3. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Sixth Edition, Pearson Education, 2013.
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