

23ITT204 - COMPUTER NETWORK

UNIT 3 - ROUTING

ROUTING AND PROTOCOLS

UNICAST ROUTING

What is Unicast Routing?

Unicast routing is the foundation of network communication, sending data from a single source to a single destination in a point-to-point fashion. This direct approach ensures reliable, efficient transmission between devices.

By leveraging routing tables and intelligent path selection, unicast routing enables precise delivery of information across complex network topologies.



Web Browsing

Direct page requests and responses



Email Delivery

Secure message transmission



VoIP Calls

Real-time voice communication



Online Gaming

Low-latency data exchange

Key Unicast Routing Protocols



RIP - Routing Information Protocol

Type: Distance-vector protocol

Metric: Hop count (maximum 15 hops)

Best for: Small networks with simple topology

Limitations: Slow convergence time and limited scalability



BGP - Border Gateway Protocol

Type: Path-vector protocol

Scope: Manages routing between autonomous systems

Best for: Internet backbone and ISP interconnections

Features: Policy-based routing with fine-grained control



OSPF - Open Shortest Path First

Type: Link-state protocol

Algorithm: Dijkstra's shortest path calculation

Best for: Large enterprise networks requiring fast convergence

Advantages: Scalable, hierarchical design with area support



EIGRP - Enhanced Interior Gateway Routing Protocol

Type: Hybrid protocol (Cisco proprietary)

Combines: Distance-vector and link-state features

Best for: Cisco-based enterprise networks

Advantages: Fast convergence with efficient bandwidth use

How Routing Decisions Are Made

The Dijkstra Algorithm in Action

01

Network Discovery

Each router exchanges link-state advertisements with neighbors to build a complete topology map of the network

02

Path Calculation

Dijkstra's algorithm processes the network graph, calculating cumulative costs from source to all destinations

03

Shortest Path Selection

The router selects the closest unvisited neighbor, updates distance values iteratively until optimal paths emerge

04

Route Installation

Optimal paths are installed in the routing table, ensuring data takes the most efficient route with minimal latency

- 📄 **Why It Matters:** This mathematical approach guarantees that packets traverse the network via the most efficient paths, minimizing latency, reducing congestion, and optimizing overall network performance.

Advantages and Challenges of Unicast Routing

Advantages

1 Resource Efficiency

Optimized band width utilization through targeted, direct transmission paths

2 Reliable Delivery

Guaranteed point-to-point communication with acknowledgment mechanisms

3 Scalability

Supports growth from small networks to massive enterprise and Internet-scale deployments

4 Security

Direct connections enable easier encryption and authentication implementation

Challenges

1 RoutingTable Management

Large networks requires substantial memory to store extensive routing information

2 Convergence Latency

Network topology changes may temporarily create suboptimal or invalid paths

3 Resource Consumption

Continuous route maintenance and updates consume CPU cycles and bandwidth

4 Configuration Complexity

Advanced protocols requirespecialized knowledge and careful planning to implement

The Role of Unicast Routing in Modern Networks

1 Internet Backbone

Forms the foundation of global Internet infrastructure, enabling billions of precise data deliveries every second across interconnected autonomous systems

2 Enterprise Networks

Powers mission-critical business applications requiring secure, direct connections between distributed offices, data centers, and cloud resources

3 Future Evolution

Continuous advancement with IPv6 adoption, machine learning optimization, and software-defined networking ensures high-performance routing for emerging technologies

Understanding unicast routing protocols is essential for network engineers, architects, and administrators tasked with designing, implementing, and managing robust, scalable network infrastructures that meet the demands of modern digital communication.