Lab Project: Building and Analyzing a Star Network Infrastructure

Objective: Design, implement, and analyze a star topology network using Cisco Packet Tracer to understand its operational principles, advantages, and practical applications in modern networking.

Part 1: Theoretical Foundation

Star Topology Overview:

A star topology features a central networking device (typically a switch) with all peripheral devices connected directly to it. This configuration creates a radial pattern resembling a star, where the central device manages all data transmission between connected nodes.

Critical Components:

- Central Controller: Layer 2/3 Switch or Hub
- Network Nodes: End devices (computers, printers, servers)
- Transmission Media: UTP cables (Cat5e/6)
- Network Interface Cards

Technical Advantages:

1. Fault Isolation: Individual link failures don't affect entire network
2. Centralized Monitoring: All traffic passes through central point
3. Easy Expansion: New devices added without disrupting existing connections
4. Performance Stability: Each connection has dedicated bandwidth

Part 2: Practical Implementation

Phase 1: Network Design & Device Placement

Step 1: Workspace Preparation

1. Launch Cisco Packet Tracer

2. Create new workspace with appropriate dimensions

3. Set up device palette with required components

Step 2: Device Selection and Placement

1. Central Device: Add Cisco Catalyst 2960 Switch

- Position in center of workspace

- Label as "CORE-SW-01"

2. Peripheral Devices:

- Add 6 PCs: PC1-PC6

- Add 1 Network Printer

- Add 1 Server (File Server)

- Arrange in circular pattern around central switch

Phase 2: Physical Connectivity

Step 3: Cable Connections

Device	**Switch Port**	**IP Configuration**
PC1	Fa0/1	192.168.10.10/24
PC2	Fa0/2	192.168.10.11/24
PC3	Fa0/3	192.168.10.12/24
PC4	Fa0/4	192.168.10.13/24
PC5	Fa0/5	192.168.10.14/24
PC6	Fa0/6	192.168.10.15/24
Network Printer	Fa0/7	192.168.10.50/24

File Server Fa0/8 192.168.10.100/24

Connection Protocol:

1. Select Copper Straight-Through cable

2. Connect each device to switch using FastEthernet ports

3. Verify green link lights appear

Phase 3: Logical Configuration

Step 4: End Device Configuration

For each PC:

Desktop Tab → IP Configuration

- IP Address: As per table above

- Subnet Mask: 255.255.255.0

- Default Gateway: 192.168.10.1

Step 5: Switch Basic Configuration

```cisco

Switch> enable

Switch configure terminal

Switch(config) hostname STAR-CORE-SW

STAR-CORE-SW(config) banner motd Authorized Access Only

STAR-CORE-SW(config) line console 0

STAR-CORE-SW(config-line) password cisco

STAR-CORE-SW(config-line) login

STAR-CORE-SW(config-line) exit
```

STAR-CORE-SW(config) enable secret class

STAR-CORE-SW(config) exit

STAR-CORE-SW copy running-config startup-config

Part 3: Network Verification & Testing

Test 1: Basic Connectivity Verification

1. Ping Test Suite:

- From PC1: `ping 192.168.10.100` (Server)

- From PC3: `ping 192.168.10.50` (Printer)

- From Server: `ping 192.168.10.10` (PC1)

2. Switch Status Verification:

```cisco

STAR-CORE-SW show ip interface brief

STAR-CORE-SW show interfaces description

STAR-CORE-SW show mac-address-table

Test 2: Traffic Analysis

1. Enter Simulation Mode

2. Create PDUs:

- PC1 to Server (FTP Request)

- PC3 to Printer (Print Job)

3. Observe packet flow through switch

4. Document path taken by each packet
```

Part 4: Advanced Configuration

Section A: VLAN Implementation

Create departmental segmentation:

```cisco
STAR-CORE-SW(config) vlan 10
STAR-CORE-SW(config-vlan) name ACCOUNTING
STAR-CORE-SW(config-vlan) exit
STAR-CORE-SW(config) vlan 20
STAR-CORE-SW(config-vlan) name MARKETING
STAR-CORE-SW(config-vlan) exit
! Assign ports to VLANs
STAR-CORE-SW(config) interface range fastEthernet 0/1-3
STAR-CORE-SW(config-if-range) switchport mode access
STAR-CORE-SW(config-if-range) switchport access vlan 10
STAR-CORE-SW(config-if-range) exit
STAR-CORE-SW(config) interface range fastEthernet 0/4-6
STAR-CORE-SW(config-if-range) switchport mode access
STAR-CORE-SW(config-if-range) switchport access vlan 20
```

Section B: Security Enhancement

```cisco
! Port Security Configuration
STAR-CORE-SW(config) interface fastEthernet 0/1
```

STAR-CORE-SW(config-if) switchport port-security

STAR-CORE-SW(config-if) switchport port-security maximum 2

STAR-CORE-SW(config-if) switchport port-security violation shutdown

STAR-CORE-SW(config-if) switchport port-security mac-address sticky

Part 5: Performance Analysis

Scenario 1: Normal Operation

1. Document baseline performance

2. Measure ping response times

3. Record switch CPU utilization

Scenario 2: Fault Simulation

1. Link Failure Test:

- Disconnect PC3 cable

- Verify only PC3 loses connectivity

- Test other devices maintain communication

2. Central Device Failure:

- Power off switch

- Document complete network outage

- Restore and observe recovery

Scenario 3: Load Analysis

1. Generate simultaneous traffic from multiple PCs

2. Monitor switch buffer utilization

3. Check for packet drops/collisions

Part 6: Troubleshooting Exercises

Exercise 1: Connectivity Issues

Problem: PC4 cannot communicate with server

Diagnostic Steps:

1. Check physical connection status

2. Verify IP configuration

3. Check VLAN assignment

4. Verify switch port status

5. Check security settings

Exercise 2: Performance Degradation

Symptoms: High latency, intermittent connectivity

Investigation:

1. Monitor switch CPU/RAM usage

2. Check for broadcast storms

3. Verify duplex settings

4. Check for spanning-tree issues

Part 7: Documentation & Reporting

Required Deliverables:

1. Network Diagram:

   - Physical layout with device labels

   - Logical topology with IP addressing

   - VLAN segmentation map

2. Configuration Files:

- Switch running configuration
- Device IP configuration tables

3. Test Results:

- Ping test success rates
- Traffic flow observations
- Failure simulation outcomes

4. Analysis Report:

- Performance evaluation
- Advantages observed
- Limitations identified
- Recommendations for improvement

Part 8: Assessment Rubric

Criteria	**Excellent**	**Proficient**	**Basic**	**Unsatisfactory**
Design Accuracy	Perfect star topography, optimal device replacement	Correct topology with minor replacement issues	Basic star structure with errors	Incorrect topology
Configuration	All devices configured correctly with advanced features	Basic configuration complete	Partial configuration	Major configuration error
Testing	Comprehensive tests with detailed analysis	All required tests completed	Basic testing only	Incomplete testing
Troubleshooting	Identifies and resolves all issues	Solves main issues with guidance	Requires significant help	Unable to troubleshoot.
Documentation	Professional, complete, well-organized documentation	Adequate documentation	Minimal documentation	Poor or no documentation

Part 9: Extension Activities (Optional)

1. Multi-Switch Star:

- Add distribution layer switch
- Implement trunk links
- Configure VTP

2. Wireless Integration:

- Add wireless access point
- Configure SSID and security
- Connect wireless clients

3. Network Services:

- Configure DHCP on server
- Implement DNS services
- Set up basic firewall rules

Learning Outcomes

Upon completion, students will be able to:

1. Design and implement a functional star topology network
2. Configure network devices with appropriate settings
3. Analyze network traffic flow through central switch
4. Troubleshoot common star topology issues
5. Evaluate network performance under various conditions
6. Document network design and configuration professionally

Submission Requirements:

- Packet Tracer file (.pkt) with complete implementation

- PDF report with all documentation

- Video demonstration (optional but recommended)

- Configuration files in text format