

NETWORKING STREAM: TECHNICAL REPORT

OVERVIEW:

This report outlines the development of an auto-topology generation and network simulation's as per the Networking Problem Statement of the Cisco Virtual Internship Program 2025. The automatically parses router configuration files, constructs a network topology, validates setting and simulates performance and failures.

MAIN-PROJECT:

GITHUB -LINK: [JhaGauravKr/CISCO-VIP-2025-Networking-Internship](https://github.com/JhaGauravKr/CISCO-VIP-2025-Networking-Internship)

INPUT CONFIGURATION-FILES:

- Config/R1.txt	- Config/S1.txt	- Config/PC1.txt	- Config/PC4.txt
- Config/R2.txt	- Config/S2.txt	- Config/PC2.txt	- Config/PC5.txt
- Config/R3.txt	- Config/S3.txt	- Config/PC3.txt	- Config/PCc.txt

Each file includes interface settings, IP addresses, bandwidth, routing protocols (OSPF/BGP) VLANs, and more.

AUTO TOPOLOGY-GENERATION:

- The system parses config files to extract link relationships, interface details, and bandwidth.

```
PS D:\download> & D:/download/.venv/Scripts/Activate.ps1
(.venv) PS D:\download> python src/main_integration.py
🚀 Cisco Virtual Internship - Complete Network Analysis Tool

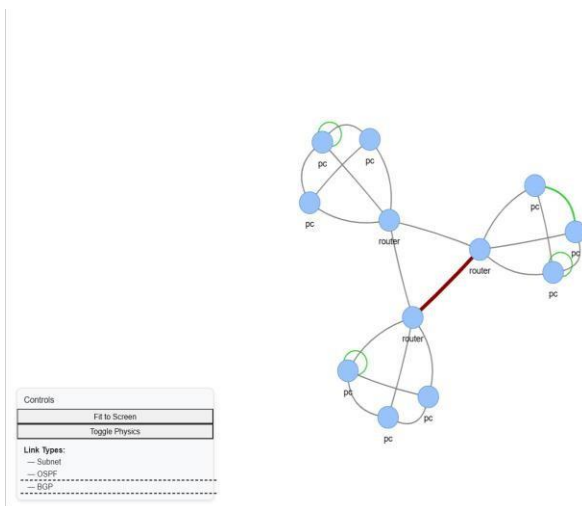
=====
📄 Step 1: Parsing device configurations with comprehensive validation...
✅ Parsed 12 configurations
```

- A hierarchical topology is generated connecting routers, switches, and end devices.

```
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(.venv) PS D:\download> python src/main_integration.py
🚀 Cisco Virtual Internship - Complete Network Analysis Tool
=====
📄 Step 1: Parsing device configurations with comprehensive validation...
✅ Parsed 12 configurations

📖 Step 2: Constructing hierarchical network topology...
✅ Built topology: 12 nodes, 24 links
```

- Visual layout auto-generates using extracted metadata.



CONFIGURATION VALIDATION & OPTIMIZATION:

The tool checks for:

- Missing configuration files (e.g., a switch config for an endpoint)
- Duplicate IPs in the same subnet
- Incorrect VLAN tags or gateway assignments
- MTU mismatches
- Potential network loops
- Suggestions to replace OSPF with BGP when scalability is needed

```

Step 3: Running comprehensive network validation...
Validation Results:
❌ missing_components: 9 issues found
  - PC S1 appears to be missing associated switch configuration
  - PC S2 appears to be missing associated switch configuration
  - PC S3 appears to be missing associated switch configuration
  ... and 6 more
✅ duplicate_ips: No issues
✅ vlan_issues: No issues
✅ gateway_issues: No issues
✅ routing_recommendations: No issues
✅ mtu_mismatches: No issues
❌ network_loops: 2 issues found
  - Potential network loop detected: R3 -> R1 -> R2 -> R3
  - Potential network loop detected: S3 -> R3 -> PC5 -> S3
✅ aggregation_opportunities: No issues

```

LOAD-MANAGEMENT & TRAFFIC AWARENESS:

- Parses bandwidth details from configs to estimate capacity.
- Models expected traffic per application type (e.g., video conferencing vs file transfer).
- If a link is overloaded, recommends load balancing or path offloading.
- Provides fallback routing paths for low-priority traffic.

```

Step 4: Analyzing traffic patterns and capacity...
Link Utilization Analysis:
⚠️ Link R1-S1 is heavily utilized (100.0%)
⚠️ Link R1-PC1 is heavily utilized (100.0%)
⚠️ Link R1-PC2 is heavily utilized (100.0%)
💡 Load Balancing Recommendations:
  - Activate alternative paths for R1-S1 to distribute load. Found 4 alternative routes.
  - Consider implementing ECMP (Equal-Cost Multi-Path) routing for R1-S1
  - URGENT: Implement traffic shaping on R1-S1 to prioritize critical applications

```

STIMULATION & FAULT-INJECTION:

- Day-1 simulation includes ARP, OSPF discovery, and neighbor formation.
- Impact on endpoints
- Routing table reconvergence
- MTU issue effect on data delivery

```

🌅 Step 6: Running Day-1 simulation scenarios...
🔧 Bringing up all network devices...
✅ All interfaces set to up
⌚ Running 60-second network stabilization...
⌚ Waiting 60s for Day 1 network stabilization...
✅ Stabilization complete
🔍 Populating ARP tables and discovering neighbors...
✅ ARP tables populated
✅ OSPF adjacencies formed: {}
✅ BGP sessions established: {}
✅ Day 1 neighbor validation passed

```

- Day-2 testing includes link failure simulation and behavior analysis:

```

🔧 Step 8: Running Day-2 comprehensive testing...
2025-08-15 19:12:08,215 - day2_testing - INFO - Checking configuration best practices
2025-08-15 19:12:08,215 - day2_testing - INFO - Checking configuration best practices
2025-08-15 19:12:08,215 - day2_testing - INFO - Checking configuration best practices
2025-08-15 19:12:08,215 - day2_testing - INFO - Checking configuration best practices
2025-08-15 19:12:08,216 - day2_testing - INFO - Checking configuration best practices
2025-08-15 19:12:08,216 - day2_testing - INFO - Checking configuration best practices
2025-08-15 19:12:08,216 - day2_testing - INFO - Checking configuration best practices
2025-08-15 19:12:08,217 - day2_testing - INFO - Checking configuration best practices
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2025-08-15 19:12:08,217 - day2_testing - INFO - Checking configuration best practices
2025-08-15 19:12:08,217 - day2_testing - INFO - Checking configuration best practices
📊 Day-2 Test Summary:
  Total tests: 31
  Passed: 85
  Failed: 10
  Warnings: 5

```

```

🌟 Step 7: Testing link failure scenarios...
🔗 Simulating failure: R1 <-> R2
2025-08-15 19:12:04,203 - SimulationEngine - INFO - Link failure injected: R1 <-> R2
✅ Network maintained connectivity
2025-08-15 19:12:06,204 - SimulationEngine - INFO - Link restored: R1 <-> R2
🔗 Restored link: R1 <-> R2
🔗 Simulating failure: R1 <-> S1
2025-08-15 19:12:06,205 - SimulationEngine - INFO - Link failure injected: R1 <-> S1
✅ Network maintained connectivity
2025-08-15 19:12:08,208 - SimulationEngine - INFO - Link restored: R1 <-> S1
🔗 Restored link: R1 <-> S1

```

- Simulation can be paused, edited, and resumed.

```

Step 11: Demonstrating pause/resume capabilities...
  Pausing simulation...
2025-08-15 19:12:09,795 - Node-R1 - INFO - Node R1 paused
2025-08-15 19:12:09,795 - Node-R2 - INFO - Node R2 paused
2025-08-15 19:12:09,795 - Node-R3 - INFO - Node R3 paused
2025-08-15 19:12:09,795 - Node-S1 - INFO - Node S1 paused
2025-08-15 19:12:09,795 - Node-S2 - INFO - Node S2 paused
2025-08-15 19:12:09,796 - Node-S3 - INFO - Node S3 paused
2025-08-15 19:12:09,796 - Node-PC1 - INFO - Node PC1 paused
2025-08-15 19:12:09,796 - Node-PC2 - INFO - Node PC2 paused
2025-08-15 19:12:09,796 - Node-PC3 - INFO - Node PC3 paused
2025-08-15 19:12:09,796 - Node-PC4 - INFO - Node PC4 paused
2025-08-15 19:12:09,796 - Node-PC5 - INFO - Node PC5 paused
2025-08-15 19:12:09,796 - Node-PC6 - INFO - Node PC6 paused
2025-08-15 19:12:09,796 - SimulationEngine - INFO - Simulation paused
  Resuming simulation...
2025-08-15 19:12:11,799 - Node-R1 - INFO - Node R1 resumed
2025-08-15 19:12:11,800 - Node-R2 - INFO - Node R2 resumed
2025-08-15 19:12:11,800 - Node-R3 - INFO - Node R3 resumed
2025-08-15 19:12:11,800 - Node-S1 - INFO - Node S1 resumed
2025-08-15 19:12:11,801 - Node-S2 - INFO - Node S2 resumed
2025-08-15 19:12:11,801 - Node-S3 - INFO - Node S3 resumed
2025-08-15 19:12:11,801 - Node-PC1 - INFO - Node PC1 resumed
2025-08-15 19:12:11,801 - Node-PC2 - INFO - Node PC2 resumed
2025-08-15 19:12:11,801 - Node-PC3 - INFO - Node PC3 resumed
2025-08-15 19:12:11,802 - Node-PC4 - INFO - Node PC4 resumed
2025-08-15 19:12:11,802 - Node-PC5 - INFO - Node PC5 resumed
2025-08-15 19:12:11,802 - Node-PC6 - INFO - Node PC6 resumed
2025-08-15 19:12:11,802 - SimulationEngine - INFO - Simulation resumed

```

SYSTEM ARCHITECTURE:

- IPC (FIFO/TCP sockets) used to exchange metadata packets.
- Logs maintained per thread to simulate MAC/IP layer activity.
- Each router/switch is represented as a multithreaded object.

```

Step 5: Initializing multithreaded simulation engine with IPC...
2025-08-15 19:11:04,192 - SimulationEngine - INFO - IPC server listening on port 54024
2025-08-15 19:11:04,193 - SimulationEngine - INFO - Starting network simulation
2025-08-15 19:11:04,193 - Node-R1 - INFO - Node R1 started
2025-08-15 19:11:04,194 - Node-R2 - INFO - Node R2 started
2025-08-15 19:11:04,195 - Node-R3 - INFO - Node R3 started
2025-08-15 19:11:04,195 - Node-S1 - INFO - Node S1 started
2025-08-15 19:11:04,196 - Node-S2 - INFO - Node S2 started
2025-08-15 19:11:04,196 - Node-S3 - INFO - Node S3 started
2025-08-15 19:11:04,196 - Node-PC1 - INFO - Node PC1 started
2025-08-15 19:11:04,197 - Node-PC2 - INFO - Node PC2 started
2025-08-15 19:11:04,197 - Node-PC3 - INFO - Node PC3 started
2025-08-15 19:11:04,197 - Node-PC4 - INFO - Node PC4 started
2025-08-15 19:11:04,197 - Node-PC5 - INFO - Node PC5 started
2025-08-15 19:11:04,198 - Node-PC6 - INFO - Node PC6 started
  Simulation engine started with IPC capabilities

```

CONCLUSION:

- The project successfully automates network topology generation and simulation, streamlining configuration validation and performance testing. By minimizing manual effort and improving accuracy, it offers a reliable, efficient, and scalable solution for modern network design and troubleshooting.

```
🚀 COMPREHENSIVE ANALYSIS COMPLETE!
=====
📁 CISCO INTERNSHIP TOOL REQUIREMENTS - COMPLIANCE SUMMARY:
  ✓ Hierarchical network topology construction
  ✓ Bandwidth analysis and capacity verification
  ✓ Load balancing strategy recommendations
  ✓ Missing component detection
  ✓ Configuration issue identification:
    • Duplicate IP detection
    • VLAN consistency validation
    • Gateway address verification
    • Routing protocol recommendations
    • MTU mismatch detection
    • Network loop identification
    • Node aggregation opportunities
  ✓ Day-1 simulation scenarios:
    • Network device bring-up
    • ARP table population
    • OSPF neighbor discovery
    • BGP session establishment
    • Link failure simulation
    • MTU mismatch impact analysis
  ✓ Implementation features:
    • Multithreaded node representation
    • IPC communication (TCP/IP)
    • Per-node statistics and logging
    • Pause/resume simulation capability
    • Fault injection testing
    • Day-1 and Day-2 scenario support
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📁 All reports and visualizations saved to: comprehensive_reports
📄 Main report: comprehensive_reports\comprehensive_analysis_20250815_191208.json
🌐 Interactive topology: comprehensive_reports\network_topology_20250815_191208.html
```