Premier University

Chattogram

Project Proposal

Design and Simulation of an IPv6 Smart City IoT Network

with Quality of Service and Resilient Routing

Submitted by

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Contents

Contents

Introduction

Modern cities deploy numerous sensors to collect information about traffic, air quality, and infrastructure usage. However, most networks still rely on IPv4, which struggles with address limitations and lacks proper support for IoT deployments. This project proposes designing a smart city network in Cisco Packet Tracer using IPv6 for unlimited addressing, Quality of Service (QoS) for prioritizing emergency traffic, and edge computing for faster local processing.

The network will demonstrate how these technologies can improve city sensor systems, especially during failures. Current IPv4 limitations include address exhaustion requiring complex NAT, lack of native IoT support, and centralized processing bottlenecks that our hierarchical IPv6 architecture with distributed fog computing will address.

Objectives

2.1 Design a smart city network in Cisco Packet Tracer with access, distribution, and core layers
2.2 Implement IPv6 everywhere to eliminate address exhaustion
2.3 Configure Quality of Service to prioritize emergency traffic
2.4 Deploy edge (fog) routers for local sensor data processing
2.5 Test network failover using HSRP and EIGRP for IPv6
2.6 Separate IoT, public Wi-Fi, and admin devices using VLANs and ACLs
2.7 Create email alerts through SMTP for critical events

Scope

This project covers the design, implementation, and testing of a smart city IoT network prototype in Cisco Packet Tracer. It includes:

- Three-tier network architecture with IPv6 addressing
- Security implementation through VLANs and ACLs
- Basic network services (SMTP, HTTP)
- Simulated IoT devices (traffic sensors, air quality monitors, smart bins)
- Failover testing and QoS validation

The project excludes physical layer considerations, advanced security features like IPSec, complex application development, and real-time analytics platforms to maintain focus on core networking concepts.

Tools and Technologies

Primary Platform: Cisco Packet Tracer 8.2.x with IoT device templates

Networking Protocols:

- IPv6 (RFC 8200) for addressing
- EIGRP for IPv6 routing
- HSRP for redundancy
- IEEE 802.1Q for VLANs
- DiffServ for QoS

Services: DHCPv6, SLAAC, SMTP, HTTP, ICMPv6

Security: Extended ACLs, VLAN segmentation, Port security

Key Features

5.1 **IPv6 Implementation:** Native IPv6 with /48 for sites and /64 for subnets, eliminating NAT complexity
5.2 **Quality of Service:** Four-tier traffic classification (Network Control, Emergency Services, Standard IoT, Best Effort)
5.3 **Edge Computing:** Fog routers near sensors for local processing and reduced latency
5.4 **Redundancy:** HSRP with sub-second failover and EIGRP for dynamic routing
5.5 **Security:** VLAN isolation between device types with ACL-based access control
5.6 **Monitoring:** SMTP alerts for critical events and HTTP dashboard for status

Project Timeline

Weeks	**Phase**	**Key Activities**
Weeks 1–2	Literature Review	Research smart city networks and IPv6 deployments
Weeks 3–4	Project Planning	Finalize objectives and submit proposal
Weeks 5–6	Network Design	Create topology in Packet Tracer
Weeks 7–8	Configuration	Implement IPv6, VLANs, and QoS
Weeks 9–10	Testing	Validate failover and security features
Week 11	Documentation	Compile results and prepare report
Week 12	Submission	Submit project and presentation

Expected Outcomes

7.1 A functional smart city network supporting 15+ IoT devices
7.2 Demonstrated sub-second failover during router failures
7.3 Validated QoS ensuring emergency traffic priority
7.4 Complete network documentation with configuration templates
7.5 Hands-on experience with enterprise networking technologies
7.6 Reference architecture for real-world smart city deployments

The project will validate that IPv6 and edge computing effectively address smart city requirements while providing practical experience for team members.

Complex Engineering Problem Attributes

Attribute	How Project Meets It
Conflicting Requirements	Balance emergency priority with fair public access
Multiple Stakeholders	IoT sensors, city staff, admin PCs, and public users share the network
Depth of Analysis	Requires IPv6, VLANs, ACLs, routing, and QoS knowledge
Extensive Knowledge	Combines networking, security, and IoT concepts
Interdependence	All components depend on each other to function
Public Impact	Improves city operations and emergency response
Innovation	Combines IPv6 and edge computing for IoT networks

Limitations

- **Simulation constraints:** Packet Tracer cannot replicate all real-world network behaviors
- **Scale:** Limited to 15-20 devices versus thousands in actual cities
- **Wireless:** Cannot test real interference and propagation issues
- **Services:** Basic SMTP/HTTP compared to production systems
- **Security:** No encryption or advanced threat protection

Despite these limitations, the project effectively demonstrates core concepts that scale to production environments.

Conclusion

This project addresses critical networking challenges faced by modern smart cities through a comprehensive IPv6-based IoT network with QoS and edge computing. The implementation demonstrates practical solutions for address exhaustion, traffic prioritization, and network resilience. By combining current technologies with proper design, we show how cities can build efficient sensor networks that improve urban operations and emergency response.

The hands-on experience gained and documented best practices will serve as valuable resources for future smart city deployments. While simulation limitations exist, the core concepts and architectures directly apply to real-world implementations, contributing to the development of more sustainable and resilient urban environments.