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SECURITY IN HETEROGENEOUS NETWORKS: GENERIC SECURITY PROTOCOL

Overview

- Introduction
- Background
- Security Categories
- Related Work
- Environmental Model
- Design
- Simulations
- Results
- Conclusion

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Introduction

- Looking at Heterogeneous networks in the context of the next-generation Internet
- Will certainly be more diverse than current Internet
- Needs a unified approach to security
- Security policy needs to be communicated beyond trust boundaries
- Work based on *proposed* architecture, details not yet defined

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Background

- This work is an extension of Postmodern Internetwork Architecture (PoMo),
- Funded by NSF under NeTS-FIND 10/2006
- Unconstrained by backward-compatibility issues
- Considers security to be a fundamental requirement for each network component

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Security Categories

- Authentication
  - Use existing methods
- Collaboration Incentives
  - Network access treated as privilege which can be lost due to misbehavior
  - Current mindset difficult to change
- Denial of Service Prevention
  - Can be malicious or accidental
  - Needs continued research

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Related Work

- Two categories of DOS avoidance research
  - Improved resource management
  - Attack prevention
- Each approach addresses a specific scenario
  - 3G cellular multicast
  - 3G cellular scheduling
  - Cellular SMS
  - (Cellular is a popular topic)

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Environmental Model

- PoMo consists of the basic elements *links*
- *Links* interconnect *nodes*
- *Nodes* may be single devices or entire sub-networks defined recursively
- These virtual nodes are referred to as *realms*
- *Realms* are separated from one-another by trust/policy boundaries
- Centralized administration with trusted resources
- Unforgeable return path for each packet

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Design: Goals

- Generic Security Protocol (GSP) [1]
- Unify policy implementation
- Facilitate inter-domain policy communication
- Enhance performance, resilience, and survivability of the network as a whole

Design: Proposed Solution

- Protocol which operates within network stack
- Roughly layer 4.5
- Relies on PoMo Internetwork layer and below
- Required for all realms, but not every individual node
- Placement comparable to BGP

Design: Framework

- Security Agent (SA) run within each realm
- Security Client (SC) optionally run on end nodes
- Security Packets (SP) carry information between entities

Design: Security Agents

- Centralized or distributed within realm
- Run on devices associated with security
  - Gateways
  - Firewalls
  - Intrusion Prevention Systems
- Policy defined around links
- Policy distributed to all SA in realm
- Events trigger response based on policy

Design: Security Clients

- Receives relevant policy info from SA within own realm
- Communicates upwards with application and/or user
- Optional implementation on given end node

Design: Security Packets

- Packet format with fields needed by GSP
  - Authentication (Both source and message contents)
  - GSP code
  - Content field for user customizable data
- Encapsulated in PoMo packet which provides source, destination, and routing/forwarding info

Design: Security Domains

- Intra-Realm
  - Implement unified policy
  - Coordinate security measures (and appliances)
- Inter-Realm
  - Communicate policy to other realms on as-needed basis
  - SP's prioritized above other traffic to ensure delivery even in DOS scenario

Security of GSP

- GSP has potential to become liability if exploited
- Public key encryption used for authentication
- SP's examined at injection and every trust boundary
- Details left to future work, must be bulletproof prior to mass deployment

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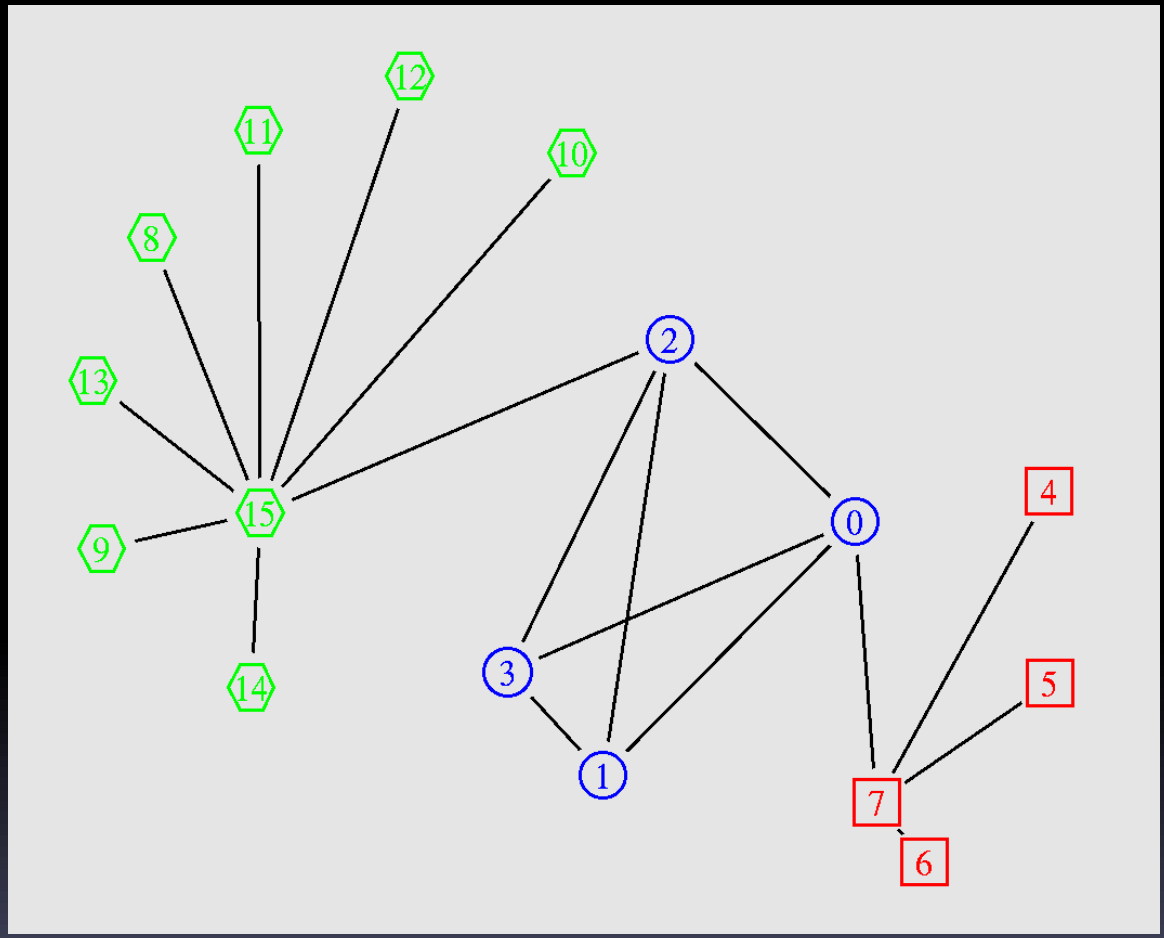
Simulations

- ns-2, three realms with different bandwidth links
- duplex links with drop-tail queuing
- Legitimate traffic simulated with PackMime traffic generator
- Misbehaving traffic simulated using single CBR stream

Simulations

- Green nodes on low bandwidth network
- Blue nodes high-bandwidth core
- Red nodes server farm
- Well behaved HTTP 1.1 traffic generated at rate of 1 request per node per second



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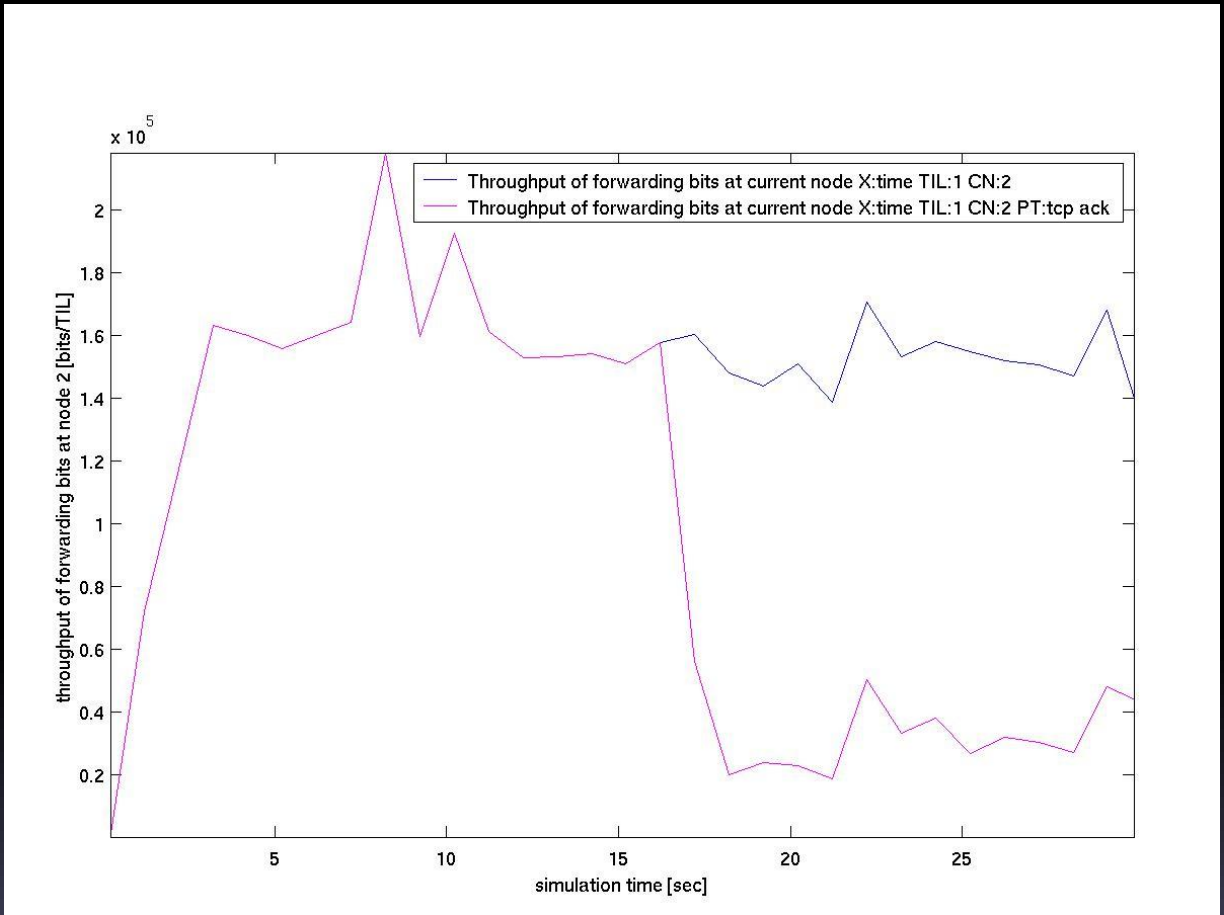
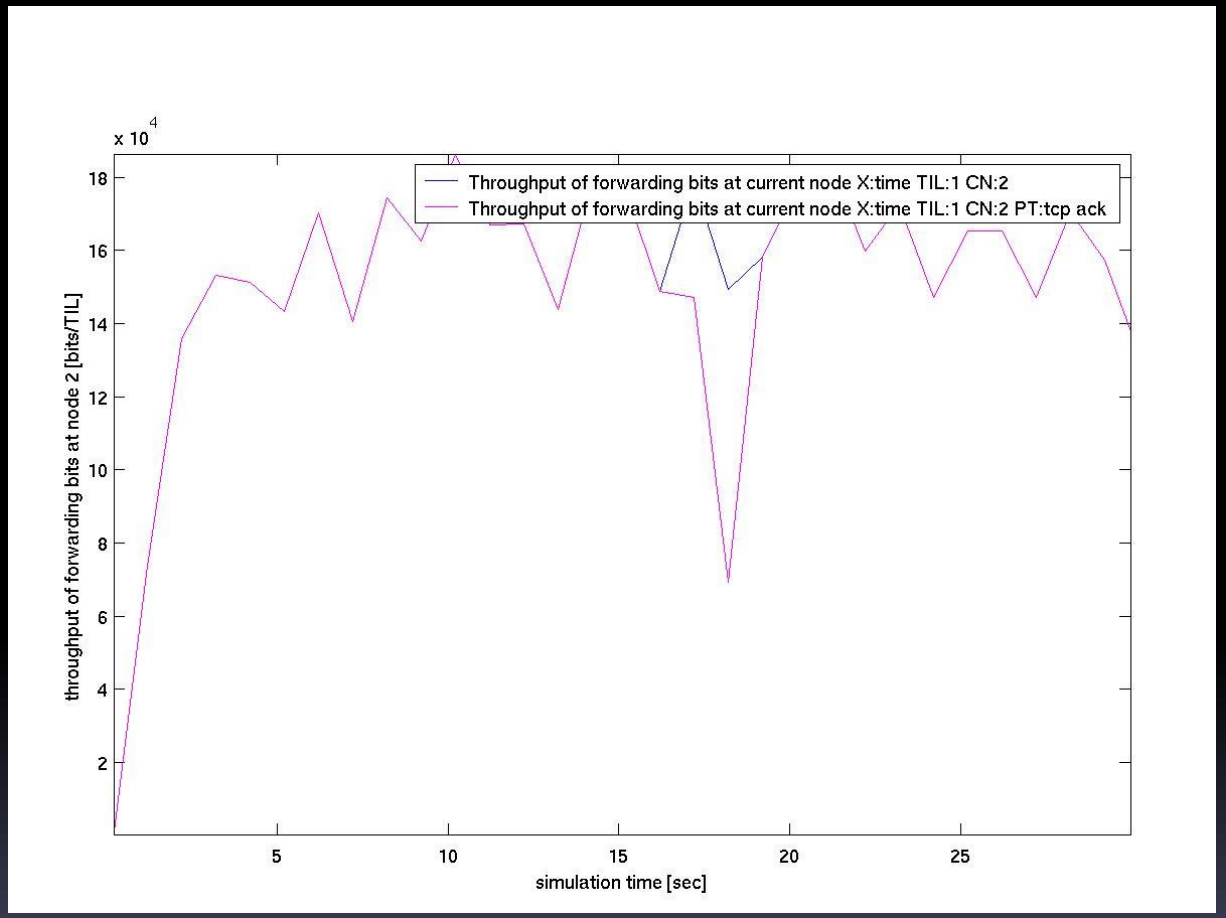
Results: Without GSP

- Node 15 acts as ordinary firewall
- Graph shows goodput on link 2-15
- CBR stream starts at about 16s
- Poor performance due to both DOS and TCP backoff



Results: With GSP

- Node 15 is a firewall with a SA
- Signals node 7 when CBR stream is detected
- Misbehaving traffic blocked at source
- Goodput returns to normal after brief downward spike



Conclusions

- Simulation limited in scope, intended to show power and flexibility of approach
- Could have been a spam flood or SSH brute force attack being block
- Many more scenarios to simulate, whole PoMo project in infancy
- Most difficult aspect will be ensuring that GSP cannot be exploited

Questions

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