# Performance Evaluation of Ring-based Peer-to-Peer Virtual Private Network (RING-P2P-VPN)

Hiroyuki Ohsaki
Graduate School of Information Sci. & Tech.
Osaka University, Japan
oosaki@ist.osaka-u.ac.jp



## 1. State Goals and Define the System

- Goals
  - Quantitatively evaluate performance of RING-P2P-VPN
  - Confirm feasibility of RING-P2P-VPN in realistic environment
  - Analyze effectiveness of several improvement options
    - Bi-directional tunnel
    - Dynamic signaling (i.e., GWDP) frequency control
    - Periodic round-trip time resampling
    - QoS-aware gateway selection (e.g., bandwidth, latency)
    - Priority control for SYN/SYN ACK packets



## 1. State Goals and Define the System (Cont'd)

- System Definition
  - SUT (System Under Test)
    - RING-P2P-VPN network including...
      - Underlying IP network (routers and links)
      - VPN gateways
      - End hosts
  - CUS (Component Under Study)
    - Bi-directional tunnel
    - Dynamic signaling (i.e., GWDP) frequency control
    - Periodic round-trip time resampling
    - QoS-aware gateway selection (e.g., bandwidth, latency)
    - Priority control for SYN/SYN ACK packets



## 2. List Services and Outcomes

- Services Provided
  - Dynamic VPN topology configuration/reconfiguration
  - VPN entity discovery/joining/removal
  - Secure communication among VPN gateways
  - Minimum resource usage at VPN gateways
- Outcomes
  - Higher connectivity between end hosts
  - (Possibly) lower transmission delay
  - Smaller number of IPsec tunnels maintained at VPN gateways



## 3. Select Metrics

- Speed (case of successful service case)
  - Individual
    - TCP/UDP throughput, latency, packet loss probability
  - Global
    - VPN configuration time
    - VPN throughput, latency, packet loss probability
    - Total # of IPsec tunnels
- Reliability (case of error)
  - None
- Availability (case of unavailability)
  - Global
    - VPN reconfiguration time (i.e., VPN recovery time)



## 4. List Parameters

- System parameters
  - Network related
    - Topology
    - Link bandwidth, latency, loss ratio
    - Queue size and discipline (e.g., DropTail or RED)
  - VPN gateway related
    - Failure rate
    - Ad-hoc tunneling threshold (IPSec signaling delay?)
- Workload parameters
  - # of VPN gateways
  - # of TCP/UDP flows, TCP/UDP traffic pattern
  - Background traffic pattern

## 5. Select Factors to Study

- System parameters
  - Network related
    - Topology (10-100 nodes, random or tier)
    - Link bandwidth (1-100Mbps), latency (0.1-100ms), loss ratio
    - Queue size and discipline (e.g., DropTail or RED)
  - VPN gateway related
    - Failure rate (0, 0.001, 0.01, 0.1)
    - Ad-hoc tunneling threshold (IPsec signaling delay?) (0.1-1000ms)
- Workload parameters
  - # of VPN gateways
  - # of TCP/UDP flows, TCP/UDP traffic pattern
  - Background traffic pattern

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## 6. Select Evaluation Technique

- Use analytical modeling?
  - No
- Use simulation?
  - Yes
- Use measurement of real system?
  - No

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## 7. Select Workload

- # of VPN gateways: 2-100
- TCP flows
  - Persistent traffic (simulating FTP traffic)
    - # of TCP flows: 1--100
  - Bursty traffic (simulating Web traffic)
    - # of TCP flows: 1--100
- UDP flows
  - Persistent traffic (exponentially distributed)
    - UDP traffic rate: 0--100% of the link bandwidth
- Background traffic
  - 30% of the bottleneck link bandwidth

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## 8. Design Experiments

- First phase (many factors & few levels)
  - System parameters
    - Network related
      - Topology (40 nodes, random)
      - Link bandwidth (10Mbps), latency (1-10ms), loss ratio
      - Queue size and discipline (e.g., DropTail or RED)
    - VPN gateway related
      - Failure rate (0)
      - Ad-hoc tunneling threshold (IPsec signaling delay?) (100ms)
  - Workload parameters
    - # of VPN gateways (20)
    - # of TCP/UDP flows (10 TCP), TCP/UDP traffic pattern (persistent)
    - Background traffic pattern (30%)
- Second phase (few factors & many levels)
  - Not yet

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## 9. Analyze and Interpret Data

- Not yet

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## 10. Present Results

- Not yet

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