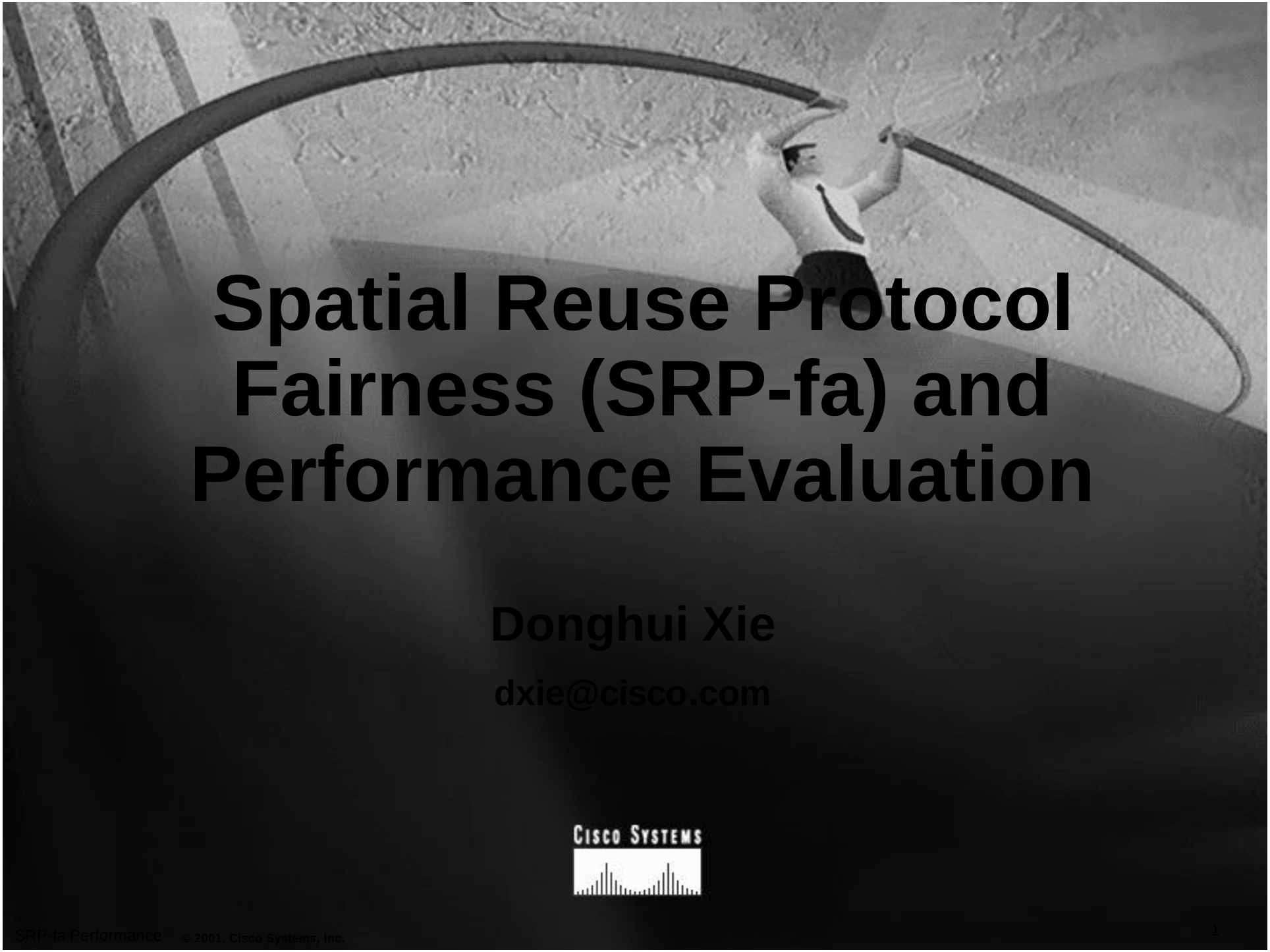


Spatial Reuse Protocol Fairness (SRP-fa) and Performance Evaluation

Donghui Xie

dxie@cisco.com

CISCO SYSTEMS

SRP-fa Agenda

- Fairness as An Objective
- SRP Overview
- SRP Fairness Algorithm
- SRP-fa Simulation Evaluation
- Summary

Fairness as An Objective

- Equal opportunity access to ring bandwidth for all stations, no single station should be starved from ring bandwidth.
- Simplify and support distributed dynamic ring bandwidth management.
- Support ring station plug and play by eliminating explicit node ring bandwidth fairness or unfairness configuration, otherwise, it may involve reconfiguring all the nodes on the ring.
- Support great and complex QoS features in higher layer traffic management by providing consistent and deterministic ring access rate.

SRP Overview

- Spatial Reuse Protocol (SRP) is the new media access control protocol for bi-directional dual counter rotating ring
  - media independent
  - utilize both rings to transport data and control packets
  - support Intelligent Protection Switching (IPS) for ring protection and restoration
  - support plug and play operation
- Enable spatial reuse by destination stripping
  - allow multiple nodes transmitting simultaneously
  - bandwidth consumed only on traversed ring segment
  - Unicast packets travels along ring spans between the src and dest nodes only
- SRP fairness algorithm (SRP-fa) controls access to the ring and enforce fairness
- Scalable to large number of nodes on the ring

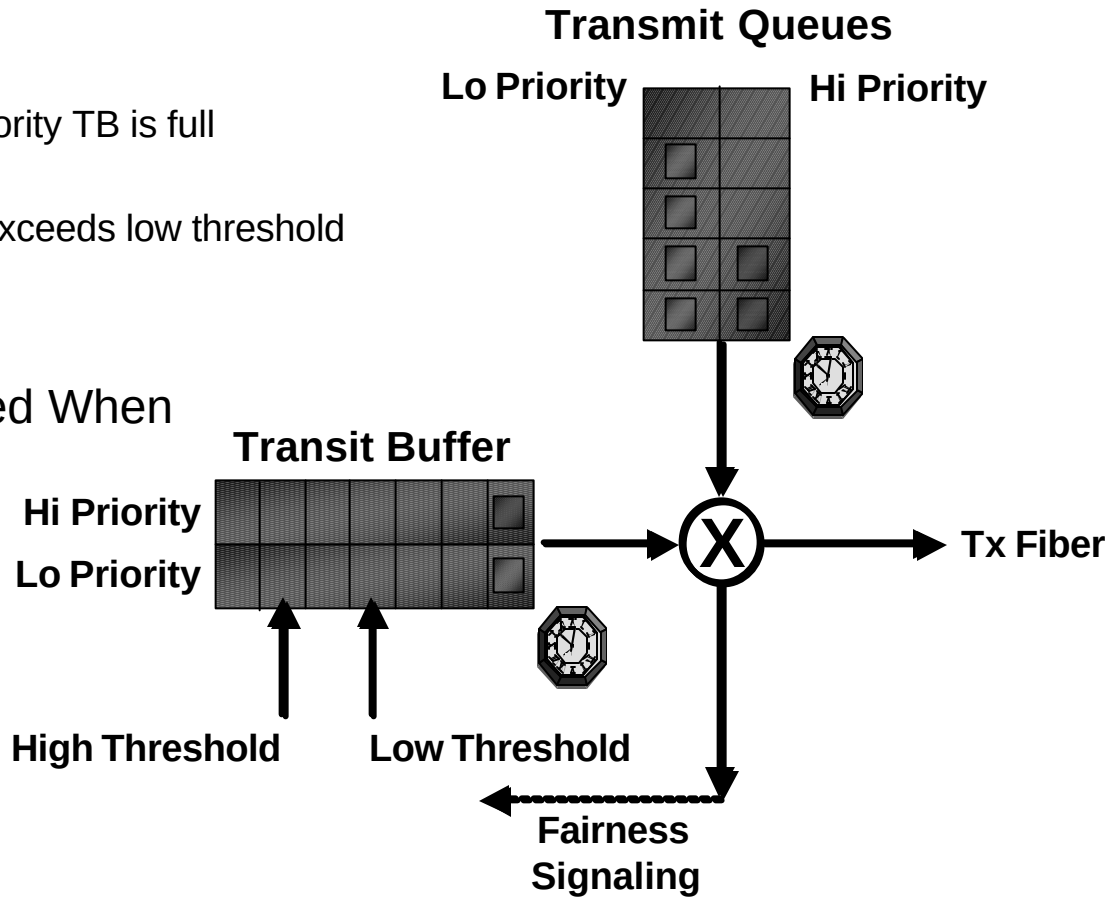
SRP Fairness Algorithm

- A distributed algorithm
  - each node executes a local copy of SRP-fa
- Periodically propagate and use bandwidth usage information to ensure global fairness
- Control low priority packets ring insertion rate and forwarding rate
- Ensure rapid fairness convergence and adaptation

Reference:
D. Tsiang and G. Suwala, “The Cisco SRP MAC Layer Protocol,” IETF RFC 2892, August 2000

SRP-fa Fairness Control

- High Priority Host Packets Are Not Rate Controlled
- SRP Transmit Order
  - High priority transit packets
  - Low priority transit packets if Low Priority TB is full
  - High priority host packets
  - Low priority transit packets if LP TB exceeds low threshold
  - Low priority host packets
  - Low priority transit packets
- Low Priority Host Packets Throttled When
  - My_usage > Allow_usage
  - My_usage > Max_allow
  - LP TB is not empty and My_usage > Fwd_rate



SRP-fa Rate Counters

- Transmit Rate Counter: My_usage
  - Incremented when transmitting low priority transmit packets

    My_usage = My_usage + Packet_Len
  - decremented by a fixed fraction at decay interval

    My_usage = My_usage - min(allow_usage/AGECOEFF, my_usage/AGECOEFF)
- Threshold Counter: Allow_usage and Max_allow
  - Allow_usage set to feedback usage from downstream neighbours
  - Allow_usage can decay upwards to Max_allow if Null usage is received

    allow_usage += (MAX_LRATE - allow_usage) / (LP_ALLOW)
  - Max_allow is statically pre-configured.
- Transit Rate Counter: Fwd_rate
  - Incremented when transmitting low priority transit packets

    Fwd_rate = Fwd_rate + Packet_Len
  - decremented by a fixed fraction at decay interval

    fwd_rate = fwd_rate - fwd_rate/AGECOEFF

SRP-fa Feedback Usage Generation

- LP TB congestion status

  congested = (lo_tb_depth > TB_LO_THRESHOLD/2)

- If congested, signal the smallest usage to throttle upstream transmit

  if (lp_my_usage < rcvd_usage)

  upstream_usage = lp_my_usage;

  else

  upstream_usage = rcvd_usage;

- If not congested but some downstream node is congested which is caused by upstream node, pass on received usage to throttle upstream

  if ((rcvd_usage != NULL) && (lp_fwd_rate > allow_usage)

  upstream_usage = rcvd_usage;

- Otherwise, signal null usage to upstream nodes

  upstream_usage = NULL

  if (upstream_usage > MAX_LRATE)

  upstream_usage = NULL

Simulation Results

- Simulations being run – results will be available at the meeting

Summary

- SRP-fa is scalable to large and high bandwidth rings for metro, regional and wide area networks.
- SRP-fa fairness provides excellent support for TCP applications by ensuring
  - fair ring access rate,
  - stable and consistent delay performance for all conforming tcp packets

