Ring Protection: Wrapping vs. Steering

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Objectives

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- Fast 50 ms protection switching
- Priority discrimination
- High available bandwidth during failure
- No dedicated protection bandwidth
- No out of order transmission of packets desired during protection switching

Service disruption

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- Call dropping (1 second)
- Video on demand flickers (< 1 second)
- TCP timeouts (few seconds)
- IGP link removal
- EGP route removal
- Disruption of communication – business revenue loss, etc.
- Legal implications

Possible solutions

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- Wrapping
  - Fast, local decision
  - Sub-optimal routing after wrap
- Steering
  - Slow, global decision
  - Traditionally in L3 via software
  - Possible in L2 via hardware
- Wrapping then steering
  - Fast, local decision for wrapping
  - Optimal routing after steering

What is wrapping?

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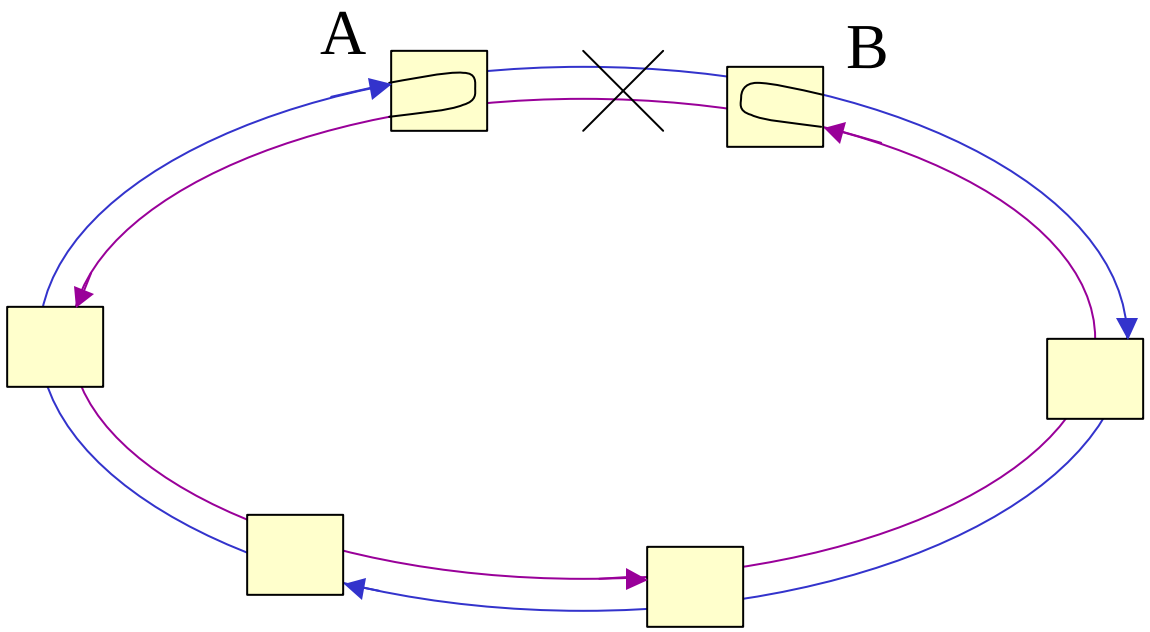

•Node A (or B) adjacent to a failure point forwards all transit traffic from its Outer (Inner) ring to its Inner (Outer) ring

- •Requires only two nodes (A and B) to detect the failure event
- •Packets may not follow the shortest available route after wrap (until a new topology discovery)

What is steering?

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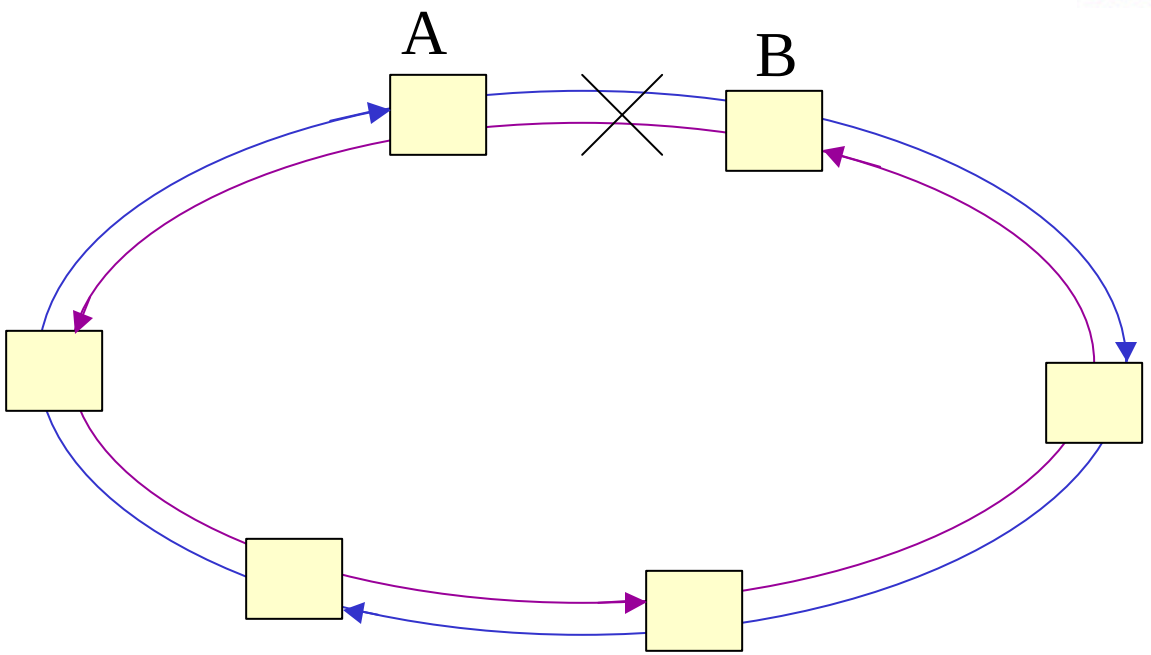

•Each node forwards its transmit traffic to either one of Inner or Outer ring so that all packets reach their destinations without the need to pass the failure point

- •Requires all nodes to be informed of the failure event to trigger topology discovery
- •After new topology is discovered, add traffic is switched to the other ring if it becomes the shortest available path
- •Special handling of multicast packets (send to both rings –> problematic when single fiber cut: 2 copies delivered to a single destination)

Wrapping then steering

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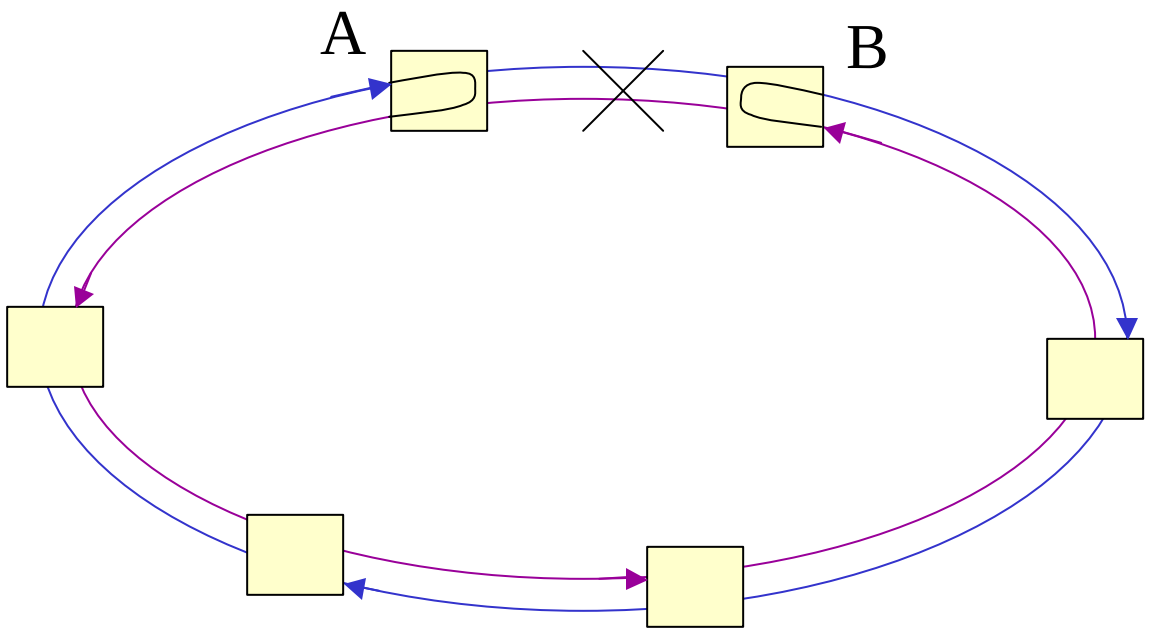

•Neighboring node A (and B) of a failure point forwards all transit traffic from its Outer (Inner) ring to its Inner (Outer) ring

- •A and/or B detect the failure event and wrap ASAP then inform other nodes to start a new topology discovery
- •After new topology is discovered, add traffic is switched to the other ring if it becomes the shortest available path

Dual fiber cut

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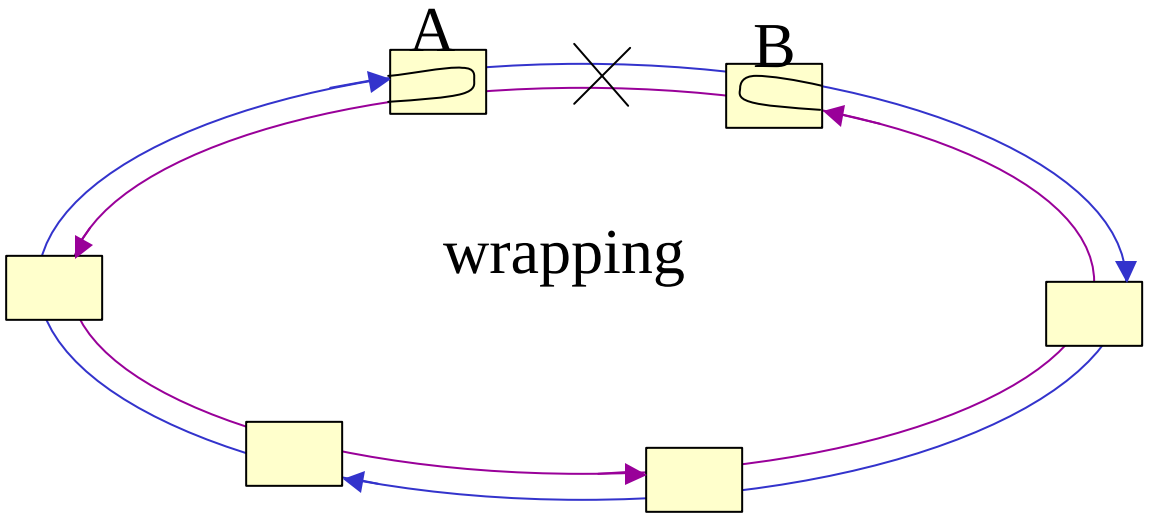

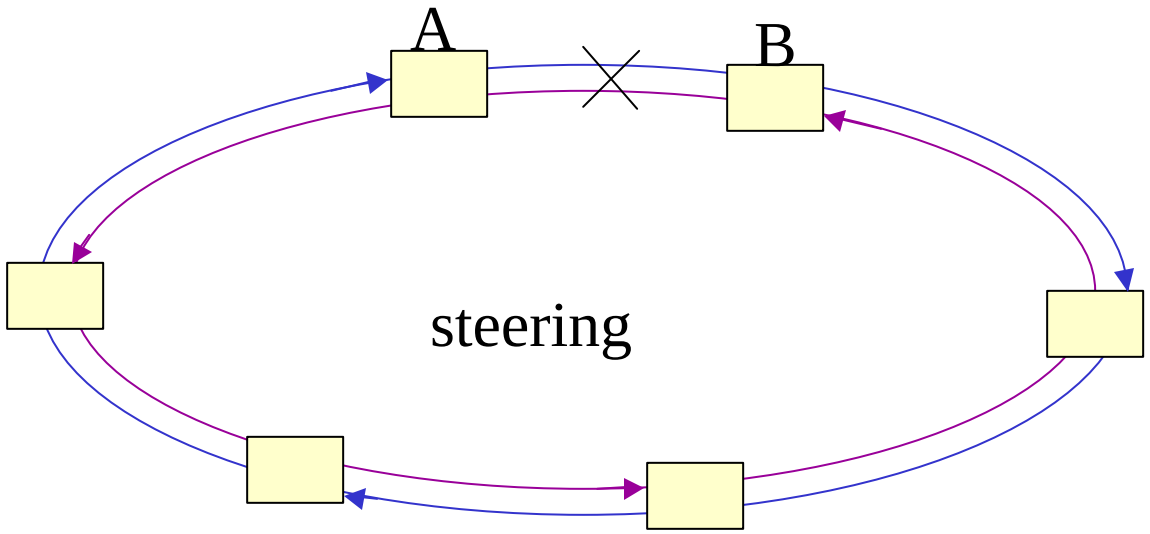

Dual fiber cut comparison

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Wrapping

- ***Fiber cut detection and wrapping***
- ***Sub millisecond*** worth of data is lost

{Fiber cut detection time + Wrap time} LineRate (i.e., [0.4ms +0.1ms] x 10Gb/s = 5Mb)

Steering

- Requires ***Fiber cut detection time + N node delays + node response time*** to switch traffic to opposite ring
- ***{Fiber cut detection time + N node/prop. delays + node steering response time} LineRate + up to (N/2) transit buffer*** worth of data is lost

CASE-1 (fast steering, small ring): [0.4ms + 32 nodes x 0.1ms + 1ms] x 10Gb/s + 16 nodes x 16KB = 48Mb << 20 km ring spans

CASE-2 (fast steering, big ring): [0.4ms + 32 nodes x 1ms + 1ms] x 10Gb/s + 16 nodes x 16KB = 370Mb << 200 km ring spans

CASE-3 (slow steering, small ring): [0.4ms + 32 nodes x 0.1ms + 1s] x 10Gb/s + 16 nodes x 16KB = 10Gb ?? << 20 km ring spans

Single fiber cut

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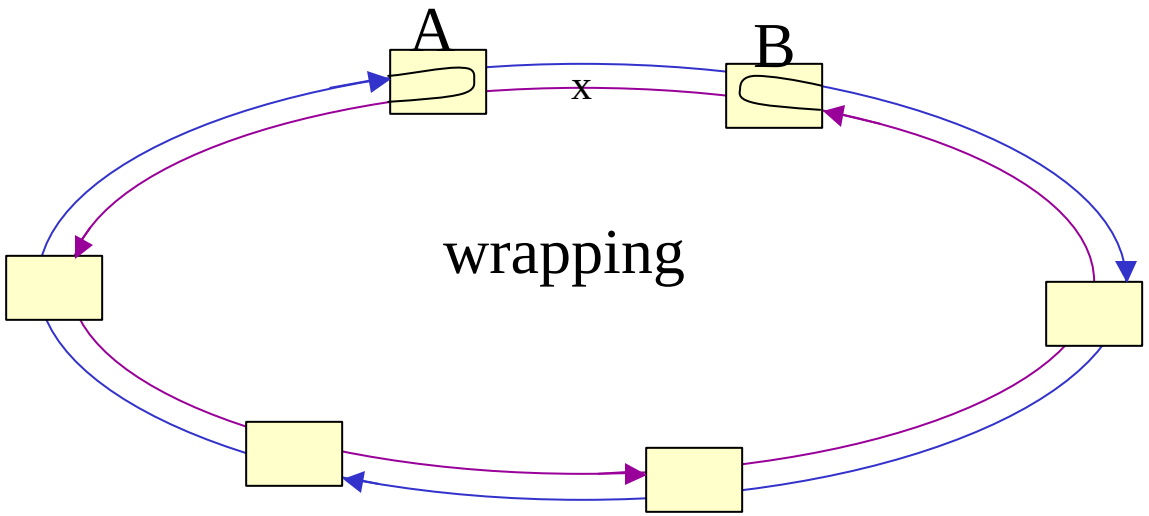

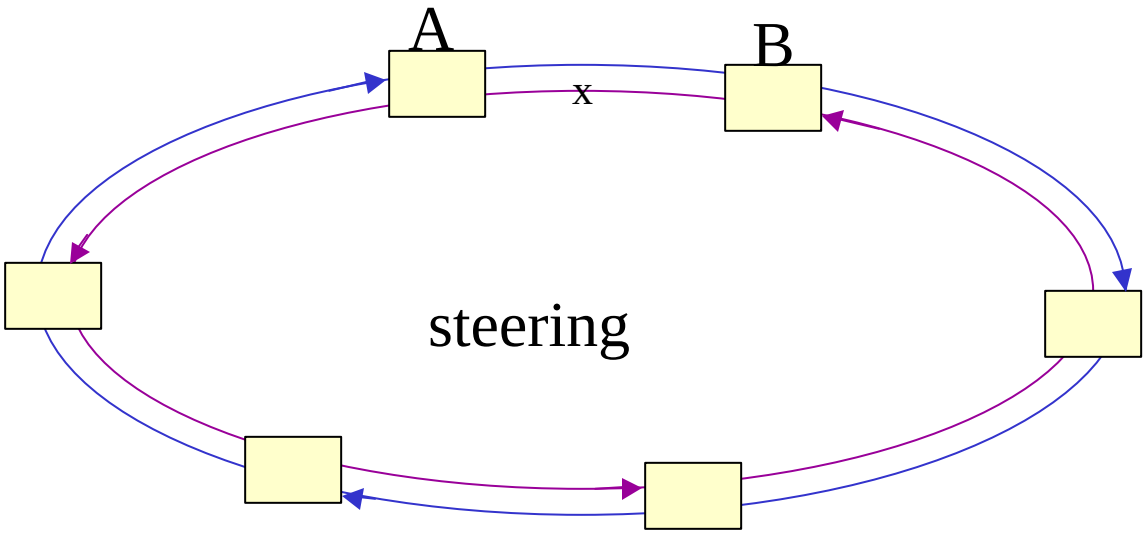

Single fiber cut comparison

Wrap

- Fiber cut detection and wrapping within ***Fiber cut detection time + Wrap time*** on node A, within ***Fiber cut detection time + Wrap time + 1 node/prop. delay*** on node B
- Sub millisecond worth of data is lost ***{Fiber cut detection time + Wrap time + 1 node/prop. delay} LineRate***

CASE-1: [0.4ms + 0.1ms + 0.1ms]x 10Gb/s = 6Mb << 20 km ring spans

CASE-2: [0.4ms + 0.1ms + 1ms]x 10Gb/s = 15Mb << 200 km ring spans

Steering

- Requires ***Fiber cut detection time + N node/prop. delays + node response time*** to switch transmit traffic to opposite ring
- ***{Fiber cut detection time + N node/prop. delays + node steering response time} LineRate + up to (N/2) transit buffer*** worth of data is lost

CASE-1 (fast steering, small ring): [0.4ms + 32 nodes x 0.1ms + 1ms] x 10Gb/s + 16 nodes x 16KB = 48Mb << 20 km ring spans

CASE-2 (fast steering, big ring): [0.4ms + 32 nodes x 1ms + 1ms] x 10Gb/s + 16 nodes x 16KB = 370Mb << 200 km ring spans

CASE-3 (slow steering, small ring): [0.4ms + 32 nodes x 0.1ms + 1s] x 10Gb/s + 16 nodes x 16KB = 10Gb ?? << 20 km ring spans

Simulation results

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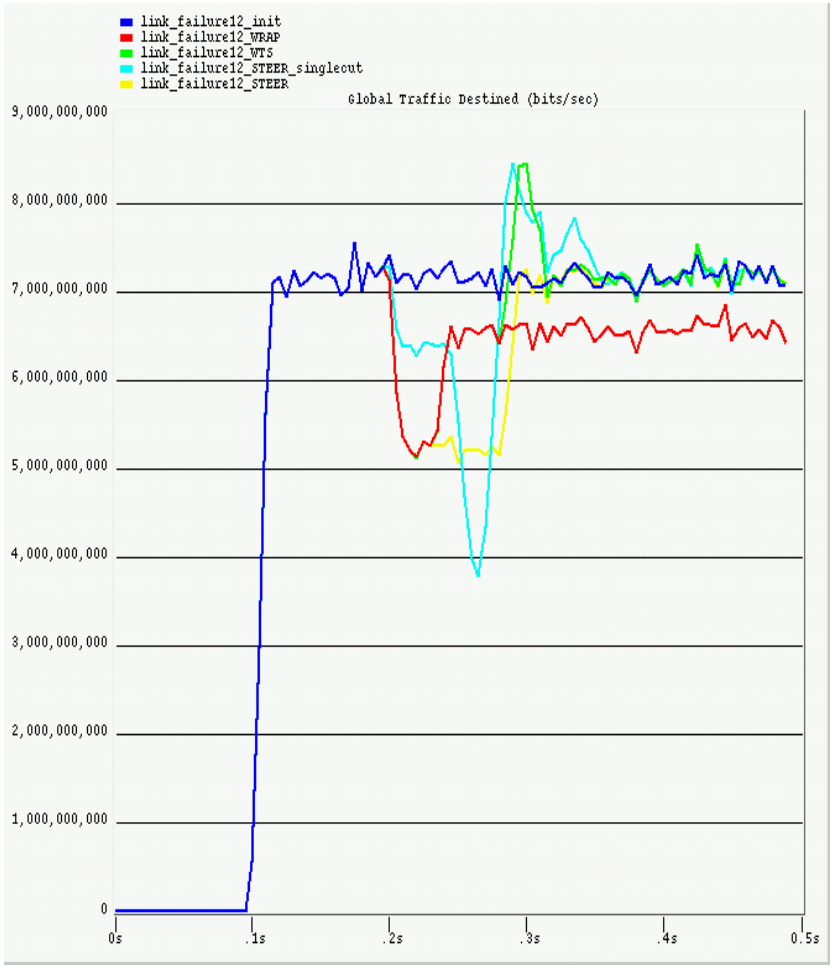

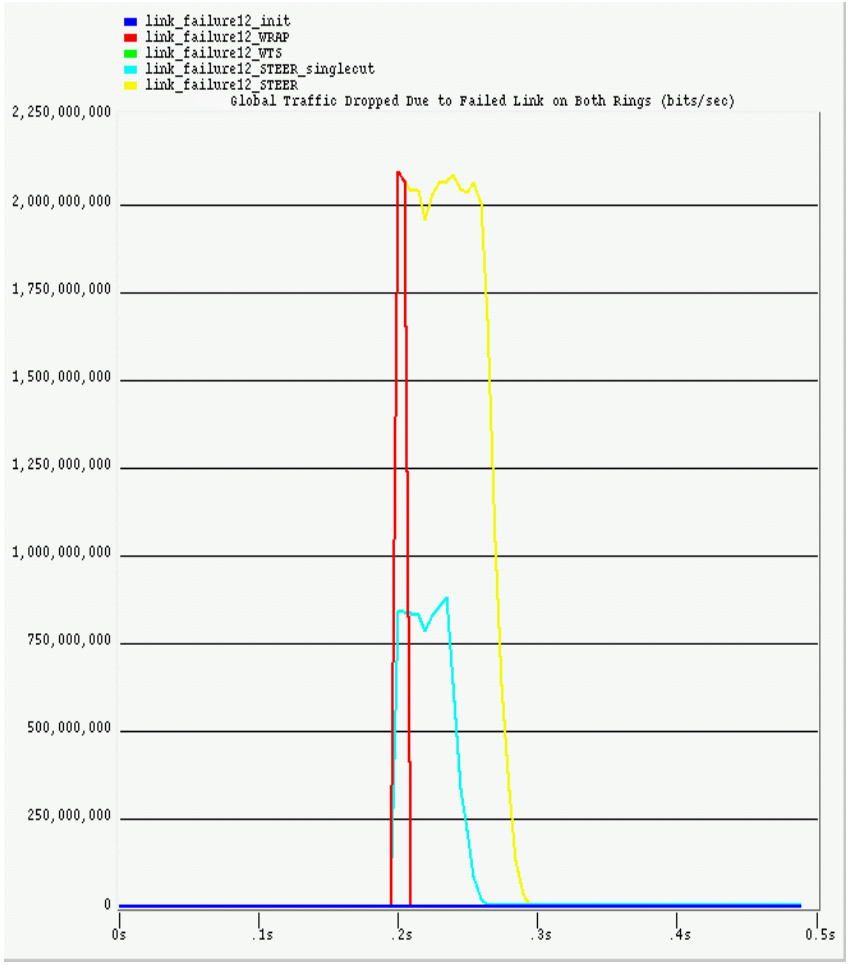

- 12 OC-48 nodes
- 3000 km ring diameter

- 2 x OC-12 transmit cap per node

Simulation results

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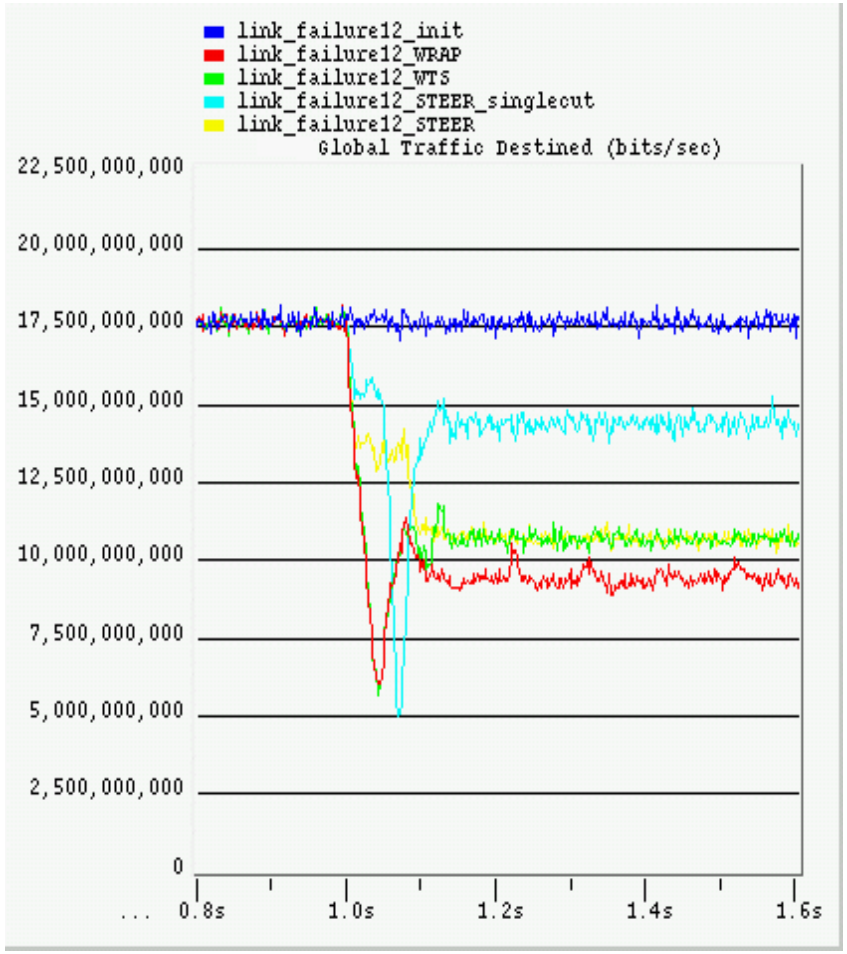

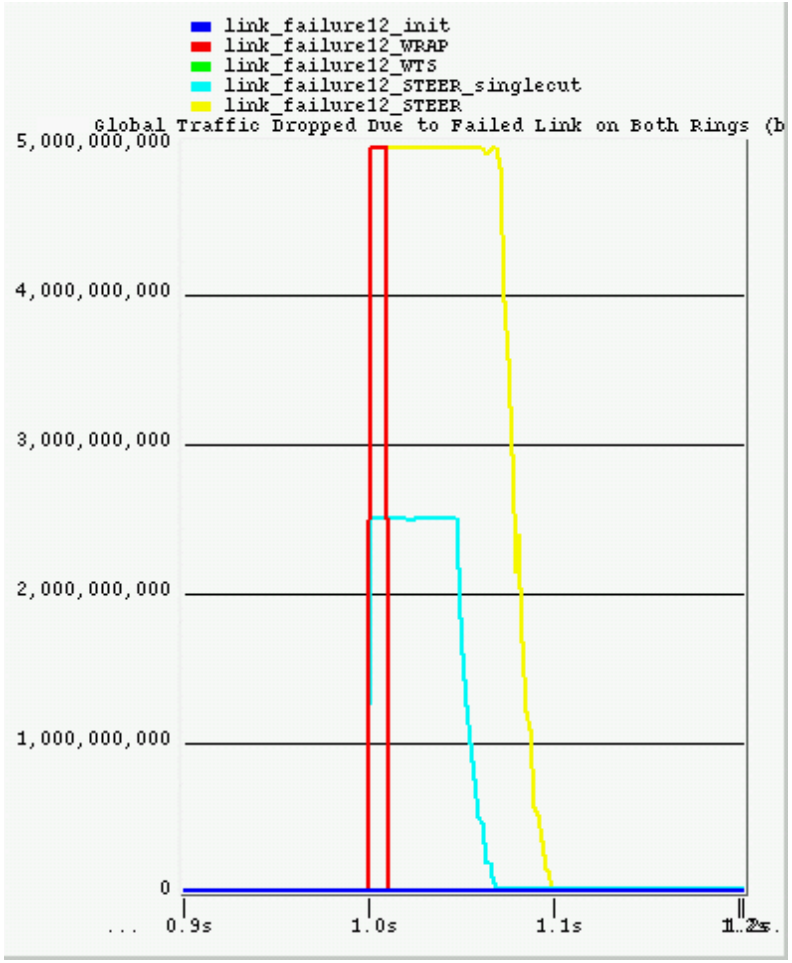

- 12 OC-48 nodes
- 3000 km ring diameter
- No transmit cap per node
- Transmit buffers always not empty

Summary

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- Advantages of wrapping then steering
  - Fast local decision
  - Guaranteed protection switching time
  - Scalability for both MAN and WAN
  - Economy of using software steering

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First wrap…

then steer!