Recommended solution for a Flexible Protection Scheme

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Background

- Two protection schemes being considered for RPR:
  - Wrap (with path reoptimization after new topology discovery)
  - Steer
- Common goal, voted and accepted:
  - Protection time < 50 msec
- Each scheme has advantages for specific applications and for specific topologies

Wrap

- Advantages
  - Fast (involves only fault detecting nodes)
  - Packet loss limited to fault detection time
  - Simple Broadcast/Multicast support (same for normal operation and under failure condition)
  - Nodes information collection packets supported under failure (node transmitting packet receives it back)
  - Performed by hardware at MAC layer

Wrap (continued)

- Disadvantages
  - Higher delay for data flows during wrap (+1 ring latency)
  - Bandwidth inefficient, until path reoptimization performed
  - Revertive only (without path reoptimization)
  - Packet reorder hit when performing path reoptimization (packets in transit between transmitting node and wrapping node)
  - Bidirectional protection only

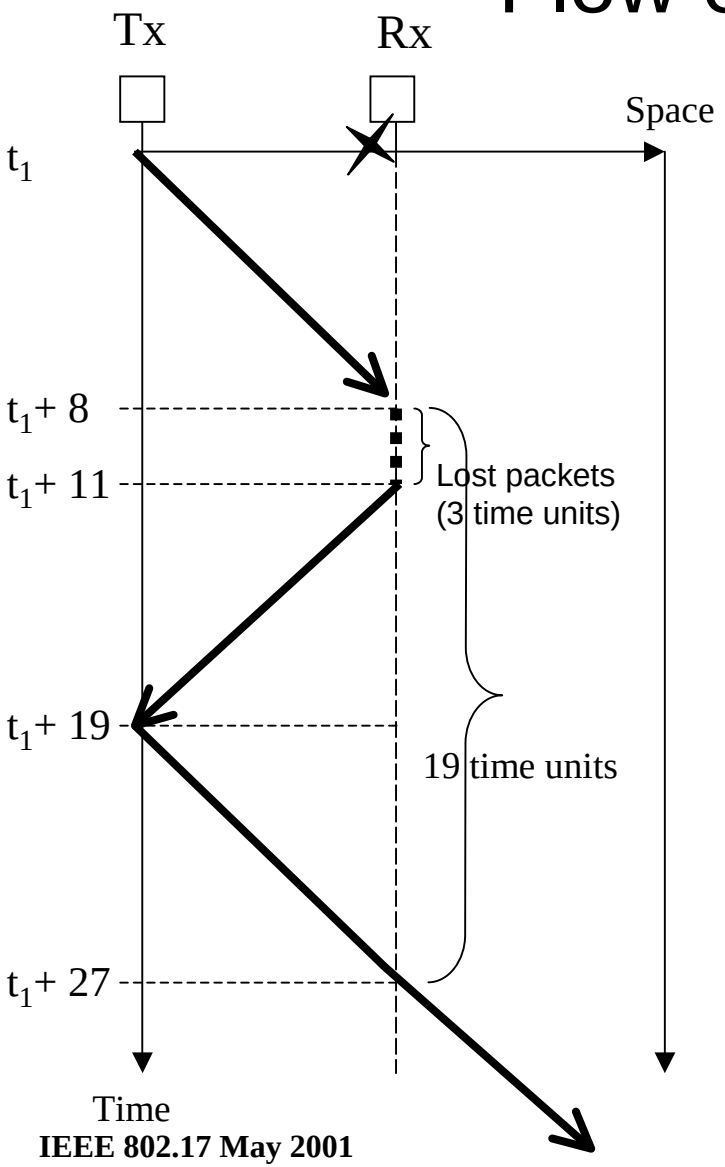
Steer

- Advantages
  - Single operation
  - Supports both: Revertive and non-Revertive schemes
  - Minimal packet reorder (non-Revertive mode)
  - Bandwidth optimal utilization (during failure and for Revertive mode)
  - Lower delay for data flows during protection
  - Supports both: Unidirectional and Bidirectional protection

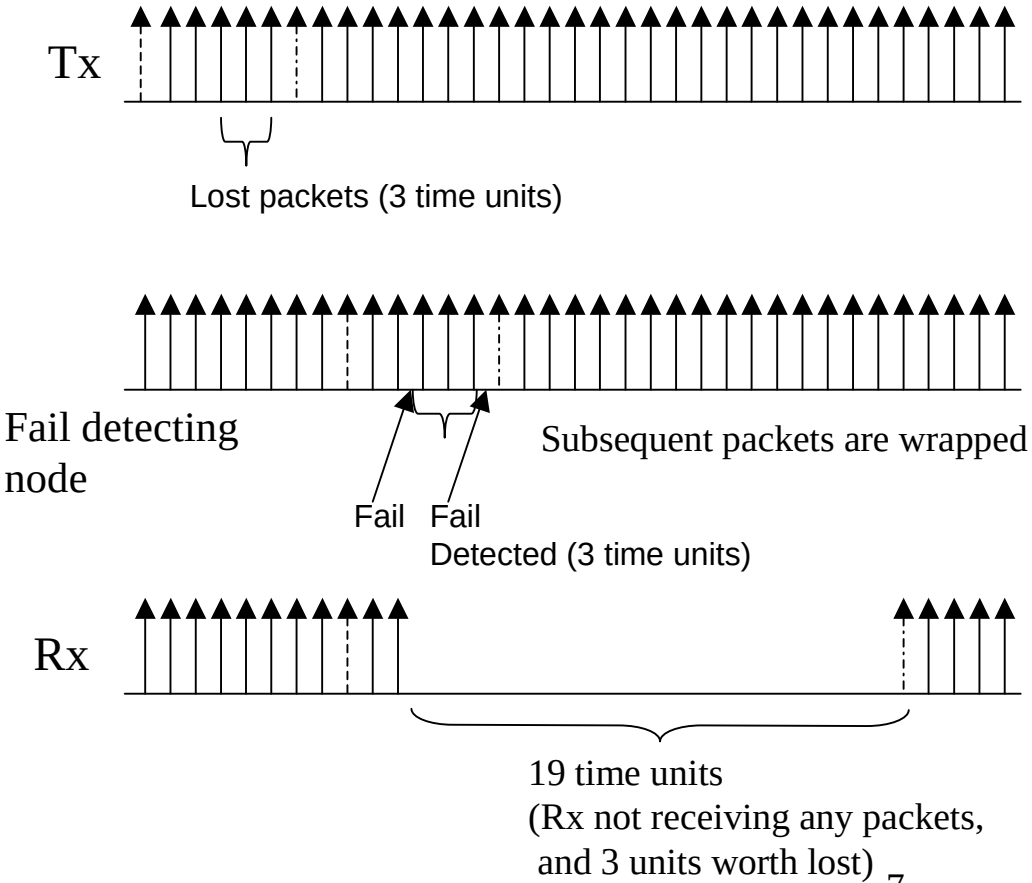
Steer (continued)

- Disadvantages
  - Higher packet loss (2 x Packet rate x alarm packet delay)
  - Different Broadcast/Multicast scheme for normal and fail state (normal transmit through one ring, during fail transmit through both)
  - No support of data collecting packet after failure

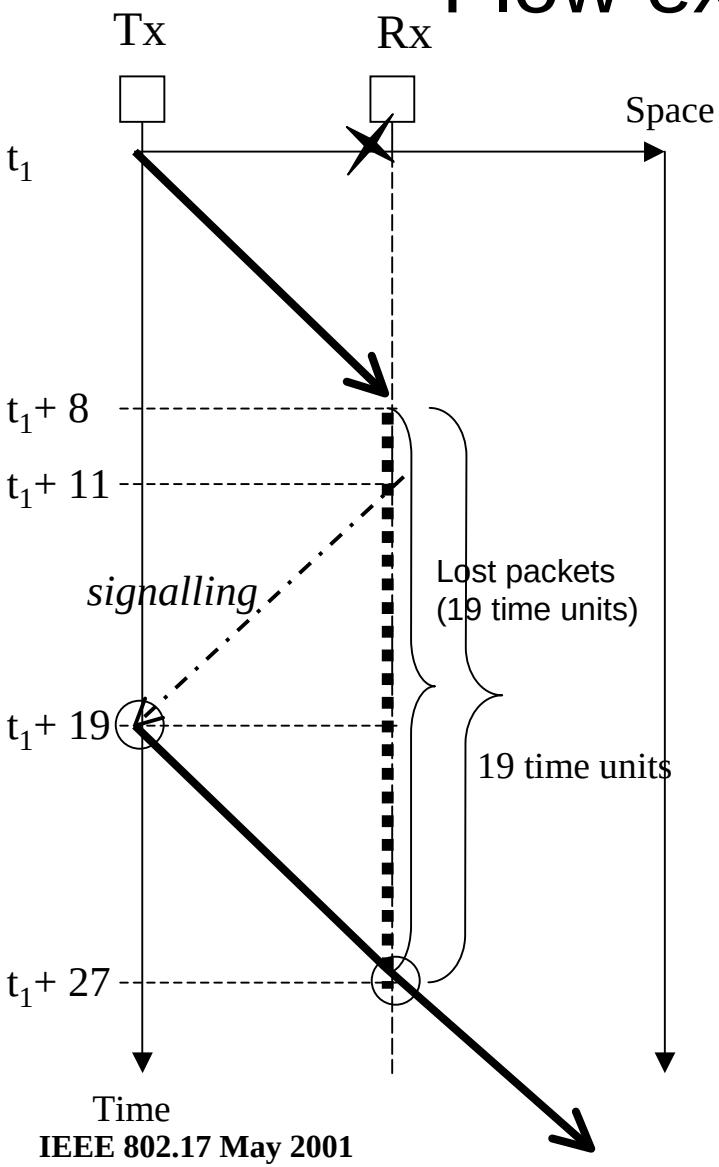
Flow example under Wrap



Ring delay between Tx node and Rx node (both sides) = 8
Ring delay between failed node and Rx node = 0
Packet rate = 1 per unit time



Flow example under Steering



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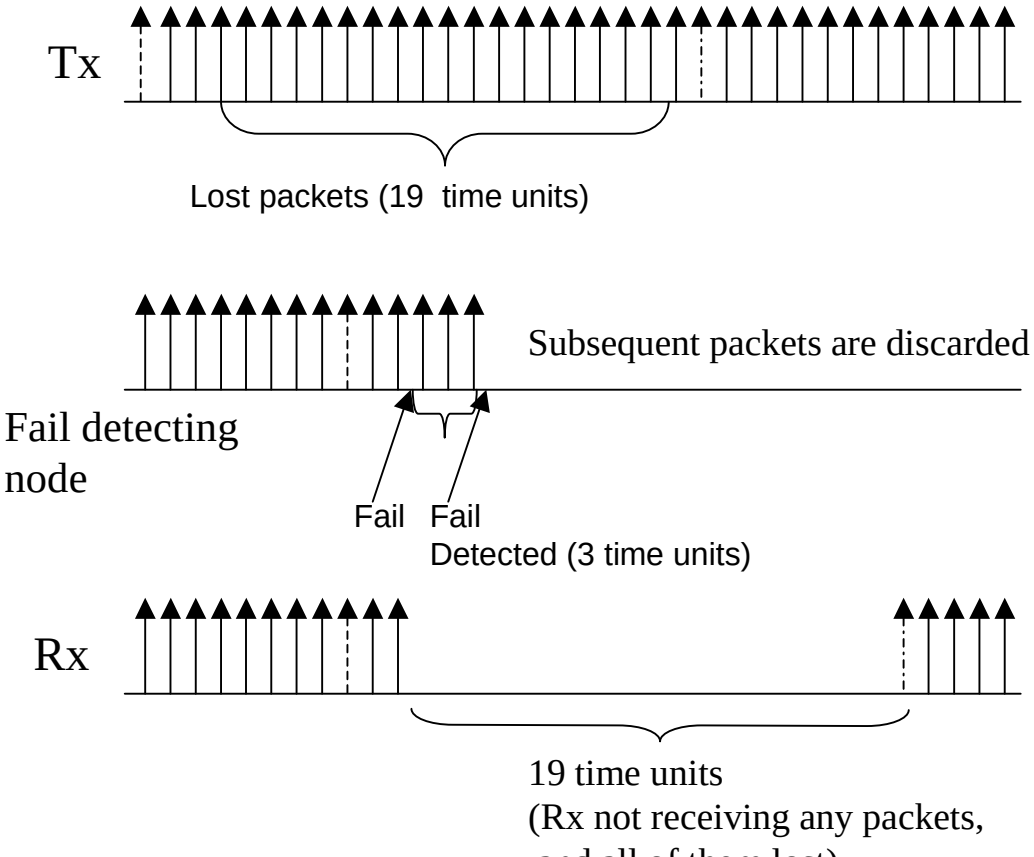
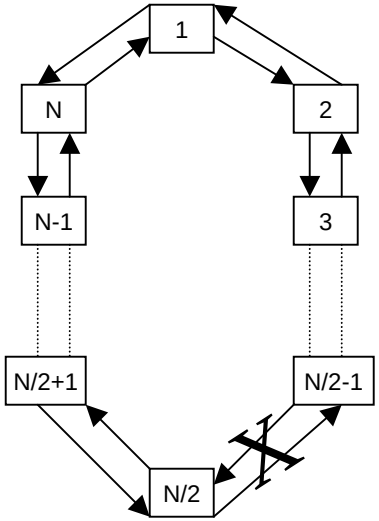
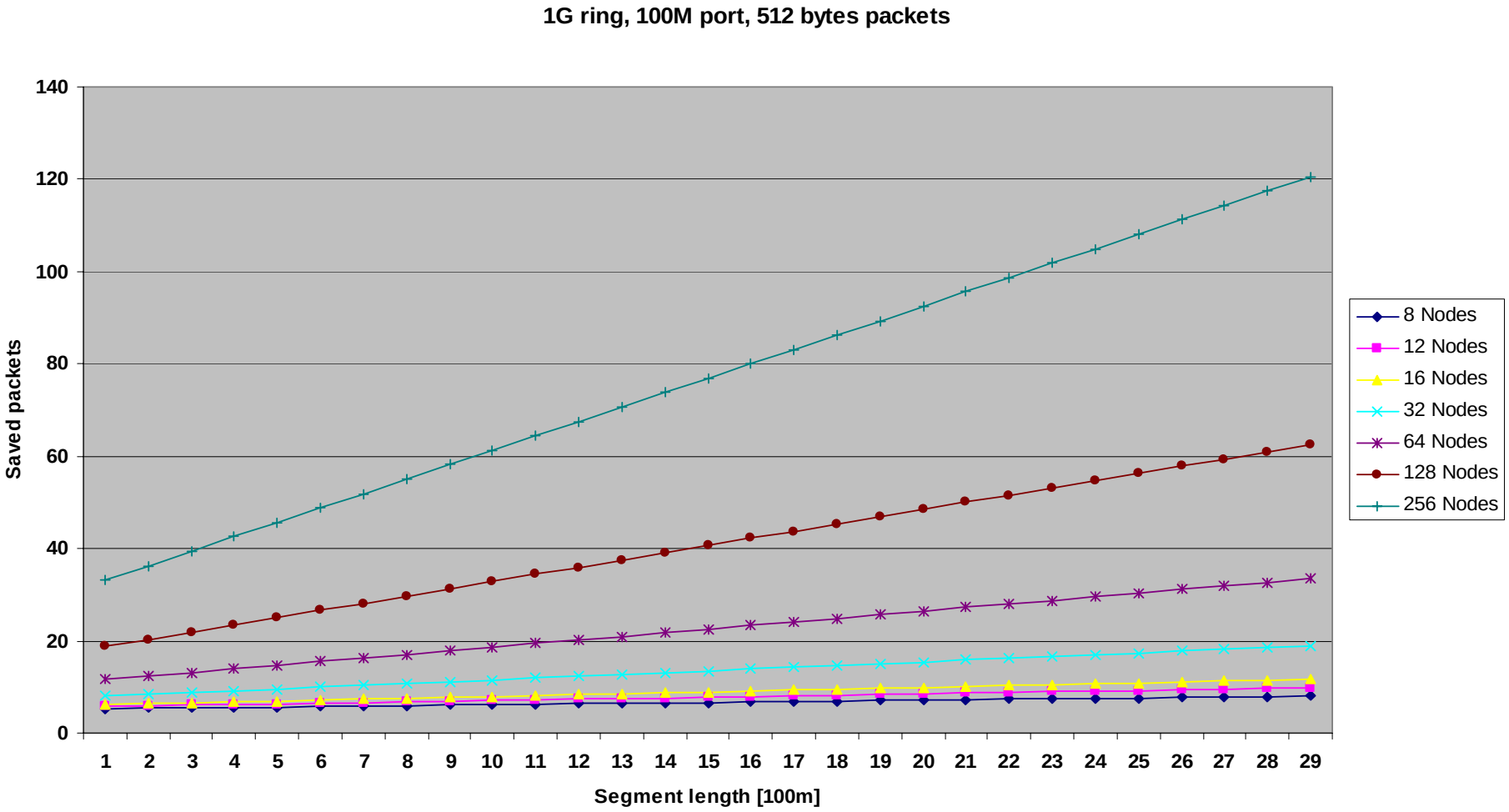


Lost packet calculation example

- Node 1 flow to Node N/2
- No buffered data
- One packet of data store and forward
- No node delay for alarm indication packet
- Wrap activation delay 10usec
- Steer activation delay 100usec



Saved packets by wrap



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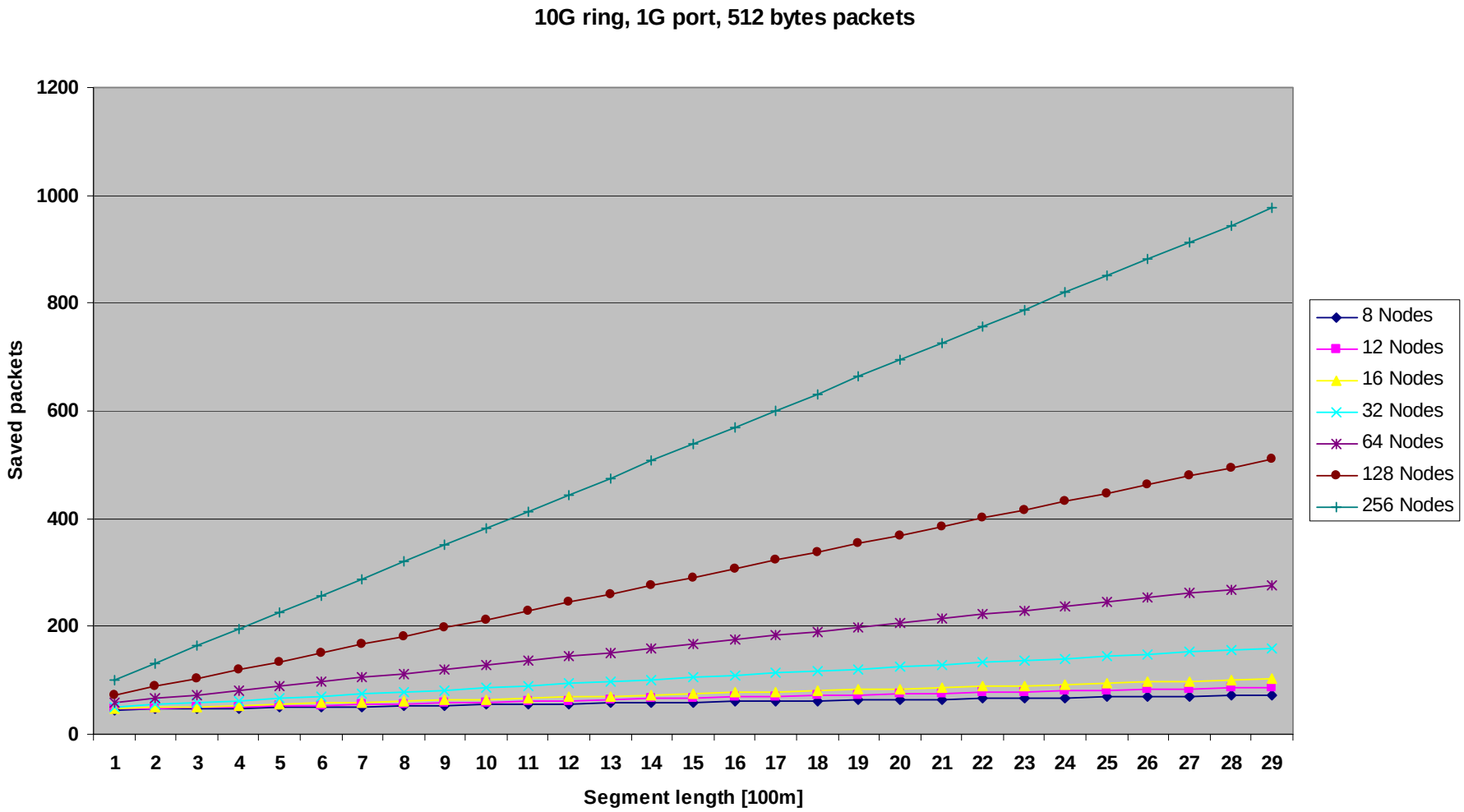


Observations

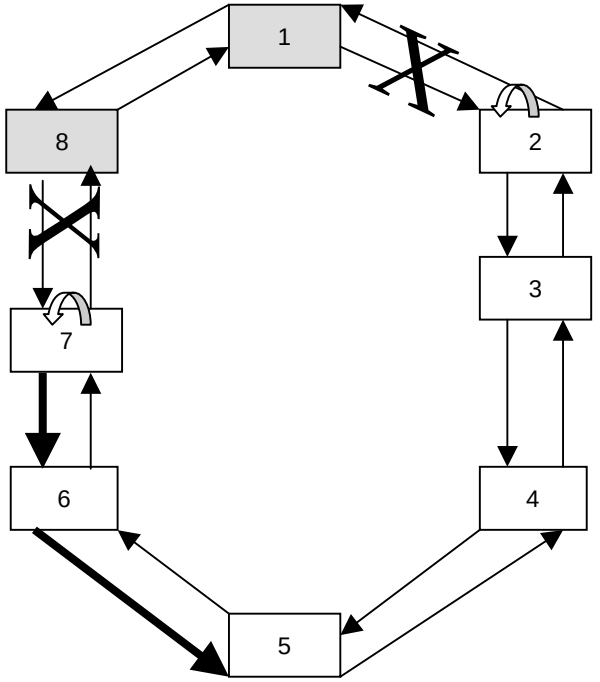
- Each scheme has advantages and disadvantages
- None will provide an optimal solution for all flavors
- SONET has two options UPSR (steer like) and BLSR (wrap)
- Alarm defect detection time is fast. For example in SONET:
  - LOS: 100 usec
  - LOF: 3 msec
  - AIS: 625 usec

Recommended Solution: Selective Wrap Independent Steer (SWIS)

- Define a “wrap” indication in packet header
  - Node detecting failure must wrap all packets with “wrap” indication set
  - Node detecting failure must discard (Bidirectional protection) or pass (Unidirectional protection) all packets with “wrap” indication clear
- Send an alarm indication (upstream and downstream) within TBD msec of detecting failure
- Send alarm indication every TBD sec if alarm persists

Multiple ring failures

- Node 5 to Node 1 flow.
- Node 1 and 8 isolated from ring
- Node 5 removes flow with SA=5
- Wrapped flow 5-1 competes with flows in segments 7-6 and 6-5



Multiple ring failures - methods

- CAC based
  - Reserve bandwidth for guaranteed wrapped traffic
  - Easy to implement,
  - Guaranteed services are bandwidth limited
  - Wrapped BE traffic competes with normal segment BE traffic
- Alarms based
  - Evaluate alarms to discover isolated nodes
  - Stop transmission to isolated nodes
  - Traffic impaired during evaluation
  - Better bandwidth utilization

SWIS in RPR

- To be defined by RPR standard:
  - Wrap indication (overhead flag) – only SWIS specific requirement
  - Alarm indication packets format
  - Alarm indication packet transmit delay
  - Alarm refresh interval (t)
  - Alarm clear declaration by nodes not adjacent to failure (2±0.5 t)
  - Alarm events that trigger protection
  - Protection commands stack
- Out of scope of RPR standard:
  - Which user packets will have the “wrap” indication set ?
  - How steer is implemented (as long as it takes less than 50 msec)
  - Unidirectional/Bidirectional scheme selection (Unidirectional for steer only rings)
  - CAC function to reserve bandwidth for wrapped traffic

SWIS advantages

- Flexible. Supports both: steer only and wrap only networks
- Supports hybrid networks, user can decide which flow to protect with which scheme
  - Steer for re-order sensitive flows
  - Wrap for packet loss sensitive flows
- Broadcast/Multicast and data collecting packets can use wrap
- Low implementation complexity

Proposal

- Use SWIS as the basis for RPR protection
- Set up ad-hoc group to define details
- Ask simulation ad-hoc group to provide simulations of SWIS