Validation of the IEEE 802.11 MAC Model in the ns3 Simulator using the EXTREME Testbed

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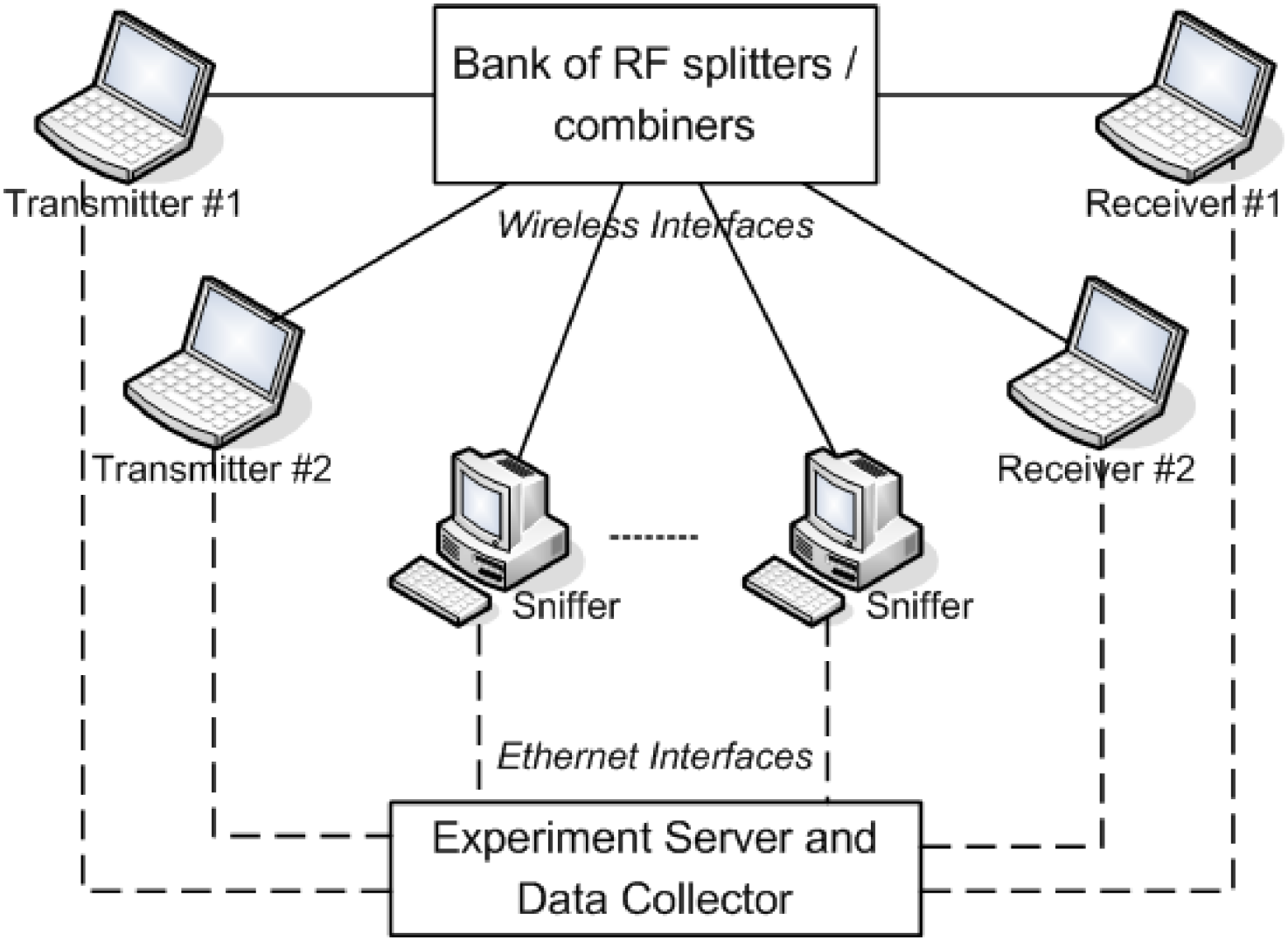
the EXTREME testbed (wifi part)



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performance metrics

- Throughput
- delay
- packet losses

} from application

- # delivered MPDUs
- # retry MPDUs
- channel busy time

} from PCAP trace

- # transmission attempts
- # CRC errors

} from athstats

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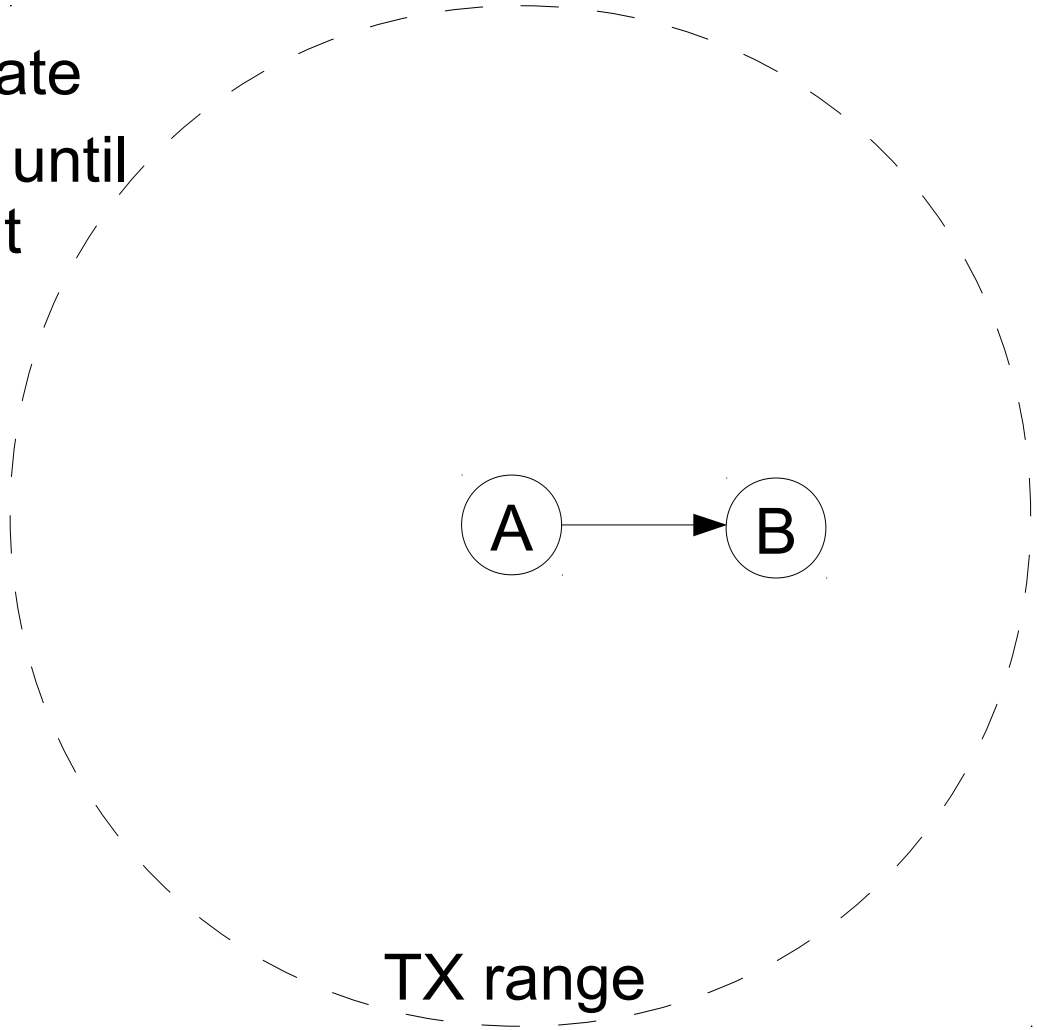
single TX/RX node pair

- CBR traffic
- 11Mbps PHY rate
- increase traffic until max throughput reached



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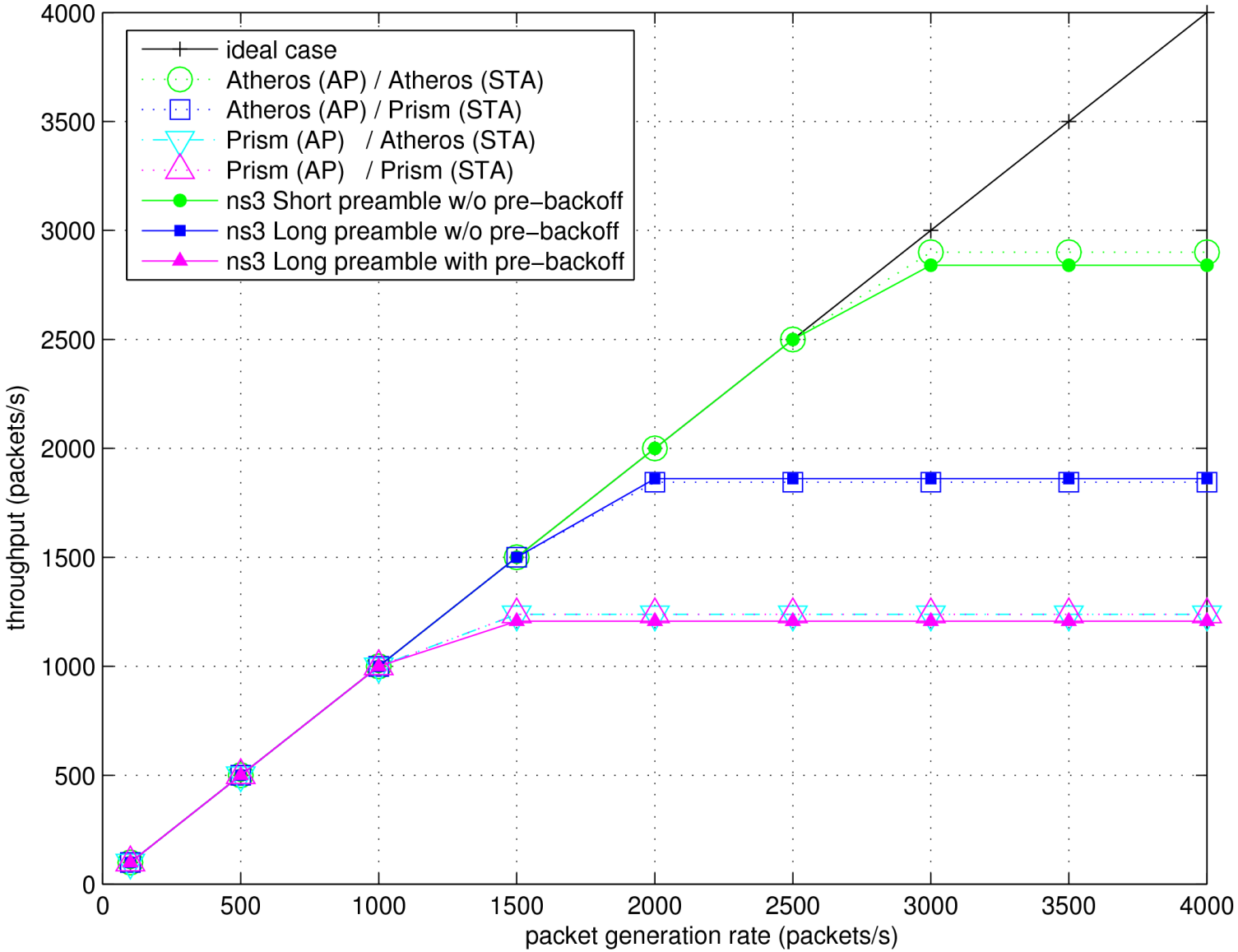
single pair scenario: throughput at 11Mbps



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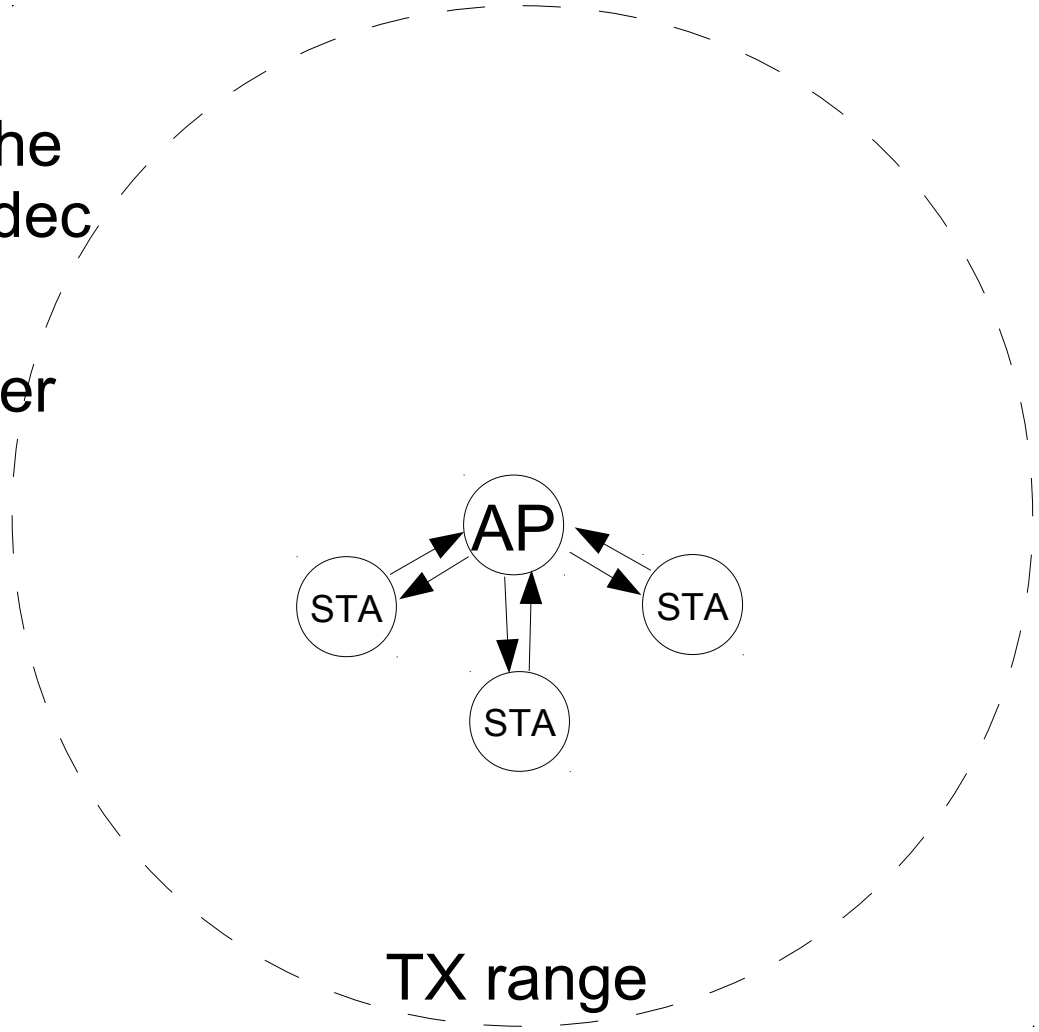
VoIP scenario

- bidirectional CBR traffic
- all nodes use the same voice codec
- fixed PHY rate
- increase number of STAs



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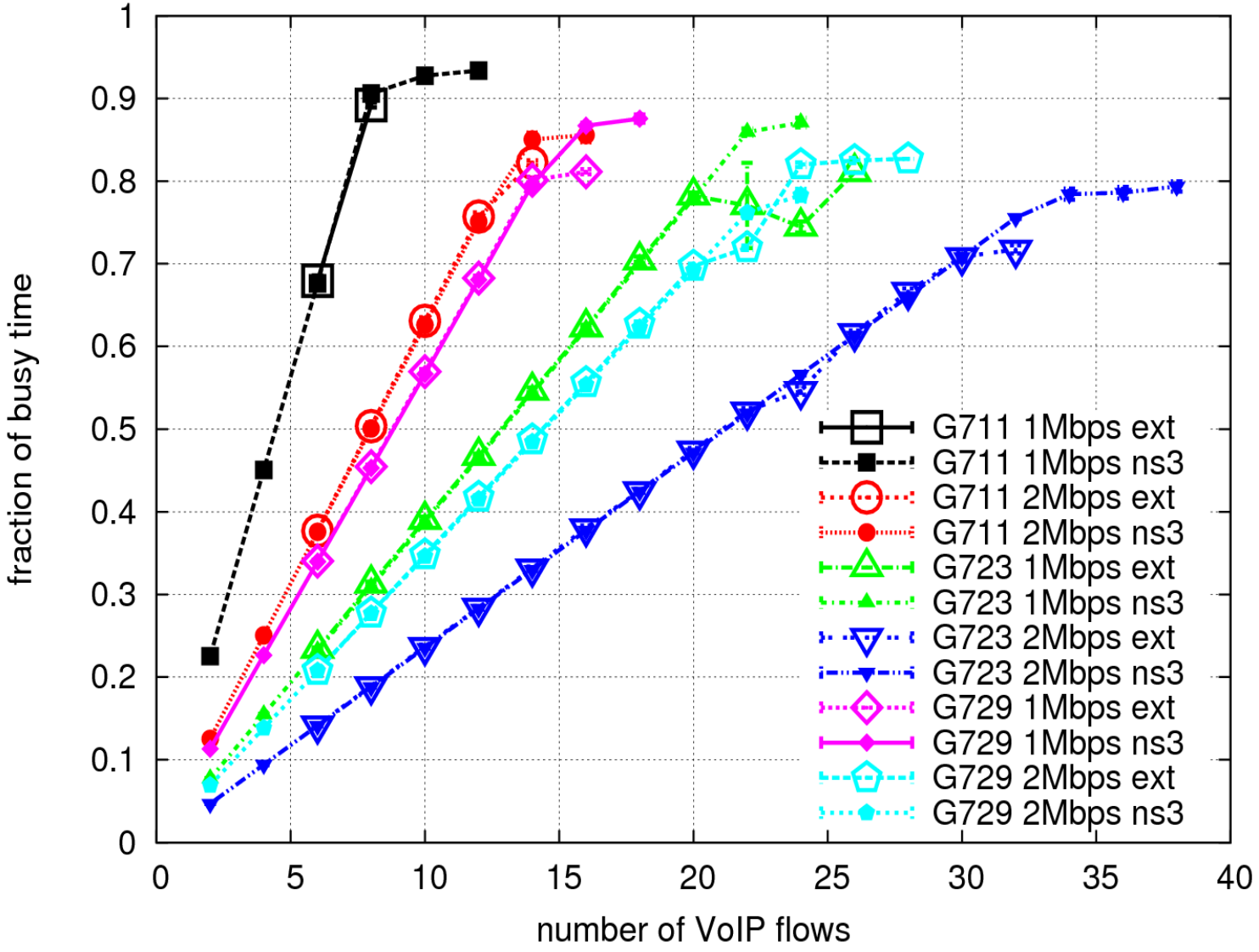
VoIP scenario: channel busy time



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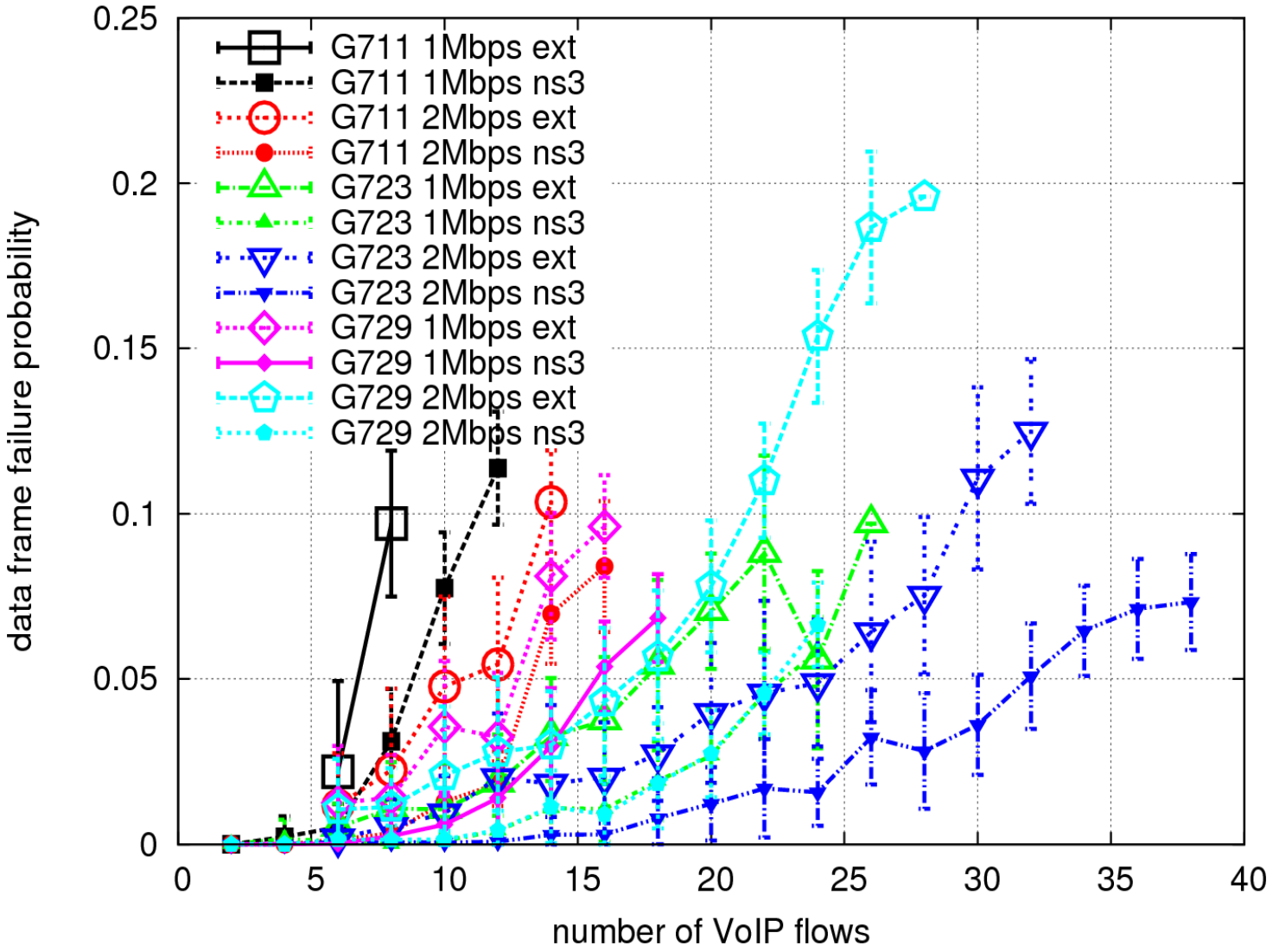
VoIP scenario: collisions



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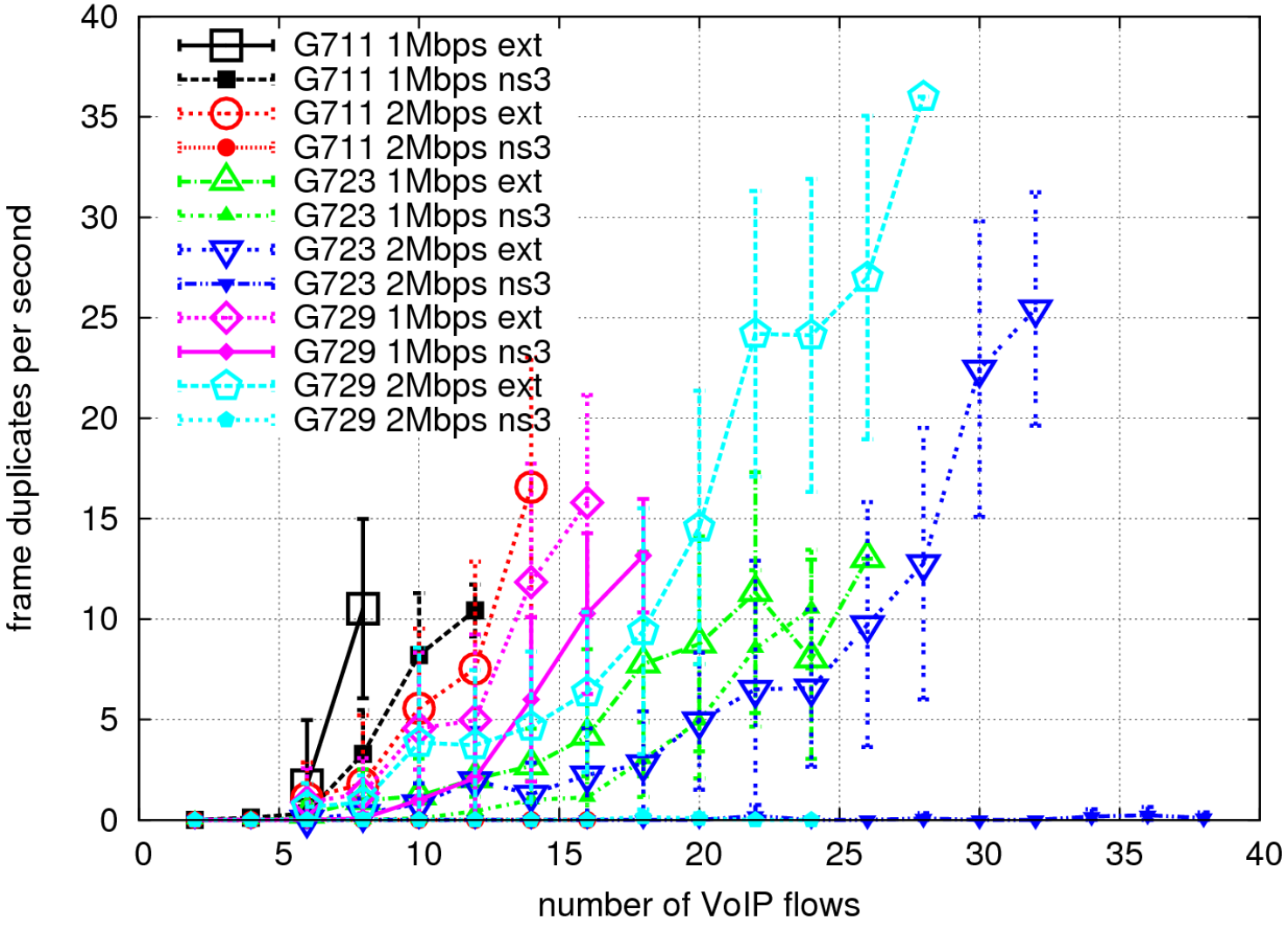
VoIP scenario: duplicate pkts



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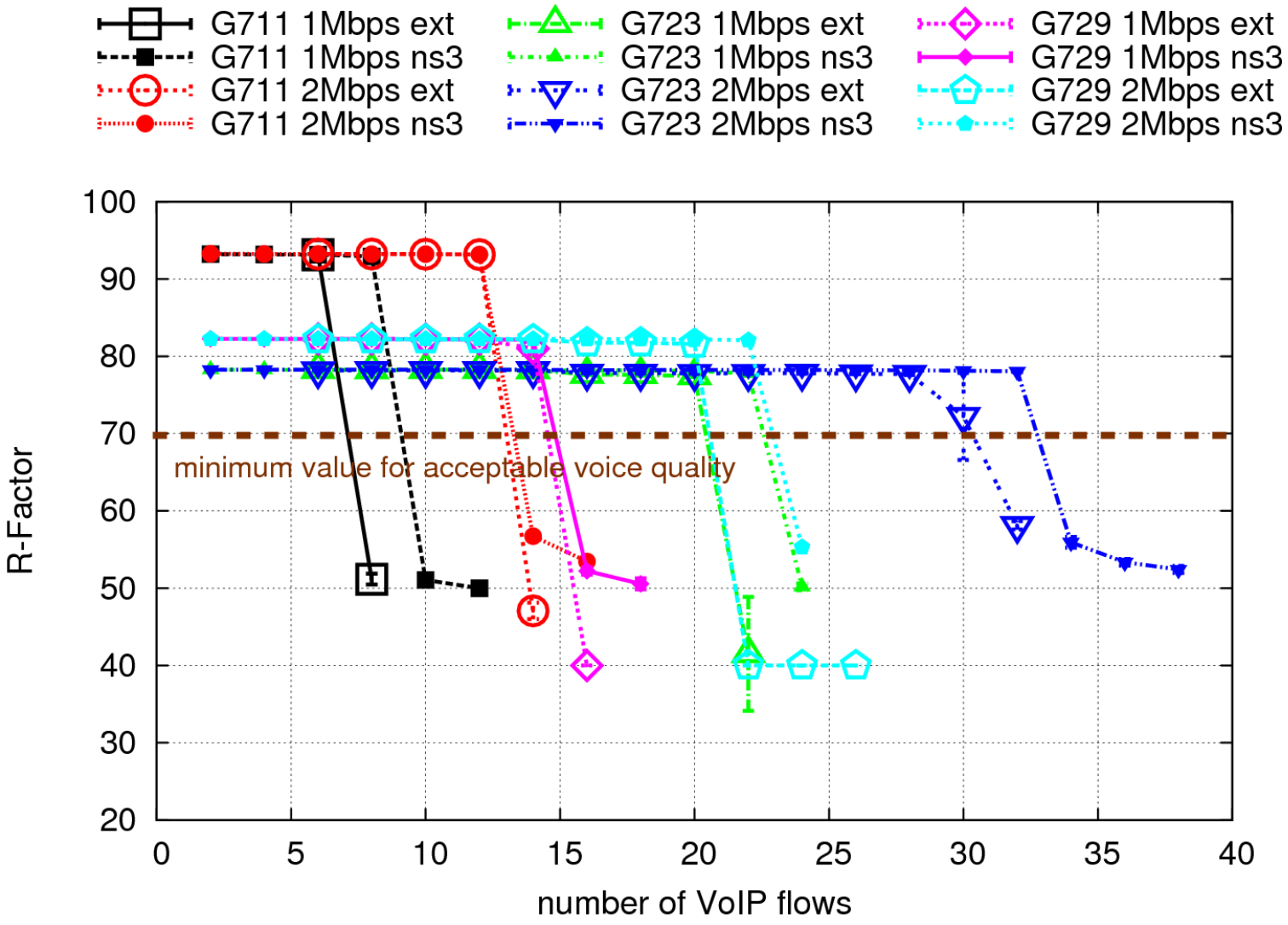
VoIP scenario: app service quality



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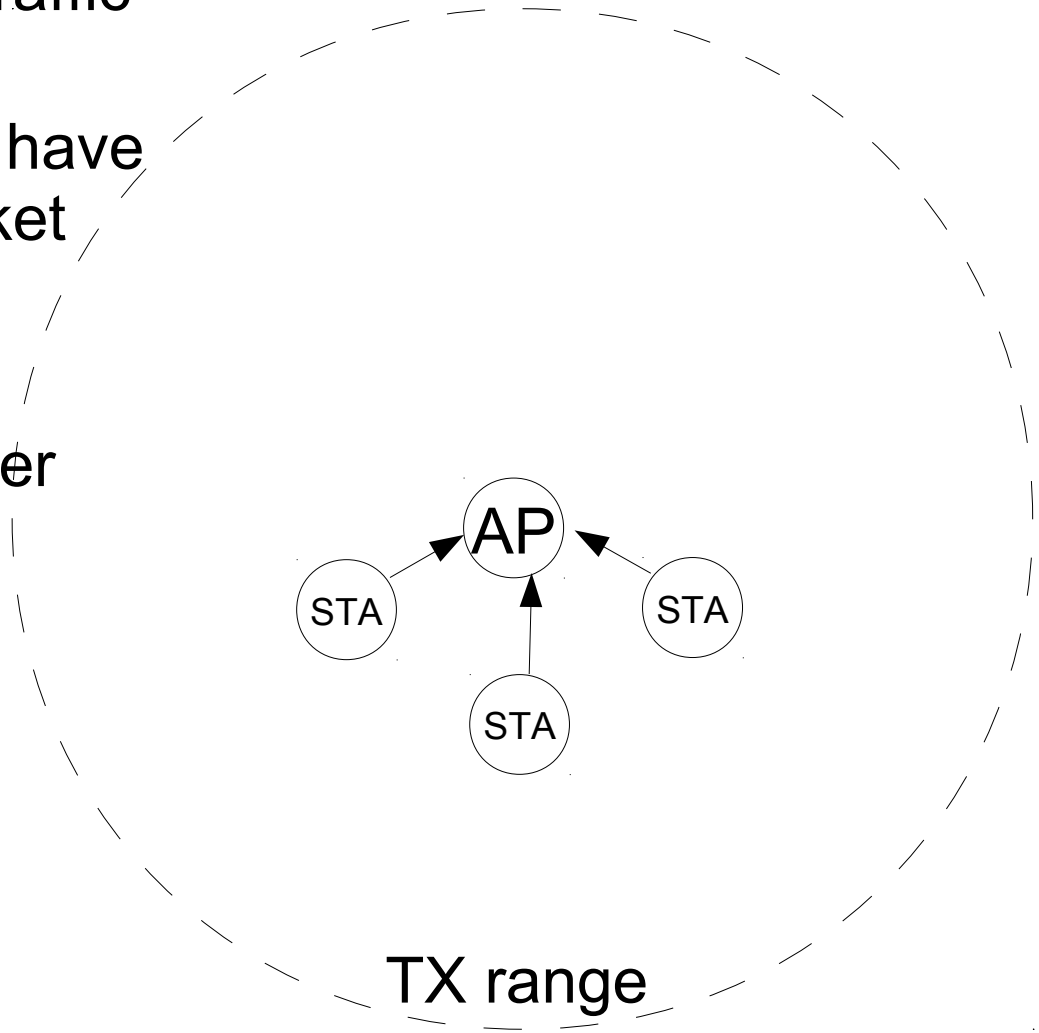
saturation scenario

- unidirectional traffic
- saturation (nodes always have a pending packet to TX)
- fixed PHY rate
- increase number of STAs



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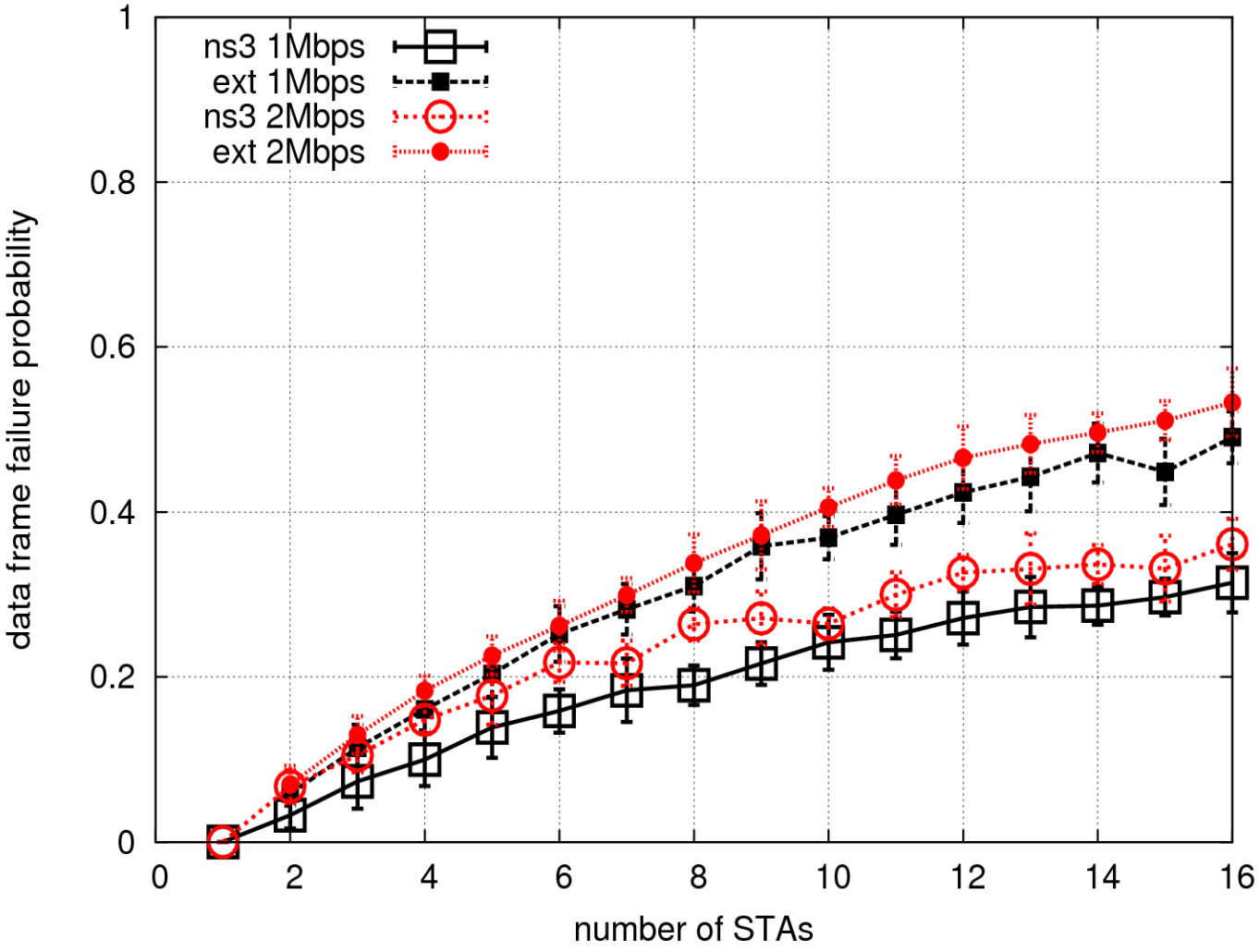
saturation scenario: collisions



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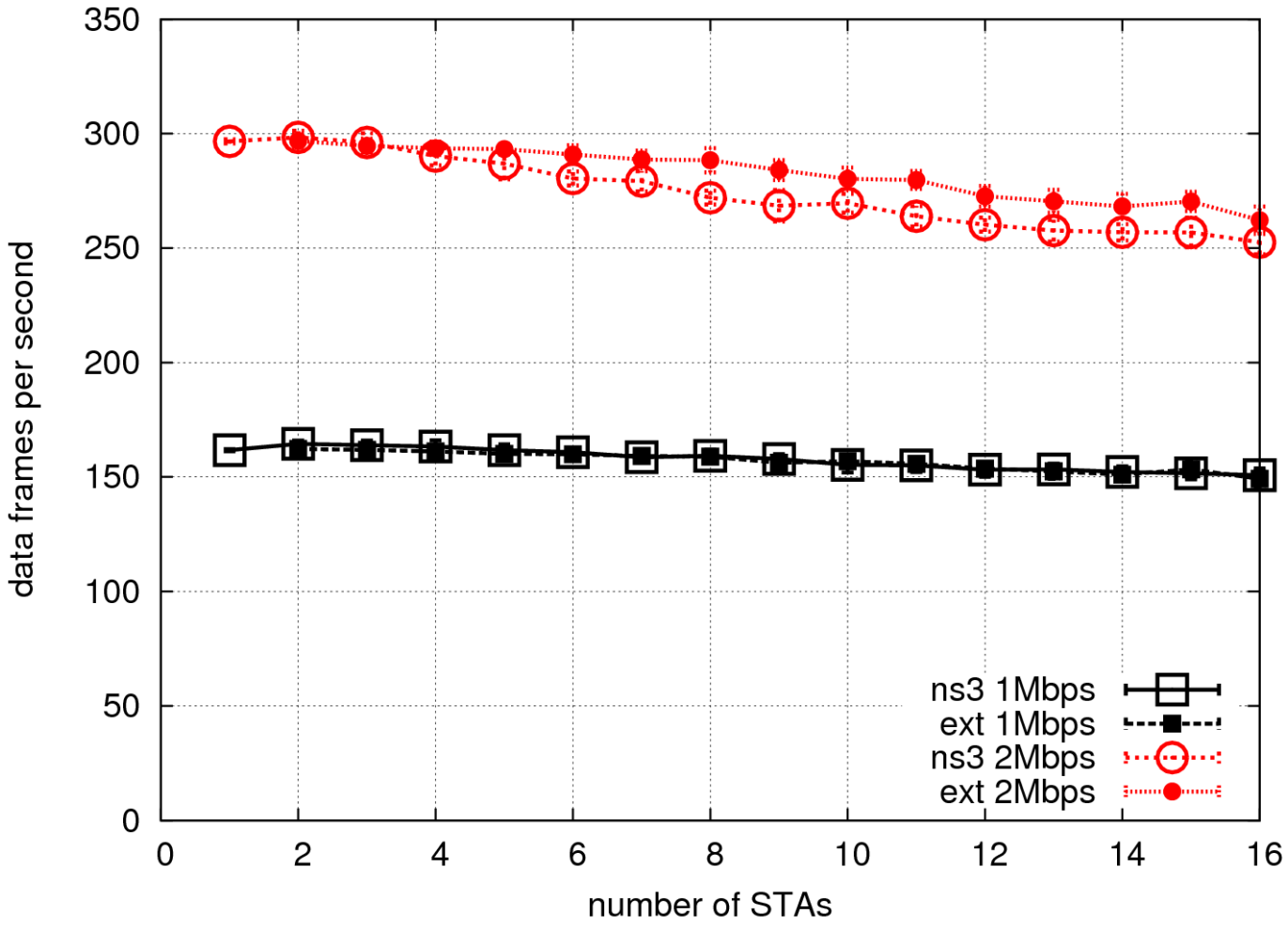
saturation scenario: throughput



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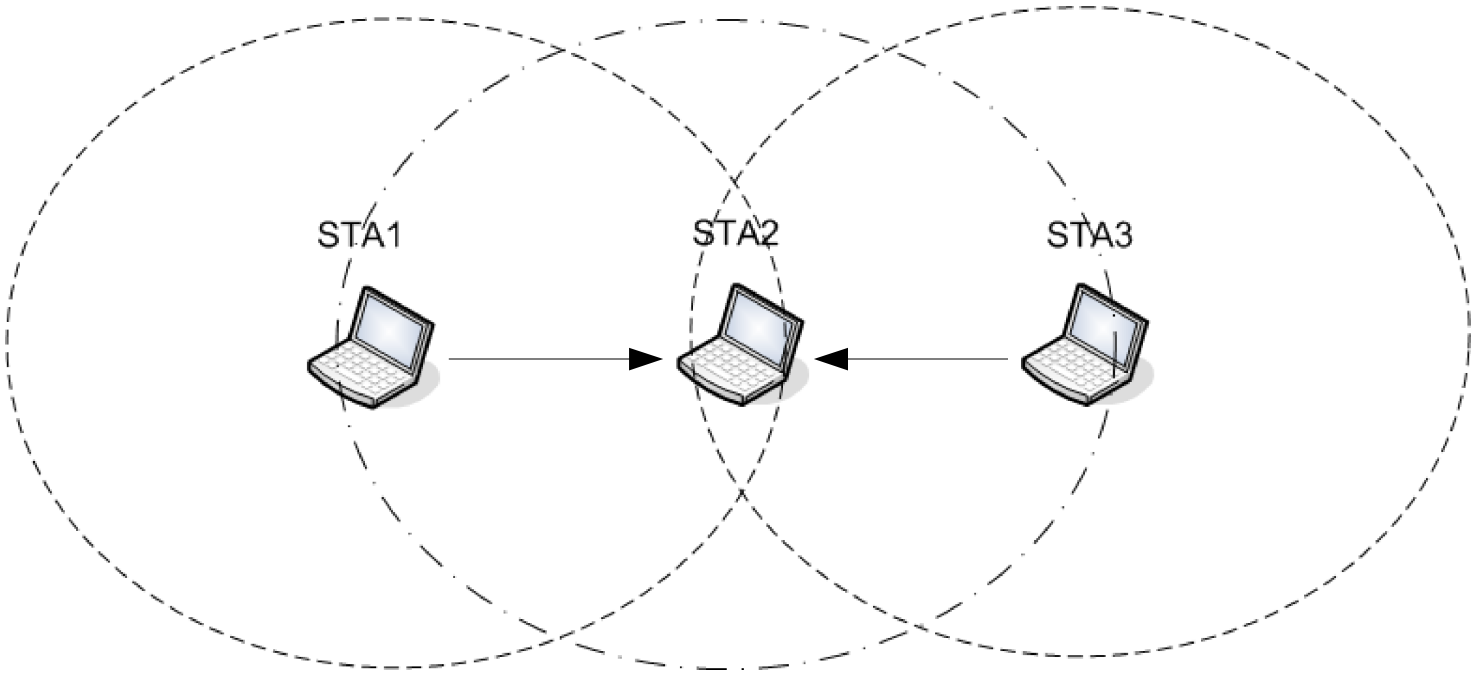
hidden node scenario

- poisson traffic
- 11 Mbps PHY rate
- STA1 fixed traffic rate
- increase traffic rate of STA3



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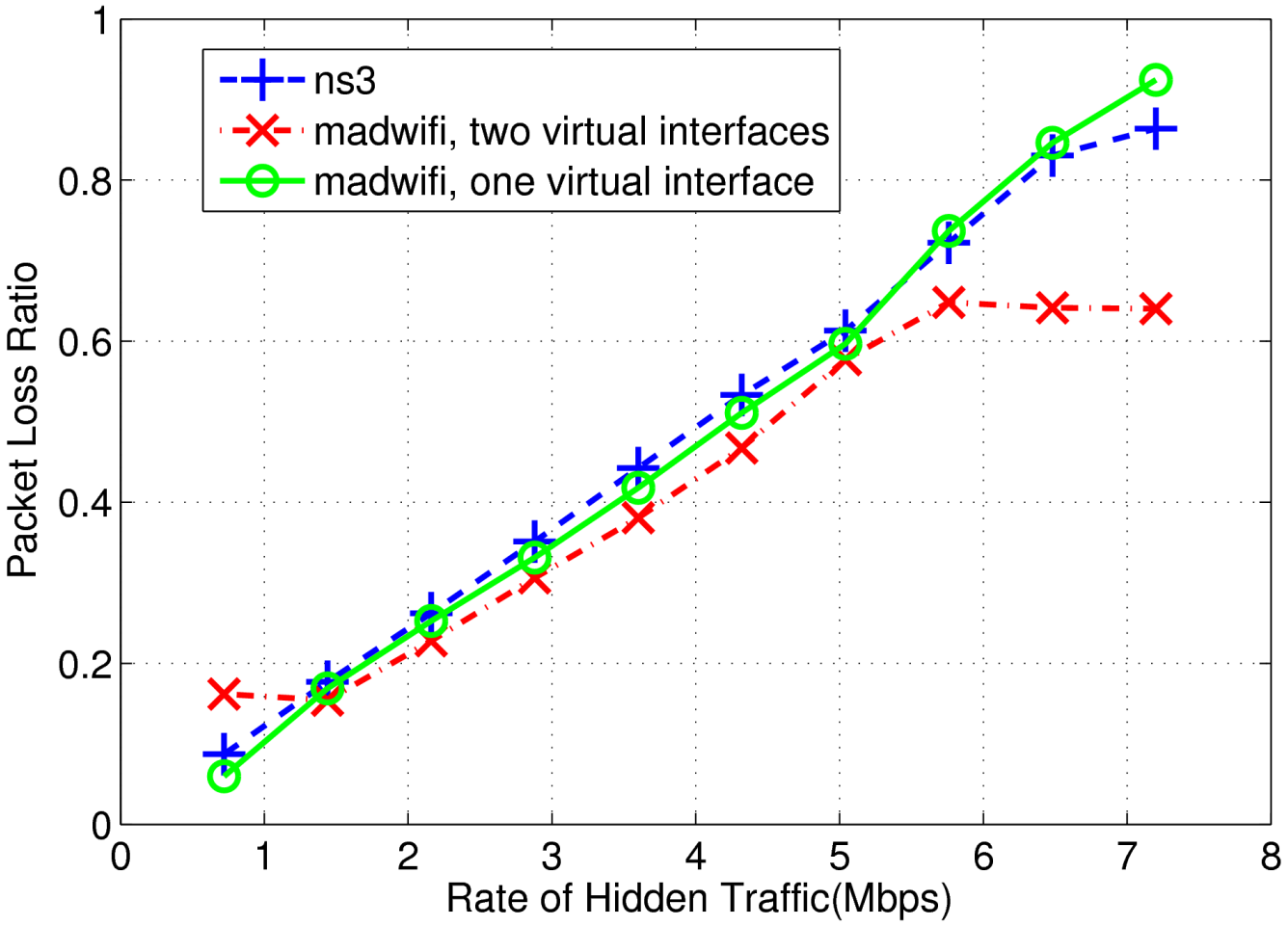
hidden node scenario: collisions



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conclusions drawn from our study

- ns-3 generally matches with testbed
  - within some %
- match is obtained after proper tuning
- some metric does not match well
  - e.g.: collisions by nodes within range
- sometimes the testbed is the culprit
- our recommendation:
  - parallel experiments on simulator and testbed (not only for validation, also for regular research)
  - iterative tuning process between simulator and testbed
  - know what you need from the simulator... your mileage may vary!