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Supporting VoIP in IEEE802.11 Distributed WLANs

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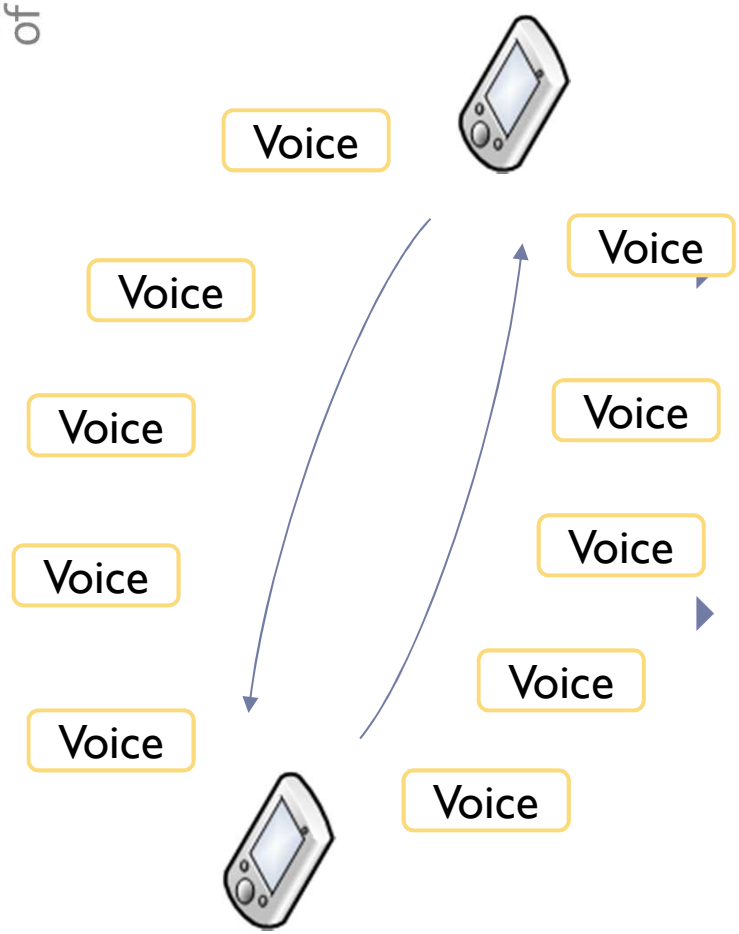
VoIP Applications



- Constant Streaming Traffic
  - Packetize interval usually 10-30 ms
  - 8 – 160 bytes each packet
  - RTP/UDP
- Time Sensitive
  - Interactive voice service
  - If round-trip delay is high (e.g. >300 ms), users may suffer in conversation
- Tolerate to Some Packet Losses
  - Conversation can go on even when some packets are not delivered in time (e.g. 10%)
  - Packet lost concealment techniques

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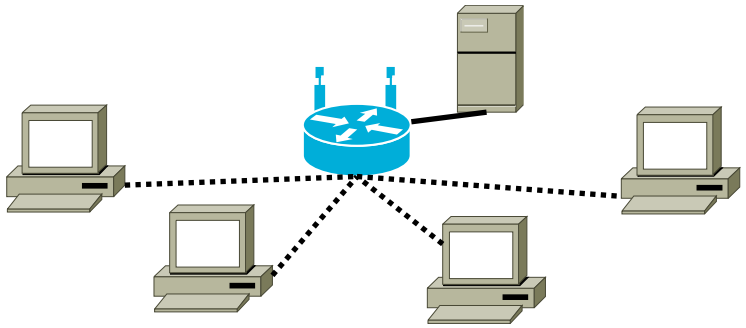
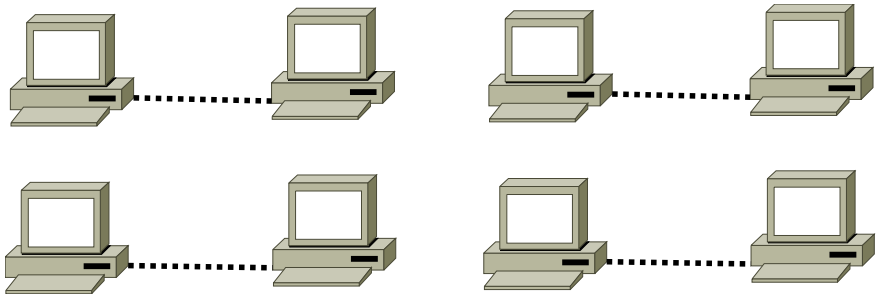
VoWLAN Scenarios

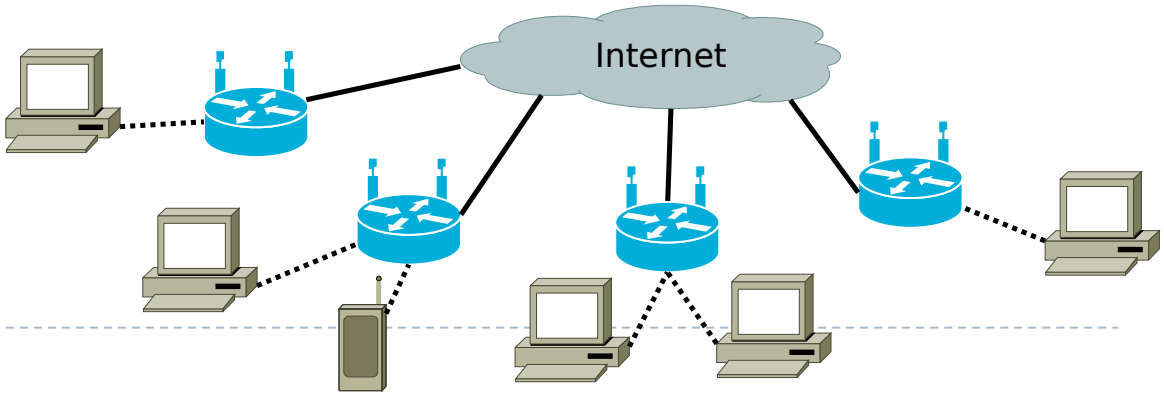
- Existing Research
  - Infrastructure
  - Unbalanced uplink/downlink traffic



- My Research
  - Fully distributed
  - Contentions for transmission opportunity



- Real World
  - Mixed



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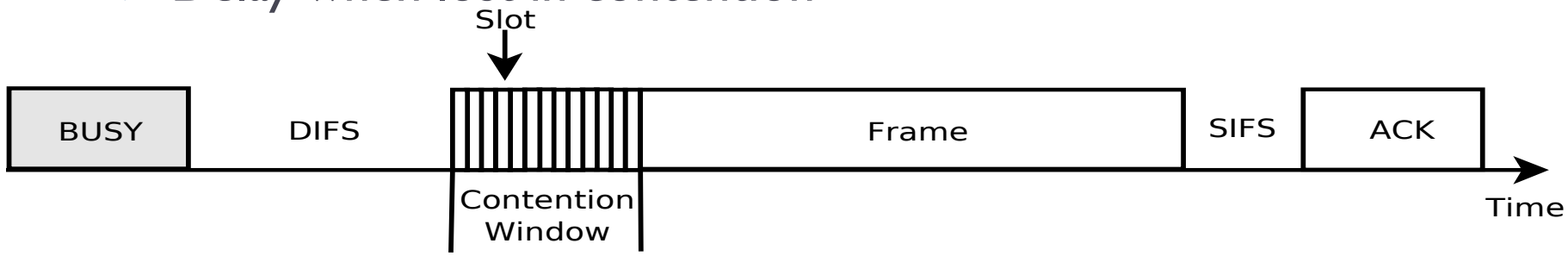
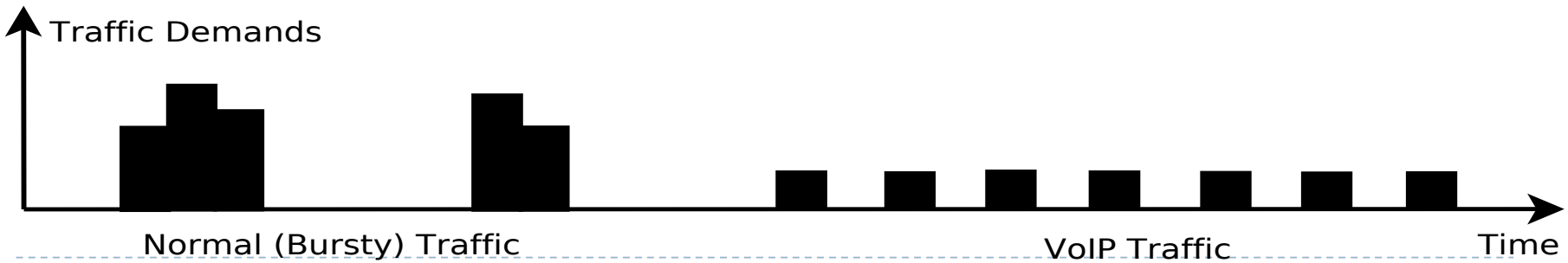
Issues for VoIP in IEEE802.11 WLAN 1

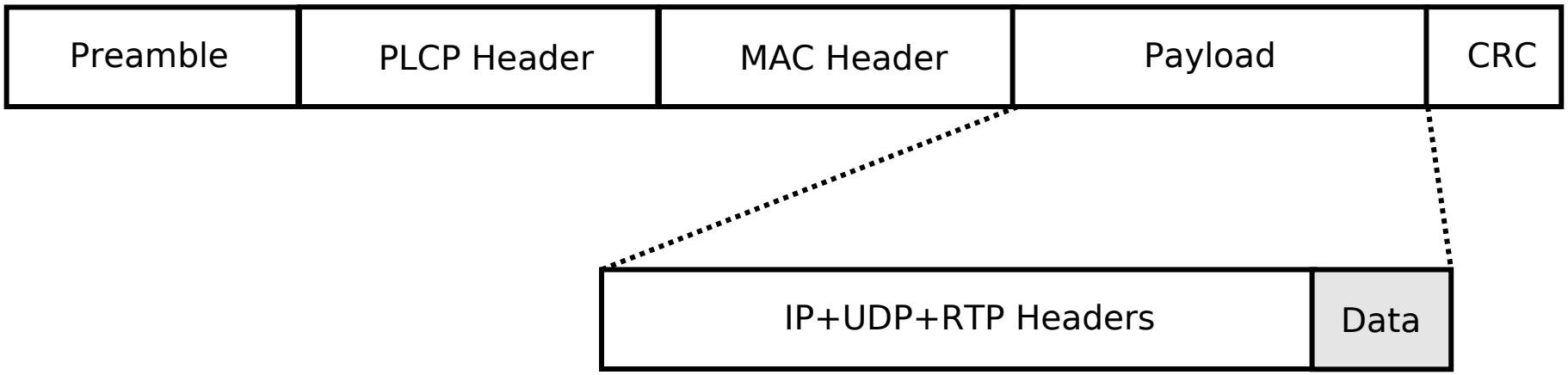
- Shared Wireless Channel
  - Overhead by contending for transmission opportunity (CSMA/CA)
  - More contentions for VoIP traffic
  - Delay when lost in contention





Issues for VoIP in IEEE802.11 WLAN 2

- Very Low Efficiency over Wireless Channel
  - Control data overhead is too large
  - Payload is tiny for each voice packet



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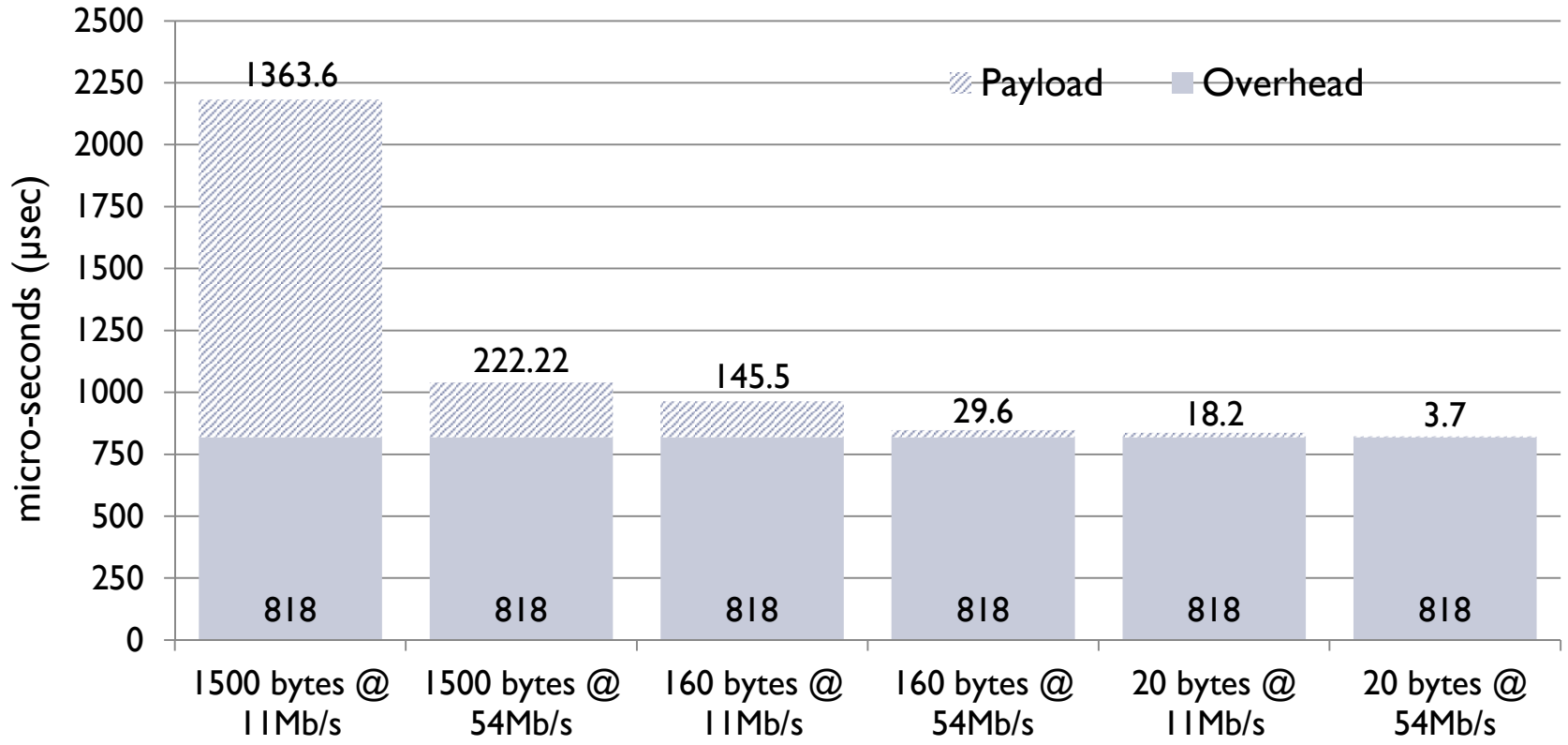
Estimations



802.11b/g	(G.711)160 bytes @ 11Mb/s	(G.711)160 bytes @ 54Mb/s	(G.729)20 bytes @ 11Mb/s	(G.729)20 bytes @ 54Mb/s
VoIP Call Capacity	10.37883	11.79802	11.95886	12.16989

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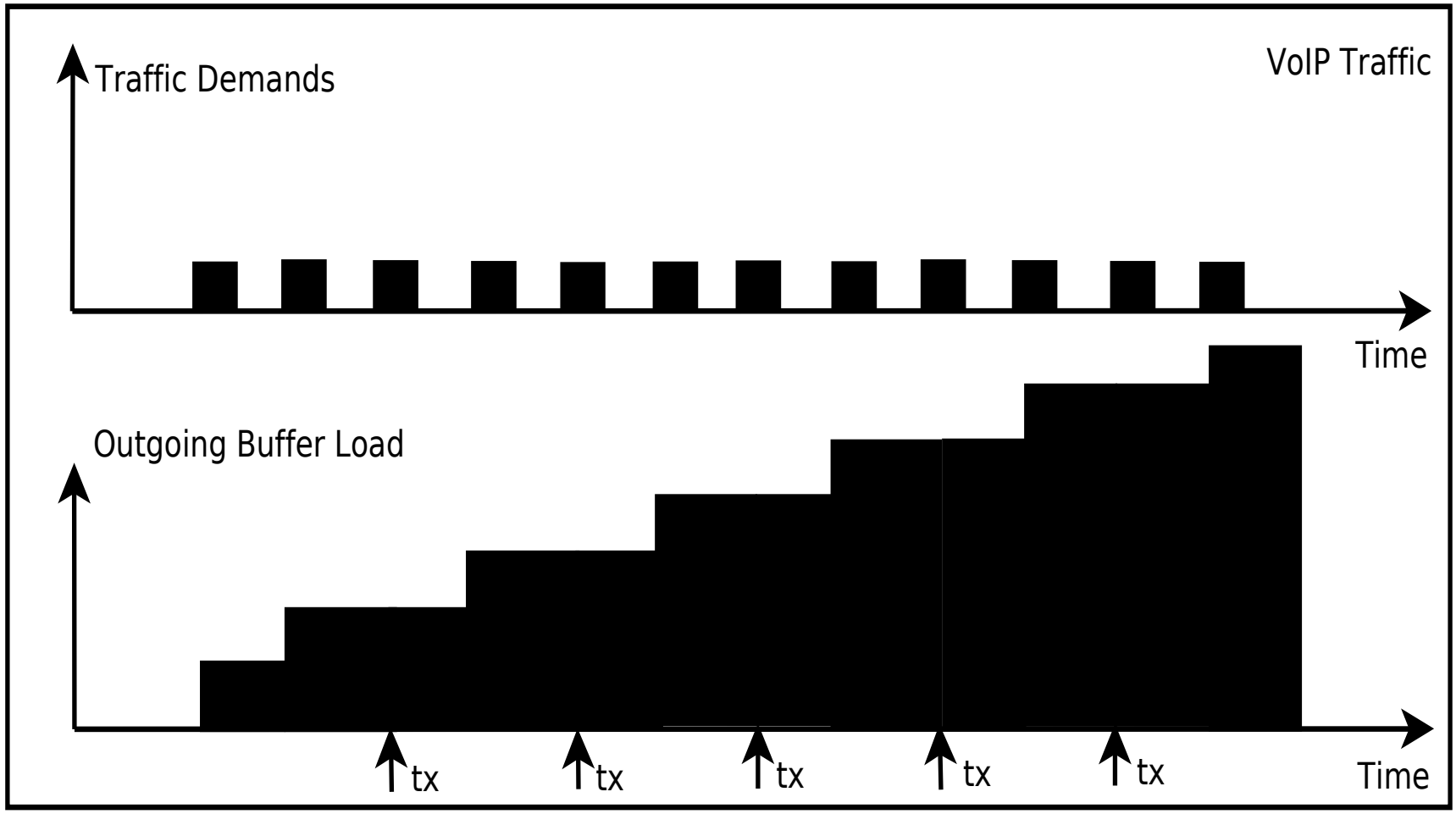
Buffer Accumulation



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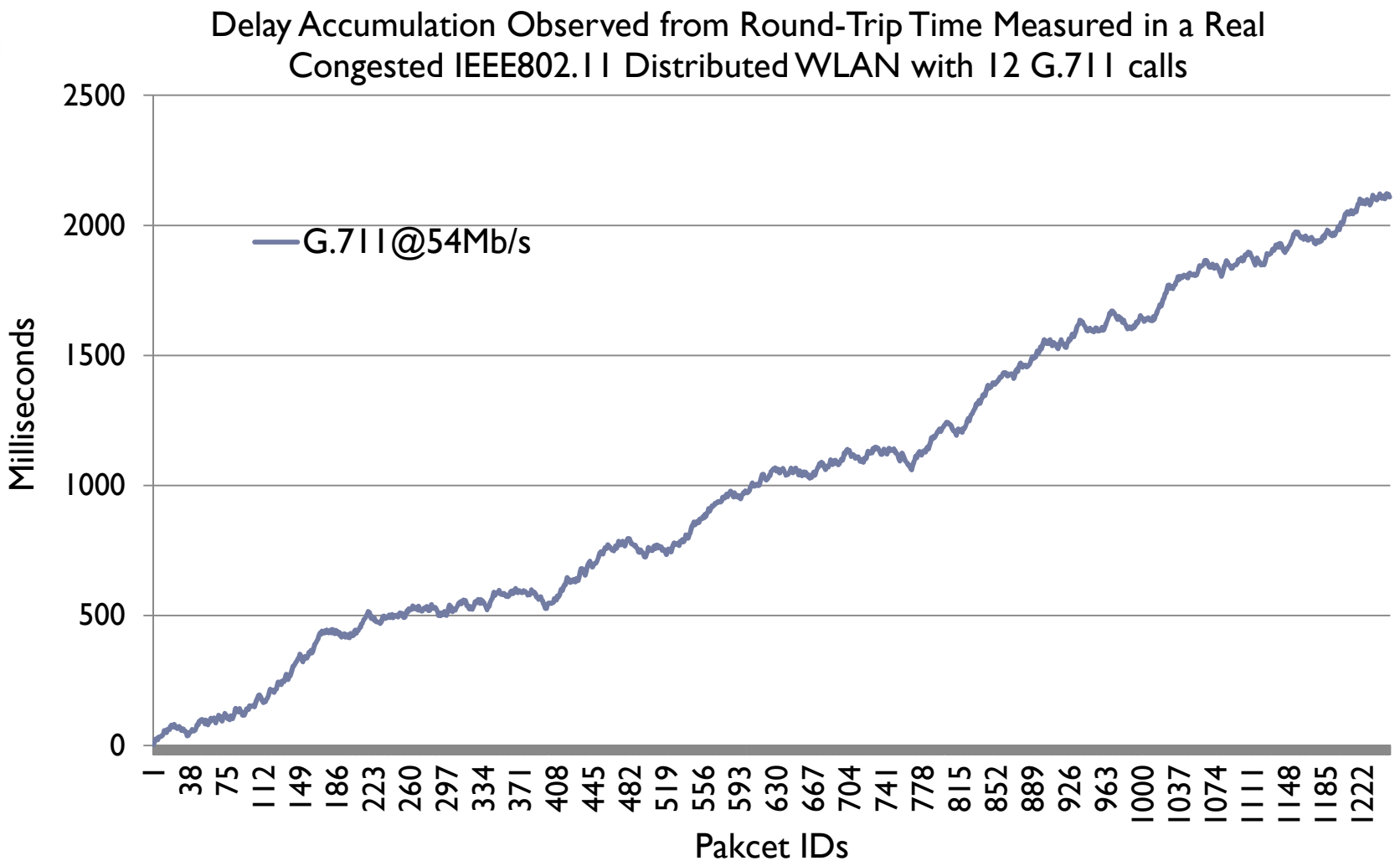
Delay Accumulation



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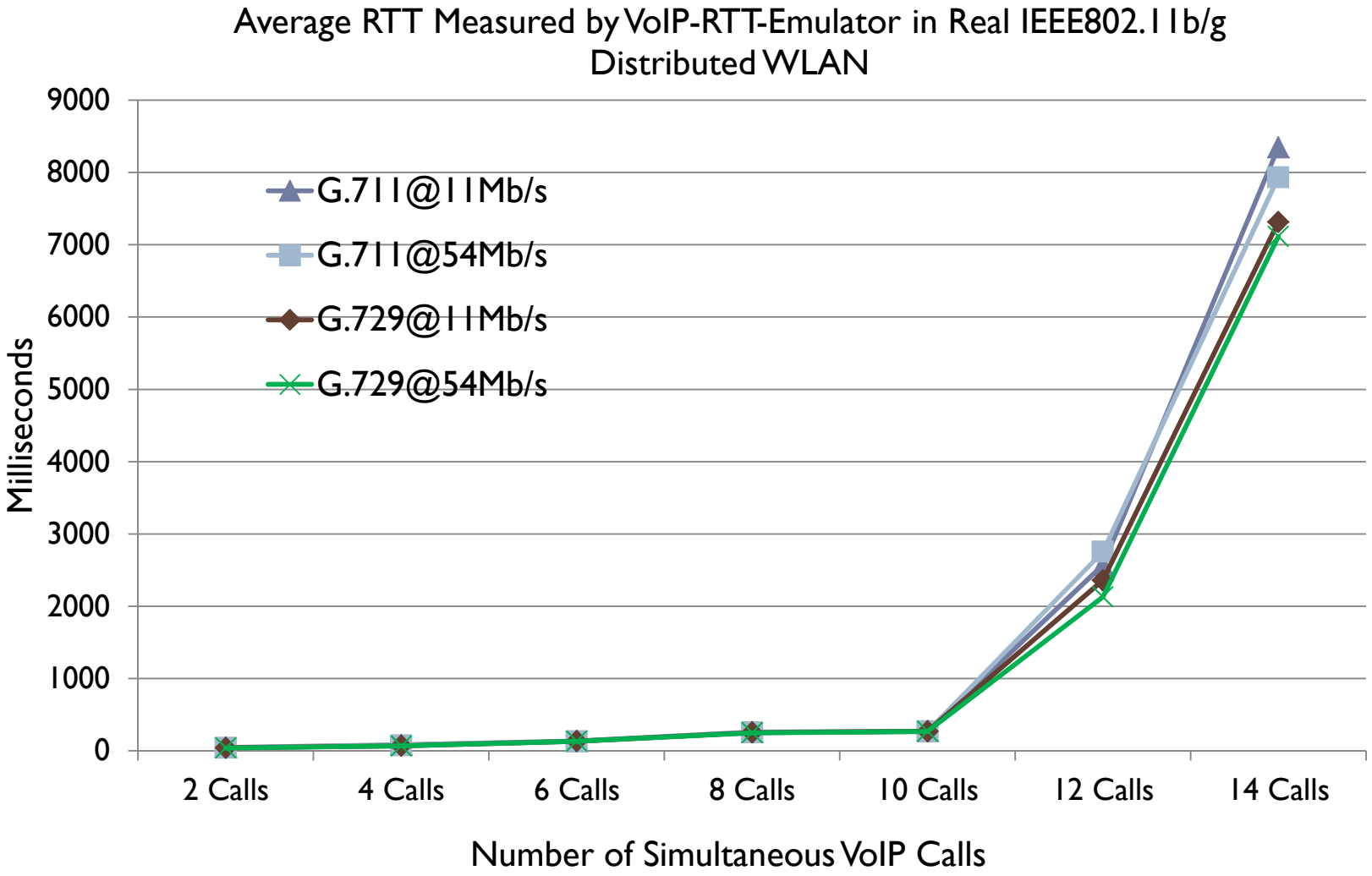
Round Trip Time in Real 802.11 WLAN



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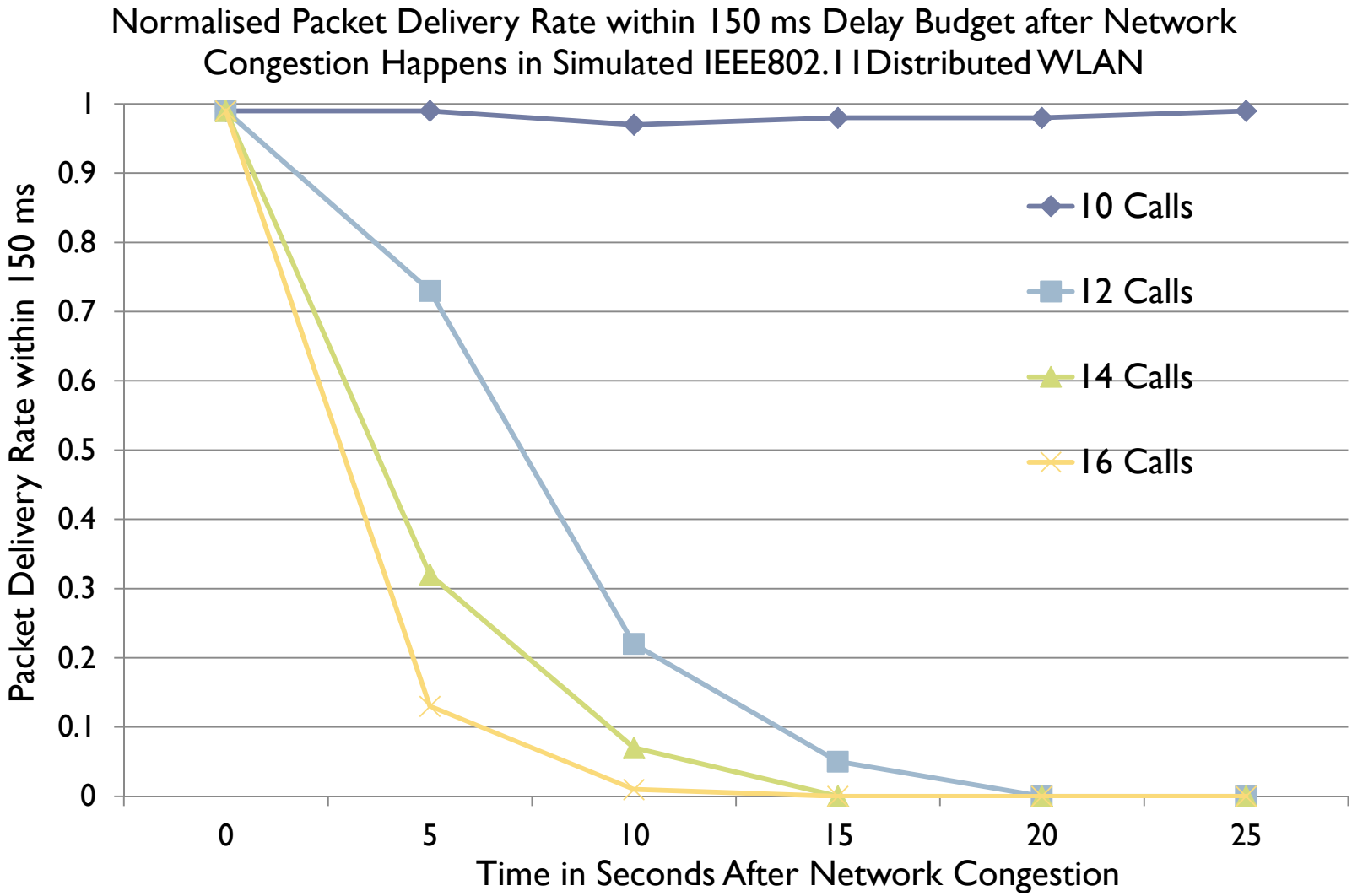
Simulated Congestion Test



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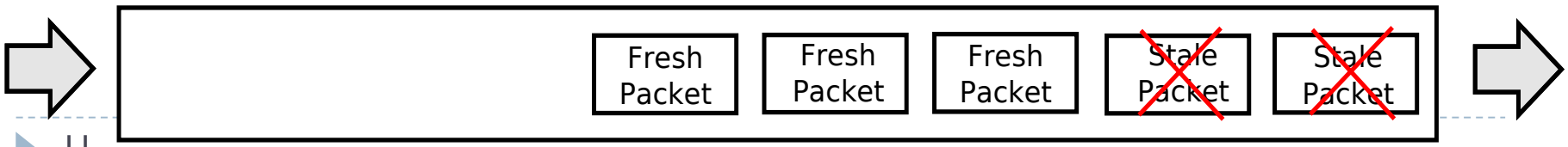
Auto Cleaning Queue (ACQ)

- Stale Voice Packets in Outgoing Buffer
  - Not possible being delivered in time
  - Receiver end already played a pseudo sample
  - Wasted transmission opportunity
- Related Work
  - Dynamic buffer size
  - Drop front/random drop (mainly for TCP)
- ACQ
  - Actively dropping voice packets older than T_{MAX}
  - Giving transmission opportunity to 'fresh' voice packets
  - Compatible with IEEE802.11e Voice (AC_VO) queue



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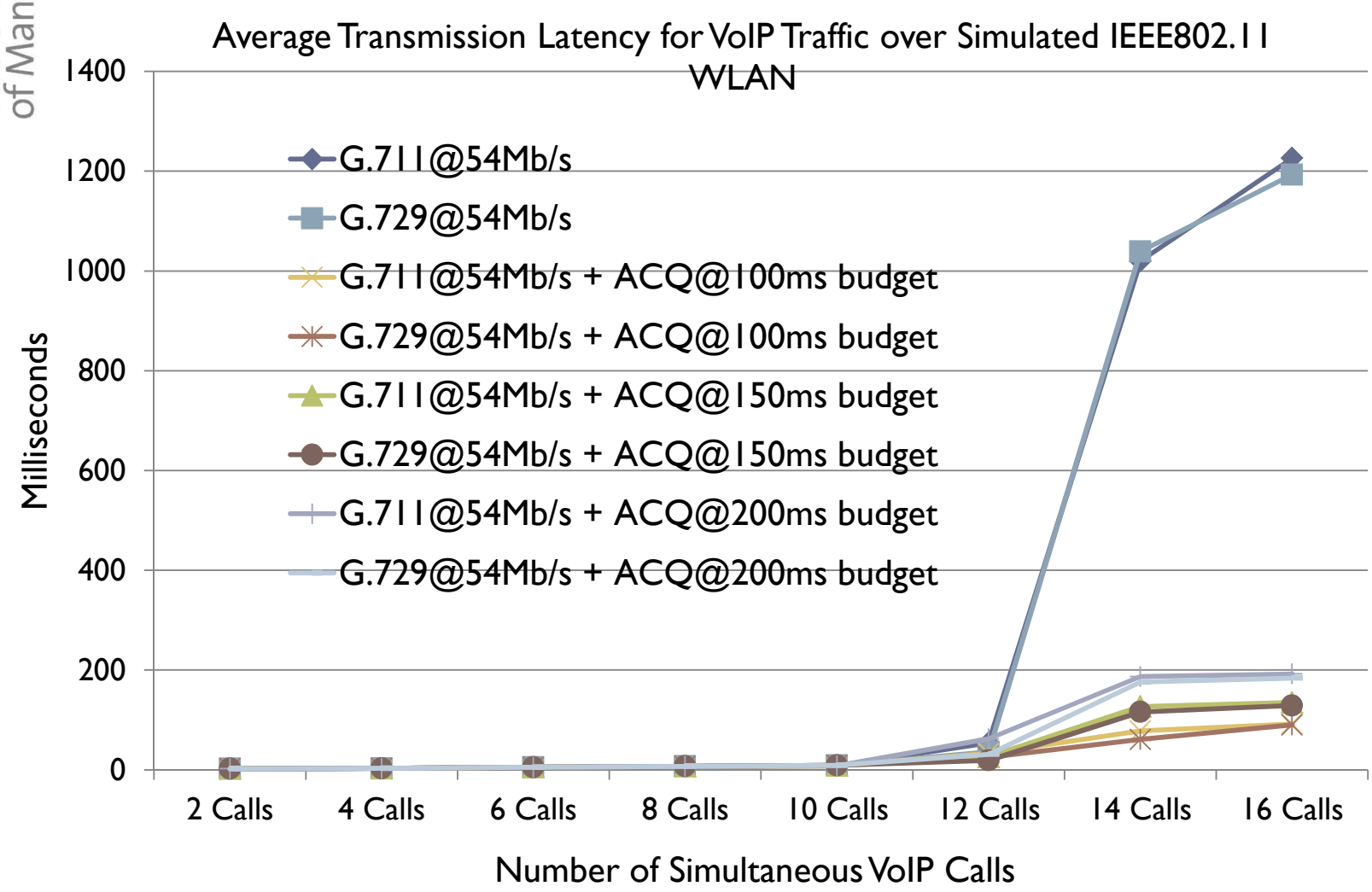
ACQ Evaluation 1



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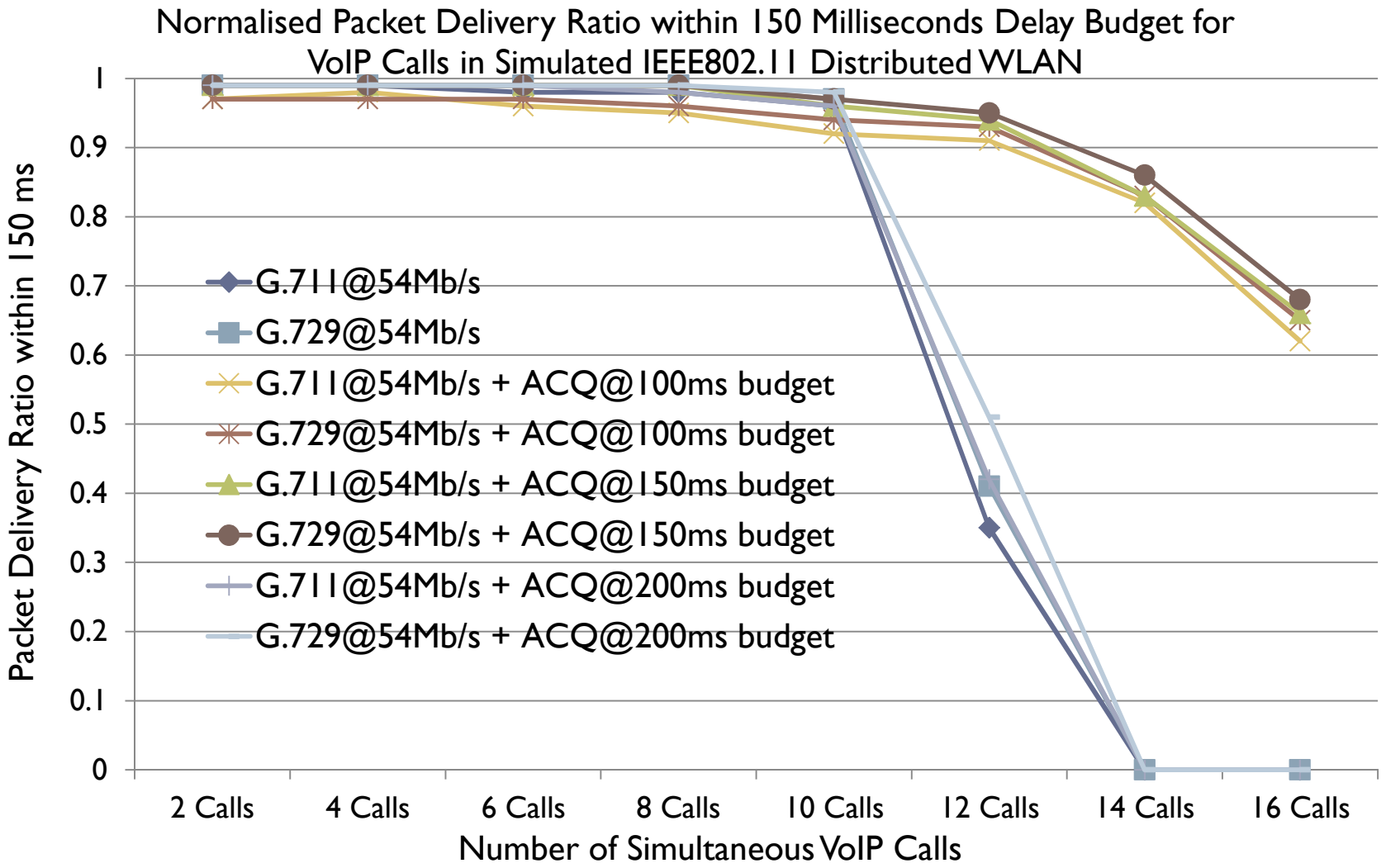
ACQ Evaluation 2



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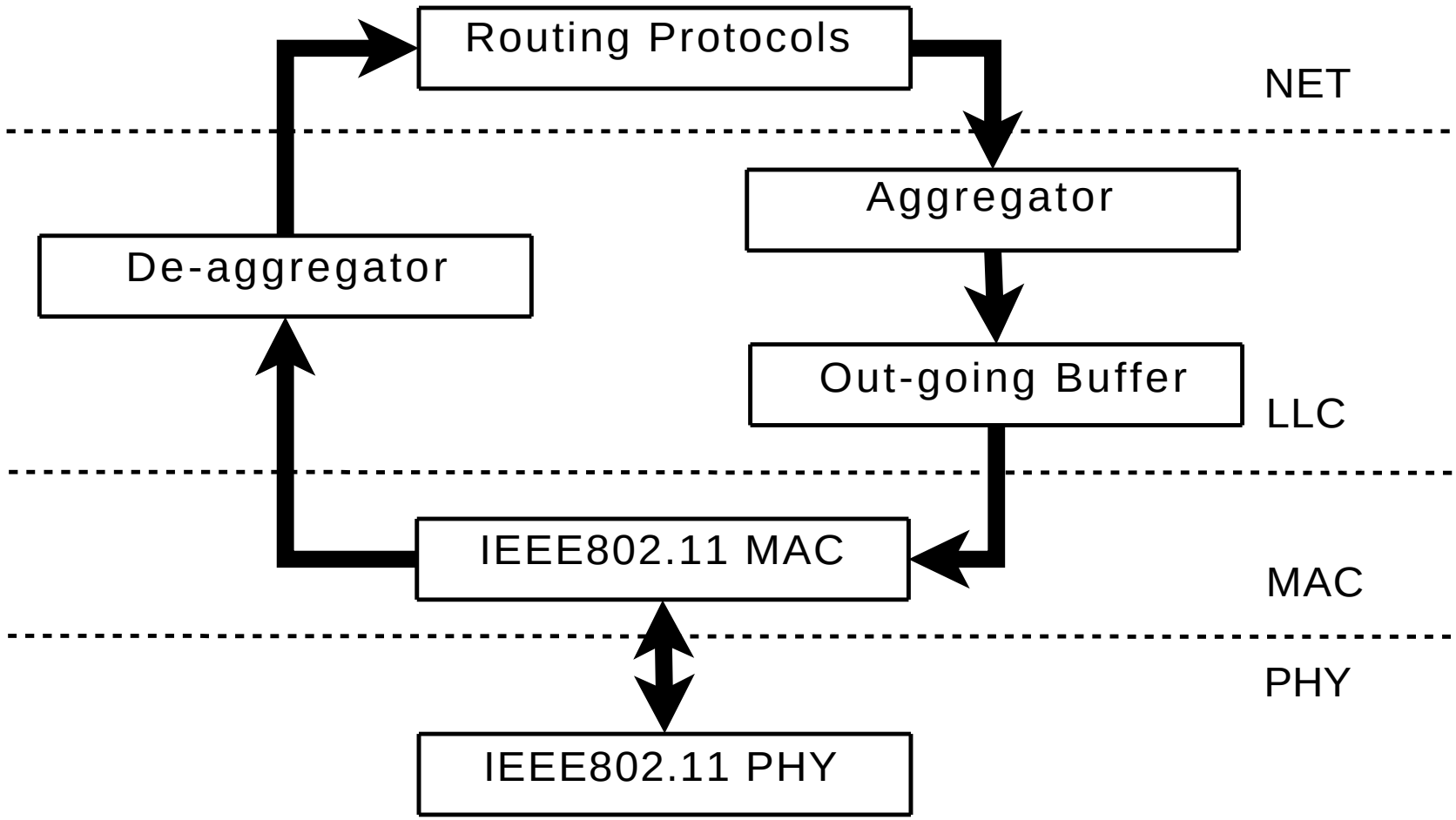
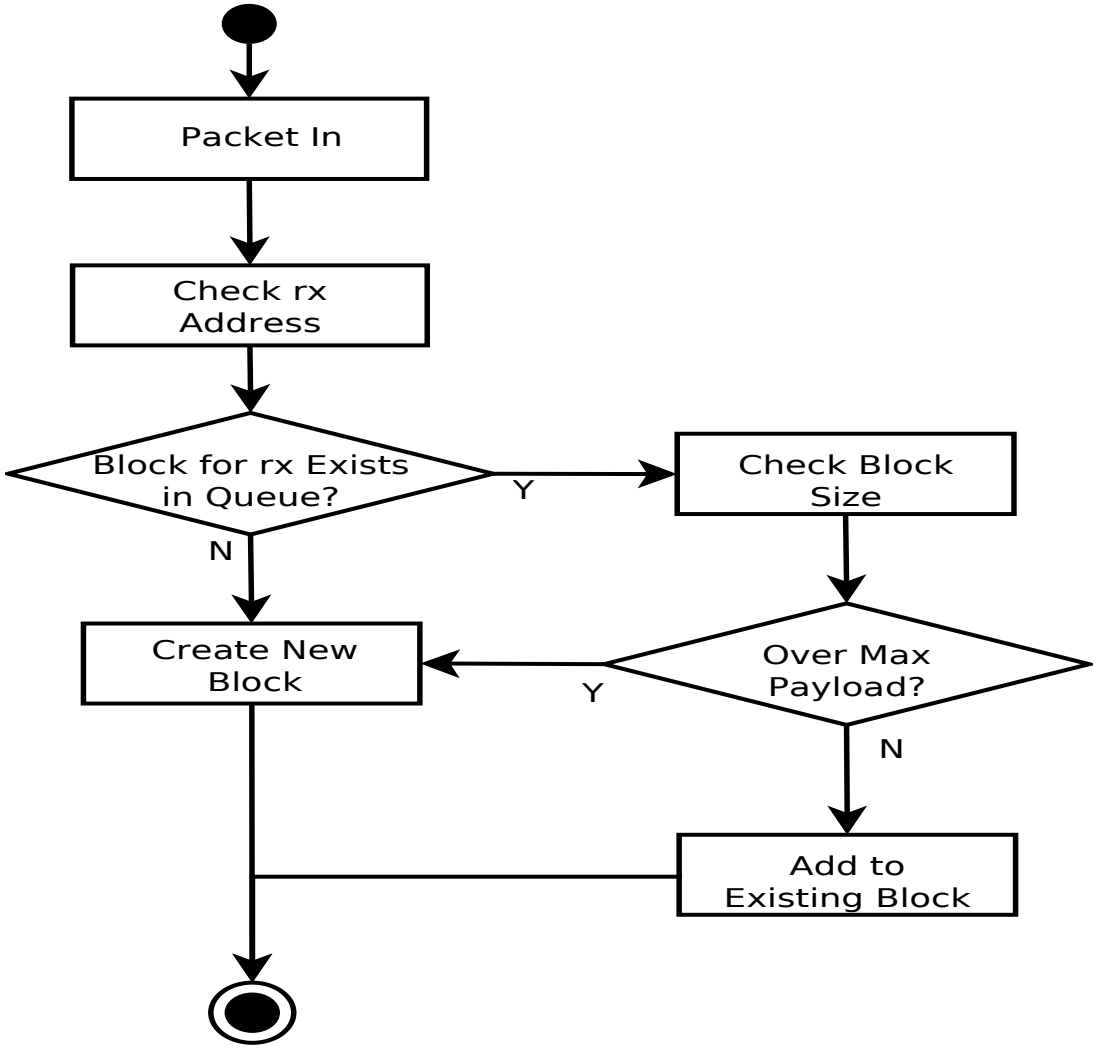
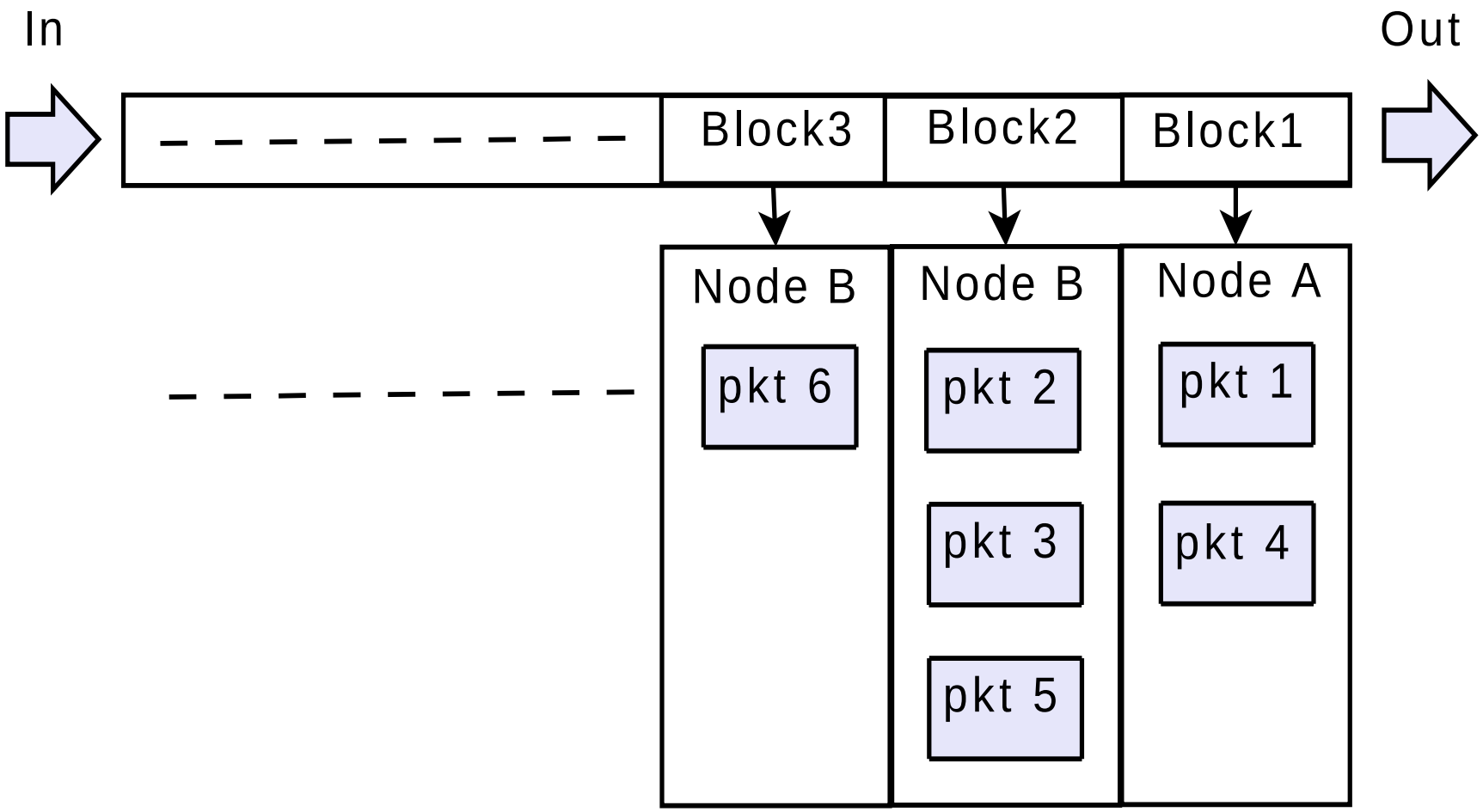
Small Packet Aggregation for Wireless Networks



SPAWN Packet En-queue Process



SPAWN Outgoing Buffer Structure



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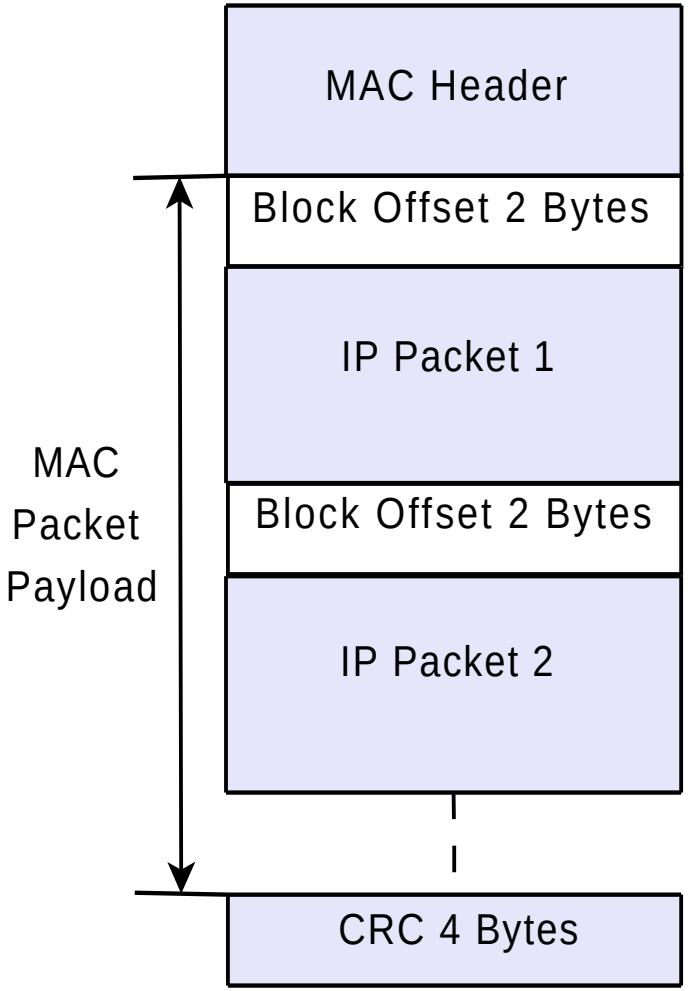
SPAWN Block Structure

- Compatible with IEEE802.11
  - No modification on frame header and structure
  - No extra operations required below LLC layer
  - IEEE802.11n aggregation (A-MPDU) resulting in new MAC protocol
- Flexible for Efficiency
  - Variable number of packets
  - Not forced to reach the maximum payload size



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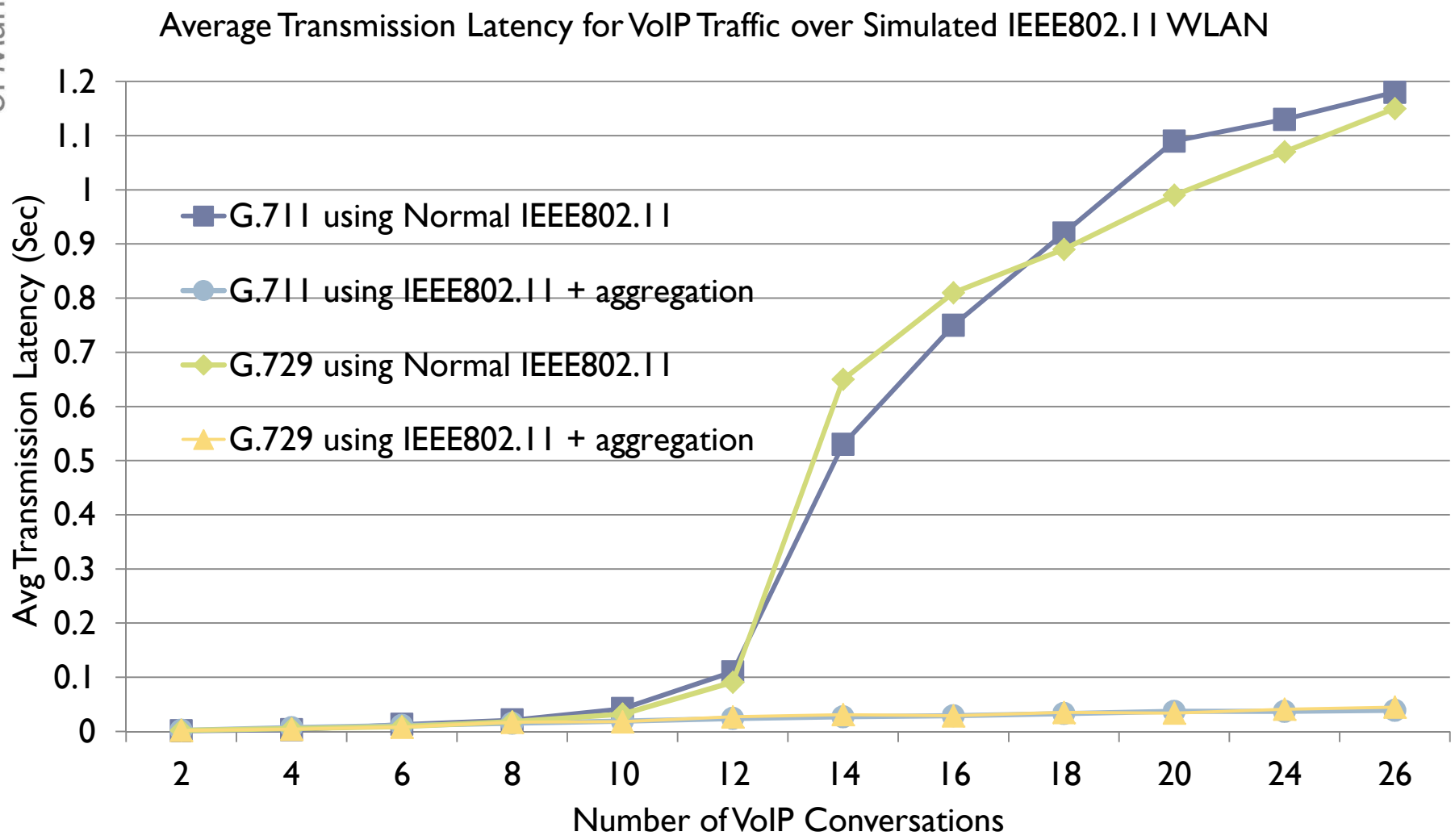
SPAWN Evaluation 1



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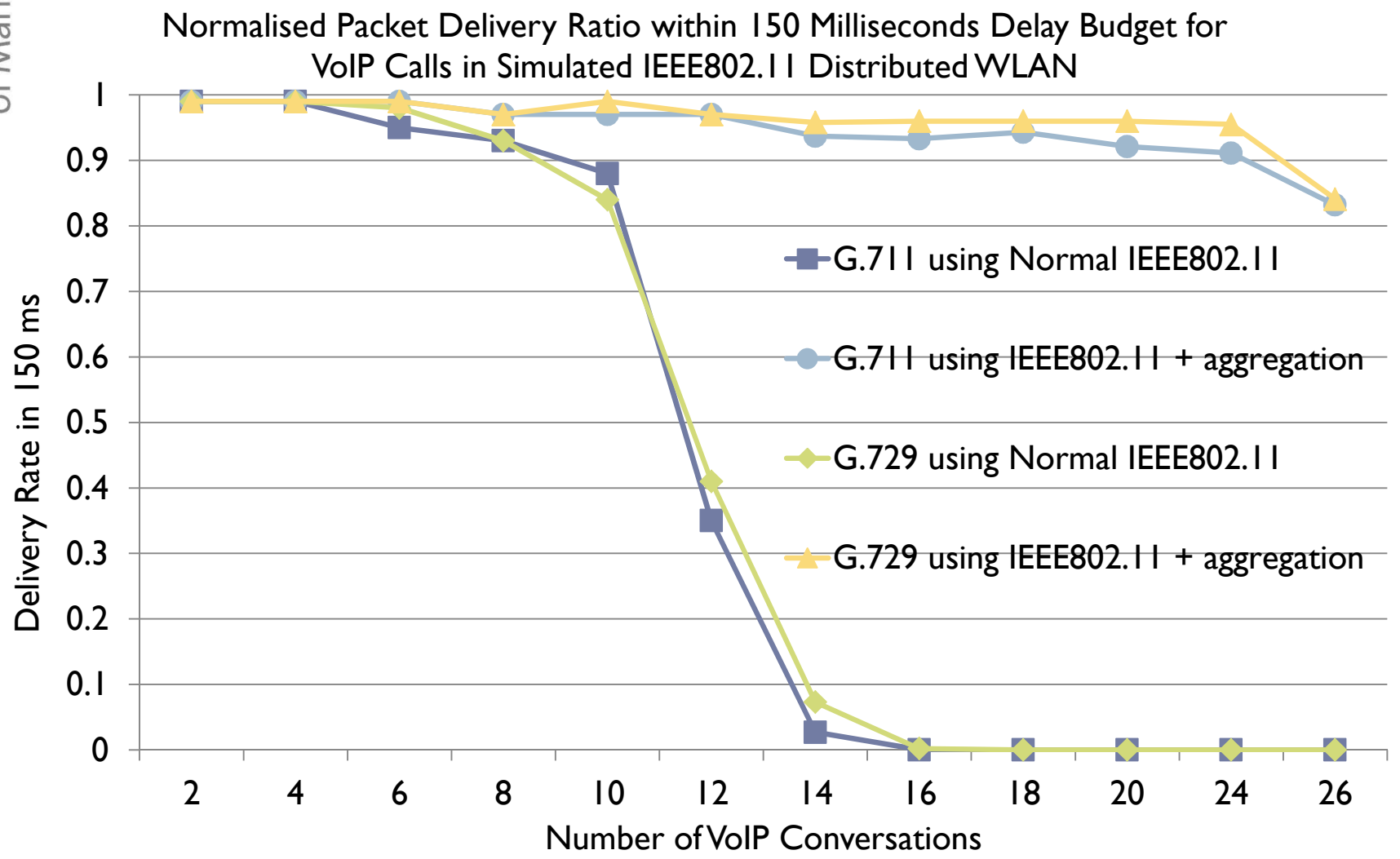
SPAWN Evaluation 2



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Conclusions

- Outcomes
  - Similar behaviour for VoIP over distributed and infrastructure WLANs
  - Delay accumulation after congestion
  - ACQ resolves the delay accumulation
  - SPAWN effectively increases the network efficiency
  - Compatible with IEEE802.11a/b/g MAC and IEEE802.11e

- Future Work
  - ACQ and SPAWN in real devices (seeking partners)
  - Dynamic T_{MAX} for ACQ
  - Multicasting SPAWN
  - Multi hops, multi flows, multi traffic types, etc.

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Thank you!

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Questions?

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