Contention Resolution

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Introduction

- **Draft 1.1 specifies a cascade of two contention schemes: random delay and exponential back-off**
- **The combined scheme utilizes the advantages of both schemes**
- **Quick reminder:**
  - Random delay: ONU delays its transmission uniformly between 0 and grant_length – required_OH – length_of_register_req
  - Exponential delay: ONU selects a number N uniformly between 0 and exponential growing number. It ignores the next N discovery gates.

Random Delay is Fast!

- **Convergence of random delay is much faster, as it extends registration window and allows several ONUs to be registered simultaneously**
  - The registration window is very big compared to Register_REQ message length → Relative window increase is not significant
- **Efficiency is emphasized when ONUs` RTT is identical**
- **Size of increase in discovery window can vary dynamically**

Exponential Backoff is Robust!

- Exponential backoff is used successfully in half-duplex Ethernet
- The limit of backoff parameter can be small based on maximal number of ONUs
- ONU with slow PMD will not reduce other ONUs registration probability
- Exponential backoff is very simple

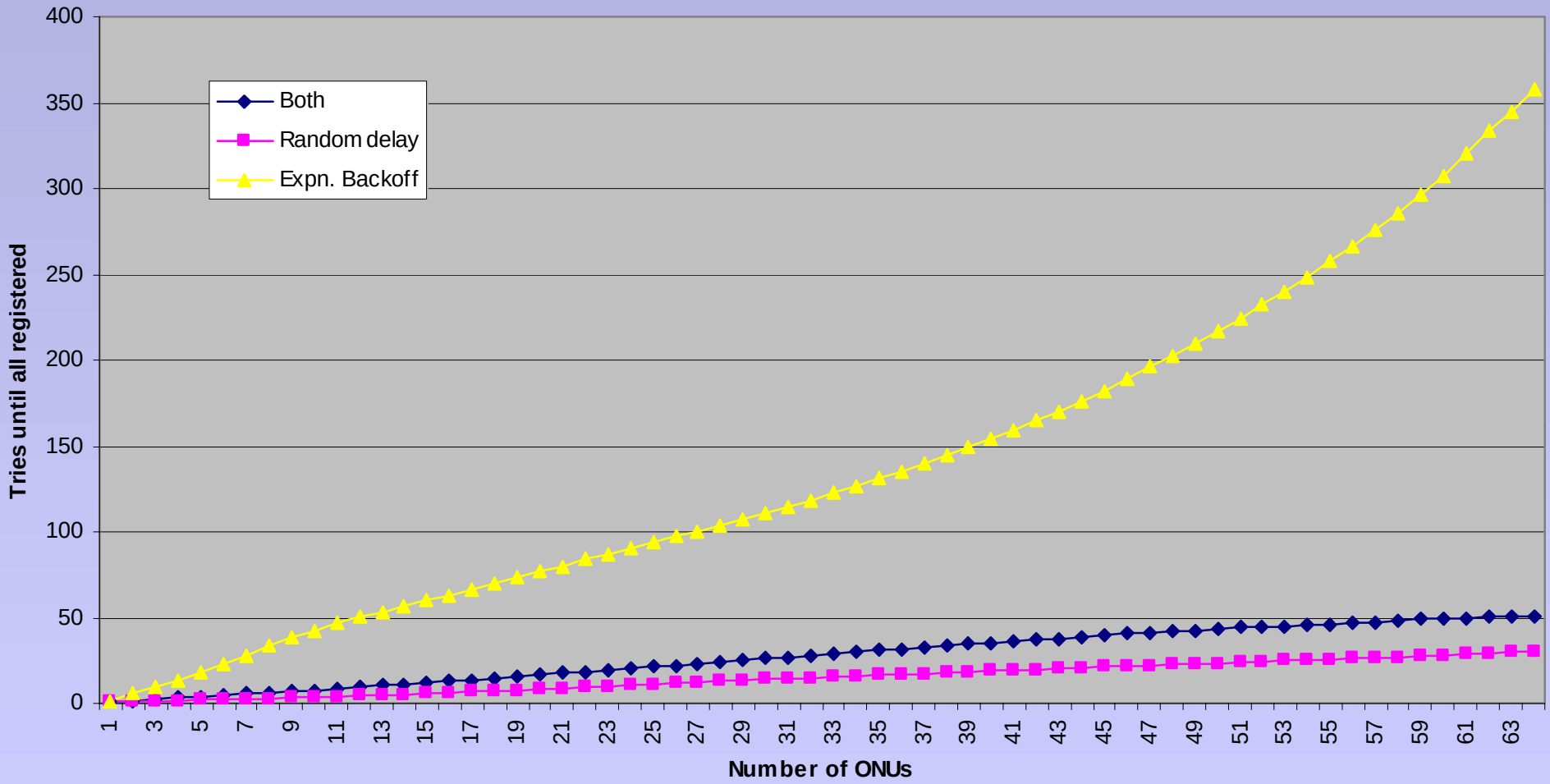
Why Using Both?

- Number of registration attempts is limited from above by exponential backoff
- When PMD is fast, convergence will be almost as fast as random delay
- When PMD is slow, registration process is guaranteed to converge

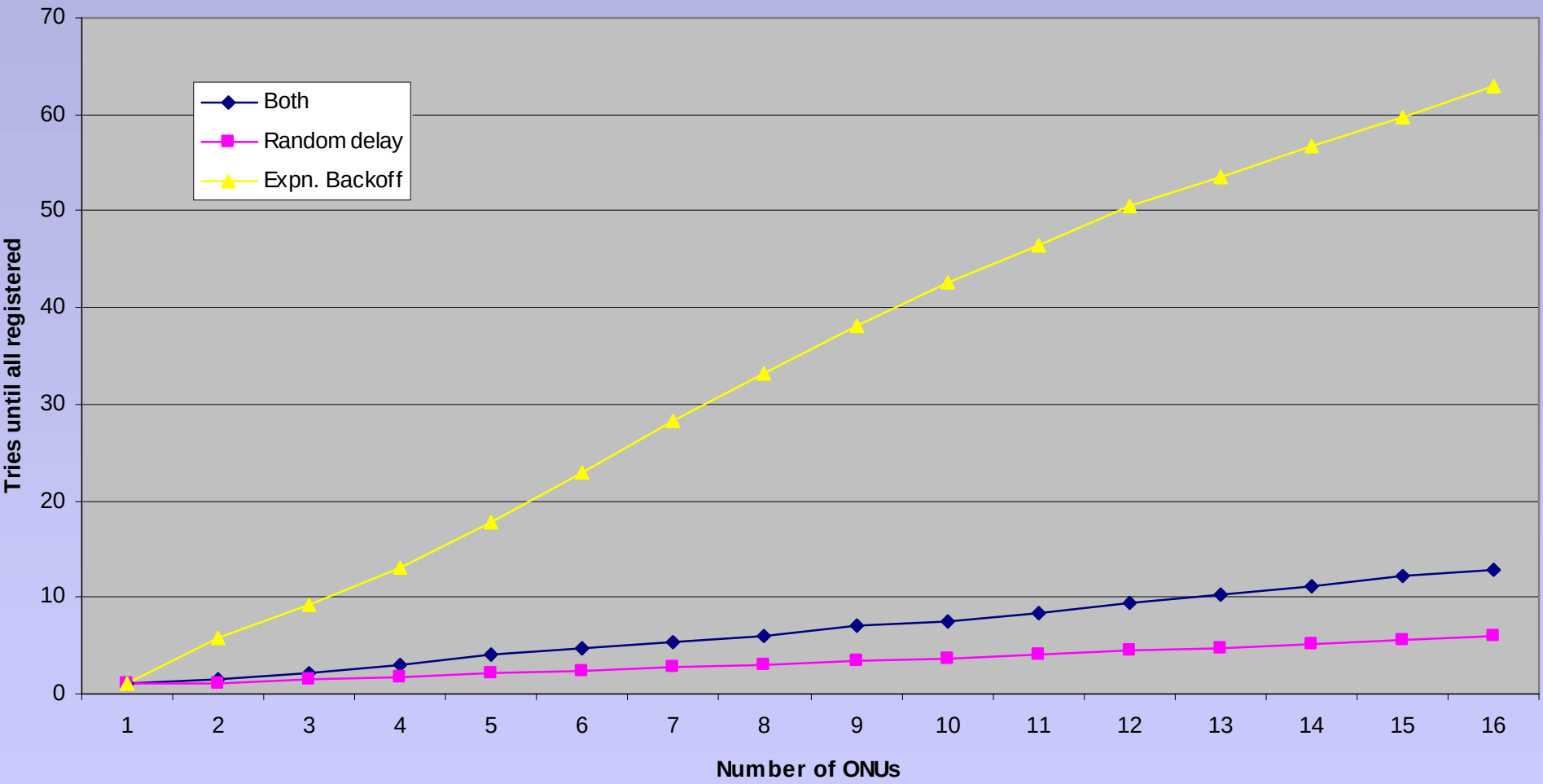
Performance Comparison – Fast PMD

- **The next two graphs are assuming:**
  - All ONUs have the same RTT (worst case)
  - Up to eight ONUs can register simultaneously during random delay
    - Notice: Window size is increased by 16 times of REGISTER_REQ and PMD overhead because model is not slotted
  - Number of ignored registration window in Exponential backoff is limited to 16
  - Collision is declared when two ONUs are transmitting simultaneously
    - Not assuming one ONU stronger than other

Fast PMD – 64 ONUs



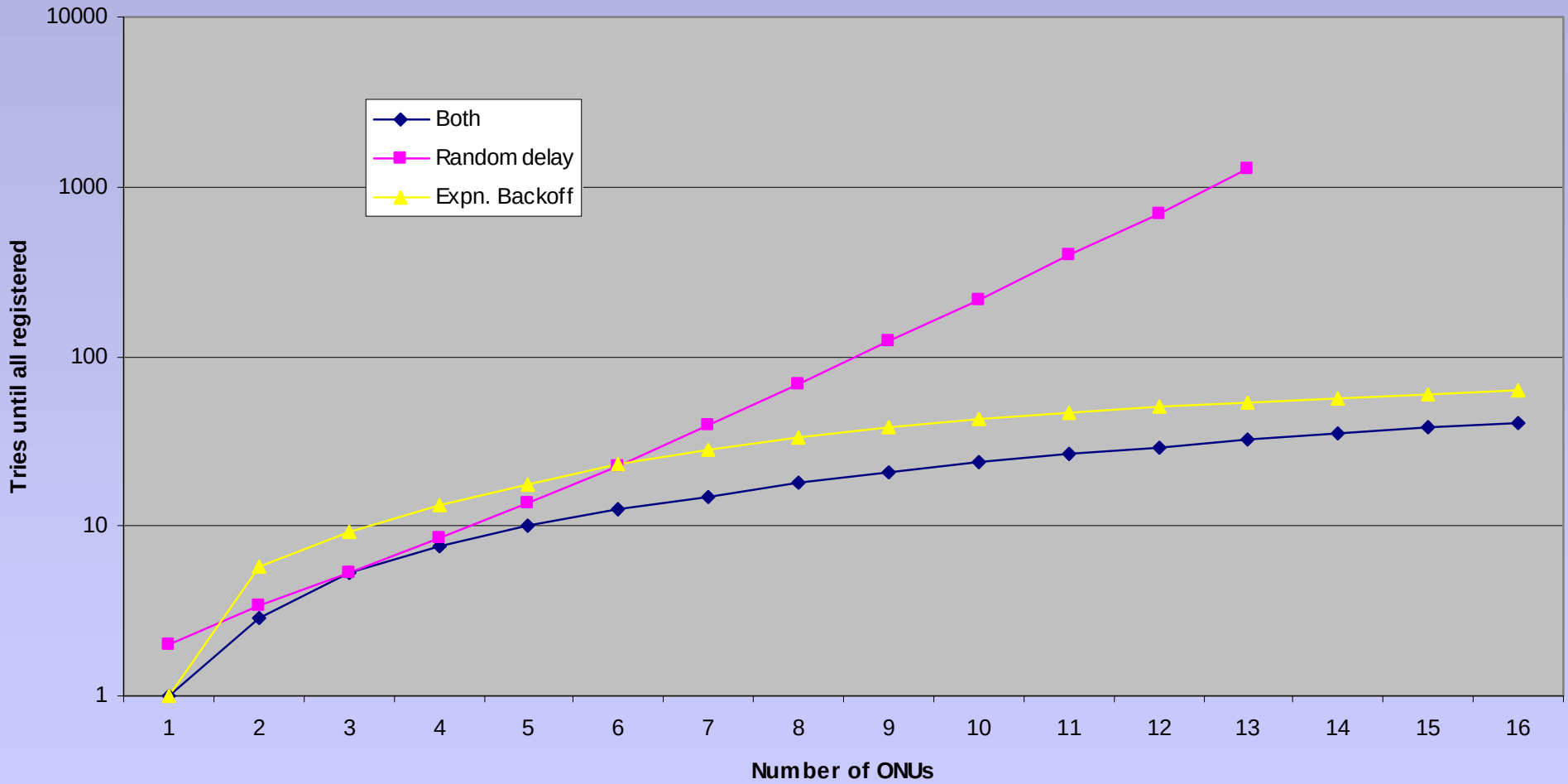
Fast PMD – 16 ONUs



Performance Comparison – Slow PMD

- **The next graph is using the same assumption except:**
  - Up to two ONUs can register simultaneously during random delay

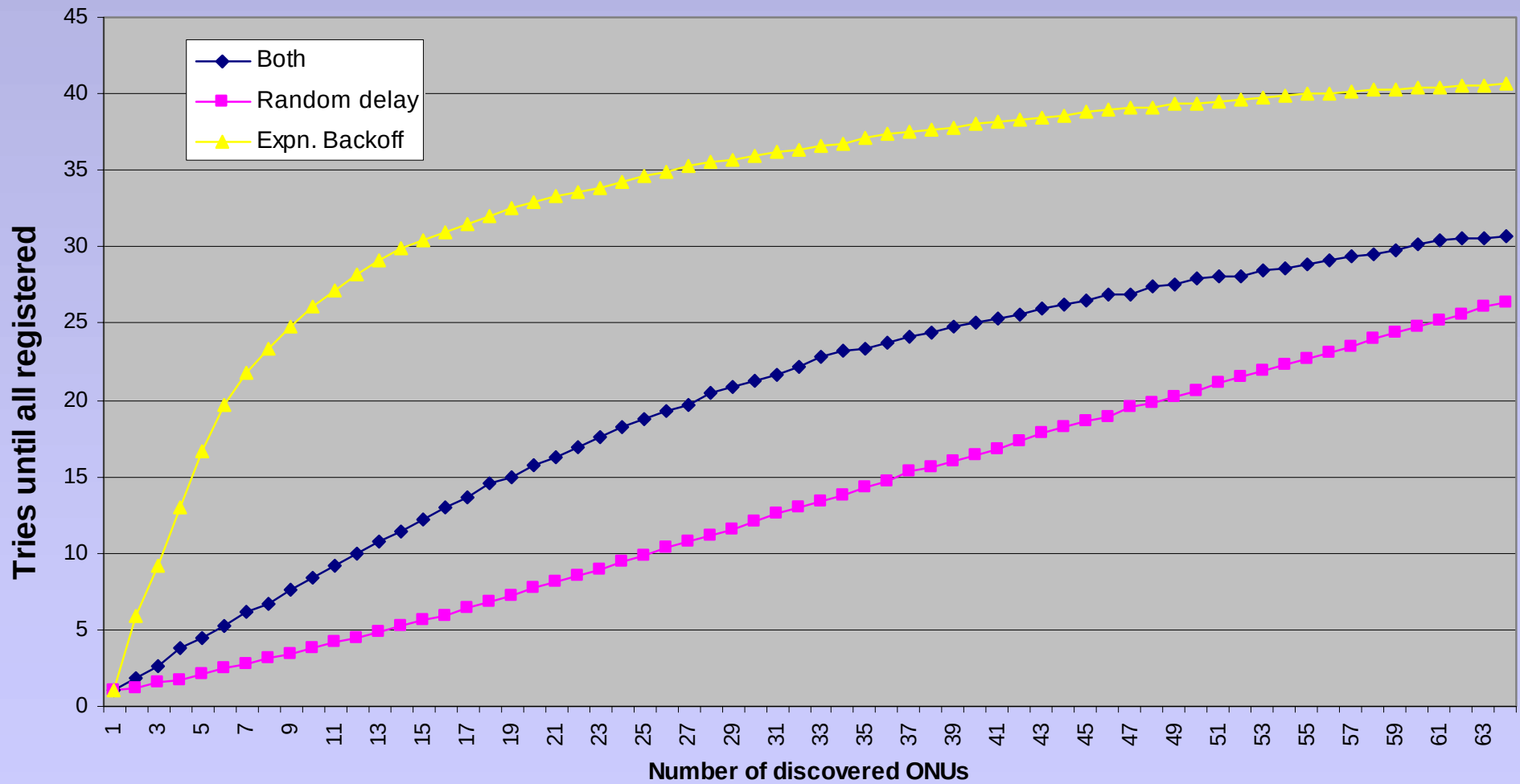
Slow PMD – 16 ONUs



Performance Comparison – Different RTT

- **It is interesting to investigate the scenario of different RTT**
- **The following graph assumes that each RTT is located precisely ¼*(REGITER_REQ + PMD OH) from previous ONU.**
  - Putting numbers: ¼*(512nS + 512nS) = 256nS = 25meter
  - Still, unslotted model is used
- **As can be seen, performance is improved for all schemes, though improve of exponential backoff is more dramatic**

Performance Comparison – Different RTT



Summary

- Combining both contention resolution scheme yields the best of two worlds
- Convergence is almost as fast as random delay when fast PMD
- Convergence is as robust as exponential backoff, at any scenario