Rebuild Strategies for Redundant Disk Arrays

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NASA/IEEE MSST 2004

12th NASA Goddard/21st IEEE Conference on

Mass Storage Systems & Technologies

The Inn and Conference Center

University of Maryland University College

Adelphi MD USA

April 13-16, 2004

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- Comparison of VSM and PCM
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- Estimation of Rebuild Time
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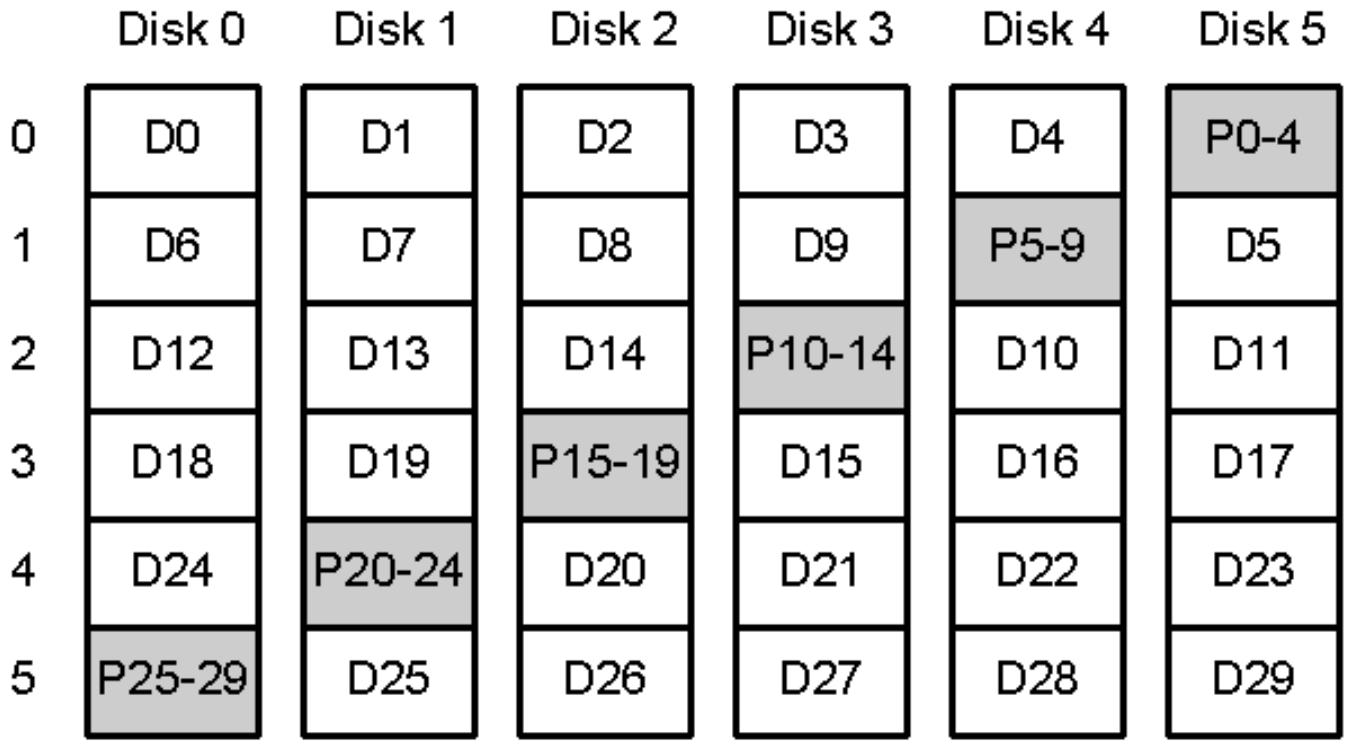
Introduction

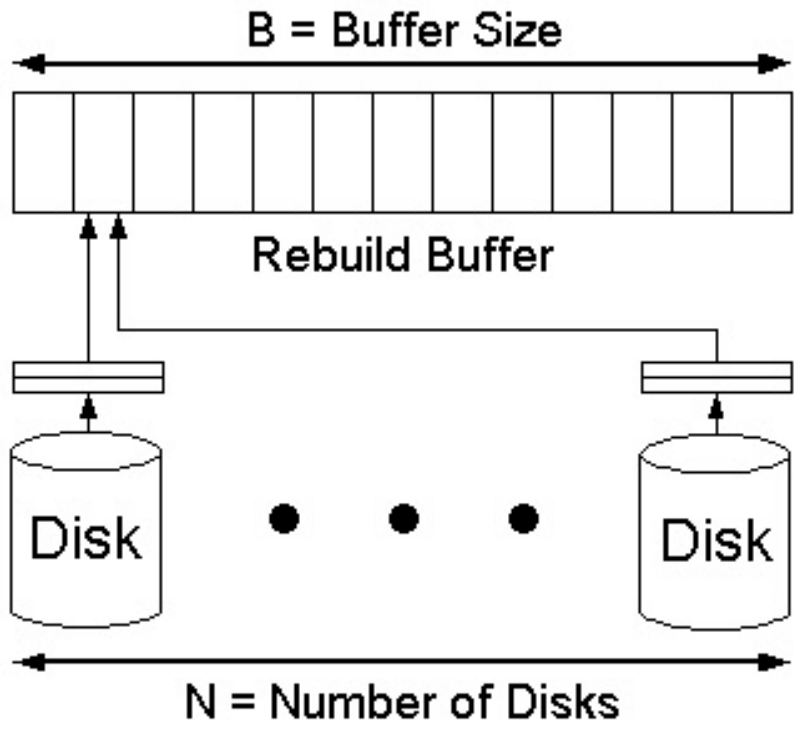


$$P_{0-4} = D_0 \oplus D_1 \oplus D_2 \oplus D_3 \oplus D_4$$

$$d_0 = p_{0-4} \oplus d_1 \oplus d_2 \oplus d_3 \oplus d_4$$

Parameters for Experiments

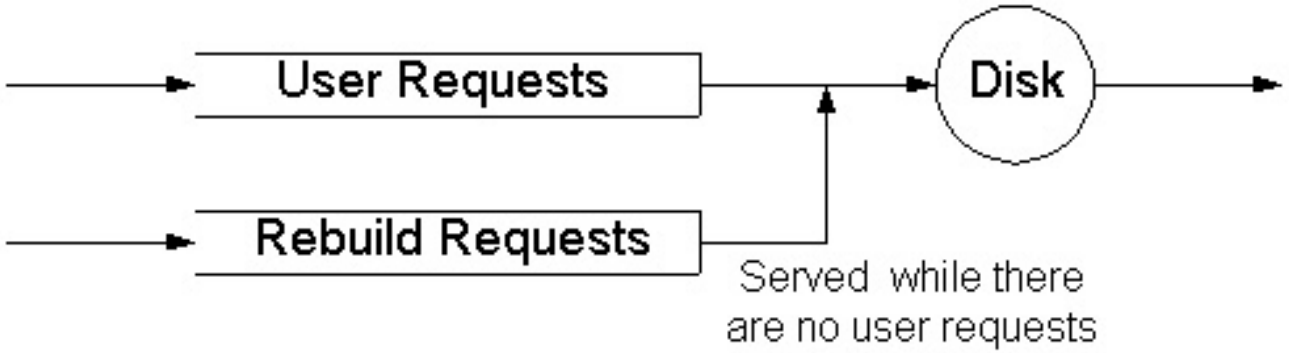
- N = number of disks
- B = buffer size in tracks
- T = rebuild unit size (default one track)
- U = disk utilization in normal mode (default 45%)
- FCFS scheduling
- IBM18es, 9GB, 7200rpm



Vacationing Server Model (VSM)

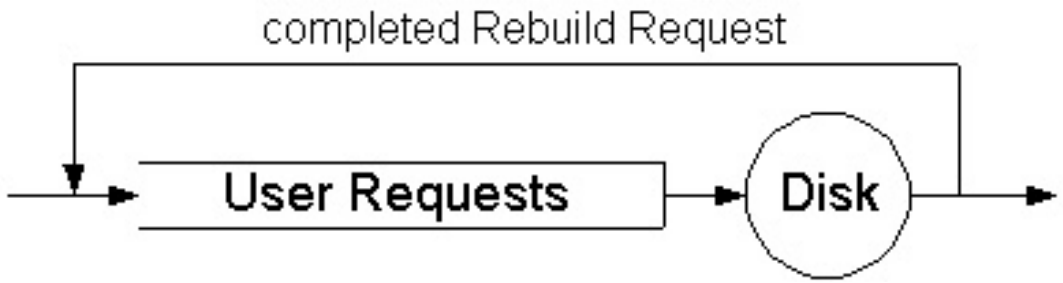
- Rebuild requests are processed at a lower priority than user requests

- Rebuild requests are processed until a user request arrives.

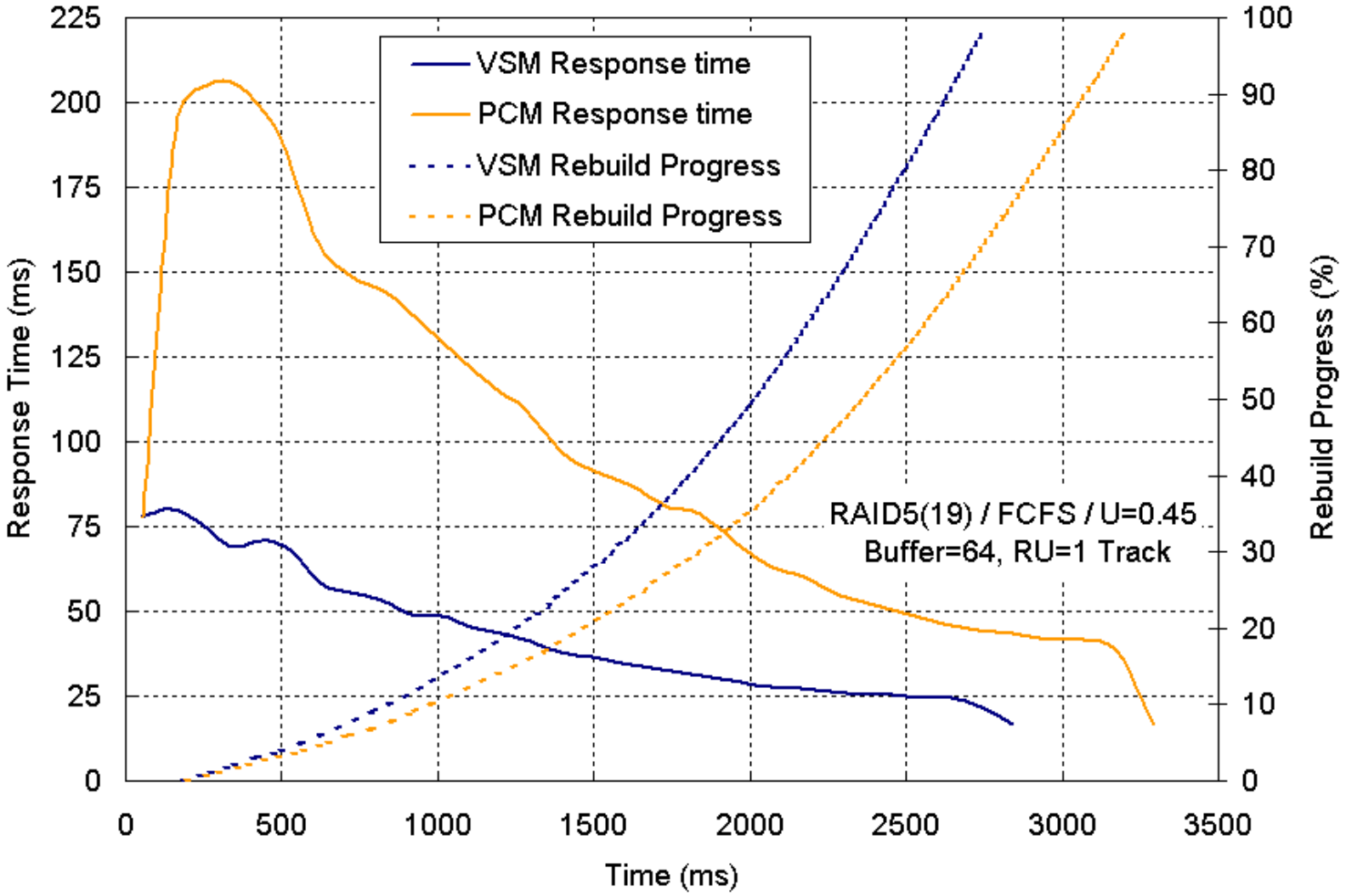


Permanent Customer Model (PCM)

- Rebuild requests are processed at the same priority as user requests.
- A new rebuild request will be issued once the previous one is completed.



Performance Comparison
VSM vs. PCM



Response Time Comparison

- VSM Response Time < PCM Response Time

- VSM rebuild requests are processed at a lower priority than user requests, while PCM rebuild requests are processed at the same priority as user requests.

Rebuild Time Comparison

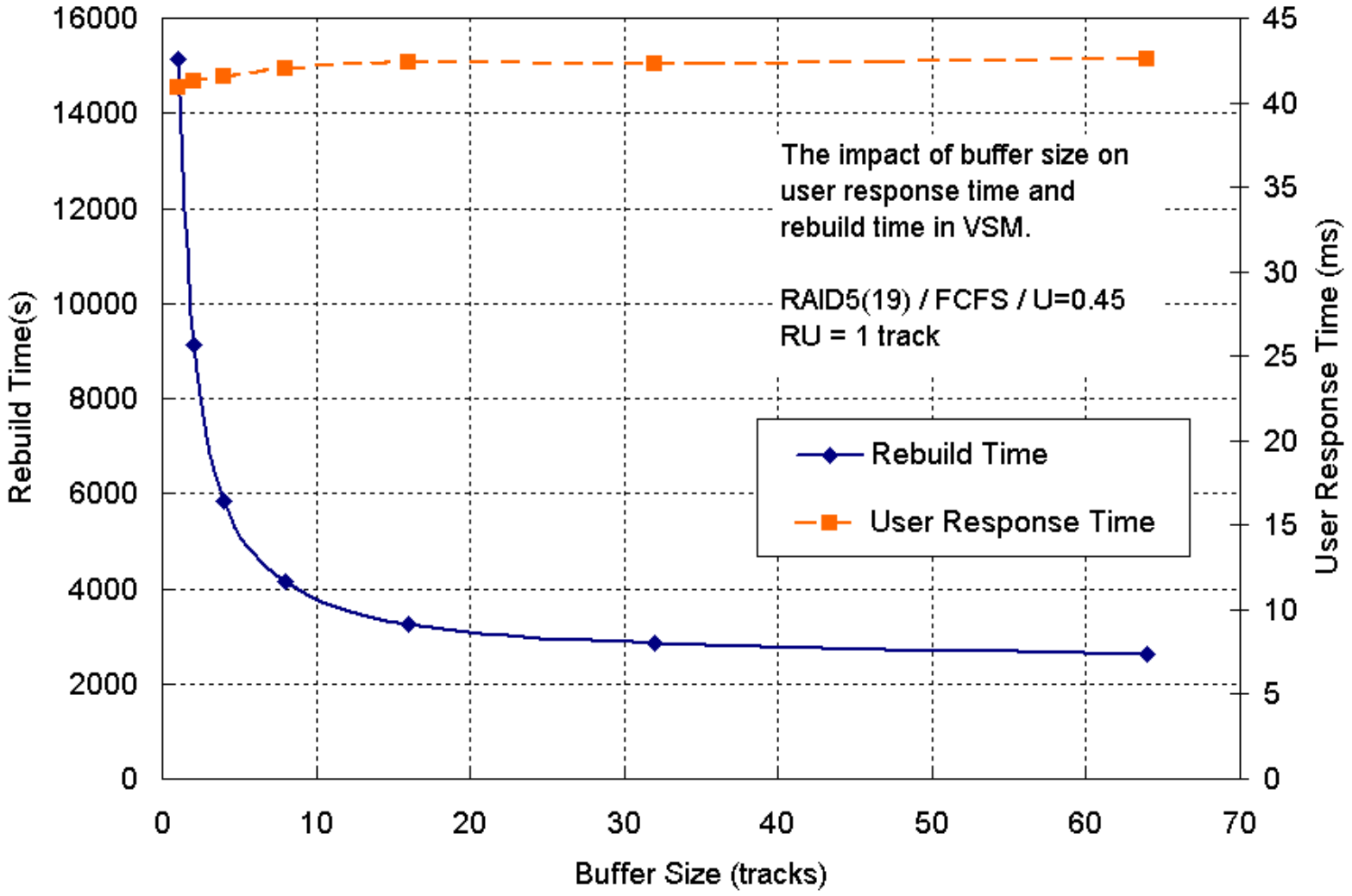
- VSM Rebuild Time <

  PCM Rebuild Time
- In VSM more rebuild requests are processed consecutively, which shortens average seek time per rebuild request.

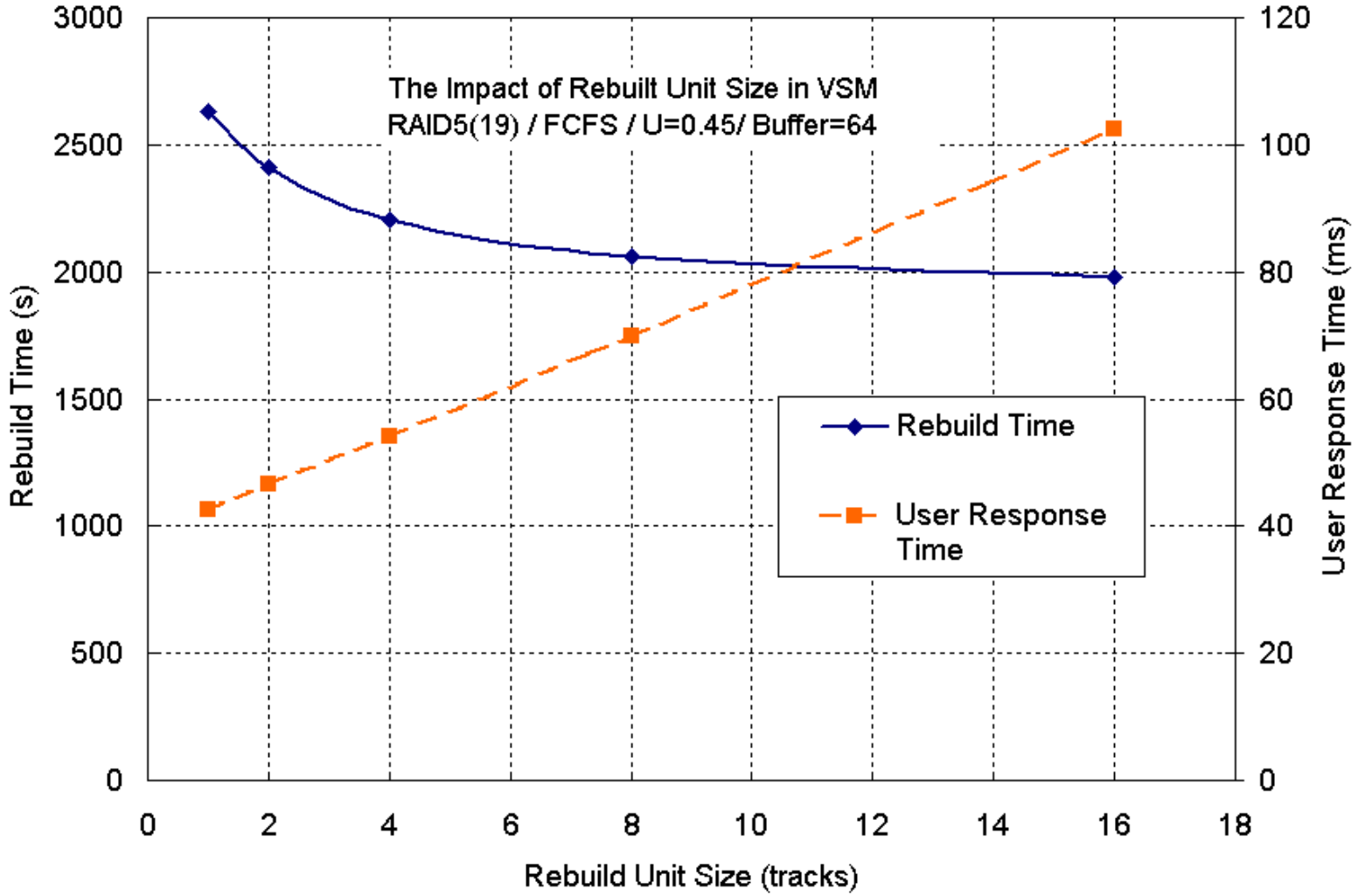
$$P_{interrupt}^{VSM} = 1 - e^{-\lambda X_{RU}}$$

$$P_{interrupt}^{PCM} = 1 - e^{-\lambda (W_{RU} + X_{RU})}$$

Impact of Buffer Size



Impact of Rebuild Unit Size

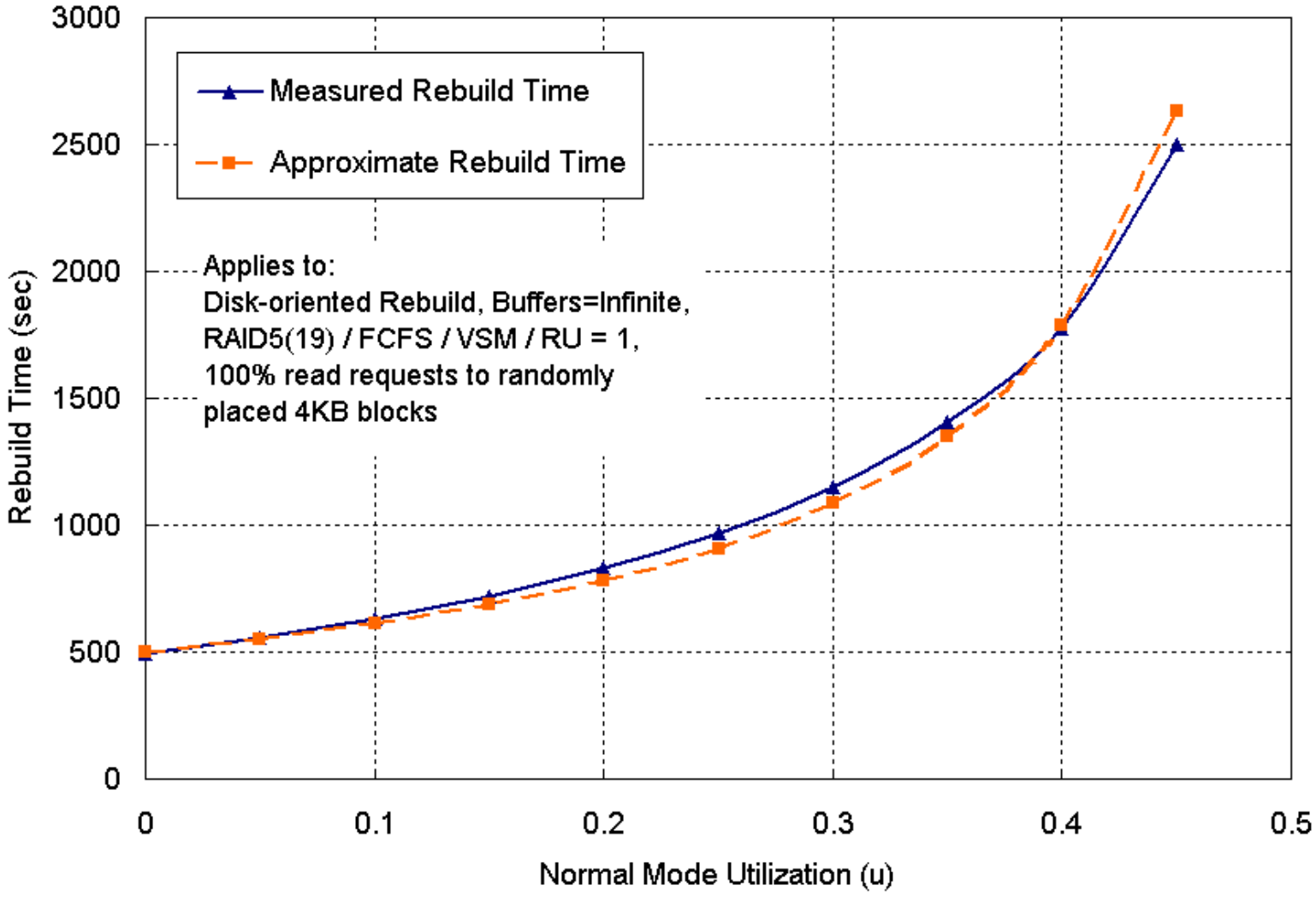


Estimation of Rebuild Time

- $T_{rebuild}(0)$ is the time to read all the tracks on a disk continuously.

$$T_{rebuild}(\rho) = \frac{T_{rebuild}(0)}{1-\alpha\rho}$$

Estimation of Rebuild Time



Conclusions and Future Work

- VSM is superior to PCM
  - Lower use response time
  - shorter rebuild time
- Buffer size
  - significant impact on rebuild time for high disk utilization
- Rebuild unit size
  - Tradeoff between user response time and rebuild time.
- More detailed analytical model for rebuild time is to be explored in the future.

Thank you!