

## **COSC 6360: Operating Systems PAPERS ON THE SUMMER 2008 FINAL**

You are only responsible for the materials discussed in class as they are *summarized* in the handouts and discussed in the PowerPoint slides. I expect you to understand these summaries and to be able to comment around them.

### **Distributed File Systems**

M. Satyanarayanan, J. J. Kistler, P. Kumar, M. E. Okasaki, E. H. Siegel, D.C. Steere, "Coda: A highly available file system for a distributed workstation environment," *IEEE Transactions on Computers*, Vol. 39, No. 4, April 1990, pp. 447-459.

- *Focus on the sharing semantics of Coda, its optimistic approach to data replication, the advantages and disadvantages of the callback mechanism and the way file hoarding allows Coda to operate in disconnected mode. For the rest, refer to the PowerPoint slides (Coda.ppt)*

E. B. Nightingale and J. Flinn. Energy-efficiency and storage flexibility in the Blue file system. *Proc. 6th USENIX OSDI Conference*, pp. 363--378, Dec. 2004.

- *We discussed the main objectives of the Blue file system, its Write to All policy (including e-nodes), how and why aggregating writes can save energy and how BlueFS selects from which device to read data.*

A. Muthitacharoen, B. Chen, and D. Mazieres, A Low-bandwidth network file system. *Proc. 18<sup>th</sup> Symposium on Operating Systems Principles (SOSP '01)*, pp. 174-187, 2001.

- *We discussed the objective of LBFS and its use of chunking to reduce file transfer and file storage costs. We did not discuss any implementation details.*

S. A. Weil, S. A. Brandt, E. L. Miller, D. D. E. Long, and C. Maltzahn, "Ceph: A scalable, high-performance, distributed object-based storage system," *Proc. 7<sup>th</sup> Symposium on Operating Systems Design and Implementation*, Nov. 2006.

- *We discussed the advantages of replacing conventional block data servers in a DFS by object storage devices in a distributed file system but did not cover the remainder of the paper. (Ceph.ppt)*

### **Fault Tolerance**

A. Adya, W. J. Bolosky, M. Castro, G. Cermak, R. Chaiken, J. R. Douceur, J. Howell, J. R. Lorch, M. Theimer and R.P. Wattenhofer, "FARSITE: Federated, Available, and Reliable Storage for an Incompletely Trusted Environment," *Proc. 5<sup>th</sup> Symposium on Operating Systems Design and Implementation (OSDI 2002)*, Boston, MA, December 2002.

- *We covered the paper in some detail. You are responsible for all the topics discussed in the PowerPoint slides.*

### **Byzantine Agreement**

R. Kotla, L. Alvisi, M. Dahlin, A. Clement and E. Wong, Zyzyva: Speculative Byzantine fault tolerance, *Proc. 21<sup>st</sup> ACM Symposium on Operating System Principles (SOSP 2007)*, Oct. 2008.

- *We discussed how Zyzzyva uses speculative execution to speed up Byzantine fault-tolerant agreements and the special role it assigns to the client but did not discuss the protocol in detail. In addition, we barely mentioned the view change sub-protocol*

S. Chong, J. Liu, A. C. Myers, X. Qi, K. Vikram, L. Zheng, and X. Zheng, Secure Web Applications via Automatic Partitioning, *Proc. 21<sup>st</sup> ACM Symposium on Operating System Principles (SOSP 2007)*, Oct. 2007.

- *We focused on the objectives of the system, its general organization and the way it handles confidentiality and trust.*

## Security

B. W. Lampson, "A note on the confinement problem," *CACM*, 16(10):613-615, Oct. 1973.

- *You need to understand the difficulty of handling covert channels. We did not discuss countermeasures in any detail.*

## Selected Revision Questions

1. Give three examples of **covert channels** a malicious process can use to pass information.
2. What are the advantages and disadvantages of **callbacks**?
3. What is the difference between **leases** and **callbacks**? Which ones are better?
4. How would you implement Coda **hoarding** today?
5. How does the BlueFS aggregate writes?
6. How does LBFS define and recognize chunks?
7. What is the most vulnerable part of the FARSITE system?
8. What is a Sybil attack? How does Farsite prevent them?
9. How do Zyzzyva clients participate in Byzantine agreements?
10. Is Zyzzyva always faster than a conventional Byzantine agreement protocol?
11. What are the purposes of Swift endorse and declassify operations?