

CHAPTER 20



Database-System Architectures

The architecture of a database system is greatly influenced by the underlying computer system on which it runs, in particular by such aspects as processor and memory architecture, and networking, as well as by requirements of parallelism and distribution.

DEC clusters running Rdb were among the early commercial users of the shared-disk database architecture. Rdb is now owned by Oracle, and is called Oracle Rdb. The Teradata database machine was among the earliest commercial systems to use the shared-nothing database architecture. The Grace and the Gamma research prototypes also used shared-nothing architectures.

Companies that allow enterprises to rent machines which are hosted and maintained by the service provider, have been around for many years. But cloud computing, and in particular the ability to rent virtual machines for short periods of time, were popularized by Amazon Web Services, which continues to be a major provider of not just computing services, but also data storage, data analysis and many other services on the cloud. There are many other major service providers, including Microsoft's Azure service, which among many other services, provides its SQL Server database as a service, IBM, Google, and many others. Many of these providers also support the ability to deploy Web applications on a scalable platform, where more servers can be deployed to cope with increased load on the Web application.

Bibliographical Notes

[Hennessy et al. (2017)] provides an excellent introduction to the area of computer architecture, including the topics of shared-memory architectures and cache coherency, parallel computing architectures, and cloud computing, which we covered in this chapter. [Gray and Reuter (1993)] provides the classic textbook description of transaction processing, including the architecture of client-server and distributed systems. [Ozsu and Valduriez (2010)] provides textbook coverage of distributed database systems. [Abts and Felderman (2012)] provides an overview of data center networking.

[DeWitt and Gray (1992)] surveys parallel database systems, including their architecture and performance measures. A survey of parallel computer architectures is

presented by [Duncan (1990)]. [Dubois and Thakkar (1992)] is a collection of papers on scalable shared-memory architectures.

[Comer (2009)], [Halsall (2006)], and [Thomas (1996)] describe computer networking and the Internet. [Tanenbaum (2002)], [Kurose and Ross (2005)], and [Peterson and Davie (2007)] provide general overviews of computer networks.

The shared-memory architecture shown in Figure 20.6 is based on the Intel QuickPath interconnect described in more detail in [Intel Corporation (2009)]. The MESI cache coherence protocol was first described in [Papamarcos and Patel (1984)].

Bibliography

- [Abts and Felderman (2012)] D. Abts and B. Felderman, “A Guided Tour of Datacenter Networking”, *Communications of the ACM*, Volume 55, Number 6 (2012), pages 44–51.
- [Comer (2009)] D. E. Comer, *Computer Networks and Internets*, 5th edition, Prentice Hall (2009).
- [DeWitt and Gray (1992)] D. DeWitt and J. Gray, “Parallel Database Systems: The Future of High Performance Database Systems”, *Communications of the ACM*, Volume 35, Number 6 (1992), pages 85–98.
- [Dubois and Thakkar (1992)] M. Dubois and S. Thakkar, editors, *Scalable Shared Memory Multiprocessors*, Kluwer Academic Publishers (1992).
- [Duncan (1990)] R. Duncan, “A Survey of Parallel Computer Architectures”, *IEEE Computer*, Volume 23, Number 2 (1990), pages 5–16.
- [Gray and Reuter (1993)] J. Gray and A. Reuter, *Transaction Processing: Concepts and Techniques*, Morgan Kaufmann (1993).
- [Halsall (2006)] F. Halsall, *Computer Networking and the Internet : With Internet and Multimedia Applications*, Addison Wesley (2006).
- [Hennessy et al. (2017)] J. L. Hennessy, D. A. Patterson, and D. Goldberg, *Computer Architecture: A Quantitative Approach*, 6th edition, Morgan Kaufmann (2017).
- [Intel Corporation (2009)] Intel Corporation. “An Introduction to the Intel QuickPath Interconnect”. <https://www.intel.com/content/www/us/en/io/quickpath-technology/quick-path-interconnect-introduction-paper.html>, retrieved June 2018 (2009).
- [Kurose and Ross (2005)] J. Kurose and K. Ross, *Computer Networking-A Top-Down Approach Featuring the Internet*, 3rd edition, Addison Wesley (2005).
- [Ozsu and Valduriez (2010)] T. Ozsu and P. Valduriez, *Principles of Distributed Database Systems*, 3rd edition, Prentice Hall (2010).
- [Papamarcos and Patel (1984)] M. S. Papamarcos and J. H. Patel, “A low-overhead coherence solution for multiprocessors with private cache memories”, In *Proceedings of International Symposium on Computer Architecture (ISCA)* (1984).

- [Peterson and Davie (2007)]** L. L. Peterson and B. S. Davie, *Computer Networks: a Systems Approach*, Morgan Kaufmann Publishers Inc. (2007).
- [Tanenbaum (2002)]** A. S. Tanenbaum, *Computer Networks*, 4th edition, Prentice Hall (2002).
- [Thomas (1996)]** S. A. Thomas, *IPng and the TCP/IP Protocols: Implementing the Next Generation Internet*, John Wiley and Sons (1996).

