Reseach on Web caching (UvA)

Implementation of the UvA Web caching System

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Outline: summary

The course gives a brief insight on the research work performed by the both the database group of the UvA to build a scalable high performance web server.

The course shows the first steps to build a "working prototype". More details on this work can be found in the publications listed here:

1. *A.J.H. Peddemors and L.O. Hertzberger*, "**A High Performance Distributed Database System for Enhanced Internet Services**" published in *Future generation computer systems*, (15):407-415, 1999
2. *A.S.Z. Belloum, E.C. Kaletas, A.W. van Halderen, A.J.H. Peddemors H. Afsarmanash, and L.O. Hertzberger*, "**A Scalable Web Cache Server Architecture**" published in World wide Web: Internet and Information Systems , (5):5-23, 2002

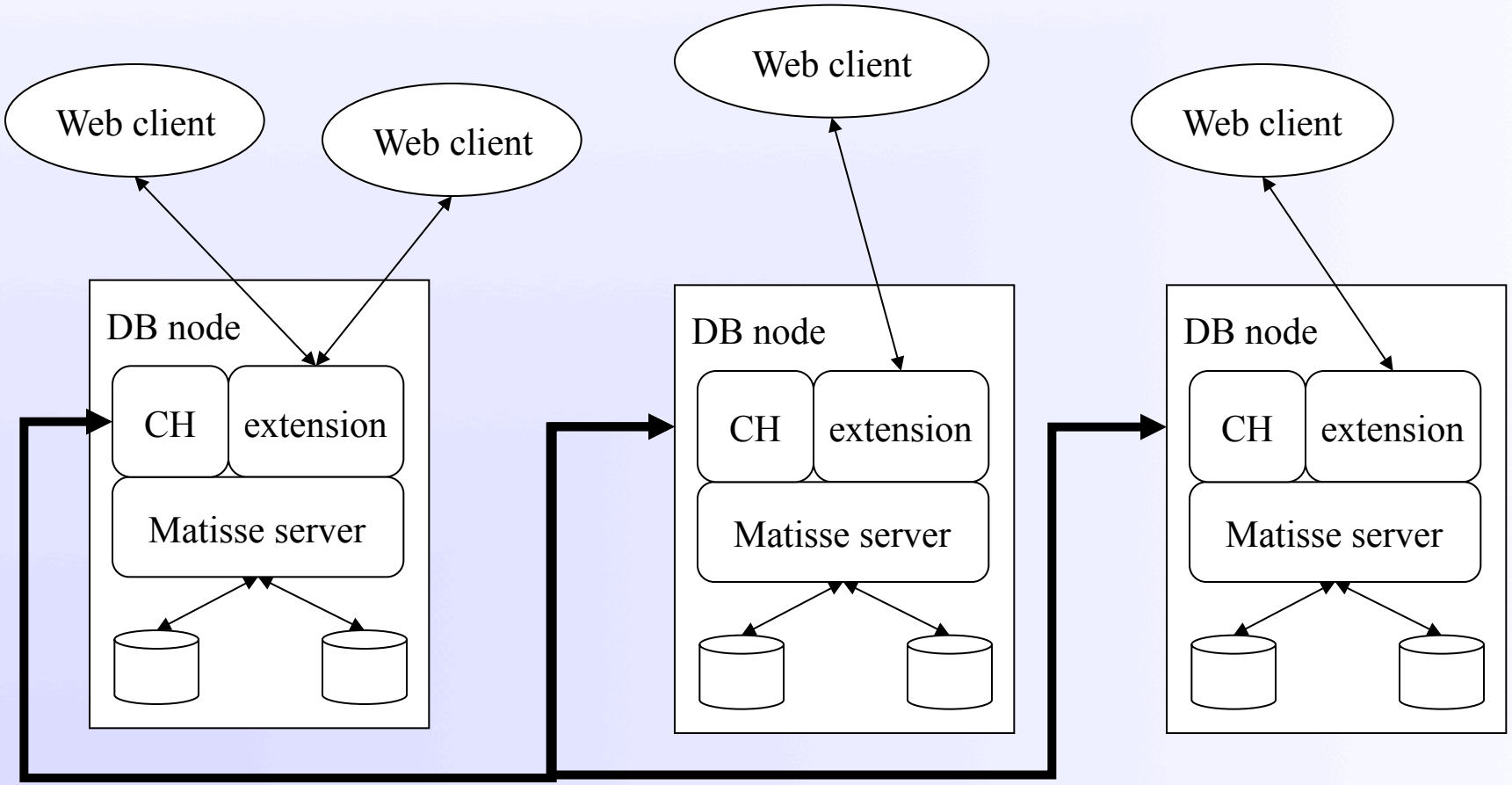
Outline: Issues addressed in this course

- Database Framework developed for advanced web applications
- Prototype and performance tests
- Building the caching mechanisms

Distributed database Framework

- The JERA prototype architecture include a database framework
  - For a better scalability
  - And better management
- Context
  - The web server can consist of a heterogeneous set of machines geographically distributed

Distributed database Framework



The features of the system (1/2)

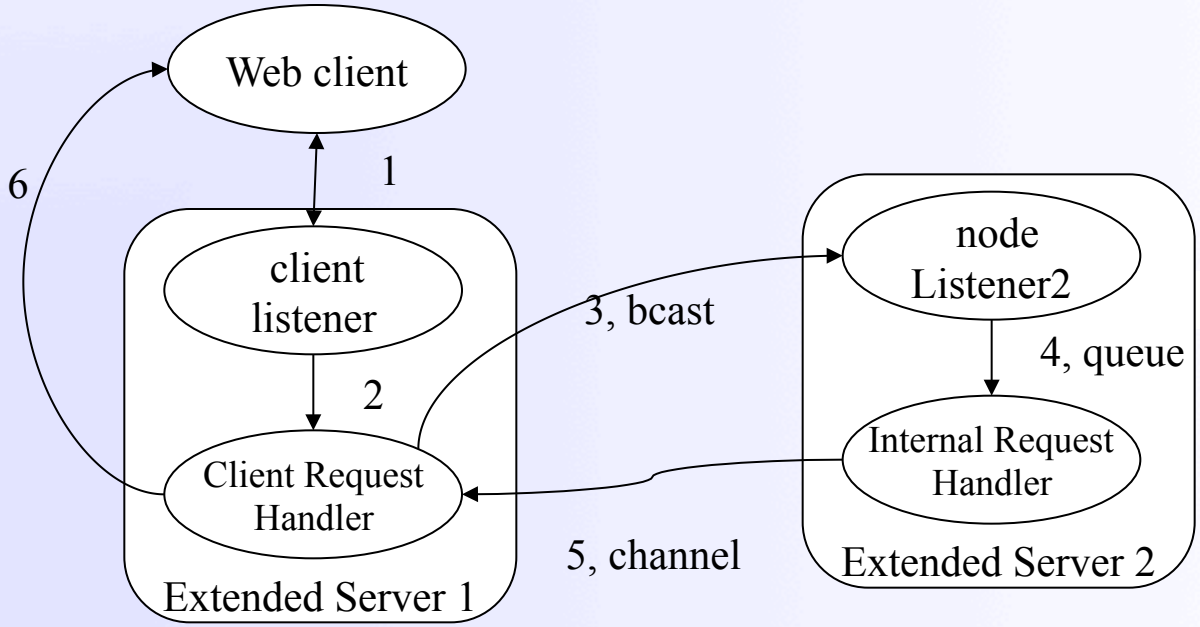
- HTTP daemon must be able to connect to any node to the distributed database
- HTTP daemon go only once through the process of setting the connection with the database
- HTTP daemon is granted full access by just connecting to a single node (entry node)
- Each server in the system can perform the role of the entry node
- From an entry node point if view, all other servers are considered an internal nodes

The features of the system (2/2)

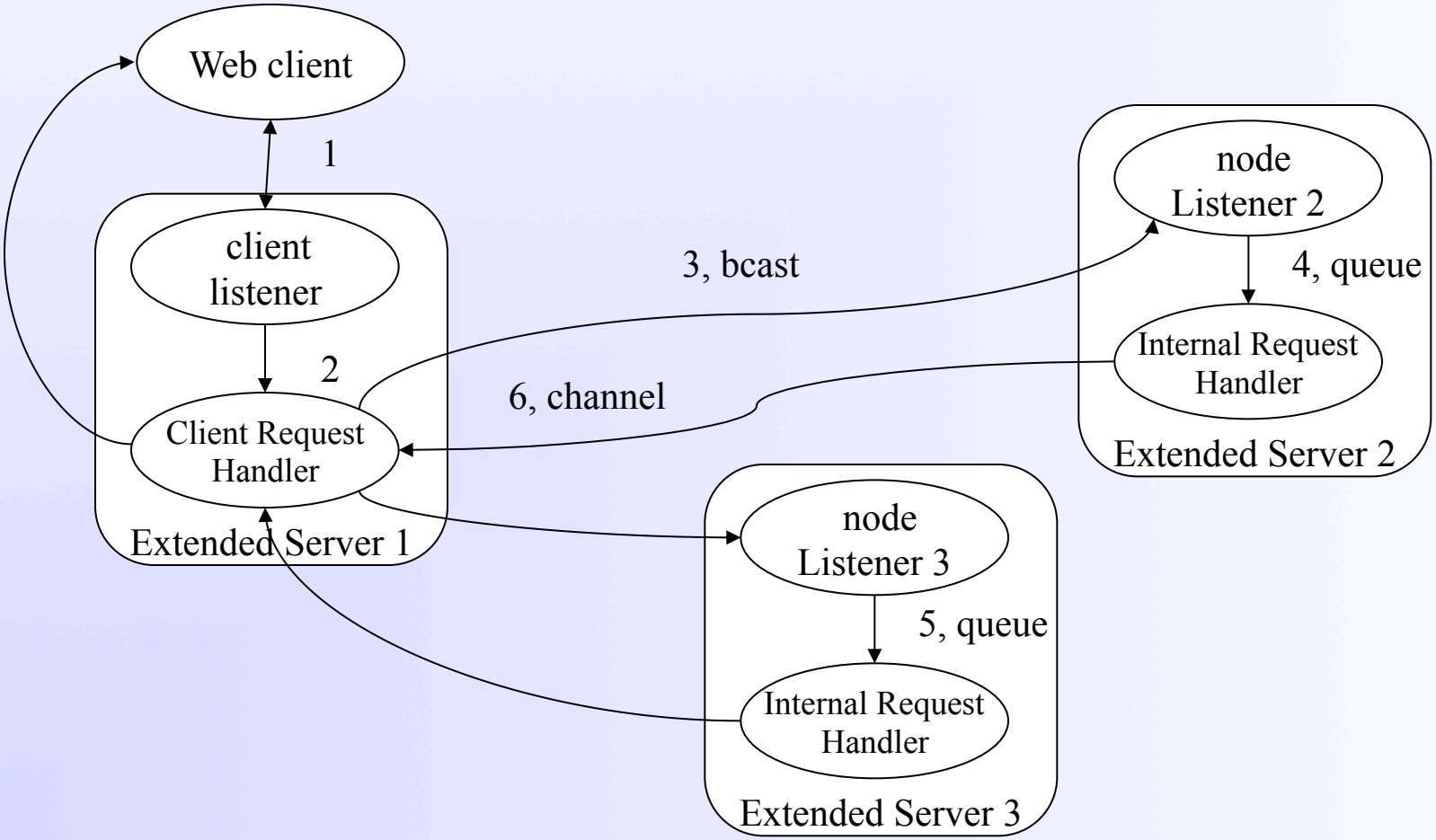
- URL are used to create a global unique identifier
- A mapping directory in each node allow to translate URLs into OID
- The objects are distributed in a round-robin fashion among the existing nodes (other methods can be applied as well for instance clustering)
- The inter-node communication protocol is based on broadcasting mechanism

Inter-node protocol (example with two nodes)

- The communication inter-node involve 6 steps



Inter-node protocol (example with three nodes)



Prototype

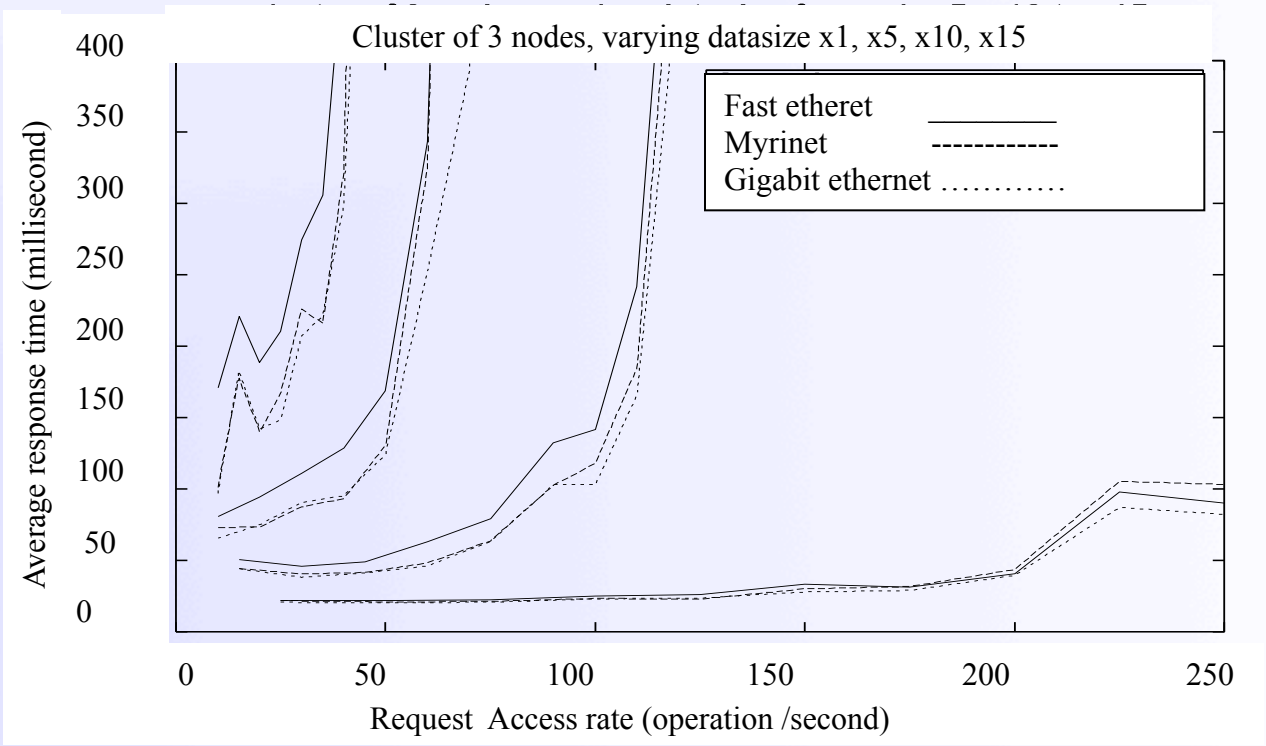
- ARCHES is the prototype built it is composed of
  - 20 dual pentium II 300 MHz machine
  - Sun Solaris OS
  - Each node has SCSI disk of 2 GB and 512 MB
  - Myrinet switched network
  - Giga Ethernet RCube-based switch with 5 ports

Performance tests (factors)

- The data set used for the test is: the SPECweb set
  - 4 class of workloads (each class has a fixed proportion of files of specific size)
- The distribution of the requests
- Communications mechanisms
- The frequency of the request put on the system
- The number of node used for Front-End and Back-End services

Performance test Results

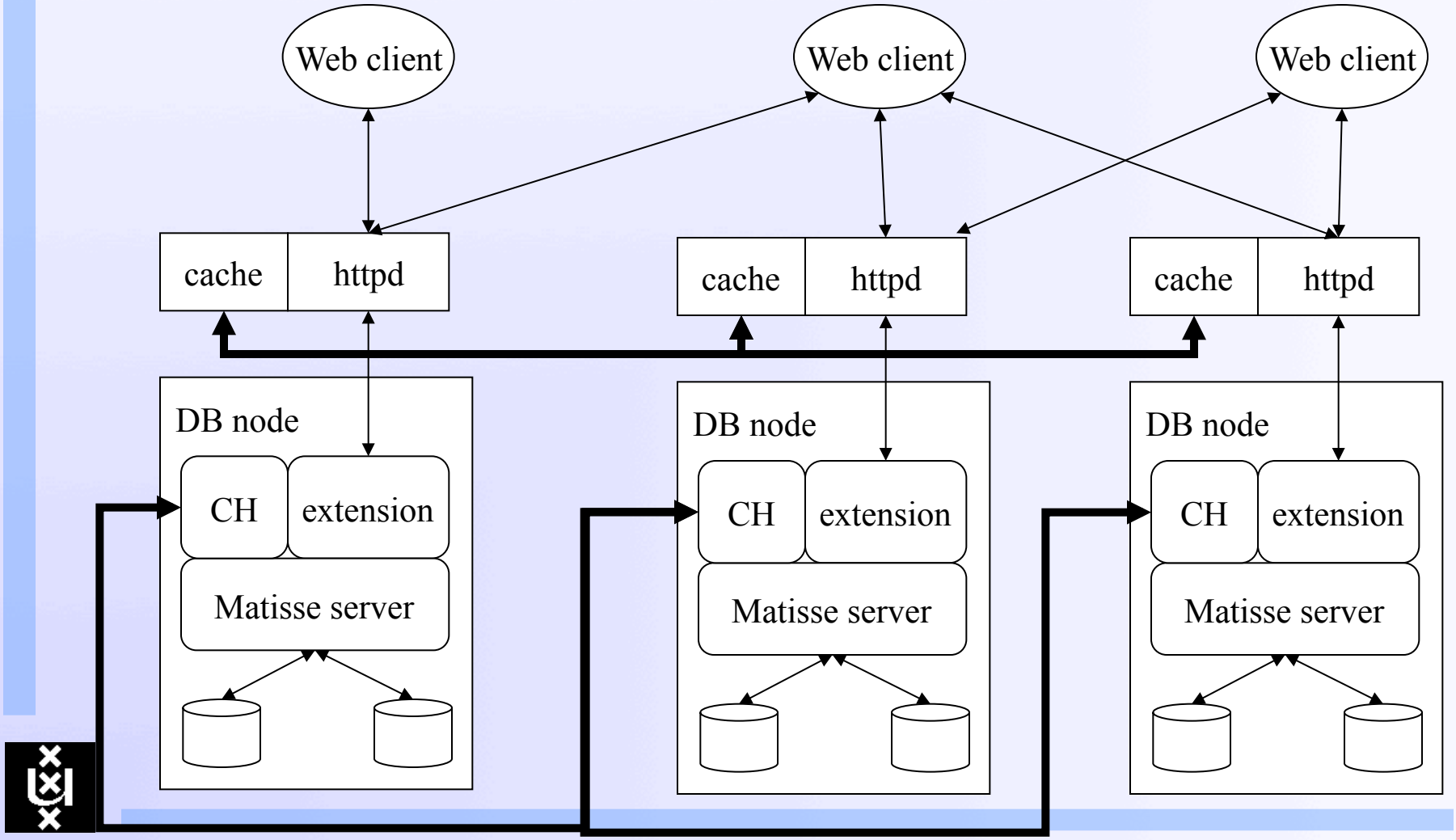
- The response time increases with the increase of the file size
- The network is not the problem



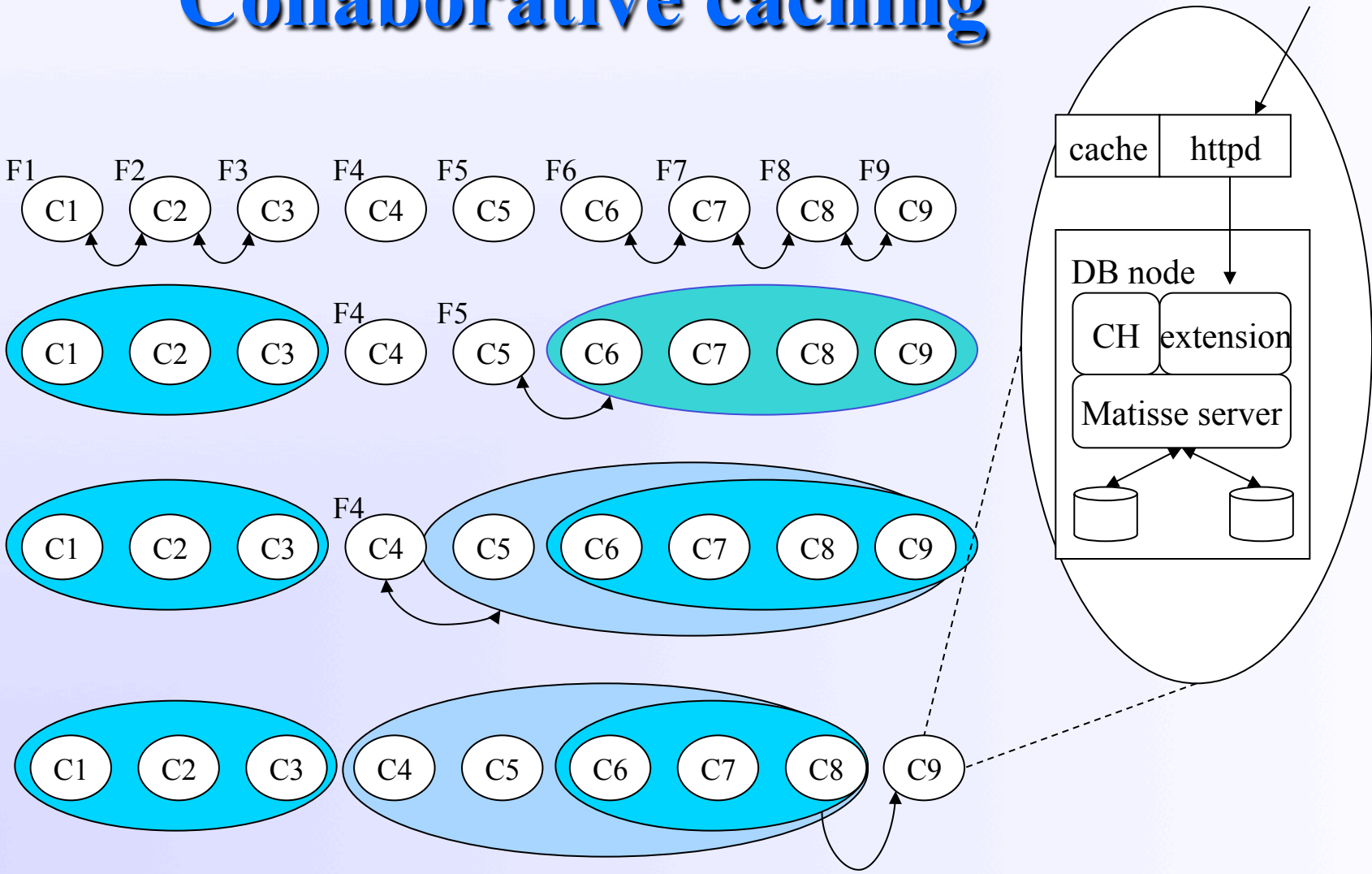
Building the web cache server on top of this framework

- The caching system should improve the performance of the system (save network bandwidth)
- Reduce to number of broadcast messages in the system
- The caching system will be integrated at the level of the HTTP daemon. The back-end system is only contacted on a miss, which should reduce the latency

Web caching integrated

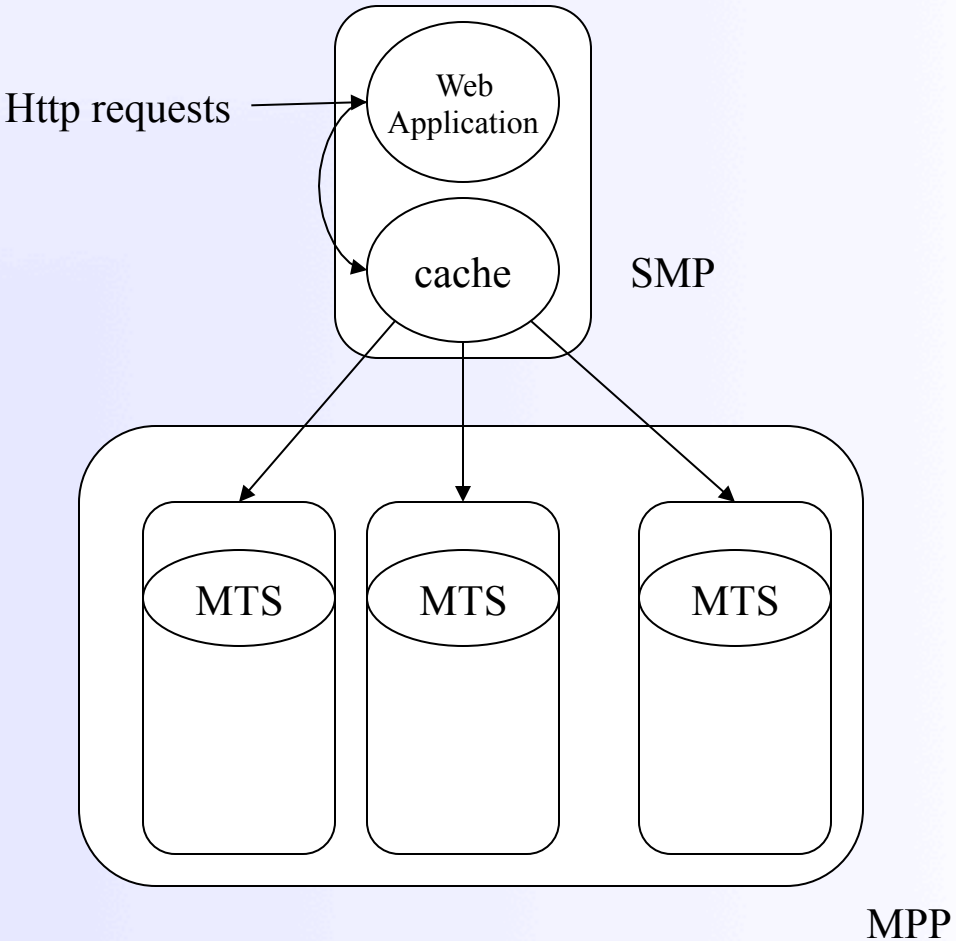


Collaborative caching

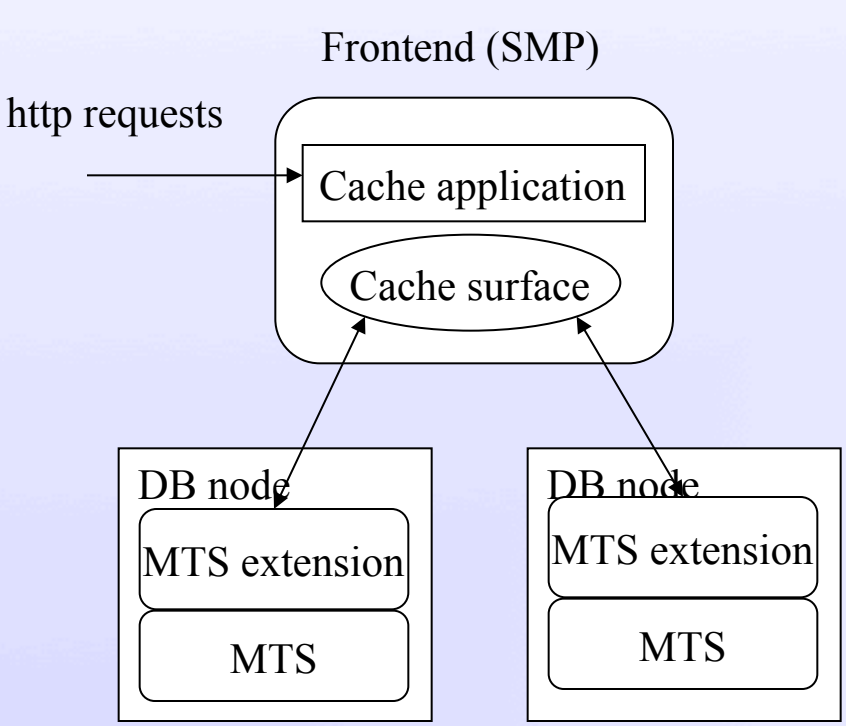


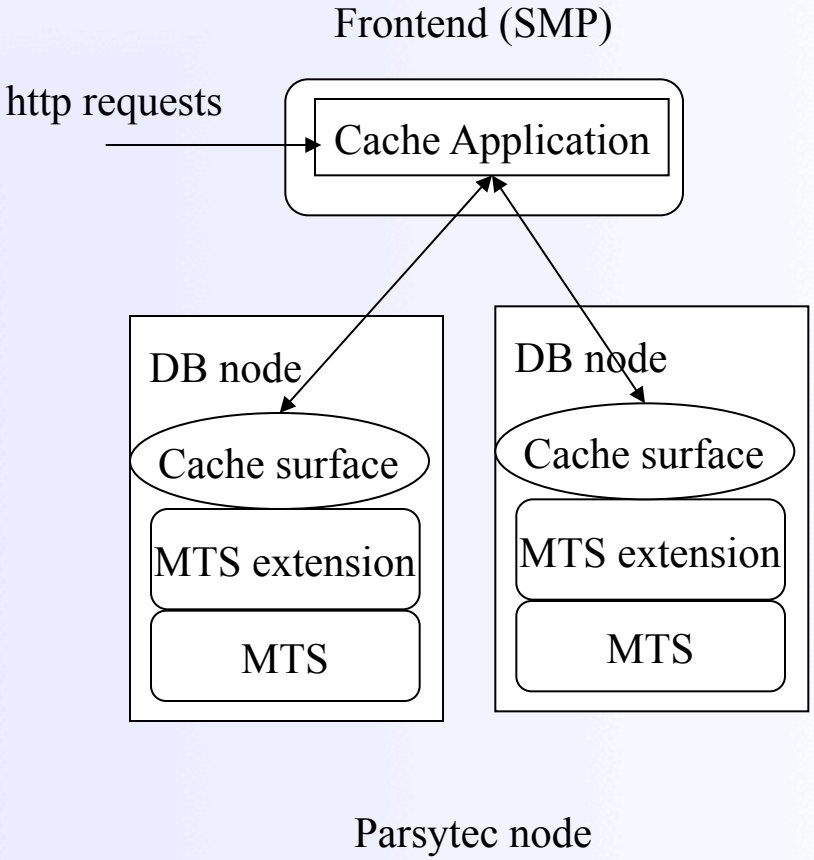
Implementation Issues

- Two tier architecture
  - Frond-End (FE) usually SMP machine
  - Back-End usually MPP machine



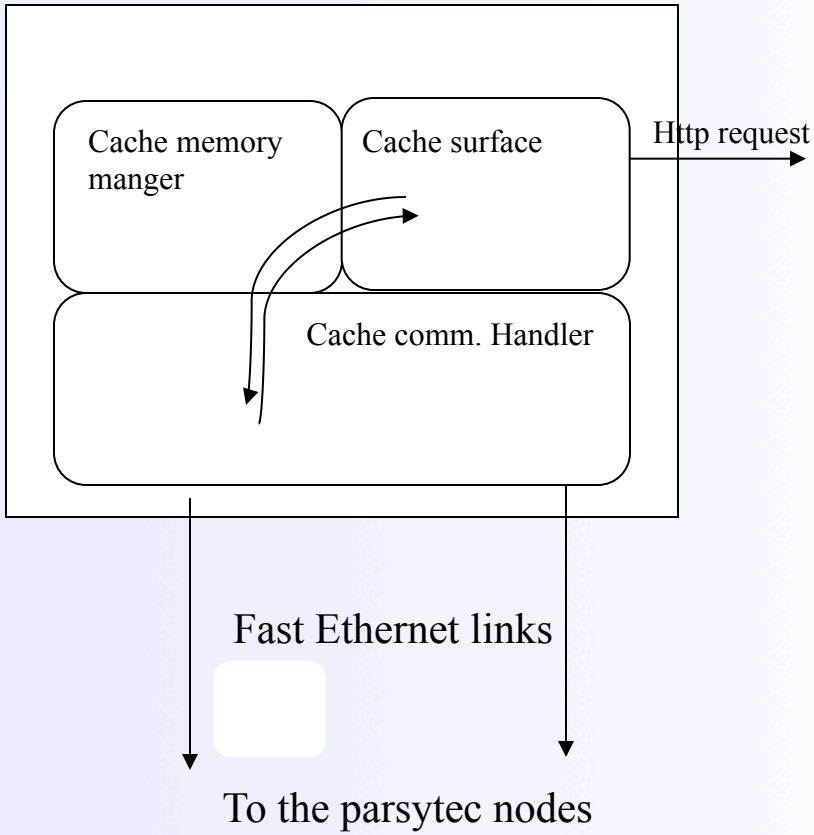
Implementation issues





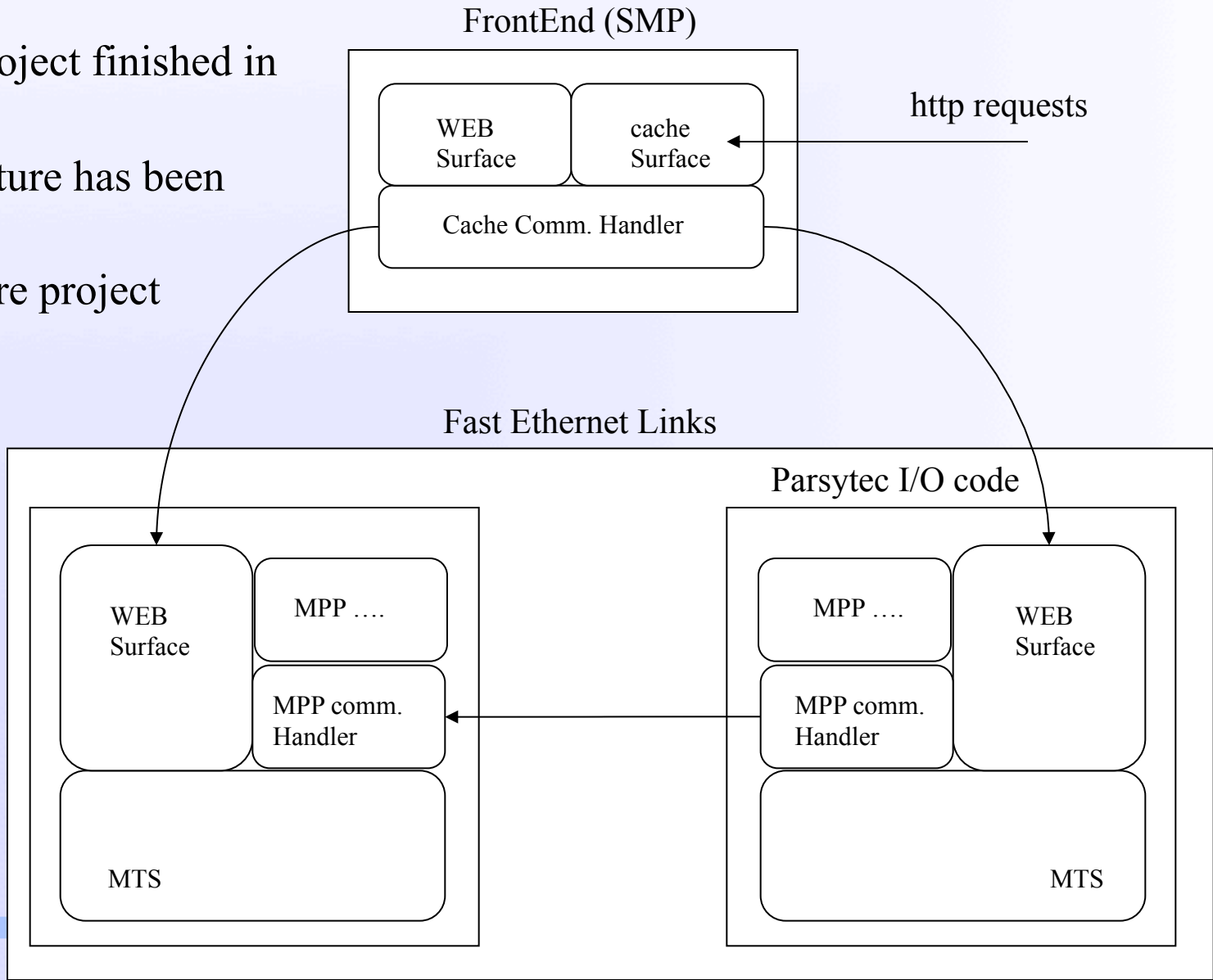
Implementation of the Integrated caching system

- Cache surface is the interface to the httpd
- memory manager (Optimized version of simulated strategies)
  - Cache replacement
  - Cache coherence
- Comm.Handler
  - Communication protocols
  - TCP/IP or MPI



The different component of the architecture of the Web Cache server

- The JERA project finished in August 1999
- This architecture has been used
  - MegaStore project



Further references

1. A.S.Z. Belloum, and L.O Hertzberger, *Concurrent Evaluation of Web Cache Replacement and Coherence,* Transactions of the Society for Modelling and Simulation, vol. 78 (2002), no. 1, pp. 28-35, doi:10.1177/0037549702078001199.
2. A.S.Z. Belloum, H. Muller, and L.O. Hertzberger, *A Scalable Federation of Web Servers,* World Wide Web Journal, vol. 4, pp. 255-275, no.4, 2001, doi:10.1023/A:1015181701674.
3. A.S.Z. Belloum and L.O Hertzberger, *The impact of the Cache Size on the Document Replacement Strategies,* Information Research Journal (special issue on Web Research), vol. 6, no. 1, 2000.
4. A.W. Van Halderen, A.S.Z. Belloum, A.D. Pimentel, and L.O Hertzberger, *On Hybrid Abstract-level Models in Architecture Simulation,* Workshop on Embedded Systems, October 2000, Utrecht, the Netherlands.
5. A.S.Z. Belloum and L.O Hertzberger*, Replacement Strategies in Web Caching,* IEEE In Proceedings of the International Conference, ISIC/CIRA/ISAS'98, Gaithersburg, September 1998, Maryland USA.
6. A.S.Z. Belloum and L.O Hertzberger, *Dealing with One-Timer Documents in Web Caching,* A In Proceedings of *Euromicro Conference, 1998*, pp. 544-550 vol.2, 25-27 Aug 1998, doi: 10.1109/ EURMIC.1998.708069.
7. A.S.Z. Belloum, A.J.H Peddemors, and L.O Hertzberger, *JERA: A Scalable Web Server* In Proceedings of the International Conference on PDPDA'98, Las Vegas, July 1998.