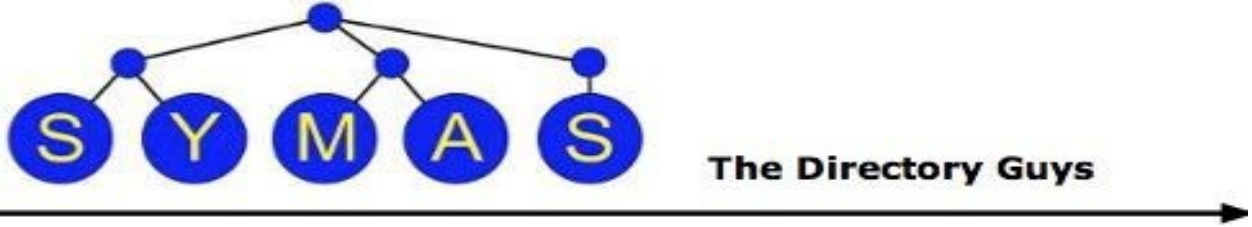
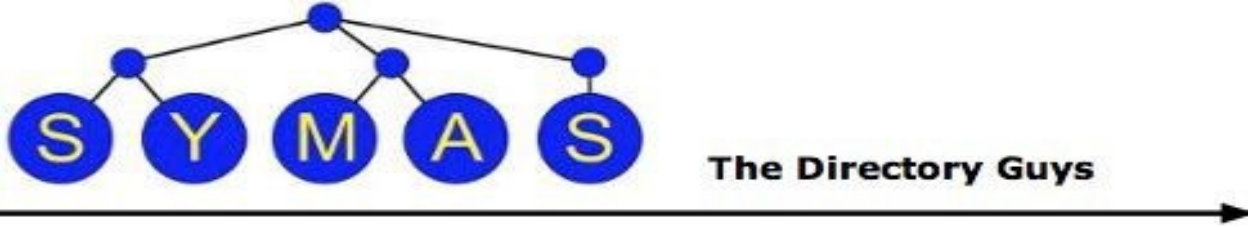



# OpenLDAP

## Highlights for 2.4

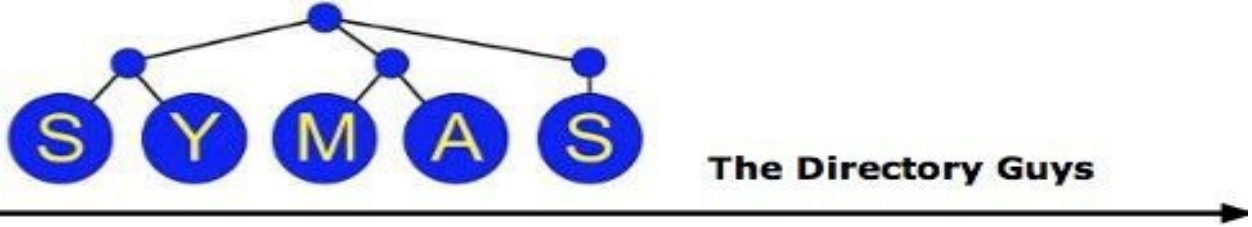
Howard Chu, hyc@symas.com
Chief Architect, Symas Corp
Chief Architect, OpenLDAP Project

ILUG 2007-09-10



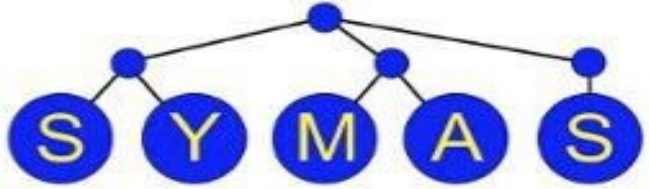

# OpenLDAP Project

- Open source code project
- Founded 1998
- Three core team members
- A dozen or so contributors
- Feature releases every 12-18 months
- Maintenance releases roughly monthly




# OpenLDAP Releases

- Release 1.x 1998/08/08 – 2001/09/11
  - Basically the UMich 3.3 code
  - Supported LDAP version 2
- Release 2.0 2000/08/31 – 2002/09/22
  - Introduced LDAP version 3 support
  - Added security with SASL and SSL/TLS
- Release 2.1 2002/06/09 – 2004/04/15
  - Significantly faster than 2.0
  - Added Unicode support
  - Added back-bdb backend

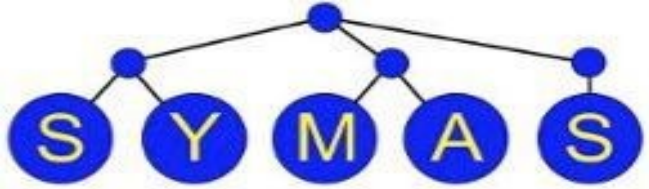



# OpenLDAP Releases, cont'd

- Release 2.2 2003/12/31 – 2005/11/21
  - Further optimization
  - Added back-hdb
  - More extensibility using slapd overlays and/or SLAPI plugins
- Release 2.3 2004/12/30 – now
  - Component-based matching
  - More overlays
  - Dynamic reconfiguration

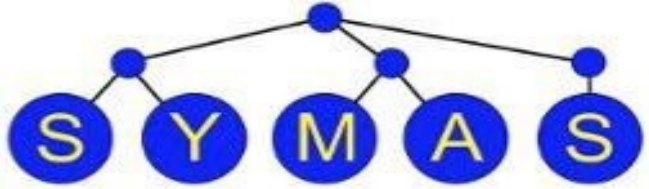
# OpenLDAP Releases, cont'd

- Release 2.4 now – ongoing (2.4.5 2007/09/04)
  - More functionality
    - More overlays
    - Multimaster syncrepl
  - More manageability
    - Further dynamic config work
    - More monitoring/tuning info



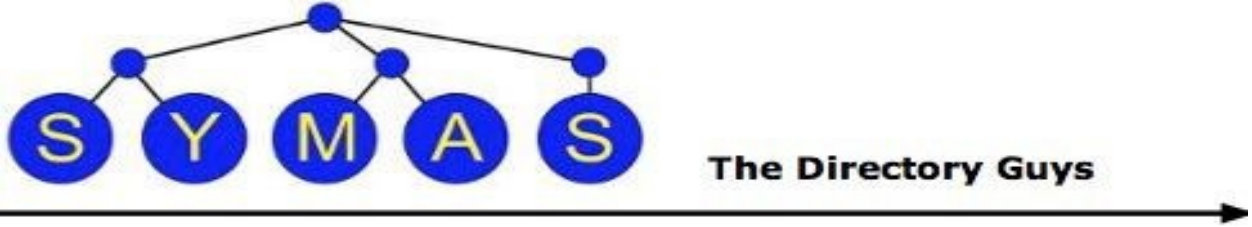

# OpenLDAP Releases, cont'd

- 2.4....
  - More performance
    - Further optimized frontend
    - Reduced locking contention in backend
  - More usability
    - Feature-complete manual pages
    - More extensive Admin Guide




# A Word About Symas

- Founded 1999
- Founders from Enterprise Software world
  - *platinum* Technology (Locus Computing)
  - IBM
- Howard joined OpenLDAP in 1999
  - One of the Core Team members
  - Appointed Chief Architect January 2007




# Notable Features

- Introduced in 2.1:
  - Transactional Backend (back-bdb)
- Introduced in 2.2:
  - Hierarchical Backend (back-hdb)
  - Content-Sync Replication (syncrepl)
  - Overlays
- Introduced in 2.3:
  - Dynamic Configuration (back-config)

# back-bdb

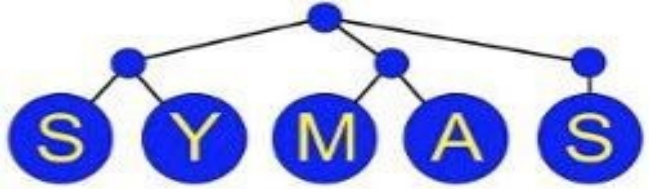
- Fully transactional backend with full ACID semantics
  - Atomicity: changes are all-or-nothing
  - Consistency: no structural corruption
  - Isolation: no in-between views of data
  - Durability: once a write returns success, it cannot be undone
- Extremely reliable

# back-hdb

- Fully hierarchical backend
  - Higher write throughput than other directory backends
  - Supports subtree renames in O(1) time
  - Based on back-bdb code – offers same transactional reliabilty

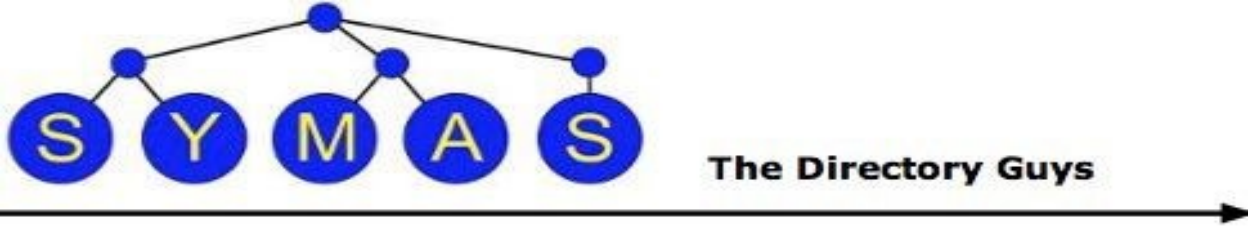
# syncrepl

- Replaces the old slurpd-based replication mechanism
- Documented in RFC4533
- Very flexible operation with minimal administration overhead




# Slapd overlays

- Modular plugin framework using slapd's native API
- Allows for rapid development and deployment of enhancements and new features




# Overlay Examples

- Enterprise-oriented features
  - In-directory password policy
  - Referential integrity
  - Translucency
  - Attribute uniqueness
  - Value sorting
  - In-directory logging

# Dynamic Configuration

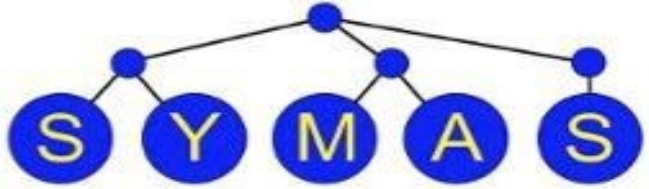
- cn=config database
  - Config engine is backward compatible with slapd.conf
  - Allows runtime changes of almost all settings
    - ACLs
    - Schema
    - Databases
    - DB indexing
    - Dynamic modules
  - Changes take effect immediately, no downtime required

# Syncrepl

- Delta-syncrepl
  - Addresses bandwidth concerns from plain syncrepl
  - Relies on a persistent log of changes
  - Ordering of log entries is fully serialized; no out of order updates
  - Automatic fallback to plain syncrepl if consumer loses sync with log

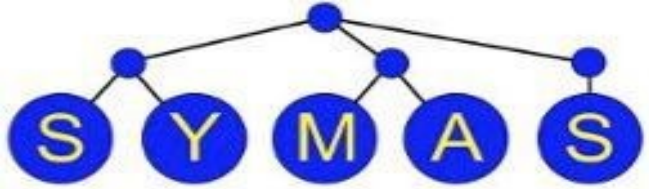
# Syncrepl...

- Push-mode syncrepl
  - Just a syncrepl consumer sitting on back-ldap
  - Can add a customization overlay for mapping the contextCSN to a suitable remote attribute, or to store the contextCSN locally
  - Provides a simple, robust, dynamically configurable replacement for slurpd



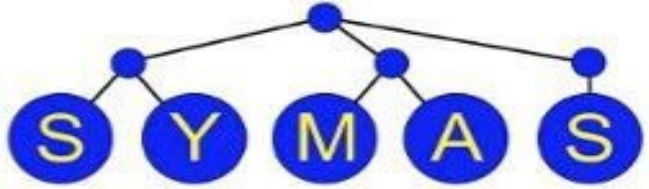

# Syncrepl...

- Mirrormode
  - Allows a single active master and many standby masters
  - Preserves single master consistency while allowing automatic promotion of alternate masters
  - Requires use of an external frontend to guarantee that writes are only sent to a single master at a time
  - Addresses the high availability/SPOF concerns with minimal fuss
  - Already in use at some Symas customer sites



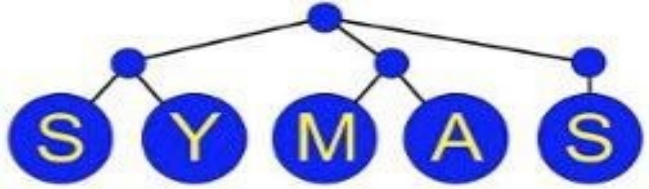

# Syncrepl...

- Full N-Way Multimaster Support
  - requires synchronized clocks for all contexts
  - requires use of hostID field of CSN
  - requires per-consumer contextCSNs in addition to (*not instead of*) provider contextCSN
  - New in OpenLDAP 2.4




# Syncrepl...

- Arbitrary topologies supported
  - any combination of partial, fractional, glued, cascaded, etc.
  - includes replication of cn=config



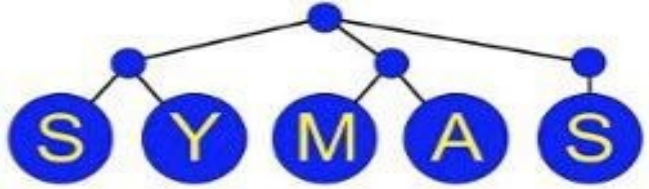

# Syncrepl Config Example

```
dn: cn=config
objectClass: olcGlobal
cn: config

dn: olcDatabase={0}config,cn=config
objectClass: olcDatabaseConfig
olcDatabase: {0}config
olcSyncRepl: rid=001 provider=$URI binddn="cn=config" bindmethod=simple
  credentials=$CONFIGPW searchbase="cn=config" type=refreshOnly
  interval=00:00:00:10
```

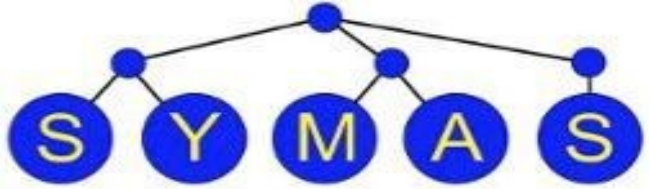
# Manageability

- ~~12~~ ~~15~~ ~~17~~ 19 overlays converted to dynamic configuration
  - only 6 converted in OL 2.3
- Full schema editing support
  - only schema adds in OL 2.3
- Full ACL support for config
  - cn=config restricted to rootDN in OL 2.3
- More extensive monitoring info
  - backend cache statistics, etc.



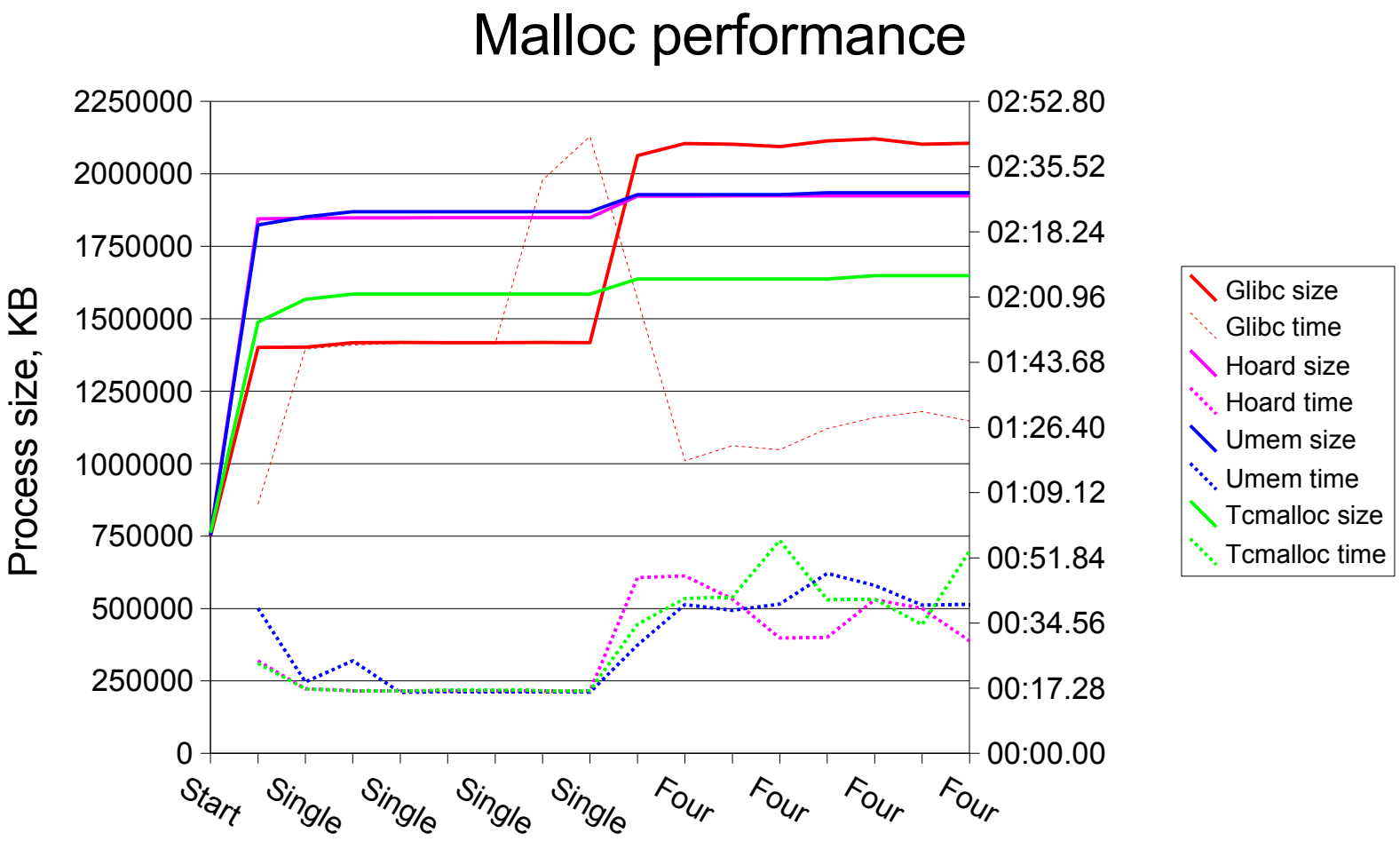

# Performance

- Fixed Lightweight Dispatcher
  - eliminated unnecessary locking in connection manager
    - slapd-auth test against back-null yielded over 32000 binds per second on 100Mbps ethernet
    - over 128000 frames per second - ~90% of available bandwidth – essentially saturated
    - No other LDAP server we tested delivers this speed on identical hardware
  - Experimental in 2.3, default in 2.4

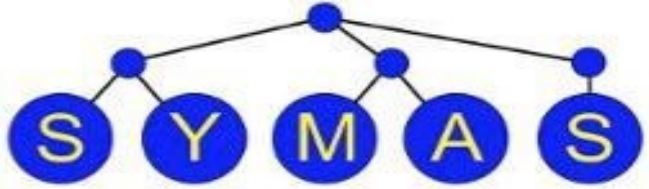



# Performance...

- libc malloc() still has a major impact
  - refactored Entry and Attribute management to further reduce number of calls to malloc
  - using a thread-oriented allocator like hoard provides further advantages



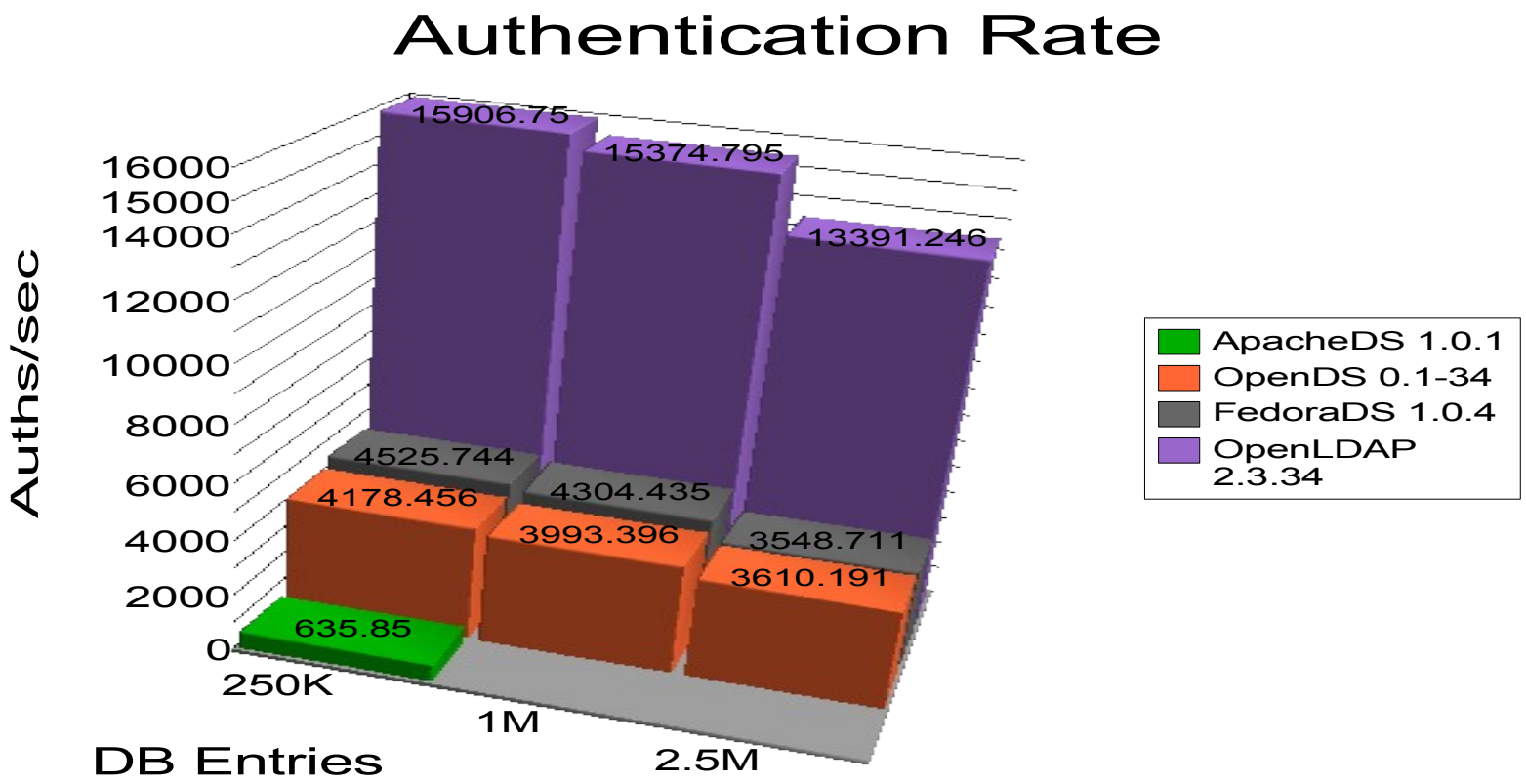

see openldap–devel August 30 2006...



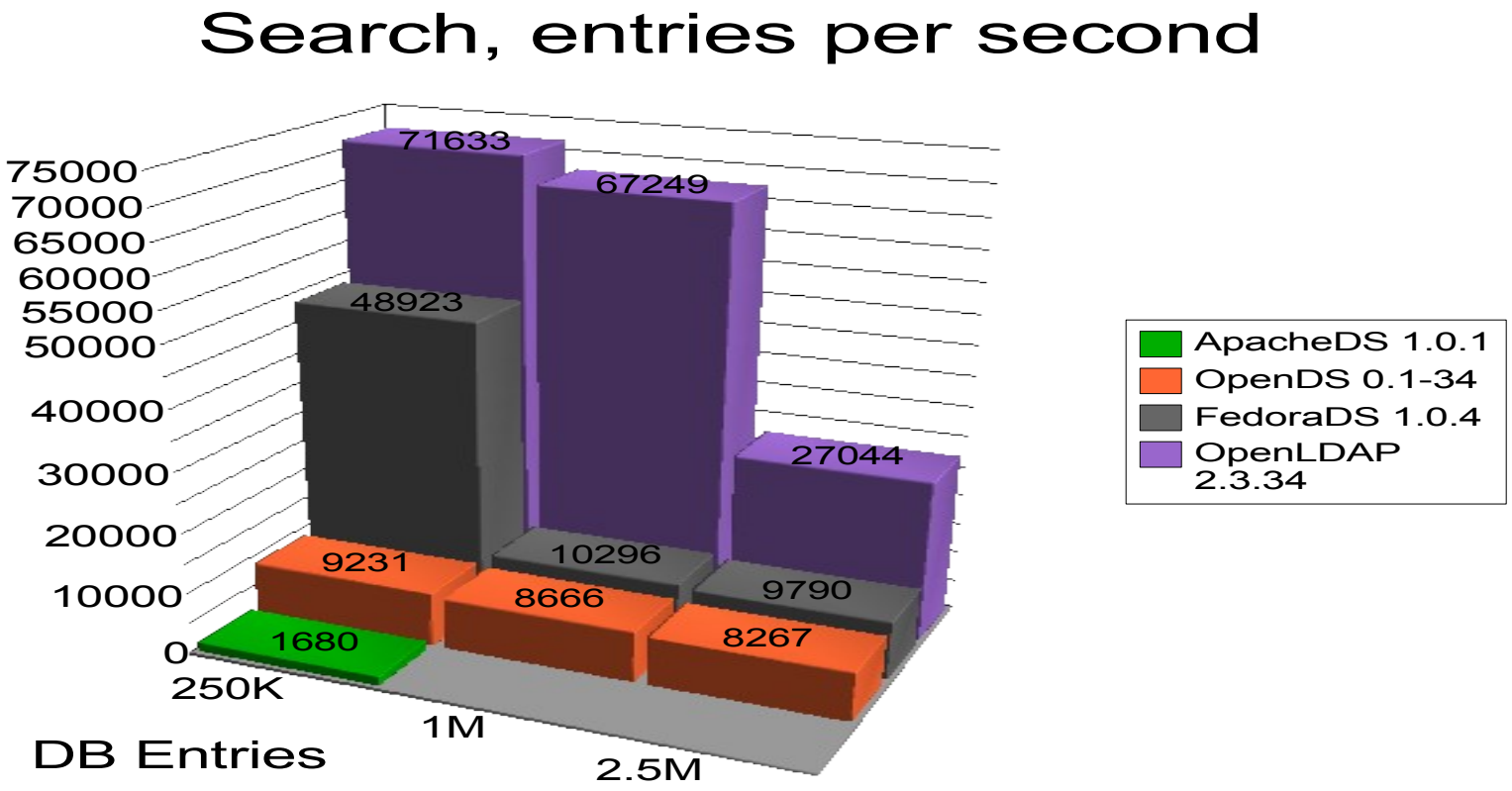

# malloc Performance

- Tested on 2.6 Linux kernel with glibc 2.3.3
- Results will obviously vary by platform
- glibc malloc does not handle tight memory conditions gracefully
- libhoard is marginally fastest
- Google tcmalloc is most space-efficient
- umem on non-Solaris appears unmaintained

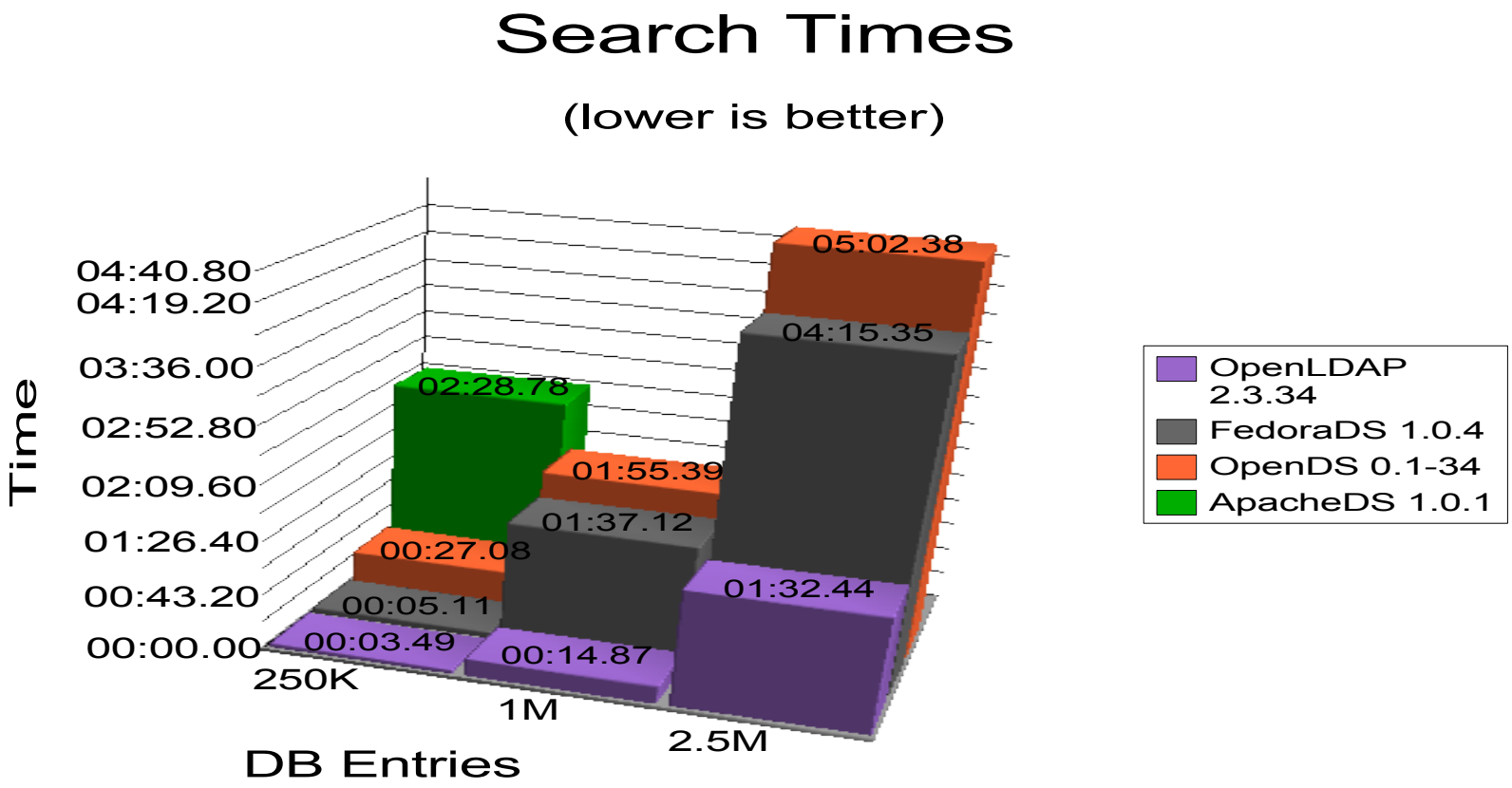
# Performance...



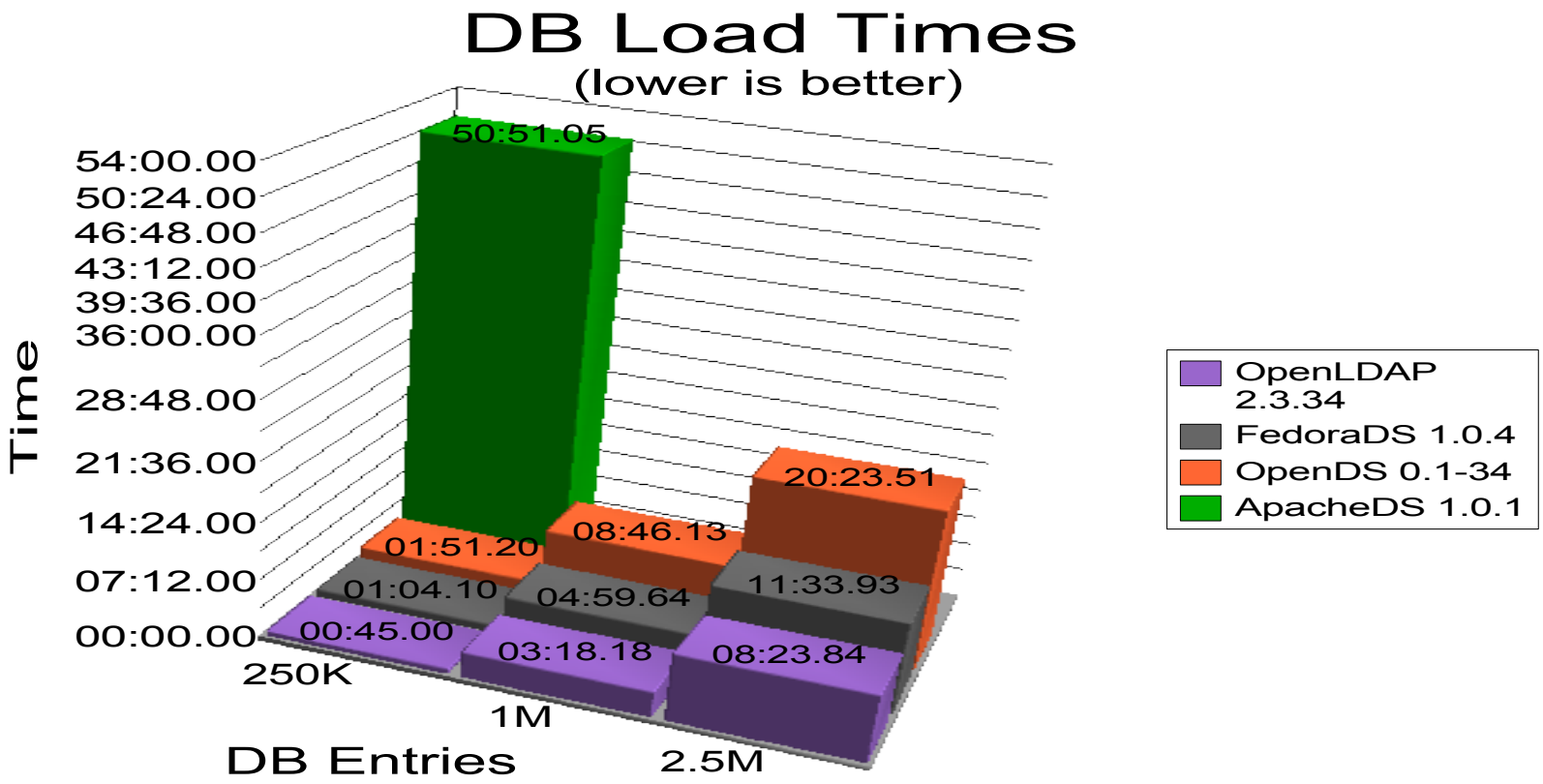
# Performance...

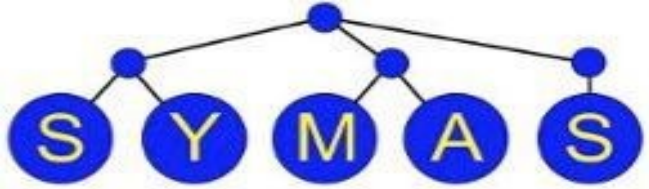


# Performance...



# Performance...






# Performance...

- benchmark details available on www.symas.com
- we may want to consider investing effort in a C-based benchmarking framework
  - existing frameworks are not credible
    - DirectoryMark in perl, fast enough to measure slow directories, not fast enough for OpenLDAP
    - SLAMD in java, same story again

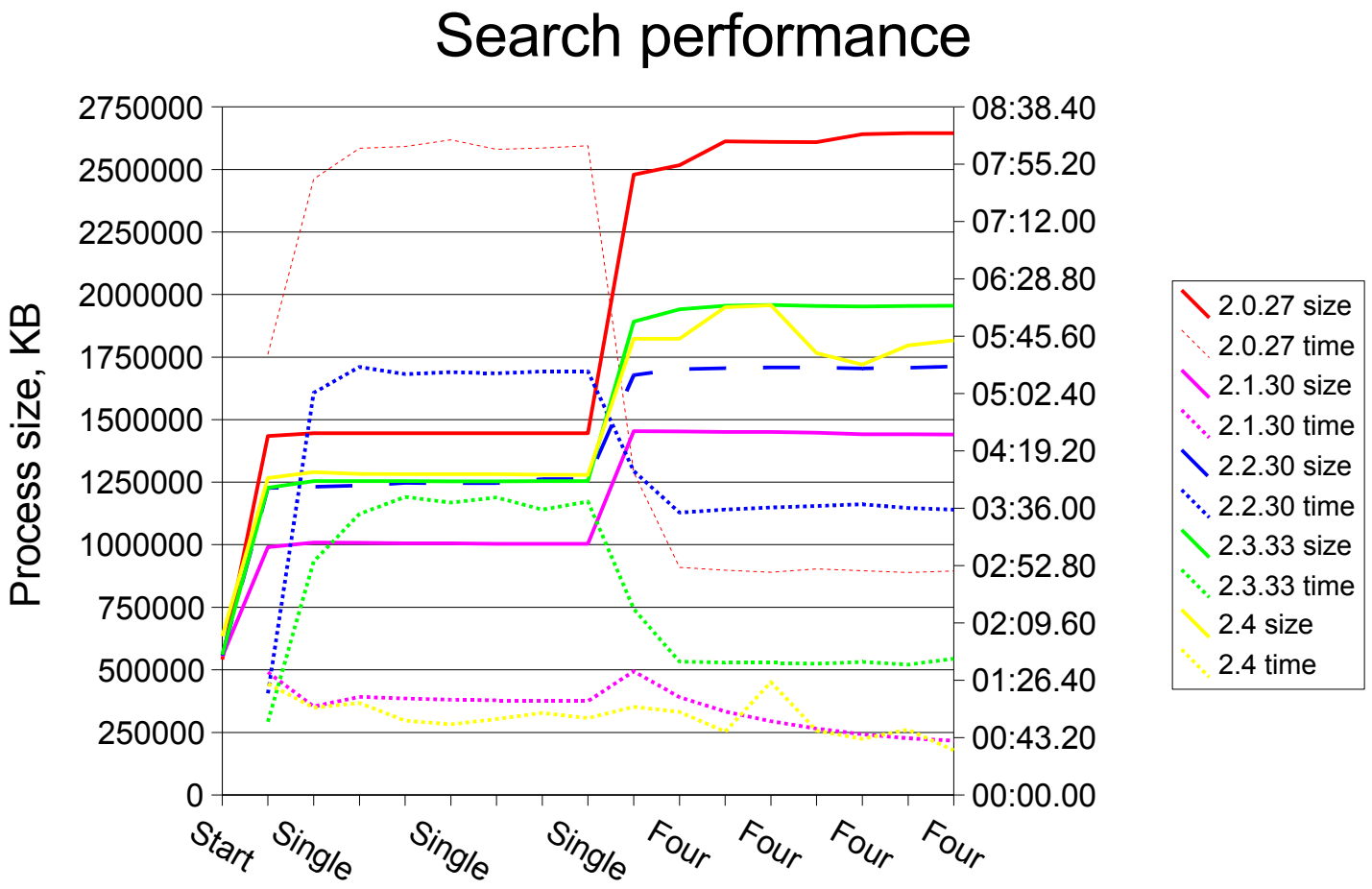
# Performance...

- Scaling to large deployments
  - Demonstrated performance at over 150 million entries
    - November 2005: 16600 queries/second, 3400 updates/second
    - April 2006: 22000 queries/second, 4800 updates/second
  - Over 1 terabyte of real data
  - Other popular directories' claims of scaling are provably false
    - Several other products were tested with the same data, all of them failed to meet the test requirements
    - Only OpenLDAP passed

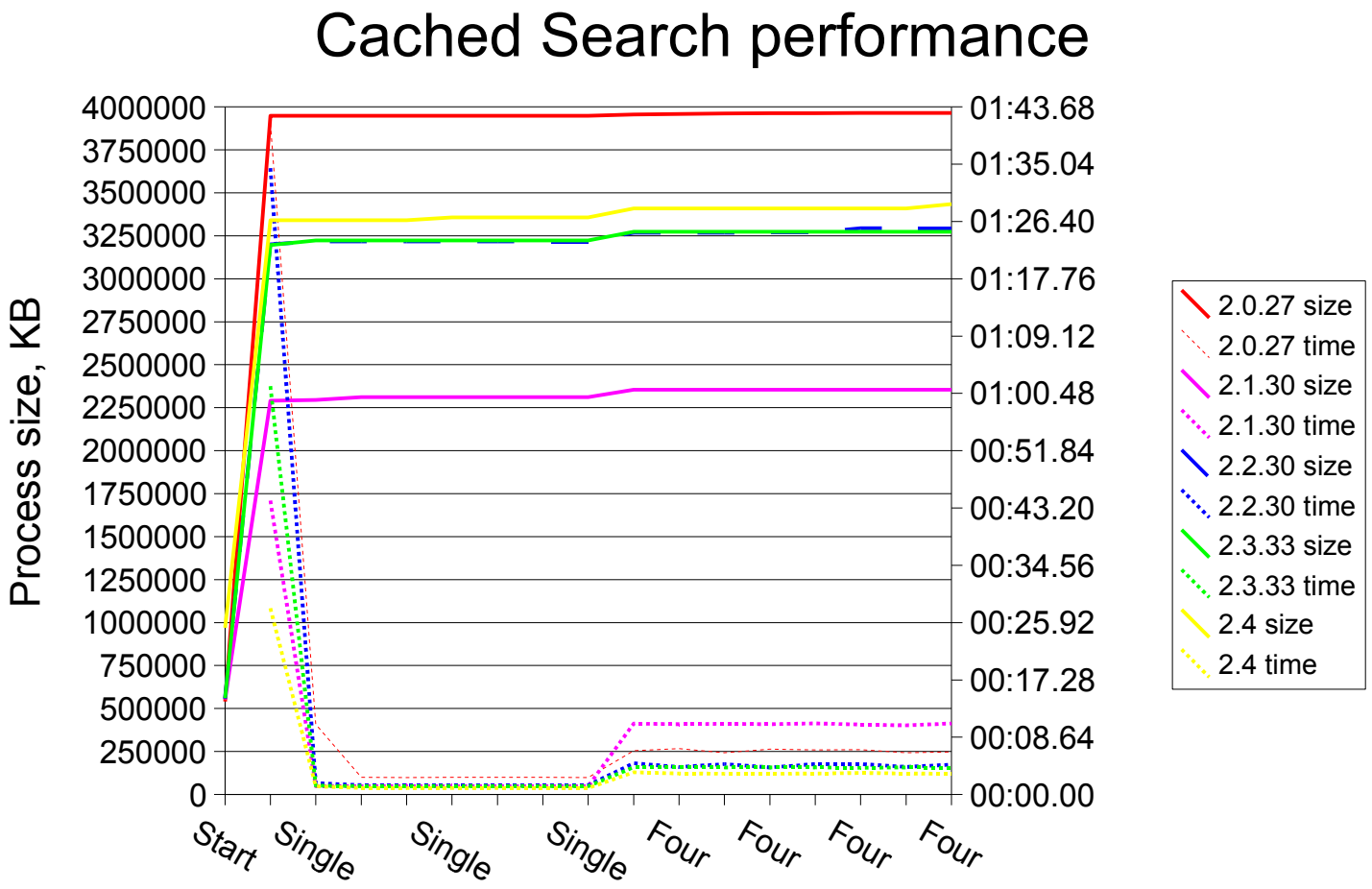
# Performance...

- Scaling to multiple CPUs
  - Single client, ldapsearch across entire 1.3GB database in 0.70 seconds
  - Two clients concurrent, ldapsearch in 0.71 seconds
  - 4 clients, 1.42 seconds
  - Practically Perfect Parallel Scaling
  - (Using AMD64 X2 dual-core processor)

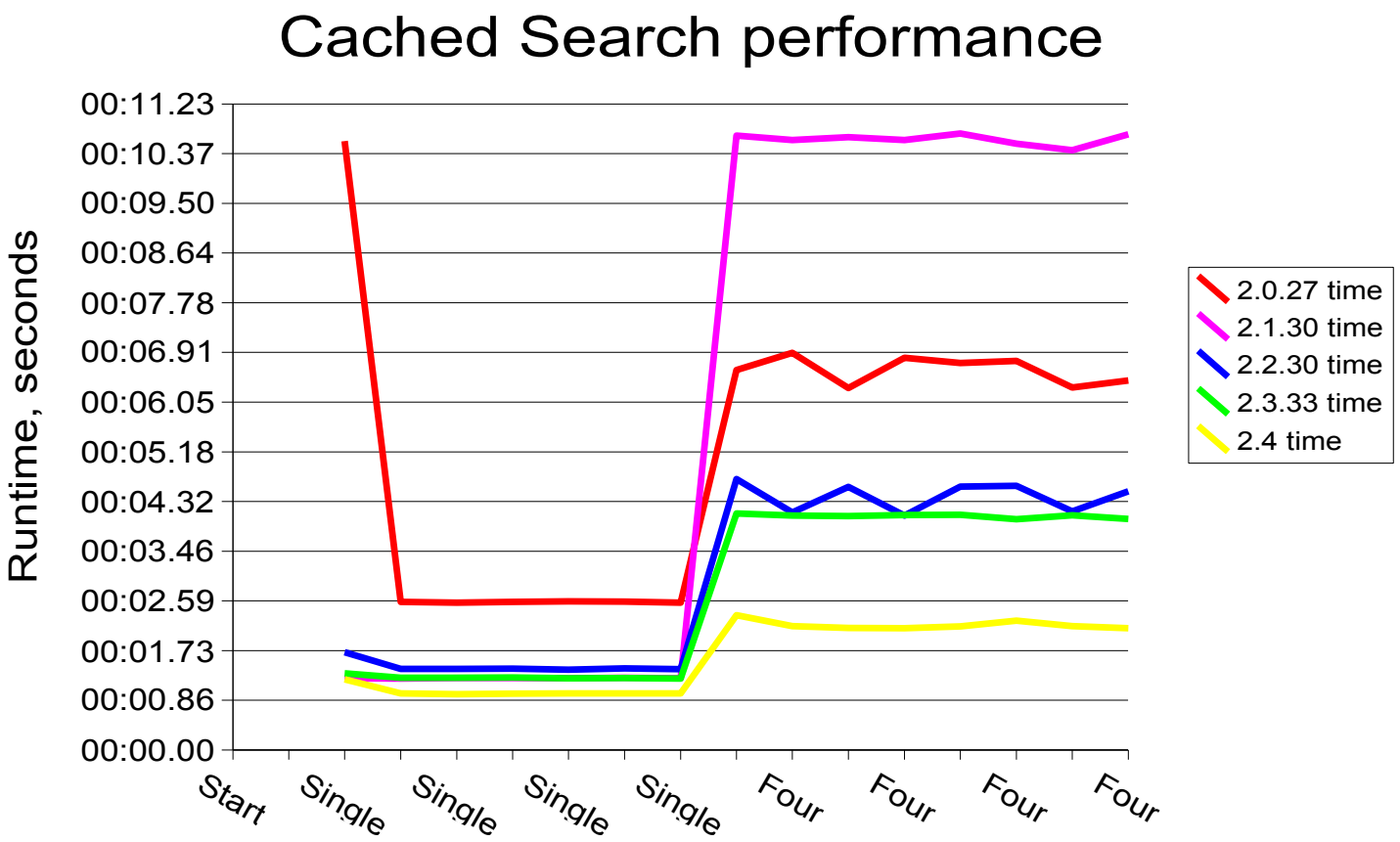
# Worst Case Search Performance



# Cached Search Performance

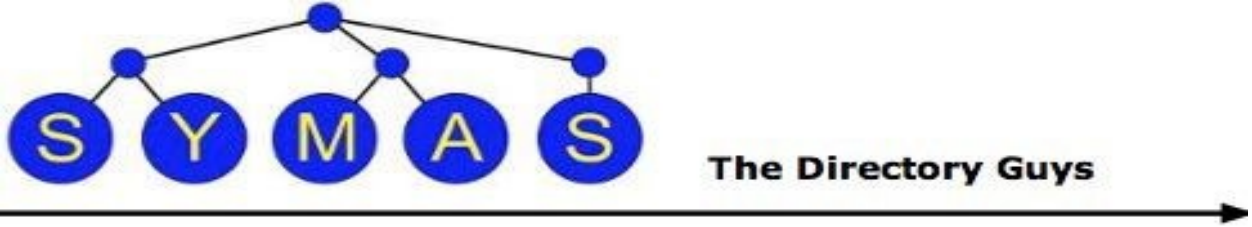


# Cached Search Performance



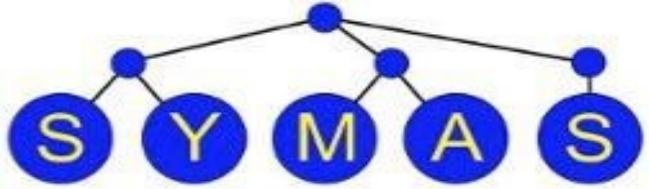
# ldapadd performance

- DB taking 2:42.64 for slapadd -q took 1:33:08.74 using ldapadd
- Optimized server and client in 2.4 bring the time down to 5:20.00
- Remaining network and encode/decode overhead unlikely to go away



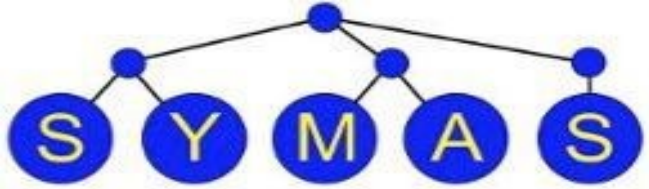

# The Road Ahead...

- Work on scale-out, vs scale-up
  - allow multi-terabyte DBs to be served without requiring a single giant server
    - page-oriented, lock-free DB to allow multiple backends to serve portions of a single shared DB
    - distributed indexing
    - cluster-friendly optimizations




# The Road Ahead...

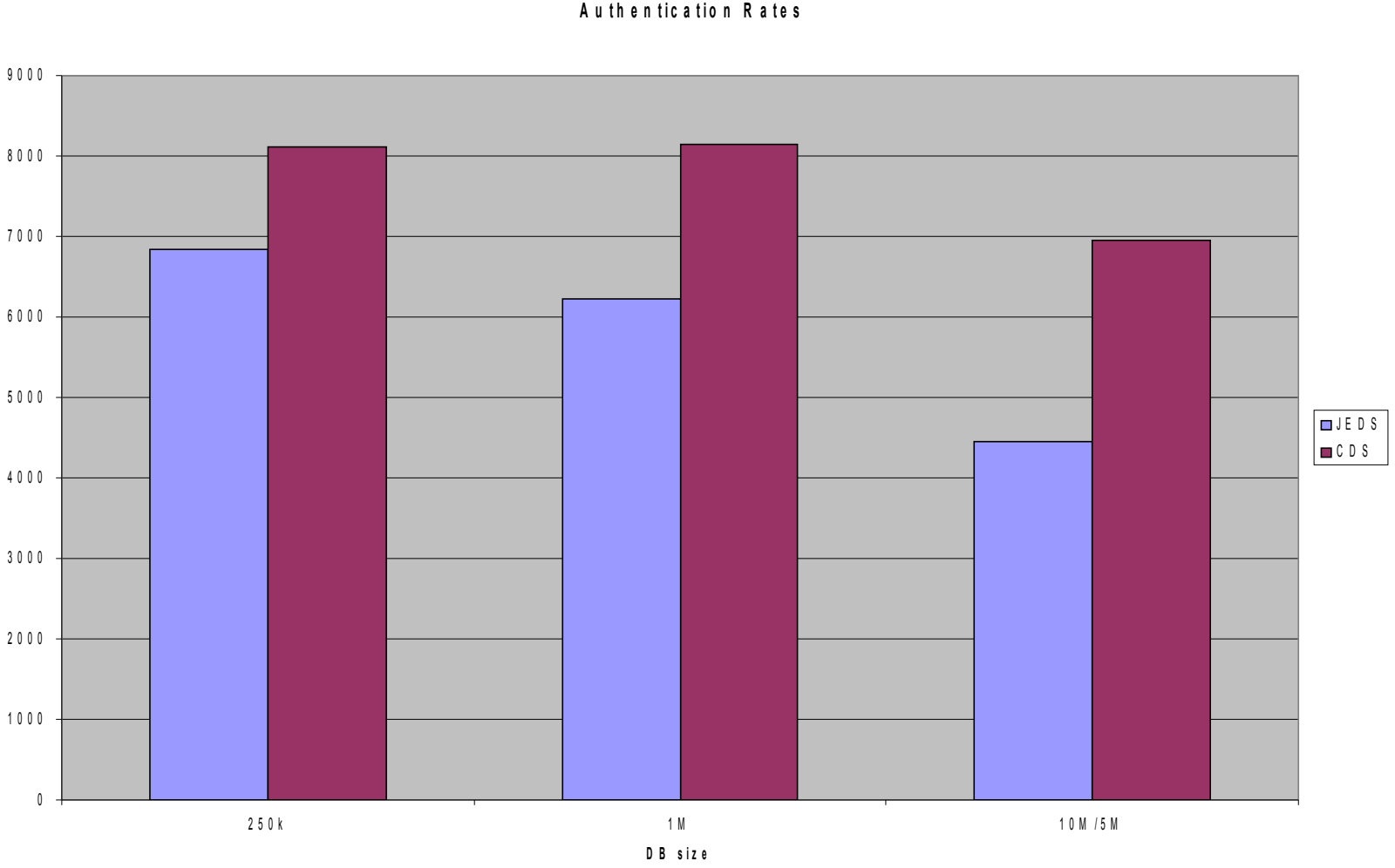
- More LDAP config functionality
  - Reduce / eliminate filesystem dependencies, so that all administration can be done without shell access
    - TLS server certs in LDAP DB instead of files
    - Dynamically loadable modules as LDAP objects
    - Automatic creation of filesystem directories for DBs




# Final Thoughts

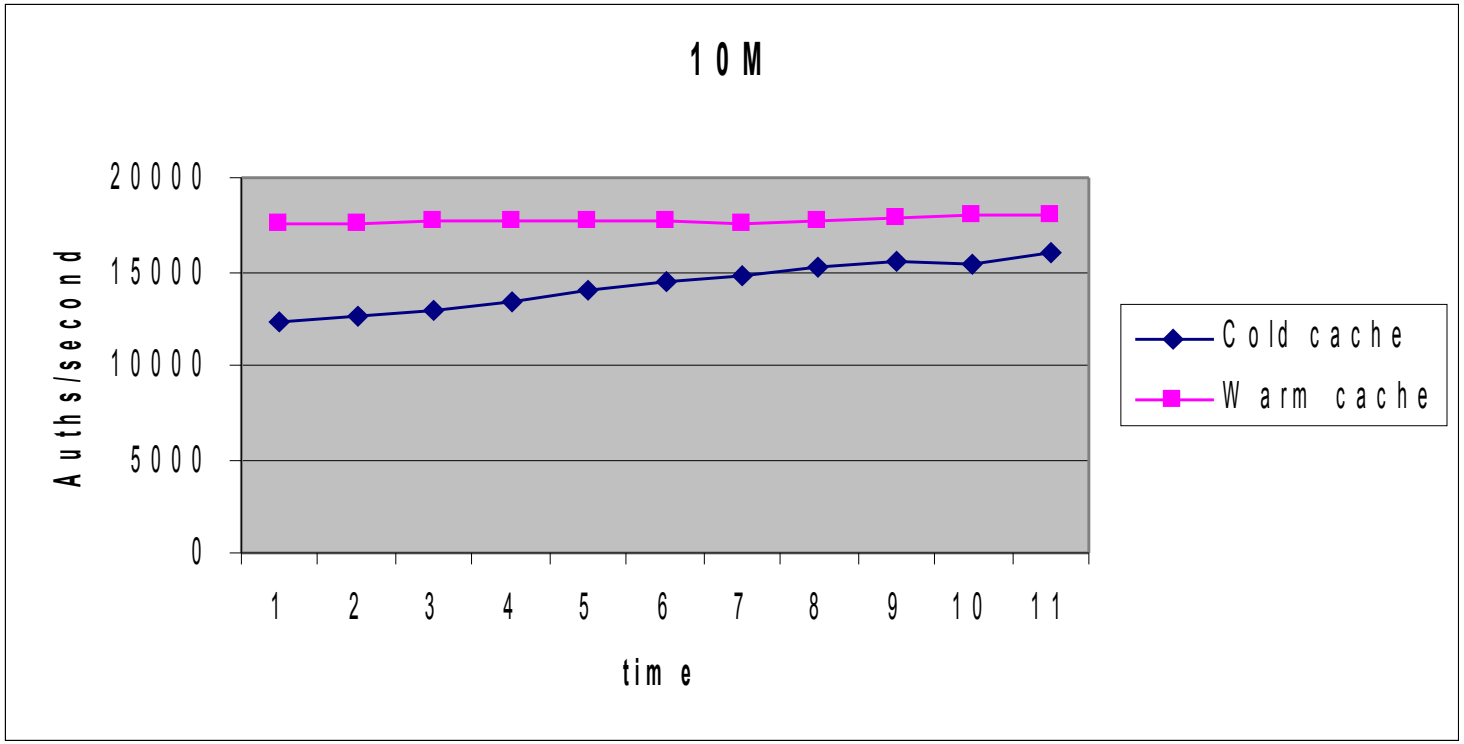
- OpenLDAP 2.4 delivers dramatic improvements while maintaining backward compatibility
- The OpenLDAP community continues to thrive
  - your thoughts, ideas, and participation are always welcome
  - when we work together everyone wins

# Authentication Performance

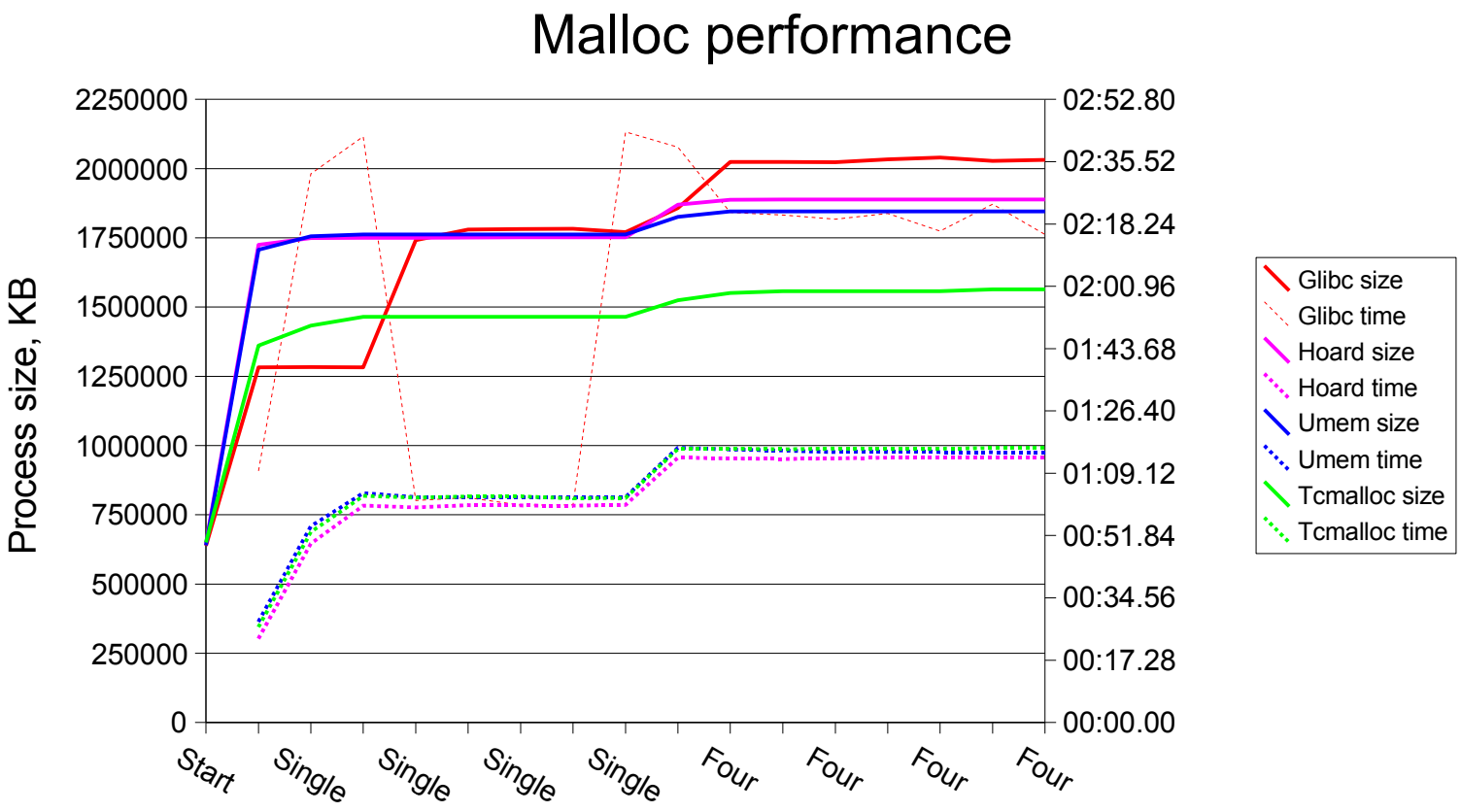


# Authentication Performance

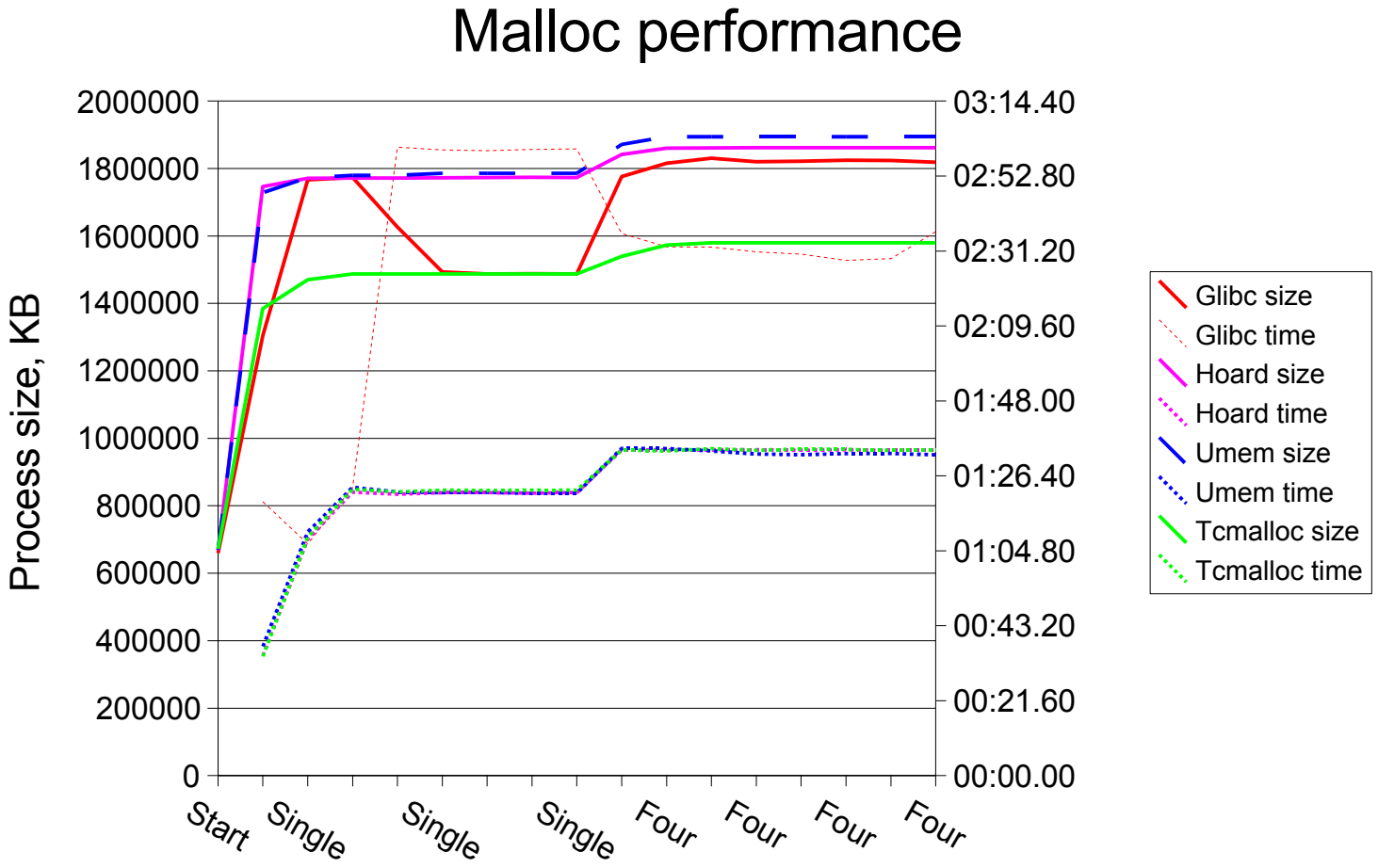
- AMD 4-processor dual-core
- 10 million entry DB



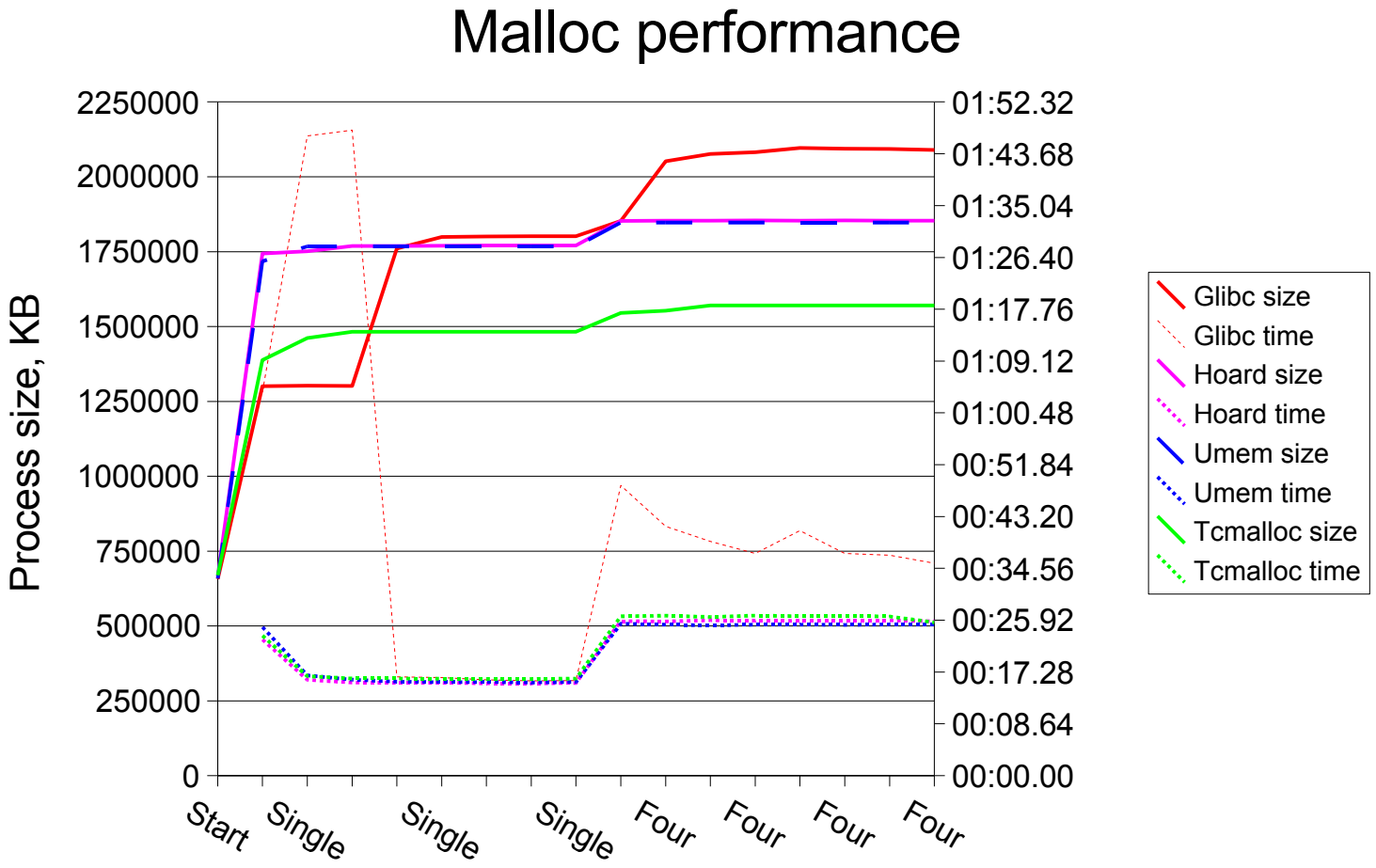
# BDB 4.2 performance



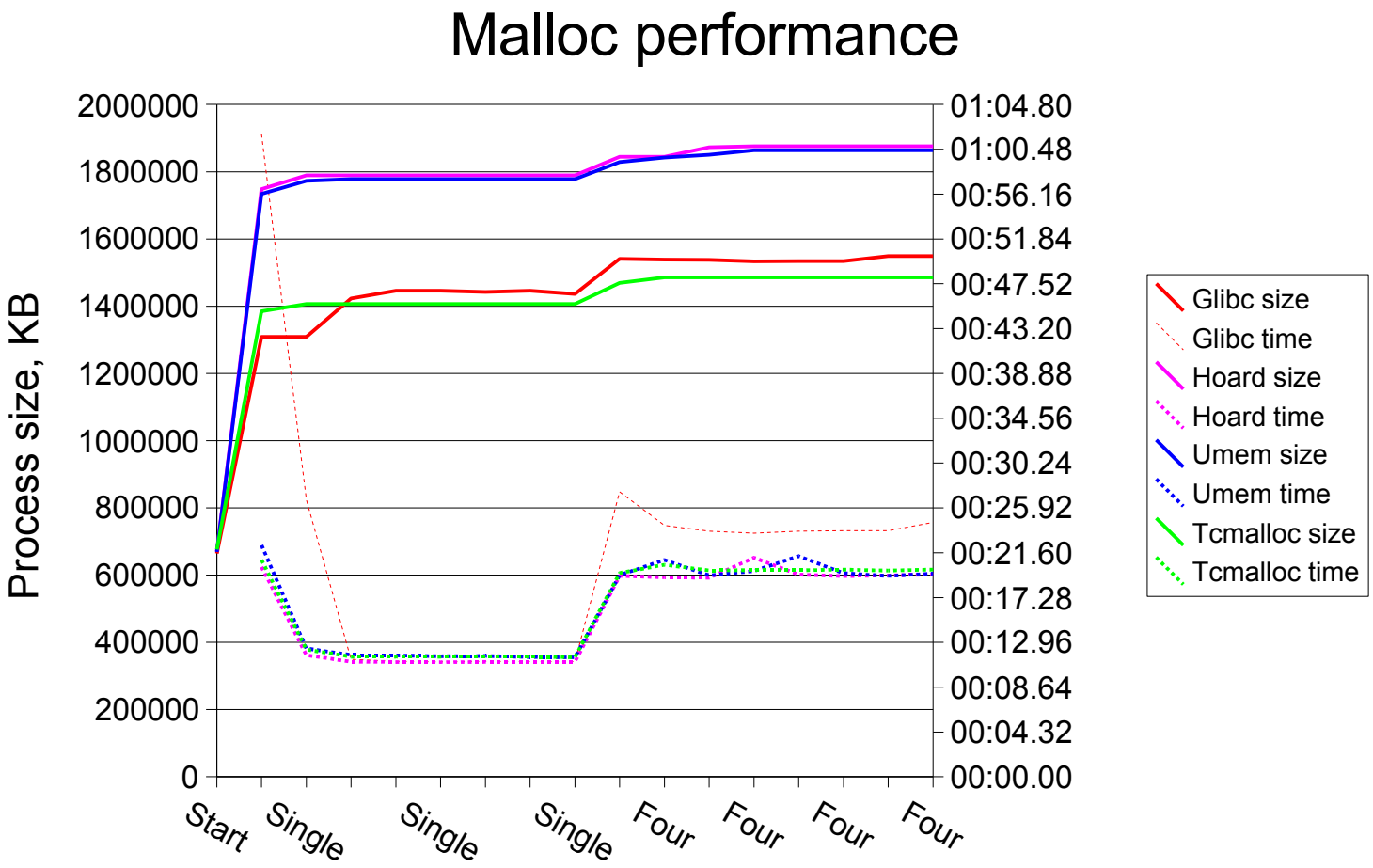
# BDB 4.5 Performance



# BDB 4.6 Performance

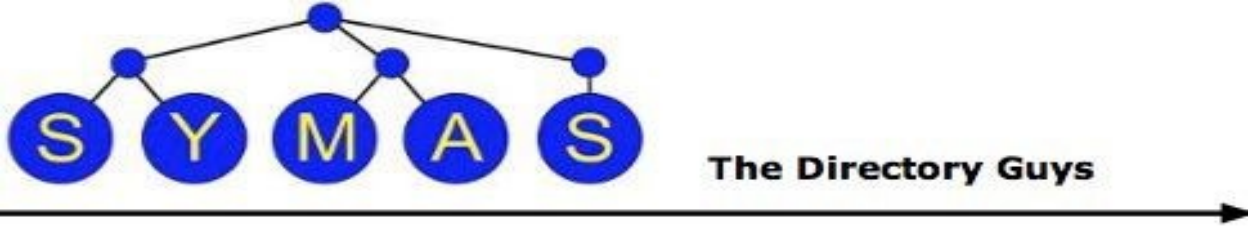


# Current Performance



# Database Parameters

- 380836 entries
  - Range in size from 3K to 10MB
- Total size on disk ~1.3GB
- Running on Socket939 2.4GHz AMD64 X2 w/512KB L2 cache per core, 4GB DDR400 ECC/REG RAM
- No disk I/O during searches
- Using 2.3 as of November 2006 unless otherwise noted

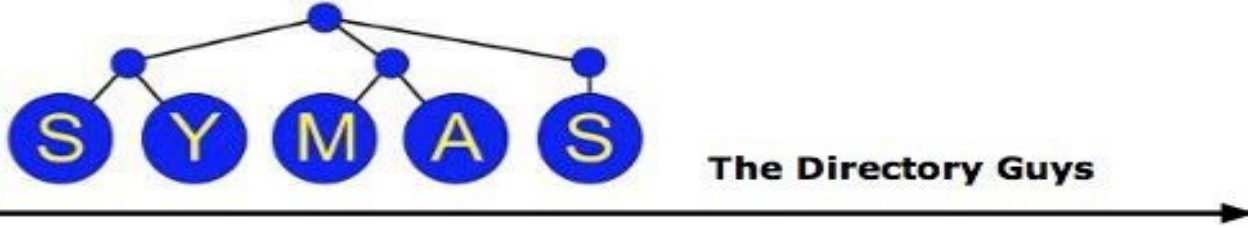



# 2.0.27 DB Parameters

```
Ldbm BDB 4.2.52 dbnosync, dbcachesize 512MB
slapadd 113.455u 8.004s 2:16.96 88.6%   0+0k 0+0io 0pf+0w
total 1281133
-rw-------  1 hyc users   88879104 2007-02-09 23:46 dn2id.dbb
-rw-------  1 hyc users 1220915200 2007-02-09 23:46 id2entry.dbb
-rw-------  1 hyc users       8192 2007-02-09 23:46 nextid.dbb
-rw-------  1 hyc users     798720 2007-02-09 23:46 objectClass.dbb
```

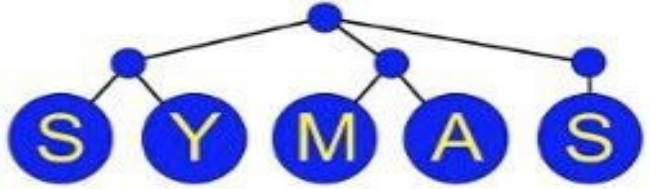
# 2.1.30 DB Parameters

```
bdb BDB 4.2.52 TXN_NOSYNC, TXN_NOT_DURABLE
slapadd 162.582u 8.300s 3:04.30 92.7%   0+0k 0+0io 7189pf+0w
total 850295
-rw-------  1 hyc users     16384 2007-02-10 04:35 __db.001
-rw-------  1 hyc users 536870912 2007-02-10 04:35 __db.002
-rw-------  1 hyc users   2359296 2007-02-10 04:35 __db.003
-rw-------  1 hyc users    663552 2007-02-10 04:35 __db.004
-rw-------  1 hyc users     16384 2007-02-10 04:35 __db.005
-rw-r--r--  1 hyc users       177 2007-02-10 01:30 DB_CONFIG
-rw-------  1 hyc users  79978496 2007-02-10 04:38 dn2id.bdb
-rw-------  1 hyc users 782745600 2007-02-10 04:38 id2entry.bdb
-rw-------  1 hyc users        28 2007-02-10 04:35 log.0000000001
-rw-------  1 hyc users   6553600 2007-02-10 04:38 objectClass.bdb
```




# 2.2.30 DB Parameters

```
bdb BDB 4.2.52 TXN_NOSYNC, TXN_NOT_DURABLE
slapadd 284.789u 10.836s 5:04.65 97.0%  0+0k 0+0io 7136pf+0w
total 1869554
-rw-------  1 hyc users      16384 2007-02-10 02:42 __db.001
-rw-------  1 hyc users  536870912 2007-02-10 02:42 __db.002
-rw-------  1 hyc users    2359296 2007-02-10 02:42 __db.003
-rw-------  1 hyc users     663552 2007-02-10 02:42 __db.004
-rw-------  1 hyc users      32768 2007-02-10 02:42 __db.005
-rw-r--r--  1 hyc users        177 2007-02-10 01:30 DB_CONFIG
-rw-------  1 hyc users   79978496 2007-02-10 02:47 dn2id.bdb
-rw-------  1 hyc users 1288781824 2007-02-10 02:47 id2entry.bdb
-rw-------  1 hyc users         28 2007-02-10 02:47 log.0000000001
-rw-------  1 hyc users    6549504 2007-02-10 02:47 objectClass.bdb
```




# 2.3.33 DB Parameters

```
bdb BDB 4.2.52 TXN_NOSYNC, TXN_NOT_DURABLE
slapadd 118.447u 9.256s 2:17.26 93.0%   0+0k 0+0io 7126pf+0w
total 1344299
-rw-r--r--  1 hyc users       2048 2007-02-10 04:42 alock
-rw-------  1 hyc users      16384 2007-02-10 04:40 __db.001
-rw-------  1 hyc users  536870912 2007-02-10 04:40 __db.002
-rw-r--r--  1 hyc users        177 2007-02-10 01:30 DB_CONFIG
-rw-------  1 hyc users   79978496 2007-02-10 04:42 dn2id.bdb
-rw-------  1 hyc users 1288142848 2007-02-10 04:42 id2entry.bdb
-rw-------  1 hyc users    6549504 2007-02-10 04:42 objectClass.bdb
```

# 2.4 DB Parameters

```
bdb BDB 4.2.52 TXN_NOSYNC, TXN_NOT_DURABLE
slapadd 138.416u 10.060s 2:39.27 93.2%  0+0k 0+0io 7127pf+0w
total 1348137
-rw-r--r--  1 hyc users       2048 2007-02-10 05:39 alock
-rw-------  1 hyc users      16384 2007-02-10 05:39 __db.001
-rw-------  1 hyc users  536870912 2007-02-10 05:39 __db.002
-rw-------  1 hyc users    2359296 2007-02-10 05:39 __db.003
-rw-------  1 hyc users     663552 2007-02-10 05:39 __db.004
-rw-------  1 hyc users      32768 2007-02-10 05:39 __db.005
-rw-r--r--  1 hyc users        177 2007-02-10 01:30 DB_CONFIG
-rw-------  1 hyc users   79978496 2007-02-10 05:38 dn2id.bdb
-rw-------  1 hyc users 1292042240 2007-02-10 05:38 id2entry.bdb
-rw-------  1 hyc users    6549504 2007-02-10 05:38 objectClass.bdb
```