

OpenLDAP

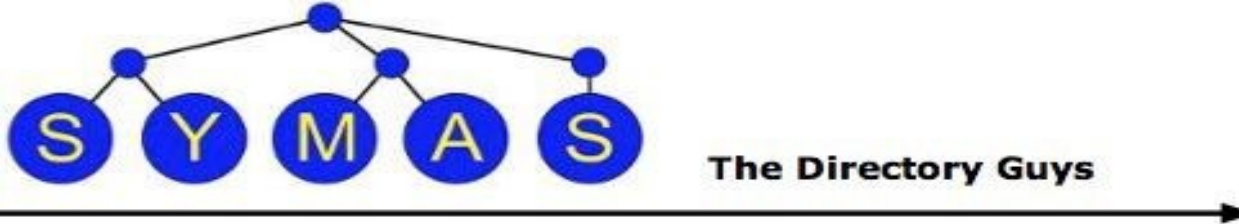
Highlights for 2.4

Howard Chu, hyc@symas.com

Chief Architect, Symas Corp

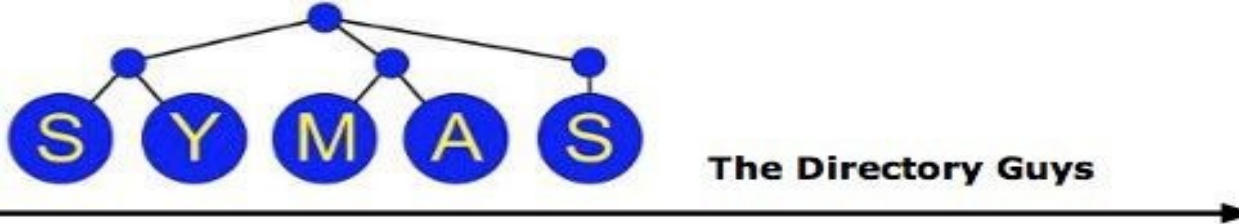
Chief Architect, OpenLDAP Project

Usenix LISA 2007-11-16



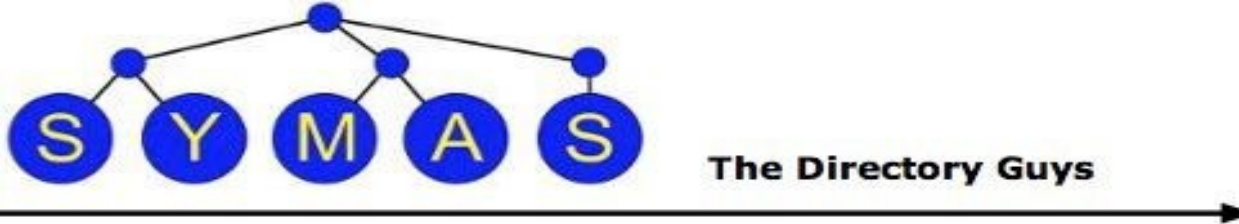
OpenLDAP Project

- 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



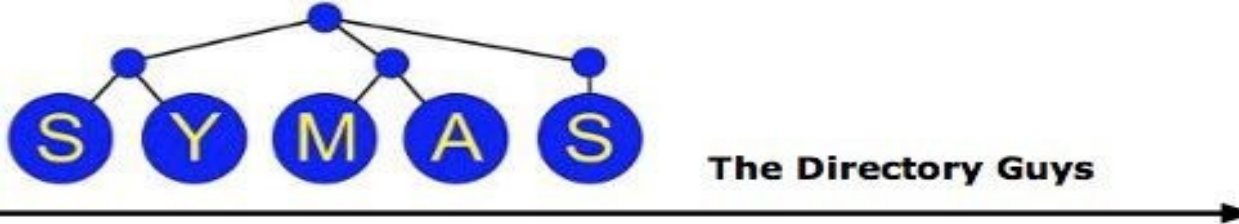
OpenLDAP Releases

- 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



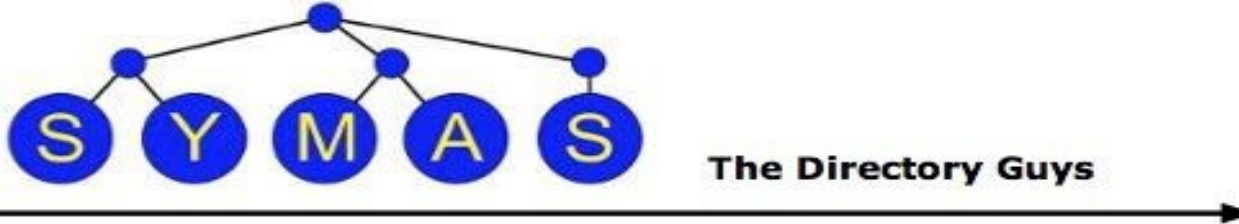
OpenLDAP Releases, cont'd

- 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



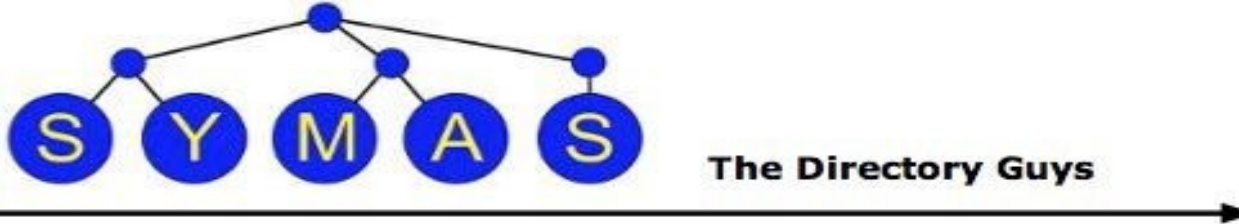
OpenLDAP Releases, cont'd

- Release 2.4 now – ongoing (2.4.6 2007/10/31)
 - More functionality
 - More overlays
 - Multimaster syncrepl
 - More manageability
 - Further dynamic config work
 - More monitoring/tuning info



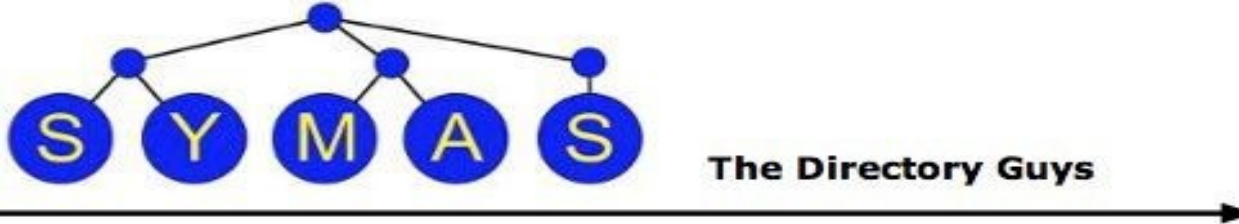
OpenLDAP Releases, cont'd

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



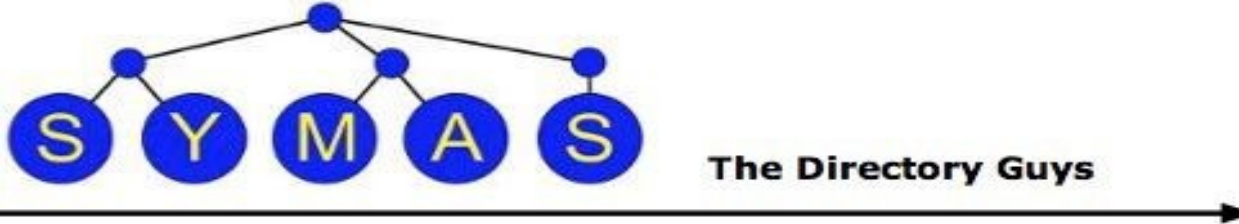
A Word About Symas

- 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



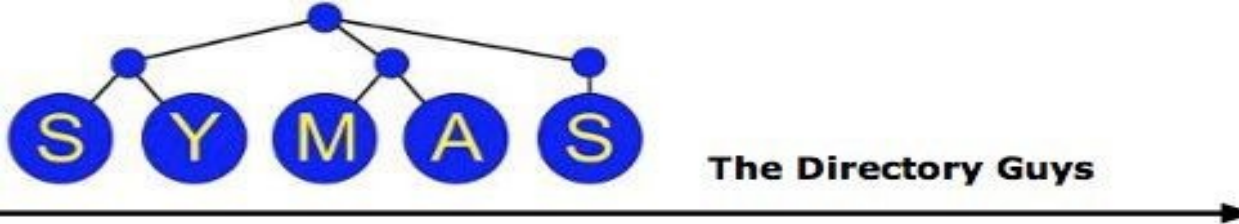
Notable Features

- 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)



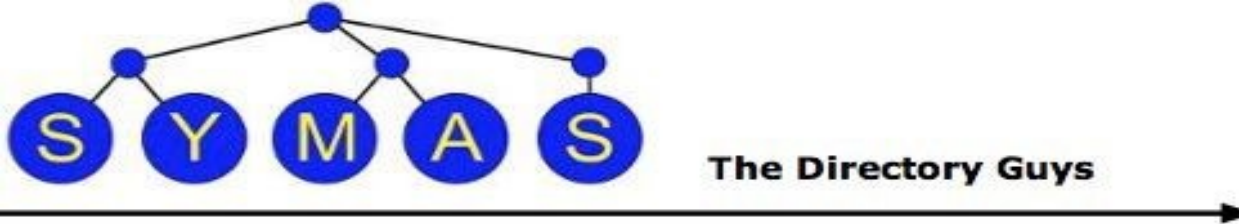
back-bdb

- 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



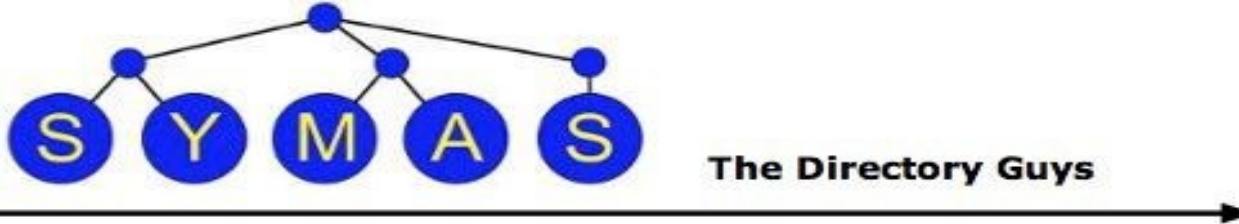
back-hdb

- 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 reliability



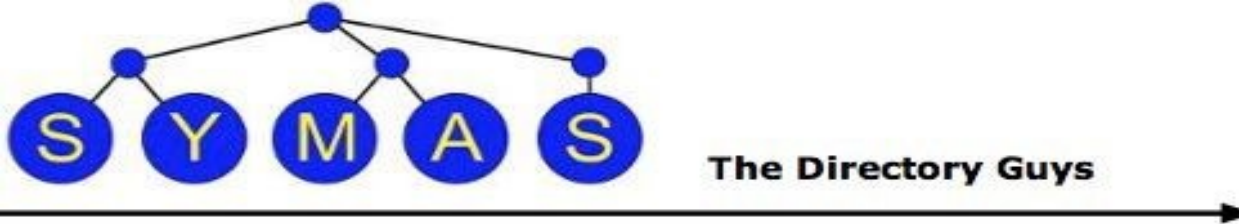
syncrepl

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



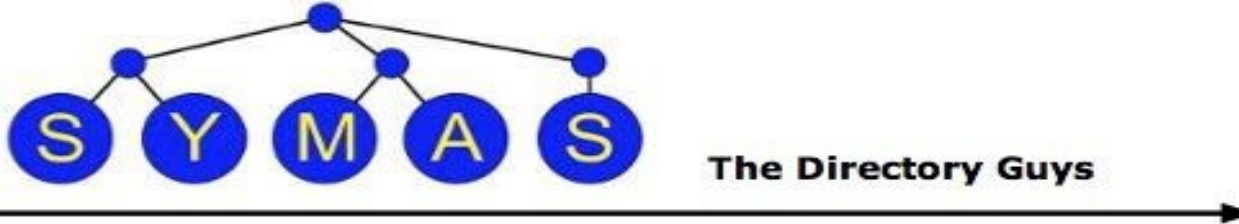
Slapd overlays

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



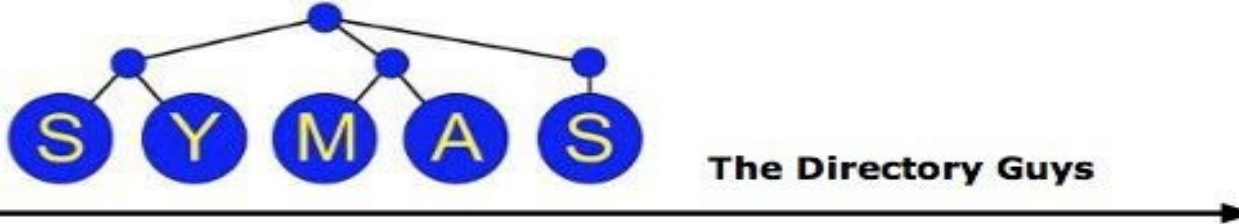
Overlay Examples

- Enterprise-oriented features
 - In-directory password policy
 - Referential integrity
 - Translucency
 - Attribute uniqueness
 - Value sorting
 - In-directory logging
- Plus many user-contributed overlays
 - 11 in 2.4 contrib tree



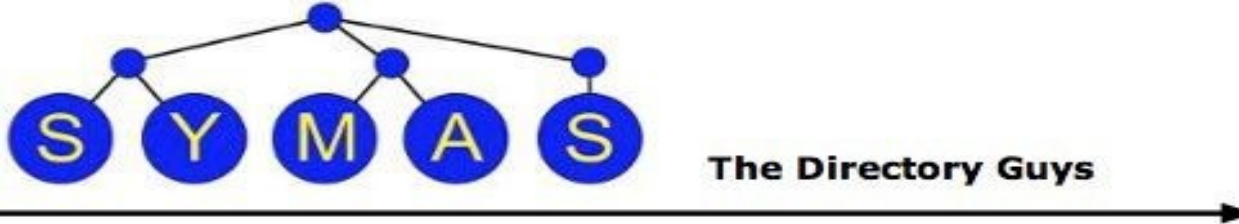
Dynamic Configuration

- 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



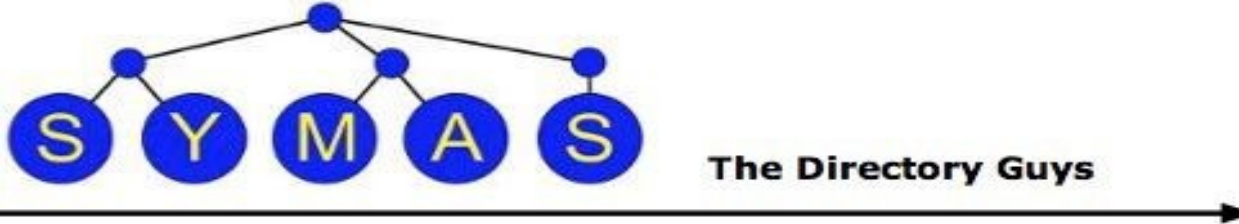
Syncrepl

- 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



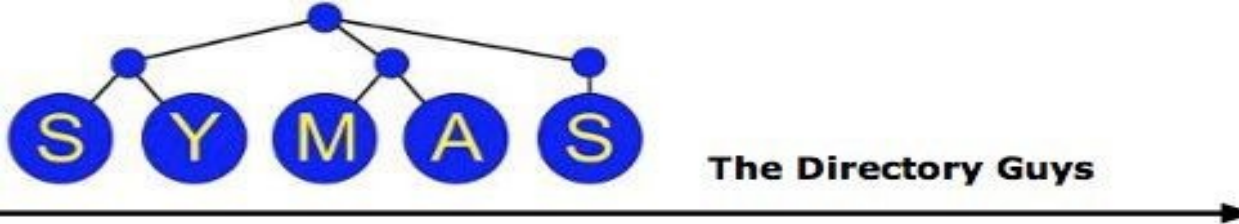
Syncrepl...

- 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



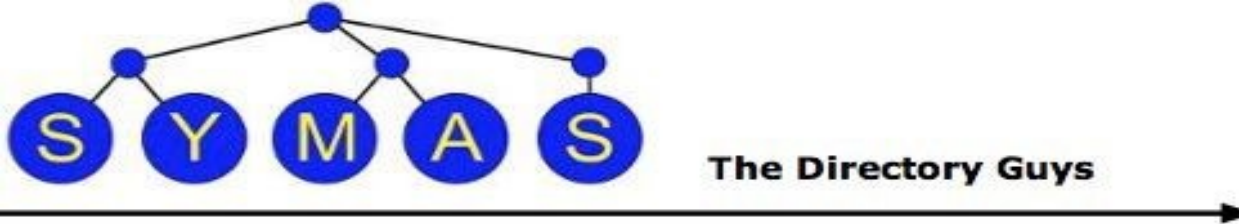
Syncrepl...

- 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



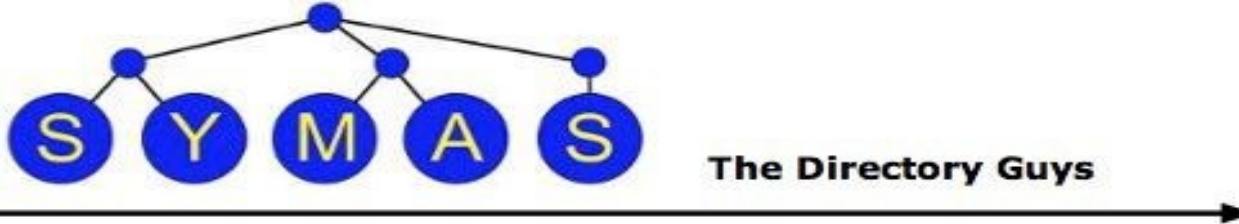
Syncrpl...

- 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



Syncrpl Config Example

```
dn: cn=config
```

```
objectClass: olcGlobal
```

```
cn: config
```

```
dn: olcDatabase={0}config,cn=config
```

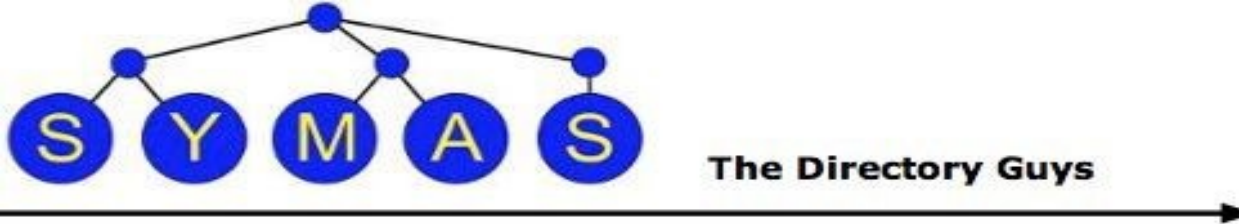
```
objectClass: olcDatabaseConfig
```

```
olcDatabase: {0}config
```

```
olcSyncRepl: rid=001 provider=$URI binddn="cn=config" bindmethod=simple
```

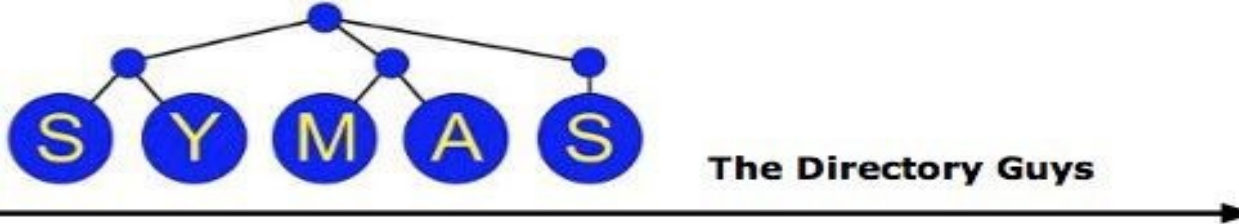
```
credentials=$CONFIGPW searchbase="cn=config" type=refreshOnly
```

```
interval=00:00:00:10
```



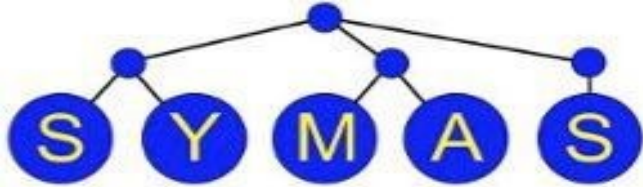
Manageability

- ~~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

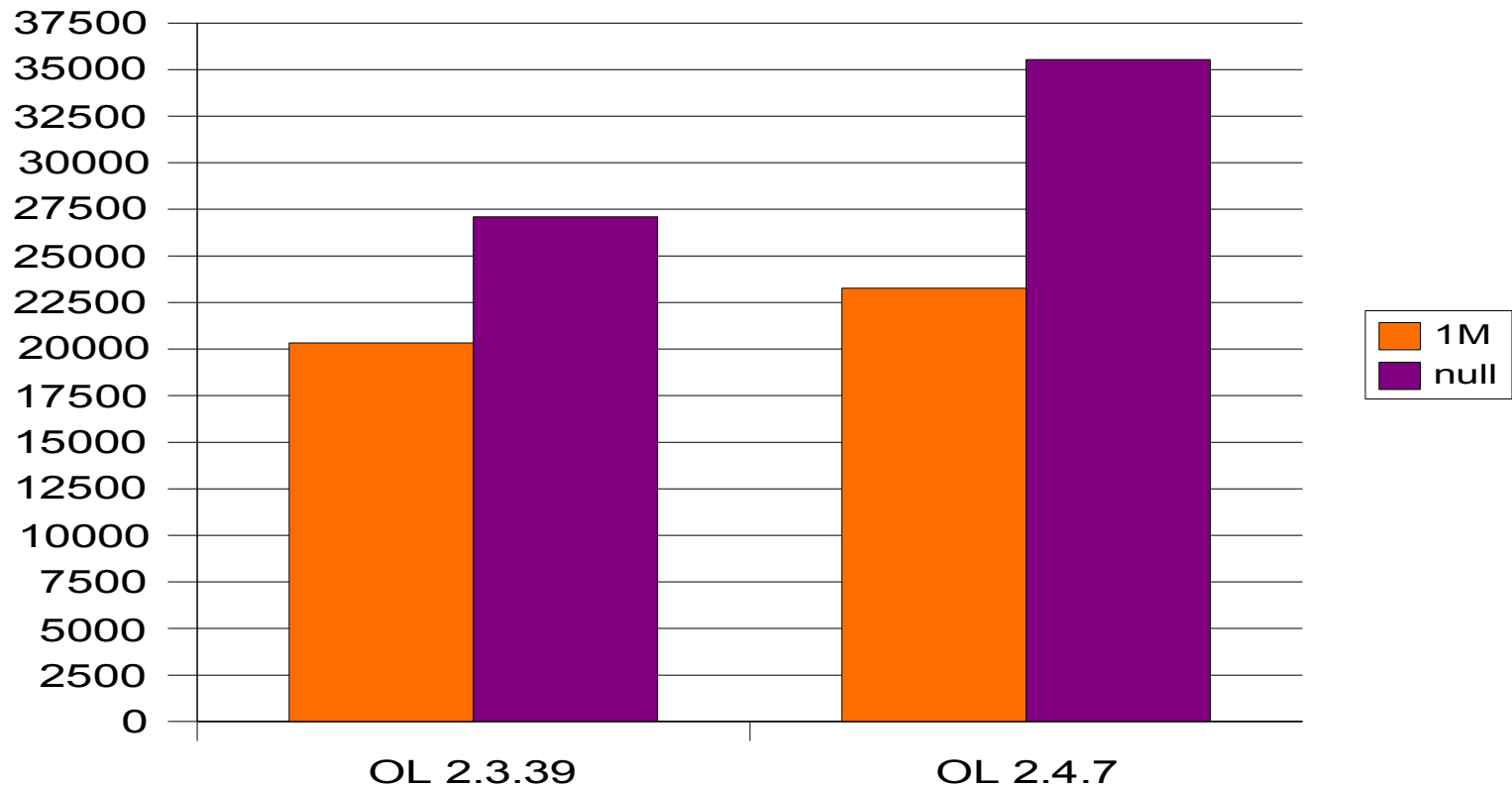
- Fixed Lightweight Dispatcher
 - eliminated unnecessary locking in connection manager
 - slapd-auth test against back-null yielded over 32000 binds per second on 100Mbps ethernet
 - over 128000 frames per second - ~90% of available bandwidth – essentially saturated
 - No other LDAP server we tested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

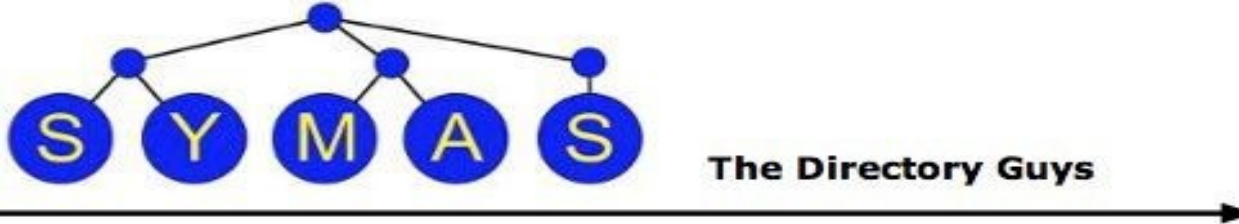


The Directory Guys

Performance

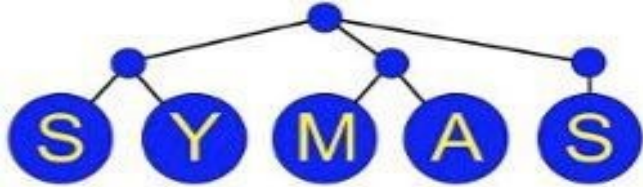
Auth Rates





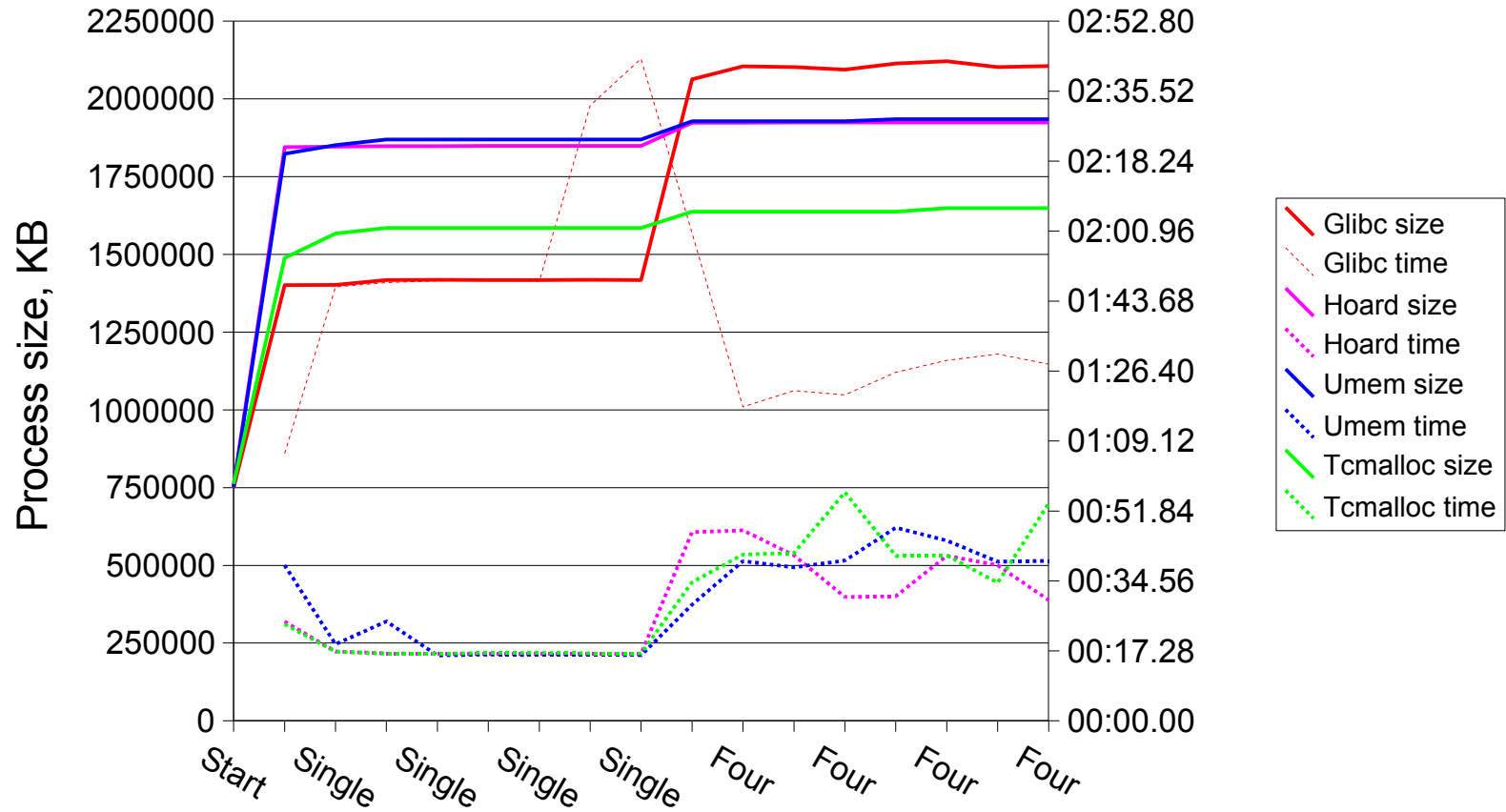
Performance...

- 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

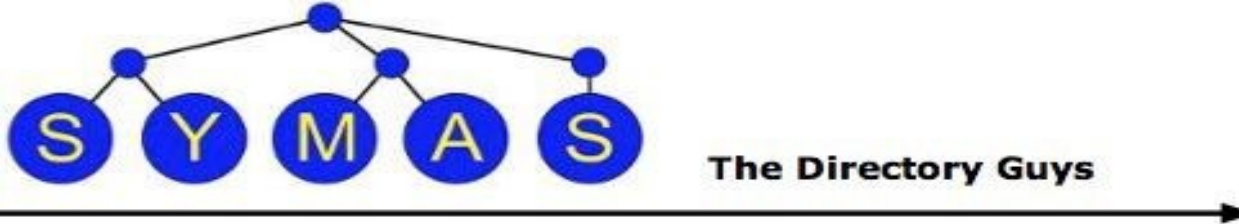


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Malloc performance

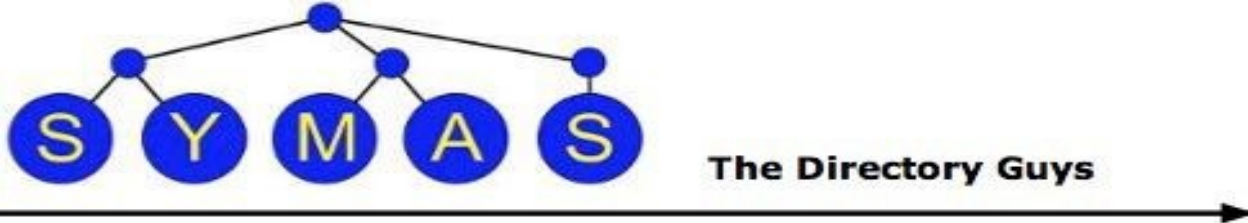


see [openldap-devel](#) August 30 2006...



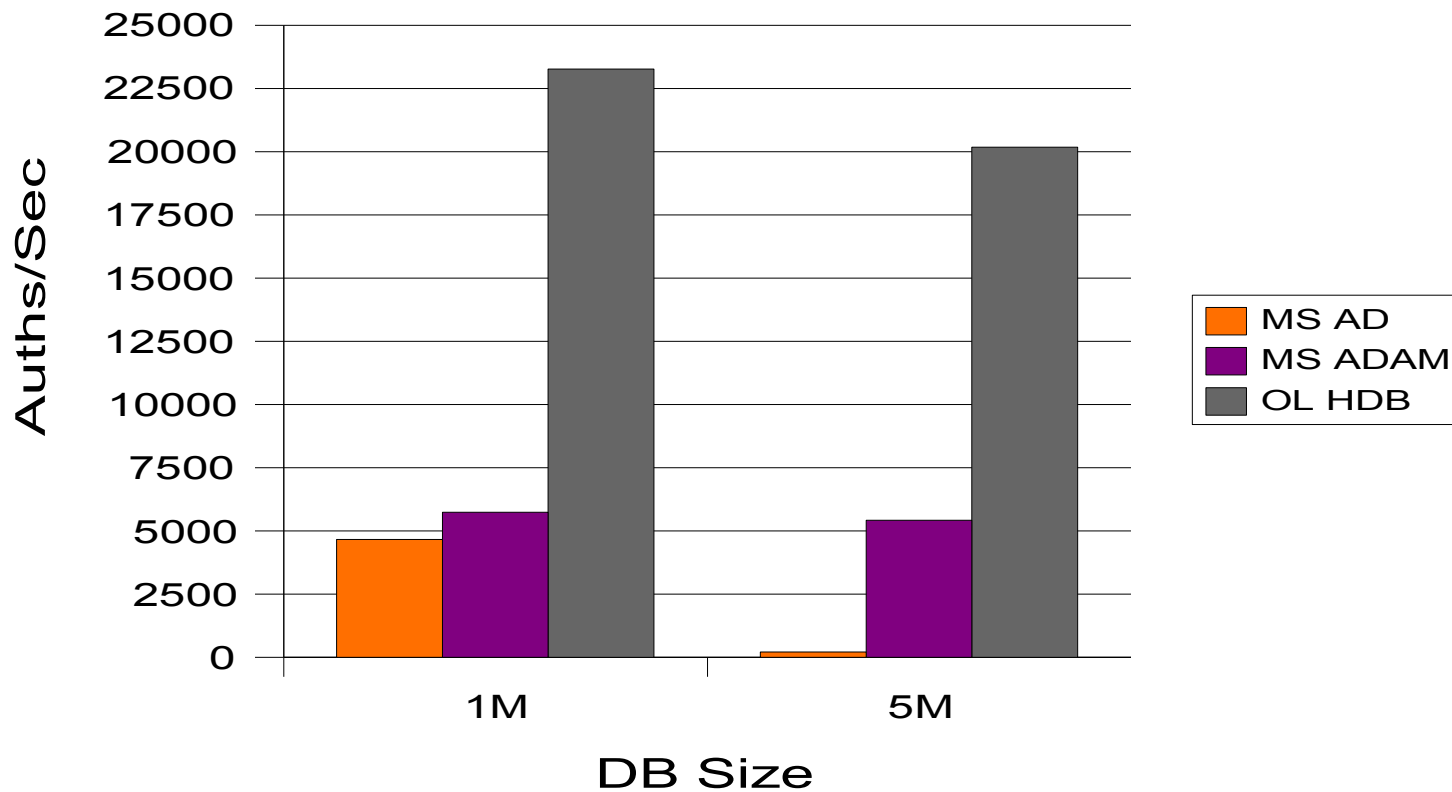
malloc Performance

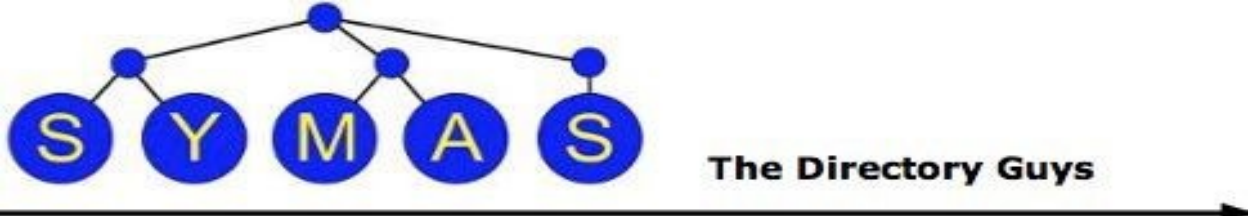
- Tested on 2.6 Linux kernel with glibc 2.3.3
- Results will obviously vary by platform
- glibc malloc does not handle tight memory conditions gracefully
- libhoard is marginally fastest
- Google tcmalloc is most space-efficient
- umem on non-Solaris appears unmaintained



Performance

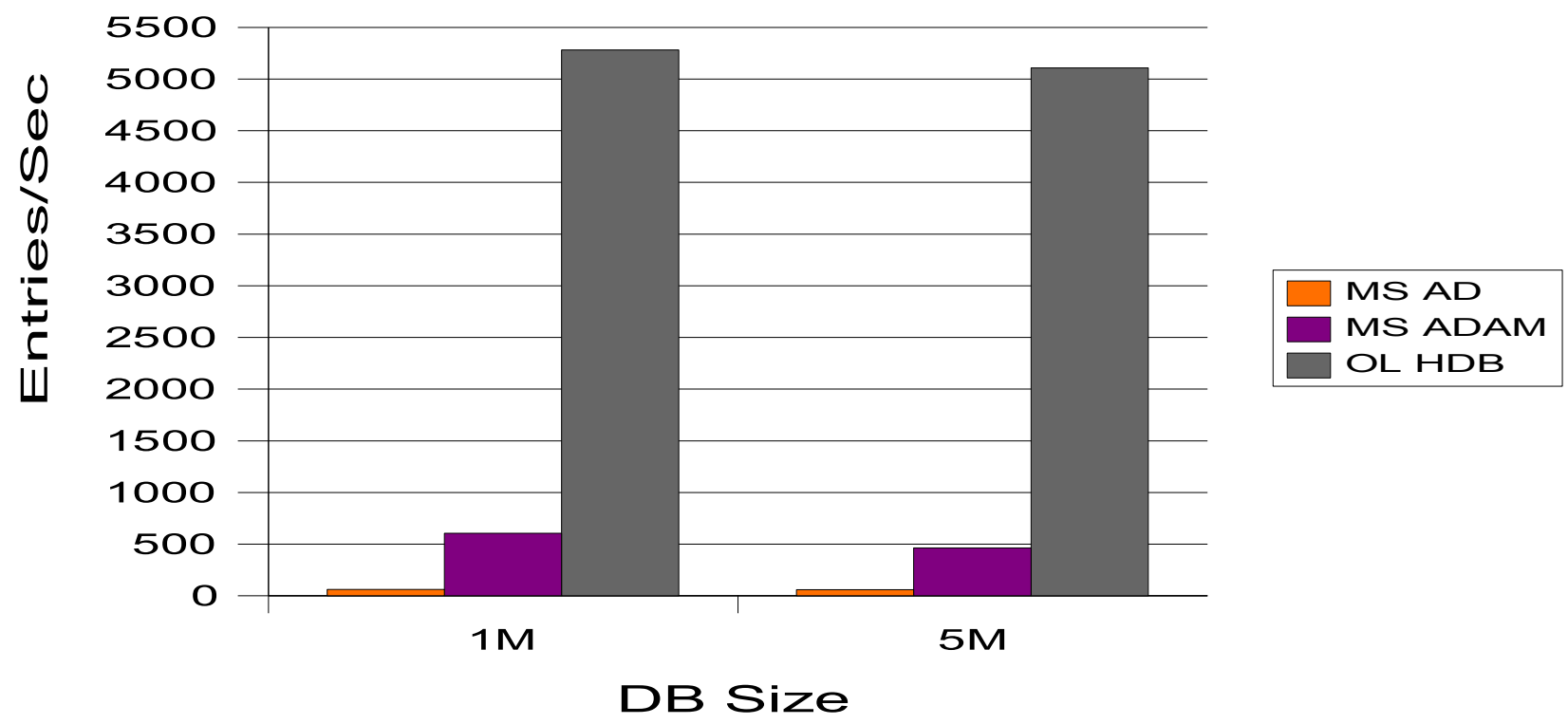
Authentication Rates

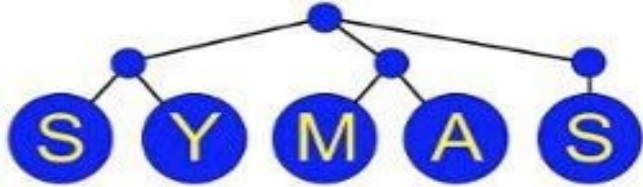




Performance

DB Load Rate

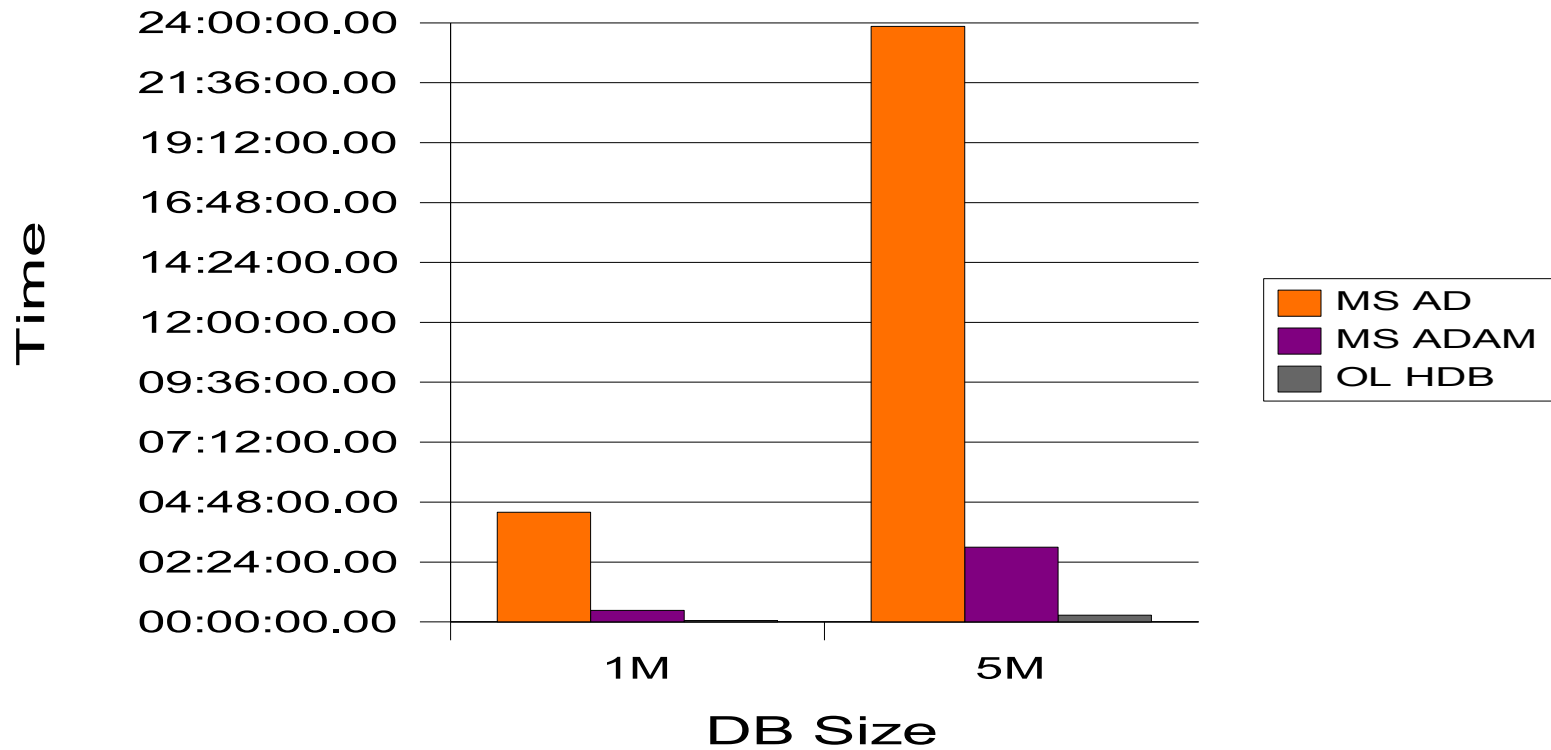


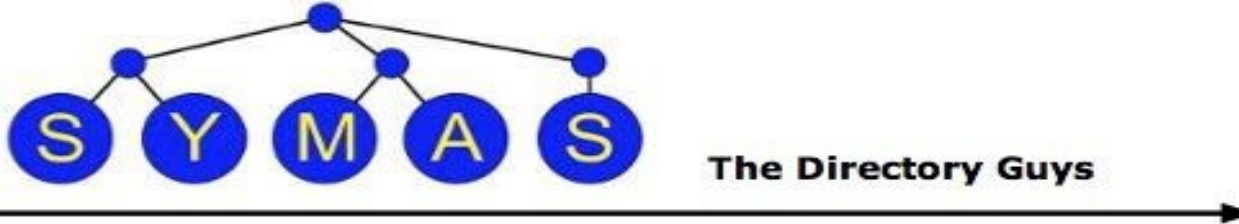


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Performance

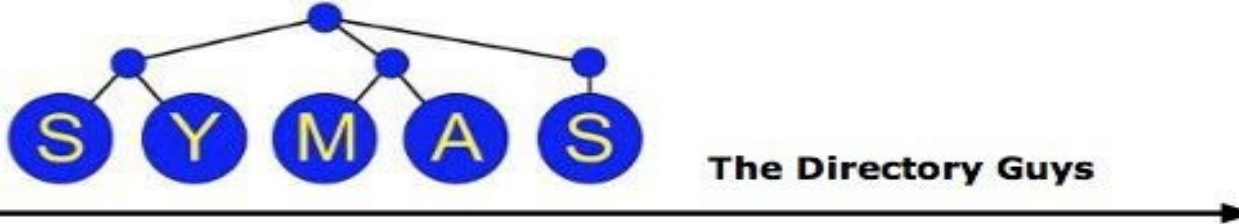
DB Load Times





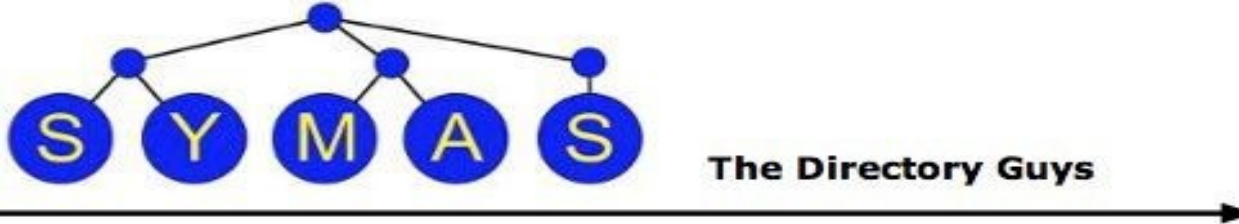
Performance...

- 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



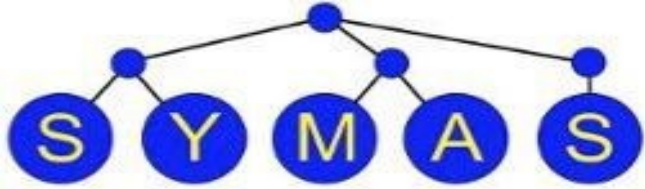
Performance...

- 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...

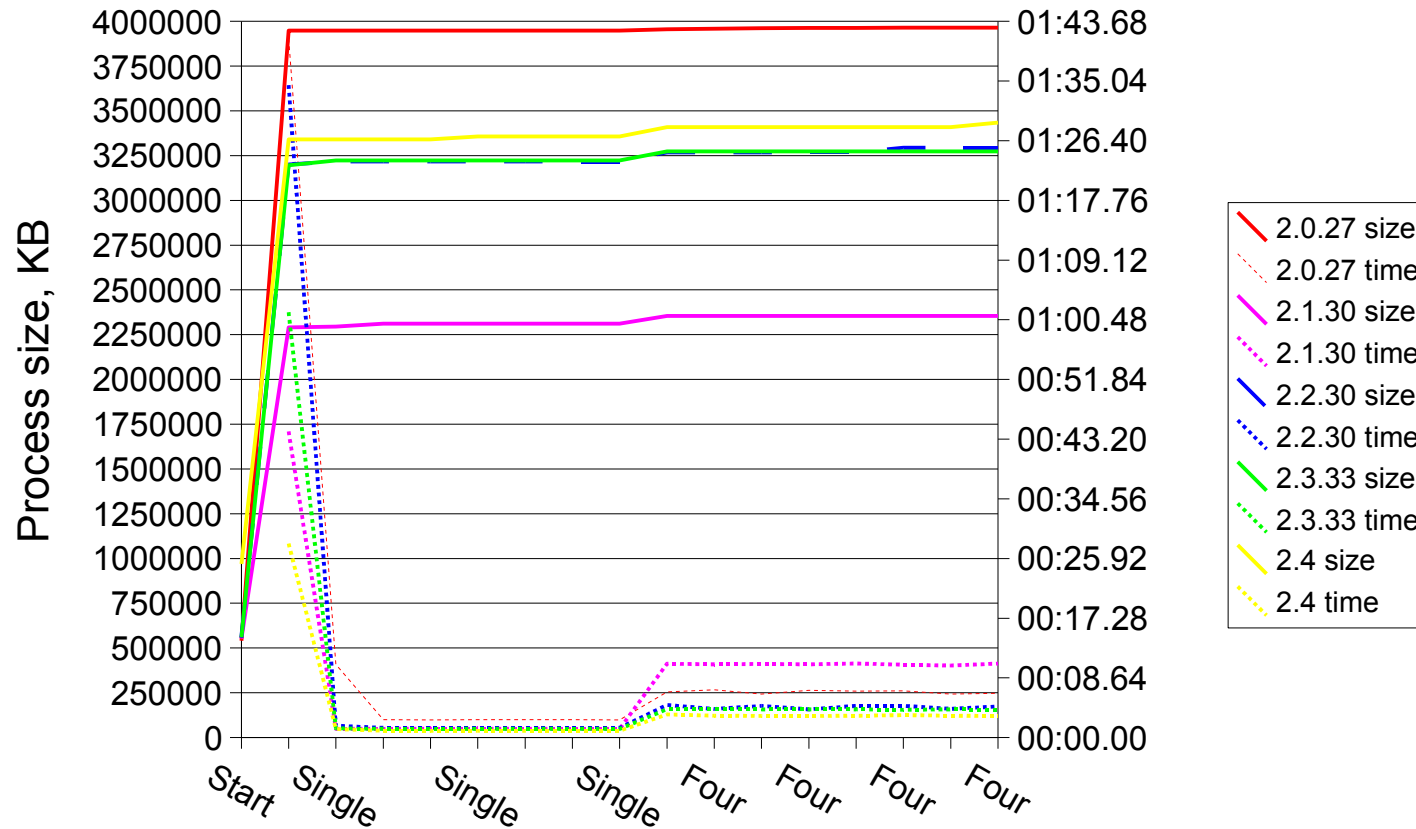
- Scaling to multiple CPUs
 - Single client, ldapsearch across entire 1.3GB database in 0.70 seconds
 - Two clients concurrent, ldapsearch in 0.71 seconds
 - 4 clients, 1.42 seconds
 - Practically Perfect Parallel Scaling
 - (Using AMD64 X2 dual-core processor)

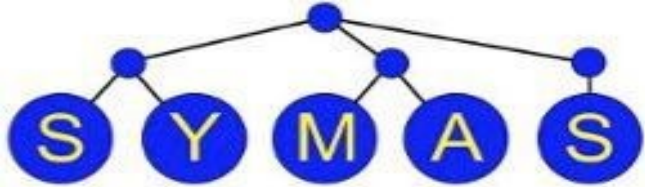


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Cached Search Performance

Cached Search performance

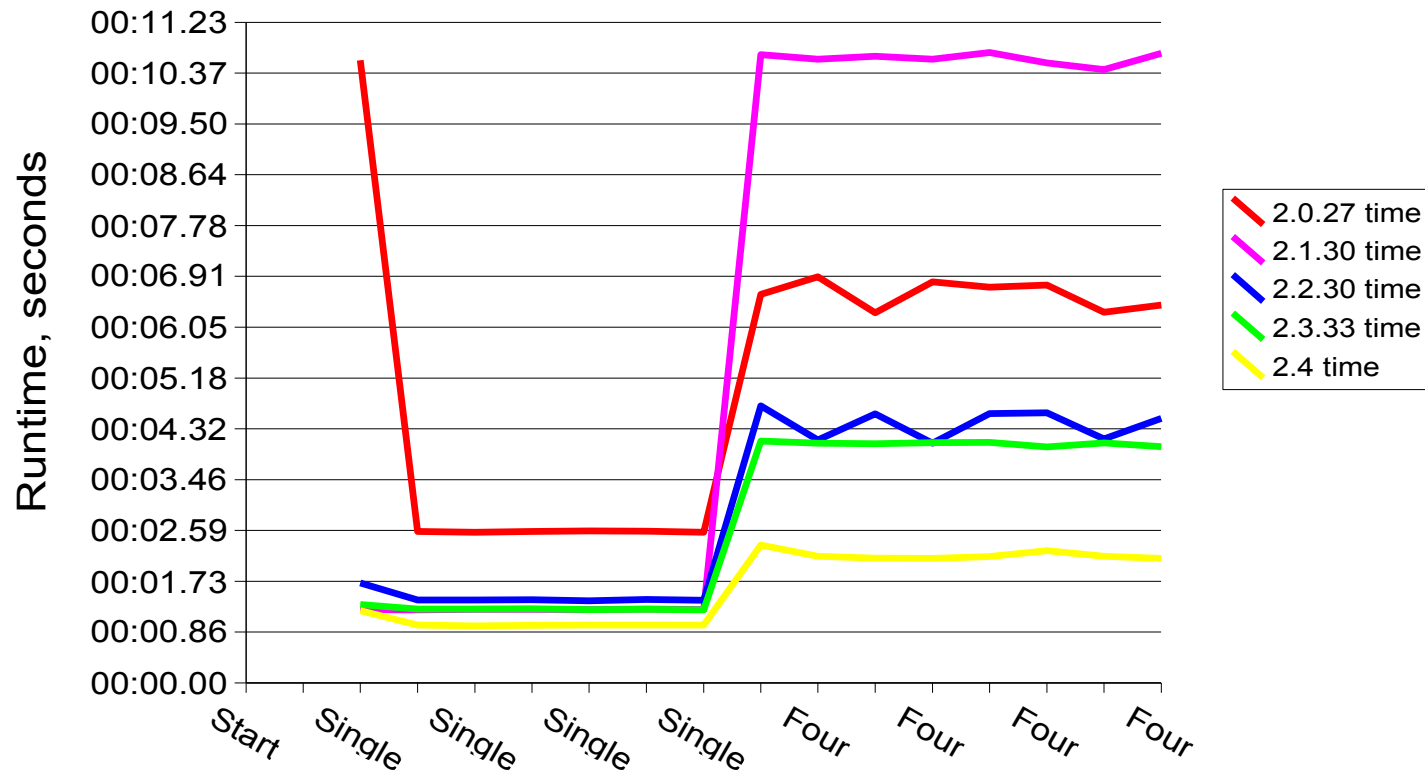


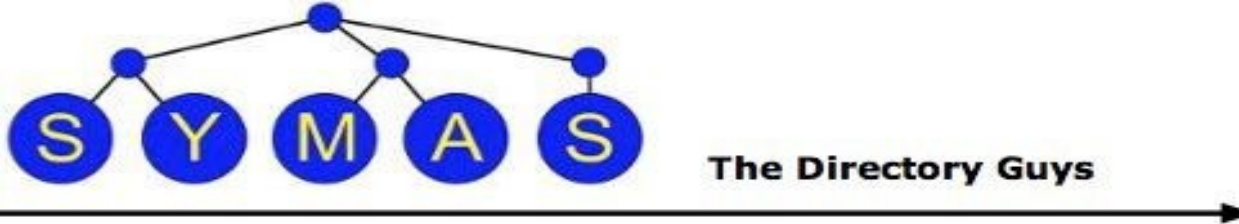


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Cached Search Performance

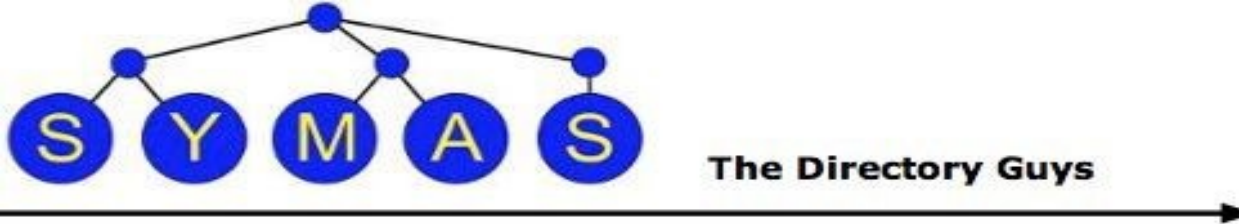
Cached Search performance





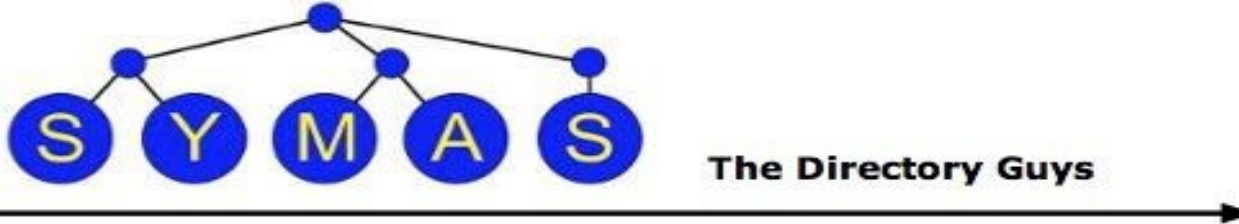
ldapadd performance

- 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



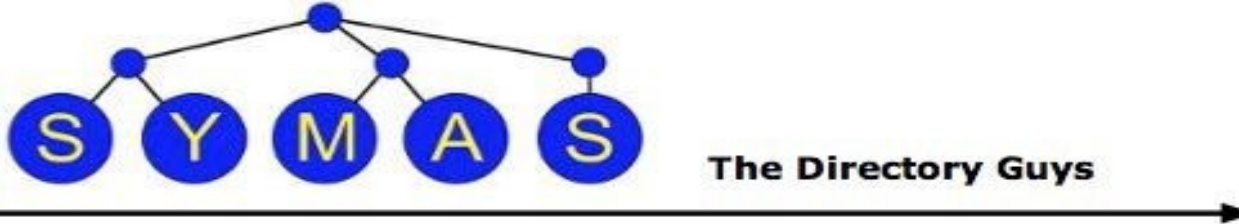
The Road Ahead...

- 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



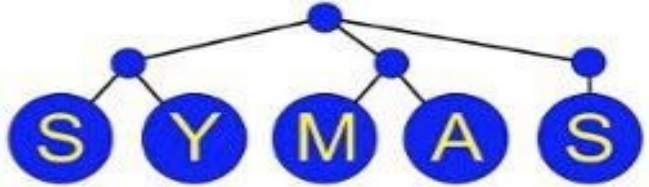
The Road Ahead...

- 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

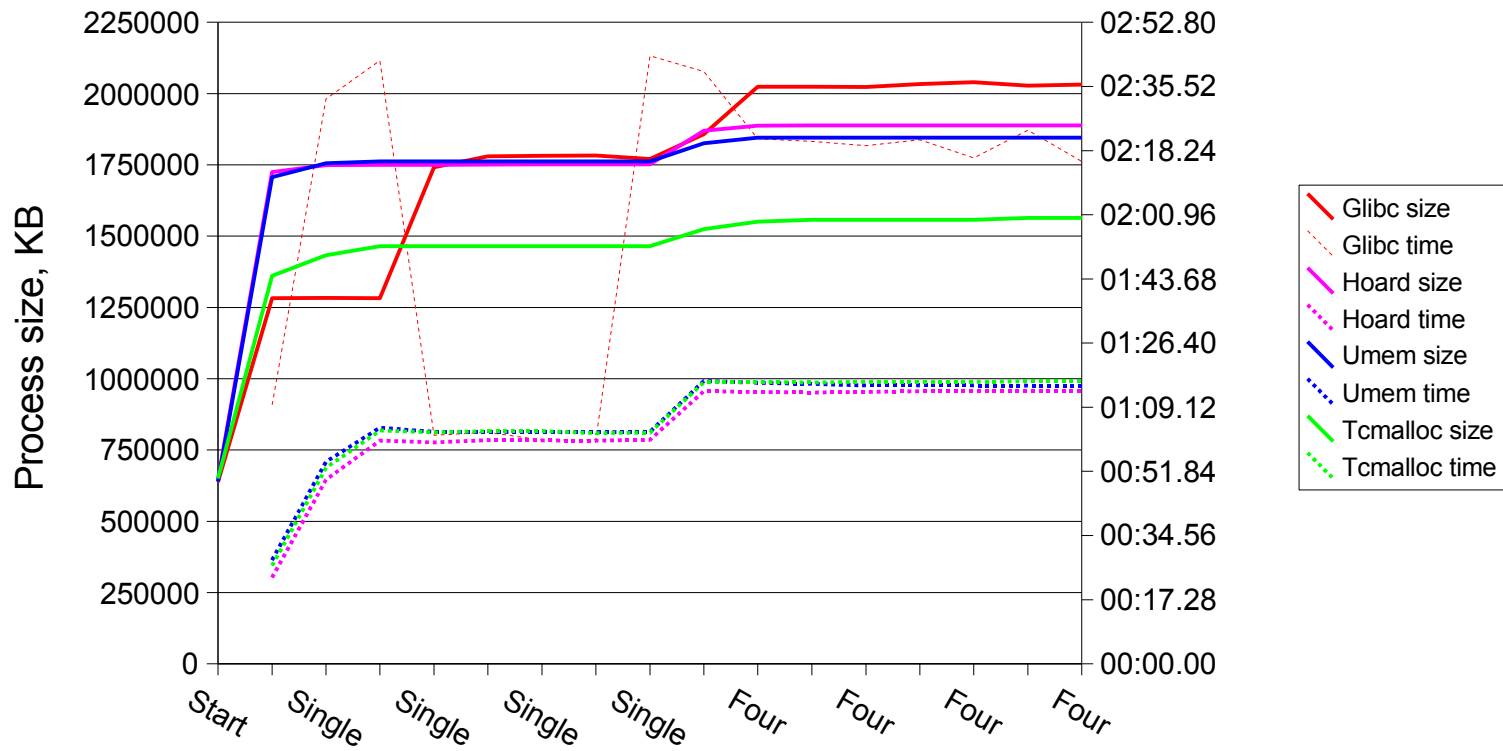
- OpenLDAP 2.4 delivers dramatic improvements while maintaining backward compatibility
- The OpenLDAP community continues to thrive
 - your thoughts, ideas, and participation are always welcome
 - when we work together everyone wins

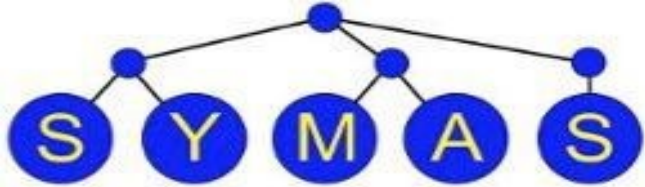


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BDB 4.2 performance

Malloc performance

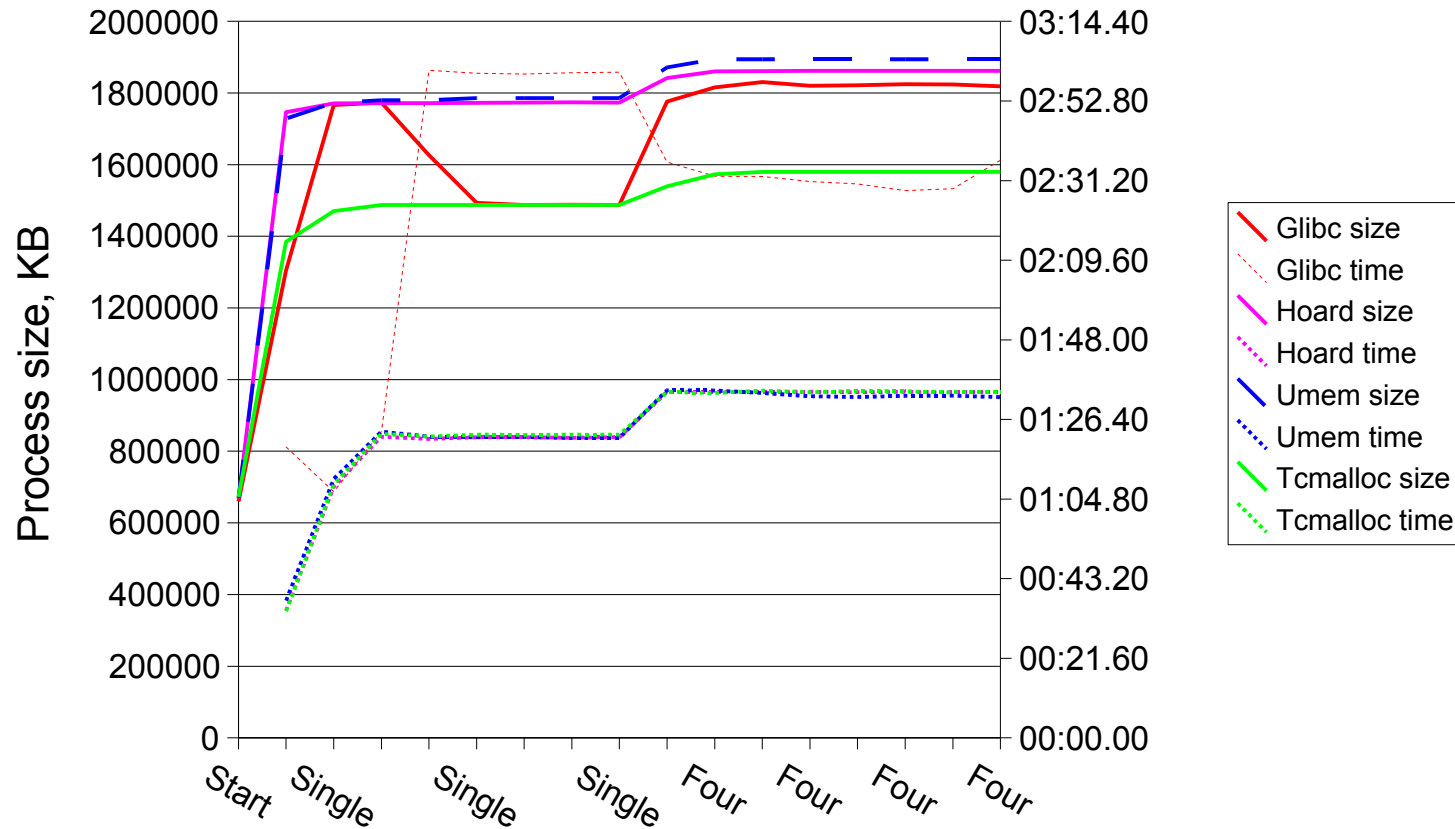


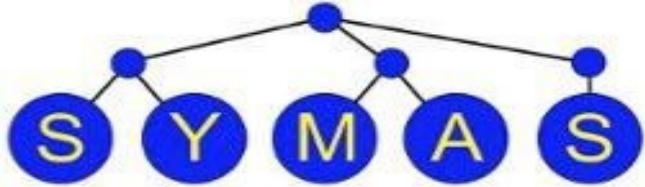


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BDB 4.5 Performance

Malloc performance

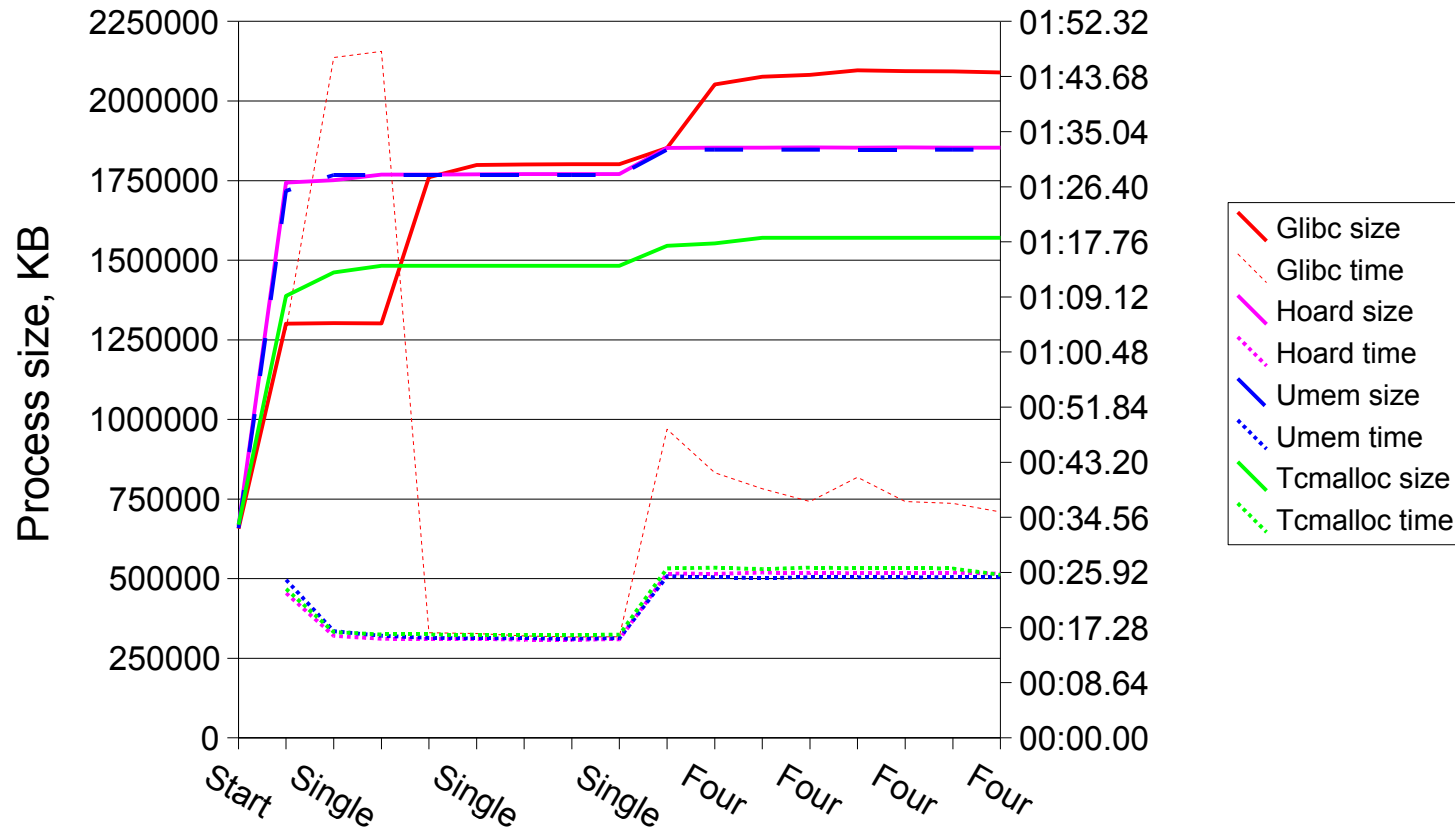


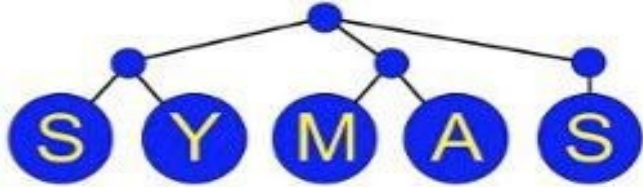


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BDB 4.6 Performance

Malloc performance

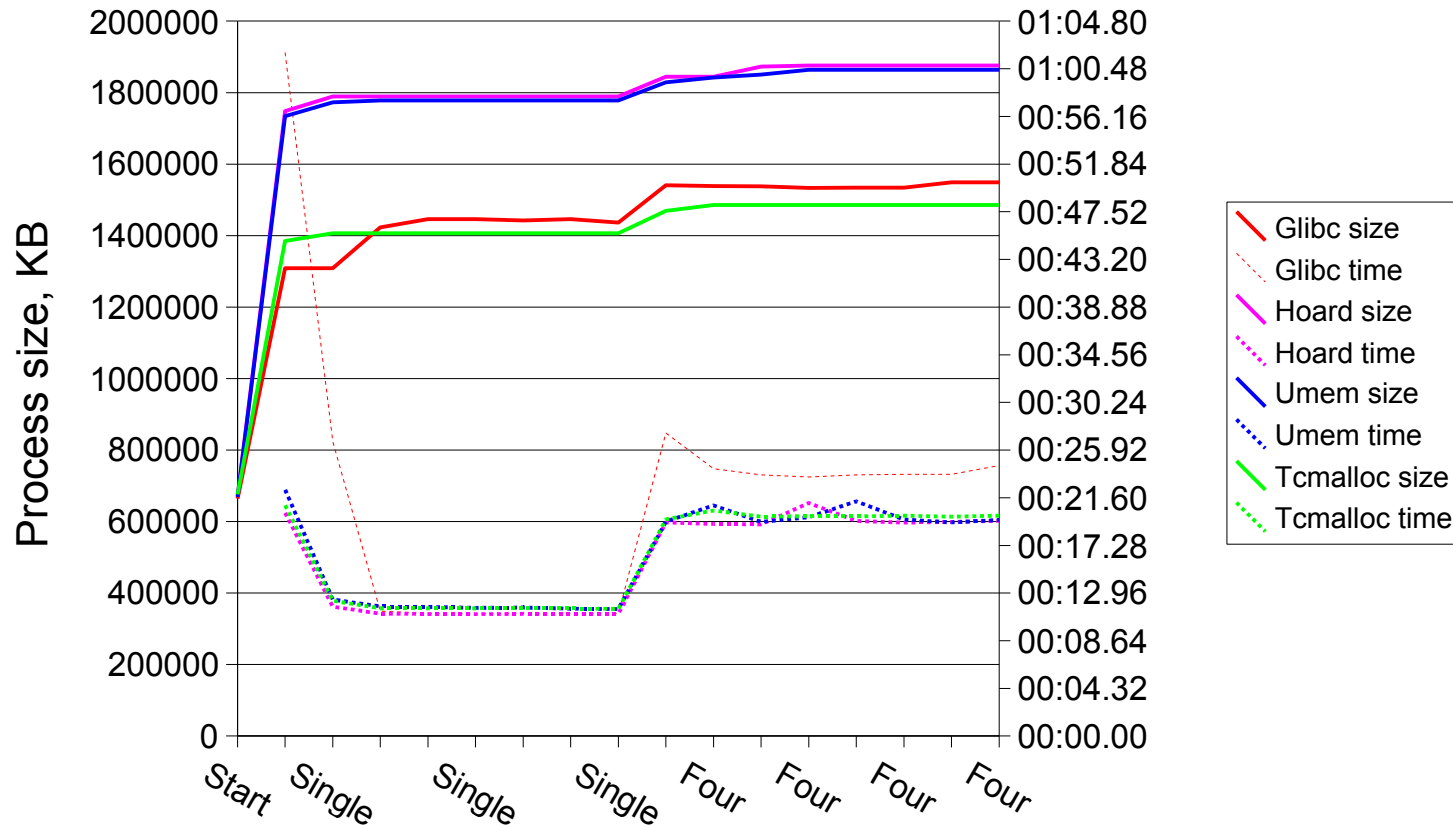


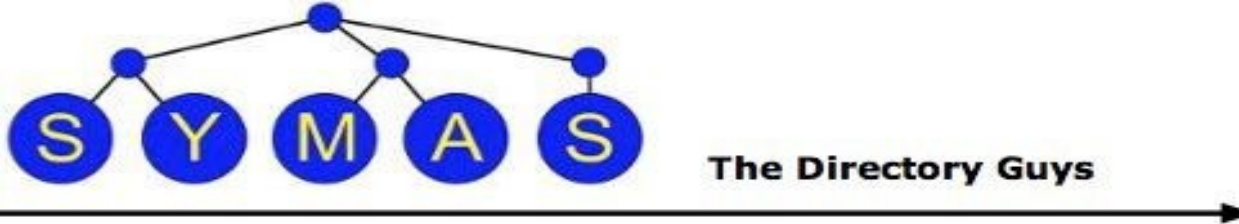


The Directory Guys

Current Performance

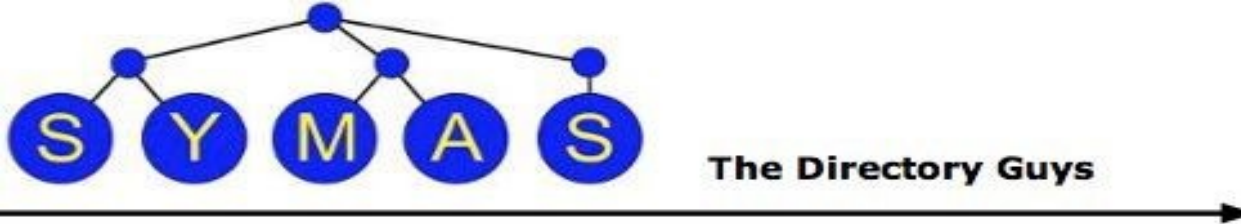
Malloc performance





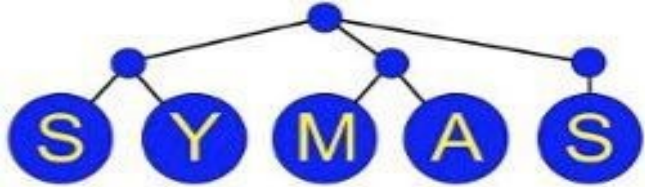
Database Parameters

- 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

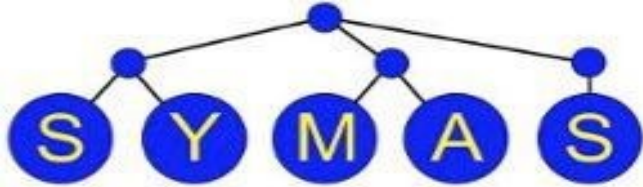
```
Ldbm BDB 4.2.52 dbnosync, dbcachesize 512MB
slapadd 113.455u 8.004s 2:16.96 88.6% 0+0k 0+0io 0pf+0w
total 1281133
-rw----- 1 hyc users 88879104 2007-02-09 23:46 dn2id.dbb
-rw----- 1 hyc users 1220915200 2007-02-09 23:46 id2entry.dbb
-rw----- 1 hyc users 8192 2007-02-09 23:46 nextid.dbb
-rw----- 1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



The Directory Guys

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
```



The Directory Guys

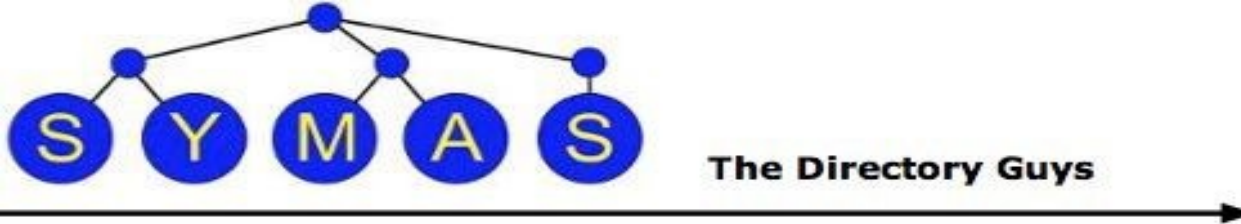
2.2.30 DB Parameters

```
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
```

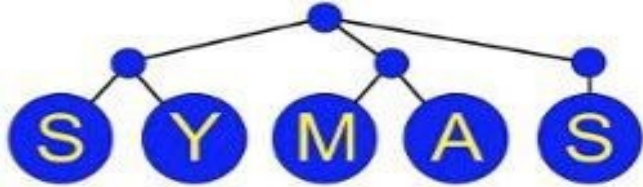
```
total 1869554
```

```
-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
```

The Directory Guys

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
```