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BP 403 Best Practices IBM Lotus Domino for Linux

Track FOUR: Best Practices

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About the speaker

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  - focused on Cross-Platform C-API, Domino® Infrastructure, Administration, Integration and Troubleshooting
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Agenda

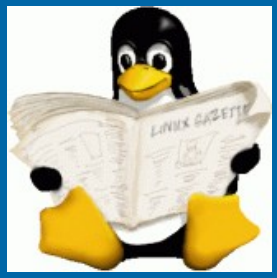
- Introduction
- Domino® 7 Scalability Improvements
- Right distribution and Linux version
- Installation and Troubleshooting
- Performance Tuning
- Q & A

Introduction

Why Domino on Linux?

- Huge dedicated Linux Developer community
  - Many excellent "free" tools (e.g. OS level admin tools, ...)
- Open Standards Based Platform
  - As scalable and much more secure than Win32 in Domino 6
  - Performance rocks in Domino 7
- Most hardware and software vendors already support Linux
  - Including Oracle®, SAP®, IBM®, Sun®, HP®, Tendmicro®, Symantec® ...
  - And many others - basically everyone except Microsoft®
- Linux® is the fastest-growing server OS
  - IDC reports 3 years double digit growth (currently over 30%)
- Current hardware (e.g. AMD64/Opteron) can be fully used with Linux
- IBM has strong commitment & investment in Linux & Open-Source

History & Current State



- First implementation was a "skunkworks" project.
  - Kenneth (Kenbo) Brunsen ported the first version in his spare time
- Finally Linux Gold shipped R5.0.2a December 1999
  - First C-API: R5.0.3
- At that time Kernel 2.2 had scalability limitations
  - 300-400 Users per box
- Kernel 2.4 / Domino 6 plus Tuning
  - Practical 1000-1500 Users per partition (maximum 3400 tested with Server.Load)
- Domino 7 with SLES8® SP3 or SLES9® (2.6 Kernel)
  - > 3000 Users per partition (maximum 15000 tested with Server.Load in D7)
  - Requires IOCP support (sys-epoll) for thread pooling

Domino 6 for Linux Limitations

- Missing support for Thread-Pools via IOCP
  - IOCP= I/O Completion Ports
  - One thread is used to serve up to 20 users
  - Network I/O is "Event Driven" and not "Polled"
  - Much more scalable and needs less resources
- Kernel 2.6 supports IOCP via sys-epoll
  - Backported to 2.4 Kernel by IBM LTC
  - Overcomes barrier to single instance Intel Linux scalability
  - Domino 6.5 for zLinux does already support thread-pools/IOCP
  - SuSE supports sys-epoll in United Linux V1.0 SP2 (aka SLES8)
- Domino 7 for Linux on Intel outperforms Win32
  - Higher scalability with less resources

Domino® 7 Scalability Improvements

Domino 7 Performance Update

- Up to 400% improvement in Intel® Linux® NotesBench Lotus Domino 6 Mail users' scalability
- Domino Linux NRPC Benchmark results around 15000 users
- Some highlights for resource savings
  - see I ID109 & ID210 for more details details
- Up to 25% reduction in Lotus Domino® server CPU utilization for Lotus Notes® Remote Procedure Call (NRPC) client access
- Up to 50% reduction in Lotus Domino® server CPU utilization for Lotus Domino Web Access®
- Up to 35% CPU utilization reduction experienced on IBM mail servers in production use

Practical Limits

- Divide NotesBench Results by 3-5 to estimate concurrent users in real world szenarios
  - Cached users, Cached authentication, ...
- Have a maximum of around 3000 concurrent users
  - There are also internal Server limitations
    - Concurrent Access to Databases (database, semaphore, ... contention)
    - Agent Manager performance
    - Indexer Performance (View & FT-Index)
    - Mail-Router Performance
- Take best benefit of hardware using Domino Partitioning included in the standard Enterprise version
- Linux OS is real multi-user enabled and does not need to run with privileged user
  - Win32 uses the System-Account ...

sys-epoll

- I/O event notification facility
- IOCP (I/O completion port) support
- Mandatory to run Domino 7

- Enables Domino on Linux to use "Thread-Pooling"
- Up to 20 users served by a single thread
- I/O is "event driven" instead of "polled"

- Reduces the number of threads/tasks needed by almost 20 times
- Network I/O is "event driven" and not "polled"

LinuxThreads vs. NPTL

- LinuxThreads
  - Older thread implementation in kernel 2.4 (part of glibc)
  - Linux Task Model (creates on kernel task per thread)
  - Threads are implemented as cloned process - clone(..)-call
  - That's why ps shows so many processes per servertask
  - Only the thread group holds those tasks together
- NPTL - Native POSIX Thread Library
  - New thread library in kernel 2.6 (part of glibc)
  - Available in SLES9 and RedHat ES 4.0
  - Threading support with way higher scalability
  - Supports user space threads
  - clone(..) call is still used but generates user space threads
  - Used by Domino on Linux if available
  - Check threads via ps -efL

LD_ASSUME_KERNEL???

- OS environment variable for overriding the glibc run time loaded by a particular application
- LD_ASSUME_KERNEL=2.4.20
  - NPTL (default mode since RHEL 3 and SLES9)
- LD_ASSUME_KERNEL=2.4.19
  - Standard LinuxThreads with floating stacks
- LD_ASSUME_KERNEL=2.2.5
  - LinuxThreads with fixed stack size.
- Check glibc version via
  - getconf GNU_LIBPTHREAD_VERSION
  - Returns e.g. NPTL 0.61 or linuxthreads-0.10

Memory Limits & Scalability

- Domino 6
  - Maximum 2 GB shared memory / 2 GB local process memory per process
- Domino 7 on SLES8/SLES9 32bit
  - Maximum 3 GB shared memory / 1 GB local process memory per process
  - By changing the mapped-base
- Domino 7 on SLES9 64Bit
  - More than 3 GB of shared memory
  - Only limit is 4 GB total memory size per process
- Domino 7 on SLES9 in 64Bit Mode supports larger number of partitions with 32Bit dedicated address space per Domino Partition (DPAR)
  - Practical limit would be 3-4 partitions with 12-16 GB of RAM
  - In combination with thread-pool support (IOCP) this allows Linux boxes to scale like AIX or Solaris
  - Take care to have fast I/O / disk subsystems

Right distribution and Linux version

Linux Distributions

- SuSE, RedHat and UnitedLinux 1.0 Enterprise are the only supported distributions
  - Different Releases of Domino support different Versions of each distribution
  - Take care that you use the right distribution else your Domino server might not run and is totally unsupported
  - Different versions use different libraries, stack sizes, Java runtime, ...
  - Using LD_ASSUME_KERNEL=xyz is not really a solution
- Only Enterprise Servers are supported
- Lotus Development build environment for D6.x is still the older egcs++ 2.91 compiler on RedHat 7.2
  - That's why the compat libs are needed
- Domino 7 uses gcc++ 3.2.2 (see details next slide)

Domino 6 for Linux C-API

- The only supported compilers and build platforms!
- Domino 6.5.x / 6.x / 5.x
  - Linux egcs++ compiler. Applications must be built on Red Hat 7.2 with the Linux egcs++ compiler (egcs 2.91.66 19990314 which is egcs 1.1.2 release). C API applications built on other Linux environments are not supported.
  - Make sure you use egcs++ in your make files and to install the right compiler
  - RH 7.2 install CD images can be downloaded from RH homepage
- Domino 7.0 for Linux
  - United Linux 1.0 SP3 (-> SLES8 SP3)
  - GNU Compiler Collection (gcc) version 3.2.2.
  - Make sure to use g++ in your makefile also for standard C programs
  - New link-option: -rpath-link $(NOTESDIR) $(LIBS)

Supported Linux Versions

- Domino R5.0.13a
  - SuSE 6.3, 6.4, 7.2
  - RedHat 6.2, RedHat 7.x
- Domino 6.5.4/6.5.5
  - Red Hat Enterprise Linux 2.1 - Update 2
  - Red Hat Enterprise Linux 3.0 - Update 1
  - UnitedLinux 1.0/Powered by UnitedLinux 1.0 - Service Pack 2
  - D6 is NOT supported on SLES9
- Domino 7.0/7.0.1
  - SLES 8 - Service Pack 3 (or higher).
  - pstack-1.1.7.IBM-1 ftp.suse.com/pub/projects/pstack/sles8-i386
  - SLES 9 - Service Pack 2 (or higher).
  - Gdb (GNU Debugger) is used instead of pstack
  - D7.0.1: RedHat Enterprise Server 4 (RHEL 4)

Checking Minimum Version Level

- /opt/ibm/lotus/.install.dat contains information about OS levels needed for installed Domino release
- Copied from install file linux/domino/sets/data/nui.cfg
  - redhat_linux_ent3_os_kernel_minver = "2.6.9-5"
  - redhat_linux_ent3_os_minimum_ver = 4
  - suse_linux_sles8_os_kernel_minver = "2.4.21-138"
  - suse_linux_sles8_os_minimum_ver = "8.1"
  - suse_linux_sles9_os_kernel_minver = "2.6.5-7.139"
  - ...
  - ul_linux_os_kernel_minver = "2.4.21-138"
  - ul_linux_os_minimum_patch = 3
  - ul_linux_os_minimum_ver = "1.0"

Installation and Troubleshooting

Differences Windows vs. Unix

- Unix & Linux are designed from scratch to support multi-user, multitasking environments!
  - Most Unix services are already implemented on kernel level
- Security is essential part of the OS core services
  - Each Domino partition run with separate users without root permissions
    - Only bindsock needs root permissions (via sticky bit) to bind to ports below 1024)
- Some Windows specific functionality is not supported on Unix
  - Like OLE, DDE, ...
  - Take care about OS level or Notes API level calls!
- You can cluster servers running different platforms
  - E.g. Linux and Win32
- File-systems and path names look different (details next page)

Filesystem Differences Unix

- There are no drive letters in Unix like C:\
  - Everything is mounted into the root tree /
  - Take care about applications using full path
  - "/" and "\" work on all platforms
  - Good practice: use / and relative path anywhere if possible
  - Or build path using notes.ini directory entry
- Other tips
  - When migrating from W32 also check Config/Server document & notes.ini!!!
  - Path names on OS level are case sensitive
  - Best Practice: keep all directories and filenames ASCII lowercase!
- Files and directories have owners and file permissions
  - Make sure your Domino user owns all files in the data directory and the directory itself (also true for translog and other directories)
  - chown -R notes:notes /local/notesdata

Mixed Casing Problems

- Customers migrating from W32 have problems with mixed case filenames
  - Cache issue with lower upper case characters for Notes and Web
  - Mailfiles, Desktop, Agents, ...
  - There is no out of the box solution yet
- Nash!Com has a (workaround-)solution based on an Extension-Manager routine
  - Free on Linux -- commercial on other platforms
  - Translates all requests to lowercase (Open, Create, Delete...)
  - Works fine if all database and directory names are converted to lowercase during migration
  - Has additional logging to trace problems (prints error codes from API calls)

Journaled Filesystems

- It's like Transaction Log for Domino but on OS level for file-system
  - Changes are grouped into atomic transactions, they either happen completely or not at all
  - Operations are first written to a journal file before any changes are made to the file-system
  - If system fails during commit the transaction can be replayed from the journal file
- Journaled file-systems are faster in most cases
  - specially when not unmounted in clean state (crash)
  - Popular Journaled Filesystems on Linux
    - ext3, ReiserFS, JFS, XFS
    - most customers use ext3 or ReiserFS
  - Each file-system has advantages and disadvantages
  - Depends on your preference
- You still need Domino Transaction Logging!

General Filesystem/Disk Considerations

- Use RAID1 instead of RAID5 at for Transaction Log
- Have separate disks for translog, view-rebuild, data
- Put different file-systems on different controllers/ multi channel controllers for large servers
- Have always at least 20-30% free space on file-systems for data
- SAN (Storage Area Network) is faster than local disks in most cases
- If you use SAN it is still recommended to have different file-systems in different SAN volumes
- Use LVM (Logical Volume Manager)
  - Acts as a layer between the physical disk and file-systems
  - Enables you to resize file-systems and add more disks/SAN space
- Don't use UNIX symbolic links within the data directory
  - Use mounted file-systems or directory links (*.dir) instead

Filesystem Structure for Domino Binaries

- /opt/lotus/bin
  - Contains links to Servertasks and main server binary
  - Servertasks need a link to tools/startup (ln -s tools/startup taskname)
  - Start /opt/lotus/bin/server
  - /opt/lotus/notes/latest/linux contains binaries
  - Latest is a link to the current version (e.g. latest -> 70000)
- /opt/lotus/notes/latest/linux/res/C
  - Contains resource files
  - Resource files are the same than what we know from Windows compile
    - Domino on Unix/Linux has own run-time environment for interpreting resources

Unix Filesystem Structure

- /local/notesdata is standard for single partition
- Proposed file-systems per partition - each on different disk ! /local/notes1/
  - notesdata
  - translog
  - viewrebuild/
- Enable Transaction Log with standard settings
- Use view_rebuild_dir=/local/notes1/viewrebuild/ (3-4 GB)
- /var for system log files
- Swap file (up to two devices)
  - up to 8GB -> 2 times the size of physical memory
  - > 2GB RAM -> 1.5 times the size of physical memory

Locale Settings on Unix

- Locale defines Date, Time, Currency and other settings ...
  - You need to set it up properly to get the right results within your Domino applications
  - Set Unix Language
  - Example: export LANG=de_DE or en_US
  - Sync Timezone/DST settings on Unix level and Domino!
  - Domino for Unix does not sync DST/TimeZone information from OS in all releases
  - Use DSTLAW (example for EMEA: DSTLAW=3,-1,1,10,-1,1)
  - Check “Show locale” and “Show timezone” via console for proper setup
- Also some locale settings are not read from OS (check notes.ini)
  - DateOrder=DMY
  - ClockType=24_HOUR
  - DateSeparator=.
  - TimeSeparator=:

Remote Setup Partitioned Servers

- Domino on Win32 stores partition information in Registry
- Domino on Linux/Unix stores partition information in /opt/ibm/lotus/.install.dat
- ls -la is needed to list files starting with a dot
  - data_directories {
  - "/local/notesdata" {
  - data_UNIX_gid = 101
  - data_UNIX_group = "notes"
  - data_UNIX_uid = 100
  - data_UNIX_user = "notes"
  - ...
  - ddir_data {
  - "/local/notesdata" {
  - size = 604309335
  - ...

Install Incremental Installers / Hotfixes

- Hotfix is only aware of the standard location for binaries and data
- If you switch chose a different binary directory you need an environment setting to specify the location

- Example: export NUI_NOTESDIR=/IBM/domino/lotus
- This allows the installer to find .install.dat
- .install.dat contains all information about the installed Domino version

Linux Installation

- Install only what you really need
  - e.g. think about skipping X-Window system and KDE
  - Ensure to use only the services you need (also check netstat -an|grep LISTEN)
  - Install gdb (GNU debugger) for SLES8 & RH ES 4.0
- Install "compat" package only for D6
  - D7 does not need the old libs
  - Take care: Some add-on products might not be recompiled with new compiler and Domino release and might need compat
- Make sure you choose the right hard-disk partitioning from very beginning. Mount points the following parts
  - Data Directory
  - Translog
  - View Rebuild
- D7 is installs in /opt/ibm/lotus instead of /opt/lotus by default
  - You can run different versions in different directories concurrently

Performance Tuning

Domino 7 Changes in memory tuning

- Domino 6 can only use 2 GB of shared memory
- Domino 7 can use 3 GB of shared memory
- By changing the mapped base (next slide)
- Memory tuning for Domino 6
  - Scale down the NSD Buffer Pool, good starting point (notes.ini settings)
    - ConstrainedSHM=1 would give you 3 GB
    - ConstrainedSHMSizeMB=1536
- New setting in Domino 7
  - MEM_AddressableMemSizeMB (see details in ID210 & ID111)
  - Does not introduce a hard limit but impacts memory size calculation
- BufferPoolSize = around 3/8 of available memory
  - Examples:
  - 1024 * 3/8 = 384
  - 1536 * 3/8 = 576

Domino 7 tunekrnl

- tunekrnl is invoked as part of the start script
- Runs with root privileges (sticky bit) to set tuning parameters
  - /proc/sys/fs/file-max has been set to "131072".
  - /proc/sys/kernel/shmmax has been set to "268435456".
  - /proc/sys/kernel/sem has been set to "250 256000 32 1024".
  - /proc/sys/net/ipv4/tcp_fin_timeout has been set to "15".
  - /proc/sys/net/ipv4/tcp_max_syn_backlog has been set to "16384".
  - /proc/sys/net/ipv4/tcp_tw_reuse has been set to "1".
  - /proc/sys/net/ipv4/ip_local_port_range has been set to "1024 65535".
- /proc/11568/mapped_base has been set to "16777216".
  - Set the mapped base to allow 3 GB shared memory

Kernel Parameter Tuning

- Depending on your start script you need the following line in all /etc/pam.d/* control files like /etc/pam.d/login,su,... to ensure limits can be set
  - session required /lib/security/pam_limits.so
  - Alternate way is to set the limit for all users (*)
- Number of open files for notes
  - /etc/security/limits.conf
  - notes soft nofile 49152
  - notes hard nofile 49152
- Number of processes/threads notes
  - user/etc/security/limits.conf
  - notes soft nproc 12500
  - notes hard nproc 12500

Additional Performance Tuning

- IPC/Shared Memory (Domino specific)
  - Depending block size of shared memory you can run into memory fragmentation
  - Environment setting: export Notes_SHARED_DPOOLSIZE=20480 (20 MB) to set the size shared memory segments allocated
- Server_Pool_Tasks=80 (default: 20)
  - Maximum number of initial thread-pool tasks (IOCP threads)
- Server_Max_Concurrent_Trans= Server_Pool_Tasks * Domino Ports
  - Number of concurrent I/O threads to run (throttle to reduce CPU usage and Context-Switches)
  - Always tune both at the same time
- NSF_DbCache_MaxEntries
  - In case of high statistical value in DbCache.OvercrowdingRejections then set this parameter to either the maximum number of concurrent users or the maximum number of databases open (whatever is higher)
  - e.g. NSF_DbCache_MaxEntries=3000

Linux IDE Disk Tuning

- Default settings for IDE disks are quite conservative
  - Tune settings with hdparm
  - -A1 -a8 -c3 -d1 -Xnn -W1 devicename
  - (-A) sets drive read lookahead flag
  - (-a) sets FS read ahead. 8 sectors (4KB) to 12 sectors (6KB)
  - (-c) sets EIDE 32bit I/O support
  - (-d) enables DMA
  - (-X) sets the DMA mode (see man page for details)
  - (-W) IDE write caching mode (be aware of possible data lost when crash)
- Example: hdparm -A1 -a8 -c3 -d1 -Xnn -W1 devicename
  - Test Performance before and after with
  - (-t) perform device read timings
  - (-T) perform cache read timings

NSD (Notes System Diagnostics)

- Troubleshooting and configuration
  - available in ND6 on all platforms
- Collects a ton of information about your Domino server and OS
- Uses pstack in D6 and gdb in D7 SLES9/RH AS/ES 4.0
- To run NSD:
  - Log in as your Domino Server user account (e.g. notes)
  - Change to the Domino data directory (e.g. cd /local/notesdata)
  - Start /opt/lotus/bin/nsd + desired options
  - -kill will kill all Domino processes and free resources
  - -dump will dump call-stacks of running Domino processes
  - -dumpandkill will do both
  - “-help” prints full list of options

NSD & pstack

- NSD uses pstack for debugging
  - D6 ships pstack (/opt/lotus/notes/latest/pstack)
  - D6 on RH 3 AS/ES uses /usr/bin/pstack
    - need to update it to pstack 1.2-3 or newer for complete call-stacks
- D7 does not ship pstack any more needed for SLES8
  - SLES8 does not include pstack
  - download at ftp://ftp.suse.com/pub/projects/pstack/sles8-i386/
  - SLES9 / RH ES 4.0
  - Kernel 2.6 always uses the GNU debugger (gdb)
  - Needs to be installed for NSD

Start/Stop Scripts

- Redirect console output stream to a file for logging
  - Some debug messages are only written to console
  - Crash info will only written to console
  - Only use Console Log if needed
    - Uses file-handle per task for writing the log file (overhead)
  - Java Controller uses Java-Code around Domino main process to control the server (more complexity)
- Redirect console input stream from a file to allow local console
  - Example: /opt/lotus/bin/server < console.in >> server.log 2>&1 &
  - Attach to input and output files for a kind of "life console"
  - More a troubleshooting mode. Better use remote console
- Free cross platform start script
  - http://www.nashcom.de/nshweb/pages/startscript.htm
  - More than a start script.
  - Allows to start/stop,monitor & troubleshoot your server (NSD...)

Best Practice Partitioning

- Partitioning allows you to optimize the usage of your hardware
  - Some internal Domino resources do only scale beyond a certain limit
  - (View/FT-Index, Amgr, Semaphores, Shared Memory, ...)
  - Don't have too many users per partition – good number is 1500 users
- Use different Unix accounts per partition & get file permissions right
  - Name Unix user like CN of the Domino Server
- Have separate IP addresses per partition plus one IP for the box
  - Bind all OS Services to the primary IP of the box
  - Bind all Notes Services to the service IP of the Domino partition
    - e.g. TCPIP_TcpIpAddress=0,192.168.1.42:1352
- Take care about resource splitting
  - PercentAvailSysResources=n or ConstraindedSHM= ...

Performance Monitoring & Troubleshooting

- Platform Statistics
  - Great way to get an overview on system performance
  - Comparable stats cross all platforms (OS level details are described in events4.nsf
  - But stats are collected once per minute only
- top, nmon
  - Information about processes -- nmon was originally developed for AIX
- vmstat
  - Virtual memory activity and CPU statistics
- iostat -x
  - I/O statistics and activity
- netstat -i
  - Summarizes network activity
- You need to install the sysstat package for iostat and sar

vmstat

- vmstat 1 100
  - procs -----------memory---------- ---swap-- -----io---- --system-- ----cpu----
  - r b swpd free buff cache si so bi bo in cs us sy id wa
  - 0 0 0 100764 40612 201828 0 0 9 4 1002 391 8 13 79 0
  - 4 0 0 100764 40612 201828 0 0 0 0 1046 1247 13 48 40 0
- For high us/sy columns (user/system CPU) check r (run-queue)
  - In case run-queue >> number of CPUs your system is CPU bound
- For high numbers of wa (wait IO in %) check iostat -x to check if machine is I/O bound
- High number of cs (context switches) e.g. more than 5000-8000 context switches per partition you might have a priority inversion

iostat

- Iostat -x 1 100

avg-cpu: %user %nice %sys %iowait %idle

21.00 0.00 42.00 3.00 34.00

Device:	rrqm/s	wrqm/s	r/s	w/s	rsec/s	wsec/s	rkB/s	wkB/s	avgrq-sz	avgqu-sz	await	svctm	%util
Hda	0.00	321.00	0.00	18.00	0.00	2712.00	0.00	1356.00	150.67	0.48	26.67	6.67	12.00

  - If %util > 50% check svctm
  - Svctm – time spent servicing the request – only disk activities
    - Should be below 10-15 msec

Interesting Free Tools

- A great free Telnet & SSH client: Putty
  - http://www.chiark.greenend.org.uk/~sgtatham/putty)
- WinSCP - Windows based copy program using SSH
  - http://winscp.sourceforge.net
- Webmin - Windows based extendable Linux Admin Client
  - http://www.webmin.com
- Nmon
  - http://www.ibm.com/developerworks/eserver/articles/analyze_aix/
- Various tools shipped in the SuSE distribution
  - Examples: network monitors, config programs, development tools, ...

Takeaways

- Domino 7 on Linux rocks and is large Enterprise ready
  - Good platform for consolidation or replacing Win32 ;-)
  - You should update to SLES9 / RH ES 4.0 and Domino 7
  - Domino 6 is not supported on SLES9
- Linux is more complex than Win32 but has way better scalability and TCO
  - Tuning Domino on Linux has become more transparent and straight forward
  - You should consider partitioning to take most benefit of your hardware resources
- Recommended platform for Domino 6
  - SuSE Enterprise Server 8 SP3
- Recommended platform for Domino 7
  - SuSE Enterprise Server 9 SP2

Additional Resources

- Redbook http://www.redbooks.com
  - SG24-6835-00 - Lotus Domino 6 for Linux
    - Installing, Administration & Tuning for Domino on RedHat & SuSE
  - REDP-3862-00 Tuning SUSE LINUX Enterprise Server on IBM Eserver xSeries Servers
    - Very detailed resource for SLES8/9 performance tuning
- Lotus Developer Domain aka Notes.Net
  - http://www.lotus.com/ldd
  - Presentations about Domino 7 Performance
  - What's new in Domino 7
- http://www.nashcom.de/linux

Related/Recommended Sessions

- BOF506 IBM Lotus Domino on UNIX and Linux
  - Eddy Bell (IBM), Kenneth Brunsen – Kenbo (IBM)
  - 24.1.2006 17:45, Y&B Asbury D
- ID210 IBM Lotus Domino and Linux: Performance Improvements of up to 400%
  - Kenneth Brunsen – Kenbo (IBM), James Powers (IBM)
  - 25.1.2006 15:00, DL S. Hemisphere II
- ID109 IBM Lotus Domino 7 Performs! Here is the Proof!
  - Razeyah Stephen (IBM), Angelo Lynn (IBM)
  - 23.01.2006 14:15, DL S. Hemisphere I

Question & Answers

- Ask questions now
- or find me in the speakers room after the session

  Swan Hotel, Room Toucan 2

- Feel free to send follow-up questions

- Email: nsh@nashcom.de
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