



## Lotus Domino Performance Tuning

Vladislav Tatarincev  
Owner of CYONE  
[Vlaad\[a-t\]cyone.eu](mailto:Vlaad[a-t]cyone.eu)  
Blog: [www.vlaad.lv](http://www.vlaad.lv)





# Agenda

- What does impact a Domino performance?
- Tools to identify problems
- OS tuning, services
- Domino database tuning
- @Time functions
- Agents, subforms, Tables, icons,
- Domino 6.x, 7.x, 8.x, 8.5.x improvements



# What impacts Domino performance

- Hardware
  - CPU (Agents, Indexes, LotusScript)
  - HDD (RAID) Data read/write
  - RAM (Virtual Memory)
- OS
- Domino configuration
- Database
  - Design
  - Full-Text Index
  - View
    - Private
    - Public



# Tools to identify problems

- User complains
- OS/Domino statistics
- Lotus Domino Domain monitoring
- Log files/debug parameters
- Agent Profiler (Domino 7.x)
- 3rd party tools (Profilers)



# Domino server tuning guide

- 1. RAID tuning
- 2. Hardware tuning
- 3. OS tuning
- 4. Domino server configuration tuning
- 5. Enable Transactional Logging
- 6. Database tuning
- 7. View tuning
- 8. Column, agent, script tuning



# RAID

- 6 disks
  - 1. OS RAID 1, 18GB,
  - 2. DATA RAID 1, RAID 1E, 72GB-240GB Stripe size 16KB
  - 3. Transactional Logging,
    - Circular uses max 4GB, 18GB
    - Archive uses the whole disk, 36GB-72
- Transactional Logging should be pointed to a separated disk
- TL significantly reduces restart time after fault
- Works together with View Logged views (\$Users, others)



## RAID (cont.)

- Stripe size should be 16K

Data to store	RAID level	Size	Speed
OS	RAID 1	18GB	15K
DATA	RAID 1, 5, 10		
Transactional Logging	RAID 1	18GB	15K

Basics | Security | Ports... | Server Tasks... | Internet Protocols... | MTAs... | Miscellaneous | Transactional Logging | Shared Mail | DB2 | Lotus Traveler | Administration

**Basics**

Transactional logging: Enabled

Log path: E:\LOGDIR\

Logging style: Circular

Use all available space on log device:  Yes  No

Maximum log space: 4096 MB

Automatic fixup of corrupt databases: Enabled

Runtime/Restart performance: Favor runtime

**Quotas**

Quota enforcement: Check file size when extending the file



# Transactional Logging

- TL – Improves performance
- TL - Reduces server restart time
- - Separate disk is necessary
- TL Best Practice  
<http://www-1.ibm.com/support/docview.wss?uid=swg27009309>
- TL should be disabled on Clubusy.nsf, log.nsf, mail.box, check notes.ini  
<http://www-1.ibm.com/support/docview.wss?uid=swg27009309#INI%20file>
- TL on SAN <http://www-1.ibm.com/support/docview.wss?uid=swg27009309#SAN>

	Recovery Time	Response Time	CPU load
DISABLED	01:40:40 (100%)	233ms (100%)	48.9% (100%)
Standars	00:17:43 (17%)	216ms (93%)	46.3 (95%)
Favor Runtime	00:33:24 (33%)	172ms (74%)	41.0% (84%)
Favor Recovery	00:12:35 (12%)	223ms (96%)	46.7% (96%)



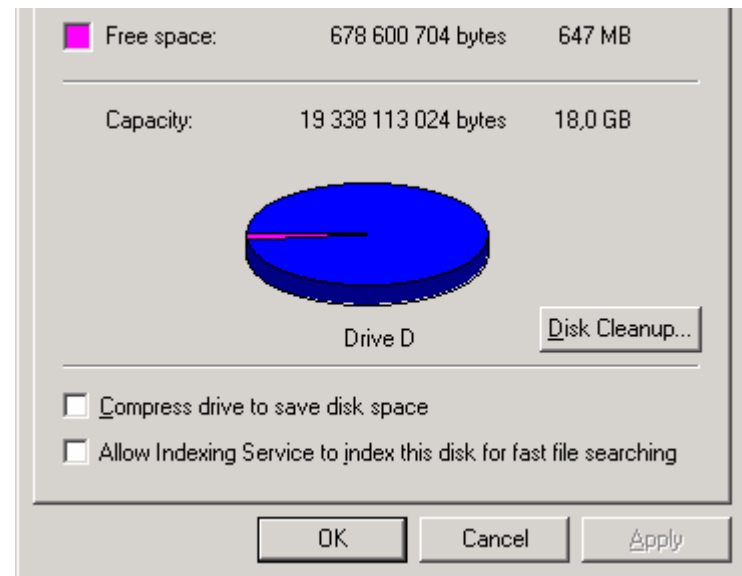
# Server type

- Mail – needs more memory (to convert emails)
- Apps – needs more CPU (LotusScripts, indexes require CPU resources)
- CLUSTER – need more MEMORY and CPU 😊
- Use IBM calculators, as well you can use similar environments that runs well



# Basic OS tuning (Windows)

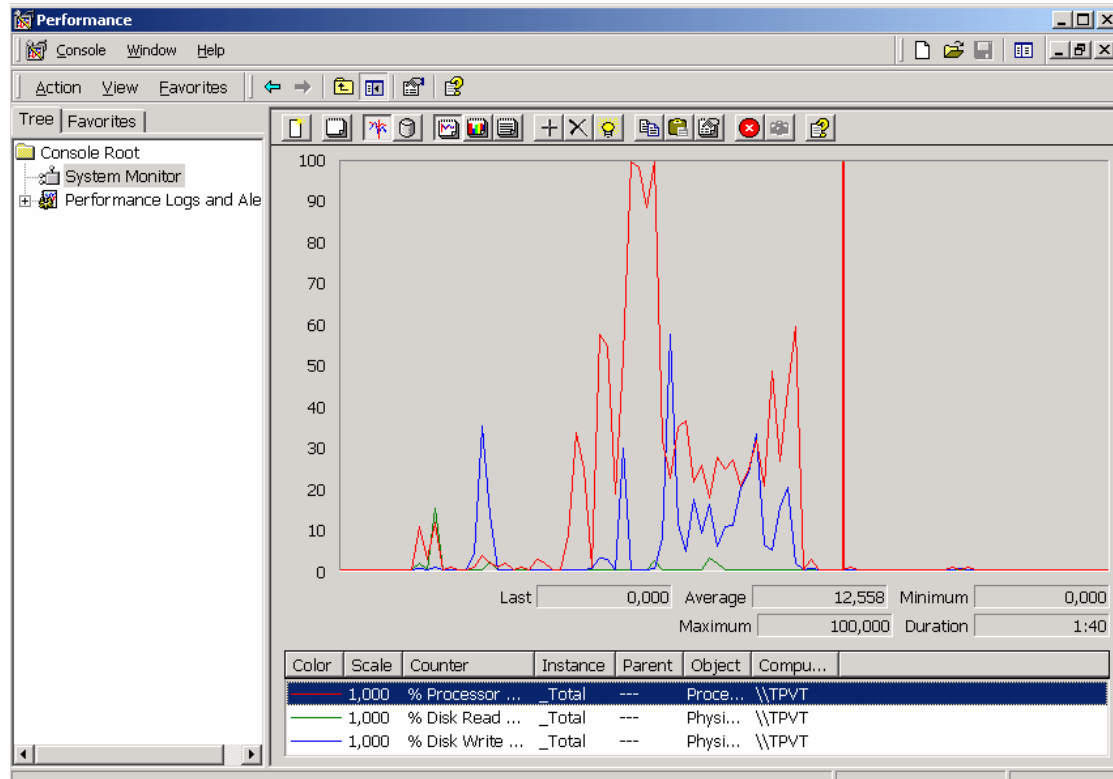
- Disable “File and Printer Sharing”
- Disable unused server services (Print Spooler)
- Disable Disk Indexing





# Windows Performance tools

- Start with Performance Monitor to identify a bottle neck
- Same tools are available on other OSES





# WebAdmin.nsf

People & Groups | Files | Server... | Messaging... | Replication | Configuration |  Logout  Preferences

Status | Analysis | Statistics

Server **Platform Statistics**  
Release 6.5.6FP3 on Windows 2003 Server Refresh Tools

- All Server Tasks
- Notes Users
- Database Users
- Internet Users
- Quick Console
- Live Console
- HTTP Statistics
- Schedules
- Operating System
  - Platform Statistics
  - Services
  - Processes

Last sampled: 11:09:28, sample interval is every 1 minute(s) Last update

CPU Statistics	
Current utilization:	20 %
Average utilization:	3.4 %
Domino utilization:	24.7 %

Memory Statistics				
	Total	Min.	Peak	Avg.
Installed:	4096 MB			
Available:	(7 %) 254 MB	40 MB	3 MB	591 MB
Pagefile utilization:				
	15.7 %		23.4 %	8.6 %

Network Adapter Statistics		
Intel(R) PRO_1000 EB Network Connection with L_O Acceleration:		
Bandwidth utilization:	NIC Speed:	
0 %	1,000 MBit/sec	
Total/sec:	Received/sec:	Sent/sec:
0 bytes	0 bytes	0 bytes

Disk Statistics			
Drive name:	Utilization:		
	Current:	Peak	Avg.
C	37.5 %	100 %	19.5 %
D	20 %	100 %	12.6 %
F	0.4 %	67 %	0.3 %

Bandwidth utilization:	NIC Speed:	
0.2 %	100 MBit/sec	
Total/sec:	Received/sec:	Sent/sec:
23,328.6 bytes	6,138.7 bytes	17,189.9 bytes



# Lotus Domino/Lotus Notes tuning



*Precision powered innovation*





## performance

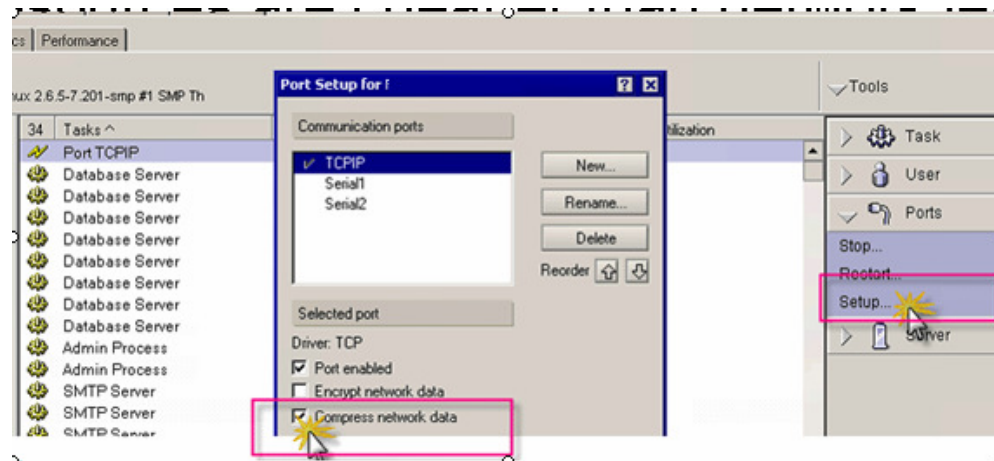
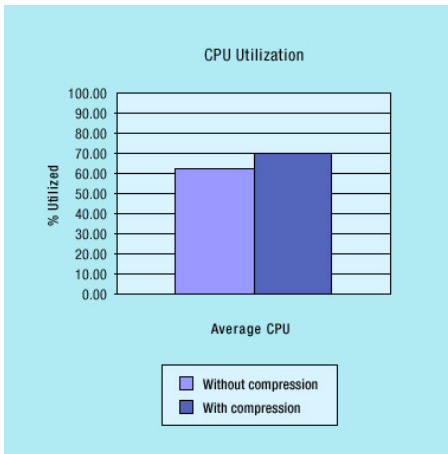
- Remote Debugger (should not be used on production server)
- Server port encryption
- +++ Traffic Compression (Lotus Domino, Lotus Notes)
- Debug parameters (only if advised by support)
- INDEXer (Full text indexer)



# Network Compression (LZ1, LZ5, LZ7, LZ7.7, LZH, LZJ, LZL, LZM, LZNM, LZP, LZS, LZSS, LZSS2, LZSS3, LZSS4, LZSS5, LZSS6, LZSS7, LZSS8, LZSS9, LZSS10, LZSS11, LZSS12, LZSS13, LZSS14, LZSS15, LZSS16, LZSS17, LZSS18, LZSS19, LZSS20, LZSS21, LZSS22, LZSS23, LZSS24, LZSS25, LZSS26, LZSS27, LZSS28, LZSS29, LZSS30, LZSS31, LZSS32, LZSS33, LZSS34, LZSS35, LZSS36, LZSS37, LZSS38, LZSS39, LZSS40, LZSS41, LZSS42, LZSS43, LZSS44, LZSS45, LZSS46, LZSS47, LZSS48, LZSS49, LZSS50, LZSS51, LZSS52, LZSS53, LZSS54, LZSS55, LZSS56, LZSS57, LZSS58, LZSS59, LZSS60, LZSS61, LZSS62, LZSS63, LZSS64, LZSS65, LZSS66, LZSS67, LZSS68, LZSS69, LZSS70, LZSS71, LZSS72, LZSS73, LZSS74, LZSS75, LZSS76, LZSS77, LZSS78, LZSS79, LZSS80, LZSS81, LZSS82, LZSS83, LZSS84, LZSS85, LZSS86, LZSS87, LZSS88, LZSS89, LZSS90, LZSS91, LZSS92, LZSS93, LZSS94, LZSS95, LZSS96, LZSS97, LZSS98, LZSS99, LZSS100)

7x, 8x, 8.5x

- Should be enabled in a client, and a server
- Only if both sides support compression, it works
- Processor resources are cheaper than network lease costs



Database	Size before network compression (MB)	Size after network compression (MB)	Percent reduction
db1.nsf (no compression)	106	51	52%
db2.nsf (R5/Huffman compression)	81	54	34%
db3.nsf (Notes/Domino 6/LZ1 compression)	79	52	35%



# ODS – On Disk Structure

- ODS 17 Domino 3.x
- ODS 20 Lotus Domino 4
- ODS 41 Lotus Domino 5 (soft deletions)
- ODS 43 Lotus Domino 6x, 7.x (LZ 1 attachment compression, Cluster unread marks)
- ODS 48 Lotus Domino 8.x (Create\_R8\_Databases=1, design compression, data compression, don't allow simple search)
- ODS 51 Lotus Domino 8.5.1 (Create\_R85\_Dataatabases=1)
  
- compact, after every migration all databases should be upgraded to new ODS, to take benefit from new release features.
- If necessary, you can downgrade ODS to the previous version using compact -r (-r=revert)
- LZ1 attachment compression



# Use DDM, Luke!



**DDM**

My Events

- By Severity
- By Date
- By Type
- By Server
- By Assignment
- Open Configuration

Open Events | Recent Events | All Events

All open events, sorted by severity

Refresh | Assign... | Change State | Add Comments...

#	Date	Server	Open Events By Severity
2			<b>Fatal</b>
1			<b>Database</b>
1			<b>Database: Compact</b>
99			<b>Failure</b>
3			<b>Application Code</b>
1			<b>Database</b>
89			<b>Messaging: Ro</b>
2			<b>Operating System</b>
2			<b>Replication</b>
1			<b>Server</b>
1			<b>Server: Adminis</b>
197			<b>Warning (High)</b>
3			<b>Database</b>
194			<b>Security: Acces</b>
50			<b>Warning (Low)</b>
4			<b>Database</b>
4			<b>Database: Com</b>
21			<b>Security</b>
21			<b>Security: Acces</b>
348			

**Monitoring Configuration**

- DDM Configuration
  - DDM Probes
    - By Author
    - By Probe Server
    - By Type**
  - DDM Filters
    - Server Collection Hierarchy
    - Open Monitoring...
    - Setup Wizards
    - Event Handlers
      - By Server
      - By Type
      - By Severity
      - By Action
      - By Author
    - Event Generators
    - Console Attributes
    - Filters
      - Log Filters
      - DDM Filters
    - Statistic Collection
      - Advanced
      - Names & Messages (Advanced)

**DDM Probes: All By Type**

Total	Enabled	Type	Probe Description	Last Modified By	Last Modified Date/T
7	0	<b>Application Code</b>			
4	0	<b>Database</b>			
10	0	<b>Directory</b>			
12	0	<b>Messaging</b>			
4	0	<b>Operating System</b>			
1	0	<b>CPU</b>	Default Operating System/CPU Probe	Lotus Notes Template Development	21.07.2005 18:02:31
1	0	<b>Disk</b>	Default Operating System/Disk Probe	Lotus Notes Template Development	21.07.2005 18:02:31
1	0	<b>Memory</b>	Default Operating System/Memory Probe	Lotus Notes Template Development	21.07.2005 18:02:31
1	0	<b>Network</b>	Default Operating System/Network Probe	Lotus Notes Template Development	21.07.2005 18:02:31
2	0	<b>Replication</b>			
5	0	<b>Security</b>			
1	0	<b>Server</b>			
2	0	<b>Web</b>			
47	0				





## Domino 6 performance improvements

- Database design element compression
- On-demand collations
- Prevent Simple Search (for database which has no Full Text Index)



## Domino 8.5 performance

- New ODS improvements
- DAOS (reduce DB size 50-70%) thus reducing db read time, disk overall load

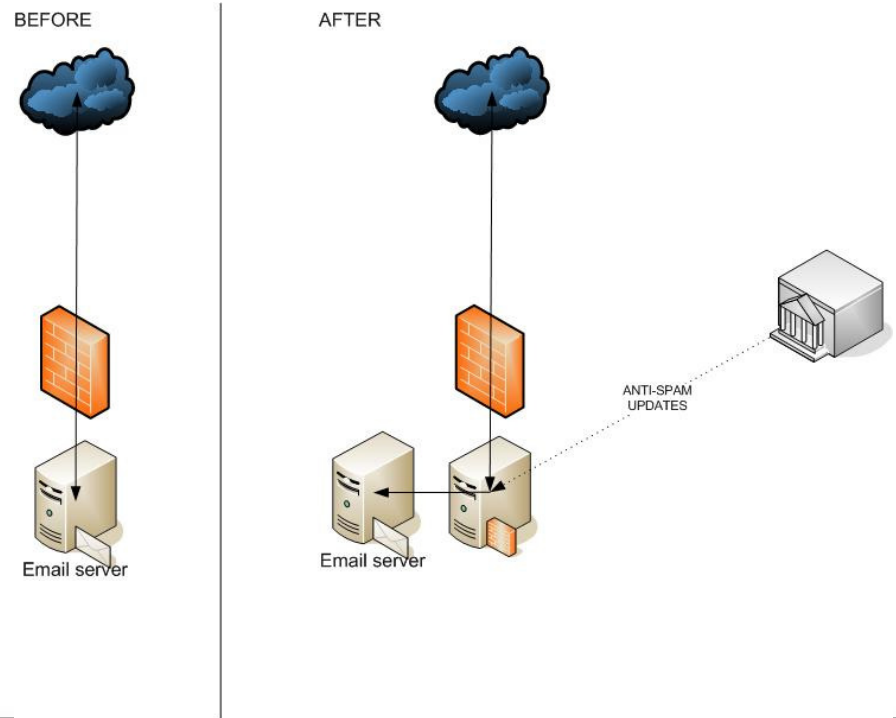
Use DAOS estimator

- GZIP compression 8.5.1



# Separate ANTI-SPAM

- Implement “Verify Local Recipient exists in Domino Directory”
- Implement BlackLists (if there is no Anti-SPAM)
- 90% of all emails – SPAM





# Mail Routing tuning

- Server should have at least 3 mailboxes
- Router when delivers mail, locks a mail.box, thus implementing 3 mailboxes improves mail delivery.
- If one mailbox is corrupted, mail flows through other mailboxes

**Configuration Settings** : \*

Basics | Smart Upgrade | LDAP | **Router/SMTP** | MIME | NOTES.INI Settings |

**Basics** | Restrictions and Controls... | Message Disclaimers | Message Tracking

**Router/SMTP Basics**

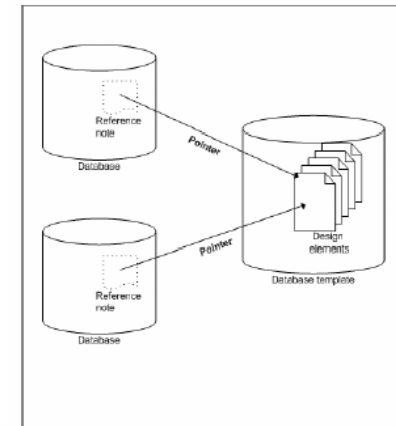
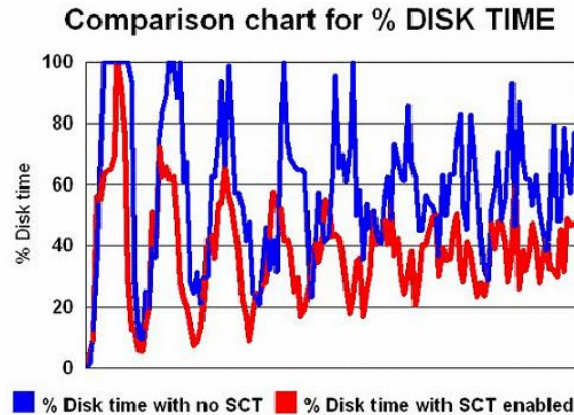
**Number of mailboxes:** 3

SMTP used when sending messages outside of the local internet domain: Enabled



## Single Copy Template (6.x, 7.x, 8.x)

- Improves read performance for mail servers
- saves ~10MB of space per user,  
10 users-100MB, 100user-1GB, 1000-10GB.
- When user count is more than 500, you may create various STC, in case if STC template is corrupted, only part of users is not working
- After upgrade, you should re-enable STC in a Template





## Domino performance depending on version

- Domino 8.5/8 is 50%-75% faster than Domino 7.x
- Domino 7.x 50% faster than Domino 6.x
- Domino 8.5,8,7.x uses CPU more effectively
- Less disk usage (caching)
- Can serve more users than Domino 6, and Domino 5





# Things to get home

1. Configure separate disk, configure Transactional Logging, RAID 1
2. Transactional Logging - Favour RunTime
3. RAID 1, RAID 10
4. Disks 10K rpm->15K rpm
5. Enable traffic compression (traffic)
6. On email servers, enable SCT (single Copy Template)
7. Archive databases (split database into two big&slow, and small&fast)
8. Perform OS tuning (Sharing, Spooler, ...)
9. OS monitoring
10. `DEBUG_CAPTURE_TIMEOUT`, `DEBUG_SHOW_TIMEOUT`, `DEBUG_THREADID` (should consult someone)
11. Don't run Oracle or other software on same box with Domino
12. Implement `VIEW_REBUILD_DIR` (for index rebuilding, else DATA disk will be used)



# Application tuning





# Database size depends on the size of

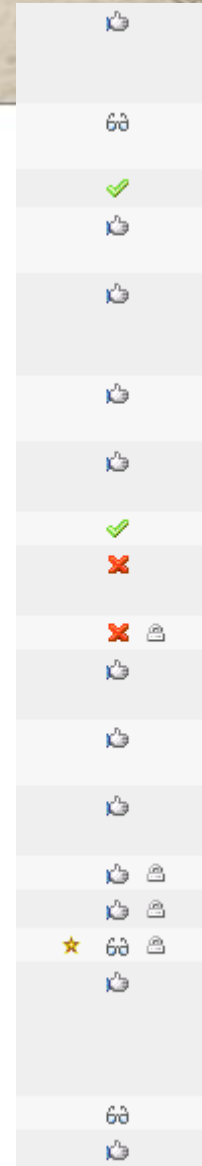
- Database design
- Documents
  - Document data
  - Attachment
  - Agent Log (!!!!)
  - Unread Marks
- View Indexes
- View indexes may occupy 60-80% of database size.
- View could should not exceed 50 views per database,





# View icons -> impacts view index

- @IF(Status="Status\_1";1;  
@IF(Status="Status\_2";90;  
@IF(Status="Status\_3;55))
- This function is calculated EVERY time, when user opens a View, this function is applied to EVERY SINGLE document. Imagine a database with 40'000 documents, x3 nested @IF
- Solution, calculate function in a document, and store result in this field will store icon number, 1, 90, or 55.
- Tremendously decreases size of View INDEX





# Database View count < 50 views, View Index size

The screenshot shows a database management interface. A context menu is open over a list of databases, with 'Manage Views...' selected. A dialog box titled 'Manage the views of this database' is displayed, showing the selected database 'requests.nsf, 1.9 GB bytes' and a summary: 'The view indexes of this database consume 334 MB of disk space, which is 17% of the entire space used by this database.' Below this is a table of views.

View name	Size	Owner	Refresh	Discard	N
Problēmas	102 738 200	Template Develc	Automatic	If inactive for 45 d	▲
Pēc projekta, klienta\stā	62 556 008	Template Develc	Automatic	On Server After 5	□
Pēc projekta, klienta\stā	52 858 664	Template Develc	Automatic	On Server After 5	□
Pēc projekta, klienta\stā	52 210 296	Template Develc	Automatic	On Server After 5	□
Pa projektiem, statusiem	22 077 280	Template Develc	Automatic	On Server After 5	□
Pa projektiem, prioritātēm	19 683 840	Template Develc	Automatic	On Server After 5	□
Pēc projekta\statusa	18 523 720	Template Develc	Automatic	On Server After 5	□
(Pēc pieteikuma koda - u	9 557 688	Template Develc	Automatic	If inactive for 45 d	▼
(Pieteikuma kodi)	6 513 232	Template Develc	Automatic	If inactive for 45 d	▼





## Show database <path\database\_filename.nsf>

show database XYZ\requests.nsf

Remote console command issued by Vladislavs Tatarincev/OrgX: show database XYZ\requests.nsf

show database XYZ\requests.nsf

DB Requests

Document Type	Live	Deleted
Documents	30 634	7
Info	1	0
Form	33	0
View	61	0
Icon	1	0
Design	1	0
ACL	1	0
Help Index	0	0
Help	1	0
Macro	80	0
Shared Field	1	0
Repl. Formula	2	0
Private Design	0	0
Unknown	71	0

View sizes

Bytes

Pēc projekta\klienta problēmu kodi 0  
Pēc projekta\prioritātes - ar dienām 185 080  
Pēc projekta\statusa, risināšanas ilguma 185 256  
Pēc projekta, klienta\stāvokļa, atbildīgā 52 210 296  
(Pieteikumu kodi) 6 513 232  
Problēmas 102 738 200  
(Pēc pieteikuma koda - uniq) 9 557 688





# UNREAD MARKS

- Unread Marks – enabled by Default
- Each user has his own set
- 10 users-10 sets, 1000-1000sets
- Before the 6<sup>th</sup> version, unread marks where stored in Workspace file, starting from 6.x in database
- 70% applications don't use UM, but by default they are calculated

View		
#		
1	Document	1
2	Document	2
3	Document	3
4	Document	4
5	Document	5

User 1		
#		
1	Document	1
2	Document	2
5	Document	5

User 2		
#		
1	Document	1
2	Document	2
3	Document	3
4	Document	4
5	Document	5

User 3		
#		
1	Document	1
2	Document	2
3	Document	3

user 4		
#		
1	Document	1
2	Document	2
4	Document	4
5	Document	5

User 5		
#		
1	Document	1
3	Document	3
5	Document	5





# VIEW Sorting

- Two-way sorting for columns

Creates a  $2^n$  tables, where  $n$  is sortable column count, and only one subset will be displayed to a user

Alias 

Last Modified 

Last Modified By 





# Categorization

- Don't use more than 3 categorized columns in a view. Categorized columns are performance killers.

The screenshot shows a software interface with a tree view on the left and a detailed view on the right. The tree view shows a hierarchy: Performance\_demo > main > 1999 > 11 > 30 > 12 > 2000 > 2001. The detailed view shows a 'Database' window with the following information:

Category	Value	Action
Size	Disk space: 18 MB	% used
	Documents: 30 000	Compact
Activity	Created: 09.10.2004 20:32:42	User Detail...
	Modified: 09.10.2004 21:45:19	
Replica ID: C2256F28:006060AC		
ODS version: 43		





# @Time functions

YEAR	MONTH	DAY	TIME
1999	11	30	

**Database**

Size: Disk space: 43 MB 98.8% % used  
Documents: 10 000 Compact

Activity: Created: 09.10.2004 20:32:42 User Detail...  
Modified: 13.10.2004 21:18:08

Replica ID: C2256F28:006060AC  
ODS version: 43

YEAR	MONTH	DAY	TIME
2001	1	1	

**Database**

Size: Disk space: 27 MB 98.8% % used  
Documents: 10 000 Compact

Activity: Created: 09.10.2004 21:50:10 User Detail...  
Modified: 13.10.2004 21:22:48

Replica ID: C2256F28:0067786D  
ODS version: 43

**YEAR (Column) : Column Value**

Display  Simple Function  Field  Formula

@Year(Date)

**YEAR (Column) : Column Value**

Display  Simple Function  Field  Formula

year



Calculate @Time functions in a form, and in the view just display results





# Tip of the Year!

- Instead of using @Today, create an agent that stamps today's date to a field fld\_Today, then use this field instead of @Today
- Benefit from this:  
Calculate once per night, use it all the day long





# Full-Text index

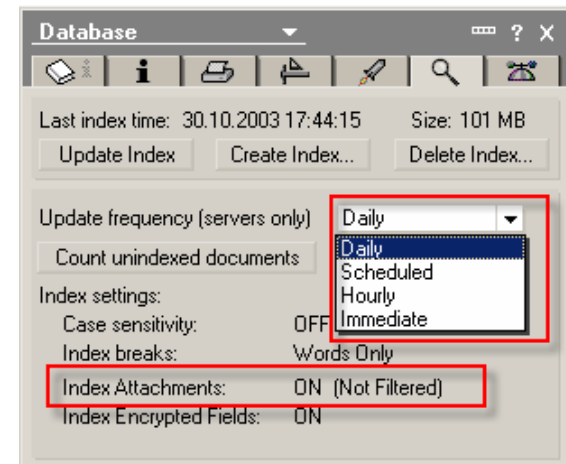
- By default index trigger is IMMEDIATE
- Index can occupy space that is close to db size
- Better use Daily trigger

notes.ini

```
UPDATE_NO_FULLTEXT=1
```

TN #1092096

- VIEW\_REBUILD\_DIR notes.ini



Use LotusScript Agent to cycle through NotesDb directory,  
and change trigger (on mail servers)





# Attachment compression

- LZ1 should be enabled only when clients are 6.x, or 7.x, don't try this in a mixed environment (5.x)
- Better enable this when all clients are at least 6.5.5 or 6.5.6 (previous versions have some bugs)
- You can convert existing attachments

Load compact -ZU mail\filename.nsf

Don't run this command during office hours... ☺

**Upgrading existing attachments from Huffman to LZ1 compression**

<http://www-1.ibm.com/support/docview.wss?uid=swg21256241>





# Agent Profiling

Agent

Run as web user  
 Run on behalf of:   
 Allow remote debugging  
 Allow user activation  
 Profile this agent  
 Set runtime security level: (1 = most secure)  
 1. Do not allow restricted operations

Default access for viewing and running this agent  
 All readers and above  
 OtherDomainServers  
 Raphael Saviz/Westford/IBM  
 Raphael Saviz/LSDevelopment

Allow Public Access users to view and run this agent

## Slow Mail Agent (ByViewEntryCollection) Profile

02/10/2005 06:31:47 PM EST  
 Elapsed time: 76800 msec  
 Total measured time: 75499 msec

Class	Method	Operation
View	GetAllEntriesByKey	
Database	Open	
DbDirectory	GetNextDatabase	
Database	GetView	
DbDirectory	GetFirstDatabase	
Database	Title	
Database	FilePath	
Database	Size	
ViewEntryCollection	Count	

## Slow Mail Agent (GetMail\_ftSearch) Profile

02/10/2005 06:17:14 PM EST  
 Elapsed time: 3400179 msec  
 Total measured time: 3375808 msec

Class	Method	Operation	Calls	Time
Database	FTSearch		27	3312723
Database	Open		76	48044
DbDirectory	GetNextDatabase		76	8292
DbDirectory	GetFirstDatabase		1	3204
DocumentCollection	GetNextDocument		243	2402
Managers	Get		27	761
GetFirstDocument			26	261
Server	Get		1	101
Title	Get		76	10
Size	Get		243	10
FilePath	Get		76	0
Size	Get		76	0
CurrentDatabase	Get		1	0
GetDbDirectory			1	0

## Slow Mail Agent (AllDocs) Profile

02/10/2005 10:19:16 PM EST  
 Elapsed time: 1675560 msec  
 Total measured time: 1460396 msec

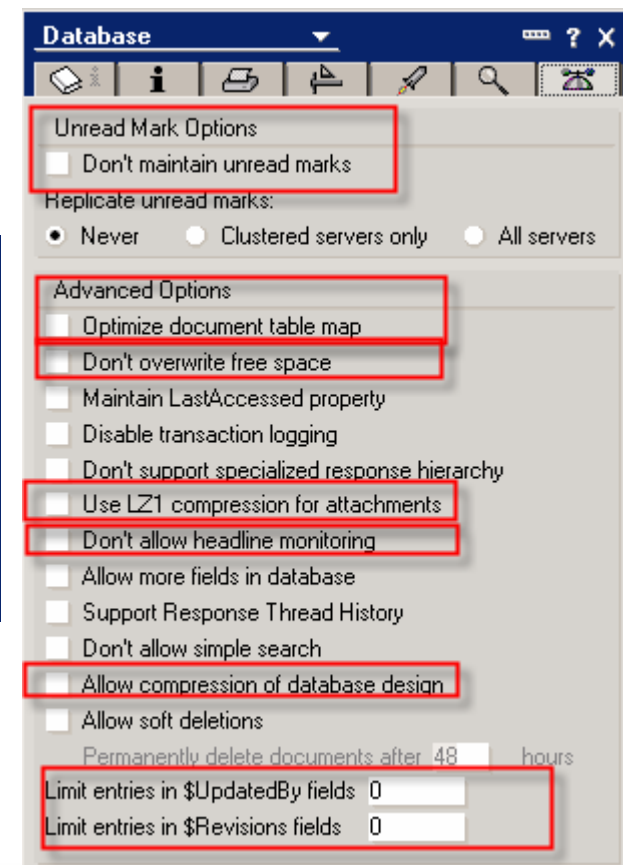
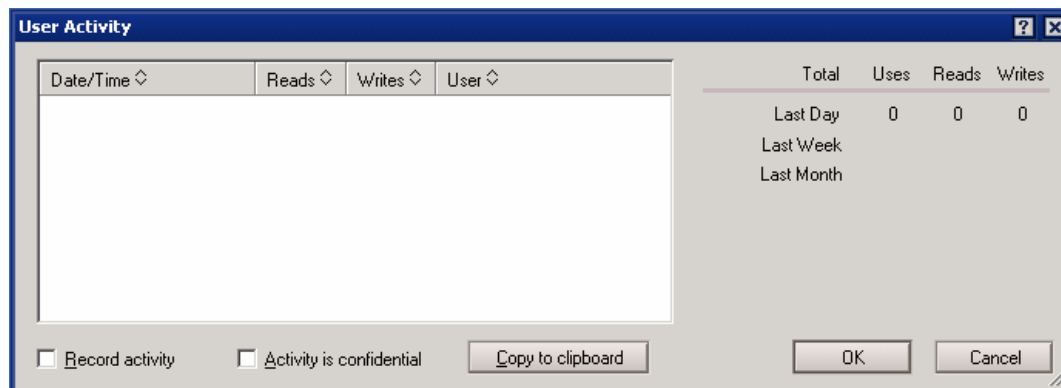
Class	Method	Operation	Calls	Time
DocumentCollection	GetNextDocument		1300359	1403516
Document	Size	Get	1300359	40625
Database	Open		89	14182
DocumentCollection	GetFirstDocument		31	1663
DbDirectory	GetNextDatabase		89	380
DbDirectory	GetFirstDatabase		1	20
Database	Title	Get	89	10
Database	FilePath	Get	89	0
Database	Size	Get	89	0
Database	AllDocuments	Get	31	0
Session	CurrentDatabase	Get	1	0
Session	GetDbDirectory		1	0
Database	Server	Get	1	0





# Database Advanced Settings

- DB Advanced settings impact performance
- User Activity Logging





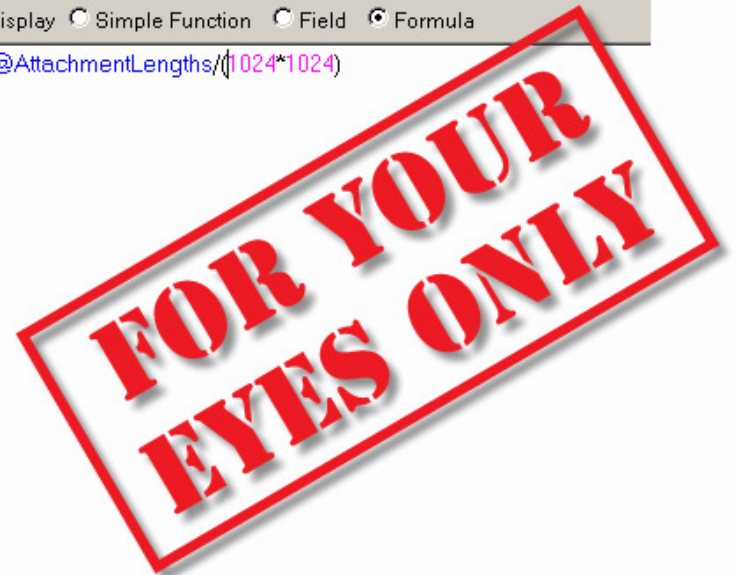
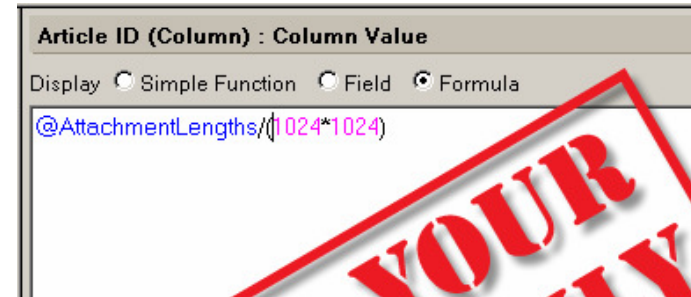
# Performance Nightmare stories





# Performance Worst Practice

- A developer created a column to depict a document size in megabytes.
- To be sure how many bytes in one megabyte he multiplied (1024\*1024)
- Multiplication took place for 32'000 documents, for EACH !!! document





## Performance worst practice (cont)

- CPU spikes on mail server every 5 minutes (3000 users)
- Every Spike is about 2 minutes when CPU utilized for 100%

- A cause of the problem:

One mail files, of a department manager, db.size=1GB,  
with ....

Full-text index IMMEDIATE





# Things to get home

1. Disable Unread Marks (if possible)
2. All calculations perform in a form, not in a view
3. Disable two-way sorting
4. Minimize a category/view/column count
5. DB.Views.Count should be less than 50
6. Full-TEXT index trigger= Hourly/Daily, not Immediate (default)
7. Advanced Database settings
8. Action buttons should call agents or functions from ScriptLibraries
9. Working with a Collection don't use GetNthDocument, use getNextDocument(doc) instead
10. Use AgentProfiling
11. Don't write comments in columns, don't use "REM".





# Internet resources

<http://www.redbooks.ibm.com/redpapers/pdfs/redp4182.pdf>

- <http://www.ibm.com/developerworks/lotus/library/domino7-enterprise-performance/>
- RedPaper – Lotus Domino Domain Monitoring

<http://www.redbooks.ibm.com/redpapers/pdfs/redp4089.pdf>

Domino Tuning Parameters in notes.ini

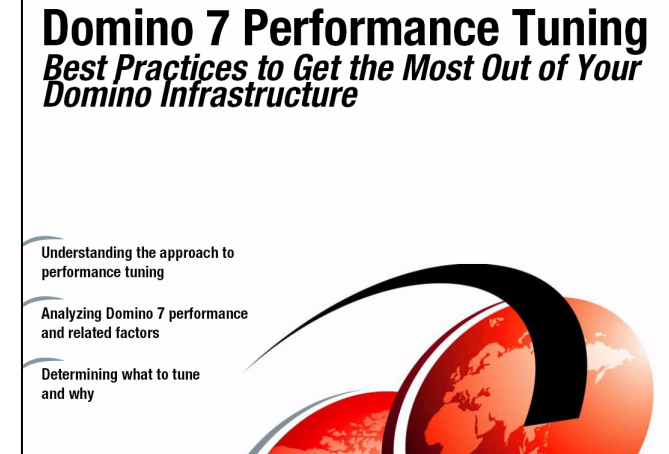
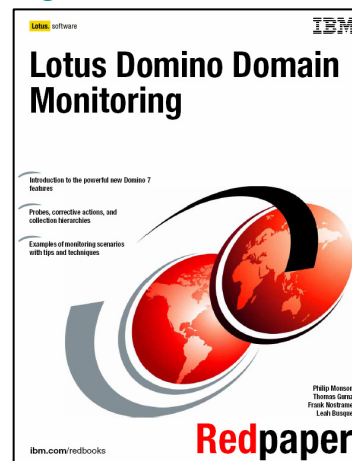
<http://www.redbooks.ibm.com/abstracts/tips0421.html?Open>

NameLookup performance fixes that address unnecessary updates

<http://www-1.ibm.com/support/docview.wss?uid=swg21254752>

Notes/Domino Best Practices: Performance (very good)

<http://www-1.ibm.com/support/docview.wss?uid=swg27008849>





# Vladislav Tatarincev

- E-mail: [vlaad@vlaad.lv](mailto:vlaad@vlaad.lv)  
[vlaad@cyone.eu](mailto:vlaad@cyone.eu)

DUAL Principal Certified Lotus Professional 5.x, 6.x, 7.x

IBM Certified Instructor Lotus Domino 6.x, 7.x, 8.x, 8.5.x

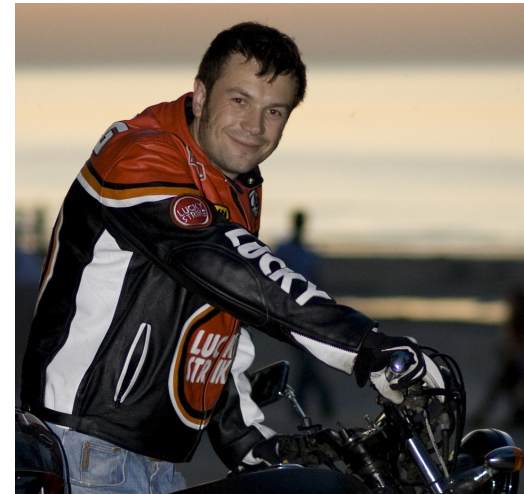
IBM Lotus Certified Security Professional

My blog: <http://www.vlaad.lv/>

Company: [www.cyone.eu](http://www.cyone.eu)

Lotus Consulting

- Migrations
- Administration
- Server consolidation
- Audits (security)
- Health checks





Thank you

