

May 6-10, 2007

San Jose Convention Center

San Jose, California, USA

Session: K08

Unix Tools and Scripts to Monitor Informix IDS

IDUG® 2007

North America

Lester Knutsen
Advanced DataTools Corporation

May 08, 2007 4:20 PM - 5:20 PM

Platform: Informix IDS



GoFurther

Presentation Abstract

- To tune the performance of your Informix IDS Server, performance statistics need to be monitored and collected.
- This session will focus on how to use Unix utilities and scripts, what to monitor, and scripts to collect data to tune your server.
- We will look at UNIX utilities including SAR, vmstat, iostat, and top to identify bottlenecks and areas where you can improve the performance of the database server.

Background

Lester Knutsen has been developing database applications with Informix databases since 1983. He is president of Advanced DataTools, an IBM-Informix Consulting, Training, and Tools Partner specializing in data warehouse development, database design, performance tuning, and Informix training and support. Currently, Lester specializes in developing web-enabled data warehouse systems. He provides training and consulting in database design and performance tuning, and is widely known in the Informix community for his extensive experience and teaching skill. Lester is also president of the Washington D.C. Area Informix Users Group, one of the largest and most active Informix user groups, and is one of the founding members of the International Informix Users Group. Lester is also a member of the IBM Gold Consultant program.

Advanced DataTools

3

Areas to Monitor and Tune

- CPU Usage – How busy are the CPUs?
- Memory Usage – How much memory is being used?
- Disk Usage – What is the disk I/O throughput?
- Network Usage – What is the network utilization?

Unix Tools we will use to Monitor Performance

- SAR – System Activity Recorder
- VMSTAT – CPU and virtual memory statistics
- MPSTAT – Per-CPU statistics
- IOSTAT – Disk I/O throughput statistics
- VXSTAT – Veritas Volume Manager statistics
- PS – Unix processes statistics
- TOP – Top Unix processes statistics
- PSTAT - Top Solaris processes statistics
- NETSTAT – Network statistics

Advanced DataTools

5

Informix Tools we will use to Monitor Performance

- ONSTAT – Shared memory server statistics
- SYSMASTER DATABASE – Shared memory server statistics
- Server Studio (New 4.0) – Command and control center for Informix Server

SAR – System Activity Recorder

- Setup as a cron job to collect statistics and saves them to a file /var/adm/sa/sa??
- Example Cron setup to collect data every 15 minutes:

```
0,15,30,45 * * * * /usr/lib/sa/sa1
```
- SAR command displays the data collected
- Can also be run in real-time:

```
sar 5 5
```

SAR Reporting Options

- a Report use of file access system routines
- b Report buffer activity
- c Report system calls
- d Report activity for each device (disk or tape drive)
- g Report paging activities
- k Report kernel memory allocation (KMA) activities
- m Report message and semaphore activities
- p Report paging activities
- q Report average queue length
- r Report unused memory pages
- u Report CPU utilization (the default)
- v Report status of process, i-node, file tables
- w Report system swapping and switching activity
- y Report TTY device activity
- A Report all data. Equivalent to -abcdgkmpqruvwy

Advanced DataTools

8

SAR Collection Options

- -i sec - Select data at intervals as close as possible to sec seconds.
- -s time - Select data later than time in the form hh[:mm]. Default is 08:00.
- -f filename - Use filename as the data source for sar. Default is the current daily data file /var/adm/sa/sadd.
- -o filename - Save samples in file, filename, in binary format.

SAR – Default Output

	%usr	%sys	%wio	%idle
00:00:00				
07:00:00	27	3	0	70
07:15:02	61	6	0	33
07:30:01	47	4	0	49
07:45:01	28	3	0	70
08:00:00	30	2	0	68
08:15:00	50	3	0	46
08:30:01	56	3	0	41
08:45:00	22	2	0	77

Advanced DataTools

10

VMSTAT – CPU and Memory

- Options:
vmstat [-cipsS] [disks] [interval [count]]
- Example:

```
lester@ >vmstat 5 5
```

procs			memory				page				disk				faults			cpu			
r	b	w	swap	free	re	mf	pi	po	fr	de	sr	s0	s1	s2	s3	in	sy	cs	us	sy	id
0	0	0	4350896	573168	0	0	0	0	0	0	0	0	1	1	7	4294967196	0	0	-5	-1	-104
0	0	0	3749680	370888	106	68	0	0	0	0	0	0	0	1	0	237	835	839	9	1	90
0	0	0	3748784	369728	3	3	0	0	0	0	0	0	0	1	0	233	368	728	25	0	75
0	0	0	3748816	369760	1	1	0	0	0	0	0	0	0	0	0	233	287	692	25	0	75
0	0	0	3748816	369760	0	0	0	0	0	0	0	0	0	1	0	226	278	715	9	2	89

MPSTAT – Per-CPU Statistics

- Options:
mpstat [-p | -P set] [interval [count]]
- Example on a 4 CPU machine:

CPU	minf	mjf	xcal	intr	ithr	csw	icsw	migr	smtx	srw	syscl	usr	sys	wt	idl
44	1	0	20	304	200	115	10	19	13	0	60	51	0	0	49
45	1	0	16	5	2	240	2	46	10	0	107	5	1	0	94
46	0	0	5	6	1	188	4	38	6	0	82	21	0	0	79
47	0	0	2	9	1	181	7	39	8	0	69	24	0	0	76
CPU	minf	mjf	xcal	intr	ithr	csw	icsw	migr	smtx	srw	syscl	usr	sys	wt	idl
44	1	0	28	303	200	133	8	22	13	0	69	39	0	0	61
45	0	0	2	11	2	182	7	38	6	0	78	27	0	0	72
46	0	0	4	8	1	191	5	42	7	0	74	9	8	0	83
47	0	0	7	12	1	175	9	38	9	0	77	33	0	0	67

IOSTAT – Disk I/O Statistics

- Options:

```
iotstat [ -cCdDeElmMnpPrstxz ] [ -l n ] [ -T u | d ] [ disk ... ] [ interval [ count ] ]
```

- Example:

```
iotstat 5 5
  tty          sd0          sd1          sd2          sd3          cpu
tin tout kps tps serv kps tps serv kps tps serv kps tps serv us sy wt id
0  33  0  0  1  58  1  11  20  1  10  38  7  2  5  1  0  94
0  47  0  0  0  0  0  0  3  0  5  5  3  3  2  1  0  96
0  16  0  0  0  0  0  0  3  0  4  0  0  0  0  0  0  100
0  16  0  0  0  0  0  0  0  0  3  0  0  0  3  0  0  96
0  16  0  0  0  0  0  0  28  4  7  0  0  0  1  0  0  98
```

VXSTAT – Veritas Volume Manager Statistics

- Part of Veritas Volume Manager
- To display disk statistics, use the `vxstat -d` command:

TYP	NAME	OPERATIONS		BLOCKS		AVG TIME(ms)	
		READ	WRITE	READ	WRITE	READ	WRITE
dm	disk01	40473	174045	455898	951379	29.5	35.4
dm	disk02	32668	16873	470337	351351	35.2	102.9
dm	disk03	55249	60043	780779	731979	35.3	61.2
dm	disk04	11909	13745	114508	128605	25.0	30.7

PS – Unix Processes Statistics

- **Key Options:**
 - e List information about every process now running.
 - f Generate a full listing.
 - l Generate a long listing.
 - P Print the number of the processor to which the process or lwp is bound.
 - t term List only process data associated with term.
 - u uidlist List only process data whose effective user ID number or login name is given in uidlist.
 - U uidlist List information for processes whose real user ID numbers or login names are given in uidlist.

PS – Unix Processes Examples

lester@atlas >ps -fu informix | more

UID	PID	PPID	C	STIME	TTY	TIME	CMD
informix	416	1	0	Apr 17	?	0:05	oninit -yv
informix	418	417	0	Apr 17	?	0:05	oninit -yv
informix	428	1	0	Apr 17	?	0:11	oninit -yv
informix	4085	3984	0	14:45:38	pts/2	0:00	dbaccess
informix	3984	3966	0	14:44:03	pts/2	0:00	bash
informix	3927	1	0	14:23:31	?	16:21	oninit
informix	3966	874	0	14:37:34	pts/2	0:00	-ksh

lester@atlas >ps -lu informix | more

F	S	UID	PID	PPID	C	PRI	NI	ADDR	SZ	WCHAN	TTY	TIME	CMD
8	S	202	416	1	0	41	20	?	17648	?	?	0:05	oninit
c	S	202	418	417	0	41	20	?	17647	?	?	0:05	oninit
8	S	202	428	1	0	40	20	?	14792	?	?	0:11	oninit
8	S	202	4085	3984	0	41	20	?	654	?	pts/2	0:00	dbaccess
8	S	202	3984	3966	0	51	20	?	311	?	pts/2	0:00	bash
8	S	202	3927	1	0	41	20	?	17389	?	?	16:21	oninit
8	S	202	3966	874	0	51	20	?	236	?	pts/2	0:00	ksh

Advanced DataTools

16

TOP – Top Unix Processes

```
last pid: 9146; load averages: 1.76, 1.65, 1.61          20:16:10
143 processes: 133 sleeping, 3 zombie, 5 stopped, 2 on cpu
CPU states: 87.6% idle, 9.9% user, 2.4% kernel, 0.0% iowait, 0.0% swap
Memory: 12G real, 1122M free, 3899M swap in use, 8K swap free
```

PID	USERNAME	THR	PRI	NICE	SIZE	RES	STATE	TIME	CPU	COMMAND
7928	root	7	58	0	28M	26M	sleep	8:36	5.17%	dsmc
2553	informix	5	30	-10	3625M	2896M	cpu17	457.3H	1.58%	oninit
2549	informix	5	59	-10	3625M	2952M	sleep	502.2H	1.23%	oninit
2551	informix	5	51	-10	3625M	2907M	sleep	613.5H	1.19%	oninit
2555	informix	5	51	-10	3625M	2888M	sleep	373.4H	0.92%	oninit
2539	informix	5	59	-10	3625M	2959M	sleep	496.5H	0.80%	oninit
2550	informix	5	59	-10	3625M	2935M	sleep	684.9H	0.70%	oninit
9145	lester	1	50	0	2544K	2120K	cpu16	0:01	0.61%	top
2552	informix	5	59	-10	3625M	2906M	sleep	528.3H	0.59%	oninit
2554	informix	5	59	-10	3625M	2894M	sleep	396.3H	0.52%	oninit
2329	root	1	58	0	13M	3040K	sleep	579:30	0.02%	jre
9121	root	1	58	0	5112K	2264K	sleep	0:00	0.02%	bpsched
14191	root	1	48	0	5176K	2336K	sleep	0:13	0.01%	bpsched
9114	lester	1	43	0	1648K	1200K	sleep	0:00	0.01%	ksh
9117	root	1	48	0	10M	5808K	sleep	0:00	0.01%	bprd

Advanced DataTools

17

PSTAT - Top Solaris Processes

```

PID USERNAME  SIZE  RSS STATE PRI NICE   TIME    CPU PROCESS/NLWP
4424 lester   1616K 1424K cpul   55   0   0:00.00  0.1% prstat/1
4414 lester   1928K 1264K sleep  41   0   0:00.00  0.1% ksh/1
853 nobody    43M   26M sleep  58   0   0:00.03  0.1% java/27
4412 root     1840K 1328K sleep  54   0   0:00.00  0.0% in.telnetd/1
407 informix  143M 1240K sleep  59  -10  0:00.00  0.0% dninit/1
405 informix  143M 1576K sleep  59  -10  0:00.00  0.0% dninit/1
406 informix  143M   12M sleep  59  -10  0:00.07  0.0% dninit/2
762 root      952K   480K sleep  51   0   0:00.00  0.0% readproctitle/1
376 root     2352K 1608K sleep  45   0   0:00.00  0.0% daspd/5
389 root     1656K  792K sleep  31   0   0:00.00  0.0% dimomboot/1
251 root     3040K 2368K sleep  52   0   0:00.00  0.0% rscd/7
225 root     3824K 2008K sleep  59   0   0:00.00  0.0% automountd/5
379 root      50M   19M sleep  58   0   0:00.00  0.0% daspeng/21
2339 root     1976K 1264K sleep  48   0   0:00.00  0.0% cron/1
257 root     3160K 1016K sleep  58   0   0:00.00  0.0% lpsched/1
388 root     1064K  672K sleep  59   0   0:00.00  0.0% utmpd/1
3527 root     3696K 1960K sleep  58   0   0:00.00  0.0% syslogd/13
224 root     2224K 1432K sleep  48   0   0:00.00  0.0% inetd/1
404 informix  143M  129M sleep  59  -10  0:00.12  0.0% dninit/2
168 root     4608K 2136K sleep  58   0   0:00.03  0.0% skipd/1
56 root     2232K 1192K sleep  53   0   0:00.00  0.0% svaeventd/9
Total: 117 processes, 586 lwps, load averages: 0.02, 0.03, 0.04

```

NETSTAT – Network Statistics

- Options:

```
usage: netstat [-anv] [-f address_family]
       netstat [-g | -p | -s] [-n] [-f address_family] [-P protocol]
       netstat -m
       netstat -i [-I interface] [-an] [-f address_family] [interval]
       netstat -r [-anv] [-f address_family]
       netstat -M [-ns] [-f address_family]
       netstat -D [-I interface] [-f address_family]
```

- Example

```
lester@atlas >netstat -i
Name Mtu Net/Dest Address Ipkts Ierrs Opkts Oerrs Collis Queue
hme0 1500 atlas.addt.com atlas.addt.com 92751 0 50571 0 0 0
lo0 8232 loopback localhost 80430 0 80430 0 0 0
```

Advanced DataTools

19

CPU Monitoring

- Are the CPUs overloaded?
- Factors:
 - Number of CPUs
 - Speed of CPUs (old vs new systems)
 - Number of process needing CPU time.

How Busy are the CPU's?

- Tools to monitor:
 - sar -u
 - vmstat
 - mpstat
 - top, prstat
- Performance Guideline - % CPU busy:
 - < 30 % - Good
 - 30-60% - Fair
 - > 60% - Poor

Advanced DataTools

21

SAR – Example

00:00:00	%usr	%sys	%wio	%idle	
07:00:00	27	3	0	70	
07:15:02	61	6	0	33	← Poor
07:30:01	47	4	0	49	
07:45:01	28	3	0	70	
08:00:00	30	2	0	68	← Fair
08:15:00	50	3	0	46	
08:30:01	56	3	0	41	
08:45:00	22	2	0	77	← Good

Advanced DataTools

22

How many process are waiting to run on the CPUs?

- Tools to monitor Load Average:
 - sar -q
 - Uptime
- Performance Guideline – number of waiting processes:
 - < 2 per CPU – Good
 - 2-4 per CPU – Fair
 - > 4 per CPU – Poor

CPU Load Average Example:

```
lester@atlas >uptime  
9:58pm up 2 day(s), 5:52, 4 users, load average: 0.03, 0.04, 0.04
```

- Displays run queue over the last 1, 5, and 15 minutes
- On a 4 CPU machine:
 - $< 2 \times 4 = \text{Good}$
 - $2-4 \times 4 = \text{Fair}$
 - $> 4 \times 4 = \text{Poor}$

Memory Monitoring

- Is memory being over-used or under-used?
- Memory shortage causing swapping to disk.
- Factors:
 - Amount of RAM
 - 32 bit vs 64 bit OS and applications
 - 32 bit Informix IDS limited to:
 - 3.6 GB on Solaris
 - 2 GB on AIX
 - 2 GB on Windows
- One of best Informix IDS performance improvements is adding BUFFERS

Advanced DataTools

25

How much Memory is Used?

- Tools to monitor
 - top
 - sar -r
 - vmstat
- Performance Guidelines
 - Don't monitor free memory since a good OS will use all extra memory as file system cache
 - Monitor swap space and paging in/outs

Memory – Key is to Monitor Paging In/Out

- Monitor vmstat:
 - pi - kilobytes paged in
 - po - kilobytes paged out
- Monitor sar –g
 - pgout/s - page-out requests per second.
 - ppgout/s - pages paged-out per second.
- Monitor sar –p
 - pgin/s - page-in requests per second.
 - ppgin/s - pages paged-in per second.



Out of Memory

What Processes are Using the Most Memory?

- Tools to monitor – look at the SIZE column:
 - top
 - prstat
 - ps
- Performance Guideline for Informix:
 - BUFFERS - number of shared memory buffers
 - SHMVIRTSIZE - initial virtual shared memory segment size
 - SHMADD - size of new shared memory segments
 - SHMTOTAL – total size of shared memory

Advanced DataTools

28

Monitoring Disks

- Goal is to balance I/O across all disks
 - Use: sar and iostat
- Find the FAST spot on the disk and locate key chunks there
- Find the optimal disk throughput
 - Use: pfred
<http://www.geocities.com/ahammau/informix/pfred.html>

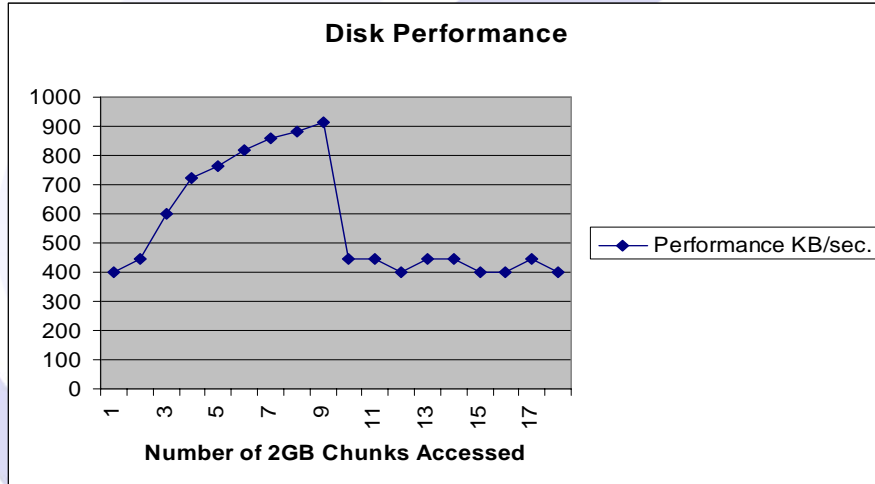
Disk Throughput

- Example pftread – 2 GB chunks on a 72 GB disk

```
pftread.ksh 1 30 /informixchunks/d4chk14
/informixchunks/d4chk14 : 1 concurrent read threads 500 KB/sec.
/informixchunks/d4chk14 : 2 concurrent read threads 500 KB/sec.
/informixchunks/d4chk14 : 3 concurrent read threads 750 KB/sec.
/informixchunks/d4chk14 : 4 concurrent read threads 800 KB/sec.
/informixchunks/d4chk14 : 5 concurrent read threads 1000 KB/sec.
/informixchunks/d4chk14 : 6 concurrent read threads 996 KB/sec.
/informixchunks/d4chk14 : 7 concurrent read threads 1071 KB/sec.
/informixchunks/d4chk14 : 8 concurrent read threads 1082 KB/sec.
/informixchunks/d4chk14 : 9 concurrent read threads 1125 KB/sec.
/informixchunks/d4chk14 : 10 concurrent read threads 500 KB/sec.
/informixchunks/d4chk14 : 11 concurrent read threads 444 KB/sec.
/informixchunks/d4chk14 : 12 concurrent read threads 500 KB/sec.
```

- Best performance is using 9 x 2GB chunks = 18GB of the 72 GB disk

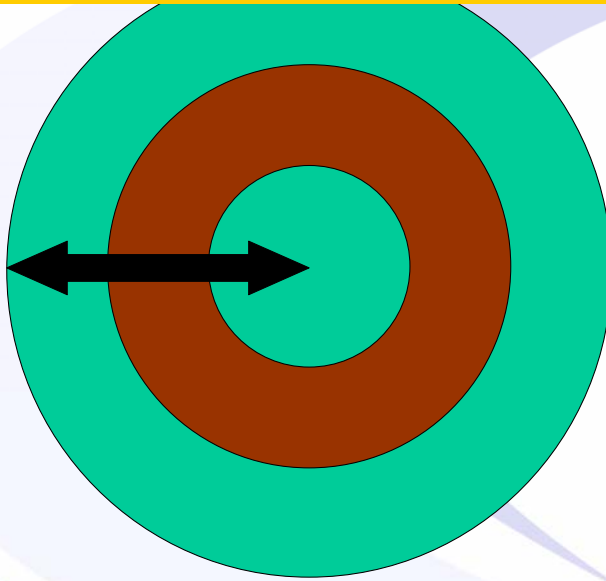
Disk Throughput – 36 GB Disk



Advanced DataTools

31

Disk Layout - The ***FASTEST*** location on a disk is where the disk arm has to move the least to read or write data



Advanced DataTools

32

Monitor Disk I/O with SAR

- Report activity for each block device (disk or tape)
 - %busy – portion of time device was busy servicing a transfer request – How busy are your disks?
 - avque – average number of requests outstanding during that time.
 - read/s, write/s, blks/s - number of read/write transfers from or to device, number of bytes transferred in 512-byte units.
 - await - average wait time in milliseconds.
 - avserv - average service time in milliseconds.

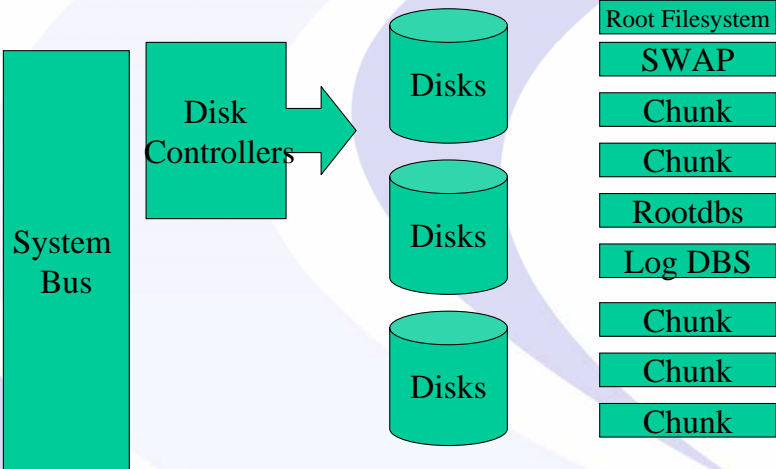
- Example `sar -d`

```
00:00:00 device %busy avque r+w/s blks/s await avserv
00:15:00 nfs1 0 0.0 0 0 0.0 0.0
sd7 11 0.7 17 225 0.0 40.2
sd7,a 0 0.0 0 0 0.0 0.0
sd7,b 0 0.0 0 0 0.0 0.0
sd7,c 0 0.0 0 0 0.0 0.0
sd7,d 0 0.0 0 0 0.0 0.0
sd7,e 11 0.7 17 225 0.0 40.2
```

Advanced DataTools

33

Map Your Disk Drives



Advanced DataTools

Create a Disk Layout Spreadsheet

- Controller/ Disk Array
- Disk
- Logical Volumes or Slices
- Chunks, Filesystems, etc...
- Tables in Chunks
- Compare results from `sar -d` and `onstat -d`

Disk Performance Spreadsheet

Disk Performance					
Disk Layout				Performance	
Controller	Disk	Volume	Chunk/Filesystem	onstat -d	sar -d
c1	disk1	d1v1			
c1	disk1	d1v2			
c1	disk1	d1v3			
c1	disk1	d1v4			
c1	disk2	d2v1			
c1	disk2	d2v2			

Advanced DataTools

36

Monitoring Network

- How measure real output of network interface?
 - FTP Test – How long does it take to ftp a 2GB file to your destination? KB per second
 - Database server cannot send data out any faster than ftp
- Measure network errors and collisions
 - Netstat -i

Network Errors and Collisions

- Tool to monitor:
 - netstat -i

- Example output:

```
lester@atlas >netstat -i
Name Mtu Net/Dest Address IpKts Ierrs OpKts Oerrs Collis Queue
hme0 1500 atlas.addt.com atlas.addt.com 102520 0 51764 0 0 0
lo0 8232 loopback localhost 101386 0 101386 0 0 0
```



- Performance Guideline – no errors or collisions

Build Your Own Monitoring System

- Provide a baseline of performance information to compare to future problems
- Collect data from:
 - sysmaster
 - sar
- Load into a database for review and analysis
- Save historical data for future comparisons

Data Collection

- Create a cron job to run data collection scripts
 - Hourly
 - Daily
 - Weekly
 - Monthly
- Build a database and load the data

Hourly Data Collection

- From sysmaster:
lk_sesprof.sql – syssession – User statistics
- From onstat:
onstat –g mgm – PDQ statistics
- From Unix:
ps –ef – collect user statistics
mpstat 5 5 – collect CPU statistics

Daily Data Collection

- From sysmaster:

- lk_profile.sql – sysprofile – System statistics
 - lk_chkio.sql – syschktab – Chunk I/O
 - lk_dbsfree.sql – sysdbspaces, syschunks – Free space
 - lk_vpprof.sql – sysvplst – VP statistics
 - lk_tabprof.sql – sysptprof – Table I/O statistics

- From sar:

- sar -u – CPU statistics
 - sar -b – Buffer statistics
 - sar -c – System calls
 - sar -d – Disk I/O statistics
 - sar -q – Run Queue statistics

Advanced DataTools

42

Weekly/Monthly Data Collection

- From sysmaster:
 - lk_tablayout.sql - sysptnext, outer systabnames
 - lk_tabextent.sql - systabnames, sysptnext
 - lk_chkstatus.sql - sysdbspaces, syschunks
 - lk_idsconfig.sql - sysconfig
- Save configuration for future reference

Updated Information

- Scripts and updated presentation at:

www.advancedatools.com

- Washington Area Informix Users group

www.iiug.org/waiug

- International Informix Users Group

www.iiug.org

Advanced DataTools

44



Thank You

Lester Knutsen

Advanced DataTools Corporation

Lester@advanceddatatools.com

Advanced DataTools

45

Session: K08

Session Title: Unix Tools and Scripts to Monitor Informix IDS

Lester Knutsen

Advanced DataTools Corporation

lester@advancedatools.com

