



# Unix Tools and Scripts to Monitor Informix IDS

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# 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.

# 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

# 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

# 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

# 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:

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

- Example:

```
iostat 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

# 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

# PSTAT - Top Solaris Processes

PID	USERNAME	SIZE	RSS	STATE	PRI	NICE	TIME	CPU	PROCESS/NLWP
4424	lester	1616K	1424K	cpu1	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%	cninit/1
405	informix	143M	1576K	sleep	59	-10	0:00.00	0.0%	cninit/1
406	informix	143M	12M	sleep	59	-10	0:00.07	0.0%	cninit/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%	caspd/5
389	root	1656K	792K	sleep	31	0	0:00.00	0.0%	dimombboot/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%	caspeng/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%	cninit/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%	svseventd/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




# 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

# SAR – Example

00:00:00	%usr	%sys	%wio	%idle	
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	

# 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:
  - $< 2 \times 4 = \text{Good}$
  - $2-4 \times 4 = \text{Fair}$
  - $> 4 \times 4 = \text{Poor}$

# How many system calls per CPU per second?

- Tools to monitor System Calls:
  - sar -c
  - vmstat
- Performance Guideline – number of System Calls per CPU (depends on speed of CPU):
  - Fast CPU - > 20,000 poor
  - Medium CPU - > 10,000 poor
  - Slow CPU - > 2,000 poor

# System Calls

- Example: `sar -c`

	scall/s	sread/s	swrit/s	fork/s	exec/s	rchar/s	wchar/s
00:00:00							
00:15:00	20606	935	299	2.52	2.06	844574	871668
00:30:00	20385	844	243	1.22	0.80	588041	1049094
00:45:00	16124	1626	812	2.54	1.74	2986193	3222280
01:00:00	16079	4983	2715	2.90	2.61	1528419	921029
01:15:00	8535	1371	478	3.66	3.55	952043	834463
01:30:00	12853	3361	535	2.80	2.09	2898274	515510
01:45:00	17618	4412	603	1.59	1.37	4723358	4413470
02:00:01	12697	1544	452	0.67	0.46	2231396	1903038
02:15:01	13821	2727	572	1.40	1.22	3362608	3644032
02:30:00	14959	4802	727	1.23	0.94	3710160	2934010
02:45:00	14583	1581	247	0.71	0.62	1567575	1431916

# 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

# 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.



# 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

# 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

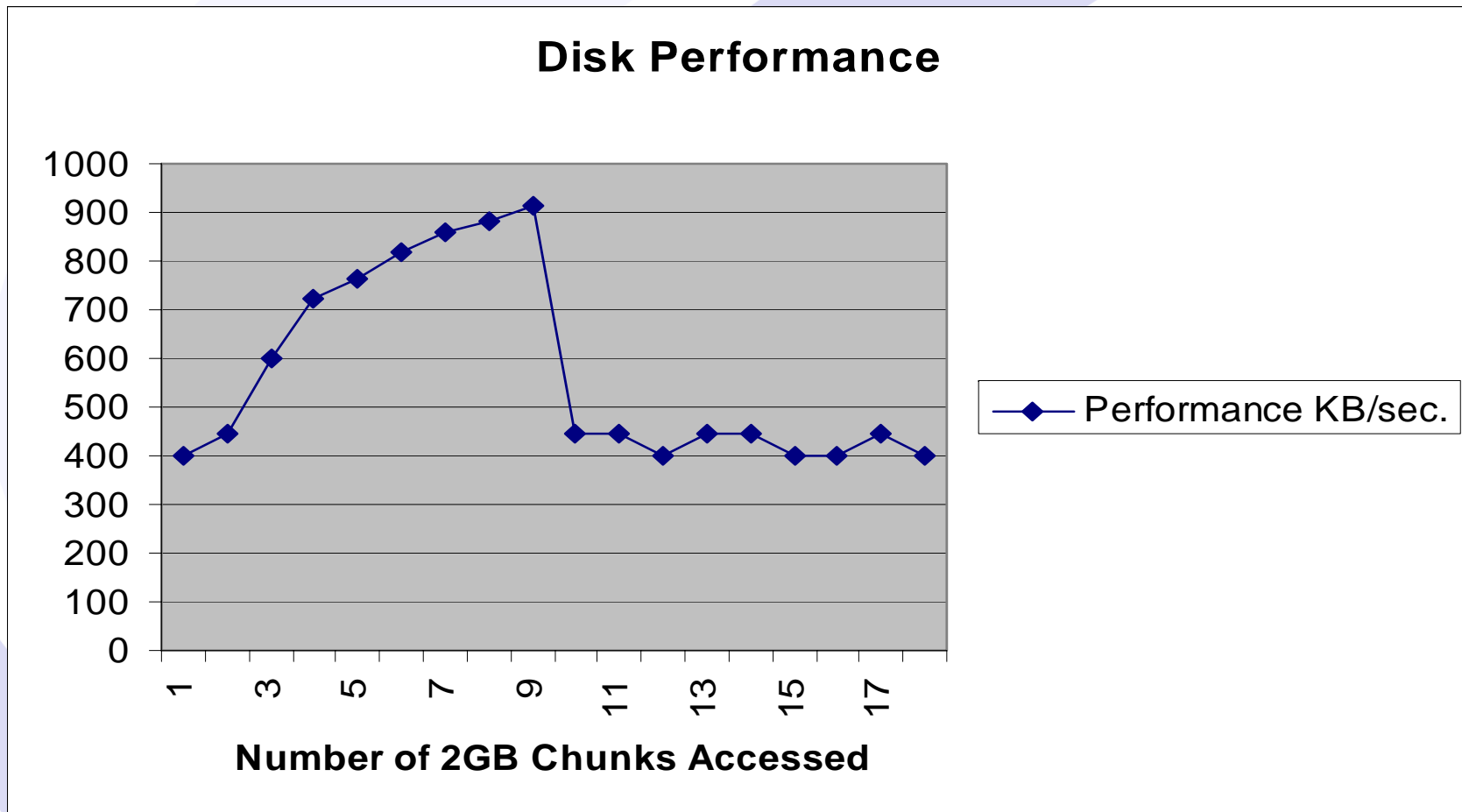
- Example pfred – 2 GB chunks on a 72 GB disk

```
pfread.ksh 1 30 /informixchunks/d4chk14
```

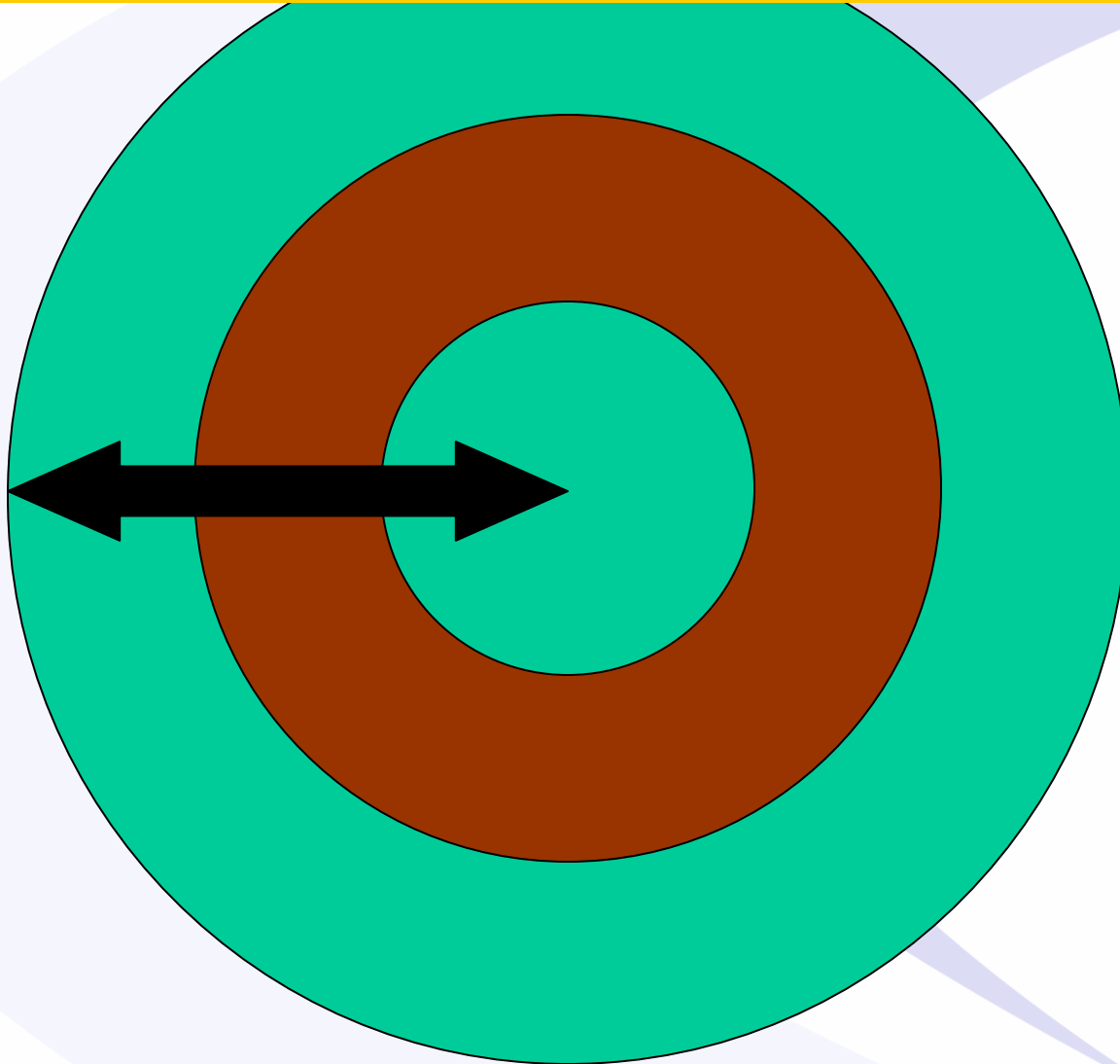
/informixchunks/d4chk14 :	1 concurrent read threads	500 KB/sec.
/informixchunks/d4chk14 :	2 concurrent read threads	500 KB/sec.
/informixchunks/d4chk14 :	3 concurrent read threads	750 KB/sec.
/informixchunks/d4chk14 :	4 concurrent read threads	800 KB/sec.
/informixchunks/d4chk14 :	5 concurrent read threads	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.
<b>/informixchunks/d4chk14 :</b>	<b>9 concurrent read threads</b>	<b>1125 KB/sec.</b>
/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



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

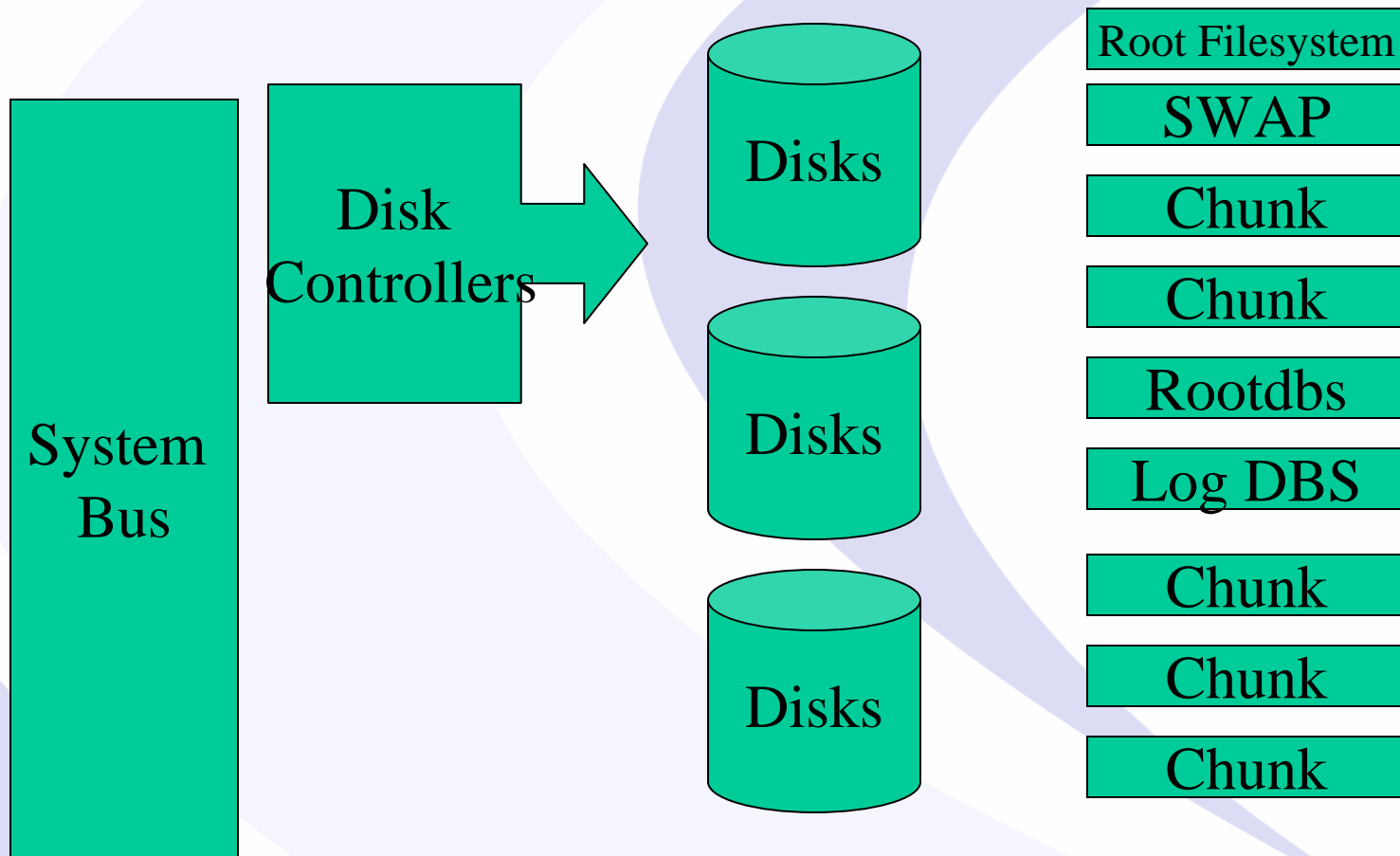


# Monitor Disk I/O with SAR

- 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

# Map Your Disk Drives



# 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			

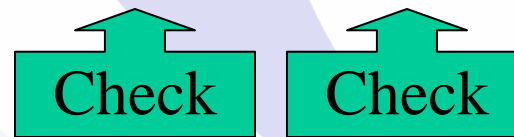
# Monitoring Network

- 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

# 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

# Coming Soon – Scripts to Collect Data

- Check:

<http://www.advanceddatatools.com/TechInfo/InformixInfo.html>

# Updated Information

- Scripts and updated presentation at:

[www.advanceddatatools.com](http://www.advanceddatatools.com)

- Washington Area Informix Users group

[www.iiug.org/waiug](http://www.iiug.org/waiug)

- International Informix Users Group

[www.iiug.org](http://www.iiug.org)



**Thank You**

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