



# Active Memory Expansion for AIX 6 & 7



**Nigel Griffiths**  
IBM Power Systems

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## Active Memory Expansion Announcement Confusion



1. Marketing thought:
  - “Expansion” sounded better than “Compression”
2. It does not “just compress memory pages”
  - It’s a lot cleverer than that!
3. “AME” also used for AIX Management Edition
  - So ActMemExp was used ..... “doh!”
  - Now AME = Active Memory Expansion

## Active Memory Expansion Pre-Reqs:

POWER7 based machine  
AIX 6.1 TL04 SP2+



Also note:

- Transparent to all applications
- Not IVM - Activation key via the HMC
  - But configured at LPAR level
- AME will switch off AIX 64KB page support
  - Can be enabled but tests showed it was slower



## Permanent Enablement - Chargeable

- One feature per server
  - No matter how many partitions (LPARs) use it
  - Permanent enablement → new server or via MES order
  - Enablement "VET" code applied to the VPD anchor card
  - Once enabled: no mechanism to move it to a different server
- Power 750 & Power 755
  - #4792 AME Enablement Feature
- Power 770 & Power 780
  - #4791 AME Enablement Feature
- It is a processor feature !!!
- One-time, 60-day Trial - No charge
  - Request via Capacity on Demand Web page  
[www.ibm.com/systems/power/hardware/cod/](http://www.ibm.com/systems/power/hardware/cod/)



## How do we switch AME on?



## Is the machine AME Capable?

Capabilities

Capability	Value
Logical Host Channel Adapter Capability	True
Logical Host Ethernet Adapter Capability	True
Huge Page Capable	True
Barrier Synchronization Register (BSR) Capable	True
Service Processor Failover Capable	True
Shared Ethernet Adapter Failover Capable	True
Redundant Error Path Reporting Capable	True
GX Plus Capable	True
Hardware Discovery Capable	True
Active Partition Mobility Capable	True
Inactive Partition Mobility Capable	True
Partition Processor Compatibility Mode Capable	True
Partition Availability Priority Capable	True
Electronic Error Reporting Capable	True
Active Partition Processor Sharing Capable	True
Firmware Power Saver Capable	True
Hardware Power Saver Capable	True
Virtual Switch Capable	True
Virtual Fibre Channel Capable	True
Active Memory Expansion Capable	True

Virtual Fibre Channel Capable  
Active Memory Expansion Capable

OK Cancel Help

HMC  
→ Server Properties  
→ Capabilities  
then scroll to the bottom

## Activate on AME on the LPAR profile

Logical Partition Profile Properties; normal @ diamond3 @ diamond-8233-E8B-SN100271P - diamond3

General Processors **Memory** I/O Virtual Adapters Power Controlling Settings HCA Logical Host Ethernet Adapters (LHEA)

Detailed below are the current memory settings for this partition profile.

**Dedicated Memory**  
Installed memory (MB): 16384  
Current memory available for partition usage (MB): 14592

Minimum memory: 0 GB 512 MB  
Desired memory: 1 GB 0 MB  
Maximum memory: 8 GB 0 MB

Specify the Barrier Synchronization Register **BSR** for this profile  
Available BSR arrays:  
BSR arrays for this profile: 0

**Huge Page Memory**  
Page size (in GB): 0  
Configurable pages:  
Minimum pages: 0  
Desired pages: 0  
Maximum pages: 0

**Active Memory Expansion**  
 Active memory expansion factor (1.00 - 10.00): 1.0

OK Cancel Help

Hard reboot (not restart) to activate LPAR in AME mode

Expansion Factor:

- 1.0 = AME on but inactive
- 1.2 to 1.5 = Good start point
- 10.0 = suicidal !

## Dynamically changing the Expansion Factor

p7hmc: Add or Remove - Mozilla Firefox

ibm.com https://p7hmc.aixncc.uk.ibm.com/hmc/content?taskId=97&refre

**Add/Remove Memory Resources - diamond3**  
You may add or remove memory from the partition by specifying the amount of memory the partition should have by changing the memory assigned to the partition.

	Gigabytes	Megabytes
Available system memory:	1	0
Minimum memory:	0	512
Maximum memory:	8	0
Assigned memory:	1	0

**Active Memory Expansion**  
Active memory expansion factor (1.00 - 10.00): 1.5

**Options**  
Timeout (minutes): 5  
Detail level: 1

OK Cancel Help

Done

Use Dynamic LPAR Memory Add/Remove and change the Expansion Factor

## How does AME work?



## AME Conceptual Model

### Memory Pages



# AME Conceptual Model

Memory Pages

RAM Disk



Not actually a RAM disk  
but similar concept

# AME Conceptual Model

Memory Pages

RAM Disk

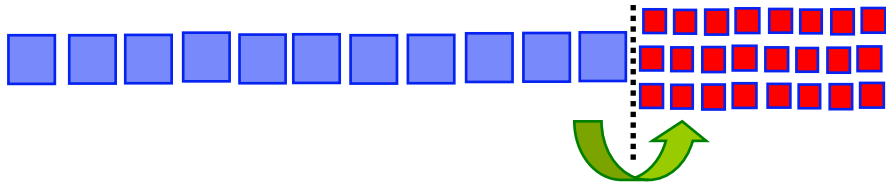


Use it like a very fast  
paging device

LRU = Least Recently Used = oldest unused

# AME Conceptual Model

Memory Pages



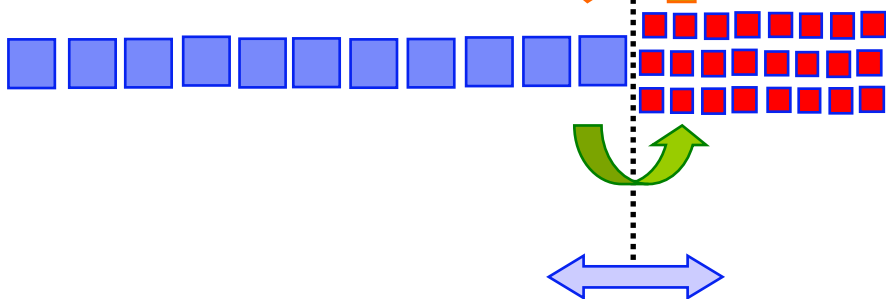
Compressed  
RAM Disk

Now while paging,  
shrink the memory pages  
so many more pages fit

15 true memory  $\rightarrow$  11+24=35 so Expansion Factor=15:35 = 2.33

# AME Conceptual Model

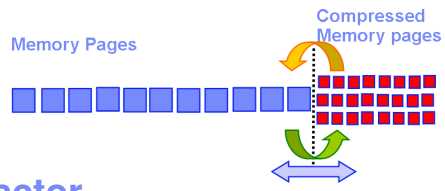
Memory Pages



Compressed  
Memory pages

Dynamically adjusted depending  
on compression ratio & target

# AME Practicalities

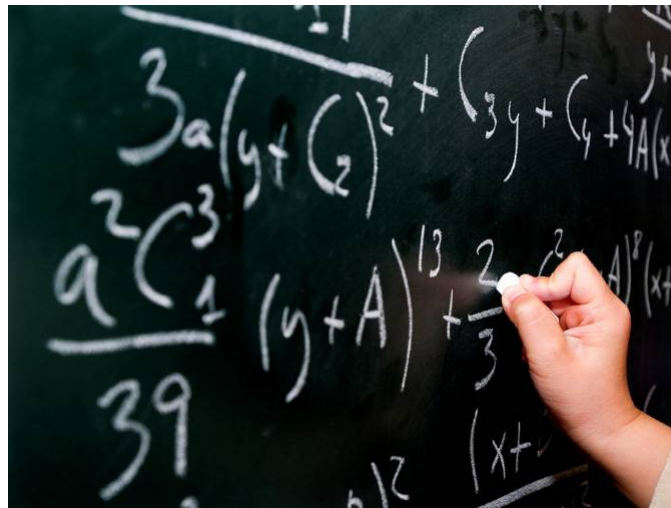


**Lower Expansion Factor**  
= Compress once little used pages  
= Near zero CPU cycles

**Higher Expansion Factor**  
= More compression  
= More CPU cycles




Balance more RAM versus more CPU cycles

## Technical Details






## Bad Compression Targets

-  ▪ AIX Kernel
  - Not a AME target
-  ▪ Filesystem cache, code or memory mapped files
  - Best to page out to filesystems
  - Performance tools → “numperm”
-  ▪ Pinned Memory
  - Pinned = never page out (AME is like paging)
  - Performance tools → “pinned pages”
- So what can AME compress?

## Good Compression Targets

-  ▪ Mostly private pages within programs
  - Data
  - Heap
  - Stack
  - Not the code

## Excellent Compression Targets




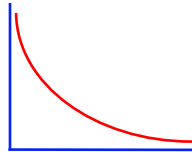
### Data that compresses well

- Data only used on program initialisation
- Pages allocated but unused = full of zeros/blanks
- Pages with lots of repeat data like database records



### Access Pattern

- Some **hot** pages, some **warm**, some **freezing**
- All pages equally used (HPC) – not so good 



## How can I work that out?

Do I have

→ Good or bad compression ratio?

→ Friendly or hostile access pattern?

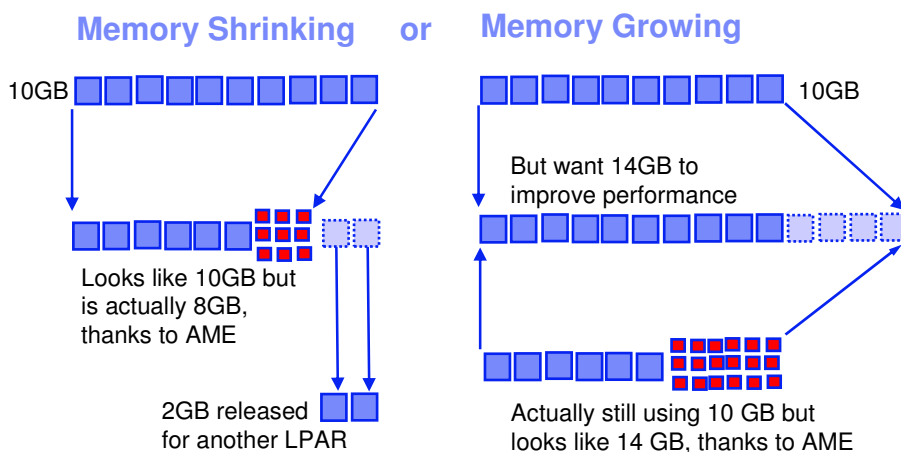
**Normally, you can't !!**

**until now ....**

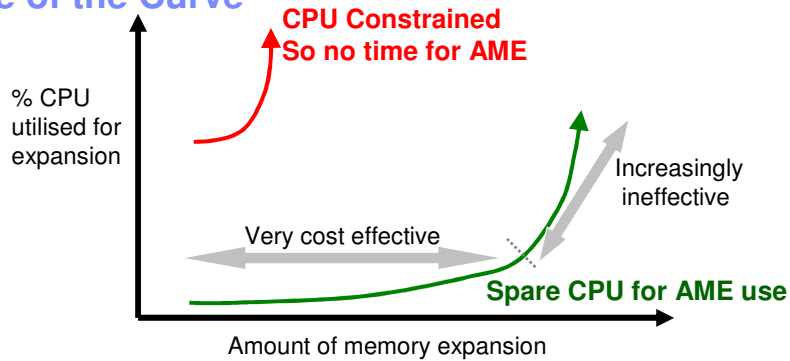
## Planning for Active Memory Expansion

- A new AIX command: **amepat**
  - Active Memory Expansion Performance Analysis Tool
  - Or someone called Patrick/Patricia – you decide!
- Scans actual memory use
  - Determines compression ratio & CPU requirement
- With AME on or AME off
  - AIX 6.1 TL04 SP2+ also works on: POWER4/5/6/7

## What is your Plan?



## Knee of the Curve



- Busy processor cores don't have resources to spare for AME
- The Expansion Factor "knee" depends on the compressibility of memory

## amepat command - Don't worry as its easy

```
# amepat -?
Usage: amepat [-u minucomp_poolsize] [-m min_mem_savings]
      {[-t tgt_expmem_size] | [-a]} [-n num_entries] [-P recfile]
      {[-e startexpfactor[:stopexpfactor[:incexpfactor]]] |
      { [-c max_cpu_overhead%] | [-C max_cpu_overhead] }}
      [-v] { [Duration] | [interval [samples]] }

amepat -R recfile { [Duration] | [Interval [Samples]] }

amepat -N [{-P|-R}recfile] [-v] {Duration|[Interval [Samples]]}

-m min_mem_savings      Unit is MB
-c max_cpu_overhead%    Unit is percentage
-C max_cpu_overhead     Unit is in number of Physical Processors
-u minucomp_poolsize    Unit is MB
-t tgt_expmem_size      Unit is MB
Duration                 Unit is minutes
interval                 Unit is minutes
```

Note: -N flag will turn off Active Memory Expansion Modeling.  
All options except -P, -R will be disabled when -N is used.

## amepat - Basics are Easy

Run & report mode gets frustrating so ...

Capture your busy hour for the whole hour

– amepat –R ame.out 60 [60 minutes]

Then try various reports

- Shrink memory:
  - amepat –P ame.out
- Expand memory:
  - amepat –P ame.out –t 4096 [target memory size in MB]

## Warning ....

- Small micro-partition example
  - Less than a whole CPU & only 1 GB memory
  - Easier to generate workload to use all memory
- Typically, LPARs are much larger
  - Rule of Thumb: 8 -16 GB per CPU or higher
- Large memory LPARs will give AME more scope

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Active Memory Expansion

## amepat output – Machine Summary

```

# amepat
Date/Time of invocation      : -
Total Monitored time        : NA
Total Samples Collected     : NA
  
```

**Machine Summary**

System Configuration:

```

Partition Name                : diamond3
Processor Implementation Mode  : POWER7
Number Of Logical CPUs        : 16
Processor Entitled Capacity   : 0.80
Processor Max. Capacity       : 4.00
True Memory                    : 1.00 GB
SMT Threads                   : 4
Shared Processor Mode         : Enabled-Uncapped
Active Memory Sharing          : Disabled
Active Memory Expansion       : Enabled
Target Expanded Memory Size   : 1.00 GB
Target Memory Expansion factor: 1.00
  
```

1 GB = very small for my test case

Factor=1 → No Compression

**Memory Summary**

System Resource Statistics:

	Current
CPU Util (Phys. Processors)	0.01 [ 0%]
Virtual Memory Size (MB)	790 [ 77%]
True Memory In-Use (MB)	985 [ 96%]
Pinned Memory (MB)	371 [ 36%]
File Cache Size (MB)	179 [ 17%]
Available Memory (MB)	184 [ 18%]

Not compressed by AME

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Active Memory Expansion

## amepat -P ame.out

-> REMOVED CONFIG DETAILS ABOVE HERE

**1GB with 1/2 memory unused**

Nothing Compressed as there is no need

AME Statistics:

	Current
AME CPU Usage (Phy. Proc Units)	0.00 [ 0%]
Compressed Memory (MB)	0 [ 0%]
Compression Ratio	2.28

Active Memory Expansion Modeled Statistics:

```

Modeled Expanded Memory Size : 1.00 GB
Average Compression Ratio    : 2.28
  
```

Good compression achievable

Expansion Factor	Modeled True Memory Size	Modeled Memory Gain	CPU Usage Estimate
1.00	1.00 GB	0.00 KB [ 0%]	0.00 [ 0%]
1.14	896.00 MB	128.00 MB [ 14%]	0.00 [ 0%]
1.33	768.00 MB	256.00 MB [ 33%]	0.00 [ 0%]

Various combinations with increasing factor with decreasing RAM  
No CPU use

AME thinks remove 0.25 GB of unused RAM is OK

Active Memory Expansion Recommendation:

The recommended AME configuration for this workload is to configure the LPAR with a memory size of 768.00 MB and to configure a memory expansion factor of 1.33. This will result in a memory gain of 33%. With this configuration, the estimated CPU usage due to AME is approximately 0.00 physical processors, and the estimated overall peak CPU resource required for the LPAR is 0.02 physical processors.

Note: it does no try below 512 MB – that is just too small.

**amepat -P ame.out**

Nothing Compressed as there is no need

1GB with 99% used

IBM © 2010 IBM 30 Active Memory Expansion

→ REMOVED CONFIG DETAILS ABOVE HERE

```

AME Statistics:
-----
AME CPU Usage (Phy. Proc Units)    Current 0.00 [ 0%]
Compressed Memory (MB)             0 [ 0%]
Compression Ratio                   2.02

```

Active Memory Expansion Modeled Statistics:

```

Modeled Expanded Memory Size : 1.00 GB
Average Compression Ratio    : 2.02

```

Good compression achievable

Expansion Factor	Modeled True Memory Size	Modeled Memory Gain	CPU Usage Estimate
1.00	1.00 GB	0.00 KB [ 0%]	0.00 [ 0%]
1.14	896.00 MB	128.00 MB [ 14%]	0.34 [ 8%]
1.33	768.00 MB	256.00 MB [ 33%]	0.72 [ 18%]

Various combinations with increasing factor with decreasing RAM with rising CPU use

AME thinks remove 0.125 GB of RAM is OK with 0.34 CPU used

Active Memory Expansion Recommendation:

The recommended AME configuration for this workload is to configure the LPAR with a memory size of 896.00 MB and to configure a memory expansion factor of 1.14. This will result in a memory gain of 14%. With this configuration, the estimated CPU usage due to AME is approximately 0.34 physical processors, and the estimated overall peak CPU resource required for the LPAR is 1.18 physical processors.

**amepat -P ame.out -t 1536**

Compression found for current memory content

How can I get to 1.5 GB?

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→ REMOVED CONFIG DETAILS ABOVE HERE

```

AME Statistics:
-----
AME CPU Usage (Phy. Proc Units)    Current 0.02 [ 1%]
Compressed Memory (MB)             65 [ 4%]
Compression Ratio                   2.04

```

Active Memory Expansion Modeled Statistics:

```

Modeled Expanded Memory Size : 1.50 GB
Average Compression Ratio    : 2.04

```

Estimating for 1.5GB

Expansion Factor	Modeled True Memory Size	Modeled Memory Gain	CPU Usage Estimate
1.00	1.50 GB	0.00 KB [ 0%]	0.00 [ 0%]
1.09	1.38 GB	128.00 MB [ 9%]	0.00 [ 0%]
1.20	1.25 GB	256.00 MB [ 20%]	0.00 [ 0%]
1.33	1.12 GB	384.00 MB [ 33%]	0.13 [ 3%]
1.50	1.00 GB	512.00 MB [ 50%]	0.28 [ 7%]

Various combinations to get to 1.5GB with decreasing RAM with increasing CPU

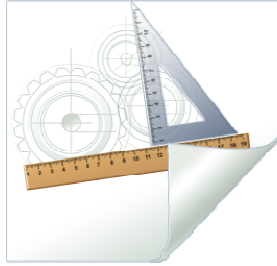
AME thinks 0.28 CPU for 0.5 GB RAM is a good trade-off = last combination

You have to make up your own mind!

Active Memory Expansion Recommendation:

The recommended AME configuration for this workload is to configure the LPAR with a memory size of 1.00 GB and to configure a memory expansion factor of 1.50. This will result in a memory gain of 50%. With this configuration, the estimated CPU usage due to AME is approximately 0.28 physical processors, and the estimated overall peak CPU resource required for the LPAR is 0.85 physical processors.

## Monitoring Active Memory Expansion in use



**lparstat -i**  
**RAM= True Memory**

**Target**  
**Expansion Factor**  
**AME memory**

```
# lparstat -i |pg
Node Name                : diamond3
Partition Name           : diamond3 AME
Partition Number         : 3
Type                     : Shared-SMT-4
Node                     : Uncapped
Entitled Capacity        : 0.60
Partition Group-ID       : 32771
Shared Pool ID           : 0
Online Virtual CPUs      : 4
Maximum Virtual CPUs    : 6
Minimum Virtual CPUs     : 1
Online Memory            : 1024 MB
Maximum Memory           : 8192 MB
Minimum Memory           : 512 MB
Variable Capacity Weight : 128
Minimum Capacity         : 0.10
Maximum Capacity         : 6.00
Capacity Increment       : 0.01
Maximum Physical CPUs in system : 6
Active Physical CPUs in system : 6
Active CPUs in Pool      : 6
Shared Physical CPUs in system : 6
Maximum Capacity of Pool : 600
Entitled Capacity of Pool : 500
Unallocated Capacity     : 0.00
Physical CPU Percentage   : 20.00%
Unallocated Weight       : 0
Memory Mode              : Dedicated-Expanded
Total I/O Memory Entitlement : -
Variable Memory Capacity Weight : -
Memory Pool ID           : -
Physical Memory in the Pool : -
Hypervisor Page Size     : -
Unallocated Variable Memory Capacity Weight : -
Unallocated I/O Memory entitlement : -
Memory Group ID of LPAR  : -
Desired Virtual CPUs     : 4
Desired Memory           : 1024 MB
Desired Variable Capacity Weight : 128
Desired Capacity         : 0.60
Target Memory Expansion Factor : 1.50
Target Memory Expansion Size : 1536 MB
#
```



## vmstat -c 1

```

C# vmstat -c 1
System configuration: lcpu=16 mem=1536MB tmem=1024MB ent=0.80 mmode=dedicated-E

```

kthr		memory										page				faults				cpu			
r	b	avm	fre	csz	cfr	dxm	ci	co	pi	po	in	sy	cs	us	sy	id	wa	pc	ec				
1	1	358101	124511	18565	5692	0	5162	5139	0	0	44	49	513	69	10	21	0	1.55	193.2				
1	0	358101	124557	18565	5750	0	6151	6143	5	0	148	150	664	62	16	21	1	1.51	188.3				
1	0	358102	124499	18565	5681	0	11911	12009	0	0	68	41	918	64	14	22	0	1.45	181.8				
1	1	358102	124740	18565	5857	0	7606	7220	0	0	1	31	457	65	14	21	0	1.46	182.3				
1	0	358102	124800	18565	5877	0	9159	9145	0	0	45	41	693	61	18	20	1	1.52	189.7				
1	0	358102	124791	18565	5857	0	6191	6250	0	0	22	32	459	66	13	20	1	1.44	180.1				
1	0	358102	124810	18565	5894	0	4569	4478	0	0	20	32	426	71	8	20	1	1.42	177.0				
2	0	358102	124777	18565	5786	0	3384	3577	1	0	46	41	410	70	9	21	0	1.48	184.8				
2	0	358102	124752	18565	5833	0	3322	3219	0	0	34	45	409	73	6	21	0	1.44	179.8				
2	0	358102	124416	18565	5695	0	2564	2823	0	0	165	102	613	72	8	18	2	1.43	179.0				
1	0	358101	124479	18565	5646	0	2576	2706	0	0	13	31	309	69	8	23	0	1.50	186.9				
1	0	358101	124538	18565	5774	0	3723	3479	0	0	72	90	451	72	7	21	1	1.45	181.0				
1	0	358101	124546	18565	5763	0	4135	4156	0	0	26	34	437	71	8	21	0	1.46	182.2				
1	0	358101	124519	18565	5750	0	4331	4324	0	0	105	61	593	65	13	22	1	1.49	186.1				
1	1	358101	124530	18565	5703	0	8336	8393	0	0	67	54	803	60	15	24	0	1.50	187.4				
1	0	358101	124699	18565	5773	0	6073	5997	0	0	28	32	551	66	13	20	1	1.45	181.5				
1	1	358111	124717	18565	5827	0	5412	5272	0	0	67	216	566	66	12	22	0	1.48	184.9				
1	0	358111	124726	18565	5812	0	3594	3652	0	0	18	32	413	67	9	24	0	1.51	189.0				
1	0	358111	124818	18565	5839	0	4273	4228	0	0	11	36	426	59	10	30	0	1.58	127.8				
1	0	358111	124631	18565	5787	0	4898	4989	0	0	116	61	679	61	10	29	1	1.56	194.8				

mem = apparent Memory  
tmem = True Memory

CI = Compressed Page In  
CO = Compressed Page Out

## lparstat -c 1

%user	%sys	%wait	%idle	physc	%ente	lbusy	vcsw	print	%xcpu	dxm
83.2	0.8	0.0	16.0	1.02	126.9	10.3	1545	1	0.0	0
93.6	0.6	0.0	5.7	1.02	127.1	12.3	1542	0	0.0	0
93.8	0.6	0.0	5.5	1.01	126.8	12.3	1527	6	0.0	0
93.8	0.7	0.0	5.5	1.01	126.8	12.4	1554	6	0.0	0
94.0	0.5	0.0	5.5	1.01	126.0	12.6	1543	5	0.0	0
93.9	0.6	0.0	5.5	1.01	126.6	12.4	1563	5	0.0	0
82.0	12.4	0.0	5.6	1.02	126.9	12.5	1576	0	11.3	0
81.0	13.0	0.0	6.1	1.02	127.3	12.4	1611	2	11.4	0
76.7	11.2	0.0	12.2	1.00	124.8	10.9	1551	3	14.4	0
77.5	8.9	0.0	13.6	1.03	128.4	10.9	1554	5	11.7	0
83.7	4.3	0.0	12.0	1.01	126.8	11.8	1559	9	5.3	0
82.9	5.4	0.0	11.7	1.01	126.7	11.1	1533	6	4.6	0
81.9	7.3	0.0	10.8	0.90	112.1	10.0	1561	4	7.7	0
72.9	9.2	0.0	17.9	0.98	123.1	9.5	1568	2	13.0	0
73.1	12.9	0.0	14.0	0.97	121.1	10.3	1573	8	18.8	0
76.5	9.4	1.6	12.6	0.96	119.9	10.1	1616	7	12.6	0
79.8	3.4	0.1	16.7	0.97	121.8	9.8	1578	0	3.6	0
80.6	1.2	0.1	18.2	0.98	122.1	9.5	1601	6	0.3	0
80.1	0.6	0.0	19.3	0.97	121.8	9.1	1546	5	0.0	0
81.2	1.0	0.0	17.8	0.82	103.1	8.1	1535	1	0.1	0
80.5	0.7	0.0	18.8	0.86	107.3	8.4	1550	1	0.0	0

%xcpu percentage of CPU time used in eXpansion!

Note: %user + %sys + %wait + %idle still = 100%

topas

```

Topas Monitor for host: diamond3
Fri Feb 5 22:41:17 2010 Interval: 2
EVENTS/QUEUES FILE/TTY
Cswitch 215 Readch 3822
Syscall 293 Writech 804
Reads 40 Rawin 0
Writes 5 Ttyout 634
Forks 0 Igets 0
Execs 0 Namei 16
Runqueue 3.0 Dirblk 0
Waitqueue 0.0

CPU User% Kern% Wait% Idle% Physc Entc
ALL 68.0 11.4 0.0 20.6 0.88 110.4

Network KBPS I-Pack O-Pack KB-In KB-Out
Total 0.9 3.0 2.0 0.2 0.8

Disk Busy% KBPS TPS KB-Read KB-Writ
Total 1.0 10.0 2.0 10.0 0.0

FileSystem KBPS TPS KB-Read KB-Writ
Total 3.7 40.1 3.7 0.0

Name PID CPU% PgSp Owner
nmem 475172 18.1 64.2 root
nmem 454690 13.7 64.2 root
nmem 491712 6.1 64.2 root
nmem 467134 5.8 64.2 root
nmem 450628 4.6 64.2 root
nmem 463030 4.1 64.2 root
nmem 458882 3.8 64.2 root
nmem 495786 3.7 64.2 root
lrud 16392 3.6 0.1 root
nmem 393362 1.4 64.2 root
cmemd 36882 1.2 0.2 root
topas 479332 0.3 4.2 root
topas 471158 0.1 4.2 root

PAGING
Faults 850 % Comp 67
Steals 843 % Noncomp 0
PgspIn 0 % Client 0
PgspOut 0
PageIn 2 PAGING SPACE
PageOut 0 Size,MB 2048
Sios 2 % Used 14
% Free 86

AME
TMEM,MB 1024 WPAR Activ 0
CMEM,MB 75 WPAR Total 0
EF[T/A] 1.5/1.5 Press: "h"-help
CI:0.8K CO:0.7K "q"-quit
  
```

TMEM = True Memory  
 CMEM = Compressed Memory  
 CI = Compressed Page In  
 CO = Compressed Page Out  
 EF = Expansion Factor  
 T = target  
 A = Actual

topas\_nmon not aware of AME (yet!)

```

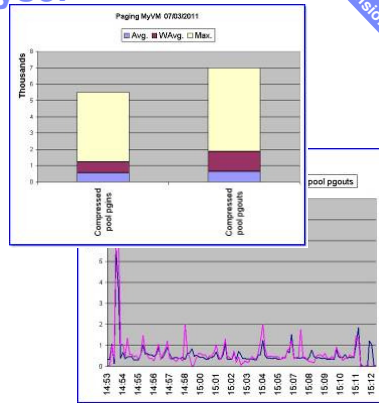
topas_nmon -A=Async-I/O Host=diamond3 Refresh=2 secs 18:06:54
CPU-Utilisation-Small-View EntitledCPU= 0.80 UsedCPU= 0.336
Logical CPUs 0-----25-----50-----75-----100
CPU User% Sys% Wait% Idle%|
0 70.4 0.5 0.0 29.1|
1 0.0 0.0 0.0 100.0|>
2 0.0 0.0 0.0 100.0|>
3 0.0 0.0 0.0 100.0|>
4 66.8 0.0 0.0 33.2|
5 0.0 0.0 0.0 100.0|>
6 0.0 0.0 0.0 100.0|>
7 0.0 0.0 0.0 100.0|>
8 0.0 0.0 0.0 100.0|>
9 0.0 0.0 0.0 100.0|>
10 0.0 0.0 0.0 100.0|>
11 0.0 0.0 0.0 100.0|>
12 0.0 0.0 0.0 100.0|>
13 0.0 0.0 0.0 100.0|>
14 0.0 0.0 0.0 100.0|>
15 0.0 0.0 0.0 100.0|>
EntitleCapaci BC 36.2 0
VP 7.2 0
EC= 42.0% v
Memory Physical PageSpace pages/sec In Out FileSystemCache
% Used 67.0% 14.5% | to Paging Space 0.0 0.0 (numperm) 0.3%
% Free 33.0% 85.5% | to File System 0.0 0.0 | Process 46.8%
MB Used 1028.8MB 296.2MB | Page Scans 0.0 | System 19.9%
MB Free 507.2MB 1751.8MB | Page Cycles 0.0 | Free 33.0%
Total (MR) 1536.0MB 2048.0MB | Page Steals 0.0 | Total 100.0%
Page Faults 11.5
  
```

Not True Memory but the expanded size like other applications will see it

## nmon capture to file then Analyser

- MEM tab

- Size of the Compressed pool (MB)
- Size of true memory (MB)
- Expanded memory size (MB),
- Size of the Uncompressed pool (MB)



- MEMNEW tab

- Compressed Pool%

- PAGE tab

- Paging rates (pages per second) but this time very quickly in & out of the compressed memory area
- Compressed pool pgins - other tools like topas call this CI
- Compressed pool pgouts - other tools like topas call this CO

## Topas AME - Very small change

```

Topas Monitor for host:green3
Thu Oct 6 17:48:40 2011 Interval:2
CPU User% Kern% Wait% Idle% Physc Entc% Reads 29 Rawin 0
Total 99.8 0.2 0.0 0.0 2.00 199.91 Writes 0 Ttyout 287
Network DPs I-Pkts O-Pkts B-In B-Out Execs 0 Namei 7
Total 1.20K 10.00 1.50 836.0 392.0 Runqueue 9.00 Dirblk 0
Disk Busy% DPs TPS B-Read B-Writ MEMORY
Total 0.0 0 0 0 0 PAGING Real,MB 2048
Faults 0 % Comp 53
FileSystem DPs TPS B-Read B-Writ Steals 0 % Noncomp 40
Total 3.62K 28.50 3.62K 0 Pgspln 0 % Client 40
Pgspln 0
WLM-Class (Active) CPU% Mem% Blk-I/O% PageIn 0 PAGING SPACE
System 0 65 0 PageOut 0 Size,MB 512
Shared 0 5 0 Sios 0 % Used 1
% Free 99
Name PID CPU% PgSp Class AME
ncpu 7536784 25.0 148K wp06 THEM 2.00GPAR Activ 2
ncpu 9044056 0.0 144K wp06 CHEN 512.00GPAR Total 2
ncpu 8388632 0.0 108K wp06 EF[T/A] 1.0/1.0Press: "h"-help
ncpu 9306134 0.0 136K wp06 CI: 0CO: 0 "q"-quit
  
```

- Units have moved

- TMem, MB 2000 → TMem 2.00G

## svmon

- Good luck with that one !

## AME Deployment Steps

①

### Planning Tool

- amepat part of AIX 6.1 TL4
- Calculates data compressibility & estimates CPU overhead due to AME
- Provides initial recommendations

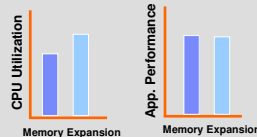


②

### 60-Day Trial

- One-time, temporarily enablement
- Config LPAR based on planning tool
- Use AIX tools to monitor AME environment
- Tune based on actual results

#### Actual Results

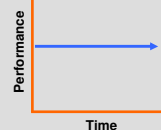


③

### Deploy into Production

- Permanently enable AME
- Deploy workload into production
- Continue to monitor workload using AIX performance tools

#### Actual Results



# AME Wiki page & AME Forum

AME Public Wiki (on the AIX wiki)

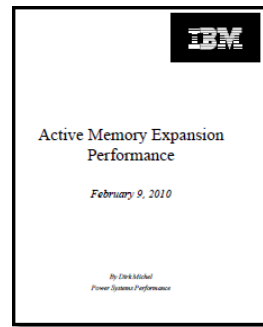
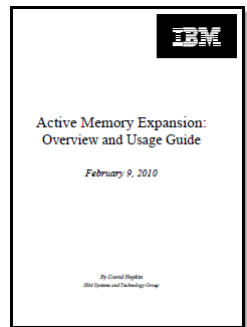
<http://www.ibm.com/developerworks/wikis/display/WikiPtype/IBM+Active+Memory+Expansion>

URL for trial, presentation, Forum, whitepapers, manual page, Perf Tune Guide, movies

AME Forum

<http://www.ibm.com/developerworks/forums/forum.jspa?forumID=2179>

## Docs



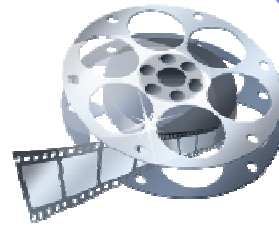
- 1) AME Overview & Usage Guide by David Hepkin 25 pages
- 2) AME Performance by Dirk Michel 18 pages

From <http://www.ibm.com/systems/power/resources/index.html>

Then click on Whitepapers

AIX Commands Infocenter → amepat, topas, vmstat, lparstat

## AME – at the Movies



<http://tinyurl.com/AIXmovies>

Look for Movie 79

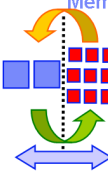
IBM  
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44  
Active Memory Expansion

### Summary & Questions

Memory Pages



Compressed  
Memory pages



1. POWER7 & AIX 6 TL04 SP2+
2. Activation Key by machine
3. 60 day Trial available
4. Set at LPAR level & dynamic Expansion Factor
5. Planning: **amepat**
6. Monitor: `vmstat -c`, `lparstat -c`, `topas`

[http://www.ibm.com/developerworks/wikis/display/WikiPtype/ ...](http://www.ibm.com/developerworks/wikis/display/WikiPtype/...)  
IBM+Active+Memory+Expansion