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**SustainIT'10 - 2/22/10**

***Effect of Data Center Vibration on  
Compute System Performance***

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# Agenda

- Testing Goals
- Testing Infrastructure
- Tests Performed
- Test Results: Metal → AVR
- Test Results: Trending
- Real Time View
- Observations and Next Steps

# Testing Goals

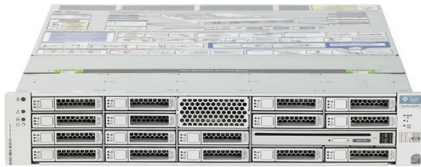
- Determine if ambient Data Center vibration effects storage system IO and performance
- Recreate Brendan Gregg yell test

***“If” a performance difference is measured:***

- Determine if performance decrease is potentially relevant to “real-world” applications
- Determine if ambient vibration could be removed through the use of a specially designed anti-vibration rack

# Testing Infrastructure

**Test Environment #1:** Professional sound room with no ambient vibration  
**Test Environment #2:** Tier 1 co-location raised floor data center



**Sun 7110 Storage**  
16 x 300GB 2.5" SAS



**Sun X4440 Server**  
16 core, 64GB RAM



**GPC AVR-1000**  
20RU, Plexan with  
carbon fiber and  
rubber anti-vibration  
modules



**CPI**  
42RU, Standard metal  
construction

# Tests Performed

## 10GB File Transfer

60+ timed transfers

Average of 280MBytes+ throughput  
across 4GigE ports

Roughly 100-106 seconds to transfer  
10GB file across single port

## FileBench 1.3.4

Customized FileIO and FileMacro scripts

Modified FileIO script run **130+** times  
producing **600+** discreet results

FileMacro script run **6** times producing  
**24** discreet results

```
DEFAULTS {  
    runtime = 120;  
    filesize = 10g;  
}  
  
CONFIG randomread2k {  
    function = generic;  
    personality =  
    randomread;  
    nthreads = 16;  
    iosize = 2k;  
}
```

# Tests Results: Metal → AVR

	Control Concrete Floor	Metal 7110 in sliderail	Metal 7110 in sliderail	Metal 7110 in sliderail	GPC Sitting on top shelf	GPC Composite Slide Rail	GPC Composite Slide Rail	Metal 7110 on X4440	Metal 7110 on X4440	Metal 7110 on X4440	GPC 7110 on top shelf of GPC
<b>Throughput breakdown (ops per second)</b>											
<b>Workload</b>											
randomread1m	440	130	131	129	627	522	514	187	156	163	405
randomread2k	1438	962	793	782	1664	1488	1526	1138	1040	1114	1391
randomread8k	1399	960	782	782	1712	1513	1518	1141	1037	1070	1461
randomwrite1m	20	22	20	17	26	25	26	19	19	20	28
randomwrite2k	189	96	102	100	193	189	158	186	115	101	171
randomwrite8k	433	156	115	139	269	242	317	202	118	152	281
singlestreamread1m	64	62	60	59	71	71	68	62	66	65	74
singlestreamreaddirect1m	58	51	51	51	62	61	55	56	58	55	64
singlestreamwrite1m	96	92	95	102	98	100	103	97	101	93	101
singlestreamwritedirect1m	16	19	19	16	22	21	21	20	19	20	22

Streaming Write:  
Streaming Read:

4% Improvement  
14% Improvement

Random Read 1M Block Size:  
Random Read 8k Block Size:  
Random Read 2k Block Size:

246% Improvement  
61% Improvement  
56% Improvement

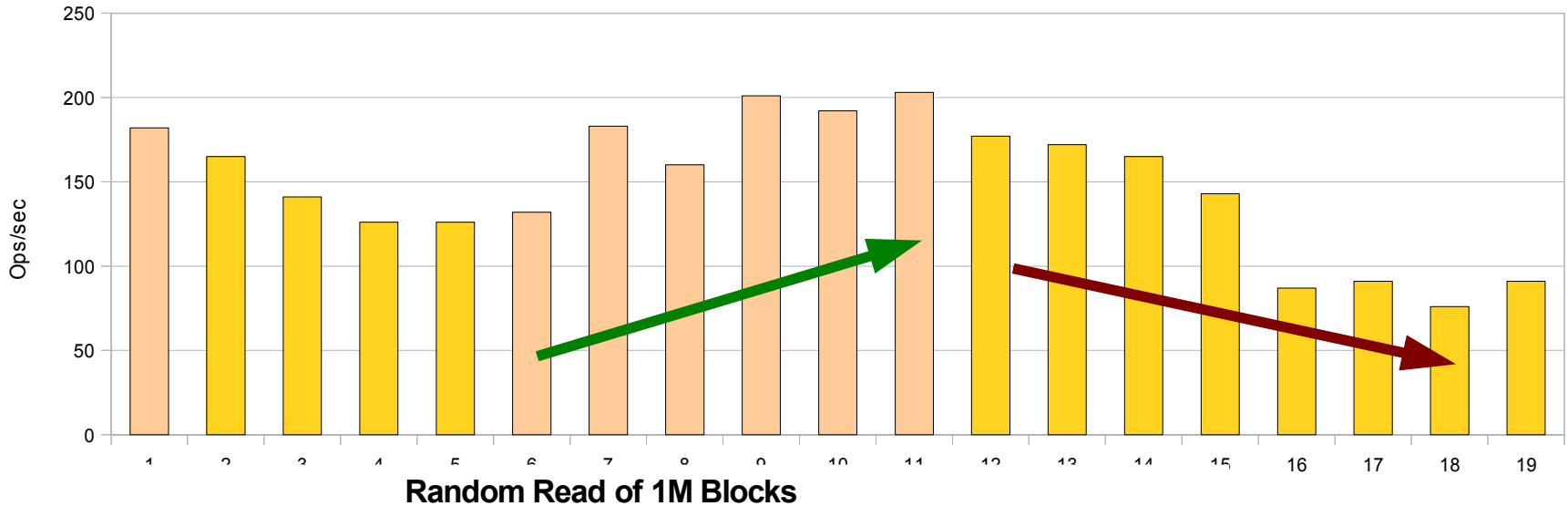
Random Write 1M Block Size:  
Random Write 8k Block Size:  
Random Write 2k Block Size:

34% Improvement  
88% Improvement  
52% Improvement

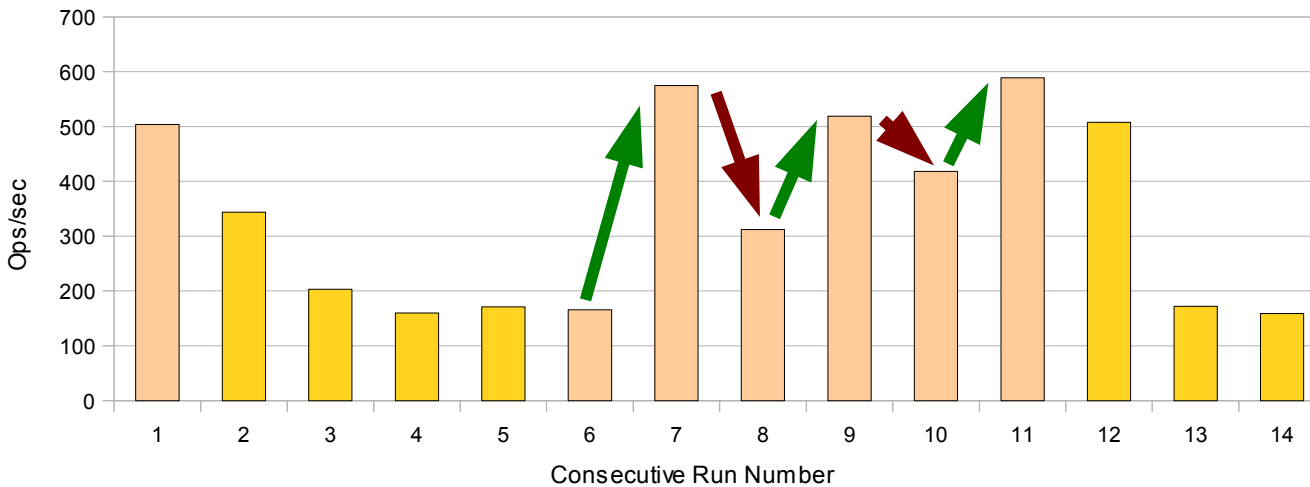
# Tests Results: Trending

## Random Write 2K Blocks

(GPC runs in orange; APC runs in yellow)



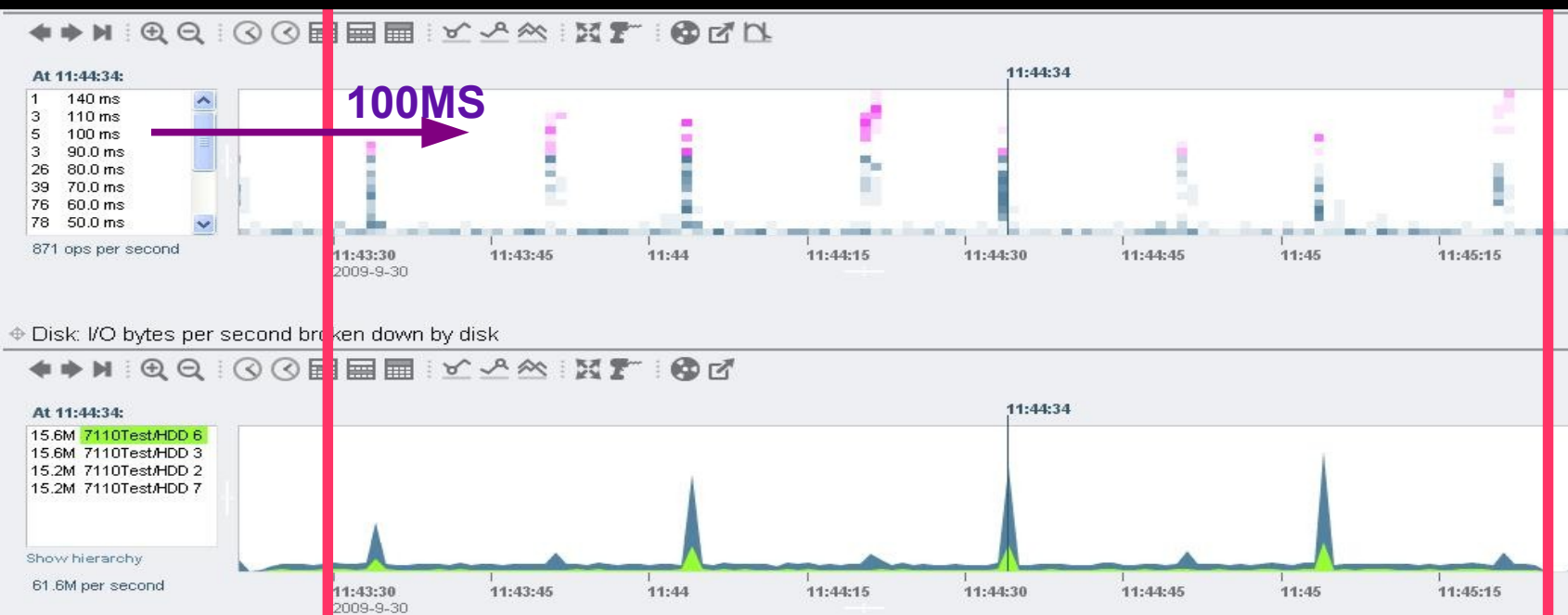
## Random Read of 1M Blocks



# Real-time View of Vibration Induced Degradation



**Bad Vibration**



**No Vibration**



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# Observations and Next Steps

**Can ambient vibration in a real-world Data Center effect the performance of an Enterprise Class storage array? YES!!!**

Potentially to a much greater degree than previously imagined.

**Now the question is no longer “Can it?”, the questions are:**

- How much vibration?
- What frequency vibration?
- How can it be mitigated?
- Is this a problem I should care about?

**Finally, what about the Brendan Gregg Yell Test? Is it relevant?**

Yelling at a server from 4” was measured at 130+ dB and imparted a measured 1.7GRMS of force (equivalent to dropping the server from a few inches onto solid concrete). This is effectively an impact force and not relevant.



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