

ezIOmeter
User Guide
v1.0.0.0



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Revision History

Revision Number	Description	Name	Revision Date
0.1	Initial release	Odle, Andrew Somers, Jaron	June 2015
0.2	Update reflecting revision of ezIOmeter for improved user experience	Pathak, Hersh	July 2015

Terms and Acronyms

Term	Definition
AHCI	Advanced Host Controller Interface
API	Application Programming Interface
ATA	Advanced Technology Attachment
DIPM	Device Initiated Power Management
GB	Gigabyte
HDD	Hard Disk Drive
KB	Kilobytes
I/O	Input/Output
IOPS	Input/Output Operations Per Second
MB	Megabytes
NCQ	Native Command Queuing
RAID	Redundant Array of Independent Disks
SATA	Serial Advanced Technology Attachment
SSD	Solid-State Drive
NVMe	Non-Volatile Memory Express

Related Documentation

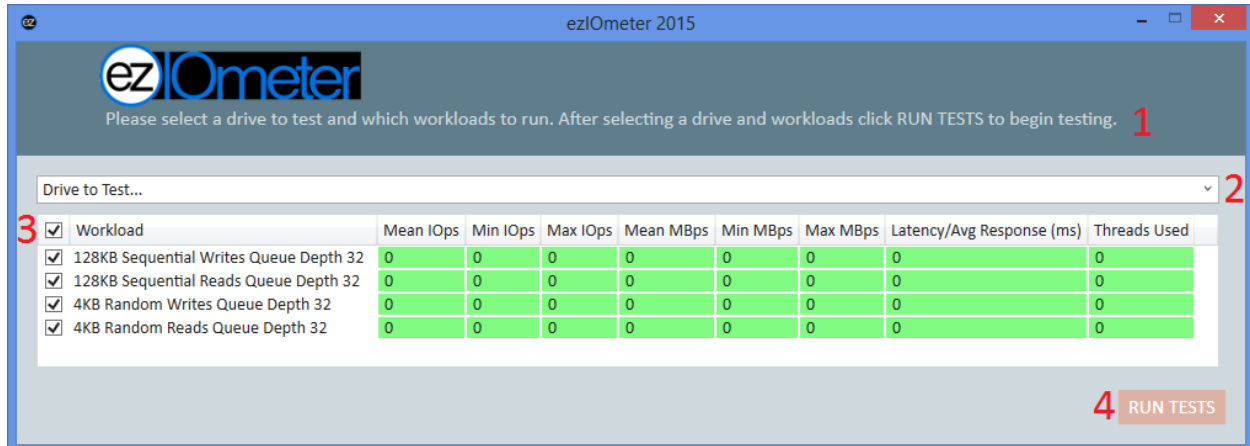
Title	Location
NVM Express	http://www.nvmexpress.org

Related Tools

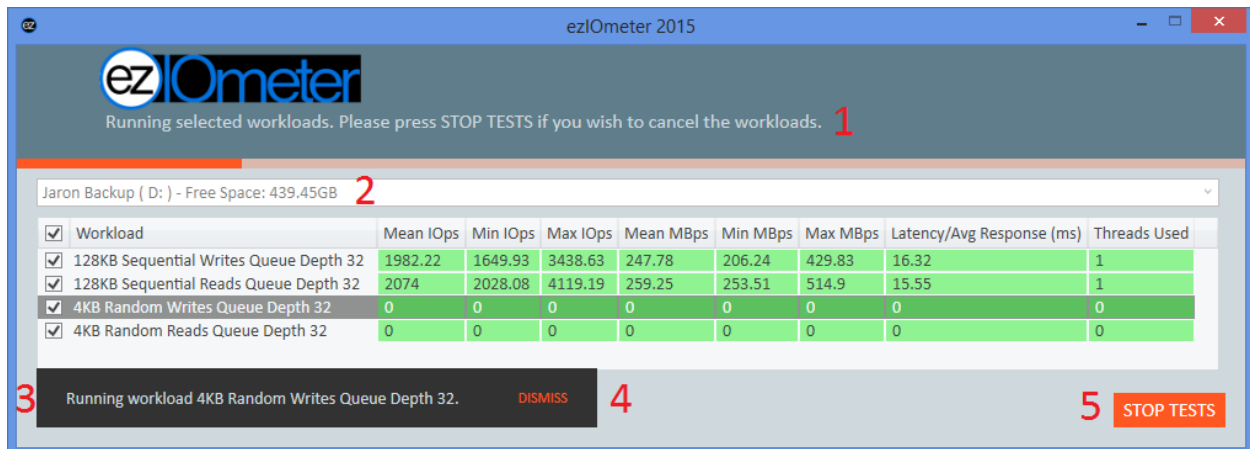
Date or Rev. #	Title	Location
1.1	IOmeter	http://www.iometer.org/

Reference

Here are the general details of ezIOmeter 2015. Each number represents an area on the UI that can help you use ezIOmeter 2015.



1. General Instructions to begin testing a drive.
2. Drop down list of testable drives
3. Checked boxes indicate a workload to run on a selected drive.
4. Click “RUN TESTS” to run the selected test(s) on the specified drive.



1. General Instructions to stop all tests.
2. The drive currently being tested.
3. The workload currently running
4. To hide the “Running workload ...” message, click “DISMISS”
5. To stop all workloads, click “STOP TESTS”

ezIOmeter 2015

ezIOmeter

Please select a drive to test and which workloads to run. After selecting a drive and workloads click RUN TESTS to begin testing.

1 Jaron Backup (D:) - Free Space: 431.45GB

2

<input checked="" type="checkbox"/> Workload	Mean IOPS	Min IOPS	Max IOPS	Mean MBps	Min MBps	Max MBps	Latency/Avg Response (ms)	Threads Used
<input type="checkbox"/> 128KB Sequential Writes Queue Depth 32	1871.4	1328.84	3413.64	233.93	166.1	426.7	17.38	1
<input checked="" type="checkbox"/> 128KB Sequential Reads Queue Depth 32	2069.97	2047.67	4113.06	258.75	255.96	514.13	15.57	1
<input type="checkbox"/> 4KB Random Writes Queue Depth 32	47911.44	41492.6	49072.59	187.15	162.08	191.69	5.36	8
<input checked="" type="checkbox"/> 4KB Random Reads Queue Depth 32	49973.83	33715.79	50511.06	195.21	131.7	197.31	5.15	8

3

4 RUN TESTS

1. The drive selected for testing
2. The selected workloads
3. Previous testing results
4. Select RUN TESTS to run the selected tests.

1. ezIOMeter Overview

ezIOMeter is a Windows-based client benchmark tool optimized for NVMe* storage devices. ezIOMeter utilizes Iometer 1.1's command line functionality to run industry trusted Iometer tests. ezIOMeter currently supports 64-bit Windows 7, 8, 8.1, 10 operating systems.

ezIOMeter was created to simplify the user experience when using IOMeter. IOMeter has an infamous reputation on being difficult to use. This is one solution to provide NVMe* testing capability while also being easy and fast to use.

This guide is intended for publications, OEMs, technical analysts, and individuals who plan to test or evaluate Client NVMe based drives for performance benefits and features. This guide gives specific and detailed instruction on how to use ezIOMeter.

This guide is significant due to the technology transition from AHCI (SATA) based SSDs to NVMe*/PCIe* based SSDs. Performance benchmarks originally designed for SATA SSDs are not optimized for NVMe SSDs. Hence, the results reflected in these benchmarks may never read maximum performance values stated in the product specification. NVMe allows multiple CPU queues with deep queue depths (up to 64K outstanding IOs). To date, NVMe* benchmark tools are lacking in numbers compared to AHCI (SATA) benchmarking tools.

For the latest on NVMe technology, go to <http://www.nvmexpress.org/>.

1.1 System Requirements

To ensure optimal tool performance, your system will need to meet the following hardware and software requirements.

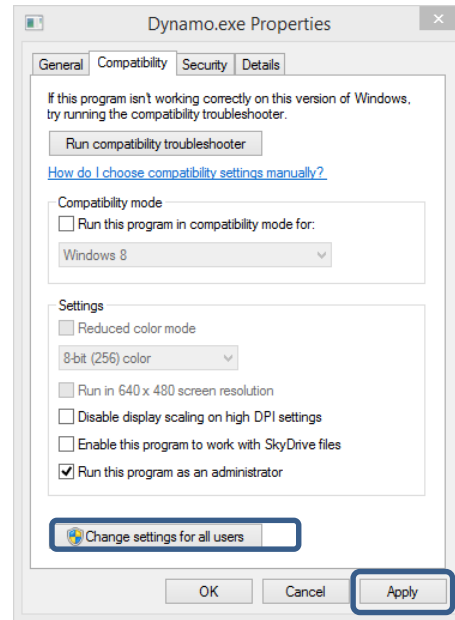
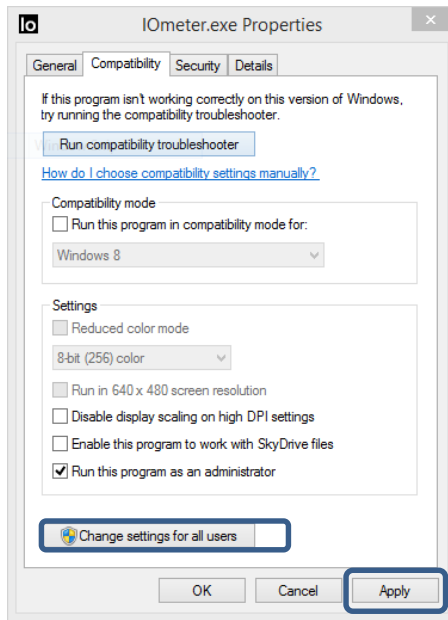
Note: ezIOMeter depends upon the .Net 4.5 (<http://www.microsoft.com/en-us/download/details.aspx?id=30653>) runtime. ezIOMeter also has a runtime dependency upon the MathNet (<http://www.mathdotnet.com/>) numerics library (This lib might be removed from the ezIOMeter package or the dependency upon the library removed at a later time.)

Title	Requirement Summary
System Recommendation for best drive performance (optional)	<p>For optimal performance analysis of the drive, we recommend having a CPU with four cores (with hyper-threading) or more to fully utilize NVMe capabilities.</p> <p>Many items can impact storage subsystem performance. Virus scanners and other various Windows based services can induce run to run variation.</p> <p>Make sure no other programs, such as a video card control panel, virus scanning software, etc., are running in the background at the same time as the workload. To ensure consistency, be sure to disable the following:</p> <ul style="list-style-type: none">• Screen Saver – Disabled• Power Management – High Performance<ul style="list-style-type: none">○ Turn off the Display - Never○ Put the Computer to Sleep – Never○ Hibernate after - Never• Windows Defender/System Protection – Disabled• Automatic Windows Updates – Disabled• Disk Defragmentation – Disabled <p>Any other Virus Protection – Disabled</p>

OPTIONAL:

The objective is to disable any automatic services which may interrupt or disrupt the performance test. Once complete, the next step is to set up permissions for IOMeter:

- Open the directory to IOMeter, right click on the IOMeter.exe icon and click Properties.
- Click on the Compatibility tab and check Run this program as an administrator.
- Click Apply.
- Repeat for Dynamo.exe.

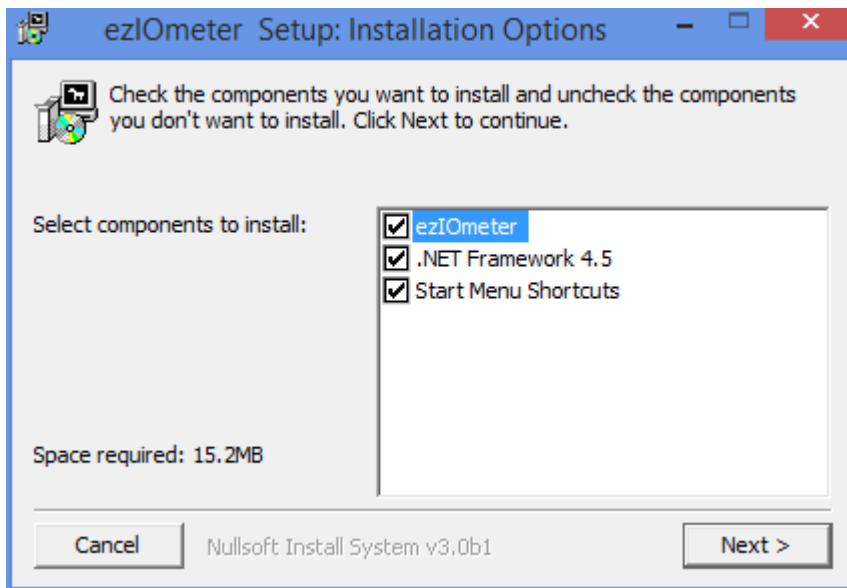


- Once complete, double click on **IOMeter** and accept the terms and conditions.

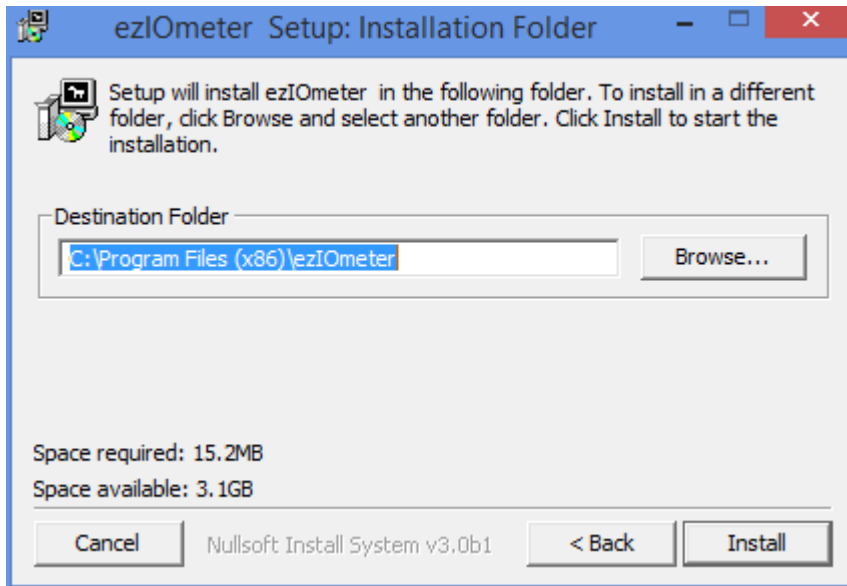
1.2 Installation

Note: The default install location is (C:\Program Files(x86)\ezIOmeter)

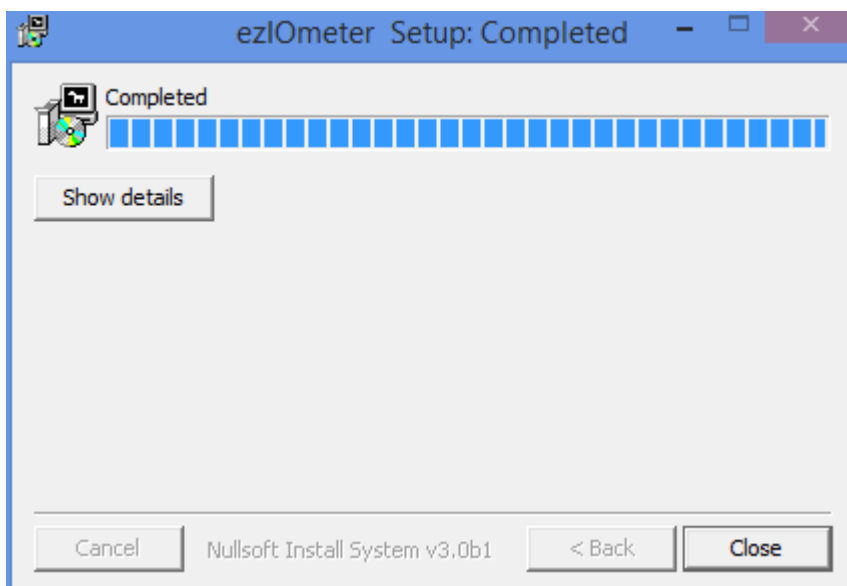
- 1.) Locate ezIOmeterSetup.exe on your computer.
- 2.) Double click the file
- 3.) Run “ezIOmeterSetup.exe”
- 4.) Click **Yes** if prompted with a **User Account Control** prompt.
- 5.) Click **Next >**.



6.) Click **Install**



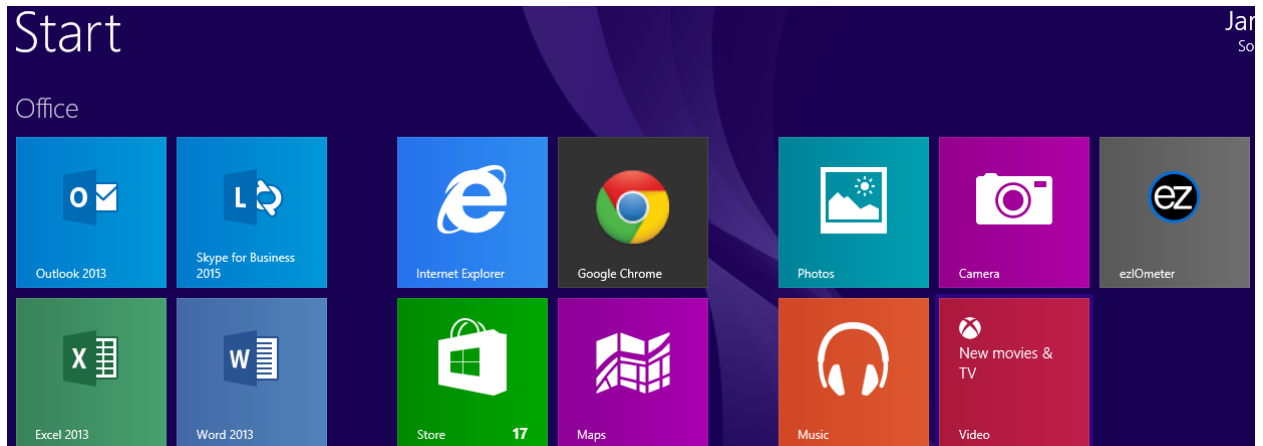
7.) Click **Close**



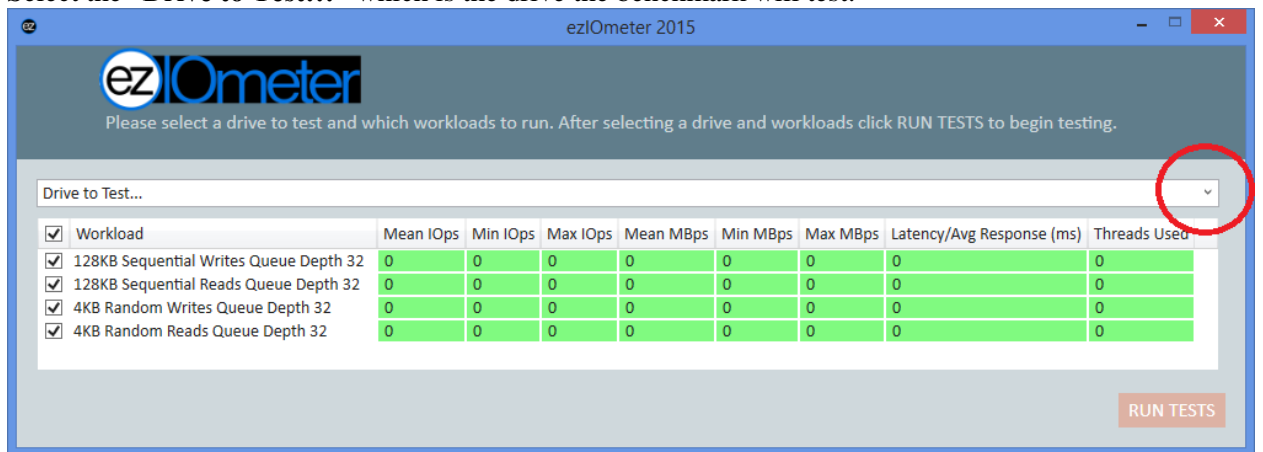
You are now ready to use ezIOmeter!

2. How to Use ezIOmeter

- 1.) Launch **ezIOmeter** from your start menu.

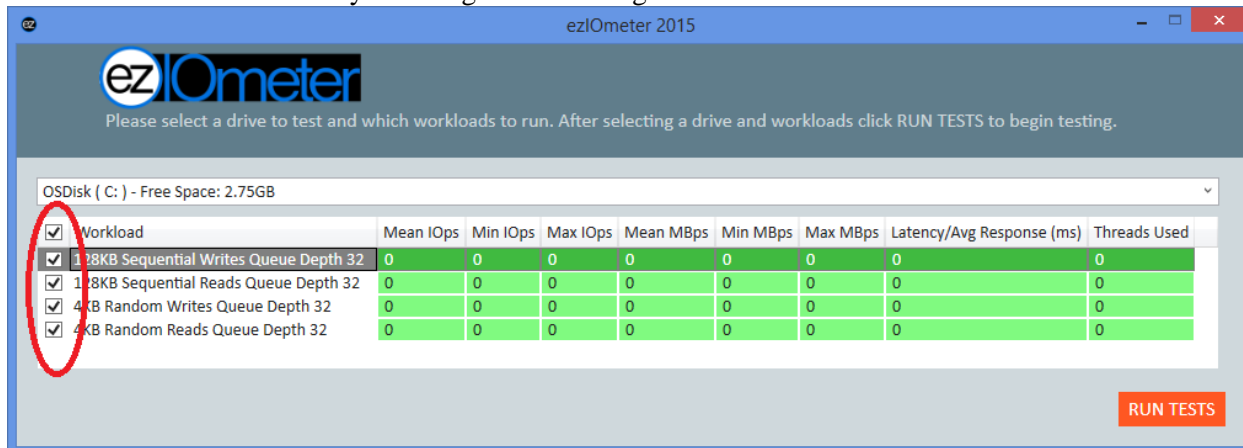


- 2.) Click **Yes** if prompted with a **User Account Control** prompt.
- 3.) Select the “**Drive to Test...**” which is the drive the benchmark will test.

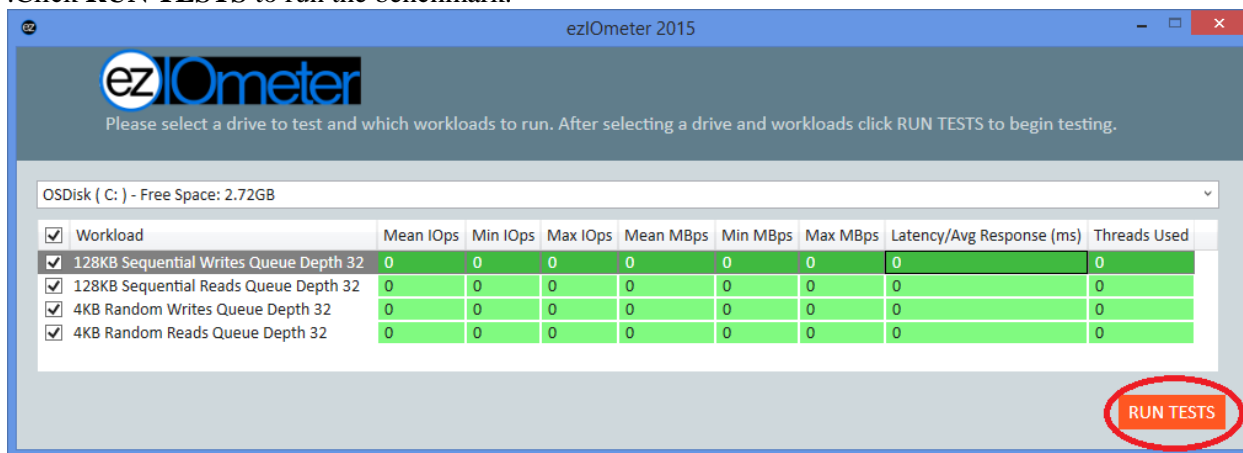


*Note: For **optimal** results, the selected drive **must** be connected to the computer as a secondary drive and **must** be partitioned and visible in Windows* before drive will be testable.*

4.) Select the workloads to run by selecting or deselecting the check boxes.



5.) .Click **RUN TESTS** to run the benchmark.



***Note: Sections 3.1-3.3 are for advanced users and are completely optional (to customize and configure ezIOMeter)**

***3.1 Settings Configuration File (settings.conf)**

The settings file can be found at the **ezIOMeter install path**. The **settings.conf** file is used to modify ezIOMeter's runtime settings.

Example settings.conf:

```
# Number of seconds each workload is run.  
workload_duration_sec=120
```

```
# A comma seperatd list to determine what order to run workloads.  
# Note: Use same name as .icf but wihtout the extension.  
workload_run_order=128KB Sequential Writes Queue Depth 32,128KB Sequential Reads Queue Depth 32,4KB Random Writes Queue Depth 32,4KB Random Reads Queue Depth 32
```

```
# Number of seconds to wait before preforming the next workload.  
sleep_between_tests_sec=5
```

```
# Mean IOps  
mean_iops_bucket_order=backward  
mean_iops_bucket0=999999999  
mean_iops_bucket1=999999999
```

```
# Stdev IOps  
stdev_iops_bucket_order=backward  
stdev_iops_bucket0=999999999  
stdev_iops_bucket1=999999999
```

```
# Min IOps  
min_iops_bucket_order=backward  
min_iops_bucket0=999999999  
min_iops_bucket1=999999999
```

```
# Max IOps  
max_iops_bucket_order=backward  
max_iops_bucket0=999999999  
max_iops_bucket1=999999999
```

```
# Mean MBps
```



```
mean_mbps_bucket_order=backward
mean_mbps_bucket0=999999999
mean_mbps_bucket1=999999999
```

```
# Stdev MBps
stdev_mbps_bucket_order=backward
stdev_mbps_bucket0=999999999
stdev_mbps_bucket1=999999999
```

```
# Min MBps
min_mbps_bucket_order=backward
min_mbps_bucket0=999999999
min_mbps_bucket1=999999999
```

```
# Max MBps
max_mbps_bucket_order=backward
max_mbps_bucket0=999999999
max_mbps_bucket1=999999999
```

```
# Latency
latency_bucket_order=backward
latency_bucket0=999999999
latency_bucekt1=999999999
```

workload_duration_sec:

The **workload_duration_sec** is used to determine the number of seconds that a particular workload will be run for.

workload_run_order:

The **workload_run_order** is used to determine the order that the IOmeter workloads will be run in. The accepted value for the **workload_run_order** is s a **comma separated list** (With no spaces) of .icf file names. The .icf file names must match the names in the list minus the file extension to work correctly.

sleep_between_tests_sec:

The **sleep_between_tests_sec** is used to determine the number of seconds to let the system settle before running the next workload.

mean_iops_bucket_order, stdev_iops_bucket_order, min_iops_bucket_order, max_iops_bucket_order, mean_mbps_bucket_order, stdev_mbps_bucket_order, min_mbps_bucket_order, max_mbps_bucket_order and latency_bucket_order:

Note: The bucket order functionality has been left out by default via the bucket values. All results are left green for evaluation purposes. The functionality is left for the user to decide how they want to evaluate their storage devices.

The **x_bucket_order** (x being the name of the bucket order) is used to determine if the value is within the specified bucket range and if the value has to be above or below the specified range value. Setting the **x_bucket_order** to **forward** means that the values have to be above the specified bucket values in order to be within that bucket range. Setting the **x_bucket_order** to **backward** means that the values have to be below the specified bucket values in order to be within that bucket range.

mean_iops_bucket0, stdev_iops_bucket0, min_iops_bucket0, max_iops_bucket0, mean_mbps_bucket0, stdev_mbps_bucket0, min_mbps_bucket0, max_mbps_bucket0 and latency_bucket0:

The **x_bucket0** (x being the name of the bucket) is used to determine if the collected value is within the specified target range.

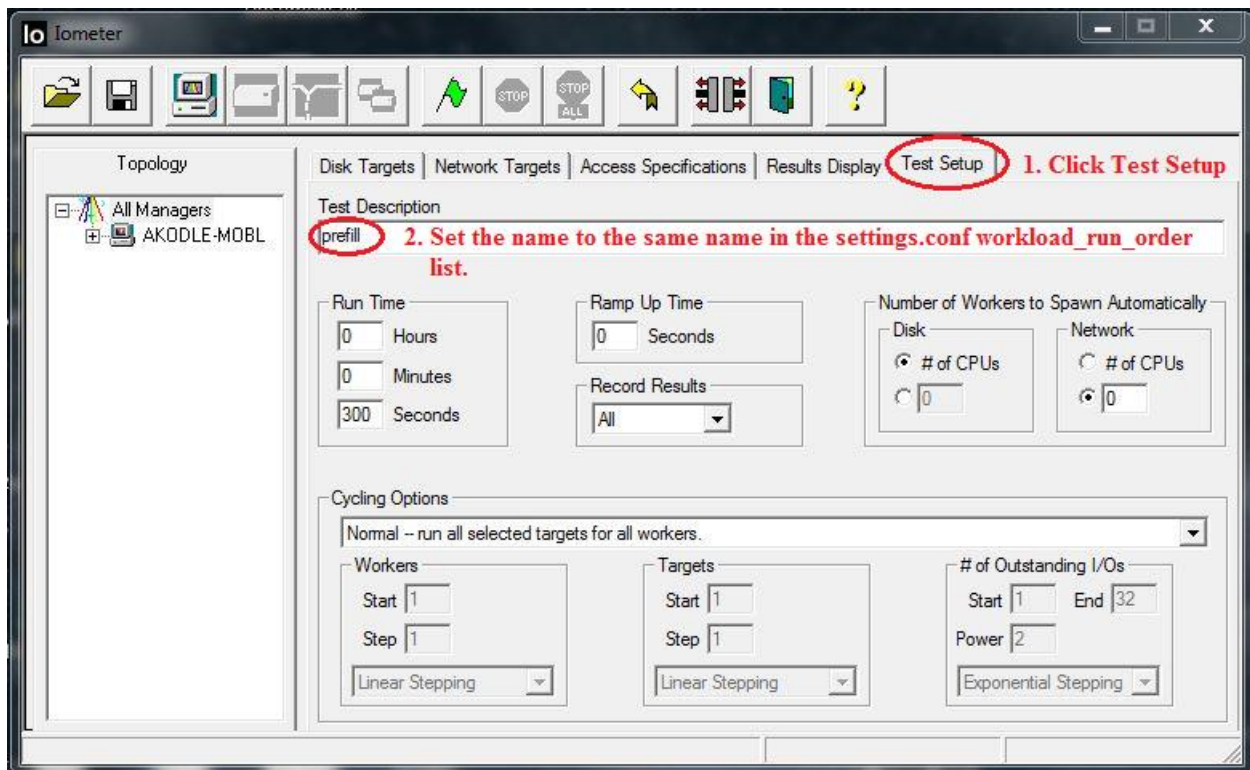
Collected test values **must** be **above** the specified **x_bucket0** but below **x_bucket1** to be placed into the next threshold category and be assigned a background color of **yellow**

- If **x_bucket_order** is assigned a value of **forward** then **x_bucket0** represents the threshold for the lowest category and is assigned a background color of **red**. I.E.
 - $0 \leq \text{Result} < \text{x_bucket0}$ would be **red**.
 - $\text{x_bucket0} \leq \text{Result} < \text{x_bucket1}$ would be **yellow**.
 - $\text{x_bucket1} \leq \text{Result}$ would be **green**.
- If **x_bucket_order** is assigned a value of **backward** then **x_bucket0** represents the threshold for the highest category and is assigned a background color of **green**. I.E.
 - $0 < \text{Result} \leq \text{x_bucket0}$ would be **green**.
 - $\text{x_bucket0} < \text{Result} \leq \text{x_bucket1}$ would be **yellow**.
 - $\text{x_bucket1} < \text{Result}$ would be **red**.

*3.2 IOmeter Configuration Files (.icf)

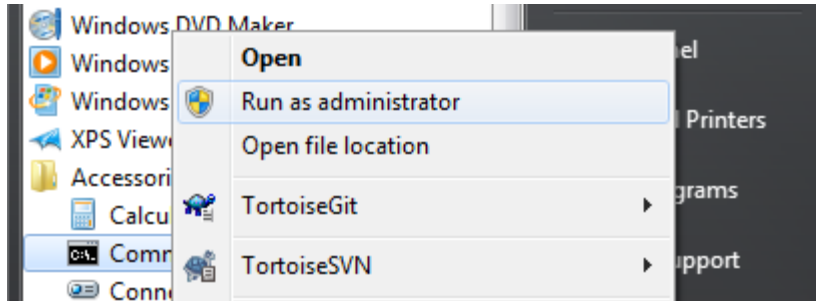
The **IOmeter Configuration Files** are the setting files that make up the individual workloads. These files can be modified using **iometer.exe** which can be found at **ezIOmeter install path\IOmeter**.

*Note: The name of the **Test Description** **must match** the name in the **settings.conf** file for the **workload_run_order** list.*



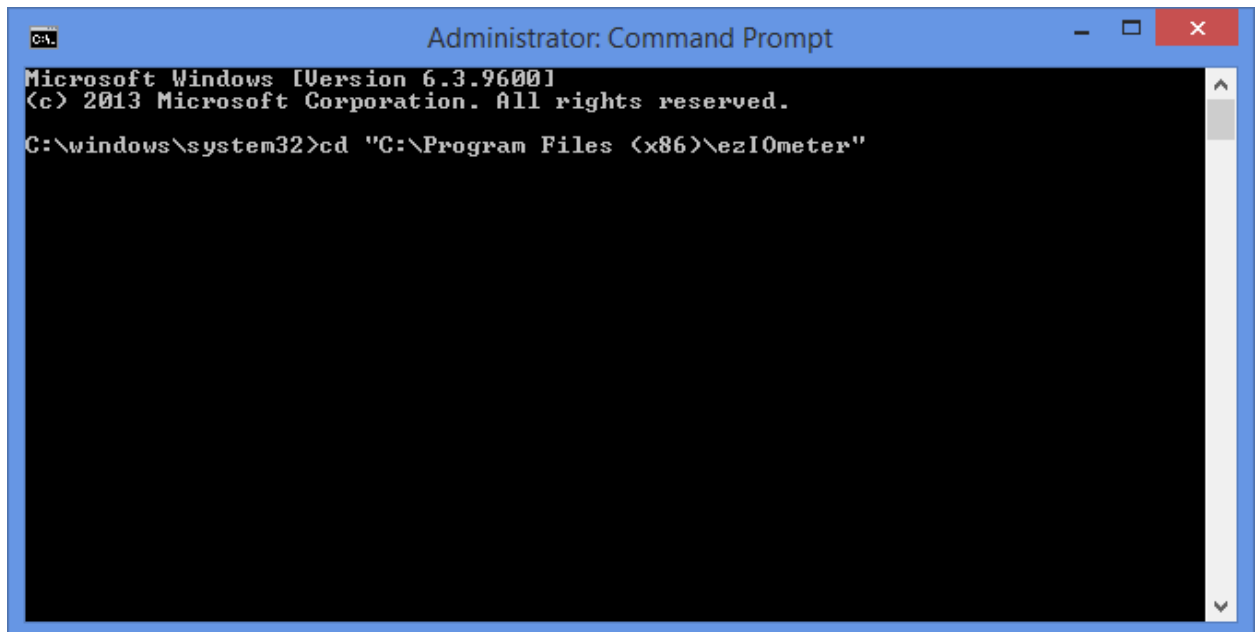
*3.3 Running ezIOMeter Command Line

- 1.) Launch a **cmd** window with **Elevated Privileges**.

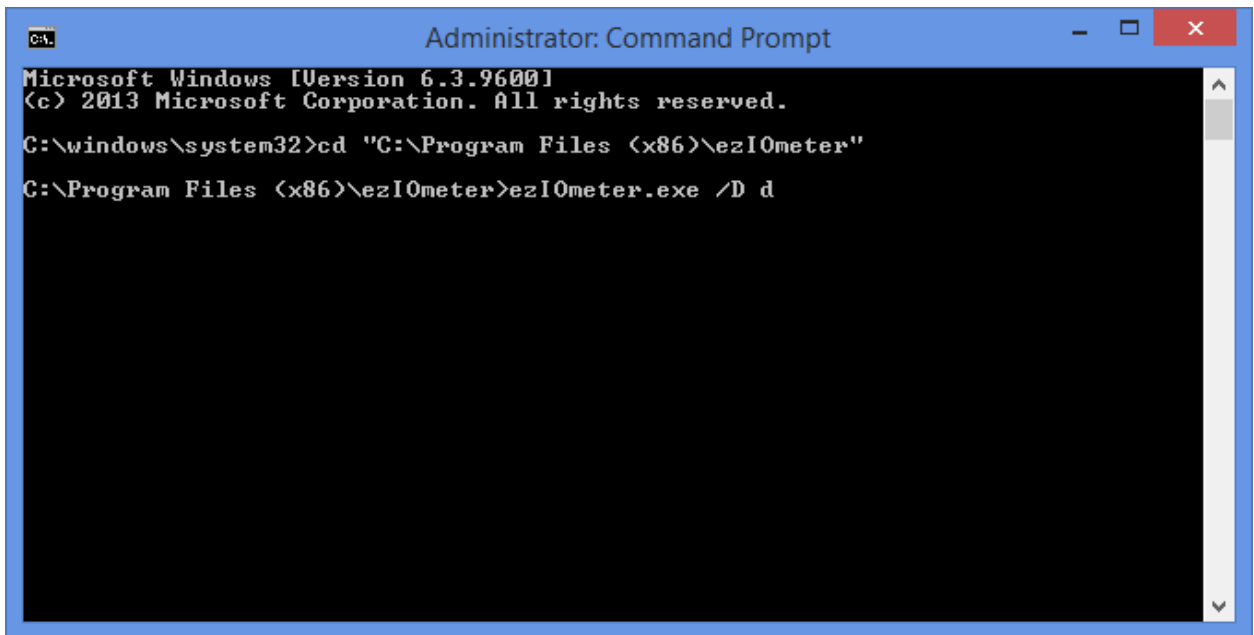


- 2.) Click **Yes** if prompted with a **User Account Control** prompt.

- 3.) Navigate to “**C:\Program Files (x86)\ezIOMeter**”



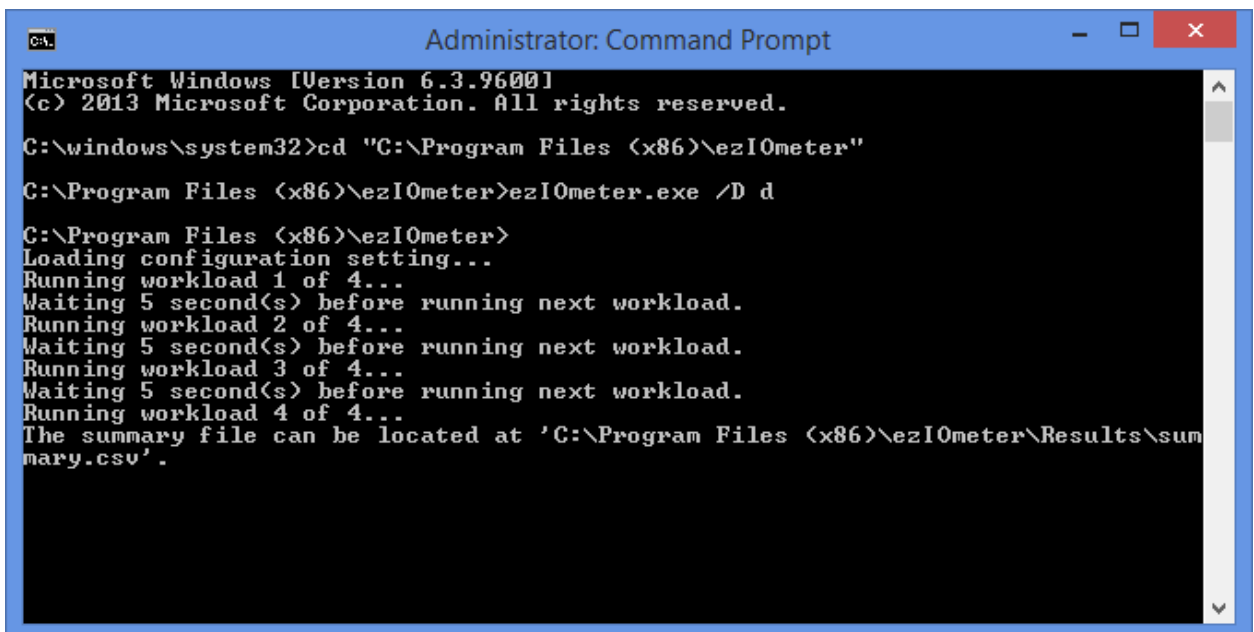
- 4.) Run “ezIOMeter.exe /D d” to run ezIOMeter targeting the **D:** drive connected to the computer as a secondary drive.



```
Administrator: Command Prompt
Microsoft Windows [Version 6.3.9600]
(c) 2013 Microsoft Corporation. All rights reserved.

C:\windows\system32>cd "C:\Program Files (x86)\ezIOMeter"
C:\Program Files (x86)\ezIOMeter>ezIOMeter.exe /D d
```

- 5.) Click **OK**, if prompted to open a port.
- 6.) **Wait** for the benchmark to complete.



```
Administrator: Command Prompt
Microsoft Windows [Version 6.3.9600]
(c) 2013 Microsoft Corporation. All rights reserved.

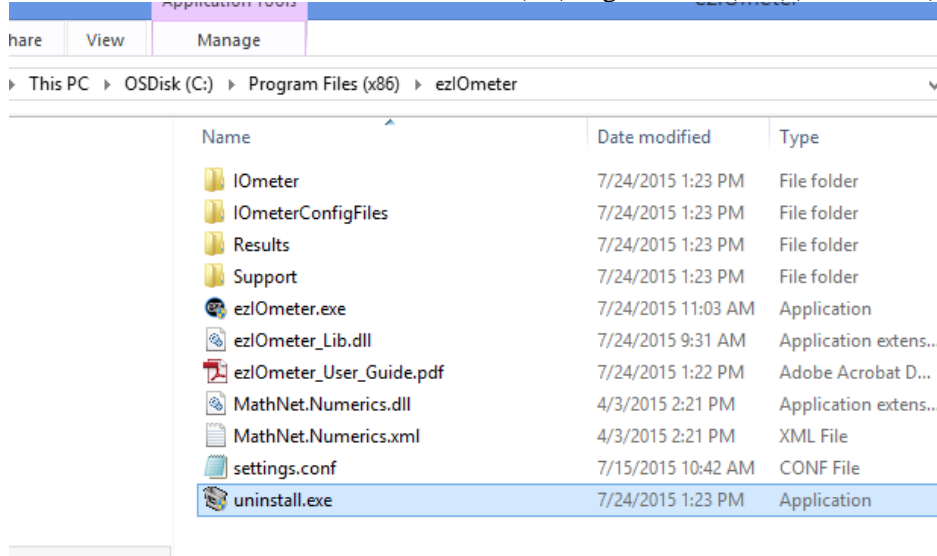
C:\windows\system32>cd "C:\Program Files (x86)\ezIOMeter"
C:\Program Files (x86)\ezIOMeter>ezIOMeter.exe /D d
C:\Program Files (x86)\ezIOMeter>
Loading configuration setting...
Running workload 1 of 4...
Waiting 5 second(s) before running next workload.
Running workload 2 of 4...
Waiting 5 second(s) before running next workload.
Running workload 3 of 4...
Waiting 5 second(s) before running next workload.
Running workload 4 of 4...
The summary file can be located at 'C:\Program Files (x86)\ezIOMeter\Results\summary.csv'.
```

- 7.) Open the **summary.csv** file located at “**C:\Program Files (x86)\ezIOmeter \Results**” to view the summary data (Intel 320 series example run).

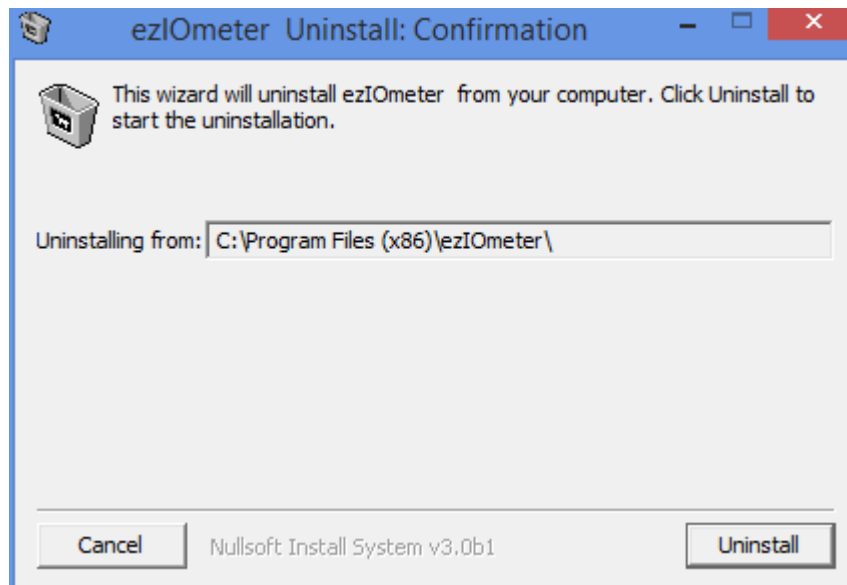
[illegible]

4. How to Uninstall ezIOmeter

1. Locate the uninstall.exe file in (C:\Program Files(x86)\ezIOmeter\uninstall.exe).



2. Double click and follow on-screen instructions to uninstall

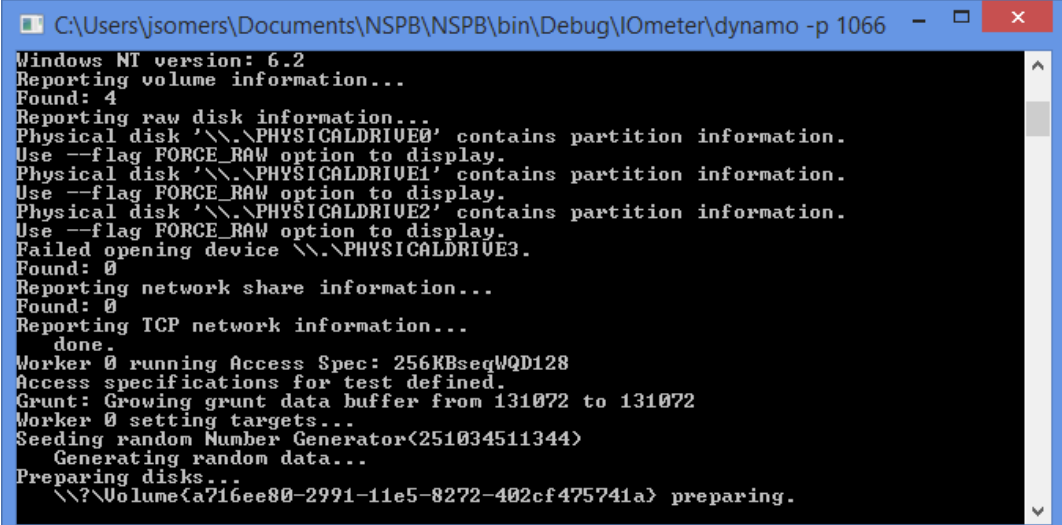


5. Troubleshooting

1. When testing for the first time, ezIOMeter may need to prepare the drive for testing. This can take up to an additional five minutes.
2. If the drive you intend to test is not being picked up in the ezIOMeter drop down menu, ensure that the drive is properly attached to the computer and is formatted. The storage drive must be formatted in order to be tested.
3. You will need to restart ezIOMeter if you unplug a storage device while ezIOMeter is running.
4. If you “Stop Tests” before a drive is done preparing, manually exit out of Dynamo.
5. An 8GB test file (“iobw.tst”) is created when you run tests using ezIOMeter. ezIOMeter attempts to delete the “iobw.tst” file after and before every test run. If you click “Stop Tests” before a drive is prepared, ezIOMeter cannot delete the file because Dynamo is using it to prepare the drive. You will either have to start up another test again and run all the way through to delete the file or manually delete the file. This file is typically located at the root directory of the tested drive.

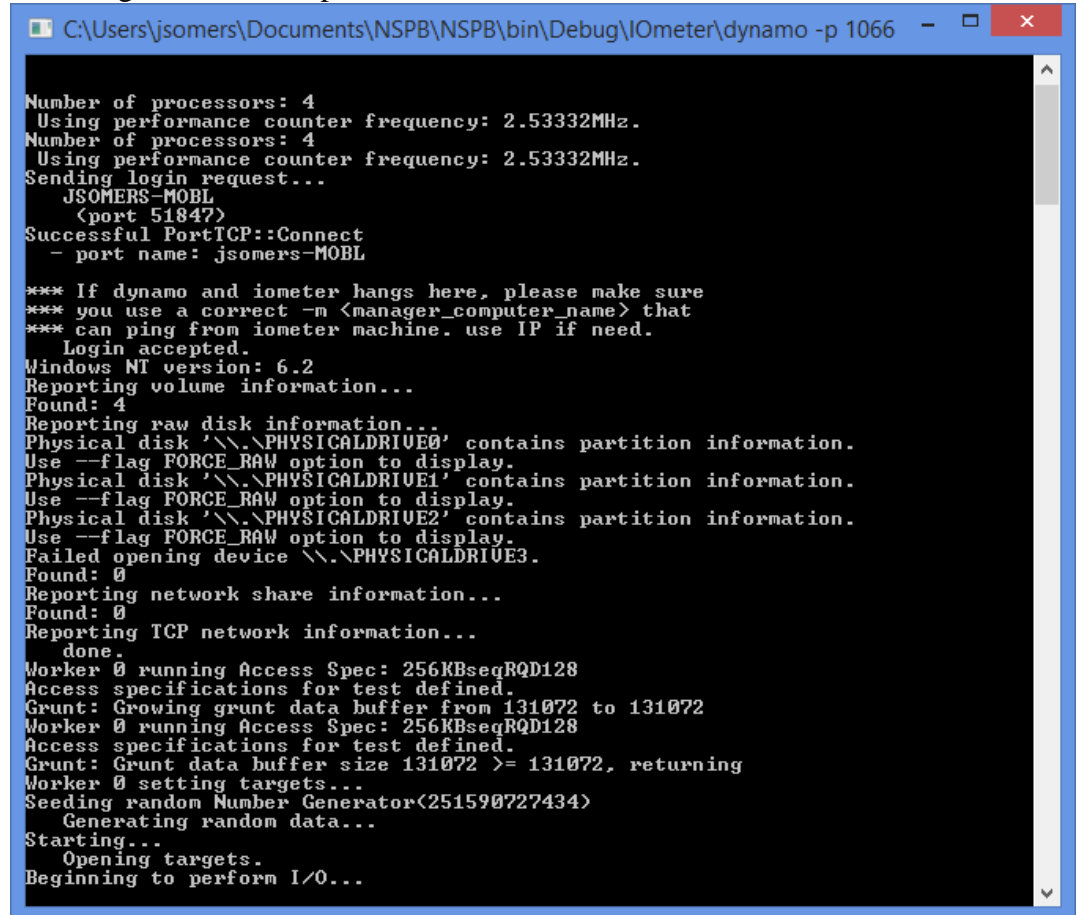
6. FAQ

1. Where is ezIOMeter installed by default?
C:\Program Files(x86)\ezIOMeter
2. Where is the configuration settings file located?
C:\Program Files(x86)\ezIOMeter\settings.conf
3. Where can I find a summary of my results?
C:\Program Files(x86)\ezIOMeter\Results\summary.csv
4. How do I know if my drive is preparing or actually running a test (performing I/O)?
 - i. There is a second application that opens once testing and preparing begins. Dynamo is the application that works alongside IOMeter. Here you can view Dynamo's output.
 - ii. If Dynamo's Console displays "Preparing Disks...." Then the drive is being prepared. For example:



```
C:\Users\jsomers\Documents\NSPB\NSPB\bin\Debug\IOMeter\dynamo -p 1066 -
Windows NT version: 6.2
Reporting volume information...
Found: 4
Reporting raw disk information...
Physical disk '\\.\PHYSICALDRIVE0' contains partition information.
Use --flag FORCE_RAW option to display.
Physical disk '\\.\PHYSICALDRIVE1' contains partition information.
Use --flag FORCE_RAW option to display.
Physical disk '\\.\PHYSICALDRIVE2' contains partition information.
Use --flag FORCE_RAW option to display.
Failed opening device '\\.\PHYSICALDRIVE3'.
Found: 0
Reporting network share information...
Found: 0
Reporting TCP network information...
done.
Worker 0 running Access Spec: 256KBseqWQD128
Access specifications for test defined.
Grunt: Growing grunt data buffer from 131072 to 131072
Worker 0 setting targets...
Seeding random Number Generator(251034511344)
Generating random data...
Preparing disks...
\\?\Volume{a716ee80-2991-11e5-8272-402cf475741a} preparing.
```

- iii. If Dynamo's console displays "Beginning to perform I/O..." then the test is being ran. For example,



```
C:\Users\jsomers\Documents\NSPB\NSPB\bin\Debug\IOmeter\dynamo -p 1066

Number of processors: 4
Using performance counter frequency: 2.53332MHz.
Number of processors: 4
Using performance counter frequency: 2.53332MHz.
Sending login request...
JSOMERS-MOBL
(port 51847)
Successful PortTCP::Connect
- port name: jsomers-MOBL

*** If dynamo and iometer hangs here, please make sure
*** you use a correct -m <manager_computer_name> that
*** can ping from iometer machine. use IP if need.
Login accepted.
Windows NT version: 6.2
Reporting volume information...
Found: 4
Reporting raw disk information...
Physical disk '\\.\PHYSICALDRIVE0' contains partition information.
Use --flag FORCE_RAW option to display.
Physical disk '\\.\PHYSICALDRIVE1' contains partition information.
Use --flag FORCE_RAW option to display.
Physical disk '\\.\PHYSICALDRIVE2' contains partition information.
Use --flag FORCE_RAW option to display.
Failed opening device '\\.\PHYSICALDRIVE3'.
Found: 0
Reporting network share information...
Found: 0
Reporting TCP network information...
done.
Worker 0 running Access Spec: 256KBseqRQD128
Access specifications for test defined.
Grunt: Growing grunt data buffer from 131072 to 131072
Worker 0 running Access Spec: 256KBseqRQD128
Access specifications for test defined.
Grunt: Grunt data buffer size 131072 >= 131072, returning
Worker 0 setting targets...
Seeding random Number Generator(251590727434)
Generating random data...
Starting...
Opening targets.
Beginning to perform I/O...
```

7.How to Contribute

Below indicates the steps you can take to contribute to the progression of ezIOmeter!
<TBD once github is setup>