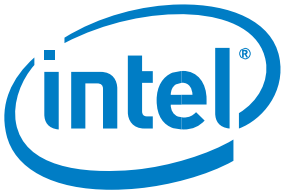

# Intel® I/O Assessment Tool 2.0 for Windows*

## Administrator's Guide

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***February 2016***

Order Number: xxxxxx-002

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# Contents



## Tables



***Revision History***

# Revision History

| Date | Revision | Description |
|---|---|---|
| March 2014 | 001 | Initial release of document. |

| | | |
|---|---|---|
| May 2014 | 002 | Updates for the 1.0 GA. |
| February 2016 | 003 | Updates for the 2.0 GA. |

# 1 About This Guide

This guide offers the quickest way to install and begin using Intel® I/O Assessment Tool. This guide assumes users have a basic knowledge of storage and application management, as well as knowledge of the Microsoft* Windows* Server environment.

## 1.1 Intel® I/O Assessment Tool Overview

The Intel® I/O Assessment Tool suite will help a user determine if they have an I/O workload that can benefit from the performance capabilities of the Intel® Cache Acceleration Software (Intel® CAS) for Windows or the Intel® Cache Acceleration Software – Workstation (Intel® CAS-W) products. For the purposes of this document, both products will be referred to as Intel CAS. The tool monitors and records the types of I/O a system experiences during a user-selectable time period. The tool not only uses this data to determine if the system can benefit from caching, but it also determines which files would most benefit from it, thus providing a key piece of information that can be used to take advantage of two of Intel CAS's key advantages: Selective Optimized Caching and Pinning.

Intel® I/O Assessment Tool contains 2 applications:

- The Profiler collects data on I/O that are executed on the system.
  - The tool is easy to configure.
  - Data is not sent outside of the system.
- The Analyzer takes data from the Profiler to establish if files on the system will benefit from Intel Cache Acceleration use.
  - Provides an assessment of the cache-ability of data and determines specific files to cache.
  - Analysis data is not sent outside of the system.

The tool is designed to analyze HDD-based storage solutions. If your system has already deployed SSDs for storage, you will most likely not realize any performance benefit from SSD based caching solutions.

## 1.2 Documentation Conventions

The following conventions are used in this manual:

- `Courier font` - code examples, command line entries, filenames, directory paths, and executables.
- **Bold text** - graphical user interface (GUI) entries and buttons.

## 1.3 Acquiring the Intel® I/O Assessment Tool

The Intel I/O Assessment Tool is available via the following Intel website:
https://registrationcenter.intel.com/RegCenter/ComForm.aspx?productid=2133

The Intel® I/O Assessment Tool is also available through direct contact with Intel Corporation. Please contact your Intel Field Application Engineer or Intel Sales Team contacts to get information on how to access the tool.

## 1.4 Intel Cache Acceleration Software

To learn more about Intel® Cache Acceleration Software go to www.intel.com/cas .

# 2 Product Specifications and System Requirements

## 2.1 Supported Platforms

Intel® I/O Assessment Tool supports the platforms listed below for 64-bit processors.

**Table 1. Supported Platforms**

| Platform | Notes |
|---|---|
| Windows* Server 2012 R2 | 64-bit |
| Windows* Server 2008 R2 | 64-bit |
| Windows* 7 | 64-bit all variations. |
| Windows* 8.1 | 64-bit only |
| Windows* 10 | 64-bit only |

Intel CAS is validated with Windows Server OSs. Intel CAS-W is validated with Windows* 7, 8 and 10.

## 2.2 System Requirements

The table below lists system requirements for Intel® I/O Assessment Tool.

***NOTE:*** Please ensure that Intel® CAS is NOT installed on the system when running the Intel® I/O Assessment Tool.

**Table 2. System Requirements**

| | |
|---|---|
| Memory | 4GB of memory minimum; 8GB or greater recommended |
| Flash/SSD | No Flash Storage is required for this application. |
| Storage to assess | Primary storage device including SAN, local disk, RAID, iSCSI, or Fiber Channel, etc.<br>NAS is currently not supported for the Intel I/O Assessment Tool. |
| Drive Usage | 10GB minimum drive space for application and data files. |

| | |
|---|---|
| Application Support | .NET Framework version 4.0 or higher is required.<br>Visual C++ Redistributable for Visual Studio 2012 Update 4 is required. |

.NET 4.0 or higher is required for the software to work properly. This package can be found in the link below and installed on the system.

http://www.microsoft.com/en-us/download/details.aspx?id=17718



***NOTE:*** If the system is not able to connect to the internet:

- Download the Microsoft .NET Framework (Standalone Installer) from a system that can access the Microsoft website.
- Copy the package to the system and install the package per Microsoft's instructions.

Visual C++ Redistributable for Visual Studio 2012 Update 4 package is required for the software to work properly. This package can be found in the link below and installed on the system.

http://www.microsoft.com/en-us/download/details.aspx?id=30679

***NOTE:*** If the system is not able to connect to the internet:

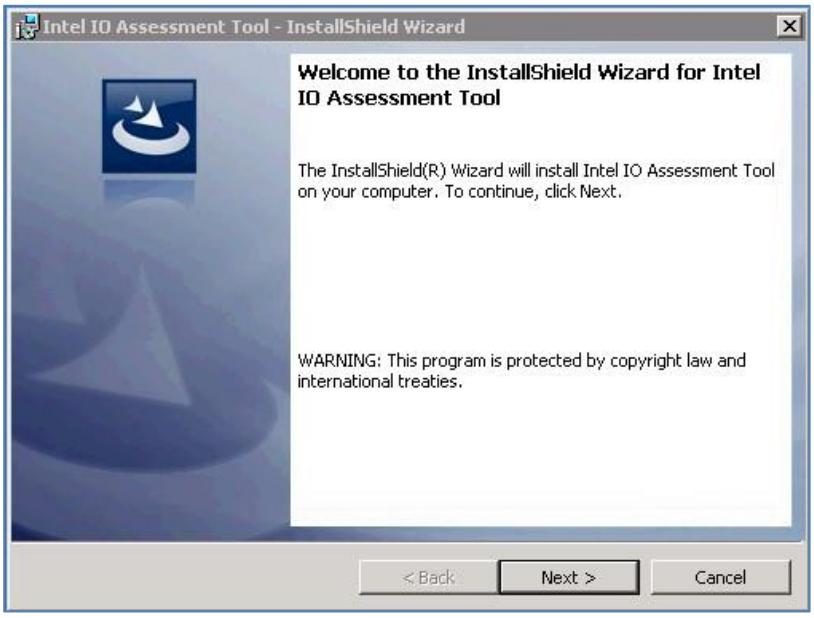
- Save the executable file from the link above.
- Copy it to the system and install the package per Microsoft's instructions.

# 3 Installation

This installation guide describes how to invoke the automated installer and describes the default settings.

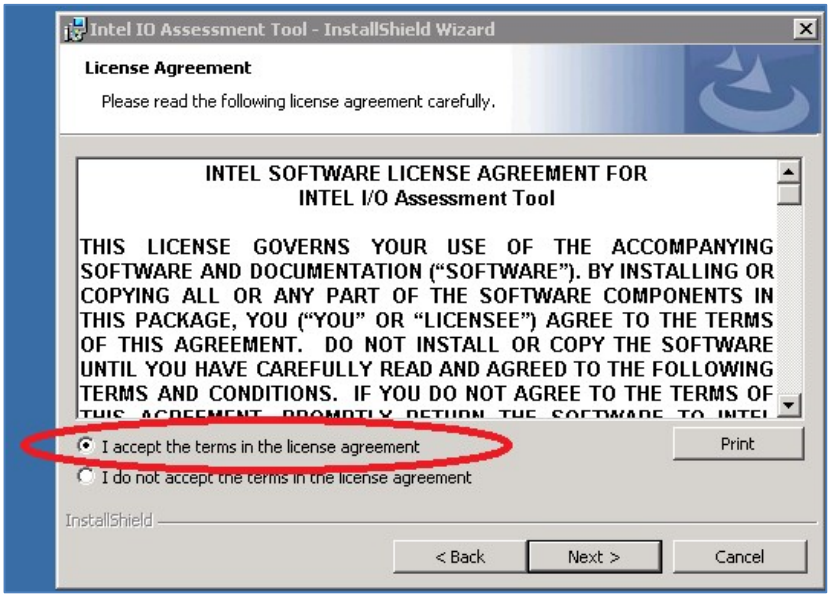
## 3.1 Installing the Software

1. Ensure that the Microsoft*software packages identified in the previous section have been installed properly.
2. Make the installation file with the name format "`ioat-02.xx.xx.xxxx.exe`" available to the system on which it is to be installed on.
3. Double click the file and follow the prompts.
4. Click **Next** to continue installation.






5. The terms of the license agreement must be accepted in order for the program to install.



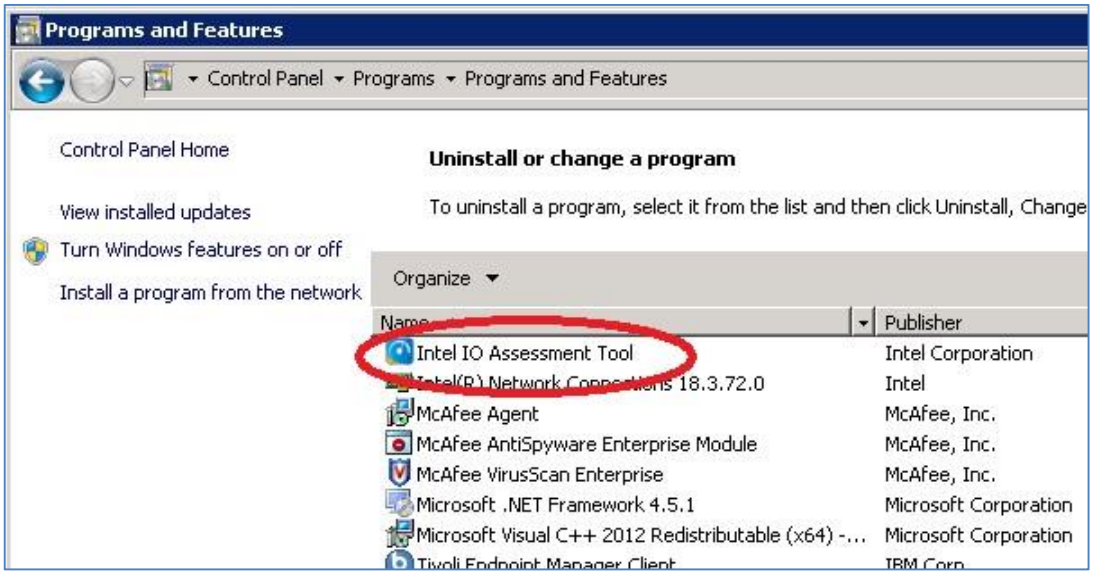

6. Once installation is complete, continue to Chapter 4 to configure and use the software.

***Installation***

## 3.2 Uninstalling the Software

To uninstall the Intel® I/O Assessment Tool use the following steps:

1. Open "**Control Panel**" from the Windows Start menu.
2. Click on "Uninstall a Program".
3. Select the Intel I/O Assessment Tool Application as shown below.




4. You may also uninstall the .NET Framework and the Visual C++ Redistributable for Visual Studio 2012 Update 4 package, if they are not required in the system.



# 4 Using the Intel® I/O Assessment Tool Profiler

Please read all instructions prior to running the assessment tool. The following information will be useful to have prior to configuring the tool:

- Information on what drive, folder, and/or files are to be profiled to assess any caching benefit.
- Information on the storage device to be used to log information the tool uses to profile.

***NOTE:*** The tool must be run with Administrator privileges. This can be done by:

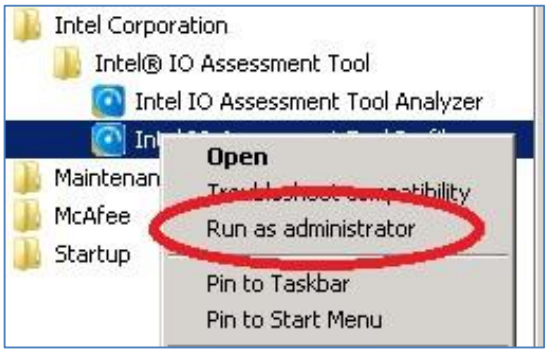
- Pressing the "**Shift**" key while pressing the right mouse button over the icon for the tool.
- Pressing the "Run as administrator" option with the left mouse button.

***NOTE:*** For Windows 7 users pressing the "Shift" key is not required. Place, the mouse pointer over the application and right click to show the option to "Run as administrator".

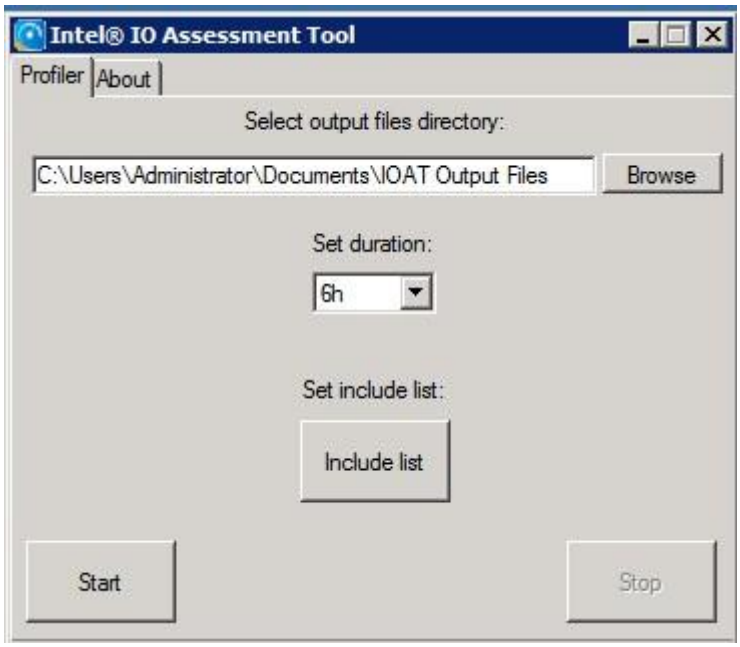
1. The Intel® I/O Assessment Tool Profiler can be found by following this path:

**Start -> All Programs -> Intel Corporation -> Intel IO Assessment Tool -> Intel IO Assessment Tool Profiler**.

***NOTE:*** Remember to select "Run as administrator" before launching the software.




***Using the Intel® I/O Assessment Tool Profiler***



2. Set directory for output file:
    a. This the directory in which the tool will save the data it collects on I/O. A default location has already been specified. You may change this location as needed.
3. Set the Duration for the tool to run:
    a. Set the duration for a time length that will best represent the usage you want to profile. You have a choice between 6, 12, and 24 hour durations.
    b. Ideally you'd like to run the application as long as possible, to get the best profile of I/O traffic. The tool will collect up to 10 GB of data regardless of run time.

***NOTE:*** The output files for the Intel® IO Assessment Tool Profiler can grow rapidly depending on amount of IO being run on the system and the length of time allowed for the profiling. The tool will display a message and stop the service if drive space becomes limited. The files used can be deleted by the user once the analysis has been completed.

4. Update what files to monitor by updating the **Include List**.

    The "Include List" is a key function that enables the Selective Optimized Caching and Pinning features of Intel CAS. It allows a user to focus the cache space to items important to accelerate. For more information on the "Include List" and these key features of Intel CAS, please refer to Appendix C.

    a. The tool requires that the user specify which drives, directories, or files and any combination thereof to be profiled.
    b. Press the "**Include List**" button to enter what is to be profiled.

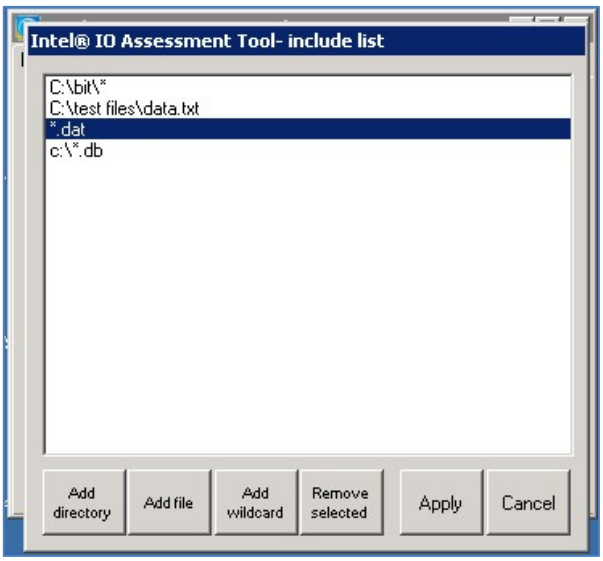


    c. There are 3 ways to add what files the tool will profile.
        1. "**Add directory**" will allow a user to select a directory that the user wishes to profile. Please keep in mind that the tool recursion of the directory structure. Automatically, any subdirectories will be included.
        2. "**Add file**" will allow a user to select a specific file to be profiled. A user can select only a single file with this option.
        3. "**Add wildcard**" will allow a user to enter in free text that specifies the types of files to be profiled. It is valid to specify a file that may not exist yet. It is valid to enter in a wild card pattern without a drive letter. The use of the wildcard character "*" is allowed.

            Examples of valid wildcard use:

            c:*, d:*.*, d:*.db, d:\hot*.db, *.db

    d. Items can be removed from the include list by highlighting the line item to be removed and pressing the "**Remove Selected**" button.




e. Once the include list has all the directories or files that a user wants to profile, press the "**Apply**" button to save the list to the tool. If you wish not the save the list, press the "**Cancel**" button to exit this dialog box without saving the latest changes.

***NOTE:*** The include list will not profile any files in the Windows directory and Intel I/O Assessment Tool Program Files directory. Additionally, the tool will not profile any executable files and dynamically link libraries (DLLs) regardless of file location.



5. Press the "**Start**" button and use the system as normal to get an accurate profile of the I/O workload.
6. If for any reason the profiling needs to be stopped, pressing the "**Stop**" button will stop the data collection and save any data collected up to that point.



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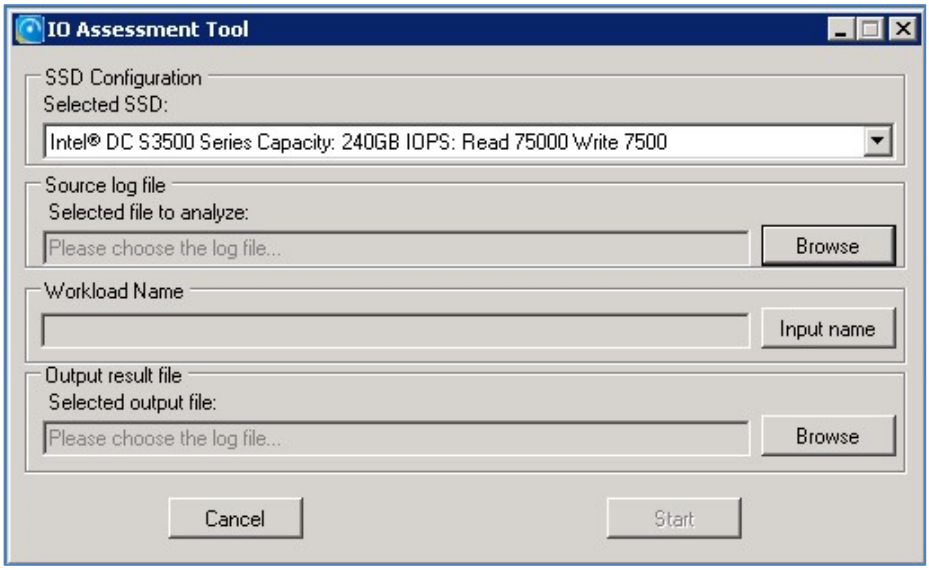
# 5 Using the Intel® I/O Assessment Tool Analyzer

The Intel® I/O Assessment Tool Analyzer takes log files saved by the Profile tool and analyzes the information to assess if the data profiled would benefit from the Intel® Cache Acceleration Software product.

1. The Intel® I/O Assessment Tool Analyzer can be found by following this path: **Start -> All Programs -> Intel Corporation -> Intel IO Assessment Tool -> Intel IO Assessment Tool Analyzer.**

The user interface will look like the picture below.



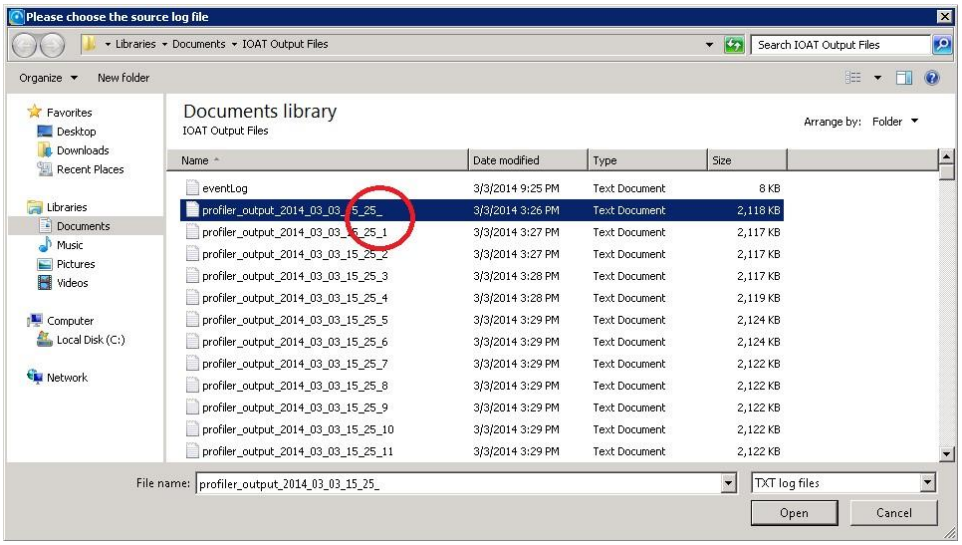

2. In the box titled "**SSD Configuration**" you will need to select a potential SSD that you may use for caching purposes. Pick the SSD most closely matches the SSD device you'd be interested in using, as this selection will be used to determine the amount of performance gain you can expect from that caching device. Basic I/Os per Second (IOPS) for the possible selections are provided. If more information on the Intel® SSDs is required, please refer to Appendix D.

***NOTE:*** No caching SSD is required for the use of this tool.

3. In the box titled "**Source Log File**" select the first file of your Intel® IO Assessment Tool Profiler output.

   - This the same file specified in the Intel® I/O Assessment Tool Profiler in section 4 step 2 above.
   - There may be multiple files produced. Please use the first file in the list. See picture for reference.

   ***NOTE*:** if the first file is not used, the analysis will continue but may not fully represent the workload for that time period.




4. In the box titled "**Workload Name**" enter a name that you can associate with that describes the traffic that was profiled.
5. In the box titled "**Output result file**" specify the location of the analyzer's results file. A default is given, but can be changed as needed.
6. Press the "**Start**" button at the bottom of the dialog box to begin the analysis.

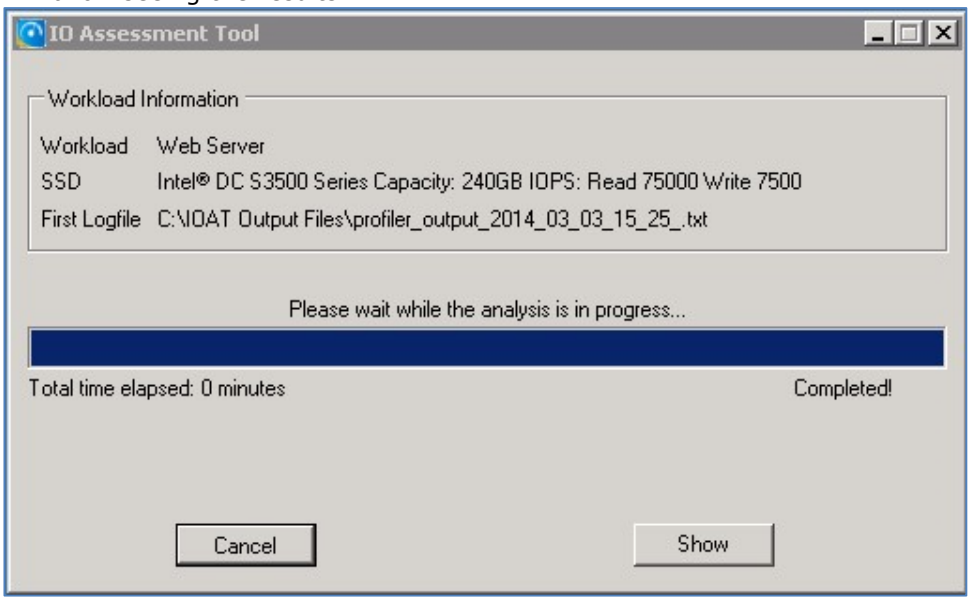
   ***NOTE:*** it may take a few minutes for the analysis to complete depending on the size of the Profiler log files.

7. The Analyzer can be re-ran after the data has been reviewed. The Selected SSD device can be changed to reflect the different performance behaviors of the devices. If more information on the Intel® SSDs is required, please refer to Appendix D.

   Please be sure to rename the output file to a unique name before each run if the output files for each analysis are to be kept.

# 6 Interpreting the Analyzer Results

1. Once the Profiler logs have been completely analyzed, pressing the "**Show**" button will allow seeing the results.

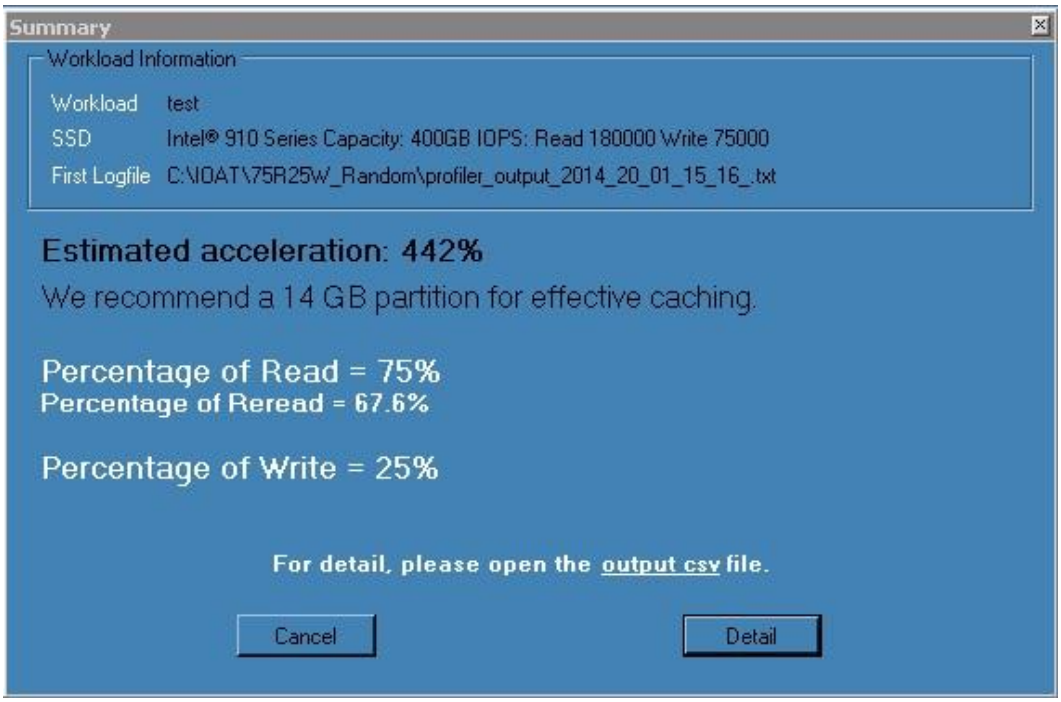



2. The "**Summary**" screen will be the displayed
    a. The "**Workload Information**" box will show:
        i. The name of the workload the user specified.
        ii. The type of SSD used by the analyzer to predict accelerated performance. iii. The First Log file produced by the Profile tool used for this analysis.
    b. The "**Estimated acceleration**": gives the expected performance change based on the Workload information provided and the log file data, in percentage.
    c. The summary also reports out the estimated size of the caching partition for the workload submitted in the Profiler's include list. This estimate only applies to the workload the tool just analyzed and is given only as a guide. Having additional cache space will allow the caching of additional data as system requirements may change.
    d. The Percentage of Reads, Rereads and Writes are given as well.
        i. These percentages are useful in determining the viability of a write-through caching solution.

***Interpreting the Analyzer Results***

ii. The percentage of Rereads notes how many of the I/Os were reads of a sector of data that has been read prior, during the workload

profile time period. The higher this number is, the greater the efficient use of a write-through cache.




3. Pressing the "**Detail**" button in the summary screen will provide a greater breakdown of the analysis.
    a. The "**Workload Information**" box will show:
        i. The name of the workload the user specified.
        ii. The type of SSD used by the analyzer to predict accelerated performance.
        iii. The first log file produced by the Profile tool used for this analysis.
    b. The "**Workload Summary**" box will show the statistics for the complete profile period.

    ***NOTE:*** The following results can be affected by what files are specified in the "include" list of the Profiler and the amount of time the Profiler is ran.

    This box shows the following statistics:

        i. System Read Time – the amount of time the host system spent reading files. ii. System Write Time – the amount of time the host system spent writing files. iii. System Read Time % – the percentage of total host system time spent reading files.



        iv. System Write Time % – the percentage of total host system time spent writing files.
        v. CAS Read Time – the amount of time estimated to be spent by CAS performing reads.

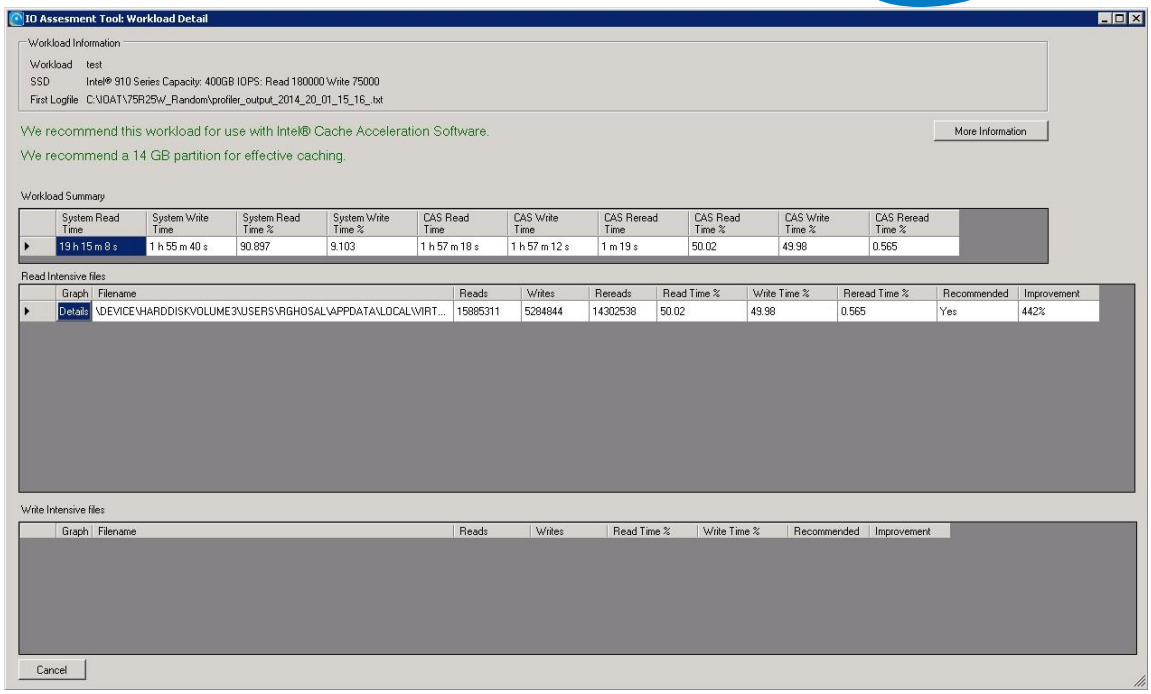
vi. CAS Write Time – the amount of time estimated to be spent by CAS performing writes. vii. CAS Reread Time – the amount of time estimated to be spent by CAS reading information already on the SSD.

***NOTE:*** A Reread is the read of a sector of data that has been accessed prior, during the workload profile time period.

c. The "**Read Intensive Files**" box will show the I/O breakdown of specific files that could benefit from caching. This box shows the following statistics:

i. "Reads" indicates the total reads performed on this file
ii. "Writes" indicates the total writes performed on this file
iii. "Rereads" shows the number of reads that were for the same data from a previous I/O for this file.
iv. Read Time % – the percentage of total CAS IO time estimated to be spent performing reads.
v. Write Time % – the percentage of total CAS IO time estimated to be spent performing writes. vi. Reread Time % – the percentage of total CAS IO time estimated to be spent reading information already on the SSD.
vii. "Recommended" indicates whether or not this file would benefit from the use of Intel CAS.
viii. "Improvement" indicates what the expected acceleration benefit would be, in %.

***Interpreting the Analyzer Results***




4. Clicking the "Detail" button in the "Read Intensive Files" box will display a histogram that breaks down the I/O analysis for that specific file even further. In this view the file broken up into separate units called chunks. It allows the tool to break down the file into small pieces that can show how reads and writes are distributed across the file.
    a. The first section of the dialog box will show what percentage of the chunks of that file fit within four categories:
        i. Cold – represents I/O which has 25% or less reads.
        ii. Somewhat warm – represents I/O that has between 25% and 50% reads.

        The "Cold" and "Somewhat warm" categories represent a workload that will not benefit from a write-through cache.

        iii. Warm – represents I/O that has between 50% and 75% reads. iv. Hot – Represents I/O that has over 75% reads.

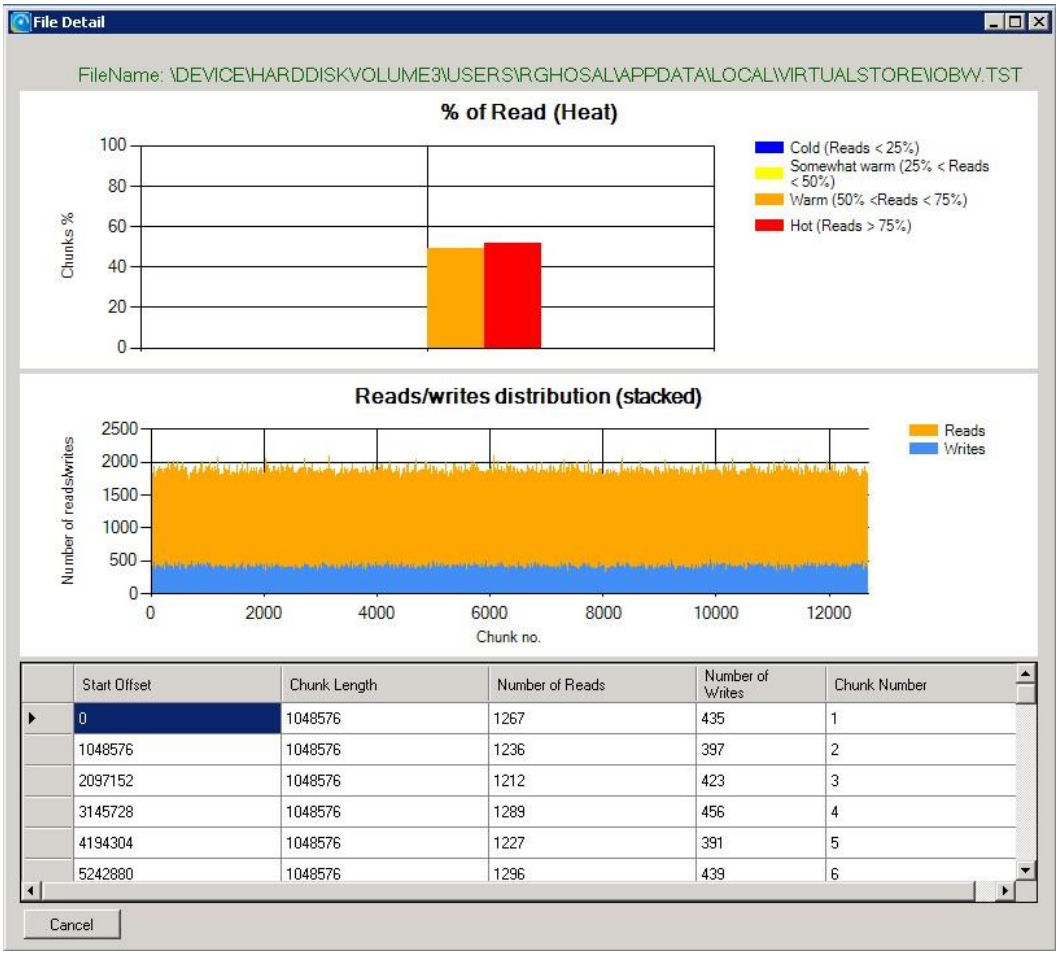
        The Warm and "Hot" categories represent a workload that may benefit from a write-through cache.

    b. The second section graphically represents the number of reads and writes for the file across all the chunks of data that make up that file.

***Interpreting the Analyzer Results***

c. The third section shows the number of reads and writes for each individual chunk. The heads for this table are described below:

1. The chuck length represents the size of the chunk that represents a section of the file.
2. The number of reads for the specific chunk
3. The number of writes for the specific chunk.
4. A unique number representing a specific chuck.




***Glossary***

# *Appendix A Glossary*

| Term | Definition |
|---|---|
| **Cache** | The transparent storage of data so that future requests for that data can be served faster. |
| **Chunk** | A set of data from a larger dataset, in this document a file. |
| **DAS (Direct-Attached Storage)** | A storage system directly attached to a server or workstation, without a storage network in between, mainly used to differentiate non-networked storage from SAN and NAS. |
| **I/O** | Abbreviation for Input/Output as it relates to the flow of data. |
| **I/O Bottleneck** | A term used to describe application slowdown due to the inability of storage I/O to keep up with application demand. |
| **IOPS** | Abbreviation for Input/output Operations Per Second. |
| **Latency (also Lag, Response Time)** | As it relates to storage, the measure of time delay from a requested I/O operation to its response. |
| **Lazy Write** | The process of mirroring data from a cache to the primary storage when I/O is available. |
| **NAS (Network-attached storage**) | A dedicated storage device, with its own network address, that provides file-based data storage services to other devices on a network. |
| **Primary Storage** | As it relates to caching, the storage system or location (DAS, SAN, NAS, etc.) where the data is stored. |
| **Reread** | The read of a sector of data that has been read prior. |
| **SAN (Storage Area Network)** | Framework used to attach remote computer storage devices to servers. Storage devices appear as if they were attached locally to the operating system. |
| **SSD (Solid-State Disk)** | A device used for data storage that utilizes memory chips instead of revolving media. |
| **Wildcard** | Refers to a character (*) that can be substituted for zero or more characters in a string. |
| **Write-Back** | A caching policy where data is written first to the cache and considered complete. Data is then mirrored to primary storage when I/O is available. The process of mirroring to primary storage is known as a Lazy Write. |
| **Write-Through** | A write caching policy where every write to the cache causes a synchronous write to primary storage. |

# Appendix B Server-Side Caching

Server-side caching involves creating a copy of frequently accessed data on fast storage media (Flash/SSD) to improve application performance. Back-end data is not moved or changed, so the enterprise data model (backups, snapshots, etc.) is unaffected.

Caching can dramatically increase I/O performance. However, the effective application performance gain depends on the following characteristics of the application workload:

### Application must be I/O Bound

Database driven applications are typically restricted by the speed at which they can access data (aka: the I/O Bottleneck). This shows up as low CPU utilization and high disk access and/or increased disk queue. Conversely, if the application is held back waiting for CPU time, then caching will not help.

### Percentage of Read Operations

Intel® CAS for Windows is a read cache, meaning that only reads of data are accelerated. Writes are done in tandem to the cache and to the data storage to assure data integrity. Therefore, the higher the percentage of reads, the higher the maximum performance gain from caching.

Transactional databases average about 65% reads, which makes the maximum performance gain 3X. 80% reads can get 5X gain, 90% can get 10X.

### Concentration of Active Data

The size of the active data set and how often the same data is re-read determines the amount of benefit that Intel® CAS provides. The industry rule-of-thumb is that 10% of data is active at any given time, meaning the cache device should be a tenth the size of the back-end data set.

> **Important:** The active data set must be larger than the amount of available DRAM on the application server in order for server-side caching to provide benefit.

Most real-world application workloads have “hot spots” of data (also known as: data locality), meaning that if a particular dataset is accessed, then it is likely to be accessed again in the near future. Locality can be difficult to see with some I/O test tools which perform purely random reads across the entire back-end dataset.

***Glossary***

# Appendix C Include List

Two key features of Intel Cache Acceleration Software are Selective Optimized Caching and Pinning, allowing administrators to target storage performance directly to the applications and data that add the most value to the company. Both Selective Optimized Caching and Pinning are managed through the Include List.

The Include List feature has been provided in the Intel I/O Assessment Tool to allow a way to show the benefits of Selective Optimized Caching and Pinning without deploying the caching software and installing an SSD. During the use of the Intel I/O Assessment Tool, the user can specify what drives, directories, types of files, or specific files they would cache. The tool will monitor the use of these entities and provide an assessment of the possible performance improvements when using Intel CAS and an SSD. The user can also use this information to take advantage of Intel CAS's Selective Optimized Caching and Pinning features. More details of these features are provided below.

Selective Optimized Caching

- Industry unique policy management focuses performance to the applications that directly impact the business
- Focusing the cache to just the important apps/data means the cache is more aligned to the application, increasing performance through increased cache hits.
- Protects the cache from I/O from other applications or system processes (such as virus scans or indexing) that would otherwise evict data from cache that is keeping your highest value applications performance at best speed.

Pinning

- Allows a portion of the cache space to keep important data resident in the cache. Pinning over-rides normal promotion and eviction, placing the data immediately in the cache and retaining it until it is un-pinned. The remaining cache space is utilized normally.
- Data can be pinned permanently (for example, for master database tables) or temporarily (for example, to accelerate upcoming projects).

***Glossary***

# Appendix D Intel SSD Information

Intel Cache Acceleration Software supports any flash/SSD device that is supported by the operating system platform. Intel CAS is end-to-end validated with the Intel SSD data center family (including Intel SSD DC S3700 and S3500 Series, and Intel SSD 910 Series):

| | **Intel® 910 Series** | **Intel® DC S3700 Series** | **Intel® DC S3500 Series** |
|---|---|---|---|
| **IOPS** | 180K/75K Random R/W IOPS[1] | 75K/36K Random R/W IOPS[2] | 75K/11.5K Random R/W IOPS[2] |
| **Endurance** | High Endurance (Up to 14.6PB*) | High Endurance (Up to 14.6PB*) | Standard Endurance (Up to 450TB*) |
| **Protection** | Power safe write cache saves data to SSD and prevents data corruption during unsafe shutdown or unexpected loss in power | | |

For more information go to: www.intel.com/ssd

[1]Read and Write IOPS (Full LBA Range, Iometer* Queue Depth 32 per NAND module) Default/Max Performance mode: — Random 4 KB reads: Up to 180,000 IOPS; — Random 4 KB writes: Up to 75,000 IOPS

[2] 4K Random Reads As measured by Intel:100GB 4K Random Writes QD=1 at 99.9 %of the time across 100% span of the drive Configuration: Intel DH67CFB3; CPU i5 Sandy Bridge i5-2400S LGA1155 2.5GHz 6MB 65W 4 cores CM8062300835404; Heatsink: HS - DHA-B LGA1156 73W Intel E41997-002 and E97379-001; Memory: 2GB 1333 Unbuf non-ECC DDR3 ; 250GB HDD 2.5in SATA 7200RPM Seagate ST9250410AS Momentus 3Gb/s; Mini-ITX Slim Flex w/PS Black Sentey 2421; Ulink Power Hub; SATA Data and Power Combo 24 in. Orange EndPCNoise Sata fp7lp4

*Based on 800GB SKU