Intel® VTune™ Profiler Installation Guide - Linux* OS

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Introduction

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Use VTune Profiler to locate or determine:

- The most time-consuming (hot) functions in your application and/or on the whole system
- Sections of code that do not effectively utilize available processor time
- The best sections of code to optimize for sequential performance and for threaded performance
- Synchronization objects that affect the application performance
- Whether, where, and why your application spends time on input/output operations
- Whether your application is CPU or GPU bound and how effectively it offloads code to the GPU
- The performance impact of different synchronization methods, different numbers of threads, or different algorithms
- Thread activity and transitions
- Hardware-related issues in your code such as data sharing, cache misses, branch misprediction, and others

This document explains how to install and configure Intel VTune Profiler on a Linux* system.

To install VTune Profiler, you can use:

- Graphical user interface (GUI) installer: Presents installation options and allows you to choose product components.
- Silent installer: Uses a single command to install the product in the background.

> **NOTE**
> A 64-bit operating system host is required to use VTune Profiler. You can use VTune Profiler to analyze both 32-bit and 64-bit applications.

Prerequisites

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The following information is important to consider before beginning to install Intel® VTune™ Profiler.

System Requirements

Review the full list of system requirements listed in the Release Notes.

> **NOTE**
> A 64-bit operating system host is required to use VTune Profiler. You can use VTune Profiler to analyze both 32-bit and 64-bit applications.

User Permissions for Install

The VTune Profiler installer is launched using the default user account. The user installing the product should have read and write permissions for the `/tmp` directory.

Most of the Intel VTune Profiler profiling features work with a non-root install. Many work on either a genuine Intel processor or a compatible processor using a driverless collection. For more information, see Profiling Hardware Without Intel Sampling Drivers Cookbook recipe.

Some advanced features that use event-based sampling require the latest OS kernel or sampling driver to be installed. Intel Atom® processors also require this driver for analysis. To install the driver, launch the installer as root or ask your system administrator to install the driver later. For information on building and setting up the drivers, see Sampling Drivers page of the online User Guide.

Required Packages for Intel VTune Profiler GUI

> **NOTE**
> The Intel VTune Profiler GUI is not supported for Red Hat* Enterprise Linux/CentOS* 6.

The following packages are required for the Intel VTune Profiler GUI to be installed:

On Ubuntu* or Debian*, install the following libraries:

```
sudo apt-get install libgtk-3-0 libasound2 libxss1 libnss3
```

On Red Hat* Enterprise Linux or CentOS*, install the following libraries:

```
sudo yum install gtk3 alsa-lib libXScrnSaver nss
```

On Fedora*, install the following libraries:

```
sudo dnf install gtk3 alsa-lib libXScrnSaver nss
```

On SUSE* Linux* Enterprise Server (SLES), install the following libraries:

```
sudo zypper install gtk3 libasound2 libXss1 mozilla-nss
```

Previous Versions of Intel VTune Profiler

You do not need to uninstall previous versions or updates of VTune Profiler before installing a newer version. However, if you do not remove older updates before installing a newer version, all product components that belong to the same major release will be replaced with the latest version for each major release update.

For example, if you are installing Update 2 of the VTune Profiler 2020, the VTune Profiler 2020 Update 1 version will be uninstalled and replaced with the new content for the next update. If you are installing VTune Profiler 2020 on top of VTune Amplifier 2019, your installation of VTune Amplifier 2019 will remain on your system and VTune Profiler 2020 will be installed beside the old version, duplicating common files, documentation, samples, and product components.

Installing in a Cluster Environment

If you are installing in a cluster environment, you can install and use multiple versions of the product on the same system. However, kernel driver usage is limited to a single version of VTune Profiler. This means you can have multiple copies of VTune Profiler installed without the Intel sampling drivers and a single version of the product with the drivers installed. The latter would be enabled with the advanced types of analysis using hardware event based sampling analysis data collection.

Installation Steps

The Intel® VTune™ Profiler installation package contains all components of the product in a downloadable file. The installer can be run as an administrator from a GUI or from a command prompt.

You can choose between these types of installation when installing VTune Profiler:

- Intel® VTune™ Profiler graphical user interface installer
- Install from the Intel® oneAPI Base Toolkit or Intel® System Bring-Up Toolkit
- Automated installation with the silent installer
- Virtual machine installation

Install with the VTune Profiler Installer Graphical User Interface

NOTE
Refer to the Prerequisites before you begin the installation.

Use the following steps to install VTune Profiler:

1. Run the following command to launch the installer:

   `./<installer>.sh`

2. The installer will guide you through the installation process. You can install using the default options or customize your installation.

3. After installation succeeds, run the following command to establish the VTune Profiler environment:

   For bash command interpreter:

   `source <install-dir>/env/vars.sh`

   For csh/tcsh command interpreter:

   `source <install-dir>/env/vars.csh`

   By default, the `<install_dir>` is `/opt/intel/oneapi/vtune/<version>/`.

You can install VTune Profiler in the following ways:

- **Recommended Installation**

  Fully installs the product with commonly used features. Uses the default path and options.
- **Custom Installation**

  Guides you through setting various options for your installation:

  1. **Component Selection**

     Select the components to install. If a component is already installed, you will be offered to upgrade the component.
  2. **Install Location**

     Specify the path for component installation.
  3. **IDE Integration**

     If a supporting IDE is detected, the installer offers to integrate VTune Profiler with the IDE.
- **Download Only**

Downloads the files required for the installation for later use.

Install from the Intel® oneAPI Base Toolkit or Intel® System Bring-Up Toolkit

To install VTune Profiler from Intel® oneAPI Toolkits, follow the Installation Guide for Intel® oneAPI Toolkits.

Virtual Machine Installation

Intel VTune Profiler can be installed and used with a variety of virtual machines. For more information, see the Targets in Virtualized Environments page of the online User Guide.

Automated Installation of Intel® VTune™ Profiler

> **NOTE**
> Refer to the Prerequisites before you begin the installation.

The automated, or silent, installation method allows you to perform a command line installation of Intel® VTune™ Profiler without answering prompts or making product selections. Use the following steps to set up and execute an automated installation:

1. Download the full installer package.
2. Run the following command to begin the installation:

   ```
   ./install.sh –s
   ```

   The installer prompts you to either proceed with default parameters or configure your installation.

The product is installed in the directory specified in the configuration file.

Installing Intel® VTune™ Profiler in a Cluster Environment

There are two typical scenarios for installing Intel® VTune™ Profiler in a cluster environment:

1. Install and enable the kernel driver on specific nodes and for specific users. The users can launch VTune Profiler on a node or machine from a shared partition mounted on their system and use this to analyze programs or system behavior on that node or machine. Even though the program's execution may be distributed among other nodes, a single instance of the tool is collecting performance data for the single node on which it is launched. This is the most common use case as it requires less administrative overhead.
2. Install VTune Profiler on a shared partition that is available to all users. You can either allow the VTune Profiler installer to automatically install the sampling drivers or you can manually install the drivers after product installation succeeds. This use case requires additional administrative oversight.

There are a few changes to the typical installation steps when installing in a cluster environment. The steps that follow set up a cluster environment so that users that belong to a custom group (`my_group`) can run hardware event based analysis on specific nodes. Users can run VTune Profiler using the GUI or the command line, depending on their display device.

Advanced Installation

> **NOTE**
> Refer to the Prerequisites before you begin the installation.

Use the following steps to complete the installation with more control over driver installation:

1. Run the install script with the following command to skip driver installation on the current machine. Running with the `--SHARED_INSTALL` option is required as users are expected to launch profiling on the compute nodes, in general, not necessarily on the main or head node or the node used by administrator for installation.

```
./install.sh --SHARED_INSTALL
```

The product installation generates the `vtune-vars.{sh|csh}` and `vtune-<version.build_number>` module file for cluster environments that use environment modules. These files are added to the top-level product directory and are used to set up the user environment for launching VTune Profiler. For more information about environment modules, see http://modules.sourceforge.net.

> **NOTE**
> Intel VTune Profiler can still be used for profiling with the predefined analysis types based on software sampling even without the sampling driver installed. Users can launch the product from a shared file system to run the predefined analysis types (hotspots, threading, etc.).

2. Build the sampling driver for the current OS. See the `<install-dir>/sepdk/src/README.txt` document for more details on building the driver.

- Build in the `src` directory using the following commands:

  ```
  cd <install-dir>/sepdk/src ./build-driver -ni
  ```
- Build in a custom directory using the `--install-dir` option to specify the installation directory. Make sure that the directories specified in the option already exist.

    1. Run the following command to build and install the driver:

    ```
    ./build-driver --install-dir=
    ```
    2. Use the following commands to copy scripts to the driver installation directory:

    ```
    cp insmod-sep <custom-install-dir> cp rmmod-sep <custom-install-dir> cp
    boot-script <custom-install-dir>
    ```
    3. Create a pax subdirectory in the new driver location and navigate to the new directory:

    ```
    cd pax
    ```
    4. Use the following commands to copy the pax driver scripts:

    ```
    cp insmod-pax <custom-install-dir>/pax cp rmmod-pax <custom-install-
    dir>/pax cp boot-script <custom-install-dir>/pax
    ```

3. Install the event based sampling kernel driver on the selected nodes.

Enter the node on which performance profiling will be completed and run the following commands from the shared directory where the driver is located:

```
cd <install-dir>/sepdk/prebuilt
```

```
./insmod-sep --group my_group
```

```
./boot-script --install --group my_group
```

The `insmod-sep` script loads the driver into the system on the current node. The `boot-script` script configures the driver boot script and installs it in the appropriate system directory. Use the `--help` option to view details on the available script options.

After installation is complete, you can verify that the kernel driver is installed and loaded on a node using the following command:

```
lsmod | grep sep
```

Example

A homogeneous cluster system is set up where the users only have direct access to one node, node1. The only disk space available for writing is the user's home directory. The users have all of their data and software on the file system mounted on node1. They start their tasks using job scripts, which involve MPI mechanisms for dispatching the tasks among the other nodes.
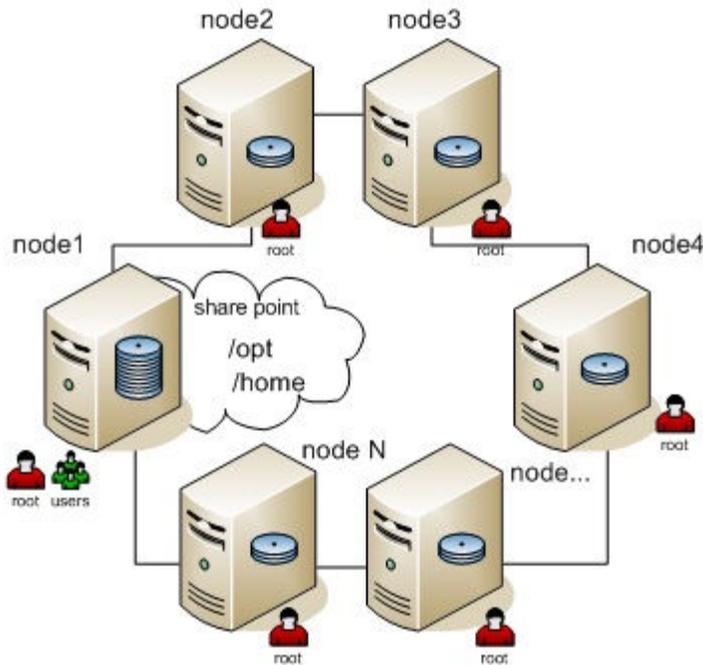
To allow users to run an analysis using VTune Profiler, the administrator has to make sure that the product can be launched on each compute node. The kernel driver also must be installed and loaded on each compute node. After the product and drivers are installed, users can run performance collection on the nodes using the scheduling system scripts to launch an analysis. For example, for MPI applications the `mpiexec` script can be used on node1 to launch the profiling collector on the other nodes by specifying a user application to run as a parameter.

Post-Installation Steps

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The table below details the suggested reading paths based on your analysis needs:

Analyze performance on a remote Linux* system	Install the remote collectors and configure SSH access on a remote Linux* system. If the remote collector installation fails to install the appropriate sampling drivers, the drivers can be installed manually. 1. Configure SSH Access for Remote Collection 2. Prepare a Target Linux* System for Remote Analysis 3. Build and Install the Sampling Drivers for Linux* Targets (optional)
Analyze performance on a remote Android* system	Configure the Android* device for analysis and connect via ADB. If the appropriate sampling drivers are not available, the drivers can be installed manually. Compile the Android* application for analysis. Specify the project search directories. 1. Set up Android* System 2. Build and Install Sampling Drivers for Android* Targets (optional) 3. Prepare an Android* Application for Analysis 4. Search Directories for Android* Targets
Analyze performance on a FreeBSD* system	Install VTune Profiler collectors and drivers on a FreeBSD* system. A FreeBSD license for Intel® System Studio is required. For more information, see Set Up FreeBSD* System.
Analyze performance on embedded Linux* systems	Review the list of supported embedded Linux* systems. Configure the embedded Linux* environment for performance analysis. Begin with Embedded Linux* Targets.
Monitor a virtual machine	Review the list of supported virtual machine managers and analysis type limitations. Configure the virtual machine for performance analysis. Begin with Targets in Virtualized Environments.
Analyze a target installed on the cloud	Review the list of supported cloud environments and learn how to configure the cloud target for remote analysis. For more information, see Targets in a Cloud Environment.

Intel® VTune™ Profiler Installation FAQs

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The following topics include answers to frequently asked questions about the Intel VTune Profiler installation and configuration process.

How do I install the drivers required by Intel® VTune™ Profiler?

Intel VTune Profiler automatically installs the required sampling drivers when the product is installed, assuming the user who installed the product has the appropriate permissions (administrative/root/sudo access). Drivers are installed on a target system when VTune Profiler connects to the target system during analysis configuration (administrative/root/sudo access required via a passwordless SSH connection). If the drivers fail to install, they can be configured manually.

The Sampling Drivers page of the online User Guide includes detailed information about installing the drivers for Linux*, Windows*, or Android* systems.

Error Message: Installing and Starting VTSS++ Driver...FAILED

Problem

When you install the drivers manually, the Intel® VTune™ Profiler may display this message if memory in the system is insufficient.

Solution

Try rebooting the system.

Error Message: No Pre-built Driver Exists for This System

When executing the `build-driver` script on Linux*, you may see a warning message similar to the following if the kernel sources are not configured properly (they do not match the kernel that is running): `Warning: Current running kernel is version 2.4.18-e.31smp.` After successfully building the driver and running the `insmod-sep3` or `insmod-sep` command, the following message appears: `No pre-built driver exists for this system.`

Solution

To resolve this issue, execute the following commands to configure the kernel sources:

```
$ cd /usr/src/linux
```

```
$ make mrproper
```

```
$ cp /boot/config-'uname-r' .config
```

```
$ vi Makefile
```

Make sure that `EXTRAVERSION` matches the tail of the output of `uname -r`. The resulting `/user/src/linux/include/version.h` should have a `UTS_RELEASE` that matches the output of `uname -r`. Once that is true, run the following commands:

```
$ make oldconfig
```

```
$ make dep
```

After completing these steps, run the `build-driver` script to build the sampling driver against the kernel sources in `/usr/src/linux`

What features are available if I install Intel® VTune™ Profiler as a non-root or non-administrator user?

Many Intel VTune Profiler features work when installed on a system as a user other than Root or Administrator. If VTune Profiler is installed by a user with permissions other than root/administrative, then VTune Profiler can collect some data. For example, VTune Profiler may try to use the Perf* utility and run a hardware event-based sampling analysis in the driverless mode.

The following features and actions require root/administrative access:

- Analysis on an Intel Atom® processor
- Installing the sampling driver
- Running a performance analysis using an analysis type that uses event-based sampling

How do I configure remote data collection using Intel® VTune™ Profiler?

Intel VTune Profiler can collect performance data on the system on which it is installed (Windows* or Linux* only; macOS* data collection is not supported) or on a remote target system (Windows, Linux, or Android* targets). To analyze performance on a remote system, follow these general steps:

1. (Linux only) Configure password-less SSH access to the target system. Password-less SSH access is required for running a remote analysis because VTune Profiler will not prompt for a password once analysis collection begins. For detailed steps, see Configuring SSH Access for Remote Collection.

   > **NOTE**
   > VTune Profiler will not automatically install drivers on the remote system unless you connect via SSH as the root user. If you want to run an event-based collection, but do not want to set up password-less SSH access using the root user account, manually install the drivers on the target system. For detailed steps, see Sampling Drivers.

2. (Android only) Configure ADB access to the target system. For detailed steps, see Android* System Setup.
3. Launch VTune Profiler and open the **Configure Analysis** window.
4. Select the appropriate target system from the **WHERE** pane. For **Remote Linux (SSH)** targets, specify the username, hostname, and port in the **SSH Destination** field.

   VTune Profiler connects to the remote target and installs appropriate collectors and drivers (if root access was provided). This can take a few seconds.
5. Specify a target type in the **WHAT** pane.

   - **Launch Application**: specify the location of the process on the target system.
   - **Attach to Process**: select a process from the list of available processes running on the target system.
   - **Launch Android Package**: select an application and corresponding package (`*.apk`) available on the target system from the list of available packages.
6. Select an analysis type from the **HOW** pane and click **Start** to run the analysis on the remote system.

For detailed steps for setting up remote collection on a specific target system, use the following topics:

- Set Up Remote Linux* Target

- Set Up Android* System

Can I install multiple versions of Intel® VTune™ Profiler on the same system?

You can install multiple major versions of Intel® VTune™ Profiler on the same system, but you cannot have multiple installations of the same major version on the same system.

> **NOTE**
> Intel® VTune™ Profiler is a new renamed version of the Intel® VTune™ Amplifier.

For example, you can have both Intel VTune Profiler 2020 and Intel VTune Amplifier 2019 Update 2 on the same system. However, installing Intel VTune Amplifier 2019 Update 3 on this system will uninstall Update 2 and replace it with the Update 3 content.

Problem: Platform Not Authorized

When attempting to use Intel® VTune™ Profiler with a floating license, you may encounter errors such as:

(License server does not support this feature (-18,327))

(This platform not authorized by license (-89,337))

Cause

This error is caused by an outdated license server.

Solution

Login to the Intel® Registration Center to download the latest license server:

> **NOTE**
> The registered owner of the license must log in. Other registered users do not get access to the license server download.

1. Log in to the Intel® Registration Center.
2. In your supported products list, look for the entry for **Intel® Software License Manager** and click the version number next to it.

   You will be taken to the download page for the Intel® Software License Manager.
3. In the **Platform** box on the right, select the operating system for your license server, then download the appropriate package for your license server.
4. Install the new license server software on your license server.
5. Ensure that the new license server software is running on the license server.

This should resolve the error. If not, see the Get Help page for your support options.

Uninstalling Intel® VTune™ Profiler

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Use the following steps to uninstall Intel® VTune™ Profiler from your system:

NOTE
These steps should be completed by the same user who installed VTune Profiler.

---

1. Open a command prompt and navigate to a folder outside of the VTune Profiler installation directory.
2. Run one of the following commands:
  * To uninstall using the command prompt:

    <install-dir>/vtune_profiler_*<version>*.*<number>*.*<package>*/uninstall.sh
  * To uninstall using the GUI:

    <install-dir>/vtune_profiler_*<version>*.*<number>*.*<package>*/uninstall_GUI.sh
3. Follow the prompts in the command prompt or the user interface.

Additional Resources **7**

The following online resources may be helpful during or after the installation of Intel® VTune™ Profiler.

- Release Notes: The VTune Profiler release notes include helpful information specific to your release version, including system requirements and known issues and limitations.
- Intel VTune Profiler User Guide: Learn about using VTune Profiler with the online User Guide.
- Troubleshooting Help: This section of the VTune Profiler online User Guide includes solutions to common problems.
- Download Intel® Parallel Studio XE documentation | Download Intel® System Studio documentation: Starting with the 2018 releases, most documentation is available on the web only. You can download a copy of all documentation for use without an internet connection.

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