Uintah Installation Guide

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Contents

1 Overview of Uintah

The **Uintah** library is composed of several executables and a generic library framework for solving PDEs on structured AMR grids on large parallel supercomputers. ***VisIt*** is used to visualize data generated from **Uintah**.

1.1 Obtaining the Code

Uintah can be obtained either as a compressed tarball from `http://www.sci.utah.edu/uintah-survey.html` or by using Subversion (SVN) to download the latest source code:

```
svn co https://gforge.sci.utah.edu/svn/uintah/trunk uintah
```

The above command checks out the **Uintah** source tree and installs it into a directory called uintah in the users home directory.

2 Installation Overview

Uintah can be installed individually and in conjunction with the visualization tool, ***VisIt***. ***VisIt*** has the Uintah database reader included in the build_visit scripts.

The installation procedure follows the basic outline:

1. Install basic dependencies: MPI, Blas, Lapack, Hypre, PETSc, Boost, *etc.*
2. Configure Uintah
3. Compile Uintah
4. Install visualization tools (optional if installing on a supercomputer or first time users).

3 Generic Library Dependencies

Uintah depends on several different libraries that are commonly available or easily installable on various Linux or Unix like OS distributions.

Required libraries:

- mpi (OpenMpi, Mpich, or LAM or a vendor supplied mpi library)
- blas
- lapack
- make
- libxml2-devel
- zlib-devel
- c++
- fortran
- subversion
- cmake (version 3.1.0 or higher) – **Required for Arches/Wasatch**
- git
- boost (version 1.54 or higher) – **Required for Arches/Wasatch**
- Hypre (version 2.9.0b or higher) – **Required**
- PETSc (version 3.5.2 or higher) – **Optional**

4 OS Version Dependencies

4.1 Debian & Ubuntu Dependencies

The **Gnu/Debian** OS http://www.debian.org and **Ubuntu** OS http://www.ubuntu.org offer the vast majority of libraries necessary for installing **Uintah** with the exception of VisIt. Either one of these distributions are the recommended OS to install.

Installing the following libraries will ensure that all dependencies required for **Uintah** are satisfied:

```
sudo apt-get install subversion libhypre-dev petsc-dev \
libxml2-dev zlib1g-dev liblapack-dev cmake libglew-dev \
libxmu-dev g++ gfortran libboost-all-dev git \
libxrender-dev libxi-dev
```

For Debian **Jessie, version 8**, add the following to /etc/apt/sources:

```
deb http://ftp.debian.org/debian jessie-backports main non-free
contrib
```

then replace an older version of cmake with a newer version of cmake that is compatible with the Wasatch component.

```
sudo apt-get update
sudo apt-get install -t jessie-backports cmake
```

4.2 Fedora Core Dependencies

Fedora Core 25 http://fedoraproject.org/ offers all the dependencies except for PETSc and HYPRE. Install the following libraries:

```
sudo dnf install make openmpi-devel openmpi lapack-devel \
gcc-gfortran blas-devel gcc-c++ libxml2-devel subversion \
cmake tar diffutils libX11-devel libXext-devel patch wget \
mesa-libGL-devel mesa-libGLU-devel libXt-devel git boost-devel \
libXrender-devel libXi-devel python qt-devel
```

Please see section 5.1 for hypre installlation instructions and section 6.1 for petsc installation instructions.

4.3 CentOS Dependencies

CentOS 7 http://www.centos.org/ is similar to **Fedora Core**. However, a more recent version of cmake and boost must be installed. Please see the sections for install cmake and boost below, along with instructions for installing hypre (required) and petsc (optional).

```
sudo yum install make openmpi-devel openmpi lapack-devel \
gcc-gfortran blas-devel gcc-c++ libxml2-devel subversion \
tar diffutils libX11-devel libXext-devel patch wget \
mesa-libGL-devel mesa-libGLU-devel libXt-devel git \
libXrender-devel libXi-devel bzip2
```

4.3.1 Boost

Install **Boost 1.64.0** http://www.boost.org/users/download/. After unzipping, then build and install boost:

```
cd path/to/boost_1_64_0
./bootstrap.sh
sudo ./b2 install
```

4.3.2 CMake

Install version 3.1.0 or higher of **CMake** https://cmake.org/download/

```
./bootstrap
  make
  sudo make install
```

Please see section 5.1 for hypre installlation instructions and section 6.1 for petsc installation instructions.

4.4 OpenSuse Dependencies

OpenSuse-Leap http://www.opensuse.org/ is similar to **Fedora Core**

```
sudo zypper install make openmpi-devel openmpi lapack \
gcc-fortran blas gcc-c++ libxml2-devel subversion \
cmake tar diffutils libX11-devel libXext-devel patch wget \
mesa-libGL-devel mesa-libGLU-devel libXt-devel git boost-devel \
libXrender-devel libXi-devel qt-devel glu-devel
```

Please see section 5.2 for hypre installlation instructions and section 6.2 for petsc installation instructions.

4.5 MacOSX Dependencies

Use Macports to install the following:

```
sudo port install openssh screen dialog zlib cmake bash autoconf \
                  xmlstarlet gdb gmake
sudo port install mpich
sudo port install mpich-gcc5
sudo port install lapack +gcc5
sudo port select --set mpi mpich-gcc5-fortran
sudo port select --set gcc mp-gcc5
sudo port install -s icu configure.compiler=macports-gcc-5  \
                     configure.cxx_stdlib="libstdc++"
sudo port install -s boost configure.compiler=macports-gcc-5 \
                     configure.cxx_stdlib="libstdc++"
sudo port install -s -v hypre +mpich
```

You will want to ensure that your path has the macports install locations before the system ones, i.e., `/opt/local/bin` before `/usr/bin`.

5 Hypre Installation – Required

Hypre can be installed by executing the following simplified instructions, however, if you encounter problems please refer to the hypre website for troubleshooting.

Download hypre-2.11.2 from https://computation.llnl.gov/casc/hypre/software.html

5.1 Fedora & CentOS

The following configure script assumes the location of MPI libraries are in `/usr/lib64/openmpi/lib`. Note that the `LD_LIBRARY_PATH` must be set. It is helpful to include the `/usr/lib64/openmpi/bin` in your path for the location of mpirun and mpiCC, mpicc, and mpif77.

```
cd hypre-2.11.2/src

LD_LIBRARY_PATH=/usr/lib64/openmpi/lib/ \
 ./configure --enable-shared \
             --prefix=/usr/local \
             --with-MPI-lib-dirs=/usr/lib64/openmpi/lib/ \
             --with-MPI-include=/usr/include/openmpi-x86_64/ \
             --with-MPI-libs="mpi mpi_cxx" \
             CC=/usr/lib64/openmpi/bin/mpicc \
             CXX=/usr/lib64/openmpi/bin/mpic++ \
             F77=/usr/lib64/openmpi/bin/mpif77

make
sudo make install
```

5.2 OpenSuse

```
cd hypre-2.11.2/src

./configure --enable-shared \
    --prefix=/usr/local \
            --with-MPI-libs="mpi mpi_cxx" \
            CC=/usr/lib64/mpi/gcc/openmpi/bin/mpicc \
            CXX=/usr/lib64/mpi/gcc/openmpi/bin/mpic++ \
            F77=/usr/lib64/mpi/gcc/openmpi/bin/mpif77

make
sudo make install
```

6 PETSc Installation – Optional

PETSc can be installed by executing the following simplified instructions. Please refer to the PETSc website for comprehensive installation instructions if you encounter any difficulties.

Download petsc-v3.7.6 from `http://www.mcs.anl.gov/petsc/petsc-as/download/index.html`

6.1 Fedora & CentOS

The following configure script assumes the location of MPI libraries are in `/usr/lib64/openmpi/lib`. Note that the `LD_LIBRARY_PATH` must be set. It is helpful to include the `/usr/lib/64/openmpi/bin` in your path for the location of mpirun and mpiCC, mpicc, and mpif77.

```
tar zxf petsc-3.7.6.tar.gz
cd petsc-3.7.6

LD_LIBRARY_PATH=/usr/lib64/openmpi/lib \
./configure --with-shared-libraries \
            --with-debugging=0 \
            --with-mpi-dir=/usr/lib64/openmpi/  \
            --prefix=/usr/local

make PETSC_DIR=/home/jas/petsc-3.7.6 PETSC_ARCH=arch-linux2-c-opt all

sudo make install
```

6.2 OpenSuse

```
tar zxf petsc-3.7.6.tar.gz
cd petsc-3.7.6

./configure --with-mpi-dir=/usr/lib64/mpi/gcc/openmpi \
            --with-shared-libraries --with-debugging=0 \
            --prefix=/usr/local

make PETSC_DIR=/home/jas/petsc-3.7.6 PETSC_ARCH=arch-linux2-c-opt all

sudo make install
```

7 Configuring and Building Uintah

7.1 Configure

The following information specifies how to run the "configure" script to prepare for building the Uintah executable. "Configure" is a program that checks the computer's environment and looks for the location of libraries and header files, etc. When it finishes running, it will create the `configVars.mk` file which will include all the information it has determined about the computer. The following lines show **generically** how to use “configure”.

Goto the directory `~/uintah` and create the following directories: `dbg` (debug) and `opt` (optimized)

```
cd ~/uintah-2.0
mkdir dbg opt
```

Go to the `dbg` directory and enter the following:

```
../src/configure --enable-debug --enable-all-components \
                 --enable-wasatch_3p --with-boost=[path to boost]
```

After the configuration process, type `make` to compile Uintah.

If you wish to attach a debugger to Uintah, make sure you use the `--enable-debug` configure option.

If you would like to reduce the amount of output given by the make system when making Uintah, you can set the environment variable `SCI_MAKE_BE_QUIET` to true:

```
setenv SCI_MAKE_BE_QUIET true (csh)

export SCI_MAKE_BE_QUIET=true (bash)
```

Once a debug build has finished, change to the `opt` directory and enter the following configure line:

```
../src/configure '--enable-optimize=-O3 -mfpmath=sse' \
                  --enable-all-components --enable-wasatch_3p \
                  --with-boost=[path to boost]
```

The debug/optimize flags do the following: –enable-debug adds “-g” to the compile line; –enable-optimize, if used without parameters, adds “-O2” to the compile line. Otherwise it adds the parameters specified during configure.

7.1.1 Other configure options

Other useful configure options are seen below. Note, depending on where libraries are installed on your system, you may or may not need to specify some (or all) of these options:

By default, Uintah does not build any simulation components (such as ICE, Arches, Wasatch, or MPM) - though Example components are built. To turn on components, use the following configure flags:

```
--enable-all-components       <= Turns on all simulation components
--enable-arches               <= Turns on Arches
--enable-ice                  <= Turns on ICE
--enable-mpm                  <= Turns on MPM
--enable-mpmice               <= Turns on MPMICE
--enable-wasatch              <= Turns on Wasatch

--enable-shared               <= Uses shared libraries (Default)
--enable-static               <= Uses static libraries
--with-mpi=/usr/lib64/openmpi <= Specifies location of MPI
--enable-64bit                <= Specifies a 32 or 64bit build
--enable-32bit
--with-petsc=/path/petsc-3.7.6            <= Specifies location of PETSc
--with-hypre=/path/hypre-2.11.2./hypre_install <= Specifies location of Hypre

F77=gfortran-4.7              <= Specifies compilers (Fortran, C, C++).
CC=/usr/bin/gcc-4.7
CXX=/usr/bin/g++-4.7
PETSC_ARCH=linux-gnu-c-real-opt <= Specifies PETSc architecture

        --without-fortran     <= Turns off the use of Fortran. (Only
useful if you are not building Arches and you do not have a working
Fortran compiler on your computer.
```

Arches requires the Wasatch component to be enabled, therefore to compile the Arches and Wasatch components add:

```
  --with-wasatch --with-boost=<path to boost install>, e.g. /usr
  --enable-wasatch_3p
```

to the configure line.

To see a full list of all the configure options type:

```
    ../src/configure --help
```

7.1.2 Common Configure Lines

Debian & Ubuntu

```
    ../src/configure --enable-debug --enable-all-components \
                     --with-boost=/usr --enable-wasatch_3p F77=gfortan
```

Fedora & CentOS

```
../src/configure --enable-debug --enable-all-components \
                 --with-mpi-lib=/usr/lib64/openmpi/lib \
                 --with-mpi-include=/usr/include/openmpi-x86_64 \
                 --with-boost={/usr,/usr/local} --enable-wasatch_3p \
                 --with-hypre=/usr/local
                 --with-petsc=/usr/local
```

OpenSuse

```
../src/configure --enable-debug --enable-all-components \
                 --with-mpi-lib=/usr/lib64/openmpi/lib \
                 --with-mpi-include=/usr/include/openmpi-x86_64 \
                 --with-boost=/usr --enable-wasatch_3p \
                 --with-hypre=/usr/local
                 --with-petsc=/usr/local
```

MacOSX

```
../src/configure --enable-debug --enable-all-components \
                 --with-boost=/opt/local --enable-wasatch_3p \
                 --with-hypre=/opt/local --with-lapack=/opt/local \
                 --with-zlib=/opt/local  \
                 CXX=mpicxx CC=mpicc F77=mpif77
```

7.2 Build

Then build the software by typing `make` at the command line and create symbolic links to the inputs directory found in `~/uintah/src/StandAlone/inputs` .

```
make
```

Please see the **User Guide** http://www.uintah.utah.edu/trac/chrome/site/uintah.pdf on how to use the various tools and executables within the **Uintah** framework.

8 Installing VisIt

Visualization of **Uintah** data is currently possible using ***VisIt***. The VisIt package from LLNL is general purpose visualization software that offers all of the usual capabilities for rendering scientific data. It is still developed and maintained by LLNL staff, and its interface to **Uintah** data is supported by the Uintah team.

VisIt may be downloaded from the following https://wci.llnl.gov/simulation/computer-codes/visit/executables.

8.1 VisIt Installation

The latest official release of ***VisIt*** is 2.12.2 However, the instructions apply to earlier versions such as 2.12.X. Using the build_visit script along with the *–uintah* option, UDA reader plugin can be built. ***VisIt*** can be installed either from one of their binary distributions, or by compiling and installing it from source. You may also need to build ***VisIt*** from source (using the build_visit script) if a binary is not provided for your exact OS and MPI versions and is the recommended installation method outlined below.

8.1.1 Caveats

- Before you install ***VisIt***, a number of dependency files are required. These include X11, GL, GLU, GLX, and libz libraries (it is possible that you will find these libraries in the following rpms: libx11-dev, libxext-dev, libxt-dev, libglu, zlib-dev – notice that most of these are the 'development' rpm). You can either install these directly and hope you get them right, or you can install the files listed here in Section 4 (which will pull in all the libraries that you need).

- MPI must be installed and the MPI compilers (mpicc, etc) must be in your path.
- The ***VisIt*** executable is not relocatable once it is built, so make sure you specify the correct installation location in the beginning.
- The build_visit script may need to be patched if you encounter a glxPtr problem when building the VTK library. Apply the patch found in `http://visitusers.org/forum/YaBB.pl?action=downloadfile;file=VTK_Mesa_2_8_1_patch.txt`. The current releases of Debian Jessie, Ubuntu 16.04, CentOS-7, Fedora-25, and OpenSuse Leap 42 requires patching the build_visit script.
- Building ***VisIt*** from scratch can take a while. As mentioned below, you can

  ```
  tail -f
      build_visit_log
  ```

  to watch the progress.
- If you are having problems please check the Uintah wiki page on building ***VisIt*** (`http://www.uintah.utah.edu/trac/wiki/visit`).

8.1.2 Using the "build_visit" Script to Build VisIt

1. Download the build_visit script from `http://portal.nersc.gov/project/visit/releases/2.12.2/build_visit2_12_2`.
2. Change the mode of the build_visit script so it can execute, and copy it to a VISIT directory (calling it Visit_2.12.2 in the following description) where you will build the VisIt source code:

   ```
   mkdir ~/Visit_2.12.2
   cp build_visit_2.12.2 Visit_2.12.2
   cd Visit_2.12.2
   chmod +x build_visit_2.12.2
   ```

3. Build the VisIt source (after it downloads everything) using two processors (or use the number of available processors on your machine). This will take a long time since all the prerequisite software will be downloaded and compiled. Select the 'parallel' option when the script starts up. You will need to set the PAR_COMPILER and PAR_COMPILER_CXX environment variables to the location of mpicc and mpic++, i.e.

   ```
   export PAR_COMPILER=‘which mpicc‘ (bash)
   export PAR_COMPILER_CXX=‘which mpic++‘ (bash)
   setenv PAR_COMPILER ‘which mpicc‘ (csh)
   setenv PAR_COMPILER_CXX ‘which mpic++‘ (csh)

   ./build_visit2_12_2 --makeflags -j6 --uintah --alt-uintah-dir ~/uintah/opt
   ```

   For Fedora 25 and OpenSuse Leap, use the system Qt version, with the following build line:

   ```
   ./build_visit2_12_2 --makeflags -j6 --uintah --alt-uintah-dir
   ~/uintah/opt --system-qt
   ```

4. After VisIt finishes building, go into the visit2.12.2/src directory and make a binary distribution for it so it can be installed.

   ```
   cd visit2.12.2/src
   make package
   ```

   Within the visit2.12.2/src directory there should be a gzip'ed tar file that can be installed in different location

   ```
   ls visit2.12.2/src
    . . .
    visit2_12_2.linux-x86_64.tar.gz
    . . .
   ```

5. Copy the gzip'd tar file to another location and install VisIt (using the visit-install script found in Visit_2.12.2/visit2.12.2/src/svn_bin/visit-install) in the directory *visit_bin_dir*.

```
cp visit2_12_2.linux-x86_64.tar.gz ~/
cd ~/
~/Visit_2.12.2/visit2.12.2/src/svn_bin/visit-install 2.12.2 linux-x86_64
visit_bin_dir
```

8.1.3 VisIt executable

After a successful build, the executable will be placed in,

```
‘‘visit_bin_dir’’/bin/
```

where “visit_bin_dir” is the directory specified either for the visit_install script if using a prebuilt binary, or for cmake if building VisIt from source.

8.1.4 Remote visualization

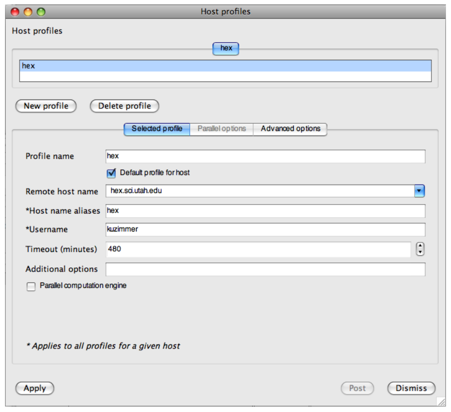
In order to read data on a remote machine, you will need to have a version of VisIt and the UDA reader plugin installed on that machine. You will also need to make sure that the VisIt executable is in your path. You may need to edit your shell’s .rc file so that the path to VisIt is included in your shell’s PATH variable.

NOTE: The version of VisIt installed on your local desktop and the remote machine should be the same.

8.1.5 Host Profile

Next you will want to set up a Host Profile for your remote machine. Select ’Host Profiles’ from the ’Options’ menu and set up a new profile as shown in Figure 1.

After filling in the remote machine information, select the ’Advanced options’ tab, then ’Networking’ and check the ’Tunnel data connections through SSH’ option. This is illustrated in figure 2a. Click on ’Apply’ and then do a ’Save Settings’ in the ’Options’ menu on the gui.



hex

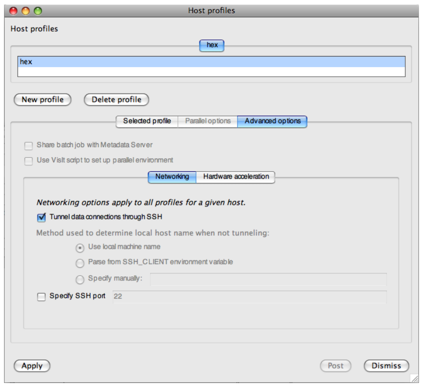
Profile name: hex
[✓] Default profile for host
Remote host name: hex.sci.utah.edu
*Host name aliases: hex
*Username: kuzimmer
Timeout (minutes): 480
Additional options:
[ ] Parallel computation engine

* Applies to all profiles for a given host

Figure 1: Setting up Host Profile

For the remote visualization option to work, you must have ports 5600 - 5609 open. You can try this by running the following on your local desktop (on Linux distributions),

```
traceroute -p 560[0-9] <remote machine>
```

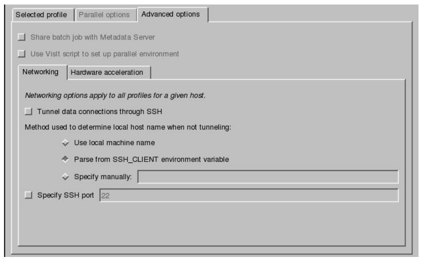


hex

☐ Share batch job with Metadata Server
☐ Use VisIt script to set up parallel environment

Networking options apply to all profiles for a given host.
☑ Tunnel data connections through SSH
Method used to determine local host name when not tunneling:
[✓ Use local machine name]
Parse from SSH_CLIENT environment variable
Specify manually:
☐ Specify SSH port 22

(a) Setting up advance options



☐ Share batch job with Metadata Server
☐ Use VisIt script to set up parallel environment

Networking options apply to all profiles for a given host.
☐ Tunnel data connections through SSH
Method used to determine local host name when not tunneling:
Use local machine name
[✓ Parse from SSH_CLIENT environment variable]
Specify manually:
☐ Specify SSH port 22

(b) Setting up advance options

Figure 2:

If the tunneling option doesn't works, try the option as shown in Figure 2b. Now you should be able select 'Open' from VisIt's 'File' menu. After selecting your host from the host entry list, you will be prompted for a password on the remote machine (unless you have set up passwordless ssh access).

Once the ssh login has completed, you should see the directory listing. You can then change directories to your UDA and load the data.