CrossGrid Installation Guide

Task 3.3.1: OCM-G

Task 3.3 - Grid Monitoring

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Abstract: This is the installation guide for the Grid application monitoring system OCM-G, developed within the CrossGrid project.

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1 About the software

The OCM-G (Grid-enabled OMIS-Compliant Monitor) is an application monitoring system which supports both cluster and Grid environments based on Globus 2.4, in particular the CrossGrid (and DataGrid) testbeds. The purpose of the OCM-G is to provide on-line information about a running parallel / distributed application to application-development-support tools, specifically performance analysis tools, like the G-PM tool. The information is obtained via a standardized interface OMIS.

1.1 Software components

The OCM-G comprises three packages:

- `cg-wp3.3-ocmg`
  Contains the executable of the monitor processes. It must be installed on UI (user interface), CE (compute element), and WN (worker node) computers.
- `cg-wp3.3-ocmg-app-devel`
  Contains all files needed to prepare an application for the use with OCM-G. This package need only be installed on the UI machines.
- `cg-wp3.3-ocmg-libmpich`
  Addendum to `cg-wp3.3-ocmg-app-devel` for MPI applications. This package contains MPI libraries (both mpich-p4 and mpich-g2) which are prepared for monitoring with OCM-G. It should be installed on the UI machines when the development of MPI application should be supported.

Figure 1.1 shows the run-time components of OCM-G, their distribution across the different kind of machines in the Grid, and their communication. All monitor processes (MainSM, SM, and LM) share the same executable, which is contained in the `cg-wp3.3-ocmg` package. The Application Monitor library (AM) is included in the `cg-wp3.3-ocmg-app-devel` package.

The whole hierarchy of OCM-G processes runs under the credentials of the user that submitted the application; the system starts up in the following way:

1. The user starts the MainSM and the tool on the UI machine.
2. The user submits the application. The application processes fork / exec one LM on each WN.
3. Each LM contacts the MainSM to get the contact string (IP-address and port) of the SM on its site (i.e. the CE responsible for its WN). The responsible CE is determined by examining value of the GLOBUS_GRAM_JOB_CONTACT environment variables passed to the application process.
   (a) If there is already a SM for this site, the MainSM replies with its contact string.
   (b) Otherwise, the MainSM starts an SM (using globus-job-run) on the CE, waits until it connects the MainSM, and then replies to the LM with the contact string.
   If this job submission fails, or the CE is unknown, the MainSM will start a default SM on the UI.
4. The LM then connects to its SM.

The OCM-G system terminates on explicit request or when the MainSM is terminated.

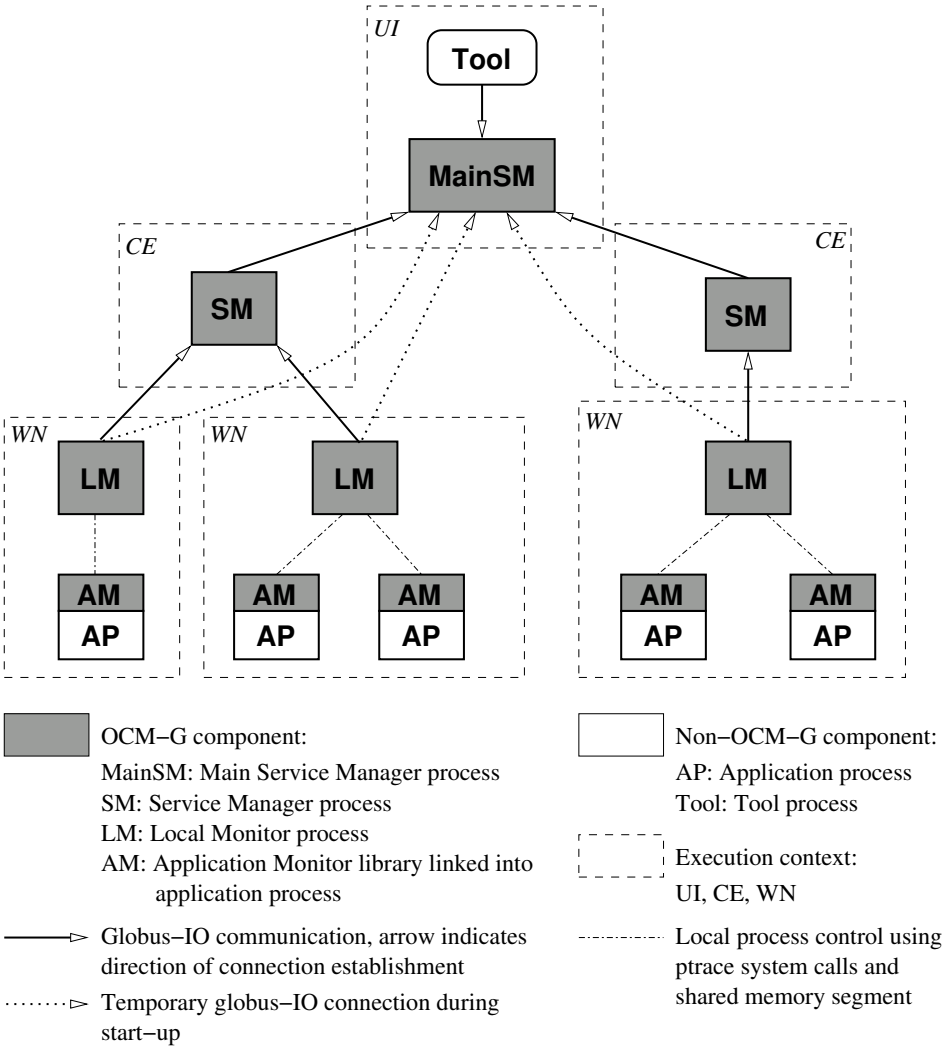

Figure 1.1: Components of OCM-G at run-time

1.2 Dependencies

OCM-G is intended to run on RedHat Linux, version 7.3.

The OCM-G packages depend on the following software during run-time:

1. `vdt_globus_essentials`, version VDTALT1.1.8-14.edg4 (due to the use of Globus-IO for communication)
2. `gcc3`, version 3.2.2 (shared C++ library)

These dependencies hold on all machine types (UI, CE, and WN).

The package `cg-wp3.3-ocmg-libmpich` in addition depends on

1. `mpich-p4`, version 1.2.5.2-cg2
2. `mpich-g2`, version 1.2.5.2-cg2

since it provides instrumented versions of the MPI libraries contained in these packages. This dependency only is relevant on the UI machine.

2 Installation in the CrossGrid testbed

The CrossGrid testbeds are managed by the LCFG deployment support tool. This tool allows an automatic installation of the software on all the required nodes.

2.1 Rpm lists for LCFG

The following lines must be included in the UI's rpmlist (usually inside the file `UserInterface-CG-rpm.h`):

cg-wp3.3-ocmg-1.9.3-1

cg-wp3.3-ocmg-app-devel-1.9.3-1

cg-wp3.3-ocmg-libmpich-1.9.3-1

Inside the rpmlists for the CE and all the WNs (usually `ComputingElement-CG-rpm.h` and `WorkerNode-CG-rpm.h` respectively) the following line is required:

cg-wp3.3-ocmg-1.9.3-1

2.2 Profile modifications for LCFG

None.

2.3 Manual post installation steps

None.

3 Manual Installation

3.1 Download

The RPMs of OCM-G are available at

- `https://savannah.fzk.de/distribution/crossgrid/autobuilt/i386-rh7.3-gcc3.2.2/wp3/RPMS/cg-wp3.3-ocmg-1.9.3-1.rpm`
- `https://savannah.fzk.de/distribution/crossgrid/autobuilt/i386-rh7.3-gcc3.2.2/wp3/RPMS/cg-wp3.3-ocmg-app-devel-1.9.3-1.rpm`
- `https://savannah.fzk.de/distribution/crossgrid/autobuilt/i386-rh7.3-gcc3.2.2/wp3/RPMS/cg-wp3.3-ocmg-libmpich-1.9.3-1.rpm`

3.2 Installation from rpm

The package `cg-wp3.3-ocmg-1.9.3-1.rpm` must be installed on the user interface (UI), computing element (CE) and worker nodes (WN).

The packages `cg-wp3.3-ocmg-app-devel-1.9.3-1.rpm` and `cg-wp3.3-ocmg-libmpich-1.9.3-1.rpm` must be installed on the user interface (UI). Note that installation of the latter package is only required, of the OCM-G should support the monitoring of MPI applications.

The software installes under `/opt/cg`.

3.3 Installation from source

1. Make sure that you are using RedHat Linux, version 7.3. OCM-G has been developed for this operating system version. However, other versions of Linux (with at least a 2.4 kernel) should work, too.
2. Make sure that you have the folloging software installed:
   - Globus client software, especially Globus-IO. This software is e.g. provided by the package `vdt_globus_essentials`. Any version should be OK (however, only VDTALT1.1.8-14.edg4has been tested).
   - `gcc`, version 3.2.2 (package `gcc3-3.2.2`). Using `gcc` version 2.95 should work, too.
   - `make`, version 3.79.1 (other versions of `gmake` should be OK, too).
   - `mpich-p4` and `mpich-g2`, any version. This is needed only if you want to create the instrumented MPI libraries for supporting the monitoring of MPI applications.
3. Get the source code of OCM-G. It is available
   - as SRPM from `https://savannah.fzk.de/distribution/crossgrid/autobuilt/i386-rh7.3-gcc3.2.2/wp3/SRPMS/cg-wp3.3-ocmg-1.9.3-1.src.rpm`,
   - or as tarball from `https://savannah.fzk.de/distribution/crossgrid/autobuilt/i386-rh7.3-gcc3.2.2/wp3/SOURCES/cg-wp3.3-ocmg-1.9.3.tgz`,

- or directly from the CVS repository (use untagged versions at your own risk!): `http://savannah.fzk.de/cgi-bin/viewcvs.cgi/crossgrid/crossgrid/wp3/wp3_3-moninfr/wp3_3_1-ocm-g/`

4. Unpack the source code.
5. Go to the top level directory of the souces (`cg-wp3.3-ocmg-1.9.3`) and invoke '`make rpm`' to create the RPM packages. The RPMs will be stored in the directory `RPMS/i386`.

3.4 Configuration

3.4.1 List of configuration files

There is no mandatory configuration file for OCM-G.

There is, however, an optional configuration file, which specifies the location of all CrossGrid software, in case it is different from the default location `/opt/cg`. There are two possible locations for this file:

1. `$HOME/.etc.sysconfig.cg` (this allows users to maintain a private installation of the CrossGrid software),
2. `/etc/sysconfig/cg` (required only if the administrator decides to install the software in a non-standard path).

The files are searched in this order.

3.4.2 Editing the configuration files

The `$HOME/.etc.sysconfig.cg` or `/etc/sysconfig/cg` should contain just a single line

`CG_LOCATION=`*path_to_the_installation_directory*

where *path_to_the_installation_directory* is the absolute path of the directory used instead of `/opt/cg`.

3.4.3 Startup scripts

None.

3.4.4 Other requirements

Environment

If set, OCM-G uses the value of the environment variable `GLOBUS_TCP_PORT_RANGE` to determine the range of TCP ports it is allowed to use for communcation (see Section 3.4.4).

Users

No special users are required. OCM-G runs under the account and/or credentials of the user submitting the application to be monitored.

Ports

OCM-G needs the following TCP connectivity for proper operation:

- between WNs (outbound) and CE (inbound),
- between WNs (outbound) and UI (inbound),
- between CEs (outbound) and UI (inbound).

Ideally, the UI should provide inbound connectivity for any hosts in the internet.

OCM-G does not use any permanent or privileged port. The MainSM and the SM each create a transient TCP port in the range specified by the `GLOBUS_TCP_PORT_RANGE` environment variable (if set). Thus, by properly setting this variable, the port numbers used by the MainSM and the SM for incoming connections can be restricted. E.g.:

```
export GLOBUS_TCP_PORT_RANGE="20000 25000"
```

Firewalls should be configured such that the port range specified by `GLOBUS_TCP_PORT_RANGE` is open for the connections listed above.

Certificates

Since OCM-G runs under the credentials of the user submitting the application to be monitored, no additional certificates are needed.

Folders

OCM-G installs under `/opt/cg`. The `cg-wp3.3-ocmg-app-devel` package on the UI machine requires that there is a publicly writable `/tmp` directory. No other directories are required.

4 Running and testing

The following describes a simple procedure to test the successful installation of the OCM-G packages.

1. Install the OCM-G packages.
2. Log in as a *normal* user on the UI machine.
3. Get the following files from the CrossGrid CVS repository:
   - `http://savannah.fzk.de/cgi-bin/viewcvs.cgi/crossgrid/crossgrid/wp2/wp2_5-integration/src/gpm_tests/ring.c`
   - `http://savannah.fzk.de/cgi-bin/viewcvs.cgi/crossgrid/crossgrid/wp2/wp2_5-integration/src/gpm_tests/probes.c`
   - `http://savannah.fzk.de/cgi-bin/viewcvs.cgi/crossgrid/crossgrid/wp2/wp2_5-integration/src/gpm_tests/check_trace.pl`
4. Compile the test program with MPICH-G2:

   ```
   cg-ocmg-cc -probes probes.c mpicc --device=g2 -o ring_ocm ring.c -DUSE_OCM
   ```

   This assumes that you are using the CrossGrid mpich-wrappers. Otherwise, you have to replace '`mpicc --device=g2`' with '`<path_to_mpich_g2>/mpicc`'.
5. Verify that the OCM-G libraries are included in the program:

   ```
   cg-ocmg-check-app ring_ocm
   ```

   It should print

   ```
   Application is linked with OCM-G
   Instrumented libraries:  libmpichg2.a
   Probes files:  probes.c
   ```

   If it prints '`Application is NOT linked with OCM-G`' there is a problem with the installation of the `cg-ocmg-app-devel` package. If it prints '`NO instrumented libraries`' there is a problem with the installation of the `cg-ocmg-libmpich` package.
6. If necessary, create a Globus proxy certificate using '`grid-proxy-init`'.
7. Invoke `cg-ocmg-monitor`. It will print something like

   ```
   Main SM connection string: 8d34a020:4e20
   ```

8. (In a new shell on the UI machine) start the `ring_ocm` program created in step 4, using `mpirun`. To do so, first create a proper 'machines' file, which lists the CE to use for the job, e.g., the file may contain:

   ```
   ce010.fzk.de
   ```

   Then, invoke

   ```
   mpirun --device=g2 -machinefile machinesCE -np 4 ring_ocm 100 \
          --ocmg-appname app --ocmg-mainsm 8d34a020:4e20
   ```

   Again, this assumes that you are using the CrossGrid mpich-wrappers. Otherwise, you have to replace '`mpirun --device=g2`' with '`<path_to_mpich_g2>/mpirun`'.

   Of course, you also have to replace `8d34a020:4e20` with the proper connection string printed by `cg-ocmg-monitor` in step 7.

Instead of '`-np 4`', you can use any number of processes ≥ 2, e.g. for stress tests. You can also increase the parameter `100`, which specifies the number of passes exsecuted by the application. In each pass, a message is sent in a ring through all the processes. Note that values larger than 1000 may result in a rasonable run time!

9. Invoke the following command (in a different shell on the UI machine):

   ```
   cg-ocmg-tracer app --num-procs 4 --terminate --ocmg-mainsm 8d34a020:4e20 \
                  > /tmp/trace
   ```

   (Be sure to replace the `4` with the proper number of processes and the `8d34a020:4e20` with the correct connection string)

   This is a simple tool, which connects to the OCM-G and prints an SDDF trace of the MPI calls executed by the monitored application. The tool waits until the specified number of processes registered with the OCM-G, thus, it can be started immediately after invoking `cg-ocmg-monitor` (even before submitting the MPI job).

   The trace file is redirected to `/tmp/trace`.

10. Make sure that both the job and the `cg-ocmg-monitor` started in steps 7 and 8 have terminated.

    Note that the application will print a couple of warnings when it terminates; this is not an error, it is perfectly OK!

    Also note that in the window where `cg-ocmg-monitor` has been started, some messages are printed after `cg-ocmg-monitor` has terminated. This may give the impression that the program did not terminate correctly. Just press RETURN to verify that you get a shell prompt and the program really terminated.

11. Invoke the perl script

    ```
    check_trace.pl /tmp/trace
    ```

    It will check that the trace file is OK. It should print something like:

    ```
    trace file is consistent
    4 processes in trace file (VERIFY THIS!)
    100 passes in trace file (VERIFY THIS!)
    ```

    Verify that the number of processes and the number of passes printed by the script correspond to the values specified in step 8.

    The script may occasionally print notices like:

    ```
    Tachyon: Process 0, tag 119 (NOTICE ONLY)
    Found 1 tachyons in trace file (NOTICE ONLY)
    ```

    These notices do not indicate any problem of the installation!

    If the script finds some problem, it will print something like:

    ```
    Error: number of MPI_Recv events is inconsistent!
    ```

    In this case, the installation has a problem.

4.1 Log files

The OCM-G processes do not write any log files.

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