System Monitoring: LLview

May 23, 2017  |  Carsten Karbach
## Motivation

- Is my job running?
- When will it start?
- How is the current load?
- How is my job placed?

<table>
<thead>
<tr>
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<th>RPL</th>
<th>Class</th>
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</tbody>
</table>
Why system monitoring?

- For users
  - Controlling own running and waiting jobs
  - Planning job submissions
  - Use of idling resources
- For administrators
  - Global overview of system utilization
  - Throughput optimization
  - Batch system configuration optimization
  - Adaptive change of scheduling parameters

⇒ LLview
  - Compact display of all usage data in one window
  - Easy access to system’s status data
  - Interactive display for linking information
  - Open Source (BSD-style)
  - Available for all JSC systems
LLview

→ Visualizes supercomputer status on a single screen

Source: Screenshot LLview for JUQUEEN
LLview Example: JURECA

- High fragmentation
- Heterogeneous
- Batch System: SLURM
- Ongoing development

Source: Screenshot LLview for JURECA
Client-Server architecture, LML_da as backend
Clients: Perl-Tk, PTP, Webinterface
Platform independent: works on Windows, Mac and Linux
Wide range of supported batch systems, minimal effort for extension
Minor performance impact on monitored system, only **central batch** system is queried
PTP – Parallel Tools Platform

What is PTP?

- **IDE** for parallel application development
- Based on **Eclipse**
- **Open-source** project
- Developers: IBM, U.Oregon, UTK, Heidelberg University, NCSA, UIUC, JSC, ...


- **PTP Download** → http://www.eclipse.org/downloads/eclipse-packages/

Eclipse for Parallel Application Developers
How to start the LLview client? I

- Four options to start LLview, sorted by effort to get started

**Option 1: via SSH**

```
ssh -X karbach@jureca
llview
```

**Option 2: Webinterface**

- Screenshots of LLview updated every minute (static)
- Link (dynamic SVG): https://llview.fz-juelich.de/LLweb/juqueen/svg/
- Access secured by JSC webservice accounts
  - register at dispatch
  - request access to LLview via jsc-dispatch@fz-juelich.de
How to start the LLview client? II

Option 3: VNC

- start VNC server on JURECA with `vncserver -profile vis`
- tunnel VNC traffic to local system
- start VNC viewer
- click on LLview links
- detailed step by step guide here

Option 4: Local installation

- Download and install the LLview client locally
Contact

- **E-mail:**
  llview.jmsc@fz-juelich.de

- **LLview** → http://www.fz-juelich.de/jsc/llview

- **JSC-PTP tutorials** →

- **PTP Download** → http://www.eclipse.org/downloads/eclipse-packages/
Part II: Appendix – Components

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Node display

- Compute resources
- Job distribution
- White = Idle, Colored = running
- Node name
- Node status
- Level of detail

Rack

Midplane

Nodeboard (512 cores)

Midplane name
Midplane state
Rack power usage
Node display

- Compute resources
- Job distribution
- White = Idle, Colored = running
- Node name
- Node status
- Level of detail

Node state divided: SMT used
2. Appendix – Components

Job list

- List of running jobs
- Most important attributes per job
- Sort by clicking on the column header
- Identifying color next to each job entry

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<th>Class</th>
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<th>nodes</th>
<th>tasks</th>
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</table>
2. Appendix – Components

Usagebar

- Summary of system load
- Job size decreases from left to right
- White space shows idling resources
- Unit for JUQUEEN is midplanes, for JURECA nodes
2. Appendix – Components

History

- 3-day load history
- Often divided into small and large jobs
  - JUQUEEN (1 midplane), JURECA (512 tasks)
- Mouse-Over for detailed information
- Green line for special history value
  - JUQUEEN (power)
Prediction

- Scheduler prediction based on submitted jobs
- Wall clock limit as job duration
- Blue = predicted job, Colored = running jobs
- Each rectangle one job,
  x-axis = time, y-axis = nodes/midplanes
- Use of idle times
- More transparent scheduling
- JUQUEEN: self-implemented, JURECA: use of SLURM’s prediction
Statistics

- Statistic overview on system status
- Histograms on job size, wait time, queue load
- Highly configurable, define x-axis/y-axis domain, logarithmic/linear scale
- Overlayed diagrams for waiting/running jobs

![Histogram Chart]

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Infobox

- Shows details on the currently focused object
- Mouse-Over triggers to display detailed data on the focused job/node/system/diagram
Interaction

- **Mouse-Over** jobs highlights job rectangles for the selected job in all components and shows details on the job in infobox.
Interaction

- **Mouse-Over** jobs highlights job rectangles for the selected job in all components and shows details on the job in infobox
- **Mouse-Down** (Hold) removes color for all other jobs, only the selected job is colored
Interaction

- **Mouse-Over** jobs highlights job rectangles for the selected job in all components and shows details on the job in infobox
- **Mouse-Down** (Hold) removes color for all other jobs, only the selected job is colored
- **Double-Click** show job detail dialog
- Mouse interaction helps to link the information shown in all components
Part III: Appendix – Customization

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LLview

- LLview is **highly customizable** due to numerous options
- Settings specific to HPC system type
- Start through option menu of main window or Ctrl+o
- Most options have **immediate effect** in the main window
- Some will become active at next start of LLview (e.g. *Data source* change)
- LLview layouts use **absolute** positioning
- You can use arrow keys to add/subtract one on numeric values
- Use Page up/Page down keys to add/subtract a bigger step on numeric values
LLview configuration files

Three configuration file locations (highest priority first):

1. anywhere on your file system passed to LLview with the -rcfile option
2. local .llview.rc configuration file in current directory or in HOME directory of the user
3. llview.rc in the installation directory of LLview. This file contains the system-wide settings

- Configuration files contain all LLview options
- You can change them in any text editor or via the LLview Option window
LLview options

- WWW: from Web-Server
- Ixqxml: Execute local command
- LocalData: tar file on local machine

- verbose
- demo version
- show +/- buttons
- Node selection regexp
- Job selection regexp (uid)
- RC
- Height
- Width
- Height (Lines)
- Geometry
- Canvas Color
- Update
- auto play
- Mark Color
- Mark Width
- version
- no frame for mainwindow
- notimestate

Anonymise user names for demonstration purposes.
LLview restart required
General Options

- *General* options for the main window
- Choose your preferred data source (*Web-Server*, *LocalData* or *local command*)
- *demo version*: anonymise usernames (for public display)
- *Job selection regexp*: filtering jobs by regular expressions
- Customize *Height* and *Width* of the main window
- *Canvas Color*: background, *Mark Color*: color for marking job in job list
- Choose time until next update
- *auto play* lets LLview mark different jobs automatically (for public display)
### LLview Element options

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<th>Elements</th>
<th>LocalData</th>
<th>WWW</th>
<th>lqxml</th>
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<th>Status</th>
<th>UsageBar</th>
<th>Nodes</th>
<th>NodeBox</th>
<th>Loc</th>
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</table>

!!! changes on following options have only effect !!!
!!! after save options and restart llview !!!

- show usage bar: on/off
- show joblist: on/off
- show waiting: on/off
- show histogram: on/off
- show info: on/off
- show partition (BG): on/off
- show prediction of usage: on/off
- show nodes: on/off
- show running: on/off
- show graph: on/off
- show status: on/off
- show history: on/off
- show reservations (BG): on/off
- show usage history: on/off

- **Choose, which Elements to show**
- **For end users: components like** `joblist, info, nodes` **and** `prediction` **etc.**
- **Changes take effect after restarting LLview**
### LLview Node options

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<td>colmap y</td>
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<td>colmap width</td>
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<td>Rack gap X</td>
<td>11</td>
<td>Rack gap Y</td>
<td>11</td>
<td>named racks</td>
<td>on/off</td>
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| Font (State) | -*-Helvetica-Medium-R-Normal--*-80-**-**-**-
| Font (Action) | -*-Helvetica-Medium-R-Normal--*-100-**-**-**-
| Font (NodeName) | -*-Helvetica-Medium-R-Normal--*-80-**-**-**-
| Font (SiteName) | -*-Helvetica-Bold-R-Normal--*-240-**-**-**-
| Font (Power) | -adobe-Courier-Medium-R-Normal--*-8-100-75 |
| show inOUT | on/off | InOut pos. X | 858 | InOut pos. Y | 419 |
| show Logo | on/off | Logo pos. X | 9 | Logo pos. Y | 0 | Image name | lib/images/JUGENE_logo |
| show Site Name | on/off | Name pos. X | 622 | Name pos. Y | 389 |
| Color | darkblue | Site Name | JUQUEEN |
Node Options

- Customize *Height*, *Width* and *Margins* of the node display
- Logical node view available for BG systems e.g. JUQUEEN ⇒ *Twin View* places adjacent midplanes next to each other in torus network
- Options for the *Twin View* are available in a new option subfolder ⇒ *Log View*
- *Node attr.:* show scalar data e.g. temperature or power usage
- Show logo or site name
## LLview Histogram options

<table>
<thead>
<tr>
<th>General</th>
<th>Elements</th>
<th>LocalData</th>
<th>WWW</th>
<th>Bxml1</th>
<th>Info</th>
<th>Status</th>
<th>UsageBar</th>
<th>Nodes</th>
<th>NodeBox</th>
<th>LogView</th>
<th>Joblist</th>
<th>Histogram</th>
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<tbody>
<tr>
<td>Diagram 1</td>
<td>Diagram 2</td>
<td>Diagram 3</td>
<td>Diagram 4</td>
<td>Diagram 5</td>
<td>Diagram 6</td>
<td>Diagram 7</td>
<td>Diagram 8</td>
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</tr>
</tbody>
</table>

- **diagram title**: Job Wait Time
- **Job selection**: ALLSEP, Legend offset X: 180, Legend offset Y: 2
- **X-Axis data**: QUEUETIME
- **Y-Axis data**: COUNT
- **Stepwidth (xdata)**: 12
- **Log x data**: LINEAR
- **Log y data**: LOG10
- **Format X**: day
- **Format Y**: %3d
- **Format AVG X**: day
- **Format AVG Y**: %3d
- **Fill Color**: darkblue
- **Fill Color (Run)**: darkgreen

### Global Option for all diagrams

<table>
<thead>
<tr>
<th>Diagram</th>
<th>Diagram 1</th>
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<tbody>
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</tbody>
</table>
Histogram Options

- Each histogram shows distribution for a single job attribute, e.g. waiting time
- You can configure up to 8 histograms
- Jobs are grouped into discrete classes, y-axis shows count of jobs in each class
- Y-axis may also show number of CPUs, CPU hours or job duration
- Scaling may be linear or logarithmic
- *Auto play* is available for public display