System Monitoring: LLview

November 25, 2016 | Carsten Karbach
Motivation

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

- 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? 1

- 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.jsc@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

<table>
<thead>
<tr>
<th>Rack</th>
<th>Midplane</th>
<th>Nodeboard (512 cores)</th>
<th>Midplane name</th>
<th>Midplane state</th>
<th>Rack power usage</th>
</tr>
</thead>
</table>

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

- Compute resources
- Job distribution
- White = Idle, Colored = running
- Node name
- Node status
- Level of detail
## 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
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
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)
2. Appendix – Components

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
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

<table>
<thead>
<tr>
<th>General</th>
<th>Elements</th>
<th>LocalData</th>
<th>WWW</th>
<th>liloxml</th>
<th>Info</th>
<th>Status</th>
<th>UsageBar</th>
<th>Nodes</th>
<th>NodeBox</th>
<th>LogView</th>
<th>Joblist</th>
<th>Hist</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

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

**Verbose**
- on/off

**Demo version**
- on/off

**Show +/- buttons**
- on/off

**Node selection regexp**
- \*  

Anonymise user names for demonstration purposes. LLview restart required

**Job selection regexp (uid)**
- ^bgldiag

**RC**
- on/off

**RC_id**
- juqueen

**Height**
- 640

**Width**
- 1220

**Height (Lines)**
- 61

**Geometry**
- 

**Canvas Color**
- grey85

**Update**
- on/off

**Update time (s)**
- 60

**Auto play**
- on/off

**Autoplay Step (s)**
- 5

**Mark Color**
- red

**Mark Width**
- 2

**Version**
- 1.3

**No frame for mainwindow**
- on/off

**Notimestate**
- on/off
3. Appendix – Customization

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

<table>
<thead>
<tr>
<th>General</th>
<th>Elements</th>
<th>LocalData</th>
<th>WWW</th>
<th>llxml</th>
<th>Info</th>
<th>Status</th>
<th>UsageBar</th>
<th>Nodes</th>
<th>NodeBox</th>
<th>Loc</th>
</tr>
</thead>
</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

| General | Elements | LocalData | WWW | lqxml | Info | Status | UsageBar | Nodes | NodeBox | LogView | Joblist | Histogram | Font |
|---------|----------|-----------|-----|-------|------|--------|----------|-------|---------|---------|---------|-----------|------|--------|
| X position | Y position | Height | Width | Box Margin West | Box Margin East | Box Margin North | Box Margin South | Draw border | Debug Layout | BOX Color | Twin View | View Type | Selector X | Selector Y | max select # | Usagebars | job attr | min | max |
| 5 | 0 | 640 | 380 | -2 | -2 | -2 | -2 | on/off | on/off | grey85 | off | Both | 655 | 16 | 3 | off |
| colmap | colmap x | colmap y | colmap width | colmap height | colmap vertical | number format | colmap unit | on/off | on/off | colmap scale factor | Monospace | use User Layout | Layout | Racks per Row | Rack gap X | Rack gap Y | named racks | on/off |
| on/off | 0 | 0 | 30 | 100 | on/off | %2.1f | on/off | 0.6 | on/off | (rack:R00-M0,R00-M1,|width=70,height=330,order=down,stack=down,frame=yes,fill=grey50,boot=false) | 4 | 11 | 11 | on/off |
| Font (State) | Font (Action) | Font (NodeName) | Font (SiteName) | Font (Power) | show inOUT | InOut pos. X | InOut pos. Y | show Logo | Logo pos. X | Logo pos. Y | show Site Name | Name pos. X | Name pos. Y | Color | 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>Ixml</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>
</tr>
</thead>
<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>
<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

#### Diagram Title
- Job Wait Time

#### Job Selection
- AllSEP

#### X-Axis Data
- QUEUE TIME

#### Y-Axis Data
- COUNT

#### Step Width (xdata)
- 12

#### Log x Data
- LINEAR

#### Log y Data
- LOG 10

#### Format X
- Day

#### Format Y
- %3d

#### Format AVG X
- Day

#### Format AVG Y
- %3d

#### Fill Color
- Dark Blue

#### Global Option for all diagrams

<table>
<thead>
<tr>
<th>Display Diagram</th>
<th>Diagram 1</th>
</tr>
</thead>
<tbody>
<tr>
<td># Diagrams</td>
<td>5</td>
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<tr>
<td>autolab delay</td>
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<tr>
<td>Legend height</td>
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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