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Monitoring system basics, and adding support for a new batch system

September 19, 2012 | Carsten Karbach and Wolfgang Frings

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Part I: PTP System Monitoring

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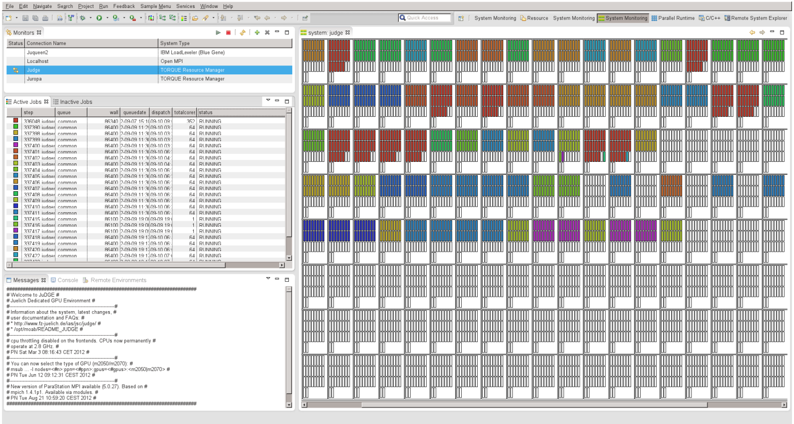
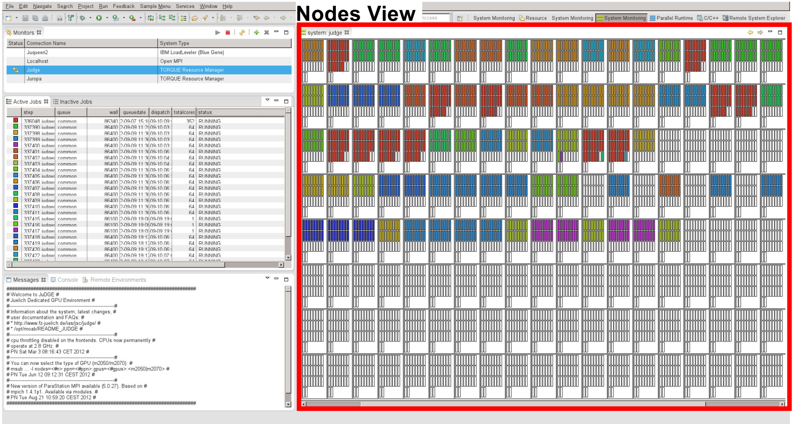
PTP Monitoring Scope

- job and system monitoring of large-scale supercomputers
- monitoring of **multiple target systems** in one perspective
- support for many batch systems (Grid Engine, LoadLeveler, Open MPI, PBS, Slurm, Torque)
- overview of the system on a **single screen**
- based on monitoring application **LLview**

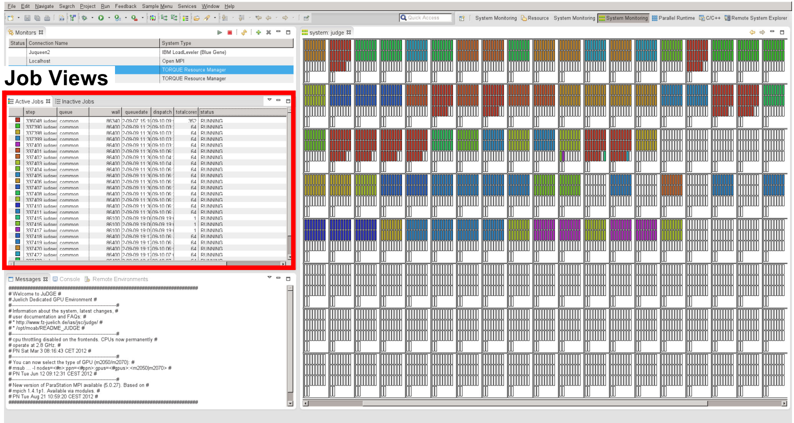
PTP Monitoring Perspective



PTP Monitoring Perspective



PTP Monitoring Perspective



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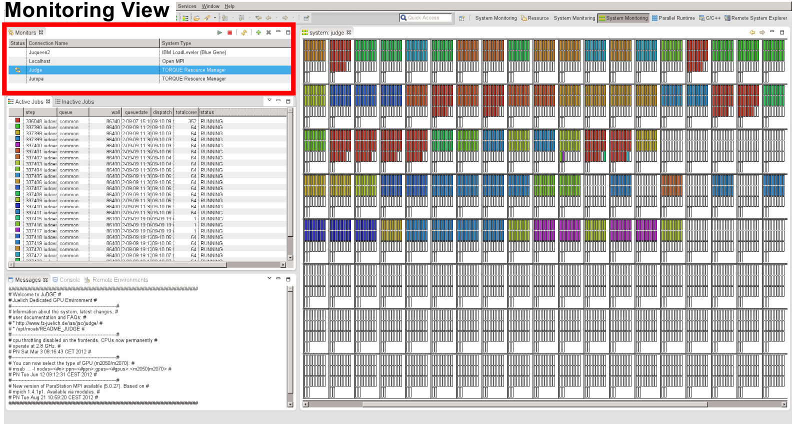
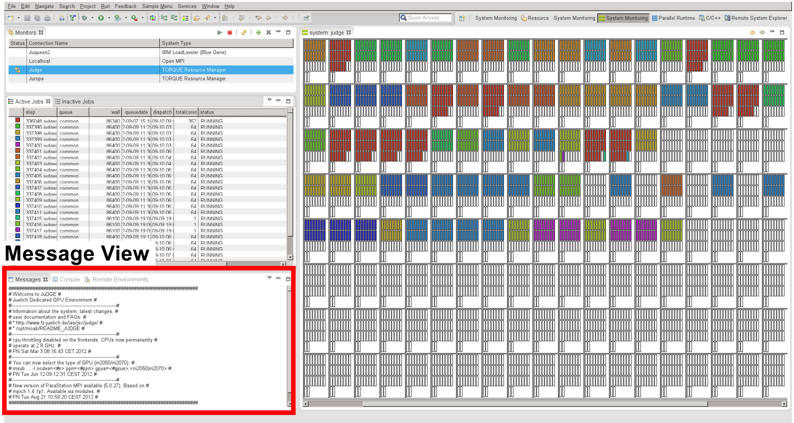
PTP Monitoring Perspective

Monitoring View



PTP Monitoring Perspective



Monitoring Views

- **Nodes View** renders target system architecture, maps jobs to compute resources
- **Active Jobs View** lists running jobs
- **Inactive Jobs View** lists queued jobs
- **Monitoring View** selects active target system, starts/stops monitoring
- **Message View** shows message of the day

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Part II: Architecture

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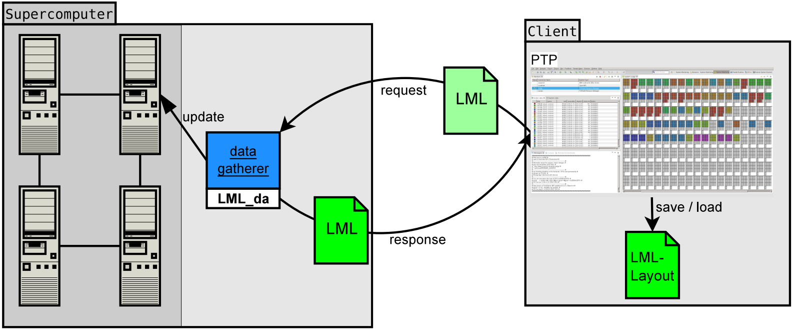
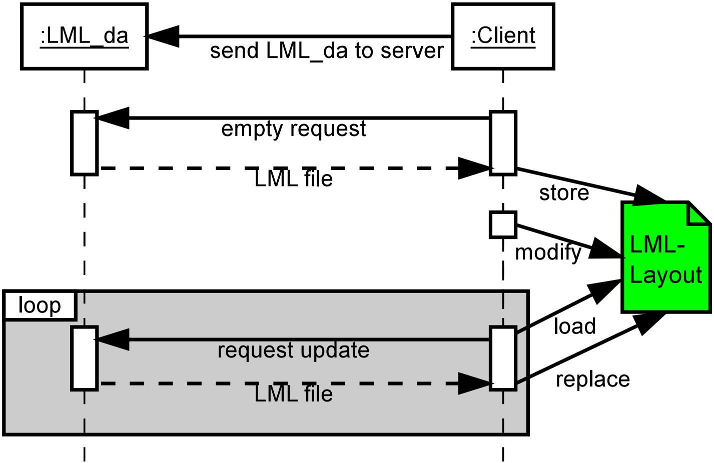
Monitoring Architecture I



Monitoring Architecture II

- **LML_da** gathers status information,
  calls target system's remote commands, written in Perl
- **LML** is a data format for status information
  of supercomputers
- LML request: contains table filtering information,
  visible/hidden columns
- LML response: contains the request and status information
- client stores **current layout** request
  for successive Eclipse sessions

Communications Protocol



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Part III: Large-scale system Markup Language (LML)

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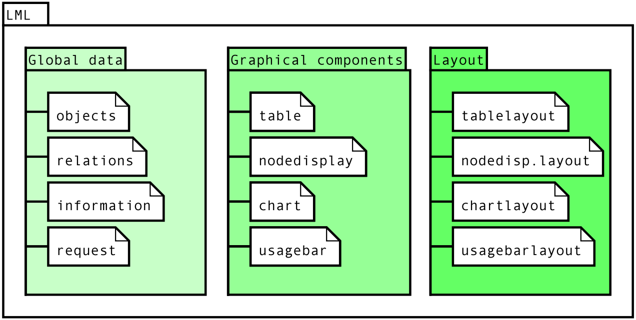
Large-scale system Markup Language (LML)

- markup language for description of supercomputer's status
- **interface** between LML_da and visualization clients
- describes all **graphical components** available in LLview (job-list, node display, charts ...)
- logical and system independent description of current status
- close to graphical representation
  $\rightarrow$ thin visualization clients
- implemented in **XML**, validation against **XML-Schema**

LML Structure



- **Global data**: intermediate data format, scheduling objects
- **Graphical components**:
  data for visualization components
- **Layout**: hints for visualization, node display hierarchy

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Example node display

LML-description of a node display

```
<nodedisplay title="Cluster" id="1">

<scheme>
        <el1 tagname="Node" min="1" max="4">
                <el2 tagname="CPU" min="1" max="3"/>
        </el1>
</scheme>

<data>
        <el1 min="1" max="2" oid="job1">
                <el2 min="3" oid="job2"/>
        </el1>
        <el1 min="3" max="4" oid="job2"/>
</data>

</nodedisplay>
```

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Part IV: Implementation

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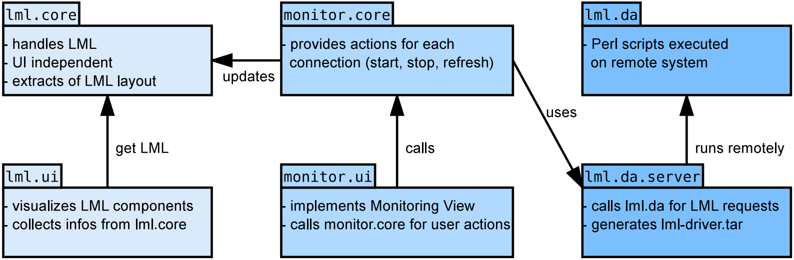
Plug-in Overview



Plug-in Details I

lml.core

- uses **JAXB** to manage LML files
- provides **helper classes** for comfortable access on LML
- defines **events and listeners** for all UI actions

lml.ui

- implements a **ViewPart** for Nodes / Jobs and Info Views
- renders LML components, considers LML layout hints
- UI implementation:
  - Jobs View $\rightarrow$ JFace TreeViewer
  - Nodes View $\rightarrow$ nests Composites, PaintListener
  - Info View $\rightarrow$ SWT Text / Table

Plug-in Details II

lml.da

- set of Perl scripts $\rightarrow$ simple installation
- split into independent modules:
  1. **Driver** calls system specific commands to get status infos
  2. **Combiner** merges LML files generated by the Driver
  3. **AddColor** assigns unique color to each job
  4. **LML2LML** converts intermediate format to final LML
- fully configurable workflow
- only Driver scripts and workflow description are target system specific

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Part V: Scalability

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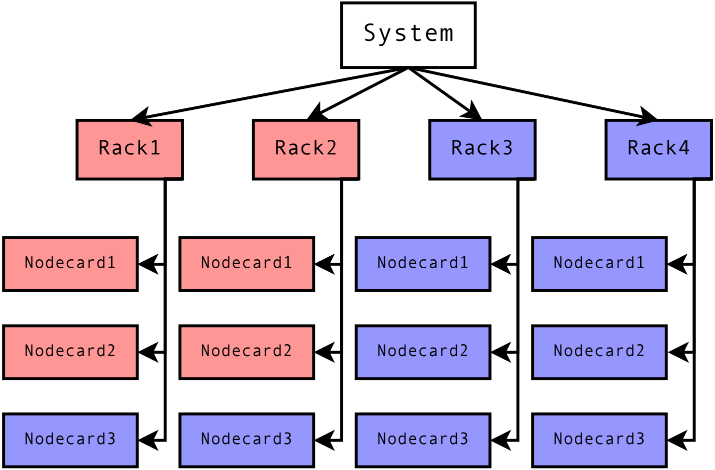
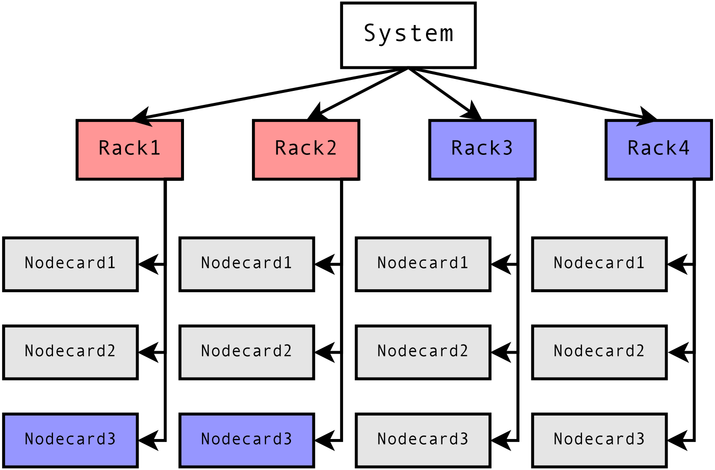
Node Display – Compression

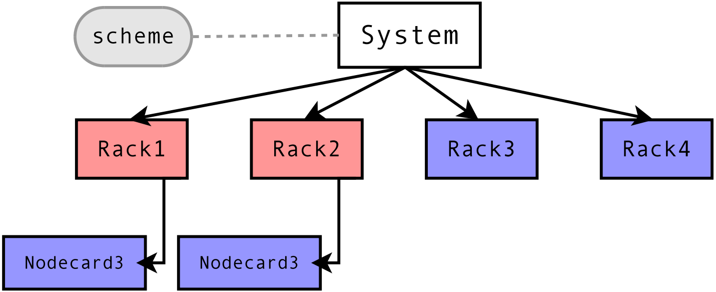


Node Display – Compression

Attribute Inheritance



Node Display – Compression

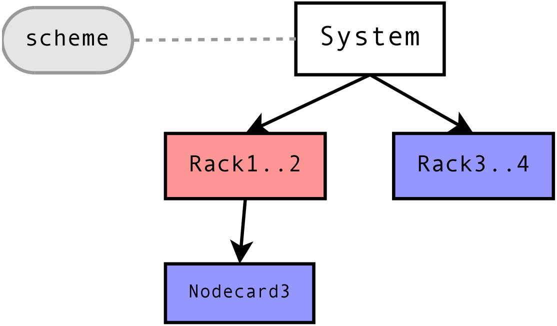


Scheme

defines architecture of **empty system**

Node Display – Compression

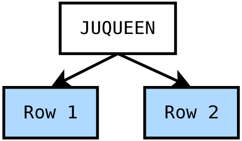
Ranges



Result

$\rightarrow$ 3 objects instead of 16

Scalable Visualization – Row Level



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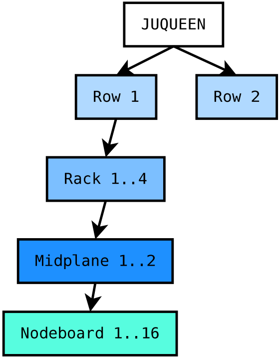
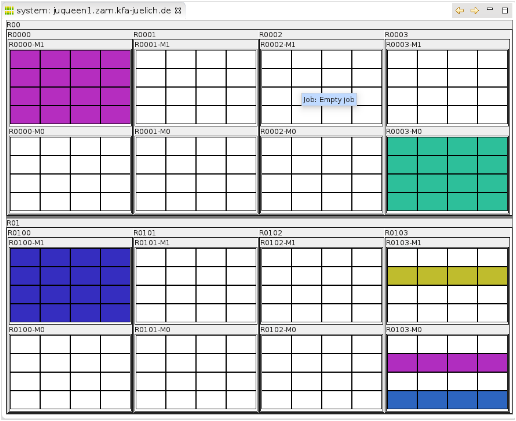
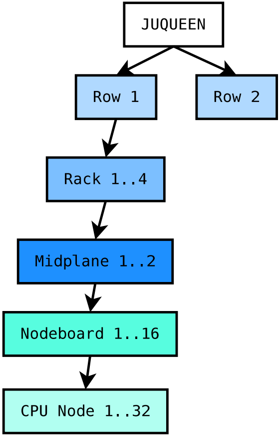
Scalable Visualization – Nodeboard Level





Scalable Visualization – CPU Node Level



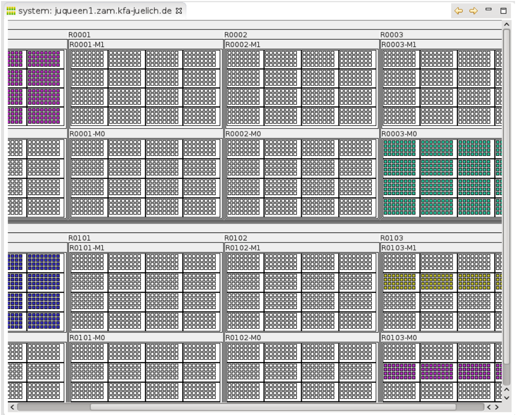
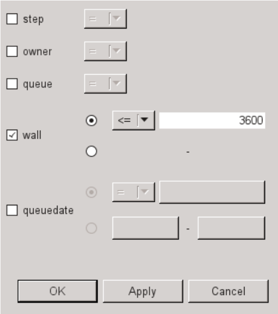


Table Filtering

- scalability of job data display
- filtering by specification of attribute values / ranges
- **server- and client-side** filtering



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Part VI: Add new target system

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LML_da – Data Extraction

Which status data is required?

- **jobs**: owner, queue, dispatch date, state ...
- **nodes**: memory, cores, state, GPUs ...
- **system**: hostname, date, high messages ...

How is status data extracted?

- one Perl script per data type
- call batch system commands
  (e.g. *qstat* and *pbsnodes* for TORQUE)
- convert output into intermediate LML files

LML_da – add new target system

1. write scripts for extracting status information e.g.
   - **da_jobs_info_LML.pl** gathers jobs
   - **da_nodes_info_LML.pl** gathers nodes
   - **da_system_info_LML.pl** gets global system information
2. write functions for checking remote commands and for composing the workflow → **da_check_info_LML.pl**
3. put all scripts into a folder in *lml.da/rms*, folder named after target system
4. add *lml.monitor.ui.monitors* extension for the new system type

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Client – add new target system

- LML_da generates **system independent** LML files
- client visualizes new target systems without any changes
- **but** a system specific LML layout can be configured
- currently this layout configuration is tricky

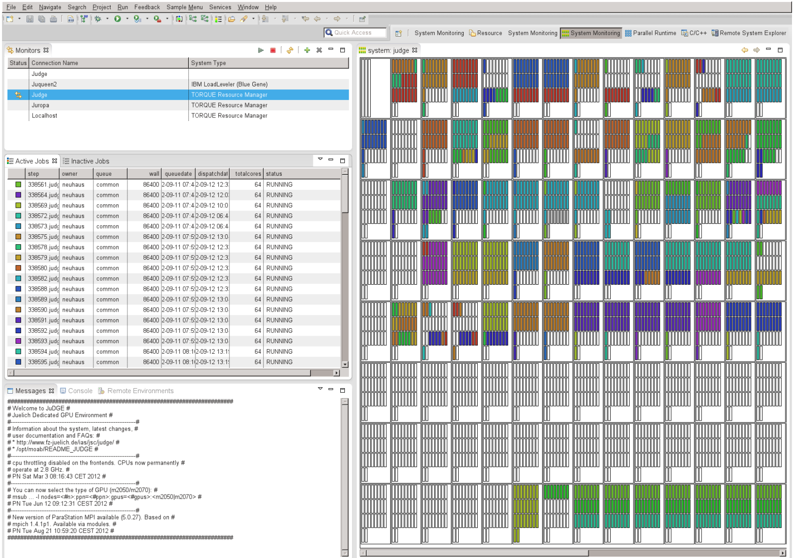
LML Layout Configuration I

- the following procedure is only meant for **testing**
- **client side configuration** of LML layout is planned
- **long-term target**:
  configure entire layout via GUI, not via XML file
- the layout could be saved together with
  the target system configuration

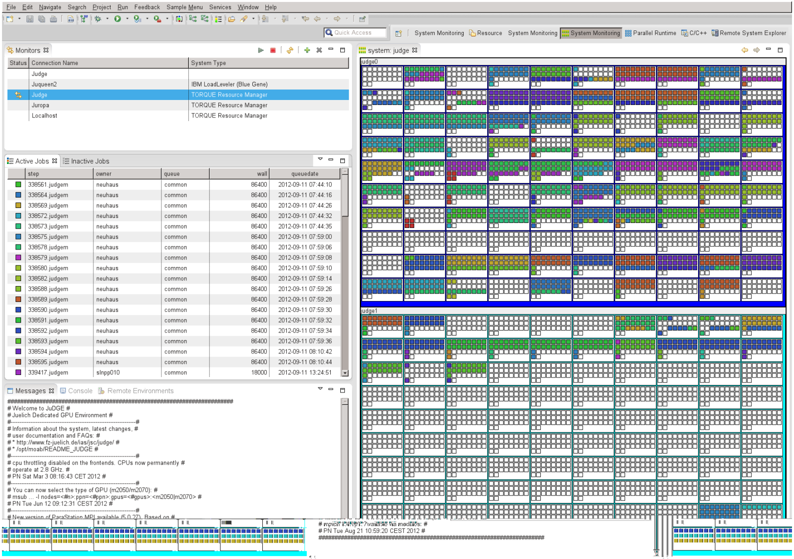
LML Layout Configuration II

1. write your own LML layout file, or adjust an existing (examples in *lml.da* plug-in)
2. start the monitoring connection to the target system
3. log-in on the remote machine and switch to the *.eclipsesettings* folder in your home directory
4. create the file **.LML_da_options** with content **nocheckrequest=1**
5. replace **samples/layout_default.xml** in *.eclipsesettings* with your own layout
6. refresh the monitoring perspective on your client

Layout Example – Default



Layout Example – Custom I



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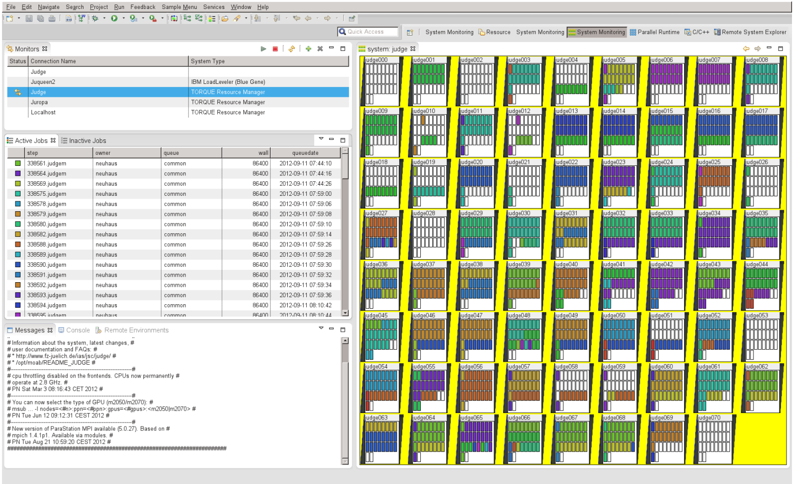
Layout Example – Custom II



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Part VII: Conclusion

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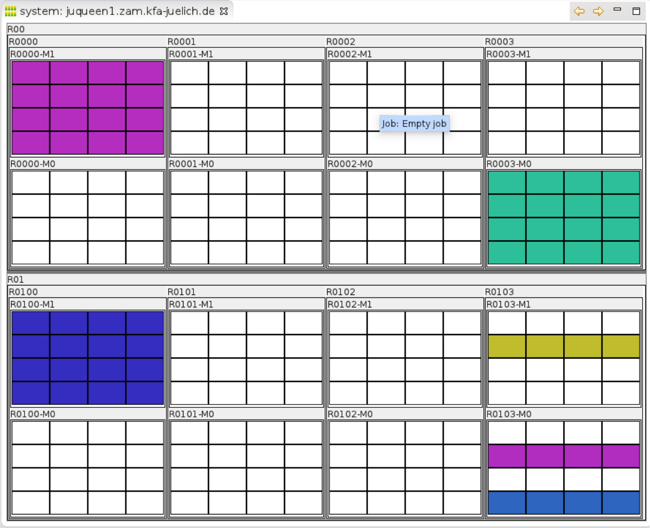
Conclusion

- 5 interacting views form the **monitoring perspective**
- **LML** as data interface between LML_da and client
- LML is divided into global data, graphical components and layout
- composition of 6 Eclipse plug-ins (lml.core/ui, monitor.core/ui, lml.da/lml.da.server)
- **new target system**: write data extraction scripts + configure layout
- Scalability
  - scalable data **acquisition**
  - scalable data **format**
  - scalable **presentation**

Questions?


system: juqueen1.zam.kfa-juelich.de
R00
R0000
R0000-M1
R0000-M0
R0001
R0001-M1
R0001-M0
R0002
R0002-M1
Job: Empty job
R0002-M0
R0003
R0003-M1
R0003-M0
R01
R0100
R0100-M1
R0100-M0
R0101
R0101-M1
R0101-M0
R0102
R0102-M1
R0102-M0
R0103
R0103-M1
R0103-M0

Contact

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- **LML** → `http://llview.zam.kfa-juelich.de/LML`
- **LLview** → `http://www.fz-juelich.de/jsc/llview`