Resource Utilization Reporting

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Warnings About RUR

- RUR is unreleased software
- Not all features discussed will be available in the first release of RUR

Why RUR?

- **Cray administrators want to know more about how systems are being used**
- **This may impact future procurements, administration decisions, or be used for billing**
- **Cray has previously offered several accounting tools, which were compelling at the time, but don't meet current needs**
  - **CSA** – designed for single system image, X2 port usable with lustre storage; lustre performance impact with large node counts
  - **Mazama ACR** – complex infrastructure and database tuning, to support lone remaining Mazama feature
  - **ARU** – limited release sortware, stop-gap to RUR Limited customization

Why RUR?

- Third Party Tools don't solve the right problem
- Server Management Tools:
- Nagios/Shinken/Incinga, Ganglia, PandoraFMS, OpenNMS, NetXMS
- Server Managers collect real-time data, not application-scale data
- OS-Noise, timescale granularity concerns
- Batch Scheduler Accounting: PBS, Moab, Slurm, LSF
- Need MOM on compute nodes, limited data

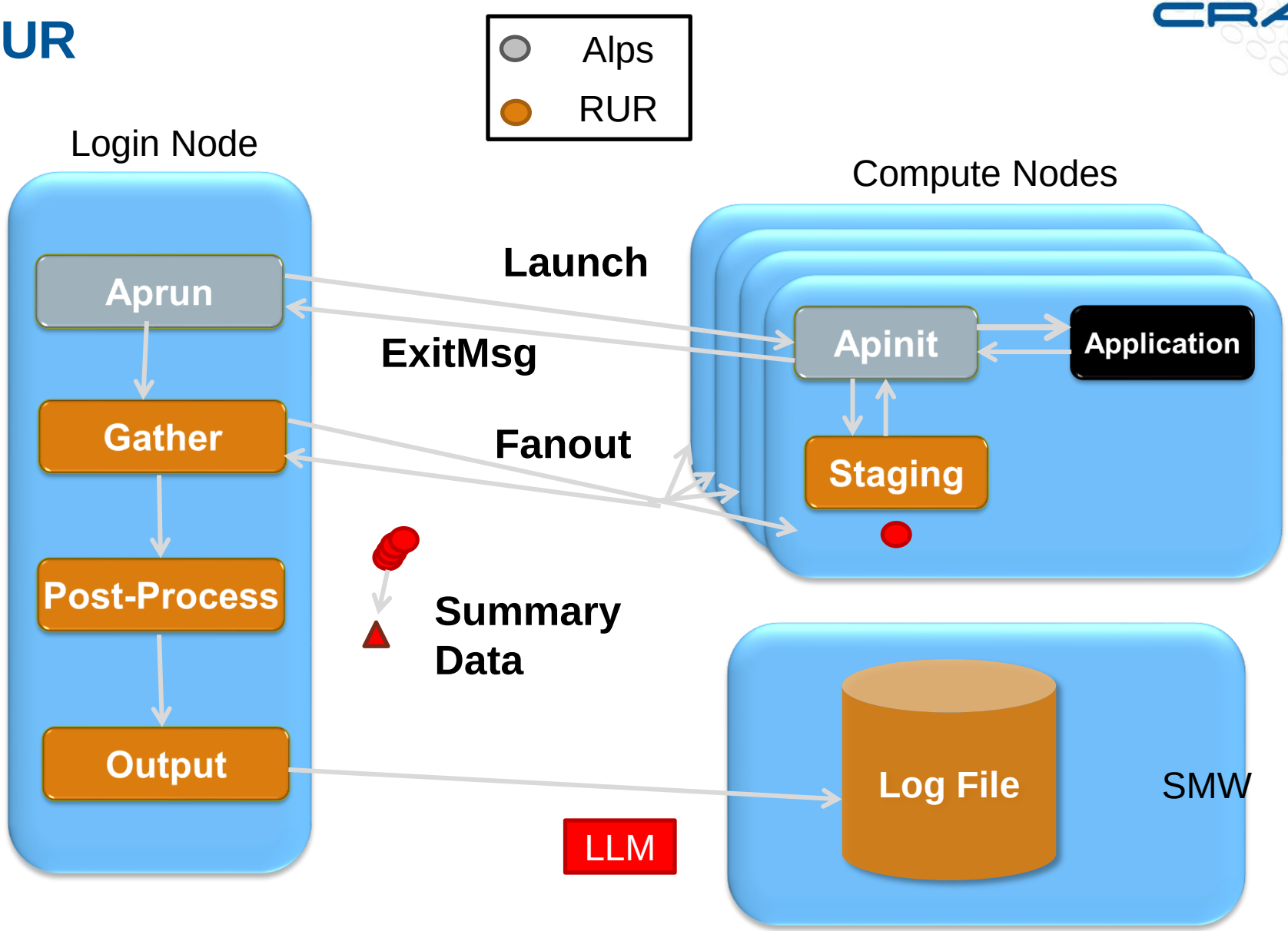
What is RUR?

- **Tool for collecting statistics about how system resources are used by applications**
  - Scalable
  - extensible
  - configurable
  - lightweight
- **Plugins architecture**
  - collection of arbitrary data from compute nodes
  - post-processing
  - storing data anywhere
  - integration with existing tools
- **CLE 4.2up02 and 5.1up00**

RUR Components

- **Data staging** on the compute nodes
- **Data collection** from computes to login
- **post-processing** to summarize data
- **logging/storage** of the output

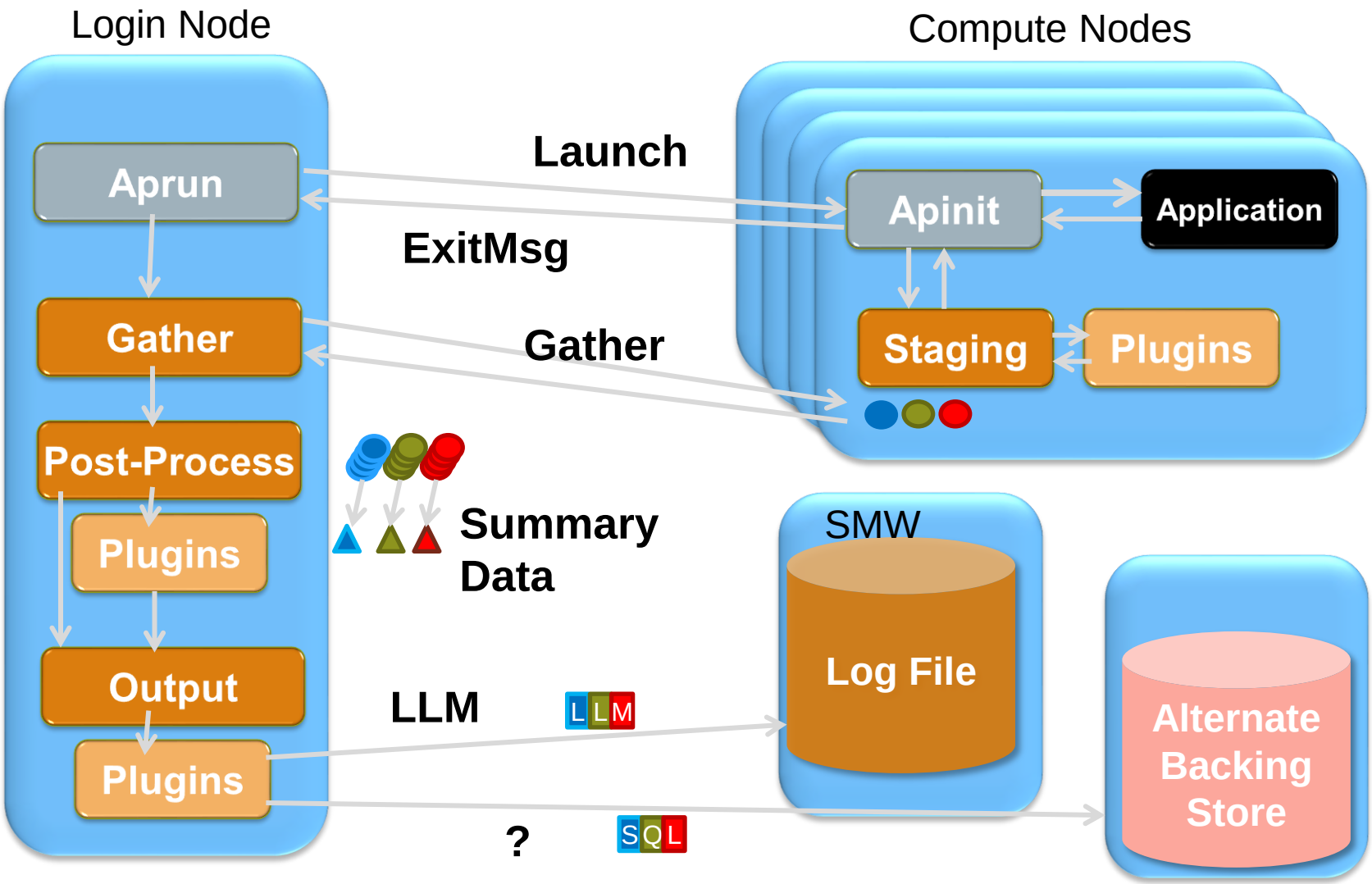
RUR


Alps
RUR
Login Node
Compute Nodes
Aprun
Gather
Post-Process
Output
Launch
ExitMsg
Fanout
Apinit
Application
Staging
Summary
Data
LLM
Log File
SMW

RUR Plugin Support

- RUR is extensible through plugins
- Plugins will each have a staging, and post-processing, and may have a logging component
- RUR infrastructure will make it simple to write basic plugins
- Can collect any data available on the target nodes
- Post-processing can be arbitrarily complex
- Store to any log, database, etc

RUR


Login Node
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Plugins
Output
Plugins
Launch
ExitMsg
Gather
Summary Data
LLM
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Apinit
Application
Staging
Plugins
SMW
Log File
Alternate Backing Store

RUR Phases

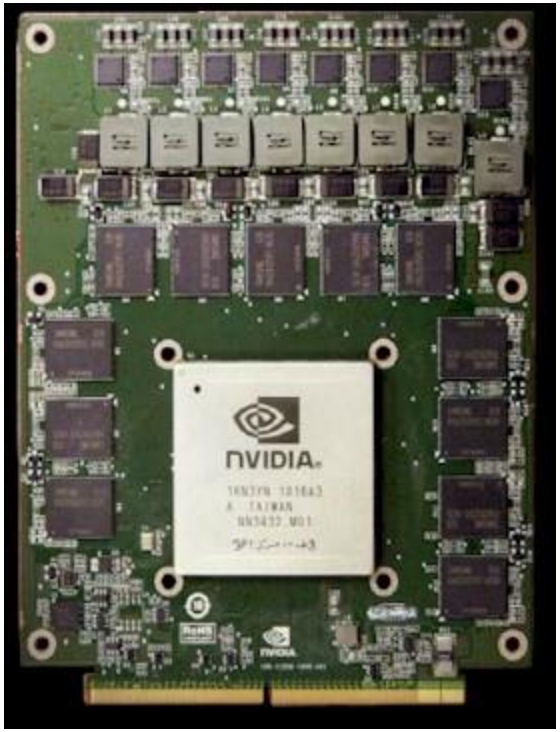
- **Data Staging on compute nodes in two phases**
  - Collect data before the application run
  - Collect data after the application run
  - The staged data is the delta of the two
  - Plugin-specific
- **Data collection:** After application is run, rur-gather on the login/mom node gathers data from compute nodes. In the future can also be launched in batch epilogue
- **The data collection uses a resilient fanout tree, with a timeout**
- **Post-processing:** built-in support for sum, min, max, mean, and histogram operations

RUR and Process Accounting

- **Cray developed RUR plugin**
- **Rusage / BSD acct style accounting**
- CPU utime, stime, Memory Highwater, File I/O
- **Pre-app:** Clear taskstats buffer
- **Post-app:** Collect taskstats buffer
- **Post-processing:** CPU: sum, MemoryHighwater: max, FileI/O: sum
- **Data storage:** Log file with LLM
- **Record includes:** userid, apid, jobid, cmdname, aggregated data

RUR and GPU Accounting

- **Cray developed RUR plugin**
- **Cray GPU accounting utility on compute nodes interface to NVML**
- **Pre-app:** Zero the GPU counters
- **Post-app:** Collect GPU counters
- **Post-processing:** MemoryUsed: max, TimeUsed: sum, Utilization: mean
- **Data storage**: Log file with LLM
- **Record includes:** userid, apid, jobid, cmdname, aggregated data

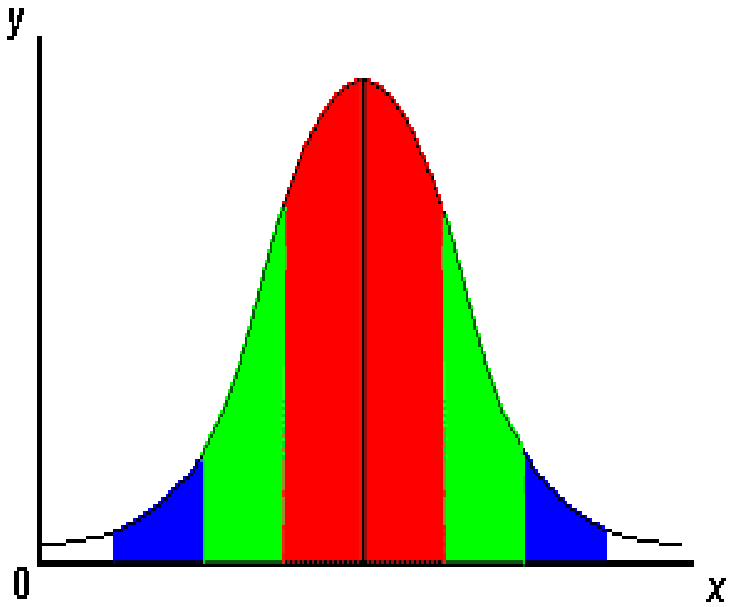


RUR and Power Accounting

- **Cray developed RUR plugin**
- **Track power usage on compute nodes for application duration**
- **Pre-app:** Collect node initial joules used
- **Post-app:** Collect node final joules used
- **Post-processing:** Sum all energy used on all nodes for the application duration
- **Data storage:** Log file with LLM
- **Record includes**: Userid, apid, jobid, cmdname, aggregated data

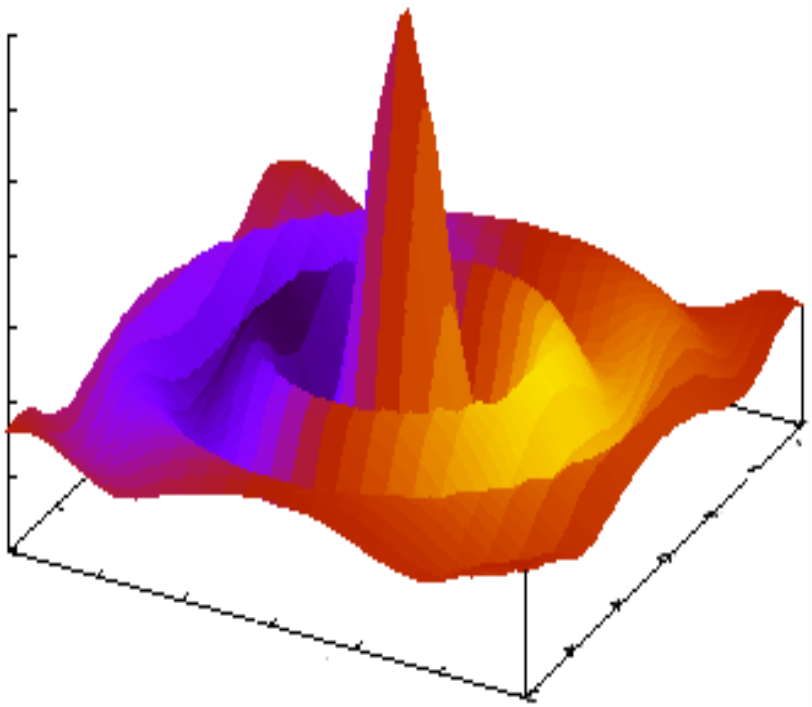
RUR and Site-Custom Plugins

- **Admin developed RUR plugin.**
- **Collect data from "widget" software, running on compute nodes**
- **Pre-app:** Collect initial number of widgets served
- **Post-app:** Collect post-app number of widgets served
- **Post-processing:** Sum of widgets served across all nodes, for application duration
- **Data storage:** Log file with LLM



RUR and Data-Rich Custom Plugins

- **Admin developed RUR plugin**
- **Collect data from advanced widget server, running on compute nodes**
- **Pre-app:** Collect initial widgets statistic matrix
- **Post-app:** Collect post-app widgets statistic matrix
- **Post-processing:** Custom generated histogram of many widget statistics
- **Data storage:** Custom output plugin records histogram in widget statistic database table; RUR LLM log file includes an record index

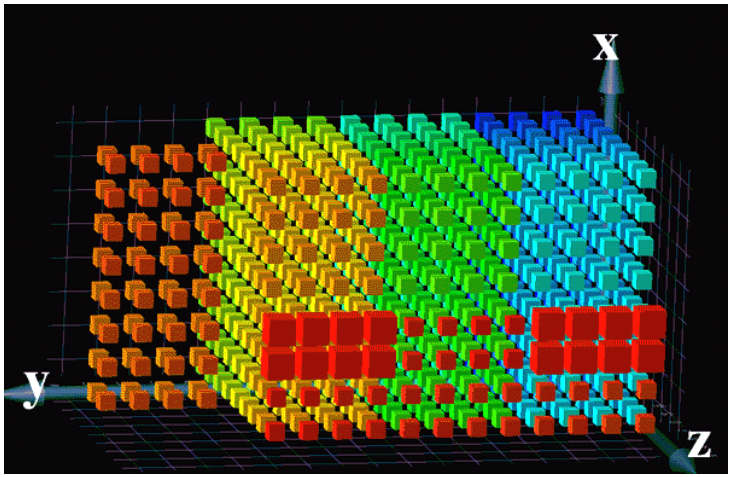


Possible Future RUR plugins

- Minor errors
- Lustre Filesystem statistics
- DVS statistics
- Per-mountpoint statistics
- Aries performance counters
- Future coprocessors
- Error codes / application completion

Possible RUR Output Plugins

- Existing database
- System visualization tool
- Interface to WLM accounting
- Output to user in batch output
- Email to admin



Job Scale Reporting

- Initially, job-scale reporting will be the sum of the applications in the job
- A user may reserve more nodes than the application actually runs on
- RUR components can be initiated by the WLM, rather than ALPS, to provide true job-scale data

Questions?