University of Reading

School of Systems Engineering
MSc Dissertation Presentation

Title of presentation:

RAS Framework Engine Prototype

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Motivation

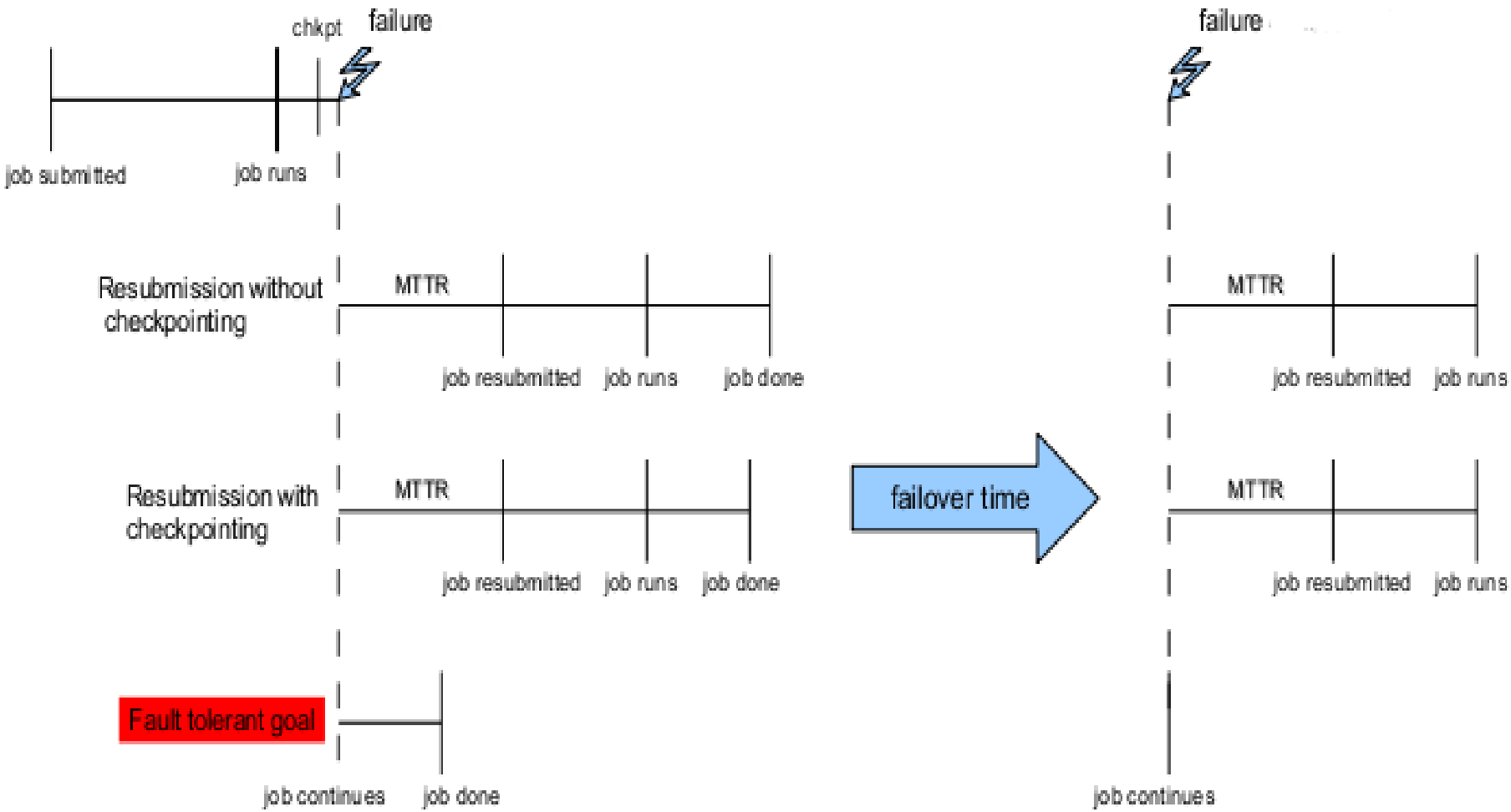
- High Performance Computing Systems reached Petaflops era
  - Roadrunner with 129,600 cores, 98 TB RAM (at Los Alamos National Laboratory, USA)
  - Jaguar with 150,152 cores, 300 TB RAM (at Oak Ridge National Laboratory, USA)
  - Kraken with 66, 000 cores (at Oak Ridge National Laboratory/University of Tennessee, USA)

- The trend is toward even larger-scale systems
- Significant increase in number of component and complexity
- Increase in failures
- Decrease in performance
- Reactive fault tolerance as checkpoint/restart is becoming less efficient
  - Experience failures
  - React to failures

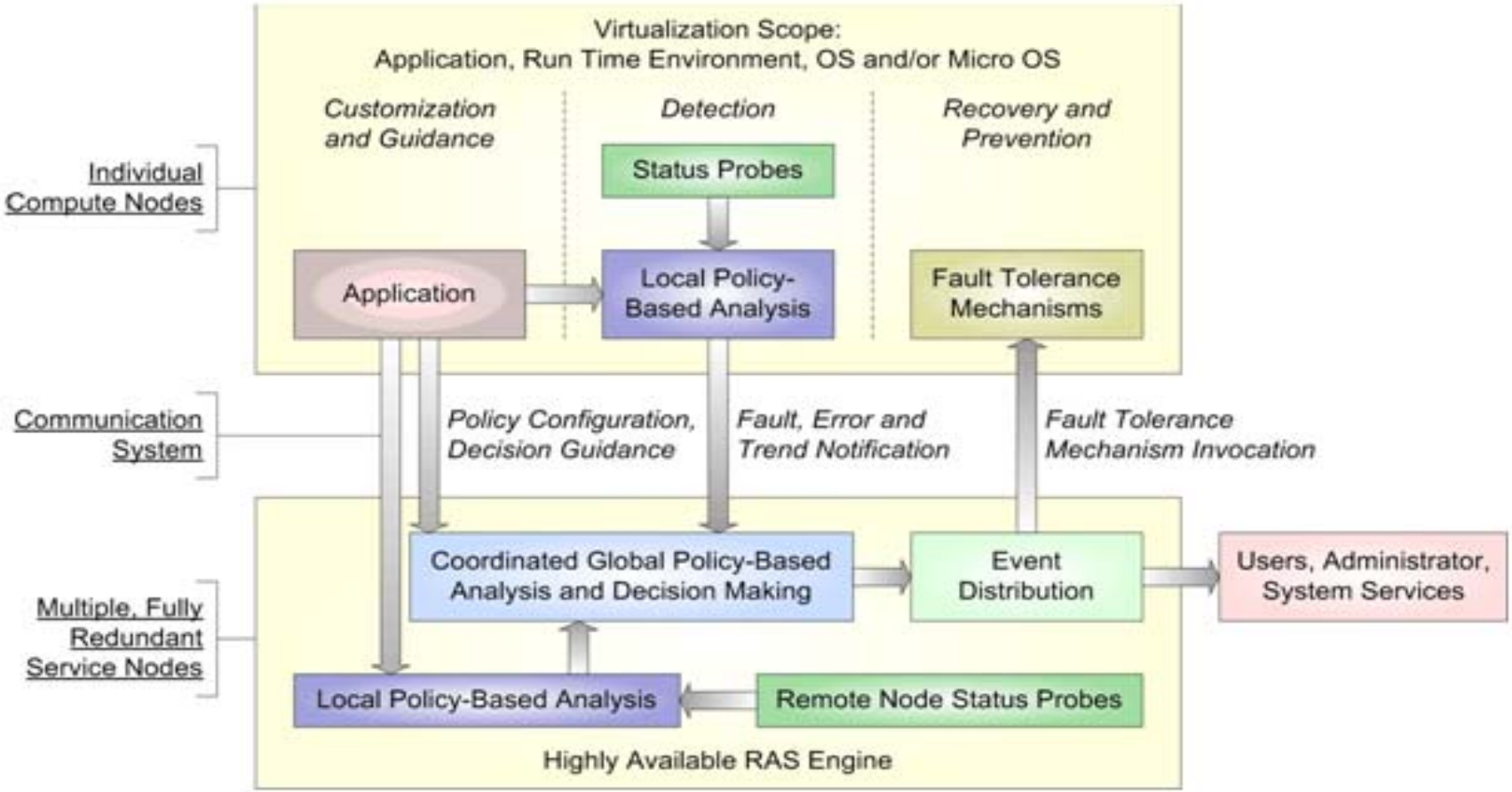
Proactive Fault Tolerance

- Proactive fault tolerance keeps parallel applications alive by
  - Avoid failures
  - Predict failures
  - Migration

Reactive vs. Proactive



RAS Framework



Reliability, Availability and Serviceability of a System

- Reliability
  - Hardware and software performance
  - Avoidance and robustness
  - Mean time between failures (MTBF)
- Serviceability
  - Component, device or system maintained and repaired

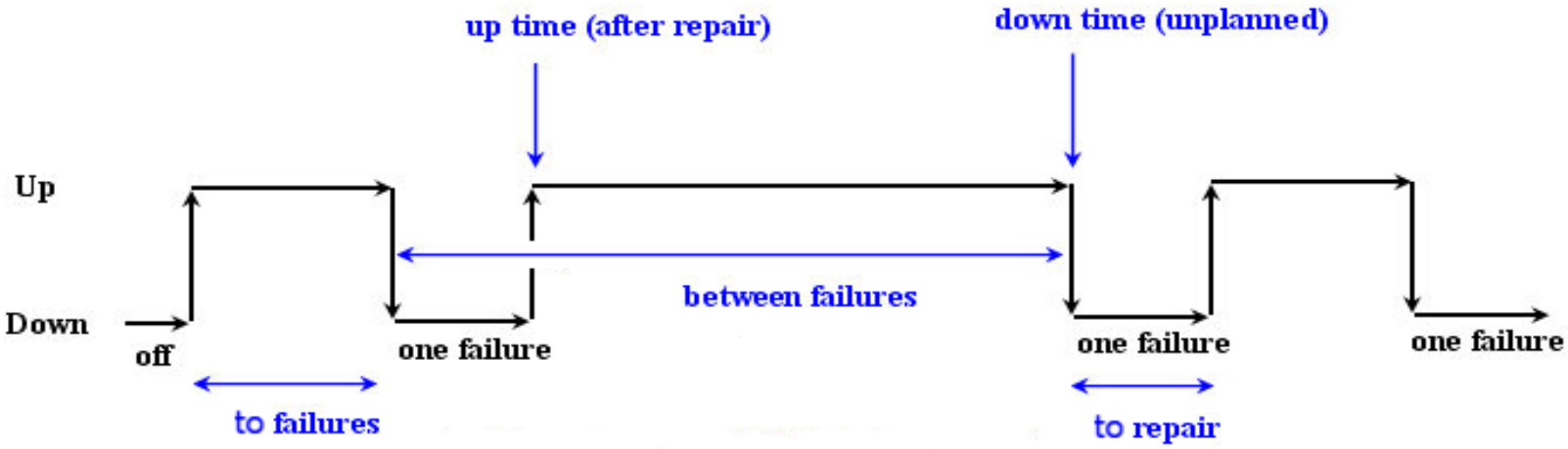
Reliability, Availability and Serviceability of a System

Mean time to failure (MTTF)

Mean time to repair (MTTR)

Mean time between failures (MTBF=MTTF+MTTR)

- Availability is MTTF/MTBF

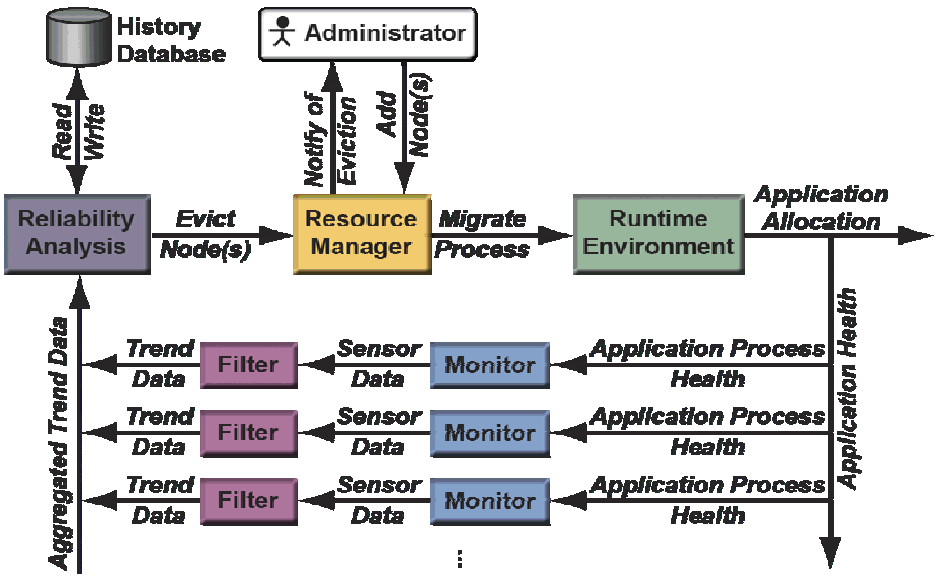


RAS Framework

- Reactive fault tolerance
- Proactive fault tolerance
- Reliability analysis
- Holistic fault tolerance
  - Reactive and Proactive

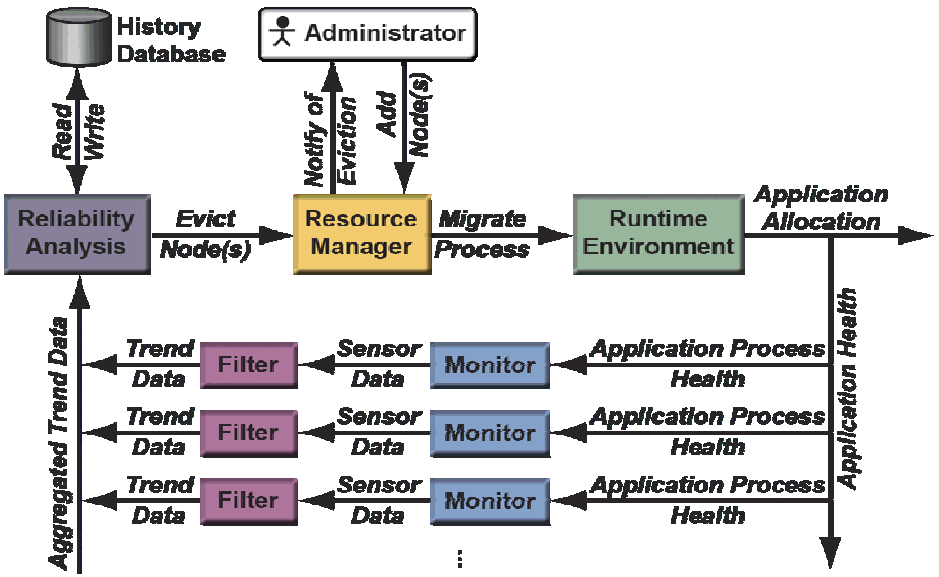
RAS Framework Engine Prototype

- Job and Resource Manager
- Monitoring System
- Event Logging
- Reliability Analysis
- Database
- Migration



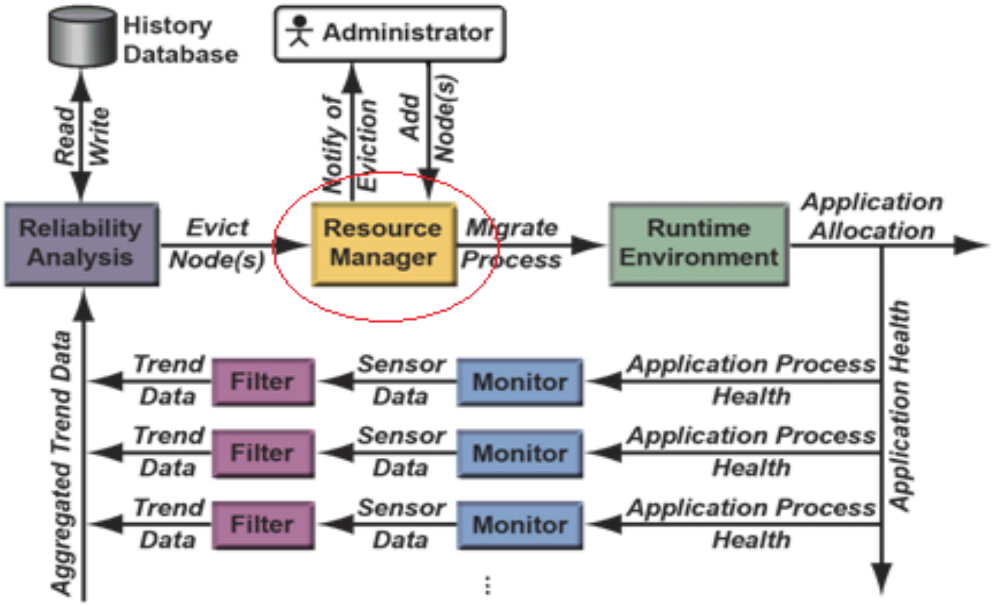
Contribution to RAS Framework Engine Prototype

- Database
- Daemons are interfaces between the Database and:
  - Monitoring System
  - Event Logging
  - Resource Manager



Job and Recourse Manager

- Accepts jobs
- Finds resources
- Submits jobs
- Provides the result

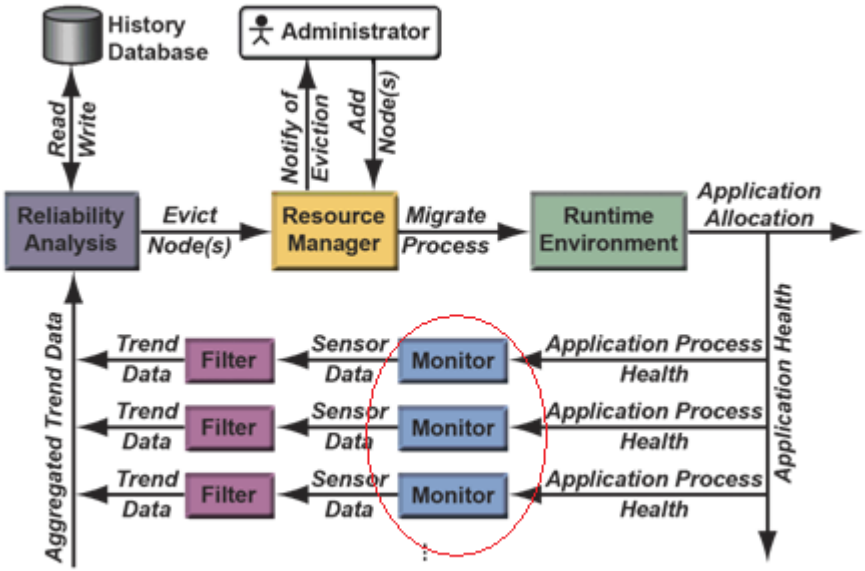


Must support migration

Collected data for Reliability Analysis

Monitoring System

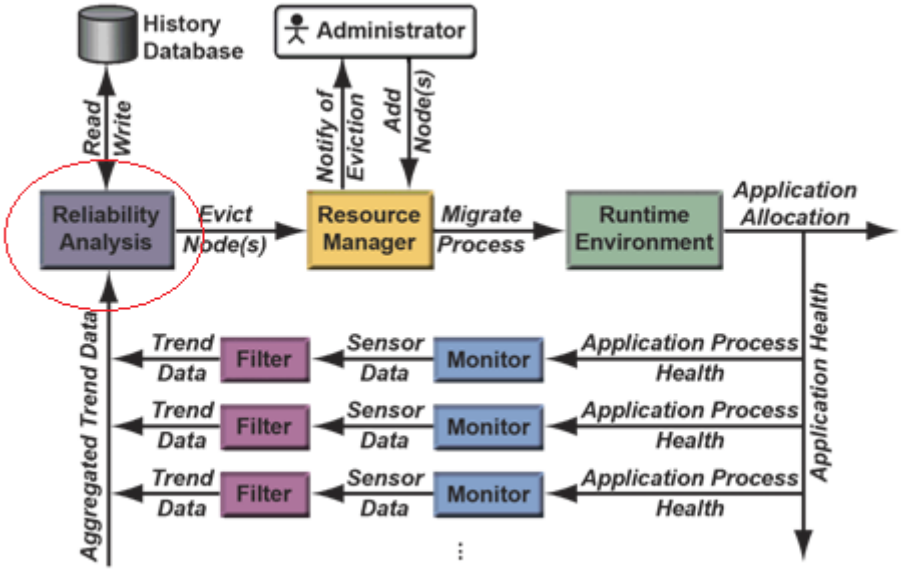
- Monitors resources
- Provides metrics values



- Collected data for Reliability Analysis

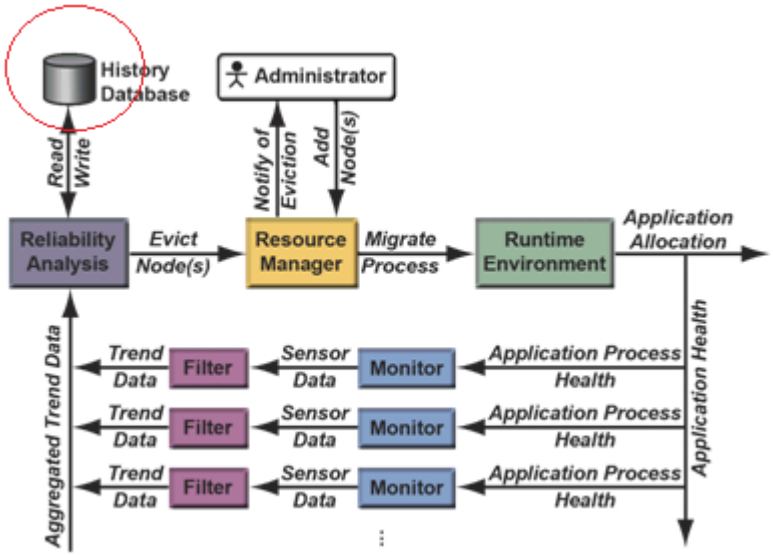
Reliability Analysis

- Analyses
- Makes predictions
- Trigger migration
- Stores data to the database



Database

- Has historical data and raw data
- Used by Reliability Analysis
- Archive data



Migration

- Job level
- Process level

- From a compute node to a node
- From a processor to a processor

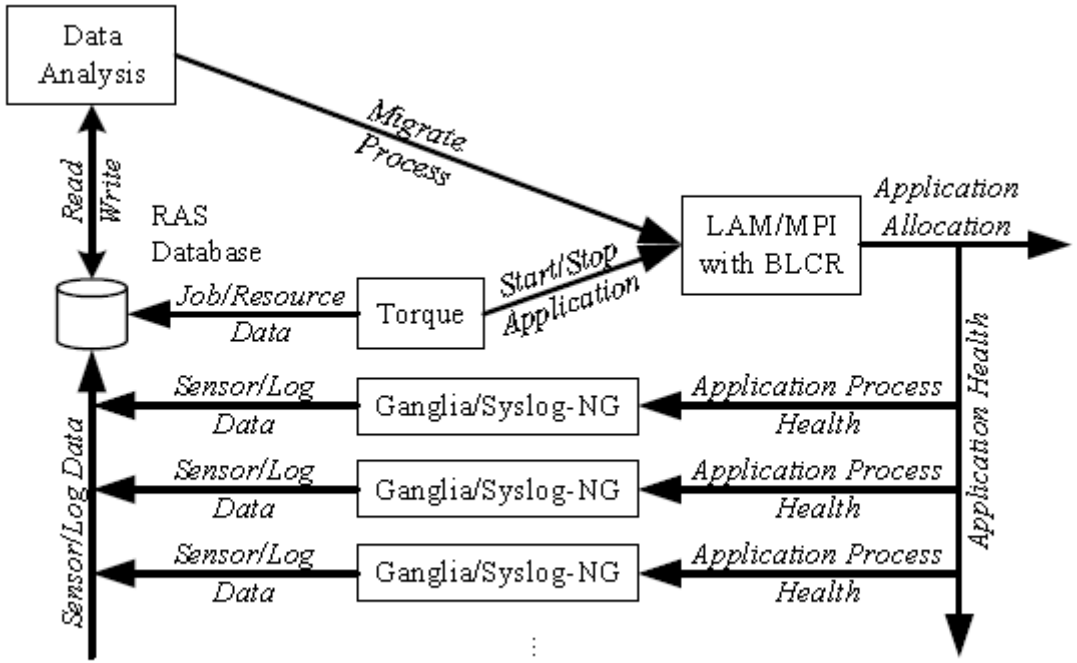
RAS Framework Engine Prototype

Uses:

- Torgue
- Ganglia (gmond)
- Syslog-ng
- MySQL

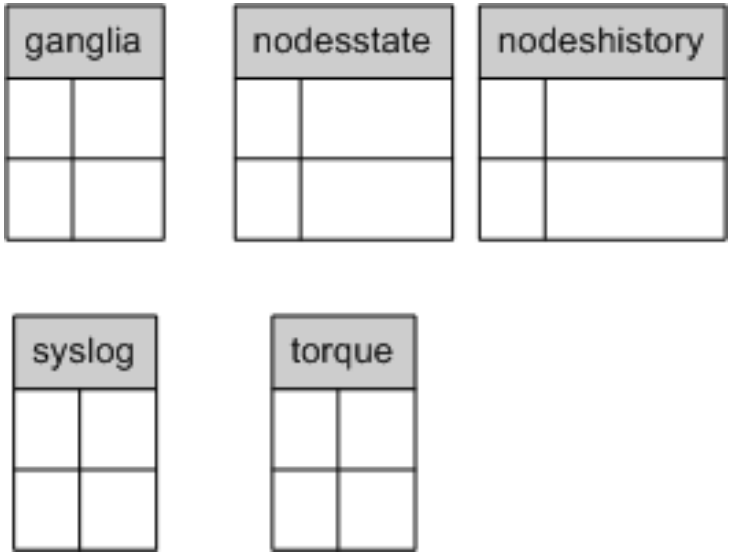
Consist of daemons:

- *Torquemysql*
- *Gangliamysqld*
- *Syslogmysqld*
- *Migrationd*
  and
  ras Database



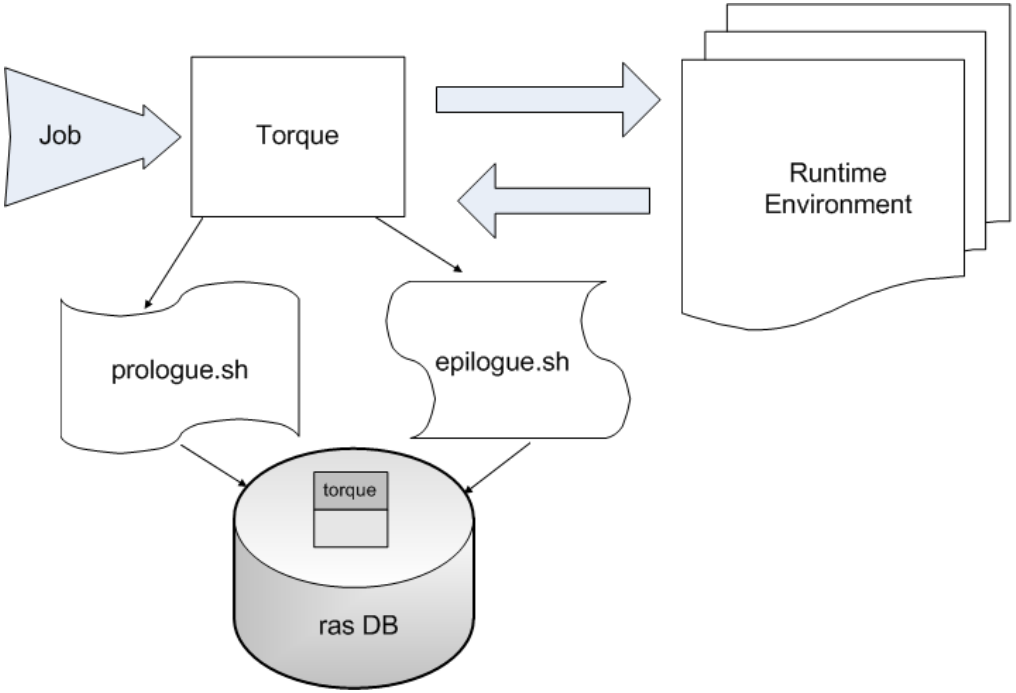
ras Database

- 5 tables
- MySQL
- No relations between tables
- Data types:
  - Int
  - Varchar
  - text



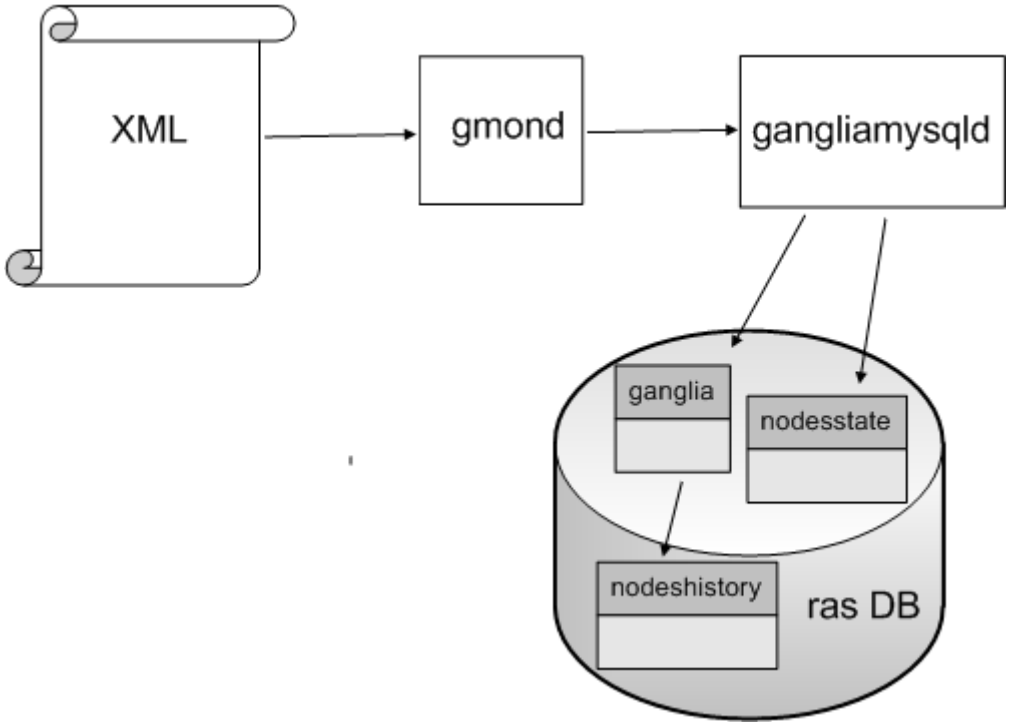
Torque/MySQL scripts

- Prologue script
- Epilogue script
- SQL statements



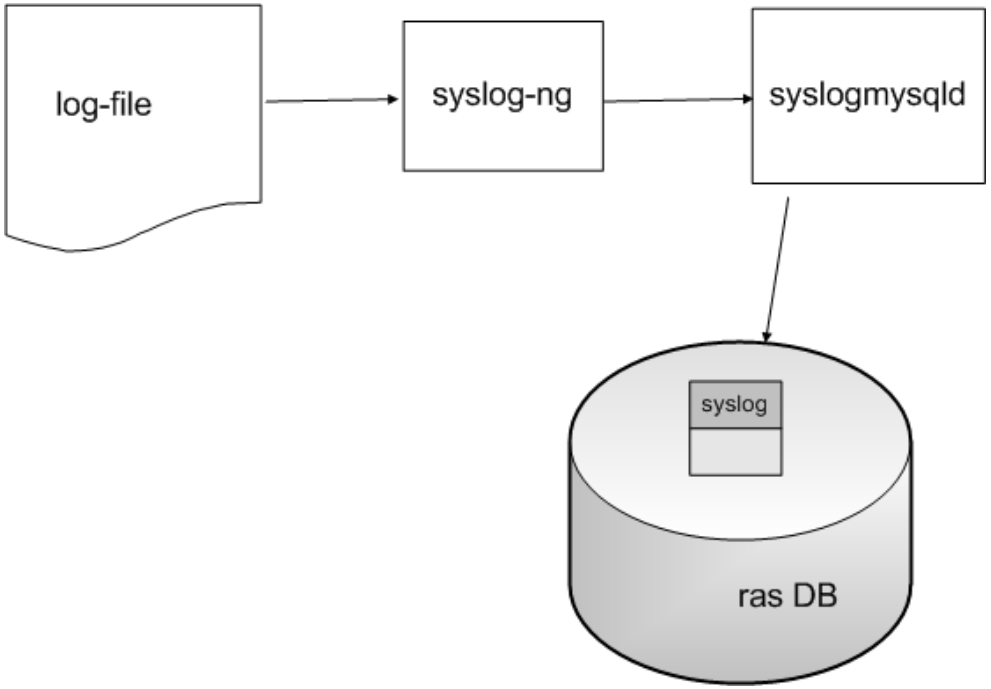
Ganglia/MySQL Daemon

- Exports in XML
- XSLTproc .xsl .xml -> .sql

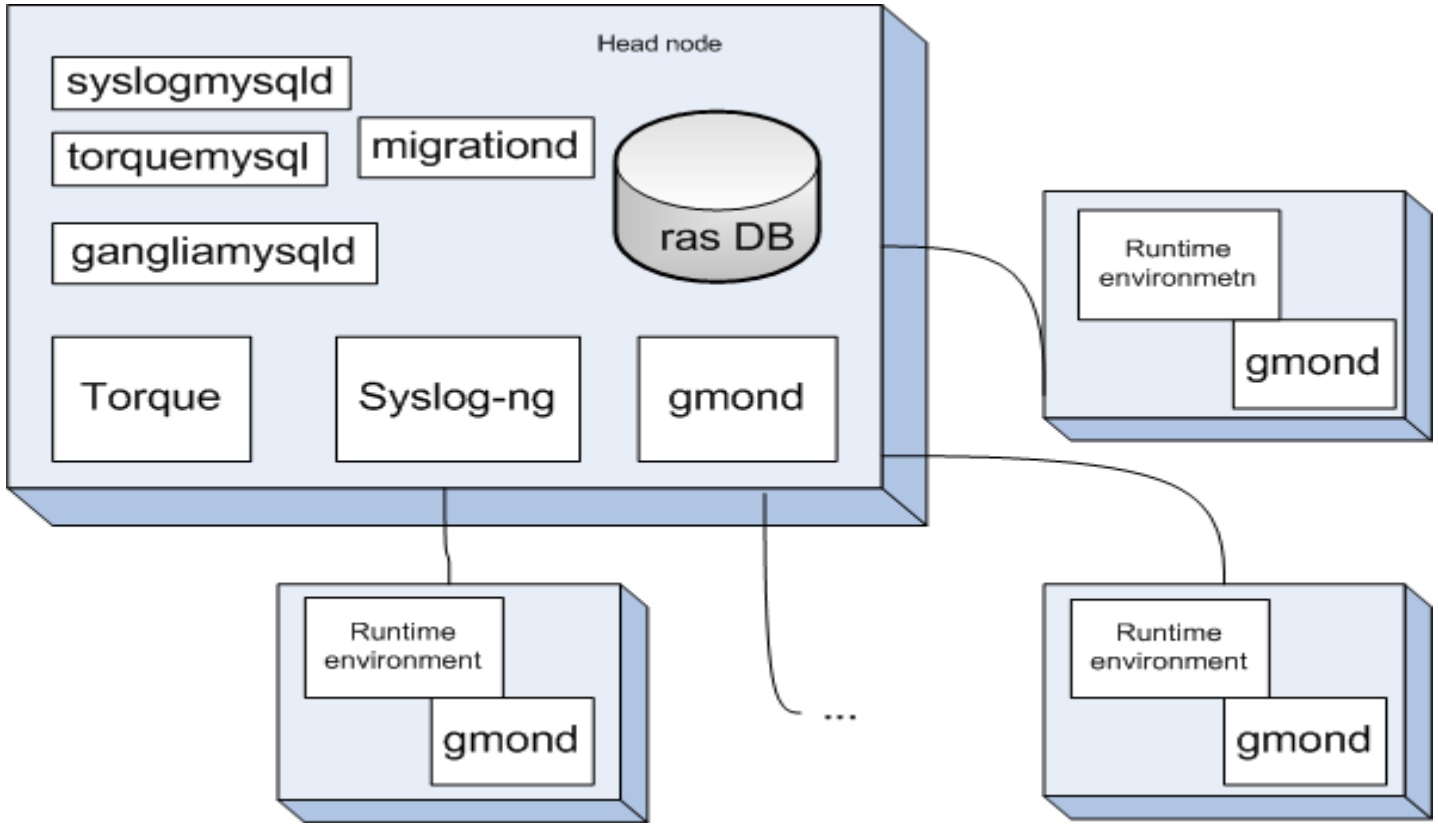


Syslog-ng/MySQL daemon

- Gets messages
- SQL statements



RAS Framework Engine Prototype integration on a system



Results

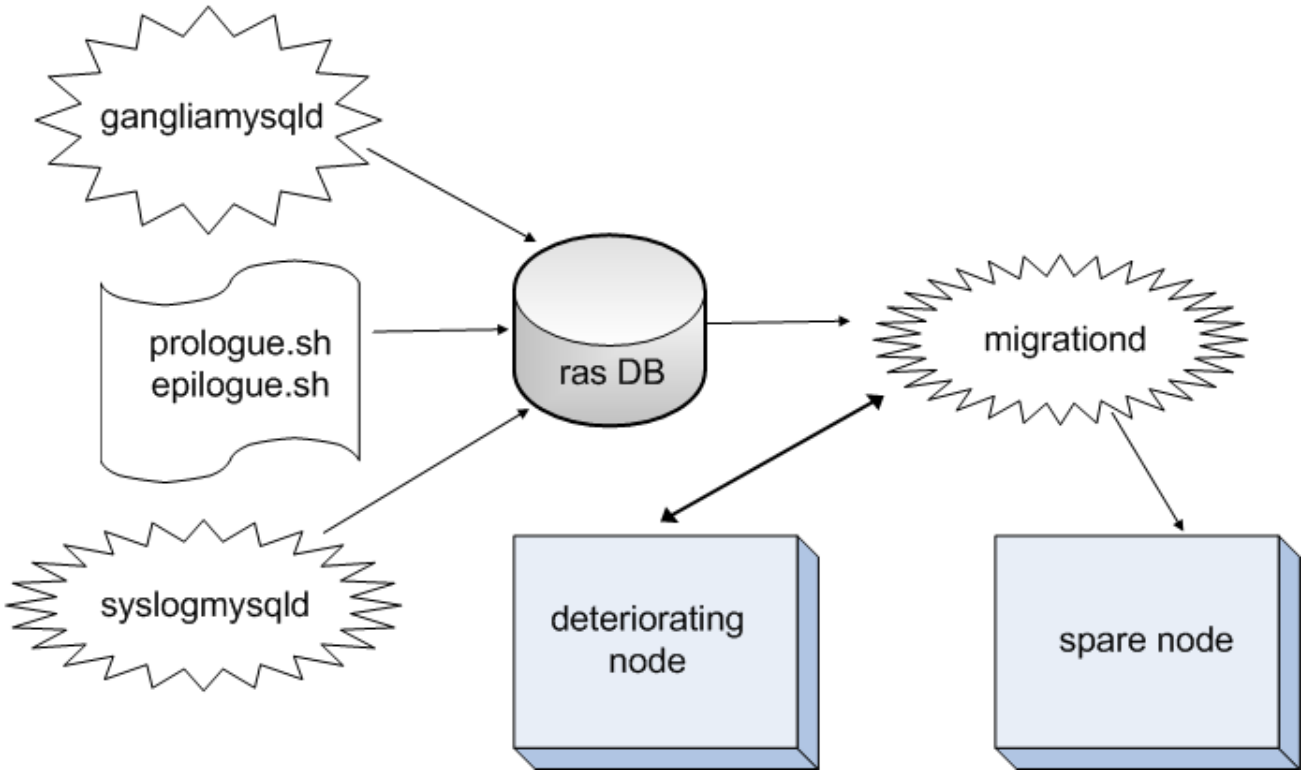
- Tested on a 48 node Linux cluster at ORNL
- Data stored from Ganglia, Torque, Syslog-ng

Limitations

- Database scalability
- Archiving data
- Time issues
- Gmond scalability

Future work: *Migration Daemon*

- Makes predictions
- Trigger migration



Paper

- A Proactive Fault Tolerance Framework for High Performance Computing

  28th IASTED International Conference on Parallel and Distributed Computing and Networks (PDCN), Innsbruck, Austria, February 16-18, 2010.

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Summary and Questions

- HPC systems, failures, Fault Tolerance
- The RAS Framework for HPC systems
- The RAS Framework Engine Prototype
- Results: data stored, has some limitations
- Future work: predictions
- Questions?