Automating usability of ATLAS Distributed Computing resources

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Distributed Processing and Data Handling A: Infrastructure, Sites and Virtualization
14/10/2013
Outline

• Automation in ATLAS Distributed Computing (ADC) operations

• Storage Area Automatic Blacklisting (SAAB) principles and implementation

• Experience with Site Availability Monitoring (SAM) tests for storage resources

• SAAB in production: monitoring and automation experience

• Further ahead: short and long term plans, then conclusions
ADC and ADC automation overview
Site Status Board (SSB)

- For all the ATLAS computing sites ADC attends to manage
  - resources: storage and computing elements, network, catalog, File Transfer System, ...
  - activities: distributed data processing and analysis, data transfers
- Tools for automatic control are being introduced in several ADC areas:
  - Switcher for automatically testing and recovering queues after downtimes
  - Panda site exclusion for automatically handling sites computing resources
  - Automatic exclusion/recovery of storage resources for downtimes or disk space quotas reaching critical thresholds
- Several tools provide monitoring information which is uniformly collected in the SSB
  - SSB views and SSB metric allow to follow sites status and history according to given metrics
Distributed Data Management (DDM)

- ADC storage resources are accounted for by Distributed Data Management (DDM) system
- The DDM End Point (DDM EP) represents the elemental ATLAS storage unit
  - Each ATLAS site has one or more of them
  - DDM system keeps track of the status of DDM EPs:
    - each of them can be in on/off/auto mode
      - only ‘auto’ DDM EPs can be automatically acted upon
- Automatic management of DDM units take into account
  - Storage downtimes, space shortage
  - Performance-related metrics missing: that’s where SAAB’s idea has started
SAAB concepts

- Given a metric regularly yielding results in time, define a fixed-width time interval taking into account several of them.
SAAB concepts

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- Define and deploy an **algorithm** providing performance-defining thresholds
SAAB concepts

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• Define and deploy an **algorithm** providing performance-defining **thresholds**
  
• according to which a **decision** is issued to be **automatically** taken

12 hours from 2013-09-18 02:00 to 2013-09-18 14:00
SAAB concepts

- Given a metric regularly yielding results in time, define a fixed-width time interval taking into account several of them.
- Define and deploy an algorithm providing performance-defining thresholds.
- According to which a decision is issued to be automatically taken.
- Repeat, by shifting the time window by constant time-steps.
SAAB concepts

• Given a metric regularly yielding results in time, define a **fixed-width time interval** taking into account several of them

• Define and deploy an **algorithm** providing performance-defining **thresholds**
  - according to which a **decision** is issued to be **automatically taken**

• **Repeat**, by shifting the time window by constant time-steps

• This approach provides a **sliding time-window** over the metric to be looked at
  - **Ground is laid for automatic blacklisting** of resources whose behavior is found not compliant with a suited blacklisting policy
SAM tests probing sites resources

- SAM is the **framework** used by the experiments to **test** status and availability of resources

- It is a **Nagios**-based service, tests have 3 possible **outcomes**: OK, WARNING, CRITICAL

- The most relevant tests for storage resources management are **Put**, **Get** and **Del** of a test file into the storage area (DDM EPs)

- SAM framework probes ATLAS sites **availability** and the results are stored into a database

  - latest results and historical data for each site are exposed through a **RESTful** interface

  - Tests are executed every **13 minutes**

  - This is the highest frequency allowed by the used machines HW
SAAB applied upon SAM tests in ATLAS

• SAAB tool first application

  • processes information of SAM Put tests and issues a set of decisions for all the DDM EPs reflecting their status

    • blacklisting/whitelisting actions for write/upload permissions on DDM EPs are taken according to such decisions

• set to be executed every 15 minutes, so that each new execution has at least one new SAM test on average as input

• exposes output compliant with the ATLAS Site Status Board (SSB)

• implemented in python
SAAB algorithm

• Thresholds and time values have been tuned after a testing experience
  • minimizing fluctuations due to temporary glitches and improving SAAB response stability
• The time window length is set to 90 minutes (customizable), hence ~6 expected tests per window (ETW).
• A string flag is assigned to each DDM EP (thresholds customizable):
  • RED (off) if 0% of the total tests number is OK (blacklisting candidate)
  • YELLOW (inter-threshold) if the OK tests are below 60% of the total tests number
  • GREEN (on) if > 60% of the total tests number is OK (whitelisting candidate)
• No less than 30% ETW is required for each site for the algorithm to be applied and action to be taken
  • if not the DDM EP is flagged as GRAY
• String flags are chosen in compliancy with the SSB color convention
SAAB actions with SAM results input

- Every 15 minutes SAAB
  - processes, for every DDM EPs, the SAM results within the last 90 minutes
  - retrieves information about the already blacklisted DDM EPs

- Blacklisting/whitelisting actions follow via sending instructions to appropriate system in DDM (DQ2):
  - RED-flagged DDM EPs are set off for 90 minutes, regardless of their current status
    - If no other change happens, DDM EPs stay off until the 90 minutes expire
    - SAM tests keep being executed anyway
  - GREEN-flagged DDM EPs currently off are set on.
  - No action taken in any other case (YELLOW, GRAY).

- Information on each execution is written into two logs, accessible via webpage for shifters consumption

- SAAB sends mail alerts and notifications:
  - to developers in case of (known and tracked) problems with SAM results retrieval
  - to sites who want to be notified whenever any of their DDM EPs gets blacklisted
SAAB integration in SSB: metrics

- SAAB outcome in **site-grained** fashion showing sites status as the OR of their DDM EPs statuses

- SAAB outcome in **DDM EP-grained** fashion showing DDM EPs status history

- Gray zones relate to SAM tests temporary glitches so that developers can look into that

- Clicking on the site SSB row redirects to the **SAM tests history** for that site (SAAB concepts slide)
SAAB integration in SSB: views

- SAAB-fed SSB metric is displayed, along with other SSB metrics, in the general SSB view for general shifters.

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Tier</th>
<th>Cloud</th>
<th>Downtime</th>
<th>DataManagement</th>
<th>Functional Tests</th>
<th>Panda Efficiency</th>
<th>Activity status now: Included-Excluded sites</th>
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<tbody>
<tr>
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<td>Site-OR of DDM upload and write permissions</td>
<td>Prod Efficiency 12h [%]</td>
<td>Prod Failed Jobs 12h</td>
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<td>ACTIVE</td>
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SAAB results into action

- Starting from July 2013 SAAB is steadily in production for the automation of upload and write permissions
- More than 14k manual actions have been taken over
  - N.B.: whitelisting actions are performed only when appropriate before a blacklisting status expiration
Next: SAAB extension

- SAAB is going to be plugged in also with Get and Del SAM tests

- **Site-granularity** instead of DDM EP-granularity is being pondered over
  - in most of the cases when a site’s DDM EP is blacklisted, other DDM EPs follow after a while
    - the idea is to blacklist other DDM EPs after the first if tests being failing, i.e. without waiting for the 0% threshold to be reached

- SAAB **principles** can be extended to metrics for **other resources**, e.g.:
  - Performance metrics for **networks** (e.g.: *PerfSonar*)
  - Experiment-specific functional tests for data **transfer**

- SAAB is not experiment-specific, it may be extended to other needs
Conclusions

SAAB design prescripts and implementation

• proved successful, within ADC Automation, to enhance the task of storage resources blacklisting upon performance by substituting
  • manual actions with automatic ones
  • human educated guesses with non-ambiguous and reproducible decision criteria

• while drawn to meet the needs of performance-based automatic handling of ADC storage areas, it is generally applicable to any resources tested by a metric
  • envision the possibility of deploying automatic, performance-based actions on ATLAS ADC resources by means of a single, uniform and clear approach
Thanks.

Questions?