

# New solutions for large scale functional tests in the CERN WLCG infrastructure with SAM/Nagios: The Department experiments experience

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### Abstract

Since several years the LHC experiments rely on the WLCG Service Availability Monitoring framework (SAM) to run functional tests on their distributed computing systems. The SAM tests have become an essential tool to measure the reliability of the Grid infrastructure and to ensure reliable computing operations, both for the sites and the experiments. Recently the old SAM framework was replaced with a completely new system based on Nagios and ActiveMQ to better support the transition to EGI and to its more distributed infrastructure support model and to implement several scalability and functionality enhancements. This required all LHC experiments and the WLCG support teams to migrate their tests, to acquire expertise on the new system, to validate the new availability and reliability computations and to adopt new visualization tools. In this contribution we describe in detail the current state of the art of functional testing in WLCG: how the experiments use the new SAM/Nagios framework, the advanced functionality made available by the new framework and the future developments that are foreseen, with a strong focus on the improvements in terms of stability and flexibility brought by the new system.

#### **Functional testing**

The four LHC experiments, ALICE, ATLAS, CMS and LHCb, need a stable infrastructure to operate. SAM is used since 2006 by WLCG to run **functional** tests to assess the functionality of 150 sites all around the globe. While WLCG runs (using the OPS VO) a set of official tests, mostly used by sites and WLCG operations, each experiment complements them with its own set of custom tests, which are used for their own computing operations.

#### Service Availability Monitor (SAM)

The new **SAM framework** is a completely **new implementation**, based on Nagios for the test scheduling and execution and on the WLCG MSG system for test result publication [1]. Each VO defines its site and service topology via VO feeds. Tested sites and services must be published in OIM/GOCDB and SRM endpoints visible in the BDII. SAM also allows to **publish** tests not run by Nagios, which is very useful to take into account metrics from other systems.

Moreover, the experiments need to run their tests across the three federated Grids in WLCG: EGI, OSG and NorduGrid; this is possible with SAM thanks to the interoperability achieved among the three Grids.

This **flexibility** is one of the main features that determined the success of SAM.

## ALICE\_CRITICAL

Test name	Functionality
rg.sam.CREAMCE.JobSubmit	Job submission to CE
rg.sam.CREAMCE.DirectJobSubmit	Direct Job submission to CREAMCE
org.sam.WN-sft-vo-swdir	Local ALICE software area check
org.sam.WN-SoftVer	Deployed middleware check

## LHCB\_PROD

Test name	Functionality
org.sam.(CREAM)CE.JobSubmit	Job submission to CE
org.sam.CREAMCE- DirectJobSumit	Direct job submission to CE
org.lhcb.WN-sft-brokerinfo	Get name of CE via glite- brokerinfo
org.lhcb.WN-sft-csh	Test if csh works
org.lhcb.WN-sft-lcg-rm-gfal	Check LCG_GFAL_INFOSYS
org.lhcb.WN-sft-vo-swdir	Check shared software area
org.lhcb.WN-sft-voms	Test if Voms script works
org.lhcb.SRM-AllLHCb	Global SRM test
orglhcb.SRM-GetLHCbInfo	Get info of storage site
org.lhcb-SRM-VODel	SRM deletion from site storage
org.lhcb.SRM-VOGet	SRM copy from site storage to client
org.lhcb.SRM-VOLs	SRM Ls method on file
org.lhcb.SRM-VOLsDir	SRM Ls method on directory
org.lhcb.SRM-VOPut	SRM copy from client to site storage
org.lhcb.LFC-Ping	Ping site file catalog
org.lhcb.LFC-Read	Read test file in LFC
org.lhcb.LFC-Readdir	Read directory in site file catalog
org.lhcb.LFC-Replicate	Write file in master and read in slave

#### Site and service availability and reliability

The **availability** is the fraction of time a site (or a service) passes a given set of "critical" SAM tests. Therefore it is calculated by an **algorithm** (officially defined in WLCG) and from a set of tests. Each VO may define multiple availabilities as multiple profiles (basically, sets of tests) according to its needs. The **reliability** is similarly defined but it excludes the periods of scheduled downtimes.

## ATLAS\_CRITICAL

Test name	Functionality
org.sam.(CREAM)CE.JobSubmit	Job submission to CE
org.atlas.WN-swtag	ATLAS local site Software
	installation
org.atlas.WN-swspace	
org.atlas.SRM-VOPut	SRM copy from client to site
	storage
org.atlas.SRM-VOGet	SRM copy from site storage to
	client
org.atlas.SRM-VODel	SRM deletion from site storage

# CMS\_CRITICAL\_FULL

Test name	Functionality
org.sam.(CREAM)CE.JobSubmit	Job submission to CE
org.cms.WN-basic	CMS local site configuration
org.cms.WN-swinst	Local CMS software installation
org.cms.WN-mc	Local file stageout
org.cms.WN-analysis	Local data read
org.cms.WN-frontier	Calibration data from Frontier
org.cms.WN-squid	Local Squid server
org.cms.SRM-GetPFNFromTFC	LFN to SURL translation
org.cms.SRM-VOPut	SRM copy from client to site
	storage
org.cms.SRM-VOGet	SRM copy from site storage to client

#### SAM profiles

Each experiment uses at least one, often many profiles. One is used by WLCG to calculate the "official" site availability for each experiment. Additional profiles are used for specific operational needs.

LICE_CRITICAL	ATLAS	CMS_CRITICAL	LHCB_CRITICAL
	ATLAS_CRITICAL	CMS_CRITICAL_FULL	LHCB_PROD
	ATLAS_CE_CRITICAL	CMS_BLACKLIST	LHCB_PILOT
		CMS_GLEXEC	LHCB_EXTERNAL

#### ALICE

ALICE monitoring is based on MonALISA and SAM is mostly used to allow comparisons with other VOs. Only a few basic job submission and worker **node** tests are run; storage is not tested because SAM does not currently support XrootD services. This is expected to change during 2012 allowing MonALISA test results for XrootD and for VO boxes to be forwarded into SAM to provide a more complete picture.

#### ATLAS

ATLAS uses SAM for job submission via gLite WMS, allowing to spot CE problems currently almost impossible to see via PanDA. On the other hand it is foreseen to have pilot jobs running the worker node tests and reporting the results to SAM, to have a closer correlation with the ATLAS job management system. Unique to ATLAS are the publication of external test results from HammerCloud into SAM and the testing of individual SRM space tokens.

#### **Topology and VO feeds**

The new SAM framework allows VOs to generate their own topology information under the assumption that only the VO knows which sites and services need to be tested. VO feeds are XML files periodically generated based on the information relevant to the VO (BDII, VO-specific site databases, etc.).

<title>CMS Topology&lt;br&gt;&lt;description&gt;&lt;/th&gt;&lt;th&gt;y Information for ATP</title>	
List of CMS site na	ames
<feed (<="" responsible="" th=""><th>dn="/DC=ch/DC=cern/OU=Organic</th></feed>	dn="/DC=ch/DC=cern/OU=Organic
—	aiz/CN=542764/CN=Pablo Saiz" name="Pablo Saiz"/>
<last update="">2012-</last>	)5-14T15:10:20Z
<vo>cms</vo>	_
<atp name="CE&lt;/th&gt;&lt;th&gt;RN-PROD" site=""></atp>	
<pre><service hostname<="" pre=""></service></pre>	e="srm-cms.cern.ch" flavour="SRMv2 "/>
<pre><service hostname<="" pre=""></service></pre>	e="ce203.cern.ch" flavour="CREAM-CE "/>

CMS uses several worker node tests for various CMS-specific functionality (software installation, Frontier/Squid, read/write to local storage). It is also running a custom, non-critical **gLExec** test adapted to be only sensitive to features relevant for Condor glidein submission. The **SRM** tests are the same as for ATLAS and LHCb (but each one has its own logical file name  $\rightarrow$ physical file name translation).

#### LHCb

LHCb uses SAM in addition to the existing DIRAC monitoring to provide extra information on basic grid functionality in case of problems. The tests run include job submission (both via gLite WMS and directly to CREAM), a few worker node tests and the standard SRM tests. Unique to LHCb is a set of **LFC** tests for both the master LFC at CERN and slave instances at Tier-1 sites. It includes a testing of the proper information replication via Oracle Streams to the Tier-1 sites.

Latest Results Historical View Hour Profiles Metric Exit Status   Site-Groups ATLAS_CRITICAL All Exit Status   Tier1s ATLAS_CRITICAL All Exit Status   Sites ATLAS_CRITICAL All Exit Status   ATLAS_CRITICAL ATLAS_CRITICAL All Exit Status   ATLAS_CRITICAL ATLAS_CRITICAL CRITICAL   ATLAS_CRITICAL ATLAS_CRITICAL OK   ATLAS_CRITICAL ATLAS_CRITICAL CRITICAL   ATLAS_CRITICAL ATLAS_CRITICAL CRITICAL	ick nep buys	Feedback	lew	Latest Results Historical View	
Site-Groups Profiles Status   Tier1s ATLAS_CRITICAL All Exit Status   Sites ATLAS_CRITICAL All Exit Status   ATLAS_CRITICAL ATLAS_CRITICAL OK   ATLAS_PROD ATLAS_PROD MISSING   CREAM-CE Org.atlas.WN-swspace REMOVED		recuback	Historical View		
Sites ATLAS_CRITICAL OK   ATLAS ATLAS ATLAS   All Sites ATLAS_CE_CRITICAL CRITICAL   BNL-ATLAS ATLAS_CE_CRITICAL CRITICAL   BNL-ATLAS ATLAS_LCGADMIN UNKNOWN   FZK-LCG2 ATLAS_PROD Org.atlas.WN-swspace   IN2P3-CC CREAM-CE Org.atlas.WN-swspace	Profiles	Profil		Site-Groups	
Sites ATLAS_CAINCAL WARNING   ATLAS_CAINCAL ATLAS_CAINCAL CRITICAL   ATLAS_CAINCAL ATLAS_CE_CRITICAL CRITICAL   BNL-ATLAS ATLAS_CE_CRITICAL UNKNOWN   BNL-ATLAS ATLAS_LCGADMIN ATLAS_LCGADMIN   ATLAS_CE_CRITICAL ATLAS_NOPROD MISSING   IN2P3-CC CREAM-CE Org.atlas.WN-swspace			ATLAS_CRITICAL	Tier1s	
All Sites ATLAS_CE_CRITICAL CRITICAL CRITICAL UNKNOWN BNL-ATLAS ATLAS_LCGADMIN ATLAS_LCGADMIN ATLAS_LCGADMIN FZK-LCG2 ATLAS_PROD MISSING CREAM-CE CRITICAL REMOVED	WARNING				
BNC-ATLAS ATLAS_LCCGDMIN   FZK-LCG2 ATLAS_PROD   MISSING   REMOVED				All Sites	
TATUS_TROUC IN2P3-CC CCE CREATE Org.atlas.WN-swspace REMOVED			ATLAS_LCGADMIN	BNL-ATLAS	
INZED-CC OIG.auas.wiv-swspace	PENOVED.				
	org.atlas.wiv-swspace				
INFN-11 OSG-CE OF GSSam.CE-JOBSubmit	org.sam.ce-jobsubmit				
NDGF-T1 All SRM flavours org.atlas.SRM-VODel OSG-SRMv2 org.atlas.SRM-VOPut					

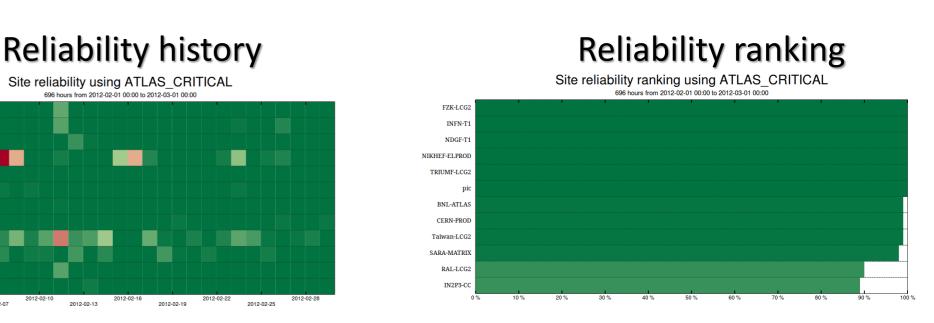
Sta	tus: NA		ОК	WARNING		TICAL	Sult Status UNKNO	WN	MISSING MA	INTENAN	CE REMOVED	
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1	org.atlas.SRM-VODe			org.atlas.SRM-VOGet			s.SRM-VOPut		org.atlas.WN-swspa		org.atlas.WN-swtag	
6	org.sam.CE-JobSubm	it 7	org.sam.CRE	AMCE-JobSubmit								
	iata											

## Latest results page

<service hostname="ce208.cern.ch" flavour="CREAM-CE "/> </atp site> </root>

			1	2	3
	OSG-SRMv2	dcsrm.usatlas.bnl.gov	OK	ОК	ОК
Sitename	Flavour	Hosts	4	5	7
FZK-LCG2	CREAM-CE	cream-1-fzk.gridka.de	OK	ОК	ОК
		cream-2-fzk.gridka.de	OK	OK	ОК
		cream-3-fzk.gridka.de	OK	OK	ОК
		cream-4-kit.gridka.de	OK	OK	OK
		cream-5-kit.gridka.de	OK	OK	OK
			1	2	3
	SRMv2	atlassrm-fzk.gridka.de	OK	OK	OK

http://dashb-alice-sum.cern.ch http://dashb-atlas-sum.cern.ch http://dashb-cms-sum.cern.ch http://dashb-lhcb-sum.cern.ch



#### **Visualisation via SUM**

The Site Usability Monitor (SUM) is an Experiment Dashboard application developed to visualise test results, availability and reliability of sites and services for each LHC experiment. SUM obtains all information by direct queries to the SAM programmatic interface. Users can drill down from site availability history plots to individual test results.

#### **Future plans and conclusions**

BNL-ATI CERN-PROI

FZK-LCG IN2P3-CC INFN-T1

NDGF-T1 NIKHEF-ELPROI

> RAL-LC SARA-MATE

The LHC experiments, with the support of the CERN IT department, have successfully migrated their functional tests to the new SAM framework and they are fully profiting from new features like VO feeds and multiple profiles. A strongly desired feature is the possibility to define their own physical and virtual services (Frontier, XrootD, etc.) without the need to register them in OIM/GOCDB. Finally it is foreseen to rethink experiment tests to achieve a better decoupling of site and experiment functionality.

[1] Andrade P et al Service Availability Monitoring framework based on commodity software, CHEP2012