Computing shifts to monitor ATLAS distributed computing infrastructure and operations

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\textbf{Abstract.} The ATLAS Distributed Computing (ADC) group established a new Computing Run Coordinator (CRC) shift at the start of LHC Run 2 in 2015. The main goal was to rely on a person with a good overview of the ADC activities to ease the ADC experts’ workload. The CRC shifter keeps track of ADC tasks related to their fields of expertise and responsibility. At the same time, the shifter maintains a global view of the day-to-day operations of the ADC system. During Run 1, this task was accomplished by a person of the expert team called the ADC Manager on Duty (AMOD), a position that was removed during the shutdown period due to the reduced number and availability of ADC experts foreseen for Run 2. The CRC position was proposed to cover some of the AMODs former functions, while allowing more people involved in computing to participate. In this way, CRC shifters help with the training of future ADC experts.

The CRC shifters coordinate daily ADC shift operations, including tracking open issues, reporting, and representing ADC in relevant meetings. The CRC also facilitates communication between the ADC experts team and the other ADC shifters. These include the Distributed Analysis Support Team (DAST), which is the first point of contact for addressing all distributed analysis questions, and the ATLAS Distributed Computing Shifters (ADCoS), which check and report problems in central services, sites, Tier-0 export, data transfers and production tasks.
Finally, the CRC looks at the level of ADC activities on a weekly or monthly timescale to ensure that ADC resources are used efficiently.

1. Introduction
The ATLAS detector [1] at LHC [2] produces a big amount of data. Currently, the ATLAS Distributed Computing (ADC) manages about 200 PB of data spread on more than 700 storage endpoints (on more than 150 sites located around the world, see Figure 1) and supports more than 5000 users and applications [3].

For data processing and running simulations, the ADC uses heterogeneous computing resources consisting of Worldwide LHC Computing Grid (WLCG) sites, cloud resources, HPCs, volunteer computing (BOINC) resources, etc. There is a stable level of 200k-300k job slots concurrently running jobs with data processing, analysis and simulations [4].

The very complex ADC infrastructure is managed by a team of ADC experts who are constantly under heavy workload, even considering continuous efforts to automatize the management of ADC resources. Several shift teams were established to triage and report issues in the ADC. People volunteer to participate in the shifts; shifters are awarded credits that are accounted to them as service tasks, and counted as their home institutes contributions to the operation of the experiment.

The Distributed Analysis Support Team (DAST) is a dedicated group of shifters that provides user support to the ATLAS community to solve issues related to running distributed analysis on the grid. Then there is ADCoS (ATLAS Distributed Computing Operations Shifts) which deals with failures of sites and data processing. As both DAST and ADCoS (the expert team too) cover dedicated areas of ADC activity, the ATLAS collaboration decided to set up a new shifter team Computing Run Coordinator (CRC) with the aim to maintain a global view of the day-to-day operations and improve management of ADC activities for the second phase of LHC data taking (Run 2). The CRC keeps track of the all aspects of the daily ADC shift operations.

![Figure 1. Geographical distribution of the ATLAS sites. The color coding represents different tiers: red (CERN), yellow (T1s), green (T2s), and magenta (T3s).](image)

2. Computing Run Coordinator
The purpose of the establishment of a Computing Run Coordinator was to have a person with a good overview of the global system, allowing to decrease the load of ADC experts and to ease the collaboration between them and the different ADC shift teams. Thus, the CRC shifter should be a person with a good knowledge of ADC activities. However, CRC is not supposed to fix issues, but rather keep an eye on the whole distributed computing system (to be sure that all long-standing problems are fixed by the corresponding experts), ease the communication.
between the ADC teams, in particular with shifters teams, and take action to call experts in case of emergency situations.

2.1. Shift Organization
The CRC shift is a one week long on-call shift (i.e. 24 hours/day availability on phone). There is one additional shadow shift day before the beginning of a shift block. The purpose is to pass the knowledge of current status and issues to the next shifter on the last day of the shift block. CRC shifts require presence at CERN. A meeting is organized by the CRC coordination once a week to discuss issues encountered during the shift, regarding both ADC issues and shift coordination.

2.2. Duties of the CRC shifter
The CRC shifter coordinates the daily ADC operations. It means the CRC shifter follows up and tracks open issues and facilitates the communication between the ADC shifters (ADCoS and DAST) and the ADC experts team. Hence, the CRC shifter functions as the main link within the ATLAS ADC communities. Amongst other communication tasks, CRC is informing ATLAS ADC community of main activities and issues on a daily basis (summary of the run meeting and ADC operation meeting) and staying in touch with the ADCoS shifters in the Virtual Control Room. Moreover, the CRC shifter reports and represents ADC in meetings within ATLAS community (ATLAS general run meeting) or outside (WLCG weekly meeting).

The CRC makes sure that ADC systems are used efficiently, detecting and analyzing issues, which may not be quite obvious, but could prevent efficient utilization of computing and storage capacity.

The CRC keeps tracks of long standing issues and foreseen maintenance activities.

2.3. CRC tools
The main tools used by the CRC shifter are monitoring related. The CRC shifters use various monitoring pages to check the status of transfers, production, services, etc. To improve the monitoring and in particular to get a better and easier overview of the systems, CRC shifters have developed and are maintaining a so called "Livepage" (illustrative snapshots on Figures 2 and 3). The Livepage aggregates information from various monitoring pages/frameworks and displays it in a compact and easy to read manner.

Other tools used by the CRC shifter are various twiki pages containing documentation and procedures, as well as mailing lists of various expert groups.

2.4. Lessons learnt
The CRC shifts have been running since the beginning of Run 2 in 2015. From the experience, we can conclude that the goal of lowering the load on ADC experts has been achieved ("CRC has shown to be very useful and efficient"). Training of a CRC shifter is a lengthy process but worth it as CRC shifts can contribute to the successful training of new ADC experts.

The CRC shifters collaborate very well with ADCoS shifters and, to a less extent, with DAST shifters. CRC shifters recognize the efficiency of ADCoS shifters’ activity when shifts are well covered and ADCoS shifters recognize the helpful support of CRC shifters.

One major problem of the shift stands out. The shift can efficiently help ADC when there is sufficient coverage. That way shifters can ensure that problems are followed up by passing the information to the next shifter. But the shift has never reached full (or even close to full) coverage, i.e. there are weeks when there is nobody available to book a shift and perform shift duties. More generally, the lack of one single shifter is difficult to quantify, considering the interconnection of the shift teams. Problems can fail to be detected, or take longer to be solved,
in case of the lack of several shifters at the same time, or of long gaps in one shift type. In all cases, it leads to a decrease in ATLAS optimal use of resources and in the quality of user support. This problem was raised in the collaboration and different solutions are discussed or already in place that should allow to give more publicity and recognition to these tasks.

3. ATLAS Distributed Computing Operations Shifts

ATLAS Distributed Computing Operations Shifts (ADCoS) provide a quick response to production system incidents. The most important duties of ADCoS shifters are to follow and report failing jobs and tasks run by ATLAS, failing transfers between individual sites, degradation of central services of ATLAS computing, inefficiencies in raw data export from CERN, staging and deletion errors, failing frontier servers, etc.

There are three flavours of ADCoS shifters: Expert, Senior, and Trainee. Trainee shifters have 8 hours long shifts with shift slots available Monday-Sunday. Each day three shifts are available, corresponding to Asia-Pacific (00:00 - 08:00, CERN time), European (08:00 - 16:00, CERN time), and US (16:00 - 24:00, CERN time) time zones. During shifts, the Trainee shifter learns all the duties of Senior shifters and practices them under supervision of a Senior/Expert shifter. When the Trainee shifter’s performance is satisfactory, (s)he can be promoted to Senior shifter. Senior shifts are also 8 hours long in one of three time zones every day of the week. Seniors shifters are the most numerous and therefore active shifters. Shifters report about ATLAS distributed computing systems issues which are then followed by other shifters (ADCoS Expert and CRCs). Expert shifts are 9 hours long in the time zone suitable for the shifter. Expert shifters book shifts in 7 day blocks (Wednesday-Tuesday). In addition to the duties of the Senior shifter, the Expert shifter also needs to be able to keep the shift documentation up-to-date, follow progress of reported issues and manage various ticketing systems used by ADCoS, and in case of serious problem of a site to remove it from the data management system.

A meeting is organized by ADCoS coordination once a week to discuss issues encountered during the week, regarding both ADC issues and shift coordination.

The major problem of the ADCoS is coverage. The shift can efficiently help ADC when there is sufficient coverage. But after the end of Run 1 the shift coverage significantly decreased and never fully recovered.

The ADCoS shift can be done remotely from the home institution of the shifter.
Figure 3. Illustrative charts shown on the production monitoring page of the Livepage (http://atlasdistributedcomputing-live.web.cern.ch/ATLASDistributedComputing-live/#BigPanda).
4. Distributed Analysis Support Team
The Distributed Analysis Support Team (DAST) is a group of expert shifters that provide to users the first point of contact to address all distributed analysis questions. User support is crucial to ensure that each and everyone is able to analyse the collision data distributed among hundreds of computing sites worldwide. DAST shifters solve user issues by escalating them to the relevant experts when needed, making sure that their intervention is necessary. Remotely from home institutes, DAST shifters monitor a dedicated mailing list, the so-called distributed analysis help forum, that users use to address all the grid-analysis-related-issues. Figure 4 shows the DAST traffic: from 1,314 users, we have exchanged 123,813 emails since Oct. 2008, that represents more than 10,000 per year.

![Figure 4. DAST traffic: number of Emails received from users (left) and the number of emails sent by shifters.](image)

There are three flavours of DAST shifters: trainee shifter, 1st level shifter, and 2nd level shifter. A trainee should have a good initial level of distributed analysis experience. Shifts are 8 hours long in two time zones: European, (8-16) and American (16-24), CERN time. The shift slot block is from Monday to Friday. The trainee shifter learns how to answer support questions. When Trainee shifters performance is satisfactory, (s)he can be promoted to 1st Level shifter. First level shifts are also 8 hours long in one of two time zones, 5 days/week. The 1st level shifter is the main person to handle user questions. Deep expertise of the distributed computing is not necessary at this level. Second level shifts require deep expertise of the system. Shifters at this level handle questions 1st level shifters cannot handle.

A regular weekly meeting is organized by DAST coordination to discuss outstanding issues and their possible improvements.

Since 2008, DAST has demonstrated that it is critical for users to get physics results quickly in a distributed data analysis system. As it is always necessary to have a continuous planning aiming to recruit new shifters, several training sessions have been organized. Since the beginning of the Run 2 the team is suffering from lack of manpower. This is the natural evolution since many of the team members are either PhD students and/or postdocs that leave once they finish their dissertation. To keep the DAST vitality, the ADC management has decided with the agreement with the physics coordinator, that every ATLAS physics group should provide at least one physicist with a good level of grid knowledge. She/he will be trained to join the DAST team effort. Currently DAST has 6 volunteers who are in the training process. This new approach in recruiting new shifters will allow DAST to ensure its mission with enough manpower.

5. Conclusions
Run 2 has required the development of a new shift organization including the setting up a new shifter team, the Computing Run Coordinator. After a year and a half of experience, it has been shown to work successfully. The goal of the new shift structure was reached. There is less load on ADC experts, communication between ADC communities has improved, and new people are now involved in ADC. The main problem is lack of shifters. The coverage problems affects all shift types. Actions to raise awareness of this problem in the collaboration were recently taken. These will lead to a better visibility and recognition of these tasks that should help to improve the situation.
References
[2] Evans L and Bryant P 2008 JINST 3 S08001