

University of Groningen

Report on CTA ACTL and DATA TDR

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Report on CTA ACTL and DATA TDR

Heidelberg 2014-11-20/21

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Purpose of the Review and Panel Charge

The purpose of this reviews is to assess the ACTL and DATA sub-projects not CTA itself, thus the panels should not concern themselves with aspects of funding etc.; the aim being to assist the sub-project in getting ready for the Critical Design Review (which also implies developing a coherent project for the future).

The remit is (Design Readiness Reviews, MAN-QA/140919, section 3.1):

1. Assess the project on the basis of what is required for the CDR as described in the Design Readiness Review remit document and the appended DoI, both in the month before the review and on the day
2. Write a short report with recommendations/advice for further improvement
3. Based on progress so far, clearly recommend to CTA Management whether you believe the documentation will be of sufficient quality by 31 December 2014 to pass a review of the level of importance as the Critical Design Review

Members of the Review Panel

Review Panel

Gianluca Chiozzi (ESO)
Kay Rehlich (DESY)
Wainer Vandelli (CERN)
Wolfgang Wild (ESO)

Ex-officio

Jim Hinton (CTA Project Scientist)
Juergen Knoedlseder (CTA Consortium Board Chair)
Rene Ong (CTA Consortium Spokeperson)

Agenda and Documentation

The agenda and the documentation are available at:

ACTL: <https://www.cta-observatory.org/indico/conferenceDisplay.py?confId=768>

DATA: <https://www.cta-observatory.org/indico/conferenceDisplay.py?confId=769>

Report structure

This report contains separate text sections for the ACTL and DATA reports. As we have identified common recommendations, the section listing the summary of recommendations has a common sections and two separate lists of items specific respectively for ACTL and DATA.

ACTL Panel Report

The panel was impressed by the presentations, the status of the project and the technical level of the members of the team. The panel commends all concerned with the project for the excellent progress with respect to the previous reviews and for the efforts made in providing the relevant documents for the review sufficiently in advance.

The panel has identified a number of detailed concerns and recommendations that are listed below. As a very positive remark, it appeared during the discussions that the Project is already aware of several of the issues and has manifested the intention to pursue them.

The TDR documentation made available contains a very detailed description of ACTL focusing on the description of the components in the Product Breakdown Structure and presenting and discussing in several cases different options. We believe that in this phase the project should present a baseline solution, where the selection among different alternative options has been done already. Therefore we recommend [R1] to reduce the amount of detail in the TDR, possibly by moving some of the material to separate, dedicated documents, or annexes. We also recommend [R2] to remove technical options and discussions in the TDR as much as possible.

At the same time, the introductory sections should provide a more complete overview of how the parts are supposed to work interconnected to each other and with the external sub-projects (DATA and telescopes in particular). We recommend [R5] to add an Executive summary to the TDR and, where present, fix inconsistencies with other TDRs. In particular we recommend [R6] to provide a more detailed and consistent description of the data and command flow across the sub-packages of ACTL and including DATA, telescopes and the other sub-projects. Ideally there should be a common diagram and each TDR document shows the part centred on the specific sub-project.

It is particularly important in our opinion to provide consistent information on the data flow from camera acquisition to final users. We recommend therefore [R3] to review data rates together with the DATA project to ensure that the information is consistent and coming from a common source. The data flow description should include the time-stamping mechanism and the event building process. Ideally, exactly the same diagrams/tables should appear in both documents.

Consistency and coherence between ACTL and DATA in terms of data flow and interfaces would be fostered by a more tight collaboration between the two projects. We therefore recommend CTA [R4] a restructuring and merging of ACTL and DATA while separating the User Support. This would put the current ACTL and DATA work under a single leadership and system architect with the user support under separate leadership. Ideally the relation between the combined ACTL/DATA and the user support would be one of “provider-customer”.

We think that the definition of the interfaces, in particular with the telescopes, is not sufficiently mature for the state of the project. There are still important open points that had been discussed already in the 2013 review. It seems that the ACTL team does not feel to have sufficient authority to make sure an agreement is reached. Therefore we recommend the project to [R7] agree on clear interfaces in particular between high

level control and the telescopes, but also with infrastructure and DATA, in early 2015. We recommend to take the decisions as the outcome of a workshop with all involved parties, including project management, where ACTL is explicitly given the authority of taking decisions in case an agreement cannot be found.

A specific case concerns the low level API for camera server readout. We strongly support the point of view of the ACTL team that an ad-hoc implementation build on top of raw TCP sockets would introduce high risks in terms of availability and maintenance. Therefore we recommend to adopt the ATCL proposal that [R8] camera server readout streaming shall be standardized using a common implementation based on ZeroMQ.

The panel commends the intent of the ACTL team of involving external user interface experts in the design and development of the operator user interface. In this respect, we also recommend to [R9] hire operators early in the project or draw from the experience of operators from other projects for the design of operator user interfaces.

The ACTL TDR documentation emphasizes the implementation of a remote control centre. The panel members believe that the implementation of safe and reliable remote operation might be very expensive. The panel recommends that [R10] remote operation, specifically for maintenance and debugging, be integrated part of the design, but be given low implementation priority. Moreover, it should be specified that remote operation is allowed only in teleconference with an operator on site, sharing the control user interfaces and able to take over at any time (for example is network connection with the remote control centre is lost).

It shall also be taken into account that operators and engineers have very different skills and requirements and that engineering interface are typically needed before operator interfaces. The panel recommends therefore to [R11] keep well separate operator and engineering user interfaces. Each should be designed and developed in tight interaction with the respective users.

The experience of the panel members is that the choice of logging and monitoring/telemetry data in terms of data points and data rates can have a strong impact in the operability and maintainability of the system. We therefore recommend to [R12] carefully analyse logging and monitoring requirements with the different user's categories (hardware engineers, maintenance personnel, scientists) in order to design an affordable efficient strategy for archival and retrieval of the monitoring data, avoiding the need for radical changes during and after the commissioning phase.

The panel shares with the ACTL team the opinion that a clear and well-designed alarm notification interface is key for successful commissioning and operation. Still, trying to implement automatic alarm recovery procedures might be very complex and results not satisfactory. The panel recommends to [R13] concentrate on the design of clear and operator-friendly alarm notification interfaces and definitions rather than trying to implement automatic recovery procedures.

For what concerns project planning, the panel thinks that it should provide concrete means to track the advancement, in order to easily identify problems. We therefore recommend to [R14] define clear, measurable milestones on a 6-months basis as a tool to monitor and assess the evolution of the project.

Such milestones should be based on the identification of specific end-to-end functionality that must be available in each phase of the commissioning and validation/integration/verification steps of the project. The panel recommends therefore to [R15] implement cross-work package "functional based teams" and introduce in the project subsystem scientists to drive the development based on the schedule of the system functionality needed at the different stages of the integration and commissioning. In the experience of the

panel members, this improves significantly the communication between the different sub-projects and allow them to focus on the delivery of the essential functionality.

The presented assessment of FTEs is clearly based on the comparison with similar projects, but as such it is not sufficiently detailed for the panel members to endorse the presented figures. We recommend [R16] to add one level of details to the presented manpower cost estimates, as this would make much easier to evaluate the reliability of the presented numbers.

For what concerns the analysis of the construction costs, the panel is not sure that all items have been taken properly into account, in particular for what concerns the infrastructure. For example, it is not clear if the cost for trenches and pipes for the cabling to the telescopes has been taken into account. The panel recommends to [R17] better detail the costs items and double check the assumptions that important cost items are under the responsibility of other work packages.

The panel saw a comprehensive list of risks and commends the ACTL team for recognizing these risks.

All in all, the panel has not identified concerns that could potentially seriously endanger the feasibility of the project as a whole and we think that, once the recommendations will be implemented, the ACTL project will be in good shape to pass a CDR review as defined by the CTA project.

DATA Panel Report

The panel would like to thank the CTA DATA team for the TDR and the detailed presentation and fruitful discussions. The panel members appreciate that a lot of work had been done by the DATA team and detailed thought had gone into many areas of the team's responsibility. The panel recognizes that the TDR which was made available before the meeting contains a great level of detail and options or possible choices which – at times – seems a bit overwhelming. The panel therefore recommends trying to [R1] reduce the amount of detail, possibly by moving some of the material to separate, dedicated documents, or annexes, and in particular, trying to [R2] remove technical options and discussions as much as possible. CTA has arrived at a stage where design and technology options need to be reduced in order to proceed further. As to the TDR document the panel recommends [R5] to add an Executive summary and, where present, fix inconsistencies with other TDRs. In particular we recommend to [R3] review data rates together with the ACTL/DATA project to ensure that the information is consistent and is coming from a common source. The data flow description should include the time-stamping mechanism and the event building process. Ideally exactly the same diagrams/tables should appear in both documents. Also, we did not get a clear and consistent picture of the adoption of the FITS file format and of its usage for the exchange of events and single camera images.

As a general remark, the panel notes that the distinction between “privileged” and “guest” observers may be perceived as two classes of users for an open observatory and suggests [R18] to CTA management to reconsider the naming of different observer types. The panel understood that “privileged” observers are those who receive Guaranteed Observing Time as reward of in-kind contributions to the CTA observatory.

The flow of data from the camera output to the final users consists of a number of steps of transferring, storing and reducing data which is distributed over the ACTL and DATA subprojects. In order to have a coherent view of the data flow and the corresponding needs for transfer bandwidth, storage space and interfaces, the panel suggests [R19] to present the data flow from beginning to end in one diagram

including the expected transfer rates, required storage capacities and durations as well as interfaces between the different data flow elements.

With regard to the architecture of the data centres (where three options were presented with a proposal to adopt one), the panel notes the importance of the following aspects in the final choice:

- Is the assumption of in-kind contributions for the “big data” handling going to be realized? What is the impact, if not, or only partial?
- The data centre architecture of central vs. distributed (with 4 or 7 centres) will affect the choice of key technologies.
- The strategic issue of having CTA data (i.e. the output of the observatory) stored in one or several centres under in-kind arrangements, and consequently with little control of risks for the long term stability of these centres.

The requirements of the data centre(s) are also driven by the amount of data to be stored and the foreseen processing needs. A rather fundamental project decision concerns the choice of data storage policies (keep all raw data? Or only part of it? For how long? Where? Keep which data products exactly where and for what duration?) which should be taken as soon as possible [R20] since it has a large impact on design and technology choices as well as on the required investment and operations funds. This decision will ultimately be a trade-off between storage of all data for a long time and the cost to do so, with the extremes of “keep all data forever at very high cost” and “keep very little data at very low cost”. The panel [R21] recommends considering the opportunity of setting up a data centre in the host country in order to reduce the dependency on high data-rate intercontinental transfers.

Regarding the technical (software) interfaces of the DATA system with other parts of the project, the panel was quite concerned about the status of interface definition. While most, if not all, interfaces have been listed and recognized, very few seem to have been defined or agreed. This poses a high risk for CTA at this stage. The panel recommends [R22] to proceed swiftly with the interface definitions in all areas and to include one or several milestones for the completion of interface definition in the planning. The CTA Project Office should monitor progress in this important area.

The CTA is planned to be an observatory open to the general science community (as opposed to a physics experiment) with an element of Guaranteed Time Observing (GTO). User Support is of crucial importance for an open observatory since it plays an essential role in how the science community perceives the observatory and its data output. The panel believes that User Support should receive more visibility and effort both in the documentation and when building the observatory and [R23] recommends creating a distinct entity for user support. This entity needs to be at the same level as the computing activities (ACTL and DATA) and would cover more the “outward” aspects while ACTL/DATA would cover more the “inward” aspects. The panel also recommends [R4] a re-structuring and merging of ACTL and DATA while separating the User Support. This would put the current ACTL and DATA work under a single leadership with the user support under separate leadership. Ideally the relation between the combined ACTL/DATA and the user support would be one of “provider – customer” where the “customer” (i.e. the user support) gets from ACTL/DATA what it needs (data, software, archive, proposal tools, etc.) while the “provider” (ACTL/DATA) gets a clear idea of user needs and priorities through the user support.

The CTA plans to do science commissioning with the consortium teams involved and using guaranteed time and some kind of “Early Science”, i.e. start open observations with a subset of telescopes before completion of observatory construction and commissioning. The panel welcomes these plans, also in view of community expectations, but noticed different views and assumptions in different parts of the project

(e.g. DATA plans to have the proposal handling tools ready when 100% of the telescope are in operation). Given the importance of (partial) operation in many aspects (community perception, readiness of subsystems, relative priorities, etc.) the panel recommends [R24] to CTA management to clarify and communicate throughout the project a decision on the definition (who will get access, what data policy is followed) and schedule of early science operation (e.g. when CTA has enough telescopes available to be more sensitive than any other facility). Such a decision will allow ACTL/DATA, infrastructure and other areas to ensure (or at least attempt) timely delivery and it will enable the user support to get ready.

Regarding the storage of technical monitoring data (TECHO data) the panel fully supports the proposal to keep those for health, trend and other analysis purposes. Given the different groups who will be interested in these data, the panel recommends [R25] to keep these data at the observatory and create a distinct work package to actively sample the needs of the future users of TECHO data, such as operators, instrument builders, IT, field and maintenance engineers, managers, etc.

The panel saw a comprehensive list of risks and complements the DATA team for recognizing these risks.

Summary of recommendations

Common recommendations

- [R1] Reduce the amount of detail in the TDR, possibly by moving some of the material to separate, dedicated documents, or annexes.
- [R2] Remove technical options and discussions in the TDR as much as possible
- [R3] Review data rates together with the ACTL/DATA project to ensure that the information is consistent and is coming from a common source. The data flow description should include the time-stamping mechanism and the event building process. Ideally exactly the same diagrams/tables should appear in both documents.
- [R4] Re-structuring and merging of ACTL and DATA while separating the User Support. This would put the current ACTL and DATA work under a single leadership and system architect with the user support under separate leadership. Ideally the relation between the combined ACTL/DATA and the user support would be one of “provider – customer”.
- [R5] Add an Executive summary to the TDR and, where present, fix inconsistencies with other TDRs.

ACTL specific recommendations

- [R6] Provide a more detailed and consistent description of the data and command flow across the sub-packages of ACTL and including DATA, telescopes and the other sub-projects. Ideally there should be a common diagram and each TDR document shows the part centred on the specific sub-project.
- [R7] Agree on clear interfaces in particular between high level control and the telescopes, but also with infrastructure and DATA, in early 2015. We recommend to take the decisions as the outcome of a workshop with all involved parties, including project management, where ACTL is explicitly given the

authority of taking decisions in case an agreement cannot be found.

- [R8] Camera servers readout streaming shall be standardized using a common implementation based on ZeroMQ.
- [R9] Hire operators early in the project or draw from the experience of operators from other projects for the design of operator user interfaces.
- [R10] Remote operation, specifically for maintenance and debugging, can be integrated as part of the design, but be given low implementation priority. Moreover, it should be specified that remote operation is allowed only in teleconference with an operator on site, sharing the control user interfaces and able to take over at any time.
- [R11] Keep well separate operator and engineering user interfaces. Each should be designed and developed in tight interaction with the respective users.
- [R12] Carefully analyse logging and monitoring requirements with the different user's categories (hardware engineers, maintenance personnel, scientists).
- [R13] Concentrate on the design of clear and operator-friendly alarm notification interfaces and definitions rather than trying to implement automatic recovery procedures.
- [R14] Define clear, measurable milestones on a 6-months basis as a tool to monitor and assess the evolution of the project.
- [R15] Implement cross-work package functional based teams and introduce in the project subsystem scientists to drive the development based on the schedule of the system functionality needed at the different stages of the integration and commissioning.
- [R16] FTEs: add one level of details to the presented manpower cost estimates (see slide 21 in the presentation "ACTL Review: Management Aspects")
- [R17] Better detail the costs items and double check the assumptions that important cost items are under the responsibility of other work packages.

DATA specific recommendations

- [R18] CTA management may want to re-consider the naming of different observer types ("privileged" and "guest" observers) with a view to the perception of the science community at large.
- [R19] Present the CTA overall data flow from beginning to end in one diagram including the expected transfer rates, required storage capacities and durations as well as interfaces between the different data flow elements.
- [R20] Take a decision as soon as possible on the data storage policies (keep all raw data? Or only part of it? For how long? Where? Keep which data products exactly where and for what duration?).
- [R21] The panel recommends considering the opportunity of setting up a data center in the host country in order to reduce the dependency on high data-rate intercontinental transfers.
- [R22] Proceed swiftly with the interface definitions in all areas and include one or several milestones for the completion of interface definition in the planning. The CTA Project Office should monitor progress

in this important area.

[R23] Create a distinct entity for user support to give it more visibility and ensure the needed effort

[R24] Regarding Early Science operations, CTA management should clarify and communicate throughout the project a decision on the definition (who will get access, what data policy is followed) and schedule (e.g. when CTA has enough telescopes available to be more sensitive than any other facility).

[R25] Keep gross TECHO (technical monitoring) data at the observatory and create a distinct work package to actively sample the needs of the future users of these data, such as operators, instrument builders, IT, field and maintenance engineers, managers, etc.