Proposal for TRIUMF Commitment (5YP 2015-2020)

Date: September 17 2012

PROJECT/COMMITMENT TITLE: ATLAS Tier-1 Data Centre

PROPONENT: Reda Tafirout **TRIUMF CONTACT:** Reda Tafirout

PRINCIPAL COLLABORATORS: ATLAS-Canada

PROJECT DESCRIPTION:

As part of the world's most advanced network and computing Grid, TRIUMF is hosting Canada's Tier-1 computing centre for the ATLAS experiment at the Large Hadron Collider (LHC). The Tier-1 centre is a large-scale data-intensive facility that is maintained and operated 24x7 in full compliance with the Worldwide LHC Computing Grid (WLCG) Memorandum of Understanding which was signed by TRIUMF in 2006. The MoU allows for a maximum integrated downtime of just one week per calendar year, therefore carefully planned interruptions for system maintenance, improvements and expansions are all crucial aspects. The TRIUMF Tier-1 is a leader in the field by being consistently at the top or near the top in terms of availability, reliability, and efficiency when compared to other sites in the world. The Tier-1 centre provides the dedicated resources necessary for the storage of the raw and secondary datasets, as well compute nodes for data processing, simulation and physics group activities in a secure environment. The Tier-1 centre plays also a central role for the Canadian Tier-2 centres located at Compute Canada shared facilities. Today, the Tier-1 centre consists of 7.2 Petabytes of usable disk storage, 5.5 Petabytes of tape storage, 4830 processor cores and 90 servers. The personnel amounts to 9.5 FTE including a user support component. This capacity needs to be refreshed and expanded in the next 5YP.

In 2006, funds in the amount of $8M in capital and $2.5M in operating have been granted to ATLAS-Canada from the CFI Exceptional Opportunities Fund. The Tier-1 proposal was led by Simon Fraser U. (M. Vetterli / PI) on behalf of a consortium of universities that are part of ATLAS-Canada. The CFI funding was matched by the BC Knowledge Development Fund (BCKDF; $4M), and in-kind contributions from TRIUMF and network providers (CANARIE and BCNet), and computing vendors (IBM and Sun Microsystems now Oracle) as significant discounts. In early 2011, another CFI proposal was submitted to secure $3.3M for the continuing operations through March 2015. Beyond that, TRIUMF is expected to take full ownership of the project for both capital and operating. Nevertheless, if other CFI opportunities present themselves, an attempt will be made to secure extra funding. For instance, a CFI Leading Edge Fund (LEF) application is in the process of being reviewed for a total project cost of $2.5M ($1M requested from CFI) to refresh equipment bought in 2007 and 2009.

SCIENTIFIC JUSTIFICATION:

The ATLAS experiment at the LHC is studying proton-proton and lead-lead collisions at very high energy. The unprecedented energy densities created are allowing us to study the structure of matter at a much smaller scale than was previously possible, to

extend investigations of the fundamental forces of Nature, to understand the origin of matter and to search for physics beyond the Standard Model (SM) of particle physics such as supersymmetry, quark substructure, and extra dimensions, to name a few. One of the primary goals of the Large Hadron Collider (LHC) is to search for the SM Higgs boson. ATLAS is collecting close to 4 Petabytes of raw data per year with similar scales for various derived datasets and simulated datasets of several physics processes. The enormous amount of data generated by ATLAS is distributed and analyzed onto the WLCG infrastructure. The Tier-1 centre at TRIUMF is presently providing 10% of the required Tier-1 resources for the successful operation and exploitation of ATLAS. In July of 2012, both ATLAS and CMS experiments announced a major and historic discovery: a new particle consistent with a Standard Model Higgs boson. This would not have been possible without the WLCG infrastructure and was fully acknowledged by many. The next steps are to study and understand as much as possible about the properties of the newly discovered Higgs-like particle and to continue the ongoing extensive searches for physics beyond the SM. The overall ATLAS physics program requires a large amount of data and dedicated computing resources with fast access at the global scale. The computing resources are critical in extracting the science from the experiment.

RELATIONSHIP TO BROADER CANADIAN RESEARCH COMMUNITY:

The Tier-1 project is run by a consortium of universities participating in ATLAS: University of Alberta, University of British Columbia, Carleton University, McGill University, Université de Montréal, Simon Fraser University, University of Toronto, University of Victoria, and York University. ATLAS-Canada collaboration consists of 38 faculty members at nine universities, plus TRIUMF, as well as 35 postdoctoral fellows, and 68 graduate students. This represents about half of the experimental particle physics community in Canada. ATLAS has been designated as the highest priority for the field in the last three NSERC sponsored long-range plans and in the last two NSERC funding Reallocation Exercises and remains a top scientific priority in the current and next TRIUMF five-year plans. More importantly, Canadians have priority access to some of the Tier-1 resources allowing them to be highly competitive within ATLAS and be lead contributors to high profile analyses. For instance, the Tier-1 centre played a key role during the recent Higgs-like particle discovery where large simulated samples were urgently needed.

BROADER IMPACTS:

The ATLAS Tier-1 is a centre of excellence where highly qualified personnel and coop students are trained using best known practices with respect to data centre design, applications development and systems administration for mission critical operations. A solid base of expertise has been assembled while deploying large-scale storage systems, databases, complex clusters and network topologies and Grid technologies. The non-ATLAS Canadian research community is benefiting also and to some extent leveraging on the extensive knowledge and expertise from the TRIUMF Tier-1 centre. Commercial entities have also expressed interest in Grid technology and HPC knowledge transfer. Excellent synergy and interplay exists with CANARIE, BCNET and Compute Canada with a close collaboration with its Tier-2 facilities. The Tier-1 centre is a key player on the global scale within WLCG.

MAJOR MILESTONES:

Description	Date
Second Tier-1 server room (satellite room) and Tape library capacity expansion	Q1 FY15
RFP process completed (purchase order) for refresh of 2012 Tier-1 resources + expansion.	Q2 FY16
RFP process completed (purchase order) for Tier-1 expansion and refresh of 2013-2014 resources purchased with CFI LEF funds	Q4 FY18

RESOURCE REQUIRMENTS:

CASH FLOW REQUIREMENTS						
\YEAR SOURCE \	ONE	TWO	THREE	FOUR	FIVE	TOTAL
TRIUMF ±10%	1,355,767	2,408,169	451,548	1,887,800	355,097	6,458,381
EXTERNAL						
TOTAL						
TRIUMF NON-CASH RESOURCES						
\YEAR RESOURCE\	ONE	TWO	THREE	FOUR	FIVE	TOTAL
IT / Systems Administration (Tier-1 personnel)	520	520	520	520	520	2600
Engineering / Mechanical	4					4
Technical / Mechanical	10					10
Engineering / Electrical	3	2		2		7
Technical / Electrician	9	4		6		19
Administration / Procurement	3	6		6		15

EXTERNAL FUNDING INFORMATION:

ONGOING OPERATIONAL REQUIREMENTS:

DECOMMISSIONING REQUIREMENT: