

# “Two Mountain” Share Model

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15 January 2016 – V5

## Introduction

Several of the infrastructure services provided by NOAO-S Facilities Operations, for example maintenance of the access road and power lines, are essential for all the programs operating on Cerro Tololo and Cerro Pachón, but are such that the cost of providing them cannot easily be apportioned based on some direct measure of use. The full cost of providing these infrastructure services is recovered by charging each program a mountain share fee with the fraction to be paid by each determined using an agreed cost-sharing model. Since the days of AOSS the cost sharing model used has been the so called *2.0-m Share model*. However, with one large Telescope project, LSST, coming to Cerro Pachón, and several new small ones to Tololo, a review of this allocation scheme was judged timely.

Consequently, following discussion by the NOAO-South Facilities Operations Working Group, a new cost sharing model, the *Two Mountain Model*, was presented at a meeting on 3 September 2014. The key participants at that meeting were: W. Smith (AURA); Kissler-Patig and Levenson (Gemini); Kahn and Krabbendam (LSST), Elias (SOAR); Silva, Blum, Heathcote and van der Bliet (NOAO), and Richardson (CAS)

This document will serve as a formal description of this *Two Mountain Model* and how it is applied in practice.

## Infrastructure Services

The scope of each of these infrastructure services is defined in Section VIII of the document *Service level Agreement for Observatory Programs at Cerro Tololo and Cerro Pachón by NOAO-South Facilities and Operations* (SLA); the sub-section of the SLA describing each service is called out in [] in the list below.

In summary, the infrastructure services discussed in this memorandum can be divided into three groups:

1. Common to both mountains
  - 1.1. Security (guard service at entrance gate) [5.]
  - 1.2. Emergency Medical Services [6.]
  - 1.3. Maintenance of communications infrastructure (telephones, and radios, etc.) [4.]
  - 1.4. Maintenance of the common section of the road from gate to El Quisco [1.]
  - 1.5. Maintenance of the common section of the power line from the gate to San Carlos [2.]
2. Services supporting Cerro Pachón only
  - 2.1. Maintenance of the road from El Quisco to Cerro Pachón [1.]

- 2.2. Maintenance of power lines from San Carlos to Cerro Pachón [2.]
- 3. Services supporting Cerro Tololo only
  - 3.1. Maintenance of the road from El Quisco to Cerro Tololo [1.]
  - 3.2. Maintenance of power lines from San Carlos to Cerro Tololo [2.]
  - 3.3. Maintenance and operation of the equipment in the power house, including the backup generator and frequency convertor that supports all users on Cerro Tololo [2.]

Note that the road and power line maintenance activities are each divided into three cost centers, one in each of the three groups above. To the extent possible actual labor and none labor costs are allocated to the appropriate cost center so as to properly capture the extent and frequency of maintenance of the different sections of the road and power line in the budgeted and actual expenditures.

These costs must be fully recovered through a “mountain share fee” charged to the Programs. The total expenditures for each cost center, required to deliver the established scope, is calculated as part of the annual budget process, primarily based on actual expenditures during the preceding year, adjusted for inflation and other long-term experiential data regarding costs for goods and services in Chile. The *Two Mountain Model* is then used to apportion this cost between the Programs.

An individual program may request services outside the scope established in the SLA, but the cost of providing such extra service is paid for directly by the requesting program and does not enter into the shared cost.

## Dividing costs between the mountains

Under the *Two Mountain Model* costs are first apportioned between the two mountains as follows:

$$\text{Cerro Pachón Infrastructure Service Cost} = M \times \text{Common} + \text{Pachón\_Only}$$

$$\text{Cerro Tololo Infrastructure Service Cost} = (1 - M) \times \text{Common} + \text{Tololo\_Only}$$

Where *Common* is the cost of services common to both mountains (group 1 above), *Pachón\_Only* is the cost of services unique to Cerro Pachón (group 2) and *Tololo\_Only* those unique to Cerro Tololo (group 3). Following discussion by the working group the constant *M* was taken to have the value 0.5 so that the common component of the costs is split equally between the two mountains.

## Dividing costs between programs on Cerro Pachón

The existing (and under construction) facilities on Cerro Pachón, are divided into two classes based on overall size

- Class 1: SOAR
- Class 2: Gemini, LSST

Shares are assigned to each class as follows:

<u>Class</u>	<u>Share</u>
1	0.8
2	1.0

Table 1 shows the shares for the telescopes operating or under construction on Cerro Pachón as of 01 October 2014. The Cerro Pachón infrastructure services cost is allocated between programs in proportion to these shares.

**Table 1 Cerro Pachón Shares for FY16**

<b>Facility</b>	<b>Aperture</b>	<b>CP-Share</b>	<b>Percentage Share</b>
LSST	8.4m + 1.2m (calibration telescope)	1.0	36%
Gemini	8.1m	1.0	36%
SOAR	4.1m	0.8	29%
Total		2.8	100%

## Dividing costs between programs on Cerro Tololo

The facilities on Cerro Tololo span a wide range in aperture and include staffed and robotic telescopes; some facilities also consist of more than one telescope, and in a few cases telescopes have been added to an existing facility, or have been taken out of service. To capture this diversity, the share for each facility on Cerro Tololo is calculated using the formula

$$CT-Share = K \times \sum D$$

Where D is the diameter of the telescope's primary mirror (meters) and the sum runs over all telescopes operated by the facility. However, a minimum Share value of 0.5 is used to acknowledge the fact that even the smallest facilities have some impact on the infrastructure; therefore, they should contribute to paying the cost of its upkeep. The factor K takes on the value of 1.0 for staffed facilities operated year round, and 0.30 for facilities which are fully robotic or are remotely operated, or that will be operated for less than four months in any given fiscal year. This factor recognizes the fact that robotic telescopes have a reduced, but not zero impact on infrastructure costs. A telescope is normally identified as robotic in the MOU for its operation, the requirement being that its normal operation should be completely unattended, with only very occasional visits for maintenance. The full fee (K = 1.0) is charged for all telescopes during construction even if they will eventually operate robotically, since construction activities typically put as much, or more load on the shared infrastructure (roads, utilities, etc.) as full operations.

Table 2 shows the shares calculated using this formula for all telescopes operating on Cerro Tololo as of 01 October 2015. This table is updated each year, to track the installation or closure of telescopes, and is published in the annual Budget document.

The Cerro Tololo infrastructure services cost is allocated between programs in proportion to these shares.

**Table 2 Cerro Tololo Shares for FY16**

Facility	Aperture	Remote or part time	CT–Share	Percent share
CTIO 4m	3.97m	No	3.97	29.71%
KASI	1.6m	No	1.6	11.99%
SMARTS 1.3m	1.3m	No	1.3	9.74%
LCOGT	3x1.0m+2x0.4m	Yes	1.14	8.54%
PROMPT	6x0.41m, 1x0.6m, 1x0.56m, 1x0.5m	Yes	1.113	8.34%
SMARTS 0.9m	0.9m	No	0.9	6.74%
T80-South	0.826m	No <sup>1</sup>	0.826	6.19%
SMARTS 1.5m	1.5m <sup>2</sup>	Yes	0.5	3.75%
WHAM	0.6m	Yes	0.5	3.75%
SARA	0.6m	Yes	0.5	3.75%
URAT	0.2m	Yes	0.5	3.75%
MEarth	Cluster of small telescopes <sup>3</sup>	Yes	0.5	3.75%
Total Shares			13.349	100%

<sup>1</sup> Staffed during commissioning, remote thereafter

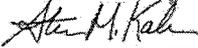
<sup>2</sup> Will operate for only four months in FY16

<sup>3</sup>Assigned the minimum share value by agreement

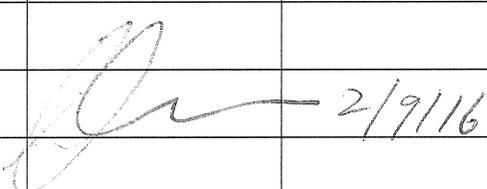
## Review and Revision

It is intended that the cost allocation should be stable over periods of several years to allow both the programs and the service provider to plan their budgets. On the other hand it is recognized that changes in the mix of facilities on each mountain, the infrastructure services provided, and the way those services are provided, may skew the distribution of costs, so that the current allocations cease to be appropriate. It is therefore agreed that the “Two Mountain Model” and its parameters should be subject to review no later than October 1 2018, and at intervals of five years thereafter, or whenever there is a major change, for example when LSST changes from construction to science operation, or when another major new telescope is about to begin construction.

Reviewed and concur

		Signed	Date
For NOAO South Facilities & Operations	Dr. N. van der Blik		9/2/2016
For NOAO	Dr. S. Heathcote	S.R. Heathcote	9 Feb 2016
For Gemini	Dr. N. Levenson		2 Feb 2016
For LSST	Dr. S. Kahn		9 Feb 2016
For SOAR	Dr. J. C. Clemens		
For AURA	Dr. R. Chris Smith		9 Feb 2016

**Reviewed and concur**

		<b>Signed</b>	<b>Date</b>
For NOAO South Facilities & Operations	Dr. N. van der Blik		
For NOAO	Dr. S. Heathcote		
For Gemini	Dr. N. Levenson		
For LSST	Dr. S. Kahn		
For SOAR	Dr. J. C. Clemens		2/9/16
For AURA			