

PUBLIC TENDER NOTICE NO.PR/PT/AS/TMT/SOFTWARE/CON/691
DATED 29TH FEBRUARY 2016



Expression of Interest

REQUEST FOR EXPRESSION OF INTEREST FOR THE "TMT Observatory Software"



Indian Institute of Astrophysics
Sarjapur Road, Koaramangala II block
Bangalore, India

Copy of the NOTICE for EXPRESSION OF INTEREST

Indian Institute of Astrophysics, Sarjapur Road, Koramangala II Block, Bangalore -560034 invites sealed "Expression of Interest (EoI) for TMT Observatory Software" from eligible and qualified public and private sector entities in India.

Important dates	
Date of this announcement	29 February 2016
Closing date and time for submission of questions for Pre-EoI meeting	14 March 2016 (1500 hrs IST)
Pre-EoI submission meeting at IIA	22 March 2016 (10hrs IST)
A1.1 Closing date and time for submission of EoI	31 March 2016 (1500 hrs IST)
Opening of EoI in the presence of contractors	31 March 2016(1600 hrs IST)
Intimation of results of EoI process	29 April 2016
Announcement of the tendering process to invite technical and commercial bids	15May 2016

- 1) Respondents shall ensure that their EoI, complete in all respects, are dropped in the tender box located at the address given above on or before the closing date and time indicated as above, failing which the EoI will be treated as late and rejected. Detailed instructions to prepare and submit the EoI are available at: <http://www.iiap.res.in/tenders>.
- 2) In the event of any of the above mentioned dates being declared as a holiday/ closed day for IIA, the EoIs will be received/opened on the next working day at the appointed time. The Director, IIA, on behalf of IIA reserves the right to postpone the dates mentioned above without citing any reason.
- 3) Only contractors shortlisted through the EoI process will be eligible to submit the technical and price bids for the work to be contracted.
- 4) EoI in which any of the prescribed condition(s) is not fulfilled or the respondents put any condition including that of conditional rebate, shall be summarily rejected. However, the EoI with unconditional rebate will be acceptable.
- 5) IIA reserves the right to reject any or all of the EoI without citing any reasons, and invite fresh EoIs at any stage of the process.

Administrative Officer

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1 Introduction and Background

The Thirty Meter Telescope (TMT), a segmented mirror telescope with a 30-meter filled aperture, will be the world's most advanced ground-based telescope operating at optical and infrared telescope wavelengths. An international consortium of institutions in the USA, Canada, China, Japan and India is building the telescope. The telescope will be located on Mauna Kea, a dormant volcano with a peak altitude of 4205 m, in the state of Hawaii of the United States of America. The construction of the telescope started in 2014 and is scheduled to finish in 2024 at a total cost of USD 1.5 billion. The detailed information on TMT can be found at <http://www.tmt.org/>.

With the signing of formal agreement between the Department of Science & Technology (DST), Government of India and the TMT International Observatory (TIO) on December, 2, 2014, India has become a full member of the collaboration with a 10% share in the project. TIO is the non profit limited liability company founded in May 2014 to carry out the construction and operation phases of the TMT project.

Within India, the TMT is set-up as a national project of the DST and the Department of Atomic Energy (DAE) of the Government of India. The project is anchored in the Indian Institute of Astrophysics (IIA) at Bengaluru, and is led by IIA, the Aryabhata Research Institute for Observational Sciences (ARIES) at Nainital and the Inter-University Center for Astronomy and Astrophysics (IUCAA) at Pune. All the activities of India-TMT are coordinated by the India TMT Coordination Center (ITCC) setup by the DST, India.

About 70% of India's contribution to the construction of TMT will be in-kind. India's work share consists of both hardware and software. In software, India-TMT is responsible for delivering the Observatory Software (OSW) and Telescope Control System (TCS). The OSW is responsible for providing requirements, architecture and software essential for building and integrating the entire TMT software system. India-TMT's work share includes 49% of the OSW. An overview of OSW, the subject of this EoI, is provided in Section 2. *A more detailed description of TMT and OSW is provided in the presentation accompanying this document.*

The purpose of this document is to invite public and private sector entities in India to submit **Expression of Interest (EoI)** to participate in the development of the Observatory Software (OSW) for the TMT. An invitation to submit EoI for OSW will be released subsequently.

The TMT Project Office (PO) is responsible for the design of the OSW software. The Common Software subsystem passed its preliminary design review in December, 2015. The preliminary design reviews for other OSW subsystems will occur in 2016. India-TMT is responsible for taking OSW through the subsequent phases i.e. (1) the Final design phase, (2) the Code and Test phase, (3) the Integration and Test phase and, finally, (4) the Assembly, Integration and Verification at Mauna Kea. There are four major components to the OSW, the details are presented in section 2.

The objective of this first i.e. EoI stage of the procurement process is to identify public and private sector entities in India capable of taking OSW through all the project phases over 2016-2024. These shortlisted entities, hereafter referred to as contractors, will be invited to participate in the second stage i.e. *tendering process* through submission of detailed technical and price bids. In the third i.e. final *contract awarding* stage, the highest ranked bidder will be awarded the contract to execute an initial phase of the project lasting up to 18 months. Although it is desired and intended to carry out the entire development of the OSW through a single contractor, the contracts for the subsequent phases will be awarded on the basis of past performance. IIA reserves the right to invite fresh EoI at any stage of the project.

Further details of the procurement and proposal submission processes are provided in Section 3.

2 TMT and OSW Overview

2.1 System Overview

The Thirty Meter Telescope (TMT) is a ground-based telescope with a large segmented mirror under construction in Hawaii. It is designed for optical and infrared observing. In addition, its adaptive optics and laser systems will help correct for image blur caused by the atmosphere of the Earth, helping it to reach the potential of such a large mirror.

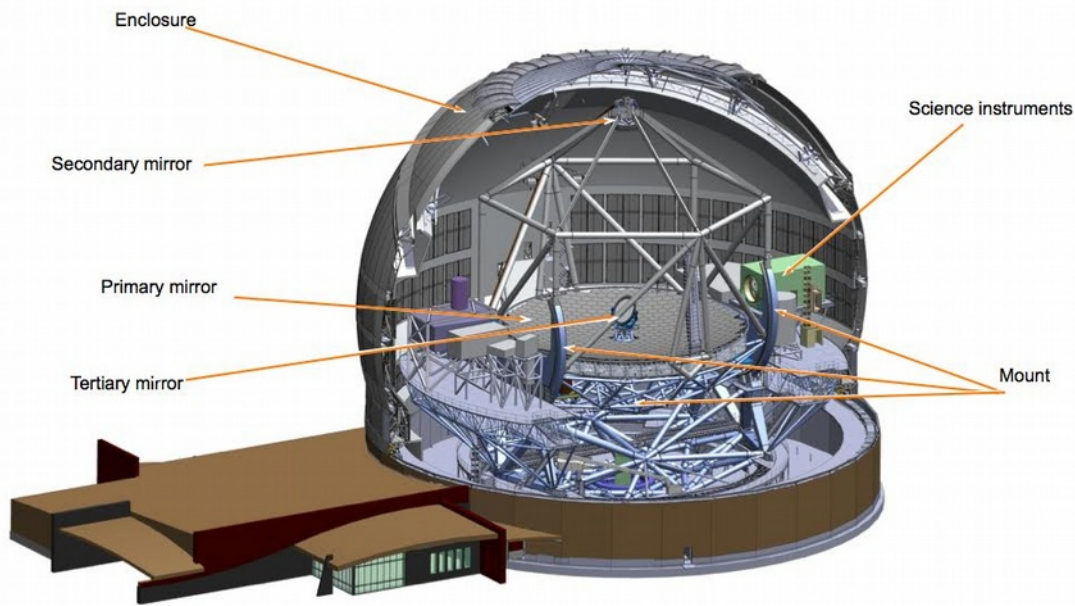


Figure TMT Telescope

The telescope is to be a Ritchey-Chretien design with an altitude-azimuth mount and a 30-metre diameter primary mirror (M1). This mirror is segmented into much smaller individual hexagonal mirrors. The shape of each segment, as well as its position relative to neighboring segments, will be actively controlled. A secondary mirror (M2) is used to focus light from the primary mirror to a flat tertiary mirror (M3), which directs the light path to science instruments mounted on the Nasmyth platforms.

The scientific observations and the telescope system will be controlled by a complex, distributed software system. At the highest level, as shown Figure 2, the TMT software system is comprised of 5 principal systems. Each principal system is focused on specific functionality. The principal systems are an abstraction; each is made up of several concrete subsystems. This view shows that the communication is hierarchical and flows down from Observatory Controls to the other principal systems. This command communication is low-bandwidth by design; any high-speed communication should occur only within a single principal system.

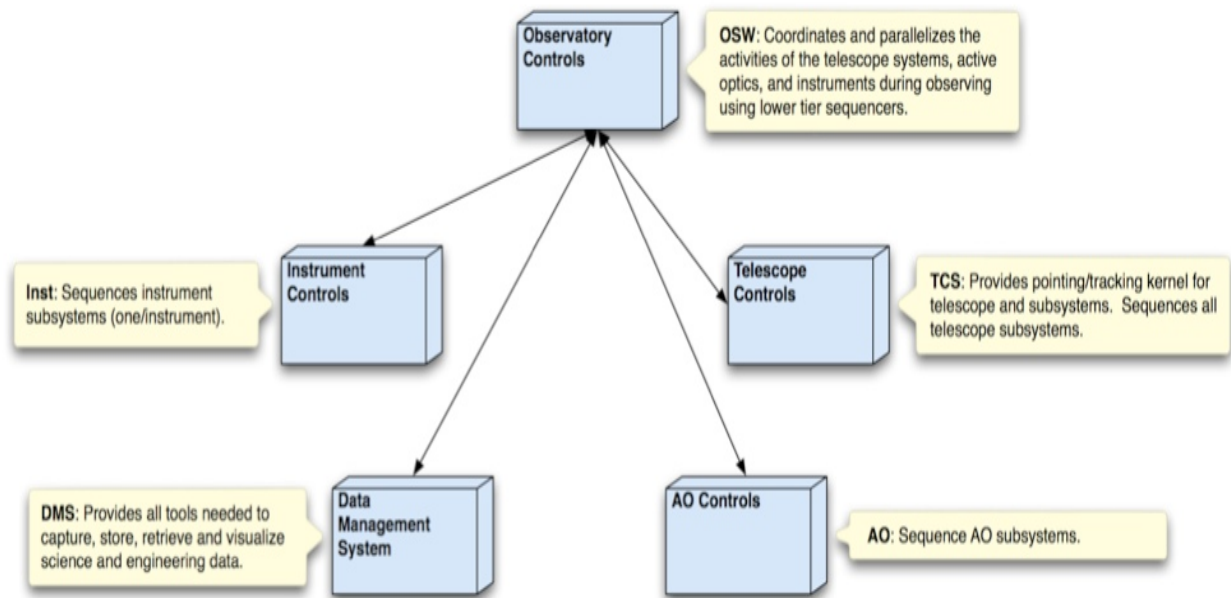


Figure : TMT Principal Software Systems

The software within Observatory Controls uses the input from the telescope operators and observers (scientists) to sequence and coordinate the activities of the other principal systems. (Observatory Software includes both Observatory Controls and Data Management System in Figure 2). The software within Telescope Controls ensures the mirrors properly track the position of the requested celestial objects. The software within Instrument Controls generates science data that matches the observer’s science requirements. The Data Management System receives and manages science data from the instruments. AO Controls contains specialized real-time software that optimizes the image quality of the telescope

Each principal system is decomposed into subsystems as show in Figure 3.

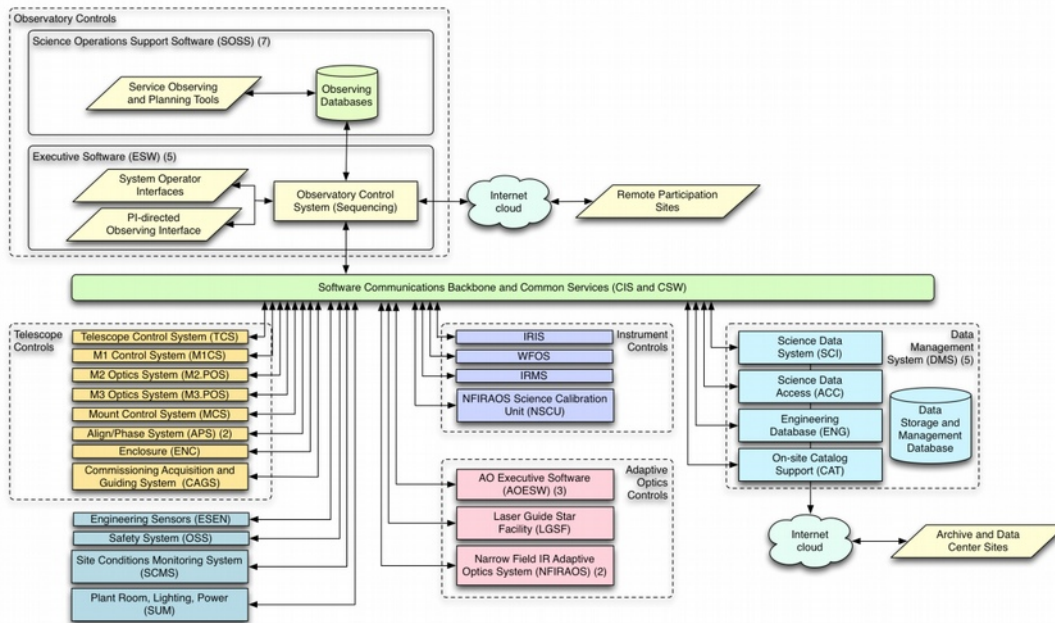


Figure : Decomposition of principal software systems into subsystems.

Observatory Software provides two roles within the TMT software architecture:

- Observatory Software provides the software architecture and infrastructure that integrates all TMT software to form one cohesive system
- Observatory Software provides the user-oriented software that supports the end-to-end observing process

The Level 2 subsystems of Observatory Software are:

- Common Monitoring Software (CSW) – provides the TMT software infrastructure needed to integrate all TMT control system software at the telescope
- Data Management System (DMS) – provides the software and hardware mechanisms and infrastructure to capture, time-stamp, describe, store, transmit, and access all science and engineering data flowing through the TMT system
- Executive Software System (ESW) – software that provides core functionality for synchronized operation of all TMT subsystems as well as the observing and monitoring user interfaces
- Science Operations Support Systems (SOSS) – provides software applications and infrastructure to enable high-level science operations from proposal preparation to observation execution

Each of these subsystems is described briefly below and in more detail in the presentation accompanying this document.

2.2 Common Software

From a software communications and integration viewpoint, TMT consists of a set of distributed software *components* interacting with each other through a *communications backbone* and *software infrastructure* (middleware), which is called TMT Common Software.

Figure is a view of the TMT Software System showing the subsystems that interact with Common Software (CSW) shown as a green bar. The arrows pointing to the green bar indicate subsystems integrating with the CSW infrastructure.

Common Software is a collection of services, a library, and a software framework, which defines the kinds of components in the software system, their roles and responsibilities, and code that supports their creation. The approach of CSW is to take advantage of standards and open-source software for the services and thereby maximizing reuse of existing packages and minimizing new code development. The services and their descriptions are shown in Table .

Choice	Description
<i>Time Service</i>	Standards-based, precision time access for synchronization
<i>Event Services</i>	Provide telemetry/status support Provide event streams through publish/subscribe
<i>Location Service</i>	Locate and register component connection information
<i>Connection and Command Service</i>	Support for receiving, sending, and completing commands in the form of configurations
<i>Database Service</i>	Access to a shared, centralized, relational database
<i>Configuration Service</i>	Manage system and component configuration file changes
<i>Authentication and Authorization Service</i>	Centrally manage user authentication/access control
<i>Logging Service</i>	View, capture, and store local and distributed logging information
<i>Framework</i>	Akka, TMT CSW library and provided framework
<i>GUI Technology</i>	Browser-based applications using JavaScript and TBD set of supporting libraries.
<i>Operating System</i>	Linux/CentOS Redhat-based distribution with MRG for real-time extensions.
<i>Languages</i>	Scala and Java in OSW, with some C++ in subsystems
<i>Scripting Language</i>	Scala and JPython

Table : TMT CSW PDR services and descriptions.

CSW has passed its preliminary design review and is currently in the final design phase. Most of the services and some of the infrastructure have been prototyped as part of the preliminary design phase. The prototype code is written in Scala and it is expected that the prototype code will be integrated into the production source code. Java interfaces are also to be provided.

The Common Software development contract will include production inizing the prototype CSW services and framework based on the existing design and code, create support for hardware controllers that are shared across the project, provide example code and documentation showing proper use of CSW services and the framework, and provide support for CSW usage to the distributed TMT development teams.

2.3 Executive Software System

The Executive Software System (ESW) is one of the OSW subsystems that provides user-oriented software. ESW provides the software concepts and infrastructure required to enable the PI-Directed operations mode. While executing observations, ESW enables synchronized operation of all the TMT subsystems from user interfaces or other programs. ESW provides user interfaces for system operators and observers as well as user interfaces for monitoring system status and overall environmental monitoring. The ESW is decomposed into 5 smaller subsystems.

The **Observatory Control System** includes the software concepts and infrastructure required to sequence the actions of all the TMT subsystems during an observation such that the science data is acquired correctly and efficiently.

The **User Interface Standards** (UISTD) subsystem includes UI tools and look and feel standards for the observatory, remote observing support, user interface example code, and best practices for developing TMT user interfaces. It includes code for integrating CSW services with user interfaces, and effort for supporting teams developing user interfaces across the observatory. UISTD refines or defines the solution for remote observing and provides any standardized support as necessary.

The **High Level Control and Monitoring** subsystem includes development of all observing interfaces for control and monitoring of the telescope, adaptive optics, and instruments during observing using the standards and tools developed as part of UISTD.

The **Data Visualization** subsystem provides infrastructure and user interface tools needed to support quick-look and acquisition of science targets at the telescope. This includes modification of existing visualization tools for reuse by TMT or creation of new tools as needed to support the instrument observing modes.

The **Acquisition Tools** subsystem provides all observing sequences that are used to execute science observations as well as target acquisition.

The Executive Software System design has passed conceptual design as part of the OSW conceptual design and will have its preliminary design in 2016, followed by a final design phase and final design review. ESW shall be implemented per the reviewed ESW final design.

2.4 Data Management System

The Data Management System (DMS) provides the mechanisms and interfaces needed to capture, time-stamp, describe, store, transmit, and access all science data flowing through the TMT software system.. DMS consists of four largely independent subsystems.

The **Science Data System** (SCI) subsystem provides the infrastructure and support for collecting and managing science data from the observatory instruments. SCI provides

standards and requirements for science data formats and science data metadata. SCI includes the hardware and software infrastructure for storing, moving, and ensuring the integrity and security of the science data. SCI provides the infrastructure to collect and manage science data metadata, and to associate metadata with science data. SCI includes the design and implantation of the model for securing data and for implementing the observatory data access policy. SCI provides the storage system design and hardware storage systems for the telescope site and support site.

The **Science Data Access** (ACC) subsystem includes the design and implementation of science data access services for use by observing software as well as software system components such as data processing that must access science data on site and off site. ACC provides a web-based access site for users to access their science data and related files. ACC provides data-oriented software services for querying science data metadata from the on-site science data collection or updating science data metadata including IVOA code and TAP services.

The **Engineering Database** (ENG) subsystem provides a database system for collecting and maintaining engineering information at the telescope site. ENG allows periodic sampling of a configurable set of telemetry/status information. ENG provides time-based, long-term storage and user access of engineering information. ENG provides a web application and user interfaces for querying, retrieving, viewing, and plotting engineering data from the archive of stored values.

The **Image and Object Catalogs** (CAT) subsystem provides observing catalogs and other resources needed for observing at the site. CAT determines which observing resources are required and provides local and remote access to these resources. CAT develops the TMT guide star catalog and provides a database and software interfaces for its access by other software tools. Development and demonstration work for the TMT guide star catalog has been started by IIA. CAT provides the hardware and database systems to store the catalogs and other resources at the telescope site.

The Data Management System design has passed conceptual design as part of the OSW conceptual design and will have its preliminary design in 2016, followed by a final design phase and final design review. DMS shall be implemented per the reviewed DMS final design.

2.5 Science Operations Support Software

The Science Operations Support Software (SOSS) provides user interfaces and applications to manage high-level science operations workflow from proposal preparation to observation execution. SOSS consists of three subsystems.

The **Observatory Database** (ODB) subsystem provides concepts and a database for storing science proposal, program, and observation information. The ODB evaluates requirements, creates models for the observing-related information, and selects a database technology based on the evaluation. The data models are implemented in the chosen database technology. ODB includes software interfaces, libraries, and/or services to allow other programs and system to access and update the ODB. ODB includes procurement of the hardware for the on-site ODB system.

The **First Light Phase 1 Tool** (FLP1) subsystem is a user interface and infrastructure system for accepting proposals from potential observers. The FLP1 tool is meant to be a minimal

implementation based on an existing system in use by TMT partners or within the astronomy community with modifications for TMT requirements. The FLP1 system and tool may be a standalone system with minimal or no integration but should use data models and interfaces of ODB if possible.

The **First Light Phase 2** (FLP2) subsystem is user interfaces and infrastructure to support minimal planning needed for first-light observations with the first-light instruments. FLP2 supports guide star acquisition and planning of observations prior to execution. FLP2 is planned to be a lightweight implementation based on an existing system in use by TMT partners or within the astronomy community. The FLP2 system and tool may be a standalone system with minimal or no integration but should use data models and interfaces of ODB if possible.

The Science Operations Support Software subsystem design has passed conceptual design as part of the OSW conceptual design and will have its preliminary design in 2017, followed by a final design phase and final design review. SOSS shall be implemented per the reviewed SOSS final design.

2.6 TMT Software Systems Engineering and Software Development Processes

The selected software vendors will be required to comply with the TMT Software Systems Engineering processes as defined in the Software Development Process document, the TMT Software Quality Assurance Plan (SQAP) and the TMT Software Configuration Management Plan (SCMP). The early stages of the process are sequential, whereas the coding, testing and integration phases will be iterative. The 6 stages of the SW Systems Engineering Process are defined as follows:

1. **Conceptual Design (CoD Phase):** Define requirements, identify critical technologies, identify problem areas and risks. Develop initial cost estimate and schedule.
2. **Preliminary Design (PD Phase):** Development of design to show that requirements are met, interfaces defined, enabling technologies developed, and major risks retired. Determine bottom-up cost estimate. Develop schedule for Code and Test, and Integration and Test phases.
3. **Final Design (FD Phase):** Development of production ready design and work scopes for subcontracts and procurements. Key technologies industrialized. Show compliance with requirements and interfaces and develop plans for test and verification, quality, safety, hazard/risk assessment, operations and maintenance plans. Develop refined cost estimate and schedule.
4. **Code and Test:** Implementation of the actual software based on the requirements, architecture and final design. The code and test phase is based on agile development as described below. Development of unit and acceptance test cases for all software components. Delivery of fully tested code that satisfies the software quality requirements specified in the SQAP as well as the specified functional and performance requirements. These activities will be carried out at the software vendor's location. This stage also includes development and delivery of the required SW documentation.
5. **Integration and Test (INT):** Integration and independent verification testing of the delivered software modules is performed by the Software Test and Integration Labs

(STILs) at the TMT Project Office and ITCC. Successful outcome of the integration and verification test activities at ITCC and the TMT PO STILs will result in acceptance of the deliverables.

6. **Assembly, Integration, Verification (AIV):** On-site Integration and testing of software in the telescope environment on real observatory equipment and hardware. The software contractor personnel may assist TMT and ITCC personnel in the integration and verification activities at Mauna Kea, Hawaii, during this phase, if applicable.

The TMT Software Development Process used during the code and test phase includes aspects of agile development methodologies, including:

- Frequent iterations and releases
- Feature-driven development
- Unit and component tests created with the source code by the development teams during each iteration
- Automated testing and continuous integration
- Distributed configuration management

OSW shall be developed using the standard software languages and tools selected for TMT. TMT requires a Unix-like operating system, which is the CentOS Linux distribution for all applications

The standard TMT programming languages are the JVM-based languages: Scala and Java. Common Software itself is written in Scala, so expertise with Scala is required. A Java API will also be provided by CSW, so experience with Java is also required. Some experience with C/C++ is useful when working with low-level hardware as part of CSW development. The standard languages for scripting are Scala and JPython.

The TMT plan includes a Software Test and Integration Laboratory (STIL) function at the TMT Project Office in Pasadena, USA, that will be responsible for software testing, quality assurance, and the integration of software for all the subsystems. The STIL staff will be a resource for all software development teams and will provide standards, tools, and support. The STIL will maintain the project source code repository and other software tools to monitor and coordinate progress. Additionally, ITCC will also have a STIL capability that will focus on integration and unit testing per the SW QA requirements defined in the Software Quality Assurance Plan. All software-related deliverables will be tested by the STIL before acceptance.

The OSW project phases are scheduled as follows:

Project phase	Period
Design Phase <ul style="list-style-type: none"> • Preliminary Design Phase • Final Design Phase 	Q4 2014 – Q4, 2017 Q1, 2016 – Q2, 2018
Code and Test	Q2, 2016 – Q2, 2024
Integration and Test	Q3, 2016 – Q2, 2022
Assembly, Integration and Verification	Q3, 2021– Q2, 2024

Table 2 OSW Project Phases

3 Engagement Model and vendor responsibilities

The development of TMT Observatory Software (OSW) will be performed in India by pre-qualified software vendors. The qualification process will be based on the standard ITCC EoI/RFP process with the selection criteria defined by ITCC and TMT PO as defined in section 4 of this document. The selected software vendors will be required to work in accordance with the terms of the contract and the scope of work agreed upon for each iteration. The selected software vendors will be required to comply with the TMT Software Systems Engineering processes as defined in the Software Development Process document, the TMT Software Quality Assurance Plan and the TMT Software Configuration Management Plan. They will also be required to work under technical direction from the ITCC and TMT Project Office Observatory Software Team.

In addition, the selected software vendors will be required to provide status updates to the ITCC Observatory Software Work Package Manager as well as contract deliverables to the ITCC Observatory Software Technical Lead for review. The contract deliverables will only be accepted following both ITCC and TMT PO review, test and acceptance.

ITCC, TMT Project Office and the selected software vendors will have frequent and open communications to discuss all technical and programmatic matters. The software vendors are thus expected to have good team integration as well as communication capabilities.

4 EoI Submission and Evaluation Process

Any public or private entity with proven technical expertise, track record and experience in design, development and integration of large, complex, distributed software systems in Scala and Java can apply. Experience in astronomy projects will be an advantage.

The EoI shall be submitted according to the guidelines provided in the Section 4.2. A pre-EoI submission meeting to provide an overview of TMT OSW and clarifications on the submission and evaluation process will be organized at IIA on 22 March 2016. The questions for the Pre-EoI meeting can be emailed to purchase@iiap.res.in, with a copy to reks@iiap.res.in

The deadline for EoI submission is **31 March 2016** at 1500 hrs IST. The EoIs will be opened in the presence of contractors on the same day at 1600 hrs IST. If the number of responses received is insufficient, IIA reserves the right to extend the deadline.

An Expert Committee constituted by ITCC, including TMT Project Office OSW Project Manager and SW Architect, will evaluate the EoIs and shortlist the contractors eligible to participate in the tendering process. The evaluation criteria to be used for evaluation are described in Section 4.1. The evaluation process will also involve presentations and face-to-face interviews of the contractors at their facilities. The date(s) for the presentations and site-visits will occur during the first two weeks of April 2016; the specific dates will be decided later and communicated to the contractor at the end of March. The results of the EoI process will be announced on **29th April 2016**. IIA will then invite the shortlisted organizations to participate in the tendering process for the work to be contracted. The details of the tendering process will be announced on **16 May 2016**.

4.1 Evaluation Criteria

The expert committee to evaluate the submitted proposals shall use the following criteria. Respondents shall address each of the following criteria in the order presented below. Nominally these criteria will be weighted equally during the evaluation process.

1. Contractor's financial stability
2. Contractor's project experience
3. Contractor's technical competencies and technical compatibility to OSW project
4. Contractor's project management capabilities
5. Contractor's experience in integrating seamlessly into a customer's team
6. Contractor's ability to acquire further domain experience as needed

The contractor shall demonstrate experience and abilities in each area of the criteria in the EoI submittal. The criteria is further defined in below:

Contractor's Financial Stability

In case of private sector entities, the contractor should be in business for at least 5 years, and have a minimum average annual turnover of about Rs. 50 crores during the last 5 years with a solvency of at least 30 crores.

Contractor's Project Experience

The respondent must have significant experience and depth in the development and integration of software for large, complex heterogeneous distributed systems, and managing

and resolving technical issues and challenges associated with such complex distributed systems. Experience with projects that are similar or applicable to OSW is desired.

The contractor should have experience with rigorous software system engineering processes (as described in section 2.6) and modern tools for software system design, coding, testing, and configuration control. The contractor must have experience over the full software design, implementation, test, deployment and support life cycle. The respondent must have demonstrated successful experience with agile development projects with a distributed team.

Contractor's Technical Competency and Technical Compatibility to the OSW Effort

Technical staff assigned to the OSW effort should have experience in object oriented and/or functional software development, and the use of and integration of open source based software into larger systems. The contractor should have experience with the required development tools and environments, particularly Scala, Java, Linux OS, and C/C++. Experience with the following packages or technical areas applicable to OSW should be mentioned: Akka, Redis, JmDNS or DNS service discovery, distributed logging, logstash, Elasticsearch, Javascript-based UI development, JSON, web applications and the Play framework in particular, authentication and authorization standards and software packages, relational and No-SQL databases, cyber-security, and other open source messaging systems.

Communication skills, motivation, experience with formal review processes, and knowledge of the complete design, development, test, deployment, and support software life cycle process are necessary. Software quality assurance and configuration management experience is required.

The contractor should demonstrate that the appropriate level of technical staff can be applied to the contract. The senior technical staff member(s) that are assigned to the OSW effort should have a minimum of eight years' experience in the development and delivery of complex distributed software systems with the tools and technologies discussed here.

Contractor's project management capabilities

The contractor shall have demonstrated experience in project management. This includes development, maintenance, and use of schedules, budgets, resource allocation, performance measurements and metrics, and risk management. The contractor must be able to assign a Project Manager to the OSW effort who has experience in managing projects of similar size and complexity. The Project Manager must be experienced in leading teams and applying agile development processes. Ideally, a single person can fill the needs for both management and technical leadership.

The successful contractor shall also have a history and mature processes for supporting and integrating into large, geographically dispersed, multi-national projects.

Contractor's experience in integrating seamlessly into a customer's team

Experience with, and the ability to, travel internationally (6 to 8 trips/year) and integrate into remote technical teams and communicate effectively are necessary. The expectations for team integration and communication are outlined in section 3 of this document and will be used as a baseline for the evaluation. Given the duration of the TMT project, long-term continuity of key personnel will be extremely important.

Contractor's ability to acquire further domain experience as needed

The successful delivery of the OSW will require domain experience in a wide variety of areas including concepts related to control and management of optical telescopes and observatories, science data curation and metadata management, astronomy data formats, virtual observatory standards, observing operations modes, telescope scheduling, and astronomy instrumentation in addition to solid software engineering skills.

This kind of domain experience is not a common skill set. TMT and ITCC will provide guidance in this area but nonetheless, the contractor will need to acquire the necessary domain knowledge. TMT will provide support to the contractor for identifying methods to fill this need but the final responsibility rests with the contractor. Any prior domain experience will be an advantage.

4.2 EoI format and submission process

The EoI shall be printed on the organization's stationary and consist of following documents:

1. Filled-in cover letter and undertaking. The formats are specified in Form-I (Appendix A1) and Form-II (Appendix A2).
2. Profile of the contractor demonstrating its *experience, financial stability and core technical competencies*. Following supporting documents shall be included *as applicable*:
 - a. Audited balance sheets for last five years.
 - b. Solvency certificates (not older than 12 months) issued by nationalized bank with which the contractor holds their current account.
 - c. Copy of Registration LST/CST/WCT No., PAN No., and TIN No. allotted by concerned authorities.
 - d. Information on certifications and appraisals to demonstrate how well organization's processes compare to international best practices and standards.
 - e. The management structure and brief bio-data of top most technical personnel
 - f. Technical staff strength in all categories
 - g. Details of Corporate office and other branches within India and abroad
3. Details of past experience in executing work of similar nature and scale. In particular, the respondent shall address each of the following concerns ***in the order*** as described below:
 - a. ***Contractor experience and core technical competencies***
Contractor shall provide a brief overview of past and present projects that have similar technical and/or programmatic characteristics to the OSW project. Focus

should be given to the role played in each of these efforts and in identifying which aspects were similar to the OSW project.

b. ***Technical compatibility to OSW***

Contractor should provide a brief overview to show how the technical needs of OSW can be met. It is important that the overview be specific to the actual group or development unit that would ultimately be involved in the OSW work. This response should include an indication of:

- The number of years of experience in developing and deploying on Linux
- A summary of the number of people available to the project, their programming languages and the years of experience using them. For the senior staff (software development leads and project managers), please provide a brief summary of their individual qualifications.
- Any experience with distributed control systems, open source solutions, real-time systems and globally distributed projects should be included. (Is this relevant?)

c. ***Contractor's project management capabilities***

Provide a description of how the respondent handles Software Project Management for efforts of similar size to that of the OSW. Include a description of tools and processes used for scheduling, resource allocation, budget, performance measurements and metrics, risk management, and brainstorming. Also include a list of tools and processes used to manage and communicate across a geographically and culturally diverse project with multiple stakeholders. Provide a description of Contractor's experience with managing projects applying Agile development processes.

d. ***Contractor's experience integrating seamlessly into a customer's team***

Provide one or more past examples of how the Contractors team integrated into a customer's team creating one seamless team. Describe the engagement model(s) that the Contractor has used in the past. Describe any tools used to enable integration of geographically dispersed teams.

Provide examples of where team members have travelled outside of India to participate in global projects. If possible, include the frequency and duration of these trips.

e. ***Contractor's ability to obtain the required domain experience***

The successful delivery of the OSW will require, in addition to demonstrated proficiency in software engineering, specific domain experience in Observatory software design. Describe the depth of internal OSW related experience available and ideas as to how gaps in the internal experience would be augmented if necessary.

4. Appreciation letters from clients [regarding projects relevant to this EoI](#) and their contact information.

The EoI in a sealed envelope bearing the heading “Expression of Interest for TMT Observatory Software” and the name and address of the respondent, should be dropped in the tender box located at IIA. The envelope should be addressed to:

**The Administrative Officer ,
Indian Institute of Astrophysics,
Sarjapur Road, Koramangala II Block
Bangalore - 560034, India.**

4.3 Important dates

Important dates	
Date of this announcement	February, 29, 2016
Closing date and time for submission of questions for Pre-EoI meeting	March, 14, 2016 (1500 hrs IST)
Pre-EoI submission meeting at IIA	March, 22, 2016 (1000hrs IST)
Closing date and time for submission of EoIs	March, 31, 2016 (1500 hrs IST)
Opening of EoIs in the presence of contractors	March, 31 2016 (1600 hrs IST)
Intimation of the results of EoI process	April, 29, 2016
Announcement of the tendering process to invite technical and price bids	May, 16, 2016

In the event of any of the above mentioned dates being declared as a holiday/ closed day for IIA, the event will take place on the next working day at the appointed time. The Director, IIA, on behalf of IIA reserves the right to postpone the dates mentioned above without citing any reason.

4.4 Contact details

For commercial clarifications, please contact during office hours:

Purchase Department
Indian Institute of Astrophysics,
SarjapurRoad,Koramangala II Block,
Bangalore – 560034, India.
Tel. +91 -80-22541244
Email: purchase@iiap.res.in

For Technical clarifications, Please contact during office hours:

Dr. Rekhesh Mohan,
Technical Lead, OSW
Indian Institute of Astrophysics,
Sarjapur Road, Koramangala II Block,
Bangalore – 560034, India.
Tel. +91-80-22541438
reks@iiap.res.in

The Email and postal enquiries should clearly mention “Enquiry for the TMT Observatory Software EoI” in the subject line or on the top of the envelope, respectively.

A1. Format of the Cover Letter

FORM- I

(Format of the Cover Letter)

(To be printed on the organization’s letterhead)

Expression of Interest for the TMT Observatory Software

The Director,
Indian Institute of Astrophysics,
Sarjapur Road, Koramangala II Block,
Bangalore – 560034, India.

Dear Sir,

In response to the request for Expression of Interests (EoI) for the "TMT Observatory Software", we are submitting herewith our EoI.

We have carefully read all the terms and conditions of the EoI and undertake to abide by them. The information/documents furnished as part of the EoI are true to the best of our knowledge and belief. We are not involved in any major litigation that may have an impact affecting or compromising the delivery of services as required under this EoI. We are not blacklisted by any Central/ State Government/ Public Sector undertaking in India.

We are well aware of the fact that furnishing of any false information/ fabricated documents would lead to the rejection of EoI.

Place:

Authorized Signatory

Date

Signature and seal

Contact details of the signatory

(Provide postal and email addresses and phone numbers)

A2. Format of the Undertaking

FORM- II

(Format of the Undertaking)

(To be printed on the organization's letterhead)

UNDERTAKING

1. I, _____ son/daughter/wife of _____
Proprietor /Director / authorized signatory of the Company / Organization
mentioned above, am competent to sign this declaration and execute this EoI
document.
2. I have carefully read and understood all the terms and conditions of the EoI and undertake
to abide by them.
3. The information/documents furnished along with the above EoI form are true and
authentic to the best of my knowledge and belief. I am well aware of the fact that
furnishing of any false information/fabricated documents would lead to the rejection of
my EoI at any stage, besides liabilities towards prosecution under appropriate law.

Place:

Authorised Signatory

Date

Sign and seal

Contact details of the signatory

(Provide postal and email addresses and phone numbers)

A3. Checklist for Submission of Documents

FORM- III
Format of the Checklist for Submission of Documents
(To be printed on the organization's letterhead)

(Please choose 'Y' or 'N' as applicable).

Document	Submitted
1. Cover letter (see Form - I)	Y/N
2. Undertaking (see Form - II)	Y/N
3. Checklist (i.e. this form)	Y/N
4. Profile of the contractor as described in Section 4.2. Provide following supporting documents <i>as applicable</i> : (i) audited balance sheets for last 5 years, (ii) solvency certificates, and (iii) copy of registration LST/CST/WCT No., PAN No. and TIN No. allotted by concerned authorities. (All items under 4.2.2)	Y/N
5. Details of past experience of the organisation in executing work of similar nature and scale. Please address the concerns described in Section 4.2.	Y/N
6. Appreciation letters from clients as well as their contact information.	Y/N
7. Any other supporting documents (give details)	Y/N

Place:

Authorised Signatory

Date

Sign and seal