**Overview of Project**

The Square Kilometre Array (SKA) is a large multi-radio telescope project that will be built in Australia and South Africa. It will have a total collecting area of approximately one square kilometer. The SKA will combine the signals received from thousands of small antennas spread over a distance of several thousand kilometers to create a single giant radio telescope capable of extremely high sensitivity and angular resolution, using a technique called aperture synthesis. Its size will make it 50 times more sensitive than any other radio instrument, and will require very high performance central computing engines and long-haul data links with a capacity greater than the current global Internet traffic. It will be able to survey the sky more than ten thousand times faster than ever before.

Construction of the SKA is scheduled to begin in 2018 for initial observations by 2020. The headquarters of the project are located at the Jodrell Bank Observatory of the University of Manchester, in Cheshire, UK.

The members of the SKA Organisation are:

• Australia: Department of Industry and Science

• Canada: National Research Council

• China: National Astronomical Observatories of the Chinese Academy of Sciences

• India: National Centre for Radio Astrophysics

• Italy: National Institute for Astrophysics

• New Zealand: Ministry of Economic Development

• South Africa: National Research Foundation

• Sweden: Onsala Space Observatory

• The Netherlands: Netherlands Organisation for Scientific Research

• United Kingdom: Science and Technology Facilities Council

The amount of sensory information collected by the SKA pose an unprecedented storage challenge and require real-time signal processing to extract relevant information from the raw data. It is estimated that the array could generate an exabyte per day of raw data, which could be compressed to around 10 petabytes. Due to the scale of the SKA, the software architecture is critical. Furthermore the SKA project has 11 different projects that will be integrated into the system, thus creating a need for software architecture standardization.

**Initial Engagement**

The SKA Telescope has a number of major constituent systems that must interoperate to achieve mission goals. Even when systems exchange information in a syntactically correct manner – using the same transport protocols, message structures, data types, etc. – the systems may not integrate as needed due to architecture mismatch.

Architecture mismatch refers to differences in assumptions about how the interfaces and systems operate, such as:

* Availability, including fault and failure handling, retry and recovery policies, maintenance window assumptions, etc.
* Performance, including latency, shared resource utilization, capacity, etc.
* Security, including authentication mechanisms, certificate policies, roles and access controls, etc.

In a multi-system context like SKA Telescope, architecture documentation is critical to enable efficient and effective communication among stakeholders to identify and resolve architecture mismatch and allow the constituent systems to integrate as planned. The Architecture Integration Workshop will lead the constituent system architects through a facilitated process to produce a SKA Architecture Documentation Plan.

The SKA Architecture Documentation Plan will include the following:

* Identification of 3-5 end-to-end Mission Threads (described below) that provide the context to identify significant system quality attributes and architecture mismatches.
* Identification of key quality attributes for system integration, expressed as a utility tree (described below).
* An architecture document template (tailored version of SEI Views and Beyond template or ISO 42010-based template) that captures sufficient information about the architecture of each system to assess quality attribute performance and to assess architecture mismatch, and will support downstream development.

A mission thread is a sequence of end-to-end activities and events, given as a series of steps that accomplish the execution of one or more SKA telescope capabilities. Mission threads can describe steady-state operation (e.g., data acquisition, processing, storage, and dissemination), software and hardware updates and migrations, initial system deployment, system management or maintenance, or any other overall SKA telescope capability that uses the integrated capabilities of constituent systems. Analysis of the flow of data and control between the constituent systems at each step in the mission thread will uncover functional and architectural mismatches, identify key integration quality attributes, and clarify assumptions embodied in the architectures of the constituent systems.

A utility tree is a structured decomposition of the quality attributes that contribute to a system’s “fitness for use”. Quality attribute requirements are expressed as scenarios that describe how the system responds to a specific, concrete stimulus.

The Architecture Integration Workshop attendees will be 1 or 2 software architects or software lead developers from each of the SKA Telescope constituent systems. The workshop will have a multiday agenda, led by two SEI architecture consultants.

**Location**: The Architecture Integration Workshop will be held on-site at SKA at Jodrell Bank Observatory of the University of Manchester, in Cheshire, UK. Exact delivery dates TBD.

**Architecture Integration Workshop Agenda:**

Day 1:

* Introductions
* Facilitated group analysis of first mission thread to identify architecture concerns, quality attributes, and functional and architecture mismatches, using the SEI Mission Thread Workshop method.

Day 2:

* Retrospective: Commonalities and themes across the findings of the first mission thread analysis.
* Training Module: Quality Attributes (drawn from existing SEI courseware)

Day 3:

* Facilitated Working Session: Expressing mission thread analysis findings as quality attribute scenarios, using parts of the SEI Quality Attribute Workshop method. (stimulus, response, environment).
* Training Module: Introduction to Views and Beyond documentation method and/or ISO 42010 (drawn from existing SEI courseware). This will cover the baseline documentation template that will be tailored for SKA Telescope in a later session.

Day 4:

* Facilitated group analysis of second mission thread to identify architecture concerns, quality attributes, and functional and architecture mismatches, using the SEI Mission Thread Workshop method. Apply quality attribute scenario methods to capture more precise architecture requirements. Incorporate discussion of where the analysis findings should appear in the documentation template.
* Training Module: Interface and behavior documentation (drawn from existing SEI courseware).

Day 5:

* Working session to collect quality attributes and scenarios into a utility tree.
* Facilitated group identification and specification of 2-3 additional mission threads. Assessment of coverage provided by the full set of mission threads.

Day 6:

* Facilitated group working session to produce tailored documentation template, reflecting where integration architecture concerns will be identified and addressed.
* Start of practice and coaching session: Break into groups of 2-3, begin documenting key inter-system interfaces.

Day 7:

* Complete practice and coaching session.
* Wrap up

The workshop agenda can be adjusted if the SKA Telescope team wants to insert other activities for the architects while they are on-site together.

The workshop will require some preparation:

* SKA Telescope team will provide system functional and architecture overview documentation/presentations to the SEI team, and make time to answer questions.
* 2-3 SKA Telescope architects or systems engineers will assist the SEI team to specify the first two mission threads. Depending on the business process documentation available, this could be a single 2-hour long teleconference, or if there is little existing end-to-end process documentation, this might need a series of teleconferences and some research by the SKA Telescope contributors.

**Workshop physical requirements**: Meeting room large enough for all attendees, available for the duration of the workshop. Ideally, multiple tables or flexible layout to allow group work. LCD projector and screen. Provision for power for attendees’ laptops. Whiteboards (and markers and erasers). Flip charts or butcher paper and tape (and markers). A second smaller room to use as breakout space would be helpful but not essential.

SEI consultants will need the ability to print small working documents to distribute to attendees (3-5 pages).

**Task Summary and Pricing:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Task | Description | Price | Travel Estimate | Total |
| 1 | Architecture Integration Workshop | $78,000 | $12,000\* | $90,000 |
|  |  |  |  |  |
|  | **Grand Total** |  |  | **$90,000** |

\*Two SEI Staff Members will participate in the Architecture Integration Workshop to be held on-site at SKA, Jodrell Bank Observatory of the University of Manchester, in Cheshire, UK.