MOOS *Operations* Subsystem Software Requirements Specification

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1. Introduction

1.1. Purpose

This document describes the software functional requirements for the Operations subsystem of MOOS. This document is intended primarily for MOOS system engineers, software designers, and project managers.

1.2. Scope

The MOOS Operations subsystem provides shore-based or ship-based interfaces to deployed instruments and platforms, including moorings and cabled observatories. The Operations subsystem enables control, monitoring, and data retrieval from those deployed devices, over a variety of communication links and protocols. The Operations subsystem

1.3. Definitions, acronyms, and abbreviations

client – software which makes requests of a *service*
data sample – a logically associated sequence of data bytes generated by an instrument
packet stream – sequential time-tagged packets of an instrument's data and metadata
ISI – Instrument Software Infrastructure
MOOS – MBARI Ocean Observation System
instrument driver – software which sends commands to an instrument and retrieves data from the instrument through a communications port (e.g. serial port)
instrument node – a deployed computer to which instruments are directly connected
remote access – access to an instrument node from an external software component

platform – a physical structure (mooring, observatory instrument node, vehicle) which contains one or more *instrument nodes*
service – software which takes some action (e.g. controls a device, provides data) on request from a *client*. A service may have multiple clients.
SSDS – Shore-Side Data System
UI – user interface

1.4. References

M. Chaffey, *MOOS Requirements*
M. Chaffey, *MOOS System Design*
D. Davis, *ISI Requirements*
J. Graybeal, *SSDS Requirements*
J. Graybeal et al, *MOOS Use Cases*
T. O'Reilly, *MOOS Deployed Software Requirements*
T. O'Reilly*, ISI Users Guide*
W. Radachonsky, *SideARM Functional Description*
IEEE Recommended Practice for Software Requirements Specifications (IEEE Std 830-1998)

1.5. Overview

1.6.

2. Overall description

2.1. Product perspective

Figure 1 is a simple block diagram of the MOOS system, showing data flow between the Deployed, Operations, and SSDS subsystems, as well as interfaces with users and systems which are external to MOOS.

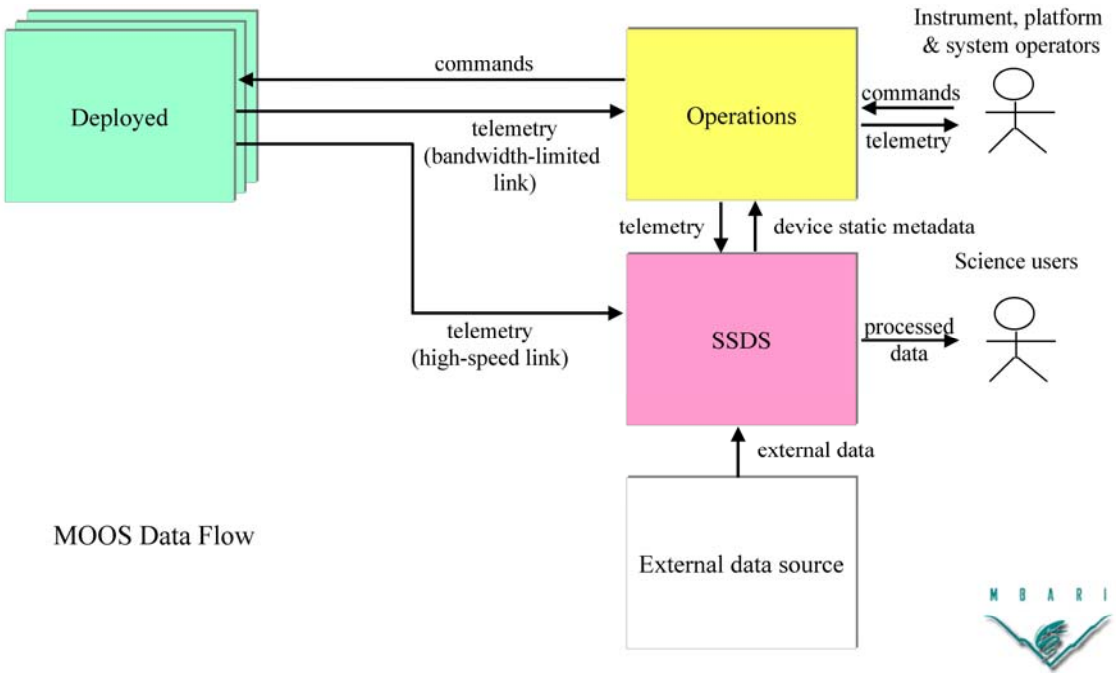

Figure 1. Block diagram of MOOS

2.1.1. System interfaces

As can be seen from Figure 1, Operations has interfaces with the Deployed and SSDS subsystems.

Interfaces to Deployed subsystem

These interfaces have the following functionality:

2.1.1.1.1. Commands are sent from Operations to Deployed platforms and instruments

2.1.1.1.2. Data are transferred from Deployed devices to Operations

Interface to SSDS subsystem

2.1.1.1.3. The Operations subsystem retrieves static device metadata from SSDS.

2.1.1.1.4. Data retrieved from Deployed devices are transferred from Operations to SSDS.

2.1.2. User interfaces

Operations provides user interfaces (UIs) for deployed devices, including platforms and instruments. These UIs enable control of devices, and retrieval of data from devices. Some of the UIs perform functions which are generic to all instruments/devices (e.g. power switching), while other UIs are tailored to specific types of devices (e.g. a mooring). In some cases, Operations retrieves the user interface code from a Deployed element, then executes that code on an Operations computer.

2.1.3. Hardware interfaces

2.1.4. Software interfaces

Interfaces with the Deployed subsystem rely heavily on ISI and ISI extensions. Thus the Operations subsystem software must be capable of interfacing to ISI, which is implemented in Java.

2.1.5. Communications interfaces

The ocean observing system will utilize a variety of communication links to connect Deployed subsystems with Operations and SSDS. A wide range of communications bandwidth and latency characterizes these links. At one end of this spectrum are high-speed/low-latency links (e.g. T1 links); instrument nodes on a mooring benthic network or cabled observatory nodes will likely use links of this sort. At the other end of the spectrum are low-speed/high-latency links such as acoustic links and store-and-forward satellite; long-range wireless platforms are likely to utilize links of this type.

	Low latency < 500 msec	High latency > 500 sec
Low rate < 2400 bps		Acoustic: Underwater vehicle, Non-cabled benthic instrument
Medium rate 2400 – 19200 bps	RF, bent-pipe satellite: Mooring, vehicle on surface	Store-and-forward satellite: Mooring, vehicle on surface
High rate > 19200 bps	Copper, optical fiber: Mooring benthic network, cabled observatory	

Operations communication elements must accommodate this variety of communication link characteristics.

2.1.6. Operational considerations

2.2. Product functions

The Operations subsystem performs the following functions:

2.2.1. Executes user interfaces for Deployed devices

2.2.2. Bandwidth management for low-bandwidth links

2.2.3. Acceptance and buffering of commands destined for Deployed devices connected by low-bandwidth/intermittent communications links.

2.2.4. Retrieval and buffering of Deployed device data over low-bandwidth/intermittent communication links.

2.2.5. Distribution of retrieved data to onshore/shipboard subsystems, including SSDS

2.2.6. Security to deployed instruments and platforms

2.3. User characteristics

Users of the Operations subsystem include system engineers and technicians as well as scientists. Engineers and technicians are primarily responsible for operation, monitoring, and troubleshooting of the Deployed platforms and infrastructure. Scientists and science technicians are responsible for operation, monitoring, and troubleshooting of specific instruments.

2.4. Constraints

The Operations subsystem relies heavily on Instrument Software Infrastructure (ISI) for its external interfaces. ISI is implemented in Java; thus the Operations subsystem must be able to utilize Java objects, directly or indirectly.

Some communication links between Deployed and Operations are characterized by very low bandwidth and/or high latency. Protocols to be utilized between Operations and Deployed subsystems must take these link qualities into account.

2.5. Assumptions and dependencies

It is assumed that Operations nodes are capable of supporting Java 2 Platform, Standard Edition (J2SE).

3. Specific requirements

3.1. External interface requirements

Operations nodes interact with Deployed elements via interfaces implemented on the connecting communication links. ISI provides mechanisms to define and

implement these interfaces, and shall be used when the communication link supports TCP/IP (e.g. for links with speed > 9600 bps and latency < 500 millisec). For very slow long-latency links (e.g. acoustic, store and forward satellite) which cannot support the ISI underlying TCP/IP protocol, other protocols and interfaces must be adopted or designed and implemented.

3.2. System features

3.2.1. Device user interfaces

3.2.2. Command forwarding

3.2.3. Data retrieval

3.2.4. Data distribution

3.2.5. Health and status monitoring

3.2.6.

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