MSE 2004 Mooring
Surface Node Electronics System Integration
Functional Requirements

Revision: 1.2

Revision	Date	Description
1.0	01/29/2003	Initial document and requirements carryover from engineering deployment
1.1	03/13/2003	Incorporated detailed requirements from MOOS System Functional and Design Requirements
1.2	03/25/2003	Defined ESD, refined power voltage, defined reset functionality, defined short/long range comms and console, refined comms GF

Functional:

- interface to meteorology instruments, solar power panels and batteries, universal node controller (UNC) and sea surface instruments
- establish communications link between the mooring system and shore based facilities
- provide the functions of data processing, data storage, communications, power control, instrument interface, and system status monitoring/fault isolation
- must provide an affordable mooring based system with consideration given to balancing the initial cost, installation and maintenance costs.
- system hardware and software is required to be routinely and efficiently configurable to support a broad range of scientific experiments, hardware configurations, sampling strategies and instrumentation
- required that the system be designed to allow a ready upgrade path for accommodating future advancements in measurement and sub-system capabilities
- required to be capable of detecting predefined environmental events by locally monitoring and processing single or multiple instrument data streams *without interrupting the normal data storage and retrieval process*
- start a pre-determined response by initiating a mission profile, taking more data with its suite of sensors, implementing new sampling strategies, launching AUV's etc. *with maximum response delay TBD (60 seconds?).*

  or

  follow a set of mission commands communicated from shore, *with maximum system connection/response delay TBD (1 hour?).*
- Must support down-loading of preprogrammed event response sampling configurations
- Power and communications must be compatible with Neptune and DEOS
- The surface float must conform to all applicable maritime regulations and include navigation lighting and radar reflector.

Communications:

- must provide bi-directional long-range wireless communications between the shore and the surface node
- must provide a hard wire copper link to the primary controller console from outside the controller housing.
- must provide a short-range wireless link to establish communications with other platforms within a TBDkm radius.
- must be able to establish a connection to MBARI from the following locations in Outer Monterey Bay:

  - within ~1M of 122° 53' 19.74" W 36° 14' 33.11" N (~57M from MBARI)
  - within ~1M of 122° 55' 56.50" W 36° 14' 34.39" N (~57M from MBARI)
- required to establish an end-to-end data/command connection within (one hour) of event detection with 90% long-term availability where "end-to-end" is defined as from instrument physical interface to shore based user terminal or MOOS data archive
- must establish a data connection at regular intervals and transport a minimum of TBD bytes of data bi-directionally with a maximum system end-to-end latency of 4 hours
- There must be a way to immediately (5 minutes?) establish a link from shore
- The total bandwidth through the shore link shall be no less than: ___________
- must communicate notice of event detection to shore *with maximum notification delay 12 hours*
- required to allow downloading of updated event detection algorithms and processes over the buoy to shore communications link
- must follow a set of mission commands communicated from shore, *with maximum system connection/response delay TBD (1 hour?).*
- Must support real-time or near real-time interactive modification of sampling rates
- must provide near real-time (1-4 hrs) bi-directional data to notify shore of the onset of an episodic event, and to receive subsequent mission commands from shore
- must provide near real time (1-4 hrs) data for engineering health monitoring of the MOOS mooring and sensors
- Must have a separate/additional shore link ground fault identification/isolation mechanism that must be separate from the system ground fault isolation mechanism
  - Ideally each communications interface will have a separate ground fault identification/isolation mechanism
- The controller must be able to establish a shore connection at routine intervals of no more than 1 hour
- The controller must be able to be reset from shore.
  - The reset must power cycle the controller(s)

Reliability:
- 10 year design life from initial deployment
- required to remain fully operational for deployments of up to 3 years duration with normal maintenance.
- minimum interval of one year between maintenance recovery and redeployment cycles

Environmental:
- requires full operation in sea-states up to and including Sea State 6. This includes the following conditions:
  - significant wave height: 4-6 meters
  - maximum sustained wind speed: 47 knots
- must survive the wave conditions of a statistical 25 year storm and return to full operation.
- HUMIDITY: must withstand constant seaspray for deployment duration (not less than 2 years)
- TEMPERATURE: must withstand daily temperature cycling between 0c and 70c
- icing requirements are TBD
- PRESSURE: normal pressure will be 1atm, but must survive a positive pressure associated with being submerged 10m as the buoy is pulled through a wave.
- EMI: must continuously operate and withstand the radar sweep from standard marine radar at a distance of 5m. (need to quantify "standard")
- VIBRATION: must endure standard deployment, ship engine motion etc., and wave motion vibration (need to quantify this)
- SHOCK: must endure a drop from 5m, which may be seen during deployment. (need to quantify this)

Instrument interface:
- Must support all meterological and upper ocean and midwater instruments listed in John Ryan's compiled MSE 2004 list.
- must communicate with at least the following quantity of instruments:

Quantity	Type

26	Serial (RS-232/RS-485)
15	Inductively coupled (RS-232/RS-485)
0	Ethernet
41	Total
+12	30% Expansion

- must provide expansion capability as listed in MOOS systems design requirements
  - must allow for a 30% increase in the number of instruments during deployment
  - must be readily modular to interface with less or more instruments.
- must communicate with the AUV dock and AUV/instruments
- must communicate with Benthic instruments
  - The cumulative bandwidth to the benthic nodes shall be no less than ____________
- must be able to communicate directly with an instrument through either the shore link or local debug console
- There must be external access to all instrument console and calibration ports <- needs clearer definition
- Must interface to instruments located:
  - on a surface tower,
  - in a cage which will be lowered inside the buoy to a depth about 1.3m,
  - via the riser cable, in a cage that will be attached in the middle (or end?) of the snubber sections,
  - via the riser cable, along the riser cable below the snubber section down to the end of the riser cable external armor.
- temporal resolution, or sampling rate, for instrumentation as listed in the MSE 2004 instrument list
- the total bandwidth to each instrument shall be no less than 300 baud and up to 115kbaud
- must support the MOOS standard instrument interface electrical protocol, EIA 232-D (which is a revision of the RS-232-C standard) with the following modifications:
  - Only transmitted data, received data, RTS, CTS and signal common return are used

Binary State	Voltage levels
Transition	-3V to +3V
0 or "Spacing"	+3V to +15V
1 or "Marking"	-3V to –15V

EIA 232 signal levels (reference)

  - The standard interface physical connector is described in the detailed MOOS system design requirements section for the individual MOOS system components.
  - The serial interface must be able to generate a variable length "**BREAK**" command (continuous spacing state) to meet specific instrument requirements.
  - In addition to the standard instrument interface the MOOS instrument interface hardware must support easy adaptation/configuration to the following communications hardware standards through the use of adapter cards or jumpers.

EIA 485

IEEE 802.31 10BASE-T

- ESD: all external interfaces, including instrument interfaces, must be isolated to ESD level 4 per IEC 100-4-2 specifications
- ESD: all internal interfaces, including individual IBC PCB interfaces, must be isolated to ESD level 2 per IEC 100-4-2 specifications

TABLE 1. IEC 1000-4-2 SEVERITY LEVELS

LEVEL	TEST VOLTAGE, kV CONTACT DISCHARGE	TEST VOLTAGE, kV AIR DISCHARGE
1	2	2
2	4	4
3	6	8
4	8	15

Controller:

- The controller must monitor internal pressure in all controller housings
- The controller must monitor internal relative humidity in all controller housings
- The controller must monitor internal temperature in all controller housings
- The controller must be able to relay it's present position to shore
  - ideally the buoy location will be obtained at shore from two independent reliable systems
- The controller must communicate with benthic nodes via fiber optic conductors
- An external interface, preferably accessible from shore, must be available to reset the surface node.

Power:

- system energy, data and weight requirements as listed in MOOS System Design Requirements
- POWER: The controller and controller functionality must not consume more than 20% of the system's average available power (which is?)
- VOLTAGE: The unit must operate on an input voltage, supplied from the power subsystem, in the range of $11.7V_{DC}$-10.26% to $14.4V_{DC}$+4.17%.
- TRANSIENT: The unit must operate, without interruption, while withstanding non-repetitive 1ms surges to $+20V_{DC}$ absolute.
- The system should be power managed, placed in a sleep state, but must wake-up to respond to events within the times defined in the functional requirements.
- The surface node must monitor and log power system parameters including, but not limited to:
  - power generation voltage(s) and current(s)
  - surface buoy power storage voltage(s) and current(s)
  - riser cable bus voltage(s) and current(s)
- power must be completely isolatable in order to isolate a ground fault in the system.
  - electrical isolation from seawater ground must be greater than 500 MOhm at 500VDC for all signals, except through a ground fault detection circuit.
  - the ground fault circuit must have reliable access to seawater ground

Data:

- all data must be stored locally within the MOOS hardware system and be recoverable during a normal maintenance cycle
- The MOOS hardware or individual instruments must contain enough memory storage (which is?) to retain all data gathered between normal maintenance intervals + 50% safety factor
- All data is saved per conditions stated in MOOS System Design Requirements
- the local storage capacity required should allow data logging for instruments that do not store their data internally for a minimum one year nominal time between mooring system maintenance cycles
- must provide a minimal data set, such as daily averages, still visual images, event logs, or event "snap-shots"
- Time synchronization across the MOOS network must be less than or equal to 1 millisecond to meet the requirements of seismic data sampling

Housings (Mechanical):

- WEIGHT: housings must be able to be carried by one person (quantify this?)
- DIMENSIONS: housings must fit in the interior of the buoy tower, preferably standing vertically next to one leg of the tower
- Connectors and caps must not be closer than 3/4" to ensure that reasonably sized fingers can disconnect them.
- pressure seals must survive without maintenance during deployment duration

Software Interface:

- The controller must be compatible with ISI/SIAM
- All firmware must be externally upgradeable without opening the housing