Unit Tests for Bosal

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REVISION HISTORY

NUMBER	DATE	DESCRIPTION	NAME
0.1	July 17, 2018	Initial separation of test cases from main bosal program.	GAM

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Introduction

This document contains a set of unit tests for test harnesses generated by the `bosal` program. The tests presented here exercise the command interface to a test harness as generated by `bosal`. The test harness used in the tests is an integration of the automated lubrication and signal I/O domains from the book, *Models to Code*.

These two domains are integrated together and `bosal` is used to supply a minimal `main()` function required to create an executable program. The tests are accomplished using Tcl and the `tcltest` package. The test program starts the execution of the integrated domains and then connects a socket to the localhost port used by `bosal` test harnesses for communications. Commands sent to the test harness are simple ASCII records with minimal syntax. Responses are retrieved from the same socket. There are a number of Tcl commands defined in the test program that are used for the communicating to the test harness. These are discussed below.

Null Command

```
<<bosal harness tests>>=
test null-1.0 {
    Null command test
} -setup {
} -cleanup {
} -body {
    harnessCmdResp null
} -result {}
```

```
<<bosal harness tests>>=
test null-2.0 {
    Null command with wrong argument count
} -setup {
} -cleanup {
} -body {
    harnessCmdResp null foo
} -result {wrong # of arguments, 2: expected, null} -returnCodes error
```

Version Command

```
<<bosal harness tests>>=
test version-1.0 {
    Version command test
} -setup {
} -cleanup {
} -body {
    set version [harnessCmdResp version]
    log::info "testing harness created by bosal $version"
    return $version
} -result {1.2.3}
```

Query Domains

```
<<bosal harness tests>>=
test query-domains-1.0 {
    query domains successfully
} -setup {
} -cleanup {
```

```
} -body {
    harnessCmdResp query domains
} -result {lube sio}
```

```
<<bosal harness tests>>=
test query-domains-2.0 {
    query domains with too many arguments
} -setup {
} -cleanup {
} -body {
    harnessCmdResp query domains foo
} -result {wrong # of arguments, 3: expected, "query domains"} -returnCodes error
```

Query Domain Operation Parameters

```
<<bosal harness tests>>=
test query-doparams-1.0 {
    No parameters
} -setup {
} -cleanup {
} -body {
    harnessCmdResp query doparams lube init
} -result {}
```

```
<<bosal harness tests>>=
test query-doparams-2.0 {
    Some parameters
} -setup {
} -cleanup {
} -body {
    harnessCmdResp query doparams sio Read_point
} -result {pid SioPointID_t}
```

```
<<bosal harness tests>>=
test query-doparams-3.0 {
    Bad domain
} -setup {
} -cleanup {
} -body {
    harnessCmdResp query doparams foo Read_point
} -result {unknown domain, "foo"} -returnCodes error
```

```
<<bosal harness tests>>=
test query-doparams-3.1 {
    Bad domain operation name
} -setup {
} -cleanup {
} -body {
    harnessCmdResp query doparams sio foo
} -result {unknown operation, "foo"} -returnCodes error
```

Query Classes

```
<<bosal harness tests>>=
test query-classes-1.0 {
    query lube classes
} -setup {
} -cleanup {
} -body {
    harnessCmdResp query classes lube
} -result {Lubrication_Schedule Injector_Design Injector Autocycle_Session Machinery  ↩
    Reservoir}
```

```
<<bosal harness tests>>=
test query-classes-2.0 {
    query classes -- unknown domain
} -setup {
} -cleanup {
} -body {
    harnessCmdResp query classes foo
} -result {unknown domain, "foo"} -returnCodes error
```

```
<<bosal harness tests>>=
test query-classes-2.1 {
    query classes -- wrong number of arguments
} -setup {
} -cleanup {
} -body {
    harnessCmdResp query classes foo bar
} -result {wrong # of arguments, 4: expected, "query classes <domain>"}\
-returnCodes error
```

Query Attributes

```
<<bosal harness tests>>=
test query-attributes-1.0 {
    Query attributes of the Injector_Design class in the lube domain
} -setup {
} -cleanup {
} -body {
    harnessCmdResp query attributes lube Injector_Design
} -result {Delivery_window Good_injection_duration Max_dissipation_pressure  ↩
    Max_system_pressure Min_delivery_pressure Model}
```

```
<<bosal harness tests>>=
test query-attributes-2.0 {
    query attributes -- too many arguments
} -setup {
} -cleanup {
} -body {
    harnessCmdResp query attributes lube Injector_Design foo
} -result {wrong # of arguments, 5: expected, "query attributes <domain> <class>"}\
-returnCodes error
```

```
<<bosal harness tests>>=
test query-attributes-2.1 {
    query attributes -- too few arguments
} -setup {
} -cleanup {
} -body {
```

```
    harnessCmdResp query attributes lube
} -result {wrong # of arguments, 3: expected, "query attributes <domain> <class>"}\
-returnCodes error
```

```
<<bosal harness tests>>=
test query-attributes-2.2 {
    query attributes -- bad domain
} -setup {
} -cleanup {
} -body {
    harnessCmdResp query attributes foo bar
} -result {unknown domain, "foo"} -returnCodes error
```

```
<<bosal harness tests>>=
test query-attributes-2.3 {
    query attributes -- bad class
} -setup {
} -cleanup {
} -body {
    harnessCmdResp query attributes lube foo
} -result {unknown class, "foo"} -returnCodes error
```

Query Instances

```
<<bosal harness tests>>=
test query-instances-1.0 {
    query instances of Injector in lube domain
} -setup {
} -cleanup {
} -body {
    harnessCmdResp query instances lube Injector
} -result {total 3 named {in1 0 in2 1 in3 2}}
```

Query States

```
<<bosal harness tests>>=
test query-states-1.0 {
    query states of Reservoir class in lube domain
} -setup {
} -cleanup {
} -body {
    harnessCmdResp query states lube Reservoir
} -result {NORMAL LOW VERY_LOW EMPTY}
```

```
<<bosal harness tests>>=
test query-states-2.0 {
    query states of class with no state model
} -setup {
} -cleanup {
} -body {
    harnessCmdResp query states lube Injector_Design
} -result {}
```

Query Events

```
<<bosal harness tests>>=
test query-events-1.0 {
    query events of the Reservoir class in the lube domain
} -setup {
} -cleanup {
} -body {
    harnessCmdResp query events lube Reservoir
} -result {Low_injection_pressure Low_lube_level Normal_lube_level Too_many_low_lube_cycles ↩
    }
```

Query Event Parameters

```
<<bosal harness tests>>=
test query-evparams-1.0 {
    query event parameters of the Reservoir class in the lube domain
} -setup {
} -cleanup {
} -body {
    harnessCmdResp query evparams lube Reservoir Low_injection_pressure
} -result {}
```

```
<<bosal harness tests>>=
test query-evparams-2.0 {
    query event parameters of the Range_Limitation class in the sio domain
} -setup {
} -cleanup {
} -body {
    harnessCmdResp query evparams sio Range_Limitation New_point
} -result {pointValue SioPointValue_t}
```

Query Current State

```
<<bosal harness tests>>=
test query-current-1.0 {
    query current state of an Injector instance in the lube domain
} -setup {
} -cleanup {
} -body {
    harnessCmdResp query current lube Injector in1
} -result {SLEEPING}
```

```
<<bosal harness tests>>=
test query-current-2.0 {
    query current state for class with no state model
} -setup {
} -cleanup {
} -body {
    harnessCmdResp query current lube Injector_Design ihn4
} -result {Class does not have a state model}\
-returnCodes error
```

Domain Operations

```
<<bosal harness tests>>=
test domainop-1.0 {
    Unknown domain
} -setup {
} -cleanup {
} -body {
    harnessCmdResp domainop foo init
} -result {unknown domain, "foo"} -returnCodes error
```

```
<<bosal harness tests>>=
test domainop-1.1 {
    No operation name
} -setup {
} -cleanup {
} -body {
    harnessCmdResp domainop sio
} -result {wrong # of arguments: 2: expected, domainop <domain> <operation> ?<arg1> <arg2>  ↩
    ...?}\
-returnCodes error
```

```
<<bosal harness tests>>=
test domainop-1.2 {
    Unknown operations
} -setup {
} -cleanup {
} -body {
    harnessCmdResp domainop sio foo
} -result {unknown operation, "foo"} -returnCodes error
```

```
<<bosal harness tests>>=
test domainop-1.3 {
    Missing operation argument
} -setup {
} -cleanup {
} -body {
    harnessCmdResp domainop lube Suspend_Autocycle_Session
} -result {wrong # arguments: got 0, expected 1} -returnCodes error
```

```
<<bosal harness tests>>=
test domainop-1.4 {
    Bad operation argument
} -setup {
} -cleanup {
} -body {
    harnessCmdResp domainop lube Suspend_Autocycle_Session foo
} -result {bad parameter: "foo"} -returnCodes error
```

```
<<bosal harness tests>>=
test domainop-2.0 {
    Initialize lube domain
} -setup {
} -cleanup {
} -body {
    harnessCmdResp eloop halt
    harnessCmdResp domainop lube init
} -result {}
```

```
<<bosal harness tests>>=
test domainop-2.1 {
    Initialize sio domain
} -setup {
} -cleanup {
} -body {
    harnessCmdResp domainop sio init
} -result {}
```

Read Attribute

```
<<bosal harness tests>>=
test read-1.0 {
    Read a single attribute
} -setup {
} -cleanup {
} -body {
    set result [harnessCmdResp read lube Injector_Design ihn4 Model]
    dict get $result Model
} -result {IHN4}
```

```
<<bosal harness tests>>=
test read-2.0 {
    Read all attributes
} -setup {
} -cleanup {
} -body {
    set result [harnessCmdResp read lube Injector_Design ihn4]
    set nattrs [dict size $result]
    set model [dict get $result Model]
    expr {$nattrs == 6 && $model eq "IHN4"}
} -result {1}
```

```
<<bosal harness tests>>=
test read-3.0 {
    Unknown attribute
} -setup {
} -cleanup {
} -body {
    harnessCmdResp read lube Injector_Design ihn4 foo
} -result {unknown attribute, "foo"} -returnCodes error
```

```
<<bosal harness tests>>=
test read-3.1 {
    Unknown attribute in a group
} -setup {
} -cleanup {
} -body {
    harnessCmdResp read lube Injector_Design ihn4 Model foo
} -result {unknown attribute, "foo"} -returnCodes error
```

Update Attribute

```
<<bosal harness tests>>=
test update-1.0 {
    Update a single attribute
} -setup {
    set oldwindow [dict get\
        [harnessCmdResp read lube Injector_Design ihn4 Delivery_window]\
        Delivery_window]
} -cleanup {
    harnessCmdResp update lube Injector_Design ihn4 Delivery_window $oldwindow
} -body {
    harnessCmdResp update lube Injector_Design ihn4 Delivery_window 42
    set result [harnessCmdResp read lube Injector_Design ihn4 Delivery_window]
    dict get $result Delivery_window
} -result {42}
```

State Machine Traces

```
<<bosal harness tests>>=
test trace-1.0 {
    Get trace status
} -setup {
} -cleanup {
} -body {
    harnessCmdResp trace
} -result {off}
```

```
<<bosal harness tests>>=
test trace-2.0 {
    Turn tracing on
} -setup {
} -cleanup {
    harnessCmdResp trace off
} -body {
    harnessCmdResp trace on
} -result {on}
```

```
<<bosal harness tests>>=
test trace-3.0 {
    Bad trace option
} -setup {
} -cleanup {
} -body {
    harnessCmdResp trace foo
} -result {unknown trace option, "foo": expected, "on | off"} -returnCodes error
```

```
<<bosal harness tests>>=
test trace-3.1 {
    Wrong number of trace arguments
} -setup {
} -cleanup {
} -body {
    harnessCmdResp trace on heavy
} -result {wrong # of arguments: 3: expected, "trace ?on | off?"}\
-returnCodes error
```

Run Event Loop

```
<<bosal harness tests>>=
test eloop-1.0 {
    Dispatch one event from the event loop
} -setup {
} -cleanup {
} -body {
    harnessCmdResp trace on
    for {set i 0} {$i < 10} {incr i} {
        harnessCmdResp eloop once
        set trace [waitForEventTrace type transition]
    }

    dict get $trace target
} -result {Reservoir.res2}
```

Instrumentation Traces

```
<<bosal harness tests>>=
test instr-1.0 {
    Instrumentation traces
} -setup {
    harnessCmdResp instr on
} -cleanup {
    harnessCmdResp instr off
} -body {
    harnessCmdResp domainop sio Read_point 0
    set match [waitForInstrTrace message *Continuous_Point_readPoint*]
    return [dict get $match message]
} -result {sio: Continuous_Point_readPoint:*} -match glob
```

Fatal Error Traces

```
<<bosal harness tests>>=
test fatal-1.0 {
    Fatal error traces
} -setup {
} -cleanup {
} -body {
    harnessCmdResp signal lube Injector in3 Good_injection
    catch {harnessCmdResp eloop once}
    set match [waitForFatalTrace message *]
    return [dict get $match message]
} -result {*CH*} -match glob
```

Signal Event

```
<<bosal harness tests>>=
test signal-1.0 {
    signal an event
} -setup {
    harnessCmdResp trace on
```

```
    set insts [harnessCmdResp query instances lube Reservoir]
    set res [lindex [dict get $insts named] 0]
    set res_state [harnessCmdResp query current lube Reservoir $res]
    log::debug "reservoir state = $res_state"
} -cleanup {
    harnessCmdResp trace off
} -body {
    harnessCmdResp signal lube Reservoir $res Low_lube_level
    harnessCmdResp eloop once
    set trace [waitForEventTrace type transition event Low_lube_level]
    dict get $trace newstate
} -result {LOW}
```

```
<<bosal harness tests>>=
test signal-2.0 {
    signal an event, unknown instance
} -setup {
} -cleanup {
} -body {
    harnessCmdResp signal lube Reservoir foo Low_lube_level
} -result {unknown instance, "foo"} -returnCodes error
```

```
<<bosal harness tests>>=
test signal-2.1 {
    signal an event, unknown event
} -setup {
} -cleanup {
} -body {
    harnessCmdResp signal lube Reservoir res1 foo
} -result {unknown event, "foo"} -returnCodes error
```

```
<<bosal harness tests>>=
test signal-2.2 {
    signal an event, bad parameter count
} -setup {
} -cleanup {
} -body {
    harnessCmdResp signal lube Reservoir res1 Low_lube_level 100
} -result {wrong # arguments: got 1, expected 0} -returnCodes error
```

Delayed Signal

```
<<bosal harness tests>>=
test delaysignal-1.0 {
    delayed signaling
} -setup {
    harnessCmdResp trace on
} -cleanup {
    harnessCmdResp trace off
} -body {
    harnessCmdResp delaysignal lube Reservoir res2 1000 Low_lube_level
    set start [clock milliseconds]
    harnessCmdResp eloop toc wait

    set trace [waitForEventTrace type transition event Low_lube_level]
    set end [clock milliseconds]

    set wait [expr {$end - $start}]
```

```
    log::debug "measured $wait delay"
    expr {$wait >= 1000 && $wait < 1100}
} -result {1}
```

Cancel Delayed Signal

```
<<bosal harness tests>>=
test cancel-1.0 {
    cancel a delayed signal
} -setup {
    harnessCmdResp trace on
} -cleanup {
    harnessCmdResp trace off
} -body {
    harnessCmdResp delaysignal lube Reservoir res2 1000 Normal_lube_level
    after 200
    harnessCmdResp cancel lube Reservoir res2 Normal_lube_level
    waitForEventTrace type transition event Normal_lube_level
} -result {timed out on receiving event traces} -returnCodes error
```

Time Remaining for a Delayed Signal

```
<<bosal harness tests>>=
test remaining-1.0 {
} -setup {
} -cleanup {
    harnessCmdResp cancel lube Reservoir res2 Normal_lube_level
} -body {
    harnessCmdResp delaysignal lube Reservoir res2 1000 Normal_lube_level
    after 200
    set remaining [harnessCmdResp remaining lube Reservoir res2\
            Normal_lube_level]
    log::debug "remaining time = $remaining ms"
    expr {$remaining > 600 && $remaining <= 800}
} -result {1}
```

Create an Instance

```
<<bosal harness tests>>=
test create-1.0 {
    create an instance of Reservoir
} -setup {
} -cleanup {
    harnessCmdResp delete sio Conversion $inst
} -body {
    set inst [harnessCmdResp create sio Conversion]
    log::debug "created instance, \"$inst\""
    return $inst
} -result {[0-9]} -match regexp
```

Create an Instance Asynchronously

```
<<bosal harness tests>>=
test createasync-1.0 {
    create instance asynchronously
} -setup {
    harnessCmdResp trace on
} -cleanup {
    harnessCmdResp trace off
} -body {
    harnessCmdResp signal lube Autocycle_Session acs3 Change_schedule Test2
    harnessCmdResp eloop toc
    set trace [waitForEventTrace type creation]
    waitForEventTrace type transition event Created
    return [dict get $trace event]
} -result {New_session}
```

Code Organization

Test Utility Procedures

```
<<test utility procs>>=
proc startHarnessExec {logfile} {
    exec ./ls_harness > $logfile &
    after 500
}
```

```
<<test utility procs>>=
proc setupHarnessComm {{port 3906}} {
    log::info "connecting to localhost:$port"
    variable hchan [socket localhost $port]
    chan configure $hchan -blocking true -buffering line
    chan event $hchan readable\
        [list [namespace current]::handleHarnessInput $hchan]
}
```

```
<<test utility procs>>=
proc cleanupHarnessComm {} {
    variable hchan
    catch {chan close $hchan}
}
```

```
<<test utility procs>>=
proc putsToHarness {cmd} {
    variable hchan
    puts $hchan $cmd
}
```

```
<<test utility procs>>=
proc handleHarnessInput {chanId} {
    set llen [chan gets $chanId line]
    if {$llen == -1} {
        if {[chan eof $chanId]} {
            log::warn "EOF on harness input -- closing \"$chanId\""
            chan close $chanId
        } elseif {[chan blocked $chanId]} {
```

```
            log::notice "partial line received"
        }
        return
    }

    if {$llen != 0} {
        log::debug "harness response: \"$line\""

        lassign $line resp_type resp_value

        switch -exact -- $resp_type {
            cmd {
                handleCmdResponse $resp_value
            }
            trace {
                handleTraceResponse $resp_value
            }
            fatal {
                handleFatalResponse $resp_value
            }
            instr {
                handleInstrResponse $resp_value
            }
            default {
                error "unknown response type, \"$resp_value\""
            }
        }
    }
}
```

```
<<test utility variables>>=
variable cmdTimeout 3000
variable cmdPattern
variable cmdSyncVar {}
```

```
<<test utility procs>>=
proc harnessCmdResp {args} {
    variable cmdPattern
    variable cmdTimeout
    set cmdPattern [dict create\
        name [lindex $args 0]\
        timer [after $cmdTimeout [namespace code cmdTimeout]]
    ]
    putsToHarness $args

    set response [waitForCmdResponse]
    set result [dict get $response result]
    if {[dict get $response status] eq "error"} {
        error $result
    }
    return $result
}
```

```
<<test utility procs>>=
proc handleCmdResponse {respValue} {
    variable cmdPattern

    set expectedName [dict get $cmdPattern name]
    set recvdName [dict get $respValue name]

    if {[string match $expectedName $recvdName]} {
```

```
        signalCmdResponse $respValue
    } else {
        log::error "expected response to $expectedName command,\
                got response to $recvdName command"
        signalCmdResponse ERROR
    }
}
```

```
<<test utility procs>>=
proc cmdTimeout {} {
    set [namespace current]::cmdSyncVar TIMEOUT
}
```

```
<<test utility procs>>=
proc signalCmdResponse {value} {
    set [namespace current]::cmdSyncVar $value
}
```

```
<<test utility procs>>=
proc waitForCmdResponse {} {
    vwait [namespace current]::cmdSyncVar
    variable cmdPattern
    variable cmdSyncVar

    if {$cmdSyncVar eq "TIMEOUT"} {
        error "timeout for command, \"[dict get $cmdPattern name]\""
    } elseif {$cmdSyncVar eq "FATAL"} {
        error "fatal error while executing, \"[dict get $cmdPattern name]\""
    } else {
        after cancel [dict get $cmdPattern timer]
    }

    if {[dict get $cmdSyncVar name] ne [dict get $cmdPattern name]} {
        error "expected response for command, \"[dict get $cmdPattern name]\",\
                got, \"[dict get $cmdSyncVar name]\""
    }
    return $cmdSyncVar
}
```

```
<<test utility variables>>=
variable traceSyncVar {}
variable tracesReceived [::struct::queue]
variable traceTimeout 3000
```

```
<<test utility procs>>=
proc handleTraceResponse {respValue} {
    variable tracesReceived

    $tracesReceived put $respValue

    set [namespace current]::traceSyncVar TRACE
}
```

```
<<test utility procs>>=
proc waitForEventTrace {args} {
    variable tracesReceived
    variable traceSyncVar
    variable traceTimeout
```

```
    set expect $args
    while {true} {
        while {[$tracesReceived size] != 0} {
            set actual [$tracesReceived get]

            set traceMatched 0
            dict for {key value} $expect {
                if {[dict exists $actual $key] &&\
                        [string match $value [dict get $actual $key]]} {
                    incr traceMatched
                }
            }
            if {$traceMatched == [dict size $expect]} {
                return $actual
            } else {
                log::notice "discarding trace, \"$actual\":\
                        failed to match, \"$expect\""
            }
        }

        set timer [after $traceTimeout [namespace code traceTimeout]]
        vwait [namespace current]::traceSyncVar
        if {$traceSyncVar eq "TIMEOUT"} {
            error "timed out on receiving event traces"
        } else {
            after cancel $timer
        }
    }
}
```

```
<<test utility procs>>=
proc traceTimeout {} {
    set [namespace current]::traceSyncVar TIMEOUT
}
```

```
<<test utility variables>>=
variable instrSyncVar {}
variable instrReceived [::struct::queue]
variable instrTimeout 3000
```

```
<<test utility procs>>=
proc handleInstrResponse {respValue} {
    variable instrReceived

    $instrReceived put $respValue

    set [namespace current]::instrSyncVar INSTR
}
```

```
<<test utility procs>>=
proc waitForInstrTrace {args} {
    variable instrReceived
    variable instrSyncVar
    variable instrTimeout

    set expect $args
    while {true} {
        while {[$instrReceived size] != 0} {
            set actual [$instrReceived get]
```

```
            set instrMatched 0
            dict for {key value} $expect {
                if {[dict exists $actual $key] &&\
                        [string match $value [dict get $actual $key]]} {
                    incr instrMatched
                }
            }
            if {$instrMatched == [dict size $expect]} {
                return $actual
            } else {
                log::notice "discarding instr, \"$actual\":\
                        failed to match, \"$expect\""
            }
        }

        set timer [after $instrTimeout [namespace code instrTimeout]]
        vwait [namespace current]::instrSyncVar
        if {$instrSyncVar eq "TIMEOUT"} {
            error "timed out on receiving instrumentation traces"
        } elseif {$instrSyncVar eq "FATAL"} {
            error "fatal error while waiting for instrumentation trace"
        } else {
            after cancel $timer
        }
    }
}
```

```
<<test utility procs>>=
proc instrTimeout {} {
    set [namespace current]::instrSyncVar TIMEOUT
}
```

```
<<test utility variables>>=
variable fatalSyncVar {}
variable fatalReceived [::struct::queue]
variable fatalTimeout 3000
```

```
<<test utility procs>>=
proc handleFatalResponse {respValue} {
    variable fatalReceived

    $fatalReceived put $respValue

    set [namespace current]::fatalSyncVar FATAL
    set [namespace current]::cmdSyncVar FATAL
    set [namespace current]::instrSyncVar FATAL
}
```

```
<<test utility procs>>=
proc waitForFatalTrace {args} {
    variable fatalReceived
    variable fatalSyncVar
    variable fatalTimeout

    set expect $args
    while {true} {
        while {[$fatalReceived size] != 0} {
            set actual [$fatalReceived get]

            set fatalMatched 0
```

```
            dict for {key value} $expect {
                if {[dict exists $actual $key] &&\
                        [string match $value [dict get $actual $key]]} {
                    incr fatalMatched
                }
            }
            if {$fatalMatched == [dict size $expect]} {
                return $actual
            } else {
                log::notice "discarding fatal, \"$actual\":\
                        failed to match, \"$expect\""
            }
        }

        set timer [after $fatalTimeout [namespace code fatalTimeout]]
        vwait [namespace current]::fatalSyncVar
        if {$fatalSyncVar eq "TIMEOUT"} {
            error "timed out on receiving fatal error response"
        } else {
            after cancel $timer
        }
    }
}
```

```
<<test utility procs>>=
proc fatalTimeout {} {
    set [namespace current]::fatalSyncVar TIMEOUT
}
```

Test Script

```
<<bosal-test.test>>=
#!/usr/bin/env tclsh
# DO NOT EDIT THIS FILE!
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#
<<copyright info>>

package require Tcl 8.6
package require cmdline
package require logger
package require struct::queue

set optlist {
    {level.arg warn {Logging level}}
    {nostart {Do not start harness executable}}
    {port.arg 3906 {TCP port for harness communications}}
    {log.arg {test.log} {Log file for harness output}}
}
array set options [::cmdline::getKnownOptions argv $optlist]

logger::setlevel $options(level)

package require tcltest
eval tcltest::configure $argv

namespace eval ::bosal::test {
    <<test utility variables>>
    <<test utility procs>>
}
```

```
namespace eval ::bosal::test {
    namespace import ::tcltest::*
    ::logger::initNamespace [namespace current] $::options(level)

    if {!$::options(nostart)} {
        startHarnessExec $::options(log)
    }
    setupHarnessComm $::options(port)

    <<bosal harness tests>>

    cleanupHarnessComm
    cleanupTests
}
```

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```
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```

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