Installation and Reference Guide
High Availability Virtualization
using HA-Lizard
with
Citrix XenServer

Version 2.1.3 - FINAL
December 2016

HA-Lizard: Open Source High Availability for XenServer
Project Sponsor: Pulse Supply http://www.pulsesupply.com

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##

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1. HA-Lizard Version 1.8

- **Purpose**

HA-lizard provides complete automation for managing Xen server pools which utilize the XAPI management interface and toolstack (as in Xen Cloud Platform and XenServer). The software suite provides complete HA features within a given pool. The overall design is intended to be lightweight with no compromise of system stability. Traditional cluster management suites are not required. HA is provided with built in logic for detecting and recovering failed services and hosts.

HA features provided:

- Auto-start of any failed VMs
- Auto-start of any VMs on host boot
- Detection of failed hosts and automated recovery of any affected VMs
- Detect and clean up orphaned resources after a failed host is removed
- Removal of any failed hosts from pool with takeover of services
- Fencing support for HP ILO, XVM and POOL fencing (forceful removal of host from pool)
- Split brain prevention using heuristics from external network points and quorum
- HA support for pools with two hosts
- Structured interface for simple "bolt-on" of fencing scripts
- Dual operating modes for applying HA to appliances or individual VMs
- Ability to exclude selected appliances and VMs from HA logic
- Auto detection of host status allows for safely working on hosts without disabling HA
- Centralized configuration for entire pool stored in XAPI database
- Command-line tool for managing global configuration parameters
- Parameter override available per host for custom configurations
- HA can be enabled/disabled via command line tool or graphical interface (like XenCenter)
- Extensive Logging capabilities to system log file
- Email alerting on configurable triggers
- Dynamic cluster management logic auto-selects roles and determines recovery policy
- No changes to existing pool configuration required. All logic is external.
- **No dependencies** – does not compromise pool stability or introduce complex SW packages. Designed to work with the resident packages on a standard XenServer host

Development is well tested and based on Xen Cloud Platform (XCP) version 1.6, XenServer 6.1, XenServer 6.x-7.x .

Release Notes

Version 1.6.40.4 - May 23, 2013

- Minor cosmetic fixes

- Corrected version number displayed when checking init script status

- Updated some default setting values to more common values

- Updated installation instructions

- Fixed missing variable in XVM expect/tcl script

Version 1.6.41 - June 27, 2013

- Improved host failure handling. No longer mandatory to "forget host" in order to recover pool. New logic will disable a failed host in the pool so that attempts to start VMs on a failed host will not be made. Previously it was mandatory to forget a failed host from the pool to ensure that no attempt was made to start a failed VM on a failed host.

- Improved installer better deals with upgrades and correctly resolves relative path to itself.

Version 1.6.41.4 - July 10, 2013

- Bug Resolved - two node pools failed to fence due to safety mechanism which prevents fencing when a Master cannot reach any slaves.

Version 1.6.42.3 - August 6, 2013

- Validated support for XenServer 6.2

- Updated ha-cfg tool to warn user that a reset is required when updating monitor timers

- Updated ha-cfg tool to warn that FENCE_HOST_FORGET will be deprecated

- Improved email alert handling prevents duplicate messages from being sent for a configurable timeout - default 60 minutes

- Updated email alert message notifying user of failed or started VM. Message now includes the VM name-label AND UUID

- Improved recovery from system crash which could erase configuration cache if crash occurs while updating configuration

- FD leak caused interrupted system calls which closed TCP sockets used to check host status - Moved TCP socket connection from FD to alternate method resolving issue with email alerts warning of failure to connect to HTTP port of slaves.

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Version 1.7.2 - October 2013

- Replaced email alert logic to prevent hanging when network or DNS is down

- Suppress email alerts to avoid sending useless alerts while HA-Lizard initializes

- New python driven MTA replaces mailx from previous version. Mailx is no longer required for alerts

- Resolved issue when using OP_MODE=1 managing appliances, UUID array was not properly read

Version 1.7.6 - December 2013

- Resolved improperly handled exit status when fencing

- Updated fencing logic. A slave must have quorum AND fence a master before promoting itself to pool master

- A slave that fails to fence a master and does not achieve quorum will now self fence with a reboot. After reboot, slave's VMs will be off.

- Master now only clears power states after successfully fencing slave. Power states unaltered when fencing is disabled, no quorum or fails.

- Clear potential dangling logger processes that could occur on unclean exit or bad configuration parameters

- Updated init script now manages logger processes

- Added HA suspension for self fenced slaves which disables HA to protect a potential split pool.

- CLI tool now warns when HA is suspended due to a fencing event

- Added email alert notification for HA suspend event

- Added script for re-enabling HA when HA-Lizard is suspended - see docs on events that can cause HA suspension

- CLI tool improved to avoid creating orphaned processes while pool is broken and called from a slave

Version 1.7.7 - May 2014

- Optimized default settings for a 2-node pool configuration

Version 1.7.8 - July 2014

- CLI arguments for "set" are no longer case sensitive - ie. "ha-cfg set mail_on 0" OR "ha-cfg set MAil_oN 0" OR "ha-cfg set MAIL_ON 0" are all valid

- Added validation to check whether XenServer HA is enabled - will warn via log and email alert and disable HA-Lizard if XenServer HA is detected

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Version 1.8.5 - Feb 2015

- Preliminary validation against XenServer 6.5 completed

- updated CLI insert function to skip over parameters that already exist in the DB to support completely automatic installation

- updated installation script requires less user input

- --nostart argument now accepted by installer

- updated CLI for compatibility with noSAN installer

- Bug Fix - improperly handled command substitution fixed

- Updated email handler eliminates dependency on sendmail

- Email debug and test option added to CLI for troubleshooting email settings

- Additional email configuration parameters added to database and CLI <smtp_server, smtp_port, smtp_user, smtp_pass>

Version 1.8.7 - May 2015

- added Fujitsu iRMC fencing support

- added tab completion for ha-cfg CLI. Dynamic context aware completion resolves all possible valid inputs

- display bug resolved which was displaying an error when get-vm-ha was called and VMs HA state was set to NULL

- bug fix - installer was not properly setting permissions on fence methods

Version 1.8.8 – September 2015

- Improved pool state caching now updates state files while HA is disabled (and service is still running). Resolves issues with pool changes not being cached while HA is disabled or maintenance operations underway

- Reduced wait states while checking for failed hosts to respond. Recovery time is now reduced ~ XAPI_COUNT X 10 seconds.

- Fixed get-vm-ha results which were not properly displayed when VM name label contained spaces

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- Improved behavior of configuration cache updates. Global settings are now updated on all pool members regardless of whether HA is enabled. Old behavior only updated global configuration params while HA was enabled.

Version 1.8.9 - June 2016

- New logic introduced: when reboot_lone_host=1 in a 2-node pool, master will self fence with a reboot upon loss of management network AND slave not visible. Self fencing allows the slave to assert primary storage role in the event that the storage link is active which would lock the master's DRBD role as Primary. This logic helps in situations where STONITH should really be used (and isn't) to shutdown the master.

- Bug Fix - When op_mode=1 (HA for appliances), setting a description for the appliance caused erroneous email alerts to be triggered. Resolved.

Version 1.9.1 - October 2016

- Improved logic for finding own hosts UUID. Previous logic depended on the host name-label matching the hostname. This caused problems in cases where users modified the system hostname. Updated logic is no longer dependent on name-label and allows for freely modifying default system hostname.

- Added master management link state tracking to allow for clean re-entry into a pool where the master has been fenced due to management link being DOWN.

- New logic prevents master from entering maintenance mode while HA-Lizard is enabled

- check_slave_status will now check manegement link state if failures are detected

- bugfix - slave was tracking whether it was in maintenance mode and would re-enable itself upon detection causing reboots to abort.

- bugfix - in certain conditions, HA could become disabled due to stale DB entry after fencing a master. Condition is now checked on success of promote_slave

- Added shutdown of all VMs on a master that lost its management link

- Improved speed of shutdown of master's VMs when the master has lost its management link.

- Improved status display from CLI now displays status of HA and associated daemons.

- bugfix - html body of email alerts were missing newline characters

- Added pool status report to email alerts

- Added validation of all VM ha-enabled state to ensure newly introduced VMs have a valid state set

Version 1.9.1.1 - November 2016

- bugfix - updated various functions to no longer depend on name-label=hostname.

```
#################################################
## Begin XenServer Version 7+ support
## Prior 1.x releases for XenServer 6.X only
#################################################
```

Version 2.0 - July 2016

- Updated version for compatibility with XenServer 7 dom0

- Improved error capturing and logging

- New init logic compatible with systemd requirements to enable operation on CentOS 7 style dom0

- Updated CLI call to log

- HA-Lizard init script updated to ALWAYS start watchdog on start.

Version 2.1.0 - November 2016

- Improved logic for finding own hosts UUID. Previous logic depended on the host name-label matching the hostname. This caused problems in cases where users modified the system hostname. Updated logic is no longer dependent on name-label and allows for freely modifying default system hostname.

- Added master management link state tracking to allow for clean re-entry into a pool where the master has been fenced due to management link being DOWN.

- New logic prevents master from entering maintenance mode while HA-Lizard is enabled

- check_slave_status will now check management link state in case failures are detected. Don't waste time checking slaves the master cannot get to

- bugfix - in certain conditions, HA could become disabled due to stale DB entry after fencing a master. Condition is now checked on success of promote_slave

- Added shutdown of all VMs on a master that lost its management link

- Added master management link tracking in support new logic which evacuates VMs from a master that lost its management link

- Improved speed of shutdown of master's VMs when the master has lost its management link. Improvement will launch several parallel processes to speed up the shutown of VMs

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- Added handling of XenServer bug XSO-586. In certain network environments, xapi requires some delay before starting. Toolstack will restart on first iteration/boot. (!! EXPERIMANTAL)

- Improved status display from CLI now displays status of HA and associated daemons.

- bugfix - html body of email alerts were missing newline characters

- Added pool status report to email alerts

- Added validation of all VM ha-enabled state to ensure newly introduced VMs have a valid state set

- Added host health status tracking in support of improved host selection logic when starting a VM. HOST_SELECT_METHOD configuration parameter added for backward compatibility.

  HOST_SELECT_METHOD=1 preserves old behavior. When a Master fences a slave, connection to xencenter will be lost and API restarted

  HOST_SELECT_METHOD=0 new logic. Tracks all host statuses and more intelligently selects a host to start a VM on. XenCenter connectivity not lost.

- bugfix - updated various functions to no longer depend on name-label=hostname.

Version 2.1.1 - November 2016
- bugfix - Updated init which was not killing timed out calls to API when connecting from a slave

- added timeout handling to CLI to deal with situations where XAPI is unresponsive

- updated default installation parameters to support 2-node HA with no configuration changes required

- added pool VM running state validation to slaves to ensure local VMs are not running elsewhere

- reintroduction delay when master regains its MGT link is now dynamically calculated based on xapi_delay and xapi_count params to ensure a slave has enough time to recover

  pool before reintroducing a former master that lost its management link.

- bugfix - erroneous log stated VM started but there was no host to start the VM on.

- added CLI option "retsore-default" to restore default configurartion. Updated tab completion

Version 2.1.2 - November 2016
- Improved VM recovery time by no longer waiting for a failed slave to respond in certain situations.

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- Added variable timeout call handling to API to handle certain long running functions

- Improved resetting of powerstates that timed out in some cases where slave was fenced but still showing as enabled in XAPI DB

- bugfix- In rare cases, certain crash scenarios left hung VMs. Master detects this and cleans up innapropriate states.

- Added master role validations to capture rare cases that leave no pool master

- Added auto removal of slave suspended-HA mode. New logic no longer requires manual intervention. Health status tracking is used to remove the suspension automatically.

- bugfix - in certain rare situations vm state validation failed due to missing or corrupted stored local host UUID. Addl validations added.

- Helpfile updates

Version 2.1.3 - December 2016

- Added ha-status, ha-enable, ha-disable actions to CLI tool. Helpful when calling ha-cfg from external scripts

- Updated tab completion - added new cli command 'restore-default' and added restrictions on set-vm-ha/get-vm-ha to exclude snapshots

- Added restriction to omit snapshots from list of pool VMs which could cause erroneous alerts when taking snapshots.

- Improved speed of cli command get-vm-ha

- bugfix - status displayed control characters in 6.x deployments

- unified codebase. Merged with 1.9.1

- Updated init for backward compatibility with xenserver 6.x environments

- bugfix - deal with path to list_domains transparently irrespective of dom0 release

- added legacy xenops detection/support for xenserver 6.x environments

- replaced host selection logic to be backward compatible

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2. Installation

An included installer is designed for default XenServer or XCP systems based on Centos DomOs. Manual installation is required for non XenServer XAPI environments. The following installation instructions will work with a standard ISO install of XCP version 1.6 or XenServer version 6.1-6.5 or XenServer 7.x.

Installing

- Copy the source tarball into a temporary location (ex. /tmp/)

- Extract its contents and move into the extracted folder
  tar –zxvf ha-lizard-*.tgz

- Move into the "scripts" folder
  cd ha-lizard-*/scripts

- Run the installer
  ./install

The installer will install the default pool parameter set in the XAPI database. This step is only required on a single host.

Once the installer is completed, HA and watchdog services will be started. Although these services are running, HA is disabled for the pool by default. HA can then be enabled via the command line tool <ha-cfg> to enable HA once installation has been completed on all hosts within a pool.

- **Removing**

An uninstall script is provided. This will completely remove all components from the host. If uninstalling on a single host (leaving other hosts in the pool), skip the step which removes the settings stored in the XAPI database.

- **Installing on non XenServer Dom0 based systems**

A non-CentOS based Dom0 is not supported. The following steps will get most of the functionality working with the exception of init and watchdog scripts which are critical in HA recovery operations. During a recovery operation it is very likely that the HA processes will be intentionally stopped due to slaves being unable to connect to XAPI upon loss of communication with a master. A watchdog is expected to restart HA threads within a few seconds, only this time hosts use data stored in their local cache to recover a pool rather than attempt communication with XAPI which may be unresponsive.

- Copy the source tarball into a temporary location (ex. /tmp/)

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- Extract its contents
  tar –zxvf ha-lizard-*.tgz

- Rename and copy the source directory to /etc/
  mv ha-lizard-* ha-lizard
  cp –r ha-lizard /etc/

- Insert the default pool settings into the XAPI database (this steps needs to be completed only one time on any of the pool hosts)
  /etc/ha-lizard/scripts/ha-cfg insert

- Insert custom field used to toggle HA on/off
  xe pool-param-add uuid=`xe pool-list –minimal` param-name=other-config XenCenter.CustomFields.ha-lizard-enabled=false

- Insert custom field used to track the autopromote-uuid
  xe pool-param-add uuid==`xe pool-list –minimal` param-name=other-config autopromote_uuid=""

- Start the service in the background
  /etc/ha-lizard/scripts/ha-lizard.mon &
  IMPORTANT: To ensure proper operation on non CentOS based Dom0, a watchdog service must be added to watch ***/etc/ha-lizard/scripts/ha-lizard.mon*** and restart it upon failure.

3. Configuring

- **ha-cfg tool**

A command line tool is provided with the package for managing configuration and enabling/disabling HA for the entire pool. Usage is displayed with "ha-cfg –help".

```
HA-Lizard Command Line Interface
Pool Configuration and Monitoring Tool for xen/xapi High Availability
Usage: ha-cfg <action> <values for selected action>

Available actions:
<help>:              Display help for parameter settings
<ha-status>          Displays HA status as true or false
<ha-enable>          Enables pool HA
<ha-disable>         Disables pool HA
<insert>:            Inserts default values into xapi pool database.
                     Use with caution. Intended for a fresh install
                     or repair of existing installation.
<remove>:            Removes all custom fields from xapi pool database
                     Use caution. Intended to repair existing installation.
<log>:               Watch HA log file output in real time
<get>:               Lists all HA params and values stored in pool database
<set>:               Sets the specified parameter to the specified value.
                     ex. [ha-cfg set MAIL_ON 0] disables email alerts
                     Values with spaces should be wrapped in double quotes.
                     Usage <ha-cfg set [parameter] [value]>
<get-vm-ha>:         Lists all pool VMs and status of HA enabled for each VM
<set-vm-ha>:         Enable/Disable HA for the specified VM
                     Only needed when configured to individually select managed VMs
                     Usage <ha-cfg set-vm-ha [vm-name-label] [true or false]>
<status>:            Displays the HA operational status of the pool
                     and enables/disables HA for the pool.
<backup>:            Backup the global configuration and store in the specified location
                     Usage <ha-cfg backup /path/to/file/filename>
<restore>:           Restore the global configuration from the specified backup file
                     Usage <ha-cfg restore /path/to/file/filename>
<restore-default>:   Usage <ha-cfg restore-default>
                     Restores default installation settings
<email>:             Sends a test email message using the configured email settings
<email_debug>:       Sends a test email message using the configured email settings
                     and prints verbose debug to stdout <AKA the screen>
```

help

Display help for parameter settings

ha-status

Displays HA status as true or false

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ha-enable

Enables pool HA

ha-disable

Disables pool HA

insert

The default Centos based installer will run this tool with the "insert" option. This action should only be completed one time for an entire pool. Insert will create all the required global parameters and write them to the XAPI database with default values. This tool is helpful when installing on non-Centos based hosts where the default installer cannot be used. Running this manually will initialize all default values. Running this over an existing installation may overwrite the global pool parameters.

remove

The "remove" option will erase all global parameters from the XAPI database. This will essentially "clean" the database and should be performed only when removing HA from a pool manually. The provided uninstall script will execute this action by default.

log

The "log" action will invoke a simple logging utility that displays system logs written by HA. It is a convenient way to watch system behavior and useful in troubleshooting.

get

The "get" action lists all of the global parameters and their values. This is useful for checking the current configuration and also for retrieving the correct syntax of a parameter to be used in a "set" command

set

The "set" action is used modify the value of any global parameter. Set requires additional command line arguments as follows:

"ha-cfg set <parameter> <value>"

Where <parameter> is the name of the parameter to be updated (correct syntax of the parameter can be retrieved by invoking "ha-cfg get") and <value> is the new value for the given parameter. Check the configuration file documentation for a list of supported values.

get-vm-ha

The "get-vm-ha" action will list all VMs within a pool and display whether HA is enabled for each VM. Additional information is provided depending on the pool setting context. This tool is useful for quickly determining the HA status of any VM.

```
Pool OP_MODE is set to 2 - all VMs that require HA should have HA enabled.
Use [ha-cfg set-vm-ha ] to set HA status on VMs.

HA-Enabled  VM-UUID                               VM-Name
false       6c792e1a-d05a-0d54-4586-40d730912c25  cent1
true        a2bb1c52-1960-fd54-7a2f-4ba2fbd3e774  cent4
true        10e740e7-8ba6-85d0-7f57-0b727a6ec98b  cent3
unset       a89b52cd-a141-2de7-2603-56c83daec6d4  cent2
```

set-vm-ha

The "set-vm-ha" action is used to enable or disable HA for the specified VM name-label. The passed in name-label must exactly match the name of the VM. Value must be set to true or false.

```
> ./ha-cfg set-vm-ha cent4 false
UUID for cent4 found: a2bb1c52-1960-fd54-7a2f-4ba2fbd3e774
Updating VM:cent4 UUID: a2bb1c52-1960-fd54-7a2f-4ba2fbd3e774 to status: false
Success: VM: cent4 updated to HA status: false
Wait at least 45 seconds for changes to be applied
```

***Important: If the vm name-label has spaces, it must be wrapped in single or double quotes as follows:
ha-cfg set-vm-ha "VM name with spaces" true***

Status

The "status" action displays whether HA is enabled or disabled for the pool and allows for the toggling of the status. This should be used to enable/disable HA for the pool as shown below.

```
[root@dev1 ~]# ha-cfg status
-------------------------------------------------------------
| ha-lizard Version:    2.1.3                                |
| Operating Mode:       Mode [ 2 ] Managing Individual VMs in Pool |
| Host Role:            master                               |
| Pool UUID:            c2684a0e-1cc6-650e-cf60-ebfe230dc505 |
| Host UUID:            0c33d04e-19d2-4bad-896f-936df9c9e63f |
| Master UUID:          0c33d04e-19d2-4bad-896f-936df9c9e63f |
| Daemon Status:        ha-lizard is running [ OK ]          |
| Watchdog Status:      ha-lizard-watchdog is running [ OK ] |
| HA Enabled:           true                                 |
-------------------------------------------------------------
Pool HA Status: ENABLED
ha-lizard is enabled. Disable? <yes or Enter to quit>
```

Backup

Usage <ha-cfg restore /path/to/file/filename>

The backup command will create a backup file of the pool configuration settings for ha-lizard. A filename must be specified to declare the filename and path for the backup.

Restore

Usage <ha-cfg restore /path/to/file/filename>

The restore command will restore a previously backed up configuration file. A filename must be specified. The restore command need only be run on a single host in the pool (any host regardless of master/slave status) Settings are restored and applied to all hosts within the pool. When restoring new values for the monitor timers and monitor triggers, a restart of the ha-lizard service is necessary for a host to read in the new settings. The service is automatically restarted on the host where the restore command is called. It is advised that the service be restarted manually on any other hosts within the pool with "service ha-lizard restart".

restore-default

Usage <ha-cfg restore-default> Restores default installation settings

Email

Usage <ha-cfg email>

The email command will sent a test email alert using the configured email settings. This is useful to for testing the configured values to ensure that email alerting is working properly. Sample output is displayed below.

```
Sending email from: someuser@somedomain.com
Sending email to: someuser@somedomain.com
Email Alert Subject: SYSTEM_ALERT-FROM_HOST:xs6
Email Alert Timestamp: Tue Feb 10 09:55:20 EST 2015
Email Alert Process: ha-lizard Version: 1.8.5
Email Alert Message Content: Test Message ID d03d865a-5ed8-4a76-bf25-f608d2cbc089
Email Alert Message Hostname: xs6
```

Email_debug

Usage <ha-cfg email_debug>

The email_debug command is identical to the email command except that it will produce verbose SMTP log and output it to stdout. This is useful when troubleshooting SMTP problems.

- **Global Configuration**

Global configuration parameters are stored in the XAPI database shared by all hosts within a pool. A command-line tool, "ha-cfg", is provided for making changes to any of the global parameters. To view the current configuration, use "ha-cfg get". Sample output is shown below.

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```
DISABLED_VAPPS=()
ENABLE_LOGGING=1
FENCE_ACTION=stop
FENCE_ENABLED=1
FENCE_FILE_LOC=/etc/ha-lizard/fence
FENCE_HA_ONFAIL=0
FENCE_HEURISTICS_IPS=192.168.20.254
FENCE_HOST_FORGET=0
FENCE_IPADDRESS=
FENCE_METHOD=POOL
FENCE_MIN_HOSTS=2
FENCE_PASSWD=
FENCE_QUORUM_REQUIRED=1
FENCE_REBOOT_LONE_HOST=0
FENCE_USE_IP_HEURISTICS=1
GLOBAL_VM_HA=1
MAIL_FROM=root@localhost
MAIL_ON=1
MAIL_SUBJECT="SYSTEM_ALERT-FROM_HOST:$HOSTNAME"
MAIL_TO=root@localhost
MONITOR_DELAY=15
MONITOR_KILLALL=1
MONITOR_MAX_STARTS=20
MONITOR_SCANRATE=10
OP_MODE=2
PROMOTE_SLAVE=1
SLAVE_HA=1
SLAVE_VM_STAT=0
SMTP_PASS=localhost
SMTP_PORT="25"
SMTP_SERVER=localhost
SMTP_USER=localhost
XAPI_COUNT=2
XAPI_DELAY=10
XC_FIELD_NAME='ha-lizard-enabled'
XE_TIMEOUT=10
```

Any global configuration parameter can be updated using the "ha-cfg set" command. For example, to disable logging globally, use "ha-cfg set enable_logging 0"

- **Override Configuration**

By default, configuration settings for the entire pool are centrally stored and managed. A single set of configuration parameters is used across all hosts within a pool, regardless of whether a host is acting as the

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pool master or a slave. This makes management simple while eliminating the need to manage individual configuration files on each host within a pool.

In cases where a custom configuration is required for individual hosts within a pool, the system will allow for the override of any global settings. All override settings are stored in /etc/ha-lizard/ha-lizard.conf. By default, all settings are commented out of this file. Uncommenting a setting will override the global setting for a particular host on the next invocation of the HA logic loop.

This is useful in cases where custom settings are required for a host that should not be shared with other hosts in the pool. One example of a good use is the SLAVE_VM_STAT setting which determines whether Slaves within the pool will try to start any VMs that are not running. By default this is disabled and only the Master is configured to start VMs that should be running. The default settings work fine for a small pool, but, in very large pools it may take some time for the Master to loop through all VMs and check their status. Enabling SLAVE_VM_STAT on a few, but not all, Slaves will speed up the process of detecting VM failures and restoring services. In this case, the override settings can be used to enable this on only selected hosts.

- **Configuration Parameters**

HA Monitor Configuration

The HA service is run by a monitoring service which runs continuously. The following Monitor settings are used to configure the behavior of the monitor. The provided installer installs and configures the Monitor with default settings that are acceptable in most cases. Once installed, the Monitor will run continuously as a service. Status can be checked with "service ha-lizard status". As of version 1.7.7 the default parameter installed will be optimized for a 2-node pool with fast detection and switching of roles (failure detection in < 15 seconds).

Some values may need to be changed depending on the environment. Host performance (how long it takes to iterate through HA processes launched by the Monitor) and the size of the pool should be considered when setting these parameters.

The Monitor will launch several HA processes in a loop every 15 seconds (MONITOR_DELAY). The default setting of 15 seconds is intended for compact pools of 2-nodes. This value should be increased for larger pools. Generally 45 seconds is adequate for pools of 3-8 hosts. It is a good idea to watch the system logs to ensure that all the HA processes have finished running within the MONITOR_DELAY window. By increasing MONITOR_DELAY, it will take longer to detect a failure. Decreasing MONITOR_DELAY will more quickly detect failures and recover. System performance and preferences should be considered carefully.

monitor_max_starts

Threshold for when o assume running processes are not responding. Sets how many failed starts to wait before killing any hung processes. Use caution with this setting. It should be set relatively high as a pool recovery procedure will take considerably more time to execute causing the system to trigger logic which attempts to detect hung processes. Processes will generally never hang unless XAPI becomes totally

unresponsive. Logic is provided to abort attempts to connect to XAPI during a failure. In this case, local state files with pool state information from the last successful iteration will be used instead. Default = 20

monitor_killall

If MAX_MONITOR_STARTS threshold is reached - set whether to kill all ha-lizard processes. Default = 1
1 = yes, 0 = no

monitor_delay

Delay in seconds between re-spawning ha-lizard. This should be adjusted to the environment. Large pools require more time for each run of ha-lizard. Default = 15

monitor_scanrate

ha-lizard will not re-spawn unless all current processes are completed. If there are active processes while attempting to start a new iteration, ha-lizard will wait the number of seconds set here before retrying. Each successive fail will increment a counter (MONITOR_MAX_STARTS) that may trigger KILLALL. Default = 10

xc_field_name

Field name used to enable / disable HA for pool. This can also be set within XenCenter management console to enable/disable HA within the pool. To make this field visible within XenCenter, create a custom pool level field with the name set here. The configuration contents will then be visible and alterable within XenCenter. See section on configuring XenCenter for more details.

op_mode

Set the operating mode for ha-lizard. 1 = manage appliances, 2 = manage virtual machines

Default value = 2

Mode 1 uses logic to manage appliances within the pool. By default, all appliances within a pool are managed by HA without requiring any additional settings. This is useful for small pools where most HA management functions can be handled from within XenCenter. Simply add VMs to appliances and those VMs are automatically managed. Any VM that is not part of an appliance is not managed by HA. This technique greatly simplifies HA management as each individual VM does not require any special settings. If some appliances should not be managed by HA, simply add the UUID of the appliances to be skipped in the DISABLED_VAPPS setting.

Managing appliances also provides a convenient way to configure startup order and delays when recovering VMs. This can be done as part of the standard appliance configuration settings.

Mode 2 provides greater flexibility by providing a mechanism for more granular control over which pool VMs are managed. Appliances are not managed in this mode. By default (when GLOBAL_VM_HA is set to 1), all VMs are automatically managed by HA. If GLOBAL_VM_HA is set to 0, then each VM within the pool must

have HA explicitly enabled or disabled. This can be set from the pool GUI with access to custom configuration parameters or via the command line tool ha-cfg.

global_vm_ha

Set whether to individually enable HA on each VM within the pool (when OP_MODE = 2)
0 = You must individually set ha-lizard-enabled to true/false for each VM within the pool
1 = ALL VMs have HA enabled regardless of setting in GUI/CLI

Default value = 1

enable_logging

Enable Logging 1=yes, 0=no. Logs are written to /var/log/messages or /var/log/user.log (depending on dom0 distribution). All log messages are labeled with "ha-lizard" for easy filtering. View/Filter real time logging with: "tail -f /var/log/[messages|user.log] | grep ha-lizard"

disabled_vapps

Specify UUID(s) of vapps that do not get automatically started by ha-lizard when OP_MODE=1 (manage appliances) Array is ":" delimited like this (UUID1:UUID2:UUID3) Leave blank if ALL vapps are managed by ha-lizard "DISABLED_VAPPS=()" Only applied when OP_MODE=1

xe_timeout

Set the maximum wait time for calls to the xe toolstack to respond. If xe does not respond within XE_TIMEOUT seconds, the xe PID will be killed. This is done to prevent xe calls from hanging in the event of a Master host failure. In the event of a Master failure, xe may hang on requests from pool slaves. This timeout will ensure that fencing the of master host is not prevented. Default setting is 5 seconds which is ample time for a well running pool. Poor performing hosts may need to set this value higher to prevent unintended process terminations during normal operation.

xapi_count

If a pool member cannot reach a pool peer, XAPI_COUNT is the number of retry attempts when a host failure is detected. If the unresponsive host is recovered before the XAPI_COUNT is reached, attempts to fence and remove the failed host will be ignored.

Default XAPI_COUNT = 2

xapi_delay

If a pool member cannot reach a pool peer, XAPI_DELAY is the number of seconds to wait in between XAPI_COUNT attempts to contact the unresponsive host.

DEFAULT XAPI_DELAY = 10 seconds

slave_ha

If the Pool Master cannot be reached and all attempts to reach it have been exhausted, set whether the autoselected slave will try to start appliances and/or VMs. (PROMOTE_SLAVE must also be set to 1 for this to work)

promote_slave

If the pool master cannot be reached - set whether slave should be promoted to pool master (this only affects a single slave: the "autoselect" winner chosen by the former master to recover the pool). More on this topic is available in the Cluster Management section.

slave_vm_stat

By default, only the pool master will check the status of all VMs managed by this script and attempt to start a VM that is not in the running state. Setting SLAVE_VM_STAT to 1 will cause any pool slaves to also check all VM statuses and attempt to start any VM not in the running state. Default = 0 In a large pool many hosts may attempt to start the same VM the first host to attempt will succeed, others will be safely declined. Enabling may create many unnecessary duplicate processes in the pool.

mgt_link_loss_tolerance

Set the maximum number of seconds that the pool master can lose its management link. The timer is triggered by the management interface being down (as in a cable pull or switch power failure). Once the timeout has been reached, the master will forcefully shutdown any VMs running on the master. Default value = 5 seconds. This timer should be kept short to ensure that a surviving slave can exclusively start any affected VMs.

host_select_method

Select the method used to select a host to start a VM on.
0 = intelligent mode. A host is selected based on its health which is tracked every few seconds.
1 = legacy mode. A slave failure will also trigger a loss of XenCenter connectivity
Default value = 0 (recommended setting is 0)

Email Alert Settings

- mail_on: Enable/Disable email alerts. 1 = enabled 0 = disabled

- mail_subject: Subject Line of email alert

- mail_from: The FROM email address used on email alerts

- mail_to: the email address to send alerts to

- smtp_server: Declare the SMTP server to use for sending email alerts

- smtp_port: Declare the port number for the SMTP server

- smtp_user: If the SMTP server requires login, set the username

- smtp_pass: If the SMTP server requires login with a password, set the password

Important: Do not use spaces when setting via the CLI tool. If spaces are required in the subject line, use the override configuration file instead and wrap the string in double quotes like this. "Mail Subject"

Fencing Configuration Settings

Currently Supported FENCE_METHOD = ILO, XVM, POOL, IRMC

ILO is the HP Integrated Light Out management interface

XVM is intended for test environments with nested xen instances where pool domos are domus within a single xen host.

POOL does not fence failed hosts. It simply allows the forceful removal of a failed host from a pool.

IRMC is a Fujitsu BMC similar to HP ILO

The name of any custom fencing agent can also be named here. See the fencing section for details on using a custom fencing script.

- ○ ***FENCE_ENABLED***

Enable/Disable Fencing 1=enabled 0=disabled

- ○ ***FENCE_FILE_LOC***

Location to store and look for fencing scripts

- ○ ***FENCE_HA_ONFAIL***

Select whether to attempt starting of failed host's VMs on another host if fencing fails 1=enabled 0=disabled

- ○ ***FENCE_METHOD***

ILO, XVM and POOL supported. "FENCE_METHOD=ILO" - custom fencing scripts can be added and called here

- ○ ***FENCE_PASSWD***

Password for fence device (only if required by the fence device)

- ○ ***FENCE_ACTION***

Supported actions = start, stop, reset

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- o *FENCE_REBOOT_LONE_HOST*

If Master host cannot see any other pool members (in pools with 3 or more hosts), choose whether to reboot before attempting to fence peers. This may not matter if quorum is used (see FENCE_QUORUM_REQUIRED) 1=enabled 0=disabled

In version 1.8.9 the logic has been expanded to deal with a 2-node pool. In a 2-node pool, the master will self fence (in the form of a reboot). This releases the primary storage role from being asserted for users running iSCSI-HA in conjunction with HA-Lizard. In doing so, a surviving slave (which promotes itself to pool master) would be able to assert the primary storage role which is required to expose disk images to VMs.

- o *FENCE_IPADDRESS*

Only used for static fencing device - currently XVM host supported. Can be used for custom fencing scripts that call a static IP such as a power strip.

- o *FENCE_HOST_FORGET*

Will be Deprecated in future release – only use if you know what you are doing. As of version 1.6.41 – this is no longer necessary. Setting this to 0 is recommended.
Select whether to forget a fenced host (permanently remove from pool) 1=enabled 0=disabled.

- o *FENCE_MIN_HOSTS*

Do not allow fencing when fewer than this number of hosts are remaining in the pool. Default value = 2 which is optimized for a 2-node pool.

- o *FENCE_QUORUM_REQUIRED*

Select whether pool remaining hosts should have quorum before allowing fencing. 1=enabled 0=disabled

- o *FENCE_USE_IP_HEURISTICS*

Select whether to poll additional IP endpoints (other than the pool hosts) and possibly create an additional vote used to determine quorum for the pool. This can be helpful in a 2 node pool where quorum cannot otherwise be achieved. 1=enabled 0=disabled

- o *FENCE_HEURISTICS_IPS*

Create a list of IP addresses or domain names to check. The list should be delimited by ":"

As of version 1.7.7 the default value is set to 8.8.8.8 which is a well-known address. *However, live production systems should NOT use the default address.* This address should ideally be set to a local IP on the management network which is very close to the management interface of the hosts. Typically this would be the IP address of the switch the hosts are connected to. If more than one IP address is specified then all of the addresses must be successfully reached with ping in order to count as a single vote.

Additional Local Configuration Parameters

Granular control over logging and email alerts is provided in the local configuration override file. These settings allow for enabling/disabling logging and email alerts on a per function basis. These can be useful when troubleshooting / logging a specific function or to minimize the volume of log files and system email alerts.

Below enables / disables logging per function 1=enable 0=disable

LOG_check_ha_enabled=1	enable / disable logging for check_ha_enabled
LOG_get_pool_host_list=1	enable / disable logging for get_pool_host_list
LOG_get_pool_ip_list=1	enable / disable logging for get_pool_ip_list
LOG_master_ip=1	enable / disable logging for master_ip
LOG_check_xapi=1	enable / disable logging for check_xapi
LOG_get_app_vms=1	enable / disable logging for get_app_vms
LOG_vm_state=1	enable / disable logging for vm_state
LOG_vm_state_check=1	enable / disable logging for vm_state_check
LOG_vm_mon=1	enable / disable logging for vm_mon
LOG_promote_slave=1	enable / disable logging for promote_slave
LOG_get_vms_on_host=1	enable / disable logging for get_vms_on_host
LOG_get_vms_on_host_local=1	enable / disable logging for get_vms_on_host_local
LOG_check_vm_managed=1	enable / disable logging for check_vm_managed

LOG_write_pool_state=0   enable / disable logging for write_pool_state ***Produces allot of logging - off by default***

LOG_check_slave_status=1	enable / disable logging for check_slave_status
LOG_fence_host=1	enable / disable logging for fence_host
LOG_email=1	enable / disable logging for email
LOG_autoselect_slave=1	enable / disable logging for autoselect_slave
LOG_check_quorum=1	enable / disable logging for check_quorum
LOG_xe_wrapper=1	enable / disable logging for xe_wrapper
LOG_check_logger_processes=1	enable / disable logging for check_logger_processes

LOG_check_xs_ha=1
LOG_disable_ha_lizard=1
LOG_update_global_conf_params=1
LOG_service_execute=1
LOG_stop_vms_on_host=1
LOG_check_master_mgt_link_state=1
LOC_write_status_report=1
LOG_validate_vm_ha_state=1
LOG_reset_vm_vdi=1
LOG_validate_this_host_vm_states=1

Below enables / disables email alerts per function 1=enable 0=disable

MAIL_get_pool_host_list=1   enable / disable email alerts for get_pool_host_list
MAIL_get_pool_ip_list=1   enable / disable email alerts for get_pool_ip_list
MAIL_master_ip=1   enable / disable email alerts for master_ip
MAIL_check_xapi=1   enable / disable email alerts for check_xapi
MAIL_get_app_vms=1   enable / disable email alerts for get_app_vms
MAIL_vm_state=1   enable / disable email alerts for vm_state
MAIL_vm_state_check=1   enable / disable email alerts for vm_state_check
MAIL_vm_mon=1   enable / disable email alerts for vm_mon
MAIL_promote_slave=1   enable / disable email alerts for promote_slave
MAIL_get_vms_on_host=1   enable / disable email alerts for get_vms_on_host
MAIL_get_vms_on_host_local=1   enable / disable email alerts for get_vms_on_host_local
MAIL_check_vm_managed=1   enable / disable email alerts for check_vm_managed
MAIL_write_pool_state=1   enable / disable email alerts for write_pool_state
MAIL_check_slave_status=1   enable / disable email alerts for check_slave_status
MAIL_fence_host=1   enable / disable email alerts for fence_host
MAIL_email=1   enable / disable email alerts for email
MAIL_autoselect_slave=1   enable / disable email alerts for autoselect_slave
MAIL_check_quorum=1   enable / disable email alerts for check_quorum
MAIL_xe_wrapper=1   enable / disable email alerts for xe_wrapper
MAIL_check_xs_ha=1
MAIL_update_global_conf_params=1
MAIL_service_execute=1
MAIL_stop_vms_on_host=1
MAIL_check_master_mgt_link_state=1
MAIL_write_status_report=1
MAIL_validate_vm_ha_state=1
MAIL_reset_vm_vdi=1
MAIL_validate_this_host_vm_states=1

4. Configuring Email Alerts

HA-Lizard can be configured to send email alerts for a variety of events that an administrator should generally be aware of. As of version 1.8, the method for configuring email has changed. Prior to version 1.8.x, HA-Lizard relied on sendmail running locally to act as an SMTP relay for sending messages. The need to install and run sendmail locally has been removed in version 1.8.x in an effort to remove ALL dependencies from HA-Lizard.

Version 1.8.x will continue to be backward compatible with earlier versions and can use a local SMTP relay (sendmail) if configured to do so.

- **Configuring a Local SMTP Server**

Email alerts require that an SMTP server is specified for sending email. The default setting for the SMTP server on a new installation is "127.0.0.1". For users running sendmail locally, this will automatically route all messages through sendmail. The following settings will work with a locally running SMTP relay that does not require user login:

MAIL_FROM=<your from email address>
MAIL_ON=1
MAIL_SUBJECT="SYSTEM_ALERT-FROM_HOST:$HOSTNAME"
MAIL_TO=<your to email address>
SMTP_PASS=
SMTP_PORT="25"
SMTP_SERVER="127.0.0.1"
SMTP_USER=

- **Configuring an SMTP Server with Authentication**

The preferred method of configuring email alerts is to use an outside SMTP server rather than run an SMTP relay on the control domain. The configuration settings will support any standard SMTP server with or without login. The following settings will work with a remote SMTP server. ***Adapt to match your environment. These settings are a sample only.***

MAIL_FROM=<your from email address>
MAIL_ON=1
MAIL_SUBJECT="SYSTEM_ALERT-FROM_HOST:$HOSTNAME"
MAIL_TO=<your to email address>
SMTP_PASS=smtp_password
SMTP_PORT="25"
SMTP_SERVER=smtp.your_smtp_domain_here.com
SMTP_USER=smtp_username

- **Troubleshooting Email Alerting**

The HA-Lizard CLI provides tools for testing and validating email settings. Once the desired configuration settings have been applied, a test email can be sent from the CLI as follows:

ha-cfg email

```
Sending email from: root@localhost
Sending email to: root@localhost
Email Alert Subject: SYSTEM_ALERT-FROM_HOST:xs5
Email Alert Timestamp: Tue Feb 10 10:34:21 EST 2015
Email Alert Process: ha-lizard Version: 1.8.5
Email Alert Message Content: Test Message ID b35e587a-74a8-451f-a701-15259f09c0fa
Email Alert Message Hostname: xs5
```

If the email and SMTP server settings are correct configured, an email alert should be received by the user set in the mail_to field.

Alternatively, the CLI can be used to send a test email while producing verbose debug. This can be very useful to troubleshoot the interaction between the host and the SMTP server. A test email with debug can be sent using the CLI as follows:

ha-cfg email_debug

An error message such as the one below may be seen when a socket connection could not be made to the configured SMTP server

```
Sending email from: root@localhost
Sending email to: root@localhost
Email Alert Subject: SYSTEM_ALERT-FROM_HOST:xs5
Email Alert Timestamp: Tue Feb 10 10:37:51 EST 2015
Email Alert Process: ha-lizard Version: 1.8.5
Email Alert Message Content: Test Message ID 72549f1f-3066-4b8d-abbf-bf1c9cf79a31
Email Alert Message Hostname: xs5
Traceback (most recent call last):
  File "/etc/ha-lizard/scripts/email_alert.py", line 104, in ?
    message = smtplib.SMTP(smtp_server, smtp_port, hostname)
  File "/usr/lib/python2.4/smtplib.py", line 244, in __init__
    (code, msg) = self.connect(host, port)
  File "/usr/lib/python2.4/smtplib.py", line 306, in connect
    raise socket.error, msg
socket.error: (111, 'Connection refused')
```

A successful email alert will produce debug similar to the below example:

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```
Email Alert Subject: SYSTEM_ALERT-FROM_HOST:xs5
Email Alert Timestamp: Tue Feb 10 10:40:25 EST 2015
Email Alert Process: ha-lizard Version: 1.8.5
Email Alert Message Content: Test Message ID e2315b11-9eeb-4590-8ad6-0b31d74efa63
Email Alert Message Hostname: xs5
send: 'ehlo xs5\r\n'
reply: '250-xs5 Hello localhost [127.0.0.1], pleased to meet you\r\n'
reply: '250-ENHANCEDSTATUSCODES\r\n'
reply: '250-PIPELINING\r\n'
reply: '250-8BITMIME\r\n'
reply: '250-SIZE\r\n'
reply: '250-DSN\r\n'
reply: '250-ETRN\r\n'
reply: '250-DELIVERBY\r\n'
reply: '250 HELP\r\n'
reply: retcode (250); Msg: xs5 Hello localhost [127.0.0.1], pleased to meet you
ENHANCEDSTATUSCODES
PIPELINING
8BITMIME
SIZE
DSN
ETRN
DELIVERBY
HELP
send: 'mail FROM:<root@localhost> size=2242\r\n'
reply: '250 2.1.0 <root@localhost>... Sender ok\r\n'
reply: retcode (250); Msg: 2.1.0 <root@localhost>... Sender ok
send: 'rcpt TO:<root@localhost>\r\n'
reply: '250 2.1.5 <root@localhost>... Recipient ok\r\n'
reply: retcode (250); Msg: 2.1.5 <root@localhost>... Recipient ok
send: 'data\r\n'
reply: '354 Enter mail, end with "." on a line by itself\r\n'
reply: retcode (354); Msg: Enter mail, end with "." on a line by itself
data: (354, 'Enter mail, end with "." on a line by itself')
send: 'Content-Type: multipart/alternative; boundary="===============0834690714=="\r\nMIME-Version: 1.0\r\nSubject:
 SYSTEM_ALERT-FROM_HOST:xs5\r\nFrom: root@localhost\r\nTo: root@localhost\r\n\r\n--===============0834690714==\r\nC
ontent-Type: text/plain; charset="us-ascii"\r\nMIME-Version: 1.0\r\nContent-Transfer-Encoding: 7bit\r\n\r\nTest Mes
sage ID e2315b11-9eeb-4590-8ad6-0b31d74efa63\r\n--===============0834690714==\r\nContent-Type: text/html; charset="
us-ascii"\r\nMIME-Version: 1.0\r\nContent-Transfer-Encoding: 7bit\r\n\r\n<table height="100" cellspacing="1" cellpa
dding="1" border="1" width="600" style="">\r\n    <tbody>\r\n        <tr>\r\n            <td width="160"><img heigh
t="111" width="150" src="http://www.halizard.com/images/ha_lizard_alert_logo.png" alt="" /></td>\r\n            <td
 width="440"><span style="color: rgb(0, 102, 0);"><strong><span style="font-size: larger;"><span style="font-family
: Arial;">HA-Lizard Alert Notification<br />\r\n            <br />\r\n            Process: ha-lizard Version: 1.8.5
 <br />\r\n        Host: xs5 <br />\r\n        Time: Tue Feb 10 10:40:25 EST 2015 </span></span></strong></
span></td>\r\n        </tr>\r\n        <tr>\r\n            <td width="600" colspan="2">\r\n            <p><br />\r\
n            <span style="font-family: Arial;"><span style="font-size: smaller;"> Test Message ID e2315b11-9eeb-459
0-8ad6-0b31d74efa63 <br />\r\n            </span></span></p>\r\n            </td>\r\n
</tr>\r\n        <tr>\r\n            <td bgcolor="#cccccc" width="600" colspan="2">\r\n            <p style="text-a
lign: left;"><strong><span style="font-size: smaller;"><span style="font-family: Arial;">website</span></span></str
ong><span style="font-size: smaller;"><span style="font-family: Arial;">: www.halizard.com    
<strong>forum</strong>: http://www.halizard.com/forum</span></span>    <strong><span style="font-siz
e: smaller;"><span style="font-family: Arial;">Sponsored by</span></span></strong><span style="font-size: smaller;"
><span style="font-family: Arial;"> </span></span><a href="http://www.pulsesupply.com"><span style="font-size: smal
ler;"><span style="font-family: Arial;">Pulse Supply</span></span></a></p>\r\n            </td>\r\n        </tr>\r\
n    </tbody>\r\n</table>\r\n<p> </p>\r\n\r\n--===============0834690714==--\r\n.\r\n'
reply: '250 2.0.0 t1AFePK9004827 Message accepted for delivery\r\n'
reply: retcode (250); Msg: 2.0.0 t1AFePK9004827 Message accepted for delivery
data: (250, '2.0.0 t1AFePK9004827 Message accepted for delivery')
send: 'quit\r\n'
reply: '221 2.0.0 xs5 closing connection\r\n'
reply: retcode (221); Msg: 2.0.0 xs5 closing connection
```

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5. Modes of Operation

Two modes of operation are supported by HA-Lizard.

Mode 1 uses logic to manage appliances within the pool. By default, all appliances within a pool are managed by HA without requiring any additional settings. This is useful for small pools where most HA management functions can be handled from within a compatible graphical configuration utility. Simply add VMs to appliances and those VMs are automatically managed. Any VM that is not part of an appliance is not managed by HA. This technique greatly simplifies HA management as each individual VM does not require any special settings. If some appliances should not be managed by HA, simply add the UUID of the appliances to be skipped in the DISABLED_VAPPS setting.

Mode 2 provides greater flexibility by providing a mechanism for more granular control over which pool VMs are managed. Appliances are not managed in this mode. By default (when GLOBAL_VM_HA is set to 1), all VMs are automatically managed by HA. If GLOBAL_VM_HA is set to 0, then each VM within the pool must have HA explicitly enabled or disabled. This can be set from the pool GUI with access to custom configuration parameters or via the command line tool ha-cfg.

The operating mode can be configured as a global setting or override setting which allows hosts within a pool to operate in a mixed environment with some hosts managing VMs while others manage appliances. Usually the default global setting which manages VMs is adequate.

The default global settings manage all VMs within a pool and attempts to move VMs from failed hosts or start them if not running. This approach works well in most instances. If more granularity is required to select only certain VMs as managed and others ignored, a configuration setting is provided which can be set per VM. Settings can be applied using the ha-cfg command line tool or via a compatible graphical management interface with visibility into custom XAPI fields.

6. Managing HA Services

- **HA-Lizard System Service**

When installing on a CentOS based Dom0, the installer will install a startup script in /etc/init.d and set it to automatically start each time the server is started. Generally there are no additional steps required in setting up the system service.

The service can be checked, stopped or invoked with the "*service*" command which manages System V init scripts. The following arguments are supported:

"service ha-lizard start": starts the service
"service ha-lizard stop": stops the service
"service ha-lizard status": reports running status of the service

By default a watchdog service is installed and started with when installing with the included installer. Important Note: Stopping the HA service while the watchdog service is running will be ineffective as the watchdog will restart the HA service within a few seconds after a stop. In previous versions of HA-Lizard, The HA-Lizard init script can be invoked with a "-w" option to also start or stop the watchdog service with the HA service. The –w option has been removed as of version 2.1 due to the inability to pass additional arguments under system/

Starting HA-Lizard

"service ha-lizard start": starts the service <u>AND</u> watchdog
"service ha-lizard stop": stops the service (watchdog will continue to run)
"service ha-lizard status": reports running status of the service

HA Watchdog Service

A watchdog service is installed by default and started/stopped via the main service init sctipt or can be individually managed with:

"service ha-lizard-watchdog start": starts the service
"service ha-lizard-watchdog stop": stops the service
"service ha-lizard-watchdog status": reports running status of the service

The default watchdog interval for checking the HA service is 10 seconds. This can be changed by editing the variable "WATCH_INTERVAL" in /etc/init.d/ha-lizard-watchdog.

Disabling the Watchdog Service

The watchdog service is mandatory when fencing is enabled. If fencing is not enabled, the watchdog service can be disabled by commenting or deleting the line "WATCHDOG=/etc/init.d/ha-lizard-watchdog" in the HA init script located in /etc/init.d/ha-lizard.

- **HA Monitor**

A *monitor daemon* is provided for manually running the HA service. This is intended only for systems that are not compatible with the provided init script as described above.

Avoid running this script if the system service is already installed as it could result in multiple monitors running that will impact performance.

The monitor is required to be running at all times for HA to work. It can be started in any of the following manners:

- Manually start the monitor and background it:
  /etc/ha-lizard/scripts/ha-lizard.mon &

- If your host runs a Dom0 operating system other than the default CentOS, an init script can be created that calls /etc/ha-lizard/scripts/ha-lizard.mon

- Add a line to /etc/rc.local which calls the monitor script on boot.
  /etc/ha-lizard/scripts/ha-lizard.mon &

- **Managing HA for the Pool**

In order for the pool to operate in HA mode, each host in the pool must be running the monitor service as described above. The monitor will periodically call the main HA-Lizard logic which executes the HA logic for the pool. A number of configurable timers and triggers can be found in the configuration settings which determine how often the monitor will invoke the HA script and when to abort. Regardless of the method chosen to run the monitor, the pool must have HA enabled to operate in HA mode.

Enabling HA is different than starting the monitor.

Three methods are provided for enabling and disabling HA for the pool:

- Enable / Disable HA via XenCenter or any compatible GUI capable of modifying a custom configuration field

- Use the CLI tool: "ha-cfg status"

- Use theh CLI too: "ha-cfg ha-enable"

Regardless of the state of HA for the pool, the monitor service will continue to run in the background on each host within the pool. The monitor will detect whether HA is enabled periodically and decide whether to provide pool level HA depending on operating status for the pool.

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Cluster Management and Fencing

Cluster management and fencing with STONITH are provided with the HA-Lizard package. The behavior is configured via the global configuration settings or override settings.

- **Pool Cluster Management**

The system does not require the use of any outside cluster manager which would add more complexity to a host/pool. The overall software design tries to avoid the addition of any packages/services which would introduce complexity and potential instability into the system. Given this, built in cluster management is provided and designed to be lightweight and fairly extensible.

Cluster Failover and Recovery Logic

Node failover and recovery logic is designed around the pool concept of "Master and Slaves". A pool can have only a single Master node and any number of Slaves. Given this, cluster management is provided in this fashion.

- Slaves cannot detect other slave failures or remove other slaves from the pool

- Only the Master host can detect a Slave Host failure and take steps to fence and remove the Slave from the pool

- Only a single Slave is allowed to detect a Master host failure. In this case the Slave can eject the former Master host and promote itself to the new pool Master. This is done intentionally to avoid a race condition where multiple Slaves try to become the Pool Master.

- The single Slave which is allowed to eject a failed Master and become the new Pool Master is dynamically chosen by the Pool Master on each invocation of HA (approximately every minute). The chosen Slave ("autopromote winner") will have its UUID stored in the XAPI database. Slaves will then determine their status in the pool by checking this value on every invocation of HA. In the event of a Master failure, XAPI may be unresponsive, in this case Slaves will use the "autopromote winner" identity stored in local state files from the last successful iteration.

- All logic is completely dynamic and requires no static settings to determine what roles hosts play in the cluster. Each iteration of HA will detect whether a host is the Pool Master or Slave and then execute logic which specifically applies to the hosts role. Each iteration also selects a new "autopromote winner". In the event of a Master failure and takeover by a Slave (autopromote winner), the new Master will then automatically select a new Slave as being eligible to take over as Master.

- **Split Brain Handling**

IP Heuristics can be used as an additional quorum vote when checking whether the remaining hosts in a pool have quorum to take over services and remove failed hosts. This can be especially useful in the case of a 2

node pool, where quorum would be impossible to achieve, thus preventing any HA recovery measures from being executed. Although there is no limit to the number of IP addresses that can be used, one should carefully consider the selection of useful addresses, keeping in mind that a large number of addresses will slow down any recovery procedures. Some good addresses to check would be the IP address of a shared storage pool and the IP address of a network switch which is common or shared by all the hosts in a pool. Regardless of the number of IP addresses that are checked, all of the IP addresses must by successfully reached with ICMP ping to count as a single vote. In a two node pool, this additional vote would give the surviving node enough votes to take over the services of the failed node.

- **HA Suspension**

To further prevent the possibility of a split brain scenario, slaves that fail to fence a master or lack quorum for the pool will enter into a suspended HA mode and reboot once. After the reboot, the host's HA logic will be suspended until either:

- an administrator resolves the pool failure and manually removes the suspension by running the following script: /etc/ha-lizard/scripts/recover_fenced_host.

- the affected host automatically removes the suspension when its health status returns to "healthy"

After the initial reboot, the host will remain in the suspended state and is blocked from employing any HA logic including:

- Fencing a master

- Starting VMs

HA suspension only affects the host that has self fenced. The remaining members of the pool are unaffected.

Checking if a Host is Suspended

The system will send an email alert when a host enters into suspended HA mode. By default, an alert will be triggered every hour until the system administrator has resolved the issue and cleared the suspension. The CLI tool can be used to check whether a host is suspended by checking status with "ha-cfg status".

A host in suspended mode will display a notice as shown below:

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```
[root@dev2 ha-lizard]# ha-cfg status
#############################################################################
## Checking whether    HA   is enabled for pool: bc552af3-1776-4876-6891-bf66ca130944 ##
## This only checks if HA is enabled for the pool. TO check whether        ##
## the ha-lizard service is running on this host, try: service ha-lizard status  ##
#############################################################################
Pool HA Status: NOTICE: This host has self fenced and HA operation is suspended.
To restore HA on this host, first ensure the pool is fully operational
and the issue that caused this host to be ejected has been resolved
HA can be reactivated by running /etc/ha-lizard/scripts/recover_fenced_host
ENABLED
ha-lizard is enabled. Disable? <yes or Enter to quit>
```

Restoring Suspended HA

A suspended host should only be restored after the pool has been fully restored to a normal operating state. Suspension is removed by executing /etc/ha-lizard/scripts/recover_fenced_host from the local command shell of the affected host. A warning is displayed – simply pressing <enter> will remove the suspension.

```
#############################################################################
#############################################################################
## DO NOT CONTINUE unless you know what you are doing                       ##
## This script will recover a host which has self fenced and is operating with HA (HA-Lizard) in suspended mode  ##
## Before continuing – make sure that the situation that caused the host to fence has been corrected  ##
## Control + C to exit or <Enter> to continue                              ##
#############################################################################
#############################################################################

Restoring HA
HA operation returned to normal for this host
[root@dev2 ha-lizard]#
```

- **Fencing and STONITH**

Currently, three fencing options are supported; POOL, ILO and XVM. Additionally, a structured interface is provided so that custom fencing scripts can be easily implemented.

ILO Fencing

ILO fencing is included as part of HA and developed and tested on ILO 2. The fencing logic will power off a host and return exit status verifying that the power state is off before forcefully removing a host from the pool configuration.

The following configuration parameters provide basic ILO fencing:

FENCE_ENABLED=1
FENCE_ACTION=stop
FENCE_FILE_LOC=/etc/ha-lizard/fence
FENCE_HA_ONFAIL=0
FENCE_HOST_FORGET=0
FENCE_METHOD=ILO
FENCE_MIN_HOSTS=3

FENCE_PASSWD=<ILO Password> Should be consistent across all hosts in pool or use override
FENCE_REBOOT_LONE_HOST=0
FENCE_QUORUM_REQUIRED=1

Additionally, the ILO.hosts file must be populated with UUID:IP pairs for each host in the pool. This file must not contain any spaces. Each line in the file will list <UUID of Host>:<ILO IP Address> delimited by a colon. The file should be placed in: /etc/ha-lizard/fence/ILO and named ILO.hosts. Capitalization and spelling are important as the file names are dynamically built using the HA configuration parameters.

To edit/create the file, type the following from the command line:

vi /etc/ha-lizard/fence/ILO/ILO.hosts
Alternatively, your preferred text editor can be used instead of "vi"

Sample file is presented below:

```
2f4a4020-fe8c-4686-a65d-501a19a06716:192.168.1.141
33e68e2c-5b7b-4d5e-ae9c-7baef5b1566b:192.168.1.132
```

Pool Fencing

Pool fencing is "dummy" fence device that does not provide STONITH (as in ILO). It is intended to provide Pool level fencing which will forcefully remove any unresponsive hosts from the pool but will not attempt to power off the host.

The following configuration parameters provide basic Pool fencing:

FENCE_ACTION=stop
FENCE_ENABLED=1
FENCE_FILE_LOC=/etc/ha-lizard/fence
FENCE_HA_ONFAIL=1
FENCE_HOST_FORGET=0
FENCE_IPADDRESS= (IP is not necessary for POOL fence method, leave blank)
FENCE_METHOD=POOL
FENCE_MIN_HOSTS=3
FENCE_PASSWD= (Password is not necessary for POOL fence method, leave blank)
FENCE_REBOOT_LONE_HOST=0
FENCE_QUORUM_REQUIRED=1

XVM Fencing

XVM fencing is intended for test environments and development environments where a large pool is simulated within a single physical host. XVM fencing will fence pool hosts that are virtual machines within a single

physical host, meaning, a single DomO will host a number of DomUs, each of which is running XCP or XenServer and are part of a pool.

The following configuration parameters provide basic XVM fencing:

FENCE_ACTION=stop
FENCE_ENABLED=1
FENCE_FILE_LOC=/etc/ha-lizard/fence
FENCE_HA_ONFAIL=1
FENCE_HOST_FORGET=0
FENCE_IPADDRESS=<IP Address of DomO>
FENCE_METHOD=XVM
FENCE_MIN_HOSTS=3
FENCE_PASSWD=<root SSH password of DomO>
FENCE_REBOOT_LONE_HOST=0
FENCE_QUORUM_REQUIRED=1

Additionally, the XVM.hosts file must be populated with UUID:UUID pairs for each host in the pool. This file must not contain any spaces. Each line in the file will list <UUID of Pool HOST>:<UUID of VM in DomO> delimited by a colon. The file should be placed in: /etc/ha-lizard/fence/XVM and named XVM.hosts. Capitalization and spelling are important as the file names are dynamically built using the HA configuration parameters.

To edit/create the file, type the following from the command line:

vi /etc/ha-lizard/fence/XVM/XVM.hosts
Alternatively, your preferred text editor can be used instead of "vi"

Sample file is presented below:

```
9b9a243a-abf3-485f-bb37-e43b29555cbe:0838afcc-1c6c-549b-a28c-d7916ca7753a
1ae14847-6169-4cb0-ad8b-79ef0219e1ee:2372bc81-0709-c8e8-6e34-3ccb085cf1ab
8b8470a5-8848-41a4-bf31-7ce6f1c7ea5e:2dcea2bd-b47c-cee3-fcda-c7b6f3953555
c8ee6f60-71fe-442f-9002-92b16f35f47e:33d4f85a-72d8-2d7a-64b0-26c77dd4b916
```

iRMC Fencing
iRMC fencing is included as part of HA-Lizard. The fencing logic will power off or reset a host and return exit status verifying that the power state is off before forcefully removing a host from the pool configuration.

The following configuration parameters provide basic iRMC fencing:

FENCE_ENABLED=1
FENCE_ACTION=stop
FENCE_FILE_LOC=/etc/ha-lizard/fence

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FENCE_HA_ONFAIL=0
FENCE_HOST_FORGET=0
FENCE_METHOD=IRMC
FENCE_MIN_HOSTS=2
FENCE_PASSWD=<iRMC Password> Should be consistent across all hosts in pool or use override
FENCE_REBOOT_LONE_HOST=0
FENCE_QUORUM_REQUIRED=1

Additionally, the IRMC.hosts file must be populated with UUID:IP pairs for each host in the pool. This file must not contain any spaces. Each line in the file will list <UUID of Host>:<iRMC IP Address> delimited by a colon. The file should be placed in: /etc/ha-lizard/fence/IRMC and named IRMC.hosts. Capitalization and spelling are important as the file names are dynamically built using the HA configuration parameters.

To edit/create the file, type the following from the command line:

vi /etc/ha-lizard/fence/IRMC/IRMC.hosts
Alternatively, your preferred text editor can be used instead of "vi"

Sample file is presented below:

```
2f4a4020-fe8c-4686-a65d-501a19a06716:192.168.1.141
33e68e2c-5b7b-4d5e-ae9c-7baef5b1566b:192.168.1.132
```

Adding your own Custom Fencing Script

A structured framework is provided for adding custom fencing scripts. The general parameters for adding a custom script are as follows:

- Choose a name for the custom fencing script. This name will be placed into the pool HA configuration and used to dynamically build file names and references. For example, for a custom fencing agent named "POWEROFF" set the fencing method configuration parameter as follows:

  FENCE_METHOD=POWEROFF

  this can be set with the command line configuration tool: "ha-cfg set FENCE_METHOD POWEROFF"

- Create a folder with the same *exact* name in /etc/ha-lizard/fence/

  mkdir /etc/ha-lizard/fence/POWEROFF

- Place your custom fencing agent in the newly created folder. The agent MUST be named POWEROFF.sh. If your agent is not a bash script and named something else like POWEROFF.py, then simply create a wrapper named POWEROFF.sh. Your script must accept the following passed in arguments:

  arg1 = UUID of the host to be fenced. Your script should employ some logic to convert this UUID to some useful data like the IP address of the host or the location of a power outlet for the given host UUID

  arg2 = Fence Action. Supported actions (configured in the global configuration) are:
  start, stop, reset

- Your script must return an exit status after executing.
  return "0" on success for the passed in action
  return "1" on general failure for the passed in action

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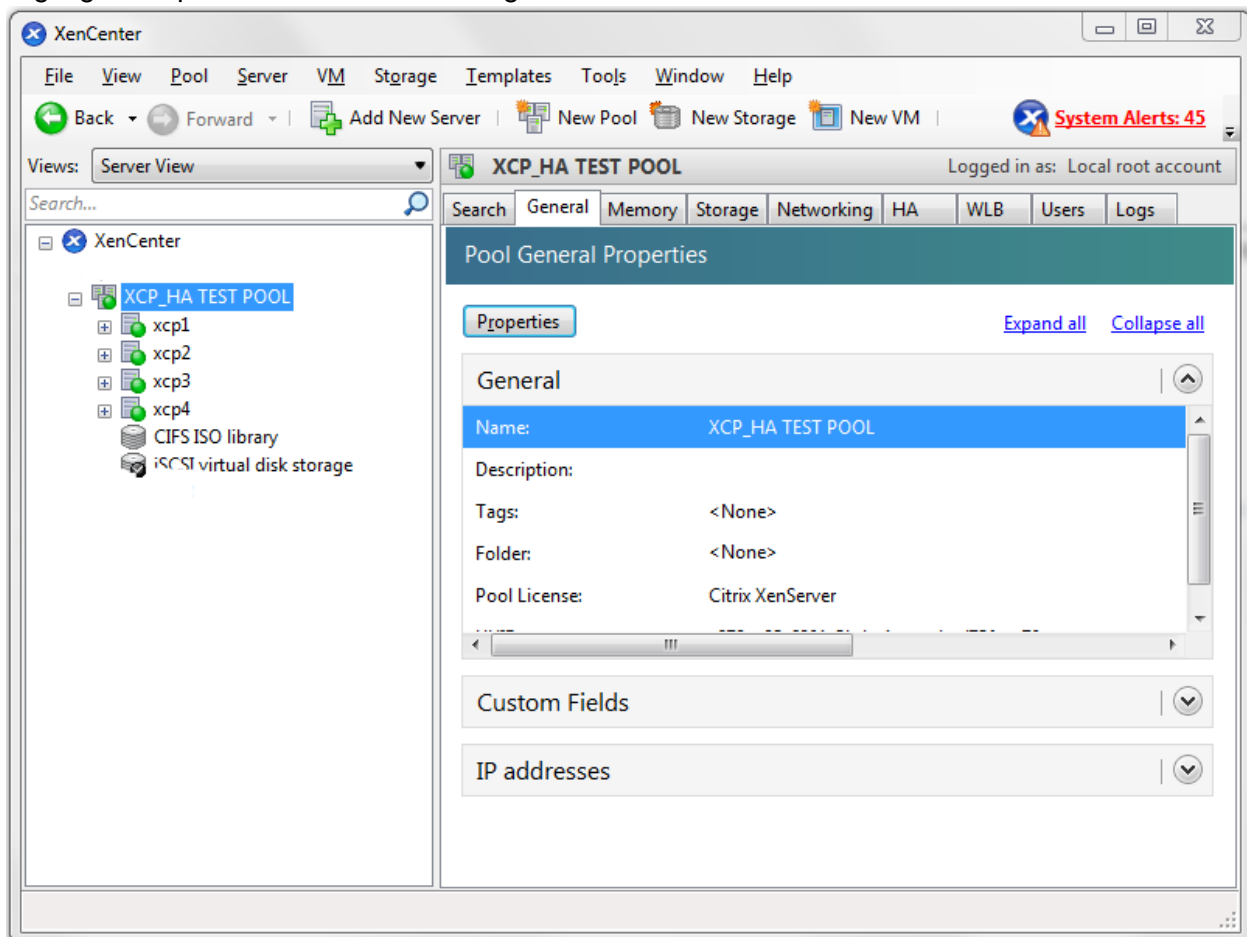Project Sponsor: Pulse Supply http://www.pulsesupply.com

7. Managing via XenCenter

Once installed, the HA service can be toggled on / off via the command line tool, ha-cfg, or via Citrix's XenCenter for users that prefer to use a graphical tool.
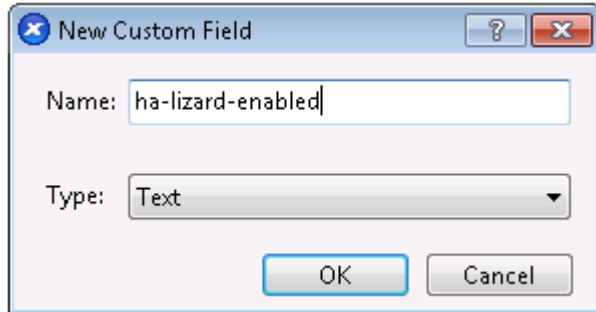
XenCenter custom fields can be added for:

- Enabling / Disabling HA for the entire pool

- Enabling / Disabling HA for specific VMs within the pool (used when GLOBAL_VM_HA is set to 0)

- Monitor health status of pool slaves

The XenCenter friendly custom fields were introduced into the pool database during installation of HA-Lizard. Follow these steps to make these fields visible from within XenCenter:

1) Highlight the pool name in the left navigation window of XenCenter and select the General tab

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2) Select Properties -> Custom Fields -> Edit Custom Fields -> Add
Add a new custom field with the **exact** name as the pool configuration setting XC_FIELD_NAME. By default this name is "ha-lizard-enabled" and create a new field with type set to "text".

3) Any settings that were previously set via the command line tool should now be visible within the new XenCenter custom field. The custom field will be automatically present at both the Pool level and individual VMs and can be used in the following manner:

- To Enable or Disable HA for the entire pool. Modify the value of the custom field at the Pool level as follows:

   set to "true" to enable HA for the Pool
   set to "false" to disable HA for the Pool

   Be aware that the entry is not validated when entered via XenCenter. The CLI tool can be used to validate the setting with "ha-cfg status". Additionally, changing the status via the CLI will also change the status viewed within XenCenter. The CLI tool does validate entries to avoid mis-spelling "true" or "false" and is the preferred method to enable/disable HA.

4) To Enable or Disable HA for a specific VM. Modify the value of the custom field for the VM as follows:

   set to "true" to enable HA for the VM
   set to "false" to disable HA for the VM

   Be aware that the entry is not validated when entered via XenCenter. The CLI tool can be used to validate the setting with "ha-cfg get-vm-ha". Additionally, changing the status via the CLI will also change the status viewed within XenCenter. The CLI tool does validate entries to avoid mis-spelling "true" or "false" and is the preferred method to enable/disable HA for VMs. Use the CLI command "ha-cfg set-vm-ha" to enbale/disable HA from the command line. **Deleteting the custom field from XenCenter will delete the HA settings for the pool.** *Do not delete the custom field once created.*

- **Manage HA from XenCenter**

With a custom field set within XenCenter, an administrator can check or edit HA status for the pool or individual VMs, depending on context as follows:

- When viewing the HA status at the Pool level – the custom field will display true/false. This is a pool-wide setting that controls HA for all hosts within the pool.
  true = HA is enbled for the pool
  false = HA is disabled for the pool
  other = Anything other than true/false will trigger an email alert. HA will not be active with an invalid setting.

- When viewing the HA status at the Host level – the custom field should be empty HA status is not currently used at the host level

- When viewing the HA status at the VM level – the custom field will display true/false. This setting enables/disables HA for a specific VM and only applies when HA is configured in OP_MODE 2 with GLOBAL_VA_HA set to 0, meaning, HA is enabled/disabled for individual host (the default HA-Lizard settings globally apply HA.)
  true = HA is enabled for the VM and will be managed/auto-started if down or durring a host failure
  false = HA is disabled for the VM and will not be managed/auto-started.
  other = Anything other then true/false will trigger an email alert. HA will not be active with an invalid setting.

At this time, settings entered via XenCenter are not validated. It is important that care is used when making changes to ensure that only valid entries are used – true/false. When setting HA status from the CLI tool, all entries are validated which prevent the possibility of entering an invalid state.

The CLI tool can also be used to validate status as follows:

- Pool level HA status can be checked with "ha-cfg status"
  An invalid entry for Pool HA status would display the following warning:

```
---------------------------------------------------------------
| ha-lizard Version:    2.1.3                                  |
| Operating Mode:       Mode [ 2 ] Managing Individual VMs in Pool |
| Host Role:            master                                 |
| Pool UUID:            c2684a0e-1cc6-650e-cf60-ebfe230dc505   |
| Host UUID:            0c33d04e-19d2-4bad-896f-936df9c9e63f   |
| Master UUID:          0c33d04e-19d2-4bad-896f-936df9c9e63f   |
| Daemon Status:        ha-lizard is running [ OK ]           |
| Watchdog Status:      ha-lizard-watchdog is running [ OK ]  |
| HA Enabled:           truew                                  |
---------------------------------------------------------------
Pool HA Status: UNKNOWN
ha-lizard-enabled is not set or set to an invalid value.
Enter <true> to enable or <false> to disable
```

The following will be displayed when HA is properly set:

```
----------------------------------------------------------------------
| ha-lizard Version:    2.1.3                                         |
| Operating Mode:       Mode [ 2 ] Managing Individual VMs in Pool |
| Host Role:            master                                        |
| Pool UUID:            c2684a0e-1cc6-650e-cf60-ebfe230dc505          |
| Host UUID:            0c33d04e-19d2-4bad-896f-936df9c9e63f          |
| Master UUID:          0c33d04e-19d2-4bad-896f-936df9c9e63f          |
| Daemon Status:        ha-lizard is running [ OK ]                   |
| Watchdog Status:      ha-lizard-watchdog is running [ OK ]          |
| HA Enabled:           true                                          |
----------------------------------------------------------------------
Pool HA Status: ENABLED
ha-lizard is enabled. Disable? <yes or Enter to quit>
```

- VM level HA status can be checked with "ha-cfg get-vm-ha"

```
[root@dev2 ha-lizard]# ha-cfg get-vm-ha
Retreiving data.. please wait
GLOBAL_VM_HA is set to 1 - HA-enabled setting not required for each VM

HA-Enabled  VM-UUID                                VM-Name
true        0a8119ea-70d3-8ef2-4650-14eb339aa8c1   cent4
unset       ebe65d4e-9f95-2972-6e1d-7d6fbfc8e336   XenServer  DDK  6.2.0
false       447700f7-5f38-9c6a-32f3-965919022100   cent3
true        fcf21b01-e53b-7756-2be0-cb0b4b192fe1   cent1
false       fe6555ee-4d90-7670-b3da-33f546c0cbe5   cent2
```

- **Viewing HA Status from XenCenter**

The custom field (ha-lizard-enabled) will be displayed from within XenCenter when viewing the pool with the "Search" tab selected. The following sample output details the meaning of the HA setting at the various pool contexts (pool, host, VM)

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Application and Settings Examples

- **Auto-Start VMs – Without Host High Availability**

The following configuration settings can be used for a basic setup where VMs are automatically started in either of the following scenarios:

1) A VM has failed during normal operation

2) A host was rebooted and VMs on the host require a restart

In this mode, HA is disabled and any host failures are ignored. In the event of a host failure, some VMs may fail to start properly while the host is still part of the pool.

```
DISABLED_VAPPS=()
ENABLE_LOGGING=1
FENCE_ACTION=stop
FENCE_ENABLED=0
FENCE_FILE_LOC=/etc/ha-lizard/fence
FENCE_HA_ONFAIL=0
FENCE_HEURISTICS_IPS=
FENCE_HOST_FORGET=0
FENCE_IPADDRESS=
FENCE_METHOD=POOL
FENCE_MIN_HOSTS=3
FENCE_PASSWD=
FENCE_QUORUM_REQUIRED=0
FENCE_REBOOT_LONE_HOST=0
FENCE_USE_IP_HEURISTICS=0
GLOBAL_VM_HA=1
MAIL_FROM=<enter email address>
MAIL_ON=1
MAIL_SUBJECT="SYSTEM_ALERT-FROM_HOST:$HOSTNAME"
MAIL_TO=<enter email address>
MONITOR_DELAY=45
MONITOR_KILLALL=1
MONITOR_MAX_STARTS=40
MONITOR_SCANRATE=10
OP_MODE=2
PROMOTE_SLAVE=0
SLAVE_HA=0
SLAVE_VM_STAT=1
XAPI_COUNT=5
XAPI_DELAY=15
XC_FIELD_NAME='ha-lizard-enabled'
XE_TIMEOUT=10
```

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- **Auto-Start VMs – With Host High Availability**

The following configuration settings can be used for a basic HA setup where VMs are automatically started in any of the following scenarios:

1) A VM has failed during normal operation

2) A host was rebooted and VMs on the host require a restart

3) A host (master or slave) has failed and had VMs running before the failure

Additionally, any host failure will be detected by HA with steps taken to automatically recover and reconfigure the pool, starting any affected services.

In this mode, HA is enabled with POOL fencing, meaning, any failed host will be detected and forcibly removed from the pool. Additional configuration possibilities are available using ILO or custom fencing agents.

```
DISABLED_VAPPS=()
ENABLE_LOGGING=1
FENCE_ACTION=stop
FENCE_ENABLED=1
FENCE_FILE_LOC=/etc/ha-lizard/fence
FENCE_HA_ONFAIL=1
FENCE_HEURISTICS_IPS=<enter IP addresses delimited by :>
FENCE_HOST_FORGET=0
FENCE_IPADDRESS=
FENCE_METHOD=POOL
FENCE_MIN_HOSTS=3
FENCE_PASSWD=
FENCE_QUORUM_REQUIRED=1
FENCE_REBOOT_LONE_HOST=1
FENCE_USE_IP_HEURISTICS=1
GLOBAL_VM_HA=1
MAIL_FROM=<enter email address>
MAIL_ON=1
MAIL_SUBJECT="SYSTEM_ALERT-FROM_HOST:$HOSTNAME"
MAIL_TO=<enter email address>
MONITOR_DELAY=45
MONITOR_KILLALL=1
MONITOR_MAX_STARTS=40
MONITOR_SCANRATE=10
OP_MODE=2
PROMOTE_SLAVE=1
SLAVE_HA=1
SLAVE_VM_STAT=1
XAPI_COUNT=5
XAPI_DELAY=15
XC_FIELD_NAME='ha-lizard-enabled'
XE_TIMEOUT=10
```

- **2-Node Pool – With Host High Availability**

A 2-node pool is a special case where IP heuristics are required to create an additional vote to achieve quorum. This technique tries to reach IP addresses outside of the pool should a peer host be unreachable. The following settings provide full HA features in a 2-node environment. For faster switching of roles and HA recovery consider shortening XAPI_COUNT and XAPI_DELAY.

```
DISABLED_VAPPS=()
ENABLE_LOGGING=1
FENCE_ACTION=stop
FENCE_ENABLED=1
FENCE_FILE_LOC=/etc/ha-lizard/fence
FENCE_HA_ONFAIL=1
FENCE_HEURISTICS_IPS=<enter IP addresses delimited by :>
FENCE_HOST_FORGET=0
FENCE_IPADDRESS=
FENCE_METHOD=POOL
FENCE_MIN_HOSTS=2
FENCE_PASSWD=
FENCE_QUORUM_REQUIRED=1
FENCE_REBOOT_LONE_HOST=0
FENCE_USE_IP_HEURISTICS=1
GLOBAL_VM_HA=1
MAIL_FROM=<enter email address>
MAIL_ON=1
MAIL_SUBJECT="SYSTEM_ALERT-FROM_HOST:$HOSTNAME"
MAIL_TO=<enter email address>
MONITOR_DELAY=45
MONITOR_KILLALL=1
MONITOR_MAX_STARTS=40
MONITOR_SCANRATE=10
OP_MODE=2
PROMOTE_SLAVE=1
SLAVE_HA=1
SLAVE_VM_STAT=1
XAPI_COUNT=5
XAPI_DELAY=15
XC_FIELD_NAME='ha-lizard-enabled'
XE_TIMEOUT=10
```

8. Miscellaneous

- **Dependencies and Compatibility**

When installing HA onto a default Centos based DomO (XCP or XenServer), all the required tools needed to run HA are resident on the system. HA-Lizard has been specifically designed to require ***zero dependencies***, fulfilling the mission of creating a very light-weight application that is easy to configure with a single set of documentation for users to follow.

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Package is compatible with XCP version 1.6, XenServer version 6.1/6.2/6. And XenServer 7.0. Prior releases may work but have not been tested.

For custom DomO installations, ensure the following tools are available:

xapi and xe toolstack
/bin/awk
/bin/echo
/bin/logger
/bin/hostname
/opt/xensource/sm/resetvdis.py
/bin/cat
/bin/grep
/usr/bin/column
/etc/init.d/functions

- **Security and Ports**

  - HTTP port 80 is used to check the running status of XAPI on hosts within the pool. Ensure that all hosts within the pool have access to port 80 on all peer hosts.

  - ICMP (ping) is used to check the running status of peer hosts. Ensure that all hosts within the pool have access to ICMP on all peer hosts.

- **Things to Know**

  - *FENCE_HOST_FORGET will be deprecated. Avoid setting this to 1 unless you know what you are doing. This will not impact recovery of a pool, but, enabling will forcefully remove a host from the pool. The host would then have to be manually repaired and reintroduced into the pool. Version 1.6.41 introduced new friendlier logic which no longer requires the forceful removal of a host.*

  - Putting the Master into maintenance mode while HA is enabled is no longer supported. It is advised that HA should be disabled before putting any hosts into maintenance mode.

  - HA should be disabled for a pool before shutting down a host. Do not shut down a host without disabling HA or host can be forcefully removed from the pool.

  - Disabling ha-lizard: This can be accomplished with a custom-field accessible via a graphical management utility or the local CLI tool, ha-cfg. IMPORTANT: slaves read ha-lizard-enabled from local state files and may take up to a minute before the cache is updated.

- **Planned Future Improvements**

- Significant modifications are underway to adapt the project to the new XenSever Centos7 style dom0.

- Possibly combine project with iSCSI-HA

- Addition of a VM start order/weighting system.

- Alerts and notifications through XenCenter

- Move serialized tasks to scheduler so that recovery operations can be parallelized

- **Support**

- Post a question on the support forum
  http://www.halizard.com/index.php/forum

- Contact the project sponsor
  http://www.pulsesupply.com
  ha@pulsesupply.com