Solaris iSNS Server

1.0 Introduction

Internet Storage Name Service (iSNS) is an industry standard which allows centralized discovery service for iSCSI and iFCP devices in an IP network. It is defined in IETF RFC 4171 and functions as a central repository for information about devices. The devices in the repository are segregated into discovery domains. Devices in common discovery domain(s) are visible to one another. iSNS is designed to be a lightweight protocol that can be deployed in iSNS Server, IP Storage switches and target devices which interact with iSNS Server as iSNS Clients. The clients register their presence with the Server, retrieve a list of devices and obtain network addressing for access to those devices from the Server. This document discusses the design and relevant implementation details of iSNS server for Solaris.

Revision History

Version	Date	Submitter	Comments
0.1	10/30/ 2006	Hyon Kim/ Victor Li	Initial spec
0.2	11/5/ 2006	Hyon Kim	Add smf profile/authority for iSNS service
0.3	1/15/ 2007	Hyon Kim	Updated architecture diagram with BUI proxy/JNI component. Added information on the XML schema for CLI and BUI operations. Updated Interface section with CLI information.
0.4	3/25/ 2007	Hyon Kim	Updated to address comments from the inception review.

2. Overview

The server will support iSNS protocol(iSNSP) as defined in RFC 4171 to communicate with clients. Along with discovery related messages, it will support State Change Notification(SCN) message to notify dynamic configuration change. Also it will support Entity Status Inquiry (ESI) message to allow a client to manage the interval of health check driven by the server.

For the iSNS server discovery, the client is expected to use static configuration or DHCP per RFC 4174.

For data store solution for configuration information, a flatfile based approach will be taken for the initial implementation. A framework to generically allow other solutions like a relational database or LDAP will be examined for a longer term solution.

The start/stop/refresh of the server and administratively

controlled settings defined in section 2.4 of RFC 4171 will be managed by Solaris Service Management Facility(SMF) framework(smf(5)).

Cluster based logical iSNS server with multiple physical nodes will be considered as a backup server solution.

Goals and non-goals

The iSNS Server will be ~~fully~~ compliant with the RFC 4171 by implementing all of mandatory features ~~unless there is security related issues. Some of optional features will be implemented~~ to fully support standard compliant iSCSI devices.

Goals are:

- ~~iSCSI device will be fully supported~~ supporting all mandatory attributes defined in RFC section 4.1.1 and mandatory messages/responses in RFC section 4.1.3.
- TCP will be supported for all of iSNS protocol~~.~~ including Entity Status Inquiry(ESI) and State Change Notification(SCN) as described in RFC section 2.9.1
- UDP will supported for registrations from clients requesting UDP-based ESI and SCN message as described in RFC section 2.9.2.
- Secured management application support scheme will be provided.
- Sun cluster based b~~B~~ackup server solution will be provided.

The followings are not supported~~Non goals are~~:

- iSNS Heartbeat message for server discovery is not supported. (RFC section 2.9.3)
- No vendor specific message described in RFC section 4.1.3 is used.

- No vendor specific server attribute in RFC section 6.1 is used.
- No vendor specific client attribute in RFC section 6.1 is supported.
- Administrative setting Default DD/DDS in RFC section 2.4 is not supported. Refer to Section 4.1.4 of this document.
- Administrative setting DD/DDS Modification in RFC section 2.4 is not supported. The implementation allows only the control node to modify Discovery Domain and Domain Set, following RFC default behavior.
- UDP will not be supported for device registration, deregisteration and device query. (RFC section 2.9.2)
- iSNS MIB for SNMP management is not supported. (RFC section 2.10)
- iFCP devices will not be supported. (RFC section 4.2)
- security related optional attributes are not supported. (Section 4.1.1)
- ~~Distribution of security information, including authorizations for communications between iSCSI peer devices and security policy for iSCSI devices, is not supported~~.

3. Architecture

Major components of this project are a server daemon, a command line utility(CLI) and a Browser based GUI interface(BUI).

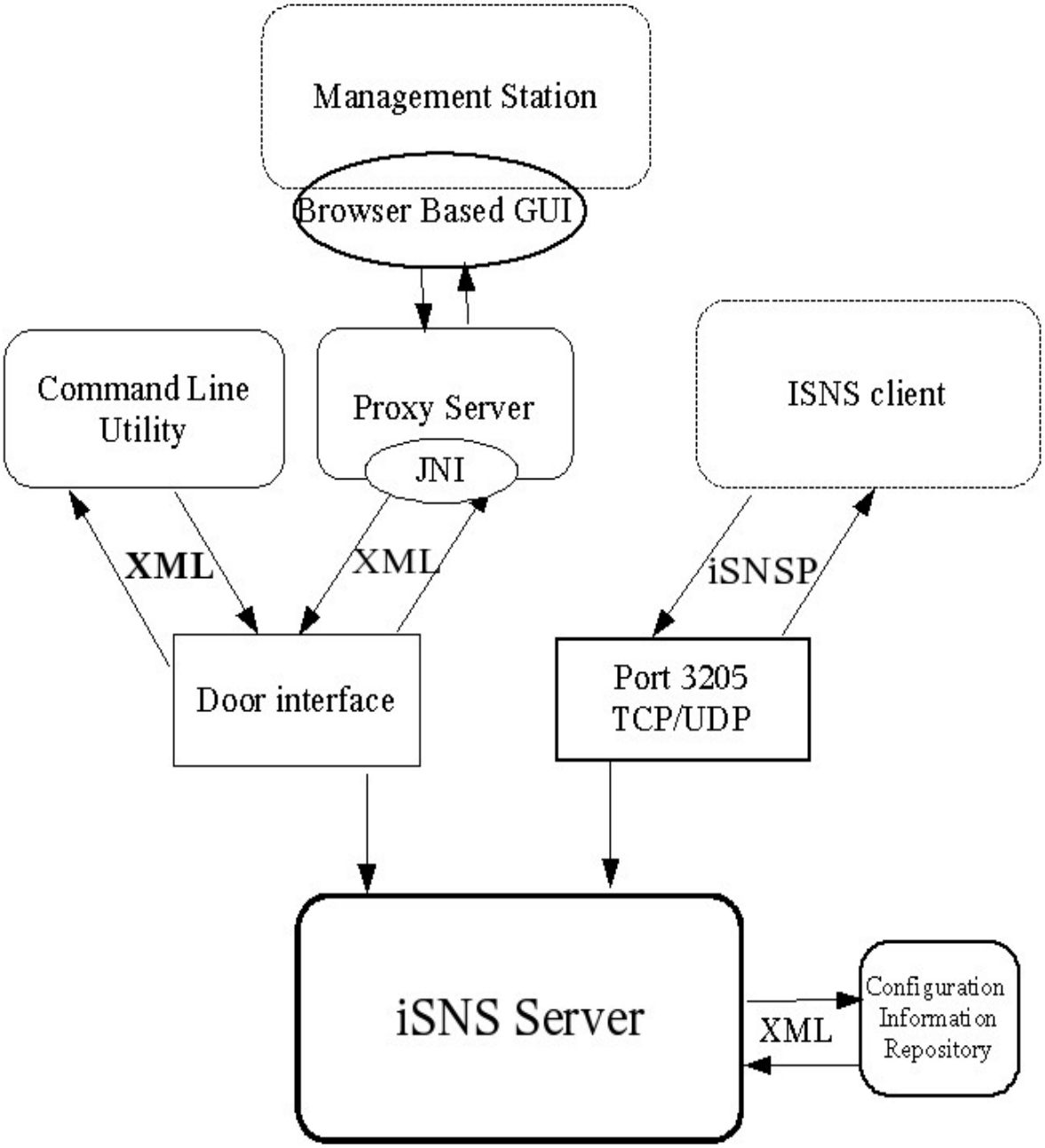
- The server daemon handles iSNS protocols through port 3205 as defined in RFC4171 and also provides a door interface that management applications can access and administer iSNS configuration data.
- The CLI and BUI allow various administrative tasks by

communicating through a door interface that is provided for management application by the server. The CLI and the Web Service Proxy for BUI that talks to the server will reside in the same system as the server.

- The format of data transport between the server and CLI/BUI will be XML based. An XML schema will be developed for iSNS objects and associated operations.

- Server uses a file to store for iSNS client attributes and configuration data.

The diagram shows the overall architecture of the components.


Management Station
Browser Based GUI
Command Line Utility
Proxy Server
JNI
ISNS client
XML
XML
iSNSP
Door interface
Port 3205 TCP/UDP
iSNS Server
XML
Configuration Information Repository

4. Technical details

4.1 Server Management

4.1.1 Administration

The iSNS Server will be defined as a service under Solaris Service Management Facility(SMF) which provides infrastructure to manage persistently running applications. The server runs as a daemon when the service is enabled during the system boot-up or through SMF service management. The associated SMF service is disabled by default. The SMF will also be used to manage administrative settings. Any modification to the settings will require the associated service to be refreshed.

4.1.1.1 Service Manifest

A service manifest will be provided in the delivery of iSNS Server package according to the requirement of SMF. The service manifest is the definition of the service bundle of the iSNS Server. It contains a list of elements for service properties, dependencies, execution methods and so on. The manifest is an XML file which follows the DTD of SMF and will be imported to SMF service repository during the installation of the iSNS Server package.

The service manifest will contain the definition of the service bundle:

<service_bundle type='manifest' name='SUNWisns~~svr~~:isns_server'>.

- The service attributes will be defined as:

  name = "network/isns_server"

  type = "service" and

  version = "1",

  the service will have only a single instance.

- The iSNS Service will require full file system access and

network name resolution.

- The exec_methods that we will provide include

  start method: it is to start the service by executing the iSNS Server daemon program.

  stop method: it is to stop the service by sending the signal SIGKILL.

  refresh method: it is to inform the service to reload the configuration by sending signal SIGHUP.

4.1.1.2 Service Properties

There will be a property group for administratively controlled settings defined in section 2.4 of RFC 4171 and other implementation choice setting.

> data_store_location: default /etc/isns/isnsdata.xml(refer to section Data Store for Configuration Information);
>
> ESI_retry_threshold_count, default value is 3;
>
> Management_SCNs_Enabled, enabled by default(relevant only if control node is enabled);
>
> ~~Default DD/DDS, disabled by default;~~
>
> ~~DD/DDS Modification for a) Control Node, b) iSCSI Target Node Type, c) iSCSI Initiator Node Type, enabled for a) and disabled for others by default;~~
>
> Authorized_Control_Nodes. Default is "-" to indicate an empty string.

The svcadm(1M) and svccfg(1M) commands are used to manage iSNS server SMF service and associated properties. Also libscf(3LIB) interfaces will be used to read in the administrative settings of the server.

4.1.1.3 Service Security

Solaris Role Based Access Control(rbac(5)) profile iSNS management will be created along with solaris.smf.manage.isns and solaris.smf.~~modify~~value.isns authorities to let the iSNS service managed under RBAC scheme. Additional authorizations, solaris.isnsmgr.read and solaris.isnsmgr.write, will be associated with the profile for the management application's view and modify operations.

4.1.2 Control Node and Management Application Support

The RFC 4171 describes a control node as an entity to create or delete discovery domain, to register a management SCN and to be endowed with access to all iSNS database records. It is identified through iSCSI name as described administratively controlled setting 'Authorized Control Nodes' but no credential based authentication method is specified in the RFC. Considering that the node name can be snooped, name validation based authentication represents a security risk. IPsec is mentioned for the security matters but IPsec is deployed at the IP layer so once a connection is made to the server there is no mechanism to securely associate a connections with a control node other than name comparison.

The project will allow a control node through administrative controlled settings defined in section 2.4 of RFC 4171. But project provided management applications won't be implemented as such even though they provide control node functionality. Instead, the server will provide a door interface to support CLI and local proxy server for BUI and apply Solaris Role Based Access Control(RBAC) using chkauthattr(3SECDB)~~door_ucred(3DOOR)~~ authorizations to check the ~~credential of the calling process~~ authorization of the user.

4.1.3 Data Model for Management Application

iSNS defined objects/attributes and associations will be communicated to CLI and BUI management applications through XML data. The XML modeling includes elements for Discovery Domain Set, Discovery Domain and Node objects and enumerate, createModify, delete, get, getAssociated

operations. The XML schema isnsmgmtSchmea.xsd provides details.

4.1.4 Behavior of Default Discovery Domain and Domain Set

The RFC 4171 defines the Default discovery domain and domain set and the 'Default DD/DDS' setting with intent of managing clients that have not assigned to any user-defined discovery domain. The server will adopt the following behaviors on the Default discovery domain and domain set.

- An unassigned client is added to the Default discovery domain. A newly registered client or a client that was removed from its last discovery domain membership are considered to be an unassigned client.
- When a client gets assigned to a user-defined discovery domain, the server will remove the client from the Default discovery domain.
- The Default discovery domain set is allowed to be administratively activated/deactivated in order to let the administrator control the discovery among the clients in the Default discovery domain. The default state of the Default discovery domain set is inactive.
- It is not allowed to administratively add a client to the Default discovery domain and add a user-defined discovery domain to the Default discovery domain set.

Since the administrator can manage the state of the Default discovery domain set through the management application the Default DD/DDS setting in section 2.4 of the RFC 4171 won't be provided by the server.

4.2 Server Operations

The server will be running as a daemon with the following implementation.

- There will be three main threads comprised in the server for iSNS client support. One is per connection of the message handler which responses for receiving clients' request, handling the request and transmit the result to

the clients. One is for State Change Notification which generates SCN messages based on the network events and transmit the messages to the corresponding clients. The third one is for ESI, which polls the clients' status for their presence.

- The door interface for the CLI and BUI management applications will be served through another thread.

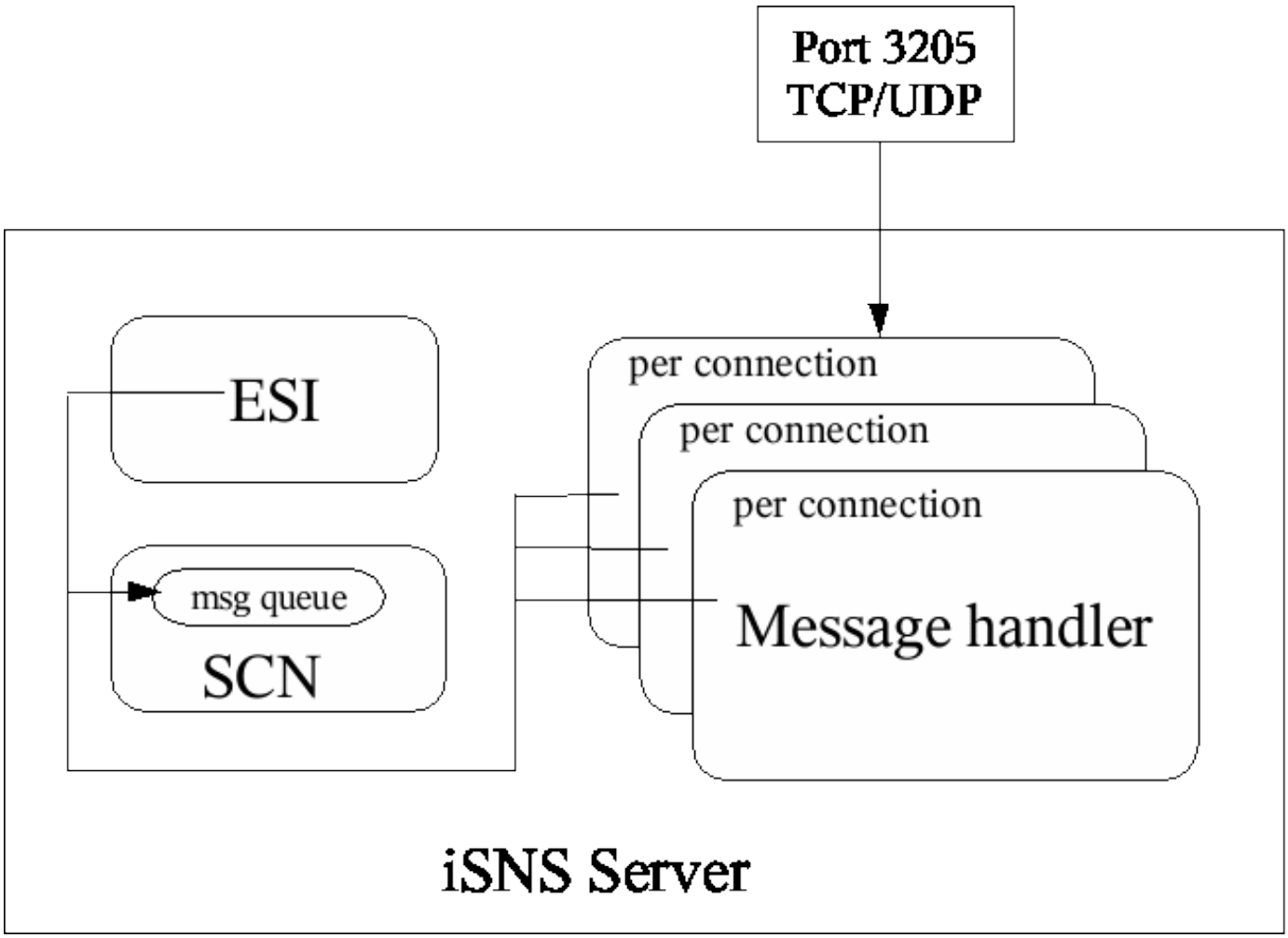
- When iSNS Server is being started, the iSNS Server loads all of discovery domain information from the stored configuration information and keep the information in memory while the server is running. The server updates the configuration information repository when there is a change happening in discovery domain or discovery domain set. When a non-control node client registers its existence in the server, the server will find any discovery domain(s) for which this client belonged to previously, and scope to those discovery domain(s) when the client queries device information from the server. If no previous association with the server exist, the client will be put into the default Discovery Domain.

- iSNS Server binds to the well known port 3205 at its startup and will listen on that port during the server is running. iSNS transmits data in packet data units (PDUs). One or more PDUs make up one iSNS message. Server performs certain operations and send back the result to the client based on the message types that are defined in RFC 4171.

- The communication method among these threads is by the use of message queue. When a device registers or deregister its existence with the server, or ESI detects a device being offline, a message is sent to the SCN generator, therefore SCN generator generates a message and sends the message to corresponding devices. The message is sent to the SCN thread in one-way direction, one message queue is only used for the communication.

- Mutex is used as locks for accessing discovery domain information by these three threads.

  The diagram of the internal architecture for handling a iSNS client is shown below.



4.2.1 Required iSNS Commands and Response Messages

The following table provides an overview of iSNSP messages for the client support. Note that control node related messages are supported only if the control node operation is enabled through the administrative setting.

Message Type	Description	Response Message
DevAttrReg (0x0001)	Provide the means for iSNS to update existing objects or registering new objects.	DevAttrRegRsp (0x8001)
DevAttrQry (0x0002)	Provide an iSNS client with the means to query the iSNS server for object attributes.	DevAttrQryRsp (0x8002)

DevGetNext (0x0003)	Provide an iSNS client with the means to retrieve each and every instance of an object type exactly once.	DevGetNextRsp (0x8003)
DevDereg (0x0004)	This message is used to remove object entries from the iSNS database.	DevDeregRsp (0x8004)
SCNReg (0x0005)	This message allows an iSNS client to register a Storage Node to receive State Change Notification (SCN) messages.	SCNRegRsp (0x8005)
SCNDereg (0x0006)	This message allows an iSNS client to stop receiving SCN messages.	SCNDeregRsp (0x8006)
SCNEvent (0x0007)	This message is sent by an iSNS client to request generation of a SCN message by the iSNS server.	SCNEventRsp (0x8007)
SCN (0x0008)	This message is generated by iSNS server, notifying a registered Storage Node of changes.	SCNRsp (0x8008)
DDReg (0x0009)	This message is used to create a new Discovery Domain (DD), to update an existing DD Symbolic Name and/or DD Features attributes, and to add DD members.	DDRegRsp (0x8009)
DDDereg (0x000A)	This message allows an iSNS client to deregister an existing Discovery Domain (DD) and to remove members from an existing DD.	DDDeregRsp (0x800A)
DDSReg (0x000B)	This message allows an iSNS	DDSRegRsp (0x800B)

	client to create a new Discovery Domain Set (DDS), to update an existing DDS Symbolic Name and/or DDS Status, or to add DDS members.	
DDSDereg (0x000C)	This message allows an iSNS client to deregister an existing Discovery Domain Set (DDS) or to remove some DDs from an existing DDS.	DDSDeregRsp (0x800C)
ESI (0x000D)	This message is sent by the iSNS server, and is used to verify that an iSNS client Portal is reachable and available.	ESIRsp (0x800D)

4.2.2 Object and Attributes

The iSNSP registration and query message PDU Payloads contain a list of attributes which are separated to source attribute, message key attribute(s) and operating attribute(s).

The following table lists the attributes for each type of object that the server supports.

Object	Attribute	Description
NETWORK ENTITY	Entity Identifier	This is a key attribute that uniquely identifies each Network Entity registered in the iSNS server.
	Entity Protocol	This attribute indicates the block storage protocol used by the registered NETWORK ENTITY.
	Management IP Address	This attribute contains the IP address that may be used to manage the Network Entity and all

Object	Attribute	Description
		Storage Nodes contained therein via iSNS MIB.
	Timestamp	This field indicates the most recent time of message handling related to the Network Entity.
	Protocol Version Range	This field contains the minimum and maximum version of the block storage protocol supported by the Network Entity.
	Registration Period	This field indicates the maximum period, in seconds, that the registration will be maintained by the server without receipt of any message from the client that registers the Network Entity.
	Entity Index	This index uniquely identifies each Network Entity registered in the iSNS server.
PORTAL	IP Address	This is a key attribute that contains the IP address of the Portal which a Storage Node can transmit and receive storage data.
	TCP/UDP Port	This is a key attribute that indicate TCP/UDP port of the Portal which a Storage Node can transmit and receive storage data.
	Portal Symbolic Name	This attribute is a user-readable description of the Portal entry in the iSNS server.
	ESI Interval	This field indicates the requested time, in seconds, between Entity Status Inquiry messages sent from the iSNS server to this Network Entity.
	ESI Port	This field contains the TCP or UDP port used for ESI monitoring by the iSNS server at the Portal IP Address.

Object	Attribute	Description
	Portal Index	This index uniquely identifies each Portal registered in the iSNS database.
	SCN Port	This field contains the TCP or UDP port used by the iSNS client to receive SCN messages from the iSNS server.
	Portal Security Bitmap	This field contains flags that indicate security attribute settings for the Portal.
PORTAL GROUP	PG iSCSI Name	This is the iSCSI Name for the iSCSI Storage Node that is associated with the PG object.
	PG IP Address	This is the Portal IP Address attribute for the Portal that is associated with the PG object.
	PG TCP/UDP Port	This is the Portal TCP/UDP Portal attribute for the Portal that is associated with the PG object.
	PG Tag	This field is used to group Portals in order to coordinate connections in a session across Portals to a specified iSCSI Node.
	PG Index	This index uniquely identifies each PG object registered in the iSNS database.
STORAGE NODE	iSCSI Name	This attribute is used to uniquely identifies a Storage Node object, it is unique across the entire database.
	iSCSI Node Type	This field is a bitmap indicating the type of iSCSI Storage Node, the types are: Control, Initiator or Target.
	Alias	This field is a user-readable description of the Node entry in the iSNS server.

Object	Attribute	Description
	iSCSI SCN Bitmap	This SCN bitmap indicates events for which the registering iSNS client wishes to receive a notification message.
	iSCSI Node Index	This index uniquely identifies each iSCSI Storage Node registered in the iSNS database.
DISCOVERY DOMAIN	DD ID	The DD ID is an unsigned non-zero integer identifier used in the iSNS directory database as a key to identify a Discovery Domain uniquely.
	DD Symbolic Name	This name uniquely identifies a Discovery Domain.
	DD Member iSCSI Node Index	This is the iSCSI Index of a Storage Node that is a member of the DD.
	DD Member iSCSI Name	This field indicates membership for the specified iSCSI Storage Node in the Discover Domain.
	DD Member iSCSI Portal Index	This field is an alternative representation for Portal membership to the Portal IP Address and Portal TCP/UDP Port.
	DD Member Portal IP Address	This attribute and the Portal TCP/UDP Port attribute indicate membership in the Discovery Domain for the specified Portal.
	DD Member Portal TCP/UDP	This attribute and the Portal IP Address attribute indicate membership in the Discovery Domain for the specified Portal.
	DD Features	The Discovery Domain Features is a bitmap indicating the features of this DD.
DISCOVERY DOMAIN	DDS	The DDS ID is an unsigned non-zero integer identifier used in the iSNS directory database as

Object	Attribute	Description
SET	Identifier	a key to indicate a Discovery Domain Set uniquely.
	DDS Symbolic Name	This is a user-readable field used to assist a network administrator in tracking the DDS function.
	DDS Status	This field is a 32-bit bitmap indicating the status of the DDS.

4.2.3 Status Code

The iSNSP response message PDU Payloads contain a Status Code followed by a list of attributes. The following is the return code that the server will use. It is defined in RFC4171 section 5.4.

Status Code	Status Description
0	Successful
1	Unknown Error
2	Message Format Error
3	Invalid Registration
5	Invalid Query
6	Source Unknown
7	Source Absent
8	Source Unauthorized

Status Code	Status Description
9	No Such Entry
10	Version Not Supported
11	Internal Error
12	Busy
13	Option Not Understood
14	Invalid Update
15	Message Not Supported
16	SCN Event Rejected
17	SCN Registration Rejected
18	Attribute Not Implemented
22	Invalid Deregistration
23	Registration Feature Not Supported

4.3 Backup Server Solution

Sun Cluster will be used as as a backup server solution, creating multiple physical iSNS servers to form a single logical iSNS server cluster as described in section 2.8 of RFC 4171. The data store for configuration information will be placed in a cluster file system to let multiple cluster nodes share data.

With Sun cluster scalable data service, one node hosts the physical interface to the cluster. This node is called a

Global Interface (GIF) Node. Multiple GIF nodes can exist in the cluster. Each GIF node hosts one or more logical interfaces that can be used by scalable services. These logical interfaces are called global interfaces. One GIF node hosts a global interface for all requests for a particular application and dispatches them to multiple nodes on which the application server is running. If the GIF node fails, the global interface fails over to a surviving node. When a failover occurs, a new Address Resolution Protocol (ARP) packets are generated and broadcast to the world. These ARP packets contain the new MAC address (of the new physical adapter to which the node failed over) and the old IP address. When another machine on the network receives one of these packets, it flushes the old MAC-IP mapping from its ARP cache and uses the new one.

When Sun cluster 3.2 is deployed, the SMF framework based administration described in section 4.1.1 can be converted to HA using the existing cluster facility. With the current cluster implementation, the administrator still needs to manually maintain properties in sync among cluster nodes. ~~is not feasible since SMF is not cluster aware.~~ ~~Instead, Sun cluster start facility will start the iSNS through its resource group framework. This means that the admin needs to feed iSNS configuration prop to the cluster and the cluster start facility will get those data and pass them when it starts iSNS server. The iSNS server will be implemented such that its start routine check if the administrative settings are given as start arguments and if they are, it will skip to call libscf.~~

Procedural steps~~details~~ on Sun cluster based operations ~~will be provided later~~ are provided in a separate document.

4.4 Data Store for Configuration Information

The server settings and the client configuration information will be stored in a flatfile with XML format. The default location will be /etc/isns/isns.xml. The file can be administratively specified by modifying the data store location prop of iSNS SMF service. When the file doesn't exist the server will create one. If it does exist, the server will check certain things like warning

message for manual edit and the content of file at loading time. If any kind of failure is detected, the server will get terminated. In a longer term, a framework to take a plugin module that handles data store with its own access method will be provided. That will allow 3rd party vendors to apply its own data store solution.

4.5 Server Discovery

The DHCP based discovery will be supported for the server. RFC 4174 iSNS option will be configured through /etc/dhcp/inittap(dhcp_inittab(4)) and dhtadm(1M)/dhcpmgr(1M). Also static discovery, i.e., manually specifying the IP address of the server would work as most of clients provide an interface to accept it today.

4.6 User Interface

The specification of CLI isnsadm is provided in a separate document, iSNS-CLI-Design.pdf file. Solaris Lockhart based BUI component will be provided in the future.

5. Interfaces

- **Exported Interfaces**

Name	Level	Comments
/usr/sbin/isnsadm Response Label Data Field Error message	Committed Uncommitted Uncommitted Uncommitted	iSNS Server CLI.
/etc/isns/isnsdata.xml	Project private	Default iSNS data store for configuration information
/var/run/isns_server_door	Project Private	A file for door

		interface
svc:/network/isns_server	Committed	SMF service for iSNS server
data_store_location	Committed	SMF property for network/isns_server
ESI_retry_threshold_count	Committed	SMF property for network/isns_server
Management_SCN_Enabled	Committed	SMF property for network/isns_server
Authorized Control Nodes	Committed	SMF property for network/isns_server

Imported Interfaces

Name	Level	Comments
IETF RFC 4171	Standard	
libscf	Evolving	
libdoor	Evolving	

References

[iSNS] "Internet Storage Name Service (iSNS)" http://www.ietf.org/rfc/rfc4171.txt?number=4171

[DHCP Option for iSNS] "The IPv4 Dynamic Host Configuration Protocol (DHCP) Option for the Internet Storage Name Service" http://www.ietf.org/rfc/rfc4174.txt

SMF PSARC/2002/547