



Xen Management API Draft

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Comments are welcome!

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Chapter 1

Introduction

This document contains a proposal for a Xen Management API—an interface for remotely configuring and controlling virtualised guests running on a Xen-enabled host.

This document is an early draft for discussion purposes only

The API is presented here as a set of Remote Procedure Calls, with a wire format based upon XML-RPC. No specific language bindings are prescribed, although examples will be given in the python programming language.

Although we adopt some terminology from object-oriented programming, future client language bindings may or may not be object oriented. The API reference uses the terminology *classes* and *objects*. For our purposes a *class* is simply a hierarchical namespace; an *object* is an instance of a class with its fields set to specific values. Objects are persistent and exist on the server-side. Clients may obtain opaque references to these server-side objects and then access their fields via get/set RPCs.

For each class we specify a list of fields along with their *types* and *qualifiers*. A qualifier is one of:

- *RO_{run}*: the field is Read Only. Furthermore, its value is automatically computed at runtime. For example: current CPU load and disk IO throughput.
- *RO_{ins}*: the field must be manually set when a new object is created, but is then Read Only for the duration of the object's life. For example, the maximum memory addressable by a guest is set before the guest boots.
- *RW*: the field is Read/Write. For example, the name of a VM.

A full list of types is given in Chapter 2. However, there are three types that require explicit mention:

- *t Ref*: signifies a reference to an object of type *t*.
- *t Set*: signifies a set containing values of type *t*.
- (t_1, t_2) *Map*: signifies a mapping from values of type t_1 to values of type t_2 .

Note that there are a number of cases where *Refs* are *doubly linked*—e.g. a VM has a field called *groups* of type $(VMGroup Ref) Set$; this field lists the VMGroups that a particular VM is part of. Similarly, the VMGroups class has a field called *VMs* of type $(VM Ref) Set$ that contains the VMs that are part of a particular VMGroup. These two fields are *bound together*, in the sense that adding a new VMGroup to a VM causes the VMs field of the corresponding VMGroup object to be updated automatically.

The API reference explicitly lists the fields that are bound together in this way. It also contains a diagram that shows relationships between classes. In this diagram an edge signifies the existence of a pair of fields that are bound together, using standard crows-foot notation to signify the type of relationship (e.g. one-many, many-many).

1.1 RPCs associated with fields

Each field, `f`, has an RPC accessor associated with it that returns `f`'s value:

- “`get_f(Ref x)`”: takes a `Ref` that refers to an object and returns the value of `f`.

Each field, `f`, with attribute `RW` and whose outermost type is `Set` has the following additional RPCs associated with it:

- an “`add_to_f(Ref x, v)`” RPC adds a new element `v` to the set¹;
- a “`remove_from_f(Ref x, v)`” RPC removes element `v` from the set;

Each field, `f`, with attribute `RW` and whose outermost type is `Map` has the following additional RPCs associated with it:

- an “`add_to_f(Ref x, k, v)`” RPC adds new pair `(k, v)` to the mapping stored in `f` in object `x`. Adding a new pair for duplicate key, `k`, overwrites any previous mapping for `k`.
- a “`remove_from_f(Ref x, k)`” RPC removes the pair with key `k` from the mapping stored in `f` in object `x`.

Each field whose outermost type is neither `Set` nor `Map`, but whose attribute is `RW` has an RPC accessor associated with it that sets its value:

- For `RW` (*Read/Write*), a “`set_f(Ref x, v)`” RPC function is also provided. This sets field `f` on object `x` to value `v`.

1.2 RPCs associated with classes

- Each class has a *constructor* RPC that takes as parameters all fields marked `RW` and `ROins`. The result of this RPC is that a new *persistent* object is created on the server-side with the specified field values.
- Each class has a “`get_all()`” RPC that returns a set of all persistent objects of that class that the system knows about. For example, `VM.get_all()` would return a set of `VM` objects that are currently installed.
- Each class has a `get_by_uuid(uuid)` RPC that returns the object of that class that has the specified `uuid`.
- Each class that has a `short_name` field has a “`get_by_short_name(name)`” RPC that returns a set of objects of that class that have the specified `name`.
- Each class has a “`to_XML()`” RPC that serialises the state of all fields as an XML string.
- Each class has a “`delete(Ref x)`” RPC that explicitly deletes the persistent object specified by `x` from the system.

1.2.1 Additional RPCs

As well as the RPCs enumerated above, some classes have additional RPCs associated with them. For example, the `VM` class have RPCs for cloning, suspending, starting etc. Such additional RPCs are described explicitly in the API reference.

¹Since sets cannot contain duplicate values this operation has no action in the case that `v` was already in the set.

1.3 Wire Protocol for Remote API Calls

API calls are sent over a network to a Xen-enabled host using the XML-RPC protocol. In this Section we describe how the higher-level types used in our API Reference are mapped to primitive XML-RPC types.

In our API Reference we specify the signatures of API functions in the following style:

```
(ref_vm Set) Host.ListAllVMs()
```

This specifies that the function with name `Host.ListAllVMs` takes no parameters and returns a Set of `ref_vms`. These types are mapped onto XML-RPC types in a straight-forward manner:

- all our “ref_” types (e.g. `ref_vm` in the above example) map to XML-RPC’s `String` type.
- ints are all assumed to be 64-bit in our API and are encoded as a string of digits, rather than using XML-RPC’s built-in 32-bit `i4` type.
- values of enum types are encoded as strings. For example, CPU flags might be conveyed as:

```
<array>
  <data>
    <value><string>CX8</string></value>
    <value><string>PSE36</string></value>
    <value><string>FPU</string></value>
  </data>
</array>
```

- for all our types, `t`, our type `t Set` simply maps to XML-RPC’s `Array` type.
- for all our types, `k` and `v`, our type `(k, v) Map` maps onto an XML-RPC array of XML-RPC structs that each contain “key” and “value” fields that contain the key and the value for each binding in the map.

```
<array>
  <data>
    <value>
      <struct>
        <member>
          <name>key</name>
          <value><string>Mike</string></value>
        </member>
        <member>
          <name>value</name>
          <value><double>2.3</double></value>
        </member>
      </struct>
    </value>
  </data>
</array>
```

- our void type is never transmitted over the wire, so it does not need a representation.

1.3.1 Return Values/Status Codes

The return value of an RPC call is an XML-RPC `Struct`.

- The first element of the struct is named **Status**; it contains a string value indicating whether the result of the call was a “Success” or a “Failure”.

If **Status** was set to **Success** then the Struct contains a second element named **Value**:

- The element of the struct named **Value** contains the function’s return value.

In the case where **Status** is set to **Failure** then the struct contains a second element named **ErrorDescription**:

- The element of the struct named **ErrorDescription** contains an array of string values. The first element of the array represents an error code; the remainder of the array represents error parameters relating to that code.

For example, an XML-RPC return value from the `Host.ListAllVMs` function above may look like this:

```
<struct>
  <member> <name> Status </name>
    <value> Success </value>
  </member>
  <member> <name> Value </name>
    <array>
      <data>
        <value> vm-id-1 </value>
        <value> vm-id-2 </value>
        <value> vm-id-3 </value>
      </data>
    </array>
  </member>
</struct>
```

1.4 Making XML-RPC Calls

1.4.1 Transport Layer

We ought to support at least

- HTTP/S for remote administration
- HTTP over Unix domain sockets for local administration

1.4.2 Session Layer

The XML-RPC interface is session-based; before you can make arbitrary RPC calls you must login and initiate a session. For example:

```
session_id  Session.login_with_password(string uname, string pwd)
```

Where `uname` and `password` refer to your username and password respectively, as defined by the Xen administrator. The `session_id` returned by `Session.Login` is passed to subsequent RPC calls as an authentication token.

A session can be terminated with the `Session.Logout` function:

```
void        Session.Logout(session_id session)
```

1.4.3 Synchronous and Asynchronous invocation

Each method call (apart from those on “Session” and “Task” objects) can be made either synchronously or asynchronously. A synchronous RPC call blocks until the return value is received; the return value of a synchronous RPC call is exactly as specified in Section 1.3.1.

Each of the methods specified in the API Reference is synchronous. However, although not listed explicitly in this document, each method call has an asynchronous analogue in the `Async` namespace. For example, synchronous call `VM.Install(...)` (described in Chapter 2) has an asynchronous counterpart, `Async.VM.Install(...)`, that is non-blocking.

Instead of returning its result directly, an asynchronous RPC call returns a `task-id`; this identifier is subsequently used to track the status of a running asynchronous RPC. Note that an asynchronous call may fail immediately, before a `task-id` has even been created—to represent this eventuality, the returned `task-id` is wrapped in an XML-RPC struct with a `Status`, `ErrorDescription` and `Value` fields, exactly as specified in Section 1.3.1.

The `task-id` is provided in the `Value` field if `Status` is set to `Success`.

Two special RPC calls are provided to poll the status of asynchronous calls:

```
Array<task_id> Async.Task.GetAllTasks (session_id s)
task_status    Async.Task.GetStatus   (session_id s, task_id t)
```

`Async.Task.GetAllTasks` returns a set of the currently executing asynchronous tasks belong to the current user².

`Async.Task.GetStatus` returns a `task_status` result. This is an XML-RPC struct with three elements:

- The first element is named `Progress` and contains an `Integer` between 0 and 100 representing the estimated percentage of the task currently completed.
- The second element is named `ETA` and contains a `DateTime` representing the estimated time the task will be complete.
- The third element is named `Result`. If `Progress` is not 100 then `Result` contains the empty string. If `Progress` is set to 100, then `Result` contains the function’s return result (as specified in Section 1.3.1)³.

1.5 Example interactive session

This section describes how an interactive session might look, using the python XML-RPC client library.

First, initialise python and import the library `xmlrpcclib`:

```
\$ python2.4
...
>>> import xmlrpcclib
```

Create a python object referencing the remote server:

```
>>> xen = xmlrpcclib.Server("http://test:4464")
```

Acquire a session token by logging in with a username and password (error-handling omitted for brevity; the session token is pointed to by the key `'Value'` in the returned dictionary)

```
>>> session = xen.Session.do_login_with_password("user", "passwd")['Value']
```

When serialised, this call looks like the following:

²The current user is determined by the username that was provided to `Session.Login`.

³Recall that this itself is a struct potentially containing status, errorcode, value fields etc.

```
<?xml version='1.0'?>
<methodCall>
  <methodName>Session.do_login_with_password</methodName>
  <params>
    <param>
      <value><string>user</string></value>
    </param>
    <param>
      <value><string>passwd</string></value>
    </param>
  </params>
</methodCall>
```

Next, the user may acquire a list of all the VMs known to the host: (Note the call takes the session token as the only parameter)

```
>>> all_vms = xen.VM.do_list(session)['Value']
>>> all_vms
['b7b92d9e-d442-4710-92a5-ab039fd7d89b', '23e1e837-abbf-4675-b077-d4007989b0cc', '2045dbc0-0734-4eea
```

Note the VM references are internally UUIDs. Once a reference to a VM has been acquired a lifecycle operation may be invoked:

```
>>> xen.VM.do_start(session, all_vms[3], False)
{'Status': 'Failure', 'ErrorDescription': 'Operation not implemented'}
```

In this case the `start` message has not been implemented and an error response has been returned. Currently these high-level errors are returned as structured data (rather than as XMLRPC faults), allowing for internationalised errors in future. Finally, here are some examples of using accessors for object fields:

```
>>> xen.VM.getname_label(session, all_vms[3])['Value']
'SMP'
>>> xen.VM.getname_description(session, all_vms[3])['Value']
'Debian for Xen'
```

1.6 To-Do

Lots and lots! Including:

1.6.1 Clarity

- Roll constructors and `get_by_uuid` etc (section 1.2) into section 2 so that it is clearer that each class has these.
- Emphasise that enums are strings on the wire, and so are not restricted to a certain number of bits.
- Specify that 64 bit ints are strings on the wire, and clarify that refs are UUIDs on the wire.
- Clarify return values, in particular that void means return a status code, potential error description, but otherwise no value.
- Talk about UUID generation.

1.6.2 Content

Model

- Add `Vm.architecture` and `Host.compatible_architecture` fields.
- Add migration calls, including the ability to test whether a migration will succeed, and authentication token exchange.
- Improve asynchronous task handling, with a registration call, a “blocking poll” call, and an explicit notification destination. Registration for “power_state” is useful.
- Specify that session keys outlive the HTTP session, and add a timeout for them (configurable in the tools).
- Add places for people to store extra data (“otherConfig” perhaps)
- Specify how hardware UUIDs are used / accessed.
- Marking VDIs as exclusive / shareable (locking?)
- Consider what happens when an object is deleted when references to it exist – do we want a cascade delete-style semantics?
- Consider how to represent CDROMs (as VDIs?)
- Define lists of exceptions which may be thrown by each RPC, including error codes and parameters.
- Make `bios/boot` a VBD reference, and remove `bios_boot_option`.
- Host characteristics: minimum amount of memory, TPM, network bandwidth, amount of host memory, amount consumed by VMs, max amount available for new VMs?
- Cooked resource monitoring interface.
- Network needs additional attributes that provide media characteristics of the NIC:
 - RO bandwidth integer Bandwidth in mbps
 - RO latency integer time in ms for an icmp roundtrip to a host on the same subnet.
- TPM
 - Would it not be better to have a class `TPM` and a member `TPMs` ((`TPM ref`) `Set`) containing an array of zero or one references to `TPMs`? I assume that an empty array would make it clear that no TPM is associated with the VM instead of encoding its existence into `TPM/instance` or `TPM/backend` somehow. The current members `instance` and `backend` could then be moved into the `TPM` class.
 - Also a Xen system can be running an access control policy where each VM’s runtime access to resources is restricted by the label it has been given compared to those of the resources. Currently a VM’s configuration file may contain a line like `access_control[policy=';name of the system's policy;',label=';label given to VM;']`. I think the identifiers `'policy'` and `'label'` should also be part of the VM class either directly in the form `'access_control/policy'` or indirectly in an `access_control` class.
- Mike Day’s `Vm.profile` field?
- Clone customisation?
- NIC teaming? The `NIC` field of the `Network` class should be a list (`Set`) so that we can signify NIC teaming. (Combining physical NICs in a single host interface to achieve greater bandwidth).

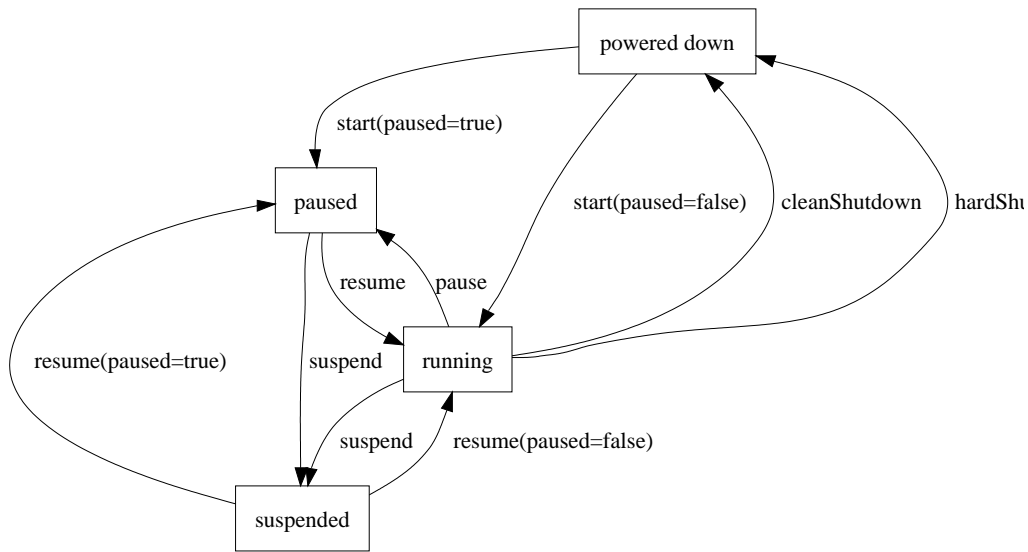


Figure 1.1: VM Lifecycle

Transport

- Allow non-HTTP transports. Explicitly allow stdio transport, for SSH.

Authentication

- Delegation to the transport layer.
- Extend PAM exchange across the wire.
- Fine-grained access control.

1.7 VM Lifecycle

Figure 1.1 shows the states that a VM can be in and the API calls that can be used to move the VM between these states.

Chapter 2

API Reference

2.1 Classes

The following classes are defined:

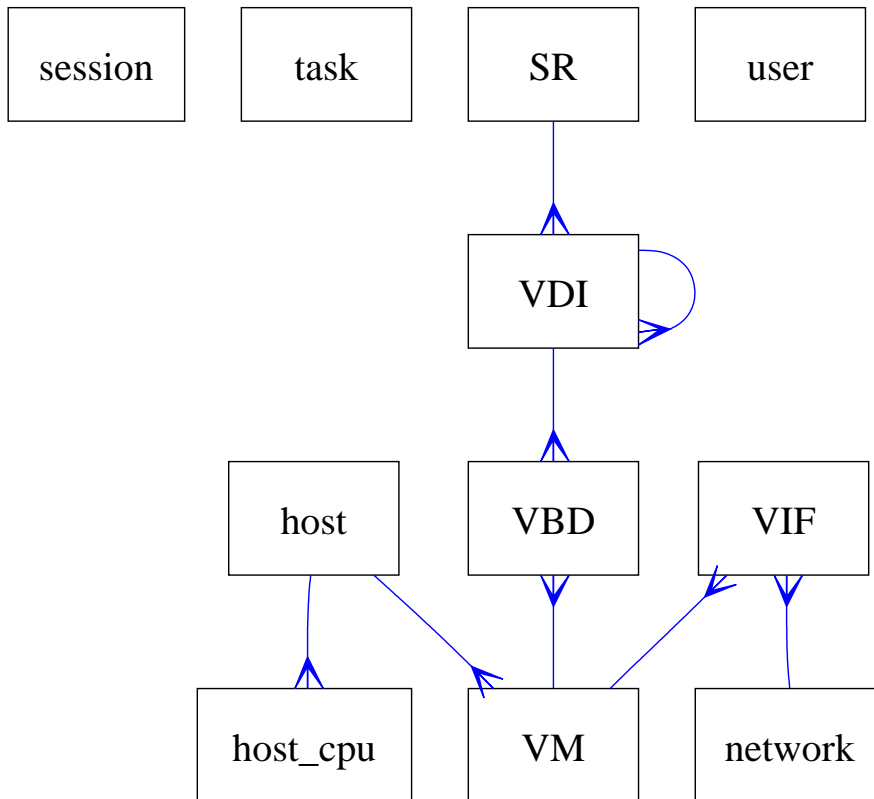
Name	Description
<code>session</code>	a session
<code>task</code>	a longrunning asynchronous task
<code>VM</code>	a virtual machine (or 'guest')
<code>host</code>	a physical host
<code>host_cpu</code>	a physical CPU
<code>network</code>	a virtual network
<code>VIF</code>	a virtual network interface
<code>SR</code>	a storage repository
<code>VDI</code>	a virtual disk image
<code>VBD</code>	a virtual block device
<code>user</code>	a user of the system

2.2 Relationships Between Classes

Fields that are bound together are shown in the following table:

<i>object.field</i>	<i>object.field</i>	<i>relationship</i>
<code>VDI.VBDs</code>	<code>VBD.VDI</code>	many-to-one
<code>VDI.parent</code>	<code>VDI.children</code>	one-to-many
<code>VBD.VM</code>	<code>VM.VBDs</code>	one-to-many
<code>VIF.VM</code>	<code>VM.VIFs</code>	one-to-many
<code>VIF.network</code>	<code>network.VIFs</code>	one-to-many
<code>SR.VDIs</code>	<code>VDI.SR</code>	many-to-one
<code>host.resident_VMs</code>	<code>VM.resident_on</code>	many-to-one
<code>host.host_CPUs</code>	<code>host_cpu.host</code>	many-to-one

The following represents bound fields (as specified above) diagrammatically, using crows-foot notation to specify one-to-one, one-to-many or many-to-many relationships:



2.2.1 List of bound fields

2.3 Types

2.3.1 Primitives

The following primitive types are used to specify methods and fields in the API Reference:

Type	Description
String	text strings
Int	64-bit integers
Float	IEEE double-precision floating-point numbers
Bool	boolean
DateTime	date and timestamp
Ref (object name)	reference to an object of class name

2.3.2 Higher order types

The following type constructors are used:

Type	Description
List (t)	an arbitrary-length list of elements of type t
Map (a → b)	a table mapping values of type a to values of type b

2.3.3 Enumeration types

The following enumeration types are used:

enum vm_power_state	
Halted	Halted
Paused	Paused
Running	Running
Suspended	Suspended
ShuttingDown	Shutting Down
Unknown	Some other unknown state

enum on_normal_exit	
destroy	destroy the VM state
restart	restart the VM

enum on_crash_behaviour	
destroy	destroy the VM state
coredump_and_destroy	record a coredump and then destroy the VM state
restart	restart the VM
coredump_and_restart	record a coredump and then restart the VM
preserve	leave the crashed VM as-is
rename_restart	rename the crashed VM and start a new copy

enum bios_boot_option	
floppy	boot from emulated floppy
HD	boot from emulated HD
CDROM	boot from emulated CDROM

enum boot_type	
bios	boot an HVM guest using an emulated BIOS
grub	boot from inside the machine using grub
kernel_external	boot from an external kernel
kernel_internal	boot from a kernel inside the guest filesystem

enum cpu_feature	
FPU	Onboard FPU
VME	Virtual Mode Extensions
DE	Debugging Extensions
PSE	Page Size Extensions
TSC	Time Stamp Counter

MSR	Model-Specific Registers, RDMSR, WRMSR
PAE	Physical Address Extensions
MCE	Machine Check Architecture
CX8	CMPXCHG8 instruction
APIC	Onboard APIC
SEP	SYSENTER/SYSEXIT
MTRR	Memory Type Range Registers
PGE	Page Global Enable
MCA	Machine Check Architecture
CMOV	CMOV instruction (FCMOVCC and FCOMI too if FPU present)
PAT	Page Attribute Table
PSE36	36-bit PSEs
PN	Processor serial number
CLFLSH	Supports the CLFLUSH instruction
DTES	Debug Trace Store
ACPI	ACPI via MSR
MMX	Multimedia Extensions
FXSR	FXSAVE and FXRSTOR instructions (fast save and restore)
XMM	Streaming SIMD Extensions
XMM2	Streaming SIMD Extensions-2
SELFSNOOP	CPU self snoop
HT	Hyper-Threading
ACC	Automatic clock control
IA64	IA-64 processor
SYSCALL	SYSCALL/SYSRET
MP	MP Capable.
NX	Execute Disable
MMXEXT	AMD MMX extensions
LM	Long Mode (x86-64)
3DNOWEXT	AMD 3DNow! extensions
3DNOW	3DNow!
RECOVERY	CPU in recovery mode
LONGRUN	Longrun power control
LRTI	LongRun table interface
CXMMX	Cyrix MMX extensions
K6_MTRR	AMD K6 nonstandard MTRRs
CYRIX_ARR	Cyrix ARRs (= MTRRs)
CENTAUR_MCR	Centaur MCRs (= MTRRs)
K8	Opteron, Athlon64
K7	Athlon
P3	P3
P4	P4
CONSTANT_TSC	TSC ticks at a constant rate
FXSAVE_LEAK	FXSAVE leaks FOP/FIP/FOP
XMM3	Streaming SIMD Extensions-3
MWAIT	Monitor/Mwait support
DSCPL	CPL Qualified Debug Store
EST	Enhanced SpeedStep
TM2	Thermal Monitor 2
CID	Context ID
CX16	CMPXCHG16B
XTPR	Send Task Priority Messages
XSTORE	on-CPU RNG present (xstore insn)
XSTORE_EN	on-CPU RNG enabled

XCRYPT	on-CPU crypto (xcrypt insn)
XCRYPT_EN	on-CPU crypto enabled
LAHF_LM	LAHF/SAHF in long mode
CMP_LEGACY	If yes HyperThreading not valid

enum vdi_type	
system	a disk that may be replaced on upgrade
user	a disk that is always preserved on upgrade
ephemeral	a disk that may be reformatted on upgrade

enum vbd_mode	
RO	disk is mounted read-only
RW	disk is mounted read-write

enum driver_type	
ioemu	use hardware emulation
paravirtualised	use paravirtualised driver

2.4 Class: session

2.4.1 Fields for class: session

Class session has no fields.

2.4.2 Additional RPCs associated with class: session

RPC name: login_with_password

Overview: Attempt to authenticate the user, returning a session_id if successful

Signature:

```
(session ref) login_with_password (string uname, string pwd)
```

Arguments:

type	name	description
string	uname	Username for login.
string	pwd	Password for login.

Return Type: session ref

ID of newly created session

RPC name: logout

Overview: Log out of a session

Signature:

```
void logout (session_id s)
```

Return Type: void

2.5 Class: task

2.5.1 Fields for class: task

Class task has no fields.

2.5.2 Additional RPCs associated with class: task

RPC name: get_status

Overview: Poll a running asynchronous RPC invocation and query its status

Signature:

```
XML get_status (session_id s, task ref task)
```

Arguments:

type	name	description
task ref	task	The ID of the RPC call to poll

Return Type: XML

XML string describing status of specified asynchronous RPC invocation, including estimated completion time

RPC name: get_all_tasks

Overview: List all asynchronous RPC calls currently executing

Signature:

```
((task ref) Set) get_all_tasks (session_id s)
```

Return Type: (task ref) Set

A list of tasks currently executing. Note that tasks are associated with users rather than sessions. Thus, if you logout and login again with a different session but the same user, this function will still return the user's running tasks.

2.6 Class: VM

2.6.1 Fields for class: VM

Name	VM		
Quals	Field	Type	Description
	Description	<i>a virtual machine (or 'guest')</i>	
<i>RO_{run}</i>	uuid	string	unique identifier/object reference
<i>RO_{run}</i>	power_state	vm_power_state	Current power state of the machine
<i>RW</i>	name/label	string	a human-readable name
<i>RW</i>	name/description	string	a notes field containing human-readable description
<i>RW</i>	user_version	int	a user version number for this machine
<i>RW</i>	is_a_template	bool	true if this is a template. Template VMs can never be started, they are used only for cloning other VMs
<i>RO_{run}</i>	resident_on	host ref	the host the VM is currently resident on
<i>RO_{ins}</i>	memory/static_max	int	Statically-set (i.e. absolute) maximum
<i>RW</i>	memory/dynamic_max	int	Dynamic maximum
<i>RO_{run}</i>	memory/actual	int	Guest's actual usage
<i>RW</i>	memory/dynamic_min	int	Dynamic minimum
<i>RO_{ins}</i>	memory/static_min	int	Statically-set (i.e. absolute) minimum
<i>RW</i>	VCPUs/policy	string	the name of the VCPU scheduling policy to be applied
<i>RW</i>	VCPUs/params	string	string-encoded parameters passed to selected VCPU policy
<i>RO_{run}</i>	VCPUs/number	int	Current number of VCPUs
<i>RO_{run}</i>	VCPUs/utilisation	(int → float) Map	Utilisation for all of guest's current VCPUs
<i>RO_{ins}</i>	VCPUs/features/required	(cpu_feature) Set	CPU features the guest demands the host supports
<i>RO_{ins}</i>	VCPUs/features/can_use	(cpu_feature) Set	CPU features the guest can use if available
<i>RW</i>	VCPUs/features/force_on	(cpu_feature) Set	CPU features to expose to the guest above the bare minimum
<i>RW</i>	VCPUs/features/force_off	(cpu_feature) Set	CPU features to hide to the guest
<i>RW</i>	actions/after_shutdown	on_normal_exit	action to take after the guest has shutdown itself
<i>RW</i>	actions/after_reboot	on_normal_exit	action to take after the guest has rebooted itself
<i>RW</i>	actions/after_suspend	on_normal_exit	action to take after the guest has suspended itself
<i>RW</i>	actions/after_crash	on_crash_behaviour	action to take if the guest crashes
<i>RW</i>	VIFs	(VIF ref) Set	virtual network interfaces
<i>RW</i>	VBDs	(VBD ref) Set	virtual block devices
<i>RO_{ins}</i>	TPM/instance	int	included for TPM support
<i>RO_{ins}</i>	TPM/backend	int	included for TPM support
<i>RW</i>	bios/cdrom	string	path for emulated CDROM e.g. /dev/cdrom or /foo.iso
<i>RW</i>	bios/boot	bios_boot_option	default device to boot the guest from

<i>RW</i>	<code>platform/std_VGA</code>	bool	emulate standard VGA instead of cirrus logic
<i>RW</i>	<code>platform/serial</code>	string	redirect serial port to pty
<i>RW</i>	<code>platform/localtime</code>	bool	set RTC to local time
<i>RW</i>	<code>platform/clock_offset</code>	bool	timeshift applied to guest's clock
<i>RW</i>	<code>platform/enable_audio</code>	bool	emulate audio
<i>RW</i>	<code>builder</code>	string	domain builder to use
<i>RW</i>	<code>boot_method</code>	boot_type	select how this machine should boot
<i>RW</i>	<code>kernel/kernel</code>	string	path to kernel e.g. /boot/vmlinuz
<i>RW</i>	<code>kernel/initrd</code>	string	path to the initrd e.g. /boot/initrd.img
<i>RW</i>	<code>kernel/args</code>	string	extra kernel command-line arguments
<i>RW</i>	<code>grub/cmdline</code>	string	grub command-line
<i>RO_{ins}</i>	<code>PCI_bus</code>	string	PCI bus path for pass-through devices
<i>RO_{run}</i>	<code>tools_version</code>	(string → string) Map	versions of installed paravirtualised drivers

2.6.2 Additional RPCs associated with class: VM

RPC name: clone

Overview: Clones the specified VM, making a new VM. Clone automatically exploits the capabilities of the underlying storage repository in which the VM's disk images are stored (e.g. Copy on Write). (This function can only be called when the VM is in the Halted State).

Signature:

```
(VM ref) clone (session_id s, VM ref vm, string new_name)
```

Arguments:

type	name	description
VM ref	vm	The VM to be cloned
string	new_name	The name of the cloned VM

Return Type: VM ref

The ID of the newly created VM.

RPC name: start

Overview: Start the specified VM. (This function can only be called with the VM is in the Halted State).

Signature:

```
void start (session_id s, VM ref vm, bool start_paused)
```

Arguments:

type	name	description
VM ref	vm	The VM to start
bool	start_paused	Instantiate VM in paused state if set to true.

Return Type: void

RPC name: pause

Overview: Pause the specified VM. This can only be called when the specified VM is in the Running state.

Signature:

```
void pause (session_id s, VM ref vm)
```

Arguments:

type	name	description
VM ref	vm	The VM to pause

Return Type: void

RPC name: unpause

Overview: Resume the specified VM. This can only be called when the specified VM is in the Paused state.

Signature:

```
void unpause (session_id s, VM ref vm)
```

Arguments:

type	name	description
VM ref	vm	The VM to pause

Return Type: void

RPC name: clean_shutdown

Overview: Attempt to cleanly shutdown the specified VM. (Note: this may not be supported—e.g. if a guest agent is not installed). Once shutdown has been completed perform poweroff action specified in guest configuration.

Signature:

```
void clean_shutdown (session_id s, VM ref vm)
```

Arguments:

type	name	description
VM ref	vm	The VM to shutdown

Return Type: void

RPC name: clean_reboot

Overview: Attempt to cleanly shutdown the specified VM (Note: this may not be supported—e.g. if a guest agent is not installed). Once shutdown has been completed perform reboot action specified in guest configuration.

Signature:

```
void clean_reboot (session_id s, VM ref vm)
```

Arguments:

type	name	description
VM ref	vm	The VM to shutdown

Return Type: void

RPC name: hard_shutdown

Overview: Stop executing the specified VM without attempting a clean shutdown. Then perform poweroff action specified in VM configuration.

Signature:

```
void hard_shutdown (session_id s, VM ref vm)
```

Arguments:

type	name	description
VM ref	vm	The VM to destroy

Return Type: void

RPC name: hard_reboot

Overview: Stop executing the specified VM without attempting a clean shutdown. Then perform reboot action specified in VM configuration

Signature:

```
void hard_reboot (session_id s, VM ref vm)
```

Arguments:

type	name	description
VM ref	vm	The VM to reboot

Return Type: void

RPC name: suspend

Overview: Suspend the specified VM to disk.

Signature:

```
void suspend (session_id s, VM ref vm, bool live)
```

Arguments:

type	name	description
VM ref	vm	The VM to hibernate
bool	live	If set to true, perform a live hibernate; otherwise suspend the VM before commencing hibernate

Return Type: void

RPC name: resume

Overview: Awaken the specified VM and resume it.

Signature:

```
void resume (session_id s, VM ref vm, bool start_paused)
```

Arguments:

type	name	description
VM ref	vm	The VM to unhibernate
bool	start_paused	Unhibernate VM in paused state if set to true.

Return Type: void

RPC name: list

Overview: Return a list of all the VMs known to the system

Signature:

```
((VM ref) Set) list (session_id s)
```

Return Type: (VM ref) Set

A list of all the IDs of all the VMs

2.7 Class: host

2.7.1 Fields for class: host

Name	host		
Description	<i>a physical host</i>		
Quals	Field	Type	Description
<i>RO_{run}</i>	uuid	string	unique identifier/object reference
<i>RW</i>	name/label	string	a human-readable name
<i>RW</i>	name/description	string	a notes field containg human-readable description
<i>RO_{run}</i>	software_version	(string → string) Map	version strings
<i>RO_{run}</i>	resident_VMs	(VM ref) Set	list of VMs currently resident on host
<i>RO_{run}</i>	host_CPUs	(host_cpu ref) Set	The physical CPUs on this host

2.7.2 Additional RPCs associated with class: host

RPC name: disable

Overview: Puts the host into a state in which no new VMs can be started. Currently active VMs on the host continue to execute.

Signature:

```
void disable (session_id s, host ref host)
```

Arguments:

type	name	description
host ref	host	The Host to disable

Return Type: void

RPC name: enable

Overview: Puts the host into a state in which new VMs can be started.

Signature:

```
void enable (session_id s, host ref host)
```

Arguments:

type	name	description
host ref	host	The Host to enable

Return Type: void

RPC name: shutdown

Overview: Shutdown the host. (This function can only be called if there are no currently running VMs on the host and it is disabled.)

Signature:

```
void shutdown (session_id s, host ref host)
```

Arguments:

type	name	description
host ref	host	The Host to shutdown

Return Type: void

RPC name: reboot

Overview: Reboot the host. (This function can only be called if there are no currently running VMs on the host and it is disabled.)

Signature:

```
void reboot (session_id s, host ref host)
```

Arguments:

type	name	description
host ref	host	The Host to reboot

Return Type: void

RPC name: list

Overview: Return a list of all the hosts known to the system

Signature:

```
((host ref) Set) list (session_id s)
```

Return Type: (host ref) Set

A list of all the IDs of all the hosts

2.8 Class: host_cpu

2.8.1 Fields for class: host_cpu

Name	host_cpu		
Description	<i>a physical CPU</i>		
Quals	Field	Type	Description
<i>RO_{run}</i>	uuid	string	unique identifier/object reference
<i>RO_{ins}</i>	host	host ref	the host the CPU is in
<i>RO_{ins}</i>	number	int	the number of the physical CPU within the host
<i>RO_{ins}</i>	features	(cpu_feature) Set	the features supported by the CPU
<i>RO_{run}</i>	utilisation	float	the current CPU utilisation

2.8.2 Additional RPCs associated with class: host_cpu

Class `host_cpu` has no additional RPCs associated with it.

2.9 Class: network

2.9.1 Fields for class: network

Name	network		
Description	<i>a virtual network</i>		
Quals	Field	Type	Description
<i>RO_{run}</i>	uuid	string	unique identifier/object reference
<i>RW</i>	name/label	string	a human-readable name
<i>RW</i>	name/description	string	a notes field containg human-readable description
<i>RW</i>	VIFs	(VIF ref) Set	list of connected vifs
<i>RW</i>	NIC	string	ethernet device to use to access this network. Note: in this revision of the API all hosts will use the specified NIC to access this network
<i>RW</i>	VLAN	string	VLAN tag to use to access this network. Note: in this revision of the API all hosts will use the specified VLAN tag to access this network
<i>RW</i>	default_gateway	string	default gateway IP address. Used for auto-configuring guests with fixed IP setting
<i>RW</i>	default_netmask	string	default netmask. Used for auto-configuring guests with fixed IP setting

2.9.2 Additional RPCs associated with class: network

RPC name: list

Overview: Return a list of all the networks known to the system

Signature:

```
((network ref) Set) list (session_id s)
```

Return Type: (network ref) Set

A list of all the IDs of all the networks

2.10 Class: VIF

2.10.1 Fields for class: VIF

Name	VIF		
Description	<i>a virtual network interface</i>		
Quals	Field	Type	Description
<i>RO_{run}</i>	uuid	string	unique identifier/object reference
<i>RW</i>	name	string	human-readable name of the interface
<i>RW</i>	type	driver_type	interface type
<i>RW</i>	device	string	name of network device as exposed to guest e.g. eth0
<i>RW</i>	network	network ref	virtual network to which this vif is connected
<i>RW</i>	VM	VM ref	virtual machine to which this vif is connected
<i>RW</i>	MAC	string	ethernet MAC address of virtual interface, as exposed to guest
<i>RW</i>	MTU	int	MTU in octets
<i>RO_{run}</i>	network_read_kbs	float	Incoming network bandwidth
<i>RO_{run}</i>	network_write_kbs	float	Outgoing network bandwidth
<i>RO_{run}</i>	IO_bandwidth/incoming_kbs	float	Read bandwidth (Kb/s)
<i>RO_{run}</i>	IO_bandwidth/outgoing_kbs	float	Write bandwidth (Kb/s)

2.10.2 Additional RPCs associated with class: VIF

Class VIF has no additional RPCs associated with it.

2.11 Class: SR

2.11.1 Fields for class: SR

Name	SR		
Description	<i>a storage repository</i>		
Quals	Field	Type	Description
<i>RO_{run}</i>	uuid	string	unique identifier/object reference
<i>RW</i>	name/label	string	a human-readable name
<i>RW</i>	name/description	string	a notes field containing human-readable description
<i>RW</i>	VDIs	(VDI ref) Set	managed virtual disks
<i>RO_{run}</i>	virtual_allocation	int	sum of virtual_sizes of all VDIs in this storage repository (in bytes)
<i>RO_{run}</i>	physical_utilisation	int	physical space currently utilised on this storage repository (in bytes). Note that for sparse disk formats, physical_utilisation may be less than virtual_allocation
<i>RO_{ins}</i>	physical_size	int	total physical size of the repository (in bytes)
<i>RO_{ins}</i>	type	string	type of the storage repository
<i>RO_{ins}</i>	location	string	a string that uniquely determines the location of the storage repository; the format of this string depends on the repository's type

2.11.2 Additional RPCs associated with class: SR

RPC name: clone

Overview: Take an exact copy of the Storage Repository; the cloned storage repository has the same type as its parent

Signature:

(SR ref) clone (session_id s, SR ref sr, string loc, string name)

Arguments:

type	name	description
SR ref	sr	The Storage Repository to clone
string	loc	The location string that defines where the new storage repository will be located
string	name	The name of the new storage repository

Return Type: SR ref

The ID of the newly created Storage Repository.

RPC name: list

Overview: Return a list of all the Storage Repositories known to the system

Signature:

((SR ref) Set) list (session_id s)

Return Type: (SR ref) Set

A list of all the IDs of all the Storage Repositories

2.12 Class: VDI

2.12.1 Fields for class: VDI

Name	VDI		
Description	<i>a virtual disk image</i>		
Quals	Field	Type	Description
<i>RO_{run}</i>	<code>uuid</code>	string	unique identifier/object reference
<i>RW</i>	<code>name/label</code>	string	a human-readable name
<i>RW</i>	<code>name/description</code>	string	a notes field containing human-readable description
<i>RW</i>	<code>SR</code>	SR ref	storage repository in which the VDI resides
<i>RW</i>	<code>VBDs</code>	(VBD ref) Set	list of vbds that refer to this disk
<i>RW</i>	<code>virtual_size</code>	int	size of disk as presented to the guest (in multiples of <code>sector_size</code> field)
<i>RO_{run}</i>	<code>physical_utilisation</code>	int	amount of physical space that the disk image is currently taking up on the storage repository (in bytes)
<i>RO_{ins}</i>	<code>sector_size</code>	int	sector size of VDI (in bytes)
<i>RO_{ins}</i>	<code>type</code>	<code>vdi.type</code>	type of the VDI
<i>RO_{ins}</i>	<code>parent</code>	VDI ref	parent disk (e.g. in the case of copy on write)
<i>RO_{ins}</i>	<code>children</code>	(VDI ref) Set	child disks (e.g. in the case of copy on write)
<i>RW</i>	<code>sharable</code>	bool	true if this disk may be shared
<i>RW</i>	<code>read_only</code>	bool	true if this disk may ONLY be mounted read-only

2.12.2 Additional RPCs associated with class: VDI

RPC name: snapshot

Overview: Take an exact copy of the VDI; the snapshot lives in the same Storage Repository as its parent.

Signature:

(VDI ref) snapshot (session_id s, VDI ref vdi)

Arguments:

type	name	description
VDI ref	vdi	The VDI to snapshot

Return Type: VDI ref

The ID of the newly created VDI.

2.13 Class: VBD

2.13.1 Fields for class: VBD

Name	VBD		
Description	<i>a virtual block device</i>		
Quals	Field	Type	Description
<i>RO_{run}</i>	uuid	string	unique identifier/object reference
<i>RW</i>	VM	VM ref	the virtual machine
<i>RW</i>	VDI	VDI ref	the virtual disk
<i>RW</i>	device	string	device seen by the guest e.g. hda1
<i>RW</i>	mode	vbd_mode	the mode the disk should be mounted with
<i>RW</i>	driver	driver_type	the style of driver
<i>RO_{run}</i>	IO_bandwidth/incoming_kbs	float	Read bandwidth (Kb/s)
<i>RO_{run}</i>	IO_bandwidth/outgoing_kbs	float	Write bandwidth (Kb/s)

2.13.2 Additional RPCs associated with class: VBD

Class VBD has no additional RPCs associated with it.

2.14 Class: user

2.14.1 Fields for class: user

Name	user		
Description	<i>a user of the system</i>		
Quals	Field	Type	Description
<i>RO_{run}</i>	uuid	string	unique identifier/object reference
<i>RO_{ins}</i>	short_name	string	short name (e.g. userid)
<i>RW</i>	fullname	string	full name

2.14.2 Additional RPCs associated with class: user

Class user has no additional RPCs associated with it.

2.15 DTD

General notes:

- Values of primitive types (int, bool, etc) and higher-order types (Sets, Maps) are encoded as simple strings, rather than being expanded into XML fragments. For example “5”, “true”, “1, 2, 3, 4”, “(1, 2), (2, 3), (3, 4)”
- Values of enumeration types are represented as strings (e.g. “PAE”, “3DNow!”)
- Object References are represented as UUIDs, written in string form

Chapter 3

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