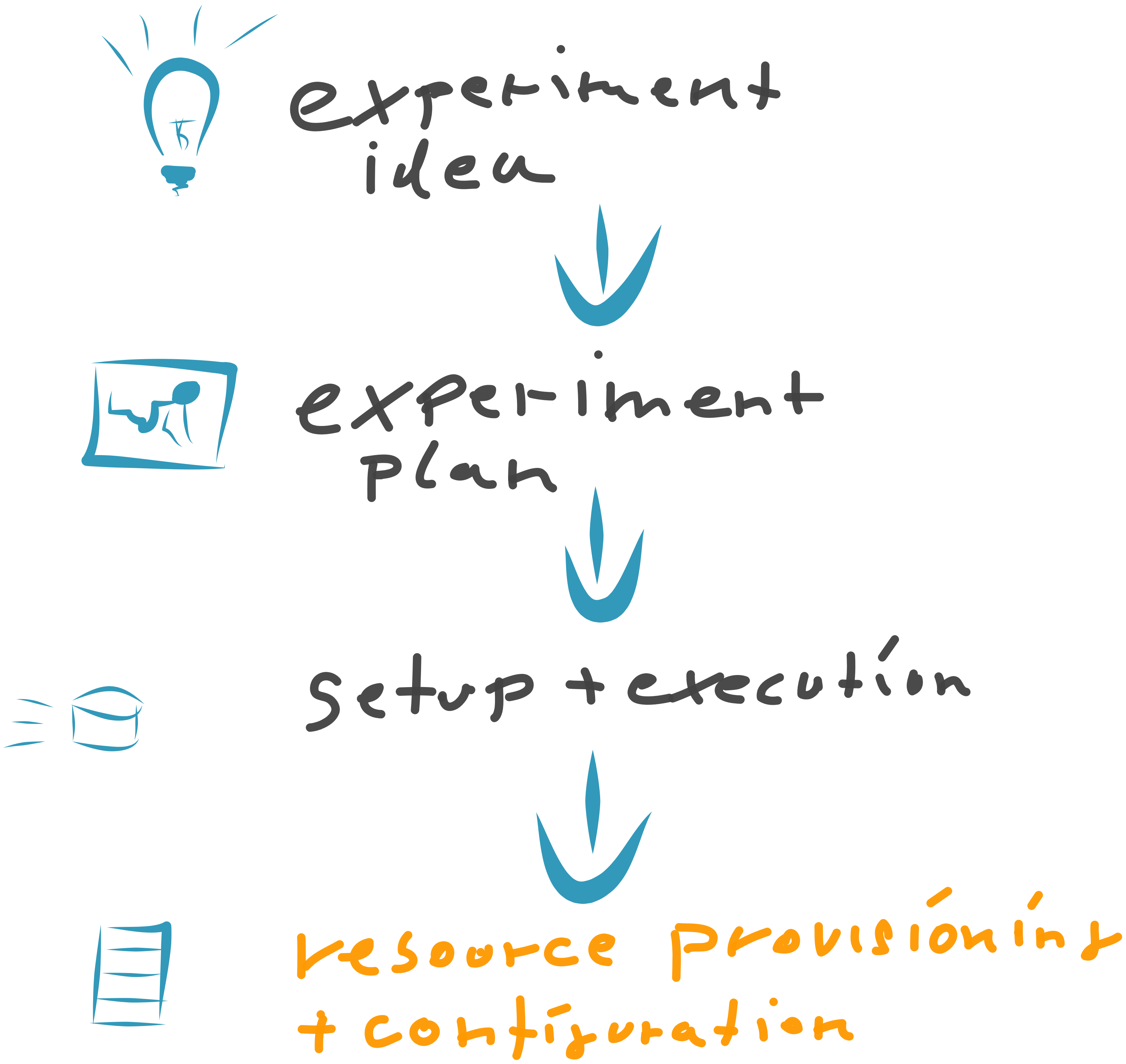
AMsoil

The glue for Aggregate Manager developers

researcher's goal



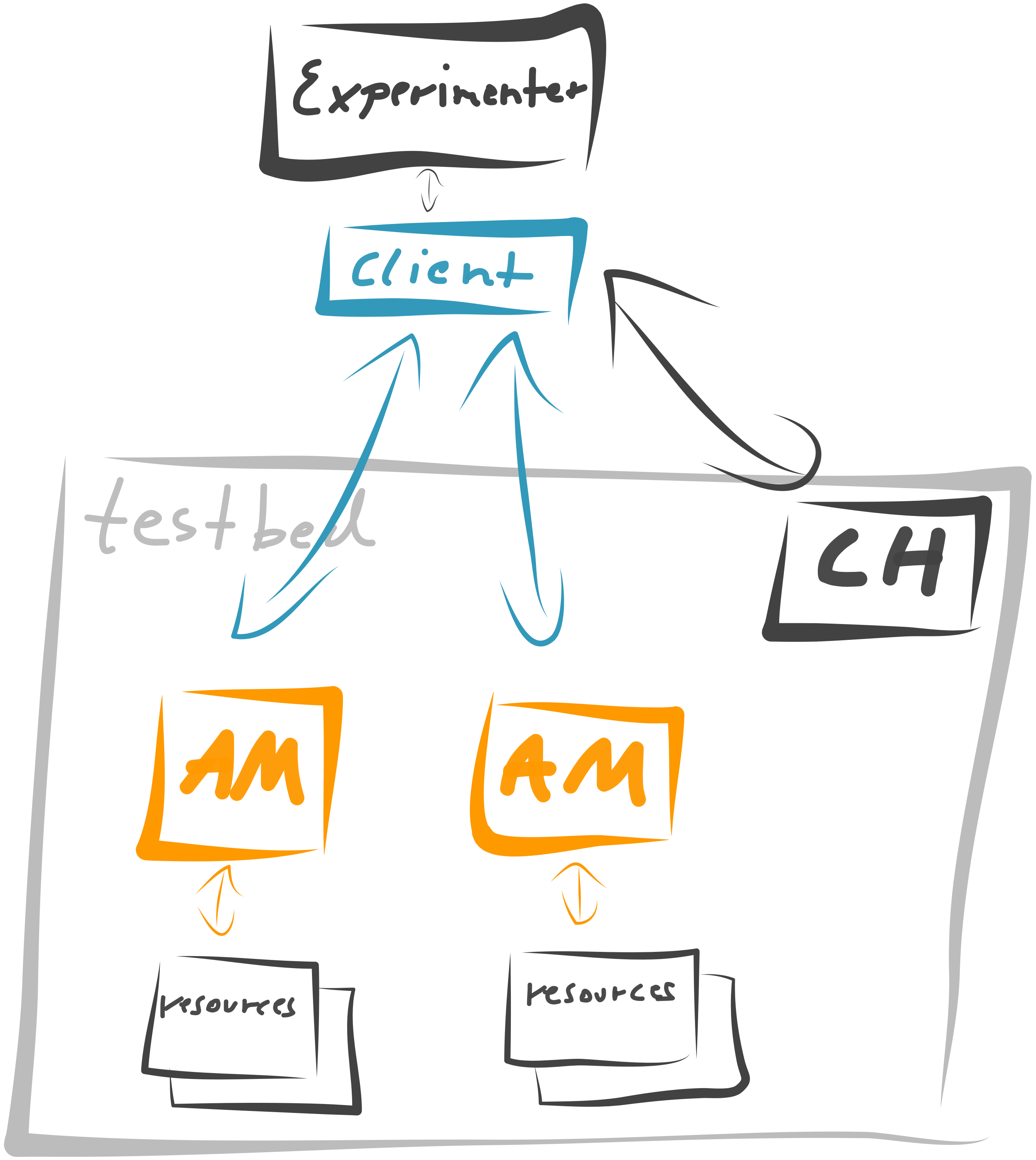
experiment idea

experiment plan

setup + execution

resource provisioning + configuration

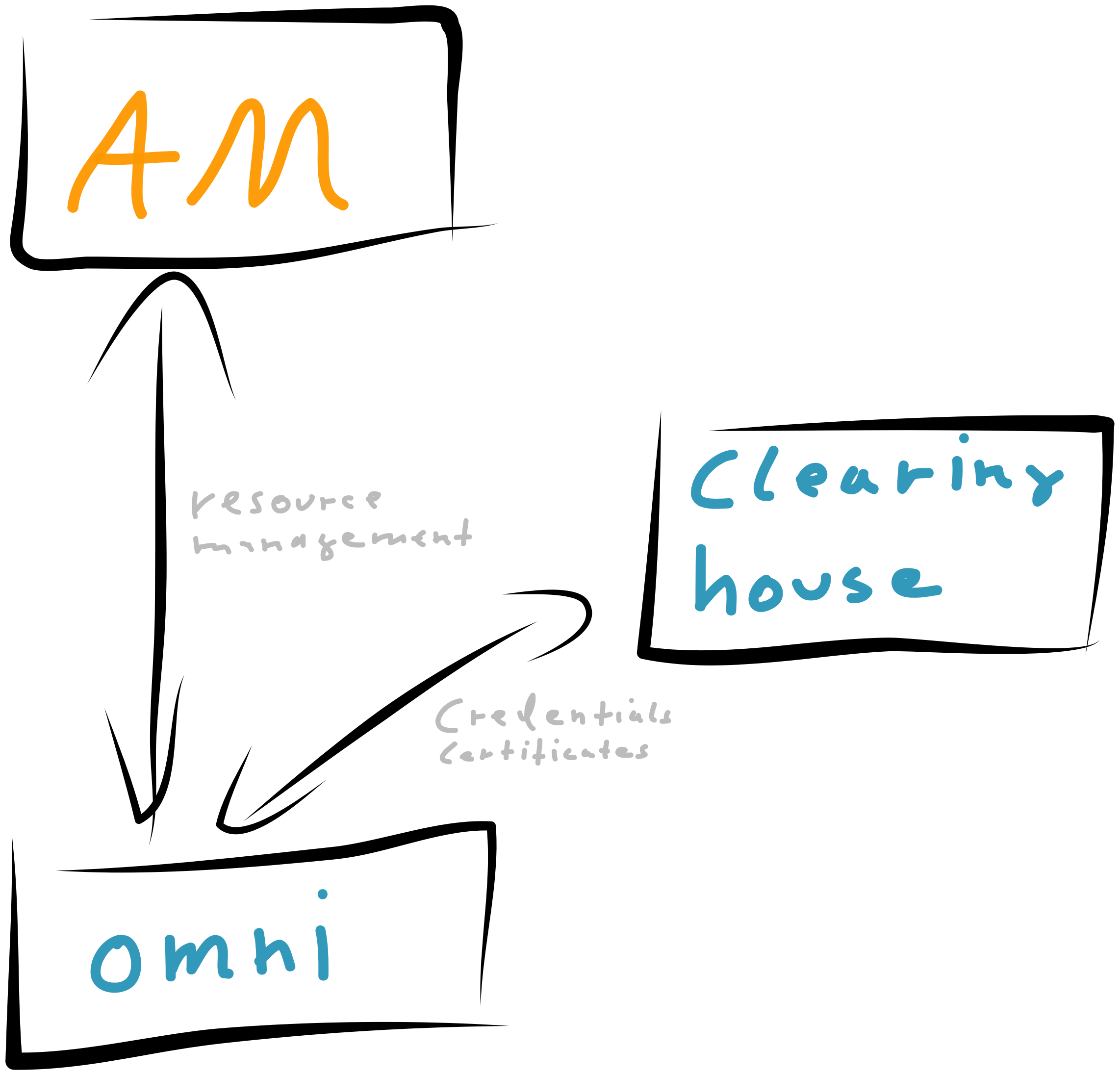
experiment execution



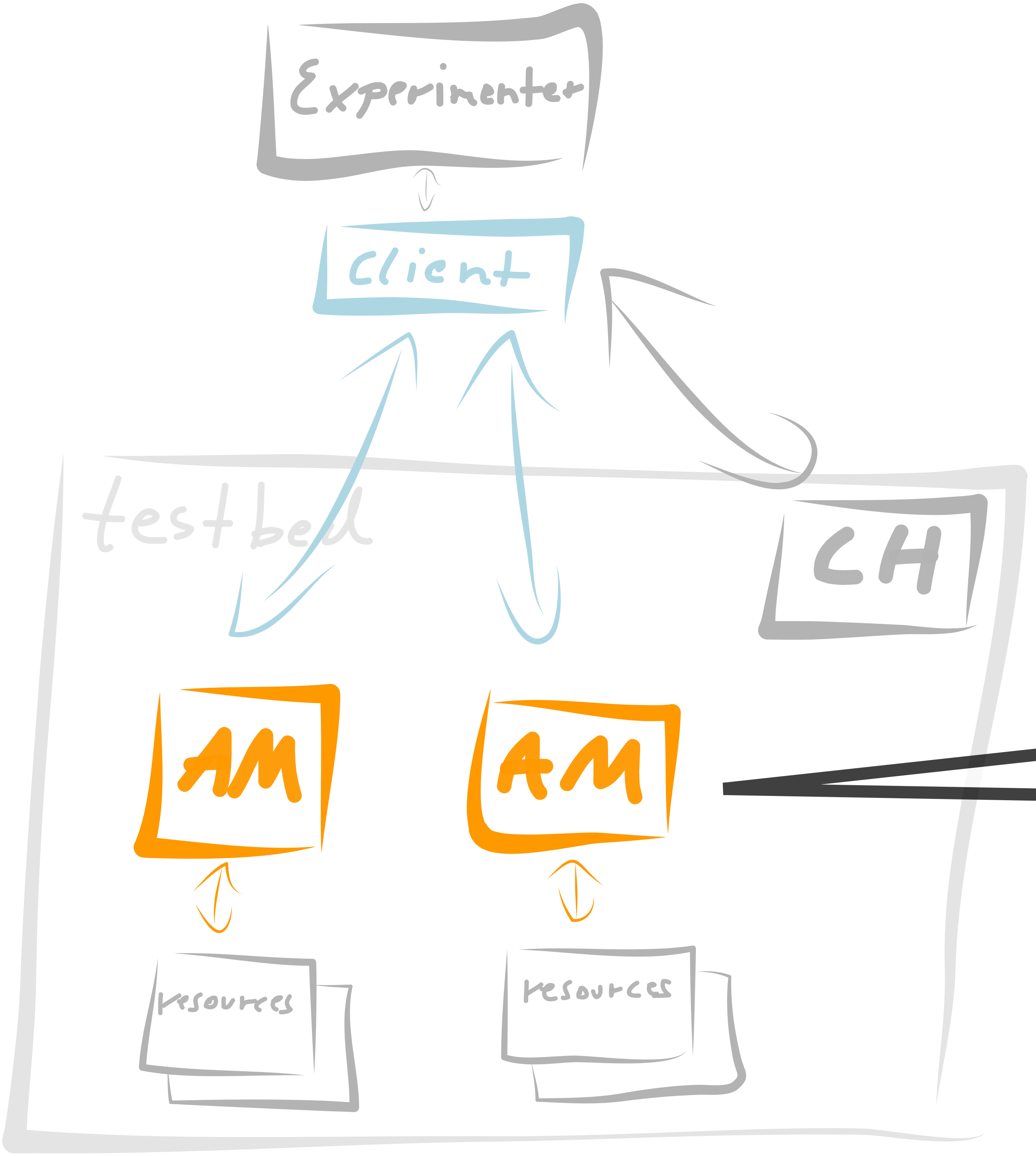
CH	Clearinghouse
AM	Aggregate Manager

test bed

- **Clearinghouse** manages certificates and credentials
- The **client** (*here:* omni) assembles the request and sends it to the Aggregate Manager
- **Aggregate Manager** manages, allocates and provisions resources



AMsoil?



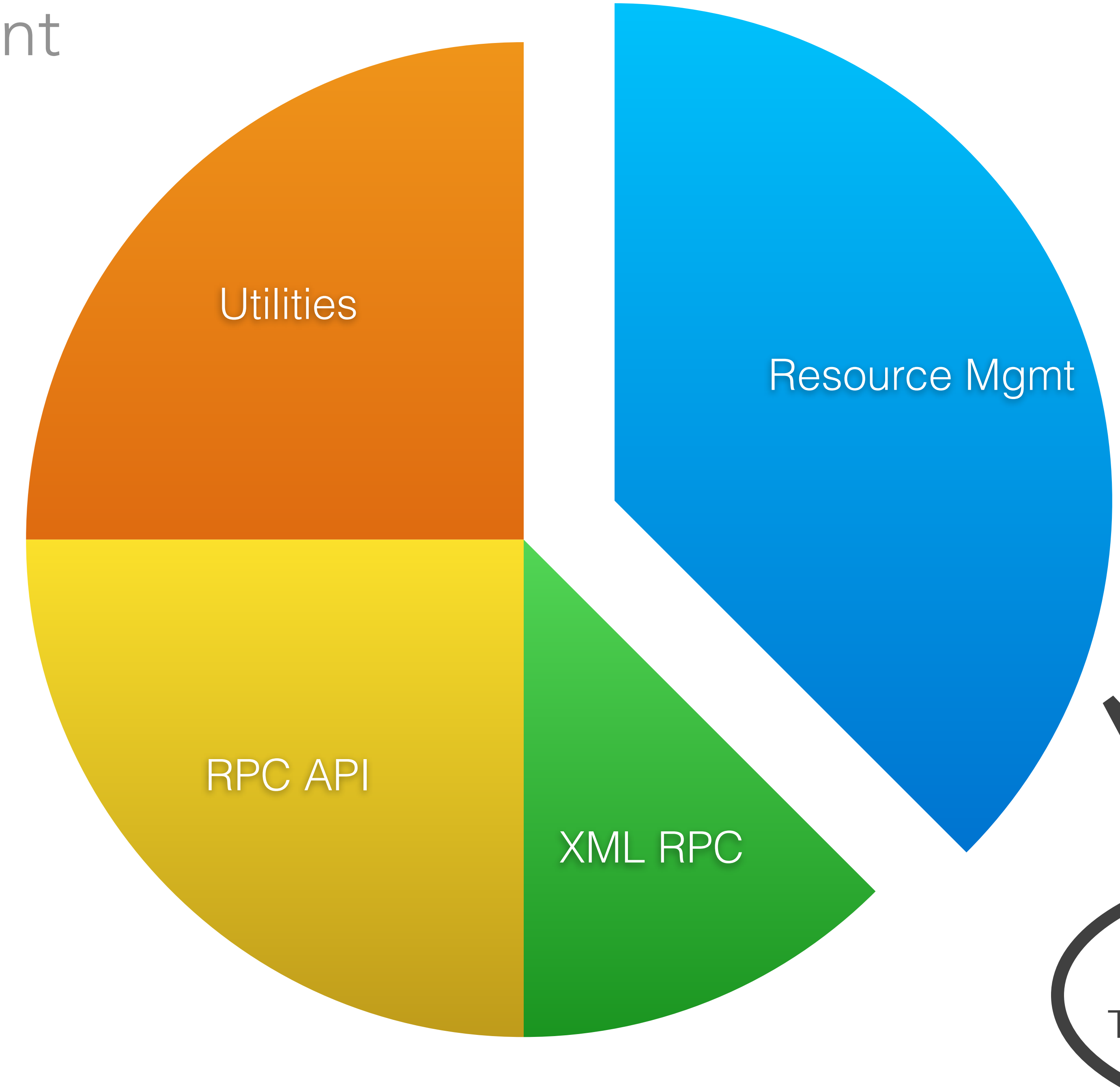
Someone needs to implement this!

AMsoil?

> AMsoil is a light-weight framework for creating Aggregate Managers in test beds.
>
> AMsoil is a pluggable system and provides the necessary glue between RPC-Handlers and Resource Managers . Also it provides helpers for common tasks in AM development.

motivation

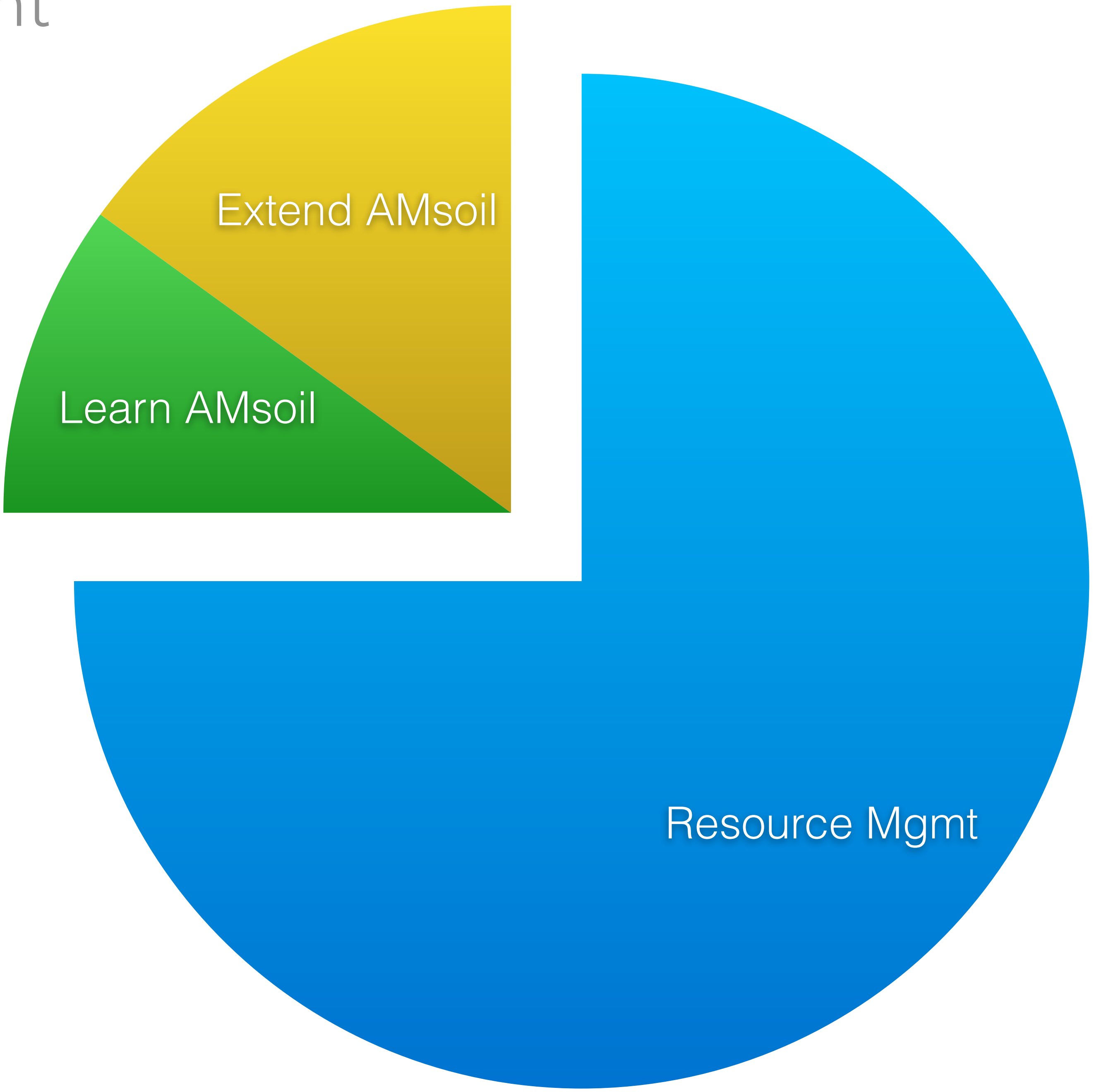
AM development without AMsoil



This is why you write an AM. The rest is just annoying.

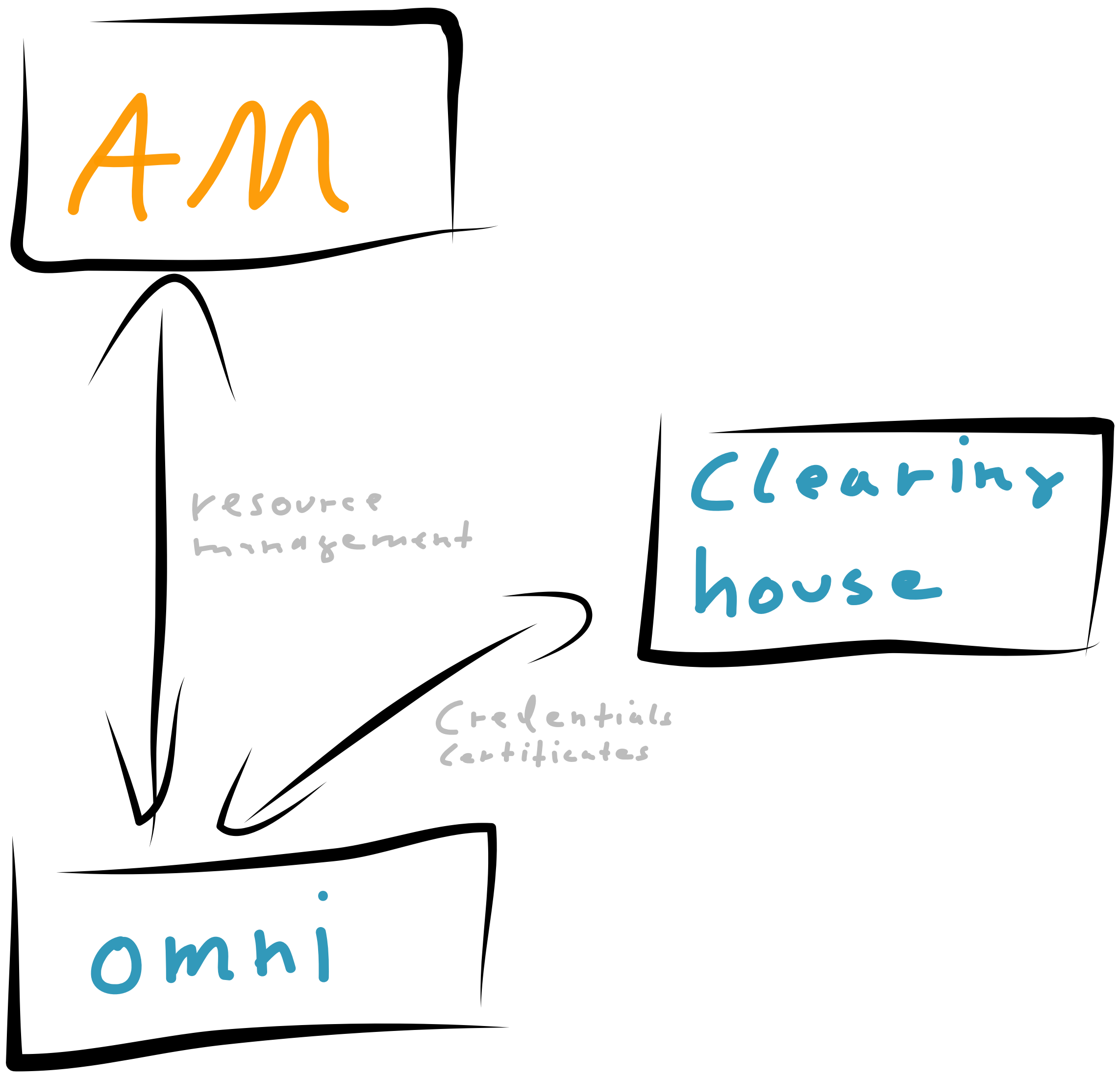
motivation

AM development
with AMsoil



how to write an AM

- Setup a little test bed
  - Install a Clearinghouse
  - Install a client
  - Install AMsoil
- Understand AMsoil
- Start hacking...



need to know

- how a GENI testbed works
- how plugins work
- what plugins you need to develop
- what else AMsoil supports

what now?

finish this presentation,

clone the repository https://github.com/fp7-ofelia/AMsoil.git

then **read** https://github.com/fp7-ofelia/AMsoil/wiki/Installation

GENI?

AMsoil managers are used in a GENI-like test bed.

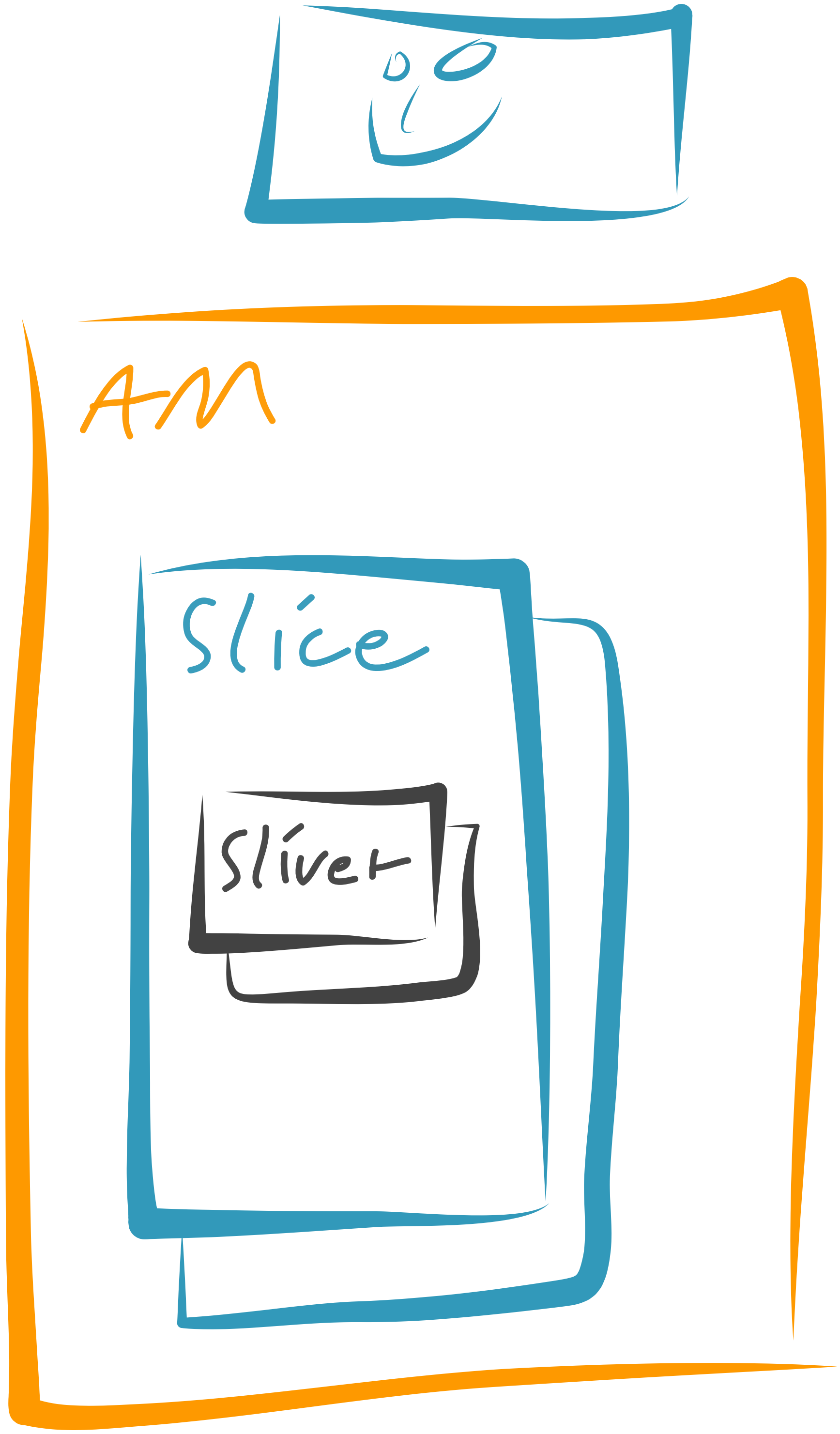
Let’s understand how GENI works.

names in GENI

- **Experimenter**
  A human user who uses a client to manage resources via an AM.

- **Sliver**
  A physical or virtual resource. It is the smallest entity which can be addressed by an AM
  (e.g. an IP address, a virtual machine, a FlowSpace).

- **Slice**
  A collection of slivers.



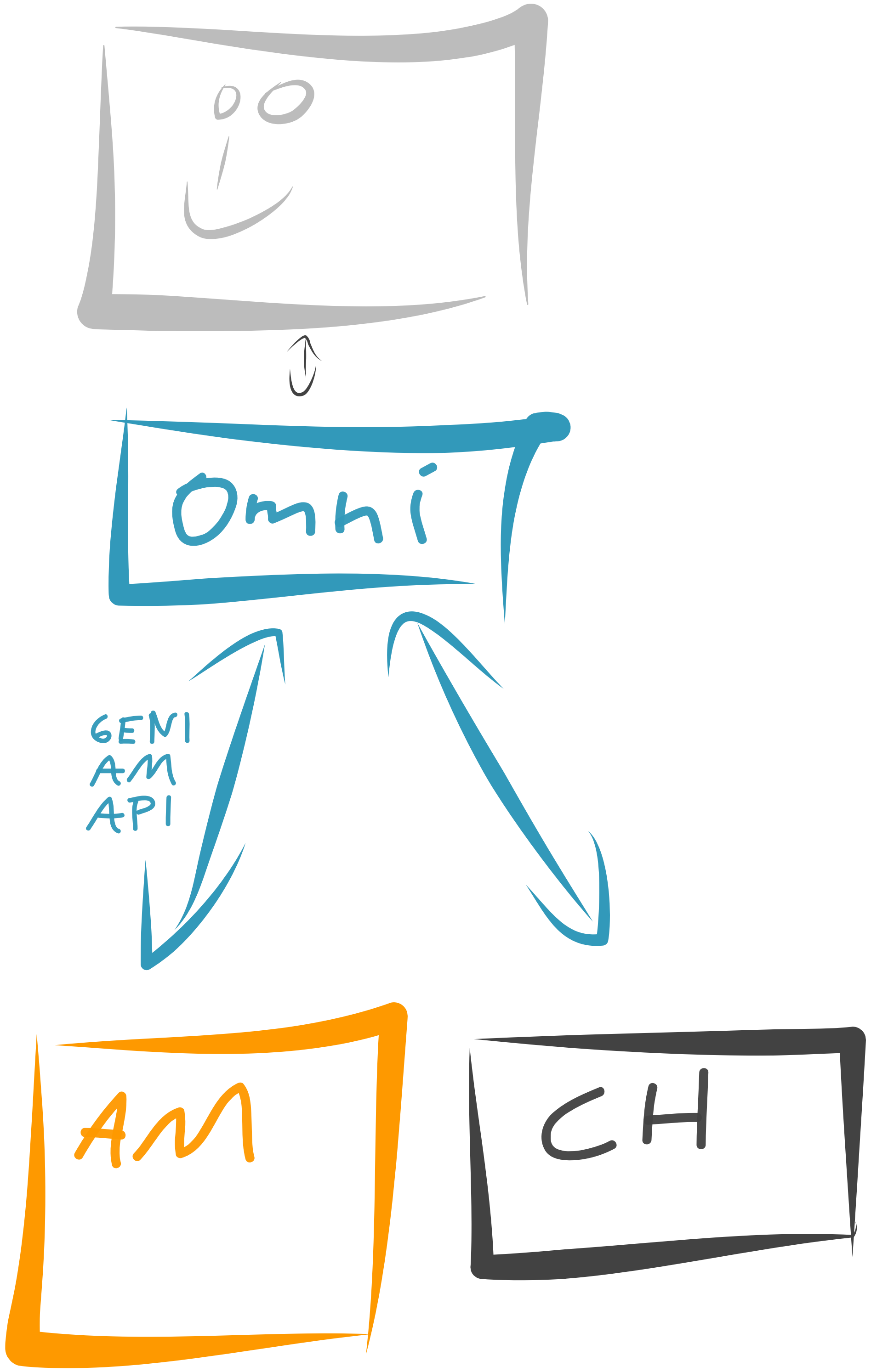
communication

- The Clearinghouse provides services to know who you are and what you may do.

  (we don't care, just use it)

- The client speaks the GENI AM API to the AM.

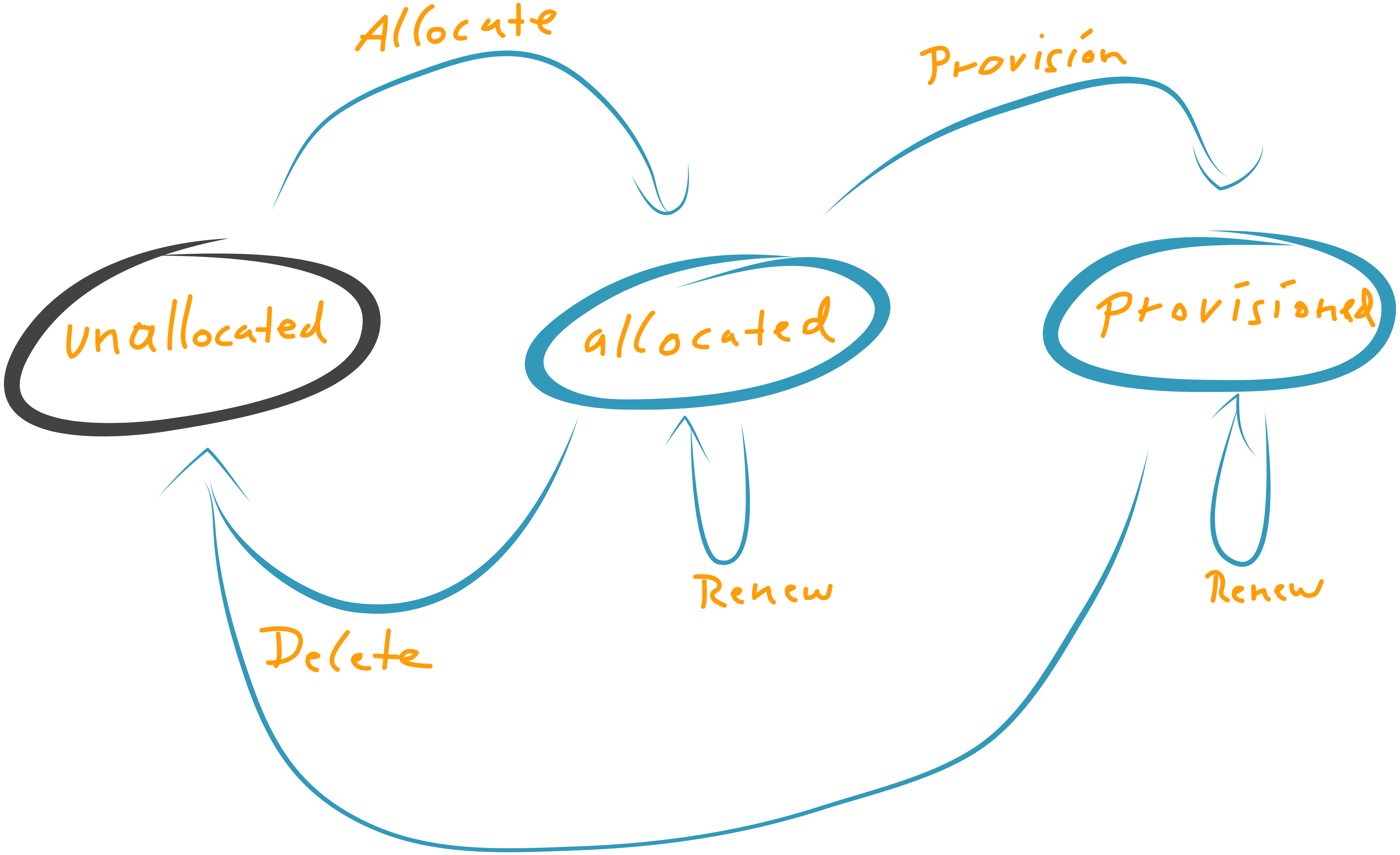
  (we care, because we implement it)



what can the API do?

`GetVersion`	Get info about the AM's
`ListResources`	Info what the AM has to offer
`Describe`	Info for a sliver
`Allocate`	Reserve a slice/sliver for a short time
`Renew`	Extend the usage of a slice/sliver
`Provision`	Provision a reservation for a longer time
`Status`	Get the status of a sliver
`PerformOperationalAction`	Change the operational state of a sliver
`Delete`	Remove a slice/sliver
`Shutdown`	Emergency stop a slice

allocate *and* provision?



allocated only for a short time resources are only booked not provisioned
provisioned the slice/sliver actually takes up resources (is actually usable)

typical experiment

Imagine a restaurant reservation.

- **ListResources**
  Call the restaurant to ask what tables are available.
- **Allocate**
  Call to tell which table you want (they will only hold the table for 2 hours).
- **Provision**
  Come and use at the table (this may take 5 hours).

how do say what I want?

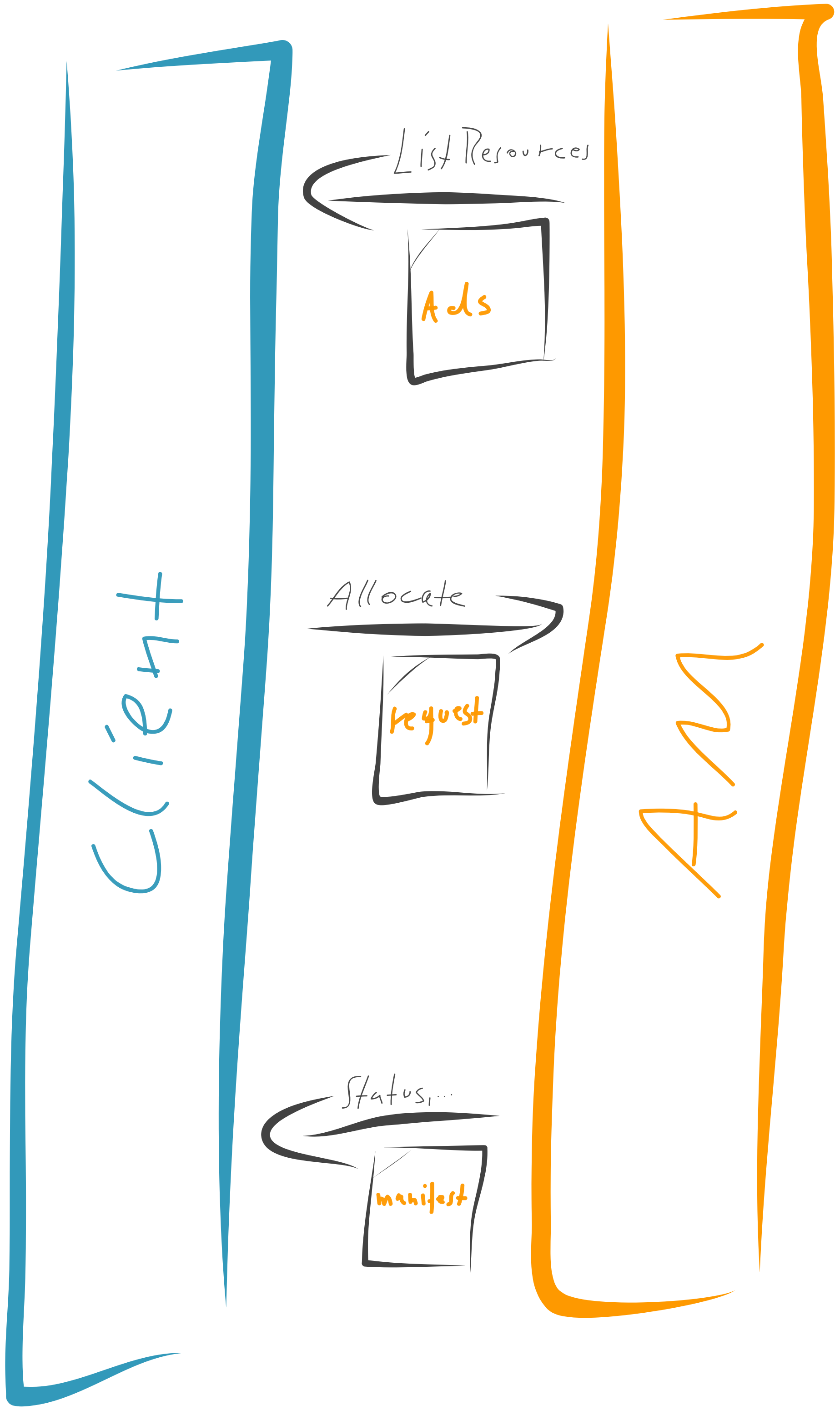
The resources are described with an XML document called RSpec.

There are three RSpec types:

- **Advertisement** *(short: ads)*
  Announces which resources/slivers are available.

- **Request**
  Specifies the wishes of the experimenter

- **Manifest**
  Shows the status of a sliver



AM… what now?

Let’s look on AMsoil and see what it can do.

a broad look

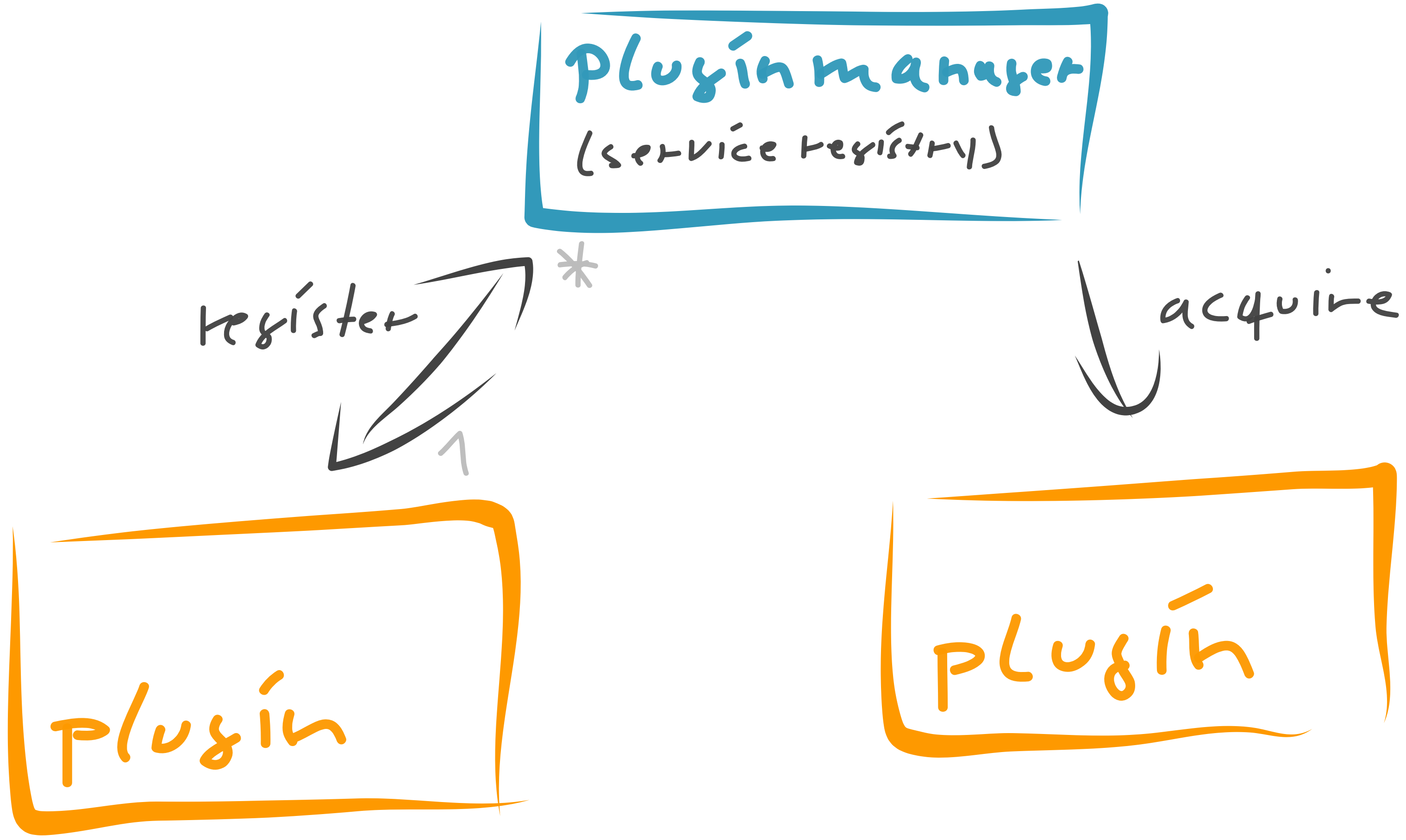
AMsoil’s directory structure

```
|-- admin
|-- deploy
|   `-- trusted
|-- doc                              Documentation
|   |-- img
|   `-- wiki
|-- log                              AMsoil's log
|-- src
|   |-- amsoil                       AMsoil's core implementation
|   |   `-- core
|   |-- disabled-plugins             Unused code/plugins
|   |   `-- ...
|   `-- plugins                      Plugins to be loaded when bootstrapping AMsoil
|       `-- ...
`-- test
```

why plugins?

- **Selection**
  An administrator can add/remove plugins/functionality.
- **Exchangeability**
  The interface remains, but the implementation be changed.
- **Clarity**
  Provide a set of services and hide the details behind.
- **Encapsulation**
  Protect implementations from other developers.

register and use plugins



```
[plugin A] import amsoil.core.pluginmanager as pm
[plugin A] pm.registerService('myservice', serviceObject)

[plugin B] service = pm.getService('worker')
[plugin B] service.do_something(123)
```

what can be a service?

short version

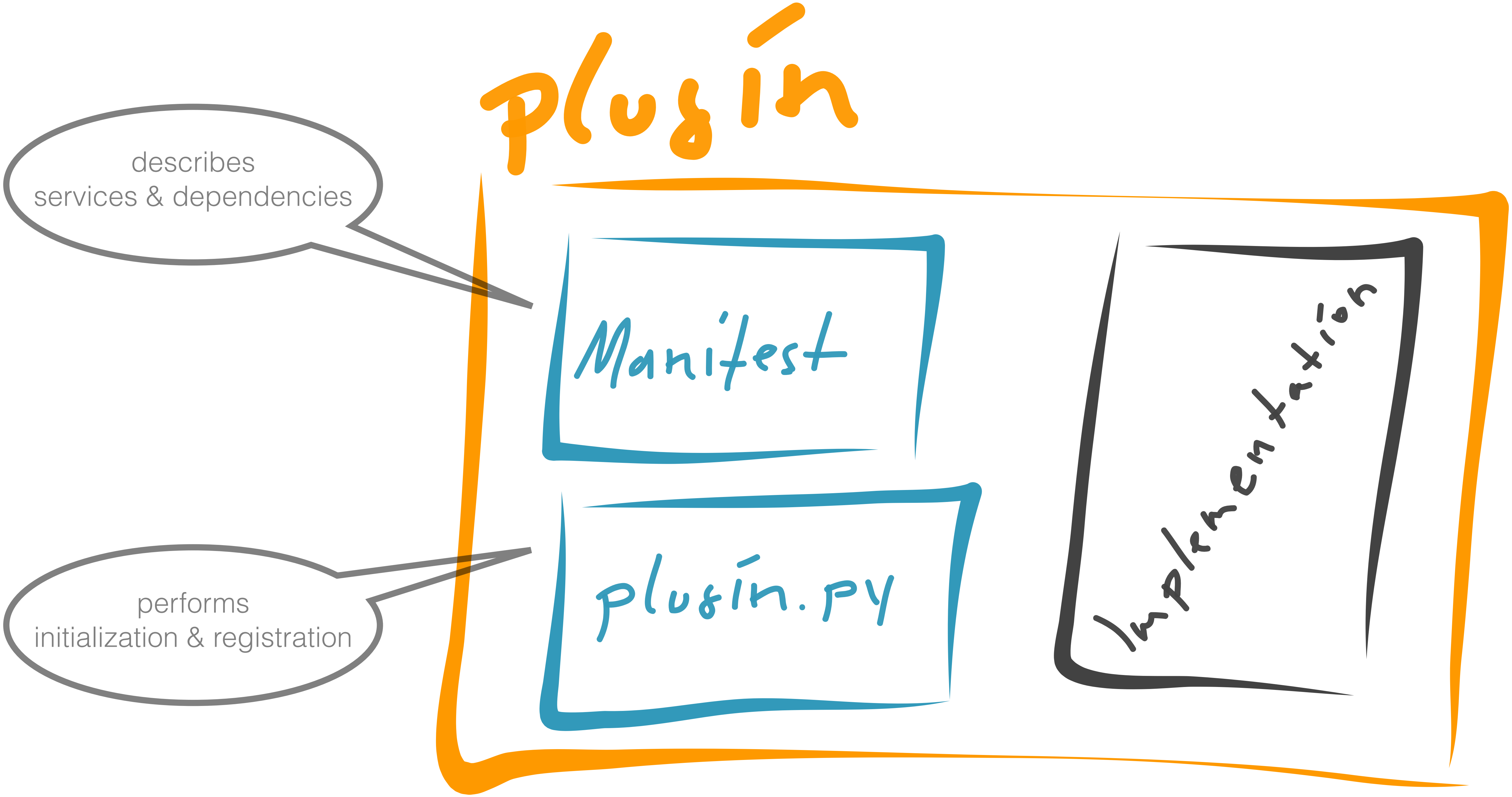
everything which can be referenced in Python

yes even packages!

long version

`ints, strings, lists, dicts, objects, classes, packages`

under the hood



describes
services & dependencies

performs
initialization & registration

implement a plugin

- create a new folder in plugins
- create the manifest.json
- create the plugin.py
  - write a setup() method
- register your services

implement a plugin

manifest.json

```
{
   "name"         : "My Plugin Name",
   "author"       : "Tom Rothe",
   "author-email" : "tom.rothe@eict.de",
   "version"      : 1,
   "implements"   : ["myservice", "myclass", "mypackage"], # you’ll register these services
   "loads-after"  : ["somedependency"],            # dependency needs to be loaded before the setup method
   "requires"     : []                             # dependency can be loaded after the setup method
 }
```

plugin.py

```
# ...imports...
 def setup():
     # register a service
     pm.registerService('myclass', ServiceClass)
     pm.registerService('myinstance', SingleClass() )
     pm.registerService('mypackage', my.python.package)
```

@serviceinterface

The methods and attributes which can should be used are marked the annotation @serviceinterface.

implementation

```
from amsoil.core import serviceinterface

class MyService(object):
  @serviceinterface
  def do_something(self, param):       # can be used by the service user
    pass
  def do_more(self, param):            # not part of the service contract, NOT to be used
    pass
```

DOs and DONTs

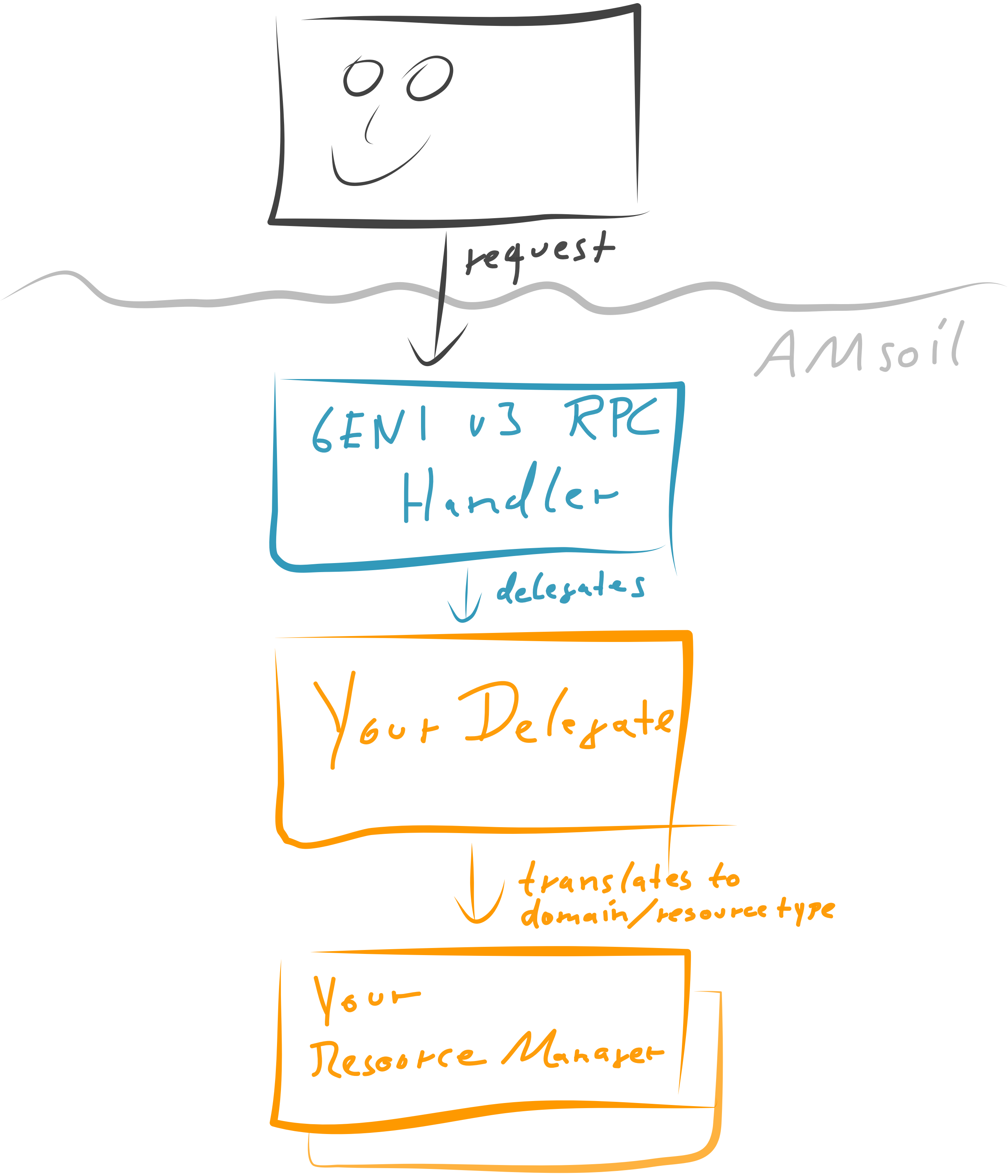
- If you have plugin-specific exceptions, create a package with all exceptions and register the package as a service.
- Separate a plugin into multiple plugins if this improves re-usability.
- Never import another plugin directly, always go via the pluginmanager via pm.getService().

incoming missile

Let’s find out how to react to RPC requests.

getting the requests

- **RPC Handler**
  Retrieves the XML-RPC request, does some magic and passes the request on to the delegate.
- **Delegate**
  Translates the GENI request into a language the Resource Manager can understand
- **Resource Manager** *(short: RM)*
  Handles the actual allocation of the resources.



why RM *and* Delegate?

> “We need to decouple the RPC API from the resource management logic.
>
> This enables AMsoil-based AMs to implement multiple APIs (e.g. GENI, SFA, OFELIA APIs) without having to re-write everything.

interfaces

- **Delegate**
  Should derive from DelegateBase and overwrite the methods prescribed (e.g. list_resources, allocate, ...).
- **Resource Manager**
  You make up the interface!
  The methods, attributes, parameters are domain-specific and depend on the resource type being handled.

a new plugin is born

Create new plugins which handle the incoming requests from the client and do the actual resource management.

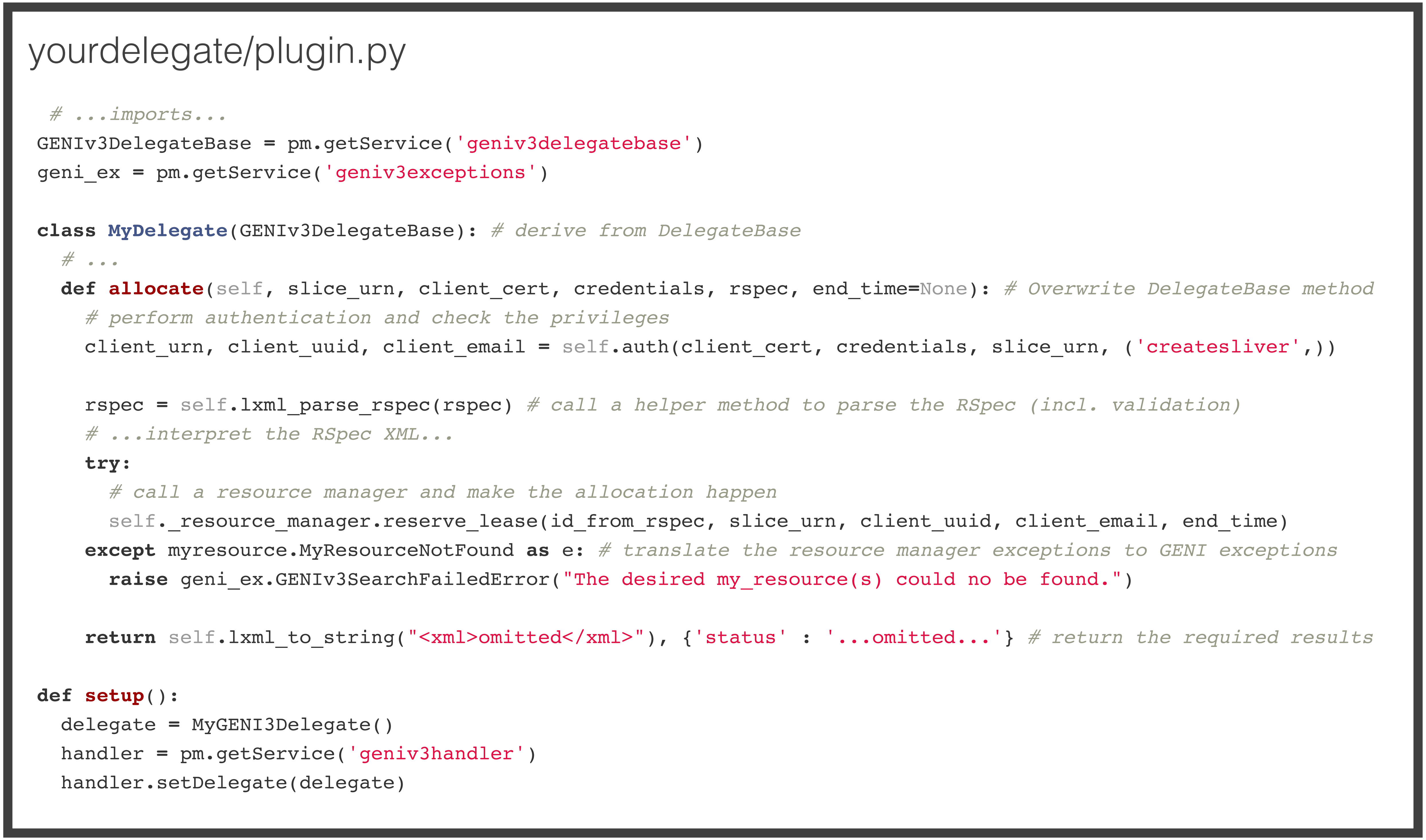
YourDelegate

- ✓ New folder for plugin
- ✓ manifest.json
- ✓ plugin.py
- ✓ a delegate object

YourResourceManager

- ✓ New folder for plugin
- ✓ manifest.json
- ✓ plugin.py
- ✓ a manager service

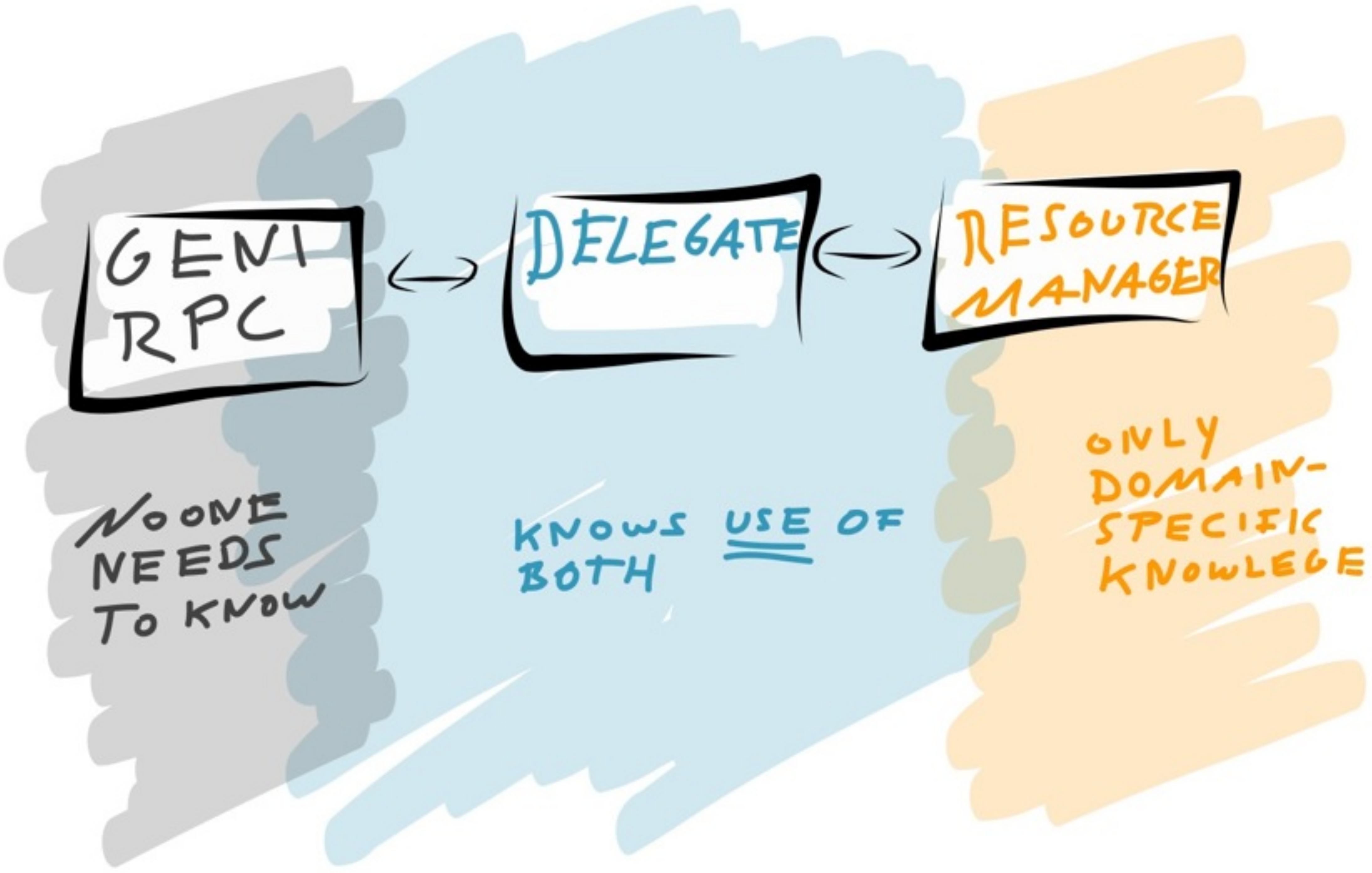
YourDelegate



yourdelegate/plugin.py

```
 # ...imports...
GENIv3DelegateBase = pm.getService('geniv3delegatebase')
geni_ex = pm.getService('geniv3exceptions')

class MyDelegate(GENIv3DelegateBase): # derive from DelegateBase
  # ...
  def allocate(self, slice_urn, client_cert, credentials, rspec, end_time=None): # Overwrite DelegateBase method
    # perform authentication and check the privileges
    client_urn, client_uuid, client_email = self.auth(client_cert, credentials, slice_urn, ('createsliver',))

    rspec = self.lxml_parse_rspec(rspec) # call a helper method to parse the RSpec (incl. validation)
    # ...interpret the RSpec XML...
    try:
      # call a resource manager and make the allocation happen
      self._resource_manager.reserve_lease(id_from_rspec, slice_urn, client_uuid, client_email, end_time)
    except myresource.MyResourceNotFound as e: # translate the resource manager exceptions to GENI exceptions
      raise geni_ex.GENIv3SearchFailedError("The desired my_resource(s) could no be found.")

    return self.lxml_to_string("<xml>omitted</xml>"), {'status' : '...omitted...'} # return the required results

def setup():
  delegate = MyGENI3Delegate()
  handler = pm.getService('geniv3handler')
  handler.setDelegate(delegate)
```

needed knowledge



Delegate tasks

- Translate GENI API into Resource Manager(s) methods
- Translate the RSpecs into Resource Manager values (and back).
- Catch Resource Manager errors and re-throw as GENIv3….
- Translate the namespace from GENI to RM (e.g. URN ↔ UUIDs).
- Specify the needed privileges for authorization.
- De-multiplex to dispatch to different Resource Managers

  (if you have multiple resource types in one AM).

yes there can only be
one Delegate per AM.

RM tasks

- Instantiate resources
- Manage persistence of reservations and resource state
- Check policies
- Avoid collisions of resources reservations / Manage availability
- Throw domain-specific errors

more info

- Please see the ↺ wiki for
  - Authentication / Authorization tools
  - RSpec generation assistance
  - More detailed description

- Checkout the code and look at the DHCP AM example
  - plugin: `dhcprm`
  - plugin: `dhcpgeni3`
  - API description of `geniv3rpc`

a table for two please

See what kind of bookings for resources are there and what is supported by AMsoil…

ways to schedule

There are two common types of scheduling

	best-effort	pre-booking
experimenter process	try and fail	convenient planning
scheduling constraints	current status only	current and future
data to maintain	past, current	past, current, future
resource usage pattern	typically sharing	typically exclusive use

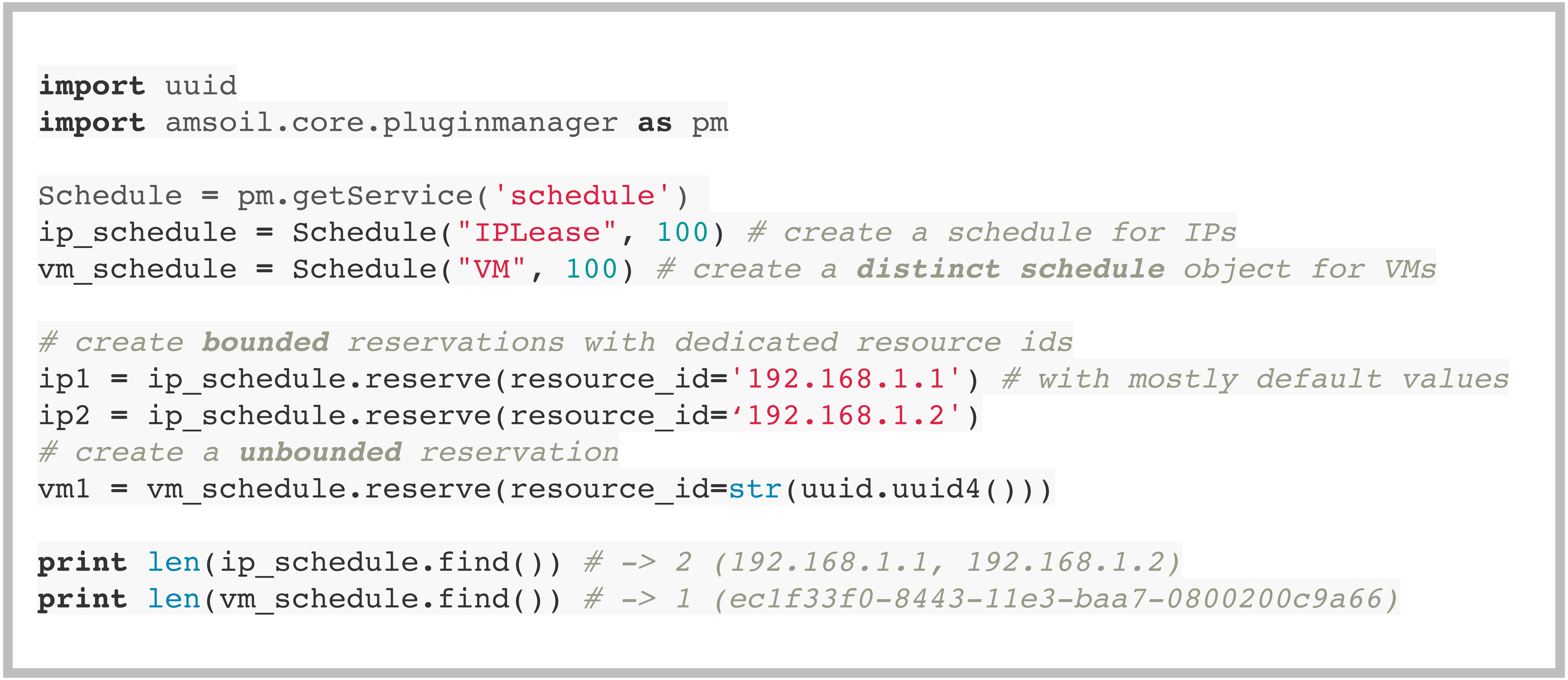
types of resources

There are two different cardinalities for resource types.

	bounded	**unbounded**
available resources	limited	unlimited
availability check	boolean check	always available (possibly limited by the total load of booked resources)
resources identifiers	well known, limited number	non-clashing, possibly infinite

schedule API

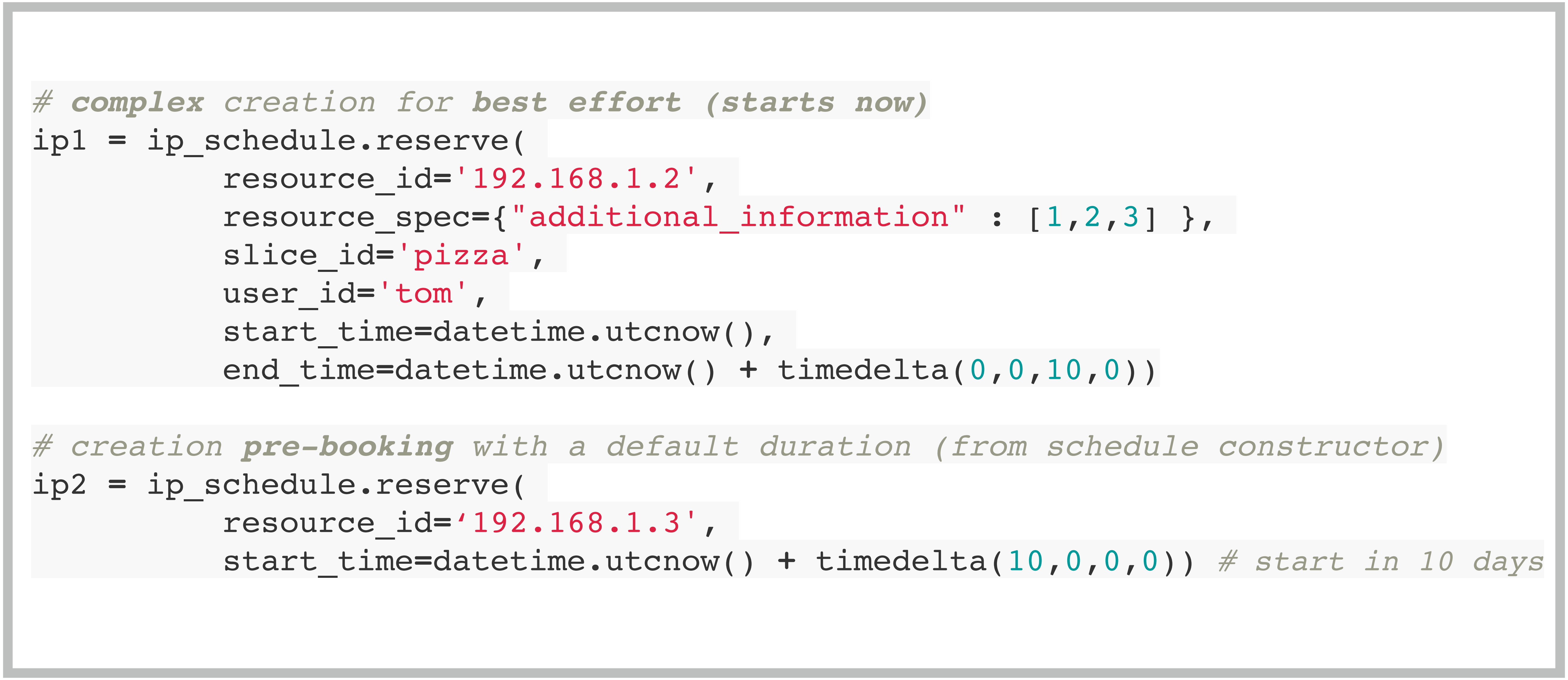
We see different schedules, simple creation, bounded and unbounded.



```
import uuid
import amsoil.core.pluginmanager as pm

Schedule = pm.getService('schedule')
ip_schedule = Schedule("IPLease", 100) # create a schedule for IPs
vm_schedule = Schedule("VM", 100) # create a distinct schedule object for VMs

# create bounded reservations with dedicated resource ids
ip1 = ip_schedule.reserve(resource_id='192.168.1.1') # with mostly default values
ip2 = ip_schedule.reserve(resource_id=‘192.168.1.2')
# create a unbounded reservation
vm1 = vm_schedule.reserve(resource_id=str(uuid.uuid4()))

print len(ip_schedule.find()) # -> 2 (192.168.1.1, 192.168.1.2)
print len(vm_schedule.find()) # -> 1 (ec1f33f0-8443-11e3-baa7-0800200c9a66)
```

schedule API

We see complex reservation pre-booking and best-effort.

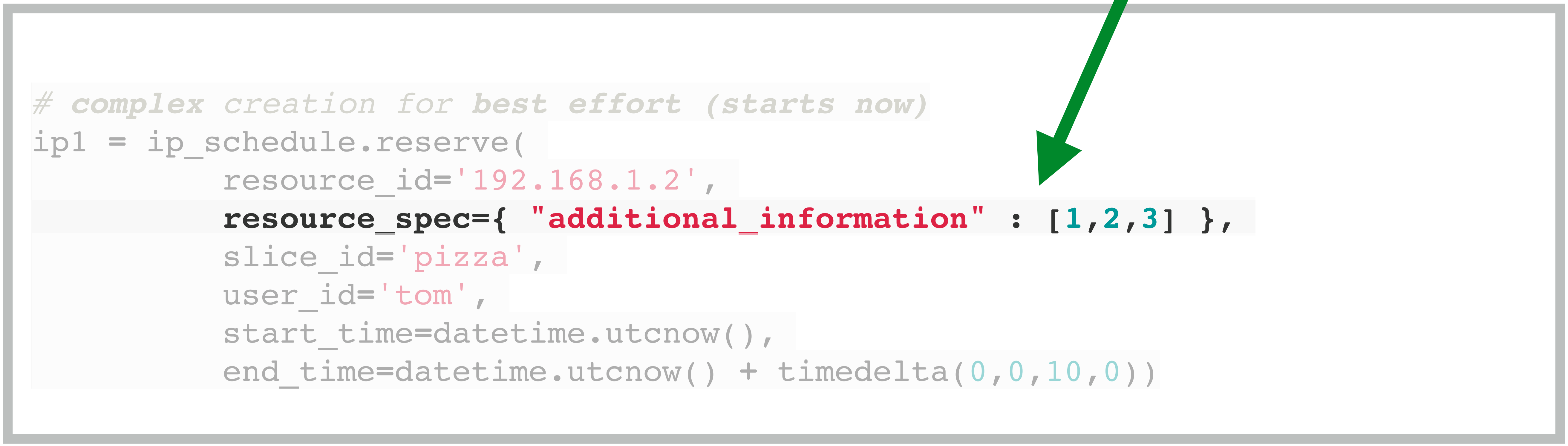


```
# complex creation for best effort (starts now)
ip1 = ip_schedule.reserve(
          resource_id='192.168.1.2',
          resource_spec={"additional_information" : [1,2,3] },
          slice_id='pizza',
          user_id='tom',
          start_time=datetime.utcnow(),
          end_time=datetime.utcnow() + timedelta(0,0,10,0))

# creation pre-booking with a default duration (from schedule constructor)
ip2 = ip_schedule.reserve(
          resource_id=‘192.168.1.3',
          start_time=datetime.utcnow() + timedelta(10,0,0,0)) # start in 10 days
```

schedule API

What a pickle! Where can I put my resource specific information?

there!



```
# complex creation for best effort (starts now)
ip1 = ip_schedule.reserve(
          resource_id='192.168.1.2',
          resource_spec={ "additional_information" : [1,2,3] },
          slice_id='pizza',
          user_id='tom',
          start_time=datetime.utcnow(),
          end_time=datetime.utcnow() + timedelta(0,0,10,0))
```

You can add custom info to each reservation (any pickle-able object).
If you can connect all info with reservations, no extra database needed.

hands on tips

Let’s see how we can make our life even easier.

testing

- ✓ Fire up the Clearinghouse
- ✓ Start the AMsoil server
- ✓ Run omni to send a request
    - ✓ Check AMsoil's logs

```
gcf#    python src/gcf-ch.py
amsoil# python src/main.py
amsoil# tail -f log/amsoil.log
gcf#    python src/omni.py -o -a https://localhost:8001 -V 3 getversion
```

development mode

- Use the configuration tool to set `flask.debug = True`
  - Now the server reloads it's files every time you change a file.

  !! Careful: The client's certificate is now read from a pre-configured file.

- For debugging
  - Throw exceptions or
  - Write to the log to see what's going on.

logging

anywhere.py

```
import amsoil.core.log
logger=amsoil.core.log.getLogger('pluginname')
# logger is a decorated instance of Python's logging.Logger, so we only get one instance per name.

def somemethod():
  logger.info("doing really cool stuff...")
  logger.warn("Oh Oh...")
  logger.error("Ba-Boooom!!!")
```

configuration

anywhere.py

```
import amsoil.core.pluginmanager as pm
config = pm.getService("config")       # get the service
myvalue = config.get("mygroup.mykey") # retrieve a value
config.set("mygroup.mykey", myvalue)  # set a value
```

plugin.py

```
import amsoil.core.pluginmanager as pm
def setup():
  config = pm.getService("config")  # get the service
  config.install("mygroup.mykey", "somedefault", "Some super description.") # install a config item
```

! Always `install` the config keys and defaults on the plugin's setup method (`install` will not re-create/overwrite existing entries).

worker

The worker enables dispatching jobs to an external process

(e.g. to perform longer tasks without blocking the client's request response).

anywhere.py

```
worker = pm.getService('worker') # get the service
worker.add("myservice", "mymethod", "parameter1") # run as soon as possible
worker.addAsReccurring("myservice", "mymethod", [1,2,3], 60) # run every minute
worker.addAsScheduled("myservice", "mymethod", None, datetime.now() + timedelta(0, 60*60*2)) # run in 2 hours
```

fire up the server (needs reboot when changing code)

```
amsoil# python src/main.py --worker
```

mailer

The mailer enables sending of plain-text mails.

anywhere.py

```
MailerClass = pm.getService('mailer')
mailer = MailerClass('root@example.org', 'mail.example.org')
mailer.sendMail("to@example.org", "Some Subject", "Some Body.")
```

! Delivering mail takes time.

!! Do not block the client’s request handling too long.

✓ If you want to send multiple mails,
dispatch the delivery of mails to the worker.

persistence

SQLAlchemy tutorial

7900 words

vs.

Need to know

926 words

Persistence

Value objects

Bootstrap

Create a table

Query and changes

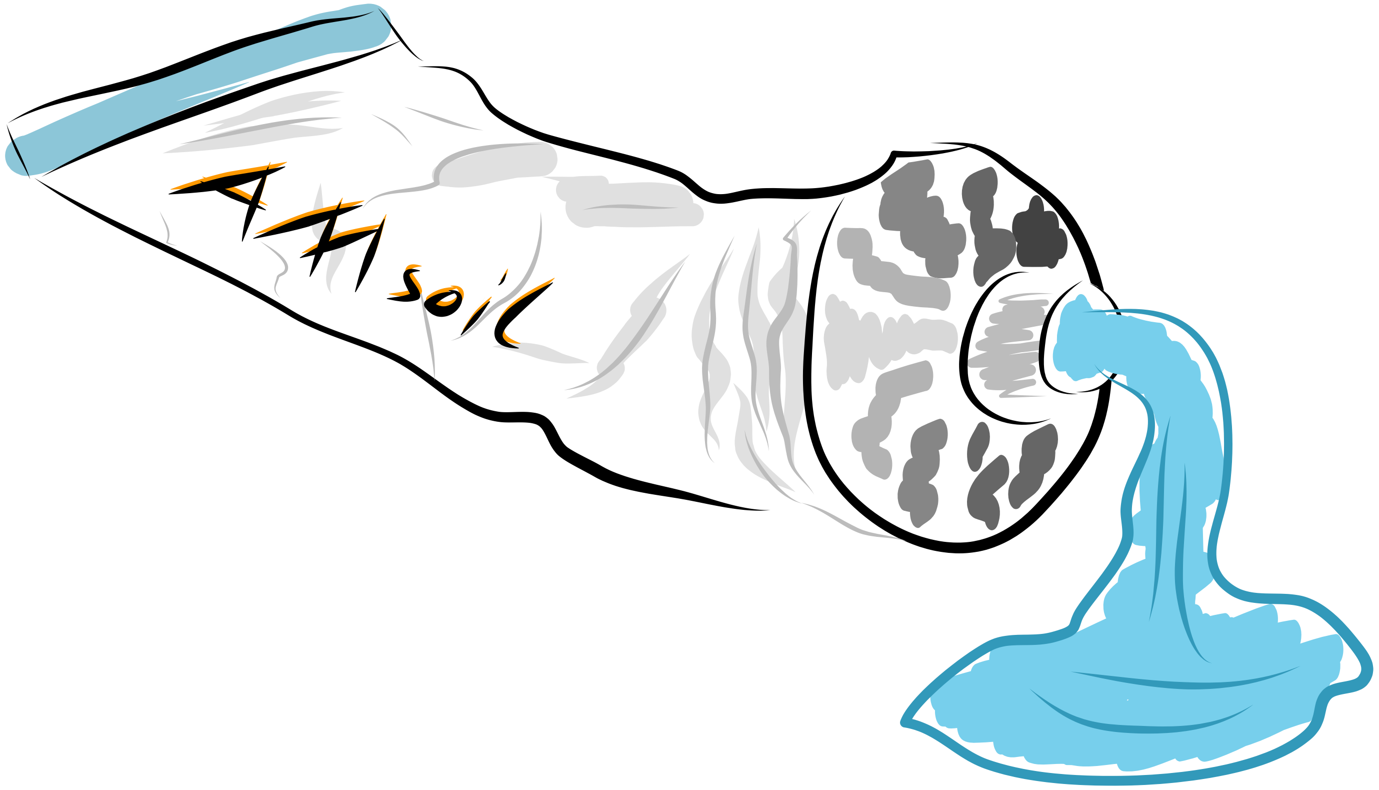
Objects in sessions

Expunge

More info

↻ persistence

you know it all



clone the repository

https://github.com/fp7-ofelia/AMsoil.git

then **read** the wiki

https://github.com/fp7-ofelia/AMsoil/wiki