

Bx-RO-Verifier: ByStar Remote-Operations Invocations And Verifications Framework

Tools And Strategies For Generalized OpenAPI/Swagger Based Verification
Of Web-Services

Mohsen BANAN

Email: <http://mohsen.1.banan.byname.net/contact>

<http://www.by-star.net/PLPC/180057>

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Outline of Part I – Overview Of mmwslcm Web Services Testing Framework

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 - A Graphical Overview Of Invoker ICMs Development Model
 - Invoker ICMs Development Model
 - Invoker Framework: Ingredients
 - Try It Out – Install The Software And Run The Examples

Obtaining The Software

Software (Open-Source):

- pip-pkg at PyPi: <https://pypi.org/project/unisos.mmwsIcm>
- GitHub: <https://github.com/bisos-pip/mmwsIcm>

***Interactive Command Modules (ICM) and Players
A Framework For Cohesive Generalized Scripting***

<http://www.by-star.net/PLPC/180050> — [4]

***Remote Operations Interactive Command Modules (RO-ICM)
Best Current (2019) Practices For Web Services Development***

<http://www.by-star.net/PLPC/180056> — [3]

***A Generalized Swagger (OpenAPI) Centered Web Services
Invocations And Testing Framework***

<http://www.by-star.net/PLPC/180057> — [1]

***Extending SON To Clouds And Things
GOSSONoT: A Generalized Open-Source Self Organizing
Network of Things Platform***

<http://www.by-star.net/PLPC/180052> — [2]

Part Of A Much Bigger Picture – ByStar and BISOS

This Software is Part Of A Much Bigger Picture.

This Software Is Part Of: **The Libre-Halaal ByStar Digital Ecosystem**

And Part Of: **BISOS: ByStar Internet Services OS**

This software is primarily being used and developed in that context.

Structure Of Web Services Implementation – Remote Operations

Implementation Of Remote Operations Can Typically Be Structured As:

- 1 Remote Performer Implementation –
<http://www.by-star.net/PLPC/180056>
- 2 Remote Invoker Implementation – <http://www.by-star.net/PLPC/180057>
- 3 Direct Operations Implementation –
<http://www.by-star.net/PLPC/180050>

This document focuses on Remote Invoker Implementation.

You should read this document alongside the mentioned documents.

Interactive Command Modules (ICM) allow for consistent Direct and Remote Operations.

Interactive Command Modules Direct And Remote Operations

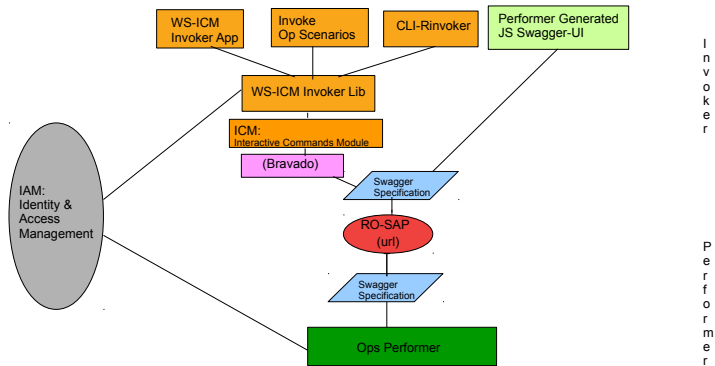
Our implementation model for remote operations is based on the model of Interactive Command Modules (ICM).

The Interactive Command Modules Framework allows for a Direct Operation to be split into a Performer Remote Operation module and an Invoker Remote Operation module.

The Interactive Command Modules Framework allows for a Remote Operation to also be used as Direct Remote.

The Interactive Command Modules Framework allows for operations to be mapped to command-line invocations.

ICM-Invoker Web Services Verification And Development Model



Invoker ICMs Development Model

Given a Service Definition (a swagger file) and a Performer Server, you should be able to conveniently Invoke any of the offered Operations through:

- 1 swagger.ui interface – usually offered by the Performer Server
- 2 unisos.mmwslcm :: rinvoke – command line and batch oriented equivalent of swagger.ui
- 3 unisos.mmwslcm :: opScn – invoke-specification – invoke-verification – invoke-reporting
- 4 unisos.mmwslcm :: Library – wsInvoker.py, ro.py – for building invoker Apps

Remote Invoker ICMs Development Model

Main software packages that implement the framework include:

- 1 Python Bravado – Equivalent of Invoker Codegenartor But Better
- 2 unisos.icm – Interactive Command Module
 - Makes icm.Cmnd classes invokable at command-line
 - do-icm :: Direct Operation ICMs (Used by performers)
- 3 unisos.mmwslcm
 - unisos.mmwslcm.wsInvoker.py – Maps invocations to http requests
 - unisos.mmwslcm.ro.py – Abstracts invoke-specifications
 - unisos.mmwslcm.rinvoker.py – Maps command-line args to invocations

Try It Out – Install The Software And Run The Examples

Install The Software:

- `pip install unisos.mmwsicm`

Run The PetStore Example:

- `rinvokerPetstore.py`
- `opScnPetstore.py`

Part II

Command Line Remote Invocation (rinvoker) – rinvokerPetstore.py Example

Outline of Part II – Command Line Remote Invocation (rinvoker) – rinvokerPetstore.py Example

- 6 rinvoker Seed Features – Commands – Parameters – Arguments
 - rinvoker.py Seed Features – Commands
 - rinvoker.py Seed Features – Parameters
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- 7 rinvokerPetstore.py Example

rinvoker.py Seed Features – Commands

- Cmnd: -i svcOpsList

svcOpsList command digests the Service Specification (swagger-file) specified on command line as --svcSpec= parameter and produces a complete list of ALL remotely invokable commands with their corresponding --resource, --opName and url or body arguments.

Applicable options, parameters and arguments are:

- * Parameter (Mandatory) : --svcSpec=

- * Parameter (Optional) : --perfSap= --headers=

- Cmnd: -i rinvoker

rinvoker command invokes the "opName" operation at "resource" with specified arguments.

Applicable options, parameters and arguments are:

rinvoker.py Seed Features – Parameters

- Parameter: `-svcSpec=` (url, or swagger-file)
The swagger file as a url or as a json/yaml file is specified with the `-svcSpec=` parameter.
- Parameter: `-perfSap=` (url)
The Performer Service Access Point Address (perfSap) is specified as a URL with the `-perfSap=` parameter.
- Parameter: `-header=` (file)
Additional headers (e.g., a token) can be included with the `-svcSpec=` parameter.
- Parameter: `-resource=` (string, corresponding to SvcSpec)
The resource to be invoked should be specified with the `-resource=` parameter
- Parameter: `-opName=` (string, corresponding to SvcSpec)
The operation name to be invoked should be specified with the `-opName=` parameter

rinvoker.py Seed Features – Arguments

- Argument: `name=value` (`string=string` corresponding to `SvcSpec`'s URL Params)
- Argument: `bodyStr=jsonStr` (`bodyStr=string` corresponding to `SvcSpec`'s Body)

rinvokerPetstore.py Example

Allows you to list all possible invocations based on a service specification (swagger file).

```
rinvoker.py --svcSpec="http://petstore.swagger.io/v2/swagger.json" -
```

Allows you to fully specify an invocation on command line. Example:

```
rinvoker.py --svcSpec="http://petstore.swagger.io/v2/swagger.json"  
            --resource="user" --opName="createUser" -i rinvoker  
            bodyStr="{...}"
```

Part III

Operation Scenarios – opScnPetstore.py Example

Outline of Part III – Operation Scenarios – opScnPetstore.py Example

- 8 Invoke-Specifications, Invoke-Verification, Invoke-Reporting
 - Model Of Invoke – Specification, Verification And Reporting – Scenarios
 - Scenario Specification For Sequences Of Invocations

- 9 opScn-Seed (Remote Operation Scenarios) – Commands – Paramters – Arguments
 - opScn Seed Features – Commands
 - OpScn Outputs And Reportings

Model Of Invoke – Specification, Verification And Reporting – Scenarios

- Invoke Scenarios Are pure python specification of sequence of invocations.
- Invoke-Expect Scenarios Are pure python specification of sequence of invocations subject to preparations and post-invoke verification and reporting.
- opInvoke class allows for complete invoke specification and complete results to be fully captured.

Scenario Specification For Sequences Of Invocations

In pure python specify invocation of each operation, for example:

```
thisRo = ro.Ro_Op(  
    svcSpec=petstoreSvcSpec,  
    perfSap=petstoreSvcPerfSap,  
    resource="pet",  
    opName="getPetById",  
    roParams=ro.Ro_Params(  
        headerParams=None,  
        urlParams={ "petId": 1},  
        bodyParams=None,  
    ),  
    roResults=None,  
)  
roList.opAppend(thisRo)
```

Validation And Reporting Of Invocations

Building on the previously mentioned Operation Specification, in pure python you can the specify Operation Expectations, for example:

```
thisExpectation = ro.Ro_OpExpectation(  
    roOp=thisRo,  
    preInvokeCallables=[sleep1Sec],  
    postInvokeCallables=[ verify_petstoreSvcCommonRo, ],  
    expectedResults=None,  
)  
roExpectationsList.opExpectationAppend(thisExpectation)
```

preInvokeCallables(ro.Ro_OpExpectation) can include a function that initializes the DB or sleepFor1Sec.

postInvokeCallables(ro.Ro_OpExpectation) can include a function that verifies the result was as expected and then reports success or failure.

opScn Seed Features – Commands

opScn-seed provides the following commands and parameters:

- Cmnd: -i roListInv

roListInv command serially invokes the list of ro.Ro_Op() operations specified in the loaded scenario files.

roListInv displays the invocation and its results. But does not do

Applicable options, parameters and arguments are:

* Parameter (Mandatory) : --load=

- Cmnd: -i roListExpectations

roListExpectations command serially invokes the list of ro.Ro_OpEx specified in the loaded scenario files.

roListExpectations displays the invocation and its results and

OpScn Outputs And Reportings

The output format is:

- * ->:: Invoke Request
- * <-:: Invoke Response
- * ==:: Invoke Validation (SUCCESS or FAILURE)

Additional information for each is include with "***" tags.

This output format can then be used in outline or org-mode.

Part IV

Complete Invoker-Applications Development

Outline of Part IV – Complete Invoker-Applications Development

- 10 Invoker-Apps Development Model
 - Invoker-Apps Can Easily Build On unisos.mmwslcm Capabilities

Invoker-Apps Can Easily Build On unisos.mmwslcm Capabilities

- Bravado does invoker code-generation on the fly.
- `unisos.mmwslcm.oplInvoke` – Abstracts invoke-specifications
- `unisos.mmwslcm.wslInvoker` – Allows for invokation and verification of `oplInvoke`

With these in place, building Invoke-Apps becomes very simple.

Part V

Security Strategies For Web Services Verification

Outline of Part V – Security Strategies For Web Services Verification

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 - Incorporation Of Authentication And Tokens In Swagger Specifications
 - IAM Interactions

- 12 Identification Of Common API Vulnerabilities
 - Identification Of Some Common API Vulnerabilities

Incorporation Of Authentication And Tokens In Swagger Specifications

- Support for formal specification of authentication methods in Swagger-2 is ad-hoc.
- Support for formal specification of authentication methods in OpenApi-3 is new.
- Proper, full specification of placement of JWT (Jason Web Tokens) in the Swagger spec is incomplete.
- Withing a bounded digital ecosystem, full support for AAA in the Swagger specification can be accomplished based on conventions.

IAM Interactions

- Within a given specific digital ecosystem, it is practical to marry IAM with swagger specifications based on conventions and best practices.

Identification Of Some Common API Vulnerabilities

- A combination of machine and human based review of the swagger file can lead to identification of potential security vulnerabilities.
- Based on these OpScn tools, specific Penetration Tests can be devised.

Part VI

Benefits Of Adopting This Generalized Swagger Centered Invocation Model


Outline of Part VI – Benefits Of Adopting This Generalized Swagger Centered Invocation Model

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 - Taking Full Advantage Of Service Specification For Testing And Development

Benefits And Advantages Of The Generalized Swagger Centered Invocation Model


- The Generalized Model and Capabilities Presented Here Apply To Any Service That Exposes Its Swagger Specifications
- A great deal of automation capabilities have become possible based on swagger specifications.
- The Testing Framework Of (invoke-specification, invoke-verification and invoke-reporting) permits for disciplined complete external testing of web-services based on swagger specifications.

Very Often, These Best Current Practices Are Not Being Followed.

-  " Mohsen BANAN ".
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