



# AMWA NMOS Automated Testing

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## Introduction

- What is NMOS?
- Why do we need a testing tool?
- What does it test and how?
- How do you use it?
- What's next?



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## What is NMOS?

- A family of specifications with the collective aim to make the use of IP production systems **as easy, or easier than**, their SDI counterparts
- Including key foundations of:
  - Discovery and registration
  - Connection management
- Agnostic to:
  - Data type, media transport, resolutions, rates and codecs
- Built upon proven Internet technologies
  - HTTP, DNS, TLS, OAuth



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## Why do we need a testing tool?

- NMOS specifications originally used paper test plans at workshops
- Many detailed tests were too time consuming to perform
- When something doesn't work in the wild, how do you know which implementation is at fault?
  
- It is critical that both vendors and end users can confirm adherence to specifications outside of scheduled industry testing events



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## Is it for me?

- Yes! It's for vendors, system integrators and end users
- Use it:
  - During software development
  - During QA ahead of releases
  - Ahead of multi-vendor trials or customer 'PoC'
  - Before you purchase new equipment
  - When you upgrade existing equipment
- If you find a fault it didn't identify, let us know!



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## Is it for me?

- All vendors were required to run the Testing Tool as a condition of attendance at the recent JT-NM Tested event



“The reason for this prerequisite is the strong intention from the industry to move to PICS-driven self-certification model”

- Ievgen KOSTIUKEVYCH, Senior IP Media Technology Architect, EBU

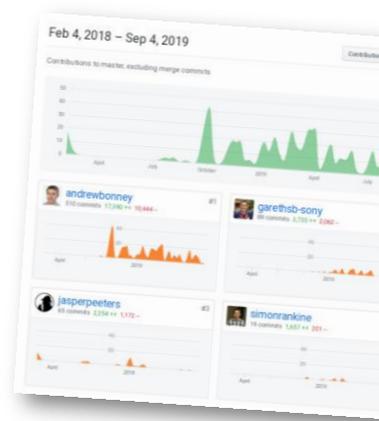


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## How did it come about?

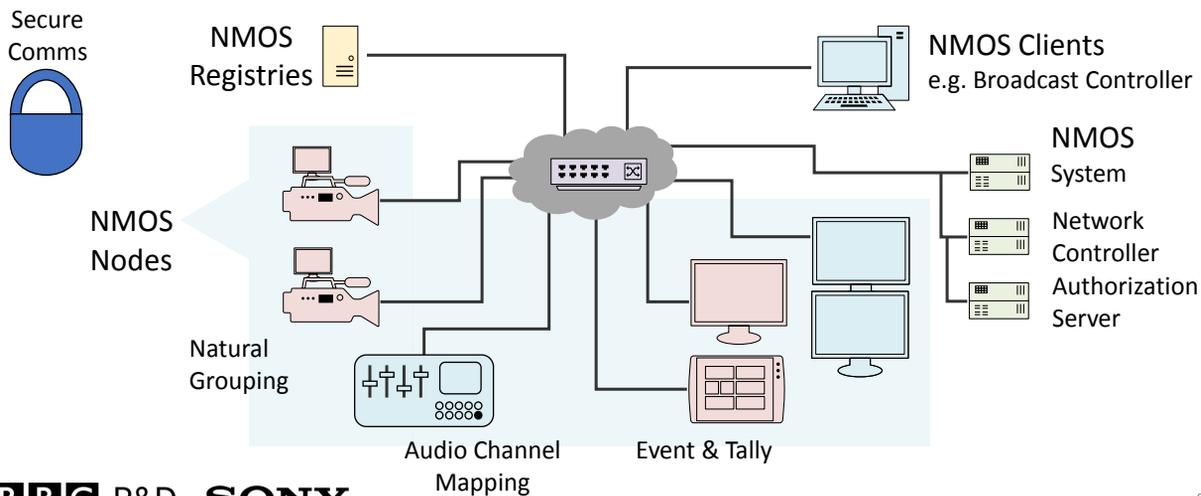
- Collaboration between end users and vendors
  - Various original tools were written by BBC, Riedel and Streampunk
  - A new effort began with BBC R&D in late 2018, aiming to integrate existing tools where possible
  - Sony and other AMWA members have contributed heavily since then
- Test coverage of the core NMOS Specifications is now high
  - Architecture enables straightforward testing of future specifications which use the same design patterns



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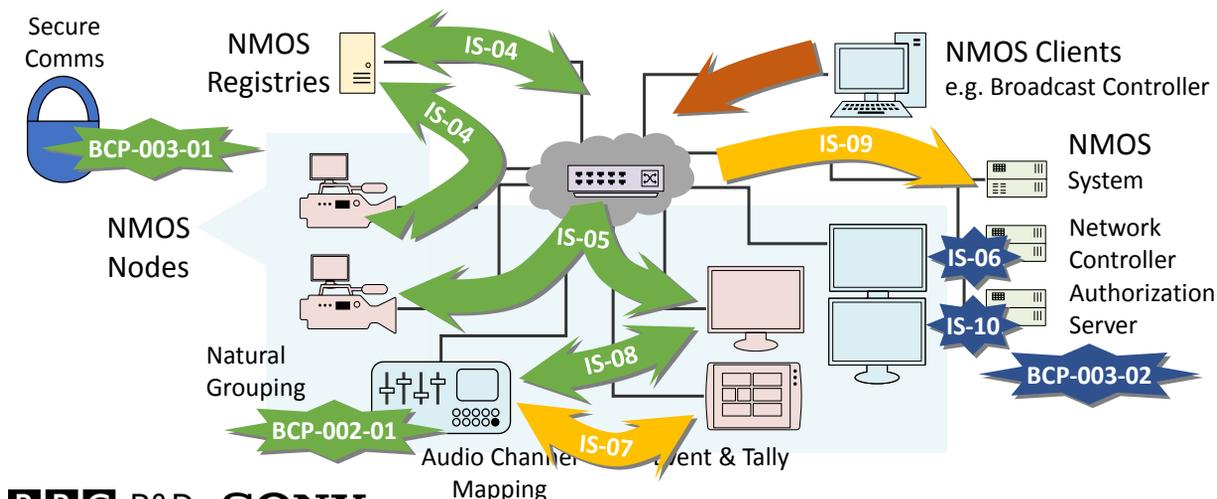
## What does it test?



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### What does it test?



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### What does it test?

- Schema conformance
- API structure
- API behaviour
- API discovery
- Common faults and inconsistencies
- As well as REQUIRED items, RECOMMENDED and OPTIONAL items are covered, with explanations of the circumstances in which they are important

Pass	Reason
Pass	Successful
Fail	Required incorrect
Warning	Not a fail which is

BBC R&D SONY

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## How does it work?

- Downloads each NMOS specification using Git
- Parses the RAML API definition and JSON schemas in order to construct basic tests automatically
- Merges automatically constructed tests with manually defined ones
- Launches a web interface to run tests from

```

78 /:
79   displayName: Base
80   get:
81     description: List of paths available from this API
82     responses:
83       200:
84         body:
85           example: !include ../examples/nodeapi-base-get-200.json
86           type: !include schemas/nodeapi-base.json
87 /self:
88   displayName: Self
89   get:
90     description: Get information about this Node
91     responses:
92       200:
93         body:
94           example: !include ../examples/nodeapi-self-get-200.json
95           type: Node
96 /sources:
97   displayName: Sources
98   get:
99     description: List Sources
100    responses:
101      200:
102        body:
103          example: !include ../examples/nodeapi-sources-get-200.json
104          type: Sources
105 //sourceId:
106   uriParameters:
107     sourceId:
108       type: string
109       patterns: "[0-9a-f]{8}-[0-9a-f]{4}-[1-5][0-9a-f]{3}-[89ab][0-9a-f]{3}-[0-9a-f]{4}"
110   get:
111     description: Get a single Source
112     responses:
113       200:
114         body:
115           example: !include ../examples/nodeapi-sourceId-get-200.json
  
```



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## How do I use it?

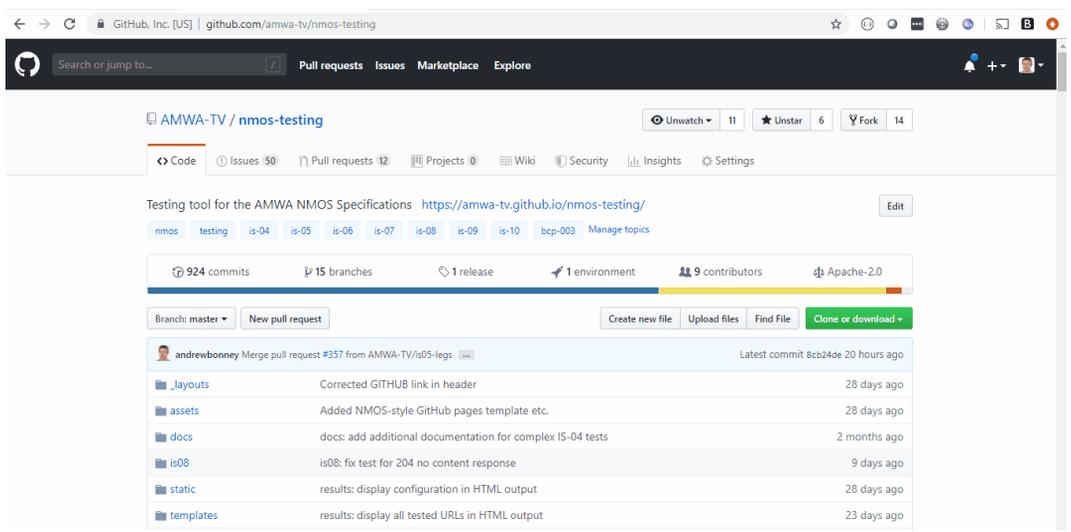
- Open source
- Windows or Linux
- Python 3 (including the pip package manager)
- Git

```

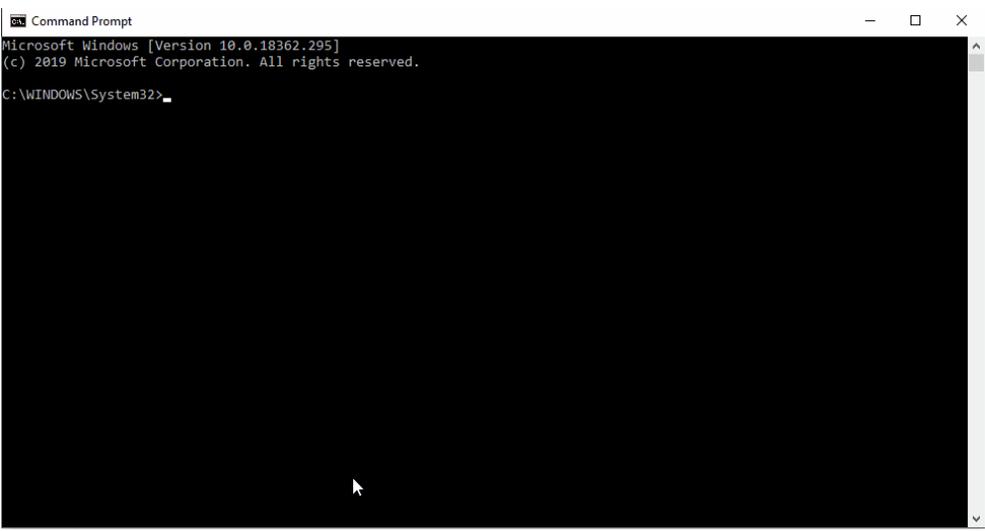
$ pip3 install -r requirements.txt
$ python3 nmos-test.py
  
```



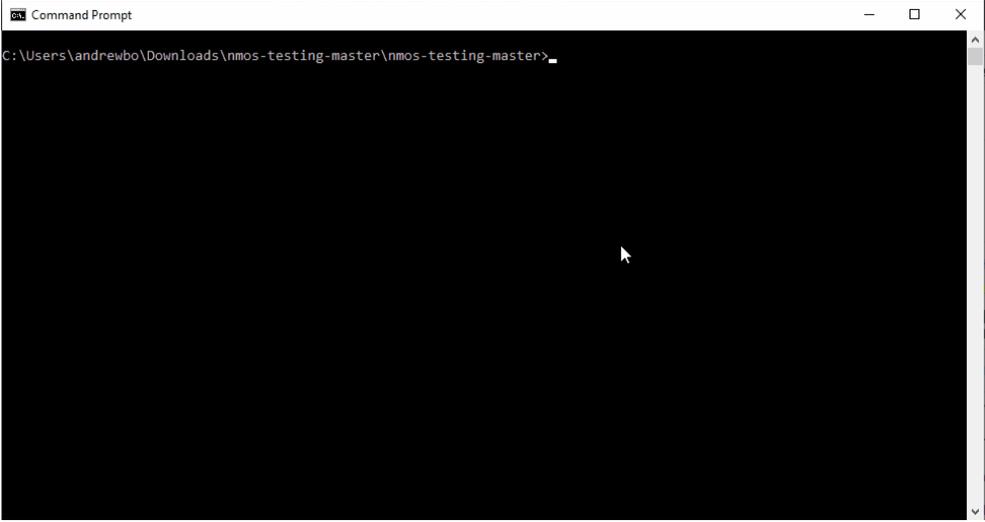
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### NMOS Test

This test suite is under active development and does not yet provide 100% coverage of specifications. We recommend regularly re-testing implementations as new tests are developed.

Test Suite:

Registration API: IP/Hostname:  Port:  API Version:

Query API: IP/Hostname:  Port:  API Version:

Protocol:

Discovery Mode:

Test Selection:

- all
- auto
- test\_01
- test\_02





### NMOS Test

This test suite is under active development and does not yet provide 100% coverage of specifications. We recommend regularly re-testing implementations as new tests are developed.

Test Suite: **IS-04 Registry APIs**

Registration API: IP/Hostname: **BCP-003-01 Secure API Communications**

Query API: IP/Hostname: **IS-04 Node API**

API Version: **v1.2**

Version: **v1.2**

test\_01

test\_02

Run



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Query API: IP/Hostname: **172.29.80.65** Port: **80** API Version: **v1.2**

Protocol: **HTTP**

Discovery Mode: **Multicast DNS**

Test Selection:

- all
- auto
- test\_01
- test\_02
- test\_03
- test\_03\_1
- test\_04
- test\_05
- test\_06
- test\_07
- test\_08
- test\_09
- test\_10
- test\_11
- test\_11\_1
- test\_12
- test\_13
- test\_14
- test\_15
- test\_16

Run



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### NMOS Test

[Download JSON](#) - [More Options](#)

Result for test suite IS-04 Registry APIs on: <http://172.29.80.65:80/x-nmos/registration/v1.2/>, <http://172.29.80.65:80/x-nmos/query/v1.2/>

Failed Tests

Test	Pass	Description	Reason	Completion Time	Time Elapsed
_init_	Not Applicable	Test initialisation		16:19:13.352	1.308s
run_tests	Not Applicable	Test setup		16:19:13.363	0.003s
<input type="checkbox"/> auto_query_1	Pass	GET /x-nmos		16:19:13.369	0.006s
<input type="checkbox"/> auto_query_2	Pass	GET /x-nmos/query		16:19:13.375	0.006s
<input type="checkbox"/> auto_query_3	Pass	GET /x-nmos/query/v1.2		16:19:13.382	0.006s
<input type="checkbox"/> auto_query_4	Pass	GET /x-nmos/query/v1.2/devices		16:19:13.395	0.013s
<input type="checkbox"/> auto_query_5	Could Not Test	GET /x-nmos/query/v1.2/devices/{deviceId}	No resources found to perform this test	16:19:13.395	0.000s
<input type="checkbox"/> auto_query_6	Pass	GET /x-nmos/query/v1.2/flows		16:19:13.436	0.041s
<input type="checkbox"/> auto_query_7	Could Not Test	GET /x-nmos/query/v1.2/flows/{flowId}	No resources found to perform this test	16:19:13.436	0.000s



← → 127.0.0.1:5000

### NMOS Test

This test suite is under active development and does not yet provide 100% coverage of specifications. We recommend regularly re-testing implementations as new tests are developed.

Test Suite:

IP/Hostname:  Port:  API Version:

Protocol:

Discovery Mode:

Test Selection:

all

auto

test\_01\_tls\_protocols

test\_02\_tls\_ciphers





## Example: IS-04 Nodes

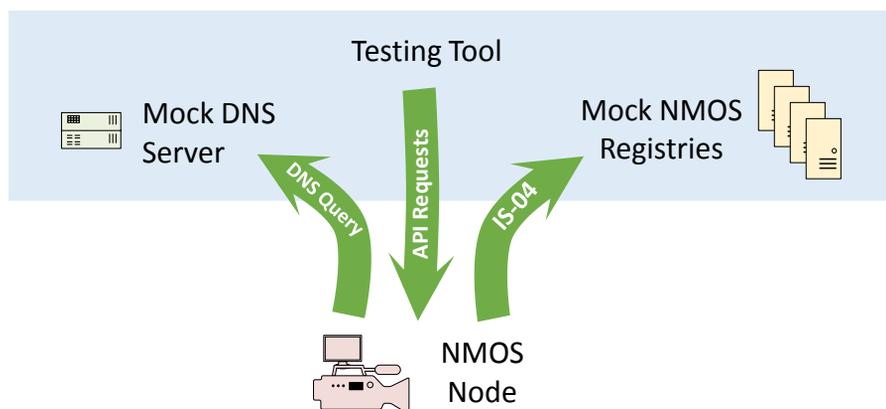
- One of the more challenging areas to test
- Mock DNS Server
  - Integrates a DNS server which is populated with records to thoroughly test IS-04 discovery
- Mock Registries
  - Launches multiple IS-04 Registration APIs to test how Nodes interact with them



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## Example: IS-04 Nodes



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## External Integrations

- SDPoker
  - Calls out to SDPoker with pre-defined command line arguments to test every SDP file a device exposes
- TestSSL
  - Calls out to TestSSL with pre-defined command line arguments to ensure TLS support is enabled, uses the correct versions and ciphers, and otherwise conforms with AMWA BCP-003-01
- OpenSSL
  - Includes a certificate authority and scripting to generate TLS certificates for testing purposes



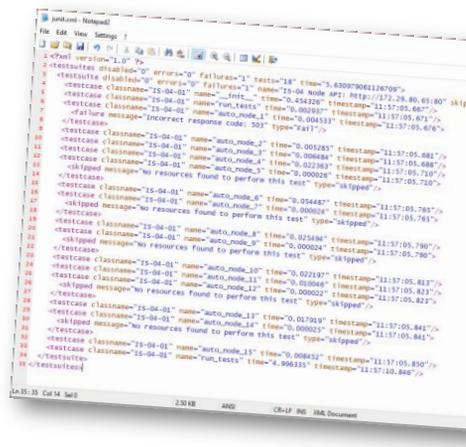
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## Advanced Usage

- Continuous Integration

```
$ python3 nmos-test.py suite
IS-04-01 --host 128.66.12.5
--port 80 --version v1.2 --
output results.xml
```

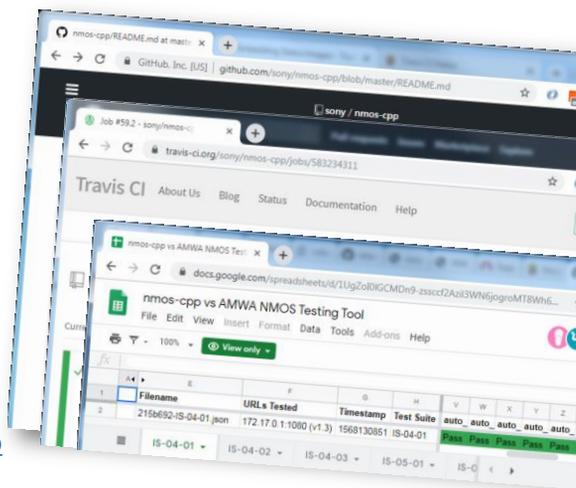


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## Continuous Integration: Case Study

- Sony nmos-cpp
  - Open-Source Software
    - <https://github.com/sony/nmos-cpp>
  - NMOS Registry & Virtual Node
  - IS-04, IS-05, IS-07, IS-09, BCP-003-01, ...
- Travis CI integration build passing
  - AMWA NMOS Testing Tool
- Docker container for interop testing
  - Published by Richard Hastie, Mellanox
    - <https://hub.docker.com/r/rhastie/nmos-cpp>



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## JT-NM Tested



- The testing tool was key in the TR-1001-1 test plan
- It enabled us to perform over 100 tests per device without manual intervention
- It identified a number of additional areas which would benefit from automated testing
- A release is available on GitHub matching the code used for this event



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## What's next?

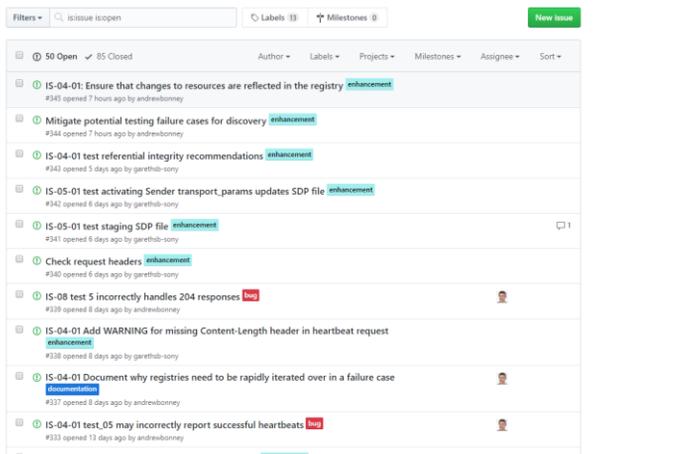
- Testing of clients
- Increased coverage of specifications
  - Such as IS-07, and IS-09/BCP-003-02 for Nodes
- Potential integrations with other tools such as EBU LIST



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## What's next?



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## More information

- Downloads and documentation:
  - <https://github.com/AMWA-TV/nmos-testing>
  - <https://amwa-tv.github.io/nmos-testing/>
- If you have a question or experience a problem:
  - <https://github.com/AMWA-TV/nmos-testing/issues>
- We recommend the testing tool as the first port of call if you experience an issue with an implementation



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## Thank you

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