



A E G I S



FHIR Testing and Touchstone

2020 May 13-15 Virtual HL7[®] FHIR[®] Connectathon

**Richard Ettema
HL7[®] FHIR[®] Proficient
Lead Consultant, AEGIS.net, Inc.
richard.ettema@aegis.net**

Goal of Session Two

- Present the FHIR Testing framework
- Introduce Touchstone:
 - User registration
 - Account setup
 - Test system setup
 - Test execution (demo)



A E G I X



*Powerful Results.
Delivered.*

FHIR Testing Framework


- To ensure interoperability between applications claiming conformance to the specification, a testing framework has been established within the FHIR specification.
- This framework defines the TestScript resource as a natural language, computable format of a test case.
- It provides a defined test methodology for the FHIR specification which can be used to validate interoperability across FHIR server and client implementations.

FHIR Testing Framework

<http://hl7.org/fhir/testing.html>



[Home](#) [Getting Started](#) [Documentation](#) [Resources](#) [Profiles](#) [Extensions](#) [Operations](#) [Terminologies](#)

 [Implementation Support](#) > **Testing FHIR**

This page is part of the FHIR Specification (v4.0.1: R4 - Mixed [Normative](#) and [STU](#)). This is the current published version. For a full list of available versions, see the [Directory of published versions](#)

7.2 Testing FHIR

[FHIR Infrastructure](#)  Work Group

[Maturity Level: 2](#)

[Standards Status: Draft](#)

The FHIR specification describes a set of [resources](#), and several different frameworks for exchanging resources between different systems. Because of its general nature and wide applicability, the rules made in this specification are fairly loose. As a consequence, and in order to insure interoperability between applications claiming conformance to this specification, a testing framework has been established within the FHIR specification. To this end, the [TestScript](#) resource provides an implementation-agnostic description of tests that allows test execution engines to evaluate if a FHIR implementation conforms with the FHIR specification. Providing a clear and concise test methodology for the FHIR specification through the TestScript resource helps to enable interoperability among various FHIR server and client implementations.



Furthermore, the TestScript resource provides clear examples of the appropriate use of the FHIR specification through test-based documentation. The TestScript resource stands as a form of executable documentation allowing developers to examine the operations defined by the tests in order to understand how various RESTful API interactions and resources should be used in coordination. The tests can also be automatically executed against systems under development to determine how well the systems adhere to the specification.

FHIR TestScript Resource


- The TestScript resource represents an executable test definition for examining the results of FHIR RESTful API interactions.
- A TestScript example would be a set of tests that exercise a certain function, such as Patient Search, and validating the responses. For this example we require:
 - Patient resource(s) required to complete this test
 - A setup procedure to create those Patient resource(s)
 - The tests which execute the functions being exercised & evaluate the results
 - A setup or tear-down procedure to initialize or clean up the test data

TestScript Resource

<http://hl7.org/fhir/testscript.html>



HomeGetting StartedDocumentationResourcesProfilesExtensionsOperationsTerminologies

 Implementation Support > **TestScript**

This page is part of the FHIR Specification (v4.0.1: R4 - Mixed [Normative](#) and [STU](#)). This is the current published version. For a full list of available versions, see the [Directory of published versions](#)

Content Examples Detailed Descriptions Mappings Profiles & Extensions R3 Conversions

7.3 Resource TestScript - Content

FHIR Infrastructure  Work Group	Maturity Level: 2	Trial Use	Security Category: Anonymous	Compartments: Not linked to any defined compartments
--	-------------------	-----------	------------------------------	--

A structured set of tests against a FHIR server or client implementation to determine compliance against the FHIR specification.

7.3.1 Scope and Usage

The TestScript resource is used to define tests that can be executed on one or more FHIR servers. The TestScript resource would typically contain

Test Engine Workflow

☆Pre-Processing

- Determine whether or not the TestScript interactions match the capabilities of the system under test.

• Setup Execution

- Optional operations that prepare the system under test for subsequent test execution.

☆Test Execution

- Execute and record each test's operations and assertions.

• Teardown Execution

- Optional operations that revert the system under test to its pre-test state.

• Post-Processing

- Cleanup of test execution data and collection of test results.

<http://hl7.org/fhir/testing.html#execution>

Pre-Processing

Capability Based Testing

- The test engine will use the CapabilityStatement of the system under test to determine how to process a TestScript.
- If the TestScript defines the testing of capabilities that the system under test does support, the test engine will continue the workflow process.
- If the TestScript defines the testing of capabilities that the system under test does not support, the test engine should allow the TestScript to be skipped.

Test Execution

Executing Operations

- Test execution consists of two action types:
 - **operation**: The FHIR RESTful API interaction to be executed.
 - **assert**: The rule that is evaluated against the results of the operation. If true, the assert passes.
- ☆ Key concept: The operation is always executed regardless of whether an assert follows.

TestScript Operations

FHIR Interactions

Instance Level Interactions

- Read (GET)
- Vread (GET)
- Update (PUT)
- Patch (PATCH)
- Delete (DELETE)
- History (GET)

Type Level Interactions

- Create (POST)
- Create via Update (PUT)
- Search (GET)
- History (GET)

Whole System Interactions

- Capabilities (GET/OPTIONS)
- Batch/Transaction (POST)
- History (GET)
- Search (GET)
- **Extended Operations**
 - <http://hl7.org/fhir/operationslist.html>
- Base Operations (All Resources)
- Operations Defined by Resource Type

Asserts

Conditions, Rules or Expressions

- An assert acts on the immediately preceding operation.
- It states a condition, rule or expression that will be evaluated against the executed operation context.

Asserts provide support for:

- Evaluation of both the inbound request or outbound response
- Complex and simple evaluation of HTTP headers and response codes
- Operators for equality, relational comparison, containment, etc.
- Expression language support for XPath, JSONPath and FHIRPath
- Payload comparison to defined fixtures (static or dynamic)
- Payload validation against defined FHIR profile(s)
- *Plus a whole lot more...*

Recap: FHIR Testing and TestScripts

- FHIR defines a Testing Framework as part of the specification
- Test Engines should follow a prescribed Workflow
- TestScript Resource Type provides a complete, executable test definition
- Support for the entire FHIR RESTful API (Operations)
- Support for Evaluation of Extensive Conditions, Rules and Expressions (Asserts)



A E G I O N

Wrap Up

Discussion

Q&A

Introducing Touchstone

Touchstone is an easy-to-use testing platform for health information exchange that implements the FHIR Testing Framework architecture.



TOUCHSTONE

AEGIS.net

www.touchstone.com

Touchstone

- Is available as a publicly accessible cloud-based testing platform
- Provides automated, internet-based interoperability testing of the HL7[®] FHIR[®] specification
- Tests the capabilities of and interoperability between both FHIR Server and Client implementations
- Is a blend between Test-Driven-Development (TDD) methodologies and Natural Language Processing (NLP) TestScripts



TOUCHSTONE

AEGIS.net

www.touchstone.com

Touchstone Landing Page

www.touchstone.com



[Docs](#) [Sign In](#) [Register](#)

[Analytics](#)

[Published](#)

[Test Definitions](#)

Touchstone - an *AEGIS* Developers Integration Lab (DIL) Initiative

[Subscription](#)

Touchstone is an Infrastructure as a Service (IaaS) and Testing as a Service (TaaS) Open Access Solution for health information exchange. Touchstone strives to live up to its dictionary *definition* - a *criterion for determining the quality or genuineness of a thing* - by offering thousands of tests in an easy-to-use system for determining a test system's conformance and interoperability against published specifications, standards, and profiles, including templates and implementation guides.

Touchstone ...

- allows for automated, internet-based interoperability FHIR Testing against the [HL7 FHIR](#) specifications and standards.
- tests interoperability with other FHIR Server and FHIR Client implementations.
- has been engineered from the ground up to leverage the new FHIR [TestScript](#) resource.
- is a blend between Test-Driven-Development (TDD) methodologies and Natural Language Processing (NLP) test scripts.
- has been featured at HL7 FHIR Connectathons and is being leveraged in a continuous testing environment by numerous leading HL7 FHIR implementers.
- plays an active role in the HL7 Conformance Testing community, the HL7 Argonaut Project, and the HSPC Implementation community.



AEGIS

Features include...

- self-registration of user accounts and organizations.
- ability for users to execute FHIR test scripts against test systems with Touchstone serving as the initiator of message exchanges.
- ability for users to initiate message exchanges from their test systems against other peer test systems with Touchstone FHIR testing tool serving as the intermediary.
- ability to drill down to individual operations and assertions in test execution results during FHIR Testing.
- ability to save configured sets of test scripts as named "test setups" for re-execution.
- controlled access to test scripts, test systems, and test results at the user, organization, and organization group levels.

Help and Documentation

- > [How to register in Touchstone](#)
- > [How to become a member of or create an organization](#)
- > [How to approve an organization membership request](#)
- > [How to create a test system](#)
- > [How to execute test scripts](#)
- > [How to execute client-side \(peer-to-peer\) tests](#)
- > [How to perform Conformance-based testing](#)
- > [How to integrate Touchstone with CI including Jenkins](#)
- > [How to reset my password](#)

Feeds

- > [Software Testing and COVID-19 Data](#) NEW Apr 3, 2020
- > [AEGIS and FHIRBall to Present at HIMSS20](#) Feb 25, 2020
- > [AEGIS Named to 2019 NVTC Tech 100](#) Dec 10, 2019
- > [ONC Interop Forum Highlights Data Quality, Testing](#) Aug 27, 2019
- > [FHIR Testing White Paper Now Available](#) Aug 19, 2019
- > [Why Software Testing Needs Independence](#) Mar 29, 2019
- > [FHIR Testing Helps Healthcare Projects Accelerate Adoption](#) Jan 11, 2019
- > [AEGIS Engages with ONC FHIR Task Force](#) Nov 16, 2018
- > [Press Release: JMIR Publishes FHIR Testing Study](#) Nov 13, 2018
- > [Healthcare Interoperability Testing with FHIR Just Got Easier!](#) Jun 18, 2018



TOUCHSTONE

AEGIS.net

www.touchstone.com

Touchstone Landing Page

Alerts: Important usage information

⚠ Getting the most out of Touchstone Analytics/Conformance Interface:

Please ensure your test system conformance (DSTU2) or capabilities (STU3) statement is available and accessible. Per the FHIR specification on [capabilities](#), 'All servers are **required** to support the capabilities interaction...'

TLS Security:


Based on the "Recommendations for Secure Use of Transport Layer Security (TLS) and Datagram Transport Layer Security (DTLS)", [RFC7525](#), Touchstone supports the secured protocol TLS v1.2 (see [RFC5246](#)).

Touchstone Updates: Describes significant released version updates

Touchstone Updates

- **Touchstone 4.0.0 and TestScript Editor 1.2.1 Released** NEW Sep 24, 2018
 - Support for CDS Hooks Specification
 - Touchstone now offers [CDS Hooks 1.0](#) testing, supporting the HL7
 - CDS Hooks test scripts can be found under [Test Definitions](#) when y
 - Support for FHIR 3.5.0 (R4 Ballot #2)
 - Touchstone now offers [FHIR 3.5.0 \(R4 Ballot #2\)](#) testing, supporting [FHIR directory of versions](#).
 - FHIR 3.5.0 test scripts can be found at [FHIR3-5-0-Connectathon19](#) test groups under [Test Definitions](#).
 - TestScript Editor now supports automatic updates. You can download th
 - See [Release notes](#) for more details.

Online Documentation: User Guide and How-tos

 Docs

Search docs

[Introduction](#)

[Registration](#)

[Test Systems](#)

[Executing Tests](#)

[Org Groups](#)

[Conformance Testing](#)

[Client/Peer-to-Peer Testing](#)

[TestScript Authoring](#)

[Continuous Integration](#)

[Downloads](#)

[Release Notes](#)

[Docs](#) » [Table of Contents](#)

Table of Contents

- [Introduction](#)
- [Registration](#)
 - [Register](#)
 - [Membership](#)
 - [New Organization](#)
 - [Become a member](#)
 - [Approving Membership](#)
- [FAQ](#)
- [Test Systems](#)
 - [Create Test System](#)
 - [Test System naming](#)



TOUCHSTONE

AEGIS.net

www.touchstone.com

Touchstone Landing Page

Feeds: News links related to FHIR, Testing and Touchstone

Feeds

- > [Software Testing and COVID-19 Data](#) NEW Apr 3, 2020
- > [AEGIS and FHIRBall to Present at HIMSS20](#) Feb 25, 2020
- > [AEGIS Named to 2019 NVTC Tech 100](#) Dec 10, 2019
- > [ONC Interop Forum Highlights Data Quality, Testing](#) Aug 27, 2019
- > [FHIR Testing White Paper Now Available](#) Aug 19, 2019
- > [Why Software Testing Needs Independence](#) Mar 29, 2019
- > [FHIR Testing Helps Healthcare Projects Accelerate Adoption](#) Jan 11, 2019
- > [AEGIS Engages with ONC FHIR Task Force](#) Nov 16, 2018
- > [Press Release: JMIR Publishes FHIR Testing Study](#) Nov 13, 2018
- > [Healthcare Interoperability Testing with FHIR Just Got Easier!](#) Jun 18, 2018

Touchstone Totals: Track participation since Touchstone v1.0 release

Touchstone Totals

Users:	1,288
Organizations:	504
Test Systems:	558
Test Scripts:	6,326
Tests:	28,117
Test Script Executions:	263,503
Test Executions:	1,080,393
Message Exchanges:	1,628,358



TOUCHSTONE

AEGIS.net

www.touchstone.com



A E G I O N

Wrap Up


Discussion

Q&A

Getting Started with Touchstone

- All testing participants need to first Register with Touchstone
- Organizations may have 1 or more registered users on Touchstone (based on the organization's subscription level)
- Registration and acceptance of registration must be completed before any testing can begin
- An organization will typically have at least 1 test system and may choose to run tests against other publicly available test systems

Register an Account in Touchstone

- Click  Register
 - Enter your username, email, password twice, and select “I’m not a robot”
 - Click the [Register](#) button

Registration


Name *

Email *

Password *

Confirm Password *

☐ I'm not a robot


reCAPTCHA
[Privacy](#) - [Terms](#)

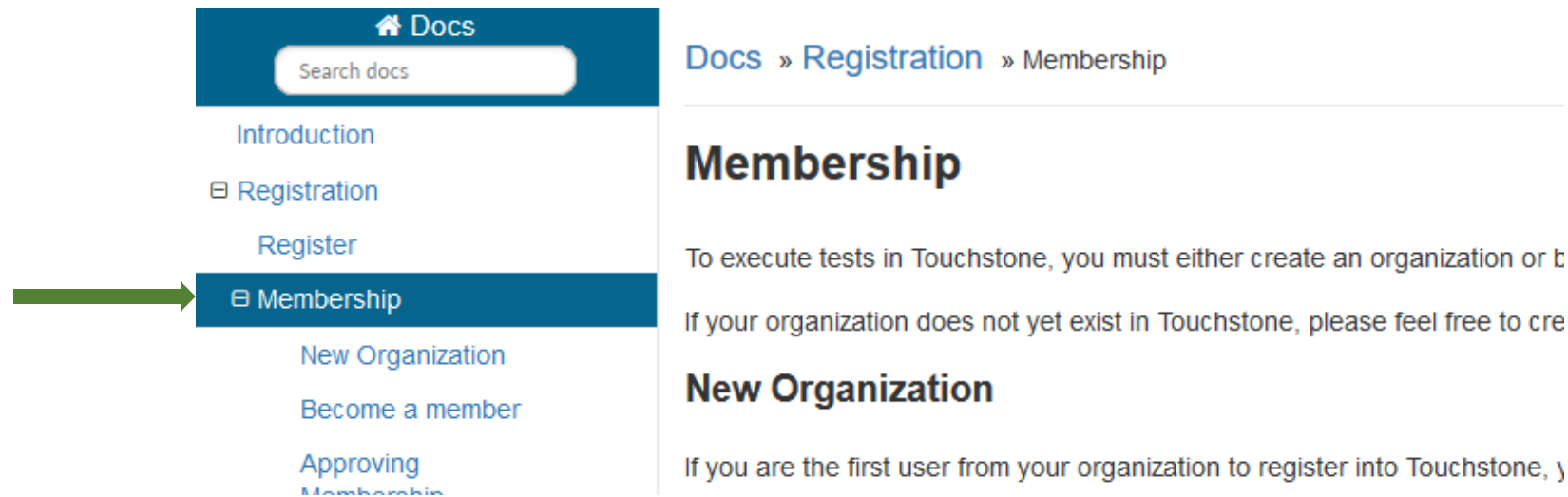
Register

Create or Join an Organization

Your user account must belong to an organization.

You can:

- Create an organization with your team
- Join an existing organization
- Use the Online Documentation if guidance is needed



The screenshot displays the Touchstone documentation interface. On the left, a sidebar menu is visible with a search bar at the top. The menu items are: Introduction, Registration, Register, Membership (highlighted with a green arrow), New Organization, Become a member, and Approving Membership. The main content area on the right shows the breadcrumb trail 'Docs » Registration » Membership' and the title 'Membership'. Below the title, the text states: 'To execute tests in Touchstone, you must either create an organization or b'. Further down, it says: 'If your organization does not yet exist in Touchstone, please feel free to cre'. Below this is the section 'New Organization' with the text: 'If you are the first user from your organization to register into Touchstone, y'.



Create or Join an Organization

- If you are the first person from your organization to register, select **Create a new organization**
- If your organization is already registered, select **Become a member of an existing organization**. Then select your organization from the dropdown list.

Organization Registration

- ☐ Become a member of an existing organization:
☒ Create a new organization

Name *

Website

Register

Organization Registration

- ☒ Become a member of an existing organization:

Submit

- ☐ Create a new organization



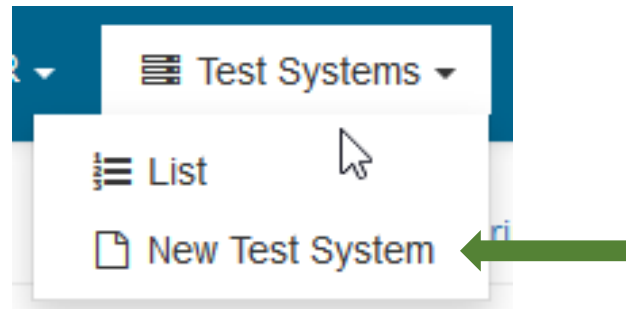
TOUCHSTONE

AEGIS.net

www.touchstone.com

Create a New Test System Definition

- To run tests, a Test System must be defined
- From the top menu
 - Go to Test Systems
 - Select **New Test System**
- Once selected, a new entry for Test System will display



Create a New Test System Definition

- Enter the test system name
- Select the specification version and supported formats
- Enter the base URL
- The IP addresses are optional (Touchstone will determine this if left blank)
- Select OAuth2 if required
- Select privacy settings:
 - who the Test System can be viewed by
 - who can execute against the Test System
 - who can modify the Test System
- Assign the supported actor profiles

New Test System

Create

Name *

Specification *
FHIR 3.0.1

Formats Supported *
☒ JSON ☒ XML

Base URL *

IP Addresses (comma-separated)

Requires

☒ OAuth2

Can be viewed by

Can be executed against by

Can be modified by

☐ Me
☐ My organization
☐ My organization groups
☒ Everyone

☐ Me
☒ My organization
☐ My organization groups
☐ Everyone

☐ Me
☒ My organization
☐ My organization groups
☐ Everyone

☒ Allow Touchstone to pull capability statement once a day (recommended)

Available Profiles

Supported Profiles *

FHIR-Client
FHIR-SDC-FormFiller
FHIR-SDC-FormManager
FHIR-SDC-FormReceiver
FHIR-SDC-FormProcessor

FHIR-Server

Create



Touchstone Demo – Test Execution



TOUCHSTONE

AEGIS.net

www.touchstone.com

Wrap Up

- Discussion
- Q&A



A E G I S

*Powerful Results.
Delivered.*