OpenTAP: Introduction to Test Composition and Automation

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5G-VINNI WP4, 03/03/20

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Agenda

- OpenTAP overview
  - Concept
  - Architecture
- Main concepts for use
  - UIs
  - Workflow
- Practical example from test composition to results
  - Demo

Introduction to OpenTAP

OPENTAP OVERVIEW

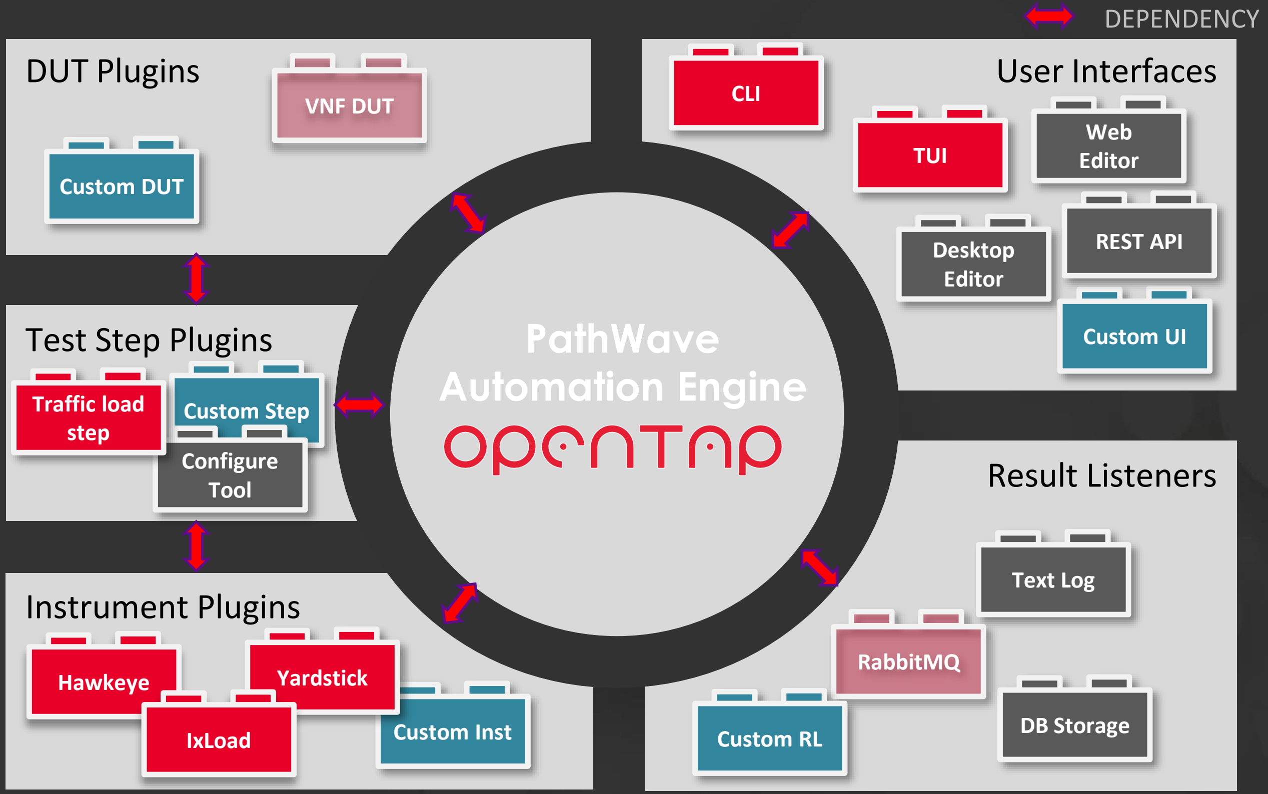
What is OpenTAP

- OpenTAP : Open(source) Test Automation Platform
- OpenTAP is a light weight sequencing engine
- OpenTAP has a highly modular structure
  - Everything (including GUIs) is seen as a plugin
- Configure DUTs/SUTs, tools
  - via instruments and test steps contained in plugins
- OpenTAP provides a low entry barrier for development and usage
  - Quick development of plugins and test steps tailored to individual needs
  - Simple drag’n’drop of test steps in test plan composition
- It is possible to “rule” all the tools (not only Keysight’s) and DUTs

Why OpenTAP for Test Automation

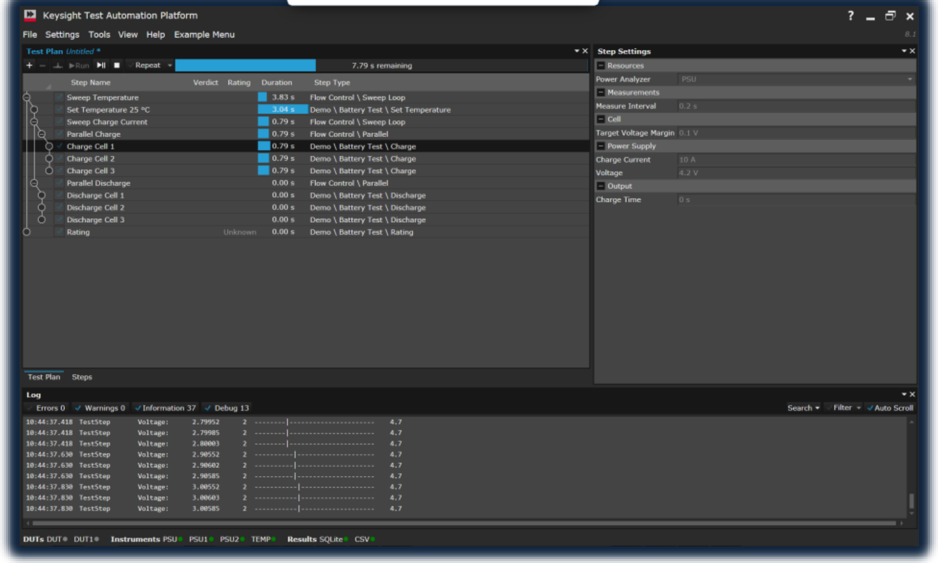
- **Simplicity**
  - Low technical barrier of entry. TAP is not “yet another programming language”
  - Does just what you need, not trying to be “everything for everyone”
  - Simple for everyone: programmers, non-programmers, and operators
- **Scalability**
  - Modular software architecture centered around a core sequencing engine
  - IP encapsulated as plugins. Build solutions through re-use, not re-invention
  - Plugins can be shared and reused
- **Speed**
  - Optimized for manufacturing (speed / time = $), yet robust for R&D usage
  - Powerful analytics such as Timing Analyzer; continuously & efficiently improve
  - Get to market faster…accelerate your deployments, outpace the competition

How does the architecture look like?



From a User's Perspective

Editor



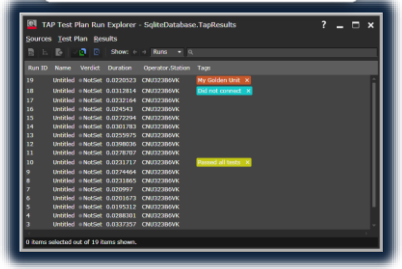
Step Name	Verdict	Rating	Duration	Step Type
Sweep Temperature			3.83 s	Flow Control \ Sweep Loop
Set Temperature 25 °C			3.04 s	Demo \ Battery Test \ Set Temperature
Sweep Charge Current			0.79 s	Flow Control \ Sweep Loop
Parallel Charge			0.79 s	Flow Control \ Parallel
Charge Cell 1			0.79 s	Demo \ Battery Test \ Charge
Charge Cell 2			0.79 s	Demo \ Battery Test \ Charge
Charge Cell 3			0.79 s	Demo \ Battery Test \ Charge
Parallel Discharge			0.00 s	Flow Control \ Parallel
Discharge Cell 1			0.00 s	Demo \ Battery Test \ Discharge
Discharge Cell 2			0.00 s	Demo \ Battery Test \ Discharge
Discharge Cell 3			0.00 s	Demo \ Battery Test \ Discharge
Rating		Unknown	0.00 s	Demo \ Battery Test \ Rating

Resources
Power Analyzer: PSU
Measurements
Measure Interval: 0.2 s
Cell
Target Voltage Margin: 0.1 V
Power Supply
Charge Current: 10 A
Voltage: 4.2 V
Output
Charge Time: 0 s

```
10:44:37.418  TestStep      Voltage:     2.79952     2  --------|---------------------      4.7
10:44:37.418  TestStep      Voltage:     2.79985     2  --------|---------------------      4.7
10:44:37.418  TestStep      Voltage:     2.80003     2  --------|---------------------      4.7
10:44:37.630  TestStep      Voltage:     2.90552     2  ----------|-------------------      4.7
10:44:37.630  TestStep      Voltage:     2.90602     2  ----------|-------------------      4.7
10:44:37.630  TestStep      Voltage:     2.90585     2  ----------|-------------------      4.7
10:44:37.830  TestStep      Voltage:     3.00552     2  -----------|------------------      4.7
10:44:37.830  TestStep      Voltage:     3.00603     2  -----------|------------------      4.7
10:44:37.830  TestStep      Voltage:     3.00585     2  -----------|------------------      4.7
```

DUTs DUT● DUT1● Instruments PSU● PSU1● PSU2● TEMP● Results SQLite● CSV●

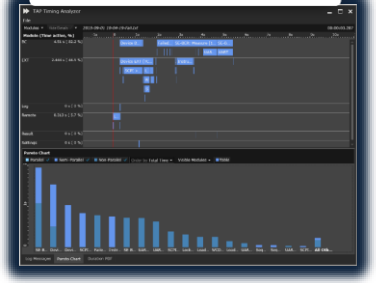
Run Explorer



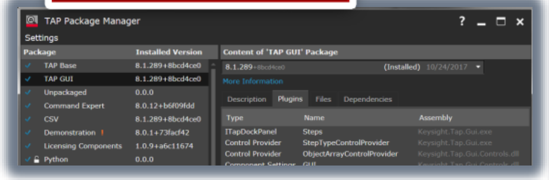
Run ID	Name	Verdict	Duration	Operator.Station	Tags
19	Untitled	●NotSet	0.0220523	CNU32386VK	My Golden Unit ✕
18	Untitled	●NotSet	0.0312814	CNU32386VK	Did not connect ✕
17	Untitled	●NotSet	0.0232164	CNU32386VK	
16	Untitled	●NotSet	0.024543	CNU32386VK	
15	Untitled	●NotSet	0.0272294	CNU32386VK	
14	Untitled	●NotSet	0.0301783	CNU32386VK	
13	Untitled	●NotSet	0.0255975	CNU32386VK	
12	Untitled	●NotSet	0.0398036	CNU32386VK	
11	Untitled	●NotSet	0.0278707	CNU32386VK	
10	Untitled	●NotSet	0.0231717	CNU32386VK	Passed all tests ✕
9	Untitled	●NotSet	0.0274464	CNU32386VK	
8	Untitled	●NotSet	0.0231865	CNU32386VK	
7	Untitled	●NotSet	0.020997	CNU32386VK	
6	Untitled	●NotSet	0.0201673	CNU32386VK	
5	Untitled	●NotSet	0.0195312	CNU32386VK	
4	Untitled	●NotSet	0.0288301	CNU32386VK	
3	Untitled	●NotSet	0.0337357	CNU32386VK	

0 items selected out of 19 items shown.

Timing Analyzer



Package Manager



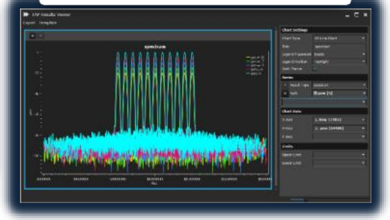
Package	Installed Version
✓ TAP Base	8.1.289+8bcd4ce0
✓ TAP GUI	8.1.289+8bcd4ce0
✓ Unpackaged	0.0.0
✓ Command Expert	8.0.12+b6f09fdd
✓ CSV	8.1.289+8bcd4ce0
✓ Demonstration !	8.0.1+73facf42
✓ Licensing Components	1.0.9+a6c11674
✓ Python	0.0.0

Content of 'TAP GUI' Package

8.1.289+8bcd4ce0 (Installed) 10/24/2017

Type	Name	Assembly
ITapDockPanel	Steps	Keysight.Tap.Gui.exe
Control Provider	StepTypeControlProvider	Keysight.Tap.Gui.exe
Control Provider	ObjectArrayControlProvider	Keysight.Tap.Gui.Controls.dll
Component Settings	GUI	Keysight.Tap.Gui.Controls.dll

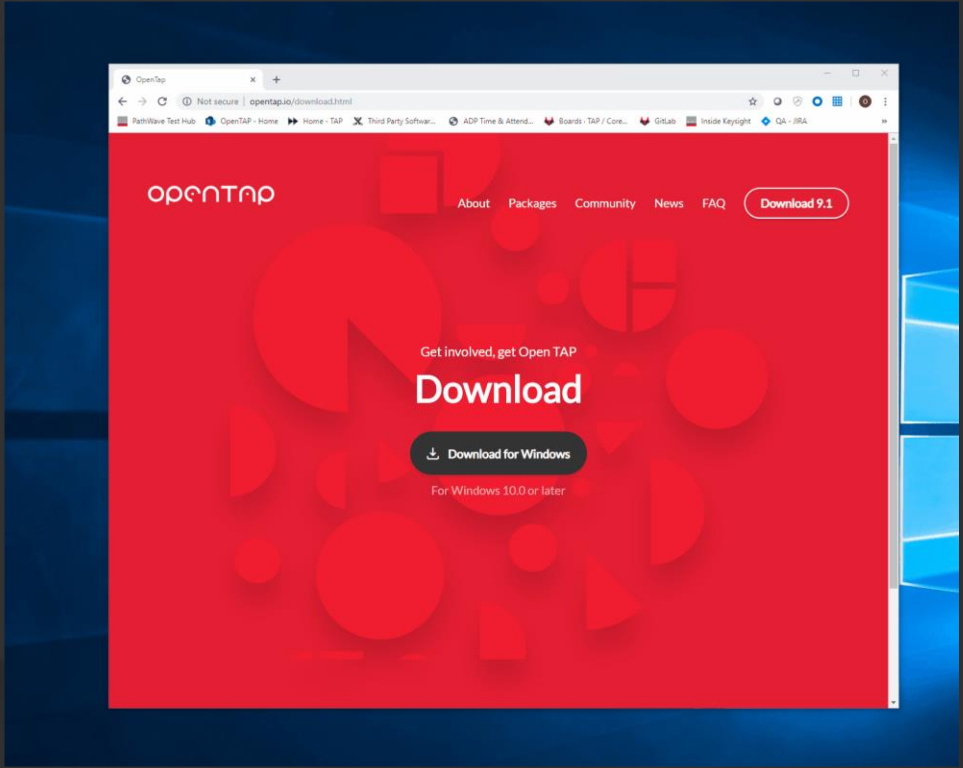
Results Viewer



5G-VINNI

Community Edition Developer GUI

- **Free to use for non-commercial organizations & open source projects**
- **Download via OpenTAP.io or Keysight.com**
- **Ready to use in under 85 seconds!**
- Quickly create & edit test plans without any programming experience
- Experiment with demo plugins requiring no hardware

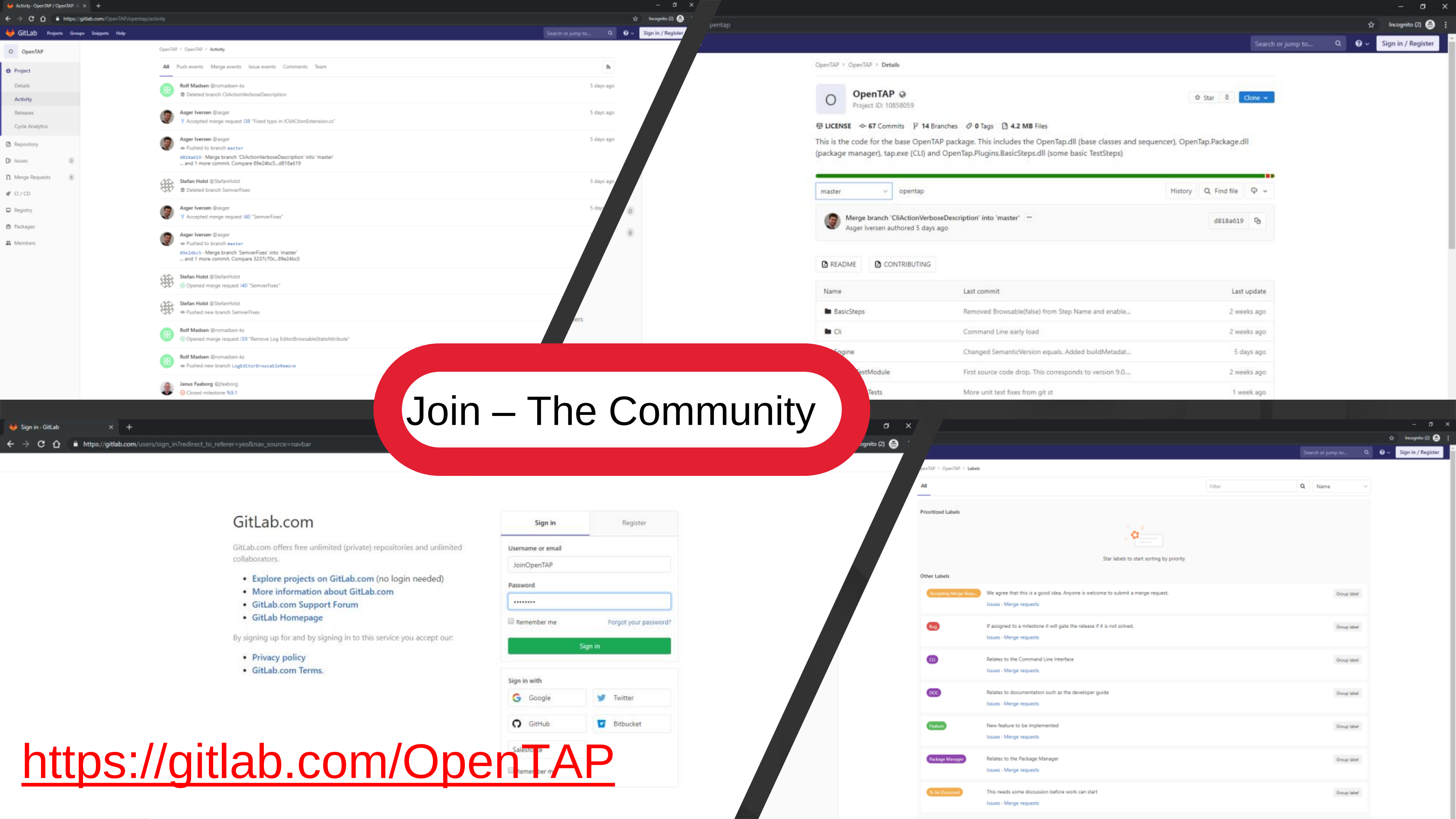


Get involved, get Open TAP

Download

For Windows 10.0 or later

Join – The Community



Rolf Madsen @romadsen-ks 5 days ago
Deleted branch CliActionVerboseDescription

Asger Iversen @asger 5 days ago
Accepted merge request !38 "Fixed typo in ICliACtionExtension.cs"

Asger Iversen @asger 5 days ago
Pushed to branch master
d818a619 · Merge branch 'CliActionVerboseDescription' into 'master'
... and 1 more commit. Compare 89e24bc5...d818a619

Stefan Holst @StefanHolst 5 days ago
Deleted branch SemverFixes

Asger Iversen @asger 5 days ago
Accepted merge request !40 "SemverFixes"

Asger Iversen @asger
Pushed to branch master
89e24bc5 · Merge branch 'SemverFixes' into 'master'
... and 1 more commit. Compare 3237c70c...89e24bc5

Stefan Holst @StefanHolst
Opened merge request !40 "SemverFixes"

Stefan Holst @StefanHolst
Pushed new branch SemverFixes

Rolf Madsen @romadsen-ks
Opened merge request !39 "Remove Log EditorBrowsableStateAttribute"

Rolf Madsen @romadsen-ks
Pushed new branch LogEditorBrowsableRemove

Janus Faaborg @jfaaborg
Closed milestone %9.1

OpenTAP
Project ID: 10858059

LICENSE · 67 Commits · 14 Branches · 0 Tags · 4.2 MB Files

This is the code for the base OpenTAP package. This includes the OpenTap.dll (base classes and sequencer), OpenTap.Package.dll (package manager), tap.exe (CLI) and OpenTap.Plugins.BasicSteps.dll (some basic TestSteps)

Merge branch 'CliActionVerboseDescription' into 'master'
Asger Iversen authored 5 days ago
d818a619

Name	Last commit	Last update
BasicSteps	Removed Browsable(false) from Step Name and enable...	2 weeks ago
Cli	Command Line early load	2 weeks ago
...ngine	Changed SemanticVersion equals. Added buildMetadat...	5 days ago
...estModule	First source code drop. This corresponds to version 9.0....	2 weeks ago
...Tests	More unit test fixes from git st	1 week ago

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- Privacy policy
- GitLab.com Terms.

Username or email
JoinOpenTAP

Password
••••••••

□ Remember me
Forgot your password?

Prioritized Labels

Star labels to start sorting by priority

Other Labels

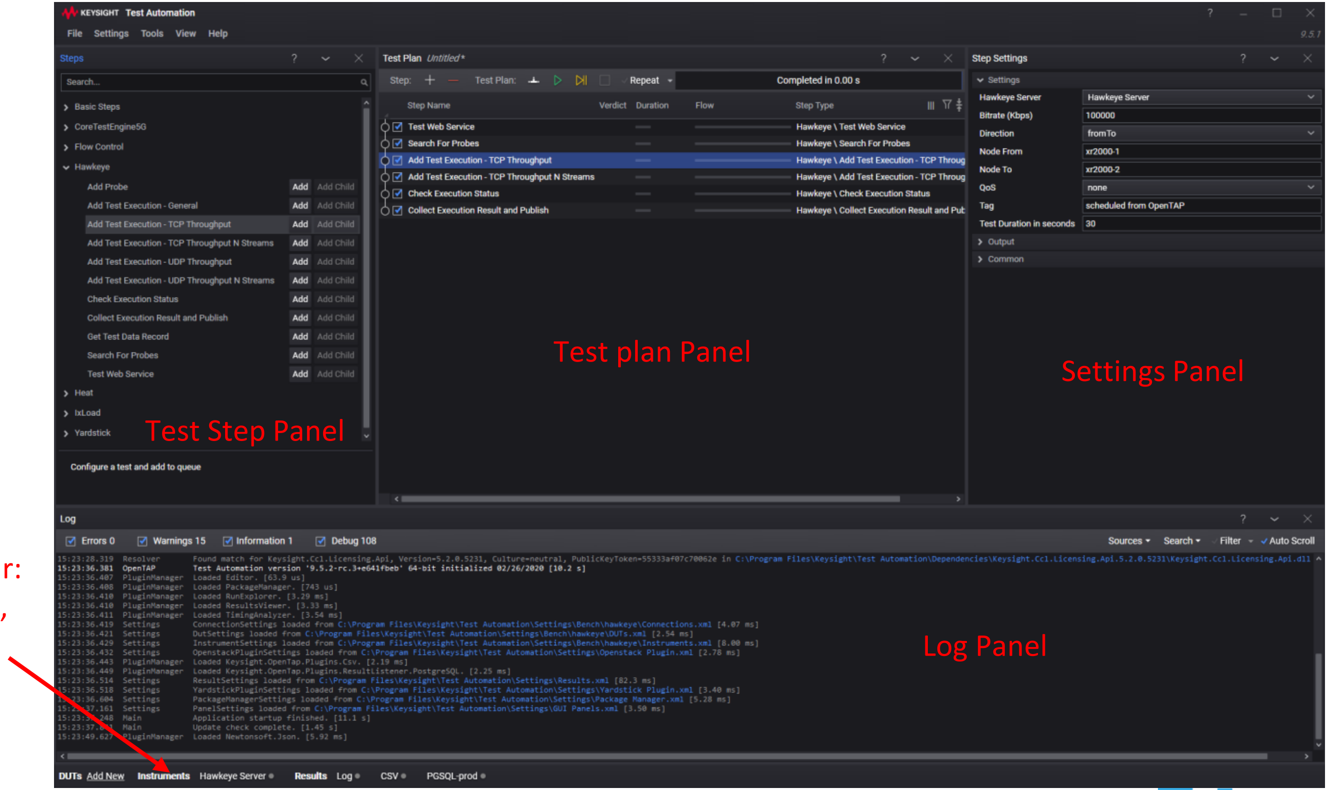
Label	Description	
Accepting Merge Requ...	We agree that this is a good idea. Anyone is welcome to submit a merge request. Issues · Merge requests	Group label
Bug	If assigned to a milestone it will gate the release if it is not solved. Issues · Merge requests	Group label
CLI	Relates to the Command Line Interface Issues · Merge requests	Group label
DOC	Relates to documentation such as the developer guide Issues · Merge requests	Group label
Feature	New feature to be implemented Issues · Merge requests	Group label
Package Manager	Relates to the Package Manager Issues · Merge requests	Group label
To be Discussed	This needs some discussion before work can start Issues · Merge requests	Group label

https://gitlab.com/OpenTAP

Introduction to OpenTAP

MAIN CONCEPTS FOR USE OF OPENTAP

OpenTAP GUI Components - Desktop



- Basic Steps
- CoreTestEngine5G
- Flow Control
- Hawkeye
  - Add Probe — Add — Add Child
  - Add Test Execution - General — Add — Add Child
  - Add Test Execution - TCP Throughput — Add — Add Child
  - Add Test Execution - TCP Throughput N Streams — Add — Add Child
  - Add Test Execution - UDP Throughput — Add — Add Child
  - Add Test Execution - UDP Throughput N Streams — Add — Add Child
  - Check Execution Status — Add — Add Child
  - Collect Execution Result and Publish — Add — Add Child
  - Get Test Data Record — Add — Add Child
  - Search For Probes — Add — Add Child
  - Test Web Service — Add — Add Child
- Heat
- IxLoad
- Yardstick

Configure a test and add to queue

Step Name	Verdict	Duration	Flow	Step Type
☑ Test Web Service		—		Hawkeye \ Test Web Service
☑ Search For Probes		—		Hawkeye \ Search For Probes
☑ Add Test Execution - TCP Throughput		—		Hawkeye \ Add Test Execution - TCP Throug
☑ Add Test Execution - TCP Throughput N Streams		—		Hawkeye \ Add Test Execution - TCP Throug
☑ Check Execution Status		—		Hawkeye \ Check Execution Status
☑ Collect Execution Result and Publish		—		Hawkeye \ Collect Execution Result and Put

Settings

Hawkeye Server	Hawkeye Server
Bitrate (Kbps)	100000
Direction	fromTo
Node From	xr2000-1
Node To	xr2000-2
QoS	none
Tag	scheduled from OpenTAP
Test Duration in seconds	30

Output

Common

☑ Errors 0 ☑ Warnings 15 ☑ Information 1 ☑ Debug 108

```
15:23:28.319  Resolver       Found match for Keysight.Ccl.Licensing.Api, Version=5.2.0.5231, Culture=neutral, PublicKeyToken=55333af07c70062e in C:\Program Files\Keysight\Test Automation\Dependencies\Keysight.Ccl.Licensing.Api.5.2.0.5231\Keysight.Ccl.Licensing.Api.dll
15:23:36.381  OpenTAP        Test Automation version '9.5.2-rc.3+e641fbeb' 64-bit initialized 02/26/2020 [10.2 s]
15:23:36.407  PluginManager  Loaded Editor. [63.9 us]
15:23:36.408  PluginManager  Loaded PackageManager. [743 us]
15:23:36.410  PluginManager  Loaded RunExplorer. [3.29 ms]
15:23:36.410  PluginManager  Loaded ResultsViewer. [3.33 ms]
15:23:36.411  PluginManager  Loaded TimingAnalyzer. [3.54 ms]
15:23:36.419  Settings       ConnectionSettings loaded from C:\Program Files\Keysight\Test Automation\Settings\Bench\hawkeye\Connections.xml [4.07 ms]
15:23:36.421  Settings       DutSettings loaded from C:\Program Files\Keysight\Test Automation\Settings\Bench\hawkeye\DUTs.xml [2.54 ms]
15:23:36.429  Settings       InstrumentSettings loaded from C:\Program Files\Keysight\Test Automation\Settings\Bench\hawkeye\Instruments.xml [8.00 ms]
15:23:36.432  Settings       OpenstackPluginSettings loaded from C:\Program Files\Keysight\Test Automation\Settings\Openstack Plugin.xml [2.78 ms]
15:23:36.443  PluginManager  Loaded Keysight.OpenTap.Plugins.Csv. [2.19 ms]
15:23:36.449  PluginManager  Loaded Keysight.OpenTap.Plugins.ResultListener.PostgreSQL. [2.25 ms]
15:23:36.514  Settings       ResultSettings loaded from C:\Program Files\Keysight\Test Automation\Settings\Results.xml [82.3 ms]
15:23:36.518  Settings       YardstickPluginSettings loaded from C:\Program Files\Keysight\Test Automation\Settings\Yardstick Plugin.xml [3.40 ms]
15:23:36.604  Settings       PackageManagerSettings loaded from C:\Program Files\Keysight\Test Automation\Settings\Package Manager.xml [5.28 ms]
15:23:37.161  Settings       PanelSettings loaded from C:\Program Files\Keysight\Test Automation\Settings\GUI Panels.xml [3.50 ms]
15:23:37.248  Main           Application startup finished. [11.1 s]
15:23:37.[illegible]  Main           Update check complete. [1.45 s]
15:23:49.627  PluginManager  Loaded Newtonsoft.Json. [5.92 ms]
```

DUTs Add New **Instruments** Hawkeye Server ● **Results** Log ● CSV ● PGSQL-prod ●

Test Step Panel

Test plan Panel

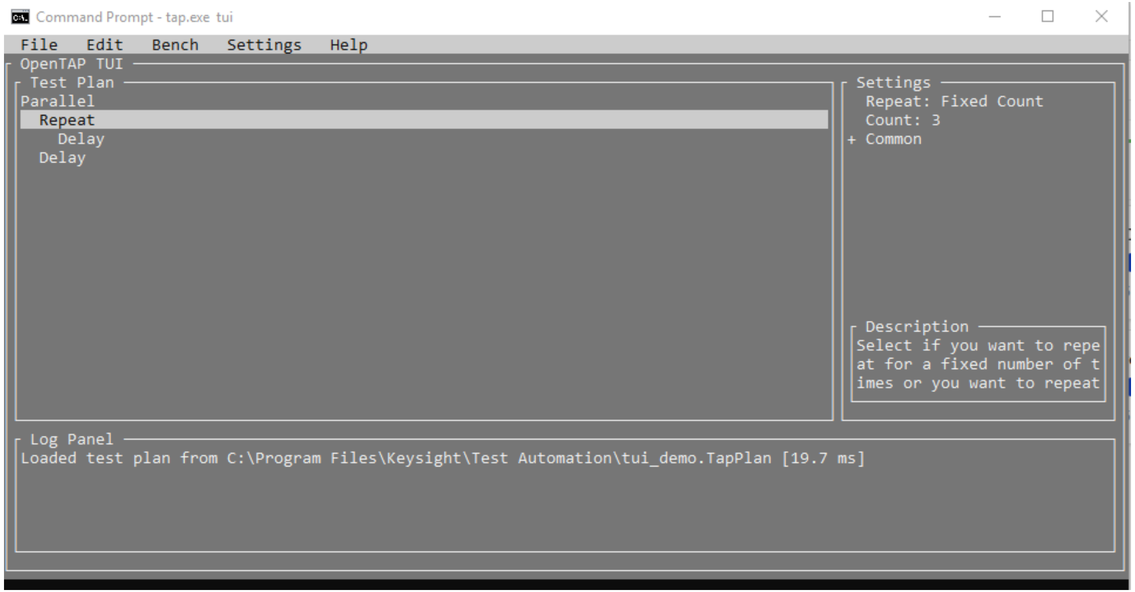
Settings Panel

Log Panel

Resource Bar: Instruments, DUTs, result listeners

OpenTAP GUI Components - TUI

- Textual based UI
- Create and edit OpenTAP plans
- Modify bench settings
- Run in almost every terminal including Docker containers



```
OpenTAP TUI
 Test Plan                                              Settings
Parallel                                                 Repeat: Fixed Count
  Repeat                                                 Count: 3
    Delay                                               + Common
  Delay




                                                          Description
                                                         Select if you want to repe
                                                         at for a fixed number of t
                                                         imes or you want to repeat

 Log Panel
Loaded test plan from C:\Program Files\Keysight\Test Automation\tui_demo.TapPlan [19.7 ms]
```

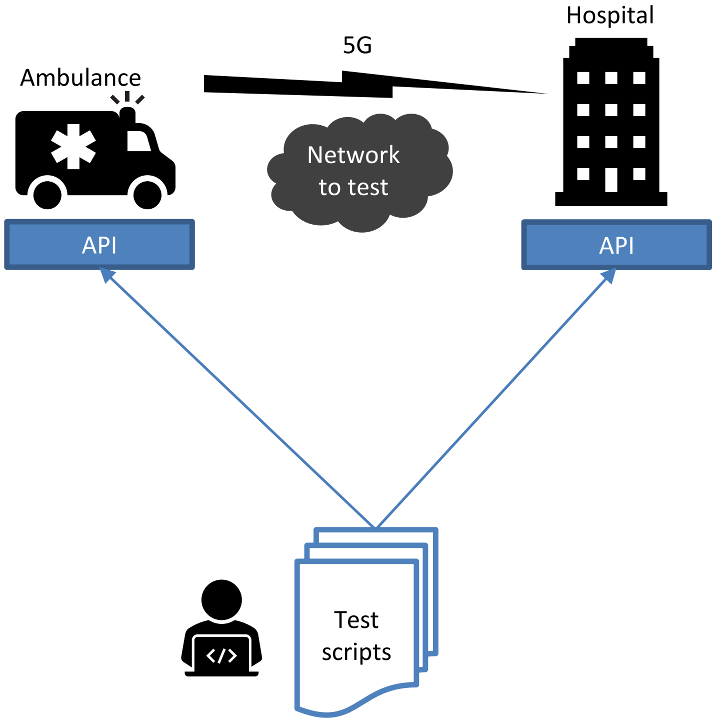
Example of OpenTAP Workflow

- Prerequisites
  - Plan what to test and how
  - OpenTAP plugins to control DUT and test tools
  - DB to store results
  - Result listener to post results to DB
- Flow
  - Install needed plugins using OpenTAP package manager
  - Configure instruments in OpenTAP editor
  - Compose OpenTAP plan using editor
  - Configure result listener
  - Run OpenTAP test plan
  - View results, e.g. in Grafana

Generic Example of Vertical Application

Use case

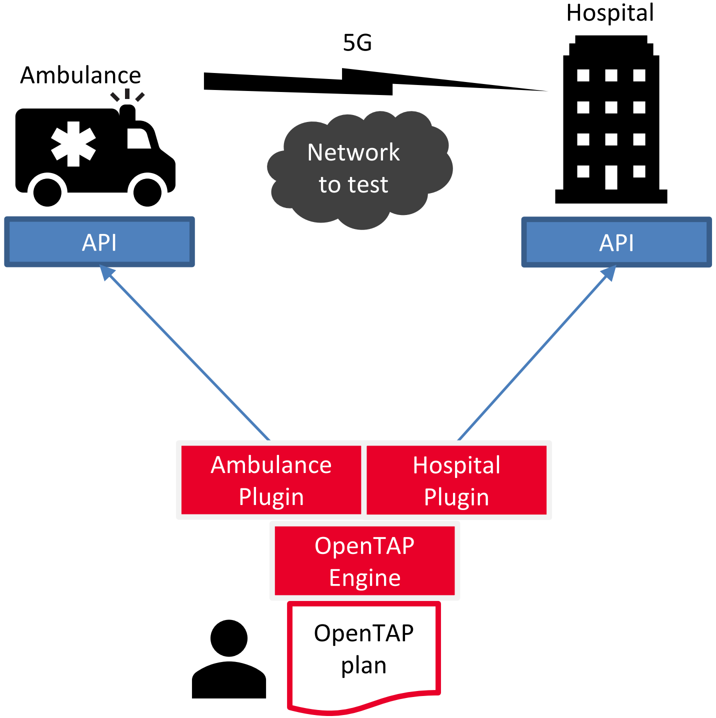
- Emergency vehicle transporting patient to hospital
- Communicate status to personal at hospital to prepare/initiate treatment
- Communication equipment in vehicle and hospital
- Equipment support functions to connect and transmit status, live video, vital signs, etc.
- Equipment can be controlled via offered APIs
- Test engineer to write scripts to test system capabilities in terms of functionality and performance



Generic Example of Vertical Application

Use case – OpenTAP approach

- Create plugin to control each entity
- Plugin offers steps to use when composing test plan (drag and drop)
- OpenTAP engine executes test steps as sequence
- Expose external parameters of selected variables
- Easy automation of tests



Introduction to OpenTAP

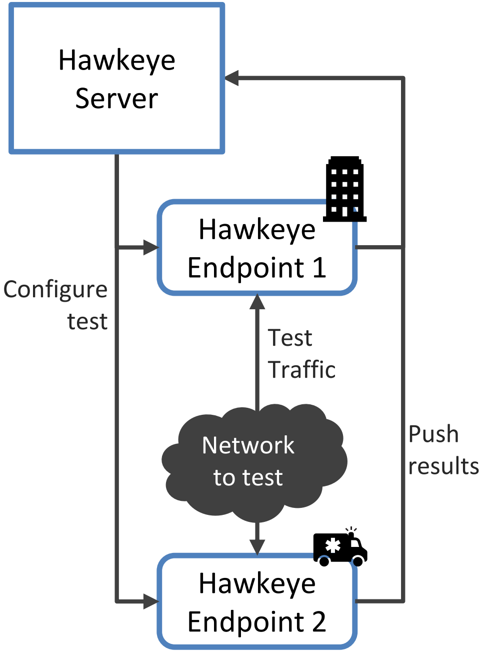
PRACTICAL OPENTAP USAGE EXAMPLE

Test Overview - Hawkeye

- Configure and run Hawkeye test between 2 endpoints
  - https://www.ixiacom.com/products/hawkeye-network-performance-monitoring
- Endpoints acting as both client and server
- Store results in DB of choice
- Create result visualizations

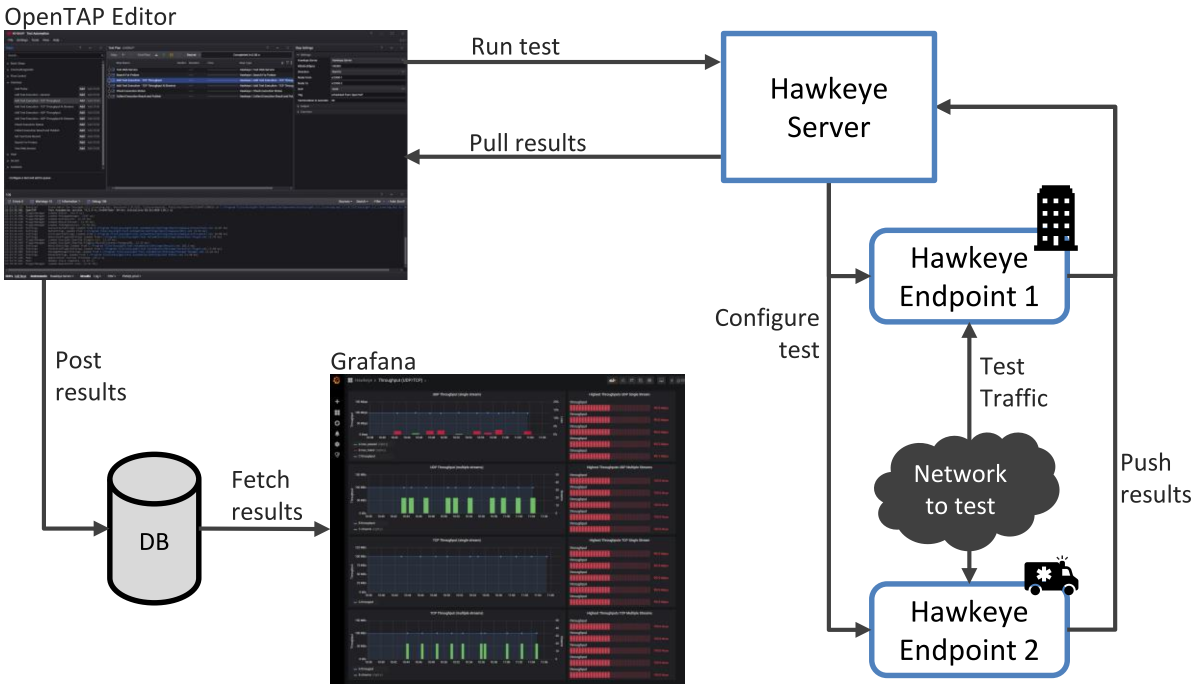
Hawkeye

- Application-layer end2end network performance test tool
- Central server and distributed endpoints
- Server acting as central registration/command and control server
- Endpoints acting as worker nodes
  - Register with server
  - Pull test specifications from server
  - Execute tests of network performance between endpoints
  - Push results to server after tests
- Supporting wide range of measurement types and application layer traffic emulation



Overview of Planned Test – OpenTAP Managed

- Create OpenTAP plan using test steps from Hawkeye plugin
- Configure tests and run
- Pull results from server
- Post results in DB via Result Listener
- Visualize results in Grafana dashboard



Use OpenTAP to Run Hawkeye Tests

DEMO

Thank you for your attention

Q&A

Resources:
OpenTAP: https://www.opentap.io/
OpenTAP on Gitlab: https://gitlab.com/OpenTAP/opentap
Hawkeye: https://www.ixiacom.com/products/hawkeye-network-performance-monitoring
5G-VINNI: https://www.5g-vinni.eu/

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