tmt

EASILY ENABLE TESTS IN FEDORA, RHEL, ON GITHUB...

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introduction

WHO

Who are we?

- Petr Šplíchal — Operating System CI
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- Miroslav Vadkerti — Testing Farm Team
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- Pavel Valena — Ruby Maintenance Team
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- František Nečas — Core Services Team
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AGENDA

What to expect from this talk?

- Short introduction
- Real life examples
- More examples
- Even more examples
- Infrastructure status
- How to get involved
- Questions (ask any time in the chat)
- A bit of theory (if interested & enough time)

See the sched event to download slides and the tmt cheat sheet

WHY

At the beginning there were user stories...

As a developer or tester I want:

- an easy way how to contribute tests
- easily run tests in my preferred environment
- easily reproduce issue revealed by the testing tool
- have more flexible test execution metadata stored at a single place
- unified, concise and human-friendly configuration for testing and gating

HOW

So what's the plan?

- Store all test execution metadata in one place
  - plain text, human readable, versioned under git, no external tcms
- Use an efficient format to store configuration, prevent duplication
  - fmf … flexible metadata format, yaml plus hierarchy, inheritance, elasticity
- Well define/design the test configuration syntax
  - specification … several metadata levels to cover well individual use cases
- Implement tool to make is easy to create, execute, debug, enable, maintain tests
  - tmt … test management tool, comfortable cli for everyday work
- Consistently use the same testing configuration across products
  - GitHub, Fedora, CentOS, RHEL…

the first steps

INSTALL

Choose the right set of packages

```
# basic features, executing tests on localhost
sudo dnf install -y tmt

# additional dependencies for executing tests in containers
sudo dnf install -y tmt-provision-container

# running tests in a virtual machine using testcloud
sudo dnf install -y tmt-provision-virtual

# all available subpackages including all dependencies
sudo dnf install -y tmt-all
```

INSTALL

Get fresh bits from copr, experiment in a container

```
# install the latest version from the copr repo
sudo dnf copr enable psss/tmt
sudo dnf install tmt

# experiment safely and easily inside a container
podman run -it --rm quay.io/testing-farm/tmt bash

# full container image with all packages (large)
podman run -it --rm quay.io/testing-farm/tmt-all bash
```

Easily enable tests in Fedora, RHEL, on GitHub...

simple

EXPLORE

Let’s look around!

```
tmt
```

Easily enable tests in Fedora, RHEL, on GitHub...

INIT

Initialize the metadata tree

```
# create a minimal template
tmt init --template mini

# usually there is a short option as well
tmt init -t mini

# empty init
tmt init
```

SIMPLE

Simple use case should be super simple to write

```
summary: Basic smoke test
execute:
    script: tmt --help
```

MINI

The minimal config

```
execute:
    script: tmt --help
```

Easily enable tests in Fedora, RHEL, on GitHub...

ENABLE

Time to create a new pull request!

```
git add .
git checkout -b smoke-test
git commit -m "Enable a simple smoke test"
git push fork -u smoke-test
```

RUN

All you need to know to run all available tests

```
tmt run
```

RESULTS

What went wrong?

```
tmt run --last report -fvvv
```

--help is your friend

tmt run --help

How can I run tests?

```
Commands:

discover   Gather information about test cases to be executed.
provision  Provision an environment for testing or use localhost.
prepare    Prepare the environment for testing.
execute    Run tests using the specified framework.
report     Provide test results overview and send reports.
finish  Perform the finishing tasks, clean up guests.

login      Provide user with an interactive shell on the guest.
plans      Select plans which should be executed.
tests      Select tests which should be executed.
```

tmt run provision --help

Which provision options are available?

```
Supported methods (virtual by default):

connect ............... Connect to a provisioned guest using ssh
local ................. Use local host for test execution
minute ................ Provision guest using 1minutetip backend
container ............. Create a new container using podman
virtual.testcloud .... Local virtual machine using testcloud

Use 'tmt run provision --help --how <method>' to learn more
about given  provision method and all its supported options.
```

tmt run provision --how virtual --help

How can I customize the virtual method?

```
-h, --how METHOD   Use specified method for provisioning.
-i, --image IMAGE  Select image to use. Short name or url.
-m, --memory MEM   Set available memory, 2048 MB by default.
-D, --disk DISK    Specify disk size in GB, 10 GB by default.
-u, --user USER    Username to use for all guest operations.

-v, --verbose      Show more details. Use multiple times to raise
-d, --debug        Provide debugging information.
-q, --quiet        Be quiet. Exit code is just enough for me.
-f, --force        Overwrite existing files and step data.
-n, --dry          Run in dry mode. No changes, please.
```

tmt run

discover

DISCOVER

Just let me see which tests would be run

```
# only selected step will be run
tmt run discover

# discover tests only for given plan
tmt run discover plan --name /plans/features/core

# show more details (list tests)
tmt run discover -v plan -n core
tmt run discover --verbose plan --name core
```

provision

CONTAINER

Run tests in container using podman

```
# choose custom provision method but run --all steps
tmt run --all provision --how container

# use custom image instead of the latest fedora default
tmt run --all provision --how container --image fedora:32
```

VIRTUAL

Run tests in a virtual machine

```
# tests are run safely in a vm by default
# (the plan can define a different provision method)
tmt run

# this is the same as above
# (command line options override configuration in plan)
tmt run --all provision --how virtual

# use custom image instead of the latest fedora default
tmt run --all provision --how virtual --image fedora-32
```

Easily enable tests in Fedora, RHEL, on GitHub...

LOCAL

Execute tests directly on the localhost

```
# this is fast but destructive tests can break your box
tmt run --all provision --how local
```

CONNECT

Connect to a provisioned guest using ssh

```
# private key authentication (recommended)
tmt run --all provision --how=connect --guest=name-or-ip \
    --key=private-key-path

# user and password
tmt run --all provision --how=connect --guest=name-or-ip \
    --user=login --password=secret
```

prepare

INSTALL

Install additional packages on the guest

```
# packages from the default repositories
tmt run --all prepare --how install --package httpd

# latest package from a copr repository
tmt run -a prepare -h install --copr psss/tmt --package tmt

# freshly built local rpm / all rpms from directory
tmt run -a prepare -h install -p tmt-0.20-1.fc32.noarch.rpm
tmt run -a prepare -h install --directory tmp/RPMS/noarch

# check --help for detailed examples
tmt run prepare -h install --help
```

ANSIBLE

Apply ansible playbook on the guest

```
# apply one or more playbooks
tmt run -a prepare -h ansible -p ansible/packages.yml

# check --help for detailed examples
tmt run prepare -h install --help
```

SHELL

Run arbitrary shell command to setup the guest

```
# install apache and start the service
tmt run -a prepare --how shell \
    --script 'dnf install -y httpd && systemctl start httpd'
```

report

REPORT

Report test results

```
# by default a brief result overview is shown
tmt run plan --name core

# show summary for all plans from the last run
tmt run --last report

# show individual tests, log paths, full output
tmt run --last report -fv
tmt run --last report -fvv
tmt run --last report -fvvv

# generate an html report, open it in the browser
tmt run --last report --how html --open
```

tmt plan

EXAMPLE PLAN

```
summary: Basic httpd smoke test
provision:
    how: virtual
    memory: 4096
prepare:
  - name: packages
    how: install
    package: [httpd, curl]
  - name: service
    how: shell
    script: systemctl start httpd
execute:
    how: shell
    script:
     - echo foo > /var/www/html/index.html
     - curl http://localhost/ | grep foo
```

Easily enable tests in Fedora, RHEL, on GitHub...

EXPLORE

Check which plans are available

```
# give an overview
tmt plans

# list available plans
tmt plans ls

# show plan details
tmt plans show

# let's see some tmt examples
vim -p plans/features/*
```

CREATE

Easily create plans based on templates

```
# minimal config (execute a script)
tmt plan create plans/mini

# base plan (discover, execute)
tmt plan create plans/base -t base

# full plan (discover, prepare, execute)
tmt plan create plans/full -t full

# fill custom data directly from command line
tmt plan create --discover <yaml> --prepare <yaml>
```

tmt test

EXAMPLE TEST

```
summary: Basic smoke test for virtualenv
description: |
     Check basic functionality of Python virtual environments (venv
     or virtualenv based). The test supports different python
     versions & implementations including pypy and jython.
path: smoke
test: ./venv.sh
tier: 1
tag: [venv]
duration: 10m
require:
     - python3
     - python34
     - python35
     - python36
     ...
```

Easily enable tests in Fedora, RHEL, on GitHub...

EXPLORE

Check which tests are available

```
# give an overview
tmt tests

# list available tests
tmt tests ls
tmt tests ls --filter tier:0

# show test details
tmt tests show

# check test metadata against the spec
tmt test lint
```

Easily enable tests in Fedora, RHEL, on GitHub...

CREATE

Easily create tests based on templates

```
# prompt for template
tmt test create tests/smoke

# use a simple shell test template
tmt test create tests/smoke -t shell

# populate with a basic beakerlib skeleton
tmt test create tests/smoke --template beakerlib
```

Easily enable tests in Fedora, RHEL, on GitHub...

LIBRARIES

Share common test code using beakerlib libraries: [example]

```
# main.fmf
require: library(httpd/http)

# test.sh
rlRun "rlImport httpd/http"
rlRun "httpSecureStart" 0 "Start https server"
rlRun "httpInstallCa $(hostname)" 0 "Install CA"
rlRun "echo ok > $httpROOTDIR/test"
rlRun "wget https://$(hostname)/test"
rlAssertGrep "ok" "test"
```

IMPORT & EXPORT

Convert test metadata from other formats

```
# convert beaker Makefile and PURPOSE
tmt test import

# fetch metadata from nitrate test case management system
tmt test import --nitrate

# sync back metadata to nitrate (fluent transition)
tmt test export --nitrate .

# try it yourself
cd examples/convert
```

CONTEXT ADJUST

Adjusting metadata based on the current context

```
# disable test on older distros
enabled: true
adjust:
    enabled: false
    when: distro < fedora-33
    because: The feature was added in Fedora-33

# a complex test requiring full virtualization
/tests/discover/libraries/main.fmf

# check the context from the command line
tmt --context distro=fedora-33 test ls --filter enabled:true
```

DEBUG TESTS

Support for fast debugging, do not repeat provision & prepare, aliases

```
# run for the first time
tmt run --until report

# adjust test, run again
tmt run --last execute --force

# aliases outlined for common steps
start, retest, retest, retest, stop
reserve
```

GUEST LOGIN

Easily login to the guest to investigate issues

```
# log in during the last enabled step
tmt run login
tmt run provision login finish

# log in during selected step
tmt run login --step prepare
tmt run login --step prepare:start
tmt run login --step prepare:end

# conditional login
tmt run login --when fail
tmt run login --when error
```

tmt story

COVERAGE

Check implementation, test and documentation coverage

```
# explore and create same as with tests and plans
tmt stories
tmt stories ls
tmt stories show
tmt story create

# coverage overview
tmt story coverage
tmt story coverage cli/test
tmt story coverage --documented
tmt story coverage --implemented
tmt story coverage --tested
```

infrastructure status

STATUS

So where is this actually working?

- GitHub
  - packages built in copr by Packit
  - triggered by pull requests or commits
  - full tmt support
- Fedora CI
  - packages built in Koji by the CI pipeline
  - triggered by pull requests or builds
  - full tmt support, including context adjust
- RHEL CI
  - triggered by pull requests or builds
  - full tmt support

EXAMPLES

A couple of real life examples

- wget: simple smoke test and https test
- tmt: the new context adjust feature, a recent github pull request
- fmf: example of integration testing with related component
- lftp: uses tests namespace for sharing tests across distros
- shells: shared tests for bash, dash, ksh, mksh, zsh, pull request support for tests
- bind: successfully open sourced around 80 internal tests
- wow: there is a fluent transition from the old workflow-tomorrow
- generic: rpminspect, rpmdeplint, installability

more

FUTURE

What's ahead of us?

- Next steps
  - Full context adjust support in all pipelines
  - Documentation cleanup, extend the guide
  - New plugins (e.g. restraint executor)
  - Improve test debugging and usability (aliases, wizard mode)
  - Implement many nice ideas (custom test templates)
  - And, of course, fix a lot of bugs :-)
- Contribute
  - Submit bugs and ideas for improvement
  - Pick a good first issue and create pull request
  - Join the #tmt channel or telegram to discuss the design

LINKS

Here's a bunch of useful links

- tmt docs
  - https://tmt.readthedocs.io/
  - tmt cheat sheet
  - the guide
- fmf docs
  - https://fmf.readthedocs.io/
- fedora quick start guide
  - https://docs.fedoraproject.org/en-US/ci/tmt/
- packit & testing farm
  - https://packit.dev/testing-farm/

thank you

a bit of theory

METADATA LEVELS

There are several levels defined in the metadata specification

- **Level 0** — Core attributes such as summary for short overview, description for detailed texts or the order which are common and can be used across all metadata levels.
- **Level 1** — Metadata closely related to individual Tests such as the test script, directory path or maximum duration which are stored directly with the test code.
- **Level 2** — This level represents Plans made up of individual Steps describing how to provision the environment for testing and how to prepare it or which frameworks should be used to execute tests relevant for given artifact.
- **Level 3** — User Stories can be used to define expected features of the application and to easily track which functionality has been already implemented, tested and documented.

fmf

FMF

Flexible Metadata Format

- Allows efficiently storing metadata in plain text files
- All test execution data directly in git, close to the test/source code
- Uses YAML to store data in a concise human and machine readable way
- Adds a couple of nice features to minimize data duplication and maintenance
  - Hierarchy
  - Inheritance
  - Elasticity
- https://fmf.readthedocs.io/

SIMPLE

The most common use cases super simple to read & write

```
summary: Check basic download options
contact: Petr Šplíchal <psplicha@redhat.com>
tag: [Tier2, TierSecurity]
test: ./test.sh
duration: 3m
```

HIERARCHY

Hierarchy defined by directory structure and explicit nesting

```
/download:
    summary: Check basic download options
    contact: Petr Šplíchal <psplicha@redhat.com>
    tags: [Tier2, TierSecurity]
    test: ./runtest.sh
    duration: 3m
/recursion:
    summary: Check recursive download options
    contact: Petr Šplíchal <psplicha@redhat.com>
    tags: [Tier2, TierSecurity]
    test: ./runtest.sh
    duration: 20m
```

INHERITANCE

Minimize duplication/maintenance by inheriting from parent

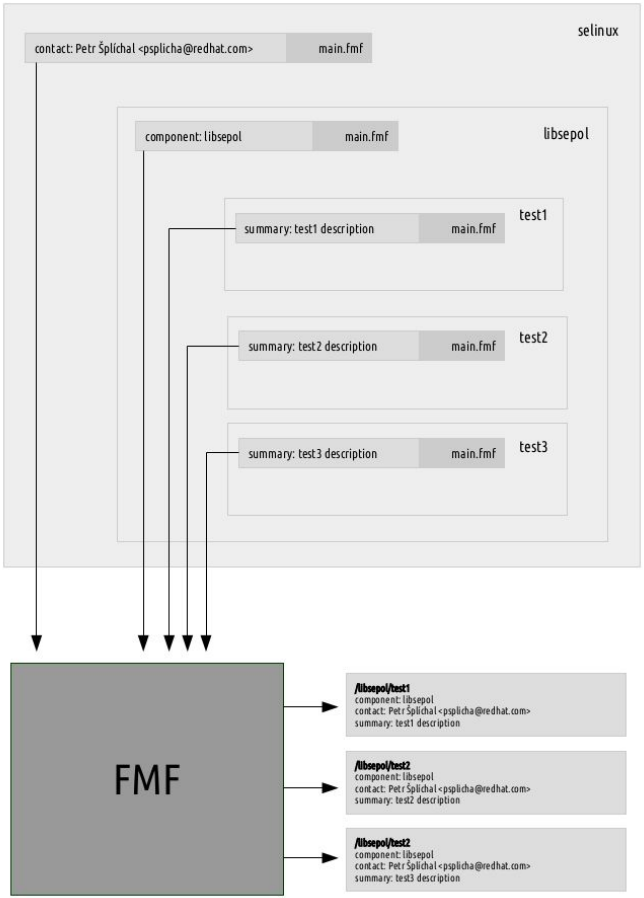
```
contact: Petr Šplíchal <psplicha@redhat.com>
tags: [Tier2, TierSecurity]
test: ./runtest.sh

/download:
    summary: Check basic download options
    duration: 3m
/recursion:
    summary: Check recursive download options
    duration: 20m
```

ELASTICITY

Allows to use a single file or scatter metadata across the hierarchy as desired by the project.

Nicely supports an "organic" growth of a project: Usually it is not possible to plan/predict in advance which parts of the system will grow more / will need more detailed configuration or related data to be stored.

Elasticity allows to move data areas which grow more into separate files on the filesystem, keeping in this way reasonable file size for maintaining the data while at the same time representing the whole metadata tree structure/content combined from all available files unchanged.



the end